m-32

West Valley Demonstration Project

Doc. ID Number WVNS-SAR-002

Revision Number 7

Revision Date 12/21/99

Controlled Copy No. 6

SAFETY ANALYSIS REPORT FOR

LOW-LEVEL WASTE PROCESSING AND SUPPORT ACTIVITIES

DAMES & MOORE FOR
WVNS ENVIRONMENT, SAFETY, QUALITY ASSURANCE AND LABORATORY OPERATIONS

HIGHEST PROPOSED HAZARD CATEGORIZATION: 2 (Facilities within the scope of this SAR have been segmented per the guidance of DOE 5480.23)

REFERENCED DOCUMENT: WD:93:1167

APPROVALS:

L. J. Chilson, Manager
Safety Analysis and Integration

E. D. Savage, Manager
Environment, Safety, Quality Assurance and Laboratory Operations

J. L. Little, Chairman
WVNS Radiation and Safety Committee

Westinghouse
Government Services Group

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

JAN 19 2000

WV-1816, Rev. 3
SAR:0000877.01

PDR PROJ M-32

NM5501 Public

WVNS RECORD OF REVISION

DOCUMENT

If there are changes to the controlled document, the revision number increases by one. Indicate changes by one of the following:

- Placing a vertical black line in the margin adjacent to sentence or paragraph that was revised.
- Placing the words GENERAL REVISION at the beginning of the text.
- Placing either FC#> or PC#> (whichever applies) in the left-hand margin at the beginning of the paragraph or section where the field/page change has been made AND placing a vertical black line in the margin adjacent to the actual change.
- Placing the words "New-Type Revision" or "On-Hold" in the description of changes.

Example:

The vertical line in the margin indicates a change. |

FC1> The FC#> in the margin along with the vertical line (redline) indicates a change. |

Rev. No.	Description of Changes	Revision On Page(s)	Dated
0	Original Issue	All	
1	Revise text to correct inaccurate descriptions of facilities and operations, update dose calculations for annual meteorology data, and adjust source terms to reference year 1987	Various changes indicated in margins	05/85
2	Per ECN #2890 Revise Text to incorporate requirements for HLW sampling and resulting accident analysis	83, 84, 192 213, 214	06/89
3	Per ECN #4288 - Issue of Addendum #1 which includes WVNS-SAR-011 DOE Approved DW:92:1367	Addendum #1	12/23/95
3	General Revision per ECN #6026 and ECN #9495 Incorporated into WVNS-SAR-002 Rev. 3, are the following documents: WVNS-SAR-004, WVNS-SAR-005, WVNS-SAR-006, WVNS-SAR-007, WVNS-SAR-008, WVNS-SAR-009, WVNS-SAR-010, WVNS-SAR-013 and WVDP-096	All	01/16/96

WVNS RECORD OF REVISION CONTINUATION FORM

Rev. No.	Description of Changes	Revision On Page(s)	Dated
4	ECN #10541 Represents an annual update of WVNS-SAR-002 as required by DOE Order 5480.23	All	02/05/97
4	Per ECN #10635 - Cancellation of WVNS-SAR-002, Addendum 1, Rev. 3, "Safety Analysis Report for the Fuel Receiving & Storage Facility". Issuance of WVNS-SAR-012, Rev. 0, will provide the authorization basis required for operation of the Fuel Receiving & Storage Facility. (formerly contained in WVNS-SAR-002, Addendum 1)	Addendum 1	05/29/97
5	ECN #11223 represents an annual update of WVNS-SAR-002 as required by DOE Order 5480.23. Incorporates and updates material from WVNS-ASA-001, Rev. 1, and WVNS-SAR-022, Rev. 0	All	02/27/98
6	ECN #11801 represents an annual update of WVNS-SAR-002 as required by DOE Order 5480.23. Incorporates and updates material from the LLW2, the NDA, the VTF, and the HEC. Removed reference to the Supercompactor. Added information and conclusions from various FHAs, including information on lightning protection.	All	12/30/98
7	Annual update of WVNS-SAR-002 as required by DOE Order 5480.23. Double contingency analyses documented, and TRU waste storage in LSA 1, 3, and 4 covered. Figures and associated text updated to reflect current operating practice. Scenario of a hydrogen peroxide spill reanalyzed, and organization charts updated. Added description of Permeable Treatment Wall. Discussion of tank corrosion updated and the estimated frequency of a potential tank leak due to corrosion has been modified. System descriptions updated as appropriate, including electrical and compressed air.	All	12/21/99

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (concluded)

LIST OF TABLES

LIST OF TABLES (concluded)

LIST OF FIGURES

LIST OF FIGURES (concluded)

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

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

B&P	Buffalo & Pittsburgh
BDAT	Best Demonstrated Available Technology
BDB	Beyond Design Basis
BDBE	Beyond Design Basis Earthquake
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

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

CSE	Criticality Safety Engineer
CSE	Cognizant System Engineer
CSER	Confined Space Entry Rescue
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
CWTP	Commercial Waste Treatment System
CY	Calendar Year
D&D	Decontamination and Decommissioning
D&M	Dames & Moore
DAC	Derived Air Concentration
DAS	Data Acquisition System
DB	Dry Bulb
DBA	Design Basis Accident
DBE	Design Basis Earthquake
DBT	Design Basis Tornado
DBW	Design Basis Wind
DC	Drum Cell
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
DOP	Dioctylphthalate
DOSR	DOE On-Site Representative
DOT	Department of Transportation
DP	Differential Pressure
dpm	Disintegrations per minute

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

DR	Data Recorder
DR	Damage Ratio
DVP	Developmental Procedure
DWPF	Defense Waste Processing Facility
DWS	Demineralized Water System
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

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

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
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
HAPR	Hot Acid Pump Room
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

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

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
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
ISM	Integrated Safety Management
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

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

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
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
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

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

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
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
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

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

NAA	North Analytical Aisle
NAD	Nuclear Accident Dosimeter
NARA	National Archives and Records Administration
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 Protection Act
NESHAP	National Emission Standard for Hazardous Air Pollutants
NFPA	National Fire Protection Association
NFS	Nuclear Fuel Services, Inc.
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

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

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}
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
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

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

PPB	Parts Per Billion
PPC	Product Purification Cell
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
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
RID	Records Inventory and Disposition Schedule

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

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
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
SER	Site Environmental Report
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

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

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
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
UL	Underwriters Laboratories, Inc.
ULO	Uranium Load Out
UPC	Uranium Product Cell
UPS	Uninterruptible Power Supply
UR	Utility Room

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

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
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
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
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
XC-1	Extraction Cell 1
XC-2	Extraction Cell 2
XC-3	Extraction Cell 3
XCR	Extraction Chemical Room
XSA	Extraction Sample Aisle

LIST OF ACRONYMS AND ABBREVIATIONS
(Concluded)

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

B.1.0 INTRODUCTION AND GENERAL DESCRIPTION OF THE IRTS/MAIN PLANT

B.1.1 Introduction

The West Valley Fuel Reprocessing Plant (Main Plant) was originally constructed by Bechtel Corporation from 1963 to 1966 for Nuclear Fuel Services, Inc. The reprocessing facility provided for spent fuel storage, mechanical handling, dissolution, chemical extraction, and product and by-product handling with a reprocessing capacity of one ton per day. Fuel receipt began in 1965 and reprocessing began in April, 1966. Operation continued until early 1972 when the plant was shut down for facility expansion. The design, construction and operation of the original facility as a fuel reprocessing plant was the subject of a U.S. Atomic Energy Commission (AEC) approved Final Safety Analysis Report (FSAR) (Nuclear Fuel Services, Inc., 1970).

NFS ceased operation of the plant in 1972 and undertook a program of plant modification and expansion, which subsequently was deemed by the AEC regulatory organization as requiring a construction permit and relicensing. During the processing of information necessary to support the construction permit, new seismic and tornadic criteria for the reprocessing facility were developed. Costs associated with application of these new criteria to the original reprocessing facility were deemed by NFS to make fuel reprocessing at the facility no longer profitable. On September 22, 1976, NFS announced its intention to withdraw from commercial nuclear fuel reprocessing operations and the plant was placed in standby status.

Under the terms of the contract executed in 1963 between NFS and the New York Atomic Research and Development Agency, New York State was obligated to assume responsibility for perpetual care of the wastes. When the State of New York subsequently indicated its unwillingness to assume this responsibility, the U.S. Congress ordered a comprehensive study of the West Valley plant to consider the problems likely to be encountered in disposing of the stored waste and decommissioning the plant. In 1980, Congress passed the West Valley Demonstration Project Act (West Valley Nuclear Services Co., October 1, 1980), directing the U.S. Department of Energy (DOE) to carry out a high-level waste (HLW) management demonstration project at the site (without taking title to the facilities or the wastes) to demonstrate solidification techniques for preparing the HLW for disposal. Through a contractual agreement with New York State, DOE is operating the Project in conjunction with the New York State Energy Research and Development Authority (NYSERDA). DOE and NYSERDA have contracted with Westinghouse Electric Company to manage the Project through a wholly-owned Westinghouse subsidiary, West Valley Nuclear Services Co., (WVNS). WVNS is a part of the Westinghouse Government Environmental Services Company, which was formed following acquisition of Westinghouse in March 1999 by a joint venture of Morrison Knudsen Corporation and BNFL Inc. (a U.S. subsidiary of British Nuclear Fuels).

As implemented by the DOE, the West Valley Demonstration Project (WVDP) comprises two primary radioactive material processing components: the Integrated Radwaste Treatment System (IRTS) and the Vitrification Facility. The IRTS was originally designed for supernatant and sludge wash solution processing, solidification and storage, while the Vitrification Facility was designed for the stabilization and storage of radioactive high-level waste sludge and zeolite. The initial objective of the IRTS was successfully completed in 1995, resulting in 19,877 drums of solidified waste placed in safe storage at the WVDP. The current function of the IRTS is to support vitrification operations by treating certain solutions, such as off-gas condensates, that are generated during production of high-level waste glass. A simplified schematic of waste processing at the WVDP is shown in Figure B.1.1-1.

The Integrated Radwaste Treatment System comprises four component systems - the Supernatant Treatment System (STS), which decontaminates solutions from the high-level waste (HLW) tanks through an ion exchange process; the Liquid Waste Treatment System (LWTS), which employs an evaporator to concentrate solutions received from the STS and byproduct solutions received from vitrification operations; the Cement Solidification System (CSS), which can be used to solidify LWTS concentrates; and the Drum Cell, which provides storage for solidified wastes received from the CSS. Schematic representations of these activities are given in Figures B.1.1-2 through B.1.1-4.

The WVDP Vitrification Facility was designed to stabilize in a borosilicate glass matrix: radioactive high-level waste sludge that had been generated during PUREX reprocessing by NFS; contaminated ion exchange resin (zeolite) generated as a byproduct of STS operations; and acidic THOREX waste that resulted from the reprocessing of thorium fuel by NFS. The Vitrification Facility is described in WVNS-SAR-003, *Safety Analysis Report for Vitrification Operations and High-Level Waste Interim Storage*.

In addition to these primary facilities, several support facilities exist at the WVDP, including facilities to provide interim storage of radioactive and hazardous waste generated during processing and decontamination activities, effluent treatment facilities, warehouses, and maintenance and office areas.

This Safety Analysis Report (SAR) documents the safety assessment of IRTS and associated support activities and facilities and was prepared to meet the requirements of Department of Energy Order 5480.23, *Nuclear Safety Analysis Reports*, for nuclear facilities, DOE Order 5481.1B, *Safety Analysis and Review System*, for non-nuclear facilities, and WVNS Policy and Procedure WV-365, *Preparation of WVDP Safety Documents*. Introductory information relating to the WVDP Act, ancillary tasks, and supporting activities is presented in Section A.1.0 of WVNS-SAR-001, *Project Overview and General Information*.

B.1.2 IRTS, Main Plant and Support Facilities Descriptions

The WVDP site, shown in Figures B.5.1-1 and B.5.1-2, occupies approximately 220 acres of chain-link fenced area within an approximately 3,345 acre reservation that constitutes the Western New York Nuclear Service Center (WNYNSC), located approximately 55 km (35 mi) south of Buffalo, New York, in rural Cattaraugus County. The communities of West Valley, Riceville, Ashford Hollow and the village of Springville are located within 8 km (5 mi) of the plant. Several roads and one railway pass through the site, but no human habitation is permitted on the WNYNSC.

The scope of this SAR covers the Integrated Radwaste Treatment System (IRTS) processes and facilities, Main Plant facilities, and associated support facilities and activities.

Facilities within the scope of this SAR include:

- STS Facilities;
  - STS Support Building
  - Spare high-level waste Tank 8D-1 (in its function as a facility for housing STS radioactive process equipment)
  - Permanent Ventilation System Building
- LWTS Facilities (Main Plant cells - see Section B.5.2.4 for a listing)
- CSS 01-14 Building;
- Drum Cell;
- Main Plant (see Section B.5.2.4 for a definition of this facility);
- Waste Management Facilities;
  - Low-Level Waste Treatment System (consisting of the North Plateau groundwater extraction wells and associated transfer pumps, the North Plateau Pump System (NPPS), the interceptors and lagoons, and the Low-Level Waste Treatment Replacement Facility (LLW2), which houses the skid-mounted process equipment)
  - Lag Storage and Solid Waste Processing Facilities (including the , Contact Size Reduction Facility (CSRF), and Container Sorting and Packaging Facility (CSPF))
  - Hazardous Waste Storage Lockers (HWSL)
  - Interim Waste Storage Facility (IWSF)
  - Chemical Process Cell - Waste Storage Area (CPC-WSA)
  - NRC-Licensed Disposal Area (NDA)
  - NDA - Liquid Pretreatment System (NDA-LPS)
- Vitrification Test Facility (VTF)
- Warehouse Facilities; and
- Utility Facilities
  - Utility Room and Yard
  - Waste Water Treatment Facility (WWTF)

Activities within the scope of this SAR include:

- IRTS processing of solutions in Tanks 8D-1 and 8D-2, and LWTS processing of Vitrification Facility byproduct solutions;
- Transfer of contaminated zeolite in Tank 8D-1 to Tank 8D-2;
- Waste storage and processing; and
- Utility and miscellaneous facility support.

Processing equipment for IRTS components is contained in independent facility structures. Radioactive processing equipment for the STS is installed in the spare high-level waste Tank 8D-1 located in the Waste Tank Farm, as indicated schematically in Figure B.1.1-2. Additional details are shown in Figures B.5.2-1 through B.5.2-6. Radioactive components located within Tank 8D-1 include a prefilter, chiller/cooler, ion exchange columns, postfilter, and mobilization and transfer pumps. A summary of equipment installed in the tank is given in Table B.5.2-4. Radioactive processing equipment for the LWTS is entirely contained within the Main Plant. Feed and product tanks for the LWTS are located in the Uranium Product Cell, while equipment to support waste concentration (i.e., evaporation) is located in Extraction Cell 3 (Figure B.1.1-3). A summary of LWTS equipment installed in the Main Plant is given in Table B.5.2-5. Equipment associated with waste solidification processes (CSS) is located in the 01-14 Building, while solidified waste storage is provided in the Drum Cell.

Liquid and solid low-level waste treatment/processing and storage facilities have also been provided at the WVDP. Liquid low-level waste at the WVDP comprises contaminated waters resulting from area or equipment decontamination, treated solutions from the LWTS, system flushwater, filter backwash, and laundry operations. Treatment of these waste waters is performed using equipment located in the Low-Level Waste Treatment Replacement Facility (LLW2) shown in Figure B.7.7-1. Temporary storage of these liquid wastes is provided by the four lagoon storage basins.

Interim (lag) storage of solid low-level radioactive wastes (LLRW), nonradioactive hazardous wastes, low-level radioactive mixed wastes, and transuranic (TRU) and suspect TRU waste is provided in the Lag Storage Facility, Hazardous Waste Storage Facility, Satellite Accumulation Areas, and the Interim Waste Storage Facility. These facility locations are shown in Figure B.7.7-1 with a summary of the corresponding stored waste type given in Table B.7.7-3.

Solid waste at the WVDP is processed to achieve volume reduction. These processing facilities are shown in Figure B.7.7-1 and include the Contact Size Reduction Facility (CSRF), Waste Reduction and Packaging Area (WRPA) compactor, and Container Sorting and Packaging Facility (CSPF). The CSRF is located north of the Main Plant building and is connected to it. This area provides facilities for decontamination and size reduction of bulk, contact-handleable equipment including failed process equipment and tanks and vessels removed during Main Plant decontamination activities.

The WRPA compactor is located in a dock area on the east side of the Main Plant building and is used for size reduction of easily compressed low-level radioactive solid wastes such as disposable anti-contamination clothing. The CSPF, a stand-alone facility located in Lag Storage Annex #4, is used to sort, segregate, and repackage LLRW, low-level radiactive mixed waste, TRU and suspect TRU waste containers into three distinct categories. The three categories are compactables, incinerables, and meltable metals.

B.1.3 IRTS Process Description

Waste treatment processes at the WVDP have been developed to decontaminate and stabilize the neutralized high-level PUREX waste contained in Tank 8D-2 and the acidic high-level THOREX waste formerly contained in Tank 8D-4. These wastes were generated during NFS fuel reprocessing operations and together serve as the feed to WVDP process facilities[1]. Due to the nature of these wastes, the WVDP requires two distinct processing systems: the IRTS and a high-level waste system (Vitrification Facility). The assessment of the IRTS is contained in this SAR, while the assessment of the Vitrification Facility is contained in WVNS-SAR-003, *Safety Analysis Report for Vitrification Operations and High-Level Waste Interim Storage*.

Originally, wastes contained in Tank 8D-2 partitioned into a supernatant layer and an associated layer of insoluble sludge. Initial STS process operations removed and decontaminated the supernatant layer. Prior to vitrification, the sludge required additional processing to remove excess sulfate salts that would have inhibited production of an acceptable vitrified waste form. Sulfate removal and "sludge washing" were achieved in the Sludge Mobilization and Wash System (SMWS) through the addition of a dilute caustic solution which was mixed with the sludge to dissolve the sulfate salts. Following mobilization and washing, the sludge was allowed to settle and the resulting sludge wash solution was removed for processing in the STS.

Due to the concentration of sulfates in the high level waste sludge, multiple washes were necessary. When the sulfate salts had been sufficiently removed from the sludge, high level THOREX waste in Tank 8D-4 was transferred to Tank 8D-2. Waste in Tank 8D-4 was produced during fuel reprocessing using the THOREX process and was stored in an acidic state. The combined high level waste was washed a final time and the wash solution again processed in the STS.

---

[1] **Note:** DOE Order 5480.23 requires documentation of safety assessments of nuclear facility operations and facilities as well as waste management activities at these facilities. IRTS and Vitrification systems have been designed and constructed for the processing and solidification of high-level wastes in Tanks 8D-2 and 8D-4. Consequently, a necessary distinction has been made, for the purposes of this SAR, between the wastes which serve as IRTS feed, process streams and product, and those byproduct streams generated during site operations which are ultimately treated by, or stored in, the LLWTS or Lag Storage facilities.

Processing of supernatant and sludge wash solutions through the STS was completed in 1995. The STS is currently available on an as-needed basis to support vitrification operations, primarily through processing excess liquid that accumulates in Tanks 8D-1 and 8D-2. Currently, excess liquid in Tank 8D-2 to be processed through STS can be transferred from Tank 8D-2 to Tank 8D-1 by use of the High Level Waste Transfer System transfer pump 55-G-014. (Reference Figure B.5.2-8.) Solutions pumped from Tank 8D-1 are directed to STS process vessels and equipment mounted in Tank 8D-1. In these vessels and components, solutions may be diluted with water as desired, and cooled in a shell-and-tube heat exchanger. Solutions are then directed through up to four columns of ion exchange zeolite for removal of cesium. A titanium-treated zeolite is used to augment or replace the standard zeolite to remove both plutonium and cesium. Decontaminated solutions are then pumped to the Liquid Waste Treatment System for concentration.

The Liquid Waste Treatment System has been designed for the concentration of decontaminated high-level waste tank solution transferred from the STS (high-level waste processed by the STS is sufficiently decontaminated to provide for a reclassification of STS product as low-level waste). Before being sent to the LWTS, decontaminated supernatant liquid is collected in Tank 8D-3. In addition, Tank 8D-3 is also used to collect a second waste stream consisting of off-gas condensates from the vitrification Concentrator Feed Makeup Tank (CFMT). These condensates do not pass through the STS but are transferred directly to Tank 8D-3 for eventual processing through the LWTS. Waste handling and processing activities associated with the LWTS are conducted in Main Plant cells.

Product transferred from Tank 8D-3 is received in Tank 5D-15B (the primary evaporator feed tank) located in the UPC. Alternatively, Tank 5D-15A1 can be used as additional storage for feed to the LWTS. From the feed tank, waste can be transferred to Tank 5D-15A1 and/or processed through the high efficiency evaporator which reduces the volume of water in the process solution. Evaporator concentrates are cooled and can be pumped to the LWTS product Tank 5D-15A1 or 5D-15A2, and are then recycled to either Tank 8D-1 or 8D-2. Overheads from the evaporator are processed through an ion exchange column loaded with zeolite for cesium removal. This effluent is then further processed in the Low-Level Waste Treatment System in preparation for final discharge to the environment.

When it was in operation, the primary function of the CSS was the solidification of concentrates received from the LWTS. LWTS product transferred to the CSS was received in the Waste Dispensing Vessel (WDV) (70D-001) located in the Waste Dispensing Cell of the 01-14 Building. Process solution in the WDV was pumped to one of two high shear mixers in the CSS Process Room, where it was mixed with portland cement and discharged to a 269 L (71 gal) square carbon steel drum. The product drum was then sealed and staged for transport to the Drum Cell for storage. Operation of the CSS to solidify supernatant and sludge wash solutions that had been processed through the LWTS concluded in 1995 and resulted in 19,877 drums of solidified waste stored in the Drum Cell. Though the CSS has not been in operation since completion of supernatant/sludge wash solution solidification, it could be used as part of future IRTS functions.

B.1.4 Identification of Agents and Contractors

Section A.1.4 of WVNS-SAR-001, *Project Overview and General Information*, identifies the agents and contractors responsible for implementing the WVDP. The relationships between WVNS and agents and contractors is illustrated in Figure A.1.4-1 of WVNS-SAR-001.

B.1.5 Hazard Categorization

DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, provides a uniform methodology for determining a facility's hazard category. As stated in DOE-STD-1027-92, the hazard category is determined by consideration of the total inventory of radioactive material in a given facility and the consequences of an unmitigated release. Using the hazard category criteria given in the Standard, it has been determined that the highest hazard category facility within the scope of this SAR represents a category 2 hazard. As stated in the Standard, this categorization affects only the review requirements of the SAR. The Standard also states that categorization should be performed on "processes, operation, or activities" and permits facility segmentation when establishing hazard categories to avoid placing excessive requirements on simple or even co-located operations. Individual facility hazard categories were performed, based on the guidance given in the Standard, for the IRTS, Main Plant, and supporting facilities and are documented in the Consolidated Implementation Plan and Schedule for DOE Orders 5480.22 and 5480.23 (Lazzaro, 1993). Individual facility hazard categories are provided in WVDP-227, *WVDP Facility Identification and Classification Matrix*.

B.1.6 Structure of the Safety Analysis Report

The Department of Energy 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 nonnuclear hazards associated with DOE non-reactor nuclear facilities.

This Safety Analysis Report has therefore been developed to the requirements of Order 5480.23. Specifically, this SAR has been written to the guidance provided in DOE Standard DOE-STD-3009-94, which was developed by the DOE 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 SAR corresponds to the format set forth in 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 SAR is provided in Table B.1.6-1.

As stated previously, the safety assessment of high-level waste process operations is contained in WVNS-SAR-003, *Safety Analysis Report for Vitrification Operations and High-Level Waste Interim Storage*. Together, WVNS-SAR-002 and WVNS-SAR-003 present the assessments of WVDP radioactive waste processing activities. Detailed documentation of site characteristics and Project administrative programs common to both high-level waste vitrification and low-level waste operations is given in WVNS-SAR-001, *Project Overview and General Information*.

Figures and tables in this SAR are located at the end of the respective chapters. Dimensions in the SAR are in the SI system 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 digits.

REFERENCES FOR CHAPTER B.1.0

Lazzaro, J. A. September 24, 1993. *Consolidated Implementation Plan and Schedule for DOE Orders 5480.22 and 5480.23.* Memo to T. J. Rowland. (WD:93:1167.).

Nuclear Fuel Services, Inc. 1970. *Safety Analysis, Spent Fuel Reprocessing Plant, AEC Docket No. 50-201.* Revision 5.

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

__________. September 23, 1986. Change 1 (May 19, 1987.) DOE Order 5481.1B: *Safety Analysis and Review System.* Washington, D.C.: U.S. Department of Energy.

__________. September 1997. DOE Standard 1027, Change 1: *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports.* Washington, D.C.: U.S. Department of Energy.

__________. July, 1994. DOE Standard 3009: *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports.* Washington, D.C.: U.S. Department of Energy.

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

West Valley Nuclear Services Co., Inc. October 1, 1980. Public Law 96-368: *West Valley Demonstration Project Act.* West Valley Nuclear Services Co., Inc.

__________. WVDP-227: *WVDP Facility Identification and Classification Matrix.* (Latest Revision.) West Valley Nuclear Services Co.

__________. WV-365: *Preparation of WVDP Safety Documents.* (Latest Revision.) West Valley Nuclear Services Co.

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

__________. Safety Analysis Report WVNS-SAR-003: *Safety Analysis Report for Vitrification Operations and High-Level Waste Interim Storage.* (Latest Revision.) West Valley Nuclear Services Co.

TABLE B.1.6-1
LOCATION OF DOE ORDER 5480.23 REQUIRED INFORMATION IN WVNS-SAR-002

DOE 5480.23 - 8.b(3) Topics	WVNS-SAR-002 (Reg. Guide 3.26 Chapters)
a) Executive Summary	B.1.0 Introduction and General Description of the IRTS/Main Plant B.2.0 Summary Safety Analysis
b) Applicable statutes, rules, regulations, and departmental orders	Each Chapter, as appropriate
c) Site characteristics	B.3.0 Site Characteristics
d) Facility description and operation, including design of principal structures, components, all systems, engineering-safety features, and processes	B.4.0 Principal Design Criteria B.5.0 Facility Design B.6.0 IRTS Process Systems
e) Hazard analysis and classification of the facility	B.1.0 Introduction B.9.0 Hazard and Accident Analysis
f) Principal health & safety criteria	B.8.0 Hazards Protection
g) Radioactive and hazardous material waste management	B.7.0 Waste Confinement and Management
h) Inadvertent criticality protection	B.8.0 Hazards Protection
i) Radiation protection	B.8.0 Hazards Protection
j) Hazardous material protection	B.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.	B.9.0 Hazard and Accident Analysis
l) Management, organization, and institutional safety provisions	B.10.0 Conduct of Operations
m) Procedures and training	B.10.0 Conduct of Operations
n) Human factors	Each Chapter, as appropriate
o) Initial testing, in-service surveillance, and maintenance	B.10.0 Conduct of Operations
p) Derivation of TSRs	B.11.0 Derivation of Technical Safety Requirements
q) Operational Safety	B.10.0 Conduct of Operations
r) Quality Assurance	B.12.0 Quality Assurance
s) Emergency Preparedness	B.10.0 Conduct of Operations
t) Provisions for decontamination and decommissioning	B.10.0 Conduct of Operations
u) Applicable facility design codes and standards	Each Chapter, as appropriate

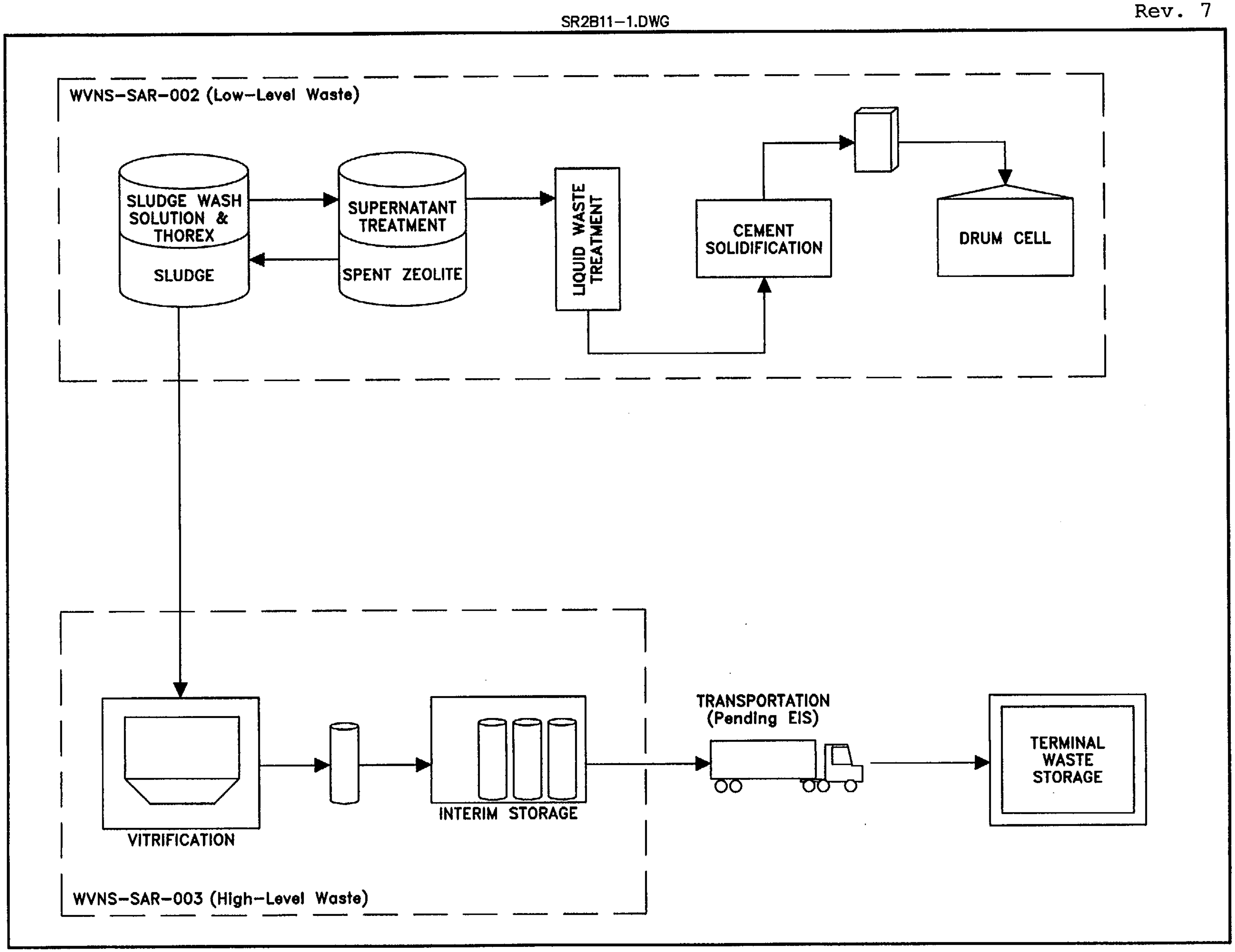
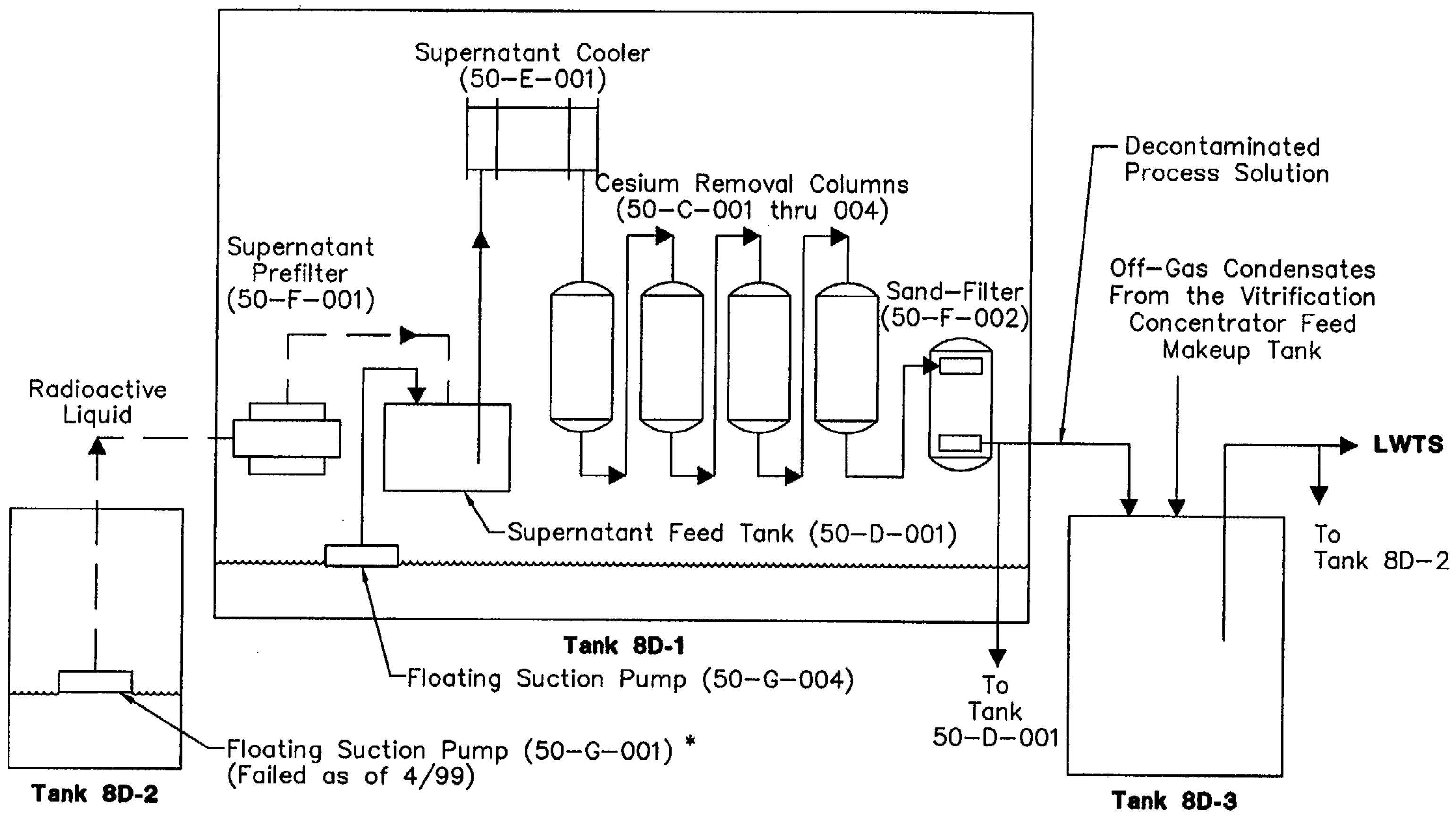


Figure B.1.1-1 Waste Processing Flow Diagram

SR2B11-2.DWG



* Excess Liquid to be Processed Through STS Can be Transferred From Tank 8D-2 to Tank 8D-1 by Use of the High Level Waste Transfer Pump 55-G-014. (Reference Figure B.5.2-8.)

VALID NOVEMBER 1999
FOR REFERENCE ONLY
NOT TO SCALE

Figure B.1.1-2 Supernatant Treatment System Process Flow Diagram

SR2B11-3.DWG

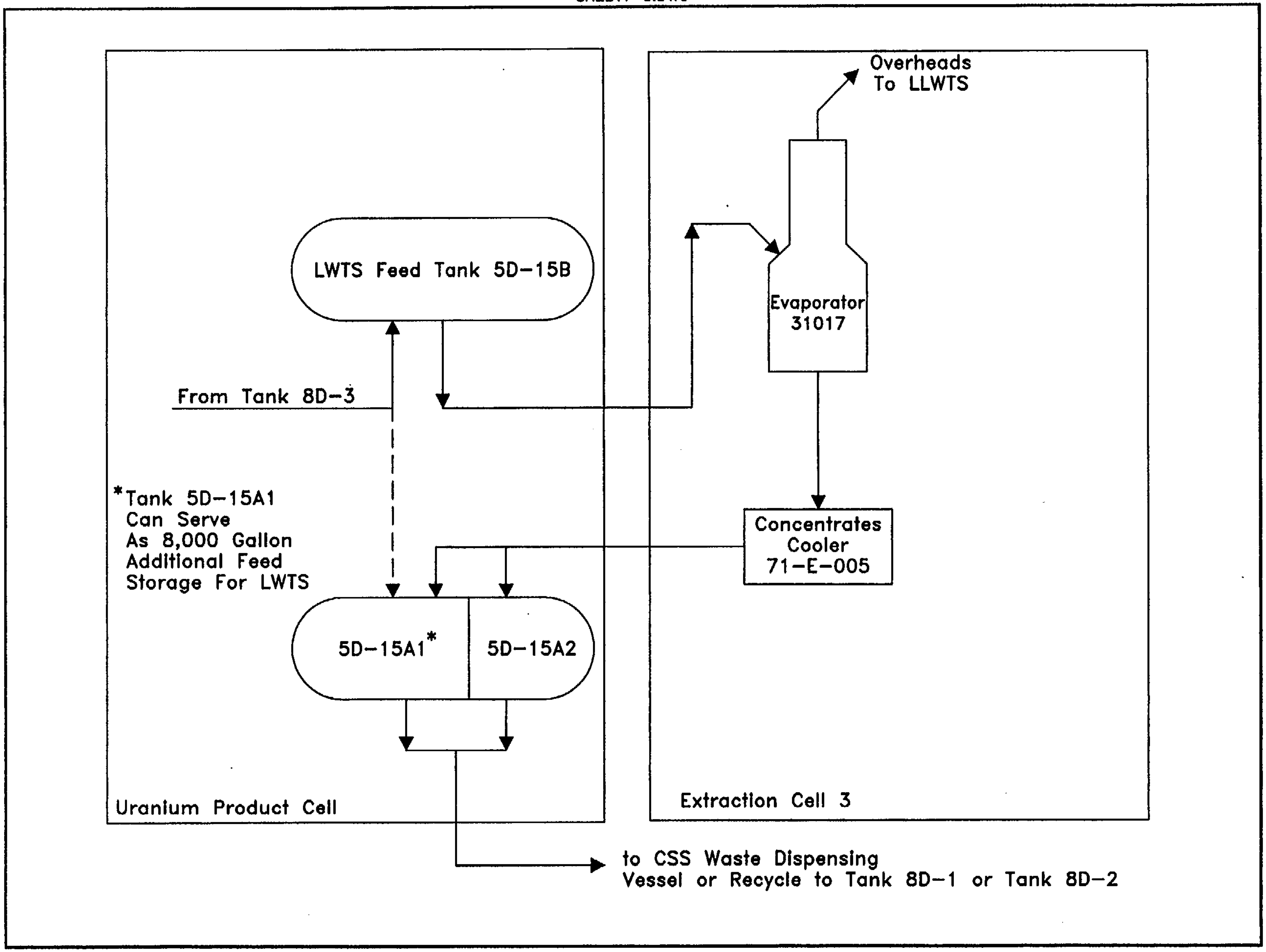


Figure B.1.1-3 Liquid Waste Treatment System Process Flow Diagram

SR2B114.DWG

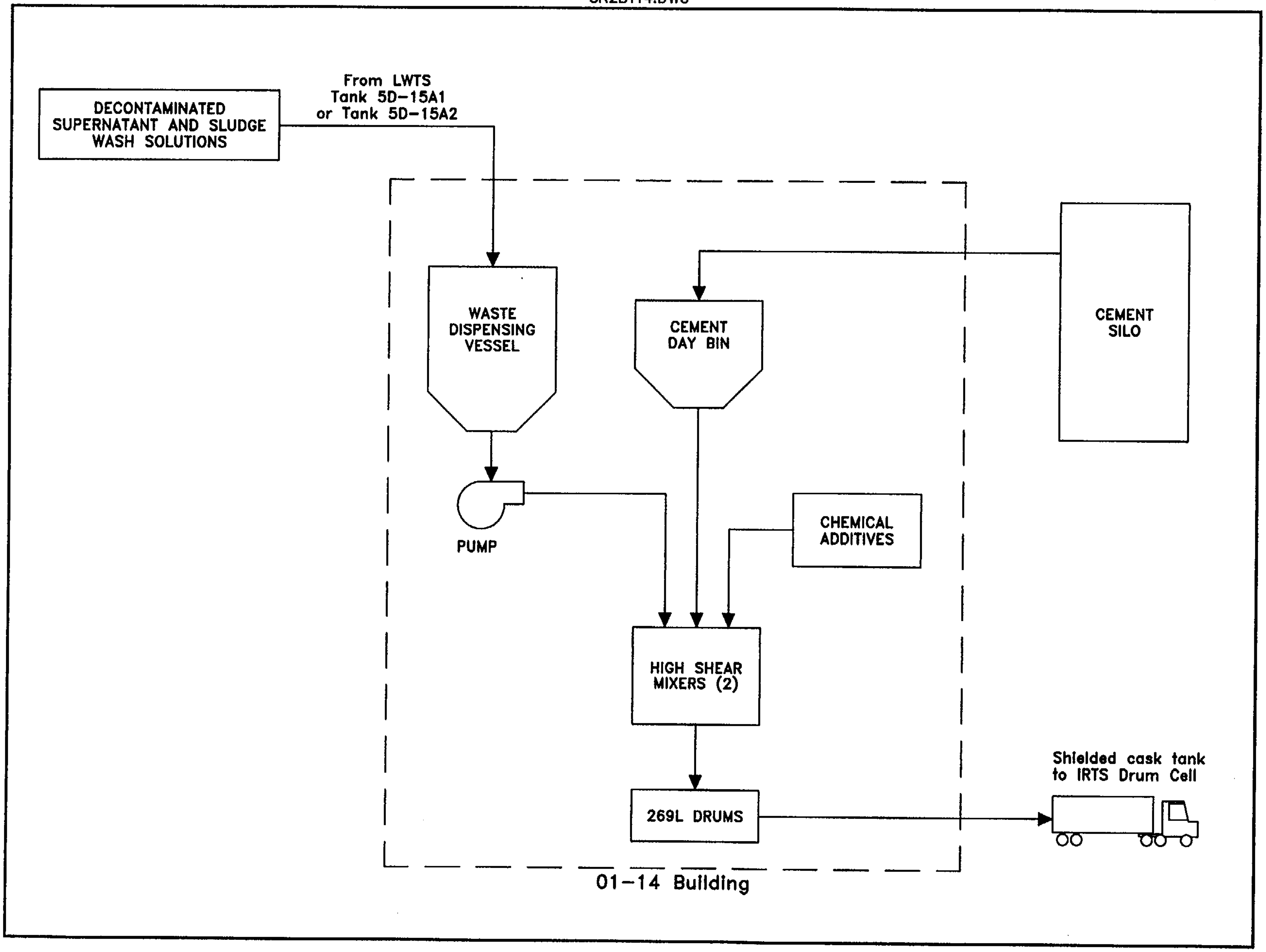


Figure B.1.1-4 Cement Solidification System Process Flow Diagram

B.2.0 SUMMARY SAFETY ANALYSIS

A summary of the safety analyses performed for the Main Plant, IRTS, and supporting facilities is presented in this chapter. In all of the accidents analyzed in this SAR, no credit was taken for any preventative or mitigative design features to reduce the risk of accidents analyzed to an acceptable level. All consequences from accidents analyzed are well below the evaluation guidelines specified in Section B.9.1.3. Doses from routine operations are 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 Sections B.8.0 and B.9.0 of this Safety Analysis Report (SAR). Evaluation Guidelines for radiological accidents are given in Figures B.9.1-2 and B.9.1-3. Evaluation Guidelines for nonradiological accidents are defined as ERPG-2 for off-site evaluations and ERPG-3 for on-site evaluations, regardless of the probability of occurrence. For the purposes of evaluating potential Unreviewed Safety Questions, these consequences present the authorization basis risk for activities conducted in facilities within the scope of this SAR.

The American Industrial Hygiene Association prepares the Emergency Response Planning Guidelines (ERPG) values to provide estimates of concentration ranges above which one could reasonably anticipate observing adverse effects. ERPG-1 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing any effects other than mild transient adverse effects or perceiving a clearly defined objectionable odor. ERPG-2 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their ability to take protective action. ERPG-3 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects (Westinghouse Safety Management Solutions, 1996).

B.2.1 Site Analysis

B.2.1.1 Natural Phenomena

Natural phenomena that impact new facility design at the WVDP include tornadoes, tornado-generated missiles, earthquakes, and snow loadings. 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. Information on tornadoes, tornado-generated missiles, earthquakes, and snow loadings at the WVDP is provided in Sections A.4.2.2, A.4.2.4, A.4.2.5, and A.4.2.6 of WVNS-SAR-001.

B.2.1.2 Site Characteristics Affecting the Safety Analysis

This SAR assesses the hazards associated with Main Plant, IRTS, and supporting facilities. Primary activities in the Main Plant include confinement of contamination in plant cells and analytical chemistry operations. Operations of the IRTS include processing of high level waste tank solutions and Vitrification Facility byproducts. All facilities covered in this SAR are located at elevations well above potential flooding.

Accidents analyzed in Section B.9.2 assess the impacts due to severe natural phenomena. The results show that in the event of a design basis earthquake or tornado, no significant quantities of radioactivity or hazardous materials would be released to the environment. Although several supporting facilities are not expected to withstand severe natural phenomena, such as an earthquake or tornado having the characteristics given in Section A.4.2 of WVNS-SAR-001, impacts associated with these failures are bounded by other accidents analyzed in Section B.9.2 of this SAR.

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.

B.2.1.3 Effect of Nearby Industrial, Transportation and Military Facilities

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

B.2.2 Impacts from Normal Operations

Chapter B.8.0 of this SAR presents both on-site and off-site dose assessments that have been performed to determine the radiological impact of normal operations at the WVDP. Occupational exposures are minimized at the WVDP through strict adherence to ALARA principles. The annual estimated worker occupational exposure for Main Plant, IRTS, and supporting facilities operations is estimated to be 18 mrem (1.8E-01 mSv), as discussed in Section B.8.4.

In calculating off-site doses, two pathways were considered: air discharges, which comprise radionuclides exhausted from the Main Plant, STS, CSS and CSRF stacks as well as portable ventilation units (PVUs) during normal operations; and routine liquid releases (as discussed in Section B.8.6). An atmospheric dispersion code

(CAP88-PC) was used to calculate the 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 3.4E-2 mrem/year (3.4E-4 mSv/year) for combined discharges from the stacks mentioned above. The dose to the maximally exposed off-site individual for the liquid pathway was estimated to be 8.1E-3 mrem/year (8.1E-5 mSv/year) based on discharges from the WVDP in 1998 and site-specific dose conversion factors for liquid releases (WVDP-065, West Valley Nuclear Services Co., Inc., October, 1990). Radiological doses from routine operations of the Main Plant and IRTS are presented in Section B.8.6.

B.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 B.9.1) are of little consequence and are not predicted to result in a significant release of radioactive or hazardous material. Qualitative radiological and nonradiological consequences from abnormal operations of the Main Plant, IRTS and supporting facilities are provided in the Process Hazards Analysis (PHA) found in Table B.9.1-1.

B.2.4 Radiological Accidents

Doses to an individual result from exposure to radioactively-contaminated material. The Main Plant, IRTS, and supporting facilities contain sources of radioactivity that have the potential for causing doses to both on-site and off-site individuals. These sources include high-level waste (HLW) stored in Tanks 8D-1 and 8D-2, radiologically-contaminated materials left over from various stages of reprocessing spent nuclear fuel, and effluent from IRTS operations. Four bounding radiological accidents associated with operation of the Main Plant, IRTS and supporting facilities have been analyzed in Section B.9.2.

One operational accident considers the effect of a pressure excursion in the Main Plant ventilation system that causes the rupture and subsequent release of the entire bank of 30 high efficiency particulate air (HEPA) filters. This accident would result in an off-site total effective dose equivalent (TEDE) of 2.7 rem (2.7E-2 Sv). Another operational accident assumes that a fire occurs in the Lag Storage Facility, resulting in the combustion of mixed, transuranic, and low-level radioactive waste. The off-site TEDE for this event is 2.9 rem (2.9E-2 Sv).

The remaining two accidents assume that a severe earthquake occurs at the WVDP. In the first accident, the earthquake causes the roof of the vault and Tank 8D-2 to collapse, exposing the tank contents to the atmosphere. This natural phenomena event would result in an off-site TEDE of 9.9 rem (9.9E-2 Sv). The second accident involves the loss of containment of LLWTS Lagoon 2 due to an earthquake with subsequent discharge to Erdman Brook. The total off-site CEDE to the maximally exposed individual is calculated to be 0.41 rem (4.1E-3 Sv). Additional information on natural phenomena events is provided in Section B.9.2.3.

B.2.5 Nonradiological Accidents

Two nonradiological accidents were analyzed for the Main Plant, IRTS, and supporting facilities. The first accident analyzed assumes catastrophic failure of two 55 gallon blue polypropylene drums of technical grade 35% hydrogen peroxide outside the oxidizer room in the Warehouse. This postulated accident resulted in a maximum concentration of 10 ppm of hydrogen peroxide at a distance of 1050 meters. The ERPG-2 value for 35% hydrogen peroxide is 50 ppm.

The second accident analyzed the rupture of a Main Plant transformer containing 586 gallons of PCB-contaminated Wemco "C" oil, a suspected carcinogen. As analyzed in Section B.9.2.2.3, this accident involved approximately 0.17 gallons of PCBs, resulting in a maximum concentration of 3.1E-3 mg/m^3 at a distance of 1050 meters. The ERPG-2 value for PCB-contaminated oil is 5.0 mg/m^3.

B.2.6 Conclusions

A summary of the consequences of accidents analyzed in this SAR is provided in Table B.2.6-1. Consequences were determined at distances of 640 m (2100 ft) and 1050 m (3444 ft) for various meteorological conditions. These distances correspond to the location of the on-site evaluation point and the site boundary, respectively, for the sector exhibiting the highest hazardous material concentration. Additionally, accident consequences were calculated for the distance yielding the maximum dose or concentration at site-specific 95% meteorology. All accidents analyzed are within the evaluation guidelines provided in Section B.9.1.3.

The failure of the 8D-2 Tank and vault results in a total effective dose equivalent (TEDE) to the maximally exposed off-site individual of 9.9 rem (9.9E-2 Sv). This represents the bounding accident for radiological releases. The spill of technical grade 35% hydrogen peroxide results in a concentration of 10 ppm of hydrogen peroxide at 1050 meters and is less than ERPG-2. This represents the bounding accident for nonradiological releases. Historical measurements indicate an average annual worker dose of 22 mrem (0.22 mSv), in keeping with the ALARA philosophy. Calculated doses to off-site persons were determined for both normal and accident conditions. Routine doses to off-site individuals are well within the requirements of DOE Order 5400.5.

B.3.0 SITE CHARACTERISTICS

Site characteristics associated with the WVDP are provided in WVNS-SAR-001, *Project Overview and General Information*, Section A.3.

B.3.1 Geography and Demography of WVDP Environs

The geography and demography of the area surrounding the WVDP site are fully described in Section A.3.1 of WVNS-SAR-001. As all accidents analyzed in Section B.9.2 have been found to be below the evaluation guidelines set forth in Section B.9.1, no significant variations in the details of the geography or demography described in WVNS-SAR-001 would affect the conclusions of this SAR.

B.3.2 Nearby Industrial, Transportation, and Military Facilities

Section A.3.2 of WVNS-SAR-001 provides information regarding facilities near the WVDP site, including industries, military installations, and transportation facilities. Based on the analyses provided in Section B.9.2, no significant impact would result at these facilities due to accidents within the IRTS, Main Plant or support areas. Furthermore, as concluded in WVNS-SAR-001, no credible accidents or abnormal operations at off-site facilities were identified which would contribute to the potential for an accident at the WVDP. All WVDP facilities are covered under a single, site wide emergency plan in WVDP-022, *WVDP Emergency Plan*, and no facilities require operators to perform a nuclear safety function.

B.3.3 Meteorology

Section A.3.3 of WVNS-SAR-001 provides information regarding meteorological conditions at the WVDP. The effects of severe natural phenomena on operations in facilities within the scope of this SAR have been assessed in the Process Hazards Analysis presented in Section B.9.1.

B.3.4 Surface Hydrology

Section A.3.4 of WVNS-SAR-001 provides a general discussion of the surface hydrological conditions at the WVDP. Specific surface hydrological conditions were not found to affect the conclusions of the analyses contained in Section B.9.1.

B.3.5 Subsurface Hydrology

Section A.3.4 of WVNS-SAR-001 provides a general discussion of the subsurface hydrological conditions at the WVDP. Specific subsurface hydrological conditions were not found to affect the conclusions of the analyses contained in Section B.9.1.

B.3.6 Geology and Seismology

Prior to Main Plant construction, soil investigations were conducted by Dames & Moore (Dames & Moore, May 8, 1963) to determine the general soil conditions at the site and to obtain soil data directly relevant to foundation design and construction. Based on its analysis of soil borings taken at the site, Dames & Moore recommended that the main process area be pile supported. Preliminary analysis of boring data indicated that shorter piles could be used if the plant was moved from the originally proposed site to an alternative location due to a significant rise in the elevation of the rock surface in that area.

As part of the characterization program, laboratory tests were conducted on soil borings to determine the shear strength of the compact soil layers and the consolidation characteristics of the silty till layers. Moisture content and dry density of all samples was also determined. A record of moisture content, density and shear strength was included on boring logs provided in the characterization report.

Piles selected for foundation support by Bechtel were 12-BP-53 steel H-piles driven into the compact glacial till soil stratum which underlies the site and consists of a mixture of sand, gravel, silt and clay. In all, 476 piles were driven to elevations between 32 and 42 feet, Plant Datum. (Elevation 100 feet, Plant Datum, corresponds to the northwest corner of the Chemical Process Cell foundation and is approximately ground level). Pile load tests and pile driving criteria developed by Dames & Moore are summarized in a report to Bechtel Corporation (Dames & Moore, July 19, 1963).

Soil conditions and site seismic criteria identified in Section A.3.6 of WVNS-SAR-001 were used in both the original design and structural review evaluations for the STS facility.

Section A.3.6 of WVNS-SAR-001 provides a complete discussion of the geology and seismology of the WVDP. The effects of severe natural phenomena on operations in facilities addressed in this SAR have been assessed in the analyses presented in Chapter B.9.

B.3.7 Validity of Existing Environmental Analyses

Environmental analyses for facilities within the scope of this SAR are contained in the following documents:

Main Plant Supplemental Analysis to the West Valley Final Environmental Impact Statement (U.S. Department of Energy, January, 1993).

STS/SMWS Revised Environmental Checklist for Tank 8D-2 PUREX Sludge Washing (Schiffhauer, August 6, 1990).

LWTS WVDP-049, Environmental Evaluation for the Liquid Waste Treatment System.

CSS WVDP-037, Environmental Evaluation for Operation of the Cement Solidification System.

Drum Cell DOE/EA-0295, Environmental Assessment for Disposal of Project Low-Level Waste West Valley Demonstration Project.

Lag Storage Environmental Checklist for Low-Level Waste Drum Supercompaction in an Addition to the Lag Storage Building and Environmental Checklist for Interim Size Reduction Facility in MSM Shop (Roberts, February, 1986), and Revised Memo to File for Operation of Site-Wide Mixed and Low Level Radioactive Waste Storage System, Including Construction of Additional, Temporary Waste Storage Facilities (Roberts, October 12, 1989).

CSRF Environmental Checklist for Low-Level Waste Drum Supercompaction in an Addition to the Lag Storage Building and Environmental Checklist for Interim Size Reduction Facility in MSM Shop (Roberts, February 24, 1986).

No significant discrepancies exist between the information provided in these documents and the information provided in WVNS-SAR-001 or in this chapter.

REFERENCES FOR CHAPTER B.3.0

Dames & Moore. May 8, 1963. *Site Investigation: Proposed Spent Nuclear Fuel Reprocessing Plant Near Springville, New York For Nuclear Fuel Services, Inc.*

__________. July 19, 1963. *Report of Consultation: Pile Load Tests and Pile Driving Criteria Spent Nuclear Fuel Reprocessing Plant Springville, New York Nuclear Fuel Services, Inc.*

Roberts, C.J. February 24, 1986. *Environmental Checklist for Low-Level Waste Drum Supercompaction in an Addition to the Lag Storage Building and Environmental Checklist for Interim Size Reduction Facility in MSM Shop.* Memo to Master Records Center. (Memo HE:86:0021.)

__________. October 12, 1989. *Revised Memo to File for Operation of Site-Wide Mixed and Low Level Radioactive Waste Storage System, Including Construction of Additional, Temporary Waste Storage Facilities.* Memo to Dr. W. W. Bixby. (Memo FB:89:0241.)

Schiffhauer, M.A. August 6, 1990. *Revised Environmental Checklist for Tank 8D-2 PUREX Sludge Washing.* Memo to C. J. Roberts. (Memo EL:90:0137.)

U.S. Department of Energy. April, 1986. DOE/EA-0295: *Environmental Assessment for Disposal of Project Low-Level Waste West Valley Demonstration Project.* Washington, D.C.: U.S. Department of Energy.

__________. January, 1993. DOE/EIS-0081: *Supplemental Analysis to the West Valley Final Environmental Impact Statement.* Washington, D.C.: U.S. Department of Energy.

West Valley Nuclear Services Co., Inc. WVDP-022: *WVDP Emergency Plan.* (Latest Revision.) West Valley Nuclear Services Co.

__________. WVDP-037: *Environmental Evaluation for Operation of the Cement Solidification System.* (Latest Revision.) West Valley Nuclear Services Co.

__________. WVDP-049: *Environmental Evaluation for the Liquid Waste Treatment System.* (Latest Revision.) West Valley Nuclear Services Co.

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

__________. Safety Analysis Report WVNS-SAR-003: *Safety Analysis Report for Vitrification Operations and High-Level Waste Interim Storage.* (Latest Revision.) West Valley Nuclear Services Co.

REFERENCES FOR CHAPTER B.3.0 (concluded)

Wolniewicz, J. C. April 19, 1994. *Technical Bases for Consolidated WVNS-SAR-002 Process Hazards Analysis*. Memo D&M:OP:0023 to File.

B.4.0 PRINCIPAL DESIGN CRITERIA

Current design criteria for non-reactor nuclear facilities are specified in DOE Order 420.1, which has been in effect since October 24, 1996. Project facilities designed by the WVDP between project inception and October, 1997, were constructed in accordance with a variety of sources. Due to the nature of the Project, a number of the Project facilities, such as the Main Plant and the HLW Tank Farm pre-date the Project and DOE's presence at the site. These facilities were constructed by NFS according to NRC license CFS-1 and various criteria in effect at the time (1964), as documented in a U.S. Atomic Energy Commission approved Final Safety Analysis Report (FSAR) (Nuclear Fuel Services, 1970).. OH/WVDP has concurred that in some cases pre-existing facilities, such as the Main Plant, may not meet the current design criteria, but are nonetheless judged to meet the Project's current needs (Bixby, W.W., July 17, 1989). Significant additions or modifications to the facility are required to comply with DOE Order 420.1 and the associated editions of the references therein. Furthermore, the Department of Energy has agreed that evaluating pre-existing facilities for compliance with DOE Order 420.1 is not required although pre-existing facilities have been evaluated for compliance with the applicable ES&H criteria of DOE 420.1.

B.4.1 Purpose of the IRTS/Main Plant

B.4.1.1 Integrated Radwaste Treatment System Feed

The IRTS was designed to process supernatant and sludge wash solutions from Tank 8D-2. This was completed in 1995, resulting in 19,877 drums of solidified cement-based waste placed in the Drum Cell. Though the CSS has not been in operation since the completion of supernatant/sludge wash solution solidification, the STS and LWTS have remained in operation to support vitrification processes. Feed to the STS consists of excess liquid in Tanks 8D-1 and 8D-2 that is not required for high-level waste glass production. This liquid is subsequently processed in the LWTS. Additionally, off-gas condensates from the Concentrator Feed Makeup Tank (CFMT) are transferred directly to Tank 8D-3 and treated in the LWTS. The total radionuclide content of Tank 8D-2 to be processed in the Vitrification System is given in Table B.4.1-1. (Recent analyses have indicated that, because of reprocessing activities, radionuclide content of tank 8D-2 is currently less than 10% of that given in Table B.4.1-1 (Barnes, S.M., September 30, 1999)).

B.4.1.2 IRTS Products and By-products

When the CSS was utilized, the product of the IRTS was solidified cement-based waste contained in 269 L (71 gallon) steel drums. The solidified product met the waste form criteria of 10 CFR Part 61 Sections 61.55 and 61.56 for low-level wastes. Table

B.4.1-2 provides a summary of radioactive waste resulting from CSS operations and currently stored in the RTS Drum Cell.

When only the STS and LWTS are used (as is currently the case), the product of the IRTS is concentrated liquid waste (which is recycled back to Tank 8D-2 or Tank 8D-1), and liquid low-level waste (which is sent to the Low-Level Waste Treatment System (LLWTS) for processing and subsequent release to the environment).

By-products resulting from maintenance and support activities of the Main Plant and IRTS include low-level radioactive liquid and solid wastes. The handling and storage of these by-products is discussed in Chapter B.7.0.

B.4.1.3 IRTS/Main Plant Facility Functions

The current function of the IRTS is to support vitrification operations by processing excess liquid in Tanks 8D-1 and 8D-2 as well as off-gas condensates from the CFMT. Excess liquid (in Tank 8D-2) can be transferred from Tank 8D-2 to Tank 8D-1 by use of the high-level waste transfer pump 55-G-014. Using the floating suction pump 50-G-004, the solution in Tank 8D-1 is cooled and then passed through zeolite-filled ion exchange columns located in Tank 8D-1 to remove a majority of cesium and some strontium and plutonium, if present. The solution is then filtered to remove suspended zeolite fines and transferred to holding Tank 8D-3 to await processing in the LWTS. Solutions are concentrated in the LWTS by evaporation. During the original operation of the IRTS, concentrated solutions were transferred to the CSS and mixed with dry portland cement and chemical additives to form a solidified waste form. For the purpose of supporting vitrification operations, concentrated liquid waste produced by the LWTS is recycled to Tank 8D-2, while liquid low-level wastes are sent to the LLWTS.

The purpose of the Main Plant is to provide housing for LWTS equipment and interim storage for vitrified high-level waste produced by the Vitrification Facility. Many areas of the Main Plant building have been placed in standby pending final decontamination and decommissioning plans. Utilization of Main Plant areas in support of the WVDP is discussed in Section B.5.2.4.

Main Plant facilities and original NFS utility and ventilation systems provide for contamination confinement and support for site activities. These facilities and support activities include:

- Housing for the Liquid Waste Treatment System and High Level Waste Interim Storage Area;

- Operations associated with the Analytical and Process Chemistry laboratory;

- Supply of utilities, including backup electricity, utility and instrument air, steam, water (including utility water, demineralized water, potable water, and water supplies for fire protection), natural gas distribution, and waste water treatment;

- Heating, ventilation and cooling for habitable Main Plant spaces;

- Collection and handling of liquid wastes within the Main Plant;

- Confinement of contamination within cells in the Main Plant; and

- Remote monitoring of 01-14 HVAC and Main Plant equipment in the Main Plant control room.

B.4.1.4 IRTS and Main Plant Interfaces With the Vitrification Facility

Consistent with the mission of the WVDP discussed in Section B.1.1, IRTS and Main Plant facilities have been utilized to the maximum extent possible. Consequently, interfaces exist between IRTS/Main Plant facilities and systems and Vitrification facilities and systems. These interfaces include:

- High-level waste preparation and mixing in Tank 8D-2 (Section B.6.3.3);
- Facility support for transfer of solid, vitrified high-level waste (EDR, CCR, CVA, COA - Section B.5.2.4);
- Interim storage of vitrified HLW in the CPC (Section B.5.2.4);
- Housing for NO_x equipment in the 01-14 Building (Section B.5.2.5);
- Ventilation support, including:
  - Main Plant Ventilation system (Section B.5.4.1)
  - Main Plant Stack (Section B.5.4.1.1.5);
- Utility support, including:
  - Fire Protection (Section B.5.3.1)
  - Electrical Supply (Section B.5.4.2)
  - Utility/Instrument Air (Section B.5.4.3)
  - Steam (Section B.5.4.4)
  - Cooling Water (Section B.5.4.5);
- Vitrification Facility Concentrator Feed Makeup Tank condensate is returned to Tank 8D-3 and subsequently processed through LWTS (Section B.6.4.1);
- Vitrification Facility Waste Header routes Vitrification Cell Sump and other non-routine waste waters back to Tank 8D-4; subsequently transferred to Tank 8D-2 for processing;

- Waste Management support, including:
  - Processing of low-level liquid wastes in the LLWTS (Section B.7.5);
  - Processing of low-level liquid wastes in the IRTS (Section B.6.4.1);
  - Solid radioactive waste interim storage (Section B.7.7);
  - Hazardous waste storage (Section B.7.8);
- Analytical chemistry support (Section B.6.7.2).

B.4.2 Structural and Mechanical Safety Criteria

Specific design criteria for the IRTS can be found in the appropriate design criteria documents listed below.

- WVNS-DC-013 *Supernatant Treatment System*
- WVNS-DC-046 *Sludge Mobilization Waste Removal System*
- WVNS-DC-025 *Liquid Waste Treatment System*
- WVNS-DC-020 *Cement Solidification System*
- WVNS-DC-037 *Radwaste Treatment System (RTS) Drum Cell*

Specific IRTS design criteria have not been relied upon in Section B.9.2 in demonstrating that the consequences of credible, bounding accidents within the IRTS are below the evaluation guidelines specified in Section B.9.1.3.

B.4.2.1 Wind Loadings

Section A.4.2.1 of WVNS-SAR-001 presents a discussion of the design basis wind loadings in place at the WVDP. Facility-specific design wind loadings for the IRTS can be found in the appropriate design criteria documents listed in Section B.4.2.

B.4.2.2 Tornado Loadings

Following the decision to cease reprocessing of spent nuclear fuel, several tornado and wind studies were performed for the NRC to determine a design basis magnitude for a tornado at the NFS site. LLNL sponsored these studies as part of a larger DOE-funded study. The LLNL study (Fujita, T.T., 1981) reviewed fastest mile-per-hour wind probabilities for the West Valley site. The results of this study were compared to an earlier study that had been performed for the NRC and the work of Simiu, et al. Another study was performed by McDonald (McDonald, J.R., July, 1981) for the same LLNL/DOE program. This study examined both tornado and straight wind probabilities. Characteristics of the WVDP design basis tornado are based on these studies and are given in Section A.4.2.2 of WVNS-SAR-001. Facility specific design tornado loadings for the IRTS can be found in the appropriate design criteria documents listed in Section B.4.2.

B.4.2.3 Flood Design

Section A.4.2.3 of WVNS-SAR-001 presents a discussion of flood protection requirements at the WVDP. Facility-specific design requirements for flood protection for the IRTS can be found in the appropriate design criteria documents listed in Section B.4.2.

B.4.2.4 Missile Protection

See Section A.4.2.4 of WVNS-SAR-001 presents a discussion of characteristics of tornado-induced missiles used at the WVDP. Facility specific design requirements for missile protection for the IRTS can be found in the appropriate design criteria documents listed in Section B.4.2.

B.4.2.5 Seismic Design

The design basis earthquake employed at the WVDP has been selected based on probabilistic assessments of earthquake exposure (see Sections A.3.6.1 and A.4.2.5 of WVNS-SAR-001). This event corresponds to a peak horizontal ground acceleration of 0.1 g, with a vertical component of two-thirds the horizontal (e.g., 0.067 g) and a recurrence frequency of 1E-3 years, consistent with the guidance of UCRL-15910 for hazard category 2 and 3 facilities. Design review response spectra and associated damping values are in accordance with NRC Regulatory Guides 1.60 (USNRC, 1973a) and 1.61 (USNRC, 1973b).

The current design basis seismic criteria are the same as that which had been applied to the design of IRTS facilities and which will be applied to new facilities and major modifications to existing facilities at the WVDP. These criteria, however, were not used in the design of the original NFS facilities. At the time of Main Plant construction (1964), no specific seismic standards had been established for nuclear fuel reprocessing facilities. In lieu of these standards, the facility was designed to meet requirements of Uniform Building Code (UBC) Seismic Zone III specifications. The UBC is a static method of analysis appropriate for non-critical facilities.

To assess the seismic safety of the then-dormant Nuclear Fuel Service reprocessing plant, structural investigations were undertaken by the Los Alamos Scientific Laboratory (LASL) and Lawrence Livermore Laboratory (LLL) in the mid to late 1970's at the request of the Nuclear Regulatory Commission (NRC) (Murray et. al., 1977 and Endebrock et. al., 1978). These studies were performed as independent analyses of an earlier assessment performed by the Chemical Plants Division of Dravo Corporation (Dravo, 1976) for NFS. The results of the LASL and LLL reports, which are summarized in Table B.4.2-1, served as the basis for the NRC conclusion that "Earthquake occurrence at the site is infrequent, and even if one did occur, the building structure itself would remain standing after the earthquake and any likely winds would not remove any significant radioactivity from the cells of the structure" (USNRC, 1982).

B.4.2.6 Snow Loading

Section A.4.2.6 of WVNS-SAR-001 presents a discussion of estimated snow loadings used at the WVDP. Facility specific design requirements for snow loadings for the IRTS can be found in the appropriate design criteria documents listed in Section B.4.2.

B.4.2.7 Process- and Equipment-Derived Loads

The parameters used to establish process and equipment loads for the Main Plant are not fully specified in the historical record of the site. Design considerations for new facilities and modifications to existing facilities will include all feasible load combinations, including process- and equipment-derived loads, in accordance with applicable building and design codes. Facility specific design requirements for process- and equipment-derived loads for the IRTS can be found in the appropriate design criteria documents listed in Section B.4.2.

B.4.2.8 Combined Load Criteria

Parameters used to establish the combined load design of the Main Plant are not fully specified in the historical site record. However, as with process- and equipment-derived loads, it may be assumed that conservative values were factored into the original design, based on performance of the systems. Facility specific design requirements for combined loads for the IRTS can be found in the appropriate design criteria documents listed in Section B.4.2.

B.4.2.9 Subsurface Hydrostatic Loadings

Section A.4.2.9 of WVNS-SAR-001 presents a discussion of subsurface hydrostatic loadings for developing design criteria for new facilities at the WVDP. Facility-specific design requirements for subsurface hydrostatic loadings for the IRTS can be found in the appropriate design criteria documents listed in Section B.4.2.

B.4.2.10 Temperature Design Loadings

The WVDP has a freeze protection program in place to prevent damage to existing equipment and facilities due to cold weather (WVDP-183, *WVDP Freeze Protection Plan*). Requirements for freeze protection are incorporated into new designs. Facilities are equipped with heating systems and are insulated to maintain inside temperatures above freezing. Main Plant building foundations and buried utilities are placed below the frost line of 1 m (3 ft). Facility specific design requirements for design temperature loadings for the IRTS can be found in the appropriate design criteria documents listed in Section B.4.2.

B.4.3 Safety Protection Systems

B.4.3.1 General

The Main Plant and the IRTS have been designed for safe operation. Specific safety protection systems are described in the following subsections.

B.4.3.2 Protection Through Defense-in-Depth

The design and operation of the IRTS, Main Plant, and Waste Management facilities provide 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 primary layers of defense are given below:

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

Details of IRTS facility design and process operations are discussed in Chapters B.4, B.5, and B.6 of this SAR while personnel training and administrative controls are discussed in Chapters B.8, B.10, B.11, and B.12. Elements of these design features and administrative controls, as they relate to defense-in-depth, are discussed below.

B.4.3.2.1 Passive Confinement Barriers

The primary safety concern in the Main Plant and IRTS is the confinement of radioactivity. Several features of the Main Plant and IRTS provide protection from the uncontrolled spread of contamination. Primary confinement for the LLW process stream in the Main Plant and IRTS is provided by tankage, process vessels, and piping. Secondary confinement is provided by cell linings and sumps, liner pans, and the concrete structures of the trenches, pump pits, tank vaults, and Main Plant cells. Typically, liners are constructed of stainless steel, cover the floor, and extend up the walls of the cells and pump pits. Liquids in these cells are accumulated in sumps and transferred to tanks via jets or pumps.

Confinement and containment barriers are designed to limit potential releases of radioactive material in accordance with ALARA practices outlined in the site Radiological Controls Manual, WVDP-010. Although the barriers are identified as confinement barriers, no credit was taken for their mitigative features in the accident analyses presented in Chapter B.9.

The primary IRTS confinement barriers of highest reliability under earthquake and tornado loading are the reinforced concrete vaults and chambers that enclose the STS process vessels and piping. These buildings and tank vaults have been designed to higher structural safety standards than required for life safety by local building codes used in the design of industrial process plants in New York State. The radiological shielding requirements for these structures generally resulted in greater reserve strength than found in conventional industrial plant building design. With a safety factor of approximately three, the connecting piping between the valve aisle, pipeway, and shield structure are the most vulnerable under earthquake.

Secondary confinement for spills from underground equipment in the Waste Tank Farm is provided by the silty till. Water is maintained around the outside of the vaults to maintain a piezometric potential greater than the level that would exist if the entire contents of either Tank 8D-1 or 8D-2 were released to their respective vaults. The head on the outside of the vault would cause the leakage to be from the outside to the inside. The water on the outside of the vaults also keeps the silty till wet and highly impermeable (very low migration rates ~ 1E-8 cm/s) to water flow.

The primary SMWS confinement barriers have sufficient reserve capacity, due to the inherent safety factors associated with the original construction as well as the conservative design incorporated in new construction, to survive extreme environmental loading (e.g., design basis earthquake and tornado events) without structural failure and leakage of high-level radioactive liquid wastes into the environment.

The margin of safety against failure of the steel tank and concrete vault, which serve as the first and second line of confinement barrier for the HLW, is conservatively estimated at six times the design basis earthquake and more than 10 times the design basis tornado. Thus, there is little potential for leakage of the high-level radioactive liquid waste into the environment even under extreme environmental loading.

The margin of safety against potential vapor released to the environment is on the order of 0.5 to 1.5 times the design basis tornado and 1.5 to 4 times the design basis earthquake, assuming the WTFVS is nonoperational. The most vulnerable link in the systems appears to be the flexible bellows connection that serves to accommodate lateral and vertical movements of the mobilization pump support structure above Tank 8D-2 and the tank access riser.

B.4.3.2.2 Waste Form and Inventory

The inventory of liquid radioactive waste in the IRTS is limited by the size of the process vessels in the system. The LWTS evaporator feed tank 5D-15B is the largest vessel in the IRTS process with a volume of 57,000 L (15,000 gal). This tank receives decontaminated solutions processed by the STS. All tanks associated with the IRTS and Main Plant are located in the heavily shielded, monolithic cells of the Main Plant. This substantial passive barrier ensures that the limited quantities of liquid radioactive waste stored in the Main Plant are adequately isolated from the environment.

The IRTS Drum Cell contains the solidified waste produced by the Cement Solidification System. Although a significant quantity of radioacitivity exists in the waste stored in the Drum Cell, this activity is tightly bound within the cement matrix of the qualified waste form received by the Drum Cell.

B.4.3.2.3 Active Confinement Barriers

Active confinement barriers in the IRTS and Main Plant have been designed to prevent the release of contamination during normal and off-normal conditions. The primary active confinement systems are building ventilation systems and vessel off-gas systems which include the Main Ventilation System, Head End Ventilation System, Vessel Off-Gas System, Waste Tank Farm Ventilation System, Permanent Ventilation System, Cement Solidification System Ventilation System, and Contact Size Reduction Facility Ventilation System. These systems ensure positive confinement of airborne radioactive material as discussed in Section B.5.4.

B.4.3.2.4 Alarms and Monitors

Alarms and monitors have been employed throughout the IRTS and Main Plant to notify operations personnel in the event of abnormal operating conditions. Ventilation systems have been provided with filter differential pressure and plenum pressure instrumentation as well as effluent monitoring equipment. These systems, discussed in Section B.6.5.1 and B.8.6, respectively, have also been provided with alarms which annunciate in the appropriate control area.

Liquid releases in areas of the IRTS and Main Plant are detected through the use of cell sump level instrumentation and alarms. The onset of conditions potentially resulting in liquid releases is detected through vessel level monitoring equipment. The pans associated with high-level waste tanks 8D-1 and 8D-2 have also been provided with leak detection capabilities.

The monitoring and alarm systems for the Main Plant are capable of being supplied with standby power during periods when normal electrical power is interrupted. The capability for supplying standby power to the monitoring and alarm systems is tested quarterly per an approved procedure.

Continuous Air Monitors (CAMS) are placed at strategic locations throughout the Main Plant to warn operators of elevated airborne contamination levels. Outputs from these monitors are continually recorded to allow identification of process upsets or changes.

Additional discussion of alarms and monitors is presented in Section B.8.3.1.4 of this SAR.

B.4.3.2.5 Personnel Training

Qualification standards and training requirements are established for all IRTS, Main Plant and Waste Management operations positions. Operators are qualified in accordance with documented performance-based training programs. In addition, certification standards are being developed for future operator positions. Training includes responsibilities and actions during emergency situations. Periodic emergency drills are performed, with follow-on critiques, to gain experience and confidence and to ensure that personnel are ready to respond to accident situations.

B.4.3.2.6 Administrative Planning and Controls

IRTS, Main Plant, and Waste Management operations are accomplished through a clearly defined organizational structure with well defined responsibilities. Operations are conducted in accordance with a protocol that has been established both procedurally and through training. Operational and maintenance activities are controlled through the use of WVNS procedures that implement applicable DOE Orders.

The WVDP Industrial Hygiene and Safety Manual (WVDP-011) establishes the policies used to control chemical and industrial hazards for all West Valley operations. Safety is ensured through facility and equipment design, protective clothing and equipment selection, personnel training, and administrative controls.

The WVDP Radiological Controls Manual (WVDP-010) 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 operation of IRTS, Main Plant, and Waste Management activities (WVDP-218). 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. Process Safety Requirements are identified per the OH/WVDP -approved radiological, nonradiological, and worker risk-reduction criteria defined in WV-365 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.

B.4.3.3 Protection by Equipment and Instrumentation Selection

Procurement of new equipment and instrumentation for operation of the Main Plant and IRTS has been done in compliance with WVNS's Quality Assurance Program which is described in Section A.12.0 of WVNS-SAR-001. Existing equipment and instrumentation is subjected to inspection and testing commensurate with its intended use. Safety Class and Quality Level designations of the individual components of the IRTS, Main Plant, and support facilities are given in WVDP-204.

Because the IRTS is a remotely-operated system, it has been designed for minimum personnel access and is heavily instrumented. Most controlled parameters have at least two sensors of dissimilar operating principles or an alternative instrument detection system that can be used in the event of failure of one sensor. Those variables that could affect the safety of operations have both an audible alarm and an illuminated face plate on an alarm panel. STS has sufficient instrumentation and controls such that it can be monitored and shutdown from the centralized control panel.

B.4.3.4 Nuclear Criticality Safety

Nuclear criticality safety is addressed in Section B.8.7 of this SAR.

B.4.3.5 Radiological Protection

Maintenance activities at the WVDP are performed in accordance with WVDP-010, *Radiological Controls Manual,* which is based on occupational radiation protection requirements given in Title 10, Code of Federal Regulations, Part 835. Shield walls, confinement and containment structures as well as administrative controls (procedures, training, etc.) are used as necessary to maintain radiation doses to occupationally-exposed personnel As Low As Reasonably Achievable (ALARA). Protective clothing (anti-C's, respiratory protection) is worn when required by radiological conditions, as prescribed in WVDP-010. In addition, system decontamination and flushing may be performed when contact maintenance is required.

B.4.3.5.1 Access Control

Area access in the Main Plant, IRTS, and supporting facilities is dictated by the requirements of the WVDP Radiological Controls Manual (WVDP-010) and 10 CFR 835.

B.4.3.5.2 Shielding

Shielding from the major sources of radioactivity in the Main Plant is provided by the massive concrete structure of plant cells and constructed shield walls as discussed in Section B.8.3. It is expected that the integrity of shield structures will be maintained for these cells in the event of severe natural phenomena, as discussed in Section B.4.2. In light of the structural ability of the shield walls to withstand tornado-induced missiles, it is reasonable to expect that integrity will also be maintained when subjected to explosion-induced missiles. Facility-specific shielding requirements for the IRTS are based on maximum concentrations of Cs-137 in the process stream as specified in the appropriate design criteria documents listed in Section B.4.2.

Routine operations in the plant are primarily associated with analytical laboratory activities. Estimated annual collective doses for this group have been calculated for the site ALARA program and are given in Table B.8.4-1. Shielding required to attenuate radiation from high-activity sources during routine maintenance activities or non-routine operations activities such as filter changeouts is determined prior to work startup.

B.4.3.6 Fire and Explosion Protection

The Main Plant, IRTS, and supporting facilities have fire detection, alarm, and suppression systems commensurate with needs as determined by the WVNS Industrial Hygiene and Safety Department and the WVNS Plant Engineering Department. Information relating to fire protection systems for the Main Plant, IRTS and supporting facilities can be found in Sections B.5.3.1. and B.8.8.

B.4.3.7 Radioactive Waste Handling and Storage

All radioactive wastes in the Main Plant, IRTS, and supporting facilities are handled per approved procedures. Liquid high level wastes are stored in remotely-instrumented and valved tanks. Low-level wastes are handled in the Low-Level Waste Treatment System. Waste minimization is achieved at the WVDP by following principles outlined in the WVDP Waste Minimization Plan (WVDP-087). Solid radioactive wastes generated at the WVDP are stored in the Lag Storage Facilities discussed in Chapter B.7.0.

B.4.3.8 Industrial and Chemical Safety

Bulk chemicals at the WVDP are received, stored, and handled per approved procedures. Administrative controls concerning industrial and chemical safety are found in the WVNS Industrial Hygiene and Safety Manual (WVDP-011), which is based on DOE Order 440.1, *Worker Protection Management for DOE Federal and Contractor Employees*, as discussed in Section B.8.5.2. Consequences of accidents involving hazardous materials are discussed in Section B.9.2. Cold chemical process systems are discussed in Section B.5.4.10.

Recognizing that major or even minor spills could result in hazards to WVDP personnel, the public, and the environment, the WVDP has implemented an Oil, Hazardous Substances, and Hazardous Wastes Spill Prevention, Control and Countermeasures Plan (WVDP-043). 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.

B.4.4 Classification of Systems, Structures, and Components

Safety Class and Quality Level designations consistent with the classification system of DOE 440.1 are provided in WVDP-204, *WVDP Quality List (Q-List)*, for the individual components of the IRTS, Main Plant, and support facilities. Retrofitting of pre-existing equipment to Safety Classes and Quality Levels to meet the requirements of the current Quality Management Manuals is not required. Procurement of existing equipment was done in compliance with the WVNS Quality Assurance Program in place at the time of construction.

Systems, structures, or components required to mitigate the off-site consequences of accidents below the evaluation guidelines given in Section B.9.1.3 are designated as safety class systems, structures or components. As demonstrated in Section B.9.2, no credit has been taken for IRTS, Main Plant, or support facilities in the evaluation of the consequences of facility accidents. All off-site consequences of the evaluated (bounding) accidents are below the evaluation guidelines. Consequently, the IRTS, Main Plant and support facilities contain no systems, structures or components required to be designated as safety class, as defined by DOE 5480.23.

B.4.5 Decommissioning

The IRTS has been designed in a manner that will facilitate eventual decontamination and decommissioning (D&D). Specific design details include the following:

- System components (such as ion exchange columns, pumps, and filters) installed in original HLW tanks have been designed to permit semi-remote removal and replacement;
- Installed in the Tank 8D-2 access sleeve are a series of spray nozzles that can be used to flush a mobilization pump as it is removed from the tank;
- Components in accessible areas (valves and instruments) are subject to either contact maintenance or modular replacement following remote decontamination via flushing of vessels, equipment, and pipes;
- Pumps, valves, and associated piping connections are designed to minimize "collection pockets" for ease of decontamination, maintenance and replacement;
- All components and lines are capable of handling a wide range of strong decontamination fluids;
- The material of construction is 300-series stainless steel to minimize incorporation of contamination into surfaces;
- Pump volutes are fitted with a volute flush line that allows flushing out the volute, impeller, and pump suction screen;
- Cell floors slope to sumps to allow for use of liquid decontamination solutions on the cell walls and exterior of vessels;
- All sumps are lined.

Final decommissioning of WVDP facilities will be addressed in appropriate safety documentation. Decommissioning activities will be performed in accordance with relevant DOE Orders.

REFERENCES FOR CHAPTER B.4.0

Barnes, S.M. September 30, 1999. *Completion of 1999 Performance Based Incentive V-3C.* Letter WD:1999:0730.

Bixby, W.W. July 17, 1989. *DOE Order 6430.1A.* Letter to R.A. Thomas CBL:010:89-0902:89:01 (DW:89:0365).

Code of Federal Regulations. Title 10, Part 61: *Licensing Requirements for Land Disposal of Radioactive Waste.*

Code of Federal Regulations. Title 10, Part 835: *Occupational Radiation Protection.*

Dravo. 1976. *Seismic Competence of the Existing Process Building at the West Valley Reprocessing Plant.* Chemical Plants Division Report No. 0476.0-15.

Endebrock, E.G, R.J. Bartholomew, J.G. Bennett, R.I. Braiser, and W.F. Corcoran. March, 1978. *Seismic Investigation of the Nuclear Fuel Services, Inc., Reprocessing Plant at West Valley, New York.* Los Alamos Report LA-7087-MS.

Fujita, T.T. 1981. *Tornado and High-Winds Hazards at Western New York Nuclear Service Center, West Valley, New York.* Report to Lawrence Livermore Laboratory.

Gates, W. E. September 10, 1992. *Report - Wind, Tornado and Seismic Vulnerability Analysis of Reprocessing Plant Guyed Stack - West Valley Demonstration Project For West Valley Nuclear Services.* Dames & Moore Report to V. A. DesCamp, WVNS, Contract No. 19-53574-C-VS.

Kennedy, R.P., S.A. Short, J.R. McDonald, M.W. McCann, Jr., R.C. Murray, and J.R. Hill. June, 1990. *Design and Evaluation Guidelines for Department of Energy Facilities Subjected to Natural Phenomena Hazards.* UCRL-15910.

McDonald, J.R. July, 1981. *Assessment of Tornado and Straight Wind Hazard Probabilities at the New York State Nuclear Service Center West Valley, New York.*

Murray, R.C., T.A. Nelson, and A.M. Davito. May, 1977. *Seismic Analysis of the Nuclear Fuel Services Reprocessing Plant at West Valley, N.Y.* LLNL Report UCRL-52266.

Nuclear Fuel Services, Inc. 1970. *Safety Analysis, Spent Fuel Reprocessing Plant, AEC Docket No. 50-201.* Revision 5.

Simiu E., M.J. Cangery, J.L. Filliben. 1979. *Extreme Wind Speeds at 129 Stations in the Continental United States.* Science 118, National Bureau of Standards. pp. 314.

REFERENCES FOR CHAPTER B.4.0 (continued)

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

__________. DOE Order 440.1A: *Worker Protection Management for DOE Federal and Contractor Employees*. Washington D.C.

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

__________. October 24, 1996. DOE Order 420.1: *Facility Safety*. Washington, D.C.

U.S. Nuclear Regulatory Commission. 1973. *Design Response Spectra for Seismic Design of Nuclear Power Plants and Damping Values for Seismic Design of Nuclear Power Plants*. Regulatory Guides 1.60 and 1.61.

__________. January, 1982. *Nuclear Regulatory Staff Safety Evaluation Report on the Dormant West Valley Reprocessing Facility*. Docket No. 50-201.

West Valley Nuclear Services Co. WV-365: *Preparation of WVDP Safety Documents*. (Latest Revision).

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

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

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

__________. WVDP-087: *WVDP Waste Minimization Plan,* (Latest Revision).

__________. WVDP-183: *WVDP Freeze Protection Plan,* (Latest Revision).

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

__________. WVDP-218: *Process Safety Requirements* (Latest Revision).

__________. WVNS-DC-013: *Design Criteria Supernatant Treatment System*. (Latest Revision).

__________. WVNS-DC-020: *Design Criteria Cement Solidification System*. (Latest Revision).

REFERENCES FOR CHAPTER B.4.0 (concluded)

__________. WVNS-DC-025: *Design Criteria Liquid Waste Treatment System*. (Latest Revision).

__________. WVNS-DC-037: *Design Criteria Radwaste Treatment System (RTS) Drum Cell*. (Latest Revision).

__________. WVNS-DC-046: *Design Criteria Sludge Mobilization Waste Removal System*. (Latest Revision).

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

TABLE B.4.1-1

TANK 8D-2 TOTAL ACTIVITY

Nuclide	Tank 8D-2 Inventory 1996 (Ci)	Nuclide	Tank 8D-2 Inventory 1996 (Ci)
H-3	1.23E+00	Ac-227	9.46E+00
C-14	5.48E-01	Th-228	7.40E+00
Fe-55	1.47E+02	Th-232	1.64E+00
Ni-59	9.93E+01	Pa-231	1.52E+01
Co-60	3.51E+02	U-232	6.53E+00
Ni-63	7.96E+03	U-233	9.07E+00
Sr-90	5.79E+06	U-234	4.33E+00
Y-90	5.79E+06	U-235	9.47E-02
Zr-93	2.72E+02	U-238	7.97E-01
Nb-93m	2.26E+02	Np-239	3.47E+02
Tc-99	1.09E+02	Pu-238	7.93E+03
Ru-106	2.30E-01	Pu-239	1.63E+03
Cd-113m	1.53E+03	Pu-240	1.19E+03
Sb-125	1.62E+03	Pu-241	6.05E+04
Te-125m	3.96E+02	Pu-242	1.58E+00
I-129	1.84E-01	Am-241	5.37E+04
Cs-134	6.91E+02	Am-242	2.83E+02
Cs-137	6.32E+06	Am-242m	2.85E+02
Ba-137m	5.98E+06	Am-243	3.47E+02
Pm-147	1.80E+04	Cm-242	2.35E+02
Sm-151	8.07E+04	Cm-243	1.16E+02
Eu-154	5.83E+04	Cm-244	6.08E+03
Eu-155	9.82E+02		

Table B.4.1-2

WVDP LOW-LEVEL RADIOACTIVE WASTE SUMMARY

Processing Operation	Volume Processed (Thousand Liters)	Cesium-137 Activity Removed (Ci)	Zeolite Used (kg)	Cement Drums Produced	Cesium-137 Activity in Cement Waste (Ci)
PUREX Supernatant	2,340	5,300,000	45,100*	10,393	302
Sludge Wash #1	1,550	910,000	11,400	7,279	201
Sludge Wash #2	1,350	130,000	1,600	754	21
PUREX/THOREX Wash	1,190	300,000	4,900	1,451	46
Totals	6,430	6,640,000	65,600	19,877	570

* 2,600 kg from nonradioactive start-up testing

TABLE B.4.2-1
SUMMARY OF REPROCESSING BUILDING SEISMIC ANALYSIS RESULTS

Cell, Area or Structure	Acceleration Resulting in Onset of Failure	
	Los Alamos[1]	LLNL[2]
GPC	Lateral pile failure at 0.14 g. No other failure below 0.2 g	Lateral pile failure at 0.11g. Onset of failure of below-grade sections at 0.09 g.
PMC	Lateral pile failure at 0.14 g. No other failure below 0.2 g	Lateral pile failure at 0.11g.
CPC	Lateral pile failure at 0.14 g. No other failure below 0.2 g	Lateral pile failure at 0.11g. Onset of failure of one wall at 0.15 g.
LWC	Lateral pile failure at 0.14 g. No other failure below 0.2 g	Lateral pile failure at 0.11g. Onset of failure of below-grade sections at 0.17 g.
XC-1,-2,-3, and PPC	Lateral pile failure at 0.14 g. No other failure below 0.2 g	Lateral pile failure at 0.11g.
ARC and OGC	Lateral pile failure at 0.14 g. No other failure below 0.2 g	Lateral pile failure at 0.11g. Failure of concrete block sections at 0.07 g.
UPC	Lateral pile failure at 0.14 g. No other failure below 0.2 g	Lateral pile failure at 0.11g.
EDR	Lateral pile failure at 0.14 g. No other failure below 0.2 g	Lateral pile failure at 0.11g.
SRR	No failure below 0.2 g.	Lateral pile failure at 0.11g.
Anal. Cells	No failure below 0.2 g.	Not analyzed.
VWR	No failure below 0.2 g.	Not analyzed.
PMCR	Separation from PMC at 0.14 g	Not analyzed.

Notes:
- Onset of shear wall failure occurs between 0.03 g and 0.07 g[1].
- Main stack integrity maintained beyond 0.1 g[3].

[1] LASL, 1978
[2] LLNL, 1977
[3] Gates, 1992

B.5.0 FACILITY DESIGN

B.5.1 Summary Description

B.5.1.1 Location and Facility Layout

The IRTS/Main Plant and associated support facilities are located within the Western New York Nuclear Service Center (WNYNSC). These facilities and their relationship to the WVDP are shown in Figure B.5.1-1.

B.5.1.2 Principal Features

B.5.1.2.1 Site Boundary

The boundary of the WNYNSC is shown in Figure B.5.1-2. This boundary encompasses approximately 3,345 acres and is irregular in shape. The site encloses the entire downstream portion of Buttermilk Creek to its confluence with Cattaraugus Creek. The perimeter of this entire area is enclosed within a 3-strand barbed wire fence.

B.5.1.2.2 Property Protection Area

The Property Protection Area comprises approximately 220 acres located near the center of the WNYNSC. This area is enclosed by an eight-foot high chain link fence topped with three strands of barbed wire. Nearly all the Project facilities are located within this area. This area is accessed through gates which are continuously manned by the Project Security Force.

B.5.1.2.3 Site Utility Supplies and Systems

Site utilities are located and controlled from a Utility Room (UR) adjacent to the process building as shown on Figure B.5.1-1. Electrical feed to the UR is routed overhead from an on-site substation which is also shown on the figure. Water to the site is provided from two man-made on-site reservoirs located approximately 1.3 km (0.8 mi) southwest of the plant. Water from the northernmost reservoir is pumped via a buried 20 cm (8 in) diameter pipe to the utility room. The southern reservoir is maintained as a backup to the primary supply. Natural gas is provided by National Fuel Gas Co. and is routed to the site via a 15 cm (6 in) high pressure gas line. This feed is regulated and metered at the Utility Room. The process building cooling tower is approximately 50 m (160 ft) south of the UR and is shown on Figure B.5.1-1. The Waste Water Treatment Facility is located approximately 50 m (160 ft) south of the cooling tower.

B.5.1.2.4 Surface Impoundments and Storage Tanks

The locations of surface impoundments are shown in Figure B.5.1-1. Primary surface impoundments at the WVDP include the Low-Level Waste Treatment System (LLWTS) lagoons and the nonradiological effluent equalization basin. A summary of surface non-radioactive water surface impoundments and outside storage tanks at the WVDP that are not discussed elsewhere in this SAR is given in Table B.5.1-1.

B.5.1.2.5 Atmospheric Release Points

The Main Plant off-gas and ventilation stack is located atop the Main Plant Building and is the primary discharge point for airborne releases from the WVDP. Ventilation discharge for the Permanent Ventilation System and 01-14 Ventilation System are to stacks atop the PVS Building and 01-14 building, respectively. Other smaller stacks associated with existing facility operations are located atop the 02 Building, Laundry Building, Container Sorting and Packaging Facility, Environmental Laboratory fumehoods, and the LLW2. Ventilation exhaust for the Contact Size Reduction Facility ventilation system is to a stack mounted on the Main Plant Building.

B.5.2 IRTS and Main Plant Buildings

B.5.2.1 Structural Specifications

The WVDP is being implemented through the use of existing technology and standard engineering practices. Engineering codes, construction codes, and standards applicable to the general design and operation of IRTS component systems are listed in Table B.5.2-1. Applicable design codes for key IRTS components are provided in Table B.5.2-2.

The Main Plant building was designed and constructed to codes and standards in effect at the time (1963). Original engineering codes, construction codes, and standards applicable to the general design of the Main Plant are listed in Table B.5.2-3.

New facility construction and major modifications to existing facilities at the WVDP conform to the criteria dictated in DOE Order 420.1.

B.5.2.2 Layout of IRTS and Main Plant Buildings

Plan and section drawings of the IRTS and Main Plant facilities are given in Figures B.5.2-1 through B.5.2-32. These drawings indicate the layout and configuration of equipment in these areas. Plan and section drawings for the Main Plant are provided only for areas housing active processes equipment.

B.5.2.3 STS/SMWS and HLWTS Facility Descriptions

Modifications have been made to the HLW tanks and their vaults in order to install STS and SMWS equipment. Major processing components that are in radioactive service are installed within Tank 8D-1 and the STS valve aisle. The decontaminated supernatant transfer pump is installed in Tank 8D-3. The sludge mobilization pumps are installed in Tank 8D-2. Zeolite mobilization pumps are installed in Tank 8D-1.

B.5.2.3.1 Tank 8D-1

Detailed discussions of the methods and safety aspects of the necessary modifications to Tank 8D-1 are presented in Brown (1985a). Major process components of the STS are located within Tank 8D-1, and the tank is used for storage of the loaded zeolite (ion exchange material) produced by the STS process. Tank modifications were made for the installation of the zeolite mobilization/removal pumps that slurry the loaded zeolite and supernatant postfilter sand from the tank bottom and transfer it to the Vitrification System.

The modifications to Tank 8D-1 included the following major steps and activities:

- Excavation to expose a portion of the tank vault concrete roof.
- Penetration of the vault roof.
- Removal of rafter sections from the tank roof and installation of cross channel beams.
- Installation of riser assemblies between the vault and tank roof. These risers are carbon steel and are welded to the tank roof.
- Penetration of the tank roof within the riser assemblies.
- Installation of STS components and zeolite mobilization pumps.

Tank 8D-1 is a reinforced carbon steel vessel, approximately 8 m (27 ft) high by 21 m (70 ft) in diameter, fully contained within a 61 cm (2 ft) thick reinforced concrete vault. The tank rests on a 30 cm (12 in) layer of perlite blocks, which in turn rests on an 8 cm (3 in) layer of pea gravel contained in a carbon steel pan. The pan rests on a second 8 cm (3 in) layer of pea gravel on the vault floor. Figures B.5.2-1 and B.5.2-3 depict the locations of STS component and zeolite mobilization pump penetrations made in the STS area of the Tank 8D-1 roof.

B.5.2.3.1.1 Function

Tank 8D-1 was originally designed and constructed to serve as a redundant spare for Tank 8D-2. Due to its size, confinement capabilities and proximity to Tank 8D-2, it has subsequently been utilized by the WVDP as a component of the STS, providing housing for major radioactive waste processing equipment and temporary storage of spent zeolite, as well as continuing to act as a spare for Tank 8D-2.

B.5.2.3.1.2 Components

Components of the STS located in Tank 8D-1 include the ion exchange columns, filters and coolers. A summary of equipment located in Tank 8D-1 is given in Table B.5.2-4.

B.5.2.3.1.3 Design Bases and Safety Assurance

The American Concrete Institute (ACI) Standard 318-77, appropriate loads and load combinations from ACI 349, the UBC Zone III, and importance factor 1.0 for seismic load definition were used in the analysis and design of the reinforced concrete portions of the 8D-1 tank top modification and vault. The American Institute of Steel Construction (AISC) Code was used in designing the structural steel elements of the structure. The loads considered in the design and/or analysis were dead loads, live loads, thermal loads, seismic loads (applied as horizontal static load to both above ground structures and as part of the dynamic soil pressure loads for below ground structures), static soil pressure, equipment and piping loads, hydrostatic loads, and construction loads.

The analysis performed by Lawrence Livermore Laboratory (LLL, May, 1978) was used to prorate and verify the calculated dynamic soil pressure. The soil pressure established for 0.1 g seismic ground acceleration was translated into an equivalent static force using a Mononobe-Okabe formula.

These loads and load combinations were utilized in the design of the steel and concrete structure. The steel framing system was designed to carry the in-tank components and piping loads and transmit them to the shield structure's concrete walls through embedded plates.

Tank 8D-1 Concrete Vault Integrity Analysis

The Tank 8D-1 concrete vault was analyzed for the following purposes:

- Maintenance of the vault integrity as a result of the loads from the shield structure and 8Q-1 pump pit;

- Verification of vault structure integrity subsequent to the removal of concrete cut-outs for the STS components and;

- Maintenance of vault integrity under a concrete bucket drop during construction.

The loads delineated above were utilized in the analysis, including the buoyant uplift due to hydrostatic pressure. These loads were applied to the vault in several different combinations and entered into the Stardyne Static Finite Element Analysis computer program. The computer output was reviewed and the most critical stress elements were then used to verify the vault reinforcement and stresses within the concrete.

Based on the assessment, Tank 8D-1 vault integrity is maintained and complies with ACI-318.

Tank 8D-1 Analysis

Since the steel roof girders were not cut and loads on the channel rafters after cutting were locally transferred to the roof girders, the steel tank as a whole was not reanalyzed dynamically or statically. The equipment suspended inside Tank 8D-1 is structurally isolated from the carbon steel tank roof. The steel liners (risers) connecting the carbon steel tank with the concrete vault contain a flexible "boot" to maintain tank and vault isolation at all times.

In summary, this structural modification approach did not cause additional stress on the original steel tank.

B.5.2.3.2 Tank 8D-2

Tank 8D-2 was originally designed for, and currently serves as, the storage vessel for high-level waste produced during NFS reprocessing operations. Modifications to the Tank 8D-2 vault and tank include:

- Coring of the vault roof.

- Removal of rafter sections from the tank roof and grinding of the roof top.

- Installation of riser assemblies between the vault and tank roof. These risers are carbon steel and are welded to the tank roof.

- Penetration of the tank roof.

- Installation of a shield plug or SMWS mobilization pumps.

Tank 8D-2 is a reinforced carbon steel vessel, approximately 8 m (27 ft) high by 21 m (70 ft) in diameter, fully contained within a 61 cm (2 ft) thick reinforced concrete vault. The tank rests on a 30 cm (12 in) layer of perlite blocks, which in turn rests on an 8 cm (3 in) layer of pea gravel contained in a carbon steel pan. The pan rests on a second 8 cm (3 in) layer of pea gravel on the vault floor. Figure B.5.2-1 provides a plan view of Tanks 8D-1 and 8D-2.

B.5.2.3.2.1 Function

Tank 8D-2 provides storage for the high-level waste generated during NFS fuel reprocessing activities, and act as a spare for waste stored in Tank 8D-1.

B.5.2.3.2.2 Components

Tank 8D-2 currently provides housing for the sludge mobilization pumps mounted in the tank risers as well as the high-level waste transfer pump 55-G-014.

B.5.2.3.2.3 Design Bases and Safety Assurance

Tank 8D-2 Concrete Vault Integrity Analysis

The Tank 8D-2 concrete vault was analyzed to verify that vault integrity would be maintained with the loads from the new access risers and subsequent to the removal of concrete cutouts for the SMWS pump components (Rockwell, August, 1985).

Detailed documentation of the concrete tank vault flotation during construction along with mitigative action has been documented by Barnstein (1965 and 1966) and Gates (1991). An extensive program of soil investigation was carried out using a series of shafts under the tank vaults to identify the state of cracking in the vault slabs as well as the voids that had developed under it.

The loads used in the analysis included the buoyant uplift due to hydrostatic pressure. These loads were applied to the vault in several different combinations and entered into the Stardyne Static Finite Element Analysis computer program. The computer output was then reviewed and the most critical stress elements used in verifying vault reinforcement and stresses within the concrete (Ebasco Services, Inc., 1986). Soil properties used in the analysis were verified by additional borings and sample testing (Gates, 1986).

In summary, based on the assessment under the load conditions and combinations discussed above, the Tank 8D-2 vault integrity has been maintained (Ebasco, 1990, 1986a).

Tank 8D-2 Analysis

The top of Tank 8D-2 was analyzed assuming the steel roof girders had not been cut and a maximum of two channel rafters had been cut. The steel tank as a whole was reanalyzed statically. The steel risers connecting the carbon steel tank were pulled in tension and supported on the vault, this results in the same roof loads as existed before modifications. In summary, this structural modification approach does not cause additional stress on the original steel tank roof (Rockwell, 1984).

B.5.2.3.3 Associated STS/SMWS Facilities

STS/SMWS Pipeway

A concrete and steel shield structure (pipeway) was erected on top of the Tank 8D-1 vault. The outer walls of the pipeway are formed by a curb with support columns to allow for piping runs. These retaining walls and columns support the structural members that span between them and support the STS equipment. The walls and columns also support the concrete roof and structural beams. Figure B.5.2-2 shows the pipeway above the 8D-1 vault with the STS components suspended from the vault roof/pipeway floor into the tank.

STS Valve Aisle

A shielded valve aisle constructed at the northwest perimeter of Tank 8D-1 contains remotely operated valves and associated instrumentation. Shield windows and manipulators permit remote operation and replacement of components. The shielded walls and roof of the valve aisle are constructed with 30 cm (12 in) of steel. The valve aisle provides secondary containment of HLW piping and valves between the operating aisle in the STS support building and Tank 8D-1. Leakage into the valve aisle or the pipeway behind the valve aisle back wall is collected in a common sump located near the back wall of the valve aisle. Sump contents are transferred to Tank 8D-2.

STS Support Building

Attached to the valve aisle is the STS support building, which contains auxiliary support systems and equipment for operation of the STS. This structure houses the demineralized water and zeolite storage tanks, associated delivery systems, control room, HVAC equipment, and utility services. The building is maintained as a radiologically "cold" area. The orientation/layout of the pipeway, valve aisle, and STS support building relative to Tank 8D-1 is shown in Figure B.5.2-2.

B.5.2.3.3.1 Function

The STS pipeway, valve aisle and support building provide maintenance access and operating areas for STS operations.

B.5.2.3.3.2 Components

The STS Support Building houses the STS control room and contains the batch tanks which supply resin for the ion exchange columns in Tank 8D-1.

B.5.2.4 LWTS/Main Plant Facility Descriptions

The Main Plant building was designed and constructed to house the equipment used by NFS for reprocessing of spent nuclear fuel. Following cessation of reprocessing activities several areas of the plant were placed in standby pending final decontamination and decommissioning. In 1981 the Department of Energy assumed control of the facility and the decision was made to utilize areas of existing facilities to the greatest extent possible. As a result several areas of the Main Plant were decontaminated and original equipment was removed. These areas were then fitted with new equipment and returned to service in support of WVDP activities. Details of facility utilization are documented in Skillern, 1986.

Areas of the Main Plant supporting WVDP activities include:

High-Level Waste Interim Storage Area (HLWISA)
The HLWISA provides support for transfer and interim storage of vitrified high-level waste processed in the Vitrification Facility. The HLWISA utilizes the following areas of the Main Plant: (1) the Chemical Process Cell (CPC), (2) the Equipment Decontamination Room (EDR), (3) the Chemical Crane Room (CCR), (4) the Chemical Viewing Aisle (CVA) and (5) the Chemical Operating Aisle (COA). The safety analysis for interim storage of HLW is documented in WVNS-SAR-003.

Liquid Waste Treatment System (LWTS)
The LWTS utilizes the following areas of the Main Plant: (1) Extraction Cell 3 (XC-3), (2) Product Purification Cell (PPC), (3) Uranium Product Cell (UPC), (4) Uranium Loadout (ULO), (5) Extraction Chemical Room (XCR), (6) Lower Warm Aisle (LWA), (7) Upper Warm Aisle (UWA), (8) Lower Extraction Aisle (LXA) and (9) Upper Extraction Aisle (UXA).

Cells within the Main Plant which directly support WVDP activities are described in the following sections.

B.5.2.4.1 Chemical Process Cell

The Chemical Process Cell (CPC) is located on the northwest side of the Main Plant building at 100 feet EPD (elevation plant datum). The cell is 28.3 m (93 ft) long north to south, 6.7 m (22 ft) wide, and 13 m (43 ft) high. The walls are of reinforced concrete 1.8 m (69 in) thick. The cell floor and the walls 0.46 (1 ft 6 in) up from the floor are lined with 304 stainless steel. Above the stainless steel, the interior surface is Amerlock-coated concrete.

B.5.2.4.1.1 Function

The function of equipment originally located in the Chemical Process Cell (CPC) was the dissolution and handling of fuel received from the General Purpose Cell (GPC). Additional cell vessels supported concentration and adjustment of process solutions. In support of the WVDP, the CPC has been designated to serve as part of the High-Level Waste Interim Storage Area (HLWISA), and as such has been utilized for the storage of canistered, solidified high-level waste received from the Vitrification Facility.

B.5.2.4.1.2 Components

Four shielded viewing windows support operations in the CPC. Three windows are located along the west wall in the Chemical Viewing Aisle (CVA). The fourth window, located in the north wall, permits viewing along the length of the cell. Shielding is provided by separated slabs of lead glass filled with mineral oil.

Equipment currently remaining in the cell includes three cranes and a power manipulator. A transfer cart housed in the EDR is available for transfers of equipment into and out of the CPC. This cart is electrically driven and can be sent into the CPC on a set of hinged rails which must be lowered into position after the CPC-EDR door is open. These hinged rails must be raised before the CPC-EDR door can be closed.

Any liquid in the CPC is collected in either the south or north sump. Liquids that accumulate in these sumps are transferred to Tank 7D-2 in the LWC and ultimately to Tank 8D-2.

Equipment installed in support of the HLWISA includes storage racks for the product waste canisters and the canister transfer cart. Equipment removed from service in the vitrification cell may also be stored in this cell until it can be removed for disposal.

B.5.2.4.1.3 Design Bases and Safety Assurance

As stated, the CPC provides storage for the solidified high level waste produced by the Vitrification Facility. Once the waste is processed from the liquid slurry form into the glass waste form and confined within stainless steel canisters, it is considerably more stable and, therefore, less mobile during accident conditions. Section C.9.6 of WVNS-SAR-003 establishes the fact that once the HLW is processed into this containerized glass waste form, substantial release to the public will not occur, even if the concrete structure confining the stored waste is damaged. For this reason, the HLWISA need not have as much structural integrity as cells containing highly dispersible radioactive materials, such as the vitrification cell. The CPC has been decontaminated and has been fitted with canister storage racks to accommodate the filled borosilicate canisters.

The CPC, EDR, and CCR were built to seismic requirements of the 1961 UBC edition which imposed requirements for a Seismic Zone III design of structures. The current edition of the UBC has lessened the seismic requirements for the WVDP site, which is now a Seismic Zone 1. Any modifications in the use of the facility which change the facility design loads, such as the addition of heavy canister storage, requires reanalysis and design in conformance with current UBC and New York building codes. The CPC has not been analyzed for its ability to withstand DBE conditions. As explained above, the stable borosilicate glass waste form present in this structure makes failure acceptable under natural phenomena accident conditions.

B.5.2.4.2 Equipment Decontamination Room

The Equipment Decontamination Room (EDR) is located at the northwest corner of the process building at elevation 100 feet EPD. The room is 13.3 m long x 9.8 m wide x 7.6 m high (43 ft 9 in x 32 ft x 25 ft). A shield door on the west side of the EDR provides an opening from the outside. Another shield door at the southeast end of the room slides west to provide access to the CPC.

B.5.2.4.2.1 Function

WVNS utilizes the EDR to serve as the transfer interface between the Vitrification Facility (VF) and the former reprocessing building. Transfer of material from the VF is through a shielded tunnel which has been connected to the room.

B.5.2.4.2.2 Components

The EDR is serviced by two 9 MT (10 ton) cranes on a single bridge with rails at elevation 121 feet 6 inches. Bridge travel is east-west. A motor-driven transfer cart runs on rails into the CPC. The transfer cart is controlled from either the EDR Viewing Aisle (EDRVA) or the north CVA. Operation of the transfer cart is described in WVNS-SAR-003.

A 15.6 m^2 (168 ft^2) section of the north EDR shield wall has been removed to permit the transfer of vitrified high level waste from the vitrification facility through the EDR. Cutting and disposition of cement block sections removed from the north EDR wall is discussed in Tundo, 1988. Additional discussion of decontamination activities in the EDR is presented in Meigs, 1985.

B.5.2.4.2.3 Design Bases and Safety Assurance

The EDR was built to seismic requirements of the 1961 UBC edition which imposed requirements for a Seismic Zone III design of structures. The current edition of the UBC has lessened the seismic requirements for the WVDP site, which is now a Seismic Zone 1. Any modifications in the use of the facility which change the facility design loads will require reanalysis and design in conformance with current UBC and New York building codes. The EDR has not been analyzed for its ability to withstand DBE conditions. As explained in Section B.5.2.4.1, the stable borosilicate glass waste form present in this structure makes failure acceptable under natural phenomena accident conditions.

B.5.2.4.3 Extraction Cell 3

Extraction Cell 3 (XC-3) measures 4.6 m x 6.5 m x 17.4 m (15 ft × 21 ft 3 in × 57 ft) high. Entry to the cell is via a personnel door from the Cell Access Aisle at ground level or through the 1.8 m (6 ft) square hatch plug in the floor of XCR. The floor is stainless steel lined to a height of 46 cm (18 in), providing a volume of 13,500 L (3,600 gal) for spill protection. Walls and ceilings are carboline coated concrete.

B.5.2.4.3.1 Function

Extraction Cell 3 currently serves as the primary location for vessels associated with the Liquid Waste Treatment System. Equipment in this cell provides for waste concentration, overheads ion exchange and collection and concentrates cooling.

B.5.2.4.3.2 Components

Equipment in XC-3 includes the LWTS evaporator, reboiler and other tanks and vessels associated with low-level waste concentration. A summary of equipment in XC-3 is given in Table B.5.2-5.

B.5.2.4.3.3 Design Bases and Safety Assurance

The original design bases for XC-3 are not contained in the historical record. Original criteria for the Main Plant is given in Table B.5.2-3. The monolithic construction of XC-3 provides assurance of confinement of radioactivity under normal and expected abnormal conditions.

B.5.2.4.4 Product Purification Cell

The Product Purification Cell (PPC) measures 6.5 m x 4.9 m (21 ft 4 in x 16 ft) and is 17.4 m (57 ft) high. Entry to the PPC is via a north wall personnel door from the Uranium Product Cell (UPC) and through an access hatch from the Extraction Chemical Room (XCR). A stainless steel liner covers the floor of the cell and extends 46 cm (18 in) up the walls, providing a volume of 14,500 L (3,800 gal) for spill protection. The remainder of the cell is carboline-coated concrete. A 3.8 L (1 gal) sump, located midway along the east wall of the cell, collects liquids to be transferred to waste holding tank 13D-8. There are no cranes, manipulators, or windows in the cell.

A concrete partition parallel to the north and south wall divides the PPC. The area south of the partition is accessible only from the floor of the PPC in the cell's present configuration.

B.5.2.4.4.1 Function

The PPC provides housing for the LWTS valve gallery located in the area of the PPC north of the shield partition.

B.5.2.4.4.2 Components

No LWTS components other than valves and equipment associated with the valve gallery are located in the PPC. The area south of the shield partition contains 28 vessels, piping and beams not required for LWTS operations. The area is highly contaminated and is currently isolated from the remainder of the PPC.

B.5.2.4.4.3 Design Bases and Safety Assurance

The original design bases for the PPC are not contained in the historical record. Original criteria for the Main Plant is given in Table B.5.2-3. The monolithic construction of the PPC provides assurance for confinement of radioactivity under normal and expected abnormal conditions.

B.5.2.4.5 Uranium Product Cell

The Uranium Product Cell (UPC) is 3.9 m (12 ft 9 in) high, 14 m (46 ft) along the east wall and 8 m (26 ft 3 in) along the north wall. The southeast corner of the cell is reduced 2.8 m (9 ft 3 in) along the south wall and 3.3 m (10 ft 9 in) along the west wall to permit access to Extraction Cell 3 from the cell access aisle.

Entry to the cell is via a door in the south end of the west wall, from the cell access aisle. The lower entry to the Product Purification Cell is through a door in the south wall of the Uranium Product Cell.

The cell floor is covered with a stainless steel liner that extends up the walls to a height of 46 cm (18 in). The remainder of the cell is carboline-coated concrete. Liquids from the floor of the cell are accumulated in a sump located approximately in the center of the cell floor. This sump drains to the interceptor. The drain is plugged with a removable plug.

B.5.2.4.5.1 Function

The UPC provides storage and spill containment for the LWTS feed and product vessels.

B.5.2.4.5.2 Components

There are two vessels in the Uranium Product Cell, each having a volume of 57,000 liters (15,000 gallons). The LWTS Concentrates Storage Tank 5D-15A has two compartments: 5D-15A1 with a capacity of 38,000 liters (10,000 gallons) and 5D-15A2 with a capacity of 19,000 liters (5,000 gallons). Tank 5D-15B serves as the LWTS feed tank. Tank 5D-15A1 also can serve as a product feed tank.

B.5.2.4.5.3 Design Bases and Safety Assurance

The original design bases for the UPC are not contained in the historical record. Original criteria for the Main Plant is given in Table B.5.2-3.

B.5.2.4.6 Uranium Load Out

The Uranium Load Out (ULO) is situated at the northeast corner of the UPC with a floor at elevation 95 feet. The ULO is 5.8 m (19 ft) high, with a length of 8.6 m (28 ft 4 in) along the north wall and 6.6 m (21 ft 10 in) along the east wall. The southwest corner of the cell is inset 2.7 m (9 ft) along the west wall and 3.3 m (10 ft 8 in) along the south wall. Access to the cell is through a doorway at the west end of the south wall. A pump niche in the ULO provides maintenance access to pumps associated with LWTS tanks in the UPC. The LWTS distribution manifold is also located in the ULO (see Section B.6.4.1.1).

B.5.2.4.7 Liquid Waste Cell

The Liquid Waste Cell (LWC) is an "L"-shaped cell located in the south central portion of the Process Building adjacent to the CPC, XC-1 and XC-2 at elevation 92 feet. The area is 4.9 m wide x 19.2 m long x 5.8 m high (16 ft x 63 ft x 19 ft). Access to the cell is from a door in the cell access aisle. The floor of the cell is lined with stainless steel extending 46 cm (18 in) up the walls, providing a volume of 42,000 L (11,300 gal) for spill protection. The remainder of the cell is carboline-coated concrete.

B.5.2.4.7.1 Function

Vessels in the Liquid Waste Cell are general purpose in nature, receiving streams from both IRTS and Main Plant areas. LWTS valving may be configured such that product solution transferred from Tank 8D-3 may be received in Tank 7D-2 in the LWC. Alternatively, off-spec LWTS solutions may be routed to Tank 8D-2 via Tank 7D-2. Vessels in this cell also receive sump effluents from several areas of the Main Plant, including LWTS and HLWISA areas.

B.5.2.4.7.2 Components

The Liquid Waste Cell contains six in-service vessels. A summary of these vessels is given in Table B.5.2-5.

B.5.2.4.7.3 Design Bases and Safety Assurance

The design basis for the LWC is not contained in the historical record. Liquids in the cell are contained within vessels. Spills resulting from a vessel or piping failure would be contained within the cell and collect in the cell sump. Sump solutions may be transferred to Tank 4D-10H.

B.5.2.4.8 Off-Gas Cell

The Off-Gas Cell (OGC) is a reinforced concrete block cell measuring 3.7 m x 9.2 m x 8.8 m high (12 ft x 30 ft 6 in x 29 ft) located at elevation 100 feet EPD south of the CPC. The cell is painted inside with carboline paint and has two floor sumps.

B.5.2.4.8.1 Function

The OGC contains the original plant vessel off-gas equipment. This system is primarily used to provide ventilation of vessels associated with the Liquid Waste Treatment System.

B.5.2.4.8.2 Components

Vessel Off-Gas equipment in the Off-Gas Cell is summarized in Table B.5.2-6.

B.5.2.4.8.3 Design Bases and Safety Assurance

The design basis for the OGC is not contained in the historical record. Scrubber solutions are contained in vessels in the cell. Spills resulting from a vessel or piping failure would be contained within the cell and collect in the cell sump. Sump solutions may be transferred to Tank 13D-8 in the Liquid Waste Cell.

B.5.2.4.9 Head End Cells

B.5.2.4.9.1 Description and Function

The head end cells (HECs) of the Main Plant are the Process Mechanical Cell (PMC), the General Purpose Cell (GPC), the Process Mechanical Cell Crane Room (PMCR),the General Purpose Cell Crane Room (GCR), the Miniature Cell (MC), the Manipulator Repair Room (MRR), the Scrap Removal Room (SRR), Chemical Process Cell (CPC), Chemical Crane Room (CCR), Equipment Decontamination Room (EDR), and the Master Slave Manipulator (MSM). The PMC and the GPC currently contain significant quantities of contamination remaining from spent fuel reprocessing activities. Other areas of the head end contain much lower levels of contamination. The PMC was used for the mechanical preparation of the fuel, which included removal of assembly hardware and the shearing of the fuel into short sections, in preparation for chemical dissolution operations in the CPC. The GPC was used for collection and storage of the sheared fuel prior to dissolution operations and for packaging and transfer of the leached hulls for disposal. The GPC is depicted in Figure B.5.2-10. The PMC is depicted in Figures B.5.2-11 and B.5.2-12.

Process Mechanical Cell

The PMC is located on the ground level of the Main Plant building. It is 16 m (52 ft) long north to south, 4 m (12 ft) wide, and 8 m (25 ft) high. A large rectangular concrete pedestal in the center of the floor serves as the base for the saw table. The cell is lined with stainless steel 6.3 m (21 in) up from the floor. Above the stainless steel, the interior surface is carboline-coated concrete. The upper half of the north wall is a 0.9 m (3 ft) thick concrete shield door that leads to the PMC Crane Room (PMCR).

The 2.4 m by 2.4 m (8 ft by 8 ft) PMC shielded transfer port and airlock is located on the 100 ft elevation adjacent to the east wall of the PMC. It was installed in the EMOA to permit small cart transfer of mechanical parts into the cell without exposure to personnel. At an elevation of 100 ft, the LWC is located south of the PMC. At an elevation of 114.5 ft, the Ventilation Supply Room lies east, the Ventilation Wash Room (VWR) lies south, and the Chemical Operating Aisle (COA) lies between the CPC and PMC.

The shield walls of the PMC are constructed of ordinary concrete with an average density of 2.36 g/cm^3 and a thickness of 1.7 m (5.5 ft). There are six lead glass oil-filled shielded viewing windows. The PMC-A, -B, -C, & -D shield windows are along the west wall; PMC-A being at the south end of the wall. Windows PMC-E and -F are in the northwest and southeast corners respectively. Windows A-D, which are 79 cm by 81 cm (31 in by 32 in) are intended to permit observation into the cell from the West Mechanical Operating Aisle (WMOA). Window PMC-F allows viewing from the East Mechanical Operating Aisle (EMOA). Above each window are two manipulator ports.

The PMC is accessible from the following seven locations:

1) A 0.91m (3 ft) thick vertical lift shield door that connects with the Process Mechanical Crane Room;
2) A 53 cm (21 in) diameter floor hatch in the southeast corner that connects with the FRS;
3) A 56 cm (22 in) square hatch in the east wall that connects to the shuttle room within the EMOA;
4) A ceiling hatch in the southwest corner that connects with the analytical Sample Storage Cell;
5) A 51 cm (20 in) diameter chute in the floor at the northeastern end that connects with the Miniature Cell (MC);
6) A 0.91 m by 1.2 m (3 ft by 4 ft) floor hatch at the north end that connects with the GPC; and
7) A 20 cm (8 in) diameter shear discharge chute that connects with the GPC.

A screened floor drain is located in the middle of the cell at its north end and another at the south end. These drain by gravity via a 7.6 cm (3 in) diameter drain line embedded within the concrete floor of the cell to the GPC sump.

The PMC contains two crane bridges of 2 ton capacity, each traveling on rails 6.5 m (21 ft) above the cell floor. Another set of rails 5.6 m (18.25 ft) above the floor carries a 1 ton power manipulator. The crane bridges travel in a north-south direction on the upper of two sets of rails. Each bridge is equipped with a trolley-mounted hoist capable of lifting two tons. Mechanical stops limit the travel of the bridges and trolleys. Limit switches are provided for the fully retracted and fully extended cable and for slack line on the hoist.

General Purpose Cell

The GPC is located below grade beneath the north ends of the CPC and PMC, the south end of the Scrap Removal Room (SRR) and under the MOA. The GPC measures 13.9 m long by 3.2 m wide and is 5.94 m high (45 ft 7 in x 10 ft 5 in x 19 ft 6 in). The north wall is constructed of high density concrete. All other walls, ceiling and floor are constructed of ordinary concrete. The GPC north and south walls are 1.2 m (4 ft) thick, the east wall is 1.3 m (4 ft) thick, and the west wall is 1.1 m (4 ft) thick. The floor is 0.91 m (3 ft) thick at the east end, tapering to 0.45 m (2 ft) at the west end. The ceiling is 1.7 m (6 ft) thick.

The floor is sloped to capture liquid run-off into a stainless steel-lined sump. The floor from the west wall to the sump, 2.4 m (8 ft) from the west wall, is sloped from an elevation of 75 ft to an elevation of 74 ft 3 in near the east wall. Around the sump is the pan area of the cell where the floor drops 18 cm (7 in) to an elevation of 73 ft 6 in and levels out to the east wall. The floor and 4.9 m (16 ft) up the walls are lined with stainless steel. The sump receives liquids from the GPC as well as liquids from the floor drains and hatch in the PMC.

The sump is equipped with a level indicator and both high and low-level alarms. Modifications have been made for the sump level-indicating equipment since the original equipment is nonfunctional. The sump contents would be transferred by two steam eductors via a 5.1 cm (2 in) diameter line to the hold side of tank 4D-10, located in the Liquid Waste Cell (LWC), but these eductors are currently nonfunctional. There is no underground piping in the GPC.

There are three oil-filled lead glass radiation shielding windows, 2M-6A to C, on the north wall, each with two manipulator ports over them. Shield windows have dimensions of 1.2 m by 1.2 m (4 ft by 4 ft) and contain five lead glass panes. A 1.2 m by 1.2 m (4 ft by 4 ft) carbon steel shutter, 2M-7A to C, covers each shielding window. In addition to the manipulator ports/plugs, there is a periscope and maintenance port in the north wall.

The GPC has three ceiling hatches: a one-ton stainless steel hatch measuring 1.2 m by 0.91 m (4 ft by 3 ft) located at the east end of the GPC and shared with the PMC; a hatch measuring 0.76 m by 1.6 m (2.5 ft by 5.25 ft) located in the GPC southwest corner and shared with the CPC; and, a carbon steel hydraulic operated hatch with dimensions of 0.99 m by 1.2 m (3.25 ft by 4 ft) located at the GPC northwest corner and shared with the SRR. There is also an 20 cm (8 in) diameter stainless steel chute leading from the bundle shear in the PMC to the Fuel Basket Loading Station in the GPC.

Ventilation flow into the GPC is through the floor hatches in the SRR, PMC and CPC. Air flow from the PMC is approximately 0.94 m^3/s (2,000 cfm). A smaller volume of air enters the GPC through the shear discharge chute. Air is exhausted from the GPC to the HEV exhaust filter inlet plenum via a 0.91 m (36 in) duct. A more detailed discussion of the Head End Ventilation system is provided in Section B.5.4.1.

B.5.2.4.9.2 Components

The PMC contains the following equipment: shielded viewing windows, in-cell lighting, crane room shield door, bridge cranes, power manipulator, master-slave manipulators, and a fire protection system. The GPC contains the following equipment: shielded viewing windows, in-cell lighting, crane room shield door, bridge crane, power manipulator, master-slave manipulators, sump eductors, and a fire suppression system. Most, if not all, of the equipment in the PMC and the GPC is out of service (Vance, 1986.)

B.5.2.4.9.3 Design Bases and Safety Assurance

The structural design basis for the Head End Cells is not contained in the historical record.

B.5.2.4.10 Inactive Cells and Rooms

The following subsections address cells and rooms in the Main Plant that do not currently support WVDP activities.

B.5.2.4.10.1 Extraction Cells 1 and 2

Extraction Cell 1 (XC-1) and Extraction Cell 2 (XC-2), along with XC-3 which is discussed in Section B.5.2.4.3, are aligned perpendicularly to the south end of the CPC. Roof plugs provide access to all three of these cells which were originally designated as "contact maintained cells," and XC-2 and XC-3 can be entered through doors from the Cell Access Aisle. XC-1 measures 4.9 m x 5.0 m x 16.8 m high (16 ft x 16 ft 6 in x 55 ft high), and XC-2 measures 6.4 m x 6.3 m x 17.5 m high (21 ft x 20 designated as "contact maintained cells," and XC-2 and XC-3 can be entered through doors from the Cell Access Aisle. XC-1 measures 4.9 m x 5.0 m x 16.8 m high (16 ft x 16 ft 6 in x 55 ft high), and XC-2 measures 6.4 m x 6.3 m x 17.5 m high (21 ft x 20 ft 9 in x 57 ft 6 in high). The floors and walls in XC-1 and XC-2 are stainless steel lined and carboline coated in a manner similar to that described for XC-3. *Estimation of Activity in the Former Nuclear Fuel Services Reprocessing Plant* (Wolniewicz, J.C., March 1993) estimates that as of 1993, XC-1 contains 570 Ci of Cs-137, 20.1 g of U-233, 953 g of U-235, 125 g of Pu-239, and 9.02 Ci of Am-241, and that XC-2 contains 4.30 Ci of Cs-137, 15.1 g of U-233, 717 g of U-235, 94.6 g of Pu-239, and 0.0681 Ci of Am-241.

After dissolution of fuel in the CPC to form a process fuel solution, the solution was put through a Purex solvent extraction process which separated and recovered uranium and plutonium as nitrate solutions. This was accomplished in a series of perforated-plate pulse columns that had the associated equipment necessary for metering, transferring, and intermediately storing solutions. Continuous solvent extraction was achieved by 10 pulse columns with various functions. All of these columns are fabricated from 304-L stainless steel. Seven columns remain in the Main Plant, with three located in XC-1 and four located in XC-2. Three columns which were originally located in XC-3 were removed to accommodate equipment for the LWTS. Seven of the 10 columns have an overall length of approximately 12.8 m (42 ft), and a "barrel" inside diameter of 26 cm (10.25 in), which comprises most of the columns' length. Generally, vessels (e.g., columns, tanks, pots) in XC-1 and XC-2 are empty. *History of Decontamination*, (Riethmiller, G.E., June 1981) states that "vessels are empty" that supported the partition cycle, uranium cycles, plutonium cycle, solvent systems, acid recovery system, uranium purification system, and the plutonium purification system.

B.5.2.4.10.2 Acid Recovery Cell and Acid Recovery Pump Room

Acid recovery was accomplished through the use of two waste evaporators, following which the acid was subjected to acid fractionation that concentrated the acid to a reusable molarity. The Acid Recovery Cell (ARC) is shown on Figure B.5.2-16, and measures 8.8 m x 9.3 m (28 ft 9 in x 30 ft 6 in) to the ceiling beneath the Off-Gas Aisle at elevation 39.0 m (128 ft). A section, 3.4 m x 3.2 m (11 ft 3 in x 10 ft 6 in), extends up to elevation 43.6 m (143 ft). This extension houses the upper part of the acid fractionator (7C-3). Access to the ARC is via a man door from the south stairs at elevation 34.0 m (111 ft 6 in) or through a 1.1 m (3 ft 6 in) hatch in the Off-Gas Acid Recovery Aisle at elevation 39.9 m (131 ft). There is a manway on the north side of the ARC that is open to the Off-Gas Cell. History of Decontamination states that ARC decontamination efforts did not involve the use of chemicals, and that all vessels are empty except for the general purpose evaporator (7C-5), which indicated a level of 24.5% in 1981, and has a total capacity of approximately 17 m3

The Acid Recovery Pump Room (ARPR), at elevation 30.5 m (100 ft), measures 4.9 m x 6.9 m x 3.3 m high (16 ft x 22 ft 10 in x 11 ft high). A pump niche, approximately 0.9 m x 0.9 m x 0.9 m high (3 ft x 3 ft x 3 ft high), is located in the northeast corner of the ARPR. Floors, walls, and the ceiling are carboline coated. Entry to the ARPR is via a door in the east wall, from the south stairway. Some equipment originally in the room, including the 7G-10 jet, 7E-11 cooler, and 7E-12 cooler, and some of the auto valves, have been removed from the ARPR to waste burial.

B.5.2.4.10.3 Hot Acid Cell

The Hot Acid Cell (HAC) is shown on Figure B.5.2-14, and measures approximately 6.6 m x 6.6 m (21 ft 6 in x 21 ft 6 in). The main components located in the HAC are the hot acid storage tank (7D-11) and the hot acid batch tank (7D-12). History of Decontamination indicates that these tanks are empty, and that they were extensively flushed during decontamination activities.

B.5.2.5 Cement Solidification System 01-14 Building

The CSS facilities located in the 01-14 building include the Waste Dispensing Cell (WDC), the Process Cell, and the Drum Loadout Area. The Waste Dispensing Cell contains the Waste Dispensing Vessel. The Process Cell contains the equipment for mixing waste received from the WDC and equipment for handling filled cement drums. The Drum Loadout Area is used to store full cement drums prior to shipout for transport to the Drum Cell.

A separate cell in the 01-14 Building contains equipment for the treatment of Vitrification Facility process off-gas.

B.5.2.5.1 Function

The purpose of the 01-14 building is to provide housing for the equipment in radioactive service in the CSS. The CSS feed vessel is located in the Waste Dispensing Cell. Equipment for cement/waste mixing and drum handling are contained in the Process Cell. Other areas provide housing for dry cement storage and ventilation system equipment.

The 01-14 building also provides housing for Vitrification off-gas treatment equipment including a heater, HEPA filters, blowers and NO_x abatement removal equipment. Anhydrous ammonia, used for NO_x abatement, is stored in a 3,200 L (850 gallons) above-ground Ammonia Storage Tank (64-D-004) located adjacent to the 01-14 Building. Safety issues associated with this equipment are addressed in WVNS-SAR-003.

B.5.2.5.2 Components

The Waste Dispensing Cell contains Tank 70D-001 (the CSS Waste Dispensing Vessel). Process Cell equipment includes the waste dispensing pump, two high-shear mixers, the drum fill head, the decant pump, the empty drum air lock, the drum lid crimper, and the drum robot smear station. This equipment is designed to mix low-level radioactive waste with cement, fill 269 L (71 gal) drums, cap the drums, survey the drums for contamination, and weigh drums and overpack drums (if necessary). A summary of CSS components in the 01-14 Building are given in Table B.5.2-7.

B.5.2.6 <u>Drum Cell</u>

The Drum Cell is located approximately 500 meters to the southeast of the Main Plant. The purpose of the Drum Cell is to provide a shielded secure area for placement of not greater than Class C solid waste. The temporary weather structure is a Butler type building that encloses the Drum Cell and waste handling equipment.

Approximately 19,877 drums of cemented waste are stored in the Drum Cell. The square, steel drums have a volume of 269 L (71 gal). There are approximately 570 curies (2.1×10^{13} Bq) of Cesium-137 contained in the 19,877 drums. The curies are spread among the drums in a generally uniform manner. On average, the drums contain approximately 9.7 nCi (3.6×10^{11} nBq) of alpha activity per gram of cement.

B.5.2.6.1 Function

The function of the Drum Cell is to provide storage of cement drums produced by CSS operations.

B.5.2.7 <u>Warehouse Facilities</u>

The WVDP operates three warehouse storage facilities. The Receiving Warehouse (Main) is a large metal building located approximately 100 m (330 ft) south of the Main Plant. This facility is the central shipping and receiving area for the WVDP.

A New Warehouse (Main 2) is located approximately 100 m (330 ft) west of the Receiving Warehouse. The facility is a metal structure on a concrete pad and is used for storage of large equipment and bulk chemicals. The main portion of the new warehouse contains nonreactive chemicals and other equipment and supplies for the site. The south end of the warehouse is divided into five individual, concrete block rooms for separate storage of acids, caustics, flammables, oxidizers, and "health hazard" materials. All of these storage rooms have grated floors set on top of berms to control spills, and individual ventilation and fire suppression systems. The vent systems discharge directly to the atmosphere. One-gallon containers are stored on reinforced shelves and 55-gallon drums are stored on pallets. Entry to each storage room is controlled by the Site Material & Receipt Manager.

The third facility is the Bulk Storage Warehouse (BSW). This building is located approximately 2.2 km (1.4 miles) southeast of the Main Plant. It is presently used by the Project for long term storage of large items such as old office equipment. Although located within the WNYNSC, there is no direct on-site route to this building. Access is by way of public roads.

B.5.3 Support Systems

B.5.3.1 Fire Protection System

Several fire hazards analysis (FHA) documents have been developed for various WVDP facilities within the scope of this SAR. These documents contain extensive fire protection system design and installation-related information. The subject FHA documents are identified in Section B.8.8 of this SAR. Fire suppression systems at the WVDP consist of water, halon, dry chemical, high expansion foam and clean agent systems. These systems are discussed below.

B.5.3.1.1 Water Supply

Water supplies for the fire protection system are provided by two on-site reservoirs containing approximately 2,100,000 m^3 (560,000,000 gal). Water is pumped from the reservoir by one of two pumps to the clarifier system and to the water storage Tank 32D-1. The capacity of the tank is 1,800,000 L (475,000 gal) with 1,100,000 L (300,000 gal) reserved for fire fighting. An electric-driven pump provided with a diesel backup is used to pump water from the storage tank through the system. Both pumps are rated at 63 L/s (1,000 gpm) at 690 kPa (100 psi). The electric motor driven fire pump is arranged to start automatically. The diesel pump subsequently starts automatically if the system water pressure continues to drop. Both fire pumps are located in the fire pump house located at the base of the water storage Tank 32D-1. A jockey pump is connected between Tank 32D-1 and the fire service main to maintain system pressure at greater than the fire pump starting pressure.

B.5.3.1.2 Water Distribution

Water is distributed throughout the site through a system of underground water mains. Dry barrel fire hydrants are provided to allow access to water for use in fire fighting. Fire water service mains also provide water to building sprinkler systems.

B.5.3.1.2.1 Wet Pipe Sprinkler Systems

Wet pipe sprinklers have their piping filled with water under pressure. When heat from a fire activates an individual sprinkler head, water is released from the system. Each sprinkler head activates individually when it is heated to its design temperature.

Wet pipe sprinklers are used only in heated facilities, where freeze protection is not a concern. These areas include: Receiving Warehouse, Annex north, Annex south, Annex conference rooms, Test and Storage Building, PVS Building, New Warehouse, CSS/LWTS Control Room, Fire Pump House, OB-1, Expanded Laboratory, Utility Room, Utility Room Expansion, Laundry, and the Main Plant Office Building. In cases where there is a need to provide sprinkler protection in an unheated area a non-freezing system is used.

B.5.3.1.2.2 Dry Pipe Sprinkler Systems

Dry pipe sprinkler system piping is maintained under air pressure which keeps the dry pipe valve closed. Air pressure is controlled automatically by an air maintenance device such as a dedicated air compressor, or the plant air system. Dry pipe sprinklers systems are installed where freezing temperatures may make wet pipe sprinkler systems inappropriate. Valves for dry pipe sprinkler systems are installed in a heated enclosure.

Areas provided with dry pipe sprinkler systems include: Receiving Warehouse, STS Building, Vitrification Test Facility and Trailer T.

B.5.3.1.2.3 Deluge Systems

The arrangement of deluge system piping is similar to that of a wet pipe system with one primary difference: open sprinkler heads (or nozzles) are used so that when the deluge valve controlling the system operates, water will flow from all the sprinkler heads.

The deluge valve is activated by a loss of supervisory air in a pilot line, or the activation of an initiating device. When the heat from a fire reaches the pilot line, it will operate a valve or will melt the link in the closed heads on the pilot line and allow the supervisory air to escape. This creates a difference in pressure in the release device, causing the deluge valve to trip.

Areas protected by deluge systems include: Cooling Tower, Expanded Lab, UR Transformer, Vit Diesel Generator Room, and the 01-14 Ammonia Tank.

B.5.3.1.2.4 Preaction Systems

Preaction systems are employed in areas where it is particularly important to prevent the accidental discharge of water. The detection system chosen to activate the preaction valve has high reliability and a separate alarm/supervisory signal to indicate status. The detection system is also designed to be more sensitive than the closed sprinklers in the preaction system, but should not cause false alarms and unnecessary activation of the preaction valve. Preaction systems are employed in the Vitrification Control Room and the Instrument and MCC rooms of the 014 Building.

B.5.3.1.2.5 Wet Standpipe Hose Stations

Standpipe systems provide fire hose connections within a building. The hose connections are supplied with water from the underground water main. The hose connections on site are equipped for use with 3.8 cm (1.5 in) fire hoses.

B.5.3.1.3 Halon Systems

Halon extinguishing systems consist of a pressurized gas cylinder, a means for automatic and manual actuation, discharge piping and nozzles, a system control panel, and local and remote alarms. Operation of an actuating device initiates an alarm condition at the system control panel. The control panel activates local and remote alarms, and also operates the control head on the halon cylinders. Once the control head on the cylinder has fired the halon is discharged through the discharge piping and the nozzle to extinguish a fire.

Halon systems currently on-site are in the Vitrification Control Room and the Heating and Ventilation Operator Station.

In addition to halon, systems utilizing FM-200, a CFC-free extinguishing agent are also in use. These systems are provided in the Dosimetry Computer Room (Trailer 61), Main Computer Room, URE Switchgear Room, and the Container Sorting and Packaging Facility.

B.5.3.1.4 Dry Chemical Systems

Dry chemical extinguishing systems at the WVDP have a fixed supply of dry chemical agent connected to fixed piping. Nozzles are arranged to discharge the extinguishing agent onto the burning surface. The extinguishing agent is discharged under pressure by a discharge gas. Actuation of the system can be either manual or automatic. Automatic operation of fixed dry chemical systems is by a bi-metallic fusible link or a heat detector located above the hazard.

B.5.3.1.5 Foam Suppression System

The Interim Waste Storage Facility (see Section B.7.8) is provided with a high expansion foam system with one 3,304 L/s (7000 cfm) foam generator. Foam is generated at a rate sufficient to produce a 2.7 m (9.0 ft) deep layer of fire-suppressing foam across the floor of the IWSF in one minute.

B.5.3.1.6 Portable Fire Extinguishers

Dry chemical, pressurized water, and CO_2-type portable fire extinguishers are located throughout the site to provide for incipient stage fire fighting.

B.5.3.1.7 Fire Alarm System

Fire detection alarms (smoke or heat detectors) are located in various areas throughout the site and water flow alarms are provided on each sprinkler system. Manual pull stations have also been provided in some areas of the site. These alarms annunciate at the alarm monitoring station located in the main security gate house. In addition to fire alarms, the Alarm Monitoring Station also is capable of monitoring low building temperature, air supervision on dry pipe systems, and valve supervision.

B.5.3.1.8 Lightning Protection

The electrical specifications for the construction of the Main Plant (Bechtel, 1964) invoke the applicable rules and regulations of the American Standards Association (known as the American National Standards Institute [ANSI] since 1969), the National Electrical Manufacturer's Association, and the "National Electrical Code," currently published by the National Fire Protection Association (NFPA). The subject electrical specifications also stipulate that (1) non-current-carrying metal parts of electrical apparatus, metallic conduit, transformer secondaries, structural steel, and storage tanks shall be grounded; (2) the conduit system shall form a tight complete metallic continuous ground system for all non-current-carrying metal parts connected to it, and these parts shall be considered grounded; and (3) all ground conductors shall be soft drawn, stranded, bare copper wire or flat copper bushbar, with a minimum size of #4 American Wire Gage (AWG) (0.20 inch diameter wire).

NFPA 780, "Standard for the Installation of Lightning Protection Systems," (NFPA 1997), states that "Strike termination devices shall not be required for those parts of a structure located within a zone of protection." A strike termination device is "a component of a lightning protection system that is intended to intercept lightning flashes and connect them to a path to ground." Strike termination devices include air terminals (i.e., lightning rods), metal masts, permanent metal parts of structures in some instances, and overhead ground wires installed in catenary lightning protection systems. A zone of protection is "the space adjacent to a lightning protection system that is substantially immune to direct lightning flashes." The Main Plant stack is considered to serve as a strike termination device, and to provide a zone of protection for several of the facilities addressed in this SAR and in other WVNS SARs. NFPA 780 states that "The zone of protection shall form a cone having an apex at the highest point of the strike termination device, with walls forming approximately a 45-degree or 63-degree angle from the vertical." Hence, the Main Plant, 01-14 Building, Utility Room and Utility Room Expansion, Fire Pump House, Fuel Receiving and Storage Facility, Vitrification Facility, and most of the Waste Tank Farm are within the Main Plant stack's zone of protection and therefore do not require strike termination devices. NFPA 780 also states that "Metal guy wires and cables used to support stacks shall be grounded at their lower ends." The guy wires used on the Main Plant stack satisfy this requirement.

WVNS-FHA-013, "Fire Hazard Analysis Cross-Reference STS/PVS Facilities," notes that the Main Plant stack substantially reduces the likelihood of a direct lightning strike at the STS and PVS facilities (as these facilities are only slightly beyond the NFPA 780 defined cone of protection provided by the Main Plant stack), and that "The facilities, systems, and equipment are grounded to ground grid." WVNS-FHA-013 cites several drawings for more detailed information in this regard.

B.5.3.2 Leak Detection Systems

A liquid level detection system exists in the pans of Tanks 8D-1 and 8D-2 to indicate a leak of high level waste from the HLW tanks or the introduction of groundwater into the vault. (An examination of the vault/pan/tank design has revealed that the primary function of the pans is leak detection rather than secondary containment. Secondary containment of high level waste is provided by the combination of the pan, concrete vaults, and the surrounding silty till.) Pumps are provided to return leaked liquids to the tanks. Groundwater may be pumped to Lagoon 2 for treatment at the LLWTS.

The carbon steel pan in the 8D-2 vault has been tested, and it is apparent that a leak exists that allows water to pass between the pan and vault. The pan therefore cannot be considered as either sole containment or as a fully functional component of the leak detection system. The pan level detection system may, however, provide indication for a leak with a rate of outflow which exceeds the rate of outflow from the pan.

Leakage in the valve aisle/pipeway areas will be collected in a sump. Actuation of a pump will return fluids to Tank 8D-2. A level alarm in this sump identifies the leakage condition. Additionally, a leak detection system is installed within the annular space between the double walls of the STS transfer piping. Leaked fluids will be returned by gravity to Tank 8D-2. The transfer conduit between Tank 8D-2 and STS is connected by a drain to Tank 8D-2 in the event that the double-walled pipe leaks into the conduit. A summary of leak detection and mitigation capabilities for the major structures/barriers of the STS is presented in Table B.5.3-1.

Leak detection equipment is installed within the annular space between each of the High Level Waste Transfer System primary and secondary pipe segments residing in the transfer trench. The leak detection equipment is installed at the low point of each continuous pipe segment. Each pump pit also has a leak detection probe installed at its drain.

B.5.3.3 Containment Metal Corrosion

WVNS has a program in place for monitoring and control of corrosion in carbon steel HLW Tanks 8D-1 and 8D-2. The design corrosion allowance for these HLW tanks is 6.4 mm (0.25 in), except for the top plate, which has a design corrosion allowance of 4.8 mm (0.188 in).

Tank 8D-1 internal corrosion coupon data show that between 1988 and 1994, the uniform corrosion rate observed in the vapor region was 0.53 mils per year, 0.05 mils per year in the liquid region, and 0.62 mils per year in the zeolite region. Between 1994 and 1997, only the vapor region indicated an increase in corrosion rates. In this region, the observed corrosion rate is in the range of 1.0 - 3.0 mils per year. The internal general corrosion rate for Tank 8D-2 between 1966 and 1976 was reported by NFS to be 0.53 mils per year in the vapor region and 0.03 mils per year in the liquid region. Internal corrosion of the carbon steel HLW tanks is controlled through the addition of corrosion inhibitors (e.g., caustic and sodium nitrate).

Since August 1996, external corrosion of the tanks has been monitored using corrosion coupons placed in the vaults of the tanks. Visual inspection indicated loose surface scale and pitting on the internal tank surfaces and a heavy deposit of corrosion products on the external surfaces. External corrosion of the tanks, which is significantly higher than internal corrosion, is controlled through the use of a nitrogen inerting system which has been in operation since 1996.

Tank 8D-3 is a stainless steel tank used as a temporary hold tank for decontaminated STS process solutions and has never been used to contain HLW. Therefore, it has never been inspected.

Tank 8D-4 is also a stainless steel tank. Inspection of corrosion coupons, which were removed in 1987, indicated minimal thinning (i.e., at least an order of magnitude less than that in Tank 8D-2 - 0.003 mm [0.12 mils] total of corrosion over a 7.5 year time span). The design corrosion allowance for the stainless steel HLW tanks is 1.8 mm (0.07 in).

The corrosion-resistant stainless steel tank is relied upon as a passive means of controlling corrosion in Tank 8D-4. The low corrosion rates observed support this approach.

B.5.3.4 NDA Interceptor Trench Liquid Pretreatment System

An interceptor trench (270 meters long) was constructed in order to intercept the subsurface migration of solvent from the NDA towards Erdman Brook and thereby prevent its entry into the surface water system which drains the site. The Liquid Pretreatment System (LPS) is designed to reduce solvent and radionuclide (I-129 in particular) content in the trench water for efficient treatment by the Low-Level Waste Treatment System (LLWTS). Operation of the LPS is determined by the results of the sample analyses taken from Manhole 4. If solvent is detected in the sample, the effluent will be processed through the LPS. If no solvent is detected, the effluent is processed through the lagoon system. Since construction of the NDA Interceptor Trench was completed, no solvent has been detected and all effluent collected in the trench has been processed through the lagoon system.

The LPS structure houses a particulate removal filter unit connected in series with two Granular Activated Carbon (GAC) units. The LPS is housed inside a rigid metal weather structure located approximately 100 m (330 ft) north of the Drum Cell (Figure B.5.1-1). All vessels and associated piping inside this structure are bermed to contain any leaks or spills. Detailed discussions of the design features of this facility are contained in the Design Objectives for the LPS (Blickwedehl, 1990).

Once approximately 380 L (100 gal) of solvent have accumulated in Tanks D-01 and D-02, this solvent will be pumped from the top of the tanks and transferred to 208 L (55 gal) drums. These drums will be stored in the LPS weather structure or in the Interim Waste Storage Facility (IWSF). Secondary containment in the form of two 24' x 24' fixed berms with 60 mil liners is provided for all tanks, GAC units, and associated pumps and pipes. In the event of a leak, each berm is of sufficient capacity to contain 23,000 (6100 gal, equal to 120% of the maximum capacity of the largest vessel inside each bermed area).

The pipe from the main sump to the LPS is placed inside a PVC conduit buried below the frost line. The slope is such that any leaks in the primary pipe will flow back to the sump. The other pumps in the LPS weather structures are equipped with pressure relief valves and re-circulation lines. Tanks are vented to the atmosphere.

Each tank is equipped with liquid-level sensors. The pumps that fill and empty the tanks will shut down automatically upon receiving a high- or low-level signal from the floats inside the tanks. If the level in any of the tanks deviates from normal operating range, indicating a possible pump or sensor malfunction or system leak, local alarms will be activated at preset alarm-high and alarm-low levels, and power to the pumps will be shut off automatically. A loss of power to any of the level controllers will activate the alarm. In addition to automatic controls, power to the pumps can also be shut off manually by the operator.

The weather structure has two space heaters that prevent freezing in winter months.

B.5.3.5 North Plateau Groundwater Recovery System

In November, 1995, the WVDP installed a groundwater pump-and-treat system on the North Plateau (northeast of the Main Plant) to mitigate the movement of Sr-90 near the leading edge of the groundwater contamination. The pump-and-treat system was upgraded in September, 1996, and now consists of three 15-foot recovery wells equipped with transfer pumps, which collect contaminated groundwater from the underlying sand and gravel unit. The groundwater is treated by ion-exchange columns housed in the Low-Level Waste Treatment Replacement Facility (LLW2). The ion-exchange columns are used to reduce the gross beta concentration of the groundwater. The treated groundwater is then transferred to Lagoons 4 or 5 or, as needed to Lagoon 2. The treated groundwater is ultimately discharged from Lagoon 3 in accordance with the State Pollution Discharge Elimination System (SPDES) permit.

In addition, a permeable treatment wall has recently been constructed to provide in-situ treatment of Sr-90-contaminated groundwater across the eastern lobe of the north plateau beta plume. This passive treatment process, which consists of treatment media in an excavated trench, relies on the natural flow of the contaminated groundwater and is intended to intercept and remove Sr-90 from it.

B.5.3.6 Vitrification Test Facility

The Vitrification Test Facility houses the Scale Vitrification System (SVS). The SVS (also referred to as the "mini-melter") is a complete processing system that uses nonradioactive chemicals to test parameters and process steps. It is the third version of the WVDP vitrification pilot plant and is therefore referred to as SVS-III. The VTF also houses several mock-up stations where workers can practice performing a job. Though the SVS-III is currently inactive, is available for testing as warranted by future activities.

The SVS-III consists of a joule-heated ceramic melter which has its own feed preparation and off-gas treatment facilities. Its design is approximately one-sixth of the capacity and 15 percent of the melt capability of the Vitrification Facility melter. There are three main subsystems involved: feed preparation, melter operations, and off-gas treatment.

Feed preparation includes:

- the addition of dry chemicals to the Slurry Mix Tank (SMT) using a pneumatic conveying system
- the addition of liquids to the SMT including waste simulant and nitric acid
- the ventilation system for the SMT
- inter- and intra-tank slurry transfers
- volume reduction through boildown in the Feed Hold Tank (FHT)
- the addition of sugar in the FHT to control the redox ratio
- the measurement of gas generation during these steps

Melter operation includes:

- feed handling
- power control
- glass discharge to drums on a conveyor

The off-gas system includes:

- collecting vapors from the FHT, Melter Feed Tank (MFT), and melter
- quenching the vapors by sending them through a venturi scrubber
- removing the moisture in a High Efficiency Mist Eliminator (HEME)
- handling of the scrubber water that is used by the venturi and is collected from the HEME
- operation of the off-gas blower that collects these vapors
- reducing the Oxides of Nitrogen (NO_x) concentration of these vapors in a Fluidized Bed Reactor (FBR)
- controlling the flow of ammonia (NH_3) to the FBR
- monitoring the effectiveness of the treatment process using the NO_x analyzers

Several safety features have been built into the SVS-III. The VTF floor slopes down to the North wall where a 15 cm (6 in) berm is located. This provides volume to contain the entire contents of all vessels that are used in the SVS-III. The feed pump to the melter will automatically shut down in the event of high melter pressure, low scrubber water flow, or failure of the off-gas treatment system. Emergency vents are located on the FHT, MFT and melter to exhaust vapors outside the VTF if excess pressure should develop in them. Separate enclosures for the NO_x analyzers and ammonia storage are used to provide the proper environment for equipment, human health, and building safety concerns.

B.5.3.6.1 Feed Preparation

All free-flowing powders are typically handled using the Vac-U-Max. Powders are typically delivered in 208 L (55 gal) drums. Those drums are positioned on a calibrated scale that is used to control the amount of feed to the SMT based on a loss in weight. A pneumatic conveyor pickup wand placed in the drums provides the means of transport. The powder is picked up by the vacuum in the wand and discharged by a solid separator stationed immediately above the SMT. The exhaust air is filtered before being discharged to the atmosphere. The collection hopper, transfer lines, and filter are made of stainless steel to ensure chemical purity and to make cleaning easier. The flexible portion of the wand is made of polyethylene.

Liquid chemicals are handled using a similar drum and wand system set on calibrated weigh scales. The mode of transport is by various pumps designed to have wetted parts compatible with the liquid that they will contact. The SMT and FHT have high level alarms with local annunciators to alert the operators before they overfill.

The SMT is a 2270 L (600 gal) (working capacity 470 gallons), agitated, jacketed stainless steel vessel, ventilated by a 5 hp fan capable of pushing 200 SCFM of air. The SMT ventilation system is skid mounted and includes a filter and a slidegate damper to control air flow. The SMT fan maintains a slight vacuum on the SMT to aid in filling and to keep dust and nuisance vapors in the area to a minimum. The feed preparation cycle is designed so that the only chemical reaction that takes place in this tank is acid/base neutralization. Chilled water runs through the jacket to absorb the heat produced in the neutralization process.

Feed maybe transferred from the SMT to the FHT after going through a grinder that keeps particle diameter below 50 microns. The FHT is an agitated, 3600 L (950 gal) (working capacity 600 gallons), semi-jacketed stainless steel vessel. The feed is boiled down here to reduce the volume of water before it is transferred to the MFT. Sugar is added during the boildown process to obtain the desired carbon to nitrate ratio.

B.5.3.6.2 Melter Operations

The MFT is used as a supply reservoir for the melter feed pump. This pump has a manually adjusted variable speed motor which gives it the ability to control the feed rate to the melter. The melter feed pump sends the feed into the melter through a water-cooled feed nozzle. The SVS-III melter is capable of simulating the operations of the VF melter. This allows the SVS-III melter to reach steady state much faster and have a quicker volume changeout. An added feature is the plenum heaters, which allow for the investigation of higher feed temperatures and the effect of temperature on the plenum area. The off-gas line is short with flanged connections to facilitate manual cleaning of the plugs.

There are two sources of power in the main melter cavity. The major source is a pair of paddle-shaped electrodes. The secondary source is four radiant-type plenum heaters made of silicon carbide. Both sources are controlled by thermocouples. The plenum heaters are used during startup to raise the temperature of the glass surface until it becomes conductive enough for the electrodes to become productive. After the glass reaches the melt temperature, 700°C (1292°F), an electric current is passed through the electrodes. The resistance to electric flow by the contents of the melter creates the heat required to melt the glass. The molten glass is discharged from the melter using an air lift. A small stream of glass flows into a 113 L (30 gal) stainless steel drum sitting on a powered roller conveyor. A bellow type seal is placed over the drums to maintain the vacuum integrity of the melter. A hand controlled reversible motor allows the conveyor to be used to move the drums under and out from the melter.

B.5.3.6.3 Off-gas Treatment

The off-gas system is operated in two distinctive modes of operation depending on whether feed is being prepared or the melter is operating. The equipment is sized such that it will not support simultaneous operation. During feed preparation the off-gas will be warm and very humid because of boil down. During melter operations the off-gas will be very hot and dry. The volume of air flow will be constant for both modes. An air in-bleed in the melter off-gas line will be used to control the pressure in the melter and FHT while the off-gas treatment system is operating.

Off-gas treatment is available to mitigate the effects of temperature, oxides of nitrogen (NO_x) formation, and particulate generation. A venturi scrubber quenches the off-gas to remove large particulate. The off-gas is then sent through the HEME to remove mist and particulates greater than submicron size before going to the FBR.

The water from the scrubber is collected in the Condensate Hold Tank (CHT). It is cooled in a heat exchanger reused in the scrubber. This water is either used in the SMT during feed preparation activities or disposed of off-site.

A skid-mounted off-gas blower (OGB) provides the vacuum necessary to pull the vapors from their origin to the NO_x reactor. The blower is a 7350 W (10 hp), rotary, positive displacement type made with stainless steel wetted parts. It is designed for outdoor use and comes equipped with an in-line air filter, intake and discharge silencers, and an external lubrication system.

The selective catalytic reduction process that is used in the FBR reduces NO_x in the off-gas to nitrogen and water. The off-gas is first heated to at least 315°C (600°F) using natural gas in a combustion chamber. Ammonia is stored in 68 kg (150 lb) cylinders and distributed from the Ammonia Storage Room (ASR) located northeast of the VTF. The off-gas is sampled for NO_x concentration before and after usage. The

NO_x analyzers are located in the Off-gas Monitoring Room (OGMR) located east of the VTF.

B.5.3.6.4 Utilities

The majority of the operations in SVS-III (including the melter) are controlled, or at least monitored, by a Programable Logic Controller (PLC). Soft water, potable water, natural gas, and utility air are provided from VTF utility headers. The cooling medium is water chilled by a chiller that uses an air-cooled condenser. This chiller is also the source of chilled water for the SMT, FHT and melter feed nozzle. A total energy controller maximizes the cooling capacity of the chiller during cooling operations.

B.5.4 Description of Service and Utility Systems

B.5.4.1 IRTS and Main Plant Building Ventilation Systems

Airborne contamination control in the IRTS and Main Plant is maintained through the use of building ventilation systems, shown in Figure B.5.4-1 through B.5.4-5. These systems have also been designed to satisfy building temperature control requirements.

Ventilation for the STS building is provided by the STS Permanent Ventilation System (PVS). This system provides a minimum differential pressure of 15 mm (0.6 in) water column between routinely occupied areas and potentially contaminated areas. Ventilation in the Main Plant building is provided by two independent ventilation systems, namely the Head End Ventilation (HEV) system and the Main Plant ventilation system. The HEV system ventilates areas in the head end of the Main Plant, including those areas identified to provide support for storage of vitrified high level waste produced in the Vitrification Facility. The Main Plant ventilation system ventilates all other areas of the Main Plant including those areas housing equipment associated with the LWTS. Ventilation for the CSS is provided by the 01-14 building heating and ventilation system.

Building ventilation systems have been designed to ensure contamination confinement during normal operations and to minimize the spread of contamination during abnormal operations. Ventilation filters and blowers are provided with redundant spares to ensure that confinement is maintained in the event of a failure in the on-line system. Airflow during normal and abnormal operations is from uncontaminated areas such as stairwells and operating aisles to areas of increasing contamination such as cell service areas and airlocks to process cells.

Although filter configurations vary between facilities, the final filter in site ventilation systems is a HEPA filter or bank of HEPA filters capable of removing 99.95 percent of aerosol particles having a mean aerodynamic diameters greater than

0.3 microns. Adequate ventilation system performance is assured through effluent stack monitoring. Operation of stack monitoring systems is described in Section B.8.6.1.1.

In addition to building ventilation systems, airborne radioactivity confinement is also provided by off-gas treatment and ventilation systems. IRTS and Main Plant off-gas and treatment systems, which include the Vessel Off-Gas system and the Waste Tank Farm Ventilation System, are described in Section B.7.4, "Off-Gas Treatment and Ventilation."

B.5.4.1.1 Major Components and Operating Characteristics

B.5.4.1.1.1 Permanent Ventilation System

The Permanent Ventilation System provides contamination and temperature control to the STS support building, valve aisle, and pipeway. Ventilation flow in the STS is shown in Figure B.5.4-2. During normal operations, air flows from the supply fan through a filter to the demineralized water/zeolite area from which air is directed to the operating area in front of the Valve Aisle. The control room has a separate HVAC system that draws from the outside air. Operating areas are protected by fire dampers between floors.

Approximately 1.9 m^3/s (4,000 cfm) of ventilation air is directed from the operating aisle to the valve aisle and into the pipeway. Air leaving the operating aisle passes through a roughing filter, HEPA filter, and tornado damper. Air is then routed directly to a train consisting of roughing and HEPA filters (two) in series. One of two trains (parallel, redundant) are always operational. The ventilation air then flows to exhaust blowers; both are powered by electricity. One is maintained as a backup designed to start automatically if the primary blower fails. An auxiliary power supply (electric) is provided to these blowers.

Permanent Ventilation System Supply and Distribution System

Outside air is supplied to the operating areas of the STS support building from separate supply fans. Approximately 0.7 m^3/s (1500 cfm) of recirculation air is provided to the control room while 2.3 m^3/s (4900 cfm) of air is supplied to the fresh zeolite and water tank area on the second floor. Inleakage is expected from the control room and from the fresh zeolite and water area. The operating area in front of the valve aisle receives approximately 1.8 m^3/s (3800 cfm) from the zeolite area. This air is then directed to the valve aisle or into the pipeway/shield structure on top of the Tank 8D-1 vault. An infiltration of 0.09 m^3/s (190 cfm) enters the pipeway from the tank farm piping trenches. The resulting 1.9 m^3/s (4000 cfm) is then exhausted to the STS PVS air treatment system.

Exhaust air from Tank 8D-1 and Tank 8D-2 may be handled through the PVS. Approximately 0.3 m^3/s (640 cfm) of air is ventilated through Tank 8D-1 or 8D-2 to the PVS during operations requiring access to Tank 8D-1 or 8D-2 through the riser openings. It is required that air flow be through a riser access opening in order to comply with the minimum capture velocity across any opening in the waste tank farm high level waste tanks. The minimum capture velocity is 0.64 m/s (1400 cfm).

Permanent Ventilation System Exhaust System

The exhaust fans (PVS blowers) provide the system draft and are rated for 100% flow capacity of the HV system with all the filters at the changeout pressure drop. Both exhaust blowers are electrically operated. The backup will automatically activate if the primary blower fails. A diesel generator provides back-up in the event of power failure.

Ventilation air flows from the pipeway and HLW pipe conduit and is exhausted through a bank of roughing filter and two banks of HEPA filters in series (see Figure B.5.4-1). The filters are housed within the air treatment system and are connected with a heater and mist eliminator. HEPA filters are contained by a housing constructed of stainless steel. The differential pressure is measured across each filter holder in the HV system. The primary filter holder has local low/high pressure alarms that sound a trouble annunciator in the control room. A remote trouble alarm in the STS control room would alert operators of a problem with the PVS.

Following off-gas treatment, the ventilation air passes through the blower and discharges to the STS PVS stack. Air is continuously sampled to assess radioactive material releases (see Section B.8.6.1).

B.5.4.1.1.2 Main Plant Ventilation System

Air in the Main Plant ventilation system is filtered (in the warmer months only), conditioned and distributed on a once-through basis from uncontaminated areas to areas containing a progressively greater degree of radioactivity. These more contaminated areas are maintained at a minimum lower relative pressure of approximately -0.075 kPa (-0.30 inches W.C.). Air from these areas exhausts to the Main Plant ventilation exhaust system where it passes through roughing and HEPA filters before being exhausted to the atmosphere through the Main Plant stack. The exhaust rate of gas through the stack by this system is approximately 14.2 m^3/s (30,000 cfm). Primary components of the Main Plant ventilation system are described below. Main ventilation system flow is shown in Figure B.5.4-3.

Main Plant Ventilation Supply and Distribution System

Fresh air entering the Main Plant ventilation system is filtered, conditioned for temperature control, and distributed to normally occupied spaces. Distribution of air from the Main Plant ventilation supply system is to the Control Room, North Analytical Aisle, East Stairs and North Stairs. Air flows from these areas to adjacent operating aisles and stairways and into process cells.

From the Control Room air flows to the East Stairs, South Stairs and Upper Extraction Aisle. Air from the East Stairs and Upper Extraction Aisle is drawn into subsequent operating areas and process cells to the Main Plant ventilation plenum. Air from the South Stairs flows to the Off-Gas Aisle, Acid Recovery Cell and Off-Gas Cell and exhausts to the Main Plant ventilation plenum. Air from the Off-Gas Aisle flows into the Analytical Cell Decontamination Area where it is filtered and cooled and subsequently drawn into the analytical cells. It is then exhausted to the Ventilation Washer plenum.

Makeup air for the Analytical Aisle is filtered, and conditioned for temperature control through an air handling unit mounted on the lab roof. Air handlers are installed in the Analytical Aisle and provide filtered and cooled air to the individual labs.

Air from the North Stairs flows into operating aisles to the Extraction Cells, Liquid Waste Cell and Process Mechanical Cell. Air from the Extraction Cells and Liquid Waste Cell is exhausted to the Ventilation Wash Cell plenum.

Main Plant Ventilation Exhaust System

Equipment for the Main Plant ventilation exhaust system is contained in the Ventilation Exhaust Cell. Air flow in the Main Plant ventilation exhaust plenum is directed to either of two filter trains and an associated blower. Each train is comprised of a bank of roughing filters and HEPA filters in series. Filter banks are each composed of an array of filters six filters wide and five filters high. The electric-driven primary blower is provided with a redundant electric-driven spare, which can be powered by the 1250 kW diesel generator located in the Utility Room Extension. The operating capacity of the blower is regulated by inlet vortex dampers on each blower which are controlled by a pressure recorder-controller in the Control Room. Other instrumentation includes recorders and alarms on filter train differential pressures and the automatic switchover controls. The configuration of Main Plant ventilation system equipment is shown in Figure B.5.4-1.

Controls are arranged such that the primary train is isolated and the secondary train is placed on line upon: (a) high filter differential pressure, (b) low filter differential pressure, (c) loss of electric power, or (d) loss of control air pressure.

B.5.4.1.1.3 Head End Ventilation System

Supply air in the HEV system is filtered, conditioned and distributed on a once-through basis from uncontaminated areas to areas containing a progressively greater degree of radioactivity. Figure B.5.4-4 presents the ventilation flow in the head end of the Main Plant. The system was designed and constructed after initiation of fuel reprocessing activities to supplement the Main Plant ventilation system. Consequently, areas currently ventilated by the HEV may be ventilated by either the HEV system or the Main Plant ventilation system through positioning of a damper in the CPC and/or PMC. Dampers in the CPC and PMC currently isolate the HEV from the Main Plant ventilation system.

The Head End Ventilation system provides contamination confinement for areas in the Main Plant formerly associated with mechanical processing activities as well as areas identified to provide storage for vitrified high level waste (i.e., the HLWISA), namely the Equipment Decontamination Room, Chemical Process Cell and Chemical Process Cell Crane Room. Air from these areas exhausts to the HEV exhaust system where it passes through prefilters, roughing filters, and two banks of HEPA filters in series before being exhausted to the atmosphere through the Main Plant stack. The exhaust rate of gas through the stack by this system is approximately 6.8 m^3/s (14,000 cfm).

The Vitrification Building interfaces with the Head End Ventilation System through limited areas. The interface area is the Transfer Tunnel from the Vitrification Cell to the EDR. The Head End Ventilation System fresh air inlet damper (EDR roof damper) allows the differential pressure between the EDR and the atmosphere, as well as the differential pressure between the EDR and the vit transfer tunnel, to be controlled (Reference Figure B.5.4-4). It also provides a source for air in-leakage, resulting in additional air flow through the CPC and thereby providing additional cooling for the high-level waste canisters. An expanded discussion of this interface with the Vitrification Facility is provided in WVNS-SAR-003.

Head End Ventilation Supply and Distribution System

Supply air in the HEV system is filtered, conditioned and distributed on a once-through basis to areas in the head end of the Main Plant. Distribution of air in the HEV is from the North Stairway and Chemical Operating Aisle (COA). From the North Stairway air is distributed to the General Purpose Cell Operating Aisle (GOA), the Process Mechanical Crane Room (PMCR) air lock, and the Chemical Process Cell Crane Room (CCR) via the North Analytical Aisle. From the COA air flows to the Equipment Decontamination Room Viewing Aisle and Scrap Removal Room (SRR).

From these areas air flows via cell dampers and inleakage into contaminated process cells. Air flow in the process cells is from the SRR, PMC and CPC, through floor hatches, to the GPC. Air is exhausted from the GPC to the HEV exhaust filter inlet plenum via a 90 cm (36 in) duct.

Head End Ventilation Exhaust System

The HEV system exhaust treatment equipment is comprised of two parallel primary blowers, a backup blower and redundant filter trains each consisting of prefilters, roughing filters, and two stages of HEPA filters. This equipment is depicted schematically in Figure B.5.4-1. The HEV exhausts 6.8 m^3/s (14,000 cfm) of air directly to the Main Plant stack where it is discharged to the atmosphere.

The redundant HEV filter trains each contain four filter banks. The first two banks are comprised of a prefilter and roughing filter in series. The roughing filters exhibit a removal efficiency of approximately 90 percent and therefore the majority of particulate contamination is removed at this point. Following the bank of roughing filters are two banks of HEPA filters in series. The second bank of HEPA filters provides assurance of particulate removal and protection from a release of radioactive material in the event of a malfunction in the upstream HEPA filters.

There are three blowers in the HEV system. The two primary blowers are each rated at 3.4 m^3/s (7,200 cfm). They are parallel mounted and powered by electric motors. There is also a 6.8 m^3/s (14,000 cfm) backup blower. The backup blower system ensures continuous operation of the HEV system in the event of loss of electrical line power. The backup blower is a single 6.8 m^3/s (14,000 cfm) blower and is powered by the WVDP backup electrical power system. Dampers control the flow of air to the blower(s) in use.

Controls are arranged such that the primary train is isolated and the backup train is placed on-line upon: (a) high filter differential pressure, (b) low filter differential pressure, or (c) loss of electric power.

Air exiting the HEV system exhaust blowers enter the stack at a 30 degree angle through a stainless steel duct that is welded to a reinforcing plate in the stack. This effluent is then sufficiently mixed with other effluent discharge streams in the stack prior to reaching the stack gas sampling and monitoring probes.

B.5.4.1.1.4 01-14 Building Heating and Ventilation System

The 01-14 Building HV System is designed to provide at least seven air changes per hour in potentially contaminated areas of the building. Ventilation flow in the 01-14 Building is shown in Figure B.5.4-5. A minimum differential pressure of 0.125 kPa (0.5 inches w.c.) is maintained between routinely occupied areas and potentially contaminated cell areas. Except for air infiltration, inlet air is filtered and, if necessary, heated for personnel comfort.

All HV system components are designed to be maintained in areas free of airborne or surface contamination. Permanent or temporary air locks maintain proper air flow during maintenance operations involving the pump niche, Waste Dispensing Cell, or the Process Cell. During shutdown of the supply air system for regular maintenance or because of failure, gravity dampers in the clean drum storage area open and allow outside air to enter the area and the Process Cell. Air infiltration and induced air flow through the air supply unit provide air for the Off-Gas Cell.

01-14 Building Ventilation Supply and Distribution System

The 01-14 building heating and ventilation system supplies outside air to the 01-14 building operating aisles from the second floor supply fan and through infiltration. A portion of this air vents the operating aisles and is ultimately processed through a roughing and HEPA filter to a blower to be vented from a stack on the 01-14 Building. The remainder of the inflow is directed to: the CSS Process Cell, the Waste Dispensing Cell, and directly to two HEPA filters. Air exiting the Process Cell is directed to the Waste Dispensing Cell. Air exiting the Waste Dispensing Cell is combined with air from the vitrification off-gas trench, ammonia valve gallery, and 01-cell and exits through a series of two HEPA filters to be vented from a stack on top of the 01-14 Building.

01-14 Building Ventilation Exhaust System

The 01-14 building ventilation exhaust system maintains two filtration systems both located on the third floor of the 01-14 building. The first system is comprised of two parallel trains consisting of a roughing filter and HEPA filter in series. Air originating in operating aisles and the filter change room is exhausted through these filters.

The second system provides filtration for air ventilated from other areas of the 01-14 building, including the CSS Process Cell and Waste Dispensing Cell, the vitrification ammonia valve gallery, and the 01-cell. Air in this system is exhausted through six parallel sets of two HEPA filters in series. The first stage of HEPA filters is located in a glove box constructed of 1.3 cm (0.51 in) stainless steel and provides for both confinement of contamination and shielding to reduce radiation levels in the filter room. The second stage of filters is located in individual filter housings.

The primary 01-14 building HVAC blower is driven by an electric motor. The backup HVAC blower is driven by an electric motor that is tied into a standby power source. Air exhausting from the ventilation system blower is routed to a stack on top of the

01-14 building. The configuration of 01-14 building ventilation exhaust equipment is shown in Figure B.5.4-1.

B.5.4.1.1.5 Ventilation System Stacks

Main Plant Stack

Effluents from ventilation and off-gas systems that discharge to the Main Plant stack are shown in Figure B.5.4-1. The ventilation stack extends to an elevation of 202 feet, approximately 62 meters above building grade. The stack is a self-supporting, guy wire stabilized gunnite cement reinforced stainless steel structure. The three guy anchor assemblies are connected to the 40.5 m and 56.1 m (133 ft and 184 ft) level holding collars by 2.22 cm (7/8 in) cables. The stack base, from roof level to 15 m (50 ft) above the roof, was reinforced by application of gunnite cement over steel dowels and holding bolts. There are two platforms on the stack, one at the top and one at the 24.4 m (80 ft) level where the stack sampling ports penetrate the stack.

PVS and 01-14 Stacks

Effluents from the STS HVAC and 01-14 building discharge to small stainless steel stacks atop the PVS and 01-14 buildings, respectively. The PVS stack is approximately 4.9 m (16 ft) in height and is 48 cm (19 in) in diameter. The 01-14 Building ventilation stack is 4.7 m (15 ft 4 in) in height and is 61 cm (24 in) in diameter. Influents to these stacks have been indicated in Figure B.5.4-1.

B.5.4.1.2 Safety Considerations and Controls

IRTS and Main Plant ventilation systems have been designed to ensure confinement of radioactivity and to minimize discharges of radioactivity off-site. Key ventilation system components such as blowers and filter trains have been provided with installed spares. These systems and the associated redundant spares are provided with standby or backup power. In the event of power loss, ventilation systems are designed so that operation will be restored either automatically or manually. The standby exhausters can be started and brought on line manually, thus overriding automatic system operation.

Airborne radioactive discharges from facilities at the WVDP are maintained within DOE guidelines by ventilating effluent through high efficiency particulate air (HEPA) filter systems. These filter systems provide the primary barrier to airborne radioactivity release to the environment. Filter system efficiency at the WVDP is determined through an in-place leak test prior to new filter operation and through subsequent annual tests. HEPA filters used at the WVDP must meet requirements prescribed by the Department of Energy (U.S. Department of Energy, October, 1988).

Instrumentation has been provided to monitor the integrity of ventilation system filters. A summary of filter monitoring instrumentation is given in Table B.5.4-1.

Permanent Ventilation System

Differential pressure is measured across each filter holder in the PVS system. The primary filter holder has local low-and high-pressure alarms that sound a general trouble annunciator in the STS control room.

In response to low/high differential alarms, the parallel and redundant filtering train will be automatically activated. This redundancy ensures continuous and adequate air filtration and treatment should filter failures occur. The PVS dampers are designed to fail safe in the event of loss of utility air pressure. The backup blower will automatically come on-line should primary electrical power be lost or the primary PVS blower fail.

Main Plant Ventilation System

The two Main Plant ventilation system filter trains (primary and back-up) each consist of a roughing filter and a final HEPA filter in series. There are two differential pressure sensing systems for the filters in each train. One system senses the pressure across the filter train, the other senses the pressure across the HEPA filter bank. The train system contains high and low differential pressure alarms that annunciate in the Control Room to signal a plugged or ruptured filter(s). In addition to the alarms, there are high and low differential pressure controllers that will cause the operating filter/exhauster train to switch should the differential pressure become too high or too low. The differential pressure sensing system for the HEPA filter bank consists of a differential pressure recorder and high and low alarms that annunciate in the Control Room.

Head End Ventilation System

The controls for the HEV system are similar to the controls for the Main Plant ventilation system. The HEV filter train controls consist of isolation dampers and differential pressure monitoring. When this pressure exceeds the set point for high differential pressure the filter train isolation dampers are automatically activated such that the standby train is brought on line and the operating train is taken off line. It should be noted that in the HEV system the filter trains can be switched without switching blowers, an operation which cannot be done in the Main Plant ventilation system. The differential pressure across the HEPA filter is also monitored. Should the differential pressure get so low as to drop below the low differential pressure set point (indicating a ruptured filter) the filter trains are switched. In addition to filter train switching, there is a high and low differential pressure alarm for the HEPA filters and a high differential pressure alarm for the filter train. These alarms annunciate in the East Mechanical Operating Aisle.

In the event that both the primary and backup blowers in the HEV system fail, approximately 3.2 m^3/s (6,800 cfm) air may be drawn out of the head end cells through the bypass valves in the CPC and PMC into the Main Plant ventilation system to maintain some negative pressures in the cells (0.025 kPa [0.1 inches W.C.]). The ventilation system in this configuration is the original Main Plant ventilation system configuration and therefore the direction of air flow would continue to be from areas of lower contamination to areas of higher contamination.

01-14 Building Ventilation System

The standby electric motor-driven blower will automatically start should electrical power be lost or the electric fan fail. The differential pressure is measured across each filter compartment. Each filter compartment also has a local pressure alarm which will, upon sensing a low or high pressure, activate an annunciator in the CSS/LWTS Control Room.

If a first-stage HEPA filter fails, the activity and media will be caught on the second stage HEPA filters. Single failure of a second-stage filter would not be expected to result in a significant release of activity as the bulk of the entrained activity will be on the first-stage filters.

The exhaust fans are controllable both from a locally mounted panel on the fourth floor, from the CSS Control Room, and from the Main Plant Control Room. Each fan is rated at 100 percent system capacity.

B.5.4.2 Electrical

Electric power for the WVDP is supplied from a 34.5 kV Niagara Mohawk Power Corporation loop system. A feeder line from a 34.5 kV switching station transmits power to the site substations where it is stepped down to 480V. The lake pumps, which supply water to the site, the RTS Drum Cell and the NDA facilities obtain power from a separate Niagara-Mohawk 4,800V - 480V rural system. Site perimeter monitoring stations receive power from this same rural system through individual 4,800V - 120V transformers.

Electricity from the 34.5 kV line is routed through fused disconnect switches to the two 2500 kVA transformer at the Process Building and the Utility Room Extension (URE) Building, which deliver standby power to 480V, three phase buses via a 4,000 amp main breaker in the Switchgear Room and at the URE substation switchgear. From the 480V, three phase buses, power flows to main circuit breakers which, in turn, supply motor control centers through underground cables, conduits, and cable trays. The motor control centers are located throughout the site facilities and supply power to motors, lighting transformers and other electrical loads.

The substation switchgears are interconnected through cables to provide backfeed capabilities in the event that any 34.5 kV - 480 V substitution transformer fails.

Three phase, 60 Hz backup power is produced at 480V by a 625 kVA standby diesel-driven generator located in the Utility Room (UR) and a 1,200 kVA standby diesel driven generator located in the URE. Diesel fuel for the 625 kVA generator is supplied from a 1,000 liter (275 gallon) day tank in the Utility Room, while a 400 gal day tank supplies fuel for the 1,200 kVA generator diesel engine. This fuel supply is sufficient for eight hours of operation. Additional fuel is supplied to the diesel generators from a 38,000 liter (10,000 gallon) above ground tank sufficient for a period of at least five days.

A summary of WVDP utility supply capabilities and IRTS use requirements is given in Tables B.5.4-2 and B.5.4-3.

Backup power is required only for IRTS and Main Plant equipment for which power failure could result in a reduction in the degree of confinement. This equipment is grouped on motor control centers (MCC) E located in the Switchgear Room, E-1 located in the Waste Tank Farm Shelter, generator switchgear P-2/SG located in the URE, MCC 21 which is also located in the URE, and the PVS MCC-A located in the PVS MCC room. Backup power is supplied by three standby generators that have the capacity to supply power to additional equipment beyond those on the MCCs and switchgear and these would be connected at the discretion of the Shift Supervisor. In the event of failure of the 34.5 kV power supply, all diesel generators will start automatically and then associated switchgears will: disconnect the utility company line; disconnect noncritical loads; and supply power to MCC E, MCC E-1, MCC 21, and to the PVS MCC-A. Additional loads can be connected to the line as required. Backup power for the STS may also be provided by automatic switching to a diesel generator with sufficient stored fuel for eight hours of continuous operations.

B.5.4.3 Compressed Air

Four compressors are supplied for plant air systems: a 300 hp steam turbine-driven compressor; a 350 hp electric centrifugal compressor; and two 200 hp screw compressors. The centrifugal compressor is normally operated, with the screw compressors configured to start automatically on loss of air pressure (either from equipment or power failure). All compressors are of non-lubricated design. A carbon monoxide monitor is installed to ensure air is of suitable quality for breathing to support manned entry to areas of elevated airborne radioactive contamination.

Instrument air is provided from the utility air system using an air dryer and a pressure reducing valve to reduce the air pressure to 380 kPa (55 psi).

IRTS and Main Plant equipment is designed to fail-safe during loss of air pressure.

B.5.4.4 Steam Generation and Distribution

The steam generation and distribution system is comprised of two natural gas fueled fire-tube boilers with a 15,658 kg/hr (34,520 lb/hr) combined steam generating capacity. Number 2 diesel fuel oil can be used as an alternate fuel source in the event of an interruption in the gas supply. Each boiler is designed to provide the full steady-state steam demand requirements. Therefore, one boiler is normally in standby. Intermittent batch demand will be satisfied in all instances except for the simultaneous operation of the Concentrator Feed Make-up Tank in the Vitrification Facility and the LWTS evaporator in the peak winter months. At these times, the intermittent steam demand is met by operating the standby boiler unit.

Return condensate is collected in one of two condensate receivers where it is sampled for radioactivity. It may then be returned to the boiler water makeup system, or pumped to the interceptor. A radiation monitor is provided on the condensate return lines to the receivers.

B.5.4.5 Water Supply

The plant water supply is taken from two man-made, interconnected lakes created by the construction of two dams near the south end of the site. The two lakes receive runoff from approximately 3,100 acres of land and contain approximately 1,200,000 m^3 (317,000,000 gal) of water. The lakes have a combined surface area of 25 acres. The pump house, which contains two 25 L/s (400 gpm) pumps, is located just inside the northern-most dam and is connected to the plant by 1,800 m (5,900 ft) of 20 cm (8 in) pipe which runs along the railroad spur.

A clarifier/filter system is installed for raw water treatment. Treated water is transferred to a 1,800,000 L (475,000 gal) tank for storage. Utility water pressure is furnished by two 16 L/s (250 gpm) pumps which supply water at a minimum pressure of 520 kPag (75 psi).

The domestic water system is allocated 10 L/s (160 gpm) from the plant system and is chlorinated for potability (utilizing sodium hypochlorite) as the water is delivered to a 3,800 liter (1,000 gal) accumulator tank. Cooling tower makeup is taken from the plant system. The demineralized water system will normally produce 1 L/s (16 gpm) of demineralized water and may produce 2 L/s (32 gpm) maximum makeup to the 6,800 L (1,800 gal) demineralized water storage tank.

The cooling water system is an open cooling tower rated at 140 L/s (2,200 gpm), making approximately 24°C (75°F) cooled water available from approximately 29°C (85°F) water returned to the tower. Chemical feed equipment is installed to support this system.

Water demand for IRTS process operations is indicated in Table B.5.4-3. Original vessels and heat exchangers in the Main Plant which were supplied with cooling water are still connected to the cooling water system. In order to prevent the migration of radionuclides into the cooling system, these cooling coils are maintained under positive pressure, but without circulation, by keeping supply valves open and return valves closed. Should a leak develop from the cooling system into a cell, it would be detected by rising level in the cell sump. Operating personnel would then take action to isolate the leaking component.

As indicated in Table B.8.3-9, radioactivity alarms are provided in the cooling water and condensate returns from the process facilities, in order to detect any contamination which might enter these systems. The primary barrier against such contamination is the positive pressure differential which exists between the systems and the contaminated process areas. Monitors are located in the main condensate and cooling water return headers from the Main Plant.

No water is to contact personnel by these systems without sample analysis, so that in the unlikely event that contamination occurs, the opportunity exists to research the source of the problem by other means, such as grab samples from individual suspect equipment.

In order to maintain compliance with SPDES-permitted limits, water from the reservoirs is also used to augment stream flows during discharges from Lagoon 3. The WVDP is continuing to work with NYSDEC to prevent exceedances of TDS limits.

B.5.4.6 Natural Gas Supply and Distribution

Natural gas service for the WVDP is supplied from a 15cm (6 in) diameter 414 kPa (60 psi) National Fuel Gas Corporation supply line. The National Fuel Gas Supply is regulated from 414 kPa (60 psi) to 170 kPa (25 psi) at a pressure regulator station located south of the Utility Room. From the pressure regulator station natural gas is distributed to supply the plant boilers and meet area heating requirements on-site.

Several areas on-site are supplied natural gas for localized heating purposes. Gas is distributed to these locations at 170 kPa (25 psi) and regulated at usage points as required. The locations of natural gas lines on site are shown in Figure B.5.4-6. Natural gas is not routed through areas containing radioactive materials.

B.5.4.7 Waste Water Treatment Facility

The wastewater treatment facility at WVNS treats sanitary sewage and non-radioactive industrial wastewater from the Utility Room.

The sanitary sewage handling system at WVDP is a dedicated system of piping, pumps and distribution. The treatment system consists of a 151,000 L/day (40,000 gpd) extended aeration system with sludge handling in the form of wasting and off-site shipment for disposal.

There are no entry points into the sewage system other than the toilet facilities, washroom and kitchen sinks and shower facilities. No process building, or office building floor drains are connected to the sanitary sewer system other than the floor drains in the facility shower rooms and lavatory facilities.

The industrial wastewater from the Utility Room enters the system through a dedicated system of pipes, tanks, and pumps. It is collected and pumped into the wastewater treatment facility, where it is mixed with the sanitary sewage and treated.

The entries to the system are dedicated lines from the Utility Room water treatment equipment, boilers, and floor drains in the Utility Room Expansion area.

The Waste Water Treatment Facility liquid discharge is one of four WVDP outfalls where liquid effluents are released to Erdman Brook. These four outfalls are identified in the WVDP State Pollutant Discharge Elimination System (SPDES) permit, which specifies sampling and analytical requirements for each outfall.

B.5.4.8 Safety Communications and Alarms

B.5.4.8.1 Safety Communications

Access to a paging system is available from all site telephones to notify WVDP personnel of an abnormal or emergency condition. When the extension "812" is dialed, a distinct tone is annunciated through the site paging system speakers. The alarm is then followed by an announcement of the type and location of the emergency.

On-site communications systems include telephones, pagers and radios. The WVDP radio network consists of nets A and B. Net A is assigned to Security and net B is assigned to Operations, Radiation Protection, the Emergency Operation Center, and Security. The Project also maintains a radio link with the Cattaraugus County Sheriff's Department which can be used to request assistance or as a source of information.

B.5.4.8.2 Alarms

Integrated Radwaste Treatment Systems are provided with instrumentation to monitor flow, pressure, fluid levels, temperature, and radiation levels to ensure system operations are controlled and system limitations are not exceeded. Major equipment is operated remotely from control panels located in the system control room. In the event of abnormal conditions, the process equipment can be manually shut off. Safety related systems (e.g., ventilation system) are designed to achieve a safe condition automatically should off-normal conditions occur (i.e., dampers close, backup fan starts, etc.) or redundant systems are activated. Automatic controls for subsystems are provided with manual override capabilities.

IRTS has instrumentation and controls to allow the system to be started, operated, monitored, and shut down from the control room. The control panels are equipped with dynamic graphic displays to reduce the likelihood of operator error. The instrumentation indicates or alarms (or both) abnormal and undesirable conditions that could adversely affect system or equipment performance or inadvertently affect interfaces with other systems. During emergency conditions, external communications can be through the plant telephone system.

Operations safety related systems that provide control room alarm indications in IRTS facilities include:

- Ventilation System differential pressures
- Radiation Monitoring Systems
- Effluent Monitoring Systems
- Leak Detection Systems
- Fire Protection System.

Alarms in the Main Plant indicate abnormal conditions in plant ventilation systems, facility vessels and cell sumps. Due to the shutdown of reprocessing activities, the Main Plant Control Room is no longer continuously manned. A video camera in the Control Room allows remote viewing of Control Room alarm panels from closed-circuit monitors in the Main Plant shift office and the utility room. An audible alarm in these areas indicates an alarm in the Control Room. The shift office and utility room are not continuously manned areas and therefore an additional audible alarm is provided in the main security guard house which is a continuously manned area. Upon receipt of a Control Room alarm, a security inspector notifies the shift supervisor of the alarm condition.

Airborne effluents are discharged through the Main Plant ventilation stack, the PVS stack, and the 01-14 Building stack. There are two continuous air monitors (CAMs) for each stack: one that records beta/gamma-emitting radioactivity and another for alpha-emitting radioactivity. High airborne radioactivity of either type (beta/gamma, or alpha) will, as appropriate, activate the Main Plant stack alarms in the Main Plant Control Room, or the PVS stack alarms in the STS Control Room, or the 01-14 Building stack alarms in the CSS/LWTS control room.

B.5.4.9 Maintenance Systems

Integrated Radwaste Treatment Systems have been designed for remote operation. Equipment not required to be located in radioactive process areas is located in "cold" areas to permit contact maintenance. Contact maintenance is performed on contaminated equipment only after sufficient decontamination in accordance with existing WVNS procedures (WVDP-010, "Radiological Controls Manual"). Where this is not feasible, equipment is remotely repaired or replaced.

Equipment and piping in radioactive service is drained and flushed to reduce radiation levels before personnel enter the process area. Instruments are designed to permit isolation for periodic maintenance. IRTS equipment and components are arranged, located, and shielded to minimize radiation exposure to plant personnel should maintenance be necessary.

B.5.4.10 Cold Chemical Systems

All components of the IRTS, with the exception of the Drum Cell, maintain a cold chemical system. The cold chemical systems for the STS/SMWS, LWTS and CSS are described below.

The SMWS Chemical Addition System provides for bulk chemical addition to Tank 8D-2 from a federal/NYS DOT-authorized truck tank trailer having a capacity of approximately 19,000 L (5,000 gals.) or smaller sized tote tanks having a capacity of approximately 2,100 L (550 gals.). If the truck tank trailer is to be emptied over an extended period of time, it is positioned within a designated area of the WTF that consists of a graded base, concrete traffic barriers, and secondary spill containment within the traffic barriers.

The chemical solution is discharged from storage by pumping from the tank trailer. The solution is volumetrically batch-metered into Tank 8D-2 through an existing spare 5 cm (2 in.) pipe in riser N12 where it free falls from the top of the tank/riser into the tank.

A chemical feed system located in the Lower Extraction Aisle of the Main Plant building provides for chemical additions in the LWTS. The feed system consists of an acid (HNO_3) and caustic (NaOH) storage tank with positive displacement pumps which reside in berms sufficient to contain potential leaks. Demineralized water is available to flush process lines of residual acid or caustic. The system is not currently used for routine operations, but does provide the ability to add acid or caustic to Tanks 5D-15A1, 5D-15A2 and 5D-15B, if necessary.

The CSS cold chemical system provides for the addition of cement recipe enhancers to waste in the high shear mixers. A 5,700 L (1,500 gal) bulk storage tank, 1,160 L (300 gal) day tank, along with pumps located in the CSS Change Room are used for the delivery of sodium silicate. Antifoaming agents, used to minimize void spaces in the waste/cement mixture, are provided from polyethylene bottles located in the Clean Drum Room via electric diaphragm metering pumps.

REFERENCES FOR CHAPTER B.5.0

Barnstein, L.S. 1965. *Investigation of Atomic Waste Disposal Vaults at the Atomic Waste Disposal Plant, at Ashford, New York, for the New York State Atomic and Space Development and Authority.*

Bechtel Associates. 1964. *Spent Fuel Processing Plant Electrical Specifications-Process Building.* Specification P-13. Rev. 1 dated June 18, 1964.

__________. January, 1966. *Report on Restoration of Atomic Waste Vaults at Ashford, New York, for the New York State Atomic and Space Development Authority.*

Brown, S.H. December 19, 1985. *Safety Analysis Report For Modifications To Tank 8D-1 and Installation of STS Components and Zeolite Removal Pumps.* Memo to R. R. Borisch. (HE:85:0258.)

Ebasco Services, Inc. 1986. *Design Review Calculations for Zeolite Mobilization 8D-1 and Sludge Mobilization 8D-2 Pump Support Structure for West Valley Demonstration Project.* WVNS/W60.

__________. 1989a. *Vault 8D-4 Finite Element Analysis.* WVNS/W56, EBAR-1348 and 1348a.

__________. 1989b. *SMS-Transfer Trench and Pit to 8Q-5 Analysis.* WVNS/W57c, EBAR-1349 and 1349a.

__________. 1989c. *SMS-Pit 8Q-5 Finite Element Analysis.* WVNS/W58, EBAR-1350 and 1358.

__________. May 1992. *Civil Design Criteria Sludge Mobilization Transfer System.* Revision 2. EBAR-1665.

__________. 1992a. *SMS Trench Pipe Supports.* WVNS/W59R, EBAR-1667.

__________. 1992b. *HLW Transfer Piping Stress Analysis.* WVT-1A, WV4-1, WV38-1, WV6-2T, WV14-A, WV08-1, WV-0292-1 and WV-0592. EBAR-1662, 1662A, 1664 and 1670.

__________. 1990. *Vault 8D-1/8D-2 Finite Element Analysis - Rebar Verification.* WVNS/W55, EBAR-1324 and 1324a.

Gates, W.E. April, 1991. *8D-2 Sludge Mobilization System Confinement Barrier Integrity Review.* Subcontract No. 19-CWV-21511, Task 10.

REFERENCES FOR CHAPTER B.5.0 (continued)

__________. March 1993. *HLWTS Confinement Barrier Integrity Review.* Subcontract WV-19-CWV-L1511, Task 10.

Lawrence Livermore Laboratory. May 1978. *Seismic Analysis of High-Level Neutralized Liquid Waste Tanks at the Western New York State Nuclear Service Center, West Valley, New York.* UCRL-52485.

Meigs, R.A. December, 1985. *Initial Decontamination of the Equipment Decontamination Room at the West Valley Demonstration Project.* DOE/NE/44139-2.

NFPA. 1997. NFPA 780: *Standard for the Installation of Lightning Protection Systems.* National Fire Protection Association.

Riethmiller, G.E. June 12, 1981. *History of Decontamination.*

Rockwell. 1984. *Tank 8D-2 New Risers 12,24, and 36 Inch Diameter, Stress Analysis, Evaluation.* SD-RE-TA-003. Revision 0.

__________. August, 1985. *West Valley Tank Riser Installation.* 65620-WWS-85-161 (ZW:86:0020). Letter from W. W. Smith to D. W. Scott.

Skillern, C.G. May, 1986. *West Valley Demonstration Project Facilities Utilization Plan for the Existing Facilities at the Western New York Nuclear Service Center.* DOE/NE/44139-12.

Tundo, D., R. F. Gessner, and R. E. Lawrence. November, 1988. *Lessons Learned at West Valley During Facility Decontamination for Re-use.* November, 1988.

Vance, R.F. November 1986. *Topical Report prepared for DOE, Characterization of the Head End Cells at the West Valley Nuclear Fuel Reprocessing Plant.*

U.S. Department of Energy. October, 1988. Nuclear Standard NE F 2-45: *Specifications for HEPA filters used by DOE Contractors.* Washington, D.C.: U.S. Department of Energy.

__________. October 24, 1996. DOE Order 420.1: *Facility Safety.* Washington, D.C.: U.S. Department of Energy.

West Valley Nuclear Services Co. WVDP-010: *WVDP Radiological Control Manual.* (Latest Revision).

__________. Safety Analysis Report WVNS-SAR-003: *Safety Analysis Report for the Vitrification Operations and High-Level Waste Interim Storage.* (Latest Revision).

REFERENCES FOR CHAPTER B.5.0 (concluded)

__________. WVNS-FHA-013: *Fire Hazard Analysis Cross-Reference STS/PVS Facilities.* (Latest Revision).

Wolniewicz, J.C. March 1993. *Estimation of Activity in the Former Nuclear Fuel Services Reprocessing Plant.*

TABLE B.5.1-1

NON-RADIOACTIVE WATER OUTSIDE STORAGE TANKS AND IMPOUNDMENTS

VESSEL/IMPOUNDMENT IDENTIFICATION	LOCATION	VOLUME	STORED MATERIAL	CONSTRUCTION
31D-4A, 31D-4B Condensate Receivers	Yard - southwest of utility room	66,200 L 17,500 Gal	Steam condensate	Stainless Steel
32D-1 Clarified Water/Fire Water Storage Tank	Yard - southeast of utility room	Total Cap. [Fire Cap.] 1,800,000 [1,140,000] L 475,000 [300,000] Gal	Plant utility water/fire water	Coated Carbon Steel
32D-2 Demineralized Water Storage Tank	Yard - south of utility room	68,000 L 18,000 Gal	Demineralized process makeup water	Aluminum
32V-2 Clarifier	Yard - south of utility room	45,000 L 11,900 Gal	Clarified water	Coated Carbon Steel
Equalization Basin	East of old warehouse	470,000 L 220,000 Gal	Waste Water Treatment Facility influent	Synthetic liner
Equalization Tank	North of Equalization Basin	37,900 L 10,000 Gal	Waste Water Treatment Facility influent	Concrete

TABLE B.5.2-1

IRTS EQUIPMENT DESIGN CODES AND STANDARDS

Equipment	Design and Fabrication	Materials [1]	Qualification and Procedures	Welder Inspection and Testing
Pressure Vessels	ASME Code Section VIII, Div 1	Section II	ASME Code Section IX	ASME Code Section VIII, Div 1
Atmospheric Tanks	ASME Code Section VIII, Div 1	Section II	ASME Code Section IX	ASME Code Section VIII, Div 1
Heat Exchangers	ASME Code Section VIII, and TEMA "C"	ASME Code Section II	ASME Code Section IX	ASME Code Section VIII, Div 1
Piping	ANSI B31.3	ASTM and ASME Code Section II	ASME Code Section IX	ANSI B31.3
Valves	ANSI B16.34 ANSI B16.11	ASTM and ASME Code Section II	ASME Code Section IX	ANSI B16.34
Pumps	Manufacturer's Standards [2]	ASME Code Section II or Manufacturer's Standard	ASME Code Section IX (as required)	Hydraulic Institute

[1] - Manufacturers' material certificates of compliance with material specifications may be provided in lieu of certified material.

[2] - Manufacturers' standard for the intended service. Hydrotesting should be 1.5 times the design pressure.

TABLE B.5.2-2

DESIGN CODES AND STANDARDS FOR KEY IRTS EQUIPMENT

IRTS Component	Design Code or Standard	Seismic Factor
Tank 8D-1		
Carbon Steel Tank	API 650 (1961 version)	None
Reinforced Concrete Vault	1961 UBC 1956 ACI, Building Code Requirements for R/C, 318-56	Zone III
Tank 8D-2		
Carbon Steel Tank	API 650 (1961 version)	None
Reinforced Concrete Vault	1961 UBC 1956 ACI, Building Code Requirements for R/C, 318-56	Zone III
Tanks 8D-3/8D-4		
Stainless Steel Tanks	ASME, Sect. VIII	None
Reinforced Concrete Vault	1961 UBC	Zone III
Tanks 5D-15A/ 5D-15B	ASME, Sect. VIII	None
LWTS Evaporator 31017	ASME, Sect. VIII & TEMA C	None

TABLE B.5.2-3

ORIGINAL DESIGN CODES AND STANDARDS FOR THE MAIN PLANT

- AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, 1961, 5th Edition.
- Pacific Coast Building Officials Conference, Uniform Building Code, 1961 Edition.
- American Concrete Institute Building Code Requirements for Reinforced Concrete, 318-56.
- American Standard Building Code Requirements for Minimum Design Loads in Buildings and Other Structures, A 58.1-1955.
- American Welding Society - Standard Code for Arc and Gas Welding in Building Construction, AWS DI.0-46.
- New York State Building Construction Code - Prefix C, 1961 Edition.

Codes and specifications for steel structures is given:

- All structural steel and steel plate conform to ASTM Specification A-36, of latest adoption, Steel for Bridges and Buildings.
- All standard bolts conform to ASTM A 307, Grade B.

TABLE B.5.2-4

SUMMARY OF MAJOR EQUIPMENT IN THE WTF AND STS

Vessel/Component	Volume (L)	Construction
Equipment in WTF Yard		
8D-1 PUREX HLW Tank	2,800,000	Carbon Steel
8D-2 PUREX HLW Tank	2,800,000	Carbon Steel
8D-3 THOREX HLW Tank	57,000	Stainless Steel
8D-4 THOREX HLW Tank	57,000	Stainless Steel
8E-1/1A WTFVS Off-Gas Condensers	N/A	N/A
Equipment in WTFVS Building		
8C-1 Off-Gas Caustic Scrubber	2,700	Carbon Steel
8E-3 Off-Gas Heater	N/A	N/A
8D-6 WTF Off-Gas Knockout Pot	1,900	Carbon Steel
8D-7 WTF Off-Gas Relief Tank	950	Carbon Steel
Equipment in Tank 8D-1		
50C-001 STS Ion Exchange Column	7,200	Stainless Steel
50C-002 STS Ion Exchange Column	7,200	Stainless Steel
50C-003 STS Ion Exchange Column	7,200	Stainless Steel
50C-004 STS Ion Exchange Column	7,200	Stainless Steel
50D-001 STS Supernatant Feed Tank	6,535	Stainless Steel
50D-004 STS Sluice Feed Tank	8,110	Stainless Steel
50E-001 STS Supernatant Cooler	N/A	Stainless Steel
50F-001 STS Prefilter	N/A	Stainless Steel
50F-002 STS Postfilter	N/A	Stainless Steel
50G-004 Sluice Lift Water Pump	N/A	N/A
Zeolite Pumps (in risers M-2 thru M-7)	N/A	N/A

TABLE B.5.2-5

SUMMARY OF MAJOR EQUIPMENT IN LWTS CELLS OF THE MAIN PLANT

Vessel/Component	Volume (L)	Construction
Equipment in Extraction Cell 3		
71C-001 Organic IX Column	535	Stainless Steel
71C-002 Zeolite IX Column	1,820	Stainless Steel
71C-003 Zeolite IX Column	1,820	Stainless Steel
71C-004 Evaporator (31017)	5,680	Stainless Steel
71D-005 Distillate Surge Tank	3,785	Stainless Steel
71D-006 Spent Resin Tank	4,650	Stainless Steel
71D-007 Spent Zeolite Tank	4,650	Stainless Steel
71D-008 Filter Backwash Tank	2,950	Stainless Steel
71D-009 Sample Tank	380	Stainless Steel
71D-011 Low TDS Feed Tank	380	Stainless Steel
71E-001 Reboiler	N/A	Stainless Steel
71E-005 Concentrates Cooler	N/A	Stainless Steel
Equipment in the General Purpose Cell Crane Room Extension		
35104 LLW Collection Tank	22,000	Stainless Steel
Equipment in the Uranium Product Cell		
5D-15A1/A2 Evaporator Concentrates Tank	38,150 18,990	Stainless Steel
5D-15B Evaporator Feed Tank	56,950	Stainless Steel
Equipment in the Liquid Waste Cell		
3D-2 Sample Collection Tank	3,785	Stainless Steel
4D-10 First U Cycle Waste C/H Tank (GPC/LWC Sump Receiver)	11,360	Stainless Steel
7D-2 LLW Collection Tank	32,220	Stainless Steel
7D-8 Rework Evaporator Feed Tank (Tank 6D-3 Overflow Receiver)	11,360	Stainless Steel
7D-14 Hot Analytical Cell Drain Catch Tank	1,900	Hastelloy "C"
13D-8 Cell Sump Receiver	2,570	Stainless Steel
Equipment in the Lower Extraction Aisle		
14D-7 HNO_3 Addition Tank	375	Stainless Steel
14D-18 NaOH Addition Tank	375	Stainless Steel

TABLE B.5.2-6

SUMMARY OF MAJOR EQUIPMENT IN GENERAL MAIN PLANT CELLS[1]

Vessel/Component	Volume (L)	Construction
Equipment in the Off-Gas Cell		
6C-3 VOG Scrubber	1,500	Stainless Steel
6D-3 VOG Condensate Catch Tank	860	Stainless Steel
6D-6 VOG Knockout Pot	240	Stainless Steel
6E-3 VOG Cooler	N/A	Stainless Steel
6E-4 VOG Heater	N/A	Stainless Steel
Equipment in Extraction Cell 1		
4D-2 Partition Cycle Waste C/H Tank (XC1 Sump Receiver)	4,160	Stainless Steel

Notes

[1] - Only currently in-service equipment in these areas is given.

TABLE B.5.2-7

SUMMARY OF MAJOR CSS EQUIPMENT IN THE 01-14 BUILDING

Vessel/Component	Volume (L)	Construction
Equipment in the CSS Waste Dispensing Cell		
70D-001 Waste Dispensing Vessel	1,890	Stainless Steel
Equipment in the CSS Process Room		
70K-002 High Shear Mixer	114	Stainless Steel
70K-004 High Shear Mixer	114	Stainless Steel
Equipment in the CSS Change Room		
70V-001 Additive Day Tank	1,160	Carbon Steel
70V-001 Additive Bulk Storage Tank	5,700	Polyethylene
Yard, west of Main Plant		
7D-13 Lab Drains Catch Tank (CSS Sump Receiver)	7,710	Stainless Steel

TABLE B.5.3-1

HIGH LEVEL WASTE LEAK DETECTION SYSTEMS

Structure Barrier	Nature of Leak	Detected By	Mitigation
Tanks 8D-1 and 8D-2	Tank leaks into vault	Leak detection system in vault pan	Vault fluids may be jetted to pan. Pan fluids may be pumped to tank; can pump fluids to other identical tank/vault system
Supernatant Pump Pit, Top of Tank 8D-2	Leak from transfer piping (single wall in pit) into pit	Major leak detected by low pressure/low flow alarms in STS control room	Gravity drain into Tank 8D-2
HLW Transfer Conduit	HLW transfer piping (double walled within conduit) leaks into conduit	Leak detection system in annular space between pipe walls Vapor detected by STS Off-Gas Treatment system effluent monitoring system	Drain pipe in conduit; gravity drain back to Tank 8D-2
Pipeway/Valve Aisle	Transfer piping or valves leak into pipeway or valve aisle	Valve aisle sump has high fluid level alarm Vapor detected by STS Off-Gas Treatment System effluent monitoring system	Pump actuates in response to high fluid level in sump returns fluids to Tank 8D-2
Components in Tank 8D-1	Fluids leak from components into tank DF across IX system less than adequate; supernatant transferred to Tank 8D-3	Laboratory analysis of sluice lift water On-line radiation monitors	Return fluids to Tank 8D-2 for rework by STS
LLW Transfer Conduit	LLW transfer within conduit	Leak detection system in annular space	Pump to Tank 8D-2, if needed
HLWTS pump pits	Leak from transfer jumper (single wall in pit) into pit	Leak detected by conductivity probe, alarms at HLWTS control station	Gravity drain into Tanks through pit drains
HLWTS components in pits	Liquid leak from components into pit	Leak detected by conductivity probe, alarms at HLWTS control station	Gravity drain into Tanks through pit drains
HLWTS utility pits	HLW transfer leaks into utility flush feed line	On-line radiation monitors	Block and bleed valving drains into pump pit, gravity drain into Tanks through pump pit drains

TABLE B.5.4-1

SUMMARY OF FILTER MONITORING INSTRUMENTATION

Ventilation System	Filter Instrumentation						Plenum or Header PAH
	PDR	PDAH	PDCH	PDAL	PDCL	PR	
Permanent Ventilation System	X	X		X			
Main Ventilation	X	X	X	X	X	X	X
Head End Ventilation	X	X	X	X	X	X	X
01-14 Building	X	X		X			
Vessel Off-Gas (Upstream)	X					X	
Vessel Off-Gas (Downstream)	X	X					
Waste Tank Farm	X	X					

PDR = Pressure Differential Recorder
PDAH = Pressure Differential Alarm High
PDCH = Pressure Differential Control High
PDAL = Pressure Differential Alarm Low
PDCL = Pressure Differential Control Low
PR = Pressure Recorder
PAH = Pressure Alarm High

TABLE B.5.4-2

SUMMARY OF UTILITY SUPPORT CAPABILITIES

Utility Supply System	Units	Peak Demand in Normal Operation	Installed Capacity
Raw Water Supply and Treatment	gpm	75	400
Demineralized Water	gpm	16	20
Cooling Water - Open System	gpm	1,785	2,250
Cooling Water - Heat Transfer	MBTU	5	31
Steam Generation - 150 psig 25 psig	lb/h	15,000	35,000
Fuel Gas	MBTU/hr	20	110
Fuel Oil	gpm	0	15
Compressed Air	scfm	1,500	3,500
Instrument Air	scfm	300	600
Electric Power	kVA	2,700	11,500

TABLE B.5.4-3

IRTS UTILITY REQUIREMENTS

Utility	Flow or Power	Pressure or Voltage
Electricity		
STS	190 to 200 kW	480 V, 3 phase
LWTS	45 kW	480 V, 3 phase 120 V, single phase
CSS	190 to 200 kW	480V, 3 phase
DC	Not Specified	480 V, 3 phase 120 V, single phase
Utility Air		
STS	1,400 L/m	690 kPa
LWTS	560 L/m	690 kPa
CSS	3,800 L/m	690 kPa
Instrument Air		
STS	8,500 L/m	725 kPa
LWTS	1,200 L/m	345 kPa
CSS	710 L/m	345 kPa
Steam Supply		
STS	Intermittent	1050 kPa
LWTS	545 kg	170 kPa 1050 kPa
CSS	Intermittent	170 kPa
Utility Water		
STS	95 L/m	350 kPa
CSS [1]	(130 L/m)	---
Demineralized Water		
STS	150 L/m	275 kPa
LWTS	20 L/m	---
CSS	(1.9 L/m)	---
Cooling Water		
LWTS	950 L/m	---

Notes
[1] - Values in parentheses are intermittent values

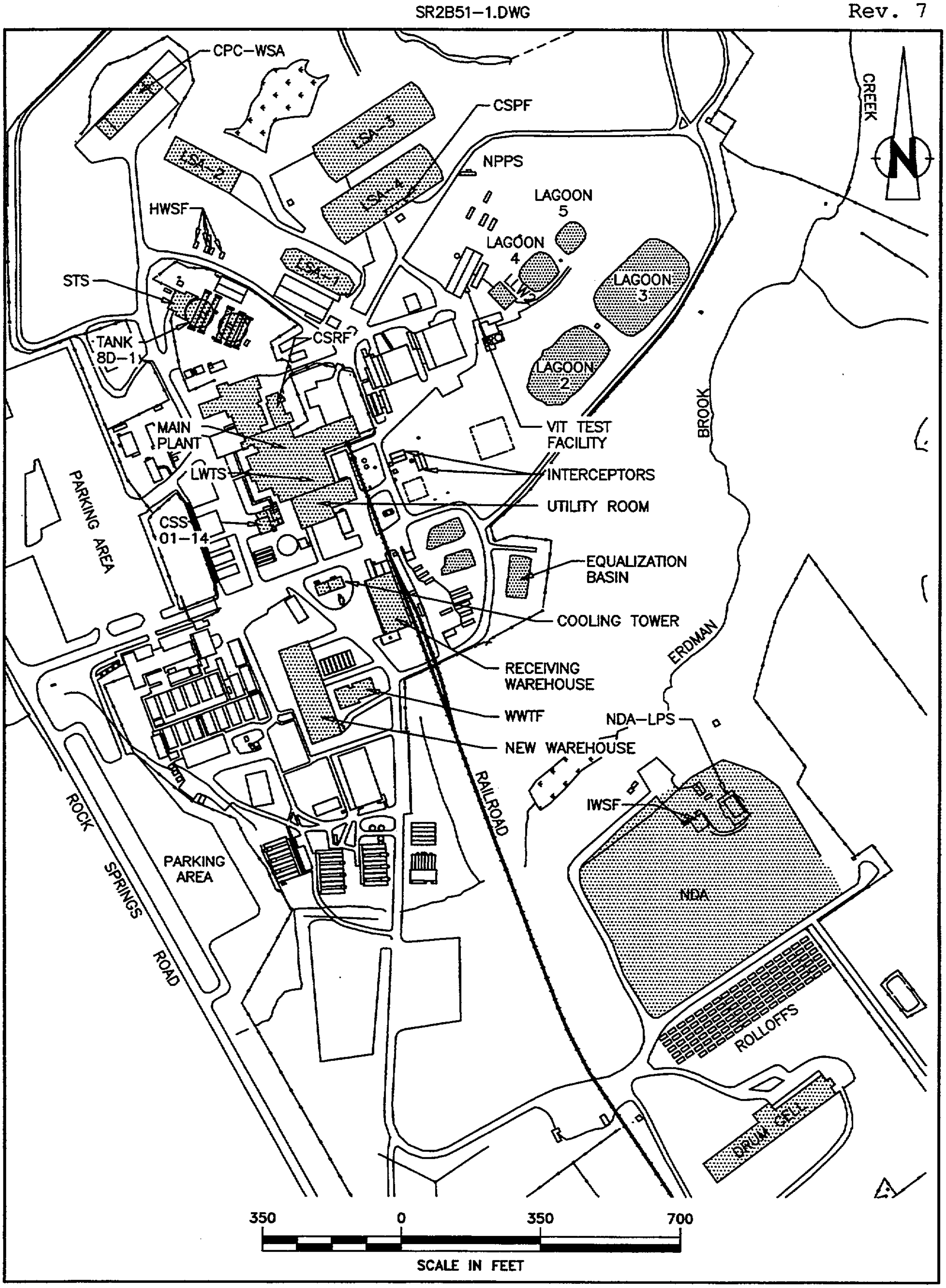


Figure B.5.1-1 Location of Select Facilities Covered in WVNS-SAR-002

SR2B51-2.DWG

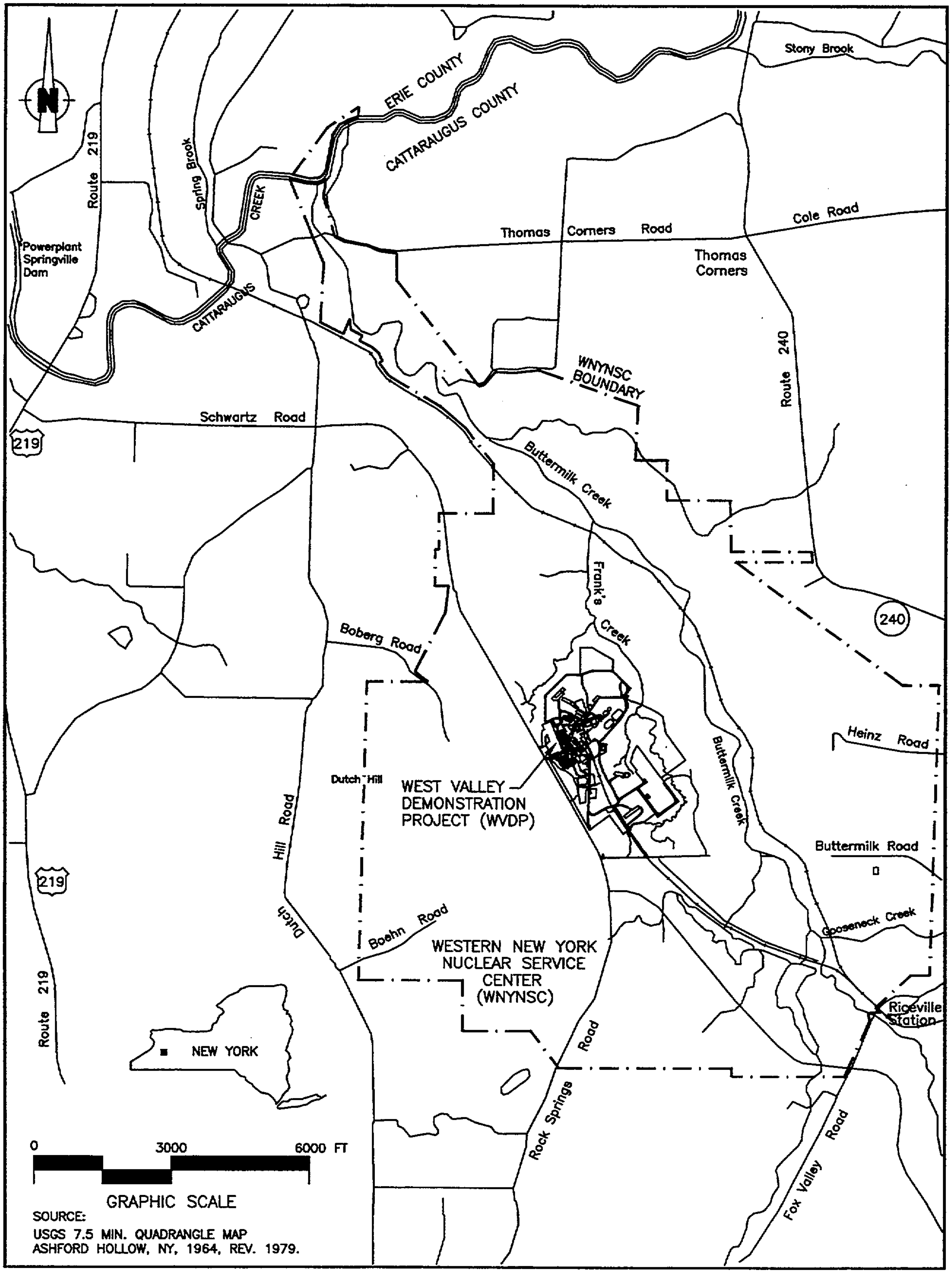


Figure B.5.1-2 Location of West Valley Demonstration Project

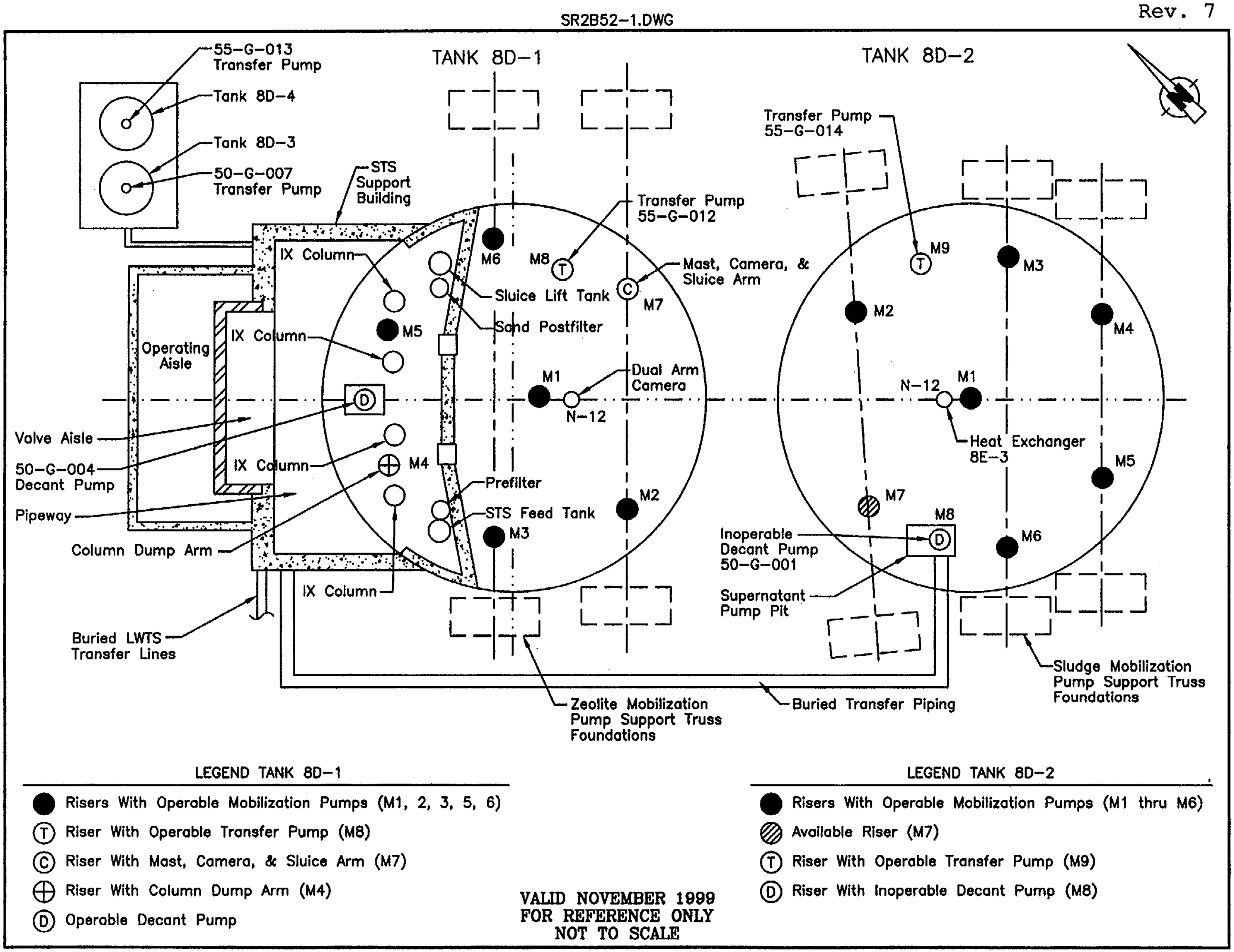


Figure B.5.2-1 Plan View – HLW Tanks 8D-1 and 8D-2

SR252-1A.DWG

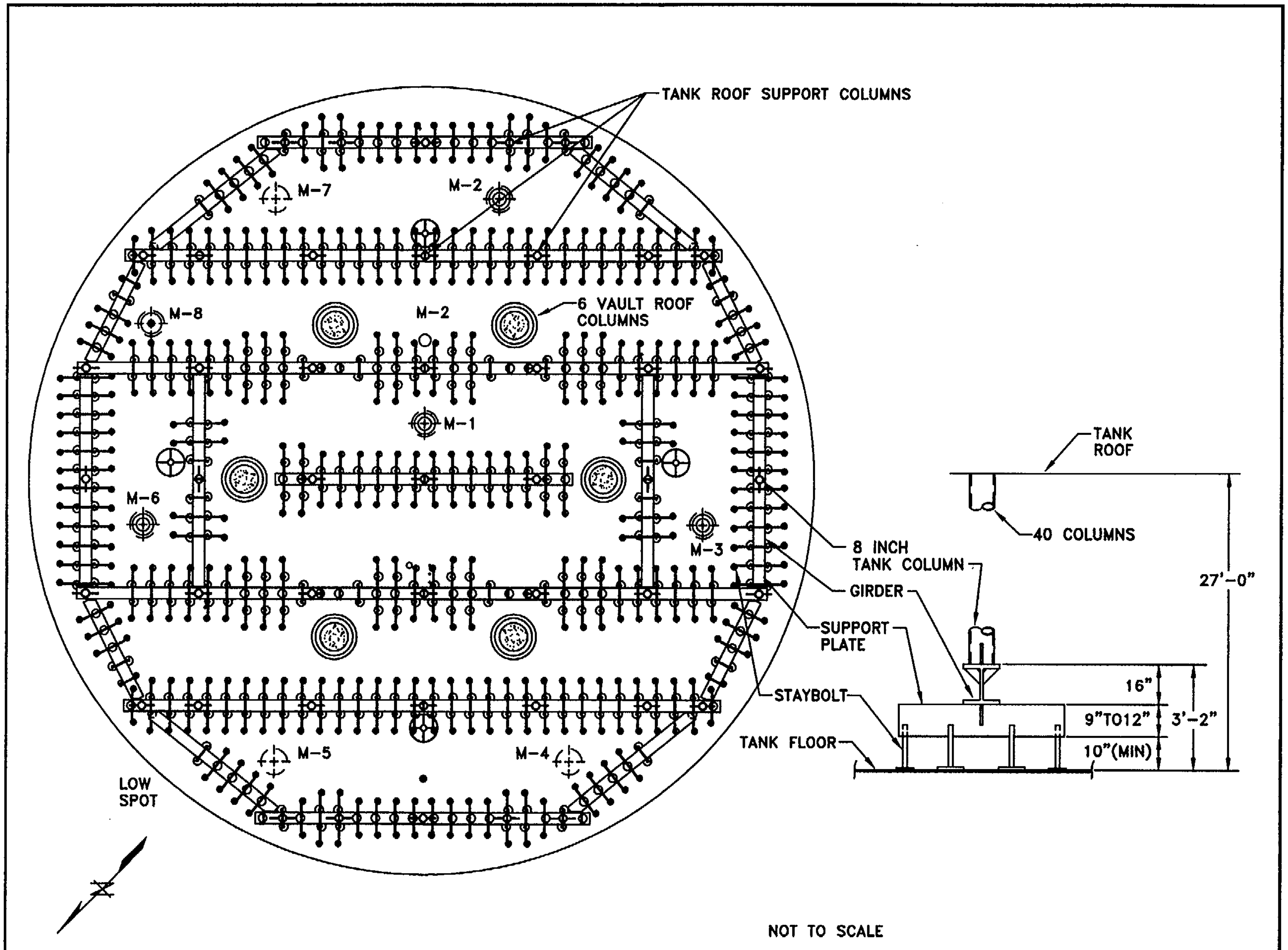
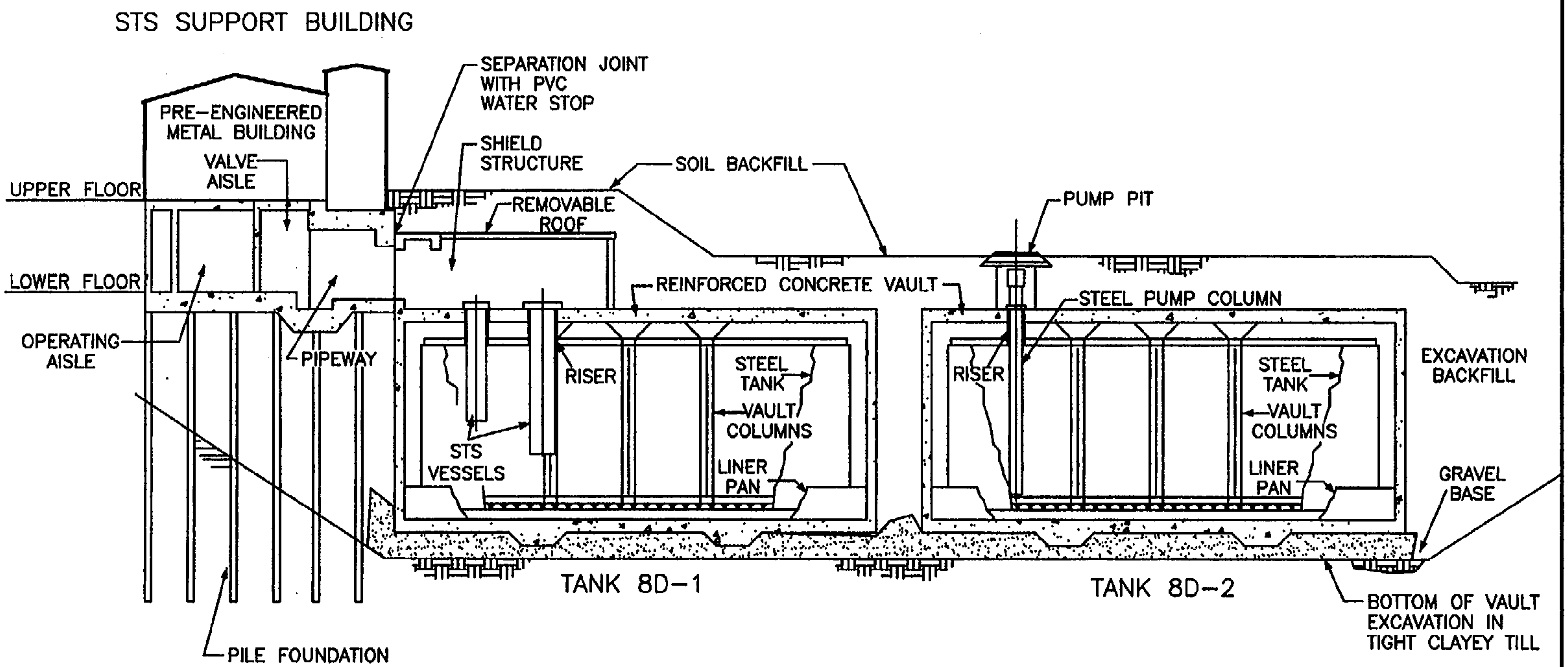


Figure B.5.2-1a Purex HLW Tank Internal Floor Structure (Typ.) (Tank 8D-1 Shown)

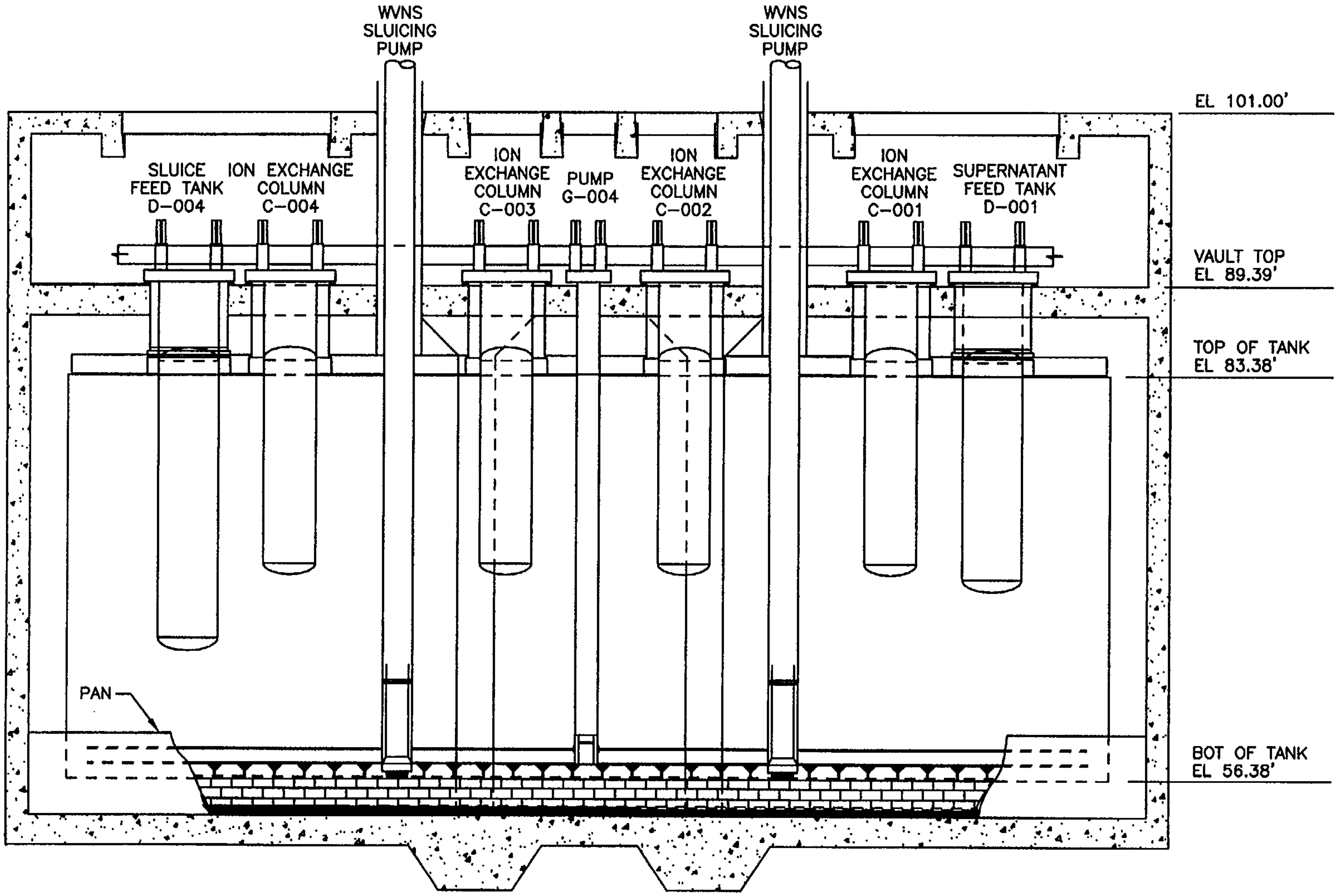
SR2B52-2.DWG



FOR REFERENCE ONLY – NOT TO SCALE

Figure B.5.2-2 STS Process Facilities Section

SR2B52-3.DWG



FOR REFERENCE ONLY – NOT TO SCALE

Figure B.5.2-3 General Arrangement – STS Tank 8D-1 Section

SR2B52-4.DWG

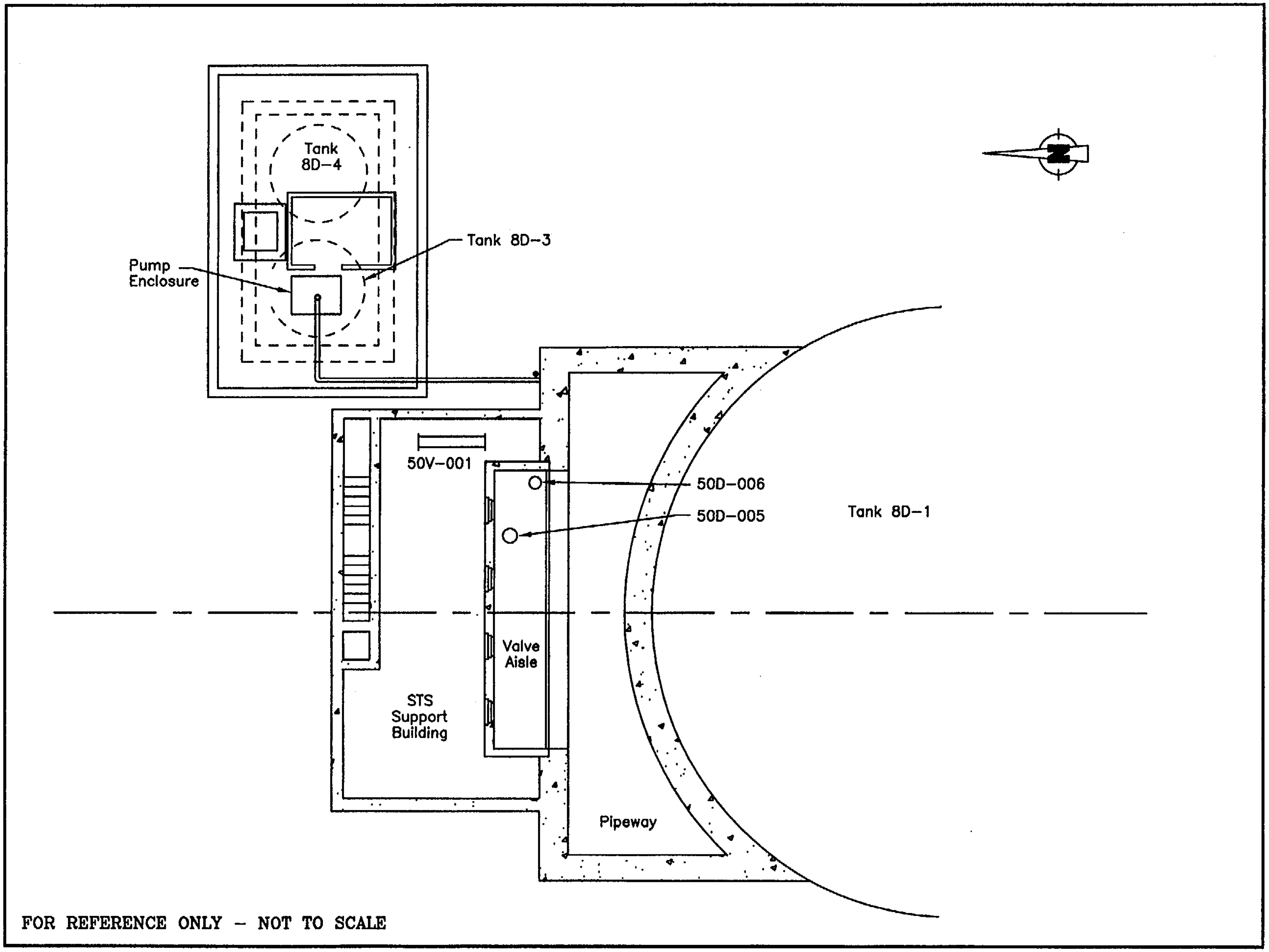
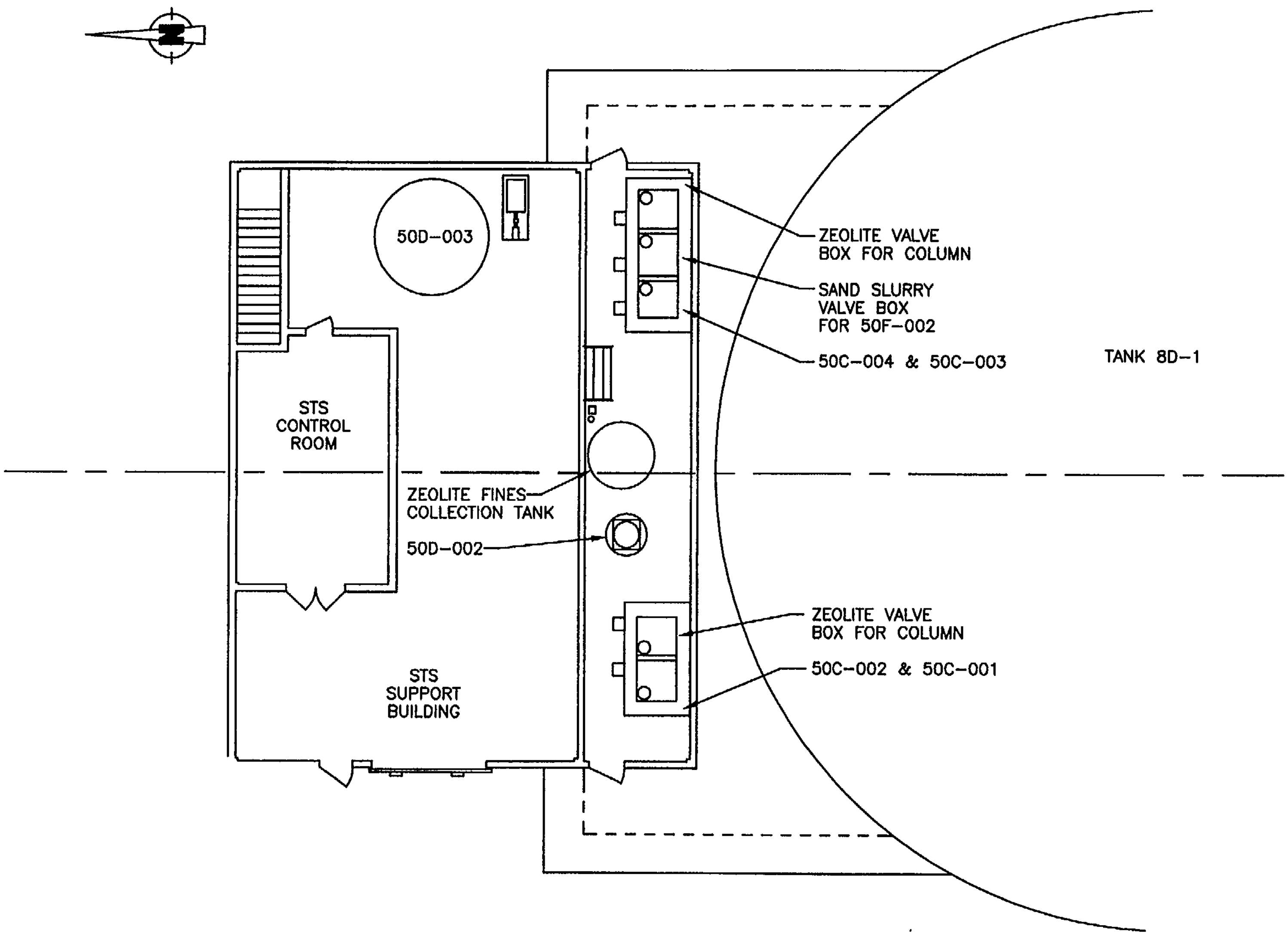


Figure B.5.2-4 General Arrangements STS Building and 8D-3 & 4 Tanks - Plan Elevation 92.0'

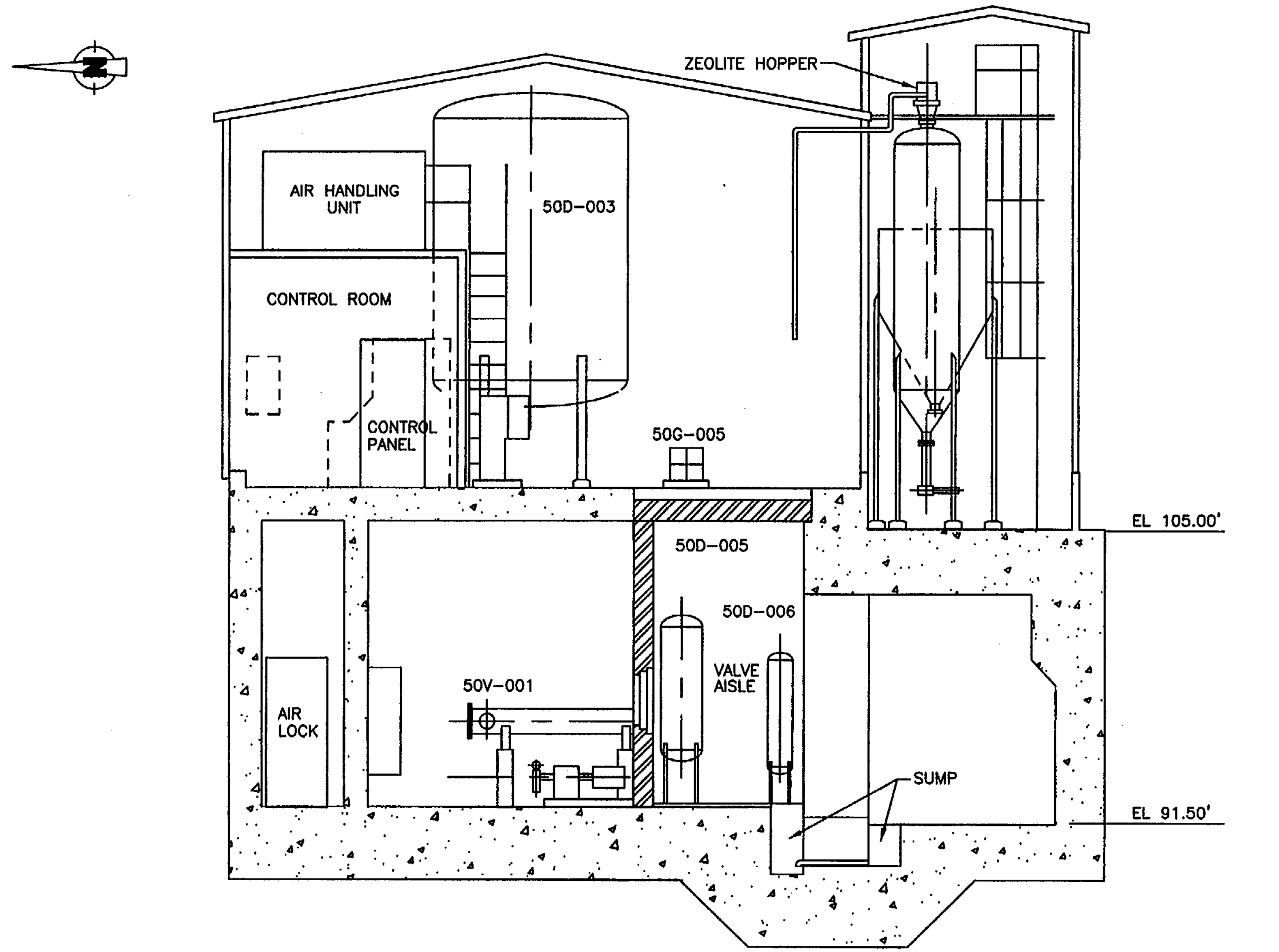
SR2B52-5.DWG



FOR REFERENCE ONLY - NOT TO SCALE

Figure B.5.2-5 General Arrangement STS Building - Plan Elevation 107.0'

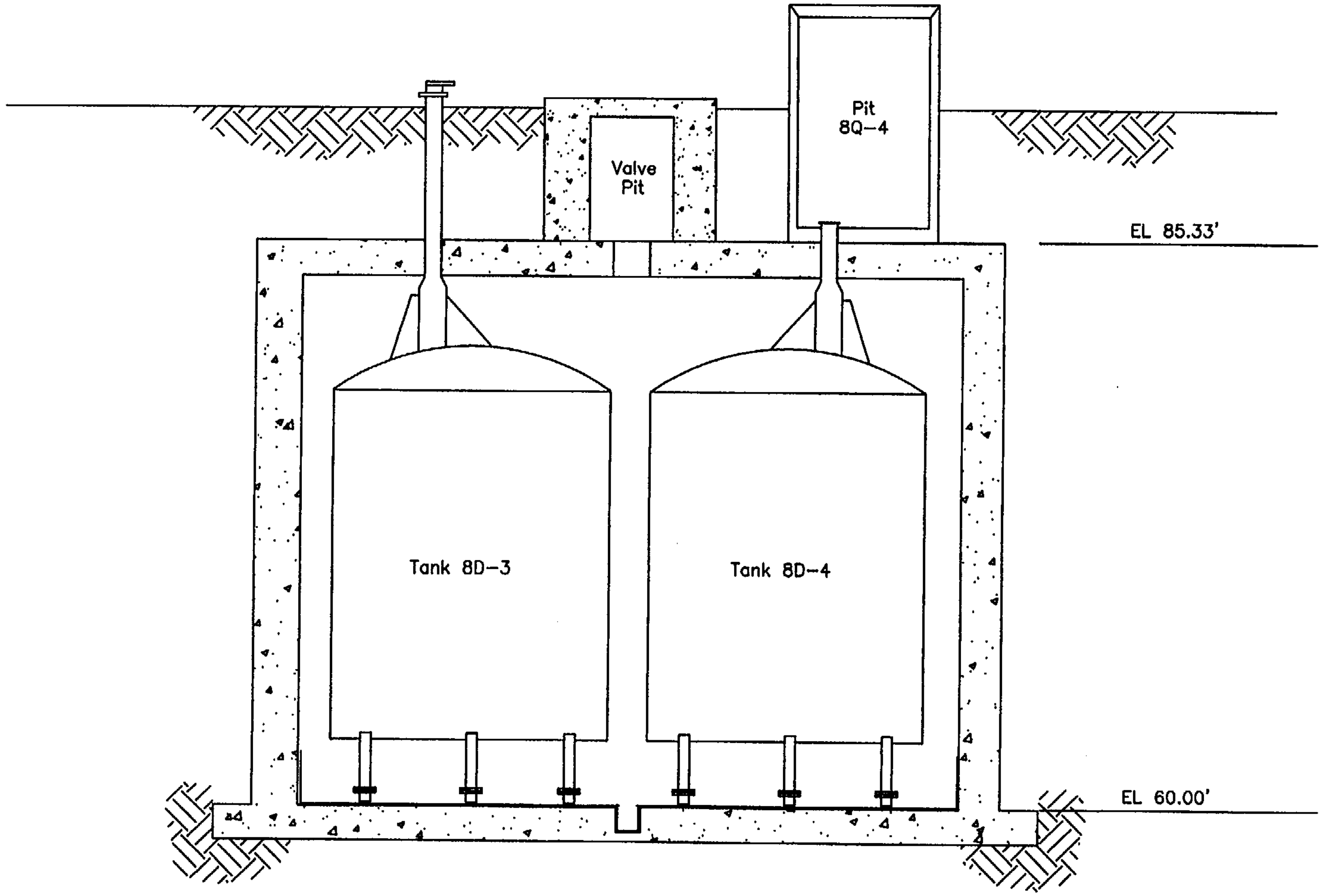
SR2B52-6.DWG



FOR REFERENCE ONLY - NOT TO SCALE

Figure B.5.2-6 General Arrangement — STS Building Sections

SR2B52-7.DWG



FOR REFERENCE ONLY - NOT TO SCALE

Figure B.5.2-7 HLW Tank 8D-3 and Tank 8D-4 Section

SR2B52-8.DWG

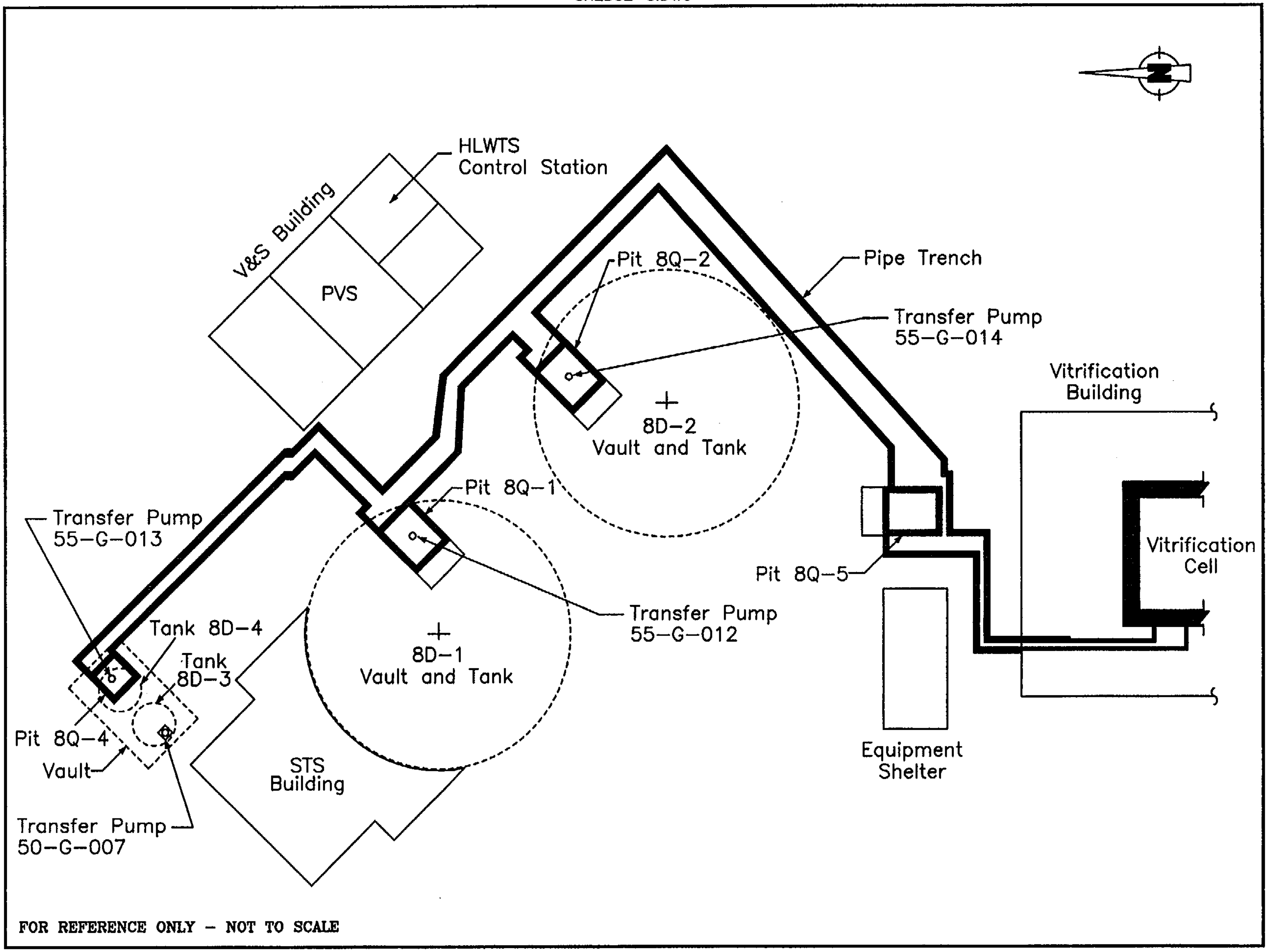


Figure B.5.2-8 High Level Waste Transfer System Plan

SR2B52-9.DWG

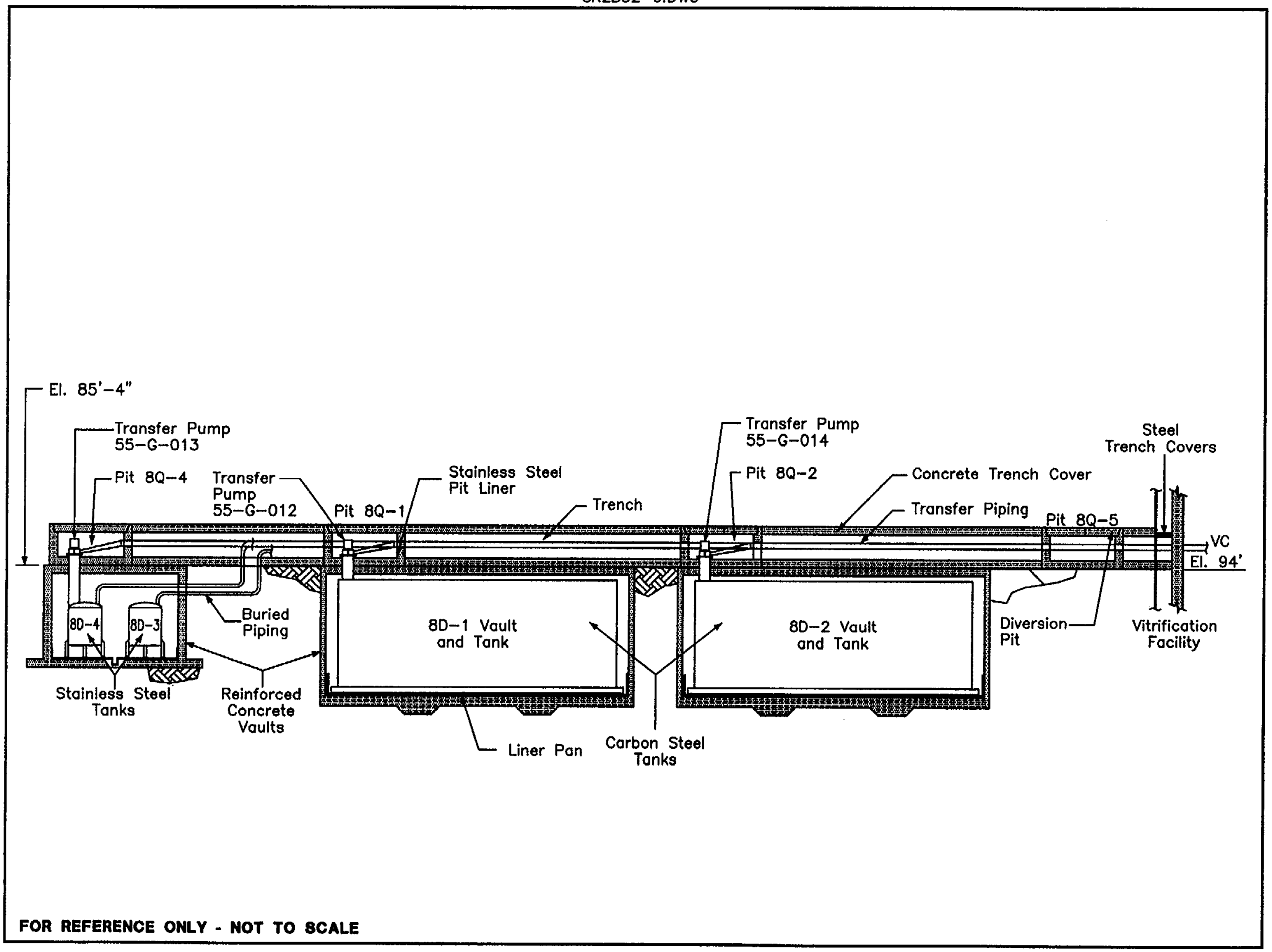
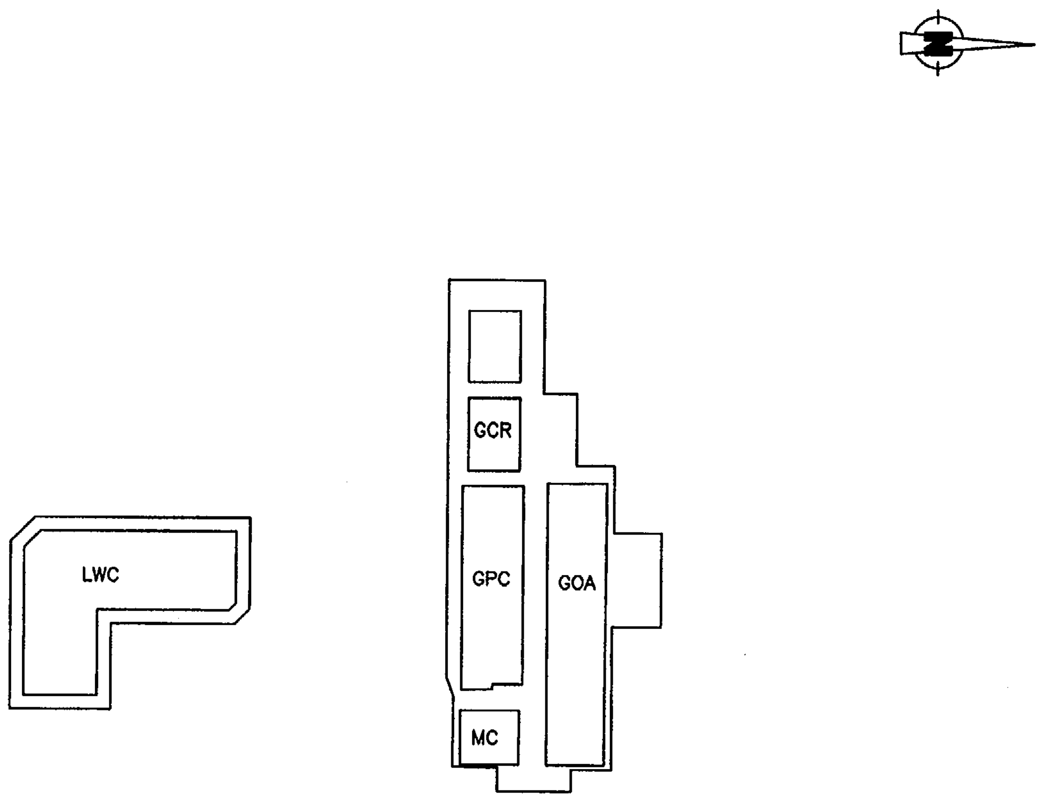


Figure B.5.2-9 High Level Waste Transfer System Section

SR2B5210.DWG



FOR REFERENCE ONLY - NOT TO SCALE

Figure B.5.2-10. Main Plant Plan Below Grade

SR2B5211.DWG

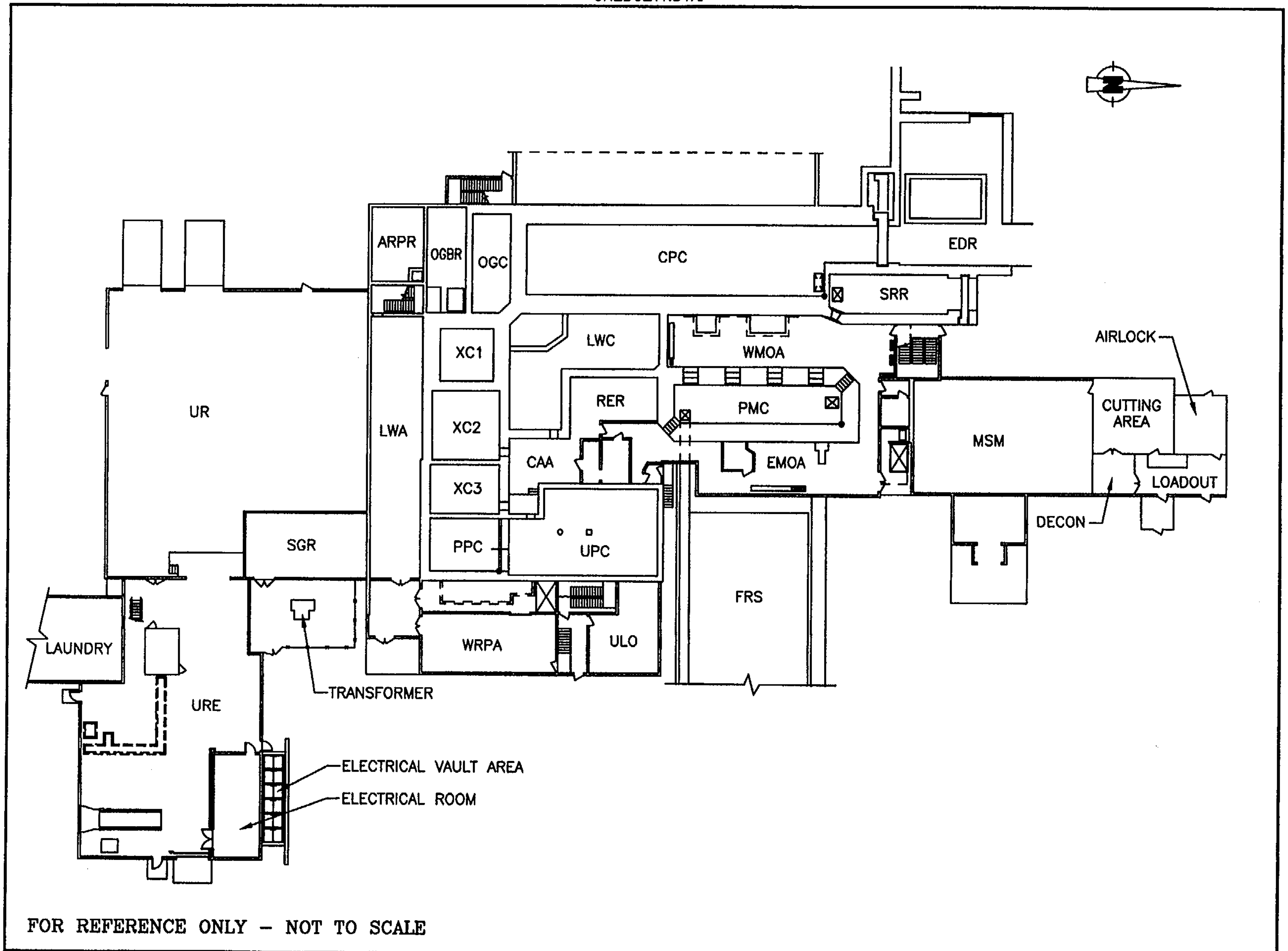
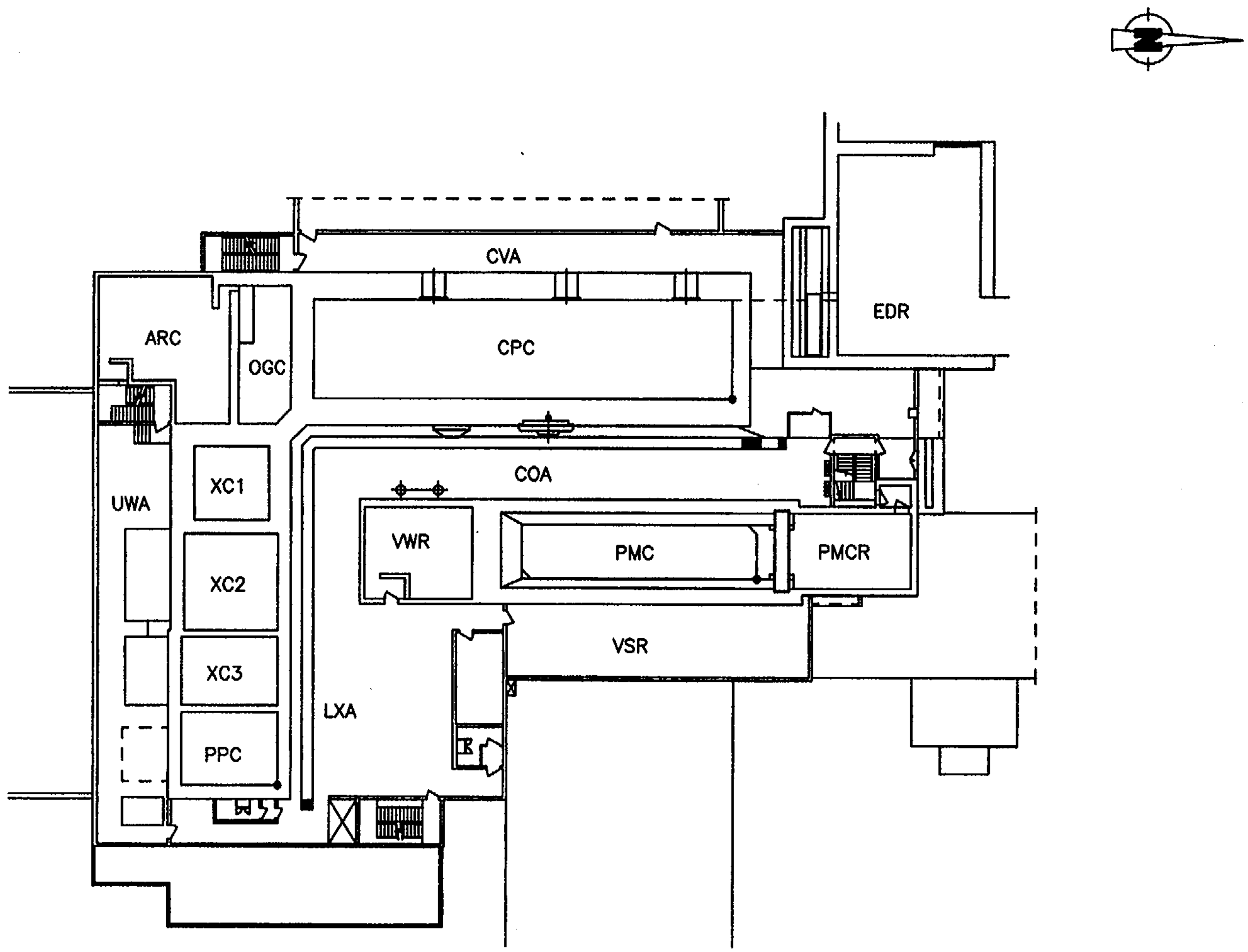


Figure B.5.2-11. Main Plant Plan at Elevation 100.0'

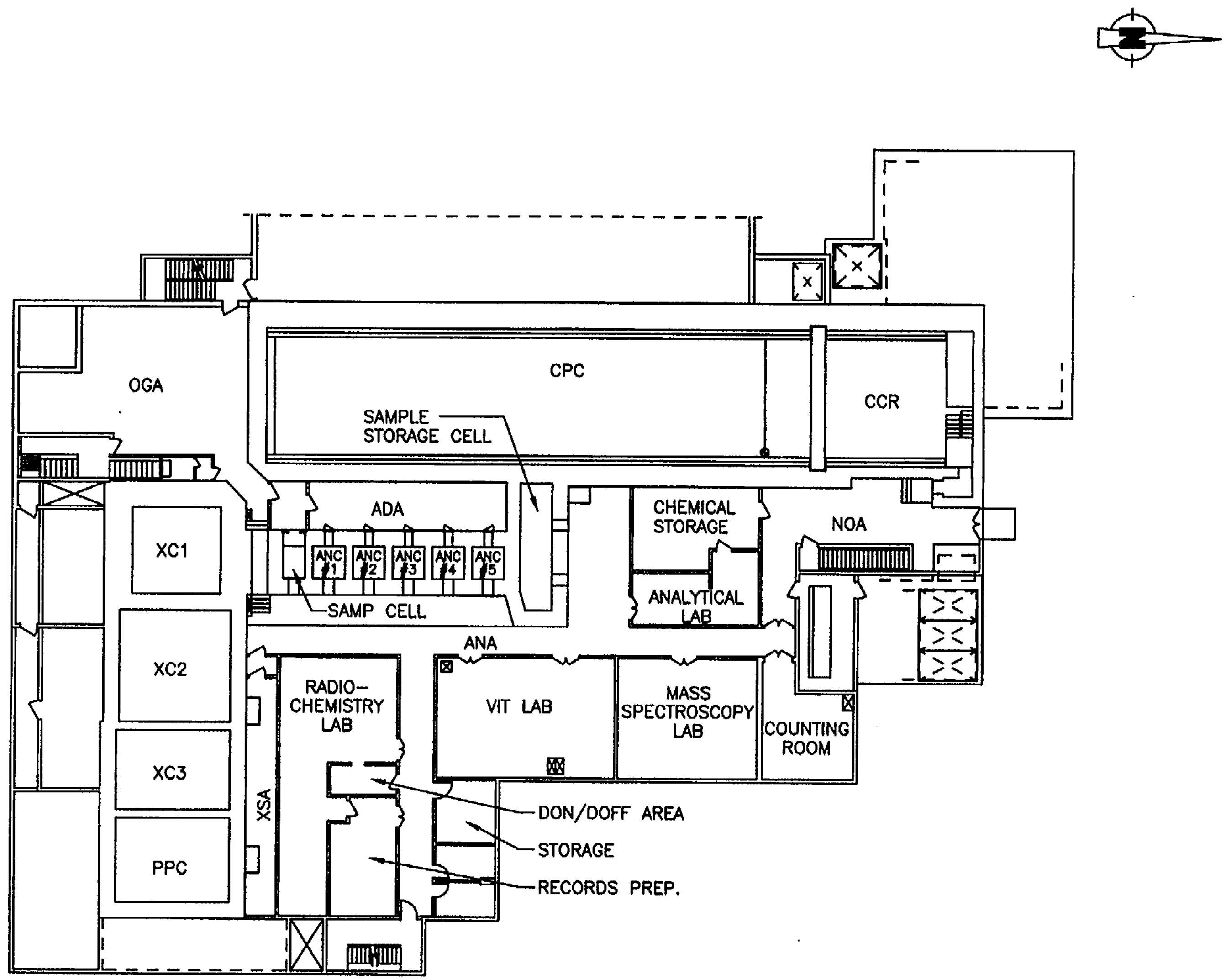
SR2B5212.DWG



FOR REFERENCE ONLY - NOT TO SCALE

Figure B.5.2-12. Main Plant Plan at Elevation 114.5'

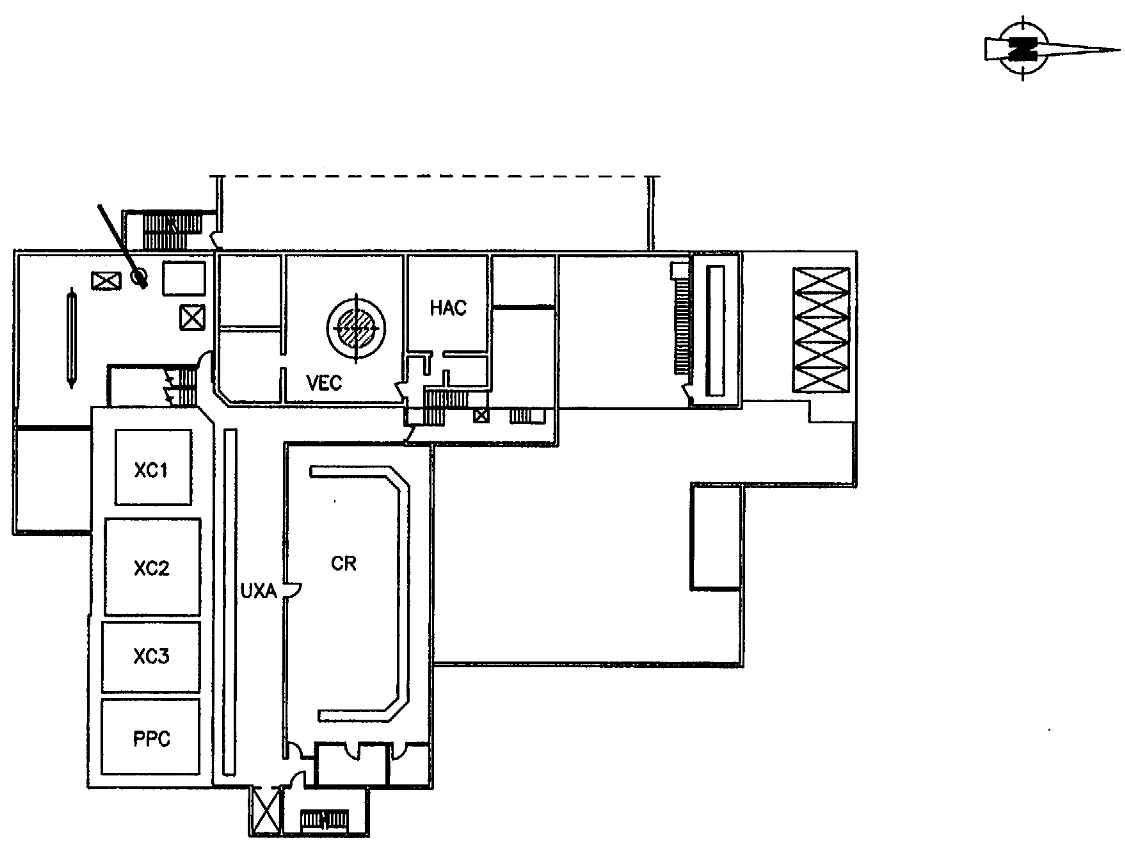
SR2B5213.DWG



FOR REFERENCE ONLY – NOT TO SCALE

Figure B.5.2-13. Main Plant Plan at Elevation 131.0'

SR2B5214.DWG



FOR REFERENCE ONLY – NOT TO SCALE

Figure B.5.2-14. Main Plant Plan at Elevation 144.0'

SR2B5215.DWG

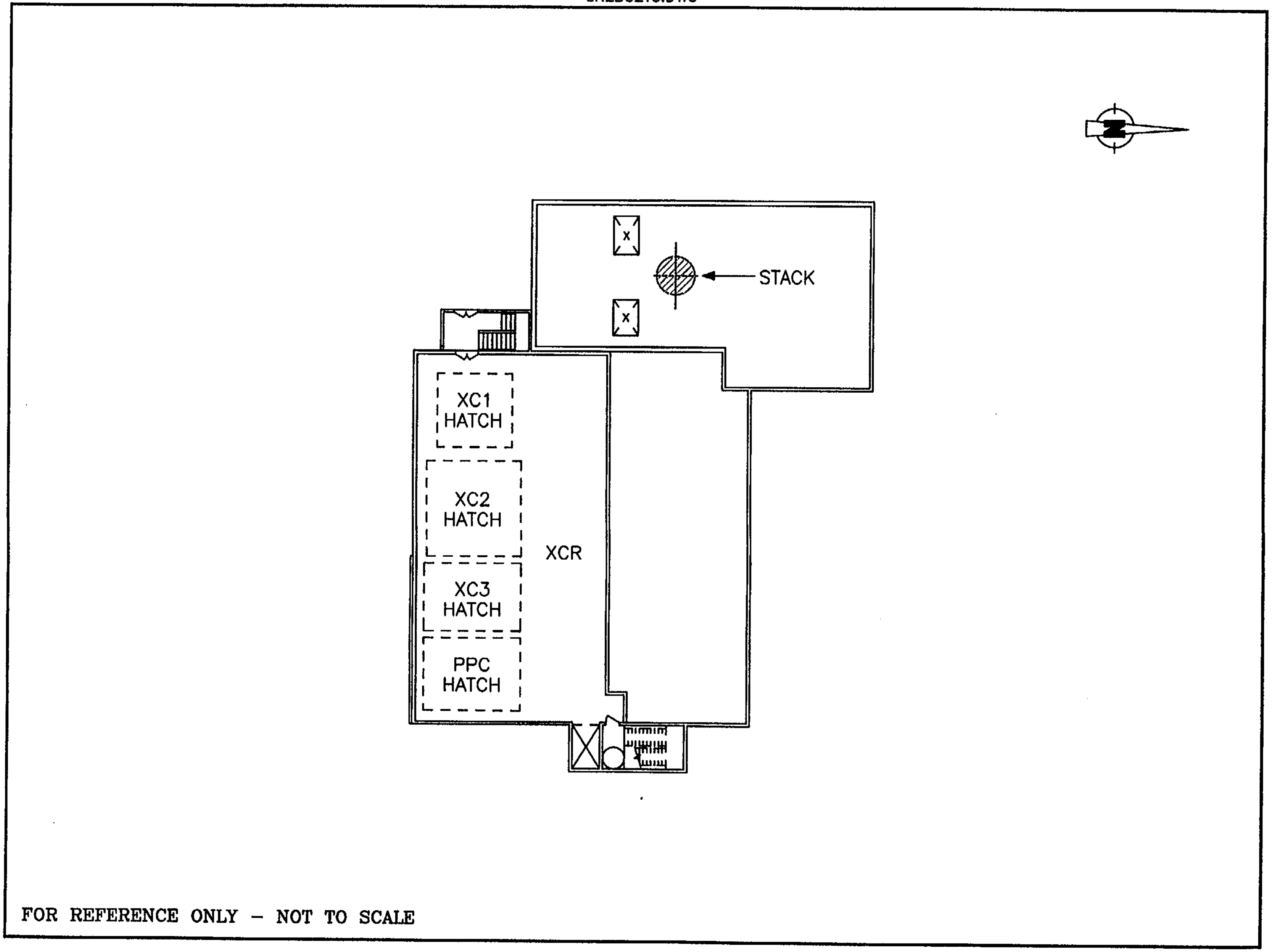
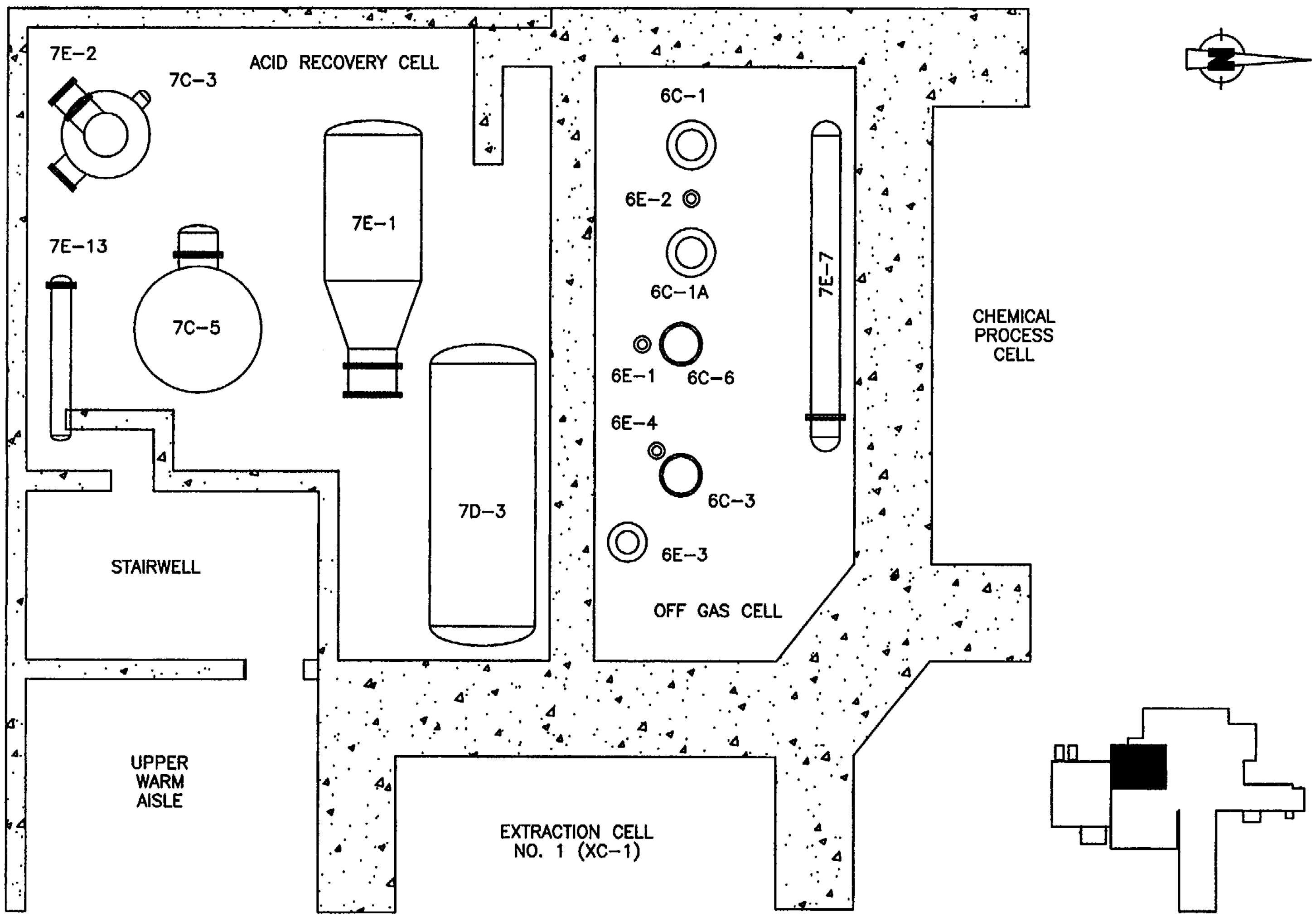


Figure B.5.2-15. Main Plant Plan at Elevation 160.0'

SR2B5216.DWG



FOR REFERENCE ONLY – NOT TO SCALE

Figure B.5.2-16 Equipment Arrangement – Off Gas and Acid Recovery Cells – Plan Elevation 111'-6" to 128'-3"

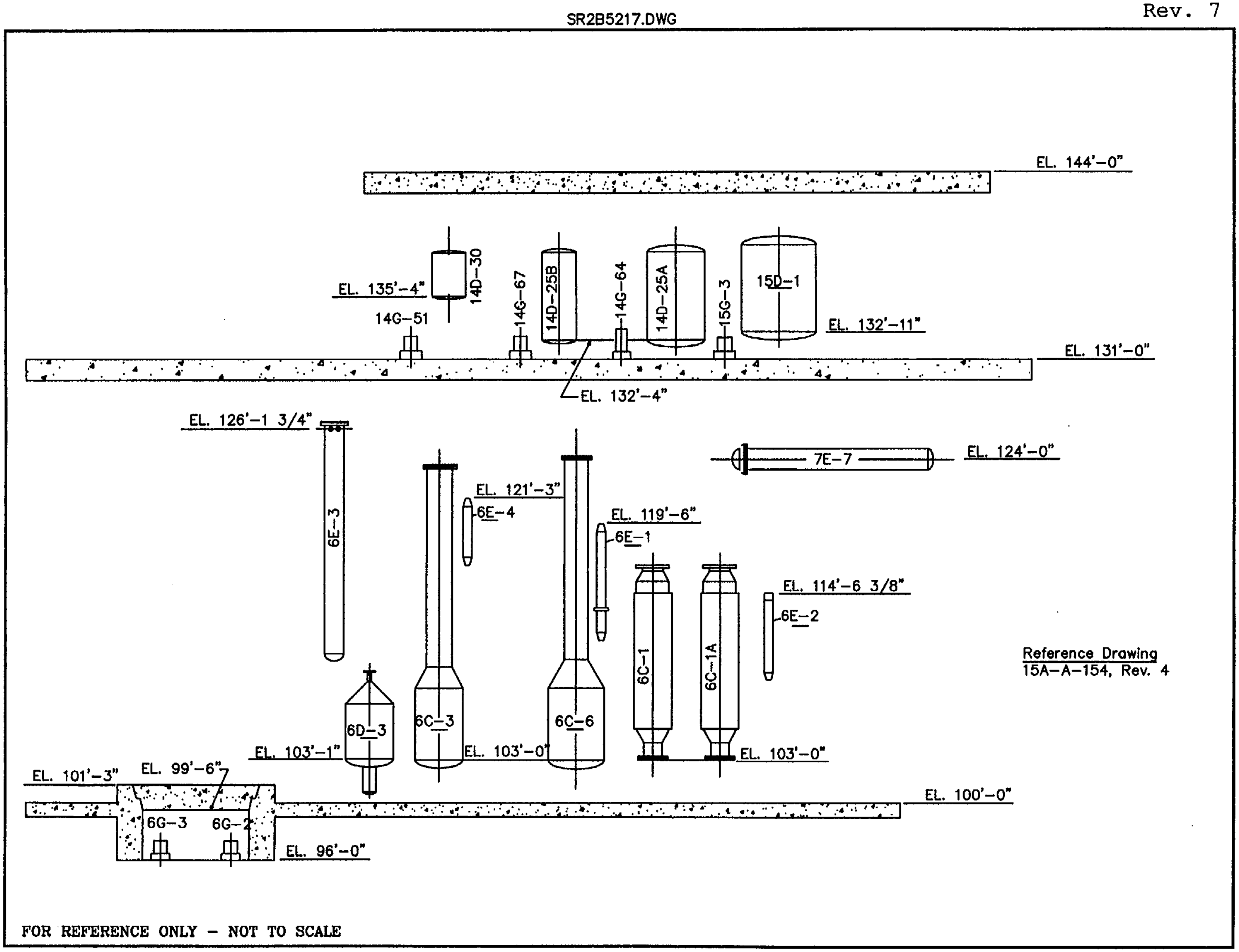


FIGURE B.5.2-17 Equipment Arrangement – Off Gas Cell, Schematic Elevation

SR2B5218.DWG

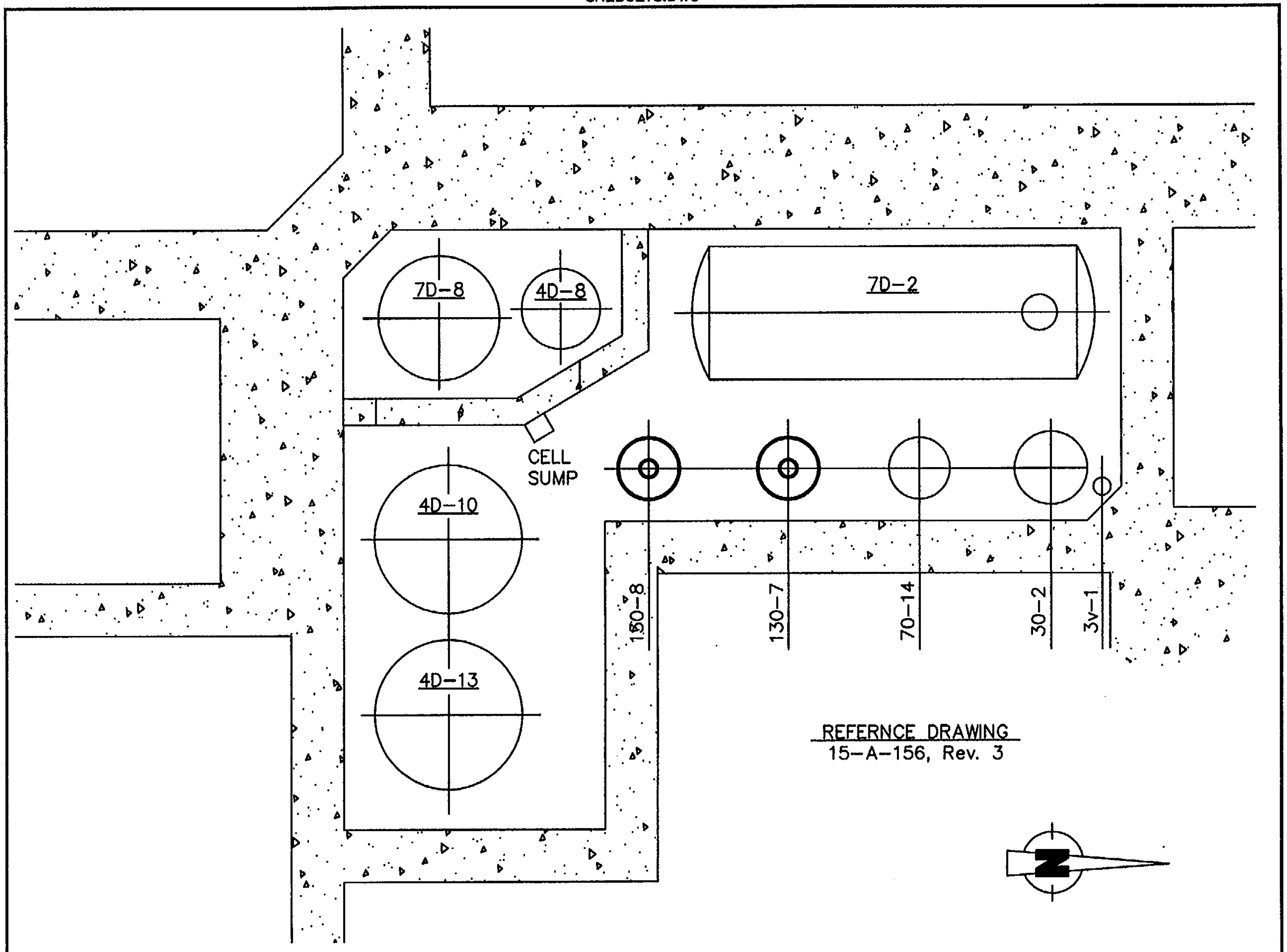
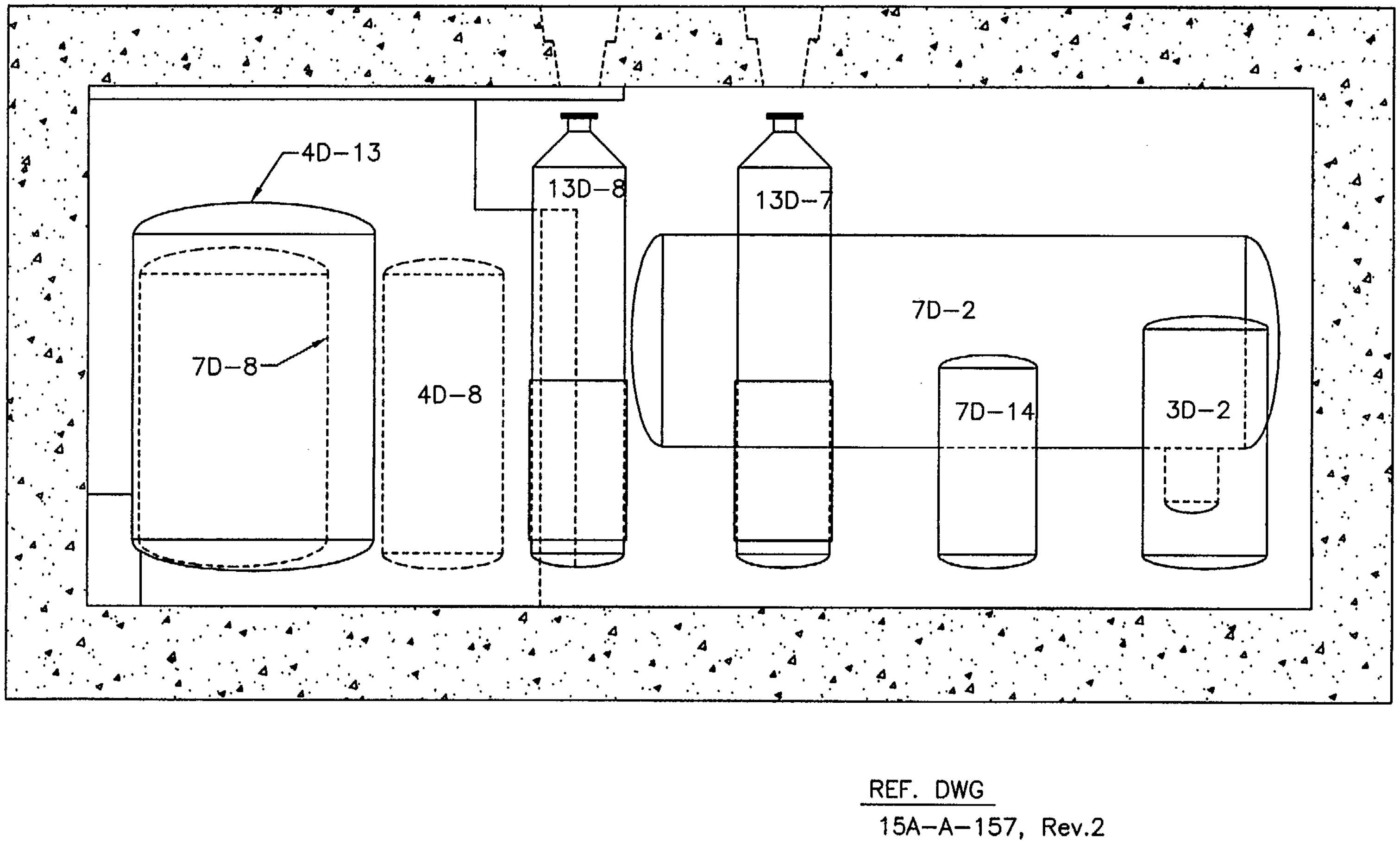


FIGURE B.5.2-18 Equipment Arrangement – Liquid Waste Cell Plan

SR2B5219.DWG



FOR REFERENCE ONLY - NOT TO SCALE

Figure B.5.2-19 Equipment Arrangement – Liquid Waste Tankage Cell – Section A-A

SR2B5220.DWG

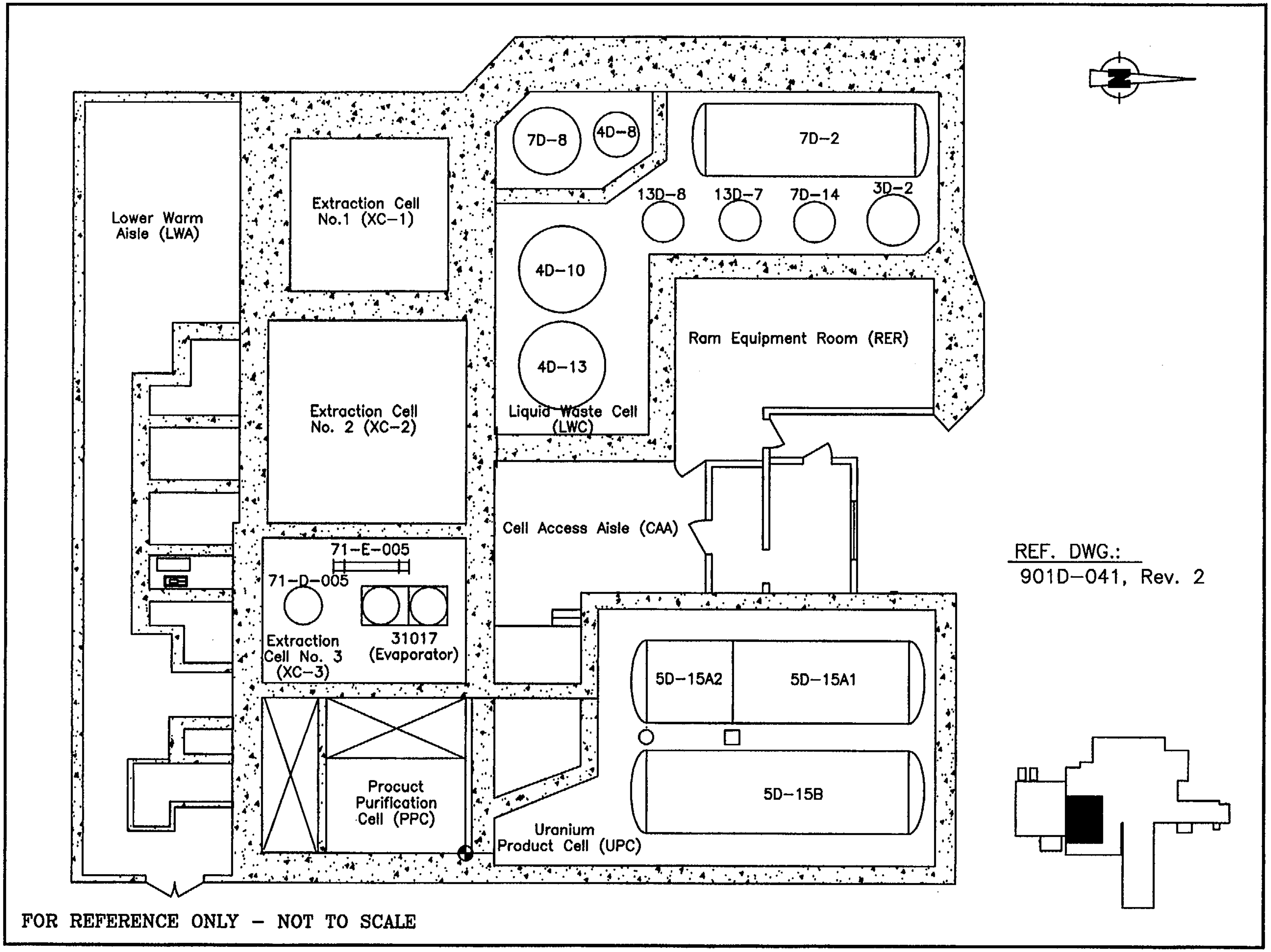


Figure B.5.2-20 LWTS Plan at Elevation 100.0'

SR2B5221.DWG

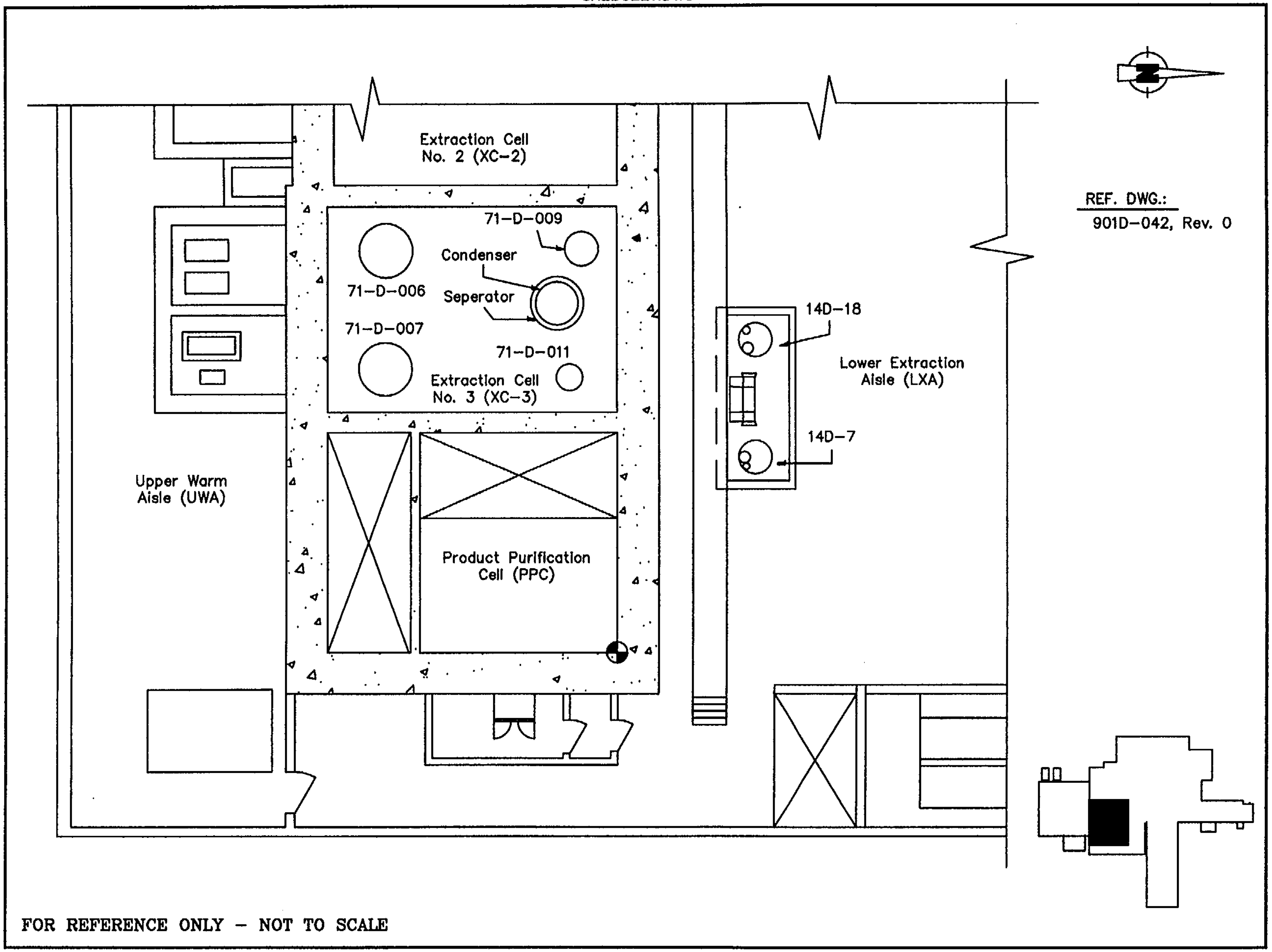
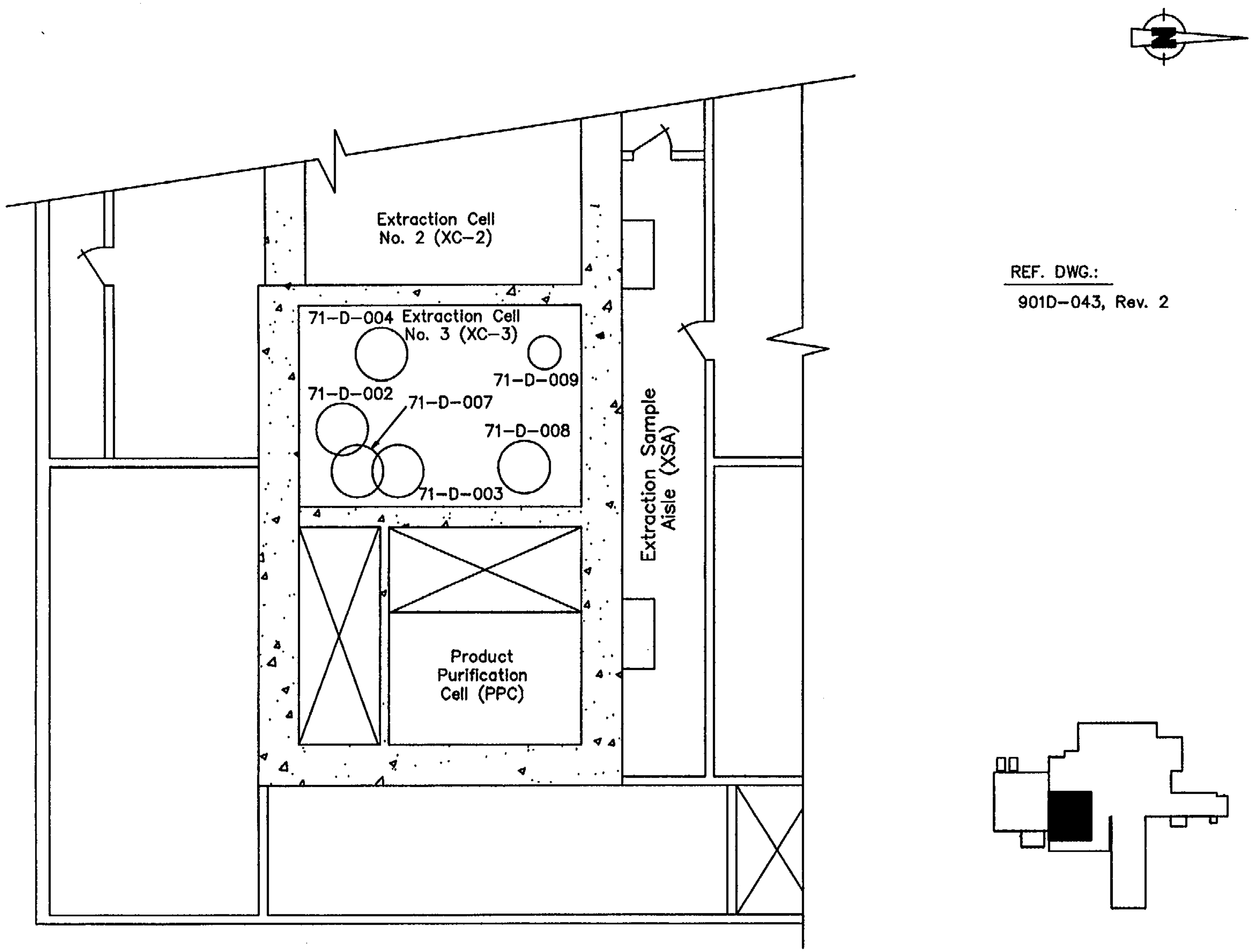


Figure B.5.2-21 LWTS Plan at Elevation 114.5'

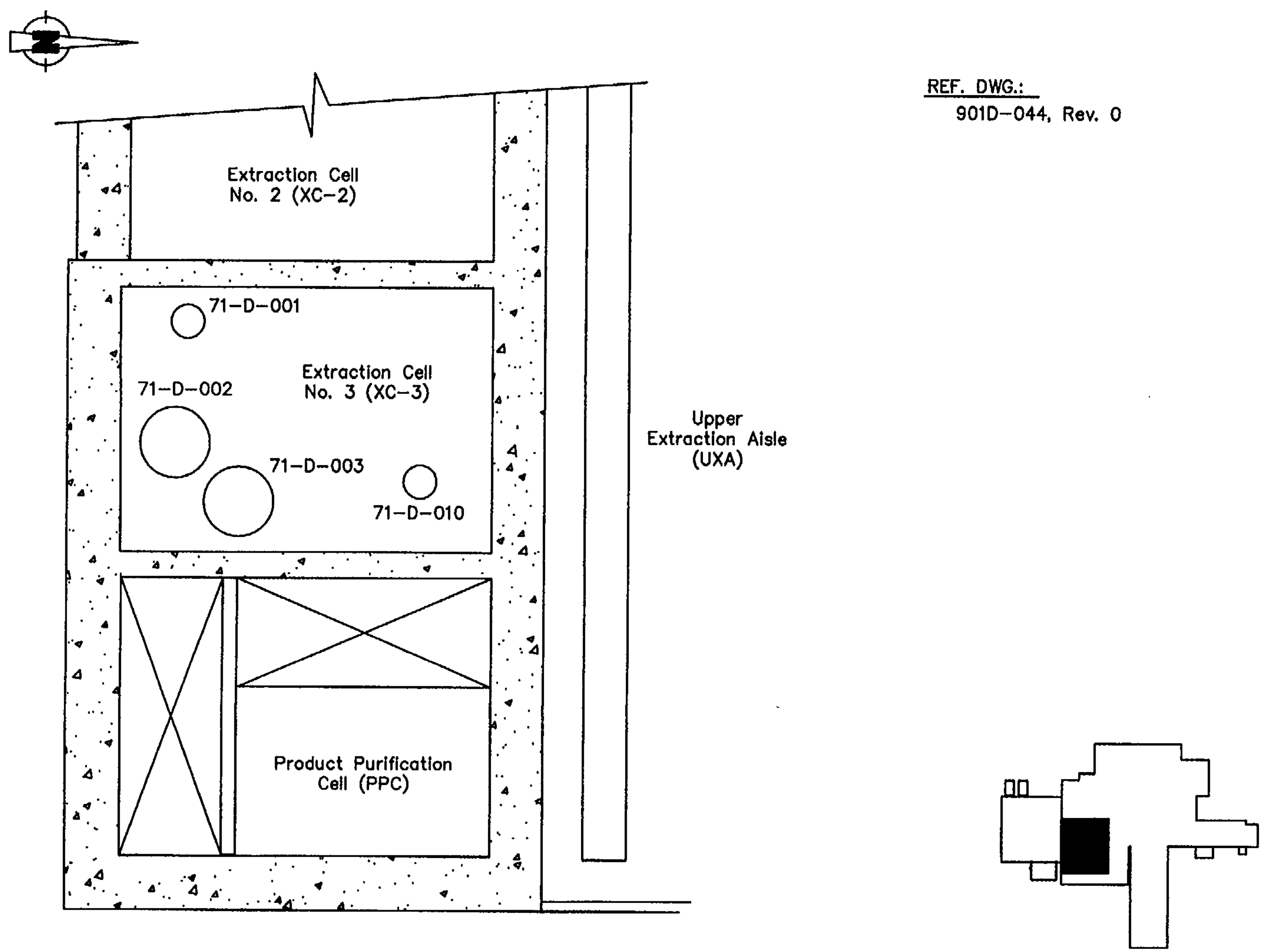
SR2B5222.DWG



FOR REFERENCE ONLY – NOT TO SCALE

Figure B.5.2-22 LWTS Plan at Elevation 131.0'

SR2B5223.DWG



FOR REFERENCE ONLY - NOT TO SCALE

Figure B.5.2-23 LWTS Plan at Elevation 144.0'

SR2B5224.DWG

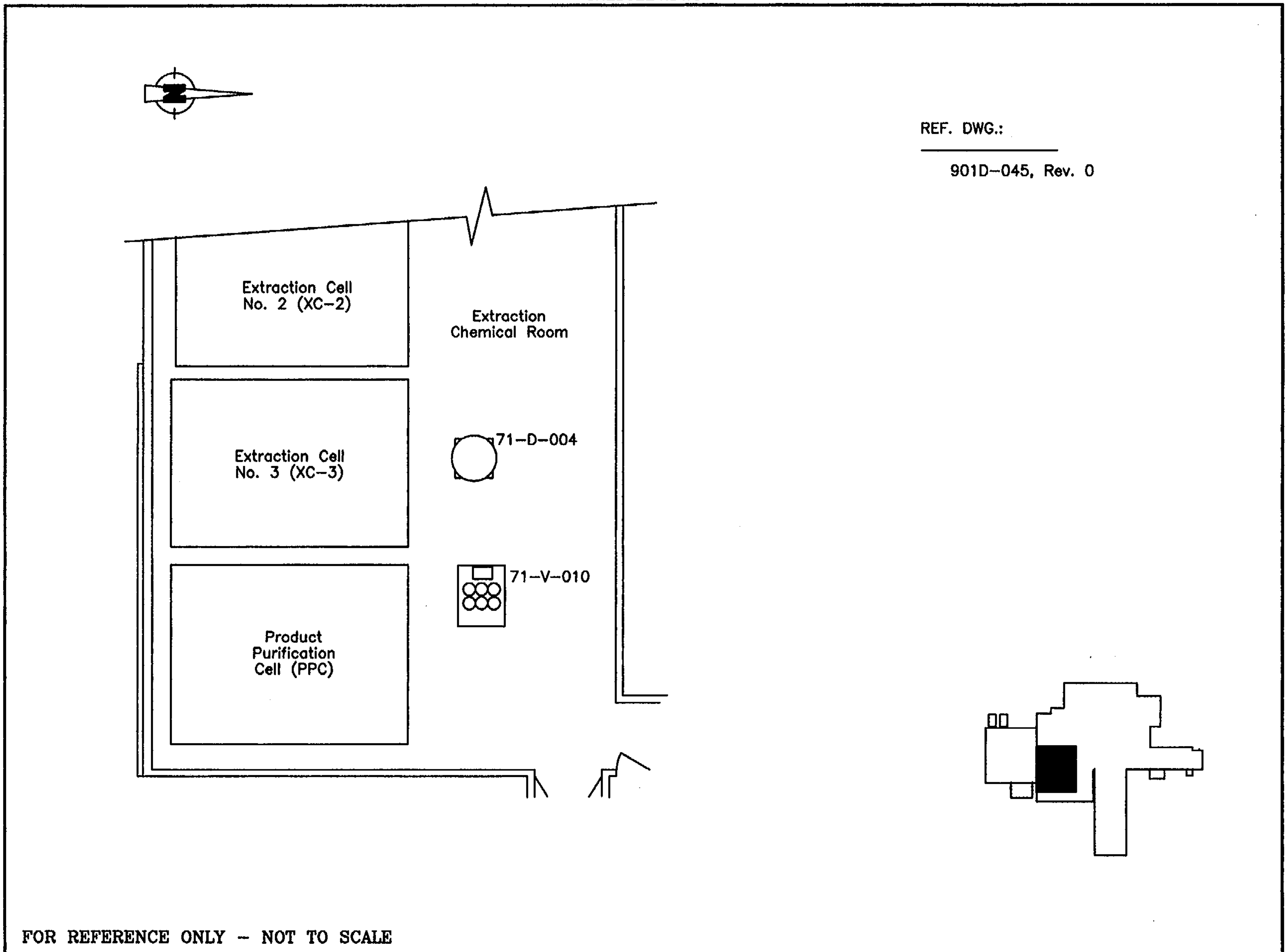
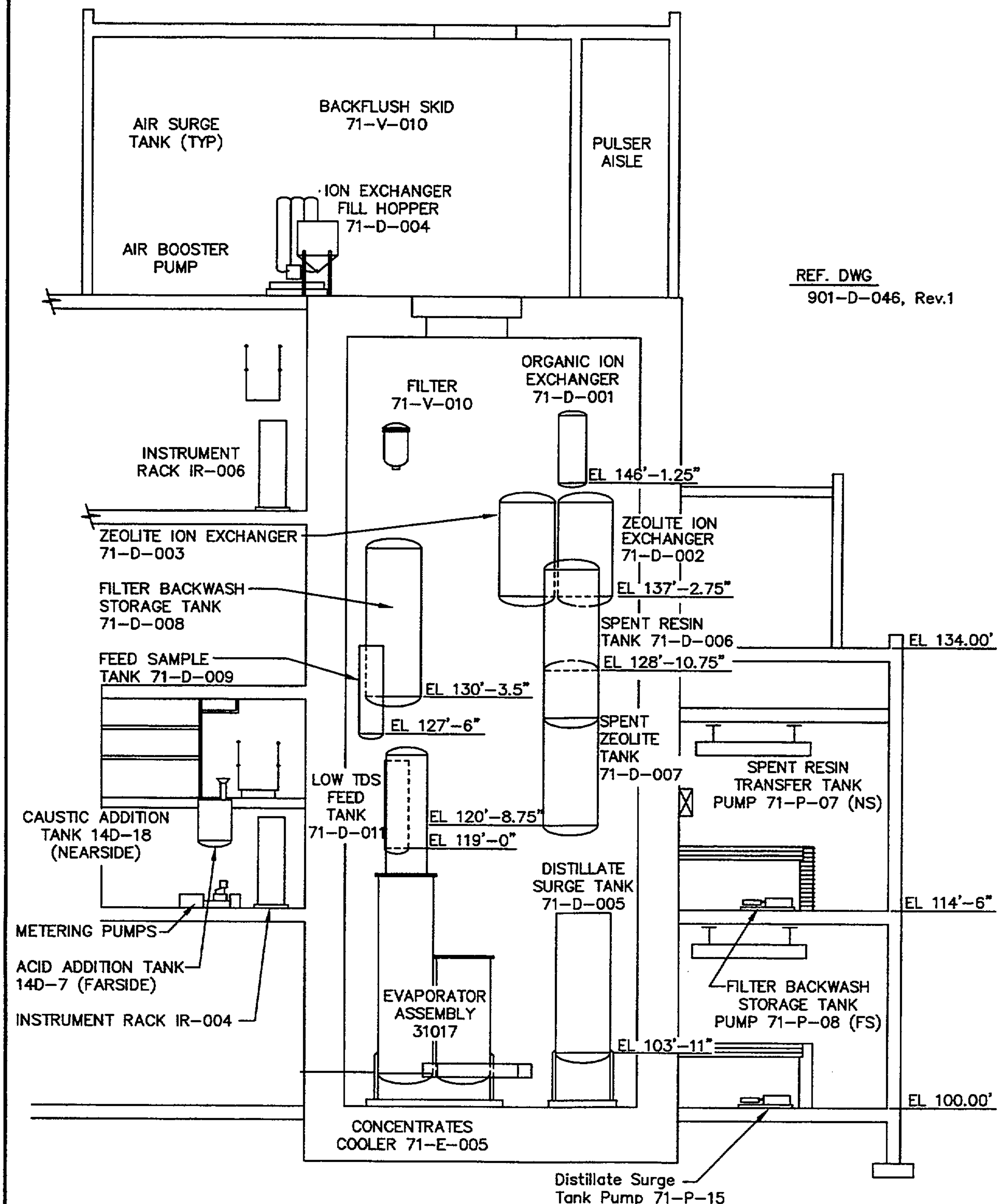


Figure B.5.2-24 LWTS Plan at Elevation 160.0'

SR2B5225.DWG



FOR REFERENCE ONLY - NOT TO SCALE

Figure B.5.2-25 LWTS Plan at Elevation 131.0'

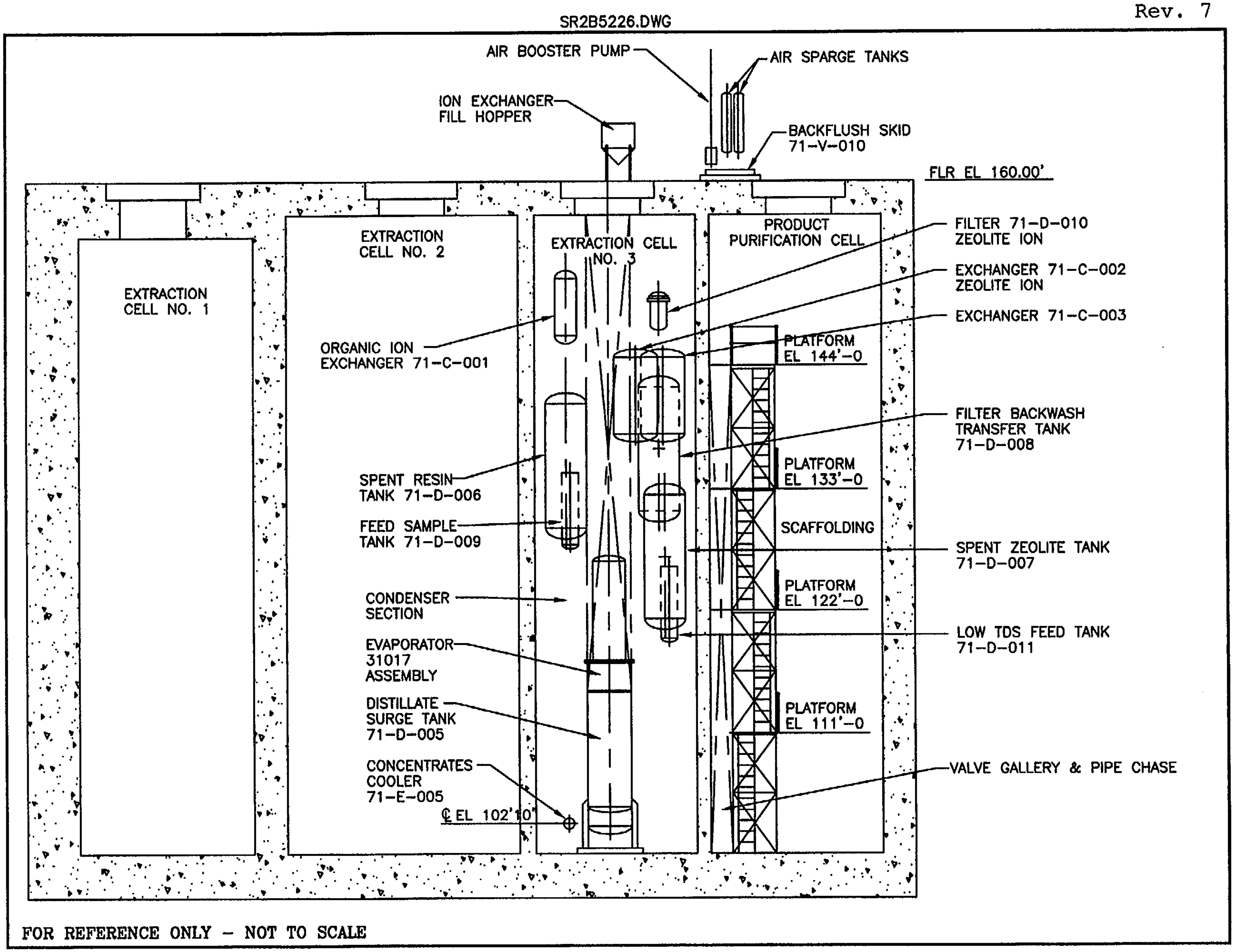


Figure B.5.2-26 General Arrangement — LWTS Sections

SR2B5227.DWG

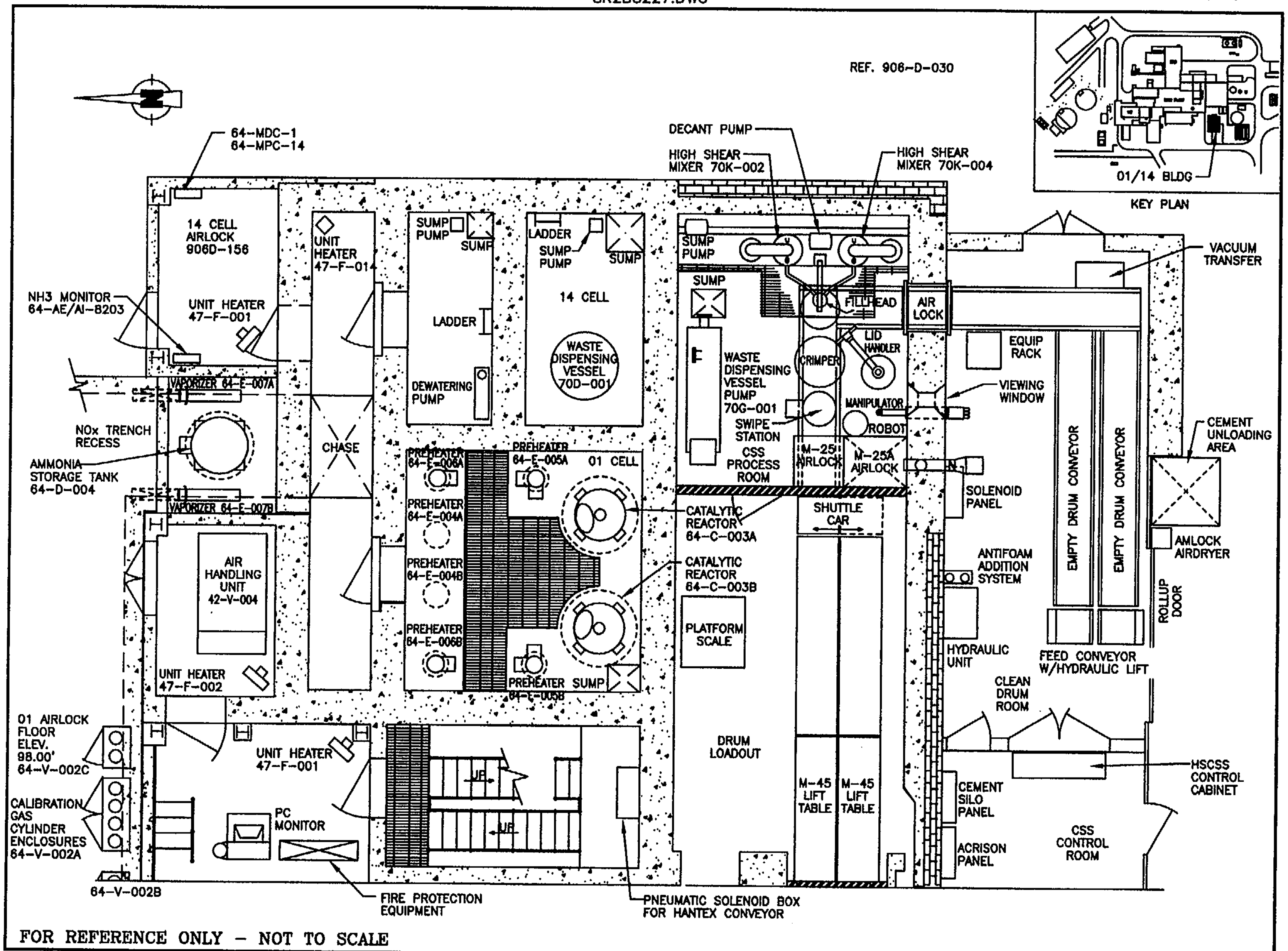


Figure B.5.2-27 General Arrangement – 01/14 Building Plan Elevation 98.0'

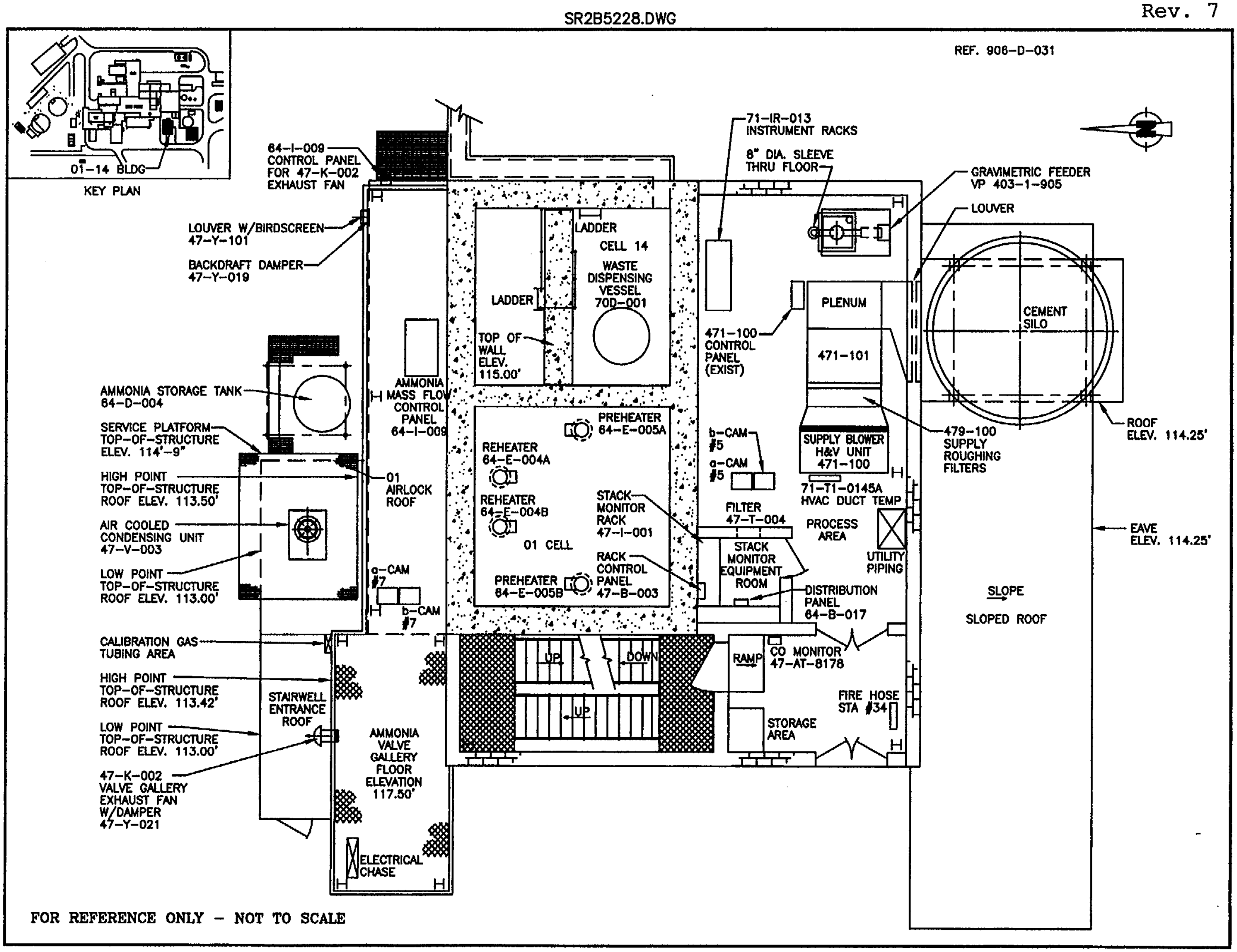


Figure B.5.2-28 General Arrangement – 01/14 Building Plan Elevation 116.5'

SR2B5229.DWG

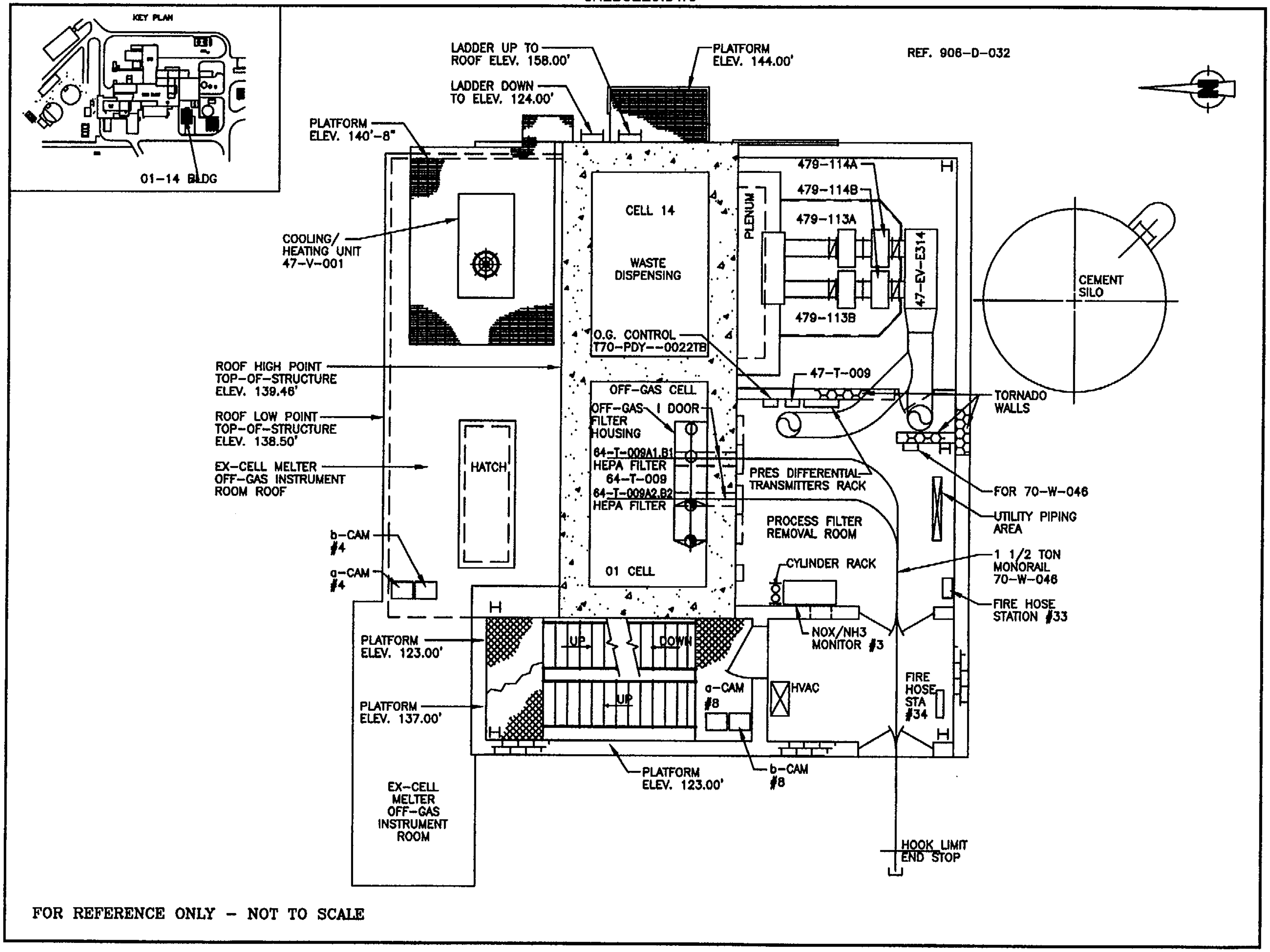


Figure B.5.2-29 General Arrangement – 01/14 Building Plan Elevation 130.0'

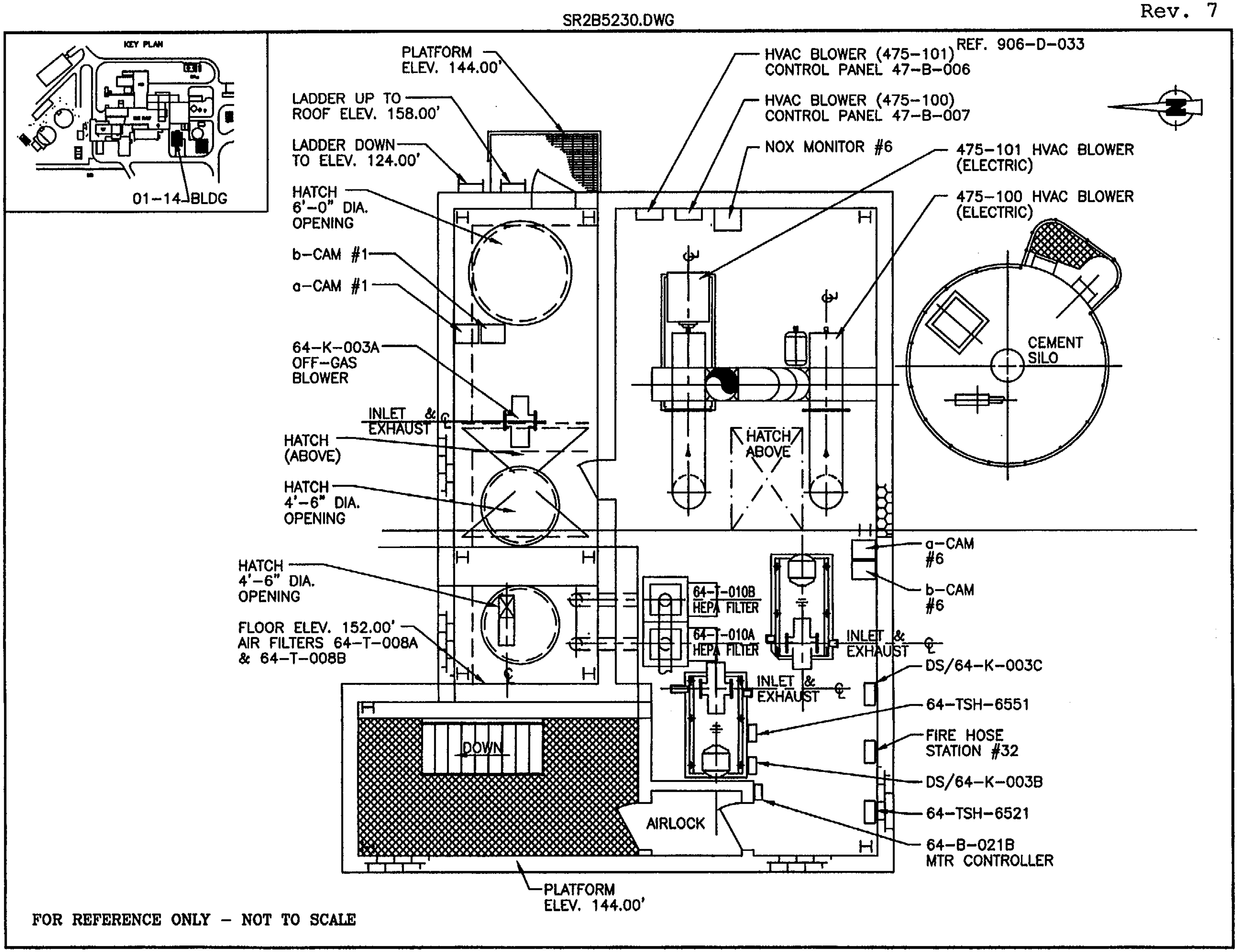


Figure B.5.2-30 General Arrangement – 01/14 Building Plan Elevation 144.0'

SR2B5231.DWG

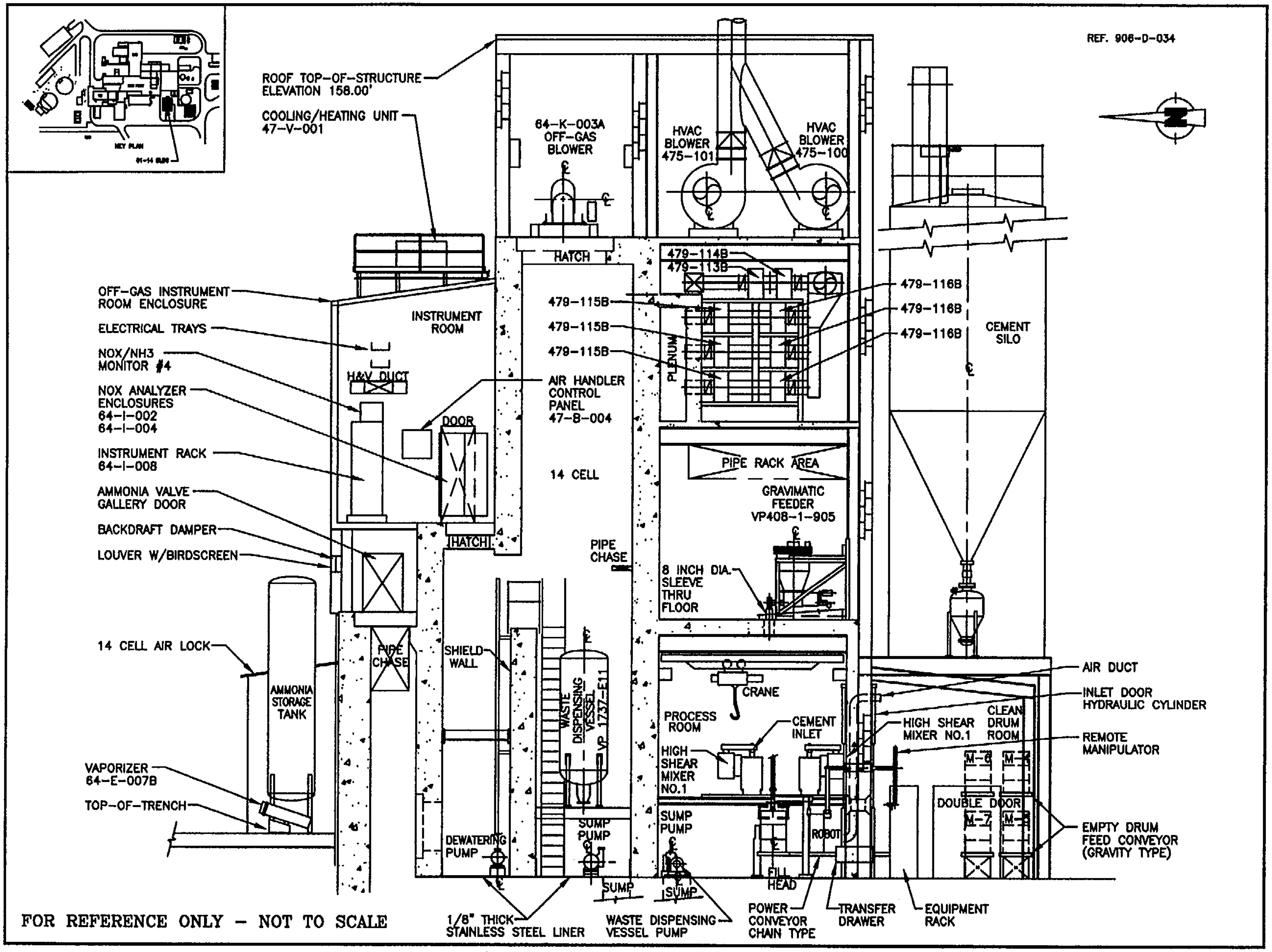


Figure B.5.2-31 General Arrangement – 01/14 Building Sections

SR2B5232.DWG

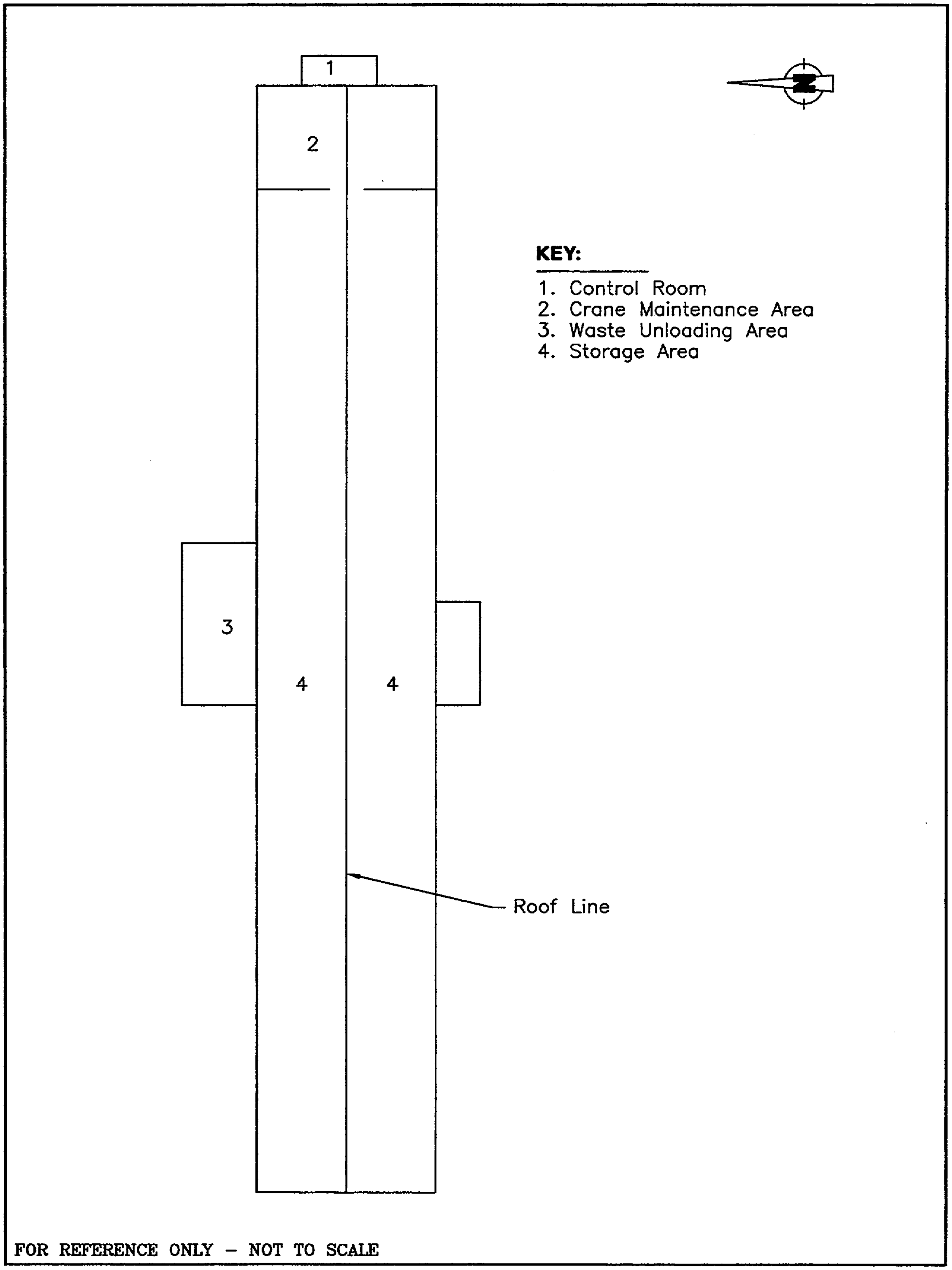


Figure B.5.2-32 Drum Cell Layout Plan

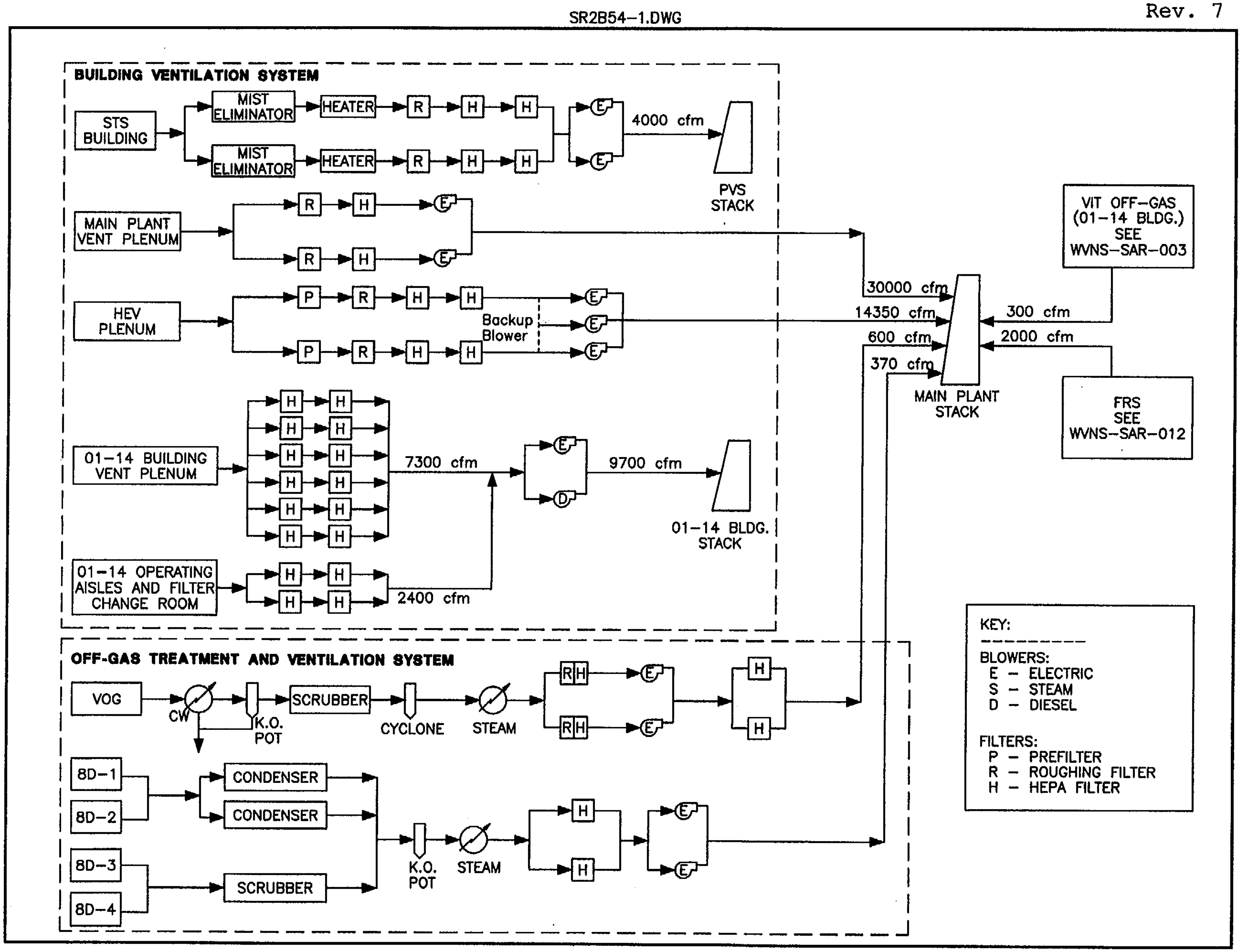


Figure B.5.4-1 Building and Off-gas Treatment Ventilation Systems

SR2B54-2.DWG

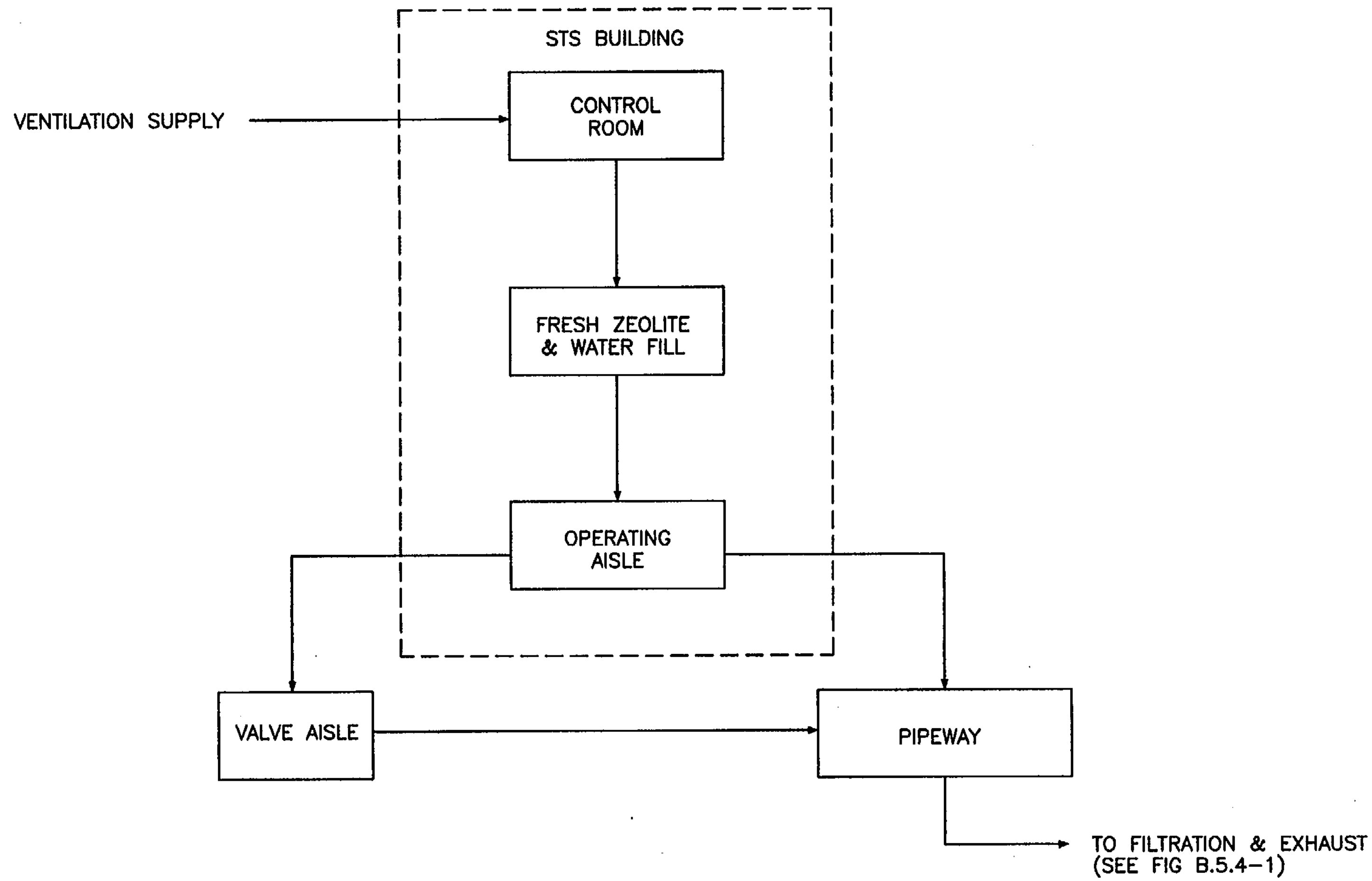


Figure B.5.4-2 STS Building Ventilation Flow

SR2B54-3.DWG

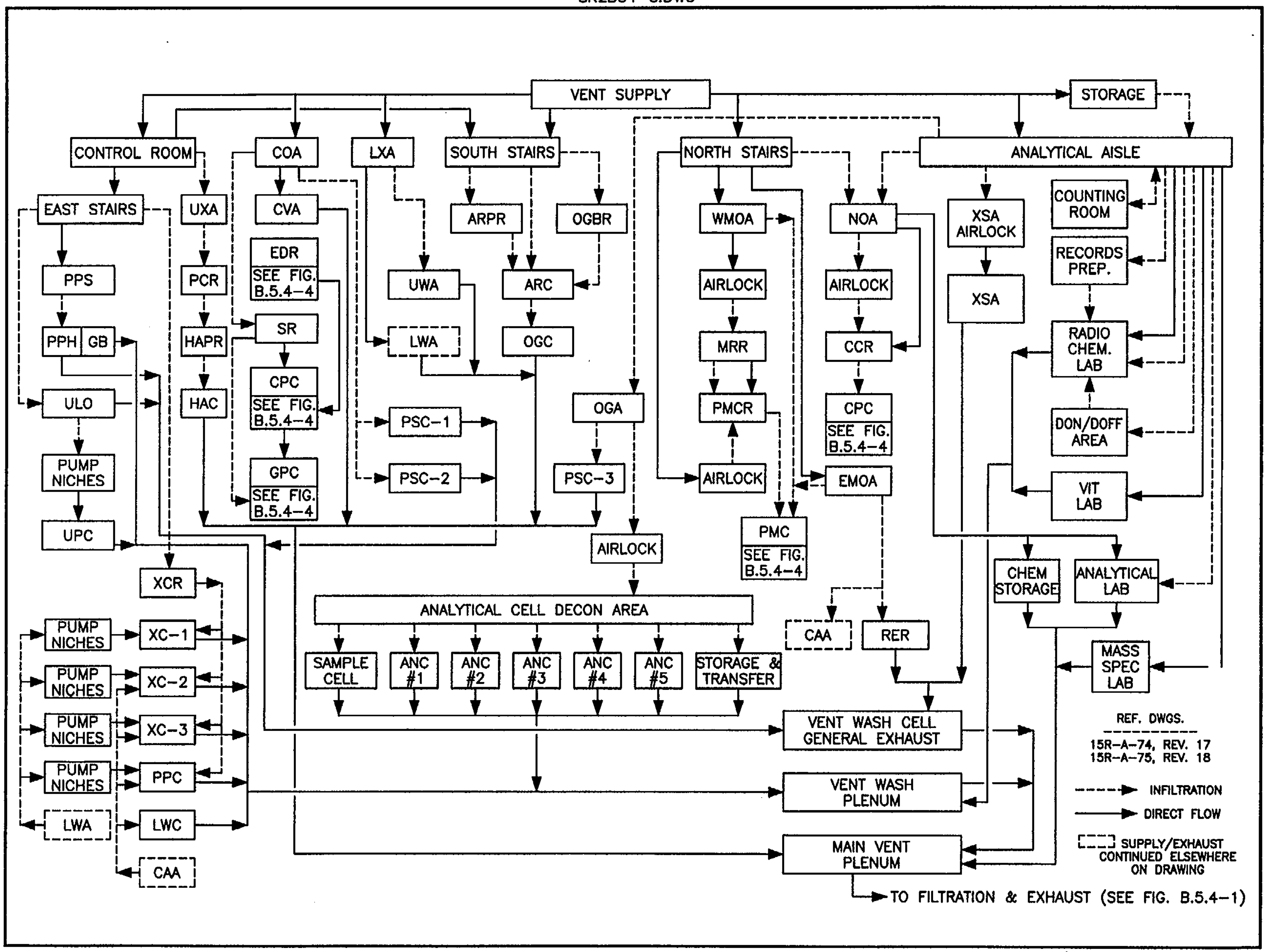


Figure B.5.4-3 Main Ventilation System Flow

SR2B54-4.DWG

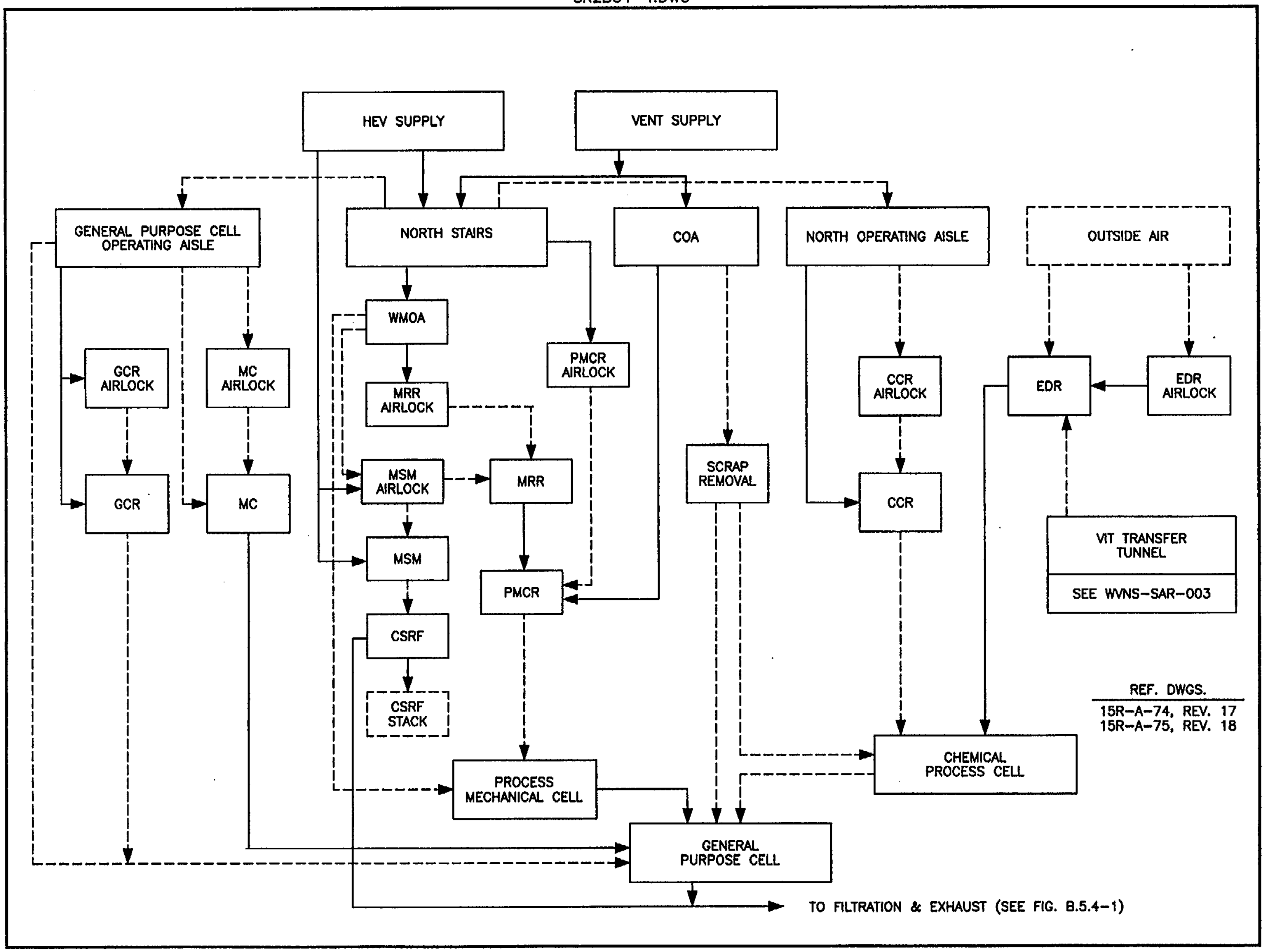


Figure B.5.4-4 Head End Ventilation System Flow

SR2B54-5.DWG

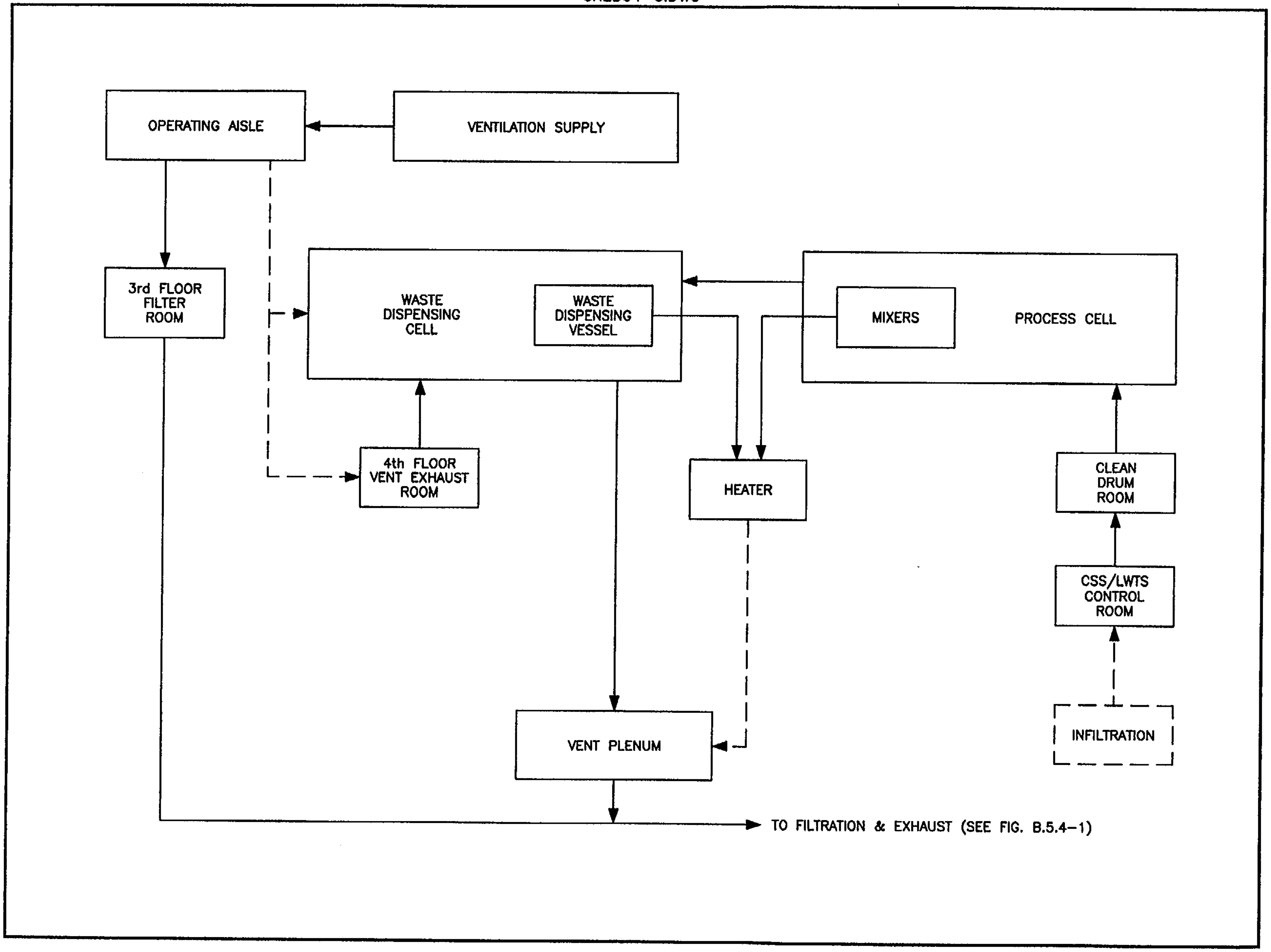


Figure B.5.4-5 01/14 Building Ventilation Flow

SR2B54-6.DWG

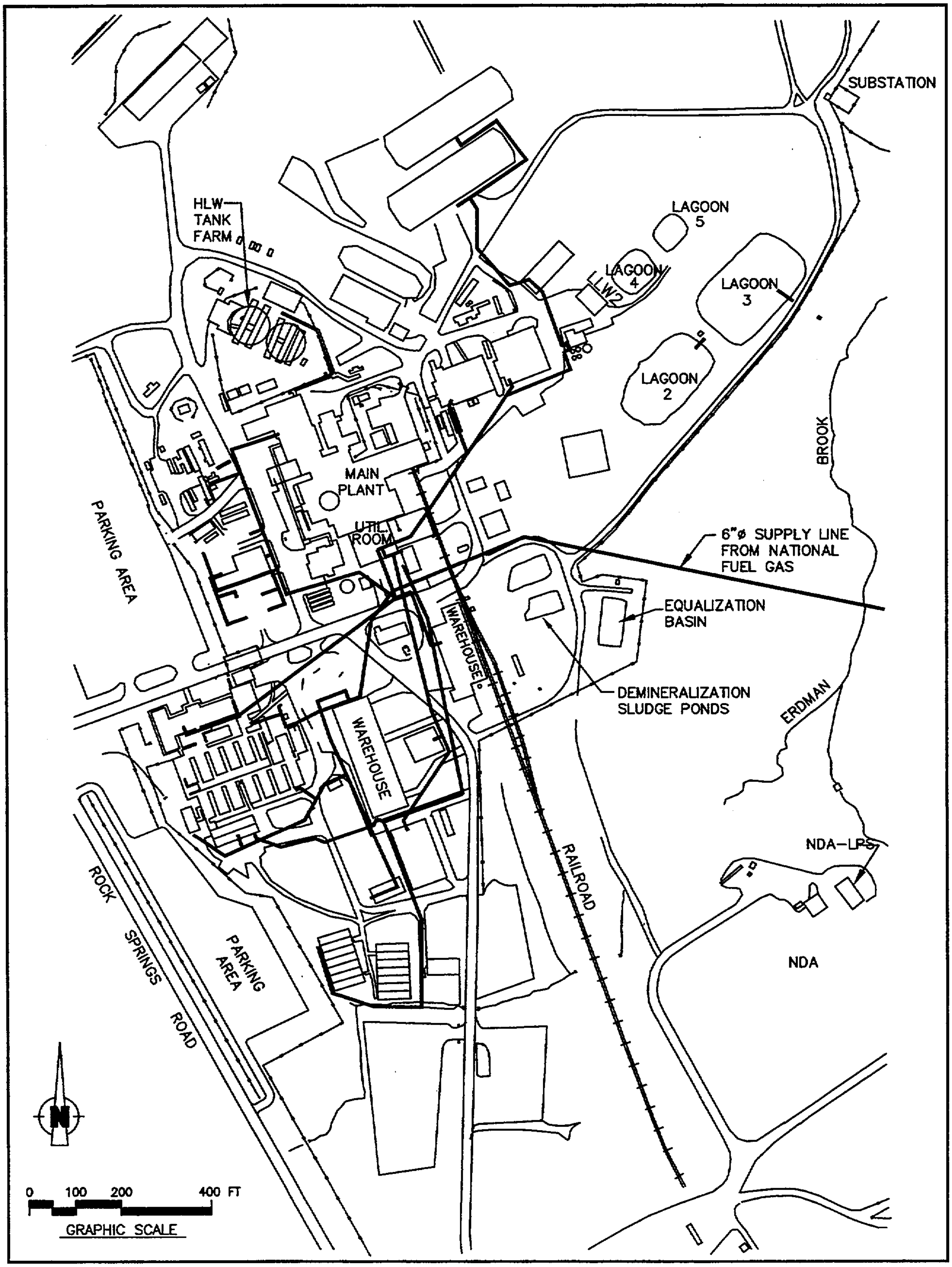


Figure B.5.4-6 Natural Gas Distribution System On-site

B.6.0 IRTS PROCESS SYSTEMS

B.6.1 Process Description

B.6.1.1 Narrative Description

The Integrated Radwaste Treatment System, comprised of the Supernatant Treatment System, Liquid Waste Treatment System, Cement Solidification System, and Drum Cell, has been designed for the decontamination, concentration, solidification, and storage of liquid high-level waste (see Figure B.6.1-1). The IRTS operates in a batch, or campaign mode; that is, the Cement Solidification System may be placed in standby while a batch of solution is processed in the Supernatant Treatment System and Liquid Waste Treatment System. Conversely, the STS and LWTS may be placed in standby while the CSS processes a batch received from the LWTS.

The initial objective of the IRTS was to process supernatant and sludge wash solutions generated during preparation of the high-level waste sludge in tank 8D-2 for vitrification. This was completed in 1995, resulting in 19,877 drums of cement-stabilized waste placed in the Drum Cell for safe storage. Prior to the start of vitrification in July 1996, the high-level waste sludge in tank 8D-2 required additional processing to remove excess sulfate salts that would have inhibited production of an acceptable vitrified waste form. Sulfate removal and "sludge washing" was effected in the SMWS through the addition of a dilute caustic solution which was mixed with the sludge to dissolve the sulfate salts.

Due to the concentration of sulfates in the high-level waste sludge, three separate washes were necessary. Two washes were required to sufficiently remove the sulfate salts from the sludge initially present in Tank 8D-2, then high-level THOREX waste in Tank 8D-4 was transferred to Tank 8D-2 for the third and final wash. Waste in Tank 8D-4 was produced during fuel reprocessing using the THOREX process and was stored in an acidic state. Wash solutions were processed through the STS and LWTS, stabilized in the CSS, and transferred to the Drum Cell for storage.

Currently, liquids to be processed in the STS are pumped from Tank 8D-1 or 8D-2 to STS process vessels mounted in Tank 8D-1. In these vessels the solution may be filtered, diluted with water as desired, and cooled in a shell-and-tube heat exchanger. The solution is then pumped through up to four columns of ion exchange zeolite for cesium removal. Titanium-treated zeolite is used as needed to augment or replace the standard zeolite to remove both plutonium and cesium. Decontaminated solution produced by the STS is pumped from the STS product tank 8D-3 to the Liquid Waste Treatment System for concentration.

All waste handling and processing activities associated with the LWTS are conducted in cells located in the Main Plant. Product transferred from Tank 8D-3 in the STS is received in primary LWTS feed tank 5D-15B located in the Uranium Product Cell (UPC). Alternatively, waste may be received in Tank 7D-2 in the Liquid Waste Cell (LWC) (via Tank 5D-15B). (High-level waste processed by the STS is sufficiently decontaminated to provide for a reclassification of STS product as low-level waste.) Tank 5D-15A1 can also be as an on-line feed tank. From the on-line feed tank, waste is processed through a high efficiency evaporator that reduces the volume of water in the process solution. Evaporator concentrates are cooled and pumped to the LWTS product tank 5D-15A1 or 5D-15A2. From here, concentrates can be recycled to Tank 8D-2 and incorporated into the vitrification feed slurry or serve as feed to the Cement Solidification System (CSS).

During operation of the Vitrification Facility, overheads from the Concentrator Feed Makeup Tank (CFMT) are condensed and transferred to Tank 8D-3 for subsequent processing by the LWTS evaporator. These concentrates are returned to Tank 8D-2 and are not solidified in the CSS.

The CSS was designed to solidify concentrates received from the LWTS. Since the completion of supernatant/sludge wash solution treatment, however, the CSS has been inactive. When the CSS was in use, LWTS product transferred to the CSS was received in Tank 70D-001 located in the Waste Dispensing Cell of the 01-14 Building. Process solution in the tank is pumped to one of two high shear mixers in the CSS Process Cell, where it is mixed with Portland cement and discharged to a 269 L (71 gal) square carbon steel drum. The product drum is then sealed, evaluated for surface contamination and staged for transport to the Drum Cell for storage.

B.6.1.2 <u>Flowsheets</u>

The IRTS process flow diagram is shown in Figures B.6.1-1 through B.6.1-3.

B.6.1.3 <u>Identification of Items for Safety Analysis Concern</u>

The concentration of activity in IRTS process solutions requires that waste processing be conducted in a manner which minimizes doses to both occupational personnel and off-site individuals. Furthermore, the hazards associated with the handling and storage of bulk chemicals and hazardous materials requires that these activities be conducted in a manner which prevents the release of hazardous materials. The major items of safety analysis concern therefore are:

- Worker protection from direct radiation and confinement of radioactivity;
- Avoiding nuclear criticality accidents;
- Avoiding high-level waste tank corrosion;

- Hazardous material protection; and
- Minimizing the risk of accidents through adherence to established policies and procedures.

B.6.1.3.1 Radiation Protection

Protection from direct radiation is achieved through shielding, work planning, and decontamination. Confinement barriers and systems in the IRTS and Main Plant preclude the uncontrolled release of radioactive contamination. These systems and barriers are summarized in Section B.4.3.2. The primary confinement systems for airborne radioactivity are the IRTS and Main Plant building ventilation systems. These systems have been described in detail in Section B.5.4.1. Radioactively-contaminated liquid is collected in facility sumps and drains for transfer to the LLWTS, which is described in Section B.7.5. Effluent radioactive releases are maintained well within the limits specified in DOE Order 5400.5.

B.6.1.3.2 Criticality Prevention

The occurrence of an inadvertent criticality during IRTS processing activities is prevented through system design and adherence to strict administrative controls. All components of the IRTS have been evaluated for criticality safety during normal and abnormal operating conditions; no credible critical condition has been identified. The potential for criticality in the General Purpose Cell of the Main Plant has been identified. A comprehensive assessment of criticality controls in place at the WVDP for IRTS and Main Plant operations and facilities is given in Section B.8.7.

B.6.1.3.3 Prevention of High-Level Waste Tank Corrosion

Wastes in high level waste tank 8D-2 are kept at a high pH to minimize the corrosion of the carbon steel tank. A chemical addition system, which is described in Section B.5.4.10, has been provided to ensure that excess caustic is available to neutralize low pH additions to the tank. Section B.5.3.3 describes the program that WVNS has in place for the monitoring and control of corrosion in both tanks 8D-1 and 8D-2.

B.6.1.3.4 Hazardous Material Protection

Nonradiological hazardous materials at the WVDP are stored in special facilities in the New Warehouse (described in Section B.5.2.7). Hazardous wastes are stored in facilities described in Section B.7.7 and B.7.8. Operations associated with these materials are conducted per the guidance of the WVDP Industrial Hygiene and Safety Manual (WVDP-011) and the Hazardous Waste Management Plan (WVDP-073).

B.6.1.3.5 Management, Organization, and Institutional Safety Provisions

All personnel at the WVDP receive extensive training in safety aspects associated with their responsibilities. Operations involving radioactive or hazardous materials are conducted in a manner consistent with the requirements of 10 CFR 835 and DOE Order 420.1, respectively. Incorporation of the requirements of these Orders into WVDP operating procedures is discussed in Section B.8.5. Additionally, an overall safety culture has been developed at the WVDP through a comprehensive implementation of the principles of the DOE Conduct of Operations philosophy as given in DOE Order 5480.19. The implementation of DOE 5480.19 at the WVDP, as given in WVDP-106, is summarized in Section B.10.1.2. Training of operations personnel is conducted per the requirements of 5480.20A, as outlined in Section B.10.3.2.

B.6.2 STS Process Chemistry and Physical Chemical Principles

STS processes have been designed for the dissolution and removal of soluble salts present in Tank 8D-2 HLW sludge and the decontamination of the resulting wash solutions to a level acceptable for subsequent processing in the LWTS and CSS.

The principle of sludge washing is the dissolution of sodium sulfate crystals present in HLW sludge through the addition of water. This process, however, also drives other soluble salts into solution, including salts of uranium and plutonium. Laboratory testing has shown that the solubility of uranium and plutonium salts may be suppressed through the addition of caustic to the wash water (Bray, L.A., December, 1990). A program for caustic addition to Tank 8D-2 has therefore been developed that is based on routine sampling and measurement of the Pu concentration in Tank 8D-2 wash solution.

If excess plutonium is present in the sludge wash solution, the primary ion exchange material (Ionsiv IE-96™) is replaced partially or in full with titanium-treated IE-96™. The Battelle-Pacific Northwest Laboratory proprietary coating produces an ion exchange media that retains plutonium and strontium while maintaining most of the cesium affinity of the original IE-96™ zeolite.

B.6.3 High-Level Waste Mobilization, Treatment, and Transfer

B.6.3.1 Sludge Mobilization

The Chemical Addition System provides the equipment to add various solutions to Tank 8D-2. Following the additions, mobilization pumps agitate tank contents and suspend settled solids.

The solutions are volumetrically batch-metered into Tank 8D-2 from a storage tank trailer located near the Waste Tank Farm. The solution enters Tank 8D-2 through an existing spare 5 cm (2 in) pipe in riser N12 and free falls from the top of the tank/riser into the tank.

Mobilization of solution in Tank 8D-2 is accomplished through the use of a series of 15 m (50 ft) long mobilization pumps which have been installed at strategic locations within Tank 8D-2 through tank access sleeves (risers). The pumps discharge a nominal 2,300 L/m (600 gpm) up to a maximum of 2,680 L/m (700 gpm) from each of the two nozzles, which spray in opposite directions while the entire pump assembly rotates about the vertical support column at rates up to 1.5 rpm. The mobilization pumps do not remove material from the tank, but serve to resuspend the settled sludge from the bottom of the tank.

The mobilization pump motor is located on the external truss above Tank 8D-2. All pump, column, drive shaft, and motor loads are carried by the independent external trusses. The trusses were designed to support a total of seven mobilization pumps. There are six pumps currently installed in risers as shown on Figure B.5.2-1. Since all the electrical and mechanical rotating equipment requiring service are external to the tank, pump maintenance (i.e., greasing bearings, oiling motors) is performed by conventional means. Calculations have determined that pump operation will not compromise structural integrity through damage to tank internals (Gates, W.E., 1987 and 1991).

Provisions have been made to allow for remote flushing and removal in case of pump failure. Tank 8D-2 solution is pumped at temperatures as high as 90°C (194°F) to the prefilter (50-F-001) in Tank 8D-1.

B.6.3.2 <u>Radioactive Liquid Treatment</u>

B.6.3.2.1 Prefiltration and Cooling

Process solution contained in Tank 8D-2 may be filtered through a sintered metal filter, depending on suspended solids loading, and must be cooled prior to processing. Filtration is performed to prevent process contamination due to carry-over of sludge particulates suspended in the process solution. Figure B.5.2-1 provides the location and arrangement of this equipment. Additionally, filtration removes some insoluble strontium and plutonium present in the suspended solids contained in the process solution. The filter currently provides for a flow forward rate of 23 L/m (6 gpm) and 1.0 µm particle retention with recirculation of excess flow back to Tank 8D-2. Instrumentation to measure the pressure differential across the filter is provided. Provisions have been made for remotely backpulsing the prefilter. The 6,400 L (1,700 gal) supernatant feed tank (50-D-001) installed in Tank 8D-1 serves as an intermediate collection and feed tank for filtered process solution for the ion exchange process. Tank 50-D-001 also receives unfiltered hlw tank liquids from within Tank 8D-1.

The stored filtered process solution provides about five hours of hold-up based on a 23 L/m (6 gpm) undiluted solution feed processing rate through the ion exchange columns. A water line and static mixer have been provided for process solution dilution. The supernatant feed tank is also attached to a chemical addition line that may be used to add decontamination or pH adjustment chemicals; however, no chemical additions via this port are planned at this time.

Solution ready for ion exchange processing is cooled to temperatures as low as 6°C (43°F) with chilled coolant (salt solution). The isolation chiller which supplies the chilled coolant to the cooler in Tank 8D-1 is located in the STS building. The process solution is pumped through the cooler (50-E-001) to the ion exchange columns (50-C-001, 50-C-002, 50-C-003, 50-C-004). Pump capacity is 98 L/m (26 gpm) with a nominal net forward flow of 23 lpm (6 gpm).

B.6.3.2.2 Ion Exchange

Following filtration, dilution (if desired), and cooling, the solution passes downward through one to four ion-exchange columns in series. The columns, are 1 m (3.4 ft) in diameter x 4.4 m (14.5 ft) in height and utilize IE-96™ zeolite for cesium removal. Titanium-treated zeolite may be used in place of some or all of the usual IE-96™ zeolite if warranted by the concentration of Pu in the solution.

The configuration of the STS ion exchange columns principally depends on the concentration of cesium, plutonium, and sodium salts in the feed solution, the number of fully functional columns available, and the zeolite consumption goals. The STS process has been designed to operate continuously using three ion exchange columns; however, it has been routinely operated as a batch system with one to four columns in use.

Continuous on-stream activity monitoring is provided to detect bed exhaustion and final product activity. Samples of the decontaminated solution are collected to ensure that an adequate process decontamination factor (DF) is achieved.

When it is determined that an ion exchange column requires media replacement (as confirmed high cesium concentrations in the lead column effluent or by reaching allowable throughput dictated by criticality control), the process solution at the top of the column is flushed back to Tank 8D-2 with water. A remotely-placed plug on the column is then removed and the zeolite is dumped with process water to the bottom of Tank 8D-1. Alternatively, zeolite may be sluiced through a dip tube located inside the column to Tank 8D-1. Any column in the series may be placed off-line and its zeolite discharged and replaced.

Following a final rinse, the column is recharged with approximately 3,600 pounds of fresh zeolite. The zeolite is loaded into a water-filled batching tank, backwashed to remove fines, and charged into the columns as a water slurry.

B.6.3.2.3 Final Filtration

Decontaminated solution exiting the last column in series is filtered to remove zeolite fines that could recontaminate the process. This filter is a sand bed type that may require periodic changeout of the filter medium. Instrumentation and valving are provided to ensure a clear decontaminated process solution. Sand bed removal and flushing is performed remotely. Spent sand is discharged to the bottom of Tank 8D-1 in the same manner as the ion exchange columns.

B.6.3.2.4 Decontaminated Solution Collection and Transfer

Filtered and decontaminated solution is fed to the original spare THOREX high-level waste storage tank 8D-3 from the STS postfilter. This 57,000 L (15,000 gal) tank serves as both intermediate storage and as a sampling tank. Continuous on-stream activity monitoring and periodic sampling ensures that decontaminated solution transferred to the CSS meets waste form specifications. A recycle line to Tank 8D-2 allows additional decontamination of the solution if required. Decontaminated solution is batch-transferred to the LWTS from Tank 8D-3 via a doubly-contained stainless steel pipe which passes from the tank vault through the STS. From the STS the pipe is routed in a transfer trench which passes in front of the Main Plant and into the Liquid Waste Cell, through a shielded pipe chase in the PPC and into the UPC to Tank 5D-15B.

B.6.3.3 <u>High-level Waste Transfer</u>

The High-Level Waste Transfer System is designed to transfer liquid waste in Tank 8D-4 and spent zeolite in Tank 8D-1 to Tank 8D-2. The combined wastes, which were transferred to Tank 8D-2 prior to the startup of vitrification operations, are mixed to achieve homogeneity and transferred to the vitrification system to serve as vit feed material. Slurry transfer to the Vitrification Facility and subsequent vitrification processes are described in WVNS-SAR-003.

Wastes contained in Tank 8D-4 are transferred to Tank 8D-2 through the use of transfer pump (55-G-013), which is inserted in the Tank 8D-4 riser. From Tank 8D-4, waste is transferred to Tank 8D-2 through the 8Q-4 pump pit to the 8Q-1 pump pit via the transfer trench, and through the 8Q-1 pump pit to the 8Q-2 pump pit to the tank, again via the transfer trench. The routing of this transfer trench through the WTF is shown in Figure B.5.2-8.

B.6.3.3.1 Zeolite Mobilization and Transfer

Prior to Vitrification startup operations, approximately 60,000 - 65,000 kg of spent zeolite resin remaining in the bottom of Tank 8D-1 following completion of supernatant and sludge wash treatment was mobilized and transferred to Tank 8D-2 to be mixed with the PUREX sludge and THOREX waste already in the tank. Mobilization of zeolite in Tank 8D-1 is effected through the use of up to five zeolite mobilization pumps shown in Figure B.5.2-1. The trusses spanning Tank 8D-1 were designed to support seven pumps. Mobilization pumps are mounted in risers that extend into the tank. Pumps and nozzles (which are located just above the bottom of Tank 8D-1 as shown in Figure B.5.2-3), are similar in design and operation to the SMWS mobilization pumps located in Tank 8D-2 (see Section B.6.3.1).

Under normal operating conditions, the pump and its supporting elements (e.g., column, drive shaft, and motor) do not produce added vertical loads on the original tank vault roof or internal steel tank, nor does the jet impingement load from pump nozzle under normal operation compromise the structural integrity of the tank internal support structure (column supports) or breach the tank wall or bottom barriers (Gates, W.E., December, 1987).

Zeolite removal is accomplished in batch transfers through the use of the vertical turbine pump 55-G-012. Zeolite slurry is pumped at a nominal flow rate of 75 gpm (110 gpm maximum) to in-line size reduction grinding equipment located in pit 8Q-2. (Grinding is necessary due to the difference in optimum zeolite size for STS processing and that for vitrification.)

A permanent transfer line flush system is provided for each of the three pump pits to permit prompt flushing of the HLW transfer lines. This flush system includes a (500 gal) break tank and a discharge pump to supply demineralized flush water to each of the pits for flushing the transfer lines in the trench or the pit jumpers. The utility flush system is connected to the STS utility air supply for air drying jumpers after flushing and prior to jumper removal. In the event of plugging or suspected plugging, this independent system supplies utility water to clear the line. However, each transfer line can be flushed with utility water to keep the transfer lines clean, thereby reducing the potential for line plugging. A minimum of two line volumes at a design flow rate of 80 gpm may be used in the flush.

B.6.4 Waste Concentration and Solidification

B.6.4.1 IRTS Liquid Waste Treatment

The Liquid Waste Treatment System has been designed to concentrate process solutions received from the STS and byproduct solutions from vitrification operations, such as CFMT off-gas condensates, that are sent directly to LWTS feed Tank 8D-3.

Concentrates produced in the LWTS then are recycled to Tank 8D-2 or serve as feed to the Cement Solidification System where they are solidified in cement for storage.

B.6.4.1.1 Feed Handling

The LWTS has been designed to receive product solution transferred from Tank 8D-3, which serves as the STS product tank, in any of three vessels all located in the Main Plant building. The primary evaporator feed tank, 5D-15B, is located in the Uranium Product Cell and has a capacity of 57,000 L (15,000 gal).

During vitrification operations the LWTS processes condensates received from the Vitrification Facility. Condensate from the Vessel Vent Header condenser in the Vitrification Facility flows by gravity to Tank 8D-3, is processed by the LWTS, then is returned to Tank 8D-2.

A series of valves and piping in the Uranium Loadout Pump Niche in the Main Plant allow the contents of Tank 5D-15B to be pumped directly to the evaporator or to Tank 5D-15A1.

B.6.4.1.2 Evaporator Concentrates and Distillate Handling

Operation of the LWTS evaporator generates two separate streams: a concentrates stream which is pumped to Tank 5D-15A2 and an overheads stream which is decontaminated and transferred to the LLWTS for processing.

Evaporator Startup

Feed in the LWTS is processed on a campaign basis. Process solution is fed to the evaporator from Tank 5D-15B at a nominal rate of 6-8 gpm (see Figure B.6.1-1). In start-up mode, evaporator condensates flow to the start-up side of the evaporator distillate surge tank. The evaporator remains in the recirculation mode while an overheads sample is analyzed to ensure that alpha/beta levels are acceptable for discharge to interceptors, at which point the distillate is sent to the run side of the distillate surge tank. The evaporation rate in the evaporator is regulated by a flow valve which controls steam supply to the evaporator. A constant concentrates level in the evaporator is maintained through the use of a specific gravity controller which controls operation of the evaporator concentrates pump.

Distillate Handling

Evaporator overheads pass through three reflux-inactive bubble cap trays and a high efficiency deentrainer wire mesh to extract liquid mists. An internal water spray is available to wash down the wire mesh to prevent a high differential pressure from developing across the mesh. Collected distillate is sent to the run side of the distillate surge tank where it is pumped to the zeolite ion exchanger (71-D-003). This ion exchanger is equipped with a differential pressure transmitter and an effluent radiation monitor. Instrument readout and alarms are located on the LWTS Control Panel. Following monitoring, the liquid is routed to the LLWTS interceptors for treatment at the LLWTS and subsequent release to the environment. Off-spec solutions (solutions having gross beta concentrations greater than 5E-03 μCi/mL) are diverted to Tank 5D-15B.

Concentrates Handling

When the specific gravity set point is reached, concentrate flow from the evaporator to the collection tank is established. Evaporator concentrates leave the evaporator at approximately 105°C (220 °F). Concentrates are cooled to approximately 35°C (95 °F) by a concentrates cooler (71-E-005) before being pumped to Tank 5D-15A1 or Tank 5D-15A2 for storage prior to transfer to Tank 8D-1, Tank 8D-2, or the CSS.

B.6.4.1.3 Evaporator Acid Wash

After extended periods of evaporator operation it may be necessary to perform a cleaning operation to remove accumulated solids. The solids increase radiation background near the evaporator, lower its boiling capacity and accumulate fissile isotopes in the evaporator scale or sludge in the bottom head. Solids form as a result of chemical changes to dissolved salts as they are heated. Removal of these salts requires dissolution through the use of up to 2M nitric acid (≤12%).

As indicated in Section B.8.7, criticality is not a concern during evaporator cleaning. However, approximately one gram per liter of boron (as boric acid) may be added to the nitric acid to act as a neutron poison for fissile isotopes should calculations of fissile material concentration indicate the potential for high concentrations. The cleaning solution is placed in the evaporator and heated until sampling results reflect limited effectiveness of further scale dissolution. Condensate is returned to the evaporator to maintain a constant liquid level. The dissolved solids solution is cooled and transferred to a holding tank for sampling. This solution is routed to Tank 8D-2 following pH adjustment.

During evaporator cleaning, airborne concentrations of NO_x and nitric acid fumes discharged from the Main Plant stack are less than 36 ppm and 5 ppb, respectively, over a four-hour period (Burn, P, April 26, 1991). No impact on the integrity of the HEPA filters is expected at such low nitric acid vapor concentrations.

B.6.4.2 Cement Solidification System

The Cement Solidification System (CSS) provides for the solidification of liquid low-level radioactive wastes. The CSS has not been in active operation since the completion of Tank 8D-2 supernatant/sludge wash solution processing in 1995; however, it is available for solidification of future IRTS waste streams, if required. When the CSS is operational, waste received in Tank 70D-001 is metered into one of two high-shear mixers where it is combined with dry Portland cement and additives necessary to aid in producing an acceptable solidified waste form. The waste is then mixed at high speed and discharged to a 269 L (71 gal) square steel drum. Filled drums are evaluated for surface contamination and staged for loadout.

B.6.4.2.1 Feed Preparation and Mixing

When the CSS is used to solidify concentrated liquid waste produced by the LWTS, concentrates transferred from Tank 5D-15A1 or 5D-15A2 in the LWTS are received in Tank 70D-001, located in the Waste Dispensing Cell of the 01-14 building. The CSS maintains two high-shear mixers in the CSS Process Cell for the processing of low-level waste concentrates. At the initiation of a mix cycle, concentrates are transferred by a metering pump from Tank 70D-001 to the on-line mixer operating on high speed. When the appropriate amount of waste has been transferred to the mixer the metering pump is placed in recirculation mode to maintain an homogenous mixture in the feed tank. The mixer is then placed on low speed and dry Portland cement is added to the mixer via a gravimetric feeder which feeds cement from a day bin located on the second floor of the 01-14 Building.

Process parameters are determined by the type of waste to be solidified and are controlled automatically. Process solution and cement are metered into the on-line mixer, which runs continuously after the process solution has been added. The batch is mixed for a duration which depends upon the type of waste and discharged into the drum. The process is then repeated, filling the drum with two batches. Approximately 125 L (33 gal) of waste/cement mixture are processed per batch.

The CSS cold chemical system provides for the addition of cement recipe enhancers to waste in the high shear mixers. A 5,700 L (1,500 gal) bulk storage tank, 1,160 L (300 gal) day tank, and an air-operated diaphragm pump located in the CSS Change Room are used for the delivery of sodium silicate. Antifoaming agents, used to minimize void spaces in the waste/cement mixture, are provided from polyethylene bottles located in the Clean Drum Room via electric diaphragm metering pumps.

B.6.4.2.2 Drum Handling and Positioning

Empty 269 L (71 gal) square drums are manually loaded onto gravity conveyors located in the Clean Drum Room east of the CSS/LWTS Control Room. Drums on the gravity conveyors are automatically pulled onto a north-south oriented conveyor by a pneumatic/hydraulic drum grabber, and passed through an airlock onto the drum staging conveyor in the Process Cell, and on to the fill station conveyor. At the fill station the drum lid is removed and a fill head descends into the drum for drum filling. After the drum is filled, the fill nozzle is removed, the lid is replaced and the drum is transferred to the lid crimp station. (The fill station is also capable of receiving and returning drums from the flush drum station conveyor.)

Full drums are sealed at the lid crimp station and the drum is then transferred to the smear station for evaluation of external drum contamination. Drums with unacceptable levels of contamination may be manually decontaminated. Acceptable drums are transferred through an airlock to a staging conveyor for transfer to a loadout conveyor. At the loadout conveyor drums are transferred to a shielded cask truck for transport to the Drum Cell for storage (see Section B.6.8).

B.6.4.2.3 Mixer Flush System

Provisions have been made in the CSS for mixer flushing to prevent the accumulation of cement in the mixers. Flushing is achieved through the addition of utility water to the mixers which are then operated at high speed. Flush solutions are then either returned to the mixer for solidification in cement or sent to a conventional 208 L (55 gal) flush drum for settling with free water decanted to Tank 7D-13. The flush drum is reused until it is approximately half full, at which time it is sampled and the contents stabilized through the addition of dry cement.

B.6.4.2.4 Dry Cement Storage and Transfer

The CSS Silo, located east of the CSS Control Room, provides bulk storage for 70 m^3 (1.4E5 ft^3) of dry cement. Dry cement delivered to the site by truck is transferred pneumatically to the bulk storage silo. Transfer air exits the silo through a dust filter on the top of the silo. A dense phase transmitter (pressure pot) located directly under the silo is gravity filled from the silo and provides transfer of dry cement from the silo to the 0.42 m^3 (8.9E2 ft^3) day bin in the 01-14 Building through the use of dried, pressurized air.

B.6.5 Process Support Systems

B.6.5.1 Instrumentation and Control Systems

STS Instrumentation and Control

The STS control panel provides the principle method of process control for the STS. A laboratory information management system (LIMS) provides control system support. The STS control panel and LIMS are designed to operate independently without loss of function if the other panel fails. There are no interconnections between the STS and the LIMS.

From the STS control panel the operator can remotely monitor the major aspects of the system through panel mounted instrumentation. This includes a panel- mounted graphic display flow diagram. The control panel allows for safe operation with an alarm system that alerts the operators to any abnormal condition. A summary of major process instrumentation for the STS/SMWS is found in Table B.6.5-1.

HLWTS Instrument and Control

Instrumentation is provided for the HLWTS to monitor process variables and provide both automatic and manual control of the processing equipment. The majority of instruments are connected to a Programmable Logic Controller (PLC) to provide local read-out and automatic control of key process variables at the HLWTS control station. Valve position switches indicating open or closed provide electrical signals to the PLC for interlock controls. Removal pumps may be operated with variable speed motor controllers to control the waste transfer. In-line pressure switches and flow meters are used to monitor the transfer.

At the control station, the operator can remotely monitor the major aspects of the transfer operation. The control station provides an alarm system which that alerts operators to an abnormal condition. Process conditions are monitored from panel-mounted instrumentation including a panel-mounted graphic display flow diagram which indicates the position of valves and the status of motors and storage tanks. Various electrical interlocks additionally ensure safe operation during any transfer operation.

Monitoring of the zeolite and sludge mobilization pumps occurs at the Motor Control Center (MCC) in the PVS building within the WTF. The mobilization pumps are operated using variable speed controllers to allow gradual starting of the pumps. Appropriate interlocks have been supplied to stop the pump on loss of utility water, high seal water leakage, or high pump amperage.

LWTS Instrumentation and Control

LWTS process instrumentation and control systems are designed to provide the primary indications of off-standard operating conditions. Instruments used for process control are designed to fail safe. LWTS instrumentation and controls have been designed to ensure that:

- The LWTS can be started, operated, monitored, and shut down from a single, centralized remote control area.

- Remotely operated valves have position indicators on the control panel when the panel is energized.

- System instrumentation provides indications and/or annunciation (alarm) of abnormal conditions.

- Process signals, alarms, interlocks, automatic process control, specific access, redundancy, and means for calibration (e.g., pressure taps, or procedures for instrument removal) have been provided for.

CSS Instrumentation and Controls

From the CSS control panel, operators can remotely monitor and control the major aspects of the system. The panel alarm system alerts operators to an abnormal condition. A panel-mounted graphic display flow diagram indicates the positions of solenoid-activated valves and the status of motors.

In addition to the primary panel, two smaller wall-mounted panels are used to control flow of cement to the gravimetric feed system and to control bulk cement filling and transfers. These panels allow for manual control of these operations.

B.6.5.2 System and Component Spares

Due to the relatively short duration of the IRTS process (<15 years), problems associated with major component failure due to factors such as fatigue and corrosion are expected to be minimal. Therefore, on-site storage of spares for most major IRTS processing components is not provided. However, spares for selected components particularly susceptible to failure such as pumps, valves, and jumpers are maintained on-site as backups.

B.6.6 IRTS and Main Plant Control Rooms

IRTS and Main Plant operations are conducted from several individual control rooms located throughout the site, as shown in Figure B.6.6-1. Control of the STS is from a control room located in the STS Support Building. SMWS and HLWTS operations are conducted from a shared control room located in the PVS Building. In a like manner, operation of the LWTS and CSS is from a shared control room in the CSS 01-14 Building addition. Drum Cell operations are conducted from a control room on the east side of the Drum Cell building as shown in Figure B.5.2.32. Vessel, sump and ventilation operations associated with the Main Plant are conducted from a control room located on the fourth floor of the Main Plant building.

All control rooms have been designed for continuous occupancy and are provided with operation and alarm panels that are clearly labelled. Programmatic and human factors considerations associated with control room operations are discussed in Section B.10.1.2.

B.6.7 Sampling-Analytical

B.6.7.1 Sampling

STS Sampling Capabilities

Routine samples of various process solutions are remotely extracted from sampling ports in the valve aisle for radiochemical analysis. Up to a 60 mL sample is collected in a sample vial which is then remotely placed into a transfer "rabbit" for pneumatic transfer to the Analytical Laboratory sample cell via the Pneumatic Transfer System. The Pneumatic Transfer System is also used to transfer vitrification feed and product samples, as discussed in WVNS-SAR-003.

LWTS Sampling Capabilities

Samples of LWTS feed may be collected from Tank 8D-3 in the Waste Tank Farm or 5D-15B in the Uranium Product Cell in the Main Plant building. LWTS product (concentrates) is sampled from Tank 5D-15A1 or 5D-15A2.

CSS Sampling Capabilities

Analytical requirements for CSS feed are satisfied through analyses of samples collected from the LWTS product Tank 5D-15A1 or 5D-15A2.

Nonroutine Sampling Activities

In support of WVDP mission goals, nonroutine sampling is periodically required for waste or site characterization purposes. These activities are performed per approved work procedures which incorporate worker health and safety requirements given in WVDP-010 and WVDP-011.

B.6.7.2 WVDP Analytical Capabilities

WVNS has a well-equipped analytical laboratory to support IRTS, Vitrification, and general operations at the WVDP site. The facilities are located on the third floor of the Main Plant Building and the east side of the Environmental Analytical Annex and include six analytical hot cells for the preparation of radioactive samples; two analytical hot laboratories, equipped with fourteen fume hoods, for the preparation or separation of radioactive samples; six gloveboxes for the transfer of samples; and several nonradiological laboratories and hoods used for the storage, preparation, and analysis of nonradiological samples.

Analytical equipment in the laboratory facilities includes the following: two inductively-coupled plasma atomic emission spectrophotometers (ICP-AES); three high purity intrinsic germanium photon detectors; a planar high purity intrinsic germanium photon detector; two single chamber, low background, alpha/beta counter; five silicon charged particle detectors; liquid scintillation counter, ion chromatograph, and other general analytical equipment required for elemental, ionic, and physical characteristic analysis (e.g. densitometer, pH meter).

All aqueous radioactive laboratory wastes are routed to Tank 8D-2 or the LLWTS interceptors (depending on activity) via drains in the hoods of the radiochemistry laboratories and the floors of the hot cells. Hazardous organic radioactive laboratory wastes are collected in approved satellite accumulation areas prior to disposal. Solid radioactive wastes are double-bagged in drums and turned over to Waste Management for disposal.

B.6.8 Product Handling

The final component of the Integrated Radwaste Treatment System, the Drum Cell, provides storage for the 269 L (71-gal) square drums of Class-C low-level cemented waste produced in the Cement Solidification System. Currently, approximately 19,877 drums of low-level waste are stored in the Drum Cell.

As discussed in Section B.6.4.2.2, full 269 L (71-gal) drums produced by the CSS are passed through the Process Cell airlock to a shuttle table which places drums in an array for transfer to the lift table. When an 8-drum array has accumulated on the loadout conveyor, the drums are transferred to a shielded cask truck for transport to the Drum Cell.

At the Drum Cell, the cask truck engages a conveyor and transfers the drums from the shielded cask to the Drum Cell conveyor. Following loadout, a bridge-mounted crane is used to lift the drums from the conveyor and transport them to their stacking location. At the stacking location the drum identification number is read electronically and the bridge, trolley, and hoist coordinates for each drum are recorded.

Operations in the Drum Cell are conducted remotely from a control room located on the east end of the Drum Cell building. Operations within the Drum Cell are indicated on a control panel and are visually verified through the use of a closed circuit television system.

REFERENCES FOR CHAPTER B.6.0

Bray, L. A. December, 1990. *Evaluation and Selection of a Process to Remove Plutonium from West Valley High-Level Waste Sludge Wash Water.* Draft C.

Burn, P. April 26, 1991. *NYSDEC Stack Release Permit Modification for LWTS Evaporator Cleaning.* Memo EO:91:0055 to G. G. Baker.

Gates, W.E. December, 1987. *8D-1 Waste Mobilization Pump Confinement Barrier Integrity Review.*

__________. April, 1991. *8D-2 Sludge Mobilization System Confinement Barrier Integrity Review.* Subcontract No. 19-CWV-21511, Task 10.

U.S. Department of Energy. *Occupational Radiation Protection,* 10 CFR 835.

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

__________. July 9, 1990. Change 1 (May 18, 1992.) DOE Order 5480.19: *Conduct of Operations Requirements for DOE Facilities.* Washington, D.C.: U.S. Department of Energy.

__________. November 15, 1994. DOE Order 5480.20A: *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities.* Washington, D.C.: U.S. Department of Energy.

__________. DOE Order 440.1: *Worker Protection Management for DOE Federal and Contractor Employees.* Washington, D.C.: U.S. Department of Energy.

West Valley Nuclear Services Co. WVDP-010: *WVDP Radiological Controls Manual.* (Latest Revision.) West Valley Nuclear Services Co., Inc.

__________. WVDP-011: *Industrial Hygiene and Safety Manual.* (Latest Revision.) West Valley Nuclear Services Co.

__________. WVDP-019: *Annual Waste Management Plan.* (Latest Revision.) West Valley Nuclear Services Co.

__________. WVDP-073: *WVDP Hazardous Waste Management Plan.* (Latest Revision.) West Valley Nuclear Services Co.

REFERENCES FOR CHAPTER B.6.0 (concluded)

__________. WVDP-106: *Westinghouse Conduct of Operations.* (Latest Revision.) West Valley Nuclear Services Co.

__________. Safety Analysis Report WVNS-SAR-003: *Safety Analysis Report for Vitrification Operations and High-Level Waste Interim Storage.* (Latest Revision.) West Valley Nuclear Services Co.

TABLE B.6.5-1

STS PROCESS INSTRUMENTATION

SYSTEM: Supernatant Treatment System (STS)

SECTION: Supernatant Filtration and Cooling

INDICATOR	LOCATION	FUNCTION/FEATURES
Liquid Level	HLW tank 8D-2 Supernatant feed tank 50-D-001 Valve aisle sump Process line secondary containment	Monitor liquid level for process control. All instruments equipped with high level alarms except tank 8D-2. The valve aisle sump level instruments have low level alarms. Tank 50-D-001 high-high level alarm is interlocked with supernatant feed pump 50-G-001 to shut off the pump and prevent overfilling D-001.
Temperature	Supernatant cooler 50-E-001 inlet and outlet Brine chiller 50-E-002 inlet and outlet	Monitor and control temperature of supernatant and brine cooling medium for proper process operation. There are high and low temperature alarms on the brine chiller effluent and on the supernatant cooler effluent.
Flow	Supernatant line tank 50-D-001 Demineralized water line to tank 50-D-001 Bubbler probe lines to tank 50-D-001	The supernatant and water flow instruments are an integral part of process control. The dilution of supernatant with water controls the salt and cesium concentration. The water flow instrument and the 50-D-001 bubbler probe flow instrument are equipped with low flow alarms.
Pressure	Inlet and effluent to Supernatant filter 50-F-001 Discharge of feed pump 50-G-002 Tank 50-D-001	These instruments serve process control functions such as monitoring differential pressure across the supernatant filter 50-F-001, pump operation and tank pressure. Alarms of high differential pressure across the filter and low pressure on pump 50-G-002 discharge are provided.

TABLE B.6.5-1 (continued)
STS PROCESS INSTRUMENTATION

SYSTEM: Supernatant Treatment System (STS)
SECTION: Ion Exchange

INDICATOR	LOCATION	FUNCTION/FEATURES
Liquid Level	Column vent/air pressurization line on jumper in STS valve aisle	These conductivity level instruments indicate the columns are full of liquid; no variable level reading.
Temperature	Upper, middle and lower area of the ion exchange columns	Monitor column temperatures at three levels. High temperature alarms are provided as warning signals to take steps to prevent the zeolite from becoming excessively hot due to radioactive decay heat.
Pressure	Inlet feed line to the columns on a valve aisle jumper	Monitors column pressure which can indicate fouling of the zeolite.
Radiation Detection	Column bottom outlet effluent line	Used for control of the process by monitoring and limiting the radioactivity of the column effluent liquid in the line. These instruments are equipped with a high radiation alarm and a warning alarm normally preset at a lower level.
Flow	Sluice/liftwater header to all columns	Monitors the flow of sluice water to the columns during regeneration of the column.

TABLE B.6.5-1 (continued)
STS PROCESS INSTRUMENTATION

SYSTEM: Supernatant Treatment System (STS)
SECTION: Final Filtration and Storage

INDICATOR	LOCATION	FUNCTION/FEATURE
Liquid Level	Decontaminated supernatant collection tank 8D-3	Monitor tank liquid level, also provide secondary method of determining flow rate through STS system. Instrument equipped with high and low level alarms.
Pressure	Inlet and outlet lines to the decontaminated supernatant filter 50-F-002 on jumpers in the STS valve aisle - inlet and outlet linked to read differential across filter.	Monitor inlet, outlet, and differential pressure across the filter to indicate fouling or plugging.
Flow	Outlet of the filter on a jumper in the STS valve aisle.	Monitor and control the flow rate through the ion exchange columns and decontaminated supernatant filter. This instrument is connected to a flow totalizer, which measures the total flow.
Radiation Detection	Outlet line of filter 50-F-002 on jumper in STS valve aisle. Discharge line of decontaminated supernatant pump 50-G-007 on jumper in STS valve aisle.	Monitor radiation levels of the lines. Both instruments are equipped with a high radiation alarm and a warning alarm normally preset at a lower level. The high radiation alarms are interlocked with auto valves to redirect or stop flow in the event of alarm. The high alarm on filter 50-F-002 effluent changes the position of a three-way valve which delivers flow to tank 8D-3 to deliver flow back to tank 50-D-001. The high alarm on the discharge of pump 50-G-007 closes the discharge valve to the liquid waste treatment system (LWTS).

TABLE B.6.5-1 (continued)
STS PROCESS INSTRUMENTATION

SYSTEM: Sludge Mobilization and Wash System (SMWS)

INDICATOR	LOCATION	FUNCTION/FEATURES
Pump Speed	Pump motor control panel in PVS building	Measures frequency to indicate pump speed during sludge mobilization.
Amperage	Pump motor control panel in PVS building	Monitors amperage to indicate relative pump operating conditions.
Time	Pump motor control panel in PVS building	Indicates the time the pump has been operated.
Radiation Detection	Individual pump enclosure	Monitors the pump column for radioactive contamination. High radiation activates the external pump enclosure visual alarm and horn.
Temperature	Individual pump enclosure	Monitors pump enclosure temperature to detect abnormal conditions. High and low temperature activates the external visual alarm and horn.

TABLE B.6.5-1 (continued)
STS PROCESS INSTRUMENTATION

SYSTEM: Supernatant Treatment System (STS)
SECTION: Final Filtration and Storage

INDICATOR	LOCATION	FUNCTION/FEATURE
Liquid Level	Decontaminated supernatant collection tank 8D-3	Monitor tank liquid level, also provide secondary method of determining flow rate through STS system. Instrument equipped with high and low level alarms.
Pressure	Inlet and outlet lines to the decontaminated supernatant filter 50-F-002 on jumpers in the STS valve aisle - inlet and outlet linked to read differential across filter.	Monitor inlet, outlet, and differential pressure across the filter to indicate fouling or plugging.
Flow	Outlet of the filter on a jumper in the STS valve aisle.	Monitor and control the flow rate through the ion exchange columns and decontaminated supernatant filter. This instrument is connected to a flow totalizer, which measures the total flow.
Radiation Detection	Outlet line of filter 50-F-002 on jumper in STS valve aisle. Discharge line of decontaminated supernatant pump 50-G-007 on jumper in STS valve aisle.	Monitor radiation levels of the lines. Both instruments are equipped with a high radiation alarm and a warning alarm normally preset at a lower level. The high radiation alarms are interlocked with auto valves to redirect or stop flow in the event of alarm. The high alarm on filter 50-F-002 effluent changes the position of a three-way valve which delivers flow to tank 8D-3 to deliver flow back to tank 50-D-001. The high alarm on the discharge of pump 50-G-007 closes the discharge valve to the liquid waste treatment system (LWTS).

TABLE B.6.5-1 (concluded)
STS PROCESS INSTRUMENTATION

SYSTEM: Zeolite Transfer System

INDICATOR	LOCATION	FUNCTION/FEATURES
Pump Speed	Monitor on pump shaft in pump pit.	Measure frequency to indicate pump speed during zeolite transfer.
Pump Flow	Monitor on jumper in pump pit.	Monitors the flow rate from Tank 8D-1 to Tank 8D-2. The instrument is connected to a flow totalizer which measures the total flow.
Pump Pressure	Monitor on jumper in pump pit.	Monitors pump discharge pressure to detect abnormal conditions.
Pump Temperature	Monitor on pump motor in pump pit.	Monitors pump enclosure temperature to detect abnormal conditions.
Amperage	Instrument at pump motor control center in PVS building.	Monitors amperage to indicate relative pump operating conditions.
Radiation Detection	Utility pits adjacent to pump pits 8Q-1 and 8Q-2.	Monitors contamination potentially backing up into high level waste transfer flush line.

SR2B61-1.DWG

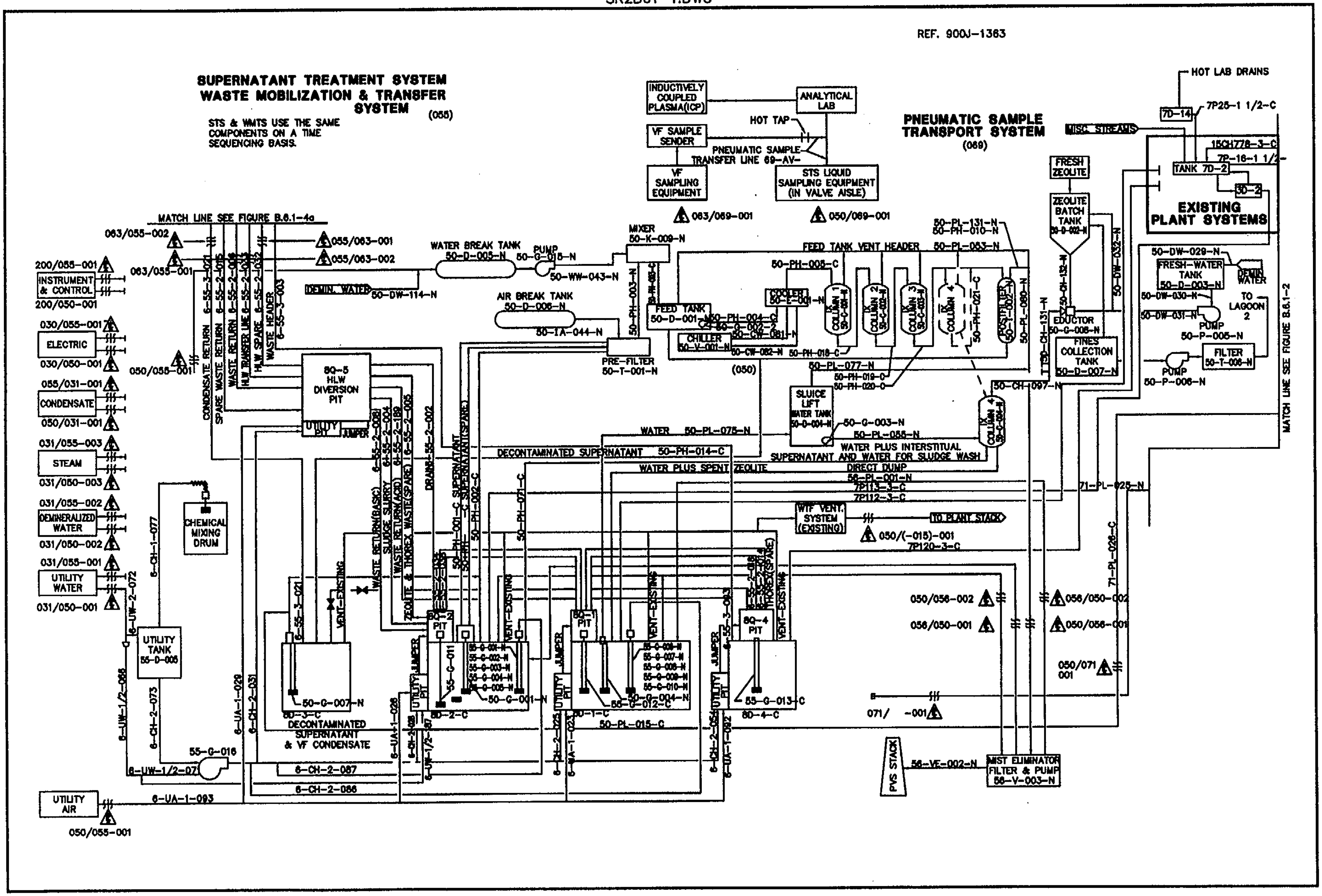


Figure B.6.1-1 IRTS Process Flow Diagram – Supernatant Treatment, Waste Mobilization & Transfer, and Pneumatic Sample Transport Systems

SR2B61-2.DWG

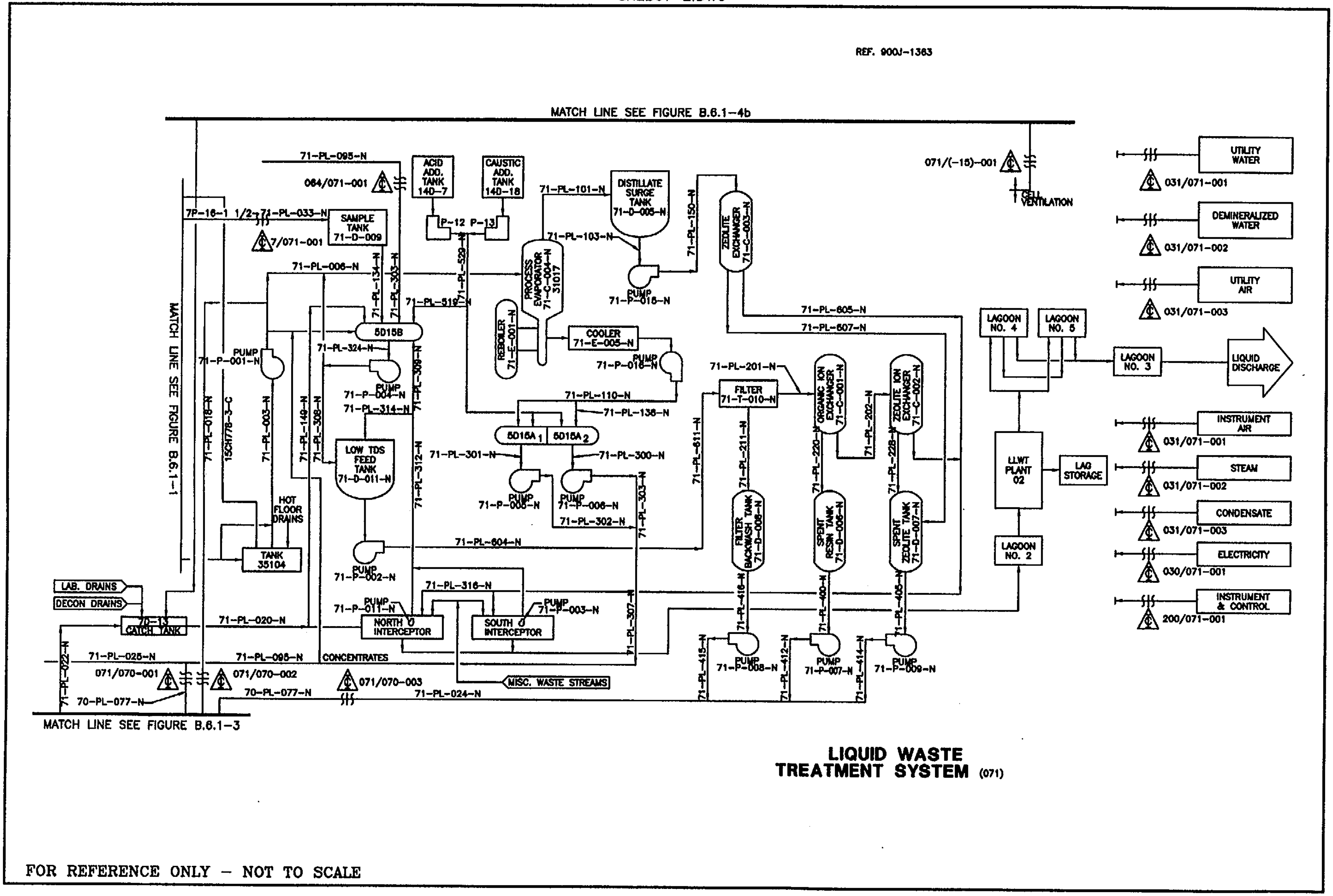


Figure B.6.1-2 IRTS Process Flow Diagram – Liquid Waste Treatment System

SR2B61-3.DWG

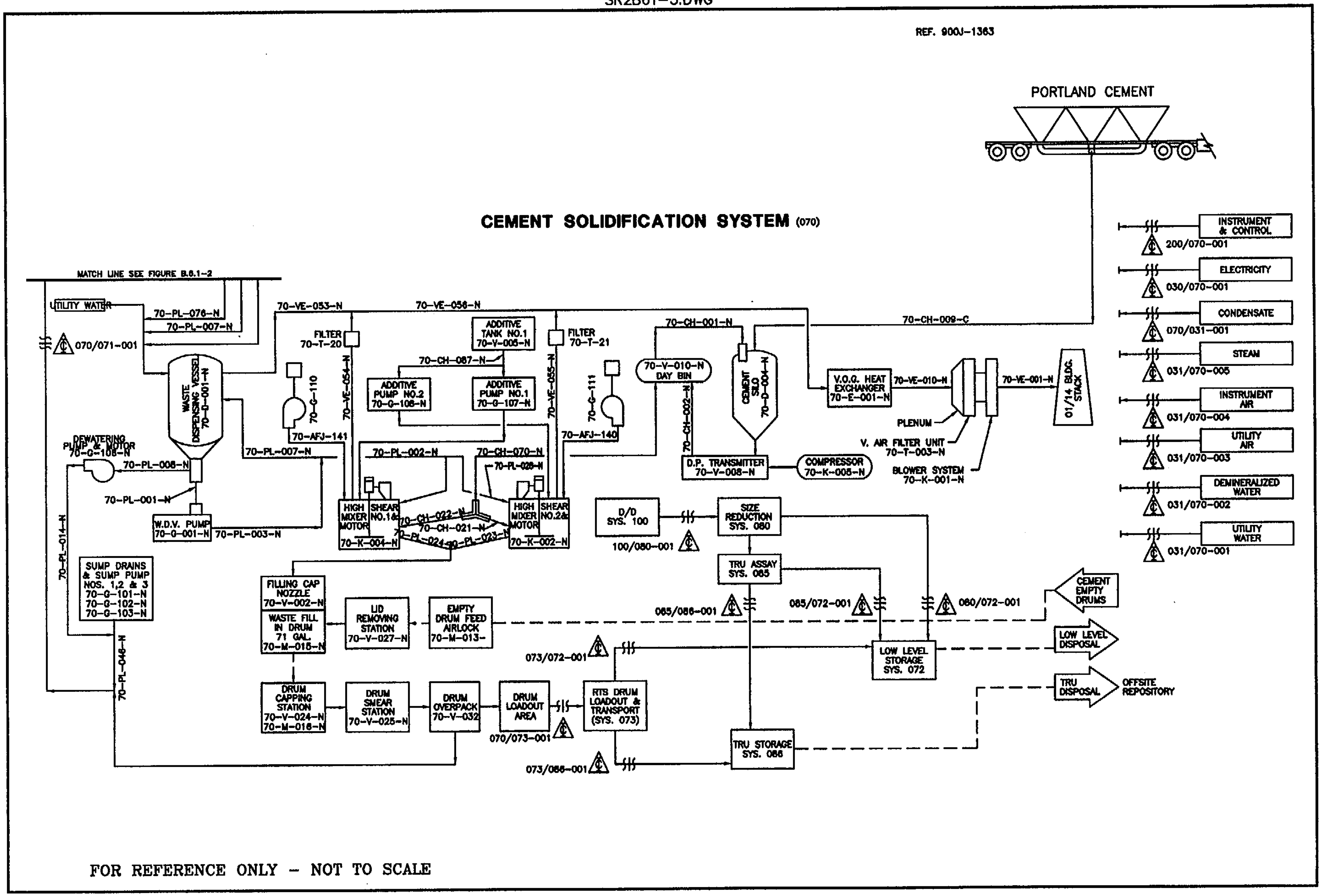


Figure B.6.1-3 IRTS Process Flow Diagram – Cement Solidification System

SR2B66-1.DWG

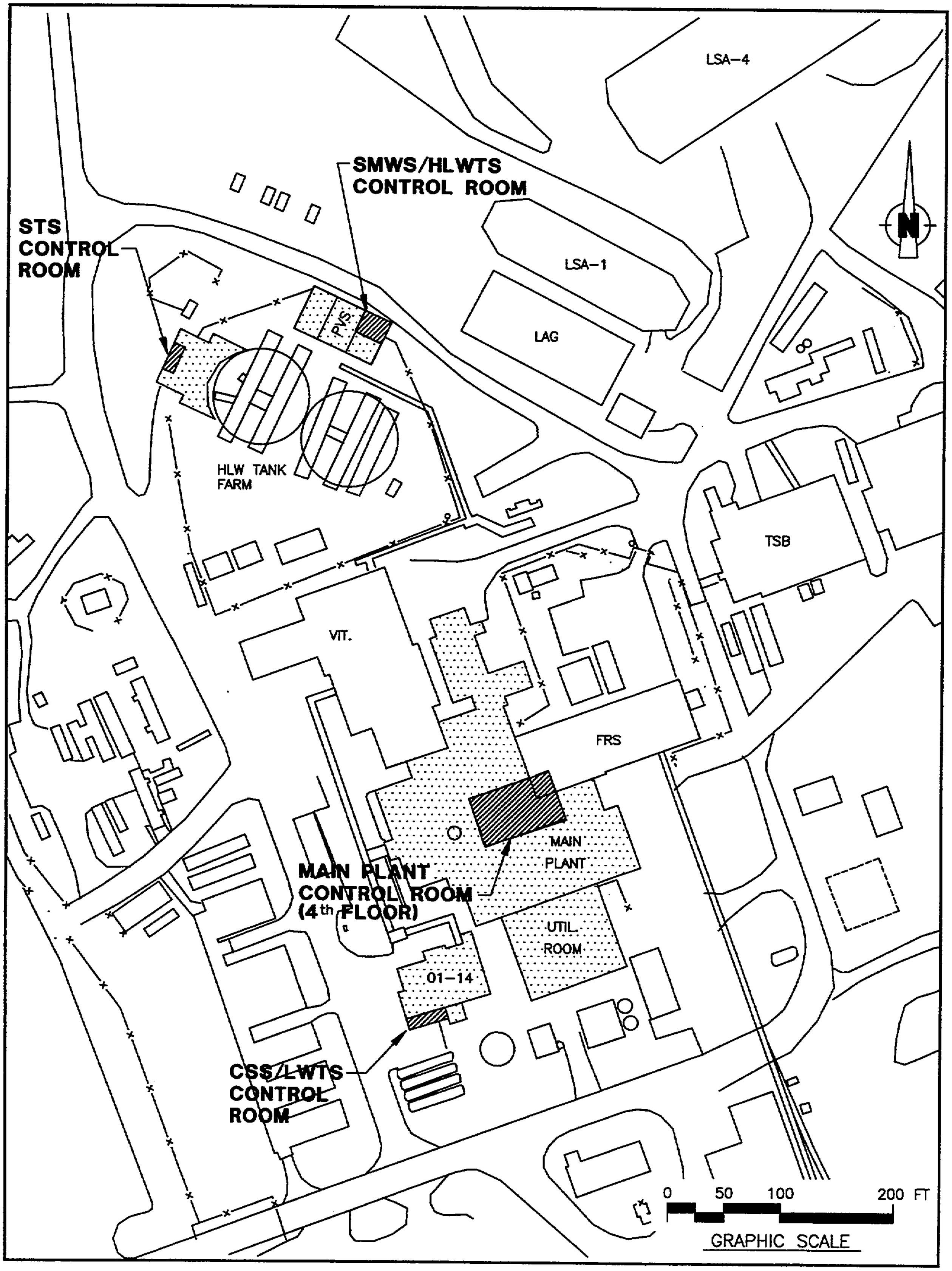


Figure B.6.6-1. Control Room Locations

B.7.0 WASTE CONFINEMENT AND MANAGEMENT

B.7.1 Waste Management Criteria

Radioactive wastes resulting from WVDP operations include gaseous, liquid and solid low-level radioactive wastes (LLRWs), liquid high-level waste, low-level radioactive mixed waste, and solid TRU/suspect TRU waste. In addition, both hazardous and nonhazardous nonradioactive (i.e., industrial and sanitary) wastes are generated as a result of WVDP activities. Waste handling and processing facilities have been designed to ensure environmental effluent releases are maintained well 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 low-level radioactive waste (LLRW), hazardous, low-level radioactive 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.

Note: *DOE Order 5480.23 requires documentation of safety assessments of nuclear facility operations and facilities as well as waste management activities at these facilities. IRTS and Vitrification systems have been designed and constructed for the processing and solidification of high-level wastes. Consequently, a necessary distinction has been made, for the purposes of this SAR, between the waste currently contained in Tank 8D-2 that serves as feed solution to the IRTS and those byproduct streams generated during site operations which are ultimately treated at, or stored in, the LLW2 or Lag Storage facilities. Discussion of high-level waste characteristics and IRTS facilities and processes are contained in Chapters 4 through 6 of this SAR while discussion of IRTS byproduct waste stream handling and treatment are the subject of the sections of this chapter.*

B.7.2 Low-Level Radioactive and Low-Level Radioactive Mixed Wastes

Low-level radioactive wastes (LLRWs) at the WVDP result from IRTS, Main Plant and LWTS operations, as well as from decontamination, maintenance, and construction activities. These wastes include gaseous, liquid and solid LLRW and solid TRU/suspect TRU waste. Contaminated lead metal is the primary source of low-level radioactive mixed waste at the WVDP. This material is currently stored in the Interim Waste Storage Facility (IWSF) and Lag Storage Building as discussed in Section B.7.8. Small quantities of liquid low-level radioactive mixed wastes are generated during analyses in the WVDP Analytical and Process Chemistry laboratories. Liquid low-level radioactive mixed waste may be stored at the IWSF, Lag Storage Building, or LSA 3 or 4 prior to final disposition.

Airborne radioactive contamination within Project facilities is filtered and exhausted to the environment through the use of building ventilation systems. Gaseous effluents from these systems are monitored per the requirements of the site NESHAPS permit.

Liquid LLRW waste generated in the IRTS/Main Plant is comprised of contaminated water resulting from area or equipment decontamination, system flush water, filter backwash, and laundry operations. Wastewater with a gross beta concentration less than 5E-3 µCi/mL (1.85E2 Bq/mL) is directed to the Low-Level Waste Treatment Replacement Facility (LLWTF) which uses an ion exchange process for liquid radioactive waste decontamination.

The WVDP is currently utilizing the NRC waste classification system prescribed in 10 CFR 61 for Class A, B, and C wastes. Based on this classification system, the primary form of solid LLRWs generated during IRTS/Main Plant operations is Class A waste. This waste is generally compactable material consisting of anticontamination clothing, bags, paper products, rags, analytical sample bottles and other miscellaneous items. Other solid LLRWs include spent ventilation filters, dewatered sludge and resin from LLWTF operations, contaminated wood products, small diameter piping and sheet metal, and failed processing components which have been removed from radioactive service and overpacked before disposal. A representative summary of typical waste, including LLRW, stored at the WVDP is presented in Table B.7.7-1. This table is an example and is provided for information only.

TRU/suspect TRU waste at the WVDP was primarily generated from plant decontamination efforts. At present, there are no major on-going decontamination projects and therefore no significant quantities of TRU/suspect TRU waste being generated. Per the requirements of DOE Order 5820.2A, *Radioactive Waste Management*, only TRU waste categorized as defense waste is acceptable for disposal at the Waste Isolation Pilot Project (WIPP). Since WVDP TRU waste resulted from reprocessing of spent fuels from both commercial and defense sources, TRU waste is not presently scheduled to be shipped to WIPP. The WVDP has developed a TRU Waste Acceptance Criteria (WAC) which invokes some of the elements of the WIPP WAC program. Discussion of this program is given in WVDP-030, *TRU Waste Certification Program Plan*.

B.7.3 Nonradiological Wastes

Nonradiological wastes generated at the WVDP are of the following basic types:

[1] Hazardous liquid and solid wastes (oils and wipes from maintenance activities, etc);

[2] Nonhazardous, solid wastes (construction and demolition debris, scrap equipment, maintenance wastes, office trash, packing material, etc.);

[3] Nonhazardous, nonradioactive effluent (sewage, utility room effluent, etc.).

Nonhazardous, nonradioactive solid wastes are disposed of off-site at a licensed landfill facility.

Project effluents are regulated by the New York State Department of Environmental Conservation (NYSDEC) for nonradiological parameters. The combined liquid effluents from the LLWTF (Section B.7.5) and waste water (sanitary sewage) treatment facility (Section B.5.4.7) are monitored to assure compliance with discharge limits identified in the State Pollutant Discharge Elimination System (SPDES) Permit. These waste streams are also monitored for radioactivity.

A small amount of hazardous waste is generated at the WVDP primarily as a result of maintenance, analytical and printing activities. 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.

B.7.4 Off-Gas Treatment and Ventilation

Airborne effluents from IRTS and Main Plant equipment are decontaminated by off-gas treatment systems prior to discharge to the environment. Off-gas treatment for vessels in the Waste Tank Farm is provided by the Waste Tank Farm Ventilation System (WTFVS) while the Vessel Off-Gas System (VOG) provides ventilation for vessels in the Main Plant, including vessels associated with the LWTS. Ventilation air from both the Waste Tank Farm Ventilation System and Vessel Off-Gas system is exhausted to the Main Plant stack.

WASTE TANK FARM VENTILATION SYSTEM

The original Waste Tank Farm Ventilation System (WTFVS) provides ventilation to Tanks 8D-1, 8D-2, 8D-3, and 8D-4. The WTFVS is an existing facility constructed in the early 1960s as part of the original reprocessing plant. This ventilation system was not seismically designed or qualified to a DBE. If this equipment does fail and/or on-site backup power is lost, negative pressure on the HLW tanks can be maintained by manually placing the tanks onto the Permanent Ventilation System (PVS).

VESSEL OFF-GAS SYSTEM

The Vessel Off-Gas system provides ventilation of exhaust gases from the LWTS evaporator and condenser, as well as a number of other vessels in the LWTS and Main Plant. A summary of vessels ventilated by the VOG is given in Table B.7.4-2.

B.7.4.1 Operating Characteristics

Off-gas treatment and ventilation systems in the Main Plant utilize HEPA filters to ensure adequate removal of radioactive particulates in effluent air streams. HEPA filters are inspected prior to installation and are in-place leak tested at installation and annually thereafter to ensure acceptable operation. HEPA filters used at the WVDP must meet requirements prescribed by the Department of Energy (U.S. Department of Energy, 1988).

WASTE TANK FARM VENTILATION SYSTEM

During normal operation of the Waste Tank Farm Ventilation System air is removed from the tanks at approximately 0.07 m^3/s (150 cfm). Supply air to the tanks is provided from inleakage. Off-gas from Tanks 8D-1 and 8D-2 passes through a condenser to remove water vapor. Off-gas from Tanks 8D-3 and 8D-4 is processed through a caustic scrubber and combines with flow from Tanks 8D-1 and 8D-2. The combined air stream passes through a knock-out drum and demister to remove entrained liquid. Condensate is returned to Tank 8D-2. The air stream is then passed through a heater prior to HEPA filtration and exhaust. Filters and blowers in the Waste Tank Farm Ventilation System are provided with redundant spares connected in parallel to provide exhaust in the event of off-gas equipment failure. Following off-gas treatment, exhaust air is combined in the Main Plant stack with effluent from other activities. The configuration of equipment in the Waste Tank Farm Ventilation System is depicted in Figure B.5.4-1.

During Sludge Mobilization System sludge mixing activities, each mobilization pump adds approximately 130 kW of heat to the Tank 8D-2 contents. The total heat input rate to the tank, with six pumps running, is approximately 790 kW. This is in addition to the 50 kW (70 hp) generated by radioactive decay of the remaining unwashed sludge. Assuming that all the heat generated by the pumps produces water vapor, approximately 1,700 L/h (6.6 gpm) of vapor would pass through the WTFVS. Since the condensers have a design capacity of 4,700 L/h (21 gpm), the water vapor generated from the sludge mixing operation should be condensed efficiently.

VESSEL OFF-GAS SYSTEM

Off-gas ventilated from LWTS and Main Plant vessels passes through the VOG Condenser 6E-3 where it is cooled. Airflow is then through Tank 6D-6 where the condensate generated in 6E-3 is collected and gravity-fed to Tank 6D-3. The stream then passes to the VOG Scrubber 6C-3. During normal operation, the VOG Scrubber does not contain a working solution and the airstream simply passes through the vessel. If off-gas scrubbing is required however, 6C-3 may be charged with a scrubber solution with the off-gas flowing through a cascade of liquid to remove and/or neutralize any chemical vapors. Off-gas leaving Scrubber 6C-3 passes into the VOG cyclone 6V-1 to remove any entrained water and then to heater 6E-4 to raise the dew point temperature prior to filtration.

There are two upstream-filter/fan trains ducted in parallel which provide filter/fan train redundancy. The two final filter trains down stream of the blowers are ducted such that either train can be used with either fan (contrary to the upstream filter ducting configuration). Equipment arrangement in the VOG system is shown in Figure B.5.4-1. Both upstream and downstream filter trains are arranged such that filter change-outs can be accomplished without interrupting system air flow. Upstream (primary) HEPA filters and blowers are located in the Off-Gas Blower Room (OGBR), adjacent to the Off-Gas Cell. Downstream (secondary) HEPA filters are located on the Off-Gas Aisle (OGA) roof. After leaving the final filters the gases are exhausted at a rate of 0.28 m^3/s (600 cfm) to the Main Plant stack where they are discharged to the atmosphere.

The primary Vessel Off-Gas filters located in the Off-Gas Blower Room consist of a roughing filter and HEPA filter in a common frame. The frame is stainless steel and has a 1.3 cm x 1.3 cm (0.5 in x 0.5 in) stainless steel screen on the downstream face. This design precludes bulk filter media from falling into the discharge plenum in the event the filter media fails.

B.7.4.2 Safety Criteria and Assurance

IRTS/Main Plant off-gas treatment and ventilation systems maintain redundant HEPA filters and blowers to ensure ventilation system operability during abnormal operating conditions. Instrumentation has been provided to monitor the integrity of ventilation system filters. A summary of off-gas filter monitoring instrumentation is given in Table B.7.4-1.

Treatment system efficiency is continuously monitored through sampling and monitoring of exhaust air in the Main Plant stack. Effluent air samples are collected weekly and analyzed in the WVDP Environmental Laboratory for gross alpha/beta and tritium activity. In addition, weekly gamma isotopic analyses are performed if gross activity rises significantly. Weekly filter samples are composited quarterly and analyzed for specific radionuclides of interest. The airborne effluent monitoring program is described completely in Section B.8.3.

B.7.5 Liquid Waste Treatment and Retention

During operations of the Main Plant, quantities of wastewater are generated which contain traces of various activation and fission product radionuclides. The purpose of the LLWTS is to intercept radioactive wastewater (from the plant and from the North Plateau); remove and confine radioactivity to the greatest extent practicable; and discharge the treated water at controlled rates to the environs. Figure B.7.5-1 shows a simplified schematic of the LLWTS. Radioactive wastewater from the plant includes, but is not limited to, wastewater from the laundry; miscellaneous low level process wastes including wastes from Main Plant operations; LWTS evaporator overheads; groundwater intrusion into the HLW pans and vaults; NDA Treatment System, Contact Size Reduction, monitoring well development and/or purging and stormwater. Separate and distinct wastewater extracted from the ground water plume northeast of the Main Plant is referred to as the North Plateau wastewater.

Low-level liquid wastes from the plant are collected batch-wise in one of the three interceptors (one old interceptor, two new interceptors [North and South]). Following radiological analysis, batches with gross alpha plus gross beta concentrations below 5E-3 µCi/mL (1.85E2 Bq/mL) are transferred to Lagoon 2. Lagoon 2 water is pumped via transfer pumps to the sump in the Low-Level Waste Treatment Replacement Facility (LLW2), which is located just west of Lagoon 4 (see Figure B.7.7-1). LLW2 houses two (2) skid-mounted equipment trains: Skid A and Skid B. Skid A is designed to treat 218,000 L/day (57,000 gpd) while Skid B is designed to treat 109,000 L/day (28,800 gpd). Under its current configuration, Skid B can treat only water from the North Plateau while Skid A can treat water from Lagoon 2 and the North Plateau. Both skids are capable of preferential removal of strontium-90 and cesium-137 depending on choice of ion exchange resin used. During CY-98, Skid A averaged about 100,000 L/day (26,000 gpd) while Skid B averaged about 33,000 L/day (8,800 gpd). Spent resin from both skids are sluiced directly to shipping containers, dewatered, packaged and transferred to temporary storage in readiness for eventual disposal. The treated liquids are collected batchwise in Lagoon 4 or 5, where further sampling and analyses are conducted. If the treated liquid meets discharge specifications, it is transferred to Lagoon 3. If the treated liquid does not meet discharge specifications, it is either transferred back to Lagoon 2 for recycle through the LLW2 or diluted with raw water, reanalyzed and, if specifications are met, transferred to Lagoon 3. Confirmatory measurements are performed on liquid transferred to Lagoon 3 prior to controlled discharge to the environment via Erdman Brook.

B.7.5.1 Design Objectives

The Low-Level Waste Treatment Replacement Facility is currently configured to process 327,000 L/day (86,400 gpd) of low-level liquid wastes. A comparison of the 1997 LLWTF discharge effluent isotopic concentration to the eight year average discharge isotopic concentration is provided in Table B.7.5-1. The estimated annual water balance for the Low-Level Waste Treatment System for CY-98 is shown in Figure B.7.5-2.

The process systems in the Low-Level Waste Treatment Replacement Facility have been authorized by the New York State Department of Environmental Conservation for treatment of influent and discharge of the effluent to the environment via permitted outfall 001. The LLWTF is operated in a manner which ensures that effluent concentrations of radionuclides from Lagoon 3 do not exceed the derived concentration guides (DCG) for those nuclides as specified in DOE Order 5400.5. Effluent from Lagoon 3 is also monitored at outfall 001 for nonradiological parameters to demonstrate compliance with limits set forth in the State Pollutant Discharge Elimination System (SPDES) permit for the LLWTF.

Liquid wastes in the LLWTF are contained in the interceptors, lagoons, LLW2 building sump and process vessels. Protection from overflow or spills in LLW2 is ensured through the use of high-level cutoffs, a sloped building floor, moisture/leak sensors, skid catch basins, and drains to the LLW2 sump. These system components are discussed in the following section.

B.7.5.2 Equipment and Systems Description

B.7.5.2.1 Neutralization Pit and Interceptors

Liquid LLRW flowing from WVDP process areas first enters the Low-Level Waste Treatment System at the neutralization pit (see Figure B.7.5-1). Currently, sodium hydroxide (NaOH) or potassium hydroxide (KOH) is added to the wastewater through floor drains in the utility room to maintain a pH of greater than 10 in Lagoon 2 for insect larvae control. Alternatively, effluent streams from the reprocessing plant with the potential for having elevated contamination levels may be directed to the original NFS (old) interceptor, thereby bypassing the neutralization pit.

Interceptors routinely receiving liquid LLRW from the reprocessing plant are dual 87,000 L (23,000 gal) stainless-steel-lined concrete pits (referred to as the North {N} interceptor or the South {S} interceptor) situated in the silty till clay. Each interceptor collects wastewater in batches for sampling and release to Lagoon 2. High-level alarms locally annunciate the potential for over-filling of an interceptor. The interceptors are constructed so that one interceptor will overflow to the other if overfilling occurs. Hydrogen peroxide (H_2O_2) is added, as needed, in summer months to the interceptors to control the growth of algae in Lagoon 2. Wastewater which has been sampled and approved for release is drained by gravity to Lagoon 2. Air sparges in the interceptors are used to keep waste water thoroughly mixed for accurate sampling and to minimize the settling of any material.

The original NFS interceptor located northwest of the stainless-steel-lined interceptor is an unlined concrete pit used to receive plant liquid effluents suspected of having elevated contamination levels. Upon verification of acceptable radioactivity levels, the contents of this interceptor are transferred to the new interceptors via a steam jet.

B.7.5.2.2 Lagoon System

There are four storage lagoons associated with the LLWTF identified as Lagoon numbers 2 through 5. Lagoons 2 and 3 are large holding basins constructed in the silty till with capacities of 9,100,000 L (2,400,000 gal) and 12,000,000 L (3,300,000 gal), respectively. This silty till has a low hydraulic conductivity and thus provides a level of confinement for the liquid wastes. Lagoons 4 and 5 are synthetic-lined holding basins with capacities of approximately 908,000 L (240,000 gal) and 700,000 L (185,000 gal), respectively.

Lagoon 2 is fed directly from the interceptors and serves as the feed point for the 02 process skid equipment in LLW2. In addition, effluents from the NDA Liquid Pretreatment System are discharged to Lagoon 2 for treatment in LLW2. Lagoon 2 also serves as an equalizing basin for recycle streams from the LLW2. Lagoon 3 is a surge basin for treated waste and is the point of discharge to the surface waters via Erdman Brook. Lagoons 4 and 5 alternate receiving and discharging LLW2 effluent water to Lagoon 3. Batch collection and sampling practices are used to monitor water quality. These lagoons discharge to Lagoon 3 normally, but can be routed to Lagoon 2 to recycle the water if required.

B.7.5.2.3 Low-Level Waste Treatment Replacement Facility (LLW2)

The LLW2 is a pre-engineered, single-story, metal-sided building (40 feet by 60 feet), located west of Lagoon 4, which houses two skid mounted (7 feet by 18 feet) process equipment modules. The floor is pitched to a longitudinal drain (running along the east wall of the building) which slopes to the sump located in the SE corner of the packaging room. The sump overflows via gravity to Lagoon 2. The LLW2 has HEPA filtration for the Packaging Room which is typically used for resin handling. Air leaving the resin handling area passes through a HEPA filter and the associated portable ventilation unit (PVU) prior to being exhausted through a short stack on the roof of the building. This stack flow is sampled to obtain periodic confirmatory information on radionuclide emissions for the annual National Emission Standards for Hazardous Air Pollutants (NESHAP) Report required by 40 CFR 61 Subpart H.

The low-level radioactive waste water stored in Lagoon 2 is transferred to the 900-gallon sump in the SE corner of the Packaging Room in the LLW2 building via two pumps housed in a shelter located on the berm between Lagoon 2 and 3. From the sump, feed water is pumped via the transfer sump pump through the sand filter prior to entering the 800-gallon surge tank. The sand filter removes suspended matter that may be present in the wastewater stream to prevent it from being deposited in the ion-exchangers.

The North Plateau well pumps remain unchanged. These pumps discharge to the surge tank (1100 gallons) which remains in the trailer associated with the North Plateau ground water. Transfer pumps in the trailer are used to transfer the North Plateau well water from the surge tank in the trailer to the surge tank (800 gallons) in the LLW2 associated with the Skid B.

B.7.5.2.3.1 Liquid Waste Handling

Low-level radioactive waste water treatment activities are performed in LLW2. The initial design and installation configuration requires the operation to process Lagoon 2 wastewater through Skid A and North Plateau waste water through the Skid B. Due to the design of the IX columns, an annual reduction of spent resins waste will be generated via this process compared to the previous waste volume generated. However, based upon operational data, it is planned to integrate the operations to further optimize the process via treating both waste streams through only one skid at a time. It is permissible for both waste streams to be processed though one skid (assuming proper ion-exchange media is present) since subsequent sampling and analysis determines whether the treated liquids are transferred to Lagoon 3 for discharge to the environment or transferred to Lagoon 2 for recycle. The following sections discuss the independent operation of the Skids A and B.

B.7.5.2.3.1.1 Skid A

The filtered water in the surge tank is pumped via an IX feed pump to the process skid for the Lagoon 2 water. The design flow rate is 20 to 50 gpm based on the current total flow rate of approximately 7 million gallons per year. The maximum flow rate is expected to be approximately 40 gpm for the Skid A equipment. The skid has three identical carbon steel ion exchange vessels with non-metallic polymer liner; each ion exchange column is capable of being charged with 50 cubic feet of dry mixed ion exchange resins. The skid mounted equipment has been designed to allow maximum flexibility in the operation of the process, such that the ion exchange columns can be used in series or parallel or by-pass in any order relative to one of the skids. The columns are designed for downflow loading and upflow elution. The pH of the effluent from the ion exchange columns is adjusted prior to transfer to Lagoon 4 or 5. A chemical feed pump drips concentrated sulfuric acid into the effluent stream to adjust the pH to approximately 7.0. Sulfuric acid used in neutralization is supplied from a 100-gallon tank (located on the sloping floor of the LLW2), which is filled via a drum pump from 55 gallon drums. Receipt and distribution of the concentrated acid is controlled by standard operating procedures. The treated effluent flows to Lagoons 4 and 5 for subsequent radiological and biochemical analyses prior to further transfer. If the effluent meets the requirements for discharge to the environment, the liquid is transferred to Lagoon 3 for discharge; otherwise, the effluent is returned back to Lagoon 2 for further processing.

B.7.5.2.3.1.2 Skid B

The NP wastewater in its associated surge tank is pumped via an IX feed pump through the process equipment on the skid. The design specifications for Skid B equipment are similar to those for Skid A. However, based upon the SPDES permit performance, the maximum flow rate was set at 20 gpm. Operation of Skid B is the same as operation of the Skid A, with the same parameters being monitored and controlled. As shown in Figure B.7.5-1, the effluent from the Skid B is combined with the effluent from the Skid A followed by the neutralization process discussed previously in Section B.7.5.2.3.1.1.

An improvement in the system configuration includes the ability to add a measured amount of sulfuric acid to Lagoon 3 from LLW2. This feature recognizes that the pH in the unbuffered open water of Lagoon 3 rises due to algae growth. The pH range for discharge from Lagoon 3 is between 6.5 and 8.5.

B.7.5.2.3.2 Resin Removal and Handling

The process skids do not have to be shutdown for an ion exchange column to be sluiced out. Only the column with the spent resin needs to be isolated. Soft water will be used to push the resin out of the column and into a shipping container (HIC or B-25 box) located in the packaging room. Here the container will be dewatered and prepared for interim storage. The process skids have to be shutdown to conduct the resin loading operation. In addition, resins in storage from the old Low-Level Waste Treatment System may be repackaged in the packaging room.

B.7.5.2.3.3 Low-Level Waste Treatment Replacement Facility Ventilation

There are three HVAC systems in LLW2. The main heating system includes 4 gas fired radiant heaters located near the ceiling throughout the building. The heater dedicated to the packaging room uses outside air for combustion and discharges to the outside, i.e., the combustion air and combustion products are isolated from the packaging room air. These units are designed to provide enough heat for all normal operations.

The second system consists of the portable ventilation unit (PVU) stationed outside the south wall of the packaging area. This unit will be used whenever personnel are in the packaging room during resin handling activities. The PVU draws air from the packaging room and in addition provides controlled vessel ventilation as appropriate during resin handling activities. Air leaving the resin handling area passes through a HEPA filter and the associated portable ventilation unit (PVU) prior to being exhausted through a short stack on the roof of the building (see Section B.7.5.2.3). Contamination levels in the water treatment portion of LLW2 are sufficiently low such that HEPA filtration is not necessary.

The third system is a forced ventilation unit for the office area that provides year-round climate control. Air from the outside is heated or cooled and discharged to the office area such that positive pressure results in the office area.

B.7.5.2.3.4 Instrumentation and Control

Controls on the LLW2 process consist of process sampling, standard operating procedures, and protective instrumentation. Samples of the LLW2 feed from the sand filter effluent and ion exchange effluent provide information on process operation and form the basis for changes in the types and quantities of chemical additives. Primary control parameters for treatment consist of radionuclide concentration and calcium and magnesium hardness in the feed stream.

Instrumentation is used in the treatment system to monitor the system feed rate, surge tank level, filter tank level, and flow rate through the ion exchange beds. The ion exchange effluent stream is controlled to a pH range of 6.5 to 8.5 as it flows to Lagoon 4 or 5. Alarms are indicated on the computer in the LLW2 office.

B.7.5.2.3.5 Fire Protection

The LLW2 was evaluated against DOE Order 420.1, *Facility Safety*, and National Fire Protection Association Codes and Standards. Fire suppression and detection are not part of the facility installation; however, other fire and life safety features provide a satisfactory measure of protection.

The building is of non-combustible or limited-combustible materials. Fire hazards include the gas-fired radiant heaters, recognized industrial electrical malfunctions, and hazards associated with the use of propane and diesel-fueled forklift trucks. The potential for a toxic, biological, and/or radiation incident due to a fire is low. A credible fire is expected to be localized to individual electrical components, with little possibility of fire propagation. Hazardous materials, such as low-level radioactive resins or sulfuric acid (which are inherent to the facility), pose only a minor risk of contamination to the immediate area.

Based upon existing and projected use of the facility, defense-in-depth during system operation is provided by the following fire protection features:

- Minimum fire loading
- Minimum ignition sources
- The 812 All-page system
- Portable fire extinguishers
- Fire Brigade and Local Fire Department response
- On-site fire hydrant coverage

Life safety considerations include emergency lighting, exit signs, and accessible exits along with the passive fire protection inherent in the materials of construction, as well as the relatively benign water treatment process.

The LLW2 is adequately separated from nearby facilities such that the potential for fire spread between facilities is unlikely.

B.7.5.3 02 Building

The 02 Building is a radiological facility that was part of the old LLWTS. It is a two-story steel-framed concrete block building 8.2 m (27 ft) by 11.9 m (39 ft) with an adjacent 7.6 m (25 ft) by 15.2 m (50 ft) bermed concrete slab and an adjacent office area. It is currently undergoing D&D. The chemical tanks located on a concrete pad outside of the 02 Building have been emptied and are also undergoing D&D.

B.7.6 Liquid Waste Solidification

Solidification of byproduct liquid waste is not performed at the WVDP.

B.7.7 Solid Low-Level Radioactive Wastes

Solid LLRWs generated at the WVDP include Class A, B, and C wastes and TRU and suspect TRU waste. Temporary storage for these wastes is provided by Lag Storage Facility buildings and hardstand areas while waste volume reduction is performed at the Waste Reduction and Packaging Area compactor, Contact Size Reduction Facility, and Container Sorting and Packaging Facility. WVDP solid LLRW storage and volume reduction facilities are fully described in the following sections. Locations of these facilities are depicted in Figure B.7.7-1.

Packaged Class A compactable materials such as small diameter piping, sheet metal, and wood products were volume-reduced in a Supercompactor. The Supercompactor was a trailer-mounted horizontal hydraulic press located adjacent to the Lag Storage building. In 1998 the supercompactor was transferred to the U.S. DOE Savannah River Site.

B.7.7.1 Design Objectives

Waste storage facilities at the WVDP have been designed for the safe storage of wastes packaged to meet the requirements of 10 CFR 61. These facilities provide interim storage for wastes generated at the WVDP prior to final disposal off-site; no radioactive wastes produced at the WVDP are disposed of on-site.

B.7.7.2 Equipment and Systems Description

Facilities providing interim storage for wastes generated on-site are discussed in Section B.7.7.6. Equipment and facilities utilized for volume reduction of solid LLRWs are discussed in the following sections.

B.7.7.2.1 Waste Reduction and Packaging Area Compactor

A small compactor located on the Waste Reduction and Packaging Area (WRPA) dock is used for compacting low activity LLRW. This waste, consisting primarily of anti-C's and paper products, is collected in polyethylene bag-lined 208 L (55 gal) drums throughout the site. Full drums and boxes are transported to the WRPA dock where the bagged waste is transferred from the drums to a 2.5 m^3 (90 ft^3) rectangular steel box and compacted by a 445 kN (50 ton) box compactor. The compactor is vented by a HEPA-filtered ventilation system to provide contamination control.

B.7.7.2.2 Contact Size Reduction Facility

The Contact Size Reduction Facility has been designed for the volume reduction of large low-dose rate (<100 mR/hr) equipment resulting primarily from WVDP decontamination activities in the Main Plant. This equipment consists of process piping, vessels and other equipment formerly housed within shielded cells which were adapted for use in the IRTS. As a result of the nature of this waste, a considerable volume reduction can be realized if this material is cut into pieces which can be packed more efficiently.

The CSRF utilizes plasma arc cutting torches for size reduction, and a high pressure water spray system for decontaminating large items. This equipment is installed in the north room of the Master-Slave Manipulator (MSM) repair shop.

Low dose rate, LLRW packages to be processed in the CSRF are staged in the north airlock pending a preliminary radiation survey to verify that the exposure rate is acceptably low. Wastes that are determined to be acceptable for processing are then transferred to the cutting room. Following safe storage or removal of flammable material from the cutting room, equipment is size-reduced through the use of a plasma arc torch.

Size-reduced materials may be decontaminated prior to packaging for assay and storage. Decontamination capabilities in the CSRF include foam application, high pressure water spray and a liquid abrasive decontamination system.

The liquid abrasive decontamination system is designed to decontaminate material sectioned in the cutting room. This system is designed to use a mixture of abrasive particles, water and air to clean the surfaces of contaminated material. Material to be decontaminated by this system is loaded onto a turntable and transferred into the system decontamination booth for application of the abrasive spray. Currently Tank 15D-6, which receives liquid effluents from the LADS system, is incapable of being jetted. Consequently, the liquid abrasive decontamination system is out-of-service.

Following decontamination, material is air-dried and transferred to an airlock for final survey prior to packaging for return to the Lag Storage Facility for waste classification assay and interim storage pending final disposal off-site.

Ventilation for the CSRF is provided by a room ventilation system and backed up by the Head End Ventilation system of the Main Plant. Room ventilation is provided by a system mounted on the roof of the cutting room. Room ventilation system air flows at a nominal rate of 2.8 m^3/s (6,000 cfm) from the south MSM, vestibules and decontamination room into the cutting room, where it is exhausted through an in-cell spark arrestor and roughing filter and a roof mounted filter train consisting of a roughing filter and two HEPA filters in series prior to discharge to a locally-mounted stack. Ventilation for the MSM decontamination shower booth and liquid abrasive decontamination system decon booth/survey glove box is provided by the Head End Ventilation system. The HEV also provides backup ventilation to the various rooms when the room ventilation system is shut down. A "source capture" system that provides localized ventilation in the cutting room discharges to the room ventilation system.

CSRF ventilation system atmospheric discharges are isokinetically sampled and continuously monitored for alpha and beta activity.

B.7.7.2.3 Container Sorting and Packaging Facility

The Container Sorting and Packaging Facility (CSPF) has been designed to sort, segregate, and repackage LLRW, low-level radioactive mixed waste into three distinct categories; incinerables, compactables, and meltable metals. This facility is also used to sort between: mixed and non-mixed wastes, compactables and meltable metals and to inspect container contents. Future use of the facility may involve segregating higher contamination items from lower contamination ones.

The 40-ft by 28-ft CSPF is a stand-alone facility located within Lag Storage Annex #4 (LSA-4). It is constructed of prefabricated, interlocking modular 22-gage stainless steel panels which form the outside walls, ceiling, and inner partition walls. Some wall and ceiling panels contain plexiglass windows for viewing and external lighting purposes. The concrete floor of LSA-4 serves as the floor of the CSPF. The CSPF consists of a sorting room, drum/box load-in room, drum load-out room, and two airlocks. The box/drum load-in and load-out rooms provide for safe and efficient movement of waste containers in and out of the facility, while the airlocks allow for personnel access and egress to the sorting room.

Unsorted and unsegregated waste packages entering the CSPF are moved into the drum/box load-in room prior to entering the sorting area. Packages are subsequently moved into the sorting area, placed on a lift-and-tilt-table, and opened. The lift-and-tilt-table elevates and tips the container, making the contents easily accessible. The waste is then sorted and segregated. Full drums or boxes containing sorted waste are later moved from the sorting room to the load-out room, covered and decontaminated as needed, and placed back into storage in the Lag Storage Facilities. Other equipment in the sorting room consists of a sorting table with liquid catch basin, drum roller, and an overhead bridge crane.

Adjacent to the CSPF is a stand-alone blower room which houses the ventilation system and other components essential to sorting operations. The CSPF ventilation system consists of a double stack 2000 cfm system with two nominal 1000 cfm blowers. This configuration permits one blower to be taken off-line and have its filter changed while still maintaining ventilation flow at an adequate level. The filter housings are manufactured from 14-gage T-304 stainless steel, adequately reinforced to withstand a negative or positive pressure of 10-in water gage.

The discharge side of the ventilation system from the filter to the discharge point at the exterior of LSA #4 has approximately 12-ft of 14-in diameter stainless steel duct. Two sections of 6-in diameter stainless steel duct direct ventilation air from the blowers to the locally-mounted stack. The stack penetrates the LSA-4 weather structure prior to discharging ventilation air to the atmosphere. Air ventilated by the system is monitored through the use of continuous air monitors.

If electrical power to the two ventilation blowers is lost, an auxiliary blower powered by a dedicated natural gas generator will provide adequate ventilation to the facility. Therefore, failure of both the exhaust blowers or loss of off-site power will not prevent the system from maintaining sub-atmospheric pressure in the CSPF.

Fire detection systems have been installed in the CSPF to provide personnel early warning of a potential fire. A Very Early Warning Smoke Detector System (VESDA) is used as the primary detection system for the CSPF. The VESDA, which can detect particles generated during the pre-combustion stages of a fire, is comprised of an air sampling system, filter assembly, aspiration system, detector and control system. In addition to the VESDA system, air duct smoke detectors have been installed in the ventilation system. The alarms are monitored through the Central Site Monitoring System by means of the Data Gathering Panel and data transmission lines.

Two manual fire pull stations have been installed in conjunction with the sorting room in the CSPF. One pull station is installed in the sorting room to be activated by the sorting personnel; the second pull station is mounted immediately outside of the CSPF to be activated by anyone observing a fire through one of the panel windows.

A Clean Agent Fire Suppression System (CAFSS) has been installed as the fire suppression system in the CSPF.

B.7.7.3 Operating Procedures

Operating procedures for the handling and storage of radioactive waste at the WVDP have been developed per the requirements of DOE Order 5820.2A and 10 CFR 61. Update of the waste management program is given WVDP-019, Annual Waste Management Plan. Development of facility procedures is consistent with the development of other procedures at the WVDP, as discussed in Section B.10.3.

B.7.7.4 Characteristics, Concentrations, and Volumes of Solid Waste

Radiological wastes stored in the Lag Storage Facility are comprised of Class A, B, and C low-level waste and TRU and suspect TRU waste packages. A representative summary of waste and volumes generated at the WVDP are presented in Table B.7.7-1. This table is an example and is provided for information only. Estimates of the typical radiological inventory of Lag Storage waste containers are provided in Table B.7.7-2.

Approximately 275 m^3 (9,700 ft^3) of TRU/suspect TRU waste was generated at the WVDP during the period 1984-1993. This volume is being stored pending processing. It is expected that the volume of TRU waste requiring storage will be reduced by decontaminating much of this waste to below the TRU waste classification threshold. TRU waste remaining after final decontamination will be stored and eventually shipped to a federal repository once it becomes available.

Solid LLRWs which contain >0.5% liquid by volume may be stored on the hardstand provided they are double-contained. These wastes are stored pending development of draining, remediation, repackaging, or overpack operations. Upon completion of operations, the waste packages are then transferred to the appropriate storage structure.

B.7.7.5 Packaging

Solid and liquid LLRWs stored in the Lag Storage Facility are packaged at a minimum to meet the requirements of 49 CFR Parts 100 to 178. As LLRW is prepared for off-site shipment/disposal, the criteria of 10 CFR 61 is evaluated and some repackaging may be required. For purposes of criticality control, TRU waste boxes are limited to a maximum of 350 g (0.77 lb) of fissile material per box and TRU waste drums are limited to a maximum of 200 g (0.44 lb) of fissile material per drum. Administrative limits for TRU waste containers are set at 200 g (0.44 lb) fissile material per box and, 125 g (0.28 lb) fissile material per drum. Additionally, TRU waste boxes or drums cannot be stacked more than four high. The detailed analysis to support these limits is included in O-Ahoofe, 1986.

B.7.7.6 Storage and Disposal Facilities

The Lag Storage Facility, which provides interim storage of WVDP wastes prior to final off-site disposal, consists of the Lag Storage Building, Lag Storage Annexes 1, 3, and 4, the Interim Waste Storage Facility, four hardstands, the NDA and the pump storage vault as discussed in following sections. Types of wastes and available storage locations are summarized in Table B.7.7-3.

Lag Storage Building

The Lag Storage Building is a pre-engineered metal structure supported by a clear span frame and anchored to a 42.7 m long by 18.3 m wide (140 ft x 60 ft) concrete slab foundation. A concrete curb encloses the inner perimeter of the building. The thickness of the concrete slab is 15 cm (10 in) at its high point and slopes downward on all sides to a thickness of 20 cm (8 in). The slab surface was originally coated with an acid-resistant two-coat application of epoxy sealer. The building is designed to withstand a snow loading of 40 pounds per square foot and a design wind loading of 100 miles per hour.

Lag Storage Annex-1

This clear span structure is a pre-engineered frame and fabric enclosure which covers an area of 58 m by 17 m (191 ft x 55 ft) with a height of 7 m (23 ft). The usable area is 51.8 m by 11.3 m by 4.3 m tall (170 ft x 37 ft x 14 ft). The weather structure is constructed using a hot dipped galvanized steel frame which meets ASTM 123. The fabric is a vinyl-coated polyester which is flame resistant and self extinguishing. The structure will support a snow load of 30 pounds per square foot and withstand a design wind velocity of 100 mph. The floor surface of LSA-1 consists of leveled, compacted fine river gravel.

Lag Storage Annex-2

The original LSA-2 facility has been dismantled and the inventory removed to Lag Storage Annexes 3 and 4. If required, a new storage facility similar in design to the current storage structures may be constructed to support future activities.

Lag Storage Annex-3

Lag Storage Annex 3 (LSA-3) is a clear span structure with a pre-engineered frame and steel sheathing and covers an area of 26.8 m by 88.7 m (88 ft x 291 ft). The usable area is 24.4 m by 86.3 m by 6.7 m tall (80 ft x 283 ft x 22 ft). The structure will support a snow load of 40 pounds per square foot and withstand a design wind velocity of 80 mph.

A 6 in high concrete curb encloses the inner perimeter. The thickness of the slab is 7 inches. LSA-3 may be heated by indirect fired, natural gas furnaces as necessary to reduce the impact of the natural freeze-thaw cycle on waste, thus minimizing the deterioration of containers stored at these locations.

Lag Storage Annex-4

Lag Storage Annex 4 (LSA-4) is a clear span structure with a pre-engineered frame and steel sheathing and covers an area of 26.8 m by 88.7 m (88 ft x 291 ft). The usable area is 24.4 m by 86.3 m by 6.7 m tall (80 ft x 283 ft x 22 ft). The structure will support a snow load of 40 pounds per square foot and withstand a design wind velocity of 80 mph.

A six-inch high concrete curb encloses the inner perimeter. The thickness of the slab is 7 inches. LSA-4 may be heated by indirect fired, natural gas furnaces as necessary to reduce the impact of the natural freeze-thaw cycle on waste, thus minimizing the deterioration of containers stored at these locations. LSA-4 provides housing for the Container Sorting and Packaging Facility described in Section B.7.7.2.4.

Interim Waste Storage Facility

The Interim Waste Storage Facility (IWSF) is a pre-engineered metal structure supported by a clear span frame and anchored to a 10.7 m by 10.7 m (35.25 x 35.25 ft) concrete slab foundation. A concrete curb encloses the inner perimeter of the IWSF. The area inside the curb is 10.4 m by 10.4 m (34 x 34 ft) with the concrete slab having a thickness of 20 cm (8 in). The siding and roof is constructed of 26-gauge steel. The interior walls and ceiling are equipped with 10 cm (4 in) thick fiberglass insulation with reinforced vinyl facing. The IWSF is heated by two 15 kilowatt (51,000 BTU) electric heaters to minimize the impact of the natural freeze-thaw cycle. On the northeast corner of the IWSF is a metal 5 m x 3 m 26-gauge metal lean-to addition that houses the fire suppression equipment which consists of a high expansion foam system with one 3,304 L/s (7,000 cfm) foam generator. Foam is generated at a rate sufficient to produce a 1.4 m (5.6 ft) deep layer of fire-suppressing foam across the floor of the IWSF in one minute.

Hardstand Facilities

The WVDP maintains four hardstands. The first is an asphalt paved area located south of the Chemical Process Cell-Waste Storage Area (CPC-WSA) structure. The second is a compacted gravel pad located west of LSA-3. These pads are used to store containers which are too big to move into the lag storage structures due to length and weight. Additionally, polyethylene containers are stored on these hardstands. Some vessels and equipment where contamination remains sealed inside the piece or is fixed (nonremovable) onto the surface, may be stored unpackaged provided the requirements of WVDP-010 are met to minimize the potential for contamination of the storage area.

The third hardstand area at the WVDP is located in the North Fuel Receiving and Storage Facility yard. This area houses the high integrity containers used to store contaminated resins and filter media from the fuel storage pool water treatment system. Safety issues associated with the storage of these containers are described in WVNS-SAR-012.

Low-level radioactive wastes including wastes containing >0.5% free standing liquids are stored on these hardstands. As needed, tarps may be used to cover some packages providing protection from wind and precipitation.

The fourth hardstand area at the WVDP is located north of the Drum Cell. This hardstand houses contaminated soil contained in roll-offs. The majority of soil contained in these roll-offs is from the excavation of the NDA-LPS interceptor trench discussed in Section B.5.3.4. The roll-offs are fitted with hoops and covers to prevent precipitation collection. Seasonal snow accumulations are removed and regular inspections are required to prevent recurrence of water infiltration problems.

NRC-Licensed Disposal Area (NDA)

The NDA covers a rectangular area of approximately 20,000 m^2 (5 acres) and is located south of the former reprocessing plant. Reprocessing wastes generated by Nuclear Fuel Services (NFS) were disposed of within a U-shaped area along the eastern, northern and western boundaries of the NDA. There are a total of 239 disposal holes in this area. Two types of holes were used for waste burial: deep holes and special holes. Deep holes are generally 81 x 198 cm (32 x 78 in.) by 15 to 21 m (50 to 70 ft.) deep, while the shallower special holes having an average depth of approximately 6m (20 ft.) were excavated with a variety of surface dimensions.

Disposal of decontamination and decommissioning wastes generated by the WVDP occurred in the unused area within the U-shaped NFS burials. Wastes were placed in trenches, except for disposals in four steel-lined caissons 2 m (7 ft.) in diameter and 18 m (60 ft.) deep outside the NFS disposals. Each of the holes and trenches were backfilled and capped with soil excavated on-site.

Historically, the materials disposed in the NDA were categorized according to the radioactivity of the waste. (Radioactivity information was available in the facility operating logs.) Chemical data, not being required by the operating license, was never generated for the wastes. Consequently, the chemical characterization of the waste streams has been based upon historical knowledge and other records of site operations.

No known RCRA-regulated hazardous wastes were disposed in the NDA. Documentation does indicate, however, that RCRA hazardous constituents (6 NYCRR Part 371, Appendix 23) are associated with some of the materials discarded in the unit. Some of these materials, such as lead shielding, may be considered RCRA-regulated wastes if disposed today.

During reprocessing, NFS received approximately 341 rail and truck shipments of fuel from twelve different generators. The fuel was reprocessed in twenty-seven campaigns between 1966 and 1972. Each of the campaigns varied, depending on the types of fuel to be reprocessed and the quality control (QC) required. Generally, however, the chemicals used for the process remained consistent from campaign to campaign.

Liquid waste materials came from the acid fractionator condensate, floor drains in various cells and chemical makeup areas, the analytical laboratory, and from wash solutions from decontamination operations. Miscible liquid wastes generated during the fuel reprocessing campaigns were either treated in the LLWTF or routed to the HLW storage tanks. Immiscible liquids such as the tri-butyl phosphate (TBP)/n-dodecane used in the extraction process were absorbed in vermiculite and disposed in the NDA.

Wastes generated during this phase included fuel hulls, general waste such as radiologically contaminated clothing and equipment, fuel canisters, ruptured fuel encased in concrete, and spent ion-exchange resins and diatomaceous filter media. As a result of all disposal operations, an estimated 417,000 curies (1.54E16 Bq) is in the NDA. Approximately 397,000 curies (1.4E16 Bq) or 95% of the total curies buried in the NDA are attributed to the fuel hulls and hardware from NFS fuel reprocessing activities.

NFS cleanup of the site in preparation for upgrading the process building and post-1975 maintenance activities included decontamination of contaminated areas and equipment to allow access to the process building, disposal of unwanted equipment, cleanup of process materials, and environmental monitoring as required by the license. The types of trace contaminants that may be from this phase include laboratory chemicals and the chemicals used in the process that could have been left as a residue on the equipment.

During the WVDP operations, waste was generated from aggressive decontamination of the process building so it could be used to house the vitrification process and provide a safe work environment for employees. This phase of operations again generated a large amount of radioactive waste consisting of fuel processing equipment, scrap, and related materials that may exhibit trace levels of decontamination chemicals and chemical residues from past fuel processing operations. Minor volumes of Class A waste from these activities are disposed of in the NDA.

An estimated 10,392 cubic meters (367,000 ft^3) of radioactive waste is buried in the NDA. Approximately 4,587 cubic meters (162,000 ft^3) of the total quantity was disposed during NFS operations, and 5,805 cubic meters (205,000 ft^3) were disposed during WVDP operations. In order to characterize the NDA, a summary profile of the waste streams and the percentage by volume that they represent was prepared for inclusion in the RCRA Facility Investigation Report (WVDP-RFI-018). This profile is included as Table B.7.7-5. The quantity of each waste stream is an approximation that is based on the two NDA waste database systems and the operation logs.

The most predominant waste streams by volume in the NDA according to the profile are contaminated soils at 36%, general process building waste at 20%, and FRS and LLWTF wastes at 14% and 13%, respectively. The combination of these four waste streams makes up almost 83% of the total wastes disposed in the NDA. The remainder of the wastes consists of decontamination-generated debris, scrap material, and equipment; analytical laboratory wastes; TBP/n-dodecane absorbed onto vermiculite; fuel hulls; fuel canisters; ruptured fuel rods; and lead shielding. Depending upon their source, some of these wastes were isolated in particular areas of the NDA. For instance, the hulls are documented as being buried exclusively in the eastern quadrant of the disposal area in the deep holes.

Based on inventory alone, and in accordance with the methodology presented in DOE-STD-1027-92, Hazard Categorization and Accident Analysis Reports, the NDA is a Category 2 Nuclear Facility. It is postulated that a natural phenomenon-induced accident involving NDA radiological materials could lead to "significant on-site consequences"; therefore, the final hazard categorization for the NDA is Category 2.

Pump Storage Vault

The pump storage vault is located behind the Lag Storage facility. It is constructed of prefabricated, interlocking modular concrete slabs. The dimensions of the vault are approximately 19 m (63 ft) long, 2.5 m (8 ft) high, 4.5 m (15 ft) wide with wall thickness of 0.6 m (2 ft). The vault stores contaminated mobilization and/or transfer pumps which have been removed from the HLW tanks. In the future the vault may be used to store other contaminated equipment.

B.7.8 Hazardous and Mixed Wastes

Hazardous wastes generated at the WVDP include nonradioactive solid and liquid hazardous wastes and solid and liquid low-level radioactive mixed waste. Programs and facilities at the WVDP provide for the safe interim storage of these wastes prior to shipment for off-site treatment and disposal. Some mixed wastes are neutralized on-site and sent to the interceptors, or to Tank 8D-2.

B.7.8.1 Characteristics and Volumes of Hazardous and Mixed Wastes

B.7.8.1.1 Hazardous Wastes

Hazardous wastes generated on-site from defined waste streams are accumulated in Satellite Accumulation Areas before transfer to the HWSF for storage prior to off-site shipment. These wastes consist primarily of oils from maintenance and analytical laboratory wastes. A summary of the quantity of hazardous waste stored at the WVDP is given in Table B.7.7-1.

B.7.8.1.2 Low-Level Radioactive Mixed Wastes

Low-Level radioactive mixed wastes are radioactive wastes which include hazardous wastes described in 40 CFR 261 and 6 NYCRR 371. These wastes, which may be stored in the Lag Storage Building, LSA-3, LSA-4, CPC-WSA, and the IWSF, are comprised of low-level and TRU radioactive wastes of solid or liquid form that contain heavy metals, combustibles, flammables, PCB-contaminated oils, and PCB-contaminated equipment.

These wastes are packaged for storage according to applicable federal and state environmental regulations and the conditions of the Federal and State Facilities Compliance Act (FSFCA). A summary of the quantity of low-level radioactive mixed waste stored at the WVDP is given in Table B.7.7-1.

B.7.8.2 Storage Facilities

Storage for solid low-level radioactive mixed wastes at the WVDP is provided in the Lag Storage Building and associated annexes discussed above. Storage of liquid low-level radioactive mixed wastes is provided in the Interim Waste Storage Facility (IWSF), LSA-3 and LSA-4. Hazardous wastes generated throughout the site are temporarily stored at the Hazardous Waste Storage Facility prior to shipment off-site for treatment and disposal. Hazardous Waste Storage Facilities are further described below.

Hazardous Waste Storage Facility

Four identical free-standing structures (lockers) located north of the Lag Storage Building are utilized for temporary storage of hazardous wastes generated at the WVDP. The hazardous waste lockers are pre-engineered structures containing segregated 1,000 mL bottles through 85-gallon drums (included bagged waste) of hazardous and nonhazardous wastes. Each locker is 2.4 m x 4.6 m x 2.4 m high (7.9 ft x 15 ft x 7.9 ft) and contains a spill basin beneath a steel grate floor with a capacity of 474 liters (125 gal). The lockers have been designed to contain flammable materials and are equipped with fire suppression devices, remote and local fire alarm systems, explosion proof electrical components, and explosion proof vents.

Chemical Process Cell-Waste Storage Area

The Chemical Process Cell-Waste Storage Area (CPC-WSA) facility consists of a 60.96 m (200 ft) long by 21.34 m (70 ft) wide by 9.14 m (30 ft) high arched, 12-gauge, galvanized steel-panel enclosure. The floor of the CPC-WSA is a gravel pad.

The CPC-WSA primarily contains wastes which were generated during the decontamination of the chemical processing cell (CPC), located in the former reprocessing facility. The area currently contains thirty-five waste storage boxes and forty-five concrete shield module overpacks. The twenty-two waste storage boxes resulting from the CPC decontamination effort consists of twelve jumper boxes, nine vessel boxes, and one general waste storage box. Several of the jumper boxes stored within shielded modules are expected to contain the RCRA wastes, lead and mercury. One hundred fifty jumpers (pipes with special connectors) were loaded into seven inner boxes within the CPC and transferred to the equipment decontamination room (EDR) adjoining the CPC. In the EDR, each inner box was lowered into an outer box (designated as storage boxes J1 through J7, see Table B.7.7-4) with a prepared liner, then sealed and decontaminated before being moved to the CPC-WSA. General waste from the CPC also was loaded into boxes designated J8 through J12 (see Table B.7.7-4) Contact exposure rates were typically 2 R/hr, with one hot spot up to 78 R/hr.

The exterior surfaces of thirteen vessels that had been part of the fuel reprocessing chemical stream in the CPC were steam-cleaned and coated with a clear fixative coating. The vessel internals were inspected with a video camera and all were found to be clean except for: the recycle evaporator, 7C-4 (subsequently loaded into box designated 7C-4) and the low-level waste accountability tank, 7D-10 (subsequently loaded into box designated 7D-10). Both pieces of equipment had a layer of sludge about 0.3 m (1 ft) thick on the bottom. Ten of the vessels were transferred to the equipment decontamination room and loaded into nine boxes (fabricated of carbon steel) with resultant contact exposure rates ranging from 0.1 R/hr to 110 R/hr. The three condensers, 7E-5, 7E-8, and 3E-1, which were originally planned to go into the vessel box with this same designation were actually loaded into jumper box J5 instead.

Final cleanup resulted in six boxes of general waste being loaded into the carbon steel vessel box designated as 7E-/7E-8/3E-1.

Following transfer of the twenty-two waste boxes with CPC jumpers, vessels, and debris to the CPC-WSA, the waste boxes with the highest dose rates were covered with shielding to reduce general area exposure rates outside the shield modules to below

15mR/hr. The CPC-WSA was planned as a temporary storage area for the twenty-two waste boxes. It is north of the waste tank farm and remote from routine traffic, and is within the site's protected and controlled area.

The twenty-two waste storage boxes are surrounded by forty-five concrete hexagonal shield module overpacks arranged in an oblong circle. These measure 2.06 m (7 feet) across the flats and 3.2 m (10.5 ft) high. To supplement the shielding ability of these overpacks, vertical steel plates were added at select locations, as determined by radiation monitoring, to inhibit streaming. Each shield module contains twenty-one 55-gallon drums. These drums were filled with either contaminated debris, or clean soil, sand, and/or gravel to enhance the shielding capabilities of the overpacks. Of the total 945 drums in the shield modules, 813 drums contain low-level radioactive waste (LLRW), which have been classified as Class A, B, or C LLRW. Of the remaining 132 drums, 128 have been classified as non-radioactive, and 4 are presently unclassified, but assumed to be Class A at this time.

Nine large waste storage boxes are on the west end of the storage pad, and on the east end there are four large waste storage boxes. These boxes have external exposure rates ranging from 1 mR/hr to 30 mR/hr.

The entire storage array is covered with a steel weather structure that shields the storage boxes and shield modules from rain and snow. When a remotely controlled size-reduction facility is available, the CPC equipment in the waste boxes will be volume-reduced and packaged for disposal.

Preliminary estimates by Meigs (1987), updated to include activity estimates for waste box J12, indicated 263 Ci (9.7E12 Bq) of Sr-90, 274 Ci (1.0E13 Bq) of Cs-137, 6 Ci (2.22E11 Bq) of Am-241, and 234 Ci total Pu are present in the twenty-two waste boxes. These activity estimates are based on actual container dose rates as measured during the 1985-1987 period. Isotopic distribution is based on a site-specific, reference spent fuel isotope distribution. Table B.7.7-4 Provides estimates of Cs-137 activity for 1987 as well as estimates of Cs-137 activity decay corrected to the year 1996. Using the following isotopic breakdown for total plutonium, 6.4% Pu-238, 2.1% Pu-239, 1.3% Pu-240, and 90.2% Pu-241, the isotopic activity can be estimated as 15 Ci (5.5E11 Bq) of Pu-238, 5 Ci (1.85E11 Bq) of Pu-239, 3 Ci (1.11E11 Bq) of Pu-240, and 211 Ci (7.8E12 Bq) of Pu-241.

Based on inventory alone, and in accordance with the methodology presented in DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, the CPC-WSA is a Category 3 nuclear facility. It is postulated that a natural phenomena-induced accident involving CPC-WSA radiological materials could lead to "significant localized consequences"; therefore, the final hazard categorization for the CPC-WSA is Category 3.

As indicated previously, a large volume of Class A, Class B, and Class C low-level radioactive waste is in 208 L (55 gal) drums within the shield modules as well as in the thirteen steel boxes located at the east and west end of the oblong circle of shield modules. Only a small percentage of these have readings above 25 mR/hr, indicating that the total nuclide activity would not increase the overall facility hazard category (since the 22 waste storage boxes are estimated to contain well below Category 2 inventory thresholds).

Prior to final size-reduction and packaging, some of the containers may need to be moved, in which case the following problems could arise:

- Moving the shield modules may require the removal of the 55-gallon drums from the module. Some drums may have corroded during the storage period to date.
- Radiological hazards must be considered when moving the jumper and vessel storage boxes.
- The twelve size-reduction boxes and one special storage box (designated SP-022) outside the shield modules contain radioactive waste that has not been well characterized at this time.

Before any waste container is moved, a radiation work permit (RWP) and an industrial work permit (IWP) will be prepared to ensure that work will be conducted safely and in accordance with WVDP-010, *WVDP Radiological Manual*, and WVDP-087, *WVDP Hoisting and Rigging Manual*.

B.7.8.3 <u>Operating Procedures</u>

Operating procedures for the handling and storage of hazardous and low-level radioactive mixed waste at the WVDP have been developed per the guidance given in WV-996, *Hazardous Waste Management Program*, WVDP-080, *PCB and PCB Contaminated Materials Management Plan*, and WVDP-019, *Annual Waste Management Plan.* These waste management plans have been developed to ensure compliance with the local and federal codes and regulations outlined in Table B.7.1-1. Development of facility operating procedures is consistent with the development of other procedures at the WVDP, as discussed in Section B.10.3.

REFERENCES FOR CHAPTER B.7.0

Code of Federal Regulations. Title 10, Part 61: *Licensing Requirements for Land Disposal of Radioactive Waste.*

__________. Title 40, Part 261: *Identification and Listing of Hazardous Waste.*

New York Codes, Rules, and Regulations. Title 6, Part 371: *Identification and Listing of Hazardous Waste.*

O-Ahoofe, K.A. July 9, 1986. *Response to Independent Reviewers Comments on the Revised Criticality Safety Analysis for the Storage of TRU-Waste.* Memo to D. J. Harward. (FB:86:0158).

U. S. Department of Energy. October, 1988. Nuclear Standard NE F 2-45: *Specifications for HEPA Filters Used by DOE Contractors.* Washington, D.C.: U.S. Department of Energy.

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

__________. September 26, 1988. DOE Order 5820.2A: *Radioactive Waste Management.* Washington, D.C.: U.S. Department of Energy.

__________. September 1997. DOE Standard 1027-92, Change 1: *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports.* Washington, D.C.: U.S. Department of Energy.

West Valley Nuclear Services Co., Inc. June, 1998. *Annual Site Environmental Monitoring Report for 1997.* West Valley Nuclear Services Co., Inc.

__________. WV-996: *Hazardous Waste Management Program.* (Latest Revision.) West Valley Nuclear Services Co.

__________. WVDP-019: *Annual Waste Management Plan.* (Latest Revision.) West Valley Nuclear Services Co.

__________. WVDP-030: *TRU Waste Certification Program Plan.* (Latest Revision.) West Valley Nuclear Services Co.

__________. WVDP-080: *PCB and PCB Contaminated Materials Management Plan.* (Latest Revision.) West Valley Nuclear Services Co.

__________. WVDP-RFI-018: *RCRA Facility Investigation Report Volume 2 - Nuclear Regulatory Commission - Licensed Disposal Area* (Rev. 0). September 1995. West Valley Nuclear Services Co., Inc.

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

__________. Safety Analysis Report WVNS-SAR-012: *Safety Analysis Report for Fuel Receiving and Storage Facility.* (Latest Revision.) West Valley Nuclear Services Co.

TABLE B.7.1-1

WASTE MANAGEMENT PLANS, CODES AND REGULATIONS EMPLOYED AT THE WVDP

WASTE MANAGEMENT PLAN	LOCAL AND FEDERAL CODES AND REGULATIONS
ENVIRONMENTAL MANAGEMENT AND MINIMIZATION OF WASTES	
WV-980 - WVNS Environmental Management System WVDP-087 - Waste Minimization/ Pollution Prevention Awareness Plan	DOE Order 231.1 DOE Order 451.1 DOE Order 5400.1 DOE Order 5400.5 DOE Order 5484.1 DOE-EH-0173T 40 CFR, Various sections 6 NYCRR, Various sections
RADIOACTIVE AND MIXED WASTES	
WVDP-019 - Annual Waste Management Plan	DOE Order 5820.2A 10 CFR 61 40 CFR 264 40 CFR 265 6 NYCRR 373 Federal and State Facility Compliance Agreement Federal Facility Compliance Act
HAZARDOUS WASTE	
WV-996 - Hazardous Waste Management Program WVDP-080 - PCB and PCB Contaminated Materials Management Plan	40 CFR 261-268 40 CFR 270 6 NYCRR 370-374 6 NYCRR 376
INDUSTRIAL WASTE	
WVDP-072 - WVDP Asbestos Management Plan WVDP-164 - Used Oil Management Plan	

TABLE B.7.4-1

SUMMARY OF OFF-GAS FILTER MONITORING INSTRUMENTATION

Ventilation System	Filter Instrumentation						Plenum or Header PAH
	PDR	PDAH	PDCH	PDAL	PDCL	PR	
Vessel Off-Gas (Upstream)	X						
Vessel Off-Gas (Downstream)	X	X					
Waste Tank Farm	X	X					

PDR = Pressure Differential Recorder
PDAH = Pressure Differential Alarm High
PDCH = Pressure Differential Control High
PDAL = Pressure Differential Alarm Low
PDCL = Pressure Differential Control Low
PR = Pressure Recorder
PAH = Pressure Alarm High

TABLE B.7.4-2

VESSELS VENTILATED BY THE VESSEL OFF-GAS SYSTEM

Vessel	Description	Cell	Reference Drawing
3D-2	Condensate Catch Tank	LWC	3R-A-1
7D-2	LL Waste Evap Feed Tank	LWC	7R-A-1
7D-8	Tank 6D-3 Overflow Receiver	LWC	7R-A-1
7D-14	Hot Anal Cell Drain Catch Tank	LWC	7R-A-1
13D-7	Solvent Waste Catch Tank	LWC	15R-A-6
13D-8	Solvent Waste Hold Tank	LWC	15R-A-6
4D-8	Empty/OOS - still negative	LWC	15R-A-6
4D-10	Empty/OOS - still negative	LWC	15R-A-6
4D-13	Empty/OOS - still negative	LWC	15R-A-6
6D-3	Catch Tank	OGC	6R-A-1
7D-13	CSS Sump Receiver	Yard	901D-021S2
5D-12A	Empty/OOS - still negative	PPC	5R-A-1
5D-12B	Empty/OOS - still negative	PPC	5R-A-1
5D-13A	Empty/OOS - still negative	PPC	5R-A-1
5D-13B	Empty/OOS - still negative	PPC	5R-A-1
5D-13C	Empty/OOS - still negative	PPC	5R-A-1
5V-1	Empty/OOS - still negative	ULO	5R-A-1
7D-3	Empty/OOS - still negative*	ARC	7R-A-2
7D-6	Empty/OOS - still negative	ARPR	7R-A-2
7E-10	Empty/OOS - still negative	AR-OG roof	7R-A-2
7D-11	Empty/OOS - still negative	HAC	7R-A-2
7D-12	Empty/OOS - still negative	HAC	7R-A-2
7E-13	Empty/OOS - still negative	ARC	7R-A-2
	LWTS System Vessels		
71C-001	Organic Ion Exchanger	XC-3	901D-023S1
71C-002	Zeolite Ion Exchanger	XC-3	901D-023S1
71C-003	Zeolite Ion Exchanger	XC-3	901D-023S2
71C-004	Evaporator/Condenser	XC-3	901D-022
71D-005	Distillate Surge Tank	XC-3	901D-022
71D-006	Spent Resin Tank	XC-3	901D-026
71D-007	Spent Zeolite Tank	XC-3	901D-026
71D-008	Filter Backwash Filter Tank	XC-3	901D-026
71D-009	Feed Sample Tank	XC-3	901D-022
71D-011	Low TDS Feed Tank	XC-3	901D-023S2
71V-010	Filter	XC-3	901D-023S1
5D-15A1	Evap Concentrates	UPC	5R-A-1
5D-15A2	Evap Concentrates	UPC	5R-A-1
5D-15B	LWTS Evap Feed Tank	UPC	5R-A-1
14D-7	Acid Add Tank	LXA	901D-059
14D-18	Caustic Add Tank	LXA	901D-059

NOTE: Tanks in the ARC, HAC, XC-1 and XC-2 are out-of-service (OOS) and have been decontaminated (Riethmiller, 1981); however, the VOG still provides negative pressure on the vent lines to these tanks.

TABLE B.7.5-1

COMPARISON OF 1998 LLWTS EFFLUENT ISOTOPIC CONCENTRATIONS TO EIGHT YEAR AVERAGE ISOTOPIC CONCENTRATIONS

ISOTOPE	8 Year Average Lagoon 3 Conc.[1] (µCi/mL)	1998 Average Lagoon 3 Conc. (µCi/mL)	Ratio of 1997 Average to 8 Year Average
Alpha	7.04E-08	1.06E-08	0.15
Beta	1.04E-06	2.62E-07	0.25
H-3	5.14E-05	4.69E-06	0.09
C-14	1.42E-07	1.67E-08	0.12
Sr-90+[2]	1.12E-07	1.72E-07	1.54
I-129	1.21E-08	2.95E-09	0.24
Cs-137+[2]	5.12E-07	4.20E-08	0.08
U-233/234	4.16E-08	5.82E-09	0.14
U-235/236	8.80E-10	2.12E-10	0.24
U-238	1.16E-08	3.21E-09	0.28
Pu-238	2.48E-10	1.10E-10	0.44
Pu-239/240	9.99E-11	6.20E-11	0.62
Am-241	2.34E-10	4.35E-11	0.19

Notes:

1. Based on eight year average of Lagoon 3 concentrations (WVNS Annual Site Environmental Report, June 1998).
2. '+' indicates tabulated activity is the sum of the parent activity and the daughter activity.

TABLE B.7.7-1

TYPICAL INVENTORY OF WASTE STORED AT THE WVDP

Waste Class	Volume or Mass
Low-Level Waste	
Class A	4,507 m^3
Class B	513 m^3
Class C	104 m^3
TRU Waste	48 m^3
Suspect TRU Waste	227 m^3
Unclassified Waste	2,851 m^3
CPC Waste/High Radiation Items	427 m^3
Contaminated Soil [1]	749 m^3
Mixed Waste Lead	15,290 kg
Mixed Waste (other than lead and contents of HLW tanks)	3,169 kg
Hazardous Waste	2,178 kg

Notes:

[1] - Quantity of contaminated soil waste is that stored in Lag Storage Facilities. Additional storage for contaminated soil is provided in covered roll-off containers stored on hardstands. The total volume of contaminated soil waste stored at the WVDP is approximately 3,500 m^3 (124,000 ft^3).

TABLE B.7.7-2

TYPICAL RADIOLOGICAL INVENTORY OF LAG STORAGE WASTE CONTAINERS

Nuclide	Drum Contents [1] (Ci)	Box Contents [2] (Ci)
Sr-90	1.1E-1	1.1E+0
Cs-137	1.5E-1	1.5E+0
Pu-238	4.9E-3	4.9E-2
Pu-239	7.9E-4	7.9E-3
Pu-240	1.3E-3	1.3E-2
Pu-241	9.4E-2	9.4E-1
Am-241	7.0E-3	7.0E-2
Am-243	3.9E-5	3.6E-4
Cm-244	1.5E-3	1.5E-2

Notes:

[1] - Isotopic distribution calculated using ORIGEN2 with the following basis: PWR fuel, 3.3 w/o U-235, 33000 MWD/MTU burnup, 30 MW/MTU specific power. Scaled to 0.15 Ci Cs-137 activity.

[2] - Isotopic distribution calculated as described in [1], scaled to 1.5 Ci Cs-137 activity.

TABLE B.7.7-3

WASTE TYPE AND AVAILABLE STORAGE LOCATIONS IN WVDP LAG STORAGE FACILITIES

Waste Type	Lag	LSA-1	LSA-3	LSA-4	IWSF	HWSF	SAA	Hardstands	NDA	Pump Storage Vault	CPC-WSA
Low-level	X	X	X	X	X			X	X		X
Transuranic	X	X	X	X					X		
Suspect Transuranic	X	X	X	X							X
Mixed	X		X	X	X			X	X		X
Liquids	X		X	X	X			X	X		
Hazardous						X	X		X		
Poly overpacks, Poly wrapped equipment, Oversized containers								X	X		
Equipment contaminated with HLW residue									X	X	X

Table B.7.7-4
Contents, Activity, and Fissile Mass in the Twenty-two Waste Storage Boxes stored in the CPC-WSA[2]

Storage Box Designation	Contents	Contents of Box WT lbs/(kg)	Average Exposure Rate mR/hr	Activity: Cs-137 Ci (Ci)[6]	Fissile Mass (U-235 equivalent) Grams (Estimated)
Twelve Jumper Storage Boxes (double boxed)					
J1[3]	Jumpers and metallic debris		157	1.96 (1.59)	3.507
J2	Jumpers and metallic debris		1,378	17.23 (14.01)	30.831
J3	Jumpers and metallic debris		1,680	21.00[4] (17.08)	37.577
J4[2]	Jumpers and metallic debris		196	2.45 (1.9)	4.384
J5[2]	Jumpers, metallic debris, three condensers (7E-5, 7E-8, and 3E-1)		326	4.08 (3.32)	7.301
J6[2]	Jumpers and metallic debris		226	2.82 (2.29)	5.046
J7[2]	Jumpers and metallic debris		266	3.33 (2.71)	5.959
J8[2]	Metallic debris		329	4.11 (3.34)	7.354
J9[2]	Metallic debris		1,057	13.20 (10.73)	23.619
J10[2]	Metallic debris		1,550	19.36 (15.74)	34.641
J11	Metallic debris		2,034	25.39 (20.65)	45.431
J12	Debris		2,360	29.50 (23.99)	52.785
Nine Vessel Storage Boxes					
3C-1	Fuel dissolver	26,015	2,634	32.93[5] (26.78)	58.925
3C-2	Fuel dissolver	26,015	2,854	35.67[4] (29.01)	63.828
7C-2[2]	LLW Evaporator	14,110	120	1.50 (1.22)	2.684
3E-2/3E-3	Dissolver Condensers	14,991	42	0.53 (0.43)	0.948
7C-4[2]	LLW Evaporator	9.921 (4,500)	98	1.23 (1.00)	2.201
7D-10[2]	LLW Accountability and Neutralizer Tank	9,921 (4,500)	47	0.59 (0.48)	1.056
7C-1[2]	HLW Evaporator	5,512 (2,500)	1,239	15.49 (12.60)	27.718
3D-1	Fuel Accountability and Feed Adjustment Tank	10,582 (4,800)	250	3.13 (2.55)	5.601
7D-4	HLW Accountability and Neutralizer Tank	5,952 (2,700)	743	9.29 (7.55)	16.624
One General Waste Storage Box					
7E-5/7E-8/3E-1	Six 44" x 44" (1.12 m x 1.12 m x 1.12 m) boxes full of general waste	2,800 (1,273)	2,360	29.50 (23.99)	52.785
TOTALS				**274.29 (233.05)**	**490.81**

2 *Based on information in memo HB:86:0161, R. Keel and R. Meigs to P. Valenti, November 5, 1986*
3 *These containers contained no equipment that was used to process fissile materials. Cs-137 inventory is due to HLW, so a spent fuel distribution conservativley overestimates fissile content.*
4 *78 R/hr hot spot was assumed to be a short line source.*
5 *7 Ci of Co-60 is assumed as a contributor to the dose rate. It was not included since it is not from the fission product inventory.*
5 *Estimated activity 1987.*
6 *Activity decay corrected to 1996.*

Table B.7.7-5
NDA Waste Disposal Summary Profile

CATEGORY	NFS-162,000 ft³		WVNS-205,000 ft³	MAXIMUM POTENTIAL TOTAL *	APPROXIMATE % OF TOTAL DISPOSAL BY VOLUME	GENERAL LOCATION OF BURIAL
	1966-1975	1976-1981	1982-1986			
Hulls	7,403	0	0	7,403	2%	Southeast Quadrant
Culligans, FRS, Filters	18,002	35,718	1,220	54,940	14%	Throughout NDA, But more predominant in Southeast Quadrant
Solvent-contaminated Materials	4,302	711	367***	5,830	1%	North Boundary Section
LLWTF Sludge	1,384	39,299	12,852	53,535	13%	
HLW and General Process Building Waste	9,093	11,319	56,696	77,108	20%	
Fuel	39	0	0	39	<.01%	Holes 48 & 102-Northeast Quadrant
Contaminated Soils	40,830	1,172	103,305	145,307	36%	North Boundary Section
Scrap, Junk, Debris	4,080	11,588	11,597	27,265	6%	
Analytical	722	321	390	1,433	<1%	
Fuel Canisters	28	7,506	3,780	11,314	3%	Holes 88, 89, 90, and WVDP-11
Lead	4	7,601**	9	7,614	2%	SH-105 and WVDP-8
Miscellaneous	N/A	N/A	10,523	10,523	3%	

(WVDP-RFI-018, Rev. 0)

* Maximum potential disposal of targeted waste streams (will not equal the total amount disposed).
** This quantity is based on the total amount disposed of in SH-105 as the specific quantity for lead was not given. Thought to be very high
*** There was a discrepancy between two different tracking databases, therefore this quantity represents the worse case scenario.

FRS - Fuel receiving and storage
HLW - High-level waste

SR2B751A.DWG

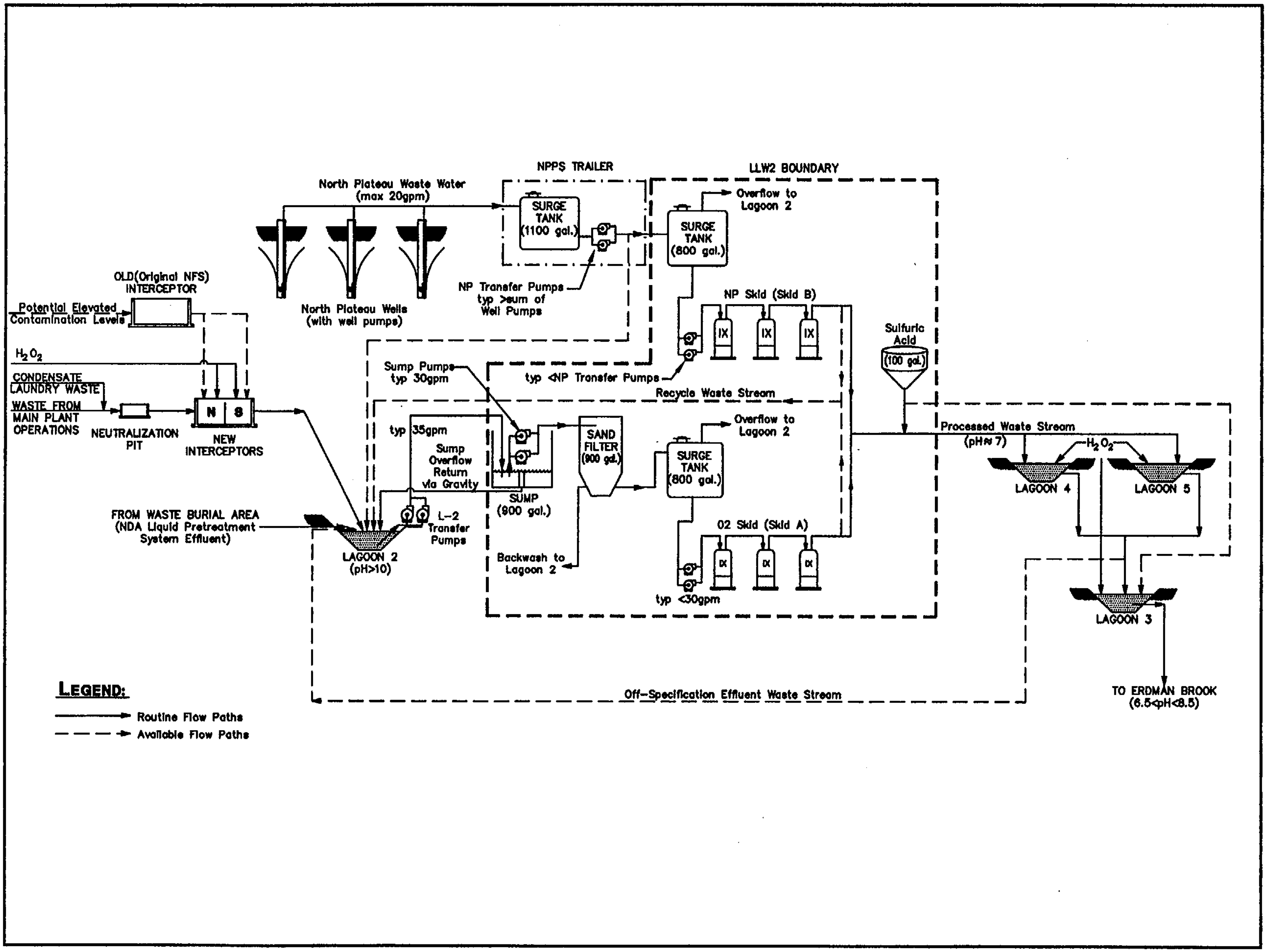


Figure B.7.5-1 Flow Diagram of Low-Level Waste Treatment System

SR2B75-2.DWG

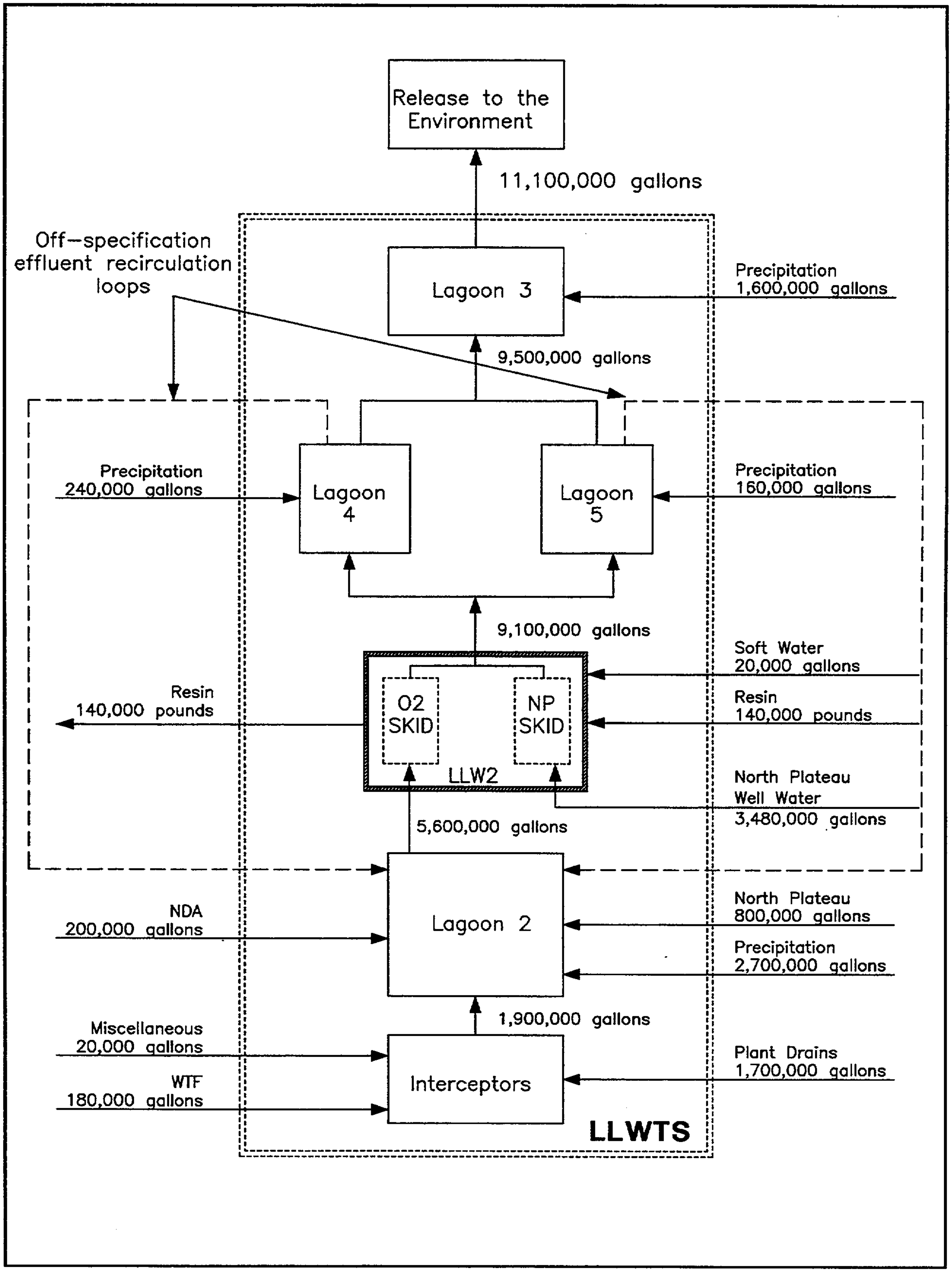


Figure B.7.5-2 Estimated Annual Water Balance for LLWTS for CY98

SR2B77-1.DWG

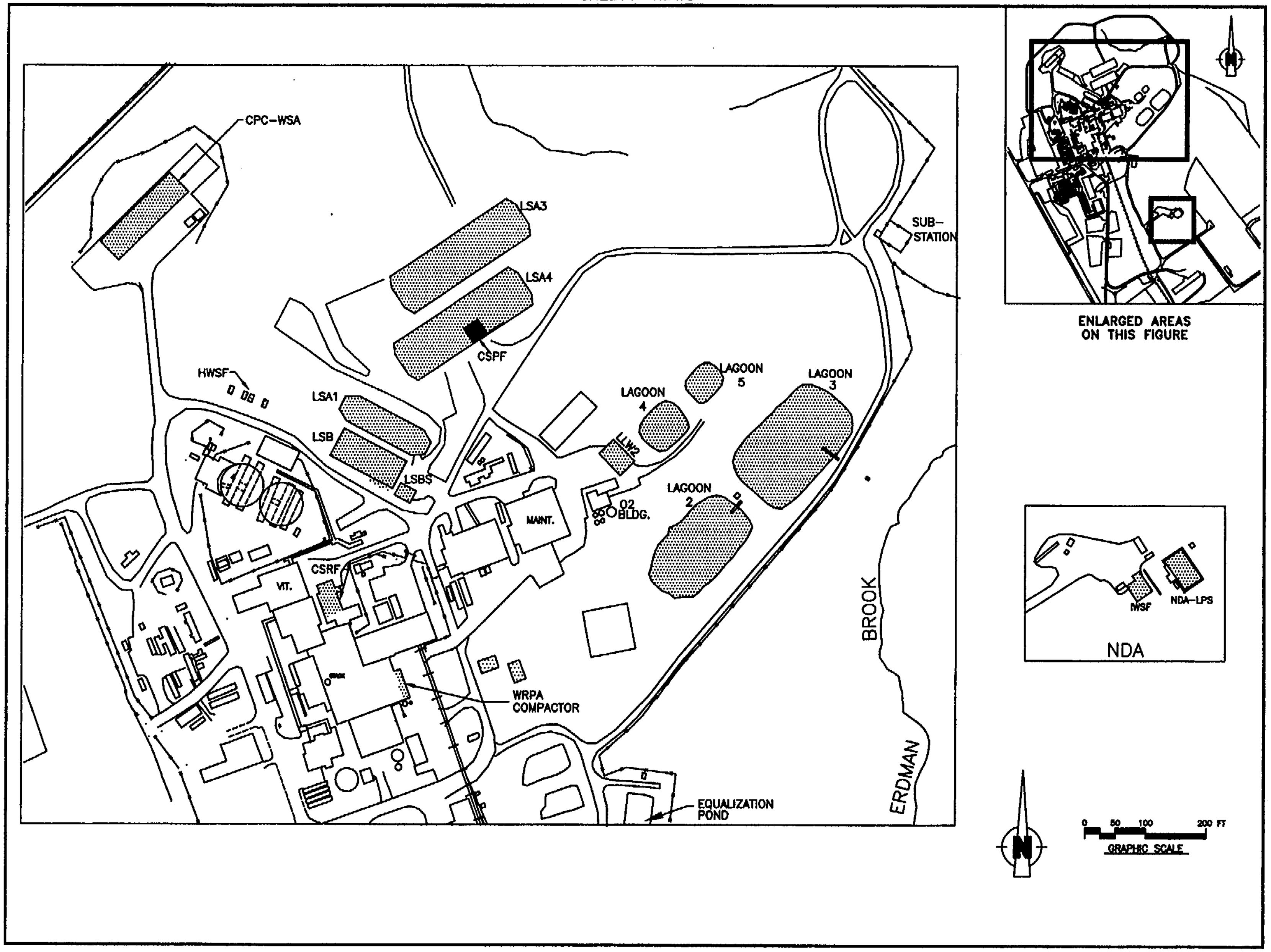


Figure B.7.7-1 Location of Waste Storage and Processing Facilities

B.8.0 HAZARDS PROTECTION

B.8.1 Assuring that Occupational Hazards Exposures Are ALARA

B.8.1.1 Policy Considerations

A formal documented program directed toward maintaining personnel radiation doses As Low As Reasonably Achievable (ALARA) has been established in WVNS Policy and Procedure WV-984, *ALARA Program*. The ALARA program is based on radiation protection requirements set forth in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, and Title 10, Code of Federal Regulations, Part 835. 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, *WVDP ALARA Program Manual*. Standard operating procedures, work instructions, and 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 the guidance of DOE adopted OSHA standards 29 CFR 1910 and 29 CFR 1926.

B.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. Design features that ensure the confinement of radioactivity include:

- Ventilation systems which maintain areas containing contamination under negative pressure relative to surrounding occupied areas.
- Remote valving and instrumentation for vessels and components containing radioactive sources.
- Ventilation filtration systems which ensure that effluent air streams are decontaminated before being discharged through a stack to the atmosphere.
- Cell sumps which collect any liquid spills released to the cell.

Additional mitigative design measures include:

- Use of redundancy in primary ventilation components.
- Ability to monitor and control liquid transfers remotely from the control panel within the control room.
- Airlocks which assist ventilation systems in maintaining contamination under negative pressure.
- Equipment design to enable remote replacement of failed components, if necessary.

Design features that ensure that exposures to nonradiological hazardous materials are maintained ALARA include:

- Specially-designed facilities in the New Warehouse which provide storage and isolation of bulk quantities of reactive chemicals.
- Laboratory fume hoods which prevent occupational exposure to analytical reagents.
- Paint spray booths to prevent maintenance personnel exposure to paint fumes.
- Berms, sumps and other spill containment mechanisms.

B.8.1.3 Operational Considerations

In addition to considerations incorporated in facility design, administrative controls are necessary to ensure that personnel hazards exposures are maintained ALARA. Administrative and procedural control is maintained in accordance with the WVNS Industrial Hygiene and Safety Manual (West Valley Nuclear Services Co., Inc., WVDP-011), the Radiological Controls Manual (WVDP-010) and specific standard operating procedures and work instructions. Site operations personnel are fully trained in elements of these programs, as discussed in Section B.10.3.

B.8.2 Sources of Hazards

B.8.2.1 Contained Sources

B.8.2.1.1 Contained Radioactive Material Sources

Radiation sources in the IRTS derive from radioactivity present in high level waste contained in Tank 8D-2 and from the radioactively contaminated zeolite in Tank 8D-1 which results from supernatant and sludge wash solution processing. High level waste in Tank 8D-2 originated during spent nuclear fuel reprocessing in the former Nuclear

Fuel Services reprocessing plant. Due to the extended post-reactor storage period, all gamma-emitting isotopes have decayed to levels insignificant with respect to Cs-137.

Radioactively-contaminated solutions in the STS are contained within process vessels located in Tank 8D-1 and in transfer piping between Tanks 8D-1 and 8D-2. Product solution from STS is stored in Tank 8D-3 prior to transfer to the LWTS.

Radiation sources in the LWTS include radioactive solutions in process vessels and piping located in the GCR extension, XC-3, UPC and LWC. Pumps and piping associated with the LWTS are located in niches in the LWA, UWA, and ULO. These facilities are all located in the Main Plant building in areas originally designed to accommodate process solutions with activity levels much greater than those currently processed in the LWTS. Shielding is therefore much greater than that necessary to attenuate exposure rates to acceptable levels.

Feed to the CSS from LWTS Tank 5D-15A1 or Tank 5D-15A2 is received by the Waste Dispensing Vessel in the WDC of the 01-14 Building. This waste is transferred to Mixer 70K-002 or 70K-004 in the CSS Process Room prior to transfer to a 269 L carbon steel drum. Full waste drums are staged in the loadout area prior to transfer to the IRTS Drum Cell for storage.

The Main Plant currently provides support to the IRTS and vitrification and also provides confinement for contamination remaining from former fuel reprocessing operations. Relative to vitrification, the High-Level Waste Interim Storage (HLW canister storage) is located in the former Chemical Process Cell (CPC) and is described in SAR-003, *Safety Analysis Report for Vitrification Operations and High-Level Waste Interim Storage,* Section C.6.5.3, *High-Level Waste Interim Storage.* Radiation sources in the plant include radioactive process solutions in vessels and piping associated with LWTS operations and radioactive particulate contamination associated with ventilation system filters. In addition, contamination in plant cells presents a significant source of radiation; however, no activities are routinely conducted in areas containing high levels of contamination. Sources of radiation associated with ventilation and off-gas operations are located in the Head End Ventilation building, Ventilation Exhaust Cell (VEC), Ventilation Wash Room (VWR) and Off-Gas Cell (OGC). These areas were designed to support operations with concentrations of radioactivity much greater than those associated with current operations. Shielding is therefore significantly greater than that necessary to attenuate current exposure rates to acceptable levels.

Design basis Cs-137 concentrations for IRTS facilities are given in Table B.8.2-1. Design basis gamma curies for Main Plant cells are given in Table B.8.2-2.

B.8.2.1.2 Contained Hazardous Material Sources

Several types of hazardous materials are present in varying quantities throughout the site. The analytical, vitrification and environmental laboratories maintain inventories of a great number of reagents; however, only very small quantities of these reagents are stored at the lab site and storage is provided in a manner that precludes reaction. Due to the physical nature of the IRTS process (i.e., ion exchange [filtration], evaporation [concentration], and solidification) few bulk chemicals are required to support low-level waste processing. Bulk chemicals that are required are primarily those utilized for pH control. These chemicals, which include caustic for SMWS operations, sulfuric acid for neutralization of LLWTS effluent, and nitric acid for utility room operations, are stored at the location of use.

Temporary storage of chemicals to be used throughout the site is provided in a specially-constructed area of the New Warehouse facility. Separate areas of this facility provide storage for various quantities of caustics, acids, and oxidizers, as indicated in Table B.9.1-1. Utilization of process chemicals in the Vitrification Facility is discussed in WVNS-SAR-003.

Maintenance activities require the use of solvents, oils and other lubricants. These materials are stored in secure storage lockers at the maintenance building. Storage for gasoline and diesel fuel is provided in above ground tanks located east of the New Warehouse. Fuel oil for steam boilers and backup equipment is located in storage tanks in the Utility Room, fire pump house, yard east of the Utility Room, STS generator room, and 01-14 Building.

In addition to these hazardous materials, hazardous wastes are stored in several facilities throughout the site. These facilities include the Lag Storage Facility, Interim Waste Storage Facility, Hazardous Waste Storage Lockers and Satellite Accumulation Areas which are described in Section B.7.7.

B.8.2.2 <u>Airborne Hazards Sources</u>

B.8.2.2.1 Airborne Radioactive Material Sources

<u>Supernatant Treatment System</u>

The STS support building is vented to ensure airflow is from regions of low airborne radioactivity to areas of potentially elevated activity. Under normal conditions, clean air within the STS control room and utility areas is exhausted into the valve aisle. Airborne radioactivity in occupied areas is low; however, continuous airborne radioactivity monitors located within the STS are provided to alert personnel to elevated levels of airborne contamination. The primary source of airborne activity in the STS is filtered, dilute, wash water vapor. Airborne radioactivity levels are maintained at less than 0.1 times the derived air concentration (DAC) for all radionuclides under normal and expected abnormal conditions within normally occupied areas of the STS and SMWS control rooms.

Liquid Waste Treatment System

The largest potential source of airborne radioactivity in the LWTS is process solution located in process vessels in XC-3. To minimize the release of airborne contamination into the cell, LWTS vessels are ventilated by the Vessel Off-Gas system. Secondary confinement of airborne radioactivity is provided by the Main Plant ventilation system which ventilates cells in which LWTS equipment is housed. Due to these multiple confinement systems, it is not expected that airborne contamination will be released from these areas; however, a fixed-position air sampler has been placed in the Cell Access Aisle to alert if an increase in airborne radioactivity occurs. A release of airborne radioactivity would not affect LWTS operations personnel as control of the LWTS is conducted from an adjacent, independently ventilated facility.

Cement Solidification System

The sources of airborne radioactivity in the CSS include the radioactive process solutions in the Waste Dispensing Vessel and the mixers. Ventilation in the CSS is provided for both the confinement vessels and the cells. Due to these confinement features and the low concentrations of activity handled by this system, negligible airborne radionuclide concentrations are expected in areas occupied by operating personnel.

Drum Cell

No significant sources of airborne radioactive contamination exist in the Drum Cell.

Main Plant

Sources of airborne radioactive material in the Main Plant have been greatly reduced due to cessation of reprocessing. A small increase in the amount of airborne radioactive particulate activity results from IRTS operations, deterioration of cell penetrations and access ports from former plant operations, operations within the analytical cells, and maintenance operations. Airborne contamination is removed by high efficiency filters in the various ventilation and off-gas systems. Airborne radioactivity levels in routinely accessed areas (e.g., operating aisles and laboratories) are maintained well below the most limiting Derived Air Concentrations values imposed by the Department of Energy (10 CFR 835).

Appropriate levels of respiratory protection are provided (e.g., air-purifying respirators, air-line respirators, and self-contained breathing apparatuses) whenever manned entries are made into airborne radioactivity areas. When dust generating equipment is used, local HEPA filtered airborne contamination control devices are used.

B.8.2.2.2 Airborne Hazardous Material Sources

Asbestos is present in the Waste Tank Farm, Cold Chemical Building, 01-14 Building, and some gasket material throughout the Vitrification Facility. Asbestos fibers may be released during removal or maintenance activities. Silicon dioxide is used as a glass former in the Cold Chemical Building and is released into the air during the makeup of glass formers. Lead can be released into the air during the handling of lead shielding or from the disturbance of lead-based paint. Anhydrous ammonia is stored outside the 01-14 Building and can be released to the atmosphere when the tank is venting, when bleeding off lines, and when filling the tank. Oxides of nitrogen are present in the melter off-gas and may be present in the off-gas trench and in some area of the 01-14 Building. Fumes may also be generated throughout the facility during painting and welding activities.

B.8.3 Hazard Protection Design Features

B.8.3.1 Radiation Protection Design Features

Radiation protection features basic to the design of the IRTS are dedicated to maintaining ALARA radiation exposures to members of the general public and work force. Effective control of radiation exposures depends primarily on design features that provide adequate shielding from all sources of radiation, provide for remote operations and maintenance, confinement of radioactivity within the process, proper ventilation, effluent control, and overall monitoring and surveillance to verify design controls. These physical design features, plus strict adherence to the operational requirements given in WVDP-010, *WVDP Radiological Controls Manual*, provide effective radiation control.

B.8.3.1.1 IRTS and Main Plant Design Features

All radioactive material handling and processing operations in IRTS components occurs within shielded confinement structures. Valves are designed for remote operation. Highly instrumented control rooms include visual display and visual/audible alarm systems, enabling IRTS operators to control processes from a remote location. Equipment and components in radioactive service have been designed for remote removal and replacement should failure occur. High maintenance equipment such as pumps are located in lower exposure rate areas. Ventilation systems provide assurance that materials contained within the cells are not released into operating aisles and areas. Airborne radioactive particulates are removed from the exhausted air and a lower air pressure is maintained in the more highly contaminated areas from adjoining areas. All IRTS and Main Plant areas are maintained with an air pressure differential which directs air into the more highly contaminated areas.

The high-level waste storage tanks provide multiple confinement barriers including: the tank, pan and vault, and the natural silty till surrounding the vault.

B.8.3.1.2 Shielding

Shielding for IRTS and Main Plant facilities has been designed and constructed to reduce radiation dose rates to acceptable levels under normal operating conditions. Areas in these facilities where shielding is not sufficient to reduce radiation levels below the level for uncontrolled access, as required by 10 CFR 835, are posted as Radiation Areas, High Radiation Areas, or Very High Radiation Areas. At the WVDP, areas where a worker can receive greater than 100 mrem (1E-3 Sv) in one year, under full-time occupancy, are posted as Radiological Buffer Areas since personnel dosimetry and monitoring is required by 10 CFR 835 at these levels.

When maintenance is required on contaminated equipment or when decontamination activities require personnel to work in elevated exposure rate areas, supplemental shielding may be used to shield workers from the radiation source and reduce exposure rate levels. Prior to initiation of work activities, the area is surveyed with an exposure rate meter to assure the effectiveness of the additional shielding with stay times established on the Radiation Work Permit (RWP).

Details of shielding design criteria for IRTS and Main Plant facilities are given below.

IRTS Shielding

Shielding for IRTS component facilities has been designed such that the radiation dose rate in full-time occupancy areas does not exceed 0.25 mrem/hour. This criterion applies to IRTS control rooms. Furthermore, shielding for full-time access areas in IRTS facilities such as operating aisles has been designed such that the dose rate does not exceed 2.5/t mrem/hr in which t is the maximum average time in hours per day that the area is expected to be occupied by one individual. Sufficient shielding has been provided such that the dose to maintenance personnel is less than 0.5 rem/yr for each planned maintenance task. Preoperational shielding calculations for each of the component systems confirmed the adequacy of shielding designs and routine operational area radiation measurements ensure that the design exposure rates are not exceeded. A summary of IRTS shielding evaluations is given in Tables B.8.3-1 and B.8.3-2.

Main Plant Shielding

The Main Plant building was designed to protect operating personnel from the intense radiation fields associated with handling spent nuclear fuel. Shielding for the plant was designed based on a fuel with the following irradiation history:

Burnup	30,000 MWD/MTU
Specific Power	35 MW/MTU
Cooling Time	150 Days

The gamma curies of design fuel are given in Table B.8.2-2. Due to shutdown of reprocessing activities in the plant and decontamination of plant areas, a great reduction in facility radiation levels has been achieved. Summary shielding descriptions for areas of the plant in which routine operations occur or in which high contamination levels exist are given in Tables B.8.3-3 through B.8.3-7 (National Federal Standards, 1970). Certain specific sources listed in these tables have been removed from the plant as a result of decontamination and dismantlement activities by WVNS. However, these sources have been included in the respective table as representing the basis for the original shielding calculations.

In areas of the plant where it was necessary to penetrate shielding walls with pipes, ducts, cables, etc, provisions in the original design features were made to assure the specified shielding requirements of the area. This was done by keeping the penetrations to a minimum in size and quantity, and by avoiding straight streaming paths by using multiple offsets, slopes, shadow shields, etc, as the individual situation required. Future shield penetrations will be evaluated to ensure continued radiological protection.

B.8.3.1.3 Ventilation

Facility ventilation systems are described in Section B.5.4.1. These systems have been designed to ensure contamination confinement during normal operations and to minimize the spread of contamination during abnormal operations. Several features have been included in the system designs to ensure that personnel safety is maintained. Continuous air samples are collected in routinely accessed areas such as stairwells and operating aisles and analyzed to ensure that internal exposures are maintained as low as practicable. Access to areas having elevated airborne contamination levels are restricted through administrative controls set forth in WVDP-010.

Normal airflow is from stairwells and operating aisles to cell service areas and airlocks to process cells. Manned entry to contaminated cells and areas is via airlocks. Airlocks ensure that sufficient negative pressure is maintained between contaminated and uncontaminated areas of the plant. Backup capability has been provided for facility ventilation systems in the event of a power outage. Redundancy is provided for both blowers and filter trains. Discussions of these systems have been provided in Section B.5.4.1.

Facility ventilation systems process air through a series of filters prior to discharge. The final filter in each system is a high efficiency particulate air (HEPA) filter, capable of removing 99.95 percent of aerosol particles greater than 0.3 microns diameter. To assure that facility ventilation systems are performing adequately, ventilation effluent is monitored in system stacks. Pressure differential instruments are calibrated annually, alarms and switchover capabilities are operationally tested quarterly, and HEPA filters are in-place leak tested annually.

The Waste Tank Farm ventilation system and the Vessel Off-Gas system provide ventilation for process vessels located in the Waste Tank Farm, Main Plant and LWTS. Configuration of these systems are discussed in Section B.7.4.

Additional protection from releases of activity into uncontaminated areas during cell or waste tank riser access is assured through the use of temporary confinement tents and portable or temporary ventilation equipment. These temporary confinement systems are erected and operated per approved work procedures which ensure that radiological and industrial safety controls specified in WVDP-010 and WVDP-011 are adequately implemented.

B.8.3.1.4 Radiation and Airborne Radioactivity Monitoring Instrumentation

Radiological monitoring instrumentation used at the WVDP are calibrated in accordance with ANSI N323A-1997. Most radiation detection equipment is calibrated on a six month cycle; however, some instruments are calibrated annually depending on the frequency and type of use or if calibration is performed off-site by a service vendor. Stack exhaust monitors and their calibration are discussed in Section B.8.6.

DOE Order 5480.4 requires that monitoring instrumentation comply with the requirements set forth in the applicable American National Standard. The WVDP has implemented these requirements in site service manuals and operating procedures. Audits, appraisals, and surveillance are conducted by external and internal groups at the WVDP to ensure compliance with DOE Orders and DOE-prescribed standards.

The continuous airborne radioactivity monitoring instrumentation used at the WVDP are the fixed filter type. Separate continuous air monitors (CAMs) are used for the detection of beta-gamma and alpha emitting radioisotopes. The type of CAM which is placed in the work area is determined by, but not limited to, the ratio between alpha and beta radioisotopes, the history of the work area, and the work to be performed.

Table B.8.3-8 provides a summary of information on the backup and/or standby power supply, range, sensitivity, accuracy, calibration frequency, alarm set points, recording devices, location of detectors, readouts and alarms for CAMs. CAMs provide local readout and alarm.

Requirements for air monitoring programs are specified in 10 CFR 835. Additional guidance is contained in DOE Guide 441-8, *Air Monitoring Guide*, and American National Standards and NUREG documents referenced therein. At the WVDP, air monitoring samples are taken in locations throughout the Main Plant building to detect and evaluate airborne radioactive material at work locations and routinely accessed operating aisles. Data obtained by air monitoring is used for assessing the control of airborne radioactive material in the workplace. The WVDP has incorporated the general guidance for placement of air monitors, provided in DOE Guide 441.1-8 and NUREG-1400, into the air monitoring program.

Continuous radiation monitoring capabilities are provided to warn of undesirable trends and/or abnormal conditions. An ARM and a CAM are located in the fresh zeolite dispensing area and in the manipulator operating aisle (minimum of two ARMs and two CAMs for each area). Radiation monitoring is connected to emergency backup power.

Area radiation monitors provide an audible alarm when a preset exposure rate is reached. These instruments operate in the range of 0.1 mR/h to 1.0 R/h. Continuous airborne monitors sample air through a fixed particulate filter at flow rates greater than 0.001 m^3/s and will alarm when a preset count rate is reached. The beta CAMs instruments use open window GM detectors, which are sensitive to both beta and gamma activity. The alpha CAMs are solid-state detectors. A summary of radiation monitors in the IRTS and Main Plant is provided in Table B.8.3-9.

There are approximately 11 alpha and 22 beta-gamma continuous air monitors (CAMs) employed at fixed locations in the Main Plant, as indicated in Table B.8.3-10. Additional units (usually between 5 and 10) of both monitoring types are frequently in service in support of work activities performed in the facility. CAM filters are routinely removed from the CAMs twice per week and counted for both gross alpha and gross beta-gamma activity and again after short-lived radionuclides have decayed to insignificant levels (i.e., approximately one week).

B.8.3.2 Hazardous Material Protection Design Features

Facility design features have been provided to protect against exposure to hazardous materials. The New Main Warehouse contains five engineered segregated storage areas for corrosives, acids, oxidizers, flammables, and health hazards (poisons). Each storage area is equipped with a 15 cm (6-in) deep basin below a steel grate floor to contain spills. Each area also has a separate ventilation system and an automatic fire suppression system and alarm. Access to these rooms is controlled by the Warehouse Manager.

The Hazardous Waste Storage Lockers are pre-engineered lockers containing segregated 208 L (55-gal) drums with a spill basin with a capacity sufficient to contain a spill equivalent to 10% of the volume of material stored in the locker. The lockers are designed to contain flammable materials and are equipped with fire suppression devices and alarms.

The Interim Waste Storage Facility is a heated, metal, Butler-type building used for the collection, sorting, handling, sampling, and interim storage of uncharacterized wastes and suspect radiological mixed wastes. Waste oils and process chemicals are held until classified. The IWSF is equipped with a class A fire suppression system and a sump for spill handling.

Exposure to hazardous chemical fumes produced during analytical or painting activities is minimized by conducting analytical procedures in ventilated laboratory hoods and painting activities in ventilated paint booths.

B.8.4 Estimated Collective On-site Dose Assessment

Activities associated with the Main Plant and Waste Processing Facilities include operation of the STS/SMWS/HLWTS, LWTS, CSS, and support activities including analytical and process chemistry, radiological control monitoring, routine maintenance activities and facility surveillance by security and safety personnel. Additional activities include operation of the Fuel Receiving and Storage (FRS) facility systems. Operations conducted in the FRS are discussed in WVNS-SAR-012.

Whole body exposure estimates for personnel providing support for plant activities or performing operations in the Main Plant and Waste Processing Facilities are calculated as part of the WVDP ALARA program. Annual occupational exposures from the WVDP ALARA program for these work groups are given in Table B.8.4-1. Calculations for the ALARA budget provide total exposure estimates for each work group, which are then compared to the actual exposures received. In 1998, the estimated ALARA budget was 106% of the actual dose received from 1998. Due to the nature of the work associated with plant operations (i.e., facilities support), it is not practical to distinguish between dose incurred as a result of Main Plant operations and dose incurred as a result of IRTS support operations conducted in the Main Plant. Therefore, the combined Main Plant/IRTS support dose for each work group is provided in Table B.8.4-1. As can be seen from this table, doses for all work groups are well within the limits set forth in 10 CFR 835 with an average annual worker exposure of 16 mrem (1.6E-4 Sv).

A program of air particulate monitoring is in place for the Main Plant and Waste Processing Facilities to ensure airborne radioactivity levels in routinely occupied areas are well within acceptable limits. This is accomplished by drawing plant air at a constant rate through glass fiber filters placed in holders. These filter assemblies are placed at breathing levels in various locations inside of the Main Plant and Waste Processing Facilities. Radiological analyses of these filters indicate typical airborne radioactivity concentrations of 1E-15 µCi/mL (3.7E-11 Bq/mL) gross alpha and 1E-15 to 1E-14 µCi/mL (3.7E-11 to 3.7E-10 Bq/mL) gross beta with occasional gross beta concentrations of 1E-13 µCi/mL measured in certain areas.

Dose estimates for workers in IRTS and Main Plant facilities due to inhalation of air can be made by using conservative values for gross alpha and gross beta concentrations and assuming the most restrictive nuclides as present on the site. Assuming:

- All gross alpha activity is Am-241
- All gross beta activity is Sr/Y-90
- 2.40E+09 mL of air is inhaled per year per worker (9,600 L/day x 250 days/year)
- A gross alpha concentration of 1 E-15 µCi/mL (3.7E-11 Bq/mL)
- A gross beta concentration of 1 E-13 µCi/mL (3.7E-9 Bq/mL)

The annual estimated inhalation dose per worker is 1.6 mrem (1.6E-5 Sv). Combining this with the annual whole body exposure of 16 mrem (1.6E-4 Sv) gives an estimated annual average occupational dose of 18 mrem (1.8E-4 Sv).

B.8.5 WVDP Hazards Protection Programs

B.8.5.1 WVDP Health Physics Program

A formally documented health physics program for the WVDP has been established in WVNS Policy and Procedure WV-905, *Radiological Protection*. The health physics program is based on requirements set forth in DOE Order 5400.5 and 10 CFR 835. At the WVDP, the health physics Program's site-specific requirements are promulgated in WVDP-010.

IRTS and Main Plant facilities are operated in compliance with the requirements given in WVDP-010. The health physics program for the Project is discussed and summarized in Section A.8.5 of WVNS-SAR-001.

B.8.5.2 WVDP Industrial Hygiene and Safety Program

The WVDP Industrial Hygiene and Safety Program is presented in Section A.8.7 of WVNS-SAR-001.

B.8.6 Estimated Collective Off-site Dose Assessment

B.8.6.1 Effluent and Environmental Monitoring Program

A comprehensive environmental monitoring program is in place at the WVDP to monitor site activities and their possible impact to the environment. Details concerning this program can be found in Section A.8.6.1 of WVNS-SAR-001.

B.8.6.1.1 Gas Effluent Monitoring

Currently there are five fixed ventilation stacks that are permitted through the Environmental Protection Agency at the WVDP. The Main Plant ventilation stack monitor and sampler equipment is housed in an insulated building located south of the Main Plant stack base on the Ventilation Exhaust Cell roof. Ventilation air exhausted from the STS is released from the STS PVS stack located at the WTF. Monitoring equipment for the PVS is located in a dedicated structure that is adjacent to the PVS building. The CSS ventilation stack is located on top of the 01/14 Building with sampling and monitoring equipment located inside of the 01/14 Building. The CSRF ventilation stack is located on top of the Main Plant about 25 m (82 ft) north of the Main Plant stack. The vitrification facility heating, ventilation and air conditioning system (Vit HVAC) directs the flow of air through the vitrification facility. The Vit stack is located on the west side of the Vitrification Building. Portable ventilation units (PVUs), also known as outdoor ventilation enclosures (OVEs), are also permitted through the Environmental Protection Agency. These units are operated at various locations around the WVDP and provide ventilation to support temporary activities in areas which are not routinely ventilated and where the potential for airborne contamination exists.

Isokinetic air samples from these stacks are continuously drawn and transported to the sampling and monitoring instruments. The sample streams pass through glass fiber particulate filters and charcoal cartridges before returning back to the stack for discharge to the environment. The filters are changed and screened weekly for gross radioactivity. Quarterly composites from both the glass fiber and charcoal filters are analyzed for gamma isotopes, Sr-90, I-129 and actinide isotopes. Currently there are no requirements for monitoring for nonradiological parameters.

Continuous air particulate monitors provide alarm indications should radioactive particulate levels in the exhaust air exceed preset levels. Flow and count-rate sensors will activate a backup vacuum pump and various alarms if equipment failures occur. The systems are provided with auxiliary backup power. Monitoring capabilities are given in Table B.8.3-9.

B.8.6.1.2 Liquid Effluent Monitoring

Liquids that are generated by plant activities are processed through the Low Level Waste Treatment System (LLWTS) before discharge to the environment. Waste liquids are processed in batches to allow greater control and the ability to re-process any liquid that is found to be out of specification. Lagoons 4 and 5 receive effluent from the LLWTS. When the on-line lagoon becomes full, the alternate lagoon is placed on-line and the full lagoon is placed off-line and is sampled for radiological analysis. Upon determination of acceptable radiological levels, the lagoon is drained by gravity to a larger holding basin (Lagoon 3). This procedure continues until Lagoon 3 becomes full. Batch transfers from Lagoons 4 and 5 are then curtailed and Lagoon 3 is sampled for radiological analysis. Upon determination of acceptable radiological levels, the lagoon is discharged to Erdman Brook in a controlled manner with a constant flow. The duration of each discharge event is approximately one week. A lagoon batch is discharged to the environment at intervals of approximately two to three months. Composite and grab samples are collected during each discharge event and analyzed for radiological and non-radiological constituents.

B.8.6.2 Analysis of Multiple Contribution

Contributions to off-site dose due to other nearby nuclear facilities is given in Section A.8.6.2 of WVNS-SAR-001.

B.8.6.3 Estimated Exposures from Airborne Releases

Airborne emissions result from the ventilation of waste processing vessels, waste storage tanks, contaminated cells in the Main Plant and areas within the Waste Processing Facilities. Ventilation air is filtered prior to discharge to the stacks. The Main Plant stack serves as the discharge point for the main ventilation system, the Head End Ventilation system, the Waste Tank Farm Ventilation System, the Vessel Off-Gas System, and the Fuel Receiving and Storage facility ventilation exhaust. Other smaller stacks (STS, CSS, CSRF, and CSPF) are in close proximity to the Main Plant stack and were used to calculate the exposure from airborne releases.

Dose assessments for discharges from the stacks identified above in addition to the contribution from Portable Ventilation Units (PVUs) were performed. The total airborne activity released per year from the Main Plant, STS, CSS, and CSRF stacks is listed in Table B.8.6-1.

The total effective dose equivalent (TEDE) to the maximally exposed off-site individual (MEOSI) in 1998 was calculated to be 3.4E-02 mrem/yr (3.4E-7 Sv/yr) for airborne discharges from all stacks. The MEOSI is located at approximately 1800 m (5900 ft) northwest of the Main Plant stack.

B.8.6.4 Estimated Exposures from Liquid Releases

An estimate of the dose to the maximally exposed off-site individual has been calculated using analytical data obtained from lagoon discharge sampling. Table B.8.6-2 lists the dose contributions from isotopes contributing greater than 0.1% to the total dose. The dose to the maximally exposed off-site individual for Main Plant liquid discharges in 1998 was 7.4E-06 rem (7.4-08 Sv).

The WVDP also operates a Waste Water Treatment Facility that processes nonradiological liquid effluents generated primarily from site lavatory facilities. Sewage is processed and collected in a lined holding basin for subsequent discharge to the environment. This effluent is sampled and analyzed for gross alpha and beta activity. This discharge is not considered a radioactive effluent and radiological analyses are used for confirmatory purposes only.

B.8.7 Prevention of Inadvertent Criticality

B.8.7.1 Introduction

Operations involving the handling, processing or storage of fissile materials are evaluated for criticality safety. Criticality safety at the WVDP is achieved primarily through the application of strict administrative controls. Evaluations have shown that there currently is no credible potential for an inadvertent criticality associated with IRTS operations. The potential for a criticality in the General Purpose Cell of the Main Plant does exist.

B.8.7.2 Requirements

Criticality safety at the WVDP is maintained through adherence to the requirements set forth in WVDP-162, *WVDP Nuclear Criticality Safety Program Manual*. This manual implements the requirements of DOE O 420.1, Attachment 2, Contractor Requirements Document, *Facility Safety,* and incorporates the elements of the following mandatory American National Standards of the American Nuclear Society (ANSI/ANS) pertaining to nuclear criticality safety:

- ANSI/ANS-8.1-1983, *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors,* (with paragraphs 4.2.2 and 4.2.3, and paragraph 3.3 modified as directed in Section 4.3.2.d of DOE O 420.1, Attachment 2);

- ANSI/ANS-8.3-1986, *Criticality Accident Alarm System,* (with paragraphs 4.1.2, 4.2.1 and 4.2.2 modified as directed in Section 4.3.2.c of DOE O 420.1, Attachment 2);

- ANSI/ANS-8.5-1986, *Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material;*
- ANSI/ANS-8.6-1983,R88, *Safety in Conducting Subcritical Neutron-Multiplication Measurements in Situ,* (with paragraph 5.3 modified as directed in DOE O 420.1, Attaachment 2);
- ANSI/ANS-8.7-1975,R87, *Guide for Nuclear Criticality Safety in the Storage of Fissile Materials,* (with paragraph 5.2 modified as directed in Section 4.3.3.c of DOE O 420.1, Attachment 2);
- ANSI/ANS-8.9-1987, *Nuclear Criticality Safety Criteria for Steel-Pipe Intersections Containing Aqueous Solutions of Fissile Materials;*
- ANSI/ANS-8.10-1983,R88, *Criteria for Nuclear Criticality Safety Controls in Operations with Shielding and Confinement;*
- ANSI/ANS-8.12-1987,R93, *Nuclear Criticality Control and Safety of Plutonium-Uranium Fuel Mixtures Outside Reactors;*
- ANSI/ANS-8.15-1981,R87, *Nuclear Criticality Control of Special Actinide Elements;*
- ANSI/ANS-8.17-1984,R89, *Criticality Safety Criteria for the Handling, Storage, and Transportation of LWR Fuel Outside Reactors,* (with paragraph 4.3 modified as directed in Section 4.3.2.g of DOE O 420.1, Attachment 2);
- ANSI/ANS-8.19-1984,R89, *Administrative Practices for Nuclear Criticality Safety;*
- ANSI/ANS-8.21-1995, *Use of Fixed Neutron Absorbers in Nuclear Facilities Outside Reactors.*

Notification, investigation, and reporting requirements are in accordance with DOE Orders 232.1A, *Occurrence Reporting and Processing of Operations Information*, and 231.1, *Environment, Safety and Health Reporting.*

B.8.7.3 <u>Criticality Concerns</u>

Processing activities in the IRTS require the handling and treatment of solutions containing fissionable materials. These processes have the potential to concentrate fissionable materials in the feed solution and consequently present a criticality concern. Specific IRTS processes that have the potential to concentrate fissionable materials include ion exchange in the STS and evaporation in the LWTS evaporator.

Solidified waste cement drums that were produced as a result of original IRTS operations and that are currently stored in the IRTS Drum Cell contain less than 100 nCi of transuranic nuclides per gram of cement. Even if it is assumed that Pu-239 is the only transuranic nuclide, these cement drums are subcritical by a wide margin.

In addition to IRTS facilities and processes, areas of the Main Plant and Lag Storage Facility may contain significant quantities of fissionable material that could present a criticality concern. (Although characterization sufficient to confirm the presence of significant quantities of fissionable materials in these areas has not been performed, it has been assumed that significant quantities do exist based on the best available information.) Areas of the Main Plant that currently contain significant quantities of fissionable material contamination remaining from NFS reprocessing activities principally include the head end cells (i.e., the PMC and GPC) although other areas of the plant, including XC-1 and XC-2, may contain lesser accumulations.

The Lag Storage Facility serves as a temporary storage location for low level and transuranic wastes produced on-site. By definition transuranic (and suspect transuranic) wastes have the potential for containing fissionable materials. Consequently, storage activities in the Lag Storage facility have to be evaluated for criticality concerns.

A more detailed discussion of the criticality concerns for the IRTS, Main Plant, and Lag Storage Facilities is given in the following subsections.

B.8.7.3.1 STS/SMWS Criticality Concerns

Fissionable material in IRTS component systems derives from high-level waste in Tank 8D-2. Table B.8.7-1 presents the total fissionable material inventory of the sludge in Tank 8D-2, the soluble mass present in the first wash solution, and the maximum ion exchange column inventory at cesium breakthrough for the first wash.

Prior to SMWS startup, a comprehensive evaluation of the criticality safety of major vessels and components in the STS was performed. For each major vessel and component the safe concentration or total mass of plutonium was determined assuming the vessel or component to be filled to capacity. The evaluations conservatively assumed the sludge wash solution to be Pu-239 in water with no credit taken for neutron absorption by other nonfissile isotopes or neutron poison materials. Based upon the results of these criticality safety evaluations (Caldwell, 1990; Yuan, 1991), the allowable safe fissile material concentration for the SMWS process was established considering the vessel or component having the minimum critical concentration (i.e., the most restrictive vessel). It was determined that approximately 1.0 kg of Pu-239 loaded onto Ti-treated zeolite within an ion exchange column in a sphere of radius 22.5 cm would result in a $k_{eff} + 2\sigma$ of 0.95 and thus identified the ion exchange columns as the most restrictive vessels. Assessment of the criticality safety evaluations has shown that criticality during STS operations is not credible under normal and abnormal operating conditions (Prowse, 1992).

A summary of the evaluations for individual vessels and components in the STS/SMWS is given below.

Sludge Mobilization in Tank 8D-2

Suspension of the sludge in Tank 8D-2 by the sludge mobilization pumps was specifically analyzed (Caldwell, 1990). The analysis indicates that under conditions of homogenous mixing, as is observed during SMWS operations, an inventory of plutonium and uranium ten times that found in Tank 8D-2 is critically safe. Therefore, Tank 8D-2 can be considered critically safe under normal and expected abnormal conditions based on fissile material concentration.

Zeolite Mobilization in Tank 8D-1

A large margin of criticality safety is maintained in Tank 8D-1 by using the zeolite mobilization pumps to distribute the spent ion exchange zeolite across the geometrically favorable tank bottom. Tests on zeolite distribution within Tank 8D-1 have been performed using a one-sixth scale model (Schiffhauer, 1987) and the results indicate that the zeolite pile is effectively distributed by operating the mobilization pumps. These pumps are operated during and/or following each discharge of zeolite from STS ion exchange columns. This provides adequate mixing and distribution of zeolite.

STS Prefilters

The prefilter is intrinsically safe. Each prefilter is 305 cm (120-in) long with an outside diameter of 10 cm (4 in). This large surface to volume ratio results in neutron leakage sufficient to prevent the $k_{eff} + 2\sigma$ from exceeding 0.95. The rigid 56 cm (22 in) spacing between prefilters ensures that the prefilters are neutronically decoupled from each other.

STS Ion Exchange Columns

The STS ion exchange columns, shown in Figure B.8.7-1, have been determined to be the most restrictive components of the STS due to geometry and process function considerations. The calculation of k_{eff} for several configurations of plutonium loaded zeolite inside the STS ion exchange column was made using the KENO-V Monte Carlo code. Material parameters and cross section sets used for these calculations are given in Table B.8.7-2. The results of parametric evaluations of k_{eff} versus geometry and composition is provided in Table B.8.7-3. These evaluations were made using the KENO-V code and various cross section data sets compiled at the Argonne National Laboratory's IBM mainframe computer systems (Yuan, 1991) and independently verified using TWODANT compiled at the Los Alamos National Laboratory's Cray mainframe computer system (Prowse, 1991). All differences between the calculational model and the actual configuration result in a conservative overestimate of k_{eff}.

Values of k_{eff} were calculated for various size spheres centered in the ion exchange column and having a total mass of 1.0 kg Pu-239 homogeneously distributed within the sphere. (This configuration represents the optimum geometry for a fixed mass confined within a cylinder.) Tabulation of the results of these calculations are given in Table B.8.7-4 while a plot of k_{eff} versus the sphere radius is shown in Figure B.8.7-2. Based on these calculations it was determined that the greatest k_{eff} occurs for a sphere having a radius of approximately 22.5 cm.

To evaluate the limiting Pu-239 mass inside the zeolite column, additional calculations were performed with the same geometric configuration but varying the mass of Pu-239 in the sphere. Results of these calculations are tabulated in Table B.8.7-5. A least squares fit of this data has been plotted in Figure B.8.7-3. It is concluded from this figure that a limit of 1.0 kg of Pu-239 inside the zeolite column will ensure that a $k_{eff} + 2\sigma$ of 0.95 is not exceeded.

The heel remaining from ion exchange column sparging will remain critically safe during normal and accident conditions. The current heel does not contain Ti-treated zeolite and the mass of Pu which could accumulate in the heel is very small. Comparison of the reactivity of 1.0 kg of Pu-239 within various cylindrical and spherical geometries constrained to the geometry of the ion exchange vessel heel reveals that a cylinder represents the most reactive configuration. As can be seen from Table B.8.7-3, a cylinder 20 cm (8 in) high having a 23 cm (9 in) radius centered in an ion exchange column uniformly loaded with 1.0 kg of Pu-239 is subcritical (Yuan, 1991). As has been shown in Table B.8.7-4 and Figure B.8.7-3, this mass of Pu-239 will remain subcritical even when placed in an optimum geometry (22.5 cm radius sphere).

B.8.7.3.2 LWTS Criticality Concerns

Decontaminated sludge wash solutions are concentrated in the LWTS. Previous experience in the LWTS revealed the accumulation of U and Pu in scale deposits in the evaporator following extended periods of evaporator operation. These deposits are removed through the acid wash procedure described in Section B.6.4.1.3. Calculations by Yuan (1991a) and Caldwell (1991) considered 460 g total of Pu-239 plus Pu-241, 1.88 kg of U-235 and 105.9 kg of U-238 dissolved in water in the bottom of the evaporator (reduced right circular cylinder of radius 60 cm (24 in) and associated height to optimize density and neutron leakage). The results confirmed that the $k_{eff} + 2\sigma$ for the fissile material configuration could not exceed 0.95. Parks and Dyer

(1991) provided an independent validation of the analytical approach. Material mass balance procedures ensure that quantities of fissile plutonium and uranium that accumulate in the evaporator do not exceed bounding masses established by criticality analyses.

B.8.7.3.3 Main Plant Criticality Concerns

The head end cells of the Main Plant (i.e., the PMC and GPC) are currently believed to contain significant quantities of fissile material contamination remaining from NFS reprocessing activities. Elevated radiation levels in the cells and video inspections are the bases for this belief. Although significant accumulations are primarily restricted to the head end cells, other areas of the plant may contain lesser accumulations (e.g. XC-1). This material is critically safe in its current configuration; however, reconfiguration of the material into a different geometry may result in a more reactive condition. Future activities which could modify the configuration of the contaminated debris will be evaluated and reviewed to ensure that the result of any material handling only serves to reduce the reactivity of the material.

Although stabilization and decontamination activities that could increase the reactivity of the accumulated material will not be permitted, cells that contain the greatest fissionable material accumulations as contamination have been provided with sufficient shielding such that the whole body exposure to workers in adjacent operating aisles due to a criticality in the cell would not exceed the whole body exposure limit given in Section B.9.1.3.

The General Purpose Cell currently contains a significant accumulation of contaminated hardware and other material, including fuel hulls, which remain from NFS reprocessing activities. Insufficient cell characterization data has resulted in varying estimates of the fissile material content of this cell (Wolniewicz, 1993 and WHC, 1993). Estimates of the quantity of fissile material in the PMC and GPC based on calculations given in Wolniewicz, 1993 are provided in Table B.8.7-6. The WHC estimate was performed as part of a larger study to evaluate the potential for criticality in the cell.

Through the use of highly conservative assumptions, an analysis by Westinghouse Hanford Corporation (WHC) (WHC, 1993) determined that under appropriate conditions of fuel inventory, enrichment, configuration and moderation a criticality in the cell sump area is possible. A subsequent analysis performed by WHC (WHC, 1996) using more realistic assumptions found that a credible potential for criticality does not exist under the current material configuration, even under the condition of full water moderation. Nevertheless, accepting that under the conditions assumed in the initial WHC analysis a criticality in the cell could be possible, subsequent analyses were performed to determine the occupational and environmental impacts of a criticality in the cell (Wolniewicz, 1993a). An analysis, based on the guidelines given in NRC Regulatory Guide 3.33, *Assumptions used for Evaluating the Potential Radiological Consequences of Accidental Nuclear Criticality in a Fuel Reprocessing Plant*, indicated that an individual in the adjacent operating aisle would receive an approximate whole body exposure of 98 mrem due to a 2E+19 fission event. An additional analysis found that there would be little environmental impact due to the fission gas release (approximately 1 mrem to the maximally exposed off-site individual).

B.8.7.3.4 Lag Storage Facility Criticality Concerns

The Lag Storage Facility, comprised of the Lag Storage Building, Lag Storage Annexes (LSA)-1, -3, -4, and Chemical Process Cell Waste Storage Area (CPC-WSA), provides temporary storage of wastes generated during Project activities. Storage of transuranic (TRU) and suspect TRU wastes, which, by definition, contain fissionable materials, is only permitted in the Lag Storage Building and CPC-WSA.

The Lag Storage Building (see Section B.7.7) receives wastes from current Project activities and provides storage for wastes generated during original facility decontamination and other activities. Matrix materials of the TRU wastes received in the Lag Storage Facility vary widely, from paper anti-contamination clothing materials to sludges and resins. The ratio of fissionable nuclides in these wastes also varies due to a process conducted by NFS to affect the chemical separation of uranium from plutonium. Analyses by O-Ahoofe (Keel, 1984) considered these variables in determining fissionable material mass limits for waste packages received for storage in the Lag Storage Facility. These limits ensure that under no circumstances will reconfiguration of the storage containers (up to a height of four tiers) result in an array having a $k_{eff} + 2\sigma$ greater than 0.95. (The container stacking limit of 4 tiers is not meant to infer that an array height of 5 tiers would represent an unsafe condition. It was selected in the analysis due to the fact that the physical dimensions of the storage facility would not permit an array higher than 4 tiers. Although a fifth tier may be safe, this has not been determined analytically and administrative controls are in place to ensure that the array height does not exceed 4 tiers.) Based on the administrative controls for fissionable materials in containers accepted for storage in the Lag Storage Building and the fact that re-packaging of TRU wastes in the Lag Storage Building is not permitted, it is concluded that a criticality in the Lag Storage Building is incredible.

The Lag Storage Facility complies with criteria associated with the Double Contingency Principle by maintaining administrative control on two independent process parameters: the concentration of fissile material in the waste containers, and the height of the array of waste containers. (Memo FD:99:0049, WVNS, June 29, 1999, and Memo FD:99:0055, WVNS, August 4, 1999.)

The CPC-WSA is utilized for the storage of high activity wastes removed from the former Chemical Process Cell in the Main Plant building and no further additions to the inventory of material in the CPC-WSA are anticipated. Based on the best available information, it has been determined that less than a significant quantity of fissionable material exists in the entire CPC-WSA facility. These estimates have been made based on indirect measurements and historical information (i.e., dose to curie conversions). This historical evidence also indicates that significant quantities of uncharacterized sludges exist is some of the removed equipment. In the current storage configuration this material is critically safe; however, prior to any subsequent decontamination activities that could concentrate the sludges in these vessels, it will be necessary to confirm the concentration of fissionable materials to ensure that criticality safety will be maintained.

B.8.7.4 Criticality Controls

Criticality controls at the WVDP are developed through the guidelines given in WVDP-162 and the references contained therein. Administrative controls are the primary means for criticality control in IRTS systems and Main Plant facilities.

B.8.7.4.1 Engineering Controls

Engineered features designed to prevent an inadvertent criticality are not provided in IRTS systems or Main Plant facilities. The geometry of containers utilized for storage of TRU waste in the Lag Storage Building ensures that a safe concentration of fissionable materials (i.e., mass per unit volume) is maintained; however, the containers themselves are not critically safe. Prevention of inadvertent criticality in the IRTS, Main Plant, and Lag Storage Facility is achieved through the use of administrative controls.

B.8.7.4.2 Administrative Controls

Administrative controls developed through the guidelines and requirements given in WVDP-162 are the primary means for criticality control in the IRTS, Main Plant, and Lag Storage Facilities. These controls ensure that activities that require the storage, processing or handling of fissile or fissionable materials are performed in a manner that provides an acceptable margin to safety for the prevention of an inadvertent criticality.

Accessible areas of WVDP facilities for which administrative controls must be maintained to preclude an inadvertent criticality as a result of the form, quantity or concentration of stored fissile or fissionable material are designated as a criticality control zone. Criticality control zones are posted to indicate a definite boundary and provide a means of accounting for and controlling fissionable material inventory in the designated location. Administrative controls placed on activities conducted in these areas ensure that amounts of moderating material are minimized, that procedures for work involving fissionable material are reviewed by a criticality safety engineer and that fissionable material in an unmoderated criticality zone is maintained as such.

Administrative control limits have been established to ensure that activities conducted within WVDP facilities maintain a wide margin to criticality. Specific process control limits have been developed for the concentration of fissionable materials in liquids transferred between tanks in the Main Plant/IRTS; for the mass of fissionable materials in TRU waste containers stored in the Lag Storage Building; and, for the mass of fissionable materials (as CPC floor debris) permitted for storage in the GPC. These controls establish limits, dictate surveillance requirements to ensure compliance with the limits, and provide corrective actions for circumstances when it is discovered that the limits are not met.

Ion exchange and evaporation activities conducted within the IRTS have the potential for concentrating fissionable materials. The WVDP has developed a surveillance program to ensure that accumulations of fissionable materials in these systems are monitored. Procedures specify parameters that are measured to determine the loss of fissionable material mass across the STS ion exchange columns and the LWTS evaporator. These procedures ensure that predetermined fissionable material mass limits for these components are not exceeded.

In addition to these controls, criticality safety has been incorporated into the WVDP Integrated Safety Management (ISM) program. ISM hazard screening requirements ensure that activities that involve the handling, storage, transfer, disposal, or processing of fissionable materials, or activities conducted in or potentially impacting areas of the WVDP known to contain fissionable materials are reviewed by a criticality safety engineer.

B.8.7.4.3 Application of Double Contingency

WVDP-162 has been written to ensure that the double contingency principle requirements set forth in DOE O 420.1, Attachment 2, are incorporated into all criticality control elements for activities conducted at the WVDP.

B.8.7.5 Criticality Protection Program

Criticality safety at the WVDP is implemented through the requirements of WVDP-162. Subsections of this section provide general information regarding the WVDP criticality safety program with added detail for features of the program which apply specifically to facilities and operations within the scope of this SAR.

B.8.7.5.1 Criticality Safety Organization

Administration of the criticality safety program at the WVDP is through the WVNS Safety Analysis and Integration (SA&I) Department. The SA&I Manager is responsible for monitoring and implementing nuclear criticality safety requirements, assisting operating management in developing programs and plans for maintaining nuclear criticality safety of the plant by regular evaluations and assessments in work areas. The SA&I Manager is responsible for developing and maintaining the criticality safety program manual and for concurring with the establishment and abolishment of criticality control zones and for criticality control zone management. Additional responsibilities of the SA&I manager are listed in WVDP-162.

The Criticality Safety Engineer (CSE) is responsible for establishing and abolishing criticality control zones and their operating limits and is responsible for performing nuclear criticality safety evaluations for activities conducted at the WVDP. In addition, the CSE provides programmatic evaluation to ensure that fissionable materials are packaged in a manner that protects worker health and safety and the environment and to ensure that nuclear criticality safety evaluations are performed to identify potential accumulations of fissionable material during production, storage, transport and handling. The CSE is responsible for developing controls for fissionable material accumulations to reduce the risk of accidental criticality.

B.8.7.5.2 Criticality Safety Plans and Procedures

Operations at the WVDP where nuclear criticality safety is a consideration are governed by written plans and procedures for initial planned operations and for subsequent modifications that may affect reactivity. Documented plans and procedures are provided for storing, processing and handling of fissionable materials. Modifications to these plans and procedures are subject to an Unreviewed Safety Question Determination to assess any potential impact to the approved authorization basis.

B.8.7.5.3 Criticality Safety Training

A criticality safety training program has been developed at the WVDP in accordance with the requirement of DOE Order 5480.20A. As indicated in Section A.10.3 of WVNS-SAR-001, criticality safety training is given to individuals who operate, maintain, and/or supervise activities in areas where significant quantities of fissionable materials are stored or handled. Elements of the training program require that each individual receive instruction in nuclear criticality safety including a summary of criticality accident history and nuclear criticality theory, normal procedures, radiation control practices, configuration control, criticality control zones, procedural compliance, and individual responsibility.

B.8.7.5.4 Determination of Operational Nuclear Criticality Limits

Operational nuclear criticality limits at the WVDP are developed based upon considerations of approved nuclear criticality safety evaluations. At the WVDP these evaluations are primarily performed using the KENO-V.a code and various cross section data provided by the Radiation Shielding Information and Computation Center (RSICC) at Oak Ridge National Laboratory. Prior to use at the WVDP, the KENO-V.a code is verified on each computing platform on which it will be used following standard site computer code verification procedures. Verification and validation guidance and information related to KENO-V.a are provided in NUREG/CR-6483, *Guide to Verification and Validation of the SCALE-4 Criticality Safety Software*. NUREG/CR-6483 concludes that for low-enriched U-235 systems there is an average bias that ranges from approximately -0.01 to +0.01 Δk depending on the system being analyzed. The results for highly enriched U-235 systems indicate an average bias ranging from -0.02 to +0.025 Δk depending on the system being analyzed. The results for U-233 systems indicate an average bias ranging from -0.02 to +0.045 Δk and for Pu-239 systems, a range of approximately +0.01 to +0.035 Δk, depending on the system being analyzed with many individual systems calculating nearly unbiased.

Safety margins for all calculations performed for WVDP activities and systems are established such that the calculated effective neutron multiplication factors, including all computational uncertainties for a unit, array of units, or systems containing fissionable material is no greater than 0.95, within a 95 percent probability and 95 percent confidence level (i.e., $k_{eff} + 2\sigma \leq 0.95$, where σ is the uncertainty associated with the method of calculation).

Analyses utilized for the development of operational limits are reviewed by the WVDP Radiation and Safety Committee in accordance with WV-906 and WV-923. Furthermore these analyses are independently reviewed by individuals whose education and experience meet or exceed the requirements of a criticality safety engineer.

B.8.7.5.5 Criticality Safety Inspection/Audits

The WVDP SA&I Manager is responsible for ensuring that independent appraisals are performed in accordance with WV-121. Appraisals review and evaluate nuclear criticality safety against DOE orders, federal and management requirements, Technical Safety Appraisal criteria listed in DOE/EH-0135 or latest DOE requirements, as well as good and best management practices.

B.8.7.5.6 Criticality Infraction Reporting and Follow-Up

Occurrence reporting requirements dictated by DOE O 232.1A, *Occurrence Reporting and Processing of Operations Information*, are implemented at the WVDP through WVNS Policy and Procedure WV-987, *Occurrence Investigation and Reporting*, and WVDP-242. This procedure establishes a system for determining, evaluating, reporting, and correcting occurrences.

As prescribed in the procedure, the Facility Manager is responsible for evaluating and categorizing occurrences, including criticality infractions, and completes oral notification per DOE requirements when determined applicable. Furthermore, the Facility Manager is responsible for ensuring that the corrective actions proposed and implemented as a result of an occurrence are adequate, and approves the closeout of identified corrective action items resulting from occurrences in areas for which they are responsible.

B.8.7.6 <u>Criticality Instrumentation</u>

DOE O 420.1, Facility Safety, requires that facilities in which the mass of fissionable material exceeds the limits established in paragraph 4.2.1 of ANSI/ANS-8.3-1986, and the probability of a criticality accident is greater than 10^{-6} per year, a criticality alarm system (CAS) shall be provided to cover occupied areas in which the expected dose exceeds 12 rads in free air. For those occupied areas in which the expected dose rate is not anticipated to exceed 12 rads in free air, a criticality detection system (CDS) shall be provided. For DOE purposes, a CAS is defined to be a criticality accident detection device and a personnel evacuation alarm, while a CDS is defined to be an appropriate criticality accident detection device but without an immediate evacuation alarm.

Analyses referenced in Section B.8.7.3 have demonstrated that, although the mass of fissionable material exceeding the limits established in paragraph 4.2.1 of ANSI/ANS-8.3-1986 does exist in certain facility areas, the credible potential for an inadvertent criticality in the IRTS or Main Plant does not currently exist. DOE O 420.1 states that under those circumstances in which an inadvertent criticality accident is determined to be incredible due to the physical form of the fissionable material, or the probability of occurrence is determined to be less than 10^{-6} per year, neither a CAS nor a CDS is required. Nevertheless, analyses of Main Plant stack effluents for Sr-89 and Cs-137 are performed to detect the occurence of a criticality, should one occur. (Calculations have shown that elevated levels of Cs-137 *and* the presence of Sr-89 in stack effluent samples would serve as indicators of an inadvertent criticality [Crotzer, 1994].) Although these analyses are not required, they are performed as a good management practice.

B.8.8 <u>Fire Protection</u>

Fire Hazard Analyses (FHAs) have been and are currently being conducted to comprehensively and qualitatively assess the fire risk within individual fire areas comprising the facilities on-site. 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. WVNS's proposed approach to performing FHAs for WVDP facilities in accordance with DOE Order 420.1 requirements (Jablonski, 1998) was accepted by OH/WVDP (Provencher, 1998). FHAs that have been developed for nuclear, radiological, and non-nuclear facilities within the scope of this SAR are as follows:

- WVNS-FHA-011, *Fire Hazard Analysis Main Process Plant*, which also covers the Fuel Receiving and Storage Facility, Waste Reduction and Packaging Area, Contact Size Reduction Facility, and Liquid Waste Treatment System

- WVNS-FHA-013, *Fire Hazard Analysis Cross-Reference STS/PVS Facilities*

The two FHAs listed above document that there are no "open findings/audit items" or "requirements" (i.e., actions required to correct fire protection deficiencies as regards compliance with mandatory fire protection requirements). The FHAs conclude that the facilities evaluated in them either meet or exceed both the DOE property loss requirements and the Life Safety requirements for special-purpose industrial occupancies or industrial occupancies, as applicable.

An FHA for the Chemical Process Cell Waste Storage Area, a Category 3 nuclear facility, is under development. The "fire service main," which includes site-wide fire water supply, storage, and distribution, is discussed in WVNS-FHA-004, *Fire Hazard Analysis Fire Service Main/Hydrant System*. WVDP-319, *Facility Fire Assessments*, provides fire assessments for various WVDP facilities.

The WVDP Fire and Explosion Protection Program is discussed in Section A.4.3.6 of WVNS-SAR-001.

REFERENCES FOR CHAPTER B.8.0

American National Standards Institute. ANSI N323A-1997: *Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments.* The Institute of Electrical and Electronic Engineers, Inc., New York, New York.

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

__________. 1986. ANSI/ANS-8.3: *Criticality Accident Alarm System.* American Nuclear Society, Lagrange Park, Illinois

__________. 1986. ANSI/ANS-8.5: *Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material.* American Nuclear Society, Lagrange Park, Illinois.

__________. 1975. ANSI/ANS-8.7: *Guide for Nuclear Criticality Safety in the Storage of Fissile Materials.* American Nuclear Society, Lagrange Park, Illinois.

__________. ANSI/ANS 8.10-1983: *Criteria for Nuclear Criticality Safety Controls in Operations with Shielding and Confinement.* American National Standards Institute. New York, New York.

__________. ANSI/ANS 8.12-1987: *Nuclear Criticality Control and Safety of Plutonium-Uranium Fuel Mixtures Outside Reactors.* American National Standards Institute. New York, New York.

__________. ANSI/ANS 8.15-1981: *Nuclear Criticality Control of Special Actinide Elements.* American National Standards Institute. New York, New York.

__________. ANSI/ANS 8.19-1984: *Administrative Practices for Nuclear Criticality Safety.* American National Standards Institute. New York, New York.

Caldwell, J.T. March 11, 1991. *Keff Calculations for WVNS.* Letter ZW:91:0031.

Code of Federal Regulations. 29 CFR 1910: *Occupational Safety and Health Administration, Department of Labor.*

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

Crotzer, M. E. February 28, 1994. *General Purpose Cell (GPC) Criticality Detection.* Memo to T. J. Rowland (IO:94:0044).

REFERENCES FOR CHAPTER B.8.0 (continued)

Ebasco Services, Inc. July 1, 1985. *LWTS Shielding Analysis Report.* WVNS Reference No. EBAR 560.

Eggert, J.A. February 26, 1987. *Transmittal of Approved CSE and OSRs for Consolidation of TRU Waste Drums Containing Process Solutes.* Memo to S. Marchetti (FB:87:0067).

Jablonski, J.F. April 3, 1998. Facilities Selected for Fire Hazard Analyses. Letter to Mr. T.J. Rowland (WD:98:0262).

Keel, R. December 17, 1984. *Revision to the Allowable Total Fissile Material Mass Limit for TRU-Waste Storage in the Interim Storage Building (Lag Storage Building).* Memo to R. E. Lawrence (FB:84:0249).

Nuclear Fuel Services, Inc. 1970. *Safety Analysis, Spent Fuel Reprocessing Plant, AEC Docket No. 50-201.* Revision 5.

Parks, C.V., and H.R. Dyer. March 19, 1991. *Visit to WVDP to Discuss Criticality Safety Concerns Associated with Fissile Material Accumulation in the Integrated Radwaste Treatment System Evaporator, February 13-14, 1991.* Letter Report to P. J. Valenti.

Provencher, R.B. April 22, 1998. Selecting Facilities for Fire Hazard Analysis (FHA), DOE Order 420.1. Letter to Mr. J.F. Jablonski (DW:98:0283).

Prowse, J.J. June 26, 1991. *Criticality Safety Analysis for WVNS Sludge Tanks and Related Processing Equipment.* Memo to Records Management (FB:91:0129).

__________. March 1992. *Fault Tree for TR-IRTS-12.* (FB:92:0061).

Schiffhauer, M. and R.E. Inzana. 1987. *Scale Model Equipment Testing Final Report for the Period FY1985 to FY1987.*

U.S. Department of Energy. June, 1990. DOE/EH-0135: *Performance Objectives and Criteria for Technical Safety Appraisals at Department of Energy Facilities and Sites.* Office of Environmental, Safety, and Health (DOE-EH). Washington, D.C.

__________. October 24, 1996. DOE Order 420.1: *Facility Safety.* Washington, D.C.

__________. March 17, 1999. DOE Guide 441.1-8: *Air Monitoring Guide.* Washington, D.C.

REFERENCES FOR CHAPTER B.8.0 (continued)

__________. June 21, 1987. DOE Order 232.1A: *Occurrence Reporting and Processing of Operations Information*. Washington, D.C.

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

__________. May 15, 1984. Change 4 (January 7, 1993). DOE Order 5480.4: *Environmental Protection, Safety, & Health Protection Standards*. Washington, D.C.

__________. November 15, 1994. DOE Order 5480.20A: *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities*. Washington, D.C.

__________. DOE Order 440.1A: *Worker Protection Management for DOE Federal and Contractor Employees*. Washington, D.C.

__________. November 7, 1996. Change 2. DOE Order 231-1: *Environment, Safety, and Health Reporting*. Washington, D.C.

U.S. Nuclear Regulatory Commission. April, 1977. Guide 3.33: *Assumptions Used for Evaluating the Potential Radiological Consequences of Accidental Nuclear Criticality in a Fuel Reprocessing Plant*.

__________. December 1996. NUREG/CR-6483: *Guide to Verification and Validation of the SCALE-4 Criticality Safety Software*.

__________. February 1993. NUREG-1400: *Air Sampling in the Workplace*.

Wolniewicz, J.C. April 23, 1993. *Transmittal of Estimate of Activity in the Former NFS Reprocessing Plant*. Letter to File (CN:93:0015).

__________. October 28, 1993. *Evaluation of a Criticality in a Main Plant Cell*. Memo to M. E. Crotzer and M. N. Haas (BJ:93:0026).

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

__________. WV-905: *Radiological Protection*. (Latest Revision).

__________. WV-906: *Radiation and Safety Committee*. (Latest Revision).

__________. WV-923: *Nuclear Criticality Safety*. (Latest Revision).

REFERENCES FOR CHAPTER B.8.0 (continued)

__________. WV-984: *ALARA Program.* (Latest Revision).

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

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

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

__________. WVDP-040: *WVDP Site Environmental Report, Calendar Years 1985-1998.*

__________. WVDP-076: *Environmental Protection Implementation Plan.* (Latest Revision).

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

__________. WVDP-163: *WVDP ALARA Program Manual.* (Latest Revision).

__________. WVDP-241: *Site Health and Safety Plan (HASP).* (Latest Revision).

__________. WVDP-242: *Event Investigation and Reporting Manual.* (Latest Revision).

__________. WVDP-319, *Facility Fire Assessments.* (Latest Revision.)

__________. WVNS-FHA-011, *Fire Hazard Analysis Main Process Plant.* (Latest Revision.)

__________. WVNS-FHA-013, *Fire Hazard Analysis Cross-Reference STS/PVS Facilities.* (Latest Revision.)

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

__________. Safety Analysis Report WVNS-SAR-003: *Safety Analysis Report for Vitrification Operations and High-Level Waste Interim Storage.* (Latest Revision.) West Valley Nuclear Services Co., Inc.

__________. Safety Analysis Report WVNS-SAR-012: *Fuel Receiving and Storage Facility.* (Latest Revision).

__________. June 29, 1999. *Closure of an Action Item Resulting from a Self-Assessment of WVDP-162 "Nuclear Criticality Safety Program Manual".* J.A. Lazzaro to L.J. Chilson, Memo FD:99:0049.

REFERENCES FOR CHAPTER B.8.0 (concluded)

__________. August 4, 1999. *Safety Documentation Requirements for the Storage of TRU Waste Containers in Lag Storage Facilities.* J.A. Lazzaro to F.A. Tarantello, Memo FD:99:0055.

Westinghouse Hanford Corporation. November 16, 1993. *West Valley, General Purpose Cell Criticality Evaluation.* WHC Radiation Physics and Shielding to M. Haas and M. Crotzer. Memo LW:93:0226.

Westinghouse Hanford Corporation. October 16, 1996. *Revised Criticality Assessment of the General Purpose Cell.* J. Greenborg to M. Crotzer. Memo LW:96:0025.

Yuan, Y.Y. January 16, 1991. *Criticality Evaluation: Sludge Wash and Mobilization System - Zeolite Column.* Memo to C. J. Roberts (FB:91:0012). West Valley Nuclear Services Co., Inc.

__________. April 11, 1991. *Criticality Evaluation IRTS Evaporator Draft, Final Report.* Memo to C. J. Roberts (FB:91:0081). West Valley Nuclear Services Co., Inc.

TABLE B.8.2-1

DESIGN BASIS Cs-137 CONCENTRATIONS FOR IRTS FACILITIES

Facility	Design Basis Cs-137 Concentration (μCi/mL)
Supernatant Treatment System	
High-level waste	1,530 [1]
Liquid Waste Treatment System	
Decontaminated HLW	50.0
Cement Solidification System	
Waste Stream	6.0
Cement Drum	3.7 [2]
Drum Cell	
Cement Drum	3.7 [2]

Notes:

[1] Evaluation basis concentration based on first sludge wash Cs-137 concentration

[2] Concentration is 1 Ci Cs-137/drum

TABLE B.8.2-2

GAMMA CURIES OF DESIGN FUEL FOR THE MAIN PLANT BUILDING*
Basis 1000 kg Uranium 150 Day Cooling

Isotope	Total Curies	Energy of Gamma Photons MeV	Gamma Photons per Second
Cs-137	9.2E4	0.66	3.1E15
Pm-147	3.2E5	0.12	1.2E15
Eu-155	4.7E3	0.15	1.4E14
Ru-106	6.8E4	2.42	5.0E12
		1.54	1.2E13
		1.05	5.0E13
		0.88	7.5E12
		0.62	2.5E14
		0.50	5.0E14
Ce-144	1.1E6	2.20	4.0E14
		0.70	4.0E14
		0.13	1.0E16
Zr-95	3.8E5	0.75	2.8E16
		0.23	2.8E14
Y-91	2.9E5	1.20	3.2E13
Sr-89	2.1E5	0.92	7.7E11
Ru-103	6.7E4	0.61	1.7E14
		0.50	2.2E15
Ce-141	6.9E4	0.14	1.8E15
La-140	5.2E2	3.00	1.9E11
		2.50	1.0E12
		1.50	1.8E13
		0.80	5.6E12
Gases			
Kr-85	1.3E4	0.52	4.7E12
I-131	2.2	0.72	2.2E9
		0.64	7.4E9
		0.36	6.9E10
		0.16	5.6E8

* Ref: Table 6.60a NFS, 1970. Gamma photons of Ru-106 are actually those of the daughter isotope, Rh-106.

TABLE B.8.3-1

SUMMARY OF STS SHIELDING CALCULATIONS

STS PIPEWAY WALLS - SHIELDING ANALYSIS

(91 cm Thickness of Concrete)

SUPERNATANT STREAM - 6210 μCi/mL Cs-137 Source

Concrete Density g/cc	Exposure Rate mR/hr
2.24	0.477
2.35	0.243
2.50	0.097
2.85	0.011
3.00	0.004
3.20	0.001

STS PIPEWAY ROOF - SHIELDING ANALYSIS

(91 cm Thicknesses of Concrete)

SUPERNATANT STREAM - 6210 μCi/mL Cs-137 SOURCE

Concrete Density g/cc	Exposure Rate mR/hr
2.24	0.450
2.35	0.227
2.50	0.090
2.85	0.010
3.00	0.004
3.20	0.001

TABLE B.8.3-1 (concluded)

SUMMARY OF STS SHIELDING CALCULATIONS

STS VALVE AISLE - FRONT WALL - SHIELDING ANALYSIS

(30 cm [12 in] Thicknesses of Steel)

76, 189, 379 L (20, 50, 100 gals) @ 230 MBq/mL (6210 µCi/mL) ^{137}Cs
SUPERNATANT SOURCE

Front Wall cm (in)	µSv/h 76 L	µSv/h 189 L	µSv/h* 379 L
30 (12)	5.900E-01	1.480E-00	2.950E-00

SOURCE GEOMETRY: (1.5 m [5 ft] X 1.8 m [6 ft] X 1.5 m [5 ft])

STS VALVE AISLE - SIDE WALL - SHIELDING ANALYSIS

(30 cm [12 in] Thicknesses of steel)

76, 189, 379 L (20, 50, 100 gals) @ 230 MBq/mL (6210 µCi/mL) ^{137}Cs
SUPERNATANT SOURCE

Side Wall cm (in)	µSv/h 76 L	µSv/h 189 L	µSv/h* 379 L
30 (12)	5.600E-01	1.420E-00	2.830E-00

SOURCE GEOMETRY: (1.5 m [5 ft] X 1.8 m [6 ft] X 1.5 m [5 ft])

STS VALVE AISLE ROOF - SHIELDING ANALYSIS

(30 cm [12 in] Thicknesses of Steel)
76, 189, 379 L (20, 50, 100 gals) @ 230 MBq/mL (6210 µCi/mL) ^{137}Cs
SUPERNATANT SOURCE

Roof cm (in)	µSv/h 76 L	µSv/h 189 L	µSv/h* 379 L
30 (12)	2.400E-02	52.980E-02	1.180E-01

SOURCE GEOMETRY: (1.5 m [5 ft] X 1.8 m [6 ft] X 1.5 m [5 ft])

* 1 µSv/h = 0.1 mrem/h

TABLE B.8.3-2

RESULTS OF LWTS SHIELDING ANALYSES [1]

Location	Elevation (ft)	Calculated [2] Exposure Rate (mR/hr)	Maximum [3] Exposure Rate (mR/hr)
ULO Pump Room - North Wall	100	2.48	2.5
ULO Pump Room - South Wall	100	2.24	2.5
UPC - N & S Walls	100	2.30	2.5
UPC - West Wall	100	1.00	2.5
UPC - East Wall	100	N/A	2.5
Pipe Chase	131	2.00	2.5

[1] - Performed by Ebasco (1985)

[2] - Calculated exposure rate with additional shielding in place

[3] - Per LWTS Design Criteria

N/A - Not Available

TABLE B.8.3-3

SHIELDING SUMMARY
FOR SOURCE AREA - PROCESS MECHANICAL CELL*

Specific Source - Three fuel assemblies in the following locations in cell:
1 at Disassembly Table 2V-11
1 at Disassembly Saw 2V-2
1 in Feed Mechanism of Shear 2V-4

Shielded Area	Elev. (feet)	Design Exposure Rate mR/hr	Shielding			Remarks
			Thick (m)	Mat'l[1]	C.F.[2]	
Lab Area	131	0.2	1.8	OC	A	
Vent Supply Room	114	1	1.7	OC	A	
Mech. Oper. Aisle	100	1	1.7	OC	A	
Chem. Oper. Aisle	114	1	1.7	OC	A	
Miniature Cell	76	10	1.7	OC	C	
Mech. Crane Room	114	100	0.9	OC	A	
General Purpose Cell	76	100	1.7	OC	C	
Vent Wash Room	114	1	1.5	OC	A	
Ram Equip Room	100	1	1.7	OC	A	

1) OC = Ordinary Concrete
HDC= High Density Concrete

2) C.F. = Controlling Factor

A. Thickness required to attenuate normal operating activity levels in source area to design dose specified.

B. Thickness required to attenuate 1/10 normal operating activity levels in source area to design dose specified, for maintenance operations.

C. Thickness provided is dictated by structural reasons and is greater than thickness required for shielding purposes.

D. Thickness arbitrarily set for shielding of a criticality incident.

* Ref: NFS, 1970

TABLE B.8.3-4

**SHIELDING SUMMARY
FOR SOURCE AREA - GENERAL PURPOSE CELL***

Specific Source - 6 full scrap drums
6 full fuel baskets in rack 2V-35
1 full fuel basket in transport

Shielded Area	Elev. (feet)	Design Exposure Rate mR/hr	Shielding			Remarks
			Thick (m)	Mat'l[1]	C.F.[2]	
Miniature Cell	76	5	1.3	HDC	C	
Miniature Cell	76	5	1.1	HDC	A	
GPC Oper. Aisle	76	1	1.2	HDC	A	3
GPC Oper. Aisle	76	10	0.9	HDC	A	4
GPC Oper. Aisle	76	10	0.9	OC	A	5
GPC Crane Room	73	100	1.1	OC	A	6
GPC Crane Room	73	100	0.8	HDC	A	6 & 8
Mech Oper. Aisle	100	1	1.7	OC	A	
Scrap Removal	100	10	1.7	OC	C	
Scrap Removal	100	200	0.3	Steel	B	7

1), 2) See Table B.8.3-3
3) Below El 87 feet
4) Near transfer hatches and above El 87 feet
5) Above El 87 feet
6) 10 mR/hr in shutdown status (ie no fuel in transport)
7) Hatch 2V-28
8) Door 2M-7

* Ref: NFS, 1970

TABLE B.8.3-5

SHIELDING SUMMARY FOR SOURCE AREA - CHEMICAL PROCESS CELL*

Sp.Source - Vessels 3C-1, 3C-2, 3C-3, 3D-1, 7C-4, 7D-10, 7C-4, 7C-1, 7C-2 Plus one fuel basket being loaded, or three dissolvers fully loaded and 1000 R/hr of background.

Shielded Area	Elev. (feet)	Design Exposure Rate mR/hr	Shielding			Remarks
			Thick (m)	Mat'l[1]	C.F.[2]	
Scrap Removal	100	10	0.5	Steel	A	
Mech Oper. Aisle	100	10	1.8	OC	A	
Liquid Waste Cell	100	100	1.8	OC	C	
Off-Gas Cell	100	100	1.5	OC	C	
Office Building	100	1	1.8	OC	A	
Equip. Decon. Room	100	10	1.2	OC	A	
Chem. Oper. Aisle	114.5	1	1.8	OC	A	
Off-Gas Cell	114.5	100	1.5	OC	A	
Chem Viewing Aisle	114.5	1	1.5	OC	C	
Equip. Decon. Room	114.5	10	1.2	OC	A	
Chem Viewing Aisle	117	1	0.6	HDC	A	3
Chem. Crane Room	131	300	0.9	OC	A	
Chem. Crane Room	131	100	0.9	OC	C	
Analytical Decon.	131	1	1.0	OC	A	
Laboratories	131	1	1.0	HDC	A	
ARC-OGC Aisle	131	1	0.9	HDC	A	
Office	131	1	1.0	HDC	A	4
Office	131	1	1.0	OC	A	5
Process Chem. Room	148	1	1.5	OC	A	
Hot Acid Cell	148	100	1.5	OC	C	
Vent Exhaust Cell	148	10	1.5	OC	C	
Roof	148	10	1.5	OC	C	
General Purpose Cell	100	100	1.7	OC	C	
GPC Crane Room	100	10	1.1	OC	A	6

1), 2) See Table B.8.3-3
3) Reflected radiation only
4) At north end of CPC
5) At south end of CPC
6) Liquid sources only
* Ref: NFS, 1970

TABLE B.8.3-6

SHIELDING SUMMARY
FOR SOURCE AREA - EXTRACTION CELL NO. 3*

Specific Source - Vessels 4C-10, 4C-11, 4C-12, 4D-12, 13C-3, 13C-6, 5D-1, 5D-2, 13D-3, 13D-6

Shielded Area	Elev. (feet)	Design Exposure[1] Rate mR/hr	Shielding			Remarks
			Thick (m)	Mat'l	C.F.[1]	
Cell Access Aisle	100'-0"	1	3'-0"	OC	D	
Cell Access Aisle	110'-0"	1	4"	Steel	A	(2)
Prod. Pur Cell	All	100(M)	1'-6"	OC	C	
X Cell No. 2	All	100(M)	1'-6"	OC	C	
Lower Warm Aisle	100'-0"	1	3'-0"	OC	D	
Lower Ext Aisle	114'-6"	1	3'-0"	OC	D	
Upper Warm Aisle	114'-6"	1	3'-0"	OC	D	
Ext Samp Aisle	131'-0"	1	3'-0"	OC	D	
Solv Storage Tanks	131'-0"	1	3'-0"	OC	D	
Upper Ext Aisle	144'-0"	1	3'-0"	OC	D	
Ext Chem Room	160'-0"	1	3'-0"	OC	D	

1) See Table B.8.3-3

2) Door 15 M-11

* Ref: NFS, 1970

TABLE B.8.3-7

**SHIELDING SUMMARY
FOR SOURCE AREA - ANALYTICAL CELLS***

ANALYTICAL HOT CELL

Specific Source - Six 5 ml samples at 8,000 Ci/L

Shielded Area	Elev. (feet)	Design Exposure Rate mR/hr	Shielding			Remarks
			Thick (m)	Mat'l[1]	C.F.[2]	
Lower Extrac. Aisle	114	1	0.6	HDC	A	
Chemical Oper. Aisle	114	1	0.6	HDC	A	
Anal. Oper. Aisle	131	1	0.9	OC	A	3
Anal. Oper. Aisle	131	1	0.6	HDC	A	4
ANC Decon. Aisle	131	1	0.3	Steel	A	5
Sample Storage Cell	134	-	0.9	HDC	-	6
Adjacent ANC	131	-	0.5	HDC	-	6
Control Room	144	1	0.9	OC	A	

ANALYTICAL SAMPLE CELL*

Specific Source - 5 L of HAF 660 Ci/L

Shielded Area	Elev. (feet)	Design Exposure Rate mR/hr	Shielding			Remarks
			Thick (m)	Mat'l[1]	C.F.[2]	
Chem. Operating Aisle	114	1	1.4	OC	A	
Anal. Operating Aisle	131	1	0.9	HDC	A	
ANC, Decon Area	132	1	0.9	HDC	A	

1), 2) See Table B.8.3-3
3) Above El 138 feet
4) Below El 138 feet
5) Door 15M-6
6) Arbitrary thickness by NFS

* Ref: NFS, 1970

TABLE B.8.3-8

SPECIFICATIONS OF MONITORING INSTRUMENTS

Specifications	Beta/Gamma Continuous Air Monitor	Alpha Continuous Air Monitor
Standby and/or Backup Power Supply	Portable - None Stack - Plant standby power	Portable - None Stack - Plant standby power
Range	10^1 to 10^5 cpm	10^0 to 10^4 cpm
Sensitivity	Counting efficiency - 30 percent (2π) (Sr-90/Y-90 Disc Source)	Counting efficiency - 10 percent (2π) (Pu-239 Disc Source)
Accuracy	±10 percent	±10 percent
Calibration Method and Frequency	Electronic/Source - Semiannual	Electronic/Source - Semiannual
Alarm Set Point	Portable - 20 cpm above bkg Stack - 4,500 cpm above bkg	Portable - 3,000 cpm above bkg Stack - 200 cpm above bkg
Recording Device	Chart Recorder	Chart Recorder
Readout	Portable - Analog-log scale on unit Stack - Readout in main control room	Portable - Analog-log scale on unit Stack - Readout in main control room
Alarm	Portable - Red beacon visual with bell audible on unit Stack - Alarm in control room	Portable - Red beacon visual with bell audible on unit Stack - Alarm occurs in control room

TABLE B.8.3-9

PROCESS AND EFFLUENT RADIATION MONITORS

Monitor	Type	Range of Measurements
Supernatant Treatment System		
Permanent Ventilation System	alpha beta/gamma	10-1M cpm 100-100k cpm
IX Column A Discharge	gamma	$0-10^7$ cpm
IX Column B Discharge	gamma	$0-10^7$ cpm
IX Column C Discharge	gamma	$0-10^7$ cpm
IX Column D Discharge	gamma	$0-10^7$ cpm
Decontaminated Supernatant Filter Discharge	gamma	$0-10^7$ cpm
Pump 50G-007	gamma	$0-10^7$ cpm
Main Plant/Liquid Waste Treatment System		
Main Plant Ventilation Exhaust Monitors	alpha beta/gamma	10-10k cpm 100-100k cpm
Utility Room Plant Cooling Water Return	gamma	$0-10^6$ cpm
Steam Condensate Return	gamma	$0 - 4x10^5$ cpm
LWTS 037/070	gamma	$0-10^6$ cpm
LWTS 082/089	gamma	$0-10^6$ cpm
Cement Solidification System		
01-14 Building Ventilation System	alpha beta/gamma	10-10k cpm 100-100k cpm

TABLE B.8.3-10

CONTINUOUS AIRBORNE RADIOACTIVITY MONITORS*

Location	Alpha	Beta/ Gamma	Pump Location**	Location Monitored	Sampling Line Length (m)	Sample Type
General Operating Aisle	---	X	Separate	General Area	---	---
Upper Extraction Aisle	---	X	Separate	General Area	---	---
Analytical Aisle	X	---	Separate	General Area	---	---
Vitrification Lab - north	X	X	Separate	General Area	---	---
Vitrification Lab - south	X	X	Separate	General Area	---	---
Radiochemical Lab - east - west	X(2)	X(2)	Separate	General Area	---	---
Mass Spectroscopy Lab	X	X	Separate	General Area	---	---
Laundry	X	X	Separate	General Area	---	---
WTF - Con Ed Building	X	---	Separate	General Area	---	---
WTF - Main Shelter	---	X	Separate	General Area	---	---
WRPA	---	X	Plant Vacuum	Compactor	3	Remote
CSRF	---	X	Separate	General Area	2	---
Stack Monitor	X(2)	X(2)	Separate	Stack Effluent	21.3	Remote
Uranium Load Out	---	X	Separate	General Area	5	---
Lower Warm Aisle	X	---	Separate	General Area	---	---
Lower Extraction Aisle	X	---	Separate	General Area	---	---
STS Upper Level	---	X	Separate	General Area	---	---
STS Operating Aisle	---	X	Separate	General Area	---	---
PVS	---	X	Separate	General Area	---	---
WTF 8D-1, M-7 Riser	---	X	Separate	General Area	---	---

TABLE B.8.3-10 (Concluded)

CONTINUOUS AIRBORNE RADIOACTIVITY MONITORS*

Location	Alpha	Beta/ Gamma	Pump Location**	Location Monitored	Sampling Line Length (m)	Sample Type
CSS	---	X	Separate	General Area	---	---
EDR	---	X	Separate	General Area	---	---
CSPF Sorting Room	X	X	Separate	General Area	---	---
LLW2 Resin Loadout	---	X	Separate	General Area	---	---

* Quantities and locations of CAMS will vary based on specific Project activities.
** Separate = vacuum pump at CAM location; Plant Vacuum = connected to plant vacuum system.

TABLE B.8.4-1

**ANNUAL OCCUPATIONAL EXPOSURES
DUE TO MAIN PLANT AND IRTS OPERATIONS, AND SUPPORT ACTIVITIES ***

ALARA Group	Average Exposure per worker (cSv or rem)
Analytical Chemistry	0.045
Construction Projects	0.010
Engineering Design	0.001
Integrated Radwaste Treatment System	0.065
Maintenance	0.018
Plant Operations	0.0018
Radiation Control	0.064
Waste Storage	0.054
Waste Support	0.102
Others	0.001

- Exposures as reported for 1998 based on personnel assignments to ALARA groups reported in December, 1998.

TABLE B.8.6-1

AIRBORNE RADIONUCLIDE EMISSIONS FOR THE YEAR 1998 AS REPORTED IN THE 1998 ANNUAL SITE ENVIRONMENTAL REPORT (WVNS,1999)

Nuclide	Main Plant (Ci)	Contact Size Reduction Facility (Ci)	Supernatent Treatment System (Ci)	Container Sorting and Packaging Facility (Ci)
H-3	3.45E-2	---	9.06E-5	---
Co-60	1.11E-7	1.57E-9	0.61E-8	<1.76E-9
Sr-90	7.05E-6	<3.49E-9	1.09E-8	<9.45E-10
I-129	4.97E-3	4.42E-9	3.79E-6	3.87E-8
Cs-137	2.47E-5	2.55E-9	2.36E-7	0.57E-9
Eu-154	1.28E-7	<1.25E-8	0.65E-8	<7.71E-9
U-232	2.68E-8	0.55E-10	9.49E-10	0.35E-10
U-233/234	8.07E-8	7.71E-10	7.73E-9	1.31E-9
U-235/236	5.69E-9	2.04E-10	7.44E-10	8.95E-11
U-238	6.25E-8	2.85E-10	8.27E-9	1.60E-9
Pu-238	9.0E-8	<6.81E-11	6.79E-10	2.08E-10
Pu-239/240	1.32E-7	0.40E-10	4.35E-10	2.81E-10
Am-241	3.07E-7	1.89E-11	5.03E-10	1.10E-10

TABLE B.8.6-2

SITE ANNUAL (1998) MAIN PLANT LIQUID EFFLUENT DISCHARGES

Nuclide[1]	Ci Released[2]	Unit Dose Factor rem/Ci	Annual Estimated Dose rem	Percentage of the Total Dose
Cs-137[3]	9.40E-04	6.10E-03	5.73E-06	77.5
U-232	4.38E-04	1.68E-4	7.36E-8	1.00
U-233/234	2.53E-04	3.68E-05	9.31E-09	0.13
C-14	7.25E-04	4.30E-04	3.12E-07	4.22
Am-241	1.89E-06	7.57E-03	1.43E-08	0.194
Sr-90[3]	3.73E-03	2.80E-04	1.04E-06	14.1
Co-60	1.28E-4	1.24E-3	1.59E-7	2.15
I-129	1.28E-04	2.80E-04	3.58E-08	0.485
		Totals	7.40E-06	99.8

Total Dose to the Maximally Exposed Off-Site Individual = 7.40E-6 rem

[1] Includes only isotopes yielding a dose of ≥ 0.1 percent of the total dose.
[2] Data from WVDP Annual Site Environmental Report for CY 1998 (WVNS, 1998).
[3] Include contributions from daughter isotopes.

TABLE B.8.7-1

FISSIONABLE MATERIAL INVENTORY FOR TANK 8D-2 AND MAXIMUM ENVELOPE FOR ION EXCHANGE COLUMNS

Nuclide	Total Fissionable Mass in Tank 8D-2 g	Max. Soluble Fissionable Mass for First Wash g	Maximum Fissionable Mass per STS IX Column g
U-233	720	270	0.4
U-234	660	250	0.3
U-235	41,000	16,000	21
U-238	2,300,000	1,000,000	1,300
Pu-238	370	14	3.9
Pu-239	27,000	924	260
Pu-240	5,700	187	52
Pu-241	640	28	7.8
Am-241	20,000	4.1	0.0
Am-243	25,000	5.0	0.0
Cm-244	200	0.0	0.0

- Assumes Cs breakthrough after processing 375,000 L (100,000 gals.) of undiluted sludge wash solution at an alpha plutonium concentration of 0.25 μCi/mL. The maximum column is analyzed as an ion exchange column containing Ti-treated zeolite and envelopes non-treated zeolite usage.

TABLE B.8.7-2

MATERIAL COMPOSITIONS AND ATOM DENSITIES FOR KENO-V CALCULATIONS

Material	Density g/cc	Volume Fraction	Nuclide	Atomic Density atom/ barn-cm	Cross-Section Source
Zeolite (SiO2: 62%, Al2O3: 18.9%) (Na2O: 6.31%, Fe2O3: 4.85%) (TiO2: 4.0%, CaO: 1.46%) (K2O: 1.46%, MgO: 0.97%)	1.75	0.4	Si	0.00440	XSDRN
			Al	0.00156	Hansen Roach
			Na	0.00086	Hansen Roach
			K	0.00013	Hansen Roach
			Fe	0.00040	Hansen Roach
			Ca	0.00011	GAM-2
			Ti	0.00031	GAM-2
			Mg	0.00010	XSDRN
			O	0.01300	Hansen Roach
Water	0.9982	0.6	H2O (X(E))	(KENO-V)	Hansen Roach
304 S.S.	7.9	1.0	SS	(KENO-V)	Hansen Roach
Plutonium	17.7	----	Pu-239	Varies	Hansen Roach

TABLE B.8.7-3

SUMMARY OF CRITICALITY EVALUATION FOR THE ZEOLITE COLUMN OF SMWS

Geometry & Composition	Radius & Length Z (cylinder only) (cm) of Pu-239 Retained Vol.	K-effective ±σ
0.44 kg of Pu-239, Pu uniformly distributed in the hemisphere	R=22.5 (hemisphere)	0.38137 ± 0.00161
1.0 kg of Pu-239, Pu uniformly distributed in the cylinder	R=45.5 (cylinder) Z=20	0.66491 ± 0.00305
1.0 kg of Pu-239, Pu uniformly distributed in the cylinder	R=23 (cylinder) Z=20	0.89920 ± 0.00464
1.0 kg of Pu-239, optimum geometry, Pu uniformly distributed in the sphere	R=22.5 (sphere)	0.94748 ± 0.00505

TABLE B.8.7-4

k_{eff} FOR A 1.0 kg Pu-239 SPHERE IN THE CENTER OF THE ZEOLITE COLUMN

Geometry	Radius cm	K-effective ± σ
Sphere	15	0.84061 ± 0.00884
Sphere	18	0.91868 ± 0.00542
Sphere	20	0.94102 ± 0.00525
Sphere	21	0.94186 ± 0.00547
Sphere	22	0.94615 ± 0.00479
Sphere	22.5	0.94748 ± 0.00505
Sphere	23	0.94612 ± 0.00445
Sphere	24	0.93074 ± 0.00470
Sphere	26	0.91059 ± 0.00419
Sphere	30	0.83864 ± 0.00367

TABLE B.8.7-5

k_{eff} FOR A 22.5 cm Pu-239 SPHERE IN THE CENTER OF THE ZEOLITE COLUMN

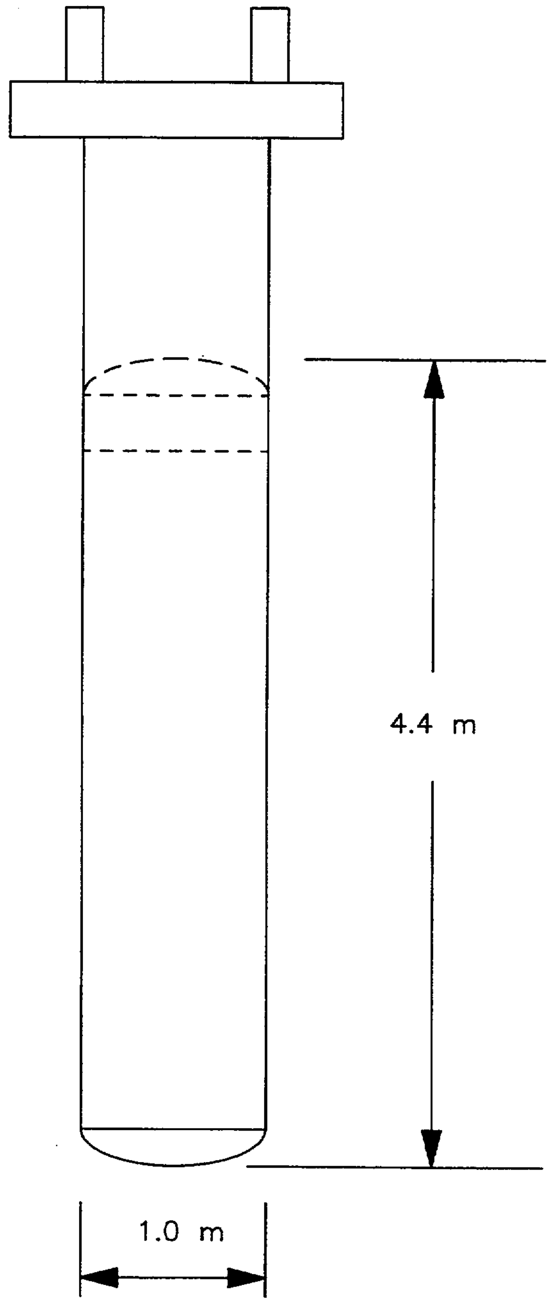
Mass Pu-239 kg	K-effective ±σ
0.8	0.88818 ± 0.00436
0.9	0.91380 ± 0.00503
1.0	0.94748 ± 0.00505
1.1	0.95440 ± 0.00517
1.2	0.98249 ± 0.00482

TABLE B.8.7-6

**ESTIMATE OF FISSILE MATERIAL IN MAIN PLANT CELLS
FOR REFERENCE YEAR 1994**

FISSILE ISOTOPE	Estimated Fissile Material Mass		
	PMC (g)	GPC (g)	XC-1 (g)
U-233	4.33E+01	1.47E+02	2.01E+01
U-235	2.05E+03	6.94E+03	9.51E+02
Pu-239	2.81E+02	9.47E+02	1.26E+02
Pu-241	6.32E+00	2.14E+01	2.84E+00

SR2B87-1.DWG



FOR REFERENCE ONLY - NOT TO SCALE

Figure B.8.7-1 STS Ion Exchange Column

B.9.0 HAZARD AND ACCIDENT ANALYSES

B.9.1 Hazard Analysis

The systematic analysis of hazards associated with IRTS operations and facilities and support activities has been accomplished in this SAR 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 SAR. Information gained through this analysis is then used in selecting accidents to be further analyzed in a more rigorous quantitative fashion in Section B.9.2 and in grading facility and process descriptions provided throughout the SAR.

B.9.1.1 Methodology

B.9.1.1.1 Hazard Identification

The process of accomplishing the PHA identifies the hazards in terms of quantity, form, 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. Primary among these sources were current facility safety documents which identify and evaluate the risks of significant hazards in Project facilities. Site service documents also provided significant information for the PHA. In demonstrating compliance with RCRA spill contingencies the WVDP has developed the Spill Prevention, Controls and Countermeasures Plan (West Valley Nuclear Services Co., Inc., WVDP-043). In support of the site emergency planning program, the *WVDP Hazards Assessment* (West Valley Nuclear Services Co., Inc., WVDP-193) has been developed. These documents supported the identification and evaluation of facility hazards. Additional information for the PHA has been obtained from process flow diagrams, facility operating procedures and miscellaneous site documents referenced therein.

Because many accidents contained in the PHA are of a similar nature (e.g. spills, leaks, fires, etc), bounding accidents may easily be identified through examination of relative inventories. Certain events, however, are more unusual and require quantitative analysis to determine the event probability or consequence. These quantitative analyses are provided in references provided at the end of Table B.9.1-1.

B.9.1.1.2 Hazard Evaluation

Evaluation of hazards for the Process Hazards Analysis required the qualitative assessment of event consequences and frequencies. Qualitative consequence and frequency classifications used in Table B.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 Frequency Classification:

Anticipated	($10^{-1} \geq p > 10^{-2}$) Incidents that may occur several times during the lifetime of the facility.
Unlikely	($10^{-2} \geq p > 10^{-4}$) Accidents that are not anticipated to occur during the lifetime of the facility.
Extremely Unlikely	($10^{-4} \geq p > 10^{-6}$) Accidents that will probably not occur during the life cycle of the facility.
Incredible	($10^{-6} \geq p$) Accidents that are not credible.

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

For each event in Table B.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 B.9.1-1. Events with negligible consequences were 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 an accident in Section B.9.2 are assigned a risk factor of "IE" (incredible but evaluated).

B.9.1.2 Hazard Analysis Results

B.9.1.2.1 Hazard Identification

Hazards at the WVDP are of two broad types: radiological and nonradiological (toxicological). These hazards exist as confined and unconfined sources. Table B.9.1-1 presents the PHA on a facility by facility (i.e. location) basis.

In developing potential initiating events, energy sources were identified. The IRTS treatment process and site waste management activities are primarily physical in nature (filtration, concentration, and encapsulation), presenting low inherent operational energy sources as could be present in chemical process facilities. Therefore, severe natural phenomena predominate as the energy source for initiating events considered.

B.9.1.2.2 Hazard Classification

The hazard classification for IRTS, Main Plant and support facilities has been presented in Section B.1.5.

B.9.1.2.3 Hazard Evaluation

B.9.1.2.3.1 Summary of Significant Worker-Safety Features

Though worker hazards protection is provided by engineered facility features, the most significant facility worker-safety feature, namely cell shield walls, are passive in nature. Therefore, the primary operational worker-safety features identified in the hazards analysis are administrative controls. Specifically, worker protection from radiological hazards is controlled through the requirements of the WVDP Radiological Controls Manual (West Valley Nuclear Services Co., Inc., WVDP-010) while worker protection from nonradiological hazards is controlled through the requirements of the WVNS Industrial Hygiene and Safety Manual (West Valley Nuclear Services Co., Inc., WVDP-011).

B.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 are presented in Section B.9.2. These accidents result from IRTS process operations and support activities that were determined 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 3. In addition, events with incredible probabilities of occurrence, but representing the bounding accident for certain classes of events, were also selected for evaluation (identified with a risk factor of "IE" in Table B.9.1-1).

Accidents selected for further evaluation are:

1) Main ventilation system HEPA bank failure
2) Hydrogen peroxide spill
3) Transformer leak

4) Fire in Lag Storage Facility
5) 8D-2 Tank and vault failure
6) LLWTS Lagoon 2 failure

While other accidents of a similar nature were identified in the hazards analysis, these accidents were selected due to their bounding risk for exposure, both radiological and nonradiological. As a result, operational accidents 1 through 4 above also represent the evaluation basis accidents for the activities analyzed in this SAR. Accidents 5 and 6 represent the beyond evaluation basis accidents analyzed in this SAR.

No major accidents or hazardous situations have occurred throughout the operational history of the site.

B.9.1.3 WVDP Evaluation Guidelines (EGs)

To facilitate the development of safety analysis evaluation guidelines for hazards associated with WVDP facilities, 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 hazard is radiological or toxicological; and
3) Whether the population at risk is the public or on-site workers.

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

For manmade accidents with either internal or external initiators, radiological EBAs are compared to EGs over the frequency spectrum of 0.1 to 1E-06 events per year. Toxicological EBAs are compared to EGs based on Secretary of Energy Notice (SEN)-35-91, *Nuclear Safety Policy,* over the frequency spectrum 0.1 to 1E-04 per year.

Public Radiological EG: Manmade EBAs 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 <1E-01 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 (.25 Sv) for accidents with estimated frequencies <1E-04 per year but >1E-06 per year. Manmade EBAs with estimated frequencies ≤1E-06 per year are not considered credible. These EGs are depicted graphically in Figure B.9.1-2.

Public Toxicological EG: For manmade EBAs with an estimated frequency of <0.1 per year but ≥1E-04 per year, the risk of prompt fatality to an average individual in the vicinity of the WVDP from accidents shall not exceed one-tenth of one percent (0.1%) of the sum of prompt fatalities resulting from other accidents to which members of the population are generally exposed. For the purposes of this SAR, this requirement shall be met by comparison of off-site hazardous material concentrations to the ERPG-2 value for that material.

On-Site Radiological EG: Manmade EBAs 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 EBAs with estimated frequencies ≤1E-06 per year are not considered credible. These EGs are depicted graphically in Figure B.9.1-3.

On-Site Toxicological EG: On-site numerical EGs shall not be required for safety assurance in the analysis of manmade accidents. For the purpose of providing a perspective for accident consequences, on-site hazardous material concentrations shall be compared against the ERPG-3 concentration for that material.

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

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

Public Toxicological EG: The risk to an average individual in the vicinity of the WVDP for prompt fatalities that might result from natural phenomena induced EBAs shall not exceed one-tenth of one percent (0.1%) of the sum of prompt fatalities resulting from other accidents to which members of the population are generally exposed. For the purposes of this SAR, this requirement shall be met by comparison of off-site hazardous material concentrations to the ERPG-2 value for that material.

On-Site Radiological EG: On-site numerical EGs shall not be required for safety assurance in the analysis of accidents induced by natural phenomena. Severe natural phenomena present hazards to on-site personnel that are dominated by nonradiological concerns. If the natural phenomena resistance capabilities for structures, systems, and components are exceeded, then the consequences of the natural phenomenon itself pose a greater risk to worker health and safety than any exposure to radioactive material released by the event.

On-Site Toxicological EG: On-site numerical EGs shall not be required for safety assurance in the analysis of accidents induced by natural phenomena.

B.9.2 Accident Analyses

B.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 SAR 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 utilize 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 codes; 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.*

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,...) and atmospheric stability is distributed into 7 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 equalled 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 SAR. See WVDP-065, *Radiological Parameters for Assessment of West Valley Demonstration Project Activities,* 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." Based on guidance presented in Regulatory Guide 1.145, Section 4, the higher value of the maximum sector χ/Q, (0.5% value) or the 5 percent overall site χ/Q, should be used in evaluations. WVDP-065 used the guidance presented above to determine that the maximum sector 0.5% χ/Q value would be used for the maximally exposed individual dose calculations. A maximum sector 0.5% χ/Q value was calculated for elevated (stack) and ground level releases. This SAR applies these χ/Q values for dose calculations performed at a distance producing maximum exposure for site-specific 95% meteorology. The expression "site-specific 95% meteorology" is often used to communicate the 5% directionally independent technique although maximum sector 0.5% χ/Q values are used for dose calculations. The rationale for this is established in Regulatory Guide 1.1.45, which 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 SAR to communicate conservatively developed site-specific χ/Q values.

Analyses to evaluate the consequences of liquid radiological releases utilize source terms developed based on the guidance given in DOE-HDBK-3010-94 and radiological dose conversion factors given in DOE/EH-0070 and DOE/EH-0071.

The consequences of nonradiological releases are calculated using a standard computer code. The Emergency Prediction Information Code (EPIcode), version 5.04, was used to model the atmospheric dispersion of nonradiological source terms from the postulated accident scenarios described in Section B.9.2.3. EPIcode is endorsed by the DOE as a useful tool for helping emergency planners estimate potential impacts from atmospheric releases of toxic substances. EPIcode used a straight-line Gaussian Plume Model to calculate peak ground-level concentrations downwind of a release. It allows the user to choose the meteorological and environmental conditions of the release, including the Pasquill-Gifford Stability Class (A-F), ground wind speed, type of terrain, effective release height, ambient temperature, and sampling time. EPIcode does not account for terrain effects, plume buoyancy, or wake effects due to nearby structures.

B.9.2.1.1 Initiating Event Summary

Initiating event summaries have not been provided for accident evaluations in this SAR as all assessments deterministically assume the occurrence of a particular accident event, with no regard for the mechanisms or chains of events necessary to arrive at the analyzed event.

B.9.2.1.2 Scenario Development

Accident scenarios have been provided in sufficient detail to support the evaluation of source terms utilized in the calculations. Scenario developments deterministically assume the occurrence of a particular accident event, with no regard for the probability of mechanisms or chains of events necessary to arrive at the analysis event.

B.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 Material-at-Risk (MAR), Damage Ratio (DR), Airborne Release Fraction (ARF) or Accident Release Rate (ARR), Respirable Fraction (RF), and Leakpath Factor (LF) and is given as: Source Term = MAR x DR x ARF x RF x LPF.

In order to bound the consequences of accidents analyzed, source terms used in this SAR are often based on the entire inventory of material at risk; that is, damage ratios and leakpath factors, as described in DOE-HDBK-3010-94, are assumed to be equal to 1. Source terms for nonradiological releases are calculated by EPIcode based on the quantity of material at risk.

B.9.2.1.4 Consequence Analysis

Consequences of radiological accidents in this SAR 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 On-site Evaluation Point (OEP), located 640 m from the center of the accident release.

Dose to off-site individuals is calculated at the nearest site boundary (1050 m (3400 ft), as shown in WVDP-065), and at the distance producing maximum exposure for site-specific 95% meteorology, namely 1700 m for an elevated (stack) release, and 2350 m (7700 ft) for a ground level release.

Consequences due to the release of radioactive liquids are calculated through multiplication of an ingested source quantity by dose factors given in DOE/EH-0071. The ingested source quantity is determined from the original accident source term, subsequent source dilution and ingestion rates taken from NRC Regulatory Guide 1.109, *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Appendix I.*

Consequences of nonradiological airborne releases are calculated for individuals at the OEP 640 m (2100 ft) and site boundary 1050 m (3400 ft). The magnitude of these consequences are calculated through use of the EPIcode which uses a straight-line Gaussian Plume Model to calculate peak ground-level concentrations downwind of a release.

B.9.2.1.5 Comparison to Guidelines

Guidelines utilized for the comparison to accident analysis consequences are given in Section B.9.1.3. Guidelines for both radiological and toxicological consequences due to operating and natural phenomena accidents are provided. Maximum acceptable consequences for radiological accidents are given in Figures B.9.1-2 and B.9.1-3. Maximum acceptable concentrations for nonradiological accidents are defined as ERPG-2 for off-site evaluations and ERPG-3 for on-site evaluations, regardless of the probability of occurrence. For the purposes of evaluation of Unreviewed Safety Questions, these consequences present the authorization basis risk for activities conducted in facilities within the scope of this SAR.

B.9.2.2 <u>Operational Accidents</u>

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 B.9.1.3 based on the probability of occurrence.

B.9.2.2.1 Ventilation System Filter Failure

B.9.2.2.1.1 Scenario Development

The Main Plant ventilation system provides contamination control for several areas in the Main Plant building including those areas associated with LWTS and Analytical Laboratory operations. Currently, site ventilation systems do not provide instruments for real-time filter activity measurements. An indication of filter activity is obtained from routine radiation surveys of adjacent operating areas. Highly conservative assumptions have been made regarding the accident source term.

The ventilation system is comprised of a bank of 30 roughing filters in series with a bank of 30 HEPA filters. The deterministic assumption has been made that a pressure excursion in the ventilation system results in the rupture and subsequent release of the entire bank of 30 HEPA filters.

B.9.2.2.1.2 Source Term Analysis

Contamination remaining from original NFS reprocessing activities is the primary source of contamination deposited on Main Plant ventilation filters. Several years of operational experience has shown that ventilation system filter changeout is initiated as a result of high filter differential pressure rather than exposure rate. Nevertheless, the assumption has been made that activity loading on Main Plant HEPA filters results in a surface exposure rate of 10 R/hr. Calculations have shown that an exposure rate of 1 R/hr at the face of a HEPA filter corresponds to a Cs-137 loading of 0.75 Ci (2.8E10 Bq) (Peterson, 1985). Assuming an exposure rate of 10 R/hr per filter, 0.75 Ci (2.8E10 Bq) of Cs-137 per R/hr measured exposure rate and 30 filters results in a filter bank Cs-137 activity loading of 225 Ci (8.3E12 Bq).

The total filter activity is found by scaling the nuclides given in Table B.9.2-1 to 225 Ci (8.3E12 Bq) of Cs-137. Based on this source inventory, the source term given in Table B.9.2-1 was computed from ARF and RF values given in DOE-HDBK-3010-94. These values are 1.0E-2 and 1.0, respectively.

At the Cs-137 levels assumed, calculations have determined that the exposure rate in the adjacent operating aisle would approach 1 R/hr, inconsistent with the ALARA principle given in WVDP-010. In addition, activity concentrations measured from dust samples collected from HEV roughing filters indicate that in order to achieve the assumed exposure rates, approximately 150 kg (330 lb) of dust would need to be deposited per filter (4.5 MT/filter bank). Based on these considerations it is therefore believed that the assumed inventory bounds any conceivable filter failure scenario.

B.9.2.2.1.3 Analysis of Results

Table B.9.2-1 presents the dose at the on-site evaluation point and to off-site individuals from the complete failure of the Main Plant ventilation system filter bank for various meteorological conditions. The maximum total effective dose equivalent at the on-site evaluation point has been calculated to be 6.4 rem, as shown in Table B.9.2-1. The maximum total effective dose equivalent received by an off-site individual has been calculated to be 2.7 rem (0.027 Sv). It should be noted that these doses have been calculated based on the highly conservative assumptions of very high filter activity loading and total filter bank failure. It is not expected that either of these analysis basis parameters would be approached.

B.9.2.2.1.4 Comparison to Guidelines

Section B.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.

Radiological evaluation guidelines given in Section B.9.1.3 state that total effective dose equivalent to the maximally exposed off-site individual due to an operational accident shall not be greater than 0.5 rem (0.005 Sv) for accidents with estimated frequencies < 0.1 event per year but ≥ 0.01 event per year; 5 rem (0.05 Sv) for accidents with estimated frequencies < 1E-2 event per year but ≥ 1E-4 event per year; and 25 rem (0.25 Sv) for accidents with estimated frequencies < 1E-4 event per year but ≥ 1E-6 event per year.

For the on-site evaluation point, the dose limit is 5 rem (0.05 Sv) TEDE for accidents with estimated frequencies <0.1 event per year but ≥0.01 event per year; 25 rem (0.25 Sv) TEDE for accidents with estimated frequencies <1E-2 event per year but ≥1E-4 event per year; and 100 rem (1.0 Sv) TEDE for those accidents with estimated frequencies <1E-4 event per year but ≥1E-6 event per year.

The doses to the maximally exposed off-site individual (2.7 rem TEDE) and the maximum exposure at the on-site evaluation point (6.4 rem TEDE) due to the failure of the bank of ventilation system filters are below the radiological dose acceptance criteria specified in Section B.9.1.3.

B.9.2.2.2 Hydrogen Peroxide Spill

B.9.2.2.2.1 Scenario Development

Technical grade 35% hydrogen peroxide is stored in 1,050 L (330 gal) polyethylene totes in the Oxidizer Room of the New Warehouse. Due to installed safety features in the Oxidizer Room (collective berm, automatic sprinkler system, controlled ventilation) and administrative controls which limit access to the room, a spill and/or a fire within the oxidizer room would be of limited severity, with no consequence to the off-site public.

A maximum of one tote can be placed on a forklift for transport at any time. With only the drum as a barrier to release to the environment, a significant spill outside of the Oxidizer Room presents a risk requiring further evaluation.

B.9.2.2.2.2 Source Term Analysis

The release rate of the hydrogen peroxide from the tote is not significant since evaporation is the dominant release mechanism. It was assumed that one tote spills its entire contents outside the warehouse (330 gal). For conservatism, it was assumed that the temperature of the hydrogen peroxide was 30°C (86°F) and that the total quantity spilled from the tote formed a uniform 1 mm (0.039 in) deep pool.

B.9.2.2.2.3 Analysis of Results

For Pasquill-Gifford stability class "F" and 1 m/s wind speed conditions, EPIcode calculated ground-level concentrations of 17.5 ppm at the 640 m (2100 ft) on-site evaluation point (OEP) and 8.75 ppm at the 1050 m (3400 ft) site boundary. Conditions of stability class "D" and 4.5 m/s wind speed resulted in ground-level concentrations of 3.08 ppm at the OEP and 1.50 ppm at the 1050 m site boundary. The 17.5 ppm OEP concentration is less than the 100 ppm ERPG-3 level, and the 8.75 ppm concentration at the 1050 m site boundary is well below the ERPG-2 level of 50 ppm.

B.9.2.2.2.4 Comparison to Guidelines

Toxicological evaluation guidelines specified in Section B.9.1.3 state that dosages to the maximally exposed off-site individual due to an operational accident shall not exceed the ERPG-2 dosage. If ERPG information is not available for a toxicological hazard, the EG shall be either (1) one-tenth of the IDLH concentration; or (2) any better toxicological information available to indicate estimated dosages do not represent a potential health threat in excess of the ERPG-2 definition.

Though on-site numerical EGs are not required for the analysis of manmade accidents, on-site hazardous material concentration are compared against the ERPG-3 concentrations for that material. If ERPG information is not available for a toxicological hazard, the evaluation guideline shall be either (1) the IDLH concentration; or (2) any better toxicological information available to indicate estimated dosages do not represent a potential health effect in excess of the ERPG-3 definition.

The dosage to the maximally exposed off-site individual (8.75 ppm) and the maximum dosage at the on-site evaluation point (17.5 ppm) due to a hydrogen peroxide spill are below the ERPG comparison values of 50 ppm and 100 ppm, respectively.

B.9.2.2.3 Main Plant Transformer Rupture

B.9.2.2.3.1 Scenario Development

The Main Plant transformer contains approximately 586 gal (2200 L) of PCB-contaminated Wemco "C" oil, a hydrotreated light napthenic that is a confirmed carcinogen, which serves as a heat-transfer media. The concentration of PCBs in the oil has been measured at 292 ppm, or about 0.17 gal (0.64 L). This contamination came from residual amounts of PCBs in the equipment used to fill the transformer.

The transformer containment could be breached by external impact or structural failure due to a seismic event. Once a puncture/failure has occurred, the coolant (PCB-laden oil) above the failure location would empty to the gravel below at a rate dependent upon the size of the failure. Evaporation of the pool formed by the spill and airborne transport of the PCBs would follow.

B.9.2.2.3.2 Source Term Analysis

The release rate of contaminated oil from the transformer is not important since evaporation of the PCBs is the dominant release mechanism. The rate of evaporation from the oil depends on the ambient temperature, wind speed, and surface area formed as a result of the spill. To achieve the maximum evaporation rate, it was assumed that the temperature of the oil was 30°C (86°F) and that the total quantity of oil in the transformer formed a uniform 1 mm (0.039 in) deep pool.

B.9.2.2.3.3 Analysis of Results

For Pasquill-Gifford stability class "F" and 1 m/s wind speed conditions, EPIcode calculated ground-level concentrations of 6.4E-03 mg/m^3 and 3.1E-03 mg/m^3 on-site and off-site, respectively. Conditions of stability class "D" and 4.5 m/s wind speed resulted in slightly lower concentrations downwind, 1.1E-03 mg/m^3 and 5.5E-04 mg/m^3, respectively. These concentrations are well below the 3 mg/m^3 ERPG-1 level.

B.9.2.2.3.4 Comparison to Guidelines

Guidelines for toxicological dosages are those specified in Section B.9.2.2.2.4. The dosage to the maximally exposed off-site individual (3.1E-3 mg/m^3) and the maximum exposure at the on-site evaluation point (6.4E-3 mg/m^3) due to a transformer leak are below the toxicological dosage acceptance criteria (3 mg/m^3 and 5 mg/m^3, respectively) specified in Section B.9.1.3.

B.9.2.2.4 Fire In Lag Storage Facility

B.9.2.2.4.1 Scenario Development

The Lag Storage Building and Lag Storage Annexes 1, 3, and 4 contain approximately 7000 m^3 (2.5E5 ft^3) of mixed, transuranic, and low-level waste stored in carbon steel drums and boxes. Of this inventory, 1650 m^3 (5.8E4 ft^3) is estimated to be combustible material such as anti-contamination clothing and flammable liquids. Lag Storage Annex #4 contains the most combustible waste by volume at approximately 620 m^3 (2.2E4 ft^3)

A fire could occur in the Lag Storage Facility, causing some of the combustible material to ignite and burn. This analysis assumes that a fire occurs in Lag Storage Annex #4 and that the combustion of waste results in airborne transport of radionuclides from the facility.

B.9.2.2.4.2 Source Term Analysis

The entire volume of combustible waste in Lag Storage Annex #4 is assumed to be consumed by the fire. Release of radionuclides to the environment occurs via airborne transport assuming ARF and RF values given in DOE-HDBK-3010-94 for thermal stress of packaged mixed waste. Bounding values of 5E-4 for ARF and 1.0 for RF are used. All major radionuclides (those contributing >0.1% of the total TEDE) are considered in the dose calculations. Typical radionuclide inventories for Lag Storage waste containers are given in Table B.7.7-2.

B.9.2.2.4.3 Analysis of Results

Radiological consequences were analyzed for airborne pathways only. Table B.9.2-2 presents the dose at the on-site evaluation point and to off-site individuals from a fire in Lag Storage Annex #4 for various meteorological conditions. The maximum Total Effective Dose Equivalent (TEDE) at the on-site evaluation point is 6.2 rem (0.062 Sv), while the maximum TEDE received by an off-site individual is 2.9 rem (0.029 Sv).

Although all combustible material in Lag Storage Annex #4 is assumed to be consumed by the fire, it is unlikely that a fire of sufficient intensity to breach and completely burn all combustible waste containers would develop before mitigative actions were taken. The envisioned fire for this accident scenario is comparable to the fire postulated for the "maximum possible fire loss" (MPFL), as presented in WVNS-FHA-003, *Fire Hazard Analysis Lag Storage Area 4*. The MPFL includes "the complete loss of the building structure, including all exterior walls, roof, and possibly steel truss structure." The most likely source of the MPFL would be a natural gas leak in the Sterling/Alton gas-fired appliance. The escaping gas could find an ignition source resulting in a fire, and a possible explosion, engulfing Lag Storage Annex #4. Since the likelihood of such a catastrophic scenario is very small, actual doses received by on-site and off-site individuals from a fire-related incident are likely to be considerably lower than doses postulated by this accident scenario.

B.9.2.2.4.4 Comparison to Guidelines

Guidelines for operational accidents are those discussed in Section B.9.2.2.1.4. The doses to the maximally exposed off-site individual (2.9 rem TEDE) and the maximum exposure at the on-site evaluation point (6.2 rem TEDE) due to a fire in Lag Storage Annex #4 are below the radiological dose acceptance criteria specified in Section B.9.1.3.

B.9.2.3 Natural Phenomena Events

Natural phenomena accidents are those events having external, natural initiators, such as earthquakes, tornadoes and floods. Consequences of these accidents are evaluated against guidelines given in Section B.9.1.3, independent of the probability of occurrence.

B.9.2.3.1 Earthquake Induced Failure of Tank 8D-2 Roof and Vault

B.9.2.3.1.1 Scenario Development

The HLW remaining from the PUREX process, the THOREX campaign, and Phase I pretreatment operations at the WVDP is contained in underground storage tank 8D-2. As shown in Figure B.5.1-1 the HLW tanks are located in the Waste Tank Farm (WTF) north of the Vitrification Facility. The primary barriers (storage tanks, risers, vaults, and pump pits) have been designed to withstand design basis earthquake described in Section B.5.2. It is assumed that the occurrence of a severe earthquake greater than six times the design basis (0.1g) causes the roof of Tank 8D-2 and its vault to collapse, exposing the tank contents to the atmosphere. The evaporated Vit feed solution is released without passing through any filtration. Tank 8D-2 contains the entire feed inventory for the WVDP high-level waste processing system (Vitrification). Failure of this vessel was therefore selected for analysis due to the large radionuclide inventory in the tank relative to other vessels.

B.9.2.3.1.2 Source Term Analysis

For this analysis it is assumed that the occurrence of a severe earthquake causes the roof of the vault and tank to collapse, allowing the evaporation of liquid from the tank. The evaporated solution is assumed to be released directly to the environment. The source term quantity is based on bounding airborne release rates given in DOE-

HDBK-3010-94 for evaporative loss from pools. Bounding release rates of 4E-8 per hour for non-volatiles and 1.0 for volatiles were applied to the source inventory given in Table B.4.1-1. The respirable fraction for all releases is assumed to be 1.0.

B.9.2.3.1.3 Analysis of Results

Radiological consequences were analyzed for airborne pathways only. All major radionuclides (those contributing >0.1% of the total TEDE) were used in the dose calculations. Table B.9.2-3 presents the dose at the on-site evaluation point and to off-site individuals from the catastrophic failure of the 8D-2 tank and vault for several meteorological conditions. The maximum total effective dose equivalent (TEDE) at the on-site evaluation point is 21 rem (0.21 Sv). The maximum TEDE to the off-site individual has been calculated to be 9.9 rem (0.099 Sv).

B.9.2.3.1.4 Comparison to the Guidelines

Section B.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 radiological dose acceptance criteria (25 rem TEDE) for the maximally exposed off-site individual specified in Section B.9.1.3, for a natural phenomena event, is independent of frequency. On-site numerical dose evaluation guidelines are not required for safety assurance in accident analyses for natural phenomena.

The dose to the maximally exposed off-site individual due to Tank 8D-2 vault failure (9.9 rem TEDE) is well below the radiological dose acceptance criteria specified in Section B.9.1.3 for natural phenomena events.

B.9.2.3.2 Earthquake Induced Failure of LLWTS Storage Lagoon 2

B.9.2.3.2.1 Scenario Development

Lagoon 2 provides temporary storage for low-level liquid wastes generated at the WVDP prior to decontamination and eventual release to the environment. As indicated in Figure B.7.7-1, Lagoon 2 is adjacent to the embankment leading to the Erdman Brook drainage basin. This embankment has not been designed to withstand seismic accelerations and the deterministic assumption is made that the lagoon basin wall fails as a result of a seismic event. Furthermore it has been assumed that Lagoon 3 has just been emptied, thereby reducing the strength and ability of the wall between Lagoons 2 and 3 to withstand a seismic event. This assumption provides additional conservatism as the contents of Lagoon 3 would act to dilute the source strength of Lagoon 2 due to decontamination by the LLWTS.

B.9.2.3.2.2 Source Term Analysis

The source term for this analysis is based on a seven year average of radionuclide concentrations measured in Lagoon 3 discharge corrected for decontamination at the LLWTS. (Derivation of Lagoon 2 concentrations from Lagoon 3 concentrations is necessitated by the fact that comprehensive analyses of radionuclides in Lagoon 2 is not routinely performed.) The calculated Lagoon 2 composition is then scaled to a maximum gross beta concentration of 5E-3 uCi/mL to achieve the analysis basis concentration which is given in Table B.7.5-1. For this analysis Lagoon 2 is assumed to be full to its operating capacity (9,500,000 L) with water having this radionuclide composition.

B.9.2.3.2.3 Analysis of Results

Table B.9.2-4 presents the dose to the maximally exposed off-site individual from ingestion of 2 L (0.53 gal) of contaminated water taken from Cattaraugus Creek. Cattaraugus Creek has an average flow rate of 3,620,000 L/h (West Valley Nuclear Services Co., Inc., WVDP-065). It has been assumed that the entire volume of Lagoon 2 reaches Cattaraugus Creek in 1 hour. The committed effective dose equivalent to the maximally exposed off-site individual is calculated to be approximately 0.41 rem (0.0041 Sv).

B.9.2.3.2.4 Comparison to Guidelines

Guidelines for natural phenomena are those discussed in Section B.9.2.3.1.4. The dose to the maximally exposed off-site individual due to a lagoon embankment failure (0.41 rem CEDE) is well below the radiological dose acceptance criteria specified in Section B.9.1.3.

B.9.2.4 <u>Accident Analysis Summary</u>

A summary of the consequences of accidents analyzed in this SAR is provided in Table B.9.2-5. All accidents analyzed are within the evaluation guidelines given in Section B.9.1.3. The failure and release of the entire liquid fraction of Tank 8D-2 results in a total effective dose equivalent to the maximally exposed off-site individual of 9.9 rem (0.099 Sv). This represents the bounding accident for radiological releases. The spill of hydrogen peroxide results in an exposure to an off-site individual of 10 ppm and an exposure to an on-site individual of 21 ppm. These exposures are below the toxicological dosage acceptance criteria. This represents the bounding accident for nonradiological releases.

REFERENCES FOR CHAPTER B.9.0

Crocker, R. L. October 10, 1989. *Vitrification Mass Balance Revision Number 7.* Letter EK:890232.

Dames & Moore. September 27, 1995. *Technical Bases for Consolidated WVNS-SAR-002 Process Hazards Analysis, Rev. 1.* Memo to File. (D&M:OP:0023)

Emergency Prediction Information Code. *EPIcode. Version 5.04.*

Gates, W. E. September, 1994. *Confinement Barrier Integrity Review High Level Waste Transfer Piping West Valley Demonstration Project for West Valley Nuclear Services Company, Inc.* Subcontract No. 10805-867-004.

Kupp, R. W. July, 1992. *Hazard Assessment for the Scale Vitrification System - III.* Attached to letter from C.J. Roberts to T.J. Rowland (WD:92:0869.)

Pacific Northwest Laboratory. November 1982. *PAVAN: An Atmospheric Dispersion Program for Evaluating Design Basis Accidental Releases of Radioactive Materials from Nuclear Power Stations.* NUREG/CR-2858, PNL-4413.

Peterson, J.M. February 8, 1985. *Correlation of Exposure Rate with Radionuclide Inventory on a Loaded HEPA Filter.* Memo to C. P. Bliss. (HE:85:0016.)

Prowse, J.J. April 23, 1991. *H_2 Generation in Tank 8D-2 During SMWS Operations.* Memo to C. J. Roberts. (FB:91:0085.)

Roberts, C.J. November 13, 1990. *Criticality Analysis for LWTS Evaporator - Rev. 2.* Memo to R. A. Humphrey. (FB:90:0300.)

U.S. Department of Energy. December, 1994. DOE-HDBK-3010-94: *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities.* Washington, D.C.: U.S. Department of Energy.

__________. September 9, 1991. Secretary of Energy Notice 35-91: *Nuclear Safety Policy.* Washington, D.C.: U.S. Department of Energy.

__________. July, 1988. DOE/EH-0070: *External Dose-Rate Conversion Factors for Calculation of Dose to the Public.* Washington, D.C.: U.S. Department of Energy.

__________. July, 1988. DOE/EH-0071: *Internal Dose Conversion Factors for Calculation of Dose to the Public.* Washington, D.C.: U.S. Department of Energy.

REFERENCES FOR CHAPTER B.9.0 (concluded)

U.S. Nuclear Regulatory Commission. October, 1977. Regulatory Guide 1.109: *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Appendix I.* Revision 1.

__________. November, 1982. Regulatory Guide 1.145: *Atmospheric Dispersion Models for Potential Accident Consequences Assessments at Nuclear Power Plants.* Revision 1.

West Valley Nuclear Services Co. 1992. WVDP-010: *WVDP Radiological Controls Manual.* (Latest Revision.) West Valley Nuclear Services Co., Inc.

__________. WVDP-011: *WVNS Industrial Hygiene and Safety Manual.* (Latest Revision.) West Valley Nuclear Services Co.

__________. WVDP-043: *Spill Prevention Control and Countermeasures Plan.* (Latest Revision.) West Valley Nuclear Services Co.

__________. WVDP-065: *Radiological Parameters for Assessment of West Valley Demonstration Project Activities.* (Latest Revision.) West Valley Nuclear Services Co.

__________. WVDP-193: *WVDP Hazards Assessment.* (Latest Revision.) West Valley Nuclear Services Co.

__________. WVNS-FHA-003: *Fire Hazard Analysis Lag Storage Area 4.* (Latest Revision.) West Valley Nuclear Services Co.

Wolniewicz, J.C. October 28, 1993. *Evaluation of a Criticality in a Main Plant Cell.* Memo to M. E. Crotzer and M. N. Haas. (BJ:93:0026.)

Yuan, Y.Y. January 30, 1991. *Criticality Evaluation (including Plutonium and Uranium) of LWTS Evaporator.* Memo to C. J. Roberts. (FB:91:0027.)

TABLE B.9.1-1

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
SUPERNATANT TREATMENT SYSTEM AND WASTE TANK FARM					
High Level Waste Transfer System					
Zeolite transfer from tank 8D-1 to 8D-2: Maximum pump rate - 110 gpm.					
HLW Zeolite (See Table B.4.1-1)	1) Leak at jumper connection 2) Transfer line rupture 3) Transfer line rupture and trench failure due to seismic event	- Double-walled stainless steel piping - Concrete trench with sealed covers - Stainless steel lined concrete pump pits with sealed covers - Leak detectors in transfer lines and pump pits - Shielding - 2 feet of concrete - Clayey till	1) Negligible 2) Negligible 3) Negligible	1) Unlikely 2) Extremely unlikely 3) Incredible [7]	1) 0 2) 0 3) 0
Supernatant Treatment System					
Airborne Contamination	1) Loss of line power 2) Backflow due to direct tornado strike 3) Loss of confinement barrier integrity due to tornado	- Redundant vent system blowers - Seals on valve aisle penetrations - Multiple barriers to direct cell access - Redundant vent system filter trains - Monolithic cell structure	1) Negligible 2) Negligible [1] 3) Negligible [1]	1) Anticipated 2) Extremely Unlikely 3) Extremely Unlikely	1) 0 2) 0 3) 0
Process Lines Between Vessels					
High level waste (See Table B.4.1-1)	1) Process line leak 2) Process line failure 3) Process line and confinement loss due to seismic event	- Clayey till	1) Negligible 2) Negligible 3) Low	1) Unlikely 2) Extremely unlikely 3) Incredible	1) 0 2) 0 3) IE
No ID # Volume: 19,000 L	Name: Caustic Addition System	Location: Yard north of HLW tanks	Construction: N/A		
NaOH	1) Tanker truck leak 2) Tanker truck failure	- Portable berm - Inflatable berm	1) Negligible 2) Negligible	1) Unlikely 2) Extremely unlikely	1) 0 2) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
8D-1 Volume: 2,800,000 L	Name: PUREX HLW Tank	Location: Waste Tank Farm	Construction: Carbon steel		
Cs loaded zeolite (See Table B.4.1-1)	1) Loss of ventilation 2) Tank leak due to corrosion 3) Tank failure due to seismic event 4) Tank and vault failure due to seismic event	- 1/2 inch carbon steel tank - Liquid level indicators - Pressure indicators - Carbon steel pan • - Reinforced concrete vault - Clayey till	1) Negligible 2) Negligible 3) Negligible 4) Low	1) Unlikely 2) Anticipated 3) Extremely unlikely 4) Incredible	1) 0 2) 0 3) 0 4) I
8D-2 Volume: 2,800,000 L	Name: PUREX HLW Tank	Location: Waste Tank Farm	Construction: Carbon steel		
High level waste (See Table B.4.1-1)	1) Loss of ventilation 2) Tank leak due to corrosion [1] 3) Tank failure due to seismic event 4) Tank and vault failure due to seismic event 5) Tank over-pressurization due to H_2 explosion	- 1/2 inch carbon steel tank - Liquid level indicators - Pressure indicators - Carbon steel pan - Reinforced concrete vault - Clayey till - Tank ventilation and natural convection to remove H_2 buildup [2]	1) Negligible 2) Negligible 3) Low 4) Moderate 5) Moderate	1) Unlikely 2) Anticipated 3) Extremely unlikely 4) Incredible 5) Incredible [2]	1) 0 2) 0 3) 1 4) IE 5) I
8D-3 Volume: 57,000 L	Name: STS Product Tank	Location: Waste Tank Farm	Construction: Stainless steel		
1) Processed HLW 2) VF CFMT overheads [See 1) Table B.4.1-1, and 2) Crocker, 1989]	1) Loss of ventilation 2) Tank leak 3) Tank failure due to seismic event 4) Tank and vault failure due to seismic event	- Stainless steel tank - Liquid level indicators - Pressure indicators - Reinforced concrete vault lined with stainless steel - Clayey till	1) Negligible 2) Negligible 3) Negligible 4) Moderate	1) Unlikely 2) Extremely unlikely 3) Incredible 4) Incredible	1) 0 2) 0 3) 0 4) I

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
8D-4 Volume: 57,000 L	Name: Waste Header Effluent Tank	Location: Waste Tank Farm	Construction: Stainless steel		
VF CFMT overheads (See Crocker, 1989)	1) Loss of ventilation 2) Tank leak 3) Tank failure due to seismic event 4) Tank and vault failure due to seismic event	- Stainless steel tank - Liquid level indicators - Pressure indicators - Reinforced concrete vault lined with stainless steel - Clayey till	1) Negligible 2) Negligible 3) Low 4) Moderate	1) Unlikely 2) Extremely unlikely 3) Incredible 4) Incredible	1) 0 2) 0 3) I 4) I
50C-001 Volume: 7,200 L 50C-002 Volume: 7,200 L 50C-003 Volume: 7,200 L 50C-004 Volume: 7,200 L	Name: IX Column Name: IX Column Name: IX Column Name: IX Column	Location: Tank 8D-1 Location: Tank 8D-1 Location: Tank 8D-1 Location: Tank 8D-1	Construction: Stainless steel Construction: Stainless steel Construction: Stainless steel Construction: Stainless steel		
High level waste (See Table B.4.1-1)	1) Column leak due to corrosion 2) Column failure due to over-pressurization 3) Column failure due to seismic event	- Stainless steel IX column - Pressure indicators - Low, high level alarms - 8D-1 carbon steel tank - Liquid level indicators - Pressure indicators - Carbon steel pan - Reinforced concrete vault - Clayey till	1) Negligible 2) Negligible 3) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Incredible	1) 0 2) 0 3) 0
50D-001 Volume: 6,535 L	Name: Supernatant Feed Tank	Location: Tank 8D-1	Construction: Stainless steel		
High level waste (See Table B.4.1-1)	1) Tank leak 2) Tank failure due to seismic event 3) Tank failure due to over-pressurization 4) Overflow	- Stainless steel tank - 8D-1 carbon steel tank - Liquid level indicators - Pressure indicators - Carbon steel pan - Reinforced concrete vault - Clayey till	1) Negligible 2) Negligible 3) Negligible 4) Negligible	1) Extremely unlikely 2) Incredible 3) Extremely unlikely 4) Unlikely	1) 0 2) 0 3) 0 4) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
50D-002	Name: Zeolite Batch Tank	Location: STS Building			
Fresh Zeolite	1) Tank leak 2) Tank failure due to seismic event	- Confinement provided by STS building	1) Negligible 2) Negligible	1) Extremely unlikely 2) Extremely unlikely	1) 0 2) 0
50D-003	Name: Fresh Water Tank	Location: STS Operating Aisle			
Fresh water	1) Tank leak 2) Tank failure due to seismic event		1) Negligible 2) Negligible	1) Extremely unlikely 2) Extremely unlikely	1) 0 2) 0
50D-004 Volume: 8,110 L	Name: Sluice Lift Tank	Location: Tank 8D-1		Construction: Stainless steel	
Sluice water (See Table B.4.1-1)	1) Tank leak 2) Tank failure due to seismic event	- Stainless steel tank - High and low level alarms - 8D-1 carbon steel tank - Carbon steel pan - Reinforced concrete vault - Clayey till	1) Negligible 2) Negligible	1) Unlikely 2) Extremely Unlikely	1) 0 2) 0
50D-005	Name: Water Break Tank	Location: STS Valve Aisle			
STS process upset safeguard tank	1) Tank leak 2) Tank failure due to seismic event 3) Overflow	- Stainless steel tank - STS valve aisle sump - STS building - High and low level alarms	1) Negligible 2) Negligible 3) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Unlikely	1) 0 2) 0 3) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
50D-006	Name: Air Break Tank	Location: STS Valve Aisle			
STS process upset safeguard tank	1) Tank leak 2) Tank failure due to seismic event	- Stainless steel tank - STS valve aisle sump - STS building - High and low level alarms	1) Negligible 2) Negligible	1) Extremely unlikely 2) Extremely unlikely	1) 0 2) 0
50D-007	Name: Fines Collection Tank	Location: STS Building			
Fresh Zeolite	1) Tank leak 2) Tank failure due to seismic event	- Confinement provided by STS building	1) Negligible 2) Negligible	1) Extremely unlikely 2) Extremely unlikely	1) 0 2) 0
50D-008 Volume: 57 L	Name: Brine Chiller Expansion Tank	Location: STS Building	Construction: Stainless steel		
Brine Sodium nitrate	1) Tank leak 2) Tank failure due to seismic event	- Concrete berm - STS operating aisle sump - Drains to tank 8D-1	1) Negligible 2) Negligible	1) Extremely unlikely 2) Extremely unlikely	1) 0 2) 0
50E-001	Name: Supernatant Cooler	Location: Tank 8D-1	Construction: Stainless steel		
High level waste (See Table B.4.1-1)	1) Cooler leak 2) Cooler failure due to seismic event	- Stainless steel cooler - 8D-1 carbon steel tank - Liquid level indicators - Pressure indicators - Carbon steel pan - Reinforced concrete vault - Clayey till	1) Negligible 2) Negligible	1) Extremely unlikely 2) Incredible	1) 0 2) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
50E-002 Volume: 220 L	Name: Brine/Heat Exchanger	Location: STS Operating Aisle	Construction: Stainless steel		
Brine solution of sodium nitrate	1) Tank leak 2) Tank failure due to seismic event	- Stainless steel tank - Concrete berm - Operating aisle sump - Sight gauge - Drains to tank 8D-1	1) Negligible 2) Negligible	1) Extremely unlikely 2) Extremely unlikely	1) 0 2) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
50F-001 Volume: N/A	Name: Prefilter	Location: Tank 8D-1	Construction: Stainless steel		
High level waste (See Table B.4.1-1)	1) Filter leak 2) Filter failure due to seismic event 3) Filter failure due to over-pressurization	- 8D-1 carbon steel tank - Stainless steel filter housing - Temperature indicator - Pressure indicator - Reinforced concrete vault - Clayey till - Low, high level alarms	1) Negligible 2) Negligible 3) Negligible	1) Extremely unlikely 2) Incredible 3) Extremely unlikely	1) 0 2) 0 3) 0
50F-002 Volume: 530 L	Name: Sand Postfilter	Location: Tank 8D-1	Construction: Stainless steel		
Processed high level waste solution (See Table B.4.1-1)	1) Filter leak 2) Filter failure due to seismic event 3) Filter failure due to over-pressurization	- 8D-1 carbon steel tank - Stainless steel filter housing - Pressure indicator - Reinforced concrete vault - Clayey till - High level alarms	1) Negligible 2) Negligible 3) Negligible	1) Extremely unlikely 2) Incredible 3) Extremely unlikely	1) 0 2) 0 3) 0
50V-001 Volume:	Name: Chiller	Location:	Construction: Stainless steel		
High level waste (See Table B.4.1-1)	1) Chiller leak 2) Chiller failure due to seismic event	- Stainless steel chiller - 8D-1 carbon steel tank - Liquid level indicators - Pressure indicators - Carbon steel pan - Reinforced concrete vault - Clayey till	1) Negligible 2) Negligible	1) Extremely unlikely 2) Incredible	1) 0 2) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
Waste Tank Farm Ventilation System					
Waste Tank Farm Ventilation System					
1) Airborne contamination 2) Contaminated liquid	1) Loss of contaminated airborne confinement due to filter failure 2) Loss of contaminated airborne confinement due to vent duct failure 3) Loss of contaminated liquid confinement due to condensate piping failure/leak 4) Loss of contaminated liquid confinement due to vessel failure	- WTF HEPA filter differential pressure indication/alarm - Redundant HEPA filter trains and blowers - Ventilation system backup via PVS - Containment of WTF ventilation system vessels by WTF shelter; drains to 8D-1 or 8D-2	1) Negligible 2) Negligible 3) Negligible 4) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Extremely unlikely 4) Extremely unlikely	1) 0 2) 0 3) 0 4) 0
8D-6 Volume: 1,900 L	Name: WTF Off-Gas Knock-Out Pot	Location: WTF Shelter	Construction: Carbon steel		
Liquid LLW (See Table B.4.1-1)	1) Tank leak due to corrosion 2) Tank failure due to seismic event 3) Overflow	- Containment by WTF shelter - Overflow to 8D-1 or 8D-2	1) Negligible 2) Negligible 3) Negligible	1) Extremely unlikely 2) Incredible 3) Unlikely	1) 0 2) 0 3) 0
8D-7 Volume: 950 L	Name: WTF Off-Gas Relief Tank	Location: WTF shelter	Construction: Carbon steel		
Liquid LLW (See Table B.4.1-1)	1) Tank leak due to corrosion 2) Tank failure due to seismic event 3) Overflow	- Containment by WTF shelter - Overflow to 8D-1 or 8D-2	1) Negligible 2) Negligible 3) Negligible	1) Extremely unlikely 2) Incredible 3) Unlikely	1) 0 2) 0 3) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
8C-1 Volume: 2,650 L	Name: Off-Gas Caustic Scrubber	Location: WTF Shelter	Construction: Carbon steel		
Liquid LLW (See Table B.4.1-1)	1) Scrubber leak due to corrosion 2) Scrubber failure due to seismic event 3) Overflow	- Containment by WTF shelter - Overflow to 8D-6 - High/low level alarm	1) Negligible 2) Negligible 3) Negligible	1) Extremely unlikely 2) Incredible 3) Unlikely	1) 0 2) 0 3) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
MAIN PLANT AND LIQUID WASTE TREATMENT SYSTEM					
Main Plant					
Airborne Contamination	1) Loss of line power 2) Backflow due to direct tornado strike 3) In-cell explosion or fire 4) HEPA filter failure 5) HEPA filter fire	- Redundant vent system blowers - Backflow filters on highly contaminated cells - Seals on penetrations - Multiple barriers to direct cell access (airlock, crane room, shield door) - No explosives contained in cells - Minimal or no combustibles in cells - Redundant vent system filter trains - Cell pressure indicators	1) Negligible 2) Negligible 3) Low 4) Moderate 5) Low	1) Anticipated 2) Extremely unlikely 3) Extremely unlikely 4) Extremely unlikely 5) Extremely unlikely	1) 0 2) 0 3) 1 4) 3 5) 1
Criticality	1) Accumulation of fissile material into critical configuration 2) Moderation of existing accumulation 3) Plateout of fissile material in vent ducting or LWTS evaporator 4) Concentration of fissile material in LWTS evaporator acid wash solution	- Strict administrative controls on storage and handling of fissile material - Substantial shielding by cells containing significant quantities of fissile material (as contamination) - Sumps and sump alarms to indicate inleakage of water - Routine plant radiation surveys to determine contamination accumulations - Critically safe design of the evaporator - Evaporator, waste vessels in heavily shielded cells	1) Low 2) Low [3] 3) Moderate [4 & 5] 4) Low [4 & 5]	1) Extremely unlikely 2) Extremely unlikely [3] 3) Incredible 4) Incredible	1) 1 2) 1 3) I 4) I

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
Contaminated Liquid	1) Overflow of cell sump 2) Transfer pipe failure 3) LWTS pump leak	- Cell sump alarm - Berms in cells containing active vessels - LWTS pumps contained in sealed niches with drains back to extraction cell	1) Negligible 2) Negligible 3) Negligible	1) Unlikely 2) Extremely unlikely 3) Anticipated	1) 0 2) 0 3) 0
Natural Gas	1) Explosion due to accumulation	- Only minor amount of gas piping in confined areas - No piping in areas containing hazardous material	1) Negligible [1]	1) Extremely unlikely	1) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
Head End Cells					
Fuel/Hull Material	28) Criticality due to accumulation of water (moderator) in the cell. 29) Metal fire involving Zr cladding or UO_2 30) Fire/explosion due to ignition of high concentrations of airborne, finely-divided particulate material 31) Fire in HEV filter bank due to pyrophoric reaction in HEC 32) Unrestricted release to environment due to HEV filter failure following fire	- Accumulation of fissile material in GPC critically safe in current configuration, even with full water moderation – Floor drain and floor hatches in PMC prevent accumulation of water in PMC – Fuel and clad material primarily in bulk form which inhibits pyrophoric reactions – Sufficient shielding in the GPC to protect worker from inadvertent criticality – No significant off-site doses due to atmospheric dispersion of fission gases – Fuel and clad material in oxidized state which inhibits pyrophoric reactions – Contaminated area of cell lined with stainless steel which prevents accumulation of static electricity – Minimal amount of smoke/embers associated with pyrophoric reactions that could become entrained in cell ventilation airstreams – Ventilation for HECs possible through Main Plant Ventilation System (Embers or burning material from HEC less likely to reach Main Plant Ventilation filters)	1) Low 2) Low 3) Low 4) Low 5) Low	1) Incredible 2) Unlikely 3) Unlikely 4) Incredible 5) Extremely Unlikely	1) I 2) 2 3) 2 4) I 5) 1

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
XC-1 and XC-2					
Residual Radioactive Material	1) Criticality due to accumulation of water (moderator) in XC-1 or XC-2 2) Fire or explosion in XC-1 or XC-2 3) Uncontrolled release to environment due to Main Plant ventilation exhaust system filter failure following fire	- Though estimated fissile material quantities in each cell slightly exceed mass single parameter limits for a uniform aqueous solution, the distribution and immobility of the fissile material make the cells critically safe, even with full water moderation - Sufficient shielding to protect worker from inadvertent criticality - Fissile material in oxidized state which inhibits pyrophoric reactions - Cells lined with stainless steel which prevents accumulation of static electricity - Very limited amount of smoke/embers that a fire would generate	1) Low 2) Low 3) Low	1) Incredible 2) Extremely Unlikely 3) Extremely Unlikely	1) I 2) 1 3) 1
Main Plant Tanks					
7D-2 Volume: 32,220 L	Name: LLW Collection Tank	Location: LWC	Construction: Stainless Steel		
Liquid LLW (See Table B.4.1-1)	1) Tank leak 2) Tank failure due to seismic event 3) Tank and ventilation failure due to seismic event 4) Tank, ventilation, and LWC failure due to seismic event 5) Overflow	- Stainless steel tank - Level recorder - High and low level alarms - Spills handled by LWC sump - Overflow contained by Tank 6D-3 - LWC, reinforced concrete	1) Negligible 2) Negligible 3) Negligible 4) Low 5) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Incredible 4) Incredible 5) Unlikely	1) 0 2) 0 3) 0 4) I 5) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
7D-8 Volume: 11,360 L	Name: Rework Evaporator Feed Tank	Location: LWC	Construction: Stainless Steel		
Liquid LLW (Activity indeterminate)	1) Tank leak 2) Tank failure due to seismic event 3) Tank and ventilation failure due to seismic event 4) Tank, ventilation, and LWC failure due to seismic event 5) Overflow	- Stainless steel tank - Level recorder - Spills handled by LWC sump - Overflow contained by Tank 6D-3 - LWC, reinforced concrete	1) Negligible 2) Negligible 3) Negligible 4) Low 5) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Incredible 4) Incredible 5) Unlikely	1) 0 2) 0 3) 0 4) I 5) 0
7D-14 Volume: 1,900 L	Name: Hot Analytical Cell Drain Catch Tank	Location: LWC	Construction: B334 Hastelloy C		
Liquid LLW (Activity indeterminate)	1) Tank leak 2) Tank failure due to seismic event 3) Tank and ventilation failure due to seismic event 4) Tank, ventilation, and LWC failure due to seismic event 5) Overflow	- Corrosion resistant tank - Level recorder - Level alarm - Spills handled by LWC sump - Overflow contained by Tank 6D-3 - LWC, reinforced concrete	1) Negligible 2) Negligible 3) Negligible 4) Low 5) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Incredible 4) Incredible 5) Unlikely	1) 0 2) 0 3) 0 4) I 5) 0
13D-8 Volume: 2,570 L	Name: Cell Sump Receiver	Location: LWC	Construction: Stainless Steel		
LWC sump receiver (Activity indeterminate)	1) Tank leak 2) Tank failure due to seismic event 3) Tank and ventilation failure due to seismic event 4) Tank, ventilation, and LWC failure due to seismic event 5) Overflow	- Stainless steel tank - Level recorder - High and low level alarms - Spills handled by LWC sump - Overflow contained by Tank 6D-3 - LWC, reinforced concrete	1) Negligible 2) Negligible 3) Negligible 4) Low 5) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Incredible 4) Incredible 5) Unlikely	1) 0 2) 0 3) 0 4) I 5) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
4D-2 Volume: 4,160 L	Name: Partition Cycle Waste C/H Tank (XC-1 sump receiver)	Location: XC-1	Construction: Stainless Steel		
Liquid LLW (Activity indeterminate)	1) Tank leak 2) Tank failure due to seismic event 3) Tank and ventilation failure due to seismic event 4) Tank, ventilation, and XC-1 failure due to seismic event 5) Overflow	- Stainless steel tank - Level recorder - Spills handled by XC-1 sump - Overflow contained by Tank 6D-3 - XC-1, reinforced concrete	1) Negligible 2) Negligible 3) Negligible 4) Low 5) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Incredible 4) Incredible 5) Unlikely	1) 0 2) 0 3) 0 4) I 5) 0
Analytical and Process Chemistry Laboratories					
Laboratory Reagents (Acids, Oxidizers, Corrosives, Poisons, Flammables)	1) Significant spill	- Small quantities used - Different categories of chemicals stored in separate locations - Isolation from environment - Restricted access/use - Chemical handling/storage per WVDP-011	1) Negligible	1) Unlikely	1) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
Liquid Waste Treatment System					
35104 Volume: 22,000 L	Name: LLW Collection Tank	Location: GCR Extension	Construction: Stainless Steel		
Processed high level waste solution (See Table B.4.1-1)	1) Tank Leak 2) Tank failure due to seismic event 3) Tank and ventilation failure due to seismic event 4) Tank, ventilation, and GCR Extension failure due to seismic event 5) Overflow	- Stainless steel tank - Level recorder - High and low level alarms - Sump in GCR - High level alarms in sump - GCR extension, reinforced concrete walls	1) Negligible 2) Negligible 3) Negligible 4) Low 5) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Incredible 4) Incredible 5) Unlikely	1) 0 2) 0 3) 0 4) I 5) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
5D-15B Volume: 56,950 L	Name: Evaporator Feed Tank	Location: UPC	Construction: Stainless Steel		
Processed high level waste solution (See Table B.4.1-1)	1) Tank leak 2) Tank failure due to seismic event 3) Tank and ventilation failure due to seismic event 4) Tank, ventilation, and UPC failure due to seismic event 5) Overflow	- Stainless steel tank - Level recorder and indicator - Low and high alarms - Spills handled by UPC sump - Sump high level alarm - Stainless steel liner in UPC - Overflow contained by Tank 6D-3 - UPC, reinforced concrete	1) Negligible 2) Negligible 3) Negligible 4) Low 5) Negligible	1) Extremely Unlikely 2) Extremely unlikely 3) Incredible 4) Incredible 5) Unlikely	1) 0 2) 0 3) 0 4) I 5) 0
5D-15A1 Volume: 38,150 L	Name: Evaporator Concentrates Tank	Location: UPC	Construction: Stainless Steel		
Evaporator concentrates (See Table B.4.1-1)	1) Tank leak 2) Tank failure due to seismic event 3) Tank and ventilation failure due to seismic event 4) Tank, ventilation, and UPC failure due to seismic event 5) Overflow	- Stainless steel tank - Level recorder - Level indicator - High and low alarms - Spills handled by UPC sump - Sump high level alarm - Stainless steel liner in UPC - Overflow contained by Tank 6D-3 - UPC reinforced concrete	1) Negligible 2) Negligible 3) Negligible 4) Low 5) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Incredible 4) Incredible 5) Unlikely	1) 0 2) 0 3) 0 4) I 5) 0
5D-15A2 Volume: 18,990 L	Name: Evaporator Concentrates Tank	Location: UPC	Construction: Stainless Steel		

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
Evaporator concentrates (See Table B.4.1-1)	1) Tank leak 2) Tank failure due to seismic event 3) Tank and ventilation failure due to seismic event 4) Tank, ventilation, and UPC failure due to seismic event 5) Overflow	- Stainless steel tank - Level recorder - Level indicator - High and low alarms - Spills handled by UPC sump - Sump high level alarm - Stainless steel liner in UPC - Overflow contained by Tank 6D-3 - UPC reinforced concrete	1) Negligible 2) Negligible 3) Negligible 4) Low 5) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Incredible 4) Incredible 5) Unlikely	1) 0 2) 0 3) 0 4) I 5) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
71C-001 Volume: 535 L	Name: Organic IX Column	Location: XC-3	Construction: Stainless Steel		
Organic IX media and low TDS process solution (See Table B.4.1-1)	1) Column leak 2) Column failure due to seismic event 3) Column and ventilation failure due to seismic event 4) Column, ventilation, and XC3 failure due to seismic event 5) Column failure due to over-pressurization	- Stainless steel column - Spills handled by XC-3 sump - Sump high level alarm - Stainless steel liner in XC3 - XC3, reinforced concrete	1) Negligible 2) Negligible 3) Negligible 4) Low 5) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Incredible 4) Incredible 5) Unlikely	1) 0 2) 0 3) 0 4) I 5) 0
71C-002 Volume: 1,820 L	Name: Zeolite IX Column	Location: XC-3	Construction: Stainless Steel		
Zeolite and low TDS processed high level waste solution (See Table B.4.1-1)	1) Column leak 2) Column failure due to seismic event 3) Column and ventilation failure due to seismic event 4) Column, ventilation, and XC3 failure due to seismic event 5) Column failure due to over-pressurization	- Stainless steel column - Spills handled by XC-3 sump - Sump high level alarm - Stainless steel liner in XC3 - XC3, reinforced concrete	1) Negligible 2) Negligible 3) Negligible 4) Low 5) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Incredible 4) Incredible 5) Unlikely	1) 0 2) 0 3) 0 4) I 5) 0
71C-003 Volume: 1,820 L	Name: Zeolite IX Column	Location: XC-3	Construction: Stainless Steel		

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
Zeolite and high level waste solution and distillate (See Table B.4.1-1)	1) Column leak 2) Column failure due to seismic event 3) Column and ventilation failure due to seismic event 4) Column, ventilation, and XC3 failure due to seismic event 5) Column failure due to over-pressurization	- Stainless steel column - High level alarm - Spills handled by XC-3 sump - High level alarm in the sump - Stainless steel liner in XC3 - XC3, reinforced concrete	1) Negligible 2) Negligible 3) Negligible 4) Low 5) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Incredible 4) Incredible 5) Unlikely	1) 0 2) 0 3) 0 4) I 5) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
71C-004 (31017) Volume: 5,680 L	Name: LWTS Evaporator	Location: XC-3	Construction: Stainless Steel		
Processed high level waste solution (See Table B.4.1-1)	1) Evaporator leak 2) Evaporator failure due to seismic event 3) Evaporator and ventilation failure due to seismic event 4) Evaporator, ventilation, and XC3 failure due to seismic event 5) Evaporator failure due to over-pressurization	- Stainless steel Evaporator - Level recorder - High, low alarms - Spills handled by XC-3 sump - Sump high level alarm - Stainless steel liner in XC3 - XC3, reinforced concrete	1) Negligible 2) Negligible 3) Negligible 4) Low 5) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Incredible 4) Incredible 5) Unlikely	1) 0 2) 0 3) 0 4) I 5) 0
71D-005 Volume: 3,785 L	Name: Distillate Surge Tank	Location: XC-3	Construction: Stainless Steel		
Processed high level waste distillate (See Table B.4.1-1)	1) Tank leak 2) Tank failure due to seismic event 3) Tank and ventilation failure due to seismic event 4) Tank, ventilation, and XC3 failure due to seismic event 5) Overflow	- Stainless steel tank - Level indicator - Spills handled by XC-3 sump - High level alarm in the sump - Stainless steel liner in XC3 - Overflow contained by Tank 6D-3 - XC3, reinforced concrete	1) Negligible 2) Negligible 3) Negligible 4) Low 5) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Incredible 4) Incredible 5) Unlikely	1) 0 2) 0 3) 0 4) I 5) 0
71D-006 Volume: 4,650 L	Name: Spent Resin Tank	Location: XC-3	Construction: Stainless Steel		

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
Spent resin (See Table B.4.1-1)	1) Tank leak 2) Tank failure due to seismic event 3) Tank and ventilation failure due to seismic event 4) Tank, ventilation, and XC3 failure due to seismic event 5) Overflow	- Stainless steel tank - Level indicator - Spills handled by XC-3 sump - High level alarm in the sump - Stainless steel liner in XC3 - Overflow contained by Tank 6D-3 - XC3, reinforced concrete	1) Negligible 2) Negligible 3) Negligible 4) Low 5) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Incredible 4) Incredible 5) Unlikely	1) 0 2) 0 3) 0 4) I 5) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
71D-007 Volume: 4,650 L	Name: Spent Zeolite Tank	Location: XC-3	Construction: Stainless Steel		
Spent zeolite (See Table B.4.1-1)	1) Tank leak 2) Tank failure due to seismic event 3) Tank and ventilation failure due to seismic event 4) Tank, ventilation, and XC3 failure due to seismic event 5) Overflow	- Stainless steel tank - Level indicator - Spills handled by XC-3 sump - High level alarm in the sump - Stainless steel liner in XC3 - Overflow contained by Tank 6D-3 - XC3, reinforced concrete	1) Negligible 2) Negligible 3) Negligible 4) Low 5) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Incredible 4) Incredible 5) Unlikely	1) 0 2) 0 3) 0 4) I 5) 0
71D-008 Volume: 2,950 L	Name: Filter Backwash Receiver Tank	Location: XC-3	Construction: Stainless Steel		
Filter backwash solution (See Table B.4.1-1)	1) Tank leak 2) Tank failure due to seismic event 3) Tank and ventilation failure due to seismic event 4) Tank, ventilation, and XC3 failure due to seismic event 5) Overflow	- Stainless steel tank - Level indicator - Spills handled by XC-3 sump - High level alarm in the sump - Stainless steel liner in XC3 - Overflow contained by Tank 6D-3 - XC3, reinforced concrete	1) Negligible 2) Negligible 3) Negligible 4) Low 5) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Incredible 4) Incredible 5) Unlikely	1) 0 2) 0 3) 0 4) I 5) 0
71D-009 Volume: 380 L	Name: Feed Sample Tank	Location: XC-3	Construction: Stainless Steel		

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
Processed high level waste solution (See Table B.4.1-1)	1) Tank leak 2) Tank failure due to seismic event 3) Tank and ventilation failure due to seismic event 4) Tank, ventilation, and XC3 failure due to seismic event 5) Overflow	- Stainless steel tank - Level indicator - Spills handled by XC-3 sump - High level alarm in the sump - Stainless steel liner in XC3 - Overflow contained by Tank 6D-3 - XC3, reinforced concrete	1) Negligible 2) Negligible 3) Negligible 4) Low 5) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Incredible 4) Incredible 5) Unlikely	1) 0 2) 0 3) 0 4) I 5) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
71D-011 Volume: 380 L	Name: Low TDS Feed Tank	Location: XC-3	Construction: Stainless Steel		
Processed high level waste (See Table B.4.1-1)	1) Tank leak 2) Tank failure due to seismic event 3) Tank and ventilation failure due to seismic event 4) Tank, ventilation, and XC3 failure due to seismic event 5) Overflow	- Stainless steel tank - Level indicator - High and low level alarms - Spills handled by XC-3 sump - High level alarm in the sump - Stainless steel liner in XC3 - Overflow contained by Tank 6D-3 - XC3, reinforced concrete	1) Negligible 2) Negligible 3) Negligible 4) Low 5) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Incredible 4) Incredible 5) Unlikely	1) 0 2) 0 3) 0 4) I 5) 0
71E-001 Volume: N/A	Name: Evaporator Reboiler	Location: XC-3	Construction: Stainless Steel		
Evaporator concentrates (See Table B.4.1-1)	1) Reboiler leak 2) Reboiler failure due to seismic event 3) Reboiler and ventilation failure due to seismic event 4) Reboiler, ventilation, and XC3 failure due to seismic event	- Stainless steel Reboiler - High level alarm - Spills handled by XC-3 sump - High level alarm in the sump - Stainless steel liner in XC3 - XC3, reinforced concrete	1) Negligible 2) Negligible 3) Negligible 4) Low	1) Extremely unlikely 2) Extremely unlikely 3) Incredible 4) Incredible	1) 0 2) 0 3) 0 4) I
71E-005 Volume: N/A	Name: Concentrates Cooler	Location: XC-3	Construction: Stainless Steel		
Evaporator concentrates (See Table B.4.1-1)	1) Cooler leak 2) Cooler failure due to seismic event 3) Cooler and ventilation failure due to seismic event 4) Cooler, ventilation, and XC3 failure due to seismic event	- Stainless steel cooler - Spills handled by XC-3 sump - High level alarm in the sump - Stainless steel liner in XC3 - XC3, reinforced concrete	1) Negligible 2) Negligible 3) Negligible 4) Low	1) Extremely unlikely 2) Extremely unlikely 3) Incredible 4) Incredible	1) 0 2) 0 3) 0 4) I

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
14D-7 Volume: 375 L	Name: HNO_3 Tank	Location: LXA	Construction: Stainless Steel		
2 M nitric acid	1) Tank leak 2) Tank failure due to seismic event 3) Tank and ventilation failure due to seismic event 4) Tank, ventilation, and LXA failure due to seismic event 5) Overflow	- Stainless steel tank - Level indicator - High level alarm - Drains to interceptor - Overflow contained by Tank 6D-3 - Berm (full capacity)	1) Negligible 2) Negligible 3) Negligible 4) Low 5) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Incredible 4) Incredible 5) Unlikely	1) 0 2) 0 3) 0 4) I 5) 0
14D-18 Volume: 375 L	Name: NaOH Tank	Location: LXA	Construction: Stainless Steel		
Sodium hydroxide	1) Tank leak 2) Tank failure due to seismic event 3) Tank and ventilation failure due to seismic event 4) Tank, ventilation, and LXA failure due to seismic event 5) Overflow	- Stainless steel tank - Level indicator - High level alarm - Drains to interceptor - Overflow contained by Tank 6D-3 - Berm (full capacity)	1) Negligible 2) Negligible 3) Negligible 4) Low 5) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Incredible 4) Incredible 5) Unlikely	1) 0 2) 0 3) 0 4) I 5) 0
Vessel Off-Gas System					
Airborne contamination	1) Filter failure	- Differential pressure monitoring instrumentation - Backup HEPA filters	1) Negligible	1) Unlikely	1) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
Contaminated liquid	1) Seismic failure of OGC vessel 2) OGC vessel leak 3) Failure of pump 6G-2 seal 4) Overfill of 6D-3 or 6C-3	- Sumps and sump alarms in OGC - OGC bermed - Pumps contained in sealed niche with drains to OGC sump - Level indicator on vessels - Level alarm on 6D-3	1) Negligible 2) Negligible 3) Negligible 4) Negligible	1) Extremely unlikely 2) Unlikely 3) Unlikely 4) Unlikely	1) 0 2) 0 3) 0 4) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
6D-3 Volume: 910 L	Name: VOG Condensate Catch Tank	Location: OGC	Construction: Stainless Steel		
Liquid LLW (See Table B.4.1-1)	1) Tank leak 2) Tank failure due to seismic event 3) Tank and ventilation failure due to seismic event 4) Tank, ventilation, and OGC failure due to seismic event 5) Overflow	- Stainless steel tank - Level indicator - High level alarm - Spills handled by OGC sump - Overflow contained by Tank 7D-8 - OGC, reinforced concrete	1) Negligible 2) Negligible 3) Negligible 4) Low 5) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Incredible 4) Incredible 5) Unlikely	1) 0 2) 0 3) 0 4) I 5) 0
6D-6 Volume: 240 L	Name: VOG Condensate Knockout Pot	Location: OGC	Construction: Stainless Steel		
Liquid LLW (See Table B.4.1-1)	1) Tank leak 2) Tank failure due to seismic event 3) Tank and ventilation failure due to seismic event 4) Tank, ventilation, and OGC failure due to seismic event 5) Overflow	- Stainless steel tank - Spills handled by OGC sump - Overflow contained by Tank 6D-3 - OGC, reinforced concrete	1) Negligible 2) Negligible 3) Negligible 4) Low 5) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Incredible 4) Incredible 5) Unlikely	1) 0 2) 0 3) 0 4) I 5) 0
6C-3 Volume: 1,500 L	Name: VOG Scrubber	Location: OGC	Construction: Stainless Steel		
Liquid LLW (potentially caustic) (See Table B.4.1-1)	1) Scrubber leak 2) Scrubber failure due to seismic event 3) Scrubber and ventilation failure due to seismic event 4) Scrubber, ventilation, and OGC failure due to seismic event	- Stainless steel tank - Spills handled by OGC sump - Overflow contained by Tank 6D-3 - OGC, reinforced concrete	1) Negligible 2) Negligible 3) Negligible 4) Low	1) Extremely unlikely 2) Extremely unlikely 3) Incredible 4) Incredible	1) 0 2) 0 3) 0 4) I

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
6V-1 Volume: 200 L	Name: VOG Cyclone	Location: OGC	Construction: Stainless Steel		
Liquid LLW (See Table B.4.1-1)	1) Cyclone leak 2) Cyclone failure due to seismic event 3) Cyclone and ventilation failure due to seismic event 4) Cyclone, ventilation, and OGC failure due to seismic event	- Stainless steel tank - Spills handled by OGC sump - OGC, reinforced concrete	1) Negligible 2) Negligible 3) Negligible 4) Low	1) Extremely unlikely 2) Extremely unlikely 3) Incredible 4) Incredible	1) 0 2) 0 3) 0 4) I
CEMENT SOLIDIFICATION SYSTEM					
Airborne contamination	1) Loss of line power to blower 2) Failure of HEPA filter 3) Explosion in WDC or Process Cell 4) Backflow due to direct tornado strike	- Redundant vent blowers - Isolation dampers on final HEPA filters - No explosives stored in cell - Barriers to direct cell access (airlocks)	1) Negligible 2) Negligible 3) Negligible 4) Negligible	1) Anticipated 2) Unlikely 3) Incredible 4) Extremely unlikely	1) 0 2) 0 3) 0 4) 0
Contaminated liquid/cement release (See Table B.4.1-1)	1) Seismic failure of transfer line from LWTS to CSS 2) Seismic failure of WDV 3) Failure of WDV seal 4) Failure of transfer line in process cell 5) Faulty discharge valve on cement mixer 6) Drum not in position under fill head 7) Lid not removed from drum to be filled	- Sumps in WDC and Process Cell - Berm in WDC - Valve position indicator/load cell on mixers - Position indicator/load cell on drum conveyor station - Lid vacuum indicator - CCTV to allow viewing of cell operations	1) Low 2) Negligible 3) Negligible 4) Negligible 5) Negligible 6) Negligible 7) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Unlikely 4) Extremely unlikely 5) Unlikely 6) Unlikely 7) Unlikely	1) 1 2) 0 3) 0 4) 0 5) 0 6) 0 7) 0
70D-001 Volume: 1,900 L	Name: Waste Dispensing Vessel	Location: CSS WDC	Construction: Stainless Steel		

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
LWTS concentrates (See Table B.4.1-1)	1) Vessel leak 2) Vessel failure due to seismic event 3) Overflow	- Stainless steel vessel - Level recorder - Level indicator - Low, high level alarms - Spills contained by WDC sump - High level alarm in sump - Stainless steel liner in WDC - WDC, reinforced concrete	1) Negligible 2) Negligible 3) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Unlikely	1) 0 2) 0 3) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
70V-001 Volume: 1,160 L 70V-001 Volume: 5,700 L	Name: Additive Day Tank Name: Additive Bulk Storage Tank	Location: CSS Change Room Location: CSS Change Room	Construction: Carbon Steel Construction: Polyethylene		
Sodium silicate	1) Tank leak 2) Tank failure	- Carbon steel tank or polyethylene tank - Level indicator - Berm	1) Negligible 2) Negligible	1) Extremely unlikely 2) Extremely unlikely	1) 0 2) 0
70K-002 Volume: 114 L 70K-004 Volume: 114 L	Name: High Sheer Mixer Name: High Sheer Mixer	Location: CSS Process Room Location: CSS Process Room	Construction: Carbon Steel Construction: Carbon Steel		
LWTS concentrates (See Table B.4.1-1)	1) Mixer leak 2) Mixer failure due to seismic event 3) Overflow	- Mixer housing - Level recorder - Level indicator - Low, high alarms - Spills handled by Process Room sump - High level alarm in sump	1) Negligible 2) Negligible 3) Negligible	1) Extremely unlikely 2) Extremely unlikely 3) Unlikely	1) 0 2) 0 3) 0
70D-004 Volume: 70 m^3	Name: Cement Silo	Location: South of 01-14 Building	Construction: Carbon Steel		
Dry portland cement	1) Silo failure	- None	1) Negligible	1) Extremely unlikely	1) 0
70V-010 Volume: 0.42 m^3	Name: Cement Day Bin	Location: Second floor of 01-14 Building	Construction: Carbon Steel		
Dry portland cement	1) Bin failure	- None	1) Negligible	1) Incredible	1) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
7D-13 Volume: 7,700 L	Name: Lab Drains/Decon Catch Tank	Location: Yard, west of Plant	Construction: Stainless Steel		
Liquid LLW (See Table B.4.1-1)	1) Tank leak 2) Tank failure due to seismic event 3) Overflow	- Level indicator - Overflow contained by Tank 6D-3	1) Negligible 2) Negligible 3) Negligible	1) Unlikely 2) Extremely unlikely 3) Unlikely	1) 0 2) 0 3) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
DRUM CELL					
Solidified cement drums located in the Drum Cell, 71 gallons					
Solid LLW (See Table B.4.1-2)	1) Drum failure	- Carbon steel drum - Concrete shield walls - Administrative controls on waste form integrity requirements	1) Negligible	1) Extremely unlikely	1) 0
LOW LEVEL WASTE TREATMENT SYSTEM					
Low Level Liquid Radioactive Waste; Spent Resin;	1) Introduction of high activity waste into system 2) Failure of transfer line (interceptors to Lagoon 2 or Lagoon 2 to LLW2) 3) Loss of spent IX resin containment in LLW2	- Analysis of liquids in interceptors prior to transfer to Lagoon 2 - Sloped floor to floor drains in LLW2 where IX resin is handled	1) Negligible 2) Negligible 3) Negligible	1) Unlikely 2) Extremely unlikely 3) Unlikely	1) 0 2) 0 3) 0
No ID # Volume: 1,900 L Name: Neutralization Pit Location: Yard, east of Plant Construction: S.S. lined concrete					
Liquid Low-Level Waste (See Table B.7.5-1 Max. Lagoon 2 Conc.)	1) Failure of pit containment 2) Overflow	- Pit located in silty till - Routine surveillance by qualified operators	1) Negligible 2) Negligible	1) Extremely unlikely 2) Unlikely	1) 0 2) 0
No ID # Volume: 87,000 L Name: N/S Interceptors Location: Yard, east of Plant Construction: S.S. lined concrete					

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
Liquid LLW (See Table B.7.5-1 Max. Lagoon 2 Conc.)	1) Failure of pit containment 2) Overflow	- Interceptors located in silty till - Overflow to off-line interceptor - High level alarm - Routine area surveillance by qualified operators	1) Negligible 2) Negligible	1) Extremely unlikely 2) Unlikely	1) 0 2) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
No ID # Volume: 57,000 L Name: Old Interceptor Location: Yard, east of Plant Construction: Concrete					
Liquid LLW (See Table B.7.5-1 Max. Lagoon 2 Conc.)	1) Failure of pit containment 2) Overflow	- Interceptor located in silty till - Routine surveillance by qualified operators	1) Negligible 2) Negligible	1) Extremely unlikely 2) Unlikely	1) 0 2) 0
No ID # Volume: 9,500,000 L Name: Lagoon 2 Location: Yard, east of Plant Construction: Clay-lined basin No ID # Volume: 12,000,000 L Name: Lagoon 3 Location: Yard, east of Plant Construction: Clay-lined basin					
Liquid LLW (See Table B.7.5-1 Max. Lagoon 2 Conc.)	1) Seismic failure of basin containment 2) Overflow of Lagoon 2 3) Overflow of Lagoon 3 4) High activity, Lagoon 3 5) Loss of lagoon confinement integrity	- Basins constructed in silty till - Level in basins maintained with sufficient margin to accommodate precipitation - Lagoon 2 overflow to Lagoon 3 - Lagoon 3 sampled prior to discharge; off-spec solutions to Lagoon 2 - Monitoring well downgradient	1) Moderate 2) Negligible 3) Negligible 4) Negligible 5) Negligible	1) Extremely unlikely 2) Unlikely 3) Unlikely 4) Unlikely 5) Extremely unlikely	1) 3 2) 0 3) 0 4) 0 5) 0
No ID # Volume: 770,000 L Name: Lagoon 4 Location: Yard, east of Plant Construction: Synthetic-lined basin No ID # Volume: 630,000 L Name: Lagoon 5 Location: Yard, east of Plant Construction: Synthetic-lined basin					
Decontaminated LLW (See Table B.7.5-1 Max. Lagoon 2 Conc.)	1) High activity in lagoon 2) Loss of lagoon confinement integrity 3) Overflow	- Analysis of contents prior to transfer to Lagoon 3 - Monitoring wells downgradient - Impermeable synthetic liners - Routine area surveillance by qualified operators during operation	1) Negligible 2) Negligible 3) Negligible	1) Unlikely 2) Extremely unlikely 3) Unlikely	1) 0 2) 0 3) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
02-D-0301 Volume: 100 Gallons Name: Sulfuric Acid Tank Location: LLW2 Construction: Polyethylene					
93% H_2SO_4	1) Vessel leak 2) Vessel failure 3) Fill line rupture 4) Overflow	- Vessel on sloped floor to drain emptying into sump - Level indicator - Handling and storage activities conducted per WVDP-011	1) Negligible 2) Low [WVDP-193] 3) Negligible 4) Negligible	1) Unlikely 2) Extremely unlikely 3) Extremely unlikely 4) Extremely unlikely	1) 0 2) 1 3) 0 4) 0
02-D-0102 Volume: 800 Gallons Name: Surge Tank A Location: LLW2 Construction: Carbon Steel					
Liquid LLW	1) Vessel leak 2) Vessel failure 3) Overflow	- Vessel on sloped floor to drain emptying into sump - Level indicator - Overflow to Lagoon 2	1) Negligible 2) Negligible 3) Negligible	1) Unlikely 2) Extremely unlikely 3) Anticipated	1) 0 2) 0 3) 0
02-D-0202 Volume: 800 Gallons Name: Surge Tank A Location: LLW2 Construction: Carbon Steel					
Liquid LLW	1) Vessel leak 2) Vessel failure 3) Overflow	- Vessel on sloped floor to drain emptying into sump - Level indicator - Overflow to Lagoon 2	1) Negligible 2) Negligible 3) Negligible	1) Unlikely 2) Extremely unlikely 3) Anticipated	1) 0 2) 0 3) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
02-C-0104 02-C-0105 02-C-0106 02-C-0204 02-C-0205 02-C-0206 Volume: 50 ft^3	Name: Ion Exchange Columns	Location: LLW2	Construction: Carbon Steel		
Liquid LLW Contaminated IX Resin (See Table 7.5-1 Max. Lagoon 2 Conc.)	1) Column leak 2) Column failure 3) Column over pressurization 4) Natural phenomena induced release of all resin in ion exchange columns (no workers assumed to be in vicinity) 5) Operational mishap releases spent resin during sluicing of resin from ion exchange columns to storage containers 6) Storage containers breached during transfer to temporary storage	- Drains to skid pan which drains to floor drain which empties into sump - Pressure indictor - Established procedures and training for operations and sluicing activities - Established procedures and training for forklift and other vehicle operations - Spent resin contained in formidable, sealed, noncombustible storage containers	1) Negligible 2) Negligible 3) Negligible 4) Negligible 5) Low 6) Negligible	1) Unlikely 2) Extremely unlikely 3) Unlikely 4) Extremely Unlikely 5) Unlikely 6) Anticipated	1) 0 2) 0 3) 0 4) 0 5) 2 6) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
NORTH PLATEAU PUMP SYSTEM					
Contaminated Groundwater	1) System breach for any reason (e.g., natural phenomena or operational mishap) leads to environmental release and/or momentary worker inundation in contaminated groundwater 2) Failure of transfer line (NPPS Surge Tank to NP Surge Tank in LLW2)	- Maximum combined flow from all three wells limited to 20 gpm - Equipment enclosed in shelter - Alarms and interlocks on various parameters, including well enclosure leak detection alarm, and high-high level in surge tank alarm (which auto-stops well pumps also). All alarms transmitted to Keltron Panel in Main Security Gate House.	1) Negligible 2) Negligible	1) Anticipated 2) Unlikely	1) 0 2) 0
02-T-0101 Volume: 900 Gallons	Name: Sand Filter (Tank)	Location: LLW2	Construction: Carbon Steel		
Liquid Low-Level Waste	1) Filter tank leak 2) Filter tank overflow 3) Filter tank failure	- Floor slopes to floor drain which empties into sump - Level instrumentation - Overflow to LLW2 sump	1) Negligible 2) Negligible 3) Negligible	1) Unlikely 2) Anticipated 3) Extremely unlikely	1) 0 2) 0 3) 0
NDA Interceptor Trench Liquid Pretreatment System (LPS)					
Solvent	1) Major spill/release for any reason 2) Fire	- Alarms and interlocks on various parameters, including high level alarms on tanks - Berms around tanks and piping - Equipment enclosed in shelter - Established procedures and training for system operations and handling and transfer of drums containing hazardous material - Continuous Air Monitors in key locations	1) Negligible 2) Low	1) Unlikely 2) Unlikely	1) 0 2) 2

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
Contaminated Water in the LPS System/Tanks	1) Release to the environment of all or major portion of water in the LPS system/tanks for any reason	- Same as above for solvent hazard	1) Negligible	1) Unlikely	1) 0
Spent (or Partially Used) Granular Activated Carbon	1) Major spill/release for any reason 2) Fire 3) Fire with solvent fire as the ignition source	- Same as above for solvent hazard	1) Negligible 2) Low 3 Low	1) Unlikely 2) Extremely unlikely 3) Unlikely	1) 0 2) 1 3) 2
UTILITY ROOM AND YARD					
PCBs in Main Plant Transformer	1) Puncture resulting in spill 2) Transformer fire	- 8 ft. chain link fence surrounding transformer	1) Moderate 2) Low	1) Extremely unlikely 2) Unlikely	1) 3 2) 2
Sodium Hypochlorite 208 L	1) Rupture of drum 2) Fire involving drum		1) Negligible 2) Negligible	1) Unlikely 2) Unlikely	1) 0 2) 0
50% NaOH 1670 L	1) Puncture resulting in spill	- Administrative control prohibiting forklift use in Utility Room	1) Negligible	1) Unlikely	1) 0
93% H_2SO_4 210 L	1) Puncture resulting in spill	- Administrative control prohibiting forklift use in Utility Room	1) Negligible	1) Unlikely	1) 0
31D-2 Volume: 38,000 L	Name: Fuel Oil Storage Tank	Location: Yard, east of Plant	Construction: Carbon steel		
No. 2 Fuel Oil	1) Tank leak 2) Tank failure	- Spill basin (87,000 L) under tank - Sight glass and level indicator	1) Negligible 2) Negligible	1) Unlikely 2) Unlikely	1) 0 2) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
G-01 Volume: 3,750 L G-02 Volume: 7,500 L	Name: Diesel Fuel Storage Tank Name: Gasoline Storage Tank	Location: Yard, east of New Warehouse Location: Yard, east of New Warehouse	Construction: Concrete with Double Steel Liner Construction: Concrete with Double Steel Liner		
Gasoline, Diesel Fuel	1) Tank leak with no fire 2) Tank failure with no fire 3) Gas Tank leak with ensuing fire 4) Diesel Tank failure with ensuing fire	- Multiple confinement barriers - Leak detection equipment installed - Anti-siphon device - Pump integral to tank	1) Negligible 2) Negligible 3) Low 4) Moderate	1) Unlikely 2) Extremely unlikely 3) Extremely unlikely 4) Incredible	1) 0 2) 0 3) 1 4) I

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
LAG STORAGE AND WASTE COMPACTION					
Lag Storage Facilities					
Airborne Contamination	1) Container failure due to tornado strike 2) Container failure due to seismic event 3) Container failure due to lightning strike 4) Fire originating external to containers leads to breaching of containers 5) Container explodes or overpressurizes due to gas buildup, spontaneous heating/combustion, or exothermic reaction due to mixing of incompatible chemicals 6) Forklift induced breaching of a container (e.g., tine puncture, forklift dropped or crushed) 7) Failure of pressurized bottle (possibly being used for maintenance work) leads to breaching of a container 8) Propane tank on propane powered forklift leaks and leads to detonation that breaches containers, but no ensuing fire 9) Sufficiently energetic event in nearby facility, fuel storage tank, or gas powered vehicle breaches containers 10)Container leaks due to corrosion or other material defect, or container manufacturing deficiency	- Wastes contained in formidable, sealed, DOT-approved noncombustible containers - No significant combustion sources stored in facility - Fire detection provided in some key areas, such as the Lag Storage Building, and manual pull stations - WVDP Fire Brigade and West Valley Volunteer Hose Company - Established procedures and training for forklift operations - Design and installation of electrical equipment to accepted electrical industry standards - Security roving watches - Procedures that govern the types (mixtures) of waste materials that can be placed in a given container, and the amounts of radioactive materials per container - Emergency Team's response after event - Prompt evacuation of personnel in the area of the event and downwind - Periodic inspections of container integrity	1) Negligible [1] 2) Low 3) Low 4) Moderate [1] 5) Low 6) Negligible 7) Low 8) Low 9) Moderate 10)Negligible	1) Extremely Unlikely 2) Unlikely 3) Extremely Unlikely 4) Extremely Unlikely 5) Unlikely 6) Antici-pated 7) Extremely Unlikely 8) Extremely Unlikely 9) Incredible 10)Anticipated	1) 0 2) 2 3) 1 4) 3 5) 2 6) 0 7) 1 8) 1 9) I 10)0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
Gamma Radiation External Exposure from Radioactive Material Displaced from Its Container	Same as events 1) through 10) above for airborne contamination hazard	- Same as above for airborne contamiantion hazard - Extremely low likelihood of any gamma source in a waste container that could give even a one rem dose over many minutes and in close proximity to a receptor	1) Negligible 2) Negligible 3) Negligible 4) Negligible 5) Negligible 6) Negligible 7) Negligible 8) Negligible 9) Negligible 10)Negligible	1) Extremely Unlikely 2) Unlikely 3) Extremely Unlikely 4) Extremely Unlikely 5) Unlikely 6) Antici-pated 7) Extremely Unlikely 8) Extremely Unlikely 9) Incredible 10)Anticipated	1) 0 2) 0 3) 0 4) 0 5) 0 6) 0 7) 0 8) 0 9) I 10)0
Liquid Release Leading to Skin Contamination and/or Ingestion Dose	Same as events 1) through 10) above for airborne contamination hazard	- Same as above for airborne contamination hazard - Extensive washing with special cleansers as necessary would be performed immediately to remove skin contamination - Training to keep hands away from eyes, nose, mouth when contaminated, thereby minimizing likelihood of ingestion dose - Generally very low concentrations of alpha particle emitting radionuclides in waste - Very little free liquids as of function of volume of all wastes	1) Negligible 2) Low 3) Low 4) Low 5) Low 6) Negligible 7) Negligible 8) Low 9) Low 10)Negligible	1) Extremely Unlikely 2) Unlikely 3) Extremely Unlikely 4) Extremely Unlikely 5) Unlikely 6) Antici-pated 7) Extremely Unlikely 8) Extremely Unlikely 9) Incredible 10)Anticipated	1) 0 2) 2 3) 1 4) 1 5) 2 6) 0 7) 0 8) 1 9) I 10)0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
Exposure to Hazardous (Non-Radioactive) Material Displaced from Its Container	Same as events 1) through 10) above for airborne contamination hazard	- Same as above for airborne contamination hazard - Extensive washing with special cleansers as necessary would be performed immediately for skin exposure - Training to keep hands away from eyes, nose, mouth when exposed to hazardous materials	1) Negligible 2) Low 3) Low 4) Low 5) Low 6) Negligible 7) Negligible 8) Low 9) Low 10)Negligible	1) Extremely Unlikely 2) Unlikely 3) Extremely Unlikely 4) Extremely Unlikely 5) Unlikely 6) Anticipated 7) Extremely Unlikely 8) Extremely Unlikely 9) Incredible 10)Anticipated	1) 0 2) 2 3) 1 4) 1 5) 2 6) 0 7) 0 8) 1 9) I 10)0
Chemical Process Cell - Waste Storage Area (CPC-WSA)					
Airborne Contamination	1) Container failure due to tornado strike 2) Container failure due to seismic event 3) Container failure due to lightning strike 4) Fire originating external to containers leads to breaching of containers 5) Improper hoisting and rigging activities and/or equipment failure leads to impact (e.g., dropping) induced breaching of a container 6) Sufficiently energetic event in nearby facility, fuel storage tank, or gas powered vehicle breaches containers 7) Container breach due to corrosion or other material defect, or container manufacturing deficiency	- Wastes contained in formidable, sealed, noncombustible containers - No significant combustion sources - WVNS Fire Brigade and West Valley Volunteer Hose Company. - Established procedures and training for rigging and hoisting operations - Security roving watches - Emergency Team's response after event - Prompt evacuation of personnel in the area of the event and downwind - Periodic inspections of container integrity	1) Low 2) Low 3) Low 4) Low 5) Low 6) Moderate 7) Low	1) Extremely Unlikely 2) Unlikely 3) Extremely Unlikely 4) Incredible 5) Unlikely 6) Incredible 7) Unlikely	1) 1 2) 2 3) 1 4) I 5) 2 6) I 7) 2

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
Gamma Radiation External Exposure Beyond That Normally Incurred	1) Tornado strike 2) Seismic event 3) Lightning strike 4) Fire originating external to containers (e.g., Sprung structure catches on fire) leads to breaching of containers or reconfiguration of containers 5) Improper hoisting and rigging activities and/or equipment failure leads to impact (e.g., dropping) induced breaching of a container or reconfiguration of containers 6) Sufficiently energetic event in nearby facility, fuel storage tank, or gas powered vehicle breaches or reconfigures containers 7) Container breach due to corrosion or other material defect, or container manufacturing deficiency	- Wastes contained in formidable, sealed, noncombustible containers - No significant combustion sources - WVNS Fire Brigade and West Valley Volunteer Hose Company. - Established procedures and training for rigging and hoisting operations - Security roving watches - Emergency Team's response after event - Prompt evacuation of personnel in the area of the event - Periodic inspections of containers' integrity and configuration	1) Low 2) Low 3) Low 4) Low 5) Low 6) Moderate 7) Low	1) Extremely Unlikely 2) Unlikely 3) Extremely Unlikely 4) Extremely Unlikely 5) Unlikely 6) Incredible 7) Unlikely	1) 1 2) 2 3) 1 4) 1 5) 2 6) I 7) 2
Waste Reduction and Packaging Area Compactor					
Solid LLW (See Table B.7.7-2)	1) Failure of HEPA filter	- Administrative controls precluding facility operation without ventilation support - HEPA filter differential pressure indicator	1) Negligible	1) Unlikely	1) 0
Contact Size Reduction Facility					
Solid LLW (See Table B.7.7-2)	1) Failure of HEPA filter 2) Failure of ventilation system blower 3) Fire	- High/low differential pressure instrumentation of HEPA filters - Backup ventilation support provided by Main Plant HEV - Administrative controls prohibiting combustibles in cutting area	1) Negligible 2) Negligible 3) Negligible	1) Unlikely 2) Unlikely 3) Extremely unlikely	1) 0 2) 0 3) 0

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
15D-6 Volume: 5,700 L	Name: HEV/CSRF Waste Catch Tank	Location: Yard east of MSM	Construction: Stainless Steel		
Liquid LLW [1] 6E-4 µCi/mL Sr-90 0.15 µg/g Total U	1) Tank leak 2) Tank failure	- Tank constructed of stainless steel - High level alarm - Tank located in silty till	1) Negligible 2) Negligible	1) Unlikely 2) Extremely unlikely	1) 0 2) 0
STORAGE AREAS					
Hazardous Waste Storage Facility					
Hazardous Wastes	1) Container failure/leak 2) Fire	- Audible and visible spill detection alarm - 255-gal capacity sump - Individual locker vents - Explosion-proof electrical lights, fixtures, and switches - Automatic dry chemical fire extinguishing system - Exterior local visual fire alarm and light on each unit - Restricted access/use - Quantity restrictions imposed by WVDP-073	1) Negligible 2) Low [6]	1) Unlikely 2) Extremely unlikely	1) 0 2) 1
Interim Waste Storage Facility					
Miscellaneous hazardous and mixed wastes	1) Container failure 2) Fire	- Collective berm for all containers - Class A (automatic) dry foam fire suppression	1) Negligible 2) Low [6]	1) Unlikely 2) Extremely unlikely	1) 0 2) 1
New Warehouse					
New Warehouse - Acid Room					

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
$Zr(NO_3)_4$ 1460 L	1) Puncture resulting in spill 2) Fire	- Berms in each individual room (but not general warehouse) - Each room has its own vent system - Restricted access controlled by warehouse manager - Automatic sprinkler system	1) Negligible 2) Low	1) Unlikely 2) Extremely unlikely	1) 0 2) 1
$ZnBr_2$ 1250 L	1) Puncture resulting in spill 2) Fire	- Berms in each individual room (but not general warehouse) - Each room has its own vent system - Restricted access controlled by warehouse manager	1) Negligible 2) Low	1) Unlikely 2) Extremely unlikely	1) 0 2) 1
H_2SO_4 760 kg	1) Puncture resulting in spill 2) Fire	- Berms in each individual room (but not general warehouse) - Each room has its own vent system - Restricted access controlled by warehouse manager	1) Negligible 2) Low	1) Unlikely 2) Extremely unlikely	1) 0 2) 1
New Warehouse - Oxidizer Room					
HNO_3 10 L	1) Spill from puncture/container failure 2) Over-pressurization during a fire	- Berms in each individual room (but not general warehouse) - Each room has its own vent system - Restricted access controlled by warehouse manager	1) Low 2) Low	1) Extremely unlikely 2) Extremely unlikely	1) 1 2) 1
$NaNO_3$ 360 kg	1) Puncture resulting in spill 2) Fire	- Berms in each individual room (but not general warehouse) - Each room has its own vent system - Restricted access controlled by warehouse manager	1) Negligible 2) Low	1) Unlikely 2) Extremely unlikely	1) 0 2) 1

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
$NaNO_2$ 680 kg	1) Puncture resulting in spill 2) Fire	- Berms in each individual room (but not general warehouse) - Each room has its own vent system - Restricted access controlled by warehouse manager	1) Negligible 2) Low	1) Unlikely 2) Extremely unlikely	1) 0 2) 1
H_2O_2 1250 L	1) Spill from puncture/container failure 2) Over-pressurization during a fire	- Berms in each individual room (but not general warehouse) - Each room has its own vent system - Restricted access controlled by warehouse manager	1) Moderate 2) Low	1) Extremely unlikely 2) Extremely unlikely	1) 3 2) 1
New Warehouse - Caustic Room					
KOH 210 L	1) Puncture resulting in spill 2) Fire	- Berms in each individual room (but not general warehouse) - Each room has its own vent system - Restricted access controlled by warehouse manager	1) Negligible 2) Low	1) Unlikely 2) Extremely unlikely	1) 0 2) 1
NaOH 320 kg	1) Puncture resulting in spill 2) Fire	- Berms in each individual room (but not general warehouse) - Each room has its own vent system - Restricted access controlled by warehouse manager	1) Negligible 2) Low	1) Unlikely 2) Extremely unlikely	1) 0 2) 1
NRC-LICENSED DISPOSAL AREA					
Release of buried radioactive waste	1) Seismic event 2) Airplane crash 3) Meteorite strike	– Waste is buried	1) Low 2) High 3) High	1) Unlikely 2) Incredible 3) Incredible	1) 2 2) I 3) I

TABLE B.9.1-1 (continued)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard *	Event	Protective and Mitigative Systems	Consequences	Frequency	Risk Factor **
VITRIFICATION TEST FACILITY					
Nonradioactive chemicals used for melter feed	1) Tank/vessel (e.g., SMT, FHT, MFT, CHT) leak 2) Tank/vessel failures due to seismic event 3) Tank/vessel overflow 4) Fire leading to tank/vessel breach 5) Tank/vessel off-gas system malfunction/failure	- Formidable and corrosion resistant tank/vessel materials of construction - Liquid level indicators - Pressure indicators - Emergency vents open on high pressure - Sloping floor directs spilled materials to bermed area along North wall of VTF - Auto-termination of feed process on high melter pressure, low scrubber water flow, or select off-gas system parameter abnormalities - Very small amounts of combustible material in the VTF making fire of any intensity or duration very remote - WVDP Fire Brigade and West Valley Volunteer Hose Company. - Off-gas analyzers and associated alarms	1) Negligible [8] 2) Low [8] 3) Negligible 4) Low 5) Negligible	1) Unlikely 2) Unlikely 3) Unlikely 4) Extremely Unlikely 5) Anticipated	1) 0 2) 2 3) 0 4) 1 5) 0
Ammonia (used in fluidized bed reactor)	1) Failure of an ammonia storage cylinder 2) Concurrent failure of 3 or 4 ammonia storage cylinders 3) Off-gas system malfunction releases excessive ammonia from VTF stock	- Off-gas analyzers and associated alarms - Stand-alone ammonia storage room (ASR), normally unoccupied - Industry standard ammonia storage cylinders - Ammonia detectors (and alarms) located in the area of the ASR	1) Negligible [8] 2) Low [8] 3) Negligible	1) Unlikely 2) Extremely Unlikely 3) Anticipated	1) 0 2) 1 3) 0

* Materials-at-risk are determined using:
the vessel volume indicated, in conjunction with the referenced hazard concentration; or
the volume of hazardous material indicated.

TABLE B.9.1-1 (concluded)

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

** See Section B.9.1.1.2 for an explanation of Risk Factor.

References:

[1] - Dames & Moore, 1995

[2] - Prowse, 1991

[3] - Wolniewicz, 1993

[4] - Roberts, 1990

[5] - Yuan, 1991

[6] - WVDP-193

[7] - Gates, 1994

[8] - Kupp, 1992

TABLE B.9.2-1

FAILURE OF MAIN PLANT HEPA FILTER BANK

Assumptions:
Airborne Release Fraction (ARF)[1] 1.0E-2 Damage Ratio (DR)[1] 1.0
Respirable Fraction (RF)[1] 1.0 Leakpath Factor (LPF)[1] 1.0

Number of Failed HEPA Filters 30 HEPA Filter Exposure Rate 10 R/hr
Release Height 60 m HEPA Filter Cs-137 Activity[2] 225 Ci

Receptor Location			640 m	640 m	640 m	1050 m	1050 m	1700 m	
Stability Class, Wind Speed			D, 4.5m/s	F, 1m/s	95%	D, 4.5m/s	F, 1m/s	95%	
Dispersion (χ/Q)			1.59E-06 s/m³	2.70E-11 s/m³	1.63E-04 s/m³	5.54E-06 s/m³	1.03E-07 s/m³	6.72E-05 s/m³	
Nuclide	Normalized Spent Fuel Activity[3]	Source Term (Ci)	On-Site Dose (rem)	On-Site Dose (rem)	On-Site Dose (rem)	Off-Site Dose (rem)	Off-Site Dose (rem)	Off-Site Dose (rem)	Percent Dose Contribution
Pu-238	5.32E-02	1.20E-01	2.91E-02	4.95E-07	2.99E+00	1.02E-01	1.89E-03	1.23E+00	46.5%
Am-241	1.58E-02	3.56E-02	9.80E-03	1.66E-07	1.01E+00	3.42E-02	6.35E-04	4.14E-01	15.6%
Pu-239	1.36E-02	3.07E-02	8.29E-03	1.41E-07	8.50E-01	2.89E-02	5.37E-04	3.50E-01	13.2%
Pu-240	1.04E-02	2.34E-02	6.32E-03	1.07E-07	6.48E-01	2.20E-02	4.09E-04	2.67E-01	10.1%
Pu-241	5.14E-01	1.16E+00	6.12E-03	1.04E-07	6.27E-01	2.13E-02	3.96E-04	2.59E-01	9.8%
Sr-90	9.26E-01	2.08E+00	1.44E-03	2.45E-08	1.48E-01	5.03E-03	9.34E-05	6.10E-02	2.3%
Cm-244	2.31E-03	5.20E-03	7.43E-04	1.26E-08	7.62E-02	2.59E-03	4.81E-05	3.14E-02	1.2%
Am-243	7.27E-04	1.64E-03	4.50E-04	7.64E-09	4.62E-02	1.57E-03	2.92E-05	1.90E-02	0.7%
U-232	2.41E-04	5.43E-04	1.93E-04	3.27E-09	1.98E-02	6.71E-04	1.25E-05	8.14E-03	0.3%
Am-242m	1.22E-04	2.75E-04	7.44E-05	1.26E-09	7.62E-03	2.59E-04	4.82E-06	3.14E-03	0.1%
U-233	3.40E-04	7.65E-04	5.26E-05	8.94E-10	5.40E-03	1.83E-04	3.41E-06	2.22E-03	0.1%
Cs-137	1.00E+00	2.25E+00	3.84E-05	6.53E-10	3.94E-03	1.34E-04	2.49E-06	1.62E-03	0.1%
		TOTAL TEDE	6.27E-02	1.07E-06	6.43E+00	2.19E-01	4.06E-03	2.65E+00	99.9%

Notes:
[1] - Based on Section 5.4.2.2, DOE-HDBK-3010-94.
[2] - HEPA activity based on 1 R/hr per 0.75 Ci Cs-137; Ref: WVNS Letter HE:85:0016.
[3] - Based on normalized spent fuel activity; Ref: CN:93:0015.

TABLE B.9.2-2

LAG STORAGE FACILITY FIRE

Assumptions:
Airborne Release Fraction (ARF)[1] 5.0E-4 Damage Ratio (DR)[2] 0.375
Respirable Fraction (RF)[1] 1.0 Leakpath Factor (LPF) 1.0

Receptor Location			640 m	640 m	640 m	1050 m	1050 m	2350 m	
Stability Class, Wind Speed			D, 4.5m/s	F, 1m/s	95%	D, 4.5m/s	F, 1m/s	95%	
Dispersion (χ,Q)			6.35E-05 s/m³	1.49E-03 s/m³	7.26E-04 s/m³	2.85E-05 s/m³	6.85E-04 s/m³	7.07E-04 s/m³	
Nuclide	Combustible Activity (Ci)	Source Term (Ci)	On-Site Dose (rem)	On-Site Dose (rem)	On-Site Dose (rem)	Off-Site Dose (rem)	Off-Site Dose (rem)	Off-Site Dose (rem)	Percent Dose Contribution
Am-241	5.48E+01	1.03E-02	1.13E-01	2.65E+00	1.29E+00	5.07E-02	1.22E+00	1.26E+00	42.7%
Pu-238	3.89E+01	7.30E-03	7.10E-02	1.67E+00	8.12E-01	3.19E-02	7.66E-01	7.91E-01	26.9%
Pu-241	7.44E+02	1.40E-01	2.95E-02	6.93E-01	3.37E-01	1.32E-02	3.18E-01	3.29E-01	11.2%
Pu-240	1.02E+01	1.91E-03	2.06E-02	4.83E-01	2.35E-01	9.23E-03	2.22E-01	2.29E-01	7.8%
Cm-244	1.19E+01	2.23E-03	1.27E-02	2.99E-01	1.46E-01	5.72E-03	1.37E-01	1.42E-01	4.8%
Pu-239	6.19E+00	1.16E-03	1.25E-02	2.94E-01	1.43E-01	5.62E-03	1.35E-01	1.39E-01	4.7%
Sr-90	8.35E+02	1.57E-01	4.34E-03	1.02E-01	4.96E-02	1.95E-03	4.68E-02	4.83E-02	1.6%
Am-243	2.82E-01	5.29E-05	5.82E-04	1.37E-02	6.65E-03	2.61E-04	6.28E-03	6.48E-03	0.2%
Cs-137	1.18E+03	2.22E-01	1.51E-04	3.55E-03	1.73E-03	6.79E-05	1.63E-03	1.69E-03	0.1%
		TOTAL TEDE	2.64E-01	6.21E+00	3.02E+00	1.19E-01	2.85E+00	2.94E+00	100.0%

Notes:

[1] - Based on Section 5.2.1.1, DOE-HDBK-3010-94.
[2] - Based on ratio of combustible waste volume in LSA #4 to total combustible waste volume in Lag Storage Facilities; values taken from WVNS Waste Management Operations LLW database.

TABLE B.9.2-3

FAILURE OF TANK 8D-2 VAULT

Assumptions:
Airborne Release Rate (ARR) 4.0E-8 hr^{-1} - see note [1] below   Damage Ratio (DR) 1.0
Respirable Fraction (RF) 1.0 - see note [1] below   Leakpath Factor (LPF) 1.0

Release Duration 24 hr
Release Height 0 m (Ground Level Release)

Receptor Location			640 m	640 m	640 m	1050 m	1050 m	2350 m	
Stability Class, Wind Speed			D, 4.5m/s	F, 1m/s	95%	D, 4.5m/s	F, 1m/s	95%	
Dispersion (χ/Q)			6.35E-05 s/m³	1.49E-03 s/m³	7.26E-04 s/m³	2.85E-05 s/m³	6.85E-04 s/m³	7.07E-04 s/m³	
Nuclide	8D-2 Inventory[2] (Ci)	Source Term (Ci)	On-Site Dose (rem)	On-Site Dose (rem)	On-Site Dose (rem)	Off-Site Dose (rem)	Off-Site Dose (rem)	Off-Site Dose (rem)	Percent Dose Contribution
Am-241	5.37E+04	5.16E-02	5.67E-01	1.33E+01	6.48E+00	2.55E-01	6.12E+00	6.31E+00	64.1%
Sr-90	5.79E+06	5.55E+00	1.54E-01	3.60E+00	1.76E+00	6.90E-02	1.66E+00	1.71E+00	17.4%
Pu-238	7.93E+03	7.62E-03	7.41E-02	1.74E+00	8.47E-01	3.32E-02	7.99E-01	8.25E-01	8.4%
Cm-244	6.08E+03	5.84E-03	3.33E-02	7.82E-01	3.81E-01	1.50E-02	3.59E-01	3.71E-01	3.8%
Pu-239	1.63E+03	1.56E-03	1.69E-02	3.96E-01	1.93E-01	7.57E-03	1.82E-01	1.88E-01	1.9%
Pu-240	1.19E+03	1.15E-03	1.24E-02	2.90E-01	1.41E-01	5.55E-03	1.33E-01	1.38E-01	1.4%
Pu-241	6.05E+04	5.80E-02	1.23E-02	2.88E-01	1.40E-01	5.51E-03	1.32E-01	1.37E-01	1.4%
Cs-137	6.32E+06	6.07E+00	4.14E-03	9.71E-02	4.73E-02	1.86E-03	4.47E-02	4.61E-02	0.5%
Am-243	3.47E+02	3.33E-04	3.66E-03	8.59E-02	4.19E-02	1.64E-03	3.95E-02	4.08E-02	0.4%
Am-242m	2.85E+02	2.73E-04	2.95E-03	6.92E-02	3.37E-02	1.32E-03	3.18E-02	3.28E-02	0.3%
Ac-227	9.46E+00	9.08E-06	1.29E-03	3.02E-02	1.47E-02	5.77E-04	1.39E-02	1.43E-02	0.1%
Cm-243	1.16E+02	1.11E-04	8.24E-04	1.93E-02	9.42E-03	3.70E-04	8.89E-03	9.18E-03	0.1%
I-129	1.84E-01	1.84E-01	6.99E-04	1.64E-02	7.99E-03	3.14E-04	7.54E-03	7.78E-03	0.1%
		TOTAL TEDE	8.84E-01	2.07E+01	1.01E+01	3.97E-01	9.54E+00	9.85E+00	99.9%

Notes:
[1] - Based on Section 3.2.4.5 (liquid covered with debris), DOE-HDBK-3010-94.
[2] - Ref: WVNS memo EK:89:0232 (Vit Mass Balance, Rev. 7).

TABLE B.9.2-4

**LOW LEVEL WASTE TREATMENT FACILITY ACCIDENT
EARTHQUAKE INDUCED LAGOON FAILURE**

ISOTOPE [1]	Max. Lagoon 2 Concentration [2] (uCi/mL)	Activity Released [3] (Ci)	Cattaraugus Creek Concentration [4] (Ci/L)	Activity Ingested [5] (Ci)	Dose Conversion Factor [6] (rem/Ci)	CEDE Off-site (rem)
Cs-137	3.23E-03	3.07E+01	2.34E-06	4.68E-06	5.00E+04	2.34E-01
Sr-90	8.82E-04	8.38E+00	6.39E-07	1.28E-06	1.40E+05	1.79E-01
					TOTAL CEDE	4.13E-01

Notes:

[1] - Based on all nuclides expected to be present in Lagoon 2. Nuclides given here represent those that contribute greater than 0.1% of the CEDE.

[2] - Based on interceptor discharge limit of 5E-3 uCi/mL gross beta activity.

[3] - Based on Lagoon 2 capacity of 9,500,000 L.

[4] - Based on Cattaraugus Creek flow rate of 3,620,000 L/hr - WVDP-065.

[5] - Based on 2L water ingested by Maximally Exposed Off-Site Individual (MEOSI).

[6] - Dose conversion factors from WVDP-065.

TABLE B.9.2-5

SUMMARY OF CONSEQUENCES OF IRTS, MAIN PLANT AND SUPPORT FACILITY ACCIDENTS

Accident Scenario	Maximum Off-Site Dose/Dosage	Maximum On-Site Dose/Dosage	Evaluation Guideline Level
Main Ventilation HEPA Bank Failure	2.7 rem	6.4 rem	On-site - 100 rem
			Off-site - 25 rem
Hydrogen Peroxide Spill	10 ppm	21 ppm	On-site - ERPG-3 (100 ppm)
			Off-site - ERPG-2 (50 ppm)
Transformer Leak of PCBs	3.1E-3 mg/m^3	6.4E-3 mg/m^3	On-site - ERPG-3 (10 mg/m^3)
			Off-site - ERPG-2 (1 mg/m^3)
8D-2 Tank and Vault Failure	9.9 rem	21 rem	On-site - Natural Phenomena, N/A
			Off-site - 25 rem
Fire in Lag Storage Facility	2.9 rem	6.2 rem	On-site - 100 rem
			Off-site - 25 rem
LLWTS Lagoon 2 Failure	4.1E-1 rem	N/A	On-site - Natural Phenomena, N/A
			Off-site - 25 rem

SR2B91-1.DWG

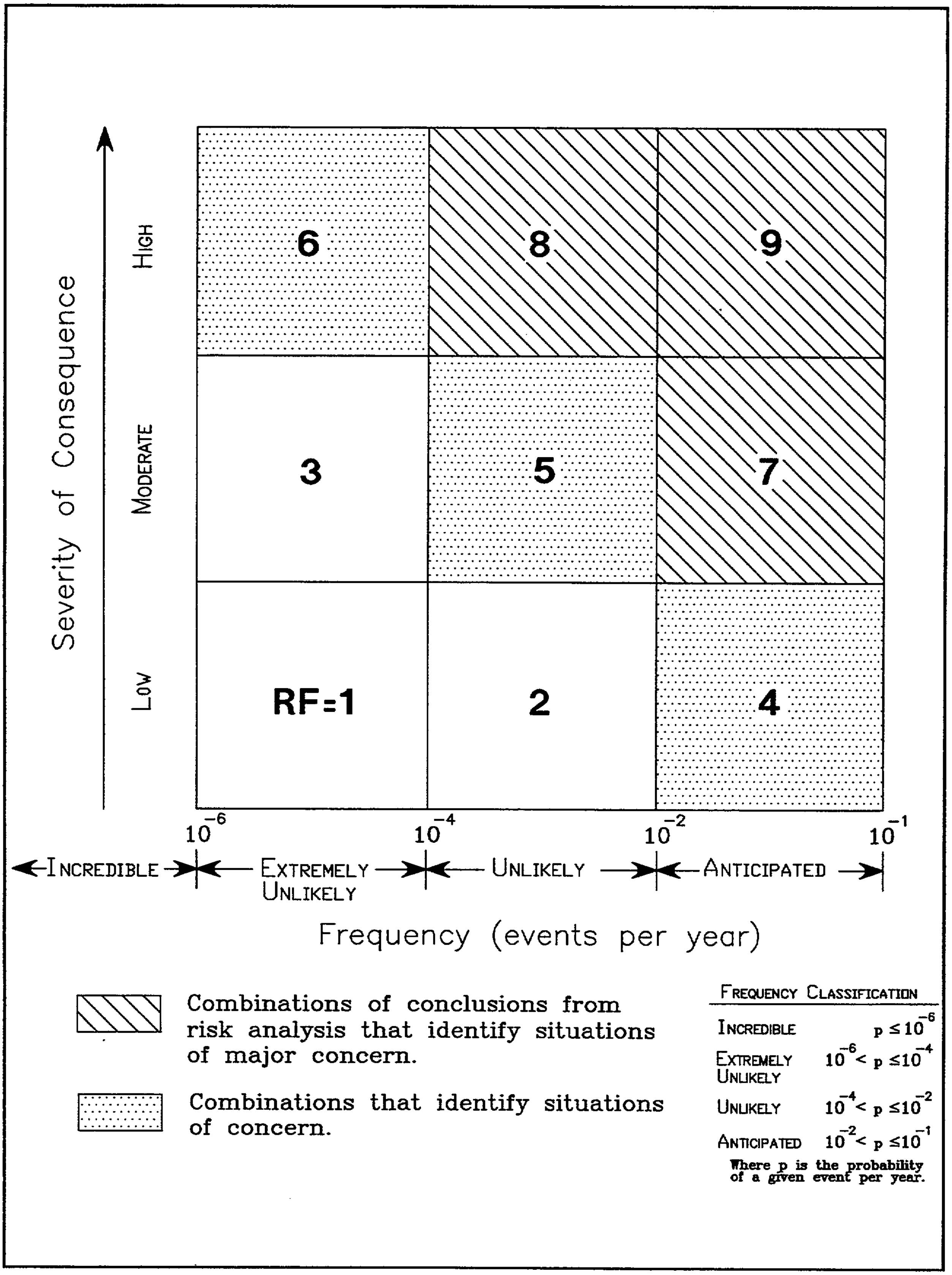


Figure B.9.1-1 Process Hazards Analysis Risk Bins

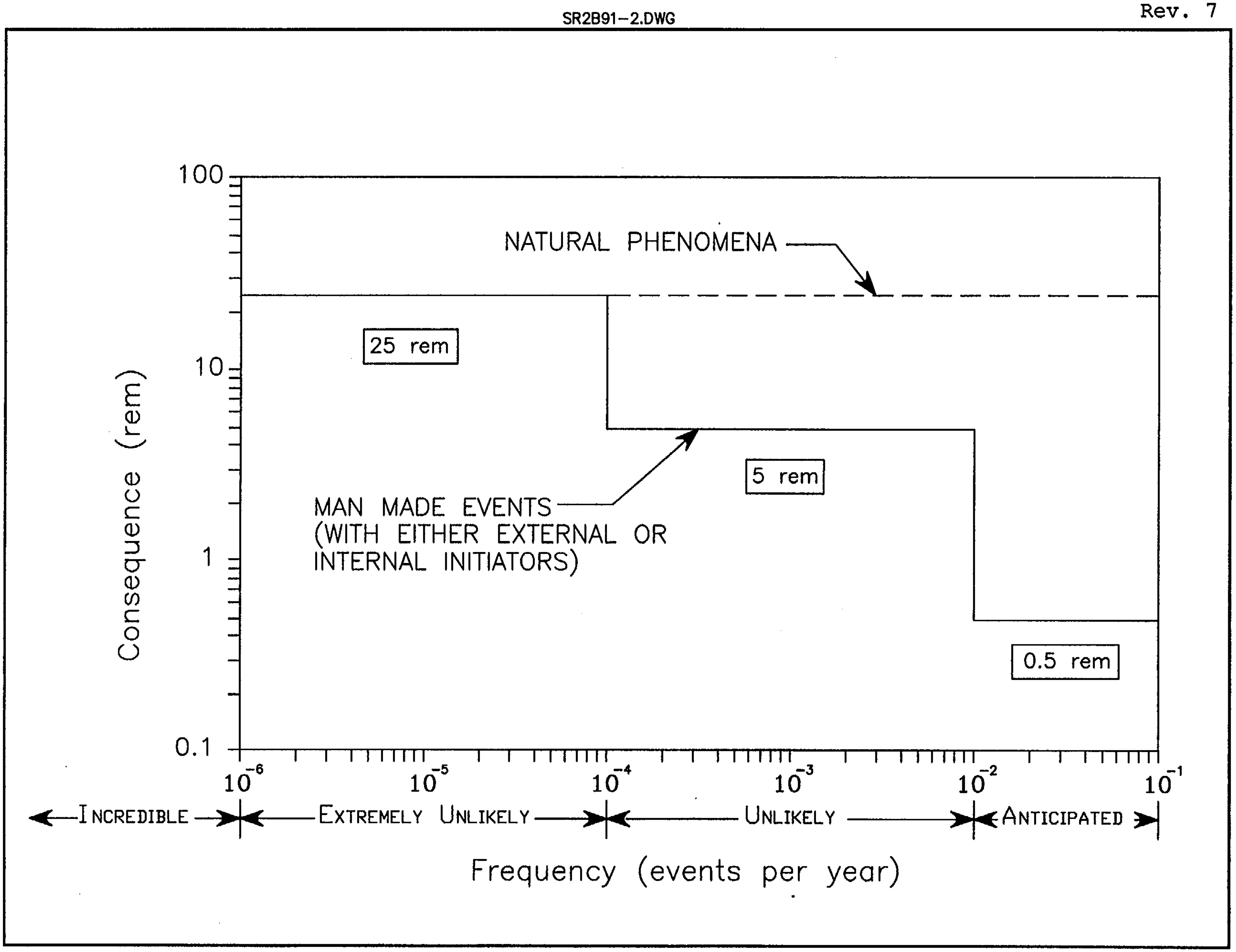


Figure B.9.1-2 Evaluation Guidelines for the Off-site Evaluation Point for Radiological Accidents

SR2B91-3.DWG

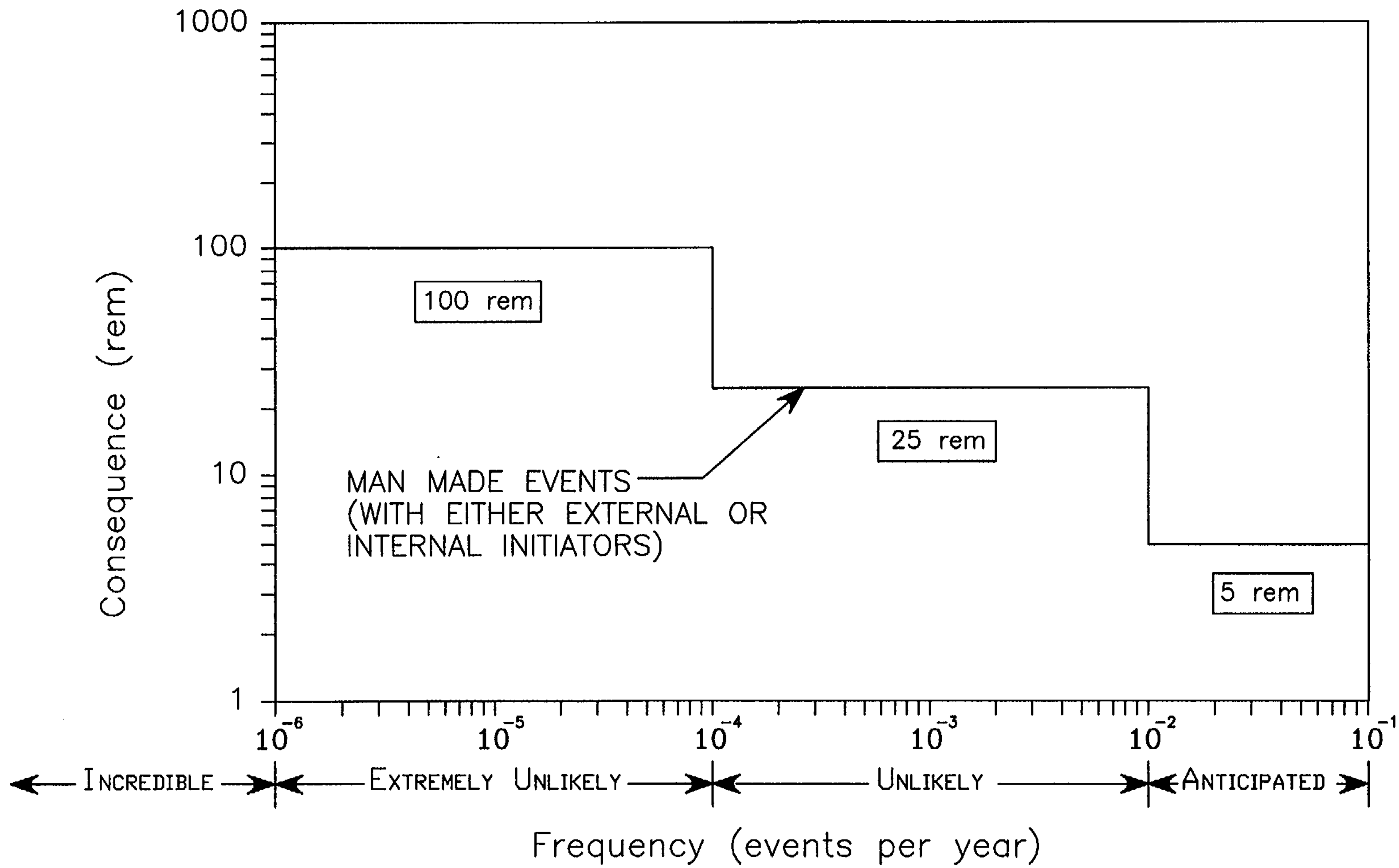


Figure B.9.1-3 Evaluation Guidelines for the On-site Evaluation Point for Radiological Accidents

B.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* (WVNS).

B.10.1 Management, Organization, and Institutional Safety Provisions

B.10.1.1 Organizational Structure

The major facilities discussed in WVNS-SAR-002 fall under the authority of one of the following major organizational groups at the WVDP: 1) Site Operations & Facility Closure Projects, 2) High-Level Waste (HLW) Projects, or 3) Waste, Fuel & Environmental Projects. Figures B.10.1-1, B.10.1-2, and B.10.1-3 present the structure of these organizations. Site Operations & Facility Closure Projects has responsibility for the operation and engineering of the Main Plant, HLW Projects has responsibility for operation and engineering of most facilities associated with the IRTS, and Waste, Fuel & Environmental Projects has responsibility for waste management services and spent fuel shipping.

The overall WVDP organizational structure is presented in Sections A.10.1 and A.10.2 of WVNS-SAR-001.

B.10.1.2 Organizational Responsibilities

WVDP organizational responsibilities are discussed in Sections A.10.1 through A.10.4 of WVNS-SAR-001.

B.10.1.3 Staffing and Qualifications

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

B.10.1.4 Safety Management Policies and Programs

Safety performance assessment, configuration and document control, event reporting, and safety culture are discussed in Section A.10.4.2 of WVNS-SAR-001.

B.10.2 Procedures and Training

B.10.2.1 Procedures

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

B.10.2.2 Training

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

B.10.3 Initial Testing, In-Service Surveillance, and Maintenance

B.10.3.1 Initial Testing Program

The Main Plant began operations in 1966 as part of the original Nuclear Fuel Services reprocessing operations. Prior to plant startup, preoperational functional checkouts of major equipment and systems were performed by both NFS and Bechtel.

The first component of the IRTS to become operational was the STS (Supernatent Treatment System), in 1988. This system, as well as each succeeding component of the IRTS, met the requirements of the initial testing (preoperational) program described in Section A.10.2 of WVNS-SAR-001 prior to being declared operational.

B.10.3.2 In-Service Surveillance and Maintenance Program

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

B.10.4 Operational Safety

B.10.4.1 Conduct of Operations

The WVDP Conduct of Operations Program is discussed in Section A.10.4.4 of WVNS-SAR-001.

B.10.4.2 Fire Protection

The WVDP Fire Protection Program is discussed in Section A.4.3.6 of WVNS-SAR-001.

B.10.5 Emergency Preparedness Program

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

B.10.6 Decontamination and Decommissioning

Though extensive decontamination of the Main Plant building has already been conducted in support of WVDP activities, final decontamination and decommissioning

(D&D) plans are dependent on facility closure plans which are yet to be determined. Facility design features which will facilitate final D&D have been described in Section B.4.5. Safety analyses and Unreviewed Safety Question Determinations (USQDs) associated with site D&D activities will be performed as appropriate.

The WVDP Decommissioning Program is also discussed in Section A.10.6 of WVNS-SAR-001.

REFERENCES FOR CHAPTER B.10.0

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

SR2B1011.DWG

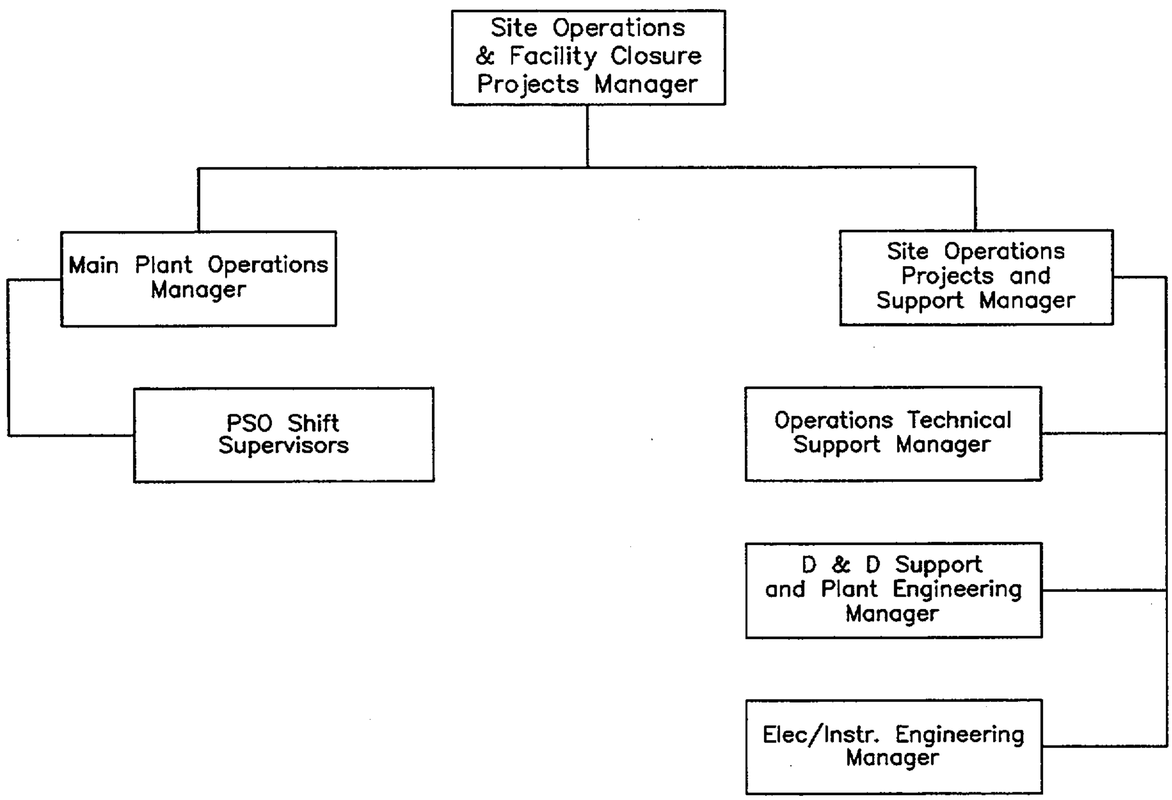


Figure B.10.1-1 Site Operations & Facility Closure Projects Organization

SR2B1012.DWG

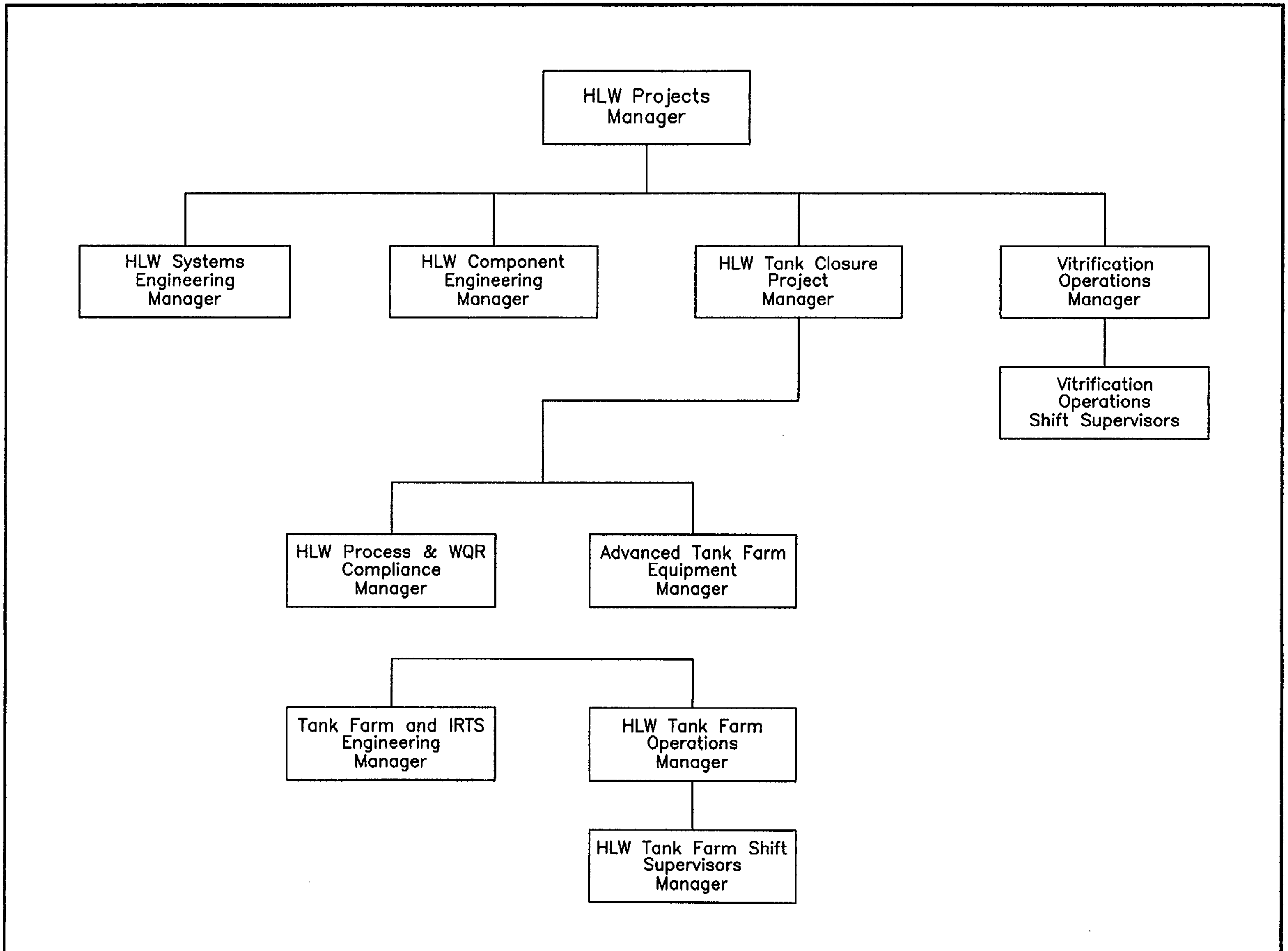


Figure B.10.1-2 HLW Projects Organization

SR2B101-3.DWG

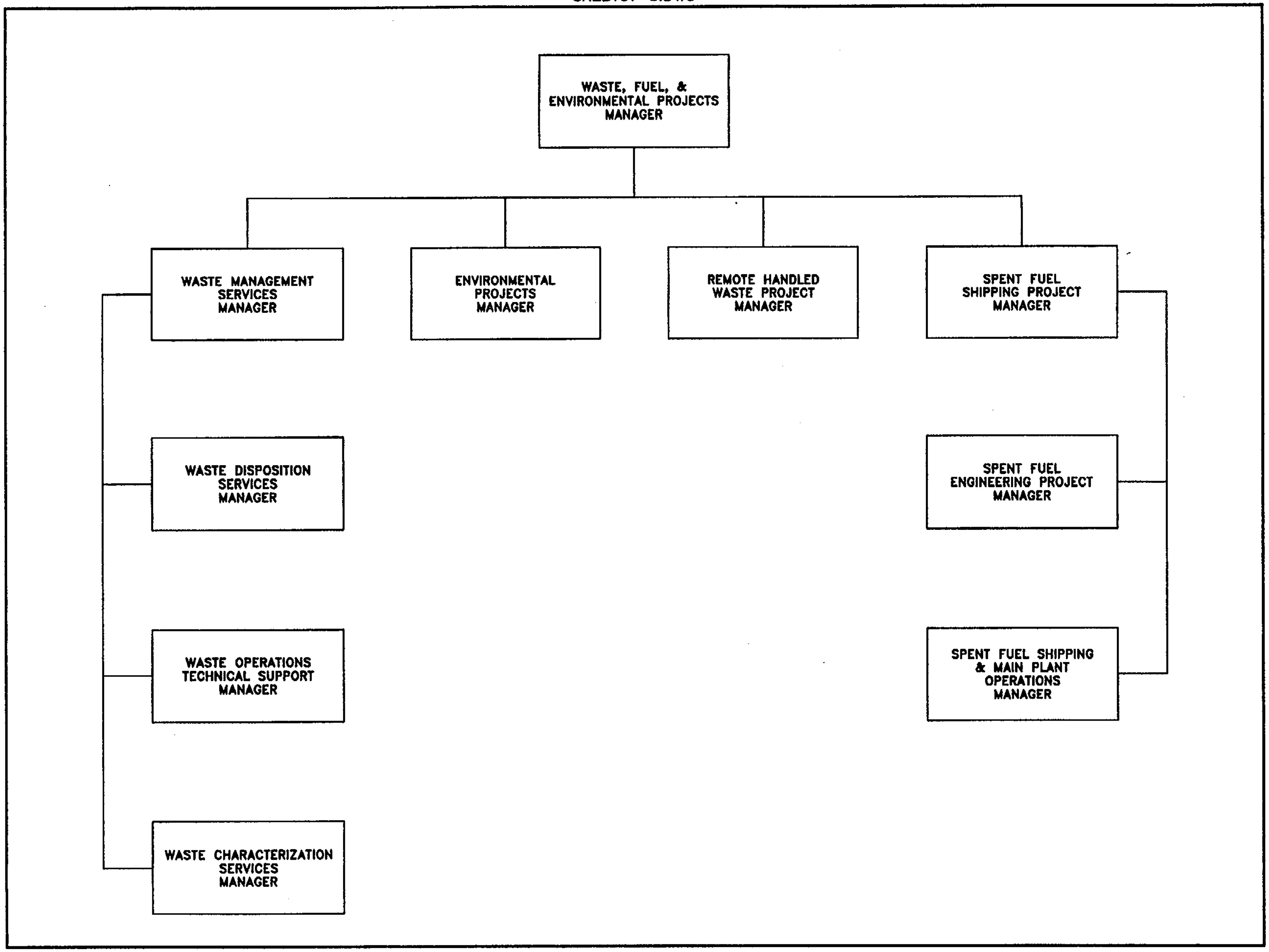


Figure B.10.1-3 Waste, Fuel, & Environmental Projects Organization

B.11.0 TECHNICAL SAFETY REQUIREMENTS

B.11.1 Introduction

The objective of this chapter is to provide information that will satisfy the requirements of DOE Order 5480.23, Topic 16 relating to the derivation of Technical Safety Requirements (TSRs). This chapter is intended to link the accident analyses, through descriptions of the Safety Class structures, systems, and components (SSCs) to TSR documents. The TSR document, as stated in DOE Order 5480.22, is intended to constitute an agreement or contract between DOE and WVNS regarding the safe operation of the WVDP facilities.

Safety Class SSCs are those structures, systems, or components whose preventive and/or mitigative functions are necessary to maintain the consequence of an accident below the off-site evaluation guidelines provided in Section B.9.1.3. Because the accidents analyzed in Chapter B.9.0 do not rely on protective or mitigative features to maintain dose consequences below the evaluation guidelines, no TSRs are required for this SAR.

B.11.2 Requirements

This SAR meets the requirements in DOE Orders 5480.23 and 5480.22, with respect to TSRs.

B.11.3 TSR Input

There are no enveloping Evaluation Basis Accidents which would exceed the EGs. There are no active Safety Class SSCs in facilities within the scope of this SAR nor are there any Safety Class SSCs which are under the direct control of operators of facilities within the scope of this SAR.

B.11.3.1 Safety Limits and Limiting Conditions for Operation

There are no evaluation basis accidents which require active Safety Class SSCs nor Safety Class SSCs under the direct control of operators of facilities within the scope of this SAR to mitigate the consequences or prevent the occurrence to meet the EGs. Initial accident conditions under the direct control of the operator have been analyzed at the maximum credible worst-case conditions (e.g., maximum vessel inventory, maximum concentration).

Therefore, no Safety Limits and Limiting Conditions for Operation are required for facilities within the scope of this SAR.

B.11.3.2 Design Features

The primary passive safety features in the IRTS and Main Plant are the high level waste tanks and vaults in the Waste Tank Farm and the massive concrete shield walls of the Main Plant. IRTS, Main Plant and support facility design features are described in Chapters 4, 5, and 6.

B.11.3.3 Administrative Controls

Administrative Controls are the provisions relating to organization and management, procedures, record keeping, reviews, and audits necessary to ensure safe operation of the facility.

Technical Safety Requirements are not based upon maintaining worker exposures below some acceptable level following an uncontrolled release of hazardous material or inadvertent criticality; rather the risk to workers is reduced through the reduction of the likelihood and potential impact of such events. Because of the necessary and inherent presence of hazardous and radioactive materials at WVDP nuclear facilities and the workers' proximity to these materials, it is impractical to reduce worker risk to an insignificant level through selection of operating limits in TSRs. The consequences of occupational exposures resulting from the release of hazardous and radioactive materials at the WVDP is reduced through the implementation of industrial hygiene and radiation protection programs which have been developed consistent with guidance given in relevant DOE Orders.

Occupational exposure to hazardous materials and/or conditions is thus regulated by the Department of Energy through its contractual commitment by WVNS for the safe operation of the WVDP facilities through compliance with these DOE Orders. Additionally, occupational exposure limits are imposed upon WVNS through Federal and State regulations, as well as through provisions in the Occupational Safety and Health Act administered by OSHA. Consequently, no TSR administrative controls for occupational exposure are required for facilities within the scope of this SAR.

B.11.4 Interface With TSRs From Other Facilities

There are no TSRs from other facilities that interface with the facilities within the scope of this SAR.

REFERENCES FOR CHAPTER B.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.

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

__________. July, 1994. DOE Standard DOE-STD-3009-94: *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports*. Washington, D.C.: U.S. Department of Energy.

B.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). The *WVNS Implementation Plan for QA Rule 10 CFR 830.120* (WVNS) contains a matrix identifying appropriate and applicable requirements of the WVNS QAP and other WVNS procedures to be used in determining compliance with the QA Rule.

The Quality Assurance Program provides guidance for determining the graded applicability of quality assurance standards to items, systems, or services. IRTS facility structures, systems, and components that are covered by the QAP 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. Criteria for quality level designations are provided in Section A.12.3 of WVNS-SAR-001.

The WVNS Quality Assurance Program is presented in Chapter A.12.0 of WVNS-SAR-001, *Project Overview and General Information* (WVNS).

REFERENCES FOR CHAPTER B.12.0

U.S. Department of Energy. Quality Assurance Requirements. 10 CFR 830.120.

West Valley Nuclear Services Co., Inc. WVNS Implementation Plan for QA Rule 10 CFR 830.120

__________. WVDP-111: Quality Assurance Program Plan. (Latest Revision.)

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

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