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West Valley Demonstration Project

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SAFETY ANALYSIS REPORT FOR

LOW-LEVEL WASTE PROCESSING AND SUPPORT ACTIVITIES

URS CORPORATION 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)

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ACRONYMS AND ABBREVIATIONS

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

LIST OF ACRONYMS AND ABBREVIATIONS

(Continued)

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

LIST OF ACRONYMS AND ABBREVIATIONS

(Continued)

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
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

LIST OF ACRONYMS AND ABBREVIATIONS

(Continued)

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

LIST OF ACRONYMS AND ABBREVIATIONS

(Continued)

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
GPCCR	General Purpose Cell Crane Room
GPCCRE	General Purpose Cell Crane Room Enclosure
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
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

LIST OF ACRONYMS AND ABBREVIATIONS

(Continued)

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
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

LIST OF ACRONYMS AND ABBREVIATIONS

(Continued)

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

LIST OF ACRONYMS AND ABBREVIATIONS

(Continued)

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
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 Policy 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

LIST OF ACRONYMS AND ABBREVIATIONS

(Continued)

NY	New York
NYCRR	New York Code of Rules and Regulations
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSERDA	New York State Energy Research and Development Authority
NYSGS	New York State Geological Survey
o.d.	Outer Diameter
OAAM	Operational Accident Assessment Manager
OAM	Operational Assessment Manager
OB	Office Building
OBE	Operating Basis Earthquake
OEP	On-Site Evaluation Point
OGA	Off-Gas Aisle
OGBR	Off-Gas Blower Room
OGC	Off-Gas Cell
OGMR	Off-Gas Monitoring Room
OGTS	Off Gas Treatment System
OH	DOE, Ohio Field Office
OH/WVDP	Ohio Field Office, West Valley Demonstration Project
OJT	On-the-Job Training
OM	Operations Manager
OOS	Out-of-Service
ORNL	Oak Ridge National Laboratory
ORR	Operational Readiness Review
ORRB	Operational Readiness Review Board
ORT	Operations Response Team
OSC	Operations Support Center
OSHA	Occupational Safety and Health Act
OSHA	Occupational Safety and Health Administration
OSR	Operational Safety Requirement
oz	Ounce
p	Pico, prefix for 10^{-12}
P	Peta, prefix for 10^{15}
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

LIST OF ACRONYMS AND ABBREVIATIONS

(Continued)

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
PMCRE	Process Mechanical Cell Crane Room Enclosure
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
PMP	Project Management Plan
PNL	Pacific Northwest Laboratory
PNNL	Pacific Northwest National Laboratory
PPB	Parts Per Billion
PPC	Product Purification Cell
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

LIST OF ACRONYMS AND ABBREVIATIONS

(Continued)

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
RMW	Radioactive Mixed Waste
RP	Radiation Protection
rpm	Revolutions per minute
RPM	Revolutions Per Minute
RPM	Radiation Protection Manager
RPSA	Rail Packaging and Staging Area
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

LIST OF ACRONYMS AND ABBREVIATIONS

(Continued)

SMS	Sludge Mobilization System
SMT	Slurry Mix Tank
SMWS	Sludge Mobilization and Wash System
SNF	Spent Nuclear Fuel
SNL	Sandia National Lab
SNM	Special Nuclear Material
SO	Security Officer
SOG	Seismic Owner's Group
SOP	Standard Operating Procedure
SPDES	State Pollutant Discharge Elimination System
SPO	Security Police Officer
Sr	Strontium
SR	Surveillance Requirement
SRE	Search and Reentry
SRL	Savannah River Laboratory
SRR	Scrap Removal Room
SRSS	Square-root-of-the-sum-of-the-squares
SS	Stainless Steel
SSC	Sample Storage Cell
SSCs	Structures, Systems, and Components
SSE	Safe Shutdown Earthquake
SSS	Security Shift Supervisor
SSS	Slurry Sample System
SSWMU	Super Solid Waste Management Unit
STC	Sample Transfer Cell
STD	Standard
STP	Standard Temperature and Pressure
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

LIST OF ACRONYMS AND ABBREVIATIONS

(Continued)

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
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

LIST OF ACRONYMS AND ABBREVIATIONS

(Concluded)

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
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 has contracted with West Valley Nuclear Services Company LLC (WVNS) to manage the Project. WVNS is a part of the Westinghouse Government Environmental Services Company, which was formed following the acquisition of WVNS in March 1999 by a joint venture of Washington Group International, Inc., formally known as Morrison Knudsen Corporation, and British Nuclear Fuels, Inc.

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.

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[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 or eventually directly to the CFMT. Overheads from the evaporator are processed through an ion exchange column loaded with zeolite for cesium removal. Two additional ion exchange columns have been installed and are being used for mercury 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.

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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.

REFERENCES FOR CHAPTER B.1.0 (concluded)

_____. 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.1.0 (concluded)

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

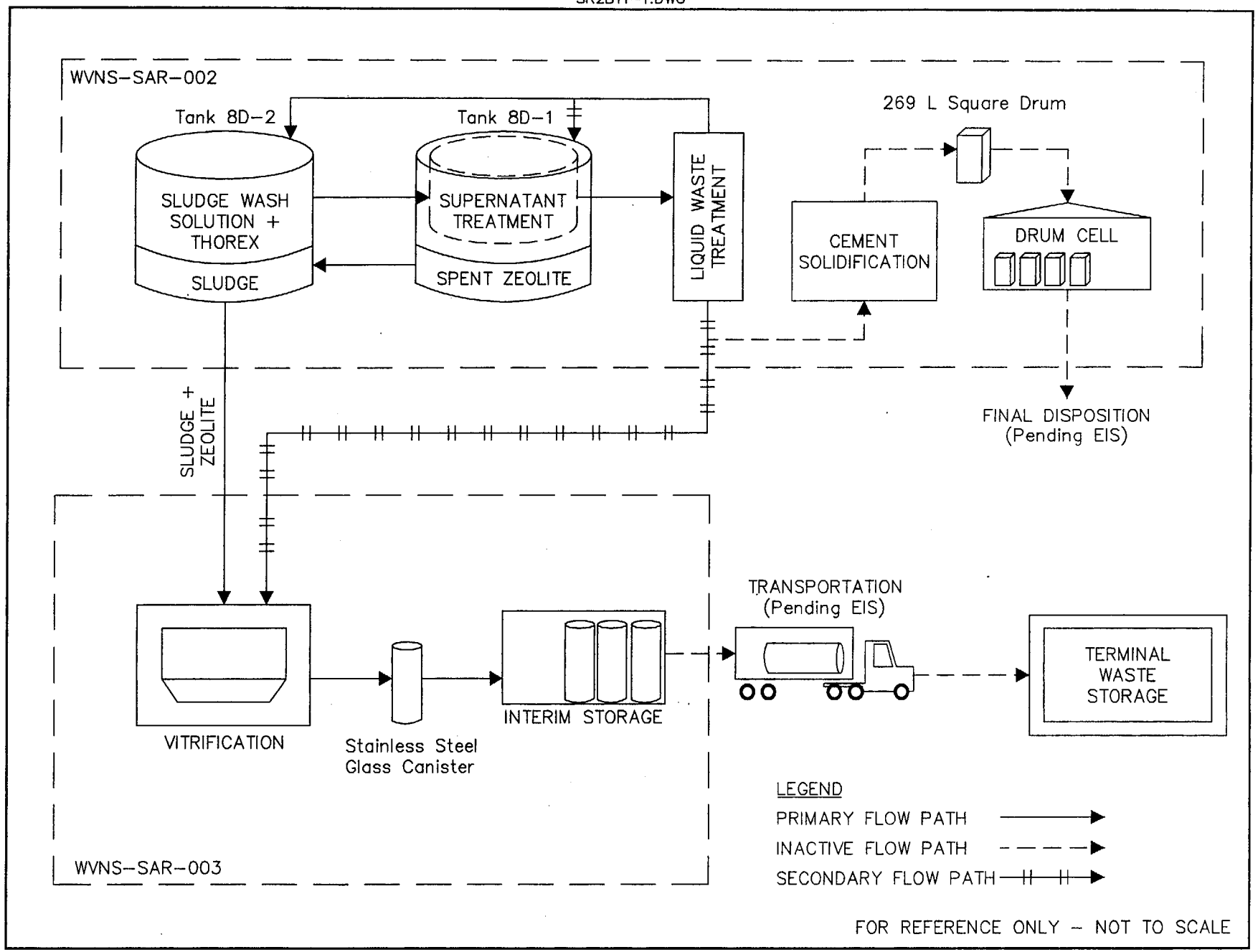

Figure B.1.1-1. Waste Processing Flow Diagram

SR2B11-2.DWG

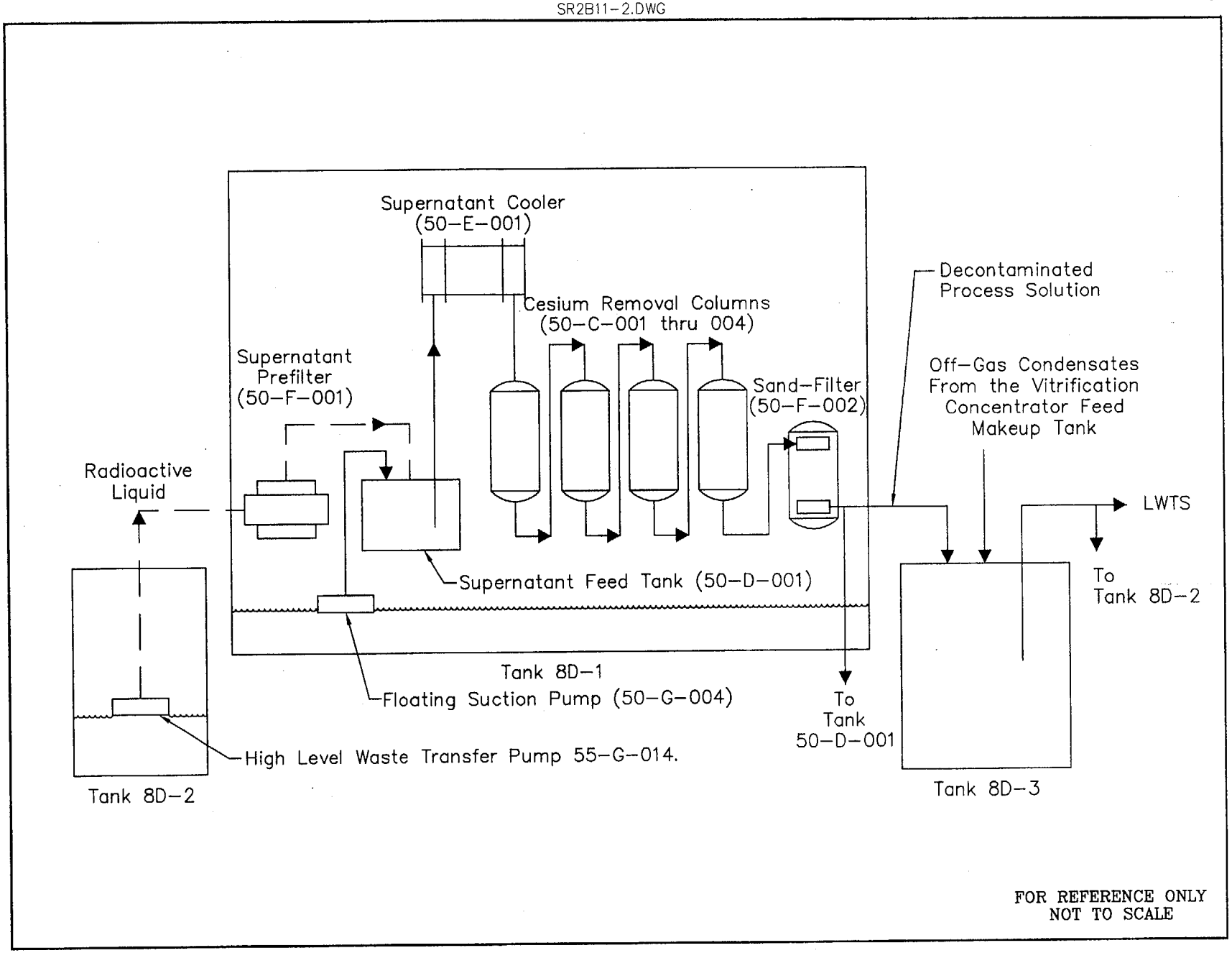

Figure B.1.1-2. Supernatant Treatment System Process Flow Diagram

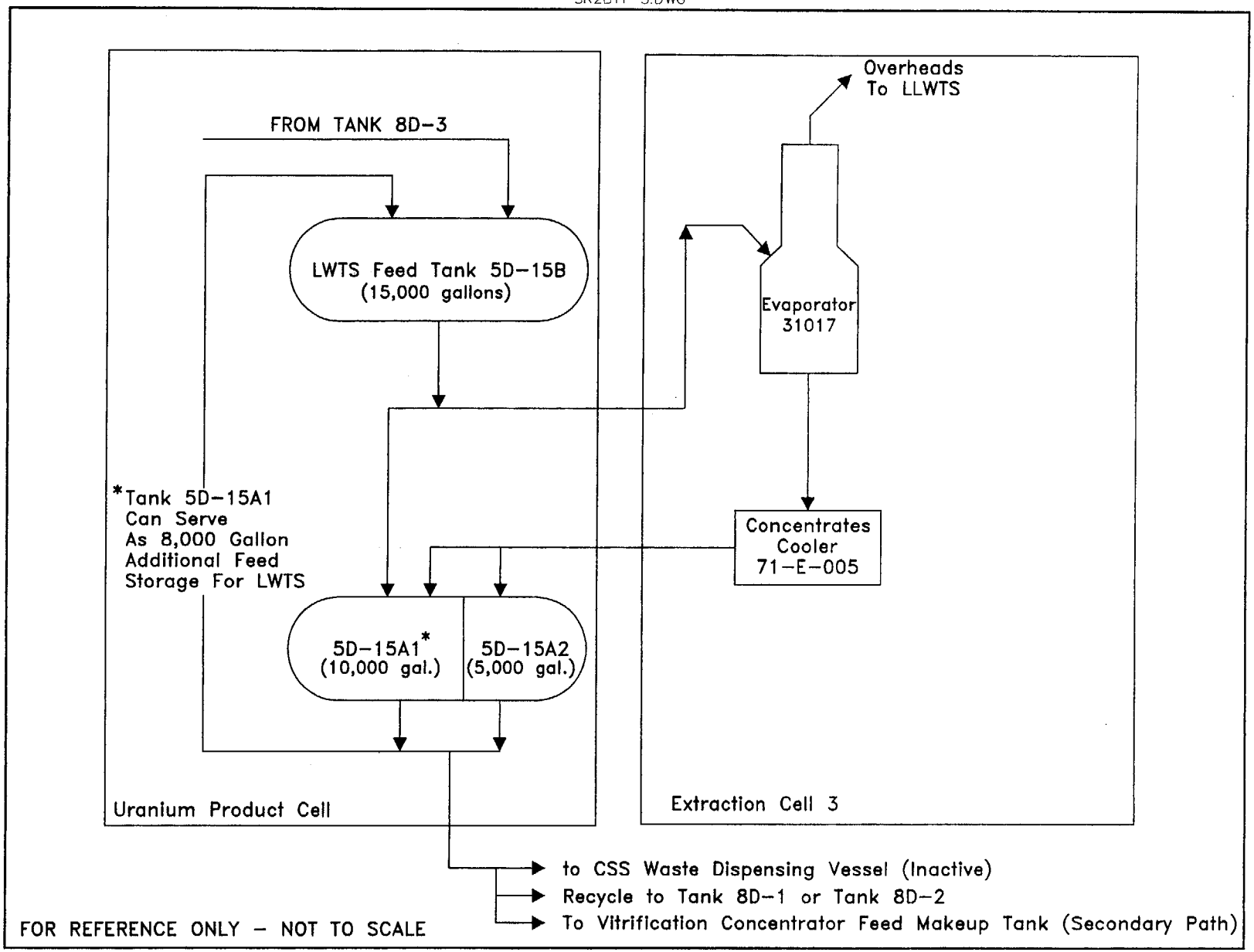

Figure B.1.1-3. Liquid Waste Treatment System Process Flow Diagram

SR2B114.DWG

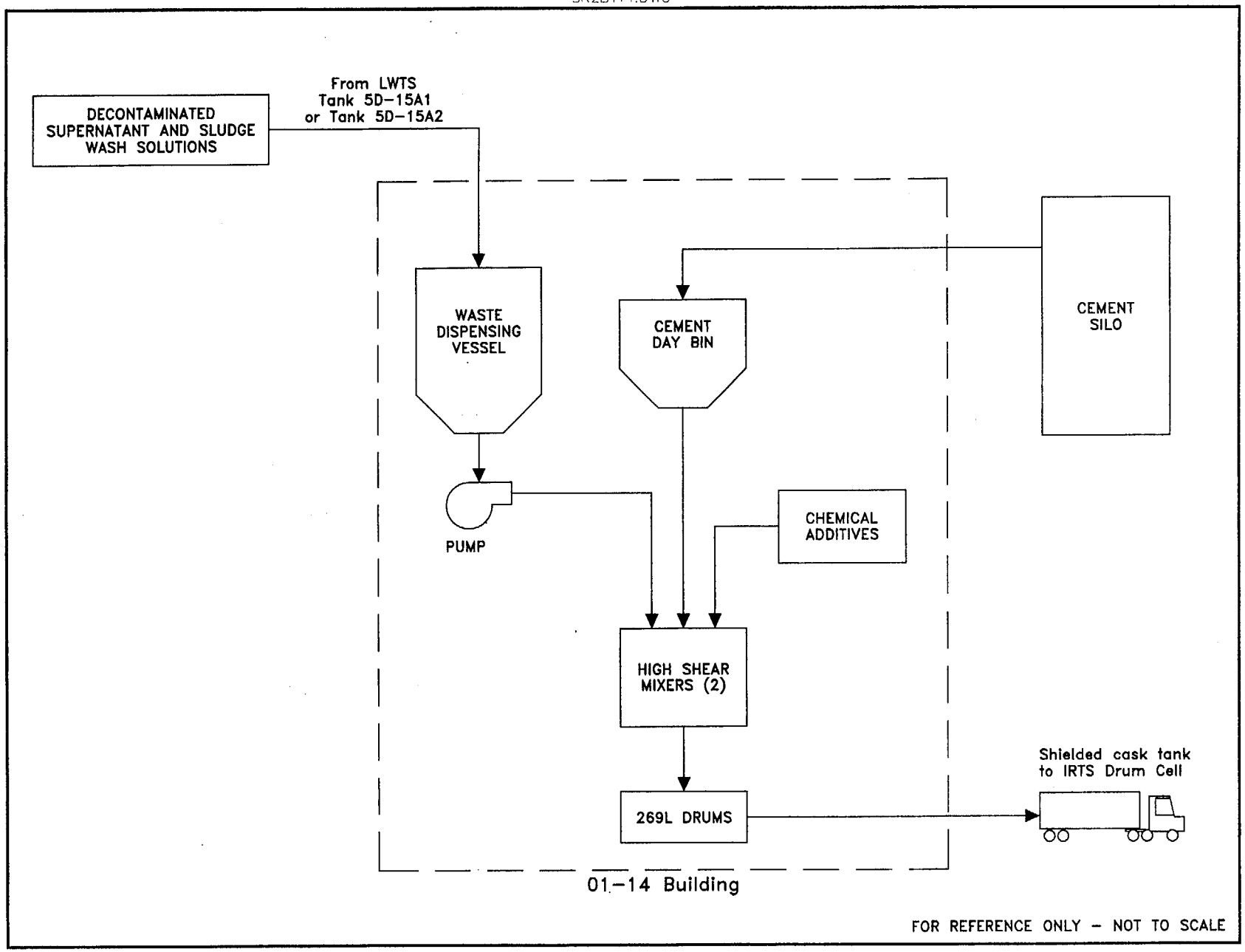

Figure B.1.1-4. Cement Solidification System Process Flow Diagram (System is Inactive)

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 (or TEEL-2) for off-site evaluations, and ERPG-3 (or TEEL-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).

Temporary Emergency Exposure Limits (TEELs) describe "interim, temporary, or equivalent exposure limits for which official Emergency Response Planning Guidelines have not yet been developed," and have been adopted by the Department of Energy's Subcommittee on Consequence Assessment and Protective Actions. TEEL-1, TEEL-2, and TEEL-3 definitions are the same as those for ERPG-1, ERPG-2, and ERPG-3, respectively, except that the TEEL definitions do not include the words "for up to one hour." ERPG and TEEL values for hundreds of chemicals are provided in *TEELS, Temporary Exposure Limits* (USDOE 10/23/00)and specific ERPG and TEEL values cited in this SAR have been taken from that reference.

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 14 mrem (1.4E-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, CSPF, 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 1.1E-2 mrem/year (1.1E-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 2.83E-2 mrem/year (2.83E-4 mSv/year) based on discharges from the WVDP in 1999 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 one 1250 L (330 gal) tote of technical grade 35% hydrogen peroxide outside the oxidizer room in the Warehouse. This postulated accident resulted in a maximum concentration of 8.75 ppm of hydrogen peroxide at a distance of 1050 m (3444 ft). The ERPG-2 value for 35% hydrogen peroxide is 50 ppm.

The second accident analyzed the rupture of a Main Plant transformer containing 2200 L (586 gal) of PCB-contaminated Wemco "C" oil, a suspected carcinogen. As analyzed in Section B.9.2.2.3, this accident involved approximately 0.64 L (0.17 gal) of PCBs, resulting in a maximum concentration of 3.1E-3 mg/m^3 at a distance of 1050 m (3444 ft). The TEEL-2 value for PCBs 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 8.75 ppm of hydrogen peroxide at 1050 m (3444 ft) 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.

REFERENCES FOR CHAPTER B.2.0

U.S. Code of Federal Regulations. *Occupational Radiation Protection*, 10 CFR 835.

United States Environmental Protection Agency. March, 1992. *User's Guide for CAP88-PC, Version 1.0*. EPA/402-B-92-001.

U.S. Department of Energy. February 2, 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.

_____. October 23, 2000. Revision 17m *TAELS, Temporary Exposure Limits*. USDOE SCAPA, Subcommittee on Consequence Assessment & Protective Actions.

West Valley Nuclear Services Co., Inc. WVDP-065: *Radiological Parameters for Assessment of West Valley Demonstration Project Activities*. (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.

TABLE B.2.6-1

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	8.75 ppm	17.5 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 - TEEL-3 (5 mg/m^3)
			Off-site - TEEL-2 (5 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

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.

REFERENCES FOR CHAPTER B.3.0 (concluded)

_____. 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.

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 vitrification activities, radionuclide content of tank 8D-2 is currently less than 5% of that given in Table B.4.1-1 (Winkler, C.J., September 29, 2000)).

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 either recycled back to Tank 8D-2 or Tank 8D-1 or routed to the Concentrator Feed Make-up Tank. Additionally, low-level liquid waste from the overheads 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 (see Figure B.1.1-2). 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 or secondarily to the Concentrator Feed Make-up Tank, while liquid low-level wastes i.e., the overheads, are sent to the LLWTS (see Figure B.1.1-3).

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 Main Plant, Waste Management, spent fuel shipping, D&D, Vit, and High-Level Waste Tank Farm operations positions. Operators are qualified in accordance with documented performance-based training programs. 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 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.

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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 a nonradiological storage 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 are associated with existing facility operations; namely, the 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.

<u>Tank 8D-1 Concrete Vault Integrity Analysis</u>

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 HLWISF 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 metric 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). 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 closed with a remotely-operated valve.

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.

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 north-south leg of the LWC is 14.10 meters (46.25 ft) long by 5.18 meters (17 ft) wide, and the east-west leg is 5.79 meters (19 ft) long by 4.80 meters (15.75 ft) wide. The LWC is 5.94 meters (19.5 ft) high across its extent. The floor of the LWC is below grade at a plant elevation of 28 meters (92 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 5.9 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. XC-2 and XC-3 can also 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 the "vessels are empty," referring to the vessels 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

(600 ft3). The makeup of the solution in the general purpose evaporator is unknown, but "is probably water that entered the ARC sump from the Off-Gas Aisle."

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. Entry to the ARPR is via a door in the east wall, from the south stairway. Some equipment originally in the room, including 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 Drum Cell

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 Warehouse Facilities

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: the Vitrification Facility, Main I and II Warehouses, Annex north, Annex south, Annex conference rooms, Test and Storage Building, PVS Building, 01-14 Building, 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, 01-14 Building, Trailer City, 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 O1-14 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 01-14 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 pressurized gas cylinders, 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.

Dry chemical systems are typically used in lab hoods and are located in facilities such as the Expanded Analytical Lab and the A&PC Labs. Dry chemical systems are also located in HAZMAT and in bulk oil storage lockers.

B.5.3.1.5 Wet Chemical System

A wet chemical extinguishing system, which has a fixed supply of wet chemical agent connected to fixed piping, is located in the site cafeteria at Trailer City. Nozzles are arranged above cooking equipment 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 actuation of the fixed wet chemical system is by fusible links located above the hazard.

B.5.3.1.6 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.5.3.1.7 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.5.3.1.8 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.5.3.1.9 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 Manhole 4 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 manhole. Tanks are vented to the atmosphere after HEPA filtration.

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 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, it 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 (30-P-1) located in the Utility Room (UR), a 1560 kVA standby diesel-driven generator (30-P-2) located in the URE, and a 750 kVA standby diesel-driven generator (50-P-1) located in the PVS mechanical room. 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 1560 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. The diesel fuel for the 750 kVA generator is supplied from a 380 L (100 gal) day tank and is automatically filled from a 2000 L (550 gal) underground tank.

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

Three compressors are supplied for plant air systems: 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 a condensate receiver 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 on demand 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, beepers, and hand-held 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.

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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 - southwest 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 (34D-14)	East of old warehouse	470,000 L 220,000 Gal	Waste Water Treatment Facility influent	Synthetic liner
Equalization Tank (34D-20)	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) (Out of Service)	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
	PDR	PDAH	PDCH	PDAL	PDCL	PR	PAH
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 SUPPLY 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	550	800
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

SR2B51-1.DWG

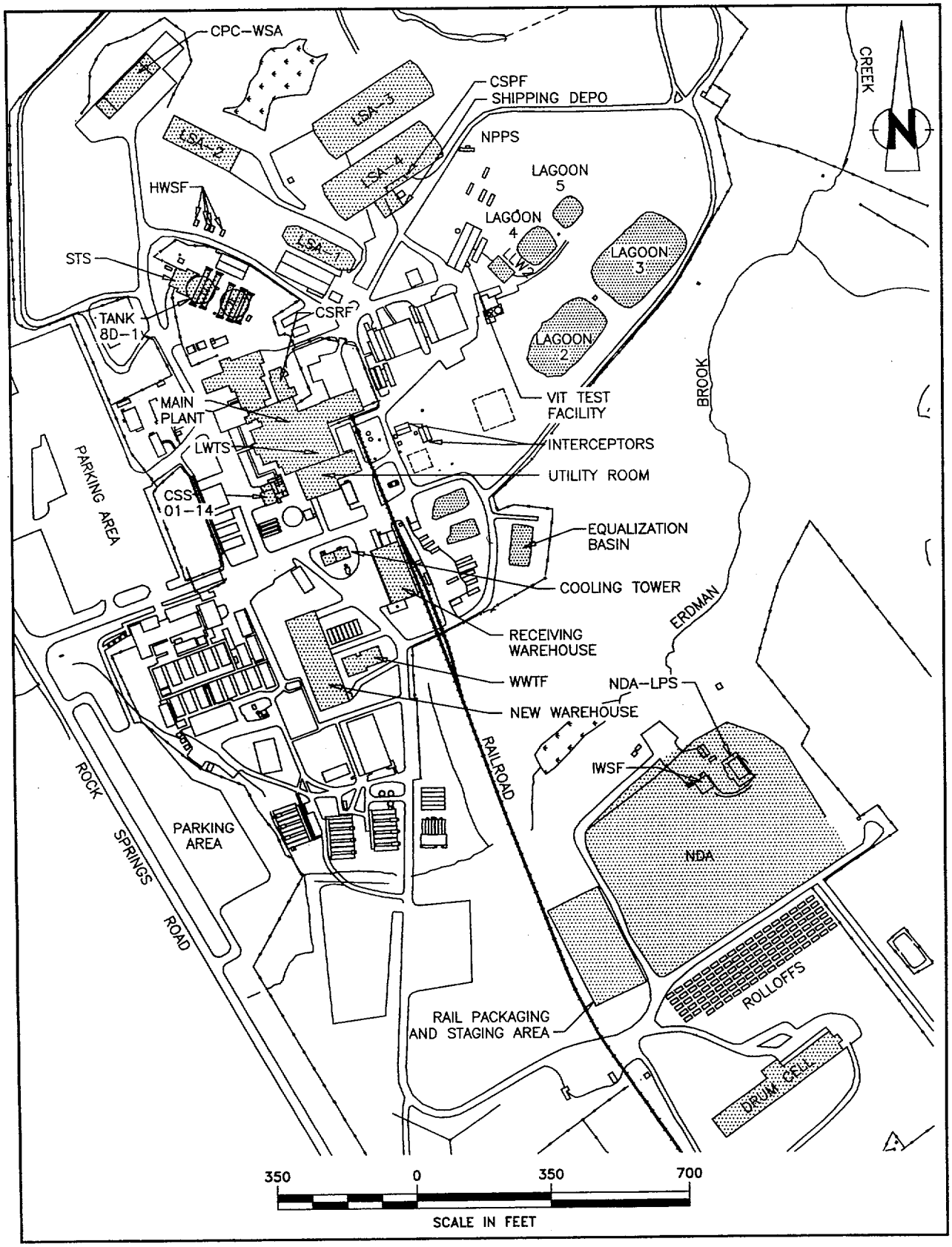

Figure B.5.1-1 Location of Select Facilities Covered in WVNS-SAR-002

SR2B51-2.DWG

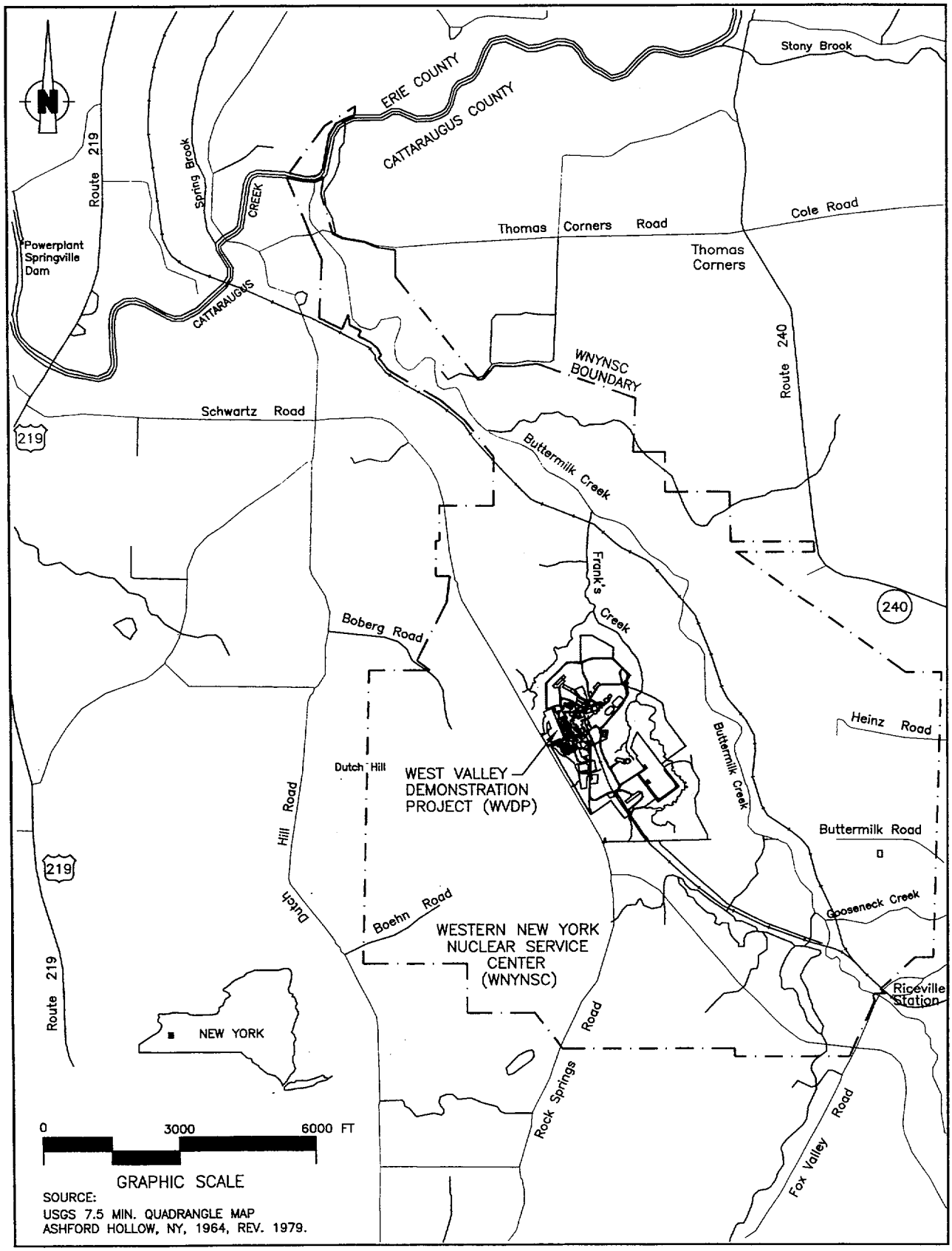

Figure B.5.1-2 Location of West Valley Demonstration Project

SR2B52-1.DWG

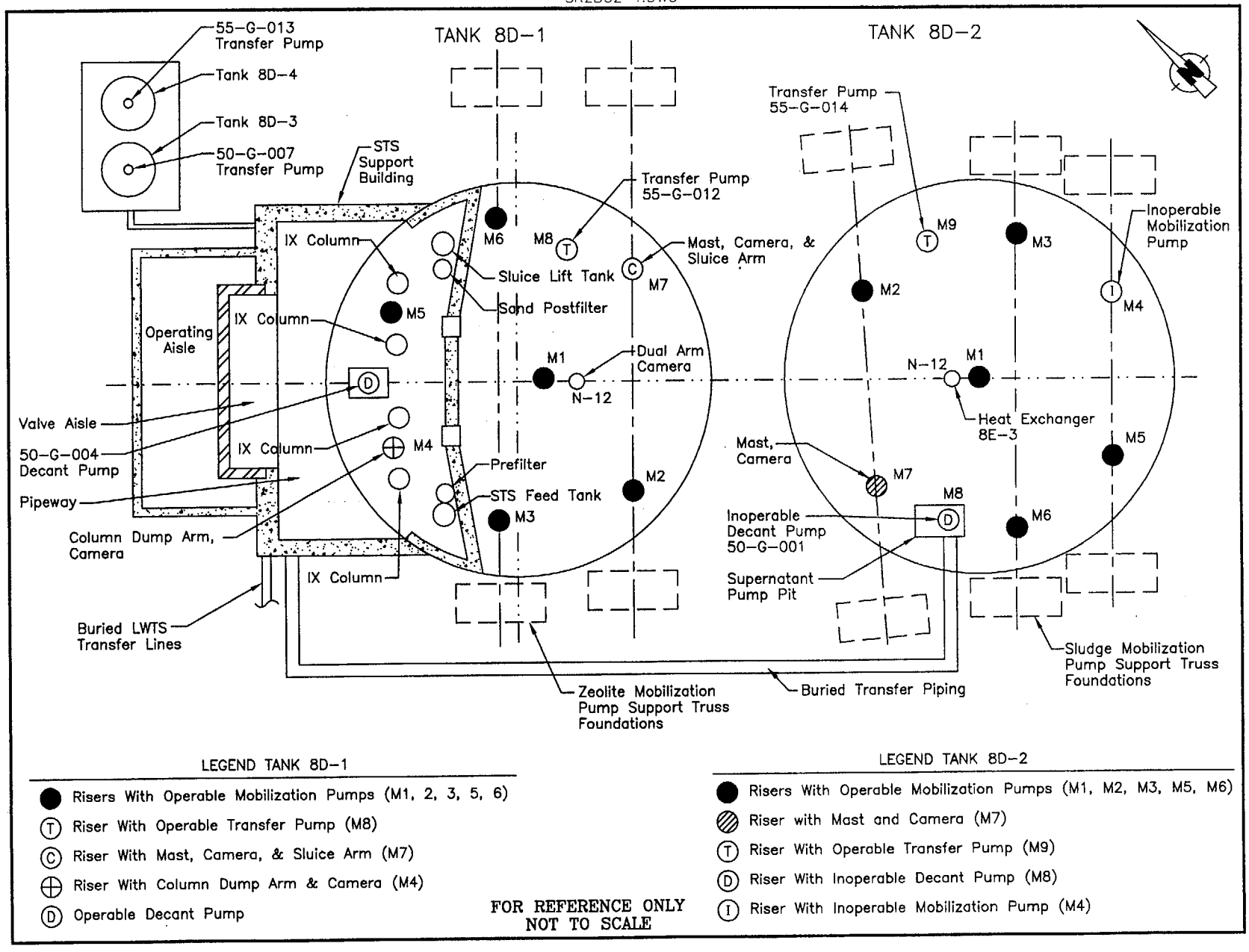

Figure B.5.2-1 Plan View – HLW Tanks 8D-1 and 8D-2

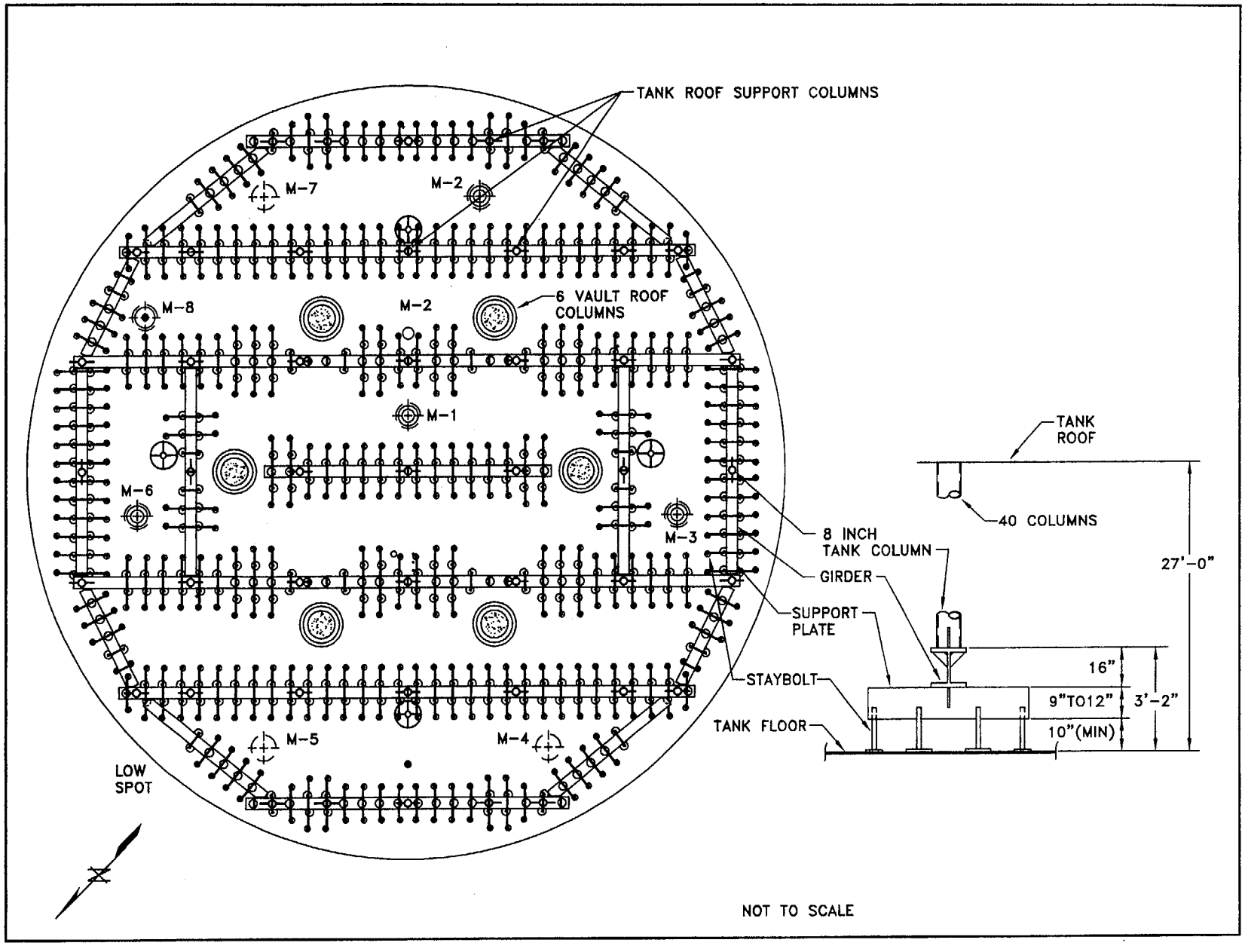

Figure B.5.2-1a. Purex HLW Tank Internal Floor Structure (Typ.) (Tank 8D-1 Shown)

SR2B52-2.DWG

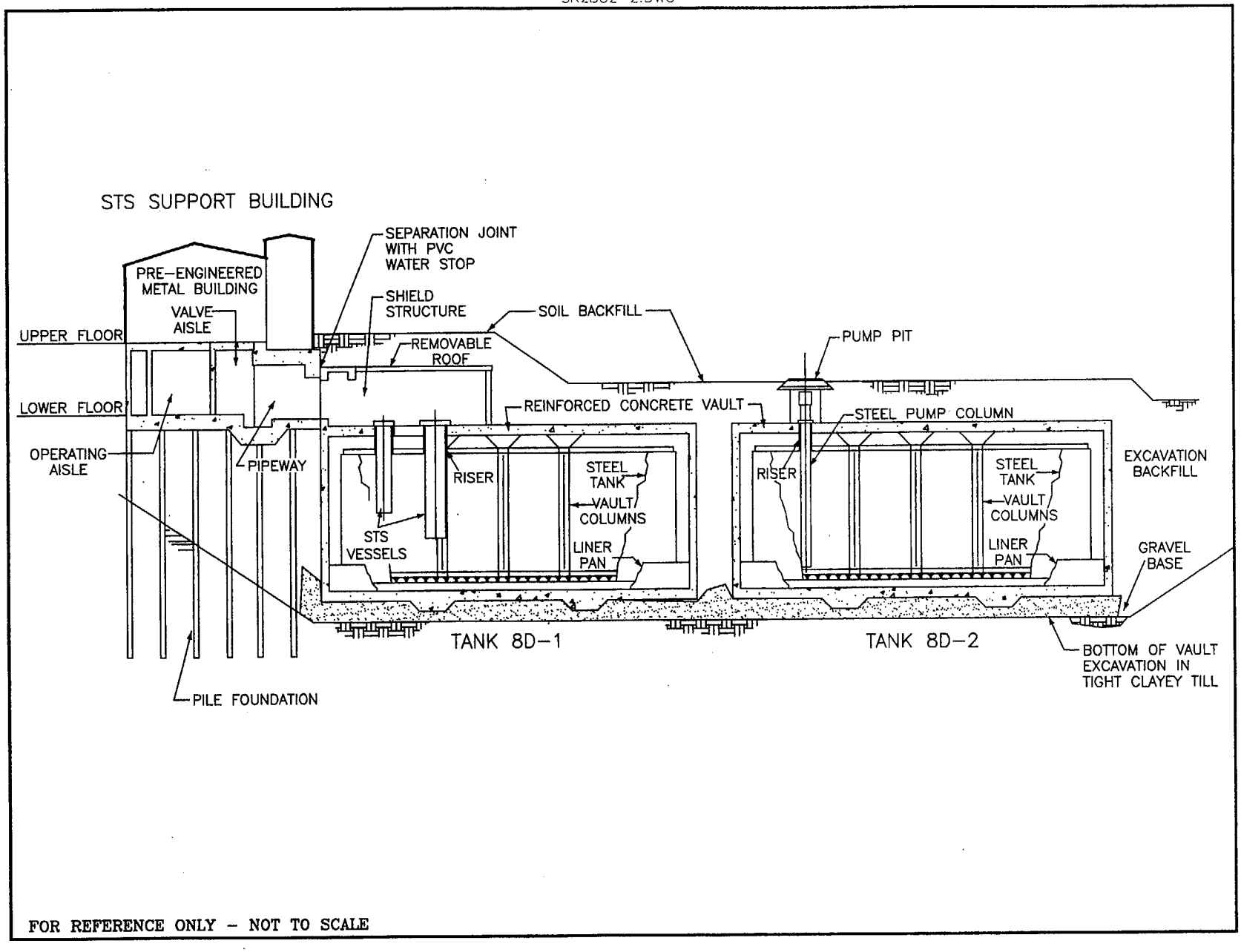

Figure B.5.2-2. STS Process Facilities Section

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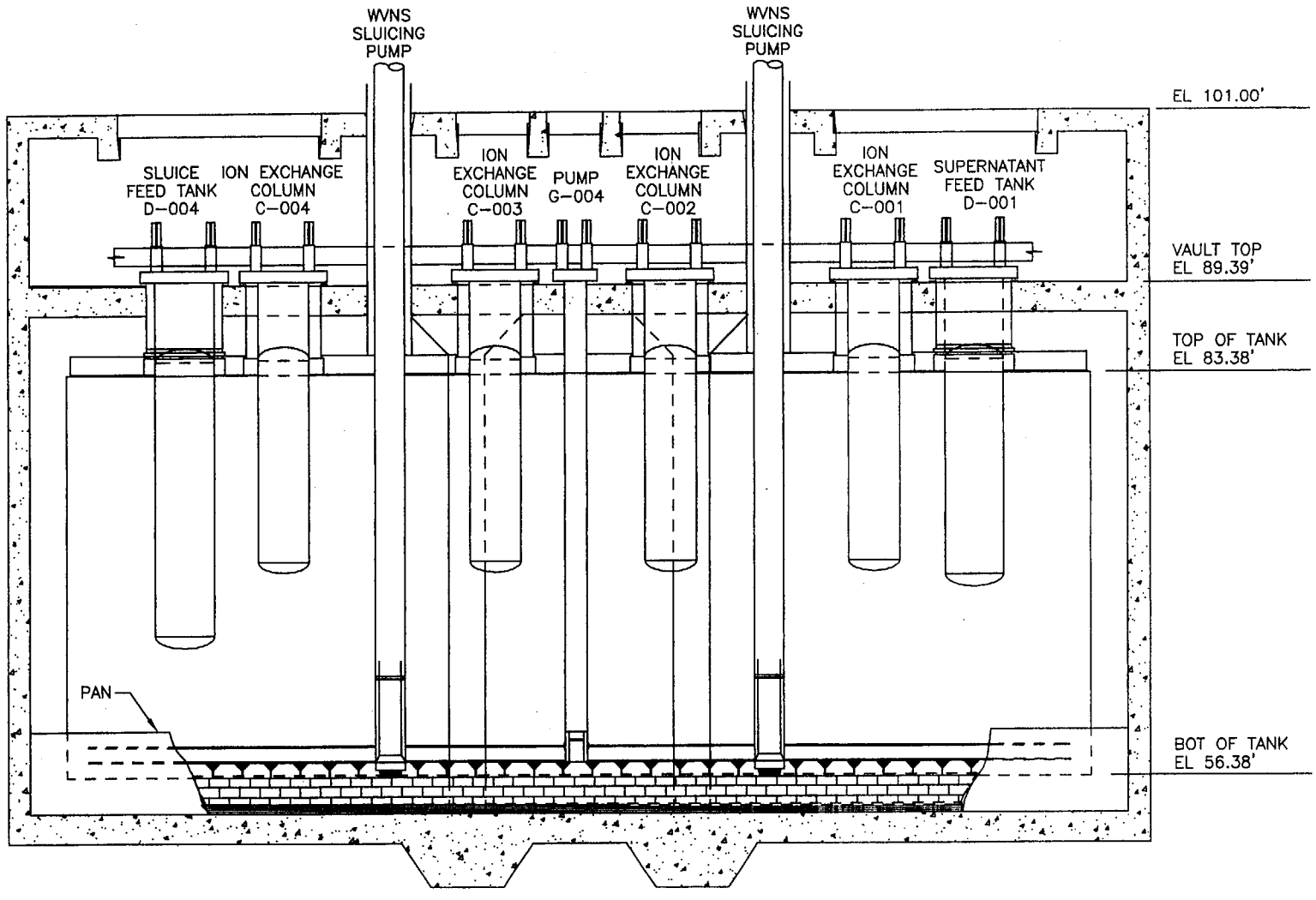


FOR REFERENCE ONLY - NOT TO SCALE

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

SR2B52-4.DWG

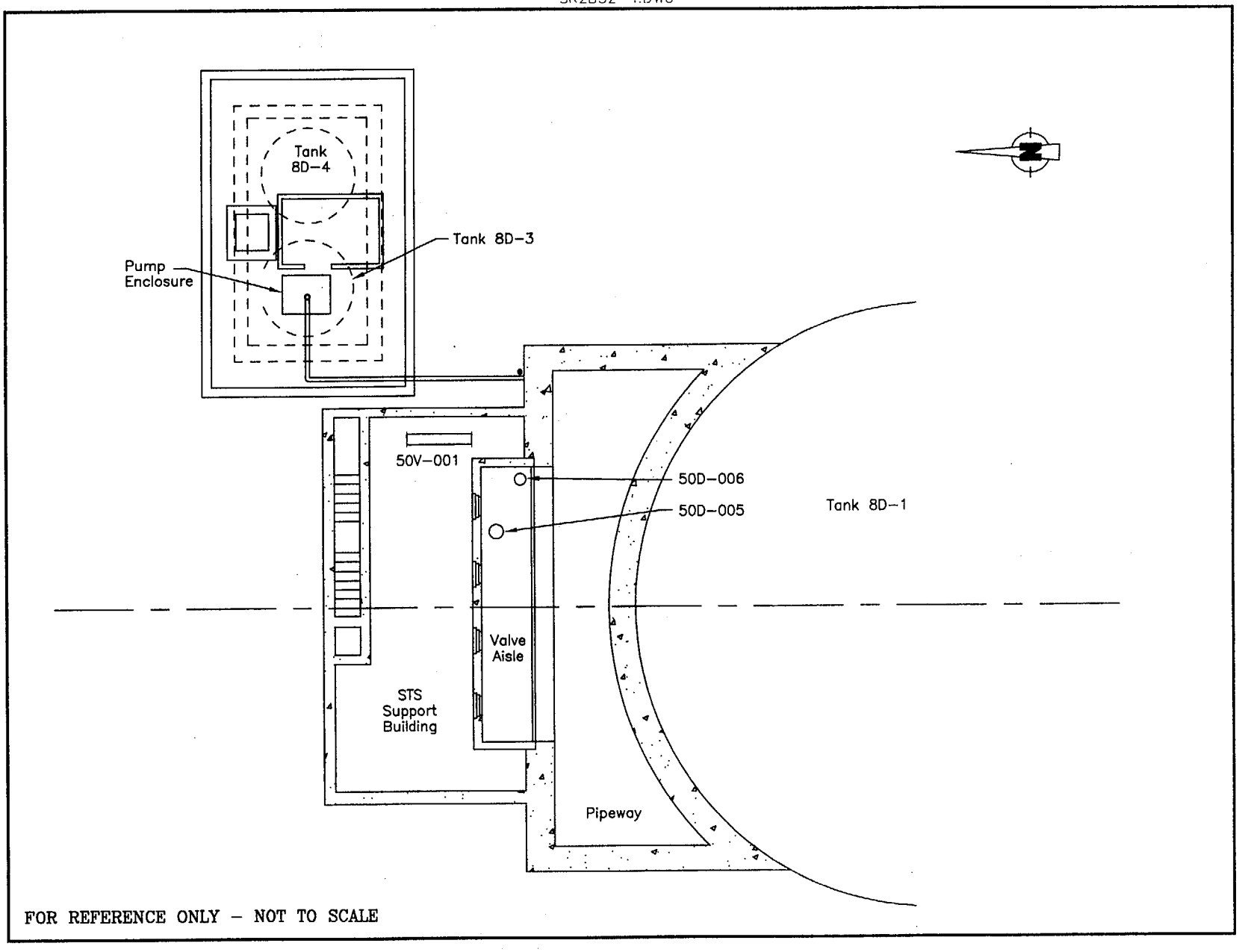


Figure B.5.2-4. General Arrangements STS Building and 8D-3 & 4 Tanks - Plan Elevation 92.0'

SR2B52-5.DWG

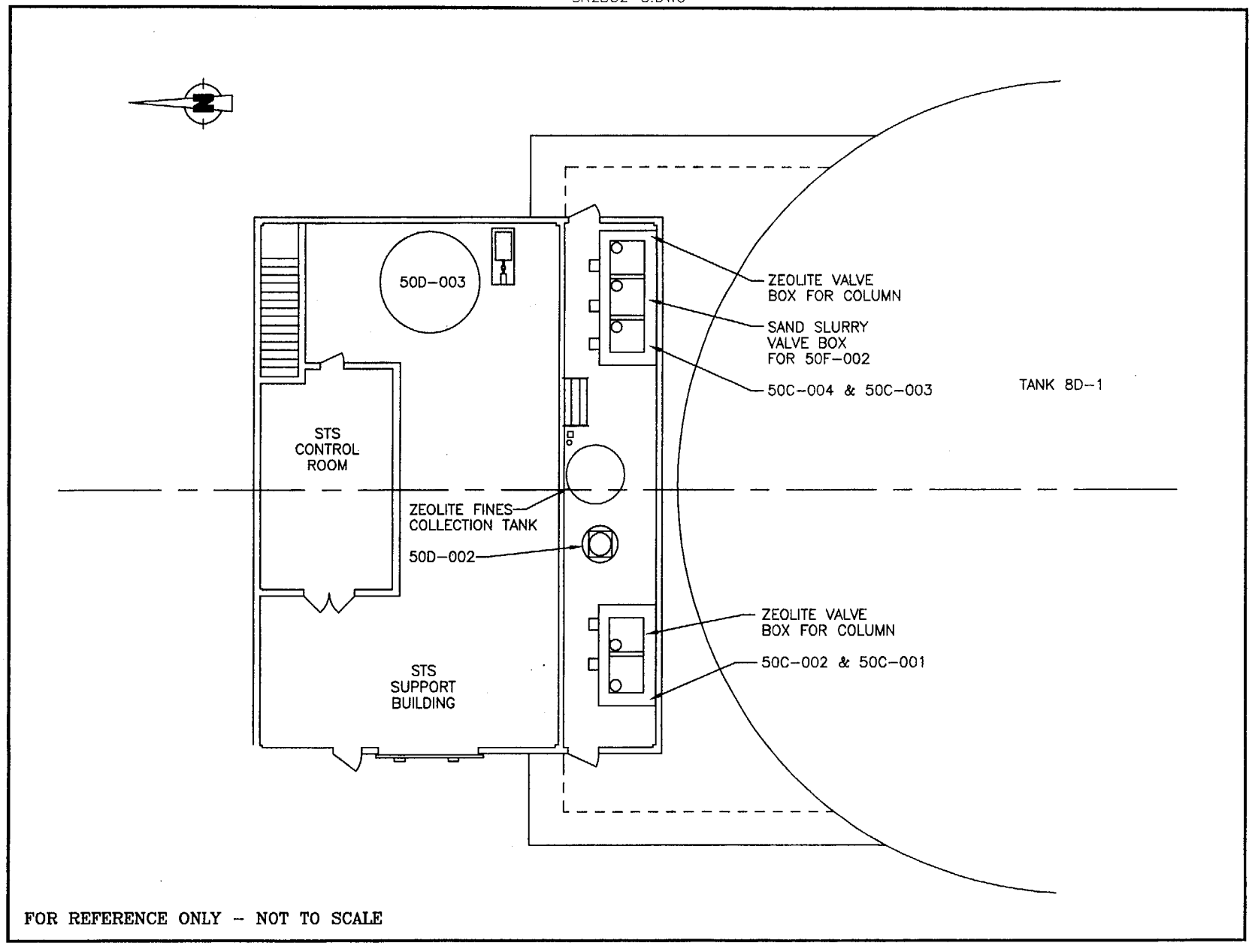


Figure B.5.2-5. General Arrangement STS Building – Plan Elevation 107.0'

SR2B52-6.DWG

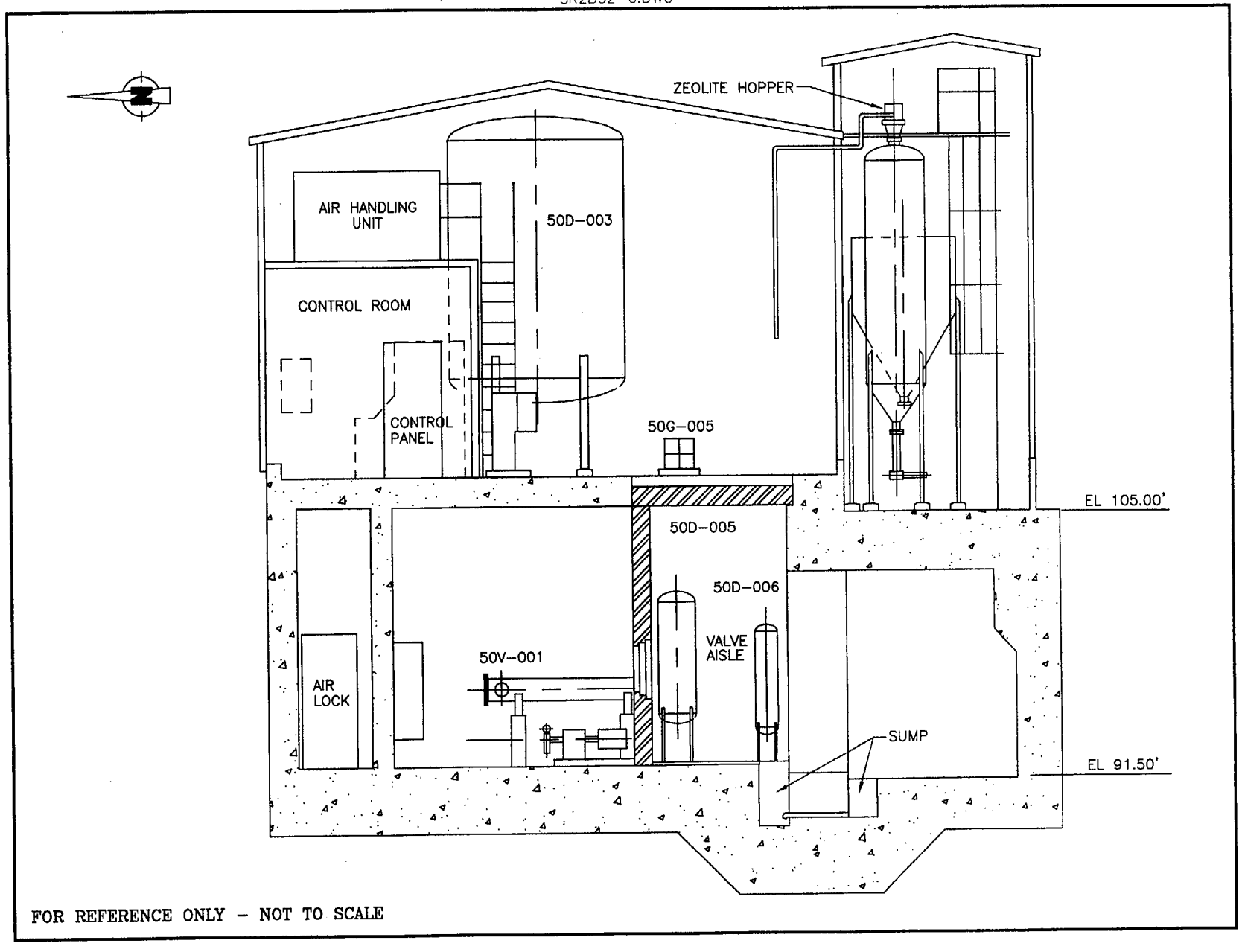
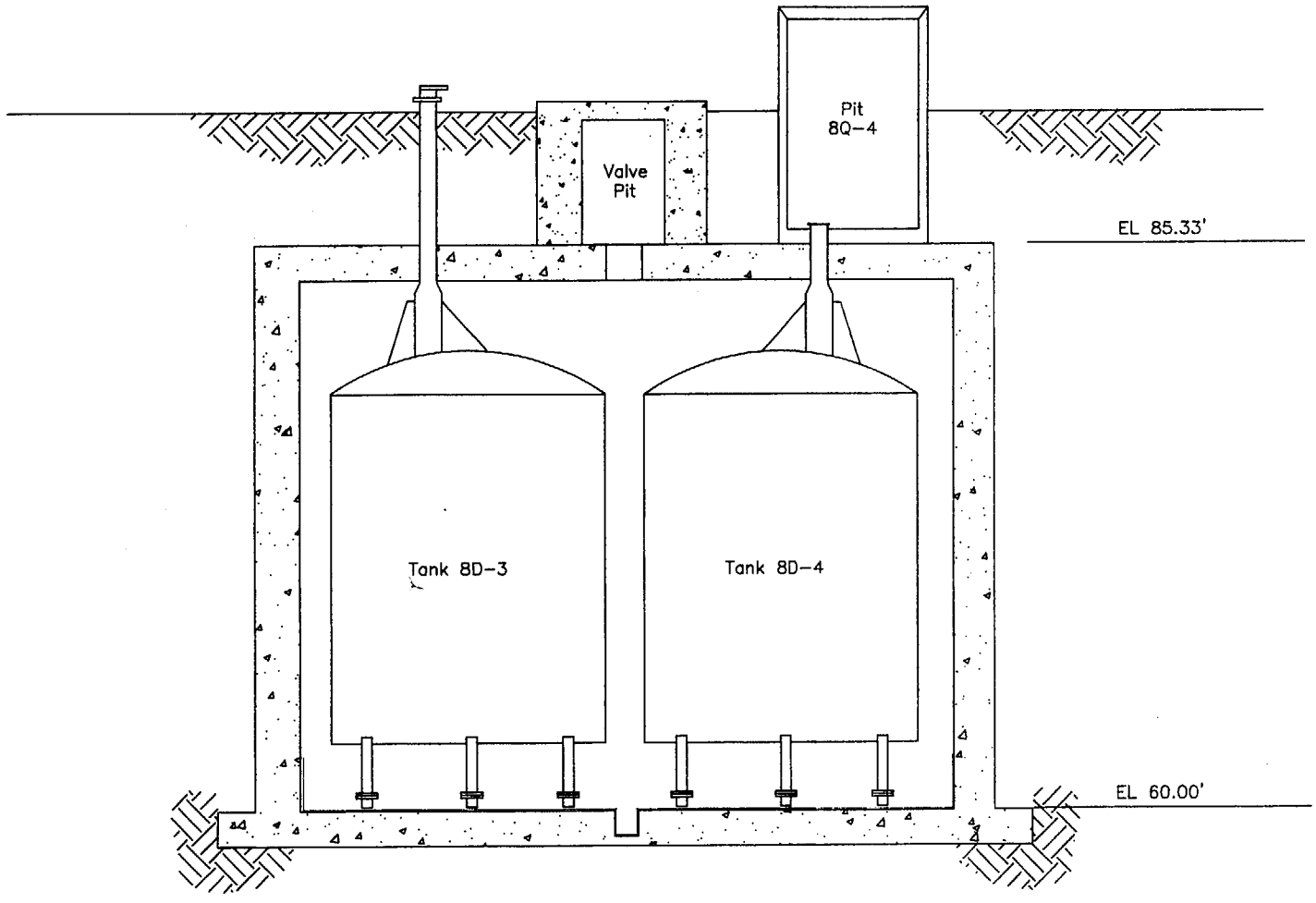


Figure B.5.2-6. General Arrangement – STS Building Sections

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

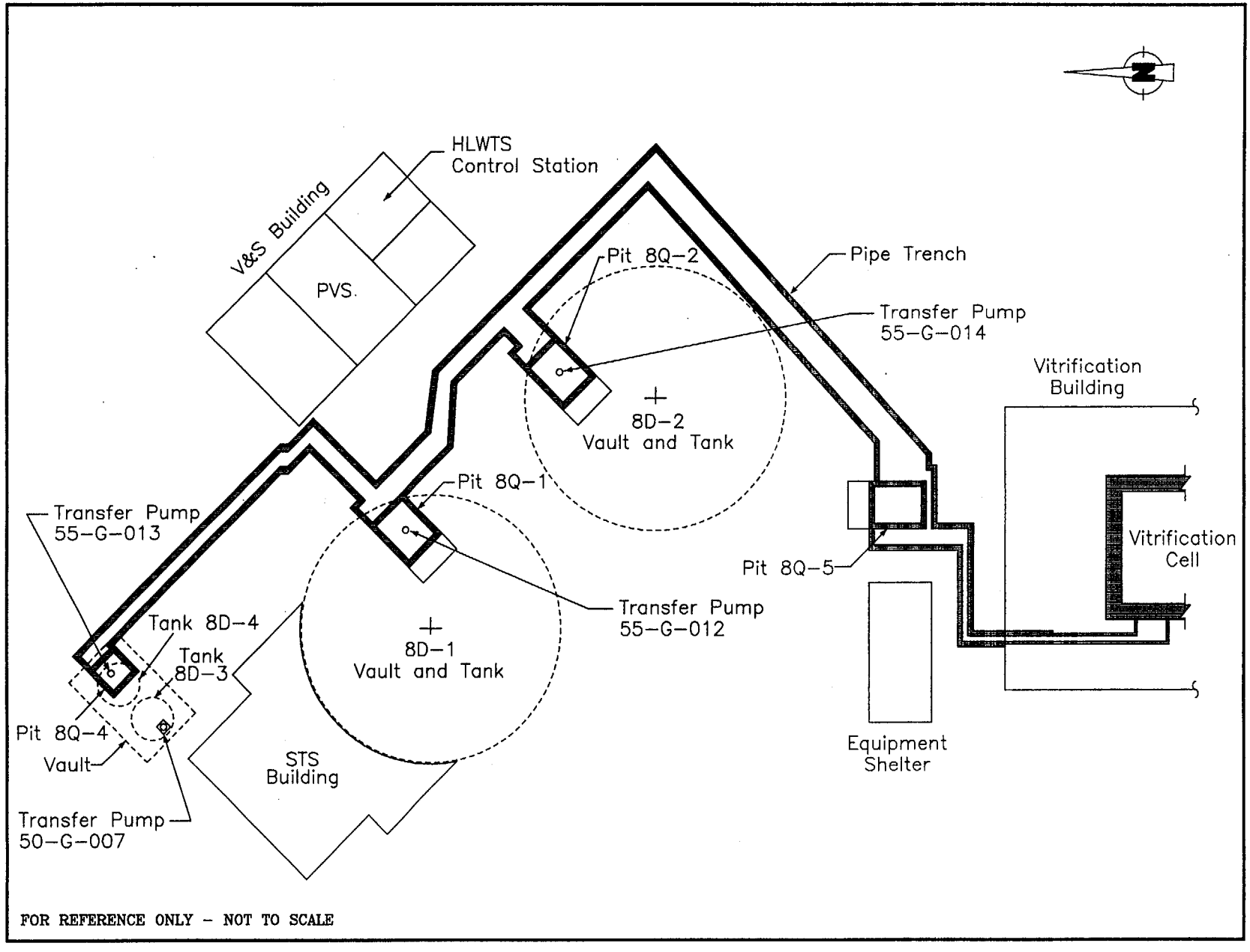


Figure B.5.2-8. High Level Waste Transfer System Plan

SR2B52-9.DWG

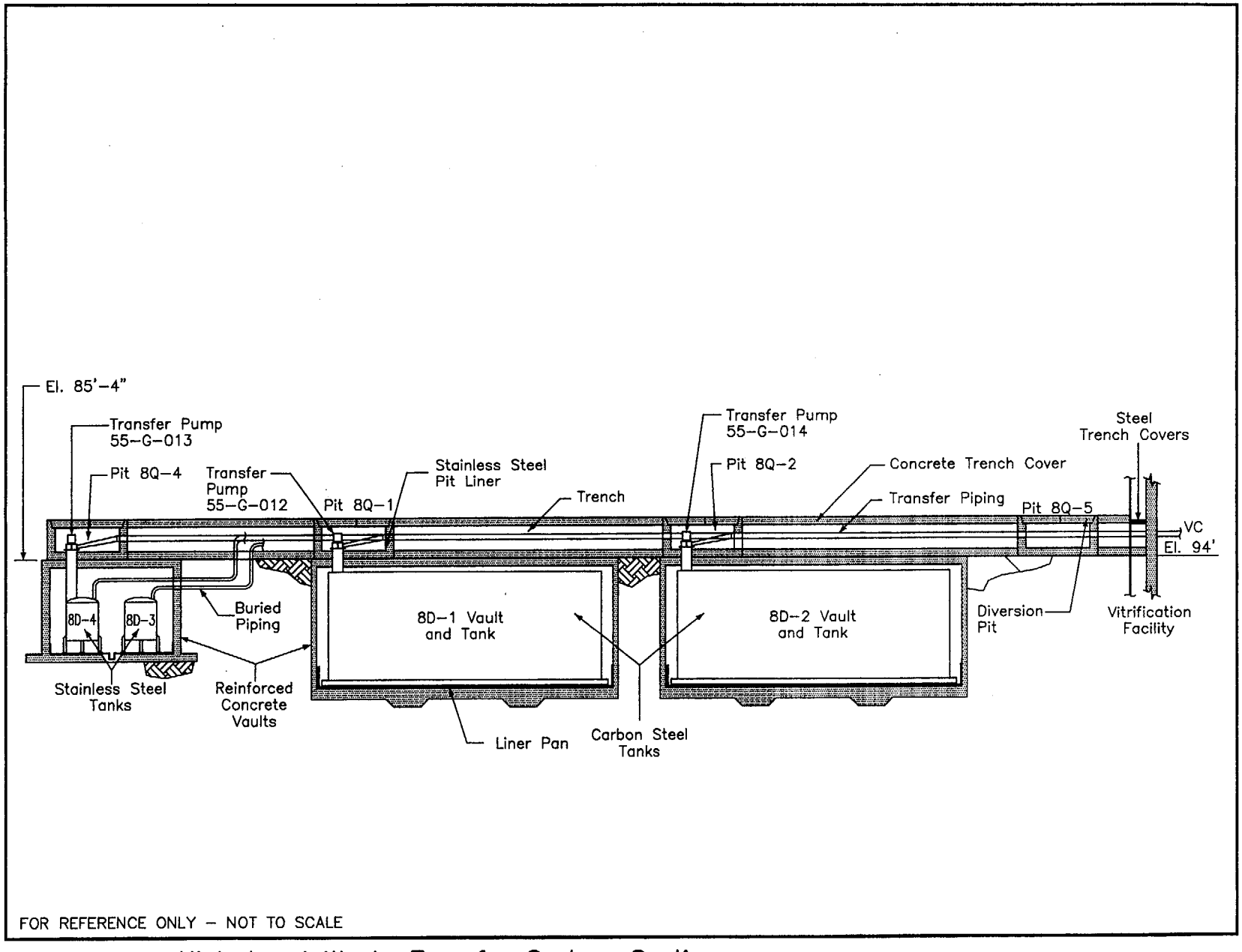


Figure B.5.2-9. High Level Waste Transfer System Section

SR2B5210.DWG

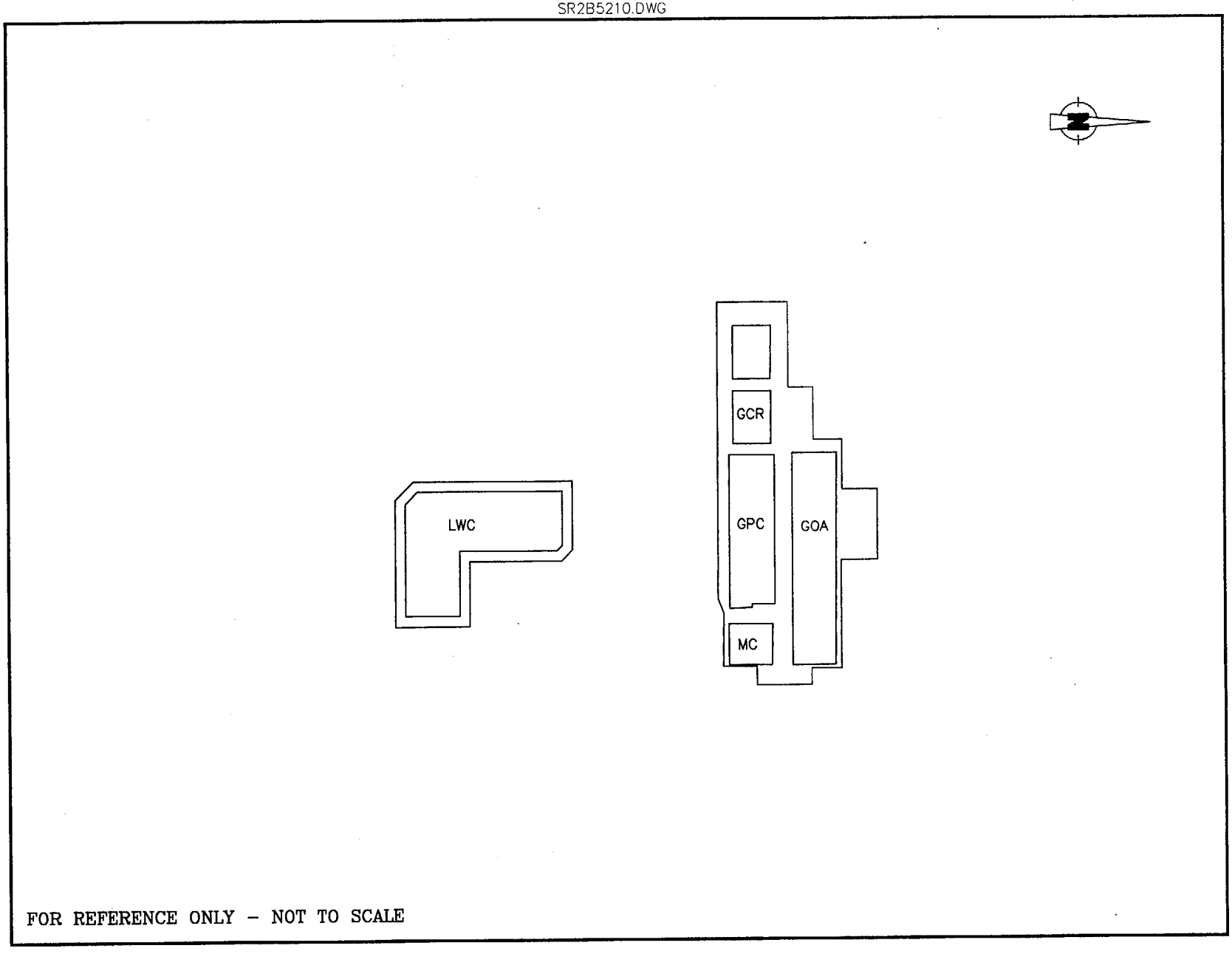


Figure B.5.2-10. Main Plant Plan Below Grade

SR2B5211.DWG

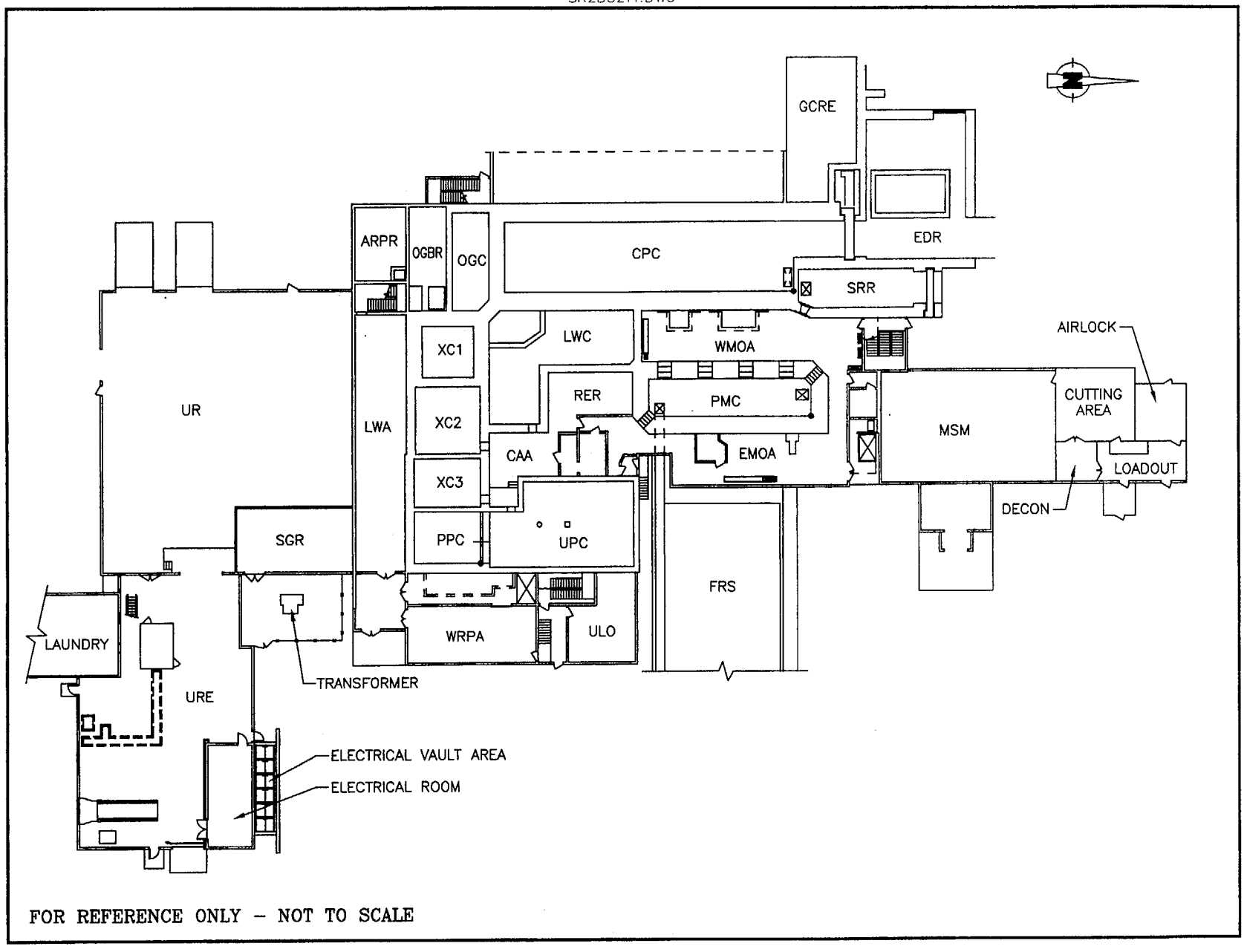
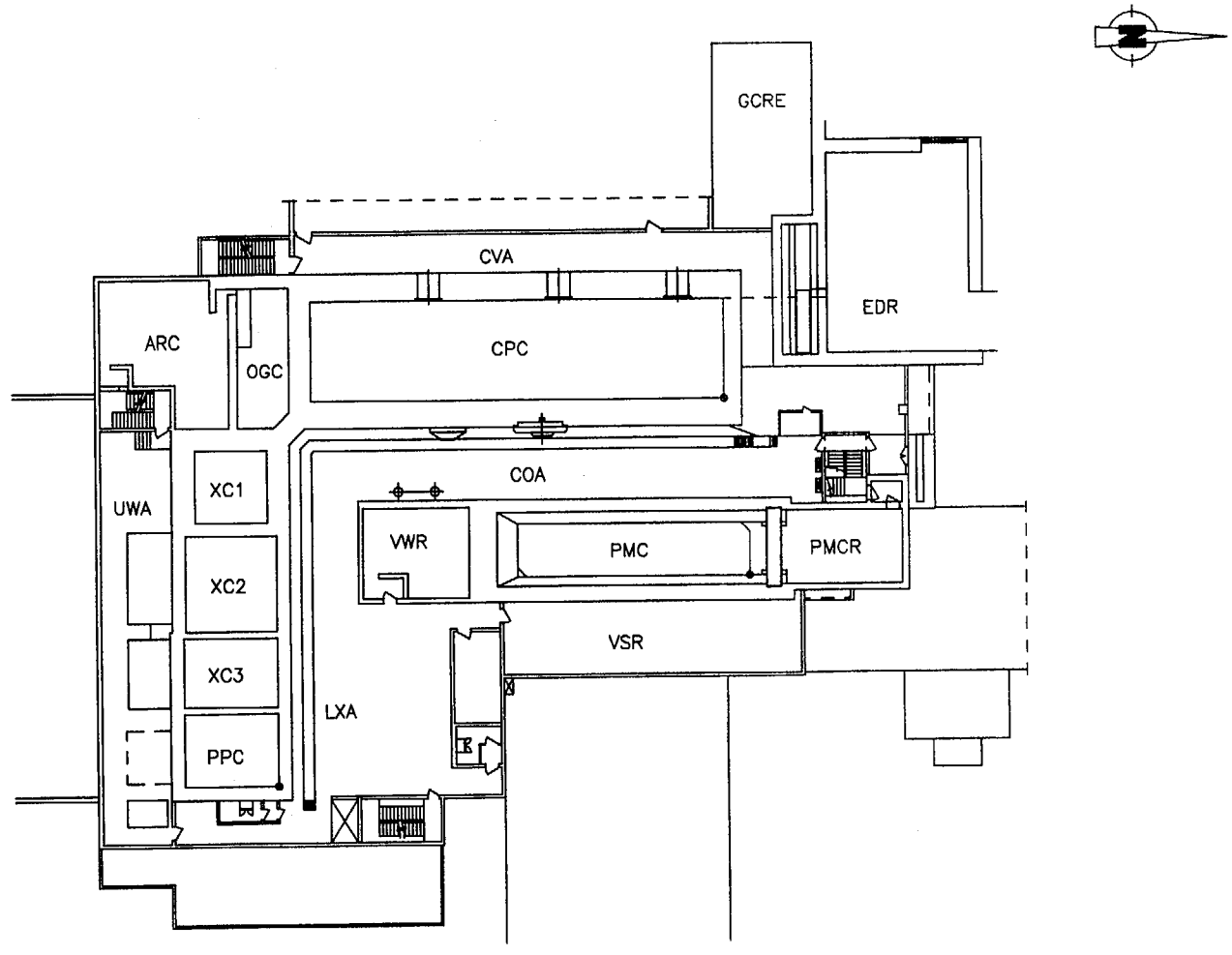


Figure B.5.2-11. Main Plant Plan at Elevation 100.0'

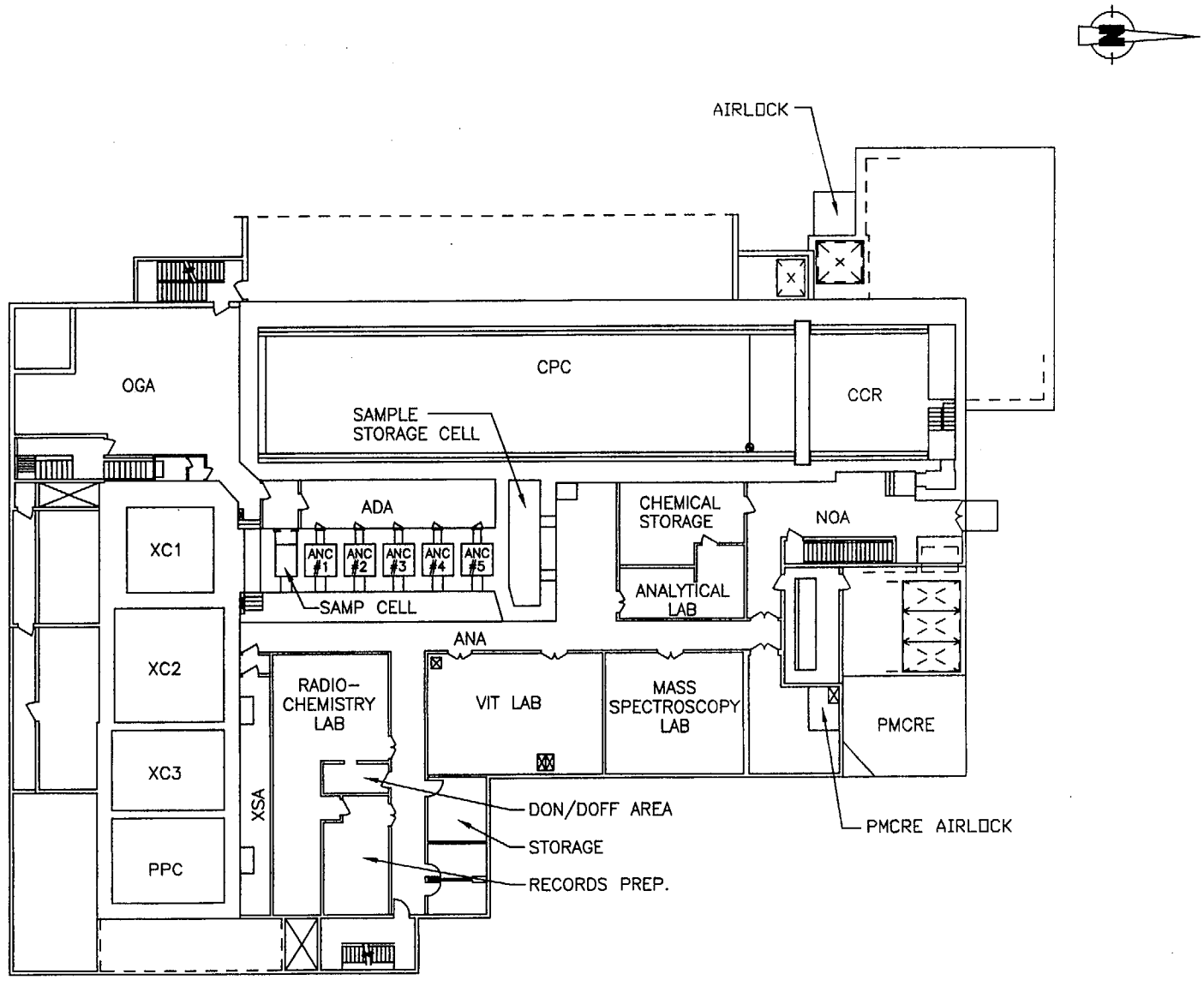
SR2B5212.DWG



FOR REFERENCE ONLY – NOT TO SCALE

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

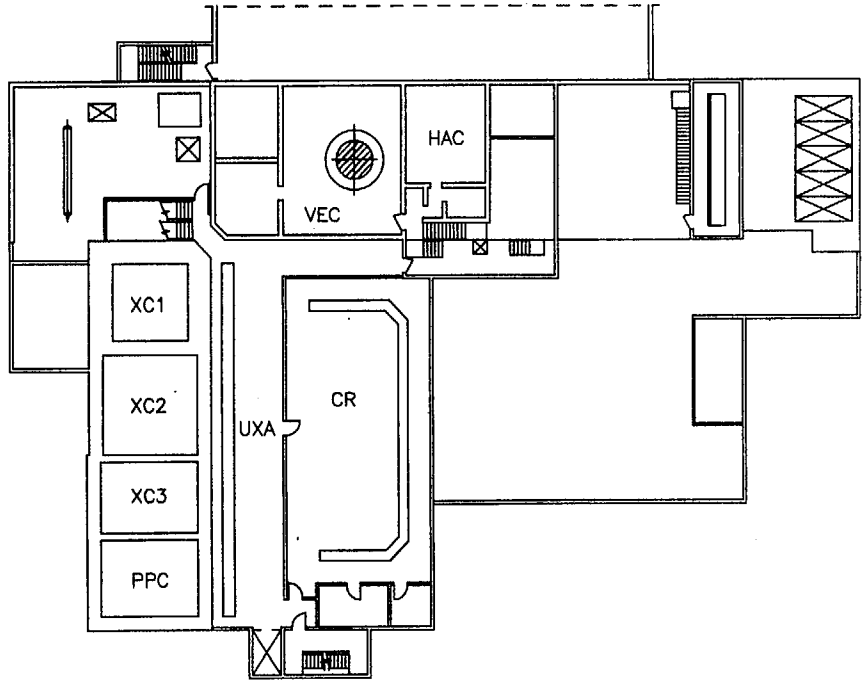
SR2B5213.DWG



FOR REFERENCE ONLY – NOT TO SCALE

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

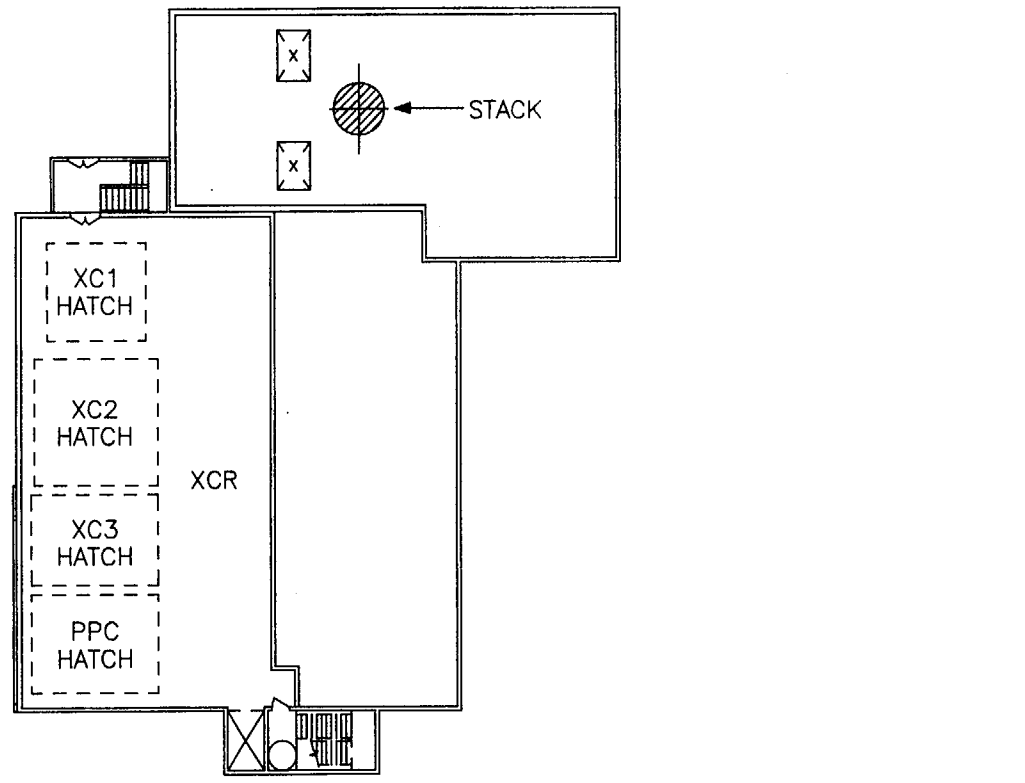
SR2B5214.DWG



FOR REFERENCE ONLY – NOT TO SCALE

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

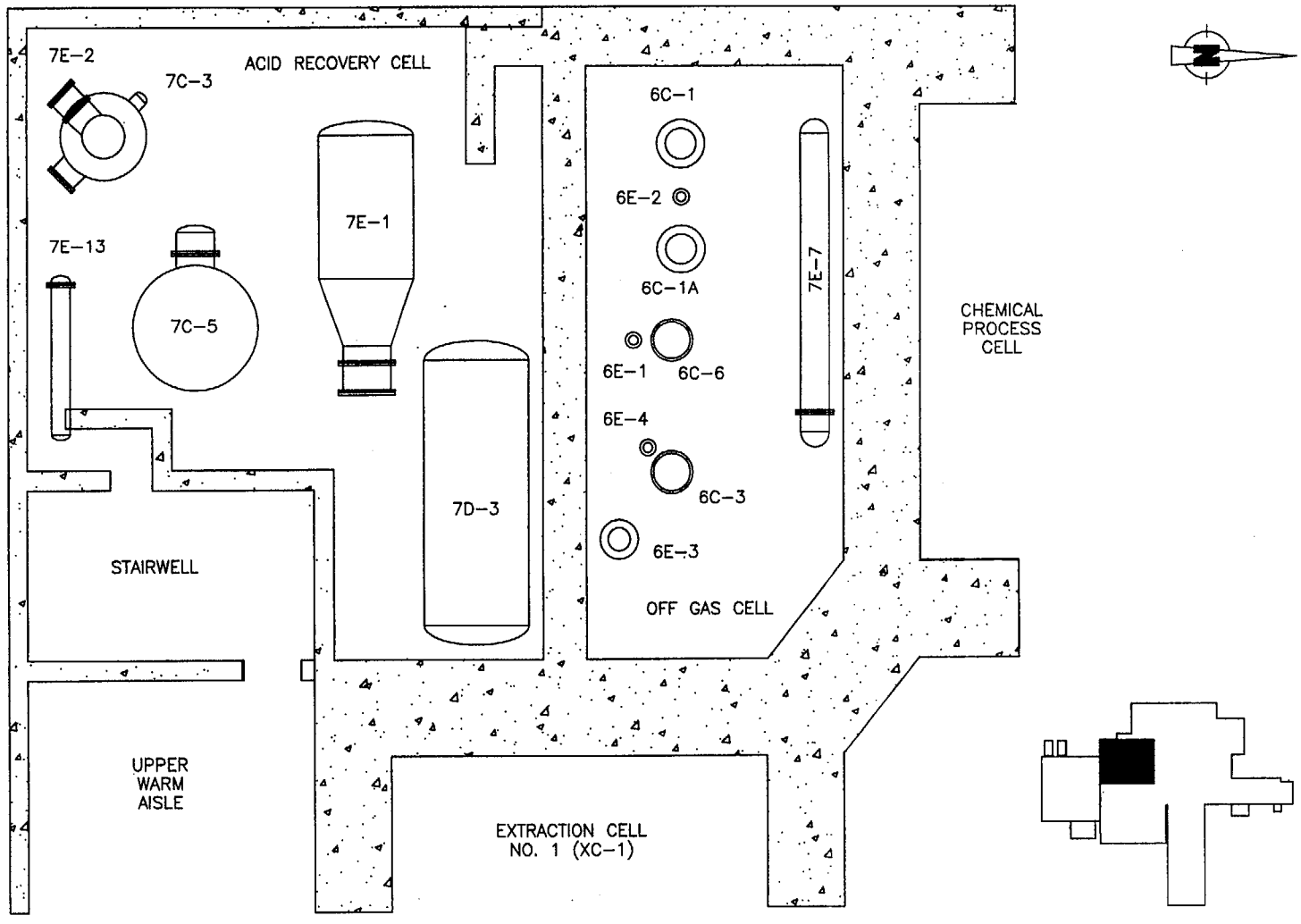
SR2B5215.DWG



FOR REFERENCE ONLY - NOT TO SCALE

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

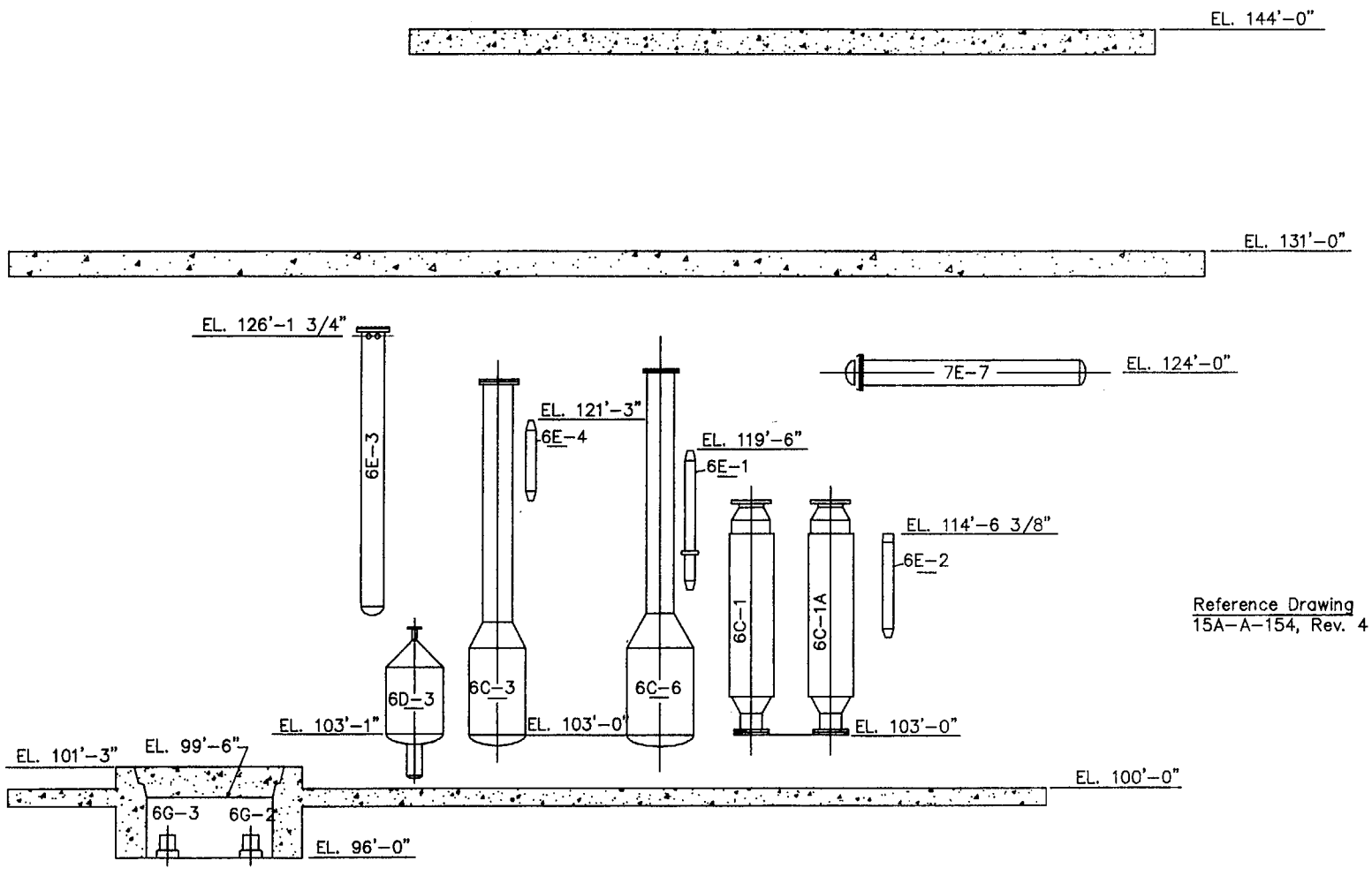
SR2B5216.DWG



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"

SR2B5217.DWG



FOR REFERENCE ONLY – NOT TO SCALE

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

SR2B5218.DWG

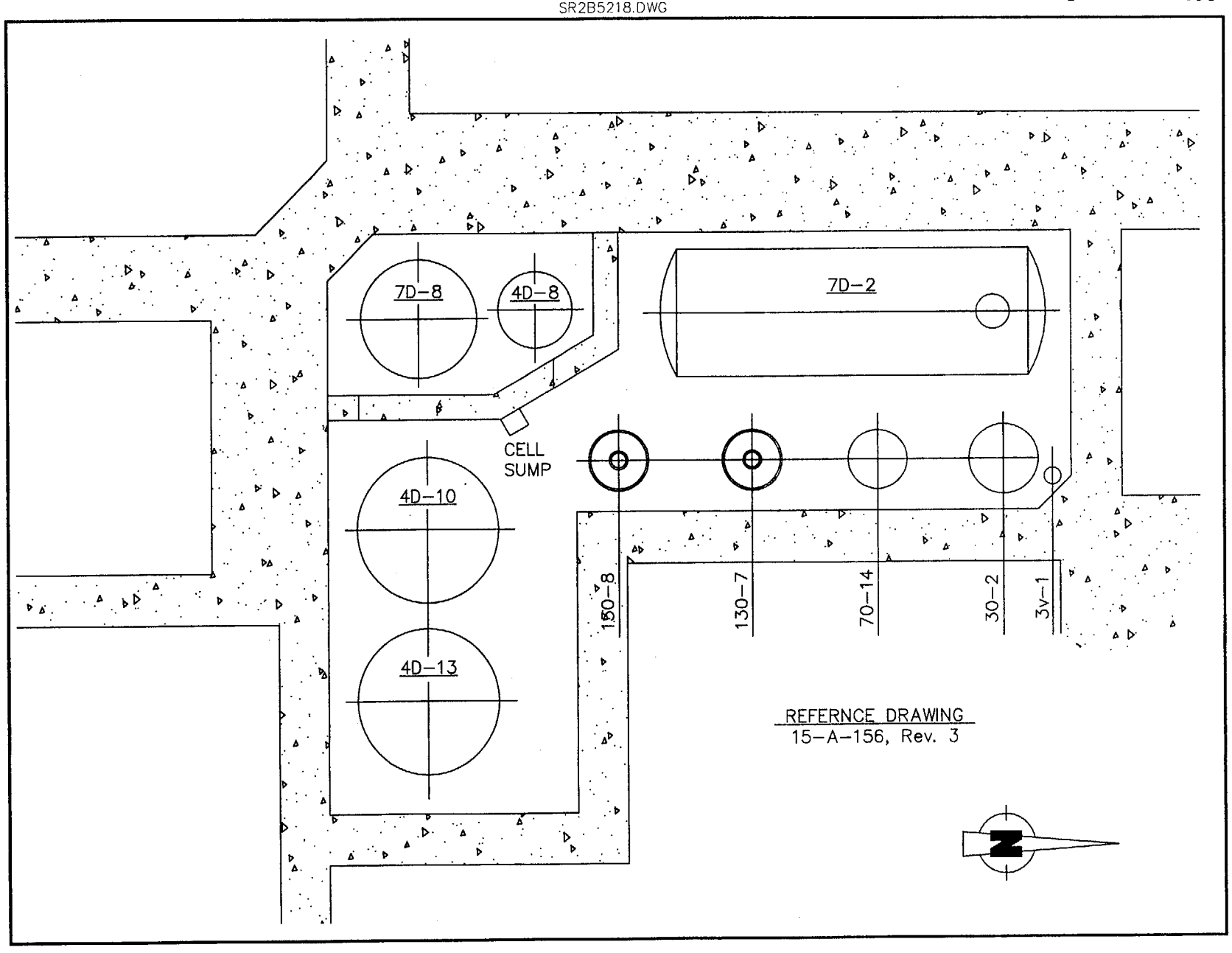
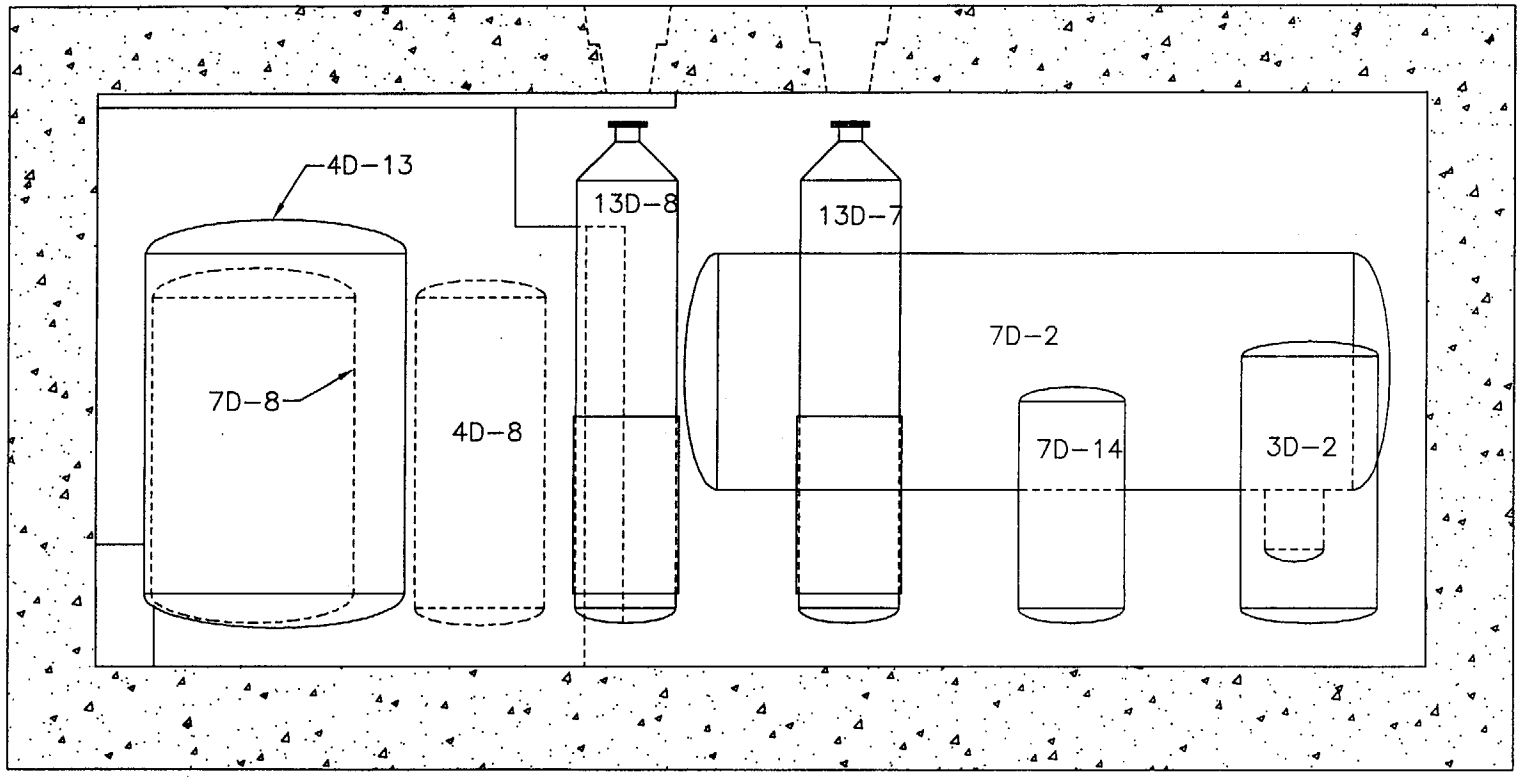


FIGURE B.5.2-18. Equipment Arrangement – Liquid Waste Cell Plan

SR2B5219.DWG

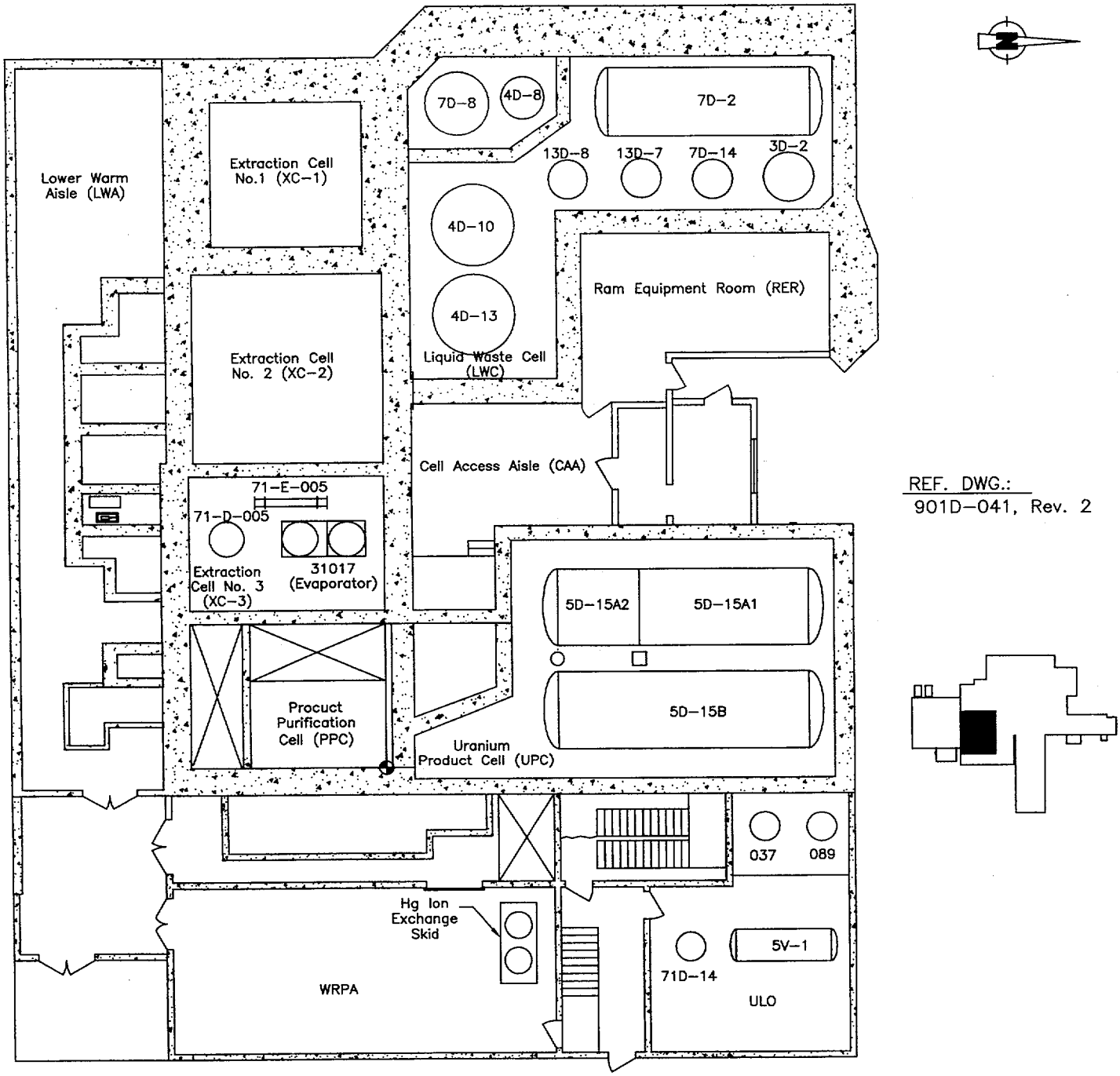


REF. DWG
15A-A-157, Rev.2

FOR REFERENCE ONLY - NOT TO SCALE

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

SR2B5220.DWG



FOR REFERENCE ONLY – NOT TO SCALE

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

SR2B5221.DWG

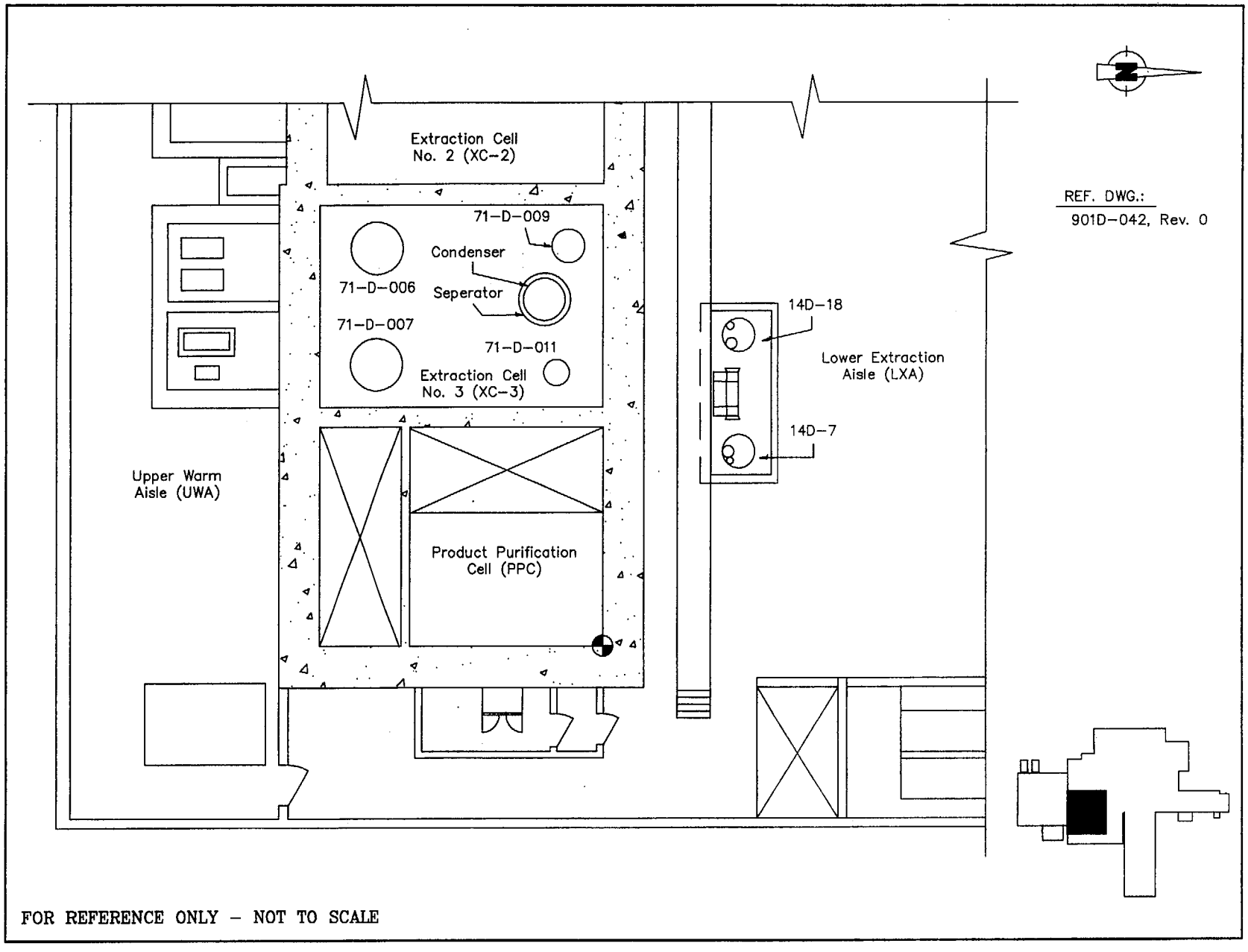


Figure B.5.2-21. LWTS Plan at Elevation 114.5'

SR2B5222.DWG

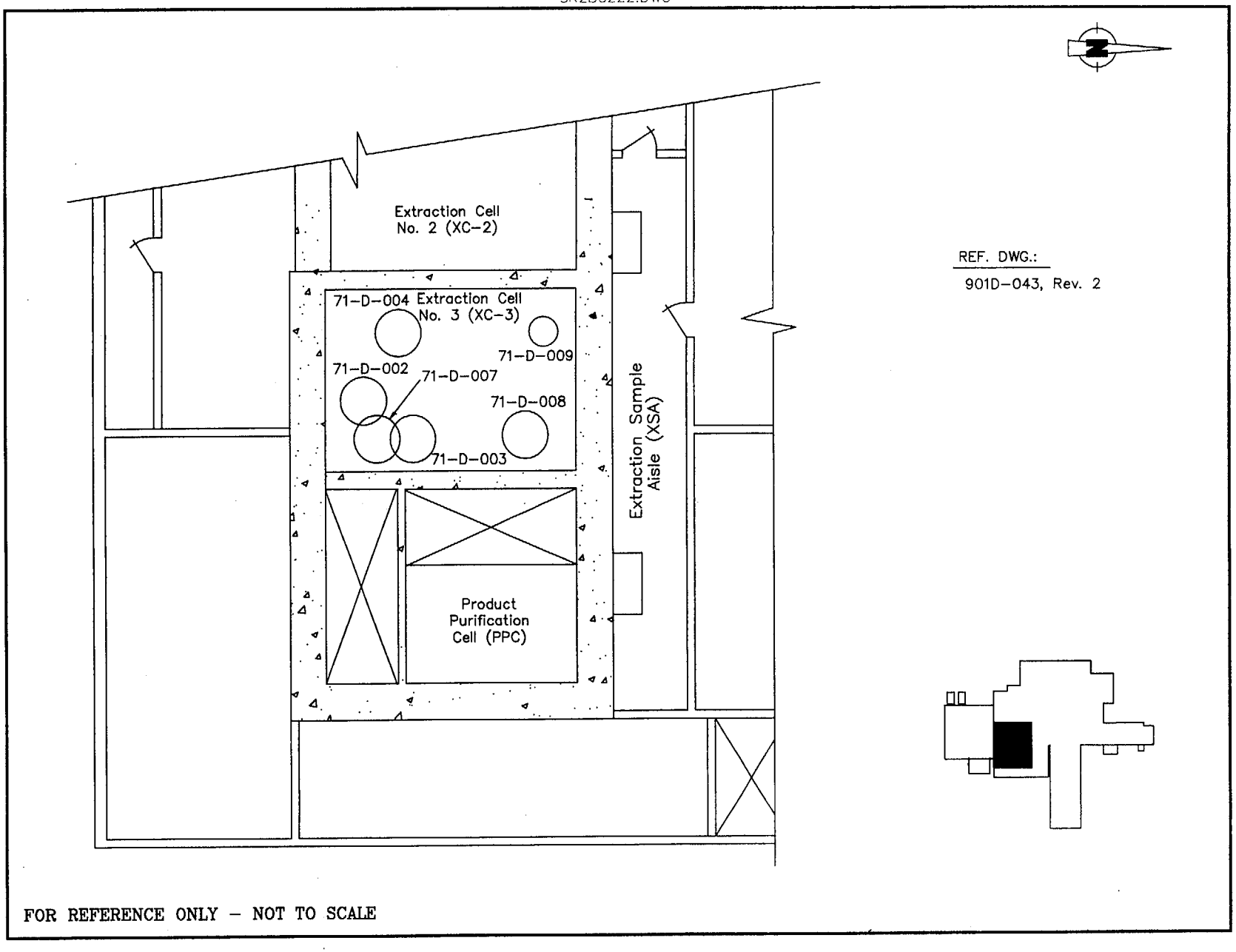


Figure B.5.2-22. LWTS Plan at Elevation 131.0'

SR2B5223.DWG

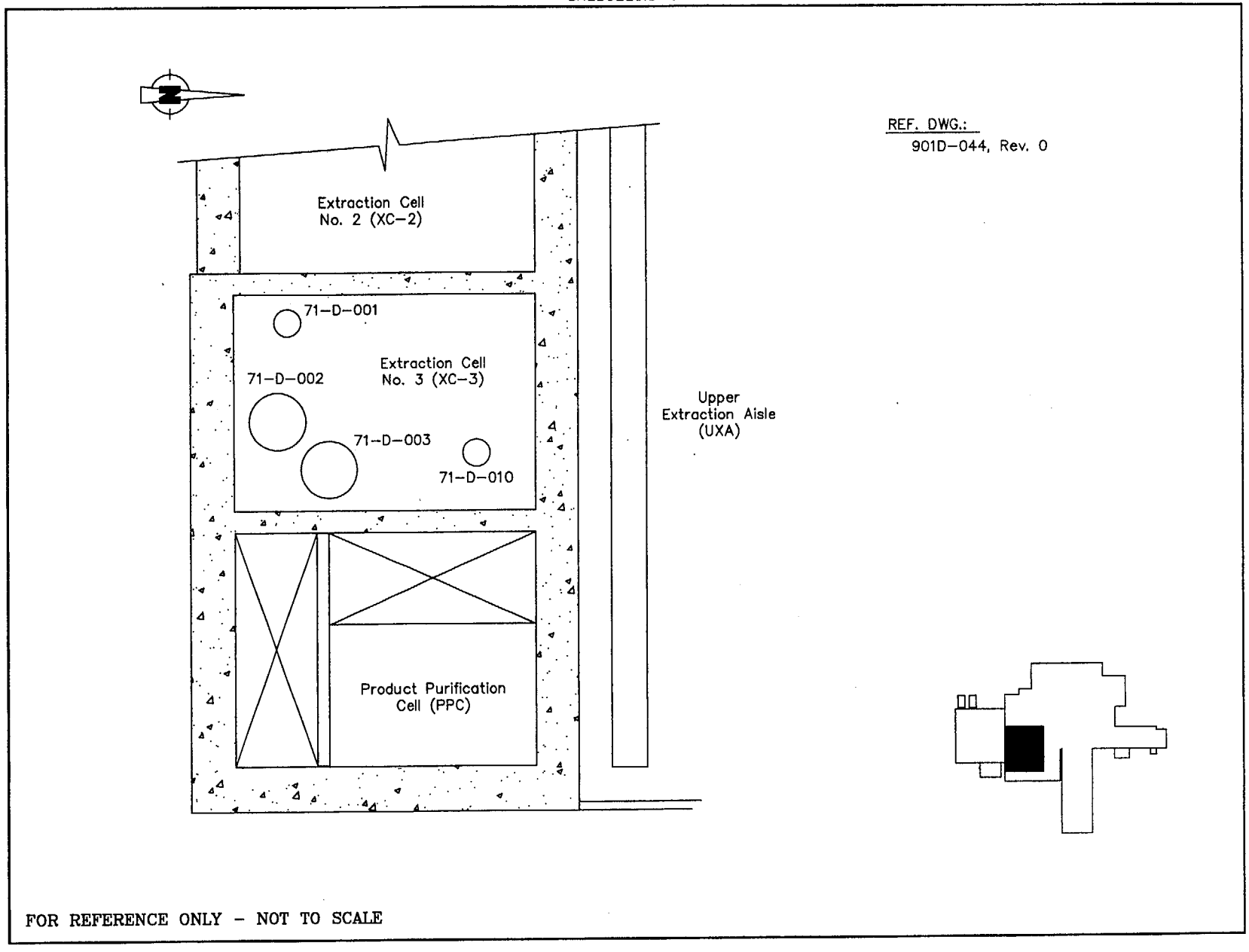


Figure B.5.2-23. LWTS Plan at Elevation 144.0'

SR2B5224.DWG

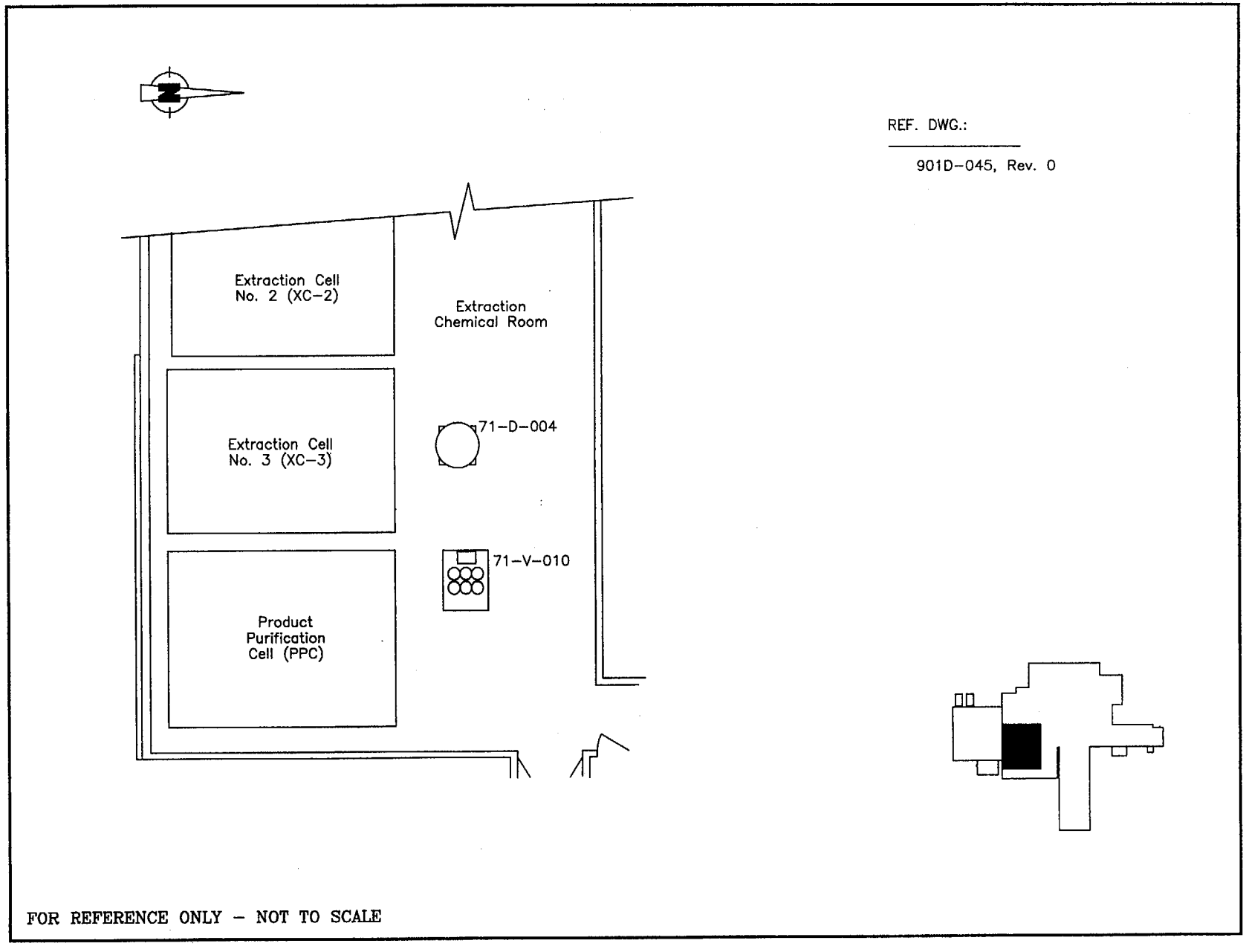


Figure B.5.2-24. LWTS Plan at Elevation 160.0'

SR2B5225.DWG

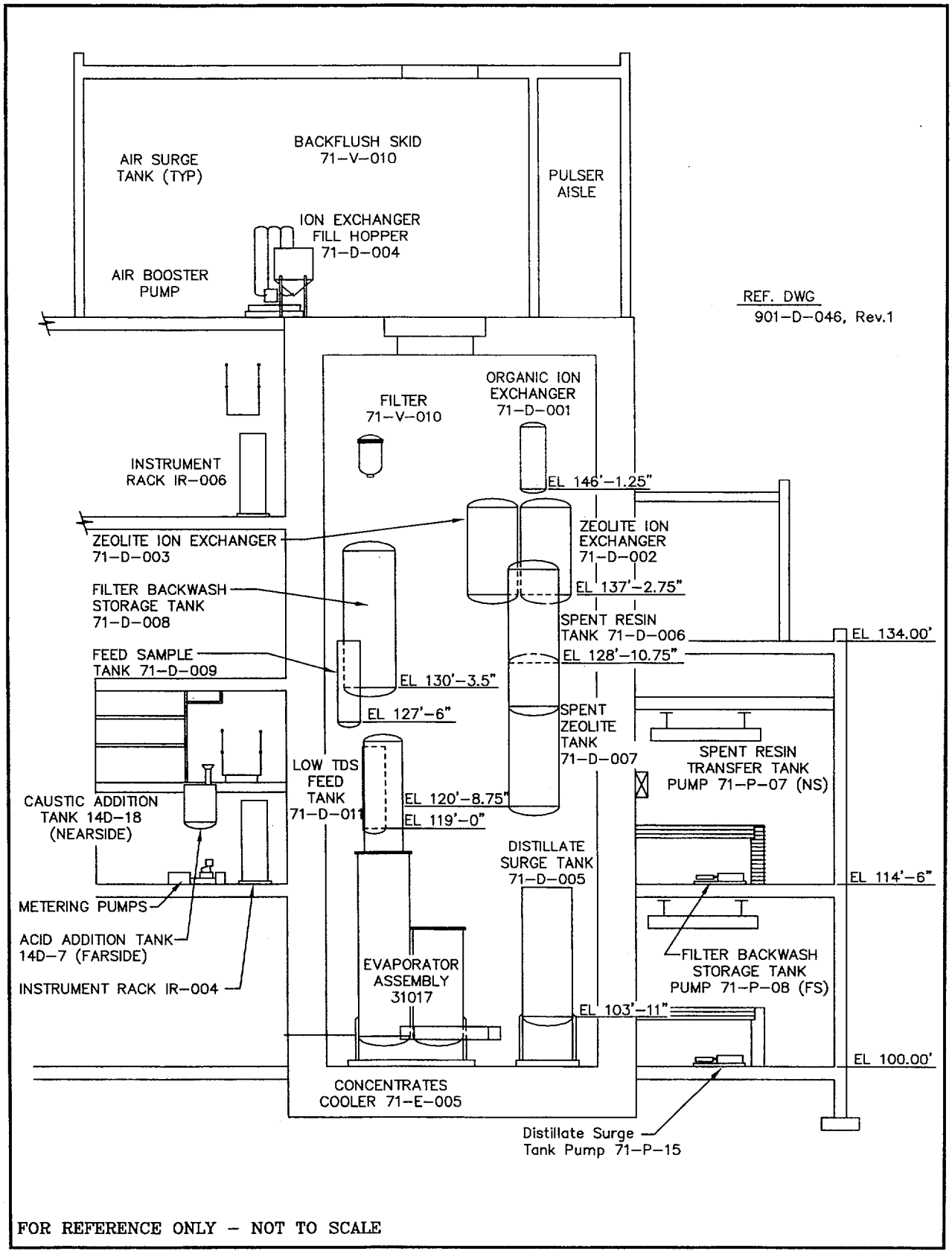


Figure B.5.2-25. LWTS Plan at Elevation 131.0'

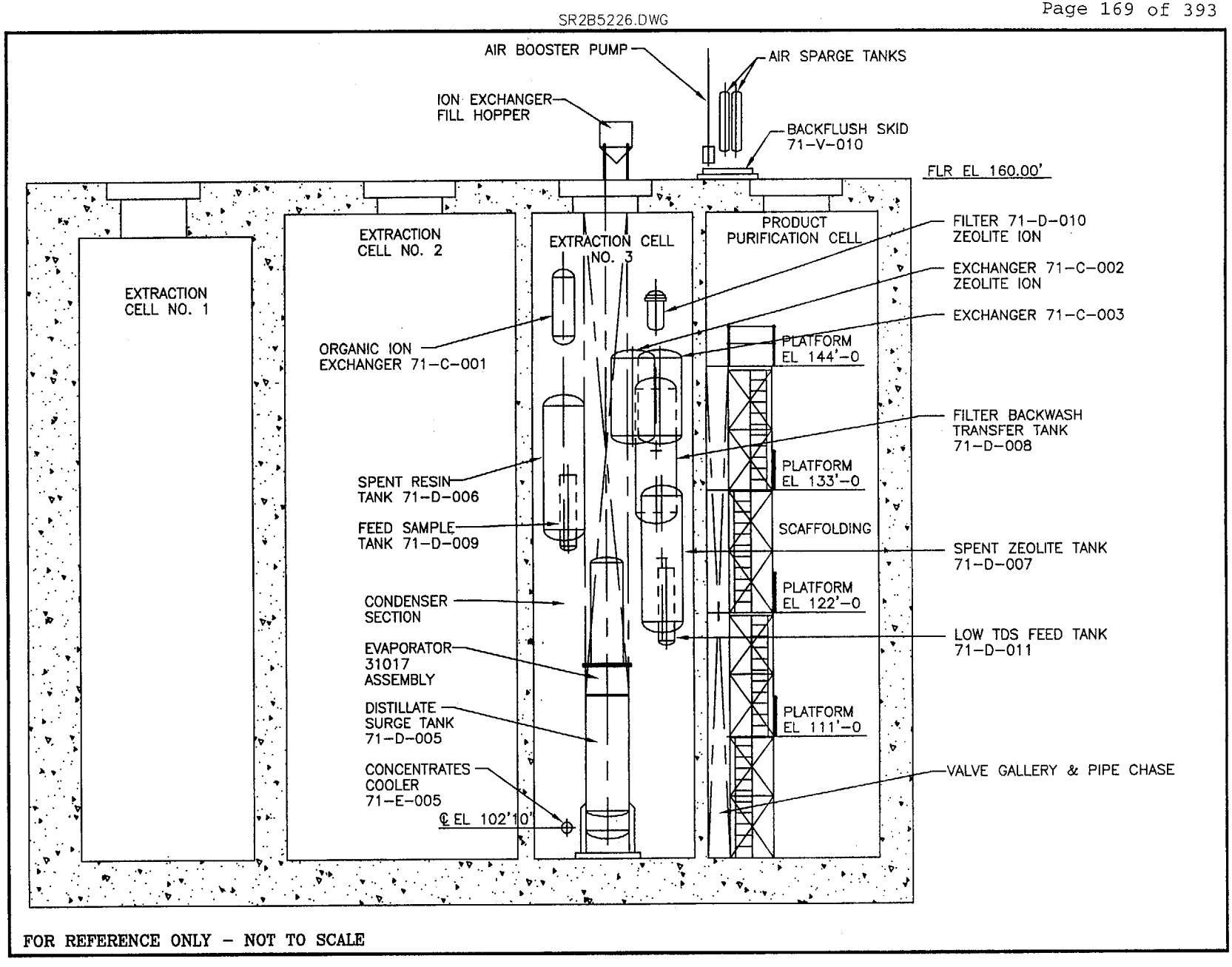


Figure B.5.2-26. General Arrangement – LWTS Sections

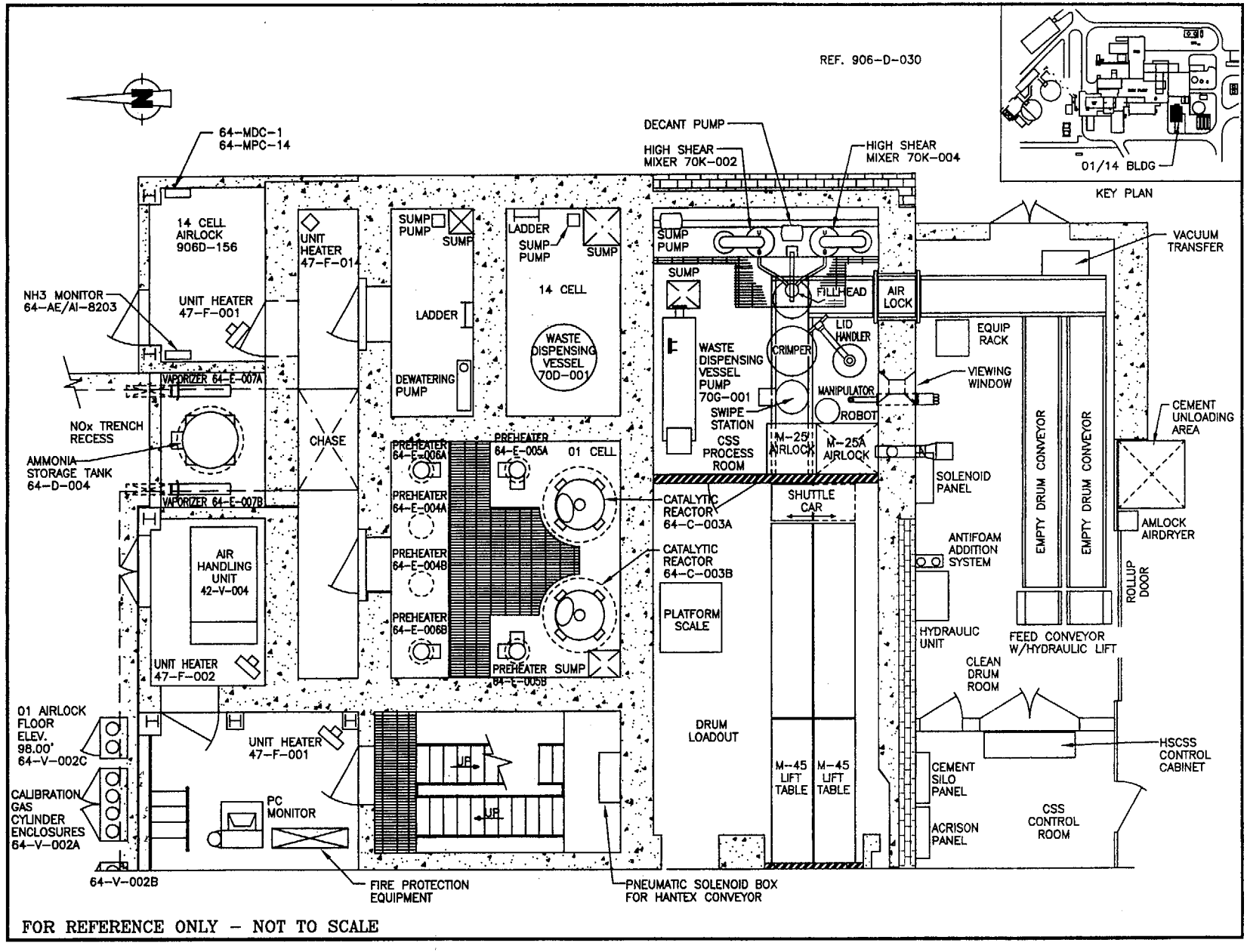


Figure B.5.2-27. General Arrangement – 01/14 Building Plan Elevation 98.0'

SR2B5228.DWG

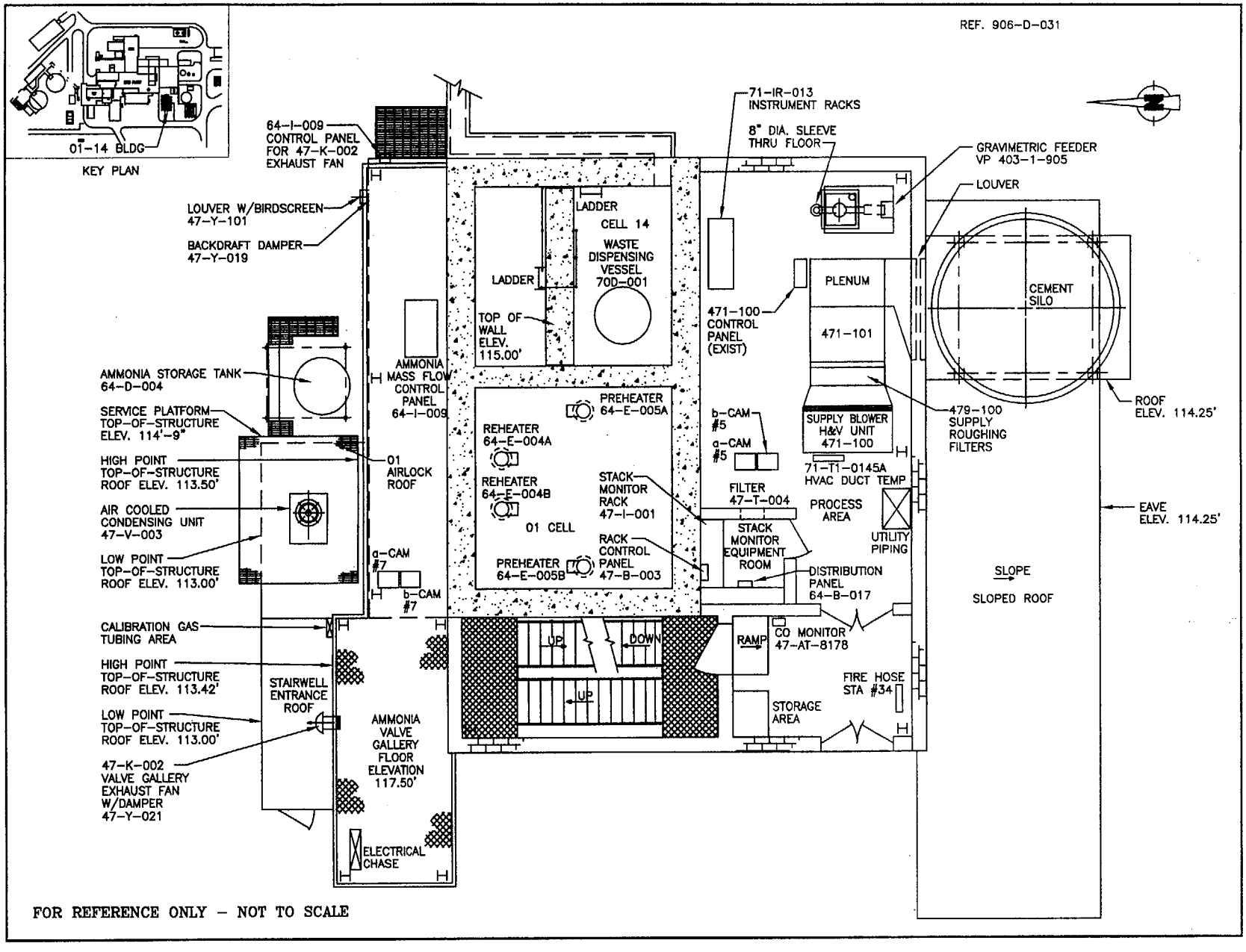


Figure B.5.2-28. General Arrangement – 01/14 Building Plan Elevation 116.5'

SR2B5229.DWG

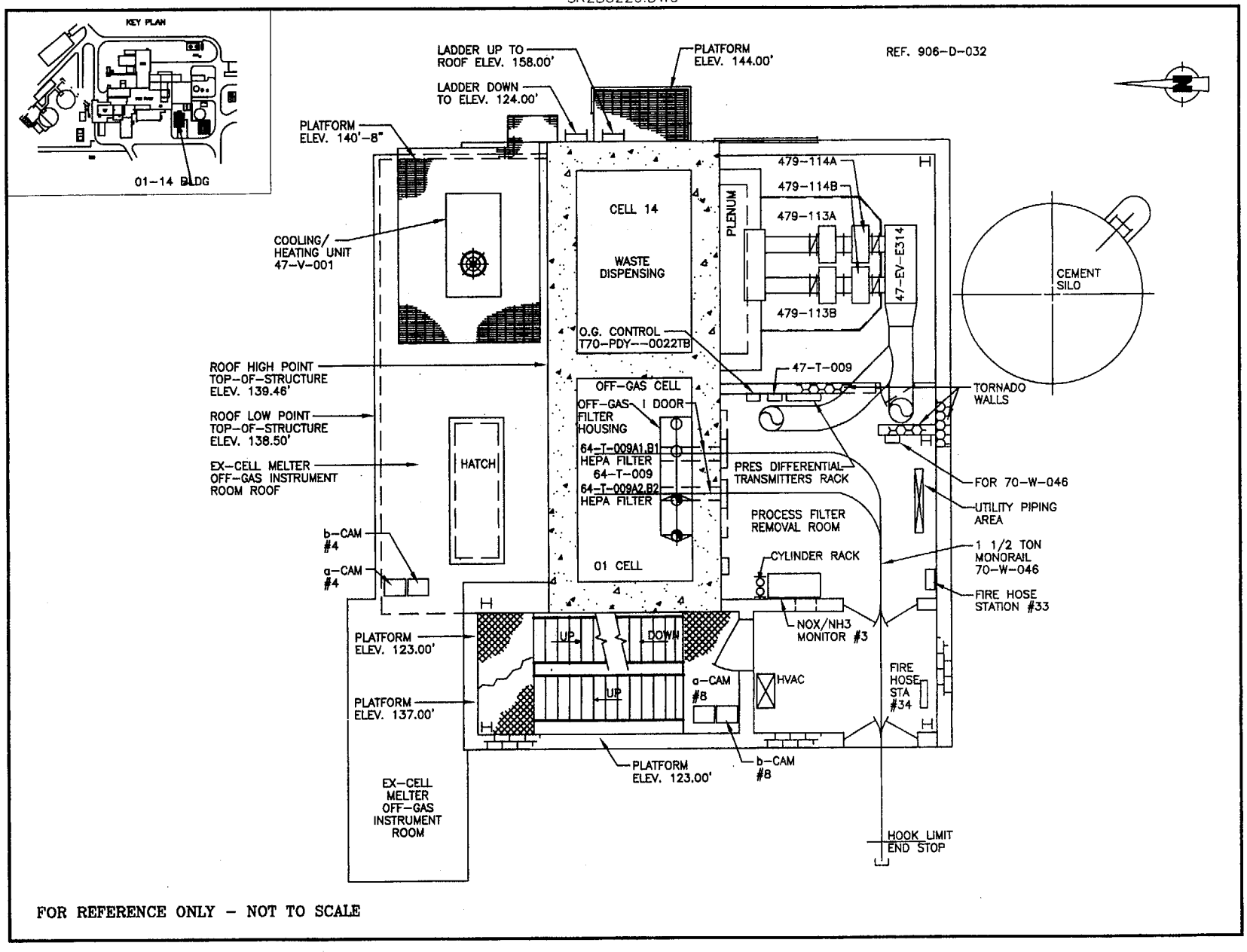


Figure B.5.2-29. General Arrangement – 01/14 Building Plan Elevation 130.0'

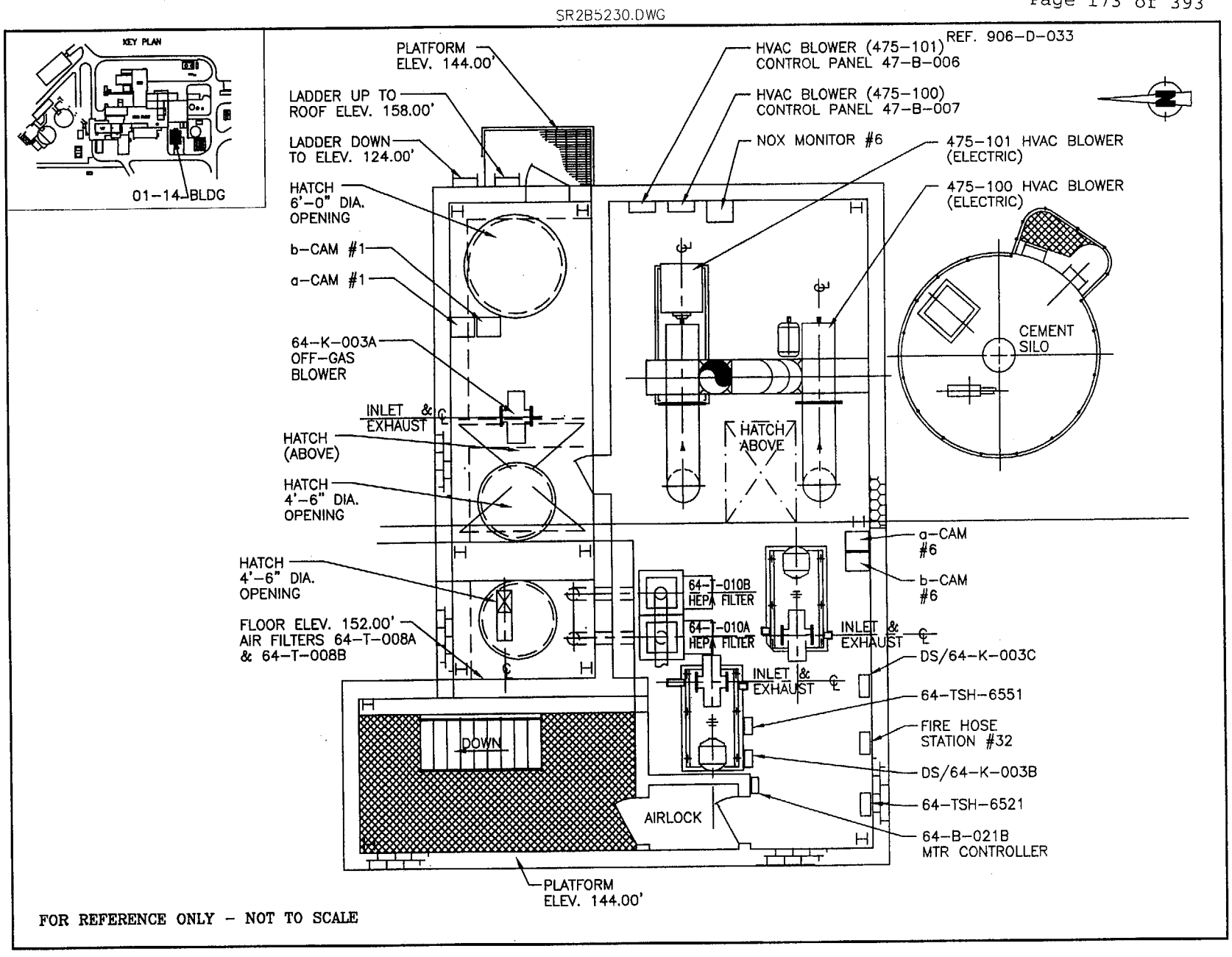


Figure B.5.2-30. General Arrangement – 01/14 Building Plan Elevation 144.0'

SR2B5231.DWG

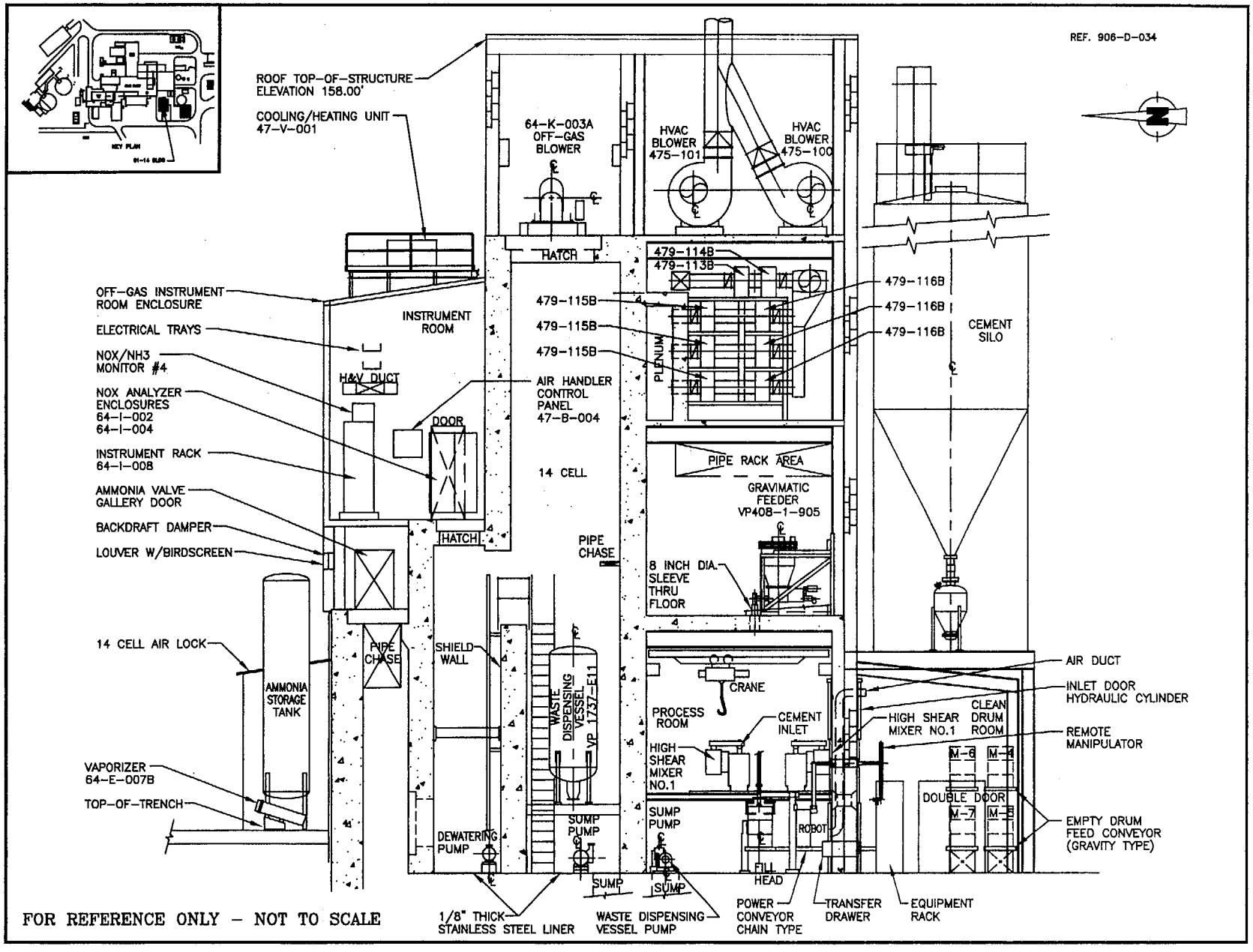
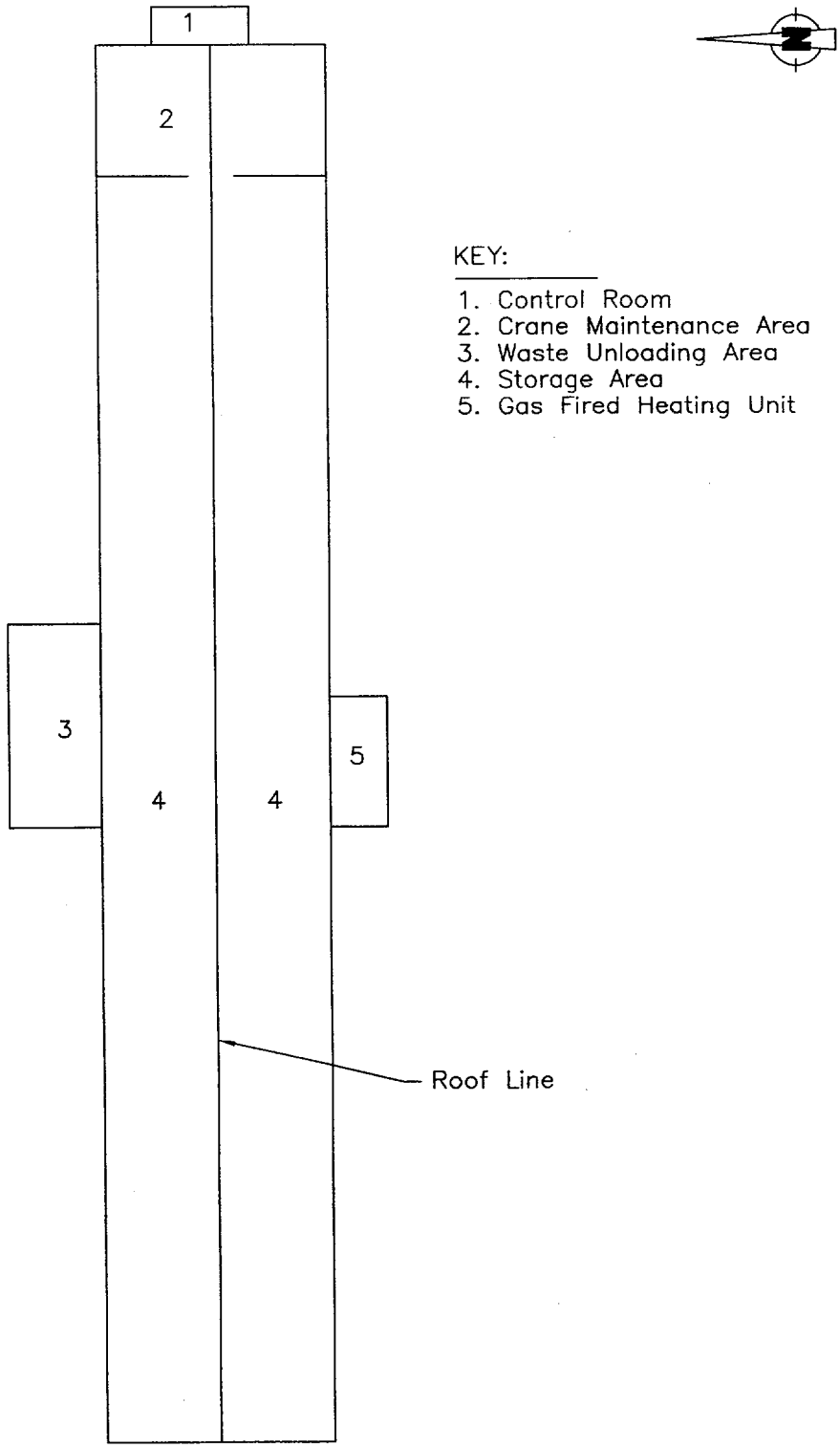


Figure B.5.2-31. General Arrangement – 01/14 Building Sections

SR2B5232.DWG



KEY:

1. Control Room
2. Crane Maintenance Area
3. Waste Unloading Area
4. Storage Area
5. Gas Fired Heating Unit

FOR REFERENCE ONLY – NOT TO SCALE

Figure B.5.2-32. Drum Cell Layout Plan

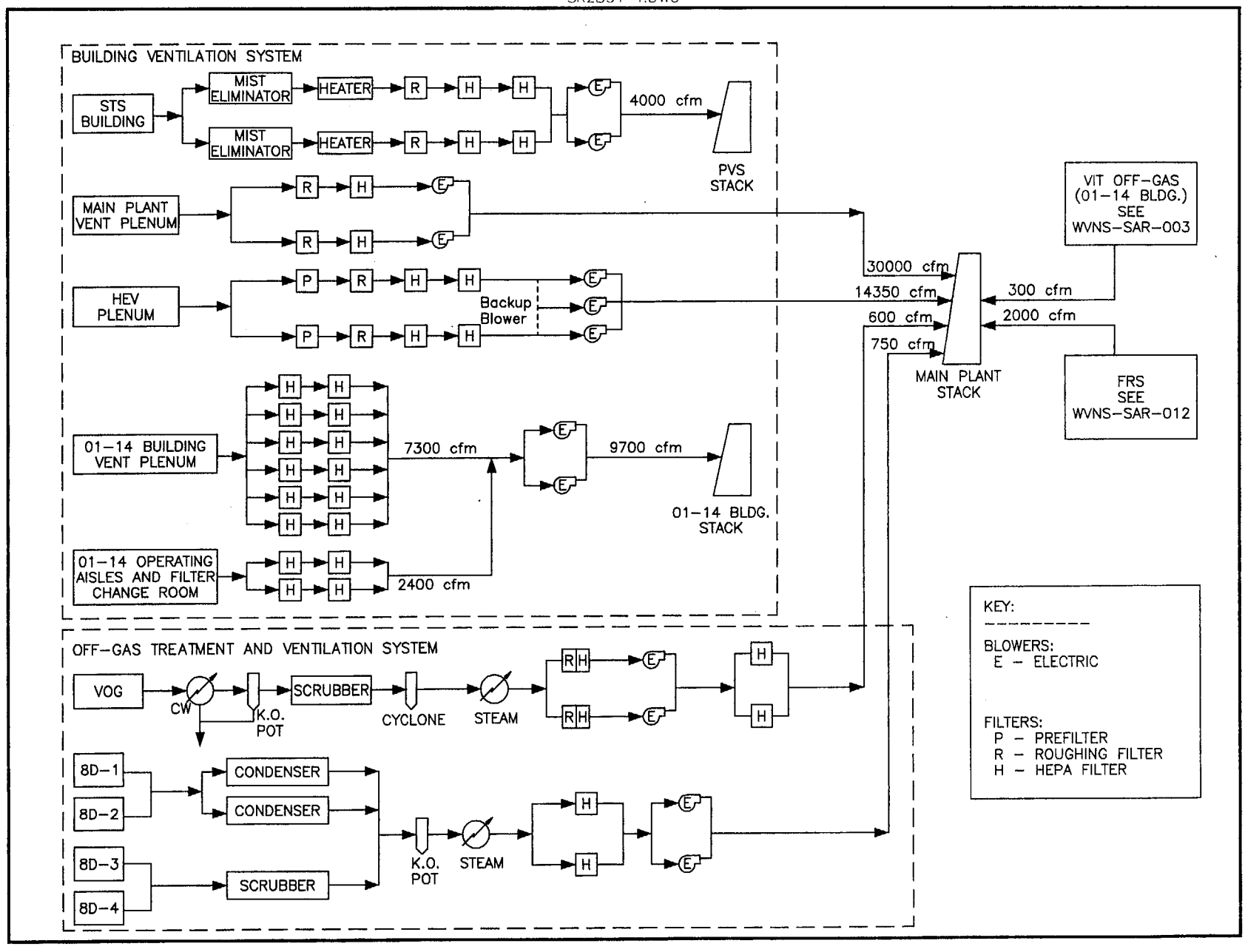


Figure B.5.4-1. Building and Off-gas Treatment Ventilation Systems

SR2B54-2.DWG

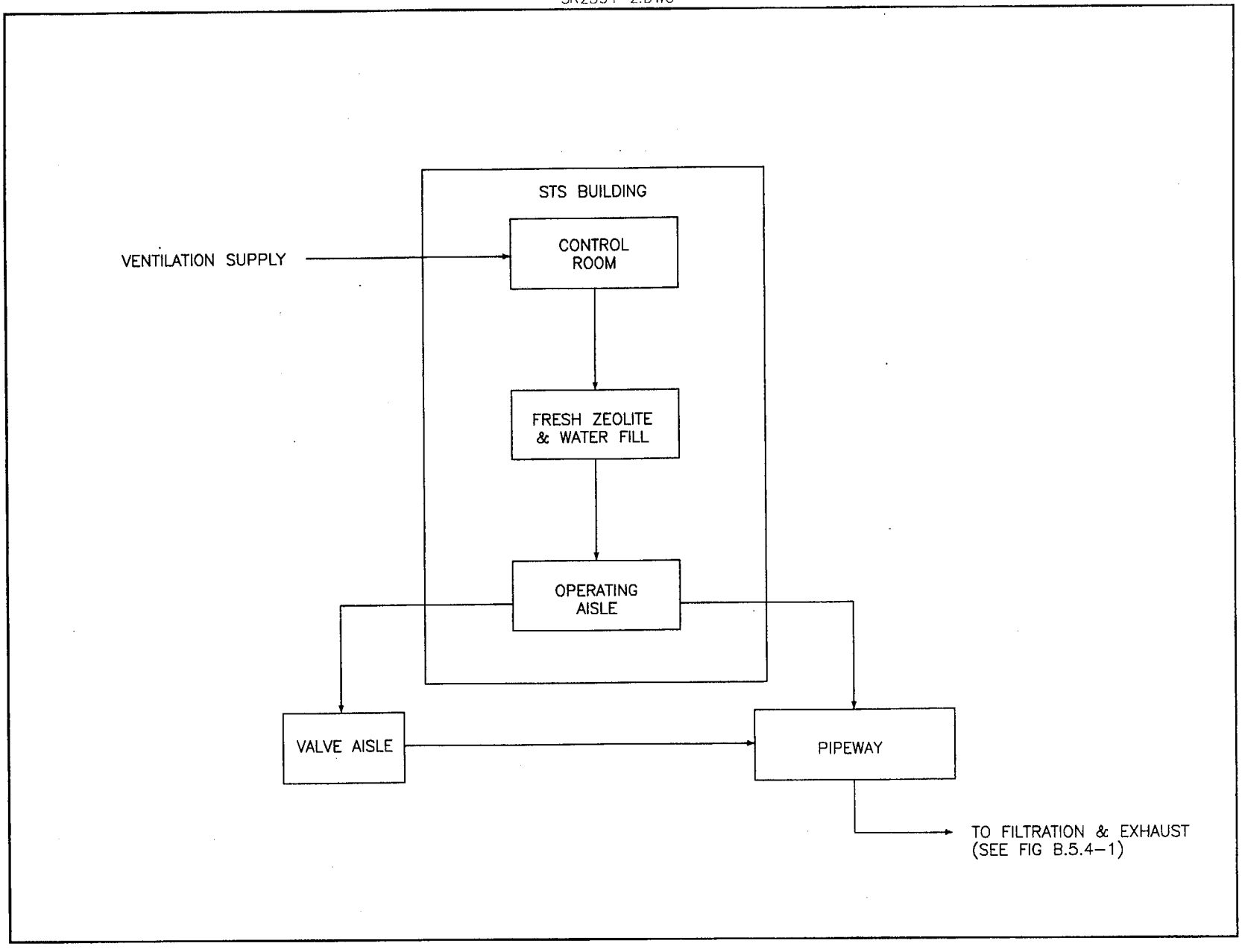


Figure B.5.4-2. STS Building Ventilation Flow

SR2B54-3.DWG

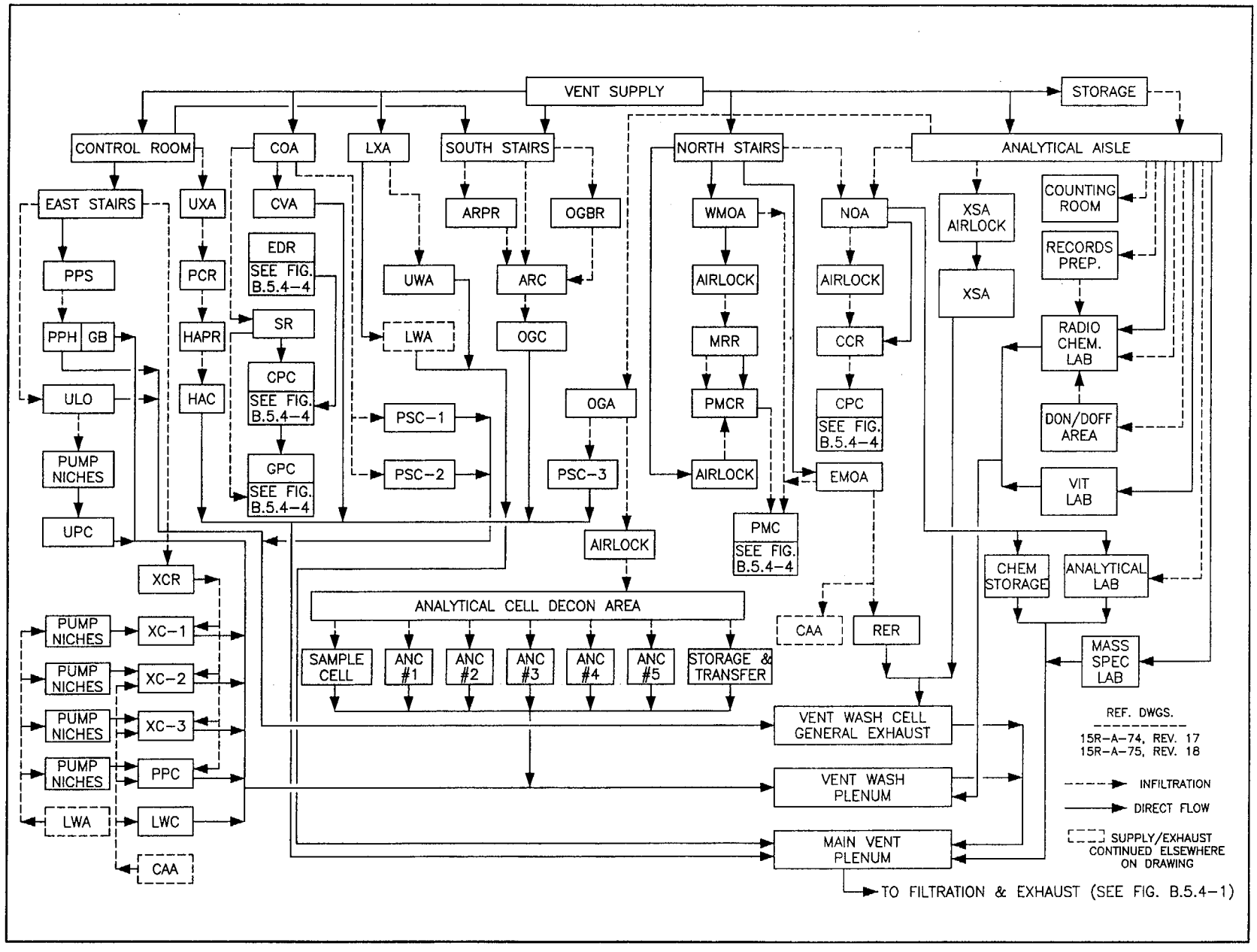


Figure B.5.4-3. Main Ventilation System Flow

SR2B54-4.DWG

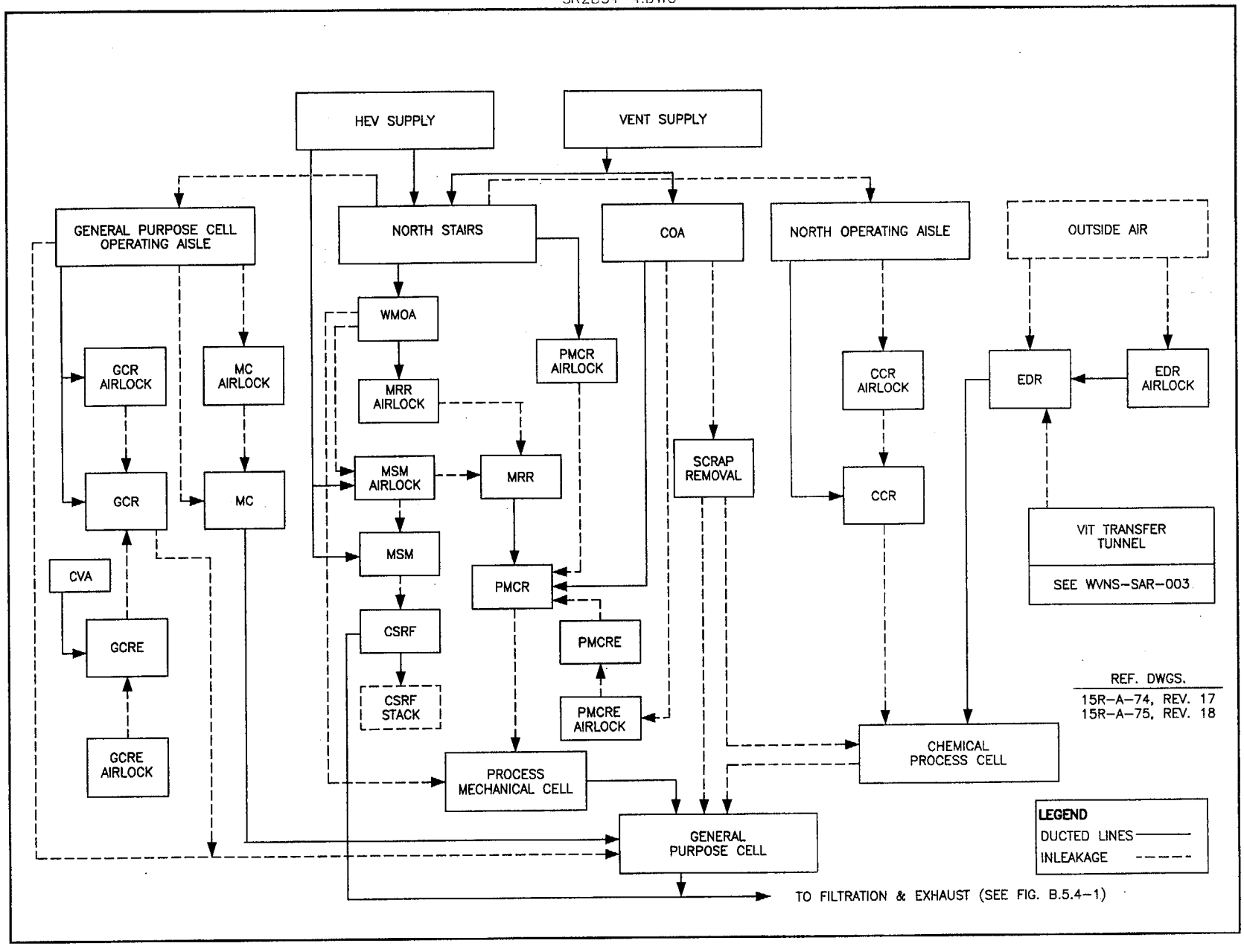


Figure B.5.4-4. Head End Ventilation System Flow

SR2B54-5.DWG

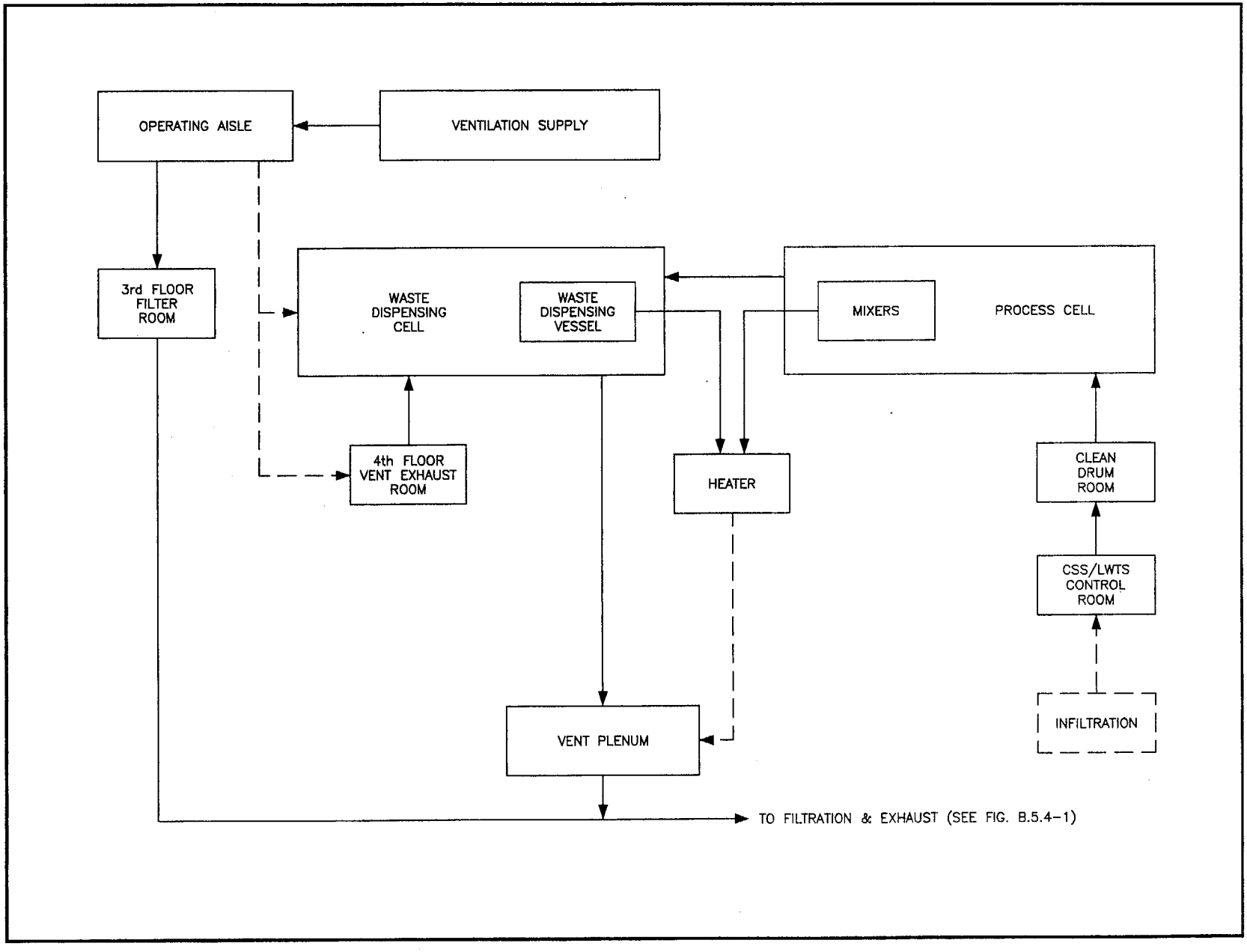


Figure B.5.4-5 01/14 Building Ventilation Flow

SR2B54-6.DWG

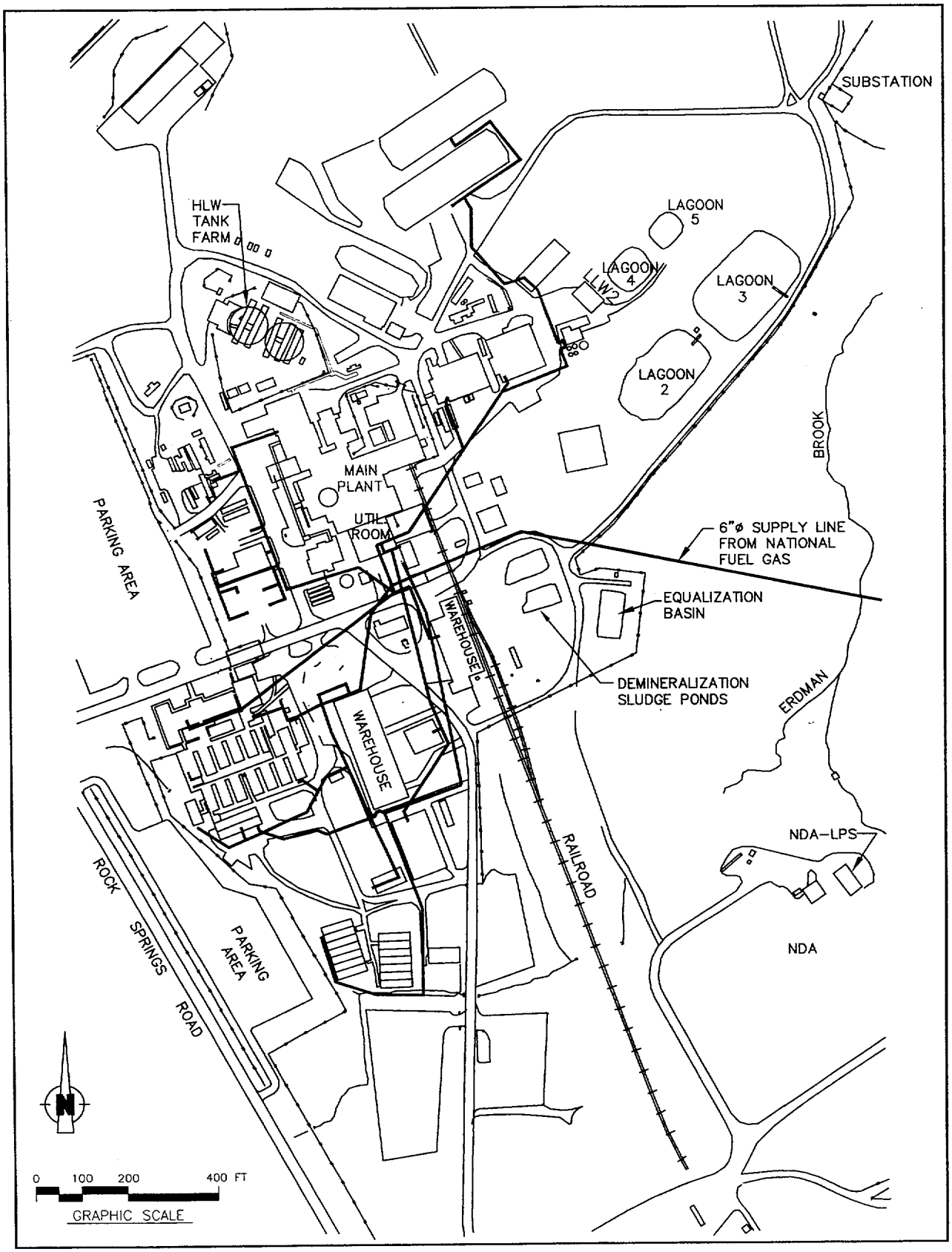


Figure B.5.4-6 Natural Gas Distribution System On-site

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 Flowsheets

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

B.6.1.3 Identification of Items for Safety Analysis Concern

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 Radioactive Liquid Treatment

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 High-level Waste Transfer

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. The distillate continues to the mercury abatement system (see Figure B.6.1-2). The system consists of two mercury-specific ion exchange columns downstream of the Zeolite ion exchanger. The typical operational mode will be to have the two columns operating in series in a lead/polishing configuration. Installation of these two columns is a system refinement needed to meet anticipated environmental release limits. 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, CSS, or Vitrification.

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 ($\leq$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, or Vit.

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 50 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. Though LWTS product (concentrates) were formerly sampled from Tank 5D-15A1 or 5D-15A2, Tank 5D-15A1 is currently configured as a feed tank.

CSS Sampling Capabilities

Though the CSS is currently deactivated, analytical requirements for CSS feed were formerly 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, the east side of the Main Warehouse, 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; five 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); four high purity intrinsic germanium photon detectors; a planar high purity intrinsic germanium photon detector; two single chamber, low background, alpha/beta counter; sixteen 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 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 recorded and the corresponding bridge, trolley, and hoist storage 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.

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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.

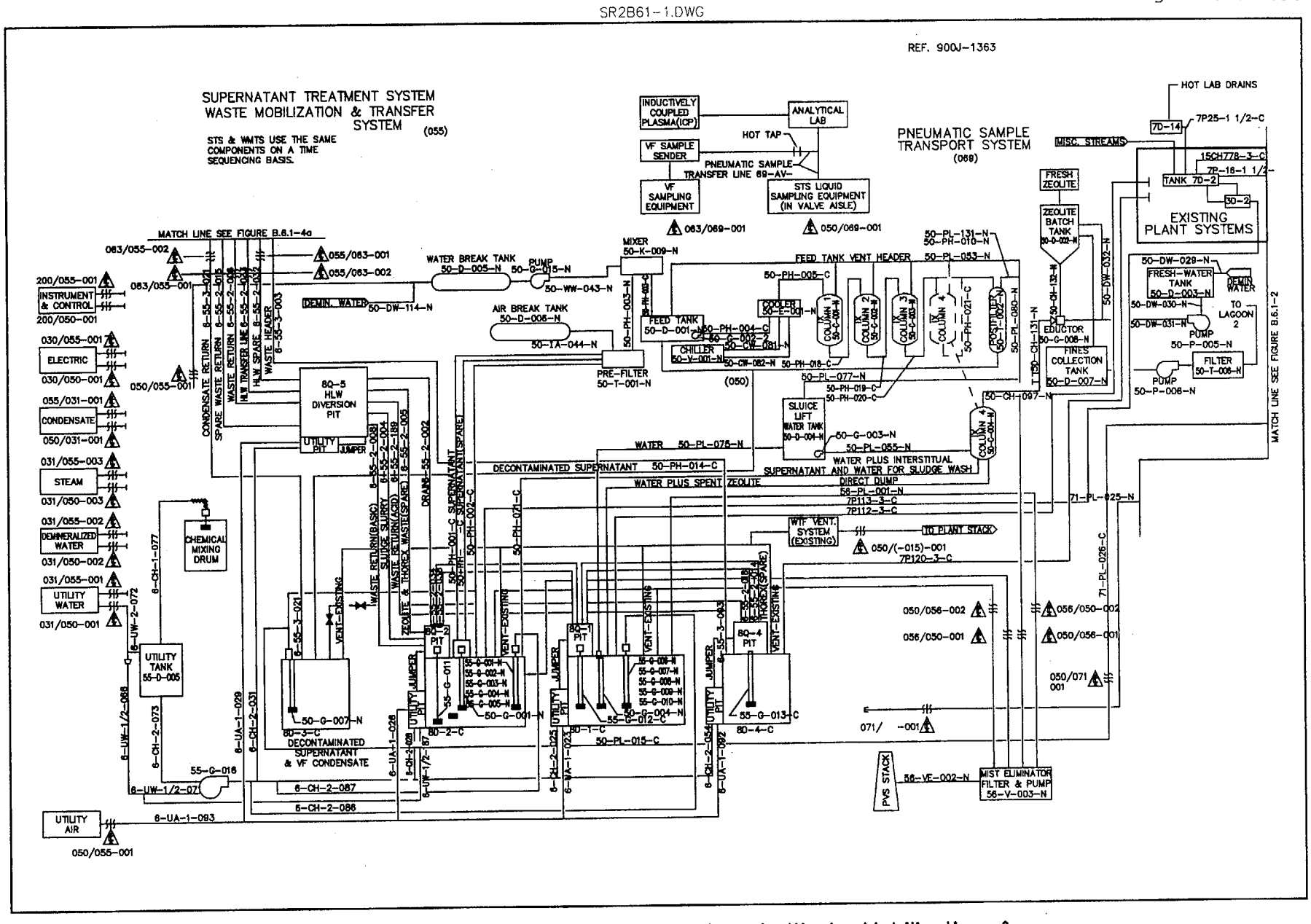
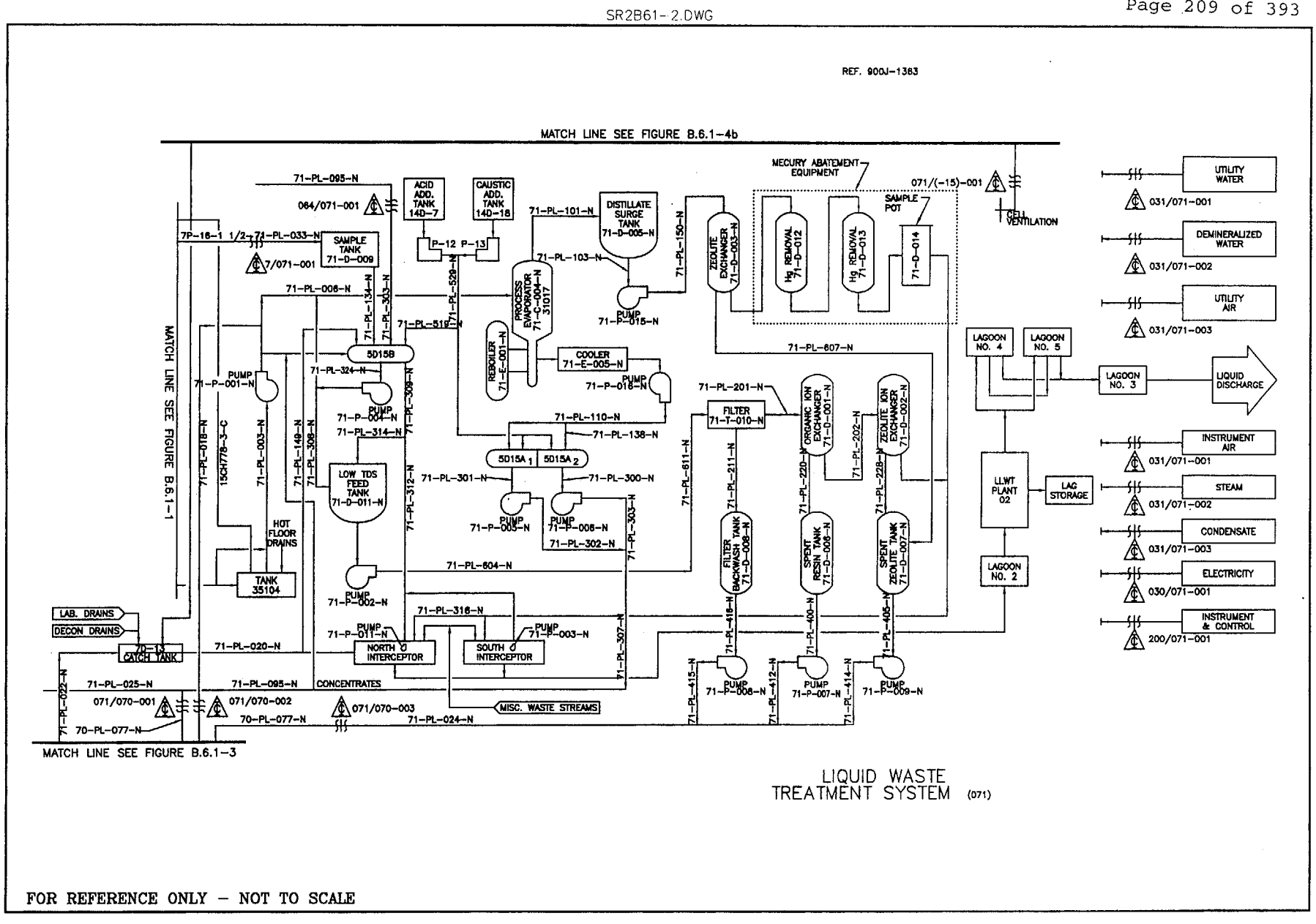


Figure B.6.1-1. IRTS Process Flow Diagram – Supernatant Treatment, Waste Mobilization & Transfer, and Pneumatic Sample Transport Systems



FOR REFERENCE ONLY – NOT TO SCALE

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

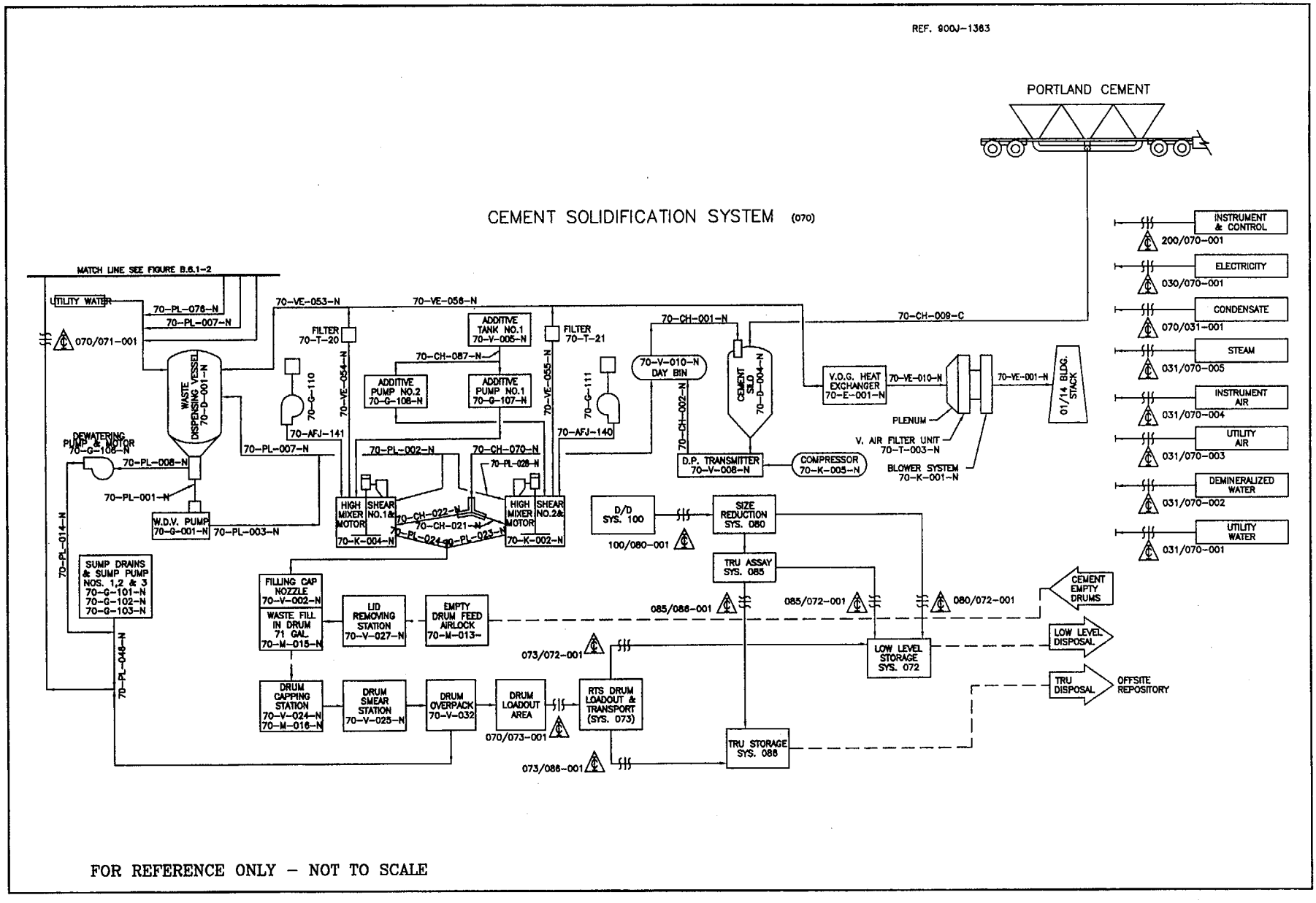


Figure B.6.1-3. IRTS Process Flow Diagram – Cement Solidification System

SR2B66-1.DWG

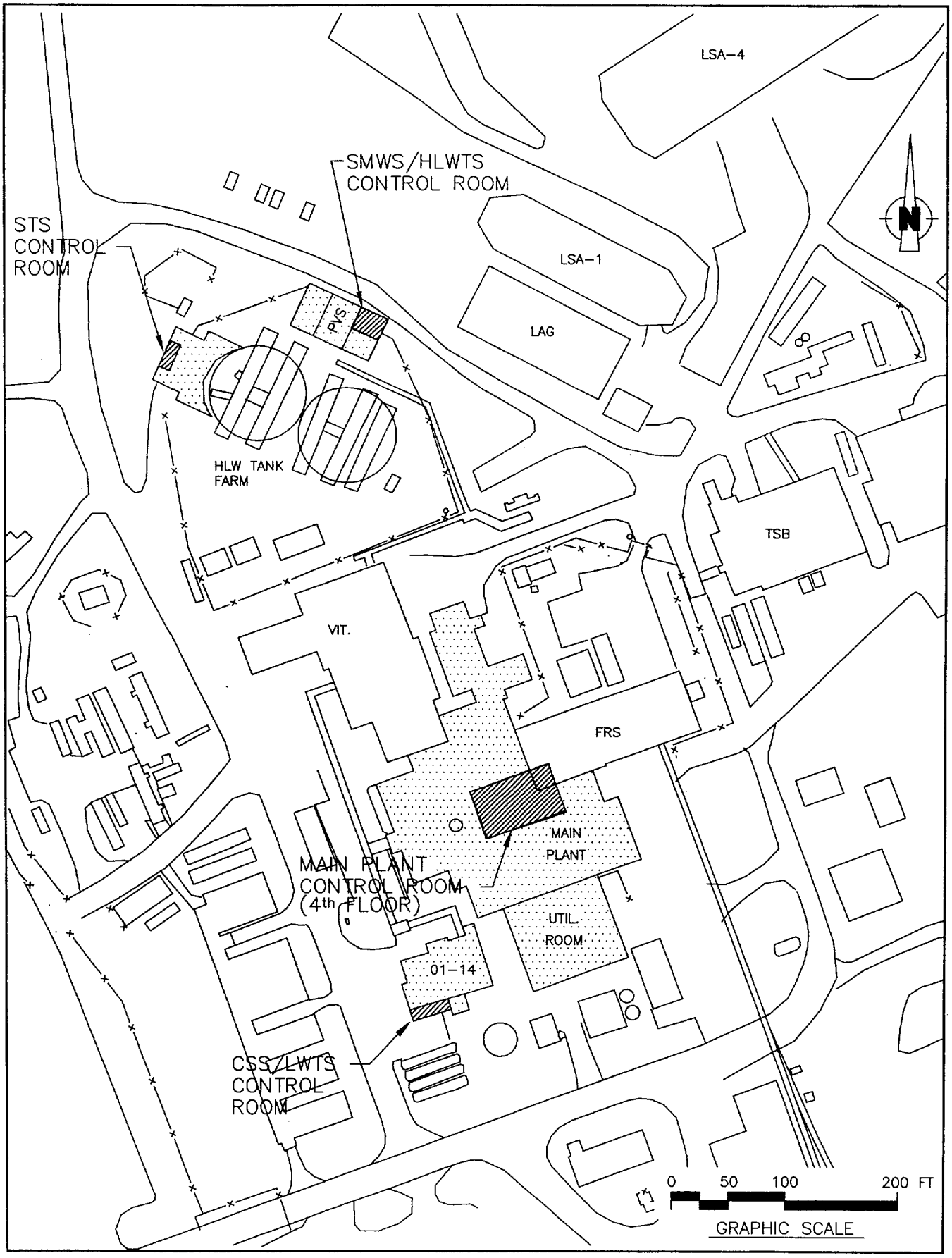


Figure B.6.6-1. Control Room Locations