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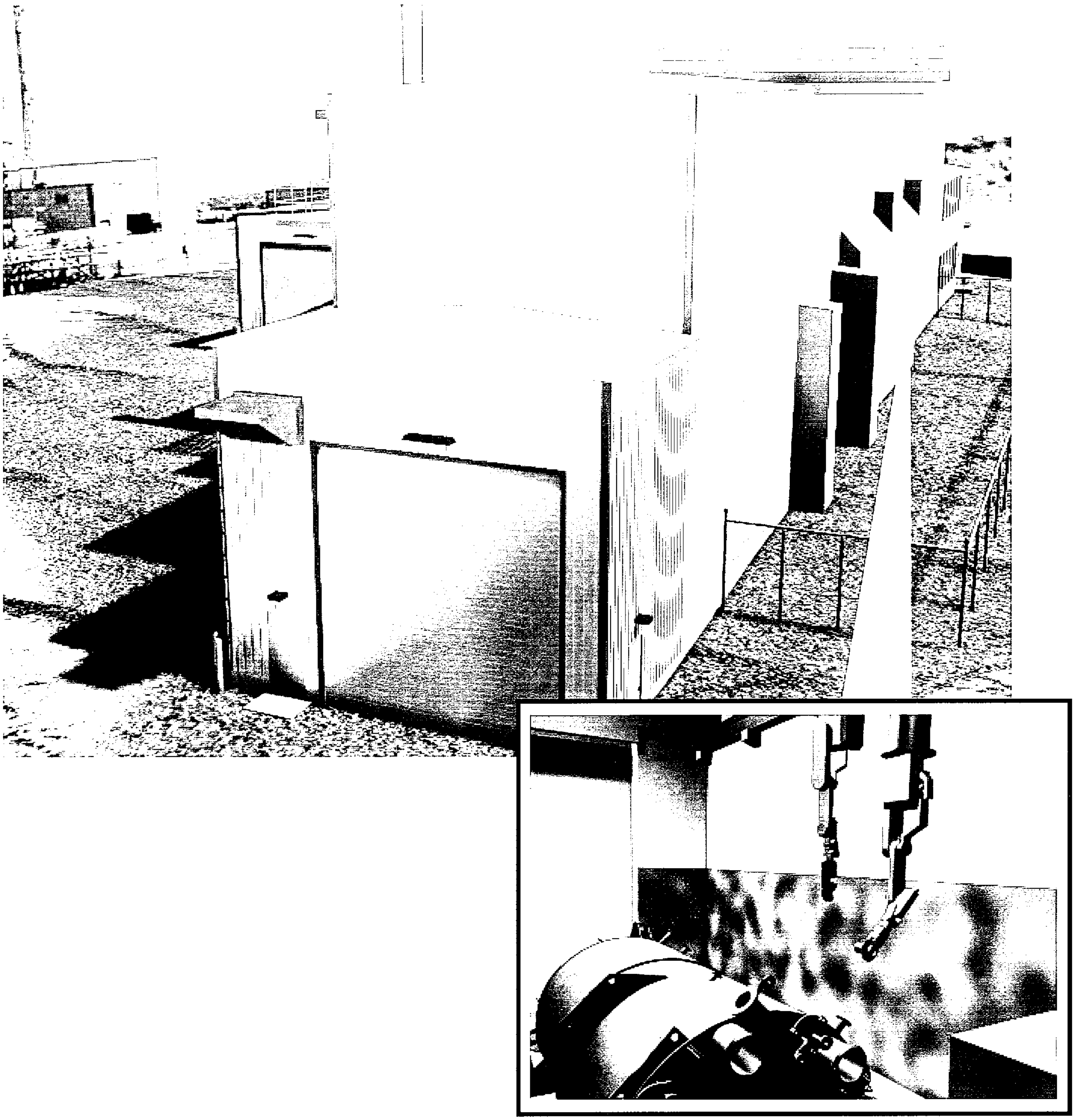

Preliminary Safety Analysis Report for the Remote-Handled Waste Facility at the West Valley Demonstration Project

WVNS-SAR-023, Rev. 0

West Valley Nuclear Services Co.
10282 Rock Springs Road
West Valley, NY 14171-9799

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West Valley Demonstration Project

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REMOTE-HANDLED WASTE FACILITY

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WEST VALLEY DEMONSTRATION PROJECT PRELIMINARY SAFETY ANALYSIS REPORT FOR

REMOTE-HANDLED WASTE FACILITY

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ACRONYMS AND ABBREVIATIONS

A/E	Architect/Engineer
Å	Angstrom (10^{-8} centimeter)
A&PC	Analytical and Process Chemistry
AA	Atomic Absorption
AAC	Assembly Area Coordinator
AADT	Average Annual Daily Traffic
ABA	Authorization Basis Addendum
ACC	Ashford Community Center
ACFM	Absolute Cubic Feet Per Minute
ACGIH	American Conference of Governmental Industrial Hygienists
ACI	American Concrete Institute
A/E	Architect/Engineer
AEA	Atomic Energy Act
AEC	Atomic Energy Commission
AED	Assistant Emergency Director
AEDE	Annual Effective Dose Equivalent
AEOC	Alternate Emergency Operations Center
AES	Atomic Emission Spectrophotometer
AIHA	American Industrial Hygiene Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ALARA	As Low As Reasonably Achievable
ALI	Annual Limit of Intake
ALS	Advanced Life Saving
AMCA	Air Movement and Control Association
AMS	Aerial Measurement System
AMS	Alarm Monitoring Station
ANC	Analytical Cell
ANL	Argonne National Laboratory
ANS	American Nuclear Society
ANSI	American National Standards Institute
AOC	Ashford Office Complex
APOC	Abnormal Pump Operating Condition
AR-OG	Acid Recovery - Off-Gas
ARC	Acid Recovery Cell
ARF	Airborne Release Fraction
ARI	Air-Conditioning and Refrigeration Institute
ARM	Area Radiation Monitor
ARPR	Acid Recovery Pump Room
ARR	Airborne Release Rate
ASCE	American Society of Civil Engineers
ASER	Annual Site Environmental Report
ASHRAE	American Society of Heating, Refrigeration, and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AU	Alfred University
AWS	American Welding Society
B&P	Buffalo & Pittsburgh
BDAT	Best Demonstrated Available Technology

ACRONYMS & ABBREVIATIONS (continued)

BDB	Beyond Design Basis
BDBE	Beyond Design Basis Earthquake
BLEVE	Boiling Liquid Expanding Vapor Explosion
BNFL	British Nuclear Fuels Limited
BNL	Brookhaven National Laboratory
Bq	Becquerel
BRP	Big Rock Point
BSW	Bulk Storage Warehouse
BWR	Boiling Water Reactor
c	Centi, prefix for 10^{-2}
C	Coulomb
CAM	Continuous Air Monitor
CAS	Criticality Alarm System
cc	Cubic Centimeter
CC	Communications Coordinator
CCB	Cold Chemical Building
CCDS	Cold Chemical Delivery System
CCR	Chemical Crane Room
CCS	Chilled Water System
CCSR	Cold Chemical Scale Room
CCSS	Cold Chemical Sump Station
CCTV	Closed-Circuit Television
CDDS	Computer Data Display System
CDS	Criticality Detection System
CEC	Cation Exchange Capacity
CEDE	Committed Effective Dose Equivalent
cfm	Cubic feet per minute
CFMT	Concentrator Feed Make-up Tank
CFR	Code of Federal Regulations
cfs	Cubic feet per second
CGA	Compressed Gas Association
CHT	Condensate Hold Tank
Ci	Curie
CLCW	Closed-Loop Cooling Water
cm	Centimeter
CMAA	Crane Manufacturers Association of America
CMP	Construction Management Procedure
CMR	Crane Maintenance Room
COA	Chemical Operating Aisle
CPC	Chemical Process Cell
CPC-WSA	Chemical Process Cell Waste Storage Area
cpm	Counts per minute
CR	Control Room
CRM	Community Relations Manager
CRT	Cathode Ray Tube
Cs	Cesium
CSDM	Cognizant System Design Manager
CSE	Criticality Safety Engineer
CSE	Cognizant System Engineer
CSER	Confined Space Entry Rescue

ACRONYMS & ABBREVIATIONS (continued)

CSPF	Container Sorting and Packaging Facility
CSR	Confined Space Rescue
CSRF	Contact Size Reduction Facility
CSS	Cement Solidification System
cSv	centi-Sievert
CTS	Component Test Stand
CUA	Catholic University of America
CUP	Cask Unloading Pool
Cv	Column Volume
CVA	Chemical Viewing Aisle
CW	Cooling Tower Water
CY	Calendar Year
D&D	Decontamination and Decommissioning
D&M	Dames & Moore
DAC	Derived Air Concentration
DAS	Data Acquisition System
DAW	Dry Active Waste
DB	Dry Bulb
DBA	Design Basis Accident
DBE	Design Basis Earthquake
DBT	Design Basis Tornado
DBW	Design Basis Wind
DC	Drum Cell
DC	Design Criteria
DCF	Dose Conversion Factor
DCG	Derived Concentration Guide
DCS	Distributed Control System
DEAR	Department of Energy Acquisition Regulation
DF	Decontamination Factor
DGR	Diesel Generator Room
DOE	Department of Energy
DOE-EM	Department of Energy - Environmental Management
DOE-HQ	Department of Energy - Headquarters
DOE-HQ-EOC	Department of Energy - Headquarters - Emergency Operations Center
DOE-ID	Department of Energy - Idaho
DOE-OCRWM	Department of Energy - Office of Civilian Radioactive Waste Management
DOE-OH	Department of Energy - Ohio Field Office
DOE-PD	Department of Energy - Project Director
DOE-WV	Department of Energy - West Valley Area Office
DOE-WVDP	Department of Energy - West Valley Demonstration Project
DOELAP	Department of Energy Laboratory Accreditation Program
DOSR	DOE On-Site Representative
DOT	Department of Transportation
DP	Differential Pressure
dpm	Disintegrations per minute
DR	Data Recorder
DR	Damage Ratio
DVP	Developmental Procedure
DWS	Demineralized Water System

ACRONYMS & ABBREVIATIONS (continued)

E-Spec	Equipment Specification
EA&SRP	Engineering Administration & Safety Review Program
EBA	Evaluation Basis Accident
EBE	Evaluation Basis Earthquake
ECN	Engineering Change Notice
ECO	Environmental Control Officer
ED	Emergency Director
EDE	Effective Dose Equivalent
EDR	Equipment Decontamination Room
EDRVA	Equipment Decontamination Room Viewing Aisle
EDS	Electrical Power Distribution
EG	Evaluation Guideline
EHS	Employee Health Services
EID	Environmental Information Document
EIP	Emergency Implementing Procedure
EIS	Environmental Impact Statement
EMC	Emergency Management Coordinator
EMOA	East Mechanical Operating Aisle
EMP	Emergency Management Procedure
EMRT	Emergency Medical Response Team
EMT	Emergency Medical Technician
EMT	Environmental Monitoring Team
EMU	Emergency Medical Unit
EOC	Emergency Operation Center
EP	Engineering Procedure
EPA	Environmental Protection Agency
EPD	Elevation Plant Datum
EPI	Emergency Prediction Information
EPIcode	Emergency Protection Information Code
EPRI	Electric Power Research Institute
EPZ	Emergency Protection Zone
ERO	Emergency Response Organization
ERPG	Emergency Response Planning Guideline
ES&H	Environmental, Safety, and Health
ESA	Endangered Species Act
ESH&QA	Environmental, Safety, Health, and Quality Assurance
ESQA&LO	Environmental, Safety, Quality Assurance, and Laboratory Operations
FACTS	Functional and Checklist Testing of Systems
FBC	Fire Brigade Chief
FBR	Fluidized Bed Reactor
FFCA	Federal Facility Compliance Act
FHA	Fire Hazards Analysis
FM	Factory Mutual
fpm	Feet per minute
fps	Feet per second
FRI	Feed Reduction Index
FRS	Fuel Receiving and Storage
FSAR	Final Safety Analysis Report
FSFCA	Federal and State Facility Compliance Act
FSP	Fuel Storage Pool

ACRONYMS & ABBREVIATIONS (continued)

ft	Feet
FWCA	Fish and Wildlife Coordination Act
g	Gram
g	Gravitational Acceleration Constant
G	Giga, prefix for 10^9
GAC	Granular Activated Carbon
gal	Gallon
GC	Gas Chromatograph
GCR	General Purpose Cell Crane Room
GCS	Gravelly Clayey Soils
GE	General Electric
GET	General Employee Training
GFE	Government Furnished Equipment
gM	Gravelly mud
GM	Geometric Mean
GM	Geiger-Mueller
GOA	General Purpose Cell Operating Aisle
GOALS	General Office Automated Logging System
GOCO	Government-Owned, Contractor-Operated
GPC	General Purpose Cell
gpd	Gallons per day
GPLI	General Purpose LAN Interface
gpm	Gallons per minute
GRS	General Record Schedule
G_s	Specific gravity
GTAW	Gas Tungsten Arc Welding
h	Hour
ha	Hectare
HAC	Hot Acid Cell
HAF	Hot Acid Feed
HAI	Hughes Associates, Inc.
HAPR	Hot Acid Pump Room
HASP	Health and Safety Plan
HAZMAT	Hazardous Materials
HAZWOPER	Hazardous Waste Operations and Emergency Response
HDC	High Density Concrete
HEC	Head End Cells
HEME	High Efficiency Mist Eliminator
HEPA	High Efficiency Particulate Air
HEV	Head End Ventilation
HFE	Human Factors Engineering
HIC	High Integrity Container
HLDS	High-Level Drainage System
HLW	High-Level Waste
HLWIS	High-Level Waste Interim Storage
HLWISA	High-Level Waste Interim Storage Area
HLWTS	High-Level Waste Transfer System
hp	Horsepower
HPGe	Hyperpure Germanium

ACRONYMS & ABBREVIATIONS (continued)

HPLC	High Performance Liquid Chromatography
HPS	High Pressure Sodium
HRA	Human Reliability Analysis
HRM	Human Resources Manager
HV	Heating and Ventilation
HVAC	Heating, Ventilation, and Air Conditioning
HVOS	Heating, Ventilation Operating Station
HWSF	Hazardous Waste Storage Facility
i.d.	Inner Diameter
I&C	Instrumentation and Control
IA	Instrument Air
IC	Incident Commander
ICEA	Insulated Cable Engineers Association
ICP	Inductively Coupled Plasma
ICR	Instrument Calibration Recall
ICRP	International Commission on Radiological Protection
ID	Idaho
IDLH	Immediately Dangerous to Life and Health
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IH&S	Industrial Hygiene and Safety
ILDS	Infrared Level Detection System
in	Inch
INEL	Idaho National Engineering Laboratory
INEEL	Idaho National Engineering and Environmental Laboratory
IRTS	Integrated Radwaste Treatment System
ISMS	Integrated Safety Management System
IV&V	Independent Validation and Verification
IWP	Industrial Work Permit
IWSF	Interim Waste Storage Facility
IX	Ion Exchange
JIC	Joint Information Center
JTG	Joint Test Group
k	Neutron Multiplication Factor
k	Kilo, prefix for 10^3
K_d	Partition Coefficient
k_{eff}	Effective Neutron Multiplication Factor
kg	Kilogram
K_h	Horizontal hydraulic conductivity
kN	Kilo-Newton
kPa	Kilo-Pascal
kPag	Kilo-Pascal gauge
kph	Kilometer per hour
kV	Kilo-Volt
K_v	Vertical hydraulic conductivity
kVA	Kilovolt-ampere
kW	kilo-Watt

ACRONYMS & ABBREVIATIONS (continued)

L	Liter
LAH	Level Alarm High
LAN	Local Area Network
LANL	Los Alamos National Laboratory
LAP	Laboratory Accreditation Program
LAP	Lower Annealing Point
LASL	Los Alamos Scientific Laboratory
lb	Pound
LCO	Limiting Condition for Operation
LEL	Lower Explosive Limit
lfpm	Linear feet per minute
LFR	Live Fire Range
LI	Level Indicate
LIMS	Laboratory Information Management System
LITCO	Lockheed Idaho Technologies Corporation
LLDS	Low-Level Drainage System
LLL	Lawrence Livermore Laboratory
LLNL	Lawrence Livermore National Laboratory
LLRW	Low-Level Radioactive Waste
LLW	Low-Level Waste
LLW2	Low-Level Waste Treatment Replacement Facility
LLWTF	Low-Level Waste Treatment Facility
LLWTS	Low-Level Waste Treatment System
LM	Liaison Manager
LMITCO	Lockheed-Martin Idaho Technologies Corporation
LOS	Level of Service
LOVS	Loss of Voltage Signal
LPF	Leak Path Factor
LPG	Liquid Propane Gas
lpm	Liters per minute
LPM	Liters per minute
LPS	Liquid Pretreatment System
LR	Level Record
LSA	Lag Storage Area
LUNR	Land Use and Natural Resources
LWA	Lower Warm Aisle
LWC	Liquid Waste Cell
LWTS	Liquid Waste Treatment System
LXA	Lower Extraction Aisle
m	Meter
m/s	Meters per second
m	Milli, prefix for 10^{-3}
M	Mega, prefix for 10^{6}
M&O	Maintenance and Operations
M&O	Management and Operating
M&TE	Maintenance and Test Equipment
MAR	Material at Risk
m_b	Earthquake Magnitude
MBtu	Mega-British Thermal Units
MC	Miniature Cell

ACRONYMS & ABBREVIATIONS (continued)

MCC	Materials Characterization Center
MCC	Motor Control Center
MCE	Maximum Credible Earthquake
mCi	milli-Curie
MEOSI	Maximally Exposed Off-Site Individual
MeV	Mega-electron Volt
MFHT	Melter Feed Hold Tank
mG	Muddy gravels
mi	Mile
MMI	Modified Mercalli Intensity
MMI	Man-Machine Interface
M&O	Management and Operating
MOA	Mechanical Operating Aisle
MOI	Maximally Exposed Off-Site Individual
mol	Mole
MOU	Memorandum of Understanding
MPag	Mega-Pascal gauge
MPC	Maximum Permissible Concentration
MPFL	Maximum Possible Fire Loss
mph	Miles per hour
MPO	Main Plant Operator
MPOSS	Main Plant Operations Shift Supervisor
mR/hr	Milli-Roentgen per hour
MRC	Master Records Center
mrem	Millirem
MRR	Manipulator Repair Room
MSDS	Material Safety Data Sheet
msG	Muddy Sandy Gravels
MSM	Master-Slave Manipulator
mSv	milli-Sievert
MT	Metric Ton
MTIHM	Metric Tons Initial Heavy Metal
MTU	Metric Tons Uranium
MUF	Material-Unaccounted-For
MW	Mega-Watt
MWD	Mega-Watt-Day
n	Nano, prefix for 10^{-9}
Na	Sodium
NAD	Nuclear Accident Dosimeter
NARA	National Archives and Records Administration
NCSE	Nuclear Criticality Safety Evaluation
NDA	NRC-Licensed Disposal Area
NDA-LPS	NRC-Licensed Disposal Area - Liquid Pretreatment System
n_e	Effective porosity
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NEPA	National Environmental Policy Act
NESHAP	National Emission Standard for Hazardous Air Pollutants
NFPA	National Fire Protection Association
NFS	Nuclear Fuel Services, Inc.

ACRONYMS & ABBREVIATIONS (continued)

NGVD	National Geodetic Vertical Datum
NIOSH	National Institute of Occupational Safety and Health
NIST	National Institute of Standards and Technology
NMC	News Media Center
NMPC	Niagara Mohawk Power Corporation
NOAA	National Oceanic and Atmospheric Administration
NP	North Plateau
NPH	Natural Phenomena Hazard
NPPS	North Plateau Pump System
NPPTS	North Plateau Pump and Treatment System
NQA	Nuclear Quality Assurance
NR	Nonconformance Report
NRC	Nuclear Regulatory Commission
NRRPT	National Registry of Radiation Protection Technology
NWS	National Weather Service
NY	New York
NYCRR	New York Code of Rules and Regulations
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSERDA	New York State Energy Research and Development Authority
NYSGS	New York State Geological Survey
o.d.	Outer Diameter
OAAM	Operational Accident Assessment Manager
OAM	Operational Assessment Manager
OB	Office Building
OBE	Operating Basis Earthquake
OEP	On-Site Evaluation Point
OGA	Off-Gas Aisle
OGBR	Off-Gas Blower Room
OGC	Off-Gas Cell
OGMR	Off-Gas Monitoring Room
OGTS	Off Gas Treatment System
OH	DOE, Ohio Field Office
OH/WVDP	Ohio Field Office, West Valley Demonstration Project
OJT	On-the-Job Training
OM	Operations Manager
OOS	Out-of-Service
ORNL	Oak Ridge National Laboratory
ORR	Operational Readiness Review
ORRB	Operational Readiness Review Board
ORT	Operations Response Team
OSC	Operations Support Center
OSHA	Occupational Safety and Health Act
OSHA	Occupational Safety and Health Administration
OSR	Operational Safety Requirement
oz	Ounce
p	Pico, prefix for 10^{-12}
P	Peta, prefix for 10^{15}

ACRONYMS & ABBREVIATIONS (continued)

P&ID	Piping and Instrument Diagram
Pa	Pascal
PA	Project Appraisals
PAG	Protective Action Guideline
PAH	Pressure Alarm High
PBT	Performance-Based Training
PC	Partition Coefficient
PCB	Polychlorinated Biphenyl
PCDOCS	Personal Computer Document Organization and Control Software
pcf	Pounds per cubic foot
PCH	Pressure Control High
PCM	Personal Contamination Monitor
PCR	Process Chemical Room
PD	Project Director
PDAH	Pressure Differential Alarm High
PDAL	Pressure Differential Alarm Low
PDCH	Pressure Differential Control High
PDCL	Pressure Differential Control Low
PDM	Powered Dextrous Manipulator
PDR	Pressure Differential Record
PEL	Permissible Exposure Limit
PF	Personnel Frisker
PGA	Peak Ground Acceleration
PGSC	Pasquill-Gifford Stability Class
PHA	Process Hazards Analysis
PHA	Product Handling Area
PID	Public Information Director
PLC	Programmable Logic Controller
PM	Preventive Maintenance
PMC	Process Mechanical Cell
PMCR	Process Mechanical Cell Crane Room
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
PMP	Project Management Plan
PNL	Pacific Northwest Laboratory
PNNL	Pacific Northwest National Laboratory
PPB	Parts Per Billion
PPC	Product Purification Cell
PPE	Personal Protective Equipment
ppm	Parts Per Million
PPM	Parts Per Million
PPS	Product Packaging and Shipping
PRC	Pressure Record Control
PRM	Process Radiation Monitor
PSAR	Preliminary Safety Analysis Report
psf	Pound per square foot
psi	Pound per square inch
psig	Pound per square inch gauge
PSO	Plant Systems Operations
PSO	Plant Systems Operator
PSR	Process Safety Requirement

ACRONYMS & ABBREVIATIONS (continued)

Pu	Plutonium
PVC	Polyvinyl chloride
PVS	Permanent Ventilation System
PVU	Portable Ventilation Unit
PWR	Pressurized Water Reactor
PWS	Potable Water System
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAP	Quality Assurance Program
QAP	Quality Assurance Plan
QAPD	Quality Assurance Program Description
QARD	Quality Assurance Requirements Document
QCN	Qualification Change Notice
QM	Quality Management
R	Roentgen
R/hr	Roentgen per hour
R&S	Radiation and Safety
R&SC	Radiation and Safety Committee
RAP	Radiological Assistance Plan
RCO	Radiological Controls Operations
RCOS	Radiological Controls Operations Supervisor
RCRA	Resource Conservation and Recovery Act
RCT	Radiological Control Technician
RCTC	Radiological Control Team Commander
RCTL	Radiation Control Team Leader
REAAM	Radiological and Environmental Accident Assessment Manager
REAM	Radiological and Environmental Assessment Manager
REG	Robert E. Ginna
rem	Roentgen Equivalent Man
RER	Ram Equipment Room
RESL	Radiological and Environmental Sciences Laboratory
RF	Respirable Fraction
RH	Remote-Handled
RHWF	Remote-Handled Waste Facility
RHWP	Remote-Handled Waste Project
RHWS	Remote-Handled Waste System
RID	Records Inventory and Disposition Schedule
RMW	Radioactive Mixed Waste
RP	Radiation Protection
rpm	Revolutions per minute
RPM	Revolutions Per Minute
RPM	Radiation Protection Manager
Rt	Route
RTS	Radwaste Treatment System
RWI	Radiological Worker I
RWII	Radiological Worker II
RWP	Radiation Work Permit
s	Second

ACRONYMS & ABBREVIATIONS (continued)

S&EA	Safety and Environmental Assessment
SA&I	Safety Analysis and Integration
SAA	Satellite Accumulation Area
SAI	Science Applications International
SAR	Safety Analysis Report
SBS	Submerged Bed Scrubber
SCBA	Self-Contained Breathing Apparatus
scfm	Standard cubic feet per minute
SCR	Selective Catalytic Reduction
SCS	Soil Conservation Service
SCSSCs	Safety-Class Structures, Systems, and Components
SDA	New York State-Licensed Disposal Area
SEAM	Safety and Environmental Assessment Manager
sec	Second
SFCM	Slurry-Fed Ceramic Melter
SFPE	Society of Fire Protection Engineers
SFR	Secondary Filter Room
SGN	Society Generale pour les Techniques Nouvelles
SGR	Switch Gear Room
SI	International System of Units
SIP	Special Instruction Procedure
slpm	Standard liter per minute
SM	Security Manager
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SMS	Sludge Mobilization System
SMT	Slurry Mix Tank
SMWS	Sludge Mobilization and Wash System
SNF	Spent Nuclear Fuel
SNL	Sandia National Lab
SNM	Special Nuclear Material
SO	Security Officer
SOG	Seismic Owner's Group
SOP	Standard Operating Procedure
SPDES	State Pollutant Discharge Elimination System
SPO	Security Police Officer
Sr	Strontium
SR	Surveillance Requirement
SRE	Search and Reentry
SRL	Savannah River Laboratory
SRR	Scrap Removal Room
SRSS	Square-root-of-the-sum-of-the-squares
SS	Stainless Steel
SSC	Sample Storage Cell
SSCs	Structures, Systems, and Components
SSE	Safe Shutdown Earthquake
SSS	Security Shift Supervisor
SSS	Slurry Sample System
SSWMU	Super Solid Waste Management Unit
STC	Sample Transfer Cell
STD	Standard
STP	Standard Temperature and Pressure

ACRONYMS & ABBREVIATIONS (continued)

STS	Supernatant Treatment System
Sv	Sievert
SVS	Scale Vitrification System
SWC	Surge Withstand Capability
SWMU	Solid Waste Management Unit
T	Tera, prefix for 10^{12}
TBP	Tri-butyl phosphate
TE	Test Exception
TEDE	Total Effective Dose Equivalent
TEEL	Temporary Emergency Exposure Limit
Ti	Titanium
TID	Tamper-Indicating Device
TIG	Tungsten Inert Gas
TIP	Test Implementation Plan
TIP	Test In-Place
TIP	Test Instruction Procedure
TLD	Thermoluminescent Dosimeter
TLV	Threshold Limit Value
TN	Transnuclear, Inc.
TPC	Test Procedure Change
TPL	Test Plan
TR	Technical Requirement
TRG	Technical Review Group
TRMS	Training Records Management System
TRR	Test Results Report
TRU	Transuranic
TSB	Test and Storage Building
TSC	Technical Support Center
TSCS	Technical Support Center Staff
TSD	Technical Support Document
TSR	Technical Safety Requirement
TVS	Temporary Ventilation System
UA	Utility Air
UAP	Upper Annealing Point
UBC	Uniform Building Code
UCRL	University of California Research Laboratory
UDF	Unit Dose Factor
UEL	Upper Explosive Limit
UL	Underwriters Laboratories, Inc.
ULO	Uranium Load Out
UPC	Uranium Product Cell
UPS	Uninterruptible Power Supply
UR	Utility Room
USDOE	U. S. Department of Energy
USDOI	U. S. Department of the Interior
USDOL	U. S. Department of Labor
USDOT	U. S. Department of Transportation
USEPA	U. S. Environmental Protection Agency
USGS	U. S. Geological Survey

ACRONYMS & ABBREVIATIONS (continued)

USNRC	U. S. Nuclear Regulatory Commission
USQ	Unreviewed Safety Question
USQD	Unreviewed Safety Question Determination
UWA	Upper Warm Aisle
UWS	Utility Water Supply
UXA	Upper Extraction Aisle
V	Volt
VA	Volt-Ampere
VAC	Volt Alternating Current
VDC	Volt Direct Current
V&S	Ventilation and Service Building
VEC	Ventilation Exhaust Cell
VEMP	Vitrification Expended Materials Process
VF	Vitrification Facility
VFFCP	Vitrification Facility Fire Control Panel
VIV	Variable Inlet Vane
VL	Vitrification Liaison
VOG	Vessel Off-Gas
VOSS	Vitrification Operations Shift Supervisor
VPP	Voluntary Protection Program
VS	Vitrification System
VSR	Ventilation Supply Room
VTF	Vitrification Test Facility
VWR	Ventilation Wash Room
W	Watt
WAPS	Waste Acceptance Product Specifications
WC	Water Column
WCC	Warning Communications Center
WCCC	Warning Communications Center Communicator
WCWRT	Work Cell Washdown Receiving Tank
WDC	Waste Dispensing Cell
WDV	Waste Dispensing Vessel
WGES	Westinghouse Government Environmental Services
WHC	Westinghouse Hanford Company
WHSE	Warehouse
WIPP	Waste Isolation Pilot Plant
WMO	Waste Management Operations
WMO	Westinghouse Maintenance Operation
WMOA	West Mechanical Operating Aisle
WNYNSC	Western New York Nuclear Service Center
WO	Work Order
WQR	Waste Qualification Report
WRPA	Waste Reduction and Packaging Area
wt%	Weight percent
WTF	Waste Tank Farm
WTFVS	Waste Tank Farm Ventilation System
WVDP	West Valley Demonstration Project
WVNS	West Valley Nuclear Services Company
WVPP	West Valley Policies and Procedures
WVVHC	West Valley Volunteer Hose Company

ACRONYMS & ABBREVIATIONS (concluded)

XC-1	Extraction Cell 1
XC-2	Extraction Cell 2
XC-3	Extraction Cell 3
XCR	Extraction Chemical Room
XSA	Extraction Sample Aisle
y	Year
Y_d	Dry density
YOY	Young of Year
yr	Year
Y2K	Year 2000
°C	Degrees Celsius
°F	Degrees Fahrenheit
μ	Micro, prefix for 10^{-6}
χ/Q	Relative concentration

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1.0 INTRODUCTION AND GENERAL DESCRIPTION OF THE REMOTE-HANDLED WASTE FACILITY

1.1 Introduction

Facilities in which radioactive waste can be safely processed in preparation for disposal are required to support completion of the West Valley Demonstration Project (WVDP) mission. Some of these wastes currently exist; others will be generated during on-going and future project activities. Wastes that have high surface radiation exposure rates and/or contamination levels require processing using remote-handling technologies to ensure worker safety. These are referred to as remote-handled (RH) wastes.

The WVDP Remote-Handled Waste Project (RHWP) is responsible for developing an integrated Remote-Handled Waste System (RHWS) for the remote handling and packaging of radioactive wastes (see Section 10.1 for a description of the RHWP Organization). Feasibility studies have indicated that an efficient system involves processing 13 of 24 identified waste streams in a new stand-alone Remote-Handled Waste Facility (RHWF), with the remaining 11 to be processed in existing or new temporary facilities at the WVDP (WVNS, August 3, 1999). RHWP processing locations and wastes streams are shown in Table 1.1-1.

The RHWF, part of the RHWS, will be a new facility at the WVDP designed with remote handling capability and shielding to protect the operators from hazards associated with RH waste processing operations.

The purpose of the RHWF is to cut up, decontaminate to a limited extent, characterize, and repackage into appropriate (standard) types of waste containers various radioactive waste forms. The purpose of this Preliminary Safety Analysis Report (PSAR) is to document the safety basis for the RHWF and provide assurance that the RHWF can be constructed, operated, maintained, and shut down safely and in compliance with applicable laws and regulations. The scope of this PSAR is safety analysis of operations within the RHWF and operations outside the RHWF on the WVDP premises that involve transfer of wastes directly to and from the RHWF.

1.1.1 Location of the Remote-Handled Waste Facility

The RHWF will be located in the northwest corner of the WVDP site, northwest of the Supernatant Treatment System (STS) Building and southwest of the Chemical Process Cell Waste Storage Area (CPC WSA). This area, which was formed by excavation and backfilling for the purpose of storing equipment, has an upper region that is fairly flat. There is a gradual slope of 7 mm/m (0.8 in/ft) from the northeast to the southwest across the area. The location of the site and orientation of the RHWF on the WVDP site are shown on Figure 1.1-1.

1.1.2 Access to the Remote-Handled Waste Facility

The RHWF will be accessible by two driveways (Figure 1.1-1), which will be connected to provide vehicular access around the entire building. One driveway will lead from the Site Perimeter/Security Road to the southeast side of the RHWF. From this driveway, vehicles will have access to the Load Out/Truck Bay, the Office Area, and the Receiving Area. The second driveway will lead from the CPC WSA access road to the north-east side of the RHWF and provide access directly to the Receiving Area. The existing perimeter/security road will be rebuilt and widened from the Main Plant road to the intersection with the road leading to the west side of the Fabrication Shop. These road improvements will maintain access to the existing Fabrication Shop and will provide a suitable pathway for off-site shipping vehicles to approach the RHWF. During construction of the RHWF, a temporary road will be constructed to allow vehicular access directly from the north end of the existing parking area through a new access gate in the site security perimeter. The road will be gravel only and will not be used after construction of the RHWF.

1.1.3 Description of the Remote-Handled Waste Facility

The RHWF, a new hazard category 2 facility at the WVDP (as determined in accordance with DOE-STD-1027-92), will be a free-standing structure. The RHWF is approximately 58.2 m long and 28.3 m wide (191 ft long and 93 ft wide) and contains the following main features or areas (as shown in Figures 5.2-1 through 5.2-6): Receiving Area, Buffer Cell, Work Cell, Contact Maintenance Area, Sample Packaging and Screening Room, Radiation Protection Operations Area, Waste Packaging and Survey Area, Operating Aisle, Office Area, and the Load Out/Truck Bay. The RHWF will be constructed to physically accommodate the outer dimensions and weight of containers and waste items for the 13 RHWF waste streams described in Table 1.1-1. The shield walls, doors, and windows of the RHWF will be constructed so that the radiation exposure rate in normally-occupied areas will be no greater than 0.1 mR/hr. The ventilation system will maintain three zones of confinement for activities in the Work Cell. A more detailed description of the major features of the RHWF is provided in Section 5.2, *Major RHWF Processing Features*.

1.1.4 Products of the Remote-Handled Waste Facility

The wastes to be processed in the RHWF are a variety of sizes, shapes, and materials including structural steel, stainless steel, concrete, grout, resins, plastics, filters, Herculite™, wood, and water. These materials will be in the form of tanks, pumps, piping, fabricated steel structures, light fixtures, conduits, jumpers, reinforced concrete sections, personal protective equipment, general rubble, and debris (Table 1.1-1).

Waste from the RHWF will be repackaged in one of the following forms: 208 L (55 gal) transuranic (TRU) waste drums, 208 L (55 gal) low-level waste (LLW) drums, and B-25 boxes with or without overpacks. In some cases, there may not be a need to repackage wastes. The estimated number of each container type that will be required for 13 waste streams to be processed at the RHWF is shown in Table 1.1-2.

1.1.5 Remote-Handled Waste Project Organization

The WVDP participants are described in WVNS-SAR-001, Section A.1.4. The WVDP RHWP organization is described in Section 10.1.

1.1.6 Remote-Handled Waste Facility Construction Schedule

The overall schedule for the design and construction of the RHWF is shown in Figure 1.1-2. This schedule is based on using a design-build approach to construct the new RHWF. The critical path extends through Department of Energy (DOE) approval of this PSAR to support the start of construction under the design-build subcontract. The actual start of construction will depend on the availability of adequate funding and DOE approval of this PSAR.

1.2 General Plant Description

As shown in Figure 5.2-1, the core functional features of the RHWF are the Receiving Area, Buffer Cell, and Work Cell. The Receiving Area provides weather protection and secondary confinement for the receipt of waste containers that require processing in the RHWF. Shield doors separate the Receiving Area from the adjacent Buffer Cell. The Buffer Cell, which is separated from the adjacent Work Cell by another set of shield doors, allows movement of waste containers to and from the Work Cell. The Work Cell is the primary work area for fully remote processing operations.

The control of operations in these core functional areas ranges from hands-on operations with shielded transfer container systems in the Receiving Area to increasingly more remote operations as the waste proceeds to the Work Cell. For example, personnel access to the Receiving Area is through a roll-up door or one of two personnel doors on the first level. Access to the Buffer Cell is via the shield door between the Receiving Area and the Buffer Cell or a double airlock on the first level that separates it from a small room at the north end of the Exhaust Ventilation Filter Room. No personnel access is provided for the Work Cell because this area is reserved for fully remote processing operations.

Operations in the Work Cell are controlled from an Operating Aisle on the second level that extends the full length of the Buffer Cell (where there is a shield window but no equipment controls) and the Work Cell. The Operating Aisle is situated between the Work Cell and the Load Out Truck Bay and one level above the Waste Transfer System that allows the transfer of packaged wastes from the Work Cell.

Additional support features of the RHWF, which are described in more detail in Chapter 5.0, include:

- Provisions for expansion modules in the Work Cell through the use of 'knock-out' sections.
- A Waste Transfer System that provides confinement for the transfer of waste packages from the Work Cell to the RHWF Load Out/Truck Bay.
- The Waste Packaging and Survey Area for receipt of waste packages from the Work Cell.
- The heating, ventilation and air conditioning (HVAC) systems for uncontaminated (Office Area) and potentially contaminated (Work Cell) air handling.
- The Contact Maintenance Area for maintenance of the crane, powered dextrous manipulators (PDMs), and other tools.

- The Sample Packaging and Screening Area located adjacent to the Operating Aisle.
- The Load Out/Truck Bay for staging completed waste packages for transfer to on-site storage or shipping depot.
- The Office Area, which provides space for up to 16 facility operations and support personnel.

1.3 General Process Description

The process flow for remote-handled waste processing in the RHWF is shown in Figure 1.3-1.

The first part of the process will involve lifting containers of RH waste from their storage area and loading them on a transfer vehicle, which may be shielded, for delivery to the RHWF Receiving Area. After the container arrives at the Receiving Area, the powered conveyor rollers on the floor of the Buffer Cell will be aligned to match the width of the container, the outside Buffer Cell shield doors will be opened, and the container will be rolled from the transfer vehicle to the Buffer Cell's powered conveyor rollers. Alternatively, the overhead bridge crane in the Receiving Area can be used to offload waste containers from the transfer vehicle.

After the container is transferred to the Buffer Cell, the outside shield doors of the Buffer Cell will be closed and the shield doors between the Work Cell and the Buffer Cell will be opened. The container will then be moved into the Work Cell using powered conveyor rollers. The container will then be staged in the Work Cell using either the 20-ton powered dextrous manipulator (PDM) or the 10-ton hoist on the 30-ton bridge crane.

Using a combination of three available PDMs and either heavy-duty or light-duty end effectors, the waste box will be opened and the contents handled, surveyed, sampled, segregated, size-reduced, decontaminated, and dewatered as necessary. Much of this work will be performed using work platforms that are located on the southeast wall of the Work Cell.

Waste items that are ready for repackaging will be placed in either drum or box liners that are staged near the box and drum liner storage drawers located in the southwest end of the Work Cell. Full box liners or drum liners will be removed from the Work Cell either by using the Waste Transfer System, which will allow the waste to pass into the waste packaging area, or by taking the package back out through the Buffer Cell and Receiving Area. The packaged waste transferred out of the Work Cell via the Waste Transfer System will be removed from the RHWF through the Load Out/Truck Bay.

1.4 Identification of Agents and Contractors

The WVDP participants are described in WVNS-SAR-001, Section A.1.4. WVDP participants in the design, construction, and pre-operational testing of the RHWF are described in Chapter 10 of this PSAR.

1.5 Hazard Categorization

The hazard categorization of the Remote-Handled Waste Facility is presented in Section 9.1.2.2. The RHWF is hazard category 2.

1.6 Structure of the Preliminary Safety Analysis Report

The DOE employs safety analyses of its nuclear and non-nuclear facilities as the principal safety basis for decisions to authorize the design, construction, or operation of these facilities. In support of the development of consistent safety documentation throughout the DOE complex, the Department has issued DOE Order 5480.23, *Nuclear Safety Analysis Reports*, to provide the requirements for the development of safety analyses that establish and evaluate the adequacy of the safety bases of the facilities. The requirements of Order 5480.23 apply to all nuclear and non-nuclear hazards associated with DOE non-reactor nuclear facilities.

This PSAR has therefore been developed to the requirements of Order 5480.23. Specifically, this PSAR has been written to the guidance provided in DOE Standard DOE-STD-3009-94 which was developed by the Department to provide more detailed direction and, thereby, assist contractors in providing analyses consistent with the intent of the Order. Because the Order does not require a specific format for nuclear safety analysis reports, the format of this PSAR corresponds to the format set forth in Nuclear Regulatory Commission (NRC) Regulatory Guide 3.26, *Standard Format and Content of Safety Analysis Reports for Fuel Reprocessing Plants*. A listing of DOE-STD-3009-94 sections, and the corresponding or equivalent sections of this PSAR, is provided in Table 1.6-1.

Figures and tables in this PSAR are located at the end of their respective chapter. Dimensions in the PSAR are in the international system (SI) of units, followed by the English unit in parentheses. In general, conversions have been made from English to SI units and rounded to two significant figures.

REFERENCES FOR CHAPTER 1.0

U. S. Department of Energy. April 30, 1992. Change 1 (March 10, 1994). DOE Order 5480.23: *Nuclear Safety Analysis Reports*. Washington, D.C.: U.S. Department of Energy.

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U.S. Nuclear Regulatory Commission. February 1975. Regulatory Guide 3.26, *Standard Format and Content of Safety Analysis Reports for Fuel Reprocessing Plants*.

West Valley Nuclear Services Co., Inc.. Letter from D. K. Ploetz to B. A. Mazurowski. Submittal of the Project Management Plan for the Remote-Handled Waste Project Completing Contract Milestone C.3, RH-1. WD:1999:0520. July 26, 1999.

__________. Approval Request 057C(RH). J. Signorelli (Scientech) to James Hurst (WVNS). Revised Report for SOW 1.3, Preferred Path for Implementing the RHWP. August 3, 1999.

__________. WVNS-SAR-001: Safety Analysis Report: *Project Overview and General Information*. (Latest Revision).

TABLE 1.1-1

RHWP PROCESSING LOCATIONS AND WASTE STREAMS

Processing Location	Waste Stream No.	Waste Stream Description
NEW FACILITY		
Remote-Handled Waste Facility	12	CPC Jumper Boxes (TRU)
	13	CPC Jumper Boxes (LLW)
	14	CPC Dissolver Vessel Boxes
	15	CPC Vessel Boxes (TRU)
	16	CPC Vessel Boxes (LLW)
	17	Vent Filter Boxes
	18	Vent Filter (in cement) Boxes
	19	Shield Boxes
	20	Shielded Boxes (Dry Active Wastes)
	21	Shielded Boxes (Resins)
	22	Shielded Drums
	23	Waste Tank Farm Pumps
	24	Main Plant Closure Wastes
EXISTING FACILITIES		
LSA #2 Hardstand Footprint	1	CPC Dissolver Pedestals
Fuel Receiving & Storage (FRS) High Bay	2	FRS Resin High-Integrity Containers (HICs) in SUREPAKs
FRS Cask Unloading Pool (CUP)	3	FRS Pool Debris Canisters
Vit Expended Materials Process (VEMP) in Vit Cell and HLWIS	4	Vit Jumpers
	5	Vit Melter Inserts
	6	Vit Discarded Equipment
	7	Vit Cell Deactivation Wastes
Head End Cells (HECs) and/or CPC	8	Hi-Vac Canisters
	9	HECs Wastes
Portable Waste Assay Trailer	10	Suspect Contact-Handled TRU Drums
	11	Suspect Contact-Handled TRU Boxes

TABLE 1.1-2

ESTIMATED NUMBER OF CONTAINERS BY TYPE GENERATED IN RHWF

Container Types	TRU Drums	Overpack Drums	B-25 Boxes
Waste Streams			
CPC Jumper Boxes (TRU)	24	---	21
CPC Jumper Boxes (LLW)	–	–	44
CPC Dissolver Boxes	18	---	11
CPC Vessel Boxes (TRU)	4	---	4
CPC Vessel Boxes (LLW)	–	–	15
Vent Filter Boxes	27	---	25
Vent Filter (in cement) Boxes	10	---	28
Shield Boxes in CPC WSA	---	---	17
Shielded Boxes with DAW	---	---	46
Shielded Boxes (Resin)	---	---	20
Shielded Drums	---	13	---
WTF HLW Pumps	109	---	85
Main Plant D&D Wastes	76	---	23
Totals	268	13	339

[WVNS, July 26, 1999]

TABLE 1.6-1

LOCATION OF DOE ORDER 5480.23 REQUIRED INFORMATION IN WVNS-SAR-023

DOE 5480.23 - 8.b(3) Topics	WVNS-SAR-023 (Reg. Guide 3.26 Chapters)
a) Executive Summary	1.0 Introduction and General Description of the Remote-Handled Waste Facility 2.0 Summary Safety Analysis
b) Applicable statutes, rules, regulations, and departmental orders	Each Chapter, as appropriate
c) Site characteristics	3.0 Site Characteristics
d) Facility description and operation, including design of principal structures, components, all systems, engineering-safety features, and processes	4.0 Principal Design Criteria 5.0 Remote-Handled Waste Facility Design 6.0 Remote-Handled Waste Facility Process Systems
e) Hazard analysis and classification of the facility	1.0 Introduction 9.0 Hazard and Accident Analyses
f) Principal health & safety criteria	8.0 Hazards Protection
g) Radioactive and hazardous material waste management	7.0 Waste Confinement and Management
h) Inadvertent criticality protection	8.0 Hazards Protection
i) Radiation protection	8.0 Hazards Protection
j) Hazardous material protection	8.0 Hazards Protection
k) Analysis of normal, abnormal, and accident conditions, including design basis accidents, assessment of risks, consideration of natural and man-made external events, assessment of contributory and casual events, mechanisms, and phenomena, and evaluation of the need for an analysis of beyond-design-basis accidents; however, the SAR is to exclude acts of sabotage and other malevolent acts since these actions are covered under security protection of the facility.	9.0 Hazard and Accident Analyses
l) Management, organization, and institutional safety provisions	10.0 Conduct of Operations
m) Procedures and training	10.0 Conduct of Operations
n) Human factors	Each Chapter, as appropriate
o) Initial testing, in-service surveillance, and maintenance	10.0 Conduct of Operations
p) Derivation of TSRs	11.0 Derivation of Technical Safety Requirements
q) Operational Safety	10.0 Conduct of Operations
r) Quality Assurance	12.0 Quality Assurance
s) Emergency Preparedness	10.0 Conduct of Operations
t) Provisions for decontamination and decommissioning	10.0 Conduct of Operations
u) Applicable facility design codes and standards	Each Chapter, as appropriate

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RHWF1-1.DWG

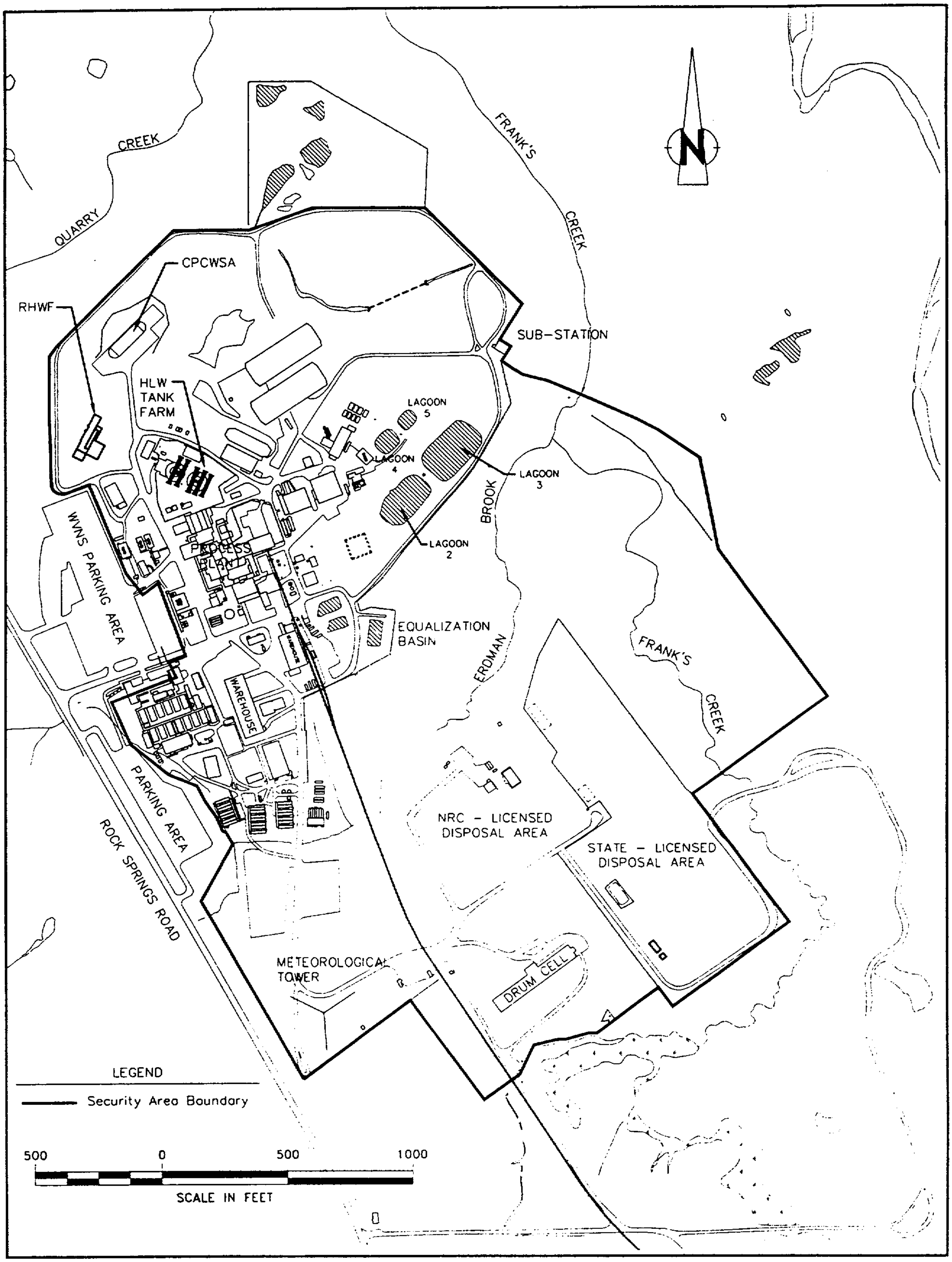


Figure 1.1-1. Location of the RHWF on the WVDP Premises.

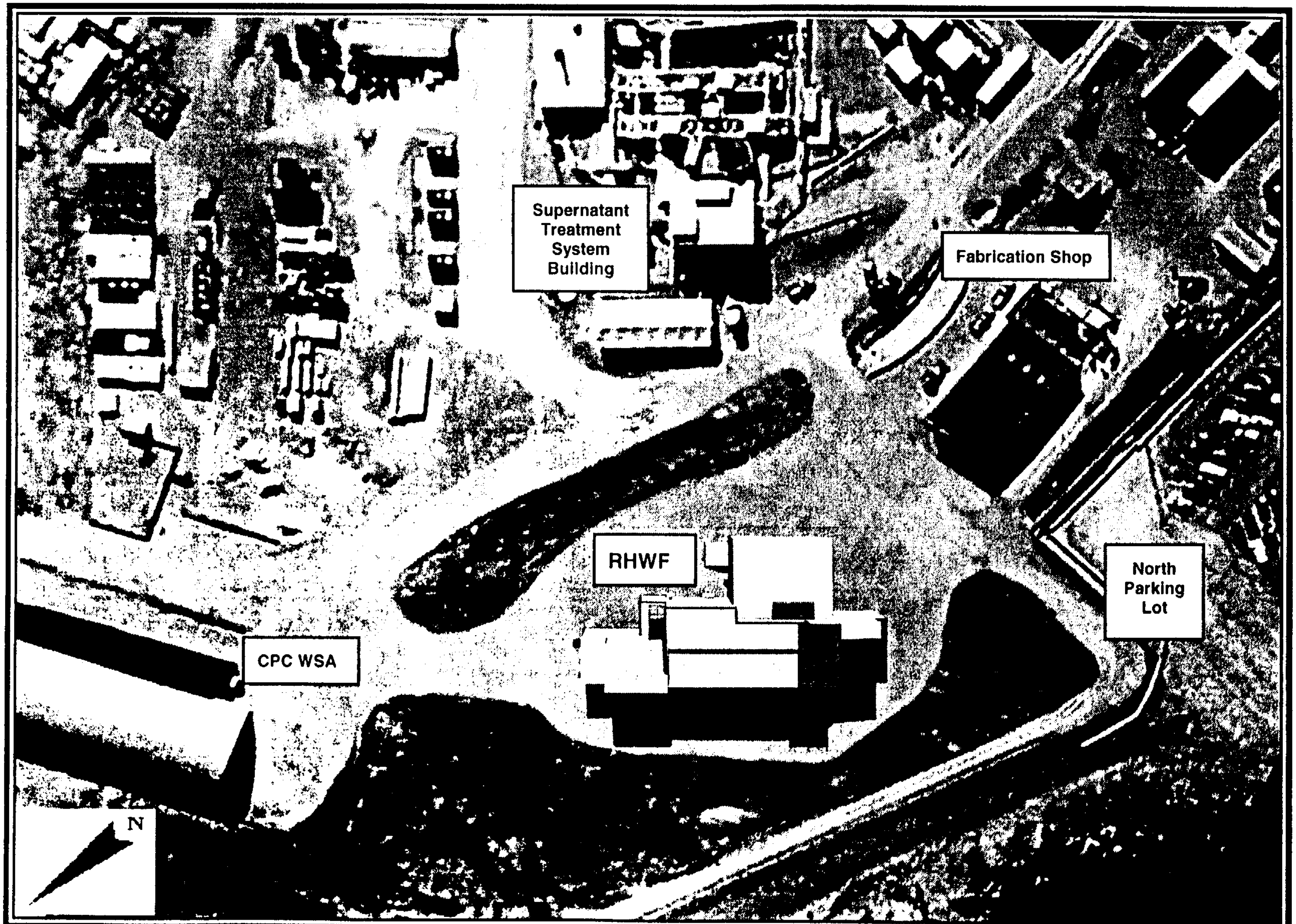
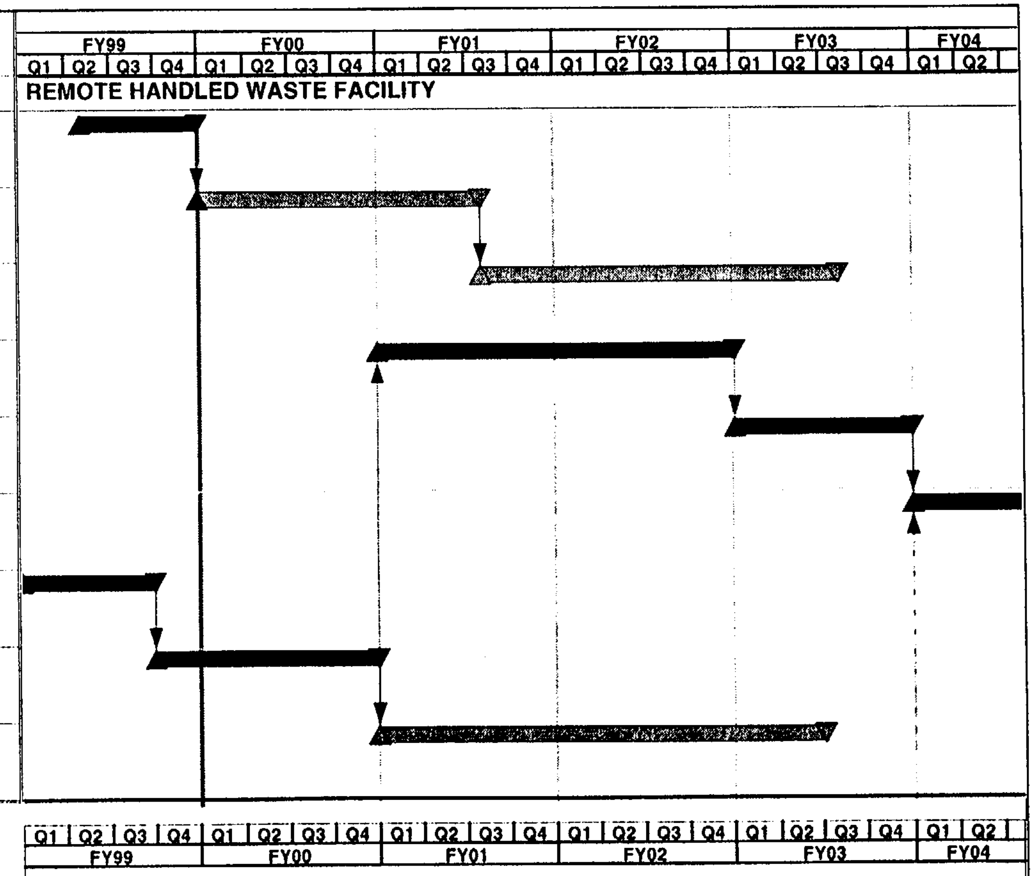


Figure 1.1-2. RHWF Site Plan (Artist Rendering)

Activity Description	Early Start	Early Finish
REMOTE HANDLED WASTE FACILITY		
DESIGN - BUILD CONTRACT (BID CYCLE)	01FEB99A	30SEP99A
DESIGN RHWF	01OCT99A	01MAY01
CONSTRUCT RHWF (LATE START)	02MAY01	02MAY03
CONSTRUCT RHWF (EARLY START)	02OCT00*	02OCT02
STARTUP / COLD TESTING / ORR	03OCT02	30SEP03
START PROCESSING RADIOACTIVE WASTE	01OCT03	01OCT10
PRELIMINARY PHA	01OCT98A	30JUN99A
PSAR	01JUL99A	01OCT00
FSAR	02OCT00	01APR03



RHWP OVERVIEW SCHEDULE

Figure 1.1-3. RHWF Construction Overview Schedule

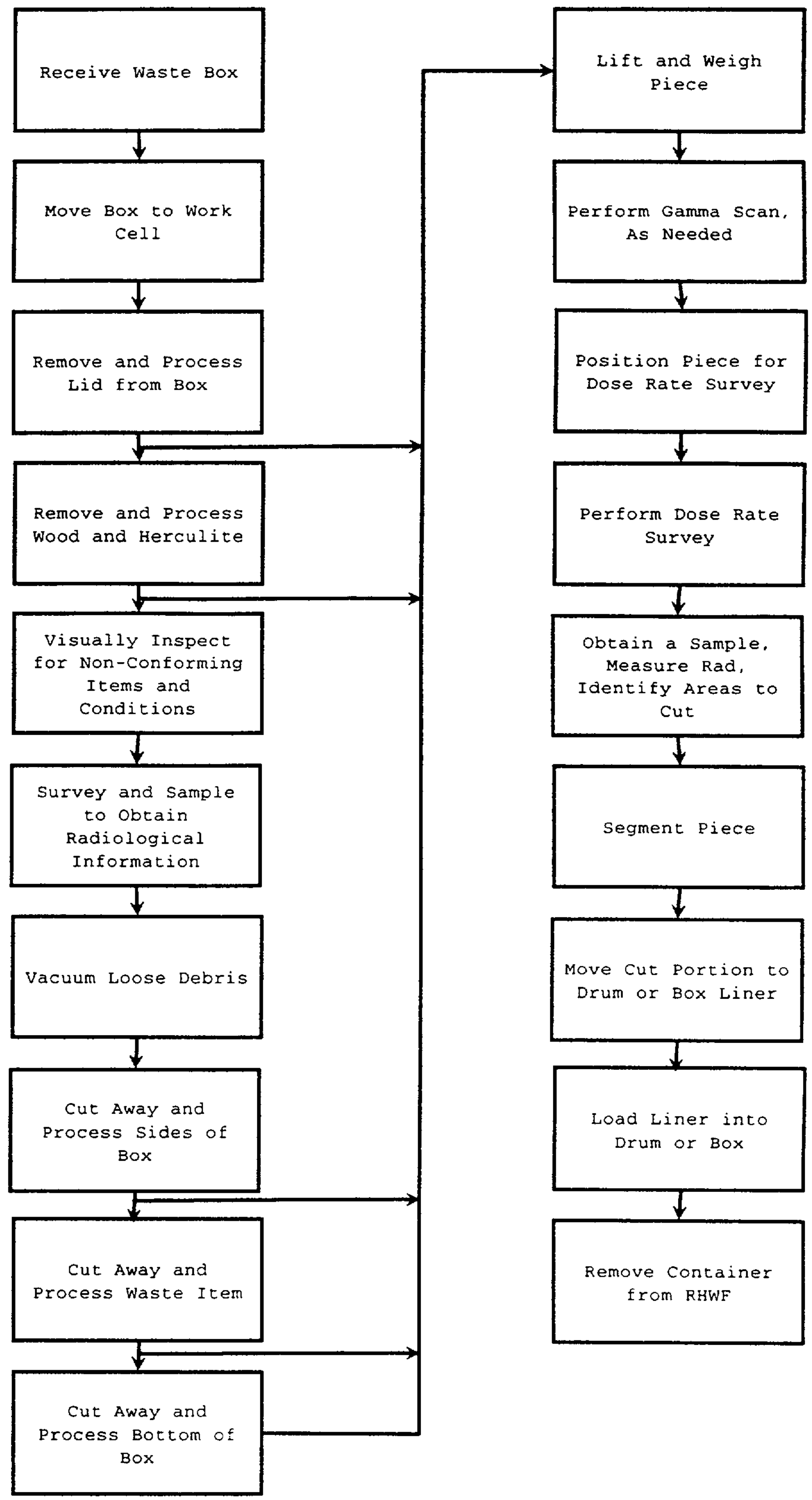


Figure 1.3-1. Remote-Handled Waste Facility Simplified Process Flow Diagram

2.0 SUMMARY SAFETY ANALYSIS

2.1 Site Analysis

A summary of the safety analyses performed for the RHWF and related on-site waste transfer activities is presented in this chapter. In the accidents analyzed in this PSAR, no credit was taken for any active preventive or mitigative systems, structures, or components (SSCs) to reduce the risk of analyzed accidents. Consequences from analyzed accidents are well below the Evaluation Guidelines (EGs) specified in Section 9.1.3. Doses from routine operations will be well below the occupational radiation protection limits established in Title 10, Code of Federal Regulations, Part 835. Additional details on these analyses and supporting systems analyses can be found in Chapters 8.0 and 9.0 of this PSAR. Evaluation Guidelines for radiological accidents are given in Figures 9.1-2 and 9.1-3.

2.1.1 Natural Phenomena

Natural phenomena that impact the RHWF design include earthquakes, wind forces, lightning, snow loadings, and rainfall. Design criteria are described in Chapter 4.0 of this PSAR. For information on natural phenomena that can affect the safety of operations at the WVDP, see Section A.2.1.1 of WVNS-SAR-001.

2.1.2 Site Characteristics Affecting the Safety Analysis

This PSAR assesses the hazards associated with RHWF operations and associated on-site waste transfer to and from the RHWF. Primary activities in the RHWF include confinement of contamination in the Work Cell while handling, assaying, segregating, cutting, and packaging remote-handled waste streams. Primary areas from which wastes will be transferred to the RHWF and returned include the CPC WSA and LAG Storage Area (LSA) described in WVNS-SAR-002.

The analysis in Section 9.2 of a beyond design basis earthquake (DBE) assesses the impacts due to severe natural phenomena.

Other site-specific loads (e.g., high winds and snow loading) are bounded by more controlling loads and their associated margins of safety. The site's topographic setting renders the likelihood of major flooding not credible, and local run-off and flooding is adequately accommodated by natural and man-made drainage systems in and around the WVDP.

2.1.3 Effect of Nearby Industrial, Transportation and Military Facilities

Nearby industrial and transportation facilities do not pose significant risks to WVDP activities due to the distance of these facilities from the site and the nature of the operations at these facilities. See Section A.2.1.3 of WVNS-SAR-001 for a further discussion of nearby transportation and military facilities.

2.2 Radiological Impacts from Normal Operations

Occupational exposures are minimized at the WVDP through strict adherence to as-low-as-reasonably-achievable (ALARA) principles. For this reason, it is not possible to accurately predict the annual worker dose based on the conceptual design of the RHWF. However, a conservative estimate for total estimated worker occupational collective dose for RHWF operations is estimated to be 56 person-rem (0.56 person-Sv) as discussed in Section 8.4. This estimate is based on an annual limit of 500 mrem (5 mSv) and an average of 16 workers per year over a 7 year campaign.

In calculating off-site doses, two pathways were considered: air discharges (radionuclides exhausted from the RHWF stack during normal operations) and routine liquid releases (Section 8.6). An atmospheric dispersion code (CAP88-PC) was used to calculate the total effective dose equivalent due to the airborne transport, deposition, and uptake of radioactive particulates by off-site individuals from routine operations. The dose to the maximally exposed off-site individual for the airborne pathway was estimated to be 1.7E-4 mrem/year (1.7E-6 mSv/year) [Dames & Moore, August 13, 1998].

As described in Section 8.6, liquid wastes from the RHWF will be processed through existing site systems or vendor-supplied systems. These releases would not be expected to result in a significant increase in the estimated dose from liquid releases from the site as reported in WVNS-SAR-002, Section B.8.6.4.

2.3 Impacts from Abnormal Operations

Abnormal operations are events which could occur from malfunctions of systems or operator error. Abnormal events are only of consequence when they affect systems in facilities which process, control, or confine radioactivity or hazardous materials. Abnormal events considered in this analysis (Section 9.1) are of little consequence and are not predicted to result in a significant release of radioactive or hazardous material. Qualitative radiological consequences from abnormal operations of the RHWF and associated on-site transfer activities are provided in the Process Hazards Analysis (PHA) found in Table 9.1-1.

2.4 Accidents

There are three design basis accidents analyzed in Section 9.2 of this PSAR, all of which have consequences below the Evaluation Guidelines (EGs). The first of these involves simultaneous mechanical failure of the Work Cell ventilation pre-filters. This extremely unlikely (frequency of occurrence of 1E-04 to 1E-06 per year) accident would result in an on-site dose of 0.93 rem (0.0093 Sv) and an off-site dose of 0.56 rem (0.0056 Sv). An anticipated event (frequency of occurrence of 1E-02 to 1E-01) involving the accidental drop of a remote-handled waste package en route to the RHWF would result in an on-site dose of 0.15 rem (0.0015 Sv) and an off-site dose of 0.088 rem (0.00088 Sv). Finally, a fire accident is analyzed in which it is postulated that fuel from a transfer vehicle will spill to the floor of the Load Out/Truck Bay, pool under waste packages staged on the truck and ignite, resulting in release of the waste package contents to the atmosphere. This extremely unlikely event would result in an on-site dose of 0.51 rem (0.0051 Sv) and an off-site dose of 0.31 rem (0.0031 Sv).

DOE Order 5480.23 requires the evaluation of accidents beyond the design basis to provide a perspective of the residual risk associated with the operation of the facility. These beyond design basis accidents are not required to provide assurance of public health and safety. Rather, the analysis of beyond design basis accidents (DBAs) is intended solely to provide information that can be used to identify additional facility features that could prevent or reduce severe beyond DBA consequences. As a result, no comparison to the EGs is required for beyond DBAs. Three beyond DBAs are analyzed in this PSAR; a beyond DBE, a criticality accident, and a natural gas explosion. The beyond DBE would result in an on-site dose of 5.6 rem (0.056 Sv) and an off-site dose of 3.4 rem (0.034 Sv). The criticality accident is postulated to originate in the Work Cell Washdown Receiving Tank, which is located in a shielded vault below the Contact Maintenance Area. The dose, attributable entirely to short-lived, noble gas fission product generation and release, would result in an on-site dose of 26 rem (0.26 Sv) and an off-site dose of 16 rem (0.16 Sv). An explosion of natural gas in the Work Cell resulting from gas leakage from a supply line to a air supply unit heater would result in an on-site dose of 8.6 rem (0.086 Sv) and an off-site dose of 5.2 rem (0.052 Sv).

2.5 Conclusions

A summary of the consequences of accidents analyzed in this PSAR is provided in Table 9.2-7. Consequences were determined at distances of 640 m (2100 ft) and 850 m (2790 ft) for various meteorological conditions. These distances correspond to the location of the on-site evaluation point and the nearest aspect to the site boundary. Additionally, accident consequences were calculated for the distance yielding the maximum dose or concentration for the site-specific 95% meteorology. All analyzed design basis accidents are within the evaluation guidelines provided in Section 9.1.3.

The simultaneous mechanical failure of the Work Cell pre-filters results in a total effective dose equivalent (TEDE) to the maximally exposed off-site individual of 0.56 rem (0.0056 Sv). This represents the bounding design basis accident for radiological releases. Routine doses to off-site individuals will be well within the requirements of DOE Order 5400.5.

REFERENCES FOR CHAPTER 2.0

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Code of Federal Regulations. 10 CFR 835: *Occupational Radiation Protection, Department of Energy.*

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West Valley Nuclear Services, Co. *Safety Analysis Report WVNS-SAR-001: Project Overview and General Information.* (Latest Revision).

________. *Safety Analysis Report WVNS-SAR-002: Low-Level Waste Processing and Support Activities.* (Latest Revision).

3.0 SITE CHARACTERISTICS

Characteristics of the WVDP site are discussed in WVNS-SAR-001, *Project Overview and General Information*, Chapter A.3.0, and in accompanying *Technical Support Documents (TSDs) for WVNS-SAR-001*. The TSDs are a compilation of the data and results of numerous past studies and evaluations of site characteristics such as meteorology and geology. The influence of these site characteristics on the design and operation of the RHWF is described below.

3.1 Geography and Demography

WVNS-SAR-001, Section A.3.1, contains a comprehensive description of the geographic and demographic features of the WVDP and surrounding areas. Neither geography nor demography affect the design and operation of the RHWF.

3.2 Nearby Industrial, Transportation, and Military Facilities

A detailed discussion of the effects on the WVDP from these nearby facilities is provided in WVNS-SAR-001, Section A.3.2. There are no direct effects on the RHWF from these facilities.

3.3 Meteorology

The meteorology of the WVDP and surrounding areas is described in WVNS-SAR-001, Section A.3.3. As discussed in other chapters of this PSAR, particularly Chapters 4, 5, and 9, meteorological characteristics of the region have been considered in the design of the RHWF. Weather is not expected to affect the safe operation of the RHWF.

3.4 Surface Hydrology

WVNS-SAR-001, Section A.3.4, describes the surface hydrology at, and in the vicinity of the WVDP. During construction, surface or storm water run-off will be diverted away from the open excavation to the extent that is practical. Following construction, storm water run-off from the building and adjacent area will use existing drainage features (i.e., ditches, swales, culverts, outfalls, etc.) to the maximum extent practicable. Storm drainage around the facility will be designed to accommodate rainfall intensity for a 100-year storm event such that backup of storm water will not flow into the facility. Thus, operation of the RHWF will not be affected by surface hydrology.

3.5 Subsurface Hydrology

WVNS-SAR-001, Section A.3.5, describes the subsurface hydrology at, and in the vicinity of the WVDP. The design of the RHWF included consideration of the local subsurface hydrology. The design will consider subsurface geologic conditions (i.e., depth to the Lavery till). This geologic unit provides a natural barrier to downward migration of potential contaminants. The design will minimize any disturbance to the Lavery till during excavation and will, to the extent possible, preclude the use of support structures that would fully penetrate the thickness of the Lavery till. Thus, operation of the RHWF will not be affected by the subsurface hydrology.

3.6 Geology and Seismology

A general discussion of geology and seismology is provided in WVNS-SAR-001, Section A.3.6. As indicated in Chapters 4, 5, and 9 of this PSAR, regional soil characteristics and seismological factors have been considered in the design of the RHWF.

3.7 Summary of Conditions Affecting Construction and Operating Requirements

WVNS-SAR-001, Section A.3.8, provides a tabular summary of site characteristics that impact design of facilities. Factors such as snowfall, wind, temperature, precipitation, earthquakes, and near-surface groundwater were considered in designing the RHWF. As a result, none of these natural phenomena pose a credible threat to the structural integrity of the RHWF or the subsequent operations conducted therein.

REFERENCES FOR CHAPTER 3.0

West Valley Nuclear Services Co. Design Criteria Remote-Handled Waste Facility. WVNS-DC-071. Revision 1. June 29, 1999.

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4.0 PRINCIPAL DESIGN CRITERIA

The RHWF will be a new, stand-alone facility at the WVDP for remote handling and packaging of radioactive waste. This chapter identifies and discusses the principal engineering design criteria and design bases for the SSCs of the RHWF. Functional requirements, design criteria, and applicable codes and standards for the RHWF are provided in WVNS-DC-071, *Design Criteria for the Remote-Handled Waste Facility*.

4.1 Purpose of the RHWF

The RHWF will be part of the WVDP RHWS. The RHWS, which will involve approximately seven facilities, is being developed at the WVDP to process and repackage LLW and TRU waste resulting from activities associated with the solidification of HLW, other site activities that have generated radioactive wastes, and radioactive wastes generated during ongoing and future WVDP activities. The RHWS will be comprised of approximately six existing facilities at the WVDP that will be modified, as necessary, to allow waste processing, and a single new facility, the RHWF. Examples of existing facilities that will be used in the RHWS are provided in Table 1.1-1, *RHWP Processing Locations and Waste Streams*. The purpose of the RHWF is to size reduce, decontaminate to a limited extent, characterize, and repackage into appropriate (standard) types of waste containers various radioactive waste forms as listed in Table 1.1-1.

4.1.1 RHWF Feeds

The RHWF can process waste streams in Table 1.1-1 in less than 7 years, assuming that the facility will operate with two shifts per day and five days per week. It is estimated that the daily throughput will range between 0.14 and 1.9 m^3/day (5 and 67 ft^3/day), depending on the waste stream being processed.

The feed wastes will be comprised of different sizes, shapes, and materials, including structural steel, stainless steel, concrete, grout, resins, plastics, and mechanical filtration media. These materials will be in the form of tanks, pumps, piping, steel fabrications, light fixtures, conduits, jumpers, reinforced concrete sections, personal protective equipment, filters, general rubble, and debris.

4.1.2 RHWF Products and Byproducts

The RHWF product will be radioactive waste packaged into standard containers (i.e., drums and boxes). By-and-large, waste byproduct will be secondary radioactive waste in the form of dust and small sized particles, liquid effluent (primarily water used for decontamination), waste containers that currently contain the radioactive wastes, contaminated equipment, and radiation survey and characterization samples.

4.1.3 RHWF Functions

The RHWF will cut relatively large components into pieces small enough to fit into standard types of waste containers, perform limited decontamination of waste items, perform characterization efforts as necessary, and repackage radioactive waste into standard types of waste containers. The RHWF will be designed to permit remote repair, replacement, and decontamination of equipment, tools, and work areas. See Chapters 5 and 6 of this PSAR for a discussion of the capabilities of RHWF SSCs.

4.1.4 RHWF Interfaces with Other WVDP Facilities

The RHWF will be a new, stand-alone facility. The conceptual design for the RHWF indicates that dependence on existing WVDP facilities will be kept to a minimum to facilitate the shutdown, deactivation, and where applicable, decontamination and decommissioning (D&D) of existing SSCs at the site. Some support utility requirements (e.g., demineralized water) may need to be supplied from the Main Plant Utility Room. Connections to existing site SSCs that provide natural gas, fire water, sewer services, potable water, and communications will be made. See Section B.5.4 of WVNS-SAR-002, *Safety Analysis Report for Low-Level Waste Processing and Support Activities*, for a description of existing service and utility systems. Radioactive liquid wastes may be transferred to the existing HLW tank farm for processing through existing on-site systems. The final design for the RHWF will provide a final determination in this regard.

4.2 Structural and Mechanical Safety Criteria

Specific structural, mechanical, and safety-related design criteria for the RHWF are provided in WVNS-DC-071. Specific RHWF design criteria have not been relied upon in the accident analyses contained in Chapter 9 in demonstrating that the consequences of all credible, bounding accidents associated with RHWF operations are below the evaluation guidelines stipulated in Chapter 9.

4.2.1 Wind Loadings

Building structures and equipment on the exterior of the structures will be designed to a 100-year wind of 35.8 m/s (80 mph) with a gust response factor of 1.21. Wind pressure will be analyzed using the methods specified in ANSI A58.1, *Building Code Requirements for Minimum Design Loads for Buildings and Other Structures*, Exposure Condition C.

4.2.2 Tornado Loadings

No tornado loading is specified for the RHWF in WVNS-DC-071. Based on the guidance contained in DOE-STD-1021-93: *Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components*, the RHWF is a Performance Category 2 facility. Based on the guidance in DOE-STD-1020-94, *Natural Phenomena Hazards Design and Evaluation Criteria for DOE Facilities*, tornado design criteria are not applicable to Performance Category 2 facilities.

4.2.3 Water Level Design

4.2.3.1 Design Rainfall

Intense rainfall is not considered to be a hazard to the RHWF. The RHWF will be designed to incorporate an industrial roof system, with a minimum 20-year life, and will incorporate industrial means and methods for waterproofing and sealing to prevent the intrusion of intense rainfall. Storm drainage around the facility will be designed to accommodate rainfall intensity for a 100-year storm event such that backup of storm water will not flow into the facility.

4.2.3.2 Reference Design Flooding

The RHWF is situated at an elevation which will not be affected by flooding of either Buttermilk Creek or Cattaraugus Creek. Thus, a flood is not considered to be a hazard to the facility. Also, the RHWF will be designed so that groundwater intrusion into the facility will not occur.

4.2.3.3 Surface Water Run-off

During construction, surface or storm water run-off will be diverted away from the open excavation to the extent that is practical. Following construction, storm water run-off from the building and adjacent area will utilize existing drainage features (i.e., ditches, swales, culverts, outfalls, etc.) to the maximum extent practicable.

4.2.4 Tornado Missile Protection

There are no design criteria pertinent to tornado generated missiles because tornadoes are not applicable to the design criteria for the RHWF.

4.2.5 Seismic Design

The WVDP DBE is addressed in Chapter 3 of WVNS-SAR-001, *Project Overview and General Information*. The RHWF will be designed to withstand the WVDP DBE, which has a horizontal peak ground acceleration 0.10 g.

Earthquake loads and evaluation methods used in the design will be, at a minimum, in accordance with the Uniform Building Code, 1991 edition for Zone 1, modified with an importance factor of 1.25.

4.2.6 Snow Loadings

Structures will be designed for a snow load of 1,915 Pa (40 lb/ft^2).

4.2.7 Process and Equipment Derived Loads

No process and equipment derived loads are specified for the RHWF in WVNS-DC-071.

4.2.8 Combined Load Criteria

No combined load criteria are specified for the RHWF in WVNS-DC-071. However, WVNS-DC-071 does stipulate certain design floor loads.

4.2.9 Subsurface Hydrostatic Loadings

For the RHWF, subsurface loadings due to soil and groundwater will be developed using accepted engineering practices, including analysis in accordance with established principles of soil mechanics. The design will consider subsurface geologic conditions (e.g., depth to the Lavery till). This geologic unit provides a natural barrier to downward migration of potential contaminants. The design shall minimize any disturbance to the Lavery till during excavation and should preclude the use of support structures that would fully penetrate its thickness.

4.2.10 Temperature Design Loadings

The SSCs of the RHWF shall be designed to withstand thermal loads. The RHWF shall have a freeze protection program in place to prevent damage to equipment due to cold weather. Requirements for freeze protection will be incorporated into the design. Heating systems and insulation shall be provided to maintain inside temperatures above freezing. The temperature inside the various areas of the RHWF will normally be maintained between 10 and 32.2°C (50 and 90°F).

4.2.11 Lightning

Lightning protection systems will comply with NFPA 780, *Standard for the Installation of Lightning Protection Systems.*

4.3 Safety Protection Systems

4.3.1 General

The RHWF will be designed for safe operation. Three primary design principles for the confinement of radioactive materials will be employed at the RHWF: 1) use sufficiently air-tight physical boundaries to keep contamination as close to the source as practical; 2) use multiple barriers, such as cells, walls, and double-contained piping; and 3) maintain pressure differentials between each confinement zone so that air flow travels from zones of lesser contamination potential to zones of greater contamination potential. Specific safety protection-related systems and features are described in the following sections.

4.3.2 Protection Through Defense-in-Depth

The design and operation of the RHWF will provide for defense-in-depth for public and worker safety during normal, off-normal, and accident conditions. Implementation of the defense-in-depth philosophy ensures that layers of defense are provided against the release of radiological and hazardous materials such that no one layer by itself is completely relied upon. The layers of defense for the RHWF are given below in order of relative importance:

- Passive confinement barriers
- Waste form and inventory
- Active confinement barriers
- Personnel training
- Administrative planning and controls

Details of the RHWF design and process operations are provided in Chapters 5 and 6 of this PSAR, while personnel training, programmatic efforts, and administrative controls are discussed in Chapters 8, 10, 11, and 12. Elements of these design features and controls, as they relate to defense-in-depth, are discussed below.

4.3.2.1 Passive Confinement Barriers

The method of confinement for a given substance depends on several factors, such as the physical form, mobility, and degree of hazard associated with the substance. Outside the Work Cell, the Herculite^{tm} in which most of the radioactive waste is currently wrapped could be considered the first confinement barrier in terms of confining radioactive material. However, Herculite^{tm} is a negligible factor for "confining" the substantial gamma radiation associated with many of the wastes, and could be torn, punctured, or improperly sealed. Hence, Herculite^{tm} wrapping serves an important function, but more commonly, the waste container for radioactive wastes is considered to be the primary confinement barrier. The Receiving Area and Buffer Cell will provide secondary confinement while a waste container is being transferred into the Work Cell.

Inside the Work Cell, the primary confinement barrier will become the Work Cell structure (i.e., walls, roof, and floor). The Work Cell floor and walls (up to approximately 6 m [20 ft]) will be lined with stainless steel, with floor drains that lead to sump(s) or other vessel(s) that will provide confinement of liquid releases within the Work Cell. The Work Cell will be constructed of reinforced concrete and designed to withstand the effects of the DBE, and will provide radiation shielding for workers located in other portions of the RHWF (e.g., the operating aisles).

4.3.2.2 Waste Form and Inventory

Table 1.1-1 provides a list of waste streams. By-and-large, the waste streams will be contaminated metal objects that in many instances have already undergone substantial decontamination efforts (e.g., the contents of the 22 boxes located in the CPC WSA). (Table 6.1-1 of this PSAR provides select radiological characteristics of the contents of the subject 22 boxes.) Another substantial waste stream will be expended ventilation system filters, which by virtue of their design tend to retain particulate matter. Given these facts, it is considered reasonable to postulate that the vast majority of the radioactive material that will pass through the RHWF is not readily dispersible (i.e., will not readily separate from the contaminated item) without the addition of a significant amount of energy (e.g., cutting operations or by accidentally dropping).

Because of certain design features and the configuration of the RHWF, there will be an "intrinsic" limitation on the inventory in the RHWF at any given time. It is not intended that the Load Out/Truck Bay will serve as an intermediate or long term storage area for repackaged wastes.

4.3.2.3 Active Confinement Barriers

Pressure differentials will be maintained between each confinement zone so that air flow travels from zones of lesser contamination potential to zones of greater contamination potential. The definition of these zones is as follows:

- Zone I designates areas that are expected to contain (airborne) radioactive materials during normal operations. The Work Cell is designated as Zone I.
- Zone II designates the operating area and other potentially contaminated areas surrounding Zone I. These spaces are normally not contaminated.

- Zone III designates areas that are expected to be free of contamination at all times. These areas include the Receiving Area, Operating Aisle, Office Areas, and Load Out/Truck Bay.

The RHWF ventilation system will ensure positive confinement of airborne radioactive material. The RHWF ventilation system is discussed in Chapter 5.

The air from all Zone I spaces will be filtered by a minimum of two fire-resistant HEPA filters in series prior to exiting to the environment. Air from all Zone II spaces will be filtered by a minimum of one fire-resistant HEPA filter prior to exiting to the environment. Filters will be located as close as possible to the source of contamination to minimize contamination of downstream ducting. The capability to test the efficiency of the subject HEPA filters after installation will be provided. Redundant exhaust blower capability will be provided, and additional HEPA filter train(s) will be provided to allow for the maintenance and testing of a given HEPA filter train. Standby electrical power from one or more of the existing on-site diesel generators will be provided to the appropriate motor control center(s) to ensure that power to select RHWF ventilation system components (e.g., exhaust blowers) can be provided in the event of a loss of off-site power, thereby ensuring desired pressure differentials will be maintained throughout the RHWF. See Section 6.4 of WVNS-DC-071 for a more detailed discussion of the design requirements associated with the RHWF ventilation system.

4.3.2.4 Personnel Training

Qualification standards and training requirements will be established for the RHWF personnel. RHWF operators will be qualified in accordance with documented performance-based training programs. This training will include responsibilities and actions during emergency situations. Periodic emergency drills will be performed, with follow-on critiques, to gain experience and confidence and to ensure that personnel are ready to respond to accident situations. A more detailed description of the WVNS training program is presented in Section A.10.3 of WVNS-SAR-001.

4.3.2.5 Administrative Planning and Controls

Construction and operation of the RHWF will be accomplished through a clearly defined organizational structure with well defined responsibilities. The overall WVDP organizational structure is presented in Sections A.10.1 and A.10.2 of WVNS-SAR-001. The RHWP organization is responsible for overseeing the design, construction, and pre-operational testing of the RHWF, and is described in Chapter 10 of this PSAR.

WVDP-011, *WVDP Industrial Hygiene and Safety Manual*, establishes the policies used to control chemical and industrial hazards for all WVDP operations. Safety is ensured through facility and equipment design, protective clothing and equipment selection, personnel training, and administrative controls. WVDP-010, *WVDP Radiological Controls Manual*, establishes the control organization, staffing and training requirements, performance goals, control zones and associated levels, posting and labeling requirements, and other administrative control requirements associated with work in radiation and contamination areas. Operations within radiologically contaminated areas require the use of work control practices to maintain exposure ALARA. These practices include the use of radiation work permits, pre-job briefings, personnel protective equipment and clothing, and dosimetry.

The WVDP uses Process Safety Requirements (PSRs) to reduce worker risk and focus attention on those systems under the direct control of the operator that are important to the safe facility operation. These requirements define limiting conditions for operation, surveillance requirements, and actions, and provide the associated bases for systems and/or components under the direct control of the operator. PSRs are identified per the OH/WVDP-approved radiological, nonradiological, and worker risk-reduction criteria defined in WV-365, *Preparation of WVDP Safety Documents*, and are implemented through standard operating procedures and other documentation. Procedure WV-365 specifies the approval authority for a PSR, which may be WVNS or OH/WVDP, depending upon the criterion which necessitated the requirement. The final determination for the need for PSRs per WV-365, or Technical Safety Requirements (TSRs) as discussed in DOE Order 5480.22, *Technical Safety Requirements*, will be made after the RHWF Final SAR has been developed.

4.3.3 Protection by Equipment and Instrumentation Selection

Procurement of new equipment and instrumentation will be performed in compliance with WVNS's Quality Assurance Program, which is described in Chapter 12 of this PSAR and WVNS-SAR-001. Safety Class and Quality Level designations for SSCs of the RHWF shall be determined using DOE Order 420.1 and criteria established in QM 2, "Quality Assurance Program," of WVDP-002, "Quality Management Manual." These designations will be listed in WVDP-204, *WVDP Quality List "Q-List"*. This "*Q-List*" is the "primary source for establishing, identifying, revising, and maintaining an up-to-date listing of safety classes and quality levels" of all facilities and their systems that are under the purview of the WVNS QA Program. The design codes and standards associated with each quality level are stated in WVDP-204.

The basic design approach for RHWF equipment and instrumentation is: 1) it must perform its operational function and if required, its safety functions, and 2) if possible, be located in a non-radiation area. If the equipment and instrumentation must be located in a radiation area then: 1) take appropriate measures to ensure a high degree of reliability, 2) use redundancy where continuous operations are required, and 3) make the equipment and instrumentation easy to maintain or replace remotely.

An electronic system and man-machine interface (MMI) for control, monitoring, and data acquisition, using the latest proven commercially available technologies, will be used in the facility. The MMIs will be user friendly and free of electrical or magnetic signal interferences, and will be integrated with the waste tracking system that is used for tracking site wastes.

Instrumentation will be selected on the basis of its applicability, simplicity, reliability, and availability, and will be standardized whenever possible to simplify the spare parts inventory. Sensitive instruments and devices will be designed to mitigate electrical and magnetic signal interferences. Instrumentation located in a radioactive environment will be subject to radiological design considerations based on the total radiation (exposure from all radiation sources) potentially affecting a particular instrument. Instrumentation will read out in English units of measurement.

4.3.4 Nuclear Criticality Safety

Nuclear criticality safety will be established at the RHWF through implementation of WVDP-162, *WVDP Nuclear Criticality Safety Program Manual*, and WV-923, *Nuclear Criticality Safety*. These documents have been written to implement the criticality-related requirements of DOE Order 420.1, *Facility Safety,* and referenced ANSI/ANS nuclear criticality safety standards. Where applicable, SSCs will be designed critically-safe(e.g., geometrically safe sumps, trenches and piping, sump particulate filters, and bottom draining liquid waste tanks). Nuclear criticality safety is further addressed in Chapter 8 of this PSAR.

4.3.5 Radiological Protection

Design features and administrative controls will provide radiological protection. The principle of ALARA will apply to all aspects of the RHWF operations and maintenance. The primary methods used for maintaining exposures ALARA will be physical design features that, to the extent practicable, ensure minimum exposure of workers to radiation. Administrative controls and procedural requirements will be employed only as supplemental methods to control radiation exposure. DOE Order 420.1 will be the governing document for facility safety, with personnel exposure levels controlled through the implementation of WVDP-010. The RHWF will include continuous air monitors for detecting the airborne release and presence of radiological materials, and area radiation monitors for detecting radiation levels above the normal operational range.

The RHWF will be designed to the following requirements:

- The maximum radiation dose rate for a full-time occupancy area will be 0.1 mrem/hr (0.001 mSv/hr). A full-time occupancy area is one in which individual(s) may be expected to spend all or most of a work day. The RHWF control areas (where control stations are located) will be defined as full-time occupancy areas.

- The maximum radiation dose rate for a full-time access area will be 1.0 mrem/t (0.01 mSv/t), where "t" is the maximum average time in hours per day that the area is expected to be occupied by any one individual. A full-time access area is one in which no physical or administrative control of entry exists.

If compliance with full-time access area requirements would be economically infeasible, impractical, or prohibitive, higher dose rates may be allowed. However, access to such fields will be strictly controlled. In these normally unoccupied areas, the maximum radiation dose rate shall be 4.0 mrem/hr (0.04 mSv/hr), except when waste packages are present.

4.3.6 Fire and Explosion Protection

The WVDP fire protection program, which will be applied to the RHWF, has been developed to meet the requirements for a comprehensive fire protection program as delineated in WVDP-177, *WVDP Fire Protection Manual*, which is based on the fire protection-related requirements in DOE Order 420.1. Administrative controls, procedures, and training to prevent fires and explosions are presented in WVDP-177. The RHWF will be designed in accordance with applicable National Fire Protection Association codes. Fire protection for the RHWF will be based upon a comprehensive Fire Hazard Analysis (FHA) of the facility and associated operations. A preliminary (pre-construction) FHA will be developed to ensure that all design criteria have been addressed as the design criteria relates to the facility's occupancy, hazards, and process. It is noted that WVNS-DC-071 states that lightning protection for the RHWF will comply with NFPA 780, *Standard for the Installation of Lightning Protection Systems.*

4.3.7 Radioactive Waste Handling and Storage

As of September 1999, DOE Order 5820.2A, *Radioactive Waste Management*, is cited and invoked as being applicable in the contract between WVNS and the DOE. Additionally, WVNS-DC-071 invokes DOE Order 5820.2A as being applicable to the RHWF. WVNS is currently preparing the implementation plan for DOE Order 435.1 that supersedes DOE Order 5820.2A.

See Chapter 7 of WVNS-SAR-001 and Chapter 7 of WVNS-SAR-002 for an overview and understanding of radioactive waste storage and handling at the WVDP. Since it is not intended that the Load Out/Truck Bay Area of the RHWF will serve as an intermediate or long term storage area for repackaged wastes, it is important to understand current WVDP radioactive waste storage and handling practices and capabilities. See Chapter 7 of this PSAR for additional RHWF radioactive waste management information. Radioactive and mixed wastes at the WVDP are addressed in WVDP-019, *Annual Waste Management Plan.*

4.3.8 Industrial and Chemical Safety

As previously noted, WVDP-011, *WVDP Industrial Hygiene and Safety Manual*, establishes the policies used to control chemical and industrial hazards for all WVDP operations. Safety is ensured through facility and equipment design, protective clothing and equipment selection, personnel training, and administrative controls. WVDP-011 requirements are based upon DOE Order 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees.*

Techniques prescribed in DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities*, will also assist in minimizing and controlling industrial and chemical hazards at the RHWF. The requirements of DOE Order 5480.19 are implemented in WVNS Policy and Procedure WV-110, *Conduct of Operations*, and WVDP-106, *Westinghouse Conduct of Operations Manual.* Good work practices will be required for RHWF operations, including orderly shift turnover, required reading lists, facility surveillances and walk-downs, and use of logbooks. Routine operations will be governed by operating procedures. An Industrial Work Permit (IWP) will be required whenever non-routine handling operations, such as maintenance, are conducted on equipment with safety hazards. Lockout/tagout procedures will be used in conjunction with the IWP and craftsmen and operators will be trained in the use of locks and tags. WVNS-SAR-001, Section A.4.3.8, addresses established WVDP industrial and chemical safety measures. These measures will be employed at the RHWF, where applicable.

Recognizing that major or even minor spills could result in hazards to WVDP personnel, the public, and the environment, the WVDP has developed and implemented WVDP-043, *WVDP Oil, Hazardous Substances, and Hazardous Wastes Spill Prevention, Control and Countermeasures Plan*. This operating plan reviews in detail release flow paths, sources, system design, and the containment of possible spills or releases as well as prevention, preparedness, response, and notification procedures.

4.4 Classification of Structures, Components, and Systems

The safety class and quality level of SSCs associated with the RHWF will be listed in WVDP-204. The definitions of safety class and quality level that are contained in WVDP-204 were developed by WVNS personnel and were chosen for reasons stated in WVDP-204. The WVDP-204 definition of safety class (and SSCs that have been designated as safety class in WVDP-204) are to be completely disassociated with safety class SSCs as defined in DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports*. Safety class SSCs per DOE-STD-3009-94 generally have TSRs associated with them.

DOE-STD-3009-94 defines safety class SSCs as follows: "Systems, structures, or components including primary environmental monitors and portions of process systems, whose failure could adversely affect the environment, or safety and health of the public as identified by safety analyses. For the purposes of implementing this Standard, the phrase 'adversely affect' means Evaluation Guidelines are exceeded. Safety class SSCs are systems, structures, or components whose preventive or mitigative function is necessary to keep hazardous material exposure to the public below the off-site Evaluation Guidelines. This definition would typically exclude items such as primary environmental monitors and most process equipment." The accident analyses presented in Chapter 9 of this PSAR do not indicate the need for any safety class SSCs at the RHWF based on this definition of safety class SSCs.

4.5 Decommissioning

The RHWF will be designed with consideration of the need for future D&D. In this regard, the RHWF will be designed in accordance with ANSI N-300, *Design Criteria for Decommissioning of Nuclear Fuel Reprocessing Plants*. Section A.10.6 of WVNS-SAR-001 provides a discussion of WVDP decommissioning planning and related efforts. Chapter 10 of this PSAR provides specific design features and measures that will be employed to facilitate D&D of the RHWF. Substantial D&D-related information for the RHWF is provided in *Closure Report on the Deactivation and Decommissioning of the Stand-Alone Alternative to the RHWF*, dated September 24, 1999.

4.6 Human Factors Engineering

The RHWF will be designed to be comfortable and natural for personnel to operate and maintain. Human factors will be considered in positioning equipment, switches, valves, and instruments from both an operating and a maintenance viewpoint. The following considerations will be incorporated into the design of the RHWF:

- Every effort will be made to locate instrument readouts at average eye elevation for ease of reading. The instruments controls will be located to permit visual monitoring without drastic shifts of body position.

- Every effort will be made to locate equipment so that it will be accessible for ease of operation and maintenance.

- Valves will be properly sized and every effort will be made to locate them for ease of operation without using ladders, platforms, or over extending the body beyond normal reach.

- Manipulators and viewing equipment will be properly located for ease of remote operation and maintenance.

- Operators with a range of physical sizes and abilities will be accommodated.

- The design will minimize or automate operations requiring special skills or special attention.

- The design will incorporate audible and visual alarms that warn operators in advance of conditions exceeding limits.

- Communications capabilities will be provided during normal and off-normal operating conditions (e.g., emergency communication systems such as the "812" All Page, intercoms, and hand-held radios).

- System control, display devices, component arrangement, vibration, noise, lighting, emergency lighting, ventilation, temperature, humidity, human dimensions, protective equipment, warning and annunciator systems, and maintainability will be considered in the control station design and layout.

- Storage areas for equipment (located in appropriate locations) will be provided.

- Provisions will be included inside the RHWF and/or in an adjacent, attached Office Area for personnel accommodations (e.g., shift supervisor's office, meeting room, restroom) based on a shift crew size of 16.

REFERENCES FOR CHAPTER 4.0

American National Standards Institute. ANSI A58.1: *Building Code Requirements for Minimum Design Loads for Buildings and Other Structures.* American National Standards Institute.

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__________. WVDP-002: *Quality Management Manual.* (Latest Revision).

__________. WVDP-010: *WVDP Radiological Controls Manual.* (Latest Revision).

__________. WVDP-011: *Industrial Hygiene and Safety Manual.* (Latest Revision).

__________. WVDP-019: *Annual Waste Management Plan.* (Latest Revision).

__________. WVDP-043: *West Valley Demonstration Project Oil, Hazardous Substances, and Hazardous Wastes Spill Prevention, Control, and Countermeasures Plan,* (Latest Revision).

__________. WVDP-106: *Westinghouse Conduct of Operations Manual.* (Latest Revision).

__________. WVDP-162: *WVDP Nuclear Criticality Safety Program Manual.* (Latest Revision).

__________. WVDP-177: *WVDP Fire Protection Manual.* (Latest Revision).

__________. WVDP-204: *WVDP Quality List (Q-List).* (Latest Revision).

__________. WVNS-DC-071: *Design Criteria for the Remote Handled Waste Facility.* (Latest Revision).

__________. WVNS-SAR-001: Safety Analysis Report: *Project Overview and General Information.* (Latest Revision).

__________. WVNS-SAR-002: *Safety Analysis Report for Low-Level Waste Processing and Support Activities.* (Latest Revision).

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5.0 REMOTE-HANDLED WASTE FACILITY DESIGN

The purpose of this chapter is to provide descriptive information on the structure and installed features of the RHWF and its location on the WVDP site. The emphasis of this chapter is on the description and evaluation of RHWF features that provide confinement functions. The descriptions provided in this chapter are based on the conceptual design of the RHWF, and therefore specific numerical values (e.g., ventilation system flowrates and differential pressures) may change based on ongoing design efforts.

5.1 Location and Layout of Facilities

The location of the site and orientation of the RHWF on the WVDP site are shown on Figure 1.1-1. The RHWF will be located in the northwest corner of the WVDP site, northwest of the STS Building and southwest of the CPC WSA. This area currently is being used as a staging area for construction materials and equipment. This area has an upper region that is fairly flat and which was formed by excavating and backfilling for the purpose of storing equipment. There is a gradual slope of 7 mm/m (0.8 in/ft) from the northeast to the southwest across the area. The location of the site and orientation of the RHWF on the WVDP site are shown on Figure 1.1-1.

The RHWF will be a free-standing structure with no structural reliance on other buildings or facilities at the WVDP site. The RHWF is approximately 58.2 m (191 ft) long and 28.3 m (93 ft) wide. The RHWF will be constructed to physically accommodate the outer dimensions and weight of containers and waste items for 13 RHWF waste streams described in Table 1.1-1.

The RHWF will have nine major processing features or areas, as follows:

- Receiving Area
- Buffer Cell
- Work Cell
- Contact Maintenance Area
- Sample Packaging and Screening Room
- Radiation Protection Operations Area
- Waste Packaging and Survey Area
- Operating Aisle
- Load Out/Truck Bay

These areas are described in Section 5.2. The four support system features or areas that are listed below are described in Section 5.3.

- Exhaust Ventilation Filter Room
- Exhaust Ventilation Blower Room
- Mechanical Equipment Area and Stack Monitor Room
- Office Area

General arrangements for the RHWF are depicted in Figures 5.2-1 through 5.2-6.

5.2 Major RHWF Processing Features

5.2.1 Receiving Area

The Receiving Area is shown in Figure 5.2-7. The area will provide weather protection for the loading and unloading of the transfer vehicles and will allow for contained movement of radioactive waste to and from the RHWF. This area will also act as a secondary barrier to ensure the confinement of radioactive contamination in the Work Cell.

The Receiving Area, 16 m (52 ft) long x 8.2 m (27 ft) wide x 14 m (45 ft) high, will be of two types of construction. The first 5 m (16.5 ft) length of the Receiving Area nearest the roll-up truck door will be constructed with steel-framed, insulated, double-walled, sheet metal walls with an insulated metal standing seam roof at elevation (EL) = 6.4 m (21 ft). The next 10.8 m (35.5 ft) length of the Receiving Area that is nearest to the shield doors providing access to the Buffer Cell will be a shielded, reinforced concrete unloading bay with a roof elevation of EL = 12.5 m (41 ft). The metal-framed portion of the Receiving Area will be an extension of the shielded portion of the facility. The floor of the Receiving Area will be 1.2 m (4 ft) below the level of the Work Cell floor (EL = -1.2 m [-4 ft]) and will allow containers to be rolled off the transfer vehicles and onto a powered roller conveyor located on the floor of the Buffer Cell (EL = 0 m [0 ft]).

At the second level of the Receiving Area (EL = 4 m [13 ft]), air supply unit no. 2 provides 2.15 m^3/s (4550 cfm) of filtered outside air through a dust filter and natural gas powered heater (Table 5.2-1). Most of this air passes to the Work Cell via the Buffer Cell and comprises the single largest contribution of makeup air for the Work Cell. A discussion of the ventilation system is provided in Section 5.4.1.

On the third level of the Receiving Area (EL = 7.6 m [25 ft]), a crane maintenance platform for the 20-ton bridge crane will be located at EL = 6.6 m (21.5 ft) on the side walls and EL = 9 m (29.5 ft) on the wall over the roll-up truck door.

Equipment within the Receiving Area includes a remotely controlled 20-ton bridge crane with rails extending the full length of the Receiving Area, Buffer Cell, and Work Cell. As a contingency in the design, the 20-ton crane will be capable of movement into the Work Cell, if required, to support recovery operations for the 30-ton bridge crane (See Work Cell, Section 5.2.3). Shielding, contamination control, and crane access between the Receiving Area and the Buffer Cell will be provided by a shield door. Contamination control and crane access for the wall area above the shield door will be provided by a swinging lower air-control door (Figure 5.2-8), and an upper roll-up door with notches to clear the crane rails. The Buffer Cell shield, air flow, and roll-up door operating mechanisms will be located inside the Receiving Area for ease of accessibility and maintenance. The roof of the Receiving Area will be comprised of removable, weather-tight roof panels to allow crane replacement.

5.2.2 Buffer Cell

The Buffer Cell, shown in Figure 5.2-8, will act as a ventilation confinement boundary between the normally uncontaminated Receiving Area and the highly contaminated Work Cell.

The Buffer Cell, 6.7 m (22 ft) long by 7 m (23 ft) wide by 11 m (37 ft) tall, will have space sufficient to accommodate the largest waste box, with the exception of the Waste Tank Farm (WTF) pumps. The Buffer Cell will be constructed entirely of shielded, reinforced concrete, sealed to facilitate cleanup and decontamination. The Buffer Cell is equipped with powered roller conveyors and shares the remotely-controlled, 20-ton overhead bridge crane with the Receiving Area, if required.

A shielded window, located on a concrete shield wall between the Buffer Cell and the Operating Aisle, will be included to allow the direct observation of operations within the Buffer Cell. Personnel access to the Buffer Cell is accomplished on the first level (EL = 0 m [0 ft]) by means of a double airlock that will be connected to a small room at the north end of the Exhaust Ventilation Filter Room.

Shielding, contamination control, and crane access between the Receiving Area, the Buffer Cell, and the Work Cell will be provided by shield doors on either end of the Buffer Cell. Contamination control and crane access for the wall area above the shield doors will be provided by swinging lower air-control doors (Figure 5.2-10), and upper roll-up doors with notches to clear the crane rails. There are sealed curbs on the floor between the Receiving Area and Buffer Cell and the Buffer Cell and the Work Cell to prevent the spread of contaminated liquids between the adjacent areas. The shield, air flow, and roll-up door operating mechanisms for the interface between the Buffer Cell and the Work Cell will be located inside the Buffer Cell for ease of accessibility and maintenance.

5.2.3 Work Cell

The Work Cell, shown in Figures 5.2-9 through 5.2-11, is a shielded space, approximately 17 m (55 ft) long x 6.7 m (22 ft) wide x 7.9 m (26 ft) high to the top of the bridge crane rails, with the floor at EL = 0 m (0 ft). The Work Cell will be constructed of shielded, reinforced concrete. The cell floors and walls will be sealed and lined with stainless steel to facilitate decontamination efforts.

On the wall opposite the Operating Aisle, two 6.1 m (20 ft) long x 7.3 m (24 ft) high "knock-out" sections that will allow the addition of expansion modules will be included as part of the outside wall of the Work Cell (see Section B-B, Figure 5.2-11). This part of the exterior wall will be constructed of removable concrete planking. The interior stainless steel liner on this wall will be supported on support beams that extend from the floor to the top (EL = 7.3 m [24 ft]) of the "knock-out" sections.

Sliding shield doors and air control doors provide a means for waste transfer and bridge crane passage between the Work Cell and the Buffer Cell. A second shield door at the opposite end of the Work Cell will allow the 30-ton bridge crane to pass to the Contact Maintenance Area.

The 30-ton bridge crane will be provided to run on the crane rails that extend the full length of the building. This 30-ton crane is designated for contaminated operations. A 20-ton PDM with a telescoping tube will be provided as part of the bridge crane and will operate from a dedicated trolley. A second trolley will be included on the bridge and will be equipped with a 10-ton hoist, hook, and cable.

The Work Cell will have powered roller conveyors on the floor near the sliding shield doors that provide access to the Buffer Cell. The placement of the powered roller conveyors will allow the incoming waste containers to be staged adjacent to the adjustable work platforms. At the work platforms, space will be provided for up to three work stations, two of which will be installed during construction. The remaining space will be reserved for possible installation of a third station in the future. The work stations will be equipped with two 2.5-ton jib cranes with PDMs and telescoping tubes. These jib cranes will position and support the tools used to inspect, sample, and cut the waste items for final disposition. All three PDMs (one each on the jib cranes and one on the bridge crane) will be capable of being remotely handled by operators in the Operating Aisle using video monitors or while looking through any of three installed shield windows in the concrete shield wall between the Work Cell and the Operating Aisle.

Storage shelves and/or racks will be provided in the Work Cell for the storage of materials awaiting analysis, partially filled liners, and PDM equipment.

Filled drum and box liners will be transferred from the Work Cell to the Waste Packaging and Survey Area using a waste transfer system. This system will allow the transfer of contaminated liners to waste packages in the Waste Packaging and Survey Area in a manner that prevents surface contamination of packages as they are moved to the Load Out/Truck Bay.

The Work Cell will be equipped with a wash-down trench and drain system. The trench and drain will be designed to be critically safe. The trench will be no larger than 15.2 cm (6 in) in width. The drains will be no larger than 10.2 cm (4 in) in diameter and contain a replaceable strainer to remove particulates. Particulates will be removed from the drain by a pre-filter basket or vacuum.

For control of airborne contamination, the Work Cell will have local downdraft vacuum systems (source capture systems) at the work stations to collect radioactive particulate matter. In addition, 24 disposable in-cell pre-filters for the Work Cell HVAC are located in an array surrounding the adjustable work platforms. This design allows capture of particulate matter that is not captured by the source capture systems. Each of the disposable in-cell pre-filters is comprised of a 10.2 cm (4 in) deep pre-filter and 30.5 cm (12 in) deep HEPA filter contained in a 50.8 cm (20 in) diameter by 81.3 cm (32 in) long cylindrical filter enclosure (Section "D-D", Figure 5.2-17). A hinged lifting bail on the top of each disposable pre-filter allows in-cell remote removal and replacement.

5.2.4 <u>Contact Maintenance Area</u>

The Contact Maintenance Area (Figure 5.2-18) will provide an area adjacent to the Work Cell where personnel can perform maintenance on the crane, PDMs, and other Work Cell equipment. It will provide four levels of access to allow for maintenance of the crane's telescoping tube. The Contact Maintenance Area will be constructed entirely of shielded, reinforced concrete.

Access to the first level (EL = 0 m [0 ft]) will be provided by a double airlock between the Contact Maintenance Area and the Radiation Protection Operations area. On the first level, a stainless-steel lined space will be provided for washdown pumps and valves in a shielded box, storage shelves, and a work bench. A floor drain will allow drainage of washdown water to the washdown collection tanks, which will be located below the floor of the Contact Maintenance Area in the tank vault. Access to the tank vault will be provided by a 1.2 m (4 ft) by 1.2 m (4 ft) square shielded access hatch and a rung ladder to the floor below (EL = -2.9 m [-9.5 ft]).

Two intermediate level platforms will be provided at approximately EL = 2.4 m (8 ft) and EL = 4.9 m (16 ft). Ladders extending through openings in each intermediate level platform and the third (upper) level provide worker access to all levels inside the Contact Maintenance Area without exiting the area.

At the top level (EL = 7.9 m [26 ft]), a second double airlock access is provided from a small room adjacent to the Mechanical Equipment Area. The floor at this level is stainless steel lined and has floor drains to capture bridge crane and PDM washdown water. The roof of the Contact Maintenance Area is comprised of removable, weather-tight roof panels to allow crane replacement.

5.2.5 Sample Packaging and Screening Room

In support of waste characterization, the Sampling Packaging and Screening Room (Figures 5.2-2 and 5.2-14) will be on the second level (EL = 4.0 m [13 ft]) adjacent to the Operating Aisle. This room will provide the capability to remove samples from the sample shelf of the Work Cell. A shield window in this room is one of three that will be installed during construction that will allow operators to view the Work Cell. A PDM controller and work station controller will be provided in this room to allow remote sample transfer operations in the vicinity of the Work Cell sample shelf. Sample transfers will be accomplished using a transfer drawer that will allow passage of the sample through the shield wall to a sample transfer glove box in the Sampling Packaging and Screening Room. A shielded sample lift system in this room will allow the packaged sample to be transferred down to the Radiation Protection Operations Area on the first level (EL = 0 m [0 ft]), where the sample will be surveyed and released to a laboratory facility for characterization.

5.2.6 Radiation Protection Operations Area

The Radiation Protection Operations Area will receive Work Cell samples via the Sample Packaging and Screening Room shielded sample lift system (Figure 5.2-18). This area is also equipped with a sample transfer glove box that will receive swipe samples of waste packages that will be obtained using the swipe survey reach rods in the adjacent Waste Packaging Area and a shielded liquid sample glove box with a drain. A hood will be provided in this area.

5.2.7 Waste Packaging and Survey Area

The Waste Packaging and Survey Area, an area 4.6 m (15 ft) long and 7.6 m (25 ft) wide at EL = 0 m [0 ft], will provide an area for transferring filled waste drums and boxes out of the Work Cell via the Waste Transfer System (Figures 5.2-12 and 5.2-13). The Waste Packaging and Survey Area is isolated from the Work Cell by a combination of shield walls, Waste Transfer System port covers, and shield covers. Access to this area is provided from the Exhaust Ventilation Filter Room, the Radiation Protection Operations Room, and the Load Out/Truck Bay.

The Waste Transfer System in this area is comprised of a drum cart and box cart on rails that extend from the area directly below the Waste Transfer System shield covers to the Load Out/Truck Bay roll-up door.

The packaging area (4.6 m [15 ft] long x 3.0 m [10 ft] wide) in which the drums and boxes will be loaded using the Waste Transfer System is separated from the survey area by two packaging area exit shield doors that open into the survey area. Each door is equipped with a periscope and a swipe survey reach rod that will allow operators in the survey area to remotely monitor and survey operations in the packaging area while the doors are closed. A sample transfer glove box will allow collection of swipe samples from one reach rod through the Work Cell shield wall (Figure 5.2-12). Samples from the other rod will be transferred directly to the sample transfer glove box in the Radiation Protection Operations Area.

A 6-ton monorail transfer hoist will be provided in the survey area for lifting and placing the drum and box transfer shield lids.

A floor drain (which will be plugged when not in use) will allow washdown of the Waste Transfer System.

5.2.8 Operating Aisle

The Operating Aisle (Figure 5.2-14) will provide a clean and shielded area for the operators who will remotely operate facility equipment. The Operating Aisle will be 31 m (102 ft) long and 4.3 m (14 ft) wide and will allow operators to view the Buffer Cell through one shield window and the Work Cell through either of three installed shield windows, or into either cell using video monitors. Each of the three Work Cell shield window areas will be equipped with a work station controller and PDM controller. Space is also reserved in the Operating Aisle for motor control centers (MCCs) and instrumentation cabinets.

The Operating Aisle will be accessed by the north stairwell and the south stairwell. From the Operating Aisle, access will be provided to the Utility Chase and the Sample Packaging and Screening Room. The Utility Chase will contain fire protection and utility piping and supply air ducting. A 1.8 m (6 ft) wide by 2.1 m (7 ft) high knock-out panel to allow for the movement into the facility of a future shield window to be installed in the space provided in the Operating Aisle (between the two installed windows) will also be provided in the Utility Chase.

5.2.9 Load Out/Truck Bay

The Load Out/Truck Bay (Figure 5.2-19) allows for filled waste containers to be removed from the facility and empty containers to be placed into the facility. The Load Out/Truck Bay will consist of a clear span pre-engineered building with a metal wall and roof system. It will be approximately 18.3 m (60 ft) by 15.2 m (50 ft). The supply air to this area is provided by Air Supply No. 3 (Table 5.2-1).

5.3 RHWF Support Systems

5.3.1 Exhaust Ventilation Filter Room

The Exhaust Ventilation Filter Room (14 m [46 ft]) long by 4.3 m [14 ft] wide) will contain two filter assemblies, each of which will be comprised of two banks of HEPA filters in series (Figure 5.2-15). Each bank in an assembly will be comprised of a 1x3 array of 0.61 m (2 ft) by 0.61 m (2 ft) HEPA filters. Disposable in-cell pre-filters in the Work Cell will reduce the potential loading on the filters in the Exhaust Ventilation Filter Room filter assemblies. For change-out, each filter assembly in the Exhaust Ventilation Filter Room can be isolated by inlet and outlet dampers. Sufficient additional aisle pull space (2.1 m [7 ft]) will be provided in the Exhaust Ventilation Filter Room to allow filters to be pulled horizontally from their housings. Each filter assembly will be attached by 40.6 cm (16 in) ducting to individual blowers in the Exhaust Ventilation Blower Room.

The Exhaust Ventilation Filter Room will be accessed from the Waste Packaging and Survey Area or the north stairwell. A door will also be provided in this room to provide access to the Buffer Cell double airlock.

5.3.2 Exhaust Ventilation Blower Room

The Exhaust Ventilation Blower Room will be a steel-framed, insulated, sheet-metal-sided, and -roofed room, and will have no shielding (Figure 5.2-15). Each secondary filter assembly housed in the Exhaust Ventilation Filter Room will be tied to a blower in the Exhaust Ventilation Blower Room. The outlets for two blowers (one of which will normally be operating, with the other in standby) will be tied to a single stack that penetrates the roof of this room (see Figure 5.2-16). The stack is anchored to the north side of the RHWF.

5.3.3 Mechanical Equipment Area and Stack Monitor Room

The Mechanical Equipment Area and Stack Monitor Room (Figure 5.2-3) are on the third level (EL = 7.9 m [26 ft]) of the RHWF over the Operating Aisle. This area is steel-framed, insulated, and sheet-metal-sided. This area contains the hydraulic system, plant air compressor and receiver, and the breathing air compressor, receiver & dryer. An air handling unit on the roof over this area (Air Supply #1, Table 5.2-1) supplies make-up air for most of the RHWF areas. Fire protection and utility piping reach this area through the Utility Chase.

The stack effluent monitors and samplers are located in the Stack Monitor Room, which will be located on the north end of the Mechanical Equipment Area.

The Mechanical Equipment Area and Stack Monitor Room will be accessed from the north stairwell and the south stairwell. Access to the roof over this area and the Work Cell is provided via a door to a platform over the roof of the Load Out/Truck Bay. From this platform a ladder provides access to the roof. A door at the top level of the north stairwell will also provide access to the stack access platform, which is located over the roof of the Exhaust Ventilation Blower Room.

5.3.4 Office Area

The Office Area (Figures 5.2-1 and 5.2-2) is separate from the processing areas and provides a clean, low-dose-rate area to perform administrative functions. The Office Area will be two stories and have space for crew offices, meeting rooms, lunch room, and sanitary facilities. The ventilation supply for this area is Air Supply No. 4 (Table 5.2-1).

5.4 Description of Service and Utility Systems

The following sections describe the service and utility systems provided for the RHWF.

5.4.1 Ventilation

The RHWF will have ventilation systems for both uncontaminated and contaminated areas. The most highly contaminated zones will have a pressure lower than adjacent uncontaminated areas to minimize the potential for migration of radioactive contamination. This results in a cascade airflow from uncontaminated areas into highly contaminated areas. The facility's proposed ventilation flow is provided in Figure 5.4-1. The ventilation system has 100% redundancy; however, it should be noted that operation of the primary or backup ventilation systems is not required to mitigate accidents analyzed in section 9.2.

5.4.1.1 Uncontaminated Zone Ventilation

The uncontaminated zones in the RHWF are supplied by four separate air supply systems (Table 5.2-1). These supply systems have dust filters to remove particulate matter and natural gas heaters to provide comfort for operators.

Flow rates and pressures are nominal values for normal operations with the shield doors closed.

5.4.1.2 Contaminated Zone Ventilation

The contaminated areas receive air from adjacent areas as shown in Table 5.2-2. Flow rates and pressures are nominal values for normal operations with the shield doors closed.

Air from contaminated areas is exhausted from the Work Cell through in-cell disposable pre-filters and HEPA filter assemblies in the Exhaust Ventilation Filter Room prior to release to the outside atmosphere through a stack approximately 18.3 m (60 ft) tall above grade level above the Exhaust Ventilation Blower Room.

5.4.2 Electrical

The RHWF will have sufficient electrical service to provide power for operation of:

- Doors
- Cranes
- Rollers

- Manipulators
- Remote Cutting and Sampling Tools and End Effectors
- Contact Handling Cutting Tools
- Washdown Equipment
- Air Compressors
- Instrumentation
- HVAC Equipment
- Radiation Monitors
- Communications and Video Equipment
- Lighting

Power will be supplied to the facility and equipment as:

- 240/120 volt, 1-phase
- 480/277 volt, 3-phase
- 208/120 volt, 3-phase

Backup power is provided; however, it should be noted that neither primary nor backup electrical power is required to prevent or mitigate the consequences of accidents evaluated in section 9.2.

5.4.3 Natural Gas

Approximately 57 m^3/hr (2000 ft^3/hr) of natural gas will be required to heat the RHWF. The natural gas header will be installed outside the RHWF. Four lines will lead from the header, one for each of the ventilation supply units described in Table 5.2-1. Section 9.2.3.3.1 provides additional information on the gas heater units and the risks associated with natural gas heating.

5.4.4 Utility Air

Utility air will be supplied from the compressors within the facility at a pressure 689 kPa (100 psi). Separate compressors will supply utility air and breathing air.

5.4.5 Steam Supply and Distribution

The RHWF will not have a steam supply.

5.4.6 Potable Water Supply

Potable water will be supplied to the RHWF at a pressure of 275 to 414 kPa (40 to 60 psi).

5.4.7 Demineralized Water Supply

The RHWF will require 38 liters per minute (10 gpm) of demineralized water for the high pressure, low volume spray washdown system. This will be supplied by an existing 10.2 cm (4 in) line outside the STS.

5.4.8 Cooling Water

Cooling water is not required in the RHWF.

5.4.9 Sanitary Sewer

The RHWF will have restrooms that will tie into the existing WVDP sanitary sewer lines. A pumping station will be located outside the Office Area of the facility for pumping the sewage into the pressurized force main for processing through the existing WVDP wastewater treatment plant, which is described in WVNS-SAR-002.

5.4.10 Safety Communication and Alarms

A communication system for paging, announcing, and general personnel communication within the RHWF will be provided. Telephone service computer network access will also be installed.

Process-related alarms will be provided to alert operators to abnormal process conditions.

All alarms will be fail-safe with contacts opening to alarm so that broken wires will be indicated as a circuit fault rather than preventing alarm conditions.

5.4.11 Fire Protection System

Fire protection for the RHWF shall be based upon a comprehensive FHA of the facility and its process. Fire protection for the facility shall include where appropriate: firewalls, doors, fire-rated dampers, windows, penetration seals, fire suppression systems, alarms, and fire detection system.

The RHWF will be supplied fire water from existing fire water lines.

5.4.12 Maintenance Systems

A Contact Maintenance Area will be provided for hands-on maintenance of the Work Cell cranes and other Work Cell equipment. This area is located at the far end of the building adjacent to the Work Cell. Personnel entry to this area will be through double airlocks located on the first and third floors of the facility. Work platforms will be provided for maintenance of the crane's telescoping tube. A workbench and tool storage area will be provided for hands-on maintenance.

REFERENCES FOR CHAPTER 5.0

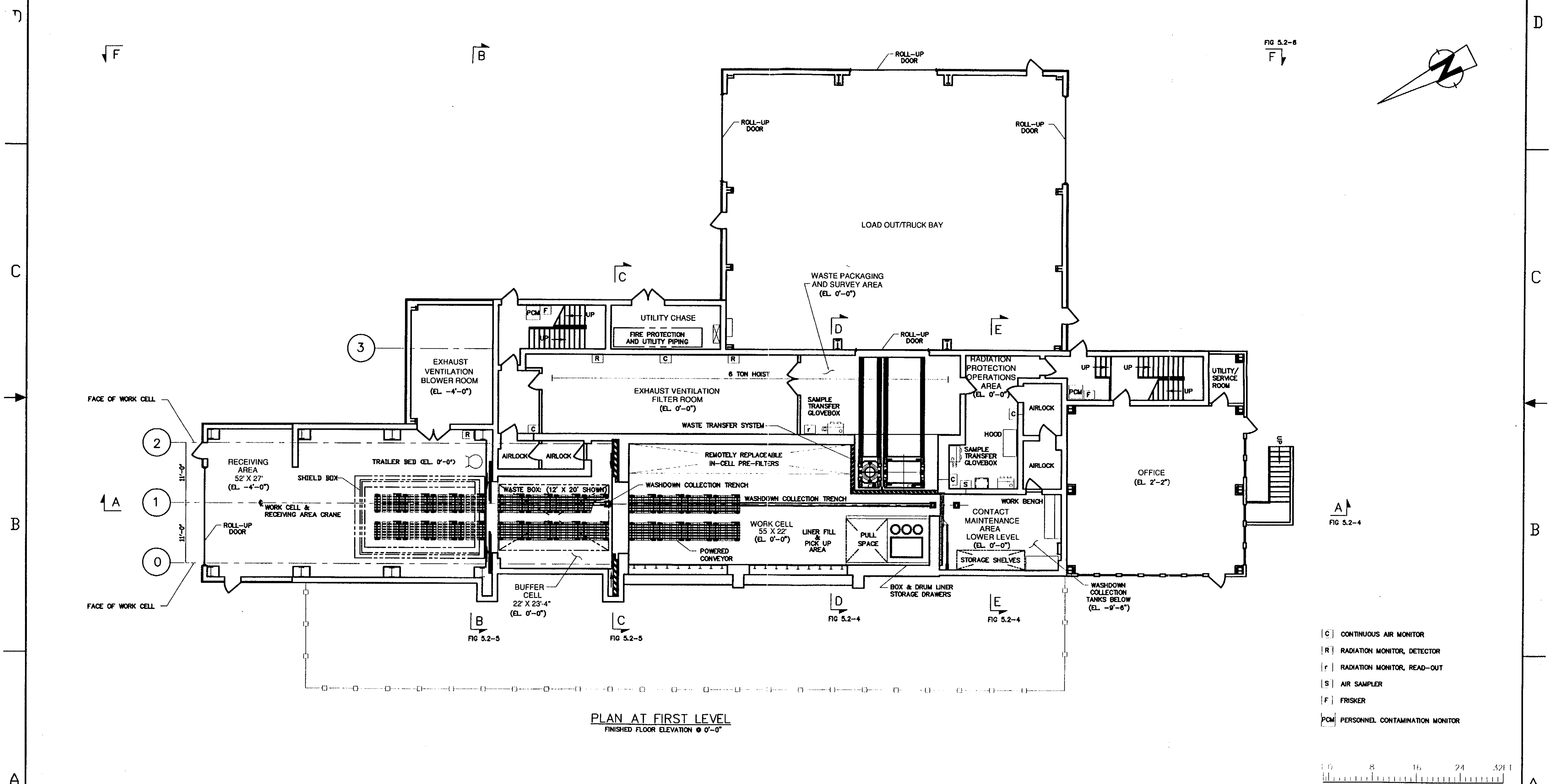
West Valley Nuclear Services, Co. July 29, 1999. Letter from D. K. Ploetz to B. A. Mazurowski (OH/WVDP). "Submittal of the Project Management Plan for the Remote-Handled Waste Project Completing Contract Milestone C.3, RH-1."

TABLE 5.2-1. Air Supply Systems for Uncontaminated RHWF Zones

Supply System	Location	Nominal Flow Rate	Areas Supplied (Typical Pressure in w.g., [Pa])
Air Supply #1	Mechanical Equipment Area	2.36 m^3/s (5000 scfm)	• Stairwells (+0.1, [25]) • Exhaust Filter Area (-0.15, [-37]) • Waste Container Survey Area (-0.1, [-25]) • Exhaust Blower Area (+0.1, [25]) • Mechanical Equipment Area (+0.1, [25]) • Operating Aisle (-0.1, [-25]) • Rad Protection Ops. Area (-0.15, [-37]) • Stack Monitor Room (+0.1, [25])
Air Supply #2	Receiving Area	2.15 m^3/s (4550 scfm)	• Receiving Area (+0.1, [25])
Air Supply #3	Load Out/ Truck Bay	1.01 m^3/s (2150 scfm)	• Load Out/Truck Bay (+0.1, [25])
Air Supply #4	Office Area Rooftop	(0.944 m^3/s) (2000 scfm)	• Office Area (+0.1, [25])

TABLE 5.2-2. Sources of Air Flow to Contaminated RHWF Zones

Facility Area	Nominal Flow Rate	Relative Pressure w.g. (Pa)	Sources
Buffer Cell	1.89 m^3/s (4000 scfm)	-0.5 (-125)	• Receiving Area • Airlock
Contact Maintenance Area	1.79 m^3/s (3800 scfm)	-0.5 (-125)	• Waste Survey Area • Sample Packaging and Screening Area • Radiation Protection Ops Area • Upper Level • Lower Level
Waste Packaging Area	0.378 m^3/s (800 scfm)	-0.5 (-125)	• Waste Survey Area
Work Cell	4.06 m^3/s (8600 scfm)	-1.0 (-250)	• Waste Transfer System • Contact Maintenance Area • Buffer Cell



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	REVISIONS	

REMOTE HANDLED WASTE FACILITY
PRELIMINARY SAFETY ANALYSIS REPORT

FIGURE 5.2-1

GENERAL ARRANGEMENT – FIRST LEVEL

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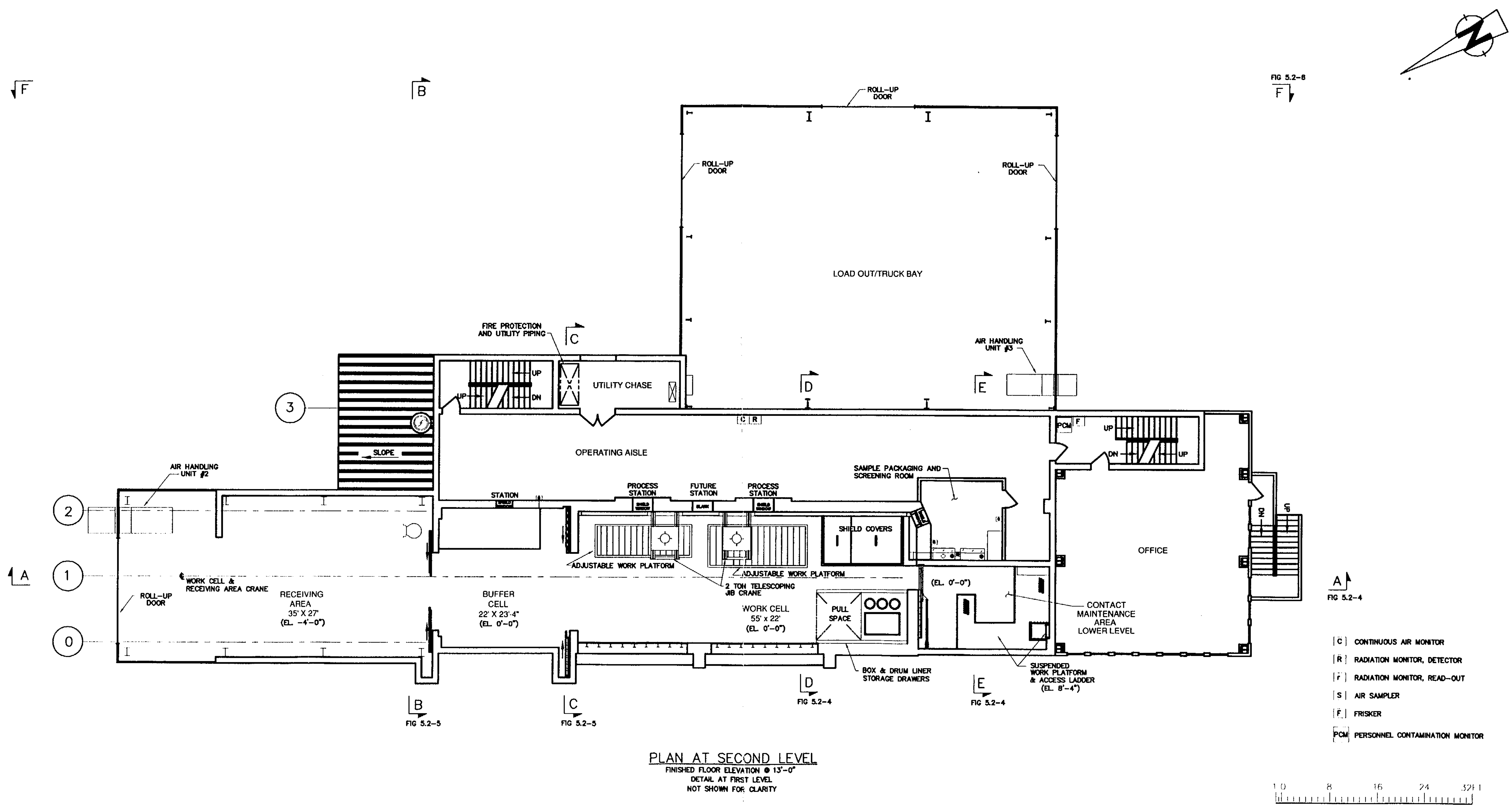

PLAN AT SECOND LEVEL
FINISHED FLOOR ELEVATION @ 13'-0"
DETAIL AT FIRST LEVEL NOT SHOWN FOR CLARITY

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FIGURE 5.2-2

GENERAL ARRANGEMENT - SECOND LEVEL

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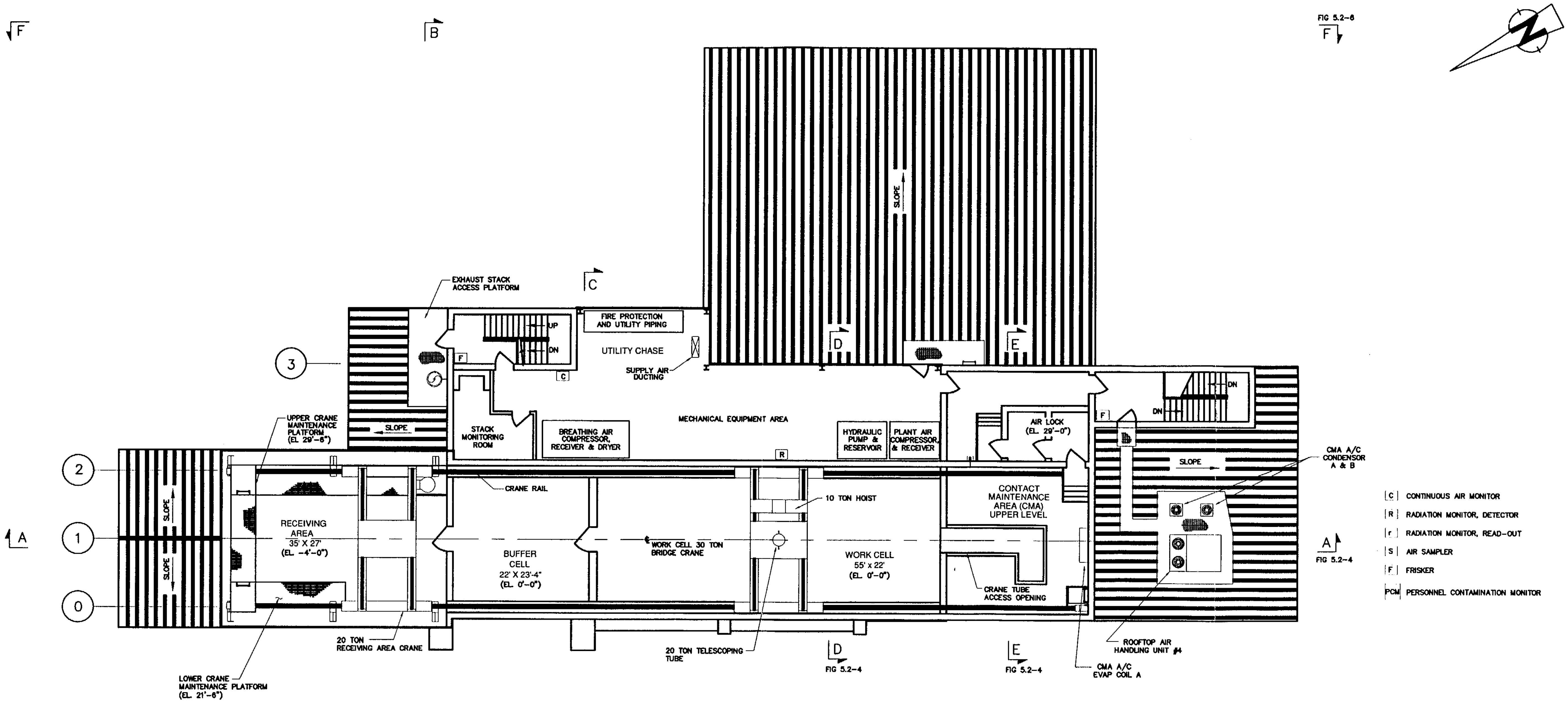

PLAN AT THIRD LEVEL
FINISHED FLOOR ELEVATION @ 28'-0"
DETAIL AT LOWER LEVELS NOT SHOWN FOR CLARITY

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PRELIMINARY SAFETY ANALYSIS REPORT

FIGURE 5.2-3

GENERAL ARRANGEMENT – THIRD LEVEL

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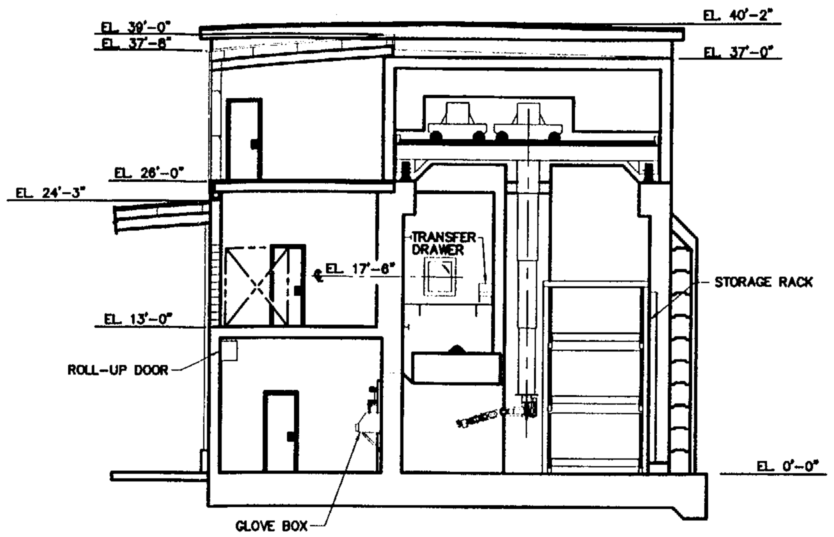
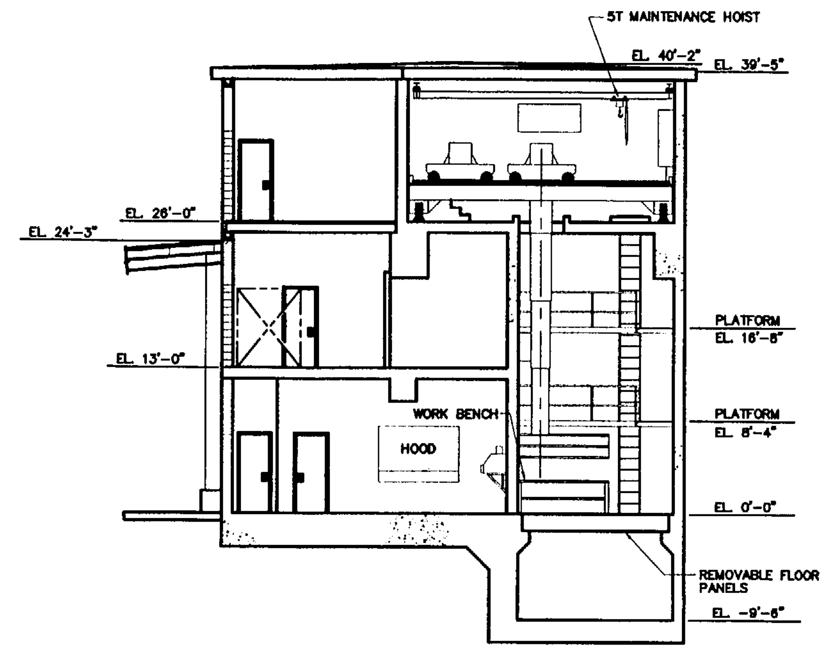


SECTION "D-D"



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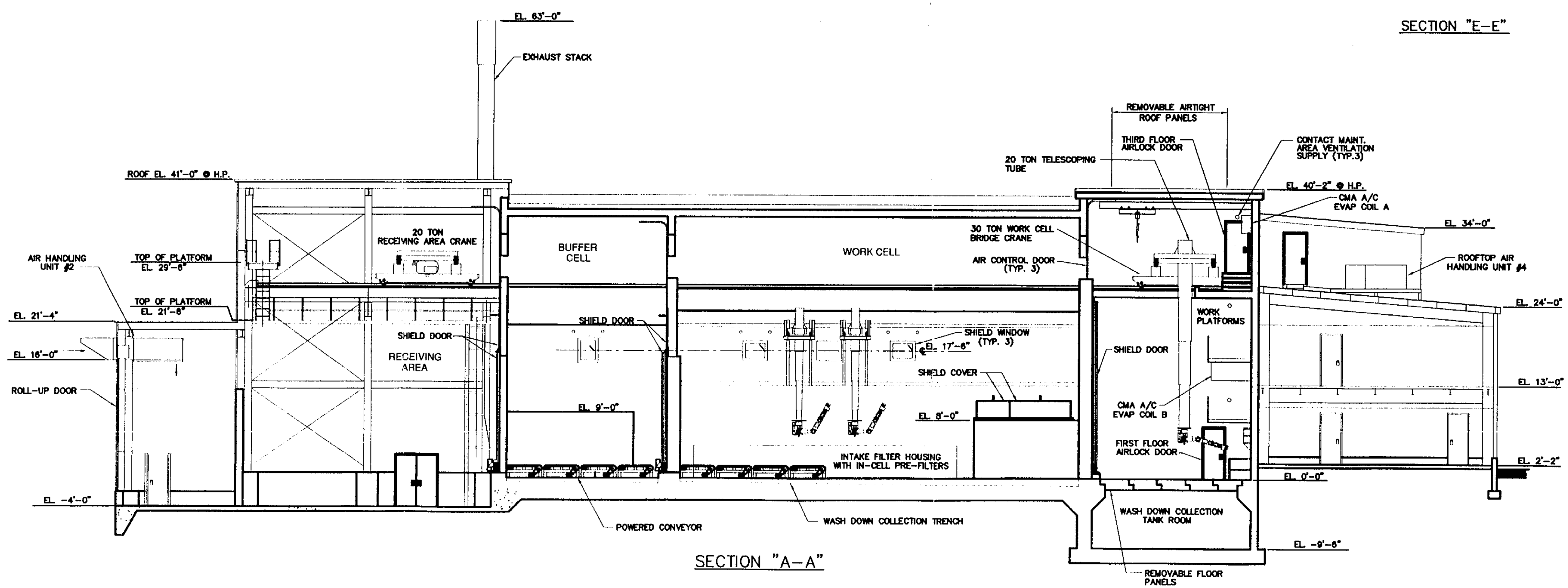

SECTION "A-A"

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REMOTE HANDLED WASTE FACILITY
PRELIMINARY SAFETY ANALYSIS REPORT

FIGURE 5.2-4

GENERAL ARRANGEMENT
SECTIONS A, D, & E

CAD DRAWING-DO NOT REVISE THIS ORIGIN

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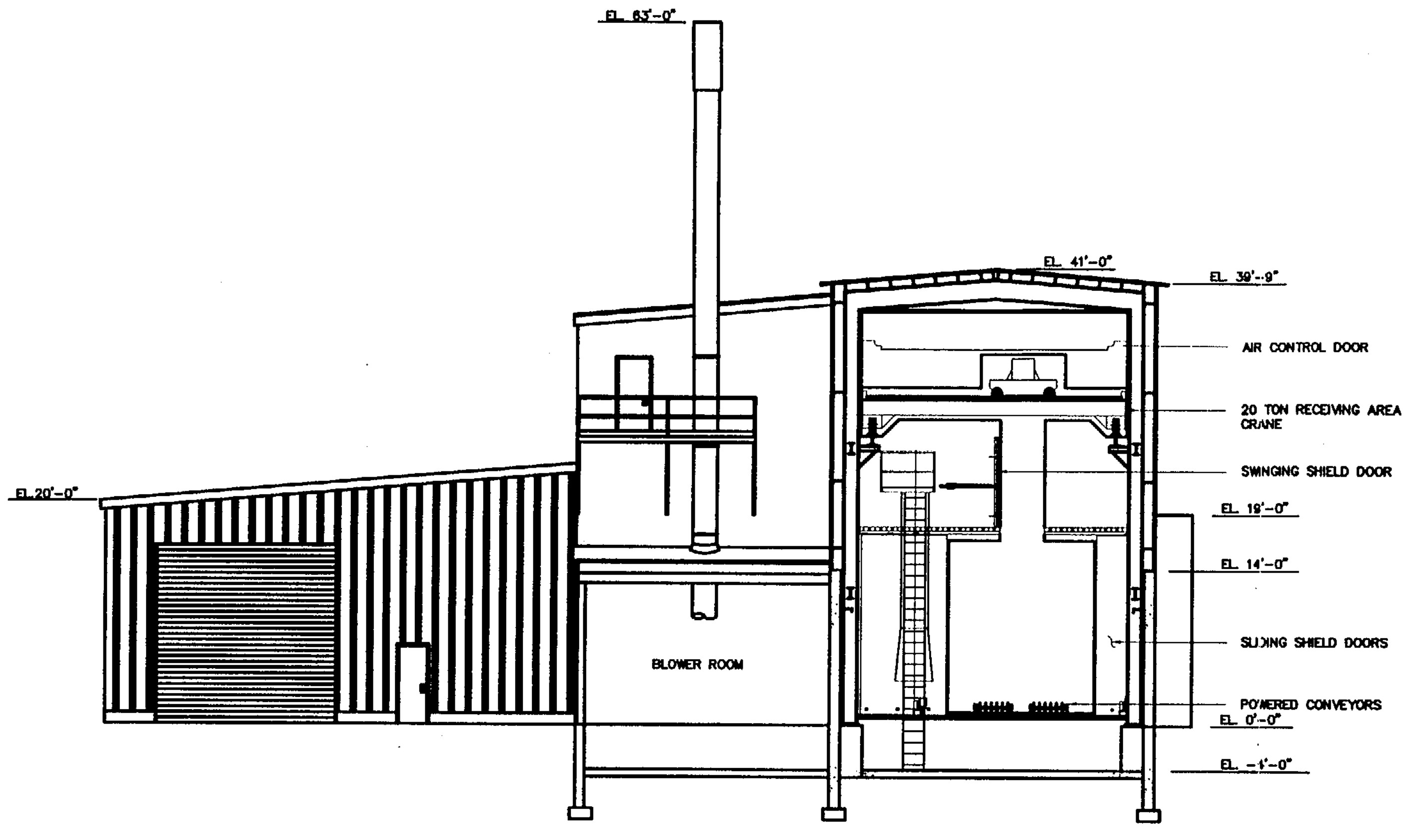
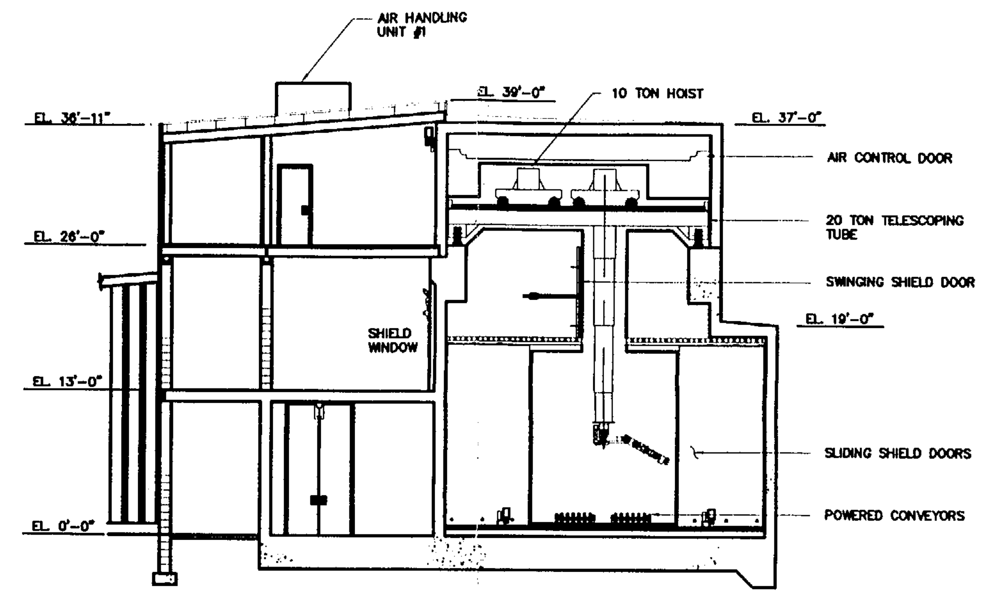


SECTION "B-B"



SECTION "C-C"

0 8 16 24 32 FT

REV	DESCRIPTION	APVD

REVISIONS

RHWFFIG52-5.1

REMOTE HANDLED WASTE FACILITY
PRELIMINARY SAFETY ANALYSIS REPORT

FIGURE 5.2-5

GENERAL ARRANGEMENT
SECTIONS B & C

CAD DRAWING-DO NOT REVISE THIS ORIGINAL

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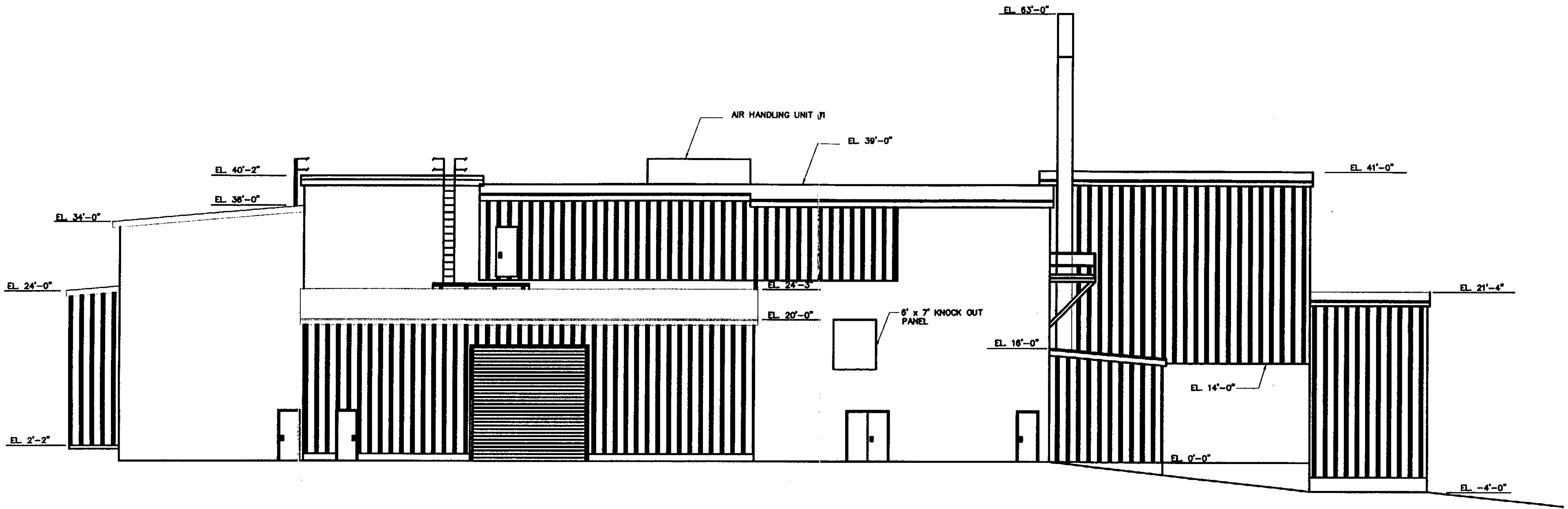

SECTION "F-F"

0 8 16 24 32FT

REV | DESCRIPTION | APVD
REVISIONS
RHWFFIG2-6.DWG

REMOTE HANDLED WASTE FACILITY
PRELIMINARY SAFETY ANALYSIS REPORT

FIGURE 5.2-6

GENERAL ARRANGEMENT SECTION F

CAD DRAWING-DO N
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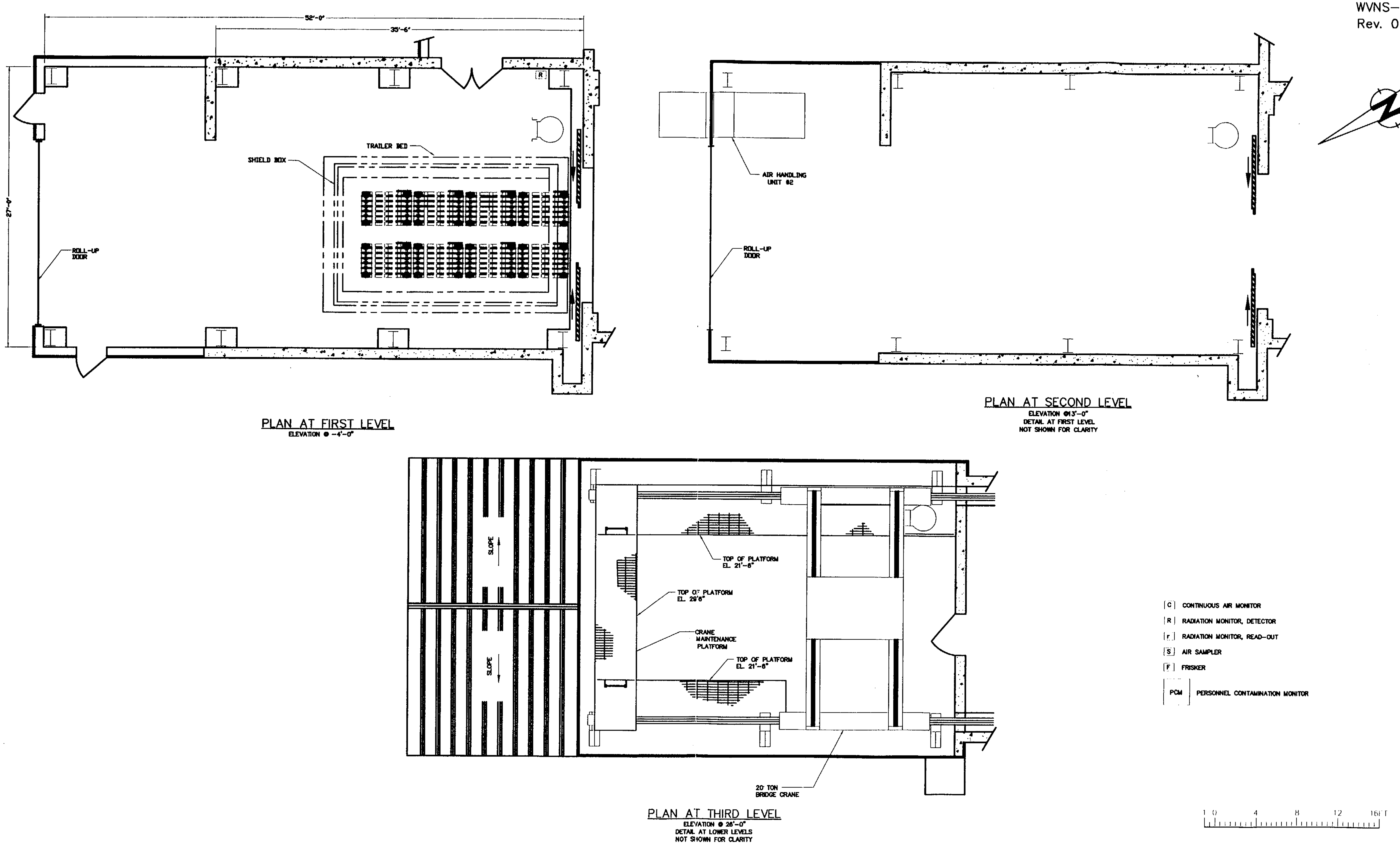


REV	REVISIONS DESCRIPTION	APVD

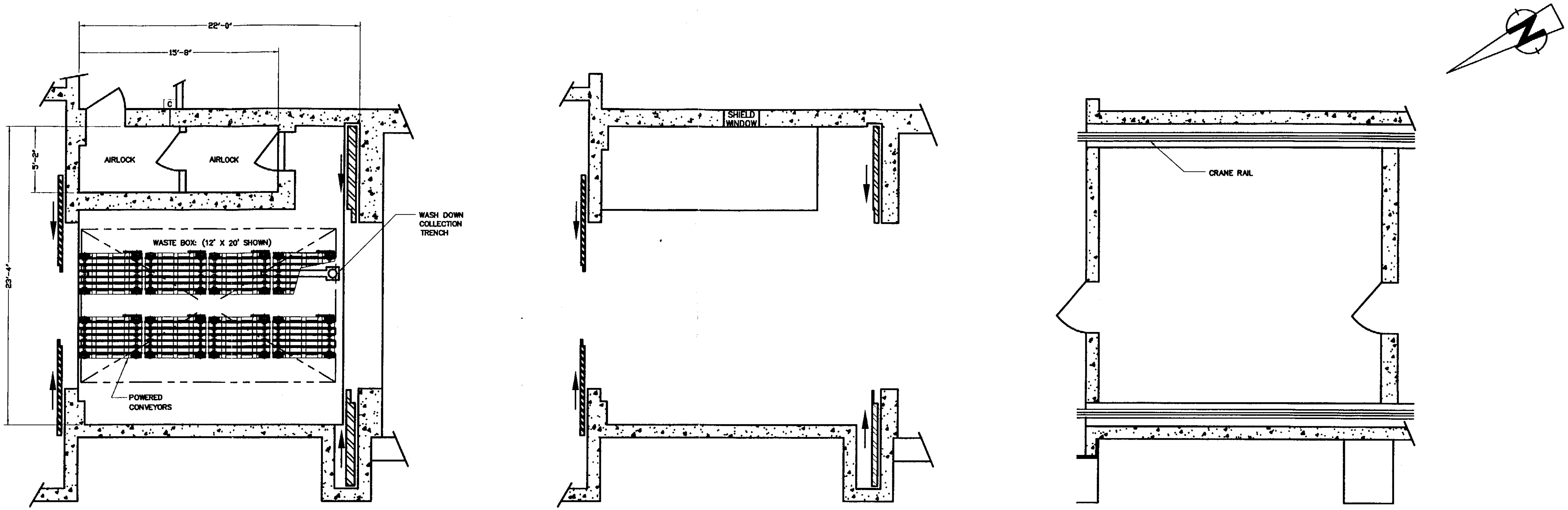
RHWFFIG

REMOTE HANDLED WASTE FACILITY
PRELIMINARY SAFETY ANALYSIS REPORT

FIGURE 5.2-7

RECEIVING AREA

CAD DRAWING-DO NOT REVISE THIS ORIGINAL



PLAN AT FIRST LEVEL
ELEVATION @ 0'-0"

PLAN AT SECOND LEVEL
ELEVATION @ 13'-0"
DETAIL AT FIRST LEVEL
NOT SHOWN FOR CLARITY

PLAN AT THIRD LEVEL
ELEVATION @ 26'-0"
DETAIL AT LOWER LEVELS
NOT SHOWN FOR CLARITY

[C] CONTINUOUS AIR MONITOR
[R] RADIATION MONITOR, DETECTOR
[r] RADIATION MONITOR, READ-OUT
[S] AIR SAMPLER
[F] FRISKER
PCM PERSONNEL CONTAMINATION MONITOR

0 4 8 12 16 FT

REV | DESCRIPTION | APV'D — REVISIONS

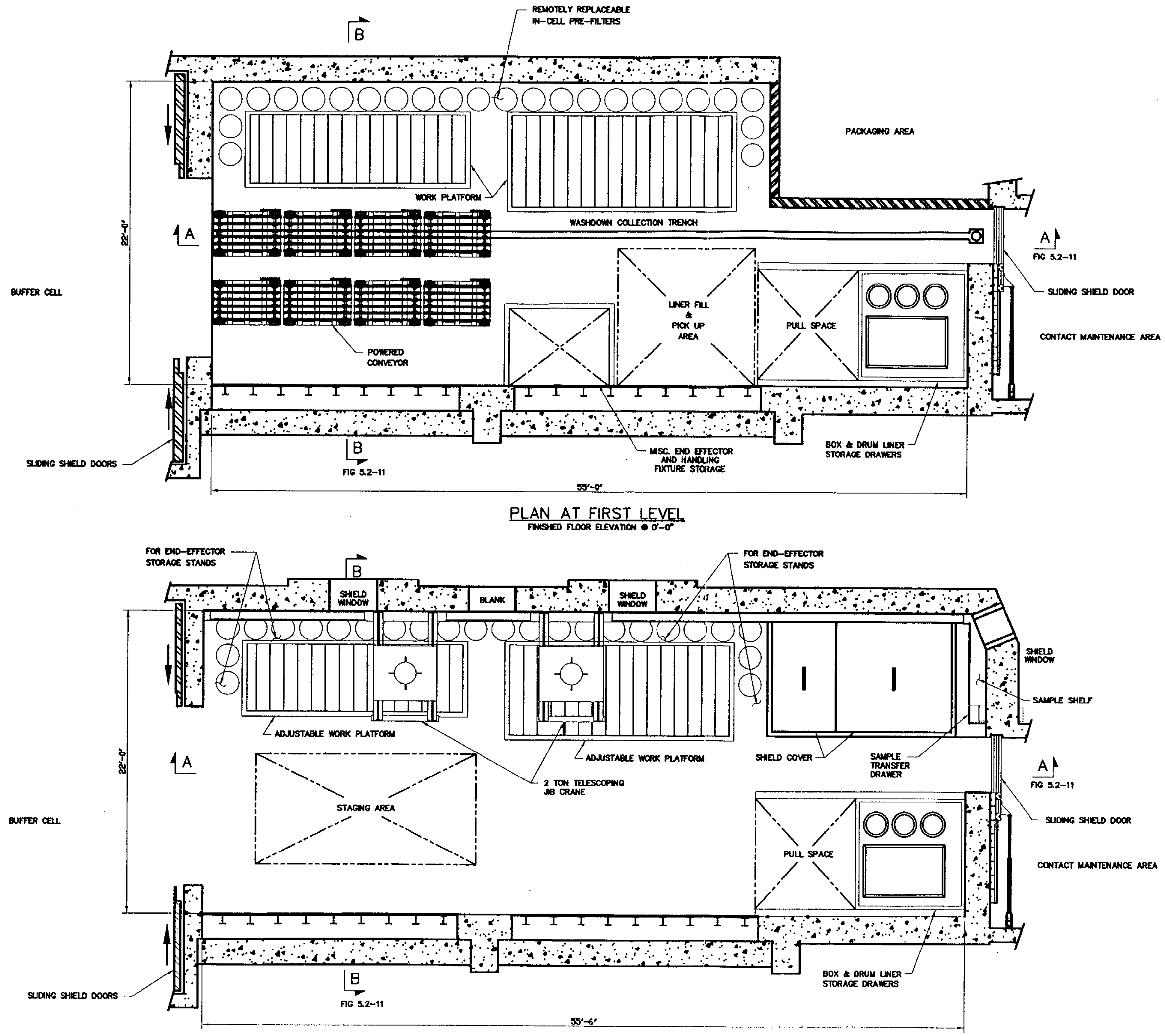
RHWFFIG52-8.DWG

REMOTE HANDLED WASTE FACILITY
PRELIMINARY SAFETY ANALYSIS REPORT

FIGURE 5.2-8

BUFFER CELL

CAD DRAWING-DO NOT REVISE THIS ORIGIN



PLAN AT FIRST LEVEL
FINISHED FLOOR ELEVATION @ 0'-0"

PLAN AT SECOND LEVEL
ELEVATION 13'-0"
DETAIL AT FIRST LEVEL
NOT SHOWN FOR CLARITY

0 4 8 12 16FT

REV	DESCRIPTION	APVD

REVISIONS

RHWFFIG52-9.DWG

REMOTE HANDLED WASTE FACILITY
PRELIMINARY SAFETY ANALYSIS REPORT

FIGURE 5.2-9

WORK CELL – FIRST AND SECOND LEVEL

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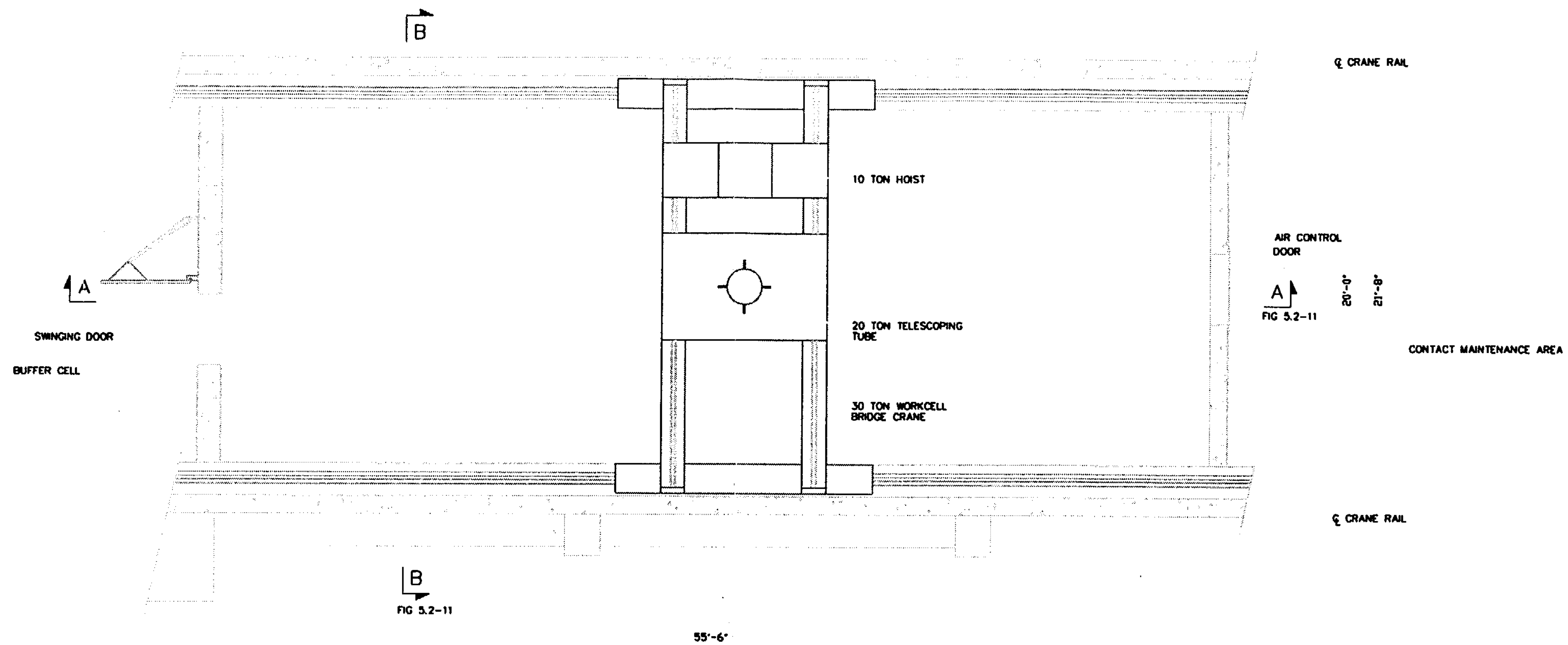

PLAN AT THIRD LEVEL
ELEVATION 26'-0"
DETAIL AT LOWER LEVELS
NOT SHOWN FOR CLARITY

1 0 4 8 12 16FT

REV	DESCRIPTION	APVD

REVISIONS

RHWFFIG52-10.DWG

REMOTE HANDLED WASTE FACILITY
PRELIMINARY SAFETY ANALYSIS REPORT

FIGURE 5.2-10

WORK CELL – THIRD LEVEL

CAD DRAWING-DO N
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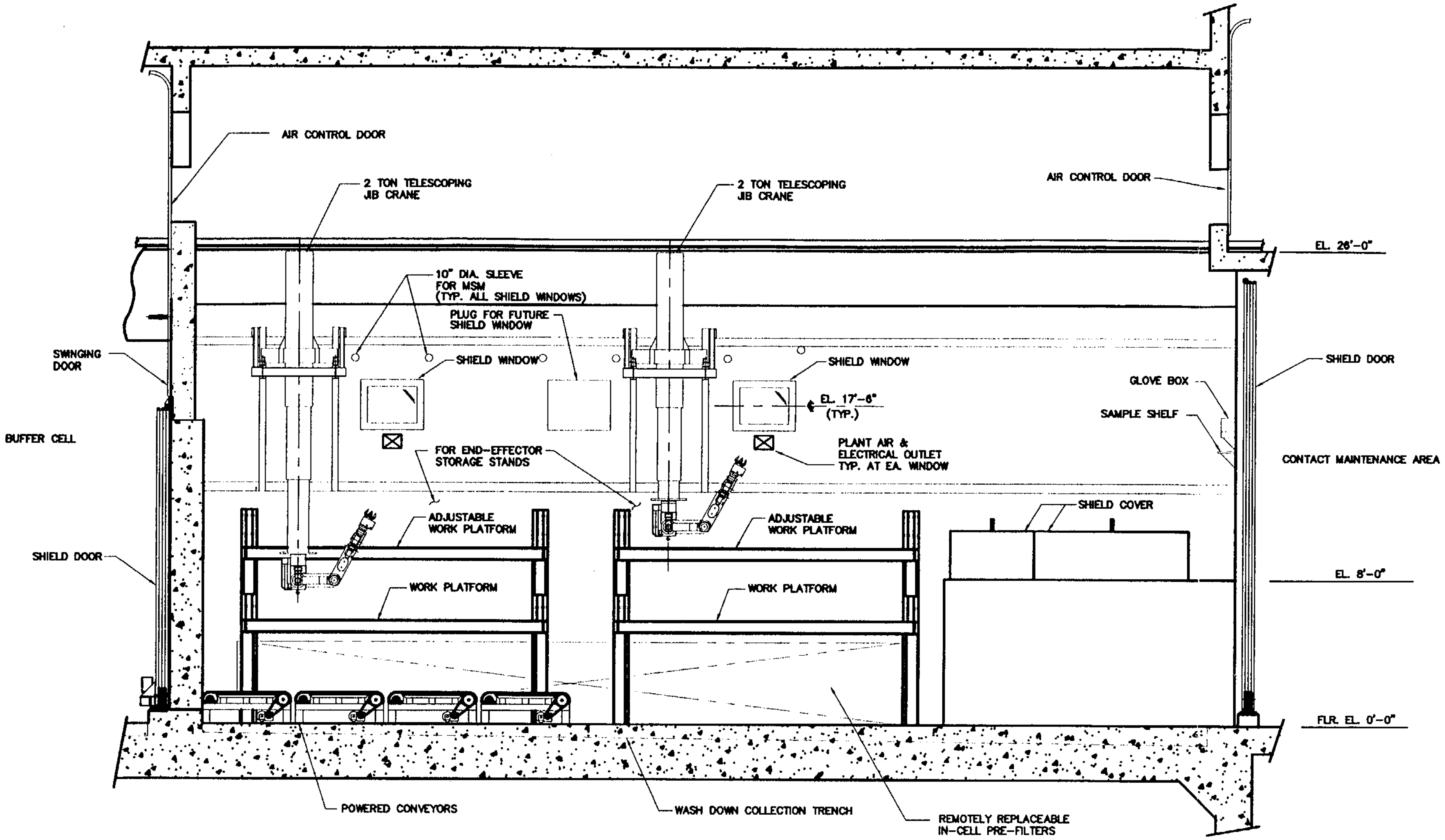
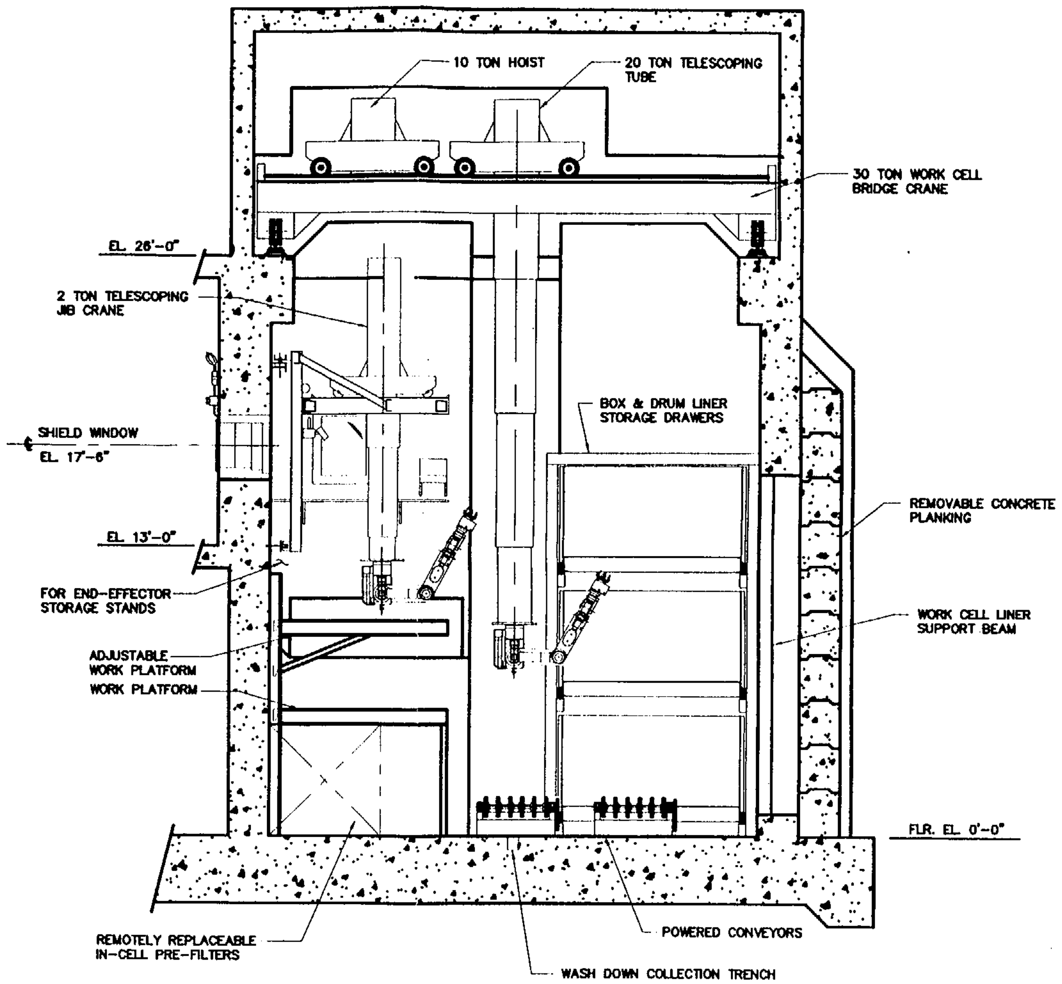


SECTION A–A



SECTION B–B

REV	DESCRIPTION	APVD
	REVISIONS	

RHWFFIG52-11.DWG

REMOTE HANDLED WASTE FACILITY
PRELIMINARY SAFETY ANALYSIS REPORT

FIGURE 5.2–11

WORK CELL – SECTIONS A & B

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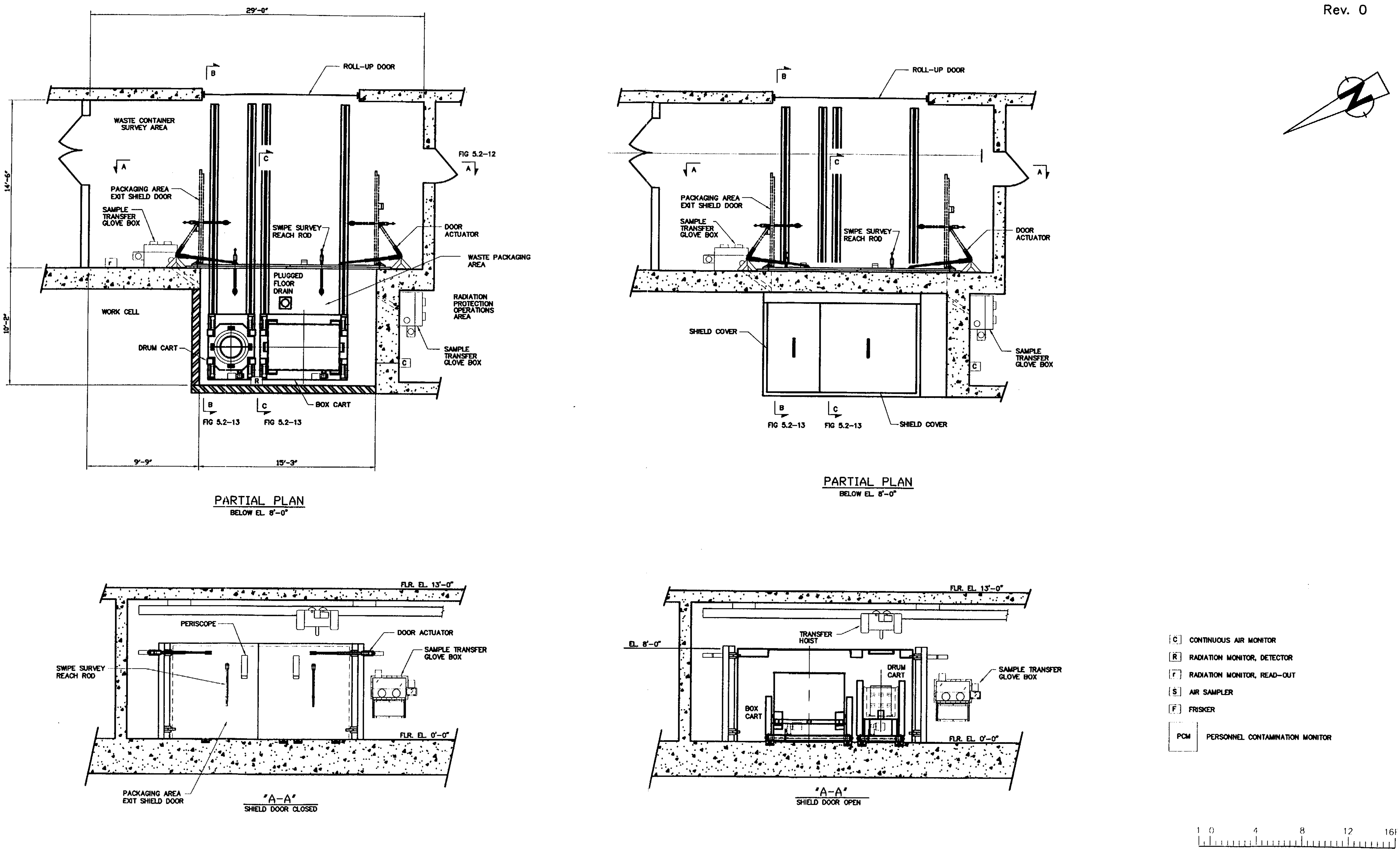

REMOTE HANDLED WASTE FACILITY
PRELIMINARY SAFETY ANALYSIS REPORT

FIGURE 5.2-12

WASTE PACKAGING AREA
PLAN AND SECTION A

RHWFFIG52-12.DWG

REVISIONS

REV	DESCRIPTION	APVD

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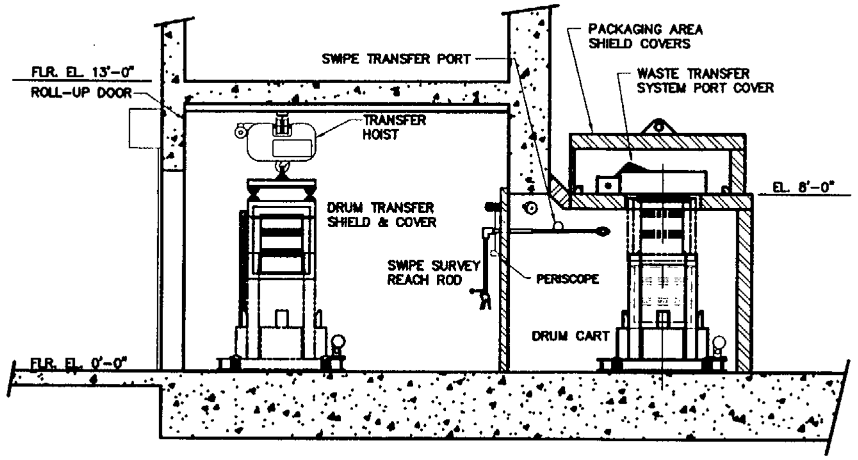
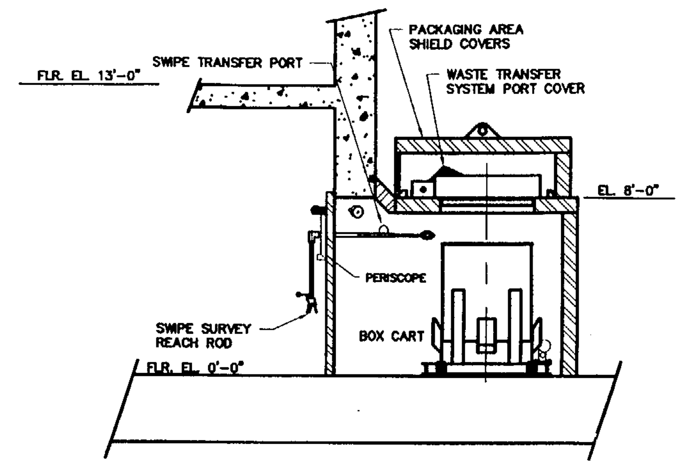


"B-B"
SHIELD DOOR CLOSED



"C-C"

REMOTE HANDLED WASTE FACILITY
PRELIMINARY SAFETY ANALYSIS REPORT

FIGURE 5.2-13

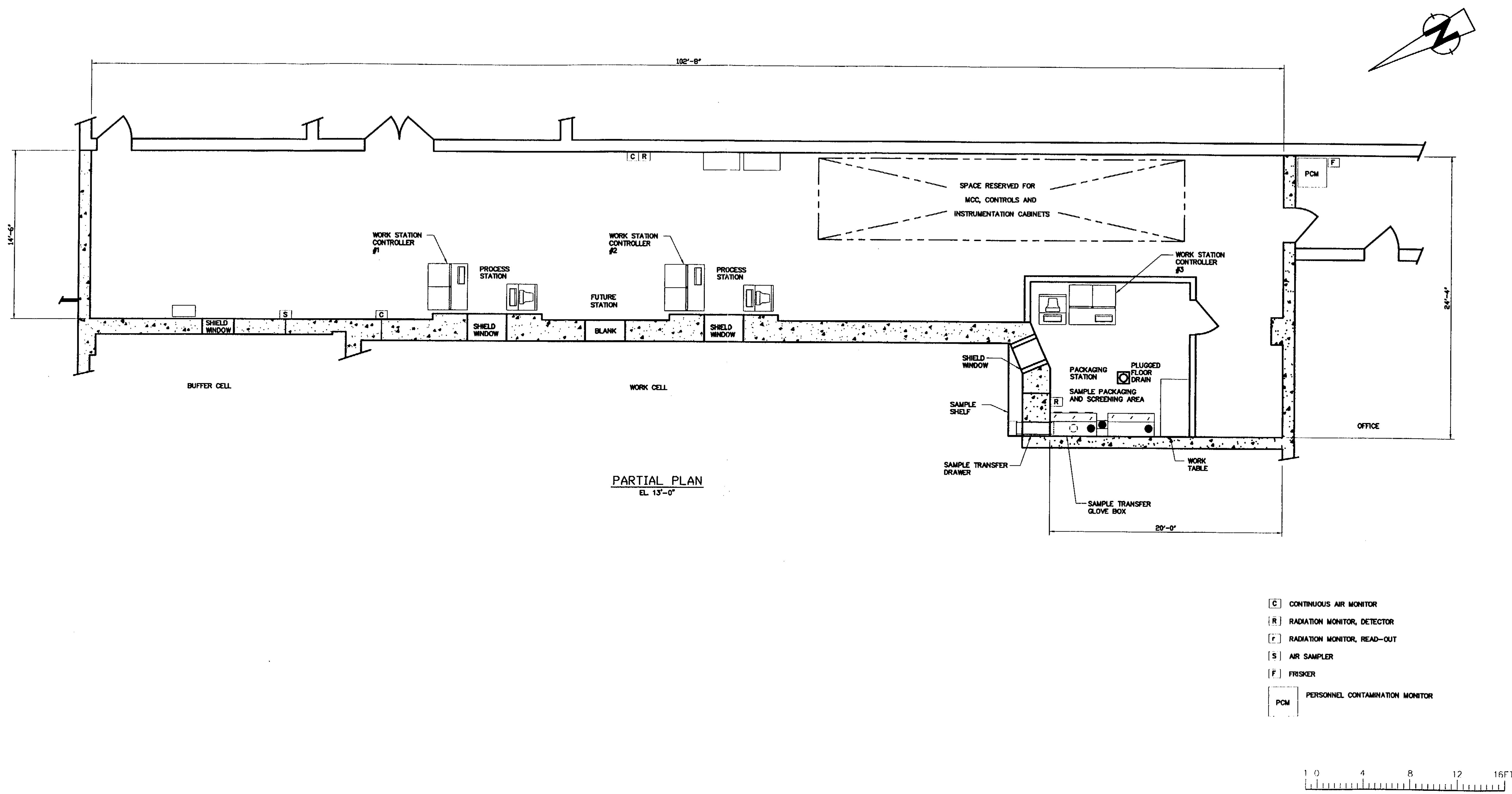
WASTE PACKAGING AREA
SECTIONS B & C

REV	DESCRIPTION	APVD

REVISIONS

RHWFFIG52-13.DWG

CAD DRAWING-DO NOT REVISE THIS ORIGINAL



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REV	REVISIONS DESCRIPTION	APVD

REMOTE HANDLED WASTE FACILITY
PRELIMINARY SAFETY ANALYSIS REPORT

FIGURE 5.2-14

OPERATING AISLE

CAD DRAWING-DO NOT REVISE THIS ORIGIN

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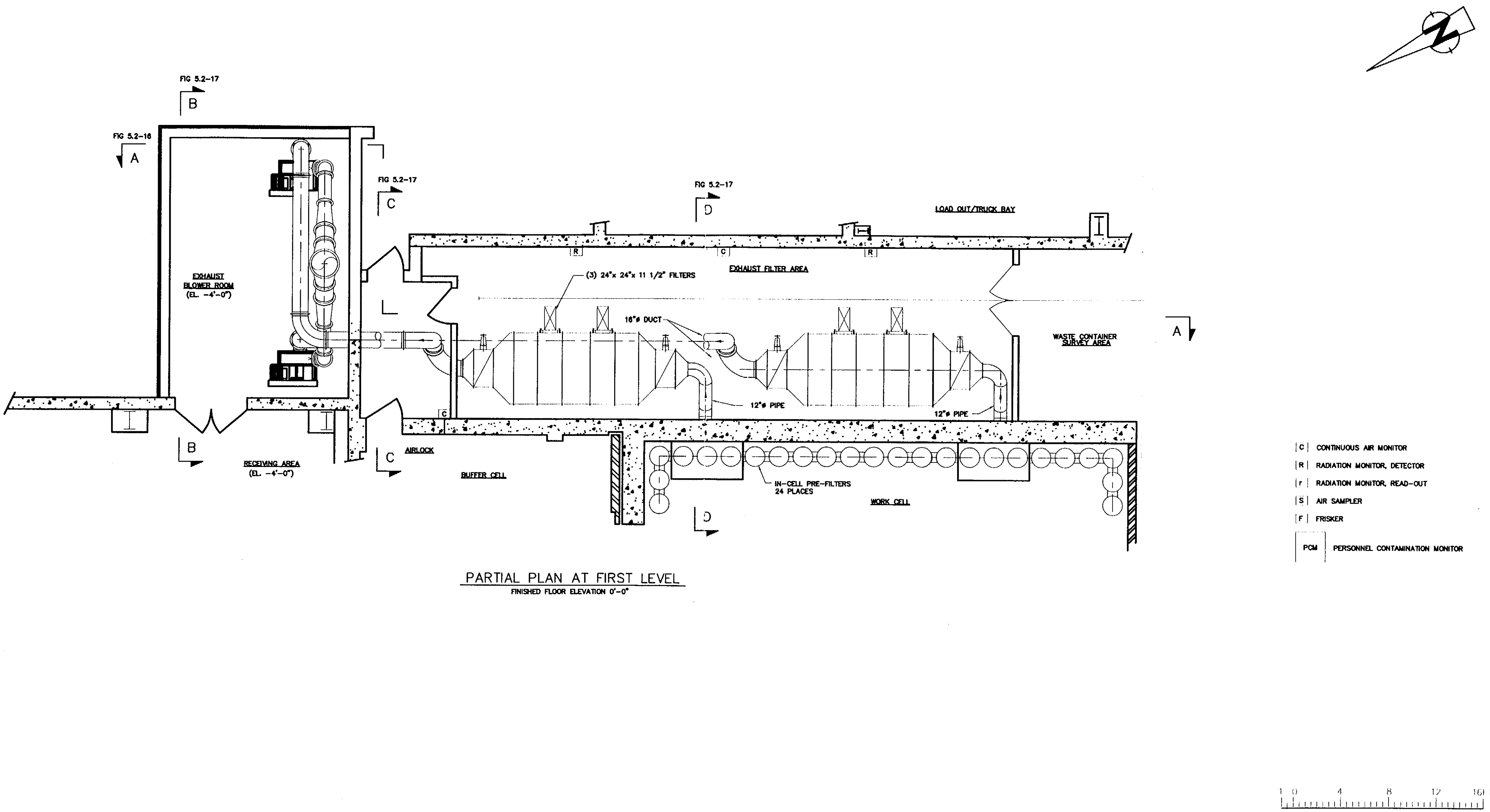
Rev. 0



REV	DESCRIPTION	APVD

REVISIONS

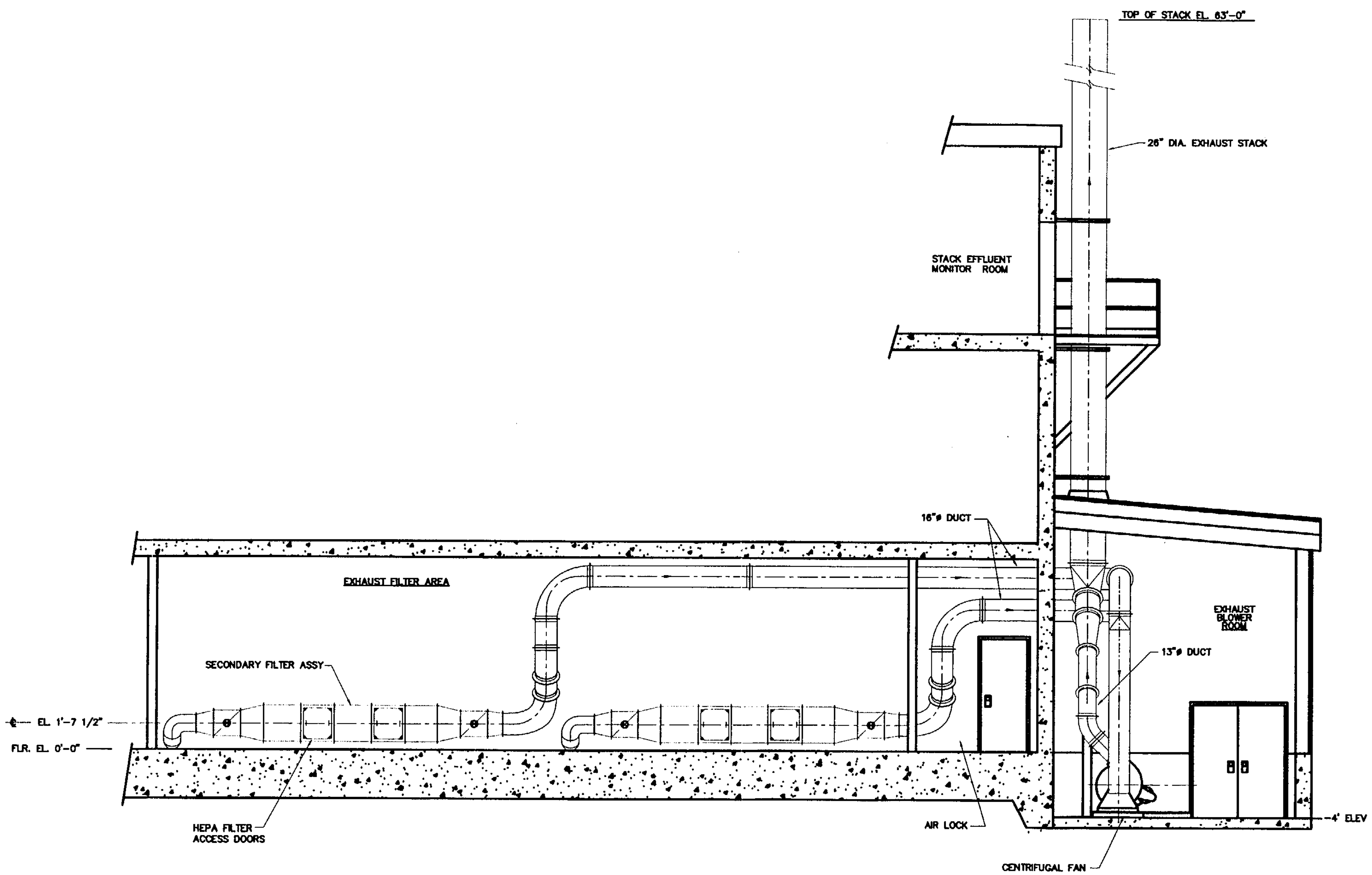
RHWFFIG52-15.DWG

REMOTE HANDLED WASTE FACILITY
PRELIMINARY SAFETY ANALYSIS REPORT

FIGURE 5.2-15

VENTILATION EXHAUST - FIRST LEVEL

CAD DRAWING-DO NOT REVISE THIS ORIGINAL



SECTION "A-A"

1 0 4 8 12 16FT

RHWFFIG52-16.DWG

REV	REVISIONS DESCRIPTION	APVD

REMOTE HANDLED WASTE FACILITY PRELIMINARY SAFETY ANALYSIS REPORT

FIGURE 5.2-16

VENTILATION EXHAUST – SECTION A

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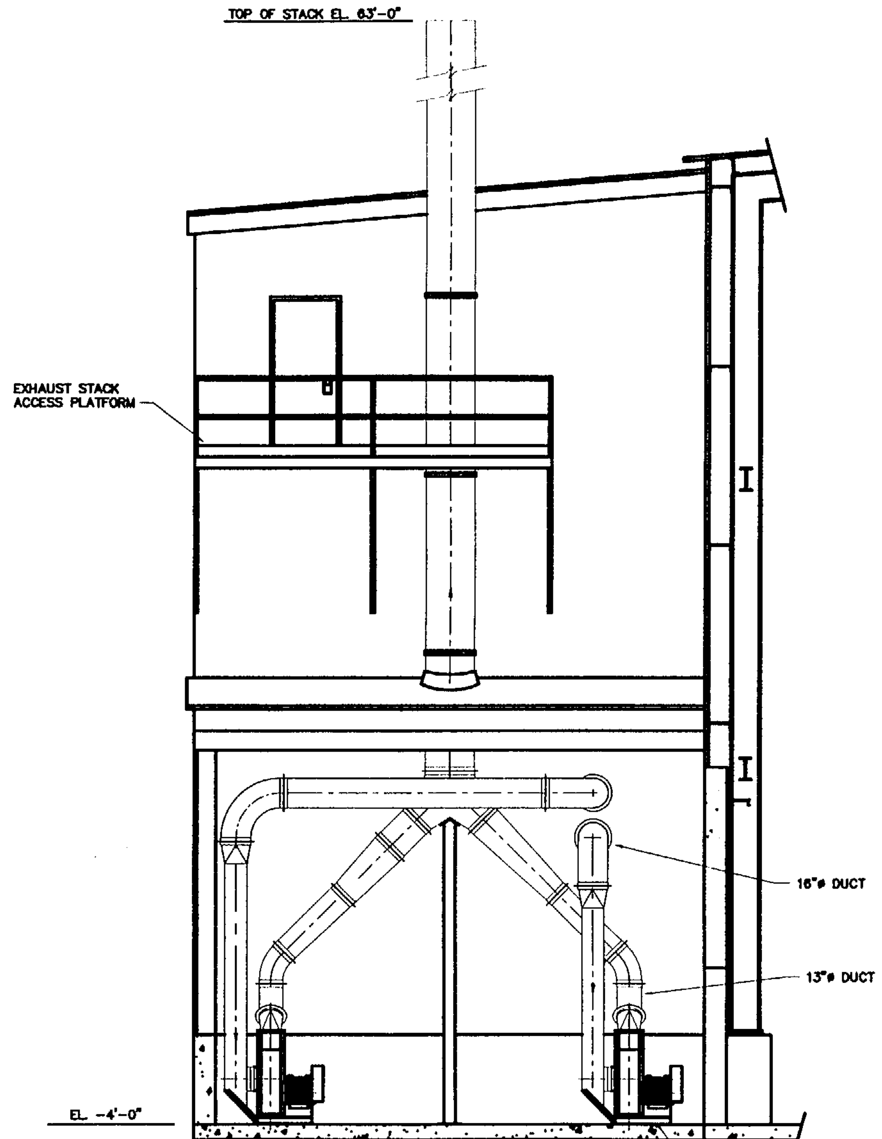
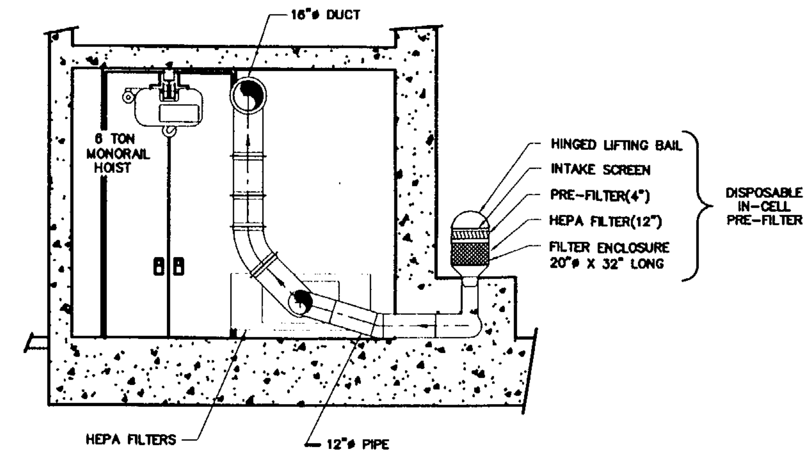
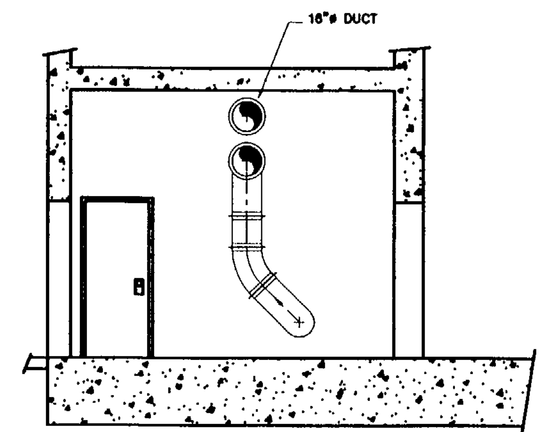


SECTION "B-B"



SECTION "D-D"



SECTION "C-C"

REV	DESCRIPTION	APVD
REVISIONS		

RHWFFIG52-17

REMOTE HANDLED WASTE FACILITY
PRELIMINARY SAFETY ANALYSIS REPORT

FIGURE 5.2-17

VENTILATION EXHAUST
SECTIONS B, C, & D

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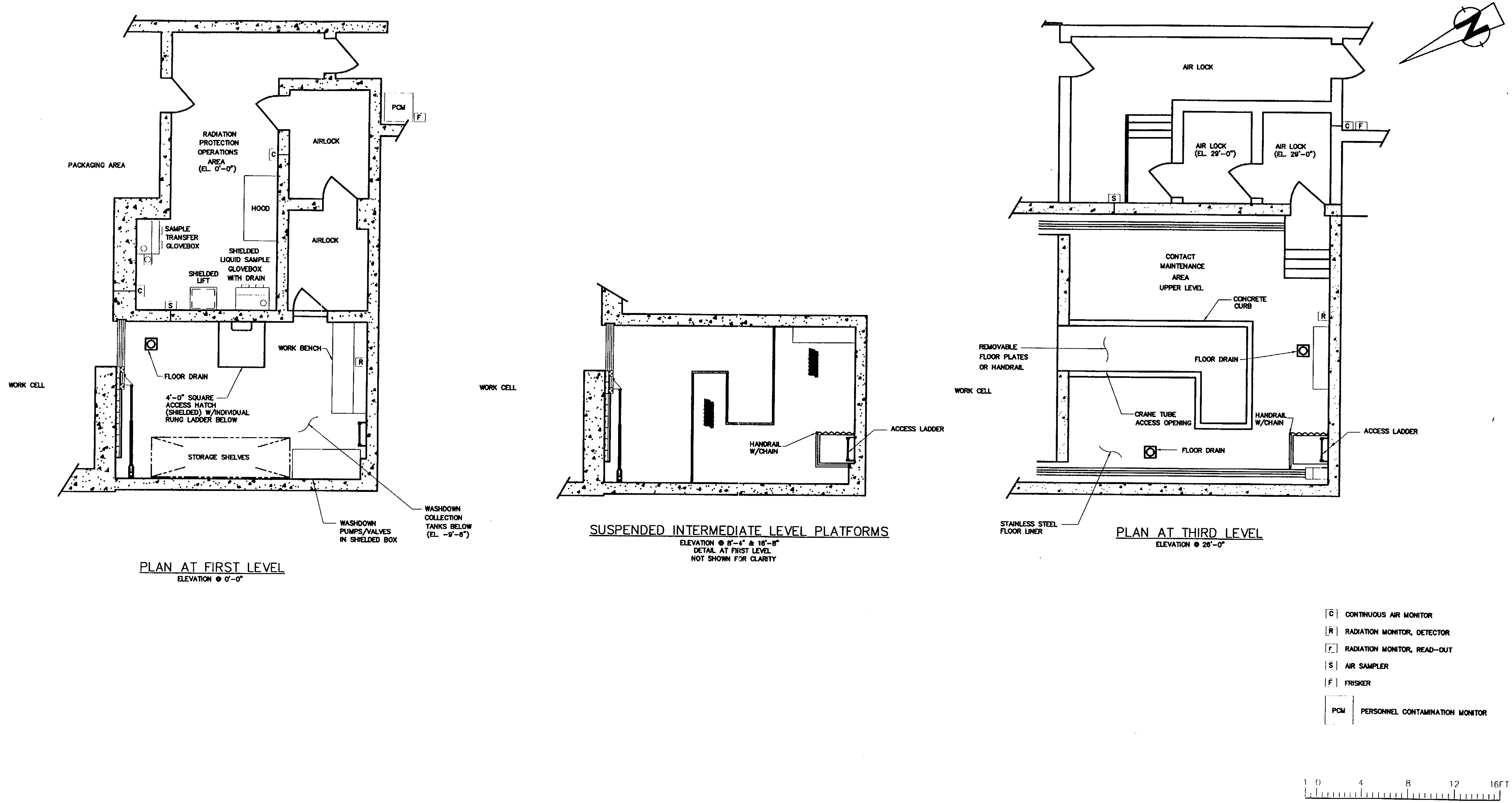
Rev. 0



REMOTE HANDLED WASTE FACILITY
PRELIMINARY SAFETY ANALYSIS REPORT

FIGURE 5.2-18

CONTACT MAINTENANCE AREAS

RHWFFIG52-18.DWG
REVISIONS
REV | DESCRIPTION | APVD

CAD DRAWING-DO NOT REVISE THIS ORIGIN

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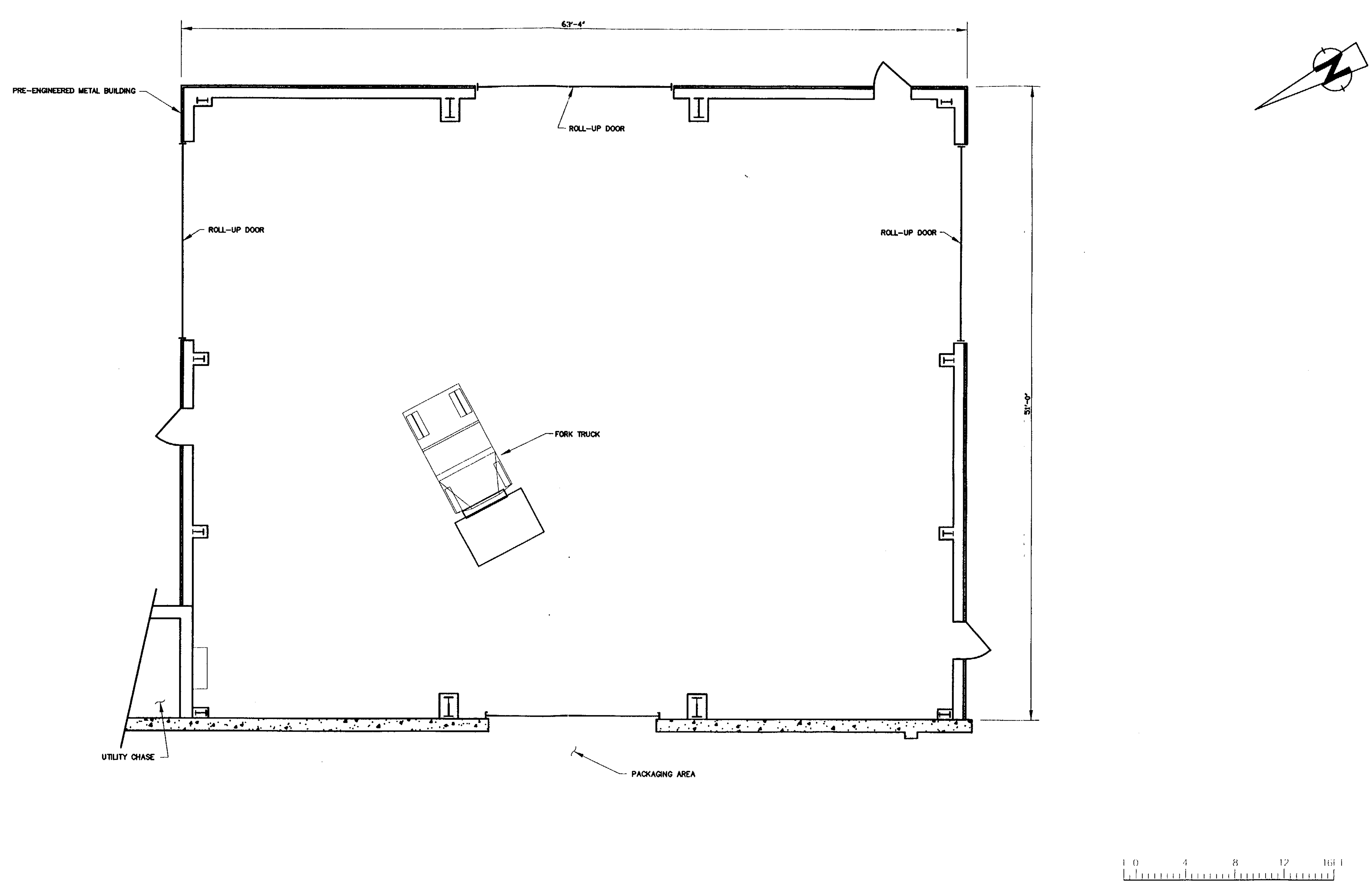
Rev. 0



REMOTE HANDLED WASTE FACILITY
PRELIMINARY SAFETY ANALYSIS REPORT

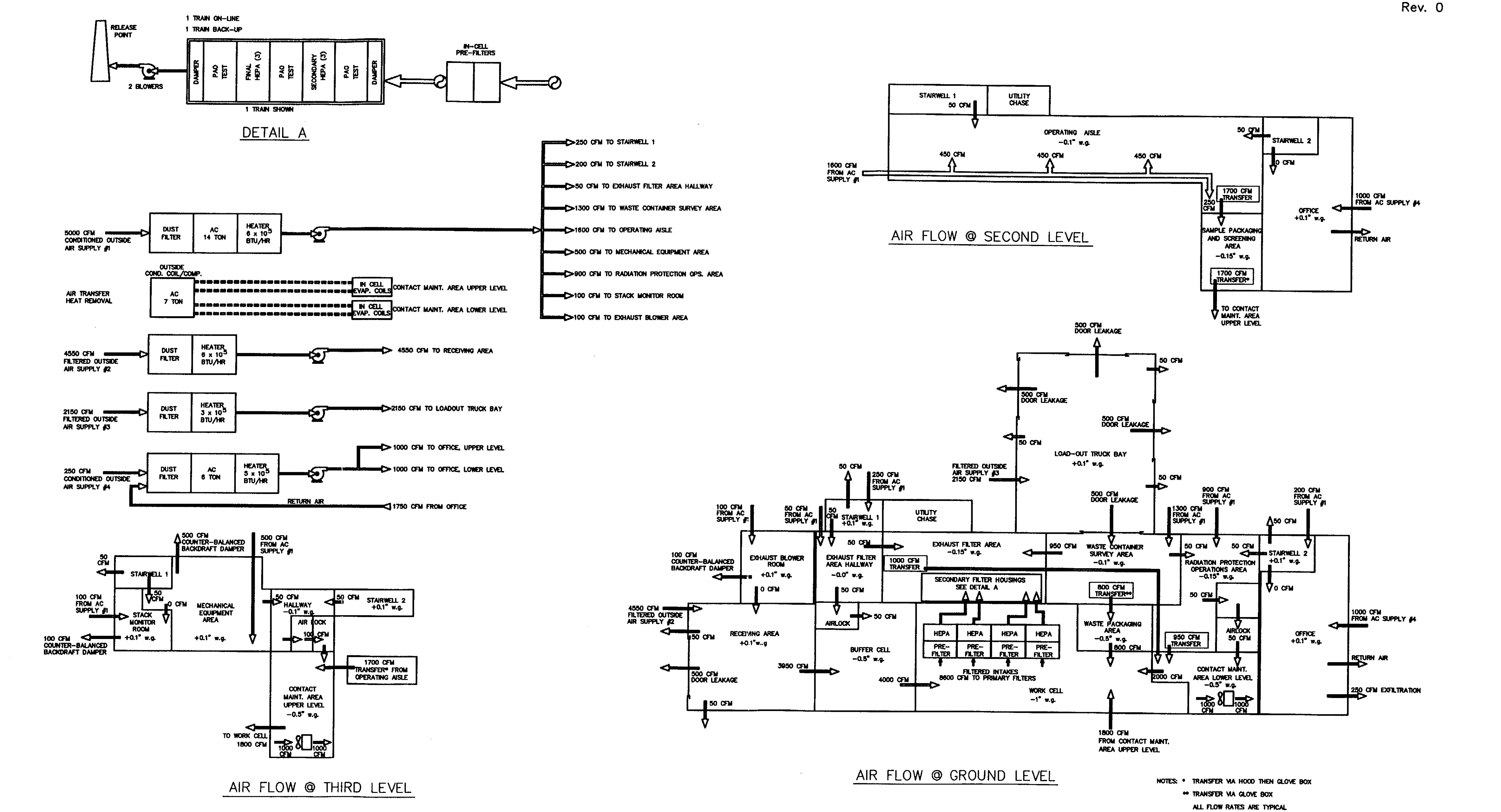
FIGURE 5.2-19

LOAD OUT/TRUCK BAY AREA

REV | DESCRIPTION | APVD
REVISIONS

RHWFFIG52-19

CAD DRAWING-DO NOT REVISE THIS ORIGINAL



REMOTE HANDLED WASTE FACILITY
PRELIMINARY SAFETY ANALYSIS REPORT

FIGURE 5.4–1

VENTILATION FLOW DIAGRAM

REVISIONS | REV. | DESCRIPTION | APVD

RHWFFIG54-1.DWG

CAD DRAWING–DO NOT REVISE THIS ORIGIN

6.0 REMOTE-HANDLED WASTE FACILITY PROCESS SYSTEMS

6.1 Process Description

6.1.1 Narrative Description

The RHWF will be part of the RHWS. The RHWF will be a new, stand-alone facility at the WVDP with remote handling capability for radioactive waste processing operations (WVNS-DC-071). The actual throughput for the facility will be based upon availability of waste streams and storage capability of repackaged wastes. It is estimated that the daily throughput will range between 0.14 and 1.9 m^3/day (5 and 67 ft^3/day), depending on the waste stream being processed. The descriptions provided in this chapter are based on the conceptual design of the RHWF, and therefore specific process aspects may change based on ongoing design efforts.

The first part of the process will involve lifting containers of remote-handled (RH) waste from their storage areas and loading them onto a transfer vehicle for delivery to the RHWF Receiving Area. (The waste boxes stored in the CPC WSA will be a major feed stream for the RHWF. The radionuclide inventory of the twenty-two boxes in the CPC WSA in the year 2003, which forms the basis for several accidents analyzed in Chapter 9, is provided in Table 6.1-1.) After the container arrives at the Receiving Area, the outside Buffer Cell shield doors will be opened, and the container will be removed from the transfer vehicle to the Buffer Cell's powered conveyor rollers.

After the container is transferred to the Buffer Cell, the outside shield doors of the Buffer Cell generally will be closed and the shield doors between the Work Cell and the Buffer Cell will be opened. Typically, the container will then be moved into the Work Cell using powered conveyor rollers.

Using the Work Cell cranes, powered dextrous manipulators (PDMs), and end effectors, the waste box will be opened and the contents handled, surveyed, sampled, segregated, size-reduced, decontaminated, and dewatered as required.

Waste items that are ready for repackaging will be placed in either drum or box liners that are staged near the box and drum liner storage drawers located in the southwest end of the Work Cell. Full box liners or drum liners will be removed from the Work Cell either by using the Waste Transfer System, which will allow the waste to pass into the Waste Packaging Area, or by taking the package back out through the Buffer Cell and Receiving Area. The packaged waste transferred out of the Work Cell by the Waste Transfer System will be removed from the RHWF through the Load Out/Truck Bay.

6.1.2 Flowsheets

A simplified and generic flowsheet for waste processing in the RHWF conceptual design is provided in Figure 1.3-1. More detailed flowsheets for each waste stream will be developed during detailed design of the RHWF.

The CPC WSA waste stream represents the bounding inventories for the RHWF. The other waste streams to be processed in the RHWF (Table 1.1-1) are not expected to contain quantities of transuranic nuclides in excess of the total of all of the CPC WSA wastes streams.

6.1.3 Identification of Items for Safety Concern

The concentration of activity in the RHWF waste streams requires that waste processing be conducted in a manner which minimizes doses to both occupational personnel and off-site individuals. The major items of safety analysis concern therefore are:

- Airborne radioactivity confinement
- Use of natural gas for heating supply air
- Waste package lifting and rigging
- Fire resulting from vehicle fuel spills
- Criticality
- Direct radiation hazards for workers
- Waste package head space overpressurization

6.1.3.1 Airborne Radioactivity Confinement

Confinement of airborne radioactivity generated by remote-handled waste processing operations in the Work Cell will be achieved by the use of multiple stages of air handling in which three zones (I, II, and III) are maintained at successively higher relative pressures in order to induce air flow from areas of low contamination to areas of higher potential contamination. Double airlocks will be installed at access points to the Buffer Cell and Contact Maintenance Area. Filters for particulate matter will be installed on the supply air systems in order to reduce dust loading on the exhaust systems in the Work Cell. In the Work Cell, source capture systems on or near cutting tools will provide an initial barrier to the spread of airborne contamination. The 24 disposable pre-filters surrounding the adjustable work platforms in the Work Cell provide a local downdraft in this area of the cell that will allow collection of particulate matter that is not captured in the source capture systems.

6.1.3.2 Natural Gas Heating

There will be four supply air systems in the RHWF, as described in Section 5.4.1. Each of these will have natural gas fired heaters to warm the inlet air in order to provide comfort to operators in occupied spaces. The safety concern is that natural gas leakage from these devices could lead to build up of gases within the facility, which is an explosion hazard. However, these devices will contain automatic flow cutoff devices for natural gas flow that sense flameout in the heater. In addition, there will be a stainless steel heat transfer device that separates the air flow from the source of heat (gas burner and flame). See Section 9.2.3.3.1 for additional discussion of the risk acceptability associated with natural gas heating.

6.1.3.3 Waste Package Hoisting and Rigging

Many of the waste packages that will be brought to the RHWF for processing are large, heavy, and of non-uniform design and construction. The safety concern is that load shifting or package structural failure will result in a dropped load. A package dropped to a hard, unyielding surface will likely release a fraction of its radioactivity inventory as airborne particulate matter. However, most of the packages of concern contain waste items wrapped in Herculite™, a flexible wrap that will contain most particulate matter. In addition, WVDP-011, *WVDP Industrial Hygiene and Safety Manual*, which implements the authorization basis program described in WV-900, *WVDP Worker Safety Policy*, describes procedures and West Valley Nuclear Services Company (WVNS) specific requirements for safe hoisting and rigging.

6.1.3.4 Fire

The inventory of combustible materials in the waste streams designated for processing in the RHWF is small. The RHWF will be constructed of primarily non-combustible materials. As a result, the most significant fire-related safety concern is the fire hazard posed by vehicle fuel in either the Receiving Area or Load Out/Truck Bay. Both of these areas contain fire detection and suppression systems.

6.1.3.5 Inadvertent Criticality

As described in section 8.7, *Prevention of Inadvertent Criticality*, a criticality involving solid waste streams is considered not credible in the RHWF. However, measures will be taken to ensure the implementation of the double contingency principle on controlled parameters for liquid wastes.

6.1.3.6 Direct Radiation Hazards for Workers

A principle safety concern in the RHWF is the direct ionizing radiation hazard posed by gamma radiation from the packaged remote-handled waste. The major ALARA principles that have been implemented in the conceptual design of the facility include:

- General arrangement of the facility to ensure movement of wastes from clean areas to more contaminated areas.
- A shielded packaging station designed for "bagged" or "bagless" transfer. In addition, shielded sample transfer drawers are installed for transfer of samples from the Work Cell.
- Shield walls surrounding the cells provide sufficient attenuation to reduce dose rates to normally occupied areas to less than 0.1 mR/hr.
- Containers of processed waste will be shielded to achieve "contact handling" dose rates.
- Remotely operated equipment (bridge cranes, PDMs, powered conveyors, jib cranes, etc.) so that all major remote-handled waste can be manipulated with end effectors (tools) to perform all sampling, surveying, segmenting, segregating, and repackaging tasks.
- An area for equipment maintenance (Contact Maintenance Area) that is separate from the highly contaminated Work Cell.

- Area radiation monitors and airborne radioactivity monitors are located throughout the occupied spaces of the facility

- Motors and controllers for contamination control doors and partitions are located in the lower dose rate areas inside the Receiving Area, Buffer Cell, and Contact Maintenance Area.

6.1.3.7 Waste Package Headspace Overpressurization

An analysis during the development of the RHWF conceptual design indicated that one waste stream designated for processing in the RHWF has "unknown closure designs, but may be gas-tight." (WVNS, July 29, 1999.) This is waste stream number 21, "Shielded Boxes (Resins)," in Table 1.1-1. Subsequent analysis and communication with cognizant engineers at WVNS indicated that the closure designs are not likely to be gas-tight. In addition, the maximum expected gas generation rate is below levels that would result in accumulation of an explosive mixture. As a result, there is no expectation of headspace pressurization within waste streams designated for processing at the RHWF.

6.2 Process Chemistry and Physical Chemical Principles

The RHWF process involves mostly mechanical forces (lifting, positioning, sawing, cutting, repackaging, etc.) with no anticipated use of chemical decontamination reagents other than water and carbon dioxide. Many of the RHWF wastes streams (e.g., the pipes, vessels and pumps) have been subject to decontamination efforts and water rinses prior to removal from operation and transfer to their current storage location. For these reasons, the RHWF process will not involve extensive use or handling of large quantities of reactive chemicals. Therefore, large scale chemical reactions are not anticipated in the processing areas. Water will be used for cell wash downs and decontamination efforts. The resulting washdown water may require pH adjustment with small quantities of acids and bases in order to facilitate wastewater transfer and/or subsequent treatment. These small adjustments would be performed by operators using drains in accessible areas.

6.3 Waste Processing in the RHWF

6.3.1 Waste Process Areas

6.3.1.1 Receiving Area

Containers of waste from various on-site locations will be transferred to the Receiving Area, Figure 5.2-7. The transfer vehicles will be unloaded in this area. The waste containers will be moved into the Buffer Cell using the remotely controlled powered conveyor. The Receiving Area Crane, a 20-ton overhead bridge crane, will be used as a backup. Also, storage and maintenance of the Receiving Area Crane will be performed in this area.

6.3.1.2 Buffer Cell

The Buffer Cell (Figure 5.2-8) will allow contained movement of waste containers into the Work Cell. The secondary use for the Buffer Cell will be as a radiologically controlled area for contact-handled operations such as over-packing or for the removal of non-standard or over-sized waste boxes from the Work Cell.

Waste containers will be transferred from the Buffer Cell into the Work Cell by powered roller conveyers. As a backup, the Work Cell Crane, a 30-ton overhead bridge crane with a 10-ton hoist, can be used for moving waste boxes into the Waste Cell. Portable work platforms are provided in the Buffer Cell to facilitate waste processing operations.

6.3.1.3 Work Cell

The Work Cell (Figures 5.2-9 through 5.2-11) will provide for remote handling, surveying, obtaining analytical samples, segregating, size reducing, washdown, and repackaging capability.

The primary means of movement of heavy waste boxes and drums into the facility will be by powered conveyor. As a backup, the Work Cell Crane, and a 20-ton overhead bridge crane will be provided for movement of waste pieces and equipment. The Work Cell Crane and jib cranes will have the ability to use different types of end effectors (Figure 6.3-1), such as shears, hacksaws, cut-off saws, and chopsaws. All three PDMs will be capable of being remotely handled by operators in the Operating Aisle using video monitors or while looking through any of the shield windows in the concrete shield wall between the Work Cell and the Operating Aisle.

Waste containers and contents will be surveyed and sampled for characterization, both radiological and hazardous material. Sampling techniques may include smear samples, coupons, and vacuuming. In addition, an overall gamma scan and dose-rate survey will be performed. The results of this survey will be used to optimize the size-reduction plan for each individual piece. The remote handling equipment will be capable of fully remote lifting, surveying, sampling, segregating, size reducing, segmenting, shearing, cutting, decontaminating, dewatering, and repackaging of wastes.

Ultimately, the waste pieces will be loaded into a standard metal drum or box liner. The liners help to control the spread of contamination and prevent damage to the waste disposal container during transfer out of the Work Cell. The liners pass through a Waste Transfer System mounted on top of the Waste Packaging Area that provides the physical boundaries necessary to bring material out of an area with radiological contamination levels greater than 10^{12} dpm/100 cm^2, while maintaining the exterior of the waste disposal containers clean.

Further contamination control is maintained through in-cell filtration. The in-cell pre-filters act as roughing filters for the HEPA filters located in the Exhaust Ventilation Filter Room.

6.3.1.4 Waste Packaging and Survey Area

The Waste Packaging and Survey Area will provide a confined and shielded space for efficiently loading waste disposal drums and boxes. A waste-filled liner will be loaded into a waste disposal container (drum or box) in the waste packaging area. The liners will be lowered through the Waste Transfer System. The Waste Transfer System is the interface between the Work Cell and the waste packaging area. Filled waste disposal containers are remotely surveyed for external removable contamination and radiation levels in the waste packaging area. Filled and surveyed containers will then be removed from the waste packaging area through double shield doors to the survey area on transfer carts. Containers with high dose rate waste will be shielded on the cart. A forklift will remove the containers from the cart and take them to the Load Out/Truck Bay.

6.3.1.5 Contact Maintenance Area

Crane, manipulator, and equipment repair and maintenance is performed in the Contact Maintenance Area. This area is also used for storage, maintenance, and change-out of end effectors for the lifting equipment.

6.3.1.6 Sample Packaging and Screening Room

The Sample Packaging and Screening Room provides the capability to package samples from the Work Cell sample shelf for transfer to an analytical facility. With the aid of a shielded window in the Work Cell shield wall, PDM controller, and work station controller for the overhead bridge crane, samples will be removed from the Work Cell sample shelf through a transfer drawer inside a glove box. A shielded sample lift system in this room will allow the packaged sample to be transferred down to the Radiation Protection Operations Area on the first level (EL = 0 m [0 ft]), where the sample will be surveyed and released to a laboratory facility for characterization.

6.3.1.7 Radiation Protection Operations Area

The Radiation Protection Operations Area will receive Work Cell samples via the Sample Packaging and Screening Room shielded sample lift system (Figure 5.2-18). This area is also equipped with a sample transfer glove box that will receive swipe samples of waste packages that will be obtained using the swipe survey reach rods in the adjacent Waste Packaging Area and a shielded liquid sample glove box with a drain.

6.3.1.8 Waste Packaging and Survey Area

The Waste Packaging and Survey Area is the accessible area near the Waste Transfer System interface with the Work Cell. This area will be used to install drum and box covers, to survey and spot decontaminate repackaged waste containers, and to overpack containers, if required.

Each side of the double shield door between the packaging area and the survey area is equipped with a periscope and a swipe survey reach rod that will allow operators in the survey area to remotely monitor and survey operations in the packaging area while the doors are closed. A sample transfer glove box will allow collection of swipe samples from one reach rod through the Work Cell shield wall (Figure 5.2-12). Samples from the other rod will be transferred directly to the sample transfer glove box in the Radiation Protection Operations Area.

A 6-ton monorail transfer hoist will be provided in the survey area for lifting and placing the drum and box transfer shield lids.

6.3.1.9 Operating Aisle

The Operating Aisle will provide a radiologically clean and low-dose-rate area for operations personnel to remotely operate Work Cell cranes, conveyors, and other equipment. There are two primary processing stations in the Operating Aisle and one packaging station in the adjacent Sample Packaging and Screening Room. Each work station will include a shielded viewing window. This area will be designed for easy installation of supplemental temporary shielding in the event that additional dose rate reduction is required to process wastes that exceed the design dose rate defined in Section 4.3.5.

6.3.1.10 Load Out/Truck Bay

The Load Out/Truck Bay will be used for weather protection and storage for palletized liners, excess liners, shipping containers, and interim storage of repackaged wastes.

6.3.2 Process support

6.3.2.1 Exhaust Ventilation Filter Room

This area is described in Section 5.3.1.

6.3.2.2 Exhaust Ventilation Blower Room

This area is described in Section 5.3.2.

6.3.2.3 Mechanical Equipment Area and Stack Monitor Room

This area is described in Section 5.3.3.

6.3.2.4 Office Area

This area is described in Section 5.3.4.

6.4 Sampling and Analytical Requirements

Process sampling is discussed in Section 6.3.1.6. Analytical and waste characterization activities will be performed in other on-site or off-site facilities.

REFERENCES FOR CHAPTER 6.0

West Valley Nuclear Services, Co. July 29, 1999. Letter from D. K. Ploetz to B. A. Mazurowski (OH/WVDP). "Submittal of the Project Management Plan for the Remote-Handled Waste Project Completing Contract Milestone C.3, RH-1."

__________. WV-900: *WVDP Worker Safety Policy.* (Latest Revision).

__________. WVDP-011: *WVDP Industrial Hygiene and Safety Manual.* (Latest Revision).

__________. WVNS-DC-071: Design Criteria for the Remote Handled Waste Facility. (Latest Revision).

__________. WVNS-SAR-002: *Safety Analysis Report for Low-Level Waste Processing and Support Activities.* (Latest Revision).

TABLE 6.1-1
SPENT FUEL DISTRIBUTION OF RADIONUCLIDES IN 22 CPC WSA BOXES IN YEAR 2003

Radionuclide	2003 Material at Risk [Ci]
Sr-90	1.65E+02
Cs-137	1.81E+02
Th-228	5.10E-02
U-232	5.06E-02
U-233	7.96E-02
U-234	3.83E-02
Pu-238	1.14E+01
Pu-239	3.19E+00
Pu-240	2.43E+00
Pu-241	7.07E+01
Am-241	3.91E+00
Am-242	2.70E-02
Am-242m	2.72E-02
Am-243	1.70E-01
Cm-244	3.54E-01

Note:

[1] - Based on information in WVNS-SAR-002, Table B.7.7-4.

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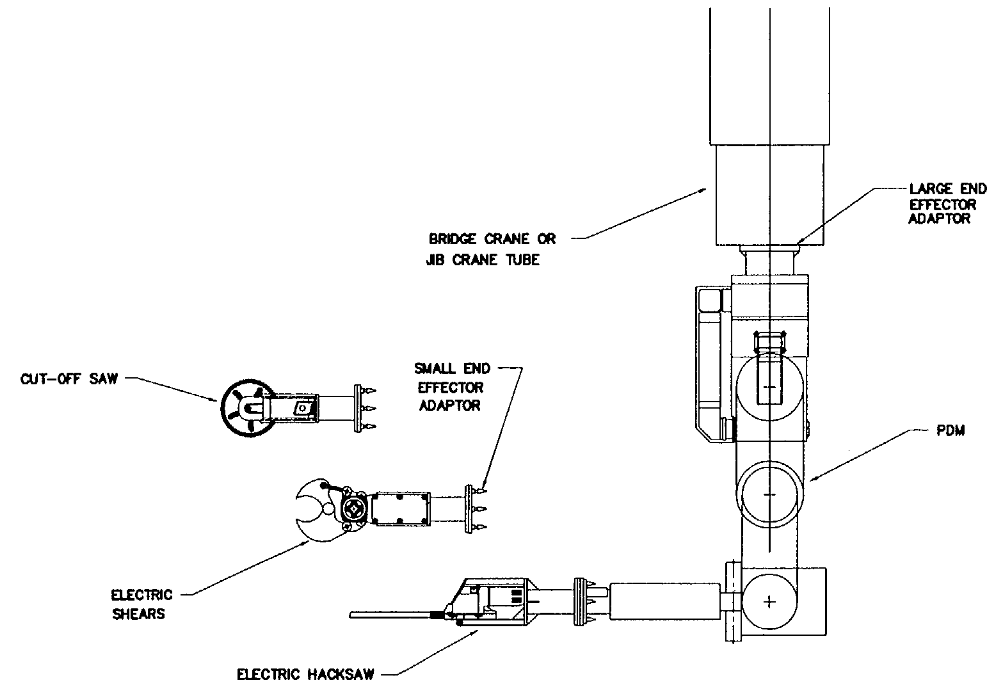
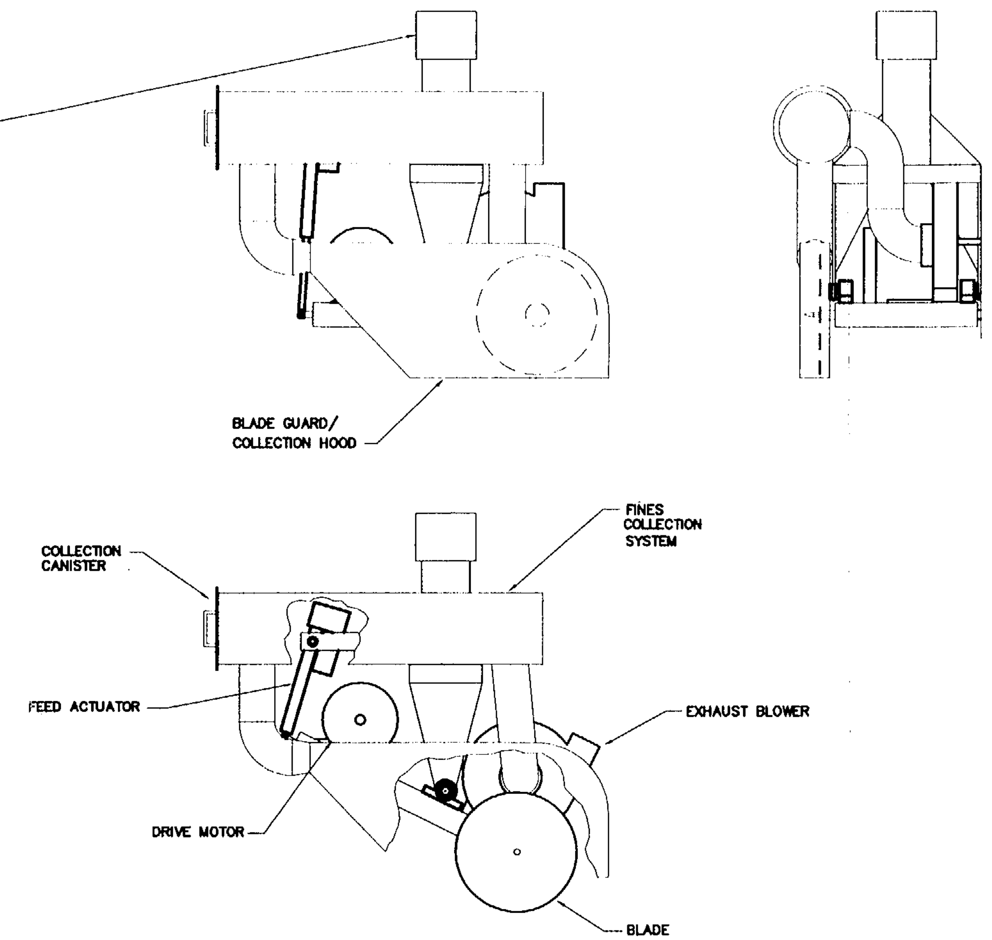


LIGHT DUTY END EFFECTORS



CHOP SAW

REVISIONS

REV.	DESCRIPTION	APV'D

REMOTE HANDLED WASTE FACILITY
PRELIMINARY SAFETY ANALYSIS REPORT

FIGURE 6.3-1

CUTTING EQUIPMENT

RHWFFIG63-1.+

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7.0 WASTE CONFINEMENT AND MANAGEMENT

This chapter addresses the handling, treatment, storage, and disposal of radiological and hazardous materials associated with gaseous, liquid, and solid waste streams that will be generated incidental to the mission of the RHWF. In regard to the content of this chapter, DOE Order 5480.23, *Nuclear Safety Analysis Reports*, states the following: "The Safety Analysis Report should include estimates of the quantity and form of radioactive wastes generated incidental to the mission of each DOE nuclear facility, as well as equipment, provisions, and plans for the management of these wastes. Note that if the management of radioactive wastes is among the missions of the facility, such waste management should be addressed under subparagraph (d), (facility description and operation, etc.)." The "management of radioactive wastes" is the primary mission of the RHWF, and hence information pertinent to the radioactive wastes that will be processed through the RHWF is provided in other chapters (i.e., Chapters 1, 5, and 6) of this PSAR.

7.1 Waste Management Criteria

As of September 1999, DOE Order 5820.2A, *Radioactive Waste Management*, is cited and invoked as being applicable in the contract between WVNS and the DOE. Additionally, WVNS-DC-071, *Design Criteria for the Remote Handled Waste Facility*, invokes DOE Order 5820.2A as being applicable to the RHWF. WVNS is currently preparing the implementation plan for DOE Order 435.1 that supersedes DOE Order 5820.2A.

The RHWF shall be designed to ensure environmental effluent releases are maintained within discharge guidelines given in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, and 40 CFR 261, *Identification and Listing of Hazardous Waste.*

The WVDP has developed comprehensive waste management plans to ensure that radioactive, hazardous, mixed, and industrial wastes are handled and stored in compliance with applicable state and federal regulations. A summary of WVDP waste management plans is given in Table B.7.1-1 of WVNS-SAR-002, *Safety Analysis Report for Low-Level Waste Processing and Support Activities*.

7.2 Radiological Wastes

Radioactive wastes that will be generated incidental to the mission of the RHWF include dust and small sized particles, waste containers that currently contain the radioactive wastes, anticontamination clothing and other personnel protective equipment, contaminated process hardware (e.g., cutting equipment) and support system hardware (e.g., HEPA filters and liquid drain system components), equipment associated with radiation survey and characterization samples, and liquid waste generated primarily through decontamination efforts with water. The conceptual design for the RHWF does not provide any mechanisms for the generation of mixed waste incidental to the mission of the RHWF, with the possible exception of small quantities being generated by laboratory analysis of waste samples.

7.3 Non-Radiological Wastes

Non-radioactive wastes will be produced incidental to RHWF operations and maintenance activities. Maintenance and miscellaneous activities generate some nonradiological, nonhazardous wastes (e.g., office trash, packing materials, scrap equipment, sewage, etc.). Nonhazardous, nonradioactive solid wastes are disposed of off-site at a licensed landfill facility. Liquid effluents shall be regulated by the New York State Department of Environmental Conservation (NYSDEC) for nonradiological parameters.

RHWF operations generally should not require the use of hazardous chemicals. Small quantities of reagents and cleaning solutions may be used periodically for various cleaning, analytical chemistry, or maintenance activities. WV-996, *Hazardous Waste Management Program*, governs all WVDP operations that "generate, classify, treat, store, transport, or dispose of hazardous waste." There is no on-site disposal of hazardous waste at the WVDP. Hazardous waste is shipped off-site for treatment and disposal by licensed and approved transporters to permitted commercial treatment, storage, and disposal facilities. This will apply to the RHWF.

7.4 Ventilation

The RHWF ventilation system is described in Chapters 4 and 5 of this PSAR. Pressure differentials will be maintained between each confinement zone within the RHWF so that air flow travels from zones of lesser contamination potential to zones of greater contamination potential. Ventilation system exhaust from contaminated zones or potentially contaminated zones (i.e., Zones I and II) shall be HEPA filtered. To ensure the ventilation system confinement function is maintained if the exhaust blowers are not available, WVNS-DC-071 states the following: "Dampers and/or HEPA filters (to be decided upon during the design stages) shall be provided to ensure that inadvertent back flows are filtered or prevented. Means (such as nuclear grade butterfly valves) should be provided to positively seal all Zone I penetrations. HEPA filters intended to act as back flow preventers between Zone I and Zone II spaces must be selected based on the available pressure differential."

Calculations performed in accordance with 40 CFR 61, *National Emissions Standards for Hazardous Air Pollutants*, estimate a potential effective dose equivalent of 1.7E-04 mrem/yr (1.7E-06 mSv/yr) to a maximally exposed off-site individual due to routine operations at the RHWF. The subject calculations are attached to Memo CA:99:0005, dated January 29, 1999. These preliminary calculations are reported here for information purposes only, as they may be revised because of RHWF design changes or for other technical reasons.

7.5 Radioactive Liquid Wastes

The RHWF conceptual design includes a liquid waste collection and transfer system. Washdowns (with water) of the Work Cell, Work Cell equipment, and waste forms will be performed periodically. By-and-large, the waste streams fed through the RHWF will be contaminated metal objects that in many instances have already undergone substantial decontamination efforts (e.g., the contents of the 22 boxes located in the CPC WSA), or objects that by their nature do not lend themselves to washdown-type decontamination efforts (e.g., expended ventilation system filters). These aspects will contribute to lowering the extent to which the washdown water becomes contaminated. Washdown of the Buffer Cell may occur on a relatively infrequent basis.

The conceptual design indicates that three tanks, located inside a tank vault underneath the Contact Maintenance Area, will be provided for liquid collection and transfer purposes. A 2839 liter (750 gal) liquid waste receiving tank, vented to the Work Cell, will be provided for the drains from the Buffer Cell and the Contact Maintenance Area upper and lower levels. A 5678 liter (1500 gal) liquid waste receiving tank, vented to the Work Cell, will be provided for the Work Cell drain, and another 5678 liter (1500 gal) liquid waste tank, also vented to the Work Cell, will be provided for batch sampling prior to transfer to a "vendor-supplied system" or to the existing HLW tank farm through double-contained piping. If a "vendor-supplied system" is employed, it shall be required to handle, treat, store, and dispose of contaminated liquid effluents in accordance with all applicable federal and state laws and regulations. RHWF liquid wastes directed to the existing HLW tank farm shall be processed through a "vendor-supplied system" or through existing site systems described in WVNS-SAR-002. Liquid wastes from the RHWF that will be processed through existing site treatment systems are expected to result in a negligible increase in dose to the maximally exposed off-site individual. Current estimates of dose from liquid effluent pathways are provided in Section B.8.6.4 of WVNS-SAR-002.

7.6 Radioactive Solid Wastes

Radioactive solid wastes that will be generated incidental to the mission of the RHWF include dust and small sized particles, waste containers that currently contain the radioactive wastes, anticontamination clothing and other personal protective equipment, contaminated process hardware (e.g., cutting equipment) and support system hardware (e.g., HEPA filters and liquid drain system components), and equipment associated with radiation survey and characterization samples. Dust-like particles generally will be captured on HEPA filters, while small sized particles will likely be swept to the liquid waste tanks during washdown activities or captured on fine mesh screen(s) located in the pathway to the tanks. Solid radioactive wastes generated within the Work Cell (e.g., small sized particles captured on screen(s) in liquid waste flowpaths, HEPA filters located in the Work Cell, expended or broken equipment located in the Work Cell, and waste containers that currently contain the radioactive wastes) will be processed in the same manner as the radioactive wastes being fed through the RHWF. This means that these incidentally generated solid radioactive waste items will be, as appropriate for a given item, cut up, decontaminated to a limited extent, characterized, and packaged into appropriate (standard) types of waste containers. By mass and likely by volume, waste containers that currently contain the radioactive wastes will be the largest solid radioactive waste stream generated during routine RHWF operations.

Packaged solid radioactive wastes that will be generated incidental to the mission of the RHWF will be (temporarily) stored on-site until shipped to a licensed repository. It is not intended that the Load Out/Truck Bay Area of the RHWF will serve as an intermediate or long term storage area. See Chapter 7 of WVNS-SAR-001, *Project Overview and General Information*, and Chapter 7 of WVNS-SAR-002 for an overview and understanding of solid radioactive waste storage capabilities and handling practices at the WVDP.

REFERENCES FOR CHAPTER 7.0

U.S. Department of Energy. July 9, 1999. DOE Order 435.1: *Radioactive Waste Management*. Washington, D.C.

__________. February 8, 1990. Change 2 (January 7, 1993). DOE Order 5400.5: *Radiation Protection of the Public and Environment*. Washington, D.C.

__________. April 30, 1992. DOE Order 5480.23: *Nuclear Safety Analysis Reports*. Washington, D.C.

__________. September 26, 1988. DOE Order 5820.2A: *Radioactive Waste Management*. Washington, D.C.

U.S. Environmental Protection Agency. 40 CFR 61. *National Emissions Standards for Hazardous Air Pollutants*. (Latest Revision).

__________. 40 CFR 261. *Identification and Listing of Hazardous Waste*. (Latest Revision).

West Valley Nuclear Services Co., Inc. Memo CA:99:0005. January 29, 1999. Subject: Process Safety Design Documentation for the Remote Handled Waste Facility.

__________. WV-996: *Hazardous Waste Management Program*. (Latest Revision).

__________. WVNS-DC-071: *Design Criteria for the Remote Handled Waste Facility*. (Latest Revision).

__________. WVNS-SAR-001: Safety Analysis Report: *Project Overview and General Information*. (Latest Revision).

__________. WVNS-SAR-002: *Safety Analysis Report for Low-Level Waste Processing and Support Activities*. (Latest Revision).

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8.0 HAZARDS PROTECTION

8.1 Assuring that Occupational Hazards Exposures are ALARA

This chapter identifies hazards that will be present in association with RHWF operations; design features and programs that will be in place to ensure that workers and the public are adequately protected from those hazards; an occupational and off-site receptor dose assessment; and a discussion on ensuring that exposures to radiological and hazardous materials are kept ALARA.

8.1.1 Policy Considerations

A formal documented program directed toward maintaining personnel radiation doses ALARA at the WVDP has been established in WVNS Policy and Procedure WV-984, *ALARA Program*. The ALARA program is based on requirements set forth in 10 CFR 835, the DOE *Radiological Control Manual* (DOE/EH-0256T), and DOE Order 5400.5, *Radiation Protection of the Public and the Environment*. The radiation protection program and the ALARA program site-specific requirements are outlined in WVDP-010, *WVDP Radiological Controls Manual*, WVDP-076, *Environmental Protection Implementation Plan*, and WVDP-163, *ALARA Program Plan*. WVDP-131, *Radiological Controls Procedures*, Standard Operating Procedures (SOPs), and other departmental procedures are used to provide more detailed instructions for workers and technical personnel. A discussion and summary of the ALARA program is provided in WVNS-SAR-001, *Project Overview and General Information*.

In addition to radiation protection programs, the WVDP has established a comprehensive industrial hygiene and safety program for the identification, assessment and monitoring of nonradiological hazards. Administration of the industrial hygiene and safety program is through WVDP-011, *WVDP Industrial Hygiene and Safety Manual*, which incorporates applicable DOE requirements as well as DOE-adopted Occupational Safety and Health Administration (OSHA) standards 29 CFR 1910 and 29 CFR 1926.

8.1.2 Design Considerations

The prime consideration in maintaining radiation and hazardous material exposures ALARA is ensuring that positive control of these materials is maintained. The RHWF design features that will ensure the confinement of radiation, radioactive materials, and hazardous materials to achieve exposure level objectives include the following:

- Radioactive waste containers shall be remotely opened, and radioactive wastes shall be remotely processed (e.g., cut up) and repackaged, in a shielded cell (i.e., the Work Cell).

- The Contact Maintenance Area shall be physically separated from the Work Cell and shall provide for maintenance of the Work Cell cranes, PDMs, and other in-cell equipment as necessary.

- Means shall be provided to permit remote waste transfer from the highly contaminated Work Cell into externally "clean" containers in a contamination free zone.

- Pressure differentials shall be maintained between each confinement zone so that air flow travels from zones of lesser contamination potential to zones of greater contamination potential as described in Chapter 5 of this PSAR.

- The RHWF ventilation system shall ensure that exhaust from contaminated zones or potentially contaminated zones (i.e., Zones I and II) shall be HEPA filtered.

- The RHWF ventilation system shall incorporate dampers and/or HEPA filters (to be decided upon during the subsequent design stages) to ensure that inadvertent back flows are filtered or prevented.

- Exhaust flowpath pre-filters shall be installed in the Work Cell to minimize the amount of contaminated ducting and to allow for remote shielded filter changeout without the loss of pressure differentials between various cells/areas within the RHWF.

- Liquid spills and water used for decontamination purposes shall drain to a sump or other confinement volume (e.g., a liquid collection tank), from which they will be routed for further processing.

- Curbs shall be provided at the base of doorways, and floors shall be sloped to a central drain to prevent the spread of liquid contamination outside of any cell.

- For contaminated liquids transferred from the RHWF to other site SSCs, double-contained piping shall be used that contains instruments to detect any leakage from the primary piping to the encasement piping.

- Shield walls, shield windows, and administrative controls shall be used to reduce the radiological dose to operators to less than 500 mrem/yr (5.0 mSv/yr), unless appropriate WVNS management approval is obtained that allows for a higher annual dose to a given operator. As part of meeting this objective, the maximum radiation dose rate for a full-time occupancy area will be 0.1 mrem/hr (0.001 mSv/hr), and the maximum radiation dose rate for a full-time access area will be 1.0 mrem/t (0.01 mSv/t), where "t" is the maximum average time in hours per day that the area is expected to be occupied by any one individual. A full-time occupancy area is one in which individual(s) may be expected to spend all or most of a work day.

- The RHWF shall include continuous air monitors in strategic locations for detecting the airborne release and presence of radiological materials, and area radiation monitors for detecting radiation levels above the normal operational range.

- Redundant equipment, sensors, and controls shall be employed in critical aspects of operations.

8.1.3 Operational Considerations

In addition to considerations that must be incorporated into the design of the RHWF, administrative procedures and controls will be necessary to ensure that personnel hazards exposures are maintained ALARA. Administrative and procedural control will be maintained in accordance with WVDP-010 and WVDP-011, and specific Standard Operating Procedures. The RHWF operations personnel shall be fully trained in elements of the radiation protection and industrial hygiene programs.

8.2 Sources of Hazards

The thirteen waste streams to be repackaged at the RHWF, as shown in Table 1.1-1 of this PSAR, will provide the radiologically hazardous materials associated with RHWF operations. Section 6.1.1 of this PSAR describes estimates of select radiological characteristics for five of the subject 13 waste streams (i.e., for the contents of the 22 waste storage boxes that were generated from CPC decontamination efforts). These waste streams from the CPC decontamination efforts bound the inventory of radiological hazard associated with the RHWF at any given time. Insights into the nature of the contamination on other waste streams can be gained from a review of select documents (e.g., WVNS-SAR-003, *Safety Analysis Report for Vitrification System Operations and High-Level Waste Interim Storage*, for the "waste tank farm pumps" waste stream, and WVNS-SAR-002, *Safety Analysis Report for Low-Level Waste Processing and Support Activities*, and *Estimation of Activity in the Former Nuclear Fuel Services Reprocessing Plant*, dated March 1993, for the "Main Plant closure wastes" waste stream). Shielding to protect workers from the radiation associated with the thirteen waste streams will be provided as discussed in Chapters 4 and 5 of this PSAR. Potential airborne radioactive materials associated with these 13 waste streams will be confined as discussed in Chapters 4, 5, and 7 of this PSAR.

8.3 Hazard Protection Design Features

Radiation protection features basic to the design of the RHWF are dedicated to maintaining radiation exposures to members of the general public and the work force ALARA. Effective control of radiation exposure depends primarily on design features that provide for adequate shielding from all sources of radiation; remote operations and maintenance; confinement of radioactive materials within designated process areas; proper ventilation, effluent control, and overall monitoring and surveillance to verify design controls. These physical design features, as well as strict adherence to the operational requirements given in WVDP-010, will provide effective radiation control. RHWF design authorities are committed to incorporating into the RHWF design the many specific hazard protection design features enumerated in Chapter 4 of this PSAR and in Section 8.1.2 above.

8.4 Occupational Dose Assessment

As previously noted, shield walls, shield windows, and administrative controls shall be used to reduce the radiological dose to RHWF workers to less than 500 mrem/yr (5.0 mSv/yr), unless appropriate WVNS management approval is obtained that allows for a higher annual dose to a given worker. As part of meeting this objective, design efforts shall ensure that the maximum radiation dose rate for a full-time occupancy area will be 0.1 mrem/hr (0.001 mSv/hr), and the maximum radiation dose rate for a full-time access area will be 1.0 mrem/t (0.01 mSv/t), where "t" is the maximum average time in hours per day that the area is expected to be occupied by any one individual. If compliance with full-time access area requirements would be economically infeasible, impractical, or prohibitive, higher dose rates may be allowed. However, access to such fields will be strictly controlled. In these normally unoccupied areas, the maximum radiation dose rate shall be 4.0 mrem/hr (0.04 mSv/hr), except when waste packages are present.

Operations will be conducted in accordance with the requirements of WVDP-010, which will ensure that occupational doses are maintained ALARA. The occupational dose for the entire waste management campaign to be performed at the RHWF is estimated to be 56 person-rem. This estimate is based on an annual limit of 500 mrem (5 mSv) and an average of 16 workers per year over a 7 year campaign.

Internal radiation dose hazards are not expected to be significant, or result in appreciable doses, due to the confinement philosophy and required use of airborne activity monitoring equipment. Appropriate respiratory protection devices will be required for entry into an area where airborne radioactive material could be present, as determined by radiation protection personnel. Per WVDP-179, *Respiratory Protection Program Plan*, respirators are issued only to personnel who are trained, fitted, and medically qualified to wear the specific type of respirator. Training and qualification testing are performed annually.

Full-time occupancy areas, such as the operating aisles and the Receiving Area have been evaluated for shielding requirements. The design basis gamma source within the Work Cell for both direct and scattered dose rate to personnel within the operating aisles is 0.01 µrem/hr (0.001 µSv/hr) (WVNS, July 24, 2000)which meets the design dose rates as described in Section 8.1.2.

The two full-time access areas adjacent to the Work Cell, Buffer Cell and Contact Maintenance Area, require special attention to ensure worker exposures are ALARA. A shielding evaluation was performed to evaluate the design basis gamma source within the Work Cell for both the direct and scattered dose rates to personnel in these two areas (WVNS, July 24, 2000). The calculated dose rates to personnel within the Buffer Cell at elevations 1.5 m (5 ft) and 2.7 m (9 ft) are 0.2 mrem/hr (0.002 mSv/hr) and 0.5 mrem/hr (0.005 mSv/hr) respectively. The calculated dose rates to personnel within the Contact Maintenance Area at elevations 1.5 m (5 ft) and 9.1 m (30 ft) are 0.1 mrem/hr (0.001 mSv/hr) and 2 mrem/hr (0.02 mSv/hr), respectively. Both the Buffer Cell and the Contact Maintenance area meet the design basis dose rates as described in Section 8.1.2. In addition, both of these areas will have airborne contamination monitors and area radiation monitors. These monitors will provide an early warning system for detecting the presence of radiological materials and radiation fields above the normal operational range. The monitors will alarm locally, at the RHWF Control Station, Radiation Control Shift Office, and the Security Gatehouse.

8.5 Hazards Protection Program

A formally documented health physics program for the WVDP has been established in WVNS Policy and Procedure WV-905, *Radiation Protection*. Site-specific requirements for the WVDP health physics program are promulgated in WVDP-010, and the RHWF will be operated in compliance with the requirements given in that document. An extensive discussion of the health physics program for the WVDP is presented in Section A.8.5 of WVNS-SAR-001.

Elements of the hazardous material protection program ensure that hazardous materials are identified, stored, and handled in a manner consistent with the ALARA philosophy. WV-921, *Hazards Identification and Analysis*, establishes the policy and means "to conduct hazards analyses for all WVNS activities during the work planning process, prior to commencement of work." WV-921 provides "the mechanism for the Work Originator, Work Group Supervisor, and/or Work Review Group to determine when the Hazards Controls Specialists shall be included in the work planning process at a task level." WVDP-241, *Site Health and Safety Plan*, has been prepared to document the WVDP Hazardous Waste Operations and Emergency Response (HAZWOPER) Program, assign responsibilities, establish personnel protection standards, prescribe mandatory health and safety practices and procedures, and provide for contingencies that may arise during the performance of hazardous waste operations work activities at the WVDP. As prescribed by WVDP-011, the site "Right-to-Know" Program is included in the general employee training required for all employees.

8.6 Off-Site Dose Assessment

Calculations performed in accordance with 40 CFR 61, *National Emissions Standards for Hazardous Air Pollutants*, estimate a potential effective dose equivalent of 1.7E-04 mrem/yr (1.7E-06 mSv/yr) to a maximally exposed off-site individual due to routine operations at the RHWF. The subject calculations are attached to Memo CA:99:0005, dated January 29, 1999. These "preliminary" calculations are reported here for information purposes only, as they may be revised because of RHWF design changes or for other technical reasons.

Other calculations attached to Memo CA:99:0005, which were performed in accordance with applicable 40 CFR 61 requirements, demonstrate that radionuclide emissions from the RHWF ventilation system exhaust stack must be continuously monitored in accordance with 40 CFR, Section 61.93, "Emission monitoring and test procedures," and DOE/EH-0173T, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*.

The RHWF conceptual design indicates that a 5678 liter (1500 gal) liquid waste tank, vented to the Work Cell, will be provided for batch sampling of RHWF liquid wastes prior to transfer of the liquid wastes to a "vendor-supplied system" or to the existing high-level waste tank farm through double-contained piping. If a "vendor-supplied system," is employed, it shall be required to handle, treat, store, and dispose of contaminated liquid effluents in accordance with all applicable federal and state laws and regulations. RHWF liquid wastes directed to the existing high-level waste tank farm shall be processed through a "vendor-supplied system" or through existing site systems described in WVNS-SAR-002. Any RHWF liquid wastes processed through existing site systems are expected, based on engineering judgment, to provide a very small to negligible increase in the estimated dose to the maximally exposed off-site individual due to liquid releases from the site as reported in Section B.8.6.4 of WVNS-SAR-002. Contaminated liquids that are generated by WVDP activities are processed through the Low Level Waste Treatment System (LLWTS) before discharge to the environment. Effluent from this system is monitored as discussed in Section B.8.6.1.2 of WVNS-SAR-002.

8.7 Prevention of Inadvertent Criticality

Nuclear criticality safety will be ensured at the RHWF through implementation of WVDP-162, *WVDP Nuclear Criticality Safety Program Manual*, and WV-923, *Nuclear Criticality Safety*. These documents have been written to implement the criticality-related requirements of DOE Order 420.1, *Facility Safety*, and referenced ANSI/ANS nuclear criticality safety standards. For each of the transuranic waste streams to be processed through the RHWF, a nuclear criticality safety evaluation (NCSE) will be performed. Where appropriate, Process Safety Requirements (WVDP-218) will be developed for administrative controls.

Only three of the waste streams to be processed through the RHWF (Table 1.1-1) have significant quantities of fissionable material: CPC Dissolver Vessel Boxes, CPC Vessel Boxes, and Main Plant Closure Wastes.

As shown in Table B.7.7-4 of WVNS-SAR-002, it is estimated that there are 491 U-235 equivalent grams of fissile material associated with the contents of the 22 waste storage boxes that were generated from CPC decontamination efforts. This fissile material is comprised of insoluble dry sludge and fixed contamination. The CPC vessels were acid washed and flushed prior to interim storage in the CPC WSA. Further, a uniform aqueous solution containing this mass of fissile material is subcritical and it is less than the minimum critical mass for U-235, as shown in ANSI/ANS-8.1, *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors.*

Main Plant Closure Wastes will be characterized and decontaminated to the extent practicable prior to transfer to the RHWF for size reduction and packaging. Therefore, it is anticipated that the quantity of fissionable material will be kept to a minimum. Any fissionable material remaining will be in the form of insoluble contamination. There are currently no plans to use aggressive decontamination solutions (e.g., nitric acid, oxalic acid) as part of the RHWF process. As part of the closure planning for each of the Main Plant Areas, WVDP-162 requires that a NCSE be performed. The NCSE for each area will take into account the transfer to and processing in the RHWF.

As indicated in Section 4.3.4, the final design of the RHWF will incorporate criticality safety features, such as geometrically safe sumps, sump particulate filters, and bottom draining liquid waste tanks. The RHWF liquid waste collection and transfer system is described in Section 7.5.

Because of the physical and chemical form of the fissionable materials that will be handled in the RHWF, the majority of the fissionable mass will remain with the contaminated items being processed and be removed from the facility in the waste packages. However, because of small uncertainties associated with the extent of fissionable material that may be captured in the liquid waste collection system, measures will be taken to ensure that double contingency, as discussed in DOE Order 420.1, will be achieved with respect to the RHWF liquid waste collection and transfer system. The final design of the RHWF will incorporate sufficient factors of safety to require at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible. In addition to the known physical and chemical characteristics of the wastes, measures will be taken to ensure that criticality is not a credible event. Some of these measures will include: geometrically safe trenches, floor drains, and piping; fine mesh particulate filters on all floor drains; bottom draining liquid waste tanks; and periodic sampling of liquid waste tank contents. Characterization information from the waste forms may also be employed to ensure critically-safe washdown activities.

The RHWF FSAR will demonstrate double contingency is satisfied in relation to the RHWF liquid waste collection and transfer system, and that a criticality accident is not credible in relation to the RHWF liquid waste collection and transfer system.

8.8 Fire Protection

The WVDP fire protection program, which will be applied to the RHWF, has been developed to meet the requirements for a comprehensive fire protection program as delineated in WVDP-177, *WVDP Fire Protection Manual*, which is based on the fire protection-related requirements in DOE Order 420.1. Administrative controls, procedures, and training to prevent fires and explosions are presented in WVDP-177. The WVDP fire and explosion protection program is discussed in Section A.4.3.6 of WVNS-SAR-001.

A Fire Hazard Analysis (FHA) for the RHWF is being developed in a time frame that approximately parallels the development of this PSAR. A complete discussion of the FHA process and its requirements are given in WVDP-177. DOE Order 420.1 states that FHAs shall be developed for "all nuclear facilities, significant new facilities, and facilities that represent unique or significant fire safety risks." The subject Order also states that FHAs shall be developed using a graded approach.

REFERENCES FOR CHAPTER 8.0

American Nuclear Society. 1983. ANSI/ANS-8.1: *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors*. LaGrange Park, Illinois.

____________. 1983. ANSI/ANS-8.10: *Criteria for Nuclear Criticality Safety Controls in Operations with Shielding and Confinement*. LaGrange Park, Illinois.

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9.0 HAZARD AND ACCIDENT SAFETY ANALYSES

9.1 Hazard Analysis

The systematic analysis of hazards associated with RHWF operations has been accomplished in this PSAR through the completion of a Process Hazards Analysis (PHA). The PHA is intended to provide a qualitative analysis of the potential sources of hazards and mitigative features associated with facilities and activities discussed in this PSAR, the scope of which is discussed in Section 1.1. Information gained through this analysis has then been used in selecting accidents to be further analyzed in a more rigorous quantitative fashion in Section 9.2.

9.1.1 Methodology

9.1.1.1 Hazard Identification

The purpose of accomplishing the PHA is to identify the hazards in terms of quantity, form and location, potential initiating events, and other events which could result in an undesirable consequence. In order to ensure that a comprehensive, systematic analysis was performed, information was obtained from several sources. The primary source of information for the PHA is the design basis and planning documents provided to DOE in July 1999 (WVNS, July 29, 1999). The PHA is shown in Table 9.1-1.

Many accidents contained in the PHA are of a similar nature (e.g., spills, fires, etc.) and, therefore, bounding accidents are identified through examination of relative inventories. Certain events, however, are more unusual and require additional analyses to determine the event probability and/or consequence.

Minor amounts of hazardous metals, including lead, mercury and uranium, are contained in wastes that will be processed in the RHWF. Though the hazard posed by these materials are analyzed in the PHA, the form and inventory of these materials preclude any significant on-site or off-site consequences associated with postulated accident scenarios. For this reason, the remainder of this chapter is concerned with the analysis of only radiological hazards.

9.1.1.2 Hazard Evaluation

Evaluation of hazards for the PHA required the qualitative assessment of event consequences and frequencies. Qualitative consequence and frequency classifications used in Table 9.1-1 are as follows:

Qualitative Consequence Classification:

Negligible Negligible on-site and off-site impact on people or the environs.

Low Minor on-site and negligible off-site impact on people or the environs.

Moderate Considerable on-site impact on people or the environs; only minor off-site impact.

High Considerable on-site and off-site impacts on people or the environs.

Qualitative Annual Frequency Classification:

Incredible ($p \leq$ 1E-6) Accidents that are not credible.

Extremely Unlikely (1E-6 < $p \leq$ 1E-4) Accidents that will probably not occur during the lifetime of the facility.

Unlikely (1E-4 < $p \leq$ 1E-2) Accidents that are not anticipated to occur during the lifetime of the facility.

Anticipated (1E-2 < $p \leq$ 1E-1) Incidents that may occur several times during the lifetime of the facility.

(p is the probability of a given event per year).

For each event in Table 9.1-1, a Risk Factor has been developed that is based on the consequence and frequency for the event. The value of the risk factor is determined from a three-by-three frequency- and consequence-ranking matrix, shown in Figure 9.1-1. Events with no consequences are assigned a risk factor of zero (0). Events having either an on-site or an off-site consequence, but with probabilities of occurrence less than 1E-6 per year (i.e., incredible events), were assigned a risk factor of "I". Incredible events that have been further evaluated as a beyond DBA in Section 9.2 are assigned a risk factor of "IE" (incredible but evaluated).

9.1.2 Hazard Analysis Results

9.1.2.1 Hazard Identification

The PHA is performed to identify the hazards in terms of energy sources and hazardous material quantity, form and location, potential initiating events, and other events which could result in an undesirable consequence. The method of presentation and analysis in the PHA documents the evaluation of these hazards on a case-by-case basis.

In developing potential initiating events, energy sources were identified. The activities conducted in the RHWF are primarily physical in nature (segregation, decontamination, and filtration), presenting low inherent operational energy sources. Therefore, with the exception of natural gas, the potential energy sources for accident initiators considered in this section are largely those either associated with the process (e.g., lifting a heavy object in the air), or that are posed by natural phenomena (e.g., the earthquake scenario).

9.1.2.2 Hazard Categorization

The RHWF is a hazard category 2 nuclear facility. This determination is based on the guidance in DOE-STD-1027-92, "Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports," in which a potential for accident consequences to exceed 1 rem at a distance of 100 meters from the facility is described as the basis for the Hazard

Category 2 threshold values for facility inventory. Accident consequences from accidents associated with the RHWF, which are described in section 9.2 of this PSAR, exceed the 1 rem threshold. There is also a potential to exceed 1,000 Ci of mixed fission products during the operation of the RHWF, even though the bounding material-at-risk (MAR)(i.e., 22 waste storage boxes from the CPC-WSA) is less. It also is expected that the fissile isotope mass threshold values for Hazard Category 2 (DOE-STD-1027-92) will be exceeded.

9.1.2.3 Hazard Evaluation

9.1.2.3.1 Summary of Significant Worker-Safety Features

Worker hazards protection is provided by engineered facility features. The most significant worker-safety facility design feature is the shield walls. Another significant worker-safety facility design feature is the ventilation system that minimizes the spread of radioactive contamination within the RHWF. In addition, significant worker protection from radiological hazards is ensured through the implementation of the requirements of WVDP-010, *"WVDP Radiological Controls Manual."*

9.1.2.3.2 Accident Selection

The identification of accidents presenting the greatest risk to on-site individuals and the off-site public is one of the primary goals of the PHA. Accidents selected for more rigorous quantitative evaluation in Section 9.2 are those accidents resulting from RHWF process operations and support activities that were qualitatively judged to present the greatest risks based on accident consequence and probability. Accidents selected were those identified in the PHA as having a risk factor greater than or equal to three. In addition, events with incredible probabilities of occurrence, but representing beyond design basis or bounding accidents for certain classes of events, were also selected for evaluation (identified with a risk factor of "IE" in Table 9.1-1).

Accidents selected for further evaluation are:

1) Contaminated Area Ventilation System Filter Failure
2) Waste Container Lift Failure
3) Fire In Load Out/Truck Bay
4) Beyond Design Basis Seismic Event
5) Beyond Design Basis Criticality Accident
6) Beyond Design Basis Natural Gas Explosion

While other accidents of a similar nature were identified in the hazards analysis and may pose similar risk, these accidents were selected due to their bounding risk for exposure. As a result, operational accidents 1 through 3 above represent the DBAs for the activities analyzed in this PSAR. Accidents 4 through 6 represent the beyond DBAs analyzed in this PSAR.

9.1.3 <u>WVDP Evaluation Guidelines (EGs)</u>

To facilitate the development of safety analysis evaluation guidelines for hazards associated with the RHWF, several distinctions have been made. These distinctions are as follows:

1) Whether the event (accident) is manmade or caused by natural phenomena;
2) Whether the population at risk is the public or on-site workers.

These distinctions lead to four different combinations for which an evaluation guideline is required. This section establishes evaluation guidelines for these four situations.

9.1.3.1 Manmade Events

For manmade accidents with either internal or external initiators, radiological DBAs are compared to EGs over the frequency spectrum of 0.1 to 1E-06 events per year.

(1) Public Radiological EG: Manmade DBAs shall not cause doses to the maximally exposed off-site individual (MOI) greater than: (1) 0.5 rem (0.005 Sv) for accidents with estimated frequencies <0.1 per year but ≥1E-02 per year; (2) 5 rem (0.05 Sv) for accidents with estimated frequencies <1E-02 per year but ≥1E-04 per year; and (3) 25 rem (0.25 Sv) for accidents with estimated frequencies <1E-04 per year but >1E-06 per year. Manmade DBAs with estimated frequencies ≤1E-06 per year are not considered credible. These EGs are depicted graphically in Figure 9.1-2.

(2) On-Site Radiological EG: Manmade DBAs shall not result in calculated doses at the on-site evaluation point (OEP) (640 meters) greater than: (1) 5 rem (0.05 Sv) for accidents with estimated frequencies <0.1 per year but ≥1E-02 per year; (2) 25 rem (0.25 Sv) for accidents with estimated frequencies <1E-02 per year but ≥1E-04 per year; and (3) 100 rem (1.0 Sv) for accidents with estimated frequencies of <1E-04 per year but >1E-06 per year. Manmade DBAs with estimated frequencies ≤1E-06 per year are not considered credible. These EGs are depicted graphically in Figure 9.1-3.

9.1.3.2 Natural Phenomena-Induced Events

Natural phenomena-induced accidents with initiating frequencies defined by applicable design criteria documents are compared against the following EGs.

(1) Public Radiological EG: Natural phenomena induced accidents shall not cause doses to the MOI greater than 25 rem (0.25 Sv).

(2) On-Site Radiological EG: Because the facility is designed to withstand design basis natural phenomena, on-site numerical EGs are not required for safety assurance in the analysis of accidents induced by natural phenomena.

9.2 Accident Analyses

9.2.1 Methodology

Accident analyses are performed through the use of established and accepted references and computer codes. Computer codes used in accident analyses are verified per approved procedures prior to use. Accidents analyzed in this PSAR represent the bounding accident for a particular event type (i.e., spills, filter failure, liquid release, etc). Events presenting the greatest risk have been identified through process hazards analysis.

Analyses to evaluate the consequences of airborne radiological releases use source terms developed from guidance given in DOE-HDBK-3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for Non-Reactor Nuclear Facilities*; site specific dispersion factors calculated using the PAVAN computer code; and radiological dose conversion factors given in DOE/EH-0070, *External Dose-Rate Conversion Factors for Calculation of Dose to the Public*, and DOE/EH-0071, *Internal Dose Conversion Factors for Calculation of Dose to the Public*.

On-site and off-site dose predictions are a function of the assumed meteorological dispersion parameters. DOE-STD-1027-92 defines the distances and meteorological parameters to be used to calculate off-site and on-site doses to maximally exposed individuals from short-term releases. The DOE standard discusses the adoption of the NRC-recommended (10 CFR 30) parameters (1 m/sec [2.2 mph] wind speed and Pasquill-Gifford Stability Class [PGSC] F) and a less conservative alternative for ground-level releases (4.5 m/sec [10.1 mph], PGSC D). The dose calculations resulting from the use of these recommended meteorological conditions will be compared to EGs.

For all accident analyses, a maximum exposure time of two hours at the site boundary is assumed. This assumption is justified by the fact that it would be possible to control (shut off) the source and/or remove the potentially exposed individuals within a two-hour period. The actual site boundary is either easily accessible for surveillance or passes through rough, relatively inaccessible terrain where a person would be extremely unlikely to be loitering. In most cases, the duration of the release is less than two hours, so truncating the exposure is not an issue.

Site-specific dispersion factors (χ/Q values) are calculated using the PAVAN computer code which implements the guidance provided in Regulatory Guide 1.145, *Atmospheric Dispersion Models for Potential Accident Consequences Assessments at Nuclear Power Plants*. The χ/Q calculations are based on the theory that material released to the atmosphere will be normally distributed (Gaussian) about the plume center-line. A straight-line trajectory is assumed between the point of release and all distances for which the χ/Q values are calculated.

The PAVAN program uses meteorological data in the form of joint frequency distributions of hourly averages of wind direction and wind speed by atmospheric stability class. Wind direction is distributed into 16 sectors (N, NNE, NE, etc.) and atmospheric stability is distributed into seven classes (A-G). For each of 16 downwind sectors, the program calculates χ/Q values for each combination of wind speed and atmospheric stability at the site boundary for the respective sector. The χ/Q values calculated for each sector are then ordered from greatest to smallest and an associated cumulative frequency distribution is derived based on the frequency distribution of wind speed and stabilities for that sector. The program then determines for each sector an upper envelope curve based on these data such that no plotted point is above the curve. From this upper envelope the χ/Q value which is equaled or exceeded 0.5% of the total time is obtained. The maximum 0.5% χ/Q value from the 16 sectors becomes the maximum sector χ/Q value, which has been used in consequence analyses in this PSAR. See WVDP-065 for additional information.

Another technique that can be employed to develop conservative χ/Q values is directionally independent (i.e., determined on an "overall site basis"), as opposed to the 0.5% directionally dependent technique discussed in the previous paragraph. Regarding the directionally independent technique, Regulatory Guide 1.145 states the following: "An overall cumulative probability distribution for all directions combined should be constructed. A plot of χ/Q versus probability of being exceeded should be made, and an upper bound curve should be drawn. The 2-hour χ/Q value that is exceeded 5 percent of the time should be selected from this curve as representing the dispersion condition indicative of the type of release being considered." Regarding the rationale for selecting 0.5% for the directionally dependent analysis, Regulatory Guide 1.145 states that "Selection of the 0.5 percent level is based on an equality, without consideration of plume meander, between the 5 percent directionally independent evaluation of χ/Q and the 0.5 percent directionally dependent evaluation of χ/Q averaged over a reasonably representative number of existing nuclear power plant sites." Given the established equality between the two techniques, and given the fact that the expression "site-specific 95% meteorology" is often used to communicate the 5% directionally independent technique, the terminology "site-specific 95% meteorology" is used in this PSAR to communicate conservatively developed site-specific χ/Q values.

9.2.1.1 Initiating Event Summary

It is important to develop a credible accident scenario with a reasonably bounding source term, as this potentially avoids expenditures associated with the unnecessary designation of certain SSCs as safety SSCs, and the imposition of unnecessary TSR administrative controls. However, this PSAR has been developed from conceptual design information that does not include the details as to the quantities of radiological and hazardous material that can be located in a given area of the RHWF. Additionally, final design features of the RHWF may be substantially different from certain conceptual design features. In consideration of these facts, it is deemed acceptable and appropriate to develop and present accident scenarios that incorporate substantially conservative assumptions, especially if the consequences of the highly conservatively developed scenario are well within evaluation guidelines. This approach is consistent with the function for a PSAR as stated in DOE Order 5480.23. The PSAR should provide accident scenarios (in consideration of design and operational uncertainties at the time of PSAR development) that are considered with a high degree of confidence to be bounding, since "a PSAR must anticipate ways the facility can be constructed, maintained, operated, and shut down safely in compliance with applicable laws and regulations," and document "the adequacy of the safety basis for a new nuclear facility."

9.2.1.2 Scenario Development

Accident scenarios have been provided in sufficient detail to support the evaluation of source terms used in the calculations.

9.2.1.3 Source Term Analysis

For radiological accident scenarios, source terms are calculated based on the method described in DOE-HDBK-3010-94. This calculation requires quantification of

MAR, Damage Ratio (DR), Airborne Release Fraction (ARF) or Airborne Release Rate (ARR), Respirable Fraction (RF), and Leakpath Factor (LPF) and is given as:

Source Term = MAR x DR x ARF x RF x LPF.

With the exception of the beyond design basis criticality accident, the estimates of MAR for each accident evaluated in this PSAR are based on a WVDP-specific spent nuclear fuel distribution of radionuclides that includes over 80 different radionuclides (WVDP-186). For each accident, the potential accident source term is calculated for all radionuclides, with due consideration for the atmospheric release fractions that are specific to each radionuclide type (i.e., non-volatile, semi-volatile, and volatile). From this list, only those radionuclides that contribute greater than 0.1% of the total effective dose equivalent are shown in the accident summary tables (Tables 9.2-1 through 9.2-6).

9.2.1.4 Consequence Analysis

Consequences of radiological accidents in this PSAR are calculated for both on-site and off-site individuals. Consequences are calculated for several meteorological conditions: Stability class "D", wind speed 4.5 m/s; Stability class "F", wind speed 1 m/s; and site-specific 95% meteorology. On-site doses are calculated at the OEP, located 640 m (2100 ft)from the center of the accident release. Dose to off-site individuals is calculated at the nearest site boundary from the RHWF stack (850 m [2790 ft]), and at the distance producing maximum exposure for site-specific 95% meteorology, namely 2100 m (6890 ft) for a ground level release.

9.2.1.5 Comparison to Guidelines

Guidelines used for the comparison to accident analysis consequences are given in Section 9.1.3. Guidelines for radiological consequences due to operating and natural phenomena accidents are provided. The maximum acceptable consequences for radiological accidents are given in Figures 9.1-2 and 9.1-3. For the purposes of evaluation of USQs, the evaluation guidelines present the authorization basis risk for activities conducted in conjunction with operation of the RHWF, including on-site transfer of wastes to and from the RHWF.

9.2.2 Design Basis Accidents

Operational accidents are those events having internal initiators, such as fires, explosions, spills, or criticality. Consequences of these accidents are evaluated against guidelines given in Section 9.1.3 based on the probability of occurrence.

9.2.2.1 Ventilation System Filter Failure

9.2.2.1.1 Scenario Development

The contaminated area ventilation system includes 24 cylindrical pre-filters installed under the portable work stations in the Work Cell. The location of these pre-filters provides a local downdraft of air near the work stations for the purpose of contamination control. The accident scenario assumes that the radionuclide loading on the 24 pre-filters is such that the radiation exposure rate is 15 R/hr at 15 cm (6 inches) from all filters. The analyzed exposure rate was selected based upon operating experience in similar facilities at the WVDP. Simultaneous mechanical failure of all 24 pre-filters is assumed (i.e., the damage ratio [DR] is equal to 1), though it is considered an extremely unlikely event. No credit is taken for the additional ventilation controls downstream of these pre-filters (e.g., HEPA filters in the 2 trains in the Exhaust Ventilation Filter Area). For this reason, the LPF is equal to 1. For conservatism, the ventilation fans are assumed to continue to operate.

9.2.2.1.2 Source Term Analysis

The estimation of the MAR on each HEPA filter is based on a dose-to-curie calculation using MicroShield v. 4.00. The filter face is modeled as a 51 cm (20 inches) diameter circular source. The dose rate is assumed to be attributable solely to cesium-137 and is measured at a distance of 15 cm (6 inches) from the face of the filter. The quantity of all other radionuclides is based on scaling factors derived from an Nuclear Fuel Services (NFS) average spent nuclear fuel distribution of radionuclides decayed to the year 2003, the anticipated start of operations. The RF is set equal to 1. The bounding airborne release fraction of 5E-04 for HEPA filters under conditions of mechanical failure is taken from DOE-HDBK-3010-94.

9.2.2.1.3 Consequence Analysis

Table 9.2-1 presents the dose at the on-site evaluation point and to the maximally exposed off-site individual from the simultaneous failure of all 24 Work Cell HEPA filter assemblies. The maximum TEDE at the on-site evaluation point has been calculated to be 0.93 rem (0.0093 Sv), as shown in Table 9.2-1. The maximum TEDE received by an off-site individual has been calculated to be 0.56 rem (0.0056 Sv).

9.2.2.1.4 Comparison to Guidelines

Section 9.1.3 defines the means by which safety assurance is shown by providing numerical criteria against which to judge the results of the accident analyses. The dose to the receptor at the on-site evaluation point (0.93 rem [0.0093 Sv]), and the dose to the maximally exposed off-site individual (0.56 rem [0.0056 Sv]), due to simultaneous mechanical failure of the 24 HEPA filter assemblies in the Work Cell are below the radiological dose acceptance criteria specified in Section 9.1.3 for this extremely unlikely event.

9.2.2.2 Waste Container Lift Failure in CPC WSA

9.2.2.2.1 Scenario Development

Each of the 22 boxes of waste in the CPC WSA must be lifted onto a transfer vehicle for transfer to the RHWF Receiving Area. This accident scenario assumes that the box containing the 3C-2 dissolver vessel structurally fails during the lift, allowing the dissolver to free fall onto the top of the second dissolver, 3C-1, which is assumed to contain an equal quantity of radioactivity. This accident is considered an anticipated event.

9.2.2.2.2 Source Term Analysis

As described in Table B.7.7-4 of WVNS-SAR-002, the 3C-2 dissolver box contains the largest inventory (35.7 Ci Cs-137) of radioactivity among the 22 waste storage boxes that were generated from CPC decontamination efforts (i.e., jumpers, condensers, tanks, dissolvers, evaporators, and metallic debris). Though the 3C-1 dissolver box is estimated to contain a somewhat smaller quantity of radioactive material [32.9 Ci Cs-137], for the purpose of this analysis, the 3C-1 dissolver box is assumed to contain as much radioactivity as the 3C-2 dissolver box. Section 4.4.3.3.2 of DOE-STD-3010-94, "Large Falling Object Impact," describes a bounding ARF and RF for this type of accident as 1E-03 and 0.1. The damage ratio and leakpath factor are assigned a value of 1.

9.2.2.2.3 Consequence Analysis

Table 9.2-2 presents the dose at the on-site evaluation point and to the maximally exposed off-site individual from the fall of dissolver 3C-2 onto an unyielding surface. When the doses shown in Table 9.2-3 are doubled to account for the dispersion of radioactive material in dissolver box 3C-1 in addition to that in 3C-2, the maximum TEDE at the on-site evaluation point is calculated to be 1.5E-01 rem (1.5E-03 Sv). The maximum TEDE received by an off-site individual is calculated to be 8.8E-02 rem (8.8E-04 Sv).

9.2.2.2.4 Comparison to Guidelines

Section 9.1.3 defines the means by which safety assurance is shown by providing numerical criteria against which to judge the results of the accident analyses. The dose to the receptor at the on-site evaluation point (1.5E-01 rem [1.5E-03 Sv]) and the dose to the maximally exposed off-site individual (8.8E-02 rem [8.8E-04 Sv]) due to failure during the lift of dissolver 3C-2 are below the radiological dose acceptance criteria specified in Section 9.1.3 for this anticipated event.

9.2.2.3 Fire in Load Out/Truck Bay Area

9.2.2.3.1 Scenario Development

A hydrocarbon fuel pool fire (e.g. diesel fuel) is postulated to occur in the Load Out/Truck Bay area as a result of a leak in the fuel tank or fuel line of a truck. Consistent with the development of an "unmitigated" accident scenario (as discussed in DOE-STD-1027-92), no credit is taken for any fire suppression systems or capabilities. The fire is assumed to fail all the waste containers located within the pool fire, and "thermally stress" the contents of the containers. It is noted that WHC-SD-SQA-ANAL-501, *Fire Protection Guide for Waste Drum Storage Arrays*, documents the results of several fire tests involving 55 gal drums. The tests show that drums engulfed in a diesel fuel pool fire are very likely to experience lid loss in a relatively short time frame. "The time to lid loss in the HAI [Hughes Associates, Inc.] tests ranged from 70 to 145 seconds, which was more rapid than the fastest lid loss measured in previous studies." In the rack storage array test, extensive drum and rack damage occurred within the confines of the pool fire, and lid failures were experienced on all tiers of the rack within the pool area. The subject study also states that "Typical ventilation devices, such as vent clips or carbon filters (e.g., Nucfil), are ineffective at relieving fire induced internal drum pressures and, therefore, have no consequence to the analysis."

9.2.2.3.2 Source Term Analysis

The contents of the 22 waste storage boxes that were generated from CPC decontamination efforts (i.e., jumpers, condensers, tanks, dissolvers, evaporators, and metallic debris) are one of the major waste streams to be processed through the RHWF. The boxes are currently stored at the CPC WSA. Select radiological characteristics of the contents of these boxes are presented in Table B.7.7-4 of WVNS-SAR-002, *Safety Analysis Report for Low-Level Waste Processing and Support Activities*. For purposes of developing a source term, it is assumed that the items in the 22 waste storage boxes are processed (e.g., cut into smaller pieces) and packaged into new waste containers with no decontamination efforts, and that these waste containers are subsequently located in the Load Out/Truck Bay area. It is recognized that the likelihood of this radiological "material at risk" scenario in the Load Out/Truck Bay area is extremely small since decontamination efforts likely will be made, and dozens of waste containers will be generated by the processing of the items in the 22 waste storage boxes. However, for reasons previously stated, this extremely conservative assumption is made, as is the assumption that all of the waste containers are within the boundaries of the fuel fire.

As described in Section 9.2.2.2.2, Table B.7.7-4 of WVNS-SAR-002 shows that the 1986 Cs-137 activity in the 22 waste storage boxes is 274 curies. For the purpose of this PSAR, this inventory is decayed to the year 2003, the anticipated start of operations. The quantity of other radionuclides in the boxes is adopted from a spent nuclear fuel distribution represented in *Estimation of Activity in the Former Nuclear Fuel Services Reprocessing Plant* (Wolniewicz, 1993). The release of radionuclides to the environment occurs via airborne transport assuming ARF and RF values given in Section 5.3.1 of DOE-HDBK-3010-94 for thermal stress of metal and other noncombustible surfaces. For non-volatile radionuclides, bounding values of 6E-03 for the ARF and 1E-02 for the RF are used. For semi-volatile elements and volatile elements (cesium, carbon, hydrogen, iodine, rhodium, ruthenium, and technetium), section 4.3.1.3.3 of DOE-HDBK-3010-94 provides atmospheric release fractions "...in line with the maximum temperatures anticipated under industrial fire conditions...". These are 0.06 for cesium (which also represents other semivolatile elements) and 0.79 for iodine.

9.2.2.3.3 Consequence Analysis

Table 9.2-3 presents the dose at the on-site evaluation point and to the maximally exposed off-site individual from a fire in the Load Out/Truck Bay area for various meteorological conditions. The maximum TEDE at the on-site evaluation point is 0.51 rem (0.0051 Sv), while the maximum TEDE received by an off-site individual is 0.31 rem (0.0031 Sv).

9.2.2.3.4 Comparison to Guidelines

Evaluation guidelines for manmade accidents are presented in Section 9.1.3. The dose to the receptor at the on-site evaluation point (0.51 rem [0.0051 Sv]) and the dose to the maximally exposed off-site individual (0.31 rem [0.0031 Sv]) due to a fire in the Load Out/Truck Bay area are below the radiological dose acceptance criteria specified in Section 9.1.3 for this extremely unlikely event.

9.2.3 Beyond Design Basis Accidents

DOE 5480.23 requires the evaluation of accidents beyond the design basis to provide a perspective of the residual risk associated with the operation of the facility. These beyond DBAs are not required to provide assurance of public health and safety. Rather, the analysis of beyond DBAs is intended solely to provide information that can be used to identify additional facility features that could prevent or reduce severe beyond DBA consequences. As a result, no comparison to the evaluation guidelines is presented in this section.

9.2.3.1 Beyond Design Basis Seismic Event

The design basis for the confinement structures of the RHWF will be an acceleration of 0.1 g at ground level (horizontal loads). Dames & Moore (Dames & Moore, 1995) has shown that for the important oscillator periods between 0.1 and 1.0 second, the annual probabilities of exceedance for the WVDP DBE are lower than 1E-3. The probability of 1E-3 is the hazard exceedance probability specified for Performance Category 2 facilities in DOE-STD-1020-94.

9.2.3.1.1 Scenario Development

A beyond design basis seismic event is assumed to result in sufficient damage to the confinement structures of the RHWF that confinement of radioactive materials is compromised. In addition, such an event is assumed to result in damage to waste packages that are staged for processing, wastes undergoing processing and processed wastes temporarily stored in the facility.

9.2.3.1.2 Source Term Analysis

The material-at-risk during the beyond design basis seismic event is assumed to be the entire contents of the 22 boxes stored inside the shield module perimeter of the CPC/WSA (see section 9.2.2.4.2). An atmospheric release fraction (ARF) of 1E-3 is chosen as a bounding value for the scenario in which the RHWF confinement structure collapses, resulting in substantial waste package damage and turbulent air flow over exposed contaminated surfaces. The leakpath factor, damage ratio, and respirable fraction are all assumed to be equal to 1.

9.2.3.1.3 Consequence Analysis

Table 9.2-4 presents the dose at the on-site evaluation point and to the maximally exposed off-site individual from a beyond design basis seismic event for various meteorological conditions. The maximum TEDE at the on-site evaluation point is 5.6 rem (0.056 Sv), while the maximum TEDE received by an off-site individual is 3.4 rem (0.034 Sv).

9.2.3.2 Inadvertent Criticality in the Work Cell Washdown Receiving Tank

The probability of a criticality accident in the RHWF is incredible ($p < 1E-6$) because preventive features and safety margins will be incorporated into the facility design and operating procedures in accordance with the WVDP Nuclear

Criticality Safety Program (WVDP-162). Because of the physical and chemical form of the fissionable materials that will be handled in the RHWF, the majority of the fissionable mass will remain with the contaminated items being processed and be removed from the facility in the waste packages. However, because of small uncertainties associated with the extent of fissionable material that may be captured in the liquid waste collection system, measures will be taken to ensure that double contingency, as discussed in DOE Order 420.1, will be achieved with respect to the RHWF liquid waste collection and transfer system. The final design of the RHWF will incorporate sufficient factors of safety to require at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible. In addition to the known physical and chemical characteristics of the wastes, measures will be taken to ensure that criticality is not a credible event. Some of these measures will include: geometrically safe trenches, floor drains, and piping; fine mesh particulate filters on all floor drains; bottom draining liquid waste tanks; and periodic sampling of liquid waste tank contents. Characterization information from the waste forms may also be employed to ensure critically-safe washdown activities.

The RHWF FSAR will demonstrate double contingency is satisfied in relation to the RHWF liquid waste collection and transfer system, and that a criticality accident is not credible in relation to the RHWF liquid waste collection and transfer system.

This accident, however, assumes failure of the nuclear criticality safety controls on the Work Cell Washdown Receiving Tank (WCWRT), a vessel in which fissile materials may accumulate if the liquid waste is not properly managed.

9.2.3.2.1 Scenario Development

The WCWRT is a 5678 liter (1,500 gal) cylindrical tank located in the Tank Vault below the Contact Maintenance Area. The tank is 1.5 m (5 ft) in diameter and 3.0 m (10 ft) long and is positioned with its axis nearly parallel to the vault floor (i.e., a slight slope in the tank "bottom" facilitates drainage). Several facility design features are incorporated to prevent fissile solids and minimize soluble fissile material transfer to and accumulation in the tank. As indicated in Section 4.3.4, the final design of the RHWF will incorporate criticality safety features, such as geometrically safe sumps, sump particulate filters, and bottom draining liquid waste tanks. The RHWF liquid waste collection and transfer system is described in Section 7.5.

For the purpose of this accident scenario, it is assumed, however, that a fissile mass accumulates in the WCWRT as a result of a routine Work Cell washdown operation, resulting in a criticality excursion.

9.2.3.2.2 Source Term Analysis

The hazard associated with a criticality excursion is fission gas generation, release and dispersion downwind from the facility. NRC Regulatory Guide 3.33 (NRC, 1977) provides estimates of the source term associated with this hazard. Source terms are listed in Table 9.2-5 for fission gas release.

9.2.3.2.3 Consequence Analysis

Table 9.2-5 presents the dose at the on-site evaluation point and to the maximally exposed off-site individual from a beyond design basis criticality accident that occurs in the WCWRT for various meteorological conditions. The maximum TEDE at the on-site evaluation point is 26 rem (0.26Sv), while the maximum TEDE received by an off-site individual is 16 rem (0.16 Sv).

9.2.3.3 Natural Gas Explosion

9.2.3.3.1 Scenario Development

It is estimated that approximately 57 m^3/hr (2000 ft^3/hr) of natural gas will be needed to heat the RHWF. There will be four external gas lines leading to rooftop or external wall mounted heating units that service the Mechanical Equipment Area, Receiving Area, Load Out/Truck Bay Area, and Office Area. The gas-fired heating chamber inside a given gas heating unit will be isolated from the conditioned air entering the RHWF by a heat exchanger. Hence, physical separation will exist between the natural gas supply and the air entering the RHWF. Design measures will ensure that combustion products (and any uncombusted natural gas) from the combustion chamber are directed away from RHWF air supply intakes. Natural gas will rise when released, because natural gas has a (typical) specific gravity of 0.6.

The composition of natural gas is not a constant, though methane (CH_4) is clearly the dominant component of natural gas. By volume, natural gas is (typically) composed of methane (94.8%), ethane (2.9%), propane (0.8%), butane (0.2%), carbon dioxide (0.1%), and nitrogen (1.2%). Natural gas has a lower explosive limit (LEL) of about 4% and an upper explosive limit (UEL) of 14%. In its pure state, natural gas is odorless, colorless, and tasteless. For safety reasons, mercaptan is added to commercial natural gas to give it a highly pungent odor.

For a natural gas explosion to occur in the RHWF, the following events would all need to occur: (1) There is a demand for natural gas; (2) The pilot ignition source fails to ignite; (3) The gas supply valve fails such that lack of ignition source allows the valve to open; (4) The heat exchanger has a leak of meaningful size, with a location and configuration such that natural gas is drawn into the air stream entering the RHWF at a concentration greater than the LEL; (5) The natural diffusion of natural gas into the atmosphere within the RHWF, and subsequent escape from within the facility via openings, cracks, vents, and door leakage, fails to reduce the concentration to below the LEL within the facility; and (6) An ignition source is present in the gas-air mixture that remains above the LEL.

The following accident scenario frequency estimate does not credit any active preventive features or detection capabilities (some of which are discussed above), such as thermocouple controlled gas supply valve, automatic (temperature interlock based) shutdown of the air supply blower motor, RHWF ventilation system gas mixing and removal effects, or detection of a gas leak by RHWF personnel based on the smelling of natural gas or the feeling of inadequate heating. Point estimates, based on engineering judgment, are 0.07/yr for pilot ignition failure (which includes the fact that there will be a "demand" for gas of about 0.7 of a given year), and conditional probabilities of 1.0E-04 for a heat exchanger breach of the necessary size, shape, and location, and 0.1 for failure to reduce the natural gas concentration below the LEL by diffusion and escape from the facility, and 0.1 for an ignition source being present within the (at least LEL) gas mixture. It should be noted that the energy required to ignite a flammable gas-air mixture is relatively small when the gas-air mixture is at or near stoichiometric concentrations; the necessary energy increases rapidly as the gas-air mixture moves toward the upper or lower flammable limits. The resulting annual frequency estimate is 7E-08/yr.

Occurrence Reports (ORs) contained in DOE's Occurrence Report and Processing System (ORPS) were reviewed for natural gas related events. Based on this review, it can be stated that most natural gas accidents occur outside of facilities/buildings and involve the breaking of a natural gas line by a backhoe, auger, bulldozer, or hand tools during construction or "trenching" activities. A few ORs document human error within a building as the mechanism for a natural gas leak (e.g., a forklift striking an overhead natural gas line, or initiation of gas supply to uncapped lines), while a few other ORs document various failure modes of various pieces of gas system hardware (e.g., valves, unions, elbows, and piping) located within a building. These types of initiators are not applicable to the RHWF since no gas system hardware/components are located in the RHWF. Regarding explosions one OR documented an event that is not pertinent to the RHWF, namely a "small explosion" in a natural gas fueled boiler installed in a mechanical equipment room. ORPS contains ORs accrued over approximately the past 10 years. The results of the review of natural gas related events contained in ORPS are considered to reinforce an extremely small natural gas explosion frequency estimate for the RHWF.

To bound the potential impact to the RHWF from a natural gas explosion event, it is postulated that a stoichiometric mixture of natural gas and air is ignited in the Work Cell. While such a scenario can be hypothesized as presented in the following sentences, it is not a credible scenario. If substantial quantities of natural gas are assumed to be continually entering an outer area of the RHWF (e.g., the Receiving Area), the ventilation system configuration in the RHWF would provide a mechanism for the gas to be swept into the Work Cell. Significant natural gas accumulation in the Work Cell would not be expected to occur because of the ventilation exhaust system that services the Work Cell, and therefore it is generally expected that the LEL for natural gas would never be reached anywhere within the Work Cell. However, some limited accumulation of natural gas in the Work Cell is considered physically possible (since natural gas is much lighter than air), and the Work Cell ventilation exhaust system takes its suction from near the floor of the Work Cell. Hence, for purposes of further developing this hypothetical scenario, it is postulated that an explosive gas-air mixture is reached in the Work Cell, and that an ignition source is encountered. Calculations indicate that an explosion involving a stoichiometric mixture of natural gas and air in the Work Cell would have the blast energy equivalent of about 28 kg (61.6 lbs) of tri-nitro toluene (TNT), and produce an overpressure on the walls and ceiling of the Work Cell of at least 0.28 MPa (40 psi).

9.2.3.3.2 Source Term Analysis

The contents of the 22 waste storage boxes that were generated from the CPC decontamination efforts (i.e., jumpers, condensers, tanks, dissolvers, evaporators, and metallic debris) are one of the major waste streams to be processed through the RHWF. The boxes are currently stored at the CPC WSA. Select radiological characteristics of the contents of these boxes are presented in Table B.7.7-4 of WVNS-SAR-002, *Safety Analysis Report for Low-Level Waste Processing and Support Activities*. For purposes of developing a bounding source term, it is assumed that all of the radioactive material associated with the items in the 22 waste storage boxes is the "material at risk." Given the postulated scenario (i.e., destruction of the RHWF by an explosion), it is considered reasonable to (conservatively) assume that all items within the RHWF are affected, though in reality some items within drums or boxes would likely not be displaced from within their containers. It is recognized that the likelihood of this radiological "material at risk" scenario is extremely small since dozens of waste containers will be generated by the processing of the items in the 22 waste storage boxes, and that it is not likely that this many waste containers will be allowed to accrue in the Load Out/Truck Bay area. However, this PSAR has been developed from conceptual design information that does not include the details as to the quantities of radiological and hazardous material that can be located in a given area of the RHWF.

Table B.7.7-4 of WVNS-SAR-002 shows that the 1986 inventory of Cs-137 in the 22 waste storage boxes is 274 curies. For the purpose of this PSAR, this inventory is decayed to the year 2003, the anticipated start of operations. The quantity of other radionuclides in the boxes is adopted from a spent nuclear fuel distribution represented in *Estimation of Activity in the Former Nuclear Fuel Services Reprocessing Plant* (Wolniewicz, 1993). The release of radionuclides to the environment occurs via airborne transport assuming ARF and RF values provided in DOE-HDBK-3010-94. Section 4.4.2.2.2 of DOE-HDBK-3010-94 states that an "ARF and RF of 5E-03 and 0.3 appear to be conservative for the suspension of powder from a smooth, unyielding surface from the pressure impulse generated (i.e., gas flow parallel to surface) by an explosion. The release phenomena is *(sic)* considered to cover powders shielded from the direct impact of the blast as well." For semi-volatile elements and volatile elements (cesium, carbon, hydrogen, iodine, rhodium, ruthenium, and technetium), section 4.3.1.3.3 of DOE-HDBK-3010-94 provides atmospheric release fractions "...in line with the maximum temperatures anticipated under industrial fire conditions...". The RFs are 0.06 for cesium (which also represents other semivolatile elements) and 0.79 for iodine.

9.2.3.3.3 Consequence Analysis

Table 9.2-6 presents the dose at the on-site evaluation point and to the maximally exposed off-site individual from a natural gas explosion in the RHWF for various meteorological conditions. The maximum TEDE at the on-site evaluation point is 8.6 rem (0.086 Sv), while the maximum TEDE received by an off-site individual is 5.2 rem (0.052 Sv).

9.2.4 <u>Accident Analysis Summary</u>

A summary of the consequences of accident analyses in this PSAR is provided in Table 9.2-7. All accident analyzed are within the evaluation guidelines given in section 9.1.3. The simultaneous mechanical failure of the Work Cell pre-filters results in a total effective dose equivalent to the maximally exposed on-site individual of 0.93 rem (0.0093 Sv) and a total effective dose equivalent to the off-site individual of 0.56 rem (0.0056 Sv). This represents the bounding accident.

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Table 9.1-1
Process Hazards Analysis for the Remote-Handled Waste Facility

HAZARD	EVENT	INITIATOR	PREVENTIVE SYSTEM(S) OR FEATURE(S)	MITIGATIVE SYSTEM(S) OR FEATURE(S)	CONSEQUENCES	FREQUENCY	RISK FACTOR
Receiving Area							
Radioactive Material (Airborne or Otherwise Uncontrolled Release)	Container rupture or leak	1. Forklift drops container or forklift tines rupture container	• Forklift care/maintenance to ensure proper operation • Administrative controls on forklift operation • Containers normally not lifted (i.e., roller system is used)	• Leak confinement design features in RHWF	Low	Unlikely	2
		2. Crane or lift fixture drops container	• Crane designed to conservative criteria and are initially load tested • Administrative control on crane and lift fixture operations	• Leak confinement design features in RHWF • Containers normally not lifted (i.e., rollers are used) • Restrict access to lift area	Low	Unlikely	2
		3. Tornado breaches facility and containers	• Advance warning so operations can be secured • Conservatively designed building superstructure	• None	Low	Extremely Unlikely	1
		4. Strong straight winds	• Conservatively designed building superstructure • Advance warning so materials can be relocated and/or secured	• Leak confinement design features in RHWF	Low	Extremely unlikely	1
		5. Seismic event	• Conservatively designed building superstructure	• Leak confinement design features in RHWF	Low	Unlikely	2

Table 9.1-1 (continued)
Process Hazards Analysis for the Remote-Handled Waste Facility

HAZARD	EVENT	INITIATOR	PREVENTIVE SYSTEM(S) OR FEATURE(S)	MITIGATIVE SYSTEM(S) OR FEATURE(S)	CONSEQUENCES	FREQUENCY	RISK FACTOR
		6. Container rupture or leak from unspecified cause (e.g., container degradation, overpressurization)	• Smear surveys of container to detect contamination • Except as noted in Section 6.1.3.7, overpressurization of containers not considered a hazard	• Leak confinement system in transfer container • Leak confinement design features in RHWF	Low	Unlikely	2
		7. Container pinched by closing shield doors	• Structural strength of containers and waste components • Administrative controls on shield door operation	• Leak confinement design features in RHWF	Low	Unlikely	2
	Fire	8. Spilled container contents ignite	• Administrative controls on amount and type of combustible materials • Administrative controls on hazardous material spill response • Lack of ignition source	• Fire detection systems • Fire suppression systems	Moderate	Extremely unlikely	3
		9. Electrical wiring	• Preventive maintenance on electrical components • Installed electrical components inspected to meet code	• Fire detection systems • Fire suppression systems	Low	Unlikely	2
		10. Vehicle fire/ explosion in Receiving Area	• Preventive maintenance on vehicles • Administrative controls on amount of combustible materials • Administrative controls and procedures for truck operations, proper training, safety culture	• Fire detection systems • Fire suppression systems	Moderate	Extremely unlikely	3

Table 9.1-1 (continued)
Process Hazards Analysis for the Remote-Handled Waste Facility

HAZARD	EVENT	INITIATOR	PREVENTIVE SYSTEM(S) OR FEATURE(S)	MITIGATIVE SYSTEM(S) OR FEATURE(S)	CONSEQUENCES	FREQUENCY	RISK FACTOR
		11. Seismic event	• Administrative controls on amount and type of combustible materials	• Fire detection systems • Fire suppression systems	Moderate	Extremely unlikely	3
	Explosion	12. Explosion from natural gas leading to loss of structural integrity or ventilation system failure	• Air supply heaters indirectly heat air	• Fire detection and suppression systems	Moderate	Extremely unlikely	3
		13. From an unspecified cause leading to loss of structural integrity or ventilation system failure		• Fire detection and suppression systems	Moderate	Extremely unlikely	3
	Water inundation	14. Inadvertent initiation of fire sprinklers or breach in fire water system piping	• Fire water system design to NFPA standards • Preventive maintenance • Operator training and sound conduct of operations to prevent inadvertent damage to fire water piping or sprinkler heads	• Training to respond to emergency and abnormal situations so that water flow is promptly terminated	Low	Unlikely	2
High Radiation Exposure Rate	Under-estimating gamma dose rate	15. Dose survey provides erroneous output or is misread	• Radiation detectors in Receiving Area • Administrative controls in performing dose surveys	• Modular shielding	Low	Unlikely	2

Table 9.1-1 (continued)
Process Hazards Analysis for the Remote-Handled Waste Facility

HAZARD	EVENT	INITIATOR	PREVENTIVE SYSTEM(S) OR FEATURE(S)	MITIGATIVE SYSTEM(S) OR FEATURE(S)	CONSEQUENCES	FREQUENCY	RISK FACTOR
Fissionable Material	Criticality	16. Configuration of fissile materials within the waste changes, or moderating materials such as water intrude	• Pre-processing waste characterization and process knowledge prior to receipt at the RHWF • Criticality safety evaluations and criticality prevention specifications • Cover waste containers during transfer to prevent water intrusion	• None	Moderate	Incredible	I
Hazardous Metals (e.g., Pb, Hg, and U)	Fire	17. Spilled container contents ignite	• Administrative controls on amount and type of combustible materials • Administrative controls on hazardous material spill response • Lack of ignition source	• Fire detection systems • Fire suppression systems	Low	Extremely unlikely	1
		18. Electrical wiring	• Preventive maintenance on electrical components • Installed electrical components inspected to meet code	• Fire detection systems • Fire suppression systems	Low	Unlikely	2
		19. Vehicle fire/ explosion in Receiving Area	• Preventive maintenance on vehicles • Administrative controls on amount of combustible materials • Administrative controls and procedures for truck operations, proper training, safety culture	• Fire detection systems • Fire suppression systems	Low	Extremely unlikely	1

Table 9.1-1 (continued)
Process Hazards Analysis for the Remote-Handled Waste Facility

HAZARD	EVENT	INITIATOR	PREVENTIVE SYSTEM(S) OR FEATURE(S)	MITIGATIVE SYSTEM(S) OR FEATURE(S)	CONSEQUENCES	FREQUENCY	RISK FACTOR
		20. Seismic event	• Administrative controls on amount and type of combustible materials	• Fire detection systems • Fire suppression systems	Low	Extremely unlikely	1
Buffer Cell							
Radioactive Material (Airborne or Otherwise Uncontrolled Release)	Container rupture or leak	1. Mishap with powered roller conveyer system breaches container	• System care/maintenance to ensure proper operation • Administrative controls and procedures for system operations, proper training, safety culture	• Leak confinement design features in RHWF	Low	Unlikely	2
		2. Crane or lift fixture drops container	• Crane designed to conservative criteria and are initially load tested • Administrative control on crane and lift fixture operations	• Leak confinement design features in RHWF • Containers normally not lifted (i.e., rollers are used) • Restrict access to lift area	Low	Unlikely	2
		3. Tornado breaches facility and containers	• Formidable structure • Advance warning so operations can be secured	• None	Low	Extremely unlikely	1
		4. Strong straight winds	• Formidable structure • Advance warning so materials can be relocated and/or secured	• Leak confinement design features in RHWF	Low	Extremely unlikely	1
		5. Seismic event	• Formidable structure	• Leak confinement design features in RHWF	Low	Unlikely	2

Table 9.1-1 (continued)
Process Hazards Analysis for the Remote-Handled Waste Facility

HAZARD	EVENT	INITIATOR	PREVENTIVE SYSTEM(S) OR FEATURE(S)	MITIGATIVE SYSTEM(S) OR FEATURE(S)	CONSEQUENCES	FREQUENCY	RISK FACTOR
		6. Container rupture or leak from unspecified cause (e.g., container degradation, overpressurization)	• Smear surveys of container to detect contamination • Except as noted in Section 6.1.3.7, overpressurization of containers not considered a hazard	• Liquid collection system in Buffer Cell • Leak confinement design features once in RHWF	Low	Unlikely	2
		7. Container pinched by closing shield doors	• Structural strength of containers • Administrative controls on shield door operation	• Leak confinement design features in RHWF	Low	Unlikely	2
	Fire	8. Spilled container contents ignite	• Administrative controls on amount and type of combustible materials • Administrative controls on hazardous material spill response • Lack of ignition source	• Fire detection systems	Moderate	Extremely unlikely	3
		9. Electrical wiring	• Preventive maintenance on electrical components • Installed electrical components inspected to meet code	• Fire detection systems	Low	Unlikely	2
		10. Vehicle fire/ explosion in Receiving Area that affects Buffer Cell contents	• Preventive maintenance on vehicles • Administrative controls on amount of combustible materials • Administrative controls and procedures for truck operations, proper training, safety culture	• Fire detection systems • Fire suppression systems	Moderate	Extremely unlikely	3
		11. Seismic event	• Administrative controls on amount of combustible materials	• Fire detection systems	Moderate	Extremely unlikely	3

Table 9.1-1 (continued)
Process Hazards Analysis for the Remote-Handled Waste Facility

HAZARD	EVENT	INITIATOR	PREVENTIVE SYSTEM(S) OR FEATURE(S)	MITIGATIVE SYSTEM(S) OR FEATURE(S)	CONSEQUENCES	FREQUENCY	RISK FACTOR
	Explosion	12. Explosion from natural gas or an unspecified cause leading to loss of structural integrity or ventilation system failure	• Proper training to identify potential situations where adverse chemical reactions might occur • Vent vessels and containers to extent practicable prior to processing operations	• Fire detection and suppression systems	Moderate	Extremely unlikely	3
High Radiation Exposure Rate	Under-estimating gamma dose rate	13. Dose survey provides erroneous output or is misread	• Radiation detectors in Receiving Area, Buffer Cell, and Operating Aisles • Administrative controls in performing dose surveys • In-process surveys of waste in Work Cell • Dose rate surveys in Buffer Cell before removing waste from shielded area	• Modular, portable shield walls in RHWF	Low	Unlikely	2
Fissionable Material	Criti-cality	14. Configuration of fissile materials within the waste changes, or moderating materials such as water intrude	• Pre-processing waste characterization and process knowledge prior to receipt at the RHWF • Criticality safety evaluations and criticality prevention specifications • Geometry control	• None	Moderate	Incredible	I

Table 9.1-1 (continued)
Process Hazards Analysis for the Remote-Handled Waste Facility

HAZARD	EVENT	INITIATOR	PREVENTIVE SYSTEM(S) OR FEATURE(S)	MITIGATIVE SYSTEM(S) OR FEATURE(S)	CONSEQUENCES	FREQUENCY	RISK FACTOR
Hazardous Metals (e.g., Pb, Hg, and U)	Fire	15. Spilled container contents ignite	• Administrative controls on amount and type of combustible materials • Administrative controls on hazardous material spill response • Lack of ignition source	• Fire detection systems	Low	Extremely unlikely	1
		16. Electrical wiring	• Preventive maintenance on electrical components • Installed electrical components inspected to meet code	• Fire detection systems	Low	Unlikely	2
		17. Vehicle fire explosion in Receiving Area that affects Buffer Cell contents	• Preventive maintenance on vehicles • Administrative controls on amount of combustible materials • Administrative controls and procedures for truck operations, proper training, safety culture	• Fire detection systems • Fire suppression systems	Low	Extremely unlikely	1
		18. Seismic event	• Administrative controls on amount and type of combustible materials	• Fire detection systems	Low	Extremely unlikely	1

Table 9.1-1 (continued)
Process Hazards Analysis for the Remote-Handled Waste Facility

HAZARD	EVENT	INITIATOR	PREVENTIVE SYSTEM(S) OR FEATURE(S)	MITIGATIVE SYSTEM(S) OR FEATURE(S)	CONSEQUENCES	FREQUENCY	RISK FACTOR
Work Cell							
Radioactive Material (Airborne or Otherwise Uncontrolled Release)	Container Rupture or Leak	1. Bridge crane or jib crane fails during lift, leading to spill of container's contents or breach of container	• Cranes designed to conservative criteria and initially load tested • Administrative controls and procedures for crane operations, proper training, safety culture • Pre-planning of complex lifts	• HEPA filtration of airborne materials • Potential wall or floor impact will not violate integrity of thick concrete walls	Low	Unlikely	2
		2. Mishap with powered conveyers, leading to spill of container's contents or breach of container	• System care/maintenance to ensure proper operation • Administrative controls and procedures for conveyor operations, proper training, safety culture	• HEPA filtration of airborne materials • Potential wall or floor impact will not violate integrity of thick concrete walls	Low	Unlikely	2
		3. Mishap with powered dextrous manipulator, cut-off saw, grinder, shears, or other such equipment leading to spill of container's contents or breach of container	• Administrative controls and procedures for crane/manipulator operations, proper training, safety culture	• HEPA filtration of airborne materials • Potential wall or floor impact will not violate integrity of thick concrete walls	Low	Unlikely	2
		4. Tornado breaches facility and containers	• Formidable structure • Advance warning so operations can be secured	• None	Low	Extremely unlikely	1

Table 9.1-1 (continued)
Process Hazards Analysis for the Remote-Handled Waste Facility

HAZARD	EVENT	INITIATOR	PREVENTIVE SYSTEM(S) OR FEATURE(S)	MITIGATIVE SYSTEM(S) OR FEATURE(S)	CONSEQUENCES	FREQUENCY	RISK FACTOR
		5. Strong straight winds	• Formidable structure • Advance warning so materials can be relocated and/or secured (i.e., close shield doors, close containers, secure ventilation)	• Leak confinement design features in RHWF	Low	Extremely unlikely	1
		6. Seismic event	• Formidable structure	• Leak confinement design features in RHWF	Low	Unlikely	2
		7. Container rupture or leak from unspecified cause (e.g., container degradation, overpressurization)	• Smear surveys of container to detect contamination • Except as noted in Section 6.1.3.7, overpressurization of containers not considered a hazard	• Leak confinement system in transfer container • Leak confinement design features in RHWF	Low	Unlikely	2
		8. Loss of confinement from Work Cell Liner, floors, sumps and Work Cell floor drains from unspecified cause (e.g., dropped load; corrosion; cut with saw)	• Administrative controls and procedures for operations, proper training, safety culture • Periodic visual inspection of confinement structures	• Leak confinement design features in RHWF • Leak detection capabilities under RHWF	Low	Extremely unlikely	1
		9. Container pinched by closing shield doors	• Structural strength of containers and waste components • Administrative controls on shield door operation	• Leak confinement design features in RHWF	Low	Unlikely	2

Table 9.1-1 (continued)
Process Hazards Analysis for the Remote-Handled Waste Facility

HAZARD	EVENT	INITIATOR	PREVENTIVE SYSTEM(S) OR FEATURE(S)	MITIGATIVE SYSTEM(S) OR FEATURE(S)	CONSEQUENCES	FREQUENCY	RISK FACTOR
	Airborne Dispersal of Radio-activity	10. Mishap with decontamination system, such as pelletized CO_2 system, spreads contaminated material throughout Work Cell	• Administrative controls and procedures for crane operations, proper training, safety culture • Cell coverage of decontamination system is limited by design	• HEPA filtration of airborne materials • Leak confinement design features in RHWF	Low	Unlikely	2
	Chemical reaction	11. Container lid removal process triggers chemical reaction that has significant energetics (i.e., displaces waste material throughout Work Cell)	• Proper training to identify potential situations where adverse chemical reactions might occur • Process knowledge prior to receipt at the RHWF	• HEPA filtration of airborne materials • Potential impact will not violate integrity of thick concrete walls, floor or ceiling	Low	Extremely unlikely	1
	Fire	12. Ignition of combustible waste by size reduction equipment (e.g., sparks or hot metal particles from grinding, sawing)	• Proper training to identify potential situations where adverse chemical reactions might occur • Administrative controls on amount of combustible materials	• HEPA filtration of airborne materials • Fire detection and manual suppression systems	Low	Unlikely	2

Table 9.1-1 (continued)
Process Hazards Analysis for the Remote-Handled Waste Facility

HAZARD	EVENT	INITIATOR	PREVENTIVE SYSTEM(S) OR FEATURE(S)	MITIGATIVE SYSTEM(S) OR FEATURE(S)	CONSEQUENCES	FREQUENCY	RISK FACTOR
		13. Flammable gases contained in waste containers or vessels ignited by size reduction equipment	• Proper training to identify potential situations where adverse chemical reactions might occur • Process knowledge prior to the receipt at the RHWF • Vent vessels and containers to extent practicable prior to performing size reduction operations	• HEPA filtration of airborne materials • Fire detection and manual suppression systems	Low	Extremely unlikely	1
		14. Spilled hydraulic fluid ignites	• Material selection during design (i.e., use of materials with minimum flammability) • Administrative controls on spill response	• HEPA filtration of airborne materials • Fire detection and manual suppression systems	Low	Extremely unlikely	1
		15. Electrical components ignite	• Preventive maintenance on electrical components • Electrical components meet electrical wiring codes, as appropriate • Administrative controls on amount of combustible materials • Electrical components inside the Work Cell are totally enclosed	• HEPA filtration of airborne materials • Fire detection and manual suppression systems	Low	Extremely unlikely	1

Table 9.1-1 (continued)
Process Hazards Analysis for the Remote-Handled Waste Facility

HAZARD	EVENT	INITIATOR	PREVENTIVE SYSTEM(S) OR FEATURE(S)	MITIGATIVE SYSTEM(S) OR FEATURE(S)	CONSEQUENCES	FREQUENCY	RISK FACTOR
		16. Pyrophoric materials ignite	• Proper training to identify potential situations where adverse chemical reactions might occur • Process knowledge prior to the receipt at the RHWF • Use low temperature cutting tools whenever possible • Administrative controls on amount of combustible materials	• HEPA filtration of airborne materials • Fire detection and manual suppression systems	Low	Extremely unlikely	1
		17. Seismic event	• Administrative controls on amount of combustible materials	• Fire detection and manual suppression systems	Moderate	Extremely unlikely	3
	Explosion	18. An explosion from natural gas or unspecified cause leading to loss of Zone 1 integrity (structural or ventilation filtration system)	• Vent vessels and containers to extent practicable prior to performing size reduction operations • Use low temperature cutting tools whenever possible • Air supply heaters indirectly heat air	• Fire detection and manual suppression systems	Moderate	Extremely unlikely	3
	HEPA filter failure	19. HEPA filters in exhaust pathway fail (random failure, chemical attack, pressure transient, overloading, load dropped on them, wetted)	• Spare HEPA filter train, with each train having redundant HEPA filters • HEPA filter differential pressure monitored and alarmed • Emissions monitoring • Administrative controls of operation of HVAC system • Periodic in-place leak testing of HEPA filters outside of the Work Cell	• Design of HEPA filters facilitates retainment of particulate matter	Moderate	Extremely unlikely	3

Table 9.1-1 (continued)
Process Hazards Analysis for the Remote-Handled Waste Facility

HAZARD	EVENT	INITIATOR	PREVENTIVE SYSTEM(S) OR FEATURE(S)	MITIGATIVE SYSTEM(S) OR FEATURE(S)	CONSEQUENCES	FREQUENCY	RISK FACTOR
Fissionable Material	Criti-cality	20. Configuration of fissile materials within the waste changes, or moderating materials such as water intrude	• Criticality safety evaluations and criticality prevention specifications • Pre-processing characterization surveys and process knowledge and radiation surveys after receipt at the RHWF • In-process characterization • Geometry control		Moderate	Incredible	I
	Criti-cality	21. Fissile material accumulates in facility systems (e.g., HEPA filters, sumps)	• Criticality safety evaluations and criticality prevention specifications • Sumps protected with filters • Source capture systems used during cutting to minimize dispersion of contamination • Administrative controls on cleanup of cell debris • In-cell pre-filters periodically replaced • Geometry control		Moderate	Incredible	IE
Hazardous Metals (e.g., Pb, Hg, and U)	Fire	22. Ignition of combustible waste by size reduction equipment (e.g., sparks or hot metal particles from grinding, sawing)	• Proper training to identify potential situations where adverse chemical reactions might occur • Administrative controls on amount of combustible materials	• HEPA filtration of airborne materials • Fire detection and manual suppression systems	Low	Unlikely	2

Table 9.1-1 (continued)
Process Hazards Analysis for the Remote-Handled Waste Facility

HAZARD	EVENT	INITIATOR	PREVENTIVE SYSTEM(S) OR FEATURE(S)	MITIGATIVE SYSTEM(S) OR FEATURE(S)	CONSEQUENCES	FREQUENCY	RISK FACTOR
		23. Flammable gases contained in waste containers or vessels ignited by size reduction equipment	• Proper training to identify potential situations where adverse chemical reactions might occur • Process knowledge prior to the receipt at the RHWF • Vent vessels and containers to extent practicable prior to performing size reduction operations	• HEPA filtration of airborne materials • Fire detection and manual suppression systems	Low	Extremely unlikely	1
		24. Spilled hydraulic fluid ignites	• Material selection during design (i.e., use of materials with minimum flammability) • Administrative controls on spill response	• HEPA filtration of airborne materials • Fire detection and manual suppression systems	Low	Extremely unlikely	1
		25. Electrical components ignite	• Preventive maintenance on electrical components • Electrical components meet electrical wiring codes, as appropriate • Administrative controls on amount of combustible materials • Electrical components inside the Work Cell are totally enclosed	• HEPA filtration of airborne materials • Fire detection and manual suppression systems	Low	Extremely unlikely	1

Table 9.1-1 (continued)
Process Hazards Analysis for the Remote-Handled Waste Facility

HAZARD	EVENT	INITIATOR	PREVENTIVE SYSTEM(S) OR FEATURE(S)	MITIGATIVE SYSTEM(S) OR FEATURE(S)	CONSEQUENCES	FREQUENCY	RISK FACTOR
		26. Pyrophoric materials ignite	• Proper training to identify potential situations where adverse chemical reactions might occur • Process knowledge prior to the receipt at the RHWF • Use low temperature cutting tools whenever possible • Administrative controls on amount of combustible materials	• HEPA filtration of airborne materials • Fire detection and manual suppression systems	Low	Extremely unlikely	1
		27. Seismic event	• Administrative controls on amount of combustible materials	• Fire detection and manual suppression systems	Low	Extremely unlikely	1
Contact Maintenance Area							
High Radiation Exposure Rate	Under-estimating gamma dose rate	1. Dose survey provides erroneous output or is misread	• Radiation detectors in Contact Maintenance Area • Administrative controls in performing dose surveys • In-process surveys of waste in Work Cell • Dose rate surveys in Contact Maintenance Area before removing waste from shielded area	• Modular, portable shield walls in RHWF	Low	Unlikely	2
Load Out/Truck Bay							
Radioactive Material (Airborne or Otherwise Uncontrolled Release)	Container Rupture or Leak	1. Forklift drops container or forklift tines rupture container	• Forklift care/maintenance to ensure proper operation • Administrative controls on forklift operation	• Leak confinement design features in RHWF	Low	Unlikely	2

Table 9.1-1 (continued)
Process Hazards Analysis for the Remote-Handled Waste Facility

HAZARD	EVENT	INITIATOR	PREVENTIVE SYSTEM(S) OR FEATURE(S)	MITIGATIVE SYSTEM(S) OR FEATURE(S)	CONSEQUENCES	FREQUENCY	RISK FACTOR
		2. Crane or lift fixture drops container (note: possible future installation of crane)	• Crane designed to conservative criteria and are initially load tested • Administrative control on crane and lift fixture operations	• Leak confinement design features in RHWF • Restrict access to lift area	Low	Unlikely	2
		3. Tornado breaches facility and containers	• Advance warning so operations can be secured • Formidable container designs	• None	Low	Extremely unlikely	1
		4. Strong straight winds (e.g. wind-generated missiles)	• Formidable container designs • Advance warning so operations can be secured	• Leak confinement design features in RHWF	Low	Extremely unlikely	1
		5. Seismic event	• Formidable container designs	• Leak confinement design features in RHWF	Low	Unlikely	2
		6. Container rupture or leak from unspecified cause	• Smear surveys of container to detect contamination • New containers will be used for repackaging operations	• Leak confinement design features in RHWF	Low	Unlikely	2
	Fire	7. Spilled container contents ignite	• Administrative controls on amount and type of combustible materials • Administrative controls on hazardous material spill response • Lack of ignition source	• Fire detection systems • Fire suppression systems	Moderate	Extremely unlikely	3

Table 9.1-1 (continued)
Process Hazards Analysis for the Remote-Handled Waste Facility

HAZARD	EVENT	INITIATOR	PREVENTIVE SYSTEM(S) OR FEATURE(S)	MITIGATIVE SYSTEM(S) OR FEATURE(S)	CONSEQUENCES	FREQUENCY	RISK FACTOR
		8. Electrical wiring	• Preventive maintenance on electrical components • Installed electrical components inspected to meet code	• Fire detection systems • Fire suppression systems	Low	Unlikely	2
		9. Vehicle fire/ explosion in Load Out/Truck Bay	• Preventive maintenance on vehicles • Administrative controls on amount of combustible materials • Administrative controls and procedures for truck operations, proper training, safety culture	• Fire detection systems • Fire suppression systems	Moderate	Extremely unlikely	3
		10. Seismic event	• Administrative controls on amount and type of combustible materials	• Fire detection systems • Fire suppression systems	Moderate	Extremely unlikely	3
	Container Over-pressuri-zation	11. Chemical reaction in repackaged waste container	• Operator training on chemical incompatibility • Vents installed on waste containers, as appropriate	• None	Low	Extremely unlikely	1
	Explosion	12. An explosion from natural gas or unspecified cause	• Proper training to identify potential situations where adverse chemical reactions might occur • Vent vessels and containers to extent practicable after repackaging operations	• Fire detection and suppression systems	Moderate	Extremely unlikely	3

Table 9.1-1 (continued)
Process Hazards Analysis for the Remote-Handled Waste Facility

HAZARD	EVENT	INITIATOR	PREVENTIVE SYSTEM(S) OR FEATURE(S)	MITIGATIVE SYSTEM(S) OR FEATURE(S)	CONSEQUENCES	FREQUENCY	RISK FACTOR
	Truck or Forklift Accident	13. Loss of vehicle control	• Routine vehicle maintenance to ensure vehicle operates properly • Administrative controls and procedures for vehicle operations within the facility • Proper training, safety culture	• None	Low	Extremely unlikely	1
		14. Waste container falls off truck or otherwise damaged while loading or unloading	• Routine vehicle maintenance to ensure truck and forklift operates properly • Administrative controls and procedures for forklift operations • Proper training, safety culture • Container tie-downs and shielded transfer container • Formidable waste container designs	• None	Low	Unlikely	2
	Failure of waste transfer system (e.g., bagless transfer system)	15. Mechanical failure	• System care/maintenance to ensure proper operation • Smear surveys of container to detect contamination	• HEPA filtration of airborne materials	Negligible	Anticipated	0
		16. Operator error	• Administrative controls and procedures for system operations, proper training, safety culture	• HEPA filtration of airborne materials	Negligible	Anticipated	0

Table 9.1-1 (continued)
Process Hazards Analysis for the Remote-Handled Waste Facility

HAZARD	EVENT	INITIATOR	PREVENTIVE SYSTEM(S) OR FEATURE(S)	MITIGATIVE SYSTEM(S) OR FEATURE(S)	CONSEQUENCES	FREQUENCY	RISK FACTOR
	Water inundation	17. Inadvertent initiation of fire sprinklers or breach fire water system piping	• Fire water system design to NFPA standards • Preventive maintenance • Operator training and sound conduct of operators to prevent inadvertent damage to fire water piping or sprinkler heads	• Training to respond to emergency and abnormal situations so that water flow is promptly terminated	Negligible	Unlikely	0
Fissionable Material	Criticality	18. Loss of controls	• Pre-processing characterization surveys and process knowledge and radiation surveys after receipt at the RHWF • In-process surveys • Criticality safety evaluations and criticality prevention specifications • Geometry control	• Ventilation removes fission product gases from occupied spaces	Moderate	Incredible	I
High Radiation Exposure Rate	Under-estimating gamma dose rate	19. Dose survey provides erroneous output or is misread	• Radiation detectors in Load Out/Truck Bay Area • Administrative controls in performing dose surveys • In-process surveys • Dose surveys in Waste Packaging Area before removing waste from shielded area	• Shielded boxes and use of transfer shields	Low	Unlikely	2
Hazardous Metals (e.g., Pb, Hg, and U)	Fire	20. Spilled container contents ignite	• Administrative controls on amount and type of combustible materials • Administrative controls on hazardous material spill response • Lack of ignition source	• Fire detection systems • Fire suppression systems	Low	Extremely unlikely	1

Table 9.1-1 (continued)
Process Hazards Analysis for the Remote-Handled Waste Facility

HAZARD	EVENT	INITIATOR	PREVENTIVE SYSTEM(S) OR FEATURE(S)	MITIGATIVE SYSTEM(S) OR FEATURE(S)	CONSEQUENCES	FREQUENCY	RISK FACTOR
		21. Electrical wiring	• Preventive maintenance on electrical components • Installed electrical components inspected to meet code	• Fire detection systems • Fire suppression systems	Low	Unlikely	2
		22. Vehicle fire/ explosion in Load Out/Truck Bay	• Preventive maintenance on vehicles • Administrative controls on amount of combustible materials • Administrative controls and procedures for truck operations, proper training, safety culture	• Fire detection systems • Fire suppression systems	Low	Extremely unlikely	1
		23. Seismic event	• Administrative controls on amount and type of combustible materials	• Fire detection systems • Fire suppression systems	Low	Extremely unlikely	1
External Area							
Radioactive Material (Airborne or Otherwise Uncontrolled Release)	Truck accident	1. Loss of control leads to truck accident while truck en route to RHWF, or truck runs into facility	• Routine vehicle maintenance to ensure truck operates properly • Administrative controls and procedures for truck operations (e.g., speed limitations, inclement weather limitations, established routes, restrictions on other site traffic) • Proper training, safety culture	• Barrier (e.g., jersey barriers)	Moderate	Extremely unlikely	3

Table 9.1-1 (continued)
Process Hazards Analysis for the Remote-Handled Waste Facility

HAZARD	EVENT	INITIATOR	PREVENTIVE SYSTEM(S) OR FEATURE(S)	MITIGATIVE SYSTEM(S) OR FEATURE(S)	CONSEQUENCES	FREQUENCY	RISK FACTOR
		2. Waste container falls during loading operation or falls off truck or otherwise damaged while in transit to or from RHWF	• Administrative controls for heavy lifts • Routine vehicle maintenance to ensure truck operates properly • Administrative controls and procedures for truck operations (e.g., speed limitations, inclement weather limitations, established routes, restrictions on other site traffic) • Proper training, safety culture • Container tie-downs • Shielded transfer containers for some waste types	• Waste enclosed in contamination barrier (i.e., Herculite(tm))	Low	Anticipated	4
	Fire	3. Helicopter crashes into facility	• Air space control limits aircraft overflights	• None	High	Incredible	I
		4. Airplane crashes into facility	• Air space control limits aircraft overflights	• None	High	Incredible	I
		5. Fire at nearby facility or environs	• Engineered features at nearby facilities to prevent fire and prevent spread of fire	• Fire detection systems • Fire suppression systems • Shutdown supply ventilation system to prevent drawing smoke into RHWF	Low	Extremely unlikely	1

Table 9.1-1 (continued)
Process Hazards Analysis for the Remote-Handled Waste Facility

HAZARD	EVENT	INITIATOR	PREVENTIVE SYSTEM(S) OR FEATURE(S)	MITIGATIVE SYSTEM(S) OR FEATURE(S)	CONSEQUENCES	FREQUENCY	RISK FACTOR
		6. Vehicle fire/ explosion	• Preventive maintenance on vehicles • Administrative controls on amount of combustible materials • Administrative controls and procedures for truck operations, proper training, safety culture		Moderate	Extremely unlikely	3
Hazardous Metals (e.g., Pb, Hg, and U)	Fire	7. Helicopter crashes into facility	• Air space control limits aircraft overflights	• None	High	Incredible	I
		8. Airplane crashes into facility	• Air space control limits aircraft overflights	• None	High	Incredible	I
		9. Fire at nearby facility or environs	• Engineered features at nearby facilities to prevent fire and prevent spread of fire	• Fire detection systems • Fire suppression systems • Shutdown supply ventilation system to prevent drawing smoke into RHWF	Low	Extremely unlikely	1
		10. Vehicle fire/ explosion	• Preventive maintenance on vehicles • Administrative controls on amount of combustible materials • Administrative controls and procedures for truck operations, proper training, safety culture		Low	Extremely unlikely	1

TABLE 9.2-1

FAILURE OF RHWF WORK CELL HEPA FILTER ARRAY

Assumptions:

Airborne Release Fraction (ARF)	5.0E-4	Damage Ratio	1.0
Respirable Fraction (RF)	1.0	Leakpath Factor	1.0
Number of Failed In-cell Pre-filters	24	HEPA Exposure Rate	15.0 R/hr
Release Height	0 m	HEPA Activity	2.5 Ci Cs-137

Receptor Location				**640 m**	**640 m**	**640 m**	**850 m**	**850 m**	**2100 m**	
Stability Class, Wind Speed				**D, 4.5 m/s**	**F, 1 m/s**	**95%**	**D, 4.5 m/s**	**F, 1 m/s**	**95%**	
Dispersion (χ/Q)				**5.2E-05 s/m³**	**1.5E-03 s/m³**	**7.3E-04 s/m³**	**3.2E-05 s/m³**	**9.0E-04 s/m³**	**7.2E-04 s/m³**	
		MAR	**Source**							
Nuclide	**2003**	**[Ci]**	**Term**	**[rem]**	**[rem]**	**[rem]**	**[rem]**	**[rem]**	**[rem]**	**Percent of Total**
Pu-238	3.37E+05	3.77E+00	1.89E-03	1.50E-02	4.31E-01	2.10E-01	9.26E-03	2.60E-01	2.08E-01	46.2%
Am-241	1.15E+05	1.29E+00	6.47E-04	5.82E-03	1.67E-01	8.13E-02	3.59E-03	1.01E-01	8.07E-02	17.9%
Pu-239	9.41E+04	1.05E+00	5.27E-04	4.65E-03	1.34E-01	6.50E-02	2.87E-03	8.06E-02	6.45E-02	14.3%
Pu-240	7.16E+04	8.03E-01	4.02E-04	3.54E-03	1.02E-01	4.95E-02	2.19E-03	6.14E-02	4.91E-02	10.9%
Pu-241	2.08E+06	2.34E+01	1.17E-02	2.02E-03	5.81E-02	2.83E-02	1.25E-03	3.50E-02	2.80E-02	6.2%
Sr-90	4.88E+06	5.47E+01	2.74E-02	6.15E-04	1.77E-02	8.60E-03	3.79E-04	1.07E-02	8.53E-03	1.9%
Cm-244	1.04E+04	1.17E-01	5.85E-05	2.73E-04	7.85E-03	3.82E-03	1.69E-04	4.73E-03	3.79E-03	0.8%
Am-243	5.00E+03	5.61E-02	2.81E-05	2.52E-04	7.25E-03	3.53E-03	1.56E-04	4.37E-03	3.50E-03	0.8%
U-232	1.49E+03	1.67E-02	8.37E-06	9.70E-05	2.79E-03	1.36E-03	5.99E-05	1.68E-03	1.34E-03	0.3%
Am-242	7.98E+02	8.95E-03	4.47E-06	4.72E-05	1.36E-03	6.60E-04	2.91E-05	8.18E-04	6.54E-04	0.1%
Th-228	1.50E+03	1.69E-02	8.43E-06	4.52E-05	1.30E-03	6.32E-04	2.79E-05	7.83E-04	6.27E-04	0.1%
Am-242m	8.02E+02	8.99E-03	4.49E-06	3.97E-05	1.14E-03	5.54E-04	2.45E-05	6.87E-04	5.50E-04	0.1%
Cs-137	5.35E+06	6.00E+01	3.00E-02	1.66E-05	4.77E-04	2.32E-04	1.02E-05	2.88E-04	2.30E-04	<0.1%
			Total EDE	**3.2E-02**	**9.3E-01**	**4.5E-01**	**2.0E-02**	**5.6E-01**	**4.5E-01**	**99.7%**

Notes:

[1] - ARF and RF are from DOE-HDBK-3010-94, section 5.4.4.1, pg. 5-33.

[2] - Radioactive loading is based upon a maximum exposure rate of 15 R/h at 6 inches from a HEPA filter housing.

TABLE 9.2-2

LIFT FAILURE OF RH WASTE CONTAINER IN TRANSIT TO RHWF

Assumptions:				
	Airborne Release Fraction (ARF)	1.0E-3	Damage Ratio	1.0
	Respirable Fraction (RF)	0.1	Leakpath Factor	1.0
	Release Height	0 m	Year 2003 Loading in Box 3C-2: 24 Ci Cs-137	

Receptor Location				640 m	640 m	640 m	850 m	850 m	2100 m	
Stability Class, Wind Speed				D, 4.5 m/s	F, 1 m/s	95%	D, 4.5 m/s	F, 1 m/s	95%	
Dispersion (χ/Q)				5.2E-05 s/m³	1.5E-03 s/m³	7.3E-04 s/m³	3.2E-05 s/m³	9.0E-04 s/m³	7.2E-04 s/m³	
		MAR	Source							Percent
Nuclide	2003	[Ci]	Term	[rem]	[rem]	[rem]	[rem]	[rem]	[rem]	of Total
Pu-238	3.37E+05	1.48E+00	1.48E-04	1.18E-03	3.39E-02	1.65E-02	7.28E-04	2.04E-02	1.64E-02	46.2%
Am-241	1.15E+05	5.09E-01	5.09E-05	4.58E-04	1.32E-02	6.40E-03	2.82E-04	7.93E-03	6.34E-03	17.9%
Pu-239	9.41E+04	4.15E-01	4.15E-05	3.66E-04	1.05E-02	5.11E-03	2.26E-04	6.34E-03	5.07E-03	14.3%
Pu-240	7.16E+04	3.16E-01	3.16E-05	2.79E-04	8.01E-03	3.89E-03	1.72E-04	4.83E-03	3.86E-03	10.9%
Pu-241	2.08E+06	9.19E+00	9.19E-04	1.59E-04	4.57E-03	2.22E-03	9.81E-05	2.75E-03	2.20E-03	6.2%
Sr-90	4.88E+06	2.15E+01	2.15E-03	4.84E-05	1.39E-03	6.76E-04	2.98E-05	8.38E-04	6.70E-04	1.9%
Cm-244	1.04E+04	4.60E-02	4.60E-06	2.15E-05	6.17E-04	3.00E-04	1.33E-05	3.72E-04	2.98E-04	0.8%
Am-243	5.00E+03	2.21E-02	2.21E-06	1.98E-05	5.70E-04	2.77E-04	1.22E-05	3.44E-04	2.75E-04	0.8%
U-232	1.49E+03	6.58E-03	6.58E-07	7.63E-06	2.19E-04	1.07E-04	4.71E-06	1.32E-04	1.06E-04	0.3%
Am-242	7.98E+02	3.52E-03	3.52E-07	3.71E-06	1.07E-04	5.19E-05	2.29E-06	6.43E-05	5.14E-05	0.1%
Th-228	1.50E+03	6.63E-03	6.63E-07	3.56E-06	1.02E-04	4.97E-05	2.19E-06	6.16E-05	4.93E-05	0.1%
Am-242m	8.02E+02	3.53E-03	3.53E-07	3.12E-06	8.96E-05	4.36E-05	1.92E-06	5.40E-05	4.32E-05	0.1%
Cs-137	5.35E+06	2.36E+01	2.36E-03	1.31E-06	3.75E-05	1.82E-05	8.05E-07	2.26E-05	1.81E-05	<0.1%
			Total EDE	**2.6E-03**	**7.3E-02**	**3.6E-02**	**1.6E-03**	**4.4E-02**	**3.5E-02**	**99.7%**

Notes:

[1] - ARF and RF are from DOE-HDBK-3010-94, section 5.2.3.2, pg. 5-20.

[2] - Inventory of Box 3C-2 is from WVNS-SAR-002, table B.7.7-4 decayed to 2003.

TABLE 9.2-3

FIRE IN THE LOAD OUT/TRUCK BAY

Assumptions: Non-volatile: Airborne Release Fraction (ARF); 6.0E-3, Release Fraction (RF); 0.01
Semi-volatile: Airborne Release Fraction (ARF); 6.0E-2, Release Fraction (RF); 1.0
Volatile: Airborne Release Fraction (ARF); 7.9E-1, Release Fraction (RF); 1.0
Damage Ratio: 1.0 Leakpath Factor: 1.0
Breathing Rate: 3.33E-04 m^3/s Year 2003 Loading in 22 CPC WSA Boxes: 181 Ci Cs-137
Release Height 0 m

Receptor Location				**640 m**	**640 m**	**640 m**	**850 m**	**850 m**	**2100 m**	
Stability Class, Wind Speed				**D, 4.5 m/s**	**F, 1 m/s**	**95%**	**D, 4.5 m/s**	**F, 1 m/s**	**95%**	
Dispersion (χ/Q)				**5.2E-05 s/m^3**	**1.5E-03 s/m^3**	**7.3E-04 s/m^3**	**3.2E-05 s/m^3**	**9.0E-04 s/m^3**	**7.2E-04 s/m^3**	
Nuclide	**2003**	**MAR [Ci]**	**Source Term**	**[rem]**	**[rem]**	**[rem]**	**[rem]**	**[rem]**	**[rem]**	**Percent of Total**
Pu-238	3.37E+05	1.14E+01	6.84E-04	5.45E-03	1.57E-01	7.61E-02	3.36E-03	9.43E-02	7.55E-02	45.3%
Am-241	1.15E+05	3.91E+00	2.35E-04	2.11E-03	6.07E-02	2.95E-02	1.30E-03	3.66E-02	2.93E-02	17.6%
Pu-239	9.41E+04	3.19E+00	1.91E-04	1.69E-03	4.85E-02	2.36E-02	1.04E-03	2.92E-02	2.34E-02	14.0%
Pu-240	7.16E+04	2.43E+00	1.46E-04	1.29E-03	3.69E-02	1.80E-02	7.93E-04	2.23E-02	1.78E-02	10.7%
Pu-241	2.08E+06	7.07E+01	4.24E-03	7.34E-04	2.11E-02	1.02E-02	4.52E-04	1.27E-02	1.02E-02	6.1%
Cs-137	5.35E+06	1.81E+02	1.09E+01	6.03E-03	1.73E-01	8.42E-02	3.72E-03	1.04E-01	8.35E-02	2.0%
Sr-90	4.88E+06	1.65E+02	9.92E-03	2.23E-04	6.41E-03	3.12E-03	1.38E-04	3.87E-03	3.09E-03	1.9%
Cm-244	1.04E+04	3.54E-01	2.12E-05	9.91E-05	2.85E-03	1.39E-03	6.12E-05	1.72E-03	1.37E-03	0.8%
Am-243	5.00E+03	1.70E-01	1.02E-05	9.16E-05	2.63E-03	1.28E-03	5.65E-05	1.59E-03	1.27E-03	0.8%
U-232	1.49E+03	5.06E-02	3.04E-06	3.52E-05	1.01E-03	4.92E-04	2.17E-05	6.10E-04	4.88E-04	0.3%
Am-242	7.98E+02	2.70E-02	1.62E-06	1.71E-05	4.92E-04	2.39E-04	1.06E-05	2.97E-04	2.37E-04	0.1%
Th-228	1.50E+03	5.10E-02	3.06E-06	1.64E-05	4.71E-04	2.29E-04	1.01E-05	2.84E-04	2.27E-04	0.1%
Am-242m	8.02E+02	2.72E-02	1.63E-06	1.44E-05	4.13E-04	2.01E-04	8.87E-06	2.49E-04	1.99E-04	0.1%
			Total EDE	**1.8E-02**	**5.1E-01**	**2.5E-01**	**1.1E-02**	**3.1E-01**	**2.5E-01**	**99.8%**

Notes:
[1] - Non-volatile ARF and RF are from DOE-HDBK-3010-94, section 5.3.1, pg. 5-21.
[2] - ARF and RF for semi-volatile and volatile compounds is from DOE-HDBK-3010-94, section 4.3.1.3.3, pg 4-51.
[3] - Inventory for twenty-two CPC-WSA waste boxes is from WVNS-SAR-002, table B.7.7-4 and has been decayed to 2003.

TABLE 9.2-4

BEYOND DESIGN BASIS SEISMIC EVENT

Assumptions: Airborne Release Fraction (ARF) 1.0E-3 Damage Ratio 1.0
Respirable Fraction (RF) 1.0 Leakpath Factor 1.0
Release Height 0 m Year 2003 Loading in 22 CPC WSA Boxes: 181 Ci Cs-137
Breathing Rate 3.33E-04 m^3/s

Receptor Location				**640 m**	**640 m**	**640 m**	**850 m**	**850 m**	**2100 m**	
Stability Class, Wind Speed				**D, 4.5 m/s**	**F, 1 m/s**	**95%**	**D, 4.5 m/s**	**F, 1 m/s**	**95%**	
Dispersion (χ/Q)				**5.2E-05 s/m^3**	**1.5E-03 s/m^3**	**7.3E-04 s/m^3**	**3.2E-05 s/m^3**	**9.0E-04 s/m^3**	**7.2E-04 s/m^3**	
		MAR	**Source**							**Percent**
Nuclide	**2003**	**[Ci]**	**Term**	**[rem]**	**[rem]**	**[rem]**	**[rem]**	**[rem]**	**[rem]**	**of Total**
Pu-238	**3.37E+05**	**1.14E+01**	**1.14E-02**	9.08E-02	2.61E+00	1.27E+00	5.60E-02	1.57E+00	1.26E+00	46.2%
Am-241	**1.15E+05**	**3.91E+00**	**3.91E-03**	3.52E-02	1.01E+00	4.92E-01	2.17E-02	6.10E-01	4.88E-01	17.9%
Pu-239	9.41E+04	3.19E+00	3.19E-03	2.81E-02	8.08E-01	3.93E-01	1.74E-02	4.87E-01	3.90E-01	14.3%
Pu-240	7.16E+04	2.43E+00	2.43E-03	2.14E-02	6.16E-01	2.99E-01	1.32E-02	3.71E-01	2.97E-01	10.9%
Pu-241	2.08E+06	7.07E+01	7.07E-02	1.22E-02	3.51E-01	1.71E-01	7.54E-03	2.12E-01	1.69E-01	6.2%
Sr-90	4.88E+06	1.65E+02	1.65E-01	3.72E-03	1.07E-01	5.20E-02	2.29E-03	6.44E-02	5.15E-02	1.9%
Cm-244	1.04E+04	3.54E-01	3.54E-04	1.65E-03	4.75E-02	2.31E-02	1.02E-03	2.86E-02	2.29E-02	0.8%
Am-243	5.00E+03	1.70E-01	1.70E-04	1.53E-03	4.39E-02	2.13E-02	9.41E-04	2.64E-02	2.11E-02	0.8%
U-232	1.49E+03	5.06E-02	5.06E-05	5.87E-04	1.69E-02	8.20E-03	3.62E-04	1.02E-02	8.13E-03	0.3%
Am-242	7.98E+02	2.70E-02	2.70E-05	2.85E-04	8.20E-03	3.99E-03	1.76E-04	4.94E-03	3.96E-03	0.1%
Th-228	1.50E+03	5.10E-02	5.10E-05	2.73E-04	7.86E-03	3.82E-03	1.69E-04	4.74E-03	3.79E-03	0.1%
Am-242m	8.02E+02	2.72E-02	2.72E-05	2.40E-04	6.89E-03	3.35E-03	1.48E-04	4.15E-03	3.32E-03	0.1%
Cs-137	5.35E+06	1.81E+02	1.81E-01	1.00E-04	2.89E-03	1.40E-03	6.19E-05	1.74E-03	1.39E-03	<0.1%
			Total EDE	**2.0E-01**	**5.6E+00**	**2.7E+00**	**1.2E-01**	**3.4E+00**	**2.7E+00**	**99.7%**

Notes:

[1] - ARF and RF are from DOE-HDBK-3010-94, section 5.3.3.2.2, pg. 5-24.

[2] - Inventory for twenty-two CPC-WSA waste boxes is from WVNS-SAR-002, table B.7.7-4 and has been decayed to 2003.

TABLE 9.2-5

BEYOND DESIGN BASIS CRITICALITY ACCIDENT

Assumptions: Noble Gas Airborne Release Fraction (ARF) 1.0 Breathing Rate 3.33E-04 m^3/s
Iodine Airborne Release Fraction (ARF) 0.25
Release Height 0 m

Receptor Location		**640 m**	**640 m**	**640 m**	**850 m**	**850 m**	**2100 m**	
Stability Class, Wind Speed		**D, 4.5 m/s**	**F, 1 m/s**	**95%**	**D, 4.5 m/s**	**F, 1 m/s**	**95%**	
Dispersion (χ/Q)		**5.2E-05 s/m³**	**1.5E-03 s/m³**	**7.3E-04 s/m³**	**3.2E-05 s/m³**	**9.0E-04 s/m³**	**7.2E-04 s/m³**	
	Total							
Nuclide	**Ci**	**[rem]**	**[rem]**	**[rem]**	**[rem]**	**[rem]**	**[rem]**	**Percent of Total**
Kr-83m	3.70E+01	2.86E-08	8.21E-07	3.99E-07	1.76E-08	4.95E-07	3.96E-07	0.0%
Kr-85m	1.70E+02	2.29E-04	6.57E-03	3.20E-03	1.41E-04	3.96E-03	3.17E-03	0.0%
Kr-85	1.60E-03	2.95E-11	8.48E-10	4.12E-10	1.82E-11	5.11E-10	4.09E-10	0.0%
Kr-87	1.00E+03	7.36E-03	2.11E-01	1.03E-01	4.54E-03	1.27E-01	1.02E-01	0.8%
Kr-88	6.60E+02	1.23E-02	3.53E-01	1.72E-01	7.57E-03	2.13E-01	1.70E-01	1.3%
Kr-89	4.10E+04	6.89E-01	1.98E+01	9.62E+00	4.25E-01	1.19E+01	9.54E+00	75.1%
Xe-131m	3.90E-03	2.75E-10	7.92E-09	3.85E-09	1.70E-10	4.77E-09	3.82E-09	0.0%
Xe-133m	2.20E+00	5.40E-07	1.55E-05	7.54E-06	3.33E-07	9.35E-06	7.48E-06	0.0%
Xe-133	2.70E+01	7.82E-06	2.25E-04	1.09E-04	4.83E-06	1.36E-04	1.08E-04	0.0%
Xe-135m	3.30E+03	1.17E-02	3.36E-01	1.63E-01	7.20E-03	2.02E-01	1.62E-01	1.3%
Xe-135	4.10E+02	8.44E-04	2.42E-02	1.18E-02	5.20E-04	1.46E-02	1.17E-02	0.1%
Xe-137	4.90E+04	7.70E-02	2.21E+00	1.08E+00	4.75E-02	1.33E+00	1.07E+00	8.4%
Xe-138	1.10E+04	1.14E-01	3.26E+00	1.59E+00	7.00E-02	1.97E+00	1.57E+00	12.4%
I-129	4.30E-10	3.35E-13	9.62E-12	4.68E-12	2.06E-13	5.80E-12	4.64E-12	0.0%
I-131	1.80E+00	2.51E-04	7.20E-03	3.50E-03	1.55E-04	4.34E-03	3.47E-03	0.0%
I-132	6.70E+00	4.24E-05	1.22E-03	5.92E-04	2.61E-05	7.34E-04	5.87E-04	0.0%
I-133	3.50E+01	8.62E-04	2.48E-02	1.20E-02	5.31E-04	1.49E-02	1.19E-02	0.1%
I-134	4.80E+02	2.95E-03	8.49E-02	4.13E-02	1.82E-03	5.12E-02	4.09E-02	0.3%
I-135	1.20E+02	9.83E-04	2.82E-02	1.37E-02	6.06E-04	1.70E-02	1.36E-02	0.1%
	Total EDE	**9.2E-01**	**2.6E+01**	**1.3E+01**	**5.7E-01**	**1.6E+01**	**1.3E+01**	**100.0%**

TABLE 9.2-6

NATURAL GAS EXPLOSION IN THE RHWF WORK CELL

Assumptions: Non-volatile: Airborne Release Fraction (ARF); 5.0E-3, Release Fraction (RF); 0.3
Semi-volatile: Airborne Release Fraction (ARF); 6.0E-2, Release Fraction (RF); 1.0
Volatile: Airborne Release Fraction (ARF); 7.9E-1, Release Fraction (RF); 1.0
Damage Ratio: 1.0 Leakpath Factor: 1.0 Release Height: 0 m
Breathing Rate: 3.33E-04 m^3/s Year 2003 Loading in 22 CPC WSA Boxes: 181 Ci Cs-137

Receptor Location				640 m	640 m	640 m	850 m	850 m	2100 m	
Stability Class, Wind Speed				D, 4.5 m/s	F, 1 m/s	95%	D, 4.5 m/s	F, 1 m/s	95%	
Dispersion (χ/Q)				5.2E-05 s/m^3	1.5E-03 s/m^3	7.3E-04 s/m^3	3.2E-05 s/m^3	9.0E-04 s/m^3	7.2E-04 s/m^3	
Nuclide	2003	MAR [Ci]	Source Term	[rem]	[rem]	[rem]	[rem]	[rem]	[rem]	Percent of Total
Pu-238	3.37E+05	1.14E+01	1.71E-02	1.36E-01	3.91E+00	1.90E+00	8.40E-02	2.36E+00	1.89E+00	45.3%
Am-241	1.15E+05	3.91E+00	5.87E-03	5.28E-02	1.52E+00	7.38E-01	3.26E-02	9.14E-01	7.32E-01	17.6%
Pu-239	9.41E+04	3.19E+00	4.78E-03	4.22E-02	1.21E+00	5.90E-01	2.60E-02	7.31E-01	5.85E-01	14.0%
Pu-240	7.16E+04	2.43E+00	3.64E-03	3.21E-02	9.23E-01	4.49E-01	1.98E-02	5.57E-01	4.45E-01	10.7%
Pu-241	2.08E+06	7.07E+01	1.06E-01	1.83E-02	5.27E-01	2.56E-01	1.13E-02	3.18E-01	2.54E-01	6.1%
Cs-137	5.35E+06	1.81E+02	1.09E+01	6.03E-03	1.73E-01	8.42E-02	3.72E-03	1.04E-01	8.35E-02	2.0%
Sr-90	4.88E+06	1.65E+02	2.48E-01	5.58E-03	1.60E-01	7.80E-02	3.44E-03	9.66E-02	7.73E-02	1.9%
Cm-244	1.04E+04	3.54E-01	5.31E-04	2.48E-03	7.12E-02	3.46E-02	1.53E-03	4.29E-02	3.43E-02	0.8%
Am-243	5.00E+03	1.70E-01	2.54E-04	2.29E-03	6.58E-02	3.20E-02	1.41E-03	3.97E-02	3.17E-02	0.8%
U-232	1.49E+03	5.06E-02	7.59E-05	8.80E-04	2.53E-02	1.23E-02	5.43E-04	1.52E-02	1.22E-02	0.3%
Am-242	7.98E+02	2.70E-02	4.06E-05	4.28E-04	1.23E-02	5.98E-03	2.64E-04	7.42E-03	5.93E-03	0.1%
Th-228	1.50E+03	5.10E-02	7.65E-05	4.10E-04	1.18E-02	5.73E-03	2.53E-04	7.10E-03	5.68E-03	0.1%
Am-242m	8.02E+02	2.72E-02	4.08E-05	3.60E-04	1.03E-02	5.03E-03	2.22E-04	6.23E-03	4.98E-03	0.1%
			Total EDE	**3.0E-01**	**8.6E+00**	**4.2E+00**	**1.9E-01**	**5.2E+00**	**4.2E+00**	**99.8%**

Notes: [1] - ARF and RF for non-volatile compounds is from DOE-HDBK-3010-94, section 4.4.2.2.2, pg. 4-69.
[2] - ARF and RF for semi-volatile and volatile compounds is from DOE-HDBK-3010-94, section 4.3.1.3.3, pg 4-51.
[3] - Inventory for twenty-two CPC WSA waste boxes is from WVNS-SAR-002, table B.7.7-4 and has been decayed to 2003.

TABLE 9.2-7
SUMMARY OF RHWF ACCIDENT CONSEQUENCES

ACCIDENT SCENARIO	MAX. ON-SITE DOSE	On-site Evaluation Guideline	MAX. OFF-SITE DOSE	Off-site Evaluation Guideline
HEPA Filter Failure	0.93 rem	100 rem	0.56 rem	25 rem
RH Waste Container Lift Failure	0.15 rem	5 rem	0.088 rem	0.5 rem
Fire in RHWF	0.51 rem	100 rem	0.31 rem	25 rem
Beyond Design Basis Seismic Event	5.6 rem	N.A.	3.4 rem	N.A.
Beyond Design Basis Criticality	26 rem	N.A.	16 rem	N.A.
Beyond Design Basis Natural Gas Explosion	8.6 rem	N.A.	5.2 rem	N.A.

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RHWF91-1.DWG

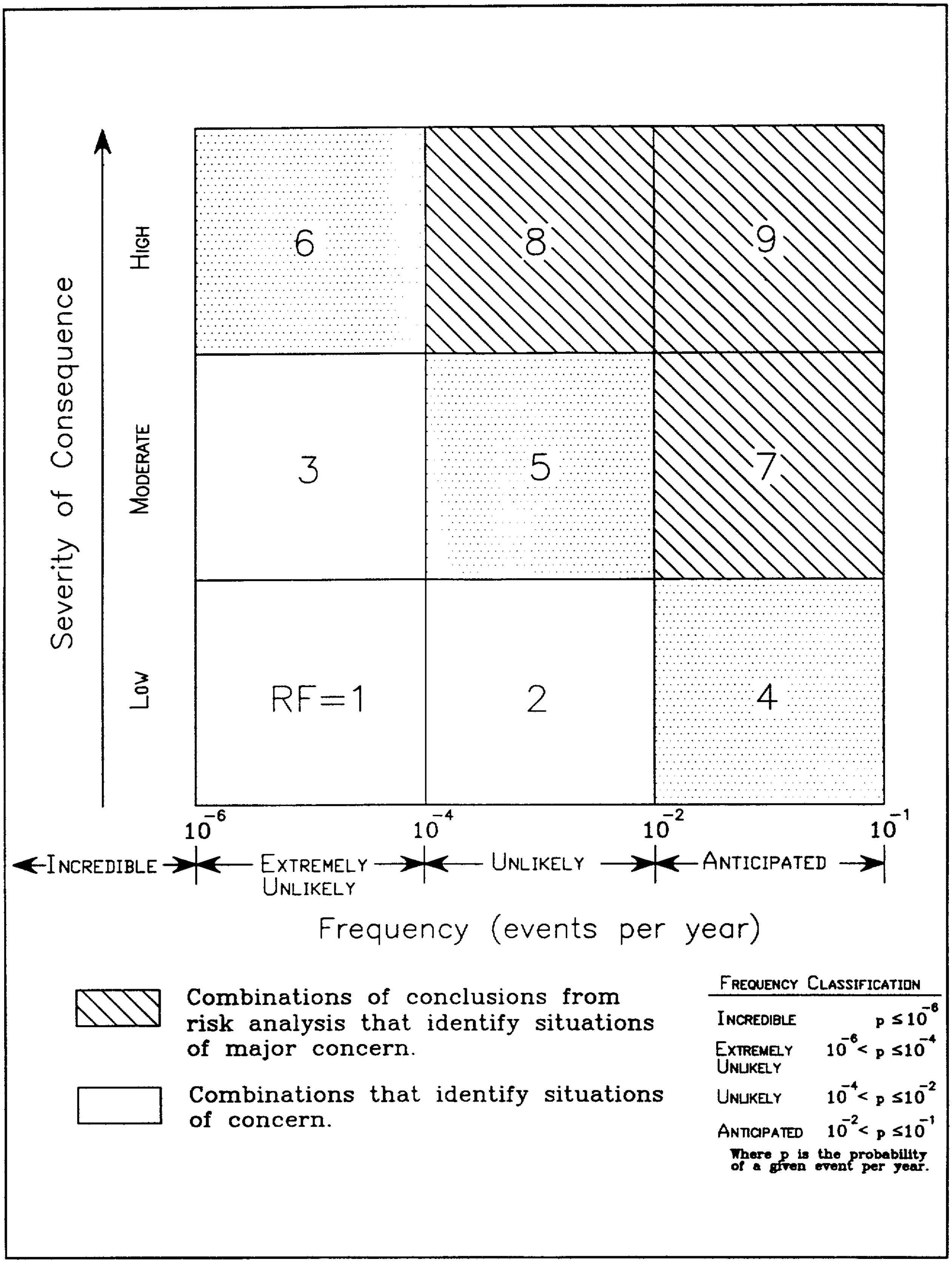

Figure 9.1–1 Process Hazards Analysis Risk Bins

RHWF91-2.DWG

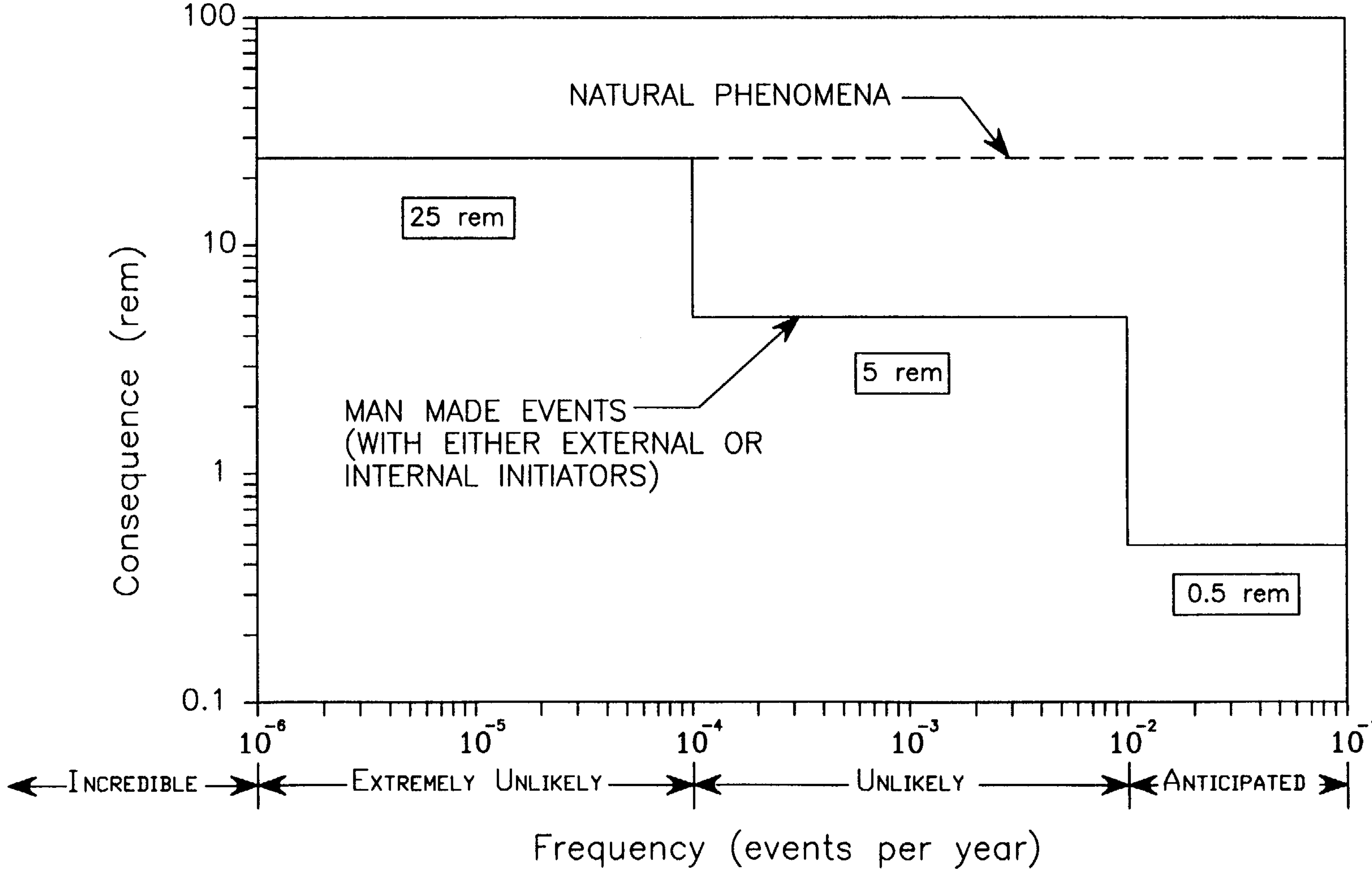

Figure 9.1–2 Evaluation Guidelines for the Off–site Evaluation Point for Radiological Accidents

RHWF91-3.DWG

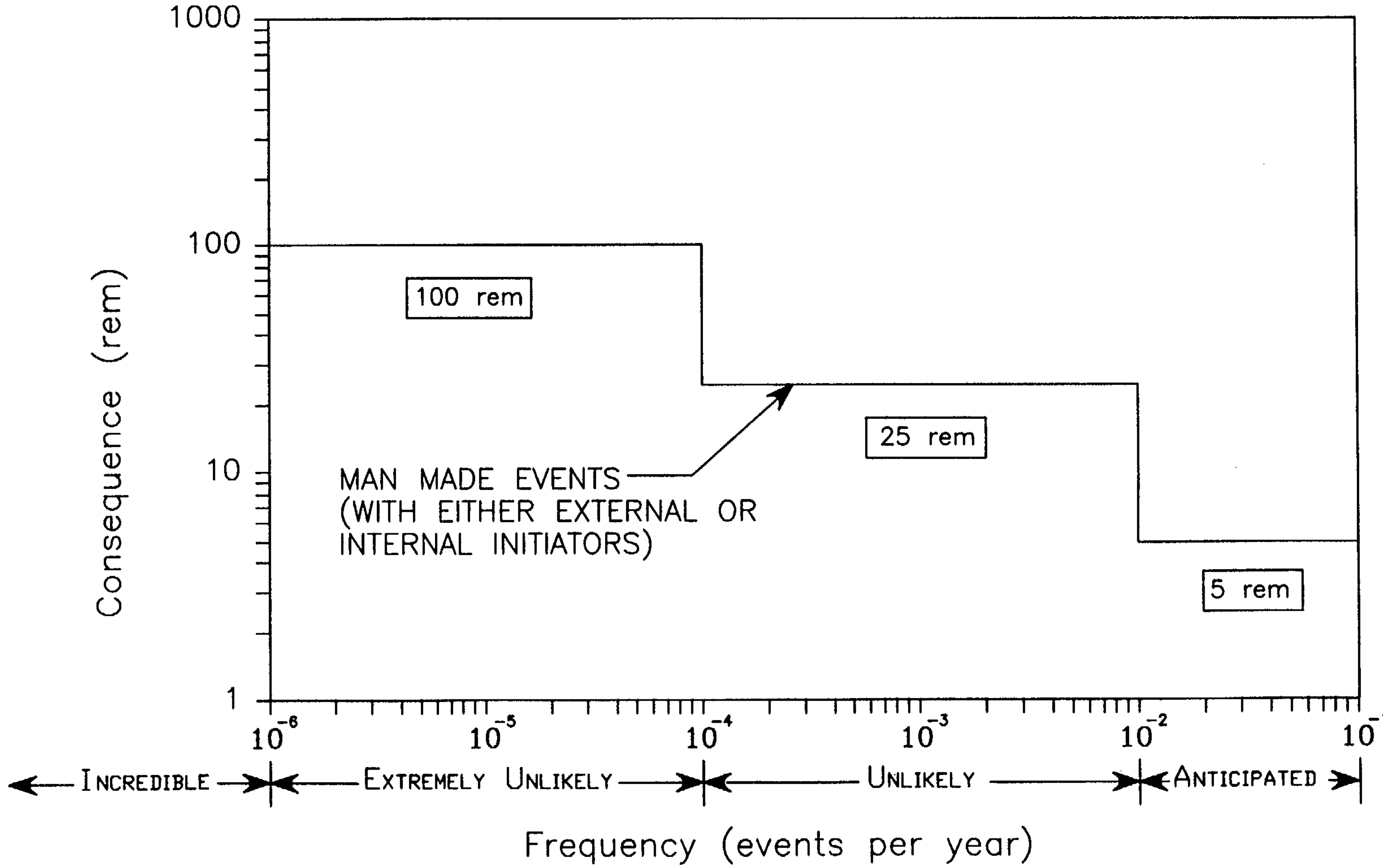

Figure 9.1-3 Evaluation Guidelines for the On-site Evaluation Point for Radiological Accidents

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10.0 CONDUCT OF OPERATIONS

The WVDP Conduct of Operations program is presented in detail in Chapter A.10.0 of WVNS-SAR-001, *Project Overview and General Information*. References to specific sections of WVNS-SAR-001 are provided below, as appropriate.

10.1 Management, Organization, and Institutional Safety Provisions

10.1.1 Organizational Structure

The overall WVDP organizational structure is presented in Sections A.10.1 and A.10.2 of WVNS-SAR-001. As of September 1999, the WVNS RHWP Manager reports to the WVNS Waste, Fuel, and Environmental Projects Manager, who reports to the President of WVNS. The organizational structure associated with the RHWF upon initiation of operations will be presented in the RHWF Final SAR. The organizational roles and responsibilities for RHWF design, construction, and pre-operational testing are presented in Table 10.1-1.

10.1.2 Organizational Responsibilities

WVDP organizational responsibilities are discussed in Sections A.10.1 through A.10.4 of WVNS-SAR-001. For the purposes of implementing Conduct of Operations requirements, the RHWP is classified as a Technical Support group. During radioactive operations, and for the purposes of implementing Conduct of Operations requirements, the RHWP will be classified as an Operations group. Specific requirements pertaining to this classification include adherence to established design control procedures, effectively and realistically planning work activities, performing self-assessments and audits of the project activities and functions, communicating clearly to project personnel, and verifying designs before proceeding to the next step of development.

10.1.3 Staffing and Qualifications

WVDP staffing and qualifications are discussed in Section A.10.1 of WVNS-SAR-001.

10.1.4 Safety Management Policies and Programs

A brief overview of safety performance assessment, configuration and document control, event reporting, and safety culture are provided below. A more complete discussion is provided in Section A.10.4.2 of WVNS-SAR-001.

10.1.4.1 Safety Performance Assessment

Safety performance appraisal of those organizations involved in the management of safety is performed in accordance with WV-121, *Self-Assessment Program* (WVNS), which covers all disciplines related to safety and includes such functional areas of inquiry as nuclear safety, emergency management, fire protection, occupational safety and health, radiological protection, and environmental protection. This program complies with applicable DOE Directives governing assessment at DOE facilities, including DOE P 450.5, *Line Environment, Safety, and Health Oversight* (USDOE October 15, 1996), and DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities* (USDOE May 18, 1992).

WVDP-242, *Event Investigation and Reporting Manual* (WVNS), contains procedures which provide for root cause analysis and trending of site ES&H performance. Other formal programs such as the Conduct of Operations Surveillance Program, implemented by WVDP-106, *Westinghouse Conduct of Operations Manual* (WVNS), and the Operational Readiness Review (ORR) Program, implemented by WV-368, *Operational Readiness Determination For Startup/Restart* (WVNS), complement the formal self assessment process described in WV-121.

10.1.4.2 Configuration and Document Control

The WVNS configuration and document control program is composed of five major elements: Program Management, Design Requirements, Document Control, Change Control, and Assessment/Review. Combined, these elements establish and maintain consistency in design requirements, physical configuration, modifications to the facility or its operation, and facility documentation.

10.1.4.3 Event Reporting

Abnormal events at the WVDP are investigated and reported in accordance with WV-987, *Occurrence Investigation and Reporting* (WVNS), and WVDP-242, *Event Investigation and Reporting Manual* (WVNS). WVDP-242 implements the requirements of DOE Order 232.1A, *Occurrence Reporting and Processing of Operations Information* (USDOE July 21, 1997), DOE Manual 232.1-1A, *Occurrence Reporting and Processing of Operations Information* (USDOE July 21, 1997), and DOE Order 5480.19, Change 1, *Conduct of Operations Requirements for DOE Facilities* (USDOE May 18, 1992). This policy establishes the requirement for WVNS to develop and implement a process for determining, evaluating, reporting, and correcting events and conditions at the WVDP, including those occurrences involving WVNS subcontractors. The types of events covered by this process include, but are not limited to, events related to safety, health, security, operations, property, quality assurance, and the environment.

10.1.4.4 Safety Culture

WVNS has implemented a comprehensive program for worker protection, based on a safety policy that states: "Exceed customer expectations without injury or illness." WVNS has formatted its safety program to be an Integrated Safety Management System (ISMS) which is implemented by the guiding principles of the OSHA Safety and Health Management Guidelines. These guidelines are the precursor to DOE Policy 450.4, *Integrated Safety Management,* (USDOE October 15, 1996). WVNS Policy and Procedure WV-100, *Integrated Safety Management and Control of Documents*, establishes WVNS policy in this regard. Documents that implement the WVDP integrated safety management system are identified in WVDP-310, *WVDP Safety Management System Description (WVNS)*.

WVNS systematically integrates safety into management and work practices at all levels so that missions are accomplished while protecting the public, the worker, and the environment. This integration is accomplished by implementing the ISMS. The DOE has developed seven guiding principles to provide the focus for implementing an ISMS. These principles are:

1) Line Management Responsibility for Safety
2) Clear Roles and Responsibilities

3) Competence Commensurate with Responsibilities
4) Balanced Priorities
5) Identification of Safety Standards and Requirements
6) Hazards Control
7) Operations Authorization

While these principles guide the implementation of an ISMS, five core functions define its make-up. These functions comprise a cycle of activities which, although different in detail, are the same for activities on a program or site level and a facility and work task level. The core functions are:

1) **Define the Scope of Work** - This function includes identifying all tasks associated with the activity and identifying resources needed to perform the activity.
2) **Analyze the Hazards -** On a work task level, this function includes identifying the physical and environmental hazards involved in an activity (radiation level, heat, or the potential for release of contaminants). On a facility or program level, this includes developing and maintaining safety analysis documentation.
3) **Develop Hazards Controls** - This function includes administrative and engineering controls, design controls, and training. As examples, the controls can take the form of personnel protective equipment or technical safety requirements.
4) **Perform Work Within Controls** - This function provides the means to ensure that once the controls are developed, the work is performed within the controls.
5) **Provide Feedback and Continuous Improvement** - This function closes the loop for the work activity. Lessons-learned from one activity are identified so that they may be incorporated into subsequent activities. This feedback includes both things that went right as well as things that went wrong.

10.2 Procedures and Training

10.2.1 Procedures

The development and maintenance of procedures is discussed in Section A.10.4.1 of WVNS-SAR-001.

10.2.2 Training

A description of the WVNS training program is presented in Section A.10.3 of WVNS-SAR-001.

10.3 Initial Testing, In-Service Surveillance, and Maintenance

10.3.1 Initial Testing Program

The design-build contractor of the RHWF will be responsible for testing all equipment, components, systems, and subsystems installed in the RHWF. Testing will include rotational checks on rotating equipment, leak testing pressurized lines, and air flow and balance tests on air handling systems. In addition to the facility system operational testing, the design-build contractor will perform shielding integrity verification in accordance with ANS-6.4, *Guidelines on the Nuclear Analysis and Design of Concrete Radiation Shielding for Nuclear Power Plants.* Control systems will be tested and calibrated, and control set point adjustments made and confirmed. All systems and components will be placed in an operational readiness state. Shielding integrity will be verified using actual radioactive waste as the source during radiological operations.

A Startup and Commissioning phase will be conducted at the close of the construction phase. During this period, the facility will be made operational. Operation of the facility will be demonstrated by the design-build contractor using all the equipment in mock-up tests to show that the systems will perform as specified. The mock-up tests will be conducted with non-radioactive materials similar to those that are expected to be processed by the RHWF. Building utility systems, remotely operated material handling and processing equipment (i.e., cranes, PDMs, roller conveyors, and transfer carts), facility ventilation and filtration systems, shield doors, electrical safety control interlocks, and all emergency systems (i.e., radiation monitoring, fire protection, and all alarm systems) will be demonstrated to be operational and able to perform their designated functions. After successful completion of Startup and Commissioning, the startup organization will train WVNS Operations, Maintenance and Technical support staff in the operation and maintenance of the facility and its systems. Training manuals, operations manuals, and maintenance manuals will be turned over to WVNS as part of the Startup and Commissioning phase. Upon completion of training, documentation turnover and sign-off, the contract for design and construction will be closed. WVNS will secure the environmental permits and registrations for the Startup and Commissioning phase for this scope of work.

10.3.2 In-Service Surveillance and Maintenance Program

A description of the WVDP In-Service Surveillance and Maintenance program is presented in Section A.10.4.3 of WVNS-SAR-001.

10.4 Operational Safety

10.4.1 Conduct of Operations

The WVDP Conduct of Operations program is discussed in Section A.10.4.4 of WVNS-SAR-001. The RHWP has the responsibility to incorporate features and configurations into the RHWF that enhance future conduct of operations.

10.4.2 Fire Protection

The WVDP fire protection program, which will be applied to the RHWF, has been developed to meet the requirements for a comprehensive fire protection program as delineated in WVDP-177, *WVDP Fire Protection Manual*, which is based on the fire protection-related requirements in DOE Order 420.1, *Facility Safety*. Administrative controls, procedures, and training to prevent fires and explosions are presented in WVDP-177. The WVDP fire and explosion protection program is discussed in Section A.4.3.6 of WVNS-SAR-001. An FHA for the RHWF is being developed in a time frame that approximately parallels the development of this PSAR. A complete discussion of the FHA process and its requirements are given in WVDP-177.

10.5 Emergency Preparedness Program

The WVDP Emergency Preparedness Program is presented in detail in Section A.10.5 of WVNS-SAR-001.

10.6 Decontamination and Decommissioning

The RHWF shall be designed with consideration of the need for future D&D. In this regard, the RHWF shall be designed in accordance with ANSI N-300, *Design Criteria for Decommissioning of Nuclear Fuel Reprocessing Plants*. Section A.10.6 of WVNS-SAR-001 provides a discussion of WVDP decommissioning planning and related efforts. Section 4.3 of WVNS-DC-071, *Design Criteria for the Remote Handled Waste Facility*, provides a listing of RHWF design features that will facilitate RHWF decontamination. Additionally, substantial D&D-related information for the RHWF is provided in *Closure Report on the Deactivation and Decommissioning of the Stand-Alone Alternative to the RHWF*, dated September 24, 1999. Specific design features and measures cited in the subject report that will be employed to facilitate D&D of the RHWF are as follows.

- The floor of the Work Cell, as well as its walls, to a height below the crane rails, will be lined with stainless steel. In addition, all surfaces in the Work Cell not lined with stainless steel, as well as all surfaces of the Buffer Cell, will be sealed with an epoxy coating. These coverings minimize or prevent the infiltration of radioactive materials into the concrete floors and walls, thereby reducing the amount of structural material (concrete) required to be removed and processed as radioactive waste.

- The work tables, at which the waste segmenting will take place, will incorporate a down draft ventilation system. This is important in that the design of the work station becomes the "first line of defense" in preventing the spread of radioactive contaminants.

- Joints/seams, such as at the liner-wall interface, will be caulked/sealed so as to prevent the spread of contaminants behind the liner. Similarly, construction joints will be sealed.

- Curbs, dikes, or other barriers will be used to confine/direct the flow of water in areas that could be decontaminated using a water wash system, or in areas where waste water will be collected (e.g., a tank room).

- Floors will be sloped toward floor drains.

- Wall, floor, and ceiling penetrations in the Work Cell will be kept to a minimum and will also be sealed so as to prevent the migration of radioactive contaminants.

- Except as needed to pass from one area to another, pipes and ducts containing potentially contaminated fluids will not be embedded or sealed in walls, floors, or ceilings.

- Floor drain lines will not run below concrete slabs which sit on grade. They will run in sealed or lined chases/trenches accessible through removable covers.

- Waste collection tanks will not be buried but located in a sealed or lined vault/room. Overflow from the tanks will be to the vault which will have sensors to detect an overflow condition. Provisions will be made to permit liquids to be taken directly from the vault using a portable pump.

- The vent from the liquid waste collection tanks will be vented to the Work Cell which is upstream of the ventilation exhaust system filters.

- Drain lines will extend into the drain tank to a point below the lowest design water level.

- Crud traps (those features in the design of fluid systems that promote the buildup of radioactive material) will be eliminated to the greatest degree possible in the drain system.

- Measures will be taken to prevent significant imbalances in the ventilation system when transferring waste from the Work Cell.

- The in-cell ventilation exhaust pre-filters will be located along one wall of the Work Cell and below the work platforms. This design will greatly reduce the level and extent of contamination within the ventilation system.

- Runs of electrical wires and instrumentation and control wires in contaminated areas will be in conduits.

REFERENCES FOR CHAPTER 10.0

American National Standards Institute. 1997. ANS-6.4: *Guidelines on the Nuclear Analysis and Design of Concrete Radiation Shielding for Nuclear Power Plants.* American National Standards Institute.

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Scientech Incorporated. September 24, 1999. *Closure Report on the Deactivation and Decommissioning of the Stand-Alone Alternative to the RHWF.* Gaithersburg, Maryland.

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West Valley Nuclear Services Co. WV-121; *Self-Assessment Program.* (Latest Revision).

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_______________. WV-368: *Operational Readiness Determination for Startup/Restart.* (Latest Revision).

_______________. WV-987: *Occurrence Investigation and Reporting.* (Latest Revision).

REFERENCES FOR CHAPTER 10.0 (concluded)

______________. WVDP-106: *Westinghouse Conduct of Operations Manual.* (Latest Revision).

______________. WVDP-242: *Event Investigation and Report Manual.* (Latest Revision).

______________. WVDP-310: *WVDP Safety Management System Description.* (Latest Revision).

______________. WVDP-342: *Operational Readiness Determination Manual for Startup and Restart of WVDP Facilities.* (Latest Revision).

TABLE 10.1-1

WVNS ORGANIZATIONAL ROLES AND RESPONSIBILITIES FOR RHWF DESIGN, CONSTRUCTION, AND PRE-OPERATIONAL TESTING

Activity \ Organizations	Remote-Handled Waste Project	Waste, Fuel, and Environmental Projects	Site Operations & Facility Closure Projects	High Level Waste Projects	Subcontractor	Environmental, Safety, Quality Assurance and Laboratory Operations and Radiation Protection	Construction and Project Administration
RH Waste System Development	Lead	Support/Review	Support/Review	Support/Review	Scientech Studies/Support	Support/Review	N/A
RHWF Design	Monitor & manage	Support/Review	Support/Review FHA	Support/Review	Design/Build Subcontractor - Lead	Support/Review	Document Control
RHWF Equipment Procurement	Monitor & manage	Support/Review	Support/Review	N/A	Design/Build Subcontractor - Lead	Support/Review	N/A
RHWF Construction	Monitor & manage	Support/Review	Support/Review	N/A	Design/Build Subcontractor - Lead	Support/Review	In-Field Document Control
Environmental & Safety Support	Monitor & manage	Support/Review	Support/Review	N/A	Dames & Moore	Lead	N/A

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11.0 DERIVATION OF TECHNICAL SAFETY REQUIREMENTS

11.1 Introduction

The objective of this chapter is to provide information that satisfies the requirements of DOE Order 5480.23, *Nuclear Safety Analysis Reports*, Topic 16, which relates to the derivation of TSRs. This chapter is normally used to link the accident analyses, through descriptions of the safety-related SSCs, to the TSR document of a given facility. The TSR document, as stated in DOE Order 5480.22, *Technical Safety Requirements*, is intended to constitute an agreement or contract between the DOE and the applicable managing and operating (M&O) contractor (in this instance WVNS) regarding the safe operation of a given facility, activity, or operation.

As stated in DOE Order 5480.22, the DOE's "first safety responsibility must be the protection of the public." This is also the first safety responsibility of WVNS. Those who work at the WVDP accept some risk of exposure to radioactive and other hazardous materials due to the nature of the materials with which the WVDP facilities operate. Nevertheless, it is incumbent upon the DOE and WVNS to ensure that WVDP facilities are operated in a manner that minimizes the risk to workers and limits exposures to hazardous materials to levels permitted by federal or state regulations and relevant DOE Orders and Notices.

11.2 Requirements

This PSAR meets the requirements in DOE Order 5480.23 and DOE Order 5480.22 with respect to TSRs. The guidance contained in DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports*, has also been considered in this regard.

11.3 Technical Safety Requirement Considerations

DOE-STD-3009-94 defines safety class SSCs as follows: "Systems, structures, or components including primary environmental monitors and portions of process systems, whose failure could adversely affect the environment, or safety and health of the public as identified by safety analyses. For the purposes of implementing this Standard, the phrase 'adversely affect' means Evaluation Guidelines are exceeded. Safety class SSCs are systems, structures, or components whose preventive or mitigative function is necessary to keep hazardous material exposure to the public below the off-site EGs. This definition would typically exclude items such as primary environmental monitors and most process equipment." The EGs for the RHWF are provided in Chapter 9 of this PSAR.

There are no DBAs analyzed in Chapter 9 of this PSAR that have consequences associated with them that exceed the EGs provided in Chapter 9. The consequence analyses developed for comparison with EGs only took credit for passive confinement barriers such as walls, shield windows, and the roof. These analyses did not take credit for HEPA filtration of releases. Therefore, it can be stated that: (1) There are no DBAs that require active safety class SSCs to ensure consequences to receptors are below EGs; and (2) There are no SSCs under the direct control of the RHWF operators that are used to mitigate the consequences to receptors such that the consequences are below EGs. Hence, consistent with the definition of a safety class SSC provided in DOE-STD-3009-94, no active SSCs associated with the RHWF have been designated as safety class.

In its discussion of worker safety, DOE Order 5480.22 states "The protection of the health and safety of workers is assured by the combination of: (1) The development of TSRs for barriers to uncontrolled releases and for preventive and mitigative systems, components, and equipment; (2) Use of PPE; (3) Emergency protection programs; (4) Worker education; and (5) Drills." Of these five items, only one is specifically addressed in TSRs, namely "barriers to uncontrolled releases and for preventive and mitigative systems, components, and equipment." Relative to barriers for protection of the public and co-located WVDP workers, no active RHWF SSCs have been designated as safety class for reasons stated in the previous paragraph. Barriers for RHWF worker protection constitute one of the (if not the) primary contributor to defense in depth. Section 4.3.2 of this PSAR contains a significant discussion of defense in depth as it pertains to the RHWF. DOE-STD-3009-94 states that SSCs that are "major contributors to defense in depth are designated as safety-significant SSCs" and "Estimates of worker consequences for the purpose of safety-significant SSC designation are not intended to require detailed analytical modeling. Considerations should be based on engineering judgment of possible effects and the potential added value of safety-significant SSC designation." Based on "engineering judgment of possible effects and the potential added value of safety-significant SSC designation," no RHWF SSCs have been designated as safety-significant SSCs (even though they may contribute to defense in depth).

Since no RHWF SSCs that are active or under an operator's direct control have been designated as safety class or safety-significant based on DOE-STD-3009-94 guidance and the rationale presented above (which incorporates the results of accident analyses presented in Chapter 9 of this PSAR), no safety limits, operating limits (including limiting control settings and limiting conditions for operation), and surveillance requirements, as described in DOE Order 5480.22, are expected to be required for the RHWF. However, the final determination for the need for TSRs as discussed in DOE Order 5480.22 will be made after the RHWF Final SAR has been developed.

11.3.1 <u>Administrative Controls</u>

DOE Order 5480.22 states that Administrative Controls are "the provisions relating to organization and management, procedures, recordkeeping, reviews, and audits necessary to ensure safe operation of the facility." The subject Order elaborates on these topics and the importance of select programs to ensure safe and healthful operation of a given facility. In discussing Administrative Controls (in the section that addresses the preparation of TSRs), DOE Order 5480.22 states, "This section should impose administrative requirements necessary to control operation of the facility such that it meets the TSR." As used in this context, TSR is evidently referring to everything TSRs shall consist of except "Administrative Controls." (Pages 10, 11, and 12 of DOE Order 5480.22 clearly state that TSRs shall consist of the following: use and application, safety limits, operating limits [including limiting control settings and limiting conditions for operation], surveillance requirements, administrative controls, and appendices that include information on basis and design features.) For reasons previously stated, there are no safety limits, operating limits, or surveillance requirements associated with the RHWF. Hence, there are no TSRs that require Administrative Controls.

WVDP workers accept some risk beyond that accepted by the public because of the necessary and inherent presence of hazardous and radioactive materials at WVDP facilities and the workers' proximity to these materials. TSRs are not based on maintaining worker exposures below some acceptable level following an uncontrolled release of radioactive and/or hazardous material or inadvertent criticality; rather, the risk to workers is reduced through the reduction of the likelihood and potential impact of such events. It is impractical to attempt to reduce worker risk to an insignificant level through TSRs. In its discussion of worker safety, DOE Order 5480.22 acknowledges that, "The impact from the release of hazardous materials is also reduced through industrial hygiene and radiation protection oversight (e.g., monitoring of worker exposures, use of personnel protective equipment [PPE] and emergency evacuation planning), as well as the use of TSRs." This statement indicates that formal measures other than TSRs are recognized by the DOE as being acceptable for ensuring worker safety. DOE-STD-3009-94 reinforces this position, stating: "It is important to develop TSRs judiciously. TSRs should not be used as a vehicle to cover the many procedural and programmatic controls inherent in any operation." Consistent with relevant DOE Orders and federal and state regulations with which WVNS is currently contractually obligated to comply, the control of the levels of hazardous and radioactive materials to which workers may, at any time, be exposed, is addressed in WVDP radiological protection and occupational safety and health programs. Furthermore, worker exposure to hazardous materials and/or conditions is regulated under the provisions of the Occupational Safety and Health Act administered by the Occupational Safety and Health Administration (OSHA).

11.3.2 Summary Regarding TSRs for the Remote-Handled Waste Facility

DOE Order 5480.22 and DOE-STD-3009-94 both indicate that, with the exception of safety class SSCs, there is significant latitude as to the content of a given facility's TSRs. This is consistent with the statement in DOE Order 5480.22 that "DOE's first safety responsibility must be the protection of the public." This latitude, in conjunction with the specifics discussed above and existing contractual health and safety related commitments that the incumbent WVDP M&O contractor has to the DOE, provide adequate justification for there not being TSRs (i.e., safety limits, operating limits, surveillance requirements, and administrative controls per DOE Order 5480.22) associated with the RHWF.

11.4 Interface with TSRs from Other Facilities

There are no TSRs from other facilities that interface with the RHWF.

REFERENCES FOR CHAPTER 11.0

U. S. Department of Energy. February 25, 1992. Change 2 (January 23, 1996). DOE Order 5480.22: *Technical Safety Requirements*. Washington, D.C.: U.S. Department of Energy.

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12.0 QUALITY ASSURANCE

The Quality Assurance Program (QAP) at the WVDP is implemented on a site-wide basis and is applied in compliance with the QA Rule, 10 CFR 830.120, *Quality Assurance Requirements*. Definition and description of the WVNS QAP is provided by the DOE-approved WVNS document WVDP-111, *Quality Assurance Program* (WVNS), which also implements the requirements of DOE O 414.1, "*Quality Assurance.*"

The QA Program is used for determining the graded applicability of quality assurance standards to items, systems, or services. RHWF structures, systems, and components are covered by the QAP and are graded and identified by quality level, which is based upon safety, environmental, health, and other programmatic considerations. The assigned list, methodology for classification, and rationale for establishment of quality levels are contained in WVDP-204, *WVDP Quality List (Q-List)* (WVNS). With activities clearly identified by quality level, existing WVNS procedures and practices provide a mechanism and process for graded quality assurance. The criteria for determining quality level designations are provided in policy QM 2 of WVDP-002, Quality Management Manual. These criteria are summarized in Section A.12.3 of WVNS-SAR-001.

A synopsis of the WVNS QAP defined in WVDP-111 is presented in Chapter A.12.0 of WVNS-SAR-001, *Project Overview and General Information* (WVNS).

REFERENCES FOR CHAPTER 12.0

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