

Department of Utility Services

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TABLE OF CONTENTS

CHAPTER 1 GENERAL

1.01	Introduction	1-1
1.02	Community Development, Entitlements and Mapping	1-8
1.03	Environmental Investigation	1-9
1.04	Site Civil Design	1-10
1.05	Survey	1-11
1.06	Agency and Utility Coordination	1-12
1.07	Proiect Processing	1-13
1.08	Advertise, Bid and Award	1-17
1.09	Construction Phase	1-17
1.10	Project Closeout	1-18
1.11	Operation and Maintenance Manuals	1-21
1.12	Start-up and Commissioning	1-24
1.13	Letter of Compliance to Design	1-28
1.14	As-Built Record Drawings	1-28
1.15	Construction Phase Checklist	1-29
CHAPTE	R 2 GEOTECHNICAL DESIGN	
2.01	Geotechnical Investigation	2-1
2.02	Geotechnical Report	2-1
2.03	Design Checklist	2-10
CHAPTE	R 3 STRUCTURAL AND SEISMIC DESIGN	
3.01	General	3-1
3.02	Site Criteria	3-2
3.03	Seismic Design Criteria	3-3
3.04	Structural Loads	3-4
3.05	Structural Design Requirements	3-5
3.06	Design Checklist	3-8
CHAPTE	R 4 CORROSION CONTROL	
4.01	Corrosion Analysis and Evaluation	4-1
4.02	Corrosion Analysis Results, Conclusions and Recommendations	4-1
4.03	Induced Voltage and Stray Current Mitigation	4-3
4.04	Materials Selection	4-3
4.05	Protective Linings and Coatings	4-5
4.06	Buried Piping	4-8
4.07	Cathodic Protection	4-9
4.08	Design Checklist	4-10
CHAPTE	R 5 WATER PUMP STATIONS	
5.01	General	5-13
5.02	Design Concept Phase	5-13
5.03	Preliminary Design Phase	5-14
5.04	Agency and Utility Coordination	5-17
5.05	Final Design Phase	5-17
5.06	Hydraulic Analysis	5-18
5.07	Surge Mitigation Measures	5-19

5.08	Site Civil	5-22
5.09	Signage	5-22
5.10	Access Gates	5-22
5.11	Security	5-22
5.12	Noise Attenuation	5-23
5.13	Vault Standards for Water Pump Stations	5-24
5.14	Architecture and Landscaping	5-25
5.15	Pump Systems Design	5-28
5.16	Pump Speed Control	5-31
5.17	Pump Station Piping	5-32
5.18	Pump Motors	5-35
5.19	Pumps	5-37
5.20	Vibration	5-39
5.21	Heating, Ventilation, Air Conditioning (HVAC)	5-40
5.22	Support Systems	5-45
5.23	Fire Protection	5-47
5.24	Chlorination Provisions	5-47
5.25	Analog Instrument Provisions	5-49
5.26	General Service Design Loads	5-49
5.27	Electrical Systems	5-50
5.28	Instrumentation and Control	5-51
5.29	Design Checklist	5-51

CHAPTER 6 RESERVOIRS

General	6-1
Design Concept Phase	6-1
Preliminary Design Phase	
Agency and Utility Coordination	
Final Design Phase	6-4
Concrete Reservoir Design	
Steel Tank Design	6-13
Electrical Systems	
Instrumentation and Control	
Landscaping	
Design Checklist	6-23
	General Design Concept Phase Preliminary Design Phase Agency and Utility Coordination Final Design Phase Concrete Reservoir Design Steel Tank Design Electrical Systems Instrumentation and Control Landscaping Design Checklist

CHAPTER 7 WATER PIPELINES

7.01	General	
7.02	Design Concept Phase	7-1
7.03	Preliminary Design Phase	7-1
7.04	Agency and Utility Coordination	7-3
7.05	Final Design Phase	
7.06	Design of Pipeline Systems	7-7
7.07	Fittings and Appurtenances	
7.08	Pipe Joints	7-9
7.09	Trench Design	
7.10	Steel Pipe Design	7-11
7.11	Ductile Iron Pipeline Design	
7.12	Protective Coatings and Linings	
7.13	Isolation Valves	
7.14	Appurtenances and Structures	

7.15	Design Checklist	7-27
CHAPTER	8 WASTEWATER LIFT STATIONS	
8.01	General	8-1
8.02	Design Concept Phase	8-1
8.03	Preliminary Design Phase	8-2
8.04	Agency and Litility Coordination	8-5
8.05	Final Design Phase	8-5
8.06	Wastewater Flows	8-5
8.07	Hydraulic Analysis	8-8
8.08	Pumping Canacity	
8.09	Wet Well Design	07
8 10	Force Main Design	07 8-0
8 11		8-10
8 12	Signage	8-10
0.12 8.13	Access Gates	8-10
0.13 8 1 <i>1</i>	Socurity	8-11
0.14	Mechanical Lavout	0-11
0.15	Neco Attenuation	0-11
0.10	Oder Centrel Eccilities	0-12
0.17	Vault Standarda for Wastewater Lift Stations	0-12
0.10	Wastewater Dumping Systems Design	0-13
0.19	Dising Systems Design	0-14
0.20	Piping Systems	0-14
0.21		0-10
8.22	Pumps	01-0
8.23	Pump Motor	0-10
8.24	Freeding, Ventilation, Air Conditioning (HVAC)	8-19
8.25	Emergency (Standby) Power Generator	8-24
8.26	Fire Protection	8-25
8.27	Potable water Facilities	8-25
8.28	Leiephones and Communications.	8-25
8.29	Facility Drainage System	8-25
8.30	Wash Down System	8-26
8.31		8-26
8.32		8-26
8.33	Design Checklist	8-29
CHAPTER	9 WASTEWATER BYPASS PLIMPING	
9.01	General	9-1
9.01	Wastewater Bynass Pumning Review Checklist	
9.02	Wastewater Bypass Pumping Plan	0_1
9.03	Poquiromonts	0_5
9.04	Flow Monitoring	0-5
9.00	Pipe Pluge	9-5
9.00	Pupper Dumping Equipment	9-0
9.U/ 0.00	Dypass r unipility Equipilient Dining	0-6.
9.U0 0.00	r Ipili y Parformanco Paquiromante	0-8
9.09	Fenomalice Requirements	9 -1
9.10		9-/
9.11	Wallitenance	9-8
9.12	Shuluown and Kemoval	9-8
9.13		9-8

CHAPTER	R 10 PRESSURE REDUCING STATIONS	
10.01	General	10-1
10.02	Design Concept Phase	10-1
10.03	Pre-Design Phase	10-2
10.04	Final Design Phase	10-7
10.05	Design Checklist	10-25
CHAPTER	R 11 LARGE METER VAULTS (3 INCHES AND LARGER)	
11 01	General	11-1
11.01	Design Concept Phase	11-1
11.03	Pre-Design Phase	11-2
11.04	Final Design Phase	
11.05	Design Checklist	11-21
CHAPTER	Constant	40.4
12.01	General	
12.02	Electrical Power System Study	
12.03	Electrical Equipment, Conduit and Conductor Sizing and Rating	
12.04	Grounding and Bonding	
12.05		
12.06	Wires and Cables	12-5
12.07	Electrical Conduit	12-0
12.08	Stanuby Power	
12.09	Non-Utility Pad-Wounted Transformers	12-7
12.10	Service Entrance Section	12-7 12 0
12.11	Variable Fraguency Drives (VEDs)	12-0
12.12	Soft Starters	
12.13	Motor Control Centers	12-9 12-11
12.14	Lightning Protection	
12.15	Electrical Ductbanks	
12.10	Lighting	12-14 12 - 14
12.17	Socurity	12-14 12-15
12.10	Electrical Drawings	
12.10	Electrical Specifications	12-15
12.20	Design Checklist	12-16
12.21		12-10
CHAPTER	R 13 INSTRUMENTATION AND CONTROL	
13.01	General	
13.02	Analog Analyzers	
13.03	Flow Measurement	
13.04		
13.05	Pressure Measurement	
13.06	Temperature Measurement	
13.07	Miscellaneous Field Instruments	
13.08	Uninterruptible Power Supply (UPS)	
13.09	Programmable Logic Controllers (PLCs)	
13.10	Supervisory Control and Data Acquisition (SCADA)	
13.11	Process Control	13-6
13.12	Controls and Instrumentation Commissioning	13-10
13.13	Calibration of Panel Mounted Instruments	

13.14	Instrumentation Specifications	13-14
13.15	Reference Information	13-14
13.16	Design Checklist	13-15

LIST OF TABLES

Table 1.1	Required Project Submittals	
Table 7.1	Maximum Allowable Hoop Stress for Welded Steel Pipeline	7-12
Table 7.2	Maximum Allowable Combined Stress for Welded Steel Pipeline	7-15
Table 7.3	Allowances for Casting Tolerance	7-18
Table 8.1	Minimum Required Louvre Sound Attention	8-23
Table 8.2	Minimum Ductwork Thickness	8-23
Table 12.1	Instrumentation Cable Identification	12-6
Table 13.1	Instrumentation and Control Standards	
Table 13.1	Loop and Tag Standardization	13-14

LIST OF FIGURES

Figure 1.1	Design Process Schematic	1-33
Figure 1.2	Construction Process Schematic	1-43
Figure 5.1	Pump Station Signage	5-63
Figure 5.2	Typical Pump Station Schematic	5-65
Figure 6.1	Reservoir Roof Vent Security Cage	6-31
Figure 6.2A	Steel Reservoir Ladder Assembly Knuckle Roof	6-33
Figure 6.2B	Steel Reservoir Ladder Assembly Knuckle Roof	6-35
Figure 6.2C	Steel Reservoir Door Cover for Access Ladder	6-37
Figure 6.3	Steel Reservoir Roof Guard Assembly	6-39
Figure 6.4	Steel Tank Underdrain	6-41
Figure 6.5A	Overflow Drain Headwall and Flap Valve	6-43
Figure 6.5B	Overflow Drain Headwall and Flap Valve	6-45
Figure 6.6A	Concrete Reservoir Roof Vent	6-47
Figure 6.6B	Steel Reservoir Roof Vent	6-49
Figure 6.7A	Concrete Reservoir Roof Access Hatch and Security Bar	6-51
Figure 6.8	Reservoir Stair Rollout	6-53
Figure 7.1	Utility Separation	7-35
Figure 7.2A	Typical Isolation Vault	7-37
Figure 7.2B	Typical Isolation Vault	7-39
Figure 7.2C	Typical Isolation Vault	7-41
Figure 7.2D	Typical Isolation Vault	7-43
Figure 7.2E	Typical Isolation Vault	7-45
Figure 7.3	Drain Valve Assembly	7-47
Figure 8.1	Wastewater Lift Station Typical Site Layout	8-39
Figure 8.2	Wastewater Lift Station Wet Well and Valve Vault Plan	8-41
Figure 8.3	Wastewater Lift Station Typical Lift Station Sections	8-43
Figure 8.4	Wastewater Lift Station Typical Lift Station Building Floor Plan	8-45
Figure 10.1	Example PRS Site Plan	10-31
Figure 10.2	Example PRS Plan	10-33
Figure 10.3	Example PRS Section	10-35
Figure 10.4	Drain	10-37

Figure 10.5	Vault Ceiling Insert and Eyebolt	10-39
Figure 10.6	PVC Pipe Wall Penetration	10-41
Figure 10.7	Steel Pipe Wall Penetration	10-43
Figure 10.8	Wall Insert	10-45
Figure 10.9	Pressure Relief Piping and Splash Pad	10-47
Figure 10.10	Vent	10-49
Figure 10.11	Galvanized Steel Ladder	10-51
Figure 10.12	Flexible Coupling with Restraining Harness	10-53
Figure 10.13	Under Pipe Support	10-55
Figure 10.14	Pipe Mounted Pressure Gage and Transmitter	10-57
Figure 10.15	3 Inch and Smaller Pipe Connection	10-59
Figure 10.16	Flush Mounted Instrument and Pipe Support	10-61
Figure 11.1	Example LMV Site Plan	11-27
Figure 11.2	Example LMV Plan	11-29
Figure 11.3	Example LMV Section	11-31
Figure 11.4	Drain	11-33
Figure 11.5	Vault Ceiling Insert and Eyebolt	11-35
Figure 11.6	PVC Pipe Wall Penetration	11-37
Figure 11.7	Steel Pipe Wall Penetration	11-39
Figure 11.8	Wall Insert	11-41
Figure 11.9	Vent	11-43
Figure 11.10	Galvanized Steel Ladder	11-45
Figure 11.11	Flexible Coupling w/Restraining Harness	11-47
Figure 11.12	Under Pipe Support	11-49
Figure 11.13	3 Inch and Smaller Pipe Connection	11-51
Figure 12.1	Electrical Single-Line Diagram Sample Layout	12-20
Figure 13.1	Process and Instrumentation Diagram Sample Layout	13-19
Figure 13.2	Device Identification, Line Symbols, Equipment/Device Symbols,	
	Valve Symbols, Instrument & Function Symbols	13-20

CHAPTER 1 GENERAL

1.01 Introduction

- A. These guidelines, entitled Henderson Utility Guidelines (HUGs), are intended to aid the Engineer of Record (Engineer) in implementing accepted COH design practices of the potable water and wastewater facilities described herein.
- B. The main purpose of the HUGs is to assure uniformity of design concepts, formats, methodologies, procedures, and quality of work products for the COH. The Engineer shall note that the details and descriptions contained within are guidelines and are not intended to preclude sound engineering judgment.
- C. Scope and Coverage:
 - 1. To effectively use the HUGs, it is beneficial to review the Table of Contents for familiarity with the format and layout of the document. The HUGs have been divided into chapters, and within each chapter are sections and subsections.
- D. Definitions: The following definitions shall be included in the Contract Documents.
 - 1. Contractor: The individual or entity with whom the Developer has entered into an agreement to complete construction activities for the project.
 - 2. Engineer: The individual or entity hired by the Developer to prepare the Contract Documents that describe the project.
 - 3. Owner: The City of Henderson (COH).
- E. References and Abbreviations:
 - 1. National Standards and Codes:

AABC	Associated Air Balancing Council
AASHTO	American Association of State Highway and Transportation Officials
ABMA	American Bearing Manufacturers Association
ACI	American Concrete Institute
ADA	Americans with Disabilities Act
ADC	Air Diffusion Council
AISI	American Iron and Steel Institute
AISC	American Institute of Steel Construction

AGMA	American Gear Manufacturers Association
AMCA	Air Movement and Conditioning Association
ANSI	American National Standards Institute
APWA	American Public Works Association
ARI	American Refrigeration Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASPE	American Society of Professional Engineers
ASTM	American Society of Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
CFR	Code of Federal Regulations
CSA	Canadian Standards Association
DIPRA	Ductile Iron Pipe Research Association
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
HI	Hydraulic Institute Standards
IBC	International Building Code
ICC	International Code Council
IFC	International Fire Code
IMC	International Mechanical Code
IPC	International Plumbing Code
IEEE	Institute of Electrical and Electronics Engineers
IFC	International Fire Code
ISA	Instrumentation Standards and Automation Society
LPI	Lightning Protection Institute
MSS	Manufacturer's Standardization Society
MUTCD	Manual on Uniform Traffic Control Devices
NACE	National Association of Corrosion Engineers
NAPF	National Association of Pipe Fabricators
NBS	National Bureau of Standards
NEBB	National Environmental Balancing Bureau
NEC	National Electric Code

NEMA	National Electric Manufacturers Association
NFPA	National Fire Protection Agency
NPT	National Pipe Thread
NSF	National Sanitation Federation
NTMA	National Tooling & Machining Association
OSHA	Operational Safety and Health Administration
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SSPC	Society for Protective Coatings
UDACS	Uniform Design and Construction Standards for Potable Water Systems
UL	Underwriters Laboratory
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
2. State a	and Local Agencies, Standards and Codes:
CCRFCD	Clark County Regional Flood Control District
CCDS	Clark County Development Services
CCUSD	Clark County Uniform Standard Drawings
DAQEM	Department of Air Quality and Environmental Management
DSC	Development Services Center
DUS	Department of Utility Services
HMC	Henderson Municipal Code
HUGs	Henderson Utility Guidelines
LVVWD	Las Vegas Valley Water District
NAC	Nevada Administrative Code
NBR	Nitrile Butrile Rubber
NDEP	Nevada Division of Environmental Protection
NDOT	Nevada Department of Transportation
NDS	New Development Services
NRS	Nevada Revised Statutes
NVE	Nevada Energy
RTC	Regional Transportation Commission
SNWA	Southern Nevada Water Authority
SNWS	Southern Nevada Water System

3. Abbreviations:

AC	Asphaltic Concrete
ac	Alternating Current
ACP	Asbestos Concrete Pipe
APN	Assessor's Parcel Number
AV	Air Valve
AWG	American Wire Gauge
BEP	Best Efficiency Point
BF	Bifurcation
BO	Blow-off Assembly
C/L	Centerline
CFC	chlorofluorocarbon
CIP	Cast Iron Pipe or Capital Improvement Program
CLSM	Controlled Low Strength Material
cm	centimeter
COH	City of Henderson
CPVC	Chlorinated Polyvinyl Chloride
CSI	Control Systems Integrator
dBA	decibels
dc	Direct Current
DCM	Design Concept Memorandum
DCR	Design Concept Report
DFT	Dry Film Thickness
DIP	Ductile Iron Pipe
DR	Diameter Ratio
DV	Drain Valve
EMS	Electronic Marker System
EPS	Expandable Polystyrene
FM	Factory Mutual System
FPS	Feet Per Second
FT	Feet
ft/s	feet per second
FNPT	Female National Pipe Thread
FRP	Fiberglass Reinforced Plastic
GFCI	Ground Fault Circuit Interrupter

GPM	Gallons Per Minute
GPS	Global Positioning System
GSS	Graffiti Solution System
HART	Highway Addressable Remote Transducer
HDPE	High Density Polyethylene
Hg	Mercury
HGL	Hydraulic Grade Line
HOAR	Hand, On, Off, Auto, Remote
hp	Horsepower
HS	Hand Switches
HUGs	Henderson Utility Guidelines
HVAC	Heating, Ventilation, and Air Conditioning
HZ	Hertz
I&C	Instrument and Control
I/O	Input/Output
ID	Inside Diameter
IP	Iron Pipe
lb	Pound
LED	Light Emitting Diode
LF	Linear Feet
LMV	Large Meter Vaults
mA	Milliampere
MAS	Multiple Address
MCC	Motor Control Center
MCP	Size Motor Circuit Protectors
MDD	Maximum Day Demand
MDFT	Minimum Dry Film Thickness
mgd	Million Gallons Per Day
mil	One Thousandth of an Inch
MLCSP	Mortar Lined and Coated Steel Pipe
MNPT	Male National Pipe Thread
MPRT	Minimum Pump Run Time
MSDS	Material Safety Data Sheet
MTW/AWM	Machine tool wire/appliance wiring material
MUE	Municipal Utility Easement

NAVD	North American Vertical Datum
NOA	Notice of Award
NPSH	Net Positive Suction Head
NPSHA	Net Positive Suction Head Available
NPSHR	Net Positive Suction Head Required
NTP	Notice to Proceed
O&M	Operation and Maintenance
OD	Outside Diameter
ORP	Oxidation Reduction Potential
P&ID	Process and Instrumentation Diagram
PCF	Pounds per Cubic Foot
PDF	Portable Document Format
PDR	Preliminary Design Report
PHD	Peak Hour Demand
PIT	Pressure Indicating Transmitter
PL	Property Line or Pilot Lights
PLC	Programmable Logic Controller
PPE	Personnel Protection Equipment
PPM	Parts Per Million
PRD	Planned Residential Development
PRS	Pressure Reducing Station
PRV	Pressure Reducing Valve
PSF	Pounds per Square Foot
PSI	Pounds Per Square Inch
PSIG	Pounds per Square Inch Gauge
PTFE	Polytetrafluoroethylene
PVC	Polyvinyl Chloride Pipe
Q	Rate of Flow
QC	Quality Control
RC	Reinforced Concrete
RCP	Reinforced Concrete Pipe
RMC	Rigid Metal Conduit
RMS	Root-Mean-Square
ROFCS	Rate of Flow Control Station
ROW	Right-of-Way

RPM	Revolutions per Minute
RPPA	Reducing Pressure Principle Assembly
RTD	Resistance Temperature Detectors
RTU	Remote Telemetry Unit
SCADA	Supervisory Control And Data Acquisition
SCFM	Standard Cubic Feet Per Minute
SPT	Standard Penetration Test
SSPC	Structural Steel Protective Coating
SST	Stainless Steel
SWC	Surge Withstand Capability
TDH	Total Dynamic Head
TDS	Total Dissolved Solids
TEFC	Totally Enclosed, Fan-Cooled
ТО	Turnout
TS	Technical Services
TVSS	Transient Voltage Surge Suppressor
UPS	Uninterruptible Power Supply
USA	Underground Service Alert
UV	Ultraviolet
V	Velocity of Flow
VFD	Variable Frequency Drive
VOC	Volatile Organic Compounds
W.C.	Water column
WOG	Water-Oil-Gas
YD	Yard

- F. Permits: The Engineer is responsible for:
 - 1. Meeting requirements of federal agencies.
 - 2. Meeting requirements of state agencies and permits.
 - 3. Satisfying requirements of local agencies and permits.
 - 4. Acquiring all federal, state, and local permits with all effort being coordinated with the COH.
- G. Security Features: City of Henderson, Department of Utility Services, Technical Services will be evaluating all proposed project design information for compliance

with the Department of Homeland Security Bio-Terrorism Act of 2002. The COH will determine whether or not the Engineer is required to include security features into the project contract documents for all new facilities or the expansion of existing facilities, as required.

- H. Deviations from Henderson Utility Guidelines:
 - 1. HUGs are intended to standardize the design and ultimately the construction of COH owned and operated utility infrastructure. Although HUGs provides direction in design, it is still the responsibility of the Engineer to provide the highest level of professional quality design. The Engineer is still charged to utilize creativity and innovation in providing an acceptable cost effective design.
 - 2. All deviations from HUGs shall be identified and noted in the PDR. Resolution and acceptance of any deviations shall be at the discretion of the Department of Utility Services.

1.02 Community Development, Entitlements and Mapping

- A. The Engineer is responsible to comply with Community Development for aboveground facilities, which include but are not limited to buildings, reservoirs, and radio towers.
- B. The Engineer shall contact the Community Development department at the beginning of the project to determine Community Development requirements, which include zoning, entitlements, permits, and Title 19 of the HMC.
- C. Entitlements: The Engineer is responsible to obtain all entitlements for a project. Entitlements include but are not limited to:
 - 1. Design reviews.
 - 2. Conditional Use permits.
 - 3. Noise mitigation per Title 19 of HMC.
 - 4. Land use.
 - 5. Zoning.
 - 6. Variances.
- D. The Engineer shall develop a written project schedule, which provides sufficient time for approval of all entitlements.

- E. Mapping: The Engineer shall be responsible for obtaining mapping for the project per the Community Development department. The following must be provided with the Final Mapping application for the project:
 - 1. Approval of entitlements.
 - 2. Approval of traffic study (if applicable).
 - 3. Approval of a drainage study (if applicable).
 - 4. Impact of the project on the existing drainage. Develop strategies for mitigation in accordance with COH and CCRFCD requirements (if necessary).
- F. The Engineer shall review zoning constraints, currently adopted building codes, and anticipated public and governmental review procedures, which will be necessary during the course of the design. Develop strategies and assign responsibilities for their successful negotiation.
- G. The Engineer shall review and document the existing and future land use that border the facility. The design and architecture of the new facility shall be consistent with existing and future land use.

1.03 Environmental Investigation

- A. General: The Engineer is responsible for environmental investigations where applicable for proposed facilities, which include field investigations, analyses, data collection, and reports.
- B. The Engineer shall coordinate with all federal, state and local agencies for environmental investigations, which may include but are not limited to the following:
 - 1. Environmental assessment.
 - 2. Environmental impact statement.
- C. The Engineer shall prepare a summary Environmental Investigation Report that describes all applicable environmental requirements for the project to be submitted with the design documents.
- D. Agencies may include but are not limited to the following:
 - 1. Clark County Department of Air Quality and Environmental Management.
 - 2. EPA.
 - 3. NDEP.

- 4. U.S. Bureau of Reclamation.
- 5. U.S. Bureau of Land Management.
- 6. U.S. Army Corps of Engineers.
- 7. State of Nevada Historic Preservation Office.
- 8. Nevada Department of Wildlife.

1.04 Site Civil Design

- A. General: The Engineer shall provide a Site Civil design for facilities.
- B. Site Description: The location of the facility shall be described and defined by the Engineer on maps and drawings. At a minimum the Engineer shall:
 - 1. Prepare a location map showing the regional location of the site with Assessor's Parcel Number (APN).
 - 2. Prepare a vicinity map depicting the site location relative to streets and recognizable features.
 - 3. Prepare a survey control map identifying the site by township, range, section, basis of bearing, coordinates, and other existing survey control features, including benchmarks.
 - 4. Provide project specific topographic mapping, locations, and descriptions of all existing and proposed easements.
- C. Site Layout: Site grading shall be sloped to drain away from the facility. Adequate setback from property lines shall be provided in accordance with Title 19 of the HMC. Sufficient setback shall also be provided to allow for fill, cut, or fill transition to existing contour elevations at property lines; and provide for access and maintenance.
- D. The facility shall be positioned and the site developed to ensure a uniform soil bearing condition. The footing and floor shall be placed on either native earth material or structural fill. The pump station shall not be situated where a portion of the station is on native material and a portion is on fill material.
- E. COH service vehicle access to major components shall be incorporated into the site layout.
- F. The Engineer shall incorporate site access and egress for COH Fire Department vehicles having the following characteristics:
 - 1. 25-foot wheelbase.

- 2. 30-degree steering locking angle.
- 3. 28-foot inside turning radius
- 4. 52-foot outside turning radius.
- G. Technical Drainage Study: The Engineer shall prepare a Technical Drainage Study for the facility in accordance with the requirements of the latest edition of the Clark County Regional Flood Control District (CCRFCD) Hydrologic Criteria and Drainage Design Manual.
- H. Grading and Drainage: The Engineer shall provide a grading plan for the facility in accordance with the requirements of the local reviewing agency.

1.05 Survey

- A. The Engineer shall perform a survey as part of the design effort and field verify locations of existing facilities. The survey shall include the following at a minimum:
 - 1. Benchmarks, including two permanent brass benchmarks and two horizontal control points located near the site at a location that is not likely to be disturbed during construction.
 - 2. Utilities research, which includes public and private utilities. Field verification / potholing of the location of all existing utilities and identification of design conflicts.
 - 3. Building footprint and limits of other site development work.
 - 4. Survey shall incorporate use of Global Positioning System (GPS) as required by the COH.
 - 5. Record of Survey map showing locations of existing property corners and monuments that may be disturbed during construction.
 - 6. File Record of Survey with the County and prepare legal descriptions, and locating of recording information for all existing easements affecting the site.
 - 7. Prepare topography of site to be used for design including aboveground and underground utilities, which includes elevations for storm drainage, wastewater collection lines, and valve operating nut locations for water mains.
 - 8. Prepare a horizontal control sheet showing basis of bearing and benchmark data.

- 9. Profile(s) and/or cross-section(s) as required.
- 10. Legal descriptions for all proposed permanent and temporary construction easements.
- 11. Establish limits of site work.

1.06 Agency and Utility Coordination

- A. The Engineer shall initiate contact and coordinate design efforts with all utilities and agencies. This includes communication during design and submitting progress submittals for conflict review.
- B. Utilities include but are not limited to:
 - 1. Century Link.
 - 2. NV Energy.
 - 3. Cox Communications.
 - 4. Southwest Gas
- C. Agencies include but are not limited to:
 - 1. City of Henderson Development Services Center.
 - 2. City of Henderson Fire Department.
 - 3. Las Vegas Valley Water District.
 - 4. Southern Nevada Water Authority.
 - 5. Clark County Regional Flood Control District
 - 6. Nevada Department of Transportation
 - 7. Regional Transportation Commission.
- D. The Engineer is encouraged to contact NV Energy for all projects that require new utility power or expansion of existing utility power.
- E. The Engineer shall be responsible for obtaining utility and agency approvals and signatures.
- F. NV Energy (NVE) design drawings are required in the final mylar submittal and to obtain final approval signatures from the COH.

1.07 Project Processing

- A. Review and Approval: Project processing has been developed by the COH to standardize the review and acceptance procedures for design of water and wastewater facilities. This section provides a brief summary of each phase as well as advancement through the review and acceptance process. The process is presented schematically in Figure 1.1. The design process entails three phases as follows:
 - 1. The Design Concept Report (DCR).
 - 2. The Pre-Design Report (PDR).
 - 3. The Final Design.
- B. Project Processing Submittals: Required submittals will be determined by the COH director of utilities. The following table generally delineates submittals required for major and minor facilities.

Project Processing Submittal	Major Facilities (Pump Stations, Reservoirs, Lift Stations)Minor Facilities (Meter Vaults, Bypass Pumping)	
DCR	May Be Required	Typically Not Required
PDR	Always Required	Typically Not Required
Geotechnical Report	Always Required	Typically Required
Traffic Study	Typically Required	Typically Required
Drainage Study	May Be Required	May Be Required
Final Contract documents	Always Required	Always Required

Table 1.1 Required Project Submittals

- C. DCR: The DCR essentially defines the project. It provides information on project location, service area (size), design alternatives, zoning, etc. A listing of items that should be addressed in the DCR has been outlined in the respective chapter for each type of facility.
- D. A DCR for the facility shall be submitted and accepted by the COH unless a written DCR exemption is provided by the COH. For submission of the DCR, the Engineer shall:
 - 1. Submit eight (8) bound copies of the DCR.
 - 2. Proceed with the PDR only upon receiving an acceptance letter of the DCR from the COH.

- E. Traffic Study: The Engineer is responsible for preparing a traffic study or traffic impact analysis for the project unless a written exemption is provided by the traffic engineer through the COH public works. The traffic study shall include the following at a minimum:
 - 1. Vicinity map.
 - 2. Trip generation volumes.
 - 3. Site plan with dimensions and locations for all roads, parking stalls, driveways.
 - 4. Identifies potential traffic and safety concerns.
 - 5. Presents impact of project on public roadways and networks.
 - 6. Determines proportionate cost participation on impacted traffic signals and intersections.
 - 7. Discusses construction impacts and proposed barricade plan.
 - 8. Queuing analysis for gates associated with residential or commercial projects (if applicable).
 - 9. Summary of how proposed facilities meet requirements of state and local agencies, which include but are not limited to COH public works, CCDS, and NDOT.
- F. Drainage Study: The Engineer is responsible for preparing a conceptual or technical drainage study for the project unless a written exemption is provided by the stormwater engineer through the COH public works. The drainage study shall include the following at a minimum:
 - 1. Proposed grading for the project.
 - 2. Establish flow patterns.
 - 3. Proposed size and location for stormwater conveyance facilities.
 - 4. Proposed size and location for stormwater retention facilities.
 - 5. Summary of how proposed facilities meet requirements of state and local agencies, which include but are not limited to CCRFCD, CCDS, NDOT.
- G. PDR: A listing of the major items that should be addressed in the PDR has been outlined in the respective chapter for each type of facility. The intent of the PDR is to build on the DCR unless the DCR requirement has been waved at which point the PDR must include all requirements of the DCR. The Engineer is

required to submit a PDR regardless of the size or complexity of the project unless a written PDR exemption is provided by the COH.

- H. The PDR (which includes 30% design drawings) shall be submitted and accepted by the COH. The PDR establishes specific design criteria and summarizes all activities that will be performed necessary to complete the detailed design. These activities include, but are not limited to:
 - 1. Property information.
 - 2. Matrix of all permits to be obtained and associated fees.
 - 3. Community Development requirements and zoning.
 - 4. Geotechnical requirements.
 - 5. Environmental review.
 - 6. Coordination workshops.
- I. For submission of the PDR, the Engineer shall:
 - 1. Submit eight (8) bound copies of the PDR.
 - 2. Submit six (6) bound copies of the traffic study to public works (if applicable).
 - 3. Submit six (6) bound copies of the drainage study (if applicable).
 - 4. Submit an electronic version of the PDR, with electronic versions of the drainage and traffic studies as PDF files on CD.
 - 5. Proceed with the Final Design only upon receiving an acceptance of the PDR from the COH.
- J. The Final Design entails producing detailed design drawings and specifications needed to bid and award the project to a Contractor for construction. Progress submittals are required during Final Design to allow the COH to incorporate review comments. The Engineer shall allow for a minimum 4-week review period to receive COH comments for each submittal. The minimum number of submittals and respective requirements are as follows:
 - 1. Latest Codes, Ordinances and Regulations: The Engineer shall provide a design that complies with the latest versions of codes, ordinances and regulations adopted by the COH by the time of the final submittal.
 - 2. Outside Agency and Utilities Coordination: The Engineer is responsible for completing review and approval of all outside agencies and utilities. The

Engineer shall allow sufficient time in the project schedule for all outside agency and utility approval. Utilities and outside agencies include but are not limited to the following:

Utility or Outside Agency	Abbreviation
Clark County Regional Flood Control District	CCRFCD
Clark County Development Services	CCDS
Cox Communications	
Century Link	
NV Energy	NVE
Nevada Department of Transportation	NDOT
Southern Nevada Water Authority	SNWA
Southwest Gas	

- 3. 60% Technical Services (TS) Submittal: Expands upon 30% PDR drawings. Provide a minimum of Three (3) Bound copies of design drawings and specifications.
- 4. 100% DSC Submittal: Expands upon 60% Submittal drawings and specifications and incorporates review comments from COH, utilities, and outside agencies. Provide the number of required bound copies of design drawings per DSC submittal requirements.
- 5. Final mylars will not be routed through the DSC until specifications are complete and accepted.
- 6. Final mylars: The DSC will notify the Engineer that Final Mylars may be submitted. The mylar cover sheet shall be signed by all outside agencies and utilities prior to submittal to COH. Final mylars are 100% Submittal drawings and specifications finalized with all review comments from COH, utilities and outside agencies. Provide mylars for all drawings with wet signatures of Engineer, outside agencies, city of Henderson departments, utilities, etc.
- 7. Electronic Drawings: The Engineer shall provide an electronic copy of all drawings in AutoCAD on a CD. The AutoCAD version for the drawings shall be determined by COH.
- K. Inactive Project Status: Projects that do progress at any stage during the DCR, PDR, and Final Design for a period of 180 calendar days will be given an inactive status by the COH. In order to reactivate the project, the Engineer shall meet with the COH and if significant changes to the project are proposed, the COH may

require that the Engineer revise and re-submit the DCR, PDR and/or contract documents.

1.08 Advertise, Bid and Award

- A. The guidelines presented in this section apply to all City and developer projects.
- B. Once signed mylars are received, the project can proceed with advertisement, bidding and contracting of the work unless a written exemption from this requirement is provided by DSC. The advertising, bidding, and award are presented below and in Figure 1.2.
 - 1. Advertise for bids.
 - 2. Bid period.
 - 3. Bid opening.
 - 4. Evaluation of bids.
 - 5. Notice of Award (NOA).
 - 6. Notice to Proceed (NTP).

1.09 Construction Phase

- A. The construction process is presented below and in Figure 1.2. Inspection of construction will remain the responsibility of the Developer. The COH will also provide inspection to ensure satisfaction that the facility is being constructed to the approved plans and specifications.
- B. Identification Badges, with name and current photograph, are required for all onsite personnel, which include the engineer, contractor, subcontractors and any personnel during construction.
- C. A checklist of the construction activities is provided below:
 - 1. Pre-Construction Conference.
 - 2. Permit acquisition.
 - 3. Permits Issued.
 - 4. Site Security Submittal.
 - 5. Mobilization.
 - 6. Control Systems Integrator Submittal

- 7. Construction and Inspection begin.
- 8. Construction progress reports and pay requests submitted to COH and Engineer.
- 9. Factory Acceptance Testing.
- 10. Preliminary Operations Plan.
 - a) Test Plan.
 - b) Start-Up Plan/Conference, minimum, 6 months, prior to Facility Testing.
- 11. Preliminary O&M Submittal(s).
- 12. Substantial Completion.
- 13. Operator Training.
- 14. Facility Testing and Commissioning Notification.
- 15. Facility Testing and Commissioning.

1.10 Project Closeout

- A. Project closeout shall include the steps outlined in the construction phase schematic presented in Figure 1.2. The closeout process shall include but not limited to the following:
 - 1. Preliminary
 - a) Preliminary O&M reviewed and accepted by Engineer;
 - b) Testing and Start-Up Plan reviewed and accepted by Engineer.
 - c) Facility Operation Plan by Engineer, submitted to City.
 - 2. Testing and Start Up
 - a) Preliminary Testing Complete by Contractor, witnessed by COH QC.
 - b) Training COH Operators.
 - c) Functional Testing of Equipment.
 - d) 7 Day Functional Test of facility.
 - 3. Substantial Completion
 - a) Engineer submits letter to COH, noting work is substantially complete.
 - b) An initial walk thru is scheduled with Engineer, Contractor and COH QC.
 - c) COH transmits letter of substantial completion with punch list.
 - d) Punch list is addressed by Contractor.

- 4. Final Completion
 - a) Engineer submits letter of Final Completion and schedules final walkthrough with Engineer, Contractor, and COH QC.
 - b) Final updated O&M manuals with site field tests, updated loop drawings, Certifications, Warranties, etc.
 - c) Complete final walkthrough.
 - d) 30-Day Performance Test by COH.
 - e) As-Built record drawings.
 - f) Final acceptance.
 - g) Confirmation of property title transfer to the City of Henderson.
 - h) Utility services records transfer and verification.
 - i) Final acceptance notification.
 - j) Release of bonds.
 - k) Warranty period.
- B. Operator Training: The Engineer shall include specifications requiring the Contractor to provide operator training for all equipment, instrumentation, and controls associated with the facility. Training shall be provided by competent and experienced manufacturer's representatives. Training sessions shall be completed during a Monday through Friday workweek between hours of 7 AM and 5 PM. Training shall also include the following at a minimum:
 - 1. Written instruction for manual and automatic operation.
 - 2. Sign-in sheet for operations.
 - 3. Onsite classroom instruction sessions.
 - 4. Safety precautions including review of lockout / tagout for electrical equipment and panels.
 - 5. Field demonstrations for maintenance procedures.
 - 6. Maintenance summary schedule with all recommended spare parts and expected life.
 - 7. Troubleshooting.
 - 8. Certificates of training completion for all attendees.
- C. Facility Testing and Commissioning: The Engineer shall include specifications requiring the Contractor to provide testing and commissioning for all equipment, instrumentation, and controls. Facility Testing and Commissioning shall include the following at a minimum:

- 1. A written start-up plan for each piece of equipment, system, and subsystem to be submitted to the Engineer 90 days prior to start-up.
- 2. Start-up Demonstration for each piece of equipment in both manual and automatic modes of operation.
- 3. A 14-Day Continuous Operational Performance Test of the entire system. If the test is interrupted for any reason, the Contractor shall re-start the test.
- 4. Certificate of Facility Testing and Commissioning completion.
- D. Development and Resolution of a Punch list: An initial project walk-through is scheduled by the COH's QC and TS with the Contractor, Developer, and Engineer. The punch list development and resolution entails the following:
 - 1. A punch list will be made of outstanding items that need to be completed.
 - 2. A final walkthrough shall be scheduled at least 15 working days in advance, which is required to verify that punch list items have been resolved to the satisfaction of COH.
 - 3. Any deficiencies noted by the COH QC will be noted in a deficiency notification that will be sent to the Contractor for resolution.
 - 4. The Contractor shall address all deficiencies identified.
- E. Substantial Completion: The Contractor shall notify the Engineer and the COH QC in writing when the project is substantially complete, which requires resolution of punch list items and verification through a final walkthrough. Reaching substantial completion triggers the following:
 - 1. Beneficial Use: Beneficial use by the COH starts from the date of substantial completion notification.
 - 2. Warranty Notification: The Contractor shall send a Warranty Notification letter to the COH and Engineer. The warranty period starts from the date of substantial completion notification. The warranty period shall be not less than 1 year from the date of substantial completion.
 - 3. Transfer Utilities: The Contractor shall provide written notification to transfer utilities to COH QC, TS, and all utilities upon substantial completion.
- F. Submit Operation and Maintenance (O&M) Manuals in accordance with this chapter.

G. Destruction of Contract Documents: The Contractor shall turn over or destroy all original and copied sets of Contract Documents in accordance with adopted COH Security procedures and Department of Homeland Security requirements.

1.11 Operation and Maintenance Manuals

- A. Operation and maintenance (O&M) manuals and Preliminary O&M manuals shall be supplied through the COH-QC to the DUS-NDS prior to project closeout. A preliminary manual is required at start up to develop the start up and functional testing. The manuals shall be supplied in a hard copy format with an electronic Portable Document Format (PDF) copy. The Contractor shall submit a total of five (5) complete copies of the O&M manuals including the PDF CD on the inside cover. Hard copies shall conform to the following:
 - 1. Binders shall be commercial quality 3-ring binders (3" maximum ring size) with durable and cleanable plastic covers. When multiple binders are used, correlate data into related consistent groupings.
 - 2. White, 8-1/2" x 11", 20 lb minimum paper for typed pages.
 - 3. Text shall be manufacturer's printed data, or neatly typewritten.
 - 4. Drawings shall be bound in with the text with a reinforced punched binder tab. Larger drawings will be folded to the size of text pages.
 - 5. Provide a flyleaf for each separate product or piece of operating equipment.
 - 6. Provide a typed description of the product and major component parts of the equipment.
 - 7. Provide indexed tabs.
 - 8. The cover of each volume shall include the title of the project, identity of each separate structure as applicable and general subject matter covered in the manual.
- B. Each O&M manual shall include the following general information:
 - 1. Date O&M issued.
 - 2. Neatly typewritten table of contents for each volume, arranged in systematic order.
 - 3. Identify the Contractor, name of the Engineer, address, and telephone number.
 - 4. List each product required to be included, indexed to content of volume.

- a) List, with each product, name, address and telephone number of:
 - 1) Subcontractor or installer.
 - 2) Maintenance Contractor, as appropriate.
 - 3) Identify area of responsibility of each.
 - 4) Local source of supply for parts and replacement and list of recommended spare parts.
- 5. Identify each product by product name and other identifying symbols as set forth in the contract documents, including nameplate information and serial numbers for each item of equipment furnished.
- 6. Include only product data sheets, which are pertinent to specific product. Annotate each sheet to:
 - a) Clearly identify specific product or part installed.
 - b) Clearly identify data applicable to installation.
 - c) Delete references to inapplicable information.
- 7. Supplement product data with drawings as necessary to clearly illustrate:
 - a) Relations of component parts of equipment and systems.
 - b) Control and flow diagrams
- 8. Coordinate drawings with information in the project record documents to assure correct illustration of completed installation.
- 9. An appendix with written Start-up and Commissioning.
- 10. Use final as-built record drawings (not design drawings) as maintenance drawings.
- 11. Provide additional written text, as required to supplement product data for a job-specific installation. Organize in a consistent format under separate headings for different procedures. Provide logical sequence of instructions for each procedure.
- 12. Provide a copy of each warranty, bond, and service contract issued. Provide an information sheet for the COH, giving:
 - a) Proper procedures in event of failure.
 - b) Instances, which might void warranties or bonds.
 - c) Life of all bonds and warranties.
 - d) Start and end date of warranty period.
- C. O&M manuals specific to equipment and systems shall include the following information as applicable:
 - 1. Contents, for each unit of equipment and system, as appropriate.

- 2. Description of unit and component parts:
 - a) Function, normal operating characteristics and limiting conditions.
 - b) Performance curves, engineering data and tests.
 - c) Complete nomenclature and part number of replaceable parts.
 - d) Life of all bonds and warranties (start and end dates).
- 3. Operating procedures:
 - a) Start-up, break in, routine and normal operating instructions.
 - b) Regulation, control, stopping, shutdown, and emergency instructions.
 - c) Summer and winter operating instructions.
 - d) Special operating instructions.
- 4. Maintenance procedures:

c)

- a) Routine maintenance.
- b) Guide to "troubleshooting."
 - 1) Alignment, adjusting and checking.
 - Disassembly, repair, and reassembly.
- d) Safety requirements.
- e) Servicing schedule.
- f) List of required lubricants.
- 5. Manufacturer's printed operating and maintenance instructions.
- 6. Description of sequence of operation.
- 7. Original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- 8. Predicted life of parts subject to wear.
- 9. Manufacturer's recommended spare parts.
- 10. Start-up & commissioning schedule and procedure as an appendix.
- D. Contents, for each electrical and electronic system, as appropriate:
 - 1. Description of system and component parts:
 - a) Function, normal operating characteristics and limiting conditions.
 - b) Performance curves, engineering data and tests.
 - c) Complete nomenclature and part number of replacement parts.
 - 2. Circuit directories of panelboards:
 - a) Electrical service.
 - b) Controls.
 - c) Communications.
 - d) As installed color-coded wiring diagrams.

- 3. Operating procedures:
 - a) Routing and normal operating instructions.
 - b) Sequences required.
 - c) Special operating instructions.
- 4. Maintenance procedures:
 - a) Routine maintenance.
 - b) Guide to "troubleshooting."
 - c) Disassembly, repair, and assembly.
 - d) Adjustment and checking.
- 5. Manufacturer's printed operating and maintenance instructions.

1.12 Start-up and Commissioning

- A. As part of the contract documents, the Engineer shall require the Contractor to develop a schedule and written procedure for start-up and commissioning the facility.
- B. Following substantial completion and prior to final completion, the Contractor shall proceed to start-up and commissioning. The Contractor shall provide all supervision, manufacturer's services, labor, tools, material and equipment for the following:
 - 1. Start-up and commissioning of each respective item of equipment and systems furnished and/or installed as part of the project.
 - 2. Assistance to service engineers and technical directors of installation for equipment installed as part of the project shall be provided by the Contractor.
 - 3. Procedures and instructions dictated by manufacturer's representatives as representatives will not be present at all times. The COH's QC representative will determine when representatives will be required.
 - 4. Resources necessary to maintain the schedule as determined by the COH's QC representative, including initial total facility start-up
- C. Start-up shall be defined as all tests, testing, initial operation, and other activities related to providing a complete, operational, and functional facility. Start-up shall include the following:
 - 1. Factory testing.
 - 2. Functional testing.
 - 3. Performance testing.

- 4. Commissioning and pre-commissioning activities.
- 5. Manufacturer's services.
- 6. Certification of proper installation.
- 7. Troubleshooting, checkout, and shakedown activities.
- 8. Documentation supporting the performance of start-up activities.
- D. The following shall be inspected and tested in the commissioning of new facilities, which include pump stations, reservoirs, valve vaults, meter vaults, PRV vaults, lift stations and pipelines:
 - 1. Bearings.
 - 2. Drives.
 - 3. Motors.
 - 4. Pumps.
 - 5. Mixing Equipment.
 - 6. Chemical Systems.
 - 7. Piping Systems, Valves and Leak Test.
 - 8. SCADA, Controls and Instrumentation.
- E. The Contractor shall submit the proposed start-up schedule to the COH QC representative for approval. The start-up schedule shall include the following:
 - 1. A 24-hour day of activities for completion.
 - 2. A minimum of 48-hour notification to provide operators for observation of the commissioning process.
 - 3. The COH's QC representative will determine when start-up has been completed. Start-up refers not only to start-up of total facility, but also individual systems requiring checkout prior to total facility start-up.
- F. Pre-Commissioning and Documentation. Pre-Commissioning shall be completed, which includes documentation for the following:
 - 1. Installation Verification through a final installation verification audit conducted by the Contractor in the presence of the COH QC representative and Engineer. Audit shall include:
 - a) Major equipment such as HVAC, pump, compressors.

- b) Piping and specialties.
- c) Valve installation and operation.
- d) Instrumentation and gauges.
- e) Documents for all tests completed, including manufacturer's factory tests.
- 2. Operation Verification through a systems check and operation checklist. The COH QC representative and engineer shall verify system operation.
 - a) Operation Procedures for Commissioning and Start-Up. The Contractor shall be responsible for notifying the COH QC representative in writing at least 2 working days in advance of commissioning and start-up activities.
- 3. Test Equipment. The Contractor shall provide and maintain the following throughout start-up and commissioning:
 - a) Test equipment and instrumentation required.
 - b) Tools for test equipment and instrumentation required.
 - c) Calibration of all test equipment and instrumentation required.
- 4. The Contractor shall provide a comprehensive list of all commissioning responsibilities including a breakdown of each trades responsibilities during commissioning activities.
- 5. The Contractor shall provide sample documentation for tests and inspections required by Code Authorities.
- 6. The Contractor shall provide record documents of alignment and vibration tolerances and readings after adjustments for all mechanical equipment.
- 7. The Contractor shall provide instrument calibration reports for each field and panel device furnished and/or installed as part of the contract documents. Sample calibration reports shall include, but not be limited to:
 - Equipment: Instrument tag number, manufacturer, model number, and serial number. For valves, include fail position, model number of actuator, model number of positioner (if included) and power requirements.
 - b) Service: Application, building, and floor location.
 - c) Test data: Test equipment used, test performance data for instruments in "As Found" and "As Left" conditions.
 - d) Date of calibration and name of individual performing calibration.
- G. Equipment Commissioning shall include the following:
 - 1. Bearings:
 - a) Inspect for cleanliness; clean and remove foreign materials.

- b) Verify alignment.
- 2. Drives:
 - a) Inspect for cleanliness; clean and remove foreign materials before starting operation.
 - b) Adjust drives for all alignment of sheaves, V-belts, and couplings.
 - c) Adjust tension in V-belt drives and adjust varipitch sheaves and drives for proper equipment speed.
- 3. Lubrication:
 - a) Lubricants for start-up and initial operation shall be furnished by Contractor.
 - b) Lubricants required for storage and flushing of equipment shall be furnished by Contractor.
 - c) Lubricate bearings and fill oil reservoir prior to operation.
 - d) Perform lubrication in accordance with manufacturer's recommendations
 - e) After Contractor lubricates equipment, Contractor shall affix a tag to equipment stating lubricant used, quantity, date lubricated, and name of person lubricating the equipment.
 - f) Submit 2 volumes of lubrication requirements to the COH QC Representative for each item of equipment furnished requiring lubrication.
- 4. Motors:
 - a) Check each motor for amperage comparison to nameplate value.
 - b) Correct conditions which produce excessive current flow and which exist due to equipment malfunction.
- 5. Pumps:
 - a) Check mechanical seals, seal water pressure and packing for cleanliness and adjustment before operating pump.
 - b) Verify that pump and connecting piping are free of dirt, debris, and scale before circulating liquid through pump.
 - c) Check for correct pump rotation.
 - d) Check running clearances.
- 6. Miscellaneous:
 - a) Inspect fan wheels for clearance and balance. Provide factory authorized personnel for adjustment when needed.
 - b) Remove any rust, scale and foreign material from equipment and renew defaced surfaces.

- H. Piping System Commissioning:
 - 1. Check settings of pipe hangers. Check piping for leaks at every point, and at every screwed, flanged, or welded connection, using "Leak-Tek" or other approved compound.
 - 2. Examine sleeve couplings and mechanical joints:
 - a) Tighten joints if needed prior to steady system operation.
 - b) Complete any repairs or modifications to piping if tightening is not sufficient to stop leaks.
 - 3. Examine flanged joints:
 - a) Tighten flanges after system has been placed in operation.
 - b) Replace flange gaskets that show any sign of leakage after tightening.
 - 4. Inspect threaded joints:
 - a) Promptly remake each joint that appears to be faulty; do not wait for rust to form.
 - b) Clean threads on both parts, apply joint compound, and remake joints.
 - 5. Vent gasses trapped in any part of the liquid systems. Verify that liquids are drained from all parts of gas or air systems. After system has been placed in operation:
 - a) Clean strainers, dirt pockets, orifices, valve seats, and headers in fluid systems to assure they are free of foreign materials.
 - b) Open air vents; remove operating elements. Clean thoroughly, reinstall internal parts, and put back in operation.
 - c) Repair damaged insulation.

1.13 Letter of Compliance to Design

A. A letter from the Engineer stating that construction is substantially complete and in compliance with the approved contract documents shall be provided to the COH QC. This letter shall be addressed to the Utility Services Technical Support Manager.

1.14 As-Built Record Drawings

- A. The Engineer shall include provisions in the contract documents for the Contractor to provide as-built record drawings at final walk-through.
- B. The contract documents shall instruct the Contractor to maintain a working set of drawings during the course of the project.
- C. The Contractor shall record information concurrently with the construction process on a full size (24" x 36") set of plans.
- D. The as-built record drawings shall indicate changes and/or revisions resulting from actual construction, change orders, field revisions, etc. The drawings shall be legibly marked, with dimensions, to record actual construction.
- E. Following final walk-through the Contractor shall submit the as-built record drawings to the Engineer.
- F. The Contractor or Engineer shall follow the Bond Release procedure through the COH Public Works for releasing bond and submitting final mylars.
- G. As part of the project scope, the Engineer shall incorporate all as-built record drawing changes compiled by the Contractor into a final mylar set and submit to the COH as final as-built record drawings.
- H. The as-built record drawings shall also include one hard copy and one electronic copy of all configuration information (to include all settings and setup information).
- I. An electronic file of the as-built record drawings and specifications shall also be provided to COH QC for distribution. The electronic documents shall:
 - 1. Include GPS coordinates and elevations on civil drawings for all structures.
 - 2. Include project drawings in COH approved AutoCAD® format (version as determined by COH).
 - 3. Include project specifications shall be submitted in PDF format.

1.15 Construction Phase Checklist

A. A Construction Phase checklist is provided at the end of this chapter for the Engineer's reference and use during the Construction Phase and may not include all applicable criteria. It is the Engineer's responsibility to review and comply with all guidelines contained herein and all applicable codes completely during this phase.

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DEPARTMENT OF UTILITY SERVICES

TECHNICAL SERVICES DIVISION NEW DEVELOPMENT SECTION

CITY OF HENDERSON 240 WATER STREET HENDERSON, NEVADA 89015

UTILITY SERVICES Construction Phase Checklist

Construction Phase

- □ Pre-construction conference
- Permit acquisition
- Permits issued
- □ Site Security Submittal
- Mobilization
- Control Systems Integrator Submittal
- Construction and Inspection begin
- Progress reports and pay requests
- □ Factory Acceptance Testing
- Preliminary Operations Plan
 - Test Plan
 - Start Up Plan/Conference
- Preliminary O&M submittals
- □ Substantial completion
- Operator training
- □ Facility testing and commissioning notification
- □ Facility testing and commissioning

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Community Development									
Developer/Engineer	Accepted Utility Master Plan]	Prepare/Submit Design Concept Report (DCR)		DCR Address Comments]		DCR Accepted	For Continuation See Sheet 2 Of
Tech Services (New Development)	No	ls Dversizing Yes Required	Refunding Agreement Process	DCR Log/Review/ Comment		DCR Final Review Acceptance	DCR Acceptance Letter		
Property Management	No Act	ion		DCR Review/ Comment On Real Property Issues					
OIL 7 OT 1 1		ATE CITY ON				HENDERSC)N UTILITY GUID	ELINES	
City Of He Clark Coun Department Of	enderson ty, Nevada Utility Service	S A Place To Call Alone		DESIGN PROCESS SCHEMATIC DESIGN CONCEPT REPORT		REVISION No. DESCRI	PTION		Figure 1



	REVISION	No.
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For Continuation See Sheet 2 Of 5	60% Design Prepare/Submit Plans/Specs	60% Design Address Comments Final			60% Design Accepted	Conti See 4	For inuation Sheet Of 5
Tech Services (new Development)		60% Design Log/Review/ Comment	60% Design Log/Review Comment				
City Of Henderson Clark County, Nevada Department Of Utility Services	THE CITY OF	DESIGN PROCESS SCHEMAT 60% DESIGN	IC	HENDERSON UTILITY	GUIDELINES		Figu 3



L						
]						
	Final Design Accepted][Prepare/ Submit Mylars *		For ntinuation e Sheet 5 Of 5	
		anaturoo	from all other	c utilitioo		
	sh to	all be of COH.	ptained prior t	o submittal		
		GUIDEI	INFS			
					Figure	1.1
					4 of	5
DESCRIPTI	ON		DRAWN BY	DATE		

Development Service Center (DSC)	Final Mylars Log/Distribute		Final Mylars Log Out		
For Developer/Engineer See Sheet 4 Of 5				Final Mylars Accepted Project Ready To Advertize and Construct	
Utility Services		Final Mylars Review/Signature			
		Final Mylars Review/Signature			
Flood Control		Final Mylars Review/Signature *	* Prior to New Developmen	mylar	
Building Safety		Final Mylars Review/Signature	signature, Fees must be bond posted.	paid and	
Fire Safety		Final Mylars Review/Signature			
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Technical Services			Utility Services Records Transfer And Verification	-	Status To Final Acceptance Copy		
Water Operations				Copy Of Utility Services Records Transfer And Verification	Status To Final Acceptance Copy		
Electrical Maintenance				Copy Of Utility Services Records Transfer And Verification	Status To Final Acceptance Copy		
Property Management			Confirmation Of Property Title Transfer To City				



PROJECT CLOSEOUT PROCEDURE

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CHAPTER 2 GEOTECHNICAL DESIGN

2.01 Geotechnical Investigation

- A. General: Geotechnical services related to design of utility facilities shall be provided by a Geotechnical Engineer experienced in geotechnical evaluation of utility sites. Geotechnical evaluations and recommendations shall be conducted by a qualified geotechnical professional who is an Engineer with current professional registration in Nevada. The Geotechnical Engineer's qualifications shall include:
 - 1. Prior utility project experience.
 - 2. Prior local project experience.
 - 3. Knowledge of local soil conditions, geological conditions as well as construction practices.
- B. Laboratory Requirements
 - 1. The laboratory performing testing associated with the project shall be AASHTO accredited and possess the knowledge and experience to perform the required testing in accordance with local agency practices and applicable standards such as those contained in ASTM, AWWA, and IBC. The laboratory technicians shall have the experience necessary to perform the required tests and shall work under the supervision of an individual having a minimum of 5 years of relevant experience. Any subcontracted tests shall also be performed by a laboratory meeting the above requirements.

2.02 Geotechnical Report

- A. Site Conditions: The Geotechnical Engineer shall be responsible for providing an evaluation of the site to determine the minimum number and the depth of exploratory borings required for the design.
 - 1. The depths of exploratory borings shall take into account invert depths of proposed structures and/or pipelines. Review of available aerial or geologic maps shall be performed and may indicate the need for additional and/or deeper borings at the discretion of the Geotechnical Engineer.
 - Borings or test pits shall be spaced at intervals no greater than 1,000 feet along the alignments of pipelines. Pipeline alignments crossing through areas containing faults, fissures, steep slopes, bedrock, expansive soils, or areas of unstable soils shall be performed at a decreased spacing of 500

feet or less as determined by the Geotechnical Engineer. Borings shall also be located within the footprints of proposed structures and at decreased spacings at bore-and-jack locations and microtunnels. Borings for pipelines shall extend to a depth of at least 10 feet below the invert elevations of proposed pipelines unless the actual pipeline invert elevations are provided, and then borings shall extend to a depth of at least 5 feet below invert elevations. Trenching shall be performed at locations where pipelines or structures cross areas containing faults or fissures at the discretion of the Geotechnical Engineer.

- 3. Test pits shall be excavated to supplement or substitute for the soil borings where permitted by the site features and where appropriate. Test pits should be used to evaluate relative degree of excavation difficulty, soil stability, depth to groundwater and infiltration rates, presence of cobbles and boulders, and depth to bedrock and its characteristics.
- 4. The Geotechnical Engineer shall be responsible to obtain encroachment permits and/or traffic control plans as applicable to perform explorations within public rights-of-way in accordance with COH Policy.
- 5. Penetration blow counts shall be obtained using a split-spoon (SPT) sampler or a ring-lined sampler as deemed appropriate by the Geotechnical Engineer based on anticipated soil type. Penetration blow counts shall be obtained using an SPT sampler within the anticipated pipe zone along proposed pipeline alignments to aid in the formulation of E' values. Pocket penetrometer tests should be performed on fine-grained soil samples recovered from the borings and recorded on the boring logs.
- B. Laboratory Testing: Laboratory testing on soil samples recovered from the exploratory borings shall include the following:
 - 1. Particle size distribution at each boring location (ASTM C 136).
 - 2. Atterberg Limits at each boring location (ASTM D 4318).
 - 3. In-place moisture content and dry density for each ring-lined sample interval within each boring location (ASTM D 2937).
 - 4. Consolidation and/or expansion for fine-grained soils at each structure location and at maximum 3,000-foot intervals for pipelines (ASTM D 2435 or Section 1802.3.3 of the Southern Nevada Amendments to the 2006 IBC).
 - 5. Unconfined compressive strength for fine-grained cohesive soils at each structure location (ASTM D 2166).

- 6. Soil cohesion and strength properties at each structure location and at maximum 3,000 foot intervals for pipelines (ASTM D 3080).
- 7. Soil resistivity tests for in-place moisture and saturated conditions at each structure location (ASTM G 57).
- 8. Maximum laboratory dry density as deemed appropriate for the evaluation of E' and soil shrinkage (ASTM D 698 or D 1557).
- C. Corrosivity Analysis for Buried Pipelines. Testing and analysis shall be done during the Geotechnical Evaluation phase and shall include the following to evaluate the corrosion potential of the site soils to buried metal pipelines, as deemed appropriate by the Geotechnical Engineer.
 - 1. Field Resistivity Testing: Field resistivity testing shall be performed at spacings of 500 feet along proposed pipeline alignments using the Wenner 4-pin method. Closer spacings may be required where frequently varying soil conditions are encountered, as determined by the Geotechnical Engineer. The resistivity test shall be performed in accordance with ASTM G 57, and should measure ground resistivity levels to the invert depths of the proposed pipeline, at a minimum of 2-, 5-, 10-, and 15-foot depth intervals.
 - 2. Laboratory Testing: Laboratory testing shall be performed on samples recovered from the borings at half and full-depth intervals along the proposed pipeline, and should include the following:
 - a) Miller box soil resistivity per ASTM G 57.
 - b) Water soluble chlorides.
 - c) Water soluble sulfate.
 - d) pH.
 - e) Total soluble salts.
 - f) Red Ox (oxidation-reduction).
 - g) Sulfide.
- D. Report Content: Geotechnical Evaluation reports shall contain the following information at a minimum:
 - 1. Review of available previous studies performed on or adjacent to the subject site, and a discussion of the findings.
 - 2. A scaled plan showing the location of the borings or test pits.
 - 3. Boring logs showing drilling equipment used, depth drilled, surface elevation, depth to groundwater observed during drilling and measured at least 24 hours after completion of drilling, and complete soil descriptions

per ASTM D 2488. Boring logs should also list the logger or geologist observing the drilling, and list any special surface or subsurface conditions observed.

- 4. Depths to cemented soils or caliche and hardness and degree of cementation, if encountered, and drilling rates.
- 5. Site description including existing structures, roadways, and subsurface improvements, if known, special geologic or drainage features, site relief, vegetation, and description for adjoining parcels.
- 6. Results of laboratory testing, including a description of the test methods performed.
- 7. A summary of the subsurface materials encountered, including any artificial fill, cemented soils, expansive or hydro-collapsible soils, and corrosive soils, and thickness of existing pavement sections, if appropriate, including asphalt concrete and aggregate base thicknesses.
- 8. A summary of anticipated loads and types of structures proposed.
- 9. Site class per Table 1613.5.5 of the International Building Code.
- 10. Representative latitude and longitude coordinates in decimal degrees to four decimal places for the purpose of determining the site seismic acceleration.
- 11. Geotechnical Evaluation reports shall be current within one year of the date of issue. Reports older than one year shall be accompanied by an update letter that addresses the current condition of the site and any supplementary recommendations.
- E. Geotechnical Parameters: The following are minimum geotechnical parameters to be addressed:
 - 1. Lateral active and passive soil pressures, including static and seismic pressures for walls, manholes and vaults, include a pressure diagram.
 - 2. Lateral at-rest soil pressure.
 - 3. Total and differential settlement for each type of foundation system.
 - 4. Design allowable bearing capacity for each type of foundation system.
 - 5. Minimum footing width and embedment.
 - 6. Recommended foundation system.

- 7. Modulus of subgrade reaction for design of mat-type foundations, when applicable.
- 8. Coefficient of friction for mat-type and spread footing foundations.
- 9. Allowable axial capacities, both compressive and uplift, for drilled shaft foundations including group factors for drilled shafts in groups where deep foundations are anticipated.
- 10. General construction recommendations for drilled shaft foundations including anticipated excavation methods, slurry or casing recommendations, and a recommendation for non-destructive shaft integrity testing (CSL or PIT) where deep foundations are anticipated.
- 11. Post-tensioned foundation recommendations, where applicable, based on the Southern Nevada Amendments to the 2006 IBC.
- 12. Design criteria for thrust blocks.
- 13. Groundwater considerations.
- 14. Recommendation for a rippability study, if warranted, where cemented soils or bedrock are encountered.
- 15. Slope stability analysis as deemed necessary where existing or proposed steep slopes are to be utilized on site.
- 16. Corrosive soils and mitigation criteria.
- 17. Considerations regarding concrete and steel reactivity.
- 18. Expansive soils and mitigation criteria.
- 19. Collapsible soils and mitigation criteria.
- 20. Locations and extent of fissures and mitigation criteria.
- 21. Location and extent of faults and mitigation criteria.
- 22. Document potentially contaminated soils and groundwater, and note on the boring logs at the appropriate depth interval.
- 23. Horizontal seismic coefficient.
- 24. Site coefficients for mapped spectral response accelerations at short period and 1-second period, FA and FV.

- 25. Mapped spectral accelerations for short period and 1-second period, SS and S1.
- 26. Potential for liquefaction and mitigation recommendations.
- 27. Seismically induced lateral earth pressures, include a pressure diagram.
- 28. Concrete mix design criteria based on soluble sulfate content of soils.
- 29. Exterior concrete flatwork recommendations.
- F. Groundwater: The Geotechnical Engineer shall evaluate and provide considerations for the following groundwater conditions where applicable:
 - 1. Dewatering during construction.
 - 2. Permanent dewatering, if required.
 - 3. Target dewatering elevations.
 - 4. Anticipated dewatering induced settlements for any existing structures.
 - 5. Anticipated seasonal groundwater level fluctuations.
- G. Site Preparation and earthwork: The Geotechnical Engineer shall provide recommendations for the following:
 - 1. Excavation constraints (rock, caliche, blasting, etc.) relative to the site and considerations for any specialized types of equipment if anticipated.
 - 2. Earthwork specifications including over excavation depths, testing methods and frequencies, maximum lift thickness, moisture conditioning recommendations, and estimated range of soil shrinkage values.
 - 3. Subgrade stabilization recommendations where soft, wet, or unstable soils are anticipated to be encountered including recommendations for geogrid and/or filter fabric and imported stabilization rock as deemed appropriate. Recommendations shall be made regarding the specific geotextile product as deemed appropriate for the anticipated soil conditions.
 - 4. On-site and imported structural fill criteria, including maximum or minimum values as applicable for soil gradation, plasticity, swell, solubility and chemical composition.
 - 5. Identification of unsuitable soils and removal and disposal recommendations.

- 6. Stability of temporary excavation slopes, with maximum allowable slope ratios.
- 7. Stability of permanent fill and cut slopes, with maximum allowable slope ratios.
- 8. Benching recommendations for fill slopes.
- 9. Mitigation of cut/fill transitions beneath improvements as applicable.
- 10. Pavement design for both flexible and rigid pavement for design ESAL values of 1,100, 7,160, 33,130, and 121,000, which correspond to Traffic Index of values 4, 5, 6 and 7, respectively.
- 11. Anticipated site drainage measures regarding finish grades adjacent to foundations and considerations for sub drains where applicable.
- 12. Protection of existing structures where earthwork is to be performed adjacent to any existing improvements, including safe setbacks for new excavations.
- H. Pipelines: Geotechnical services related specifically to design of pipelines shall be provided by a Geotechnical Engineer experienced in geotechnical design of pipelines and associated structures. The Geotechnical Engineer shall be responsible for determining the specific design criteria and site conditions as described in these guidelines. In addition the Geotechnical Engineer shall provide recommendations for the following:
 - 1. Trench excavatability and sidewall setbacks.
 - 2. E' Values for each boring location at half-depth and full-depth of the boring.
 - 3. Allowable excavation slopes.
 - 4. Vertical soil pressures.
 - 5. Minimum trench width.
 - 6. Bedding material, pipe zone, and trench backfill for trenches in both paved and unpaved areas.
 - 7. The use of geotextiles, where necessary to separate fine-grained soils from bedding or pipe zone backfill materials.
 - 8. Suitability of native soils for backfill and or processing requirements.
 - 9. Coefficient of friction between pipe materials and soil within pipe zones including CLSM.

- 10. Backfill and stabilization recommendations for trenches excavated below static groundwater levels including the use of geosynthetics where deemed appropriate by the Geotechnical Engineer.
- 11. Provide an evaluation of soil corrosivity and recommendations for cathodic protection.
- 12. Recommendations to mitigate pipe float during backfilling.
- I. Reservoirs: Geotechnical services related specifically to design of reservoirs shall be provided by a Geotechnical Engineer experienced in geotechnical evaluation of water storage reservoir sites. The Geotechnical Engineer shall be responsible for determining the specific foundation design criteria and site conditions as described in these guidelines. In addition the Geotechnical Engineer shall:
 - 1. Evaluate seismic parameters specific to the proposed reservoirs.
 - 2. Provide both geotechnical data and recommendations specific to foundations supporting reservoirs, including appropriate values for lateral support, bearing capacity and modulus of subgrade reaction values for reservoirs supported on large mats.
 - 3. Provide an evaluation of soil corrosivity and recommendations for cathodic protection.
 - 4. Provide backfill and drainage recommendations for soils used as wall backfill for subsurface reservoirs.
 - 5. Provide soil stabilization and/or specific earthwork specifications for soils supporting large reservoir foundations, including stabilization recommendations in the event that subsurface soils become saturated.
- J. Pump stations and lift stations: Geotechnical services related specifically to design of pump stations or lift stations shall be provided by a Geotechnical Engineer experienced in geotechnical evaluation of pumping facilities and subsurface vaults. The Geotechnical Engineer shall be responsible for determining the specific foundation design criteria and site conditions as described in these guidelines. In addition the Geotechnical Engineer shall:
 - 1. Address potential for differential settlement between structures and interconnected pipelines, including mitigation measures.
 - 2. Provide a corrosivity analysis for soils throughout the invert depth of any proposed pipelines or deep vaults.

- 3. Address foundation loading conditions including those of storage tanks, pumping equipment, valves and pipes for single level or multiple-level structures as necessary.
- 4. Address considerations for electrical conduits or pipeline crossings including protection, separation and backfill recommendations and address minimum pipe cover as necessary where pipelines or conduits are anticipated to be relatively shallow.
- 5. Address any potential impacts to existing structures from adjacent new improvements including pipelines, pumping stations or lift stations and associated structures.
- K. Subsurface Vaults: Geotechnical services related specifically to design of deep subsurface vaults shall be provided by a Geotechnical Engineer experienced in geotechnical evaluation of subsurface vaults. The Geotechnical Engineer shall be responsible for determining the specific foundation design criteria and site conditions as described in these guidelines. In addition the Geotechnical Engineer shall:
 - 1. Provide excavation considerations down to the invert elevation of proposed vaults, including an evaluation of possible cemented soil, bedrock, cobbles, or boulders that may be encountered during excavation or at the proposed subgrade elevation.
 - 2. Provide shoring or slope considerations for deep excavations and anticipated minimum setback distances from any existing structures. Provide design values for soil anchors when necessary.
 - 3. Address potential for differential settlement between near-surface structures and interconnected deep vaults or wells, including mitigation measures.
 - 4. Address lateral earth pressures throughout the anticipated depth of deep vaults, including pressures from adjacent structures or anticipated traffic.
 - 5. Address groundwater considerations and any uplift pressures that could occur when vaults with invert elevations below the static groundwater elevation are to be drained.
 - 6. Address compaction considerations for soil adjacent to subsurface walls to mitigate the potential for wall failure from heavy equipment or compaction loads.
 - 7. Provide static and seismically induced lateral earth pressures for anticipated backfill conditions behind subsurface walls.

8. Provide net allowable bearing capacity values for soils supporting deep subsurface vaults including a suitable factor of safety.

2.03 Design Checklist

A. A checklist is provided at the end of this chapter for the Engineer's reference and use during design and may not include all applicable design criteria. It is the Engineer's responsibility to review and comply with all guidelines contained herein and all applicable codes completely prior to submitting for review.
DEPARTMENT OF UTILITY SERVICES

TECHNICAL SERVICES DIVISION NEW DEVELOPMENT SECTION

CITY OF HENDERSON 240 WATER STREET HENDERSON, NEVADA 89015

UTILITY SERVICES Geotechnical Design Review Checklist

Geotechnical Investigation

Laboratory Requirements

Geotechnical Report

Site Conditions:

- Exploratory borings/boring depths
- Boring or test pit locations and spacing
- Encroachment permits
- Penetration blow counts
- Pocket penetrometer test

Laboratory Testing

Laboratory testing on soil boring samples

Corrosivity Analysis for Buried Pipe Lines

- Corrosivity testing and analysis of site soils
- Geotechnical Evaluation Report Content (Minimum)
- Review previous studies
- □ Scaled plan for boring or test pit locations
- Boring logs
- Depths to cemented soils/caliche
- □ Site description
- Laboratory testing results

- □ Summary of subsurface materials encountered
- □ Summary of loads and structures proposed
- □ Site class
- Geotechnical evaluation reports
- Latitude and longitude coordinates

Geotechnical Parameters (Minimum)

- Lateral soil pressures
- □ Total and differential settlement
- □ Allowable bearing capacity
- □ Minimum footing width and embedment
- Foundation system
- □ Modulus of subgrade reaction
- Coefficient of friction
- □ Allowable axial capacities
- Construction recommendations
- □ Foundation recommendations
- Thrust block design criteria
- Groundwater considerations
- Rippability study
- □ Slope stability analysis
- Corrosive soils and mitigation criteria
- □ Concrete and steel reactivity considerations
- Expansive soils and mitigation criteria
- Collapsible soils and mitigation criteria
- □ Fissures and mitigation criteria
- □ Faults and mitigation criteria
- □ Contaminated soils and groundwater
- Horizontal seismic coefficient
- □ Site coefficients for spectral accelerations
- Liquefaction and mitigation recommendations

- □ Seismically induced earth pressures
- Concrete mix design criteria
- Concrete flatwork recommendations

Groundwater

- Dewatering
- Dewatering elevations
- Dewatering induced settlements
- □ Seasonal groundwater level fluctuations

Site Preparation and Earthwork

- Excavation constraints
- Earthwork specifications
- Subgrade stabilization
- On-site and imported structural fill criteria
- □ Identification of unstable soils
- □ Stability of temporary excavation slopes
- □ Stability of permanent fill and cut slopes
- Benching recommendations
- □ Mitigation of cut/fill transitions
- Pavement design
- Anticipated site drainage measures
- Protection of existing structures

Pipelines

- □ Trench excavability and sidewalk setbacks
- E' values
- Allowable excavation slopes
- Vertical soil pressures
- □ Minimum trench width
- Bedding material, pipe zone, and trench backfill
- Use of geotextiles
- □ Suitability of native soils

- Coefficient of friction
- Trench backfill and stabilization
- □ Soil corrosivity evaluation
- Pipe float mitigation

Reservoirs

- **D** Evaluate seismic parameters
- Geotechnical data
- □ Soil corrosivity evaluation
- Backfill and drainage recommendations
- □ Soil stabilization and/or specific earthwork specifications

Pump Stations and Lift Stations

- Differential settlement
- Corrosivity analysis
- □ Foundation loading conditions
- Electrical conduits or pipeline crossings
- Potential impacts to existing structures

Subsurface Vaults

- Excavation
- □ Shoring and slope
- Differential settlement
- Earth pressures
- Groundwater
- Compaction
- □ Static and seismically induced earth pressures
- Allowable bearing capacity values

CHAPTER 3 STRUCTURAL AND SEISMIC DESIGN

3.01 General

- A. The purpose of this chapter is to set forth structural and seismic design guidelines for both new facilities as well as for retrofitting existing facilities. The intent is to establish minimum guidelines as well as reference currently adopted building codes and industry standards. This is intended to serve as an introduction to structural design requirements and should not be construed as an all-inclusive list.
- B. The Engineer is responsible for the final design and contents of this chapter and shall not absolve the Engineer of the responsibility to design in accordance with all federal, state, and local requirements.
- C. Applicability: This chapter shall apply to the design, repair and rehabilitation of large utility facilities, which include the following:
 - 1. Buildings: All occupied or unoccupied buildings including pump stations, pressure reducing stations, administration buildings, electrical buildings, and warehouses.
 - 2. Water Retaining Structures: All reservoirs, clearwells, wetwells, water and wastewater treatment structures, and splitter structures.
 - 3. Buried Structures: All valve vaults, meter vaults, water and wastewater treatment structures, and pressure reducing stations.
 - 4. Buried Pipelines: All water and wastewater transmission or collection pipelines.
- D. Reference Standards and Codes The currently adopted reference standards and code shall be used in the design:
 - 1. Aluminum Association:
 - a) Aluminum Design Manual: Specifications and Guidelines for Aluminum Structures.
 - 2. American Concrete Institute (ACI).
 - a) Code Requirements for Environmental Engineering Concrete Structures and Commentary (350/350R).
 - b) Building Code Requirements for Reinforced Concrete and Commentary (ACI 318/318R).
 - c) Building Code Requirements for Masonry Structures (530).
 - 3. American Institute of Steel Construction (AISC) Steel Construction Manual.

- 4. American Water Works Association (AWWA):
 - a) Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks (D 110).
 - b) Welded Steel Tanks for Water Storage (D 100).
 - c) Factory-Coated Bolted Steel Tanks for Water Storage (D 103).
- 5. International Code Council (ICC):
 - a) International Building Code (IBC).
- 6. Occupational Safety and Health Act.
- 7. Transmission Pipelines Seismic Guidelines for Water Pipelines, American Lifelines Alliance

3.02 Site Criteria

- A. Seismologic and/or Geologic Studies: The Engineer shall determine site criteria based on recent or site specific seismologic or geologic studies. These studies shall consider the following:
 - 1. Identification of faults.
 - 2. Geologic features that impact proposed facilities.
 - 3. Historic seismicity with earthquake recurrence for region.
 - 4. Deterministic estimates of ground motions for an earthquake.
 - 5. Probabilistic analysis of earthquake ground motions with a selected probability level over the life of a structure.
 - 6. Occupancy Categories and Importance Factors per IBC for propose structures.
- B. Geotechnical Studies: The Engineer shall complete a geotechnical study, which identifies all seismic loads for analysis and design of a structure and in accordance with the requirements of Chapter 2. The geotechnical report shall also address the following:
 - 1. Liquefaction for projects located on granular soils, which include silt, sand, and gravel.
 - 2. Landslide damage for projects beneath or on top off steep slopes or cuts.
 - 3. Differential settlement based on site-specific data.
 - 4. Dewatering during construction.

5. Mitigation of Buoyant forces due to groundwater.

3.03 Seismic Design Criteria

- A. Each structure shall be designed in accordance with the appropriate edition of the IBC and per site-specific seismic design recommendations as given in the project's geotechnical report(s). For minor isolated structures where a sitespecific study may not be performed, the appropriate provisions of the IBC shall be used to determine seismic forces.
- B. Seismic Forces: Seismic forces resulting from dead loads shall be determined using the appropriate ground acceleration and in accordance with IBC required importance factor criteria.
- C. Water Retention Structures: The Engineer shall design all water retention structures as follows:
 - 1. Open roofed basins per ACI 350.
 - 2. Circular basins per AWWA D 110.
 - 3. Internal components and equipment shall be designed per currently adopted codes and current industry standards.
- D. Equipment: The Engineer is responsible for evaluating seismic loads for all equipment and accessories. Equipment that must be evaluated for seismic loads includes but is not limited to the following:
 - 1. Clarifier mechanisms.
 - 2. Impeller mixers.
 - 3. Vertical pumps.
 - 4. Horizontal pumps.
 - 5. Air Compressors.
 - 6. Centrifugal blowers.
 - 7. Motor Control Centers (MCCs).
 - 8. Generators.
- E. Anchors: The Engineer shall provide anchors suitable for the anticipated seismic conditions using design forces for anchorage and bracing per IBC requirements with a minimum factory of safety of 4.0. Anchors may include the following:
 - 1. Cast-In-Place anchors such as headed studs. J-bolts shall not be used.

- 2. Epoxy and expansion anchors may be used when cast-in-place anchors are not practical. Epoxy and expansion anchors should not be used for vibrating equipment. Anchors shall meet the current seismic provisions for cracked concrete.
- 3. Welded anchors shall be designed and detailed with embedded plates with bolted connections to avoid field welding.

3.04 Structural Loads

- A. The design criteria presented herein are minimum guidelines. The Engineer is responsible for determining whether or not the minimum guidelines are appropriate for the project.
- B. Dead Loads are defined as the load of all material and equipment, which is constant throughout the life of a structure. The following unit weights shall be used at a minimum:

<u>Material</u>	<u>Minimum Dead Load (pcf)</u>
Aluminum	169
Concrete	150
Concrete Masonry	135
Steel	490

C. Live Loads are defined as the load that a structure is designed to oppose, which includes the constant or 'dead' load in addition to any temporary or moving load. The following live loads shall be used at a minimum:

Description	Minimum Live Load
Roof Load	More stringent of IBC or local code*
Stairs, Platforms, Walkways	100 psf or per local code
Electrical Equipment Areas	150 psf
Equipment Areas	250 psf**

Roof Load to include maximum loads due to lifting eyebolts and roof joists.
To be useful due equipment information

- * To be verified by equipment information
- D. Wind Loads shall be in accordance with currently adopted code.
- E. Lateral Loads shall be designed using soil conditions as defined in the geotechnical report. Hydrostatic pressure shall be included for areas subjected to saturated soil and/or groundwater.

- F. Seismic Loads shall be considered in accordance with this chapter.
- G. Vibration Loads shall be included where applicable and shall be included based on the equipment manufacturer.
- H. Impact Loads shall be considered where applicable.
- I. Miscellaneous Loads shall be determined by the Engineer and include but are not limited to the following:
 - 1. Loads due to thermal expansion and contraction.
 - 2. Thrust in pipelines.
 - 3. Vehicular loads on or near structures.

3.05 Structural Design Requirements

- A. Reinforced Concrete Structures: The Engineer shall design all reinforced concrete structures per the requirements of ACI 318 and ACI 350R. The following criteria also apply:
 - 1. Minimum Specified Concrete Compressive Strength: 28-day compressive strength of 4,000 psi.
 - 2. Minimum Reinforcing Steel Strength: Yield strength of 60,000 psi per ASTM A 615.
 - 3. Where the concrete is exposed to sulfate containing soils, the Minimum Specified Concrete Compressive Strength shall be increased as required by ACI 318.
 - 4. Joints: Expansion and construction joints shall be provided in to allow flexibility and to adequately tolerate differential movements and shrinkage stress. Joints shall be in accordance with ACI 350R to mitigate cracking. The following types of joints should be considered:
 - a) Expansion joints.
 - b) Contraction joints.
 - c) Construction joints.
- B. Steel Structures: The Engineer shall design all steel structures in accordance with AISC. The following criteria also apply:
 - 1. Structural steel W and WT shapes per ASTM A 992.
 - 2. Structural steel shapes other than W and WTs, plates, and bars per ASTM A 36.

- 3. Structural steel pipe per ASTM A 501 or ASTM A 53, Type E, Grade B.
- 4. Hollow Structural Sections per ASTM A 500, Grade B.
- 5. Structural stainless steel shapes, plates and bars per ASTM A 167 and ASTM A 276.
- 6. Composite steel deck per AISC, Manual of Steel Construction, and AISI Specifications.
- 7. Crane supports shall be designed for the more stringent of maximum deflection of 1/500 times the span or the crane manufacturer's requirements.
- C. Structural Aluminum: The Engineer shall adhere to the following in design of structural aluminum:
 - 1. Structural aluminum shapes, plates and bars per Aluminum 6061-T6 alloy and ASTM B 209, B 221 and B 308.
- D. Masonry Structures: The Engineer shall design all masonry structures in accordance with ACI 530. Facilities constructed of reinforced masonry block shall be designed based upon the working stress analysis method. The following criteria also apply:
 - 1. Materials: Hollow Concrete Masonry Units made from normal weight aggregates (ASTM C 33).
 - 2. Nominal Block Size: 8 inches by 16 inches.
 - 3. Minimum Concrete Block Strength: 1,500 psi per ASTM C90, Grade N, Type II.
 - 4. Mortar per ASTM C270, Type M or S.
 - 5. Minimum Reinforcing Steel Strength: Yield strength of 60,000 psi per ASTM A 615, Grade 60.
 - 6. Steel Reinforcing Wire: No. 9 gauge steel wire, ASTM A 951, hot-dip galvanized in accordance with ASTM A 153, Class B-2.
 - 7. Grout per ASTM C 476 or requirements IBC.
 - Joints: Provide expansion joints and control joints in accordance with ACI 530.

- E. Concrete Foundations: The Engineer shall design concrete foundations in accordance with the recommendations of the geotechnical report. The following items apply to concrete foundations:
 - 1. Mat Foundations shall be designed as a slab on an elastic foundation with construction, expansion, and contraction joints per ACI 350R.
 - 2. Spread Footings shall be cast monolithically with floor slab.
 - 3. All foundations shall be provided with construction, expansion, and contraction joints per ACI 350R and with PVC waterstop.
- F. Equipment Footings: The Engineer shall design equipment footings for the maximum load under operating or test conditions. The following items also apply to equipment footings:
 - 1. The worse case effects from wind and seismic loads shall be considered.
 - 2. The factor of safety against wind and seismic overturning and sliding shall not be less than 1.5.
 - 3. Equipment piping shall not be used as a means to resist wind or seismic loading.
 - 4. Consider movement and shear on equipment support caused by removing components.
- G. Rotating and Reciprocating Equipment: The Engineer shall design structures considering forces resulting from vibration and torque from equipment in accordance with ACI 350R and per the equipment manufacturer's recommendations. The following items also apply:
 - 1. Support shall be isolated from the surrounding slab to minimize the effect of vibration on adjacent structures whenever possible.
 - 2. Equipment shall be anchored to the support with Type 316 stainless steel anchor bolts designed for vibration, impact, torque, seismic and wind loading. Bolts shall have a minimum diameter of 3/4 inches.
- H. Concrete Walls: The Engineer shall design concrete walls considering the following:
 - 1. Cantilever walls with active soil pressure.
 - 2. Walls restrained at the top with at rest soil pressures.
 - 3. Cantilevered Walls shall consider restraint at end walls or cross walls.

- 4. Construction joint spacing shall not exceed 30 feet.
- 5. Minimum reinforced concrete wall thickness shall be 8 inches
- 6. Minimum thickness for reinforced concrete walls greater than or equal to 10 feet high and retaining water shall be 12 inches.
- Vertical wall construction joints shall align with the floor joints. Construction joints shall utilize (as a minimum) 3/8-inch by 6-inch PVC ribbed waterstop and 3/4-inch triangular sealant grooves. Expansion joints shall utilize (as a minimum) 3/8-inch by 9-inch PVC ribbed waterstop and 3/4-inch triangular sealant grooves
- 8. Two techniques are recommended to reduce the tendency for vertical wall cracking that results from footing restraint:
 - a) The wall shall be keyed into a joint at the tip of the wall footing. In order to minimize water demand from the footing on the fresh wall concrete, the keyway in the footing should be kept wet until the wall concrete is placed.
 - b) Additional horizontal reinforcing shall be placed in the bottom 3 feet of the wall.
- I. Concrete Floor Slab: The Engineer shall design concrete floor slabs considering the following:
 - 1. Facility floor slabs shall be sloped to provide adequate drainage to the floor drain or sump.
 - 2. Minimum thickness: 6 inches.
 - 3. Joints: Control joints, construction joints shall be provided in the slab structure per ACI 350R with roof joints aligned with wall joints.
 - 4. Construction joint spacing shall not exceed 30 feet.

3.06 Design Checklist

A. A checklist is provided at the end of this chapter for the Engineer's reference and use during design and may not include all applicable design criteria. It is the Engineer's responsibility to review and comply with all guidelines contained herein and all applicable codes completely prior to submitting for review.

DEPARTMENT OF UTILITY SERVICES

TECHNICAL SERVICES DIVISION NEW DEVELOPMENT SECTION

CITY OF HENDERSON 240 WATER STREET HENDERSON, NEVADA 89015

UTILITY SERVICES

Structural and Seismic Design

Structural and Seismic Design

□ Reference Standards and Codes

Site Criteria

Seismic and/or Geologic Studies

- □ Identification of Faults
- Geological Features impacting proposed facilities
- Historic Seismicity
- Deterministic estimates of ground motions
- Probabilistic analysis of earthquake ground motion
- Occupancy Categories and Importance Factors

Geotechnical Studies

- Liquefaction
- Landslide Damages
- Differential Settlement
- Dewatering
- Mitigation of Buoyant Forces

Seismic Design Criteria

Seismic Design Recommendations

Per latest IBC and geotechnical report

Seismic Forces

- Seismic forces determined using appropriate ground acceleration
- U Water Retention Structures Design Open Roofed Basin
- Circular Basins
- □ Internal Components
- **Equipment**
- Clarifier mechanisms
- □ Impeller mixes
- U Vertical pumps
- Horizontal pumps
- Air Compressors
- Centrifugal blowers
- □ Motor Control Centers (MCCs)
- Generators
- Anchor Design
- Structural Loads
- Dead Loads
- Live Loads
- □ Seismic Loads
- Uibration Loads
- □ Impact Loads
- Miscellaneous Loads
- Impact Loads
- Miscellaneous Loads
- Structural Design Requirements
- Reinforced Concrete Structures
- □ Steel Structures
- August 2010

- □ Structural Aluminum Structures
- Masonry Structures
- Concrete Foundations
- Equipment Footings
- **D** Rotating and Reciprocating Equipment
- Concrete Walls
- Concrete Floor Slab

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CHAPTER 4 CORROSION CONTROL

4.01 Corrosion Analysis and Evaluation

- A. General: The purpose of this chapter is to provide general guidelines for design of corrosion control measures for new facilities. Corrosion control measures including materials selection, protective coatings, protective linings, and/or cathodic protection. These guidelines must be considered in conjunction with current industry standards. Corrosion control and prevention must be evaluated for all projects by a NACE certified professional
- B. The Engineer shall address soil corrosivity as part of the geotechnical investigation.
- C. The need for and type of corrosion control measures shall be based on field investigations and laboratory analyses that assess the corrosion potential of the environment on the proposed facilities.
- D. Soil samples for laboratory testing and analyses shall be collected at the proposed locations and depths of all buried concrete structures and along proposed pipeline alignments.
- E. The Engineer shall include corrosion testing and laboratory analyses of soil samples. Corrosion testing and laboratory analyses of selected soil samples shall include:
 - 1. Electrical Resistivity per ASTM G 57.
 - 2. Soil pH per ASTM D 2976/D 4972/G 51.
 - 3. Oxidation Reduction Potential (ORP) per ASTM D 1409.
 - 4. Sulfides per ASTM 4658.
 - 5. Soluble Chlorides per ASTM D 512C.
 - 6. Soluble Sulfates per ASTM D 516A.

4.02 Corrosion Analysis Results, Conclusions and Recommendations

- A. General: Corrosion control recommendations shall address the following:
 - 1. Selection of corrosion resistant materials.
 - 2. Protecting any materials susceptible to corrosion with protective linings and/or coatings.

- 3. Locations for cathodic protection system (if applicable).
- 4. Quantitative assessment of corrosivity of soil and service for proposed materials.
- B. Interpretation of Results: Results of field investigations shall be evaluated by a NACE certified professional to determine the needs for cathodic protection. The following shall be taken into consideration:
 - 1. The evaluation shall include consideration of the information in the "Protective Coatings and Linings" section.
 - 2. The practices and recommendations of accepted standards and references shall be used during the course of the work.
- C. Conclusions and Recommendations: The evaluation of corrosion protection needs must present recommendations for corrosion protection of the facility under design according to the following guidelines:
 - 1. In general, corrosion protection should be provided for buried or submerged metallic structures if any of the following conditions exist:
 - a) Soil resistivity is 12,000 ohm-cm or less, or when a wide range of soil resistivity exists regardless of the absolute values.
 - b) Soil with high chloride or sulfate concentrations.
 - c) Waters with high chloride concentrations, high TDS, or high dissolved oxygen concentration.
 - d) Areas subject to stray electrical currents.
 - e) Support facility piping for natural gas, fuel, compressed air, chemicals, and steel storage tanks.
 - 2. The evaluation will reach one of two possible conclusions. The first possible conclusion is that, at the time the study is conducted, cathodic protection is necessary. This approach will result in the installation of cathodic protection systems concurrent with construction of the pipeline. The cathodic protection system would be designed for a minimum service life of 30 years, after which it would require replacement for continued service.
 - 3. A major consideration for the cathodic protection alternative is that stray current from the cathodic protection system must be controlled to prevent damage to other facilities. The cost savings resulting from leak prevention on the protected pipeline could be surpassed by the costs of damage to other facilities.

4. The second possible conclusion of the evaluation is that cathodic protection is not required at the time of construction. All pipelines would then be provided with the test stations and joint bonding system necessary to allow corrosion monitoring of the pipeline. Corrosion monitoring results are used to determine when, or if, cathodic protection is required.

4.03 Induced Voltage and Stray Current Mitigation

- A. General: Stray current testing is required for proposed buried piping that crosses or parallels electrical transmission lines and/or natural gas pipelines or oil pipelines protected with impressed current cathodic protection. Other potential sources of DC current include industrial sources such as metal processors and welding shops.
- B. The Engineers shall determine potential effects on the proposed buried piping as well as safety issues to operations and maintenance personnel when proposed facilities cross or are located near electrical transmission lines, natural gas pipelines, and petroleum pipelines.
- C. The Engineer shall design corrosion control measures to mitigate stray current effects on proposed facilities from existing facilities.
- D. Acceptable methods of mitigating stray currents and induced voltage for buried pipelines include but are not limited to:
 - 1. Insulating flanges, grounding cells, and test stations.
 - 2. Sacrificial anode shield systems and associated test stations.
 - 3. Personnel safety grounding mats.

4.04 Materials Selection

- A. General: The Engineer shall evaluate materials based on the project conditions and select materials resistant to corrosion or provide corrosion mitigation for materials subject to corrosion.
- B. Materials for Buried and Submerged Piping and Accessories: Acceptable materials for buried piping and accessories include:
 - 1. Steel, lined and coated in accordance with this chapter.
 - 2. Ductile Iron, lined and coated, in accordance with this chapter.
 - 3. PVC, except when in contact with organic compounds that may result in degradation.

- 4. Concrete.
- 5. Fiberglass Reinforced Polymer Mortar, except when in contact with organic compounds that may result in degradation.
- 6. High-Density Polyethylene, except when in contact with organic compounds that may result in degradation.
- 7. Corrosion-resistant Cast Iron.
- 8. Type 316 stainless steel hardware.
- C. Materials for Exposed Piping and Accessories:
 - 1. Steel, lined and coated with amine-cured epoxy in accordance with this chapter.
 - 2. Ductile Iron, lined and coated, in accordance with this chapter.
 - 3. PVC, except when in contact with organic compounds that may result in degradation. PVC shall be coated per manufacturer's recommendations to inhibit UV degradation.
 - 4. Copper coated with equipment epoxy in accordance with this chapter.
 - 5. Black Steel.
 - 6. Galvanized steel hardware for exposed dry and non-wastewater service.
 - 7. Type 316 stainless steel hardware for damp and wastewater service.
- D. Concrete: All concrete subject to corrosive environments shall be provided with corrosion protection. This applies to pipe and structures, which include manholes, vaults, and wet wells. The Engineer shall select adequate corrosion mitigation based on the following:
 - 1. Protective Coatings for Buried and Submerged service include polyurethane, acrylic and coal-tar epoxy in accordance with this chapter.
 - 2. Protective Coatings for Wastewater service include polyurethane, coal-tar epoxy and amine-cured epoxy in accordance with this chapter.
 - 3. Utilizing Type V ASTM C 150 Portland cement.
 - 4. The use of PVC liner for protecting concrete from corrosion is not acceptable.

- E. Steel: All steel structures subject to corrosive environments shall be provided with corrosion protection. This applies to pipe, reservoirs, vaults, and other structures. The Engineer shall select adequate corrosion mitigation based on the following:
 - 1. Protective Coatings for Buried and Submerged service include polyurethane, amine-cured epoxy and coal-tar epoxy in accordance with this chapter.
 - 2. Protective Coatings for Wastewater service include coal-tar epoxy and amine-cured epoxy in accordance with this chapter.
 - 3. Cathodic protection in accordance with this chapter.
 - a) Steel vaults shall utilize a passive cathodic protection system
 - b) Steel Reservoirs shall utilize impressed current cathodic protection system.
- F. Aluminum: Aluminum is acceptable for exposed service for applications such as ladders, grating, guardrail, handrail, and kickplate. Aluminum shall not be used for buried or submerged service or in direct contact with concrete.
- G. Copper and Brass: Copper and Brass are acceptable for exposed service such as water piping and finish hardware. Piping shall be coated in accordance with this chapter. Copper and Brass shall not be used for corrosive chemical service (acids, hypochlorite, ferric chloride, etc.), buried service, submerged service, or wastewater service unless approved in writing by the COH.

4.05 **Protective Linings and Coatings**

- A. General: Corrosion control methods of materials subject to corrosion may include a combination of protective coatings and/or other measures as determined by the Engineer, which include:
 - 1. Protecting materials susceptible to corrosion with protective linings and/or coatings.
 - 2. Providing passive cathodic protection system.
- B. Surface Preparation:
 - 1. Solvent Cleaning (SSPC-SP1): Removal of oil, grease, soil, drawing and cutting compounds, and other soluble contaminants from steel surfaces by cleaning with solvent, vapor degreasing, emulsion or alkaline cleaners or steam.

- 2. Hand Tool Cleaning (SSPC-SP2): Removal of all loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter by hand chipping, scraping, sanding, and wire brushing.
- 3. Power Tool Cleaning (SSPC-SP3): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by rotary or impact power tools, power wire brushing, or power abrading.
- 4. White Metal Blast Cleaning (SSPC-SP5/NACE1): Removal of all visible oil, grease, soil, dust, dirt, mill scale, rust, coating, oxides, corrosion products, and other foreign matter by blast cleaning.
- 5. Commercial Blast Cleaning (SSPC-SP6/NACE3): Removal of all visible oil, grease, dust, dirt, mill scale, rust coating, oxides, corrosion products, and other foreign matter, except that random staining shall be limited to no more than 33 percent of each unit area of surface.
- 6. Brush-Off Blast Cleaning (SSPC-SP7/NACE4): Removal of all visible oil, grease, dirt, dust, loose mill scale, loose rust, and loose coating, all of which shall be considered tightly adherent if they cannot be removed by lifting with a dull putty knife.
- 7. Near-white Blast Cleaning (SSPC-SP10/NACE1): Removal of all visible oil, grease, dirt, mill scale, rust, coating, oxides, corrosion products, and other foreign matter, except that random staining shall be limited to no more than 5 percent of each unit area of surface.
- 8. Adherence to the following referenced "surface preparation of ferrous surfaces" with existing coatings standards of the Society for Protective Coatings (SSPC) are a requirement of this scope.
- C. Protective Coatings:
 - 1. Aliphatic Polyurethane, Concrete: Two component aliphatic polyurethane coating material with following properties:
 - a) Solids content of 65% by volume.
 - b) Filler sealer comprised of two-component epoxy.
 - c) Prime filler sealer coat thickness = 2 mils DFT.
 - d) Intermediate coat thickness = 5 mils DFT.
 - e) Finish coat (2 coats minimum) thickness = 2 mils DFT.
 - 2. Acrylic, Concrete: Single component industrial grade, high molecular weight with following properties:
 - a) Solids content of 35 percent by volume.

- b) Filler sealer comprised of two-component epoxy w. solids of 64 percent by volume.
- c) A 100 percent solids epoxy surface shall be used to fill holes and patch the concrete surface after abrasive blasting.
- d) Prime filler sealer coat shall be applied with squeegee to achieve a smooth, void-free surface.
- e) Finish coat (2 or more) thickness = 5 mils DFT.
- 3. Amine Cured Epoxy: High build, amine cured, epoxy resin with a solids content of 80 percent by volume suitable for long-term immersion service in potable or municipal wastewater with the following properties:
 - a) NSF Standard 61 certification for potable water service.
 - b) Prime coat and finish coat thickness = 18 mils DFT.
 - c) Coating thickness for valves and non-submerged equipment = 14 mils DFT.
- 4. Polyamide Cured Epoxy: High build, polyamide epoxy resin shall have a solids content of at least 56 percent by volume suitable for long-term immersion in potable water and municipal wastewater with the following properties:
 - a) NSF Standard 61 certification for potable water service.
 - b) Prime and finish coat (3 coats or more) thickness = 14 mils DFT.
 - c) Coating thickness for valves and non-submerged equipment = 14 mils DFT.
- 5. Cold-Applied Tape, AWWA C209: Prefabricated tape shall be Type II. System shall include the following:
 - a) Primer layer.
 - b) Inner layer with thickness = 35 mils DFT.
 - c) Outer layer with thickness = 35 mils DFT.
- 6. Coal Tar Epoxy, AWWA C203: High build, two-component amine or polyamide cured coal tar epoxy with solids content of 75% by volume suitable for immersion in wastewater and for coating buried surfaces with the following properties:
 - a) Conforms to SSPC Paint 16 Coal Tar Epoxy-Polyamide Black (or Dark Red) Paint.
 - b) Prime coat thickness = 2 mils DFT.
 - c) Finish coat (2 or more) thickness = 18 mils DFT.
 - d) Total system DFT = 18-23 mils DFT if shop primed (16 20 mils DFT if not shop primed).
- 7. Equipment Epoxy: Two-component, rust inhibitive polyamide cured epoxy coating material with solids content of 66% by volume resistant to moisture,

splash and spillage of lubricating oils and washdown. The epoxy shall include the following:

- a) Prime coat thickness = 4 to 6 mils DFT.
- b) Finish coat (2 or more coats) thickness = 4 to 6 mils DFT.
- c) Total system DFT = 10 mils.
- 8. Fusion Bonded Epoxy: The coating material shall be 100% powder epoxy applied in accordance with ANSI/AWWA C 213 Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines. The system shall include the following:
 - Liquid Epoxy: as recommended by powder epoxy manufacturer permitted for field repairs shall be 100% solids and applied with not less than 3 coats for DFT of 14 - 16 mils.
 - b) Total system DFT = 14 to 16 mils.
 - c) Valve coating DFT = 14 to 16 mils.
- 9. Cement Mortar Lining and Coating, AWWA C205: A 1-inch minimum thickness mortar coating reinforced with welded wire fabric shall be provided. The cement mortar shall:
 - a) Contain less than one part Type V cement to three parts sand.
 - b) Be cured by a curing compound meeting ASTM C 309.
 - c) Be applied per AWWA C602 for in-situ lining of pipelines.
- 10. Polyethylene Tape and Cement Mortar Coating: A flexible pipe dielectric coating system (polyethylene tape) and cement mortar protective overcoat (rock shield) shall be provided. Polyethylene tape shall be a 3-layer system with:
 - a) A total thickness of 80 mils.
 - b) Conforms to ANSI/AWWA C 214.
 - c) Rock shield with reinforcement conforms to ANSI/AWWA C 205.
 - d) Cement mortar shall be Type V.
- 11. Polyurethane Linings and Coatings for Steel Pipe, AWWA C 222: A flexible coating system with the following:
 - a) A total thickness of not less than 30 mils.
- 12. Polyurethane Coating for Ductile Iron Pipe: The exterior surface of ductile iron pipe and fittings shall be protected with a minimum 25-mil thickness of polyurethane coating. Polyurethane coatings shall be Corrocote 11 TX-15 by Madison Chemical, Tnemec Series 406 Elasto-Shield, or equal. Coating shall conform to National Association of Pipe Fabricators (NAPF) 500-03.

4.06 Buried Piping

A. Steel Pipe:

- 1. The Engineer shall provide one or more of the accepted methods for controlling corrosion of buried steel pipe which can be used individually or in combination:
 - a) Protective linings and coatings such as polyethylene tape, cementmortar, fusion-bonded epoxy, and polyurethane in accordance with this chapter.
 - b) Cathodic protection in accordance with this chapter. All piping shall be tied with test lead stations reference cell.
 - c) Inhibitive environment installed around the pipeline.
- B. Ductile Iron Pipe:
 - 1. The Engineer shall provide one or more of the two common methods for controlling corrosion of ductile iron pipe:
 - Polyethylene encasement utilizing double layers of 8-mil polyethylene. The polyethylene shall be tightly wrapped with tape every two feet minimum.
 - b) Polyurethane lining and coating in accordance with this chapter.
 - c) Cathodic protection in accordance with this chapter. All piping shall be tied with test lead station reference cell.

4.07 Cathodic Protection

- A. General: The need for cathodic protection systems shall be determined on a case-by-case basis by the Engineer with special consideration given to service, soil conditions and stray currents as well as the COH. The two methods of cathodic protection commonly used are described in this section.
- B. Passive System: consists of a galvanic cell created using a sacrificial-anode material such as magnesium or zinc. The system is designed so that the structure or pipeline being protected becomes the cathode and a sacrificial metal becomes the anode. This system is generally used in lightly or moderately corrosion soils where it is desirable to apply small amounts of current at a number of locations.
- C. Impressed Current System: operates much like the galvanic system utilizing an ac-powered rectifier to drive a direct current through the system. Impressed current cathodic protection systems are generally used in heavily corrosive soils.
- D. Bonding of Pipeline Joints: Bonding of joints is required where cathodic protection is provided by the Engineer or is anticipated in the future as determined by the COH. All joints shall be bonded at the time of installation and test stations shall be provided along the pipeline.

E. Service Life: The Engineer shall design the cathodic protection system such that replaceable components such as anodes have a minimum service life of 25 years when coupled with routine monitoring and maintenance.

4.08 Design Checklist

A. A checklist is provided at the end of this chapter for the Engineer's reference and use during design and may not include all applicable design criteria. It is the Engineer's responsibility to review and comply with all guidelines contained herein and all applicable codes completely prior to submitting for review.

DEPARTMENT OF UTILITY SERVICES

TECHNICAL SERVICES DIVISION NEW DEVELOPMENT SECTION

CITY OF HENDERSON 240 WATER STREET HENDERSON, NEVADA 89015

UTILITY SERVICES Corrosion Control Review Checklist

Corrosion Analysis and Evaluation

- □ Soil corrosivity
- □ Soil samples
- Corrosion testing and laboratory analyses

Corrosion Analysis Results, Conclusions, and Recommendations

- Corrosion resistant material selection
- Protection
- Locations for cathodic protection system
- **Quantitative assessment of corrosivity**
- □ Interpretation of results
- Conclusions and recommendations

Induced Voltage and Stray Current Mitigation

- Detential affects on proposed buried piping
- Corrosion control measures
- Methods of mitigating stray currents

Materials Selection

- □ Materials for Buried and Submerged Piping and Accessories
- □ Materials for exposed piping and accessories

August 2010

Concrete

Steel

□ Aluminum

Copper and brass

Protective Linings and Coatings

□ Surface preparation

Protective coatings

Buried Piping

Steel pipe

□ Methods for controlling corrosion control

Ductile Iron Pipe

□ Methods for controlling corrosion control

Cathodic Protection

Cathodic protection system

CHAPTER 5 WATER PUMP STATIONS

5.01 General

- A. The intent of this chapter is to provide guidelines for the design of water pump stations.
- B. This chapter assumes that the proposed water pump station will be a vertical turbine pump station with 3 or more pumps installed.
- C. The COH preference is a factory-built, packaged pump station. Each project will be evaluated individually by the COH as to whether or not a factory-built, packaged pump station is appropriate.

5.02 Design Concept Phase

- A. General: The Design Concept Report (DCR) for the pump station shall be used to evaluate and analyze pump station design criteria and alternatives. The Engineer shall meet with the COH to develop a scope of work that addresses the specifics as it pertains to the pump station, the system, and future needs. The DCR shall be submitted to the COH. The DCR shall address as a minimum, but not limited to the listings provided below:
 - 1. Determining site ownership per Chapter 1.
 - 2. Preliminary site plans and stations location.
 - 3. Preliminary plan with electrical room, pump room, and restroom locations identified.
 - 4. Identify refunding area, if applicable.
 - 5. Pumping and piping configuration:
 - a) Minimum of three total pumps.
 - b) Minimum of one standby pump.
 - 6. Recap demand requirements from utility master plan to include maximum day demand (MDD) and total dynamic head (TDH).
 - 7. Expandability of station and provisions for on-site expansion (if applicable).
 - 8. Major equipment design criteria.
 - 9. Recap of discussion with NV Energy.
 - 10. Alternate power source requirements.

- 11. Noise attenuation to satisfy requirements of Title 19 of the HMC.
- 12. Review of utility master plan analysis and effects on existing facilities within applicable water zone(s).
- 13. Instrumentation and control parameters.
- 14. Building design parameters.
- 15. Community Development entitlement submittals, etc.
- 16. Preliminary cost estimate.
- B. It is the responsibility of the Engineer to ensure that the design meets the requirements of NAC 445A.

5.03 Preliminary Design Phase

- A. General: The preliminary design of the project shall be summarized and presented in a preliminary design report (PDR). The report will be submitted to the COH for review and acceptance. A PDR is required for any water facility considered in this document, regardless of the project's size or complexity. The PDR is the basis for the ensuing design process and must be presented in a fashion, which allows the reader to gain a thorough and complete understanding of the necessity of the project. Without an accepted DCR, the Engineer will not be allowed to submit the PDR.
- B. The PDR shall include, but not be limited to:
 - 1. Executive Summary.
 - 2. Table of Contents.
 - 3. The project background.
 - 4. Identify refunding area, if applicable.
 - 5. Existing site conditions.
 - 6. List major stakeholders and utilities with contact information for each.
 - 7. Summary of utility conflict information, including pothole information or recommendations for utilities proposed to be potholed.
 - 8. Preliminary survey information.
 - 9. Preliminary utilities research.
 - 10. Topographic mapping information summary.

- 11. Draft Geotechnical Investigation Report.
- 12. Draft Environmental Investigation Report.
- 13. Draft Corrosion Control/Cathodic Protection Report.
- 14. Summary of the applicable drainage and traffic study findings with references to those documents submitted separately.
- 15. Hydraulic analysis.
- 16. Surge analysis.
- 17. Summary of individual electrical loads with total connected electrical load.
- 18. Preliminary Electrical Coordination Study in accordance with Chapter 12.
- 19. Standby generator sizing with proposed fuel type, fuel tank size, fuel consumption, and power output.
- 20. Description of Pump Selection to include at a minimum:
 - a) Technical selection criteria including operational scenarios of flow and head with the selected pumps.
 - b) Cost considerations including capital costs and operating and maintenance costs.
 - c) Description of anticipated operational set points.
 - d) Summary of constructability issues.
 - e) Summary of maintenance issues.
 - f) Quantity of duty and standby pumps (minimum of 3 total).
 - g) Proposed pump type and configuration, including the motor horsepower, desired number of stages, and impeller diameter.
 - h) Table that summarizes the pump design criteria, including design head, design flow, motor horsepower, net positive suction head available, and design efficiency.
- 21. Preliminary drawings (30 percent design drawings) illustrating:
 - a) Property ownership, right-of-way and easement information.
 - b) Proposed grading and civil site improvements.
 - c) Site layout locating and/or addressing all drivable access gates, pedestrian gates, perimeter walls, antenna, power/electrical, generator, HVAC, meters, and emergency and maintenance vehicle access/operation requirements.
 - d) Site access for maintenance.
 - e) Proposed offsite improvements where applicable.
 - f) Pipeline plans and profiles where applicable.

- g) Plans with dimensions to indicate equipment locations including all initial and future equipment.
- h) Site/civil drawings showing existing facilities as "screened" and heavy line weights for preliminary locations of facilities.
- i) Pump station plans and sections.
- j) Building plans and elevations.
- k) Major sections indicating pipe centerline elevations.
- I) Electrical single-line diagrams.
- m) Preliminary P&IDs.
- n) All existing utilities.
- o) References all existing utilities with approved plan numbers.
- p) SNWS requirements, as applicable.
- 22. Alternatives evaluation summary.
- 23. Description of provisions for future expansion, including but not limited to future pumps, future piping, future HVAC and future electrical equipment facilities with spacing criteria.
- 24. Project considerations such as:
 - a) Equipment procurement.
 - b) Project schedule, which includes design, bidding, and construction.
 - c) Stakeholder impact, which includes public and private entities.
- 25. Identification of any permanent and temporary ROW/easement constraints and acquisition needs.
- 26. Responsibility matrix summary of permits to be obtained and preliminary schedule for submittals and approvals.
- 27. List of agencies and utilities to review and sign the drawings.
- 28. Outline of technical specification sections and list of final design drawings.
- 29. Preliminary quantities and associated cost estimates.
- 30. Preliminary construction schedule.
- 31. Project correspondence log, including meeting minutes.
- 32. Inventory of existing facilities and improvements.
- 33. Graphics, detail sketches, tables, and other displays to support analyses and recommendations.
- 34. List of relevant reports, plans, and maps reviewed and other relevant project information.

- 35. Work plan for how construction is to be accomplished if connecting into existing facilities (phasing, shutdowns, etc.).
- 36. "Line of Sight" study for PLC/Radio Control (as requested).
- 37. Description of security features, in accordance with the COH Security Master Plan.
- 38. Preliminary description of operation and controls.
- 39. Equipment sizes.
- 40. Preliminary description of architectural features.
- 41. Description of operational noise and noise attenuation, which may include engineering controls. Noise levels shall be estimated within the pump room. Refer to Title 19 of the HMC for noise limitations at the property boundary.
- 42. Required restroom facility at pump station locations.

5.04 Agency and Utility Coordination

A. The Engineer shall initiate contact and coordinate efforts with outside utilities and agencies in accordance with Chapter 1.

5.05 Final Design Phase

- A. General: The Engineer shall provide a Final Design, which builds upon work completed during the DCR and PDR. The Final Design shall include:
 - 1. Final design drawings.
 - 2. Final specifications.
 - 3. Final drawings and specifications shall meet the general requirements presented in Chapter 1.
 - 4. Final Geotechnical Investigation Report.
 - 5. Final Environmental Investigation Report.
 - 6. Final Corrosion Control/Cathodic Protection Report.
 - 7. Final Electrical Coordination Study.
 - 8. Final facilities operations plan.

5.06 Hydraulic Analysis

- A. The Engineer shall perform a hydraulic analysis on all new, upgraded, or modified pump station designs. Hydraulic analysis is required if upgrades or modifications involve:
 - 1. Pump replacement.
 - 2. Modifications to pumping capacity, pump control, and operation adjustment.
 - 3. Significant changes in total dynamic head (TDH) and check valve/control valve closure time adjustments, etc.
- B. The hydraulic analysis will be used to determine the type and size of equipment necessary for efficient pump hydraulic operation and to alleviate hydraulic surges during the normal starting and stopping supply of the pumps and during electrical power failures.
- C. Steady State Analysis: The Engineer shall perform a steady-state hydraulic headloss analysis of the pumping and transmission system to determine the TDH requirements of the pump station. TDH calculations shall be made for new facility designs as well as existing facility design modifications. The Engineer shall:
 - 1. Obtain pipeline route and profile elevations from the COH if available.
 - 2. Perform a detailed headloss analysis of the pump suction piping and determine the net positive suction head available (NPSHA) for the pumping system. NPSHA shall always be more than the net positive suction head required (NPSHR) of the selected pump(s) under an agreed-upon, worst-case scenario.
 - 3. Provide a system head-capacity curve.
 - 4. Determine pumping head requirements. TDH shall not exceed 25 feet above nominal pressure zone head or a 10-psi fluctuation for residents within the zone.
 - 5. Provide flow velocities in the suction header and discharge header.
 - 6. If applicable, the COH shall provide the Engineer the necessary operating criteria of the existing pumped system, i.e. operation levels, existing and future flow demand, as-built drawings (if available), existing pump curves, pumping rates and discharge pressures.
 - 7. Provide minimum and maximum static head analysis.

- 8. Provide recommended pumping rates.
- 9. Determine pipe class rating.
- 10. Ensure pump shutoff head is less than pipe class rating.
- 11. Provide a list of friction factors for proposed pipe materials.
- D. Surge Analysis: Every pump, transition main, distribution line system, etc. is subject to transient pressures and conditions. The Engineer shall perform a transient (surge) analysis for all pumped systems whether new or a modification of an existing system. The transient analysis shall consider the following:
 - 1. Normal operating conditions (pump startup and shutdown).
 - 2. Emergency shutdown at firm capacity.

5.07 Surge Mitigation Measures

- A. The Engineer shall be responsible for all elements of the pump station design, including the surge protection equipment. The surge protection equipment recommendation shall be addressed in detail in the PDR.
- B. The Engineer shall utilize the surge pressure envelope derived from the transient analysis as the basis for establishing the design of the yard and station piping, including the design of pipe joints (gaskets), fittings, valves, surge tanks and appurtenances used in the yard, station, and transition system piping.
- C. The handling of transients is a site specific issue. Depending upon the analysis performed and the results obtained, surge mitigation strategies can vary widely and, depending upon the system, can be required on both the suction and discharge sides of the pumping units. Typical surge control/protection measures shall include:
 - 1. Attenuation of surge pressure by programmed pump control valve closure.
 - 2. Use of surge relief control valve or surge anticipation valves.
 - 3. Design pipelines, valves and flanges to resist upsurge and downsurge pressures based on the surge envelope.
 - 4. Selection and location of proper control devices, i.e. air relief/air vacuum valves.
 - 5. Identification of proper start-up, operation, and shutdown procedures for the system.
 - 6. One-way or two-way surge tanks if warranted by the transient analysis.

- D. Pump control valves shall be designed with a hydraulically controlled closure mechanism that will provide soft/restrained closure of the valve during power failure and not allow the valve to slam closed.
- E. Surge relief control valves or surge anticipation valves will be considered if provisions are included in the design to provide an acceptable method to pipe the discharge back into a tank/reservoir.
- F. Surge Tanks: Depending on the transient hydraulic analysis performed and the results obtained, pump stations may be required to be designed with a surge tank on the discharge and/or supply side of the pump for surge protection. If required, the Engineer shall design hydro pneumatic tanks to be:
 - 1. Compliant with all paint and primer codes TT-P-86 and AWWA Standards.
 - 2. Sized to reduce incremental surge pressure increase to a maximum of 33 percent of the pipeline design pressure.
 - 3. Rated to withstand pressure of 1.5 times the maximum design pressure for the system and be rated for full vacuum pressure of -14.7 psig unless otherwise justified by a surge analysis.
 - 4. Designed, fabricated and tested in accordance with ASME Section VIII Pressure Vessel Code.
 - 5. Designed to meet site-specific seismic criteria and wind criteria.
 - 6. Provided with a 1/16-inch thick corrosion allowance.
 - 7. Equipped with a pad-mounted compressed air system and level sensor to maintain the air-to-water ratio and alarms.
 - 8. Included with air compressor, controls and accessories as an integrated package provided by a single responsible party or packaged pump station manufacturer.
 - 9. Equipped with all accessories required for proper operation, which include the following at a minimum:
 - a) Pressure relief valve vented and piped to a safe location.
 - b) Access manholes.
 - c) Integrated level sensors/indicators (magnetic coupled level indicator).
 - d) Level switches manufactured by Gems or B/W Controls.
 - e) Isolation valves.
 - f) Drain piping.
 - g) Recirculation piping.
- h) Pressure sensor fittings and compressor fittings shall be copper or stainless steel. Galvanized fittings are not acceptable.
- 10. Provided with packaged, pad-mounted air-compressors manufactured by Ingersoll Rand, Gardner/Denver or Chicago Pneumatic. Compressors shall be:
 - a) Equipped with an integral air reservoir.
 - b) Designed to deliver the required air flow and pressure to sustain a hydro-pneumatic tank sized appropriately for the identified surge condition.
 - c) Capable of producing a minimum of 50 scfm.
 - d) Included with surge tank, controls and accessories as an integrated package provided by a single responsible party or packaged pump station manufacturer.
- G. Surge Tank Control System: shall be provided by a single entity and shall include:
 - 1. An automatic air-volume control system that utilizes a surge tank level probe and packaged air-compressor system to control the air/water ratio and shall include the following functions at a minimum:
 - a) High water level condition shall open an air supply valve after a time delay to increase the air volume in the surge tank.
 - b) Low water level condition shall open an air bleed valve after a time delay.
 - 2. Stainless steel, NEMA 4X control panel with all necessary instrumentation controls in accordance with Chapter 13, which indicates the following at a minimum:
 - a) Tank liquid levels.
 - b) High water alarm light.
 - c) Low water alarm light.
 - d) Surge tank level probe fault alarm light.
 - e) Valve positions.
 - 3. Surge tank level probe shall be conductivity type equipped with control relay, electrodes, and electrode holder as manufactured by B/W Controls or Warrick.
- H. Pump stations, regardless of surge tank requirements, will be required to have an air-compressor to run air tools.

5.08 Site Civil

- A. The pump station shall be located such that suction, discharge piping, and static head are minimized.
- B. The pump station location shall not be located in an area with steep slopes or area that presents construction and/or operation and maintenance challenges.
- C. Yard Piping: Pipe materials approved for use as yard piping on the COH facilities include the following:
 - Mortar Lined and Coated Welded Steel pipe conforming to ANSI/AWWA C 200.
 - 2. Ductile Iron pipe conforming to ANSI/AWWA C 151.

5.09 Signage

A. Each pump station site shall be identified with a sign mounted on the exterior of the masonry perimeter wall adjacent to the site access gates. Exact location will be determined by the site layout on a case-by-case basis. Traffic control signs shall be provided as needed per Figure 5.1 The sign shall be 18-inches wide by 24-inches tall by 0.04-inches, aluminum with baked enamel finish, and suitable for exterior locations. Signage shall be in accordance with Figure 5.1.

5.10 Access Gates

- A. Access to the pump station site shall be through a minimum 24-foot wide steel frame swing (double leaf) gate or rolling gate. Provisions shall be made by the Engineer to provide enough space for maintenance vehicles to park out of traffic and adequate sight distance to safely enter and exit the site.
- B. Gates shall be automatically operated.
- C. At a minimum, one 4-foot wide pedestrian access gate, which locks from the exterior, shall be provided.
- D. Motor operated gates shall be equipped with sensors, card swipe, automatic vehicle identification loop, and all features identified in the COH Security Master Plan.

5.11 Security

- A. At a minimum, an eight (8) foot tall masonry perimeter wall with locked entrance shall be provided around the building. The perimeter wall shall also:
 - 1. Be equipped with security pickets installed on the entire perimeter wall.

- 2. Be compatible with the surrounding environment, including landscaping.
- 3. Be equipped with downcast site lighting, (both wall and pole mounted) with at least two photocell-operated lights in accordance with Chapter 12.
- 4. Satisfy all COH architectural and other Community Development requirements for appearance, colors, and coatings.
- B. All other security issues shall be addressed by the Engineer, which include items described in the latest version of the COH Security Master Plan.

5.12 Noise Attenuation

- A. Maximum noise levels in working environments are regulated under the federal Occupational Safety and Health Act (OSHA). OSHA requirements as well as local, state and federal regulations shall be included in the design of all facilities to mitigate noise levels. Station noise discussed herein applies to both pump station facilities and facility boundaries.
- B. Noise due to construction or operation of pump stations shall meet the requirements of Title 19 per the HMC. Examples of noise include the following:
 - 1. Operating equipment such as pumps, standby generators, HVAC, compressors.
 - 2. Construction and maintenance activities such as operating tools and construction equipment.
- C. Facility Noise Production Studies: The Engineer shall complete a Noise Production Study for all pumping stations located near residential or commercial areas or if required by the COH.
- Engineering Noise Controls: The Engineer is responsible for all engineering noise controls for pump stations, which shall mitigate noise to appropriate levels. Use of an experienced acoustical engineer may be required. Examples of engineering controls include:
 - 1. Sound enclosures and/or insulated rooms for equipment.
 - 2. Selection of pump and air compressor equipment.
 - 3. Selection of HVAC equipment, inlets, outlets, and duct.
 - 4. Use of sound barriers, sound traps, acoustical shrouding, and/or insulation.
 - 5. Incorporating additional dead space at doorways and windows.

5.13 Vault Standards for Water Pump Stations

- A. General: The Engineer shall locate vaults in non-traffic areas whenever feasible.
- B. Drainage: All vaults shall be designed to drain to a sump equipped with a sump pump or equipped for a portable pump as determined by the COH.
- C. Valve Vaults: For ease of access and maintenance, the COH requires the use of vaults for buried valves 24 inches and larger.
- D. Traffic Area Considerations: Vaults shall incorporate heavy-duty, cast iron frames and covers capable of withstanding H-20 live loads imposed by heavy maintenance equipment, chemical delivery trucks, and other vehicles. Vault access shall be provided by hatches as manufactured by Bilco, or approved equal.
- E. Non-Traffic Area Considerations: Vaults shall be designed for live loads due to foot traffic and maintenance equipment such as hoists. Vault manway access shall be provided by hatches as manufactured by Bilco, or approved equal.
- F. Vault entrance risers shall be a minimum of 36 inches in diameter complete with access ladders. Because of the "confined space" regulations and safety issues, the COH has requested that prior to starting final design of any vaults, the Engineer must receive prior approval for their use through the COH.
- G. Only necessary instrumentation and electrical equipment and accessories such as intrusion switches, GFCI power receptacles, and interior lighting are allowed inside vaults. Whenever possible, all electrical and instrumentation shall be located in a remote, dry and secure area.
- H. Flow Meter Vault Considerations:
 - 1. Magnetic flow meters shall be used for flow measurement of pump stations in accordance with the requirements of Chapter 13.
 - 2. Magnetic flow meters shall be sized and located with sufficient upstream and downstream straight runs of pipe in accordance with the requirements of Chapter 13.
 - 3. Flow meters shall be provided with manual isolation valves that can be operated without the need to enter the vault to remove meter from service.
 - 4. Magnetic flow meters shall be located above grade whenever possible to avoid confined space entry issues.

- 5. An exterior panel shall be provided for flow meters located inside buried vaults to provide a visual display of the flow meter in units of gallons per minute or million gallons per day as determined by the COH.
- 6. The flowmeter transmitter shall be located inside a building.
- 7. Flowmeters located inside buried vaults shall be equipped with high water level or "flood" alarm, sump pump or provisions for portable pump, interior lighting, ventilation pipe and power receptacle for portable forced ventilation.

5.14 Architecture and Landscaping

- A. Design Appearance Guidelines: The Engineer shall establish criteria for the architectural and landscaping features based on nearby facilities through the COH. Both landscaping and architectural design should be developed in character, style, form, color, and materials to harmonize effectively with the surrounding environment.
- B. Representatives of the COH shall review with the Engineer existing COH facilities in terms of massing, materials, and colors. Traditionally established COH preferences and guidelines for materials and appearance systems, structural systems and major building envelope systems will be discussed and their appropriateness to the specific application will be assessed. These preferences and guidelines will be developed within the context of the specific location of the project site, and therefore not all facility designs should be expected to have the same architectural theme and character.
- C. Construction materials and methods shall be established and defined, both in terms of their physical appearance and overall visual effect in harmonizing with the surrounding environment, their emergence from the basic structural system, and their appropriateness in accommodating the deployment of mechanical and electrical systems within the facility.
- D. Weathering systems shall also be defined in terms of the desert climate in the area. The roofing system and the building perimeter envelope shall be established for optimum durability over the full range of climatic variations typical to the area.
- E. These examinations shall form the basis of directions to the Engineer for appearance of the new building. From these discussions, the Engineer shall develop specific graphic and written statements defining the architectural theme and character of the new structure as well as its relationship to other functions on the project site and its harmony with the visual context of surrounding land uses.

The following are suggested design parameters, which may assist in these aspects of the design of the facility.

- F. Height of Structures: The facilities shall be kept as low in profile as is functionally possible.
- G. Reflective Finishes: Visible and highly reflective materials and surface finishes should be avoided on the exterior of the facility.
- H. Exterior Walls: The use of low maintenance indigenous materials such as splitface masonry block for exterior walls of the site and pump building is encouraged. Employment of surface textures and horizontal banding of harmonious colors are some of the techniques, which should be considered in blending the facility with its environment. Material coloration should be achieved through the use of integral coloration rather than applied coloration such as paint, which must be maintained.
 - 1. All exterior walls of the pump station building shall be constructed with block core insulation in either of two forms:
 - a) Loose beads comprised of expandable polystyrene (EPS) or inert volcanic glass such as vermiculite.
 - b) Solid block core inserts comprised of EPS.
- I. Anti-Graffiti Coating: At a minimum the exterior of the masonry perimeter wall shall be coated with anti-graffiti protection system that meets the following requirements:
 - 1. Two component high build epoxy polymer system with at least 35 percent solids by volume.
 - 2. Coating shall provide resistance to weather and rain damage, abrasion, peeling, ultraviolet degradation yellowing, and chemical attack.
 - 3. Coating system shall withstand 120 cleaning cycles without degradation and shall allow 100 percent removal of paint and graffiti without signs of deterioration or change in appearance. System shall not require reapplication to maintain performance over 10 years.
 - 4. Color shall be clear unless indicated otherwise.
 - 5. Base Coats: GSS Barrier by American Polymer Corporation. Apply at least 2 coats at rate and thickness required by the manufacturer to produce a pinhole free base.
 - 6. Finish Coats: At least 2 coats of Graffiti Solution System GSS-10 by American Polymer Corporation.

- 7. Extra Material: Furnish to the COH one gallon of Erasol AP 400 for each 5000 square feet of surface receiving the Anti-Graffiti Protection System.
- 8. At the discretion of the COH additional areas of the facility may be required to be treated with an anti-graffiti coating system.
- J. Roofing: The design of roof systems should be carefully developed to harmonize with the visual context of the facility. Pitched, ceramic, or concrete tiled roofs are desired and consideration should be given to selection of the pitch, the tile materials, and coloration to harmonize with the surroundings. Highly reflective roof surfaces shall not be visible from adjacent property. Interior open wood truss construction is acceptable.
- K. The Engineer shall incorporate roof deck insulation on top of the open truss system into the design of the pump station building. The deck insulation shall be a "sandwich" type design, incorporating a surface suitable for nailing the roofing tiles and a thermally efficient insulation board separated by vent spacer strips creating a cross ventilating airspace. The roof insulation shall provide a minimum insulation value of R=6.
- L. The Engineer shall incorporate roof hatches in the design of the pump station building. The roof hatch shall be installed over each pump within the building. Hatches shall be sized to accommodate the removal of the motors and pumps. Safe access and security of the hatches shall be determined on a case-by-case basis. Roof hatches shall be motorized and capable of operation at ground-level, connected to standby power where applicable.
- M. Insets, Grills, Trim and Accents: Insets, grills, trim material, and accents should be employed where necessary or appropriate in achieving compatibility with adjacent structures. Insets, grills, trim and accents shall be consistent with the color palette chosen for the facility and should avoid bold, strong, or reflective colors.
- N. Doors and Frames: Door and frame colors shall be compatible with the wall surface in which they are located. A minimum 10-foot wide, minimum 10-foot high, overhead roll-up steel door shall be provided at one end of the pump station for maintenance vehicle access. Single doors shall be installed on opposite walls of the station for maintenance access. If the MCC is located in a separate room, the Engineer shall provide an exterior double door for access and maintenance.
- O. Lighting: Lighting should satisfy functional and security needs while not creating light pollution in the form of point sources of direct glare which are visible from a distance. Lighting should be sensitive to the privacy of adjacent land uses. Fixtures should be carefully selected for efficiency, cut-off, consistent lamp coloration throughout the project, and effectiveness in delivering only the light,

which is necessary to the task, while avoiding unnecessary spill lighting beyond the site boundaries. Low level, directional light fixtures, which light immediate areas, are encouraged.

- P. Equipment and Service Areas: All mechanical and electrical equipment as well as service yards and service areas shall be screened from public view.
- Q. Material Safety: Materials employed in the construction of the facility shall conform in composition and application to all applicable regulations, including but not limited to, those concerning Volatile Organic Content, lead, mercury, Chlorofluorocarbons (CFCs), and asbestos.
- R. Site Constraints: The Engineer shall cooperate closely with the civil engineering disciplines associated with site planning for the facility to assure that view sheds are optimized while hydraulic elevations and storm drainage provisions are preserved. Regardless of visual circumstances, the facility shall in all cases be located above the 100-year storm flood elevation.
- S. Landscape Coordination: The landscape must be perceived as an extension of the directions established for the materials and form of the building. As such, the Engineer shall be responsible for guiding and coordinating the landscape design for the project, either by retaining the services of a subconsultant or engaging a landscape professional on his own staff.
- T. The Engineer shall observe all applicable codes and other requirements adopted by local permitting agencies. The currently adopted version of these documents shall be used as reference for design purposes. In case of conflict between the requirements of this document and any code adopted by local permitting agency, the code requirements will govern.

5.15 Pump Systems Design

- A. General: The Engineer shall include the following in the project design:
 - 1. Design head and design flow for pump.
 - 2. Design requirements for the pump, motor, drive (constant or variable speed).
 - 3. Materials of construction for drive shaft, barrels, couplings, supports, and impellers.
 - 4. Instrumentation, controls, and appurtenances.
 - 5. The pump and motor shall be provided by the pump supplier.

- B. General Station Layout: The Engineer shall work with the COH to establish a preliminary layout of the pump station. A schematic to aid in preparing a pump station layout is presented in Figure 5.2. The layout shall address:
 - 1. General room dimensions and use, including length and arrangement of exposed piping, location of valves, flow meters, pumps, tanks, MCC panels, and all equipment.
 - 2. The footprint of the individual pumps will affect the dimensions of the station and thus must be established early in the design process.
 - 3. The layout shall address the number of pumps for the facility which shall include at a minimum 3 pumps (2 duty, 1 standby) Space may be required for future pump station expansion.
- C. System Head Curves: The Engineer shall develop a series of system head curves for pump scenarios, which includes the following at a minimum:
 - 1. Curve for low head condition (high-level in supply reservoir and low-level in receiving reservoir) and high head condition (low-level in supply reservoir and high-level in receiving reservoir).
 - 2. Each System Head Curve shall indicate:
 - a) Variation of TDH with flow.
 - b) Family of curves for a variety of operating conditions, which include minimum, typical and maximum values for static head, flow, pipe roughness coefficient.
 - c) Number of operating pumps.
 - d) Selected pump(s) and impeller characteristics.
 - e) Curves at varying speed if pump speed control is required.
 - f) Efficiency.
 - g) Net Positive Suction Head Required (NPSHR).
 - h) Brake Horsepower.
 - 3. The Engineer shall analyze the System Head Curves at varying operating conditions and number of pumps running and shall confirm the following for the selected pump(s):
 - a) Pump curve is not "flat" where small change in TDH would result in a large change in pump flow.
 - b) Typical operating point on the system curve is near the maximum efficiency point or Best Efficiency Point (BEP).
 - c) The pump will operate such that pump shutoff or run out operation is not expected at either minimum or maximum operating conditions.
 - d) The pump/impeller combination is located near the center of the pump operating curve.

- D. Pump Selection: In general, pump stations should be designed with consideration of the station's firm pumping capacity in accordance with the current COH service rules as the initial design capacity. The firm capacity of the pump station is the total pumping capacity of the station (maximum day demand) with the largest pump out of service, at maximum static differential levels. The pump station is assumed to take suction from a reservoir or clearwell.
- E. Pump Inlet Configuration: The Engineer shall calculate the Net Positive Suction Head Available (NPSHA) for maximum flow at maximum temperature and at minimum flow at maximum temperature. The pump inlet shall be:
 - 1. Designed in accordance with Hydraulic Institute Standards to prevent turbulence, vortexing and jet velocities
 - 2. Designed such that the Net Positive Suction Head Required (NPSHR) is less than the NPSHA (where NPSHA is reduced by a minimum of 5 feet to provide a factor of safety):
 - a) For maximum flow conditions.
 - b) For minimum flow conditions.
- F. Pump Spacing and Clearances: In general, pumps shall be arranged to provide convenient access for operation, maintenance, equipment installation, and equipment removal on at least three sides. Minimum clearance requirements are as follows:
 - 1. Unless otherwise required by OSHA or NEC, a minimum of 3-foot clearance around equipment shall be provided on at least 3 sides of pump equipment.
 - 2. Equipment, piping, etc. shall be oriented in the pump station to provide convenient safe access for operation and maintenance, including the installation and removal of equipment.
 - 3. A minimum of 3 feet, 6 inches walkway corridor shall be provided between the piping/appurtenances of all pump station walls, stairways, ladders, etc.
 - 4. The Engineer shall indicate any horizontal and vertical clear spaces in contract documents and denote that these spaces are to be kept free of conduit, panels, piping, HVAC, and other accessories.
 - 5. The Engineer shall be responsible for providing minimum vertical and horizontal clearances per the manufacturer's recommendation for all equipment with an additional 12 inches.
 - 6. Vertical obstructions shall be located a minimum of 7 feet, 6 inches above the finished floor.

- G. Pump Efficiency: The Engineer shall select pumps such that pumping hydraulic efficiencies are not less than 84 percent at design flows and not less than 80 percent within the full operating range of the pumps. Requirements for lower efficiencies should be referred through the COH.
- H. Expandability: Pump station expandability will be evaluated by the COH on a case by case basis:
 - 1. If a pump station is planned to be expanded in the future, the Engineer shall ensure that adequate space is provided to accommodate installation of future equipment.
 - 2. The suction and discharge piping manifold shall be sized for future flows.
- I. Drive Equipment: Based on the variation in operation, pump speed control with variable speed drives should be considered. In cases where constant speed motors are used soft start and soft stop features shall be provided.

5.16 Pump Speed Control

- A. The Engineer shall justify use of variable frequency drives (VFDs) for the project. Every project for which VFDs are proposed requires review and approval by the COH.
- B. Variable Speed Control: All VFDs shall meet the requirements of Chapter 12. In addition, VFDs shall include the following:
 - 1. Complete description of the power system including requirements for operating through standby generators.
 - 2. Power requirement as a function of pumping capacity.
 - 3. Allowable supply voltage wave form distortion.
 - 4. Allowable supply voltage notch area.
 - 5. Minimum and maximum allowable power factor over working speed range.
 - 6. Minimum allowable efficiency at full speed and load.
 - 7. Required operating ambient temperature range.
 - 8. Required diagnostics provisions.
 - 9. Control and monitoring signal interface.
 - 10. Acceptable ambient noise level.
 - 11. Adjustable ramp acceleration/deceleration time.

- 12. Characteristics (available short circuit current X/R ratio) of power supply including alternate and standby power supplies.
- 13. Allowable speed regulator error.
- 14. Provide VFD recommended spare parts.
- 15. Cooling requirements.
- C. Packaged Pump Stations: Use of non-factory fabricated package pump stations will be evaluated by COH on an individual basis.

5.17 Pump Station Piping

- A. General: The Engineer shall design pump station piping according to the requirements of this section. The general piping requirements include but are not limited to:
 - 1. Flanges and pressure classes shall be compatible for all piping.
 - 2. All equipment, piping, and valves shall be provided with sufficient vertical and horizontal clearance for maintenance and removal.
 - 3. Valves and operators shall be readily accessible and located not more than 5 feet above the finished floor unless approved by the COH.
 - 4. All piping shall be adequately supported.
 - 5. All pressurized piping shall be restrained.
- B. Exposed piping within the pump station shall be flanged welded steel pipe or flanged ductile iron pipe in accordance with the following.
 - 1. Steel pipe shall conform to the requirements of ANSI/AWWA C 200 and design requirements of AWWA M 11 and shall be primed / painted with a primed epoxy coating and fusion bonded epoxy lining system.
 - 2. DIP shall be minimum pressure Class 150 cement mortar-lined with a primed epoxy coating and cement mortar lining.
 - 3. All flanged joints shall conform to the requirements of ANSI/AWWA C 207.
 - 4. Fusion bonded epoxy system shall conform to requirements of ANSI/AWWA C 213.
 - 5. All materials and coatings shall meet requirements of NSF 61.
- C. Suction piping shall be designed to minimize long runs and high points. The Engineer shall also provide the following:

- 1. Maximum suction piping velocity of 5 fps. Higher velocities are only allowed under emergency conditions unless otherwise approved by the COH.
- 2. Air relief valves at all high points on piping shall be hard piped to a nearby drain.
- 3. High quality dampening pressure gauges with an appropriate range.
- 4. Reducers of the eccentric type (flat end on top) shall be used upstream of the pump suction.
- 5. Isolation valves shall be AWWA C 504 butterfly valve with geared hand wheel operator upstream of each pump suction.
- D. Discharge piping shall be designed to minimize high points. The Engineer shall also provide the following:
 - 1. All joints on suction and discharge piping shall be restrained.
 - 2. Pump discharges shall be joined to a common discharge header, which shall pass through a flow meter located to provide sufficient upstream and downstream pipe diameters per the flow meter manufacturer. Maximum discharge header velocity of 10 fps. Higher velocities are only allowed under emergency conditions unless otherwise approved by the COH.
 - 3. A high pressure relief valve shall be provided between the discharge header and supply header, hard piped from the discharge header back to the suction header.
 - 4. Air relief valves at all high points on the discharge piping shall be hard piped to a nearby drain.
 - 5. High quality dampened pressure gauges with an appropriate range.
 - 6. Reducers of the concentric type shall be used downstream of the pump discharge. Air relief discharge shall be piped to an adjacent drain.
 - 7. Isolation valves shall be AWWA C 504 butterfly valve with geared hand wheel operator downstream of each pump discharge.
 - 8. Discharge manifold to utilize flanged end connections to individual pump connections.
 - 9. Spool with minimum 1-inch NPT welded coupling for steel pipe or manufactured instrument Tee for DIP to accommodate a pressure gauge and pressure switch.

- 10. Spool with welded outlet for steel pipe or manufactured Tee for DIP to accommodate an air vacuum/air release valve, if required.
- 11. Provide restrained coupling adapters or flexible couplings as manufactured Victaulic Depend-O-Lock, or approved equal. Dismantling joints may also be used as manufactured by Romac Industries, or approved equal to facilitate disassembly and removal.
- 12. Provide dismantling joints in accordance with requirements of Chapter 7.
- E. Flexible Couplings: shall be provided between pump equipment and rigid connections to mitigate vibration, cushion shock loads, accommodate misalignment, and facilitate disassembly and reassembly. Additional requirements are as follows:
 - 1. Pump Suction: couplings located between the pump inlet isolation valve and pump.
 - 2. Pump Discharge: couplings located between the pump and discharge check valve.
 - 3. Provide anchors on pump and piping for longitudinal restraint.
- F. Insulating Flanges and Gaskets shall be provided at the transition between dissimilar metals and between the pump skid and the underground piping to mitigate galvanic corrosion.
- G. Pump isolation valves shall be AWWA C 504 butterfly valves.
- H. Check Valves shall be installed on horizontal piping runs if required. Check valves shall be:
 - 1. Silent, globe style, non-slamming type.
 - 2. As manufactured by APCO, Golden Anderson (GA) Industries, Inc., Valmatic, or approved equal, with model determined by the application.
- I. Air Release Valves shall be provided at high points and shall be manufactured by APCO, GA Industries, Inc., or Valmatic and shall be epoxy-coated inside and outside with stainless steel trim.
- J. Combination or Vacuum/Air Release Valves shall be provided in locations determined by the Engineer and shall be as manufactured by APCO, Valmatic, GA Industries or approved equal. and shall be epoxy-coated inside and outside with stainless steel trim.

- K. Manual Valve Operators shall be sized for operating pressures. Operators shall be manufactured by Limitorque, EIM, Dezurik, Pratt, or Rotork.
- L. Pipe Restraints shall be provided and shall include the following at a minimum:
 - 1. Thrust restraints designed to resist maximum operating pressures and surge pressures.
 - 2. Anchor rings for all pipes that penetrate walls.
 - 3. Longitudinal restraint shall be provided through flanged coupling adapters and flexible sleeve couplings.
- M. Liquid Filled Pressure Gauges: Shall be standard bourdon-style oil (glycerin)filled pressure gauges, 4-inch diameter, 4-inch face. Type 316 Stainless Steel construction. Typical operating conditions should register at the middle of the scale Pressure gauges shall be as manufactured by:
 - 1. Ashcroft.
 - 2. H.O. Trerice.
 - 3. Ametek/US Gauge.
- N. Provide piping supports and straps to keep all weight off the pumps. The Engineer shall be responsible to ensure that sufficient pipe supports are provided such that no loads are transferred to equipment flanges.
- O. Provide hatch and door openings of sufficient dimension to facilitate the removal of pump, motor, and major equipment.

5.18 Pump Motors

- A. General: Motors shall comply with requirements of Chapter 12.
- B. Manufacturers: Acceptable motor manufacturers are:
 - 1. US Motors.
 - 2. General Electric (GE).
 - 3. Toshiba.
 - 4. Reliance.
 - 5. Baldor.
- C. Pump Motor Material: shall be cast iron with UL, FM, CSA or NSF International approval required.

- D. Access: For line shaft vertical turbine pumps, a catwalk, service grating, or some type of access/maintenance platform shall be provided in order to allow servicing of the motors.
- E. Prime mover: Vertical electric motor of premium-efficiency design, NEMA type, open drip-proof weather protected Type I, squirrel cage induction type with Class F insulation and designed for a Class B rise, designed and applied in compliance with NEMA, IEEE, NFPA and the NEC.
- F. Space Heaters: Motor space heaters are not required.
- G. All rotation changes (phase reversal) shall be made at the motor and not at the MCC.
- H. Pump motors shall not be loaded to use more than the rated horsepower with a minimum service factor of 1.15.
- I. Drive on each pump shall be a vertical, solid shaft, high-efficiency, high thrust, non-reverse ratchet electric motor. Each electric motor shall be designed to accept the total, unbalanced thrust force imposed by the pump.
- J. Electric motors from 5 hp to 400 hp shall be rated at 460 Volts, 3 phase, 60 Hz.
 (COH reserves the right to modify this requirement depending upon the design and operation flexibility.)
- K. Ratings for electrical motors larger than 400 hp shall be reviewed by the COH.
- L. Line-shaft vertical turbine pumps shall be in the range of 900 and 1800 rpm. COH reserves the right to modify these minimum and maximum requirements depending upon design and operation flexibility.
- M. Motor noise shall be less than 90 dBA at a distance of five (5) feet from the motor.
- N. The motor torque and locked rotor characteristics shall be specified in the NEMA standards for Design B and shall be selected to be non-overloading throughout the driven pump's full speed performance curve.
- O. The motor shall be of the solid-shaft type, steel cast and adapted to a four (4)piece flanged coupling assembly that will adapt to the bowl shaft assembly.
- P. Motors located indoors shall be specified for a 50 degree Celsius ambient temperature.
- Q. Motors located outdoors with sun shielding shall be specified for 60 degree Celsius.

- R. Once the motors have been installed, the specifications shall specify that a vibration analysis and summary report be prepared and submitted to the COH through the QC representative.
- S. Where used in conjunction with variable speed drives, provide Inverter Duty Rated electric motors fully compatible with the variable speed controllers that comply with the requirements of NEMA MG-1 Part 31.
- T. Motor connection terminals or power distribution blocks shall be provided for motors over 100 horsepower.
- U. Aluminum motor rotor bars shall not be provided.
- V. All motors except those for variable speed drive systems shall have a service factor of 1.15.
- W. Motors 100 horsepower and larger shall be:
 - 1. Totally Enclosed, Fan-Cooled (TEFC).
 - 2. Equipped with velocity transducers for vibration monitoring with alarm. Velocity transducers shall be as manufactured by Bently, Nevada or equal.
 - 3. Provided with at least 2 Resistance Temperature Detectors (RTDs) per phase of windings with alarm. RTDs shall be 100-ohm platinum, 3-wire type.
- X. Motors located in below-grade facilities shall be provided with moisture sensing devices with contacts to indicate leak detection alarms.

5.19 Pumps

- A. General: The Engineer shall specify vertical multistage turbine, barrel-mounted, water lubricated pump with impellers of such design that the head capacity curve is equal to or slightly better than required.
- B. All pumps and materials shall be UL and NSF approved.
- C. The pump manufacturer shall be responsible for providing the pump, column, can, and motor.
- D. Bowls shall be (typical) cast-iron. Internal surfaces of the bowl units shall be coated with 8 mils of fusion bonded epoxy.
- E. Impeller shall be zinc-less bronze, stainless steel or aluminum bronze and statically and dynamically balanced with Type 316 stainless steel bolting.

- F. Wear rings shall be aluminum bronze, hard faced replaceable (wear ring alloy shall not gall when used with impeller alloy).
- G. Shaft shall be stainless steel, Type 410, 416, or 316.
- H. Suction bell shall be cast iron, with bottom bearing and streamlined ribs; for lining and coating; see bowls.
- I. Column shall be steel pipe, not less than Schedule 40, fusion bonded epoxylined and coated, in maximum 10-foot lengths, flanged with registered fit and through Type 316 stainless steel bolting.
- J. Line shaft couplings shall be Type 316 or Type 416 Stainless Steel shaft and couplings in maximum 10-foot lengths, sized for a critical speed of minimum 20 percent above maximum operating speed.
- K. Shaft lubrication shall be water.
- L. Shaft seal shall be a mechanical split seal.
- M. Line shaft bearings shall be zinc-less bronze, stainless steel, or aluminum bronze at each joint for open line shaft.
- N. Discharge head shall be steel and shall also be provided with 1-1/4-inch connections for air valve, pressure switch, and drain connections.
- O. Motor shaft coupling shall be a flanged Type 316 stainless steel coupling.
- P. Suction Bowl Bearings: shall be close tolerance bronze sleeve type with selfcontained grease lubrication system filled with graphite type non-soluble grease; provide bearing with sand cap. Grease shall be approved by Food and Drug Administration for use in potable water. Grease tube and fitting shall be Type 316 stainless extended to base plate.
- Q. Bowl and suction case bearings shall be water lubricated zinc-less bronze or aluminum bronze sleeves.
- R. Acceptable manufacturers are listed below:
 - 1. Flowserve.
 - 2. Floway.
 - 3. Byron Jackson.
 - 4. Goulds/ITT Pumps, Inc.
 - 5. Peerless Pumps.

- S. Provide the following spare parts:
 - 1. One complete spare bowl assembly for each pump size.
 - 2. One complete split mechanical seal.
 - 3. One split mechanical seal rebuild kit for each pump.
- T. Pump Cans shall meet the following requirements:
 - 1. Maximum can velocity shall not exceed 5 fps or as specified in the latest edition of HI.
 - 2. Pump cans shall be of a sufficient diameter to avoid limiting or restricting the flow of water into the pump inlet.
 - 3. Steel cans shall be fusion bonded epoxy lined and coated conforming to AWWA C 213-91. The powder coating product shall be National Sanitation Foundation (NSF) Standard 61 certified material.
 - 4. The can shall have bolt-on flanges to allow for removal.
 - 5. The cans shall be of sufficient depth to accommodate the pump.
- U. In order to reduce the potential for pump cavitation, the pump impeller shall be mounted a minimum of 1-1/2 times the diameter of the pump bowl away from the bottom of the pump can. This distance of clearance has been presented in various texts as a function of the pump inlet diameter. It is recommended that the Engineer consult with various experts in the field of pumping to verify the minimum clearance required for the particular design condition.
- V. Future expansion provisions such as using larger pump cans, additional pump cans, etc. shall be discussed with the COH.
- W. Power Monitoring: Power monitoring equipment shall be provided for all pumps in accordance with requirements of Chapters 12 and 13. A Microprocessor based device shall be used such as GE Multilin 269 for pump equipment.
- X. Alarms and Monitoring: Instrumentation and switches for monitoring and alarms to SCADA shall be provided in accordance with requirements of Chapter 13.
- Y. Factory Acceptance Testing shall be verified by an independent third party Engineer registered in the State of Nevada.

5.20 Vibration

A. General: The Engineer shall design the pumping facility such that equipment is isolated from vibration and within the vibration limits provided herein.

B. Vertical Pump Vibration Limits: Vertical pump field vibration acceptance limits shall be laterally (horizontally) not more than 3.5 mils peak-to-peak displacement and not more than 0.15 inches per second RMS velocity measured in any direction at the motor base flange. Displacement and velocity measurements shall be unfiltered, and the pump shall be operating at maximum speed and at any flow within the rated range of the pump. Field vibration levels shall also be reported for the thrust bearing at the top of the motor. Acceptance limits for vibration at the motor thrust bearing shall be calculated based on the distances of the motor base flange and the motor thrust bearing above the discharge head soleplate as follows:

 $Au=3.5 + 6.64 \times log10 (D1/Db)$

Where:Au = unfiltered displacement, mils peak-to-peakD1 = distance to thrust bearing, inchesDb = distance to motor base, inches

C. The vibration limit only applies when the pump control valve is fully open. The pumps shall not exhibit unusual or abnormal frequency components on either the shaft or the casing vibration measurements. Normal frequency components are defined as excitations, such as rotational speed or vane passing frequency that are inherent with the mechanical construction of the pump and motor train. Unusual or abnormal frequency components are excitations that are non-synchronous or not related to the known geometry of the pump and motor train. All vibration measurements taken during performance testing shall be made with calibrated instruments with certification of NBS traceable reference vibration sources.

5.21 Heating, Ventilation, Air Conditioning (HVAC)

- A. General: The Engineer shall design HVAC for pumping facilities in accordance with this chapter, which include heating systems, air conditioning systems, and evaporative cooling systems.
- B. Air Conditioning Systems: Air conditioning is required for all occupied spaces such as control rooms and restrooms as well as electrical rooms where major electrical equipment is housed such as motor control centers, variable speed drives. The packaged air conditioning system shall be as follows:
 - 1. Located at ground level to avoid roof access for maintenance.
 - 2. Compressors shall be hermetically sealed, high efficiency, reciprocating or scroll type equipped with high-pressure relief.

- 3. Evaporator fan shall be direct or belt driven centrifugal type. Steel. ball bearings shall be permanently sealed and lubricated. A variable speed or two-speed evaporator fan shall be provided for evaporator fans that exceed 7.5 horsepower.
- 4. Condenser fan shall be propeller type, direct drive with aluminum blades, dynamically balanced. Ball bearings shall be permanently sealed and lubricated.
- 5. Induced draft blower shall be direct or belt drive, forward curved centrifugal type statically and dynamically balanced. Material shall be steel with corrosion resistant finish.
- 6. Coils: Evaporator and condenser coils shall be seamless copper tubes with mechanically bonded aluminum plate fins.
- 7. Controls features shall include the following at a minimum:
 - a) Evaporator fan controls.
 - b) Motor contactors.
 - c) Power disconnect switch.
 - d) Electronic thermostat.
 - e) 5-minute compressor cycle delay.
 - f) Differential enthalpy economizer control.
 - g) Economizer capable of compressor operation while modulating to utilize up to 100 percent outdoor air for cooling when outdoor air and humidity are at set acceptable levels.
- 8. Safety features shall include the following at a minimum:
 - a) High pressure switches.
 - b) Compressor over-temperature and over-current.
 - c) Loss of charge/low pressure switch.
 - d) Freeze stat on evaporator.
 - e) Lock out protection.
- 9. All materials shall be corrosion-resistant or coated with corrosion resistant finish per Chapter 4.
- 10. All motors shall be in accordance with Chapter 12.
- 11. Acceptable manufacturers are:
 - a) Carrier Series 50HJ.
 - b) York Series D1E.
 - c) Trane Model THC.

- C. Evaporative Cooling Systems: Evaporative cooling shall be provided for all pump rooms, mechanical rooms, and other non-occupied rooms. The evaporative cooler system shall be either single stage or double stage with a water conservation type water spray control system. Evaporative cooler ductwork for the pump room shall be directed to discharge above pump motors. The following requirements also apply to evaporative cooling:
 - 1. The evaporative media shall be a rigid cross fluted pad or cellulose material impregnated with anti-rot salts.
 - 2. Each evaporative cooler shall be controlled by a separate thermostat designed to operate the unit to satisfy temperature set points inside the pump station.
 - 3. Multi-stage units shall have multi-stage thermostats to control the stage separately.
 - 4. All controls shall have phase fail relays to protect control circuits.
 - 5. A reduced-pressure principle backflow prevention assembly (RPPA) is required.
 - 6. Acceptable manufacturers are:
 - a) Spec-Air.
 - b) Energy Laboratories.
 - c) Munters.
- D. Where applicable, local exhaust systems shall be proved for the pump rooms, any chemical rooms, rest rooms, janitor rooms, and storage rooms. Exhaust fans shall be as follows: Where applicable, local exhaust systems shall be provided for the pump rooms, any chemical rooms, rest rooms, janitor rooms, and storage rooms.
 - 1. Fan shall be a square, in-line centrifugal type with backward-inclined, nonoverloading, aluminum wheel; statically and dynamically balanced.
 - 2. The housing shall be square type with duct transitions to match fan supplied; galvanized steel or aluminum as scheduled, minimum 20-gauge panels with 10-gauge stiffeners and frame as required.
 - 3. Fan shall be belt driven with the motor mounted on exterior of housing
 - 4. Provide an external NEMA 3R disconnect and junction box for field connection of electrical wires.
 - 5. Finish shall be baked enamel on steel units, or Kynar on aluminum units.

- 6. Manufactured by Greenheck, Model BSQ, Loren Cook, Model SQI, or Penn Ventilator, Centrex Inliner.
- E. Louvers shall be provided for air intakes or discharges for pump rooms, chemical rooms, or generator rooms. Where ductwork is connected to the louver, provide a backdraft damper. Louvers shall be as follows:
 - 1. Louver material shall be minimum 0.081-inch thick extruded or formed aluminum for frame and blades.
 - 2. Frame shall be 6-inch deep formed aluminum frame with 0.100-inch nominal wall thickness.
 - 3. Blades shall be 0.040-inch perforated aluminum interior surface; blades positioned at 45-degree angle and spaced approximately 6 inches center to center. Louver free area shall be 25 percent, minimum.
 - 4. Pressure drop through the louver shall be a maximum 0.13 inches water column pressure drop at 1,000 feet per minute free area velocity for intake louvers.
 - 5. Provide a bird screen of 1/2-inch mesh by 19-gauge aluminum or stainless steel with removable frame.
 - 6. Finish shall be mill baked enamel, epoxy, Kynar, Acrodize, prime coat, integral color, or clear anodize.
 - 7. Louver shall have sound attenuation of at least:

Frequency (hertz)	Attenuation (dB) 6" Depth
63	8
125	8
250	10
500	12
1,000	19
2,000	24
4,000	24
8,000	24

F. Maintenance: All HVAC equipment shall be designed to provide adequate space for installation, operation, and maintenance. Clearances around equipment shall be per the manufacturer's recommendation with an additional 12 inches. In addition:

- 1. Provide minimum clearance for all electrical panels, control panels and equipment per NEC and OSHA.
- 2. All electrical equipment associated with HVAC system shall be UL listed, shall conform to NEMA standards, and shall conform to the project Technical Specifications.
- 3. Provide a local disconnect switch for maintenance.
- 4. Power cleaners or "Dump Pump" to automatically discard water after a specified number of hours shall be provided for all evaporative coolers.
- G. Drainage: All HVAC equipment shall be designed such that condensate and spent water is routed to a nearby drain.
- H. Heating Systems: The heating system shall utilize electric infrared heaters equipped with a steel enclosure with a zinc alloy metal sheathed heating element with a ceiling mounting bracket. The system shall come with a multiple unit controller with contacts for thermostat operation for each heater and power transformer. The heaters shall be supplied by Q-Mark, Trane, or Chromalox.
- I. The U.S. Environmental Protection Agency (EPA) and currently adopted codes may have special requirements regarding equipment or materials used for the HVAC systems. The Engineer should be cognizant of these requirements and others, which may supersede general industry codes and standards.
- J. The Engineer should address the following during the design phase:
 - 1. Building insulation requirements.
 - 2. Noise and vibration control mitigation measures.
 - 3. Earthquake/seismic restraints for equipment, ductwork, and piping. Redundant equipment requirements and/or emergency electrical service.
 - 4. Any equipment and piping containing liquids which may be subject to freezing must be provided with heat tracing located under the insulation and controlled by a thermostat.
 - 5. Design temperature and humidity in pump station structures shall conform to ASHRAE 62.2 requirements.
 - 6. Equipment selection shall include high efficiency units that minimize electrical energy usage and water consumption.

5.22 Support Systems

- A. Air Systems: The Engineer shall size and evaluate the plant air demand for each individual pump station facility. Compressed air shall be used for surge tanks, maintenance air tools, etc. The capacity of the air compressors for the surge tank system shall include sufficient capacity for air tools. The plant air system shall consist of the following:
 - 1. Lubricated motor-driven air compressors.
 - 2. Air or liquid-cooled aftercooler.
 - 3. Coalescing filter.
 - 4. Air receiver.
 - 5. Pressure switches, relief valves, pressure reducing valves with bypasses.
 - 6. Condensate removal system shall consist of timer controlled solenoid valve.
 - 7. Air tool outlets, filters, pressure regulators, and lubricators.
 - 8. Where plant air usage is considered critical (like surge tank makeup air), a redundant compressor unit should be installed. The compressors shall be reciprocating type, with ASME-approved receiver.
 - 9. Air piping shall be designed with a separate piping header to each type of service to ensure that equipment will maintain an uninterrupted supply of compressed air.
- B. Water: The potable water supply system shall be protected by a RPPA, in accordance with currently adopted code requirements. Water systems shall be designed to avoid possible contamination. If the backflow preventer is mounted adjacent to a wall, it shall be mounted a minimum of 8 inches away and no greater than 4 feet high to allow for maintenance.
- C. Service Water: Service water shall be obtained from a potable water supply. An RPPA shall be provided. Service water will be used for general housekeeping purposes, landscaping and for chemical dilution systems.
- D. Washdown Systems:
 - 1. The Engineer shall provide washdown piping with hose bibs mounted on the interior of each pump station. The wash down system shall be connected to the high-pressure side of the station discharge header piping for source water. Hose bibs shall be 3/4 inch and conveniently located for

station housekeeping service. Each hose bib shall be provided with a galvanized or epoxy coated steel hose rack and a 50-foot, 3/4-inch hose.

- 2. The Engineer shall ensure that all wash down system water connections to the potable waterlines be protected by a RPPA. The washdown water supply system shall be protected by a RPPA, in accordance with currently adopted code requirements. Washdown water systems shall be designed to avoid possible contamination. If the backflow preventer is mounted adjacent to a wall, it shall be mounted a minimum of 8 inches away and no greater than 4 feet high to allow for maintenance.
- 3. A pressure-reducing valve shall be provided to limit downstream washwater pressure to 80 psig.
- 4. Washdown piping shall be Type K rigid copper pipe. All isolation valves shall be brass body full port ball valves.
- E. Pump Room Drainage System: The drainage system shall consist of a floor drain, hub drain, floor sink, cast iron drain pipe, holding sump and sump pumps, as necessary. The drainage system shall be designed to handle drainage from the pump seals, housekeeping, and HVAC equipment such as evaporative coolers. A floor flood switch shall be provided and connected to SCADA. It is the Engineer's responsibility to consult all governing authorities to design the drainage system to meet currently adopted codes. The holding sump shall be designed with adequate volume to prevent the pump from cycling in excess of the number of starts per hour recommended by the motor manufacturer. The sump may be covered with aluminum grating.
- F. Sump pumps (if necessary) shall be duplex type submersible pumps complete with lifting chain, discharge valve, check valve, piping, starter, level controls and automatic alternator. High water level alarms shall be annunciated to SCADA.
- G. The drainage system shall be designed to convey drainage from the pump seals, housekeeping and the evaporative coolers offsite. The drainage shall be piped to the wastewater collection system. If not available, the location of the offsite drainage shall be determined on a case-by-case basis by the COH.
- H. Wastewater System: Pump stations facilities will be provided with toilet, service sink, mop sink and lavatory facilities. The Engineer must address the handling and disposal of the wastewater generated. The system provided must meet standards of the authorities with jurisdiction.
- I. Telephones and Communications: Pump stations shall be supplied with a telephone board and four (4) 2-inch buried conduits for the addition of telephones and other security electrical needs. Conduits shall be extended to telephone

company approved junction box outside the pump station facility. Approved telephone company drawings shall be submitted as part of project as-builts.

5.23 Fire Protection

- A. Fire protection measures for pump stations shall be designed in accordance with COH, IBC and IFC requirements.
- B. Fire hydrant(s) shall be provided for fire protection in accordance with requirements of the COH Fire Department.
- C. Fire sprinkler systems may be required for facilities with areas that exceed 5,000 square feet.
- D. Fire alarm systems, which annunciate to SCADA are required for facilities with occupied spaces such as offices and control rooms.

5.24 Chlorination Provisions

- A. Chlorination storage and feeding system shall be provided by a single vendor in accordance with this section and where required. The system shall use commercially available sodium hypochlorite solution and shall consist of the following at a minimum:
 - 1. Linear polyethylene storage tanks with secondary containment.
 - 2. Chemical metering pumps that meet the requirements specified in this section.
 - 3. Chlorine residual analyzers that meet the requirements specified in this section.
 - 4. Sodium hypochlorite injection diffusers, piping, valves, electrical systems, and controls.
 - 5. All equipment shall be constructed of materials compatible with sodium hypochlorite solution.
 - 6. Sodium hypochlorite solution shall be from 10 to 15 percent sodium hypochlorite.
- B. Capacity and Points of Injection: The system shall be designed for a capacity of sufficient magnitude to maintain a chlorine residual at the end of the distribution network of 0.5 to 1.0 mg/L, unless otherwise revised through the COH. Sodium hypochlorite solution shall be injected at the reservoir and/or at the pump station suction or discharge manifold. Capacity of the chlorination system shall be based on maximum discharge rate for the pump station, or designed to increase the

residual of the total reservoir volume from 0.2 mg/L to 1.2 mg/L in a 24 hour period, whichever is greater.

- C. Selection of Type of System: The Engineer shall perform an evaluation to determine the most economical, reliable, easy to operate and COH-preferred sodium hypochlorite system to be used. During the evaluation, the Engineer shall receive input from the local chemical supplier(s) to assess operational issues such as off-gassing, availability and cost.
- D. Chemical Solution Piping: Chemical solution piping shall be schedule 80 chlorinated polyvinyl chloride (CPVC) pipe. All isolation valves shall be CPVC diaphragm valves with either union or flanged ends. Buried underground chemical piping shall be double-wall type with leak monitoring system. Overhead interior piping shall be double walled for safety and to prevent leaks where personnel or equipment could be impacted.
- E. Storage Tanks: Chemical storage tanks shall be linear fiberglass reinforced polyethylene designed and manufactured in accordance with applicable ASTM Standards. Storage tanks shall be furnished with inlet, outlet, visual level indicator and transmitter, vent and drain nozzles with an access manhole. Storage tanks shall be provided with a lined containment basin or dike sized in accordance with the (IBC). The containment area shall have a liquid detector with indicator light as well as discrete output to SCADA. Tank size shall be calculated based on 30 days of usable storage volume not tank volume.
- F. Safety: At a minimum, a combination eyewash/shower that utilizes potable water shall be provided within an envelope of the hypochlorite storage and hypochlorite metering system as determined by the more stringent of local regulations or OSHA. System shall be fitted with an alarm annunciated to SCADA.
- G. Chemical Metering Pump: Chemical metering pumps for sodium hypochlorite solution service shall be peristaltic type and suitable for chemical metering service. The metering pumps shall be manufactured by Watson Marlow Bredel. Each pump shall be complete with base, drive and tubing. Metering pumps injecting into the main pump station suction manifold shall be controlled by flow and residual. Injecting in to the discharge manifold shall not be allowed. Accessories shall include calibration column, and all other appurtenances for a complete and functional dosing system. The following shall also be provided:
 - 1. One 4-20 mA analog input for dosage control.
 - 2. One discrete output for common alarm to SCADA.
 - 3. One 4-20 mA analog output.

- 4. Manual and remote controlled dosage control.
- 5. Chemical injection quill with appropriate material at the point of injection.
- 6. At least one installed standby pump.
- H. Sample lines: shall be sized to provide fresh and representative samples to the analyzers. Sample line sizes and the location of sample points, metering pumps and analyzing equipment shall be coordinated by the Engineer through the COH.
- I. Residual Analyzers: shall be provided to sample chlorine residual as appropriate for controlling chlorine residual and equipped with 4-20 mA analog output. Residual analyzers shall be manufactured by Rosemount or equal.
- J. Chlorine Residual Sampling: Options for the disposal of sample water shall be submitted to the COH for review and approval prior to implementation. Sampling systems shall be pressurized using either system pressure or a system supply pump and/or a residual analyzer return pump.

5.25 Analog Instrument Provisions

- A. Provisions for other analog instruments such as ORP analyzers and pH analyzers will be included per COH requirements.
- B. Analog instruments shall meet the requirements of Chapter 13.

5.26 General Service Design Loads

- A. Each structure shall be designed to safely support the imposed live and dead loads in accordance with the more stringent requirements of Chapter 3 or this section. Loading combinations and live load reductions shall be according to the requirements/limitations set forth in the IBC. All live and dead loads used for purpose of design shall be developed for the intended use or occupancy of the particular structure.
- B. The following general service design loads shall be used in the design of pump station and vault structures. These loads include dead loads, live loads, impact and vibration loads, wind loads, earthquake loads, hydrostatic loads, lateral soil loads and miscellaneous loads.
- C. Dead Load Unit Weights: In addition to the dead load of the basic structural elements, the following items, at a minimum shall be used:
 - 1. Piping 12 inches in diameter and smaller shall be treated as uniformly distributed loads. Typical values are 20 pounds per square foot (psf) for extensive piping and 10 psf for light to moderate piping.

- 2. Piping larger than 12 inches in diameter shall be considered as concentrated loads.
- 3. Pipeline thrust under maximum pressure conditions.
- 4. Earth: 120 pounds per cubic foot (pcf), or as recommended by the project/development's geotechnical engineer.
- D. Live Loads: In addition to concentrated loads, the following items shall be used:
 - 1. General roof live loads, walkways, platforms and stairs shall have a minimum (unreduced live load of 100 psf. Additional consideration shall be given for the type, size and weight of specific equipment and maintenance of equipment, in determining the actual design live loads and concentrated loads. Requirements are as follows:
 - a) Mechanical/Electrical Rooms: Equipment weight + 100 psf.
 - b) Stairs/Walkways: Use the greatest of 100 psf or 1,000 lbs.
 - c) Grating: Use a concentrated load of 250 lb/ft with less than 1/4-inch deflection.
 - d) Use HS20 load per AASHTO for truck loading.
 - e) Electrical and pipe space areas can be estimated by using 150 psf or more as determined by the actual equipment.
- E. Hydrostatic Loads and Lateral Soil Loading: The values for lateral soil pressures and soil-bearing pressures for below grade structures or parts of structures shall be designed in accordance with the project's geotechnical report(s)/project's geotechnical engineer.
- F. Buried reinforced concrete structures shall be designed for hydrostatic forces imposed by the presence of groundwater. The design of these structures shall include resistance to uplift forces.
- G. Lateral soil loadings shall include active soil pressures for yielding walls, at-rest soil pressures for non-yielding walls and surcharge pressures due to a soil minimum cover of 2 feet or equal to the actual depth of the soil cover above the structure.
- H. Seismic soil pressures in accordance with the Geotechnical Report.
- I. For buried hydraulic structures use high operational water level without backfill (33 percent overstress).

5.27 Electrical Systems

A. Electrical systems such as Motor Control Centers, lighting, wire, and conduit, panels shall be designed in accordance with Chapter 12.

B. Power System Reliability: pump station power distribution systems shall be designed with redundant or standby power in accordance with NAC 445A Chapter 12 such that no single fault or loss of the preferred primary power source will result in the disruption of greater than 30 minutes of electrical service to more than one MCC associated with vital components.

5.28 Instrumentation and Control

- A. The Engineer shall prepare a comprehensive controls strategy for the facility with the technical specifications for all SCADA, PLC and associated instrumentation in accordance with Chapter 13 and the COH SCADA master plan.
- B. Instrumentation shall meet the requirements of Chapter 13, which includes switches, level measurement, and pressure measurement.
- C. The Engineer shall require that a single integrator or subconsultant to be responsible for all PLC programming, and SCADA. This includes instrument installation, instrument calibration, start-up testing and loop checks.
- D. The Engineer shall also require that the integrator provide detailed description of each operation for every loop associated with the facility.

5.29 Design Checklist

A. A checklist is provided at the end of this chapter for the Engineer's reference and use during design and may not include all applicable design criteria. It is the Engineer's responsibility to review and comply with all guidelines contained herein and all applicable codes completely prior to submitting for review.

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DEPARTMENT OF UTILITY SERVICES

TECHNICAL SERVICES DIVISION NEW DEVELOPMENT SECTION

CITY OF HENDERSON 240 WATER STREET HENDERSON, NEVADA 89015

UTILITY SERVICES Water Pump Stations Review Checklist

Design Concept Phase

Design Concept Report (DCR)

- □ Site ownership
- □ Site plans and station locations
- Plan with electrical room, pump room, and restroom locations
- Refunding area
- D Pumping and piping configuration
- **Recap demand requirements**
- Expandability
- Adjor equipment design criteria
- Recap discussion with NV Energy
- Alternate power source requirements
- Noise attenuation
- Utility master plan analysis
- □ Instrumentation and control parameters
- Building design parameters
- Community Development entitlement submittals
- Preliminary cost estimate
- □ NAC445A requirements

Preliminary Design Phase

Preliminary Design Report (PDR)

- Executive Summary
- □ Table of Contents
- Project background
- Refunding area
- Existing site conditions
- List major stakeholders and utilities
- Utility conflict information
- □ Survey information
- Utility research
- □ Topographic mapping
- Draft Geotechnical Investigation Report
- Draft Environmental Investigation Report
- Draft Corrosion Control/Cathodic Protection Report
- Drainage and Traffic Study findings
- □ Hydraulics and surge analysis
- Electrical loads
- □ Preliminary electrical coordination study
- □ Standby generator sizing
- Description of pump selection
- Preliminary drawings (30 percent drawings)
- □ Alternatives evaluation
- Description of provisions for future expansion
- □ Project considerations
- □ Permanent and temporary row/easement
- Responsibility matrix
- List of agencies and utilities
- Outline of technical specification sections and list of final drawings
- □ Preliminary quantities and cost estimates
- Preliminary construction schedule
- Project correspondence log

- □ Inventory of existing facilities and improvements
- Graphic/sketches/tables
- List of relevant reports, plans, and maps
- □ Work plan for construction
- □ "Line of sight" study for PLC/radio control
- Description of security features
- Preliminary description of operation and controls
- Equipment sizes
- Preliminary description of architectural features
- Description of operational noise and noise attenuation

Agency and Utility Coordination

□ Contact and coordinate with utilities and agencies

Final Design Phase

- □ Final design
- Final design drawings
- □ Final specifications
- □ Final drawings and specifications meet requirements
- □ Final Geotechnical Investigation Report
- □ Final Environmental Investigation Report
- □ Final Corrosion Control/Cathodic Protection Report
- □ Final Electrical Coordination Study
- □ Final Facilities Operations Plan

Hydraulic Analysis

- Hydraulic analysis
- □ Steady-state analysis
- □ Surge analysis

Surge Mitigation Measures

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- □ Surge control/protection measures
- Attenuation of surge pressure
- □ Surge relief control valve or surge anticipation valves
- Design pipelines, valves, and flanges
- □ Selection and location of proper control devices
- □ Identification of proper startup, operation, and shutdown procedures
- One-way or two-way surge tanks
- Surge tanks
- □ Paint and primer codes
- □ Sized and rated
- Designed, fabricated, and tested
- Designed to meet site-specific seismic criteria
- Corrosion allowance
- □ Pad mounted compressed air system
- Air compressor, controls, and accessories
- Required accessories
- Requirements for packaged, pad-mounted air compressors
- Surge tank control system
- **D** Pump stations air compressor requirement

Site Civil

- Pump station location
- □ Yard piping approved materials

Signage

Traffic control signs

Access Gates

- □ Minimum 24-foot wide steel frame swing gate or rolling gate
- Automatically operated

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- □ Minimum one 4-foot wide pedestrian access gate
- Motor operated gates

Security

- □ 8-foot tall masonry perimeter wall
- Security pickets
- Compatible with surrounding equipment
- Downcast site lighting
- COH architectural/community development requirements
- Other security issues

Noise Attenuation

- OSHA local, state, and federal regulations
- Construction or operation noise requirements
- □ Facility Noise Production Study
- Engineering noise controls

Vault Standards for Water Pump Stations

- □ Vault location
- Drainage
- Valve vaults
- □ Traffic area considerations
- □ Non-traffic area considerations
- □ Vault entrance risers
- □ Instrumentation, electrical equipment, and accessories
- Flow meter vault considerations

Architecture and Landscaping

- Design Appearance Guidelines
- Construction materials and methods

- Weathering systems
- □ Architectural theme and character
- Height of structures
- Reflective finishes
- Exterior walls
- □ Anti-graffiti coating
- **D** Roofing
- □ Insets, grills, trim, and accents
- Doors and frames
- Lighting
- Equipment and service areas
- □ Material safety
- □ Site constraints
- □ Landscape coordination

Pump Systems Design

Project Design

- Design head and design flow
- Design requirements
- □ Materials of construction
- □ Instrumentation, controls, and appurtenances
- Pump supplier
- General station layout
- System head curves
- Pump selection
- Pump inlet configuration
- Pump spacing and clearances
- Pump efficiency
- Expandability
- Drive Equipment

Pump Speed Control

- □ Variable frequency drives (VFDs)
- □ Variable speed control

Pump Station Piping

- General piping requirements
- Exposed piping
- Suction piping
- Discharge piping
- □ Flexible couplings
- □ Insulating flanges and gaskets
- Pump isolation valves
- Check valves
- □ Air release valves
- Combination or vacuum/air release valves
- Manual valve operators
- Pipe restraints
- Liquid filled pressure gauges
- □ Piping supports and straps
- Hatch and door openings

Pump Motors

- Manufacturers
- D Pump motor material
- Access
- Prime mover
- □ Space heaters
- D Pump drive
- Electric motors

- Line-shaft vertical turbine pumps
- □ Motor noise
- Motor torque and locked rotor characteristics
- Motor type
- Motor location
- Uibration Analysis and Summary Report
- Variable speed drives
- □ Motor connection terminals or power distribution blocks
- Aluminum motor rotor bars
- Service factor
- □ Motors 100 horsepower and larger
- Moisture sensing devices

Pumps

- Pump type
- Bowls
- □ Shafts
- Impellers
- U Wear rings
- Suction bell
- Column
- Line shaft couplings
- Discharge head
- □ Suction bowl bearings
- Manufacturers
- □ Spare parts
- Pump cans
- **G** Future expansion provisions
- Dever monitoring
- Alarms and monitoring

Vibration

- □ Horizontal pump vibration limits
- Bearing housing vibration
- Vertical pump vibration limits

Heating, Ventilation, Air Conditioning (HVAC)

- Air conditioning systems
- Evaporative cooling systems
- Local exhaust systems
- Louvers
- Maintenance
- Drainage
- Heating systems
- EPA requirements
- □ Inclusions
- Building insulation requirements
- Noise and vibration control mitigation measures
- Earthquake/seismic restraints
- Heat tracing location
- Design temperature and humidity
- Equipment selection

Support Systems

- □ Air systems
- U Water
- □ Service water
- U Washdown systems
- Pump room drainage system
- □ Sump pumps
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- □ Off-site drainage system
- □ Wastewater system
- Telephones and communications

Fire Protection

- Pump stations
- □ Fire hydrants
- □ Sprinkler systems
- □ Alarm systems

Chlorination Provisions

- □ Chlorination storage and feed system
- Capacity and points of injection
- □ Selection of type of system
- Chemical solution piping
- Storage tanks
- □ Safety
- Chemical metering pump
- □ Sample lines
- Residual analyzers
- Chlorine residual sampling

General Service Design Loads

- Dead load unit weights
- Live loads
- Hydrostatic loads and lateral soil loading
- Buried reinforced concrete structures
- □ Seismic soil pressures





(3) BUTTERFLY VALVE
(4) COUPLING W/ RESTRAINTS
5 SUCTION PUMP BARREL
6 COMBINATION AIR RELEASE VALVE (TO COMMON DRAIN PIPING)
(7) PUMP
8 FUTURE PUMP
(9) CHECK VALVE
0 FUTURE CHECK VALVE (INSTALL BLIND FLANGE)
1 BUTTERFLY VALVE
DUTTERFLY VALVE
1 DISCHARGE HEADER
(1) MAGNETIC FLOW METER
(15) BUTTERFLY VALVE
16 PRESSURE RELIEF VALVE
FLANGED COUPLING ADAPTER
(18) MAINTENANCE STAND W/ HAND RAIL, SAFETY CHAIN, PUMP GAUGE BOARD
(19) COMBINATION AIR RELEASE VALVE
Ø BUTTERFLY VALVE
PRESSURE REDUCER TO POTABLE WATER
2) HOSE BIB W/ ATM. VACUUM BREAKER
3 SURGE TANK LEVEL PROBE STILLING WELL WITH MAGNETICALLY COUPLED LEVEL INDICATI

Department Of Utility Services



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DEVISION No	

ENDERSON UTILITY	GUIDELINES			
			Figure	5.2
			-	
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DESCRIPTION	DRAWN BY	DATE		

CHAPTER 6 RESERVOIRS

6.01 General

- A. This chapter describes the information needed to proceed through the design concept; pre-design and final design phases for the construction of both steel and concrete reservoirs. For these applications, a reservoir is defined as a facility that provides operational, emergency, and fire protection storage, as well as regulation and control of potable or reclaimed water.
- B. The design criteria for steel and concrete reservoirs are governed by the guidelines of this chapter as well as the standards and codes presented in Chapter 1.
- C. It is the Engineer's responsibility to make reference to and/or utilize industry standards not otherwise directly referenced within this document.
- D. Site Selection: Site selection requires direct coordination with COH to ensure the design meets the requirements of the water system master plan for the project as well as the COH Water Master Plan. Final selection of the site will be approved, upon review and modification, if necessary, by the COH. The list below describes site selection criteria specific to reservoir design. In addition to the following, the Site Civil Design described in Chapter 1 must be evaluated:
 - 1. Proximity to existing and future water pump stations.
 - 2. Distribution system hydraulic capacity requirements including overflow elevations.
 - 3. Access to facility including staging plan and construction access.
 - 4. Site drainage.
 - 5. Future expansion.
 - 6. HMC Title 19.
- E. It is the responsibility of the Engineer to ensure all requirements within Chapter 6 adhere to NAC 445A.

6.02 Design Concept Phase

A. General: The purpose of the Design Concept Phase is to provide the Engineer and the COH with general information about the project emphasizing the purpose and need for the reservoir.

- B. Report: A Design Concept Report must be submitted and approved through the COH. Without an approved Design Concept Report, the Pre-Design Report will not be accepted. The Design Concept Report must meet at a minimum the requirements described below:
 - 1. Location of the reservoir (Site map, APN, etc.).
 - 2. Site Analysis.
 - 3. Site Description.
 - 4. ROWs, easements, ownership, etc.
 - 5. Reservoir Sizing.
 - 6. Overflow and finished floor elevations.
 - 7. Dimensions.
 - 8. Reservoir material:
 - a) Steel (2 tanks required).
 - b) Concrete.
 - 9. Water Quality Analysis.
 - 10. Service Area.

6.03 Preliminary Design Phase

- A. General: The Preliminary Design phase of the project shall be summarized and presented in a Preliminary Design Report (PDR). The PDR is the basis for the ensuing design process and must be presented in a fashion that allows the reader to gain a thorough and complete understanding of the necessity of the project. Without an approved PDR, the Engineer will not receive COH approval to proceed to the final design.
- B. Report: Prepare a Preliminary Design Report with the items below and all design calculations supporting decisions and/or recommendations. The report will be submitted to the COH for review and acceptance. Submit the items below and other applicable items to support the preliminary design to the COH for review and approval:
 - 1. Executive Summary.
 - 2. Table of Contents.
 - 3. The project background.

- 4. Existing conditions.
- 5. Summary of utility conflict information, including pothole information or recommendations for utilities proposed to be potholed.
- 6. Topographic mapping information summary.
- 7. Draft Geotechnical Investigation Report.
- 8. Draft Environmental Investigation Report.
- 9. Draft Corrosion Control/Cathodic Protection Report.
- 10. Draft Technical Drainage Study in accordance with requirements of CCRFCD.
- 11. Summary/overview of the applicable drainage and traffic study findings with references to those documents submitted separately.
- 12. Preliminary plans and centerline profiles (30 percent design drawings) illustrating at a minimum:
 - a) Proposed site plan and improvements.
 - b) Preliminary grading plan.
 - c) Slope stabilization options, as required by the geotechnical report.
 - d) The recommended pipeline alignment and profile.
 - e) Any offsite improvements.
 - f) Appropriate sections, elevations, or details.
 - g) Existing topography.
 - h) Property ownership information.
 - i) Rights-of-way/easements.
 - j) P&IDs.
- 13. Site access, temporary, and permanent, to include staging plan, as necessary.
- 14. Alternatives evaluation summary.
- 15. Recommendations for future connection and tee locations.
- 16. Identification of appurtenant facilities and spacing criteria.
- 17. Opinions and recommendations for bidding packages, scheduling, Contractor staffing, and impacts to public areas.
- 18. Identification of any permanent and temporary ROW/easement constraints and acquisitions.

- 19. Matrix summary of permits to be obtained and fees.
- 20. List of agencies and utilities to review and sign the drawings.
- 21. Outline of technical specification sections and list of final design drawings.
- 22. Preliminary quantity and associated cost estimates.
- 23. Preliminary construction schedule.
- 24. Project correspondence file, including meeting minutes.
- 25. Inventory of existing facilities and improvements.
- 26. Graphics, detail sketches, tables, and other displays to support analyses and recommendations.
- 27. List of relevant reports, plans, and maps reviewed and other relevant project information.
- 28. Work plan for how construction is to be accomplished if connecting into existing facilities (phasing, shutdowns, etc,).
- 29. Preliminary description of operations and controls to include communication with SCADA.
- 30. Design calculations.
- 31. Major equipment selection.
- 32. Preliminary outline of Specification Sections.

6.04 Agency and Utility Coordination

A. The Engineer shall initiate contact and coordinate efforts with outside utilities and agencies in accordance with Chapter 1.

6.05 Final Design Phase

- A. General Submittal Requirements: The Engineer may proceed with the final design of the project upon acceptance of the Preliminary Design Report. After review and approval of the preliminary documents, the Engineer shall produce final construction plans and specifications.
- B. The design shall provide for the complete construction of a reservoir facility including a tank(s); a building (if necessary), associated site improvements; associated piping and appurtenances; valve vaults; manholes and/or storm drainage; electrical power; instrumentation and controls; interface to the COH

SCADA system; and other associated work identified by the COH as necessary to make the facility fully functional.

- C. The final design of the reservoir shall include:
 - 1. A minimum design service life of 50 years. The facility shall also be capable of accommodating future components anticipated for projected growth in the service area.
 - 2. The reservoir shall be architecturally compatible with the surrounding area. Additionally, the exterior of the reservoir shall be of a low maintenance design.
 - 3. Ease of access for operation and maintenance.
 - 4. Site development for current and future expansion including adequate right-of-way for vehicular access and parking, supply pipeline and drain, security fencing, access gate(s), security lighting, drainage, site signage, and low maintenance landscaping which eliminates or minimizes the need for automated irrigation.
 - 5. A tank of a proven design with a long history of use and a minimal cost of maintenance.
 - 6. Inlet, outlet, drain, and overflow piping with all necessary control and measurement features; altitude valves; isolation valves; flapper valves; roof vent; reservoir access; couplings; and other appurtenances required for a complete and operable system.
 - 7. Water quality provisions as required.
 - 8. Plumbing systems for potable water, non-potable water, and drainage.
 - 9. Electrical systems for lighting, power, grounding, communications, security, control, and instrumentation.
 - 10. A design that allows remote monitoring of the reservoir through a connection with the COH's SCADA system. The reservoir shall have a SCADA system in accordance with COH standards. A reservoir PLC may be required in accordance with COH standards.
- D. Volume Criteria:
 - 1. Shall be determined by the Engineer, if not provided by the approved Water Master Plan. The Engineer shall consider operational storage, fire suppression storage, emergency storage, and water quality requirements in determining the volume of a proposed reservoir.

- a) Operational Storage is the volume of the reservoir devoted to supplying the water to the system under normal operating conditions. Operational storage is equal to the peak hour demand minus the maximum day demand rate for 6 hours.
- Emergency Storage shall be considered during the design process.
 The amount of emergency storage shall be based upon an assessment of risk and the desired degree of system dependability.
- c) Fire Suppression Storage is the volume required to deliver fire flows in accordance with the fire flow requirements set forth by the currently adopted edition of the International Fire Code and any COH amendments.
- E. Volume Calculations:
 - 1. Volume is calculated using two storage criteria to determine the volume of the reservoir. The larger of the two volumes shall be provided. Both criteria utilize operational storage, which is expressed below.
 - a) Operational Storage = (PHD-MDD)*6 hrs.
 - 1) PHD is Peak Hour Demand.
 - 2) MDD is Maximum Day Demand.
 - b) The first criterion states that the volume of the reservoir must equal twice the operational storage. The second criterion states the reservoir volume be equal to the operational storage plus the fire suppression storage. The two criteria are presented below.
 - 1) Volume = $2 \times Operational Storage.$
 - 2) Volume = Operational Storage + Fire Suppression Storage.
- F. Yard Piping:
 - Mortar Lined and Coated Steel Pipe (MLCP) or Ductile Iron Pipe (DIP) shall be used for yard piping. Steel piping shall conform to the requirements of ANSI/AWWA C 200. Mortar coating shall be provided for buried and submerged conditions. Cement-mortar lining and coating shall conform to ANSI/AWWA C 151. Unless otherwise approved all mainline valves shall be the same diameter as the pipeline. Yard piping shall include above ground tank isolation valves.
 - 2. Multiple tanks shall be piped such that each tank can operate independently, in parallel, or in series.
 - 3. For operation and maintenance, an 8-inch wastewater collection line with a terminal manhole will be required for any reservoir site within approximately 400 feet of current or future wastewater collection system.
- G. Security and Safety:

- 1. The site shall be enclosed with a design approved by the COH Community Development Department. At a minimum, an eight (8) foot tall masonry perimeter wall with lockable entrance will be required. Embedded security pickets shall be installed on the top of the entire perimeter wall. The wall shall be compatible with the surrounding environment, including landscaping.
- 2. At a minimum, the exterior of the masonry perimeter wall shall be coated with anti-graffiti protection per requirements of Chapter 5 Water Pump Stations. At the discretion of the COH, additional areas of the facility may be required to be treated with anti-graffiti protection.
- 3. An acceptable card reader system will be required for access to the site. At a minimum, four (4) 2-inch conduits shall be installed up to the gate.
- 4. Down cast site lighting, both wall and pole mount, shall be provided with at least two photocell-operated lights.
- 5. At locations agreed upon by COH, conduit shall be installed and stubbed up for future site security equipment. Other security features will be required at the discretion of the COH.
- 6. All access, safety, and structural components shall be designed per current OSHA requirements for the safety of COH personnel. At a minimum the following safety equipment is required:
 - a) Ladder cages.
 - b) Rest platforms.
 - c) Handrails.
 - d) Guardrails.
 - e) Fall protection.
 - f) Any other appropriate devices to conform to all applicable state and federal requirements for occupational safety and health.
- H. Paving, Curb, and Gutter:
 - 1. Paving, curbs, and gutters shall be designed in accordance with the CCUSD. A minimum of 12 feet of drivable asphaltic concrete (AC) paving shall be installed around the entire perimeter of the tank.
- I. Disinfection
 - 1. Reservoirs must be disinfected before being put into service for the first time and after being entered for cleaning, repair, maintenance, rehabilitation, or painting.
 - 2. Disinfection shall be in accordance with AWWA C 652 Method 3.

- J. Water Quality Provisions
 - 1. The Engineer shall provide chlorination provisions for reservoirs such as electrical conduit and piping for chlorination equipment, which includes sodium hypochlorite storage, sodium hypochlorite metering pumps, sampling ports, and analyzers in accordance with Chapter 5.

6.06 Concrete Reservoir Design

- A. General: The COH concrete tank standard is prestressed concrete tank with cast-in-place core wall, vertical post-tensioned tendons, and circumferential prestressed strands.
 - 1. Prestressed concrete tank with cast-in-place core wall, vertically posttensioned tendons, and circumferential prestressed strands shall be complete with foundation, walls, roof, seismic cables, exterior protective coatings, roof hatches, roof vent(s), external and internal ladders, tank hand railing, separate inlet and outlet piping, overflow drains, and all associated appurtenances for a complete and functional system. Circumferential prestressed strands shall be tensioned by elongation methods with continuous electronic monitoring and recording. Prestressing by die drawing will not be allowed.
- B. Design Criteria:
 - 1. Tanks with precast concrete wall panels with internal post-tensioned tendons, and tanks with precast concrete wall panels with circumferential wrapped prestressing are not acceptable for use.
 - 2. The following currently adopted version of standards and codes shall govern and shall be used for the design of concrete tanks:
 - a) International Building Code of the International Conference of Building Officials with Southern Nevada Amendments.
 - b) Building Code Requirements for Minimum Design Loads in Building and Other Structures, ASCE 7.
 - c) Wire and Strand-Wound Circular, Prestressed Concrete Water Tanks, ANSI/AWWA D 110.
 - d) Building Code Requirements for Reinforced Concrete ACI 318.
 - e) National Sanitation Foundation Standard 61 Drinking Water System Components
- C. Seismic Loads:
 - 1. Seismic Loads shall be in accordance with the requirements of AWWA D110 as amended by the IBC and ASCE 7.

- 2. The COH Building Department shall be consulted for verification of the latest seismic zone designation.
- 3. Site specific seismic design recommendations, as provided in the geotechnical report, shall be considered.
- D. Foundation and Tank Floor:
 - 1. A structural floor or slab-on-grade foundation is allowable.
 - 2. The concrete floor shall be cast continuously, without construction joints, when possible. Curing of the floor shall be done with water only.
 - 3. A slab-on-grade type floor shall be designed to transmit loads to the subbase through the floor. Anchored flexible base is preferred.
 - 4. At a minimum, a membrane liner on the sub-base and covered with an aggregate sub-base; a liner sloped away from the center of the tank; and perimeter drains shall be provided.
 - 5. The Design Engineer shall be responsible for the design of the foundation and tank floor according to codes for live and dead loads and for operating requirements and loading conditions during construction. The allowable loads shall be listed on the contract documents.
- E. Tank Roof:
 - 1. The roof pitch shall not preclude operators from walking on the roof. Fall protection anchors shall be located where operators can attach to anchors before stepping on the above grade roof. Roof drains shall be provided on the entire perimeter of the tank.
 - 2. A concrete tank shall have a precast/cast-in-place roof; or a flat precast/cast-in-place, two-way reinforced concrete flat slab roof. The joint between the roof and wall, separated by an elastomeric bearing pad is preferred on a concrete tank. Aluminum roofs will not be allowed.
 - 3. For buried reservoirs, the roof shall be designed for H20 traffic load.
- F. Inlet and Outlet Piping:
 - 1. Inlet and outlet piping shall be ductile iron (AWWA C151) or steel pipe, mortar-lined and coated (AWWA C200 and C205).
 - 2. Inlet and outlet piping shall be designed to ensure water circulation inside the reservoir.

- 3. Reinforced concrete piers shall be designed to support the pipe and to protect against uplift of the pipe due to buoyancy.
- 4. The inlet should be controlled by a valve outside the tank that can be closed for maintenance or inspection.
- 5. The outlet pipe shall be located away from the inlet pipe to accomplish maximum water circulation within the reservoir. The outlet pipe should be controlled by a valve outside the tank that can be closed for maintenance or inspection.
- G. Drain:
 - 1. A tank drain shall be provided on the tank. It shall have an isolation valve located outside of the tank and be piped to a discharge manhole or storm drain vault.
 - 2. All reservoir drains must have an air gap.
- H. Overflow:
 - Piping shall enter through the floor of concrete tanks near the tank wall. The overflow system must be designed to discharge not less than 12 inches or more than 24 inches above the surface of the ground to provide an air gap (See Figure 6.5). Overflow discharge shall be sloped for complete drainage and discharge over a drainage inlet, plunge pool or splash plate without causing erosion.
 - 2. The overflow shall be provided on the interior of the tank. Overflow pipe shall be sized for the maximum possible fill rate.
 - 3. A flap gate and air gap shall be provided at the discharge point of the overflow drain. It shall be piped to a manhole or drainage facility for manual flow monitoring.
 - 4. Verification in writing shall be provided to confirm that overflows will not impact adjacent properties.
 - 5. An energy dissipater may be required to control erosion at point of discharge of the overflow system.
 - a) The overflow pipe shall be designed to discharge to an energy dissipater at a maximum flow rate to be determined by the Engineer. The Engineer shall design the energy dissipater to ensure that water within the reservoir is protected from cross-contamination with surface water.

- b) The energy dissipater shall be designed by the Engineer in accordance with the latest edition of CCRFCD Hydrologic Criteria and Drainage Design Manual.
- I. Reservoir Access:
 - 1. Tanks shall have a minimum of two hinged, leak proof, spring-loaded, alarmed, aluminum, lockable hatches.
 - 2. Each hatch shall have a hold open device, hasp lock, intrusion alarm, and security bar.
 - 3. A COH standard locking hatch, shown on Figure 6.7A shall be used.
 - 4. Both hatches shall be a minimum 48-inch by 48-inch opening. One hatch shall be a personnel access hatch and located near the tank inlet pipe.
 - 5. One of the roof hatches shall be located above the overflow system and the other is to be located at the interior ladder with ladder post safety device (generally opposite from the overflow hatch).
 - 6. Hatches shall have a minimum 4-inch curb and the cover shall have a downward overlap of at least 3 inches on concrete tanks.
 - 7. If the concrete tank is buried, the hatch shall be designed for H20 loading and drainage away from the hatch shall be provided.
- J. Roof Vent:
 - 1. Roof vents shall be sized to prevent excess pressure or vacuum buildup during the maximum inflow or outflow of water.
 - 2. A minimum of one vent near the center of the tank shall be supplied. Roof venting shall be provided with two (2) stainless steel mesh screens to prohibit entry of insects, birds, or undesirable objects. The insect screen shall be #22 to #24 mesh and shall be located behind the vent grille. See Figure 6.6.
 - 3. For security, a metal cage shall be installed over the roof vent per standard detail. The metal roof vent security cage is shown on Figure 6.1.
- K. Roof Access:
 - 1. General: The Engineer shall provide roof access for reservoirs via ladders or stairs per the requirements herein. All stairs and ladders shall be designed to meet currently adopted codes and standards.

- 2. External Ladders: shall be located at each access hatch and constructed of hot dipped galvanized steel or epoxy coated steel. Ladders shall be routed from ground level with a ladder cover extending from 4 inches below the bottom rung to a height of 8 feet to prevent unauthorized access and be equipped with the following:
 - a) Safety ladder cage per OSHA requirements with the bottom fully blocked whenever the ladder cover is in the closed position.
 - Extended a minimum of 4 feet 6 inches above the roof. Refer to Figure 6.2A, Figure 6.2B, and Figure 6.2C for a typical ladder assembly.
- 3. Internal Ladders: shall be constructed of stainless steel and be located at each access hatch.
- 4. External Stairs: shall be provided as required by COH. Refer to Figure 6.8 for reservoir stair access. Stairs shall be constructed of hot-dipped galvanized steel or epoxy coated steel and shall incorporate the following features:
 - a) Stringers constructed of 10-inch or 12-inch channel.
 - b) Tread connections to stringers shall be bolted with stainless steel hardware.
 - c) Minimum stairway width of 36 inches.
 - d) Minimum tread length of 24 inches.
 - e) Maximum riser height of 7 inches.
 - f) Non-slip tread surface.
 - g) Aluminum rail system that is OSHA-approved that can withstand 250-pound load applied in any direction.
- 5. All conduit shall be located behind the ladder or stairs for security.
- L. Underdrain System:
 - 1. The underdrain system shall protect against uplift that occurs when the tank is drained and to detect excessive leakage from the tank. An underdrain system shall be provided for partially-buried and buried prestressed concrete tanks. At a minimum the underdrain system shall consist of a perimeter ring drain system. Water collected from beneath the tank and around the perimeter is discharged to a drainage facility or overflow/drain manhole.
 - 2. The size and configuration of drain rock, polyethylene or PVC sheeting, filter fabric, and PVC perforated piping shall be determined by the Geotechnical Engineer.
- M. Sampling Station:

1. A minimum of two (2) sampling stations shall be provided. The taps shall be a stainless steel locking ball valve and shall be placed in a weatherproof secured locking box.

6.07 Steel Tank Design

- A. General: The COH steel tank standard is ground level, fixed roof, epoxy-coated welded steel tank.
 - 1. Standpipes and bolted steel tanks are not acceptable to the COH.
- B. Design Criteria:
 - 1. The currently adopted version of standards and codes shall govern and shall be used for the design of steel tanks.
 - a) International Building Code of the International Conference of Building Officials with Southern Nevada Amendments.
 - b) Building Code Requirements for Minimum Design Loads in Building and Other Structures, ASCE 7.
 - c) Standards for Welded Steel Tanks for Water Storage, ANSI/AWWA D 100.
 - d) Building Code Requirements for Reinforced Concrete ACI 318.
 - e) AWWA standard for Painting Steel Water Storage Tanks, ANSI/AWWA D 102.
 - f) National Sanitation Foundation Standard 61 Drinking Water System Components.
- C. Seismic Loads:
 - 1. Seismic Loads shall be in accordance with the requirements of AWWA D110 as amended by the IBC and ASCE-7.
 - 2. The COH Building Department shall be consulted for verification of the latest seismic zone designation.
- D. Wind Loads:
 - 1. Load (pressure) asserted on the tank shall be as recommended by ANSI/AWWA D100 on the basis of a basic wind speed of 100 mph or the requirements of the local code, whichever is more stringent.
- E. Roof Design:
 - The tank roof shall be structural-steel-supported, steel roof having a 3/4-inch vertical to a 12-inch horizontal slope. A knuckle with a 2-foot to 4-foot radius shall be provided at the roof and wall junction.

- 2. The roof plate that is not in contact with water shall be at least 3/16-inch thick; the roof plate submerged in water during normal operations shall be 1/4-inch minimum.
- 3. Corrosion allowance is not required for the roof plate.
- 4. The roof plate construction shall be in accordance with the standard practice of ANSI/AWWA D 100, by continuous fillet weld at the topside only.
- 5. Full penetration welds shall be used to join the roof knuckle together.
- 6. The roof plate shall not be seal welded at the support members.
- 7. The roof supports shall be hot-rolled structural shapes with a minimum thickness of 3/16 inch.
- 8. Shape, bar, and plate submerged in water shall be 1/4 inch minimum.
- Lateral bracing of the roof rafter compression flanges shall be required. Friction between rafters and roof plates may be considered unless otherwise restricted by ANSI/AWWA D100.
- 10. Figure 6.3 depicts a typical roof guardrail.
- 11. Bolts inside the reservoir shall be Type ASTM A 325.
- 12. Columns shall be fabricated from steel pipe that is seal welded at both ends. Column base shall be fabricated from steel plate and designed for a maximum allowable soil bearing as recommended by a Geotechnical Engineer. The column base shall not be welded to the bottom plate to allow for rotation during seismic events, but must be restrained from any lateral movement. The base assembly shall be fully coated prior to erection per ANSI/AWWA D 100.
- F. Wall Design:
 - 1. The tank wall design shall be in accordance with ANSI/AWWA D100 standard.
 - 2. The design fabrication and inspection requirements specified in ANSI/AWWA D100 will be allowed.
 - 3. The lowest 1-day mean ambient temperature at the tank site shall be generally at 20 degrees Fahrenheit unless a lower ambient temperature is required by the COH.

- 4. Corrosion allowance is not required. Minimum tank wall thickness shall be in accordance with the requirements of ANSI/AWWA D 100.
- 5. The tank wall shall be designed for stability without the requirements of intermediate girders on the inside or outside surface of the wall.
- G. Tank Bottom:
 - 1. The bottom shall be lap welded continuously from the top of the plate with a minimum thickness of 5/16 inch.
 - 2. The bottom plate shall be extended a minimum of 1-1/2 inches beyond the exterior of the tank.
 - 3. The joint between the tank wall and the bottom plate shall be continuously welded from inside and outside of the tank wall.
 - 4. Corrosion allowance is not required.
 - 5. The width and thickness of the bottom annular ring shall conform to the requirements of ANSI/AWWA D 100.
 - 6. The requirements of the butt-welded bottom annular ring shall be in accordance with the requirements of ANSI/AWWA D 100.
 - 7. An underdrain system as depicted in Figure 6.4 shall be installed.
- H. Footings and Foundations:
 - 1. Reinforced concrete ring footings shall be provided.
 - 2. The top on the ring footing shall be approximately 6 inches above the finished surface.
 - 3. The minimum embedment of the ring footing shall be as recommended by the geotechnical Engineer, but shall not be less than 2 feet, 6 inches.
 - 4. Ring footings shall be reinforced to resist the lateral soil pressure on the confined earth.
 - 5. The width and height of the ring footing shall be sized for the loads in Chapter 3 and the allowable soil bearing pressure recommended in the geotechnical report.
 - 6. The minimum width shall not be less than 1 feet, 6 inches.
 - 7. A compressive strength of 4,500 psi shall be used for the concrete; 60,000 psi yield strength shall be required for reinforcing steel.

- 8. Concrete cover for rebar shall be in accordance with the requirements of ACI 318.
- 9. The Alternate Design method is recommended for the design reinforcement. Corrosion protection for concrete shall be as recommended by the Geotechnical Engineer.
- I. Allowable Stress:
 - 1. Allowable stress for steel plate and structural steel shall be in accordance with the requirements of ANSI/AWWA D 100.
 - 2. Allowable stresses for tank concrete footing shall be in accordance with the requirements of ACI 318.
- J. Inlet and Outlet Piping:
 - 1. Inlet and outlet piping shall be designed to maximize water circulation inside the tank.
 - Both pipes shall penetrate the bottom plate or lower wall plate (minimum of 12 inches from floor) and shall be separated as much as is practical for circulation. In-line valves shall be the same diameter as inlet/outlet piping.
 - 3. Pipe penetration openings through the bottom plate shall be reinforced in accordance with the requirements of ANSI/AWWA D 100.
- K. Overflow:
 - 1. Overflow pipe shall be sized for the maximum possible fill rate.
 - 2. To ensure a proper air gap, the overflow system must be designed to dispense not less than 12 inches or more than 24 inches above the surface of the ground, be sloped for complete drainage, and discharges over a drainage inlet, plunge pool or splash plate without causing erosion.
 - 3. The overflow shall be provided on the interior of the tank.
 - 4. The overflow pipe shall be brought down the inside of the tank and discharged into a drainage structure with an energy-dissipating feature, if needed.
 - 5. Figure 6.5 illustrates the overflow discharge structure, which includes a flap valve. The overflow pipe shall be braced against the tank wall.

- 6. The Engineer shall design the overflow system to ensure that water within the reservoir is protected from cross contamination with surface water, insects, and animal intrusion, etc.
- 7. Verification in writing shall be provided to confirm that overflows will not adversely impact adjacent properties.
- L. Drain:
 - 1. An appropriately sized drain pipe shall be installed at the bottom of the tank (minimum size 8 inches).
 - 2. If the tank is unanchored, the location of the penetration in the bottom plate shall conform to the requirements of Chapter 13 of the ANSI/AWWA D 100.
 - 3. The drain line may be discharged to a drainage structure or facility common with the overflow pipe.
 - 4. All reservoir drains must have an air gap.
- M. Roof Vent:
 - 1. Roof vents shall be sized to prevent excess pressure or vacuum buildup during the maximum inflow or outflow of water.
 - 2. A minimum of one vent near the center of the tank shall be supplied. Roof venting shall be provided with two (2) stainless steel mesh screens to prohibit entry of insects, birds, or undesirable objects. The insect screen shall be #22 to #24 mesh and shall be located behind the vent grille. See Figure 6.6.
 - 3. For security, a metal cage shall be installed over the roof vent per standard detail. The metal roof vent security cage is shown on Figure 6.1.
 - 4. Four (4) eye bolts shall also be supplied for tie-offs.
- N. Reservoir Access:
 - 1. Two (2) 30-inch minimum diameter hinged-type manways shall be provided at the bottom shell course. Manways shall be hinged and inward opening.
 - 2. Design of the manway and reinforcement around the wall opening shall conform to the requirements of ANSI/API Standard 650.
 - 3. A galvanized steel staircase with means to prevent unauthorized access shall be provided at the outside of the tank and shall extend to the roof.
 - 4. A lockable steel door with cage shall be provided for ladder access.

- 5. A platform with galvanized steel grating and railing shall be provided and installed on the roof adjacent to the stairs.
- 6. All conduits running up the tank wall shall be located behind the ladder or stairway for additional security.
- O. Roof Access:
 - 1. General: The Engineer shall provide roof access for reservoirs via interior ladders or exterior stairs. All stairs and ladders shall be designed to meet currently adopted codes and standards.
- P. Roof Access:
 - 1. Tanks shall have a minimum of two hinged, leak proof, spring-loaded, alarmed, aluminum, lockable hatches as follows:
 - a) Each hatch shall have a hold open device, hasp lock, intrusion alarm, and security bar.
 - b) A COH standard locking hatch, shown on Figure 6.7A shall be used.
 - c) Both hatches shall be a minimum 48-inch by 48-inch opening. One hatch shall be a personnel access hatch and located near the tank inlet pipe.
 - d) One of the roof hatches shall be located above the overflow system and the other is to be located at the interior ladder with ladder post safety device (generally opposite from the overflow hatch).
- Q. Protective Coatings:
 - 1. Protective coatings shall be provided in accordance with Chapter 4 for welded steel reservoirs and all interior surfaces including, but not limited to shell, roof framing, roof plates, columns, floor, piping, manways, and ladders; and painting of all exterior surfaces including, but not limited to shell, roof, manways, ladders (including cage and door), hatches, vents, and exposed piping is required.
 - 2. All interior coatings shall meet requirements of NSF 61 for drinking water service.
 - 3. All parts of steel shall be painted in accordance with the requirements of ANSI/AWWA D 102.
 - 4. Corrosion Control: Corrosion control measures such as cathodic protection shall meet the requirements of Chapter 4.

- 5. The warranty from defects in material and workmanship shall extend for a period of one (1) year from the date of acceptance of the work. This first anniversary inspection requirement shall conform to ANSI/AWWA D102.
- 6. Application procedures, safety precautions, and testing of coatings shall be in accordance with the requirements of ANSI/AWWA D102.
- 7. A NACE certified coating inspector will be required to monitor the entire coating process from surface preparation to finished coating and perform integrity tests on the coatings to confirm proper application.
- 8. Interior Coating Systems:
 - a) Epoxy or polyurethane coating system is required for all interior surfaces including the tank wall, roof plate, bottom plate, and roof support member.
 - b) The epoxy shall be a self-priming epoxy coating intended for potable water contact. The epoxy formulation shall use 80 percent solids and zero VOC.
 - c) The polyurethane coating shall be self-priming; plural-component lining that uses 80 percent solids and zero VOC.
 - d) All welds, rafter edges, top of truss beams, etc. shall be stripe-coated by hand.
 - e) Surface preparation shall be near white blast cleaning that conforms to SSPC-SP10. The surface profile shall be 2.5 3.5 mils.
- 9. Exterior Coating Systems:
 - a) For exposed exterior metal surfaces of the tank, a coating system composed of epoxy, intermediate epoxy, and polyurethane will be applied.
 - b) The epoxy is a polyamide or polyamine, anticorrosive converted epoxy primer containing rust inhibitive pigments.
 - c) The intermediate epoxy is a two-component epoxy capable of 4 to 6 MDFT per coat.
 - d) The aliphatic polyurethane shall be a two-component acrylic based polyurethane, semi-gloss finish. This paint shall only be used in areas where reflection is not a problem.
- R. Sampling Station:
 - 1. A minimum of two (2) sampling stations shall be provided. The taps shall include a stainless steel locking ball valve.

6.08 Electrical Systems

- A. Electrical systems shall be designed in accordance with the requirements of Chapter 12.
- B. The electrical system providing power to components of the reservoir shall be designed by a qualified electrical engineer registered in the State of Nevada.
- C. Raceways shall be installed using rigid steel conduit, flexible liquid tight conduit, plastic-coated rigid steel conduit, and/or plastic conduit.
- D. Exposed raceways shall be rigid steel conduit, flexible liquid tight conduit in noncorrosive areas; exposed raceways shall be plastic-coated rigid steel conduit, flexible liquid tight conduit in corrosive areas; underground conduits shall be plastic conduit with plastic-coated steel conduits for all bend greater than 45 degrees and all risers and shall be encased in a concrete reinforced duct bank.
 - 1. Boxes available for use are pull boxes, junction boxes, outlet boxes, and terminal boxes and shall be of the same type material as that of the conduit system.
 - The wire and cable used shall be 600-volt and single conductor, type XHHW 2. Nameplates shall be provided on each electrical panel, motor starter, and control device.
 - 3. Underground, non-metallic, utility marking tape shall also be provided.
 - 4. All conduit on aboveground tank exterior wall shall be located behind the tank roof access ladder or stairway for security.
 - 5. Pull boxes shall be identified with COH marking.

6.09 Instrumentation and Control

- A. All instrumentation and control shall be provided per the requirements of Chapter 13.
- B. Level Monitoring:
 - 1. The reservoir level shall be measured, locally indicated, and transmitted to a Level Monitoring Cabinet and Programmable Logic Controller (PLC) using a field instrument as discussed below.
 - 2. Reservoir level signals shall be transmitted to the COH HEN-NET.
 - 3. The level transmitter shall be an ultrasonic-type level instrument for buried tanks.

- 4. For above ground tanks, use a 3-inch flange mounted differential pressure transducer.
- 5. In instances where a pumping station takes suction from the reservoir; the low-level switch activated from the level transmitter signal will be used to protect the pumps from cavitation.
- 6. In instances where a pumping station pumps to a reservoir, the high- and low-level switch alarms activated from the level transmitter signal shall be transmitted to the pumping station to protect the reservoir from overflow.
- 7. In instances where a Rate of Flow Control Station (ROFC) feeds the reservoir or tank, the high- and low-level switches shall be transmitted to the ROFC for shutdown of the station.
- 8. Reservoirs shall have a separate high/high level switch.
- 9. The Engineer shall, as part of the design, develop system hydraulic profiles and include them in the contract documents.
- 10. As part of the hydraulic profiles the Engineer shall define levels needed for system controls such as reservoir high-high, normal operating band, and low-low water levels.
- 11. The Engineer shall also include elevations needed for all alarm conditions that will be programmed into the system during startup.
- 12. In the event some of the alarm conditions are to be provided by suppliers of the equipment, those shall be clearly defined in the contract documents and defined as the responsibility of the Contactor.
- 13. Underground reservoirs shall have level transmitters and junction boxes in an accessible location for maintenance.
- C. Pump Station Control Interface:
 - 1. In locations where there is a pump station located adjacent to a reservoir, a PLC shall be located at the pumping station site.
 - 2. The reservoir level signal will be transmitted directly to the PLC, so that the signal can be sent through to the COH HEN-NET even during a power outage. The pumping station shall also be shut down when a high-level alarm is transmitted from the discharge reservoir or tank site.
 - 3. A low hydraulic level, sensed by a pressure switch or pressure transmitter on the pump station discharge header, shall shut down the pumping station.

- 4. The switch set point shall be set at the lowest minimum allowable hydraulic pressure to prevent cavitation damage to the pumps and detect a possible pipeline failure.
- 5. The pump station shall be shut down when a low water alarm is transmitted from a low suction pressure switch in the suction piping.
- D. Reliability:
 - In order to enhance reliability of the instrumentation and control system, the use of redundant instruments and power supplies is encouraged. PLCs and critical instruments must be powered with uninterruptible power supplies, preferably by DC battery supply. Critical instruments shall be backed up with "in place" spares. UPS shall be APC-XL1000 – NET with additional batteries and smart relay card for DI. UPS shall also be sized to enable 12 hours of use.
- E. Fluid Level Monitoring:
 - 1. Level monitoring units shall be installed on all future storage tanks and reservoirs in an accessible location.
 - 2. Output shall be 4-20 mA signal.
 - 3. High-high level switch shall be Magnitrol A15-IH3A-BAQ, 4-inch displacement type.
- F. Field Instrumentation:
 - 1. For underground reservoirs, the level transmitter shall be a Hydro-Ranger by Milltronics. For above ground reservoirs, the level transmitter shall be a pressure transmitter by Endress & Hauser, model Cerebar S. The pressure transmitter shall be 3-inch flange mounted with block and bleed piping.
 - 2. Field transmitters may be subjected to temperature in excess of the manufacturer's recommendations and may have to be protected by locating them in the nearby PLC cabinet or by vented metal housing painted white or a sunshade structure. No instrumentation will be allowed in vaults.
 - 3. Tanks for storing chemicals used in the disinfection system shall have ultrasonic level transmitters with level indication in the area where the operator will connect the fill line. This level signal shall also be transmitted to the PLC. Chemical metering pumps shall be under local manual control. However, their operating status and speed shall be input to the PLC.

- 4. All reservoir, vault access hatches, and doors, in addition to doors at a building on the site, shall be individually monitored for intrusion by the PLC. The alarm shall be annunciated to SCADA.
- Instruments shall be protected by lightning protection units at both the field instrument and PLC inputs. Coastal Instrumentation and Telemetry (CIT) Model LPB is the approved model for surge protection. CIT's number is (805) 497-7570.
- G. Hatch Intrusion Alarm Switches:
 - 1. Hatch Intrusion Alarm Switches Shall be heavy duty industrial grade, NEMA 4X, limit switches with a mechanical arm and roller. Limit switch shall be mounted to the inside hatch wall and arm shall sense hatch location. Alarm switches shall be individually monitored by the PLC and the PLC shall alarm.

6.10 Landscaping

- A. Landscaping shall be site specific and conform to local landscaping schemes. The landscape must be perceived as an extension of the directions established for the tank aesthetics. As such, the Engineer shall be responsible for guiding and coordinating the landscape design for the Project, either by retaining the services of a subconsultant, or engaging a landscape professional on his own staff.
- B. Block walls shall conform to local community standards.

6.11 Design Checklist

A. A checklist is provided at the end of this chapter for the Engineer's reference and use during design and may not include all applicable design criteria. It is the Engineer's responsibility to review and comply with all guidelines contained herein and all applicable codes completely prior to submitting for review.

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DEPARTMENT OF UTILITY SERVICES

TECHNICAL SERVICES DIVISION NEW DEVELOPMENT SECTION

CITY OF HENDERSON 240 WATER STREET HENDERSON, NEVADA 89015

UTILITY SERVICES Reservoirs Review Checklist

Design Concept Phase

- Design Concept Report (DCR)
- Location of reservoir
- □ Siting analysis
- □ Site description
- Rows, easements, ownership, etc.
- Reservoir sizing
- Overflow and finished floor elevations
- Dimensions
- Reservoir material
- Water quality analysis
- Service area

Preliminary Design Phase

- Preliminary Design Report (PDR)
- Executive Summary
- **Table of Contents**
- Project background
- Existing conditions
- Utility conflict information
- □ Topographic Mapping Information Summary
- Draft Geotechnical Investigation Report

- Draft Environmental Investigation Report
- Draft Corrosion Control/Cathodic Protection Report
- Draft Technical Drainage Study
- Drainage Study and Traffic Study Findings
- Preliminary plans and centerline profiles (30 percent design drawings)
- □ Site access
- □ Alternatives Evaluation Summary
- □ Recommendation for future connections
- □ Identification of appurtenant facilities and spacing criteria
- Opinions and recommendations
- □ Identification of ROW/easement constraints and acquisitions
- □ Matrix of permits and fees
- List of agencies and utilities
- Outline of technical specifications and final design drawings
- Preliminary quantity and associated cost estimates
- □ Preliminary construction schedule
- Project correspondence file and meeting minutes
- □ Inventory of existing facilities and improvements
- Graphics, sketches, tables, and other displays
- List of relevant reports, plans, and maps reviewed
- □ Work plan for construction
- Preliminary description of operations and controls
- Design calculations
- □ Major equipment selection
- □ Preliminary outline of specification sections

Agency and Utility Coordination

Contact and coordinate with outside utilities and agencies

Final Design Phase
Final Design

- □ Minimum design service life of 50 years
- Architecturally compatible with the surrounding area
- □ Final Corrosion Control/Cathodic Protection Report
- □ Final Geotechnical Report
- □ Final Environmental Investigation Report
- Design drawings and details
- Ease of access for operation and maintenance
- □ Site development for current and future expansion
- Tank of proven design, long history of use, and minimal cost of maintenance
- Appurtenances required for a complete and operable system
- □ Water quality provisions
- □ Plumbing and electrical systems
- Remote monitoring and SCADA system
- U Volume criteria
- Volume calculations
- □ Yard piping
- Security and safety
- Paving, curb, and gutter
- Disinfection
- U Water quality provisions

Concrete Reservoir Design

- COH concrete tank standard
- Design criteria
- Seismic loads
- □ Foundation and tank floor
- Tank roof
- □ Inlet and outlet piping
- Drain

- Overflow
- Reservoir access
- Roof vent
- Roof access
- Underdrain system
- □ Sampling station

Steel Tank Design

- COH steel tank standard
- Design criteria
- Seismic loads
- Wind loads
- Roof design
- U Wall design
- Tank bottom
- □ Footings and foundations
- □ Allowable stress
- □ Inlet and outlet piping
- Overflow
- Drain
- Roof vent
- Roof access
- Reservoir access
- □ Protective coatings
- □ Interior coating systems
- Exterior coating systems
- □ Sampling station

Electrical Systems

□ Requirements designed by a qualified electrical engineer

Raceways

Instrumentation and Control

- Level monitoring
- Pump station control interface
- Reliability
- □ Fluid level monitoring
- □ Field Instrumentation
- □ Hatch intrusion alarm switches

Landscaping

Guiding and coordinating the landscape design

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BILL OF MATERIALS								
PIECE DESCRIPTION						SPECIFICATION		
	1 ROUND BAR, 3/4" DIA x 16"							
	2 FLAT BAR, $3/8" \times 2 1/2" \times \LG$							
	3 ANGLE, $1/4" \times 3 \times 3 \times 4'-10$ 27/32" LG 4 SAE_T_CLIME PAIL \times W/ 4'_E" EVT WITH HADNESS & SLEEVE							
		5 FLAT BAR.	3/8" x 2"	<u>x 4" LG W\21/32" H</u>	IOLE 1" FROM END CENTERED	SS316		
	6 FLAT BAR. 3/8" x 2" x 8" IG DRIII AS SHOWN							
		7 FLAT BAR,	3/8" x 2"	x 6" LG DRILL AS SH	IOWN	A36		
	8 BOLT, 1/2–13 UNC x 1 1/2" LG W\ NUT							
		9 INSULATION	KIT (SEE	SHEET IK)		A36		
		10 FLAT BAR,	3/8° x 2° > x /4" DU	x 5° LG W\21/32° F	HOLE 1" FROM END, CENTERED	A36		
	-	12 FLAT BAR	3/8" x 2	1/2" x IG		A36		
		3 FLAT BAR.	3/8" x 2	1/2" x 8" LG		A36		
	-	14 FLAT BAR,	3/8" x 2	1/2" x 7" LG		A36		
		15 ANGLE, 1/4	" x 3" x 3	3"× 36"LG W∖ 2-1/	/2" HOLES 26 3/4" CENTERED	A36		
		16 GRIPSTRUT	ANCHORING	DEVISE (FOR PLATFO	RMS)	A36		
		17 PLATE, 1/4	·" x 7 3/4	" x 20" LG PER TEMP	PLATE	A36		
		18 PLATE, 3/1	6″ x 36 1	/2" x 17" LG FORM /	AS REQUIRED	A36		
		19 BOLL, 3/8-	-16 UNC X	1" LG W\ NUI		GALV		
	-	20 GRIPSTRUT 21 FLAT RAR	1/4" x 2"	$x 20^{\circ}-0^{\circ}$ STD FNGT	Ή	GALV A36		
		221 1 DAT DAR, 22 ANGLE 3/1	6" x 2" x	2" x 9 5/8" LG		A36		
		23 FLAT BAR,	1/4" x 2	" x 7'-1 9/16" LG		A36		
	2	24 FLAT BAR,	1/4" x 2	" x 8'-3 3/16" LG		A36		
		25 SAF-T-CLI	/IB RAIL	×		GALV		
	2	26 PIPE, 1.66	OD x 94"	LG, CRIMP BOTH ENDS	S	A53-B		
	2	27 EXPANDED	METAL $3/4$	", #13, 4' x 8' SI	HEET	GALV		
	2		I, 6 LG	WELDED TO LA	ADDER SUPPORTS)	A36		
NOTE: EXTERIOR AND INTERIO		9" 9" 9" 9" 2 0" 9" 2 0" 0" 0" 0" 0" 0" 0" 0" 0" 0"	28 9" EW B-E PLCS	1" 1" 13 1/2" 13 1/2" 18" RAD TYP 3/16	¢21/32" TYP 1" 1" 6 9 8 7 CENTERLINE	TYP 3/16 3 1" 30' 3/16 TANK SHELL OF LADDER	30'-3 21/32 INSIDE LADDER LEG DETAIL	<u>?</u> "
INTERIOR AND INTERIO INTERIOR LADDER SHA METAL INSULATION KIT	AND NO	CAGE.			City Of He	(CC endersor	DNTINUED FROM PA	GE 1)
					Clark Count	y, Nevada		
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DESIGNED_D.H.			AL CIT	200	-			
DRAWN RDB			(°		STEEL RESERV	/OIR	SUALE AS INU	
		1	-	- AL	LADDER ASSEM	I BLY	NO.	REV.
APPROVED			·** * **	a oti	KNUCKLE RO	OF	FIGURE 6.2B	0
DATE 07-01-04			A Place To Co	ell sticne				









	PARTS LIST					
	NO	NAME				
	1	FRAME				
	2	COVER				
	3	PIVOT LUG				
	4	HINGE LINK				
	5	HINGE STUD & NUTS				
	6	HINGE PIN				
	7	HINGE BUSHING				
S	8	WASHERS				
	9	SPRING PIN				
	10	SET SCREW				
	11	LUBE FITTING				





					City Of Henderson Clark County, Nevada Department Of Utility Services				
REVISIONS	DWN	APVD	APVD	DATE					
designed <u>D.H.</u> Drawn <u>RDB</u>				ANE 217	OVERELOW DRAIN SCALE AS N	OTED			
			1		HEADWALL NO.	REV.			
APPROVED			1	AFADER	AND FLAP VALVE FIGURE 6.5	B 0			
DAIL 07-01-04				A Place To Cal	t down				











A Day To Mall

HENDERSON UTILITY GUIDELINES Figure 6.8 DESCRIPTION DRAWN BY DATE

GENERAL NOTES:

- See drawings for stair orientation dimensions "H", "L", "R", "t" and "W". Stair width shall be 3'-0" unless otherwise indicated.
- MATERIAL SHALL BE PAINTED STEEL UNLESS OTHERWISE INDICATED.
- STAIR AND HANDRAIL SHALL COMPLY WITH OSHA, IBC AND LOCAL CODES.
- LANDINGS AND STAIR TREADS SHALL BE SLIP RESISTANT.
- RESERVOIR SHELL SHALL BE STIFFENED AS REQUIRED FOR LOADS IMPARTED BY STAIRS.
- ATTACHMENT WELDS TO RESERVOIR SHALL MEET THE REQUIREMENTS OF AWWA D100.
- BOTTOM OF DOOR SHALL BE 7'-0" MINIMUM ABOVE FINISH GRADE.

CHAPTER 7 WATER PIPELINES

7.01 General

- A. This chapter outlines the requirements for the Design Concept Phase, the Pre-Design Phase, and the Final Design Phase of large-diameter pipeline projects. Large-diameter pipelines have a minimum diameter of 16 inches.
- B. In addition, this chapter presents the standards that shall be followed in the design and construction of pipelines.

7.02 Design Concept Phase

- A. General: At the beginning of the design phase, a Design Concept Report (DCR) must be submitted and approved through the COH. The purpose of the DCR is to provide the Engineer and the COH with general information about the project emphasizing the purpose and need for the pipeline. Without an accepted DCR, the Pre-Design Report will not be accepted.
- B. Design Concept Report: The DCR must meet the requirements described in Chapter 1 and include, but not be limited to:
 - 1. System Overview.
 - 2. Location of pipeline.
 - 3. Approximate Length.
 - 4. Design flow rate.
 - 5. Preliminary diameter.
 - 6. Right-of-Way (ROW), permit needs, and all existing easements.
 - 7. Preliminary material selection.
 - 8. Preliminary Schedule, which includes design and construction.
 - 9. Proposed easements for alignment, power, water/wastewater, etc.

7.03 Preliminary Design Phase

A. General: The pre-design phase of the project must be presented in a Pre-Design Report (PDR), which must be submitted to the COH for review and approval. The PDR is the basis for the subsequent design process and must provide a thorough description of the project. Without an accepted PDR, the Engineer will not receive COH acceptance for the Final Design.

- B. Pre-Design Report: The PDR shall include, but not be limited to:
 - 1. Executive Summary.
 - 2. Table of Contents.
 - 3. Existing conditions.
 - 4. Summary of utility conflict information, including pothole information or recommendations for utilities locations.
 - 5. Topographic mapping information summary.
 - 6. Draft Geotechnical Investigation Report.
 - 7. Draft Environmental Investigation Report.
 - 8. Summary/overview of the applicable drainage and traffic study findings with references to those documents submitted separately.
 - 9. Preliminary plans and centerline profiles (30 percent design drawings) illustrating the recommended pipeline alignment and profile, facility plan views, proposed site plans and improvements, any offsite improvements, appropriate sections, elevations and details, existing topography, adjacent and underlying property ownership, ROW/easements, etc.
 - 10. Alternative alignments studied and recommended alignment.
 - 11. Recommendations for future connection(s) and tee locations.
 - 12. Recommendations regarding pipeline design parameters and materials.
 - 13. Identification of appurtenant facilities and spacing criteria.
 - 14. Recommendations for bidding packages, scheduling, Contractor staging, construction sequencing, and impacts to public areas and other stakeholders.
 - 15. Identification of any permanent and temporary ROW/easement constraints and acquisition needs.
 - 16. Design calculations including thrust restraint, thickness, and air-valve calculations.
 - 17. Matrix summary of permits to be obtained.
 - 18. List of agencies and utilities to review and sign the drawings.

- 19. Outline of technical specification sections and preliminary list of final design drawings.
- 20. Preliminary quantities and associated cost estimates.
- 21. Preliminary construction schedule.
- 22. Project correspondence file, including meeting minutes.
- 23. Inventory of existing facilities and improvements.
- 24. Graphics, detail sketches, tables, and other displays to support analysis and recommendations.
- 25. List of relevant reports, plans and maps reviewed, and other relevant project information.
- 26. Work plan for how construction is to be accomplished if connecting into existing facilities (phasing, shutdowns, etc.).
- 27. Corrosion mitigation analysis and design.

7.04 Agency and Utility Coordination

- A. The Engineer shall initiate contact and coordinate efforts with outside utilities and agencies in accordance with Chapter 1.
- B. Existing Utilities:
 - 1. It is the responsibility of the Engineer to coordinate with all utility entities during design to accurately identify and locate all existing utilities in the project area.
 - 2. All existing and proposed, public and private utilities shall be presented on plan and profile drawings. See respective Sections in this Chapter for Underground Service Alert (USA) and potholing requirements. Examples of utilities include but are not limited to water, irrigation, wastewater collection, storm water collection, gas, petroleum, power, communication, FAST, and traffic control.
- C. Record Drawings of Existing Utilities
 - 1. It is the Engineer's responsibility to obtain all available utility maps and as-built drawings from utility companies when infrastructure crosses or parallels a proposed COH pipeline.
 - 2. The COH standard datum, North American Vertical Datum of 1988 (NAVD 88) shall be used. If the datum on the as-built drawings and utility

maps is not NAVD 88, then data adjustments shall be made to conform to the current datum.

- D. Field Verification of Utilities:
 - 1. It is necessary to perform a field reconnaissance to locate existing utilities along the proposed pipeline alignment. Usually this is done with the field survey or walk thru completed as part of the PDR. The location of the existing utilities shall be compared with the locations recorded on utility drawings and utility maps. If discrepancies exist between utility drawings and field data, the particular utility or entity shall be contacted to resolve the discrepancy. Any USA markings or future facility markings should be field located and included on the plans.
- E. Underground Service Alert:
 - 1. USA shall be contacted at least 48 hours prior to digging at 1-800-227-2600. Water-soluble white paint shall be used to mark the project area for the various USA member agencies.
 - 2. The potholing or geotechnical boring companies shall be responsible for contacting USA directly and shall provide USA with the street address, cross streets, city, and county to identify the location of the work. In open country, USGS coordinates shall be provided. The construction Contractor shall be responsible for contacting USA during construction of the project.
- F. Potholing:
 - 1. All utility crossings or close utility interference shall be located and exposed by digging test pits (potholes). The design survey shall record the size, nature, and location of the potential crossing by station, offset, and elevation.
 - 2. The number of potholes required shall be sufficient to determine the alignment and grade of the utility.
 - 3. Use of "Soft Dig" (Vactor truck) technologies is encouraged to minimize the amount of soil disturbed during the potholing process. Many utility companies utilize this technology, for the risk of damaging the utility is low.
 - 4. Any disturbance to pavement, roads, or soil during potholing work shall be fully restored in accordance with valley-wide standards.
 - 5. Any repairs or damages caused by potholing shall be the responsibility of the potholing Contractor.

- 6. The Engineer shall be responsible for coordinating the potholing effort. The pothole Contractor shall be required to obtain all permits related to their work.
- G. Separation Requirements:
 - 1. Minimum separation distances shall be maintained around all utilities.
 - 2. The minimum horizontal and vertical separation requirements for all utilities, except wastewater collection lines, reclaimed water lines, and storm drains are shown in Figure 7.1.
 - 3. Separation for overhead utilities shall be as required by the affected utility entity.
 - 4. Horizontal and vertical separation of wastewater collection lines, reclaimed water pipelines, and storm drains from potable water facilities must comply with the currently adopted "Uniform Design and Construction Standards for Potable Water Systems."
- H. Utility Relocations:
 - 1. Utility relocations may include but are not limited to existing communications cable, utility power, wastewater collection, natural gas, or petroleum.
 - 2. If the relocation of an existing utility is necessary, an evaluation of the feasibility of moving an existing utility shall be conducted and relocation alternatives shall be developed with the utility owner.
 - 3. The utility owner shall be presented with the alternatives developed for utility relocation. If all issues are addressed and the utility owner is agreeable to relocating the utility, the utility owner needs to determine if they will design the relocation or if the Engineer will proceed with the relocation design.
 - 4. The drawings for relocating utilities shall be included in the contract documents, unless the utility owner chooses to relocate its own utility.
 - 5. For relocation of existing pipelines, the Engineer shall determine a new alignment, the new high or low points, and if air/vacuum valves and/or blowoff assemblies are needed.
 - 6. Once a decision is made to relocate an existing utility and the preferred alignment is set, provisions shall be included in the contract documents for

uninterrupted service during construction, unless otherwise allowed by the utility owner.

7. Costs: Utility relocation fees shall be included with the cost of the project, and are not paid directly by the COH.

7.05 Final Design Phase

- A. General: The Final Design Phase of the project must combine all the elements presented in the previous phases into detailed design drawings and specifications needed to bid and construct the project. Progress submittals are required during Final Design in accordance with Chapter 1 to allow the COH to incorporate review comments. The submittal process is described in Chapter 1.
- B. Final Design Drawings: The Final Design Drawings must include, but are not limited to:
 - 1. Cover Page.
 - 2. Sheet Index.
 - 3. Utility signatures.
 - 4. Final Geotechnical Report.
 - 5. Final Environmental Investigation Report.
 - 6. Design Drawings and details for each discipline (i.e. Land Surveying, Civil, Structural, Mechanical, Electrical).
 - 7. Contract documents shall be wet stamped and signed according to Nevada Revised Statutes.
 - 8. Plans and profiles.
 - 9. Existing topography, pothole, and utility information.
- C. Final Design Specifications: The Final Design Specifications shall include, but not be limited to:
 - 1. Cover Page.
 - 2. Table of Contents.
 - 3. Specification Sections for each design discipline (i.e. Civil, Structural, Mechanical, Electrical).
 - 4. Contract documents shall be wet stamped and signed according to Nevada Revised Statutes.
7.06 Design of Pipeline Systems

- A. General: When considering design of a water pipeline, the Engineer shall consider a number of factors including pumping costs, system demand, frictional losses, flow velocities, and turnover concerns early in the planning period. Typically, transmission facilities are sized in the pump station PDR or presented in a utility master plan. In the absence of a PDR, the Engineer is required to consult with COH for pipeline design criteria.
- B. Horizontal Pipe Alignment: Preliminary horizontal pipe alignment must be developed as part of the PDR. The following considerations shall be taken for the development of horizontal pipe alignment:
 - 1. The preliminary pipe alignment must identify design and coordination issues such as: utility conflicts, constructability issues, environmental issues, permitting requirements, and easement/right-of-way needs.
 - 2. The pipeline horizontal alignment shall maintain minimum separations from wastewater collection lines, storm drains, or reclaimed lines in accordance with UDACS.
- C. Vertical Pipe Alignment: Preliminary vertical pipe alignment must be developed as part of the PDR. The following shall be considered for the development of vertical pipe alignment:
 - 1. The vertical alignment must conform with the following considerations:
 - a) Pipeline material and fabrication.
 - b) Potential interference with exiting and future utilities.
 - c) Safety.
 - d) Geotechnical conditions.
 - e) Permitting requirements.
 - f) Construction requirements.
 - g) Maintenance requirements.
 - h) Minimize number of high points.
- D. Plan and Profile Drawings: Plan and profile drawings shall include, but not be limited to:
 - 1. Pipeline centerline stations.
 - 2. Invert elevations at grade breaks and the matchlines of each sheet.
 - 3. Pipe information table, i.e. wall thickness, pressure class, etc.
 - 4. Pipe joint type and restraining requirements.
 - 5. Pipe material.

- 6. Pipe lining and coating.
- 7. Pipeline horizontal curve data.
- 8. Pipeline appurtenances.
- 9. Easement limits with recording information.
- 10. Existing utility information including pothole information.
- 11. Existing COH drawing numbers.
- E. As-built drawings: As-built drawings shall be in accordance with Chapter 1. As-builts shall incorporate GPS data as required by COH.
- F. Pipe Materials: Material shall be:
 - 1. Mortar Lined and Coated Welded Steel pipe conforming to ANSI/AWWA C200.
 - 2. Ductile Iron pipe conforming to ANSI/AWWA C 151.

7.07 Fittings and Appurtenances

- A. Steel Fittings:
 - 1. Steel fittings shall comply with ANSI/AWWA C 208. Flanges located above ground or in vaults shall comply with ANSI/AWWA C 207. Flanges shall be selected in accordance with working pressure, test pressure, surge pressure, and the drilling pattern of the adjoining flange. In general, buried flanged applications will not be allowed.
 - 2. Welded steel fittings shall be designed in accordance with standard practice as stated in AWWA M 11 and other applicable industry standards. Bolt holes on flanges shall straddle the vertical centerline. Welded steel pipe elbows shall be as follows: 0 to 30 degrees two piece, 30 to 45 degrees three piece; 45 to 60 degrees four piece; and 60 to 90 degrees five piece. Outlets for blowoffs and air valves shall be as shown in the "Appurtenances and Structures" section of this chapter. Joints for fittings shall be welded or flanged.
 - Reinforcement and wall thickness of steel fittings shall conform to AWWA M 11 and other applicable industry standards. Rating of flanges shall comply with ANSI/AWWA C 207.
- B. Ductile Iron Fittings:

- 1. Fittings shall be push-on or mechanical joint below grade and flanged above grade or in vaults. Where the design dictates, push-on and mechanical joints shall be restrained.
- Ductile Iron fittings shall be furnished in accordance with ANSI/AWWA C 110 or ANSI/AWWA C 153. Ductile Iron fitting pressure ratings shall be as follows:
 - a) Fittings 4 inch through 24 inch rated for 350 psi.
 - b) Fittings 30 inch through 48 inch rated for 250 psi.
 - c) Fittings 54 inch through 64 inch rated for 150 psi.
- 3. Fittings shall be in accordance with all applicable requirements of ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53 with the exception of the manufacturer's proprietary design dimensions.
- 4. Joint components shall be in accordance with the requirements for push-on joints in ANSI/AWWA C 111/A 21.11.
- 5. Cement lining shall be either standard thickness cement lining or double thickness cement lining in accordance with ANSI/AWWA C 104/A 21.4.

7.08 Pipe Joints

- A. Steel Pipe Joints:
 - 1. Steel pipe joints shall be welded, flanged, grooved, or bell and spigot, depending on the pipe diameter, longitudinal force, flexibility requirements, the type of adjoining end, and the need to disassemble the joint.
 - Bell and spigot joint preparation shall be in accordance with ANSI/AWWA C 200. Rubber gasketed joints may be used for special design conditions as approved by the COH.
 - 3. Depending on the longitudinal force due to thrust and the effect of temperature, the large diameter transmission pipe joints may be lap welded or butt welded. The procedure for design of the joint to resist longitudinal forces is discussed in Chapter 8 of AWWA M11. Butt strap joints may be necessary on closure sections, or to connect to existing sections of the pipeline.
 - 4. Expansion joints shall be designed as recommended by AWWA M11, Section 8.6
- B. Ductile Iron Pipe Joints:

- 1. For direct bury applications, mechanical joint restrained systems are required unless otherwise approved by the COH.
- 2. The ANSI/AWWA C 111 standard applies to rubber gasketed joints for ductile iron pipe. Push-on joints may be used on straight pipe runs. Mechanical joints are required for all other applications.
- 3. The ANSI/AWWA C 115 standard applies to flanged ductile iron pipe and fittings. Flanged fittings are only permitted in aboveground or in-vault installations, unless otherwise approved by the COH.

7.09 Trench Design

- A. Trench Width: The Engineer shall determine the appropriate trench width by considering the pipe diameter, depth of cover, type of material to be removed, the space required for installation of the pipe and operation of equipment, general construction practices, and guidelines presented in the following paragraphs:
 - 1. The Engineer shall indicate that trench spoils shall be placed at a sufficient distance away from the edge of the trench to minimize trench collapse.
 - 2. The Engineer shall indicate that trench shoring be used to protect workers in accordance with local, state and OSHA requirements.
 - 3. The trench should be as wide as necessary for proper installation of the pipe and backfilling, and should provide adequate room to meet safety requirements for workers. A minimum clearance of 12 inches horizontally on both sides of the pipe as measured from the outer diameter (OD) shall be provided. Maximum horizontal clearances shall be based on design calculations. AWWA M 41 Section 11.3 and AWWA M 11 Chapter 13 requirements also apply to trenching, embedment, pipe installation, and backfilling. Laying conditions for ductile-iron pipe are presented on Figure 11-6 of the AWWA M 41.
 - 4. The method and equipment used for excavating trenches will depend on the type of material to be excavated, the depth of the trench, and space available for trenching operations. The choice of method and equipment is typically left up to the Contractor. The Contractor should only use equipment capable of meeting trench width limitations. Provisions should be included in the contract specifications that require corrective measures to be used by the Contractor if allowable trench widths are exceeded, except when safety requirements dictate a wider trench.

- 5. The Contractor shall ensure that trenches excavated during construction are the same configuration and width as indicated in the design. If trench excavations are not the same (e.g., sloped sides versus straight sides), the contract documents shall provide for verification that pipe wall design is adequate to meet loading requirements for the actual trench configuration.
- B. Pipe Bedding and Backfill: The Engineer shall rely on a qualified geotechnical engineer registered in the State of Nevada to determine soil requirements for pipe bedding, pipe zone, and backfill. The following guidelines shall be taken into consideration:
 - 1. Bedding beneath the pipe shall be designed based on trench conditions, pipe weight and soil conditions. Bedding shall not be less than 6 inches deep.
 - 2. Pipe Zone is comprised of the area above the pipe bedding to at least 12 inches above the top of pipe. The pipe zone shall be designed to ensure that firm support is provided to prevent lateral movement during final backfill. The Engineer shall determine appropriate methods for backfill of the pipe zone, which may include manual methods and mechanical equipment.
 - 3. Backfill materials shall be in accordance with the Geotechnical Report recommendations.
 - 4. Minimum Depth of Cover is 5 feet as measured from finished grade to the top of pipe unless otherwise approved by the COH. In areas where finished grade is unknown, the COH shall be consulted for pipe cover requirements.

7.10 Steel Pipe Design

- A. General: The design of steel pipe must include external load, internal pressure, and surge pressure according to AWWA M 11 standards.
 - 1. External loads to be considered on a pipe include dead loads and live loads. Potential heavy construction loads shall also be considered, when necessary.
 - 2. Groundwater: The pipe shall be designed to resist uplift from groundwater when such situations.
 - 3. Vacuum Pressure: The pipe shall be designed to withstand anticipated vacuum pressures as determined by a surge analysis as described in Chapter 5 or as described in AWWA M 11.

- 4. Internal Pressure: Considerations for working pressure and field test pressure shall be as follows:
 - a) Working Pressure: shall be determined from the maximum HGL the pipeline will see in operation. Pressure calculations shall reflect the difference in elevation between the HGL and the centerline of the pipe. See Table 7.1 for allowable hoop stresses for cement mortar or dielectrically coated steel pipe.
 - b) Field Test Pressure:
 - 1) Field air pressure testing of all welded pipe joints and field hydrostatic pressure tests of the completed pipeline shall be conducted.
 - 2) The hydrostatic test pressure shall be equal to the maximum working plus surge pressure, the pump shutoff pressure (where applicable), or 1.25 times the maximum working pressure whichever is greater. The hydrostatic test pressure shall not produce a hoop stress in the pipe wall exceeding that noted in Table 7.1. Valves (body and seat) shall not be subjected to test pressures greater than the manufacturer's recommendation. In some cases, this may require an increase in the valve pressure class.

Working Pressure		Test Pressure		Surge Pressure	
Mortar	Dielectric	Mortar	Dielectric	Mortar	Dielectric
Coating	Coating	Coating	Coating	Coating	Coating
50% of Yield	50% of Yield	62.5% of Yield	62.5% of Yield	66.7% of Yield	66.7% of Yield
16,500 psi	21,000 psi	20,625 psi	26,250 psi	22,000 psi	28,000 psi
maximum	maximum	maximum	maximum	maximum	maximum

Table 7.1 Maximum Allowable Hoop Stress for Welded Steel Pipeline

- 5. Surge Pressure: The surge pressure shall be obtained from a surge analysis as described in Chapter 5.
- B. Wall Thickness Design:
 - 1. The pipe wall thickness selected shall be the greater of the thicknesses computed for the loading conditions listed below. The design procedure for welds at the joints is discussed in a subsequent section. The design procedure to determine wall thickness shall consider the following conditions:
 - a) Minimum thickness for handling.
 - b) External loads.

- c) Internal pressure.
- d) Surge pressure.
- e) Longitudinal thrust forces caused by valves or changes in alignment.
- f) Longitudinal forces resulting from changes in temperature.
- g) Combined stress (hoop and longitudinal).
- 2. Minimum Wall Thickness for Handling: The minimum thickness for handling shall be determined by the following equation:

Thickness = Pipe Outside Diameter (inches) / 240

- 3. Design for External Loads:
 - a) Two conditions for external loads shall be considered:
 - 1) Live load plus dead load with full depth of cover.
 - 2) Live load plus dead load with minimal cover. The minimal cover used in the calculation must be coordinated with the specifications. The specifications must state the amount of cover required prior to operating heavy equipment above the pipe. The live loads must represent the heaviest equipment anticipated for use in compaction or hauling material above the pipe.
 - b) Minimum wall thickness for external loads shall be determined by using the lowa formula as presented in AWWA M 11. Deflection for mortar-lined and -coated steel pipe shall be limited to 2.0 percent of the diameter.
 - c) When a cement mortar coating is applied over a dielectric coating to protect the dielectric coating from damage (rock shielding), it need not be considered a mortar coating for purposes of deflection requirements.
- 4. Design for Internal Pressure: The minimum wall thickness for internal pressure shall be determined by using the equation provided in AWWA M11 (t = pd/2s). The allowable hoop stress at working pressure for cement mortar lined and coated steel pipe shall be limited to that noted in Table 7.1 to minimize the potential for cracking of the coating as the pipe expands under pressure. Mortar coating used to protect dielectric coating shall not be considered for purposes of pressure design.
- 5. Design for Surge Pressure: The minimum wall thickness for surge pressure shall be determined by using the equation provided in AWWA M11 with an allowable steel stress noted in Table 7.1.
- Thrust Forces: Longitudinal thrust force shall be calculated by the method described in Chapter 13 of AWWA M 11. Closed valves will create the full "P x A" (pressure times area) force. Note that this force may cause tension

or compression in the pipe wall depending on the location of the resisting forces. Bends in the alignment will create forces as shown in AWWA M 11. Longitudinal thrust forces must be considered in the combined stress analysis described in a subsequent section.

- 7. Longitudinal Force Due to Change in Temperature: When the pipe joints are welded, the temperature of the steel will likely be higher than when the pipe is in service and conveying water. The stress in the pipe wall attributable to a change in temperature shall be mitigated by procedures described in Chapters 12 and 13 of AWWA M 11. The specifications must state the maximum allowable temperature of the steel when the closure joints are welded. If controlled low strength material (CLSM) is used to backfill the pipe zone, the maximum temperature of the CLSM must also be stated in the specifications. The minimum temperature of the steel shall be considered 50 degrees Fahrenheit. The force due to a drop in temperature, between the time the joints are welded and the pipe is placed in service, will always create tension in the pipe wall. Temperature stresses must be considered in the combined stress analysis described in a subsequent section.
- 8. Longitudinal Force Due to Effect of Poisson's Ratio: As the pipe expands due to internal pressure, it will tend to contract longitudinally. If the pipe is restrained from contracting, a longitudinal stress will develop in the pipe wall. The maximum magnitude of the stress is given by the formula:
 - a) Longitudinal Stress = (Hoop Stress) x Poisson's Ratio.
 - b) For steel, Poisson's ratio may be assumed to be 0.303. The longitudinal stress resulting from the effect of Poisson's ratio should be added to the stress caused by a change in temperature. The Engineer is advised that situations may occur where the total longitudinal stress includes the temperature stress, Poisson's stress, and bulkhead thrust stresses.
- 9. Design for Combined Stress:
 - a) Combined stress shall be calculated by using the Hencky-Mises theory. If the maximum combined stress exceeds those values in Table 7.2, the steel wall thickness shall be increased. Repeat the calculations and compare again. Combined stress calculations are not applicable for rubber gasket pipe.

Working Pressure	Test Pressure	Surge Pressure	
Mortar or Dielectric Coating	Mortar or Dielectric Coating	Mortar or Dielectric Coating	
50% of Yield	62.5% of Yield	66.7% of Yield	
(21,000 psi maximum)	(26,250 psi maximum)	(28,000 psi maximum)	

Table 7.2Maximum Allowable Combined Stress for Welded Steel Pipeline

C. Welding Specifications

- 1. The design of welds shall take into consideration the following guidelines:
 - a) Joint welds may be lap welds or butt welds.
 - b) Weld certification per AWS D1.1 shall be provided.
 - c) Field welding must be made by welders certified by ASME Boiler and Pressure Vessel Code.
 - d) In case of exterior welds, space must be provided for welding and inspection of joints.
 - e) NDT Weld testing must be performed on all field welded joints in accordance with ANSI/ASTM:
 - 1) Magnetic Particle Weld Testing according to ANSI/ASTM E 709.
 - 2) Air Weld Testing: All joints shall also be air tested in accordance with AWWA C 206 by shop drilling and tapping two 1/4-inch NPT air test holes in the lap or bell end of the pipe. Apply 40 psi of air, or other suitable gas, into the connection between the two fillet welds. Paint the welds with soap solution. Mark leaks indicated by the escaping gas bubbles.
- 2. Lap Welds: Lap welded joints must be in accordance to AWWA C206.
 - a) The allowable force on a lap weld shall be computed by the Engineer. The strength of the seal weld shall not be included in the allowable force calculation. Note that the AWWA M 11 procedure assumes minimal space between the bell and spigot surfaces. It is important that this space and the resulting eccentricity be in accordance with the requirements of AWWA C 200.
 - b) If the actual force is greater than the allowable force, three options should be considered:
 - 1) The wall thickness could be increased.
 - 2) A double lap weld (inside and outside of the pipe) could be used instead of a single lap weld with a seal weld.
 - 3) A butt weld could be used instead of a lap weld.
 - c) Where more than one pass is required:
 - 1) Each pass except the first and final one shall be peeked to relieve shrinkage stresses.

- 2) All dirt, slag and flux shall be removed before the succeeding bead is applied
- d) Each weld pass shall place no more than a 1/8 inch of weld material using a combination of stitch and weave weld.
- 3. Butt Joint Welds: Full penetration butt joint welds with appropriate inspection and nondestructive testing must be capable of resisting a longitudinal force equal to the force resisted by the pipe wall.
- 4. Butt Strap Welds:
 - a) The allowable force on a butt strap weld shall be computed in accordance with the procedure used for lap welds.
 - b) Butt strap welds must be a minimum of 10 inches wide and have the same thickness as the pipe wall.
 - c) A minimum of 2-inch lap must be provided at each pipe joint.
- D. Restrained Joints: The Engineer shall design the restrained joint system to resist thrust forces through the development of friction forces between the pipe and the surrounding soil. The Engineer shall also determine the length of pipe necessary to transmit the force into the soil and indicate this on the project drawings. Factors affecting this length include pipe size, internal pressure, depth of cover, and the characteristics of the surrounding soil. Connections of valves, fittings, and reducers can incorporate rigid or flexible connections as follows:
 - 1. Rigid Connections:
 - a) Includes lap welded joints, butt-welded joints, butt strap joints, flanged joints, and harness joints.
 - b) Joints are restrained from tension forces as well as compression and shear forces, except for harness joints.
 - c) A harness can transmit axial tension forces, but has little capacity to transmit shear or compression forces.
 - d) All joints are to be designed to transmit the thrust force in either direction.
 - e) The most common type of restraining joint in steel pipelines is the welded joint. This joint shall be used on all steel transmission pipelines unless sufficient justification for using an alternate joint is approved by the COH.
 - 2. Flexible Connections:
 - a) Includes bell and spigot rubber gasket joints, Carnegie shape rubber gasket joints, and mechanical coupling joints.
 - b) Flexible connections are unrestrained and require harnesses to protect against axial transient forces.

c) The design procedure for harnesses is covered in Chapter 13 of AWWA M 11.

7.11 Ductile Iron Pipeline Design

- A. General: The design of ductile iron pipe for COH facilities shall adhere to the design procedures presented in DIPRA's Design of Ductile Iron Pipe or AWWA Manual M 41.
- B. Wall Thickness Design Procedures: The thickness shall be determined by considering external loads and internal pressures individually and then selecting the larger of the thickness using both methods.
 - 1. The design thickness of ductile iron pipe shall be determined according to AWWA C150 and as described below:
 - a) Calculate external loads (earth load plus truck loads).
 - b) Calculate internal pressure (static pressure plus surge pressure allowance).
 - c) Choose larger pipe thickness value.
 - d) Add a 0.08-inch service allowance.
 - e) Check pipe deflection.
 - f) Add a standard casting allowance.
 - 2. The appropriate pipe pressure class shall be determined with the calculated design thickness.
 - 3. Internal pressure design of standard pressure classes shall be based on rated working pressure plus a surge pressure allowance of 100 psi.
 - 4. Calculations must be based on a minimum yield strength in tension of 42,000 psi and 2.0 safety factor times the sum of working pressure and 100 psi surge allowance.
- C. External Load Design:
 - 1. The net wall thickness required for an external load is based on two design considerations:
 - a) Limiting ring bending stress to provide a safety factor of 2.0 based on ultimate ring strength.
 - B) Ring deflection is limited to 3 percent of the outside diameter for cement-mortar lined pipe and 5 percent of the outside diameter for flexible linings.
 - 2. A net thickness shall be computed using both the bending stress and deflection equations in DIPRA. The larger of the two thicknesses is then selected as the net thickness required for external load design.

- D. Internal Pressure Design: The hoop stress formula shall be used to calculate net thickness required for internal pressure as described in DIPRA. A safety factor of 2.0 must be applied to the sum of maximum working pressure and surge allowance. The standard surge allowance is 100 psi; however, the maximum anticipated surge pressure should be used if it is higher than the standard.
- E. Standard Allowances: Once the net thickness has been determined, certain allowances are added to obtain the total calculated thickness requirement:
 - 1. A service allowance (0.08 inch for all pipe sizes) shall be added to provide an additional safety factor for service allowance.
 - 2. Casting tolerance shall be added to provide the latitude required by the manufacturing process and to prevent the possibility of significant deviation from design thickness. Casting allowance is dependent on pipe size as shown below.

Size (inches)	Casting Tolerance (inches)
42 and smaller	0.07
48	0.08
54	0.09

Table 7.3Allowances for Casting Tolerance

F. Restrained Joints: Thrust restraint design for Ductile Iron Pipe is covered in Chapter 8 of AWWA M41 and shall be used in designing thrust restraint systems for COH ductile iron transmission pipelines. Calculations for restrained joint systems shall be submitted to the COH with the 100 percent design. Joint restraint systems shall be per the COH Approved Materials List.

7.12 Protective Coatings and Linings

- A. General: Protective coatings and linings shall be applied for corrosion control as required in Chapter 4. Coatings must be properly applied in order to extend the life of a pipeline by deterring corrosion and pipeline deterioration. AWWA standards, listed below, must be used in specifying coatings and linings for COH pipeline facilities.
 - 1. For Steel Pipe:
 - a) AWWA/ANSI C 203.
 - b) AWWA/ANSI C 205.
 - c) AWWA/ANSI C 209.
 - d) AWWA/ANSI C 210.
 - e) AWWA/ANSI C213.
 - f) AWWA/ANSI C 214.

- g) AWWA/ANSI C 215.
- h) AWWA/ANSI C 216.
- i) AWWA/ANSI C 217.
- j) AWWA/ANSI C 218.
- k) AWWA/ANSI C 222.
- I) AWWA/ANSI C 225.
- m) AWWA/ANSI C 602.
- 2. For Ductile Iron Pipe:
 - a) AWWA/ANSI C 104.
 - b) AWWA/ANSI C 105.
- B. Linings: Linings are installed on the interior surface of pipelines and protect against corrosion while maintaining low hydraulic frictional resistance. Main considerations related to linings include:
 - 1. Cement mortar linings for steel and ductile iron pipe provide excellent corrosion protection while maintaining a smooth surface on the interior of the pipe.
 - 2. Large steel pipelines are generally cement-mortar lined. However, polyurethane or epoxy linings may be used to avoid cracking of cement mortar lining if pipe is subjected to wet/dry cycles. For small diameters polyurethane or epoxy linings may be used to preserve hydraulic characteristics.
 - 3. Other reference material includes RP0175-75, Control of Internal Corrosion in Steel Pipelines and Piping Systems. This document is available from NACE International, Houston, Texas.
- C. Coatings: Coatings are materials applied to the exterior of the pipe for corrosion protection.
 - 1. The exterior protection for steel pipe shall be cement mortar. Dielectric tape wrapping shall be used depending on soil conditions. For exposed installation, the coating shall be polyurethane or epoxy.
 - 2. Exterior protection for ductile iron pipe shall be a double layer of AWWA C105 polyethylene in accordance with Chapter 4, except as otherwise required by corrosion report.
- D. The piping manufacturer shall be responsible for providing all piping material, linings, and coatings.

7.13 Isolation Valves

- A. General: The Engineer shall provide isolation valves for water pipelines in accordance with the COH requirements provided herein and the following:
 - 1. Valve coating and lining shall match the respective coating and lining for the pipeline.
 - 2. Valve shall be Class 150B or Class 250B based on the anticipated system pressure.
 - 3. Buried valves and valves located inside buried vaults shall be equipped with AWWA 2-inch operating nut and Type 304 stainless steel valve stem extension designed for maximum torque of 150 ft-lbs.
 - 4. Exposed valves shall be equipped with hand wheel or chain operators designed for maximum pull of 50 lbs.
- B. Butterfly Valves: shall generally be used for isolating pipelines 20 inches and larger in diameter and shall be AWWA C504 general butterfly valves equipped with the following:
 - 1. Bodies shall be flanged or mechanical joint ends, short-body type constructed of ASTM A 126 cast iron or ASTM A 536 Ductile Iron.
 - 2. Discs shall be mechanically secured to shaft with stainless steel and manufactured of materials per Section 4.4 of AWWA C504. Bronze discs are not acceptable to COH.
 - 3. Acceptable manufacturers:
 - a) Henry Pratt Company.
 - b) Dezurik Inc.
 - c) Crispin.
- C. Resilient-Seated Gate Valves: shall generally be used for isolating pipelines under 20 inches in diameter and shall be AWWA C 509 valves equipped with the following:
 - 1. Iron-bodied, non-rising stem type with O-ring seals.
 - 2. Bonnet connected to body by bolts and nuts or studs.
 - 3. Bolts, nuts and studs constructed of cadmium-plated steel or Type 304 stainless steel.
 - 4. Valve stems shall be bronze with a minimum tensile strength of 60,000 psi and containing not more than 5 percent zinc and 2 percent aluminum.

- 5. Acceptable manufacturers:
 - a) American Flow Control.
 - b) Clow Valve Company.
 - c) Mueller Company.

7.14 Appurtenances and Structures

- A. General: Pipeline appurtenances/structures include mainline valves, outlets, air vacuum assemblies, drain valve stations, access structures/assemblies, conduit for communications cable, marking tape, pipeline markers, and cathodic protection test stations. Each of these items is discussed in the following sections.
- B. Dismantling Joints: shall be equipped with flanged connections suitable for the system pressure and provide the following features:
 - 1. Spool constructed of steel pipe in accordance with ASTM A 53 for sizes 3 to 12 inches or ASTM A 36 for sizes 14 inches to 72 inches.
 - 2. End ring constructed of ASTM A 536 ductile iron for sizes 3 inches to 12 inches, or ASTM A 36 or A 53 for sizes 14 inches to 72 inches.
 - 3. Follower ring constructed of ASTM A 536 ductile iron or ASTM A 36 steel.
 - 4. Bolts and Nuts:
 - a) Aboveground: constructed of high-strength, low alloy steel in accordance with AWWA C 111.
 - b) Buried and underwater: constructed of Type 316 stainless steel in accordance with ASTM F 593.
 - 5. Tie Rods: high tensile steel in accordance with ASTM A 193 Grade B7.
 - 6. Coating and Lining shall match the associated piping.
- C. Mainline Valves: Design of mainline valves shall consider spacing and location and layout of valve structure as follows:
 - 1. Mainline valves shall be placed every 1/2 mile. The location, size, and type shall be as recommended by the Engineer and accepted by COH.
 - 2. Unless otherwise approved, mainline valves shall be the same diameter as the pipeline.
 - 3. Valves 24 inches in diameter and larger must be placed in a vault.

- D. Mainline Valve Vaults: Layout of Vault: Figure 7.2 presents a typical sketch of a mainline valve structure and appurtenances. The vault design shall consider the following:
 - 1. Vault may be pre-cast or cast in place.
 - 2. Vault must allow proper accessibility for maintenance and inspection.
 - 3. Vault shall be designed with proper drainage to avoid internal water accumulation and must include a sump for drainage.
 - 4. Pipe penetrations shall be leak proof to avoid water transfer in or out of structure.
 - 5. Reinforcement steel shall not be in contact with pipe to avoid shortcircuiting of the cathodic protection system.
 - 6. A dismantling joint shall be provided for maintenance and removal of the valve.
 - 7. A blow-off system shall be designed as indicated Figure 7.2.
 - 8. In-line valves shall be placed in a section of pipeline with no slope. If a valve vault is required with the valve, the wall of the structure shall not be designed to restrain the full axial thrust.
 - 9. Mainline manual butterfly valve actuators shall be manufactured by:
 - a) Rotork.
 - b) DeZurik.
 - c) Pratt.
 - d) EIM.
 - e) Limitorque.
- E. Outlets: An outlet (future or current) is simply a specified diameter tee or outlet branching off the main transmission line.
 - 1. Outlets for future connections must have an isolation valve in a vault, if 24 inches, or larger. The isolation valve shall be followed by a short spool pipe extending outside of the vault by at least 5 feet with a bumped head or end cap with thrust restraint.
- F. Air Valves: Properly designed air valves shall be used to allow release or admittance of air into the pipeline system during filling, draining, and normal operations, to permit air release from high points in the pipeline, and to protect the pipeline from vacuum pressures caused by surge conditions. The following considerations shall be taken:

- 1. AWWA Manual M51 shall be used as a guide for selecting, sizing, and locating air valves in COH transmission pipelines.
- 2. In the design of transmission pipelines, AWWA C 512 shall be used as a standard for air valve design. Special air valves deviating from the AWWA C 512 Standards shall receive prior written approval by COH. It is the Engineer's responsibility to address the following considerations during the design of transmission air valves:
 - a) Location of air valve.
 - b) Type of air valve.
 - c) Size of air valve.
- 3. Reliability in air valves must be provided at critical locations and shall be incorporated into the design by having one additional valve of each type.
- 4. Critical valves are those which, if removed or damaged, could create adverse air buildup, negative pressures, etc. under certain operational, filling, draining or catastrophic failure conditions; which damage the pipeline or connected facilities.
- 5. PVC valves are not allowed.
- 6. All air valves shall have a street valve can with a plastic lockable insert.
- G. Air-release valves: Air-release valves are designed to release pockets of air as they accumulate at high points in a pressurized pipeline. The valve is characterized by the size of the outlet orifice. Typical orifice sizes in air-release valves are between 1/16 inch and 1 inch in diameter. The following considerations shall be taken:
 - 1. Air-release valves will not provide vacuum protection nor will they vent large quantities of air quickly during filling.
 - 2. Air release valves must be installed at all high points within a pipeline system.
 - 3. A typical air-release valve assembly consists of one or more air-release valves, isolation valves, surge check valves, and stem piping from a single outlet at the crown of the pipe.
- H. Air/vacuum valve: Float operated device, which provides vacuum protection and allows large quantities of air to be released or admitted into the pipeline during filling and draining. Air/vacuum valves are characterized by outlet orifice size. Discharge outlet sizes range between 1/2 inch and 20 inches in diameter and shall be equal in size to the inlet port. The size of an air/vacuum valve is a very important consideration, for the size of the valve controls the pressure differential

in which air is exhausted during filling and the degree to which vacuum conditions are minimized during negative internal pressures in the pipeline.

- 1. Air/vacuum valves shall be installed at high points and grade changes along the pipeline.
- 2. Air/vacuum valves will not open and vent air as it accumulates at high points during normal operating conditions.
- 3. The allowable internal vacuum pressure can be estimated per AWWA M 11, Section 6.3 for buried pipeline. For above-grade crossings or pipelines in casings without control density fill, or similar situations, the vacuum pressure can be estimated per AWWA M11, Section 4.4.
- I. Air Combination Air Valves: The combination air valve combines the operating features of the air-release valve and the air/vacuum valve.
 - 1. Combination air valves shall be installed at all high points along the pipeline.
 - 2. Combination air valves shall be as specified in UDACS and as listed on the COH Approved Materials List.
- J. 6-inch Manual Blow-off Assembly: Drain valves will need to be included along the pipeline to enable drainage of the pipeline during times of maintenance or emergency. The following considerations shall be taken for selection and design:
 - 1. Blow-off assemblies shall be located at all low points in the pipeline.
 - 2. Blow-off assemblies shall also be required on the high side of isolation valves that create low points when closed.
 - 3. Blow-off assemblies shall be configured per UDACS 6-inch blow-off assembly standard plate.
 - 4. The Engineer shall verify that water from the blow-off assembly will not adversely affect neighboring properties or facilities.
 - 5. It is anticipated that blow-off assemblies will discharge to washes or storm drains.
- K. Special Connection Points: The pipeline may connect to various facilities, including pumping stations and reservoirs. Each connection is unique and requires special consideration.

- L. Marking Tape: The drawings and specifications shall require three strips of marking tape at two locations above the pipeline (per UDACS). The following guidelines must be considered:
 - 1. The upper location shall be 3 feet below finish grade with one strip placed over the centerline of the pipe and another strip 1 foot past the edge of pipe on each side.
 - 2. The lower location shall be 3 feet above the crown of the pipe located over the centerline of the pipe and at a distance of 1 foot past the edge of pipe on each side.
 - 3. The tape shall be 12 inches wide and the three strips shall be spaced as noted above.
 - 4. Tape in the upper location shall be metallic marking tape.
 - 5. The tape shall be blue with repeating 1-inch high black lettering as follows:

"CITY OF HENDERSON WATER SYSTEM - WATER LINE BURIED BELOW"

- M. Pipeline Markers: Pipeline markers shall be provided to locate buried transmission lines:
 - 1. Pipeline markers shall be per UDACS where applicable.
 - 2. Passive, Electronic Markers shall be buried with the pipeline and/or associated utility will be provided as determined by COH in areas where Carsonite markers or brass cap markers are not appropriate. The passive markers for water lines shall be blue colored and shall incorporate the following features:
 - a) 4-inch diameter ball marker with self-leveling feature and internal mixture of propylene glycol and water for trench depths up to 5 feet.
 - b) 15-inch diameter shield marker for trench depths up to 8 feet.
 - c) Constructed of durable polyethylene shell impervious to minerals, chemicals, and changes in temperature from 30 degrees Fahrenheit up to 100 degrees Fahrenheit.
 - d) Various marker colors for services other than water such as yellow for natural gas service, green for wastewater service, red for power and orange for telephone. Colors for other services to be determined by COH.
 - e) Electronic Marker System (EMS) as manufactured by 3M or equal.
 - 3. Carsonite Survivor markers installed directly over the pipeline will be used in open, unimproved areas with the following information:
 - a) COH.

- b) Name.
- c) Appurtenance abbreviation such as Air Valve (AV), Blow-off Assembly (BO), Turnout (TO), Bifurcation (BF), Lateral Centerline (C/L).
- d) Station Number.
- e) Distance and direction to appurtenance or lateral centerline (C/L).
- 4. Brass Cap Type markers shall consist of a brass cap, 2.5 inches in diameter (LIETZ 8134-04, or equal) installed in the top of existing curb by drilling curb and marker post set in epoxy. Brass cap markers shall be used in developed areas where there are nearby curbs or other fixed improvements and where the Carsonite markers would be inappropriate stamped with the following information:
 - a) COH.
 - b) Name.
 - Appurtenance abbreviation such as Air Valve (AV), Blow-off Assembly (BO), Turnout (TO), Bifurcation (BF, Lateral Centerline (C/L).
 - d) Station Number.
 - e) Distance and direction to appurtenance or transmission pipeline centerline (C/L).
- 5. Markers or monuments shall be installed at the following locations:
 - a) Maximum distance between markers or monuments is 1000 feet.
 - b) Where the pipeline crosses section lines.
 - c) At blow-off assemblies.
 - d) At both sides of major road crossings.
 - e) Where the pipeline changes direction.
 - f) At bifurcations or turnouts.
- N. GPS Coordinates: Contract specifications shall require that all pipelines and appurtenances be located by GPS coordinates and recorded on as-built drawings.
- O. Thrust Restraint Systems: Thrust forces occur at changes in pipeline size or direction, such as at elbows, tees, reducers, caps, plugs, closed valves, etc. The following considerations shall be taken for design:
 - 1. The Engineer is responsible for identifying the thrust forces within a pipeline facility and calculating per AWWA standards.
 - 2. Once the forces have been determined, remedial actions can be considered for restraint. Thermal stresses and surge or transient pressures

caused by water hammer or pump shutoff head must be considered in conjunction with hydrostatic thrust forces.

- 3. The Engineer shall utilize a restrained joint system to balance thrust forces.
- 4. The Engineer shall design all thrust restraints to withstand maximum anticipated pressure, whether operational, testing, or surge.
- 5. Engineers shall completely design the thrust restraint system. A performance specification that requires the pipe manufacturer or Contractor to submit a thrust restraint design for review is not acceptable.
- 6. Engineer shall provide the COH all thrust restraint calculations.
- P. Thrust Blocks: Thrust blocks will not be allowed on COH transmission lines.

7.15 Design Checklist

A. A checklist is provided at the end of this chapter for the Engineer's reference and use during design and may not include all applicable design criteria. It is the Engineer's responsibility to review and comply with all guidelines contained herein and all applicable codes completely prior to submitting for review.

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DEPARTMENT OF UTILITY SERVICES

TECHNICAL SERVICES DIVISION NEW DEVELOPMENT SECTION

CITY OF HENDERSON 240 WATER STREET HENDERSON, NEVADA 89015

UTILITY SERVICES Water Pipelines Review Checklist

Design Concept Phase

Design Concept Report (DCR)

- System overview
- Pipeline location
- □ Approximate length
- Design flow rate
- Preliminary diameter
- ROW, permit needs, and existing easements
- Preliminary material selection
- Preliminary schedule
- Proposed easements for alignment

Preliminary Design Phase

Preliminary Design Report (PDR)

- Executive Summary
- Table of Contents
- Existing conditions
- Draft Geotechnical Investigations Report
- Draft Environmental Investigation Report
- Drainage and Traffic Study findings
- Preliminary plans and centerline profiles (30 percent design drawings)
- □ Alternative alignments

- Recommendations for future connections
- Pipeline design parameters and material recommendations
- □ Identification of appurtenant facilities and spacing criteria
- Recommendations for bidding packages, scheduling, Contractor staging, construction sequencing, impacts to public areas and other stakeholders
- □ Identification of permanent and temporary ROW/easement constraints and acquisitions
- Design calculations
- Matrix of permits
- List of agencies and utilities
- Technical specification sections and list of final drawings
- Preliminary quantities and associated cost estimates
- □ Preliminary construction schedule
- Project correspondence file
- □ Inventory of existing facilities and improvements
- Graphics, sketches, tables, and other displays
- List of relevant reports, plans, and maps reviewed
- □ Work plan for construction
- Corrosion mitigation analysis and design

Agency and Utility Coordination

- **D** Existing Utilities
- Record drawings of existing utilities
- □ Field verification of utilities
- □ Underground Service Alert
- Potholing
- Separation requirements
- Utility relocations

Final Design Phase

- □ Final design drawings
- Cover page
- □ Sheet index
- Utility signatures
- □ Final Geotechnical Report
- □ Final Environmental Investigation Report
- Design drawings and details
- □ Stamped and signed contract documents
- Plans and profiles
- Existing topography, pothole, and utility information
- □ Final design specifications
- Cover page
- □ Table of Contents
- □ Specification sections for each design discipline
- □ Stamped and signed contract documents

Design of Pipeline Systems

- Horizontal pipe alignment
- □ Vertical pipe alignment
- Plan and profile drawings
- As-built drawings
- Pipe materials

Fittings and Appurtenances

- □ Steel fittings
- Ductile iron fittings

Pipe Joints

- □ Steel pipe joints
- Ductile iron pipe fittings

Trench Design

- Trench width
- Pipe bedding and backfill

Steel Pipe Design

<u>General</u>

- External loads
- Groundwater
- □ Vacuum pressure
- □ Internal pressure
- □ Surge pressure

Wall Thickness Design

- □ Minimum wall thickness for handling
- Design for external loads
- Design for internal pressure
- □ Thrust forces
- Longitudinal force due to change in temperature
- Longitudinal force due to effect of Poisson's ratio
- Design for combined stress

Welding Specifications

- Lap welds
- Butt joint welds
- Butt strap welds

Restrained Joints

- □ Rigid connections
- □ Flexible connections

Ductile Iron Pipeline Design

□ Wall thickness design procedures

- External load design
- □ Internal pressure design
- □ Standard allowances
- Restrained joints

Protective Coatings and Linings

- □ Steel pipe
- Ductile iron pipe
- Linings
- Coatings
- Responsibility

Isolation Valves

- □ Valve coating and lining
- U Valve class
- Buried valves
- Exposed valves
- Butterfly valves
- Resilient-seated gate valves

Appurtenances and Structures

- Dismantling joints
- □ Mainline valves
- Mainline valve vaults
- Outlets
- Air valves
- □ Air-release valves
- Air/vacuum valve
- Air combination air valves
- □ 6-inch manual blow-off assembly

- □ Special connection points
- Marking tape
- Dipeline markers
- GPS Coordinates
- □ Thrust restraint systems
- □ Thrust blocks










	V	AULT LOCATION	MAIN PIPE AND VALVE SIZE	MIN WORKING PRESSURE RATING – ALL COMPONENTS				
	S	TA		PSI	_			
BUTTERFLY VALVE W/GEAR OPERATOR, FLG x 1 FLG, SIZE TO MATCH CONNECTED PIPING.								
	2 DISMANTLING JOINT – RESTRAINED, SIZE TO MATCH CONNECTED PIPING.							
		3	18" DIA HAND WH STEM EXTENSION.	EEL W/2" NUT FOR VALVE				
		4	6" AWWA C509 GA	TE VALVE W/HAND WHEEL.				
		5	6" DISMANTLING JO	DINT RESTRAINED.				
		6	6" FLANGED OUTL	ET.				
		7	6"90°ELBOW					
		8	6" SPOOL, 12" LO REQUIRED FOR VAL CLEAR MAIN PIPING	NG±, LENGTH AS .VE AND HAND WHEEL TO G.				
NOTES: 1. VAULT AND APPURTENANCES SHOWN ASSUME STEEL PIPE MAINLINE. IF DUCTILE IRON PIPE IS SELECTED. CONTRACTOR SHALL SUBMIT SPECIFIC DETAILS ON HOW APPURTENANCES WILL BE CONNECTED.								
2. VAULTS SHALL BE DESIGNED BY CONTRACTOR. VAULTS MAY BE PRECAST OR CAST-IN-PLACE.								
3. WALLS SHALL BE DESIGNED TO RESIST A LATERAL EARTH PRESSURE OF 60 x H IN PSF WHERE H—DEPTH OF BURIAL.								
4. ROOF SHALL BE DESIGNED FOR HS-20 LOADING AND COVER DEPTH AS SHOWN ON PLAN OR PROFILE DRAWINGS.								
5. CONTRACTOR SHALL COORDINATE DRILLING PATTERNS OF FLANGES ON PIPE AND APPURTENANCES.								
				City Of Hender	son			
				Clark County, Neva	da Services			
DESIGNED D.H.	/ /////		BALL DATE		scale AS NOTED			
CHECKED			A CONTRACTOR	VALVE VAULT	NO. REV.			
APPROVED DATE 07-16-04			Rear To Call slow		FIGURE 7.2E 0			

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CHAPTER 8 WAS TEWATER LIFT STATIONS

8.01 General

- A. The intent of this chapter is to provide guidelines for the design of wastewater lift stations.
- B. These guidelines presented in this chapter apply to lift stations with a peak hour pumping capacity up to approximately 2 mgd, with total dynamic head (TDH) of not more than approximately 160 feet. Lift stations with capacity and/or TDH higher than the flow and TDH limits are considered special designs not addressed by this chapter.
- C. For the flow and TDH limits stated above, this chapter assumes that the proposed lift station will be a submersible lift station with 2 or 3 pumps installed in a concrete wet well, and a buried valve vault with discharge piping.
- D. Factory-Built Systems: The COH accepts that wastewater lift stations in the sizes covered by these guidelines may be factory-built systems. The lift station, valve vault, electrical panels, control panels, and discharge piping may be assembled at the factory and shipped to the site for installation. Responsibility for the entire lift station facility rests with one entity.

8.02 Design Concept Phase

- A. General: The DCR for the lift station is used to evaluate and analyze design criteria and alternatives. The Engineer shall meet with the COH to develop a scope of work that addresses specific project issues that pertain to the lift station, the force main system, and future needs. The DCR shall be submitted to the COH for approval and shall address the following at a minimum:
 - 1. Determining site ownership per Chapter 1.
 - 2. Preliminary site plans and stations location.
 - 3. Preliminary plan showing equipment and piping configuration, including force main alignment.
 - 4. Flow Conditions.
 - 5. Hydraulic analysis.
 - 6. Reliability.
 - 7. Expandability of lift station, including force mains, and provisions for on-site expansion (if applicable).

- 8. Major equipment design criteria for the following at a minimum:
 - a) Pumps: including but not limited to type and quantity of duty and standby units, and horsepower of each pump.
 - b) Summary of individual electrical loads with total connected electrical load.
 - c) Standby generator: including but not limited to fuel type, fuel tank size, fuel consumption, power output.
- 9. Standby power noise attenuation to satisfy requirements of Title 19 of the HMC.
- 10. Odor control facilities for lift station and force mains.
- 11. Analysis of existing wastewater facilities that are affected by the proposed lift station and force mains.
- 12. Instrumentation and control parameters.
- 13. Building design parameters.
- 14. Community Development entitlement submittals, etc.
- 15. Preliminary cost estimate.
- B. It is the responsibility of the Engineer to ensure that the design meets the requirements of NAC 445A.

8.03 Preliminary Design Phase

- A. General: The pre-design phase of the project shall be summarized and presented in a Pre-Design Report (PDR). The report will be submitted to the COH for review and acceptance. A PDR is required for any wastewater facility considered in this document, regardless of the project size or complexity. The PDR is the basis for the ensuing design process and must be presented in a fashion that allows the reader to gain a thorough and complete understanding of the necessity of the project. Without an accepted DCR, the Engineer will not be allowed to submit the PDR.
- B. The PDR shall include, but not be limited to:
 - 1. Executive Summary.
 - 2. Table of Contents.
 - 3. The project background.
 - 4. Existing conditions, including but not limited to existing utilities, and a list of major stakeholders with contact information for each.

- 5. Summary of utility conflict information, including pothole information or recommendations for utilities proposed to be potholed.
- 6. Topographic mapping information summary.
- 7. Preliminary utilities research.
- 8. Draft Geotechnical Investigation Report.
- 9. Draft Environmental Investigation Report.
- 10. Draft Corrosion Control/Cathodic Protection Report.
- 11. Summary of the applicable drainage and traffic study findings with references to those documents submitted separately.
- 12. Description of pump selection to include at a minimum:
 - a) Summary of wastewater source(s) to be pumped.
 - b) Technical selection criteria including operational scenarios of wet well volume, pump cycle time, flow, and TDH for selected pumps.
 - c) Expandability features of facility including number of pumps, impeller size to accommodate range of flows for current and throughout all phases of expansion.
 - d) Cost considerations including capital costs and operating costs.
 - e) Description of operability issues.
 - f) Summary of constructability issues.
 - g) Recommendation of pump type and configuration, including the motor horsepower and impeller diameter.
 - h) Table that summarizes the pump design criteria, including design head, design flow, motor horsepower, and pump design efficiency.
- 13. Flow monitoring data, if available.
- 14. Preliminary drawings (30 percent design drawings) illustrating:
 - a) Property ownership, right of way, and easement information.
 - b) Proposed grading and civil site improvements.
 - c) Site access for maintenance.
 - d) Electrical single-line diagram.
 - e) HVAC schematic.
 - f) Preliminary P&IDs.
 - g) Proposed offsite improvements where applicable.
 - h) Force main plans and profiles.
 - i) Plans with dimensions to indicate equipment locations.
 - j) Major sections indicating pipe centerline elevations.
- 15. Alternatives evaluation summary.

- 16. Recommendations for future connection locations.
- 17. Identification of appurtenant facilities and spacing criteria, including preliminary design of odor control facilities.
- 18. Project considerations such as:
 - a) Equipment procurement.
 - b) Project schedule, which includes design, bidding, and construction.
 - c) Stakeholder impact, which includes public and private entities.
- 19. Identification of any permanent and temporary ROW/easement constraints and acquisition needs.
- 20. Matrix summary of permits to be obtained and preliminary schedule for submittals and approval.
- 21. List of agencies, stakeholders, and utilities to review and sign the drawings.
- 22. Outline of technical specification sections and list of final design drawings.
- 23. Preliminary quantities and associated cost estimates.
- 24. Preliminary construction schedule.
- 25. Project correspondence file, including meeting minutes.
- 26. Inventory of existing facilities and improvements.
- 27. Graphics, detail sketches, tables, and other displays to support analyses and recommendations.
- 28. List of relevant reports, plans and maps reviewed, and other relevant project information.
- 29. Work plan for how construction is to be accomplished if connecting into existing facilities (phasing, shutdowns, etc,).
- 30. "Line of Sight" study for PLC/Radio Control (as requested).
- 31. Description of security features, in accordance with COH Security Master Plan.
- 32. Preliminary description of station operational scheme and controls.
- 33. Equipment sizes.
- 34. Preliminary description of architectural features.

35. Description of operational noise and noise attenuation, which may include engineering controls to satisfy requirements of noise control per Title 19 of the HMC.

8.04 Agency and Utility Coordination

- A. The Engineer shall initiate contact and coordinate efforts with outside utilities and agencies in accordance with Chapter 1.
- B. A relay shall be provided to monitor power use, and the information shall be reported to SCADA. The relay shall be as approved by NV Energy.

8.05 Final Design Phase

- A. General: The Engineer shall provide a Final Design, which builds upon work completed during the DCR and PDR. The Final Design shall include:
 - 1. Final design drawings.
 - 2. Final specifications.
 - 3. Final drawings and specifications shall meet the general requirements presented in Chapter 1.
 - 4. Final Geotechnical Investigation Report.
 - 5. Final Environmental Investigation Report.
 - 6. Final Corrosion Control/Cathodic Protection Report.
 - 7. Final Electrical Coordination Study.
 - 8. Final Facilities Operations Plan.

8.06 Wastewater Flows

- A. Wastewater Generation Rates: The Engineer shall meet with COH personnel to discuss the initial and ultimate wastewater quality and quantity that will be conveyed by the proposed lift station. Sources of flow and land uses will be identified and overall project phasing will be established.
- B. Using information from the COH regarding the existing wastewater collection system, GIS, peaking factors, and diurnal flow fluctuations, the Engineer will set up a hydraulic model of the lift station service area. Using this model, wastewater flows will be analyzed with the use of an extended period simulation that demonstrates how the proposed facilities respond to daily peaks and minimum flows throughout the service area. The hydraulic model shall include a sufficient

amount of the downstream existing wastewater collection system to verify that no adverse effects are attributed to the proposed facility.

C. The results of the hydraulic modeling shall be summarized in a table that shows the average, peak and minimum hour flow rates for each proposed project phase. This data will be used to size pumping units, piping, odor control, and force main systems.

8.07 Hydraulic Analysis

- A. The Engineer shall perform a hydraulic analysis on all new, upgraded, or modified lift station designs. Hydraulic analysis is required if upgrades or modifications involve:
 - 1. Pump replacement.
 - 2. Modifications to pumping capacity, pump control, and operation adjustment.
 - 3. Significant changes in total dynamic head (TDH), and check valve/control valve closure time adjustments, etc.
- B. The hydraulic analysis will be used to determine the type and size of equipment necessary for efficient pump operation during the normal starting and stopping supply of the pumps and during electrical power failures.
- C. Steady State Analysis: The Engineer shall perform a steady-state hydraulic headloss analysis of the pumping and force main system to determine the TDH requirements of the lift station. TDH calculations shall be made for new facility designs and existing facility modifications. The Engineer shall:
 - 1. Determine pumping head requirements, TDH system curves, flow velocities and travel times.
 - 2. Establish minimum and maximum static head.
 - 3. Provide recommended pumping rates.
 - 4. Determine pipe class rating.
 - 5. Establish maximum allowable shutoff head.
 - 6. Use Darcy-Weisbach or Hazen-Williams equations.
 - 7. Provide a list of friction factors for typical pipe materials.

8.08 Pumping Capacity

- A. Lift stations will be designed with consideration of the station's design peak inflow, as well as the design minimum inflow, for both the current and future conditions. The firm capacity of the lift station is the total pumping capacity of the station (design peak inflow) with the largest pump out of service, at maximum static differential levels.
- Β. Minimum requirements (design criteria) for lift stations are included herein. The COH accepts the use of factory fabricated package lift stations utilizing submersible wastewater pumps for the size ranges noted at the beginning of this chapter. Non-factory fabricated package lift stations will be considered on a caseby-case basis. Main pumping equipment shall be specially selected for individual application/service. At a minimum, all lift stations shall be equipped with two (2) pumps and have the capability of automatically alternating the pumps from lead to stand-by. With two pumps furnished, each pump shall be capable of pumping the design peak inflow determined for the station as follows unless otherwise justified by the Engineer and approved by the COH:

Design Peak Inflow = 1.36 X Calculated Peak Inflow

8.09 Wet Well Design

- A. Flow Data: Establish wastewater flows and pumping capacity per the aforementioned sections. Provide a table of flow data for the wastewater collection system that discharges into the wet well.
- B. Wet Well Inlet: The wet well inlet shall be designed in accordance with ANSI/HI 9.8 Pump Intake Design Standard for Solids-Bearing Liquids. The wet well inlet pipe invert shall be above the high water operating level, and the inlet shall be designed to minimize turbulence and odor generation, with no free fall discharge into the wet well under any operating condition. Wet well inlet shall include an external drop inlet with means to bypass the wet well, and a manhole designed to catch rocks and other debris, generally as shown on Figure 8.2 and Figure 8.3.
- C. Wet Well Operating Volume: The wet well operating volume and pump sequencing start/stop levels must be configured to meet all ranges of inflow, from minimum inflow conditions through design peak inflow conditions. Total wet well operating volume is the volume between the all pumps stop level and the all pumps start level. For periods of very low inflow, the volume to be pumped by the first pump shall be as small as possible to help prevent septic conditions, but the volume must also be large enough to provide at least 5 minutes of pumping time at minimum inflow to prevent overheating of the electric motor.

- D. Wet Well Sizing: The wet well shall be sized considering the following at a minimum:
 - 1. Minimum Inflow Rates: Sizing of the lift station wet well must take into account the minimum influent flow rates to the station to control cycling of the pumps.
 - 2. The wet well should be large enough to provide at least 5 minutes of running time for the pump, to prevent overheating of the motor.
 - 3. The wet well shall not be oversized, which would result in septic conditions and odors due to long detention times.
 - 4. An appropriate minimum flow factor will be used to size the wet well. The Minimum Flow Factor (the ratio of minimum to average flow for small wastewater service areas) less than 1 mgd average flow is approximately 0.2. The Minimum Flow Factor increases to approximately 0.3 for service areas having a flow greater than 5 mgd.
 - 5. Therefore, the required wet well operating volume for the first pump to start is as follows:

First Pump Wet Well Operating Volume = [(Pump capacity) – (Minimum inflow)] x 5 minutes

Where:

(Minimum inflow) = (Average Dry Weather Flow) x (Minimum Flow Factor)

- 6. Alternate methods of wet well sizing may be considered on a project-specific basis.
- E. Wet Well Operating/Alarm Levels: The wet well high and low operating levels, pump sizes, impeller sizes, and the high and low alarm levels, shall be shown on the design drawings for all phases of expansion current and future. The pump automatic shutoff level shall allow for sufficient net positive suction head based on the selected pump. Submergence of the pump suction bells shall be in accordance with the Hydraulic Institute Pump Intake Design Standard, and the pump manufacturer's requirements.
- F. Emergency Storage Volume: The emergency storage volume allows operating and maintenance personnel time to respond to a station alarm and/or to perform emergency repairs to correct a failure condition. In addition to the wet well operating volume, the Engineer shall:

- 1. Demonstrate that the wet well and system upstream of the pumps has a volume that can accommodate two hours of storage at design peak inflow.
- 2. Review electrical utility records if available for frequency of power outages in evaluating the emergency storage volume.
- 3. Define the total storage volume (i.e., the volume of the wet well above the pump "off" level to the lowest wastewater spill point upstream of the wet well) can be defined using any combination of additional storage in the wet well above the operating volume, separate overflow tank, and storage in the inlet pipe up to the lowest spill level.
- G. Storage in Influent Wastewater Collection System: Except as noted above for Emergency Storage Volume, the wet well influent pipe shall not be designed to accommodate wastewater storage during normal lift station operation. For example, normal lift station flows shall not require the use of influent lines for wet well storage.

8.10 Force Main Design

- A. Capacity of Downstream Wastewater Facilities: The Engineer shall meet with the COH to verify that the wastewater collection system downstream of the force main discharge point has sufficient capacity (both current and future) to handle the increased flows. This investigation should go sufficiently far downstream to a point that the lift station flow component is not a significant factor. If sufficient capacity is not available, the project must include provisions to add the required capacity.
- B. Multiple Force Main Considerations: A minimum velocity of 3 ft/s must be maintained at minimum flows. During force main sizing to accommodate both present and future flows, consideration should be given to the installation of multiple force mains as a method to control velocities in the pipe during initial phases of development. Combining smaller force main sizes for smaller flows, and larger force mains for larger flows will allow higher velocities in each force main, thereby reducing potential solids deposition in the pipe and reducing the overall retention time.
- C. Force Main Retention Time: The Engineer shall prepare calculations to determine the maximum retention time within the force main. The following calculations shall be prepared:
 - Min. Pump Run Time (MPRT) = 5 minutes = (First Pump Wet Well Operating Volume)/[(Pump Capacity) – (Minimum Inflow)]

- Number of Cycles (for force main volume) = Force Main Volume / [(Pump Capacity) x MPRT]
- Max. Wet Well Fill Time = (First Pump Wet Well Operating Volume) / (Minimum Inflow)
- 4. 1 Cycle Period = Max. Wet Well Fill Time + MPRT
- Max. Retention Time = [Number of Cycles (for force main volume)] x (1 Cycle Period)

8.11 Site Civil

- A. Site Layout: Site grading shall preclude site drainage from gaining access to the lift station building. Adequate setback from property lines shall be provided in accordance with the Henderson Development Code. Sufficient setback shall also be provided to allow for fill, cut, or fill transition to existing contour elevations at property lines. A fill or cut slope of 4:1 or less is desirable but 3:1 is acceptable. A typical lift station site layout is shown on Figure 8.1.
- B. The lift station shall be positioned and the site developed to ensure a uniform soil bearing condition. The footing and floor shall be placed on either native earth material or structural fill. The lift station shall not be situated where a portion of the station is on native material and a portion is on fill material. See Chapter 2 of these Guidelines for Geotechnical Requirements.
- C. COH service vehicle access to major station components shall be incorporated into the site layout. These service vehicles may include pickup trucks, vactor trucks, cranes, delivery vans, and chemical tanker trucks.

8.12 Signage

A. Each lift station site shall be identified with a sign mounted on the exterior of the masonry perimeter wall adjacent to the site access gates. Exact location will be determined by the site layout on a case-by-case basis.

8.13 Access Gates

- A. Access to the lift station site shall be through a minimum 24-foot wide double leaf steel frame swing gate. Provisions shall be made by the Engineer to provide enough space for maintenance vehicles to park out of traffic and adequate sight distance to safely enter and exit the site.
- B. Sites will be evaluated on a case-by-case basis by the COH, as to whether the gates shall be automatically operated. At a minimum, four (4) 2-inch conduits shall be installed up to the gate for future use.

C. Motor operated gates, if required, shall be equipped with electronically active edge sensors. A card swipe shall be included on a 4-inch by 4-inch gooseneck stand to allow for access. A free exit loop shall be provided for vehicle exit from the site. The gates shall also include automatic vehicle identification including loops and transmitters for emergency access to the site. One (1) 3/4-inch conduit from the keypad to the pull box containing four (4) 2-inch conduits shall be provided. Pull boxes shall be identified with COH marking.

8.14 Security

- A. The site shall be enclosed with a design approved by the COH. As a minimum, an 8-foot tall masonry perimeter wall with a locked entrance will be provided. Embedded extension arms with three strands of barbed wire shall be installed on the top of the entire perimeter wall. The wall shall be compatible with the surrounding environment, including landscaping. Down cast site lighting, both wall and pole mounted shall be provided with at least two photocell-operated lights. Hand/Off/Auto Switch shall be provided for all exterior lights to enable testing. A motion sensor shall be located at a strategic location in the interior of the site, which will activate site lighting. At locations agreed upon by COH personnel, conduit shall be installed and stubbed up for future site security cameras. Pull boxes shall be identified with COH marking.
- B. Security issues for the lift station building shall also be addressed by the Engineer. Some examples include intrusion alarms on all doors and roof hatches, reinforced or caged roof hatches and cages preventing building access through the louvers. Specific building security issues shall be discussed with the COH during the design process.

8.15 Mechanical Layout

- A. General Station Layout: The Engineer shall work with the COH to establish a preliminary layout of the lift station. The layout shall address general room dimensions and use, including length and arrangement of station piping, location of valves, flow meters, pumps, tanks, MCC panels, control panels and major equipment.
- B. At a minimum, all lift stations shall be equipped with two (2) pumps and have the capability of automatically alternating the pumps from lead to stand-by. Station equipment, piping, etc. shall be oriented in the station to provide convenient safe access for operation and maintenance, including the installation and removal of equipment. Typical wet well, valve vault and building floor plan are presented in Figure 8.2 and Figure 8.4.

8.16 Noise Attenuation

- A. Maximum noise levels in working environments are regulated under the federal Occupational Safety and Health Act (OSHA). OSHA requirements as well as local, state and federal regulations shall be included in the design of all facilities to mitigate noise levels. Station noise discussed herein applies to both lift station facilities and facility boundaries.
- B. Noise due to construction or operation of lift stations shall meet the requirements of Title 19 per the HMC. Examples of noise include the following:
 - 1. Operating equipment such as pumps, standby generators, HVAC, compressors.
 - 2. Construction and maintenance activities such as operating tools and construction equipment.
- C. Facility Noise Production Studies: The Engineer shall complete a Noise Production Study for all lift stations located near residential or commercial areas or if required by COH.
- Engineering Noise Controls: The Engineer is responsible for all engineering noise controls for lift stations, which shall mitigate noise to appropriate levels. Use of an experienced acoustical engineer may be required. Examples of engineering controls include:
 - 1. Sound enclosures and/or insulated rooms for equipment.
 - 2. Selection of pump equipment.
 - 3. Selection of HVAC equipment, inlets, outlets, and duct and acoustical louvers.
 - 4. Use of sound barriers, sound traps, acoustical shrouding, and/or insulation.
 - 5. Incorporating additional dead space at doorways and windows.

8.17 Odor Control Facilities

- A. Odor control measures shall be provided for all lift stations. Odor control may also be required for influent wastewater collection lines and discharge force mains.
- B. Liquid Phase Odor Control systems shall include the following at a minimum:
 - 1. Liquid calcium nitrate type system, designed to provide a source of biological oxygen that will bio-oxidize existing sulfides in the wastewater and prevent the formation of hydrogen sulfide.

- 2. Designed to directly deliver chemical to the wet well and/or a manhole upstream on the influent line.
- 3. The liquid phase treatment system will be sized for a 30-day on-site supply, and shall consist of storage tanks with secondary containment, along with associated peristaltic type metering pumps (duty + standby), controls, and piping. All liquid phase odor control equipment shall be furnished and installed as an integrated package. The equipment shall be located in the lift station building.
- 4. Peristaltic metering pump shall be Watson Marlow Series 520 Du or equal.
- C. Vapor Phase Odor Control systems shall utilize a hydroxyl ion fog odor control system to oxidize the odors in the wet well and adjacent odorous spaces such as pipelines and manholes. Requirements for vapor phase odor control will be determined by the COH on a case-by-case basis at the beginning of design.

8.18 Vault Standards for Wastewater Lift Stations

- A. General: The Engineer shall locate vaults in non-traffic areas whenever feasible.
- B. For access and maintenance, the COH requires the use of vaults for all buried valves used for wastewater service.
- C. Vaults shall incorporate heavy-duty aluminum hatches with Type 316 stainless steel hardware, capable of withstanding H20 loads imposed by traffic, heavy maintenance equipment, chemical delivery trucks, etc.
- D. Vault entrance hatches shall provide a minimum clear opening of 36 inches in diameter complete with access ladder.
- E. If the design will result in "confined space" regulations and associated safety issues, the COH requires that the Engineer receive approval, prior to completing the design.
- F. Flow Meter Considerations: Vaults equipped with flow meters shall be:
 - 1. Sized with sufficient upstream and downstream straight runs of pipe to maximize meter accuracy.
 - 2. Provided with manual isolation valves that can be operated without the need to enter the vault to remove meter from service.
 - 3. Equipped with exterior panel adjacent to the vault with visual reading of flow meter in units of gallons per minute or million gallons per day as determined by the COH.

8.19 Wastewater Pumping Systems Design

- A. System Responsibility: In general, the Engineer shall include in its project design, specifications requirements for the pump, drive motor, supports, Type 304 stainless steel rails, constant speed equipment and specific controls and appurtenances to be provided by a single manufacturer/supplier who shall take unit responsibility for the entire system.
- B. Pump Inlet Configuration: The pump inlet shall be designed in accordance with the Hydraulic Institute Standards to minimize turbulence.
- C. Equipment Access: In general, pumps, lifting chains, level controls, access hatches, etc., shall be arranged to provide safe and convenient access for operation, maintenance, equipment installation, and equipment removal.
- D. Expandability: Lift station expandability will be evaluated on a case-by-case basis. If a lift station is planned to be expanded in the future, the Engineer shall ensure that adequate space is provided to accommodate future equipment. The discharge piping manifold shall be sized for future flows. Pumps shall be selected to provide stable and efficient operation throughout the range of both current and future operating conditions provided by the wet well.

8.20 Piping Systems

- A. On-Site Piping: Lift station piping shall be arranged in accordance with the following requirements:
 - 1. Engineer shall specify accessories and manufacturers as provided in the most current Approved Materials List.
 - 2. Individual pump discharge, header, and force main piping shall be designed to ensure a velocity of between 4 and 10 fps.
 - 3. Check valves: Flanged swing check valves with outside lever, suitable for use in raw wastewater equipped with the following:
 - a) Mechanical disc position indicator, which has continuous contact with the disc under all flow conditions.
 - b) Screw type backflow actuator to allow opening of valve during noflow conditions.
 - c) Epoxy coating and polyurethane lining.
 - 4. Isolation valves: Flanged eccentric plug valves.
 - 5. Flow Meter: Flanged magnetic Flow Meter In accordance with Chapter 13.
 - 6. Air vacuum/air release combination valves: shall be in accordance with latest approved materials list.

- 7. Provide pipe, valves, and fittings for an alternative pump discharge header and pig launching station above the valve vault. General configuration shall be as shown on Figure 8.2 and Figure 8.3.
- 8. On-site wastewater piping shall be epoxy lined ductile iron pipe with flanged joints in the wet well and valve vault, and mechanical joints for buried piping.
- 9. Joint restraint shall be accomplished by the use of flanged or restrained mechanical joints, or harnesses for flexible couplings. Patented joint restraint methods may be considered by the COH if the application fits the recommended use and design data from the joint restraint manufacturer.
- 10. Odor Control and Chemical Piping Shall be furnished and installed in accordance with equipment manufacturer's recommendations. Allowable materials include PVC, CPVC, and polyethylene tubing inside a PVC sleeve for chemical feed piping, and CPVC or FRP ducts for odor control.

8.21 Force Mains

- A. Materials: Force mains shall be polyurethane lined ductile iron pipe designed in accordance with AWWA M 41 or DIPRA's Design of Ductile Iron Pipe for all force main sizes, or C 900 PVC for force main diameters under 12 inches.
- B. Marking tape shall be provided for location of buried force mains in accordance with the following:
 - 1. Metallic Tape: minimum 5.5 mils thick and 12 inches wide, comprised of aluminum foil with pipe diameter and service imprinted on high visibility polyethylene jacket. Lettering shall be at least 1 inch tall. Metallic tape shall not be used in corrosive soils.
 - 2. Plastic Tape: minimum 4 mils thick and 12 inches wide, comprised of polyethylene impervious to acids, chemicals and solvents. Lettering shall be at least 1 inch tall.
- C. Joints: Joints for force main pipe and fittings shall be mechanical joints or restrained push-on joints for all underground piping. Aboveground piping shall be flanged.
- D. Joint Restraint: Provide joint restraint at all tees, bends, valves, and pipe terminations. The Engineer shall provide calculations for restraint length, using formulas approved by the DIPRA. Approved methods of joint restraint include restrained mechanical joints, and restrained push-on joints as manufactured by US Pipe (TR-Flex), Pacific States (Perma-Lock), and American (Flex Ring or Lok Ring).

- E. Depth of Bury: The minimum depth of bury for force mains shall be 5 feet, subject to profile design as described below.
- F. Profile Design: The Engineer shall design the profile of the force main to specific slopes to keep the number of high and low points to an absolute minimum, and to provide the required clearances from other utilities as specified by the State of Nevada and other utility owners. High points shall be equipped with automatic combination air vacuum/air release valves as noted above. Low points shall be equipped with manually operated pump-out connections. Since high and low points in force mains represent potential locations of odor release, the Engineer shall designate their locations as a part of the PDR for review and concurrence by the COH.
- G. Force Main Discharge Design: Except where specifically approved otherwise, force mains shall terminate in a dedicated manhole before wastewater flows into the gravity wastewater collection system. The force main shall be brought into the manhole and piped to a shaped manhole invert that directs the flow in the direction of the wastewater flow. Design of the manhole and force main connection shall keep turbulence in the incoming and outgoing wastewater stream to a minimum to avoid release of odors from the manhole. Preliminary details of the discharge manhole shall be included in the PDR.

8.22 Pumps

- A. General: The Engineer shall specify submersible pumps suitable for pumping raw, untreated, unscreened municipal wastewater in a corrosive environment capable of passing a 3-inch sphere without clogging.
- B. Pump construction shall be two-piece pump and motor casing as follows:
 - 1. Motor case and seals watertight to submerged depths of up to 65 feet.
 - 2. Constructed from ASTM A 48, minimum Class 35 cast iron.
- C. Impellers shall be multi-vane, non-clog design constructed of ASTM A 48 cast iron with hardened impeller vane leading edges.
- D. Pump shafts shall be Type 431 stainless steel, designed to withstand 1.5 times the maximum operating torque.
- E. Bearings shall be permanently sealed, grease lubricated, anti-friction type that meet the ABMA standards and shall be designed as follows:
 - 1. Lubrication system designed to absorb heat energy generated in bearing under maximum ambient temperature.

- 2. Bearing life shall be not less than 24,000 hours at bearing design load imposed by pump shutoff at rated speed or L10 life of 50,000 hours in accordance with ABMA standards at rated design point.
- F. Shaft seals shall be positively driven, rotating tungsten carbide rings with the following features:
 - 1. Oil chamber lubrication with air volume to mitigate oil expansion due to temperature variations with standard drain and inspection plug.
 - 2. Will not require pressure differential to affect sealing.
 - 3. Will not rely on pumped media for lubrication.
 - 4. Capable of dry (unsubmerged) pump operation for extended periods.
 - 5. Springs and other hardware shall be Type 316 stainless steel.
- G. Discharge base and elbow shall be constructed of same material as pump casing and shall be:
 - 1. Able to firmly support guide rails, discharge piping, and pumping unit.
 - 2. Equipped with integral support legs with anchors to floor.
 - 3. Provided with discharge interface that is self-aligning without entering the wet well and also provides a watertight seal by means of machined metal-to-metal contact.
- H. Guide rails, brackets and lifting chain shall be constructed of Type 316 stainless steel with the following features:
 - 1. Dual pipes or rails that extend from discharge base to upper bracket.
 - 2. Sized to fit discharge base and sliding bracket of pump.
 - 3. Integral, self-aligning, guide rail sliding brackets that seal pump to discharge base.
 - 4. Upper guide rail bracket.
- I. All bolts and associated hardware shall be Type 316 stainless steel.
- J. Drive Equipment: Lift stations that pump to a gravity wastewater collection system via force mains shall be provided with constant speed motors with across the line starters for motor sizes under 20 horsepower, and soft start/soft stop starters for motor sizes 20 horsepower and larger.

- K. Acceptable manufacturers are listed below:
 - 1. ITT/Flygt Corporation.
 - 2. ABS Pumps.
 - 3. KSB Pumps.
- L. Provide the following spare parts:
 - 1. Thrust bearing set.
 - 2. Radial bearing set.
 - 3. Upper and lower mechanical seal set.
 - 4. Casing seal gaskets or O-rings.

8.23 Pump Motor

- A. General: Motors shall comply with requirements of Chapter 12.
- B. Pump Motor shall be dielectric oil filled or liquid cooled single phase, Class F, NEMA L design and shall be:
 - 1. Suitable for 230 V or 460 V, 3 Phase, 60 Hertz.
 - 2. Mounted in a sealed submersible housing with stator, rotor, and bearings.
 - 3. Suitable for continuous operation at ambient temperature for the project at site altitude.
 - 4. Capable of continuous operation under load with the motor submerged, partially submerged or exposed, without derating the motor.
 - 5. Equipped with cooling system with jacket that encircles the stator housing for dissipation of motor heat in a closed loop system.
 - 6. Equipped with stators securely held in place with a removable end ring and threaded fastener to be easily removed in the field and must be capable of being repaired or rewound by a local motor service. No special tools shall be required for pump or motor. Stator windings shall have Class F insulation (suitable for 155 degrees Celsius or 311 degrees Fahrenheit).
 - 7. Enclosed in a housing with rotor, stator separated and protected from the pumped liquid by an oil-filled seal housing, which incorporates two sets of carbon ceramic mechanical seals mounted in tandem.

- 8. The mechanical seal housing shall be equipped with two moisture sensing probes sensing the presence of moisture, which shall be automatic and continuous.
- 9. The sensor probes shall be electrically isolated with a resistor between each probe to eliminate grounding to the casing.
- 10. Equipped with thermal protection, which shall be low resistance, bi-metal disc that is temperature sensitive that annunciates to SCADA designed as follows:
 - a) Sensor shall be mounted directly in the stator and sized to open when stator temperature exceeds 120 degrees Celsius or 130 degrees Celsius and automatically reset at 30 to 35 degrees Celsius differential.
 - b) Sensor shall be connected in series with the motor starter coil such that the starter is tripped if a heat sensor opens. The motor starter shall be equipped with overload heaters so all normal overloads are protected by external heater block.
- 11. Equipped with moisture detection, which shall be a sensor in the seal chamber or motor housing that annunciates to SCADA.

8.24 Heating, Ventilation, Air Conditioning (HVAC)

- A. General: The Engineer shall design HVAC facilities in accordance with this chapter, which includes heating systems, air conditioning systems, and evaporative cooling systems.
- B. HVAC systems, ductwork, and accessories must be designed for a service life of at least 20 years. Therefore, industrial grade equipment must be provided and materials shall be suitable for wet and corrosive conditions in accordance with Chapter 4.
- C. The Engineer shall design the air conditioning system suitable for ventilation of the lift station at air change rates that meet or exceed requirements of NFPA 820.
- D. All HVAC equipment shall be designed to provide adequate space for installation, operation, and maintenance. Clearances around equipment shall be per manufacturer's recommendations with an additional 12 inches. In addition:
 - 1. Provide minimum clearance for all electrical panels, control panels, and equipment per NEC and OSHA.
 - 2. All electrical equipment associated with HVAC systems shall be UL listed and shall conform to NEMA standards.

- 3. A local disconnect switch shall be provided to de-energize equipment and panels for maintenance.
- E. All electrical equipment associated with HVAC system shall be UL listed, shall conform to NEMA standards and shall conform to the project Technical Specifications. Provide a local disconnect switch for maintenance.
- F. Air Conditioning Systems: Air conditioning is required for all occupied spaces and electrical rooms where major electrical equipment resides such as motor control centers (MCCs) and variable frequency drives (VFDs). The packaged air conditioning system shall be designed as follows:
 - 1. Located at ground level to avoid roof access for maintenance.
 - 2. Compressors to be hermetically sealed, high efficiency, reciprocating or scroll type equipped with high-pressure relief.
 - 3. Evaporator fan shall be direct or belt-driven centrifugal type with steel ball bearings permanently sealed and lubricated. A variable speed or two-speed evaporator fan shall be provided for evaporator fans that exceed 7.5 horsepower.
 - 4. Condenser fan shall be propeller type, direct drive with aluminum blades, dynamically balanced. Ball bearings shall be permanently sealed and lubricated.
 - 5. Induced draft blower shall be direct or belt drive; forward curved centrifugal type, statically and dynamically balanced. Material shall be steel with corrosion resistant finish.
 - 6. Coils: Evaporator and condenser coils shall be seamless copper tubes with mechanically bonded aluminum plate fins.
 - 7. Controls features shall include the following at a minimum:
 - a) Evaporator fan controls.
 - b) Motor contactors.
 - c) Power disconnect switch.
 - d) Electronic thermostat.
 - e) 5-minute compressor cycle delay.
 - f) Differential enthalpy economizer control.
 - g) Economizer capable of compressor operation while modulating to utilize up to 100 percent outdoor air for cooling when outdoor air and humidity are at set acceptable levels.
 - 8. Safety features shall include the following at a minimum:
 - a) High pressure switches.

- b) Compressor high temperature and overcurrent.
- c) Loss of charge/low pressure switch.
- d) Freeze stat on evaporator.
- e) Lock out protection.
- 9. All motors shall be in accordance with Chapter 12.
- 10. Acceptable manufacturers are:
 - a) Carrier Series 50HJ.
 - b) York Series D1E.
 - c) Traine Model THC.
 - d) Greenheck.
- G. Evaporative Cooling Systems: Evaporative cooling shall be provided for pump rooms, mechanical rooms, and other non-occupied spaces. The evaporative cooling system shall be either single stage or double stage with a water conservation type water spray control system. Evaporative cooling ductwork for the pump room shall be directed to discharge above pump motors. Ventilation rates shall meet or exceed requirements of NFPA 820. Air shall not be recirculated; it shall be exhausted from the room with an exhaust fan that meets the requirements of this Chapter. The following requirements also apply to evaporative cooling systems:
 - 1. The evaporative media shall be a rigid cross fluted pad or cellulose material impregnated with anti-rot salts.
 - 2. Each evaporative cooler shall be controlled by a separate thermostat designed to operate the unit to satisfy temperature set points inside the lift station.
 - 3. Multi-stage units shall have multi-stage thermostats to control the stage separately.
 - 4. All controls shall have phase fail relays to protect control circuits.
 - 5. A reduced-pressure principle backflow prevention assembly (RPPA) is required for potable water connections to equipment.
 - 6. Power cleaners or "Dump Pump" to automatically discard water after a specified number of hours shall be provided for all evaporative coolers.
 - 7. Acceptable manufacturers are:
 - a) Spec-Air.
 - b) Energy Laboratories.
 - c) Munters.

- H. Exhaust fans: Where applicable, local exhaust fans shall be provided for pump rooms, chemical rooms, restrooms, and storage rooms. Exhaust fans shall be designed as follows:
 - 1. Fan shall be a square, in-line centrifugal type with backward-inclined, nonoverloading, aluminum wheel, statically and dynamically balanced.
 - 2. The housing shall be square type with duct transitions to match fan supplied; galvanized steel or aluminum as scheduled, minimum 20-gauge panels with 10-gauge stiffeners and frame as required.
 - 3. Fan to be belt driven with the motor mounted on exterior of housing.
 - 4. Provide an external NEMA 3R disconnect and junction box for field connection of electrical wires.
 - 5. Finish shall be baked enamel on steel units, or Kynar on aluminum units.
 - 6. Acceptable manufacturers are:
 - a) Greenheck Model BSQ.
 - b) Loren Cok Model SQI.
 - c) Penn Ventilator.
- I. Louvers: Louvers shall be provided for air intakes or discharges for pump rooms, chemical rooms, or generator rooms. Where ductwork is connected to the louver, provide a backdraft damper. Louvers shall be designed as follows:
 - 1. Extruded aluminum construction with minimum thickness of 0.081 inches.
 - 2. Formed aluminum frame, 6 inches deep with minimum wall thickness of 0.10 inches.
 - 3. Blades shall be 0.04-inch perforated aluminum interior surface; blades positioned at 45-degree angle and spaced approximately 6 inches center to center. Louver free area shall be 25 percent, minimum.
 - 4. Pressure drop through the louver shall be a maximum 0.13 inches water column pressure drop at 1,000 feet per minute free area velocity for intake louvers.
 - 5. Equipped with a bird screen of 1/2-inch mesh by 19-gauge aluminum or stainless steel with removable frame.
 - 6. Finish shall be mill, baked enamel, epoxy, Kynar, Acrodize, prime coat, integral color, or clear anodize.
 - 7. Louver shall have sound attenuation as follows:

Frequency (Hz)	Attenuation (dB) at 6-inch Depth	
63	8	
125	8	
250	10	
500	12	
1,000	19	
2,000	24	
4,000	24	
8,000	24	

 Table 8.1 Minimum Required Louvre Sound Attention

- 8. Acceptable manufacturers are:
 - a) Ruskin Company.
 - b) Airolite Company.
 - c) Industrial Acoustics Company.
- J. Ductwork: Ductwork shall be aluminum alloy 3003-H14 in accordance with ASTM
 B 209 with minimum thicknesses as follows unless otherwise dictated by
 SMACNA based on system pressure:

Table 8.2	Minimum	Ductwork	Thickness
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Duct Diameter or Large Dimension of Duct, Inches	Minimum Thickness, Inches (B&S gauge)	
Up to 12	0.025 (22)	
13 to 30	0.032 (20)	
31 and Larger	0.040 (18)	

- K. The electric infrared heaters shall consist of a stainless steel enclosure with heating elements brazed to common fins. Unit shall be equipped with a ceiling mounting bracket. The system shall come with a multiple unit controller with contacts for thermostat operation for each heater and power transformer. The heaters shall be supplied by Q-Mark or COH approved equal.
- L. Drainage: All HVAC equipment shall be designed such that condensate and spent water is routed to a nearby drain. A trap primer system may also be required per building code if condensate drainage is routed to a wastewater collection system.
- M. The U.S. Environmental Protection Agency (EPA) and local codes may have special requirements regarding equipment or materials used for the HVAC

systems. The Engineer should be cognizant of these requirements and others, which may supersede general industry codes and standards.

- N. The Engineer should address the following during the design phase:
 - 1. Building insulation requirements.
 - 2. Noise and vibration control mitigation measures.
 - 3. Earthquake/seismic restraints for equipment, ductwork, and piping.
 - 4. Redundant equipment requirements and/or emergency electrical service.
 - 5. Any equipment and piping containing liquids which may be subject to freezing must be provided with heat tracing located under the insulation and controlled by a thermostat.
 - 6. Design temperature and humidity in lift station structures shall conform to ASHRAE requirements.
 - 7. Equipment selection shall include high efficiency units that minimize electrical energy usage and water consumption.

8.25 Emergency (Standby) Power Generator

- A. General: Each lift station shall be furnished with an emergency standby power generator with an automatic transfer switch.
- B. The generator and switch shall be sized to operate the lift station facility including the pumping units at the station's maximum rated or firm capacity. In addition, for lift stations with two installed pumps the generator shall be sized to operate both pumps simultaneously.
- C. The generator shall be pad-mounted and located inside a soundproof enclosure suitable for outdoor service. Access requirements for the generator shall be in accordance with the generator manufacturer's requirements.
- D. The automatic transfer switch shall be provided by the generator manufacturer and designed to work in conjunction with the generator to provide relays for all modes of operation and alarms.
- E. Fuel source for the generator shall be natural gas, connected directly to the utility service main.
- F. The generator shall meet the noise requirements of HMC Title 19.
- G. The generator control panel shall report the run status to the SCADA system.

8.26 Fire Protection

- A. Fire protection measures for lift stations shall be designed in accordance with COH, IBC, and IFC requirements.
- B. Fire hydrant(s) shall be provided for fire protection in accordance with requirements of the COH Fire Department.
- C. Fire sprinkler systems may be required for facilities with areas that exceed 5,000 square feet.
- D. Fire alarm systems, which annunciate to SCADA are required for facilities with occupied spaces such as offices and control rooms.

8.27 Potable Water Facilities

- A. The potable water supply system shall be protected by a reduced pressure principle backflow preventer, in accordance with local code requirements. Water systems shall be designed to avoid possible contamination. If the backflow preventer is mounted adjacent to a wall, it shall be mounted a minimum of 8 inches away to allow for maintenance.
- B. Service Water: Service water (plant water or utility water) shall be obtained from a potable water supply. A backflow preventer or air gap tank shall be provided. Service water will be used for general housekeeping purposes and for chemical dilution systems.
- C. Wastewater System: Lift stations that are located remotely from other facilities will be provided with a toilet, service sink, mop sink and lavatory facilities. The requirement of such facilities will be reviewed and determined by the COH. Where these facilities are provided, the Engineer must address the handling and disposal of the wastewater generated. The system provided must meet standards of the authorities with jurisdiction.

8.28 Telephones and Communications

- A. Lift stations shall be supplied with a telephone board and four(4), 2-inch buried conduits for the addition of telephones and other security electrical needs.
- B. Approved telephone utility drawings shall be submitted as part of project as-builts.

8.29 Facility Drainage System

A. Sump pumps (if necessary) shall be duplex type submersible pumps complete with lifting chain, discharge valve, check valve, piping, starter, level controls and

automatic alternator. High water level alarms shall be connected to the lift station control panel PLC.

8.30 Wash Down System

- A. The Engineer shall provide wash down piping with hose bibs mounted on the interior of each lift station. The wash down system shall be connected to the high-pressure side of the station discharge header piping for source water. Hose bibs shall be 3/4 inch and conveniently located for station housekeeping service. Each hose bib shall be provided with a galvanized or epoxy coated steel hose rack and a 50-foot, 3/4-inch hose.
- B. The Engineer shall ensure that all wash down system water connections to the potable waterlines be protected by a RPPA. The washdown water supply system shall be protected by a RPPA, in accordance with currently adopted code requirements. Washdown water systems shall be designed to avoid possible contamination. If the backflow preventer is mounted adjacent to a wall, it shall be mounted a minimum of 8-inches away and no greater than 4 feet high to allow for maintenance.
- C. Washdown piping shall be Type K rigid copper pipe. All isolation valves shall be brass body full port ball valves.

8.31 Electrical and Instrumentation

- A. General: All electrical equipment, instrumentation, control panels and associated conduit and wiring shall be properly grounded with ring tongue terminals and shall be intrinsically safe per NFPA 70E for arc flash, and NFPA 820 Class 1, Division 1.
- B. Lockout Safety: Disconnects and circuit breakers shall be provided to safely de energize the panel and equipment using "lockout/tagout" procedures.

8.32 Controls

- A. General: All control voltage shall be 24 DC, accomplished by means of a power supply with a control fuse and on/off switch to protect and isolate control voltage from the line.
- B. Control Strategy: The Engineer shall include a written control strategy as part of the design documents. The control strategy shall address anticipated operating and alarm scenarios, which includes but is not limited to the following:
 - 1. Pump operation in Hand, Off, Automatic.
 - 2. Lead, Lag and Standby pump operation.

- 3. Low wet well level alarm.
- 4. High wet well level alarm.
- 5. High high wet well level alarm.
- 6. Pump Failure.
- 7. Power Failure.
- 8. Generator.
- C. Control Floats: Shall be provided for high high level alarm annunciation and shall be Rotofloat Model SM30N0 as manufactured by Anchor Scientific, or approved equal.
- D. Level Measurement: Milltronics Hydroranger per Chapter 13. High-High float switch as described above.
- E. Control Panel: A steel, NEMA 4X enclosure located inside the lift station building electrical room shall be provided for each control panel. In addition, control panels shall be:
 - 1. Completely assembled at the factory and tested by the supplier.
 - 2. Identified by a nameplate permanently affixed, which includes model number, voltage, phase, hertz, ampere rating, and horsepower rating.
 - 3. Provided with green run light mounted in the exterior of the panel, with run light having an electrical life of 50,000 hours. One light per pump.
 - 4. Provided with red lights for all alarms with an electrical life of 50,000 hours.
 - 5. Equipped with hand-off-auto switch for each pump on the exterior of the panel. HOAR switch shall be rocker type with an electrical life of 50,000 operations.
 - 6. PLC per Chapter 13.
- F. Duplex Pump Controller: An ultrasonic level sensor shall be used for pump control and alarm and shall:
 - 1. Indicate level circuit operations utilizing red LED indicator lights with the LED light function shown on a permanent label on the pump controller.
 - 2. Function to start/stop and alternate pumps.

- 3. Include a back-up start/stop circuit that is relay controlled and float actuated.
- 4. Include connectors and terminal blocks with box type lug connectors made of polyamide thermoplastic. Phenolic terminal blocks are not acceptable.
- 5. Include alternating circuit of the low voltage type and be operational from the transformer mounted on the pump controller board.
- 6. Utilize wiring with male header assemblies constructed of a corrosion resistant thermoplastic material having a temperature range of -55 deg Celsius to 105 deg Celsius and copper alloy, bright acid tin over nickel plating contacts.
- 7. Incorporate plug connectors for wiring of HOAR switches, run lights, contactors, and overloads to the pump controller.
- G. Power and Control Cords shall be water resistant 600V, 60 deg Celsius, UL and/or CSA approved and applied dependent on amp draw for sizes. Additional requirements for the power cord are as follows:
 - 1. Each individual lead shall be stripped down to bare wire, at staggered intervals, and each strand shall be individually separated.
 - 2. Power cord entry into the cord gap assembly shall first be made with a compression fitting.
 - 3. The cord gap shall be sealed with Buna N Rubber O-ring on a beveled edge to assure proper sealing where bolted to the connection box assembly.
 - 4. Strain relief shall be provided, to keep the cord from being pulled out.
- H. Surge Protection shall be provided, which complies with ANSI C62.4-1, Category B and shall be installed in accordance with the manufacturer's instructions.
- I. Circuit Breaker shall be used to protect from line faults and to disconnect the pump from the incoming power. The circuit breaker shall be thermal magnetic airtype and sized to meet NEC requirements for motor controls.
- J. Starter: Shall be solid state, reduced voltage type for all pumps 20 horsepower and larger, and across-the line for pumps less than 20 horsepower. Magnetic starter shall include a contactor with a minimum mechanical life of 3,000,000 operations and a minimum contact life of 1,000,000 operations. The magnetic

starter shall include an overload relay, which is ambient temperature compensated and bimetallic.

- K. SCADA, Alarms and Monitors shall be provided in accordance with Chapter 13 and include the following at a minimum:
 - 1. When a high-level or low-level condition occurs, the alarm system shall activate the light and alarm horn located on the exterior of the building. The high-high float switch shall send an alarm signal to SCADA, as well as starting the pumps for a selectable length of time determined by wet well size and pump down time.
 - 2. A push-to-test and push-to-silence button shall be provided.
 - 3. A pump failure contact circuit shall be provided to activate the alarm and close dry contacts.
 - 4. An overhead tripped indicator light shall be mounted on the enclosure door.
 - 5. A heat sensor tripped light shall be mounted on the enclosure door.
- L. Telemetry contacts shall be provided for additional high or low level as well as for motor overload, which shall indicate a visible alarm at the control panel.
- M. Elapsed time meters shall be provided for each pump.
- N. Seal Failure Indicators shall be provided for each pump, which shall indicate a visible alarm at the control panel and shall report to SCADA.

8.33 Design Checklist

A. A checklist is provided at the end of this chapter for the Engineer's reference and use during design and may not include all applicable design criteria. It is the Engineer's responsibility to review and comply with all guidelines contained herein and all applicable codes completely prior to submitting for review.

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DEPARTMENT OF UTILITY SERVICES

TECHNICAL SERVICES DIVISION NEW DEVELOPMENT SECTION

CITY OF HENDERSON 240 WATER STREET HENDERSON, NEVADA 89015

UTILITY SERVICES Wastewater Lift Stations Review Checklist

Design Concept Phase

Design Concept Report (DCR)

□ Site ownership

- □ Preliminary site plans and stations location
- □ Preliminary plan showing equipment and piping configuration
- □ Flow conditions
- Hydraulic analysis
- Reliability
- Expandability
- Adjor equipment design criteria
- □ Standby power noise attenuation
- Odor control facilities
- □ Analysis of existing wastewater facilities
- □ Instrumentation and control parameters
- Building design parameters
- Preliminary cost estimates
- Requirements of NAC 445A

Preliminary Design Phase

Preliminary Design Report (PDR)

- Executive Summary
- Table of Contents

August 2010

- Project background
- Existing conditions
- □ Summary of utility conflict information
- **D** Topographic mapping information
- Preliminary utilities research
- Draft Geotechnical Investigation Report
- Draft Environmental Investigation Report
- Draft Corrosion Control/Cathodic Protection Report
- □ Summary of applicable Drainage and Traffic Study findings
- Description of pump selection
- □ Flow monitoring data
- Preliminary drawings (30 percent design drawings)
- □ Alternatives evaluation summary
- Recommendations for future connections
- □ Identification of appurtenant facilities and spacing criteria
- □ Identification of permanent and temporary ROW/easement constraints and acquisition needs.
- Matrix of permits
- □ List of agencies, stakeholders, and utilities
- Outline of technical specification sections and final design drawings
- Preliminary quantities and associated cost estimates
- Preliminary construction schedule
- □ Project correspondence file
- □ Inventory of existing facilities and improvements
- Graphics, detail sketches, tables, and other displays
- □ List of relevant reports
- □ Work plan for construction
- □ "Line of Sight" study for PLC/radio control
- Description of security features
- □ Preliminary description of station operations scheme and controls
- Equipment sizes

- Description of architectural features
- Description of operational noise and noise attenuation

Agency and Utility Coordination

□ Initiate contact and coordinate with outside utilities and agencies.

Final Design Phase

- □ Final design
- □ Final design drawings
- □ Final specifications
- □ Final Geotechnical Investigation Report
- □ Final Environmental Investigation Report
- □ Final Corrosion Control/Cathodic Protection Report
- □ Final Electrical Coordination Study
- □ Final Facilities Operations Plan

Wastewater Flows

- U Wastewater generation rates
- □ Hydraulic model of lift station service area

Hydraulic Analysis

- Hydraulic Analysis
- □ Steady state analysis

Pumping Capacity

- □ Lift station inflow
- Requirements

Wet Well Design

- Flow data
- Wet well inlet

August 2010

- U Wet well operating volume
- U Wet well sizing
- U Wet well operating/alarm levels
- Emergency storage volume
- □ Storage in influent wastewater collection system

Force Main Design

- □ Capacity of Downstream Wastewater Facilities
- □ Multiple Force Main Considerations
- □ Force Main Retention Time

Site Civil

□ Site layout

Signage

Lift Station

Access Gates

Access to lift station site

Security

□ Site security design

Mechanical Layout

General station layout

Noise Attenuation

- OSHA requirements
- □ Facility Noise Production Studies
- **D** Engineering noise controls

Odor Control Facilities

- Liquid phase odor control systems
- □ Vapor phase odor control systems

Vault Standards for Wastewater Lift Stations

- Vault access
- Flow meter considerations

Wastewater Pumping Systems Design

- System responsibility
- Pump inlet configuration
- Equipment access
- **Expandability**

Piping Systems

On-site piping

Force Mains

- Materials
- □ Marking tape
- Joints
- □ Joint restraints
- Depth of bury
- Profile design
- □ Force main discharge design

Pumps

General

August 2010

- Pump construction
- □ Impellers
- □ Shafts
- Bearings
- □ Lubrication system
- Bearing life
- □ Shaft seals
- Discharge base and elbow
- Guide rails, brackets and lifting chains
- Bolts and associated hardware
- Drive equipment
- Manufacturers
- □ Spare parts

Pump Motor

Design criteria

Heating, Ventilation, Air Conditioning (HVAC)

- Design criteria
- Air conditioning systems
- Evaporative cooling systems
- Exhaust fans
- Louvers
- Ductwork
- Electric infrared heaters
- Drainage
- 🖵 EPA
- Design phase requirements

Emergency (Standby) Power Generator

- Automatic transfer switch
- □ Fuel source
- □ Noise requirements
- Control panel

Fire Protection

- □ Fire protection measures lift stations
- □ Fire hydrants
- □ Sprinkler systems
- □ Alarm systems

Potable Water Facilities

- □ Reduced pressure principle backflow preventer
- □ Service water
- Wastewater system

Telephones and Communications

Lift stations

Facility Drainage System

Sump pumps

Wash Down System

Requirements

Electrical and Instrumentation

Grounding

August 2010

Lockout safety

Controls

- Control voltage
- Control strategy
- Control floats
- Level measurement
- Control panel
- Duplex pump controller
- Level circuit operations
- Connectors
- Power and control cords
- □ Surge protection
- Circuit breaker
- □ Starter
- SCADA
- **Telemetry contacts**
- **D** Elapsed time meters
- Seal failure indicators





HEI



KEY NOTES:

- ALL FORCE MAIN PIPING SHALL BE FLANGED, GROOVED JOINT OR RESTRAINED MECHANICAL JOINT WITHIN BOUNDS OF THE LIFT STATION
- $\overline{3}$ NEENAH HEAVY DUTY R-6663-01H W/ TYPE G HANDLE OR EQUAL
- 4 H20 RATING, SIZED TO ALLOW PUMP REMOVAL
- 5 PRESSURE SENSOR (0-150 psi)
- ULTRA SONIC LEVEL INSTRUMENT
- ALL FORCE MAIN AND GRAVITY PIPING WITHIN THE BOUNDS OF THE LIFT STATION SHALL BE DIP POLYBOND LINED OR EQUAL
- 9 45 ELBOW UP
- 45" ELBOW DOWN
- 12 WYE
- (14) MAGNETIC FLOW METER

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WASTEWATER LIFT STATION TYPICAL LIFT STATION SECTIONS

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KEY NOTES:

> all force main piping shall be either flanged, grooved joint or mechanical joint restrained within boundary of the lift station

 $\overleftrightarrow{3}$ install SS guide rails, lifting cable and pipe/ rail support in accordance with manufacturer installation instructions

 $\overleftarrow{4}$ preform recess to receive precast manhole, seal recess with NON-Shrink grout.

 $\stackrel{\textstyle <}{\searrow}$ recess conc under pump as directed by pump MFR, but not deeper than 4" W/O engr approval

6 4000 PSI, CONC TO DIMENSIONS PER PUMP MFR SPECS

STATION LEVEL SET POINT TABLE				
MP OPERATING LEVELS				
	(OFF)	(ON)	(HLA)	
1				
т				



City Of Henderson Clark County, Nevada **Department Of Utility Services**



HENDERSON UTILITY GUIDELINES			- •	0.4		
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CHAPTER 9 WAS TEWATER BYPASS PUMPING

9.01 General

- A. This chapter describes the planning, checklist, piping, equipment, operation, maintenance, training, and staff required for Wastewater bypass pumping.
- B. The Contractor shall be responsible for the performance as well as means and methods associated with Wastewater Bypass Pumping.
- C. The Contractor shall demonstrate sufficient experience and knowledge needed to design, install, and operate the Wastewater Bypass Pumping system to the COH and Engineer.

9.02 Wastewater Bypass Pumping Review Checklist

- A. The Contractor shall submit a complete Wastewater Bypass Pumping Review Checklist, which is provided at the end of this chapter, with required information to the COH for approval prior to bypass pumping. The checklist is provided at the end of this chapter.
- B. The Contractor is responsible for allowing sufficient time in the project schedule for COH review and approval.
- C. The completed checklist shall be signed by the Contractor's representative.

9.03 Wastewater Bypass Pumping Plan

- A. General: The Contractor shall provide a Wastewater Bypass Pumping Plan for approval by the Engineer and acceptance by the COH. The Wastewater Bypass Pumping Plan shall provide detailed information regarding the Contractor's qualifications, design, installation, and operation of the bypass pumping system.
- B. The Wastewater Bypass Pumping Plan shall include but not be limited to the following:
 - 1. A brief explanation of the project and need for bypass pumping.
 - 2. A detailed schedule that includes date, time, and duration of bypass pumping. The schedule shall allow sufficient time for review and approval by COH per the Wastewater Bypass Pumping Review Checklist.
 - 3. Bypass Pump Capacity information shall be provided based on the following:
 - a) Bypass pumps shall be sized to accommodate minimum, average, and peak flows with an allowance for wet weather flows.

- b) Flow data shall be used to determine the range of flows and corresponding bypass pump capacity and confirmed by the COH per the Wastewater Bypass Pumping Checklist.
- c) A brief summary of the impact to any lift station(s) where applicable.
- 4. Piping Plan and Profile information shall be provided and include:
 - a) Location of existing manholes to be used as suction and discharge points, collapsible pipe plugs, nearby lift stations (if applicable), size of wastewater collection line, invert and grade elevation, size, length, and material of discharge piping.
 - Proposed staging area for equipment and material used during bypass pumping operation with all impacted easements and rights-ofway.
 - c) Proposed discharge locations, which must not entail any discharge to ground surface, storm drains or any location that would result in groundwater contamination.
 - d) Spill prevention, containment and control measures for wastewater and fuel spills that exceed 5 gallons with a signed statement from the Contractor acknowledging responsibility for all cleanup, damages, and fines that result from a backup, spill or unauthorized discharge.
- 5. Odor Control Plan shall include:
 - a) Proposed odor control measures and equipment to be utilized during bypass operation.
 - b) Proposed odor control measures to respond to potential odor complaints, which will require immediate action.
- 6. Public Access Plan shall include:
 - a) Proposed Traffic Control Plan that shall be approved by the COH Public Works Department prior to any bypass pumping operations.
 - b) Provisions for vehicular access, pedestrian access in accordance with the MUTCD and ADA requirements.
 - c) Contractor's acknowledgement that selected diversion manholes will not block major intersections, businesses, or access to homes.
- 7. Equipment Operations Plan:
 - a) Proposed qualified personnel to monitor, operate, and maintain the Wastewater bypass pumping system.
 - b) Proposed names and documentation that demonstrate the personnel have been properly trained to monitor, operate, and maintain the wastewater bypass pumping equipment for this specific application in accordance with the Equipment Operations Plan.
 - c) Contractor's acknowledgement that a minimum of two (2) operators must be onsite during all bypass pumping operations.

- 8. Emergency Response Plan shall include:
 - a) Contractor's acknowledgement to maintain a copy of the Emergency Response Plan onsite at all times.
 - b) Detailed spill containment plan.
 - c) Emergency contact information that includes Contractor's personnel and COH personnel.
 - d) Equipment failure procedures.
- 9. Inspection Plan shall include:
 - a) Contractor's acknowledgment to inspect bypass pumping equipment and piping for leaks or spills on an hourly basis.
 - b) Sample daily inspection log sheet.
- 10. Equipment List: The Contractor shall provide a detailed list of all equipment to be onsite and available for the bypass pumping system, which shall be subject to inspection by COH. The Contractor shall maintain the listed equipment onsite or readily available. Equipment shall include but not be limited to the following:
 - a) Bypass Pumps.
 - b) Bypass Piping.
 - c) High level alarm at the upstream or suction manhole.
 - d) Noise control equipment.
 - e) Temporary pipe plugs.
 - f) Vacuum truck and/or debris removal equipment.
 - g) Odor control equipment.
- 11. Design calculations for sizing bypass pumps and piping, which include:
 - a) Minimum flow, average flow, and peak flow.
 - b) Static head and dynamic head over anticipated flow range.
 - c) Pump curves showing operating range of flow and total dynamic head (TDH) over minimum and peak conditions.
 - d) Static lift, friction losses, and flow velocity.
- 12. Bypass Pumps information shall include:
 - a) Sizing information with design calculations based on static lift, friction losses and corresponding flow.
 - b) Cut sheets that indicate pumps' ability to pass at least a 3-inch spherical solid.
 - c) Materials of construction and protective coatings.
 - d) Standby pump and driver capacity such that system will handle peak wet weather flows with largest pump out of service.
 - e) Cut sheets with that indicate sufficient capacity for electrical and/or generator equipment to provide standby power for bypass pumping equipment.

- f) Cut sheets for fuel storage vessels including materials of construction.
- g) Fuel capacities and consumption information.
- h) Power requirements for pumps and standby equipment.
- 13. Bypass Piping information shall include:
 - a) Proposed pipeline sizes and materials, pressure class and diameter ratio (DR).
 - b) Quantity of bypass pipeline required, which accounts for system redundancy.
 - c) Pipeline connections and fittings.
 - d) Cut sheets and materials of construction for all thrust restraint, pipe supports and anchors.
- 14. Design plans, which indicate piping, valves, equipment, and location with methods for installation of suction and discharge piping.
- 15. Section views, which indicate maximum and minimum water surface elevations, suction and discharge pipe centerline elevations, pipe depth, type of pipe bedding, fill and backfill.
- 16. Valve cut sheets.
- 17. High Level Alarm catalog cut sheets with power requirements.
- 18. Noise Control Equipment catalog cut sheets with power requirements.
- 19. Temporary Pipe Plugs catalog cut sheets.
- 20. Vacuum truck and/or debris removal equipment.
- 21. Odor Control Equipment catalog cut sheets with power requirements.
- 22. Detailed safety procedures, which include but are not limited to the following:
 - a) Confined space entry.
 - b) Personal protective equipment.
 - c) Electrical safety.
 - d) Traffic control measures and safety.
 - e) Signage.
- 23. Flow monitoring data per 9.05 to determine peak, average and minimum flows.
- 24. Methods for protecting equipment, piping, and accessories from damage from general public, traffic, and erosion.

- 25. Field quality control including leak testing, inspection, and monitoring.
- 26. Maintenance procedures.

9.04 Requirements

- A. The Contractor shall notify the following prior to the COH departments at a minimum 5 working days prior to commencing work:
 - 1. COH Field Operations.
 - 2. COH Water Reclamation Facility.
- B. The Contractor shall assume responsibility for damage to public or private property, overflows from the wastewater collection system, and violations resulting in fines as a result of bypass pumping operation.
- C. Private Property: entry onto private property is not permitted without right-ofentry/right-of-access agreement from the property owner.
- D. The Contractor shall provide all labor, materials, and supervision to temporarily provide bypass pumping and flow control in accordance with the specific needs of the project.
- E. No interruption of wastewater flow shall be permitted throughout the duration of the project. Should COH resources be required, the Contractor shall reimburse the COH accordingly.
- F. The Contractor shall repair all disturbances to existing landscaping and pavement.
- G. The Contractor shall provide Public Notice if required by the COH.

9.05 Flow Monitoring

- A. General: Flow monitoring shall be completed by the Contractor as part of the Wastewater Bypass Pumping Plan to determine peak, average and minimum flows.
- B. Flow monitoring shall entail measuring flows at the bypass location(s) for a period of not less than 14 days to determine peak, average and minimum flows for design of the bypass pumping equipment and piping.

9.06 Pipe Plugs

A. General: The Contractor shall use Pipe Plugs to block flow in and out of bypass manhole locations.

- B. Plugs shall be inflatable type of corrosion-resistant materials.
- C. Plugs shall be equipped with safety inflation lines for remotely inflating and deflating without the need for manhole entry.

9.07 Bypass Pumping Equipment

- A. All pumps shall be fully automatic self-priming centrifugal type, which do not require use of foot-valves or vacuum pumps for priming.
- B. Pumps shall be capable of passing 3-inch diameter solids, rags, rocks, hair, and other debris encountered in municipal wastewater.
- C. A minimum of two pumps shall be provided. The pumping system shall be suitable for pumping peak flows with the largest pump out of service.
- D. Pumps shall be diesel powered and include following:
 - 1. Minimum 24-hour capacity diesel fuel tank as defined by fuel consumption during peak pumping rate.
 - 2. Fuel gauge with red warning light when tank approaches empty.
- E. Pumps shall be capable of dry operation for up to 5 hours to accommodate large fluctuations in flow.
- F. The Contractor shall provide all necessary Start/Stop, instrumentation and controls needed for operation and monitoring each pump.

9.08 Piping

- A. General: Temporary bypass piping, joints, fittings, and accessories shall be suitable for wastewater and shall be designed for the anticipated flows and twice the anticipated working pressure.
- B. All suction and discharge piping shall be rigid high-density polyethylene (HDPE) of not less than 6 inches in diameter with a DR 17 suitable for the anticipated operating pressures.
- C. Use of collapsible hose or solvent-welded PVC on any portion of the suction or discharge piping is not allowed.
- D. All discharge piping shall employ restrained joints.
- E. All piping in roadways shall be buried at least 24 inches below grade as measured from the top of pipe unless otherwise approved by the COH.

F. Exposed piping shall be protected by concrete traffic barricades in roads or rightof-way areas. Exposed piping shall be routed inside a spill containment vessel to contain leaks.

9.09 Performance Requirements

- A. The Contractor shall protect water resources, wetlands, public property, private property, and the general public.
- B. The Contractor is responsible for operating the system such that no interruptions in flow occur throughout installation and operation.
- C. The Contractor is responsible for operating the system such that there is zero discharge of fuel or wastewater throughout installation and operation.
- D. The bypass system operation shall comply with all local, state, and federal requirements.
- E. The bypass system shall meet odor control requirements established by the COH if applicable.
- F. The bypass system shall meet the noise control criteria established by the COH if applicable.

9.10 Field Quality Control

- A. Leak Test: Prior to start-up of the bypass pumping system, the Contractor shall perform leakage and pressure tests of the bypass pumping discharge piping using potable water. The successful completion of the leak test requires:
 - 1. No visible leaks at equipment, discharge piping, or joints.
 - 2. Maximum pressure decay of 0.5 psig over a period of 4.0 hours as recorded by the Contractor and witnessed by COH or Engineer's representative.
- B. Monitoring: The Contractor shall inspect the bypass pumping system on a continuous basis during operation and record the following at a frequency of not less than every half hour at a minimum:
 - 1. Pump discharge pressure.
 - 2. Liquid level in bypass manhole locations.
 - 3. Fuel gauge reading.

9.11 Maintenance

- A. The Contractor is responsible for all maintenance of the bypass pumping system, which includes but is not limited to:
 - 1. Bypass pump equipment.
 - 2. Piping, supports, plugs, fittings and joints.
 - 3. Fuel storage.
 - 4. Monitoring equipment, gauges, and instrumentation.

9.12 Shutdown and Removal

- A. The Contractor shall be responsible for bypass system shutdown, cleaning, and removal.
- B. The Contractor shall follow procedures to ensure zero discharge of wastewater and fuel when decommissioning and removing the bypass system.
- C. Restoration: The Contractor is responsible to restore all disturbed areas such as landscaping, pavement, and sidewalks to initial conditions.

9.13 Design Checklist

A. A checklist is provided at the end of this chapter for the Engineer's reference and use during design and may not include all applicable design criteria. It is the Engineer's responsibility to review and comply with all guidelines contained herein and all applicable codes completely prior to submitting for review.

DEPARTMENT OF UTILITY SERVICES

TECHNICAL SERVICES DIVISION NEW DEVELOPMENT SECTION

CITY OF HENDERSON 240 WATER STREET HENDERSON, NEVADA 89015

UTILITY SERVICES

Wastewater Bypass Pumping Review Checklist

Wastewater Bypass Pumping Plan

- Brief project explanation
- □ Schedule
- Bypass pump capacity
- D Piping plan and profile information
- Odor control plan
- Public access plan
- Equipment operations plan
- Emergency response plan
- □ Inspection plan
- Equipment list
- Design calculations
- Bypass pumps information
- Bypass piping information
- Design plans
- Section views
- Valve cut sheets
- □ High level alarm catalog cut sheets
- □ Noise control equipment catalog cut sheets
- Temporary pipe plugs catalog cut sheets
- □ Vacuum truck and/or debris removal equipment

- Odor control equipment catalog cut sheets
- Detailed safety procedures
- **G** Flow monitoring data
- Field quality control
- □ Maintenance procedures

Requirements

- Notifications
- Responsibility
- Private property
- Public notice

Flow Monitoring

□ Flow monitoring requirements

Pipe Plugs

Dipe plug requirements

Bypass Pumping Equipment

Bypass pumping equipment requirements

Piping

- Piping material
- □ Collapsible hose or solvent-welded PVC
- **Restrained joints**
- Discharge piping
- Exposed piping

Performance Requirements

- Responsibility
- Local, state, and federal requirements

- □ Odor control requirements
- □ Noise control requirements

Field Quality Control

- Leak test
- Monitoring

Maintenance

□ Maintenance of bypass pumping system

Shutdown and Removal

Responsibility

Restoration

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CHAPTER 10 PRESSURE REDUCING STATIONS

10.01 General

- A. Pressure Reducing Station (PRS) Definition: A pressure reducing station (PRS) is used to convey water from a higher pressure zone to a lower pressure zone. The pressure reducing station, containing one or more pressure reducing valves, shall automatically reduce the higher inlet pressure to a steady lower downstream pressure. The COH will determine when a PRS will be required.
- B. Type of Pressure Reducing Stations: The below-grade PRS, factory-built PRS, and the above-grade PRS are the three types allowed within the COH. Each type is discussed below:
 - 1. Site-Built Below-Grade PRS. The site-built PRS will either be cast-in-place or a precast vault, built with individual components.
 - 2. Factory-Built PRS. The factory-built PRS will only be a below-grade PRS which will be delivered to the job site with the interior piping and appurtenances completely assembled within a pre-cast vault or steel capsule. The factory-built PRS shall be placed into a prepared excavation with minimal connections to the exterior inlet and outlet headers.
 - 3. Above-Grade PRS. The design of an above-grade PRS shall require approval by COH on a case-by-case basis.
- C. Location of Pressure Reducing Stations: The PRS shall be located within the street right-of-way (ROW) or within an existing and/or additional municipal utility easement (MUE). The COH preference is for the PRS to be placed behind the sidewalk or curb and gutter if there is no sidewalk. PRSs located within the unpaved or paved surface of a roadway will require prior COH approval.

10.02 Design Concept Phase

- A. General: A Design Concept Memorandum (DCM) shall be submitted to and approved by the COH. As a minimum the report shall address the following:
 - 1. Pressure Reducing Station identification number and file number.
 - 2. Location of the pressure reducing station (site map, assessor's parcel number, etc.).
 - 3. Site Plan and Grading.
 - 4. Site Description.

- 5. ROW's, easements, ownership, etc.
- 6. Hydraulic analysis of zones.
- 7. Preliminary pressure reducing valve(s) sizing.
- 8. Underground vault or above grade.
- 9. Site-built station or factory-built station.
- B. The purpose of the DCM is to provide the Engineer and the COH with a general overall perspective of purpose and need for the PRS. Without an approved DCM, the Pre-Design Memorandum will not be accepted.

10.03 Pre-Design Phase

- A. General: The pre-design phase of the project shall be summarized and presented in a Pre-Design Report (PDR). The report will be submitted to the COH for review and acceptance. The PDR is the basis for the ensuing design process and must be presented in a fashion which allows the reader to gain a thorough and complete understanding of the necessity of the project. Without an approved PDR, the Engineer may not receive COH approval to proceed to the final design.
- B. The Pre-Design Memorandum shall include, but not be limited to:
 - 1. Project background.
 - 2. Draft Geotechnical Investigation Report.
 - 3. Draft Environmental Investigation Report.
 - 4. Preliminary plans and section (30 percent design drawings) illustrating the proposed:
 - a) Site plan and improvements.
 - b) Vault mechanical plan and sections.
 - c) Proposed elevations or details.
 - d) Property ownership info, rights-of-way/easements, existing utilities, etc.
 - e) Proposed power locations and connections.
 - 5. Recommendations for connections to the existing system.
 - 6. Pressure reducing valve sizing and calculations.
 - 7. Identifications of appurtenant facilities and spacing criteria.

- 8. Identification of any permanent and temporary ROW/easement constraints and acquisition needs.
- 9. List of relevant reports, plans and maps reviewed, and other relevant project information.
- 10. Instrumentation (pressure gages).
- 11. Preliminary cost estimate.
- 12. In addition, if the pressure reducing station is to be a stand-alone project (not associated with developer plans), then the following items should also be addressed in the pre-design memorandum:
 - a) Preliminary construction schedule.
 - b) Work plan for how construction is to be accomplished if connecting into existing facilities (phasing, shutdowns, etc,).
- C. Field Investigations (see Chapter 1).
- D. Hydraulics: The selection of pressure reducing valve size is based on a thorough understanding of the water demands in the reduced zone. Prior to the submittal of any potable water drawings that include a PRS, a hydraulic analysis shall be submitted to COH for approval. The hydraulic analysis shall include the anticipated flows, including fire flows in the reduced zones, sizing of valves, piping sizes, and system headlosses based on the design criteria. The hydraulic analysis shall be per UDACS 2.03, latest edition.
 - 1. Design Criteria: A minimum of two valves shall be installed in the pressure reducing station, unless otherwise directed by COH. The smaller pressure reducing valve shall be sized to accommodate minimum day demands and peak hour demand under continuous flow conditions provided in the approved Master Plan. The larger valve shall be sized to accommodate the maximum day demand plus fire flow demands.
 - a) The COH shall determine if a pressure relief valve will be required at the PRS on a case-by-case basis. The pressure relief valve shall be sized to accommodate the design flow of the larger valve. The maximum velocity through the valve shall be 45 feet per second.
 - b) The COH Service Rules, latest edition, defines the water demand for various types of development in Table 2-A and provides the definition of the demand criteria as follows:
 - 1) Annual Average Water Use based on Service Rules Table 2-A.
 - 2) Average Day Demand (gallons per minute) equals 0.62 times the annual average water use (AFY).
 - 3) Maximum Day Demand = Average Day x 2.0.
 - 4) Peak Hour Demand = Maximum Day x 1.7.

- c) Fire flow requirements of the COH Fire Department. If the PRS serves a non-looped system, dual fire flow pressure reducing valves will be required.
- d) The target pressure for the pressure reducing valves is the downstream zone pressure at the centerline of the pressure reducing valves. The smaller pressure reducing valve shall be set to open when the downstream pressure drops from the target pressure set point and will close at the target pressure set point. The larger pressure reducing valve shall be set to open when the downstream pressure drops 5 psi from the target pressure set point and will close at the target pressure set point and will close at the target pressure set point and will close at the target pressure set point and will close at the target pressure set point and will close at the target pressure set point. The pressure relief valve shall begin to open when the downstream pressure rises 10 percent above the target pressure set point and will close when the downstream pressure falls below 10 percent of the target pressure set point.
- e) The PRS inlet/outlet header pipe size shall be sized for a maximum velocity of 8 feet per second per UDACS 2.02.02.
- 2. Calculations: The design engineer shall provide calculations to COH for review and approval. The calculations shall support the design of the PRS components. At minimum, the calculations should include:
 - a) Pressure Reducing Valves: Design calculations shall be provided that size the pressure reducing valves based on flow, pressure drop across the valve, and cavitation.
 - b) Pressure Relief Valve: The COH will determine if a pressure relief valve will be required at the PRS on a case-by-case basis. The pressure relief valve will be located downstream of the pressure reducing valve and is intended to release pressure build-up in the system if the pressure reducing valve fails to operate as intended. The pressure relief valve will discharge to an approved discharge location.
 - c) Vault buoyancy: The design engineer shall assume groundwater exists to the ground surface for all prepared buoyancy calculations unless approved by COH based on findings of the geotechnical investigation. Vault buoyancy shall be designed with a 1.25 factor of safety.
- E. Preliminary Site Selection: Site selection should be based on providing good maintenance access to the PRS.
 - 1. Site Description: Engineer shall provide a general site description indicating location of the pressure reducing station, the surrounding area land use, existing facilities including utilities, project boundaries, and purpose of the pressure reducing station.

- 2. Site Layout: To provide access for maintenance around the PRS, a minimum of ten (10) feet of clearance outside of the buried piping shall be required (See Figure 10.1). A minimum of five (5) feet clearance is required between the PRS easement and the vault walls.
 - a) For PRS located behind sidewalk, a driveway cut-out shall be required. For PRS located directly behind curb and gutter, no driveway cut-out shall be required.
 - b) If a pressure relief valve is required, the overflow relief may be discharged to a splash pad within the easement area behind the curb and gutter. COH shall have final approval of the relief overflow discharge location.
- 3. ROW or Easement Acquisition: If the PRS, with associated required spacing surrounding the vault or building walls extends outside of the existing right-of-way, a municipal utility easement (MUE) shall be provided for those portions outside of the right-of-way.
- F. Preliminary PRS Layout: The following section addresses interior design of the pressure reducing station so that a preliminary design can be presented to the COH for approval.
 - 1. Mechanical Layout: The layout of the PRS shall address general vault dimensions, including length and arrangement of PRS piping, and location of valves. The size of the vault will be determined by the inlet/outlet piping size, the valve sizes, and required clearances. In addition, the layout of the mechanical equipment within the vault should be designed with consideration to allow room for operators to enter, access, and maintain the equipment.
 - a) Valves:
 - Pressure Reducing Valves: The pressure reducing valve shall be capable of automatically reducing a higher inlet pressure to a steady lower downstream pressure. The downstream pressure shall be maintained regardless of fluctuating flow rates or inlet pressures. When the downstream pressure exceeds the upstream pressure, the valve shall automatically shut.
 - 2) Pressure Relief Valves: The pressure relief valve shall be capable of automatically discharging volumes of water downstream of the pressure reducing valves to relieve system pressure. When the downstream pressure meets the pre-set value the relief valve will shut.
 - Isolation Valves: Isolation valves shall be provided within the vault on either side of each pressure reducing valve. In addition, isolation valves shall be provided on the inlet and discharge

headers outside of the vault. Valve boxes, valve box covers, and valve key extensions shall be provided for isolation valves on the headers.

- 2. Pipe Material: The pipe material within the PRS shall be fusion-bonded epoxy-lined and epoxy-coated welded steel pipe.
 - a) Expandability: The design engineer shall contact the COH to determine if expandability of the PRS is required. Expandability in the design is achieved by placing the pressure reducing valve between reducers so if future demands require a larger pressure reducing valve, significant pipeline replacement is unnecessary. If expandability is not required, then the PRS shall be designed with the inlet/outlet header being the same diameter as the largest pressure reducing valve. The by-pass piping and by-pass pressure reducing valve shall also be the same diameter.
- 3. Ventilation: Ventilation shall be provided for the underground pressure reducing stations. The ventilation piping shall consist of passive vents and an exhaust fan. The vents shall be located at opposite sides of the vault, one at high elevation and the other at a lower elevation. The minimum size of the ventilation piping shall be 6 inches. The exhaust fan/blower shall be capable of providing a minimum six (6) room air changes per hour.
- 4. Access: Vault access is dependent on the location of the PRS. An aluminum or galvanized steel ladder shall be provided at the access.
 - a) If the underground vault is located in an area with low potential for traffic and/or within a sidewalk, the access shall be through an aluminum, H20 occasional load-rated, double-leaf hatch. The minimum size for the hatch shall be 48-inches by 48-inches and large enough to remove the largest piece of equipment. Removable bollards shall be provided around the PRS if space is available.
 - b) If the underground vault is located within the unpaved or paved surface of a roadway, the access shall be through an H20 rated manhole opening. The minimum size for the manhole shall be 30 inches. Underground vaults within the unpaved or paved surface of a roadway shall require prior approval by COH.
 - c) Manhole openings shall not be used in lieu of hatches. Manhole openings shall be used only within the paved surface of a roadway.
- 5. Pressure Measurement. Pressure measurement shall be provided upstream and downstream of the pressure reducing valves. The measurement shall be on the inlet and outlet headers between the isolation valves and the vault wall, thus ensuring pressure reading available at all times. The measurement shall consist of a pressure gage with stainless

steel tubing and fittings at the inlet/outlet header. In addition, copper tubing shall be used to pressure gages located near the vault hatch such that entry into the vault is not required for reading line pressure.

10.04 Final Design Phase

- A. General: The final design shall contain all the information necessary for the Contractor to construct the PRS in accordance with COH guidelines. This section provides guidance on the final design criteria for PRS's.
- B. Site Civil: The site civil shall include control points or clearly defined dimensions/bearings from existing/proposed permanent improvements to locate the pressure reducing station structure and easements. The site civil information shall include retaining wall information (location, top of wall, bottom of wall), if necessary. All elevations necessary for setting top of structure shall be provided for corners of vaults, hatches, or building pads within the proposed easement. All facilities shall be included within the easement with set-backs as noted in Section 10.03.E.3. See Figure 10.1 for typical site plan.
 - 1. Yard Piping: Yard piping pertains to the buried piping a minimum of one (1) foot outside of the PRS. Refer to the Transmission Piping Chapter for the buried inlet and outlet piping to the PRS. The one-foot segment shall end with a ANSI/AWWA C207 Class D flange with an insulating flange kit. All buried pipe sections shall be wrapped with a three-layer petrolatum wax tape coating system per AWWA C217.
 - a) Three layer petrolatum wax tape coating:
 - 1) Primer: All surfaces shall be prime coated with a blend of petrolatum, plasticizer, inert fillers, and corrosion inhibitors having a paste-like consistency. Minimum primer thickness shall be 3 mils.
 - 2) Wax Tape: Covering material shall be a synthetic felt tape, saturated with a blend of petrolatum, plasticizers, and corrosion inhibitors that is formable over irregular surfaces.
 - Plastic Outer Wrap: The primed and wax taped surface shall be covered with a plastic outer wrap consisting of three layers of 150-gauge (1.5 mil) polyvinylidene chloride or PVC, high cling membrane wound together.
 - 4) Minimum wax tape coating thickness shall be per manufacturer's recommendation, but shall not be less than 40 mils.
 - 5) A 3/4-inch cement mortar coating (rock shield) reinforced with welded wire fabric conforming to the requirements of AWWA C205 shall be applied around the wax-tape coating for protection.

- b) Insulating Flange Kit (to be provided as shown in Figures 10.2 and 10.3):
 - Gaskets: ANSI B-16.21, Type E, NEMA G10 glass with a rectangular o-ring seal for operation between 20 degrees Fahrenheit and 150 degrees Fahrenheit. Gaskets shall be suitable for the temperature and pressure rating of the piping system in which they are installed.
 - Insulating Sleeves: 1/32-inch thick tube, full length, G10 glass material per NEMA LI-1 for operation between 20 degrees Fahrenheit and 150 degrees Fahrenheit. For installation at threaded valve flanges, half-length sleeves shall be used.
 - Insulating Washers: 1/8-inch thick, G10 glass per NEMA LI-1 for operation between 20 degrees Fahrenheit and 150 degrees Fahrenheit.
 - 4) Steel Washers: 1/8-inch cadmium plated steel placed between the nut and insulating washer.
 - 5) All buried insulating flanges and buried non-coated metallic pipe and specials shall be wax tape coated per AWWA C217. See Section 10.04 B.1.a above for wax tape installation.
- 2. Site Security: For underground vaults, hatches shall have recessed hasp lock. Manholes in streets shall have locking manholes.
 - a) Keys for hasp locks shall be provided by the Contractor to the COH and keyed by the COH locksmith.
 - b) For above-grade PRS, a lock shall be provided on the station enclosure. Lock shall be keyed by the COH locksmith.
- 3. Grading: Grading for PRS located behind the curb shall be graded to drain away from the underground PRS access.
 - a) The vault lid shall be level. If a retaining wall is required to maintain the vault lid level, then retaining walls shall be located a minimum of ten (10) feet clear of the vault yard piping.
 - b) Retaining walls shall be per Southern Nevada Building Officials Regional Standard Detail Drawing B-101 for retaining walls less than 4-feet high. If wall height is higher, wall shall be designed in accordance with the Uniform Standard Specifications for Public Works Construction, Clark County Area Improvements, latest edition. All structural calculations and design shall be signed and stamped by a Registered Engineer in the State of Nevada.
 - c) The access to the underground PRS shall not be located in the low spot of the surrounding area. The PRS hatch shall be flush with the adjacent grading. No concrete curbs to raise the hatch shall be allowed.
- 4. Mechanical Layout: In determining the vault size, the following minimum clearances shall be observed:
 - a) 12-inches clear distance between wall and first flange.
 - b) A minimum of 24-inches clear distance between wall and centerline of pipe for pipe sizes 16 inches and smaller and a minimum 36inches clear distance for pipe sizes 18 inches and larger. A minimum of 48-inches clear distance between wall with ladder and centerline of pipe.
 - c) Between 20- and 30-inches of clearance shall be between floor and centerline of pipe.
 - d) Any deviations from the above clearances shall require approval from COH.
 - e) NEC clearances shall be maintained at all times.
- C. Site-Built Below Grade PRS:
 - 1. Vault Interior Piping: Typical vault mechanical plan and section views may be found in Figures 10.2 and 10.3.
 - a) The piping within the vault walls shall be steel pipe that meets the requirements of ASTM A53 Grade B with minimum steel yield strength of 35,000 psi and shall be sized conforming to ASME/ANSI B36.10.
 - 1) Minimum wall thickness for pipe diameters 24 inches and smaller shall be 0.25 inches.
 - 2) Minimum wall thickness for pipe diameters greater than 24 inches shall be 0.375-inches.
 - b) Steel piping within the vault shall be welded per ANSI/AWWA C206. The steel pipe shall have fusion bonded epoxy lining meeting the requirements of AWWA C213. The minimum lining thickness shall be 16 mils dry film thickness (DFT). The epoxy powder coating shall be Valspar, Inc., Pipe Clad® 1500 Red; 3M Scotchkote 134; or approved equal.
 - c) The exterior steel pipe coating shall be an amide-cured epoxy system, Tnemec 69 Hi-Build Epoxoline II, PPG Amercoat 133, or approved equal. Piping color shall be Voyager Sky or approved by COH prior to application. Primer shall be per manufacturer's recommendations.
 - Steel flanges shall conform to the requirements of ANSI/AWWA C-207. Flanges shall be Class D.
 - e) Drain outlets shall be provided on the inlet/outlet headers to facilitate draining the pipeline for valve maintenance and repair. Drain detail is found in Figure 10.4.

- 2. Vault: The site-built below-grade PRS shall have either a pre-cast vault or a cast-in-place vault.
 - a) Lifting eyelets shall be provided in the vault ceiling to facilitate the removal of isolation valves and the bonnets of the pressure control valves when the hatch opening is not directly overhead. See Figure 10.5 for lifting eye detail.
 - b) Pre-Cast Vault. The pre-cast vault shall meet the requirements of ASTM C-858 for Pre-Cast Structures. The minimum 28-day compressive strength of the concrete shall be 3,500 psi and the concrete shall be Type V. The vault shall be designed with the following load requirements:
 - Dead loads attributable to the weight of the backfill shall be included using compacted soil weight determined by the geotechnical investigation. Lateral soil pressure shall be considered in the design. Groundwater loadings shall also be considered.
 - 2) Live loads caused by standard highway loadings (HS-20) shall be computed in accordance with AASHTO. Structural calculations shall be submitted with the shop drawings for the pre-cast vault by the vault manufacturer.
 - 3) The structural calculations shall specify wall thickness, foundation thickness, top slab thickness, reinforcement of all walls, foundation, top slab, and around openings, including rebar lap lengths. The structural design shall also indicate location of joints, recommended waterstops and sealants, concrete strength and design, and buoyancy calculations.
 - 4) All structural calculations and design shall be signed and stamped by a Registered Engineer in the State of Nevada.
 - c) Cast-in-Place Vault (Case-by-case basis):
 - 1) Reinforced concrete vaults shall be designed for both strength and serviceability. The ultimate strength design method and the working stress method (alternative design method) are acceptable for reinforced concrete design. The minimum 28-day compressive strength of the concrete shall be 3,500 psi and the cement shall be Type V. Design of cast-in-place vault shall meet all requirements of the Uniform Standard Specifications for Public Works Construction, Clark County Area, Nevada, and latest edition.
 - Structural calculations shall be submitted with the design drawings during the review process. The structural calculations shall specify wall thickness, foundation thickness, top slab thickness, reinforcement of all walls, foundation, top slab, and

around openings, including rebar lap lengths. All structural calculations and design shall be signed and stamped by a Registered Engineer in the State of Nevada.

- 3. Vault Access:
 - a) All vaults, regardless of location, are considered to be permitted confined space entry. A clearly visible caution sign indicating permitted confined space entry shall be posted on the underside of vault lid or on the manhole riser. As discussed in Section 10.03.E.2, access is dependent on vault location. Discussed below are the access options:
 - 1) Vault with Low to High Potential for Traffic Loads. A rectangular roof hatch shall be provided for access into the vault.
 - (a) The minimum hatch size shall be 48-inches by 48-inches and large enough to remove the largest piece of equipment.
 - (b) Engineer may provide more than one hatch for a larger vault since it is desirable to have open access above the pressure reducing valves. A ladder shall be located at the hatch opening.
 - (c) Hatches shall be aluminum with 1/4-inch diamond pattern plate designed to withstand an occasional live load of H20 rating.
 - (d) Channel frame shall be 1/4-inch steel with an anchor flange around the perimeter.
 - (e) Leaf shall be equipped with heavy stainless steel hinges, stainless steel pins, spring operators or piston-cylinder assembly for easy operation, and an automatic hold open arm with red vinyl grip release handle. When the door leaf is in the raised position, the hold open arm will engage a lock open device to prevent accidental closing of the door leaf. The access door will be fabricated for keyed entry, by having a padlock protective pocket with hinged cover contiguous with the channel frame or have an internal latch which uses a hatch key and special socket to open. Recess flush cover shall be of the same material as leaf. Cover shall be retained by a single flat head screw.
 - (f) A 1 1/2-inch drainage coupling shall be located in the front right corner of the channel frame. Hardware shall be 304 stainless steel. Aluminum in contact with other metal or concrete shall be shop-painted with 1 coat of zinc chromate and 2 coats of approved aluminum metal-andmasonry paint. Drains shall discharge away from the vault.
 - (g) Hatches shall be Bilco JDAL-H20, USF THD, or approved equal. A COH standard locking hatch, shown on Figure 6.7A (in Reservoir section), shall be used.
 - (h) The access hatch shall be positioned such that the clear opening parallels the street.

- 2) Vault in Traveled Roadway: A single, locking, H20-rated manhole cover shall be provided for access into the vault.
 - (a) The minimum size of the manhole opening shall be 30 inches and large enough to remove the largest piece of equipment.
 - (b) Manhole cover shall be from the COH approved materials list and shall be per the Design and Construction Standards for Wastewater Collection Systems, Standard Drawing S-3, latest edition.
 - (c) The words "Sanitary Sewer" shall be replaced with "PRV #XXX" where "XXX" is the pressure reducing station number.
- 4. Height: The minimum interior vault height shall be 7 feet 0 inches.
- 5. Pipe Penetrations: Pipe penetrations through wall openings shall be sealed to prevent moisture from entering into the vault and to provide for some movement of the vault. Pipe penetration sealants for polyvinyl chloride piping, i.e., vent pipe, shall be with epoxy-coated grout (see Figure 10.6). Steel pipe penetration sealant shall be modular, mechanical type sealant consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall openings (see Figure 10.7). The pre-cast or the cast-in-place vault wall openings shall be sufficiently large enough to accommodate the type of sealant specified.
 - a) The steel pipe penetration mechanical type sealant shall be a modular pipe penetration seal product PSI Link-Seal, APS Innerlynx, or an approved equal.
 - b) Upon installation of the mechanical type sealant per manufacturer's instructions, the remaining annular space shall not be filled with grout and plastered.
 - c) Another allowable penetration is the wall insert (see Figure 10.8) for electrical and control wiring.
- 6. Coatings:
 - a) Vault Interior: The vault interior shall be protected with either a polyurethane, epoxy, or fiber-reinforced epoxy protective coating system.
 - 1) Polyurethane system: A polyurethane protective coating system for concrete which uses a high adhesion and moisture tolerant epoxy base coat and a high build polyurethane elastomer top coat is acceptable for coating the vault interior. The application of the polyurethane must take place before the epoxy becomes tack-free. The thickness of the epoxy coat shall be a between 1 and 3 mils and the polyurethane coating shall be between 60 and 125 mils depending on the surface profile. The surface

preparation shall be per manufacturer's recommendations. The interior coating shall be Sancon 100, Tnemec Elastoshield 264, or approved equal. The color of the interior of the vault shall be "Off-White".

- 2) Epoxy System: A 100 percent solids, ultra high-build epoxy system is acceptable for coating the vault interior. The system shall have the following characteristics:
 - (a) Product type: amine-cured epoxy.
 - (b) VOC Content per ASTM D2584: 0 percent.
 - (c) Minimum Compressive Strength per ASTM D695: 18,000 psi.
 - (d) Minimum Tensile Strength per ASTM D638: 7,500 psi.
 - (e) Minimum Flexural Modulus per ASTM D790: 13,000 psi
 - (f) The coating shall have a minimum wet film thickness of between 60 and125 mils. The color shall be off-white or light blue. The surface preparation shall be per manufacturer's recommendations. The coating shall be RLS Raven 405, Polycoat Industries, Inc, Polycoat 133, or approved equal.
- 3) Fiber-Reinforced Epoxy System: A spray-applied fiber-filled material specially formulated for corrosive protection of concrete and steel. The system shall have the following characteristics:
 - (a) Minimum compressive strength per ASTM C579: 6,800 psi.
 - (b) Minimum tensile strength per ASTM C307: 2,500 psi.
 - (c) Minimum flextural strength per ASTM C580: 4,600 psi.
 - (d) The sprayed coating shall have a minimum dry film thickness of 60 mils. The surface preparation shall be per manufacturer's recommendations. The coating shall be Sauereisen SewerGuard 210S, Tnemec Perma-Shield 436, or approved equal.
- b) Vault Exterior: The vault exterior coating shall be a waterproofing material suitable for coating concrete. It shall be a cementitious coating of a blend of Portland cement, fine treated silica sand, and active proprietary chemicals. When the product is mixed with water and applied, the active chemicals cause a catalytic reaction which generates a non-soluble crystalline formation of dendritic fibers within the pores and capillary tracts of concrete. The process causes the concrete to become permanently sealed against the penetration of liquids. The coating system shall be Xypex Chemical Corporation Xypex, ICS Penetron International Peneplug, or approved equal.
 - 1) The manufacturer shall provide a one-year warranty for the product from date of final acceptance.
 - 2) The waterproofing applicator shall be experienced in the installation of cementitious crystalline waterproofing materials as demonstrated by previous successful installations, and shall be approved by the manufacturer in writing. The applicator shall

provide warranty that, upon completion of the work, surfaces treated with cementitious crystalline waterproofing will be and will remain free from water leakage resulting from defective workmanship or materials for a period of one year from date of final acceptance.

- 3) Coating shall be applied per manufacturer's instructions.
- 7. Drainage: The underground vault shall be provided with a floor sump and sump pump to remove nuisance water. The floor of the underground vault shall be sloped a minimum two (2) percent grade to a 1 foot by 1 foot by 1 foot floor sump covered with reinforced fiberglass grating. The reinforced fiberglass grating shall be capable of supporting a minimum loading of 250 pounds per square foot. Grating size shall be a maximum 1-1/2 inch square and can be either from a molded or protruded process. The grating manufacturer shall be Fibergrate, Century Composites, LLC, or approved equal.
 - a) The sump pump (discussed in the mechanical section) shall discharge to the curb and gutter through a curb outlet or to the splash pad drain (see Figure 10.9).
- 8. Ventilation Piping: Ventilation shall be provided by two 6-inch vents and an exhaust fan (see Section 10.03.F.3). The buried ventilation piping from the vault shall be Schedule 80 polyvinyl chloride (PVC) pipe manufactured in accordance to the requirements of ASTM D-1785. The polyvinyl chloride used in the manufacture of the pipe shall be domestically produced rigid PVC compound, Type I Grade I, with a Cell Classification of 12454 as defined in ASTM D1784. The above-grade ventilation piping shall be enclosed in a steel cover as shown in Figure 10.10.
- 9. Lighting: There shall be one or more two-tube, 32 watt per tube, electronic start, enclosed and gasketed, forty-eight (48) inch minimum length fluorescent light fixtures installed within the underground vault. One (1) light fixture shall be located directly over the main control panel. A proximity switch shall activate the lights and the exhaust fan when the hatch is opened. If a manhole opening is used, the proximity switch shall be mounted on the manhole riser no more than 10-inches from the manhole cover. Open fluorescent or incandescent fixtures will not be accepted.
- Ladders: An aluminum or galvanized steel ladder shall be provided in the vault and extend to the ceiling. The ladder shall meet all OSHA requirements (Subpart X, Tile 29 Code of Federal Regulations, Part 1926.1050 through 1926.1060) including, but not limited to:
 - a) Minimum perpendicular clearance between the centerline of the fixed ladder rungs and steps and any obstruction on the climbing side of

ladder shall be 30 inches. If an obstruction is unavoidable, a clearance of 24 inches shall be allowed provided a deflection device is installed to guide workers around the obstruction.

- b) Minimum perpendicular clearance between fixed ladder rungs or steps and any obstruction behind the ladder shall be 7 inches.
- c) Minimum clearance between the sides of individual rung/step ladders and between the side rails of other fixed ladders shall be 16 inches.
- d) Minimum clearance between the nearest permanent object on each side of the centerline of the ladder or step shall be 15 inches.
- e) Fixed ladders must be able to support at least two loads of 300 pounds each, concentrated between any two consecutive attachments.
- f) Each step or rung of a fixed ladder must be able to support a load of at least 300 pounds applied in the middle of the step or rung.
- g) In addition each ladder shall be provided with either a walk-through extension or a ladder-post safety device. The walk-through extension shall be provided by the ladder manufacturer and shall meet OSHA requirements. The ladder-post safety device shall be galvanized steel as manufactured by Bilco Ladder-Up, Maxam Metal Products SLP-2, or approved equal.
- h) The ladder may be supplied through a manufacturer or constructed. If the ladder is supplied through a manufacturer, shop drawings shall certify compliance with all OSHA requirements. Ladder shall be attached to vault wall per manufacturer's recommendations. Typical fabricated steel galvanized ladder is shown in Figure 10.11.
- i) A ships ladder may be provided in lieu of the vertical ladder. The ships ladder shall conform to all OSHA standards.
- D. Factory-Built Below-Grade PRS: The below-grade structure housing the factorybuilt pressure reducing station can be either a pre-cast vault or a steel capsule vault.
 - 1. Pre-cast vault: All the requirements of Section 10.04.C shall be applicable to the pre-cast factory-built PRS.
 - 2. Steel capsule vault. All requirements of Section 10.04.C shall be applicable to the steel capsule vault with the following exceptions:
 - a) Structure: The underground steel capsule vault shall be large enough to contain all the equipment, have the required clearances, and be structurally sound for the loading conditions anticipated. COH shall determine if the piping clearances are adequate during the shop drawing review. The manufacturer shall submit structural calculations that indicate the designed welded steel capsule can support the soil,

foundation, groundwater, and H20 loadings. All structural calculations and design shall be signed and stamped by a Registered Engineer in the State of Nevada.

- The steel plates used to form the capsule shall have a minimum wall thickness of 0.25 inches and meet the requirements of ASTM A36. The capsule shall be made of all new steel plates.
- 2) Only vertical welds are allowed on the side sheets. Patching of steel plates are not allowed.
- 3) The side sheets of the capsule shall be connected to the top and bottom of the capsule with a lap joint. The lap joint shall be a full fillet weld inside and outside, and shall be a minimum of 1-1/2 inch from the bottom and top plates.
- b) Pipe Penetrations: Pipe penetrations shall be per manufacturer's design if steel capsule is used. The capsule wall penetrations shall have a penetration sleeve placed over the outside of the pipe diameter. The sleeve shall be welded to the pipe prior to fusion bonded lining. The sleeve shall have a minimum thickness of 1/2 inch.
- c) Coatings: All surfaces of the steel capsule shall be grit-blasted equal to commercial blast cleaning per SSPC-SP6. All welds shall be brush-coated using Tnemec 69 Hi-Build Epoxoline II, PPG Amercoat 133, or approved equal. The interior and exterior of the steel capsule shall have an epoxy coating that shall be a two component, high solids, amide-cured self-priming epoxy system. The protective coating shall be in a minimum of two coatings with a total DFT of 8.0 mils. The epoxy coating shall be Tnemec 69 Hi-Build Epoxoline II, PPG Amercoat 133, or approved equal. The color shall be Voyager Sky or approved equal.
- d) Drainage: Manufacturer shall provide floor sump and sump pump. Floor sump design shall be per manufacturer. Sump and pressure relief discharge piping shall discharge to the splash pad as shown in Figure 10.9.
- e) Ventilation Piping: Ventilation piping shall be per manufacturer's design. Ventilation piping shall be in agreement with Figure 10.10.
- f) Corrosion protection for the steel capsule shall be magnesium anodes. A minimum of four (4) seventeen pound packaged standard potential magnesium anodes (H-1) shall be used for cathodic protection and shall be equally spaced around the steel capsule unless otherwise specified by a corrosion study. The anodes shall be buried equally spaced around the station and connected to the station lugs by heavy copper wire. A cathodic test station shall be provided to measure the potential of the anodes. Insulating flange

gasket kits shall be used at connection points outside and inside of the vault to isolate the PRS piping.

- g) The supplier of the factory-built PRS shall provide to COH certification that the factory-built PRS shall operate as intended and shall provide a one-year written warranty for the complete system from the date of acceptance by COH. Acceptance of the station shall be after successful PRS start-up. The warranty shall cover all equipment, components and systems provided in or with the station by the manufacturer. The manufacturer shall bear the full cost of labor and materials for replacement and /or repair of faulty or defective components. There shall be no cost to COH during the warranty period for the manufacturer to provide a fully operational station with non-defective components
 - An Underwriter's Laboratories (UL) label attesting to finished equipment full compliance to the provisions of standard category "Packaged Pumping Systems (QCZJ)" shall be fixed onto the station interior.
 - 2) The Contractor shall be required to provide manufacturer startup service, including, but not limited to, the services of a qualified start-up service technician employed by the manufacturer. One full day shall be provided by the manufacturer for start-up and training. The manufacturer shall provide two bound Operation and Maintenance Manuals.
 - 3) The Contractor shall be required to provide COH with manufacturer's shop drawings for the factory-built PRS including design calculations, structural calculations for the vault, all electrical and mechanical equipment included within the station, all coatings and linings for piping and the vault, and clearances between equipment and walls.
 - 4) Manufacturers: Station manufacturer shall be Engineered Fluid, Inc (EFI), Centralia, Illinois, or approved equal.
- h) Coordination with Civil: The design engineer shall provide any site improvements required for setting the prefabricated pressure reducing station. In particular, any reinforced concrete pad shall be designed to support the prefabricated pressure reducing station. All structural calculations for the reinforced concrete pad shall be signed and stamped by a Registered Engineer in the State of Nevada.
- E. Above-Grade PRS: All requirements of Section 10.04.C shall be applicable to the above-grade PRS with the following exceptions:

- 1. Site Security: The above-grade pressure reducing station shall be in a building or utility box that can be locked and secured. Security fencing, walls, or gates may be required by COH on a case-by-case basis.
- 2. Structure: The structure enclosing the pressure reducing station shall be a prefabricated utility box or prefabricated structure. The prefabricated utility box shall be a "hot box" as manufactured by Hot Box, Jacksonville, Florida, or approved equal. The structure shall be evaluated on a case-by-case basis.
- 3. Structural Design: The manufacturer of the prefabricated utility box or prefabricated structure shall certify that the structure has been constructed according to the building standards for Clark County and COH. The structure shall be capable of supporting the wind and seismic loads for the region. Prefabricated building designs shall be signed and stamped by a Registered Engineer in the State of Nevada.
- 4. Mechanical Layout: If the structure is a prefabricated utility box such that access to the piping is available from all sides, then the minimum clearance distance between piping and the utility box walls specified in Section 10.04.B.4 may be reduced. COH shall determine if the minimum distance requirements can be waived and whether the access to piping and equipment is acceptable.
 - a) For prefabricated buildings, the minimum clearance requirements outlined in Section 10.04.B.4 are still applicable. Any deviation from these requirements shall require written approval by COH.
- F. Mechanical:
 - 1. COH Standards: All valves and appurtenances shall be from the latest edition of the COH Approved Materials List.
 - 2. Type of Valves:
 - Pressure Reducing Valves: Pressure reducing valves shall be pilot controlled, hydraulically operated, diaphragm actuated, globe pattern valves.
 - The valve shall be single seated and have a removable seat insert. The disc shall contain a replaceable, resilient rubber seat that will guarantee drip tight shut off when closed against the seat insert.
 - 2) The valve shall be equipped with Y-strainer, isolation cocks, closing speed control, and opening speed control.
 - Valve shall have ductile iron body and Buna-N rubber disc. Diaphragm shall be nylon-reinforced Buna-N rubber.

- 4) Wetted interior of valves shall be epoxy coated meeting the requirements of ANSI/AWWA C-550-01 and have fusion bonded epoxy exterior coating conforming to the requirements of ANSI/AWWA C-116.
- 5) Internal trim shall be 304 stainless steel.
- 6) Valve ends shall be flanged conforming to the requirements of ANSI B16.42 Class150 and be flat-faced.
- 7) The control pilot shall be a direct acting, adjustable, springloaded, normally open diaphragm valve designed to permit main valve opening when the reduced outlet pressure is less than the pilot set point. The control pilot shall be Type 303 Stainless Steel. All tubing and fittings shall also be Type 303 Stainless Steel.
- 8) An indicator rod shall be fastened directly to the main control valve stem to indicate valve position. The tube shall be contained within a housing which is open on two opposite sides to permit clear vision of the indicator rod. Materials in contact with operating fluid are to be either brass, Pyrex, or Buna-N.
- 9) Pressure reducing valves shall be Cla-val Model 90G-01, no exceptions.
- b) Pressure Relief Valves: The need for a pressure relief valve shall be determined by COH on a case-by-case basis (see Section 10.03 D.). The relief valve shall be a pilot controlled, hydraulically operated, diaphragm type automatic control valve.
 - 1) The valve shall be single seated and have a removable seat insert.
 - 2) The disc shall contain a replaceable, resilient rubber seat that will guarantee drip tight shut off when closed against the seat insert.
 - 3) The valve shall be equipped with flow clean strainer, isolation cocks, closing speed control, and opening speed control.
 - 4) Valve shall have ductile iron body and Buna-N rubber disc.
 - 5) Diaphram shall be nylon-reinforced Buna-N rubber.
 - 6) Wetted interior of valves shall be epoxy coated meeting the requirements of ANSI/AWWA C-550-01 and have fusion bonded epoxy exterior coating conforming to the requirements of ANSI/AWWA C-116.
 - 7) Internal trim shall be 304 stainless steel.
 - 8) Valve ends shall be flanged conforming to the requirements of ANSI B16.42 Class150 and be flat-faced.
 - 9) The control pilot shall be a direct-acting, adjustable, spring loaded, normally closed pilot designed to close the main valve

whenever the sensed pressure is below the pilot spring setting. The relief valve shall function to limit the discharge header pressure to the value set into the control pilot. The control pilot shall be Type 303 Stainless Steel. All tubing and fittings shall also be Type 303 Stainless Steel.

- 10) Relief valve shall be Cla-val Model 50A-01, no exceptions.
- c) Isolation Valves:
 - 1) Within the Vault:
 - (a) Isolation valves 2-1/2 inches and smaller shall be ball valves that have either cast-bronze body or stainless steel body.
 - i) Cast-bronze body ball valve shall meet ASTM B62, have stainless steel ball and stem, reinforced Teflon seat, zinc plated steel handle and handle nut, and vinyl handle cover. Valve shall have female national pipe thread (FNPT) end connections and shall be rated for 400 psi water-oil-gas (WOG) minimum. Valves shall be "Capri" model ball valves, No. 9302 S, as manufactured by Crane Company, Apollo Valves 70-140 Series, or approved equal.
 - ii) Stainless steel ball valves shall meet ASTM Spec CF8M. The valves shall be all stainless steel with full bore bodies with blowout proof systems, ball and gland. The gland packing and seats shall be polytetrafluoroethylene (PTFE). The valves will be national pipe thread (NPT) threaded pattern complete with stainless steel lever operators. Maximum working pressure shall be 800 psi. Valves shall be Kitz Type 800 Model 53F, Apollo Valves 76-100 series, or approved equal.
 - (b) Main piping isolation valves within the vault shall be butterfly valves (see Section 10.04.F2).
 - (c) All 3-inches and larger shall be supplied with hand wheel operators. All valves smaller than 3 inches shall be supplied with lever operators.
 - 2) Outside of the Vault:
 - (a) Isolation valves shall be provided on the inlet/outlet header to the PRS and shall be per the transmission main section. Buried valves shall be supplied with two 2-inch valve nut operator and key valve extensions, if required. Valves shall be provided with valve cans and covers per UDACS Plate 8 and thrust blocks provided per UDACS Plate 3.
 - (b) If the isolation valves are gate valves, they shall have ductile-iron body and conform to the requirements of ANSI/AWWA C-509 or C-515. In addition the gate valves shall meet the following requirements:
 - i) Wetted interior of all gate valves shall be epoxy coated conforming to the requirements of ANSI/AWWA C-550-01 and have fusion bonded

epoxy exterior coating conforming to the requirements of ANSI/AWWA C-116.

- ii) Valve ends shall be flanged conforming to the requirements of ANSI/AWWA C110.
- iii) Gate valves shall be per the COH Approved Materials List.
- d) Butterfly valves shall have ductile-iron body and conform to the requirements of ANSI/AWWA C-504.
 - Direct bury butterfly valves located on the inlet/outlet headers to the PRS shall have worm-gear operators and shall be per the transmission main section. Butterfly valves in vaults can have traveling nut operator. Valves shall be provided with valve cans and covers per UDACS Plate 8 and thrust blocks provided per UDACS Plate 3.
 - Wetted interior of valves shall be epoxy coated conforming to the requirements of ANSI/AWWA C-550-01 and have fusion bonded epoxy exterior coating conforming to the requirements of ANSI/AWWA C-116.
 - Valve ends shall be flanged conforming to the requirements of AWWA C504.
 - 4) Butterfly valves shall be Pratt 2FII, Dezurik Series BG2, or approved equal.
- e) Air Release and Vacuum Valves. AWWA Manual M51 provides common methodology in sizing air-release valves, air/vacuum valves, and combination air valves. For specific sizing of valves, the Engineer shall refer to manufacturers' charts, graphs and formulas and the methodologies presented in AWWA M51.
 - 1) Air release and vacuum valves shall be epoxy-coated and have stainless steel trim.
 - 2) Air release and vacuum valves shall be on the COH approved materials list.
- 3. Couplings: A restrained dismantling piece shall be used on pipe runs to facilitate the removal of valves for maintenance.
 - a) The dismantling joint shall be rated for a minimum 200 psi. The dismantling joint consists of a flanged coupling adapter and a flanged steel spigot in one assembly. The dismantling joint shall have a steel body and end ring made with steel having minimum yield strength of 30,000 psi.
 - b) The gasket shall be virgin nitrile butrile rubber (NBR).
 - c) The steel flanges shall meet the requirements of AWWA C207 Class D flange.
 - d) Bolts and nuts shall be Type 304 stainless steel. Tie rods shall be high tensile steel per ASTM A193 grade B7.

- e) Dismantling piece shall have fusion bonded epoxy coating. Dismantling joints shall be Smith-Blair Model 975, Romac Industries Model DJ400, or approved equal.
- f) A flexible coupling shall be located outside of the buried vaults to allow for any settling of the vault. The flexible coupling shall be on the COH approved materials list. The flexible coupling shall require a harness to restrain axial tension forces. The restrained coupling shall conform to AWWA M11 design. An example of a restrained coupling is shown in Figure 10.12.
- 4. Ventilation Fan: The fan shall be capable of supplying a minimum of six (6) room air changes per hour.
 - a) The fan shall operate on 120 volts AC, single-phase power and shall be a shaded pole motor-squirrel cage blower.
 - b) The fan shall be hard-wired in conduit to conduit box with motor per UL 400-1.
 - c) A wall-mounted thermostat and Hand/AUTO switch shall be provided on the control panel.
 - d) The proximity switch shall activate the fan when the hatch is opened.
 - e) Above grade exhaust and air piping shall be enclosed in an air valve can (seer Figure 10.9).
 - f) The fan manufacturer shall be Dayton, Greenheck, or approved equal.
- 5. Sump Pump: The sump pump shall be used to discharge any nuisance water accumulating in the vault and shall be sized to discharge a minimum 15 gallons per minute.
 - a) The pump discharge head shall be a function of the cumulative piping headloss and the elevation difference between the suction and the discharge elevation.
 - b) The cast-iron body sump pump shall be of fully submersible construction with UL listed submersible oil-filled motor, UL listed rubber power cord, thermal overload protection, and operate on 120 volts, single phase power.
 - c) The discharge shall be either to the curb or to the pressure relief splash pad (if a relief valve is incorporated into the pressure reducing station).
 - d) The pump shall be able to pass solids up to 1/2-inch diameter. A check valve shall be installed on the discharge header to prevent flow back into the vault.
 - e) The sump shall operate on a float operated, submersible mechanical switch integral to the pump.
 - f) Pump shall be Zoeller Model 53, Hydromatic, or approved equal.

- Pipe Supports: Galvanized pipe supports shall be provided on both sides of the pressure reducing and isolation valves, and as needed to support pipe. Pipe support shall be adjustable with carbon steel saddle. Neoprene pad shall be placed between pipe and saddle. See Figure 10.13 for the typical pipe support detail.
- 7. Cathodic Protection: Cathodic protection shall be provided for the factorybuilt steel capsule pressure reducing station as identified in Section 10.04.D unless a site-specific corrosivity study was performed and indicates otherwise. See Chapter 1 for field investigation requirements.
- 8. Pressure Measurement: Pressure measurement upstream and downstream of the pressure reducing valves shall be from a set of pressure gages at the pipeline and at the vault lid.
 - a) Standard bourdon-style pressure gages, 4 1/2-inch diameter face, Type 316 stainless steel construction, shall be provided on header upstream and downstream of the pressure reducing valves. Inlet pressure gage range shall be 0-200 psi, 20 psi figure intervals with graduating marks every 2 psi. Outlet pressure gage range shall be 0-100 psig with 5 psi figure intervals, with gradating marks every 0.5 psi. All gages shall have 1/2-inch NPT thread. The movement shall be rotary, of 400 Series stainless steel with Teflon coated pinion gear and segment. Pressure gages shall be specified with diaphragm seals and snubbers. Normal operating conditions shall be at the middle of the scale. Pressure gages shall be provided by Ashcroft Duragauge Plus Model 1279SSL, Omega Model PGH-45, or approved equal.
 - b) See Figures 10.14 and 10.16 for pressure gage configurations.
- G. Electrical Systems: The electrical system providing power to components of the pressure reducing station shall be designed by a qualified Electrical Engineer in the State of Nevada. All electrical work shall comply with the latest edition of NFPA-70 (NEC). Coordinate power requirements and meter pedestal with NV Energy. Provide an electrical service plan to COH.
 - 1. General Design Guidelines:
 - All circuit breakers shall be incorporated into a control panel. The electrical service provided for the PRS shall be 230V, 1 phase, 60 cycle, 3-wire.
 - b) There shall be provided at a minimum, thermal-magnetic trip circuit breakers as follows:
 - 1) Spare.
 - 2) Lights.
 - 3) Convenience Outlets.

- 4) Exhaust Fan.
- 5) Sump Pump.
- c) Raceways shall be installed using rigid steel conduit, flexible liquid tight conduit, plastic-coated rigid steel conduit, and/or Schedule 40 PVC solvent weld pipe. Conduits shall be moisture-proof. Minimum conduit size shall be 3/4-inch or sized to handle the type, number and size of equipment conductors to be carried in compliance with in compliance with Article 347 of the National Electrical Code and NEMA TC-2, Federal WC-1094A and UL-651 Underwriters Laboratory Specifications.
 - Where flexible conduit connections are necessary, the conduit used shall be liquid-tight, flexible, totally nonmetallic, corrosion resistant, nonconductive, U.L. listed conduit sized to handle the type, number and size of equipment conductors to be carried - in compliance with Article 351 of the National Electrical Code.
- d) All junction boxes shall be NEMA 4 rated. Boxes shall be standard one-piece units, galvanized or cast metal, or shape and size best suited to that particular location, of sufficient size to contain enclosed wires without crowding.
- e) All electrical devices in the vault shall be rated NEMA 4 unless otherwise noted. All control and accessory wiring shall be sized for load, type MTW/AWM (Machine tool wire/appliance wiring material) as set forth in Article 310 and 670 of the National Electrical Code, Schedule 310-13 and NFPA Standard 79 for flame retardant, moisture, heat and oil resistant thermoplastic, copper conductors in compliance with NTMA and as listed by Underwriters Laboratories (AWM), except where accessories are furnished with a manufacturer supplied UL approved rubber cord and plug.
- f) All signal conductors shall be #14TPSH. No conductors, conduits, fixtures, devices, etc., shall be attached to the vault hatch.
- g) Nameplates shall be provided on each electrical panel, motor starter, and control device. Underground, non-metallic, utility marking tape shall also be provided.
- h) All service entrance, power distribution, control and starting equipment panels shall be constructed and installed in strict accordance with Underwriters Laboratories (UL) Standard 508 "Industrial Control Equipment." The UL label shall also include an SE "Service Entrance" rating stating that the main distribution panel is suitable for use as service entrance equipment. The panels shall be shop inspected by UL, or constructed in a UL recognized facility. All panels shall bear a serialized UL label indicating acceptance under

Standard 508 and under Enclosed Industrial Control Panel or Service Equipment Panel.

- i) All electrical equipment items in the station shall be properly grounded per Section 250 of the National Electrical Code. Items to be grounded include, but are not limited to, control panel, convenience receptacles, dedicated receptacle for sump pump, lights, light switch, and exhaust fans. All ground wires from installed equipment shall be in conduit and shall lead back to the control panel to a plated aluminum ground buss specific for grounding purposes and so labeled. The ground bus shall be complete with a lug large enough to accept the installing electrician's bare copper earth ground wire. The bus shall serve as a bond between the earth ground and the equipment ground wires.
- j) Pull boxes shall be identified with COH marking.
- 2. Outlet/Plug: A minimum of three (3) duplex, ground fault circuit interrupter type receptacles shall be furnished about the periphery of the vault interior, with one (1) receptacle adjacent to the main control panel. One (1) receptacle, three-wire grounded type, shall be installed and dedicated solely to sump pump service only. Ground fault interrupter shall be UL approved. Electrical box shall be Cantex Type FSE, Loyola Model I-ICE, or approved equal.
- H. Instrumentation & Control:
 - 1. Lighting: The proximity switch shall turn on the lights when the hatch is opened. If a manhole opening is used, the proximity switch shall be mounted on the manhole riser no more than 10 inches from the manhole cover.
 - 2. Ventilation/Fan: The proximity switch shall activate the exhaust fan when the hatch is opened. If a manhole opening is used, the proximity switch shall be mounted on the manhole riser no more than 10 inches from the manhole cover.
 - 3. Sump Pump: The sump pump shall operate on the level switch integral to the sump pump.

10.05 Design Checklist

A. A checklist is provided at the end of this chapter for the Engineer's reference and use during design and may not include all applicable design criteria. It is the Engineer's responsibility to review and comply with all guidelines contained herein and all applicable codes completely prior to submitting for review.

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DEPARTMENT OF UTILITY SERVICES

TECHNICAL SERVICES DIVISION NEW DEVELOPMENT SECTION

CITY OF HENDERSON 240 WATER STREET HENDERSON, NEVADA 89015

UTILITY SERVICES

Pressure Reducing Systems Review Checklist

Design Concept Phase

- □ PRS identification numbers
- Locations
- □ Site plan and grading
- Site description
- ROW, easement, ownership
- Hydraulic analysis
- Preliminary PRS sizing
- Underground vault
- □ Site-built station or factory-built station

Preliminary Design

Pre-design memorandum

- Project background
- Draft geotechnical investigation report
- Draft environmental investigation report
- Preliminary plans and section
- Pressure reducing valve sizing and calculations
- □ Identifications of appurtenant facilities and spacing criteria
- □ Identifications of permanent and temporary ROW/easement constraints

- □ Instrumentation
- □ Preliminary cost estimate
- □ Stand-alone project
- □ Preliminary construction schedule
- □ Field Investigations

Hydraulics

- Design criteria
- Calculations
- Preliminary site selection
- □ Site description
- □ Site layout
- □ ROW or easement acquisition
- Preliminary PRS layout
- Mechanical layout
- Valves
- Pipe material
- Ventilation
- Access
- □ Pressure measurement

Final Design Phase

Site civil

- □ Yard piping
- □ Site security
- Grading

Mechanical layout

Site-built below grade PRS

- □ Vault interior piping
- □ Vault and vault access

- Height
- □ Pipe penetrations
- **Coatings**
- Drainage
- U Ventilation piping
- Lighting
- Ladders
- Factory-built below grade PRS
- Pre-cast vault
- □ Steel capsule vault

Above grade PRS

- □ Site security
- □ Structure
- Structural design

Mechanical layout

- Mechanical
- COH standards
- Type of valves
- **Couplings**
- Ventilation fans
- **G** Sump pump
- Pipe supports
- Cathodic protection
- Pressure measurement

Electrical systems

- General design guidelines
- Outlet/Plug

Instrumentation and Control

- Lighting
- August 2010

Uentilation/fan

Gamma Sump Pump





EQUIPMENT SCHEDULE

(1)	PRECAST CONCRETE VAULT
2-	DRAIN, SEE FIGURE 10.4
3	SUMP PUMP FORCE MAIN
	VENT, SEE FIGURE 10.10
(5)	8" CML & EPOXY COATED STEEL TEE W/3" OUTLET
6)-	8"x8"x4" CML & EPOXY COATED STEEL TEE
(7)	8" BUTTERFLY VALVE W/ HANDWHEEL
(8)-	8" DISMANTLING COUPLING
(9)	4'-0"x 4'-0" ACCESS HATCH
(10)-	4" CML & TAPE COATED SCHED 40 STEEL PIPE
	8" PRESSURE REDUCING VALVE
(12)-	4" BUTTERFLY VALVE W/ HANDWHEEL
(13)	4" PRESSURE REDUCING VALVE
(14)-	4" DISMANTLING COUPLING
(15)	WALL INSERT, SEE FIGURE 10.8
(16)-	6" SCHED 80 PVC PIPE AND FITTINGS
<u></u>	DEEP, W/ CAST IRON GRATE
_(18)-	PVC PIPE WALL PENETRATION, SEE FIGURE 10.6
(19)	STEEL PIPE WALL PENETRATION, SEE FIGURE 10.7
(20)-	4" CMC & EPOXY LINED SCHED 40 STEEL PIPE
(21)	2'-0" OD x 4'-0" HIGH STEEL COVER, SEE UDACS PLATE 37
(22)-	MIN 6" THICK, 3/4" CRUSHED ROCK BACKFILL
(23)	INSULATING FLANGE KIT IF CONNECTING TO
(24)-	SUMP PUMP
25—	VAULT CEILING INSERT AND EYEBOLT, SEE FIGURE 10.5
26-	UNDER PIPE SUPPORT, SEE FIGURE 10.13
27)	PRESSURE GAGE, SEE FIGURE 10.14
	PRESSURE RELIEF PIPING AND SPLASH PAD
29	INLET/OUTLET HEADER (BY OTHERS)
_30-	4" ANGLE PRESSURE RELIEF VALVE
(31)	THRUST BLOCK, SEE FIGURE 10.9
_(32)-	GALVANIZED STEEL LADDER, SEE FIGURE 10.11
33—	· 1/4" COPPER TUBING & PRESSURE GAGE, SEE FIGURE 10.16
_(34)-	VENTILATION FAN
(35)	LIGHT FIXTURE
36–	CONTROL PANEL
37—	CATHODIC TEST STATION (IF STEEL CAPSULE)
NOT	ES:

- 1. THIS IS AN EXAMPLE OF A PRESSURE REDUCING STATION. OTHER PIPING CONFIGURATIONS ARE POSSIBLE.
- 2. ONLY MAJOR PIPING ITEMS ARE ANNOTATED. ELECTRICAL CONDUITS AND WIRING NOT SHOWN.
- 3. PETROLATUM TAPE COATING PER AWWA C217 WITH 3/4" CEMENT MORTAR COATING (ROCK SHIELD) FOR FOR BURIED STEEL PIPING.
- 4. BUTTERFLY VALVES SHALL BE INSTALLED ON INLET AND OUTLET HEADERS FOR STATION ISOLATION.

V ES ES	EXAMPLE PRV PLAN	scale NO SCALE		
		NO.	REV.	
		FIGURE 10.2	0	



EQUIPMENT SCHEDULE

1	PRECAST CONCRETE VAULT
_(2)-	DRAIN, SEE FIGURE 10.4
(3)	SUMP PUMP FORCE MAIN
(4)-	VENI, SEE FIGURE 10.10
	A CML & EPOXY COATED STEEL TEE W/3 OUTLET
	8 X8 X4 GML & EPOXY COATED STEEL TEE
	8" DISMANTLING COUPLING
<u>_</u>	4'-0"x 4'-0" ACCESS HATCH
(10)-	4" CML & TAPE COATED SCHED 40 STEEL PIPE
(11)	8" PRESSURE REDUCING VALVE
	4" BUTTERFLY VALVE W/ HANDWHEEL
(13)	4" PRESSURE REDUCING VALVE
(14)-	4" DISMANTLING COUPLING
(15)	WALL INSERT, SEE FIGURE 10.8
(16)-	6" SCHED 80 PVC PIPE AND FITTINGS
(17)	DEEP, W/ CAST IRON GRATE
	PVC PIPE WALL PENETRATION, SEE FIGURE 10.6
(19)	STEEL PIPE WALL PENETRATION, SEE FIGURE 10.7
(20)-	4" CMC & EPOXY LINED SCHED 40 STEEL PIPE
(21)	2'-0" OD x 4'-0" HIGH STEEL COVER, SEE UDACS PLATE 37
(22)-	MIN 6" THICK, 3/4" CRUSHED ROCK BACKFILL
23) 60	INSULATING FLANGE KIT IF CONNECTING TO METALLIC PIPE
(24)	VALUET CELLING INSERT AND EVEROLET SEE EIGURE 10.5
60-	UNDER PIPE SUPPORT SEE FIGURE 10.13
27)	PRESSURE GAGE. SEE FIGURE 10.14
28-	PRESSURE RELIEF PIPING AND SPLASH PAD
(29)	INLET/OUTLET HEADER (BY OTHERS)
(30)-	4" ANGLE PRESSURE RELIEF VALVE
31-	THRUST BLOCK, SEE FIGURE 10.9
32–	GALVANIZED STEEL LADDER, SEE FIGURE 10.11
33—	1/4" COPPER TUBING & PRESSURE GAGE,
(34)-	VENTILATION FAN
(35)	LIGHT FIXTURE
(36)-	CONTROL PANEL
37)	CATHODIC TEST STATION (IF STEEL CAPSULE)
NOT	ES:
1. SUN	MP PUMP SHOWN OUT OF SECTION FOR CLARITY

1) /		scale NO SCALE	
	EXAMPLE PRV	NO.	REV.
ES	SECTIONS	FIGURE 10.3	0





		2"		PACK ANNULA W/ NON-SHRIN	PVC PIPE R SPACE	
SECTION						
REVISIONS	DWN APVF		DATE			
DESIGNED PBS&J DRAWN PBS&J CHECKED COH APPROVED APPROVED DATE 03-12		HENDE UTILITY STANDA	ERSON, NV GUIDELINES ARD PLATES	PVC PIPE WALL PENETRATION	scale NO SCALE no. rev. FIGURE 10.6 0	


1 1/2" SCHED 40 PVC CPLG (THREAD X SOCKET) 1 1/2" SCHED 40 PVC THREADED PLUG (TYP OF 2) OUTSIDE VAULT 1 1/2" SCHED 40 PVC PIPE		
<u>NOTE:</u> TO BE USED ONLY FOR ELECTRICAL AND CONTROL WIRING.		
REVISIONS DWN APVD APVD DESIGNED PBS&J DRAWN PBS&J CHECKED COH APPROVED HENDERSON, NV APPROVED STANDARD DATE 03-12-10	WALL INSERT	scale NO SCALE no. rev. FIGURE 10.8 O

















CHAPTER 11 LARGE METER VAULTS (3 INCHES AND LARGER)

11.01 General

- A. Large Meter Vaults (LMV) Definition: A large meter vault (LMV) is used to house one or more water meters 3 inch and larger that measure the volume of water passing through a controlled point. The meters shall automatically record the volume of water passing through the piping in the vault.
- B. Type of Large Meter Vaults: The site-built LMV and the factory-built LMV are the two types allowed within the COH. Each type is discussed below:
 - 1. Site-built LMV. The site-built LMV is below-grade in a pre-cast or cast-in-place vault, built with individual components.
 - 2. Factory-built LMV. The factory-built LMV is a below-grade LMV delivered to the job-site with the interior piping and appurtenances completely assembled within a pre-cast vault or steel capsule. The factory-built LMV shall be placed into a prepared excavation with minimal connections to the exterior pipelines.
- C. Location of Large Meter Vaults: The LMV shall be located within the street rightof-way (ROW) or within an existing and /or additional municipal utility easement (MUE). The COH preference is for the LMV to be placed behind the sidewalk or curb and gutter if there is no sidewalk. LMVs located within the unpaved or paved surface of the roadway will require prior COH approval.

11.02 Design Concept Phase

- A. General: A Design Concept Memorandum (DCM) shall be submitted to and approved by the COH. As a minimum the report shall address the following:
 - 1. Location of the large metering vault (site map, assessor's parcel number, etc.).
 - 2. Siting Analysis.
 - 3. Site Description.
 - 4. ROW's, easements, ownership, etc.
 - 5. Preliminary Water Meter Size(s).
 - 6. Discussion of water meter demands and preliminary size.
 - 7. Stand-alone or integrated into site improvement plans.

- 8. Site-built station or factory-built vault.
- B. The purpose of the DCM is to provide the Engineer and the COH with a general overall perspective of purpose and need for the LMV. Without an approved DCM, the Pre-Design Memorandum will not be accepted.

11.03 Pre-Design Phase

- A. General: The pre-design phase of the project shall be summarized and presented in a Pre-Design Report (PDR). The report will be submitted to the COH for review and acceptance. The PDR is the basis for the ensuing design process and must be presented in a fashion which allows the reader to gain a thorough and complete understanding of the necessity of the project. Without an approved PDR, the Engineer may not receive COH approval to proceed to the final design.
- B. The Pre-Design Memorandum shall include, but not be limited to:
 - 1. Project background.
 - 2. Draft Geotechnical Investigation Report.
 - 3. Draft Environmental Investigation Report.
 - 4. Preliminary plans and section (30 percent design drawings) illustrating the proposed:
 - a) Site plan and improvements.
 - b) Vault mechanical plan and sections.
 - c) Proposed elevations or details.
 - d) Property ownership info, rights-of-way/easements, existing utilities, etc.
 - e) Proposed power locations and connections.
 - 5. Recommendations for connections to the existing system.
 - 6. Water meter type and size.
 - 7. Identifications of appurtenant facilities and spacing criteria.
 - 8. Identification of any permanent and temporary ROW/easement constraints and acquisition needs.
 - 9. List of relevant reports, plans and maps reviewed and other relevant project information.
 - 10. Preliminary cost estimate.

- 11. In addition, if the large meter vault is to be a stand-alone project (not associated with developer plans), then the following items should also be addressed in the pre-design memorandum:
 - a) Preliminary construction schedule.
 - b) Work plan for how construction is to be accomplished if connecting into existing facilities (phasing, shutdowns, etc.).
- C. Field Investigations (see Chapter 1).
- D. Hydraulics: Prior to the submittal of any potable or reclaimed water drawings that include a LMV, a hydraulic analysis shall be submitted to COH for approval. The analysis will include project demands, including fire flow if required, sizing of meters and valves, sizing of piping, and system headlosses based on the design criteria. The hydraulic analysis shall be per UDACS 2.03, latest edition.
 - Design Criteria. Selection of water meter size is based on a thorough understanding of customer water demands. An oversized meter may not accurately register low flows whereas an undersized meter may result in poor service to the customer and higher maintenance costs. Water meter sizing guidance is provided in AWWA M22 – Sizing Water Service Lines and Meters, latest edition.
 - a) The minimum meter size shall meet the instantaneous peak hour demand and the requirements in UDACS 2.15.01. Any irrigation water demands shall be included in determining the instantaneous peak hour demand as well as seasonality considerations. Although there is no maximum velocity stated for non-fire flows, a flow velocity between 5 and 8 feet per second at peak design flow is generally acceptable.
 - b) Fire flow meters shall be sized to meet the fire flow requirements of the City of Henderson Fire Department. Under design fire flow conditions, the pipeline shall be sized such that the maximum velocity is less than 20 feet per second per UDACS 2.02.02. The minimum fire flow pressure shall be 20 psi on the customer's side of the meter in a maximum day plus fire flow condition per UDACS 2.02.02.
 - 2. Calculations: The design engineer shall provide calculations to COH for review and approval. The calculations shall support the design of the LMV components. At minimum, the calculations should include:
 - a) Water Meter Sizing: Design calculations shall be provided that size the meter for instantaneous peak hour demand, pipe sizing, and design pressure after the meter.
 - b) Vault buoyancy: The design engineer shall assume groundwater exists to the ground surface for all prepared buoyancy calculations unless approved by COH based on findings of the geotechnical

investigation. Vault buoyancy shall be designed with a 1.25 factor of safety.

- E. Preliminary Site Selection: Site selection should be based on providing:
 - 1. Site Description: Engineer shall provide general site description indicating location of the large meter vault, the surrounding area land use, existing facilities including utilities, project boundaries, and purpose of the water meter.
 - 2. Site Layout: To provide access for maintenance around the LMV, a minimum of ten (10) feet of clearance outside of the buried piping shall be required (See Figure 11.1). A minimum of five (5) feet clearance is required between the LMV easement and the vault walls.
 - 3. ROW or Easement Acquisition: If the LMV, with associated required spacing surrounding the vault, extends outside of the existing right-of-way, a municipal utility easement (MUE) shall be provided for those portions outside of the right-of-way.
- F. Preliminary LMV Layout: The following section addresses interior design of the large meter vault so that a preliminary design can be presented to the COH for approval.
 - 1. Mechanical Layout. The layout of the LMV shall address general vault dimensions, including length and arrangement of LMV piping, and location of the meter and valves. The size of the vault will be determined by the main piping size, the meter sizes, valve sizes, and required clearances. In addition, the layout of the mechanical equipment within the vault should be designed with consideration to allow room for operators to enter, access, and maintain the equipment.
 - a) Water Meter and Valves:
 - 1) Water Meters. The water meter (3 inches and larger) shall be supplied by the Contractor. The meter shall be meet the requirements of AWWA C701, C702, C703, and C712 and be on the COH Approved Materials List.
 - 2) All water meters shall be equipped with encoder type, remoteregistration system per AWWA C707. The system shall consist of a meter register and an electronic data-storage module so that visual numerical reading of the water meter can be obtained from the register and semi-automatically at a location remote from the meter. Display shall show measurement in cubic feet. A single supplier shall supply the water meter and the encoder type, remote-registration system.

- 3) Isolation Valves: Isolation valves shall be provided within the vault on either side of the water meter.
- 2. Test Ports: A 2-inch minimum diameter test port shall be provided downstream of the water meter, but upstream of the last isolation valve within the vault.
- 3. By-Pass Piping: A tee with by-pass valve shall be provided on both sides of the main meter between the isolation valves and the vault wall. The by-pass valve shall have a blind flange. The by-pass shall not be hard-piped between the by-pass valves.
- 4. Pipe Material: The pipe material within the LMV shall be fusion bonded epoxy lined and epoxy coated welded steel pipe.
- 5. Expandability: The LMV shall be designed so that the main pipe diameter is the same as the largest water meter.
- 6. Ventilation: Ventilation shall be provided for the large meter vaults. The ventilation piping shall consist of passive vents and an exhaust fan. The vents shall be located at opposite sides of the vault one at high elevation and the other at a lower elevation. The minimum size of the ventilation piping shall be 6 inches. The exhaust fan/blower shall be capable of providing a minimum six (6) room air changes per hour.
- 7. Access: Vault access is dependent on the location of the LMV. An aluminum or galvanized steel ladder shall be provided at the access.
 - a) If the underground vault is located in an area with low potential for traffic and/or within a sidewalk, the access shall be through an aluminum, H20 occasional load-rated, single-leaf hatch. The minimum size for the single-hatch shall be 42-inches by 42-inches and large enough to remove the largest piece of equipment. The access lid should be centered over the meter.
 - b) If the underground vault is located within the unpaved or paved surface of a roadway, the access shall be through a full traffic H20 rated hatch. Underground vaults within unpaved or paved surface of a roadway shall require prior approval by COH.

11.04 Final Design Phase

A. General: The final design shall contain all the information necessary for the Contractor to construct the LMV in accordance with COH guidelines. This section provides guidance on the final design criteria for the LMV's.

- B. Site Civil: The site civil shall include control points or clearly defined dimensions/bearings from existing/proposed permanent improvements to locate the large meter vault structure and easements. The site civil information shall include retaining wall information (location, top of wall, bottom of wall), if necessary. All elevations necessary for setting top of structure shall be provided for corners of vaults and hatches, within the proposed easement. All facilities shall be included within the easement with set-backs as noted in Section 11.03.B. See Figure 11.1 for typical site plan.
 - 1. Yard Piping: Yard piping pertains to the buried piping a minimum of one (1) foot outside of the LMV. Refer to the Transmission Piping Chapter for the buried piping to the LMV. The one-foot segment shall end with a ANSI/AWWA C207 Class D flange with an insulating flange kit. All buried pipe sections shall be wrapped with a three-layer petrolatum wax tape coating system per AWWA C217.
 - a) Three layer petrolatum wax tape coating:
 - Primer: All surfaces shall be prime coated with a blend of petrolatum, plasticizer, inert fillers, and corrosion inhibitors having a paste-like consistency. Minimum primer thickness shall be 3 mils.
 - 2) Wax Tape: Covering material shall be a synthetic felt tape, saturated with a blend of petrolatum, plasticizers, and corrosion inhibitors that is formable over irregular surfaces.
 - Plastic Outer Wrap: The primed and wax taped surface shall be covered with a plastic outer wrap consisting of three layers of 150-gauge (1.5 mil) polyvinylidene chloride or PVC, high cling membrane wound together.
 - 4) Minimum wax tape coating thickness shall be per manufacturer's recommendation, but shall not be less than 40 mils.
 - 5) A 3/4-inch cement mortar coating (rock shield) reinforced with welded wire fabric conforming to the requirements of AWWA C205 shall be applied around the wax-tape coating for protection.
 - b) Insulating Flange Kit:
 - Gaskets: ANSI B-16.21, Type E, NEMA G10 glass with a rectangular o-ring seal for operation between 20 degrees Fahrenheit and 150 degrees Fahrenheit. Gaskets shall be suitable for the temperature and pressure rating of the piping system in which they are installed.
 - Insulating Sleeves: 1/32-inch thick tube, full length, G10 glass material per NEMA LI-1 for operation between 20 degrees Fahrenheit and 150 degrees Fahrenheit. For installation at threaded valve flanges, half-length sleeves shall be used.

- Insulating Washers: 1/8-inch thick, G10 glass per NEMA LI-1 for operation between 20 degrees Fahrenheit and 150 degrees Fahrenheit.
- 4) Steel Washers: 1/8-inch cadmium plated steel placed between the nut and insulating washer.
- 5) All buried insulating flanges and buried non-coated metallic pipe and specials shall be wax tape coated per AWWA C217. See Section 11.04B.1.a above below for wax tape installation.
- 2. Site Security: For underground vaults, hatches shall have plug with hatch key.
- 3. Grading: Grading for LMV located behind the curb shall be graded to drain away from the hatch entrance.
 - a) The vault lid shall be level. If a retaining wall is required to maintain the vault lid level, then retaining walls shall be located a minimum of ten (10) feet clear of the vault lid.
 - b) Retaining walls shall be per Southern Nevada Building Officials Regional Standard Detail Drawing B-101 for retaining walls less than 4-feet high. If wall height is higher, wall shall be designed in accordance with the Uniform Standard Specifications for Public Works Construction, Clark County Area Improvements, latest edition. All structural calculations and design shall be signed and stamped by a Registered Engineer in the State of Nevada.
 - c) The access to the underground LMV shall not be located in the low spot of the surrounding area. The LMV hatch shall be flush with the adjacent grading. No concrete curbs to raise the hatch shall be allowed.
- 4. Mechanical Layout: In determining the vault size, the following minimum clearances shall be observed:
 - a) 12-inches clear distance between wall and first flange.
 - b) A minimum of 24-inches clear distance between wall and centerline of pipe for pipe sizes 16 inches and smaller and a minimum 36inches clear distance for pipe sizes 18 inches and larger. A minimum of 48-inches clear distance between wall with ladder and centerline of pipe.
 - c) Between 20 and 30 inches of clearance shall be between floor and centerline of pipe.
 - d) Any deviations from the above clearances shall require approval from COH.
 - e) NEC clearances shall be maintained at all times.
- C. Site-Built LMVs:

- 1. Vault Interior Piping: Typical vault mechanical plan and section views may be found in Figures 11.2 and 11.3.
 - The piping within the vault walls shall be steel pipe that meets the requirements of ASTM A53 Grade B with minimum steel yield strength of 35,000 psi and shall be sized conforming to ASME/ANSI B36.10.
 - Minimum wall thickness for pipe diameters 24 inches and smaller shall be 0.25 inches. (To be confirmed with the Transmission Main section).
 - Minimum wall thickness for pipe diameters greater than 24 inches shall be 0.375 inches. (To be confirmed with the Transmission Main section).
 - b) Steel piping within the vault shall be welded per ANSI/AWWA C206. The steel pipe shall have fusion bonded epoxy lining meeting the requirements of AWWA C213. The minimum lining thickness shall be 16 mils dry film thickness (DFT). The epoxy powder coating shall be Valspar, Inc., Pipe Clad® 1500 Red; 3M Scotchkote 134; or approved equal.
 - c) The exterior steel pipe coating shall be an amide-cured epoxy system, Tnemec 69 Hi-Build Epoxoline II, PPG Amercoat 133, or approved equal. Piping color shall be Voyager Sky or approved by COH prior to application. Primer shall be per manufacturer's recommendations.
 - d) Steel flanges shall conform to the requirements of ANSI/AWWA C-207. Flanges shall be Class D.
 - e) Drain outlets shall be provided on the inlet/outlet piping to facilitate draining the pipeline for meter and valve maintenance and repair. The outlet shall be located between the meter isolation valves. Drain detail is found in Figure 11.4
- 2. Vault: The site-built LMV shall have either a pre-cast vault or a cast-in-place vault.
 - a) Lifting eyelets shall be provided in the vault ceiling to facilitate the removal of isolation valves and the bonnets of the meters when the hatch opening is not directly overhead. See Figure 11.5 for lifting eye detail.
 - b) Pre-Cast Vault: The pre-cast vault shall meet the requirements of ASTM C-858 for Pre-Cast Structures. The minimum 28-day compressive strength of the concrete shall be 3,500 psi and the concrete shall be Type V. The vault shall be designed with the following load requirements:
 - 1) Dead loads attributable to the weight of the backfill shall be included using compacted soil weight determined by the

geotechnical investigation. Lateral soil pressure shall be considered in the design. Groundwater loadings shall also be considered.

- 2) Live loads caused by standard highway loadings (HS-20) shall be computed in accordance with AASHTO. Structural calculations shall be submitted with the shop drawings for the pre-cast vault by the vault manufacturer.
- 3) The structural calculations shall specify wall thickness, foundation thickness, top slab thickness, reinforcement for all walls, foundation, top slab, and around openings, including rebar lap lengths. The structural design shall also indicate location of joints, recommended waterstops and sealants, concrete strength and design, and buoyancy calculations.
- 4) All structural calculations and design shall be signed and stamped by a Registered Engineer in the State of Nevada.
- c) Cast-in-Place Vault (Case-by-case basis): The cast-in-place vault shall be either designed by a Registered Engineer or shall meet the requirements of UDACS Drawing C-475, unless noted herein.
 - Designed by Registered Engineer. Reinforced concrete vaults shall be designed for both strength and serviceability. The ultimate strength design method and the working stress method (alternative design method) are acceptable for reinforced concrete design. The minimum 28-day compressive strength of the concrete shall be 3,500 psi and the concrete shall be Type V. Design of cast-in-place vault shall meet all requirements of the Uniform Standard Specifications for Public Works Construction, Clark County Area, Nevada, latest edition.
 - 2) Structural calculations shall be submitted with the design drawings during the review process. The structural calculations shall specify wall thickness, foundation thickness, top slab thickness, reinforcement of all walls, foundation, top slab, and around openings, including rebar lap lengths. All structural calculations and design shall be signed and stamped by a Registered Engineer in the State of Nevada.
 - 3) The cast-in-place vault design shall conform to meet the requirements of UDACS Drawing C-475 unless specifically addressed herein. For example, the vault shall be sized large enough to meet the spacing requirements stated herein and dimensions supersede vault sizing in Table 1 of Drawing C-475.
- 3. Vault Access:
 - a) All vaults, regardless of location, are considered to be permitted confined space entry. A clearly visible caution sign indicating

permitted confined space entry shall be posted on the underside of vault lid or on the manhole riser.

- b) The meter serial number and the register serial number(s) shall be etched on brass tags and affixed to the vault lid. The register number tags shall be located next to each register reader. COH shall supply the brass tags.
- c) As discussed in Section 11.03.F.7, access is dependent on vault location. Discussed below are the access options.
 - 1) Vault with Low Potential for Traffic Loads: A rectangular roof hatch shall be provided for access into the vault.
 - (a) The minimum size of the single-leaf hatch shall be 42 inches by 42 inches and large enough to remove the largest piece of equipment. The hatch shall be located above the meter and ladder shall be located at hatch opening.
 - (b) Hatches shall be aluminum with 1/4-inch diamond pattern plate designed to withstand an occasional live load of H20 rating.
 - (c) Channel frame shall be 1/4-inch steel with an anchor flange around the perimeter.
 - (d) Leaf shall be equipped with heavy stainless steel hinges, stainless steel pins, spring operators or piston-cylinder assembly for easy operation, and an automatic hold open arm with red vinyl grip release handle. When the door leaf is in the raised position, the hold open arm will engage a lock open device to prevent accidental closing of the door leaf. The hatches shall be lockable with internal latch and use a hatch key and special socket to open.
 - (e) A 1 1/2-inch drainage coupling shall be located in the front right corner of the channel frame. Hardware shall be 304 stainless steel. Aluminum in contact with other metal or concrete shall be shop-painted with 1 coat of zinc chromate and 2 coats of approved aluminum metal-andmasonry paint. Drains shall discharge away from the vault.
 - (f) Hatches shall be Bilco JAL-H20, USF TH, or approved equal. A COH standard locking hatch, shown on Figure 3.7 (in Reservoir section), shall be used.
 - (g) The access hatch shall be positioned such that the clear opening parallels the street.
 - Vault in Traveled Roadway. The hatch provided shall be the same as in a) above, except that the hatch shall be designed to withstand a constant traffic rated H20-loading.
- 4. Height: The minimum interior vault height shall be 7 feet 0 inches for precast vault or steel capsule. If cast-in-place vault is provided per UDCAS Drawing C-475, the vault height shall be as noted in C-475.

- 5. Pipe Penetrations: Pipe penetrations through wall openings shall be sealed to prevent moisture from entering into the vault and to provide for some movement of the vault. Pipe penetration sealants for polyvinyl chloride piping, i.e., vent pipe, shall be with non-shrink grout (see Figure 11.6). Steel pipe penetration sealant shall be modular, mechanical type sealant consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall openings (see Figure 11.7). The pre-cast or the cast-in-place vault wall openings shall be sufficiently large enough to accommodate the type of sealant specified.
 - a) The steel pipe penetration mechanical type sealant shall be a modular pipe penetration seal product PSI Link-Seal, APS Innerlynx, or an approved equal.
 - b) Upon installation of the mechanical type sealant per manufacturer's instructions, the remaining annular space shall not be filled with grout and plastered.
 - c) Another allowable penetration is the wall insert (see Figure 11.8) for electrical and control wiring.
- 6. Coatings:
 - a) Vault Interior: The vault interior shall be protected with either a polyurethane, epoxy, or fiber-reinforced epoxy protective coating system.
 - 1) Polyurethane system: A polyurethane protective coating system for concrete which uses a high adhesion and moisture tolerant epoxy base coat and a high build polyurethane elastomer top coat is acceptable for coating the vault interior. The application of the polyurethane must take place before the epoxy becomes tack-free. The thickness of the epoxy coat shall be a between 1 and 3 mils and the polyurethane coating shall be between 60 and 125 mils depending on the surface profile. The surface preparation shall be per manufacturer's recommendations. The interior coating shall be Sancon 100, Tnemec Elastoshield 264, or approved equal. The color of the interior of the vault shall be "Off-white".
 - Epoxy System: A 100 percent solids, ultra high-build epoxy system is acceptable for coating the vault interior. The system shall have the following characteristics:
 - (a) Product type: amine-cured epoxy.
 - (b) VOC Content per ASTM D2584: 0 percent.
 - (c) Minimum Compressive Strength per ASTM D695: 18,000 psi.
 - (d) Minimum Tensile Strength per ASTM D638) 7,500 psi.
 - (e) Minimum Flexural Modulus per ASTM D790: 13,000 psi.

- (f) The sprayed coating shall have a minimum wet film thickness of between 60 and 125 mils. The color shall be off-white or light blue. The surface preparation shall be per manufacturer's recommendations. The coating shall be RLS Raven 405, Polycoat Industries, Inc. Polycoat 133, or approved equal.
- 3) Fiber-Reinforced Epoxy System. A spray-applied fiber-filled material specially formulated for corrosive protection of concrete and steel. The system shall have the following characteristics.
 - (a) Minimum Compressive Strength per ASTM C579: 6,800 psi.
 - (b) Minimum tensile strength per ASTM C307: 2,500 psi.
 - (c) Minimum flextural strength per ASTM C580: 4,600 psi.
 - (d) The coating shall have a minimum dry film thickness of 60 mils. The surface preparation shall be per manufacturer's recommendations. The coating shall be Saurereisen SewerGuard 210S, Tnemec Perma-Shield 436, or approved equal.
- b) Vault Exterior: The vault exterior coating shall be a waterproofing material suitable for coating concrete. It shall be a cementitious coating of a blend of Portland cement, fine treated silica sand, and active proprietary chemicals. When the product is mixed with water and applied, the active chemicals cause a catalytic reaction which generates a non-soluble crystalline formation of dendritic fibers within the pores and capillary tracts of concrete. The process causes the concrete to become permanently sealed against the penetration of liquids. The coating system shall be Xypex Chemical Corporation Xypex, ICS Penetron International Peneplug, or approved equal.
 - 1) The manufacturer shall provide a one-year warranty for the product from date of final acceptance.
 - 2) The waterproofing applicator shall be experienced in the installation of cementitious crystalline waterproofing materials as demonstrated by previous successful installations, and shall be approved by the manufacturer in writing. The applicator shall provide warranty that, upon completion of the work, surfaces treated with cementitious crystalline waterproofing will be and will remain free from water leakage resulting from defective workmanship or materials for a period of one year from date of final acceptance.
 - 3) Coating shall be applied per manufacturer's instructions.
- 7. Drainage: The vault shall be provided with a floor sump and sump pump to remove nuisance. The floor of the underground vault shall be sloped a minimum two (2) percent grade to a 1 foot by 1 foot by 1 foot floor sump covered with reinforced fiberglass grating. The reinforced fiberglass grating

shall be capable of supporting a minimum loading of 250 pounds per square foot. Grating size shall be a maximum 1-1/2 inch square and can be either from a molded or protruded process. The grating manufacturer shall be Fibergrate, Century Composites, LLC, or approved equal.

- a) The sump pump (discussed in the mechanical section) shall discharge to the curb and gutter through a curb outlet or to the splash pad drain (see Figures 11.2 and 11.9)
- 8. Ventilation Piping: Ventilation shall be provided by two 6-inch vents and an exhaust fan (see Section 11.03.F.6). The buried ventilation piping from the vault shall be Schedule 80 polyvinyl chloride (PVC) pipe manufactured in accordance to the requirements of ASTM D-1785. The polyvinyl chloride used in the manufacture of the pipe shall be domestically produced rigid PVC compound, Type I Grade I, with a Cell Classification of 12454 as defined in ASTM D1784. The above-grade ventilation piping shall be enclosed in a steel cover as shown in Figure 11.9.
- 9. Lighting: There shall be one or more two-tube, 32 watt per tube, electronic start, enclosed and gasketed, forty-eight (48) inch minimum length fluorescent light fixtures installed within the underground vault. One (1) light fixture shall be located directly over the main control panel. A proximity switch shall activate the lights and the exhaust fan when the hatch is opened. Open fluorescent or incandescent fixtures will not be accepted.
- 10. Ladders: An aluminum or galvanized steel ladder shall be provided in the vault and extend to the ceiling. The ladder shall meet all OSHA requirements (Subpart X, Tile 29 Code of Federal Regulations, Part 1926.1050 through 1926.1060) identified in Section 10.04.C.10. In addition each ladder shall be provided with either a walk-through extension or a ladder-post safety device. The walk-through extension shall be provided by the ladder manufacturer and shall meet OSHA requirements. The ladder-post safety device shall be galvanized steel as manufactured by Bilco Ladder-Up, Maxam Metal Products SLP-2, or approved equal.
 - a) The ladder may be supplied through a manufacturer or constructed. If the ladder is supplied through a manufacturer, shop drawings shall certify compliance with all OSHA requirements. Ladder shall be attached to vault wall per manufacturer's recommendations. Typical fabricated steel galvanized ladder is shown in Figure 11.10.
 - b) The ladder in UDACS Plate C-475 is acceptable so long as it is installed according to Section 10.04.C.10 and the ladder is anchored to the floor.
- D. Factory-Built LMV: The factory-built LMV can be either a pre-cast vault or a steel capsule.

- 1. Pre-cast vault: All the requirements of Section 11.04.C shall be applicable to the pre-cast factory-built LMV.
- 2. Steel capsule vault: All requirements of Section 11.04.C shall be applicable to the steel capsule vault with the following exceptions:
 - a) Structure: The steel capsule vault shall be large enough to contain all the equipment, have the required clearances, and be structurally sound for the loading conditions anticipated. COH shall determine if the piping clearances are adequate during the shop drawing review. The manufacturer shall submit structural calculations that indicate the designed welded steel capsule can support the soil, foundation, groundwater, and H20 loadings. All structural calculations and design shall be signed and stamped by a Registered Engineer in the State of Nevada.
 - The steel plates used to form the capsule shall have a minimum wall thickness of 0.25-inches and meet the requirements of ASTM A36. The capsule shall be made of all new steel plates.
 - 2) Only vertical welds are allowed on the side sheets. Patching of steel plates are not allowed.
 - 3) The side sheets of the capsule shall be connected to the top and bottom of the capsule with a lap joint. The lap joint shall be a full fillet weld inside and outside, and shall be a minimum of 1 1/2inch from the bottom and top plates.
 - b) Pipe Penetrations: Pipe penetrations shall be per manufacturer's design if steel capsule is used. The capsule wall penetrations shall have a penetration sleeve placed over the outside of the pipe diameter. The sleeve shall be welded to the pipe prior to fusion bonded lining. The sleeve shall have a minimum thickness of 1/2 inch.
 - c) Coatings: All surfaces of the steel capsule shall be grit-blasted equal to commercial blast cleaning per SSPC-SP6. All welds shall be brush-coated using Tnemec 69 Hi-Build Epoxoline II, PPG Amercoat 133, or approved equal. The interior and exterior of the steel capsule shall have an epoxy coating that shall be a two-component, high solids, amide-cured self-priming epoxy system. The protective coating shall be in a minimum of two coatings with a total DFT of 8.0 mils. The epoxy coating shall be Tnemec 69 Hi-Build Epoxoline II, PPG Amercoat 133, or approved equal. The color shall be Voyager Sky or approved equal.
 - d) Drainage: Manufacturer shall provide floor sump and sump pump.
 Floor sump design shall be per manufacturer. Sump pump force main shall discharge to the splash pad as shown in Figures 11.2 and 11.9.

- e) Ventilation Piping: Ventilation piping shall be per manufacturer's design. Ventilation piping shall be in agreement with Figure 11.9.
- f) Corrosion protection for the steel capsule shall be magnesium anodes. A minimum of two (2) seventeen pound packaged standard potential magnesium anodes (H-1), or as recommended by the manufacturer or the corrosivity study, shall be used for cathodic protection and shall be equally spaced around the steel capsule unless otherwise specified by a corrosion study. The anodes shall be buried equally spaced around the vault and connected to the vault lugs by heavy copper wire. A cathodic test station shall be provided to measure the potential of the anodes. Insulating flange gasket kits shall be used at connection points outside and inside of the vault to isolate the LMV piping.
- g) The supplier of the factory-built LMV shall provide to COH certification that the factory-built LMV shall operate as intended and shall provide a one-year written warranty for the complete system from the date of acceptance by COH. Acceptance of the station shall be after successful LMV start-up. The warranty shall cover all equipment, components and systems provided in or with the vault by the manufacturer. The manufacturer shall bear the full cost of labor and materials for replacement and /or repair of faulty or defective components. There shall be no cost to COH during the warranty period for the manufacturer to provide a fully operational vault with non-defective components.
 - An Underwriter's Laboratories (UL) label attesting to finished equipment full compliance to the provisions of standard category "Packaged Pumping Systems (QCZJ)" shall be fixed onto the vault interior.
 - 2) The Contractor shall be required to provide COH with manufacturer's shop drawings for the factory-built LMV including design calculations, structural calculations for the vault, all electrical and mechanical equipment included within the vault, all coatings and linings for piping and the vault, and clearances between equipment and walls.
 - 3) Manufacturers. Vault manufacturer shall be Engineered Fluid, Inc., (EFI), Centralia, Illinois or approved equal.
- h) Coordination with Civil. The design engineer shall provide any site improvements required for setting the prefabricated LMV. In particular, any reinforced concrete pad shall be designed to support the prefabricated LMV. The structural calculations for the reinforced concrete pad shall be signed and stamped by a Registered Engineer in the State of Nevada.

- E. Mechanical:
 - 1. COH Standards. All valves and appurtenances shall be from latest edition of the COH approved materials list.
 - 2. Type of Meters and Valves:
 - a) Water Meters: Water meters shall be from the COH Approved Materials List and shall have:
 - All Iron/Steel meters shall have fusion-bonded epoxy coating composed of materials referenced in ANSI/AWWA C213 or C550. Bronze or brass meters shall not be coated.
 - 2) A strainer shall be provided upstream of all water meters. The strainer can be integral with the water meter.
 - 3) All flanges shall meet ANS B16.1 Class 125 drill pattern and size.
 - All meters shall be provided with either a direct-reading or encoder-type remote-registration system per ANSI/AWWA C706 and C707.
 - 5) Registers shall display in cubic feet.
 - 6) Water meters shall have one serial number etched onto the body or a metal tag with one serial number attached to the meter body. Each register shall have one serial number clearly labeled either on the face of the register or on the register cover. The serial numbers of the meters and registers shall be coordinated with COH Meter Services staff.
 - b) Isolation Valves:
 - 1) Isolation valves 2-1/2 inches and smaller shall be ball valves that have either cast-bronze body or stainless steel body.
 - (a) Cast-bronze body ball valve shall meet ASTM B62. Ball valves shall have stainless steel ball and stem, reinforced teflon seat, zinc plated steel handle and handle nut, and vinyl handle cover. Valve shall have female national pipe thread (FNPT) end connections and shall be rated for 400 psi water-oil-gas (WOG) minimum.
 - (b) Bronze valves shall be "Capri" model ball valves, No. 9302
 S, as manufactured by Crane Company, Apollo Valves 70-140 Series, or approved equal.
 - 2) Stainless steel ball valves shall meet ASTM Spec CF8M. The valves shall be all stainless steel with full bore bodies without blowout proof systems, ball and gland. The gland packing and seats shall be polytetrafluoroethylene (PTFE). The valves will be national pipe thread (NPT) threaded pattern complete with stainless steel lever operators. Maximum working pressure shall be 800 psi.

- (a) Valves shall be Kitz Type 800 Model 53F, Apollo Valves 76-100 series, or approved equal.
- (b) Main piping isolation valves within the vault shall be gate valves.
- c) Isolation valves 3 inches and larger shall be non-rising stem gate valves. Gate valves shall have ductile-iron body and conform to the requirements of ANSI/AWWA C-509 or C-515.
 - Buried gate valves located outside the vault on the main piping into/out of the LMV shall be per the transmission main section. Valves shall be provided with valve cans and covers per UDACS Plate 8 and thrust blocks provided per UDACS Plate 3.
 - Wetted interior of all gate valves shall be epoxy coated conforming to the requirements of ANSI/AWWA C-550-01 and have fusion bonded epoxy exterior coating conforming to the requirements of ANSI/AWWA C-116.
 - 3) Valve ends shall be flanged conforming to the requirements of ANSI/AWWA C110.
 - 4) Gate valves shall be per the COH Approved Materials List.
- d) An approved backflow assembly shall be installed downstream of the meter vault per UDACS 2.17.
- 3. Test Ports: A test port shall be provided downstream of the water meter but upstream of the mainline isolation valve. The 2-inch diameter minimum test port outlet shall have a male national pipe thread (MNPT) with a 2-inch ball valve with FNPT. The ball valve shall have a threaded plug.
- 4. Couplings: A restrained dismantling piece shall be used on pipe runs to facilitate the removal of valves and meters for maintenance.
 - a) The dismantling joint shall be rated for a minimum 200 psi. The dismantling joint consists of a flanged coupling adapter and a flanged steel spigot in one assembly. The dismantling joint shall have a steel body and end ring made with steel having minimum yield strength of 30,000 psi.
 - b) The gasket shall be virgin nitrile butrile rubber (NBR).
 - c) The steel flanges shall meet the requirements of AWWA C207 Class D flange.
 - d) Bolts and nuts shall be Type 304 stainless steel. Tie rods shall be high tensile steel per ASTM A193 grade B7.
 - e) Dismantling piece shall have fusion bonded epoxy coating. Dismantling joints shall be Smith-Blair Model 975, Romac Industries Model DJ400, or approved equal.
 - f) A flexible coupling shall be located outside of the buried vaults to allow for any settling of the vault. The flexible coupling shall be on the COH Approved Materials List. The flexible coupling shall require a

harness to restrain axial tension forces. The restrained coupling shall conform to AWWA M11 design. An example of a restrained coupling is shown in Figure 11.11.

- 5. Ventilation Fan. The fan shall be capable of supplying a minimum of six (6) room air changes per hour.
 - a) The fan shall operate on 120 volts AC, single phase power and shall be a shaded pole motor-squirrel cage blower.
 - b) The fan shall be hard-wired in conduit to conduit box with motor per UL 400-1.
 - c) A wall-mounted thermostat and Hand/AUTO switch shall be provided on the control panel.
 - d) The proximity switch shall activate the fan when the hatch is opened.
 - e) Above grade exhaust and air piping shall be enclosed in an air valve can (see Figure 11.10).
 - f) The fan manufacturer shall be Dayton, Greenheck, or approved equal.
- 6. Sump Pump: The sump pump shall be used to discharge any nuisance water accumulating in the vault and shall be sized to discharge a minimum 15 gallons per minute.
 - a) The pump discharge head shall be a function of the cumulative piping headloss and the elevation difference between the suction and the discharge elevation.
 - b) The cast-iron body sump pump shall be of fully submersible construction with UL listed submersible oil-filled motor, UL listed rubber power cord, thermal overload protection, and operate on 120 volts, single phase power.
 - c) The discharge shall be either to the curb or to the vent enclosure (see Figures 11.2 and 11.9).
 - d) The pump shall be able to pass solids up to 1/2-inch diameter. A check valve shall be installed on the discharge header to prevent flow back into the vault.
 - e) The sump shall operate on a float operated, submersible mechanical switch integral to the pump.
 - f) Pump shall be Zoeller Model 53, Hydromatic, or approved equal.
- 7. Pipe Supports: Galvanized pipe supports shall be provided on piping on both sides of the meter and isolation valves, and as needed to support pipe. Pipe support shall be adjustable with carbon steel saddle. Neoprene pad shall be placed between pipe and saddle. See Figure 11.12 for the typical pipe support detail.
- 8. Cathodic Protection. Cathodic protection shall be provided for the factorybuilt steel capsule metering vault as identified in Section 11.04.D.2f unless a site-specific corrosivity study was performed and indicates otherwise. See Chapter 1 for field investigation requirements.
- F. Electrical Systems: The electrical system providing power to components of the pressure reducing station shall be designed by a qualified Electrical Engineer in the State of Nevada. All electrical work shall comply with the latest edition of NFPA-70 (NEC). Coordinate power requirements and meter pedestal with NV Energy. Provide an electrical service plan to COH.
 - 1. General Design Guidelines:
 - All circuit breakers shall be incorporated into a control panel. The electrical service provided for the LMV shall be 230V, 1 phase, 60 cycle, 3-wire.
 - b) There shall be provided at a minimum, thermal-magnetic trip circuit breakers as follows:
 - 1) Spare.
 - 2) Lights.
 - 3) Convenience Outlets.
 - 4) Exhaust Fan.
 - 5) Sump Pump.
 - c) Raceways shall be installed using rigid steel conduit, flexible liquid tight conduit, plastic-coated rigid steel conduit, and/or Schedule 40 PVC solvent weld pipe. Conduits shall be moisture-proof. Minimum conduit size shall be 3/4 inch or sized to handle the type, number and size of equipment conductors to be carried in compliance with in compliance with Article 347 of the National Electrical Code and NEMA TC-2, Federal WC-1094A and UL-651 Underwriters Laboratory Specifications.
 - Where flexible conduit connections are necessary, the conduit used shall be liquid-tight, flexible, totally nonmetallic, corrosion resistant, nonconductive, U.L. listed conduit sized to handle the type, number and size of equipment conductors to be carried in compliance with Article 351 of the National Electrical Code.
 - d) All junction boxes shall be NEMA 4 rated. Boxes shall be standard one-piece units, galvanized or cast metal, or shape and size best suited to that particular location, of sufficient size to contain enclosed wires without crowding.
 - e) All electrical devices in the vault shall be rated NEMA 4 unless otherwise noted. All control and accessory wiring shall be sized for load, type MTW/AWM (Machine tool wire/appliance wiring material) as set forth in Article 310 and 670 of the National Electrical Code,

Henderson Utility Guidelines

Schedule 310-13 and NFPA Standard 79 for flame retardant, moisture, heat and oil resistant thermoplastic, copper conductors in compliance with NTMA and as listed by Underwriters Laboratories (AWM), except where accessories are furnished with a manufacturer supplied UL approved rubber cord and plug.

- f) All signal conductors shall be #14TPSH. No conductors, conduits, fixtures, devices, etc., shall be attached to the vault hatch.
- g) Nameplates shall be provided on each electrical panel, motor starter, and control device. Underground, non-metallic, utility marking tape shall also be provided.
- h) All service entrance, power distribution, control and starting equipment panels shall be constructed and installed in strict accordance with Underwriters Laboratories (UL) Standard 508 "Industrial Control Equipment." The UL label shall also include an SE "Service Entrance" rating stating that the main distribution panel is suitable for use as service entrance equipment. The panels shall be shop inspected by UL, or constructed in a UL recognized facility. All panels shall bear a serialized UL label indicating acceptance under Standard 508 and under Enclosed Industrial Control Panel or Service Equipment Panel.
- i) All electrical equipment items in the station shall be properly grounded per Section 250 of the National Electrical Code. Items to be grounded include, but are not limited to, control panel, convenience receptacles, dedicated receptacle for sump pump, lights, light switch, and exhaust fans. All ground wires from installed equipment shall be in conduit and shall lead back to the control panel to a plated aluminum ground buss specific for grounding purposes and so labeled. The ground bus shall be complete with a lug large enough to accept the installing electrician's bare copper earth ground wire. The bus shall serve as a bond between the earth ground and the equipment ground wires.
- j) Pull boxes shall be identified with COH marking.
- 2. Outlet/Plug. A minimum of three (3) duplex, ground fault circuit interrupter type receptacles shall be furnished about the periphery of the vault interior, with one (1) receptacle adjacent to the main control panel. One (1) receptacle, three-wire grounded type, shall be installed and dedicated solely to sump pump service only. Ground fault interrupter shall be UL approved. Electrical box shall be Cantex Type FSE, Loyola Model I-ICE, or approved equal.
- G. Instrumentation & Control:

- 1. Lighting: The proximity switch shall turn on the lights when the hatch is opened.
- 2. Ventilation/Fan: The proximity switch shall activate the exhaust fan when the hatch is opened.
- 3. Sump Pump: The sump pump shall operate on the level switch integral to the sump pump.

11.05 Design Checklist

A. A checklist is provided at the end of this chapter for the Engineer's reference and use during design and may not include all applicable design criteria. It is the Engineer's responsibility to review and comply with all guidelines contained herein and all applicable codes completely prior to submitting for review.

Henderson Utility Guidelines

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DEPARTMENT OF UTILITY SERVICES

TECHNICAL SERVICES DIVISION NEW DEVELOPMENT SECTION

CITY OF HENDERSON 240 WATER STREET HENDERSON, NEVADA 89015

UTILITY SERVICES

Large Meter Vaults (3 Inches and Larger) Review Checklist

Design Concept Phase

- Locations
- □ Siting analysis
- □ Site description
- ROW, easements, and ownership
- □ Preliminary water meter sizes
- □ Stand-alone or integrated into site improvement plans
- □ Site-built station or factory-built vault

Pre-Design Phase

Pre-design report (PDR)

- Project background
- Draft geotechnical investigation report
- Draft environmental investigation report
- Preliminary plans and section
- U Water meter type and size
- □ Identification of appurtenant facilities and spacing criteria
- □ Identification of permanent and temporary ROW/easement constraints

- □ Preliminary cost estimate
- □ Stand-alone project
- □ Preliminary construction schedule
- □ Field Investigations

Hydraulics

- Design criteria
- Calculations
- Preliminary site selection
- □ Site description
- □ Site layout
- ROW or easement acquisition
- Preliminary LMV layout
- Mechanical layout
- Test ports
- Bypass piping
- Pipe material
- Expandability
- Ventilation
- Access

Final Design Phase

<u>General</u>

- Site civil
- □ Yard piping
- □ Site security
- Grading
- Mechanical layout
- □ Site-built LMVs
- □ Vault interior piping
- Vault

- □ Vault access
- Height
- □ Pipe penetrations
- Coatings
- Drainage
- U Ventilation piping
- Lighting
- Ladders
- □ Factory-built LMV
- Pre-cast vault
- □ Steel capsule vault

<u>Mechanical</u>

- COH standards
- Type of meters and valves
- Test ports
- **Couplings**
- Ventilation fan
- Sump pump
- Pipe support
- Cathodic protection
- Electrical systems
- General design guidelines
- Outlet/plug
- Instrumentation and control
- Lighting
- Ventilation/fan
- **G** Sump pump

Henderson Utility Guidelines

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EQUIPMENT SCHEDULE

1)	PRECAST CONCRETE VAULT
2-	8" RESILIENT SEATED GATE VALVE W/ HANDWHEEL,
3—	INSULATING FLANGE KIT (IF CONNECTING TO
(4)-	8"x3" EPOXY LINED & COATED STEEL TEE, FLG X FLG
(5)—	8" COMBINATION METER
6-	3" RESILIENT SEATED GATE VALVE W/ HANDWHEEL & BLIND FLANGE
(7)	8" DISMANTLING COUPLING
8-	8" STEEL SPOOL, EPOXY LINED & COATED, FLG X FLG
9	PRECAST CONCRETE SUMP, 12" SQUARE x 12" DEEP, W/ FRP GRATE
_(10)-	STEEL PIPE WALL PENETRATION, SEE FIG 11.7
(11)	CATHODIC TEST STATION (IF STEEL CAPSULE)
_(12)-	UNDER PIPE SUPPORT, SEE FIGURE 11.12
(13)	GALVANIZED STEEL LADDER, SEE FIGURE 11.10
(14)-	3'-6"x 3'-6" ACCESS HATCH, SINGLE LEAF
(15)	8" STEEL SPOOL, EPOXY LINED & COATED, FLG X FLG W/2 1/2" FNPT OUTLET
(16)-	2" BALL VALVE W/LEVER, FNPT X FNPT
(17)	6" SCHEDULE 80 PVC PIPE & FITTINGS
(18)-	SUMP PUMP FORCE MAIN
(19)	SUMP PUMP
60-	MINIMUM 6" THICK, 3/4" CRUSHED ROCK
(21)	VENTILATION FAN
22-	LIGHT FIXTURE
23	CONTROL PANEL
(24)-	VENT, SEE FIGURE 11.9
25—	2'-0" OD X 4'-0" HIGH STEEL COVER, SEE UDACS PLATE 37
26)-	DRAIN, SEE FIGURE 11.4
27)	WALL INSERT, SEE FIGURE 11.8
	PVC PIPE WALL PENETRATION, SEE FIGURE 11.6
29-	VAULT CELING INSERT AND EYEBOLT, SEE FIG 11.5

NOTES:

- 1. THIS IS AN EXAMPLE OF A LARGE METER VAULT. OTHER PIPING CONFIGURATIONS ARE POSSIBLE.
- 2. ONLY MAJOR PIPING ITEMS ARE ANNOTATED. ELECTRICAL CONDUITS AND WIRING NOT SHOWN.
- 3. PETROLATUM TAPE COATING PER AWWA C217 WITH 3/4" CEMENT MORTAR COATING (ROCK SHIELD) FOR FOR BURIED STEEL PIPING.
- 4. A COH APPROVED BACKFLOW ASSEMBLY SHALL BE INSTALLED DOWNSTREAM OF THE METER VAULT PER UDACS 2.17.

		scale NO SCA	ALE
V FS	EXAMPLE LMV	NO.	REV.
ES	PLAN	FIGURE 11.2	0



EQUIPMENT SCHEDULE

(1)	PRECAST CONCRETE VAULT
	8, RESILIENT SEATED GATE VALVE W/ HANDWHEEL,
(3)	INSULATING FLANGE KIT (IF CONNECTING TO
(4)-	METALLIC PIPE) 8"x3" EPOXY LINED & COATED STEEL TEE, FLG X FLG
(5)	8" COMBINATION METER
6-	3" RESILIENT SEATED GATE VALVE W/ HANDWHEEL & BLIND FLANGE
7	8" DISMANTLING COUPLING
	8" STEEL SPOOL, EPOXY LINED & COATED, FLG X FLG
(9)	PRECAST CONCRETE SUMP, 12" SQUARE x 12" DEEP, W/ FRP GRATE
(10)-	STEEL PIPE WALL PENETRATION, SEE FIG 11.7
(11)	CATHODIC TEST STATION (IF STEEL CAPSULE)
(12)-	UNDER PIPE SUPPORT, SEE FIGURE 11.12
(13)	GALVANIZED STEEL LADDER, SEE FIGURE 11.10
(14)-	3'-6"x 3'-6" ACCESS HATCH, SINGLE LEAF
(15)	$8^{\prime\prime}$ Steel spool, epoxy lined & coated, FLG x FLG W/2 1/2" fnpt outlet
(16)-	2" BALL VALVE W/LEVER, FNPT X FNPT
(17)	6" SCHEDULE 80 PVC PIPE & FITTINGS
(18)-	SUMP PUMP FORCE MAIN
(19)	SUMP PUMP
	MINIMUM 6" THICK, 3/4" CRUSHED ROCK
(21)	VENTILATION FAN
(22)-	LIGHT FIXTURE
23	CONTROL PANEL
24)	VENT, SEE FIGURE 11.9
(25)	2'-0" OD X 4'-0" HIGH STEEL COVER, SEE UDACS PLATE 37
26-	DRAIN, SEE FIGURE 11.4
27	WALL INSERT, SEE FIGURE 11.8
	PVC PIPE WALL PENETRATION, SEE FIGURE 11.6
29-	VAULT CELING INSERT AND EYEBOLT, SEE FIG 11.5

NOTES:

1. SUMP PUMP SHOWN OUT OF SECTION FOR CLARITY.

./		scale NO SCA	ALE 🛛
v FS	EXAMPLE LMV	NO.	REV.
ES ES	SECTION	FIGURE 11.3	0





	PVC PIPE PACK ANNULAR SPACE W/ NON-SHRINK GROUT			
SECTION				
REVISIONS DWN APVD APVD DATE				
DESIGNED PBS&J DRAWN PBS&J CHECKED COH APPROVED UTILITY GUIDELINES APPROVED 03–12–10	PVC PIPEscale NO SCALEWALL PENETRATIONNO.FIGURE 11.60			



1 1/2" SCHE (THREAD X 1 1/2" SCHE THREADED F (TYP OF 2) 1 1/2" SCHE PIPE	D 40 PVC CPLG - Socket) D 40 PVC PLUG <u>OUTSI</u> <u>VAUL</u> D 40 PVC	DE T	
<u>NOTE:</u> To be used only for electrical and control wiring.			
REVISIONS DWN APVD DESIGNED PBS&J DRAWN PBS&J CHECKED COH APPROVED	APVD DATE HENDERSON, NV JTILITY GUIDELINES	WALL INSERT	scale NO SCALE no. rev.
APPROVED APPROVED DATE03-12-10	STANDARD PLATES		FIGURE 11.8 0











CHAPTER 12 ELECTRICAL REQUIREMENTS

12.01 General

- A. The electrical systems shall comply with the National Electric Code (NEC) with Southern Nevada Amendments, currently adopted by the COH. The electrical equipment shall be manufactured in accordance with the standards of the Institute of Electrical and Electronic Engineers (IEEE) and the National Electrical Manufacturers Association (NEMA). All electrical equipment shall be "labeled" indicating compliance with the standards of a nationally recognized testing organization, i.e., Underwriters Laboratory (UL), Factory Mutual System (FM), or Canadian Standards Association (CSA).
- B. The electrical design shall include service entrance sections, switchgear sections, motor control sections, standby and/or dual-power systems, conduit and wiring. Some electrical equipment shall not be included in the design based on the mechanical equipment selected in the facilities. Motor Control Center (MCC) panels shall be housed in an air conditioned space. All equipment shall address structural requirements. Each design shall include power demand information that will be needed in order for Contractor to apply for electrical service from the NV Energy. The design shall be provided with short-circuit protection and improper phase rotation protection.
- C. The Engineer is encouraged to initiate contact and coordinate efforts with NV Energy for projects requiring new power supply or expansion of facilities currently being served that will affect NV Energy. NV Energy design drawings are required in the final mylar submittal and to obtain final approval signatures from the COH.
- D. The electrical design shall include appropriate lightning protection devices for power system protection.
- E. The electrical design shall include appropriate grounding based on the NEC.
- F. The Engineer shall design all electrical equipment and accessories in accordance with state, federal and local regulations, which include adopted COH codes.
- G. The design of all electrical facilities shall be completed by a registered electrical Professional Engineer in the state of Nevada.
- H. The design shall incorporate provisions necessary for future expansion, which includes but is not limited to future equipment, future instrumentation, future security system, future alarm systems, electrical power for both current and future equipment, spare power conduit, spare control conduit, space for future electrical equipment.

12.02 Electrical Power System Study

- A. The Engineer shall prepare an Electrical Power System Study using ETAP Power Station software or equivalent for all projects, which includes the following:
 - 1. Background section to describe existing conditions and proposed loads, which addresses future expansion.
 - 2. Single Line diagrams that illustrate existing and proposed loads, which addresses future expansion.
 - 3. Electrical Short-circuit analysis of proposed facilities, which addresses future expansion.
 - 4. Load Flow Analysis with load summary.
 - 5. Arc-Flash Analysis.
 - 6. Harmonic Analysis.
 - 7. Recommendations and conclusions.
 - 8. The results shall be summarized in a written report that is signed and sealed by an electrical engineer registered in the state of Nevada.
- B. The Engineer shall include in the design specification that the Contractor shall be required to update the existing Electrical Power System Study developed by the Engineer with actual installed equipment information using ETAP Power Station software or equivalent for all projects, which includes the following:
 - 1. Background section to describe existing conditions and proposed loads, which addresses future expansion.
 - 2. Single Line diagrams that illustrate existing and proposed loads, which addresses future expansion.
 - 3. Electrical Short-circuit analysis of proposed facilities, which addresses future expansion.
 - 4. Load Flow Analysis with load summary.
 - 5. Arc-Flash Analysis.
 - 6. Harmonic Analysis.
 - 7. Protective Coordination Study.
 - 8. Recommendations and conclusions.
- 9. The results shall be summarized and submitted for review by the Engineer of record before inclusion as part of the operation and maintenance manuals.
- 10. Contractor shall be responsible for updating the protective devices settings in field based on the recommendations of the report.

12.03 Electrical Equipment, Conduit and Conductor Sizing and Rating

- A. Electrical equipment shall be sized to continuously carry 120 percent of all electrical loads, both current and future, without overloading. Equipment and materials shall be rated to withstand and/or interrupt the available fault current.
- B. Electrical power conductors shall be sized in accordance with the NEC and in addition to the heating characteristics of conductors under fault conditions. Temperature rise shall be limited to a maximum of 200 degree Celsius within 30 cycles. Conductors applied to continuous load shall be sized at 125 percent of the full load current. Conductors applied to intermittent loads shall be sized at 100 percent of the full load current.
- C. Electrical power conduits shall be sized for ultimate design conditions. For conduits installed in concrete or under base slabs, etc., the Engineer shall provide and stub-up at all major equipment and panels at least one spare conduit for every 5 placed with a minimum of one spare. The minimum size of the spare conduits shall be larger of 1-inch diameter or the largest size conduit used, whichever is largest.

12.04 Grounding and Bonding

- A. Ground rods shall be copper-clad steel conforming to UL 467, 3/4 inch in diameter by 10 feet in length of earth contact.
- B. Connections above grade shall be made with bolted solderless connectors, and those below grade shall be made by a fusion-welding process.
- C. Grounding Electrode Conductor, Service entrance ground wires shall be sized in accordance with NEC.
- D. Equipment grounding conductors shall be sized in accordance with NEC. Ground wires shall be protected by conduit, where such wires run exposed above grade or are run through concrete construction.
- E. Equipment frames of motor housings, metallic tanks, metallic equipment enclosures, metal splicing boxes, chain-link fencing, handrails, and other metallic noncurrent-carrying metal items, shall be grounded. Connections to earth shall be made in the same manner as required for system grounding.

- F. Surge arresters shall be grounded. Resistance to ground for intermediate-class arresters shall be not more than 10 ohms and for distribution-class arresters shall be not more than 25 ohms. Ground wire connections shall be not less than No. 4 AWG for distribution arresters and No. 1/0 AWG for intermediate arresters.
- G. Lighting poles base shall be connected to an adjacent ground rod.
- H. Metallic structures and buildings shall be grounded per NEC.
- I. Grounding rings shall be installed using bare copper cable with ground rods at least 25 feet intervals using thermoweld connecting means in accordance with NEC requirements.
- J. Duct banks shall contain a concrete encased system #2/0 bare copper ground conductor. The system ground conductors shall run continuously in duct banks, through handholes and other raceway boxes. The system ground shall be connected to the structure grounding systems to provide a continuous grounding system. Each metallic raceway, panel, switchboard, and other metallic devices associated with the electrical and control systems shall be bonded to this grounding system.

12.05 Electrical Identification

- A. Color-coded conduit markers based on manufacturer's standard pre-printed, flexible or semi-rigid, permanent, plastic-sheet conduit markers, extending 360 degrees around conduits; designed for attachment to conduit by adhesive, adhesive lap joint of marker, matching adhesive plastic tape at each end of marker, or pretensioned snap-on. Provide 8-inch minimum length for 2-inch and smaller conduit, 12-inch length for larger conduit. Exterior installation shall meet weatherproof requirements.
- B. Cable and conductor wire markers shall be self-laminating vinyl on white background, printed using a Brady printer, Seton printer, or equal. Handwritten wire markers are not acceptable.
- C. Engineer shall provide a cable/conductor identification schedule in the design drawings, which shall include, but not be limited to cable/conductor identification, including voltage, phase and feeder number, on each cable/conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present, except where another form of identification (such as color-coded conductors) is provided. Match identification with marking system used in panelboards, shop drawings, specifications, and similar previously established identification for project's electrical work.
- D. Circuit Identification:

- 1. The 3 phase wires shall be identified at the switchgear, panelboards, and MCCs as Phases A, B, and C.
- 2. In addition to color coding each conductor shall be identified in panelboard, cable tray, or termination with circuit identification markers. This identification is applicable to all power, control, alarm, and instrumentation conductors. Markers shall be slip on PVC sleeve type as manufactured by Brady, Seton, or equal.
- 3. Markers for other cabling shall be label number B-292 vinyl as manufactured by Brady, Seton, or equal.
- 4. Exposed medium voltage conduits shall be labeled at 50-foot intervals with 1-inch letters stating the voltage example "12,470 volts". Labels shall be vinyl plastic as manufactured by Brady, Seton, or equal.

12.06 Wires and Cables

- A. 600 Volt Class Cable Conductor:
 - 1. Wire sizes shall be American Wire Gauge (AWG) sizes with Class B stranded construction. No. 2 AWG and smaller shall be factory color coded with a separate color for each phase and neutral, which shall be used consistently throughout the system. Larger cables shall be coded by the use of colored tape. Conductors sized No. 1 and larger shall be Type 2, rated for 90 degrees Celsius. All circuit conductors, No. 6 or smaller shall be "THWN" stranded copper. All other conductors shall be "XHHW-2" stranded copper.
 - 2. Individual or multiple conductor cables for power, control, and alarm circuits of 480 volts or less shall be insulated for not less than 600 volts. No wire external to panels and MCCs shall be less than No. 12 AWG. Panel control wiring shall not be less than No. 14 AWG.
 - 3. Power conductors for lighting and receptacles only may utilize "THWN" solid conductors.
- B. Instrumentation Cable:
 - Instrument cable shall be Type TC and shall be insulated for not less than 600 volts. Conductor size shall be No. 16 AWG minimum. Twisted shielded, grounded instrumentation cable shall be used for all analog signals.
 - 2. Cable Identification:

- a) All conductors shall be numbered with "tube sleeve" type tags with heat impressed letters and numbers.
- b) Color code all wiring as follows:

CONDUCTOR	120/208 VAC	480 VAC	24V DC	4-20 ma Tp#16	120VAC Control / Power	12V DC
Phase 1	Black	Brown	Blue	Black	Pink	Red
Phase 2	Red	Orange	(-) Brown	White		(-) Black
Phase 3	Blue	Yellow				
Neutrals	White	White			White	

Table 12.1Instrumentation Cable Identification

- c) 240V 3-Phase Open Delta shall be orange.
- d) Color code ends of feeder phase conductors only.

12.07 Electrical Conduit

- A. Raceways:
 - 1. Exposed conduit in an unclassified or hazardous area shall be rigid metal conduit (RMC).
 - 2. Conduits in the corrosive areas shall be PVC coated RMC.
 - 3. Underground and/or concrete encased conduits shall be PVC, except elbows, which shall be PVC coated RMC.
 - 4. Underground to aboveground conduit transitions shall be PLC coated RMC.
 - 5. No above-ground conduit shall be less than 3/4 inch.
 - 6. No underground conduit shall be less than 1 inch.
 - 7. In unclassified areas, flexible conduit shall be grounding type, weatherproof, corrosion resistant, and watertight. Conduit shall not exceed a maximum of 36 inches in length.
 - 8. All spare conduits shall be installed with a blue nylon pull string and shall be capped or plugged.
 - 9. Brass labels shall be connected at each starting and ending point of the conduit to identify the "to" and "from" locations.

12.08 Standby Power

- A. Acceptable Manufacturers:
 - 1. The Generator set shall be manufactured by Cummins, Kohler, Caterpillar, or equal.
- B. Portable or permanent standby power shall be provided where it is not feasible or economical for critical facilities to be provided with redundant power.
- C. Pump stations shall be designed with a portable diesel generator connection. The connections shall be lug type suitable for connect with the COH's portable generators.
 - 1. The generator connection shall be sized to operate all pumps in the facility and to run all essential loads.
 - 2. The generator shall be tied into the system via a distribution circuit breaker fed off the main service equipment with a Kirk-Key system. Normal power and standby power shall not be in operation at the same time.
- D. Lift stations shall be designed with permanent natural gas type generator. The source of gas shall be identified in the initial stage of the project with coordination from the COH.
 - 1. The generator shall be sized to operate all pumps in the facility and to run all essential loads and any other proposed future loads.
 - 2. The generator shall be tied into the system via automatic transfer switch fed off the main service equipment.

12.09 Non-Utility Pad-Mounted Transformers

- A. Acceptable Manufacturers:
 - 1. The substation transformer shall be manufactured by Howard Industries, Square D, Westinghouse, ABB, Cutler Hammer, or equal.
 - 2. The transformer shall carry its continuous rating with average winding temperature rise by resistance that shall not exceed 65 degrees Celsius temperature rise, based on average ambient of 30 degrees Celsius over 24 hours with a maximum ambient of 40 degrees Celsius, as defined by ANSI, without loss of service life expectancy.

12.10 Service Entrance Section

A. Utility Demand Meter:

1. The meter shall be equipped with a power pulse relay that shall produce a signal capable of being brought into the COH SCADA system.

12.11 Switchgears

- A. Acceptable Manufacturers:
 - 1. The Switchgear shall be manufactured by General Electric, Square-D, Cutler-Hammer, or equal.
- B. All switchgears shall be provided with a solid state monitoring device (Square D Power Logic or equal). In general, switchgear shall have the ability to be provided with Hand Switches (HS) – HOARs (Hand, On, Off, Auto, Remote); SCADA; and Indicator Lights – On/Off/Fail, Alarm. All equipment lights shall be Light Emitting Diodes (LEDs).
- C. The construction of the switchgear shall be of the universal frame type using dieformed welded and bolted members; panels should be 11-gauge steel bolted in place.
- D. Busbars shall be copper, fully insulated, and silver plated at the joints. A fulllength ground bus shall be provided at the bottom of the switchgear enclosure.
- E. Incoming and outgoing switch or circuit breakers sections shall have ample spaces for medium voltage, 133 percent shielded, jacketed single conductor stress-cone terminations and lighting arrestors.
- F. There shall be a clear indication of switch or circuit breaker position, a high impact type viewing window for interrupter switches and status lights for circuit breakers.

12.12 Variable Frequency Drives (VFDs)

- A. Acceptable Manufacturers:
 - 1. The Switchgear shall be manufactured by Square-D, Allen-Bradley, Cutler-Hammer, or equal.
- B. The VFD shall consist of 6- or 18-pulse full wave diode bridge rectifier, a DC bus, a power transfer inverter and line load reactor and an input single loss relay to trip the drive. 6 pulse shall only be utilized on smaller motors that are not compatible with a 18-pulse drive.
- C. If required harmonic suppression equipment is necessary based on a harmonic analysis study, the equipment shall be provided in conjunction with variable frequency drive. Equipment selection and design, as well as, design calculations will be reviewed by the COH on a case by case basis.

- D. VFD system motors shall have a service factor of 1.20 (or 1.15 and de-rated by 5 percent of nameplate horsepower). Motors shall be specifically designed for operation with selected variable-speed drive for the specific application.
- E. Where applicable VFDs shall be housed in the MCC. Where VFDs cannot be housed in the MCC a stand-alone enclosure is acceptable.
- F. Specifications for VFDs shall address the following:
 - 1. Motor protection relay.
 - 2. Power requirement as a function of pumping capacity.
 - 3. Allowable supply voltage wave form distortion.
 - 4. Allowable supply voltage notch area.
 - 5. Minimum and maximum allowable power factor over working speed range.
 - 6. Minimum allowable efficiency at full speed and load.
 - 7. Required operating ambient temperature range.
 - 8. Required diagnostics provisions.
 - 9. Control and monitoring signal interface.
 - 10. Allowable acoustical noise level.
 - 11. Adjustable ramp acceleration/deceleration time.
 - 12. Characteristics (available short-circuit current X/R ratio) of power supply including alternate and standby power supplies.
 - 13. Allowable speed regulator error.
 - 14. Provide VFD recommended spare parts based on manufacturer requirements.
 - 15. VFD shall be provided with a communication port capable of communicating with the PLC identified in the SCADA Guidelines.

12.13 Soft Starters

- A. Acceptable Manufacturers:
 - 1. The Soft Starter shall be manufactured by Square-D, Allen-Bradley, Cutler-Hammer, or equal.

- B. Where used with constant speed pumps 20 horsepower or larger, provide power factor corrections capacitors with soft start and soft stop motor starters. Starters shall be designed for the pump control algorithm.
- C. Soft Starter shall be equipped with an integral bypass.
- D. Each motor control starter section will shall have a General Electric Multilin 369 motor protection relay that is programmed according to the coordination study and shall have the following features:
 - 1. All across-the-line motor starters 100hp and larger shall have a Multilin relay.
 - 2. Motors larger than 200hp shall have winding and bearing temperature sensors.
 - 3. VFD starters have built-in voltage and current protection that is never bypassed. Thus, VFD starters generally do not require a Multilin. The City will review this application on a case by case basis.
 - 4. The Multilin shall be programmed to trip above the RVSS or VFD settings, but below the starter MCP.
 - 5. An RVSS that has a bypass contactor, where overload protection is bypassed, should also have a Multilin.
 - 6. The Multilin relay will monitor and control each of the following:
 - a) high temperature protection
 - b) ground fault protection
 - c) rotor temperature protection
 - d) overload and underload protection
 - e) voltage and frequency protection
 - f) other unbalanced functions
 - g) number of starts, stops, and run time
 - h) not allow more than the specified number of starts per hour
 - 7. Multilin control power shall be a separate source from the motor starter control power, such as a lighting panel or UPS. The Multilin must retain power in order to be able to retrieve event data.
 - 8. Warning labels shall be installed in the starter enclosure stating "Foreign Voltages Present".
 - 9. Multilin functions and settings should be consistent and identical for identical motor applications.
 - 10. Alarms and trip functions must be consistent throughout pumping stations.

- Multilin communications port (RS-485) should be wired and provided with a 9-pin DB connector for local laptop PC interface. Install with an RS-485 to RS-232 converter.
- 12. Communications from multiple Multilins should be daisy-chained together to one common 9-pin DB connector. The DB connector should be mounted on the front panel of the PLC cabinet for easy access.
- 13. The communications port should be connected to the PLC (Modicon) and data transmitted via Hennet for archiving or trending.
- 14. Each Multilin should be setup with a unique address on the RS-485 data link.

12.14 Motor Control Centers

- A. Acceptable Manufacturers:
 - 1. The Soft Starter shall be manufactured by Square-D, Allen-Bradley, Cutler-Hammer, or equal.
- B. All MCCs shall be provided with a solid state monitoring device (Square D Power Logic or equal). In general, MCCs shall be provided with Hand Switches (HS) HOARs (Hand, On, Off, Auto, Remote); SCADA; and Indicator Lights On/Off/Fail, Alarm. All equipment lights shall be Light Emitting Diodes (LED's).
- C. Main Disconnect: The Engineer shall layout the facility such that the main disconnect on the MCC is located adjacent to an exterior door or provided in a dedicated electrical room with exterior access. If site requirements or other building requirements prevent this, a service disconnect shall be located just inside an easily accessible exterior door.
- D. A yellow sign with black lettering shall be affixed to the MCC identifying the main disconnect. If a service disconnect is required, a similar yellow sign shall be used to indicate its location. Finally, another yellow sign shall be attached to the outside of the exterior door indicating that the main and/or service disconnect are located inside the building. If there are additional sources of power within the facility, i.e., UPS, additional signage will be required. It is preferred that the disconnect for UPS be located adjacent to the MCC main disconnect.
- E. According to the latest Southern Nevada Amendments to the NEC, the use of a shunt/trip device is no longer an acceptable means of disconnecting power to the facility.
- F. When the main and/or service disconnect is located within the building or dedicated electrical room, a fire department approved KNOX box shall be

installed on the exterior of the building adjacent to the main entry door to the building.

- G. Additional requirements for MCC units are as follows:
 - 1. Low-voltage motor control assemblies conforming to the standards for NEMA Class I, Type B assemblies.
 - 2. Each assembly shall consist of vertical, free-standing sections in accordance with industry standards.
 - 3. The door of each unit containing a disconnect device shall be interlocked so the door cannot be opened unless the device is in the "OFF" position. All unit doors shall be swing doors, with locks and continuous length hinges. All MCC units shall be rodent proof.
 - 4. All indicator lights mounted on the MCC shall be of the push-to-test type, LED bulbs only.
 - 5. Each wire end, terminal, and terminal connection shall be uniquely identified with a number.
 - 6. Provide Transient Voltage Surge Suppressor (TVSS) surge protection.
 - 7. Provide Arc Flash stickers with Personnel Protection Equipment (PEE) requirements.
 - 8. All lighting transformers and panelboards shall be integral within the MCC. If size of transformer exceeds the manufacturer's recommendations of integral, an external transformer and panelboard is acceptable.
 - 9. MCC drawings shall identify all wiring numbers.
- H. Trip Calibration:
 - Motor overload protection shall be selected based on final motor nameplate information. Size Motor Circuit Protectors (MCP) to coordinate with motor starting characteristics and overload protection. Submit the following for each motor to the COH:
 - a) Equipment project identification number.
 - b) Nameplate information.
 - c) Overload device trip range.
 - d) Overload device setting.
 - e) MCP trip device rating.
 - f) MCP trip device setting if different from rated value.

- 2. Set trip devices per the coordination study and verify devices are operating within manufacturer's tolerances. Make changes to settings not complying with requirements furnished by the Engineer in accordance with the Technical Specifications. Device settings will be furnished for following equipment:
 - a) Medium-voltage system.
 - b) Low voltage switchgear.
 - c) Secondary unit substations.

12.15 Lightning Protection

- A. The Engineer shall provide lightning protection for all facilities, which utilize motorized equipment and/or instrumentation.
- B. Standards: The lightning protection system will meet the requirements of the following:
 - 1. Lightning Protection Institute (LPI) LPI 175 Standard of Practice.
 - 2. ANSI/NFPA 780 Lightning Protection Code.
 - 3. UL 96 Lightning Protection Components.
 - 4. UL 96A Installation Requirements for Lightning Protection Systems.
- C. Lightning Protection shall be ANSI/NFPA 780; Class I UL 96A and consist of the following at a minimum:
 - 1. Copper Air terminals on roof(s).
 - 2. Bonding of structure where applicable and other metal objects.
- D. Conductor Installations:
 - 1. Install the lightning protection roof system(s) grounding and bending conductors exposed on flat roof areas and concealed at ridge roof areas.
 - 2. Install main downleads completely concealed and sleeved.
 - 3. Other than for the purpose of protecting downlead conductors from damage up to 6 inches above grade level, do not use exposed conduits to conceal the downleads on the exterior of outside walls.
 - 4. Use minimum 1-inch PVC conduits to protect lightning system conductors from damage and bond both ends of PVC-coated rigid steel conduit to conductor.
- E. Clearances: Assure 6 foot minimum distance required by NEC:

- 1. From lightning rod conductors to non-current carrying metal parts of electrical equipment unless they are bonded to the rods.
- 2. From lightning system conductors to open conductors of communication systems.
- 3. From lightning protection grounding electrodes to electrodes of other grounding systems.
- F. UL Inspection Certification: Upon completion of installation the Lightning Protection, the Engineer shall require that the lightning protection system be physically inspected and certified by Underwriters Laboratories and furnish a U.L. Master Label.
- G. Lightning protection shall be as manufactured by:
 - 1. CIT.
 - 2. Thompson Lightning Protection, Inc.
 - 3. Harger Lightning and Grounding.

12.16 Electrical Ductbanks

- A. Concrete encase ductbanks below grade shall be polyvinyl chloride (PVC) Schedule 40 conduits in concrete envelop. PVC coated rigid steel conduit shall be used for all stub-ups and the last 3 feet before exit from earth or entry to structure. The minimum concrete over the outside of the conduit shall be 4 inches. All ductbanks shall be reinforced with a minimum of four #4 reinforcement bars per each ductbank at a maximum of 18 inches on center parallel to the duct bank and #3 reinforcement bar wraps on 24 inches centers (maximum) for the length of the ductbank. The minimum concrete cover over the reinforcing steel shall be 2 inches. Red concrete shall be required for all ductbanks.
- B. A 3-inch Wide Detectable Plastic Marker tape with Inscription "Caution Electric Lines Buried Below" shall in place above the ductbank.
- C. Unless otherwise noted by the COH, all ductbanks shall have 36 inches of backfill cover.

12.17 Lighting

- A. General: The Engineer shall provide interior and exterior lighting for all projects.
- B. Interior Lighting: shall utilize fluorescent, compact fluorescent, metal halide high intensity discharge, or incandescent lamps. Lamps shall be high efficiency rated.

- C. Exterior Lighting: shall utilize High Pressure Sodium HID or Metal Halide HID lamps. Lamps shall be high efficiency rated. Lighting shall also be:
 - 1. Provided with integral mounting pole and bracket shall be capable of withstanding:
 - a) Designed for wind levels per site conditions without damage.
 - b) Designed for seismic levels per site conditions.
 - c) Equipped with corrosion-resistant hardware and hinged doors or lens retainer.
 - 2. Lighting shall be equipped with one photoelectrical control, which shall be tied into all the fixtures.
 - 3. Hand/Off/Auto Switch for all exterior lights to enable testing shall be located in the interior of a building.
 - 4. Each entrance or exit door to a building shall have a fixture mounted overhead.
 - 5. All exterior and interior light fixtures shall be connected to light switches for manual on/off purposes.
 - 6. Electrical pull boxes shall be identified with COH-DUS marking.

12.18 Security

A. The Engineer shall contact the COH to request the most recent security guidelines.

12.19 Electrical Drawings

- A. Electrical drawing package shall include the following drawings in addition to other drawings to clearly convey a complete and constructible project.
 - 1. Electrical Layout drawings shall identify, but not limited to the following:
 - a) All electrical equipment, field instrument and instrument panel that has electrical connections.
 - b) All ductbanks, and handhole/manhole locations.
 - c) Grounding system.
 - d) Electric utility information.
 - e) Routing of exposed and unexposed conduits. All conduits shall have unique numbers.
 - f) Demolition equipment.
 - g) Approved NV Energy power drawings.
 - 2. Electrical single-line diagram drawings shall identify, but not be limited to the following:

- a) Main service entrance equipment, which identifies the protective devices and power pulse relay brought into the COH SCADA system.
- b) 480 Volt distribution equipment, motor loads, non-motor loads.
- c) Load Calculations for each piece of electrical equipment.
- d) 120 V lighting transformer and panelboards.
- e) 120 V panel schedules.
- f) Conduit and cable schedules shall show all unique wire numbers.
- g) Refer to Figure 12.1 for a visual template layout.
- 3. Electrical schematic drawings shall identify, but not be limited to the following:
 - a) The control circuit, which identifies all necessary components to control the equipment based on the Process and Instrumentation Diagrams (P&ID) and the control philosophy.
 - b) The discrete and analog input/outputs from the Programmable Logic Controller to the electrical equipment and instruments.
 - c) Connection diagram showing the wires from the electrical equipment or instruments to associated pieces of equipment.
- 4. Electrical details.

12.20 Electrical Specifications

A. The Engineer shall compile electrical specifications for each type of field and panel-mounted electrical equipment and associated appurtenances (i.e., conductors, wires, conduits) to be provided.

12.21 Design Checklist

A. A checklist is provided at the end of this chapter for the Engineer's reference and use during design and may not include all applicable design criteria. It is the Engineer's responsibility to review and comply with all guidelines contained herein and all applicable codes completely prior to submitting for review.

DEPARTMENT OF UTILITY SERVICES

TECHNICAL SERVICES DIVISION NEW DEVELOPMENT SECTION

CITY OF HENDERSON 240 WATER STREET HENDERSON, NEVADA 89015

UTILITY SERVICES Electrical Requirements

Electrical Power System Study

- Background Section
- □ Single Line diagrams
- Electrical Short-circuit analysis
- Load Flow Analysis
- □ Arc-Flash Analysis
- Harmonic Analysis

Electrical Equipment, Conduit and Conductor Sizing and Rating

- Electrical Equipment
- Electrical Power Conductors
- Electrical Power Conduits

Grounding and Bonding

- Ground Rods
- □ Above Ground Connections
- Grounding Electronic Conductors
- Equipment Frames
- □ Surge Arresters
- Lighting Poles
- Metallic Structures
- Grounding Rings
- Ductbanks
- August 2010

Electrical Identification

- Conduit Markers
- Cable and Conductor Wire Markers
- □ Cable/conductor identification
- Circuit Identification

Wires and Cables

- □ Class Cable Conductor
- □ Instrumentation Cable

Electrical Conduit

□ Raceways

Standby Power

- Manufacturer
- Redundancy
- Pump Stations
- Lift Stations

Non-Utility Pad Mounted Transformers

Manufacturer

Service Entrance Section

Utility Demand Meter

Switchgears

- Manufacturer
- □ Solid State Monitoring Device
- Given Frame
- Busbars
- □ Circuit Breaker Sections

Variable Frequency Drives (VFDs)

Manufacturers

August 2010

- Equipments
- □ Harmonic Suppression Equipment
- UFD System Monitors
- □ Specifications

Security

Contact COH

Electrical Drawings

Electrical Layout

- Electrical equipment, Field Instrument and Instrument Panel
- Ductbanks
- Handhole/manhole locations
- Grounding systems
- Electric Utility Information
- □ Routing of exposed and unexposed conduits
- Demolition equipment
- Approved NV Energy power drawings

Electrical single-line diagram drawings

- □ Main service entrance equipment
- □ 480 Volt distribution equipment
- Load Calculations
- □ 120 V lighting transformer and panelboards
- □ 120 V panel schedules
- Conduit and cable schedules

Electrical schematic drawings

- □ 120 V panel schedules
- Control Circuit
- Discrete and Analog input/outputs
- Connection diagram
- Electrical Details

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FIGURE 12.1

HENDERSON UTILITY GUIDELINES

B LOAD CALCULATIONS

7/DESCRIPTION	KVA	HF	FLA
MOTORI DADS			
IENT NAME (EQUIPMENT TAG NUMBER)		0.0	0.0
IENT NAME (EÚUT/MENT TAÓ NUMBER)		0.0	0.0
IENT NAME (EQUIPMENT TAG NUMBER)		0.C	0.0
IENT WARE (EQUIPMENT TAG NUMBER)		0.0	00
NON MOTOR LOADS			
IENT WARE (EQUIPMENT TAG NUMBER)	00		00
IENT NAME (EQUIPMENT TAG NUMBER)	0.0		0.0
IENT NAME (EQUIPMENT TAG NUMBER)	0.0		0.0
SUB OTAL			0.0
1.25% OF LARGEST MOTOR.			0.0
TOTAL AMES @ 400V/3EHASE			0.0
SERVICE SIZE (AVIPS)			0.0

CHAPTER 13 INSTRUMENTATION AND CONTROL

13.01 General

- A. The instrumentation and control systems design shall comply with National Electric Code (NEC) and applicable local codes. The equipment shall be manufactured in accordance with the standards of the Institute of Electrical and Electronic Engineers (IEEE) and the National Electrical Manufacturers Association (NEMA). Where applicable, the instrumentation and control equipment shall require a "label" indicating compliance with the standards of a nationally recognized organization, such as Underwriters Laboratory (UL) or Factory Mutual System (FM). Instrumentation and controls facilities shall be provided to measure, control, and monitor pumping operations and other auxiliary equipment. Pumping operations include, but not limited to, pump stations, surge tanks, regulating reservoirs, wastewater lift stations, pressure reducing stations, meter vaults, and turnout/rate of flow control systems.
- B. Applicable Codes and Standards:

Reference	Title
API RP550	Manual on Installation of Refinery Instruments and Control Systems
IEEE 100	Dictionary of Electrical and Electronic Terms
IEEE 472	Guide to Surge Withstand Capability (SWC) Tests
ISA S5.1	Instrumentation Symbols and Identification
ISA S5.3	Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Systems
ISA S5.4	Instrument Loop Diagrams
ISA RP7.3	Quality Standard for Instrument Air
ISA RP12.6	Installation of Intrinsically Safe Instrument Systems in Class I Hazardous Location
ISA S18.1	Annunciator Sequences and Specifications
ISA S20	Specification Forms for Process Measurement and Control Instruments, Primary Element and Control Valves
ISA 51.1	Process Instrumentation Terminology
NEMA 250	Enclosures for Industrial Controls and Systems
NEMA ICS	Industrial Control
NFPA 70	National Electrical Code (NEC)

Table 13.1Instrumentation and Control Standards

NFPA 72	National Fire Alarm Code
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C. The Engineer shall be responsible for requiring the Contractor to have a qualified Control Systems Integrator (CSI) on the construction team. This CSI will be responsible for single point of responsibility for providing software, hardware, programming, telemetry, instrumentation, loop checks, commissioning and startup. The CSI shall be responsible for a full and operational instrumentation and control system of the project.

13.02 Analog Analyzers

- A. Residual Chlorine/pH Analyzers: shall be provided to sample chlorine residual as appropriate for controlling chlorine residual and shall be:
 - 1. Equipped with 4-20 mA analog output.
 - 2. Manufactured by Rosemount, Series FCLi.
- B. ORP Analyzers: shall be provided to sample the Oxidation Reduction Potential (ORP) in and solution and shall be:
 - 1. Equipped with 4-20 mA analog output.
 - 2. Manufactured by Strantrol (Seimens), Series 880.
- C. H2S Analyzers: shall be provided to sample Hydrogen Sulfide in the immediate area of the analyzer and shall be:
 - 1. Equipped with 4-20 mA analog output.
 - 2. Manufactured by Industrial Scientific, Series iTrans.
- D. Chlorine Gas Detection: shall be provided to sample chlorine gas and shall be:
 - 1. Electrochemical sensor type.
 - 2. Equipped with 4-20 mA analog output.
 - 3. Suitable to measure chlorine gas from 0 to 10 parts per million.
 - 4. Manufactured by ATI, Series 12.

13.03 Flow Measurement

A. Magnetic Flow Meters: The selection of the magnetic flow meter and its location depends on many factors. A few of these factors include having adequate station area to allow installation of the selected meter; providing sufficient straight pipe

runs upstream and downstream of the meter; and having the appropriate piping orientation and configuration for the type of meter chosen. The required distance of straight-run pipe upstream and downstream of a flow meter depends on the type and manufacturer of meter chosen. The use of flow straightening vanes prior to the meter can significantly reduce the required straight-run distance. The Engineer shall evaluate each flow meter application on an individual basis. The minimum flow meter requirements are as follows:

- 1. Magnetic flow meters shall be a flow tube type meters.
- 2. A remote transmitter shall be mounted in a building or a shaded area.
- 3. Lining and electrodes shall be compatible with appropriate water type.
- 4. A 4-20 mA output for flow rate and pulse output totalization.
- 5. Meter shall have "smart" electric circuitry and shall be of the two-wire type and must support Highway Addressable Remote Transmitter (HART) protocol.
- 6. Acceptable manufacturers for flow meters are as follows:
 - a) ABB, Series MAG 50XM.
 - b) Endress Hauser, Series Promag.
- 7. Flow metering shall be performed above grade to avoid confined space entry issues.
- 8. If confined space entry conditions cannot be avoided, refer to Chapter 11 for vault requirements.
- B. Flow Switches:
 - 1. Contacts shall be dry type and shall be rated 10 amperes at 120 volts ac.
 - 2. Switches shall be "snap-action" switch type.
 - 3. Manufacturer of the switch shall be approved during design by the COH.

13.04 Level Measurement

- A. Ultrasonic Level Sensors:
 - 1. Equipped with 4-20 mA analog output.
 - 2. Acceptable manufacturers for Level Transmitters are as follows:
 - a) Single Element:
 - 1) Siemens, Series HydroRanger200.
 - b) Dual Element:

- 1) Siemens, Series Siemens Airanger.
- B. Level Switches:
 - 1. Contacts shall be dry type and shall be rated 10 amperes at 120 volts ac.
 - 2. Switches shall be "snap-action" switch type.
 - 3. Manufactured by Magnetrol, Series STI A15.

13.05 Pressure Measurement

- A. Smart Pressure and Pressure Sensing Level Transmitters:
 - 1. Acceptable manufacturers for Level Transmitters are as follows:
 - a) Endress Hauser, Series Cerabar M PMC71.
 - b) Foxboro, Series IGP10.
 - 2. Transmitters shall have "smart" electronic circuitry and shall be of the twowire type and must support Highway Addressable Remote Transducer (HART) protocol.
 - 3. Process fluid shall be isolated from the sensing elements by AISI Type 316 stainless steel, Hastelloy C or cobalt-chromium-nickel alloy diaphragms and a silicone fluid fill.
 - 4. Transmitters shall have self-diagnostics and electronically adjustable span, zero and damping with a rangedown of 10:1 with a reference accuracy of 0.075 percent as well a stability of plus or minus 0.15 percent of upper range over 5 years.
 - 5. Transmitters shall have integral temperature compensation capabilities.
 - Transmitters shall be suitable for operation at temperatures from 0 degrees Fahrenheit to 180 degrees Fahrenheit and relative humidity of 5 to 100 percent. All parts shall be cadmium-plated carbon steel, stainless steel or other corrosion-resistant materials. Drift specs of not to exceed 0.125 percent URL for 5 years.
 - 7. Transmitters shall have over-range protection to maximum line pressure.
 - 8. Accuracy of the transmitter shall be 0.10 percent of span and transmitter output shall be 4-20 mA DC without the need for external load adjustment.
 - 9. Transmitters shall not be damaged by reverse polarity and shall have a surge protection circuit.

- 10. Transmitter shall have an elevated or suppressed zero as required by the application.
- 11. For calibrated spans of less than 0.8 PSIG, a differential pressure type transmitter with wide side vents shall be utilized.
- 12. Transmitters shall be provided with AISI Type 316 stainless steel brackets for wall and pipe-stand mounting and shall have AISI Type 316 stainless steel block and bleed valve.
- 13. Transmitters tagged on the drawings or specified to be indicating type shall be furnished with LCD type digital indicators, scaled in engineering units.
- B. Pressure Switches:
 - 1. Acceptable manufacturers for pressure switches are as follows:
 - a) Ashcroft, Series B400.
 - b) Mercoid/Dwyer, Series DA.
 - 2. Pressure switches shall be field adjustable and shall have a trip point repeatability of better than 1 percent of actual pressure.
 - 3. Contacts shall be rated 10 amperes at 120 Volts ac.
 - 4. Switches shall have over-range protection to maximum process line pressure.
 - 5. Switches mounted inside panels shall have NEMA Type 1 housings. All other switches shall have NEMA 4X housings.
 - 6. Switches shall be of the differential pressure type where indicated on the drawings or in the device schedules.
 - 7. Switches shall be "snap-action" switch type. No mercury bulb types will be allowed.

13.06 Temperature Measurement

- A. Temperature Transmitter:
 - 1. Equipped with 4-20 mA analog output.
 - 2. Manufactured by Hoffman, Series ATEM.

13.07 Miscellaneous Field Instruments

A. Miscellaneous Field Instruments:

- 1. Digital Panel Indicators: 3 .5-inch digit, 4-20 mA current loop panel meter, zero and span potentiometer.
- 2. Signal Isolator: AGM Loop Powered Isolator, Model AUX4000-24, adjustment screw to fine tune 4-20 mA output.

13.08 Uninterruptible Power Supply (UPS)

- A. An uninterruptible power supply (UPS) shall be provided to power communications, PLC, and instruments only. UPS shall be evaluated for emergency exhaust systems associated with chemical feed systems.
- B. Each panel furnished with a programmable logic controller (PLC) shall have one UPS. The UPS shall be true double conversion, on-line unit with total harmonic distortion of less than 2.5%. The UPS shall comply with IEEE Standard 519 with the point of common coupling defined as the panelboard feeding the UPS and be designed to provide battery backup power for a minimum of 12 hours. UPS shall have discrete outputs to the PLC indicating "UPS on battery power" and "UPS low battery".
- C. The UPS shall be APC 1000XL with extra battery banks.
- D. The UPS shall be provided with the monitoring battery status option which can be tied into the PLC.

13.09 Programmable Logic Controllers (PLCs)

A. The Engineer shall provide PLC and operator interface equipment in accordance with approved equipment listed in Section 13.15.

13.10 Supervisory Control and Data Acquisition (SCADA)

A. The Engineer shall contact the COH to request the most recent SCADA Guidelines.

13.11 Process Control

- A. Process and Instrumentation Diagrams (P&IDs): The Engineer shall develop detailed P&IDs for all facilities, which utilize analog or discrete instrumentation for operation and control of motorized equipment, which includes pump stations, pressure-reducing stations, reservoirs, and lift stations. P&IDs shall meet all ISA standard 5.1 and follow the template shown in Figure 13.1 P&IDs shall include the following at a minimum:
 - 1. Schematics to represent left-to-right flow of all liquid and solids streams.

- 2. Standard symbols for equipment, valves, instrumentation, and process streams.
- 3. Standard symbols for discrete and analog signals and corresponding pushbuttons, toggle switches, displays and lights.
- 4. Interlocks and alarms.
- B. P&ID Support Documents: Support documents shall be developed to provide a completed design that is constructible and biddable. Support documents shall be provided to the COH in hard copy and electronic format and include the following:
 - 1. PLC input and output point summary lists.
 - 2. Instrument summary list.
 - 3. Control Strategies.
 - 4. Instrumentation detail drawings.
 - 5. Panel layout drawings.
 - 6. SCADA system communication block diagram.
- C. PLC Input and Output Point Summary Lists: The Engineer shall compile a listing of all the required I/O points associated with the I&C system. The tabulation shall list all points required to meet immediate and future process needs as separate entities. I/O shall be in a logical order of the P&ID drawings referenced. Spare points shall not be annotated. The I/O list shall include tag/loop number, process description, P&ID drawing reference, I/O type (analog, discrete, digital link), associated number, and a remarks column to present clarifications as needed (e.g. if a pulse input is required, future point required). Each instrument and I/O summary shall be organized by PLC and shall include the following information:
 - 1. Tag number of I/O point.
 - 2. Description of I/O point.
 - 3. P&ID drawing number on which the I/O point is indicated.
 - 4. Associated specification section.
 - 5. I/O type (analog, discrete, digital link, etc.).
 - 6. Associated control panel number.
 - 7. Applicable installation detail.

- 8. Applicable remarks or comments not covered elsewhere.
- 9. Total number of digital input, digital output, analog input and analog output points associated with each PLC.
- 10. Data map with all registers and functions.
- D. Instrumentation Summary List: The Engineer shall compile a listing of all required instruments. The instrument summaries shall list each instrument's tag and loop number, specification number, associated instrument panel name/number, I/O list (including tag and loop number, process description and P&ID drawing reference), installation detail number, instrument range, instrument setpoints, trip points, NEMA rating, material requirements and all other data needed to precisely define the instrument requirements. Presented in hardcopy and electronic format.
- E. Control Strategies: The Engineer shall develop a control strategy shall be prepared for each instrument loop that controls equipment. In addition, overall process control strategies, which interlock numerous individual control strategies to provide an efficient operator interface, shall also be prepared. Control and process strategies shall:
 - 1. List all applicable inputs and outputs.
 - 2. Provide a general description of operation of the overall system(s) controlled by the PLC identifying each control loop and its integrated function within the overall system(s). Provide description of indication, alarming, trending, and control functions not shown on the P&IDs required for the operator interface for operation of each system.
 - 3. Provide an explicit description of how each device in the control loop functions and its integrated function within the loop if there is more than one device within the loop. Provide description of indication, alarming, trending and control functions not shown on the P&IDs required for the operator interface for operation of each device.
 - 4. Describe monitoring, alarm and control functions associated with Local, Remote-Auto and Remote-Manual control. Local shall be defined as control and/or monitoring of a device in the field at the device. Remote-Auto and Remote-Manual are defined as control and/or monitoring of a device by the operator using the control system.
 - 5. Describe in detail the sequence of operations required to start or stop a device under normal and abnormal conditions under Local, Remote-Auto

and Remote-Manual control. Describe all required interlocks and permissives both process and safety.

- 6. Describe what happens under abnormal conditions such as a control system failure including transmitter failure, abnormal process values and loss of communication between PLCs and power failure. Describe recovery of the control system from abnormal conditions.
- 7. Describe emergency/power outage shutdown procedures.
- 8. Shall identify all process trip points, set points, and timers required by a control loop.
- 9. Be annotated using the instrument and equipment tag numbers shown on the P&IDs and a P&ID reference will be provided.
- 10. Allow for documentation to be presented in hardcopy and electronic format.
- F. Instrumentation Detail Drawings: The Engineer shall provide installation details of all instruments.
- G. Panel Layout Drawings: The Engineer shall develop panel layout detail drawings which are required for control panels. Each face-mounted device shall show a reference number which is coordinated with the instrument and I/O summary. Front-view drawings shall show maximum cabinet dimensions, with minimal detail dimensions because the specific equipment dimensions and clearances are not generally known during design. Nameplate and Operator Interface Schedules will be shown on the drawings.
 - 1. Control Panels: Control panels shall be installed in enclosures that are environmentally suitable for the area. Lens covers for indicating lights on all control panels will be colored as determined by the COH.
 - 2. Control Panels: In addition to meeting present needs, all control panels shall have a spare capacity (e.g. I/O cards, memory, panel size, terminations, power supplies, and cable management) of 20 percent above total design capacity to be allocated for future needs. All control panels which are designed to accommodate future expansion will be provided with blank plates to cover cutouts.
- H. SCADA System Communication Block Diagram: The Engineer shall provide a SCADA System Communication Block Diagram that details the telemetry of a new system and describes how a new facility ties into the existing COH SCADA system.
- I. The Engineer shall also follow these criteria:

- 1. Field Instrumentation: All field instruments shall be of the latest proven design and manufacturing. Each instrument shall have a history of successful use in its specified application. If the failure of any single field instrument could jeopardize the continuous operation of the process, redundant instruments shall be designed for a fault-tolerant configuration. Analog signals shall be 4 to 20 mA.
- 2. Detailed design shall promote commonality of hardware in accordance with COH standards.
- 3. Controllers, instruments, and control panels shall be designed to accommodate all design loads, immediate and future. The Engineer shall allocate all required space and resources needed to support the installation of equipment and control panels. All instrument ranges will be scaled in English units to the measured variable of the process.

13.12 Controls and Instrumentation Commissioning

- A. The Contractor's CSI shall provide and submit a testing and start-up plan for approval by the Engineer prior to the commencement of work.
- B. Prior to commissioning:
 - 1. The Contractor's CSI and its instrument suppliers to prepare and submit loop diagrams conforming to ISA 5.4. The Contractor shall provide loop diagrams conforming to the expanded format of ISA 5.4 for all loops. The loop diagrams shall incorporate all instruments and all loops associated with the I&C system.
 - 2. Remove shipping stops from instruments before starting with procedures specified.
 - 3. Contractor's CSI shall provide instruction manuals.
 - 4. Install temporary testing components as required, furnished separately.
 - 5. Verify nameplate data with respect to conditions of range, operating temperature, specific gravity, and components as stated on unit specifications. Discrepancies shall be immediately called to attention of the COH QC representative and report of its condition confirmed in writing.
- C. Commissioning responsibilities:
 - 1. Verify instrument installation in conformance with manufacturer's recommendations.

- 2. Follow manufacturer's recommendations for calibrating control system components including instruments, switches, valves, etc.
- 3. Calibrate instruments individually and where applicable, as a system (i.e. transmitter, controller and control valve).
- 4. Verify control system components calibration meets published accuracies over full operational range.
- Defective equipment: If any instruments cannot be properly adjusted or does not meet manufacturer's specifications, immediately call to attention of the COH QC Representative and report of its condition confirmed in writing. Repair or replace equipment furnished as part of the contract documents.
- 6. Calibration of supplementary supply and output pressure gauges contained on instruments will not be required. If the gauge is found to be faulty, follow the requirements of the troubleshooting section of the manufacturer's maintenance and operation manual.
- 7. Complete data sheets in accordance with ISA S20 for all instruments shall be prepared and submitted.
- 8. Complete calibration report form for each instrument and control device and include with applicable O&M manual.
- 9. Calibration stickers: Upon successful calibration, affix calibration sticker to instrument or control component. Calibration sticker shall contain equipment identification number, calibrated range or switch set and reset conditions, date of calibration, due date for next calibration, and name of person performing calibration.
- 10. Check instrument and control wiring for proper operation.
- 11. After energizing and prior to start-up, check control circuits and programs for proper sequence of operations and interlocking functions.
- 12. Correct any wiring changes required as a result of checks including properly changing terminal strip and/or wiring markers, and associated documentation including schematics and termination diagrams.
- D. Test procedures:
 - 1. Analog devices: Include 9-point span test (0 percent, 25 percent increasing, 50 percent increasing, 75 percent increasing, 100 percent, 75

percent deceasing, 50 percent decreasing, 25 percent decreasing, 0 percent) verifying linearity and hysteresis meets specified values.

- 2. Discrete devices: Use multiple state changes to verify set point, reset point and deadband.
- E. Acceptable calibration standards:
 - 1. Vacuum or draft:
 - a) 0 5 inches w.c.: Inclined water-filled manometer graduated in hundredths of inches of water.
 - b) 5 25 inches Hg: Mercury manometer graduated in tenths of inches of mercury.
 - c) 5 60 inches w.c.: Water manometer graduated in tenths of inches of water.
 - d) Electronic: Digital manometer, ±0.25 percent full scale accuracy, 3.5digit LCD display, ranges of 0 - 19.99 inches w.c. and 0 -199.9inches w.c., ±1 percent LSD.
 - 2. Pressure:
 - a) 0 5 inches w.c.: Inclined water-filled manometer graduated in hundredths of inches of water.
 - b) 5 60 inches w.c.: Water manometer graduated to tenths of inches of water.
 - c) 3 psig 25 psig: Mercury manometer graduated to tenths of a psi.
 - d) 25 psig 150 psig: Precision pressure gauge, 0-160 psig, 1/4 of 1 percent accuracy, 8-1/2 inches dial minimum.
 - e) 150 psig 750 psig: Precision pressure gauge, 0-800 psig, 1/2 of 1 percent accuracy, 8-1/2 inches dial minimum.
 - f) 750 psig 2,750 psig: Precision pressure gauge, 0-3,000 psig, 1/2 of 1 percent accuracy, 8-1/2 inches dial minimum.
 - g) Electronic: Digital manometer, ±0.1 percent full scale accuracy, 3.5digit display, ranges of 0 psig to 19.99 psig, 0 psig -199.9 psig and 0 psig - 1,999 psig, ±1 LSD.
 - 3. Differential:
 - a) 0 5 w.c.: Inclined water-filled manometer graduated in hundredths of inches of water.
 - b) 5 300 w.c.: Mercury manometer graduated in tenths of inches of water.
 - c) 5 25 psig: Mercury manometer graduated in tenths of a psi.
 - d) Above 25 psig: Use pressure gauges specified.

- e) Electronic: Digital differential manometer, ±0.1 percent full scale accuracy, 5-digit LCD display, ranges of 0 200-inches w.c. and 0 2,000 w.c., ±1 LSD.
- 4. Temperatures:
 - a) -20 250°Farenheit: Laboratory thermometers of suitable range.
 - b) Other ranges: Use thermocouple and precision potentiometer.
 - c) Electronic: Digital thermometer, ±0.1 percent of reading accuracy, 4digit LCD display, ±1 LSD.
- 5. DC process signal calibrator: 2-wire transmitter simulator:
 - a) 4-20 mA range: ±0.5 percent full scale accuracy, 4-digit LCD display, ±1 LSD.
 - b) 10-50 mA range: ±0.06 percent full scale accuracy, 4.5-digit LCD display, ±1 LSD.

13.13 Calibration of Panel Mounted Instruments

- A. Receiver instruments:
 - 1. Perform 9-point span test (0 percent, 25 percent increasing, 50 percent increasing, 75 percent increasing, 100 percent, 75 percent decreasing, 50 percent decreasing, 25 percent decreasing, 0 percent) verifying linearity and hysteresis by impressing measured signal into input or signal connections on instrument.
- B. Controllers (panel or control room mounted):
 - 1. Check for proper operation and adjust in accordance with manufacturer's instructions. Vary process input signal and check output signal for direction.
 - 2. Set initial proportional band, reset rate, and rate time as recommended by manufacturer. It may be necessary to determine the process dynamics in actual operation before settings can be made.
 - 3. Control loops shall be observed for operability and conformance by impressing simulated input signal at primary element and checking response of final control element.
- C. Integrators, ratio relays, etc.:
 - 1. Check in conformance to manufacturer's recommendations. Receiver integrators shall be calibrated for proper operation and multiplication factor by feeding maximum input signal for specified period of time with stopwatch.

- 2. Check conformance to manufacturer's recommendations. Ratio signals shall be simulated to check proper ratio settings and output.
- D. Graphic panel:
 - 1. If possible, trip each alarm actuator (field device) in sequence and observe graphics. Check "acknowledge" and "test" pushbuttons.

13.14 Instrumentation Specifications

A. The Engineer shall compile instrument specifications for each type of field and panel-mounted instrument to be provided.

13.15 Reference Information

- A. PLC Equipment
 - 1. Programmable Logic Controller
 - a) The Engineer shall contact COH to request the most recent SCADA Guidelines.
 - 2. Data Panel
 - a) Maple Systems, Inc.: 12" Silver Plus Series Part # 5121T
 - 3. Communications
 - a) NR&D Universal Comm: QUCM-OE
 - b) NR&D SPE4 Plus: SPE4-2S
 - c) NR&D Media Converter: DDC21
 - d) MDS Radio: 9710A, 9710B, or INET based on the communication path approved by COH.
 - e) MDS RS232/RS422: 01-2358A01, Rev. 1 Converter
 - f) 4-Wire Data Modem: Adtran 4-wire Data Modem DSU III AR Part # 1202011L1
 - 4. UPS
 - a) APC: 1000XL
 - b) Extra Battery Pack: SUA24XLBP
- B. Loop and Tag Standardization

Table 13.1Loop and Tag Standardization

Loop	Standard Tag
Loop 01, 11	Reservoir Level Indications, and Alarms
Loop 02, 12	Remote Reservoir level Indications Alarms

Loop	Standard Tag
Loop 03, 13,	Pump Section Pressure
Loop 04, 14	Compressor/Surge Tank
Loop 05, 15,	Discharge Flow (i.e. Pump, Etc)
Loop 06	Communications, Radio or Modem
Loop 07, 17,	Discharge Pressure (i.e. Pump, Etc)
Loop 08, 18,	Intrusion, Hatch Intrusion
Loop 09	Commercial Power
Loop 10, 20,	To be used as needed (Chlorine, Etc)
Loop 90	Standby Power, Generators, and UPS
Loop 100	Pump 1 Status and Alarms (or Flow Control Valve)
Loop 200	Pump 2 Status and Alarms (or Flow Control Valve)
Loop 300	Pump 3 Status and Alarms (or Flow Control Valve)
Loop 400	Pump 4 Status and Alarms (or Flow Control Valve)
Loop 500	Pump 5 Status and Alarms (or Flow Control Valve)
Loop 600	Pump 6 Status and Alarms (or Flow Control Valve)
Loop XX0	PLC Health Status, PLC Halted and PLC Clock (Last Three Digits

13.16 Design Checklist

A. A checklist is provided at the end of this chapter for the Engineer's reference and use during design and may not include all applicable design criteria. It is the Engineer's responsibility to review and comply with all guidelines contained herein and all applicable codes completely prior to submitting for review.

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DEPARTMENT OF UTILITY SERVICES

TECHNICAL SERVICES DIVISION NEW DEVELOPMENT SECTION

CITY OF HENDERSON 240 WATER STREET HENDERSON, NEVADA 89015

UTILITY SERVICES Instrumentation and Control

Design

- □ Analog Analyzers
- **G** Flow measurement
- Level Measurement
- Pressure Measurement
- Temperature Measurement
- Calibration of Panel Mounted Instruments

Specifications

□ Specifications

Henderson Utility Guidelines

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DESCRIPTION			DRAWN BY	DATE		
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					FIGURE	
ENDERSON	UTILITY	GUIDEL	lnes			

EXAMPLE - DEVICE IDENTIFICATION		
FORST LETTER	PROCESS INTERCONNECTIONS NO 1 N	
	GATE VALVE	$ \ominus$
PREFIX (NOTE 5)		
LOOP NUMBER (NOTE 6)	PNEUMATIC, INSTRUMENT AIR	
	L L L L HYDRAULIC LINE	
FIRST LETTER	ELECTRIC TRACED LINE DALL VALVE	
TAG NUMBER/LETTER IDENTIFICATION		
MEASURED OR MODIFIER READOUT OR OUTPUT MODIFIER INITIATED VARIABLE PASSIVE FUNCTION FUNCTION		
A ANALYSIS (NOTE 1) ALARM	PROCESS OR EQUIPMENT CONTROL PANEL/ENCLOSURE	
C CONTROL CLOSE/CONTROL CLOSED	1/1 SIGNAL ISOLATOR	
D DENSITY OR SPECIFIC GRAVITY E VOLTAGE PRIMARY ELEMENT EAST	FLOW INDICATOR	
F FLOW RATIO G NDTE 4 GLASS OR GAUGE	SONIC FLOW METER ///////////////////////////////////	
H HAND (MANUAL) HIGH (OPE	D VORTEX SENSOR SOLENOID VALVE - 2 WAY	
J POWER SCAN CONTROL STATION		
L LEVEL LIGHT (PLOT) LOW	M MAGNETIC FLOW METER	
N DOOR NORTH NORTH		
O NOTE 4 OPEN P PRESSURE OR VACUUM PLC		
Q QUANTITY OR EVENT TOTALIZE R RADIATION REMOTE RTU	Sonic Level Indicator/Transmitter	
S SOLENOID SWITCH SOUTH T TEMPERATURE TRANSMIT	-D- CONCENTRIC REDUCER	
U MULTIVARIABLE MULTIFUNCTION VALVE		
WEIGHT WELL/WATER SERVICE		
Y PRESENT STATE OR EVENT RELAY OR COMPUTE		
Z POSITION, LIMIT ACTUATOR,	ELBOW - AWAY FROM VIEWER POLSATION DAMPENER WITH PRESSURE GAUGE P PRESSURE GAUGE	
POSITIONER		
 ON EDGRAM, "WELSIG AND LOSID IN INC. THE OF AVAILABLE IN THE OF AVAILABLE OF START WILL BE USED TO A LIMITED EXTENT. MEANINGS WILL DEFINED OUTSIDE TAGGING BALLOON. INTENDED TO COMPUTING DEVICE WILL BE DEFINED OUTSIDE TAGGING BALLOON. USER'S CHOICE. THE INSTRUMENT LOOP NUMBERS SHALL BE PRECEDED BY THE FOLLOWING PREFIXES: PREEIX LOCADIDN USER'S CHOICE. DISTRICT STANDARD LOOP NUMBERS SHALL BE PRECEDED BY THE FOLLOWING PREFIXES: 	EQUIPMENT/DEVICE SYMBOLS IL BE IL BE	
City Of Henderson	DEVICE IDENTIFICATION, LINE SYMBOLS	HŁ
	EQUIPMENT/DEVICE SYMBOLS. VALVE SYMBOLS	
Clark County, Nevada	INSTRUMENT AND FUNCTION SYMBOLS	
Department Of Utility Services		
A Parts Coll de	RE	VISION No.

TRUMENT AND FUNCTION SYMBOLS	
PRIMARY DEVICE/ELEMENT, FIELD MOUNTED	
DEVICE/ELEMENT, OPERATOR ACCESS, INSTALLED NEAR ELEMENT OR ON LOCAL PANEL	
DEVICE/ELEMENT, NO OPERATOR ACCESS, INSTALLED BEHIND LOCAL PANEL	
AUXILIARY DEVICE/ELEMENT, OPERATOR ACCESS, INSTALLED ON AUXILIARY PANEL	
AUXILIARY DEVICE/ELEMENT, NO OPERATOR ACCESS, INSTALLED BEHIND AUXILIARY PANEL	
INDICATING LIGHT, OPERATOR ACCESS, FIELD MOUNTED	
ILLUMINATED LIGHT, OPERATOR ACCESS, INSTALLED NEAR ELEMENT OR ON LOCAL PANEL	
ILLUMINATED LIGHT, NO OPERATOR ACCESS. INSTALLED BEHMD LOCAL PANEL	
AUXILIARY ILLUMINATED LIGHT, OPERATOR ACCESS, INSTALLED ON AUXILIARY PANEL	
AUXILARY ILLUMINATED LIGHT, NO OPERATOR ACCESS, INSTALLED BEHIND AUXILIARY PANEL	
DUAL DISPLAY/CONTROL FUNCTION, OPERATOR ACCESS, FIELD MOUNTED	
DUAL DISPLAY/CONTROL FUNCTION, OPERATOR ACCESS, INSTALLED NEAR ELEMENT OR ON LOCAL PANEL	
DUAL DISPLAT/CONTROL FUNCTION, NO OPERATOR ACCESS, INSTALLED BEHIND LOCAL PANEL	-
AUXILIARY, DUAL DISPLAY/CONTROL FUNCTION, OPERATOR ACCESS, INSTALLED ON AUXILIARY PANEL	
AUXILIARY, DUAL DISPLAY/CONTROL FUNCTION, NO OPERATOR ACCESS, INSTALLED BEHIND AUXILIARY PANEL	
PLC, PRIMARY LOGIC ELEMENT, FIELD INPUT/OUTPUT	
PLC, PRIMARY LOGIC ELEMENT, OPERATOR ACCESS, PRIMARY/MAIN INPUT/OUTPUT	
PLC, PRIMARY LOGIC ELEMENT, NO OPERATOR ACCESS, PRIMARY/MAIN INPUT/DUTPUT, VIRTUAL SOFTWARE	
PLC, AUXILARY/REMOTE LOGIC ELEMENT, OPERATOR ACCESS, AUXILLARY/REMOTE INPUT/OUTPUT	
PLC, AUXILMARY/REMOTE LOGIC ELEMENT, NO OPERATOR ACCESS, AUXILMARY/REMOTE INPUT/OUTPUT	
PCS/COMPUTER PRIMARY LOGIC ELEMENT, FIELD INPUT/OUTPUT	
PCS/COMPUTER PRIMARY LOGIC ELEMENT, OPERATOR ACCESS, PRIMARY/MAIN INPUT/OUTPUT	
PCS/COMPUTER PRIMARY ELEMENT, NO OPERATOR ACCESS, PRIMARY/MAIN INPUT/OJTPUT	-
PCS/COMPUTER AUXILIARY ELEMENT, OPERATOR ACCESS, AUXILIARY/REMOTE INPUT/OUTPUT	-
PCS/COMPUTER AUXILIARY ELEMENT, NO OPERATOR ACCESS, AUXILIARY/REMOTE INPUT/OUTPUT	
XYZ INSTRUMENT OR DEVICE CONTROL FUNCTION DESIGNATIONS HOA HAND-OFF-AUTO LOR LOCAL (OFF) REMOTE HS HAND SWITCH RSL RAISE-STOP-LOWER OCA OFFN-CLOSE-AUTO AM AUTOMATIC-MANUAL LOS LOCKOUT STOP SS STOP-START SL SELECT SD SHUTDOWN	
NDERSON UTILITY GUIDELINES	
	FIGURE
	13.2

DESCRIPTION

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