



PRELIMINARY DESIGN REPORT –POTABLE WATER TREATMENT PLANT

DUKE ENERGY OF FLORIDA

CITRUS COUNTY COMBINED CYCLE PROJECT

CITRUS COUNTY, FL

PRELIMINARY DESIGN REPORT

FOR

POTABLE WATER TREATMENT PLANT





PRELIMINARY DESIGN REPORT –POTABLE WATER TREATMENT PLANT

This specification has been revised as indicated below and described in the revision record on the following page. Please destroy all previous revisions.

Revision No.	Date	Originator's Name & Initials	Reviewed/Checked By Name & Initials	Pages Revised
A	07-Sep-16	Eileen M. Juhnevicz	J. Philip Bolton	N/A
00	07-Nov-16			N/A

APPROVALS

SIGNATURES

DATE

Lead Engineer: _____

Engineering Manager: _____

ISSUED FOR :

☐ Design ☐ Construction ☒ Other PERMIT



PRELIMINARY DESIGN REPORT –POTABLE WATER TREATMENT PLANT

Record of Revisions

Rev. No.	Date	Description
A	07-Sep-16	Issued for Review (IFR)
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PROFESSIONAL ENGINEER CERTIFICATION

The information contained in this report was prepared in accordance with sound engineering principals and the recommendations contained within have been discussed with the permittee.

J. Philip Bolton, P.E.

Florida License No. 79878

Date



PRELIMINARY DESIGN REPORT –POTABLE WATER TREATMENT PLANT

1.0 Introduction

This preliminary engineering report is submitted to the FDEP by Fluor Enterprises, Inc., J. Philip Bolton, P.E., consultant engineering for Duke Energy Florida, LLC. (DEF), the owner and operator of Citrus Combined Cycle Plant (CCCP) Units 1 & 2 located in Citrus County, Florida in order to comply with these requirements.

The proposed electrical generating facilities will be located on an approximately 400-acre site (Site) adjacent to the eastern boundary of DEF's existing Crystal River Energy Complex (CREC) and north of the existing transmission line right-of-way to the CREC. The facilities will consist of two natural gas-fired combined cycle units with each unit utilizing two advanced combustion turbine generators (CTGs), two heat recovery steam generators (HRSGs), one steam turbine generator (STG), and directly associated facilities. The proposed facilities also include several on- and off-Site associated linear facilities, including 230- and 500-kilovolt (kV) electrical transmission lines and pipelines for cooling tower makeup and blowdown, augmentation water, and well water. The off-Site portions of these linear facilities will be located within corridors wholly contained within DEF-owned CREC property. Each combined cycle unit will have a nominal generating capacity of 820 megawatts (MW), for a total nominal generating capacity of 1,640 MW. A location map and USGS quad map are provided in Attachment 1. The CCCP Site Layout is provided in Attachment 2.

The CCCP will require groundwater for various plant process and potable water uses. Process and potable freshwater needs for the Project include demineralized water for steam cycle makeup, plant service water, wash water, fire protection water, and potable water.

The proposed source of drinking water for the CCCP during operation is the Floridan aquifer. The freshwater needs will be provided through groundwater withdrawals from wells serving the existing CREC operations. In the Site Certification Application (SCA), DEF proposed obtaining groundwater "from the existing or replacement wells that serve Crystal River Units 1, 2, and 3" (SCA p. 4-30) via a connection to an existing well water supply pipeline within the proposed pipeline corridor (SCA p. 9-1, 9-5, Figure 9.0.0-1). DEF is continuing to evaluate the final details of the locations of potential replacement wells, but further engineering analysis has determined that a preferable option is to connect to the existing 24 inch well water supply pipeline for CREC Units 4 and 5, rather than Units 1, 2, and 3. In the fourth quarter of 2017, replacement wells for CREC Units 1, 2, and 3 will be installed and connections made to the raw water lines. Once engineering is complete on this work, this information will be submitted to FDEP for review. This change will not have impacts on groundwater usage because of the facility-wide allocation reflected in the existing conditions of certification. Operation of the CCCP is not expected to have any adverse impacts on the quality or quantity of the drinking water source.

The purpose of this permit application is to permit the CCCP potable water treatment plant that will be used at the facility. The potable water treatment system meets the applicable requirements of 62-555.320 FAC Design and Construction of Public Water Systems as noted in the following table.



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62-555.320 Design and Construction of Public Water Systems	Preliminary Design Report Section
(1) Sound Engineering Practice	All Sections
(2) Innovative or Alternative Processes and Equipment	Not Applicable
(3) Direct or Indirect Drinking Water Additives	Section 11.0, 12.0
(4) Flood Protection	Section 6.0
(5) Security	Section 6.0
(6) Capacity of Drinking Water Treatment Facilities	Section 3.0
(7) Raw Surface Water Pumping Stations	Not Applicable
(8) Well Pump Housing Well Pump Discharge Piping, and Well Pump Appurtenances.	Not Applicable
(9) Odor Control at Drinking Water Treatment Plants	Section 5.0
(10) Color Coding of Piping at Drinking Water Treatment Plants	Section 12.0
(11) Alarms for Nitrate/Nitrite Removal Equipment	Not Applicable
(12) Disinfection of Drinking Water	Section 10.0
(13) Chlorination Facilities for Disinfection of Drinking Water	Section 5.0, 6.0, 7.0, 10.0
(14) Standby Power	Section 13.0
(15) High-Service or Booster Pumps	Not Applicable
(16) Finished-Drinking-Water Meters	Attachment 3 (PFD), Attachment4 (Culligan P&ID)
(17) Finished Drinking Water Sampling Taps	Attachment 3 (PFD), Attachment4 (Culligan P&ID)
(18) Pumps Suction Piping	Not Applicable
(19) Finished Drinking Water Storage Capacity	Section 4.0
(20) Hydropneumatic Tanks	Section 4.0, Attachment 4 (Culligan drawings)
(21) Drinking Water Piping and Appurtenances	Section 10.0, 12.0, Attachment 5

The FDEP Conditions of Certification for CCCP is as follows:

The potable water supply system shall be designed and operated in conformance with the applicable requirements of Chapters 62-550, 62-555, 62-560, and 62-699, F.A.C. Information as required in Chapters 62-550, 62-555, 62-560, and 62-699, F.A.C., shall be submitted to FDEP 180 days prior to installation and operation of any potable water system. The operator of the potable water supply system shall be certified in accordance with Chapters 62- 602 and 62-699, F.A.C. All monitoring reports shall be submitted to FDEP SWD, Potable Water Section, and the Siting Coordination Office (SCO).



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2.0 Name/Location of New Water Treatment Plant

Citrus County Combined Cycle Plant
14385 N. Access Road
Crystal River, FL 34428

3.0 Design Capacity of New Water Treatment Plant

The new system is designed for 2250 gallons per day (GPD).

The potable water treatment package serves the Citrus County Combined Cycle Power Plant. There will be approximately 58 full time equivalent employees on site per day, with an estimated 21 equivalent shift personnel on site on weekends and holidays. Sizing of the system is based on 58 people using 25 gallons per day per person with approximately 55% additional margin ($58 \text{ people} \times 25 \text{ GPD/person} \times 1.55 = 2250 \text{ GPD}$).

4.0 Name/Location/Type/Useful Capacity of New Potable Water Storage Tank

The Potable Water Storage Tank (Equipment Tag 00YD-TNK-0100) has a total capacity of 4000 gallons with a daily water usage level of 2250 gallons. The hydropneumatic tank is designed and constructed in accordance with ASME VIII, Division 1 and 62-555.320(20), F.A.C. The tank is designed for 150 psig pressure and 100°F. The tank is located inside the Service Building (Attachment 2).

5.0 System Description

The CCCP Raw Water system is supplied from the existing CREC facility well water pipelines. For CCCP, new underground 8" HDPE piping (PE4710 SDR 11) will be tied to each header and combined to a single header that fills the two (2) Service Water/Fire Water Storage Tanks, each with a capacity of 430,000 gallons. The well water will be chlorinated in the aboveground carbon steel (ASTM 106-B) common header before it fills each Service Water/Fire Water Storage Tank. This chlorination will encourage the precipitation of iron, which will generally settle in the Service Water/Fire Water Storage Tanks and will be cleaned out periodically.

Two (2) x 100% Service Water pumps rated at 900 gpm at 186 feet TDH draw suction from each Service Water/Fire Water Storage Tank (total of 4 x 100% pumps). The Service Water pumps supply water for various applications throughout the plant such as washdown hoses in various buildings, demineralized water treatment and drinking water treatment. The Service Water piping (underground and aboveground) is carbon steel per ASTM A106-B.

The service water branch piping supplies water to the drinking water treatment skid, which is located in the Service Building. Water enters the 20 micron primary filter housing (two x 100% filters, one operating, one in standby). A turbidity meter is installed after the 20 Micron Filters to measure the level of turbidity still in the water as it enters the carbon block filters (two x 100%, one operating, one in standby). The carbon block filters are utilized to reduce the Total Organic Carbon (TOC) level in the water. The carbon block filters ensure compliance with odor control requirements referenced in 62-555.320(9), F.A.C.

Chlorine is fed into the water downstream of the carbon block filters to maintain the chlorine residual in the water. Two (2) x 100% chemical pumps are supplied. A static mixer is used to ensure proper mixing. A flow meter is utilized to provide a way of measuring the flow rate of water and feed it back to the plant DCS.

Inlet/outlet isolation valves and a bypass valve are provided for both the 20 Micron Cartridge Filter System and the Carbon Block Cartridge Filter System. Additionally, each has differential pressure transmitters so that pressure drop across the systems can be monitored for replacement. If replacement of the cartridge filter is required, the filter housing is isolated while the other filter is in operation. The cartridges will be disposed of off-site and there are no wastewater flows associated with the treatment process.



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The potable water leaves the skid and enters the 4000 gallon Potable Water Storage Tank. The tank has a sight glass indicator to monitor the water level. A drain down valve is provided in the sight glass indicator to flush out contaminants for maintenance purposes. The level in tank is controlled by demand. There are three (3) valves installed on the tank: Air Inlet, Safety Relief and Pressure Relief. When the level in the tank drops below a low level setting, the make-up water fill valve located on the water treatment skid, will open up filling the tank, in addition the Air inlet valve on top of the tank will open up. An oil-free air compressor will supply 65 PSI to the top of the tank. The pressure relief valve will remain closed. When level in tank reaches a high set point, both the make-up water valve and air inlet valve will close, and the pressure relief valve will open. A chlorine monitor is installed on the outlet of tank to monitor chlorine levels that is sent to the plant DCS.

The Process Flow Diagram for the system is provided in Attachment 3.

6.0 Site Plan /Flooding Elevation/Security

The CCCP Site Layout is shown in Attachment 2.

During Site construction, the facility footprint is expected to be raised by 8 to 9+ feet with compacted structural fill for flood protection to protect the facilities from Category 2 storm surge flooding as required by the Site Certification Application. The final constructed plant footprint will direct Site stormwater to four (4) stormwater detention ponds for infiltration. Stormwater flows, in the areas outside of the plant footprint, are expected to follow pre-construction flow-paths. All equipment will be placed on foundations with top of concrete (TOC) at 15'-6". This exceeds the requirements for a Category 2 storm surge. Potable water lines are separated from Sanitary or Storm sewers in accordance with 62-555.314. Underground potable water piping is installed per the Specifications and Drawings included in Attachment 5.

The Sodium Hypochlorite Injection Skid, which chlorinates the well water upstream of the Service/Firewater Tanks, is located in the Block 20 Cooling Tower Chemical Feed Pump Enclosure (Attachment 2). The injection pump skid takes suction from the 5000 gallon Sodium Hypochlorite Storage Tank located in the same enclosure. The 5000 gallon tank is a single walled tank that is surrounded by a 3'-0" high containment wall sized for 110% of the tank volume. The injection skid is surrounded by a 6-inch high curbed containment. The enclosure includes safety shower/eyewash stations.

The Drinking Water Treatment Skid and Potable Water Storage Tank will be located in the Service Building (Attachment 2). The treatment skid includes a 50 gallon single-walled, sodium hypochlorite tank. The entire skid is surrounded by curbed containment sized for 110% capacity of the maximum storage volume. The Service Building includes three safety shower / eyewash stations along with fire protection equipment and curbs to drain chemical to a safe location for disposal. This treatment shall be operated within a power plant that administratively monitors all personnel in the field to ensure they are meeting safety requirements.

The existing wellheads are secured in locked well houses or enclosed by a fence with a locked gate for security. The entire site is enclosed by a fence with an entrance gate controlled by security. Access to the site is controlled by card reader and a security camera at the gate. All camera images at the gate can be monitored at the control room in accordance with 62-555.320(5), F.A.C.



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7.0 Manufacturer's Technical Data

The Culligan Engineered System is designed for the following conditions:

	Design	Operating
Flow (gpm)	50	50
Pressure (psig)	150	100
Temperature (°F)	100	70

The Culligan Engineered System includes the following NSF certified equipment mounted on single skid:

- 2 x100% 20-Micron Primary Cartridge Filters (7 filter elements per housing)
- 1 – Turbidimeter
- 2 x 100% Carbon Filter s (7 filter elements per housing)
- 1 – 50 gallon chlorine tank
- 2 x 100% - 2.5 gph chlorine feed metering pumps
- 1 – static mixer
- 1 – flowmeter
- Various instrumentation and valves for a complete system.

The 4000 gallon pressurized storage tank, with a 2250 gallon potable water working capacity, is separate and comes with the following accessories:

- Pressure relief valves
- Level indicating transmitter
- Chlorine monitor with backflow preventer
- Drain valves

Attachment 4 provides the Culligan drawings and catalog cutsheets for their system.

8.0 Water quality data

The CCCP Drinking Water System is supplied initially by the CREC Units 4 and 5 water lines and wells. DEF is continuing to evaluate the locations of the replacement wells for the CREC Units 1, 2 and 3. Once final engineering is completed this information will be submitted to the FDEP for review and approval

The new drinking water treatment skid will meet or exceed applicable primary drinking water standards. After startup, the new system will be sampled for compliance with primary and secondary drinking water standards and the analytical results will be submitted with the Construction Completion Report.

9.0 System operation

The system will be available 24 hours per day, 7 days per week, operating on a demand basis controlled by the water level in the pressurized potable water storage tank. A flow diagram of the system is included in Attachment 3.

10.0 Disinfection

The water source is not impacted by surface water and there have been no recent detections of coliform bacteria in the source wells. Consequently, treatment for Cryptosporidium, Giardia lamblia and other virus inactivation has not been planned.



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After filtration, sodium hypochlorite will be injected to maintain a minimum free chlorine residual greater than 0.2 mg/L throughout the drinking water distribution system at all times. Disinfectant contact shall occur in the potable water storage tank.

Prior to being placed in service, the new system will be disinfected in accordance with AWWA C-651 (Disinfecting Water Mains), AWWA C-652 (Disinfection of Water Storage Facilities), AWWA C-653 (Disinfection of Water Treatment Plants), as incorporated into rule 62-555.330, FAC, and as required by 62-555.340, FAC.

Upon completion of the disinfection process, a bacteriological evaluation will be performed and the results submitted to the FDEP Southwest District Office.

11.0 Chemicals

The only chemical used in the drinking water treatment system is 12.5% sodium hypochlorite. The chemical used will conform to NSF Standard 60 and other documents adopted by 62-555.335, F.A.C.

12.0 Materials

All materials will comply with the following:

- NSF Standard 61 per 62-555.335, FAC
- Lead use prohibition per 62-555.322, FAC

Piping Material Specifications are included in Attachment 5.

New underground HDPE piping will be color-coded as required by NSF and 62-555.320(21)(b)3, F.A.C.

New aboveground piping will be color-coded in accordance with 62-555.320(10), F.A.C.

13.0 Standby Power

Standby power is not an issue for this drinking water facility as it will be located on-site at the Citrus County Power Plant, a power generating facility.

14.0 Attachments

Attachment 1: Site Location Map

Attachment 2: CCCP Site Layout and Building Drawings

Attachment 3: Process Flow Diagram and associated P&IDs

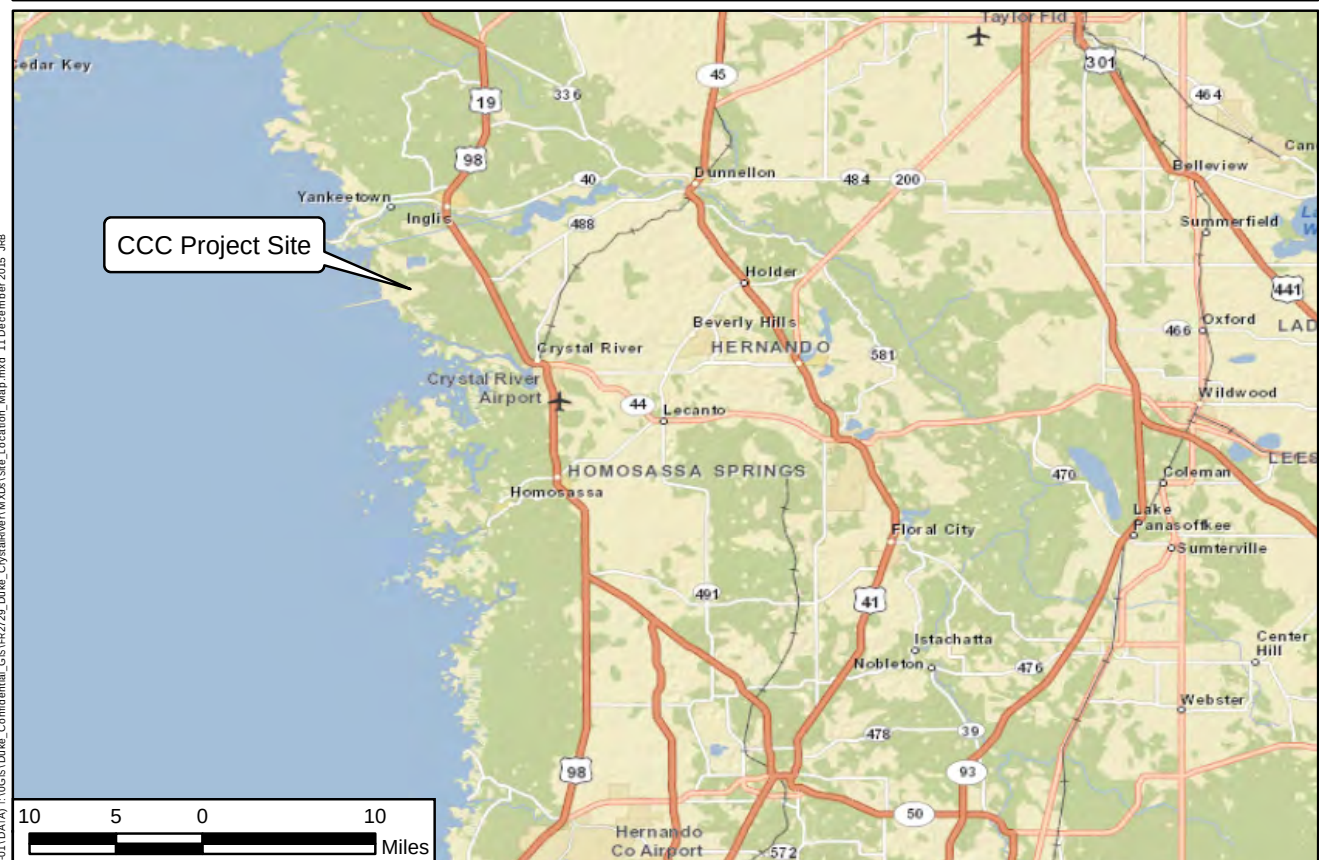
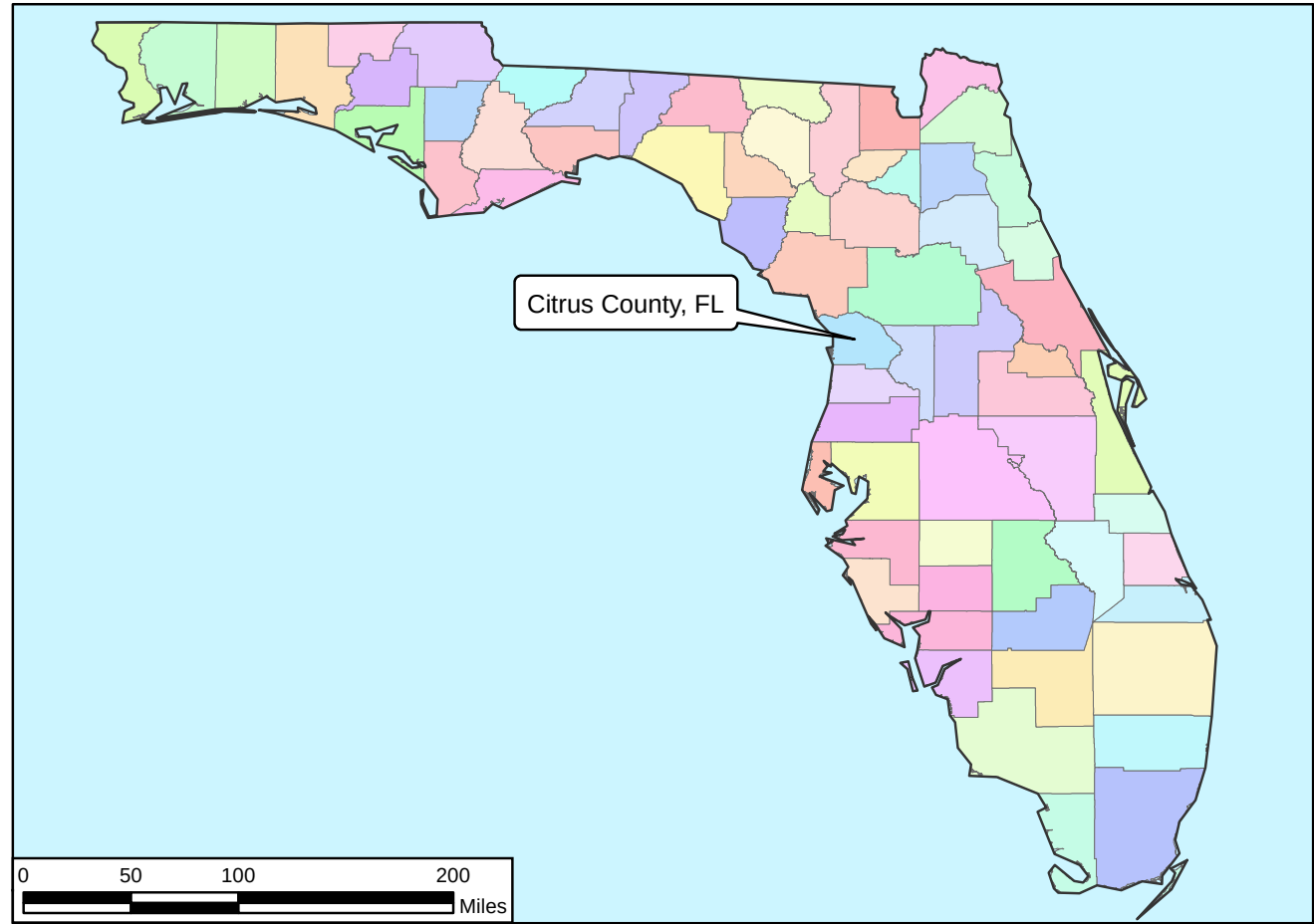
Attachment 4: Culligan Engineered Systems' Drawings for Drinking Water Treatment System

Attachment 5: Fluor Design Specifications, Drawings, Calculations

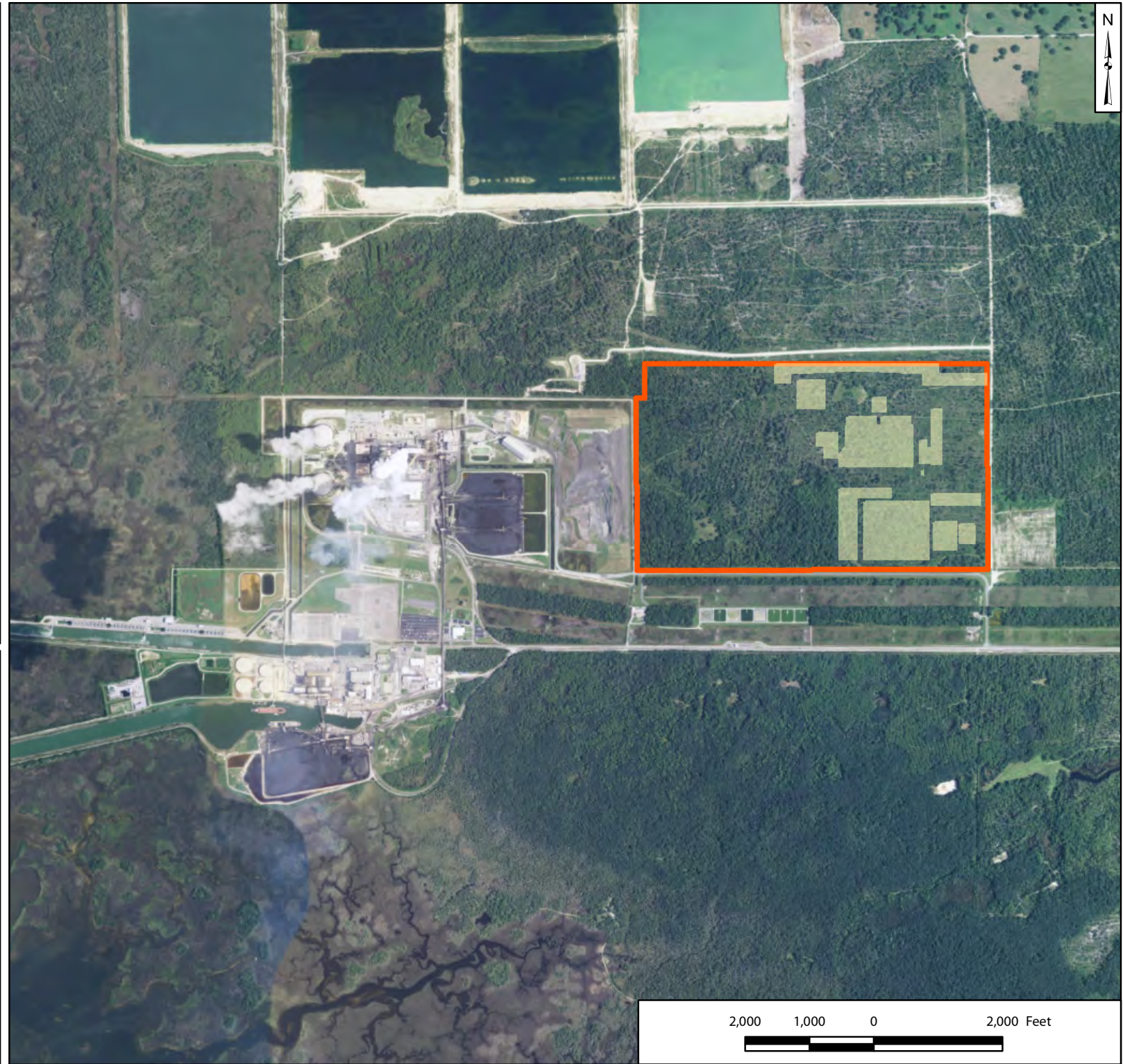


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Site Location Map



Note:
World Street Map Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community.



Legend CCC Project Footprint CCC Project Site	Site Location Map Citrus Combined Cycle Project 14385 N. Access Road Crystal River, FL 34428	
Notes: 1. CCC Project footprint obtained from Duke Energy Florida, Inc. Citrus Combined Cycle Project Site Certification Application, ECT, 2014. 2. Property boundary obtained from the Citrus County Property appraiser's office. 3. 2013 World Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community.	Geosyntec consultants	
	Tampa, FL	December 2015
		Figure 1



PRELIMINARY DESIGN REPORT – POTABLE WATER TREATMENT PLANT

CCCP Site Layout and Building Drawings

- CCC00-GA-M-00.00.PL-01 Rev. 03 Mechanical General Arrangement Plot Plan
- CCC00-AD-A-SB.00.PL-01 Rev. 02 Architectural Service Building Conceptual Floor and Roof Plan
- CCC20-AD-A-CL.00.PL-02 Rev. 01 Architectural Cooling Tower Chemical Feed Pump Enclosure
Conceptual Floor and Roof Plan



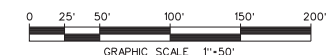
Raw Water Sodium Hypochlorite
Injection skid location.
See drawing CCC20-AD-A-CL.00.PL-02

Drinking Water Treatment Skid
& Potable Water Storage Tank
in Service Building
See Drawing CCC00-AD-A-SB.00.PL-01

Service/Firewater Tanks

- 1 GAS TURBINE GENERATOR
- 2 HEAT RECOVERY STEAM GENERATOR
- 3 HRSG STACK
- 4 CIRCULATING WATER PUMPS
- 5 GAS TURBINE GSU
- 6 UNIT AUX TRANSFORMER
- 7 COOLING TOWER
- 8 COOLING TOWER PDC
- 9 COOLING TOWER CHEMICAL FEED ENCLOSURE/SHED
- 10 CO2 BOTTLE RACK
- 11 DEMINERALIZED WATER TANKS
- 12 SERVICE ENCLOSURE
- 13 ADMIN / WAREHOUSE / SHOP BUILDING
- 14 AUXILIARY BOILER
- 15 AUX BOILER CHEMICAL FEED SYSTEM
- 16 FIRE PUMP ENCLOSURE
- 17 SEWAGE TREATMENT PACKAGE
- 18 WATER TREATMENT SYSTEM
- 19 VT&SA CUBICAL (VTS&A)
- 20 AIR COMPRESSORS
- 21 INLET AIR FILTER
- 22 H2 STORAGE
- 23 ATMOSPHERIC DRAIN TANK
- 24 AUX COOLING WATER PUMP
- 25 AMMONIA STORAGE
- 26 GTG ELECTRICAL CONTROL MODULE
- 27 GTG LUBE OIL
- 28 SFC/EXCITATION MODULE
- 29 SFC TRANSFORMER
- 30 GTG EXCITATION TRANSFORMER
- 31 NGR CUBICLE
- 32 TURBINE COOLING AIR COOLER
- 33 GTG CO2 STORAGE TANK
- 34 GTG FUEL GAS UNIT
- 35 HRSG BLOWDOWN TANK
- 36 DUCT BURNER SKID
- 37 AMMONIA CONTROL SKID
- 38 TURBINE AREA SUMP
- 39 SCR CATALYST LAYDOWN AREA
- 40 CALORIMETER
- 41 FUEL GAS CONDITIONING UNIT
- 42 FUEL GAS HEATER
- 43 STEAM TURBINE DRAIN TANK SUMP
- 44 SAMPLE PANEL
- 45 CEMS MODULE
- 46 HRSG ELEVATOR
- 47 FUEL GAS INLET FILTER
- 48 TRANSFORMER SUMP
- 49 PIPE RACK ACCESS STAIR
- 50 NITROGEN GENERATOR PAD
- 51 BOILER FEED PUMPS
- 52 WASTEWATER COLLECTION SUMP
- 53 SERVICE / FIREWATER TANK
- 54 HRSG BLOWDOWN SUMP
- 55 SPILL CONTAINMENT SUMP FOR CT BULK CHEMICAL
- 56 OIL WATER SEPARATOR
- 57 CTG AREA SUMP
- 58 HRSG OVERHEAD WALKWAY
- 59 CWW HEAT EXCHANGERS
- 60 CLOSED COOLING WATER PUMPS
- 61 STEAM TURBINE GENERATOR
- 62 STEAM TURBINE LUBE OIL
- 63 CONDENSATE PUMPS
- 64 CONDENSATE POLISHER
- 65 NEUTRALIZATION TANK
- 66 PERMANENT CONSTRUCTION POWER EQUIPMENT
- 67 EMERGENCY DIESEL GENERATOR
- 68 GTG GENERATOR CIRCUIT BREAKER
- 69 GAS TURBINE PDC
- 70 STG GANTRY CRANE DROP ZONE
- 71 OIL STORAGE BUILDING
- 72 LOADING DOCK
- 73 SANITARY LIFT STATION
- 74 PHOSPHATE ENCLOSURE
- 75 STEAM TURBINE PDC
- 76 EXCITATION MODULE
- 77 SERVICE BUILDING FIREWATER COLLECTION SUMP
- 78 HRSG CHEMICAL INJECTION
- 79 AUX BOILER DEAERATOR
- 80 AMMONIA TANK AND PUMP SKIDS
- 81 RESERVED SPACE
- 82 VACUUM PUMPS
- 83 HYDRAULIC POWER UNIT
- 84 AUX BOILER STACK
- 85 DRINKING WATER TANK & TREATMENT SKID
- 86 CRANE PAD
- 87 WASH WATER DRAINS SUMP
- 88 FUEL GAS SCRUBBER
- 89 COMPRESSOR BLADE WASHING UNIT
- 90 SPENT REAGENT TANK
- 91 REAGENT TANK
- 92 STG LUBE OIL SUMPS
- 93 STEAM TURBINE GSU
- 94 FUEL GAS STARTUP HEATER
- 95 COLLECTOR BUS SUPPORTS (BY OTHERS)

CENTERLINE OF STACK
PLANT GRID COORDINATES
N 10000.00
E 20000.00



MECH	LAYOUT	CSA	ELEC	REV	DATE	JOB NO.	PROJECT TYPE	DES	DFT	CHK	DNGR	APPD
MECH	LAYOUT	CSA	ELEC	REV	DATE	JOB NO.	PROJECT TYPE	DES	DFT	CHK	DNGR	APPD
W	SAJ	SAJ	SAJ	REV	DATE	JOB NO.	PROJECT TYPE	DES	DFT	CHK	DNGR	APPD
W	JCB	JCB	JCB	REV	DATE	JOB NO.	PROJECT TYPE	DES	DFT	CHK	DNGR	APPD
W	JRM	JRM	JRM	REV	DATE	JOB NO.	PROJECT TYPE	DES	DFT	CHK	DNGR	APPD
W	JCB	JCB	JCB	REV	DATE	JOB NO.	PROJECT TYPE	DES	DFT	CHK	DNGR	APPD
W	JRM	JRM	JRM	REV	DATE	JOB NO.	PROJECT TYPE	DES	DFT	CHK	DNGR	APPD

RESERVED FOR PROFESSIONAL ENGINEER'S SEAL, IF APPLICABLE

FLUOR
6700 LAS COLINAS BLVD.
IRVING, TEXAS 75039
714-526-3500
704-526-3500
CERTIFICATE OF AUTHORIZATION LICENSE NUMBER: 3833

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TITLE
DUKE ENERGY FLORIDA
CITRUS COUNTY COMBINED CYCLE PROJECT
MECHANICAL
GENERAL ARRANGEMENT
PLOT PLAN

FOR
CITRUS COUNTY COMBINED CYCLE - UNIT 00

SCALE: 1"=50'
DWT TYPE: GA
JOB NO: C1000C
DATE: 12/15/2014

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ARCH E1
30.0"x42.0"

DRAWING NO.
CCC00-GA-M-00.00.PL-01

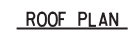
DES: JCB
DFT: PTD
CHK: RH
ENGR: JCB
APPD: JRM

REVISION
03



DOOR TYPES

ROOM		FLOOR	BASE	WALL	CEILING	REMARKS
NUMBER	NAME					
230	CT CHEM FEED AREA	SEALED CONCRETE	N/A	METAL PANEL SYSTEM	EXPOSED TO ROOF STRUCTURE	INSIDE SURFACES OF CONTAINMENT AREA INCLUDING CURBED EQUIPMENT AREA TO RECEIVE EPOXY COATING.

RESERVED FOR PROFESSIONAL ENGINEER'S SEAL, IF APPLICABLE

TITLE		DUKE ENERGY FLORIDA CITRUS COUNTY COMBINED CYCLE PROJECT	
		ARCHITECTURAL COOLING TOWER CHEMICAL FEED PUMP ENCLOSURE CONCEPTUAL FLOOR AND ROOF PLAN	
FOR		CITRUS COUNTY COMBINED CYCLE - UNIT 20	
 DUKE ENERGY®	SCALE: 1/4"=1'-0"	DES: YJLM	
	DWG TYPE: AD	DFTW: YJLM	
	JOB NO: CCCCOC	CHKD: TAB	
	DATE: 04/18/16	ENGR: SAJ	
FILENAME: CCCC20-AD-A-CL.00.PL-02.DGN		APPD: SS	
DWG SIZE	DRAWING NO.	REVISION	
ARCH ET 30.00x24.00	CCC20-AD-A-CL.00.PL-02	01	

ENCEE ARCHITECTURE SERVICES, P.C.

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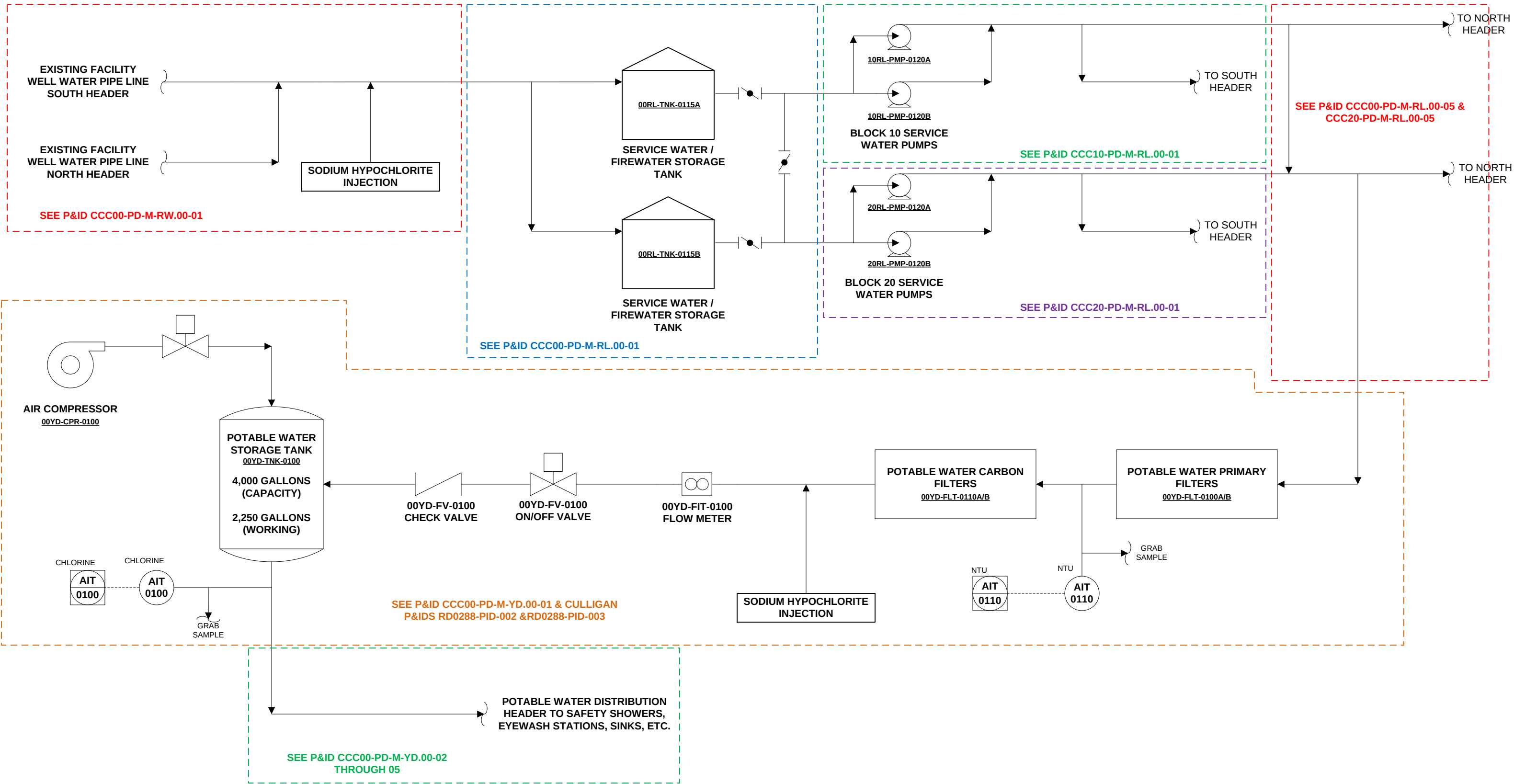


PRELIMINARY DESIGN REPORT – POTABLE WATER TREATMENT PLANT

Process Flow Diagram and P&IDs

- Potable Water Treatment System Process Flow Diagram
- CCC00-PD-M-RW.00-01 Rev. 03 Piping and Instrumentation Diagram – Raw Water (RW) System
- CCC00-PD-M-RL.00-01 Rev. 03 Piping and Instrumentation Diagram – Service Water (RL) System
- CCC10-PD-M-RL.00-01 Rev. 03 Piping and Instrumentation Diagram– Service Water (RL) System
- CCC20-PD-M-RL.00-01 Rev. 01 Piping and Instrumentation Diagram– Service Water (RL) System
- CCC10-PD-M-RL.00-05 Rev. 01 Piping and Instrumentation Diagram– Service Water (RL) System
- CCC20-PD-M-RL.00-05 Rev. 01 Piping and Instrumentation Diagram– Service Water (RL) System
- CCC00-PD-M-YD.00-01 Rev. 02 Piping and Instrumentation Diagram – Drinking Water(YD) System
- CCC00-PD-M-YD.00-02 Rev. 02 Piping and Instrumentation Diagram – Drinking Water(YD) System
- CCC00-PD-M-YD.00-03 Rev. 03 Piping and Instrumentation Diagram – Drinking Water(YD) System
- CCC00-PD-M-YD.00-04 Rev. 03 Piping and Instrumentation Diagram – Drinking Water(YD) System
- CCC00-PD-M-YD.00-05 Rev. 03 Piping and Instrumentation Diagram – Drinking Water(YD) System
- CCC20-PD-M-YA.00-03 Rev. 00 Piping and Instrumentation Diagram – Chemical Addition (YA) System Cooling Tower

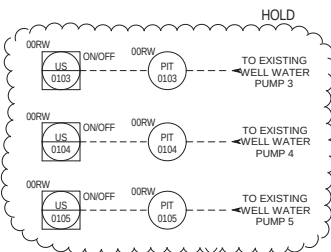
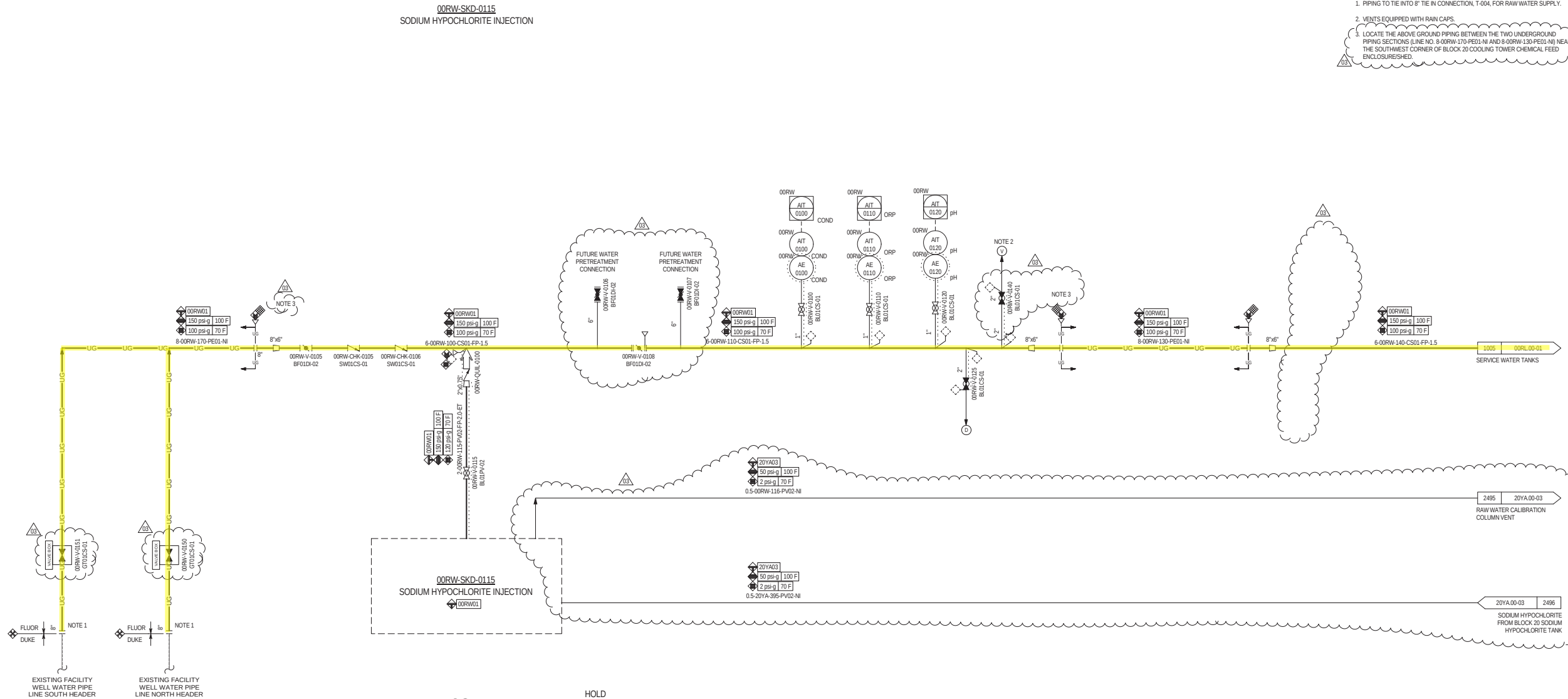
POTABLE WATER TREATMENT SYSTEM PROCESS FLOW DIAGRAM



DRAWING NO. CCC00-PD-M-RW.00-01

REV. 03

- NOTES:
1. PIPING TO TIE INTO 8" TIE IN CONNECTION, T-004, FOR RAW WATER SUPPLY.
 2. VENTS EQUIPPED WITH RAIN CAPS.
 3. LOCATE THE ABOVE GROUND PIPING BETWEEN THE TWO UNDERGROUND PIPING SECTIONS (LINE NO. 8-00RW-170-PED1-NI AND 8-00RW-130-PED1-NI) NEAR THE SOUTHWEST CORNER OF BLOCK 20 COOLING TOWER CHEMICAL FEED ENCLOSURE/SHED.



NOTE 1
EXISTING FACILITY WELL WATER PIPE LINE SOUTH HEADER

NOTE 1
EXISTING FACILITY WELL WATER PIPE LINE NORTH HEADER

DRAWING NUMBER	REFERENCE DRAWINGS	MECH	LAYOUT	CSA	ELEC
		WB1	MWW	WAIVED	SAS
DRAWING NUMBER	REFERENCE DRAWINGS	MECH	LAYOUT	CSA	ELEC
		WB1	MWW	WAIVED	SAS

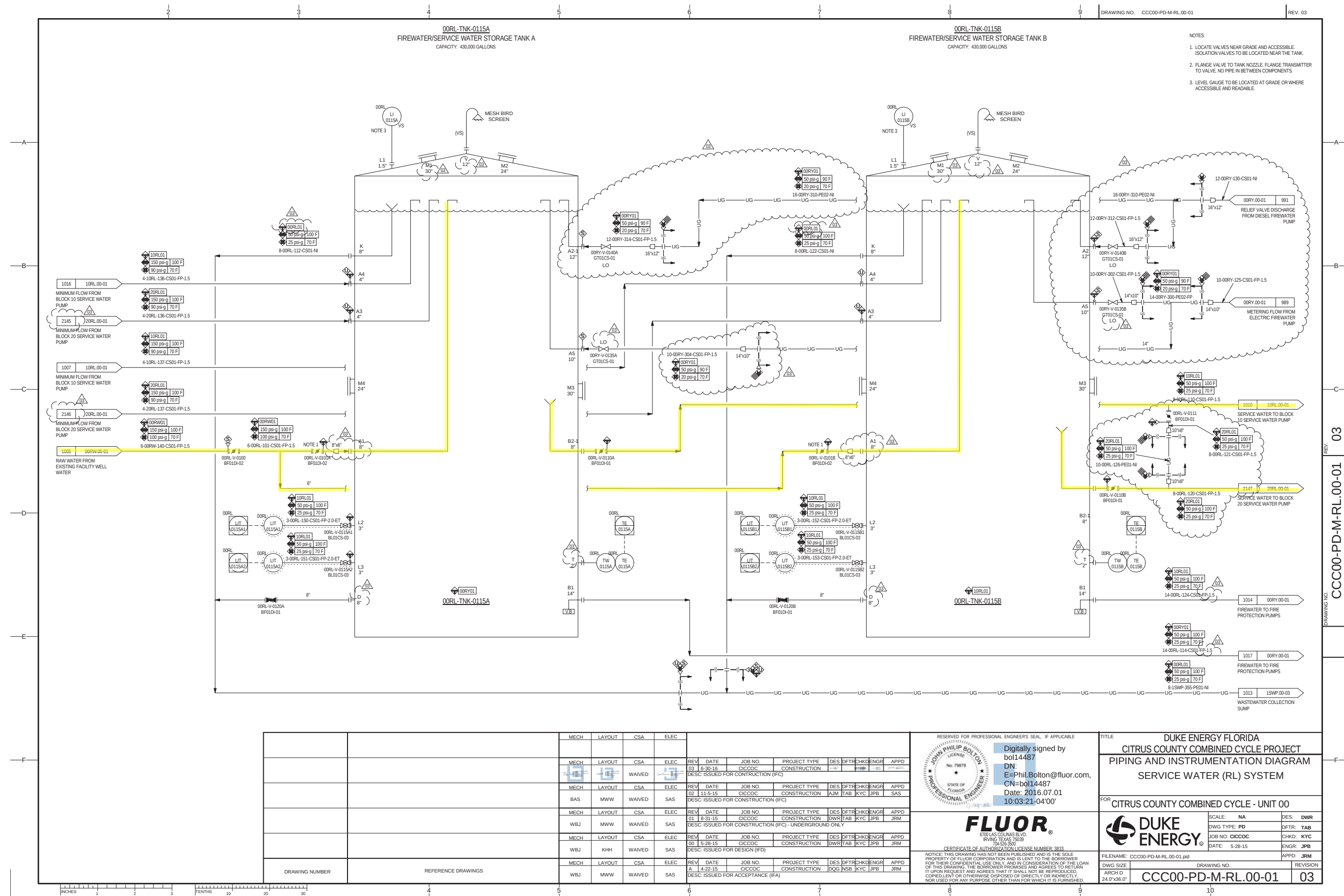
RESERVED FOR PROFESSIONAL ENGINEERS SEAL, IF APPLICABLE

FLUOR
6700 LAS COLINAS BLVD.
IRVING, TEXAS 75039
(940) 552-3500

CERTIFICATE OF AUTHORIZATION LICENSE NUMBER: 3833

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DUKE ENERGY FLORIDA CITRUS COUNTY COMBINED CYCLE PROJECT PIPING AND INSTRUMENTATION DIAGRAM RAW WATER (RW) SYSTEM			
FOR CITRUS COUNTY COMBINED CYCLE - UNIT 00			
FILENAME: CCC00-PD-M-RW.00-01.ppt	DWG SIZE: ARCH D 24.0"x36.0"	DRAWING NO. CCC00-PD-M-RW.00-01	REVISION 03



MECH	LAYOUT	CSA	ELEC	REV	DATE	JOB NO.	PROJECT TYPE	DES	DFT	CHK	ENGR	APPD
MECH	LAYOUT	CSA	ELEC	03	6-30-16	CICOC	CONSTRUCTION	DES	DFT	CHK	ENGR	APPD
DESC: ISSUED FOR CONSTRUCTION (IFC)												
MECH	LAYOUT	CSA	ELEC	02	11-5-15	CICOC	CONSTRUCTION	AJM	TAB	KYC	JPB	SAS
DESC: ISSUED FOR CONSTRUCTION (IFC)												
MECH	LAYOUT	CSA	ELEC	01	8-31-15	CICOC	CONSTRUCTION	DWR	TAB	KYC	JPB	JRM
DESC: ISSUED FOR CONSTRUCTION (IFC) - UNDERGROUND ONLY												
MECH	LAYOUT	CSA	ELEC	00	5-28-15	CICOC	CONSTRUCTION	DWR	TAB	KYC	JPB	JRM
DESC: ISSUED FOR DESIGN (IFD)												
MECH	LAYOUT	CSA	ELEC	00	4-22-15	CICOC	CONSTRUCTION	DQS	NSB	KYC	JPB	JRM
DESC: ISSUED FOR ACCEPTANCE (IFA)												

RESERVED FOR PROFESSIONAL ENGINEERS SEAL, IF APPLICABLE

FLUOR
6700 LAS COLINAS BLVD.
IRVING, TEXAS 75039
(940) 552-3500

CERTIFICATE OF AUTHORIZATION LICENSE NUMBER 3833

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TITLE
DUKE ENERGY FLORIDA
CITRUS COUNTY COMBINED CYCLE PROJECT
PIPING AND INSTRUMENTATION DIAGRAM
SERVICE WATER (RL) SYSTEM

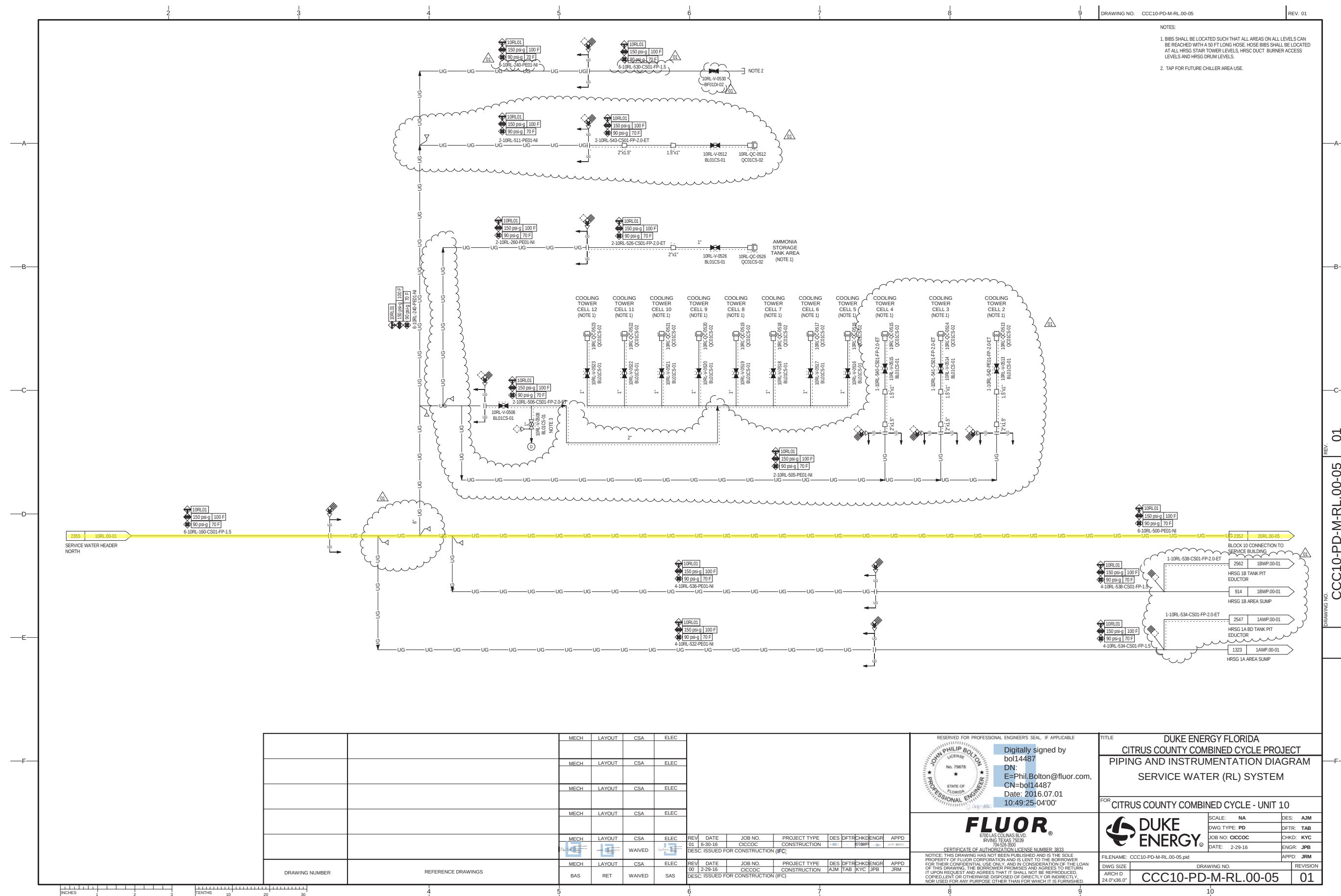
FOR
CITRUS COUNTY COMBINED CYCLE - UNIT 00

SCALE: NA DES: DWR
DWG TYPE: PD DFT: TAB
JOB NO: CICOC CHKD: KYC
DATE: 5-28-15 ENGR: JPB

FILENAME: CCC00-PD-M-RL-00-01.pid
DWG SIZE: 24.0"x36.0"
DRAWING NO.: **CCC00-PD-M-RL-00-01**
REVISION: **03**













DRAWING NO. CCC00-PD-M-YD.00-03

REV. 03

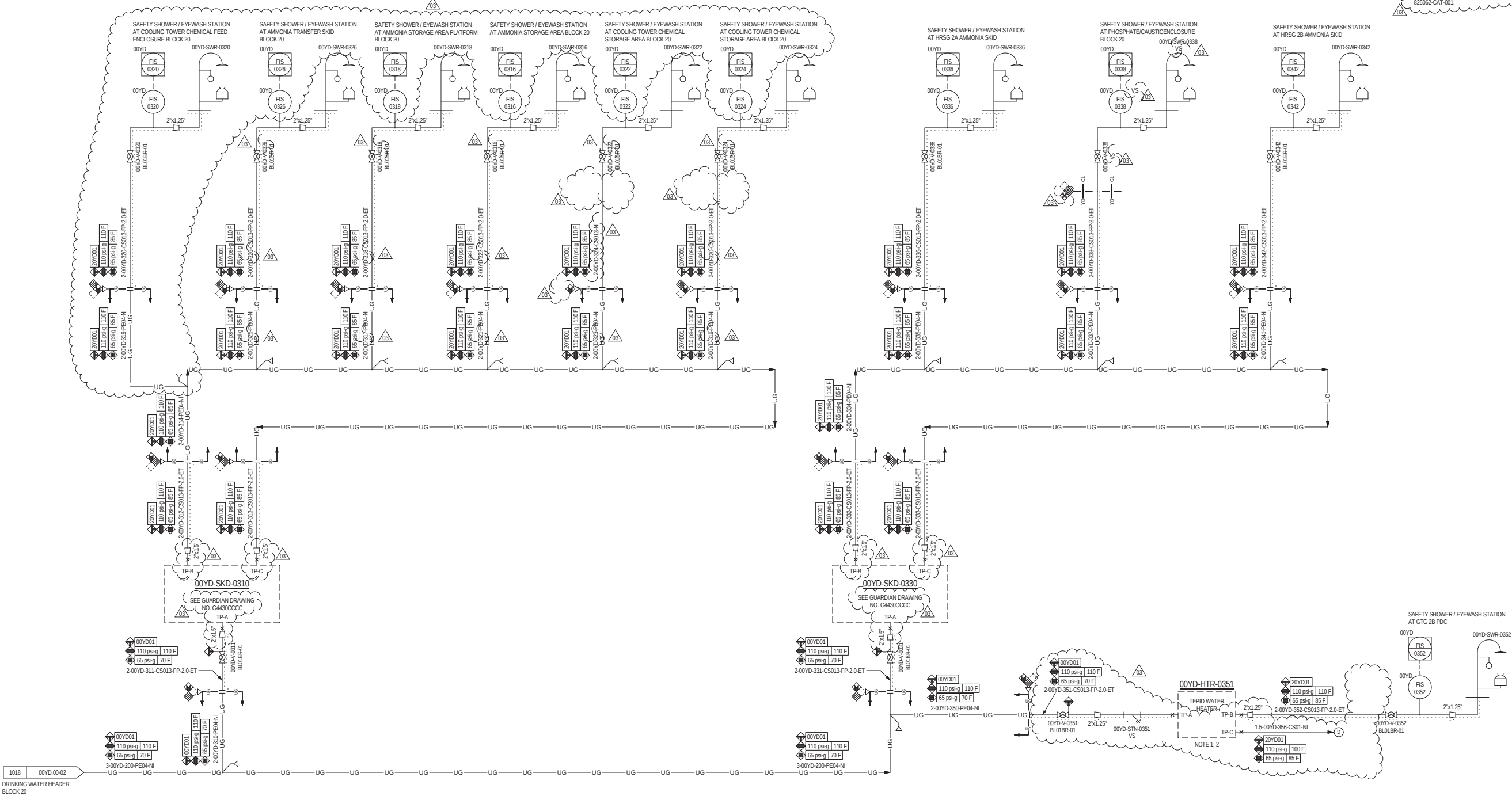
NOTES:

1. LOCATE HEATER MINIMUM DISTANCE FROM SHOWER.
2. REFERENCE DOOLEY TACKBERRY DRAWING NO. 825062-CAT-001.

00YD-SKD-0310
AMMONIA STORAGE AND COOLING
TOWER CHEMICAL FEED AREA BLOCK 20
TEPID WATER SKID

00YD-SKD-0330
HRSG BLOCK 20 AREA TEPID
WATER SKID

00YD-HTR-0351
GTG 2B PDC
TEPID WATER HEATER



MECH	LAYOUT	CSA	ELEC	REV	DATE	JOB NO.	PROJECT TYPE	DES	DFT	CHKD	ENGR	APPD
MECH	LAYOUT	CSA	ELEC	03	6-30-16	CICCO	CONSTRUCTION	DES	DFT	CHKD	ENGR	APPD
DESC: ISSUED FOR CONSTRUCTION (IFC)												
MECH	LAYOUT	CSA	ELEC	02	11-18-15	CICCO	CONSTRUCTION	KYC	TAB	AJM	JPB	JRM
DESC: ISSUED FOR CONSTRUCTION (IFC)												
MECH	LAYOUT	CSA	ELEC	01	9-14-15	CICCO	CONSTRUCTION	DQG	TAB	KYC	JPB	JRM
DESC: ISSUED FOR CONSTRUCTION (IFC) - UNDERGROUND ONLY												
MECH	LAYOUT	CSA	ELEC	00	6-18-15	CICCO	CONSTRUCTION	DQG	TAB	KYC	JPB	JRM
DESC: ISSUED FOR DESIGN (IFD)												
MECH	LAYOUT	CSA	ELEC	A	4-30-15	CICCO	CONSTRUCTION	DQG	NSB	KYC	JPB	JRM
DESC: ISSUED FOR ACCEPTANCE (IFA)												
WB	J	M	W									

RESERVED FOR PROFESSIONAL ENGINEER'S SEAL, IF APPLICABLE		TITLE	
		DUKE ENERGY FLORIDA CITRUS COUNTY COMBINED CYCLE PROJECT PIPING AND INSTRUMENTATION DIAGRAM DRINKING WATER (YD) SYSTEM	
FOR		CITRUS COUNTY COMBINED CYCLE - UNIT 00	
FILENAME: CCC00-PD-M-YD.00-03.ppt		SCALE: NA	DES: DQG
DWG SIZE: ARCH D 24.0"x36.0"		DWG TYPE: PD	DFT: TAB
CCC00-PD-M-YD.00-03		JOB NO: CICCO	CHKD: KYC
REVISION		DATE: 6-18-15	ENGR: JPB
APPD: JRM		REVISION	









PRELIMINARY DESIGN REPORT – POTABLE WATER TREATMENT PLANT

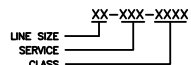
Culligan Engineered Systems'

Drawings for Drinking Water Treatment System

• RD0288-PID-001	Rev. B	Citrus County Combined Cycle Water Treatment Package A5V1 P&ID
• RD0288-PID-002	Rev. I	Citrus County Combined Cycle Water Treatment Package A5V1 P&ID
• RD0288-PID-003	Rev. K	Citrus County Combined Cycle Water Treatment Package A5V1 P&ID
• RD0288-GA, Sheet 1	Rev. E	Water Treatment Skid General Arrangement
• RD0288-GA, Sheet 2	Rev. H	Pressurized Potable Water Storage Tank 3000 gallons General Arrangement
• CCC-M-0703-04-00065-2		Sequence of Operation
• CCC-M-0703-04-00025-2		Global Filter Cartridge Vessel Catalog Cut sheet GTCH742F2615EPU
• CCC-M-0703-04-00018-2		Global Filter Data Sheet Model GWTB20A40MC
• CCC-M-0703-04-00022-2		Pentair Carbon Block Filter Data Sheet
• CCC-M-0703-04-00027-3		LMI Chemical Storage Tank Data Sheet Model 26350
• CCC-M-0703-04-00028-1		LMI Electronic Metering Pump
• CCC-M-0703-04-00026-3		Hach Chlorine Analyzer
• CCC-M-0703-04-00081-1		Chemical Feeder Sizing – 1 ppm
• CCC-M-0703-04-00082-1		Chemical Feeder Sizing – 4 ppm
• CCC-M-0703-04-00019-2		Hace Turbidimeter Analyzer Data Sheet
• CCC-M-0703-04-00064-2		Line List
• CCC-M-0703-04-00067-5		Valve List

EQUIPMENT			PIPING			VALVES		ACTUATORS		INSTRUMENTATION		LINE SYMBOLS		TAG NOMENCLATURE	
	CARTRIDGE FILTER: BOWL TYPE		PUMP: METERING		CAP		TUBE-IN-PIPE		ANGLE		CYLINDER/PISTON		PANEL MOUNTED	AE - ANALYZER ELEMENT	
	CARTRIDGE FILTER: FILTERITE TYPE (50% SCALE)		PUMP: PISTON		CHEMICAL SEAL/ DIAPHRAGM		UNION		BALL (TWO-WAY)		CYLINDER: SINGLE-ACTING W/O POSITIONER		LOCAL MOUNTED	ABF - ACTUATED BUTTERFLY VALVE	
	COMPRESSOR: CENTRIFUGAL		PUMP: SUMP		VICTAULIC COUPLING		VENT (INDOOR)		BALL-CHECK		CYLINDER: DOUBLE-ACTING W/O POSITIONER		PROGRAMMABLE LOGIC CONTROL	AR - ANALYSIS RECORDER	
	COMPRESSOR: PISTON AIR		REVERSE OSMOSIS ELEMENT HOUSING (75% SCALE)		EXPANSION JOINT		VENT (OUTDOOR)		DIAPHRAGM		DIAPHRAGM W/ POSITIONER		LIGHT PANEL MOUNTED	AV - ANGLE VALVE	
	DEGASSIFIER/ DECARBONATOR				FLANGE		VENTURI		DIAPHRAGM W/ PNEUMATIC POSITIONER		DIAPHRAGM: PRESSURE-BALANCED		LIGHT LOCAL INDICATING	ATM - ATMOSPHERE	
	EDUCTOR/EJECTOR		STATIC MIXER		FLEXIBLE CONNECTION		WYE-TYPE STRAINER		PRESS. BAL. DIAPH: AIR TO OPEN, LINE PRESSURE TO CLOSE		ALARM PANEL MOUNTED		CAPILLARY TUBING (FILLED SYSTEM)	BFP - BACKFLOW PREVENTER	
	ELECTRIC MOTOR DRIVE		TANK: COVERED BRINE SCALE AS NECESSARY		FLOW ARROW				PRESS. BAL. DIAPH: AIR TO CLOSE, LINE PRESSURE TO OPEN		ALARM LOCAL MOUNTED		ELECTRICAL SIGNAL	BFV - BUTTERFLY VALVE	
	ENERGY RECOVERY TURBINE		TANK: DOMED STORAGE SCALE AS NECESSARY		FLOW MEASURING ORIFICE				PRESS. BAL. DIAPH: AIR TO OPEN, SPRING TO CLOSE		CONTROLLER INPUT		HYDRAULIC SIGNAL	BV - BALL VALVE	
	FILTER/STRAINER		TANK: PORTABLE EXCHANGE DEIONIZER		FLOW RESTRICTING ORIFICE				PRESS. BAL. DIAPH: AIR TO CLOSE, SPRING TO OPEN		CONTROLLER OUTPUT		SKID LIMIT	CE - CONDUCTIVITY ELEMENT	
	HEAT EXCHANGER: PLATE-AND-FRAME		ULTRA-VIOLET STERILIZER		INSULATION				ELECTRO-HYDRAULIC		FLOW INDICATOR ROTAMETER TYPE		"PLUME" PRIMARY PIPING ("BY CULLIGAN")	CI - CONDUCTIVITY INSTRUMENT	
	HEAT EXCHANGER: SHELL-AND-TUBE				MIXING TEE				HAND ACTUATOR OR HANDWHEEL		FLOW INDICATOR TURBIDIMETER TYPE			COND - CONDUCTIVITY	
	MIXER/AGITATOR				PLUG				T		FLOW ELEMENT MAGMETER TYPE			CP - CENTRIFUGAL PUMP	
	MOTOR				PIPE SPEC BREAK (UP & DOWN)				PRESS. BAL. DIAPH: W/ LIMIT STOP ON OPENING		FLOW ELEMENT PADDLE WHEEL TYPE			CR - CONDUCTIVITY RECORDER	
	PRESSURE TAP				POINT-OF-CONTACT (TIE-IN POINT)				PRESS. BAL. DIAPH: AIR TO OPEN, SPRING TO CLOSE		FLOW ELEMENT ULTRASONIC TYPE			CS - CONDUCTIVITY SWITCH	
	PULSATION DAMPENER: IN-LINE				QUICK DISCONNECT				REGULATOR: PRESSURE REDUCING, SELF-CONTAINED					CV - CHECK VALVE	
	PULSATION DAMPENER: BOTTLE				QUILL				REGULATOR: PRESSURE REDUCING, SELF-CONTAINED					DV - DIAPHRAGM VALVE	
	PUMP: CENTRIFUGAL				REDUCER: CONCENTRIC -OR- ENLARGER				REGULATOR: BACK PRESSURE, W/ EXTERNAL TAP					EH - ELEMENT HOUSING	
					REDUCER: ECCENTRIC (FOB: FLAT ON BOTTOM) (FOT: FLAT ON TOP)				REGULATOR: BACK PRESSURE, W/ EXTERNAL TAP					EV - ELECTRICALLY ACTUATED VALVE	
					REVISION TRIANGLE				SOLENOID OPERATED					F - FILTER OR CARTRIDGE STRAINER	
					RUPTURE DISC PRESSURE TYPE				SPRING FOR PRESSURE RELIEF OR SAFETY VALVES ONLY					FC - FAIL CLOSED	
					RUPTURE DISC VACUUM TYPE				THREE-WAY SOLENOID					FCV - FLOW CONTROL VALVE	
					SERVICE CONNECTION				TWO-WAY SOLENOID					FE - FLOW ELEMENT	
					SIGHT FLOW GLASS (IN-LINE)									FG - FLOW GLASS	
					SPRAY NOZZLES									FI - FLOW INDICATOR	
					STEAM TRAP									FO - FLOW OPEN	

LINE DESIGNATION SYSTEM



PIPING CLASS

- PVC - POLYVINYLCHLORIDE, SCH. 80
- SS - STAINLESS STEEL, 316 SCH. 40
- CS - CARBON STEEL
- GS - GALVANIZED STEEL
- PE - POLYETHYLENE
- PP - POLYPROPYLENE

PIPING SERVICE

- CRW - CLARIFIED RIVER WATER
- FRW - FILTERED RIVER WATER
- ROP - R.O. PERMEATE
- ROC - R.O. CONCENTRATE
- CIP - CLEAN-IN-PLACE WATER

D - REVIEWED FOR INFORMATION ONLY **FLUOR**
Authorization to proceed does not relieve Contractor/Supplier of its responsibility
or liability under the Contract and or Purchase Order.
By: Gene Edwards, EDW21853.2/22/2016

FLUOR 00A5V100
DOC. NO. REC'D: 20-JAN-2016
CCC-M-0703-04-00070-1
EQUIP/TAG NUMBER
00YD-SKD-0100 00YD-TNK-0100

DO NOT SCALE DRAWING TOLERANCES: ±1/8" UNLESS OTHERWISE NOTED				
Let.	Change	By	App	Date
A	RELEASED FOR APPROVAL	JG	CH	11/25/15
B	REVISED PER CUSTOMER REQUEST	JG	CH	1/12/16

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ENGINEERED SYSTEMS
LIBERTYVILLE, ILLINOIS
PRINT AND BILL OF MATERIAL ARE NOT
TO BE USED WITHOUT THE WRITTEN
CONSENT OF CULLIGAN INTERNATIONAL CO.

NAME: CITRUS COUNTY COMBINED CYCLE WATER TREATMENT PACKAGE A5V1		
DETAILED BY: JG 11/25/2015	APP. BY: CH 11/25/2015	SHEET 1 OF 3
REF. NO. RD0288	PART NO. RD0288-PID-001	

A - PROCEED

FLUOR.

Authorization to proceed does not relieve Contractor/Supplier of its responsibility or liability under the Contract and or Purchase Order.
By Don Parker on Jun 23, 2016

00YD-FLT-0100A/B
20 MICRON PRIMARY FILTER

MAKE: GLOBAL FILTER
MODEL: GTCH742-F-2-6-15-EPU CARTRIDGE
BODY/HOUSING MOC: 316 STAINLESS STEEL A.S.M.E
CONNECTION: 2" RF FLANGE
PRESSURE RATING: 150 PSIG @ 250°F
CARTRIDGE LENGTH: 40 INCHES
CARTRIDGE RATING: 20 MICRON
CARTRIDGE MOC: POLYPROPYLENE DOE
NSF 61

00YD-FLT-01100A/B
CARBON BLOCK FILTER

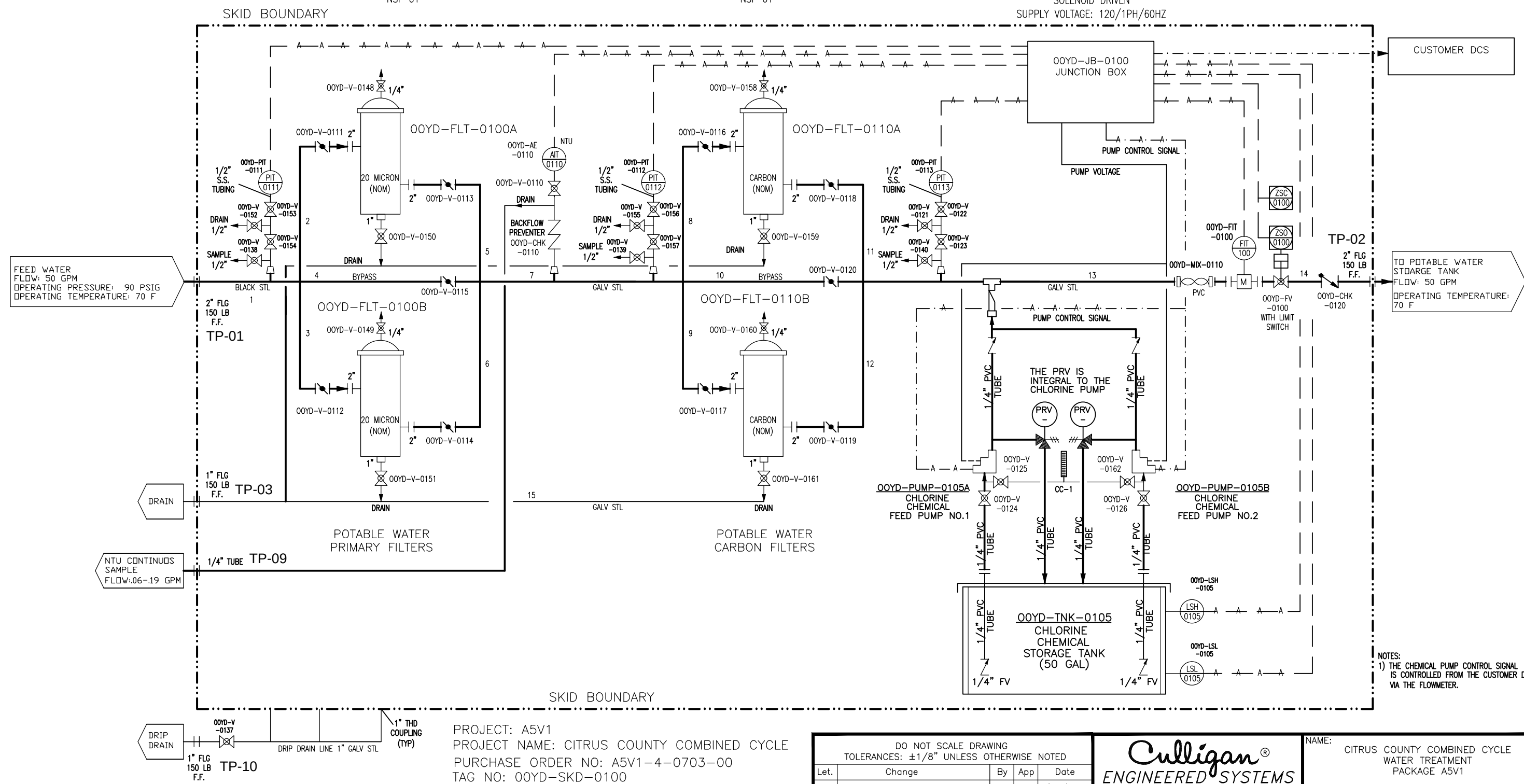
MAKE: GLOBAL FILTER
MODEL: GTCH742-F-2-6-15-EPU CARTRIDGE
BODY/HOUSING MOC: 316 STAINLESS STEEL A.S.M.E
CONNECTION: 2" RF FLANGE
PRESSURE RATING: 150 PSIG @ 250°F
CARTRIDGE LENGTH: 40 INCHES
CARTRIDGE RATING: 5 MICRON
CARTRIDGE MOC: BONDED PAC
NSF 61

00YD-PMP-0105A/B
CHLORINE PUMP

MAKE: LMI
MODEL: AD911-A10HI
TYPE: METERING
SUCTION: 1/4" TUBE
DISCHARGE: 1/4" TUBE
FLOW RATE: .021 GPH
PRESSURE: 100 PSI
ELECTRICAL LOAD 1.5 AMP
SOLENOID DRIVEN
SUPPLY VOLTAGE: 120/1PH/60HZ

FLUOR

00A5VI00
DOC. NO. REC'D: 22-JUN-2016
CCC-M-0703-04-00071-6
EQUIP/TAG NUMBER
00YD-SKD-0100 00YD-TNK-0100



PROJECT: A5V1
PROJECT NAME: CITRUS COUNTY COMBINED CYCLE
PURCHASE ORDER NO: A5V1-4-0703-00
TAG NO: 00YD-SKD-0100

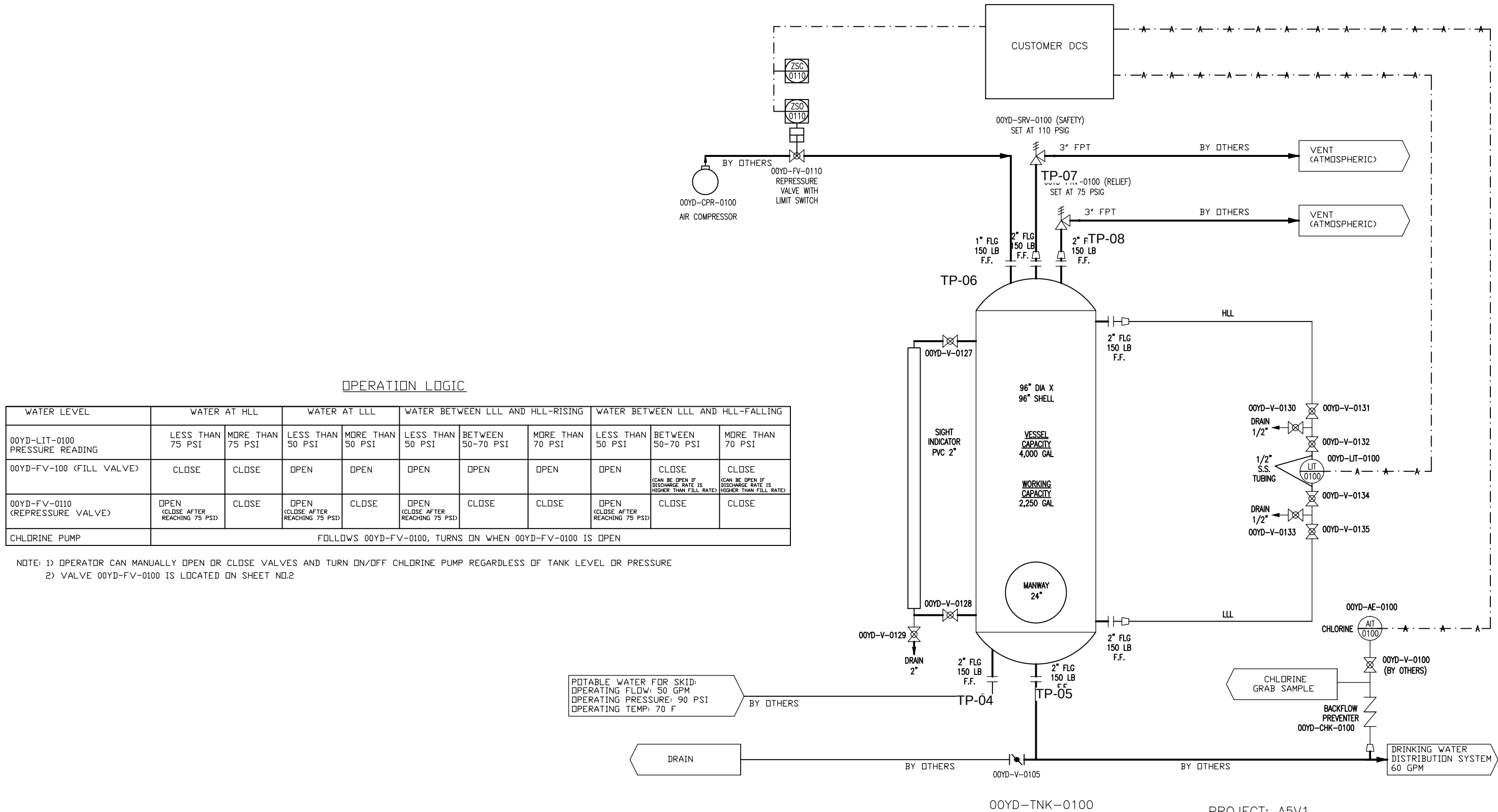
DO NOT SCALE DRAWING TOLERANCES: ±1/8" UNLESS OTHERWISE NOTED				
Let.	Change	By	App	Date
F	REVISED PER CUSTOMER REQUEST	JG	CH	4/14/16
G	REVISED PER CUSTOMER REQUEST	JG	CH	5/21/16
H	REVISED PER CUSTOMER REQUEST	JG	CH	6/15/16
I	REVISED PER CUSTOMER REQUEST	JG	CH	6/21/16

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ENGINEERED SYSTEMS
LIBERTYVILLE, ILLINOIS

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NAME: CITRUS COUNTY COMBINED CYCLE WATER TREATMENT PACKAGE A5V1		
DETAILED BY: JG 11/25/2015	APP. BY: CH 11/25/2015	SHEET 2 OF 3
REF. NO. RD0288	PART NO. RD0288-PID-002	

NOTES:
1) THE CHEMICAL PUMP CONTROL SIGNAL IS CONTROLLED FROM THE CUSTOMER DCS VIA THE FLOWMETER.



OPERATION LOGIC

WATER LEVEL	WATER AT HLL		WATER AT LLL		WATER BETWEEN LLL AND HLL-RISING			WATER BETWEEN LLL AND HLL-FALLING		
00YD-LIT-0100 PRESSURE READING	LESS THAN 75 PSI	MORE THAN 75 PSI	LESS THAN 50 PSI	MORE THAN 50 PSI	LESS THAN 50 PSI	BETWEEN 50-70 PSI	MORE THAN 70 PSI	LESS THAN 50 PSI	BETWEEN 50-70 PSI	MORE THAN 70 PSI
00YD-FV-100 (FILL VALVE)	CLOSE	CLOSE	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	CLOSE (CAN BE OPEN IF DISCHARGE RATE IS HIGHER THAN FILL RATE)	CLOSE (CAN BE OPEN IF DISCHARGE RATE IS HIGHER THAN FILL RATE)
00YD-FV-0110 (REPRESSURE VALVE)	OPEN (CLOSE AFTER REACHING 75 PSI)	CLOSE	OPEN (CLOSE AFTER REACHING 75 PSI)	CLOSE	OPEN (CLOSE AFTER REACHING 75 PSI)	CLOSE	CLOSE	OPEN (CLOSE AFTER REACHING 75 PSI)	CLOSE	CLOSE
CHLORINE PUMP	FOLLOWS 00YD-FV-0100, TURNS ON WHEN 00YD-FV-0100 IS OPEN									

NOTE: 1) OPERATOR CAN MANUALLY OPEN OR CLOSE VALVES AND TURN ON/OFF CHLORINE PUMP REGARDLESS OF TANK LEVEL OR PRESSURE
2) VALVE 00YD-FV-0100 IS LOCATED ON SHEET NO.2

PROJECT: A5V1
PROJECT NAME: CITRUS COUNTY COMBINED CYCLE
PURCHASE ORDER NO: A5V1-4-0703-00

FLUOR
DOC. NO. 00A5V100
REC'D: 03-NOV-2016
CCC-M-0703-04-00072-8
EQUIP/TAG NUMBER
00YD-SKD-0100 00YD-TNK-0100

DO NOT SCALE DRAWING TOLERANCES: ±1/8" UNLESS OTHERWISE NOTED				
Let.	Change	By	App	Date
H	REVISED PER CUSTOMER REQUEST	JG	CH	6/15/16
I	REVISED PER CUSTOMER REQUEST	JG	CH	6/21/16
J	REVISED PER CUSTOMER REQUEST	JG	CH	10/14/16
K	REVISED PER CUSTOMER REQUEST	JG	CH	10/31/16

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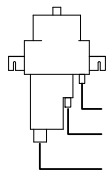
NAME: CITRUS COUNTY COMBINED CYCLE WATER TREATMENT PACKAGE A5V1		
DETAILED BY: JG 11/25/2015	APP. BY: CH 11/25/2015	SHEET 3 OF 3
REF. NO. RD0288	PART NO. RD0288-PID-003	

DEVICE LISTING FOR CUSTOMER WIRING

PRESSURE TRANSMITTER NO.1
PRESSURE TRANSMITTER NO.2
PRESSURE TRANSMITTER NO.3
CHEMICAL PUMP NO.1
CHEMICAL PUMP NO.2
FLOW METER TRANSMITTER
TURBIDIMETER
LEVEL TRANSMITTERS (2)

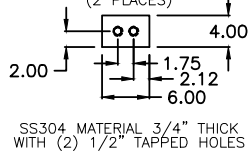
TO CUSTOMER DCS

TURBIDIMETER
SENSOR



SAMPLE INLET
SAMPLE DRAIN (BY OTHERS)
SERVICE DRAIN (BY OTHERS)

GROUND LUG DETAIL
(2 PLACES)

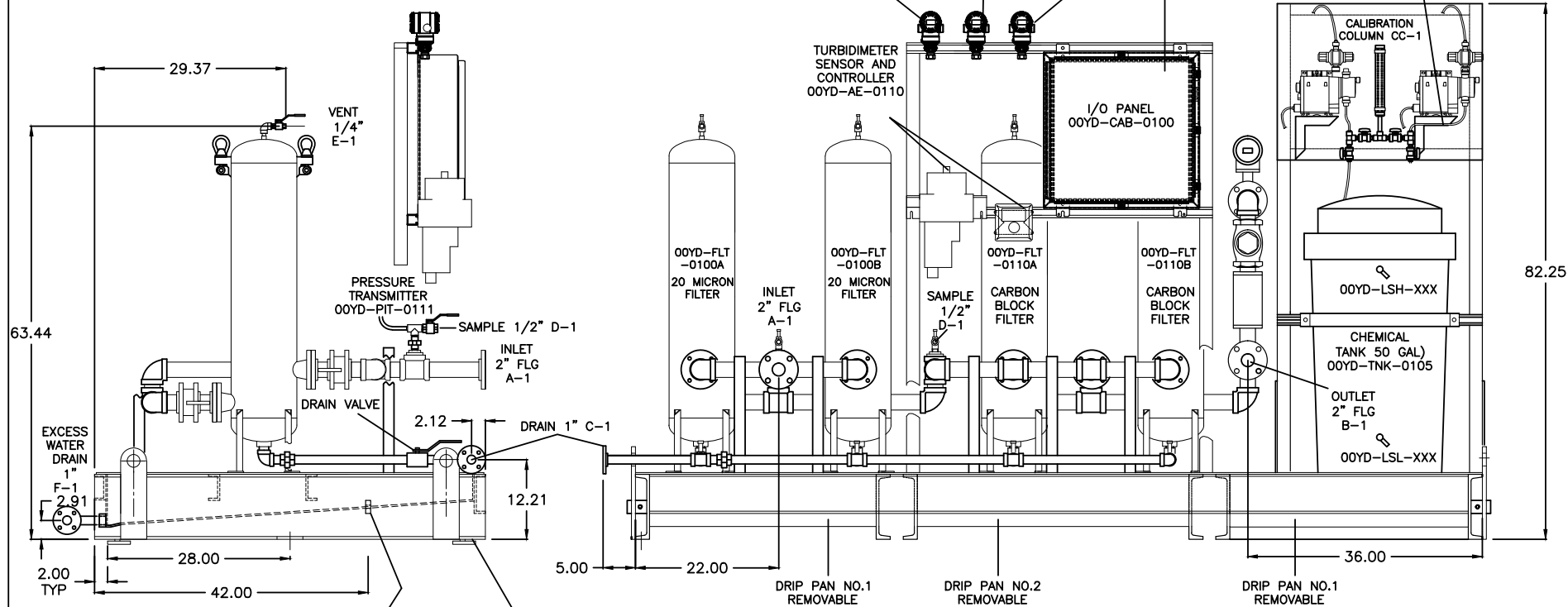


SS304 MATERIAL 3/4" THICK
WITH (2) 1/2" TAPPED HOLES

NOZZLE SCHEDULE

MARK NO.	SIZE	TYPE NO.	SERVICE
A-1	2"	150LB FLANGE F.F.	INLET
B-1	2"	150LB FLANGE F.F.	OUTLET
C-1	1"	150LB FLANGE F.F.	FILTER DRAIN
D-1	1/2"	THREADED	SAMPLE VALVE
E-1	1/4"	THREADED	FILTER VENT
F-1	1"	150LB FLANGE F.F.	EXCESS WATER DRAIN
G-1	1/4"	THREADED	CHEMICAL INJECTION

WEIGHTS (ESTIMATED):
SHIPPING: 2,000 LBS
OPERATING: 3,000 LBS



A - PROCEED

FLUOR.

FLUOR
DOC. NO.

CCC-M-0703-04-00016-3

EQUIP/TAG NUMBER
00YD-SKD-0100

00A5VI00
REC'D: 25-MAR-2016

PROJECT: CITRUS COUNTY COMBINED CYCLE
CUSTOMER: DUKE ENERGY FLORIDA
PO: A5V1-4-0703-00
TAG: 00YD-SKD-0100

DO NOT SCALE DRAWING
TOLERANCES: $\pm 1/8"$ UNLESS OTHERWISE NOTED

Let.	Change	By	App	Date
B	RELEASED FOR APPROVAL	JG	JTG	12/7/2015
C	REVISED PER CUSTOMER REQUEST	JG	CH	1/27/2016
D	REVISED PER CUSTOMER REQUEST	DH	JG	2/11/2016
E	REVISED PER CUSTOMER REQUEST	DH	JG	3/23/2016

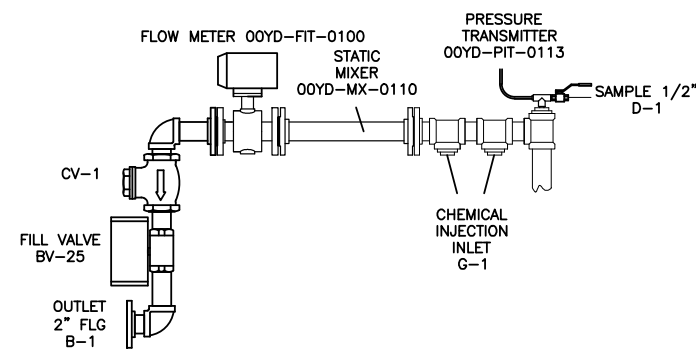
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ENGINEERED SYSTEMS
LIBERTYVILLE, ILLINOIS

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CONSENT OF CULLIGAN INTERNATIONAL CO.

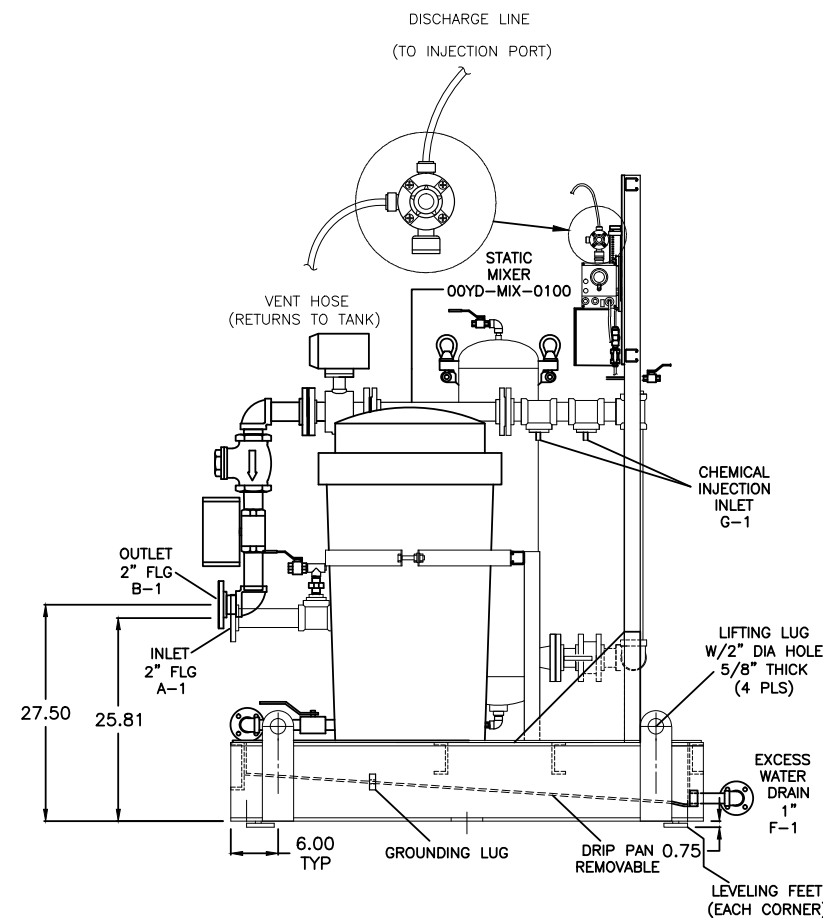
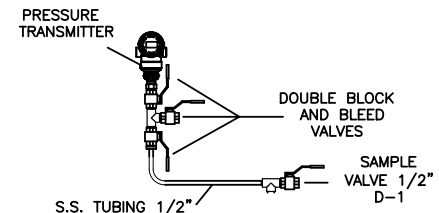
NAME
WATER TREATMENT SKID

DETAILED BY: JG 11/11/2015	APP. BY: JG 11/11/2015	SHEET 1 OF 2
REF. NO. RD0288	PART NO. RD0288-GA	

SECTION A-A

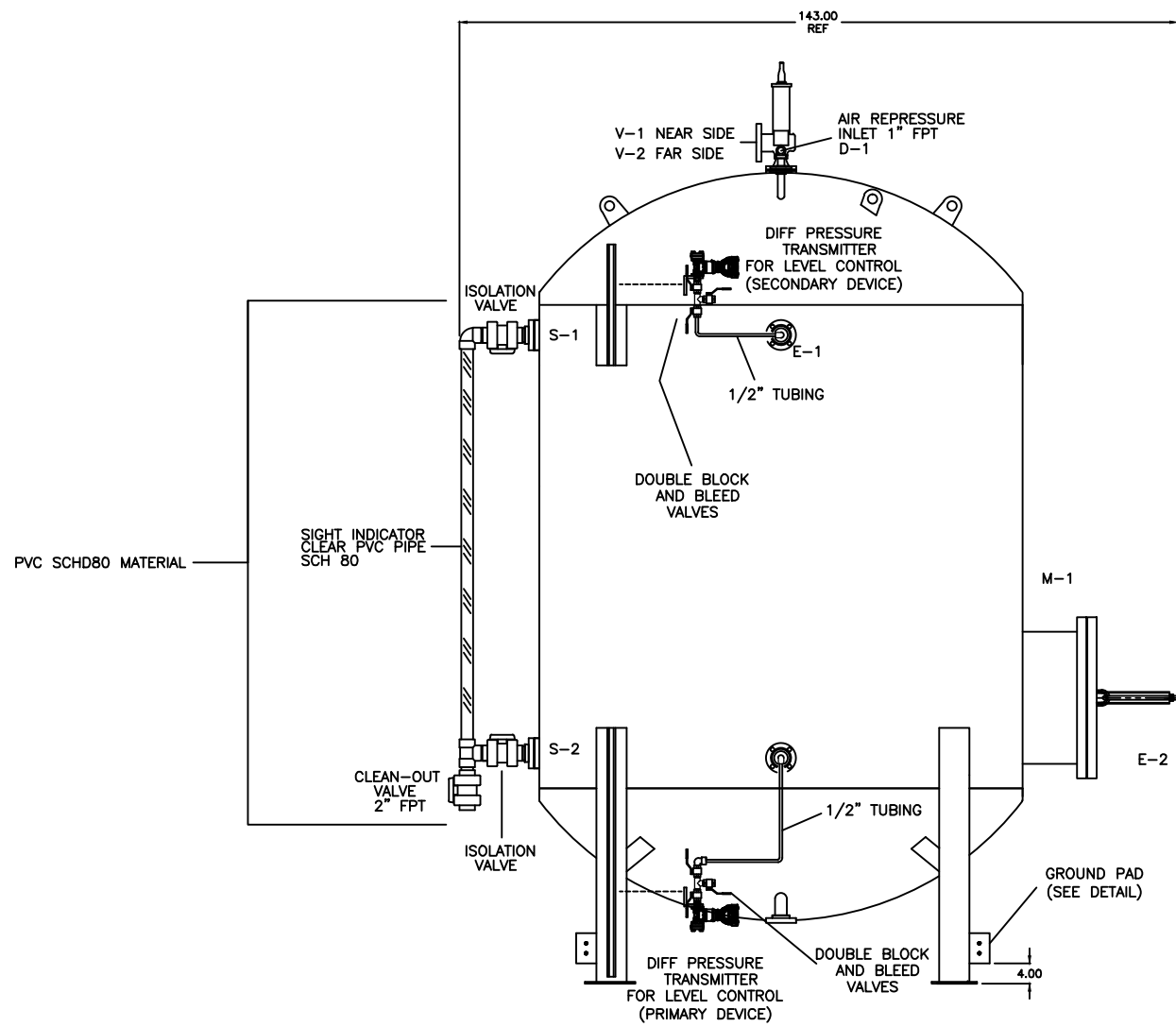
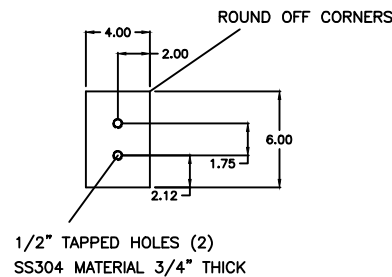
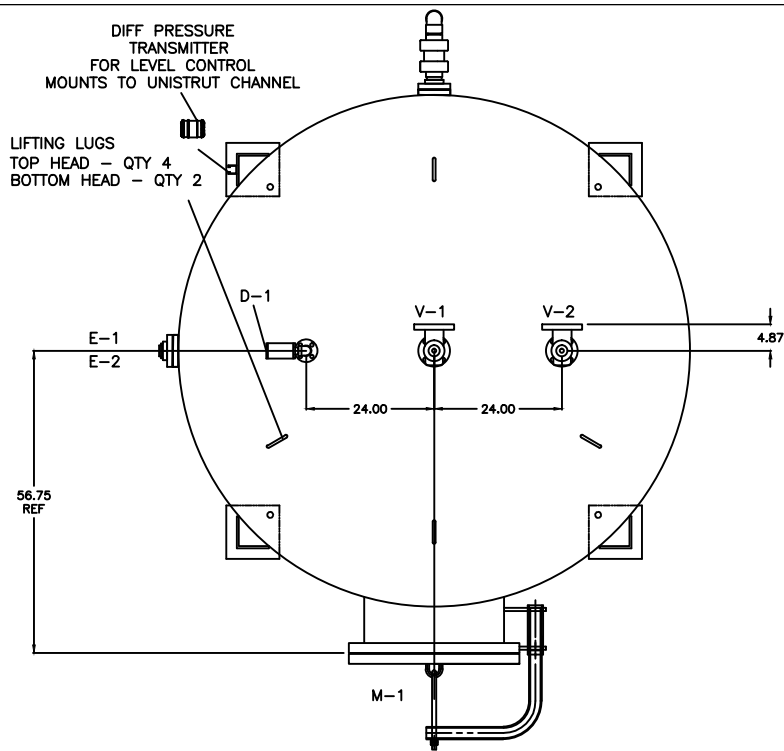


PRESSURE TRANSMITTER DETAIL

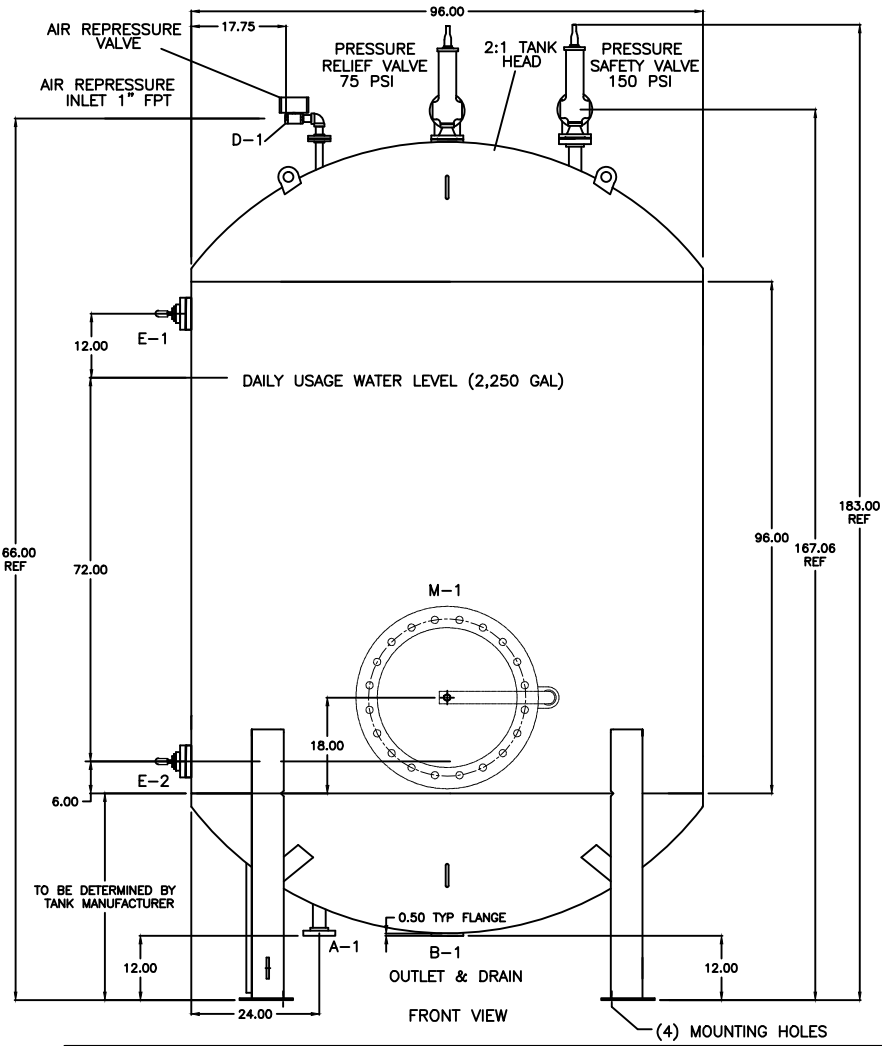


NOZZLE SCHEDULE			
MARK NO.	SIZE	TYPE NO.	SERVICE
A-1	2"	150LB FLANGE F.F.	INLET
B-1	2"	150LB FLANGE F.F.	OUTLET/DRAIN
D-1	1"	FEMALE THREADED	AIR REPRESSURE
E-1	2"	150LB FLANGE F.F.	LEVEL CONTROL
E-2	2"	150LB FLANGE F.F.	LEVEL CONTROL
M-1	24"	MANWAY DAVIT	MANWAY
S-1	2"	150LB FLANGE F.F.	SIGHT INDICATOR
S-2	2"	150LB FLANGE F.F.	SIGHT INDICATOR
V-1	3"	150LB FLANGE R.F.	PRESSURE RELIEF
V-2	3"	150LB FLANGE R.F.	PRESSURE SAFETY

TANK CONSTRUCTION:
CARBON STEEL A.S.M.E. 150 PSI
INSIDE LINING:
DEVCO 233H
EXTERIOR PAINT:
TNEMEC N69F SAFETY BLUE COLOR
VESSEL CAPACITY
4,000 GALLONS
WORKING CAPACITY
2,250 GALLONS



LEFT SIDE VIEW



FRONT VIEW
(4) MOUNTING HOLES

FLUOR 00A5VI00
DOC. NO. REC'D: 03-NOV-2016
CCC-M-0703-04-00017-5
EQUIP/TAG NUMBER
00YD-TNK-0100

- NOTES:
- 1) CHLORINE ANALYZER AND BACKFLOW PREVENTER TO DISTRIBUTION IS NOT SHOWN, THESE ITEMS ARE SHIPPED LOOSE.
 - 2) DRAIN VALVE IS NOT SHOWN, THIS ITEM IS SHIPPED LOOSE.
 - 3) COMMUNICATION CABLE BETWEEN PRIMARY AND SECONDARY PT IS NOT SHOWN.

PROJECT: CITRUS COUNTY COMBINED CYCLE
CUSTOMER: DUKE ENERGY FLORIDA
PO: A5V1-4-0703-00
TAG: 00YD-TNK-0100

DO NOT SCALE DRAWING TOLERANCES: $\pm 1/8"$ UNLESS OTHERWISE NOTED				
Let.	Change	By	App	Date
E	REVISED PT TUBING ORIENTATION	JG	JG	6/29/2016
F	REVISED FOR TAG INFORMATION	JG	JG	7/13/2016
G	ADDED TANK CAPACITY INFO	JG	JG	10/31/2016
H	DELETED TITLEBLOCK DESCRIPTION	JG	JG	11/2/2016

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NAME PRESSURIZED POTABLE WATER STORAGE TANK		
DETAILED BY: JG 11/11/2015	APP. BY: JG 11/11/2015	SHEET 2 OF 2
REF. NO. RD0288	PART NO. RD0288-GA	



FLUOR

DOC. NO.

00A5VI00

REC'D: 11-MAR-2016

CCC-M-0703-04-00065-2

EQUIP/TAG NUMBER

00YD-SKD-0100

00YD-TNK-0100

Sequence of Operation

Project Name: Citrus County Combined Cycle

Project Number: A5V1

PO#: A5V1-4-0703-00

Tag#:

Culligan#: Sequence of Operation, Rev 1, 3/10/2016

A - PROCEED

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By: MECHANICAL - CHRISTOPHER KRONENWETTER, KRO16260, 4/7/2016

Revision History

Date	Version	Description	Author
12/8/2015	0.0	Initial release	Joe Giuffre
3/10/2016	1.0	Revised per customer request	Joe Giuffre

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1. Drawing Reference and Equipment Lists

1.1 Drawing Reference

- Reference number RD0288 - RD0288-PID-001
- Reference number RD0288 - RD0288-PID-002
- Reference number RD0288 - RD0288-PID-003
- Reference number RD0288 - RD0288-GA-001
- Reference number RD0288 - RD0288-GA-002

1.2 Equipment

Water Treatment Skid:

- 20 Micron Primary Filter Cartridge Housing (2) - 00YD-FLT-0100A/B
- Carbon Block Cartridge Housing (2) - 00YD-FLT-0110A/B
- Pressure Transmitter (3) - 00YD-PIT-0111/0112/0113
- Static Mixer - 00YD-MIX-0100
- Flow Transmitter - 00YD-FIT-0100
- Chemical Pump (2) - 00YD-PUMP-0105A/B
- Calibration Column - CC-1
- Chemical Tank - 00YD-TNK-0105
- Turbidity Monitor - 00YD-AE-0110
- Level Switches - 00YD-LSL-XXXX/00YD-LSH-XXXX
- Make Up Water Valve - 00YD-FV-0100

Storage Tank

- Level Control (Differential Pressure Type - 00YD-LIT-0100
- Air Inlet valve - 00YD-FV-0110
- Safety Pressure valve - 00YD-SRV-0100
- Pressure Relief valve - 00YD-PRV-0100
- Chlorine Monitor - 00YD-AE-0100
- Air Compressor

2. System Description

2.1 General Description:

This system consists of 2 pieces of equipment:

- Water Treatment skid
- Storage Tank

The Water Treatment skid:

- (2) 20 Micron primary filter cartridges housings, (2) Carbon Block cartridge housings. (2) Chlorine chemical pumps, static mixer, flow meter, turbidimeter and water make-up valve.

The storage tank consists of:

- 3,000 gallon storage tank, air compressor, air inlet valve, safety relief valve and pressure relief valve, with level control and chlorine monitor.

2.2 Philosophy of Operation:

Water Treatment Skid:

Water enters the 20 micron primary filter housing. (2) filter housings are supplied, but only one is in use at a time, the other is in standby. Pressure transmitters upstream and downstream of the housings are for reading pressure to determine the pressure differential sent to a customer DCS. Inlet/outlet isolation valves and a bypass valve are also provided. The NTU level is monitored by a turbidity monitor. The monitor has a continuous sample bleed to drain. The water then enters (2) carbon block filter housings, each housing contains (7) cartridges. The purpose of the carbon block is to reduce the TOC level in the water. (2) filter housings are supplied, but only one is in use at a time, the other is on standby. Pressure transmitters upstream and downstream of the housings are for reading pressure to determine the pressure differential sent to a customer DCS. Inlet/outlet isolation valves and a bypass valve is also provided. Chlorine is fed into the water to maintain the desired chlorine level in the water. (2) chemical pumps are supplied, but only one is in use at a time, the other is in standby. A static mixer is used to ensure proper mixing. A flow meter is utilized to provide a flow rate which is feed back to the customer DCS. The flow rate can be utilized to change the

dosage of the chemical pumps if necessary. Water flows thru the flow meter and the water make up valve. The system is controlled by the customer DCS.

Storage Tank:

Water enters a 3,000 storage tank. The tank has a sight glass indicator to monitor the water level. A drain down valve is provided in the sight glass indicator to flush out containments for maintenance purposes. The level in tank is controlled by demand. There are 3 valves installed on the tank: Air Inlet, Safety Relief and Pressure Relief. When the level in the tank drops below a low level setting, the make-up water fill valve located on the water treatment skid, will open up filling the tank, in addition the Air inlet valve on top of the tank will open up. An air compressor will supply 65 PSI to the top of the tank. The pressure relief valve will remain closed. When level in tank reaches a high set point, both the make-up water valve and air inlet valve will close, and the pressure relief valve will open. A chlorine monitor is installed on the outlet of tank to monitor chlorine levels, this can be sent to the customer DCS. The system is controlled by the customer DCS.

FLUOR 00A5VI00
DOC. NO. REC'D: 21-JUN-2016
CCC-M-0703-04-00025-2
EQUIP/TAG NUMBER
00YD-SKD-0100 00YD-TNK-0100



Validated Filtration Solutions to Industry Leaders®

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By Don Parker on Jun 22, 2016

Vessel Data Sheet

Multi - Cartridge Liquid Vessels

GTCH Series

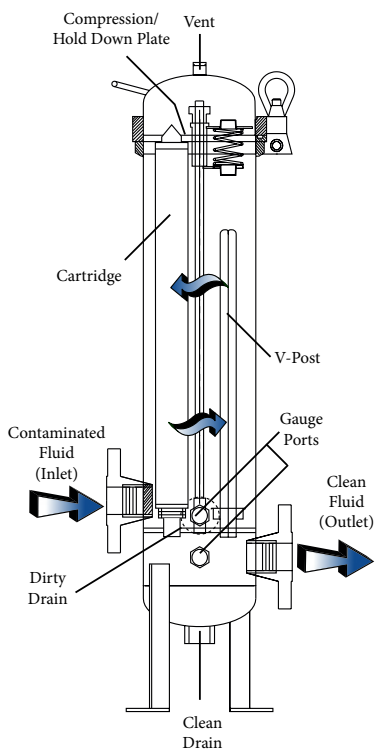
GTCH Series Multi-Round Cartridge Vessels are designed for industrial and high purity applications. Vessels are constructed of 304 or 316 stainless steel and accept DOE, 222/FLAT and 222/FIN end cartridges in 10, 20, 30 & 40 inch lengths.

Features

- 304 & 316 stainless steel construction
- 150 PSI pressure rating standard
- Single o-ring design (Buna-N standard)
- Easy-access eye-nuts/swing-bolt closure
- Universal seat cups and alternate compression/hold-down plates allow vessels to accept DOE, 222/FLAT or 222/FIN cartridges
- Heavy-duty welded angle mounting/support legs
- Bearing-assisted hand-wheel closure davit (GTCH12 & larger)

Options

- ASME Code Stamp
- Electropolish
- Sanitary Porting
- Alternate Seal Materials (EPDM, Viton, Silicone)



Project Name: Citrus County Combined Cycle
Project Number: A5V1
PO: A5V1-4-0703-00
Tag#: 00YD-FLT-0100A/0100B/0110A/0110B
Culligan#: Filter Housing Data Sheet Rev 1, 6/16/16

Ordering Information

GTCH	# of Cartridges	Length	Inlet/Outlet Size	Inlet/Outlet Style	Outlet	Material	Pressure Rating	Surface Finish	ASME Code Stamp
	3	1 = 10"	1 = 1"	N = FNPT	1 = Bottom Outlet	4 = 304 SS	15 = 150 PSI @ 250°F	GB = Glass Bead	Blank = None
	5	2 = 20"	1.5 = 1.5"	F = RF Flange	2 = Opposite Outlet	6 = 316 SS		EP = Electropolish	U = ASME
	7	3 = 30"	2 = 2"	T = TC ferrule					
	12	4 = 40"	3 = 3"						
	21		4 = 4"						
	36		6 = 6"						
	51		8 = 8"						

DISCLAIMER: Filtration data presented is representative of performance observed in controlled laboratory testing. It is not given as a warranty, specification or statement of fitness for use. Specific performance can vary widely depending on contaminant type, fluid properties, flow rates and environmental conditions. It is recommended that users conduct thorough qualification testing to assure the product functions as required.

Rev. 14.0

Global Filter LLC . 7201 Mt. Vernon Rd. SE . Cedar Rapids, IA 52403
Phone: (319) 743-0110 . Fax: (319) 743-0220 . Toll Free: 877-603-1003 . www.globalfilter.com

1

FLUOR 00A5VI00
DOC. NO. REC'D: 21-JUN-2016
CCC-M-0703-04-00018-2
EQUIP/TAG NUMBER
00YD-SKD-0100 00YD-TNK-0100



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By Don Parker on Jun 22, 2016

Filter Data Sheet

Model GWTB20A40MC

MuniClear-MB

NSF/ANSI 61 Certified Meltblown Polypropylene Filter Cartridge

- Graded pore structure enhances dirt holding capacity
- 100% polypropylene construction
- Free of surfactants & binders
- All end-configurations available
- Water Grade, High Performance, and Absolute Grade cartridges available to fit all application requirements

Maximum Differential Pressures

Forward.....35 psid

Reverse25 psid

Recommended Change Out

Differential Pressure20 psid

FDA Listed Materials

Manufactured from materials, which are listed for food contact applications in Title 21 of the U.S. Code of Federal Regulations.

NSF/ANSI 61

All cartridges certified by NSF for contact with drinking water components.



Project Name: Citrus County
Combined Cycle
Project Number: A5VI
PO: A5VI-4-0703-00
Tag#: 00YD-FLT-0110A/0110B
Culligan#: Cartridge Data Sheet
Rev 1, 6/16/16
20 Micron

Ordering Information

GWTB	Micron Size		A	Length	–	End Cap Code	O-Rings	–MC
Water Grade	1	3	A = 2.5"	9.75"		Blank = None (DOE, no gaskets)	Blank = None	MC = NSF/ANSI 61 Certified
GCTB	5	10		10"		3 = 222 w/Fin	B = Buna-N	
High Performance	25			19.5"		4 = 222 w/Flat Cap		
GATB	50			20"		5 = 222 w/Spring		
Absolute				29.25"		6 = 226 w/Flat Cap		
				30"		7 = 226 w/Fin		
				39"		8 = 226 w/Spring		
				40"		9 = SOE w/Spring		
						10 = DOE w/pp Core Ext.		
						13 = SOE w/pp Core Ext/Spring		



Dimensions (nominal)

Outside Diameter.....2.5 inches (6.4 cm)

Inside Diameter.....1 inch (2.6 cm)

Lengths.....9.75 to 40 inches (24.8 to 102 cm)

Construction Materials

Filtration Media.....Polypropylene

End Caps.....Polypropylene

O-Rings/Gaskets.....Buna

Performance Specifications

Micron Ratings: 1, 3, 5, 10, 25, 50

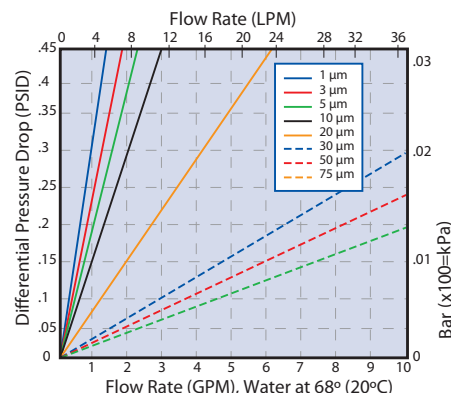
Efficiency:

Water Grade = 80%

High Performance = 90%

Absolute = > 95%

Typical Flow vs. Differential Pressure for Application Sizing (Based on GCTB)



Model 155815-03



Project Name: Citrus County Combined Cycle
Project Number: A5VI
PO: A5VI-4-0703-00
Tag#: 00YD-FLT-0110A/0110B
Culligan#: Carbon Block Cartridge Data Sheet, Rev 1, 6/16/16

PENTEK® EP SERIES CARBON BLOCK CARTRIDGES

IDEAL CHOICES FOR A WIDE RANGE OF APPLICATIONS

FLUOR 00A5VI00
DOC. NO. REC'D: 21-JUN-2016
CCC-M-0703-04-00022-2
EQUIP/TAG NUMBER
00YD-SKD-0100 00YD-TNK-0100

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By Don Parker on Jun 22, 2016



Pentek® EP Series Carbon Block Cartridges are manufactured using a process that yields a cartridge with a nominal 5-micron filtration rating and high dirt-holding capacity. A high porosity design helps prevent the cartridge from plugging before its adsorption capacity is exhausted, maximizing the utilization of the carbon while maintaining low pressure drop.

These cartridges are protected by a uniquely formulated polyolefin bilaminate pre-filter, designed to significantly increase the useful life of the cartridge by trapping sediment that typically plugs carbon block cartridges.

EP Series Cartridges make an ideal choice for a wide range of residential, food service, commercial and industrial applications.

FEATURES/BENEFITS

High dirt-holding capacity maximizes utilization of the carbon block*	Nominal 5-micron rating
Highly effective bad taste & odor and chlorine taste & odor reduction*	

SPECIFICATIONS

Filter Media – Bonded PAC	Gaskets – Buna-N
Endcaps – Polypropylene	Temperature Rating – 40-180°F (4.4-82.2°C)
Outer Wrap – Polyolefin	
Netting – Polyethylene	



This EP-10, EP-20, EP-BB and EP-20BB are Tested and Certified by NSF International to NSF/ANSI Standard 42 for material requirements only.

* Based on manufacturer's internal testing.

SPECIFICATIONS AND PERFORMANCE

PART #	MODEL #	MAXIMUM DIMENSIONS	RATING* (NOMINAL)	INITIAL ΔP (PSI) @ FLOW RATE (GPM)	CHLORINE TASTE & ODOR REDUCTION @ FLOW RATE
155531-43	EP-10	2.88" x 9.75" (73 mm x 248 mm)	5 micron	3.4 psi @ 1 gpm (0.23 bar @ 3.8 Lpm)	>6,000 gallons @ 1 gpm (22,700L @ 3.8 Lpm)
155529-43	EP-20	2.88" x 20" (73 mm x 508 mm)	5 micron	3.4 psi @ 2 gpm (0.23 bar @ 7.6 Lpm)	>12,000 gallons @ 2 gpm (45,400L @ 7.6 Lpm)
155698-43	EP-30	2.88" x 30" (73 mm x 762 mm)	5 micron	3.4 psi @ 2 gpm (0.23 bar @ 7.6 Lpm)	>18,000 gallons @ 2 gpm (68,137L @ 7.6 Lpm)
155815-03	EP5-40	2.88" x 40" (73 mm x 1,016 mm)	5 micron	3.4 psi @ 2 gpm (0.23 bar @ 7.6 Lpm)	>24,000 gallons @ 2 gpm (90,849L @ 7.6 Lpm)
155548-43	EP-BB	4.63" x 9.75" (118 mm x 248 mm)	5 micron	4.3 psi @ 2 gpm (0.30 bar @ 7.6 Lpm)	>22,000 gallons @ 2 gpm (83,300L @ 7.6 Lpm)
155583-43	EP-20BB	4.63" x 20" (118 mm x 508 mm)	5 micron	5.5 psi @ 5 gpm (0.38 bar @ 19 Lpm)	>40,000 gallons @ 4 gpm (151,400L @ 15.1 Lpm)

*Based on manufacturer's internal testing.

NOTES: Cartridges may contain a very small amount of carbon fines (very fine black powder). After installation, follow the instructions for flushing the cartridge to remove the fines before using the water. You should flush the tap at least 20 seconds prior to using water for drinking or cooking purposes. This is particularly important if the tap has not been used daily. Micron ratings based on 85% or greater removal of given particle size. Data obtained from actual particle counts using AC Fine Test Dust and Latex spheres. Estimated capacity using 2 ppm free available chlorine (FAC) at continuous flow with greater than 90% reduction.

WARNING: Do not use with water that is microbiologically unsafe or of unknown quality without adequate disinfection before or after the system.



FILTRATION & PROCESS

5730 NORTH GLEN PARK ROAD, MILWAUKEE, WI 53209
P: 262.238.4400 | F: 262.238.4404 | WWW.PENTAIRAQUA.COM | CUSTOMER CARE: 800.279.9404

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Culligan Rev A 12/17/2015

Information Sheet

Polyethylene Tank and Cover Assembly and Accessories

MODEL NO. 26350 50 GALLON TANK ASSEMBLY

- Ultraviolet resistant, molded yellow polyethylene tank.
- High rigidity black polyethylene cover with molded recess for mounting of pump, agitator* and liquid level switch.
- 5 gallon (20 liter) graduations
- Self supporting, tapered sides.
- Suitable for most corrosive and noncorrosive solutions.
- Can be nested up to four (4) per carton for shipping economy.
- Certified to NSF/ANSI Standard 61 and 372.

Project Name: Citrus County Combined Cycle
Project Number: A5VI
PO: A5VI-4-0703-00
Tag#: 00YD-TNK-0105
Culligan#: Chemical Storage Tank Data Sheet ,
Rev 1, 6/16/16

FLUOR

DOC. NO.

00A5VI00

REC'D: 21-JUN-2016

CCC-M-0703-04-00027-3

EQUIP/TAG NUMBER

00YD-SKD-0100

00YD-TNK-0100

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By Don Parker on Jun 22, 2016

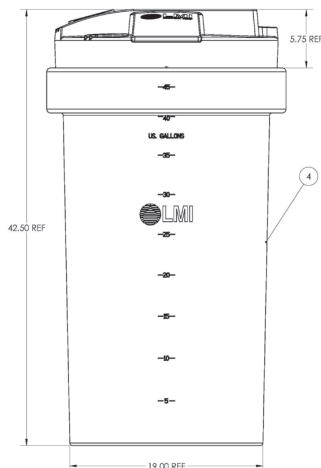
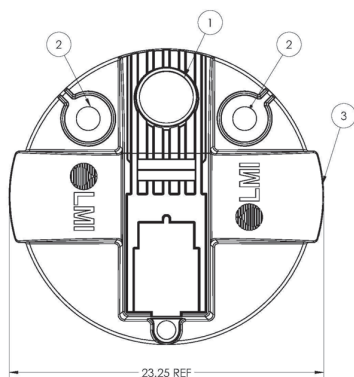


Model No. 26350

COMPONENT PARTS

Ref No.	Part No.	Description	Qty
1	25985	Caplug Assembly Black Polyethylene	1
2	10346	Caplug Assembly Black Polyethylene	2
3*	26637	Cover, Black Polyethylene	1
4	25688	Tank, 50 Gallon Yellow Polyethylene	1

Shipping wt. 25 lbs (11.4 kg)



NOTES:

1. Full, flat bottom support required.
2. Maximum solution/ambient temperature 110°F (43°C)
3. Minimum solution/ambient temperature 0°F (-18°C)
4. Maximum weight limit for cover 50 lbs (23 kg)
5. Not suitable for use with concentrated organic solvents, oils and related materials.

***Cover must be drilled at factory for agitator mounting.
Please indicate your desire for this option when ordering.**



Certified to
NSF/ANSI 61 & 372



201 Ivyland Road
Ivyland, PA 18974 USA
TEL: (215) 293-0401
FAX: (215) 293-0445
<http://www.lmipumps.com>

Project Name: Citrus County Combined Cycle Project
Number: A5VI
PO: A5VI-4-0703-00
Tag#:N/A
Culligan#: Chemical Pump Data Sheet, Rev 0, 12/22/15

Data Sheet

Series B

Electronic Metering Pumps

Model B921-D90HI

Configuration Data

Model **B92** **1** - **392SI**

Control & Output Code with Standard Liquid End

Manual Control

Speed (stroking frequency) and stroke length manually adjustable.

B11	--	1.6 GPH	(6.1 l/h)	---	150 psi	(10.30 Bar)
B12	--	2.5 GPH	(9.5 l/h)	---	100 psi	(6.90 Bar)
B13	--	4.5 GPH	(17.0 l/h)	---	50 psi	(3.4 Bar)
B14	--	7.0 GPH	(26.5 l/h)	---	30 psi	(2.07 Bar)

Instrument Responsive/Manual Control

Manual adjustment features of Series B1 plus switch conversion to external control for automatic systems.

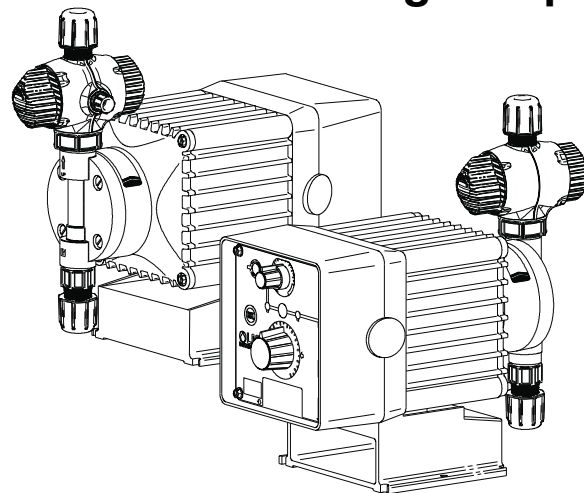
B71	--	1.6 GPH	(6.1 l/h)	---	150 psi	(10.30 Bar)
B72	--	2.5 GPH	(9.5 l/h)	---	100 psi	(6.90 Bar)
B73	--	4.5 GPH	(17.0 l/h)	---	50 psi	(3.4 Bar)
B74	--	7.0 GPH	(26.5 l/h)	---	30 psi	(2.07 Bar)
B91	--	1.6 GPH	(6.1 l/h)	---	150 psi	(10.30 Bar)
B92	--	2.5 GPH	(9.5 l/h)	---	100 psi	(6.90 Bar)
B93	--	4.5 GPH	(17.0 l/h)	---	50 psi	(3.4 Bar)
B94	--	7.0 GPH	(26.5 l/h)	---	30 psi	(2.07 Bar)

Voltage Code

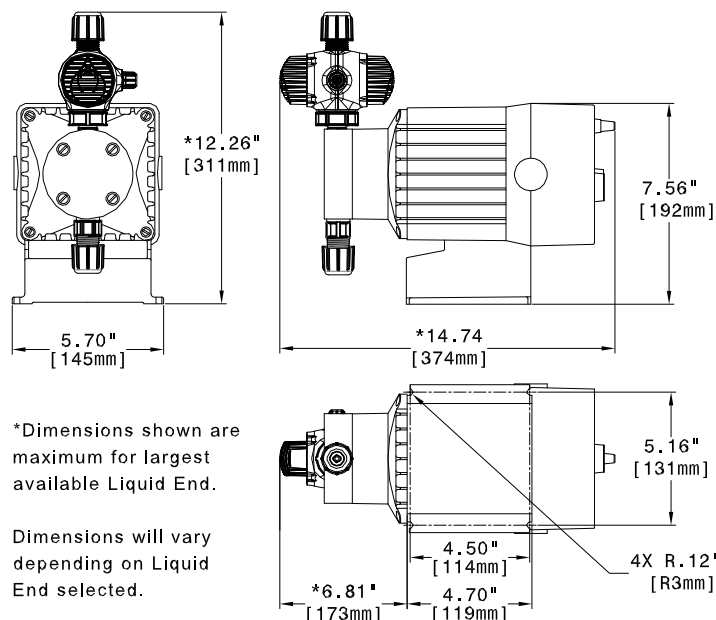
1	-----	120 VAC, US Plug
2	-----	240 VAC, US Plug
3	-----	220-240 VAC, DIN Plug
5	-----	240-250 VAC, UK Plug
6	-----	240-250 VAC, AUST/NZ Plug
7	-----	220-240 VAC, SWISS Plug

Liquid End

See next page for complete liquid end specifications and selection.



Dimensions



*Dimensions shown are maximum for largest available Liquid End.

Dimensions will vary depending on Liquid End selected.

Specifications

Series	Strokes Per Minute (Adjustable)		Stroke Length (Adjustable) Recommended Minimum	Average Input Power @Max Speed	Shipping Weight
B11, B71, B91 B12, B72, B92 B13, B73, B93 B14, B74, B94	1	100	10%	29 watts	15 lbs (6.9 kg)

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By: **Glen Edwards EDW21853 1/22/2016**



FLUOR

DOC. NO.

CCC-M-0703-04-00028-1

EQUIP/TAG NUMBER

00YD-SKD-0100

00A5VI00

REC'D: 29-DEC-2015

00YD-TNK-0100

201 Ivyland Road
Ivyland, PA 18974 USA
TEL: (215) 293-0401
FAX: (215) 293-0445
<http://www.limpumps.com>

Standard Liquid End Configuration Data & Materials of Construction

Drive Assembly	Liquid End No.	Size Code	Materials of Construction				Accessory	Tubing & Connections
			Head & Fittings	Balls	Liquifram™	Check Valve		
B91 ■ - B92 ■ - B71 ■ - B72 ■ - B11 ■ - B12 ■ -	498SI†	0.9	PVC/PVC	Ceramic	Fluorofilm™	PVDF/Polyprel®	4FV	PE .375" O.D.
	490SI†	0.9	Acrylic/PVC	Ceramic	Fluorofilm™	PVDF/Polyprel®	4FV	PE .375" O.D.
	499SI†	0.9	Acrylic/PVDF	PTFE	Fluorofilm™	PVDF/Polyprel®	4FV	PE .375" O.D.
	398SI†	0.9	PVC/PVC	Ceramic	Fluorofilm™	PVDF/Polyprel®	4FV	PE .375" O.D.
	393SI†	0.9	PVDF/PVDF	Ceramic	Fluorofilm™	PVDF/PTFE	4FV	PE .375" O.D.
	392SI†	0.9	PVDF/PVDF	Ceramic	Fluorofilm™	PVDF/Polyprel®	4FV	PE .375" O.D.
	85HV	0.9	Polypropylene	316 S.S.	Fluorofilm™	PTFE		PE .5" O.D. Vinyl .938" O.D.
	86HV	0.9	Acrylic/PP	316 S.S.	Fluorofilm™	Viton®		PE .5" O.D. Vinyl .938" O.D.
	495SI†	0.9	Polypropylene	Ceramic	Fluorofilm™	PTFE	4FV	PE .375" O.D.
B93 ■ - B73 ■ - B13 ■ -	297	0.9	316 S.S.	316 S.S.	Fluorofilm™	316 S.S.		Pipe 1/4" NPT M
	468SI†	1.8	PVC/PVC	Ceramic	Fluorofilm™	PVDF/Polyprel®	4FV	PE .375" O.D.
	460SI†	1.8	Acrylic/PVC	Ceramic	Fluorofilm™	PVC/Polyprel®	4FV	PE .375" O.D.
	469SI†	1.8	Acrylic/PVDF	PTFE	Fluorofilm™	PVDF/Polyprel®	4FV	PE .375" O.D.
	368SI†	1.8	PVC/PVC	Ceramic	Fluorofilm™	PVC/Polyprel®	4FV	PE .375" O.D.
	363SI†	1.8	PVDF/PVDF	Ceramic	Fluorofilm™	PVDF/PTFE	4FV	PE .375" O.D.
	362SI†	1.8	PVDF/PVDF	Ceramic	Fluorofilm™	PVDF/Polyprel®	4FV	PE .375" O.D.
	465SI†	1.8	Polypropylene	Ceramic	Fluorofilm™	PTFE	4FV	PE .375" O.D.
	75HV	1.8	Polypropylene	316 S.S.	Fluorofilm™	PTFE		PE .5" O.D. Vinyl .938" O.D.
B94 ■ - B74 ■ - B14 ■ -	76HV	1.8	Acrylic/PP	316 S.S.	Fluorofilm™	Viton®		PE .5" O.D. Vinyl .938" O.D.
	277	1.8	316 S.S.	316 S.S.	Fluorofilm™	316 S.S.		Pipe 1/4" NPT M
	312SI†	3.0	PVDF/PVDF	.375 Ceramic	Fluorofilm™	PVDF/Polyprel®	4FV	PE .5" O.D.
	313SI†	3.0	PVDF/PVDF	.375 Ceramic	Fluorofilm™	PVDF/PTFE	4FV	PE .5" O.D.
	318SI†	3.0	PVC/PVC	.375 Ceramic	Fluorofilm™	PVC/Polyprel®	4FV	PE .5" O.D.
	410SI†	3.0	Acrylic/PVC	.375 Ceramic	Fluorofilm™	PVDF/Polyprel®	4FV	PE .5" O.D.
	415SI†	3.0	Polypropylene	Ceramic	Fluorofilm™	PTFE	4FV	PE .5" O.D.
	418SI†	3.0	PVC/PVC	.375 Ceramic	Fluorofilm™	PVC/Polyprel®	4FV	PE .5" O.D.
	419SI†	3.0	Acrylic/PVDF	.375 PTFE	Fluorofilm™	PVDF/Polyprel®	4FV	PE .5" O.D.
	217	3.0	316 S.S.	316 S.S.	Fluorofilm™	316 S.S.		Pipe 1/4" NPT M

#These liquid ends use 3/8" diameter valve balls. Pump output may be reduced in some applications. Size 3.0 liquid ends use the accessory type AutoPrime valve.

Output Information with Standard Liquid End

Series	Gallons per Hour*		Liters per Hour*		mL/cc per Minute*		mL/cc per Stroke		Maximum Injection Pressure
	Min	Max	Min	Max	Min	Max	Min	Max	
B11, B71, B91	0.002	1.6	0.006	6.1	0.10	101	0.10	1.01	150 psi (10.30 Bar)
B12, B72, B92	0.003	2.5	0.009	9.5	0.16	158	0.16	1.58	100 psi (6.90 Bar)
B13, B73, B93	0.005	4.5	0.017	17.0	0.28	284	0.28	2.84	50 psi (3.4 Bar)
B14, B74, B94	0.007	7.0	0.027	26.5	0.44	442	0.44	4.42	30 psi (2.07 Bar)

*Minimum output is based on 1 stroke per minute and 10% stroke setting, minimum output can be reduced further in external mode. Series B9 pumps may be programmed for strokes per hour for lower outputs.

AutoPrime™ Liquid End Configuration Data & Materials of Construction

Drive Assembly	Liquid End No.	Size Code	Materials of Construction				Accessory	Tubing & Connections
			Head & Fittings	Balls	Liquifram™	Check Valve		
B92, B91, B72 B71, B12, B11	D90HI	0.9	Acrylic/PVC	Ceramic	Fluorofilm™	PVDF/Polyprel®	4FV	PE 0.375" O.D.
	D98HI	0.9	PVC/PVC	Ceramic	Fluorofilm™	PVDF/Polyprel®	4FV	PE 0.375" O.D.
B93, B73, B13	D60HI	1.8	Acrylic/PVC	Ceramic	Fluorofilm™	PVDF/Polyprel®	4FV	PE 0.375" O.D.
	D68HI	1.8	PVC/PVC	Ceramic	Fluorofilm™	PVDF/Polyprel®	4FV	PE 0.375" O.D.
B94, B74, B14	D10HI	3.0	Acrylic/PVC	Ceramic	Fluorofilm™	PVDF/Polyprel®	4FV	PE 0.5" O.D.
	D18HI	3.0	PVC/PVC	Ceramic	Fluorofilm™	PVDF/Polyprel®	4FV	PE 0.5" O.D.

Output Information – AutoPrime™ Liquid Ends (Liquid end models beginning with “D”)

Series	Maximum Output				Maximum Pressure	
	GPH	Liters/hr	mL/cc per minute	mL/cc per stroke	PSI	Bar
B11, B71, B91	1.4	5.3	88.3	0.88	150 psi	10.3
B12, B72, B92	2.3	8.7	145.1	1.45	100 psi	6.9
B13, B73, B93	4.0	15.1	252.4	2.52	50 psi	3.4
B14, B74, B94	6.8	25.7	429.1	4.29	30 psi	2.07

AutoPrime™ liquid ends have 3 check valves: suction on the bottom; discharge on the front; and autoprime bleed on the top. By design, a repeatable portion of the process fluid continuously bleeds through the top check valve to be returned to the chemical supply. The result is the assurance that any gas in the head is automatically relieved thus eliminating air-binding. The maximum output per the tables above is reduced to account for the continuous bleed.

- See front page for voltage code specifications.
- Plastic heads with tubing connection include ½" NPT and ½" BSP.
- † To specify ½" NPT male, change 'I' to 'P'.
- To specify black, UV resistant tubing, change 'I' to 'U'.
- To specify 3FV, change 'S' to 'T'.

- 3FV** indicates that the pump is equipped with an LMI Three Function Valve (pressure relief, priming aid, line drain).
- 4FV** indicates that the pump is equipped with an LMI Four Function Valve. This diaphragm type, anti-syphon/pressure relief valve is installed on the pump head. It provides anti-syphon protection and aids priming, even under pressure.

Fluorofilm™ is a copolymer of PTFE and PFA.
Polyprel® is an elastomeric PTFE copolymer.
Polyprel is a registered trademark of the Milton Roy Company.
Fluorofilm and Liquifram are trademarks of the Milton Roy Company.
Viton® is a registered trademark of E.I. DuPont Company.

CL17 CHLORINE ANALYZER

Project Name: Citrus County
Combined Cycle
Project Number: A5VI PO:
A5VI-4-0703-00
Tag#:00YD-AE-0100
Culligan#: CL17 Data Sheet
Rev 1, 6/16/16

Applications

- Beverage
- Collection Systems
- Drinking Water
- Field Use
- Food QC Lab
- Pharmaceutical
- Power
- Semiconductor
- Wastewater



Model 5440000

This is the same as model number 5440002 on page 4, the 544000 model is less chemicals which are supplied as separate items.

Dependable, colorimetric DPD free or total chlorine analysis.

Accurate, Reliable Results

The Hach CL17 Chlorine Analyzer uses colorimetric DPD chemistry to monitor water continuously for free or total residual chlorine. The CL17 analysis method is not affected by changes in chlorine concentration, sample pH, temperature, flow or pressure, thus offering more accuracy than other methods in today's market.

Simple, Predictable Maintenance

Monthly routine maintenance for the CL17 can usually be performed in 15 minutes, including changing reagents and cleaning the colorimetric cell. No special tools are required. For typical use, the CL17 will operate unattended for 30 days. Challenging applications may require more frequent cleaning.

Factory Calibrated

The CL17 Chlorine Analyzer is factory calibrated. A built-in electronic calibration curve is preprogrammed into the instrument. This instrument does not require recalibration unless specified by your regulatory agency for compliance reporting purposes.

EPA Compliant

The CL17 is compliant with US EPA regulation 40 CFR 140.74. Both Method 4500-CL G and Method 334.0 can be used for measuring residual chlorine in drinking water.

FLUOR

DOC. NO.

CCC-M-0703-04-00026-3

EQUIP/TAG NUMBER

00YD-SKD-0100

00A5VI00

REC'D: 21-JUN-2016

00YD-TNK-0100

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By Don Parker on Jun 22, 2016



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Specifications*

Range	0 to 5 mg/L free or total residual chlorine
Accuracy	± 5 % or ±0.03 mg/L (ppm) as Cl ₂ , whichever is greater
Lower Limit of Detection (LOD)	0.03 mg/L (ppm)
Cycle Time	2.5 minutes
Inlet Pressure	1 to 5 psig (0.07 to 0.34 bar), .5 psi is optimum
Pressure Limit	Inlet Pressure to Sample Conditioning: 1.5 to 75 psi (0.1 bar to 5.2 bar)
Inlet	1/4-inch OD polyethylene tube, quick-disconnect fitting
Drain	1/2-inch ID flexible hose, hose barb
Air Purge	0.1 cfm (0.17 m ³ /h) instrument quality air at max. 20 psig (ca. 1.4 bar) with 1/4-inch OD tube, quick disconnect fitting
Sample Flow Rate	200 to 500 mL per minute minimum
Sample Temperature	5 to 40 °C (41 to 104 °F)
Operating Temperature Range	5 to 40 °C (41 to 104 °F)
Operating Humidity	Up to 90% at 40 °C (104 °F) maximum
Interferences	Other oxidizing agents such as bromide, chlorine dioxide, permanganate and ozone will cause a positive interference. Hexavalent chromium will cause a positive interference: 1 mg/L Cr ⁶⁺ = approximately 0.02 mg/L as Cl ₂ . Hardness must not exceed 1,000 mg/L as CaCO ₃ .
Recorder Outputs	One 0/4-20 mA with an output span programmable over any portion of the 0 to 5 mg/L range. Recommended load impedance 3.6 to 500 ohms, 130 V isolation from earth ground.

Alarm	Two alarms selectable for sample concentration alarm, analyzer system warning, or analyzer system shut- down alarm. Each is equipped with an SPDT relay with contacts rated for 5A resistive load at 230 V AC.
Certifications	Europe, CE Approved with: EN 61326-1 CISPR 11 EN 61010-1 IEC 60529 North America: UL 61010A-1 CAN/CSA C22.2 No. 1010.1-92
Power Requirements (Voltage)	100 - 115/230 V AC
Power Requirements (Amps)	2.5 A
Power Requirements (Hz)	50/60 Hz
Display	LCD, 3-1/2 inch digit measurement readout and six-character alphanumeric scrolling text line
Light Source	Class 1 LED (light emitting diode) with a peak wavelength of 520 nm; 50,000 hours estimated minimum life
Enclosure Construction	ABS plastic, two clear polycarbonate windows, IP62-rated with the gasketed door latched.
Mounting Style	Wall mount
Dimensions Metric (H x W X D)	454 mm x 314 mm x 179 mm
Weight	23.13 lbs. (10.49 kg)

**Subject to change without notice.*

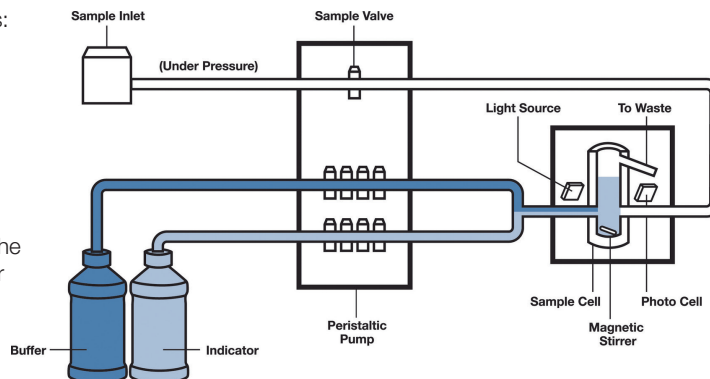
CL17 Chlorine Analyzer

Principle of Operation

The CL17 Chlorine Analyzer has three operating components:

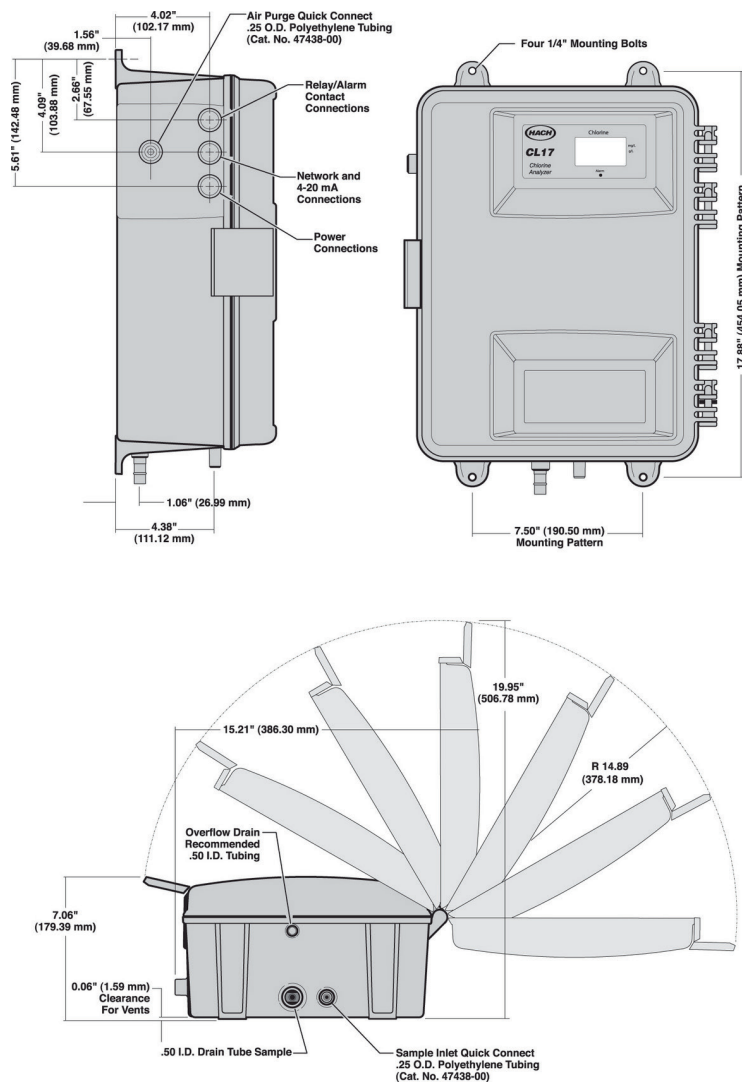
- A linear peristaltic pump to precisely control the volume of incoming samples and reagents.
- A colorimeter with seal-free, solid-state mixing system that includes a self-cleaning stir bar.
- One-month supply of reagents (indicator and buffer)

A zero reference point is established with the first sample in the cycle by measuring blank absorbance. (This compensates for the sample's color intensity and turbidity before the chlorine measurement is made.) Then, indicator and buffer reagents are added to the sample while a magnetic stirrer mixes the solution and the sample changes color. A compact colorimeter then measures the light transmitted through the sample. The measured color intensity is compared to a reference standard. Finally, the sample cell is flushed with new sample so that the cycle can repeat itself every 2.5 minutes.



Dimensions

The CL17 is designed to be wall-mounted with four 1/4-inch screws. Adequate clearance must be left at the sides and bottom of the case for plumbing and electrical connections. The sample inlet connection is 1/4-inch quick-disconnect fitting and the drain connection is 1/2-inch I.D. flexible hose. Electrical connections are inside the instrument case. Holes for three 1/2-inch conduit fittings are provided.



Ordering Information

Hach CL17 Chlorine Analyzers are shipped with a one-month supply of reagents, maintenance kit, installation kit, and manual. (The power cord is ordered separately.)

- 5440001** Model CI17 Free Residual Chlorine Analyzer
- 5440002** Model CI17 Total Residual Chlorine Analyzer
- 5440003** Model CI17 Free Residual Chlorine Analyzer with AquaTrend® Network Capability
- 5440004** Model CI17 Total Residual Chlorine Analyzer with AquaTrend® Network Capability

Accessories

- 5448800** North American Power Cord Kit with Strain Relief, 125V
- 5448900** European Power Cord Kit with Strain Relief, 230V
- 5444300** Maintenance Kit, 1 year, includes tubing, caps, funnel, and fittings
- 5444301** Maintenance kit, 1 year, includes preassembled tubing, caps, funnel, and fittings.
- 4643600** Sample Inlet Flow Meter
- 5449000** CI17 Calibration/Verification Kit

Reagents

Reagents

- 2556900** Free Chlorine Reagent Set
- 2557000** Total Chlorine Reagent Set
- 2297255** CI17 DPD Indicator Powder (Free and Total)
- 2314011** CL17 Free Chlorine Indicator Solution
- 2314111** CL17 Free Chlorine Buffer Solution
- 2263411** CL17 Total Chlorine Indicator Solution
- 2263511** CL17 Total Chlorine Buffer Solution



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hach.com

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In the interest of improving and updating its equipment,

Hach Company reserves the right to alter specifications to equipment at any time.



FLUOR 00A5VI00
DOC. NO. REC'D: 17-FEB-2016
CCC-M-0703-04-00081-1
EQUIP/TAG NUMBER
00YD-SKD-0100 00YD-TNK-0100



Chemical Feeder Sizing

Project Name: Citrus County Combined Cycle
Project Number: A5VI
PO#: A5VI-4-0703-00
Tag#:
Culligan#: RD0288 Chemical Feeder Sizing 1 PPM, Rev A, 1/26/2016

Chemical Selected is: Bleach 12.5%

Dosage of 1.0 ppm Chlorine

Input Parameters:

Max. Conc., lbs/gal	: 1.0
Dosage, mg/l	: 1.0
Flow Rate, gpm	: 50.0

Feeder Design Data:

Calc. Feed Rate, gpd	: 0.6
Recommended Feeder, gpd	: 1.0
Selected Feed Rate, gpd	: 0.5
Selected Feeder, gpd	: 1.0
Solution Conc., ml/gal	: 4540.0

Solution Preparation:

Volume of Solution to be Made, gal	: 50.0
------------------------------------	--------

Chemical does not require dilution.

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By: Bob Day, DAY13403, 3/8/2016



FLUOR 00A5VI00
DOC. NO. REC'D: 17-FEB-2016
CCC-M-0703-04-00082-1
EQUIP/TAG NUMBER
00YD-SKD-0100 00YD-TNK-0100

Chemical Feeder Sizing

Project Name: Citrus County Combined Cycle
Project Number: A5VI
PO#: A5VI-4-0703-00
Tag#:
Culligan#: RD0288 Chemical Feeder Sizing 4 PPM Rev A, 1/26/2016

Chemical Selected is: Bleach 12.5%

Dosage of 4.0 ppm Chlorine

Input Parameters:

Max. Conc., lbs/gal	: 1.0
Dosage, mg/l	: 4.0
Flow Rate, gpm	: 50.0

Feeder Design Data:

Calc. Feed Rate, gpd	: 2.4
Recommended Feeder, gpd	: 5.0
Selected Feed Rate, gpd	: 2.5
Selected Feeder, gpd	: 5.0
Solution Conc., ml/gal	: 3632.0

Solution Preparation:

Volume of Solution to be Made, gal : 50.0

Add 181.6 liter/47.98 gal/398.22 lbs to 2 gal of Soft Water. Add enough Soft Water to Raise the Solution to 50.0 gal. Mix Well.

Note: Soft Water MUST be less than 500 mg/l TDS.

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By: Bob Day, DAY13403, 3/8/2016

DATA SHEET

1720E Low Range Turbidimeter

Project Name: Citrus County Combined Cycle
Project Number: A5VI
PO: A5VI-04-0703-00
Tag#:00YD-AE-0110
Culligan#: Turbidimeter Analyzer Data Sheet, Rev 1, 6/16/16

Features and Benefits

USEPA Reporting

The 1720E Low Range Turbidimeter applies the instrument design and meets performance criteria established by the U.S. Environmental Protection Agency (USEPA) in Method 180.1, making it suitable for regulatory reporting.

Accuracy

Continuously flowing sample flows through the patented* bubble removal system, which vents entrained air from the sample stream and eliminates the most significant interference in low level turbidity measurement. The 1720E Turbidimeter is not affected by variations in flow and pressure.

Nephelometric Measurement

Incandescent light directed from the sensor head assembly down into the turbidimeter body is scattered by suspended particles in the sample. The sensor's submerged photocell detects light scattered at 90° from the incident beam. Sample enters the center column of the turbidimeter, rises into the measuring chamber and spills over the weir into the drain port. This configuration results in an optical flat surface free of turbulence.

Simplicity

A simplified two-module design includes the sensor and the controller interface. The controller accepts two turbidity sensors—adding a second 1720E sensor makes a system with two complete turbidimeters. Connections are simple plug & play.

Data Collection and Display

The 1720E Turbidimeter uses the sc200 Controller to receive data from up to two sensors. A built-in data logger collects turbidity measurement at user selectable intervals (1-15 minutes), along with calibration and verification points, alarm history, and instrument setup changes. Communications using MODBUS®/RS485 or MODBUS®/RS232.

Experience

The 1720E Turbidimeter reflects nearly 50 years of Hach leadership in turbidity measurement science. Hach has the largest turbidimeter installation base in the world. And, Hach offers a two-year warranty on the 1720E.

*U.S. patent 5,831,727

DW = drinking water WW = wastewater municipal PW = pure water / power
IW = industrial water E = environmental C = collections FB = food and beverage



FLUOR

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00A5VI00

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By Don Parker on Jun 22, 2016



DW

PW

IW

The Model 1720E Low Range Turbidimeter is the newest in a long line of successful Hach turbidimeters—from the unsurpassed world leader in turbidity measurement.

Fast Calibration and Verification

Calibration and verification can be performed without loss of sample flow using the ICE-PIC™ Calibration/Verification Module. One-point calibration with prepared StablCal™ Stabilized Formazin Solution eliminates the errors of user-prepared formazin suspension dilution. Features of the ICE-PIC Module include:

- Calibrate or verify the performance of each sensor in less than one minute
- Factory calibrated and provided with a certificate of accuracy
- Cost effective, one-time investment. No consumables are needed
- Small, lightweight design can be used for spot verification in the facility
- Available in 20 and 1.0 NTU



Be Right™

Specifications*

Range

0.001-100 Nephelometric Turbidity Units (NTU)

Accuracy

(Defined according to ISO 15839.)
 $\pm 2\%$ of reading or ± 0.015 NTU
(whichever is greater) from 0 to 40 NTU;
 $\pm 5\%$ of reading from 40 to 100 NTU

Displayed Resolution

0.0001 NTU up to 9.9999 NTU;
0.001 NTU from 10.000 to 99.999 NTU

Repeatability

(Defined according to ISO 15839.)
Better than $\pm 1.0\%$ of reading or
 ± 0.002 NTU, whichever is greater

Response Time

Initial response in 1 minute, 15 seconds
for a full-scale step change

Signal Average Time

User selectable from 6, 30, 60, 90
seconds; default 30 seconds

Sample Temperature

0 to 50°C (32 to 122°F)

Sample Flow Required

200 to 750 mL/minute
(3.1 to 11.9 gal/hour)

Operating Temperature

Single sensor system:
0 to 50°C (32 to 122°F)
Two sensor system:
0 to 40°C (32 to 104°F)

Operating Humidity

5 to 95% non-condensing

Storage Temperature

-20 to 60°C (-4 to 140°F)

Power Requirements

100-230 Vac, 50/60 Hz,
auto selecting; 40 VA

Sample Inlet Fitting

1/4" NPT female, 1/4" compression
fitting (provided)

Drain Fitting

1/2" NPT female, 1/2" hose barb (provided)

Recorder Outputs

Two selectable for 0-20 mA or 4-20 mA;
output span programmable over any
portion of the 0-100 NTU range;
built into the sc100 Controller

Alarms

Three set-point alarms, each equipped
with an SPDT relay with unpowered
contacts rated 5A resistive load at
230 Vac; built into the sc200 Controller

Enclosure

NEMA-4X (indoor)/IP66 Controller

Digital Communication

Network card compatible;
MODBUS®/RS485, MODBUS/RS232,
LonWorks® protocol (optional)

Compliance

Standard Methods 2130B, USEPA 180.1,
Hach Method 8195

Certifications

Safety:

Listed by ETL to UL 61010A-1:
Certified by ETL to CSA C22.2
No. 1010.1: CE certified by Hach
Company to EN 61010-1

Immunity:

CE certified by Hach Company to
EN61326 (industrial levels)

Emissions:

Class A: EN 61326, CISPR 11, FCC
Part 15, Canadian Interference-Causing
Equipment Regulation ICES-003

Mounting

Turbidimeter body and head assembly:
wall and floor stand

sc200 Controller:

wall, pole, panel, and floor stand

Dimensions

Turbidimeter body and cap:
25.4 x 30.5 x 40.6 cm (10 x 12 x 16 in.)

Shipping Weight

1720E Turbidimeter and

sc200 Controller:

6.12 kg (13.5 lbs.)

1720E Turbidimeter:

4.54 kg (10 lbs.)

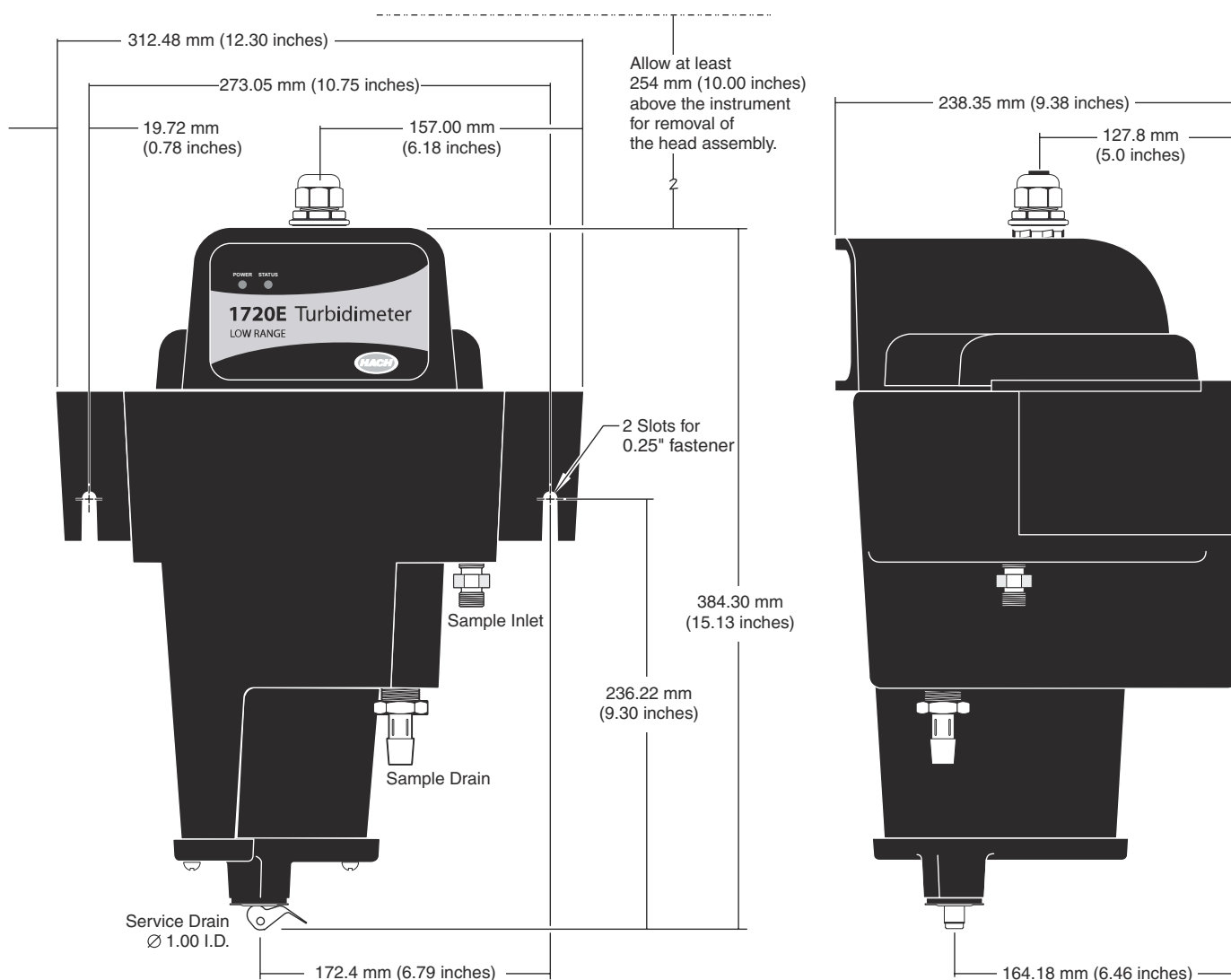
*Specifications subject to change without notice.

Engineering Specifications

- The turbidimeter shall be a microprocessor-based, continuous-reading, on-line nephelometric instrument
- The turbidity monitoring system shall include one or two turbidimeter(s) and one interface unit.
- The turbidimeter shall measure turbidity in the range of 0.001-100 NTU
- Accuracy shall be $\pm 2\%$ of reading or ± 0.015 NTU (whichever is greater) from 0 to 40 NTU; $\pm 5\%$ of reading from 40 to 100 NTU
- Displayed resolution shall be 0.0001 NTU from 0 to 9.999 NTU and 0.001 NTU from 10.000 to 9.999 NTU.
- Repeatability shall be better than $\pm 1.0\%$ of reading or ± 0.002 NTU (whichever is greater).
- The turbidimeter shall meet all design and performance criteria specified by USEPA method 180.1.
- Light shall be directed through the surface of the sample and the detector shall be immersed in the sample, eliminating glass windows and flow cells.
- Optical components shall be mounted in a sealed head assembly that can be removed for calibration/ service without disturbing sample flow.
- The turbidimeter body shall be constructed of corrosion-resistant polystyrene.
- An internal bubble removal system shall be included to vent entrained air from the sample stream.
- Calibration of the turbidimeter shall be either formazin-based (20 or 1 NTU) or instrument comparison-based calibration method.
- User selectable signal averaging, bubble removal, alarm and recorder output hold, and self-test diagnostics shall be provided.
- Connections between the turbidimeter(s) and the controller shall be "plug and play."
- The Interface unit shall allow operators to control sensor and interface functions with menu-driven software and shall provide data logging of measurement data.
- The interface unit shall have a built-in data logger with the capacity to store data on 15-minute intervals for up to 6 months.
- The interface unit shall be housed in a NEMA-4X (indoor) industrial metal/plastic enclosure.
- The DC power supply shall be housed in the interface unit
- The DC power supply shall automatically accept input in the range of 100 to 230 Vac, 50/60 Hz.
- All system components shall be ETL listed to UL 61010A-1, certified to CSA C22.2 No. 1010.1, and CE certified by manufacturer to EN 61010-1.
- All system components shall be CE certified by the manufacturer to EN 61326 (industrial levels) for immunity and emissions, Class A.
- All system components shall meet FCC Part 15 for North America and Canadian Interference-Causing Equipment Regulation ICES-003, and CISPR 11 Class A levels for rest of the world.
- The turbidimeter shall be Hach Company Model 1720E Low Range Turbidimeter with the sc200 Controller.

Dimensions

The 1720E turbidimeter can be installed on a wall or a floor stand. No tools are needed to connect the controller unit to the turbidimeter. The distance between the two units can be a maximum of 9.62 m (31.6 ft) with the use of an extension cable.



Ordering Information

1720E Turbidimeter

6010101	1720E Turbidimeter, sensor only
2978100	1720E Turbidimeter with sc200 Controller, 1 channel
2978200	1720E Turbidimeter with sc200 24 Vdc Controller, 1 channel
2976800	1720E Turbidimeter with sc200 Controller, 2 channel
2976900	1720E Turbidimeter with sc200 24 Vdc Controller, 2 channel

Cables

5796000	Extension Cable, 7.7 m (25 ft.)
----------------	---------------------------------

Note: Power cables must be ordered separately.

Accessories

5743200	Floor Stand
9218200	SD card reader (USB) for connection to PC
9218100	4 GB SD card

Calibration Supplies

ICE-PIC Calibration/Verification Module / 1720E:

5225000	20 NTU Module
5221500	1 NTU Module

StablCal Comparative Calibration Standards

2660153	20.0 NTU, 1 L each (Calibration Cylinder, P/N 44153-00, must be ordered separately.)
----------------	--

StablCal Verification Standards

2697953	0.3 NTU, 1 L each
2698053	0.5 NTU, 1 L each
2723353	0.1 NTU, 1 L each
2659853	1.0 NTU, 1 L each
2746353	40.0 NTU, 1 L each

Formazin Calibration Standards

4415600	Formazin Calibration Kit for user-prepared calibration (includes 500 mL of 4000 NTU Formazin, TenSette® Pipet, and calibration cylinder)
246149	Formazin Primary Standard, 4000 NTU, 500 mL (replacement for P/N 4415600)
4415300	Calibration Cylinder, 1 L

To complete your turbidity measurement system, choose from these Hach controllers...

Model sc200 Controller

(see Lit. #2665)

LXV404.99.00552	sc200 controller, 2 channel, digital
LXV404.99.00502	sc200 controller, 1 channel, digital
LXV404.99.00542	sc200 controller, 2 channel, digital & mA input

Model sc1000 Controller

(see Lit. #2403)

LXV402.99.00002	sc1000 Display Module
LXV400.99.1R572	sc1000 Probe Module, 4 sensors, 4 mA Out, 4 mA In, 4 Relays, 110-230V
LXV400.99.1B572	sc1000 Probe Module, 4 sensors, 4 mA Out, 4 mA In, 4 Relays, RS-485 (MODBUS), 110-230V
LXV400.99.1F572	sc1000 Probe Module, 4 sensors, 4 mA Out, 4 mA In, 4 Relays, PROFIBUS DP, 110-230V
LXV400.99.1R582	sc1000 Probe Module, 6 sensors, 4 mA Out, 4 mA In, 4 Relays, 110-230V

Lit. No. 2457 Rev 1

C11 Printed in U.S.A.

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In the interest of improving and updating its equipment, Hach Company reserves the right to alter specifications to equipment at any time.

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Keep it pure.

Make it simple.

Be right.

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Be Right™



Line List

Project Name

Citrus County Combined Cycle

Project Number

A5VA

PO#

A5V1-4-0703-00

Tag#

Culligan#

Line List, Rev 2, 2/25/2016

Remarks:

	Line No.	Service Description	Process Conn Size	Material	P&ID Diagram Page
1	1	Feed Inlet Primary Filters No.1/No.2	2"	Carbon Steel Schd 80 A106-B	2
2	2	Feed Inlet to inlet of Primary Filter No.1	2"	Carbon Steel Schd 80 A106-B	2
3	3	Feed Inlet to inlet of Primary Filter No.2	2"	Carbon Steel Schd 80 A106-B	2
4	4	Bypass Line to upstream of Primary Filter Bypass Isolation Valve	2"	Galv Steel Schd 80 NSF A53-B	2
5	5	Outlet of Primary Filter No.1	2"	Galv Steel Schd 80 NSF A53-B	2
6	6	Outlet of Primary Filter No.2	2"	Galv Steel Schd 80 NSF A53-B	2
7	7	To inlet of Carbon Block Filters No.1/No.2	2"	Galv Steel Schd 80 NSF A53-B	2
8	8	To Carbon Block Filter No.1	2"	Galv Steel Schd 80 NSF A53-B	2
9	9	To Carbon Block Filter No.2	2"	Galv Steel Schd 80 NSF A53-B	2
10	10	Bypass Line to upstream of Carbon Block Bypass Isolation Valve	2"	Galv Steel Schd 80 NSF A53-B	2
11	11	Outlet of Carbon Block Filter No.1	2"	Galv Steel Schd 80 NSF A53-B	2
12	12	Outlet of Carbon Block Filter No.2	2"	Galv Steel Schd 80 NSF A53-B	2
13	13	Main line to inlet of Static Mixer	2"	Galv Steel Schd 80 NSF A53-B	2
14	14	Main Line from downstream of flowmeter to outlet	2"	Galv Steel Schd 80 NSF A53-B	2
15	15	Drain Line Primary and Carbon Filters	1"	Galv Steel Schd 80 NSF A53-B	2

FLUOR 00A5VI00
DOC. NO. REC'D: 05-MAR-2016
CCC-M-0703-04-00064-2
EQUIP/TAG NUMBER
00YD-SKD-0100 00YD-TNK-0100

A – PROCEED

FLUOR®

Authorization to proceed does not relieve Contractor/Supplier of its responsibility or liability under the Contract and or Purchase Order.
By Christopher Kronenwetter on Mar 14, 2016



FLUOR
DOC. NO. 00A5VI00
REC'D: 19-JUL-2016
CCC-M-0703-04-00067-5
EQUIP/TAG NUMBER
00YD-SKD-0100 00YD-TNK-0100

Valve List

A - PROCEED
FLUOR
Authorization to proceed does not relieve Contractor/Supplier of its responsibility or liability under the Contract and/or Purchase Order.
By Don Parker on Jul 19, 2016

Project Name:	Citrus County Combined Cycle					Remarks: 00YD-V-0111,0112,0113,0114,0115,0116,0117,0118,0119,0120				
Project Number:	ASV1									
PO#:	ASV1-4-0703-00									
Tag#:	See Notes in Remarks									
Culligan#:	RD0288 Valve List, Rev 5, 6/28/2016									
	Instrument Tag No.	Type Service Description	Process Conn Size	Material	Connection	Rating	Seal	Qty	Manufacturer/Model No.	P&ID Diagram Page
1	See Notes in Remarks	Filter Housings (Inlet/Outlet/Bypass)	2"	Ductile Iron Body	Flange	150#	EPDM	10	Pentair Series 920	2
2	00YD-CHK-0110/0100	Backflow Preventor (Turbidity and Chlorine Monitor)	1/4"	Bronze	NPT	150#	Rubber	2	Watts LF-009	2,3
3	00YD-V-0148/0149/0158/0160	Vent Valve Filter Primary Filters No.1/2/Vent Valve Carbon Filters No. 1/2	1/4"	SS	NPT	150 #	SS	2	Apollo 76-101-01A	2
4	00YD-V-0150/0151/01059/0161	Drain Valve Filter Primary Filters No.1/2/Drain Valve Carbon Filters No. 1/2	1"	Bronze	NPT	150#	Bronze	2	Apollo 70LF-105-01	2
5	00YD-V-0152/0153/0154	Block and Bleed Valves for PIT-0111	1/2"	SS	NPT	150#	SS	3	Apollo 76-103-01A	2
6	00YD-V-0155/0156/0157	Block and Bleed Valves for PIT-0112	1/2"	SS	NPT	150#	SS	3	Apollo 76-103-01A	2
7	00YD-V-0121/0122/0123	Block and Bleed Valves for PIT-0113	1/2"	SS	NPT	150#	SS	3	Apollo 76-103-01A	2
8	00YD-V-0124/0125/0126/0162	Calibration Valves for Chem Feed	1/4"	PVC	NPT	150#	EPDM	4	Spears 1080-002	2
9	00YD-V-0127/0128/0129	Sight Glass Isolation and Drain Valve (Storage Tank)	2"	PVC	NPT	150#	EPDM	3	Spears 1829-020	3
10	00YD-PRV-0100	Pressure Relief Valve 75 PSI (Air Out)	2" Inlet/3" Outlet	Carbon Steel	Flange	150#	Soft Iron	1	Consolidated 1905-00J-2CC-MS-31-RF-LA-HP	3
11	00YD-V-0130/0131/0132	Block and Bleed Valves for LIT-0100 HLL	1/2"	SS	NPT	150#	SS	3	Apollo 76-103-01A	3
12	00YD-V-0133/0134/0135	Block and Bleed Valves for LIT-0100 LLL	1/2"	SS	NPT	150#	SS	3	Apollo 76-103-01A	3
13	00YD-SRV-0100	Safety Relief Valve 110 PSI (Air Out)	2" Inlet/3" Outlet	Carbon Steel	Flange	150#	Soft Iron	1	Consolidated 1905-00J-2CC-MS-31-RF-LA-HP	3
14	00YD-V-0105	Drain	2"	Ductile Iron Body	Flange	150#	EPDM	1	Pentair Series 920	3
15	00YD-FV-0100	Fill Valve	2"	Bronze	NPT	150#	EPDM	1	Apollo 71-AR8-64	3
16	00YD-FV-0110	Repressurization Valve	1"	Bronze	NPT	150#	EPDM	1	Apollo 71-AR5-64	3
17	00YD-CHK-0120	Check Valve	2"	Bronze	NPT	300 WOG	Bronze	1	Ultrapure UP509	2
18	00VD-V-0137	Drip Drain Valve	1"	Bronze	NPT	150#	RPTFE	1	Apollo 70LF-105-01	2
19	00VD-V-0138/039/140	Sample Valve 1/2" Pre-Post Filter	1/2"	SS	NPT	150#	SS	3	Apollo 76-103-01A	2



PRELIMINARY DESIGN REPORT – POTABLE WATER TREATMENT PLANT

Fluor Specifications, Drawings, Calculations

- | | | |
|-----------------------|---------|---|
| • CS01 | Rev. 0 | Piping Specification for Aboveground Potable Water |
| • PE04 | Rev. 0 | Piping Specification for Underground Potable Water |
| • CCC00-SP-P-CZ-01 | Rev. 0 | Field Installation of Underground Piping Systems |
| • CCC00-SP-C-SI-01 | Rev. 03 | Site Preparation, Excavation, Compaction & Backfill Specification |
| • CCC00-CV-C-00.SD-02 | Rev. 0 | Civil General Sections and Details Sheet 2 |

SEQ NO.	REV	NOTE NO.	ITEM NAME	ITEM CODE	SIZE RANGE / SMALL END SIZES	DESCRIPTION	REFERENCE / LARGE END SIZES	NOTES						
10						***** VALVES *****		NR1 SIZES SHOWN IN SIZE COLUMNS ARE THE SMALL END OF REDUCERS AND THE BRANCH SIZE OF OLETS AND TEES.						
20														
21														
22			Butter	BF01DI-09	3 - 4	BUTTERFLY , DUCTILE IRON, LUGGED, MANUAL GEAR								
23			BALSCR	BL01BR-01	3/4 - 3/4	BALL VALVE, 150 CLASS, BRASS, THREADED								
30								3/4 - 4						
40						***** PIPE *****								
50														
60			Piping	5355380	1/2 - 2	PIPE XS SMLS STL A53-B TYPE S GALV NSF STD 61								
61			Piping	5355381	3 - 4	PIPE SCH STD SMLS STL A53-B TYPE S GALV NSF STD 61		3/4 - 4						
70														
80		NR1				***** FITTINGS *****								
90														
100			90 Deg	5489015	1/2 - 4	ELL 90 DEG 150# SCR D GALV MI A197		3/4 - 4						
110			45 Deg	5484515	1/2 - 4	ELL 45 DEG 150# SCR D GALV MI A197								
120			Tee	5488150	1/2 - 4	TEE 150# SCR D GALV MI A197								
130			Reduci	5481513	1/2 - 3	TEE RED 150# SCR D GALV MI A197								
140			Cap	5488197	1/2 - 4	CAP 150# SCR D GALV MI A197		3/4 - 4						
150			Coupli	5481519	1/2 - 4	COUPLING 150# SCR D GALV MI A197								
160			Union	5481500	1/2 - 4	UNION 150# SCR D GALV MI BRASS TO IRON								
170			Plug	5488766	1/2 - 4	PLUG SQ HEAD SCR D GALV MI A197 NSF								
180			Coupli	5481975	1/2 - 4	COUPLING REDUCING 150# SCR D GALV MI A197		3/4 - 4						
190			Bushin	5488702	1/2 - 4	BUSHING HEX HEAD SCR D GALV MI A197								
200														
210						*****PIPE NIPPLES*****								
220								3/4 - 4						
230			Nipple	5535303	1/2 - 2	NIPPLE XS GALV STL A53-B TP S TBE 3" LONG NSF 61								
240			Nipple	5535304	1/2 - 2	NIPPLE XS GALV STL A53-B TP S TBE 4" LONG NSF 61								
250			Nipple	5535306	1/2 - 2	NIPPLE XS GALV STL A53-B TP S TBE 6" LONG NSF 61								
260								3/4 - 4						
270						***** PIPE FLANGES *****								
280														
290			Flange	5599594	1/2 - 4	FLG SCR D 150# FF GALV STL A105								
291			Flange	5599589	1/2 - 4	FLG SCR D 150# RF GALV STL A105		3/4 - 4						
300			Blind	5615486	1/2 - 4	FLG BLIND 150# FF GALV STL A105								
301														
310			SPAFF	5711818	1/2 - 4	RING COMPENSATION/SPACER 150# PP FOR ADAPTING RF TO FF		3/4 - 4						
320						***** GASKETS *****								
330														
340														
350			GASFF	5669711	1/2 - 4	GASKET 150# NON-ASB FULL FACE 1/16" THK		3/4 - 4						
351			GASFF	5664297	1/2 - 4	GASKET 150# SYNTHETIC FIBER W/ RUBBER BINDER FULL FACE 1/16" THK								
360														
370						***** BOLTING *****								
380								3/4 - 4						
390			BOLM	5675631	1/4 - 99	MACHINE BOLT STEEL A307 GRADE B W/NUT								
400														
410														
			CITRUS COUNTY COMBINED CYCLE PROJECT Fluor Enterprises, Inc - DUKE ENERGY FLORIDA, INC A5VI CRYSTAL RIVER, FLORIDA			CONSTRUCTION		CITRUS COUNTY COMBINED CYCLE PROJECT						
						4" & SMALLER - SCREWED		CORR. ALLOW.	DATE	BY	REV	SHEET	PA	CLASS
								0 IN	18FEB15	CDM	0	1 OF 2	5	CS013

SEQ NO.	REV	NOTE NO.	ITEM NAME	ITEM CODE	SIZE RANGE / SMALL END SIZES	DESCRIPTION	REFERENCE / LARGE END SIZES	NOTES				
420 430 440 450 451						***** BRANCHES ***** USE TEES FOR ALL BRANCHES						
								SERVICE				
								ABOVEGROUND POTABLE WATER DESIGN: 150 PSIG @ 100 F CODE: ASME B31.1/ASME B16.3				
								MATERIAL: GALVANIZED STEEL FLANGE RATING: 150 FF TEMPERATURE RANGE: 100 / 100 °F COMMENT: 100F				
FLUOR			CITRUS COUNTY COMBINED CYCLE PROJECT Fluor Enterprises, Inc - DUKE ENERGY FLORIDA, INC A5VI CRYSTAL RIVER, FLORIDA			CONSTRUCTION	CITRUS COUNTY COMBINED CYCLE PROJECT					
						4" & SMALLER - SCREWED	CORR. ALLOW. 0 IN	DATE 18FEB15	BY CDM	REV 0	SHEET 2 OF 2	PA 5

SEQ NO.	REV	NOTE NO.	ITEM NAME	ITEM CODE	SIZE RANGE / SMALL END SIZES	DESCRIPTION	REFERENCE / LARGE END SIZES	NOTES						
10						*****VALVES*****		DRISCOPLEX 4100 SERVICE DRINKING WATER (YD) DESIGN CONDITIONS = 150 PSIG @ 100 F CODE = ASME B31.1 MATERIAL: HDPE BLUE STRIPE NSF FLANGE RATING: 150 FF TEMPERATURE RANGE: / °F COMMENT: DESIGN TEMP = 100F						
20						*****PIPE*****								
30														
40														
50			Piping	5760047	3/4 - 16	PIPE PE4710 POLYETHYLENE SDR 11 NSF								
60														
70						*****FITTINGS*****								
80														
90			90 Deg	5770018	3/4 - 4	ELL 90 DEG MLD BUTT PE4710 POLYETHYLENE SDR11 NSF								
100			45 Deg	5770017	3/4 - 4	ELL 45 DEG BUTT PE4710 POLYETHYLENE SDR 11 NSF								
110			Tee	5770019	3/4 - 4	TEE MOLDED BUTT PE4710 POLYETHYLENE SDR 11 NSF								
120			Reduci	5770020	3/4 - 3	TEE RED BUTT PE4710 POLYETHYLENE SDR 11 NSF	1 - 4							
130			Concen	5710020	3/4 - 3	REDUCER CONC MLD PE4710 POLYETHYLENE SDR 11 NSF	1 - 4							
140			COADP	5713280	1/2 - 2	TRANSITION ADAPTER STL FTE X SDR 11 HDPE								
150			Union	5490285	1/2 - 2	UNION 3000# SCRDL STL A105								
160														
170			90 Deg	5770093	12 - 16	ELL 90 DEG FAB BUTT PE4710 POLYETHYLENE SDR 11 NSF								
180			45 Deg	5770094	12 - 16	ELL 45 DEG FAB BUTT PE4710 POLYETHYLENE SDR 11 NSF								
190			Tee	5770095	12 - 16	TEE FAB BUTT PE4710 POLYETHYLENE SDR 11 NSF								
200			Reduci	5770098	3 - 12	TEE RED FAB BUTT PE4710 POLYETHYLENE SDR 11 NSF	16 - 16							
210			Concen	5710020	10 - 14	REDUCER CONC MLD PE4710 POLYETHYLENE SDR 11 NSF	12 - 16							
220			22.5 D	5770022	2 - 16	ELL 22-1/2 DEG MITERED BUT PE4710 PE SDR 11 NSF								
230														
250						*****FLANGES*****								
260														
270			Flange	5775517	3/4 - 16	BACK UP RING 150# DI A536 HOT DIP GALVANIZED								
280			GASKET	5664552	3/4 - 16	GASKET 150# RED RUBBER FULL FACE 1/8" THK								
290			BOLM	5675635	3/4 - 16	MACHINE BOLT GALV STEEL A307 GR B W/NUT								
300			Flange	5770021	3/4 - 16	FLANGE ADAPTER SDR 11 PE4710 HDPE NSF								
310			COADP	5713695	3/4 - 16	ADAPTER MECH JOINT SDR 11 HDPE MOLDED	DRISCOPLEX 4100							
311			GASFF	5664297	3/4 - 16	GASKET 150# SYNTHETIC FIBER W/ RUBBER BINDER FULL FACE 1/16" THK								
FLUOR			CITRUS COUNTY COMBINED CYCLE PROJECT Fluor Enterprises, Inc - DUKE ENERGY FLORIDA, INC A5VI CRYSTAL RIVER, FLORIDA			CONSTRUCTION	CITRUS COUNTY COMBINED CYCLE PROJECT							
							CORR. ALLOW. IN	DATE 01OCT14	BY CDM	REV 0	SHEET 1 OF 1	PA 5	CLASS PE04	

Duke Energy Florida
Citrus County Combined Cycle Project
Contract A5VI

Project Specification CCC00-SP-P-CZ-01
Date 28Jan2016
Page 1 of 13
Revision 0



FIELD INSTALLATION OF UNDERGROUND PIPING SYSTEMS

This specification has been revised as indicated below and described in the revision record on the following page.
Please destroy all previous revisions.

Revision No.	Date	Originator's Name & Initials	Reviewed/Checked By Name & Initials	Pages Revised
A	12-Jul-15	Gina David	James Copeland	n/a
0	28-Jan-16	 cop26344 cn=cop26344, email=James.L.Copeland@fluor.com 2016.02.02 16:14:40 -05'00'	 ma35516 cn=ma35516, email=Durant.Mianheimer@fluor.com 2016.02.02 16:17:12 -05'00'	5, 12

APPROVALS

SIGNATURES

DATE

Lead Engineer:



twi60941
cn=twi60941,
email=Stewart.Twilley@fluor.com
2016.02.02 17:56:38 -05'00'

Engineering Manager:

med56880

Digitally signed by med56880
DN: E=John.Medlin@fluor.com,
CN=med56880
Date: 2016.02.03 08:31:27 -05'00'

ISSUED FOR :

☐

Design

☒

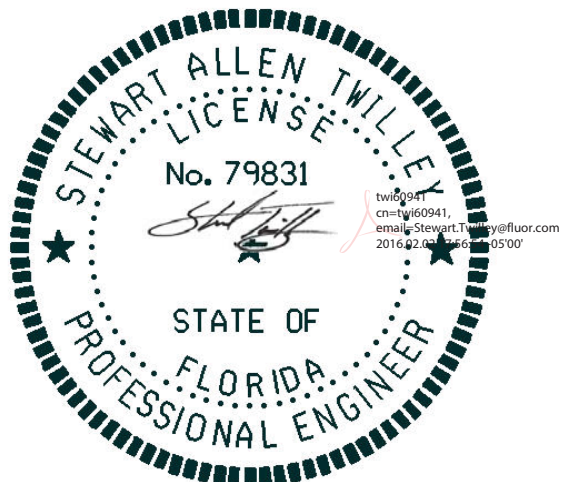
Construction

☐

Other

Fluor Enterprises, Inc.
6700 Las Colinas Boulevard
Irving, Texas 75039
704-526-3500
Certificate of Authorization License Number: 3833

Project Site Address:
14385 North Access Rd
Crystal River, FL 34428



Duke Energy Florida
Citrus County Combined Cycle Project
Contract A5VI

Project Specification CCC00-SP-P-CZ-01

Date 28Jan2016

Page 2 of 13

Revision 0



FIELD INSTALLATION OF UNDERGROUND PIPING SYSTEMS

Record of Revisions

Rev. No.	Date	Description
A	12-Jul-15	Issued for Review (IFR)
0	28-Jan-16	Issued for Construction (IFC) -Moved Leakage Testing to CCC00-SP-P-PF-07

Duke Energy Florida
Citrus County Combined Cycle Project
Contract A5VI

Project Specification CCC00-SP-P-CZ-01
Date 28Jan2016
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Revision 0



FIELD INSTALLATION OF UNDERGROUND PIPING SYSTEMS

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FIELD INSTALLATION OF UNDERGROUND PIPING SYSTEMS

1.0 GENERAL

1.1 Scope of Work

This Specification covers the requirements for installation of buried and embedded utility and process piping for the Citrus County Combined Cycle Project. Storm drainage piping systems furnished as part of the civil discipline are specifically excluded from this specification.

1.2 Definitions

- A. Engineer Fluor Enterprises Inc.
- B. Supplier/Constructor The firm awarded a contract for this scope of work

1.3 Piping, Fittings and Equipment

- A. Engineer will furnish piping and fittings shown on the piping isometric bills of material with appropriate surplus (normally 5 - 10%), if required, to cover normal installation conditions. Engineer will furnish manholes, lift stations, hydrants, valves, gasketing and bolting associated with flanged joints.
- B. Constructor is responsible for procuring additional needed quantities to make up for shortages due to loss, field revisions, waste, etc.
- C. All materials shall be purchased in accordance with the requirements of the Project Line Class Specification CCC00-SP-P-PF-02.

1.4 Installation Materials

- A. Engineer will furnish bag anodes as part of the Cathodic Protection package, if required for steel pipe.
- B. Constructor will furnish PVC primer and PVC solvent cement.
- C. Constructor to furnish metallic trench marking ribbon for non-metallic underground piping.

1.5 Installation Equipment

- A. Special tools and other required installation equipment such as slings, lever tools, ratchet jacks, pulling cables, etc., for makeup of joints shall be furnished by the Constructor.
- B. Fusion machine for butt fusion of HDPE piping shall be furnished by the Constructor.
- C. Test plugs, hydrotest pumps, gauges, relief valves, and all testing equipment shall be furnished by the Constructor.

Duke Energy Florida
Citrus County Combined Cycle Project
Contract A5VI

Project Specification CCC00-SP-P-CZ-01
Date 28Jan2016
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Revision 0



FIELD INSTALLATION OF UNDERGROUND PIPING SYSTEMS

1.6 Related Project Specifications

A.	CCC00-SP-C-SI-01	Site Preparation, Excavation, Compaction and Backfill, Piping
B.	CCC00-SP-P-CZ-03	Field Installation of Above Ground Piping Systems
C.	CCC00-SP-P-CP-01	Cathodic Protection
D.	CCC00-SP-P-PF-02	Specification for Utility Piping and Piping Line Classes
E.	CCC00-SP-P-PF-08	Specification for Coating Underground Steel Piping
F.	CCC00-DC-M-00.00.SC-01	Duke Energy, Mechanical Design Criteria
G.	PGO-ENG-NA-STND-CS-0014	Duke Energy, Underground Natural Gas Piping Coating Standard L-7
H.	FHG-ENG-NA-STND-CS-0003	Duke Energy, Cooling Water Pipe Lining Standard L2
I.	CCC00-SP-P-PF-07	Specification for Piping System Pressure Testing

1.7 Codes and Standards

The publications listed below form part of this specification. Each publication shall be the latest revision and addendum in effect as of the purchase order date. Except as modified by the requirements specified herein, work included in this specification shall conform to the applicable provisions of these publications.

In the event of any conflict between any of the referenced codes, standards, and specifications, it shall be the responsibility of Seller to call attention to the discrepancy and request a written ruling from Engineer.

- A. National Fire Protection Association (NFPA)
 - 1. NFPA 24, Standard for Installation of Private Fire Service Mains
- B. American Water Works Association (AWWA)
 - 1. AWWA C600, Installation of Ductile-Iron Water Mains and Their Appurtenances
 - 2. AWWA M23, PVC Pipe Design and Installation
 - 3. AWWA M55, PE Design and Installation
- C. American Society of Testing and Materials



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1. ASTM F2164, Standard Practice for Field Leak testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure
- D. Piping Codes
 1. ASME B31.1, Power Piping
- E. Other
 1. TN-38, Plastics Pipe Institute - Bolt Torque For Polyethylene Flanged Joints
 2. IPC, International Plumbing Code and Commentary
 3. Plastic Pipe Institute (PPI) Handbook of Polyethylene Pipe – 2nd Edition
 4. AASHTO, American Association of State Highway and Transportation Officials

2.0 PRODUCTS

Underground and embedded piping for the project consist of the following process and utility piping systems:

- A. Compressed Air – VI
- B. Circulating Water - RC
- C. Condensate – CM
- D. Generator Hydrogen - GH
- E. Combustion Turbine Generator - GT
- F. Fuel Gas - FG
- G. Exterior Fire Protection – RY
- H. Inlet Chilling – KI
- I. Closed Cooling - KR
- J. Cooling Tower Makeup – RM
- K. Plant Drains - WP
- L. Sanitary Sewer – WT
- M. Service Water – RL
- N. Drinking Water – YD

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- O. Raw Water - RW
- P. Turbine Drains - TD

3.0 EXECUTION

3.1 Delivery, Storage, and Handling

- A. Upon receipt of equipment and materials, Constructor shall verify quantities, general condition, and type of material. Material and equipment to be used in the work shall be delivered to the site and stored in a protective manner to prevent damage from weather, dirt, or vandals. Constructor shall ensure that piping and material is properly stored at the job Project Site. The Constructor shall have a foreign material exclusion (FME) program on piping and material stored outside. Piping shall be equipped with end caps or covers that prevent internal contamination. Caps or covers shall be such that they stay in position until removed by construction personnel during erection. Piping shall be stored off the ground. Material shall be checked for foreign material before it is installed. Foreign material shall be removed before installation if present.
- B. Stainless steel piping, alloy piping, and carbon steel piping shall be separated at the Project Site so that cross contamination does not occur.
- C. PVC pipe shall be stored in unit packages as received from manufacturer until just prior to use. Protect PVC pipe from direct sunlight by covering with opaque material if storage period will exceed six (6) weeks.
- D. Use care while cutting banding from bundles of piping material. HDPE coiled stock contains spring energy and uncontrolled releases can be dangerous to personnel.
- E. Maximum stacking height of HDPE pipe shall be in accordance with the manufacturer's recommendations or equivalent for storage requirements, based on pipe size and wall thickness. A representation of general requirements are reproduced here based on anticipated sizes and wall thickness (per PPI Handbook of Polyethylene Pipe, Chapter 2):

Pipe OD Size (inches)	No. of Rows High (DR 17 and below)
4	12
6	8
8	6
10	5
12	4
14	4
16	3
18	3
20	3
24	2
30	2
36	1
42	1



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- F. Inspect all pipe for damage before installation. Damaged pipe should be returned to supplier and replaced with sound pipe. As defined in PPI Handbook of Polyethylene Pipe, Chapter 2, cuts and gouges that reduce wall thickness of HDPE pipe by more than 10% may impair service life, and should be cut out and discarded.
- G. Pipe or components shorter than 20 feet should be handled near the middle with wide slings. Spreader bars should be used for longer pipe lengths. Use of cable slings is discouraged.
- H. When storing HDPE and PVC pipe, stack the heaviest pipe at the bottom.
- I. This project will be using several wall thickness of HDPE piping, including SDR 9, SDR 11, and SDR 17. Segregated storage is recommended to prevent mixing of SDR material ratings.

3.2 Installation Requirements

- A. Piping crossings under roadways are designed for AASHTO HS-20 loadings. All pipe shall be buried to a minimum depth of 3' - 0" for frost heave and freeze protection as measured from the top of the pipe unless otherwise indicated on Engineer's drawings.
- B. All Fuel Gas piping shall have 100% of the welds examined by radiography.
- C. All direct buried carbon steel and stainless steel pressure pipe shall be cathodically protected. All Carbon steel and stainless steel pipe requires an epoxy coat on exterior of pipe, fittings and field welds. Cathodic protection shall be by magnesium anodes. Refer to Specification for Coating Underground Steel Pipe (CCC00-SP-P-PF-08) and Cathodic Protection Specification (CCC00-SP-P-CP-01) for specific requirements.
- D. All cathodically protected underground pipe shall be isolated from above ground pipe by using an above ground flanged joint with dielectric gasket, bolt sleeves and washers. Washers shall be installed under a steel washer against flange. Washers shall be used on both sides of the flanged joint. All gaskets specified for underground piping are considered dielectric. Bolt sleeves shall be polyethylene. Dielectric washers shall be phenolic type.
- E. All nonmetallic underground piping shall have trace tape or cable installed for locating in the future.
- F. Potable water lines shall be laid at least ten (10) feet horizontally from a parallel sewer pipe. Where the horizontal separation cannot be maintained, the water line may be installed closer than ten (10) feet, provided that the bottom of the water line is at least eighteen (18) inches above the top of the sewer pipe. A minimum of 18" vertical separation, measured pipe to pipe, shall be maintained at crossings with sewer pipes, with the water line passing above the sewer.
- G. Pipe lines intended to be straight shall be so laid. Where vertical or horizontal alignment requires deflection from straight line or grade, such deflection shall not exceed maximum deflection recommended by the pipe manufacturer. If alignment requires deflection exceeding recommended limits, furnish special bends or a sufficient number of shorter lengths of pipe to provide angular deflections within the allowable limits.

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- H. Gradual offsets are preferred over fittings. Engineer has attempted to make use of gradual radius offsets in the piping layout where possible, while considering allowable joint deflections and bending radii. Constructor is encouraged to make use of this technique wherever possible to minimize field joints.
- I. Pipe shall be cut neatly and without damage to the pipe. Unless otherwise recommended by the pipe manufacturer, cut pipe with mechanical cutter only. Cut plastic pipe square, using hand saw, and remove all burrs.
- J. Lower pipe and accessories into trench by means of derrick, ropes, belt slings, or other equipment recommended by the pipe supplier. Take special care in handling prefabricated sections of HDPE pipe – the fused fittings are generally not capable of carrying the weight of adjacent piping. Do not dump or drop any of the materials of this specification into the trench. Except where necessary in making connections to other lines, lay pipe with the bells facing in the direction of laying.
- K. Rest the full length of each section of the pipe solidly on the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Take up and relay pipe that has the grade or joint disturbed after laying. Do not lay pipe in water, or when trench conditions are unsuitable for the work. Keep water out of the trench until jointing is completed.
- L. Securely close open ends of the pipe, fittings, and valves when work is not in progress.

3.3 Thrust Restraint

- A. Mechanical joint adapters used in HDPE piping for connection to valves and hydrants are rated for thrust loads under backfilled conditions and, as such, do not require thrust blocks unless otherwise indicated on Engineer's drawings.

3.4 Joint Assembly

- A. Assembly of standard push-on joints (procedure adapted from AWWA C600, Installation of Ductile Iron Water Mains and their Appurtenances):
 - 1. Thoroughly clean the groove and the bell socket of the pipe or fitting; also clean the plain end of the mating pipe. Using a gasket of the proper design for the joint to be assembled, make a small loop in the gasket and insert it in the socket, making sure the gasket faces the correct direction and that it is properly seated. In cold weather, it is necessary to warm the gasket to facilitate insertion.
 - 2. Apply lubricant to the gasket inner surface and plain end of the pipe. Lubricant is furnished from the pipe supplier in sterile cans, and every effort should be made to keep it sterile. Do not lubricate the gasket groove, only the gasket inner surface and plain end of pipe.
 - 3. Be sure that the plain end is beveled. Square or sharp edges may damage or dislodge the gasket and cause a leak. When pipe is cut in the field, bevel the plain end with a heavy file or grinder to remove all sharp edges. Push the plain end into the bell socket of the



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mating pipe. Keep the joint straight while pushing. Make deflection, if necessary, after the joint is assembled.

- B. Assembly of flanged joints for transitioning to aboveground piping - HDPE pipe to Ductile Iron and Carbon/Stainless Steel flanges (reference Plastics Pipe Institute TN-38 for general guidance):
 1. Wipe clean the flanged surface of the component and face of the HDPE adapter.
 2. Insert the gasket after installing the top half of the flange bolts. Keep the joint straight during assembly.
 3. Apply a light duty grease or 30 weight motor oil (metal or mineral lubricating greases shall NOT be used) to the bolt-thread, nut-thread, nut face, washer and around the bolt hole before assembly. Install a through-hardened flat washer – the preferred installation method is to install the washer under the nut. The bolt-head shall then be held and the nut rotated. If space is restricted, the flat washer may be installed under the bolt-head, the nut held and the bolt-head rotated for ALL bolts/nuts on a particular joint. Regardless, the washer shall be installed under the rotated component.
 4. The following torque values (per the Initial Minimum Lubed Torque column of Table 3 of PPI TN-38) SHALL NOT BE EXCEEDED on flanged joints utilizing red rubber gaskets:

Nominal Pipe Size	Bolt Diameter (Inches)	Number of Bolts	Initial Maximum Lubed Torque (Ft·Lbs)
2"	0.625	4	22
3"	0.625	4	30
4"	0.625	8	30
6"	0.75	8	44
8"	0.75	8	58
10"	0.875	12	58
12"	0.875	12	75
14"	1	12	140
16"	1	16	140
18"	1.125	16	140
20"	1.125	20	140
22"	1.25	20	160
24"	1.25	20	180

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26"	1.25	24	180
28"	1.25	28	180
30"	1.25	28	180
32"	1.5	28	240
34"	1.5	32	240
36"	1.5	32	260

5. Utilize the torquing process per the "Checklist and Flange Torque Record" of PPI TN-38 with a mandatory 24 hour re-torque. Remove any excess oil/grease from the exposed threads and joints.
 6. After the mandatory re-torque, the male threads on the bolt shall not be disturbed at the nut to prevent loosening.
- C. Pipe Joint assembly for HDPE and Steel Pipe:
1. Butt fused joints in HDPE piping shall be made by craft persons certified for the fusion machine and piping materials being utilized. Initial training or a refresher course by a certified instructor is recommended.
 2. Welded steel and stainless steel pipe shall be field fabricated from the provided random length materials, or shop fabricated spools, using approved site welding procedures.
- D. Assembly of solvent welded joints in PVC and CPVC piping shall be as follows:
1. Solvent weld joints shall be made with square-cut ends, with burrs removed, and ends beveled slightly if necessary. Visually inspect inside of pipe, couplings and fittings removing all dirt and moisture with clean rag.
 2. Apply primer to surface of pipe and socket of fitting if required for cement being used, or lightly sandpaper surfaces.
 3. Apply solvent cement evenly and quickly around the outside of the pipe at a width slightly greater than depth of fitting socket.
 4. Apply a light coat of cement around the inside of the fitting socket.
 5. Quickly insert into fitting socket bottom and give pipe or fitting a slight twist to evenly distribute the cement, hold in place to prevent fitting rebound. Remove excess cement from pipe and fitting while cement is still soft.



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6. Allow joints to cure at least 24 hours before filling with water and applying pressure to the piping system.

3.5 Excavation, Bedding and Backfilling

- A. Reference the Site Preparation, Excavation, Compaction and Backfill specification CCC00-SP-C-SI-01 for specific details on materials and placement requirements.
- B. Non-metallic piping shall be laid with metallic trace tape or cable to be easily located with a metal detector.
- C. All pressure pipe under building slabs shall be wrapped at the slab or trench penetration with minimum ½" fibrous expansion joint material to prevent contact with reinforcing steel and to protect the pipe from damage due to movement of the slab or settling of the pipe. Fully encased piping does not require additional protection.
- D. Appropriate provisions shall be made to prevent pipe flotation and foreign material from entering pipe openings.

3.6 Leakage Testing – See CCC00-SP-P-PF-07 for details

3.7 Valve Boxes, Hydrants and Post Indicators

- A. Valve boxes and post indicators shall be centered on the valves, setting plumb. Each valve box shall be placed directly over the valve wrench nut it serves and set to pavement grade, ground surface, or other elevation as may be required.
- B. Valve bodies shall be set on a concrete support footing. Fill shall be tamped around each valve to a distance of 5 feet on all sides, or to the undisturbed trench face if less than 5 feet.
- C. Before installing any valve, care shall be taken to see that all foreign substances are removed from within the valve body, that the stuffing boxes are properly packed and the gland nuts tightened, and the valve opened and closed to see that all parts are in first-class working condition.
- D. Hydrants shall be set on a concrete support footing, surrounded by a bed of clean washed stone for drainage. Hydrants shall be set plumb and to the correct bury depth. Fill shall be tamped around each hydrant to a distance of 5 feet on all sides, or to the undisturbed trench face if less than 5 feet.
- E. Position indication windows on post indicators shall be oriented parallel to the pipeline serviced by the valve. Face position window such that it can be viewed from adjacent roadway if possible.
- F. Hydrants shall be oriented with 4½" steamer connection facing the adjacent roadway.
- G. Post indicators, hydrants, and hydrant houses shall be protected from traffic impact with pipe bollards as detailed on project drawings.

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3.8 Above Grade Terminal Points

- A. All interfaces between below grade HDPE piping and above grade steel piping shall be made above grade.
- B. Fuel Gas larger than 2" NPS shall be designed with provision to allow cleaning by pigging (e.g.: removable above ground spool pieces).

END OF SPECIFICATION

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This specification has been revised as indicated below and described in the revision record on the following page. Please destroy all previous revisions.

Revision No.	Date	Originator's Name & Initials	Reviewed/Checked By Name & Initials	Pages Revised
A	15-Jun-15	Scott A. Jacobs (SAJ)	David M. Bryan (DMB)	N/A
B	28-Jul-15	Scott A. Jacobs (SAJ)	Michael P. Martin (MPM)	N/A
00	15-Sep-15	Scott A. Jacobs (SAJ)	Michael P. Martin (MPM)	5
01	08-Oct-15	Scott A. Jacobs (SAJ)	Michael P. Martin (MPM)	31, 32
02	21-Oct-15	Scott A. Jacobs (SAJ)	Michael P. Martin (MPM)	11,30,37,40
03	18-Dec-15	 Digitally signed by jac36526 DN: cn=jac36526, email=Scott.A.Jacobs@fluor.com Date: 2015.12.18 13:07:36 -05'00'	 mar11627 cn=mar11627, email=Michael.P.Martin@fluor.com Date: 2015.12.18 13:28:52 -05'00'	19, 31

APPROVALS

SIGNATURES

DATE

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Engineering Manager:



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2015.12.21 07:11:34 -05'00'

ISSUED FOR :

☐

Design

☒

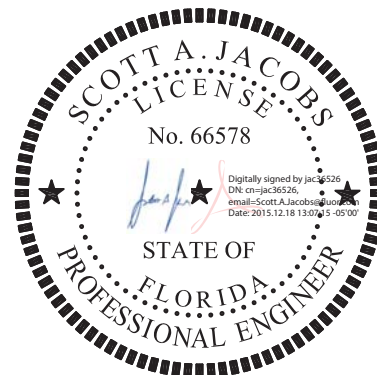
Construction

☐

Other

Fluor Enterprises, Inc.
6700 Las Colinas Blvd. Irving, TX 75039
Phone: 704-526-3500
Certificate of Authorization License Number: 3833

Project Site Address:
14385 North Access Rd. Crystal River, FL 34428



Scott A. Jacobs FL PE #66578

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Record of Revisions

Rev. No.	Date	Description
A	15-Jun-15	Issued for Acceptance (IFA)
B	28-Jul-15	Issued for Bid (IFB)
00	15-Sep-15	Issued for Construction (IFC)
01	08-Oct-15	Issued for Construction (IFC)
02	21-Oct-15	Issued for Construction (IFC)
03	18-Dec-15	Issued for Construction (IFC)

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GENERAL

1.1 Summary

A. Scope of Specification

This specification describes the requirements for the following:

1. The excavation required for construction of footings, foundations, and other structures and the placement and compaction of backfill to restore finished grade around completed structures.
2. The disposal of unsatisfactory and surplus excavated materials.
3. The furnishing, placement and compaction of fill or backfill material when required.
4. The control of excavation runoff water, general surface runoff, and groundwater as necessary for the environmentally sound, safe and efficient execution of the work.
5. QC inspection and testing to ensure that the work meets the requirements of this specification and the contract documents.

B. Related Specifications and Documents

1. The following documents prescribe items of related work.
 - a. Geotechnical Engineering Report – Citrus County Combined Cycle Project, Terracon, July 2015
 - b. CCC00-SP-C-SI-08 Civil Testing & Inspection Services Specification
2. Coordinate work described by this specification with work described by the above listed geotechnical reports and specification.
3. Project Quality Plan.
4. Project health, safety, environmental plan.

C. Terminology

The following terms are defined as stated, unless otherwise indicated:

1. Contractor: The party identified as such in the contract documents as that which will perform the work.

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2. Degree of Compaction: The measurement of controlled compaction of fill or backfill as determined by comparing in-place dry density to that determined as specified under "Filling and Backfilling."
3. Earth: Any material not classified as rock and that does not require blasting for removal. The term "soil" is synonymous.
4. Earthwork Debris: All material unsuitable for use or reuse encountered during earthwork operations performed under this project such as, but not limited to, muck, rock, refuse, stumps, logs, concrete, asphalt and other combustible or non-combustible materials.
5. Final Grades: Designed site grades to be constructed by the completion of the project.
6. Geotechnical Engineer: The Florida Registered Professional Engineer designated or retained by the Company who is responsible for evaluating the suitability of the soil and rock materials involved in the work, and for verifying the compliance of the related geotechnical work with the requirements of the specifications.
7. Grading: All moving, placing or compacting of earth, and related work, pertaining to general cutting and filling required.
8. Impact Roller: A 4 or 5 sided roller that imparts an increased level of energy due to its non-round nature and has a minimum static drum weight of 29,000 lbs.
9. Inspection and Testing Agency: The company, partnership, or corporation retained by the Company to perform the inspections and tests required to determine and verify compliance of the work with the requirements of this specification and in accordance with ASTM D 3740.
10. Minimum Average Roll Value (MARV): Property value calculated as typical minus two standard deviations. Statistically, it yields a 97.7 percent degree of confidence that any sample taken during quality testing will exceed value reported.
11. Modified Proctor Density: The maximum dry density achieved per ASTM D1557 when testing a sample of material representative of that to be placed and compacted in the field.
12. Over-excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by the Company. Over-excavation, as well as related remedial work, shall be without additional compensation.
13. Company: Fluor Enterprises, Inc.
14. Owner: Duke Energy
15. Proof-Rolling: Applying loads imposed by means recommended by the Geotechnical Engineer over the surface of a designated area to locate and permit the timely correction

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of deficiencies in subsurface soils that are likely to adversely affect the performance of an overlying pavement or structure.

16. Project Quality Plan: The project specific quality plan provided by Company that identifies the Quality Assurance (QA) and Quality Control (QC) processes and procedures to be used to ensure the standard of work complies with contractual and technical requirements.
17. Rock: Solid, homogenous material with firmly cemented or laminated masses, or conglomerate deposits that cannot be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or other concrete masses (except sidewalks, pavements and slabs) larger than 0.5 cubic yards in volume.
18. Rough Grades: Designed site grades to be constructed by the initial site development Contractor.
19. Satisfactory Material: Soil classified per ASTM D2487 or ASTM D2488 and meets the requirements for fill material as prescribed in this specification. Satisfactory material shall be free from frozen lumps, excessive organics, refuse, rocks that do not meet the sieve requirement per the soil classification, or other material that might prevent proper compaction or cause the completed backfill to have insufficient bearing capacity for the expected superimposed loads.
20. Soil Classification Symbols: Where used in this specification, symbols for soil classification shall be based on the Unified Soil Classification System as determined per ASTM D2487 or ASTM D2488.
21. Structural Fill: Fill as detailed in Section 2.1.B that will ultimately be subjected to structural loads, such as those imposed by foundations and roadways.
22. Select Structural Fill: Fill as detailed in Section 2.1.B that will underlay the Structural Fill.
23. Unsatisfactory Material: Soil or other material having insufficient strength or stability to carry the loads that will be superimposed on the completed backfill without excessive consolidation or loss of stability; material containing refuse, frozen lumps, large rocks, debris, or other deleterious materials that could cause the backfill not to compact; and organic soils (soils having organic matter greater than 2% by dry weight). For example, soil with excessive moisture due to rain.

1.2 References

The publications listed below form part of this specification. Each publication shall be the latest revision and addendum in effect on the date of contract award unless noted otherwise. Except as modified by the

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requirements specified herein or the details of the drawings, all work included in this specification shall conform to the applicable provisions of these publications.

- A. AASHTO American Association of State Highway and Transportation Officials
 - AASHTO T103 Standard Method of Test for Soundness of Aggregates by Freezing and Thawing
 - AASHTO T104 Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
- B. ACI American Concrete Institute
 - ACI 229R Report on Controlled Low-Strength Materials
- C. ASTM American Society for Testing and Materials:
 - ASTM C 33 Standard Specification for Concrete Aggregates
 - ASTM C 150 Standard Specification for Portland Cement
 - ASTM C 422 Standard Test Method for Particle-Size Analysis of Soils
 - ASTM C 535 Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
 - ASTM D 1140 Standard Test Methods for Determining the Amount of Material Finer than No. 200 (75 μ m) Sieve in Soils by Washing
 - ASTM D 1556 Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method
 - ASTM D 1557 Standard Test Method for laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³)
 - ASTM D 2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
 - ASTM D 2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
 - ASTM D 2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)
 - ASTM D 2937 Standard Test Method for Density of Soil in Place by the Drive Cylinder Method

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ASTM D 2974	Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils
ASTM D 3740	Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM D 3786	Standard Test Method for Bursting Strength of Textile Fabrics—Diaphragm Bursting Strength Tester Method
ASTM D 4253	Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
ASTM D 4254	Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D 4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 4491	Standard Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D 4533	Standard Test Method for Index Trapezoid Tearing Strength of Geotextiles
ASTM D 4595	Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
ASTM D 4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	Standard Test Method for Determining the Apparent Opening Size of a Geotextile
ASTM D 4833	Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
ASTM D 4873	Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
ASTM D 4959	Standard Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating
ASTM D 5080	Standard Test Method for Rapid Determination of Percent Compaction
ASTM D 5261	Standard Test Method for Measuring Mass per Unit Area of Geotextiles
ASTM D 6241	Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe

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ASTM D 6637 Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-rib Tensile Method

ASTM D 6913 Standard Test Methods for Particle Size Distribution (Gradation) of Soils Using Sieve Analysis

ASTM D 6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

D. ICC International Code Council:

2014 Florida State Building Code (FBC)

E. OSHA Occupational Safety and Health Administration

OSHA 29 CFR 1926 - Safety and Health Regulations for Construction

F. FDOT Florida Department of Transportation

Standard Specifications for Road and Bridge Construction, January 2015

1.3 Quality Control

A. General

1. For all work covered under this specification, the Contractor and the Inspection and Testing Agency shall have an acceptable QA program implemented and maintained. This QA program shall conform to all of the applicable requirements of this Specification and Company's Project Quality Plan. The QA program shall be submitted to the Company for review and acceptance.
2. Unless otherwise specified in the contract documents, a qualified independent Inspection and Testing Agency in accordance with the criteria of ASTM D3740 shall be retained by the Company to perform the QC inspection and testing work identified in this specification.
3. During construction, the Company shall have access to all the Contractor's facilities and records for the purpose of conducting performance inspection/audits.
4. During an audit by the Company, any inspection and test reports, and/or engineering analyses and calculations associated with the scope of work shall be provided upon request.

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B. Surveying

1. After starting from horizontal and vertical control furnished by the Company, all lines and grades shall be provided by a Florida licensed land surveyor retained by the Contractor for Contractor's operations.
2. The Contractor shall be solely responsible for the accuracy of survey work performed.

C. Inspection

1. The Inspection and Testing Agency, retained by the Company, shall be responsible for QC inspection and testing to document that the work meets the requirements of this specification and the contract documents.
2. The Inspection and Testing Agency shall perform tests as outlined in Section 3.10.B or as otherwise specified in the contract documents. The performance or lack of performance of such tests and inspections shall not be construed as granting relief from the requirements of this specification or the other contract documents.
3. If completed work is not in accordance with this specification, the Contractor shall be responsible for repairing or reconstructing the deficiencies to meet this Specification and the other contract documents.

1.4 Permanent Property Markers

- A. All established boundary markers and benchmarks on the site shall be sufficiently referenced prior to the beginning of the work to keep easy reference to lines and grades intact during the progress of the work.

1.5 Specially Designated Locations on the Site

- A. Borrow pits, designated by the Company, may be used for obtaining material to be compacted if this material meets the requirements for the intended use. If used, such pits shall be neatly trimmed and drained during and after each removal of material.
- B. Spoil areas designated by the Company shall be the only areas on the site which the contractor may use for disposal of debris and unsatisfactory material. Such areas shall be kept suitably graded for adequate drainage and maintained as directed by the Company.

1.6 Changed Conditions

- A. During the progress of the work it may be necessary to change the alignment, slopes, grades or dimensions of the earthwork from those shown on the drawings. Promptly notify the Company in writing, of any such conditions differing materially from those indicated in the contract.



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- B. During the process of work, it may be found that the rock, soil, or ground water, are not the type or condition indicated on the drawings, in the geotechnical reports, and in the design. The contractor shall notify the Company in writing of such conditions prior to proceeding.

1.7 Submittals

- A. Excavation Safety Plan as per Section 1.12.B.
- B. Contractor's QA program as per Section 1.3.A.1.
- C. Testing and Inspection Agency's QA program as per Section 1.3.A.1.
- D. Water Control Plan: A Water Control Plan shall be submitted to the Company for review and approval no less than 10 days before the scheduled date for the start of earthwork operations. The plan shall indicate the methods and techniques to be used for control of groundwater, and storm water runoff and direct the runoff to a location the Company agrees suitable.
- E. The Inspection and Testing Agency shall generate the submittals outlined in the Civil Testing and Inspection Services Specification.
- F. Material Certificates: Certificates signed by manufacturers or suppliers certifying that each material complies with requirements.
- G. Product Data: For each product specified, include technical data and tested physical and performance properties.
- H. Submit for approval a detailed Earthwork Plan describing the plan for all the earthwork activities identified herein.
- I. Contractor shall submit a stockpile management plan that describes the procedures for maintaining borrow soil stockpiles. This should include how the piles will be built, organized, controlled, and utilized. The plan shall be submitted to the Company for review. Approval is required prior to starting work.
- J. Identification of the trench and excavation competent person and submit proof that this person has successfully completed an approved OSHA Competent Training Class.
- K. If excavation bracing (i.e., shoring and sheeting) is required, the Contractor shall provide the following submittals to the Company:
 - 1. Plans, sketches, and/or details
 - 2. Supporting calculations prepared by a professional engineer registered in the State of Florida
 - 3. Description of the materials and shoring system to be used

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4. Indication of whether any components will remain after filling or backfilling
5. Indication of the sequence and method of installation
- L. If dewatering of an excavation is required, the Contractor shall submit proposed methods and details to the Company for review before beginning excavation.
- M. Utility Submittals: Data shall include horizontal dimensions, elevations, size, and slope gradients, as appropriate for the utility and as required by the Company:
 1. Accurately recorded as-built locations of Contractor-installed underground utilities
 2. Tie-in points/interferences encountered during project construction
- N. The use of explosives is not permitted. If the Contractor believes blasting with explosives will be required, a request shall be submitted detailing the need for blasting in addition to the benefits that the use of explosives will have on cost and schedule. Included in this submittal shall be a summary of the alternate technique in place of using explosives and the impact using the alternative will have on cost and schedule.
- O. Geosynthetic Submittals
 1. The Contractor shall submit the geosynthetic manufacturer's certificate of compliance. All brands of geosynthetic and all seams that are used in construction shall be accepted on the following basis: At least 5 days prior to installation, the Contractor shall furnish, in duplicate, a mill certificate or affidavit signed by a legally authorized official from the company manufacturing the geosynthetic.
 2. The certificate shall contain the signer's title, name and address of the Contractor, subcontract number, and project name and location. The mill certificate or affidavit shall attest that the geosynthetic meets the chemical, physical, and manufacturing requirements stated in this specification and that any seams used meet the seam requirements. Furthermore, the mill certificate or affidavit shall list the properties of the geosynthetic certified, not limited to tensile strengths, seam strengths, and Apparent Opening Size (AOS).

1.8 Protection

- A. Slope Stabilization
 1. Stabilize the sides of excavations as necessary to prevent slope failure or any other earth movement that might injure personnel, or damage existing buildings, structures, or other facilities in the vicinity of the work. The stabilization method employed shall comply with pertinent requirements of the Construction Industry Standards, and other applicable federal, state, and local codes and regulations. The Contractor shall submit the



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stabilization methods for review by the Company. Approval is required prior to beginning implementing the Contractor proposed stabilization.

2. Remove sheeting, bracing, and shoring systems employed for slope stabilization as the progress of the work eliminates their need, unless they are permitted or required to remain by other provisions of these specifications or other contract documents. Carefully remove such systems in order to prevent subsidence or other soil movement that might damage existing or newly constructed structures or other facilities.

B. Existing or Completed Utilities

1. Unless otherwise specified, before earthwork begins, the Contractor shall locate and mark all known utilities within the project limits or note them in the contract documents.
2. If other utility locations become evident as earthwork progresses, work stoppages may be required until utilities are identified and until the Company provides specific direction.
3. Inactive and abandoned utilities encountered in excavating and grading operations shall be reported to the Company and shall be removed, plugged or capped as indicated or as directed.
4. Active utilities shown on the drawings shall be adequately protected from damage and removed or relocated only as indicated or specified. Where active utilities are encountered but are not shown on the drawings, the Company shall be advised. Existing facilities to remain shall be adequately protected, supported or relocated as directed.
5. Use care in moving machinery and equipment over existing or newly installed pipes and utilities during construction so as not to damage completed work. Power-driven equipment shall not be used to excavate any closer than 2 feet from an existing utility or structure. For work immediately adjacent to, or for excavation exposing an existing utility or other structure, use manual or light equipment excavating techniques. Start manual or light equipment excavation before reaching the obstruction, and continue until the obstruction is uncovered, or until clearance for the new pipe or utility is ensured. Support uncovered pipes and other existing work affected by the excavation until they are properly supported by backfill. Report immediately to Company any damage to utility lines or other subsurface facilities.
6. Rules and regulations governing the respective utilities shall be observed in executing all work under this section.

C. Protect newly graded areas from damage due to traffic, erosion, or settlement. Repair and re-establish damaged or eroded slopes and finished grades, restoring them to their required finished condition.

D. Any damage to structure, utility lines, or graded areas caused by erosion shall be repaired to the original condition at no cost to the Company. This includes areas that are seeded until such time that the vegetation prevents erosion.

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- E. Surrounding property shall be adequately protected from damage resulting from the presence of water, mud and silt during construction. Local, county, state and federal regulations pertaining to storm and wastewater runoff shall be strictly observed.
- F. The Contractor shall be solely responsible for the stability of all adjoining or adjacent structures and facilities. The method of construction adopted by the Contractor for the execution of the excavation, earthworks, and associated temporary works shall be such that roadways, access road, facilities or structures outside the immediate work area are adequately protected from the detrimental effects of instability and ground subsidence. The Contractor shall be required to assess the settlements and ground movements that are possible around the work area as a result of the work. Any calculations and assumptions on which these assessments will be made shall be prepared by a professional engineer registered in the State of Florida and be submitted to the Company for review. Approval by the Company is required prior to beginning the work. The Contractor shall plan the work such that the submittal of this information, including a minimum of 5 days for review, shall not impede the work.
- G. The Contractor shall be responsible for avoiding damage to and preserving trees, shrubs, and all other vegetation and wetlands in the areas beyond the designated grading areas.
- H. Temporary fences, guardrails, barricades, lights, and other protective measures required for the safety of personnel and the premises shall be installed and maintained in good condition.
- I. All reference points (e.g., property markers, benchmarks, etc.) shall be carefully maintained during excavation, backfilling, compaction, and earthwork.
- J. If a reference point is damaged during performance of the work, the reference point shall be repaired or replaced at the Contractor's expense as directed by the Company.
- K. Bracing and shoring shall be used to protect excavations adjacent to existing underground installations (e.g., foundations, piping manholes, electrical, and duct banks) and personnel engaged in excavation activities during construction.
- L. Unless otherwise shown in the contract documents, excavation under foundations shall not be permitted.
- M. During the performance of the work, the Contractor shall take proper and efficient measures to reduce dust and to prevent dust from harming individuals and damaging adjacent properties and equipment.

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N. Geosynthetics

1. Geosynthetic labeling, shipment, and storage shall follow ASTM D4873. Product labels shall clearly show the manufacturer or supplier name, style name, and roll number.
2. Each geosynthetic roll shall be wrapped with a material that will protect the geosynthetic from damage due to shipment, water, sunlight, and contaminants.
3. During storage, geosynthetic rolls shall be elevated off the ground and adequately covered to protect them from the following: site construction damage, precipitation, extended ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames including welding sparks, excess temperatures, and any other environmental conditions that may damage the physical property values of the geosynthetic.

1.9 Quality Assurance Surveillance

- A. All work shall be subject to quality assurance surveillance by the Geotechnical Engineer and/or Company to ensure compliance with the testing, inspection, and other quality control or quality assurance requirements contained herein and in the Project Quality Plan.
- B. All work shall be performed in compliance with the Project Quality Plan, Safety, and Environmental Plans.

1.10 Site Conditions

- A. Site topographic maps, soil reports and other topographic or soil data shown on the contract drawings or included in these specifications are only for general information. The Company is not responsible for their accuracy, completeness or usefulness and meaning. The Contractor shall make such additional investigations as required to acquaint himself with the site topography and subsurface soil conditions for preparation of his bid, and for successful execution of the work.

1.11 Environmental

A. Contaminated Soils

1. Any known contaminated soils within the construction limits shall be managed in accordance with a contaminated soil management plan provided by the Company before the start of excavation.
2. If unexpected soil contamination is encountered during the work, the work shall be stopped and the Company shall be notified immediately.

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B. Erosion/Sediment Control

1. Erosion control measures shall be installed per the drawings prior to starting earthwork operations.
2. All procedures and work shall be in accordance with local, state, and federal regulations (e.g., terms of the NPDES General Permit for Construction Activity, other USEPA documents such as Storm Water Management for Construction Activities, or specific project permit).
3. All areas shall be maintained using temporary erosion and sediment control measures during construction until the Contractor is relieved by the Company or until permanent measures are completed and functioning in a satisfactory manner.

1.12 Safety

A. General

1. Unless otherwise specified in the contract documents, a work permit shall be obtained from the Company before performing any earthwork.

B. Excavation Safety

1. An Excavation Safety Plan shall be submitted to the Company for review and approval no less than 10 days before the scheduled date for start of excavation operations. The plan shall indicate the systems, methods, and techniques to be used to ensure that excavation sidewalls are properly guarded to protect personnel, and existing facilities and structures in the vicinity of the work. The plan shall include the name, title, and mobile phone number of the Contractor's "Competent Person", as defined in 29 CFR Part 1926, Subpart P. All work shall be in compliance with the Quality Plan and Project Health, Safety, Environmental Plan that the Contractor supplies the Company for approval.

1.13 Clean-up

- A. Soil that is spilled or washed onto paved areas or streets shall be removed daily from the surface.
- B. Soil that is spilled or washed into drains, pipes, gutters, or ditches or onto adjacent property shall be removed daily. Contractor shall provide measures to prevent recurrence.
- C. Maintain all work covered by this specification during construction until final acceptance. Provide the drainage of surface runoff along and throughout the length of any excavation, construct temporary ditches and use any other methods necessary to control excessive soil erosion during construction and until final acceptance of the work.

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2.0 MATERIALS

2.1 Backfill Material

A. Basic Requirements

1. Unless otherwise specified in the contract documents, fill and backfill materials shall be from either on-site excavation, designated borrow areas, or approved off-site sources in accordance with the requirements of Section 2.1.B.
2. Unsuitable material that is placed shall be removed and replaced with suitable material at the expense of the Contractor.
3. All excavated unsuitable material and earthwork debris shall be disposed of by the Contractor in an area designated by the Company.
4. All suitable materials excavated on the site shall remain the property of the Company and be placed or disposed of by the Contractor to the satisfaction of the Company.
5. The Company shall review and approve all borrow material prior to use.
6. Fill and backfill shall contain no rocks or stones larger than 2 inches (75 mm) and shall be free of frozen lumps, excessive organic matter, trash, chunks of highly plastic clay, snow, ice, contamination, or other unsatisfactory material and shall meet the requirements for Structural Fill.
7. Any material proposed for use as fill by the Contractor, including excavated material, shall be subjected to soil tests before use to ensure that it meets the material specifications indicated herein.
8. Fill materials should possess minimal corrosion/degradation potential relative to metal and concrete. All fill material shall conform to the following:
 - a. Chemically inert
 - b. Chlorides less than 500 parts per million (ppm)
 - c. Sulfates less than 1000 ppm.
 - d. Electrical Resistivity greater than 3000 Ohm-cm and less than 50,000 Ohm-cm

B. Fill Materials

1. Fill and backfill to be used as specified by the design documents or otherwise directed by the Geotechnical Engineer shall consist of satisfactory soils categorized as Structural Fill. Each fill type shall be classified in accordance with ASTM D 2487 and meet the requirements provided below.

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2. Structural Fill – Derived from approved sources and shall consist of soils with USCS classifications of GM, GC, SW, SP, SM, and SC provided that any debris, excessive root matter and particles greater than 2 inches in diameter are removed prior to placement, and the water content is properly controlled. The material shall be non-plastic, shall have an organic content of less than 2 percent by dry weight per ASTM D2974, and shall have a fines content not exceeding 25%. Structural fill shall be screened with a ½ inch screen to remove excessive root material as determined by the Geotechnical Engineer.
3. Select Structural Fill – Derived from approved sources and shall consist of soils with USCS classifications of SM, SM-SC, and SC provided that any debris, excessive root matter and particles greater than 2 inches in diameter are removed prior to placement, and the water content is properly controlled. The material shall be non-plastic, shall have an organic content of less than 2 percent by dry weight per ASTM D2974, and shall have a fines content between 12 and 25%. Select Structural fill shall be screened with a ½ inch screen to remove excessive root material as determined by the Geotechnical Engineer.
4. Unsuitable Fill – The following soil types are considered to be unsuitable for use as backfill: soil not accepted as Structural Fill. Also considered unsuitable are organic soils (PT, OH, OL); and highly plastic soils (CH, MH); soil or other material having insufficient strength or stability to carry the loads that will be superimposed on the completed backfill without excessive consolidation or loss of stability; material containing refuse, frozen lumps, large rocks, debris, or other material that could cause the backfill to not compact.
5. Riprap Material – Unless noted otherwise on contract documents, riprap shall conform to FDOT specifications Section 530 and shall be Rubble (Ditch Lining) Riprap per the FDOT classifications. Material used for riprap may be approved by the Geotechnical Engineer by visual inspection if the rock is determined to be sound and durable.
6. Topsoil – Natural, friable, fertile, fine, loamy soil that possesses suitable characteristics or qualities for producing heavy growth of crops, grass or other vegetation. Topsoil shall be free from subsoil and objectionable material that would hinder plant growth or maintenance and shall not contain more than 5 percent by volume of stones, lumps, or other objects larger than 2 inches in any dimension.

C. Controlled Low-Strength Material (CLSM)

1. CLSM or “flowable fill” may be substituted for structural fill material, where approved by the Company.
2. Unless otherwise specified, CLSM shall be in accordance with ACI 229R.
3. The mix design shall be proportioned to produce a 28-day compressive strength between 100 and 200 psi, pretested using the actual raw materials, and approved by the Company before use on the project.

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4. Unless otherwise specified, simple visual inspection only shall be required for field testing.
- D. The Geotechnical Engineer, prior to placement shall determine the suitability of all material for fill zone construction.

2.2 Water

- A. Water used for compaction shall be clean potable or raw water, free of deleterious substances, with pH between 6.5 and 8.0.

2.3 Geosynthetics

- A. Furnish geosynthetics consisting of either geotextiles or geogrids. Geotextiles consisting of woven or nonwoven polyester, polypropylene, stabilized nylon, polyethylene, or polyvinylidene chloride. Geogrids consisting of a biaxial grid of polymer tensile elements manufactured into a regular network of material consisting of high tenacity polyester, high density polyethylene (HDPE) or polypropylene that is formed by stretching, heat welding, chemical welding, knitting, weaving or combinations of these methods. All geosynthetics shall have the minimum strength values in the weakest primary direction. The contractor may use nonwoven fabric that is one or a combination of the following: needle punched, heat bonded, or resin bonded.
- B. Subsurface Drainage Requirements
 1. This section is applicable to placing a geotextile against a soil to allow for long-term passage or removal of water. The primary function of the geotextile in subsurface drainage applications is filtration.
 2. Geotextile Requirements. The geotextile shall meet the minimum requirements of Table 1 unless otherwise indicated by the contract documents. Woven slit film geotextile (i.e., geotextile made from yarns of a flat, tape-like character) will not be allowed. All numeric values in Table 1, except AOS represent MARV as noted. Values of AOS represent maximum average roll values.

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Table 1 - Subsurface Drainage Geotextile Minimum Requirements

Mechanical Properties	Test Method	Unit	MARV in MD ²	MARV in CD ³
Grab Tensile Strength	ASTM D4632	lbs	120	120
Grab Tensile Elongation	ASTM D4632	%	50	50
Puncture	ASTM 4833	lbs	65	
Apparent Opening Size ¹	ASTM D4751	U.S. Sieve	70	
Permittivity	ASTM D4491	sec ⁻¹	1.7	
Flow Rate	ASTM D4491	gal/min/ft ²	120	

¹ ASTM D4751: AOS is a Maximum Opening Diameter Value

² Machine Direction

³ Cross Direction

- The property values in Table 1 represent default values which provide sufficient geotextile survivability under most construction conditions anticipated during the work. The Contractor shall submit details on the proposed use of the geosynthetic to the Company for review prior to use.

C. Separation Requirements

- This section is applicable to the use of a geotextile to prevent mixing of a subgrade or underlying soil and an aggregate cover material (sub base, base, select embankment, fill section etc.). This may also apply to situations where separation of two dissimilar materials is required but where water seepage through the geotextile is not a critical function.
- The separation application is appropriate for pavement structures constructed over soils with a California Bearing Ratio (CBR) equal to or greater than 3 (CBR > 3). It is appropriate for unsaturated subgrade soils. The primary function of a geotextile in this application is separation.
- Geotextile Requirements. The geotextile shall meet the minimum requirements of Table 2 unless otherwise indicated by the contract documents. All numeric values in Table 2 except AOS represent minimum average roll values as noted.

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Table 2 Separation Geotextile Minimum Requirements

Mechanical Properties	Test Method	Unit	MARV in MD	MARV in CD
Grab Tensile Strength	ASTM D4632	lbs	170	170
Grab Tensile Elongation	ASTM D4632	%	15	10
CBR Puncture Strength	ASTM D6241	lbs	500	500
Trapezoid Tear Strength	ASTM D4533	lbs	75	75
Puncture	ASTM D 4833	lbs	700	
Weight	ASTM D5261	oz/yd ²	4.0 (woven), 8.0 (non-woven)	
Apparent Opening Size ¹	ASTM D4751	U.S. Sieve	40	
Permittivity	ASTM D4491	sec ⁻¹	0.05	

¹ ASTM D4751: AOS is a Maximum Opening Diameter Value

4. The property values in Table 2 represent default values which provide for sufficient geotextile survivability under most construction conditions anticipated during the work. The Contractor shall submit details on the proposed use of the geosynthetic to the Company for review prior to use.

D. Stabilization Requirements

1. Description. This section is applicable to the use of a geogrid to provide reinforcement for a roadway or soil embankment. If a geotextile is preferred in a particular application over a geogrid for soil reinforcement, details of the proposed geotextile including all pertinent design information shall be submitted to the Company for review prior to use. The use of a geotextile may be required in combination with the geogrid to provide adequate separation if required. Stabilization is applicable to pavement structures constructed over soils with a California Bearing Ratio between one and three (1<CBR<3).
2. The stabilization application is appropriate for subgrade soils which are saturated due to a high groundwater table or due to prolonged periods of wet weather. This specification is not appropriate for embankment reinforcement where stress conditions may cause global subgrade foundation or stability failure unless adequately accounted for in the design. Reinforcement of a pavement section is a site specific design issue.
3. Geogrid Requirements. The geogrid shall meet the requirements of Table 3. All numeric values in Table 3 represent MARV in the weakest principal direction.

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Table 3 Stabilization Geosynthetic Minimum Requirements

Mechanical Properties	Test Method	Unit	MARV in MD	MARV in CD
Ultimate Tensile Strength	ASTM D6637	lbs	850	1300
Tensile Strength @ 2% Strain	ASTM D6637	lbs	280	450
Tensile Strength @ 5% Strain	ASTM D6637	lbs	580	920

4. The property values in Table 3 represent default values which provide for sufficient geosynthetic survivability under most construction conditions anticipated during the work. The Contractor shall submit details on the proposed use of the geosynthetic to the Company for review prior to use.

3.0 EXECUTION

3.1 Preparation

A. Preliminary Site Examination

1. Prior to excavating, thoroughly examine the area to be excavated to verify the locations of features indicated on the engineering drawings and to ascertain the existence and location of any structure or other item not shown on the engineering drawings that might interfere with the new structure. Notify Company of any obstructions that could impact accomplishment of the work as indicated on the drawings.

B. Construction Layout

1. Unless otherwise stipulated elsewhere in the contract documents, the work covered by this specification includes the performance of all calculations, and the setting of all marks and stakes necessary to ensure that the work conforms to the required lines, grades and dimensions. Relate such layout to the coordinate grid system, elevation datum, and related survey control monuments and bench marks identified on the drawings or elsewhere in the contract documents. The Contractor shall utilize a licensed surveyor and shall be responsible for setting out and maintaining the accuracy of all pertinent lines, grades and levels as shown on the drawings during the period of construction.
2. All discrepancies in levels or setting out shall be entirely the responsibility of the Contractor and he shall be liable to make good such discrepancies to the complete satisfaction of the Company.

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C. Clearing and Grubbing

1. Clearing and grubbing shall consist of the removal and satisfactory disposal of trees, stumps, roots down to finger size, vegetation, logs, rubbish, and other unsuitable material. Root raking shall be performed to a depth of at least 12 inches below grade. The raking pattern should consist of perpendicular patterns to more effectively remove root mats. All existing fill and native soils with significant organic matter (greater than approximately 2% organics by dry weight) shall be completely removed from below foundations, slab, and pavement areas prior to fill or concrete placement. Maximum roots shall finger size.
2. Except for trees and shrubs in areas designated in the contract documents for preservation, areas designated for clearing and grubbing shall be cleared.
3. During construction operations, trees, shrubs, and other landscape features specifically designated in the contract documents for preservation shall be carefully protected from abuse, marring, or damage.
4. Trees and other vegetation outside the construction area shall not be damaged in any manner.
5. Unless otherwise specified in the contract documents, trees, stumps, and other vegetation in the areas designated for clearing and grubbing shall be removed to the bottom of their root zone.
6. Depressions made by clearing and grubbing operations shall be filled with suitable material and compacted to conform to the adjacent surface of the original ground.
7. Where excavations must be made in areas of existing paving that is to remain, remove the pavement using neat, straight and square or parallel saw cuts, no less than 1 foot outside of the line of intersection between the excavation sidewall and the pavement subgrade surface. In the case of Portland cement concrete pavement, the line of removal may be the nearest existing pavement joint outside of the 1 foot limit. Cut and carefully bend out of the way of the excavation any steel reinforcement exposed by the pavement removal. Position the steel reinforcement so that a sufficient amount of it projects into the removed area to allow for a lap splice with the new replacement reinforcement required for restoration of the pavement.

D. Stripping

1. Stripping shall consist of the excavation, removal, and satisfactory disposal of all topsoil and soil containing organic material. Such stripped materials shall not be used as structural fill material under any circumstances.
2. Before any soil is removed, the area shall be cleared of all debris.

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3. Unless otherwise directed by the Geotechnical Engineer, topsoil shall be removed to full-depth or as specified in the contract documents.
 4. Reusable materials shall be stockpiled as necessary for the Contractor's operations in areas approved by the Company.
- E. Rough Grading
1. General area grading shall be completed to within a tolerance of ± 0.20 feet of the elevations shown in the contract documents, but shall not be uniformly high or low.
- F. Finish Grading
1. If unsatisfactory field conditions caused by rain, inclement weather, or other circumstances prevent satisfactory performance of the work, earthwork operations shall be suspended after consultation with the Geotechnical Engineer and the Company.
 2. Trim and finish-grade the surface of areas involved in work covered by this specification to within a tolerance of ± 0.10 feet of the elevations shown in the contract documents, but shall not be uniformly high or low. The resulting surface shall be reasonably smooth and free of ruts, ridges, depressions, and other significant irregularities. Finish ditches so that no ponding occurs.
 3. After completing grading operations and before grassing operations, the graded areas that are not to be further improved shall be overlaid with topsoil of a compacted thickness of 4 inches minimum.

3.2 Control of Water and Dewatering

- A. General
1. All dewatering methods and disposal of water shall be approved by the Company.
 2. Prevent or control water flow into excavations, or water accumulation in excavations, to ensure that the bottoms and sides of excavations remain firm and stable throughout construction operations.
 3. A surface seal (e.g., sealing with a smooth drum roller) shall be performed as required to prevent saturation during wet weather or temporary shutdown of operations.
 4. When the water table is higher than the lowest excavation limits, dewatering shall be coordinated with the scheduled construction work to lower and maintain the water level accordingly, in accordance with the following requirements:
 - a. Obstructions - Excavated areas posing obstruction to construction work shall be minimized.



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- b. Discharging Water - All water removed by dewatering shall be discharged in areas, which are suitable for discharging such water as determined by Company.
- c. Preventing Displacement of Soil - All work shall be performed in such manner as to prevent displacement of soil at the bottoms of the excavations.
- d. Water Level Elimination - Under backfill and under foundations placed on natural or compacted soil, the water level shall be maintained at least 12 inches below the construction level.
- e. Well Points - Well points, if used, shall be equipped with screens, as recommended by the well point manufacturer for the type of encompassing soil, and the top of the screens shall be set at least 24 inches below the bottom of the excavation.
- f. Additional requirements may be imposed based on what stage during construction the dewatering is performed.

B. Surface Waters

- 1. Plan and conduct excavation operations so as to minimize the disruption of stormwater drainage in the vicinity of the work. Provide diversion ditches, dikes, and other suitable measures to control and direct runoff around and away from the excavation. Protect the sides of excavations from erosion and sloughing by stormwater runoff. Promptly remove stormwater accumulations in excavations. The systems and equipment for controlling surface water shall be of sufficient capacity to accommodate the runoff rate expected from rainfall events, with no significant disruption of the construction schedule, or damage to existing features or facilities in the vicinity of the work.
- 2. Where drainage measures such as catch basins or drains, protected from adverse sediment deposition, are spaced at 150 feet apart or more, a well graded, compact surface slope of two percent shall be provided during construction in order to provide positive drainage of surface water. The slope can be reduced to 1 percent if the drainage spacing is 150 feet or less. Where it is not possible to provide positive drainage, other appropriate measures should be utilized. These measures include ditches, subsurface drains, commercially available drainage devices, and relatively impervious soil or synthetic caps

C. Groundwater

- 1. When the bottom of the excavation must be extended below the groundwater piezometric surface, or to such proximity to the piezometric surface that the excavation bottom will become soft due to its being saturated by groundwater, take measures to lower the piezometric surface sufficiently to maintain the stability of the excavation bottom. Design the groundwater control system using accepted professional methods of design and engineering consistent with the best modern practice. The system shall include trenches and sumps with pumps, well points, and such other equipment, appurtenances, and related earthwork necessary to achieve the groundwater control needs of the work.



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Carefully design and operate the system to avoid damage to existing structures and other facilities in the vicinity of the work.

D. Disposal of Removed Stormwater

1. Convey water removed by the water control systems to an existing stormwater drainage facility or structure that has sufficient capacity to accommodate the flow rates involved without damage. Secure permits or other approvals required from authorities having jurisdiction for such stormwater discharge.
2. Any water to be discharged that is potentially suspect of quality shall be tested by the Contractor for water quality to determine whether the water can be disposed of through the natural waterways or whether it shall be contained for treatment.

E. System Removal

1. After completing construction operations needing water control, remove materials, equipment, and other facilities used for that purpose, and clean up and restore affected areas as required.

3.3 Excavation

A. General

1. Prior to commencing excavation the contractor shall establish and verify the location of all buried services on and adjacent to the site.
2. All trenches and excavations shall be made with sides, slopes or shoring conforming to the design documents and the 2014 Florida State Building Code or as otherwise directed by the Company. Wherever deemed necessary by the Company or specified in the codes, standards or geotechnical reports, the sides of all excavations shall be securely shored and supported to protect against slips and falls of earth, etc., into the excavation. If slips or falls occur and cause any instability which endangers the work or adjacent structures, the contractor shall execute such remedial measures that the Company may require in order to rectify the instability. All slipped or fallen earth, etc. shall be removed from the excavation at the expense of the contractor. All temporary shoring, if any, shall be removed during backfilling.
3. Excavations shall be adequate for construction and inspection of all work under the contract. Excavations shall be made to the lines, grades and dimensions shown on the drawings or established by the Geotechnical Engineer. All excavation work shall be maintained and protected against earth collapse from natural causes or subsequent construction work and shall be in accordance with OSHA requirements. Water shall be controlled in accordance with the control of water and dewatering subsections.
4. Suitable excavated material, as indicated on the design documents or otherwise determined by the Geotechnical Engineer, may be used as fill material pending approval



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by the Company. Excavated material proposed to be used for fill shall be stockpiled and tested to confirm that the properties meet the requirements of Section 2.1.B. Material unsuitable for use as fill material shall be hauled to areas designated by the Company.

5. Excavate pits for constructing cast-in-place concrete foundations, footings, and other structures to permit the placement of each monolithic element of the structure to the full width and length required with a full horizontal bed. If the excavation sidewalls are to be used to form the sides of the structure, take special care during excavation to secure a true surface conforming to the lines and dimensions indicated on the plans for the structure. Corners and edges of the excavation shall be true and square, not rounded or undercut.

B. Structural Excavation

1. Structural excavation shall include excavations for footings, grade beams, pits, retaining walls, manholes, catch basins, etc.
2. Structural excavation shall be performed in accordance with the contract documents to the dimensions, grades, and elevations as noted and as required for formwork.
3. If soft, compressible soil is encountered at footing grades as shown in the contract documents, the soft soil shall be removed and replaced with Structural Fill or as otherwise recommended by the Geotechnical Engineer.
4. Upon approval from the Company, over-excavation at footings may be backfilled with lean concrete or CLSM in accordance with Section 2.1.C. Lean concrete shall have a mix design proportioned to achieve a minimum 28-day compressive strength 1,000 psi.
5. Should undisturbed soil be present in and around foundations, all necessary precautions shall be taken to preserve the material in the soundest possible condition below and beyond the line of all excavations. If the soil is disturbed during excavation, contractor must compact the native soil to the satisfaction of the Geotechnical Engineer.
6. Lowered Excavations - Unplanned excavations or foundations below required grade shall be backfilled with Structural Fill as directed by the Geotechnical Engineer. If unsuitable bearing material is encountered, the excavation shall be lowered under the direction of the Geotechnical Engineer to the level of suitable material.

C. Earthen Structures

1. Earthen structures include permanent work items such as ponds, canals, ditches, etc.
2. Excavation for earthen structures shall be made to the lines, grades, and cross sections in accordance with the contract documents.
3. Side slopes of excavations shall be cut true and straight and shall be graded to the proper cross section.

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4. Unstable soil in the slopes shall be removed, and the slopes properly prepared.
5. The bottoms of excavations shall be graded to the elevations and configurations in accordance with the contract documents.
6. Over-excavation shall be backfilled with suitable material and compacted in accordance with Table 4.

D. Trenching

1. The Contractor's competent person shall inspect trenches daily to ensure a safe working environment is maintained. The excavation competent person shall complete and document daily inspections as required in accordance with applicable OSHA requirements and submit to the Company on a daily basis. Contractor shall assume full responsibility for maintaining the stability of all excavated faces in compliance with OSHA until final acceptance is made of the work.
2. Contractor shall notify the Company of any obstructions encountered and shall provide support, protection, or removal of such obstructions as directed by the Company.
3. Contractor shall excavate trenches to the minimum depths and widths necessary for installing the pipeline and associated appurtenances in accordance with the requirements of this specification and the lines and grades indicated on the plans or elsewhere in the contract documents. In the pipe embedment zone, the trench sidewalls shall be as nearly vertical as practical. From the top of the pipe embedment zone to the surface, the trench sidewalls shall be either sloped sufficiently to prevent sloughing or cave-in, or shall be properly supported.
4. When soft, yielding, or otherwise unstable soil conditions are encountered at the required trench bottom elevation, over-excavate the trench to a depth of no less than 12 inches below the required pipe bottom elevation, and backfill with bedding material. The Company shall be notified prior to over-excavating deeper than 12 inches below the required trench bottom elevation. If conditions are so severe that over-excavating and backfilling will not achieve a stable condition, notify the Company immediately so that appropriate corrective measures may be identified.
5. If rock, stone, or other hard, unyielding material is encountered at or above the required trench bottom elevation, remove it to provide a clearance of no less than 6 inches below and on each side of pipes and associated fittings, valves, and other appurtenances. Backfill the over-excavated area with bedding material compacted in accordance with the requirements of Table 4.
6. Flooded excavations shall be dewatered and all muck removed before proceeding with the work.
7. If pipe joint diameter exceeds pipe outside diameter (e.g., bell and spigot piping), bell holes shall be manually excavated after the trench bottom has been graded.

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E. Excavation for Appurtenances

1. Excavations for precast manholes and other similar structures shall be of sufficient size to permit proper placement of the structures in their intended positions and to permit proper placement and compaction of backfill around the structures after their placement. For cast-in-place appurtenances, excavations shall be of sufficient size to permit placement and removal of necessary formwork.
2. When concrete is to be placed against the bottom or sides of an excavation, take care not to disturb the native soils that the concrete bears against. Excavate to final line and grade just before the concrete or masonry is to be placed. Remove loose or unstable materials. Clean any rock of loose material and other debris and cut to a firm and stable surface that is level, stepped, or serrated.

F. Rock Excavation

1. Unless otherwise specified in the contract documents, rock excavation shall consist of excavation of boulders or pieces of detached rock measuring one cubic yard in volume or greater, or rock in ledges, bedded deposits, and conglomerate deposits so firmly cemented that they present all the characteristics of solid rock, which cannot be excavated with heavy equipment. All other excavation shall be earth excavation.
2. If unexpected hard rock is encountered within the excavation limits, as defined in Section 3.3.F.1, the work shall be stopped until the Company provides specific direction.

3.4 Stockpiling

- A. Material shall be stockpiled in areas as approved by the Company.
- B. Stockpiles shall be placed, graded, and shaped for positive drainage away from the stockpile.
- C. Arrange stockpiles so as not to obstruct drainage or other construction operations in the vicinity of excavation
- D. Storage or stockpiling of material shall not be permitted on a completed subgrade unless otherwise approved by the Company.
- E. Stockpiling of contaminated soils shall be in accordance with a Company approved contaminated soils management plan or as specified by the Company.
- F. Protect stockpiles containing satisfactory backfill material from contamination with unsatisfactory material or other material that may adversely affect the quality of the material and render it unfit for use.



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3.5 Disposal of Excess and Waste Materials

- A. Where practicable and upon approval by the Geotechnical Engineer, all suitable materials removed by excavation shall be used as fill.
- B. Excavated material in excess of that required for normal embankment construction shall be stockpiled within the construction limits or shall be placed in a designated spoil area beyond the construction limits as specified by the Company.
- C. Material unsuitable for fill and debris removed by clearing, grubbing, stripping, and excavation shall be removed to a disposal area approved by the Company.
- D. Burning of combustible materials is not permitted unless approved by the Company

3.6 Preparation of Areas for Fill or Loading

- A. Areas to receive fill, foundations, or pavement or areas to be used in the future to support structural loads as shown on the contract drawings shall be free of roots, trash, snow, ice, or other foreign material and shall not be frozen.
- B. Following the removal of all unsuitable soils and any additional excavation required to achieve design grade, areas shall be prepared for fill or loading as follows:
 - 1. Site shall be drained so that it is free of standing water.
 - 2. Prior to proof rolling operations, the subgrade soils shall be moisture conditioned to within +/- 3 percent of optimum moisture content per the discretion of the Geotechnical Engineer.
 - 3. Impact Roller Proof-rolling – crossing the designated area repeatedly and methodically with at least 10 passes with an Impact Roller. Proof-rolling shall continue until the exposed subgrade has achieved at least 95 percent of the material's maximum dry density as determined by the Modified Proctor Test (ASTM D1557). The number of passes may be modified per the Geotechnical Engineer based on the performance of the Impact Roller. Where isolated areas with limited access require a proof roll, alternate proof roll equipment may be used upon approval by the Geotechnical Engineer of the specific type and weight of the proof roll equipment.
 - 4. Conventional Proof-Rolling– crossing the designated area repeatedly and methodically with at least 10 passes with a vibratory roller with a minimum static weight of 25,000 lbs. Proof-rolling shall continue until the exposed subgrade has achieved at least 95 percent of the material's maximum dry density as determined by the Modified Proctor Test (ASTM D1557). The number of passes may be modified per the Geotechnical Engineer based on the performance of the subgrade and the rate of compaction. Alternatively, a loaded articulating dump truck may also be used for proof-rolling in areas designated for conventional proof-rolling. Where isolated areas with limited access require a proof roll,

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alternate proof roll equipment may be used upon approval by the Geotechnical Engineer of the specific type and weight of the proof roll equipment.

5. Soft soils removed and replaced with Structural Fill.
 6. Top 6 inches scarified, moisture conditioned to within 3% of optimum moisture content, and re-compacted.
- C. The top 6 inches of subgrade in areas for fill and loading shall be compacted to the minimum density per Table 4.
- D. Trench Bedding
1. Unless otherwise indicated on the design documents, where trench bottom soil can be cut and graded without difficulty, pipe may be installed directly on the prepared trench bottom. The bottoms of trenches or bedding material (as applicable) shall be firm and graded to provide uniform bearing of the pipe and be free of ridges, hollows, and lumps. When encountering rocks, boulders, or large stones that may cause point loading on the pipe, remove the rocks, boulders, and large stones and pad the trench bottom with a minimum of 6 inches of tamped bedding material unless otherwise indicated on the design documents.
 2. Areas that receive specialized bedding material shall be indicated on approved design documents.
 3. After the excavation reaches the required trench bottom elevation and any unsatisfactory subgrade conditions are corrected as specified, prepare the bottom of the trench for placement of the pipe by spreading in the trench a layer of bedding material, when required, to attain a level above the outside bottom of the pipe that is specified on the pipe trench details on the design documents. Carefully shape the surface of this layer of loose material to ensure that uniform and continuous support is provided to the bottom quadrant of each pipe section along its entire length. In the prepared trench bottom, excavate small depressions (bell holes) of the minimum size necessary to allow removing the pipe handling slings, to allow assembly of pipe joints, and to avoid the development of bearing loads on the pipe bells or flanges.
 4. Structural Fill is acceptable for use as bedding material unless otherwise indicated on design documents.



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3.7 Pipe Laying and Assembly

- A. Place the pipe, pipe assemblies, and fittings on the prepared trench bottom, embedding the bottom of the pipe into the loosely placed bedding materials true to the required line and grade. Ensure that the barrel of each pipe section is uniformly supported along its entire length, and that no point loads are developed on bells, flanges, or elsewhere. Assemble joints in accordance with the applicable piping system requirements.

3.8 Haunching

- A. After placing the pipe and assembling joints in accordance with the applicable system installation specifications, carefully fill bell holes with bedding material and place compact bedding material under the sides of the pipe to the pipe spring line. Take care during placement and compaction of this material to ensure sound support is developed for the sides of the pipe while avoiding either vertical or lateral displacement of the pipe from its intended position. Place haunching area material and compact to the required density in uniform lifts of not over 6 inches loose thickness using manual or mechanical tamping techniques.

3.9 Filling and Backfilling

- A. General
 - 1. Compaction shall be performed with equipment compatible with soil type.
 - 2. Before placement of fill or backfill, the area to receive the fill shall be prepared in accordance with Section 3.6
 - 3. Do not place backfill around new cast-in-place concrete structures until the concrete has attained 75% of 28-day compressive strength or unless written permission is obtained from Company; or, when the backfill will result in the development of unbalanced earth pressure loads on the structure. Backfill shall be placed around structures to avoid ponding of water.
 - 4. Where fill will be placed against an existing slope of 4H:1V or steeper, the existing slope should be benched or keyed into as to allow compaction against a horizontal surface and provide interlock of the fill with the existing material. Benches should be cut a minimum of 4 feet horizontally into competent undisturbed materials as fill is placed, with a new bench starting wherever the vertical cut of the adjacent bench intersects the ground surface.
 - 5. Place and compact backfill symmetrically about any structures so as to avoid the development of unbalanced earth pressure loads on the structure.
 - 6. Heavy equipment shall not be used, moved, or placed within 4 feet from structures such as retaining walls, pits, and basements. Appropriate hand operated equipment shall be used to compact backfill within 4 feet of the structure in order to meet the compaction requirements.

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7. No fill shall be placed until the Geotechnical Engineer has approved the receiving area.
8. The gradation and distribution of material throughout the fill zone shall be such that the fill volume shall be free from lenses, pockets, streaks and layers of material differing substantially in texture and gradation from surrounding material. Should such lenses, pockets, streaks, and layers of unsuitable material occur in the fill, such material shall be removed and replaced with suitable material.

B. Moisture Control

1. Compacting shall begin only after the fill or backfill has been properly placed and after the material to be compacted is at the proper moisture content.
2. Compact backfill material at a moisture content suitable for that material using the compaction equipment employed. Unless otherwise directed by the Geotechnical Engineer compact Structural Fill at a moisture content within plus 3 percent and minus 3 percent of optimum per ASTM D1557. Fill materials shall be conditioned as necessary to achieve the required moisture content, without additional cost to the Company.
3. When water must be added, distribute it uniformly over the surface of the layer, and thoroughly incorporate it into the soil by manipulation (plowing, discing, raking or blading) to achieve a uniform distribution of moisture throughout the material. When the moisture content is excessive, defer compaction until the material has dried to a suitable moisture content. Natural drying may be accelerated by manipulation to increase the rate of evaporation, or by blending in a dry material. If drying is accomplished by blending in a dry material, take care not to exceed the specified maximum layer thickness for compaction. Remove any excess material from the layer before compaction.

C. Compaction Criteria

1. At locations indicated, on firm, exposed, clean, unfrozen surfaces, backfill material or excavated material satisfying requirements of Section 2.1.B shall be uniformly placed at suitable moisture content and each layer shall be compacted with approved power-operated mechanical equipment until the lift in which the layers occur has attained its intended total compacted thickness and meets the following criteria:

Table 4 - Minimum Compaction Requirements

Fill Location	Percent of Max. Dry Density ¹
Within 24 inches beneath and within a distance of 5 feet from walls, shallow foundations, and mat foundations	98
Greater than 24 inches below and within a distance of 5 feet from walls, shallow foundations, and mat foundations	95



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Within 24 inches beneath and within a distance of 2.5 feet from slabs-on-grade, pavement sections, and concrete sidewalks	98
Greater than 24 inches below and within a distance of 2.5 feet from slabs-on-grade, pavement sections, and concrete sidewalks	95
Trench backfill	95
Select Structural Fill	98

¹ Expressed as a percentage of the maximum dry density determined by ASTM D1557 (Modified Proctor)

2. Unless otherwise noted in the contract documents, material shall be placed in loose lifts not exceeding the following criteria, provided that the specified compaction is achieved for the full depth:
 - a. When heavy compaction equipment is used, Structural fill and Select Structural Fill shall be placed in lifts of 8 inches maximum in loose depth.
 - b. Unless otherwise approved by the Geotechnical Engineer, for hand-operated compaction equipment, general and structural fill materials shall be placed in lifts of 6 inches maximum in loose depth. For Structural Fill placed at 6 inch lifts, the maximum particle size shall be reduced to 1 inch.
 - c. Lift thicknesses may be modified based on actual compaction results upon review and approval by the Geotechnical Engineer.
3. The minimum thickness of lifts shall be at least twice the dimension of the largest particle size of the fill material.
4. Compaction by water jetting or flooding shall not be permitted.
5. In the event that the nature of a fill material is such that a Proctor-based compaction-curve cannot be determined, compaction acceptance criteria will be based on relative density per the recommendations of the Geotechnical Engineer.

D. Bedding

1. Bedding material shall be placed per the requirements of FDOT Standard Specification Section 125 or as otherwise indicated on the drawings.
2. Bedding material shall be placed under and equally along both sides of the pipe in uniform layers not exceeding 6 inches loose depth to a height of the centerline of the pipe and compacted by hand, pneumatic tamper, or other approved means.

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3. Bedding material shall be compacted to a density approximately that of the undisturbed site soil materials or as specified in the contract documents.
 4. If compacted, the pipe bed shall provide uniform bearing for the bottom of the pipe.
 5. Localized loading and differential settlement shall be minimized where the pipe crosses other utilities or subsurface structures or in areas having special foundations such as pile caps or sheeting. A cushion of bedding shall be provided between the pipe and any such point of localized loading.
 6. Flowable fill (controlled low-strength material, CLSM) may be used for bedding material only when approved by the Company.
- E. Trench Backfilling
1. Place and compact the bedding material, from the spring line of the pipe to one foot above the top of the pipe in uniform horizontal lifts. Bring up the level of bedding material uniformly on opposite sides of the pipe along the full length of each pipe section. Take care not to damage the pipe or any protective coating it may have.
 2. When installing high density polyethylene (HDPE) pipe, polyvinyl chloride (PVC) pipe, corrugated metal pipe (CMP), or any other flexible type pipe, give special attention to proper compaction of the materials in the pipe haunch area and sides to ensure that adequate side support of the pipe is developed while avoiding any vertical or lateral displacement of the pipe. For flexible type pipe, the material directly above the pipe in the pipe embedment zone shall be only lightly compacted to avoid distorting the pipe. Compacted density requirements do not apply to materials in this area directly over flexible type pipe.
 3. Structural Fill is acceptable for use as trench backfill unless otherwise indicated on design documents. If the trench is excavated within the mass fill section, the material excavated for the trench may be used as trench backfill.
 4. The trench shall be backfilled and compacted in 6 inch maximum loose lifts and to a density equal to that specified on the contract documents or equal to that of the adjacent in situ material where not otherwise specified.
 5. As soon as possible after pipe joints are made, backfill material shall be placed along the sides of the pipe with care to prevent movement of the line or grade.
 6. Joints shall be left exposed until completion of leak testing if required.
 7. Backfilling of trenches shall be completed immediately after testing.
 8. Backfilling shall be compacted in a manner that avoids displacement or damage to the pipe.



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9. Construction machinery or vehicles shall not be allowed to pass over the trench until the trench is backfilled and compacted sufficiently to prevent damage to the pipe.
10. Flowable fill (CLSM) may be used for backfill material if specified in contract documents.

3.10 Soil Compaction Control

A. General

1. Fill material shall be compacted by equipment approved by the Geotechnical Engineer.
2. Compact bedding and backfill materials using vibratory or impact type compaction equipment suitable for use in confined areas, and operated at the frequency and amplitude recommended by the equipment manufacturer for the type of material and lift thickness involved in the work.

B. Testing

1. Tests of gradation, plasticity, density, and moisture content shall be performed for each type of fill material. These tests shall include the following:
 - a. Two standard sieve analyses in accordance with ASTM D422 and ASTM D1140.
 - b. Two liquid and plastic limit determinations in accordance with ASTM D4318. This may be waived by the Geotechnical Engineer based on the source of the material.
 - c. Two Modified Proctor Tests in accordance with ASTM D1557.
 - d. The number of tests may be adjusted by the Company based on the size of the stockpile.
2. For granular soils that do not exhibit a well-defined moisture-density relationship, index density, unit weight, and relative density shall be determined in accordance with ASTM D4253 and ASTM D4254.
3. Materials in the field should be sampled frequently to assure that the two gradations and maximum densities are comparable and/or ASTM test method D5080 be used when monitoring the compaction process. If the type or the source of fill material changes, the testing in Section 3.10.B.1 shall be performed again with the new material.
4. Unless otherwise specified in the contract documents, the in-place dry density and moisture content testing (i.e., field density testing) on compacted fill shall be performed using the sand-cone method in accordance with ASTM D1556.

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5. Nuclear density tests, in accordance with ASTM D6938, may be used in lieu of the sand-cone density test (per ASTM 1556), provided that a correlation first be established comparing the results of the nuclear density test with the sand cone density test. This correlation shall be reviewed and approved by the Geotechnical Engineer prior to the nuclear density test being used for production work. Once the correlation is established and approved, the nuclear density test can be used for all in-place density testing. However, a companion sand cone density test shall be performed every 15 nuclear density tests or a minimum of two companion test per week where nuclear density tests are performed. The use of the nuclear density test and/or the frequency of companion sand cone density testing may be adjusted based on the evaluation of the companion data by the Geotechnical Engineer.
6. Unless otherwise specified in the contract documents, the field density testing shall be performed at the following frequencies:
 - a. Structural fill under foundations and building slabs within the power plant road system and areas under buildings and tank farms – one test every 10,000 square feet of each lift or change in material type. Within 12 inches below building slabs, field density testing shall be performed every 2,500 square feet.
 - b. Column footings – one test per each 50 square feet of footing bearing surface for individual footings.
 - c. Continuous footings – one test per 50 linear feet of continuous (strip) footing.
 - d. Other areas such as parking areas, laydown areas, and temporary office locations – one test every 10,000 square feet of each lift or change in material type.
 - e. Roadways – one test every 200 linear feet of road for each lift or change in material type.
 - f. Backfill of trenches (for utility lines or foundations) – one test for every 150 linear feet of each lift or change in material type.
 - g. Other areas – Areas outside of structures, roadways, parking areas or as otherwise indicated on the drawings - one test every 25,000 square feet of each lift or change in material type to within 2 ft of structure and pavement subgrades.
7. As a minimum, one in-place moisture content and density test shall be performed on every lift of fill. Additionally, no less than three density tests shall be performed per structure or one test per each day of work.
8. Until the required dry density has been achieved, further placement of fill shall not be permitted.

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9. The number of field density tests shall be increased if a visual inspection determines that the moisture content is not uniform or if the compacting effort is variable and not considered sufficient to attain the specified dry density.
 10. The Geotechnical Engineer may approve a decrease in the number of tests once a compaction procedure has met project requirements.
 11. For trenching, the following items shall be inspected and/or monitored during the work:
 - a. Trench alignment and width
 - b. Alignment and width shall be monitored and spot measured on 100-foot intervals
 - c. Trench subgrade
 - d. Trench subgrade shall be observed and approved by the Inspection and Testing Agency prior to installing bedding material
 - e. Bedding/backfill lift thickness
 - f. Lift thickness shall be checked/measured at intervals of 100 feet maximum
 - g. Bedding material placement & compaction
 - h. Placement and compaction shall be continuously monitored by the Inspection and Testing Agency
- C. Evaluation of Test Results
1. The Geotechnical Engineer shall interpret the test results per the requirements of the contract documents.
- D. Test Reports
1. The results of all field density testing shall be submitted in writing to the Company and the Geotechnical Engineer immediately after each day's testing. Each report shall accurately identify the location of each test.
- E. Correction of Compaction
1. If any group of tests show inadequate compaction for the particular material compacted and additional compaction fails to bring the material within compliance, the contractor shall remove the material from within the density test area and the lift which the group of tests represent, and shall either attempt to reuse this material or replace it with new material which complies with specified requirements. After re-compaction, testing shall be repeated as specified. This procedure, or a variation as recommended by the



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Geotechnical Engineer, shall continue until test results show compliance with the specifications.

3.11 Repairing Damage

- A. Settlement, washing or damage of any work performed under this section prior to acceptance of the work shall be repaired and grades shall be re-established to the required elevations and slopes in the manner herein specified.

3.12 Installation of Geosynthetic

- A. Install geosynthetic at locations shown on the drawings or at locations as needed based on field conditions and review by the Company. The geosynthetic shall be installed in accordance with the manufacturer's instructions.
- B. Fill material shall be placed in lifts and compacted as directed under Section 3.9. Fill material shall be placed, spread, and compacted in such a manner that minimizes the development of wrinkles in the geosynthetic and/or movement of the geosynthetic.
- C. The Contractor shall examine the surface of the areas on which the geosynthetic is to be placed. The surface shall be smooth, have the specified percentage of maximum modified Proctor dry density, clean, and free of mud, frost, and snow. Do not proceed until unsatisfactory conditions are corrected.
- D. Seams or laps may be utilized per manufacturer's recommendations to produce panels of geosynthetic large enough to cover the area shown on the drawings or as needed based on field conditions. Seams or laps for the stabilization geosynthetic shall be perpendicular to the centerline of the machine direction, and shall be placed and lapped/seamed in accordance with manufacturer's instructions. The Contractor will be responsible for all factory or field seams.
- E. The Contractor shall prepare the surface to receive the geosynthetic to insure that the surface is relatively smooth and free of obstructions, depressions, or debris which could damage the geosynthetic during placement.
- F. The geosynthetic shall be placed in the manner and at the locations shown in the drawings or otherwise indicated by the Contractor on the submittal to the Company based on field conditions.
- G. At the time of installation, the geosynthetic shall be rejected if it has defects, rips, holes, flaws, deterioration or damage incurred during manufacture, transportation or storage.
- H. All wrinkles and sags shall be stretched out immediately before material is placed on the geosynthetic. The geosynthetic may be temporarily secured in place with ties, staples, pins, sand bags or backfill as required by fill properties, fill placement procedures or weather conditions or as directed by the Company. The work shall be scheduled so that all of the geosynthetic that is placed is covered with a layer of material by the end of each workday. Failure to comply shall require remedial action as determined by the Company. Remedial



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action shall consist of re-stretching the geosynthetic or discarding the portion of geosynthetic in question and replacing it with new geosynthetic. Any geosynthetic that is rejected or damaged shall be replaced by the Contractor at no additional cost to the Company.

- I. A minimum loose fill thickness of 6 inches is required prior to operation of tracked vehicles over the geosynthetic. Turning of tracked vehicles should be kept to a minimum to prevent tracks from displacing the fill and damaging the geosynthetic. Fill ruts formed during construction to maintain adequate cover over geosynthetic. Do not blade ruts down. Rubber-tired equipment shall not be allowed directly on the geosynthetic.

3.13 Riprap Placement

A. Preparation

1. Cut or fill and grade to the slopes, lines and grades shown on the drawings the foundation on which the riprap is to be placed and trim areas to receive rock to a uniform surface. Remove from foundations, surface irregularities, loose material, vegetation, and all foreign matter. Fill minor potholes and hollows with selected materials, well tamped-in to the approval of the Geotechnical Engineer. When fill is required, it shall consist of materials conforming to the specified requirements. Do not place rock and bedding until the foundation preparation has been completed, and the subgrade surfaces have been inspected and approved by the Geotechnical Engineer.

B. Placement

1. Place riprap material per FDOT Specification Section 530.
2. To provide a stable foundation and protection against any undercutting, the riprap shall be thickened at the toe, laid horizontally to form an apron or keyed into the bed of the watercourse, all as indicated on the drawings or as directed by the Geotechnical Engineer.
3. A subsurface drainage geotextile with properties equivalent to shown in Table 1 shall be placed beneath the rock on the bottom and sides of the basin and should be anchored in a trench at the top of the slope.
4. The rock shall be compacted with methods acceptable to the Geotechnical Engineer.
5. The completed top surface of the riprap shall conform to the lines and grades of the plan. Riprap placement that obstructs flow in ditches and channels is not acceptable.

3.14 Ditches and Culverts

A. Ditches

1. Ditches shall be constructed to the elevations and cross-sections and to a uniform slope between the elevations shown on the drawings.

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2. Ditches shall be constructed to neat lines and shall be within eight inches of design alignment at any location.
3. All loose material over two inches in diameter shall be removed from the ditch.

B. Culvert

1. Culvert pipe wall thickness and material type shall be in accordance with the drawings.
2. Culverts are to be laid at a uniform grade between the elevations shown on the drawings.
3. Culvert connections shall be as per manufacturer's specifications or as otherwise indicated on the design documents.
4. Structural fill is suitable for use for backfill around culverts.
5. All backfill placed adjacent to the culvert and up to 8 inches above the culvert crown shall be compacted using a small hand operated dual drum roller and compacted to a minimum 98% of maximum dry density Modified Proctor (ASTM D1557).

4.0 ATTACHMENTS

Not applicable

End of Specification

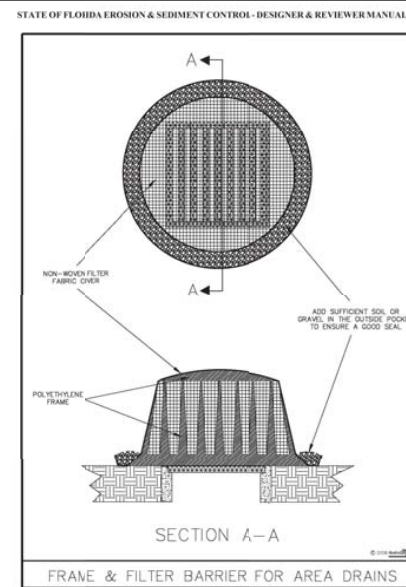


Figure V-47: Illustration of a Frame & Filter Barrier for Area Drains

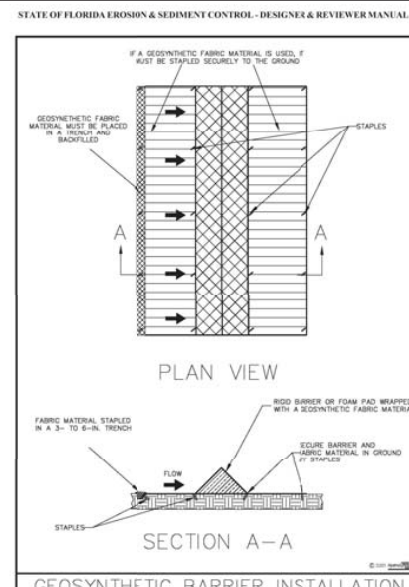


Figure V-43: Illustration of a Geosynthetic Barrier

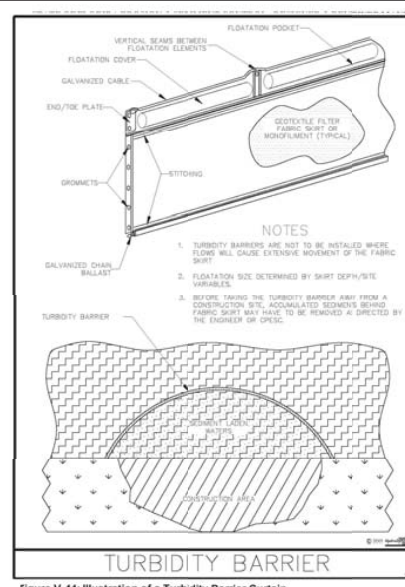


Figure V-44: Illustration of a Turbidity Barrier Curtain

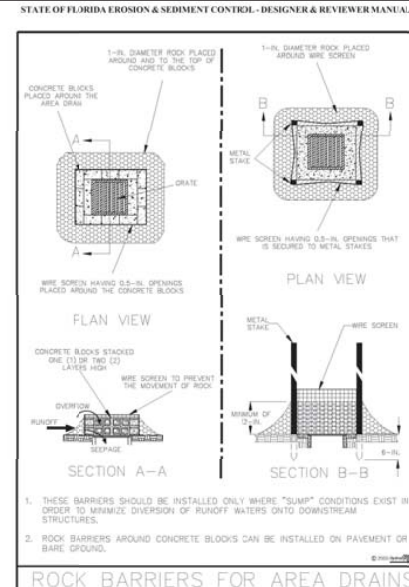


Figure V-46: Illustration of Rock Barriers around Area Drains

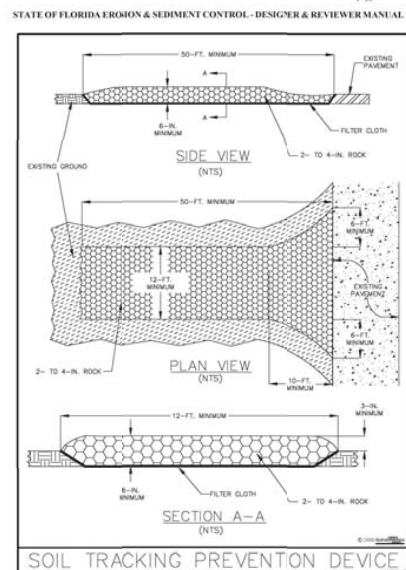


Figure V-52: Illustration of a Soil Tracking Prevention Device

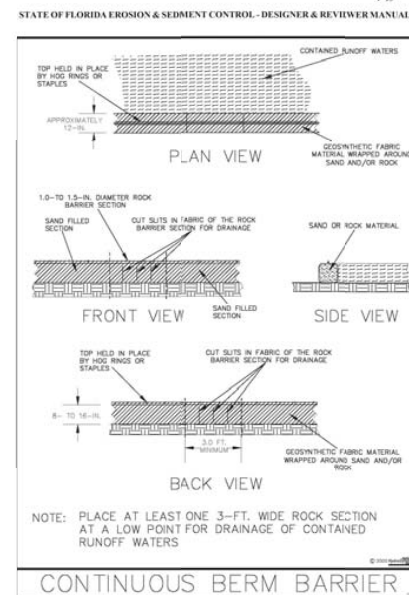


Figure V-42: Illustration of a Continuous Berm Barrier

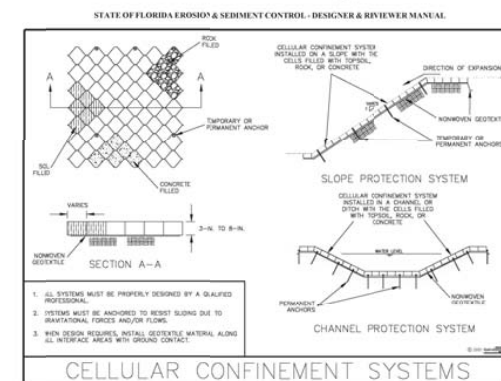


Figure Y-53: Illustration of uses for Cellular Confinement Systems

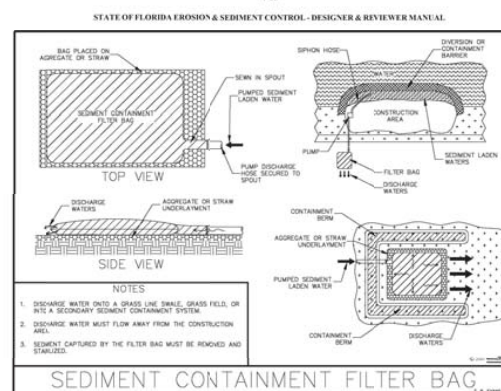
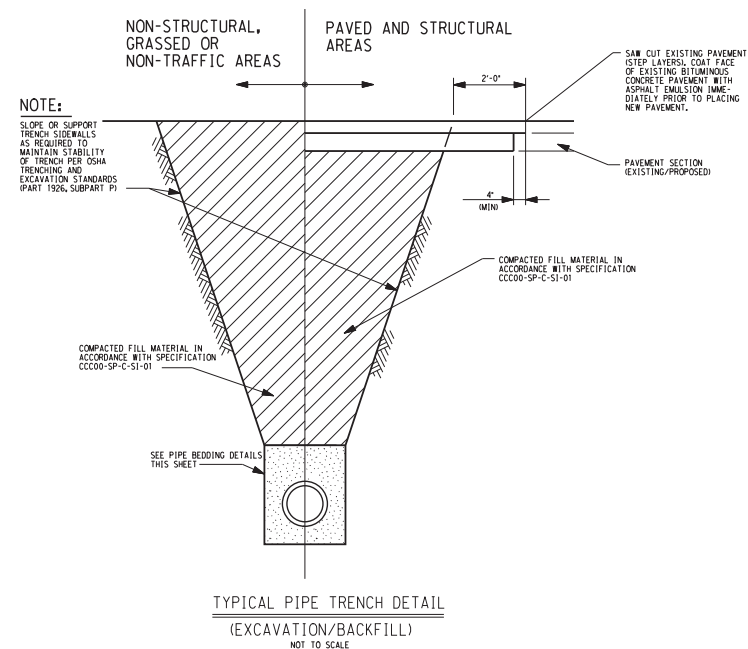
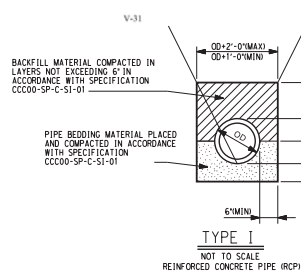


Figure I/-38: Illustration of a Sediment Containment System Filter Bag

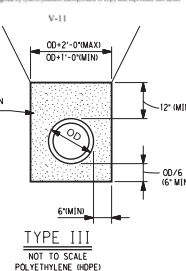


TYPICAL PIPE TRENCH DETAIL
(EXCAVATION/BACKFILL)
NOT TO SCALE



TYPICAL PIPE BEDDING DETAILS

NOT TO SCALE

[illegible]

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		GENERAL	
		SECTIONS AND DETAILS	
		SHEET 2	
Michael P. Furr, PE 79730		FOR CITRUS COUNTY COMBINED CYCLE - UNIT 005	
 6702 LAS COLINAS BLVD. IRVING, TEXAS 75039 (714) 222-2000			
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