SGW-40043
Revision 2

200 West Area Pump and Treat System Functional Design Criteria

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-08RL14788

CH2MHILL
Plateau Remediation Company

P.O. Box 1600
Richland, Washington 99352

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Document Type: FDC Program/Project: SGWRP

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Date Published
August 2010

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Release Approval 8/30/2010 Date

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CHPRC RECORD OF REVISION (ROR)	(1) Document Number SGW-40043	Page 1 of 1

(2) Title
200 West Area Pump and Treat System Functional Design Criteria

Change Control Record

(3) Revision	(4) Description of Change – Replace, Add, and Delete Pages	Authorized for Release (5) DA/TA Date
1	Revised PHMC procedures to current CHPRC procedures. Revised process information to most recent data. Deleted discussion of , Phase I and Phase TI approach to funding issues. Updated CC expected influent concentrations to latest information. Added requirement for bulk solids silo. Revised software V&V 1 requirements for engineered control system. Referred to existingTech Memos for updated information on occupancy classification,corrosion control and materials of construction. Updated flowR% rates based on new well information. Updated control systemproject preferences. Added change rooms to treatment facility. Updated references. Per PRC-EDC-10-44316	J.G. Riddelle
2 RS	Added requirements for inclusion of extraction wells near S-SX Tank Farm, other wells in 200-UP-1 Operable Unit and associated equipment. Modified number of extraction wells that may be included in the system. Added considerations for reinjection wells. Modified requirements for freeze protection and added associated backup power. Revised process and well design information to most recent data. Referenced certain work completed for the system. Updated applicable codes and standards, updated references and made editorial changes. Per ECR-10-0001099	J.G. Riddelle 8/26/10 for BLS

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TERMS

ACI	American Concrete Institute
AFD	Adjustable Frequency Drive
AHJ	Authority Having Jurisdiction
AISC	American Institute of Steel Construction
ALR	Authorized Limit Request
ANSI	American National Standards Institute
ARAR	Applicable or Relevant and Appropriate Requirement
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
BGS	Below Ground Surface
BOP	Balance of Plant
CAT	Construction Acceptance Test
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CHPRC	CH2M HILL Plateau Remediation Company
CMAA	Crane Manufacturers Association of America
COC	Constituent of Concern
DCS	Distributed Control System
DOE	U.S. Department of Energy
EIA	Electronic Industries Association
EPA	U.S. Environmental Protection Agency
FAT	Factory Acceptance Test
FDC	Functional Design Criteria
FHA	Fire Hazards Analysis
FY	Fiscal Year
GAC	Granular Activated Carbon
HC	Hazard Category
HDPE	High-Density Polyethylene
HLAN	Hanford Local Area Network
HMI	Human-Machine Interface

HVAC	Heating, Ventilation, and Air Conditioning
I-129	Iodine-129
IBC	International Building Code
ICBO	International Conference of Building Officials
IECC	International Energy Conservation Code
IEEE	Institute of Electrical and Electronics Engineers
IESNA	Illuminating Engineering Society of North America
IMC	International Mechanical Code
IRM	Interim Remedial Measure
ISA	Instrument Society of America
MCFL	Maximum Credible Fire Loss
MCL	Maximum Contaminant Level
MNA	Monitored Natural Attenuation
MPFL	Maximum Possible Fire Loss
MSA	Mission Support Alliance, LLC
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NRTL	Nationally Recognized Testing Laboratory
OU	Operable Unit
P&ID	Piping and Instrumentation Diagram
PC	Performance Category
PFHA	Preliminary Fire Hazards Analysis
PLC	Programmable Logic Controller
PROFIBUS	Process Field Bus
PVC	Polyvinyl chloride
QA	Quality Assurance
RCRA	Resource Conservation and Recovery Act of 1976
RCW	Revised Code of Washington
REDOX	Reduction-Oxidation Plant
ROD	Record of Decision
SCADA	Supervisory Control and Data Acquisition
SDI	Steel Deck Institute
SSC	Structure, System, and Component
TCE	Trichloroethylene
Tc-99	Technetium-99
UBC	Uniform Building Code

UL	Underwriters Laboratories, Inc.
USC	United States Code
WMA	Waste Management Area
WDOE	Washington State Department of Ecology
WSDOT	Washington State Department of Transportation

METRIC CONVERSION CHART

Into Metric Units			Out of Metric Units		
If You Know	*Multiply By*	*To Get*	*If You Know*	*Multiply By*	*To Get*
Length			**Length**		
Inches	25.40	millimeters	millimeters	0.0394	inches
Inches	2.54	centimeters	centimeters	0.394	inches
Feet	0.305	meters	meters	3.281	feet
Yards	0.914	meters	meters	1.094	yards
Miles (statute)	1.609	kilometers	kilometers	0.621	miles (statute)
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.093	sq. meters	sq. meters	10.764	sq. feet
sq. yards	0.0836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.591	sq. kilometers	sq. kilometers	0.386	sq. miles
acres	0.405	hectares	hectares	2.471	acres
Mass (weight)			**Mass (weight)**		
ounces (avoir)	28.349	grams	grams	0.0353	ounces
pounds	0.454	kilograms	kilograms	2.205	pounds
ton (short)	0.907	ton (metric)	ton (metric)	1.102	ton (short)
Volume			**Volume**		
teaspoons	5	milliliters	milliliters	0.034	ounces (U.S., liquid)
tablespoons	15	milliliters	liters	2.113	pints
fluid ounces	29.573	milliliters	liters	1.057	quarts (U.S., liquid)
cups	0.24	liters	liters	0.264	gallons (U.S., liquid)
pints	0.473	liters	cubic meters	35.315	cubic feet
quarts	0.946	liters	cubic meters	1.308	cubic yards
gallons	3.785	liters			
cubic feet	0.0283	cubic meters			
cubic yards	0.764	cubic meters			
Temperature			**Temperature**		
Fahrenheit	(°F-32)*5/9	Celsius	Celsius	(°C*9/5)+32	Fahrenheit
Radioactivity			**Radioactivity**		
Picocuries	37	millibecquerel	millibecquerel	0.027	picocuries

1.0 INTRODUCTION

This document was developed as the Functional Design Criteria (FDC) for the new 200 West Area Pump and Treat System for the 200-ZP-1 Groundwater Operable Unit (OU) and the 200-UP-1 Groundwater OU, which are part of the Hanford Site, 200 Area, in Benton County, Washington. This FDC provides the fundamental technical criteria and design requirements necessary for remedial design of this project to meet the cleanup goals as specified in the *Record of Decision, Hanford 200 Area, 200-ZP-1 Operable Unit Superfund Site, Benton County, Washington* (referenced herein as the Record of Decision [ROD]).

Interim action cleanup goals for the 200-UP-1 OU are provided in DOE/RL-97-36, Revision 3, *200-UP-1 Groundwater Remedial Design/Remedial Action Work Plan* (200-UP-1 OU Work Plan) for the Technetium-99 (Tc-99) extraction system at Waste Management Area (WMA) S-SX. The 200-UP-1 OU Work Plan has been modified by Meeting Minutes, *S-SX Extraction Well Locations,* and ECF-2 00P01-10-0056, *S-SX Submodel Preliminary Base Case and Sensitivity Analysis Calculations*. To incorporate these changes, the term modified 200-UP-1 OU Work Plan will be used herein. In addition a 200-UP-1 feasibility study and proposed plan supporting the final remedial decision process is currently being prepared. Final remedial action requirements including, cleanup goals for the 200-UP-1 OU, will be established as part of the ROD process, currently planned to be complete in late Fiscal Year (FY) 2011. After the ROD is in place for 200-UP-1, a final action remedial design/remedial action work plan will be prepared for implementing the final actions.

Specifically, this FDC will provide the design criteria for a new pump and treat remediation system of the 200-ZP-1 OU with some contribution from the 200-UP-1 OU as described in DOE/RL-2008-78, *200 West Area 200-ZP-1 Pump-and-Treat System Remedial Design/Remedial Action Work Plan,* and the modified 200-UP-1 OU Work Plan. It is noted that these work plans have specific design and construction activities divided into Phase I and Phase II activities. This FDC recognizes this, but specifically seeks to avoid designating when certain activities will take place in order to allow for as much flexibility in the design process as possible since the phasing of activities is dependent on funding and not on any technical concerns.

The three major subsystems for the 200 West Area Pump and Treat System addressed by this FDC are listed below:

1. The Treatment Facility, which will be centrally located and house all of the process treatment equipment as well as the control systems for the project. The Treatment Facility will house treatment trains to treat chemical constituents of concern (COCs) in extracted groundwater. Two treatment trains will be installed initially with a third treatment train designed and installed at a later date depending on funding. Space for a future third treatment train will be provided. The Treatment Facility will also house treatment for extraction wells in the 200-UP-1 OU (e.g., S-SX Tank Farm well group) and possibly existing 200-ZP-1 OU wells. 200-UP-1 OU interim action requirements include the extraction and treatment of Tc-99 plumes near WMA S-SX extraction system. Following completion of the final ROD for the 200-UP-1 OU, treatment system requirements for final 200-UP-1 OU remedial actions will be defined (e.g., uranium plume). Details of planned treatment are provided in Section 2.1

2. Extraction and injection wells will be installed. Initially, approximately 15 extraction wells and 6 injection wells will be installed in the 200-ZP-1 OU. Three extraction wells will be installed near the S-SX Tank Farm. Additional wells may be installed near the S-SX Tank Farm and in other areas of the 200-UP-1 OU and these wells will be considered for process design. Depending on funding, the 200-ZP-1 OU wells may be expanded to a total of 20 extraction wells and 16 injection wells. Only wells in the 200-ZP-1 and 200-UP-1 OUs are currently included in the scope of this project for design and installation. Actual number of wells and their location is dependent upon funding and continued groundwater monitoring and modeling as long as the requirements of the ROD are met to reduce the mass of carbon tetrachloride, total chromium (chromium III and chromium VI), nitrate, trichloroethylene (TCE), and Tc-99, throughout the 200-ZP-1 OU by a minimum of 95% in 25 years and provide treatment for the Tc-99 plume at the S-SX Tank Farm according to the modified 200-UP-1 OU Work Plan, as an interim action. Following completion of the final ROD for 200-UP-1, additional extraction well systems will likely be defined (e.g., uranium plume).

3. The balance of plant (BOP) includes the piping and Transfer Buildings in 200-ZP-1 OU and in 200-UP-1 OU and transfer pumps, as necessary, to pump the extraction well water to the Treatment Facility, and convey the treated water from the Treatment Facility to the injection wells. BOP also includes any administrative, maintenance, or other facilities and utilities designed to support the Treatment Facility. Interim action requirements for 200-UP-1 include piping and a Transfer Building for the WMA S-SX extraction system. Following completion of the final ROD for 200-UP-1, additional BOP requirements for final 200-UP-1 remedial actions will be defined (e.g., uranium plume).

This FDC was prepared following the guidance of PRC-PRO-EN-8258, *Functional Design Criteria,* and PRC-EN-GD-8004, *Functional Requirements Document.*

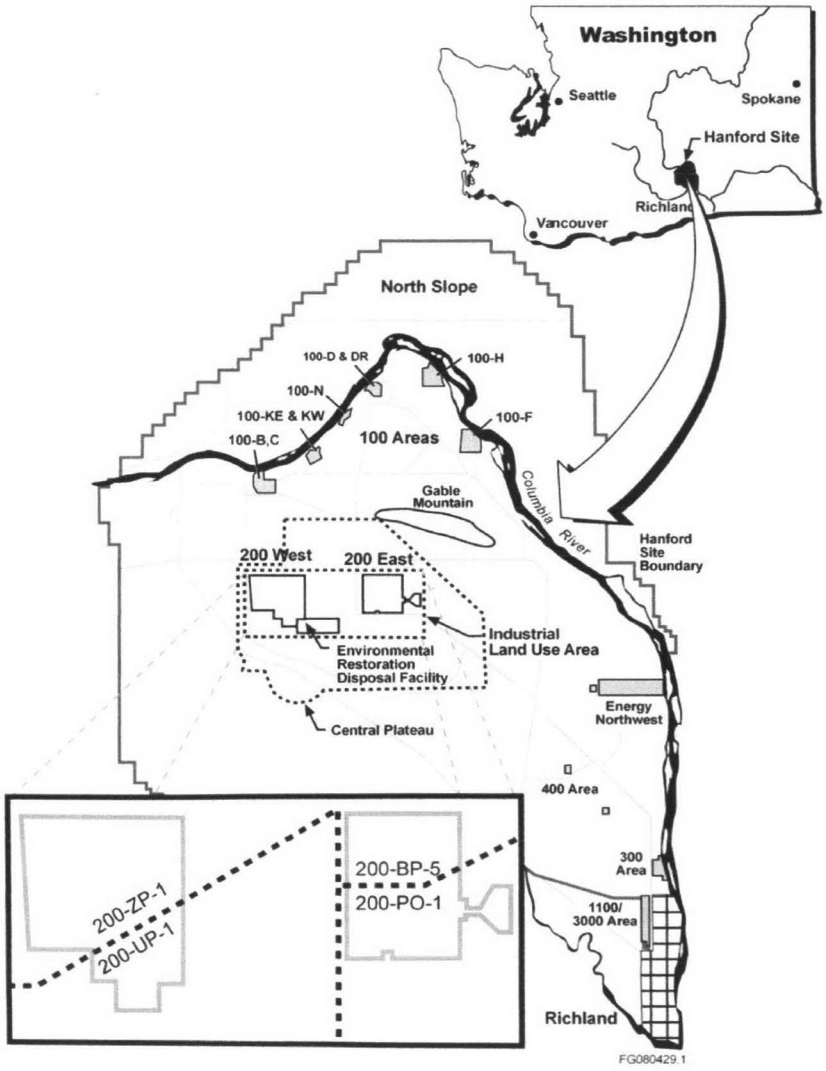
The use of "shall," "will", "should" and "may" in this document is as follows:

- Whenever the word "shall" appears, it is to be interpreted to mean that the requirements are binding.
- The words "will", "should", and "may" it are to be interpreted as non-mandatory provisions.
    - The word "will" is also used to express declaration of purpose or simple futurity.
    - The word "should" is used to express non-mandatory desired or preferred method of accomplishment.
    - The word "may" is used to express an acceptable or suggested means of accomplishment.

1.1 Background

The U.S. Department of Energy's (DOE's) Hanford Site is a 1,517-km^2 (586-mi^2) Federal facility located in southeastern Washington State along the Columbia River (see Figure 1-1). The Hanford Site is situated north and west of the cities of Richland, Kennewick, and Pasco, an area commonly known as the Tri-Cities. This region includes these cities as well as surrounding communities in Benton, Franklin, and Grant counties. For administrative purposes, the Hanford Site was divided into four National Priorities List sites (Title 40, Protection of Environment, *Code of Federal Regulations* [CFR], Part 300, "National Oil and Hazardous Substances Pollution Contingency Plan" [40 CFR 300], Appendix B) under Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), one of which is the 200 Area. The CERCLA site identification number for the 200 Area is WA1890090078.

Figure 1-1. Hanford Site.



The 200 Area National Priorities List site contains numerous waste sites, contaminated facilities, and groundwater contamination plumes. To facilitate cleanup, these waste sites, contaminated facilities, and groundwater plumes were grouped by geographic areas, process types, and/or cleanup components into several OUs. The 200-ZP-1 and 200-UP-1 OUs have several groundwater contamination plumes beneath part of the 200 West Area (Figure 1-1). The 200 West Area is a DOE-controlled area of approximately 8 km^2 (3 mi^2) near the middle of the Hanford Site (Figure 1-1); it is about 8 km (5 mi) south of the Columbia River and 11 km (6.8 mi) from the nearest Hanford Site boundary. The 200 West Area contains waste management facilities and former irradiated fuel-reprocessing facilities. The 200 West Area is located on an elevated, flat area, often referred to as the Central Plateau, and there are no wetlands, perennial streams, or floodplains.

The major waste streams that contributed to groundwater contamination in the 200-ZP-1 OU were associated with plutonium-separation operations at the T Plant facilities and plutonium concentration and recovery operations at the Z Plant facilities in the 200 West Area. The liquid waste disposal in the cribs and trenches near these facilities resulted in several groundwater contamination plumes in the 200-ZP-1 OU. Plutonium separation operations at the Reduction-Oxidation (REDOX) Plant and uranium recovery at U Plant and associated tank waste storage contributed to groundwater contamination in the 200-UP-1 OU. The major COCs for the 200-ZP-1 OU are carbon tetrachloride and Tc-99. The other COCs are total chromium (trivalent [III] and hexavalent [VI]), nitrate, TCE, iodine-129 (I-129), and tritium. The COCs in the 200-ZP-1 OU are also expected to be COCs in the 200-UP-1 OU with the addition of uranium. Following completion of the final ROD for 200-UP-1 OU, final COCs for 200-UP-1 OU remedial actions will be defined.

The DOE has operated an interim remedial measure (IRM) pump-and-treat system to prevent carbon tetrachloride from spreading in the 200-ZP-1 OU since 1994. Carbon tetrachloride concentrations have decreased in the original target area. The IRM pump-and-treat system was expanded by adding additional extraction wells between FY05 and FY08. In FY08, the pump-and-treat system included 16 extraction wells. Since 1994, more than 3.7 billion L (975 million gal) of groundwater have been extracted. More than 10,900 kg (24,000 lb) of carbon tetrachloride have been removed from groundwater and treated since 1994. Additional information on the IRM is provided in the *Proposed Plan for Remediation of the 200-ZP-1 Groundwater Operable Unit* (DOE/RL-2007-33) and the *Feasibility Study Report for the 200-ZP-1 Groundwater Operable Unit* (DOE/RL-2007-28).

The DOE is the lead agency for remediation of the 200-ZP-1 and 200-UP-1 OUs. The U.S. Environmental Protection Agency (EPA) is the lead regulatory agency for remediation of this OU, as identified in Section 1.5.1 and Appendix C of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989), "Action Plan."

The 200 West Area Pump and Treat System Treatment Facility will be sized to treat water from both 200-ZP-1 and 200-UP-1 OUs. **Basis:** ROD Part II, Section 1.0 for 200-ZP-1; modified 200-UP-1 OU Work Plan. In addition, treatment of specific contribution from 200-UP-1 OU has been requested by DOE. Therefore, the groundwater expected cleanup level criteria for 200-UP-1 OU will be the same as for 200-ZP-1 OU with the addition of using the maximum contaminant level (MCL) for uranium.

1.2 Facility Type

1.2.1 Treatment Facility

The Treatment Facility may be divided into more than one building as determined by the project team for the purpose of operations and materials. For example, it may be beneficial to move radionuclide treatment to a separate area or building at the Treatment Facility for the purpose of controlling dose rates and hazard categories.

Construction Type: Type IIB non-combustible

International Building Code (IBC), Section 602.2, Table 601

Occupancy Classification (mixed use occupancy):

The Occupancy Classification of specific rooms of the Treatment Facility in accordance with IBC, Chapter 3 shall be determined during the design phase. Current facility Occupancy Classifications are contained in 382519-TMEM-015, *200 West Area Pump and Treat Design Architecture.* The goal will be to arrange and manage chemicals in the facility to keep the Occupancy Classification as low as possible.

Special Purpose Industrial Occupancy, per National Fire Protection Association (NFPA) 101, *Life Safety Code.*

1.2.2 Transfer Buildings

Construction Type: Type IIB non-combustible

IBC, Section 602.2, Table 601

Occupancy Classification:

The Occupancy Classification of the Transfer Buildings in accordance with IBC, Chapter 3 shall be determined during the design phase. Current facility Occupancy Classifications are contained in 382519-TMEM-015. The goal will be to arrange and manage chemicals in the facility to keep the Occupancy Classification as low as possible. The Transfer Buildings are not normally occupied.

Special Purpose Industrial Occupancy, per NFPA 101.

1.2.3 Facility Hazard Category

This 200 West Area Pump and Treat System has been categorized as less than Hazard Category (HC)-3 in accordance with PRC-PRO-NS-8366, *Facility Hazard Categorization.* This includes all facilities and systems associated with the 200 West Area Pump and Treat System. See Section 3.2 for further discussion.

All facilities and systems will be General Service.

1.3 Scope, Mission, and Performance Summary

The selected remedy for the 200-ZP-1 OU in accordance with Part 2, Section 12.2 of the ROD is, "Pump-and-Treat, Monitored Natural Attenuation (MNA), Flow-Path Control, and Institutional Controls." This FDC covers the requirements for the 200 West Area Pump and Treat System and Flow-Path control portion of the selected remedy.

Following extraction from wells, the COCs in groundwater (except tritium) will be treated to achieve, at a minimum, the final cleanup levels listed in Table 1-1, and then the groundwater will be reinjected through injection wells placed to provide flow path control. For two of the primary COCs requiring active treatment to meet the cleanup levels (carbon tetrachloride and Tc-99), the Treatment Facility will be designed to achieve beyond the final cleanup level, i.e., a nominal operating treated effluent target of 60 percent of the final cleanup level under normal operations (thus, 2 μg/L for carbon tetrachloride and 540 pCi/L for Tc-99). These process design levels will provide an allowance for a slight upward trend during stressed operating periods. The upward trend will be acted on by the operations staff to bring the system back to normal operations. Treatment for nitrate, which also must meet the cleanup levels, will be designed to achieve a nominal operating treated effluent target of 20 percent of the cleanup level (thus, 2,000 μg/L as nitrogen). This lower level is being selected because biological treatment systems can be less stable and an extra operating margin is desired. The system will not be specifically designed to treat to 60 percent of the final cleanup levels for the other COCs (chromium [hexavalent and total] and TCE) because the blended influent will be below or close to the cleanup levels, and/or they will be removed concurrently with the primary COCs. For example, TCE will be removed with the carbon tetrachloride and hexavalent chromium will be removed with the nitrate.

The groundwater from selected planned extraction wells in the 200-ZP-1 OU will be blended with groundwater from planned extraction wells near S-SX Tank Farm and in other 200-UP-1 OU areas for treatment for Tc-99 and uranium. After Tc-99 and uranium treatment, this water will be mixed with other extracted groundwater for further treatment in the Treatment Facility. The mixed treated water from the Treatment Facility will be reinjected in the 200-ZP-1 OU unless otherwise required. For the interim action S-SX extraction system water will be reinjected in 200-ZP-1 OU. For the uranium plume, local reinjection may be required. The assumed 200-UP-1 OU final cleanup levels (referred to as expected cleanup levels) for reinjection are provided in Table 1-2. The process design levels are also provided in Tables 1-1 and 1-2 that will serve as the design and process control points for the treatment process to ensure the treated water meets final and expected cleanup levels prior to reinjection into the groundwater. The system will be designed to capture and treat contaminated groundwater to reduce the mass of carbon tetrachloride, total chromium (chromium III and chromium VI), nitrate, TCE, and Tc-99, throughout the 200-ZP-1 OU by a minimum of 95% in 25 years. **Basis:** ROD Part 1, Section 4.3.1 and Part 2, Section 9.1.3.1, uranium MCL for 200-UP-1 OU; and DOE/RL-2008-78, Sections 2.1 and 3.1.2.3.

Table 1-1. Final Cleanup and Design Levels for 200-ZP-1 OU Groundwater.

COC	Federal MCL[1]	State MCL[1]	Model Toxics Control Act Method B Cleanup Levels		Final Cleanup Level	Process Design Level
			Non-Carcinogens	Carcinogens at 10^{-5} Risk Level		
Carbon tetrachloride	5	5	5.6	3.4	3.4	2.0
Chromium (total)	100	100	24,000	-	100	Note 5
Hexavalent chromium	N/A[4a]	N/A[4a]	48	-	48	Note 5
Nitrate [6]	10,000	10,000	25,600	-	10,000	2,000
Trichloroethylene (TCE)	5	5	2.4	1[4b]	1[4c]	1
Iodine-129 (I-129)	1	1	-	-	1	Note 5
Technetium-99 (Tc-99)	900	900	-	-	900	540
Tritium	20,000	20,000	-	-	20,000	Note 7

NOTES:

1. MCL = maximum contaminant level.
2. Units are "µg/L" for nonradionuclides and "pCi/L" for radionuclides.
3. Federal MCL values from 40 CFR 141, "National Primary Drinking Water Regulations," with I-129 and Tc-99 values from EPA's *Implementation Guidance for Radionuclides* (EPA 816-F-00-002).
4. State MCL values from Washington Administrative Code (WAC) 246-290, "Public Water Supplies."
   a. There is no MCL specific to hexavalent chromium.
   b. The Model Toxics Control Act Method B cleanup levels for carbon tetrachloride and TCE are from the Washington State Department of Ecology's CLARC table current as of September 25, 2008.
   c. The DOE will clean up COCs for the 200-ZP-1 OU subject to WAC 173-340, (carbon tetrachloride and TCE), so the excess lifetime cancer risk does not exceed 1×10^{-5} at the conclusion of the remedy.
5. No treatment required due to low influent levels.
6. Nitrate measured as nitrogen
7. Tritium treatment is not required.

Basis: ROD Table 1-1. Process design levels are 20% of final cleanup levels for nitrate, and 60% for others.

Table 1-2. Expected Cleanup and Design Levels for 200-UP-1 OU Groundwater.

COC	Federal MCL[1]	State MCL[1]	Model Toxics Control Act Method B Cleanup Levels		Expected Cleanup Level	Process Design Level
			Non-Carcinogens	Carcinogens at 10^{-5} Risk Level		
Carbon tetrachloride	5	5	5.6	3.4	3.4	2.0
Chromium (total)	100	100	24,000	-	100	Note 5
Hexavalent chromium	N/A[4a]	N/A[4a]	48	-	48	Note 5
Nitrate [6]	10,000	10,000	25,600	-	10,000	2,000
Trichloroethylene (TCE)	5	5	2.4	1[4b]	1[4c]	1
Iodine-129 (I-129)	1	1	-	-	1	Note 5
Technetium-99 (Tc-99)	900	900	-	-	900	540
Tritium	20,000	20,000	-	-	20,000	Note 7
Uranium	30	30	-	-	30	18

NOTES:
1. MCL = maximum contaminant level.
2. Units are "µg/L" for nonradionuclides and "pCi/L" for radionuclides except uranium which is "µg/L".
3. Federal MCL values from 40 CFR 141, with I-129 and Tc-99 values from EPA 816-F-00-002.
4. State MCL values from WAC 246-290.
   a. There is no MCL specific to hexavalent chromium.
   b. The Model Toxics Control Act Method B cleanup levels for carbon tetrachloride and TCE are from the Washington State Department of Ecology's CLARC table current as of September 25, 2008.
   c. Assumes the DOE will clean up COCs for the 200-UP-1 OU subject to WAC 173-340, (carbon tetrachloride and TCE), so the excess lifetime cancer risk does not exceed 1×10^{-5} at the conclusion of the remedy
5. No treatment required due to low influent levels.
6. Nitrate measured as nitrogen.
7. Tritium treatment is not required.

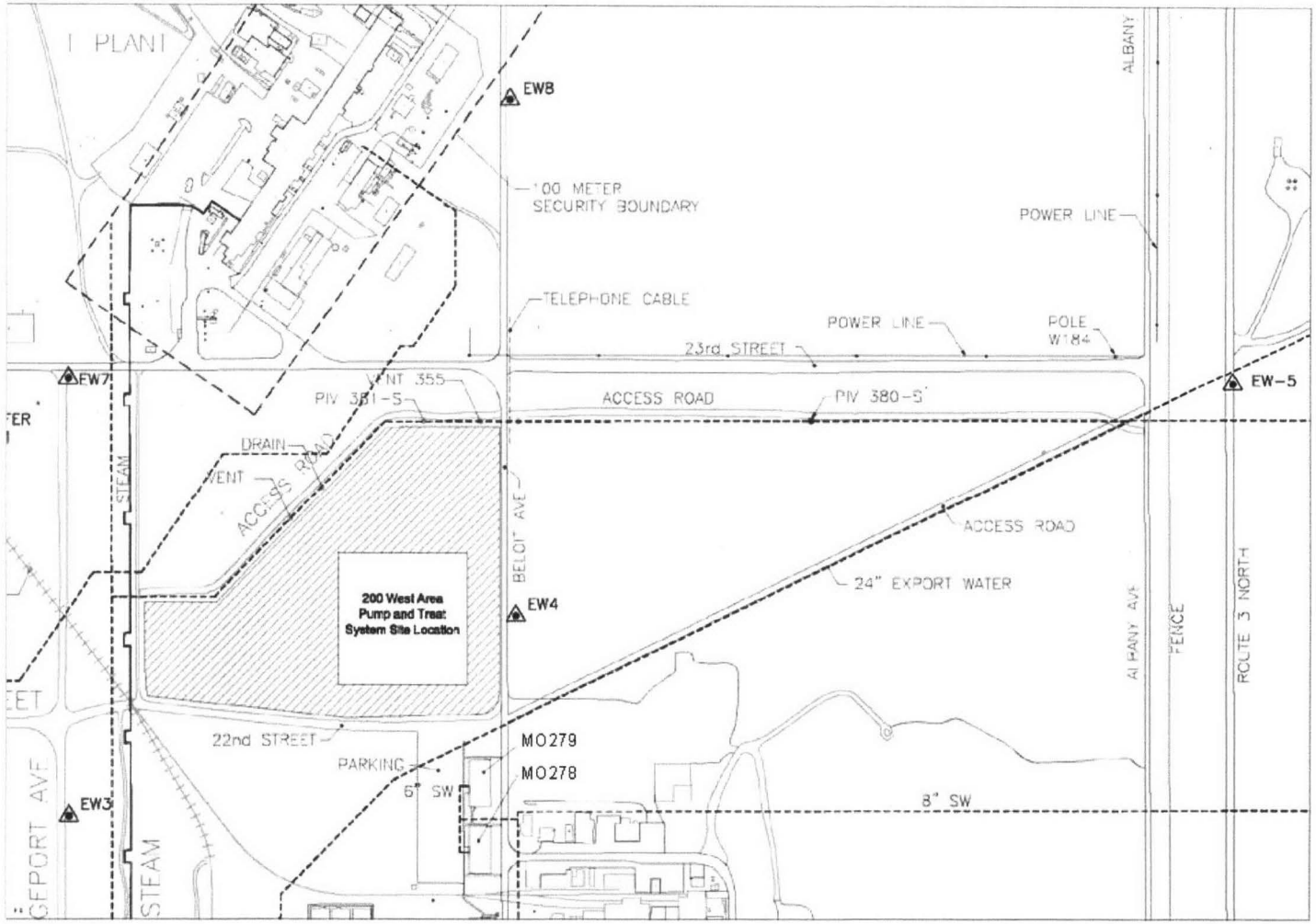
Basis: ROD Table 1-1 plus MCL for uranium. Process design levels are 20% of expected cleanup levels for nitrate and 60% for others.

1.4 Treatment Facility Location

The location for the Treatment Facility was selected on Beloit Avenue between 22nd and 23rd Streets in the 200 West Area. A sketch of the location is provided in Figure 1-2. **Basis:** Site Evaluation Form, dated 11/14/08.

A biological review of the location was performed with the finding that no plant or animal species protected under the Endangered Species Act, candidates for such protection, or species listed by the Washington State government as threatened or endangered were observed in the vicinity. These findings, along with some additional recommendations were documented in PNNL Letter ECR-2009-200-004, *Biological Review of the 200 West Area Groundwater Treatment Facility's Proposed Sites.*

Figure 1-2. 200 West Area Treatment Facility Location.



200 WEST AREA PUMP AND TREAT SYSTEM
CONCEPTUAL SITE PLAN

SK-2W-SITE-1 R5

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Extraction and injection wells will be located based on groundwater modeling scenarios with the goal being to expedite the cleanup of the contaminant plumes. Planned well locations are shown on drawing H-2-833610, *200 West Pump and Treat Overall Project Extraction/Injection Piping*, but are subject to change with updates to groundwater modeling, interferences found on installation, and funding. **Basis:** ROD Part 1, Section 4.3.1 and Part 2, Section 12.2.1, and DOE/RL-2009-38, *Description of Modeling Analyses in Support of the 200-ZP-1 Remedial Design/Remedial Action Work Plan.*

The output from extraction wells in the 200-ZP-1 OU will be pumped to two or more extraction Transfer Buildings for consolidation and pumping to the Treatment Facility, or pumped directly to the Treatment Facility. Likewise, the output from extraction wells in the 200-UP-1 OU will be pumped to one or more extraction Transfer Buildings for consolidation and pumping to the Treatment Facility. The size, number, and location of these extraction Transfer Buildings will be determined during remedial design with the goal being to minimize the total cost of pipe and pumping equipment to transfer the groundwater to the Treatment Facility. Another requirement that will affect the location of these extraction Transfer Buildings is that the groundwater from wells that require Tc-99 treatment shall not be co-mingled with water from wells that do not require Tc-99 treatment until after that treatment has taken place. Whether wells that require uranium treatment should be segregated also shall be assessed during remedial design. Planned 200-ZP-1 OU wells that are expected to have Tc-99 concentrations greater than the final cleanup level are EW-2, EW-6, EW-7, EW-16 and possibly EW-13 based on the groundwater modeling results of DOE/RL-2009-38. In addition, all groundwater from wells near the S-SX Tank Farm and other 200-UP-1 OU areas is likely to have Tc-99 concentrations greater than the expected cleanup level so that it will similarly not be co-mingled. Finally, groundwater from the 200-UP-1 OU wells may have uranium concentrations greater than the expected cleanup level.

The number and location of injection wells will be determined during remedial design to provide flow path control. The output from the Treatment Facility may be pumped to injection Transfer Buildings, where it will then be split up and pumped to the individual injection wells, or the Treatment Facility. The size, number, and location of these injection Transfer Buildings will be determined during remedial design with the goal being to minimize the total cost of pipe and pumping equipment to transfer the groundwater from the Treatment Facility to the injection wells.

1.5 Project Interfaces

Both organizational and physical interfaces are defined in the following subsections.

1.5.1 Organizational Interfaces

Project organizational interfaces are defined in HNF-40140, *200 West Area Pump-and-Treat System Project Execution Plan.*

All tie-ins to existing utilities shall be coordinated and approved by the site water purveyor or site electrical utilities as appropriate.

Tie-ins to telephone lines and HLAN shall be coordinated with Mission Support Alliance, LLC (MSA).

1.5.2 Physical Interfaces

Access Roads – The east side of the site for the Treatment Facility has a two-lane asphalt road (Beloit Avenue) that has access to Route 3 via 20th Street. The south side of the Treatment Facility site has a two-lane gravel road (22nd Street) that also has access to Route 3 via 20th Street. There should be no upgrades to existing roads for construction or operation of the facility, but new entries from the Treatment Facility and road will interface with existing roads.

Communications – Phone and Hanford Local Area Network (HLAN) connections shall be provided in the Treatment Facility. A telephone line is located on the east side of Beloit Avenue. Communications for remote monitoring of the new Treatment Facility shall be connected into the existing communications network linking 200E/MO-285 and ZP-1 OU. The remote monitoring communication network will thus be extended to the existing 200-ZP-1 OU interim Pump and Treat System allowing for remote monitoring of the new system at MO-285. If a wireless communication system is to be used, then coordinate with MSA to ensure appropriate security standards are used and that the system does not interfere with other systems.

Electrical – 13.8 kV overhead power lines are present and will be tapped at the most convenient location. Site electric utilities are responsible for approval of the transformer and tie-ins to the 13.8 kV lines. The project is responsible for specifying and installing the transformer and transformer feeds.

Raw Water – There is an existing 12-in. raw water line about 700 ft from the Treatment Facility site that may be utilized if required. Actual tie-in point(s) shall be confirmed with the Fire Protection Engineer (if used for fire water). Back flow prevention is required and shall be approved by the site water purveyor.

Sanitary Water – There is an existing 12-in. sanitary water supply line about 500 ft from the Treatment Facility that will be utilized. Actual tie-in point(s) shall be confirmed with the Fire Protection Engineer (if used for fire water). Back flow prevention is required and shall be approved by the site water purveyor.

Sewer – A sewage holding tank (sized for weekly pump-out) and pump-out connection will be installed at the Treatment Facility. If the holding tank is not acceptable, then a septic system or alternate system will be selected during remedial design.

Site – The Treatment Facility location is as described in Section 1.4. Site survey data will be obtained at the beginning of the design phase.

1.6 Anticipated Design / Construction Schedule

The project schedule for design and construction is contained in HNF-40140.

1.7 Method of Performance

The method of performance for this remedial action is described in detail in HNF-40140.

2.0 FUNCTIONS

2.1 Process Production Rates and Chemical End States

Overall system production rates shall be designed to capture and treat contaminated groundwater to reduce the mass of carbon tetrachloride, total chromium (chromium III and chromium VI), nitrate, TCE, and Tc-99, throughout the 200-ZP-1 OU by a minimum of 95% in 25 years. The system will also capture and treat contaminated groundwater in selected areas of the 200-UP-1 OU to treat carbon tetrachloride, total chromium (chromium III and chromium VI), nitrate, TCE, Tc-99 and uranium. Current flow rates and chemical end states for achieving this are provided below. **Basis:** ROD Part 1, Section 4.3.1 and Part 2, Section 12.2.1; modified 200-UP-1 OU Work Plan. Final remedial action requirements for 200-UP-1 OU will be defined at the completion of the final ROD.

Each of the initial 15 extraction wells in 200-ZP-1 OU shall be designed to have a production rate that is controllable from 80-130 gpm. The actual production rate at each well will depend on hydrogeologic factors, well screening, distance to be pumped, treatment operating capacity, etc. The 15 new 200-ZP-1 OU wells are predicted to nominally operate at about 100 gpm each. Three new wells will be installed in 200-UP-1 OU for the WMA S-SX Tc-99 plumes, which are predicted to nominally operate at about 20 to 30 gpm each for a nominal total of 80 gpm. **Basis:** DOE/RL-2008-78 and average modeled flow rate of 70 gpm in DOE/RL-2009-38; modified 200-UP-1 OU Work Plan.

The flow from four of 15 new 200-ZP-1 OU wells (wells EW-2, EW-6, EW-7, and EW-16) will be combined with the groundwater from S-SX Tank Farm (approximately 80 gpm total) and pretreated for Tc-99. The flow pretreated for Tc-99 is then blended with flow from the remaining other 11 of 15 new 200-ZP-1 OU wells (approximately 902 gpm total) and treated at the centralized Treatment Facility, which is designed for three trains, but will initially have two trains installed. The design operating flow rate for each process train is 1,250 gpm. A Transfer Building will be provided for pumping groundwater from the S-SX area to the Treatment Facility that will be sized for four wells although only three wells will be installed initially.

To accommodate for system downtime for planned and unplanned maintenance, and allow for additional flexibility in the system, the Treatment Facility shall be designed with space for three chemical treatment trains with each train having a design flow rate of approximately 1,250 gpm. Two trains shall be installed initially. Installation of a potential third train will be assessed and, if necessary, installed at a later date. **Basis:** Initial plans for 15 extraction wells and 1,000 gpm average flow rate per DOE/RL-2008-78 and DOE/RL-2009-38 while allowing for 80% availability.

Five additional (20 total) extraction wells will be installed as funding is available, and each of the 20 wells is expected to nominally have a production rate of 107 gpm each. The actual production rate at each well will depend on hydrogeologic factors, well screening, distance to be pumped, treatment operating capacity, etc. Extracted groundwater from the uranium plume near U-Plant within the 200-UP-1 OU (up to 300 gpm) will be pretreated for uranium, if this portion of the treatment system is constructed, depending on funding availability and 200-UP-1 final ROD requirements. It is expected that new wells will need to be installed for the uranium plume.

This may entail up to six wells at 50 gpm each or more depending on 200-UP-1 final ROD requirements. Such a system would likely need localized reinjection.

The flow from four of the 200-ZP-1 OU wells (wells EW-2, EW-6, EW-7, and EW-16) will be combined with the groundwater from 200-UP-1 OU (pretreated for uranium), and S-SX Tank Farm (approximately 670 gpm total) and pretreated for Tc-99. The flow pretreated for uranium and Tc-99 is then blended with flow from the other 200-ZP-1 wells (approximately 1,830 gpm) and treated at a centralized Treatment Facility. The total combined operating flow rate for the two process train system is 2,500 gpm.

Detailed design of the first and second chemical treatment trains shall be completed initially and included on drawings. The third train shall be "ghosted in" for installation at a later date if necessary. Utilities shall be sized appropriately for installation and operation of all three planned treatment trains.

Conceptual design of the uranium and Tc-99 portions of the train shall be completed initially with enough detail to provide for adequate space in the Treatment Facility, or if funding is available, these capabilities will be included in the complete detailed design.

Following treatment in the Treatment Facility, the water shall meet the Process Design Level requirements of Tables 1-1 and 1-2 prior to reinjection into the groundwater through the injection wells. **Basis:** ROD Part 2, Section 12.2, and uranium MCL for 200-UP-1 OU.

Each treatment train shall be capable of operating between 50% and 100% of design flow rate (625 gpm and 1,250 gpm) with no process recirculation. A recirculation line shall be installed such that treated groundwater that does not meet the Final Cleanup Level requirement of Tables 1-1 and 1-2 prior to reinjection may be reprocessed. Provisions shall be provided to add additional carbon substrate, nutrients, and nitrate to the recirculated water so that the bioremediation process functions properly. **Basis:** Process design and the need to ensure groundwater meets final and expected cleanup levels of Tables 1-1 and 1-2 prior to reinjection.

The design effluent (treated water) shall have a pH (about 6.5 to 8.5) and be essentially particulate and foulant-free to avoid scaling or plugging the injection wells. **Basis:** WAC 173-200, "Water Quality Standards for the Ground Waters of the State of Washington," and engineering practice.

2.2 Operational Effectiveness Requirements and Availability

The 200 West Area Pump and Treat System shall have a high overall system availability goal without providing complete redundancy of all systems. Transfer pumps should be redundant (two out of three), having on-line spares based on past experience. A reliability, availability, and maintainability analysis shall be conducted at the equipment level during the remedial design phase to determine the availability of the system. The system shall have a minimum availability of 80%, with a goal of 95% if it can be shown to be economic. **Basis:** Experience with current systems.

2.3 Preferred Technology and Justification

As stated previously in Section 1.3, the selected remedy for the 200-ZP-1 OU in accordance with Part 2, Section 12.2 of the ROD is, "Pump-and-Treat, MNA, Flow-Path Control, and Institutional Controls." The selected remedy for the interim action at WMA S-SX within the 200-UP-1 OU is "Pump-and-Treat and Institutional Controls" as provided in Section 2.1 of the modified 200-UP-1 OU Work Plan. Final remedial action requirements for the 200-UP-1 OU will be established as part of the ROD process. The expectation is that additional pump and treat/flow-path control action(s) will be required for 200-UP-1 plumes (e.g., uranium) with MNA/institutional control components.

The preferred technology and justification for the treatment technologies to be used are documented in DOE/RL-2008-78, Section 3.3, "Treatment System Conceptual Design."

2.4 Safety

The 200 West Area Pump and Treat System has been assessed in accordance with 29 CFR 1910.119, "Process Safety Management of Highly Hazardous Chemicals" and guidance DOE-STD-1100, *Chemical Process Hazards Analysis*. This assessment is provided in the hazard analysis. Release of the hazard analysis document is pending. **Basis:** 29 CFR 1910.119 and DOE-STD-1100.

Eye wash stations and safety showers shall be located in the Treatment Facility process room and sample preparation room, or any other location where the eyes or body of any person may be exposed to injurious corrosive materials in accordance with 29 CFR 1910.151, "Medical Services and First Aid." **Basis:** 29 CFR 1910.151.

Other Occupational Safety and Health Administration regulations shall be complied with as applicable per 29 CFR 1910.

The design of the project shall minimize non-fixed ladder use through the implementation of fixed ladders or stairs and platforms where possible, and ensuring space for scaffolding or rolling ladders around equipment for maintenance where required according to CH2M Hill Plateau Remediation Company, (CHPRC) ladder policy, PRC-PRO-SH-10321, *Walking/Working Surfaces*. **Basis:** PRC-PRO-SH-10321.

For emergency preparedness, a screening for radiological, chemical, and biological hazards shall be performed in accordance with DOE O 151.1C, *Comprehensive Emergency Management System*. **Basis:** DOE O 151.1C.

The 200 West Area Pump and Treat System shall meet the obligation for worker protection promulgated under the 10 CFR 851, "Worker Safety and Health Program."

2.5 Unique Environmental Protection Requirements

A biological review of the Treatment Facility site was performed with the finding that no plant or animal species protected under the Endangered Species Act of 1973, candidates for such protection, or species listed by the Washington State government as threatened or endangered

were observed in the vicinity. These findings along with some additional recommendations were documented in PNNL Letter ECR-2009-200-004.

In 1987 and 1988, a comprehensive archaeological resources review of the Central Plateau was conducted, including an examination of a stratified random sample of the undisturbed portions of the 200 West Area. That inventory reported no significant surface archaeological sites. Cultural resource reviews will be conducted as part of excavation permits (see Section 4.4). **Basis:** ROD, Sections 5.1.6.1, 5.1.6.2, and 5.1.7.

Construction and operation of the new Treatment Facility and associated groundwater piping and related structures should not interfere with future remediation of waste sites in the vicinity. **Basis:** PRC-RD-EP-15332, *Environmental Protection Requirements,* and PRC-PRO-EP-15333, *Environmental Projection Processes.*

2.6 Waste Acceptance Criteria

Treatment Facility solid waste (biological sludge and spent ion exchange resin) shall meet the disposal requirements of the Environmental Restoration Disposal Facility in WCH-191, *Environmental Restoration Disposal Facility Waste Acceptance Criteria,* and 0000X-DC-W0001, *Supplemental Waste Acceptance Criteria for the Environmental Restoration Disposal Facility.* Additional criteria for smearable surface contamination, fixed contamination, and activity levels are prescribed in 0000X-DC-W0001, for radioactive wastes. **Basis:** DOE goal for no offsite disposal of wastes.

Miscellaneous solid waste shall also be disposed at the Environmental Restoration Disposal Facility.

Liquids from sampling analysis and screening shall be disposed at the Effluent Treatment Facility. The waste acceptance criteria are defined in HNF-3172, *Liquid Waste Processing Facilities Waste Acceptance Criteria.*

Other wastes that meet the criteria for acceptance at a Resource Conservation and Recovery Act of 1976 (RCRA) Subtitle D facility (e.g., construction debris, office waste, excess chemicals) may be disposed off-site.

Where possible, the process should be designed so that hazardous wastes and radioactive wastes are segregated (i.e., avoid generating mixed wastes).

Granular Activated Carbon (GAC) will be sent offsite for regeneration until provisions for onsite regeneration are made available. The regeneration of Hanford Site GAC canisters is currently performed by Siemens Water Technologies in accordance with Contract No. 13269, Modification 14, *Regeneration of Granular Activated Carbon (GAC).* The shipment and regeneration of GAC canisters has been approved by DOE-Richland Operations Office in accordance with the Fluor Hanford, Inc. Authorized Limit Request (ALR) for the *Regeneration of Granular Activated Carbon at 200-ZP-1 and 200-PW-1 Pump and Treat Operations* (FH-0602994.1). This authorization is only applicable to the shipment and regeneration of the GAC at the Siemens Water Technologies Corporation facility located in Parker, Arizona. This ALR shall be modified by the project with information from the 200 West Area Pump and Treat

Facility process design in compliance with DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, and utilizing the guidance in DOE G 441.1-XX, *Control and Release of Property With Residual Radioactive Material for Use With DOE 5400.5, "Radiation Projection of the Public and the Environment."* **Basis:** Contract No. 13269, *Regeneration of Granular Activated Carbon (GAC)*, Part I, "Statement of Work."

2.7 Testing and Inspection Requirements

Factory acceptance tests (FATs) will be conducted as specified by design engineering to ensure the structures, systems, and components (SSCs) and software meet certain requirements prior to shipment. FATs are conducted by the vendor and may be witnessed as desired by an engineering representative, an inspector, or both.

Construction acceptance tests (CATs) will be conducted as specified by design engineering to verify proper installation of SSCs and software. Typically, CATs include visual inspection, pressure tests, leak tests, cleanliness, electrical continuity tests, equipment alignment, motor rotation checks, and verification of component functionality. System functional checks may be specified in lieu of continuity checks.

Construction acceptance testing is performed by the Construction Contractor in accordance with their procedures to ensure that the construction activities were properly performed in accordance with industry practices, codes and standards, and the quality requirements of the contract. These tests ensure the electrical, mechanical and hydraulic integrity of the new or modified SSCs, and ensure that all equipment was properly installed.

Basis: PRC-PRO-EN-286, *Testing of Systems and Equipment*, Section 1.2.

A schedule of inspections shall be determined by engineering as required for facility safety – (e.g., anchor bolt inspection) as further detailed in Section 4.1.1.

Acceptance testing and operational acceptance testing will be conducted upon successful completion of any CATs. Acceptance testing is performed to demonstrate that fabrication, assembly, installation, and construction requirements have been met. Operational acceptance testing is performed by the operator with items in their final in-service configuration to verify that functional, operational, and design requirements have been met. **Basis:** PRC-PRO-EN-286, Appendix A.

Any additional unique or special testing requirements shall be identified by the design engineering organization as design proceeds.

2.8 Design Life

The nominal design life for the 200 West Area Pump and Treat System is 25 years. Replacement of equipment and piping during this period is allowed to meet this goal if life-cycle cost analysis shows it is the lowest cost option of meeting this criterion. **Basis:** ROD Part 1, Section 4.3.1.

2.9 Special Operation and Maintenance Requirements

Control room shall be network ready so as to facilitate ethernet connection among programmable logic controller (PLC), communications room backboard, and control room desktop human-machine interface (HMI), using cabinet- or rack-mounted ethernet switch and flush-mounted ethernet receptacle. Control capability will be administratively controlled during operation and startup of the facility by password.

Facility and equipment layout and design shall consider the provision of adequate space and means of access to perform maintenance, material handling, operations, and future expansion anticipated to meet remedial action objectives. Design shall consider such items (but not be limited to) change out of ion exchange resin, changing filters, access to instrumentation, access to valves, pump maintenance, air compressor maintenance, and other activities.

2.10 Special Safeguards and Security Requirements

There are no special safeguards and security requirements identified for the 200 West Area Pump and Treat System. Security to buildings will be maintained by coded locks. There will be no potential for control of the System from off-site locations. Safeguards and security personnel will participate in design reviews to determine if any additional security measures are required.

3.0 PROJECT INPUTS

3.1 Existing SSCs to be Modified

No existing SSCs will be modified by this project with the exception of the tie-ins with existing utilities, roads, and communication systems described in Section 1.5.2.

3.2 Safety Basis

The HC of the 200 West Area Pump and Treat System is based on DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*. The HC is determined in accordance with PRC-PRO-NS-8366.

The 200 West Area Pump and Treat System sum-of-fractions for the HC-3 threshold is well below unity; therefore, the System is less than HC-3. This is documented in PRC-PRO-NS-8366, Form B and Form E, and released as SGW-40031, *Initial Hazard Categorization for the 200 West Area Pump and Treat System.*

Parts of the 200 West Area Pump and Treat System will be constructed adjacent to the Low Level Burial Grounds and the Central Waste Complex, which are Hazard Category 2 nuclear facilities managed by the Waste & Fuels Management Project. The System will be designed, constructed, and operated in a manner that will ensure it does not violate the Low Level Burial Grounds and the Central Waste Complex safety basis (HNF-14741, *Solid Waste Operations Complex Master Documented Safety Analysis*).

3.3 Design Assumptions and Associated Risks

It is assumed that I-129 concentrations will be below the final and expected cleanup level for reinjection. This was assessed in the numerical modeling conducted on the initial wells which showed that no wells had an average concentration above the final cleanup level of 1.0 pCi/L, and that only one well (EW-2) had a maximum concentration above this limit at 15.6 pCi/L. Concentration into the treatment train are estimated to be 0.31 pCi/L initially and 0.53 pCi/L during operation of additional extraction wells.

It is assumed that 130 gpm or more can be achieved from the extraction wells by increasing the open screen intervals. The risk of not meeting the capacity requirements is introduced by the lack of quantitative data on the ability of the aquifer to yield sufficient quantity of groundwater to the extraction wells. This information will not be available until the wells are drilled and tested after the completion of the design. The wells design shall be in accordance with standard well completion practices, as well as meeting state requirements for well construction. Well field modifications may include but not necessarily be limited to pump motor size, well locations, and number of wells needed to satisfy the operational objectives.

200-UP-1 contaminant plumes can be limited to the upper unconfined aquifer requiring a limited well screen interval and extraction rate to focus capture on the target plume (e.g., WMA S-SX extraction wells are expected to operate at 20-30 gpm each).

The injection distribution design assumes a 240 gpm peak injection well capacity.

It is assumed that the 200-UP-1 OU final (expected) cleanup levels will be the same as those for 200-ZP-1 OU with the addition of the uranium MCL.

It is assumed that the sewage holding tank is performed under CERCLA and therefore permitting is not required. The substantive state requirements for the holding tank will be met.

Well production numbers are needed for proper pump and pipe sizing. Over or under sizing could cause freezing issues or over pressurizing of the pipes. Initial design will size for 80-130 gpm until well production numbers are available.

It is assumed that the treatment technologies chosen for carbon tetrachloride and nitrate will also treat chromium and TCE with sufficient efficiency to reduce them below process design levels.

3.4 Constraints

Constraints to the system design that are not noted elsewhere (such as location of the Treatment Facility and utility locations) are noted in this section.

There will be constraints on the routing of piping and location of road crossings to and from wells, transfer and process facilities.

If pumping systems are off-line for a period of time during temperatures below freezing, it may be necessary to wait for higher temperatures to start-up.

4.0 DESIGN CRITERIA

4.1 General Criteria

4.1.1 Quality Assurance Requirements for Design

The preliminary hazard classification has resulted in a less-than-HC-3 finding. As such, there will not be any safety-class or safety-significant SSCs. A project-specific quality assurance (QA) program plan will not be required for this project. The CHPRC QA Program is comprised of PRC-MP-QA-599, *Quality Assurance Program Description*, and QA Program plans, such as CHPRC-00189, *CH2M Hill Plateau Remediation Company Environmental Quality Assurance Program Plan,* and implementing documents. PRC-MP-QA-599 describes how CHPRC implements the requirements of DOE O 414.1C, *Quality Assurance,* and 10 CFR 830, "Nuclear Safety Management," and is based on the criteria of ASME NQA-1. The design contractor shall implement a QA Program that addresses the criteria stated in PRC-MP-QA-599 as appropriate. CHPRC-00189 describes implementation requirements for CHPRC environmental activities. The QA Program shall be used by the design contractor to develop verification criteria in design documents (i.e., drawings, specifications, and test procedures).

The PRC-MP-QA-599 describes a graded approach for applying quality classes to items and services on the Soil and Groundwater Remediation Project.

1. Utilize the approach to applying quality classes as outlined in PRC-PRO-QA-259, *Graded Approach*, Section 3.0, "Process."

2. Additional Items and Services in Soil & Groundwater Remediation Program that are general service Enhanced Commercial (formerly Quality Class-3) include:

    a. Design and construction of critical elements of in-situ groundwater barriers.

    b. Testing of instruments used to demonstrate regulatory compliance.

    c. Procurement of services or standards used to calibrate instruments used to collect environmental data.

    d. Procurement of services to develop CERCLA response action documents that include tasks requiring the use of computational and analytical software, including spreadsheets. Such tasks would include, but not be limited to vadose zone and groundwater contaminant fate and transport modeling and the conduct of human health, ecological, and protection of groundwater risk assessments. CERCLA response action documents include the administrative and technical plans and reports developed to support the selection and implementation of removal and/or remedial actions.

e. Procurement of selected items that are susceptible to counterfeiting as described in DOE G 414.1-3, *Suspect/Counterfeit Items Guide* (e.g., graded fasteners, circuit breakers, ratchet type tie downs and other items as determined by the Design Authority and QA). Purchase orders for such items shall include clauses or statements regarding procurement of potentially suspect or counterfeit items and shall require receipt inspection.

Some SSCs may be general service Enhanced Commercial (formerly Quality Class-3) as described in PRC-PRO-QA-259, such as American Society of Mechanical Engineers (ASME) Code items (requiring independent verification), and procurement of items shown to be vulnerable to counterfeiting (requiring receipt inspection). Such items will be specified and procured in accordance with the codes and standards defined in Section 5.0.

Additional QA requirements for this project are listed below.

- Any materials or components that, due to economic constraints must be tolerated by design as a single point of failure with respect to safety of life, health and property, must appear in a suitable inspection plan, or in a submittal of an inspection report:
  - Qualified QA inspection plan (e.g., pressure vessels, ASME piping, NFPA 70, *National Electrical Code* electrical inspection), and
  - Engineer's inspection report (e.g., structures).
- Other material and components that are not single points of failure, yet may have some consequence with respect to safety of life, health and property; these will require individual engineering assessment of any risks remaining with partially redundant systems, throughout the course of design. Appropriate specifications, submittals, inspection plans, and reports are to be included, as appropriate.
- The design and construction of the system shall comply with the cleanliness and foreign material exclusion requirements of Section 4.1.9.
- Hydrostatic and initial service leak/pressure testing shall be conducted and documented by a qualified individual.

4.1.2 Additional Criteria

4.1.2.1 Radiological

Conduct radiological design reviews in accordance with PRC-PRO-RP-1622, *Radiological Design Review Process.* The goal will be to maintain exposure levels below 0.5 mrem/hr, and as far below that as is reasonably achievable per 10 CFR 835, "Occupational Radiation Protection."

It is desirable to remove radionuclide constituents as early in the process as possible in order to minimize exposure and the potential contact with radioactive material, especially if that would require the use of personal protective equipment. The System should be designed to minimize the generation of radioactive material for storage or as waste.

4.1.2.2 Hazard Identification and Environmental Description

A hazard analysis of the 200 West Area Pump and Treat System has been performed in accordance with 29 CFR 1910.119 and guidance DOE-STD-1100. Release of the hazard analysis document is pending. **Basis:** 29 CFR 1910.119 and DOE-STD-1100.

4.1.2.3 Environmental Compliance and Permitting

No environmental permitting actions are necessary for this project, as the project is being conducted under the authority of the CERCLA. In lieu of permitting, substantive compliance with applicable or relevant and appropriate requirements (ARARs) in state and federal codes and regulations will be achieved. The ARARs are fully identified in the ROD, Hanford 200 Area, 200-ZP-1 Superfund Site, Benton County, Washington, Appendix A. The 200-ZP-1 ROD is planned to be amended to add 200-UP-1 COCs and final remedial action requirements. It is expected that the new Treatment Facility will have the potential for radiological and nonradiological point source and/or diffuse/fugitive emissions to the atmosphere. The ARARs and compliance strategy are summarized here.

4.1.2.3.1 Radiological Air Emissions

The *Revised Code of Washington* (RCW) 70.94, "Washington Clean Air Act," requires regulation of radioactive air pollutants. The State implementing regulation WAC 173-480, "Ambient Air Quality Standards and Emission Limits for Radionuclides," sets standards that are as stringent or more so than the Federal *Clean Air Act of 1990* and Amendments (42 United States Code [USC] 7401 et seq.), and under the Federal implementing regulation, 40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities." All combined radionuclide airborne emissions from the DOE Hanford Site "facility" are not to exceed amounts that would cause an exposure to any said member of the public of greater than 10 mrem/yr effective dose equivalent. The State implementing regulation WAC 246-247, "Radiation Protection – Air Emissions," which adopts the WAC 173-480 standards and the 40 CFR 61, Subpart H standard, requires verification of compliance with the 10 mrem/yr standard, and is applicable or relevant and appropriate to this remedial action.

The proposed remedial activity shall be evaluated with respect to determining the potential-to-emit radionuclides from any point source or diffuse/fugitive source. To accomplish this, the total unabated potential release, in curies, will be determined, and the annual dose to the maximally exposed individual calculated using the DOE/RL-2006-29, *Calculating Potential-to-Emit Radiological Releases and Doses,* or modeled using the CAP-88PC computer model. Control and monitoring requirements for potential radiological air emissions will be based on the calculated/modeled value of the potential-to-emit. The evaluation threshold is 0.1 mrem/yr for the differentiation between major ($\geq$0.1 mrem/yr) and minor (<0.1 mrem/yr) sources.

Basis: 42 USC 7401 et seq.; 40 CFR 61, Subpart H; RCW 70.94; WAC 173-480; and WAC 246-247.

4.1.2.3.2 Nonradiological Air Emissions

Under WAC 173-400, "General Regulations for Air Pollution Sources," and WAC 173-460, "Controls for New Sources of Toxic Air Pollutants," requirements are established for the regulation of emissions of criteria/toxic air pollutants. Nonradioactive emissions resulting from this remedial action could be gaseous or particulate matter.

To demonstrate compliance with ARARs of WAC 173-400 and WAC 173-460, an acceptable source impact analysis and new source review shall be completed. The analysis will demonstrate that, after application of toxics best available control technology, the new source's maximum incremental ambient air impact levels do not exceed the WAC 173-460 Class A or Class B acceptable source impact levels; or, if applicable, the new source toxic air pollutant emission rates do not exceed the small quantity emission rates specified in WAC 173-460. A comparison will also be conducted to the exemption levels provided in WAC 173-400-110 (5). **Basis:** WAC 173-400 and WAC 173-460.

GAC will be used for treatment of the treatment system off gas. If used, the GAC canisters shall meet the following design criteria. **Basis:** Contract No. 13269.

- Should be movable by truck or forklift.
- Be constructed of volatile organic compound corrosion resistant material.
- Serve as shipping containers for carbon tetrachloride contaminated GAC compliant to U.S. Department of Transportation regulations.
- Be designed and acceptable for operation in series or parallel applications.
- Provide a readily accessible carbon tetrachloride sampling mechanism.
- Have inlets and outlets fitted with valved male Camlock®[1] (or similar) couplers with end caps.
- Be capable of regeneration at an offsite facility, or at a future onsite facility.

Use of existing GAC canister design is highly desired to minimize purchase of equipment and ensure compatibility with regeneration facility. Exceptions may be approved.

4.1.3 Flexibility and Future Expansion

To accommodate for system downtime for planned and unplanned maintenance, and allow for additional flexibility in the system the Treatment Facility shall be designed to the flow requirements contained in Section 2.1.

[1] Camlock is a registered trademark of Camlock Systems Limited, Eastbourne, East Sussex, United Kingdom.

An expansion strategy shall be developed during the remedial design that addresses how future expansion (e.g., installation of the second and third process trains) can be accomplished with minimal facility downtime. **Basis:** Phased installation of process trains.

Wells will be completed and started in phases so that aquifer testing and treatment optimization can be performed and future wells located more optimally. **Basis:** DOE/RL-2008-78.

Consideration shall be given to designing the roof of the Treatment Facility such that major equipment installation or removal may be performed by crane through removable panels or equivalent. **Basis:** Potential need for access due to phased installation approach of DOE/RL-2008-78.

4.1.4 Natural Phenomena Hazards Criteria

Design activities prior to November 19, 2009, Natural Phenomena Hazard Criteria shall have conformed to the guidance in HNF-PRO-097, *Engineering Design and Evaluation (Natural Phenomena Hazard).* **Basis:** HNF-PRO-097.

For design activities performed on or after November 19, 2009, management directive PRC-MD-EN-40250, *Engineering Design and Evaluation (Natural Phenomena Hazard),* was promulgated which allows for the use of IBC for PC-1 and PC-2 structures with the parameters identified in the management directive. **Basis:** PRC-MD-EN-40250.

The IBC shall be the design code of record, but if more restrictive load cases are provided in PRC-MD-EN-40250 or American Society of Civil Engineers code ASCE/SEI 7-05, *Minimum Design Loads for Buildings and Other Structures*, these shall be taken into account as design input.

It is expected and assumed that a hazard analysis will determine that all BOP systems to be Performance Category (PC)-1.

The Treatment Facility may be shown to be PC-2 by the hazard analysis.

The 200 West Area is outside of a flood plain according to PRC-PRO-EN-097.

4.1.5 Materials of Construction and Protective Coatings

The Treatment Facility and Transfer Buildings will consist of prefabricated metal (modular) buildings with factory primed steel structural columns, beams, purlins and girts. If high humidity, exposure to chemicals, or other corrosive environmental conditions are present, these ferrous materials will receive a high-build epoxy coating. In constantly humid and/or wet areas, consideration will be given to use masonry block (concrete masonry unit) with epoxy paint to minimize associated maintenance. These facilities will be supported on reinforced concrete foundations. The floors and curbing will have an epoxy resin coating.

Generally the piping shall be non-metallic where applicable. The ductwork for process air streams will be fiber reinforced plastic or stainless steel. Galvanized steel or aluminum ductwork will be used for the heating, ventilation, and air conditioning (HVAC) applications.

A corrosion Technical Memorandum (382519-TMEM-022, *200 West Area Pump and Treat System Materials of Construction and Corrosion Control),* prepared in the Schematic Design Phase (30%) provides all recommended materials and protective coatings for process flow streams as well as the building structure and related materials. This Technical Memorandum does and shall continue to state that uncoated carbon steel must not be used for any wetted part in order to avoid Tc-99 accumulation. **Basis:** 382519-TMEM-022, and TE-SGRP-07-005-1, *Radiation Protection Technical Evaluation*, provides basis for fiber reinforced plastic not accumulating Tc-99.

4.1.6 Human Factors

The design should be consistent with the guidance of DOE-HDBK-1140, *Human Factor/Ergonomics Handbook for the Design for Ease of Maintenance.*
Basis: PRC-PRO-EN-8258.

4.1.7 Fire Protection

Facilities shall conform to the fire resistance requirements of the IBC 2006 in regard to the allowable floor area, building height limitations, and building separations.
Basis: CRD O 420.1B (Supplemented Rev. 4), *Facility Safety,* Section B.1).a.

Building construction related to egress and life safety shall comply with NFPA 101. Conflicts between the IBC and NFPA 101 related to fire resistance rating shall conform to the more restrictive body of requirements contained in either document. **Basis:** CRD O 420.1B (Supplemented Rev. 4), Section B.1).a.

A Preliminary Fire Hazards Analysis (PFHA) is required to be done during 30% remedial design. The PFHA developed during the design process shall address to the maximum extent possible the elements identified in Section 4.1.8.1. The intent of the PFHA is to determine the key factors on which to determine fire protection requirements for the detail design phase.
Basis: CRD O 420.1B (Supplemented Rev. 4), Section B.2).a

The PFHA shall be revised during 90% remedial design to become the Facility Fire Hazards Analysis (FHA). All of the elements of the FHA as identified in Section 4.1.8.1 shall be addressed. **Basis:** CRD O 420.1B, (Supplemented Rev. 4), Section B.2).a.

A reliable and adequate supply of water for fire suppression is required. **Basis:** DOE O 420.1B, Chapter II, Section 3.c.1.

Distribution mains, either sanitary or raw water, that are being extended to supply water for domestic and/or process water and will provide water for fire suppression systems (sprinklers and/or hydrants), shall be at least 12 inches in diameter. **Basis:** CRD O 420.1B (Supplemented Rev. 4), Section B.7).a.

Sectional valves shall be installed on water distribution main installations and upgrades.
Basis: CRD O 420.1B (Supplemented Rev. 4), Section B.7).a.

Multiple sectional valves shall be provided at each intersection between a supply source and a main loop (one valve per each leg). **Basis:** CRD O 420.1B (Supplemented Rev. 4), Section B.7).b.

Sectional valves shall be installed in accordance with a point system, such that no more than six points accumulate between sectional valves. The points for this arrangement are: one point for a fire hydrant and two points for an automatic sprinkler system. **Basis:** CRD O 420.1B (Supplemented Rev. 4), Section B.7).b.1.

For new buildings, each building fire sprinkler riser (if required) shall be served by an independent underground water supply connection controlled by a supervised indicating control valve. Multiple system risers supplied by a single supply riser manifold are prohibited. A wet pipe system shall be permitted to supply an auxiliary (secondary) dry pipe, preaction, or deluge system provided the water supply is adequate (i.e., freezer, computer room, loading dock, etc.). **Basis:** CRD 420.1B (Supplemented Rev. 4), Section B.7).b.2.

Underground distribution systems for fire protection water supplies shall be of the looped grid type arranged with two-way flow and sectional valving to provide alternate flow paths from source to any point in the distribution system for buildings or groups of buildings with a Maximum Possible Fire Loss (MPFL) exceeding $15 million. **Basis:** CRD O 420.1B (Supplemented Rev. 4), Section B.7).b.3.

For new facilities, one fire hydrant of the minimum number required, shall be provided within 100 feet of any sprinkler system fire department connection, but no closer than 40 feet from the building. **Basis:** CRD O 420.1B (Supplemented Rev. 4), Section B.7).b.4.

Additional hydrants shall be provided and spaced with consideration given to accessibility and obstructions in accordance with the following criteria:

- A minimum of two operational fire hydrants shall be provided such that all parts of the exterior of the building or buildings can be reached with hose lays not over 300 feet where the MPFL exceeds $15 million.
- A minimum of one fire hydrant shall be provided such that all parts of the exterior of the building or buildings can be reached by a hose lay of not over 300 feet where the MPFL is $3 million to $15 million.
- For a building where the MPFL is less than $3 million, the need for fire hydrants shall be based on a documented Hanford Fire Marshal's Office evaluation as to the effectiveness of adequately controlling a fire without hydrants.
- Hydrants shall be the standard type currently used on the Hanford Site.

Basis: CRD O 420.1B (Supplemented Rev. 4), Section B.7).b.4.

Complete automatic fire suppression system per NFPA standards are required in all structures having a Maximum Possible Fire Loss (MPFL) in excess of $3 million, when required by a NFPA standard, or when the IBC requires it for construction height, allowable square footage

size, construction type, or occupancy classification. **Basis:** CRD O 420.1B (Supplemented Rev. 4), Section D.1.

New project and facility design, construction and modifications involving fire alarm systems, fire suppression systems, and water supplies shall be designed in accordance with the DOE Fire Protection Handbook, Hanford Chapter (HNF-36174, *Hanford Chapter of the DOE Fire Protection Resource Manual*). **Basis:** CRD O 420.1B (Supplemented Rev. 4), Section D.3.

Fire-rated assemblies shall be installed, as required by DOE-STD-1066-99, *Fire Protection Design Criteria*, the FHA, NFPA, or the IBC to reduce loss potential. **Basis:** CRD O 420.1B (Supplemented Rev. 4), Section D.5.

The fire sprinkler system (if required) shall be designed for an Ordinary Hazard Group 2 Occupancy in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*. The sprinkler system shall be hydraulically designed in accordance with NFPA 13.

The underground water supply to the fire suppression system shall comply with the requirements of NFPA 24, *Standard for the Installation of Private Fire Service Mains and their Appurtenances*.

The fire alarm system (if required) shall comply with the requirements in NFPA 72, *National Fire Alarm Code*, and HNF-36174.

The installation of a Radio Fire Alarm Reporter shall be in compliance with the requirements of HNF-36174. The Radio Fire Alarm Reporter is only required if the fire suppression system and/or the fire alarm system is installed.

If applicable, systems for flammable and combustible liquid (e.g., methanol, ethanol, etc.) shall comply with the requirements of NFPA 30, *Flammable and Combustible Liquids*. The guidance of NFPA 497, *Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*, shall be used to classify the areas in which these systems are located.

If propane or other liquid petroleum gas is used, the storage systems shall comply with NFPA 58, *Liquid Petroleum Gas Code*.

The Treatment Facility and Transfer Buildings shall be furnished with handheld portable fire extinguishers in approximate classes to effectively serve extinguishing purposes specific to the area (i.e., electrical room versus process or pump room). Units shall be spaced at distance intervals established by NFPA 10, *Standard for Portable Fire Extinguishers*.

Automatic fire suppression (sprinkler) systems shall be provided in all hazardous areas (H-3 occupancies) as required by code (IBC 903.3.1.1) and other areas where construction advantages are realized (i.e., allowable floor area increases, reduced fire separation, etc.).

The Hanford Fire Marshal's Office shall perform the following services:

- Review and approve Acceptance Test Procedures;
- Review and approve site construction documents and shop drawings; and
- Perform the initial review of the facility fire hazards analysis.

Basis: CRD O 420.1B (Supplemented Rev. 4), Section E.1), Subsections 1, 2, and 3.

4.1.8.1 PFHA and FHA Content and Guidance

The PFHA and FHA shall contain, but not be limited to, the following elements:

- Description of Operations;
- Description of Construction;
- Protection of essential safety-class and safety-significant equipment;
- Fire protection features;
- Description of fire hazards;
- Life safety considerations;
- Critical Process Equipment;
- High value property;
- Damage potential: Maximum Credible Fire Loss (MCFL) and MPFL;
- Fire Department Response;
- Recovery Potential;
- Potential for a toxic, biological and/or radiation incident due to a fire;
- Emergency Planning;
- Security considerations related to fire protection;
- Natural hazards (earthquake, flood, wind) impact on fire safety;
- Exposure fire potential, including the potential for fire spread between fire areas;
- Risk of fire and related hazards (direct flame impingement, hot gases, smoke mitigation, fire fighting water damage, and such); and

- Deficiencies or "recommendations" that are required to meet fire protection objectives.

The FHA as prepared during remedial design shall arrive at the conclusion that the facility meets or does not meet the fire protection objectives. The document shall substantiate the conclusion by showing the thought process and assumptions. If the objectives are not met, then implementation requirements must be identified. **Basis:** CRD O 420.1B (Supplemented Rev. 4), Section B.2).b.

The FHA must include an assessment of the risk from fire and related hazards (wildland fire, direct flame impingement, hot gases, smoke migration, fire fighting water damage, fire exposure to structural members, etc.) in relationship to existing or proposed fire safety features to ensure that the facility can be safely controlled and stabilized during and after a fire.

Basis: CRD O 420.1B (Supplemented Rev. 4), Section B.2).c.

The "graded approach" concept can be applied to development of the PFHA and the FHA. This approach would allow the level of detail addressed in the PFHA and FHA to be directly related to the complexity of the facility and the potential risk to the public, the worker, and the environment. **Basis:** CRD O 420.1B (Supplemented Rev. 4), Section B.2).c.

The focus of the PFHA and FHA shall be the individual fire areas that comprise the facility unless analytical deterministic modeling methods can demonstrate a lesser or greater fire potential. A fire area is defined as a location bounded by fire-rated construction having a minimum fire resistance rating of two hours. **Basis:** CRD O 420.1B (Supplemented Rev. 4), Section B.2).d.

Fire models developed by the National Institute of Standards and Technology or fire models acceptable by the DOE Authority Having Jurisdiction (AHJ) that utilize deterministic fire behavioral methods may be used in the development of the fire hazard analysis provided that the model has undergone a formal software quality assurance program in accordance with DOE requirements. The fire hazards analysis shall not preclude the assumption of a fire occurring when an energy source and a combustible source are present. **Basis:** CRD O 420.1B (Supplemented Rev. 4), Section B.2).e.

The PFHA and the FHA shall be performed by or under the supervision of a qualified fire protection engineer. **Basis:** CRD O 420.1B (Supplemented Rev. 4), Section B.2).g.

A qualified fire protection engineer is an individual who satisfies one of the following requirements:

- An engineer that is a graduate of an accredited university or college with a Bachelor of Science in an engineering or related technical field and meets the qualifications of Member Grade in the Society of Fire Protection Engineers.
- An engineer that has a Member Grade in the Society of Fire Protection Engineers
- An engineer that is a Registered Professional Fire Protection Engineer

Basis: CRD O 420.1B (Supplemented Rev. 4), Section 3).a.

4.1.8 Cleanliness and Foreign Material Exclusion

Cleanliness and foreign material exclusion requirements throughout the project life-cycle (manufacturing, shipment, storage, installation, operation, and maintenance) shall be in accordance with PRC-PRO-QA-33415, *Structures, Systems Components Cleaning/Cleanliness and Foreign Material Exclusion.* **Basis:** PRC-PRO-EN-8258.

During shipment and installation, precaution will be taken to keep foreign material out of all piping and piping systems. These precautions include the following:

- Ensure the initial removal of any deleterious contaminants;
- Minimize the introduction of foreign materials into interior surfaces and spaces; and
- Ensure the cleanliness of SSCs during/after installation, operation, maintenance, repair, or modification.

Extra precaution is to be taken when installing the high-density polyethylene (HDPE) groundwater transfer pipe across the ground. **Basis:** Site experience.

4.2 Process Design Criteria

The process design shall consider the use of existing Hanford Site designs for pump and treat systems. Specifically:

- Extraction and Injection Well Head Piping,
- Extraction Well Electrical Racks,
- GAC canisters,
- Siemens S-7 Control System,
- Adjustable Frequency Drives (AFDs), and
- Transfer Pumps.

Alternatives may be acceptable and can be approved by the CHPRC Chief Engineer.

4.2.1 Process Design and Operating Limits

The process feed (extracted well water) into the Treatment Facility will typically run from 49°F to 90°F depending on ambient temperatures, the amount of sunlight on the transfer pipe, and the distance from the extraction well. **Basis:** Experience with existing pump and treat systems.

The piping design temperature shall be 110°F. The process feed temperature during startup may be as low as 32°F to well over high ambient temperatures (high temperatures during startup may

be handled by letting the stagnant pipes cool overnight and conducting startup in the morning). **Basis:** Existing design setpoints and experience with similar systems.

Range of outdoor temperatures is -23°F (February 1950) to +113°F (August 1961), as reported by Hanford Meteorological Station. Additional site climatological data may be obtained from PNNL-14616, *Hanford Site Climatological Data Summary 2003 with Historical Data.*

Design concentrations of the COCs and other chemical parameters at the Treatment Facility are based on numerical groundwater modeling and assumptions about extraction rates and blending of well streams prior to treatment. The results for COCs are documented in calculation 382519-CALC-021, *Estimated Influent Concentrations of Contaminants of Concern (COCs).* The results for non-COCs are documented in calculation 382519-CALC-020, *Estimated Influent Concentrations of Non-Contaminants of Concern (Non-COCs).* The results for other constituents of interest that might have an impact on process design are documented in calculation, 382519-CALC-033, *Estimated Influent Concentrations of Constituent of Interest for Mass Balance.*

Storage for needed process substrates and reagents shall be sized to provide for two weeks of full capacity operations. Currently planned substrates and reagents are included in Technical Memorandum 382519-TMEM-022.

A process flow diagram with mass balance of water, COCs, reagents, and substrates will be prepared during remedial design. The format is to be consistent with PRC-STD-EN-40279, *Engineering Drawing Standards.*

Additional process limits determined during the design process shall be explicitly stated in a System Design Description, as complete sets of limits and operating points such as:

- Physical Design Limit;
- Nominal Design Operating Limit, if different than physical design limit due to a margin of safety being provided; and
- Maximum Operating set-point recommendation should be sufficiently inside of the Operating Limit to allow a reasonable margin of controller/operator overshoot as well as effective warning indications.

4.2.2 Process Mechanical

Groundwater transfer piping shall be HDPE, single-wall designed to ASME B31.3, *Process Piping*, not to be restrained to allow for temperature changes. The pipe will be installed above grade and inspected on a daily basis to meet the leak detection requirements of WAC 173-303-640, "Tank Systems." Materials other than HDPE may be used on a case-by-case basis with the approval of the mechanical design authority. If double-wall pipe is needed for other reasons (e.g., non-accessible location, insulating properties, etc.) it will be evaluated on a case-by-case basis during design review. **Basis:** Current operating practice.

The transfer pumps, feed pumps and injection pumps at Transfer Buildings and the Treatment Facility shall each be a scalable set of pumps sized so that the process may continue at peak capacity upon loss of one individual pump out of the set. **Basis:** Current operating practice to maintain flow.

Outdoor piping velocity is critical to prevent overheating and freezing. Optimum line sizing shall be calculated to minimize freezing potential and to minimize solar heating of the water. The goal is that heat trace or other freeze protection shall only be used on any outdoor metallic piping at the well head, or any other pipe installed (e.g., PVC) that could be damaged due to freezing. HDPE piping does not require freeze protection. **Basis:** Current operating practice.

Where required freeze protection to protect equipment damage during power outages will be provided by heat tracing and insulation. During power outages back-up generators will power the heat tracing if this is justified by heat losses during cold weather. **Basis:** DOE directed change order referenced in 382519-TMEM-071, *Backup Power Proposal for 200 West Area P&T Facility.*

Freeze protection to the Transfer Buildings and Treatment Facility building will be provided by propane fueled heaters during power outages. **Basis:** Current operating practice.

Extraction well head design to be such that during pump maintenance/replacement, isolation can be achieved. Water is to be drained from piping back to the well to prevent untreated water going to the ground surface. **Basis:** Past replacement experience.

Overhead cranes installed in a facility shall meet the requirements of DOE/RL-92-36, *Hanford Hoisting and Rigging Manual;* ASME B30.2, *Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist;* and Crane Manufacturers Association of America (CMAA) 70, *Single Girder Cranes*, or CMAA 74, *Multiple Girder Cranes*, as applicable.

Access will be provided to equipment and components so that they can be replaced or repaired in place with minimal relocation or removal of other components. **Basis:** Past maintenance experience.

Tanks used for water and/or chemical storage shall be designed to national consensus codes such as API-620, *Design and Construction of Large, Welded, Low-Pressure Storage Tanks*; API-650, *Welded Steel Storage Tanks for Oil Storage;* and American Water Works Association (AWWA) D100, *Welded Steel Tanks for Water Storage.* Selection of applicable codes shall be made by the design agent and approved by the CHPRC design authority.

Silos used for bulk solids storage shall consider design loads of ASCE/SEI 7-05. Other national consensus codes should be considered in the design for determination of internal loads as applicable such as American Concrete Institute (ACI) 313, *Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Material.* Selection of applicable codes shall be made by the design agent and approved by the CHPRC design authority.

4.2.3 Well Design Data

Extraction and injection wells shall be designed in compliance with WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," and the exceptions provided in Washington State Department of Ecology (WDOE) letter, *200-ZP-1 Well Design and Installation.* The actual well depths and screened intervals will be determined in the field based on contaminant concentration data, groundwater depth and projected groundwater level fluctuation.

4.2.3.1 Extraction Wells

Maximum Depth Extraction Well

- Total Depth - 520 ft below ground surface (bgs)
- Depth to Water – 295 ft bgs
- Anticipated drawdown – 50 % of the saturated screen length, or approximately 110 ft.

Minimum Depth Extraction Well

- Total Depth - 324 ft bgs
- Depth to Water – 232 ft bgs
- Anticipated drawdown – 10 ft of the 82 ft saturated screen length

Diameter – 8 inch.

4.2.3.2 Injection Wells

Maximum Depth Injection Well

- Total Depth - 455 ft. below ground surface (bgs),
- Depth to Water – 320 ft. bgs
- Anticipated drawdown – 50 % of the saturated screen length, or approximately 110 ft.

Minimum Depth Injection Well

- Total Depth - 325 ft. below ground surface (bgs),
- Depth to Water – 242 ft. bgs
- Anticipated drawdown – 10 ft of the 45 ft saturated screen length.

Diameter – 8 inch.

Air juttering capability will be installed on one of the injection wells to test its effectiveness in cleaning injection well screens. All wells will be designed to allow installation of air juttering capability.

4.2.4 Process Electrical

Electrical power shall be supplied from existing 13.8 kV power lines.

It is preferred that each well head shall have an electrical rack with a main disconnect, an AFD, a remote input/output computer interface, panelboard with step down transformer, heat trace controller, and a 120 V convenience outlet.

Electrical service design, and any required extension of utilities distribution system, shall be compliant with Hanford Electrical Utilities organization and engineering standards, the *National Electrical Safety Code* (Institute of Electrical and Electronics Engineers [IEEE] C2) and NFPA 70.

All circuit breakers shall be provided with a permanently attached lock-out provision.

Arc-flash calculations for distribution components and loads, starting with the service transformer primary fuse, are required and shall be performed in accordance with IEEE 1584, *Guide for Performing Arc-Flash Calculations*.

All electric driven pumps and motorized equipment greater than or equal to 1/2 HP shall be 480 VAC, and all motors greater than 1/4 HP shall be three phase to minimize motor maintenance. **Basis:** Cost of motor maintenance.

All control systems equipment and wiring shall be 24 VDC. **Basis:** Worker safety and Hanford lock and tag implementation.

Power supplies fed by 120 VAC or other voltage more than 50 V shall be located in a separate cabinet from the process control sensing and control and communication equipment. **Basis:** Current operating practice and Hanford hazardous energy control implementation.

Outdoor electrical enclosures shall be outdoor rated and dust-tight. **Basis:** NFPA 70 compliance and site experience.

All electrical panelboards shall have approximately 20% spare capacity for future expansion.

All electrical equipment installed or used on the Hanford Site must be approved by the AHJ according to NFPA 70. Electrical equipment is approved, and, therefore, acceptable for use, under the following conditions.

1. If it is accepted, certified, listed, labeled, or otherwise determined to be safe by an Occupational Safety and Health Administration-recognized nationally recognized testing laboratory (NRTL) as indicated by an NRTL label applied by the manufacturer; or

2. If it has been labeled by an NRTL representative following an NRTL field evaluation; or

3. With respect to an installation or equipment that does not comply with Item 1 or 2 listed above, and for which written justification for the non-compliance is provided to the AHJ prior to installation and energization, it may be approved if it is inspected or tested, using

the non-NRTL Electrical Equipment AHJ Approval Report Checklist, by a Technical Representative designated by the AHJ.

Basis: PRC-RD-SH-11827, *Hanford Electrical Safety Program Requirements.*

Adjustable Frequency Drives

Adjustable frequency equipment with AFDs is the preferred method of providing pump speed/flow control rather than throttling valves. **Basis:** To meet energy management goals, reduce cost of maintenance, reduce cost of control system engineering, and reduce operating costs.

AFDs shall be located at their motors to comply with NFPA work-safety requirements for proximity of motors, motor controllers and disconnects.

No motor disconnect, circuit breaker, power supply, or any other device shall be enclosed in the same cabinet with an AFD. Expressly for electrical work safety, motor disconnect switches shall disconnect the source of power to the AFD housing, rendering the entire AFD housing energy free. NEMA 1 factory-supplied housing will be appropriate unless intended to be purposely washed down, or located outdoors.

The AFD's operator interface will be appropriate for use by operations personnel (i.e., user friendly).

AFDs shall include process field bus (PROFIBUS) communication adaptors having full access to all configuration parameters and operating status from the PLC.

4.2.5 Process Control

The industrial control system network shall be PROFIBUS standard for compatibility with existing PLC and HMI systems of Supervisory Control and Data Acquisition (SCADA).

The SCADA system, PLCs, HMIs, and distributed control system components of the control system shall be Siemens S7. **Basis:** To be consistent with existing systems and thereby reduce spares, maintenance and operator training, and engineering tool costs.

All treatment and normal process systems and equipment shall be remotely operable from centrally located SCADA stations. All treatment and normal process warning indications and alarms shall be remotely visible and acknowledgeable. All relevant treatment and normal process measurements and status indications shall be visible remotely.

A performance monitoring plan and design shall be developed during remedial design. Performance monitoring of the treatment system will be designed to evaluate COC removal and compliance with the final and expected cleanup levels of Tables 1-1 and 1-2. The design will include both hydraulic and chemical monitoring of the treatment system. Hydraulic monitoring will consist of measuring flow rates and total flow at each extraction well, the treatment system influent, and treated effluent discharge lines. Chemical monitoring will consist of treatment system influent and effluent sampling for the COCs of Tables 1-1 and 1-2 except for tritium.

Real-time monitoring of the most abundant COCs (nitrate and carbon tetrachloride) may be performed if current technology can cost effectively achieve the necessary detection limits.

Operations monitoring shall also be designed during remedial design for monitoring of various parameters as necessary to support the treatment process.

The control system physical design and equipment shall accommodate remote controls via HMI and PLC. Flows for each extraction well shall be independently adjustable with insignificant interaction between wells. The principal point of control is manual setting of the extraction well flow rates by the operator.

Measuring instruments and transmitters shall be provided sufficient to remotely control each process variable (i.e., each flow stream, each pump discharge pressure, each tank or vessel level, each throttle valve position, and any other process attribute to be controlled, such as temperature or pH).

Process control actuators (i.e., Adjustable Frequency Pump Drives, Motor Operated Throttling Valves, Solenoid or Air Powered Valves, Motor Controllers, and other actuators) shall be provided sufficient to remotely control each process variable.

Heat trace controllers shall be microprocessor/PLC based and provide for local control as well as interface with the SCADA system for remote monitoring and control.

Basis: Required support for remote control systems, operation efficiency and economic productivity.

Control room shall be network ready so as to facilitate ethernet connection among PLC, communications room backboard, and control room desktop HMI, using cabinet or rack-mounted ethernet switch and flush mounted ethernet receptacle. **Basis**: Option to provide network connectivity to evaluate plant operation from other locations if problems occur during unattended operation.

A flow indicating transmitter shall be installed for each extraction well at the wellhead and at the final discharge of its conveyance piping and for each injection well. **Basis:** Mandatory point of process control.

Flow transmitters will also be installed at the beginning and end of any long overland piping runs (e.g., between Transfer Buildings and Treatment Facility or between Transfer Buildings and wells). **Basis:** Allow for indication of leak on overland piping runs.

Detection of a leak in any injection or extraction line shall automatically shut down flow to that line and activate an alarm to notify personnel of the leak. **Basis:** Mitigate consequences of a leak.

For the injection lines downstream of Injection Transfer Building 2 (289-TE), the automatic shut down and alarm feature is required for compliance with PRC-PRO-CM-40297, *Configuration Control for 200-ZP-1 and 200 West Pump and Treat System Injection Lines*. **Basis:** PRC-PRO-CM-40297.

Remote control throttles shall be installed on the injection wells. The valves may be controlled via the PLC. **Basis:** Injection flows are often siphoning and interactive, requiring throttles to control. Manual valve adjustments have proven to be ineffective.

Design is to include explicit listing of any sensing instrument that requires verification of accuracy during the life of the facility, including the quantitative accuracy required, the justification for maintaining that accuracy, and a proposed initial frequency of accuracy checks. **Basis:** Project preference.

HMI response time over SCADA network communications and input/output conversions is to be limited to one second total from operator input (e.g., start) to sensor driven display (e.g., running). **Basis:** Project preference.

Provisions are to be made in the SCADA design such that no knowledge of or use of software design tools is required by day-to-day users, facility operations and maintenance personnel, to maintain the facility. **Basis:** Project preference.

The HMI is to be furnished with displays that are intended for all maintenance crafts and engineers who have no knowledge of software configuration tools, for making adjustments to any process control parameter that is to be software resident and that might be changed during the life of the facility. These displays shall include the ability to temporarily defeat any software resident interlocks that would otherwise prevent verification of instrument sensor accuracy, such verification as may be required by process control design to be outside the range of associated interlocks. **Basis:** Project preference.

All software adjustable process control parameters are to be maintained by non-volatile PLC memory. The control room HMI is to be provided with a means of capturing all such parameters from the PLC into a generic spreadsheet format, and a means of retrieving them back from the generic format into the PLC after any change of the affected PLC data structure or upon a catastrophic loss of PLC memory. The capturing and reloading of these parameters shall be secured from accidental execution, such that temporary changes and tests cannot become inadvertent or unauthorized change of permanent plant configuration. **Basis:** Project preference.

Access to HMI resident configuration tools is to be secured such that those displays are unlikely to be encountered during normal conduct of operations. **Basis:** Project preference.

The HMI system is to be configured as a client-server arrangement, such that access to historical and alarm database has minimum impact on performance of the facility control room resident HMI client. **Basis:** Project preference.

All HMI servers are to start up automatically after a loss-of-power event, fully functional, unattended. **Basis:** Project preference.

All software is to include documentation that explains:

- What the software is, and
- Why it takes a particular form or uses a particular method.

Basis: Project preference.

The following information is to be integrated within the software, augmented with external reference documents only where necessitated by order of complexity.

- Sensible naming of parameters and procedures;
- Tagging of all inputs and outputs, identical to piping and instrumentation diagrams (P&IDs);
- Definition of, the meaning and not the initial purpose of, intermediate resultants;
- Supplemental cross-reference, only where standard cross-reference tools are eclipsed;
- Data organization and structure;
- Scope and organization of procedures;
- Run-time performance matters; and
- Economic performance concerns – ease of design, flexibility, security, etc.

Basis: Project preference.

All motorized equipment shall be both remotely and locally operable and have a local Remote-Off-Local switch.

All controls required to ensure safety of life, health, and property, including environment, shall be mechanical or hard-wired electrical. Electrical interlock and alarm status shall also be visible remotely.

HMI screen designs shall be consistent with existing pump and treat HMI screens.
Basis: Training of operators and conduct of operations.

If economical, instrument transmitters shall include local indicators, and their display configuration shall be locally accessible without special communication or programming devices.

Any instrument transmitter that is required to support a mechanized approach to performance monitoring, data acquisition for release beyond the boundaries of engineering and operations organizations, as defined by DOE/RL-2008-78, shall be provided with a local indicator, and engineered statement of accuracy requirements and calibration check interval. **Basis:** Required for operations verification of data acquisition and reporting accuracy and reliability

Where building floor sumps or low points are located for spill containment (see Section 4.3.1) continuous leak detection shall be provided. **Basis:** WAC 173-303-640.

The manufacturer's calibration certificate is to be submitted during procurement or construction as certified vendor data for future engineering decisions regarding vendor quality control, and is not to determine actual accuracy of the instrument calibration. **Basis:** Project preference.

Instrument installation and configuration is to exclude calibration. Construction inspection or acceptance test reports are to ensure that instruments are installed and configured in accordance with facility design and manufacturer's installation instructions. **Basis:** Project preference.

Process control software functions that are essential to conduct of operations are to be identified in acceptance tests to be performed during the design, procurement, or construction of the facility. Technical Memorandum 382519-TMEM-045, *200 West Pump and Treat Facility Process Control System Software Development Proposal*, outlines the development of testing guidelines that will be used to verify the software may be used for additional guidance as necessary. **Basis:** Project preference.

4.2.6 Operating Assumptions

The 200 West Area Pump and Treat System shall be designed for continuous operation 24-hrs/day, 7-days/week, unattended for up to five days. The System will be manned for 40-hrs/week (nominally 4x10 hrs/day).

During an unexpected shutdown, the control system shall have an automated calling system to notify responsible personnel to begin recovery operations. **Basis:** Unattended operation provides considerable operational cost savings.

Planned outages for maintenance should be performed during the normal work day, with the system restored to operation by the end of the shift. It is expected that, where possible, the system design will allow maintenance activities without shutting down the (entire) plant. For example, with parallel pumps or trains, one could be taken down for maintenance with only a reduction in plant throughput. **Basis:** Planned pump-and-treat system availability.

4.2.7 Operating Provisions

The system shall shut down on loss of site power, and shall not restart without operator initiation. The need for a master shut-down control shall be determined during remedial design.

All operator instruments or adjustments shall be designed for ergonomic access from the operating floor level, or shall be provided with suitable permanent access platforms.

The system shall be designed to reasonably handle transients/upsets without overflow of tanks, specifically for the following transient conditions:

1. Simultaneous start/stop of any two wells,

2. Shutdown of a Transfer Building, and

3. Failure of any single instrument or pump.

4.2.8 Process Data

All analog input values shall be archived for information and analysis. Current and historical data shall be available in real-time at the control station or by authorized remote logons. The archival data shall also be transmitted to a remote "data server" and made available to general users. **Basis**: Needed for engineering trending.

4.2.9 Process System Structural

IBC, Section 1621 requires that nonstructural components and their attachments, and attachments for permanent equipment shall be designed for seismic forces ASCE/SEI 7-05 except as modified in Sections 1621.1.1, 1621.1.2 and 1621.1.3. This includes piping support, electrical equipment and racks. The attachment to concrete floors will be as noted in PRC-PRO-EN-097.

4.2.10 General Process Criteria

P&IDs shall show all process equipment, instruments and physical interlocks or governances in compliance with PRC-STD-EN-40279. Operational support P&IDs will be developed that meet the criteria of PRC-STD-EN-40279. P&IDs shall use the equipment tags described in Section 4.4.1 of this document.

All electrical wiring subject to NFPA compliance for work safety and fire protection shall be shown on drawings clearly identified as Electrical drawings, including all wiring of electrical instrumentation and controls.

Design of electrical overcurrent and fault protection shall be made to accommodate ease of illustrating and tabulating electrical loads, wire sizing, and protection requirements.

Loop diagrams shall not be acceptable for electrical wiring unless actually illustrating a bona-fide current loop through three or more devices in series AND the rare example of such a circuit cannot be reasonably illustrated on electrical ladder diagrams. For lock and tag safety, every control circuit entering or leaving a cabinet, regardless of voltage or purpose, shall be on an elementary ladder diagram for that cabinet. Loop diagrams may still be developed, but not in place of appropriate wiring diagrams or ladder diagrams.

Ladder diagrams shall include all electrical control wiring, distributed control system (DCS) inputs and outputs, motor control elementary diagrams, with:

- Organization by electrical enclosure, clearly showing the boundaries of the topic enclosure and every source of energy into or out of that enclosure.
- Every circuit load and short protective device in the enclosure or otherwise dedicated to the enclosure.
- Distinct wire terminal identification for each item of equipment. These may be generic if manufacturer is unknown, and as-built by end of construction.

- DCS module terminals should be designed for direct landing of field wiring without auxiliary field-terminal blocks. Land wires directly on all control-device terminals, if possible. Exclude field-terminal blocks, unless necessary. If field terminal blocks cannot be avoided, use a different termination symbol for field-terminals than for control-device terminals.

- Node based wire identification for all wires, usually by fuse number or signaling device tag, for class 2 control circuits feeding externally mounted transmitters or switches.

- Standard motor control elementary, if applicable, to be included in the elementary ladder diagrams.

- Cross-reference among sheets showing destination/source of wiring leaving/arriving an enclosure.

- Standard ladder logic cross-reference for location of contacts belonging to relays.

4.3 Facility Design Criteria

4.3.1 Architectural and Civil/Structural

Access and egress shall be provided in accordance with the requirements of the IBC and NFPA 101.

Roadway (including crossings of existing roads) and parking shall be designed in accordance with Washington State Department of Transportation (WSDOT) M41-10, *Standard Specifications for Road, Bridge and Municipal Construction.*

Fences shall be designed in accordance with WSDOT M41-10.

Potable water piping shall be designed to requirements of AWWA.

Sewage system design (holding tank) will substantively comply with WAC 246-272, "On-site Sewage Systems." This compliance will be demonstrated through design drawings, calculations, specifications and other design media as necessary.

Storm drainage water shall be managed by appropriately sloping paved areas to cause drainage away from the facilities to the surrounding low lying area for infiltration into the native soil.

Steel design, fabrication, and installation shall be in accordance with the American Institute of Steel Construction (AISC) M011, *Manual of Steel Construction – Allowable Stress Design.*

Welding shall comply with the applicable American Welding Society (AWS) standards.

Concrete design and installation shall be in accordance with ACI 318, *Building Code Requirements for Structural Concrete.*

The Treatment Facility and Transfer Buildings shall house as much of the equipment and instrumentation as reasonable. **Basis:** To minimize exposure to weather and increase the efficiency of maintenance. The preliminary size and space allocation for the Treatment Facility and Transfer Buildings are subject to change during remedial design, and are as follows:

Treatment Facility:

Pre-fabricated metal building with the following spaces:

- Process Room: Houses most treatment process equipment, overhead roll-up doors spaced along building sides located as required for service/equipment access, hollow metal personnel doors located for function/access and per code (egress) requirements.
- Ion Exchange Room: A separate room or building adjacent to the Process Room where ion exchange columns are housed, overhead roll-up doors spaced along building sides located as required for service/equipment access, hollow metal personnel doors located for function/access and per code (egress) requirements. If the 200-UP-1 OU groundwater is segregated and pretreated for uranium, an additional separate room may be required for the uranium treatment ion exchange columns.
- Control Room: Houses SCADA HMI with view window(s) to process room and facility entrance, access to entry area (off small lobby/viewing hall) and process area.
- Sample Preparation Room: For general wet chemistry – will include chemical resistant casework (epoxy-resin counter tops, etc.) and stainless steel fixtures, hardware, fume hoods, as required. Size to be determined based on identified needs during remedial design.
- Restrooms: Men's and women's, each with single shower.
- Change Rooms: Men's and women's, approximately 200 ft^2 each.
- Mechanical/Electrical Room: Mechanical (HVAC, hot water supply, service sink), and electrical service (lighting, power, and communications) for spaces above. Note that the switchgear may not be located in this room.
- Electrical Switchgear Room: A separate climate controlled and lockable room to house electrical switchgear.

Transfer Buildings:

Pre-fabricated metal buildings, with low-maintenance sloped metal roofing, with the following spaces:

- Pump Room: For housing equalization tank and transfer pumps, with overhead roll-up doors spaced along building sides located as required for service/equipment access, hollow metal personnel doors located for function/access and per code (egress) requirements.

Access to the Treatment Facility shall be designed for a chemical truck and maintenance vehicles to access and maintain the facility. The access shall lead to an unloading station for chemical delivered by tanker truck. **Basis:** WB-50, *Geometric Design of Highways and Streets.*

Access to facilities by the roll-up doors shall not be restricted due to grading or installation of equipment. **Basis:** Ensure access for heavy loads by forklift and other means.

A minimum of 100 ft of paved apron shall be installed around the Treatment Facility with additional adequate space for storage of drums, luggers, equipment, racks, etc.
Basis: Operations safety and utilization needs.

Parking shall be provided for ten vehicles.

Treatment Facility and Transfer Building floors shall be curbed or sloped to a sump to provide secondary containment. Secondary containment shall also be provided for any outdoor liquid tanks containing listed hazardous materials. The secondary containments shall be designed to contain 100% of the capacity of the largest tank in the containment. **Basis:** WAC 173-303-640.

The facilities shall include a plant paging system controlled from the Treatment Facility Control Room. The system shall be able to select various or all portions of the facilities for announcements to include the Treatment Facility and associated spaces, the Transfer Buildings, and any other facilities to be built. **Basis:** Operations preference.

Facilities shall have compressed gas bottle storage areas if any gases are to be used in the area.
Basis: Operations preference.

4.3.2 Energy Efficiency and HVAC

The facilities and systems shall comply with the requirements of DOE O 430.2B, *Departmental Energy, Renewable Energy, and Transportation Management*, Section 4.C.(6) for energy efficiency. This requires compliance with 10 CFR 433, "Energy Efficiency Standards for the Design and Construction of New Federal Commercial and Multi-Family High-Rise Residential Buildings," to achieve energy savings of at least 30 percent below American National Standards Institute (ANSI)/American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)/Illuminating Engineering Society of North America (IESNA) Standard 90.1-2004, *Energy Standard for Buildings Except Low-Rise Residential Buildings,* if cost effective. This standard applies to the design of the building envelope, HVAC, lighting, and electric motor efficiency. **Basis:** DOE O 430.2B.

4.3.3 Utilities

Electrical, communication and water utility tie-ins are described in Section 1.5.2. Additional utilities to be provided by the project include:

Air – Instrument air shall be provided for the Treatment Facility. The air shall meet the requirements of ISA 7.0.01. Other compressed air needs shall be determined during remedial design.

Propane – A storage tank or tanks shall be provided at the Treatment Facility if required for any process heat exchangers or other uses.

Chemicals – Storage for needed process substrates and reagents shall be sized to provide for two weeks of full capacity. Storage solutions shall provide for secondary containment in accordance with WAC 173-303-640.

4.4 General Requirements

Process control set points, interlocks, and behavior of process regulators shall be documented in a system design description as the definitive configuration control document for the process control system, in addition to the information on the P&ID.

Measurements shall be in English units. Any exceptions shall reflect the most common industry practices for:

- The subject materials and equipment,
- The involved construction organizations, and
- The responsible operations and maintenance organization.

For portability, systems shall not use physical well numbers. Well numbers shall appear only on site plans and on the physical well symbol of the P&ID. **Basis:** Current operating practice.

Routing of piping into and out of buildings shall allow clearances for access by emergency equipment and a minimum 30-ft fire buffer zone free of weeds. **Basis:** Current operating practice.

In addition to *National Electrical Safety Code* (IEEE C2) clearance requirements, layout of 13.8 kV distribution and structural guying shall be arranged to be conspicuous, avoiding blind spots, and out of the way of any interference with safe pedestrian or vehicular traffic, parking and access for loading and unloading. **Basis:** Current operating practice.

All aspects of the outdoor design shall compliment the special requirements to protect cultural resources, wildlife activities and habitat, and environment and any special requirements as identified in the Ecological/Cultural Resource Review. This will be implemented through compliance with PRC-PRO-SH-090, *Excavating, Trenching, and Shoring,* which requires these reviews as part of the excavating permit process. **Basis:** PRC-PRO-SH-090.

Outdoor piping and wiring shall be protected by markers where off road, reflective markers shall be used within 5 ft of vehicular traffic. **Basis:** Current operating requirements.

Design of systems and facilities shall consider the energy isolation controls of DOE-0336, *Hanford Site Lockout/Tagout*. For example, if a piping system will have fluids of over 200°F or 500 psig, then provisions for two-valve isolation during maintenance shall be provided in the design.

Any sample preparation room fume hoods shall meet the requirements of UL 1805, *Laboratory Hoods and Cabinets.*

4.4.1 Equipment and Instrument Identification and Labeling

Unique identification tags are required for all equipment meeting any of these conditions:

- Subject to failure and replacement;
- Manually operable;
- Has a purpose in, or is the object of safety lock-out;
- Valve manifolds for line-up of flow through series of treatment stages.

A project-specific labeling scheme for systems, equipment, instruments, wiring, and piping shall be developed and approved by the 30% design review and take into consideration existing schemes developed for existing pump-and-treat systems, the guidance in DOE-STD-1044-93, and the guidance of ANSI/ISA S5.1 *Instrumentation Symbols and Identification* (but not limited to instruments). The labeling scheme shall also include a scheme for equipment and instrument labels within the control system software.

Identification tags to be applied in the field shall follow the guidance of DOE-STD-1044-93 and DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities*, Chapter 18, "Equipment and Piping Labeling."

Labeling for equipment and components on PLC screens shall be the same as the field labels.

4.5 Decontamination and Decommissioning

Design of the systems shall consider that all SSCs installed will ultimately be removed and disposed of at the end of their useful life. Materials that come in contact with hazardous materials should consider the ease with which it can be decontaminated to acceptable levels.

5.0 CODES AND STANDARDS

The following codes and standards are applicable to the design of the 200 West Area Pump and Treat Systems and shall be implemented as appropriate.

5.1 Architectural/Civil/Structural Codes and Standards

STANDARD NUMBER/REFERENCE	TITLE
American Concrete Institute (ACI)	
ACI 301	Specification for Structural Concrete
ACI 313	Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Material
ACI 318	Building Code Requirements for Structural Concrete
ACI 350-06	Code Requirements for Environmental Engineering Concrete Structures and Commentary
ACI 350.3-06	Seismic Design of Liquid-Containing Concrete Structures and Commentary
American Institute of Steel Construction (AISC)	
AISC 325-05	Steel Construction Manual, 13th Edition
AISC 360-05	Specification for Structural Steel Buildings
AISC M011	Manual of Steel Construction – Allowable Stress Design, 9th edition
American Welding Society (AWS)	
AWS A 2.4	Weld Symbols
AWS D1.1	Structural Welding Code—Steel
AWS D1.2	Structural Welding Code—Aluminum
AWS D1.3	Structural Welding Code—Sheet Steel
AWS D1.4	Structural Welding Code—Reinforcing Steel
AWS D1.6	Structural Welding Code—Stainless Steel
AWS D9.1	Structural Welding Code—Sheet Metal
AWS QC-1	Guide to AWS Welding Inspector Qualifications and Certification

STANDARD NUMBER/REFERENCE	TITLE
American Society of Civil Engineers (ASCE)	
ASCE/SEI 7-05	Minimum Design Loads for Buildings and Other Structures
American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)	
ASHRAE 90.1-2004	Energy Standard for Buildings Except Low-Rise Residential Buildings
American Society for Testing and Materials (ASTM)	
ASTM A 53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 74	Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM C 39/C 39M	Standard Test Methods for Compressive Strength of Cylindrical Concrete Specimens
American Water Works Association (AWWA)	
AWWA	Cross-Connection Control Manual
AWWA D100	Welded Carbon Steel Tanks for Water Storage
International Code Council	
IBC 2006	International Building Code
IECC 2006	International Energy Conservation Code
IFC 2006	International Fire Code
IFGC 2006	International Fuel Gas Code
IMC 2006	International Mechanical Code
IPC 2006	International Plumbing Code
International Conference of Building Officials (ICBO)	
UBC 1997	Uniform Building Code
National Association of Architectural Metal Manufacturers	
MBG531-00	Metal Grating Manual
MBG532-00	Heavy Duty Metal Grating Manual
Steel Deck Institute (SDI)	
SDI 31	Design Manual for Composite Decks, Form Decks and Roof Decks

5.2 Mechanical Codes and Standards

STANDARD NUMBER/REFERENCE	TITLE
American Petroleum Institute	
API-620	Design and Construction of Large, Welded, Low-Pressure Storage Tanks
API-650	Welded Steel Storage Tanks for Oil Storage
American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)	
ASHRAE 90.1-2004	Energy Standard for Buildings Except Low-Rise Residential Buildings
American Society of Mechanical Engineers (ASME)	
ASME B&PV Code	Boiler and Pressure Vessel Code, Section III, and Section VIII
ASME B16.3	Malleable iron threaded fittings class 150
ASME B16.34	Valves Flanged, Threaded and Welding End
ASME B16.5	Pipe Flanges and Flanged Fittings NPS ½ through NPS 24
ASME B30.2	Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)
ASME B31.1	Power Piping
ASME B31.3	Process Piping
ASME B31.9	Building Services Piping
American Society of Testing and Materials (ASTM)	
ASTM A47	Standard Specification for Ferritic Malleable Iron Castings
ASTM A53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A105	Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A106	Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A182	Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A193	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications

STANDARD NUMBER/REFERENCE	TITLE
ASTM A194	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A197	Standard Specification for Cupola Malleable Iron
ASTM A312	Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM D2467	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D3261	Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D3350	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
American National Standards Institute (ANSI)	
ANSI/ASHRAE/IESNA 90.1	Energy Standard for Buildings Except Low-Rise Residential Buildings
American Water Works Association (AWWA)	
AWWA D100	Welded Carbon Steel Tanks for Water Storage
AWWA M55	PE Pipe--Design and Installation
Crane Manufacturers Association of America (CMAA)	
CMAA 70	Single Girder Cranes
CMAA 74	Multiple Girder Cranes
International Code Council	
IBC 2006	International Building Code
IECC 2006	International Energy Conservation Code
IFC 2006	International Fire Code
IFGC 2006	International Fuel Gas Code
IMC 2006	International Mechanical Code
IPC 2006	International Plumbing Code
U.S. Department of Energy (DOE)	
DOE/RL-92-36	Hanford Hoisting and Rigging Manual

STANDARD NUMBER/REFERENCE	TITLE
Underwriters Laboratories, Inc. (UL)	
UL 1805	Laboratory Hoods and Cabinets

5.3 Electrical Codes and Standards

STANDARD NUMBER/REFERENCE	TITLE
American National Standards Institute (ANSI)	
ANSI/IEEE 1016	IEEE Recommended Practice for Software Design Descriptions
ANSI/ISA S5.1	Instrumentation Symbols and Identification
Electronic Industries Association (EIA)	
EID/TIA 569	Commercial Building Standard for Telecommunications Pathways and Spaces.
Illuminating Engineering Society of North America (IESNA)	
	Illuminating Engineering Society of North America Lighting Handbook
Institute of Electrical and Electronics Engineers (IEEE)	
IEEE C2	National Electrical Safety Code
IEEE 1584	Guide for Performing Arc-Flash Calculations
Instrumentation, Systems, and Automation Society (ISA)	
ISA 7.0.01	Quality Standard for Instrument Air
ISA S5.1	Instrumentation Symbols and Identification
National Electrical Manufacturers Association (NEMA)	
NEMA AB1	Molded Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures
NEMA C12.1	Code for Electricity Metering
NEMA ICS 2	Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 5	Industrial Control and Systems: Control Circuit and Pilot Devices

STANDARD NUMBER/REFERENCE	TITLE
NEMA KS 1	Enclosed and Miscellaneous Distribution Switches (600 V Maximum)
NEMA 250	Enclosures for Electrical Equipment (1,000 V Maximum)
National Fire Protection Association (NFPA)	
NFPA 10	Standard for Portable Fire Extinguishers
NFPA 13	Standard for the Installation of Sprinkler Systems
NFPA 24	Standard for the Installation of Private Fire Service Mains and Their Appurtenances
NFPA 30	Flammable and Combustible Liquids
NFPA 58	Liquefied Petroleum Gas Code
NFPA 70	National Electrical Code
NFPA 72	National Fire Alarm Code
NFPA 101	Life Safety Code
NFPA 497	Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas
NFPA 780	Standard For The Installation of Lightning Protection Systems.
Underwriters Laboratories, Inc. (UL)	
UL 98	Standard for Enclosed and Dead-Front Switches
UL 248	Standard for Low Voltage Fuses
UL 486E	Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors
UL 489	Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures
UL-508A	Industrial Control Equipment
UL 943	Standard for Ground-Fault Circuit-Interrupters
UL 1059	Standard for Terminal Blocks
UL 1479	Fire Tests of Through-Penetration Fire Stops
UL 1805	Laboratory Hoods and Cabinets

5.4 Washington State Codes and Standards

STANDARD NUMBER/REFERENCE	TITLE
WAC 173-160	Minimum Standards for Construction and Maintenance of Wells
WAC 173-200	Water Quality Standards for the Ground Waters of the State of Washington
WAC 173-218	Underground Injection Control
WAC 173-303	Dangerous Waste Regulations
WAC 173-303-640	Tank Systems
WAC 173-304	Minimum Functional Standards for Solid Waste Handling
WAC 173-340	Model Toxics Control Act - Cleanup
WAC 173-350	Solid Waste Handling Standards
WAC 173-400	General Regulations for Air Pollution Sources
WAC 173-460	General Regulations for New Sources of Toxic Air Pollutants
WAC 173-480	Ambient Air Quality Standards and Emission Limits for Radionuclides
WAC 246-247	Radiation Protection – Air Emissions
WAC 246-272	On-site Sewage Systems
WAC 246-290	Group A Public Water Supplies
WSDOT M22-01	Washington State Department of Transportation Design Manual
WSDOT M41-10	Standard Specifications for Road, Bridge and Municipal Construction

5.5 Federal Codes and Standards

NUMBER	TITLE
10 CFR 433	Energy Efficiency Standards for the Design and Construction of New Federal Commercial and Multi-Family High-Rise Residential Buildings
10 CFR 830	Nuclear Safety Management
10 CFR 835	Occupational Radiation Protection
10 CFR 851	Worker Safety and Health Program

NUMBER	TITLE
29 CFR 1910.119	Process Safety Management of Highly Hazardous Chemicals
29 CFR 1910.151	Medical Services and First Aid
40 CFR 61	National Emission Standards for Hazardous Air Pollutants
40 CFR 141	National Primary Drinking Water Regulations
40 CFR 268	Land Disposal Restrictions
40 CFR 300	National Oil and Hazardous Substances Pollution Contingency Plan
40 CFR 300.430	Remedial Investigation/Feasibility Study and Selection of Remedy
15 USC 2601	Toxic Substances Control Act of 1976
16 USC 1531	Endangered Species Act of 1973
16 USC 469aa-mm	Archeological and Historic Preservation Act of 1960
16 USC 470 Section 106	National Historic Preservation Act of 1966
25 USC 3001	Native American Graves Protection and Repatriation Act
42 USC 103	Superfund Amendments and Reauthorization Act of 1986
42 USC 2011	Atomic Energy Act of 1954
42 USC 6901	Resource Conservation and Recovery Act of 1976
42 USC 7401	Clean Air Act of 1990
42 USC 9601	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CRD O 420.1B	Facility Safety
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NUMBER	TITLE
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DOE/RL-2006-29	Calculating Potential-to-Emit Radiological Releases and Doses
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