2) Remote Automatic: In AUTO mode, the valve is positioned by the FILTER Automatic Control Sequence described in Loop 94 or Loop 95.

D. Alarms/Monitoring

1. Valve Fault indication, XA-21-115. An audible alarm is produced at CP-01.

E. Data Collection

1. N/A

LOOP 89 FILTER 3 WASH WATER BUTTERFLY VALVE; XV-21-116

A. General

1. OPEN-CLOSE (OC) and POSITION to discharge Wash Water from the Filter to the Sludge Holding Tank during the Backwash process.

B. Software Interlocks

1. If the valve is not in REMOTE, HSI-21-116, the PLC system places the valve in the manual.

2. If the valve has a FAULT, XA-21-116, the PLC system places the valve in the PLC manual.

C. Control

1. OPEN-CLOSE (OC) and POSITION control available at the valve actuator, LCP (CP-F-03) or from OWS.

2. Local:

a. The valve must be able to operate from the actuator.

b. Control Mode:

1) Local Manual: When in the manual, HSI-21-116, the valve should be able to open and close from actuator.
2) Local Automatic: None.

3. Remote:

a. Control (XC-21-116) is transferred to OIT/OWS. The valve can be controlled at OIT/OWS in MANUAL or AUTO modes.
b. Control Mode:

1) Remote Manual: The Operator to manually OPEN or CLOSE the valve from the OIT/OWS, XC-21-116. OIT/OWS mut show an OPEN (ZIO-21-116) and Close (ZIC-21-116) indication.
2) Remote Automatic: In AUTO mode, the valve is positioned by the FILTER Automatic Control Sequence described in Loop 94 or Loop 95.

D. Alarms/Monitoring

1. Valve Fault indication, XA-21-116. An audible alarm is produced at CP-01.

E. Data Collection

1. N/A

LOOP 90 FILTER 3 FILTERED WATER BUTTERFLY VALVE; XV-21-117

A. General

1. OPEN-CLOSE (OC) and POSITION to permit the transfer of Filtered Water from the Filter Unit to the Clearwell.

B. Software Interlocks

1. If the valve is not in REMOTE, HSI-21-117, the PLC system places the valve in the manual.

2. If the valve has a FAULT, XA-21-117, the PLC system places the valve in the PLC manual.

C. Control

1. OPEN-CLOSE (OC) and POSITION control available at the valve actuator, LCP (CP-F-03) or from OWS.

2. Local:

a. The valve must be able to operate from the actuator.

b. Control Mode:

1) Local Manual: When in the manual, HSI-21-117, the valve should be able to open and close from actuator.
2) Local Automatic: None.

3. Remote:

a. Control (XC-21-117) is transferred to OIT/OWS. The valve can be controlled at OIT/OWS in MANUAL or AUTO modes.
b. Control Mode:

1) Remote Manual: The Operator to manually OPEN or CLOSE the valve from the OIT/OWS, XC-21-117. OIT/OWS mut show an OPEN (ZIO-21-117) and Close (ZIC-21-117) indication.
2) Remote Automatic: In AUTO mode, the valve is positioned by the FILTER Automatic Control Sequence described in Loop 94 or Loop 95.

D. Alarms/Monitoring

1. Valve Fault indication, XA-21-117. An audible alarm is produced at CP-01.

E. Data Collection

1. N/A

LOOP 91 FILTER 3 FILTER TO WASTE BUTTERFLY VALVE; XV-21-118

A. General

1. OPEN-CLOSE (OC) and POSITION to discharge discarded water from Filter Unit to the Sludge Holding Tank during the Backwash process.

B. Software Interlocks

1. If the valve is not in REMOTE, HSI-21-118, the PLC system places the valve in the manual.

2. If the valve has a FAULT, XA-21-118, the PLC system places the valve in the PLC manual.

C. Control

1. OPEN-CLOSE (OC) and POSITION control available at the valve actuator, LCP (CP-F-02) or from OWS.

2. Local:

a. The valve must be able to operate from the actuator.

b. Control Mode:

1) Local Manual: When in the manual, HSI-21-118, the valve should be able to open and close from actuator.
2) Local Automatic: None.

3. Remote:

a. Control (XC-21-118) is transferred to OIT/OWS. The valve can be controlled at OIT/OWS in MANUAL or AUTO modes.
b. Control Mode:

1) Remote Manual: The Operator to manually OPEN or CLOSE the valve from the OIT/OWS, XC-21-118. OIT/OWS mut show an OPEN (ZIO-21-118) and Close (ZIC-21-118) indication.
2) Remote Automatic: In AUTO mode, the valve is positioned by the FILTER Automatic Control Sequence described in Loop 94 or Loop 95.

D. Alarms/Monitoring

1. Valve Fault indication, XA-21-118. An audible alarm is produced at CP-01.

E. Data Collection

1. N/A

LOOP 92 FILTER 3 BACKWASH BUTTERFLY VALVE; XV-21-119

A. General

1. OPEN-CLOSE (OC) and POSITION will permit Backwash water from Wash Water Storage Tank to Filter Unit during the Backwash process.

B. Software Interlocks

1. If the valve is not in REMOTE, HSI-21-119, the PLC system places the valve in the manual.

2. If the valve has a FAULT, XA-21-119, the PLC system places the valve in the PLC manual.

C. Control

1. OPEN-CLOSE (OC) and POSITION control available at the valve actuator, LCP (CP-F-03) or from OWS.

2. Local:

a. The valve must be able to operate from the actuator.

b. Control Mode:

1) Local Manual: When in the manual, HSI-21-119, the valve should be able to open and close from actuator.
2) Local Automatic: None.

3. Remote:

a. Control (XC-21-119) is transferred to OIT/OWS. The valve can be controlled at OIT/OWS in MANUAL or AUTO modes.
b. Control Mode:

1) Remote Manual: The Operator to manually OPEN or CLOSE the valve from the OIT/OWS, XC-21-119. OIT/OWS mut show an OPEN (ZIO-21-119) and Close (ZIC-21-119) indication.
2) Remote Automatic: In AUTO mode, the valve is positioned by the FILTER Automatic Control Sequence described in Loop 94 or Loop 95.

D. Alarms/Monitoring

1. Valve Fault indication, XA-21-119. An audible alarm is produced at CP-01.

E. Data Collection

1. N/A

LOOP 93 FILTER 3 - AIR SCOUR BUTTERFLY VALVE; XV-21-120

A. General

1. OPEN-CLOSE (OC) and POSITION to permit air pass from the Air Scour System to Filter Unit during the Backwash process.

B. Software Interlocks

1. If the valve is not in REMOTE, HSI-21-120, the PLC system places the valve in the manual.

2. If the valve has a FAULT, XA-21-120, the PLC system places the valve in the PLC manual.

C. Control

1. OPEN-CLOSE (OC) and POSITION control available at the valve actuator, LCP (CP-F-03) or from OWS.

2. Local:

a. The valve must be able to operate from the actuator.

b. Control Mode:

1) Local Manual: When in the manual, HSI-21-120, the valve should be able to open and close from actuator.
2) Local Automatic: None.

3. Remote:

a. Control (XC-21-120) is transferred to OIT/OWS. The valve can be controlled at OIT/OWS in MANUAL or AUTO modes.
b. Control Mode:

1) Remote Manual: The Operator to manually OPEN or CLOSE the valve from the OIT/OWS, XC-21-120. OIT/OWS mut show an OPEN (ZIO-21-120) and Close (ZIC-21-120) indication.
2) Remote Automatic: In AUTO mode, the valve is positioned by the FILTER Automatic Control Sequence described in Loop 94 or Loop 95.

D. Alarms/Monitoring

1. Valve Fault indication, XA-21-120. An audible alarm is produced at CP-01.

E. Data Collection

1. N/A

LOOP 94 FILTER 3 - OPERATION

A. General

1. Filter operation removes suspended particles, contaminants, and microorganisms to ensure the process water complies with turbidity threshold and quality established by regulatory requirements. The control operation is either at the CP-F-03 or OWS.

B. Hardware Interlocks
a. None

C. Software Interlocks

1. If one of the valves has a FAULT, the PLC system places the Filtering Process in the PLC manual.

D. Control

1. Control sequence of operation of the Filtering process that includes Filter Unit and associated valves: Inlet Valve, Wash Water Valve, Filtered Water Valve, Filter to Waste Valve, Backwash Valve and Air Scour Valve. Also, the instrumentation

(Turbidity, Differential Pressure, Level and Flow) that will monitor, control and generate alarm during the process

2. Local:

   a. Valves will be used to isolate or permit flow from in or out of the filter.

      1) Control Mode:
         a) Local Manual: When the Filter is in manual operation, all valves must be able to operate from the actuator:

            Filter Inlet Valve, XV-21-115, Refer to Loop 88
            Wash Water Valve, XV-21-116, Reer to Loop 89
            Filtered Water Valve, XV-21-117, Refer to Loop 90
            Filter To Waste Valve, XV-21-118, Refer to Loop 91
            Backwash Valve, XV-21-119, Refer to Loop 92
            Air Scour Valve, XV-21-120, Refer to Loop 93

         b) Local Automatic: None.

3. Remote:

   a. Control is transferred to OIT/OWS. The valves can be controlled at OWS/OIT in MANUAL or AUTO modes.
   b. Control Mode:

      1) Remote Manual: The Operator to manually OPEN or CLOSE the valve from the OWS/OIT.

         Filter Inlet Valve, XV-21-115, Refer to Loop 88
         Wash Water Valve, XV-21-116, Reer to Loop 89
         Filtered Water Valve, XV-21-117, Refer to Loop 90
         Filter To Waste Valve, XV-21-118, Refer to Loop 91
         Backwash Valve, XV-21-119, Refer to Loop 92
         Air Scour Valve, XV-21-120, Refer to Loop 93

      2) Remote Automatic: After the water has gone through initial treatments, it enters the filtration unit. Filter Inlet Valve, XV-21-115, (Refer to Loop 88) is open. Clear water from sedimentation basins passes through the filtration media. Water level at the filter unit is monitored by Level transmitter, LIT-21-203 (Refer to Loop 84). As the water passes through the filter media, filtered water, now free of most particulates and contaminants, is collected at the bottom of the filter bed and directed to the Clear Well. Filtered Water Valve, XV-21-117 (Refer to Loop 90) is opened. Filtered water turbidity is monitored by Turbidity Transmitter, AIT-21-104 (Refer to Loop 86)

         During this process:

a) Wash Water Valve, XV-21-116 (Reer to Loop 89) is closed.
b) Filter To Waste Valve, XV-21-118 (Refer to Loop 91) is closed
c) Backwash Valve, XV-21-119(Refer to Loop 92) is closed
d) Air Scour Valve, XV-21-120 (Refer to Loop 93) is closed

3) In this operation sequence Air Scour System is Off.

E. Alarms/Monitoring

1. If turbidity value at Turbidity Transmitter, AIT-21-104 (Refer to Loop 86) exceeds a predetermine value an alarm must be generated.

2. If differential pressure values at Differential Pressure Transmitter, DPT-21-303 (Refer to Loop 85) exceeds a predetermine value, an alarm must be generated.

3. If one of the valves has a FAULT, an alarm is generated. An audible alarm is produced at CP-01.

F. Data Collection

1. None

LOOP 95 FILTER 3 - BACKWASH

A. General

1. The backwash process is to maintain and clean filter, to restore the filter's efficiency and ensure consistent water quality. A detailed control sequence operation of the Backwash process is described. Operation is either at the CP-F-03 OIT or OWS.

B. Hardware Interlocks
a. None

C. Software Interlocks

1. Only one of the three filters can run a Backwash process at a time.

2. If one of the valves has a FAULT, the PLC system places the Backwash Process in the PLC manual.

D. Control

1. Control sequence of operation of the Backwash process that includes Filter Unit and associated valves: Inlet Valve, Wash Water Valve, Filtered Water Valve, Filter to Waste Valve, Backwash Valve and Air Scour Valve. Also, the instrumentation (Turbidity, Differential Pressure, Level and Flow) that will monitor, control and generate alarm during the process

2. Local:

   a. Valves will be used to isolate or permit flow from In or Out of the filter.

      1) Control Mode:
         a) Local Manual: When the Filter is in manual operation, all valves must be able to operate from the actuator:

            Filter Inlet Valve, XV-21-115, Refer to Loop 88
            Wash Water Valve, XV-21-116, Reer to Loop 89
            Filtered Water Valve, XV-21-117, Refer to Loop 90
            Filter To Waste Valve, XV-21-118, Refer to Loop 91
            Backwash Valve, XV-21-119, Refer to Loop 92
            Air Scour Valve, XV-21-120, Refer to Loop 93

         b) Local Automatic: None.

3. Remote:

   a. Control is transferred to OIT/OWS. The valves can be controlled at OWS/OIT in MANUAL or AUTO modes.
   b. Control Mode:

      1) Remote Manual: The Operator to manually OPEN or CLOSE the valve from the OWS/OIT.

         Filter Inlet Valve, XV-21-115, Refer to Loop 88
         Wash Water Valve, XV-21-116, Reer to Loop 89
         Filtered Water Valve, XV-21-117, Refer to Loop 90
         Filter To Waste Valve, XV-21-118, Refer to Loop 91
         Backwash Valve, XV-21-119, Refer to Loop 92
         Air Scour Valve, XV-21-120, Refer to Loop 93

      2) Remote Automatic: When Backwash start is selected in Automatic mode, Clear water intake is isolated from Filter. Filter Inlet Valve, XV-21-115, closes (Refer to Loop 88). The water level at Filter drops to a predetermined level. Level is determined by level transmitter, LIT-21-203 (Refer to Loop 84). Air Scour Valve, XV-21-120 (Refer to Loop 93), opens and compressed air motor is turned ON. The Air will cause the Filter Bed to expand breaking up the compacted filter bed and forcing the accumulated particles into suspension. Air Scour treatment will last up to a predetermined time. After the air scour cycle, the air scouring valve is closed. The Backwash Valve, XV-21-119 (Refer to Loop 92), and Wash Water Valve, XV-21-116 (Refer to Loop 89), opens. Clean backwash water is forced upwards through the filter bed continuing the filter bed expansion and carrying the particles in suspension into the backwash troughs, and then, ending in the Sludge Holding Tanks via the Wash Water Valve. Backwashing

continues for a fixed time. At the end of the backwash cycle, the upward flow of water is terminated by closing the Backwash Valve. The filter bed settles by gravity into its initial configuration. Water to be filtered is then applied to the filter by opening the Inlet Valve XV-21-115 (Refer to Loop 88). The Filter to Waste Valve opens XV-21-118 (Refer to Loop 91) and water will be directed to the Sludge Holding Tank until turbidity values (Turbidity Analyzer, AIT-21-104, Refer to loop 86) get below 0.15 NTU value. After turbidity values comply with value, Filter to Waste Valve, XV-21-118 (Refer to Loop 91) closes and Filtered Water Valve Opens, XV-21-117 (Refer to Loop 90). The filter enters into operation.

E. Alarms/Monitoring

1. If one of the valves has a FAULT, an alarm is generated. An audible alarm is produced at CP-01.

F. Data Collection

1. None

LOOP 96 FILTER 4 – WATER LEVEL INDICATION; LIT-21-207.

A. General

1. Continuous monitoring of water level at Filter 4 using a Level Indication (LI-21-207) and Transmitter to CP-F-04.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. None.

E. Alarms/Monitoring

1. Provide water level monitoring as shown on the P&IDs.

F. Data Collection

1. N/A.

LOOP 97 FILTER 4 – DIFFERENTIAL PRESSURE INDICATION; DPT-21-304.

A. General

1. Continuous monitoring of differential pressure (DPI-21-304) between the filter media using a Differential Pressure Indication and Transmitter to CP-F-04.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. None.

E. Alarms/Monitoring

1. Provide differential pressure monitoring as shown on the P&IDs.

2. Generate a High Differential Pressure Alarm, PAH-21-304, when exceeds a predetermined value. If predetermined value is exceeded, the alarm event will indicate operator to perform a backwash to the filter

F. Data Collection

1. N/A.

LOOP 98 FILTER 4 - FILTERED WATER INSTANTANEOUS TURBIDITY INDICATION; AIT-21-111.

A. General

1. Continuous monitoring of filtered water Turbidity (AI-21-111) using a Turbidity Indication and Transmitter to CP-F-04.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None.

D. Control

1. None

E. Alarms/Monitoring

1. Provide turbidity monitoring as shown on the P&IDs.

2. Generate a High Turbidity Alarm, AAH-21-102, when filtered water turbidity exceeds 0.15 NTU. If 0.15 NTU value is exceeded, the alarm event will indicate operator to perform a backwash to the filter. An audible alarm is produced at CP-01.

F. Data Collection

1. N/A.

LOOP 99 FILTER 4 – FILTERED WATER INSTANTANEOUS FLOW INDICATION; FIT-21-106.

A. General

1. Continuous monitoring of filtered water flow (FI-21-106) using a Flow Indication and Transmitter to CP-F-04.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. None.

E. Alarms/Monitoring

1. Provide Instantaneous flow monitoring as shown on the P&IDs.

F. Data Collection

1. None.

LOOP 100 FILTER 4 INLET BUTTERFLY VALVE; XV-21-121

A. General

1. OPEN-CLOSE (OC) and POSITION to isolate clear water flow from the sedimentation tanks to the Filter.

B. Software Interlocks

1. If the valve is not in REMOTE, HSI-21-121, the PLC system places the valve in the manual.

2. If the valve has a FAULT, XA-21-121, the PLC system places the valve in the PLC manual.

C. Control

1. OPEN-CLOSE (OC) and POSITION control are available at the valve actuator, LCP (CP-F-04) or from OWS.

2. Local:

a. The valve must be able to operate from the actuator.

b. Control Mode:

1) Local Manual: When in the manual, HSI-21-121, the valve should be able to open and close from actuator.
2) Local Automatic: None.

3. Remote:

a. Control (XC-21-121) is transferred to OIT/OWS. The valve can be controlled at OIT/OWS in MANUAL or AUTO modes.
b. Control Mode:

1) Remote Manual: The Operator to manually OPEN or CLOSE the valve from the OIT/OWS, XC-21-121. OIT/OWS mut show an OPEN (ZIO-21-121) and Close (ZIC-21-121) indication.
2) Remote Automatic: In AUTO mode, the valve is positioned by the FILTER Automatic Control Sequence described in Loop 106 or Loop 107.

D. Alarms/Monitoring

1. Valve Fault indication, XA-21-121. An audible alarm is produced at CP-01.

E. Data Collection

1. N/A

LOOP 101 FILTER 4 WASH WATER BUTTERFLY VALVE; XV-21-122

A. General

1. OPEN-CLOSE (OC) and POSITION to discharge Wash Water from the Filter to the Sludge Holding Tank during the Backwash process.

B. Software Interlocks

1. If the valve is not in REMOTE, HSI-21-122, the PLC system places the valve in the manual.

2. If the valve has a FAULT, XA-21-122, the PLC system places the valve in the PLC manual.

C. Control

1. OPEN-CLOSE (OC) and POSITION control are available at the valve actuator, LCP (CP-F-04) or from OWS.

2. Local:

a. The valve must be able to operate from the actuator.

b. Control Mode:

1) Local Manual: When in the manual, HSI-21-122, the valve should be able to open and close from actuator.
2) Local Automatic: None.

3. Remote:

a. Control (XC-21-122) is transferred to OIT/OWS. The valve can be controlled at OIT/OWS in MANUAL or AUTO modes.
b. Control Mode:

1) Remote Manual: The Operator to manually OPEN or CLOSE the valve from the OIT/OWS, XC-21-122. OIT/OWS mut show an OPEN (ZIO-21-122) and Close (ZIC-21-122) indication.
2) Remote Automatic: In AUTO mode, the valve is positioned by the FILTER Automatic Control Sequence described in Loop 106 or Loop 107.

D. Alarms/Monitoring

1. Valve Fault indication, XA-21-122. An audible alarm is produced at CP-01.

E. Data Collection

1. N/A

LOOP 102 FILTER 4 FILTERED WATER BUTTERFLY VALVE; XV-21-123

A. General

1. OPEN-CLOSE (OC) and POSITION to permit the transfer of Filtered Water from the Filter Unit to the Clearwell.

B. Software Interlocks

1. If the valve is not in REMOTE, HSI-21-123, the PLC system places the valve in the manual.

2. If the valve has a FAULT, XA-21-123, the PLC system places the valve in the PLC manual.

C. Control

1. OPEN-CLOSE (OC) and POSITION control are available at the valve actuator, LCP (CP-F-04) or from OWS.

2. Local:

a. The valve must be able to operate from the actuator.

b. Control Mode:

1) Local Manual: When in the manual, HSI-21-123, the valve should be able to open and close from actuator.
2) Local Automatic: None.

3. Remote:

a. Control (XC-21-123) is transferred to OIT/OWS. The valve can be controlled at OIT/OWS in MANUAL or AUTO modes.
b. Control Mode:

1) Remote Manual: The Operator to manually OPEN or CLOSE the valve from the OIT/OWS, XC-21-123. OIT/OWS mut show an OPEN (ZIO-21-123) and Close (ZIC-21-123) indication.
2) Remote Automatic: In AUTO mode, the valve is positioned by the FILTER Automatic Control Sequence described in Loop 106 or Loop 107.

D. Alarms/Monitoring

1. Valve Fault indication, XA-21-123. An audible alarm is produced at CP-01.

E. Data Collection

1. N/A

LOOP 103 FILTER 4 FILTER TO WASTE BUTTERFLY VALVE; XV-21-124

A. General

1. OPEN-CLOSE (OC) and POSITION to discharge discarded water from Filter Unit to the Sludge Holding Tank during the Backwash process.

B. Software Interlocks

1. If the valve is not in REMOTE, HSI-21-124, the PLC system places the valve in the manual.

2. If the valve has a FAULT, XA-21-124, the PLC system places the valve in the PLC manual.

C. Control

1. OPEN-CLOSE (OC) and POSITION control are available at the valve actuator, LCP (CP-F-01) or from OWS.

2. Local:

a. The valve must be able to operate from the actuator.

b. Control Mode:

1) Local Manual: When in the manual, HSI-21-124, the valve should be able to open and close from actuator.
2) Local Automatic: None.

3. Remote:

a. Control (XC-21-124) is transferred to OIT/OWS. The valve can be controlled at OIT/OWS in MANUAL or AUTO modes.
b. Control Mode:

1) Remote Manual: The Operator to manually OPEN or CLOSE the valve from the OIT/OWS, XC-21-124. OIT/OWS mut show an OPEN (ZIO-21-124) and Close (ZIC-21-124) indication.
2) Remote Automatic: In AUTO mode, the valve is positioned by the FILTER Automatic Control Sequence described in Loop 106 or Loop 107.

D. Alarms/Monitoring

1. Valve Fault indication, XA-21-124. An audible alarm is produced at CP-01.

E. Data Collection

1. N/A

LOOP 104 FILTER 4 BACKWASH BUTTERFLY VALVE; XV-21-125

A. General

1. OPEN-CLOSE (OC) and POSITION will permit Backwash water from Wash Water Storage Tank to Filter Unit during the Backwash process.

B. Software Interlocks

1. If the valve is not in REMOTE, HSI-21-125, the PLC system places the valve in the manual.

2. If the valve has a FAULT, XA-21-125, the PLC system places the valve in the PLC manual.

C. Control

1. OPEN-CLOSE (OC) and POSITION control are available at the valve actuator, LCP (CP-F-04) or from OWS.

2. Local:

a. The valve must be able to operate from the actuator.

b. Control Mode:

1) Local Manual: When in the manual, HSI-21-125, the valve should be able to open and close from actuator.
2) Local Automatic: None.

3. Remote:

a. Control (XC-21-125) is transferred to OIT/OWS. The valve can be controlled at OIT/OWS in MANUAL or AUTO modes.
b. Control Mode:

1) Remote Manual: The Operator to manually OPEN or CLOSE the valve from the OIT/OWS, XC-21-107. OIT/OWS mut show an OPEN (ZIO-21-125) and Close (ZIC-21-125) indication.
2) Remote Automatic: In AUTO mode, the valve is positioned by the FILTER Automatic Control Sequence described in Loop 106 or Loop 107.

D. Alarms/Monitoring

1. Valve Fault indication, XA-21-125. An audible alarm is produced at CP-01.

E. Data Collection

1. N/A

LOOP 105 FILTER 4 AIR SCOUR BUTTERFLY VALVE; XV-21-126

A. General

1. OPEN-CLOSE (OC) and POSITION to permit air pass from the Air Scour System to Filter Unit during the Backwash process.

B. Software Interlocks

1. If the valve is not in REMOTE, HSI-21-126, the PLC system places the valve in the manual.

2. If the valve has a FAULT, XA-21-126, the PLC system places the valve in the PLC manual.

C. Control

1. OPEN-CLOSE (OC) and POSITION control are available at the valve actuator, LCP (CP-F-04) or from OWS.

2. Local:

a. The valve must be able to operate from the actuator.

b. Control Mode:

1) Local Manual: When in the manual, HSI-21-126, the valve should be able to open and close from actuator.
2) Local Automatic: None.

3. Remote:

a. Control (XC-21-126) is transferred to OIT/OWS. The valve can be controlled at OIT/OWS in MANUAL or AUTO modes.
b. Control Mode:

1) Remote Manual: The Operator to manually OPEN or CLOSE the valve from the OIT/OWS, XC-21-126. OIT/OWS mut show an OPEN (ZIO-21-126) and Close (ZIC-21-126) indication.

2) Remote Automatic: In AUTO mode, the valve is positioned by the FILTER Automatic Control Sequence described in Loop 106 or Loop 107.

D. Alarms/Monitoring

1. Valve Fault indication, XA-21-126. An audible alarm is produced at CP-01.

E. Data Collection

1. N/A

LOOP 106 FILTER 4 OPERATION

A. General

1. Filter operation removes suspended particles, contaminants, and microorganisms to ensure the process water complies with turbidity threshold and quality established by regulatory requirements. The control operation is either at the CP-F-04 or OWS.

B. Hardware Interlocks

a. None

C. Software Interlocks

1. If one of the valves has a FAULT, the PLC system places the Filtering Process at the PLC in manual.

D. Control

1. Control sequence of operation of the Filtering process that includes Filter Unit and associated valves: Inlet Valve, Wash Water Valve, Filtered Water Valve, Filter to Waste Valve, Backwash Valve and Air Scour Valve. Also, the instrumentation (Turbidity, Differential Pressure, Level and Flow) that will monitor, control and generate alarm during the process

2. Local:

a. Valves will be used to isolate or permit flow from in or out of the filter.

1) Control Mode:

a) Local Manual: When the Filter is in manual operation, all valves must be able to operate from the actuator:

Filter Inlet Valve, XV-21-121, Refer to Loop 100
Wash Water Valve, XV-21-122, Reer to Loop 101
Filtered Water Valve, XV-21-123, Refer to Loop 102
Filter To Waste Valve, XV-21-124, Refer to Loop 103

Backwash Valve, XV-21-125, Refer to Loop 104
Air Scour Valve, XV-21-126, Refer to Loop 105

b) Local Automatic: None.

3. Remote:

a. Control is transferred to OIT/OWS. The valves can be controlled at OWS/OIT in MANUAL or AUTO modes.
b. Control Mode:

1) Remote Manual: The Operator to manually OPEN or CLOSE the valve from the OWS/OIT.

Filter Inlet Valve, XV-21-121, Refer to Loop 100
Wash Water Valve, XV-21-122, Reer to Loop 101
Filtered Water Valve, XV-21-123, Refer to Loop 102
Filter To Waste Valve, XV-21-124, Refer to Loop 103
Backwash Valve, XV-21-125, Refer to Loop 104
Air Scour Valve, XV-21-126, Refer to Loop 105

2) Remote Automatic: After the water has gone through initial treatments, it enters the filtration unit. Filter Inlet Valve, XV-21-121, (Refer to Loop 100) is opened. Clear water from sedimentation basins passes through the filtration media. Water level at the filter unit is monitored by Level transmitter, LIT-21-207 (Refer to Loop 96). As the water passes through the filter media, filtered water, now free of most particulates and contaminants, is collected at the bottom of the filter bed and directed to the Clear Well. Filtered Water Valve, XV-21-123 (Refer to Loop 102) is opened. Filtered water turbidity is monitored by Turbidity Transmitter, AIT-21-111 (Refer to Loop 98)

During this process:
a) Wash Water Valve, XV-21-122 (Reer to Loop 101) is closed.
b) Filter To Waste Valve, XV-21-124 (Refer to Loop 103) is closed
c) Backwash Valve, XV-21-125 (Refer to Loop 104) is closed
d) Air Scour Valve, XV-21-126 (Refer to Loop 105) is closed

3) In this operation sequence Air Scour System is Off.

E. Alarms/Monitoring

1. If turbidity value at Turbidity Transmitter, AIT-21-111 (Refer to Loop 98) exceeds a 0.15 NTU value an alarm must be generated.

2. If differential pressure values at Differential Pressure Transmitter, DPT-21-304 (Refer to Loop 97) exceeds a predetermine value an alarm must be generated.

3. If one of the valves has a FAULT, an alarm is generated. An audible alarm is produced at CP-01.

F. Data Collection

1. None

LOOP 107 FILTER 4 BACKWASH

A. General

1. The backwash process is to maintain and clean filter, to restore the filter's efficiency and ensure consistent water quality. A detailed control sequence operation of the Backwash process is described. Operation is either at the CP-F-04 OIT or OWS.

B. Hardware Interlocks

a. None

C. Software Interlocks

1. Only one of the three filters can run a Backwash process at a time.

2. If one of the valves has a FAULT, the PLC system places the Backwash Process at the PLC in manual.

D. Control

1. Control sequence of operation of the Backwash process that includes Filter Unit and associated valves: Inlet Valve, Wash Water Valve, Filtered Water Valve, Filter to Waste Valve, Backwash Valve and Air Scour Valve. Also, the instrumentation (Turbidity, Differential Pressure, Level and Flow) that will monitor, control and generate alarm during the process

2. Local:

a. Valves will be used to isolate or permit flow from In or Out of the filter.

1) Control Mode:

a) Local Manual: When the Filter is in manual operation, all valves must be able to operate from the actuator:

Filter Inlet Valve, XV-21-121, Refer to Loop 100
Wash Water Valve, XV-21-122, Reer to Loop 101
Filtered Water Valve, XV-21-123, Refer to Loop 102

Filter To Waste Valve, XV-21-124, Refer to Loop 103
Backwash Valve, XV-21-125, Refer to Loop 104
Air Scour Valve, XV-21-126, Refer to Loop 105

b) Local Automatic: None.

3. Remote:

a. Control is transferred to OIT/OWS. The valves can be controlled at OWS/OIT in MANUAL or AUTO modes.
b. Control Mode:

1) Remote Manual: The Operator to manually OPEN or CLOSE the valve from the OWS/OIT.

Filter Inlet Valve, XV-21-121, Refer to Loop 100
Wash Water Valve, XV-21-122, Reer to Loop 101
Filtered Water Valve, XV-21-123, Refer to Loop 102
Filter To Waste Valve, XV-21-124, Refer to Loop 103
Backwash Valve, XV-21-125, Refer to Loop 104
Air Scour Valve, XV-21-126, Refer to Loop 105

2) Remote Automatic: When Backwash start is selected in Automatic mode, Clear water intake is isolated from Filter. Filter Inlet Valve, XV-21-121, closes (Refer to Loop 100). The water level at Filter drops to a predetermined level. Level is determined by level transmitter, LIT-21-207 (Refer to Loop 96). Air Scour Valve, XV-21-126 (Refer to Loop 105), opens and compressed air motor is turned ON. The Air will cause the Filter Bed to expand breaking up the compacted filter bed and forcing the accumulated particles into suspension. Air Scour treatment will last up to a predetermined time. After the air scouring cycle, the air scouring valve is closed. The Backwash Valve, XV-21-125 (Refer to Loop 104), and Wash Water Valve, XV-21-122 (Refer to Loop 101), opens. Clean backwash water is forced upwards through the filter bed continuing the filter bed expansion and carrying the particles in suspension into the backwash troughs, and then, ending in the Sludge Holding Tanks via the Wash Water Valve. Backwashing continues for a fixed time. At the end of the backwash cycle, the upward flow of water is terminated by closing the Backwash Valve. The filter bed settles by gravity into its initial configuration. Water to be filtered is then applied to the filter by opening the Inlet Valve XV-21-121 (Refer to Loop 100). The Filter to Waste Valve opens, XV-21-124, (Refer to Loop 103) and water will be directed to the Sludge Holding Tank until turbidity values (Turbidity Analyzer, AIT-21-111, Refer to loop 98) gets below 0.15 NTU. After turbidity values complies with value, Filter to Waste

Valve, XV-21-124 (Refer to Loop 103) closes and Filtered Valve Opens, XV-21-123 (Refer to Loop 102). The filter enters into operation.

E. Alarms/Monitoring

1. If one of the valves has a FAULT, an alarm is generated. An audible alarm is produced at CP-01.

F. Data Collection

1. None

LOOP 108 SAMPLE PUMP; PU-21-305

A. General

1. Sample Pump draws raw water from the combined filtered line to the continuous monitoring area for turbidity, ph and chlorine. Sample pump will operate in manual mode at the LCP.

B. Hardwired Interlocks

1. None

C. Software Interlocks

1. None.

D. Control

1. Sample pump will operate in manual mode

2. Local:

a. Control Mode:

1) Local Manual: The sample pump will start when the pump power switch is in the On position. The sample pump will stop when the power switch is in the Off position.
2) Local Automatic: None

3. Remote:

a. None

E. Alarms/Monitoring

1. None

F. Historical Data Collection

1. N/A

LOOP 110 AIR SCOUR BLOWER NO. 1; BL-22-501

A. General

1. Air scour blower in the backwash process of a filter serve to enhance the cleaning of the filter media. During backwashing, air is injected into the filter to create bubbles that help dislodge trapped particles and contaminants from the media.

B. Hardwired Interlocks

1. The Blower cannot run if the following conditions are detected:

a. Two blowers started simultaneously.
b. High Motor Temperature

C. Software Interlocks

1. None

D. Control

1. The motor blowers starts when the signal from automatic backwash process is received, XC-22-501, (Refer to Loops 71,83 and 95) or manual activation, HSI-22-501, from the LCP OR OWS.

2. Local:

a. When the LCP is not in the ‘A’ position, the control will be transferred to the LCP.
b. Control Mode:

1) Local Manual: The motor blower will start when the HOA is in the Hand position, HSI-22-501. The motor blower will stop when the HOA is in the Off position.
2) Local Automatic: None.

3. Remote:

a. When the LCP is in the "A" position, the control will reside on the PLC.
b. Control Mode:

1) Remote Manual: the operator can start/stop the motor blowers from the OWS, XC-22-501. OWS mut show a run indication (XI-22-501).
2) Remote Automatic: The motor blower starts when signal from automatic backwash process is received (Refer to Loops 71,83 and 95). Blower motor will operate for a predetermined time period during the backwash process.

E. Alarms/Monitoring

1. Motor Fault indication, XA-22-501. An audible alarm is produced at CP-01.

F. Historical Data Collection

1. N/A

LOOP 111 AIR SCOUR BLOWER NO. 2; BL-22-502

A. General

1. Air scour blower in the backwash process of a filter serve to enhance the cleaning of the filter media. During backwashing, air is injected into the filter to create bubbles that help dislodge trapped particles and contaminants from the media.

B. Hardwired Interlocks

1. The Blower cannot run if the following conditions are detected:

a. Two blowers started simultaneously.
b. High Motor Temperature

C. Software Interlocks

1. None

D. Control

1. The motor blowers start when the signal from automatic backwash process is received, XC-22-502, (Refer to Loops 71,83 and 95) or manual activation, HSI-22-502, from the LCP OR OWS.

2. Local:

a. When the LCP is not in the ‘A’ position, the control will be transferred to the LCP.
b. Control Mode:

1) Local Manual: The motor blower will start when the HOA is in the Hand position, HSI-22-502. The motor blower will stop when the HOA is in the Off position.
2) Local Automatic: None.

3. Remote:

a. When the LCP is in the "A" position, the control will reside on the PLC.
b. Control Mode:

1) Remote Manual: the operator can start/stop the motor blowers from the OWS, XC-22-502. OWS mut show a run indication (XI-22-502).
2) Remote Automatic: The motor blower starts when signal from automatic backwash process is received (Refer to Loops 71,83 and 95). Blower motor will operate for a predetermined time period during the backwash process.

E. Alarms/Monitoring

1. Motor Fault indication, XA-22-502. An audible alarm is produced at CP-01.

F. Historical Data Collection

1. N/A

LOOP 130 BACKWASH PUMP NO. 1; PU-52-101

A. General

1. Backwash Pumps draw filtered water from the Clearwell tank to the Wash Water tank. Backwash pump will operate in automatic and manual mode at the LCP and OWS.

B. Hardwired Interlocks

1. The Backwash pump cannot run if the following conditions are detected:

a. Two Backwash pumps started simultaneously.
b. High Motor Temperature
c. Low Water level at Clearwell tank; Level Switch LS-52-301.

C. Software Interlocks

1. High Pressure value at the Wash Water Intake line; PS-52-201.

D. Control

1. Backwash pump will operate in automatic and manual mode. In automatic mode at the OWS, pump start/stop operation will be determined by two conditions in reference to water level at the Clearwell tank, Level switch LS-52-301 (Refer to Loop 122) and Wash Water Tank Water level, Level Transmitter LIT-27-205 (Refer to loop 200). Backwash pump will stop when pressure at the Wash Water intake line rises to 120 PSI value; Pressure switch PS-52-201 (Refer to Loop 124)

2. Local:

    a. When the LCP is not in the 'A' position, the control will be transferred to the LCP.
    b. Control Mode:

        1) Local Manual: The Backwash pump will start when the Pump HOA is in the Hand position, HSI-52-101. The Backwash pump will stop when the HOA is in the Off position.
        2) Local Automatic: None

3. Remote:

    a. When the LCP is in the "A" position, the control will reside on the PLC.
    b. Control Mode:

        1) Remote Manual: the operator can start/stop the Backwash pumps from the OWS, XC-52-101. OWS must show a Run indication, XI-52-101.
        2) Remote Automatic: Backwash pump shall start, XC-52-101, when the water level at the Clearwell rises to normal operation level, LI-51-204 (Refer to Loop 146) and Wash Water Tank water level gets below a predetermined level, LI-27-205 (Refer to Loop 200). OWS must show a Run indication, XI-52-101. Backwash pump must stop when water level drops to a predetermined level at the Clearwell tank; Level switch LS-52-301 (Refer to Loop 122) and pressure at the Wash Water intake line gets to 120 PSI value, PI-52-101 (Refer to Loop 123).

E. Alarms/Monitoring

1. Motor Fault indication, XA-52-101. An audible alarm is produced at CP-01.

F. Historical Data Collection

1. N/A

LOOP 131 BACKWASH PUMP NO. 2; PU-52-102

A. General

1. Backwash Pumps draw filtered water from the Clearwell tank to the Wash Water tank. Backwash pump will operate in automatic and manual mode at the LCP and OWS.

B. Hardwired Interlocks

1. The Backwash pump cannot run if the following conditions are detected:

a. Two Backwash pumps started simultaneously.
b. High Motor Temperature
c. Low Water level at Clearwell tank; Level Switch LS-52-301.

C. Software Interlocks

1. High Pressure value at the Wash Water Intake line; PS-52-201.

D. Control

1. Backwash pump will operate in automatic and manual mode. In automatic mode at the OWS, pump start/stop operation will be determined by two conditions in reference to water level at the Clearwell tank, Level switch LS-52-301 (Refer to Loop 122) and Wash Water Tank Water level, Level Transmitter LIT-27-205 (Refer to loop 200). Backwash pump will stop when pressure at the Wash Water intake line rises to 120 PSI value; Pressure switch PS-52-201 (Refer to Loop 124)

2. Local:

a. When the LCP is not in the ‘A’ position, the control will be transferred to the LCP.
b. Control Mode:

1) Local Manual: The Backwash pump will start when the Pump HOA is in the Hand position, HSI-52-102. The Backwash pump will stop when the HOA is in the Off position.
2) Local Automatic:

3. Remote:

a. When the LCP is in the "A" position, the control will reside on the PLC.
b. Control Mode:

1) Remote Manual: the operator can start/stop the Backwash pumps from the OWS, XC-52-102. OWS must show a Run indication, XI-52-102.
2) Remote Automatic: Backwash pump shall start, XC-52-102, when the water level at the Clearwell rises to normal operation level, LI-51-204 (Refer to Loop 146) and Wash Water Tank water level gets below a predetermined level, LI-27-205 (Refer to Loop 200). OWS must

show a Run indication, XI-52-102. Backwash pump must stop when water level drops to a predetermined level at the Clearwell tank; Level switch LS-52-301 (Refer to Loop 122) and pressure at the Wash Water intake line gets to 120 PSI value, PI-52-101 (Refer to Loop 123).

E. Alarms/Monitoring

1. Motor Fault indication, XA-52-102. An audible alarm is produced at CP-01.

F. Historical Data Collection

1. N/A

LOOP 132 CLEARWELL TANK BACKWASH PUMP LEVEL OPERATION – LOW AND NORMAL OPERATION LEVEL INDICATION; LEVEL SWITCH LS-52-301.

A. General

1. Clearwell tank Low (LAL-52-301) and normal water level indication for Backwash pumps operation.

B. Hardware Interlocks

1. None.

C. Software Interlocks

1. None.

D. Control

1. Provides Low level and Normal operation indication to Backwash pumps.

E. Alarms/Monitoring

1. If the water level goes below a predetermined level, generate a LOW LEVEL alarm (LAL-52-301)at LCP and OWS. An audible alarm is produced at CP-01.

F. Data Collection

1. N/A.

LOOP 133 WASH WATER INTAKE LINE – INSTANTANEOUS PRESSURE INDICATION; PIT-52-101.

A. General

1. Continuous monitoring of Wash water pressure (PI-52-101) line from Backwash Pumps to Wash Water tank using a pressure transmitter to RIO 2.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None.

D. Control

1. None.

E. Alarms/Monitoring

1. Provide pressure monitoring as shown on the P&IDs.

F. Data Collection

1. N/A.

LOOP 134 WASH WATER INTAKE LINE– PRESSURE SWITCH; PS-52-201.

A. General

1. Signal indication when pressure at the Wash Water Tank intake line exceeds a 120 PSI value using a Pressure switch to OWS.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. None.

E. Alarms/Monitoring

1. Pressure switch activation generates a High Pressure Alarm, PAH-52-201. An audible alarm is produced at CP-01.

F. Data Collection

1. N/A.

LOOP 150 DISTRIBUTION PUMP NO. 1; PU-51-103

A. General

1. Distribution Pump draw water from the Clearwell tank to service. Distribution pump will operate in automatic and manual mode at the LCP and OWS.

B. Hardwired Interlocks

1. The Distribution pump cannot run if the following conditions are detected:

a. Two Distribution pumps started simultaneously.
b. High Motor Temperature
c. Low Water level at Clearwell tank; Level Switch LS-51-302.

C. Software Interlocks

1. High Pressure value at the Service line; PS-51-202.

D. Control

1. Distribution pump will operate in automatic and manual mode. In automatic mode at the OWS, pump start/stop operation will be determined by two conditions in reference to water level at the supply tank, Level switch LS-51-302 (Refer to Loop 142). Distribution pump will stop when pressure at the Service line rises to a 120 PSI value; Pressure switch PS-51-202 (Refer to Loop 144)

2. Local:

a. When the LCP is not in the ‘A’ position, the control will be transferred to the LCP.
b. Control Mode:

1) Local Manual: The Distribution pump will start when the Pump HOA is in the Hand position, HSI-51-103. The Distribution pump will stop when the HOA is in the Off position.
2) Local Automatic:

3. Remote:

a. When the LCP is in the "A" position, the control will reside on the PLC.
b. Control Mode:

1) Remote Manual: the operator can start/stop the Distribution pumps from the OWS, XC-51-103. OWS must show a Run indication, XI-51-103.

2) Remote Automatic: Distribution pump shall start, XC-51-103, when the water level at the Supply tank rises to normal operation level, LI-51-204 (Refer to Loop 146). OWS must show a Run indication, XI-51-103. Distribution pump must stop when water level drops to a predetermined level at the supply tank; Level switch LS-51-302 (Refer to Loop 142) and pressure at the Service line gets to a 120 PSI value, PI-51-102 (Refer to Loop 143).

E. Alarms/Monitoring

1. Motor Fault indication, XA-51-103. An audible alarm is produced at CP-01.

F. Historical Data Collection

1. N/A

LOOP 151 DISTRIBUTION PUMP NO. 2; PU-51-104

A. General

1. Distribution Pump draw water from the Clearwell tank to service. Distribution pump will operate in automatic and manual mode at the LCP and OWS.

B. Hardwired Interlocks

1. The Distribution pump cannot run if the following conditions are detected:

a. Two Distribution pumps started simultaneously.
b. High Motor Temperature
c. Low Water level at Clearwell tank; Level Switch LS-51-302.

C. Software Interlocks

1. High Pressure value at the Service line; PS-51-202.

D. Control

1. Distribution pump will operate in automatic and manual mode. In automatic mode at the OWS, pump start/stop operation will be determined by two conditions in reference to water level at the supply tank, Level switch LS-51-302 (Refer to Loop 142). Distribution pump will stop when pressure at the Service line rises to a predetermined value; Pressure switch PS-51-202 (Refer to Loop 144)

2. Local:

a. When the LCP is not in the ‘A’ position, the control will be transferred to the LCP.
b. Control Mode:

1) Local Manual: The Distribution pump will start when the Pump HOA is in the Hand position, HSI-51-104. The Distribution pump will stop when the HOA is in the Off position.
2) Local Automatic:

3. Remote:

a. When the LCP is in the "A" position, the control will reside on the PLC.
b. Control Mode:

1) Remote Manual: the operator can start/stop the Distribution pumps from the OWS, XC-51-104. OWS must show a Run indication, XI-51-104.
2) Remote Automatic: Distribution pump shall start, XC-51-104, when the water level at the Supply tank rises to normal operation level, LI-51-204 (Refer to Loop 146). OWS must show a Run indication, XI-51-104. Distribution pump must stop when water level drops to a predetermined level at the supply tank; Level switch LS-51-302 (Refer to Loop 142) and pressure at the Service line gets to a predetermined value, PI-51-102 (Refer to Loop 143).

E. Alarms/Monitoring

1. Motor Fault indication, XA-51-104.

F. Historical Data Collection

1. N/A

LOOP 152 CLEARWELL TANK DISTRIBUTION PUMP LEVEL OPERATION – LOW AND NORMAL OPERATION LEVEL INDICATION; LEVEL SWITCH LS-51-302.

A. General

1. Clearwell tank Low and normal water level indication for Distribution pumps operation.

B. Hardware Interlocks

1. None.

C. Software Interlocks

1. None.

D. Control

1. Provides Low level and Normal operation indication to Distribution Pumps.

E. Alarms/Monitoring

1. If the water level goes below a predetermined level, generate a LOW LEVEL alarm (LAL-51-302) at LCP and OWS. An audible alarm is produced at CP-01.

F. Data Collection

1. N/A.

LOOP 153 SERVICE LINE – INSTANTANEOUS PRESSURE INDICATION; PIT-51-102.

A. General

1. Continuous monitoring of Service pressure line (PI-51-102) from Distribution Pumps to service using a pressure transmitter to RIO 2.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None.

D. Control

1. None.

E. Alarms/Monitoring

1. Provide pressure monitoring as shown on the P&IDs.

F. Data Collection

1. N/A.

LOOP 154 SERVICE LINE– PRESSURE SWITCH; PS-51-202.

A. General

1. Signal indication when pressure at the Service line exceeds a predetermined value using a Pressure switch to OWS.

B. Hardware Interlocks

1. None.

C. Software Interlocks

1. None

D. Control

1. None.

E. Alarms/Monitoring

1. Pressure switch activation generates a High-Pressure Alarm, PAH-51-202. An audible alarm is produced at CP-01.

F. Data Collection

1. N/A.

LOOP 155 SERVICE LINE – INSTANTANEOUS FLOW INDICATION; FIT-51-105

A. General

1. Continuous monitoring Distribution water flow (FI-51-105) using a flow transmitter to CP-01.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. None.

E. Alarms/Monitoring

1. Provide instantaneous flow indication as shown on the P&IDs.

F. Data Collection

1. None.

LOOP 156 SERVICE LINE – WATER LEVEL INDICATION; LIT-51-204.

A. General

1. Continuous monitoring of water level (LI-51-204) at Clearwell Tank using a Level Indication and Transmitter to CP-01.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. None.

E. Alarms/Monitoring

1. Provide water level monitoring as shown on the P&IDs.

2. If water level exceeds a pre determine value, generate a HI LEVEL (LAH-51-204) alarm at main control Panel.

F. Data Collection

1. N/A.

LOOP 157 SAMPLE PUMP; PU-51-306

A. General

1. Sample Pump draws raw water from the distribution Tank to the continuous monitoring area for turbidity, ph and chlorine. Sample pump will operate in manual mode at the LCP.

B. Hardwired Interlocks

1. None

C. Software Interlocks

1. None.

D. Control

1. Sample pump will operate in manual mode

2. Local:

a. Control Mode:

1) Local Manual: The sample pump will start when the pump power switch is in the On position. The sample pump will stop when the power switch is in the Off position.
2) Local Automatic: None

3. Remote:

a. None

E. Alarms/Monitoring

1. None

F. Historical Data Collection

1. N/A

LOOP 170 SLUDGE HOLDING TANK PUMP 1 – TRANSFER PUMP FROM SLUDGE HOLDING TANK TO THICKNER; PU-18-105

A. General

1. Sludge Transfer Pumps transfer sludge from the Sludge Holding Tank to Sludge Thickener. Sludge pumps will operate in automatic and manual mode at the LCP and OWS.

B. Hardware Interlocks

1. The pump cannot run if any of the following alarms are active:

a. Moisture/Thermal Protection is activated, TA-18-105.
b. Low sludge level at the Sludge Holding Tank; Level Switch LS-18-303.
c. High Motor Temperature.

C. Software Interlocks

1. A high Sludge level indication from level Transmitter; LIT-18-206 shall shut down Pump in remote operation.

D. Control

1. Sludge Transfer pump will operate in automatic and manual mode. In automatic mode at the LCP, pump start/stop operation will be determined by sludge level at the Sludge Holding Tank, Level switch LS-18-303 (Refer to Loop 163).

2. Local:

    a. When the LCP is not in the ‘A’ position, the control will be transferred to the LCP, HSI-18-105.
    b. Control Mode:

        1) Local Manual: The Sludge Transfer Pump will start when the Pump HOA is in the Hand position. The Sludge Transfer Pump will stop when the HOA is in the Off position. OWS must show a Run indication, XI-18-105.
        2) Local Automatic: None.

3. Remote:

    a. When the pump local control switch is in AUTO position, the control will be executed from OWS.
    b. Control Mode:

        1) Remote Manual: The pump can be manually started or stopped by the OWS. OWS must show a Run indication, XI-18-105.
        2) Remote Automatic: Sludge Transfer Pump shall start when sludge level at the Sludge Holding Tank rises to normal operation level, LI-18-206 (Refer to Loop 164) and a start signal from the OWS is activated, XC-18-205. Sludge Transfer Pump must stop when sludge level drops to a predetermined level; Level switch LS-18-303 (Refer to Loop 163).

E. Alarms/Monitoring

1. Motor Fault indication, XA-18-105. An audible alarm is produced at CP-01

2. Thermal and Moisture Fault Indication, TA-18-105. An audible alarm is produced at CP-01

F. Data Collection

1. N/A

LOOP 171 SLUDGE HOLDING TANK PUMP 2 – TRANSFER PUMP FROM SLUDGE HOLDING TANK TO THICKNER; PU-18-106

A. General

1. Sludge Transfer Pumps transfer sludge from the Sludge Holding Tank to Sludge Thickener. Sludge pumps will operate in automatic and manual mode at the LCP and OWS.

B. Hardware Interlocks

1. The pump cannot run if any of the following alarms are active:

   a. Moisture/Thermal Protection is activated, TA-18-106.
   b. Low sludge level at the Sludge Holding Tank; Level Switch LS-18-303.
   c. High Motor Temperature.

C. Software Interlocks

1. A high Sludge level indication from level Transmitter; LIT-18-206 shall shut down Pump in remote operation.

D. Control

1. Sludge Transfer pump will operate in automatic and manual mode. In automatic mode at the LCP, pump start/stop operation will be determined by sludge level at the Sludge Holding Tank, Level switch LS-18-303 (Refer to Loop 163).

2. Local:

   a. When the LCP is not in the 'A' position, the control will be transferred to the LCP.
   b. Control Mode:

      1) Local Manual: The Sludge Transfer Pump will start when the Pump HOA is in the Hand position, HSI-18-106. The Sludge Transfer Pump will stop when the HOA is in the Off position. OWS must show a Run indication, XI-18-106.
      2) Local Automatic: None.

3. Remote:

   a. When the pump local control switch is in AUTO position, the control will be executed from OWS.
   b. Control Mode:

      1) Remote Manual: The pump can be manually started or stopped by the OWS, XC-18-106. OWS must show a Run indication, XI-18-106.
      2) Remote Automatic: Sludge Transfer Pump shall start when sludge level at the Sludge Holding Tank rises to normal operation level, LI-18-206 (Refer to Loop 164) and a start signal from the OWS is activated, XC-18-106. Sludge Transfer Pump must stop when sludge level drops to a predetermined level; Level switch LS-18-303 (Refer to Loop 163).

E. Alarms/Monitoring

1. Motor Fault indication, XA-18-106. An audible alarm is produced at CP-01

2. Thermal and Moisture Fault Indication, TA-18-106. An audible alarm is produced at CP-01

F. Data Collection

1. N/A

LOOP 172 SLUDGE HOLDING TANK SLUDGE TRANSFER PUMP LEVEL OPERATION – LOW AND NORMAL OPERATION LEVEL INDICATION; LEVEL SWITCH; LS-18-303.

A. General

1. Sludge Holding Tank Low and normal sludge level indication for Sludge Transfer Pumps operation.

B. Hardware Interlocks

1. None.

C. Software Interlocks

1. None.

D. Control

1. Provides Low level and Normal operation indication to Sludge Transfer Pumps and Sludge Mixer.

E. Alarms/Monitoring

1. If the sludge level goes below a predetermined level, generate a LOW LEVEL alarm (LAL-18-303) at LCP and OWS. An audible alarm is produced at CP-01

F. Data Collection

1. N/A

LOOP 173 SLUDGE HOLDING TANK – SLUDGE LEVEL INDICATION; LIT-18-206.

A. General

1. Continuous monitoring of sludge level (LI-18-206) at Sludge Holding Tank using a Level Indication and Transmitter to RIO 1.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. None.

E. Alarms/Monitoring

1. Provide sludge level monitoring as shown on the P&IDs.

2. If water level exceeds a pre determine value, generate a HI LEVEL (LAH-18-206) alarm at main control Panel.

F. Data Collection

1. N/A.

LOOP 190 SUDGE THICKENER SCRAPPER MOTOR, MX-19-206

A. General

1. Thickener Scrapper Motor controlled via a variable speed drive removes settled solids from the bottom of the Sludge Thickener Tank. Thickener Scrapper Motor will operate in automatic and manual mode at the VFD LCP and OWS.

B. Hardwired Interlocks

1. The pump cannot run if the following alarms are detected:

a. Emergency Stop
b. High Motor Temperature

C. Software Interlocks

1. None.

D. Control

1. Thickener Scrapper Motor is started when a speed (%) setpoint is entered manually by the operator. VFD will maintain motor speed. Motor Run Status, XI-19-206, and Motor Speed indication, SI-19-206, shall be displayed at OWS.

2. Local:

    a. The Scrapper can be controlled at the VFD LCP if the HAND-OFF-AUTO (HOA) selector is HAND, HSI-19-206.
    b. Control Mode:

        1) Local Manual: The operator must be able to start/stop and change speed from VFD keypad at LCP

        2) Local Automatic: None.

3. Remote:

    a. When the HAND-OFF-AUTO (HOA) selector is in AUTO, HSI-19-206, the control will be executed from OWS, XC-19-206.
    b. Control Mode:

        1) Remote Manual: The operator must be able to start/stop, XC-19-206, and change the VFD speed via OWS, SC-19-206.

        2) Remote Automatic: None,

E. Alarms/Monitoring

1. Motor Fault indication, XA-19-206. An audible alarm is produced at CP-01

F. Historical Data Collection

1. N/A

LOOP 210 WASH WATER TANK – WASH WATER LEVEL INDICATION; LIT-27-205.

A. General

1. Continuous monitoring of wash water level (LI-27-205) using a level indication and transmitter to RIO 3.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. None.

E. Alarms/Monitoring

1. Provide level monitoring as shown on the P&IDs.

F. Data Collection

1. None

LOOP 211 WASH WATER TANK – INSTANTANEOUS FLOW INDICATION; FIT-27-107

A. General

1. Continuous monitoring Wash Water flow Filter 3 and 4 (FI-27-107) using a flow transmitter to CP-F-01.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. None.

E. Alarms/Monitoring

1. Provide instantaneous flow indication as shown on the P&IDs.

F. Data Collection

1. None.

LOOP 212 WASH WATER TANK - MODULATING BUTTERFLY VALVE; FV-27-201

A. General

1. Modulating and POSITION control are available at the local control station or from OWS.

B. Software Interlocks

1. If the valve is not in REMOTE, the PLC system places the valve in the manual.

2. If the valve has a FAULT, the PLC system places the valve in the PLC manual.

C. Control

1. The valve will be used to modulate flow from the Wash Water Tank to the Backwash process Filter 3 and 4.

2. Local:

a. The valve must be able to operate from the actuator.

b. Control Mode:

1) Local Manual: When in manual, HSI-27-201, the valve should be able to modulate its % of travel from actuator.
2) Local Automatic: None.

3. Remote:

a. Control is transferred to OWS. The valve can be controlled at OWS in MANUAL or AUTO modes.
b. Control Mode:

1) Remote Manual: The Operator to manually modulate the valve from the OWS, FC-27-201. OWS mut show position feedback indication, ZI-27-201.
2) Remote Automatic: None

D. Alarms/Monitoring

1. Valve Fault indication, XA-27-201. An audible alarm is produced at CP-01

E. Data Collection

1. N/A

LOOP 213 WASH WATER TANK – INSTANTANEOUS PRESSURE INDICATION; PIT-27-103.

A. General

1. Continuous monitoring of pressure line (PI-27-103) from Wash Water Tank to filters 3 and 4 using a pressure transmitter.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None.

D. Control

1. None.

E. Alarms/Monitoring

1. Provide pressure monitoring as shown on the P&IDs.

2. If the Pressure reading exceeds 120 PSI value, generate a HI PRESSURE alarm (PAH-27-103) at main control Panel

F. Data Collection

1. N/A.

LOOP 214 WASH WATER TANK – INSTANTANEOUS FLOW INDICATION; FIT-27-108

A. General

1. Continuous monitoring Wash Water flow Filter 1 and 2 (FI-27-108) using a flow transmitter to CP-F-01.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. None.

E. Alarms/Monitoring

1. Provide instantaneous flow indication as shown on the P&IDs.

F. Data Collection

1. None.

LOOP 215 WASH WATER TANK - MODULATING BUTTERFLY VALVE; FV-27-202

A. General

1. Modulating and POSITION control are available at the local control station or from OWS.

B. Software Interlocks

1. If the valve is not in REMOTE, the PLC system places the valve in the manual.

2. If the valve has a FAULT, the PLC system places the valve in the PLC manual.

C. Control

1. The valve will be used to modulate flow from the Wash Water Tank to the Backwash process Filter 1 and 2.

2. Local:

a. The valve must be able to operate from the actuator.

b. Control Mode:

1) Local Manual: When in manual, HSI-27-202, the valve should be able to modulate its % of travel from actuator.
2) Local Automatic: None.

3. Remote:

a. Control is transferred to OWS. The valve can be controlled at OWS in MANUAL or AUTO modes.
b. Control Mode:

1) Remote Manual: The Operator to manually modulate the valve from the OWS, FC-27-202. OWS mut show position feedback indication, ZI-27-201.
2) Remote Automatic: None

D. Alarms/Monitoring

1. Valve Fault indication, XA-27-202. An audible alarm is produced at CP-01

E. Data Collection

1. N/A

LOOP 216 WASH WATER TANK – INSTANTANEOUS PRESSURE INDICATION; PIT-27-104.

A. General

1. Continuous monitoring of pressure line (PI-27-104) from Wash Water Tank to filters using a pressure transmitter.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None.

D. Control

1. None.

E. Alarms/Monitoring

1. Provide pressure monitoring as shown on the P&IDs.

2. If the Pressure reading exceeds 120 PSI value, generate a HI PRESSURE alarm (PAH-27-104) at main control Panel

F. Data Collection

1. N/A.

LOOP 230 PLANT DISCHARGE – INSTANTANEOUS TOTAL CHLORINE; AIT-71-401.

G. General

1. Continuous monitoring of discharge water Total Chlorine (AI-71-401) using a Total Chlorine Analyzer and transmitter to RIO 4.

H. Hardware Interlocks

1. None

I. Software Interlocks

1. None

J. Control

1. None.

K. Alarms/Monitoring

1. Provide Total Chlorine monitoring as shown on the P&IDs.

L. Data Collection

1. N/A.

LOOP 231 PLANT DISCHARGE – INSTANTANEOUS FLOW INDICATION; FIT-71-201

A. General

1. Continuous monitoring of discharge water flow (FI-71-201) using a flow transmitter to RIO 4.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. None.

E. Alarms/Monitoring

1. Provide flow totalization and monitoring as shown on the P&IDs.

F. Data Collection

1. None.

LOOP 232 SAMPLE PUMP; PU-71-307

A. General

1. Sample Pump draws sample water from the plant discharged pipe to the chlorine analyzer, AIT-71-401. Sample pump will operate in manual mode at the LCP.

B. Hardwired Interlocks

1. None

C. Software Interlocks

1. None.

D. Control

1. Sample pump will operate in manual mode

2. Local:

a. Control Mode:

1) Local Manual: The sample pump will start when the pump power switch is in the On position. The sample pump will stop when the power switch is in the Off position.
2) Local Automatic: None

3. Remote:

a. None

E. Alarms/Monitoring

1. None

F. Historical Data Collection

1. N/A

LOOP 250 COAGULANT FEED PUMP; PU-32-402

A. General

1. Feed pump that ensures consistent, accurate dosing of coagulant to optimize coagulation and flocculation.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. If Streaming Current control signal, AC-13-301, is lost, pumps enter in manual operation.

D. Control

1. Streaming current analyzer, AIT-13-301 (Refer to Loop 40), measures the electrical charge characteristics of the water, which correlates with the presence of suspended solids, organic matter, or other contaminants. The streaming current signal is processed in the analyzer controller. A target streaming current value is established on the instrument by the operator, based on optimal coagulation conditions. The controller sends a control signal, AC-13-301, to modulate the feed pump dosing rate.

2. Local:

    a. In local, the pumps must be controlled through the local pump controller.
    b. Control Mode:

        1) Local Manual: When the Auto/Off/Manual switch is in the "Manual" position, the pump is turned “On” if there is power, and its speed is controlled through the local speed controller. The pump shuts down when the Auto/Off/Manual switch (HS) is in the "Off" position.
        2) Local Automatic: None.

3. Remote:

    a. Control is transferred to OWS.
    b. Control Mode:

        1) Remote Manual: Control is passed to the OWS, XC-32-402. The Operator to manually operate the Feed pump speed, SC-32-402
        2) Remote Automatic: Feed Pump is configured to automatic. Streaming current signal is processed in the analyzer controller. A target streaming current value is established on the instrument by the operator, based on optimal coagulation conditions. The controller sends a control signal, AC-13-301, to modulate the feed pump dosing rate, SC-32-402.

    c.

E. Alarms/Monitoring

1. Motor Fault indication, XA-32-402.

F. Data Collection

1. None

LOOP 251 SODIUM HYPOCHLORITE FEED PRE-TREATMENT 1; PU-31-401

A. General

1. Feed pump that ensures consistent, accurate dosing of Sodium Hypochlorite to optimize chlorination in Pre-Treatment.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. If Flow signal, FI-13-103, is lost, pumps enters in manual operation.

D. Control

1. Flow Meter, FIT-01-101 (Refer to Loop 01), flow measurement signal is transmitter to the Feed Pump controller, SC-31-401. Control relies on a flow signal that is directly proportional to the feed pump's speed. The desired hypochlorite flow rate or pump speed setpoint is established based on process requirements. The controller compares the actual flow (derived from pump speed) against the target flow setpoint.

2. Local:

   a. In local, the pumps must be controlled through the local pump controller.
   b. Control Mode:

      1) Local Manual: When the Auto/Off/Manual switch is in the "Manual" position, the pump is turned "On" if there is power, and its speed is controlled through the local speed controller. The pump shuts down when the Auto/Off/Manual switch (HS) is in the "Off" position.
      2) Local Automatic: None.

3. Remote:

   a. Control is transferred to OWS.
   b. Control Mode:

      1) Remote Manual: Control is passed to the OWS, XC-31-401. The Operator to manually operate the Feed pump speed, SC-31-401
      2) Remote Automatic: Feed Pump is configured to automatic and control is passed to the OWS, XC-31-401. Flow measurement signal is transmitter to the Feed Pump controller, SC-31-401. Control relies on a flow signal that is directly proportional to the feed pump's speed. The desired hypochlorite flow rate or pump speed setpoint is established based on process requirements.

   c.

E. Alarms/Monitoring

1. Motor Fault indication, XA-31-401.

F. Data Collection

1. None.

LOOP 252 SODIUM HYPOCHLORITE FEED FILTERS; PU-31-405

A. General

1. Feed pump that ensures consistent, accurate dosing of Sodium Hypochlorite to optimize chlorination at the clear water before filtration.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. If Flow signal, FI-01-101, is lost, pumps enters in manual operation.

D. Control

1. Flow Meter, FIT-01-101 (Refer to Loop 01), flow measurement signal is transmitter to the Feed Pump controller, SC-31-405. Control relies on a flow signal that is directly proportional to the feed pump's speed. The desired hypochlorite flow rate or pump speed setpoint is established based on process requirements. The controller compares the actual flow (derived from pump speed) against the target flow setpoint.

2. Local:

a. In local, the pumps must be controlled through the local pump controller.
b. Control Mode:

1) Local Manual: When the Auto/Off/Manual switch is in the "Manual" position, the pump is turned "On" if there is power, and its speed is controlled through the local speed controller. The pump shuts down when the Auto/Off/Manual switch (HS) is in the "Off" position.
2) Local Automatic: None.

3. Remote:

a. Control is transferred to OWS.
b. Control Mode:

1) Remote Manual: Control is passed to the OWS, XC-31-405. The Operator to manually operate the Feed pump speed, SC-31-405

2) Remote Automatic: Feed Pump is configured to automatic and control is passed to the OWS, XC-31-405. Flow measurement signal is transmitter to the Feed Pump controller, SC-31-405. Control relies on a flow signal that is directly proportional to the feed pump's speed. The desired hypochlorite flow rate or pump speed setpoint is established based on process requirements.

E. Alarms/Monitoring

1. Motor Fault indication, XA-31-405.

F. Data Collection

1. None.

LOOP 270 CONTINUOUS MONITORING AREA RAW WATER– INSTANTANEOUS TURBIDITY; AIT-01-105

A. General

1. Continuous monitoring of raw water turbidity using a Turbidity transmitter to CP-01.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. None.

E. Alarms/Monitoring

1. Provide instantaneous turbidity monitoring as shown on the P&IDs.

F. Data Collection

1. None.

LOOP 271 CONTINUOUS MONITORING AREA RAW WATER – INSTANTANEOUS PH & TEMPERATURE INDICATION; AIT-01-202.

A. General

1. Continuous monitoring of raw water PH & Temperature using a PH/Temperature transmitter to CP-01.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. None.

E. Alarms/Monitoring

1. Provide PH and Temperature monitoring as shown on the P&IDs.

F. Data Collection

1. N/A.

LOOP 272 CONTINUOUS MONITORING AREA SEDIMENTATION TANK 1– INSTANTANEOUS TURBIDITY; AIT-16-106

A. General

1. Continuous monitoring of Sedimentation Tank 1 effluent turbidity using a Turbidity transmitter to CP-01.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. None.

E. Alarms/Monitoring

1. Provide instantaneous turbidity monitoring as shown on the P&IDs.

F. Data Collection

1. None.

LOOP 273 CONTINUOUS MONITORING AREA SEDIMENTATION TANK 1 – INSTANTANEOUS PH & TEMPERATURE INDICATION; AIT-16-203.

A. General

1. Continuous monitoring of Sedimentation Tank 1 effluent PH & Temperature using a PH/Temperature transmitter to CP-01.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. None.

E. Alarms/Monitoring

1. Provide PH and Temperature monitoring as shown on the P&IDs.

F. Data Collection

1. N/A.

LOOP 274 CONTINUOUS MONITORING AREA SEDIMENTATION TANK 1 – INSTANTANEOUS RESIDUAL CHLORINE; AIT-16-402.

A. General

1. Continuous monitoring of Sedimentation Tank 1 effluent residual chlorine using a Residual Chlorine Analyzer and transmitter to CP-01.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. None.

E. Alarms/Monitoring

1. Provide Residual Chlorine monitoring as shown on the P&IDs.

F. Data Collection

1. N/A.

LOOP 275 CONTINUOUS MONITORING AREA SEDIMENTATION TANK 2– INSTANTANEOUS TURBIDITY; AIT-16-107

A. General

1. Continuous monitoring of Sedimentation Tank 2 effluent turbidity using a Turbidity transmitter to CP-01.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. None.

E. Alarms/Monitoring

1. Provide instantaneous turbidity monitoring as shown on the P&IDs.

F. Data Collection

1. None.

LOOP 276 CONTINUOUS MONITORING AREA SEDIMENTATION TANK 2 – INSTANTANEOUS PH & TEMPERATURE INDICATION; AIT-16-204.

A. General

1. Continuous monitoring of Sedimentation Tank 2 effluent PH & Temperature using a PH/Temperature transmitter to CP-01.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. None.

E. Alarms/Monitoring

1. Provide PH and Temperature monitoring as shown on the P&IDs.

F. Data Collection

1. N/A.

LOOP 277 CONTINUOUS MONITORING AREA SEDIMENTATION TANK 2 – INSTANTANEOUS RESIDUAL CHLORINE; AIT-16-403.

G. General

1. Continuous monitoring of Sedimentation Tank 2 effluent residual chlorine using a residual chlorine analyzer and transmitter to CP-01.

H. Hardware Interlocks

1. None

I. Software Interlocks

1. None

J. Control

1. None.

K. Alarms/Monitoring

1. Provide Residual Chlorine monitoring as shown on the P&IDs.

L. Data Collection

1. N/A.

LOOP 278 CONTINUOUS MONITORING AREA FILTERS COMBINED EFFLUENT– INSTANTANEOUS TURBIDITY; AIT-21-108

A. General

1. Continuous monitoring of filters combined effluent turbidity using a Turbidity transmitter to CP-01.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. None.

E. Alarms/Monitoring

1. Provide instantaneous turbidity monitoring as shown on the P&IDs.

F. Data Collection

1. None.

LOOP 279 CONTINUOUS MONITORING AREA FILTERS COMBINED EFFLUENT – INSTANTANEOUS PH & TEMPERATURE INDICATION; AIT-21-205.

A. General

1. Continuous monitoring of filters combined effluent PH & Temperature using a PH/Temperature transmitter to CP-01.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. None.

E. Alarms/Monitoring

1. Provide PH and Temperature monitoring as shown on the P&IDs.

F. Data Collection

1. N/A.

LOOP 280 CONTINUOUS MONITORING AREA FILTERS COMBINED EFFLUENT – INSTANTANEOUS RESIDUAL CHLORINE; AIT-21-404.

G. General

1. Continuous monitoring of Filters combined effluent residual chlorine using a residual chlorine Analyzer and transmitter to CP-01.

H. Hardware Interlocks

1. None

I. Software Interlocks

1. None

J. Control

1. None.

K. Alarms/Monitoring

1. Provide Residual Chlorine monitoring as shown on the P&IDs.

L. Data Collection

1. N/A.

LOOP 281 CONTINUOUS MONITORING AREA CEARWELL– INSTANTANEOUS TURBIDITY; AIT-52-109

A. General

1. Continuous monitoring of Clearwell turbidity using a Turbidity transmitter to CP-01.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. None.

E. Alarms/Monitoring

1. Provide instantaneous turbidity monitoring as shown on the P&IDs.

F. Data Collection

1. None.

LOOP 282 CONTINUOUS MONITORING AREA CEARWELL – INSTANTANEOUS PH & TEMPERATURE INDICATION; AIT-52-206.

A. General

1. Continuous monitoring of Clearwell PH & Temperature using a PH/Temperature transmitter to CP-01.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. None.

E. Alarms/Monitoring

1. Provide PH and Temperature monitoring as shown on the P&IDs.

F. Data Collection

1. N/A.

LOOP 283 CONTINUOUS MONITORING AREA CLEARWELL – INSTANTANEOUS RESIDUAL CHLORINE; AIT-52-405.

G. General

1. Continuous monitoring of Clearwell residual chlorine using a residual chlorine analyzer and transmitter to CP-01.

H. Hardware Interlocks

1. None

I. Software Interlocks

1. None

J. Control

1. None.

K. Alarms/Monitoring

1. Provide Residual Chlorine monitoring as shown on the P&IDs.

L. Data Collection

1. N/A.

LOOP 284 CONTINUOUS MONITORING AREA DISTRIBUTION– INSTANTANEOUS TURBIDITY; AIT-51-110

A. General

1. Continuous monitoring of distribution turbidity using a turbidity transmitter to CP-01.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. None.

E. Alarms/Monitoring

1. Provide instantaneous turbidity monitoring as shown on the P&IDs.

F. Data Collection

1. None.

LOOP 285 CONTINUOUS MONITORING AREA DISTRIBUTION – INSTANTANEOUS PH & TEMPERATURE INDICATION; AIT-51-207.

A. General

1. Continuous monitoring of Distribution PH & Temperature using a PH/Temperature transmitter to CP-01.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. None.

E. Alarms/Monitoring

1. Provide PH and Temperature monitoring as shown on the P&IDs.

F. Data Collection

1. N/A.

LOOP 286 CONTINUOUS MONITORING AREA DISTRIBUTION – INSTANTANEOUS RESIDUAL CHLORINE; AIT-51-402.

G. General

1. Continuous monitoring of Distribution residual chlorine using a residual chlorine analyzer and transmitter to CP-01.

H. Hardware Interlocks

1. None

I. Software Interlocks

1. None

J. Control

1. None.

K. Alarms/Monitoring

1. Provide Residual Chlorine monitoring as shown on the P&IDs.

L. Data Collection

1. N/A.

LOOP 290 EMERGENCY GENERATOR – FUEL LEVEL INDICATION; LIT-80-209.

A. General

1. Continuous monitoring of the emergency Generator fuel level using a Level Indication (LI-80-209) and Transmitter to RIO 3.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. None.

E. Alarms/Monitoring

1. Provide fuel level monitoring as shown on the P&IDs.

F. Data Collection

1. N/A.

LOOP 291 EMERGENCY GENERATOR – AUTOMATIC TRANSFER SWITCH; ATS-80-501

A. General

1. Transfers electrical loads from the normal utility source to the emergency generator upon detection of a power failure or unacceptable power conditions. Continuously monitors both power sources providing operation status (YS-80-501), Emergency Generator operation status, XI-80-501, ATS fault indication, YA-80-501, and Emergency Generator fault indication, XA-80-501.

B. Hardware Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. Automatically transfer the electrical load between the normal utility source and the emergency generator based on the availability of each power source. Upon restoration of normal power, the ATS shall automatically retransfer the load to the utility source.

2. .Local:

a. None

3. Remote:

a. None

E. Alarms/Monitoring

1. ATS Fault indication, YA-80-501. An audible alarm is produced at CP-01.

2. ATS Status operation, YS-80-501.

3. Emergency Generator operation status indication, XI-80-501

4. Emergency Generator fault indication, XA-80-501.

F. Data Collection

N/A

SECTION 13306
I&C – Applications Engineering Services

PART 1 GENERAL

A. The Process Control Systems Supplier (PCSS) shall adhere to Puerto Rico Aqueduct and Sewer Authority (PRASA) PLC/SCADA software and programming standards, including but not limited to programming in ladder logic (LAD), statement list (STL), or structured control language (SCL) and Function block diagram (FBD) programming.

B. PCSS must coordinate and integrate the data mapping to be exchanged with all Programmable Logic Controllers (PLCs), including vendor package systems, to be aligned with PRASA PLC/SCADA software and programming standards.

1.1 DEFINITIONS

A. Automation Engineer: An automation engineer is an individual who improves the efficiency of various manufacturing and computer systems by automating certain parts of the systems to do work on their own.

B. Applications Engineering System Supplier (AESS): The entity that provides all programming, configuration, and related services for the control system equipment supplied by the PCSS.

C. Functional Block Diagram (FBD): Functional Block Diagram (FBD) is a graphical programming language used in industrial automation and control systems to represent control logic through interconnected blocks, showing the flow of data and signals between different components and functions.

D. General Contractor (GC): A general contractor is a person or company responsible for overseeing a construction project.

E. Human Machine Interface (HMI): A software-based user interface with supervisory level control and of machine-level equipment.

F. Ladder Loggic (LAD): Ladder logic is a programming language representing a program by a graphical diagram based on the circuit diagrams of relay logic hardware.

G. Leadership in Energy and Environmental Design (LEED): A green building certification indicating that a building was designed and constructed to be environmentally responsible and use resources efficiently.

H. Maintenance of Plant Operations (MOPO): A construction plan that prevents or limits process disruptions during construction.

I. Original Equipment Manufacturer (OEM): An original equipment manufacturer is defined as a company whose goods are used as components in another company's products, which then sells the finished item to users.

J. Operator Interface Terminal (OIT): A hardware component of the SCADA system used for device-level control and monitoring.

K. Operator Workstation (OWS): A hardware component of the SCADA system used for supervisory level control and monitoring.

L. The Puerto Rico Aqueduct and Sewer Authority (PRASA) is a public corporation and instrumentality of the government that owns and operates Puerto Rico's public water supply and wastewater systems.

M. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

N. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

O. Real-Time Monitoring and Control Software (RTMC): A software used to create and run graphical screen representation and interface in actual time.

P. Section 1334X "Sections for Instruments Hardware": The X in the number indicates all spec sections starting with the first four numbers (indicating a category described in the accompanying text) are included in the reference.

Q. Sequential Function Chart (SFC): is a graphical programming language used in industrial automation and control systems to represent complex control logic as a series of interconnected steps and transitions, clearly visualizing the sequential execution of tasks.

R. Software Development Life Cycle (SDLC) is a systematic process or methodology that outlines the steps and stages involved in the development, implementation, and maintenance of software applications. It provides a structured approach for software development teams to plan, design, code, test, and deploy software products efficiently while ensuring quality and meeting project requirements.

S. Statement List (STL): STL (Statement List) is a low-level programming language used in industrial automation and control systems to define and execute control logic using a list of sequential statements.

T. Structural Control Language (SCL): Structural Control Language (SCL) is a specialized programming language used in structural engineering to define and control the behavior of structural systems in simulations and analyses.

U. Supervisor Control and Data Acquisition (SCADA): Hardware and software components used for high-level supervisory monitoring of industrial processes. Typical devices that are part of the SCADA network include computers (OWS), PLCs, Ethernet switches, OITs, and HMIs.

1.2 SCOPE OF WORK

A. Refer to section 13300 Instrumentation and Controls-General Provisions.

B. If referred to anywhere else in the project manual, Application Engineering or Applications Engineering System Supplier (AESS) services are specified in this section.

C. Provide all programming, configuration, and related services required to achieve a fully integrated and operational system as specified herein. All equipment shall be controlled in full conformity with the contract drawings, process control descriptions, specifications, engineering data, instructions, and equipment manufacturer recommendations. Coordinate the control system for proper operation with related equipment and materials furnished by other suppliers under other sections of these specifications and with related existing equipment.

1. Provide configuration of the PLC for all equipment shown on the drawings, except for control equipment shown as being provided as part of a vendor package system.

2. Provide configuration of the SCADA Workstation, Human-Machine Interface (HMI) System Software, Operator Interface Terminals (OITs), and drivers for all equipment shown on the drawings, including equipment provided by vendor package systems.

3. Provide integration of vendor systems connected to the SCADA.

4. Integrate networked and hardwired UPS status to the SCADA application.

5. Provide the programming and configuration of networked UPS software to allow the execution of auto shutdown based on low battery level and auto-on when UPS is online.

6. Provide for and test communications and functionality between all connected devices (such as PLCs) and the HMI software packages, including devices supplied by others, as depicted on the system architecture drawings to provide a comprehensive working system of data collection, storage, and reporting.]

D. All work shall be coordinated with plant operating personnel to minimize impacts on daily operations. Project delays caused for any reason must be noted and formally submitted to the owner representative or PRASA as a letter.

1.3 PRASA PLC AND HMI STANDARD

A. Coordinate with the owner representative and PRASA for the documentation and electronic use of the latest version of the standard applications for PLC programming and HMI applications.

B. Coordinate owner representative and PRASA meetings for clarification and project-specific implementation of PRASA PLC and HMI Standards.

C. AESS to re-use any templates available in the PRASA PLC and HMI Standards for corresponding intended applications.

D. SCADA application programming should follow PRASA PLC and HMI standards.

E. SCADA application developer must provide all required software licenses during the application development.

F. The SCADA application developer must ensure the current workstation operating system and application software versions are the ones PRASA currently uses.

G. System integration shall be designed to meet the PRASA requirements using the Archestra Platform for remote telemetric monitoring. Object design specifications should be delivered to PRASA IT for final approval.

H. PRASA IT department will be responsible for the deployment in a production environment with contractor assistance.

I. PRASA IT is responsible for providing application software licenses under the production environment.

J. PRASA IT is responsible for providing a network communication line (PRASA Telemetry Network). Shall be provided for communication with the [Barbosa Building Server].

K. As part of PRASA IT software requirements, the contractor shall complete the Software Development Life Cycle (SDLC). At least the contractor must comply with the following phases:

1. Documentation

2. Development

3. Validation or Testing

4. Training

5. Implementation

1.4 RELATED WORK

A. Refer to Section 13300 Instrumentation and Controls-General Provisions.

1.5 SUBMITTALS

A. Provide all required submittals by Section 13300 , Submittals. The submittals listed below shall be provided by as a minimum.

1. HMI Operator Interface

2. Controller Program

3. Reports

4. Alarm Documentation

5. O&M Manuals

6. Cybersecurity

7. Supplement the "Project Plan, Deviation List, and Schedule" submittal in section 13300 by adding the following items to the submittal requirements:
   a. List all graphics intended to be created for this project.
   b. List all PLC programs that will be created or modified for this project.

B. Supplement to Input/Output (I/O) List Submittal

1. Supplement the "Input/Output (I/O) List " submittal in section 13300 by adding the following item to the submittal requirements:
   a. LOGICAL POINT ADDRESS: I/O address of each point.

C. Approach of use of PRASA SCADA and PLC Standards and Conventions Submittal

1. Submit the letter confirming the standards and conventions used on this project. The submittal shall define, at a minimum:
   a. A list of the PLC and Graphic library object to be used associated with the process equipment and instruments.
   b. System naming conventions, such as graphic display naming, database naming, tag names, and computer naming.
   c. System configuration, including network addressing and PLC/RTU addressing.
   d. Alarm configuration, including priorities and logging.
   e. Security configuration standards, including user groups and privileges.
   f. PLC/RTU standard programming modules, including analog input scaling, flow totalization, equipment runtime, motor start/stop, valve open/close, and any other standard logic planned to be used.

D. HMI Operator Interface

1. Submit a draft of all proposed graphic displays; for those graphics that will be duplicated more than once for similar types of equipment, submit the graphics for the first equipment only.

2. Following the draft graphics review meeting and before the factory test, submit a ready-for-testing version of all graphic displays. Besides incorporating comments and changes resulting from testing, these graphics should be finished.

3. Submitted graphic displays and trends.

E. Controller Program Submittal

1. Submit the following using the manufacturer's built-in printing functions for each controller. Electronic submission of Adobe Portable Document Format ("pdf") files instead of paper submittals is acceptable. The submittal is intended to review general program organization, level of documentation, and overall programming standards (basic pump and valve control, for example). The submittal is not intended to validate the accuracy of the logic. It will only attempt to confirm that the logic works correctly for some loops.
   a. PLC programs showing ladder logic, function block, high-level language, or other controller language used. Include individual rung, network, and command descriptions with abundant comments to identify each code segment's function and intent clearly. Each logic segment shall be clearly presented, the function of each timer described, and the purpose of each subroutine call labeled and defined, etc. Program documentation shall be sufficiently clear to allow determination of compliance with the process control requirements included in the control descriptions and with the Drawings. The submittal shall demonstrate that this project’s logic follows the same structure and format and reflects a standard programming approach.

b. Submit a memory usage report for the controller. This report shall indicate total memory capacity and unused memory capacity.
c. Submit cross-reference index of I/O allocation and controller memory address. Every physical I/O point and calculated or virtual I/O required to implement the process scheme shall be included.

2. Submit details of control system communication. Submit a "memory map" or other means showing which signals are exchanged between PLCs. Also, submit an HMI tag database showing all signals exchanged between the PLCs and HMI. Any specific communication block memory addresses shall be defined.

F. Historical Data Configuration

1. Following the SCADA HMI Workshop, submit a description of the approach of all the main aspects of the historical data configuration strategy considering as minimum the storage method, Deadband, and interpolation type .

G. Reports

1. Following the SCADA HMI Workshop, submit all aspects of the reports generation system and shall include, as a minimum, the following:
   a. A complete list of all reports to be developed.
   b. A complete listing of all signals to be reported, including calculated values.
   c. Description of reporting data storage design, including method data is polled and stored.
   d. Description of methodology for entering manual data and interface used.
   e. Procedures for recall, generation, and printing of reports
   f. Printout of each report with details of each cell, where data comes from, and calculation of raw data.]

H. Alarm Documentation:

1. Submitt for review and approval following the alarm workshop the alarm list including as minimum the following:
   a. Alarm's description
   b. Priority
   c. Cause and effect, and consequence
   d. Response time
   e. Recommended operator action will be documented for each alarm

I. Cybersecurity plan Submittal

1. Submit a Cybersecurity plan containing the following:
   a. Preliminary list of cybersecurity controls, cybersecurity software and cybersecurity hardware, including version numbers, solely to determine compliance with the requirements of the Contract Documents before beginning development of cybersecurity controls and configuration. Reviewing and approving this preliminary list does not relieve the PCSS of meeting the functional and performance requirements of the system specified herein. Substitution of manufacturer or model/version of these systems after approval of this submittal is not permitted without engineer approval.

b. Proposed cybersecurity controls to be utilized for this project based on the ISA/IEC-62443 3-3 Security Level (SL) required herein.
c. Hardware to be used for security and configuration standards
d. Software applications utilized for security and configuration standards
e. Impacts on system performance and operations
f. Testing methodology

2. The cybersecurity configuration may begin after approval of the Cybersecurity Standards and Requirements submittal.

3. Submit Firewall and Network Segmentation Configuration Information
   a. Submit preliminary firewall configuration details for review by the engineer and/or PRASA. Include the following:
      1) Network configuration settings
      2) Preliminary ruleset, including a description of what each rule does and how it protects the network
   b. Once preliminary configuration is approved and firewalls are configured and operational, submit final firewall configuration details, including plain English descriptions and configuration exports or screenshots of the devices interface showing selections and configuration details keyed to the plain English descriptions.
   c. Submit information on network segmentation configurations (VLANs, switch port configuration, etc.). The network segmentation information must include VLAN identifier, Description of VLAN, devices included in each VLAN, which VLANs can communicate with each other, and if communication between VLANs is controlled by Layer 3 switch Access Control Lists or through the firewall.

J. O&M Manuals - Software Maintenance Manuals

1. This document must include instructions covering the use and operation of the control system equipment to perform the intended functions

2. Include these manuals in 13300 "Operation and Maintenance Manuals". This required information is in addition to any requirements of Section 13300.

3. Software Listings and Databases - Submit hard copies of the same information required in the "Controller Program Submittal," except include files updated to reflect the as-built system. Include PDF versions of these files in the USB thumb drive specified below.

4. PID Loop Tuning Parameters - Submit annotated chart recorder traces or computer system trend screen printouts showing tuned control loop response to plus and minus 40 percent of span step changes of loop setpoint for each loop. For cascade loops, submit charts showing the response of the secondary loop with a secondary setpoint on manual and the response of the entire cascade control loop in automatic mode. Include a description of the tuning methodology used. Clean historical data and trends used for startup and test purpose.

5. If available as part of the software provided, supply hard copies of configuration information for the HMI systems, reporting systems, Historian Systems, and any other programs developed under this Contract.

6. Readable Machine Documentation - Provide two sets of as-built software documentation on a USB thumb drive in original electronic format for all PLC, HMI systems, reporting

systems, Historian Systems, and other programs developed under this Contract. Any changes made during or after testing, start-up, and commissioning shall be incorporated.

K. O&M Manuals - Operator Manuals

1. Provide Operator's Manuals before final acceptance of the system.

2. These manuals shall be separately bound and contain all information necessary for the operator to monitor and control the plant from the control system. The manuals shall be written in non-technical terms and shall be organized for quick access to each detailed description of the operator's procedure. Manuals shall contain, but not be limited to, the following information:
   a. A comprehensive table of contents of the manual.
   b. A simple overview of the entire system indicating the function and purpose of each piece of equipment.
   c. A detailed description of the operation of the HMI and OIT, including all appropriate displays. Including a screenshot of each HMI and OIT display screen and annotating each function in the text is an acceptable format for presenting this information.
   d. Step-by-step procedures for starting up or shutting down an individual component of the control system and the entire system.
   e. Login/logout procedures.
   f. Complete step-by-step procedures for printing reports and entering manual data.
   g. Complete step-by-step procedures for performing system or selected file backup and restoration, including archiving historical data. Include recommended archiving schedule for historical data.
   h. Operational description for operating HMI computer equipment and peripherals, including printers, removable bulk storage devices, UPS, etc. The description shall include procedures for typical maintenance and troubleshooting tasks.
   i. A complete glossary of terms and definitions of acronyms.
   j. List of personnel to be contacted for warranty and emergency services, including name, address, telephone number, pager or cell phone number, fax number, and email address.

3. Include these manuals in 13300 " Operation and Maintenance Manuals ". This required information is in addition to any requirements of Section 13300.

1.6 COORDINATION MEETINGS AND WORKSHOPS

A. Refer to Section 13300 Instrumentation and Controls-General Provisions. The meetings below are in addition to the meetings specified in that section.

B. Schedule and conduct a standards and conventions workshop. This workshop shall review how the AESS will use the PRASA PLC/HMI standards, conventions, and methodologies used to program and develop the programs (i.e., HMI and PLC databases, HMI graphics, PLC programming, etc.). It will solicit Engineer and PRASA's input. Submit an agenda with examples of items to be discussed at a client workshop.

C. Schedule and conduct a draft graphics review meeting. This meeting shall present draft graphics for the Owner's and Engineer's review and feedback before creating the complete set of graphics for review. For repetitive graphics, such as graphics for multiple process trains, include an example of the first graphic only for discussion. Include a discussion of process and overview

displays, examples of pop-ups, trends, and system navigation tools. Expect major comments and incorporate any changes resulting from those comments.

D. Schedule and conduct a historical data configuration, . The purpose of this workshop shall be to discuss and solicit Owner Representative/PRASA input relate to the storage configuration.

E. Schedule and conduct report workshop. Bring examples of all these documents for review and discussion.

F. Schedule and conduct a factory testing coordination meeting [two (2)] weeks before factory testing. This meeting aims to discuss the specifics of the proposed tests and provide a forum for coordinating the required factory testing.

G. Schedule and conduct a field-testing coordination meeting two (2) weeks before field testing. This meeting aims to discuss the specifics of the proposed tests and provide a forum for coordinating the required field testing.

1.7 WARRANTY

A. Refer to Section 13300 Instrumentation and Controls-General Provisions and supplement that with the requirements below.

B. Provide telephone technical support within four (4)] hours of a warranty claim. If failure cannot be resolved by telephone, provide onsite technical support within twenty-four (24) hours of a warranty claim.

1.8 MAINTENANCE

A. Refer to section 13300 Instrumentation and Controls-General Provisions.

PART 2 PRODUCTS

2.1 NOT USED

PART 3 EXECUTION

3.1 GENERAL

A. The system specified herein shall perform the following generalized functions:

1. The system shall allow the operator to control equipment such as pumps and valves as shown on the Drawings and as defined in Section 13305 Instrumentation and Controls-Control Descriptions.

2. Perform real-time process control, including proportional integral derivative control action, sequencing, process calculations, etc.

3. Collect, calculate, and store accurate, reliable operating information for present and future uses.

4. Assist remote site operating personnel by noting and communicating off-normal operating conditions and equipment failures.

5. Accumulate and store equipment running times for use in preventative maintenance.

6. Provide color graphic displays and reports for the system operating and supervisory personnel.

7. Provide trending for all analog values.

8. Provide control system diagnostics.

9. All process control functions, including PID, calculations, sequencing, timing, etc., shall be done in the process controller. The HMI software shall perform the real-time database, report generation, graphic screens, program development, setpoint modification, data archiving, etc.

10. The system shall allow the operator to control manually (by keyboard entry and mouse type pointing device) the status of pumps, valves, etc. (i.e., on off, open close, setpoint value, etc.) when viewing the appropriate graphic screen on the HMI.

3.2 CONTROLLER PROGRAMS

A. All application programs shall be structured and follow an intuitive arrangement so that an instrumentation technician with basic programming knowledge will be able to understand. Programs shall utilize standard program templates or subroutines for repetitive logic such as equipment control, total flow calculations, and equipment runtime calculations.

B. Make changes to the application programs and software configuration based on comments during the submittals, the factory tests, the field tests, and commissioning to meet the design intent at no additional cost to PRASA.

C. PLC I/O. Organize PLC I/O by data type floating point, integer, bits, etc.. Use PLC data structures and RTMC I/O capabilities to organize data transfer operations for ease of modification and expansion.

D. Control Functions and Calculations. Perform all control functions and calculations in the PLC. This includes calculations like runtime, flow totalizers, and control limit parameters. Alarms setpoints and limits for SCADA standard objects are set to be configured thru the SCADA application then pushed to PLC. Where required provide for easy operator viewing and entry of operator adjustable parameters in human units. Where operations procedures require it, include security protection only to accept changes from those authorized to do so.

3.3 GRAPHIC DISPLAYS - GENERAL

A. Process graphic displays shall be develop using the PRASA Standard Archestra Object and graphics following the standard HMI layouts based on the P&IDs, site plan drawings, mechanical drawings, and electrical drawings included in these Contract Documents. The graphic shall depict process flow streams, process structures, and all major items of process equipment and control devices in a schematic format.

B. Unless specifically noted, all timers, setpoints, alarm actuation levels, etc., shall be adjustable from the operator interface.

C. All interlocks affecting equipment operation shall be identified by alarm and HMI indication.

D. All structures and equipment shall be identified by name, appropriate equipment, and loop tags.

E. Follow PRASA HMI standard for color coding for equipment status.

F. Alarm setting must be done base on alarm :

1. Date/Time entry
2. Limit changes
3. Any commanded or uncommanded change of any point
4. Alarm conditions
5. PLC activation or deactivation
6. Operator login or logout activity

G. General Graphics Characteristics. Present text in English. Use pre-developed symbols from existing Owner Galaxy symbol libraries where practical. Select or develop graphic symbols to clearly differentiate similar equipment types. “3d” Representation is not allowed. Only include equipment identification numbers or names to distinguish between several parallel equipment items. Use only the minimum text required to identify each item.

H. Analog Values. Depict analog values graphically wherever appropriate; for example, a tank level. However, avoid using gauges where graphic space is limited; text is the preferred representation method in these cases. Where several related analog variables are located on a single display, display them as a vertically aligned set; for example, process value and setpoint on a Process Integral Derivative (PID) controller.

I. Graphics Hierarchy: Arrange graphic displays in a hierarchy. Levels in the hierarchy are system-wide, plant-wide, unit process, field variables, equipment control or pop-up (equipment control) graphics.

J. Place flow stream connectors on graphics where a flow “enters” or “leaves” a graphic and the source or destination is depicted on another graphic. Use pushbutton targets to provide quick access to related graphics. These pushbuttons should be included in the graphic template.

K. Equipment Control: Equipment control will be a two-step process. A pushbutton serves as the target. Selection of the target will cause a control pop-up window to appear only if the logged user has operator interface permission. The equipment control pop-up window will contain control targets (start/stop buttons, setpoint adjustment targets, etc.) which can be selected to perform the desired action. After selecting the control target, the operator will be prompted to confirm that the requested control action is to be executed. Displays, Files, Disk Locations, and Naming.

L. Rapid Application Development Tools: Fully utilize rapid application development tools (Wizards) to ease application development and maintenance. Utilize objects already developed by PRASA.

M. Database Conventions: Database record (point) and function naming conventions must follow PRASA Standards.

N. Alarming and Messaging: Configuration for alarms loggings and events to alarm and event summary files and to the alarm printer. Events are normal (expected) status changes such as operator log-on, setpoint change, and automatic equipment cycling. Annunciate alarms visually and audibly. For selected alarms, initiate the automated operator paging system. Work with the owner representative to develop operator paging conventions and standards during design.

O. Configure Trending shall provide historical charts using with the AVEVA historian.

P. Manual Data Entry and Reporting. In general, provide graphic displays for manual entry of operator-conducted analysis. Provide control developed visual studio connecting to Microsoft's SQL Server for editing and approving manually entered data from operator and remote Workstations.

Q. Security: Security to be implemented in accordance with Owner HMI Standard and be consistent with that of the existing HMI application.

3.4 SPECIFIC GRAPHIC SCREENS

A. At a minimum, provide the following types of graphic screens indicated below.

1. Plant Overview screen shall include a site plan representation, indicating the geographic location of each process and each building. This screen shall includes Key Performance Indicators (KPI's) like total flow, total power, etc.

2. Overall plant process block flow diagram screen shall show all major processes in block form with flow arrows. Each block shall include a text description of key individual treatment processes. Navigational buttons to the individual treatment processes shall be performed by pressing on the text description.

3. Individual treatment process screens shall graphically screen key process variables and equipment. Individual process flow screens for each process shall include all process components, including tanks, pumps, blowers, mixers, drives, flow meters, valves, mechanical devices, as well as manual shutoff and isolation valves. These diagrams shall be generally depicted from the P&ID, and there shall be at least one screen per P&ID on average.

4. Individual unit process screens depicted from the P&IDs are used to control and display each major item of process equipment, process variables, and control devices, including pumps, blowers, valves, gates, mixers, drives, etc. Navigational buttons shall consist of the P&ID's flow arrows to other individual unit processes. The unit process screens shall allow the operator to access individual equipment popup screens. These diagrams shall be generally depicted from the P&ID, and there shall be at least two screens per P&ID on average.

5. PLC system diagnostic screens, showing the operational status, and fault conditions of all PLC components, including processors, I/O modules, OITs, power supplies, and UPS units.

6. Communications diagnostic screens, showing the details of network status, and communications status of all major components, including Operator Workstations, peripheral devices, and network components.

7. Analog variable screens showing a tabular summary of main plant process variables, in operator-assigned groupings.

3.5 SECURITY AND CYBERSECURITY CONSIDERATIONS

A. Follow ANSI/ISA-62443-3-3 (99.03.03)-2013 Security for industrial automation and control systems Part 3-3: System security requirements and security levels. System must include security controls required to satisfy SL2 as applicable for the equipment and software provided for this contract.

B. The system shall be configured and implemented with security to prevent unauthorized access. The system shall allow authorized changes to system operation through defined user accounts and password verification.

C. Coordinate with PRASA's user account information, including login name and password for each account.

D. HMI Security groups of "display only", "operator mode", "supervisor mode", and "engineer mode" will be used for assigning permissions to individual users. Each user will have a unique user account and assigned to one of the user groups based on their required access level. The "display only" security level shall automatically be entered on system startup. In the "display only" mode, information can be displayed on the screen, but no changes may be made. In the "operator mode", changes may be made to process set points, times, etc.; however, the overall control concepts may not be modified. In the "supervisor mode", all operator functions can be modified and any special reports or critical process set points (data can be modified; however, the overall control concepts may not be modified). In the "engineer mode" level, all user modifiable parameters of the system shall be available for modification.

3.6 HISTORICAL DATA CONFIGURATION

A. The following features shall be provided for the processing and storage of system historical data:

1. For any scope related to historical data management to be customized or not included in the PRASA HMI Standards, the following consideration must be followed:
   a. All process analogs, flow totals, and run-time indications of all primary process equipment motors shall be sampled and stored in the historican.
   b. The storage method must be configure based on delta method with a deadband setting that optimized the use of the storage and network.

3.7 REPORTS

A. Quantity and format of reports shall be determined at the historical data management and reports workshop and, as a minimum, shall include shift, daily, monthly and yearly reports.

B. The system shall be able to generate reports from online historical data files or prompt the user for the appropriate archived data files.

C. Reports shall be initiated automatically based on the time of day or manually upon operator request.

D. User interface displays for report generation shall be developed with easy recall of reports by entering time:day: year target values.

E. User interface displays shall allow the operator to define the destination of the report (e.g., display, printer, computer file, etc.) and when it is to be printed (e.g., immediately, on demand, or automatically at a specified time).

F. It shall be possible to print quality tags alongside the value.

G. Values for which no data is available shall be identified with a unique character. Thus, only values which are actually zero shall be printed as such.

H. Operational Report Types. The following operational report types shall be provided with the system:

1. Shift Operation Summary Report:
   a. An operator-adjustable time interval shift operation report shall summarize plant operation from the start and finish time of operation. .
   b. The report format shall consist of the following: correct date, plant name, report name, page number, group headings, subheadings, point identification, and engineering units.]

2. Daily Operation Summary Report:
   a. The daily operation report shall summarize plant operation for the previous day. The printed information shall be the stored values (not averages) including scanned, lab, and manually entered data.
   b. The report format shall consist of the following: correct date, plant name, report name, page number, group headings, subheadings, point identifications, and engineering units.
   c. The daily minimum, average, maximum, and total where applicable shall also be calculated and printed for each point and stored.]

3. Monthly Operation Summary Report:
   a. The monthly operation summary report shall summarize plant operation for the previous calendar month.
   b. The report format shall be arranged so that the first several pages shall con-form to the requirements of the state regulatory agencies and may be separated from the rest of the monthly operation report for transmittal to the regulatory agency.

c. The report format shall be similar to the daily operation summary report. It shall consist of the following: month and year, plant name, report name, page number, group headings, sub-headings, point identifications, and engineering units.
d. Monthly minimum, average, maximum, and totals, where applicable, shall also be printed for each column of points printed.]

4. Annual Operation Summary Report:
   a. The annual operation summary report shall summarize plant operations for the previous calendar year. The report shall contain scanned, lab, and manually entered data.
   b. The format of the report shall be identical to the monthly operation summary report except for replacing the month with a year in the heading and replacing the date with the calendar month.

3.8 TESTING

A. Refer to section 13302 Instrumentation and Controls- Testing.

B. Supplement to Field Testing requirements

1. Before leaving the site, use the PRASA's programming computer to monitor all PLC processors online, make online changes, and upload and download the processor to ensure programming software version compatibility.

2. Loop Tuning - All PID control loops (single or cascade) shall be tuned following device installation but before the commencement of the Functional Test.
   a. Optimal loop tuning shall be achieved either by auto-tuning software or manually by trial and error, Ziegler-Nichols step-response method, or other documented process tuning method.
   b. Determine and configure optimal tuning parameters to assure stable, steady state operation of final control elements under control PID. Each control loop with anti-reset windup features shall be adjusted to provide optimum response following startup from an integral action saturation condition.
   c. Tune all PID control loops to eliminate excessive oscillating final control elements. Loop parameters shall be adjusted to achieve a decay ratio of 1 / 4 or better. In addition, the loop steady state shall be achieved at least as fast as the loop response time associated with critical damping.
   d. Step changes to setpoint in the field shall verify loop performance and stability.
   e. Submit loop tuning documentation as specified in Part 1 of these Specifications.]

3.9 TRAINING

A. Refer to Section 13303 Instrumentation and Controls-Training for general training requirements.

END OF SECTION

SECTION 13310
INSTRUMENTATION AND CONTROLS – COMPUTER SYSTEM HARDWARE

PART 1 GENERAL

1.01 DEFINITIONS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.02 SCOPE OF WORK

A. This section covers the furnishing, installation, and services for computer system hardware as detailed in the Contract Drawings.

B. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.03 RELATED WORK

A. Section 13300 Instrumentation and Controls – General Provisions.

1.04 SUBMITTALS

A. Refer to Sections 13300 Instrumentation and Controls – General Provisions and Section 13340 Instrumentation and Controls – Instruments.

1.05 COORDINATION MEETINGS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.06 REFERENCE STANDARDS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.07 QUALITY ASSURANCE

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.08 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.09 NOMENCLATURE AND IDENTIFICATION

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.10 WARRANTY

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.11 MAINTENANCE CONTRACT

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.12 PROJECT/SITE REQUIREMENTS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.13 SPARE PARTS

A. None required.

1.14 TEST EQUIPMENT

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.15 TECHNOLOGY OBSOLESCENCE AND MITIGATION

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

PART 2 PRODUCTS

2.01 GENERAL

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

2.02 SCADA WORKSTATION TYPE 1

A. Workstations shall be set up to run HMI development and client applications, PLC & HMI development software, and Reporting & Analysis software depending on their use as shown.

B. Tower workstation form factor

C. Intel i9 Processor, E-Core Max 3.80 GHz, P-Core Max 5.00 GHz with Turbo Boost, 16 Cores, 24 Threads, 30 MB Cache.

D. 32 GB of RAM DDR4

E. Expansion slots

1. One PCIe 3.0 x16, half-length (< 189mm) full-height (< 104mm)

2. Two PCIe 3.0 x1, half-length (< 189mm) full-height (< 104mm)

3. One dummy slot, only bracket for optional port extension

4. Two M.2 slots (one for WLAN, one for SSD)

F. Internal Disk

1. 500 GB SSD

G. Video graphics capable of 1920 x 1200 pixels, 60 Hz refresh rate. VGA and HDMI or Display Port outputs. Card must be dual monitor capable.

H. I/O Ports & devices

1. Minimum of two USB 3.1 Gen1 ports

2. Minimum of one USB-C 3.1 Gen1 port

I. Interface devices

1. Generic USB 104 key (Windows) keyboard, no hot keys onboard

2. Two button USB optical mouse with scroll wheel

3. 24" monitor

J. Networking

1. All network interfaces shall have the following features

a. Support for latest Microsoft operating system
b. Gigabit Ethernet port, copper connection accepting standard CAT-5 cables for CAT-6
c. IEEE 802.3ab support for gigabit networking standard
d. IEEE 802.Q VLAN support
e. Auto sensing 10/100/1000 Mbps
f. SNMP manageable

K. Power supplies must operate from the voltage specified in Section 13300 Instrumentation and Controls – General Provisions.

L. Operating system

1. Latest release of 64-bit Windows 11, compatible with the current version of AVEVA System Platform used by PRASA.

M. Backup software

1. Backup software is required above the default Microsoft Windows Backup utility included with the operating system. The backup software shall have the following features:

a. Support the Windows operating system installed on server.
b. Perform full system backups including all open files, system state and open database files without the need to stop any services or applications running on the server.
c. Full restore of server from bare metal state.
d. Restore individual files from tape to original locations or to alternative locations on the server.
e. Backup job scheduler capable of supporting multiple schedules for full, incremental and partial backup jobs.
f. Backup software shall keep a log file of the status of all backup and restore activities. Log file shall easily export to a text file.

2. Provide Acronis or Symantec back-up software or equal.

N. Other Software

1. Microsoft:

    a. Office Professional Plus 2013 or newer shall include the following programs at a minimum.
        1) Microsoft Excel
        2) Microsoft Word
        3) Microsoft Access
        4) Microsoft PowerPoint
    b. Microsoft Edge and WebView2 Runtime
    c. Microsoft .NET Core 3.5 and 4.8
    d. ASP.NET Core Hosting Bundle 6.0

2. Microsoft SQL Server:

    a. SQL Server 2019
    b. SQL Server newer version
    c. SQL Server Management Studio 18.2
    d. SQL Server Reporting Services 2019
    e. SQL Express

3. Provide UPS Safe shutdown and UPS managements according to provided UPS as specified in section 13335.

    a. Schneider Electric PowerChute Business Edition 10
    b. Eaton Intelligent Power Manager
    c. Liebert MultiLink software
    d. Or Approved Equal.

4. Antivirus:

    a. Windows Defender
    b. Sophos Endpoint Agent
    c. Falcon CrowdStrike Windows Sensor
    d. Velociraptor
    e. ManageEngine UEMS Agent

5. Adobe:

    a. Acrobat Reader (Latest Edition)

O. Typical Workstations

1. Lenovo, Model M70t

2. Or Approved Equal

2.03 SCADA WORKSTATION TYPE 2

A. Workstations shall be set up to run HMI development and client applications, PLC & HMI development software, and Reporting & Analysis software depending on their use as shown.

B. Tower workstation form factor

C. Intel i9 Processor, E-Core Max 3.90 GHz, P-Core Max 5.10 GHz with Turbo Boost, 16 Cores, 24 Threads, 30 MB Cache.

D. 32 GB of RAM DDR4

E. Expansion slots

1. One PCIe 3.0 x1, full-height slot (length < 215mm)

2. One PCIe 3.0 x16, full-height (length < 215mm)

3. Two M.2 slots (one for WLAN, one for SSD)

F. Internal Disk

1. 500 GB SSD

2. 1TB HDD

G. Video graphics capable of 1920 x 1200 pixels, 60 Hz refresh rate. HDMI or Display Port outputs. Card must be dual monitor capable.

H. I/O Ports & devices

1. Minimum of two USB 3.2 Gen1 ports

2. Minimum of two USB 3.2 Gen2 ports

Minimum of one USB-C 3.2 Gen1 port

I. Interface devices

1. Generic USB 104 key (Windows) keyboard, no hot keys onboard

2. Two button USB optical mouse with scroll wheel

3. 24” monitor

J. Networking

1. All network interfaces shall have the following features

a. Support for latest Microsoft operating system
b. Gigabit Ethernet port, copper connection accepting standard CAT-5 cables for CAT-6
c. IEEE 802.3ab support for gigabit networking standard

d. IEEE 802.Q VLAN support
e. Auto sensing 10/100/1000 Mbps
f. SNMP manageable

K. Power supplies must operate from the voltage specified in Section 13300 Instrumentation and Controls – General Provisions.

L. Operating system

1. Latest release of 64-bit Windows 11, compatible with the current version of AVEVA System Platform used by PRASA.

M. Backup software

1. Backup software is required above the default Microsoft Windows Backup utility included with the operating system. The backup software shall have the following features:

a. Support the Windows operating system installed on server.
b. Perform full system backups including all open files, system state and open database files without the need to stop any services or applications running on the server.
c. Full restore of server from bare metal state.
d. Restore individual files from tape to original locations or to alternative locations on the server.
e. Backup job scheduler capable of supporting multiple schedules for full, incremental and partial backup jobs.
f. Backup software shall keep a log file of the status of all backup and restore activities. Log file shall easily export to a text file.

2. Provide Acronis or Symantec back-up software or equal.

N. Other Software

1. Microsoft:

a. Office Professional Plus 2013 or newer shall include the following programs at a minimum.
1) Microsoft Excel
2) Microsoft Word
3) Microsoft Access
4) Microsoft PowerPoint
b. Microsoft Edge and WebView2 Runtime
c. Microsoft .NET Core 3.5 and 4.8
d. ASP.NET Core Hosting Bundle 6.0

2. Microsoft SQL Server:

a. SQL Server 2019
b. SQL Server newer version
c. SQL Server Management Studio 18.2
d. SQL Server Reporting Services 2019
e. SQL Express

3. Provide UPS Safe shutdown and UPS managements according to provided UPS as specified in section 13335.

    a. Schneider Electric PowerChute Business Edition 10
    b. Eaton Intelligent Power Manager
    c. Liebert MultiLink software
    d. Or Approved Equal.

4. Antivirus:

    a. Windows Defender
    b. Sophos Endpoint Agent
    c. Falcon CrowdStrike Windows Sensor
    d. Velociraptor
    e. ManageEngine UEMS Agent

5. Adobe:

    a. Acrobat Reader (Latest Edition)

O. Typical Workstations

1. Lenovo, Model P360

2. Or Approved Equal

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method:

1. Conductors and cables must be inside conduit.

2. Conceal conduit in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.02 IDENTIFICATION

A. Refer to drawings for tagging designations.]

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Prepare test and inspection reports.

3.04 STARTUP SERVICE

A. PCSS shall perform startup services.

1. Complete installation and startup check according to manufacturer's written instructions.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train PRASA representative or PRASA's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION

SECTION 13311
INSTRUMENTATION AND CONTROLS – PLC HARDWARE AND SOFTWARE

PART 1 GENERAL

1.01 DEFINITIONS

A. Analog Input (AI): An electrical signal (1-5 Volts DC or 4-20 milliamps, for example) to be interpreted by a PLC.

B. Analog Output (AO): An electrical signal (1-5 Volts DC or 4-20 milliamps, for example) sent from a PLC to a field device.

C. Digital/Discrete Input (DI): A binary signal (0 or 1) to be interpreted by a PLC.

D. Digital/Discrete Output (DO): A binary signal (0 or 1) sent from a PLC to a field device.

E. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

F. Human Machine Interface (HMI): A software-based user interface with supervisory level control and of machine level equipment.

G. Operator Interface Terminal (OIT): A hardware component of the HMI used for device level control and monitoring.

H. Peer to Peer: Communication between two or more devices, typically PLC's, in which each device can control the communication exchange.

I. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

J. Remote I/O (RIO): I/O that is located remotely from the processor. Remote I/O can communicate over a variety of communication protocol and can use standard rack based I/O, or specialized Remote I/O hardware referred to as Distributed I/O.

1.02 SCOPE OF WORK

A. This Section includes programmable logic controllers (PLCs) and operator interface terminals (OITs) for control of process equipment, process-oriented machinery, and process systems.

1.03 RELATED WORK

A. Section 13300 Instrumentation and Controls – General Provisions.

B. Section 13306 Instrumentation and Controls – Application Engineering Services.

C. Section 13330 Instrumentation and Controls – Control Panel Enclosures and Panel Equipment.

D. Section 13335 Control Panel UPS (Single-Phase).

1.04 SUBMITTALS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.05 COORDINATION MEETINGS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.06 REFERENCE STANDARDS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.07 QUALITY ASSURANCE

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver PLC components in packaging designed to prevent damage from static electricity and physical damage.

B. Store PLC equipment according to manufacturer requirements. At a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. Protect PLCs from exposure to dirt, fumes, water, corrosive substances, and physical damage. Also, protect the PLC from all forms of electrical and magnetic energy that could reasonably cause damage.

1.09 NOMENCLATURE AND IDENTIFICATION

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.10 WARRANTY

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.11 MAINTENANCE CONTRACT

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.12 PROJECT/SITE REQUIREMENTS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.13 SPARE PARTS

A. None required.

1.14 TEST EQUIPMENT

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.15 TECHNOLOGY OBSOLESCENCE AND MITIGATION

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

PART 2 PRODUCT

2.01 GENERAL

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

2.02 SYSTEM DESCRIPTION

A. Networked Programmable Controller incorporated in a Main Control Panel with Power Supply, 4 communications modules, two 10-30 Vdc Isolated Input modules 16 pts, one 10-30 Vdc Isolated Output modules 16 pts, four analog Input Modules (8 Isolated Points, current) and one analog output Modules (8 Isolated Points, current). Network programmable controller will be communicating to four (4) Remote I/O via Fiber optic communication cable with the following configuration:

1. Remote I/O 1 (RIO 1)
   a. One Ethernet Adapter
   b. Three Digital Input 24 Vdc module, 16-point sinking
   c. One Digital Output 24 Vdc module, 16-point sourcing
   d. Two Analog Input module, 8 channel Universal
   e. One Analog Output module, 8 channel Universal

   Remote I/O will be monitoring Raw Water, Sedimentation Tanks and Sludge Holding Tank instrumentation, Turbidity, Flow, Streaming Current, pH, Sludge level and tank Level. It will be monitoring and providing control to Flash Mixer, Flocculation Mixers, Sludge Holding Tank pumps and Mixer. In addition shall control Sedimentation Tank sludge removal butterfly valves.

   1. Instrumentation

      a. Flow Meter FIT-01-101
      b. Turbidity Transmitter AIT-01-101
      c. PH/Temperature Transmitter AIT-01-201
      d. Streaming Current AIT-13-301
      e. Sludge Level Transmitter LIT-16-101
      f. Sludge Level Transmitter LIT-16-102
      g. Level Switch LS-18-303
      h. Level Transmitter LIT-18-206

   2. Pumps
      a. VFD Mixer MX-14-202
      b. VFD Mixer MX-14-204
      c. VFD Mixer MX-14-205
      d. Pump PU-18-105
      e. Pump PU-18-106

   3. Isolation Valves
      a. Butterfly Valve XV-16-101
      b. Butterfly Valve XV-16-102

2. Remote I/O 2 (RIO 2)
    a. One Ethernet Adapter
    b. One Digital Input 24 Vdc module, 16-point sinking
    c. One Analog Input module, 8 channel Universal

    Remote I/O will be monitoring water Level, Pressure and Flow in Distribution and Backwash pump system.

        1. Instrumentation
            a. Level Transmitter LIT-51-204
            b. Level Transmitter LIT-52-208
            c. Pressure Transmitter PIT-51-102
            d. Pressure Transmitter PIT-52-101
            e. Flow Transmitter FIT-51-105
            f. Pressure Switch PS-52-201
            g. Pressure Switch PS-51-202

3. Remote I/O 3 (RIO 3)
    a. One Ethernet Adapter
    b. One Digital Input 24 Vdc module, 16-point sinking
    c. One Analog Input module, 8 channel Universal
    d. One Serial Module remote I/O

    Remote I/O will be monitoring Wash Water Tank water Level and fault signal form Network Switch and panel open indication.

        1. Instrumentation
            a. Level Transmitter LIT-27-205
            b. Fuel Level Transmitter LIT-80-209

4. Remote I/O 4 (RIO 4)
    a. One Ethernet Adapter
    b. One Digital Input 24 Vdc module, 16-point sinking
    c. One Digital Output 24 Vdc module, 16-point sourcing
    d. Analog Input module, 8 channel Universal
    e. Analog Output module, 8 channel Universal

    Remote I/O will be monitoring chlorine and flow parameter at plant discharge. Remote I/O shall be transmitting control parameters of Thickener Mixer.

        1. Instrumentation
            a. Chlorine Residual Analyzer Transmitter AIT-71-401
            b. Flow Transmitter FIT-71-201
        2. Mixers
            a. VFD Mixer MX-19-206

Main Controller shall monitor and control remote Backwash pumps, Service pumps, blowers and chemical feed pumps. Control panels of Backwash, service pumps and blowers shall be integrated to the main controller and status indications shall be transmitted to the Main Controller.

Instrumentation
1. Turbidimeter Transmitter AIT-01-105

2. pH and Temperature Transmitter AIT-01-202'
3. Turbidimeter Transmitter AIT-16-106
4. pH and Temperature Transmitter AIT-16-203
5. Chlorine Analyzer and Transmitter AIT-16-402
6. Turbidimeter Transmitter AIT-16-107
7. pH and Temperature Transmitter AIT-16-204
8. Chlorine Analyzer and Transmitter AIT-16-403
9. Turbidimeter Transmitter AIT-21-108
10. pH and Temperature Transmitter AIT-21-205
11. Chlorine Analyzer and Transmitter AIT-21-404
12. Turbidimeter Transmitter AIT-52-109
13. pH and Temperature Transmitter AIT-52-206
14. Chlorine Analyzer and Transmitter AIT-52-405
15. Turbidimeter Transmitter AIT-51-110
16. pH and Temperature Transmitter AIT-51-207
17. Chlorine Analyzer and Transmitter AIT-51-406

Backwash Pumps

1. Pump 1 - PU-52-101
2. Pump 2 - PU-52-102

Service Pumps

1. Pump 1 - PU-51-103
2. Pump 2 - PU-51-104

Blowers

1. Blower 1 - BL-22-501
2. Blower 2 - BL-22-502

Main Controller shall monitor and control Chemical Feed systems.

1. Metering Pump for Sodium Hypochlorite PU-31-401
2. Metering Pump for Coagulant PU-32-402
3. Metering Pump for Sodium Hypochlorite PU-31-405

B. Programmable Controller incorporated in a Control Panel with Power Supply, one network switch, three 16 channel 24 Vdc Sink Input Module, One 16 Channel 24 Vdc Source Output module, three four Channel Universal Voltage/Current/RTD/TC Analog input Module and four channel voltage/current analog output module. Controller shall control and monitor Filter 1 unit daily operation and Backwash process.

1. Instrumentation

    a. Flow Meter FIT-21-102
    b. Turbidimeter Transmitter AIT-21-102
    c. Level Transmitter LIT-21-201
    d. Differential Pressure transmitter DPT-21-301
    e. Flow Meter FIT-27-107
    f. Pressure Transmitter PIT-27-103
    g. Flow Meter FIT-27-108
    h. Pressure Transmitter PIT-27-104

2. Isolation Valves
    a. Butterfly Valve XV-21-103

b. Butterfly Valve XV-21-104
c. Butterfly Valve XV-21-105
d. Butterfly Valve XV-21-106
e. Butterfly Valve XV-21-107
f. Butterfly Valve XV-21-108
g. Modulating Butterfly Valve FV-27-201
h. Modulating Butterfly Valve FV-27-202

C. Programmable Controller incorporated in a Control Panel with Power Supply, one network switch, two 16 channel 24 Vdc Sink Input Module, One 16 Channel 24 Vdc Source Output module, and two four Channel Universal Voltage/Current/RTD/TC Analog input Module. Controller shall control and monitor Filter 2 unit daily operation and Backwash process.

3. Instrumentation

a. Flow Meter FIT-21-103
b. Turbidimeter Transmitter AIT-21-103
c. Level Transmitter LIT-21-202
d. Differential Pressure transmitter DPT-21-302

4. Isolation Valves

a. Butterfly Valve XV-21-109
b. Butterfly Valve XV-21-110
c. Butterfly Valve XV-21-111
d. Butterfly Valve XV-21-112
e. Butterfly Valve XV-21-113
f. Butterfly Valve XV-21-114

D. Programmable Controller incorporated in a Control Panel with Power Supply, one network switch, two 16 channel 24 Vdc Sink Input Module, One 16 Channel 24 Vdc Source Output module, and two four Channel Universal Voltage/Current/RTD/TC Analog input Module. Controller shall control and monitor Filter 3 unit daily operation and Backwash process.

5. Instrumentation

a. Flow Meter FIT-21-104
b. Turbidimeter Transmitter AIT-21-104
c. Level Transmitter LIT-21-203
d. Differential Pressure transmitter DPT-21-303

6. Isolation Valves

a. Butterfly Valve XV-21-115
b. Butterfly Valve XV-21-116
c. Butterfly Valve XV-21-117
d. Butterfly Valve XV-21-118
e. Butterfly Valve XV-21-119
f. Butterfly Valve XV-21-120

E. Programmable Controller incorporated in a Control Panel with Power Supply, one network switch, two 16 channel 24 Vdc Sink Input Module, One 16 Channel 24 Vdc Source Output module, and two four Channel Universal Voltage/Current/RTD/TC Analog input Module. Controller shall control and monitor Filter 3 unit daily operation and Backwash process.

7. Instrumentation

a. Flow Meter FIT-21-106

b. Turbidimeter Transmitter AIT-21-111
c. Level Transmitter LIT-21-207
d. Differential Pressure transmitter DPT-21-304

8. Isolation Valves
    a. Butterfly Valve XV-21-121
    b. Butterfly Valve XV-21-122
    c. Butterfly Valve XV-21-123
    d. Butterfly Valve XV-21-124
    e. Butterfly Valve XV-21-125
    f. Butterfly Valve XV-21-126

2.03 SPARE I/O, SLOTS, AND FUTURE EXPANSION

A. Spare PLC I/O:

1. Provide 20 percent points per AI, AO, DI, and DO for future use, regardless of whether any of those point types are used in that panel or not.

2. Provide spare I/O points of same type of I/O modules supplied.

B. Spare PLC Slots (Chassis-Based PLC Systems): Provide at least 2 spare slots for addition of future I/O in each chassis provided.]

C. Future PLC Expansion (Non-Chassis-Based PLC Systems):

1. Provide adequate space to the right of the last I/O card per row of I/O cards for 2 future I/O cards.

2. Card width based on the widest I/O card provided in panel.]

D. Provide external relays for spare output points that require their use.

E. Wire all unused points on all I/O to terminal blocks in the order that they occur on the I/O modules.

2.04 CHASSIS-BASED PLC SYSTEM

A. General:

1. Provide processor, power supply, I/O modules, communication modules, redundancy modules, and remote interface modules as required to meet system requirements.

2. Listed and classified by UL, CSA, or FM approval as suitable for purpose specified and indicated.

3. Contains the required memory and functional capacity to perform the specified sequence of operation with the scheduled inputs and output points.

4. Designed for continuous industrial service.

5. Provide products of a single manufacturer.

6. Provide equipment models that are currently in production.

7. In the event of power interruption, the system undergoes an orderly shutdown with no loss of memory and resumes normal operation without manual intervention when power is restored.

8. Provide PLCs that communicate between workstations, servers, instruments, switches, controllers, process actuators, etc., as shown on the Drawings.

9. PLC capable of stand-alone operation in the event of failure of the communication link to the HMI subsystem.

B. Physical:

1. Vibration: 2g @ 10…500Hz. Vibration tested in accordance with IEC 60068.

2. Shock, Operating: 30 g, in accordance with IEC 60068-2-6 (Test Fc, Operating).

3. Operating Temperature: 32 to 140 degrees F (0 to 60 degrees C).

4. Temperature Nonoperating: -40 to 185 degrees F (-40 to 85 degrees C).

5. Relative Humidity: 5 to 95 percent, non-condensing.

6. ESD Immunity: 6 kV contact discharge; 8 kV air discharges. IEC 61000-4-2.

7. Enclosure Type rating: None (Open-Style).

8. All products have corrosion protection.

C. Identification:

1. Identify all major assemblies and sub-assemblies, circuit boards, and devices using permanent labels or markings indicating:
   a. Module product type such as analog or digital.
   b. Module catalog number.
   c. Module major revision number.
   d. Module minor revision number.
   e. Module manufacturer vendor.
   f. Module serial number.

D. PLC Central Processing Unit (CPU):

1. General:
   a. Minimum 32-bit microprocessor with system timing and is responsible with scheduling I/O updates with no user programming required to ensure discrete or analog update.
   b. Executes user relay ladder logic programs, communicates with intelligent I/O modules, and performs on-line diagnostics.
   c. Consists of a single module which solves application logic, stores the application program, stores numeric values related to the application processes and logic, and interfaces to the I/O.

d. Samples all discrete and analog inputs and outputs including internal coils and registers, and service special function modules every scan. The CPU processes the I/O with user programs(s) stored in memory and controls outputs based on the results of the logic operation.
e. Supply the CPU with a battery-backed time of day clock and calendar.
f. CPU family allows for user program transportability from one CPU model to another.

2. Diagnostics:
   a. Perform on-line diagnostics that monitor the internal operation of the PLC. If a failure is detected, initiate orderly system shutdown and fail-over. Monitor the following, at a minimum:
      1) Memory failure
      2) Memory battery low
      3) General fault
      4) Communications port failure
      5) Scan time over run
      6) I/O failure
      7) Analog or special function I/O module failure
   b. Make diagnostic information accessible to the host communications interfaces and to the PLC program.
   c. PLC indicators and on-board status area for the following conditions:
      1) CPU run
      2) CPU error or fault
      3) I/O failure or configuration fault
      4) Status of battery or back-up power module
      5) Communications indicator

3. Memory:
   a. Provide non-volatile battery backed memory of type CMOS RAM program memory or equivalent.
   b. Memory Backup System: Provide lithium battery backup or equivalent capable of retaining all memory for a minimum of three months and a Flash memory system capable of reloading program in the event of memory loss.
      1) Backup Storage: Provide backup battery capable of being replaced without disrupting memory integrity. Provide a visual indication of low battery voltage or module error and an alarm bit in the PLC program.
      2) SD Memory Card: Provide memory card storage with capacity greater than processor memory capacity. Install memory cards in processors for factory testing.
   c. Operating system contained in non-volatile firmware.
   d. The memory containing the operating system is field updateable via a separate update tool.

4. Programming Environment:
   a. Programming port: Use PLC Ethernet port for programming.
   b. On-Line programming: Application programs may be modified or stored while the CPU is running, with minimal impact on the scan time.
   c. Online programming including runtime editing.
   d. IEC 61131-3 programming languages supported: Ladder logic, function block, sequential function chart, and structured text.
   e. Supply all hardware and software necessary to program the CPU in these languages.

5. Communication Ports:
    a. Provide expandable CPU supplied with additional modules to support the required communication interfaces.

6. Remote I/O Communications:
    a. Provide CPU capable of communicating with up to 12 remote base locations. Automatically sample and update all local and remote I/O modules each scan cycle of the CPU.
    b. Provide communication link between the CPU and any RIO chassis as recommended by the PLC manufacturer.
    c. Provide diagnostic and equipment status information from each RIO.
    d. Provide remote I/O system with a remote input/output arrangement capable of operating at locations physically separated from the PLC CPU, as detailed on the drawings.
    e. Communicate with the remote I/O arrangement through cable, as recommended by the PLC manufacturer, and provided by the PLC system supplier under this specification Section.

E. Power Supplies:

1. Power Input: 120/240VAC, 50/60Hz..

2. Provide DC power supplies capable of handling ripple up to 2.4V peak to peak.

3. Chassis mounted power supplies to power the chassis backplane and provide power for the processor and applicable modules.

4. Provide clearly visible LED to indicate that the incoming power is acceptable, and the output voltage is present.

5. Provide over-current and over-voltage protection designed to operate in most industrial environments without the need for isolation transformers.

6. Size power supplies to accommodate the nominal load plus 30%.

7. Provide surge protection, isolation, and outage carry-over up to 2 cycles of the AC line.

8. Power Supply Redundancy:
    a. Provide redundant power supplies that comply with all the requirements of non-redundant power supplies, in addition to the features stated below.
    b. Design redundant power supplies to share the current required by the chassis.
    c. In the event of a failure of one redundant power supply, the remaining supply accommodates the entire load of the chassis without disruption to the chassis activity.
    d. Provide a failsafe fuse that is not accessible by the customer.
    e. Provide a solid-state relay connection to allow for failure annunciation when wired to an input module.
    f. Provide diagnostic LED status indicators for Power and redundancy.]

F. Chassis:

1. Distribute all system and signal power to the CPU, and support modules on the backplane. No interconnecting wiring between these modules via plug-terminated jumpers is acceptable.

2. Provide free air cooling for all system modules, main, and expansion chassis. No internal fans or other means of cooling except heat sinks is permitted.

3. Provide means to remove all system modules from the chassis or insertion of the chassis while power is being supplied to the chassis without faulting the processor or damaging the modules.

4. Modules designed to plug into a chassis and to be keyed to allow installation in only one direction, must prohibit upside down insertion of the modules, as well as safeguard against the insertion of a module into the wrong slot or chassis via an electronic method for identifying a module. Perform an electronic keying check to ensure that the physical module is consistent with what was configured.

G. Discrete Input & Output Modules:

1. General:
   a. Digital input and output modules provide ON/OFF detection and actuation capability.
   b. Provide cards of I/O type and count as required to implement the functions specified, plus an allowance for active spares, as specified herein.
   c. Provide modules capable of being installed or removed while chassis power is applied.
   d. Provide the following status indicators.
      1) On/Off state of the field device.
      2) Module's communication status.
      3) Module health.

2. Module Specifications – 24VDC Input Module
   a. Nominal Input Voltage: 24VDC
   b. On-State Current: 10mA at 30VDC maximum
   c. Maximum Off-State Voltage: 5V
   d. Maximum Off-State Current: 1.5mA
   e. Number of Points per Card: 16

3. Module Specifications – 24 Vdc Output Module
   a. Output Voltage Range: 12/24 Vdc.
   b. Output Current Rating:
      1) Per Point: 2.5 mA @ 24 Vdc
   c. Output delay time:
      1) Off to On: 1 ms max
      2) On to Off: 2ms max
   d. Total backplane power: 1.8 W.
   e. Off-state leakage current per point: 0.5 mA per point
   f. On-state voltage drop: 1.2V DC @ 2A
   g. Number of Points per Card: 16.

H. Analog Input & Output Modules:

1. General:
    a. Analog input modules convert an analog signal (1 to 5 Volts DC, 4 to 20 milliamps, for example) that is connected to the module's screw terminals into a digital value. The digital value representing the magnitude of the analog signal is transmitted on the backplane.
    b. Furnish analog output modules to convert a digital value that is delivered to the module via the backplane into an analog signal on the module's screw terminals.
    c. Provide modules designed to be installed or removed while chassis power is applied.
    d. Provide the following status indicators:
        1) Module's communication status.
        2) Module health
        3) Input/output devices
    e. Hardware and software indication provided when a module fault has occurred. Each module provided with an LED fault indicator and the programming software displays the fault information.
    f. Provide analog modules that are software configurable through the I/O configuration portion of the programming software.
    g. Following status can be examined in ladder logic:
        1) Module Fault Word: Provides fault summary reporting.
        2) Channel Fault Word: Provides under-range, over-range and communications fault reporting.
        3) Channel Status Words: Provides individual channel under-range and over-range fault reporting for process alarm, rate alarms, and calibration faults.
    h. Provide 24 VDC power for analog instrument loops as a part of the system. Derive 24 VDC power supply from the 120 VAC input power circuit to the PLC control panel. Group the field side of the 24 VDC power sources(s) as individual or grouped (of logically associated circuits) fusing, and provide with a readily visible, labeled blown fuse indicator.

2. Differential Analog Input Module:
    a. Input Range: 0-20 mA, -10 to 10V dc, 0 to 10V dc, 0 to 5 V dc.
    b. Resolution: approximately 24 bits across range.
    c. Input Impedance: Greater than 249 Ohms.
    d. Isolation Voltage: 250V.
    e. Data Format: IEEE 32-bit floating point.
    f. Module Conversion method: Sigma-Delta
        1) Channel to Ground/Chassis - 100% tested at 1000 VDC minimum for 1s based on 250 VAC.
    g. Provide individual isolators, in addition to the surge suppression devices specified, in the control panels listed in Section 13330 Instrumentation and Controls – Control Panel and Panel Mounted Equipment for all signals that enter the panel from outside the building. Substitution of isolated analog input cards to meet this requirement is acceptable.

3. Isolated Analog Output Current Module:
    a. Output Current Range: 4 to 20 mA.
    b. Current Resolution: 16 bits.
    c. Open Circuit Detection: None.
    d. Output Overvoltage Protection: 24V DC/AC maximum.
    e. Output Short Circuit Protection: 20 mA or less (electronically limited).
    f. Calibration Accuracy: 0.05% of range from 4 mA to 20 mA.

g. Number of Points per Card: 8.

I. Communication Interfaces:

1. Supported protocols:
   a. EtherNet/IP
   b. CIP Sync / IEEE 1588
   c. CIP Motion
   d. CIP Safety
   e. Device-Level Ring (DLR)
   f. TCP/IP and UDP

2. Ports:
   a. Two (2) 10/100/1G Ethernet

3. Utilizing in-chassis communication modules or built-in ports on the PLC is acceptable to meet communication interface requirements.

J. Required Accessories:

1. Include all necessary cables as specified by the manufacturer. Assemble and install cables per manufacturer recommendations.

K. Manufacturers:
   a. Rockwell Automation Allen-Bradley, Model 1756 -L83E ControlLogix
   b. No Substitutions Allowed]

2.05 COMPACT PLC SYSTEM

A. General:

1. Provide processor, power supply, I/O modules, communication modules, and remote interface modules as required to meet system requirements.

2. PLC is modular-based, rather than chassis-based.

3. Listed and classified by UL, CSA, or FM approval as suitable for purpose specified and indicated.

4. Contains the required memory and functional capacity to perform the specified sequence of operation with the scheduled inputs and output points.

5. Designed for continuous industrial service.

6. Provide products of a single manufacturer.

7. Provide equipment models that are currently in production.

8. In the event of power interruption, the system undergoes an orderly shutdown with no loss of memory, and resumes normal operation without manual intervention when power is restored.

9. Provide PLCs that communicate between workstations, servers, instruments, switches, controllers, process actuators, etc., as shown on the Drawings.

10. PLC capable of stand-alone operation in the event of failure of the communication link to the HMI subsystem.

B. Physical:

1. Vibration: 5 g @ 10 to 500 Hz:
   a. DIN rail-mounted PLC
   b. In compliance with IEC 60068-2-6.

2. Shock Operating: 30 g, IEC 60068-2-27 (Test Ea, Unpackaged Shock)

3. Shock nonoperating: 50g IEC 60068-2-27 (Test Ea, Unpackaged Shock)

4. Operating Temperature: 32 to 140 degrees F (0 to 60 degrees C).

5. Nonoperating Temperature: -40 to 185 degrees F (-40 to 85 degrees C).

6. Relative Humidity: 5 to 95 percent, non-condensing.

7. ESD Immunity: 6 kV contact discharge; 8 kV air discharges

8. Enclosure: None (open-style)

C. Identification:

1. Identify all major assemblies and sub-assemblies, circuit boards, and devices using permanent labels or markings indicating:
   a. Module product type such as analog or digital.
   b. Module catalog number.
   c. Module major revision number.
   d. Module minor revision number.
   e. Module manufacturer vendor.
   f. Module serial number.

D. PLC Central Processing Unit (CPU):

1. General:
   a. Minimum 32-bit microprocessor with system timing and is responsible with scheduling I/O updates with no user programming required to ensure discrete or analog update.
   b. Executes user relay ladder logic programs, communicates with intelligent I/O modules, and performs on-line diagnostics.
   c. Consists of a single module which solves application logic, stores the application program, stores numeric values related to the application processes and logic, and interfaces to the I/O.
   d. Samples all discrete and analog inputs and outputs including internal coils and registers, and services special function modules every scan. The CPU processes the

I/O with user programs(s) stored in memory and controls outputs based on the results of the logic operation.

e. Supply the CPU with a battery-backed time of day clock and calendar.
f. CPU family allows for user program transportability from one CPU model to another.

2. Diagnostics:
   a. Perform on-line diagnostics that monitor the internal operation of the PLC. If a failure is detected, initiate orderly system shutdown and fail-over. Monitor the following, at a minimum:
      1) Memory failure.
      2) Memory battery low.
      3) General fault.
      4) Communications port failure.
      5) Scan time over run.
      6) I/O failure.
      7) Analog or special function I/O module failure.
   b. Make diagnostic information accessible to the host communications interfaces and to the PLC program.
   c. PLC indicators and on-board status area for the following conditions:
      1) CPU run.
      2) CPU error or fault.
      3) I/O failure or configuration fault.
      4) Status of Battery or back-up power module.
      5) Communications indicator.

3. Memory
   a. Provide non-volatile memory (Flash Memory) for program and data storage or equivalent.
   b. Memory Backup System: Provide lithium battery backup or equivalent capable of retaining all memory for a minimum of three months and a Flash memory system capable of reloading program in the event of memory loss.
      1) Backup Storage: Provide backup battery capable of being replaced without disrupting memory integrity. Provide a visual indication of low battery voltage or module error and an alarm bit in the PLC program.
      2) Flash SD Memory Card: Provide memory card storage with capacity greater than the processor memory capacity. Install memory cards in processors for factory testing.
   c. Operating system contained in non-volatile firmware.
   d. The memory containing the operating system is field updateable via a separate update tool.

4. Programming Environment
   a. Programming port: Use PLC Ethernet port for programming.
   b. On-Line programming: Application programs may be modified or stored while the CPU is running, with minimal impact on the scan time.
   c. Online programming including runtime editing.
   d. IEC 61131-3 programming languages supported: Ladder logic, function block, sequential function chart, and structured text.
   e. Supply all hardware and software necessary to program the CPU in these languages.

5. Communication Ports:

a. Provide expandable CPU supplied with additional modules to support the required communication interfaces.

6. Remote I/O Communications:
   a. Provide CPU capable of communicating with up to 12 remote base locations. Automatically sample and update all local and remote I/O modules each scan cycle of the CPU.
   b. Provide communication link between the CPU and any RIO chassis, as recommended by the PLC manufacturer.
   c. Provide diagnostic and equipment status information from each RIO.
   d. Provide remote I/O system with a remote input/output arrangement capable of operating at locations physically separated from the PLC CPU, as detailed on the drawings.
   e. Communicate with the remote I/O arrangement through cable, as recommended by the PLC manufacturer and provided by the PLC system supplier under this specification Section.

E. Power Supplies:

1. Power Input: 24 VDC.

2. Provide DC power supplies capable of handling 18 to 32 Vdc.

3. Power supply provide power for the processor and applicable modules.

4. Provide clearly visible LED to indicate that the incoming power is acceptable, and the output voltage is present.

5. Provide over-current and over-voltage protection designed to operate in most industrial environments without the need for isolation transformers.

6. Size power supplies to accommodate the nominal load plus 30%.

7. Provide power supplies capable of sustaining brown out conditions of at least 1/2 of a cycle, a harmonic rate of 10%, and continuous operation through momentary interruptions of AC line voltage of 10ms or less.

8. Automatically shut down the PLC system whenever its output power is detected as exceeding 125% of its rated power.

9. Provide surge protection.

F. Discrete Input & Output Modules:

1. General:
   a. Digital input and output modules provide ON/OFF detection and actuation capability.
   b. Provide cards of I/O type and count as required to implement the functions specified, plus an allowance for active spares, as specified herein.
   c. Provide modules capable of being installed or removed while chassis power is applied.
   d. Provide the following status indicators.

1) On/Off state of the field device.
2) Module's communication status.
3) Module health.

2. Module Specifications – 24VDC Input Module
   a. Nominal Input Voltage: 24VDC.
   b. On-State Current: 4mA minimum @ 10 Vdc.
   c. Maximum Off-State Voltage: 5VDC.
   d. Maximum Off-State Current: 1.5mA.
   e. Number of Points per Card: 16.

3. Module Specifications – 24VDC Output Module
   a. Nominal Input Voltage: 12/24VDC.
   b. On-State Current per Channel: 1mA minimum.
   c. On-State Voltage, max: 32 Vdc.
   d. Off-State leakage Current: < 0.5 mA per Point.
   e. Number of Points per Card: 16.

G. Analog Input & Output Modules:

1. General:
   a. Analog input modules convert an analog signal (1 to 5 Volts DC, 4 to 20 milliamps, for example) that is connected to the module's screw terminals into a digital value.
   b. Furnish analog output modules to convert a digital value that is delivered to the module into an analog signal on the module's screw terminals.
   c. Provide modules designed to be installed or removed while power is applied.
   d. Provide the following status indicators:
      1) Module's communication status.
      2) Module health.
      3) Input/output devices.
   e. Hardware and software indication provided when a module fault has occurred. Each module provided with an LED fault indicator and the programming software displays the fault information.
   f. Provide analog modules that are software configurable through the I/O configuration portion of the programming software.
   g. Following status can be examined in ladder logic:
      1) Module Fault Word: Provides fault summary reporting.
      2) Channel Fault Word: Provides under-range, over-range and communications fault reporting.
      3) Channel Status Words: Provides individual channel under-range and over-range fault reporting for process alarm, rate alarms, and calibration faults.
   h. Provide 24 VDC power for analog instrument loops as a part of the system. Derive 24 VDC power supply from the 120 VAC input power circuit to the PLC control panel. Group the field side of the 24 VDC power sources(s) as individual or grouped (of logically associated circuits) fusing, and provide with a readily visible, labeled-blown fuse indicator.

2. Differential Analog Input Module:
   a. Input Range: -10 to 10 Vdc, 0 to 10 Vdc, 0 to 5 Vdc, 0 to 20 mA, 4 to 20 mA.
   b. Resolution: approximately 16 bits across range.
   c. Input Impedance: Greater than 1 MOhms.

d. Overvoltage Protection: +/- 30 Vdc.
e. Normal Mode Rejection: 65 dB at 50/60 Hz.
f. Common Mode Noise Rejection: 130 dB at 50/60 Hz.
g. Isolation Voltage: 250V
    1) Channel to Ground/Chassis - 100% tested at 1000 VDC minimum for 1s based on 250 VAC.
h. Provide individual isolators, in addition to the surge suppression devices specified, in the control panels listed in Section 13330 Instrumentation and Controls – Control Panelsand Panel Mounted Equipment for all signals that enter the panel from outside the building. Substitution of isolated analog input cards to meet this requirement is acceptable.

H. Communication Interfaces:

1. Supported protocols:
    a. EtherNet/IP
    b. Dual-IP Mode

2. Ports:
    a. One 10/100/1G Ethernet
    b. USB 2.0 Type B

I. Required Accessories:

1. Include all necessary cables as specified by the manufacturer. Assemble and install cables per manufacturer recommendations.

J. Manufacturers:

1. Provide all PLCs from a single manufacturer. If the PLC manufacturer has authorized third party vendors to provide modules that are compatible with their platforms, then products manufactured by these authorized third-party vendors will be acceptable.
    a. Rockwell Automation Allen-Bradley, Model 5069 CompactLogix

2.06 PLC SOFTWARE

A. General:

1. Provide a PLC configuration and application development software package complete with documentation and installation media.

2. Install the PLC software package and associated licensing and/or activation on the computers shown on the Drawings.

3. Allows for on-line/off-line program development, annotation, monitoring, debugging, uploading, and downloading of programs to the PLCs.

4. Provide all required hardware (including cables, cable adapters, etc.) for connection to PLCs.

5. Provide all software licenses required to achieve the functionality described in the Specifications.

6. Include a software license agreement allowing PRASA's representative or PRASA the right to use the software as required for any current or future modification, documentation, or development of the PLCs provided for this project.

7. Provide software capable of the following IEC 61131-3 functions:
   a. Ladder logic.
   b. Function block.
   c. Sequential function chart.
   d. Structured text.

8. Add-on instruction editor allows for the development of custom reusable function blocks. The software permits function block modification while on-line.

9. Software is Microsoft Windows-based and run on the supplied computers.

10. Software includes a security feature to prevent unauthorized personnel from modifying and downloading the programs.

11. Provide an I/O simulator which allows the PLC application load program to be tested on a PC with simulated analog and digital inputs and outputs, allowing I/O testing and debugging to be performed in a safe, isolated environment without the need for running the PLC CPU and process I/O boards.

2.07 OPERATOR INTERFACE TERMINALS (OIT)

A. General:

1. OITs are standalone devices with an integrated hardware/software platform to monitor and control a process through an interactive display.

B. Features:

1. Software:
   a. OITs pre-packaged with all configuration and programming software necessary to perform functions as shown on drawings and within the specifications.
   b. Integrated OIT software has the following features:
      1) Trending
      2) Data logging
      3) Alarms
      4) Graphic symbols
      5) Animations

2. Hardware:
   a. Minimum one Secure Digital (SD) card slot

C. Communications:

1. Ports:

a. Minimum two (2) 10/100MB Ethernet
b. Minimum one (1) USB

2. Protocols:
a. EtherNet/IP
b. Modbus TCP/IP

D. Display:

1. Minimum of 6” viewable as measured diagonally across screen

2. Minimum display resolution
a. 320 x 240 for 4” to 6" displays
b. 800 x 600 for 8" to 10" displays
c. 1024 x 768 for 12" to 15” displays
d. 1280 x 1024 for displays larger than 15”

3. Color Active Matrix TFT.

4. Display supports touch screen input

5. Keypad physical buttons

E. Environmental:

1. Rating: OIT rated to maintain the rating of the control panel it will be mounted on and meet the area classification.

2. Operating Temperature: 32 to 122 degrees F (0 to 50 degrees C).

F. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
a. Schneider Electric, Model Harmony SCU series
b. Rockwell Automation Allen-Bradley, Model PanelView Plus 7 Performance series

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method:

1. Conductors and cables must be inside conduit.

2. Conceal conduit in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.02 IDENTIFICATION

A. Refer to drawings for tagging designations.]

3.03 FIELD QUALITY CONTROL

A. Manufacturer’s Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.]

B. PLCs and OITs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.04 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup services.

1. Complete installation and startup check according to manufacturer’s written instructions.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train PRASA’s representative or PRASA’s maintenance personnel to adjust, operate, and maintain units.

END OF SECTION

SECTION 13315
HMI SYSTEM SOFTWARE

PART 1 GENERAL

1.01 DEFINITIONS

A. Human Machine Interface (HMI): A software-based user interface with supervisory level control and machine level equipment.

B. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

C. Network Interface Card (NIC): A physical or virtual component that connects a computer to a network.

D. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

E. Virtual Machine (VM): An emulated computer system created by software. A VM shares the physical system resources of the host computer.

1.02 SCOPE OF WORK

A. This Section includes process control human-machine interface (HMI) software.

1.03 RELATED WORK

A. Section 13300 Instrumentation and Controls – General Provisions.

B. Section 13306 Instrumentation and Controls – Application Engineering Services.

C. Section 13310 Instrumentation and Controls – Computer System Hardware.

D. Section 13311 Instrumentation and Controls – PLC Hardware and Software.

1.04 SUBMITTALS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.05 COORDINATION MEETINGS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.06 REFERENCE STANDARDS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.07 QUALITY ASSURANCE

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Not applicable.

1.09 NOMENCLATURE AND IDENTIFICATION

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.10 WARRANTY

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.11 MAINTENANCE CONTRACT

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.12 PROJECT/SITE REQUIREMENTS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.13 SPARE PARTS

A. None required.]

1.14 TEST EQUIPMENT

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.15 TECHNOLOGY OBSOLESCENCE AND MITIGATION

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

PART 2 PRODUCTS

2.01 GENERAL

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

2.02 HUMAN MACHINE INTERFACE (HMI) SOFTWARE REQUIREMENTS

A. Manufacturer:

1. Manufacturers and their products are subject to compliance with requirements. Provide the following:
   a. AVEVA System Platform
   b. No Substitutions Allowed

B. Licensing Requirements:

1. Each facility must be provided with at least two physical computers, with two functioning as redundant IO server/automation objects servers.

2. Provide an HMI Supervisory client license for each SCADA node as shown on the Drawings.
    a. Provide the following licences for SCADA node
        1) AVEVA System Platform Runtime (bootstrap)
        2) AVEVA InTouch Runtime (InTouch Application Manager, InTouch Windows Viewer)

3. Provide as a supervisory client license and a communication driver license for each connected operator workstation as shown on System Architecture.
        1) Allow viewing of unlimited I/O points. [AVEVA Historian Client (Trend, Query)
        2) AVEVA Enterprise License Sever/Manager
        3) AVEVA Operation Integration Core
        4) AVEVA Operation Integration – Allen Bradley ABCIP
        5) AVEVA Operation Integration – Automation Direct KOYO
        6) AVEVA Operation Integration – Gateway Communication
        7) AVEVA Operation Integration – General Electric GESRTP
        8) AVEVA Operation Integration – Modbus MBTCP
        9) AVEVA Operation Integration – Siemens SIDIRECT

4. All licenses must be acquired under Puerto Rico Aqueduct and Sewer Authority (PRASA). Licenses under a third party name won't be allowed.

5. Allow collection of unlimited I/O points and have no licensing restrictions on the number of connected HMI clients.

6. Allow an unlimited number of graphic displays and allow an unlimited number of operator logins available.

7. AESS must have its own development licenses for HMI and application development licenses for application development purposes.
    a. Allow an unlimited number of graphic displays.

2.03 HISTORIAN SOFTWARE

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide the following:
    a. Local AVEVA Historian / AVEVA IDAS
    b. No Substitutions Allowed

2.04 REPORTING SOFTWARE

A. Manufacturers:

1. SQL Server Express and SQL Server Reporting Services installed.]

PART 3 EXECUTION

3.01 EXAMINATION

A. Not applicable.

3.02 INSTALLATION

A. Not applicable.

3.03 IDENTIFICATION

A. Not applicable.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. HMI software will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.05 STARTUP SERVICES

A. PCSS shall perform startup services.

1. Complete installation all required software and startup check according to manufacturer's written instructions.

2. Refer to specification section 13302 "testing" for validation of software installation to ensure complete and functional operation of provide applications.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train PRASA's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION

SECTION 13320
CONTROL AND DATA NETWORK EQUIPMENT

PART 1 GENERAL

1.1 DEFINITIONS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.2 SCOPE OF WORK

A. Furnish the labor and materials required to install and bring the control and data network into operation as shown on the Drawings and specified herein.

B. The network shall support communications between all servers, operator workstations, PLCs, RTUs, and other communication devices, as shown on the system architecture block diagram(s). Furnish all necessary cables, face plates, connectors, modems, transceivers, repeaters, modules, splice kits, etc., for a complete and operational network. The system architecture diagram(s) are for network understanding only. Some communication devices may be required for network operation, which may not be explicitly shown on the Drawings. The system shall be designed to accommodate an increase of 100 percent of network nodes.

C. Furnish and install a complete data highway that supports communications between all PLCs, RIOs, Network Capable Equipment, and IIot devices, as shown on the system architecture block diagram. Furnish all necessary cables, face plates, connectors, modems, transceivers, repeaters, modules, splice kits, etc., for a complete and operational data highway.

D. The control and data network shall include all nodes on the network. Communication between nodes may be via Ethernet, Fiber Optic, Serial, Fieldbus, or another method, as shown in the Drawings.

1.3 RELATED WORK

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.4 SUBMITTALS

A. Refer to Sections 13300 Instrumentation and Controls – General Provisions.

B. Descriptive literature, bulletins, catalog cuts, and Drawings for the equipment specified herein.

C. Complete bill of materials for the equipment.

D. Spare parts list.

E. Complete system architecture diagram showing, in schematic form, the interconnections between major hardware components, including control centers, panels, power supplies, consoles, computer and peripheral devices, networking equipment, processors, I/O modules, local operator interfaces, process equipment vendor controllers, and like equipment. The system architecture shall be complete and depict all required cables, media type between components, the network protocol used at each network level, and details on connection requirements such as

cable pin-outs, port numbers, and rack slot numbers. This specification requirement intends to develop a complete diagram to allow the purchase of all required equipment by part number and allow a qualified technician to interconnect all equipment without referring to additional manuals or literature. Sheet size shall be 11"x17", and using more than one sheet is acceptable.

1.5 COORDINATION MEETINGS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.6 REFERENCE STANDARDS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: The Cabling Installer must have personnel certified by BICSI or with 5 years of demonstrated experience providing a list of similar projects during the last two years.

1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by a Technician.

2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at the Project site.

B. Testing Agency Qualifications: The testing agency must have personnel certified by BICSI or an on-site supervisor with 5 years of experience providing a list of similar projects during the last two years.

1.9 WARRANTY

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.10 MAINTENANCE CONTRACT

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.11 PROJECT/SITE REQUIREMENTS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.12 SPARE PARTS

A. General requirements for spare parts are specified in section 13300 Instrumentation and Controls – General Provisions.

B. The following Network and Communications System spare parts shall be furnished:

1. One switch of each type is provided.

2. One media converter of each type provided

3. Manufacturer's cables - one of each type installed.

4. Five-10ft CAT 6 cables with connectors installed

1.13 TEST EQUIPMENT

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.14 TECHNOLOGY OBSOLESCENCE AND MITIGATION

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

PART 2 PRODUCTS

2.1 GENERAL

A. A manufacturer's name and model or catalog number are used to establish the standard of quality and general configuration desired.

2.2 PANEL MOUNT MANAGED ETHERNET DISTRIBUTION SWITCH

A. General:

1. Provide a panel mount managed Ethernet switch for connection to the network as shown in the Drawings and specified herein.

2. Provide ethernet switches by the same manufacturer for the project, regardless of the type.

B. Physical Features:

1. Refer to the system architecture diagram and Ethernet Switch Schedule for the number of switches and ports.

2. Construction such that additional copper and fiber ports can be added and removed.

3. SFP slots: 8 x 1G SFP slots.

4. Power-over-Ethernet (PoE) copper ports: 4 x 10/1000/ ports.

5. Copper ports: 8 x 10/1000 ports.

6. Operating temperature: -40 to 140 degrees F (-40 to 60 degrees C)

7. Power: 15…54 Vdc.

8. Enclosure: Metal case.

9. Rating: UL Class 1, Division 2 Groups A, B, C, and D, when required.

C. Network Features:

1. Operative System must be CISCO IOS

2. Layer 2

3. Support CIP Ethernet/IP, PROFINET v2, IEEE1588 PTP v2, Modbus TCP, Default Profile, CIP Time Sync, NTP to PTP Translation, SPAN Traffic Time Stamping.

4. Topology: Support Redundancy Resilient Ethernet Protocol (REP), Parallel Redundancy Protocol PRP. Support stackable connection for network expansion.

5. Spanning Tree Protocol (STP).

6. Rapid Spanning Tree Protocol (RSTP) (IEEE 802.1w).

7. Full duplex on all ports.

8. Auto-negotiation and manual configurable speed and duplex.

9. Wire speed-switching fabric.

10. IGMP snooping.

11. IGMP filtering.

12. Configuration password protected.

13. Configuration backup capability required.

14. SNMP V3.

15. Lock port function for blocking unauthorized access based on MAC address.

16. Uplink port.

D. Additional Features:

1. Provide a dry contact rated for 120 VAC 5A for common trouble and programmable alarms. If the contact cannot use 120 VAC 5A, provide the necessary 24 VDC power from the PLC panel and provide interposing relays in the PLC panel.]

E. Accessories

1. SFP modules/transceivers:
   a. 8 single-mode 1G modules.
   b. 8 multi-mode 1G modules.

F. Acceptable Manufacturers

1. Allen Bradley, Model 5800

2. Or Approved Equal

2.3 INDUSTRIAL-MANAGED ETHERNET SWITCHES

A. General

1. Refer to the system architecture diagram and Ethernet Switch Schedule for the number of switches and ports.

2. Provide a managed Ethernet switch(s) for connection to the control network backbone as shown in the Drawings and specified herein.

3. Provide ethernet switches by the same manufacturer for the project, regardless of the type.

B. Physical Features

1. SFP slots: 2 x 1G SFP slots (Combo ports)

2. Copper ports: 8 x 100/1000 Full FW, DLR, PRP,NAT, quantity as the schedule requires.]

3. Operating temperature: -40 to 140 degrees F (-40 to 60 degrees C)

4. Power: 24 VDC

5. Enclosure: Metal case, DIN-rail mountable

6. Rating: None (open-style)

C. Network Features

1. The Operative System must be CISCO IOS.

2. Layer 2 switching

3. Fault tolerant for use in a ring topology if shown on drawings. The switch shall be able to detect a blocked port and redirect data flow in the opposite direction. The 200 ms profile supports a maximum recovery time of 200 ms.

4. Spanning Tree Protocol (STP).

5. Industrial Ethernet : Support CIP Ethernet/IP, PROFINET v2, IEEE1588 PTP v2 Modbus TCP, Default Profile, CIP Time Sync, NTP to PTP Translation.

6. Topology: Support Redundancy Resilient Ethernet Protocol (REP), Parallel Redundancy Protocol PRP, Device Level Ring DLR.

7. Rapid Spanning Tree Protocol (RSTP) (IEEE 802.1w).

8. Full duplex on all port.

9. Auto-negotiation and manual configurable speed and duplex.

10. Wire speed-switching fabric.

11. IEEE 802.1w RSTP.

12. IGMP snooping.

13. IGMP filtering.

14. Configuration password protected.

15. Configuration backup capability required.

16. SNMP V3.

17. Lock port function for blocking unauthorized access based on MAC address.

18. Uplink port.

D. Additional Features

1. The converter shall come equipped with a dry contact rated for 120 VAC 5A that shall be used for common trouble alarms. The alarm shall be programmable. If the contact cannot use 120 VAC 5A, provide the necessary 24 VDC power from the PLC panel and provide interposing relays in the PLC panel.]

E. Acceptable Manufacturers

1. Stratix, Model Stratix 5200 Series, Stratix 5800 Series.

2. Or Approved Equal

2.4 ETHERNET MEDIA CONVERTERS

A. General

1. Provide Ethernet media converter(s) as shown in the Drawings and specified herein.

B. Physical Features

1. RJ45 ports: 10/100BaseTX to 100BaseTX

2. Fiber uplinks: 100BaseTX to 100BaseFX (ST/SC connectors)

3. Fiber optics: Multi- or single-mode capability as shown in the Drawings

4. Operating temperature: 32 to 130 degrees F (-17 to 54 degrees C)

5. Power: 24 VDC

6. Enclosure: DIN-rail mountable

C. Acceptable Manufacturers

1. Phoenix Contact, Model FL MC 2000E LC - FO converters.

2. N-Tron, Model 1002MC-LX-10

3. Moxa, Model PTC-101-M-LC-HV

4. Or Approved Equal

2.5 FIBER OPTIC

A. Refer to specification section 13321 for Fiber Optic cable specifications.]

2.6 ETHERNET WIRES AND CONNECTORS

A. CAT 6 Ethernet 10/100/1000 BASE-T/TX Cable.

1. Description: Four-pair, balanced-twisted pair cable,[with internal spline,] certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.

2. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.

3. Conductors: 100-ohm, 23 AWG solid copper.

4. Shielding/Screening: Shielded balanced twisted pairs (FTP).

5. Cable Rating: Plenum.

6. Jacket: Orange, Aqua, Yellow thermoplastic.

B. CATEGORY 6a TWISTED PAIR CABLE

1. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6a cable at frequencies up to 500MHz.

2. Standard: Comply with TIA-568-C.2 for Category 6a cables.

3. Conductors: 100-ohm, 23 AWG solid copper.

4. Shielding/Screening: Shielded balanced twisted pairs (FTP)

5. Cable Rating: Plenum.

6. Jacket: Orange, Aqua, Yellow thermoplastic.

C. [RIO Data Highway Cable

1. The RIO data highway cable shall be a plenum-rated cable recommended by the PLC manufacturer. All terminations shall be done in a professional and workmanlike manner. Terminations shall provide for proper strain relief on the cable jacket. Strain relief on the wire and/or wire insulation shall not be acceptable.]

D. CABLING IDENTIFICATION

1. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

E. SOURCE QUALITY CONTROL

1. Testing Agency: Engage a qualified testing agency to evaluate cables.

2. Factory test cables on reels according to TIA-568-C.1.

3. Factory test cables according to TIA-568-C.2.

4. Cable will be considered defective if it does not pass tests and inspections.

5. Prepare test and inspection reports.

F. INSTALLATION OF COPPER CABLES

1. Comply with NECA 1 and NECA/[BICSI 568.

2. General Requirements for Cabling:
   a. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.
   b. Comply with BICSI's "Information Transport Systems Installation Methods Manual (ITSIMM)," Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
   c. Install 110-style IDC termination hardware unless otherwise indicated.
   d. Do not untwist twisted pair cables more than 1/2 inch from the termination point to maintain cable geometry.
   e. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
   f. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
   g. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
   h. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified by the manufacturer. Use lacing bars and distribution spools.
   i. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice the cable between termination, tap, or junction points. Remove and discard the cable if it is damaged during installation and replace it with a new cable.
   j. In the communications equipment room, install a 10-foot-long service loop on each end of the cable.
   k. Pulling Cable: Comply with manufacturer recommendations. Monitor cable pull tensions.

3. Separation from EMI Sources:
   a. Comply with BICSI's "Telecommunications Distribution Methods Manual" recommendations and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.

b. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
   1) Electrical Equipment Rating Less Than 2 kVA: At least 5 inches
   2) Electrical Equipment Rating between 2 and 5 kVA: At least 12 inches.
   3) Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches
c. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
   1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches
   2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches
   3) Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches
d. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
   1) Electrical Equipment Rating Less Than 2 kVA: No requirement.
   2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches
   3) Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches
e. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches
f. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.]

2.7 OTHER DEVICES

A. Not Applicable

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.]

B. Wiring Method:

1. Conductors and cables must be inside conduit.

2. Conceal conduit in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.2 IDENTIFICATION

A. Refer to control system architecture for tagging designations.]

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

Network system will be considered defective if they do not pass tests and inspections.

B. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. PCSS shall perform startup service.

1. Complete installation and startup checks according to the manufacturer's written instructions.

2. Refer to specification section 13302 “testing” for validation of software installation to ensure complete and functional operation of provide applications.

3. For Managed Ethernet Switches:
   a. The owner will provide the IP addresses and segments.
   b. Enable the lock port function to block unauthorized access based on MAC address for each switch and router. Assign static IP addresses to devices connecting to switch.
      1) Lock down all spare switch and router ports.

3.5 ESTABLISHING COMMUNICATIONS

A. The PCSS is responsible for establishing all Remote site communications, RIO communications, PLC to PLC communications, PLC to HMI/OIT communications, and all other network and communication systems shown on the drawings. The PCSS shall perform the following tasks to ensure this communication is achieved:

1. Coordinating with the contractor at the beginning of the project to determine which vendor packages are provided with PLCs. The PCSS shall submit the listing of these PLCs as part of their Hardware submission for review by the Engineer.

2. Identifying any additional hardware or software required to ensure communications as part of the PCSS hardware submittal.

3. Coordinate with PRASA to determine a suitable IP subnet.

4. During factory testing and field testing, the PCSS must demonstrate communications to the Engineer. The burden of proof of communications is the transfer of 1 analog and one discrete register in both directions. The PCSS must turn over all configuration files and programming to the AESS upon successful testing.

5. Assistance during field testing by on-site when AESS tests communications with their software.

3.6 SWITCHES SCHEDULE

1. Provide the devices in the following schedules:

Table 1. Ethernet Switch Schedule

Switch Designation	Type	Mount	Fiber Uplinks (1G/10G SFP)	Copper Ports (10/100/1000 BaseT(X), RJ45)	PoE Copper Ports (10/100/1000 BaseT(X), RJ45)	Panel
NS-180	Modular base, Layer 2 managed Ethernet switch	Din Rail	2GE	8GE	-	CP-01
NS-185	Modular base, Layer 2 managed Ethernet switch	Din Rail	2GE	8GE	-	CP-01
NS-180	Layer 2, fully managed industrial Ethernet switch	Din Rail	2GE Combo	8GE	-	RIO 1
NS-160	Layer 2, fully managed industrial Ethernet switch	Din Rail	2GE Combo	8GE	-	RIO 2
NS-148	Layer 2, fully managed industrial Ethernet switch	Din Rail	2GE Combo	8GE	-	RIO 3
NS-160	Layer 2, fully managed industrial Ethernet switch	Din Rail	2GE Combo	8GE	-	RIO 4
NS-185	Layer 2, fully managed industrial Ethernet switch	Din Rail	2GE Combo	8GE	-	CP-F-1_2
NS-185	Layer 2, fully managed industrial Ethernet switch	Din Rail	2GE Combo	8GE	-	CP-F-3_4

]

END OF SECTION

SECTION 13321
FIBER OPTIC CABLING AND EQUIPMENT

PART 1 GENERAL

1.01 DEFINITIONS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

B. BICSI: Building Industry Consulting Service International.

C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

D. RCDD: Registered Communications Distribution Designer.

1.02 SCOPE OF WORK

A. The Work of this Section includes providing a fiber optic communications infrastructure including, but not limited to, fiber optic cable (FOC), patch panels, terminations, testing, and implementation.

B. The Work includes testing individual fiber cables installed under this Contract, and testing a completed fiber optic communications network.

1.03 RELATED WORK

C. Process Instrumentation and Control System in Section 13300 Instrumentation and Controls - General Provisions.

1.04 SUBMITTALS

A. Submit to the Designer the following:

1. Catalog Data: Catalog data on fiber-optic cable, termination devices, patch panels, breakout enclosures, splice kits, pigtails, and fan-outs where applicable. Product data sheets shall include the manufacturer's name and catalog number for each item, the manufacturer's descriptive literature, catalog cuts, and any power supply requirements.

2. Certification of compliance in writing stating the fiber optic cable, anticipated layout, and components are compatible, acceptable for use, and in compliance with these specifications.

3. Detailed bill of materials for fiber-optic cable, terminations, patch panels, breakout enclosures, splice kits, connectors, pigtails, and fan-outs.

4. Drawings indicating the locations of all patch panels, termination points, or breakout enclosures.

5. Catalog data on all testing devices proposed for use plus certifications of accuracy, calibration, and traceability to standards of the National Institute for Standards and Testing.

B. Installer qualifications per section 1.07.C

C. The Fiber Optic System Supplier shall provide a fiber optic power budget for each cable run in excess of 1000 feet. The budget shall include transmitter power, receiver sensitivity, connector losses, cable losses, and a 3db-aging margin. Fiber optic transmission line shall maintain a minimum of 10db safety margin.

D. Training plan and schedule for fiber optic cable termination training.

E. Test reports.

F. O&M manuals.

1.05 COORDINATION MEETINGS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.06 REFERENCE STANDARDS

A. The optical fiber cable shall conform to the latest issue of the following standards documents, which are incorporated by reference into this specification:

1. EIA-455: Standard Fiber Optic Test Procedures (FOTPs) Devices.
2. EIA-598-A: Standard Colors for Color Identification and Coding.
3. MIL-202: Test Methods for Electronic and Electrical Component Parts.
4. MIL-454: Standard General Requirements for Electronic Equipment.
5. MIL-810: Environmental Test Methods and Engineering Guidelines.
6. EIA-568-B.3: Commercial Building Telecommunications Cabling Standard: Optical Fiber Cabling Components.
7. ICEA 5-83-696: Fiber Optic Premises Distribution Cable (Indoor/Outdoor).
8. National Electrical Code (NEC) Article 770.
9. UL 1581 VW-1 - Vertical Tray Cable Flame Test.
10. UL 1666 - UL Standard for Safety Test for Flame-Propagation Height of Electrical and Optical-Fiber Cables Installed in Vertical Shafts.
11. NFPA 262 – Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use IN Air-Handling Spaces.
12. IEEE Standard 383 - Flame Retardancy.
13. DOD-STD-1678.
14. National Electrical Manufacturers Association (NEMA).

15. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

B. All fiber optical cables shall be constructed in accordance with EIA-455, and 100 percent of all optical fibers and jacketing shall meet or exceed the requirements contained in this specification.

1.07 QUALITY ASSURANCE

A. The cable manufacturer shall be ISO9001 certified and registered.

B. The fiber optic cabling system materials furnished under this Section shall be provided by Fiber Optic Suppliers who have been providing these types of materials for the past three years. The Fiber Optic Suppliers shall provide personnel capable of providing technical assistance during installation.

C. Installer Qualifications: The Cabling Installer must have personnel certified by BICSI or with 5 years of demonstrated experience providing a list of similar projects during the last two years.

1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by a Technician.

2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.

D. Testing Agency Qualifications: The testing agency must have personnel certified by BICSI or an on-site supervisor with 5 years of experience providing a list of similar projects during the last two years.

E. The Designer shall determine whether a product is an Equal based upon the information listed herein and the manufacturer's data sheets regarding the models specified. Alternate equipment must meet the criteria listed herein and any additional information in the manufacturer's data sheets in order to be accepted as an Equal.

1.08 DELIVERY, STORAGE, AND HANDLING

A. The cable shall be packaged in cartons and/or wound on spools or reels. Each package shall contain only one continuous length of cable. The packaging shall be constructed so as to prevent damage to the cable during shipping and handling.

B. When the length of an order requires a large wooden reel, the cable will be covered with a three-layer laminated protective material. The outer end of the cable shall be securely fastened to the reel head so as to prevent the cable from becoming loose in transit. The inner end of the cable shall project into a slot in the side of the reel or into housing on the inner slot of the drum, in such a manner and with sufficient length to make it available for testing.

C. Test tails shall be at least two meters long. The inner end shall be fastened so as to prevent the cable from becoming loose during shipping and installation. Reels shall be permanently marked with an identification number that can be used by the manufacturer to trace the manufacturing history of the cable and fiber.

D. Wooden reels shall be plainly marked to indicate the direction in which it should be rolled to prevent loosening of the cable on the reel.

E. All fiber optic cables shall be attenuated tested. The attenuation of each fiber shall be provided with each cable reel by the manufacturer.

F. The attenuation shall be measured at 1310 nm and 1550 nm for single-mode fibers and 850nm and 1300nm for multimode fiber cables after received on site. The manufacturer shall submit the test results prior to installation of the cable.

G. Packaging

1. The completed cable shall be packaged for shipment on non-returnable wooden reels. It is the responsibility of the Contractor to determine all required cable lengths.

2. Top and bottom ends of the cable shall be available for testing.

3. Both ends of the cable shall be sealed to prevent the ingress of moisture.

4. Each reel shall have a weatherproof reel tag attached identifying the reel and cable. The reel tag shall include the following information:

a. Cable Number Gross Weight.
b. Shipped Cable Length in Meters.
c. Product Number.
d. Date Cable was Tested.
e. Cable Length Markings Item Number.

H. Each cable shall be accompanied by a cable data sheet.

1.09 NOMENCLATURE AND IDENTIFICATION

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.10 WARRANTY

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.11 MAINTENANCE CONTRACT

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.12 PROJECT/SITE REQUIREMENTS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.13 SPARE PARTS

1. Provide a minimum five percent spares of ST connectors and dust covers, but not less than 20 spare ST style connectors and 40 dust covers.

2. Provide a minimum five percent spare 36" spare multimode patch cables with connectors (both ends) terminated, but not less than ten 36" spare multimode patch cables with connectors (both ends) terminated.]

1.14 TEST EQUIPMENT

A. Test Equipment and Tools

1. One complete fiber optic connector termination tool kit. The kit shall be the high-performance tool kit, compatible with LC, SC and ST connectors, Model TKT-UNICAM-PFC by Corning Cable Systems, or approved equal.

2. Optical power source and test meter shall be a combination type unit in a single handheld device.

a. Optical source shall provide stable transmission of plus or minus 0.1dB at 23 degrees C (73 degrees F) for eight hours with accurate wavelengths. Sources shall be 850/1300nm multimode (LED) and 1310/1550nm (multimode) or combined quad wavelength source. Provide with visual fault locator (VFL).
b. Test meter utilizes InGaAs wide area detector calibrated for 850, 1300, 1550, and 1625nm wavelengths. Provide fiber identification by audible detection of 2 kHz tone.

c. Provide data storage: Windows-based PC software and cabling for reports, printing, viewing, and export.
d. Power source/meter shall include jumpers, sleeves, cleaning kit, and transit case.

1.15 TECHNOLOGY OBSOLESCENCE AND MITIGATION

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

PART 2 PRODUCTS

2.01 GENERAL

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

2.02 GENERAL MATERIALS

A. Cabinets: cabinets shall be provided as indicated on the contract Drawings.

B. Provide tight buffered cables that are not gel filled and are suitable for indoor/outdoor applications. These cables shall be flame retardant for indoor applications and water and fungus resistant for outdoor applications.

C. Optical Fiber Characteristics

1. All fibers in the cable must be usable fibers and meet required specifications.

2. Each optical fiber shall consist of a doped silica core surrounded by a concentric silica cladding. The fiber shall be matched clad design.

D. Manufacturers

1. Corning Cable Systems Corp.

2. CommScope.

3. Belden Cable.

4. Or Approved Equal.

2.03 PERFORMANCE REQUIREMENTS

A. General Performance: Fiber optic cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.

2. Smoke-Developed Index: 450 or less.

C. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

D. Grounding: Comply with TIA-607-B.]

2.04 850 NANOMETER LASER-OPTIMIZED, 50/125 MICROMETER, MULTIMODE OPTICAL FIBER CABLE (OM3)

E. Description: Multimode, 50/125-micrometer, 4-fiber, nonconductive tight buffer, optical fiber cable.

F. Standards:

1. Comply with ICEA S-83-596 for mechanical properties.

2. Comply with TIA-568-C.3 for performance specifications.

3. Comply with TIA-492AAAC for detailed specifications.

G. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.

H. Minimum Overfilled Modal Bandwidth-length Product: 1500 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

I. Minimum Effective Modal Bandwidth-length Product: 2000 MHz-km at 850 nm.

J. Jacket:

K. Jacket Color: Aqua.

L. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.

M. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

N. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

1. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.]

2.05 850 NANOMETER LASER-OPTIMIZED, 50/125 MICROMETER, MULTIMODE OPTICAL FIBER CABLE (OM4)

A. Description: Multimode, 50/125-micrometer, 4-fiber, nonconductive tight buffer, optical fiber cable.

B. Standards:

1. Comply with ICEA S-83-596 for mechanical properties.

2. Comply with TIA-568-C.3 for performance specifications.

3. Comply with TIA-492AAAD for detailed specifications.

C. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.

D. Minimum Overfilled Modal Bandwidth-length Product: 3500 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

E. Minimum Effective Modal Bandwidth-length Product: 4700 MHz-km at 850 nm.

F. Jacket:

1. Jacket Color: Purple.

2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.

3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

G. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

1. [Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.]

2.06 9/125 MICROMETER SINGLE-MODE, INDOOR-OUTDOOR OPTICAL FIBER CABLE (OS1)

H. Description: Single mode, 9/125-micrometer, 6 fibers, single loose tube, armored optical fiber cable.

I. Standards:

1. Comply with TIA-492CAAA for detailed specifications.

2. Comply with TIA-568-C.3 for performance specifications.

3. Comply with ICEA S-104-696 for mechanical properties.

J. Armored cable shall be [steel] [aluminum] armored type.

K. Maximum Attenuation: 0.4 dB/km at 1310 nm; 0.3 dB/km at 1550 nm.

L. Jacket:

1. Outer Jacket Color: Black.

2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.

3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

M. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

1. Riser Rated, Armored (Conductive): Type OFNR in metallic conduit.

2.07 9/125 MICROMETER, SINGLE-MODE, INDOOR-OUTDOOR OPTICAL FIBER CABLE (OS2)

A. Description: Single mode, 9/125-micrometer, 6 fibers, single loose tube, optical fiber cable.

B. Standards:

1. Comply with TIA-492CAAB for detailed specifications.

2. Comply with TIA-568-C.3 for performance specifications.

3. Comply with ICEA S-104-696 for mechanical properties.

C. Maximum Attenuation: 0.4 dB/km at 1310 nm; 0.3 dB/km at 1550 nm.

D. Jacket:

1. Jacket Color: Yellow.

2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.

3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

E. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

1. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.]

2. Riser Rated, Nonconductive: Type OFNR or Type OFNP, complying with UL 1666.]

2.08 9/125 MICROMETER SINGLE-MODE, INSIDE PLANT OPTICAL FIBER CABLE (OS2)

A. Description: Single mode, 9/125-micrometer, 6 fibers, single loose tube, optical fiber cable.

B. Standards:

1. Comply with TIA-492CAAB for detailed specifications.

2. Comply with TIA-568-C.3 for performance specifications.

3. Comply with ICEA S-83-596 for mechanical properties.

C. Maximum Attenuation: [0.5] [Insert number] dB/km at 1310 nm; [0.5] [Insert number] dB/km at 1550 nm.

D. Jacket:

1. Jacket Color: Yellow.

2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.

3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

E. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

1. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.

2. Riser Rated, Nonconductive: Type OFNR or Type OFNP, complying with UL 1666.]

2.09 9/125 MICROMETER SINGLE-MODE, OUTSIDE PLANT OPTICAL FIBER CABLE (OS2)

A. Description: Single mode, 9/125-micrometer, 6 fibers, single loose tube, optical fiber cable.]

B. Standards:

1. Comply with TIA-492CAAB for detailed specifications.

2. Comply with TIA-568-C.3 for performance specifications.

3. Comply with ICEA S-87-640 for mechanical properties.

C. Maximum Attenuation: 0.4 dB/km at 1310 nm; 0.3 dB/km at 1550 nm.

D. Jacket:

1. Jacket Color: Black

2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.

3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).]

2.10 OPTICAL FIBER CABLE HARDWARE

A. Standards:

1. Comply with Fiber Optic Connector Intermateability Standard (FOCIS) specifications of the TIA-604 series.

2. Comply with TIA-568-C.3.

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths.

D. Connector Type: Type LC complying with TIA-604-10-B

E. Plugs and Plug Assemblies:

1. Male; color-coded modular telecommunications connector designed for termination of a single optical fiber cable.

2. Insertion loss not more than 0.75 dB.

F. Jacks and Jack Assemblies:

1. Female; quick-connect, simplex and duplex; fixed telecommunications connector designed for termination of a single optical fiber cable.

2. Insertion loss not more than 0.75 dB.

3. Designed to snap-in to a patch panel or faceplate.]

2.11 CABLE IDENTIFICATION

A. The individual fibers shall be color coded for identification. The optical fiber color coding shall be in accordance with EIA/TIA-598, "Color Coding of Fiber Optic Cables." The coloring material shall be stable over the temperature range of the cable, shall not be susceptible to migration, and shall not affect the transmission characteristics of the optical fibers. Color coded buffered fibers shall not adhere to one another. When fibers are grouped into individual units, each unit shall be numbered in the unit jacket for identification. The number shall be repeated at regular intervals.

B. The outer cable jacket shall be marked with the manufacturer's name or UL file number, date of manufacture, fiber type, flame rating, UL symbol, and sequential length markings every two feet. The markings shall be in contrasting color to the cable jacket.

2.12 CABLE TESTING REQUIREMENTS

A. Fiber cables shall be tested in accordance with the following industry standard (EIA-455) tests:

1. FOTP-41, Compressive Loading Resistance Test.
2. FOTP-104, Fiber Optic Cable Cyclic Flexing Test.
3. FOTP-25, Repeated Impact Testing.
4. FOTP-33, Fiber Optic Cable Tensile Loading and Bending Test.
5. FOTP-85, Fiber Optic Cable Twist Test.
6. FOTP-181, Lightning Damage Susceptibility Test.
7. FOTP-3, Procedure to Measure Temperature Cycling Effects on Optical Fibers, Cables, and other Passive Fiber Optic Components.
8. FOTP-82, Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable.
9. FOTP-37, Low or High Temperature Bend Test for Fiber Optic Cable.
10. FOTP-98, External Freezing Test.
11. FOTP-27, Fiber Diameter Measurements.
12. FOTP-28, Measurement of Dynamic Tensile Strength.
13. FOTP-34, Interconnection Device Insertion Loss Test.
14. FOTP-89, Cable Jacket Elongation and Tensile Strength Test.

B. The Contractor shall submit laboratory test reports on representative samples of similar cable design to demonstrate compliance prior to cable installation.

2.13 FIBER CABLE TERMINATIONS, CONNECTORS, AND CABLE ASSEMBLIES

A. Pigtail Splicing

1. For termination of fiber cables at a termination or connector panel (patch panel), with one end of a piece of cable preconnectorized and the other end unterminated for splicing to the cable that needs to be terminated. Splicing and connectors shall meet the requirements listed in this Section.
2. A splice/termination tray shall house the splices and serve to fully protect excess lengths of loose tube fibers from exposure. Splice tray shall be compatible with the selected patch panel and installed for easy access to the spliced cable sections.
3. Pigtail assemblies shall match fiber cable type and model and shall be as manufactured by Corning Cable Systems or equal.

B. Buffer Tube Fan-Out Kits

1. Individual fibers within a loose tube cable with 250 µm coated fibers shall use a fan-out kit to maintain flexibility and ease of handling fibers within a termination cabinet. Fan-out kits shall be installed in the patch panel enclosures to transition the loose tube fibers to ruggedized tight-buffered fiber pigtail cables. Optical fusion splices shall connect the loose tube fibers to the tight-buffered pigtail cables. The optical splice loss shall comply with the specifications for optical splices. Splice protection sleeves shall be employed on all splices to protect the splices.

2. The tight-buffered pigtails shall be factory-preconnectorized with STTM connectors as specified.

C. Connectors (Cable Assemblies)

1. The fiber optic communications system shall utilize stainless steel LC style connectors for all fiber optic connections. ST style connectors will be acceptable only if LC style connectors are not compatible with the equipment being provided. The connectors shall be designed for use with 50/62.5/125/250 micron cable. Each connector shall cause a maximum signal attenuation of 1.6 dB.

2. Factory-Installed Connectors: All cable assemblies shall have connectors installed at the factory. The connectors shall provide tight-fitting termination to the cladding and buffer coating. Epoxy-based or "hot melt "adhesives shall be used to bond the fiber and buffer to the connector ferrule and body prior to polishing the endface.]

3. Field-Installed Connectors: LC design with ceramic or polymer ferrule and strain relief boot. The connector installation shall not require the use of epoxies, adhesives or ovens. The connector shall be installable upon 900 µm buffered fiber in one minute or less and upon 2.9 mm jacketed cable in three minutes or less total time. The connector shall contain a mechanical splice and have a tool kit available to aid in assembly. The installation tools used to terminate the connector shall be able to terminate other small-form-factor and single-fiber UniCam connector designs. The connector shall not require end-face polishing in the field. The connector shall have a factory polished optical fiber stub in the connector ferrule that is bonded in the ferrule micro hole. Ferrule material shall be available in ceramic or polymer. Connector specifications shall be as follows:

   a. Insertion loss (typical): 0.3 dB
   b. Durability (mating cycles): 500 (minimum)
   c. Repeatability: Less than 0.2 dB
   d. Operating Temperature: 0 to plus 60 degrees C]

4. After termination with connectors, the fiber ends must be visually inspected at a magnification of not less than 100 power for multimode and 200x for single mode to check for cracks or pits in the endface of the fiber.

5. Connectors shall have a maximum allowable connection loss of 0.3 dB per mated pair, as measured per EIA-455-34. No index-matching gel is to be used; dry interfaces only.

6. Each connector shall be of the industry standard ST type compatible; designed for single-mode and multimode tolerances; shall meet or exceed the applicable provisions of EIA-455-

5, 455-2A, and 455-34; and shall be capable of 100 repeated ratings with a maximum loss increase of 0.1 dB. Connectors shall incorporate a key-way design and shall have a Zirconia ceramic ferrule. Connector bodies and couplings shall be made of corrosion-resistant and oxidation-resistant materials such as nickel-plated zinc, designed to operate in humid environments without degradation of surface finishes. Connectors shall be capable of operating in a range of -40 to 80 degrees C.

7. Manufacturers

   a. Corning Cable Systems, Hickory, NC
   b. AMP, Inc., Harrisburg, PA
   c. 3M Telecom Systems Group, Austin, TX
   d. Or Approve equal.

D. Fiber Optic Patch Cables

1. Fiber optic patch cable shall be two-fiber zipcord 50/125 core micron multimode riser rated cable.

2. Installation of patch cables shall include all spares and observe the minimum fiber bend radius and strain relief.

2.14 FIBER OPTIC TERMINATION PATCH PANELS

A. General

1. Patch panels shall be suitable for wall mounting, comprised of internal mounting plate, cable holders, slack cable take up/organizer blocks, patch block with connectors, and ground lugs as indicated. Panels shall be NEMA 4X, 316 stainless steel construction for outdoors; and NEMA 12, 316 stainless steel or fiberglass for indoor use. Patch panels shall be suitable for operation at the wavelengths of the fiber optics cables patched in the panel. Patch panels shall be suitable for ST or LC connectors. The patch panels shall be sized to handle the number of fibers as required. All fibers shall be terminated in the patch panel.

2. Where shown on the plans or in the related specification Sections, the fiber optic cable shall terminate inside a communications cabinet on a termination patch panel. All fiber sub-cables within the exposed buffer tube shall be terminated with fan-out kits with preconnectorized pigtails. The patch panel shall have a fiber capacity equal to the total number of fibers (connected and spare) for all cables to be connected.

3. Unused buffer tubes shall be uncut and looped within the patch panel for continuous routing of the fiber buffer tube within the cable assembly.

4. Patch panels shall be designed for either rack mounting on a standard equipment rack or housed in an enclosure for direct wall mounting. The patch panel shall contain "ST" type bayonet or LC couplings. All unused couplings shall have protective dust covers. All panels shall be furnished with locking doors.

5. Factory-terminated, tight-buffered, aramid-reinforced fiber optic jumper assemblies or interconnect cables, standard 3.0-mm O.D., shall connect the optical cable terminations to the patch panel couplings.

6. The termination patch panel shall be equipped with a suitable means for routing and securing of cables, and shall provide a suitable means of protection for the mounted fiber connectors to prevent damage to fibers and connectors during all regular operation and maintenance functions. All cables shall be provided with strain relief. Bend diameters on cable fibers and jumpers must be greater than four inches at all times to ensure optical and mechanical integrity of the optical fibers.

7. Termination panels shall be equipped with splice trays (where applicable) and holders for pigtail and through fiber splicing.

8. Termination panels shall be provided with all hardware, options, and accessories to provide for a complete installation of the fiber optic system.

9. Panels shall be as manufactured by Corning Cable Systems LANscape or equal.

B. Wall/Panel Mount Fiber Distribution Center

1. Splice trays shall be provided for pigtail splicing. The WDC shall be provided with pass-thru splice trays for continuation of the fiber cable system to additional sites.

2. Provide one spare splice tray.

3. The WDC shall provide space and support the addition of future fiber cable splice trays.

PART 3 EXECUTION

3.01 EXAMINATION

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

3.02 INSTALLATION

A. Comply with NECA 1, NECA 301 and NECA/BICSI 568.

B. Wiring Method:

1. Fiber optic cabling must be inside conduit when exiting buildings and for all segments connecting to control panels or equipment.]

2. Conceal conduit in accessible ceilings, walls, and floors where possible.]

3. Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters Conceal raceway and cables except in unfinished spaces.

E. Wiring method: conceal conductors and cables in accessible ceilings, walls, and floors where possible.

F. Wiring within enclosures: bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

G. Terminate all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

H. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

I. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

J. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, Use lacing bars and distribution spools.

K. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

L. In the communications equipment room, provide a 10-foot- (3-m-) long service loop on each end of cable.

M. Pulling Cable: Comply with [BICSI ITSIMM, Ch. 4, "Pulling Cable."][manufacturer recommendations.] Monitor cable pull tensions.

N. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

O. Open-Cable Installation:

   a. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

   b. shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

P. Installation of Cable Routed Exposed under Raised Floors:

   a. Plenum-rated cable only.

   b. Install cabling after the flooring system has been installed in raised floor areas.

Q. Group connecting hardware for cables into separate logical fields.

R. Grounding

   a. Grounding according to BICSI ITSIMM, "Grounding (Earthing), Bonding, and Electrical Protection" Chapter. [Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors].

   b. Comply with TIA-607-B and NECA/BICSI-607.

c. Grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

d. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.03 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B.

a. Administration Class: Class 3.

b. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 3 level of administration, including optional identification requirements of this standard.

C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for ProjectLabel each termination point.

D. Cable and Wire Identification:

a. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

b. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.

c. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).

d. Label each unit and field within distribution racks and frames.

e. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

f. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606-B, for the following:

i. Flexible vinyl or polyester that flexes as cables are bent.

3.04 FIELD QUALITY CONTROL

E. Perform tests and inspections[with the assistance of a factory-authorized service representative

3.05 PHYSICAL CHECKOUT

A. General Procedures

1. Conduct physical checkout of the fiber optic data highway network.

2. Physical checkout shall be performed prior to functional testing.

B. Check Procedures

1. Verify that fiber optic cable reels have been off-loaded from truck carefully and not damaged.

2. Submit to the Designer all test data provided by the fiber manufacturer.

3. Verify that the optical fibers of the cable assembly are the type and quantity as specified and as recommended by the Instrumentation System Supplier.

4. Verify that cable construction is the type specified.

5. Verify that fiber optic patch panels have been installed plumb and level at locations indicated.

6. Verify that optical fiber connections or terminations within patch panels and splice closures are in accordance with cable manufacturer's recommendations.

3.06 FIBER OPTIC CABLE TESTING

A. General: The Contractor shall perform pre-installation and post-installation FOC tests. The Construction Manager shall be notified a minimum of 10 days in advance so that these tests are witnessed. All test equipment shall be traceable to NIST standards.

B. Test equipment: The Contractor shall use the following to perform pre-installation and post-installation FOC tests:

1. Optical time domain reflectometer (OTDR). The OTDR shall be laser precision, and be able to test single mode or multimode systems with a visual fault locator. The OTDR shall be as manufactured by Corning, Agilent Technologies, Fluke Networks, or equal.

C. Pre-installation Tests

1. The purpose of these tests is to perform acceptance tests on the cable prior to installation to verify that the cable conforms to the manufacturer's specifications; is free of defects, breaks, and damages by transportation and manufacturing processes; and to provide baseline readings in dB.

2. Prior to removal of each cable from the delivery reel, all optical fibers within the cables shall be tested by the Contractor using an OTDR. The OTDR tests shall consist of end-to-end length and fiber attenuation (dB/km) measurements to ensure proper performance of the fiber optic cable. The tests shall be performed from both ends of each fiber to ensure complete fiber continuity within the cable structure.

3. Pre-installation, "on-reel" test results shall be compared with the manufacturer's test report delivered with the cable. Gross dissimilarities shall be noted and remedied between the Contractor and manufacturer. In all cases, all fibers must meet the optical attenuation specifications prior to cable installation.

4. The Contractor shall perform tests on all reels of cable. The Construction Manager shall be notified a minimum of 15 days prior to any test.

5. The Contractor shall document each test and submit the report to the Construction Manager for review. Documentation shall consist of both hard copy and 3.5 inch electronic disk complete with all application software.

6. Cable shall not be installed until the Construction Manager has reviewed the test report.

D. Post-installation tests: After FOC has been installed and connectorized, the following tests shall be performed:

1. Visually inspect terminal connectors for out-of-round condition and surface defects such as micro-chips and cracks using a 200X (minimum) inspection microscope.

2. A recording OTDR shall be used to test for end-to-end continuity and attenuation of each optical fiber. The OTDR shall have an X-Y plotter to provide a hard copy record of each trace of each fiber. The OTDR shall be equipped with sufficient internal masking to allow the entire cable section to be tested. This may be achieved by using an optical fiber pigtail of 30 feet or more to display the required cable section.

3. The OTDR shall be calibrated for the correct index of refraction to provide proper length measurement for the known length of reference fiber.

4. A transmission test shall be performed with the use of a 1310 and 1550 nm stabilized light sources and 1310 nm/1550 nm power meters for SMF. This test shall be conducted in both directions on each fiber of each cable.

5. Hard and electronic copies of test documentation shall be submitted to the Construction Manager. The documentation shall include:

   a. The trace plot.
   b. Index.
   c. dB/km loss.
   d. Cable length.
   e. Date and time of test.
   f. Wavelength.
   g. Pulse width.
   h. The test site.
   i. Cable ID.

j. Fiber number and type.
k. Operator's initials.
l. The Contractor shall compare the pre-installation test results to the post-installation results. If a deviation of greater than one dB occurs, the Construction Manager shall be notified in writing by the Contractor, and the cable shall be removed and replaced at no additional cost to PRASA.

6. Upon completion of the previous tests, all FOC coils shall be secured with ends capped to prevent intrusion of dirt and water.

E. Certification of completion of pre- and post-fiber installation testing including test results shall be provided to the Designer. Test results shall be submitted on paper in a binder, including results indicated in tables or a spreadsheet. Test results that exceed specification limits shall be noted. The electronic copy shall be included in the binder.

F. Required OTDR Trace Information

1. All traces shall display the entire length of cable under test, highlighting any localized loss discontinuities (installation-induced losses and/or connector losses). The trace shall display fiber length (in kilofeet), fiber loss (dB), and average fiber attenuation (in dB/km), as measured between two markers placed as near to the opposite ends of the fiber under test as is possible while still allowing an accurate reading. Care shall be taken to ensure that the markers are placed in the linear region of the trace, away from the front-end response and far-end Fresnel reflection spike. Time averaging shall be used to improve the display signal to noise ratio. The pulse width of the OTDR shall be set to a sufficient width to provide adequate injected power to measure the entire length the fiber under test.

2. If connectors exist in the cable under test, then two traces shall be recorded. One trace shall record the fiber loss (dB) and average attenuation (dB/km) of the entire cable segment under test, including connectors. The second trace shall display a magnified view of the connector regions, revealing the connector losses (dB). All connector losses shall be measured using the five-point splice loss measurement technique.

3. The OTDR trace shall also include the following information:

a. The date and time of the test.
b. The cable ID number.
c. The cable segment ID number.
d. The fiber color or sub-cable number.
e. Launch point connector number.
f. The optical wavelength used for the test.
g. The refractive index setting of the OTDR.
h. The pulse width setting of the OTDR.
i. The averaging interval of the test.

3.07 TRAINING

G. Provide one half-day training on termination techniques and testing for up to 3 students prior to installation.

H. Provide training as soon as possible following submittal of proposed fiber optic cable.]

END OF SECTION

SECTION 13330
INSTRUMENTATION AND CONTROLS – CONTROL PANELS AND PANEL-MOUNTED EQUIPMENT

PART 1 GENERAL

1.01 DEFINITIONS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.02 SCOPE OF WORK

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

B. Furnish and install control panels and panel-mounted equipment as specified herein and shown on the Drawings.

C. All new panels and panel components shall match existing equipment makes and models wherever possible, so that system additions can be most easily integrated with respect to operation and maintenance training, spare parts inventory, and service contracts. Even when exact matches are not possible, equipment furnished must be fully compatible with the existing system. Color, size, and material of new panels should conform to that of existing panels.

1.03 RELATED WORK

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.04 SUBMITTALS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

B. Descriptive literature, bulletins, catalog cuts, and Drawings for the equipment specified herein.

C. Complete bill of materials for the equipment.

D. Spare parts list.

E. Panel Layout Drawings and Wiring Diagrams Submittal

1. Where direct hardwired interfaces exist between the PCSS control panels and vendor provided control panels furnished under other Divisions, the Contractor shall provide to the PCSS the approved submittals in order for the PCSS to provide complete wiring diagrams showing all wiring connections in the I/O system. This includes but is not limited to terminal block numbering, relay contact information, instruments, equipment, and control panel names. These drawings shall be included in the Final O&M submittal. Leaving this information blank on the Final Documentation drawings is not acceptable.

2. Panel Layout Drawings: Drawings shall be furnished for all panels, consoles, and equipment enclosures specified. Panel assembly and elevation drawings shall be drawn to scale and detail all equipment in or on the panel. At a minimum, the panel drawings shall include the following:
   a. Interior and exterior panel elevation drawings to scale.

b. Nameplate schedule.
c. Conduit access locations.
d. Panel construction details.
e. Cabinet assembly and layout drawings to scale. The assembly drawing shall include a bill of material on the drawing with each panel component clearly defined. The bill of material shall be cross-referenced to the assembly drawing so that a non-technical person can readily identify any component of the assembly by manufacturer and model number.
f. Fabrication and painting specifications including color (or color samples).
g. Construction details, NEMA ratings, intrinsically safe barrier information, gas sealing recommendations, purging system details, etc. for panels located in hazardous locations or interfacing to equipment located in hazardous areas.
h. For every control panel, heating and cooling calculations for each panel supplied indicating conformance with cooling requirements of the supplied equipment and environmental conditions. Calculations shall include the recommended type of equipment required for both heating and cooling. Calculations shall include sun shields where installed.
i. Submit evidence that all control panels shall be constructed in conformance with UL 508 and bear the UL seal confirming the construction. Specify if UL compliance and seal application shall be accomplished at the fabrication location or by field inspection by UL inspectors. All costs associated with obtaining the UL seal and any inspections shall be borne by the Contractor.

3. Panel Wiring Diagrams: Panel wiring diagrams depicting wiring within and on the panel, as well as connections to external devices. If Loop Wiring Diagrams are not specified below, equipment external to the control panel and related external connections shall be shown on the Panel Wiring Diagrams.
   a. Panel wiring diagrams shall include power and signal connections, UPS and normal power sources, all panel ancillary equipment, protective devices, wiring and wire numbers, and terminal blocks and numbering.
   b. Wiring labeling used on the drawings shall match that shown on the Contract Documents or as developed by the PCSS and approved by the Engineer.
   c. I/O wiring shall be numbered with rack number, slot number, and point number.
   d. Two-wire and four-wire equipment shall be clearly identified and power sources noted. Submit final wire numbering scheme.
   e. Panel drawings shall be 11" x17" in size.

4. Loop Wiring Diagrams: The Loop Drawings shall be furnished for all devices external to the control panel and related external connections.
   a. Wiring labeling used on the drawings shall match that shown on the Contract Documents or as developed by the PCSS and approved by the Engineer.
   b. Field device wiring shall include the device tag and a unique numeric identifier. The diagrams shall identify all device terminal points that the system connects to, including terminal points where I/O wiring lands on equipment not supplied by the PCSS.
   c. I/O wiring shall be numbered with rack number, slot number, and point number.
   d. Two-wire and four-wire equipment shall be clearly identified and power sources noted. Submit final wire numbering scheme.
   e. Loop drawings shall be 11" x17" in size.

1.05 COORDINATION MEETINGS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.06 REFERENCE STANDARDS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.07 QUALITY ASSURANCE

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.09 NOMENCLATURE AND IDENTIFICATION

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.10 WARRANTY

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.11 MAINTENANCE CONTRACT

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.12 PROJECT/SITE REQUIREMENTS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.13 TEST EQUIPMENT

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.14 TECHNOLOGY OBSOLESCENCE AND MITIGATION

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

PART 2 PRODUCTS

2.01 GENERAL

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

2.02 LIGHTNING/SURGE PROTECTION

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

2.03 CONTROL PANEL GENERAL REQUIREMENTS

A. The dimensions within this Section and on the Contract Drawings are for general reference only. Ensure that final enclosure sizing and panel arrangements accommodate all required equipment for a fully integrated and operational system as specified herein and in the Contract Documents.

B. Each control panel and terminal cabinet shall bear the UL label. The UL label shall apply to the enclosure, the specific equipment supplied with the enclosure, and the installation and wiring of the equipment within and on the enclosure. If required for UL labeling, provide ground fault protective devices, isolation transformers, fuses, and any other equipment necessary to achieve compliance with UL 508 requirements. The Drawings do not detail all UL 508 requirements.]

C. All panel doors shall have a lock installed in the door handle, or a hasp and staple for padlocking. Locks for all panels provided under this Contract shall be keyed alike.

D. All panels shall have an intrusion detection (Panel Open) switch connected to the SCADA PLC.

E. The devices designated for rear-of-panel mounting shall be arranged within the panel according to respective panel drawings and in a manner to allow for ease of maintenance and adjustment. Heat generating devices such as power supplies shall be located at or near the top of the panel.

F. All components shall be mounted in a manner that shall permit servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Component mounting shall be oriented in accordance with the manufacturer's recommendations. The internal components shall be identified with suitable plastic or metal engraved nametags mounted adjacent to (not on) each component identifying the component in accordance with the drawing, specifications, and PCSS's data.

G. All exterior panel mounted equipment shall be installed with suitable gaskets, faceplates, etc. required to maintain the NEMA rating of the panel.

H. Nameplates

1. All panels and panel devices shall be supplied with suitable nameplates, which identify the panel and individual devices as required. Unless otherwise indicated, each device nameplate shall include up to three lines with the first line containing the device tag number as shown on the drawings, the second line containing a functional description (e.g., Recirculation Pump No. 1), and the third line containing a functional control description (e.g., Start).]

2. Unless escutcheon plates are specified or unless otherwise noted on the Drawings, nameplates shall be 3/32-inch thick, black and white, Lamicoid with engraved inscriptions. The letters shall be Black against a White background unless otherwise noted. Edges of the nameplates shall be beveled and smooth. Nameplates with chipped or rough edges will not be acceptable.

3. Nameplate fasteners and mounting shall be epoxy adhesive or stainless-steel screws for cabinet mounted nameplates.

4. For every panel, provide a panel nameplate with a minimum of 1" high letters. Provide legend plates or 1-in by 3-in engraved nameplates with ¼-in lettering for identification of door mounted control devices, pilot lights, and meters.

I. Mounting Elevations

1. ISA Recommended Practice RP60.3 shall be used as a guide in layout and arrangement of panels and panel mounted components. Dimensions shall account for all housekeeping pads that panels will sit on once they are installed.

2. Centerline of indicators and controllers shall be located no lower than 48-inches or higher than 66-inches above the floor on a panel face.

3. Centerline of lights, selector switches, and pushbuttons shall be located no lower than 32-inches or higher than 70-inches above the floor on a panel face.

4. Tops of annunciators shall be located no higher than 86-inches above the floor on a panel face.

5. Installation of panel components shall conform to component manufacturers' guidelines.

2.04 PANEL MATERIALS AND CONSTRUCTION

A. Structure and Enclosure

1. Panels shall be of continuous welded-steel or FRP construction as shown on the Panel Schedule. Provide angle stiffeners as required on the back of the panel face to prevent panel deflection under instrument loading or operation. Internally, the panels shall be supplied with a structural framework for instrument support purposes and panel bracing. The internal framework shall permit panel lifting without racking or distortion. Provide removable lifting rings designed to facilitate simple, safe rigging, and lifting of the control panels during installation.

2. Each panel shall be provided with full height, fully gasketed access doors where shown. Doors shall be provided with a three-point stainless steel latch (except for NEMA 4X panels) and heavy-duty stainless steel locking handle. Rear access doors (if included) shall be conveniently arranged and sized such that they extend no further than 24-inches beyond the panel when opened to the 90-degree position. Front and side access doors shall be as shown. Panel access doors shall be provided with full length, continuous, piano type stainless steel hinges with stainless steel pins. Front access doors with mounted instruments or control devices shall be of sufficient width to permit door opening without interference from flush mounted instruments.

3. The panels, including component parts, shall be free from sharp edges and welding flaws. Wiring shall be free from kinks and sharp bends and shall be routed for easy access to other components for maintenance and inspection purposes.

4. The panel shall be suitable for top and bottom conduit entry as required by the Electrical Drawings. For top mounted conduit entry, the panel top shall be provided with nominal one-foot square removable access plates, which may be drilled to accommodate conduit and cable penetrations. All conduit and cable penetrations shall be provided with ground

bushings, hubs, gasketed locknuts, and other accessories as required to maintain the NEMA rating of the panel and electrical rating of the conduit system.

5. All panels in indoor, dry, non-corrosive environments shall be NEMA 12 unless otherwise noted. All panels in outdoor, wet, non-chemically corrosive environments shall be NEMA 4 unless otherwise noted. Panels in chemically corrosive environments shall be NEMA 4X unless otherwise noted. All panels located in a hazardous location shall be rated for the type of hazard (e.g., NEMA 7 for Class 1, Division 1).

B. Freestanding and Floor-Mounted Vertical Panels

1. Freestanding and floor-mounted vertical panels shall meet the NEMA classification as shown on the drawings or specified herein. The panels shall be constructed of 12 gauge sheet steel, suitably braced internally for structural rigidity and strength. All NEMA 4X rated panels shall be constructed of 316 stainless steel, unless FRP is specifically indicated to be provided. Front panels or panels containing instruments shall be not less than 10 gauge stretcher leveled sheet steel, reinforced to prevent warping or distortion.]

C. Wall and Unistrut Mounted Panels

1. All wall and Unistrut mounted panels shall meet the NEMA classification as shown on the drawings or specified herein. The panels shall be constructed of not less than USS 14 gauge steel, suitably braced internally for structural rigidity and strength. All NEMA 4X rated wall mounted panels shall be constructed of 316 stainless steel, unless FRP is specifically indicated. FRP panels shall be used in chlorine areas. All FRP panels located in direct sunlight shall be provided with a protective coating and sun shield to prevent discoloration and cracking.]

D. Finish Requirements

1. All sections shall be descaled, degreased, filled, ground, and finished. The enclosure, when fabricated of steel, shall be finished with two rust resistant phosphate prime coats and two coats of enamel, polyurethane, or lacquer finish, which shall be applied by either the hot air spray or conventional cold spray methods. Brushed anodized aluminum, stainless steel, and FRP panels will not require a paint finish.

2. The panels shall have edges ground smooth and shall be sandblasted and then cleaned with a solvent. Surface voids shall be filled and ground smooth.

3. Immediately after cleaning, one coat of a rust-inhibiting primer shall be applied inside and outside, followed by an exterior intermediate and topcoat of a two-component type epoxy enamel. A final sanding shall be applied to the intermediate exterior coat before top coating.

4. Apply a minimum of two coats of manufacturer’s standard flat, light-colored lacquer on the panel interior after priming.

5. Unless otherwise noted, the finish exterior colors shall be ANSI 61 gray with a textured finish.

E. Print storage pockets shall be provided on the inside of each panel. The storage pockets shall be steel, welded onto the door, and finished to match the interior panel color. The storage pocket shall be sufficient to hold all of the prints required to service the equipment, and to accommodate 8.5 inch by 11 inch documents without folding.

F. Where specified on the Panel Schedule, a folding shelf shall be provided on the inside of the door on all free-standing and floor-mounted panels. The shelf shall be suitable for a laptop computer and shall be placed such that an open laptop computer does not interfere with any door-mounted devices. The folded shelf shall not interfere with any internal panel components when the door is closed. The folding shelf shall automatically lock in the horizontal position when raised. The folding shelf shall be approximately 18 inches wide by 12 inches deep and shall have a minimum distributed load rating of 100 pounds. All parts shall be made of heavy gauge steel and shall be painted white or finished to match the interior panel color.

2.05 ENVIRONMENTAL CONTROL

A. All panels shall be provided with louvers, sun shields, heat sinks, forced air ventilation, or air conditioning units as required to prevent temperature buildup inside of panel. The internal temperature of all panels shall be regulated to a range of 45 degrees F to 104 degrees F (7.22 degrees C to 40 degrees C) under all conditions. Under no circumstances shall the panel cooling or heating equipment compromise the NEMA rating of the panel.

B. Except for panels mounted with their backs directly adjacent to a wall, louvers shall be in the rear of the panels, top and bottom, and shall be stamped sheet metal construction.

C. For panels mounted with their backs directly adjacent to a wall, louvers shall be on the sides.

D. Forced air ventilation fans, where used, shall provide a positive internal pressure within the panel, and shall be provided with washable or replaceable filters. Fan motors shall operate on 120-volt, 60-Hz power.

E. Provide custom fabricated sun shields for all outdoor panels in accordance with the following requirements:

1. Sun shield shall be provided with the enclosure by the enclosure manufacturer. Welding studs directly to the enclosure for sun shield mounting is acceptable when done prior to shipping to site. Drilling holes directly to the enclosure for sun shield mounting is not permitted.

2. Sun shields shall be fabricated from minimum 12 gauge Type 316 stainless steel. Units shall be designed, fabricated, installed, and supported to fully cover and shade the top, sides, and back of the enclosure, and to partially shade the front panel of the enclosure from direct exposure to sunlight from sunrise to sunset.

3. Depending on overall size, sun shields may be fabricated in single or multiple segments for attachment to the enclosure support framing or to separate free standing framing around the enclosure.

4. The sun shield shall be designed and mounted to provide a minimum 3-inch air gap all around the enclosure for air circulation and heat dissipation.

5. The top section of all sun shields shall be sloped at a minimum angle of 5 degrees from horizontal. For wall-mounted enclosures, the top section shall slope downward away from the wall and towards the front of the enclosure. For free standing, floor mounted and frame mounted enclosures, the top section shall slope downward towards the back side of the enclosure.

6. The front edge of the top section of all sun shields shall incorporate a narrow and more steeply sloped drip shield segment which sheds water away from the front of the enclosure and prevents it from dripping or running directly onto the front panel of the enclosure.

7. All seam welds used in sun shield fabrication shall be continuous and shall be ground smooth.

8. All exposed corners, edges, and projections shall be smooth rounded or chamfered to prevent injury.

F. All outdoor enclosures and enclosures located in unheated areas indoors or in areas subject to humidity and moisture shall be provided with an integral heater, fan, and adjustable thermostat or Hygrostat to reduce condensation and maintain the minimum internal panel temperature. Mount the unit near the bottom of the enclosure with discharge away from heat-sensitive equipment.

2.06 CORROSION CONTROL

A. Panels shall be protected from internal corrosion by the use of corrosion-inhibiting vapor capsules as manufactured by Northern Technologies International Corporation, Model Zerust VC; Hoffman, Model AHCI; or equal.

2.07 CONTROL PANEL - INTERNAL CONSTRUCTION

A. Internal Electrical Wiring

1. All interconnecting wiring shall be stranded, type MTW, and shall have 600 volt insulation and be rated for not less than 90 degrees Celsius. Wiring for systems operating at voltages in excess of 120 VAC shall be segregated from other panel wiring either in a separate section of a multi-section panel or behind a removable Plexiglas or similar dielectric barrier. Panel layout shall be developed such that technicians shall have complete access to 120 VAC and lower voltage wiring systems without direct exposure to higher voltages.

2. Power distribution wiring on the line side of fuses or breakers shall be 12 AWG minimum. Control wiring on the secondary side of fuses shall be 16 AWG minimum. Electronic analog circuits shall utilize 18 AWG shielded, twisted pair, cable insulated for not less than 600 volts.

3. Power and low voltage DC wiring systems shall be routed in separate wireways. Crossing of different system wires shall be at right angles. Different system wires routed parallel to each other shall be separated by at least 6-inches. Different wiring systems shall terminate on separate terminal blocks. Wiring troughs shall not be filled to more than 60 percent visible fill.

4. Terminations

a. All wiring shall terminate onto single tier terminal blocks, where each terminal is uniquely and sequentially numbered. Direct wiring between field equipment and panel components is not acceptable.
b. Multi-level terminal blocks or strips are not acceptable unless they are approved by the Engineer. If approved, they shall be mounted on angled din rail elevated from the back panel.
c. Terminal blocks shall be arranged in vertical rows and separated into groups (power, AC control, DC signal). Each group of terminal blocks shall have a minimum of 25 percent spares.
d. Terminal blocks shall be the compression type, fused, unfused, or switched as shown on the Contract Drawings or specified elsewhere in Division 13.
e. Discrete inputs and outputs (DI and DO) shall have two terminals per point with adjacent terminal assignments. All active and spare PLC and controller points shall be wired to terminal blocks.
f. Analog inputs and outputs (AI and AO) shall have three terminals per shielded pair connection with adjacent terminal assignments for each point. The third terminal is for shielded ground connection for cable pairs. Ground the shielded signal cable at the PLC cabinet. All active and spare PLC and controller points shall be wired to terminal blocks.
g. Wire and tube markers shall be the sleeve type with heat impressed letters and numbers.
h. Only one side of a terminal block row shall be used for internal wiring. The field wiring side of the terminal shall not be within 6-inches of the side panel or adjacent terminal or within 8-inches of the bottom of free-standing panels, or within 3-inches of stanchion mounted panels, or 3-inches of adjacent wireway.
i. Circuit power from the SCADA cabinet out to field devices (switches, dry contacts etc.) that are used as discrete inputs to the PLC input cards shall be isolated with an isolating switch terminal block with a flip cover that is supplied with a dummy fuse. Isolation switch block shall be an Allen Bradley, Model 1492-H7, or equal. One isolating switch terminal block per loop numbered piece of equipment and one per spare I/O point is acceptable.
j. All PLC discrete outputs to the field shall be isolated with individual isolating fuse switch terminal blocks with flip covers and neon blown fuse light indicators. The single circuit fusible terminal block shall be an Allen Bradley, Model 1492-H4 or equal.

5. All wiring to hand switches and other devices, which are live circuits independent of the panel's normal circuit breaker protection, shall be clearly identified as such.

6. All wiring shall be clearly tagged and color coded. All tag numbers and color coding shall correspond to the panel wiring diagrams and loop drawings prepared by the PCSS. All power wiring, control wiring, grounding, and DC wiring shall utilize different color insulation for each wiring system used. The color-coding scheme shall be:
   a. Incoming 120 VAC Hot - Black
   b. 120 VAC Hot wiring downstream of panel circuit breaker – Red
   c. 120 VAC Hot wiring derived from a UPS system – Red with Black stripe.
   d. Three phase power – Brown, Orange, Yellow, and Green ground or as specified in Electrical specifications.
   e. 120 VAC neutral - White
   f. Ground - Green
   g. DC power or control wiring – Blue

h. DC analog signal wiring – Black (+), White (-)
i. Foreign voltage – Yellow

7. Provide surge protectors on all incoming power supply lines at each panel per the requirements of Section 13300 Instrumentation and Controls - General Provisions.

8. Each field instrument furnished under Division 13 and shown on the Drawings as deriving input power from the control panel(s) shall have a separate power distribution circuit with a circuit breaker or fuse and blown fuse indication. All instruments requiring 120VAC power shall be powered from the UPS source in the panel where the instrument signals lands.

9. Provide redundant 24 VDC power supplies to power field instruments and panel devices. Twenty-four VDC power supplies shall be as specified in this Section.]

10. Wiring trough for supporting internal wiring shall be plastic type with snap-on covers. The side walls shall be open top type to permit wire changing without disconnecting. Trough shall be supported to the subpanel by stainless steel screws. Trough shall not be bonded to the panel with glue or adhesives.

11. Each panel shall have a low powered LED light that can be mechanically fastened internally to the ceiling of the panel while maintaining panel UL listing. Light fixture shall be switched and shall be complete with LED light and appurtenances.

12. Each panel shall have a specification grade duplex convenience receptacle with a ground fault interrupter, mounted internally within a stamped steel device box with appropriate cover. Convenience receptacle shall not be powered from a UPS and shall be protected by a dedicated fuse or circuit breaker.

13. Each panel shall be provided with an isolated copper grounding bus for all signal and shield ground connections. Shield grounding shall be in accordance with the instrumentation manufacturer's recommendations.

14. Each panel shall be provided with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.

15. Each panel shall have control, signal, and communication line surge suppression in accordance with Section 13300 Instrumentation and Controls – General Provisions.

16. All microprocessor-based electronic devices in the panel that are powered by 120VAC, shall be powered by the UPS (refer to appropriate Section in Division 13).

17. Each panel shall be provided with a circuit breaker to interrupt incoming power.

18. Additional electrical components including transformers, motor starters, switches, circuit breakers, etc. shall be in compliance with the requirements of Division 16.

B. Relays required to be provided under other divisions and required for properly completing the control function specified in Division 13 or shown on the Drawings shall be provided under this Section.

C. The orientation of all devices including PLC and I/O when installed, shall be per the manufacturer's recommendations. No vertical orientation of PLC racks shall be allowed unless specifically indicated by the manufacturer as an acceptable mounting alternative, and also approved by the Engineer.

2.08 ELECTRICAL COMPONENTS

A. The main circuit breaker shall be a thermal-magnetic molded case breaker, by Square D Company, or approved equal.

B. A mechanical disconnect mechanism, with bypass, shall be installed on each motor circuit protector, capable of being locked in the “OFF” position to provide a means of disconnecting power to the motor.]

C. [Auxiliary contacts shall be provided for remote run indication and indication of each status and alarm condition. Additional controls shall be provided as specified herein and as required by the detailed mechanical equipment requirements, the P&IDs (Division 13), the Control Wiring Diagrams Division, and as shown on the Drawings.]

D. All operating control devices and instruments shall be securely mounted on the exterior door. All controls shall be clearly labeled to indicate function and shall be in accordance with the electrical area classification indicated on the Electrical Contract Drawings.

E. The control panel shall be provided with a lightning and surge protection unit on the line side of the main circuit breaker. Unit shall be 600 Volt, 3 Phase, General Electric "Tranquell" Series, or approved equal.]

F. Specific control devices, control descriptions, and other data are specified under the detailed specification for the mechanical equipment with which the control panel is supplied.]

2.09 PILOT TYPE INDICATING LIGHTS

A. Type: Energy efficient Solid State LED Lamps.

B. Functional:

1. Units shall be provided with low voltage LED lamps suitable for the voltage supplied.

2. Lights supplied with 120V AC power shall have integral reduced voltage transformers.

3. Lamps shall be replaceable from the front of the unit.

C. Physical:

1. Lens color:
   a. Running, on, open – [Green].
   b. Stopped, off, closed – [Red].
   c. Alarm – [Amber].
   d. White - Power on
   e. Blue - All other status indications not covered by the above

f. Lens caps shall be approximately .46 inch diameter. Provide legend faceplates engraved to indicate the required function of each device; NEMA rating - 4X.

D. Manufacturer(s):

1. Cutler-Hammer,

2. Allen Bradley,

3. General Electric,

4. Square D,

5. Crouse Hinds (NEMA 7),

6. Refer to drawings Or Approved Equal

2.10 SELECTOR SWITCHES AND PUSHBUTTONS

A. Type:

1. Control devices shall be heavy-duty oil-tight type with stackable contact blocks.

B. Functional:

1. Provide contact arrangement and switching action as required for the control system specified.

C. Physical:

1. For 120 VAC service, provide contacts rated 10 amps at 120 VAC; for 24 VDC service, provide silver sliding contacts rated 5 amps at 125 VDC; for electronic (millivolt/ milliamp) switching, provide contacts rated lamp at 28 VDC.

2. Pushbuttons shall have flush type operators.

3. Selector switches shall have knob or wing lever operators; NEMA rating - 4X; Provide legend plates denoting switch/pushbutton position/ function.

D. Manufacturer(s):

1. Cutler-Hammer,

2. Allen Bradley,

3. General Electric,

4. Square D,

5. Crouse Hinds (NEMA 7),

6. Refer to Drawings Or Approved Equal

2.11 GENERAL PURPOSE RELAYS AND TIME DELAYS

A. Type:

1. General purpose plug-in type.

B. Functional:

1. Contact arrangement/function shall be as required to meet the specified control function; Mechanical life expectancy shall be in excess of 10 million.

2. Duty cycle shall be rated for continuous operation; Units shall be provided with integral indicating light to indicate if relay is energized.

3. Solid state time delays shall be provided with polarity protection (DC units) and transient protection.

4. Time delay units shall be adjustable and available in ranges from .1 second to 4.5 hours.

C. Physical:

1. For 120 VAC service, provide contacts rated 10 amps at 120 VAC; for 24 VDC service, provide contacts rated 5 amps at 28 VDC; for electronic (milliamp/millivolt) switching applicator, provide gold plated contacts rated for electronic service. Relays shall be provided with dust and moisture resistant covers.

D. Options/Accessories Required:

1. Provide mounting sockets with pressure-type terminal blocks rated 300 volt and 10 amps.

2. Provide mounting rails/holders as required.

E. Manufacturer(s):

1. Allen Bradley,

2. Potter & Brumfield,

3. Refer to drawings Or Approved Equal]

2.12 SIGNAL ISOLATORS/BOOSTERS/CONVERTERS

A. Type:

1. Solid state, ASIC technology; electronic type.

B. Functional:

1. Accuracy: 0.15 percent.

2. Inputs: Current, voltage, frequency, temperature, or resistance as required.

3. Outputs: Current or voltage as required.

4. Isolation: There shall be complete isolation between input circuitry, output circuitry, and the power supply.

5. Adjustments: Zero and span adjustment shall be provided.

6. Protection: Provide RFI protection.

C. Physical:

1. Mounting: DIN Rail.

D. Manufacturer(s):

1. Action Instruments Slim Pak,

2. Acromag,

3. Or Approved Equal

2.13 EMERGENCY ALARM BEACON AND AUDIBLE HORN

A. Beacon alarm light:

1. Type:
   a. Beacon alarm light.

2. Physical:
   a. Beacon alarm light for building exterior mounting shall be 120 VAC, flush mounted, weatherproof construction.
   b. A 750,000-candle power xenon strobe tube and red polycarbonate lens.

3. Manufacturer(s):
   a. Federal Signal,
   b. Edwards,
   c. Wheelock,
   d. Or Approved Equal

B. Alarm Horn:

1. Type:
   a. Alarm horn shall be a vibrating type for 120 Volts, 60 Hz.

2. Manufacturer(s):
   a. Federal Signal Corp,
   b. Edwards Co,
   c. Benjamin,
   d. Or Approved Equal

2.14 24 VDC POWER SUPPLIES

A. Redundant power supplies that operate in parallel with an independent redundancy module 24VDC power supply to power field instruments and panel devices as shown on the drawings.

B. The 24 VDC power supply shall meet the following requirements:

1. Input power: 115 VAC, plus or minus 10 percent, 60 Hz.

2. Output voltage: 24 VDC.

3. Output voltage adjustment: 5 percent.

4. Line regulation: 0.05 percent for 10-volt line change.

5. Load regulation: 0.15 percent no load to full load.

6. Ripple: 3 mV RMS.

7. Operating temperature: 32 to 140 degrees Fahrenheit.

C. Size the 24 VDC power supply to accommodate the design load plus a minimum 25 percent spare capacity.

D. If power supply on/off status signal is shown, provide a relay contact (internal to the power supply or external if the power supply is not so equipped) to indicate on/off status of the power supply.

E. Provide output overvoltage and overcurrent protective devices with the power supply to protect instruments from damage due to power supply failure and to protect the power supply from damage due to external failure.

F. Mount the 24 VDC power supply such that dissipated heat does not adversely affect other panel components.

G. Manufacturer(s):

1. Allen-Bradley,

2. Phoenix Contact,

3. SOLA HD.

4. Or Approved Equal

2.15 DIGITAL PANEL METER

A. Type:

1. Electronic, 3.5 digit, 0.56-inch-high efficiency LED display.

2. Sunlight Readable LCD display.

B. Operation:

1. To accept 4-20 mA DC input signal and provide indication in engineering units of measured variable.

C. Functional:

1. Power supply: 24 VDC or 115 VAC, plus or minus 10 percent, 50/60 Hz, 10 VA.

2. Input: 4-20 mA DC into 100 ohms.

3. Indication: 0.56-inch LED display.

D. Physical:

1. Case size nominal 2.5 inch high by 5 inch wide by 6 inch deep.

2. Case type: watertight and dust tight (NEMA 4X).

3. Mounting: flush panel suitable for high density mounting arrangements.

E. Performance: Linear input accuracy plus or minus 0.05 percent of calibrated span, plus or minus 1 count.

F. Manufacturer(s):

1. Precision Digital,

2. Red Lion,

3. Or Approved Equal

2.16 SPARE PARTS

A. General requirements for spare parts are specified in Section 13300 Instrumentation and Controls - General Provisions.

B. The following control panel spare parts shall be furnished:

1. Timers and sockets - Two of each type installed.

2. Relays and sockets - Two of each type installed.

3. Fuses and circuit breakers - 10% (minimum of 10 fuses and 2 circuit breakers) of each type and size installed.

4. Light bulbs - 10% (minimum of 10) of each type installed. For LED type lights, 5% (minimum of 3) of each color installed.

5. Panel Mounted power supplies - one of each type installed.

6. Selector switches/pushbuttons - Two of each type installed including contact blocks.

7. Provide touch-up paint of each type and color used for all cabinets, panels, and consoles supplied.]

PART 3 EXECUTION

3.01 EXAMINATION

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

3.02 INSTALLATION

A. The panels shall be installed at locations as shown on the Contract Drawings.

B. Refer to Section 13300 Instrumentation and Controls - General Provisions.

3.03 IDENTIFICATION

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

3.04 FIELD QUALITY CONTROL

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

3.05 STARTUP SERVICE

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

3.06 DEMONSTRATION

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

3.07 TESTS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

END OF SECTION

SECTION 13332
INSTRUMENTATION AND CONTROLS – SURGE SUPPRESSORS

PART 1 GENERAL

1.01 DEFINITIONS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.02 SCOPE OF WORK

A. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install surge protective devices (SPDs) in the control panels and on-field devices, as required herein and shown on the drawings.

1. Provide surge protection devices to protect field instruments and equipment from the effects of transient surges caused by lightning and other electrical sources.

2. SPDs shall be installed at the following locations:
   a. On 120 VAC, 60Hz power connections to control panels.
   b. On all analog signals at the control panel as the first point of entry to the panel. Include surge protection at 24 VDC loop-powered field instruments for wiring distances over 75 feet from the control panel.
   c. Provide surge protection on all four-wire, 120 VAC field instruments.
   d. On all discrete signals with portions of interconnecting wiring located outside of protected buildings.
   e. On all copper data lines that have portions of interconnecting wiring located outside of protected buildings

1.03 RELATED WORK

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.04 SUBMITTALS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

B. Clearly indicate which instruments will have surge protection and separate enclosures or conduit mounts. Provide listings and/or tables indicating the location of both building and field devices.

C. Product Test Reports: Each Surge Supressor for tests performed by manufacturer

1.05 COORDINATION MEETINGS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.06 REFERENCE STANDARDS

A. National Fire Protection Association 79, Annex “D” Standards, (NFPA).

B. National Electrical Code (NEC).

C. National Electrical Manufacturer's Association Standards (NEMA).

D. UL 1449 Fourth Edition, Standard for Safety Surge Protective Devices (SPDs).

E. UL 497B, Protectors for Data Communications and Fire-Alarm Circuits.

F. International Electrotechnical Commission (IEC).

G. Institute of Electrical and Electronics Engineers (IEEE).

H. State and Local code requirements.

I. Where any conflict arises between codes or standards, the more stringent requirement shall apply.

1.07 QUALITY ASSURANCE

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.09 NOMENCLATURE AND IDENTIFICATION

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.10 WARRANTY

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.11 MAINTENANCE CONTRACT

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.12 PROJECT/SITE REQUIREMENTS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.13 SPARE PARTS

A. One per five of each type of surge protective device; minimum of one of each type of surge protective device.

B. One per five of each type of signal isolator and IS barrier; minimum of one of each type of surge protective device.

1.14 TECHNOLOGY OBSOLESCENCE AND MITIGATION

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

PART 2 PRODUCT

2.01 GENERAL

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

2.02 SURGE PROTECTION FOR CONTROL SYSTEMS

A. Function/Performance:

1. Provides surge protection of electronic instrumentation from induced surges propagated along the signal and power supply lines from lightning, utility, or the plan electrical systems.

2. Protection system lower than the instrument withstand level, while not interfering with normal operation.

3. Maintenance-free and self-restoring.

4. Response time: Within nanoseconds.]

B. Required Surge Protection:

1. Control Panel Power Feed (120VAC)
   a. Nominal Discharge surge current: 20kA (at an 8x20µs impulse waveform) when nominal Current is 20A and accepts 12-24 AWG wire connection.
   b. Provide surge protector from one of the following:
      1) Phoenix Contact, Model "PLT/PT" or VAL-US series
      2) Citel, Model [DS40 series]
      3) MCG Surge Protection, Model PT Series (for Control Panels)/ 400 series (For Equipment)
      4) Or Approved Equal

2. 4-Wire Field Instrument Power:
   a. Provide surge protection at the field device to protect 120 VAC power and 24 VDC power to analog instruments.
   b. Mount transmitter surge protectors in separate NEMA 4X enclosures for field installations.
   c. Refer to Instrument List for transmitters requiring surge protection in the field.
   d. Nominal Discharge surge current: 2.5kA (at an 8x20µs impulse waveform).
   e. Provide Field Mounted (at instrument) surge protector from one of the following:
      1) Phoenix Contact, Model BoxTrab BXT-N4X Series
      2) MTL Surge Technologies, Model SDyyX series
      3) Or Approved Equal

3. Analog Signal (4-20mA) Circuits:
   a. Provide surge protection where any part of the circuit is outside of the building envelope.
   b. Protect circuit at the PLC panel / control system side only.
   c. Nominal Discharge surge current: 10kA (at an 8x20µs impulse waveform). Provide Field Mounted (at instrument) surge protector from one of the following:

1) Phoenix Contact, Model SurgeTrab S-PT Series
2) MTL Surge Technologies, Model TP48
3) Citel, Model TSP M series
4) Or Approved Equal

d. Provide panel mounted surge protector for Field Mounted Instruments from one of the following:
1) Phoenix Contact, Model TermiTrab TTC Series
2) MTL Surge Technologies, Model SD series
3) Citel, Model DLA series or DLC series
4) Or Approved Equal

4. Discrete Inputs:
a. Provide surge protection at the PLC panel / control system for discrete signal connections.
b. Nominal Discharge Current (24 VDC circuit): 5kA (at an 8x20µs impulse waveform)
c. Nominal Discharge Current (120 VAC circuit): 2.5kA (at an 8x20µs impulse waveform
d. Provide surge protector from one of the following:
1) Phoenix Contact, Model TermiTrab TTC Series or PT series
2) MTL Surge Technologies, Model SD series
3) Citel, Model DLA series or DLC series
4) Or Approved Equal

5. Non-Fiber Based Data Highway or Communications Circuits:
a. Provide protection on all communication and data highway circuits that leave a building or are routed external to a building.
b. Provide circuit protection at both ends of the line.
c. Nominal Discharge surge current: 2kA (at an 8x20µs impulse waveform)
d. Provide surge protector from one of the following based on the specific application:
1) Phoenix Contac, Model DATA Trab or PlugTrab PT Series
2) MTL Surge Technologies, Model Zone Barrier NC Series
3) Citel, Model DLA series or MSP Series
4) Or Approved Equal

6. Ethernet Connection:
a. Provide protection on all communication and data highway circuits that leave a building or are routed external to a building.
b. Mount surge protectors in enclosures for field installations.
c. Provide circuit protection at both ends of the line.
d. Nominal Discharge surge current: 2kA (at an 8x20µs impulse waveform)
e. Provide surge protector from one of the following based on specific application:
1) Phoenix Contact, Model DATA Trab Series
2) MTL Surge Technologies, Model Zone Barrier NC Series
3) Citel, Model DLA series or MJ8 Series
4) Or Approved Equal

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method:

1. Conductors and cables must be inside conduit.

2. Conceal conduit in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.02 IDENTIFICATION

A. Refer to drawings

3.03 FIELD QUALITY CONTROL

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

3.04 STARTUP SERVICE

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

3.05 DEMONSTRATION

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

END OF SECTION

SECTION 13335
UNINTERRUPTIBLE POWER SUPPLY
(SINGLE-PHASE AND DC – DC)

PART 1 GENERAL

1.01 DEFINITIONS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.02 SCOPE OF WORK

A. Labor, equipment, supervision and materials for the installation, testing, startup, and training for the uninterruptible power supply (UPS) as shown on the Drawings and as specified herein.

1.03 RELATED WORK

A. PRASA General Standard Specifications

B. Section 160500 – General Electric Work

C. Section 161410 – Wiring Device

D. Section 60810 – Electrical Field Acceptance Tests

1.04 SUBMITTALS

A. Submittals shall be in accordance with Section 13300 Instrumentation and Controls - General Provisions . Submittals shall include shop drawings and product data, for the following:

1. Product brochure.

2. Bill of materials listing all components provided.

3. Deviation list indicating all proposed exceptions.

4. Power single line and control schematics drawings. All external connection details and their terminal block locations shall be fully detailed. All internal wiring shall include terminal numbers and color coding.

5. UPS performance specifications:

   a. kVA rating.
   b. Input and output voltage and phase.
   c. Run time at full and half load.
   d. Voltage (output regulation, input tolerance, unbalance, transfer/retransfer voltage, etc.).
   e. Heat rejection.

6. Operating Instruction manuals and recommended replacement parts.

7. Name, address, and telephone number of the nearest service facility.

8. Battery specifications and warranty.

9. UPS Loading and battery sizing calculations to support runtimes as specified herein.

1.05 COORDINATION MEETINGS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.06 REFERENCE STANDARDS

A. ANSI C62.41/IEEE 587 – Standards for Surge Withstand ability.

B. FCC (Federal Communications Commission) Rules and Regulations, Part 15, Subpart B, Class A certified compliance.

C. UL (Underwriters Laboratories) 1778 Listed (Rev. Jan 5, 2000), UL497A.

D. CSA 22.2, No. 107.1 M95 AND 107.2.

E. IEC 62040-2 Emission and Immunity.

F. IEC 62040-3 (Uninterruptible Power Systems, Part 3).

G. EN 60529 Equipment Protection.

H. National Electric Code (NFPA-70).

I. ISO 9001.

1.07 QUALITY ASSURANCE

A. UPS systems shall utilize a field proven design. The UPS manufacturer shall demonstrate at least ten years of continuous field operating experience with equipment of similar size and design.

B. A factory authorized service and parts organization shall be located within 100 miles of the project location. Submit the name and address of the factory authorized service and parts organization. The manufacturer shall have a complete selection of service options that may include onsite service by factory-employed service engineers and factory depot quick-return service plan options.

C. Equipment shall be UL or ETL labeled.

D. The UPS manufacturer shall have ISO 9001 certification.

1.08 DELIVERY, STORAGE AND HANDLING

A. Provide delivery, storage and handling in accordance with Section 13300 Instrumentation and Controls - General Provisions and per the following:

1. Store the equipment indoors in a clean, dry, heated storage facility until ready for installation. Do not install the equipment in its final location until the facilities are

permanently weather tight. Furnish, install and wire temporary electric space heaters in the equipment until the permanent heating equipment is operational. Protect the equipment at all times in storage or equipment room from exposure to moisture and chemicals.

1.09 NOMENCLATURE AND IDENTIFICATION

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.10 WARRANTY

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

B. UPS: In addition to the basic warranty, the UPS manufacturer shall provide a standard warranty for the UPS for a period of one year from the date of purchase. The Contractor shall provide an additional one year extended warranty to cover delays associated with equipment startup or date of receipt by end user, whichever occurs first.

C. Battery: In addition to the basic warranty, the UPS manufacturer shall provide a standard warranty for the batteries for a period of one year from the date of purchase. The Contractor shall provide an additional one year extended warranty to cover delays associated with equipment startup or date of receipt by end user, whichever occurs first.

1.11 MAINTENANCE CONTRACT

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.12 PROJECT/SITE REQUIREMENTS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.13 SPARE PARTS

A. None required.

1.14 TEST EQUIPMENT

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.15 TECHNOLOGY OBSOLESCENCE AND MITIGATION

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

PART 2 PRODUCTS

2.01 GENERAL

A. See products requirements 13300-2.01 in Section 13300 Instrumentation and Controls – General Provisions.

2.02 SINGLE PHASE UPS - INTERNAL TO CONTROL PANELS

A. SYSTEM DESCRIPTION

1. Provide an industrially rated continuous-duty, on-line, solid state, line interactive, single-phase uninterruptible power system.

2. The UPS shall provide power conditioning and power backup for PLC, communications hardware, and other critical electronic loads as indicated on the Drawings.

3. The UPS system shall consist of the following major components:

    a. Rectifier and battery charger.
    b. Inverter.
    c. Batteries.
    d. Other features as described in this specification and as indicated on the Drawings.

4. The UPS shall be:

    a. Allen Bradley, model 1609 Series
    b. Phoenix Contact, model Quint Series
    c. APC, model [Smart-UPS Series Industrial
    d. Or Approved Equal.

B. GENERAL REQUIREMENTS

1. Battery protection shall be provided to an internal circuit breaker disconnect.

2. Current limiting circuitry shall protect the inverter output under any load condition.

3. The AC output neutral shall be electrically isolated from the UPS chassis. The UPS chassis shall have an equipment ground terminal. Provisions for installation of a bonding connector shall be provided.

4. The UPS shall be suitable for installation in a UL508A listed panel.

5. The UPS shall be DIN rail mountable.

6. UL recognized components for industrial applications in accordance with UL508 without derating.

C. PERFORMANCE REQUIREMENTS

1. Ratings

    a. Output power: 350VA – 800VA.
    b. Battery runtime: 14 minutes at full-load, 34 minutes at half-load.

2. Environment:

    a. Ambient temperature: 0 to 40 degrees C (32 to 104 degrees F).
    b. Elevation: Up to 500-ft above mean sea level.
    c. Relative humidity: 1 to 95 percent non-condensing.

3. System Input – Primary source:

a. Single input: Nominal Input Voltage: 120 VAC.
b. Frequency: 45 to 65 Hz.
c. Input Power Factor: 0.95 lag minimum, 50 to 100 percent load.
d. Input Surge Withstand ability: Per IEEE 587/ANSI C62.41. Category A and B, (6 kV).

4. System Output:

a. Nominal Output Voltage:120 VAC.
b. Frequency: 60 Hertz plus or minus 3 Hertz.
c. 100 percent load with 3:1 Crest Ratio
d. Frequency Slew Rate: 1 Hz/second. (Adjustable at startup.)

5. AC to AC Efficiency: (100 percent load @ rated PF): 88 percent online, 86 percent on battery.

6. Acoustical Noise: Noise generated by the UPS under normal operation shall not exceed 65 dBA (60 dBA typical) at one meter from any surface, measured at 25 degrees C (77 degrees F) and full load.

7. EMI Suppression: The UPS shall meet FCC Rules and Regulation 47, Part 15, Subpart J, for Class A devices.

D. MODES OF OPERATION

1. The UPS shall operate as a line interactive on-line, fully automatic system in the following modes:

a. Normal: The critical load shall be continuously supplied with filtered and regulated AC power by the inverter. The rectifier/battery chargers shall derive power from the preferred AC source and supply DC power to the inverter while simultaneously floats charging the batteries.
b. Emergency: Upon failure of the preferred AC power source, the critical load shall continue to be supplied by the inverter. Inverter power shall be supplied without switching from the storage battery. There shall be no interruption to the critical load upon failure or restoration of the preferred ac sources. If the AC source cannot be restored before the battery discharges to its low voltage dropout value, the UPS shall automatically shut itself down in an orderly manner.
c. Recharge: Upon restoration of the AC source, the rectifier/battery charger shall power the inverter and simultaneously recharges the batteries. This shall be an automatic function causing no interruption to the critical load.

E. RECTIFIER/CHARGER

1. The term rectifier/charger shall denote the solid-state equipment and controls necessary to convert incoming AC power to regulated DC power for input to the inverter and for battery charging. The rectifier/charger shall be a Solid-State Relay/Insulated Gate Bipolar Transistor (SCR/IGBT) power transistor type with constant voltage/current limiting control circuitry.

F. INVERTER

1. The inverter shall include all solid-state equipment and controls to convert DC power from the rectifier/charger or battery to a regulated AC power for powering the critical load. The inverter shall use Insulated Gate Bipolar Transistors (IGBTs) in a phase-controlled, pulse width modulated (PWM) design capable of providing the specified AC output.

2. The inverter shall be capable of supplying current and voltage for overloads exceeding 100 percent. The inverter is to provide 150 percent of full load for 30 seconds and 125 percent of full load for 2 minutes. A status indicator and audible alarm shall indicate overload operation.

3. The output voltage shall be maintained to within plus or minus 5 percent.

4. The output voltage Total Harmonic Distortion (THD) shall not be greater than 5 percent at full load.

G. BATTERIES

1. The batteries shall be High Temperature sealed, maintenance-free, high-rate discharge, lead-acid cells suitable for use indoors with no off gassing, or water addition requirements. Batteries shall not require special ventilation. The battery shall consist of one or more battery banks with the number of cells required to meet the requirements of the rest of these specifications.

2. Battery Design Life: three to five years.

H. CONTROLS AND MONITORING

1. Microprocessor-controlled circuitry: Fully automatic operation of the UPS shall be provided through the use of a microprocessor-based controller. All operating and protection parameters shall be firmware-controlled. The logic shall include system test capability to facilitate maintenance and troubleshooting. Startup, battery charging, and transfers shall be automatic functions.

2. Front Indicators: As a minimum, the following indicators shall be provided on the UPS control panel:

    a. On-line (UPS is using utility power to power the load)
    b. In bypass mode
    c. On battery
    d. Overload
    e. Replace battery / battery disconnected
    f. Fault
    g. Bar graph for utility voltage
    h. Bar graph for battery

3. Front Panel Controls: As a minimum, the following controls shall be provided on the UPS control panel.

    a. Power On/Off
    b. Self-test
    c. Alarm silence

d. Cold start
e. Load off

4. Remote alarm and status indication: Isolated SPDT dry contacts shall be provided to indicate UPS status for remote monitoring. Contacts shall be rated for 250VAC @ 5A or 30VDC @ 5A Individual contacts shall be provided for separate annunciation of the following alarm and status conditions: On Battery Common Alarm On Static Bypass.]

PART 3 EXECUTION

3.01 EXAMINATION

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

3.02 INSTALLATION

A. Install and connect the equipment in accordance with the manufacturer's instructions.

B. Remove temporary lifting angles, lugs and shipping braces.

C. Touch up damaged paint finishes.

3.03 IDENTIFICATION

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

3.04 FIELD QUALITY CONTROL

A. Manufacturer’s Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. UPS will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.05 FACTORY TESTING

A. Prior to shipment, the complete UPS system shall undergo the manufacturer's standard factory test.

3.06 FIELD TESTING

A. Perform the following minimum test and checks:

1. Verify that all connections are completed in accordance with shop drawings.

2. Verify supply voltage and phase sequence are correct.

3. Check mechanical interlocks for proper operation.

4. Test ground connections for continuity and resistance.

5. Check control circuit interlocking and continuity.

B. Submit the test plan for review and approval.

C. The Contractor shall include testing of battery runtime under full load with loss of AC power.

D. In the event of an equipment fault, notify the Designer immediately. After the cause of the fault has been identified and corrected, a joint inspection of the equipment shall be conducted by the Contractor, the Construction Administrator and the equipment manufacturer's factory service technician. Repair or replace the equipment as directed by the Construction Administrator.

3.07 ADJUSTMENT

A. Make all UPS adjustments necessary for manual and automatic operation of the entire system.

3.08 CLEANING

A. Remove all rubbish and debris from inside and around the equipment. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint free rags. Do not use compressed air.

3.09 STARTUP SERVICES

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

3.10 DEMOSTRATION

A. Provide training of staff in accordance with Section 13300 Instrumentation and Controls – General Provisions.

END OF SECTION

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SECTION 13340
INSTRUMENTATION AND CONTROLS – INSTRUMENTS

PART 1 GENERAL

1.01 DEFINITIONS

A. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

B. Applications Engineering System Supplier (AESS): The entity that provides all programming, configuration, and related services for the control system equipment provided by the PCSS.

1.02 SCOPE OF WORK

A. This section covers the furnishing, installation, and services of instruments.

B. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.03 RELATED WORK

A. Section 13300 Instrumentation and Controls – General Provisions.

B. Section 13341 through section 13346, if included.

1.04 SUBMITTALS

A. Submit complete documentation of all field instruments using ISA-TR20.00.01-2007 data sheet formats. Submit a complete Bill of Materials (BOM) or Index that lists all instrumentation equipment. The list shall be sorted by Loop Number.

B. Submit separate data sheets for each instrument, including:

1. Plant Equipment Number and International Society of Automation (ISA) tag number per the drawings

2. Product (item) name used herein and on the Contract Drawings

3. Manufacturer's complete model number

4. Location of the device

5. Input - output characteristics

6. Range, size, and graduations in engineering units

7. Physical size with dimensions, enclosure National Electrical Manufacturers Association (NEMA) classification, and mounting details in sufficient detail to determine compliance with requirements

8. Materials of construction for enclosure and wetted parts

9. Instrument or control device sizing calculations where applicable

10. Manufacturer independent certified calibration data for all flow metering devices

11. Two-wire, four-wire, or smart IIot device type as applicable

C. All standard vendor documentation furnished shall have all portions that apply clearly indicated with arrows or circles. All portions that do not apply shall be neatly lined out or crossed out. Groups of pages that do not apply to the specific model supplied shall be removed.

D. Submit catalog cuts for all instruments. Submit descriptive literature for each hardware component, which fully describes the units being provided.

E. Submit index and data sheets in electronic format as well as hard copies in 8-1/2" x 11" formats. The electronic format shall be in Microsoft Excel or Word. Submit electronic copy on USB thumb drive.

F. Instruments calibration service shall be performed by technicians with the following certification: Certificación de Técnico en Instrumentación expedido por la Junta Examinadora de Puerto Rico.

1.05 COORDINATION MEETINGS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.06 REFERENCE STANDARDS

A. Refer to individual instrument specification sections.

1.07 QUALITY ASSURANCE

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.09 NOMENCLATURE AND IDENTIFICATION

A. Refer to individual instrument specification sections.

1.10 WARRANTY

A. Refer to individual instrument specification sections.

1.11 MAINTENANCE CONTRACT

A. Refer to individual instrument specification sections.

1.12 PROJECT/SITE REQUIREMENTS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.13 SPARE PARTS

A. Refer to individual instrument specifications for spare parts requirements.

1.14 TEST EQUIPMENT

A. Not Applicable

1.15 TECHNOLOGY OBSOLESCENCE AND MITIGATION

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.16 OZONE/OXYGEN SERVICE

A. This paragraph applies to gaseous, liquid, or mixtures of ozone, oxygen, ozone off-gas, and ozone vent gas.

B. All instrumentation equipment, valves, analyzers, seals, gaskets, valve seats, and associated appurtenances to be used with the above-noted special services shall be cleaned, sealed, and protected in accordance with Compressed Gas Association (CGA) publication G-4-1 and certified for oxygen service before shipping.

C. All equipment, valves, valve seats, analyzers, seals, gaskets, welds, and all associated appurtenances to be used with the above noted special services shall be specially certified resistant to degradation and gas losses due to the use of these gases or liquids.

D. Greases and lubricants shall be oxidation resistant and shall be DuPont "Krytox" for the above-noted special services.

E. Gaskets shall be expanded PTFE, Teflon, or Hypalon (80 Durometer) or Viton "A."

F. All pipe, tube, fittings, couplings, and appurtenances for use with these services shall be Type 316L stainless steel.

G. Where necessary, diaphragm seals shall be provided as specified in Section 13343 Instrumentation and Controls – Pressure Devices.

1.17 MANUFACTURERS' STARTUP AND TRAINING SERVICES

A. If indicated in the individual instrumentation paragraphs, the instrument manufacturer or manufacturer's certified service representative shall provide start-up and training services. This work shall not be done by the PCSS or AESS contractor.

B. The startup services shall be to calibrate, oversee the installations of the sensor, and startup the sensor/transmitter in order to provide reliable measurement at the instrument and to a remote system. The vendor shall work with the PCSS and AESS to verify the transmitter sends correct

information to the remote system (i.e., that the scaling and units are the same at the instrument and on the remote operator interface).

C. While the instrument manufacturer or manufacturer's certified service representative is starting up the instrumentation, training shall be provided to the PRASA's instrumentation technicians. The training shall be on how to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor and transmitter.

PART 2 PRODUCTS

2.01 GENERAL

A. See products requirements 13300-2.01 in Section 13300 Instrumentation and Controls – General Provisions.

2.02 INSTRUMENT TAGS

A. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, as indicated in the Contract Drawings, shall be provided on each piece of equipment supplied under this Section and related sections. Equipment shall be tagged before shipping to the site.

B. Provide 1/8-in by 3/8-in, Type 316 stainless steel button head machine screws or paper tag.

C. All supplied instrument transmitters and instrument transmitter elements shall have a stainless steel or paper identification tag attached to each transmitter and element prior to shipment. Tag shall be attached via stainless steel chain or stainless steel wire (24 gauge min) to a non-removable part of the device. The tag size shall be a minimum of 1.5 square inches. Tag shall include the ISA alphanumeric instrument number as indicated in the P&ID, loop, and detail Contract Drawings. The alphanumeric instrument number shall be stamped into the tag and shall have a minimum of 3/16-in high alphanumeric characters.

PART 3 EXECUTION

3.01 GENERAL

A. See execution requirements in Section 13300 Instrumentation and Controls – General Provisions.

B. Unless specifically indicated, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure transmitters, 5-valve manifolds for calibration, testing, and blow down service shall also be provided. For chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.

C. Instrument calibration installed in the project is to be done by the PCSS using PRASA's calibration Standard Operating Procedures (SOPs) and forms.

3.02 EXAMINATION

A. Refer to individual instrument specification sections.

3.03 INSTALLATION

A. Refer to individual instrument specification sections.

3.04 IDENTIFICATION

A. Refer to individual instrument specification sections.

3.05 FIELD QUALITY CONTROL

A. Refer to individual instrument specification sections.

3.06 STARTUP SERVICE

A. Refer to individual instrument specification sections.

3.07 DEMONSTRATION

A. Refer to individual instrument specification sections.

3.08 FIELD INSTRUMENT SCHEDULE

A. The field instrument schedule Section 13340 Instrumentation and Controls - Instruments APPENDIX A itemizes field instruments being provided by the PCSS (Division 13) or manufacturers of vendor provided equipment.

B. Each column of the field instrument schedule is defined as follows:

1. DRAWING NO.: The P&ID or drawing where the I/O point appears on.

2. ISA TAG NAME AND LOOP NO.: The identifier assigned to the field instrument.

3. LOOP SUFFIX: Used to distinguish instruments that share an ISA tag and loop number.

4. TYPE: The type of instrument to be provided. For example, if the instrument is a pressure, this will specify whether it is a differential pressure transmitter, gauge pressure transmitter, etc. Specific criteria will also be included in this column, such as if a diaphragm seal is required.

5. RANGE: Required measurement span of the instrument.

6. UNITS: Engineering units being measured.

7. LOCATION AND DESCRIPTION: The process being measured.

8. PROVIDE BY: The entity responsible for providing the instrument.

9. SPEC: The specification section number where the instrument details can be found.

10. INSTALLATION DETAIL: Detail on the drawings showing specific installation requirements.

END OF SECTION

SECTION 13340 APPENDIX-A: FIELD INSTRUMENT SCHEDULE

Drawing No.	ISA tag name and loop No.	Loop Suffix	Type	Range	Units	Location & Description	Spec.	Installation Detail (I drawing unless otherwise stated)
P&ID 03	FIT-01-101	-	Flow Meter Transmitter and Indicator	0.2 - 32	FPS	Raw Water	13341	P&ID 03
P&ID 03	AIT-01-101	-	Turbidimeter Transmitter and indicator	0 TO 10000	NTU	Raw Water	13345.100	P&ID 03
P&ID 03	AIT-01-201	-	pH/temperature Meter	-2.0 to 14.0	pH	Raw Water	13345.90	P&ID 03
P&ID 03	AIT-13-301	-	Streaming Current Transmitter and Controller	-10.0 to 10.0		Flash Mix	13345.80	P&ID 03
P&ID 03	LIT-16-101	-	Sludge level Transmitter and Indicator	0.65 to 39.4	FT	Sedimentation Tank 1	13345.60	P&ID 03
P&ID 04	FIT-21-102	-	Flow Meter Transmitter and Indicator	0.2 - 32	FPS	Filter 1	13341	P&ID 04
P&ID 04	LIT-21-201	-	level Transmitter	0 to 50	FT	Filter 1	13342	P&ID 04
P&ID 04	DPT-21-301	-	Differential Pressure Transmitter	0 to 30	PSI	Filter 1	13343	P&ID 04
P&ID 04	AIT-21-102	-	Turbidimeter Analyzer Low Range	0 to 700	NTU	Filter 1	13345.100	P&ID 04
P&ID 04	FIT-21-103	-	Flow Meter Transmitter and Indicator	0.2 - 32	FPS	Filter 2	13341	P&ID 04
P&ID 04	LIT-21-202	-	level Transmitter	0 to 50	FT	Filter 2	13342	P&ID 04
P&ID 04	DPT-21-302	-	Differential Pressure Transmitter	0 to 30	PSI	Filter 2	13343	P&ID 04
P&ID 04	AIT-21-103	-	Turbidimeter Analyzer Low Range	0 to 700	NTU	Filter 2	13345.100	P&ID 04
P&ID 04	FIT-21-104	-	Flow Meter Transmitter and Indicator	0.2 - 32	FPS	Filter 3	13341	P&ID 04
P&ID 04	LIT-21-203	-	level Transmitter	0 to 50	FT	Filter 3	13342	P&ID 04

Drawing No.	ISA tag name and loop No.	Loop Suffix	Type	Range	Units	Location & Description	Spec.	Installation Detail (I drawing unless otherwise stated)
P&ID 04	DPT-21-303	-	Differential Pressure Transmitter	0 to 30	PSI	Filter 3	13343	P&ID 04
P&ID 04	AIT-21-104	-	Turbidimeter Analyzer Low Range	0 to 700	NTU	Filter 3	13345.100	P&ID 04
P&ID 07	AIT-71-401	-	Chlorine Analyzer	0 to 10	PPM	Plant Discharge	13345.40	P&ID 07
P&ID 07	FIT-71-201	-	Flow Meter Transmitter and Indicator	0.2 - 32	FPS	Plant Discharge	13341	P&ID 07
P&ID 03	LIT-16-102	-	Sludge level Transmitter and Indicator	0.65 to 39.4	FT	Sedimentation Tank 2	13345.60	P&ID 03
P&ID 06	FIT-27-107	-	Flow Meter Transmitter and Indicator	0.2 - 32	FPS	Wash water Tank	13341	P&ID 06
P&ID 07	LS-51-302	-	Level Switch	-	-	Distribution	13342	P&ID 07
P&ID 05	LS-52-301	-	Level Switch	-	-	Backwash Tank Pumps	13342	P&ID 05
P&ID 06	LIT-51-204	-	level Transmitter	0 to 50	FT	Distribution	13342	P&ID 06
P&ID 06	PIT-51-102	-	Pressure Indidcator and Transmitter	-15 to 1450	psi	Distribution	13343	P&ID 06
P&ID 06	LIT-27-205	-	level Transmitter	0 to 50	FT	Wash Water Tank	13342	P&ID 06
P&ID 07	LS-18-303	-	Level Switch	-	-	Sludge Holding Tank 1	13342	P&ID 07
P&ID 07	LIT-18-206	-	level Transmitter	0 to 50	FT	Sludge Holding Tank 1	13342	P&ID 07
P&ID 05	PIT-52-101	-	Pressure Indicator and Transmitter	-15 to 1450	psi	Backwash Tank Pumps	13343	P&ID 05
P&ID 05	FIT-51-105	-	Flow Meter Transmitter and Indicator	0.2 - 32	FPS	Distribution	13341	P&ID 05
P&ID 06	PIT-27-103	-	Pressure Indicator and Transmitter	-15 to 1450	psi	Wash Water Tank	13343	P&ID 06
P&ID 05	PS-52-201	-	Pressure Switch	-15 to 1450	psi	Backwash Tank Pumps	13343	P&ID 05

Drawing No.	ISA tag name and loop No.	Loop Suffix	Type	Range	Units	Location & Description	Spec.	Installation Detail (I drawing unless otherwise stated)
P&ID 06	PS-51-202	-	Pressure Switch	-15 to 1450	psi	Distribution	13343	P&ID 06
P&ID 09	AIT-01-105	-	Turbidimeter Transmitter and indicator	0 TO 10000	NTU	Raw Water (Monitoring station)	13345.100	P&ID 09
P&ID 09	AIT-01-202	-	pH/temperature Meter	-2.0 to 14.0	pH	Raw Water (Monitoring station)	13345.90	P&ID 09
P&ID 09	AIT-16-106	-	Turbidimeter Analyzer Low Range	0 to 700	NTU	Sedimentation Tank 1 (Monitoring Station)	13345.100	P&ID 09
P&ID 09	AIT-16-203	-	pH/temperature Meter	-2.0 to 14.0	pH	Sedimentation Tank 1 (Monitoring Station)	13345.90	P&ID 09
P&ID 09	AIT-16-402	-	Chlorine Analyzer	0 to 10	PPM	Sedimentation Tank 1 (Monitoring Station)	13345.40	P&ID 09
P&ID 09	AIT-16-107	-	Turbidimeter Analyzer Low Range	0 to 700	NTU	Sedimentation Tank 2 (Monitoring Station)	13345.100	P&ID 09
P&ID 09	AIT-16-204	-	pH/temperature Meter	-2.0 to 14.0	pH	Sedimentation Tank 2 (Monitoring Station)	13345.90	P&ID 09
P&ID 09	AIT-16-403	-	Chlorine Analyzer	0 to 10	PPM	Sedimentation Tank 2 (Monitoring Station)	13345.40	P&ID 09
P&ID 09	AIT-21-108	-	Turbidimeter Analyzer Low Range	0 to 700	NTU	Combine Filters (Monitoring Station)	13345.100	P&ID 09
P&ID 09	AIT-21-205	-	pH/temperature Meter	-2.0 to 14.0	pH	Combine Filters (Monitoring Station)	13345.90	P&ID 09
P&ID 09	AIT-21-404	-	Chlorine Analyzer	0 to 10	PPM	Combine Filters (Monitoring Station)	13345.40	P&ID 09
P&ID 09	AIT-52-109	-	Turbidimeter Analyzer Low Range	0 to 700	NTU	Clearwell (Monitoring Station)	13345.100	P&ID 09
P&ID 09	AIT-52-206	-	pH/temperature Meter	-2.0 to 14.0	pH	Clearwell (Monitoring Station)	13345.90	P&ID 09
P&ID 09	AIT-52-405	-	Chlorine Analyzer	0 to 10	PPM	Clearwell (Monitoring Station)	13345.40	P&ID 09

Drawing No.	ISA tag name and loop No.	Loop Suffix	Type	Range	Units	Location & Description	Spec.	Installation Detail (I drawing unless otherwise stated)
P&ID 09	AIT-51-110	-	Turbidimeter Analyzer Low Range	0 to 700	NTU	Distribution (Monitoring Station)	13345.100	P&ID 09
P&ID 09	AIT-51-207	-	pH/temperature Meter	-2.0 to 14.0	pH	Distribution (Monitoring Station)	13345.90	P&ID 09
P&ID 09	AIT-51-406	-	Chlorine Analyzer	0 to 10	PPM	Distribution (Monitoring Station)	13345.40	P&ID 09
P&ID 04	FIT-21-106	-	Flow Meter Transmitter and Indicator	0.2 - 32	FPS	Filter 4	13341	P&ID 04
P&ID 04	LIT-21-207	-	level Transmitter	0 to 50	FT	Filter 4	13342	P&ID 04
P&ID 04	DPT-21-304	-	Differential Pressure Transmitter	0 to 30	PSI	Filter 4	13343	P&ID 04
P&ID 04	AIT-21-111	-	Turbidimeter Analyzer Low Range	0 to 700	NTU	Filter 4	13345.100	P&ID 04
P&ID 06	FIT-27-108	-	Flow Meter Transmitter and Indicator	0.2 - 32	FPS	Wash water Tank 2	13341	P&ID 06
P&ID 06	PIT-27-104	-	Pressure Indicator and Transmitter	-15 to 1450	psi	Wash Water Tank 2	13343	P&ID 06
P&ID 06	LIT-52-208	-	level Transmitter	0 to 50	FT	Backwash Tank Pumps	13342	P&ID 06
P&ID 06	LIT-80-209	-	Fuel level Transmitter			Emergency Generator	13342	P&ID 06

SECTION 13341
INSTRUMENTATION AND CONTROLS – FLOW DEVICES

PART 1 GENERAL

1.01 DEFINITIONS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.02 SCOPE OF WORK

A. This section covers the furnishing, installation, and services for flow-related instruments as detailed in the Drawings.

B. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.03 RELATED WORK

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.04 SUBMITTALS

A. Refer to Sections 13300 Instrumentation and Controls - General Provisions and 13340 Instrumentation and Controls - Instruments.

1.05 COORDINATION MEETINGS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.06 REFERENCE STANDARDS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.07 QUALITY ASSURANCE

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.08 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.09 NOMENCLATURE AND IDENTIFICATION.

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.10 WARRANTY

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.11 MAINTENANCE CONTRACT

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.12 PROJECT/SITE REQUIREMENTS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.13 SPARE PARTS

A. None required.

1.14 TEST EQUIPMENT

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.15 TECHNOLOGY OBSOLESCENCE AND MITIGATION

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

PART 2 PRODUCTS

2.01 GENERAL

A. See products requirements 13300-2.01 in Section 13300 Instrumentation and Controls – General Provisions.

2.02 MAGNETIC FLOWMETER

A. Flow Element

B. Type:

1. Pulsed DC type.

C. Function/Performance:

1. Operating Temperature: Process liquid temperatures of 0 to 140 degrees F (-18 to 60 degrees C) or greater dependent upon liner and an ambient of minus 30 to 150 degrees F (-34 to 66 degrees C).

2. Radio Frequency Interference (RFI) protection: RFI protection shall be provided as recommended by the manufacturer.

3. Pressure rating: Equal to piping system where meter is installed.

4. Additional: Meter shall be capable of running empty indefinitely without damage to any component.

D. Physical:

1. Metering Tube: 304 stainless steel or equivalent.

2. Flanges: ANSI 150 lb. or DIN PN 16 carbon steel, as the piping system requires, unless otherwise indicated. ANSI 150 lb. or DIN PN 16 stainless steel flanges shall be used on all SS process pipes.

3. Electrodes: 304 stainless steel standard minimum requirements. All electrodes to be compatible with process fluid as indicated on the Contract Drawings or electrodes to be supplied as listed in the Instrument Device Schedule on Section 13340 Instrumentation and Controls - Instruments.
    a. For sludge, polymer, or any slurry application where the electrodes will be coated, a self-cleaning or a removable electrode option must be provided with that meter.]

4. Housing: For meters with remote-mounted transmitters (vault installation), meters below grade shall be suitable for submergence for up to 168 hours to a depth of 10 ft (3m). Meters above grade shall be National Electrical Manufacturers Association (NEMA) 4X (IP68). .

5. Finish: All external surfaces shall have a chemical and corrosion-resistant finish.

E. Accessories/Documentation Required:

1. Factory calibration: All meters shall be factory calibrated. A copy of the calibration report shall be included in the O&M manual.

2. Grounding: Meter shall be grounded in accordance with the manufacturer's recommendation. Provide ground ring, ground wires, gaskets, etc., as required. All materials shall be suitable for the liquid being measured and must be compatible with process fluid and with the process pipe.]

3. For meters with remote mounted transmitters, the signal cable length between the flowtube and the transmitter shall be as required by installation guidelines on the Contract Drawings.

F. Flow Converter/Transmitter

1. Type:
    a. Microprocessor based; intelligent transmitter compatible with flowtube provided.
    b. Integral mount or mounted remote from the flowtube as shown on the drawings or as required by the physical location.

2. Functional/Performance:
    a. Accuracy (including flowtube): Plus/minus 0.5 percent of flowrate or better.
    b. Operating Temperature: range –20 to 140 degrees F (-29 to 60 degrees C).
    c. Output: Isolated 4-20 mA. Current output adjustable over the full range of the instrument. Provide a dry contact to indicate reverse flow.
    d. Diagnostics: Self diagnostics with on screen display of faults.
    e. Display: Digital indicator displaying flow in engineering units indicated in the Instrument Device Schedule on Section 13340 Instrumentation and Controls - Instruments.
    f. Totalizer: A fully configurable totalizer integral to the transmitter. Totalized flow shall be displayed.
    g. Empty Tube Zero: The transmitter shall include a feature that will lock the output at zero when no flow is detected. This feature shall be enabled automatically when the transmitter detects no flow or manually through a contact input.
    h. Provide electrode cleaning unit to match flow element requirements.

3. Physical:
    a. Transmitter shall be suitable for surface or pipe stand mounting.

b. Enclosure shall be NEMA 4X (IP65).

4. Power Requirements:
   a. The transmitter shall be 120 VAC powered instrument.

5. Accessories/ Required:
   a. Keypad where required for transmitter configuration.

G. Manufacturer: [

1. ABB, MagMaster Series / WaterMaster Series

2. Endress + Hauser, Promag Series

3. ISOIL, ISOMAG Series

4. Krhone, Optiflux Series / Enviromag /Water Flux

5. Magnetrol, 8732C

6. McCrometer, ULTRA MAG Series

7. MJK, MAG FLUX

8. Rosemount, 8705 Series / 8732E Series

9. Schneider, 8000 Series / 9000 Series

10. Siemens, Sitrans FM MAG

11. Yokowaga, Admag Series

12. Or Approved Equal]

2.03 ULTRASONIC OPEN CHANNEL FLOW METER

A. Sensor

1. Type:
   a. Non-contact, ultrasonic level transducer.

2. Function/Performance:
   a. Measuring Range: Sensor range shall be suitable for the installation indicated on the Drawings.
   b. Operating Temperature: –22 to 158 degrees F (-30 to 70 degrees C).
   c. Relative humidity: 0 to 100 percent.
   d. Temperature Compensation: Sensors shall be provided with integral temperature sensors for temperature compensation.

3. Physical:
   a. Sensors shall be potted/encapsulated in a Kynar, or other chemical and corrosion resistant housing. Where the Contract Drawings indicate sensors are to be installed in

hazardous areas, they shall be approved for installation in Class I, Division 1, Groups C and D (Zone 0) environments.
b. Sensors shall be capable of being completely submersed without damage.
c. Sensors shall be suitable for surface, pipe, or flange mounting as indicated on the Contract Drawings or in the Instrument Device Schedule in Section 13340 Instrumentation and Controls - Instruments.

4. Power Requirements:
a. Transducer shall receive its power from the remote transmitter.

5. Accessories Required:
a. The supplier shall be responsible for coordinating all sensor mounting requirements and shall furnish dimensional and elevation drawings to ensure a proper and satisfactory installation.
b. For meters with remote mounted transmitters, the signal cable length between the sensor and the transmitter shall be as required by the installation guidelines on the Contract Drawings. Cable length up to 1000 ft (300 m).

B. Transmitter/Converter

1. Type:
a. Microprocessor based transmitter.

2. Functional/Performance:
a. Range: 0 to 10 feet (0 to 3.1 m).
b. Temperature Range: 32 to 122 degrees F (0 to 50 degrees C).
c. Output: One isolated 4-20 mA output and four alarm contacts adjustable to trip at any point in the instrument range. Output contacts shall be rated 0.5 A at 120 VAC.
d. Resolution (including sensor): Plus or minus 0.1 percent of range or 0.08 inch (2 mm), whichever is greater.
e. Accuracy (including sensor): Plus or minus 0.25 percent of alarm contacts adjustable to trip at any point in the instrument range. Output contacts shall be rated 0.5 A at 120 VAC.
f. Temperature Compensation: Compensation over the temperature range of the sensor.
g. Display: Digital indicator displaying flow in engineering units indicated on the Drawings or in the Instrument Device Schedule.
h. Totalizer: A fully configurable totalizer integral to the transmitter. Totalized flow shall be displayed.
i. Diagnostics: On screen instructions and display of self-diagnostics.
j. Loss of Signal: Transmitter shall ignore momentary loss-of-echo and shall indicate sustained loss of echo on the transmitter unit.
k. Flume Curve: The transmitter shall include a facility for entering points on a flume curve for characterization of the instrument output.
l. Configuration Protection: Programmable parameters shall be protected using E2PROM. Battery backup protection is not acceptable.

3. Physical:
a. Integral mount suitable for surface or pipe stand mounting; or mounted remote from the meter as shown on the drawings or as required by the physical location.
b. Enclosure shall be NEMA 4X (IP65). Where hazardous areas are indicated on the Contract Drawings, the equipment shall be rated for that area.

c. The transmitter shall be 120 VAC powered instrument.

4. Accessories Required:
   a. Handheld programmer where required, for configuration or calibration of the instrument.

C. Manufacturer(s): [

1. Endress + Hauser FMU Series
2. Flomotion, FM8000
3. Foxboro / Schneider, IMT25
4. Greyline, SLT Series / OCF Series
5. Hach, U53 / SC200
6. Magnetrol, 341
7. Siemens, Sitrans L Series
8. Vega, Vegason Series
9. Or Approved Equal

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method:

1. Conductors and cables must be inside conduit.
2. Conceal conduit in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.02 IDENTIFICATION

A. Refer to drawings for tagging designations.]

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Flow devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.04 STARTUP SERVICES

A. Engage a factory-authorized service representative to perform startup services.

1. Complete installation and startup check according to manufacturer's written instructions.

2. The startup services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. Work with the PCSS and AESS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system's operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train PRASA's maintenance personnel to adjust, operate, and maintain units.

B. While starting up the instruments, the factory authorized representativeshall provide training to the PRASA's instrumentation technicians as follows:

1. How to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor and transmitter.

END OF SECTION

SECTION 13342
INSTRUMENTATION AND CONTROLS - LEVEL DEVICES

PART 1 GENERAL

1.01 DEFINITIONS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.02 SCOPE OF WORK

A. This section covers the furnishing, installation, and services for level-related instruments as detailed in the Contract Drawings.

B. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.03 RELATED WORK

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.04 SUBMITTALS

A. Refer to Sections 13300 Instrumentation and Controls - General Provisions and 13340 Instrumentation and Controls-Instruments.

1.05 COORDINATION MEETINGS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.06 REFERENCE STANDARDS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.07 QUALITY ASSURANCE

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.08 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.09 NOMENCLATURE AND IDENTIFICATION

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.10 WARRANTY

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.11 MAINTENANCE CONTRACT

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.12 PROJECT/SITE REQUIREMENTS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.13 SPARE PARTS

A. None required.

1.14 TEST EQUIPMENT

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.15 TECHNOLOGY OBSOLESCENCE AND MITIGATION

A. Refer to section 13300 Instrumentation and Controls - General Provisions.

PART 2 PRODUCTS

2.01 GENERAL

A. See products requirements 13300-2.01 in Section 13300 Instrumentation and Controls – General Provisions.

2.02 ULTRASONIC LEVEL/DIFFERENTIAL LEVEL METER

A. Transducer

1. Type
   a. Non-contact, ultrasonic level transducer.

2. Function/Performance
   a. Measuring Range: Transducer range shall be suitable for the installation indicated on the Drawings, up to 50 ft (15m).
   b. Temperature Range: –4 to 140 degrees F (–20 to 60 degrees C).
   c. Relative Humidity: (0 to 100) percent.
   d. Temperature Compensation: Transducers shall be provided with integral temperature sensors for temperature compensation at above temperature ranges.

3. Physical
   a. Transducers shall be potted/encapsulated in a Kynar or other chemical and corrosion-resistant housing. Where indicated on the Contract Drawings, transducers shall be approved for installation in Class I, Division 1, Groups C and D (Zone 0) environments.
   b. Transducers shall be capable of being completely submerged without damage.
   c. Transducers shall be suitable for surface, pipe, or flange mounting as indicated on the Contract Drawings or Instrument Device Schedule in Section 13340 Instrumentation and Controls - Instruments. Appropriate mounting hardware shall be provided. Flanges shall be six inch (150 mm) and resistant to attack by the medium being metered or, where required, shall be protected by corrosion- resistant coatings and facings.

4. Options/Accessories Required
    a. Signal cable as recommended by the manufacturer, for installation between the transducer(s) and the transmitter. Length, up to 1000 feet (300 m), shall be as required by installation indicated on the Contract Drawings.

B. Manufacturer(s) [

1. ABB, Model LST200 / LST300

2. Endress + Hauser, Model Prosonic FDU Series / Prosonic FMU Series

3. Greyline / Pulsar, Model LIT25 / SLT 5.0 / SLT 25

4. MJK, Model Shuttle

5. Siemens, Model Hydroranger/Multiranger /Sitrans LU

6. VEGA, Model Vegason

7. Or Approved Equal

C. Transmitter/Converter

1. Type
    a. Microprocessor based compatible with the transducer(s) provided.

2. Functional/Performance
    a. Resolution (including transducer): Plus or minus 0.1 percent of range or 0.08 inches (2 mm), whichever is greater.
    b. Accuracy (including transducer): Plus or minus 0.25 percent of range or 0.24 inches (6 mm).
    c. Range: As required by the installation indicated on the Contract Drawings.
    d. Temperature Range: -4 to 122 degrees F (-20 to 50 degrees C).
    e. Output: Minimum one isolated 4-20 mA output and minimum four alarm contacts (number of contacts above 4 required of each device to be determined by signals required as shown on the Contract Drawings adjustable to trip at any point in the instrument range. Output contacts shall be rated 5 A at 230 VAC).
    f. Temperature Compensation: Compensation over the temperature range of the sensor.
    g. Display: Digital indicator displaying level/differential level or volume in engineering units or percent as indicated on the Contract Drawings or in the Instrument Device Schedule on Section 13340 Instrumentation and Controls-Instruments.
    h. Diagnostics: On-screen instructions and display of self- diagnostics.
    i. Loss of Signal: Transmitter shall ignore momentary loss-of-echo signals and shall indicate loss of echo on the transmitter unit.
    j. Configuration Protection: Programmable parameters shall be protected using E2PROM. Battery backup protection is not acceptable.

3. Physical
    a. Transmitter shall be suitable for surface or pipe stand mounting.
    b. Enclosure shall be National Electrical Manufacturers Association (NEMA) 4X (IP65).

4. Power Requirements:
   a. The transmitter shall be 24 VDC powered instrument.

5. Accessories Required
   a. Hand-held programmer where required for configuration and calibration of the instrument.]

6. Manufacturer(s)
   a. ABB, Model LST200 / LST300 / LST400]
   b. Endress + Hauser, Model Prosonic FMU Series
   c. Greyline / Pulsar, Model LIT25 / SLT 25
   d. Krohne, Model Optisound
   e. MJK, Model Shuttle
   f. Nivelco, Model EchoTREK
   g. Rosemount, Model 3100 Series
   h. Siemens, Model Hydroranger/Multiranger / Sitrans LU
   i. Or Approved Equal

2.03 FLOAT SWITCHES

A. Type

1. Mercury free ball float switch.

B. Function/Performance

1. Differential: Less than 8 inch (200 mm).

2. Switch Rating: 1 amps at 120 VAC or 100 VA @ 120 VAC

3. Provide NO or NC type contact for fail-safe operation per section 13300-2.01. F or as shown on the Contract Drawings.

C. Physical

1. Float: 304 stainless steel, Teflon or non-stick coating, minimum 5 inch (127 mm) diameter.

2. Totally encapsulated switch.

3. Cable shall be heavy-duty, PVC or equivalent jacketed integral to float.

D. Options/Accessories Required [

1. Provide stainless steel hardware.

2. Lead wire shall be a waterproof cable of sufficient length so that no splice or junction box is required in the vault.

3. Provide a cast-aluminum weatherproof junction box outside the sump pit with terminals for all floats and tapped as required for conduit connections.

E. Manufacturer(s) [

1. Contegra, Model FS90
2. Kobold, Model NSE / NST Series
3. MJK, Model 7030
4. Siemens, Model 9G-EF
5. Or Approved Equal

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method:

1. Conductors and cables must be inside conduit.
2. Conceal conduit in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.02 IDENTIFICATION

A. Refer to drawings / control system architecture for tagging designations.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Level devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.]

3.04 STARTUP SERVICES

A. PCSS shall perform startup services.

1. Complete installation and startup check according to manufacturer's written instructions.

3.05 DEMONSTRATION

A. Train PRASA's maintenance personnel to adjust, operate, and maintain units.

B. While starting up the instruments, the PCSS shall provide training to the PRASA's instrumentation technicians as follows:

1. How to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor.

END OF SECTION

SECTION 13343
INSTRUMENTATION AND CONTROLS – PRESSURE DEVICES

PART 1 GENERAL

1.01 DEFINITIONS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.02 SCOPE OF WORK

A. This section covers the furnishing, installation, and services for pressure-related instruments as detailed in the Contract Drawings.

B. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.03 RELATED WORK

A. Section 13300 Instrumentation and Controls – General Provisions.

B. Section 13340 Instrumentation and Controls – Instruments.

1.04 SUBMITTALS

A. Section 13300 Instrumentation and Controls – General Provisions.

B. Section 13340 Instrumentation and Controls – Instruments..

1.05 COORDINATION MEETINGS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.06 REFERENCE STANDARDS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.07 QUALITY ASSURANCE

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.08 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.09 NOMENCLATURE AND IDENTIFICATION

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.10 WARRANTY

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.11 MAINTENANCE CONTRACT

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.12 PROJECT/SITE REQUIREMENTS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.13 SPARE PARTS

A. None required.

1.14 TEST EQUIPMENT

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.15 TECHNOLOGY OBSOLESCENCE AND MITIGATION

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

PART 2 PRODUCTS

2.01 GENERAL

A. See products requirements 13300-2.01 in Section 13300 Instrumentation and Controls – General Provisions.

2.02 DIFFERENTIAL PRESSURE TRANSMITTERS

A. Type:

1. Microprocessor based, intelligent type.

B. Function/Performance:

1. Range: As shown in the field instrument schedule in Section 13340 Instrumentation and Controls – Instruments.

2. Accuracy: 0.075 percent of span (linear output).

3. Operating Temperature: -4 to 176 degrees F (-20 to 80 degrees C).

4. Temperature Effect: Combined temperature effects shall be less than 0.2 percent of maximum span per 82 degrees F (28 degrees C) temperature change.

5. Static Pressure Effect: Effect on accuracy due to static pressure changes shall be negligible.

6. Output: 4-20 mA DC adjustable over the instrument range, with HART protocol. Output shall be linear for differential pressure applications. For flow metering applications, the output shall be proportional to the square root of the input differential pressure.

7. Stability: 0.05 percent of upper range limit for 1 year.

8. Display:
    a. Digital indicator displaying differential pressure or flow in the engineering units indicated in the field instrument schedule in Section 13340 Instrumentation and Controls – Instruments.

9. Diagnostics:
    a. Self-diagnostics with transmitter failure driving output to above or below out of range limits.
    b. Simulation capability for inputs and loop outputs.
    c. Test terminals available to ease connection for test equipment without opening the loop.
    d. Data registers available to record minimum and maximum pressure and temperatures transmitter has been exposed to.

10. Over Range Protection: Provide positive over range protection to 150 percent of the maximum pressure of the system being monitored by the instrument.

C. Physical:

1. Enclosure: National Electrical Manufacturers Association (NEMA) 4X (IP66). Where indicated on the drawings to be installed in a hazardous location, the sensor assembly shall be explosion proof approved for Class I, Division 1, Groups C and D (EEx d IIC T5).

2. Process Wetted Parts: Isolating diaphragm and other wetted metal parts shall be 316L stainless steel. Gaskets and O-rings shall be Teflon.

3. Power Supply: 24 VDC loop power.

4. Sensor Fill Fluid: Silicone.

D. Accessories Required:

1. Provide span and zero adjustment at each transmitter and through the handheld programming unit.
    a. Configuration of the transmitter may be accomplished using the local display and pushbuttons without the use of an external programming device.

2. For each transmitter provide a five (5)-valve manifold. The manifold shall be 316 stainless steel. Manifolds may be mounted directly to the instrument or separately mounted. Manifolds shall be by the instrument manufacturer or by D/A Manufacturing, Anderson Greenwood, Or Approved Equal.

E. Manufacturer(s): (

1. Endress + Hauser, Model Deltabar

2. Rosemount, Model 3051CD

3. Siemens, Model Sitrans, P320/420

4. Or Approved Equal

2.03 DIAPHRAGM SEAL - THREADED

A. Type:

1. Thread attached.

2. Welded Metal Diaphragm.

B. Function/Performance:

1. Maximum Pressure: Two times the maximum process pressure.

2. Operating Temperature: -40 to 212 degrees F (-40 to 100 degrees C).

C. Physical:

1. All 316L stainless steel construction.

2. Teflon gaskets and O rings on process connection.

3. Sensing Liquid: Silicone Oil.

4. Bleeding connection provided.

D. Accessories Required:

1. Stainless steel armored capillary tubing as required for the installation.

E. Manufacturer(s): (

1. Rosemount, Model 1199

2. Ashcroft, Model 510-511

3. Siemens, Model 7MF Series

4. Or Approved Equal

2.04 GAUGE PRESSURE OR PRESSURE SENSING LEVEL TRANSMITTERS

A. Type:

1. Microprocessor based, intelligent type.

B. Function/Performance:

1. Range: As shown in the field instrument schedule in Section 13340 Instrumentation and Controls – Instruments.

2. Accuracy: 0.075 percent of span.

3. Operating Temperature: -4 to 176 degrees F (-20 to 80 degrees C).

4. Temperature Effect: Combined temperature effects shall be less than 0.2 percent of maximum span per 82 degrees F (28 degrees C) temperature change.

5. Output: 4-20 mA DC linear with pressure or level, with HART protocol. Zero adjustable over the range of the instrument provided calibrated span is greater than the minimum calibrated span.

6. Stability: 0.05 percent of upper range limit for 1 year.

7. Display: Digital indicator displaying pressure or level in the engineering units indicated in the field instrument schedule in Section 13340 Instrumentation and Controls – Instruments.

8. Diagnostics:
   a. Self-diagnostics with transmitter failure driving output to above or below out of range limits.
   b. Simulation capability for inputs and loop outputs.
   c. Test terminals available to ease connection for test equipment without opening the loop.
   d. Data registers available to record minimum and maximum pressure and temperatures transmitter has been exposed.

9. Over Range Protection: Provide positive over range protection to 150 percent of the maximum pressure of the system being monitored by the instrument.

10. If required to meet the range or suppression/elevation requirements, a differential pressure transmitter shall be provided.

C. Physical:

1. Enclosure: NEMA 4X (IP66). Where indicated on the drawings to be installed in a hazardous location, the sensor assembly shall be explosion proof approved for Class I, Division 1, Groups C and D (EEx d IIC T5).

2. Process Wetted Parts: Isolating diaphragm and other wetted metal parts shall be 316L stainless steel. Gaskets and O-rings shall be Teflon.

3. Power Supply: 24 VDC loop power.

4. Sensor Fill Fluid: Silicone.

D. Accessories Required:

1. Provide span and zero adjustment at each transmitter and through the handheld programming unit.
   a. Configuration of the transmitter may be accomplished using the local display and pushbuttons without the use of an external programming device.

2. For each transmitter, provide a 316 stainless steel block & bleed shut off valve. Valves may be mounted directly to the instrument or separately mounted. Valves shall be by the instrument manufacturer or by D/A Manufacturing or Anderson Greenwood.

3. For each transmitter provide a diaphragm seal as shown on the drawings.

E. Manufacturer(s): (

1. Endress + Hauser, Model Cerabar
2. Rosemount, Model 3051CG
3. Siemens, Model Sitrans, P320/420
4. Schneider/Foxboro, Model IAP05S / IGP05S
5. Yamatake/Azbil, Model GTX
6. Krohne, Model Optibar Serie
7. Or Approved Equal

2.05 FLANGE MOUNTED PRESSURE SENSING LEVEL TRANSMITTER

A. Type:

1. Flanged mounted, microprocessor based, intelligent type.

B. Function/Performance:

1. Range: As shown in the field instrument schedule in Section 13340 Instrumentation and Controls – Instruments.
2. Accuracy: 0.075 percent of span.
3. Operating Temperature: -4 to 176 degrees F (-20 to 80 degrees C).
4. Temperature Effect: Combined temperature effects shall be less than 0.2 percent of maximum span per 82 degrees F (28 degrees C) temperature change.
5. Output: 4-20 mA DC linear with pressure or level with HART protocol.
6. Zero adjustable over the range of the instrument, provided calibrated span is greater than the minimum calibrated span.
7. Stability: 0.05 percent of upper range limit for 1 year.
8. Display: Digital indicator displaying level in engineering units, as indicated in the field instrument schedule in Section 13340 Instrumentation and Controls – Instruments.
9. Diagnostics:
   a. Self-diagnostics with transmitter failure driving output to above or below out of range limits.
   b. Simulation capability for inputs and loop outputs.
   c. Test terminals available to ease connection for test equipment without opening the loop.

d. Data registers available to record minimum and maximum pressure and temperatures transmitter has been exposed to.

10. Over Range Protection: Provide positive over range protection to 150 percent of the maximum pressure of the system being monitored by the instrument.

C. Physical:

1. Enclosure: NEMA 4X (IP66). Where indicated on the drawings to be installed in a hazardous location, the sensor assembly shall be explosion proof approved for Class I, Division 1, Groups C and D (Exx d IIC T5).

2. Process Wetted Parts: Isolating diaphragm and other wetted metal parts shall be 316L stainless steel. Gaskets and O-rings shall be Teflon.

3. Flange: Flange shall be ANSI 3-inch, 150 lb. (DN 80, PN 25 or 40) carbon steel.

4. Power supply shall be 24 VDC loop power.

5. Sensor Fill Fluid: Silicone.

D. Accessories Required:

1. Provide span and zero adjustment at each transmitter and through the handheld programming unit.
   a. Configuration of the transmitter may be accomplished using the local display and pushbuttons without the use of an external programming device.

2. Provide seals for the flange connection suitable to the process liquid being metered.

E. Manufacturer(s): (

1. ABB, Model 266DHH

2. Rosemount, Model 3051L

3. Siemens , Model Sitrans P DS III

4. Or Approved Equal

2.06 PRESSURE SWITCH

A. Type:

1. Diaphragm actuated.

B. Function/Performance:

1. Repeatability: Better than 1 percent of full scale.

2. Setpoint: Field adjustable and set between 30 and 70 percent of the adjustable range.

3. Dead Band: Adjustable to 60 percent of full scale

4. Reset: Unit shall be of the automatic reset type unless noted otherwise in the field instrument schedule in Section 13340 Instrumentation and Controls – Instruments.

5. Over Range Protection: Over range protection to 150 percent of the maximum process line pressure.

6. Output: Single pole double throw (SPDT) unless requirement for double pole double throw (DPDT) switch is shown on the field instrument schedule in Section 13340 Instrumentation and Controls – Instruments. Switch rating shall be 10 A at 230 VAC.

C. Physical:

1. Housing: NEMA 4X (IP65) for non-hazardous areas. For installation in hazardous areas, housing shall be explosion proof approved for Class 1, Division 1, Groups C and D (EEx d IIB).

2. Switch Assemblies: Hermetically sealed switches.

3. Wetted Parts: 316L stainless steel diaphragm, Viton seals, 316 stainless steel connection port.

D. Accessories/Options Required:

1. Shutoff Valve: Provide a 316 stainless steel shutoff valve. Valve shall be by D/A Manufacturing, Anderson Greenwood, or Approved Equal.

2. Provide diaphragm seals as shown on the drawings.

3. Where indicated on the Contract Drawings, provide a 316 stainless steel snubber for pulsation dampening.

E. Manufacturer(s): (

1. Ashcroft, Model B Series

2. Mercoid, Model DA Series

3. Dwyer Instruments, Inc, Model Series CXA / Series A6

4. Or Approved Equal

2.07 PRESSURE GAUGE

A. Type:

1. Bourdon tube actuated dial face pressure gauge.

B. Function/Performance:

1. Accuracy: Plus or minus 1.0 percent of span or better.

C. Physical:

1. Case: Type 316 stainless steel for surface/stem mounting with a pressure relieving back. The case shall be vented for temperature/atmospheric compensation. Gauge shall be capable of being liquid filled in the field or at the factory.

2. Window: Clear acrylic or shatter proof glass.

3. Bourdon tube: Stainless steel.

4. Connection: 1/2 in. NPT.

5. Gauge size: Minimum 4-in. viewable.

6. Pointer travel: Not less than 200 degrees not more than 270-degree arc.

7. Range: As shown in the field instrument schedule in Section 13340 Instrumentation and Controls – Instruments.

D. Accessories/Options Required:

1. Shutoff valve: Each gauge shall have a process shutoff valve that can also be used as an adjustable pressure snubber.

2. Special scales: Engineer reserves the right to require special scales and/or calibration if the manufacturer's standard is not suitable for the application.

3. Provide diaphragm seals as shown on the Contract Drawings.

4. Sensing Liquid: Silicone Oil.

5. Liquid filled at the factory.

E. Manufacturer(s): (

1. Ametek US Gauge, Model 659

2. Ashcroft, Model 1259

3. Omega Engineering, Inc, Model PGT Series

4. Or Approved Equal

2.08 PRESSURE TRANSMITTER/PRESSURE SWITCH

A. Product Characteristics

1. Number of inputs and outputs: Number of digital outputs: 1; Number of analog outputs: 1

2. Measuring range -15...1450 psi

3. Process connection: threaded connection G 1 external thread sealing cone

B. Application:

1. Medium temperature: -25...125 °C, (145 max. 1h)
2. Min. bursting pressure: 9425 psi
3. Type of pressure: relative pressure

C. Electrical:

1. Operating voltage V: 18...32 DC

D. Output:

1. Total number of outputs: 2
2. Output signal: switching signal; analog signal; (configurable)
3. Electrical design: PNP/NPN
4. Number of digital outputs: 1
5. Output function: normally open / closed; (configurable)
6. Max. voltage drop switching output DC (V):2
7. Permanent current rating of switching output DC (mA): 250
8. Switching frequency DC (Hz):6
9. Number of analog outputs: 1
10. Analog current output (mA): 4...20, invertible; (scalable 1:4)
11. Max. load (Ω): (Ub - 10 V) / 20 mA
12. Analog voltage output (V): 0...10, invertible; (scalable 1:4)
13. Min. load resistance (Ω): 2000
14. Short-circuit protection: yes
15. Type of short-circuit protection: yes (non-latching)
16. Overload protection: yes

E. Measuring/setting range

1. Measuring/setting range: (-1...100 bar) (-15...1450 psi) (-0.1...10 MPa)
2. Set point SP: (-0.8...100 bar) (-13...1450 psi) (-0.08...10 MPa)

3. Reset point rP: (-1...99.8 bar) (-15...1448 psi) (-0.1...9.98 MPa)

4. Analog start point: (-1...75 bar) (-15...1088 psi) (-0.1...7.5 MPa)

5. Analog end point: (24...100 bar) (348...1450 psi) (2.4…10 Mpa)

6. In steps of (0.1 bar) (1 psi) (0.01 MPa)

F. Accuracy / deviations

1. Switch point accuracy (% of the span): < ± 0,5; (Turn down 1:1)

2. Repeatability (% of the span): < ± 0,1; (with temperature fluctuations < 10 K; Turn down 1:1)

3. Characteristics deviation (% of the span): < ± 0,5; (Turn down 1:1 , linearity, incl. hysteresis and repeatability , limit value setting to DIN EN IEC 62828-1)

4. Linearity deviation (% of the span): < ± 0,15; (Turn down 1:1)

5. Hysteresis deviation (% of the span):< ± 0,15; (Turn down 1:1)

6. Long-term stability (% of the span): < ± 0,1; (Turn down 1:1; per year)

7. Temperature coefficient zero point (% of the span / 10 K): < ± 0,2; (0...70 °C)

8. Temperature coefficient span (% of the span / 10 K): < ± 0,2; (0...70 °C)

G. Reaction times

1. Response time (ms): < 100

2. Damping process value dAP (s): 0.1...100

3. Damping for the analog output dAA (s): 0.1...100

4. Step response time analog output (ms): 25

H. Operating conditions

1. Ambient temperature: (-25...80 °C) (-13...176 °F)

2. Storage temperature: (-40...100 °C) (-40.. 212 °F)

3. Protection: IP 67; IP 69K

I. Mechanical data

1. Material: stainless steel (1.4404 / 316L); (PC); (PBT); (PEI); (FKM); (PTFE)(

2. Materials (wetted parts): ceramics; PTFE; stainless steel (1.4435 / 316L); surface characteristics: Ra < 0,4 / Rz 4

3. Min. pressure cycles: 100 million

4. Process connection: threaded connection G 1 external thread sealing cone

J. Displays / operating elements

1. Display: Display unit 4 x LED, green

2. Switching status LED, yellow

3. Function display alphanumeric display, 4-digit

4. Measured values alphanumeric display, 4-digit

5. Display unit: bar; psi; MPa; % of the span

K. Manufacturer(s): (

1. IFM Electronic, Model PI269x

2. Or Approved Equal

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method:

1. Conductors and cables must be inside conduit.

2. Conceal conduit in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.02 IDENTIFICATION

A. Refer to drawings for tagging designations.)

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Pressure devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.)

3.04 STARTUP SERVICES

A. PCSS shall perform startup services.

1. Complete installation and startup check according to manufacturer's written instructions.

3.05 DEMONSTRATION

A. Train PRASA's maintenance personnel to adjust, operate, and maintain units.

B. While starting up the instruments, the PCSS shall provide training to the PRASA's instrumentation technicians as follows:

1. How to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor and transmitter.

END OF SECTION

SECTION 13345.40
INSTRUMENTATION AND CONTROLS – CHLORINE RESIDUAL ANALYZERS

PART 1 GENERAL

1.01 DEFINITIONS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

B. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

C. Applications Engineering System Supplier (AESS): The entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.

1.02 SCOPE OF WORK

A. This section covers the furnishing, installation, and services for chlorine instruments as detailed in the Drawings.

B. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.03 RELATED WORK

A. Section 13300 Instrumentation and Controls – General Provisions.

B. Section 13340 Instrumentation and Controls – Instruments.

1.04 SUBMITTALS

A. Section 13300 Instrumentation and Controls – General Provisions.

B. Section 13340 Instrumentation and Controls – Instruments.

1.05 COORDINATION MEETINGS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.06 REFERENCE STANDARDS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.07 QUALITY ASSURANCE

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

B. Provide components compatible with functions required to form complete working system.

C. Ensure that materials of construction of wetted parts are compatible with process liquid.

D. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.08 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.09 NOMENCLATURE AND IDENTIFICATION

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.10 WARRANTY

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.11 MAINTENANCE CONTRACT

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.12 PROJECT/SITE REQUIREMENTS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.13 SPARE PARTS

A. None required.

1.14 TEST EQUIPMENT

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.15 TECHNOLOGY OBSOLESCENCE AND MITIGATION

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

PART 2 **PRODUCTS**

2.01 GENERAL

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

2.02 SINGLE-PARAMETER UNIVERSAL TRANSMITTER

A. Type:

1. Microprocessor-based, intelligent transmitter compatible with a minimum of sensor (digital or analog) inputs.

2. Transmitter manufacturer shall be the same as the instrument sensor where possible.

B. Function/Performance:

1. Accuracy: plus or minus 0.1% of span.

2. Repeatability: plus or minus 0.05% of span.

3. Response Time: 60 seconds to 90% of the value on a step change.

4. Temperature Compensation: Compensation over the entire temperature range of the instrument.

5. Environmental Conditions: 14 to 131 degrees F (-10 to 55 degrees C) and 5 to 95% relative humidity.

6. Outputs:

   a. Minimum: Two (2) 4-20mA outputs.
   b. Minimum: Four (4) 120VAC, 5A, configurable relays.

7. Network Communication:

   a. Modbus RS485.
   b. Modbus TCP/IP.
   c. EtherNet/IP.]

8. Diagnostics: On-screen instructions and display of self-diagnostics.

C. Physical:

1. Transmitter shall be suitable for surface or pipe stand mounting.

2. Enclosure shall be NEMA 4X (IP65).

3. Where indicated on the drawings to be installed in hazardous locations, the sensor assembly shall be explosion proof approved for Class 1, Division 1, Group C and D (EEx d IIC).

4. Power Requirements: 120VAC.

D. Accessories:

1. Provide sensor connection cable and plug between the transmitter and the analyzer sensor for rapid attachment and exchange of sensor.

2. Provide a connection box for analyzers.

E. Manufacturers: [

1. Hach, Model [SC4500].

2. s::can, Model [con::lyte].

3. Endress + Hauser, Model Liquiline CM Series.

4. Or Approved Equal/

2.03 COLORIMETRIC CHLORINE RESIDUAL ANALYZER

A. Type:

1. Microprocessor based electronic transmitter/converter flow-through sample cell.

2. Colorimetric chlorine analyzer for monitoring of free or total residual chlorine.

3. Instrument chemistry will employ N, N-diethyl-p-phenylenediamine (DPD) method.

4. Other methods of chlorine measurement such as amperometric, potentiometric, and iodometric that employ electrodes or other electrochemical techniques are not acceptable.

5. Compliant with US EPA 40 CFR 141.74 (US EPA Method 334.0, SM 4500 CLG).

B. Function/Performance:

1. Range:0-10 ppm.

2. Accuracy:

a. Below 5 ppm: Plus or minus 5 percent of full scale or 0.04 ppm , whichever is greater.
b. Above 5 ppm: Plus or minus 10 percent of reading.

3. Resolution: 0.01 ppm .

4. Precision: Plus or minus 5 percent of reading or 0.01 ppm, whichever is greater.

5. Lower Limit of Detection (LOD): 0.03 PPM.

6. Cycle Time: 2.5 minutes (adjustable)

7. Ambient temperature range: 35 to 122 degrees F (2 to 50 degrees C).

8. Diagnostics: On screen instructions and self-diagnostics.

9. Response: 90 percent of full scale within 2.5 minutes.

C. Physical:

1. Electronics enclosure shall be NEMA 4X.

2. Power Requirements: 120 VAC/60 Hz.

3. Outputs: Isolated 4-20 mA output and three (3) programmable alarm contacts rated for 5A at 120-240 VAC.

4. Display: Dot matrix or LCD type displaying chlorine residual in ppm.

5. Internal pump to control sample draw and reagent useage with the following operational criteria:

a. Sample Flow Rate: 60 to 200 ml/minute.
b. Sample Filtration: Y-strainer with 40-mesh screen or higher.
c. Water Pressure: Internal pressure regulator for line pressure up to 150 PSIG.
d. Inlet Pressure (Analyzer): 1.5 to 5 PSIG.
e. Sample Temperature: 41 to 104 degrees F (5 to 40 degrees C).
f. Operating Humidity: 0 to 90 percent, non-condensing.

D. Accessories Required:

1. Provide one year's supply of consumables and one spare electrode.

2. Installation kit with mounting brackets and hardware required for the installation location shown on the drawings.

3. Sampling line close to the analyzer with a sampling pump, and also on the analyzer discharge location

4. If the selected chlorine analyzer does not have a built-in microprocessor-based transmitter, provide a compatible single- parameter transmitter, in accordance with the above requirements.

E. Manufacturers:

1. Hach, Model CL17sc

2. YSI, Model 3017M DPD.

3. Thermo Scientific, Model Orion Chlorine XP Analyzer.

4. Or Approved Equal.

PART 3 **EXECUTION**

3.01 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method:

1. Conductors and cables must be inside conduit.

2. Conceal conduit in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer’s limitations on bending radii.

3.02 IDENTIFICATION

A. Refer to drawings for tagging designations.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Analytical devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.]

3.04 STARTUP SERVICES

A. Engage a factory-authorized service representative to perform startup services.

1. Complete installation and startup check according to manufacturer's written instructions.

2. The startup services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. Work with the PCSS and AESS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system's operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train PRASA's maintenance personnel to adjust, operate, and maintain units.

B. While starting up the instruments, the factory authorized representative shall provide training to PRASA's instrumentation technicians as follows:

1. How to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor and transmitter.

END OF SECTION

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SECTION 13345.60
SLUDGE BLANKET ANALYZERS

PART 1 GENERAL

1.01 DEFINITIONS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.02 SCOPE OF WORK

A. This section covers the furnishing, installation, and services for analytical-related instruments as detailed in the Drawings.

B. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.03 RELATED WORK

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.04 SUBMITTALS

A. Refer to Sections 13300 Instrumentation and Controls - General Provisions and 13340 Instrumentation and Controls – Instruments.

1.05 COORDINATION MEETINGS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.06 REFERENCE STANDARDS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.07 QUALITY ASSURANCE

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.09 NOMENCLATURE AND IDENTIFICATION

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.10 WARRANTY

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.11 MAINTENANCE CONTRACT

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.12 PROJECT/SITE REQUIREMENTS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.13 SPARE PARTS

A. See Section 13340 Instrumentation and Controls – Instruments for spare part requirements.

B. All mounting hardware required for pipe stand, surface, or other mounting shall be provided.

C. Each instrument shall be provided with a manufacturer-installed stainless steel tag identifying the instrument tag number.

1.14 TEST EQUIPMENT

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.15 TECHNOLOGY OBSOLESCENCE AND MITIGATION

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.16 MANUFACTURER START-UP AND TRAINING SERVICES

A. If indicated in the instrumentation paragraphs below, the instrument manufacturer or manufacturer's certified service representative shall provide start-up and training services. This work shall not be done by the PCSS or AESS contractor.

B. The start-up services shall be to calibrate, oversee the installations of the sensor, and start up the sensor/transmitter in order to provide reliable measurement at the instrument and to the control system. The vendor shall work with the PCSS and AESS to verify the transmitter sends correct information to the remote system (i.e., that the scaling and units are the same at the instrument and on the remote operator interface). Vendor to submit an instrument calibration report in order to document the calibration procedure of the instruments.

C. While starting the analyzers, the vendor shall train the PRASA's Representative or PRASA instrumentation technicians. The training shall be in how to calibrate, install, troubleshoot, read the diagnostics, and maintain the analyzer and transmitter.

PART 2 PRODUCTS

2.01 GENERAL

2.02 SLUDGE BLANKET INTERFACE LEVEL ANALYZER, ULTRASONIC

A. General:

1. The purpose of this instrument is to measure the depth of a sludge blanket in wastewater treatment plant clarifiers/thickeners. The measurement technique for determining sludge

level shall be underwater ultrasonic capable of providing a continuous sludge level measurement. The system shall consist of microprocessor-based Smart Sensor(s), transmitter/display, power supply if required, standalone indicators if required, interconnecting cable, mounting brackets and hardware.

B. Type:

1. Acoustic impulses emitted from a transducer located in the process liquid are reflected back from material in the process liquid or from a liquid or gas in the process with differing physical properties and are received by the transducer. The transmit time of the pulse from generation to echo is measured. The elapsed time is proportional to the distance between the transducer and material surface(s). The relative strength of return echo is plotted on a proportional graphic display and is representative of the pattern of material distributed beneath the transducer. Relatively strong and persistent echo patterns are identified as interface points between clear liquid and liquid containing greater solids concentrations.

C. Sensor

1. When sensor or sensor cable is located in classified explosion hazard areas, the sensor and sensor cable shall be selected with FM approval rating to meet the requirements for use in those areas.

2. Underwater Acoustic Sensor with integral cable.

3. Range: 1.0 to 32.0 feet.

4. Accuracy: Level: 0.1 feet at 10 feet.

5. Operating Temperature: 34 to 125 degrees F (1 to 52 degrees C).

6. Wetted Materials: PVC, epoxy, Kynar, ABS.

7. Mounting assembly: shall be all 316 SS and have provisions to protect the transducer from surface skimmer action.

8. Self-cleaning transducer: required for clarifier and thickener applications in which no surface skimmer is present.

9. Cable shielded: Integral to sensor. Verify length required prior to ordering, no splices. Provide additional length as required to facilitate sensor maintenance without disconnecting cable.

10. Sensors may be configurable by the transmitter serving an individual sensor or by a common transmitter in a distributed sensor network.

11. Process Connections:

    a. 3/4-inch NPT.
    b. Provide flexible sensor mounting arrangement required for tanks with surface skimmers.

D. Transmitter:

1. Enclosure: NEMA 4X Polycarbonate.

2. Power Supply: 120VAC, 10 percent, 60 Hertz Nominal.]

3. Resolution: 0.12 inches at 10.0 feet.

4. Frequency: 500 – 750 kHz.

5. Operating Temperature: -40 to 140 Degrees F (-40 to 60 degrees C).

6. Signal Output:

   a. Galvanic Isolated 4-20 mA DC proportional to level.
   b. Signal output shall be HART compatible if available from the manufacturer.

7. Display: Back-lit LCD, multi-function graphical user interface and membrane keypad with alpha/numeric setup menu and system parameters, and digital indication of Level or Range measurement and graphical representation of the return echo profile. A built-in keypad shall be used for display and menu select/editing functions.

8. Memory: non-volatile memory shall retain all calibration, application, and user parameters.

9. Self-test and automatic calibration.

10. Provide local back-lit LCD indication of level at each basin scaled in feet.

E. ACCESSORIES:

1. Manufacturers 316 Stainless steel hinged swing bracket/multi-flex sensor mounting assembly and mounting hardware for handrail mount.

2. Provide all necessary mounting hardware for handrail or wall mount.

F. MANUFACTURERS: [

1. Analytical Technologies, Inc., model EchoSmart Series

2. Hycontrol, model Sonarflex

3. Hach, model Sonatax with SC4500 Controller

4. Or Approved Equal.

G. Manufacturer Start-up and Training services:

1. Provide manufacturer's start-up and training services as specified in the start-up and training services paragraph.

PART 3 EXECUTION

3.01 INSTALLATION

A. Sensor(s) shall be positioned in the tank approximately six inches below liquid level and installed in accordance with manufacturer recommendations. A flexible mounting arrangement shall be required in applications in which a scum skimmer passes at the surface of the tank and rotates the sensor out of its path. A self-cleaning sensor with integral wiper blade shall be used in applications with no scum skimmer to rotate the sensor out of its path.

B. Comply with NECA 1.

C. Wiring Method:

1. Conductors and cables must be inside conduit.

2. Conceal conduit in accessible ceilings, walls, and floors where possible.

D. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer’s limitations on bending radii.

3.02 IDENTIFICATION

A. Refer to drawings for tagging designations.]

3.03 FIELD QUALITY CONTROL

A. Manufacturer’s Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Verify operation of the devices.

C. Prepare test and inspection reports.]

3.04 STARTUP SERVICES

A. Engage a factory-authorized service representative to perform startup services.

1. Initial startup of analyzer by Manufacturer's representative with 4 hours of on-site maintenance training.

2. Complete installation and startup check according to manufacturer’s written instructions.

3. The startup services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. Work with the PCSS and AESS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system’s operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.]

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train PRASA's maintenance personnel to adjust, operate, and maintain units.

B. While starting up the instruments, the factory authorized representative shall provide training to the PRASA's instrumentation technicians as follows:

1. How to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor and transmitter.

END OF SECTION

SECTION 13345.80
INSTRUMENTATION AND CONTROLS – STREAMING CURRENT ANALYZERS

PART 1 GENERAL

1.01 DEFINITIONS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

B. Streaming current units (SCU): The measurement of positive and negative surface charges in water, primarily measured following coagulation.

C. Single pole, double throw (SPDT): A switch with a single input terminal and two output terminals.

D. Ultra-high molecular weight (UHMW): A thermoplastic polyethylene with corrosion, abrasion, and impact-resistant properties.

1.02 SCOPE OF WORK

A. This section covers the furnishing, installation, and services for streaming current analyzers as detailed in the Drawings.

1.03 RELATED WORK

A. Section 13300 Instrumentation and Controls – General Provisions.

B. Section 13340 Instrumentation and Controls – Instruments.

1.04 SUBMITTALS

A. Section 13300 Instrumentation and Controls – General Provisions.

B. Section 13340 Instrumentation and Controls – Instruments.

1.05 COORDINATION MEETINGS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.06 REFERENCE STANDARDS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.07 QUALITY ASSURANCE

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

B. Provide components compatible with functions required to form a complete working system.

C. Ensure that construction materials of wetted parts are compatible with the process liquid.

D. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

E. Submit quality assurance certificate with signal performance data and final inspection certificate

1.08 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.09 NOMENCLATURE AND IDENTIFICATION

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.10 WARRANTY

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.11 MAINTENANCE CONTRACT

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

B. Contractor must include a manufacturer's Service Agreement that covers all the manufacturer's recommended preventative maintenance, regularly scheduled calibration, and any necessary repairs from the time of equipment startup through to end user acceptance/plant turnover and the first 12 months of end-user operation post turnover.]

C. Maintenance to be performed by the manufacturer's factory-trained service personnel. Field service and factory repair by personnel not certified by the manufacturer won't be allowed.

D. Contractor must use manufacturer's service parts and reagents. Third-party parts and reagents are not approved for use.

1.12 PROJECT/SITE REQUIREMENTS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.13 SPARE PARTS

A. 2 Replacement sensor cartridge, piston, and cam rod to piston linkage for each unit provided.

1.14 TEST EQUIPMENT

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.15 TECHNOLOGY OBSOLESCENCE AND MITIGATION

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

PART 2 PRODUCTS

2.01 GENERAL

A. See products requirements 13300-2.01 in Section 13300 Instrumentation and Controls – General Provisions.

2.02 STREAMING CURRENT ANALYZERS

A. Type:

1. The Streaming Current Analyzer shall be a fully self-contained sensor/monitor/controller for measuring the charge on particles in the coagulation phase of water, wastewater, or industrial treatment processes.

2. The instrument shall be microprocessor-controlled. The instrument shall calculate the reading using advanced digital processing. The streaming current shall be calculated based on an algorithm custom designed for the streaming current signal. The algorithm shall account for the shape of the small current signal generated by the sensor. It shall not be rectified and filtered traditionally.

B. Function/Performance:

1. Range: Plus or minus 1000 SCU.

2. Accuracy: Plus or minus 0.5 percent of a full scale

3. Resolution: 1.0 SCU

4. Response Time: 1 second

5. Sample Flow Rate: up to 5 GPM

6. Sample Temperature: 45 to 95 degrees F (7 to 35 degrees C)

7. Zero Offset: Automatic, adjustable over full-scale range.

8. Operating Temperature: 32 to 122 degrees F (0 to 50 degrees C)

9. Outputs: Isolated 4-20mA outputs adjustable over the full measuring range.

10. PID controller, proportional and integral type; manually tuned with anti-integral windup bumpless auto / manual transfer and parameter change. Forward or reverse acting.

11. Alarm Contacts: Two programmable (2) SPDT alarm contacts rated 5A @ 230 VAC / SPDT alarm contacts rated 6A @ 30 VDC

12. Self-calibrating and self-diagnostic

13. Communication Interface: Modbus/TCP / RS485

C. Physical:

1. Enclosure: NEMA 4X.

2. Electronics Housing: corrosion-resistant ABS plastic. Includes clear-hinged front cover for accessing keypads for programming, zeroing, or manual adjustments.

3. Sensor Module – Bracket-mounted sensing assembly containing the following:

a. 110V Drive Motor, gearbox, and reciprocating piston
b. Integral process fittings for inlet and outlet sample flow, the sizing of which corresponds to the standard sampling accessories and constant head flow device available

4. Mounting: Wall, panel, or Unistrut mountable.

5. Wetted Parts: Type 316 stainless steel, UHMW polyethylene, and epoxy.

6. Input Power: 85-264 VAC, 47-63 Hz

D. Display:

1. Liquid crystal multiples display (LCD) with backlight.

2. Menu-Driven Functions

3. Keypad Interface

E. Accessories Required:

1. Automatic sensor flush with programmable flush intervals, durations, and hold periods. The option includes the required water connections.

2. Provide piping bypass circuit to the sample analyzer as shown in drawings

3. Sensor Maintenance Option: Sensor flush & chemical wash

4. Provide replacement sensor cartridge, piston, and cam rod to piston linkage as spare parts.

5. Provide all cables, connectors, and tubing required for a fully operational system.

F. Manufacturers:

1. Hach, Model AF7000

2. ChemTrac, Model [DuraTrac 4+ HydroACT Analyzer

3. Micrometrix, SCD-W610

4. Or Approved Equal

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method:

1. Conductors and cables must be inside conduit.

2. Conceal conduit in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding the manufacturer's limitations on bending radii.

3.02 IDENTIFICATION

A. Refer to drawings for tagging designations.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Analyzers will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.]

3.04 STARTUP SERVICES

A. Engage a factory-authorized service representative to perform startup services.

1. Complete installation and startup check according to the manufacturer's written instructions.

2. The startup services include calibration, oversight of sensor installations, and start-up of the sensor/transmitter to provide reliable measurement at the instrument. Work with the PCSS and AESS to verify that the transmitter sends correct information to the control system (i.e., the scaling and units are the same at the instrument and on the control system's operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3. The manufacturer's factory-trained service personnel must perform startup. Field service by personnel not certified by the manufacturer won't be allowed

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train PRASA's maintenance personnel to adjust, operate, and maintain units.

B. While starting up the instruments, the factory authorized representative shall provide training to the PRASA's instrumentation technicians as follows:

1. How to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor and transmitter.

END OF SECTION

SECTION 13345.90
INSTRUMENTATION AND CONTROLS – pH/ORP ANALYZERS

PART 1 GENERAL

1.01 DEFINITIONS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.02 SCOPE OF WORK

A. This section covers the furnishing, installation, and services for pH/ORP analyzers as detailed in the Drawings.

1.03 RELATED WORK

A. Section 13300 Instrumentation and Controls – General Provisions.

B. Section 13340 Instrumentation and Controls – Instruments.

1.04 SUBMITTALS

A. Section 13300 Instrumentation and Controls – General Provisions.

B. Section 13340 Instrumentation and Controls – Instruments.

1.05 COORDINATION MEETINGS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.06 REFERENCE STANDARDS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.07 QUALITY ASSURANCE

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

B. Provide components compatible with functions required to form complete working system.

C. Ensure that materials of construction of wetted parts are compatible with process liquid.

D. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.08 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.09 NOMENCLATURE AND IDENTIFICATION

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.10 WARRANTY

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.11 MAINTENANCE CONTRACT

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.12 PROJECT/SITE REQUIREMENTS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.13 SPARE PARTS

A. None required.

1.14 TEST EQUIPMENT

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.15 TECHNOLOGY OBSOLESCENCE AND MITIGATION

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

PART 2 PRODUCTS

2.01 GENERAL

2.02 SINGLE-PARAMETER UNIVERSAL TRANSMITTER

A. Type:

1. Microprocessor-based, intelligent transmitter compatible with a minimum of sensor (digital or analog) inputs.

2. Transmitter manufacturer shall be the same as the instrument sensor where possible.

B. Function/Performance:

1. Accuracy: plus or minus 0.1% of span.

2. Repeatability: plus or minus 0.05% of span.

3. Response Time: 60 seconds to 90% of the value on a step change.

4. Temperature Compensation: Compensation over the entire temperature range of the instrument.

5. Environmental Conditions: 14 to 131 degrees F (-10 to 55 degrees C) and 5 to 95% relative humidity.

6. Outputs:

a. Minimum: Two (2) 4-20 mA outputs.
b. Minimum: Four (4) 120 VAC, 5A, configurable relays.

7. Network Communication:

a. Modbus RS485.
b. Modbus TCP/IP.
c. EtherNet/IP.]

8. Diagnostics: On-screen instructions and display of self-diagnostics.

C. Physical:

1. Transmitter shall be suitable for surface or pipe stand mounting.

2. Enclosure shall be NEMA 4X (IP65).

3. Where indicated on the drawings to be installed in hazardous locations, the sensor assembly shall be explosion proof approved for Class 1, Division 1, Group C and D (EEx d IIC).

4. Power Requirements: 120VAC

D. Accessories:

1. Provide sensor connection cable and plug between the transmitter and the analyzer sensor for rapid attachment and exchange of sensor.

2. Provide a connection box for analyzers.

E. Manufacturers: [

1. Hach, Model SC4500

2. Rosemount Analytical, Model 1066

3. Endress + Hauser, Model Liquiline CM442, Single-Channel

4. Or Approved Equal

2.03 PH FIELD ANALYZERS

A. Type:

1. pH-sensitive glass membrane electrode, double or triple-junction reference electrode and ground electrode with integral preamplifier.

2. Flow-through application.

B. Function/Performance:

1. Range: 0 to 14.

2. Temperature Compensation: Temperature element integral to sensor for temperature compensation.

C. Physical:

1. Flat glass or shrouded pH electrode.

2. Sensor assembly constructed of PVDF, Tefzel, or similar material.

3. Sealed electrodes.

D. Accessories Required:

1. Manufacturer's cable for connection of sensor to transmitter. Length of cable as required by installation indicated on Drawings.

2. One year's supply of consumables for calibration.

3. Handrail mounting kit where indicated on the Drawings.

4. If the selected pH analyzer does not have a built-in microprocessor-based transmitter, provide a compatible single-parameter transmitter, in accordance with the above requirements.

E. Manufacturers: [

1. Rosemount Analytical, Model 3900 / 396 Series

2. Hach, Model pHD Sensor

3. Endress + Hauser, Model Digital Memosens Sensor Series

4. Or Approved Equal

2.04 PH/ORP PORTABLE ANALYZERS

A. Type:

1. Handheld pH/ORP sensor and transmitter assembly.

B. Function/Performance:

1. Accuracy:

a. pH: Plus or minus 0.01.
b. ORP: Plus or minus 1 mV.
c. Temperature: Plus or minus 0.9 degrees F (0.5 degrees C).

C. Physical:

1. Power: Battery with charger.

2. Graphic Display: Backlit LCD.

3. PC Interface: USB.

4. Enclosure: IP67 waterproof.

D. Manufacturers: [

1. Thermo Scientific, Model Orion Star A221 Portable pH Meter

2. Hach, Model HQ1110

3. Hanna Instruments, Model HI98190

4. Endress + Hauser, Model Liquiline To Go CYM290

5. Or Approved Equal

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method:

1. Conductors and cables must be inside conduit.

2. Conceal conduit in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.02 IDENTIFICATION

A. Refer to drawings for tagging designations.]

3.03 [FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Analyzers will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.]

3.04 STARTUP SERVICES

A. Engage a factory-authorized service representative to perform startup services.

1. Complete installation and startup check according to manufacturer's written instructions.

2. The startup services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. Work with the PCSS and AESS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system's operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train PRASA's maintenance personnel to adjust, operate, and maintain units.

B. While starting up the instruments, the factory authorized representative shall provide training to the PRASA's instrumentation technicians as follows:

1. How to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor and transmitter.

END OF SECTION

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SECTION 13345
INSTRUMENTATION AND CONTROLS – TURBIDITY ANALYZERS

PART 1 GENERAL

1.01 DEFINITIONS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.02 SCOPE OF WORK

A. This section covers the furnishing, installation, and services for turbidity analyzer instruments as detailed in the Drawings.

B. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.03 RELATED WORK

A. Refer to Sections 13300 Instrumentation and Controls - General Provisions and 13340 Instrumentation and Controls - Instruments.

1.04 SUBMITTALS

A. Refer to Sections 13300 and 13340.

1.05 COORDINATION MEETINGS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.06 REFERENCE STANDARDS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.07 QUALITY ASSURANCE

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

B. Provide components compatible with functions required to form complete working system.

C. Ensure that materials of construction of wetted parts are compatible with process liquid.

D. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.09 NOMENCLATURE AND IDENTIFICATION

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.10 WARRANTY

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.11 MAINTENANCE CONTRACT

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.12 PROJECT/SITE REQUIREMENTS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.13 SPARES PARTS

A. None required.

1.14 TEST EQUIPMENT

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.15 TECHNOLOGY OBSOLESCENCE AND MITIGATION

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

PART 2 PRODUCTS

2.01 GENERAL

A. See products requirements 13300-2.01 in Section 13300 Instrumentation and Controls – General Provisions.

2.02 SINGLE-PARAMETER UNIVERSAL TRANSMITTER

A. Type:

1. Microprocessor-based, intelligent transmitter compatible with a minimum of sensor (digital or analog) inputs.

2. Transmitter manufacturer shall be the same as the instrument sensor where possible.

B. Function/Performance:

1. Accuracy: plus or minus 0.1% of span.

2. Repeatability: plus or minus 0.05% of span.

3. Response Time: 60 seconds to 90% of the value on a step change.

4. Temperature Compensation: Compensation over the entire temperature range of the instrument.

5. Environmental Conditions: 14 to 131 degrees F (-10 to 55 degrees C) and 5 to 95% relative humidity.

6. Outputs:

   a. Minimum: Two (2) 4-20mA outputs.
   b. Minimum: Four (4) 120VAC, 5A, configurable relays.

7. Network Communication:

   a. Modbus RS485.
   b. Modbus TCP/IP.
   c. EtherNet/IP.]

8. Diagnostics: On-screen instructions and display of self-diagnostics.

C. Physical:

1. Transmitter shall be suitable for surface or pipe stand mounting.

2. Enclosure shall be NEMA 4X (IP65).

3. Power Requirements: 120VAC powered.

D. Accessories:

1. Provide sensor connection cable and plug between the transmitter and the analyzer sensor for rapid attachment and exchange of sensor.

2. Provide a connection box for analyzers.

E. Manufacturers:

1. Hach, Model SC4500

2. Swam Analytical, Model Transmitter AMI / AMU Transmitters

3. Or Approved Equal

2.03 [LOW-RANGE TURBIDIMETER

A. Type:

1. Microprocessor-based, continuously flowing, turbidimeter using [white light] [Laser] technology.

2. For Compliance must be EPA 180.1 or 10258.

B. Function/Performance:

1. Accuracy: plus or minus 2% of reading from 0 to 40 NTU; and plus or minus 5% of reading from 40 to 100 NTU.

2. Repeatability: plus or minus 1% of reading or plus or minus 0.002 NTU; whichever is greater.

3. Resolution: 0.001 NTU.

4. Range: 0 to 100 NTU.

5. Environmental Conditions: 32 to 104 degrees F (0 to 40 degrees C) and 0 to 95% relative humidity, non-condensing.

6. Analyzer Isolated Output: 4-20 mA outputs adjustable over the full instrument range, and at least 2 SPDT alarm contacts rated for 5A at 230 VAC, which can be adjusted to trip at any point in the instrument range.

7. Display: Digital indicator displaying turbidity in NTUs.

C. Physical:

1. Suitable for surface or pipe stand mounting.

2. Power: 120 VAC/60 Hz.

3. NEMA 4X (IP55) enclosure. If the instrument will be installed in flooding area, the instrument shall be installed in an IP68 enclosure (NEMA 6P).

D. Accessories Required:

1. A factory-calibrated optical device for verification of calibration without the use of consumables.

2. One year supply of consumables for calibration.

3. All cables, connectors, tubing, and flow cell accessories are required for a fully operational turbidimeter.

4. Supply all flow cell accessories as required by the manufacturer.

E. Transmitter:

1. Include a compatible transmitter by the same manufacturer as specified elsewhere in this section if the transmitter is not already integrated with the sensor.

F. Manufacturer(s): [

1. HACH, Model TU5300SC]

2. Swam Analytical, Model Monitor AMI Turbiwell

3. Or Approved Equal

2.04 HIGH-RANGE TURBIDIMETER – IN-SITU

A. Type: Microprocessor-based continuous-reading instrument using Infrared Duo scattered light technique for color-independent turbidity measurement Turbidity in accordance with DIN EN ISO 7027 / TS equivalent DIN 38414 or four-beam ratiometric technologies to measure water turbidity.

B. Function/Performance:

1. Accuracy: plus or minus 5% of reading or plus or minus 0.1 NTU, whichever is greater.

2. Repeatability: plus or minus 1% or plus or minus 0.04 NTU, whichever is greater.

3. Resolution: 0.01 NTU.

4. Range: 0 to 4000 NTU, minimum.

5. Operating Temperature: 32 to 122 degrees F (0 to 50 degrees C).

C. Physical:

1. Suitable for [immersion in open tanks] [insertion in pipes].

2. Power requirements: power and communication over the manufacturer's cable.

3. NEMA 4X (IP 68) enclosure.

D. Accessories Required:

1. All cables and connectors required for a fully operational in-situ turbidimeter.

2. Self-cleaning system. Wiper arm.

3. One year supply of consumables for calibration.

4. Standardization plates or optical cubes for verification of calibration without use of consumables.

5. Provide installation assembly for insertion in pipe.

E. Transmitter:

1. Include compatible transmitters by the same manufacturer as specified elsewhere in this section.

F. Manufacturer(s):

1. Hach, Model Solitax

2. Or Approved Equal

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method:

1. Conductors and cables must be inside conduit.

2. Conceal conduit in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.02 IDENTIFICATION

A. Refer to drawings for tagging designations.]

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Analyzer devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.]

3.04 STARTUP SERVICES

A. Engage a factory-authorized service representative to perform startup services.

1. Complete installation and startup check according to manufacturer's written instructions.

2. The startup services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. Work with the PCSS and AESS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system's operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train PRASA's maintenance personnel to adjust, operate, and maintain units.

B. While starting up the instruments, the factory authorized representative shall provide training to the PRASA's instrumentation technicians as follows:

1. How to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor and transmitter.

END OF SECTION

SECTION 13346
INSTRUMENTATION AND CONTROLS – MISCELLANEOUS DEVICES

PART 1 GENERAL

1.01 DEFINITIONS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.02 SCOPE OF WORK

A. This section covers the furnishing, installation, and services for the field-mounted instruments that are not specified in other sections of Division 13, as detailed on the Drawings and in the Loop Diagrams.

B. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.03 RELATED WORK

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.04 SUBMITTALS

A. Refer to Sections 13300 Instrumentation and Controls - General Provisions and 13340 Instrumentation and Controls - Instruments.

1.05 COORDINATION MEETINGS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.06 REFERENCE STANDARDS

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.07 QUALITY ASSURANCE

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.08 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.09 NOMENCLATURE AND IDENTIFICATION.

A. Refer to Section 13300 Instrumentation and Controls – General Provisions.

1.10 WARRANTY

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.11 MAINTENANCE CONTRACT

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.12 PROJECT/SITE REQUIREMENTS

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.13 SPARE PARTS

A. None required.

1.14 TEST EQUIPMENT

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

1.15 TECHNOLOGY OBSOLESCENCE AND MITIGATION

A. Refer to Section 13300 Instrumentation and Controls - General Provisions.

PART 2 PRODUCTS

2.01 GENERAL

A. See products requirements 13300-2.01 in Section 13300 Instrumentation and Controls – General Provisions.

2.02 PANEL-MOUNTED DIGITAL INDICATORS

A. Type:

1. Digital indicator.

B. Function/Performance:

1. Accuracy: plus or minus [0.25] percent of calibrated range.

2. Operating Temperature: [-4 to 158 degrees F (-20 to 70 degrees C)].

3. Input: One (1) 4 to 20 mA.

4. Output: One (1) 4 to 20 mA.

5. Digital Outputs: Two (2) Form C programmable contacts rated for 5A at 120/240 VAC.

6. Display: 0.56-inch-high efficiency, 5-digit LED display. For outdoor applications the display must be rated for direct light. Outdoor displays to have sunshields provided.

7. Indicator Failure: Failure of the indicator will not cause failure of the 4-20 mA loop.

C. Physical:

1. Suitable for panel mounting.

2. NEMA 4X

3. Programmable via integrated keypad.

4. Power Requirements: 120 VAC/60 Hz.

D. Manufacturer(s): [

1. Precision Digital, Model ProVu Series

2. Red Lion Controls, Model PAXDP Series

3. Or Approved Equal

2.03 4 TO 20 MA LOOP CALIBRATOR

A. Type:

1. Portable 4-20 mA loop calibrator capable of reading, sourcing, and simulating control loop currents.

B. Function/Performance:

1. Modes of Operation:
   a. Read: Read the 4-20 mA control current in a loop.
   b. Simulate: Simulates operation of 2-wire transmitter in a current loop with external power.
   c. Source: Provides 24 VDC power to a current loop and regulates the current at a selected value.
   d. Read/Power: Provides 24 VDC power to a transmitter and reads the transmitter output.

2. Button to step through current values of 4, 12, and 20 mA.

3. Current output of calibrator selectable to any value between 0 and 24 mA.

4. Accuracy: plus or minus 0.05 percent of full scale.

5. Operating Temperature: 14 to 122 degrees F (-10 to 50 degrees C).

6. Display: LCD display, showing current in mA or percent.

C. Physical:

1. Powered by single 9-volt battery.

D. Accessories Required:

1. Leads for connection of the calibrator into the control loop circuit.

2. One spare battery.

3. Carrying case.

E. Manufacturer(s): [

1. Altek, Model 830

2. Fluke, Model 705

3. Or Approved Equal

2.04 ANNUNCIATOR AND INDICATING PANEL

A. The panel shall be a NEMA 4X panel arranged for surface mounting with front access. Hinged front access door shall be provided with a safety glass window for viewing an alarm condition and loop-powered level indicators. The push buttons shall be mounted on the front door. The steel panel shall be ground, base coated, prime coated and finish coated in a glare free enamel. All panel equipment shall be mounted, pipe and/or wired on or within the panel. All wiring shall comply with local and National Electrical Code in open bundles wired to numbered terminals. Panel layout and fabrication details shall be submitted to the Engineer for approval. White engraved windows in light-boxes shall be provided for visual annunciator of off-normal conditions as indicated on the Drawing.

B. Annunciator cabinet alarm modules shall be furnished for mounting as indicated on the Drawings. The cabinets shall include lamp boxes and annunciator logic plug-in alarm cards. Cabinets shall be of metal construction and well-ventilated to reduce heat buildup.

C. Each alarm module shall accept either normally open or normally closed field contacts and shall be readily field-selectable. Lamp modules shall be separate plug-in modules with a minimum of two bulbs per alarm point.

D. The alarm sequence will be manual reset (ISA-218.1, sequence M) and operate as follows:

1. An off-normal field contact condition shall initiate a flashing visual signal corresponding to the point in the alarm condition and sound an audible signal. Manually depressing the acknowledge push button silences the audible alarm and changes the flashing light to a steady light. When the off-normal field contact returns to normal, change in status shall occur, but only if the alarm is acknowledged. A test push button circuit shall be included which, when activated, will flash all alarm lamps and will not activate auxiliary relays used for retransmission of alarms.

2. The push buttons and horn shall be separately mounted on the panel.

E. The annunciators shall operate from 115 Volts, 60 Hz, and be supplied with the necessary power supplies to run the logic system.

F. The annunciator logic system shall function with the [Put # of alarm windows/lights] alarm windows or alarm lights as specified.

G. The panel shall come equipped with [Put # of indicators] Loop-powered Level Indicators

1. Type: Electronic, 3.5 digit, 0.35-in high efficiency LCD display.

2. Operation: To accept 4-20 mA DC input signal and provide indication in Engineering Units of measured variable.

3. Functional: Loop powered, 10 VA; Input - 4-20 mA DC into 100 ohms; Indication - 0.35-in LED display.

4. Physical: Suitable to be mounted with annunciator modules as shown on Drawing.

5. Performance: Linear input accuracy plus or minus 0.1% of calibrated span, ±1 count.

H. Product and Manufacturer(s): [

1. Ronan

2. Panelalarm

3. Or Approved Equal

2.05 LIMIT SWITCH

A. Type:

1. Direct opening 2 position snap action.

B. Function/Performance:

1. Minimum 2 double pole single throw (DPST) NO contacts or 2 double pole double throw (DPDT) contacts.

C. Physical:

1. Lever or button style spring return actuator.

2. Contact rating for 120 VAC/30 VDC, 100VA minimum.

D. Accessories/Options Required:

1. Non-corrosive, NEMA 4X.

2. If a sealed pre-wired switch is used, a separate connection or junction box of equal environmental protection rated will be supplied and installed.

E. Manufacturer(s): [

1. Allen-Bradley, Model 802 Series

2. Square D, Model 9007 Series / L100/300

3. Or Approved Equal

PART 3 EXECUTION

3.01 GENERAL

A. See execution requirements in Section 13300 Instrumentation and Controls – General Provisions.

END OF SECTION

SECTION 13350
I&C – Vendor Package System Controls Integration

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This section is related to the vendor system requirements for integration with the PRASA Control and SCADA system.

1.02 COMPATIBILITY OF THE OWNER'S PROGRAMMING EQUIPMENT WITH THE VENDOR SYSTEM

1. The PCSS and the Vendor Package System shall coordinate SCADA Integration Workshops before the start of project construction. The purpose of the Workshops shall be to provide a forum to discuss, refine, and coordinate what is to be expected of the integration, connectivity, PRASA Standard, data mapping, and control narrative implementation involved with the interaction between the SCADA Plant and the Vendor System.

2. When providing OITs screen as part of the vendor SCOPE, the Vendor coordinates with the contractor for a workshop OIT graphic application review with a PRASA representative. The purpose of the assistance is to provide input about the development of the vendor's Operator Interface Terminals displays and its integration with the SCADA system.

3. Readable Machine Documentation: The Vendor supplier shall provide two sets of documented unprotected as-built Electronic Programmable Logic Controller (PLC), Program Counter (PC), Human-Machine Interface (HMI), and all other required software files on a USB thumb drive in a native machine-readable format, final software programs, and any passwords or hardware/software needed to modify or restore all programs and configurations developed under this Contract. This machine-readable documentation shall include all documentation files, including logic and annotation files. Any changes made during or after the factory acceptance test shall be incorporated at no additional cost to the Puerto Rico Aqueduct and Sewer Authority (PRASA). Supply of these items shall not require any ongoing support contract or long-term relationship with the supplier.]

4. Before leaving the site, the Vendor supplier shall ensure that any devices or programming computers that PRASA will use to maintain the system can monitor the control processors online, make online changes, and upload and download the processors to ensure proper communication has been set up and that programming software versions are compatible with the processors provided.

5. Before leaving the site, the Vendor supplier shall ensure the PLC and HMI addresses ("IP addresses" if an Ethernet network) are configured to be compatible with the plant's Supervisory control and data acquisition (SCADA) system. Also, before leaving the site, the supplier must perform a communication verification of each piece of data listed on the memory map.]

1.03 MEMORY MAPS REQUIREMENTS

1. Submit a memory map of PLC registers to be transmitted and received and function from and to the plant PLC in coordination with the Process Control System Supplier/ Applications

Engineering System Supplier (PCSS/AESS) and in concordance with the PRASA PLC SCADA Standard requirements.

2. PLC shall communicate to the plant the SCADA system as shown on the Contract Instrumentation drawings.

3. All control and monitoring functions available on the vendor control panel or operator interface shall be designed for duplication in the plant's SCADA system.

4. All vendors supplying control panels that communicate with the plant SCADA network shall submit a memory map of PLC registers to the AESS by 30 days before the scheduled shipment of the vendor equipment to the site. The vendor shall contact and coordinate with the AESS to ensure a compatible configuration of the vendor PLCs to match the facility network. The vendor shall configure the network addresses in their equipment to check the addresses determined by the AESS, PRASA IT. Software communication shall be provided in contiguous registers. One set of records shall be provided for writing discrete-type information, and one set shall be provided for reading discrete-type information. One set of registers shall be provided for writing floating-point information (i.e. from Analog input or internal Setpoints), and one set shall be provided for reading floating-point information (i.e. Analog output or Setpoints command).

1.04 SURGE PROTECTION REQUIREMENTS FOR VENDOR EQUIPMENT

1. Provide individual device protection for any 4-20 mA signal and 120VAC or 24 VDC power to an instrument or equipment mounted outside the building or facility housing. Instruments shall be housed in a grounded metallic case. Device surge protectors shall be mounted within the instrument enclosure or a separate junction box coupled to the enclosure. Refer to Surge Protection specification 16192 Surge Protective Devices Electrical Power System and 13332- Instrumentation and Controls (IC) - Surge Suppressors

2. Provide a network surge suppressor for each ethernet connection to the Plant PLC network. Refer to 13332- Instrumentation and Controls (IC) - Surge Suppressors

3. Hardwired discrete connection between Plant PLC and vendor PLC must be done via interposing relays.

END OF SECTION

SECTION 150100
MECHANICAL GENERAL PROVISIONS

PART ONE - GENERAL

1.01 DESCRIPTION

A. The work in this Section covers the installation and testing of all equipment. The provisions of this Section shall apply equally to all equipment specified under other sections.

B. Such work shall include all supervision, labor, materials, tools, equipment and services as required for the delivery, installation, start-up, testing and adjustment of all equipment in accordance with the Drawings and Specifications.

C. Installation work shall include the placement, assembly, shimming, anchoring, grouting, cleaning, lubrication, assembly, and adjustment of all equipment.

D. The CONTRACTOR shall provide a complete operating installation, with all necessary accessories, and in compliance with the requirements of this Section, the Specifications, and as shown or indicated on the Drawings, or otherwise required.

E. The CONTRACTOR shall be responsible for all installation of instrumentation as specified elsewhere in these Specifications and as shown on the Drawings.

1.02 CODES, PERMITS AND INSPECTION

A. Installation of equipment shall comply with all applicable Federal and local laws.

B. The CONTRACTOR shall furnish, for any equipment where such is required, a certificate of final inspection and approval from the inspection authority having jurisdiction.

1.03 RESPONSIBILITY FOR EQUIPMENT

A. The CONTRACTOR shall be liable for all damage to equipment installed under this contract, as well as for any damage to the building structures or other property, real or personal, resulting from the movement of equipment or installation work. Said responsibility shall continue until the installation of the equipment is accepted by the FCWSA.

B. The CONTRACTOR shall deliver, unload and protect equipment to be furnished under this contract and installed under this contract until such time as the equipment is accepted by PRASA.

C. The CONTRACTOR shall be responsible to determine weights of all equipment to be handled, and to provide adequate handling equipment and experienced riggers. Any weights indicated in the Specifications or Drawings are approximate and are to be used at the CONTRACTOR's discretion.

1.04 QUALITY OF WORKMANSHIP

A. All equipment shall be installed true and level and to exact location as shown on the Drawings. All work shall be performed to the satisfaction of the ENGINEER. Precision gages and levels shall be used in setting all equipment.

B. The CONTRACTOR shall be responsible for installation of the equipment in accordance with local code requirements, in accordance with manufacturer's instructions, and in accordance with industry standards. The installation shall be such that all warranties will be enforceable.

C. Equipment and appurtenances shall be designed in conformity with the standards of ANSI, ASME, IEEE, NEMA, AISC, API, AGMA and other generally accepted or specified standards. All electrically powered equipment shall be UL listed. Equipment and appurtenances shall be of rugged construction and of sufficient strength to withstand all stresses which may occur during testing, installation, and all conditions of normal operation. All bearings and moving parts shall be protected against wear. Provision shall be made for lubrication with accessible devices.

D. Machinery parts shall conform to the dimensions shown on the approved equipment manufacturer's working drawings. The corresponding parts of identical machines shall be made interchangeable. Clearance shall be provided for repairs, inspection and adjustment.

E. Exposed surfaces shall be finished in appearance. All exposed welds shall be ground smooth and the corners of structural shapes shall be rounded or cambered, for personnel protection.

F. All machinery and equipment shall be safeguarded in accordance with the safety codes of the ANSI, OSHA, and local industrial codes.

G. All machinery and equipment shall comply with the provisions of the Occupational Safety and Health Act of 1970 and subsequent amendments.

1.05 PERFORMANCE GUARANTEE

Each equipment manufacturer shall guarantee that the equipment shall be capable of fulfilling the contract requirements.

1.06 EQUIPMENT WARRANTIES

All equipment warranties shall be in accordance with Section 017400 Warranties and Bonds. If warranty requirements are detailed in individual equipment specifications, those requirements shall preside over the requirements of Section 017400.

1.07 EQUIPMENT MANUFACTURER'S INSTALLATION INSTRUCTIONS

The CONTRACTOR's work procedure shall conform to the approved equipment manufacturer's installation instructions unless expressly directed otherwise by the ENGINEER.

1.08 MANUFACTURER'S ERECTION REPRESENTATIVE

A. The following equipment installed under this Contract requires the services of equipment manufacturer's erection representatives for the purpose of assisting and directing the installation, adjustment, and testing of equipment. All costs relative to services of equipment manufacturer's erection representatives shall be included in the equipment cost, but if not included, cost shall be borne by the CONTRACTOR.

Specification Section	**Equipment**
112140	Vertical Turbine Pumps
113240	Water Level Transducers
113250	Magnetic Flow Meters
113290	Free Chlorine Analyzer
113500	Shower Eyewash Station
118000	Chemical Feed Equipment
162220	Diesel-Engine Generating Set and Appurtenances

B. If additional services are required, as determined by the ENGINEER, the costs of such additional services shall be negotiated between the equipment supplier and the CONTRACTOR, and any additional expense shall be borne by the equipment supplier or the CONTRACTOR.

1.09 OPERATING INSTRUCTIONS AND PRASA PERSONNEL TRAINING

A. The CONTRACTOR, through manufacturer's representatives or other qualified individuals, shall adequately instruct designated employees of the PRASA in the operation and care of all equipment installed.

B. The CONTRACTOR shall be responsible for submitting all requested operating and maintenance manuals of CONTRACTOR purchased equipment to the ENGINEER. Submittals shall be in accordance with the General Conditions and Section 01300 Submittals.

PART TWO - PRODUCTS

2.01 TOOLS AND ACCESSORIES

The CONTRACTOR shall furnish with each type, make, or size of equipment, any special tools and appliances which may be needed to adjust, operate, maintain, or repair the equipment. Such tools and appliances shall be new, high grade, properly labeled, and delivered to the OWNER prior to initial operation of the equipment.

2.02 IDENTIFICATION NAMEPLATES

Each piece of equipment shall be provided with a substantial stainless steel nameplate, securely fastened in a conspicuous place and clearly inscribed with the manufacturer's name, year of manufacture, serial number, and principal rating data. These nameplates shall not be painted.

2.03 LUBRICATION

A. The CONTRACTOR shall thoroughly lubricate all equipment in accordance with the manufacturer's instructions. Lubricating oils and greases shall be of type and viscosity as recommended by the equipment manufacturer and approved by the ENGINEER.

B. All lubricants shall be furnished by the CONTRACTOR. He shall also furnish a complete listing of the required lubricants and directions for use.

C. The grease fittings on all equipment shall be such that they can be serviced with a single type of grease gun. Fittings shall be Alemite No. 1184 button head type, or approved equal, unless otherwise stated in the Specifications or recommended by the manufacturer.

2.04 PROTECTIVE COATINGS

A. All machined surfaces and shafting shall be cleaned and protected from corrosion by coating to assure protection during shipment.

B. Oil lubricated gearing, bearings, and reducers shall be shipped with an oil soluble protective coating. The coating selected shall provide protection for one year minimum from date of shipment.

C. All equipment not factory painted shall be field painted in accordance with the manufacturer's recommendations and application instructions. The CONTRACTOR shall be responsible for coordinating all shop painting and priming to assure compatibility of field coats. All damage to coatings during shipping and installation shall be repaired by the CONTRACTOR to the ENGINEERS satisfaction.

D. Electric controls shall be factory finished prior to delivery and shall be protected from damage during and after installation.

2.05 ANCHORS AND SUPPORTS

A. The CONTRACTOR shall furnish, install, and protect all necessary guides, bearing plates, anchor and attachment bolts, and all other appurtenances required for a complete installation. All anchors and supports shall be made of ample size and strength for the purpose intended and shall be approved by the ENGINEER.

B. Generally, galvanized or stainless steel anchor bolts shall be furnished by the equipment manufacturer and shall be approved by the ENGINEER.

C. Shop drawings for installation shall be furnished by the equipment manufacturers and suitable templates shall be used by the CONTRACTOR when required in equipment installation.

PART THREE - EXECUTION

3.01 INSTALLATION AND EQUIPMENT

A. The CONTRACTOR shall have on site sufficient proper construction equipment and machinery of ample capacity to facilitate the work and to handle all emergencies normally encountered in work of this character. To minimize field erection problems, mechanical units shall be factory assembled insofar as practical.

B. The CONTRACTOR shall fully coordinate all mechanical, structural and electrical dimensions, configurations, and connections shown on the Drawings or otherwise required with the equipment to be installed.

C. Equipment shall be erected in a neat and workmanlike manner on foundations and supports at the locations and elevations shown on the Drawings, unless directed otherwise by the ENGINEER during installation.

D. For all equipment which requires field alignment and connections, the CONTRACTOR shall provide the services of the manufacturer's qualified mechanic, millwright, machinist, or authorized representative, to align the equipment and motor prior to making piping connections and when anchoring the pump base. All pumps and drivers, mixers, and other rotating equipment shall be aligned in the field.

E. All spare parts and stand-by equipment that requires no installation shall be crated and labeled and delivered to the storage area designated by the ENGINEER.

3.02 TESTING

A. General: The CONTRACTOR shall furnish all labor, lubricants, materials, equipment, instruments and technical direction of a factory trained representative necessary for testing. When an item of equipment, including controls and instrumentation, has been completely erected, the CONTRACTOR shall notify the ENGINEER and the FCWSA 48 hours before performing all tests described below. "Completely erected" shall mean that the installation is complete in regard to connections to utility supply adjustments, lubrication, charging of any hydraulic or other systems, and cleanup. All testing shall be done in the presence of the FCWSA and the ENGINEER.

B. Wet test: All tanks and compartments which are to hold liquids shall be tested by filling with water after installation has been completed. After cleaning, each tank or compartment shall be tested separately. After a 24-hour soak, tanks shall be refilled to original capacity and shall be allowed to stand for an additional 24 hours with no measurable leakage. Should the water level drop, the leak shall be located, the structure repaired, and the same test repeated until satisfactory results are obtained. Water for testing shall be provided by the CONTRACTOR.

C. Operational test procedure: After wet testing has been completed and accepted by the ENGINEER, each equipment item shall be operationally tested to the performance requirements of the Specifications and to the satisfaction of the FCWSA and ENGINEER. Potable water shall be used. All mechanical equipment shall be activated during this test. Testing of equipment shall be complete when total equipment run time equals 24 hours,

unless otherwise determined by the ENGINEER. Field testing of all pumps shall be performed in the presence of the ENGINEER. After the test period, all defective and non-performing equipment shall be repaired or replaced at the CONTRACTOR's expense, and the same test repeated until satisfactory results are obtained. During testing, all equipment shall be the sole responsibility of the CONTRACTOR. In addition to reports required from manufacturer's start-up technician, the CONTRACTOR shall submit to the ENGINEER a written report outlining the test results within 10 calendar days of test. After completion of testing, all tanks and equipment shall be dewatered. Water shall be disposed of in a manner approved by the ENGINEER.

3.03 FAILURE OF TESTS

A. All defects in equipment, or failure to meet the guarantees or requirements of the Specifications, shall be promptly corrected by the CONTRACTOR by replacements or otherwise. The decision of the ENGINEER as to whether or not the CONTRACTOR has fulfilled his obligation under the Contract shall be final and conclusive. If the CONTRACTOR fails to make these corrections, or if the approved equipment when tested shall fail again to meet the guarantees or specified requirements, the OWNER notwithstanding his having made partial payment for work and materials which have entered into the manufacture of such equipment, may reject that equipment and order the CONTRACTOR to remove it from the premises at the CONTRACTOR's expense and replace it with equipment meeting the requirements of the contract documents.

3.04 RESPONSIBILITY DURING TESTS

The CONTRACTOR shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall not make any claim for damage which may occur to equipment prior to the time of formal acceptance by the FCWSA.

3.05 ACCEPTANCE OF EQUIPMENT BY THE PRASA

After an item of equipment has been made "ready for operation", tested in accordance with the procedures detailed above, and demonstrated to the PRASA's satisfaction that the equipment is ready for operation, the equipment shall then be designated as "accepted" and the PRASA will be responsible for all further maintenance and operation of same.

END OF SECTION

SECTION 150600
PROCESS PIPING

PART ONE - GENERAL

1.01 DESCRIPTION

A. Work included: Provide, install, and test all pipe, pipe supports, fittings, specials, valves, and all appurtenances as shown on the Drawings and as required to make the entire piping systems operable. The Work shall include all sewage, water, chemical, drainage, air, process, and other piping not specified under other sections. All pipe, fittings and valves shall be of U.S. manufacture.

B. Related work described elsewhere:

1. Trench Excavation for Pipe - Section 02A092
2. Painting – Section 099100
3. Process Valves - Section 150900

1.02 QUALITY ASSURANCE

A. Standards:

1. ANSI - American National Standards Institute
2. ASTM - American Society of Testing and Materials
3. AWWA - American Water Works Association

B. Qualifications of manufacturer: Products used in the Work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production acceptable to the ENGINEER.

C. Qualifications of installers: Use sufficient and experienced workmen to ensure proper and adequate installation. In the acceptance or rejection of installed pipe work, no allowance will be made for the lack of skill on the part of workmen.

1.03 SUBMITTALS

A. General: Comply with the provisions and approved submittal schedule of Section 01300.

B. Shop Drawings: Submit the required number of shop drawings to the ENGINEER for review. Shop drawings shall include the following information as a minimum:

1. Manufacturer's catalog cuts for all piping materials.
2. Technical data for all materials to be supplied under this Section.
3. CONTRACTOR’s proposed testing and disinfection procedures.

1.04 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of the Work before, during, and after installation and to protect the materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the ENGINEER and at no additional cost to the OWNER.

PART TWO - PRODUCTS

2.01 GENERAL

A. All pipe, fittings and appurtenances shall be new, free from defects or contamination, and shall be the standard product of one manufacturer.

B. In the event that a joint or fitting necessary for proper installation is not indicated on the Drawings, the end connections shall be of the same type as adjoining connections, subject to the approval of the ENGINEER.

2.02 PIPING

A. Schedule 40 Galvanized Steel

1. RATING: Non-shock working pressure equivalent to Class 150 malleable iron fittings
2. CONSTRUCTION: Threaded
3. PIPE: Schedule 40 galvanized steel, threaded, seamless ANSI B36.10 ASTM A53
4. FITTINGS: Class 150 malleable iron, threaded ANSI B 16.3 ANSI B2.1 (threads) ASTM A197
5. UNIONS: 1/2"-6" Class 150 malleable iron, threaded, brass to iron seat 4" Class 300 malleable iron, threaded, brass to iron seat COUPLINGS: Class 150 malleable iron, threaded ANSI B16.3 ASTM A197
6. FLANGES: 250 psi forged carbon steel with Class 150 drilling, plain face with (holes) bolt holes and circles to match Class 125 cast iron, threaded ANSI B16.1 ANSI ASTM 126
7. COATING: All galvanized steel pipe, fittings, and accessories to be placed underground shall be bituminous coated prior to placement. Above ground steel pipe shall be painted per the Specifications of Section 09900.

B. Schedule 40 carbon steel

1. MATERIAL: Carbon steel pipe with carbon steel fittings
2. RATING: Non-shock working pressure of 250 psi
3. CONSTRUCTION: Welded
4. PIPE: Schedule 40 carbon steel, plain end, seamless ASTM A53
5. FITTINGS: Schedule 40 carbon steel, butt welded ANSI B16.28 ANSI B16.9 ASTM A234
6. FLANGES: 250 psi forged carbon steel. Where bolting to flat face cast iron flanges, steel flanges, steel flanges shall be furnished with flat face. Raised face shall Class be as approved by the ENGINEER. ANSI B 16.1 (holes) ANSI B16.5
7. BOLTING: Standard square head machine bolts, carbon, steel, with one heavy semi furnished hexagon Grade B nut per bolt ASTM A307
8. GASKETS: Flat ring type for raised face joints, full face for flat face joints, 1/16" thick compressed asbestos, dimensions to conform with ANSI B16.21

9. COATING: Steel pipe and fittings shall be AWWA C203 internally coated with a bituminous AWWA No. M-11 seal coat. All pipe to be placed underground shall be bituminous coated and pipe to be placed above ground or inside a structure shall be primed for field finishing (primer shall be compatible paint system specified in Section 09900). Field welded joints shall be treated according to the pipe location and the specifications of AWWA's C203 and No. M-11.

C. Copper Tubing:

1. MATERIAL: Copper tubing, medium wall, Type K
2. CONSTRUCTION: Compression or soldered fittings
3. PIPE: Medium wall, meeting or exceeding Federal Specifications WW-T-799 and ASTM B88

D. CMP-1, Asphalt Coated Corrugated Metal Pipe

1. MATERIAL: Asphalt coated corrugated metal pipe shall conform with AASHTO M190 and be manufactured of galvanized, 16 gauge steel pipe with the corrugations 5" x 1" and continuous butt-welded seams. Minimum thickness shall be 0.064".
2. JOINTS: Joints shall be made via a circumferentially corrugated connecting band at least 10-1/2" wide, meeting VDOT Sec. 240.04.
3. COATING: Asphalt shall conform to AASHTO M190 and be a minimum of 0.050" thick.
4. PAVED: Paving over the lower ½ of the circumference shall be INVERT completed using additional thickness of the asphalt coating until the thickness is 1/8" over the crests of the corrugations.

E. PE-1

1. MATERIAL: High Density Polyethylene (HDPE) tubing
2. RATING: Working pressure of 90 psi
3. CONSTRUCTION: Compression fittings
4. PIPE: NSF 61 Certified and meeting requirements of AWWA C901 Polyethylene (PE) Pressure Pipe and Tubing, ½ in. (13mm) Through 3 in. (76mm) for Water Service

F. DI-1

1. MATERIAL: Ductile iron pipe with cast iron fittings
2. RATING: Working pressure of 350 psi plus surge allowance of 100 psi. Pipe design shall be based on total pressure with a 2.0 factor of safety. Hydrostatic test of fittings at 3.0 times rated working pressure without bursting.
3. CONSTRUCTION: Flanged.
4. PIPE: Thickness Class 50 - 54 for 3"-24" ANSI A21.50 and for 6"-54" ductile iron, coated ANSI A21.51 and lined, plain end, seamless AWWA C150 AWWA C151 ANSI A21.50 ANSI A21.51 shall be as noted on the Drawings for each construction application.
5. FLANGES: 3"-54", 350 psi ductile iron, threaded ANSI B16.1 (chemical and physical properties (holes) shall conform to AWWA C110 and ANSI 21.10). Flanges shall be plain faced without AWWA C115 projection or raised face.
6. FITTINGS: 3"-24" 350 psi and 24"-54" 150 psi cast ANSI 21.10 iron, flanged. AWWA C153

7. COATING: Pipe and fittings with internal "Protecto 401" ceramic epoxy lining for sanitary sewer service by Induron Protective Coatings, Inc. (Birmingham, AL). Exterior of pipe and fittings shall be coated as follows:
   a. Underground service - Bituminous coated and encased in 4 mil high density cross laminated polyethylene tube wrap.
   b. Above ground service - Shop primed (Tnemec Series 37-77 or equal).
8. BOLTING: Standard square or hex head machine ASTM A-307 bolts carbon steel, with one heavy Grade B semi-finished hexagon nut per bolt. ANSI B18.2.1 (bolts) ANSI B18.2.2 (nuts) ANSI B1.1 (screw threads) ASTM A-307
9. GASKETS: Full face rubber gaskets, for flat face joints, 1/8 thick, dimensions to conform to ANSI B16.1 DI-1 shall be as specified above, unless otherwise indicated on the Drawings.

G. DI-2

1. MATERIAL: Ductile iron pipe with cast iron fittings.
2. RATING: Working pressure of 350 psi plus surge allowance of 100 psi. Pipe design shall be based on total pressure with a 2.0 factor of safety. Hydrostatic test of fittings at 3.0 times rated working pressure without bursting.
3. CONSTRUCTION: Mechanically joined
4. PIPE: Thickness Class 50 - 54 for 3"-24" ANSI A21.50 and for 6"-54" ductile iron, ANSI A21.51 mechanical joint, with bell-flanged end AWWA C150 and plain end AWWA C151 shall be as noted on the Drawings for each construction application.
5. MECHANICAL: 350 lb. mechanical joints furnished
6. JOINTS: Complete with: AWWA C111, ANSI A21.11
   a. cast iron gland
   b. sealing gasket
   c. tee-head alloy steel bolts with hex nuts
7. FITTINGS: 3"-24", 350 psi and 24"-48", 150 psi cast iron, mechanical joint AWWA C153 ANSI A21.10
8. COATINGS: Pipe and fittings with internal "Protecto 401" ceramic epoxy lining for sanitary sewer service by Induron Protective Coatings, Inc. (Birmingham, AL). Exterior of pipe and fittings shall be bituminous coated and encased in 4 mil high density cross laminated polyethylene tube wrap.
9. Mechanical joint pipe shall be used for all underground service, where pipe is "crowded" between structures and pipe must be cut to fit, as well as all other locations so noted on the Drawings.

H. DI-3

1. MATERIAL: Ductile iron pipe with cast iron fittings.
2. RATING: Working pressure of 350 psi plus surge allowance of 100 psi. Pipe design shall be based on total pressure with a 2.0 factor of safety. Hydrostatic test of fittings at 3.0 times rated working pressure without bursting.
3. CONSTRUCTION: Push on joints.
4. PIPE: Thickness Class 50 -54 for 3"-24" ANSI A21.50 and for 6"-54" ductile iron coated and lined, ANSI A21.51 plain end with push on joints, AWWA C111 shall be as noted on the Drawings for each construction application.
5. MECHANICAL: 350 lb. mechanical joints furnished

6. JOINTS: Complete with: AWWA C111, ANSI A21.11
   a. Integral pipe bell and plain end
   b. Sealing gasket
7. FITTINGS: 3"-24", 250 psi AWWA C153, ANSI A21.10
8. COATINGS: Pipe and fittings with internal "standard ANSI A21.4 thickness" cement mortar lining and AWWA C104 bituminous seal coat. Exterior of pipe and fittings shall be bituminous coated.

I. PVC-1

1. MATERIAL: Polyvinyl chloride (PVC) pipe with PVC fittings
2. RATING: 230 psi @73oF
3. CONSTRUCTION: Solvent welded joints
4. PIPE: Schedule 40 or 80 PVC, plain end, Type 1, ASTM D1784 Grade 1 ASTM D1785
5. FITTINGS: Schedule 40 or PVC, solvent weld, Type 1 ASTM D2466 Grade 1
6. UNIONS: Schedule 40 or 80 PVC, solvent weld, Type 1, Grade 1
7. PVC-1 shall be as specified above, unless otherwise indicated on the Drawings. Appropriate schedule shall be indicated on the Drawings based on service pressures expected. Should schedule rating not be indicated on the Drawings, schedule 80 shall be used.

J. PVC-2

1. MATERIAL: Polyvinyl chloride (PVC) water pipe (C-900) with PVC fittings.
2. CONSTRUCTION: Elastomeric gasket and integral bell.
3. PIPE: PVC water or sewer, ASTM D1784 / AWWA C-900
4. JOINT: Push-on joint, ASTM D-3139
5. GASKET: Flexible Elastomeric Seal, ASTM F477
6. POTABLE WATER CERTIFICATION: NSF NO. 61

K. PVC-3

1. MATERIAL: Polyvinyl chloride (PVC) water (SDR 14) with PVC fittings.
2. CONSTRUCTION: Elastomeric gasket and integral bell.
3. PIPE: PVC water or sewer, ASTM D2241
4. JOINT: Push-on joint, ASTM D-3139
5. GASKET: Standard Elastomeric Seal, UNI-B-9
6. POTABLE WATER CERTIFICATION: NSF NO. 14

L. SS-1

1. MATERIAL: Stainless steel pipe with stainless steel fittings
2. RATING: Non-shock working pressure of 250 psi
3. CONSTRUCTION: Welded
4. PIPE: Schedule 10, 304 stainless steel, plain end, seamless
5. FITTINGS: Schedule 10, 304 stainless steel, butt welded
6. FLANGES: 250 psi forged stainless steel. Where bolting to flat face stainless steel flanges to match cast iron flange fittings.
7. BOLTING: Standard square head machine bolts, stainless steel, with one heavy semi furnished hexagon Grade B nut per bolt ASTM A307

8. GASKETS: Flat ring type for raised face joints, full face for flat face joints, 1/16" thick compressed asbestos, dimensions to conform with ANSI B16.21

PART THREE - EXECUTION

3.01 SURFACE CONDITIONS

A. Inspection:

1. Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that the work of this Section is completed in strict accordance with all pertinent codes and regulations, the approved Shop Drawings, and the manufacturers' recommendations.

3. Check each piece of equipment and pipe in the system for defects, verifying that all parts are properly furnished and installed, and that all items function properly.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the ENGINEER.

2. Do not proceed in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 LOCATION OF PIPING

A. General: Arrange and install piping approximately as indicated, straight, plumb, and as direct as possible. Form right angles or parallel lines with building wall and floor. Keep pipe close to walls, partitions and ceilings. Offset only where necessary to follow walls. Where so indicated and wherever possible, conceal piping in building construction before erection of closing construction. When furred spaces are indicated, keep pipes as close to structural members as possible. Pipes shall be sloped as necessary for proper functioning of the system.

B. Install piping so as to leave all parts of the system readily accessible for repairs and maintenance.

C. Parallel pipes: Where several pipes are run together, they shall run parallel and shall be spaced at distances which will permit application of full insulation and access for servicing, unless provisions for pitching the pipes dictate different elevations.

D. Interferences: Avoid interference with structure, and with work of other trades, preserving adequate headroom and clearing all doors and passageways.

E. Electrical equipment: Avoid locating pipe lines over switchboards, panels, motor starters and other electrical equipment. If lines must be located over such equipment, provide as

directed by the ENGINEER, with galvanized steel drip pans with drains. Pipe to nearest open drain.

3.03 INSTALLATION OF PIPING

A. General:

1. Pipe shall be protected during handling against impact shocks and free fall.

2. Piping shall be cut accurately to measurements established at the site and shall be placed without springing, forcing, excessive cutting or weakening of the building structure. Pipes shall be installed in a manner permitting proper drainage, venting and free expansion and contraction. Changes in direction shall be made with factory manufactured fittings.

3. Reductions in pipe shall be made with reducing fittings only. Bushings are prohibited unless shown on the Drawings or approved by the ENGINEER.

4. Nipples shall be the same material and pressure rating as the remainder of the piping system. Use nipple of next higher pressure rating when length of unthreaded part of nipple is less than 1-1/2 inch.

5. Unions or flanged spool pieces shall be used to facilitate piping installation and shall be installed between valves and equipment to facilitate removal of equipment for repair.

6. Installation practices shall be in accordance with the best standards of the trade. All piping shall be reamed after cutting to remove burrs and rough edges. All piping shall be cleaned free of cuttings and oil prior to installation. All pipe lines shall be capped during construction to avoid the entry of foreign materials into the piping.

7. Installation of the piping system shall be such as to allow for thermal expansion and contraction while preventing undue stresses and strains on the systems and connected equipment. CONTRACTOR shall take proper care that lines will be installed so as to allow proper drainage, avoid trapping of air, and allow for normal expansion movements. CONTRACTOR shall be held liable to correct any defects in installation or proper performance of the piping systems under Contract.

B. Pipe cleaning:

1. The CONTRACTOR shall make every effort to handle and place all material so that no foreign matter may enter either before, during, or after being installed. Any such matter which unavoidably gets into the pipe shall be carefully removed by the CONTRACTOR. No end of pipe trench shall remain open overnight.

2. Clean pipe, pipe fittings and valves before erection. Cap or plug open ends of piping and equipment during construction to keep dirt and foreign material out of system.

3. After threading any pipe, clean pipe ends carefully to remove cutting oil and particles. Any pipe which is stored shall have threading protected until installation commences.

4. Before making pipe joints, all surfaces of the portions of the pipe to be joined shall be clean and dry.

C. Below grade piping: Below grade piping shall be as described under Section 02A092.

3.04 JOINING OF PIPES

A. General: Lubricants, primers and adhesives shall be used as recommended by the pipe manufacturer. Pipe shall be installed in accordance with the manufacturers' recommendations.

B. Threaded joints:

1. Screwed connections shall have full threads of true taper, accurate to gage, and conforming to ANSI B2.1.

2. Pipe shall be reamed and threaded. Remove cutting oil and make up joints with Teflon thread tape or pipe dope on the male connection only.

C. Flanged joints:

1. Flange faces shall be in perfect alignment with the holes straddling the vertical center line of the piping. Where 125 lb. cast iron flanges are bolted to 150 lb. steel flanges, the 1/16" raised face on the steel flange shall be removed. Joints made by using a steel flange with raised face shall not be used, unless approved by the ENGINEER. When bolting such flanges together using a flat ring gasket extending to the inner edge of the bolts, the bolting shall be of carbon steel without heat treatment other than stress relief equivalent to ASTM A307, Grade B. When bolting such flanges together using a full face gasket, the bolting may be heat treated carbon steel, ASTM A261, or alloy steel, ASTM A193.

2. Where 250 lb. cast iron flanges are bolted to 300 lb. steel flanges, no change shall be made in the raised face of either flange. When bolting such flanges together using a flat ring gasket extending to the inner edge of the bolts, the bolting shall be carbon steel without heat treatment other than stress relief equivalent to ASTM A307, Grade B. Raised face on the steel flange should be removed, but also in this case, bolting shall be of carbon steel without heat treatment other than stress relief equivalent to ASTM A307, Grade B.

3. Bolts shall be well lubricated over the entire thread length with heavy graphite and oil mixture prior to the tightening operations. Bolts shall be tightened with proper wrenches, care being taken to secure uniform pressure on the bolts and gaskets and to avoid over stressing of the bolts, dishing of flanges, and compression of the gasket beyond its proper limits.

D. Dissimilar metals:

1. Wherever possible, connections between equipment, piping, and hangers of dissimilar metals shall be avoided.

2. Wherever such a connection or contact between dissimilar metals is to occur, insulate the two different materials using a best quality dielectric insulating material.

3. Flanged connections shall be provided with all necessary gaskets, sleeves and washers of insulating material to assure complete isolation of any two different metals.

4. Where copper or brass pipe or fittings are to connect to steel or iron piping, provide insulating flanges, bushings, couplings or unions to preclude contact between the different metals.

3.05 HYDROSTATIC TESTING

A. Hydrostatic Test

1. All installed piping shall be tested for leakage. All water and all costs for such testing shall be borne by the CONTRACTOR.

2. Pressure and leakage testing shall be performed in accordance with AWWA C600. The CONTRACTOR shall secure a copy of AWWA C600 on site prior to the commencement of any testing.

3. Pipe trenches shall be backfilled before the pressure test if local conditions or the ENGINEER require backfilling.

4. CONTRACTOR shall supply all necessary equipment and all water required for hydrostatic testing at no additional cost to the OWNER.

B. Pressure test: The test pressure shall be 150 psi or 1.5 times the normal operating pressure of the piping system (based on the lowest point in the line or section under test), whichever is greater. All joints or fittings showing visible leaks after one hour of testing shall be replaced or repaired to the satisfaction of the ENGINEER at no additional cost to the OWNER.

C. Leakage test: The hydrostatic leakage test pressure shall be as described above. No pipe installation will be accepted if the leakage is greater than that determined by the formula:

$$L = \frac{SD \times SQRT(P)}{148{,}000}$$

Where L = maximum allowable leakage, gal/hr.
S = length of pipe tested, feet
P = average test pressure, psig
D = nominal diameter of pipe, inches

If any pipe has a leakage greater than that calculated, the CONTRACTOR shall locate and repair the pipe until the leakage is within these limits at no additional cost to the OWNER.

3.06 WARRANTY

All materials and workmanship shall be warranted to be of good quality and in conformance with best commercial practice as well as this specification. Any material or workmanship that is found to be defective within one year following project completion shall be repaired or replaced by the CONTRACTOR.

END OF SECTION

SECTION 150900
PROCESS VALVES

PART ONE - GENERAL

1.01 DESCRIPTION

A. Work included: Provide complete, in place and free from leakage, all valves as shown on the Drawings and in accordance with this Specification. The valves shall be furnished complete with valve operators and accessories necessary for a complete assembly adequate for the specified or indicated purpose. Valve assemblies shall be installed, painted, tested and adjusted.

B. Related work specified elsewhere:

1. Painting – Section 099100
2. Mechanical General Provisions - Section 150100
3. Process Piping - Section 150600

1.02 VALVE OPERATORS

Valves shall be rising or non-rising stem, with handwheel, lever, gear, electric or hydraulic operator as shown on the Drawings and specified herein. All buried valves shall be furnished with extension stems, as required, and shall be wrench operated unless otherwise shown or specified. All valves designed for manual operation and installed six feet six inches (6'-6") or higher above finished floor shall be provided with chain wheel operators, chains and guides.

1.03 VALVE SUPPORTS

All valves over 4" diameter shall be provided with appropriate valve supports.

1.04 QUALITY ASSURANCE

A. Standards: Comply with all standards specified in this Section.

B. Qualifications of manufacturers: Products used in this Work shall be produced by manufacturers regularly engaged in the manufacture of similar items and with a history of quality production acceptable to the ENGINEER.

C. Qualifications of installers: Use experienced workmen to ensure proper installation of the products specified herein. In the acceptance or rejection of installed Work, no allowance shall be made for the lack of experience on the part of the workmen.

1.05 SUBMITTALS

A. General: All submittals shall be made in accordance with Section 013340 of these Specifications.

B. Shop drawings: As a minimum, shop drawings shall include a complete bill of materials showing the type and class of materials, catalog and engineering data showing

compliance with the specified requirements. Valve set points shall be as directed by the ENGINEER.

C. Erection drawings: As a minimum, erection drawings shall include the procedures for installing, supporting, anchoring, adjusting and testing all valve assemblies.

D. Maintenance instructions: Submit corrective and preventative maintenance instructions, including recommended spare parts.

1.06 PRODUCT HANDLING

A. Protection: Use all means necessary to protect materials of this Section before, after and during installation and to protect installed work and materials of other trades.

B. Replacement: In the event of damage, immediately make all repairs and replacements necessary to the approval of the ENGINEER and at no additional cost to the OWNER.

C. Storage: All valves and related materials shall be stored and protected in accordance with instructions of the applicable Supplier.

1.07 WARRANTY

All equipment and materials supplied under this section shall be warranted to be free from defects in materials and workmanship for a minimum of one (1) year following acceptance by the OWNER.

PART TWO - PRODUCTS

2.01 GENERAL

Design is based upon the use of valves furnished by the specified manufacturers, and terminology used may include reference to the specified manufacturer's product and performance. Such reference shall be construed only as establishing the quality of materials and workmanship to be used under this Section and shall not, in any way, be construed as limiting competition.

2.02 GATE VALVES

A. General: All gate valves shall be double disc gate valves of the bottom wedging type with two part floating wedge contact unless otherwise specified. Gate valves shall be as manufactured by the American Flow Control company, Kennedy Valve Company, or equal and shall have a bronze mounted cast iron body with an ASTM B584 bronze stem with cast iron collar. Valves 12" and smaller shall be rated 200 psi and valves 14" - 48" shall be rated 150 psi and all valves shall meet AWWA C509.

B. End connections: Valve end connections shall be as shown on the Drawings, and shall conform to the following requirements.

1. Flanged valves shall be faced and drilled to the ANSI 125/150 lb. standard.
2. Mechanical joint ends shall be to the AWWA Standard C111-64.
3. Bell ends shall be to the AWWA Standards C100-55 Class B.
4. Screwed ends shall be to the NPT standard.

C. Port areas: Port areas shall be 100% of full pipe area in 4"-60" valves.

D. Valve bodies: Valve bodies shall be of ASTM A126 Class B cast iron in compliance with AWWA C504. Bodies in 3" and larger valves shall be furnished with a welded overlay seat of not less than 90% pure nickel in accordance with AWWA C507 Section 7.2.

2.03 BALL VALVES

A. Full port ball valves: Full port, quarter turn, brass ball valves in sizes from ½ to 2-inches shall be as manufactured by Apollo, Red-White Valve Corporation, or pre-approved equal. Valve shall be a two-piece design, with virgin PTFE seats and seals and a brass body, and shall be equipped with balancing stops to allow for throttling purposes. Valve shall have blow-out proof stem and static pressure rating shall be 400 psi for water service.

2.04 CHECK VALVES

A. Flanged Silent Globe check valves shall be spring loaded poppet, Model 81-02/681-02 as manufactured by Cla-Val, or approved equal.

B. The silent globe check valve shall consist of an epoxy-coated ductile iron body, stainless steel seat, disc and spring. The valve disc shall be center guided at both ends with an integral shaft and shall be spring loaded for silent operation. The spring shall be helical or conical and stone tumbled to achieve a micro-finish to resist mineral deposits, for ease of maintenance, the seat and disc shall be replaceable in the field.

C. Check valve shall be capable of silent operation when installed in vertical or horizontal positions with either flow up or flow down. The flow area through the body shall be equal to or greater than the cross-section area of the equivalent pipe size. Sizes 2 ½: to 10” shall allow bolting a wafer style butterfly valve directly to the outlet flange without a spool piece.

2.05 BUTTERFLY VALVES

A. Standards: The valves shall conform to the latest editions of applicable codes and international standards as mentioned elsewhere Valves in general shall conform to the requirements of the following standards:

1. Design code: Double flanged/ wafer type of low Leakage rate confirming to AWWA C504 Class 150 B/ EN 593 Class PN 10.
2. Valves inspection test: AWWA C-504 Class 150 B (Bubble tight) /EN 12266 Rate A (No visible weeping or formation of drops or bubbles).
3. Valve flanges shall conform to ANSI B 16.5 CL 150. (in case of EPDM lining valve is to be designed with Flat faced
4. Valve shall accommodate any (manual gear box, pneumatic or electric) actuator, vendor to design valve with actuator mounting flange dimension as per ISO 5211

B. Specification For Design & Construction:

a. The valves as well as all accessories should be designed for easy disassembly and maintenance.

b. Valves to be installed outside shall be required to have the stem properly protected against atmospheric corrosion.

c. The valves supplied shall be suitable for raw water, process water, clarified water, and WTP sludge application.

d. The seals, both on the body (sleeve) and on the disc shall be of the material specified. Necessary shaft seals shall be provided and adequately designed to ensure no leakage across the seal. This seal shall be designed so that they will allow replacement without removal of the valve shaft. The sealing ring on the disk shall be continuous type and easily replaceable.

e. For all types of valves, the design with shaft eccentric to the disc is preferred. The shaft shall be solid type and shall pivot on bushings. Bushings/sleeve type bearings shall be contained in the hub of valve body. The bearing shall be self-lubricated type with low coefficient of friction and should not have any harmful effect on water and on valve components.

f. The design of the shaft shall be such that it will safely sustain maximum differential pressure across the closed valve. The shaft and any key (taper pin etc.) for transmitting the torque between shaft and disc shall be capable of withstanding the maximum torque required to operate the valve.

g. The disc shall rotate from the full open to the tight shut position. The disc shall be contoured to ensure the least possible resistance to flow and shall be suitable for throttling operation. While the disc is in the throttled position, the valve shall not create any noise or vibration. The operating mechanism shall be mounted directly on or supported from the valve body.

h. All valves shall be complete with: position indicator (located in a visible place), arrow indicating the flow direction; adjustable mechanical stop limiting devices to prevent over travel of valve disc in open/close position; all valves shall be "tight shut off" and with locking device open/close position or any position

i. Manual override:

    i. Manually operated Valve:

        1. handle will be sufficient for valve diameter up to 150mm

        2. worm and worm wheel gear unit for 200mm and above

    ii. Electrically operated valve:

        1. All valve, worm & worm wheel

    iii. For Pneumatic valve:

        1. Up to 150mm hand lever & 200 and above Worm and worm wheel.

j. Limit and torque switches (if applicable) shall be IP 65

k. All valves shall be provided with proper name plates indicating complete information about the valves.

l. All valves shall be provided with embossed name plate giving details such as tag number, type, size etc.

m. The actuator-operated valves shall be designed on the basis of the following:

i. The internal parts shall be suitable to support the pressure caused by the actuators.

ii. The valve-actuator unit shall be suitably stiff so as not to cause vibrations, misalignments, etc.

iii. All actuators operated valves shall open/ close fully within the time required by the process but not later than 60 seconds after actuators starts.

iv. The maximum temperature to be considered for the valve design is 100°C.

C. Painting of Valves: Total 120 micron thickness as below Power tool cleaning, Red oxide Zinc phosphate primer to IS 12744 (two coat 30+30 micron) Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats 30+30 micron.

2.06 FLANGELESS (INSERT) BUTTERFLY VALVES

A. In some cases, in which the space for valve installation is limited, butterfly valves designed for installation between flanges will be used.

B. The butterfly valve shall be as specified in Section 2.05. except that they are installed between two flanges.

C. The operator of these valves shall be manual.

2.07 ELECTRIC ACTUATED BUTTERFLY VALVES

A. The butterfly valves shall be provided with an electrical actuator to respond to remote controls.

B. The butterfly valve shall be as specified in Section 2.05.

C. Electric valve actuators receive a control signal (either digital or analog) that dictates how much to open and close the valve. The actuator's electric motor generates motion, which is then transmitted to the valve through a gear mechanism. This mechanism allows for the adjustment of the valve position, through rotary motion for quarter-turn valves.

D. Specification for Electrical Actuator

a. Type	: Non-Intrusive & SIL2 Electrical actuator; or approved equal.
b. Make	: Rotork/Auma/ Limit torque/ Any renowned make, or approved equal.
c. Failure position (power failure)	: stay put
d. Local Position Indicator	: To be provided.
e. Hand wheel for manual	: Required
f. Actuator torque	: Vendor to specify
g. Actuator Protection Class	: IP-68
h. Actuator Thrust	: Vendor to specify
i. Actuator travel time	: Vendor to specify.

j. Power supply : 480/240 V, 3Phase-60 HZ Power supply
k. Working current of actuator : Vendor to specify
l. Stall current of actuator : Vendor to specify.
m. Torque switch / rating : 2 NOS, 2 NO+2NC contacts suitable for 24V DC/230V AC, min 5A for 24 V DC
n. Limit switch for open/close feed back Control box : Integral starter required with PLC, remote. manual operation from operator work standard.

2.08 FLOW RATE CONTROL VALVE (FLOW MODULATIING VALVE)

A. The flow rate control valve shall be a butterfly valve provided with an electrical actuator and able of carrying out modulating control which is often referred to as a digital positioning system (DPS).
B. The butterfly valve and actuator shall be as specified in Section 2.05.
C. The DPS shall be able to accurately position the valve anywhere between the fully open and fully closed position (between 0° to 90°).
D. Flow modulation shall be achieved using a control loop system and a positioning circuit board (PCB) placed in the actuator. It shall compare the input position (desired position) to the physical position of the output shaft (actual position).
E. The output shaft's location shall be fed back to the PCB board by a potentiometer that is driven by the output shaft. The PCB board shall compare the two positions, and if there is a difference it considers this an 'error'. To correct the error, the control unit will operate the valve until it reaches the desired position (within a tolerance).
F. The control signals shall be either 0-10 V DC or 4-20 mA. A 0 V DC or 4 mA signal completely closes the valve while a 10Vdc or 20mA would completely open it. Any signal between these would cause a corresponding partially opened or closed position.

2.09 BURRIED ELECTRICALLY OPERATED VALVES

A. The valve shall be able to work buried in the ground and shall be able to handle sludge. It shall be free of maintenance. It should not have cavities, or seals that can become clogged or leak, and full port opening to eliminate plugging.
B. All routine maintenance and operation can be done from the surface.
C. The valve shall be Red valve, Pinch Valve, Series 75B, or approved equal

2.10 COMBINATION RATE OF FLOW & PRESSURE SUSTAINING AND CHECK VALVE

A. The combination Rate of Flow & Pressure Sustaining and Check Valve shall be Cla-Val Model 40-25D with CV Closing Speed that automatically limits the maximum flow rate, regardless of changing line pressure or demand. It shall also sustain the upstream pressure to a pre-determined minimum.
B. The valve shall be hydraulically operated, pilot-controlled diaphragm valve. The pilot system shall include a direct acting pressure sustaining pilot and rate of flow differential control. The pressure sustaining pilot shall be responsive to slight variations in upstream pressure and shall modulate the main valve should the pressure drop to the control setpoint.
C. The rate of flow control shall respond to the differential pressure produced across an orifice plate in the main line.

2.11 FLOAT VALVES

A. The float valve shall be Cla-Val Model 124-01 a non-modulating valve that accurately controls the liquid level in tanks. This valve shall open fully when the liquid level reaches a pre-set low point and close drip-tight when the level reaches a preset high point.

B. The valve shall be hydraulically operated, pilot controlled, diaphragm type globe or angle valve. The Float Valve shall be actuated by a float ball to limit the high and low liquid levels in the tank by closing or opening the main valve. High and low liquid levels shall be adjustable. The float control can be remotely located only if the flowing line pressure at the valve inlet (in psi) is equal to or greater than the elevation (in feet) from the main valve to the float pilot control.

2.12 PRESSURE RELIEF VALVES

A. The pressure relief valve shall be Cla-Val Model 650-01 that automatically opens when the set up pressure is surpassed.

B. The valve shall be hydraulically operated, pilot-controlled valve, actuated by the line pressure through a pilot control system, opening fast to maintain steady line pressure but closing gradually to prevent surges, Operation shall be completely automatic

2.13 COMBINATION AIR VALVES

A. General: The combination air valves shall have three functions. They will vent the pipelines as they are being filled with water and then close tight once the system is full and pressurized. They will also release air that accumulates in the valve while the system is operational. And, they will automatically open to admit air to limit vacuum formation when the pipeline or system is drained and/or a negative pressure occurs in the valve.

B. The Valves shall be installed at the locations shown on the Drawings. Valve sizes shall be as shown on the Drawings and/or as recommended by the valve manufacturer for the specific installation conditions. Unless otherwise approved by the ENGINEER, all combination air release valves shall be by the same manufacturer.

C. The combination air valves shall be of the type which automatically releases air, gas or vapor under pressure during system operation. Valves shall be GA Industries, Figure 945-T air valve for clean water, or approved equal

2.14 VALVE BOXES

Valve boxes shall be of three-piece design with top section, center section and bases as manufactured by Bingham & Taylor, Clow Corporation, or equal. Bases shall be or round or oval design to fit specific size valves. Valve boxes adjacent to public roadways shall be furnished with locking covers. All other valve boxes shall be furnished with drop-in covers.

PART THREE - EXECUTION

3.01 INSPECTION

Examine all areas and conditions under which the Work of this Section shall be performed. Correct conditions detrimental to the proper and timely completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Clean all valves to remove all dirt or other foreign material.

B. Valve stems shall be oriented as shown on the Drawings, making exceptions only for accessibility as approved by the ENGINEER. Do not install valves with stems in the downward direction.

C. Valves shall be installed such that no forces are transmitted to the valve through piping or supports.

D. All valves shall be rigidly supported using approved hangers and supports. Supports shall be of rugged construction and shall provide at least 120 degrees of support of the underside of the valve body. Supports shall be amply proportioned for all stresses that may occur during installation and operation.

E. Paint valves in accordance with Section 0990 – Painting. Do not paint over manufacturer's nameplates.

F. All valves and appurtenances shall be flushed clear of all foreign material after installation.

G. Field test all valves and appurtenances for proper operation; adjustments and settings; freedom from vibration, binding, or scraping and other defects. Check all valve supports for strength and high quality of workmanship.

H. Hydrostatic and leakage tests to be performed in accordance with Section 15060 – Process Piping.

I. Pressure relief and flow control valves shall be adjusted and set as directed by the ENGINEER. Proper operation shall be confirmed during commissioning of the system.

END OF SECTION

SECTION 151300
PRESSURE GAUGES AND TRANSMITTERS

PART ONE - GENERAL

1.01 DESCRIPTION

A. Work included: Furnish all labor, materials, tools, and equipment necessary to furnish and install pressure actuated gauges, switches, and control as shown on the Drawings and in accordance with this Specification.

B. Related work specified elsewhere:

1. Mechanical General Provisions - Section 150100
2. General Electric Work – Section 160500

1.02 QUALITY ASSURANCE

A. Standards: Comply with all standards specified in this Section and as listed in Section 010850.

B. Qualification of manufacturers: Products used in this Work shall be produced by manufacturers regularly engaged in the manufacturer of similar items and with a history of quality production acceptable to the ENGINEER.

1.03 SUBMITTALS

A. General: All submittals shall be made in accordance with Section 013340 of these Specifications.

B. Shop Drawings: As a minimum, the following shop drawing information shall be submitted to the ENGINEER for review and approval:

1. Manufacturer's catalog cuts for all gauges and appurtenances to be provided, to include materials of construction and operating ranges.
2. Complete bill of materials to be provided.

1.04 PRODUCT HANDLING

A. Protection: Use all means necessary to protect materials of this Section before, after and during installation and to protect installed work and materials of other trades.

B. Replacement: In the event of damage, immediately make all repairs and replacements necessary to the approval of the ENGINEER and at no additional cost to the OWNER.

1.05 WARRANTY

All equipment and materials supplied under this section shall be warranted to be free from defects in materials and workmanship for a minimum of one (1) year following acceptance by the OWNER.

PART TWO - PRODUCTS

2.01 GENERAL

Design is based upon the use of valves furnished by the specified manufacturers, and terminology used may include reference to the specified manufacturer's product and performance. Such reference shall be construed only as establishing the quality of materials and workmanship to be used under this Section and shall not, in any way, be construed as limiting competition.

2.02 PRESSURE GAUGES

A. General: Pressure gauge assemblies shall consist of liquid filled pressure gauge, diaphragm protector (as required), root connection, isolation ball valve and associated piping for a complete assembly.

B. Circumferential Diaphragm Mounted Liquid Filled Gauges: Gauges shall be Type 1009, as manufactured by Ashcroft Instrument Division of Dresser Industries, or equal. Gauges shall conform to ANSI B40.1, Grade 1A (1%) accuracy. Pressure gauge construction shall be as follows:
   1. Size: 4-1/2" dial size.
   2. Case: Stainless steel.
   3. Ring: Stainless steel, bayonet type.
   4. Connection: 1/4 - inch NPT bottom connection.
   5. Mounting: Mounted in circumferential diaphragm protector by diaphragm manufacturer.
   6. Window: Polycarbonate.
   7. Pointer: Friction adjustable.
   8. Bourdon Tube: Bronze, stainless steel.
   9. Gasket: Neoprene.
   10. Movement: Stainless steel.
   11. Dial: Brushed aluminum.
   12. Dampening Liquid: Glycerine.
   13. Range: as specified on the Drawings.

C. General Service Gauges: Gauges shall be Type 1009, as manufactured by Ashcroft Instrument Division of Dresser Industries, or equal. Gauges shall conform to ANSI B40.1, Grade A (2-1/2%) accuracy. Pressure gauge construction shall be as follows:
   1. Size: 4-1/2" dial size.
   2. Case: Stainless steel.
   3. Ring: Stainless steel, bayonet type.
   4. Connection: 1/4 - inch NPT bottom connection.
   5. Mounting: Stem, surface or flush, as indicated on the Drawings.
   6. Window: Polycarbonate.
   7. Pointer: Friction adjustable.
   8. Bourdon Tube: Bronze.
   9. Gasket: Neoprene.
   10. Movement: Stainless steel.
   11. Dial: Brushed aluminum.
   12. Range: as shown on the Drawings.

D. Electronic Pressure Transmitters: Electronic pressure transmitter shall be IGP10, as manufactured by Foxboro, Invensys or approved equal and shall be standardized to be able to be used with MODBUS TCP/IP protocol.

2.03 DIAPHRAGM PROTECTORS

A. Standard diaphragm protectors:

1. General: As indicated in the pressure gauge schedule shown on the drawings, pressure gauges requiring diaphragm protectors shall be furnished with Type 50-101 capsule type diaphragm protector, as manufactured by Ashcroft Instrument Division of Dresser Industries, or equal.

2. Construction: Diaphragm material shall be 316 stainless steel, with a 316 stainless housing, and a 1/4" gauge and 1/2" process connections. Diaphragm protectors shall be provided with 1/4" NPT fill plugs in the diaphragm housings and shall be equipped with flushing connections. Fill liquid shall be glycerine.

B. Circumferential diaphragm protectors:

1. General: Circumferential diaphragm protectors shall be provided where indicated on the drawings, and shall be provided a full 360 degree circumferential measurement of fluid pressures while fully isolating them from the process stream. Circumferential diaphragm protectors shall be Series 40, as manufactured by Red Valve Company, Inc. or approved equal.

2. Construction: Flanged sensors shall be drilled to standard ANSI 125# specifications. Face-to-face dimensions for the entire sensor shall be no longer than allowed by MSS_SP67. Sensor construction shall include a coated carbon steel body mounted between two stainless steel flanges which are through-bolted to the process piping. Flexible sleeve material shall be BUNA-A, and intermediate fluid shall be a mixture of ethylene glycol and water. There shall be at least two gauge taps on the body.

2.04 PRESSURE GAUGE CONNECTIONS

Pressure gauge assemblies shall be attached to process piping via the installation of a pressure gauge root connection. All gauge connections to process piping shall include an isolation ball valve to allow removal of the gauge with the process pipe in service. The pressure gauge root connection shall consist of the following:

A. Steel Piping: Nipolet@ fitting as manufactured by Bonney Forge or equal. Nipolets shall be forged steel rated at 3,000 psi (with a wall thickness greater than or equal to Schedule 160 pipe) formed with a large contoured butt-weld end that fits over the pipe wall and facilitates welding. Nipolets shall be manufactured of carbon steel and shall be butt-welded to the process pipe.

B. Ductile Iron Piping: Schedule 160 forged steel pipe nipple, 3" long, minimum. Each end shall be NPT suitable for threading into tapped holed in ductile iron process pipe and threading into valve.

C. PVC Piping: PVC pipe saddle or tee with NPT outlet and Schedule 160, 316 stainless steel threaded pipe nipple suitable for connection to ball valve as shown on the attached drawing.

PART THREE - EXECUTION

3.01 INSPECTION

Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

Pressure gauge assemblies shall be installed as shown on the Drawings. Piping and valves shall be as specified in Section 150600 and 150900, respectively. Hydrostatic testing shall be performed in accordance with the conditions of the specific pipe and Section 150600 – Process Piping.

END OF SECTION

SECTION 154000

GENERAL PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 NOTE

A. The requirements of Section 150100 apply to work performed under this Section.

1.2 SCOPE

A. The work under this Section of the Specification shall include the furnishing of labor, materials and equipment for the installation of complete plumbing systems, including interior sanitary soil, waste and vent piping; storm, interior domestic hot and cold water piping, plumbing fixtures and appliances to provide continuous and satisfactory service.

1.3 CONNECTIONS TO EQUIPMENT

A. Provide labor and materials to connect equipment furnished under this Section of the Specification.

B. Provide labor and materials to connect equipment furnished under other Sections of the Specification and requiring plumbing connections as if the equipment was furnished under this Section of the Specification. Provide traps, water stop valves, etc., for equipment requiring such connections to provide functioning systems.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Cleanouts shall be provided at ends of runs, at changes of direction and near the base of each vertical soil, waste, or drain pipe. Cleanouts shall be placed on horizontal lines every 50 feet unless the conditions require them at closer intervals. Cleanouts at the base of vertical pipes shall be placed in a fitting just above the floor. Cleanouts shall consist of Y branches or 1/4 bends the full size of the line for piping 4 inches and smaller, and 4 inches for larger pipes. Cleanouts in horizontal lines shall be extended to floor level or grade as necessary. Cleanouts shall be series as listed below:

1. Below concrete floors with no finish or ceramic tile finish.
   a. Zurn - ZN-1400-3
   b. J. R. Smith
   c. Watts
   d. Josam
   e. Mifab

2. Below carpeted floors (flush with concrete with identification screw through carpet).
   a. Zurn - ZN-1400-15
   b. J. R. Smith
   c. Watts
   d. Josam
   e. Mifab
3. Below resilient tile floors.
   a. Zurn - ZN-1400-7
   b. J. R. Smith
   c. Watts
   d. Josam
   e. Mifab
4. Exposed horizontal piping.
   a. Zurn - Z-1440A
   b. J. R. Smith
   c. Watts
   d. Josam
   e. Mifab
5. Concealed in finished wall-prime coat.
   a. Zurn - Z-1440-1
   b. J. R. Smith
   c. Watts
   d. Josam
   e. Mifab
6. Base of exposed vertical pipes.
   a. Zurn - Z-1445
   b. J. R. Smith
   c. Watts
   d. Josam
   e. Mifab
7. Base of concealed vertical pipes.
   a. Zurn - Z-1445-1
   b. J. R. Smith
   c. Watts
   d. Josam
   e. Mifab

B. Cleanouts shall consist of cast iron ferrules and shall seat against a lead seal. Access covers shall be polished nickel bronze in finished areas, brass below carpeting. Access covers will be secured by non-ferrous tamperproof screws.

2.2 DRAINS

A. Provide roof, floor and area drains shown on Drawings and/or described below. Drains shall be Zurn, J. R. Smith, Josam or Mifab.

B. Floor drains shall be served by trap primers. Trap primers shall be bronze bodied “Flow – Through” type. Trap primers shall come with built-in air gap, trap primers shall meet the requirements of ASSE Standard 1018. Trap primers shall be set above the floor level of the drains they serve. Trap primer valves located behind

walls shall be provided with access doors. Access doors to be coordinated with the Engineer. Extend water line from trap primer to floor drain trap.

1. J. R. Smith – 2699
2. Watts
3. Zurn
4. Josam
5. Mifab

C. Floor drains shall be of the following type:

1. FD-1 -cast iron adjustable nickel bronze 8 inch round strainer.
   a. Zurn - Z-415B
   b. J. R. Smith
   c. Watts
   d. Josam
   e. Mifab

2.3 PLUMBING FIXTURES

A. Provide plumbing fixtures as shown on the Drawings or as described herein. Exposed metal parts of fixtures, including faucets, waste fittings, waste plugs, strainers, flush valves, traps, supply and waste pipes and escutcheons shall be brass, chromium plated.

B. Mounting Heights of Fixtures

1. To provide for the physically disabled, plumbing fixtures shall be provided for their use at a mounting height suitable for the disabled as set forth by the Federal Government. Fixtures for special uses need not meet this requirement. Fixture mounting heights are generally indicated on the drawings.
2. Hot water and drain piping accessible to a wheelchair patient shall be suitably protected against high temperature by molded vinyl piping covers with access to shut-off valves, trap cleanout, etc. Insulation shall have out of sight fastening system, tie bands are not approved. Covers shall be Truebro Lav Guard 2 E-Z.

C. Hot and cold water connections to fixtures shall be provided with a stop valve. Stop valves, risers, etc. shall be commercial/institutional grade as manufactured by Brass Craft, Chicago, Engineered Systems or McGuire.

D. Provide metal supports necessary to adequately and substantially hang and set fixtures. Supports shall be Zurn, Josam or J. R. Smith and suitable for the wall thickness and piping arrangements shown.

E. Plumbing fixtures shall be caulked at wall and floor with silicone caulking material of same color as the fixture.

F. Locate countertop sinks furnished under this Division. Furnish templates to the countertop fabricator for cutting of required holes.

G. For sinks and fixtures specified under other Divisions or other contracts and not provided with faucets, tailpieces, traps, and stop valves; provide necessary fittings and completely connect the sinks and fixtures.

H. Fixtures shall be as follows:

1. P-1 Countertop Sink - single compartment 18 gauge, type 302 stainless steel sink punched with three faucet holes. Sink bowl shall be 21 x 16 x 7-1/2 inches deep. Provide cast brass P trap and water stop valves.
   a. Model
      i. Elkay - LR-2522
      ii. Just
   b. Faucet - single lever faucet with 8 inch swivel spout and aerator.
      i. Elkay - LK-4100
      ii. Just
   c. Drain - stainless steel body with crumb strainer and tailpiece.
      i. Elkay - LKJ-35
      ii. Just

2.4 VALVES

A. Provide valves as indicated on Drawings, as specified below and as required. Valves, where possible, shall be of one manufacturer, Stockham, Nibco or Jenkins, Jomar whose figure numbers are used below.

B. Valves 2 inches and smaller, which will be operated frequently, or will be used for throttling services, shall be ball or globe valves. Stop valves shall be ball valves.

C. Valves in the domestic hot water, cold water and hot water recirculating system shall be:

	FOR STEEL PIPE		
Description	Nibco	Jenkins	Stockham
Gate-4" and larger IBBT, OS & Y, flanged	F-617-0	651A	G-623
Gate-3” and smaller BBT, rising threaded stem	T-111	47	B-100
Globe–4” and larger IBBT OS&Y, flanged	F-718-B	613	G-512
Globe-3” and smaller BBT, threaded	T-211-Y		B-13-T
Check Valves 4” and larger IBBT, swing, flanged	F-918-B	624	G-931
Check Valves 3” and smaller BBT, swing, threaded	T-413-Y	92A	B-319
	For Copper Tube		
Description	Nibco	Jenkins	Stockham

Gate-2-1/2” and smaller, bronze rising stem, solder end.	S-111	1242	B-108
Globe–2-1/2” and smaller, bronze solder end	S-211-Y		B-14-T
Check Valves 2-1/2”and smaller, bronze, swing solder end	S-413-Y	1222	B-309

D. Circuit Setter Plus Calibrated Balance valves by Bell and Gossett models RF, MC, CB, may be used for balancing and shut off valves in hot water circulating lines. Valve shall be lead free for use in domestic water systems. Adjustable stop and tapping on the downstream side for pressure gauge connections shall be provided with balancing services. This valve may also be used in lieu of gate and globe valves where shown.

E. Flow measuring ball valves may be used for balancing purposes on domestic recirculation systems. Flow measuring ball valves shall be Watts LFCSM-61-S. Provide positive memory feature, positive shut-off, be bi-directional and include blowout resistant stems. Valves shall be Lead Free and meet NSF 61 Annex G.

F. Ball valves may be used for shut off and balancing purposes except on gas piping where they shall not be used except as indicated below. Ball valves shall be NIBCO figure S-580-M, Jomar T-100 or Apollo. Provide memory stop on balancing valves. Ball valves may be used for shut off purposes in gas piping 1 inch and smaller. Ball valves in gas piping shall be NIBCO GB10/GB1A

G. Butterfly valves may be used for shut off or balancing purposes in lieu of gate or globe valves on piping 2-1/2 inches and larger. Valves shall be 200 pound and have EPDM liner, aluminum bronze disc and lever lock operator. NIBCO LD-2000-3, Jenkins 23ZE, Centerline, or DeZurik. On piping 8 inches and larger provide gear operator NIBCO LB-2000-5.

H. Non-slam check valves shall be installed on discharge of pumps, in vertical piping and elsewhere as shown and shall be 125 pound wafer style iron body, bronze fitted with renewable seat and disc and spring actuator, Miller 162, NIBCO W910, Hager or Smolensky.

I. The backflow prevention device serving the domestic water service shall be an ASSE 1013, Reduced Pressure Zone Assembly that consist of two independent spring loaded “Y” pattern check valves and one differential pressure relief valve. The assembly shall automatically reduce the pressure in the zone between the check valves to at least 5 PSI lower than inlet pressure. Mainline valve body and caps including relief valve body and cover shall be Lead Free cast copper silicon alloy. Check valve and relief valve components shall be constructed so they may be serviced without removing the valve body from the line. The assembly shall be rated to 175 PSI working pressure and water temperature range from 32 deg F to 140 deg F. Assembly shall be a Febco LF825Y or Watts Regulator Company LF009.

J. Tempered water mixer shall be as indicated on plan.

PART 3 - EXECUTION

3.1 SANITARY AND STORM PIPING

A. Storm drainage shall be extended from roof drains, clear water floor drains and foundation drainage to discharge to the storm drainage system shown on the drawings.

B. Sanitary piping shall be extended from fixtures, appliances, etc., to the existing sanitary sewer. Verify location, size and elevation of the existing line before performing work and notify the Engineer if discrepancies are noted.

C. Sanitary and storm drain piping below the lowest finished floor to their connections to existing utilities shall be service weight cast iron pipe, ASTM A 74-15, modified and made up with neoprene double seal gaskets of the same manufacturer as the pipe. Pipe and fittings shall bear the mark of the Cast Iron Soil Pipe Institute.

D. Sanitary and storm drain piping within the building, above ground shall be service weight cast iron "no hub" pipe with neoprene and stainless steel connectors.

E. Where lines pass under or through footings, encase them in concrete to uniform thickness as approved by the engineer.

F. In connection with underground piping, connections and turns, unless otherwise specified, shall be made with Y fittings and 1/8 bends.

3.2 WATER PIPING

A. Water service underground outside the building shall be cement lined ductile iron ASA 21.6 or ASA 21.8 made up with Tyton joints. Provide proper bedding for piping and concrete buttresses at all fittings according to AWWA standards.

B. Water piping inside the building shall be type "L" hard drawn copper water tube, ASTM B88 with solder type wrought copper fittings, ANSI A40.3. Brass solder joint valves shall be used with copper tubing. Solder shall be 95-5 tin antimony type. Protect piping from materials which may cause corrosion of copper.

C. Exposed piping at fixtures shall be IPS red brass, chromium plated.

D. Mains, branches and connections of the hot and cold water distribution piping systems shall be provided with valves placed at the points shown on drawings or directed by the Engineer for proper isolation and control of the system. Equipment or appliances shall be separately valved so that service can be shut off and the piece of equipment or appliance removed without disturbing the piping system. Valves shall be located so as to be accessible to the operator. Separate valves for equipment and appliances are in addition to faucets supplied herein or in other Sections.

E. Provide for expansion of piping subject to temperature changes. This shall be accomplished by swings, bends or loops.

3.3 INSULATION

A. After the systems have been installed and tested, insulation as specified below shall be applied. Materials shall be UL, Inc., approved and shall be applied as recommended by the manufacturer's written instructions. Materials used shall be the products of Owens Corning, PPG, Manville, Knauff Corporation, Certainteed, Armstrong, Eagle Picher, Insul Coustic or Benjamin Foster and shall be equal to those products that meet the Specifications below.

B. Insulate new cold water piping, hot water piping, tempered water piping, hot water circulating piping except chrome plated piping exposed at plumbing fixtures. Insulation shall be heavy density long strand fiberglass, sectional insulation with all service vapor barrier jacket and double side adhesive self-sealing lap, Johns Manville Micro-Lok system or equal of Owens Corning. Insulation shall comply with ASTM E84 with a flame spread rating of 25 or less and smoke developed rating of 50 or less. Insulation thickness shall be in accordance with the Energy Code but shall not be less than 1 inch. Fittings, valve bodies, etc., shall be covered with Zeston type precut vinyl insulation jackets with pre-shaped fiberglass insert.

C. Insulate aboveground, exterior, finished water piping. Insulation shall be heavy density long strand fiberglass, sectional insulation with all-service vapor barrier jacket and double side adhesive self-sealing lap, Johns Manville Micro-Lok system or equal of Owens Corning. Insulation shall comply with ASTM E84 with a flame spread rating of 25 or less and smoke developed rating of 50 or less. Insulation thickness shall be in accordance with the Energy Code but shall not be less than 1 inch. Fittings, valve bodies, etc., shall be covered with Zeston type precut vinyl insulation jackets with pre-shaped fiberglass insert. Provide with .016 aluminum insulation jackets.

D. On exposed insulated piping in finished areas within seven feet of the floors, provide .010 inch thick galvanized steel insulation jackets. This does not include piping exposed in unfinished areas such as boiler rooms, storage rooms, etc.

E. At pipe hangers, for piping carrying fluids with temperatures below 70 degrees, provide a rigid core of insulation to support the pipe. Rigid insulation shall be the same thickness as the adjacent semi-rigid insulation and have the same flame spread and smoke developed ratings. Vapor barrier shall be continuous and integral between the rigid and semi-rigid sections of insulation. Rigid insulation shall be composed of hydrous calcium silicate. Rigid insulation shall be Johns Manville Thermo-12 Gold or equal of Owens Corning.

END OF SECTION

SECTION 16370
OVERHEAD POWER DISTRIBUTION

PART 1 GENERAL

1.1 DESCRIPTION

A. Furnish, install, test, and leave ready for operation, the overhead power distribution complete including poles, cross arms, hardware and conductors with all appurtenances, as indicated and specified.

B. Furnish all labor, materials, tools and apparatus for a complete overhead distribution system including all necessary and required primary and secondary extension therefrom, to and within the project.

1.2 REFERENCES

A. P.R.E.P.A. STANDARDS - Puerto Rico Electric Power Authority standards manuals.

B. ANSI/IEEE C2 - National Electrical Safety Code

C. ANSI C29.2 - Insulators - Wet-Process Porcelain and Toughened Glass - Suspension Type.

D. ANSI C29.3 - Wet-Process Porcelain Insulators - Spool Type.

E. ANSI C29.4 - Wet-Process Porcelain Insulators - Strain Type.

F. ANSI C29.5 - Wet-Process Porcelain Insulators - Low and Medium Voltage Type.

G. ANSI C29.7 - Wet-Process Porcelain Insulators - High- Voltage Line-Post Type.

H. ANSI C37.42 - Specifications for Distribution Cutouts and Fuse Links.

I. ANSI C135.1 - Galvanized Steel Bolts and Nuts for Overhead Line Construction.

J. ANSI C135.2 - Threaded Galvanized Ferrous Strand-Eye Anchor Rods and Nuts for Overhead Line Construction.

K. ANSI C135.4 Galvanized Ferrous Eyebolts and Nuts for Overhead Line Construction.

L. ANSI C135.5 - Galvanized Ferrous Eyenuts and Eyelets for Overhead Line Construction.

M. ANSI C135.17 - Galvanized Ferrous Bolt-Type Insulator Pins with Lead Threads for overhead Line Construction.

N. ANSI C135.22 - Galvanized Ferrous Pole-Top Insulator Pins with Lead Threads for Overhead Line Construction.

Ñ. ANSI C135.30 - Galvanized Ferrous Ground Rods for Overhead or Underground Line Construction.

0. ANSI C135.31 - Galvanized Ferrous Single and Double Upset Spool Insulator Bolts for Overhead Line Construction.

P. ANSI 05.1 - Specifications and Dimensions for Wood Poles.

Q. ASTM A475 - Zinc-Coated Steel Wire Strand.

R. ASTM A675 - Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.

S. ANSI/ASTM B1 - Hard-Drawn Copper Wire.

T. ANSI/ASTM B2 - Medium-Hard-Drawn Copper Wire.

U. ASTM B3 - Soft or Annealed Copper Wire.

W. ASTM B8 - Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

X. ANSI/ASTM B228 - Concentric-Lay-Stranded Copper-Clad Steel Conductors

Y. ANSI/ASTM B232 - Concentric-Lay-Stranded Aluminum Conductors, Coated-Steel Reinforced (ACSR).

Z. ASTM D390 - Coal-Tar Creosote for the Preservative Treatment of Piles, Poles, and Timers for Marine, Land, and Fresh Water Use.

AA. AWPA C4 - Standard for the Preservative Treatment of Poles by the Pressure Process.

BB. AWPA C25 - Standard for the Preservative Treatment of Crossarms by the

Pressure Process.

CC. FS TT-W-571 - Wood Preservation: Treating Practices.

DD. NEMA LA1 - Surge Arrestors.

EE. ANSI/UL 96 - Lightning Protection Components

1.3 SUBMITTALS

A. Submit the following in accordance with the Section 16050.

1. Manufacturer's specifications, catalog data, descriptive matter, illustrations, diagrams, support points, weight, electrical characteristics including connection requirements and installation instructions.
2. Dimensions and schematic wiring diagrams. Data indicating materials and construction of hardware and line conductors.

B. Accurately record exact location of poles, guys, anchors, and required horizontal and vertical clearances.

C. Performance Test Reports: Upon completion of installed system, submit in booklet form the results of factory and field testing and inspection.

1.4 QUALITY ASSURANCE

A. Contractor to ensure that conduit size and wire quantity, size, and type are suitable for the equipment supplied. Contractor to review the proper installation of the equipment and of each type of device with the equipment supplier prior to installation. Service Engineer shall assist in location of poles, lines, devices, methods of mounting, field erection, start-up and testing.

1.5 DELIVERY AND STORAGE

Protect all equipment placed into storage from weather, humidity and temperature variations, dirt, dust, and other contaminants.

1.6 WARRANTY AND SERVICE

A. Guarantee all components, parts, and assemblies supplied by manufacturer against defects in materials and workmanship for a period of 12 months.

B. Ensure that equipment manufacturer has local branch office staff with trained, full-time employees who are capable of performing testing, inspecting, repair,

and maintenance services.

PART 2 PRODUCTS

2.1 POLES

A. Poles shall be of concrete or metal complying with latest P.R.E.P.A. requirements.

B. Select poles for straightness and minimum sweeps and short crooks.

2.2 CROSSARMS

A. Straight-grained, free of twists to within 0.1 inch per foot of length, with bends and twists in only one direction.

2.3 POLE HARDWARE

A. Miscellaneous Pole Hardware: Hot-dipped galvanized after fabrication.

B. Crossarm Braces: Structural steel zinc coated to ASTM A675.

C. Angle Braces: 60 inch span x 18 inches (1.5 m span x 450 mm), drop-formed in one piece from 1-3/4 x 1-3/4 inch (45 x 45 mm) angle.

D. Flat Braces: 1/4 x 1-1/4 inch (6 x 32 mm).

A. Eye Bolts and Nuts: ANSI C135.4.

B. Anchor Rods and Nuts: ANSI C135.2

C. Bolts and Nuts: ANSI C135.1

D. Eyenuts and Eyelets: ANSI C135.5.

E. Ground Rods: ANSI C135.30.

F. Butt Plate: Copper.

G. Bolt-type Insulator Pins: ANSI C135.17.

H. Pole-top Insulator Pins: ANSI C135.22

I. Spool Insulator Bolts: ANSI C135.31.

J. Hot-line Clamps: Screw type with concealed threads. Fill thread chamber with corrosion-resistant compound.

K. Secondary Racks: Furnish with spool insulators.

L. Guy Strand: High strength 7-strand steel cable galvanized to ASTM A475, Class A or B.

M. Guy Termination: Preformed type.

N. Guy Guards: 8 foot (2 m) long Plastic, colored yellow.

O. Ground Wire: Soft drawn copper conductors, 6 AWG minimum size.

P. Air Terminal: ANSI/UL 96; high copper air terminal.

2.4 INSULATORS

A. Insulators: Radio interference free wet process porcelain insulators with minimum wet flashover.

B. Line Post Insulators: ANSI C29.7

C. Suspension Insulators: ANSI C29.2

D. Spool Insulators: ANSI C29.3

E. Pin Insulators: ANSI C29.5

F. Guy Strain Insulators: ANSI C29.4

2.5 LINE CONDUCTORS

A. Medium Voltage Overhead Line Conductors: Bare aluminum conductor steel reinforced: ANSI/ASTM B232.

B. Secondary Conductors: Aluminum triplex cable with 600 volt cross-linked polyethylene insulation for phase conductors. Use bare ACSR messenger for neutral

2.6 ARRESTERS AND CUTOUTS

A. Surge Arresters: NEMA LA1.

B. Fused Cutouts: ANSI C37.42.

C. Fuses: Type AS REQUIRED BY P.R.E.P.A.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that site is ready to receive work.

B. Verify field measurements are as shown on Drawings.

C. Verify that required utilities are available, in proper location and ready for use.

D. Beginning of installation means installer accepts existing conditions.

3.2 INSTALLATION

A. Set poles in straight line. Place curved poles with curvature in line with lead pole. Maintain an even grade.

B. Dig setting holes large enough to permit use of tampers to full depth. Place earth in maximum 6 inch (150 mm) layers and pack to 45 percent density.

C. Rake poles located at corners, angles, and dead ends so that poles are vertical after line installation.

D. Do not install poles along the edge of cuts and embankments or where soil may be washed out.

E. Identify each pole using aluminum marker stamped with characters 2-1/2 inches (60 mm) high minimum. Locate to provide maximum visibility [from roadway] and fasten with aluminum nails.

F. Set crossarms at right angles to line for straight runs; and to bisect the angle of turns in line direction.

G. Provide two braces for each crossarm.

H. Install conductors to ANSI/IEEE C2.

3.3 FIELD QUALITY CONTROL

A. Field testing will be performed under provisions of Section 16999.

B. Field test at least one anchor of each capacity installed to rated holding power.

END OF SECTION

SECTION 16402
UNDERGROUND DISTRIBUTION SYSTEM

PART 1 GENERAL

1.1 DESCRIPTION:

A. Furnish and install complete underground distribution system as indicated and specified.

B. Adhere to lines, grades, elevations, and dimensions. Resolve interferences with other underground conduit, piping or equipment, either new or existing with the Engineer. Match components suitable for proper installation.

C. Install concrete encasement of duct system where indicated. Include all necessary forms and reinforcing in installation.

D. Furnish and install manholes and handholes complete with ground rods, windows, ladders, frames, covers, end bells, and other inserts. Use reinforced concrete.

1.2 REFERENCE STANDARDS:

A. NEMA: National Electrical Manufacturers Association, 2101 L Street, Northwest, Washington, D.C., TCB 2-2000, TC 9-2004.

B. ANSI C2: National Electrical Safety Code Published by Institute of Electrical and Electronics Engineers Inc., 345 East 47th Street, New York, NY 10017.

C. NFPA-70: National Electric Code, Published by National Fire Protection Association, Battery March Park, Quincy, MA 02269.

1.3 SUBMITTALS:

A. Submit shop drawings and manufacturers' product data in accordance with section 16050.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Polyvinylchloride (PVC) Conduit

1. Triangle Conduit & Cable Co. Inc., New Brunswick, NJ.
2. Replublic Steel Corp., Cleveland, OH.
3. Carlon Inc., Cleveland, OH.

B. Rigid Steel Conduit, Galvanized

1. Section 16110

C. Manhole Waterproofing Material

1. Heavy Duty Black, No. 46-449, by Tnemec Company, Inc., No. Kansas City MO.
2. Hi-Build Bituminous Coating, No. 35-J-10, by Mobil Chemical Company, Edison, NJ.
3. Bitumastic Super Service Black, by Koppers Company, Inc., Pittsburg, PA.
4. Acceptable equivalent.

D. Conduit Spacers: Furnish conduit spacers made of plastic to maintain spacing of 3-in. (76 mm) between conduits and 6-in. (150 mm) between power and communication conduits as indicated.

E. Concrete: Minimum compressive strength, 3,000 psi (210 kg per square centimeter).

F. Hot-dipped galvanized steel conduit painted with bituminous paint.

PART 3 EXECUTION

3.1 INSTALLATION OF CONDUITS:

A. Lay conduits, indicated to be direct buried in the ground, in trench on 4-in. (100 mm) bed of sand and cover with an equivalent 4-in. (100 mm) bed of sand. Ensure that no rocks come in contact with conduit during backfilling. Dig trenches to depth and location indicated. Do not allow top of ductbank to be less than 2-ft. (0.61 m) below finished grade.

B. Install conduit, indicated to be encased in concrete with concrete, spacers, reinforcing, etc., as specified and as indicated.

C. Install conduit runs following routing on drawing and running in straight lines as far as possible. Where deviation from a straight line becomes necessary, install bends of sufficient radius for proper rodding and installation of cable.

D. Accomplish changes in direction of runs exceeding total of 10 degrees, either vertical or horizontal, by long sweep bends having minimum radius of curvature of 25 ft. (7.62 mm), except that manufactured bends may be used at ends of short runs of 100-ft. (30.48 m) or less, and then only at or close to end of run. Long sweep bends made up of one or more curved or straight sections and/or combinations thereof. Install manufactured bends with minimum radius of 36-in. (915 mm) where larger radius cannot be used.

E. Lay duct lines to minimum slope of 4 inches (100 mm) per 100-ft. (30.48 m) and slope to manholes and handholes, as indicated. Duct lines are to slope away from buildings where possible. Where a duct line is between 2 manholes, put high point in the center and slope toward the manholes.

F. Install spacers at intervals of approximately 4 ft. (1.22 m) and stagger between tiers of ducts to provide not less than 12-in. (300 mm) of longitudinal separation. Install base spacers to provide at least 3-in. (76 mm) between bottom of trench and underside of bottom conduits. Completely fill space with concrete. Firmly wire conduits and spacers together before concrete is placed.

G. Prior to placing of concrete, remove all dirt, sand, and any other debris from between conduits and from trench bottoms. Hold conduits in place to prevent floating or accidental movement.

H. Stagger joints in conduits at least 6-in. (150 mm). Do not allow couplings to rest on bottom of trench. Install couplings for plastic conduit in accordance with manufacturer's recommendations.

I. Install concrete encasements so minimum clearance of 12-in. (300 mm) from concrete to parallel pipes, lines, structures, etc., is maintained. Where ducts cross, minimum clearance of 6 inches (150 mm) will be acceptable. Do not allow the top of concrete to be less than 36-in. (915 mm) below finished grade or paving. Submit special conditions which may require lesser clearances to Engineer for approval.

J. Do not use power-driven vibrators for spading of concrete around ducts.

K. Roll and grade backfill, and restore surface to condition at least equal to which it was found immediately before work was begun, or as otherwise indicated.

L. Locate duct-bank markers at ends of all duct banks except at manholes or handholes, at approximately every 200 ft. (61.0 m) along duct run, and at each change in direction of duct run. Place markers approximately on duct bank. Install markers 6-in. (150 mm) square or round section by 3 ft. (0.91 m) long made of Class B concrete. Imprint the letter "D" or cast it on top of the marker. Install top

of duct arkers flush in paved areas, protruding no more 2-in. (50 mm) above finished grade in paved areas. In finished lawns, allow marker to protrude 1/2-in. (13 mm).

M. Keep conduits clean of concrete, dirt, and other substances during the course of construction. After the duct lines have been completed, pull a standard flexible mandrel not less than 12-in. (300 mm) long, having a diameter approximately 1/4-in. (6 mm) less than the inside diameter of the conduit, through each conduit, after which pull a brush with stiff bristles through each conduit to make certain that no particles of earth, sand, or gravel have been left in the line. Replace conduit runs that do not allow the passage of the mandrel at no additional cost to the Owner. Pneumatic rodding may be used to draw in the lead wire. Plug and seal spare conduits after cleaning.

N. Where electrical ducts cross under roads, encase them in reinforced concrete.

O. Precast manholes, pull box and hand holes are acceptable.

3.2 MANHOLES AND HANDHOLES:

A. Construct manholes and handholes of Class A concrete cast in place or of precast-concrete sections, as indicated.

B. Install manholes with cable racks, hooks, insulators, and other features, as indicated.

C. Place a 6-in. (150 mm) crushed-stone base under each manhole and handhole.

D. Construct cast-in-place manholes and handholes with forms, complete with centering cores and molds, to conform to shape, form, line, and grade required and maintain sufficiently rigid to prevent deformation under load. Make all joints leakproof and arrange horizontally or vertically. Place forms on successive units for continuous surfaces and fit to accurate alignment, assuring a smooth completed surface, free from irregularities.

E. At convenient point close to wall, drive 3/4-in. by 10 ft.- 0 long copper-clad steel ground rod into earth as indicated. Extend ground rod approximately 6-in. (150 mm) above finished manhole floor. After completion of manhole, connect 6 foot (1.83 m) length of No. 4 bare copper ground wire to ground rod and coil it within manhole or handhole.

F. Size space, and place reinforcing bars as indicated and as specified.

G. Set manhole and handhole frames to the required grade, in full bed of concrete

mortar to make watertight connection.

H. Unless otherwise indicated, install tops of manhole and handhole covers in unpaved areas approximately 1/2-in. (13 mm) above finished grade, and in paved areas install flush with finished surface of paving.

I. Install galvanized corrosion-resistant channel support, with continuous slot and required fittings designed for concrete encasement.

J. Install inserts in the manholes as indicated.

K. Install two cable pulling irons in wall opposite each duct bank entrance into manhole, one 6-in. (150 mm) above floor and one 6-in. (150 mm) below the roof of manhole. Where indicated on drawings, install additional features such as openings in manhole walls for future conduit entrances. Seal future entrances with required courses of brick.

L. Where duct lines enter manholes, terminate conduits in end bells. Terminate steel conduit entering manholes and handholes in grounding bushing.

3.3 MANHOLE AND HANDHOLE WATERPROOFING:

A. Apply two coats of bituminous waterproofing material to exterior surfaces of manholes and handholes. Apply by brush or spray, in accordance with manufacturer's instructions. Allow time between coats to permit sufficient drying.

B. As-Built Drawings of Underground Work: Furnish one set of marked copies of contract drawings, showing exact routing and depths of all underground conduit, duct handholes and manholes. Furnish scaled plot plans, showing principal outline of buildings and structures. Reference conduits, ducts, and manholes, and all bends deviating from straight line, dimensionally from fixed objects or structures.

END OF SECTION

SECTION 16450
GROUNDING

PART 1 GENERAL

1.1 DESCRIPTION:

A. Furnish and install a single, complete, integrated grounding system, including all conductors, raceways, and connections, specified and indicated.

B. Include grounding of switchgear, substations, motor control centers, electric equipment enclosures etc., outdoor substations, transformers, switch structures, etc.; ground grid systems with ground rod and water pipe connections; structural steel, and lightning protection system.

C. Include grounding conductors completely interconnecting water supply pipe, ground rods, ground grid, substation, switchgear and motor control center ground buses, other distribution equipment, and other groundable equipment.

1.2 REQUIREMENTS OF REGULATORY AGENCIES:

A. Install complete grounding system in accordance with codes, and standards.

1.3 REFERENCE STANDARDS:

A. American National Standards Institute:

1. ANSI C2.-1978 National Electrical Safety Code

B. National Fire Protection Association, 470 Atlantic Avenue, Boston, MA:

1. NFPA 70-1981 National Electric Code
2. NFPA 78-1975 Lightning Protection Code

C. Puerto Rico Electric Power Authority

1. “Manual de Patrones de Distribución Soterrada”
2. “Manual para el Diseño y Construcción de Mallas conectadas a tierra”

1.4 TESTS:

A. Measure ground grid resistance with earth test megohmmeter and install additional ground rods and conductors as required until resistance to interconnected ground system is 5 ohms or less. Measure ground resistance in normally dry conditions and not less than 48 hours after rainfall.

PART 2 PRODUCTS

2.1 MANUFACTURERS ACCEPTABLE:

A. Contingent upon products' compliance with the specifications.

B. Ground rods - Copperweld Corporation, 2 Oliver Plaza, and Pittsburgh, PA.

2.2 CONDUCTORS:

A. Furnish soft drawn stranded copper grounding conductors. Minimum size of unenclosed grounding conductor shall be No. 6 Awg. All conductors shall be protected if physical damage would result from exposure.

B. Furnish bare conductors where buried in earth or where embedded in concrete.

C. In buildings run insulated grounding conductors with green insulation only.

D. Furnish insulated grounding conductors with insulation rated at 600 volts.

E. Furnish grounding conductors for installation in all non-metallic raceway in addition to, and not to be considered as, the neutral wire of the system.

F. Connect a grounding conductor between panelboard and grounding system. Where a grounding bar is furnished with panelboard, connect grounding conductor to bar.

2.3 GROUND BUS:

A. Furnish and install a 2-in. by 1/4-in. copper bar complete with bolted type connectors as indicated. Connect grounding conductors from equipment in area to this ground bus. Connect ground bus to grounding system. Mount ground bus on 600v pedestal insulators, at bottom of switchboards, panelboards and motor control centers.

2.4 CONNECTIONS:

A. Make all buried and concealed ground connections by exothermic welding.

B. Make accessible connections to structural members by exothermic welding process or by bolted connector. Connections to equipment or ground bus by acceptable bolted connectors. Furnish bolted ground connectors suitable for, and matching, grounding provisions furnished.

C. Furnish copper, brass, or silicon bronze ground clamps for use on copper or brass pipes.

D. Furnish ground clamps, for use on iron pipes, of galvanized or malleable iron, or of standard noncorrosive material.

E. Furnish ground clamps, for use on pipes, with rigid metal base providing good contact by proper seating on the pipe. Do not use strap type clamps.

F. Install cable to ground rod connectors capable of being installed without having to pass over end of ground rod.

G. Where conduits are not effectively grounded by firm contact with a grounded enclosure, apply grounding bushings on at least one end of conduit run.

H. Furnish copper-clad steel or galvanized steel ground rods; type, diameter and length as indicated on drawings.

PART 3 EXECUTION

3.1 INSTALLATION OF GROUNDING CONDUCTORS:

A. Install grounding conductors so not exposed to physical damage. Install connections firm and tight. Arrange conductors and connectors so no strain on connections.

B. Bury equipment grounding conductors 18-in. deep. Bring loops or taps up for connection to equipment or other items to be grounded.

C. Where raceways are used to contain and protect grounding conductors, install in accordance with Electrical Raceway Systems Section.

D. Where bare grounding conductors are contained within metallic raceways, bond ends of raceways to conductors by suitable fittings.

E. Install loop type, low impedance, grounding system interconnecting all components so at least two grounding connections are provided for each major item of electrical equipment. Ensure that severing of any single grounding conductor in this system does not remove grounding protection on any major item.

F. Connect structural steel at locations indicated by an external perimeter loop of grounding conductor installed around all sides of building foundation, buried at least 18-in. (450 mm) below grade, and connect to each vertical column by loop or tap. Connect two opposite points on external loop to two different points on grounding system.

G. Perform exothermic welding with properly sized molds in good condition.

3.2 INSTALLATION OF GROUND RODS:

A. Install ground rods in manholes in accordance with requirements specified under the section Underground Distribution Systems. Connect each grounding conductor entering a manhole to ground rod.

B. Install ground rods where indicated. Install the top of the rod 12-in. below the ground surface. Measure ground resistance of electric power service ground rod and if it is not 5 ohms or less, drive additional rods to obtain resistance of 5 ohms or less.

C. Make connection to overall grounding system as indicated.

D. Ensure that final resistance of interconnected ground system is 5 ohms, or less. Measure ground resistance in normally dry conditions, and not less than 48 hours after rainfall.

3.3 EQUIPMENT GROUNDING:

A. Ground each piece of electrical equipment by means of a grounding conductor installed in raceway feeding that piece of equipment with copper wire sized in accordance with National Electric Code. Grounding conductors installed in conduit furnished with green, 600-volt insulation.

B. Connect transformer cases and neutrals to grounding system. Connect neutral ground connection at transformer terminal. Provide two separate, independent, diagonally opposite, connections for power transformers so removal of one connection will not impair continuity of other.

C. Connect two separate ground connections from ground grid to ground bus of

switchgear assemblies, motor control centers and all outdoor substation equipment. Ensure that each connection for item of equipment is from different section of ground grid.

D. Install a separate grounding conductor from ground system to motors of 25 hp. and larger, in addition to raceway system. Ground motor ground connection to motor frame, independent of mounting bolts or sliding base. Ground motor to nearest point on grounding system, unless otherwise indicated.

E. Connect lightning arresters to ground system by copper conductors, size and type as indicated on drawings.

F. Connect emergency generator neutral to grounding system by a grounding copper conductor size and type as indicated on drawings. Connect grounding conductor to generator disconnect enclosure and generator neutral on generator side of disconnect. Ground generator frame with two separate independent connections, so removal of one connection will not impair continuity of other.

G. Ground each street lighting standard by ground rod driven near base of standard, in accordance with requirements of National Electric Safety Code. Connect ground rods to grounding conductor brought with street lighting feeder cable.

H. Ground transformers, lightning arresters, insulators etc., installed on poles, poles and timber structures, or metal structure. Run grounding conductors between poles or structure and ground rods. Protect grounding conductor by molding applied for at least 8 ft. above ground, with both molding and conductor stapled. Install ground rod where indicated and driven until top of rod is 1 ft. below ground. Measure ground resistance of rod and if not 5 ohms or less, drive additional rods to obtain resistance of 5 ohms or less.

I. Where lightning arresters are furnished with electrical equipment and grounding connections are not inherently provided, ensure that suitable separate grounding conductor connects lightning arresters with system ground. Minimum size shall be coordinates with inspector engineer.

J. Ground wire fences when used to enclose electrical equipment. Unless otherwise indicated, provide minimal grounding by buried outside peripheral ground loop; connections to each corner fence post and nearby ground rod; flexible connections to each gate; and at least two connections to grounding system from approximately opposite positions on fence.

K. Also connect the ground rods to the grounding conductor run with the direct burial cable.

3.4 COMMERCIAL GROUNDING:

A. Telephone:

1. Install one insulated ground conductor to ground bus in telephone equipment cabinet as indicated on drawings.

END OF SECTION

SECTION 16481
MOTOR CONTROL PANELBOARDS

PART 1 GENERAL

1.1 DESCRIPTION:

This section specifies the furnishing, installation, and connection of the motor control panelboards.

1.2 RELATED WORK:

A. Section 160500, GENERAL ELECTRICAL WORK.

B. Section 16450, GROUNDING.

1.3 SUBMITTALS:

A. Submit in accordance with Section 160500, GENERAL ELECTRICAL WORK.

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include electrical ratings, dimensions, mounting, material, running overcurrent protection, branch circuit overcurrent protection, wiring diagrams, and accessories.

C. Manuals:

1. Complete operating and maintenance manuals shall be provided, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
2. Deliver four copies of the above data to the Resident Engineer prior to the final inspection.

D. Certifications: Prior to final inspection, deliver to the Resident Engineer four copies of the following:

1. Certification by the manufacturer that the panelboards conform to the requirements of the drawings and specifications.
2. Certification that the equipment has been properly installed, adjusted, and tested.

1.4 APPLICABLE PUBLICATIONS:

A. The publications listed below form a part of this specification to the extend referenced. The publications are referenced in the text by the basic designation only.

B. Underwriters Laboratories, Inc. (UL):

- 508-89.....Industrial Control Equipment
- 67-88.....Panelboards
- 98-87.....Enclosed and Dead-Front Switches
- 489-86.....Molded-Case Circuit Breakers and Circuit Breaker Enclosures

C. National Fire Protection Association (NEPA):

- 70.....National Electrical Code (NEC)

D. National Electrical Manufacturers Association (NEMA):

- ICS l-88.....General Standards for Industrial Control and Systems
- ICS 2-88.....Industrial Control Devices, Controllers And Assemblies
- ICS 6-88.....Enclosures for Industrial Control And Systems

PART 2 PRODUCTS

2.1 MOTOR CONTROL PANELBOARD:

A. Motor control panelboards shall be in accordance with UL, NEMA, NEC, and as shown on the drawings.

B. Motor control panelboards shall be complete, self standing, metal-enclosed, grounded, outdoor type, panelboard and cabinet assemblies.

C. Ratings shall be not less than shown on the drawings. Interrupting ratings shall be not less than the maximum short circuit currents available where the panelboards are being installed.

D. Coordinate components of the panelboards and their arrangements electrically

and mechanically. The components and the control wiring shall conform to the approved shop drawings as furnished for the various applicable electrical and mechanical sections of the specifications.

E. Thoroughly clean, phosphatize and paint the metal surfaces at the factory with primer and baked enamel or lacquer finishes.

F. Shall have the following features:

1. Each motor controller individually enclosed in steel with an individual door.
2. Tubs and trims not less than code gage steel.
3. Tubs:

    a. Wiring gutters completely around the panelboards with adequate cross sections to accommodate both the present and future wires.
    b. Cover unused openings with snap-in metal covers.

4. Trims with concealed, self-retaining fasteners for attaching them to the tubs.
5. Doors mechanically interlocked to prevent their opening unless the disconnect is open. Incorporate "defeater" mechanism for inspection by qualified personnel.
6. External operating handles with lock-open padlocking provisions and ON and OFF position indicators.
7. Bus Bars:

    a. Shall be copper.
    b. Bus bar joints shall be constant-high-pressure type.
    c. Ground bar with terminals as required in each panelboard for all of the grounding wires.

8. Completely equipped spaces for future motor controllers.
9. Motor Controllers:

    a. Products of a single manufacturer.
    b. Interchangeable for the same ratings in all of the motor control panelboards being installed under this contract.

10. Identify each motor controller, circuit breaker and switch with a separate nameplate of laminated black phenolic resin with white core and engraved lettering not less than 3/16-inch high. Identify each motor by its number or other designation and indicate the function fulfilled by the motor.

G. Test the motor control panelboards at the factory to assure that the panelboards do not have any defects.

PART 3 EXECUTION

3.1 INSTALLATION:

A. Installation shall be in accordance with the NEC, and as shown on the drawings.

B. Mount the panelboards so the tops of the cabinets will be six feet above the finished floors, except where otherwise shown on the drawings or required to avoid conflicts. For panelboards which are too high, mount them so the bottoms of the cabinets will be not less than six inches above the finished floors.

C. Locate the cabinets so the present and future conduits can be conveniently connected. Prior to the fabrication of the cabinets, coordinate the size of the cabinets with the designated installation space dimensions.

END OF SECTION

SECTION 16485
ADJUSTABLE FREQUENCY DRIVE SYSTEMS

PART 1 GENERAL

1.1 PURPOSE

This specification shall establish the minimum requirements for adjustable frequency drive equipment. Drives that do not meet these requirements shall not be acceptable. The adjustable frequency drive equipment shall be the AF-300 G11 as furnished by the GE Fuji Drives USA, Inc.

1.2 DRIVEN EQUIPMENT

The Drive shall be capable of operating a NEMA design B squirrel cage induction motor with a full load current equal to or less than the continuous output range of the Drive. At base speed (60 hertz) and below, the Drive shall operate in constant volts per hertz mode. Above base speed (60 hertz), the Drive may selectively operate in either a constant volt per hertz mode or a constant voltage extended frequency mode.

1.3 DRIVE CONSTRUCTION

The adjustable frequency Drive shall be a sinusoidal PWM type Drive with sensor-less Dynamic Torque Vector Control capability. The Drive shall be provided in a NEMA 12 enclosure at all ratings. NEMA 4 enlcosures shall be available up to 10 HP ratings, NEMA 12 enclosures shall be available for 15 through 30 HP ratings, and IP00 enclosures shall be available for 40 HP and above. The Drive shall be of modular construction for ease of access to control and power wiring, and maintenance. It shall consist of the following general components:

A. Full wave diode rectifier to convert supply AC to a fixed DC voltage.

B. DC link capacitors.

C. Insulated Gate Bipolar Transistor (IGBT) power section, for constant torque applications.

D. The Drive shall be microprocessor based with an LED and LCD display to monitor operating conditions. The Drive display section shall allow for local operation and setting of Drive function codes and display fault indication and reasons associated with the fault. The LED display shall offer nine (9) different display settings and the LCD shall have the capacity to display five (5) lines of information at a time.

E. Separate control and power terminal boards, with option plug shall be provided by the drive to allow for remote operation.

F. The Drive shall have an RS485 port as a standard and options for communicating with recognized industry standard device level networks such as DeviceNet, Interbus-S, Profibus, Modbus Plus, and GENIUS™.

G. The keypad shall be capable of copying, uploading and down loading Drive function codes.

2.0 OPERATING CONDITIONS

A. The Drive's operating ambient temperature range shall be -10°C to 50°C. Storage temperatures shall be between -25°C to 65°C.

B. The relative humidity range shall be 5-95% non-condensing.

C. The Drive shall be suitable for operation at altitudes up to 3300 feet without de-rating.

D. The Drive shall meet IEC 61200-2 for vibration levels.

E. The Drive shall be capable of side-by-side insulation with zero clearance at 30 HP and below.

3.0 STANDARDS

A. The Drive shall be UL and cUL listed and not require external fuses. The Drive shall also be CE labeled and comply with standards EN 61800-3 for EMC compliance and EN 61800-2 for low voltage compliance.

B. The Drive shall be designed in accordance with applicable portions of NEMA standards.

C. The Drive shall be compatible with the installation requirements of interpretive codes such as National Electric Code (NEC) and Occupational Safety & Health Act (OSHA).

D. The Drive with optional filters shall be capable of operating in compliance with IEEE 519- 1992.

4.0 INPUT POWER

A. The Drive design shall be such that it will be available for use either with 200-230 or 380- 480 VAC, 3-phase power input.

B. The Drive shall be able to withstand voltage variations of -15% to +10% and imbalance no greater than 3% without tripping or affecting Drive performance.

C. System frequency shall be 50 or 60 Hertz with a maximum frequency variation of ±5%.

D. The displacement power factor of the Drive shall be 0.95 lagging or higher with the use of a DC reactor. (Note: Displacement power factor is not the same as the actual power factor.)

E. Drive efficiency at rated load shall be 96% or higher depending on Drive's operating carrier frequency and rating.

F. Line notching, transients, and harmonics on the incoming line shall not affect Drive performance.

G. The Drive shall have provisions to add a DC Link Inductor, if required by the installation but not for the Drive's operation (less than 100 Hp). Ratings 100 Hp and above shall be supplied with a DC Link Inductor.

5.0 OUTPUT POWER

A. The Drive shall be capable of horsepower ratings from fractional through 450 HP (constant torque) and output frequencies up to 400 Hertz. It shall also have an energy saver feature with the capability of selecting a V/Hz automatic control function that will modify the V/Hz curve based on light load characteristics that will minimize power consumption.

B. Drive output voltage shall vary with frequency to maintain a constant volts/hertz ratio up to base speed (60 hertz) output. Constant or linear voltage output shall be supplied at frequencies greater than base speed (60 hertz).

C. Rated output voltage shall be programmable for motor ratings from 180 to 240 volts, or from 320 to 480 volts.

D. The Drive shall be capable of a minimum of 100% rated current in continuous operation, in accordance with the requirements of NEC Table 430-150.

E. The Drive one minute overload current rating shall be 150% of rated current, and 180 (40 Hp and higher) or 200% (1/4 to 30 Hp) for 0.5 seconds.

6.0 DRIVE FEATURE

A. The Drive shall have a graphic back-lit liquid crystal display (LCD) which can be configured to display frequency, current, function code set points, or Drive status and fault codes. It shall display 4 lines with 13 characters of text, providing display of:

1. **Programming Mode**: Function Code Numbers, Set points, and Status.
2. **Diagnostic Mode**: Fault Indication Codes (See Section 9.1).
3. **I/O Check Mode**: Analog and digital input/output signal status.
4. **Copy Function Mode**: Function Data Copy.

B. The Drive shall display operating data, fault information, and programming prompts in English with graphic representations of functions where applicable. The Drive shall have six (6) different language LCD readout capabilities (English, French, German, Italian, Spanish, and Japanese).

C. The Drive shall have four digital LED readouts providing display of: Output Current, Output Voltage, Output frequency, Frequency reference, Motor synchronous speed (adjustable for 2 to 12 pole motors), Line speed (calibration adjustable from 0 to 200% of frequency, with 0.01% resolution), kW power consumption, PID setting value, PID remote set value, PID feedback value, and Torque calculations value.

D. The Drive shall also have a built in keypad that shall be extendible, by optional cable, to a remote location up to 100 feet from the Drive. The keypad shall include the following buttons, allowing 3 modes of operation: Forward/Reverse/Stop/Jog keys, Drive reset key, and Reference increment/decrement keys.

E. The Drive shall be capable of remote mounting with simple connection to the keypad or via an RS485 serial port.

F. Upon a fault condition, the LCD shall display Drive current, voltage, frequency, torque, DC link voltage, operating hours, I/O terminal status, and temperature at the time of fault. The last four (4) faults will be stored in memory and selectively be displayed on the LCD.

G. Unless the application requires it, the Drive shall operate as an open-loop control system requiring no feedback devices. The drive shall have the option to add a tachometer feedback card for flux vector control for speed and torque regulation applications.

H. The Drive shall accept and follow a selectable external frequency reference of either analog 0-5 VDC, 0±10 VDC, 4 - 20mA with signal inversion.

I. The Drive shall maintain the output frequency to within 0.2% of reference when the reference is analog, and to within .01% of reference when the reference is digital (Speed level inputs from keypad, contact closure or digital interface).

J. The Drive shall maintain set frequency regardless of load fluctuations.

K. The Drive shall be capable of at least 4 different acceleration rates and 4 different deceleration rates. Each acceleration and deceleration rate shall be independently adjustable from 0.01 to 3600 seconds.

L. The Drive will have a starting torque of 200% at 0.5 Hz for 30 HP and below and 180% at 0.5 Hz for 40 HP and above when the Dynamic Torque Vector Control function is activated.

M. The Drive will have the capability of determining motor characteristics to optimize its operation through the use of pre-programmed motor data information or self-tuning operation where the Drive can determine the motor characteristics initially.

N. The Drive shall allow the user to select whether the shaft does or does not move during auto-tune.

O. The Drive Auto-tune will include an online mode that automatically and dynamically compensates the drive's regulator for changes in motor temperature.

P. The Drive shall offer three selectable acceleration/deceleration patterns: linear, S-curve, and non-linear for variable torque loads.

Q. He drive shall have selectable torque (voltage) boost settings that will enable smooth acceleration of high inertia or high static friction type loads during starting. One level will allow for automatic calibration that will compensate for the ac motor's primary resistance (IR compensation); one level is to be set for variable torque loads; one level is to be for proportional torque loads where torque is directly related to set speed, or for constant torque loads. A second Torque Boost function setting is to be available for a 2nd motor with different characteristics and/or set of operating requirements.

R. The Drive shall have a selectable Automatic Torque Boost function that will adjust motor torque based on the operating load conditions.

S. All Drive Operating Function Codes shall be stored in non-volatile memory (EEPROM). Potentiometer adjustments are not required nor allowed. The Drive will have a default set of Function Code settings.

T. The Drive shall have adjustable switching frequency settings ranging from 0.75 kHz to 15 kHz to limit and adjust the level of audible motor noise.

Ranges:	Up to 100 HP	0.75-15 kHz
	125 HP and greater	0.75-10 kHz

U. The Drive shall be able to operate with its output disconnected for troubleshooting and startup.

V. The Drive shall have a reference filter that eliminates the effects of noise that may be present in the analog signals.

W. The Drive shall have a selectable function to prevent reverse operation of the drive.

X. The Drive shall be able to reset itself up to ten (10) times (adjustable with adjustable intervals of 2-20 seconds) after over-current, over-voltage, overheating, and overload faults.

Y. The Drive shall be able to operate after a voltage dip below 175 VAC on 230 VAC input power and 310 VAC on 460 VAC input power for 15 milliseconds at 85% full load current without any disturbances in output power delivered to the load. If power exceeds this level, six (6) different modes or active and inactive restart modes will be available. The decrease in motor speed will be adjustable in the event of a momentary power outage.

Z. The Drive shall have a programmable start frequency, adjustable from 0.1 to 60 hertz, with a 1 hertz resolution (refer to 7.9), with a holding time adjustable from 0.1 to 10 seconds.

AA. The Drive shall have the ability to operate in a sensor-less, dynamically controlled torque vector mode for applications that require improved motor speed control and operating characteristics.

BB. The Drive shall have IGBT soft switching and a low noise control power supply system to reduce the noise from the drive.

CC. The Drive shall have the ability to operate in a closed loop flux vector mode with motor speed feedback for advanced applications.

7.0 SPEED CONTROL

7.1 Drive base shall be programmable from 25 to 400 hertz, and maximum frequency shall be programmable from 50 to 400 hertz, both with 1 hertz resolution.

7.2 The Drive shall have both low frequency limit and high frequency limit functions. Each will be programmable from 0-400Hz of maximum frequency, with 1Hz resolution.

7.3 The Drive shall have a frequency bias (starting frequency) function programmable from -400-400 Hz of maximum frequency, with 0.1 Hz resolution.

7.4 Drive frequency gain shall be programmable from 0-200%, with 0.1% resolution.

7.5 The Drive shall be capable of at least fifteen (15) independently programmable preset frequencies, adjustable from 0.00 to 400.00 hertz.

7.6 The Drive shall be capable of selectable operation in Pattern (programmed cycles) Operation using up to the fifteen (15) preset speeds with at least seven (7) independently programmable timers with an adjustment range of 0.00 to 6000 seconds, four acceleration and deceleration ramp rates, as well as a hold command at set frequency and a reset command to restart the programmed cycle.

7.7 The Drive shall be capable of starting into a rotating load (forward or reverse) and shall smoothly accelerate or decelerate to the set point without experiencing component damage.

7.8 The Drive shall be capable of motor slowdown or stop by selectable regenerative (to the DC link) dynamic braking while following one of the four selectable deceleration ramps, and control the braking torque by setting it's value from 0, 20 to 200%, 999 (no limit) of Drive rating. It will also be capable of changing the rate of deceleration automatically by stopping the braking action long enough to avoid Drive over-voltage trip.

7.9 The Drive shall be capable of stopping by selectable DC injection braking. It shall be adjustable from 0 to 100% braking level and have a programmable starting frequency for DC braking (0.2-60 hertz) and programmable braking time (0.1 to 30.0 seconds).

7.10 The Drive shall have a start Frequency Setting that incorporates a Holding Time at the Frequency Setting, adjustable up to 10 seconds in duration.

7.11 The Drive shall provide at least three selectable skip frequencies with programmable band widths, adjustable 0 to 30 Hz , which will not allow operation at or near mechanical resonance speeds.

7.12 The Drive shall provide selectable slip compensation, which will sense output current and adjust output frequency, to improve motor speed fluctuations. This will allow approximately 1% or less (depending in the slip value selected) speed regulation without the use of a speed feedback device. This function is to be adjustable over a range of 0 to 15.00 Hz.

7.13 The Drive shall have Droop operation, balancing drooping characteristics to speed and load variations. This function shall be adjustable from –9.9 to 0.0 Hz.

7.14 The Drive shall be constructed to support external signals, whether variable reference or discrete inputs, from distances up to 66 feet when proper cable is used.

7.15 Required Drive performance criteria include.

- Frequency Control Range:
  0.1 to 400 Hertz
- Frequency Stability:

  Digital reference: ± 0.01 % of maximum frequency

  Analog reference: ± 0.2 % of maximum frequency

- Frequency Resolution:

  Digital reference: 0.01 Hz at max. frequency up to 99.99 Hz
  0.1 Hz at max frequency 100 Hz and above

  Analog reference: 1/3000 at max frequency

8.0 DRIVE CONTROL

8.1 The Drive shall accept inputs from external dry contacts for the following functions.

A. Run forward command

B. Run reverse command

C. Multi-step frequency selection

D. Acceleration/Deceleration time selection

E. Stop command

F. Coast to stop command

G. Alarm reset

H. Trip command (external fault)

I. Jogging operation

J. Frequency setting 2 and Frequency setting 1

K. Motor 2 and Motor 1 setting

L. DC brake command

M. Torque limiter 2 and Torque limiter 1

N. Switching operation between line and inverter (50 and 60 Hz)

O. Speed Increase command

P. Speed Decrease command

Q. Write enable for keypad

R. PID control cancel

S. Inverse mode changeover

T. Interlock signal

U. Torque control cancel

V. Link enable

W. Universal DI

X. Pick up start mode

Y. Feedback enable command

Z. Zero speed command

AA. Forced stop command

BB. Forced stop command with Deceleration time

CC. Pre-excitation command

8.2 The Drive shall be capable of selectable external start/stop control, either 2-wire or 3-wire type.

8.3 The frequency reference shall be from, selectively, an external speed potentiometer, external analog signals (0-5 VDC, 0±10 VDC, 4 to 20mA with signal inversion), from the built in keypad, or from bus communication.

8.4 The Drive shall provide an adjustable (to a maximum of 0-200% / 10.3 VDC) analog output and a frequency pulse output. The analog output shall be selectively proportional to either output frequency (before or after slip compensation), output current, output voltage, output torque, load factor, input power, PID feedback value, tachometer feedback value, DC link voltage. The frequency pulse output shall be suitable for both an analog meter indication as well as digital frequency indication.

8.5 The Drive shall provide selectable outputs indicating the following:

A. Four (4) Programmable digital open collector outputs and a dry contact output for:

1. Inverter running
2. Frequency equivalence signal
3. Frequency level detection
4. Torque polarity
5. Torque limiting
6. Auto-restarting
7. Overload early warning
8. Keypad operation mode
9. Inverter stopping
10. Ready input
11. Line/Inverter changeover
12. Motor 2 / Motor 1
13. Auxiliary terminal
14. Time-up signal
15. Cycle completion time
16. Stage No Indication (1, 2, and 4)
17. Alarm Indication (1, 2, 4, and 8)
18. Fan operation signal
19. Auto resetting
20. Universal DO
21. Overheat early warning
22. Synchronization completion signal
23. Second frequency level detection
24. Second overload early warning
25. Terminal C1 off signal

B. Transistor output (Y1 to Y4) are either sink or source operation.

C. The Drive shall be compatible with the GE Fanuc GENIUS LAN, DeviceNet, PROFIBUS-DP, MODBUS Plus, and INTERBUS-S by an option card and allow for communication interface either directly or via third party interface boards.

D. The Drive keypad shall have the capability to store Function Codes that are either preset, internal, or are operational code settings used for a specific application. The keypad shall be able to download function codes into other drives.

9.0 PROTECTIVE AND DIAGNOSTIC FEATURES

9.1 When a fault occurs, the Drive shall have a controlled shut down sequence. The reason for the fault condition shall be enunciated on the LED display, and the LCD graphic screen shall display the current, temperature, frequency, and voltage at the time of the fault as well as potential reasons for the condition. The Drive shall monitor, sense, and display the following fault conditions:

A. Over-current during acceleration

B. Over-current during deceleration

C. Over-current during constant speed operation

D. Ground fault

E. Input phase loss

F. Fuse blown

G. Over-voltage during deceleration

H. Over-voltage during constant speed operation

I. Under-voltage

J. Overheating of heatsink

K. External thermal relay

L. Over-temperature of internal air

M. Overheating at Dynamic Braking circuit

N. Motor 1 overload

O. Motor 2 overload

P. Inverter unit overload

Q. Over-speed

R. PG Error

S. Memory Error

T. Keypad panel communication error

U. CPU error

V. Option error (quantity 2)

W. Operational procedure error

X. Output wiring error / Impedance imbalance

Y. Modbus-RTU error

9.2 The Drive shall have a selectable Torque Limiting function for both motoring and braking that will sense an overload condition and will reduce frequency and current temporarily until the load reaches acceptable levels. If the overload condition is not settled in the proper amount of time, the Drive will trip on overload. The Torque Limiting shall be programmable from 20-200% of Drive rated motor torque (30 HP an below) and from 20-180% of Drive rated motor torque (40 HP and above), with 1% resolution.

9.3 The Drive shall have a selectable electronic inverse time thermal overload function as required by NEC and UL Standard 991 for an AC Induction Motor (Refer to applicable codes for specific installation requirements). The overload shall be programmable from 20 - 135% of Drive rated current.

9.4 The Drive shall have an over-voltage protection function that operates if supply voltage rises above rated value or by motor's regeneration.

9.5 The Drive shall treat short circuits in either the output load or the output module as an over-current.

9.6 If the Drive heat sink temperature exceeds approximately 100°C, the Drive will shut down on over temperature fault.

9.7 The Drive shall provide output ground fault protection.

9.8 The Drive shall provide LED indication of DC bus voltage, which, when lit, will signify to maintenance people the presence of potentially dangerous voltage.

10.0 QUALITY ASSURANCE

10.1 All Drives shall be 100% factory tested to ensure proper performance upon delivery.

10.2 The Drive vendor shall provide a warranty for material and workmanship, for a period of 12 months after start up or 18 months after shipment, whichever occurs first.

11.0 START-UP SERVICE AND TRAINING

Drive operational and maintenance training and/or startup service shall be offered by the Drive vendor separately. The Drive vendor shall have factory trained personnel at field locations convenient to the installation site, available for trouble shooting and/or startup assistance.

12.0 DOCUMENTATION

An instruction manual, complete with wiring diagrams, schematics, operating, and maintenance instructions, shall be provided with the Drive at the time of shipment.

13.0 SPARE PARTS

Spare parts shall be available locally through local stocking distributors.

END OF SECTION

SECTION 16520
EXTERIOR LIGHTING

PART 1 GENERAL

1.1 APPLICABLE PUBLICATIONS:

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1. American National Standards Institute (ANSI) Publications:

- C2-87 National Electrical Safety Code
- C78.1351-81 250-Watt S50 High-Pressure Sodium Lamps
- C78.1355-81 150-Watt 55-Volt S55 High-Pressure Sodium Lamps
- C136.3-84 Roadway Lighting Equipment-Luminaire Attachments

2. Illuminating Engineering Society (IES) Publication:

- Lighting handbook, Reference (1984) and Application (1981) Volumes

3. National Electrical Manufacturers Association (NEMA) Publications:

- ICS 2-83 Industrial Control Devices, Controllers (Rev. 2-85) and Assemblies
- ICS 6-83 Enclosures for Industrial Controls and (Rev. 3-86) Systems

4. National Fire Protection Association (NFPA) Publication:

- NFPA 70 National Electrical Code (NEC)

5. Prestressed Concrete Institute (PCI) Publication:

- JR275 5/6-83 Guide for Design of Prestressed Concrete Poles

6. Underwriters Laboratories inc. (UL) Publications:

- Plug-In, Locking Type Photocontrols for (R Feb 86) Use With Area Lighting

- High-Intensity-Discharge Lamp Ballasts (R May 83)
- High-Intensity-Discharge Lighting (R Jul 86) Fixtures

1.2 GENERAL REQUIREMENTS:

Section 16010, "Basic Electrical Requirements," applies to this section, with the additions and modifications specified herein. Materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 16402, "Underground Distribution System" and Section 16120, "Electric Wiring and Cables". Lighting fixtures and accessories mounted on exterior surfaces of buildings are specified in Section 16510, "Building Lighting Interior."

1.3 SUBMITTAL:

Data, shop drawings, and reports shall employ the terminology, classifications, and methods prescribed by the IES Lighting Handbook, as applicable, for the lighting system specified.

A. Manufacturer's Data: When data that describe more than one type, size, model, or item is being provided. Data shall be sufficient to show conformance to specified requirements.

1. Luminaries
2. Poles and brackets
3. Photocell switch
4. Time switch
5. Lighting contactor

B. Shop Drawings:

1. Luminaries: Include dimensions, accessories, and installation and construction details. Photometric data, including Zonal lumen data, average and minimum ratio, aiming diagram and computerized candlepower distribution data shall accompany shop drawings.
2. Poles: Include dimensions, wind load determined in accordance with AASHTO LTS-2, pole deflection and pole class.

C. Certified Test Reports:

1. Luminaries:

a. Computerized horizontal illumination levels footcandles at ground level, taken every 10 feet. Include average

maintained footcandle level and maximum/minimum ratio.

b. Distribution data according to IES classification type as defined in IES Lighting Handbook.

PART 2 PRODUCTS

2.1 LUMINARIES:

UL 1572. Provide luminaries as indicated. Provide luminaries complete with lamps of the number, type, and wattage indicated. The details, shapes, and dimensions are indicative of the general type desired, but are not intended to restrict selection to luminaries of any particular manufacturer. Luminaries of similar designs and equipment, light distribution and brightness characteristics, and of equal finish and quality will be acceptable as approved.

A. Lamps: Provide the type and wattage indicated.

1. High-Pressure Sodium Lamps: 150-watt conforming to ANSI C78.1351.

B. Ballasts for High-Intensity-Discharge (HID) Luminaries: UL 1029 and ANSI C82.4, and shall be constant wattage autotransformer (CWA) or regulator, high power factor type. Ballasts shall limits harmonics to 10%. Ballasts shall be designed to operate on the voltage system to which they are connected. Provide single lamp ballasts with a minimum starting temperature of minus 30 degrees Celsius (C). Ballasts shall be constructed so that open circuit operation will not reduce their average life. High Pressure Sodium (HPS) ballasts shall have a solid state igniter/starter with an average life in the pulsing mode of 10,000 hours at the intended ambient temperature. Igniter case temperature shall not exceed 90 degrees C in any mode. Average life is defined as the time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

2.2 PHOTOCELL SWITCH:

UL 773 or UL 773A, hermetically sealed cadmium-sulphide cell rated 120 volts ac, 60 hertz with single-throw contacts rated 1000 watts, and 120 volts. Mount switch in a high-impact-resistant, noncorroding and nonconductive molded plastic housing with an EEI-NEMA locking-type receptacle. The Photocell switch shall turn on below 3 footcandles and off at 3 to 10 footcandles. A time delay shall prevent accidental switching from transient light sources. Mount a directional lens in front of the cell to prevent fixed light sources from creating a turnoff condition. Aim switch according to manufacturer's recommendations.

2.3 POLES:

Provide poles designed for wind loading of 100 miles per hour determined in accordance with AASHTO LTS-2 while supporting luminaries having effective projected areas indicated. Poles shall be embedded base type designed for use with underground supply conductors.

A. Concrete Poles: Provide concrete poles conforming to PCI JR275 an as follows:

1. Prestresed concrete pole shafts shall be reinforced with steel prestressing members. The design shall provide internal longitudinal loading by either pretensioning or post tensioning of the longitudinal reinforcing members.
2. Primary (Longitudinal) reinforcing steel used in prestressed concrete poles shall be high strength, stress relieved uncoated wire type, either stranded or solid in accordance with ASTM Standards A416 or A421.
3. Supplementary reinforcing steel, if required, may be of either high strength or of medium strength steel in accordance with ASTM Standard A416 (75,000 psi min).
4. The primary reinforcement steel used for a prestressed concrete pole shaft shall be tensioned to 60 percent to 70 percent of its ultimate strength. The amount of reinforcement shall be such that when reinforcement is tensioned to 70 percent of its ultimate strength, the total resultant tensile force does not exceed the minimum section compressive strength, the total resultant tensile force does not exceed the minimum section compressive strength of the concrete.
5. Reinforcing steel shall be spaced and secured so as to insure a minimum concrete coverage of 1/2 inch thickness. Where minimum internal coverage cannot be maintained next to required core openings, such as handhold and wiring inlet, the reinforcing shall be protected with a vaporproof non-corrosive sleeve over the length without the 1/2 inch concrete coverage. Each steel reinforcing member which is to be post-tensioned shall have a non-migrating slipper coating applied prior to the addition of concrete to insure the uniformity of stress throughout the length of such member.
6. The cement used for the concrete shall be portland cement in accordance with ASTM Standard C150. Types I or III shall be used for general service. However, if resistance to sulfates is necessary, portland cement types II or V may be substituted.
7. The aggregate used for the concrete shall be fine grade, either natural or artificial. Natural aggregate shall conform to ASTM Standard C33, fine grade except that five to ten percent shall be retained by a number 4 sieve. Artificial aggregates shall conform to applicable sections of ASTM Standards C33 and C330 regarding size and strength. Either type shall

have been proven for the following:

a. Moisture absorption, two percent maximum of weight.
b. Good resistance to abrasion.

8. The water used for concrete shall be clean and free of injurious quantities of substances deleterious to concrete or to prestressing steel.
9. The portions of cement, aggregate, and water for the concrete, and the processing and curing of the concrete, shall be such as to develop a minimum compressive strength of 3500 psi beforestress transfer in prestressing. Further natural curing shall achieve a 28-day compressive strength of 7000 psi. Poles shall not be subjected to severe temperature changes during the curing period.
10. The completed prestressed concrete pole shaft shall be clean, smooth, and free of surface voids and internal honeycombing.

2.4 BRACKETS AND SUPPORTS:

A. ANSI C136.3, except ANSI C136.13 for brackets and supports for concrete or aluminum poles. Pole brackets shall be not less than 1-1/4 inch galvanized steel pipe secured to pole. Slip-fitter or pipe-threaded brackets may be used, but brackets shall be coordinated to the luminaries provided, and all brackets for use with one type of luminaire shall be identical. Brackets for pole-mounted street lights shall correctly position the luminaire no lower than the mounting height indicated. In no case the brackets shall be of metal which will not promote galvanic reaction with the luminaire head.

PART 3 EXECUTION

3.1 INSTALLATION:

A. ANSI C2, NFPA 70, and to the requirements specified herein.

1. Concrete Poles: Install according to pole manufacturer's instruction.
2. Pole Setting: Depth shall be as indicated on drawings. Poles in straight runs shall be in a straight line. Dig holes large enough to permit the proper use of tampers to the full depth of the hole. Place backfill in the hole in 6 inch maximum layers and thoroughly tamp. Place surplus earth around the pole in a conical shape and pack tightly to drain water away.

3.2 GROUNDING:

Ground noncurrent-carrying parts of equipment including metal poles as specified in Section 16450, "Grounding" Where the copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.3 FIELD TESTS:

A. The Contractor shall provide electric power required for field tests.

1. Operating Test: Upon completion of installation, conduct an operating test to show that the equipment operates in accordance with the requirements of this specification section.
2. Insulation Resistance Test: Perform as specified in Section 16450, "Grounding" both before and after connection of fixtures and equipment.
3. Ground Resistance Tests: Perform as specified in Section 16450, "Grounding".

END OF SECTION

SECTION 16950
ELECTRICAL TESTING

PART 1 GENERAL

1.1 REFERENCES:

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI):

   a. C2, National Electrical Safety Code.

2. Institute of Electrical and Electronics Engineers (IEEE):

   a. 43, Recommended Practice for Testing Insulating Resistance of Rotating Machinery.
   b. 81, Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
   c. 95, Recommended Practice for Insulation Testing of Large AC Rotating Machinery with High Direct Voltage.
   d. 118, Standard Test Code for Resistance Measurement.
   e. 400, Guide for Making High-Direct-Voltage Tests on Power Cable Systems in the Field.

3. National Electrical Manufacturers Association (NEMA):

   a. AB 4, Guideline for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications.
   b. PB 2, Deadfront Distribution Switchboards.
   c. WC 7, Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
   d. WC 8, Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

4. International Electrical Testing Association (NETA): ATS, Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
5. National Fire Protection Association (NFPA):

   a. 70, National Electrical Code (NEC).

b. 70E, Standard for Electrical Safety Requirements for Employee Workplaces.

1.2 SUBMITTALS:

A. Administrative Submittals: Submit 30 days prior to performing inspections or tests:

1. Schedule for performing inspection and tests.
2. List of references to be used for each test.
3. Sample copy of equipment and materials inspection form(s).
4. Sample copy of individual device test form.
5. Sample copy of individual system test form.

B. Quality Control Submittals: Submit within **30** days after completion of test:

1. Test or inspection reports and certificates for each electrical item tested.

C. Contract Closeout Submittals:

1. Operation and Maintenance Data:

a. After test or inspection reports and certificates have been reviewed by ENGINEER and returned, insert a copy of each in operation and maintenance manual.

1.3 QUALITY ASSURANCE:

A. Testing Firm Qualifications:

1. Corporately and financially independent organization functioning as an unbiased testing authority.
2. Professionally independent of manufacturers, suppliers, and installers, of electrical equipment and systems being tested.
3. Employer of engineers and technicians regularly engaged in testing and inspecting of electrical equipment, installations, and systems.
4. Supervising engineer accredited as Certified Electrical Test Technologist by National Institute for Certification of Engineering Technologists (NICET), or International Electrical Testing Association and having a minimum of 5 years testing experience on similar projects.
5. Technicians certified by NICET or NETA.
6. Assistants and apprentices assigned to project at ratio not to exceed two certified to one noncertified assistant or apprentice.
7. Registered Professional Engineer to provide comprehensive project report outlining services performed, results of such services, recommendations, actions taken, and opinions.

8. In compliance with OSHA Title 29, Part 1907 criteria for accreditation of testing laboratories

B. Test equipment shall have an operating accuracy equal to, or greater than, requirements established by NETA ATS.

C. Test instrument calibration shall be in accordance with NETA ATS.

1.4 SEQUENCING AND SCHEDULING:

A. Perform inspection and electrical tests after equipment has been installed.

B. Perform tests with apparatus de-energized whenever feasible.

C. Inspection and electrical tests on energized equipment are to be:

1. Scheduled with RESIDENT ENGINEER prior to de-energization.
2. Minimized to avoid extended period of interruption to the operating plant equipment.

D. Notify RESIDENT ENGINEER at least 24 hours prior to performing tests on energized electrical equipment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL:

A. Tests and inspection shall establish that:

1. Electrical equipment is operational within industry and manufacturer's tolerances.
2. Installation operates properly.
3. Equipment is suitable for energization.
4. Installation conforms to requirements of Contract Documents and NFPA 70, NFPA 70E, and ANSI C2.

B. Perform inspection and testing in accordance with NETA ATS, industry standards, and manufacturer's recommendations.

C. Adjust mechanisms and moving parts for free mechanical movement.

D. Adjust adjustable relays and sensors to correspond to operating conditions, or as recommended by manufacturer.

E. Verify nameplate data for conformance to Contract Documents.

F. Realign equipment not properly aligned and correct unlevelness.

G. Properly anchor electrical equipment found to be inadequately anchored.

H. Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench to manufacturer's recommendations, or as otherwise specified.

I. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.

J. Provide proper lubrication of applicable moving parts.

K. Inform RESIDENT ENGINEER of working clearances not in accordance with NFPA 70.

L. Investigate and repair or replace:

1. Electrical items that fail tests.
2. Active components not operating in accordance with manufacturer's instructions.
3. Damaged electrical equipment.

M. Electrical Enclosures:

1. Remove foreign material and moisture from enclosure interior.
2. Vacuum and wipe clean enclosure interior.
3. Remove corrosion found on metal surfaces.
4. Repair or replace, as determined by RESIDENT ENGINEER, door and panel sections having dented surfaces.
5. Repair or replace, as determined by RESIDENT ENGINEER, poor fitting doors and panel sections.
6. Repair or replace improperly operating latching, locking, or interlocking devices.
7. Replace missing or damaged hardware.
8. Finish:

    a. Provide matching paint and touch up scratches and mars.
    b. If required due to extensive damage, as determined by RESIDENT ENGINEER, refinish the entire assembly.

N. Replace fuses and circuit breakers that do not conform to size and type required by the Contract Documents.

3.2 LOW VOLTAGE CABLES, 600 VOLTS MAXIMUM:

A. Visual and Mechanical Inspection:

1. Inspect Each Individual Exposed Power Cable No. 6 and Larger For:

a. Physical damage.
b. Proper connections in accordance with single-line diagram.
c. Cable bends not in conformance with manufacturer's minimum allowable bending radius where applicable.
d. Color coding conformance with specifications.
e. Proper circuit identification.

2. Mechanical Connections For:

a. Proper lug type for conductor material.
b. Proper lug installation.
c. Bolt torque level in accordance with NETA ATS, Table 10.1, unless otherwise specified by manufacturer.

3. Shielded Instrumentation Cables For:

a. Proper shield grounding.
b. Proper terminations.
c. Proper circuit identification.

4. Control Cables For:

a. Proper termination.
b. Proper circuit identification.

5. Cables Terminated Through Window Type CTs: Verify that neutrals and grounds are terminated for correct operation of protective devices.

B. Electrical Tests for Conductors No. 4 and larger:

1. Insulation Resistance Tests:

a. Utilize 1,000-volt dc megohmmeter for 600-volt insulated conductors and 500-volt dc megohmmeter for 300-volt insulated conductors.
b. Test each conductor with respect to ground and to adjacent conductors per IEEE 118 procedures for 1 minute.

c. Evaluate ohmic values by comparison with conductors of same length and type.
d. Investigate values less than 50 megohms.

2. Continuity test by ohmmeter method to ensure proper cable connections.

3.3 GROUNDING SYSTEMS:

A. Visual and Mechanical Inspection:

1. Equipment and circuit grounds in panelboards assemblies for proper connection and tightness.
2. Ground bus connections in assemblies for proper termination and tightness.
3. Effective transformer core and equipment grounding.
4. Accessible connections to grounding electrodes for proper fit and tightness.
5. Accessible exothermic-weld grounding connections to verify that molds were fully filled and proper bonding was obtained.

B. Electrical Tests:

1. Fall-Of-Potential Test:

a. In accordance with IEEE 81, Section 8.2.1.5 for measurement of main ground system's resistance.
b. Main ground electrode system resistance to ground to be no greater than 5 ohms.

2. Two-Point Direct Method Test:

a. In accordance with IEEE 81, Section 8.2.1.1 for measurement of ground resistance between main ground system, equipment frames, and system neutral and derived neutral points.
b. Equipment ground resistance shall not exceed main ground system resistance by 0.25 0.50 ohm.

3.4 REQUIRED EQUIPMENTS TO BE TESTED:

A. For included electrical equipment performs all test specified by NETA acceptance testing specified for electrical power distribution equipment and systems:

1. Dry type transformers
2. Safety Switches
3. Molded and Insulated case Circuit Breakers

4. Emergency Generator
5. Power Transformers
6. Panelboards
7. Switched Power Factor
8. Distribution Switchboards
9. Feeder Busway
10. Motor Control Centers
11. Fire Alarm System
12. Paralleling Switchboard

END OF SECTION

A.8 FORM OF AGREEMENT

GUILARTE WATER TREATMENT PLANT REHABILITATION (FAAST)
ADJUNTAS, PUERTO RICO
CIP: 4-01-6012
BID NUMBER: 27-SP-026

CONTRACT NUMBER 2027-000____

NOTICE: In accordance with Law No. 243 of 2006, when issuing copy of this document, please make illegible the social security numbers of the parties.

AGREEMENT made at San Juan, Puerto Rico, this _____ day of _____, _____ by and between the PUERTO RICO AQUEDUCT AND SEWER AUTHORITY, a public corporation of the Commonwealth of Puerto Rico created by Act No. 40 of May 1, 1945, as amended, hereinafter ("PRASA"), party of the first part, represented in this act by its Executive Infrastructure Director, Gabriel Morales Rodríguez, of legal age, married, an engineer, and a resident of Caguas, Puerto Rico, authorized to appear in the present agreement by virtue of Resolution 2160, 2421 and _____ of PRASA's Board of Directors dated August 11, 2015, September 18, 2008 and _____, respectively; and _____ , social security _____, party of the second part, hereinafter ("Contractor"), a juridical person organized and existing under the laws of the Commonwealth of Puerto Rico, File _____, and duly authorized to do business in the Commonwealth of Puerto Rico, represented by its _____, _____, of legal age, _____, and resident of _____, Puerto Rico, for the following project: **GUILARTE WATER TREATMENT PLANT REHABILITATION (FAAST), ADJUNTAS, PUERTO RICO, CIP NUMBER: 4-01-6012, BID NUMBER: 27-SP-026, hereinafter the ("Project").**

ARTICLE 1. DEFINITION OF TERMS

The terms used in this Agreement are defined in Article 1. - Definitions, of the General Conditions unless otherwise indicated.

ARTICLE 2. FUNDING AGENCY

This project will be financed with funds from the Puerto Rico Aqueduct and Sewer Authority (PRASA), the Federal Management Emergency Agency (FEMA) under the FEMA's Accelerated Obligation Strategy (known as FAAST), and the Community Development Block Grant Disaster Recovery (CDBG-DR) Program.

ARTICLE 3. WORK

The Contractor shall complete all Work for the Project, as specified, or indicated in the Contract Documents. The Work shall be done to the complete satisfaction of the PRASA Executive Director for Infrastructure, and in accordance with the Laws and Regulations.

ARTICLE 4. CONTRACT TIME

All time limits indicated in this contract including Milestones, Substantial Completion and Final Acceptance are of the essence of the Contract. Work in the Project shall achieve Substantial Completion within **four hundred fifty (450)** Days from the Date of Commencement of Work indicated in the Notice to Proceed. Work in the Project shall achieve Final Acceptance and be ready for final payment within sixty (60) Days from the termination of the period specified for the achievement of Substantial Completion of Work or in accordance to the provisions of the Section 13.7 - "Final Payment" of the General Conditions. The Contracting Officer may specify at the pre-construction conference a period for achieving Final Acceptance after the achievement of Substantial Completion, that is longer than the thirty (30) consecutive calendar days specified herein, but never more than sixty (60) consecutive calendar days. The final payment shall be made in accordance with the provisions of Section 13.7 – "Final Payment", of the General Conditions and on the period specified in the Contract Documents after the date of Final Acceptance.

ARTICLE 5. CONTRACT PRICE

The Contract Price for completion of the Work in accordance with the Contract Documents, including furnishing all materials, labor, tools, plant, equipment and others necessary for the Project**,** is an amount in current funds equal to: _____ _____**(_____).**

All the Allowances included in Addendum _____, A.4 of the Allowances Form, are part of the Work, and are included as part of the Contract Price. Whenever the cost attributable to any Allowance item is more or less than the stated Allowance amount, the Contract Price shall be adjusted by means of a Change Order in accordance with the General Conditions. The amount of the Change Order shall be the difference between the actual allowable costs to the Contractor and the stated Allowance amount. Payment to Contractor will be subject to the terms, conditions and schedule indicated in the Contract Documents.

Payment to Contractor will be subject to the terms, condition and schedule indicated in the Contract Documents.

Pursuant to **Certification of Funds** by Assistant Director of Administration and Finance Affairs dated _____, all payments charged to the Project under this Agreement shall be made against **PRASA Account PMC** _____, **Resolution** _____, **Cost Center 00801 – Directorado de Infraestructura**.

ARTICLE 6. CONTRACT DOCUMENTS

1. The Contract Documents are the rights and obligations of the parties in this Agreement. The Contract File, the Project Documents (Volume A) and Standard Contract Documents (Volume B) hereto attached specify the documents and forms that are part of the Contract Documents. The Contract Documents include the Advertisement for Proposals, Standard and Supplementary Instructions to Bidders, Pre-Proposal meeting Attendance Affidavit, Non-Collusive Affidavit, Site Visit Affidavit, Proposal, Payment, Performance and other Bonds to be submitted by Contractor as indicated in the Contract Documents, Notice of Selection, Notice to Proceed, Construction Drawings, General Conditions, Special Conditions, Supplementary Conditions, Standard Technical Specifications, Supplementary Technical Specifications, Descriptive Memoir, Permits, Endorsements, General Information for Contractors including all documents required to be produced therein, Supplementary

Content for Federal Projects, Addenda, Hold Harmless Agreement, Proposal Form including all documents to be submitted in Proposal as specified in Article 2 of the Supplementary Instructions to Bidders, Agreement, Change Orders, Written Amendments, Release of Debt. Only printed or hard copies of these items are Contract Documents.

2. The Construction Drawings when issued shall become part and parcel of the Contract Documents.

Section 6.01 Coordination of Contract Documents

The Contract Documents are essential parts of the contract. They are complementary and a requirement occurring in one is binding as though occurring in all. They are intended to be complimentary and to describe and provide for a complete Work. In case of discrepancy, the following Contract Documents will prevail in the order shown:

1. Written Amendment
2. Agreement
3. Change Orders – those of a later date taking precedence over those of an earlier date
4. Proposal Form, including all documents to be submitted with Proposal as specified in Article 2 of the Supplementary Instructions to Bidders
5. Addenda
6. General Information for Contractors
7. Supplementary Instruction to Bidders
8. Standard Instructions to Bidders
9. Supplementary Conditions
10. General Conditions
11. Supplementary Technical Specifications, Permits, Endorsements and Reports
12. Standard Technical Specifications
13. Construction Drawings, if applicable.
14. Detailed Construction Drawings and written specifications or clarifications issued by Engineer during construction.
15. Descriptive Memoir

Nevertheless, the applicable Federal laws and regulations take precedence over any other contract provision.

If there should be a difference between the text of this Agreement and the Exhibit and/or schedules that may be or are attached hereto, (in the Contract File, Volume A or Volume B) then the text of this Agreement shall always prevail.

ARTICLE 7. NOTICES

All notices, requests, demands and other communications required or permitted under this Project shall be in writing unless otherwise provided herein, and shall be deemed to have been received when delivered against receipt or on the third business day following the mailing by register or certified mail, postage prepaid, return receipt requested, whether accepted or rejected, thereof addressed as set forth below:

If to PRASA: PRASA Infrastructure Executive Director
Puerto Rico Aqueduct & Sewer Authority
604 Barbosa Avenue
San Juan, Puerto Rico 00917

If to Contractor: _____
_____

Physical Address: _____
_____
_____
Telephone: (____) _____-_____
Fax: (____) ___-_____

Mailing Address: _____
_____
_____

E-mail Address: _____

Any party may change the address to which communications or copies are to be sent by giving notice of such change of address in conformity with the provisions of this Section for the giving of notice.

ARTICLE 8. MISCELLANEOUS

Section 8.01 Entire Agreement

The contract documents constitute the entire integrated contract of and between the parties, and any and all prior or contemporaneous promises, representations, agreements or understandings, whether oral or written, between or of the parties related to the Work are expressly merged into this contract and superseded hereby.

Section 8.02 Severability

If any provision of this Agreement is declared or determined to be invalid or unenforceable by a court of competent jurisdiction, such declaration or determination shall not affect or impair the validity or enforceability of the remaining provisions of this Agreement, and the parties hereto agree to comply with such remaining provisions.

Section 8.03 Execution in Counterparts

This Agreement may be executed in multiple counterparts, each of which shall be an original and all of which shall constitute one and the same instrument and any of the parties hereto may execute this Agreement by signing any such counterpart.

Section 8.04 Dissemination of Information

Certain of PRASA's confidential or proprietary information may come into the Contractor's possession in the course of performing its obligations under this Agreement. The Contractor shall hold such information and all other information that it develops or obtains from PRASA or otherwise regarding the Project in confidence, shall not use such information other than for performance of its obligations under this Agreement, and shall require its employees, agents, subcontractors and sub-subcontractors to be bound to PRASA by the same obligation of confidentiality. PRASA reserves the

right to release all information to the public and to the media relating to this Agreement and the Work. The Contractor agrees, and to cause its employees, agents, subcontractors and sub-subcontractors, to refer all inquiries about this Agreement or the Work to PRASA.

Section 8.05 Cancellation and Termination

Notwithstanding any provision of the General Conditions, in the event of a substantial or material breach of this Agreement by the Contractor or an emergency or other circumstance requiring PRASA to take immediate action to protect its interests, limit its liability or prevent injury to any person or damage to any property, PRASA shall have the right to rescind, cancel, terminate or suspend this Agreement immediately and without prior notice to the Design-Builder. The exercise by PRASA of its right to rescind, cancel, terminate or suspend this Agreement shall not be construed as a waiver by PRASA of any right or remedy it may have under this Agreement or at law for any delay or breach by the Contractor in the performance of its obligations under this Agreement.

Section 8.06 Criminal Charges Clause

a) Certification

The Contractor certifies and guarantees that at the execution of this Agreement, the Contractor or its partners have not been convicted, have not admitted culpability or have no knowledge of being the subject of any investigation in either a civil or a criminal procedure in a state or federal court for criminal charges related to the public treasury, the public trust, a public function, or a fault that involves public funds or property that are of the type of crimes identified under Article 3 of Act Number 428, enacted on September 22, 2004. It is expressly acknowledged that this certification is an essential condition of this Agreement. If the certification is not correct in its entirety or in any of its parts, it shall constitute sufficient cause for PRASA to terminate this Agreement immediately, without prior notice, and the Contractor will have to reimburse PRASA any amount of money received under this Agreement.

If the status of the Contractor with regards to the charges previously mentioned changes at any time during the term of this Agreement, the Contractor shall notify PRASA immediately. Failure to comply with this responsibility constitutes a violation of this clause and shall result in the remedies mentioned in the immediate previous paragraph.

b) Sworn Statement

In accordance with Act Number 428 of September 22, 2004, the Contractor has submitted the sworn statement required by such law, which is made part this Agreement.

c) Subcontractors

The provisions of this Section shall be made extensive and applicable to all Subcontractors. The Contractor shall be responsible for providing PRASA the sworn statement required herein from all its Subcontractors.

Section 8.07 Registry at the Office of the Comptroller

Pursuant to Act Number 18 of October 30, 1975, as amended by Law Number 127 of May 31, 2004, the Puerto Rico Aqueduct and Sewer Authority advises Contractor that until a copy of this Agreement is remitted to the Office of the Comptroller, neither party may demand any Contractual obligation from each other; such is the case as well for any amendment (change order).

Section 8.08 Laws of Puerto Rico and Consent Decree

The Contractor has obtained a copy of Act Number 12 of July 24, 1985, as amended, and Act Number 84 of June 18, 2002, as amended, and is responsible to abide by their provisions. The Contractor warrants he will comply with the provisions of both Acts. Also, the Contractor warrants it will comply with Article 10 of Act Number 14 of January 8, 2004, as amended, regarding the preference for use of articles extracted, produced, assembled, packaged or distributed by businesses operating in Puerto Rico or distributed by agents established in Puerto Rico.

The Contractor certifies and guarantees that, according to the Contract Documents, the performance of any engineering, architecture, surveying and landscape architecture services in Puerto Rico under this Contract, shall be commissioned to a licensed professional or a professional services organization in accordance with Act. No. 173 of August 12, 1988, as amended, "Act of the Examiner Board of Puerto Rico's Engineers, Architects, Surveyors and landscapers, and Act No. 319 of May 15, 1938, as amended "Act to create the Board of Engineers and Surveyors." Contractor hereby expressly acknowledges that only engineers, architects, surveyors and landscape architects duly authorized and licensed to practice in the Commonwealth of Puerto Rico may perform professional services in Puerto Rico under this Contract. In the event that a professional services organization will perform the above-mentioned services under this Contract under a partnership or professional association, all partners or principals of said entity shall hold a license in their respective professions and shall be enrolled in the corresponding Register of Professional Partnerships. If the professional services organization is a corporation, all the shareholders shall be licensed in their respective professions and said corporation shall be organized as a professional corporation pursuant to the provisions of sections 711 to 711z of Act No. 173, supra, and the "General Corporation Act of Puerto Rico".

The Contractor acknowledges the receipt of a copy of and having been informed about the Consent Decree entered between PRASA and the Environmental Protection Agency in the case *United States of America v. PRASA et al,* Civil Action 06-1624 (SEC) and agrees to abide by the requirements therein applicable to the Work.

The Contractor acknowledges the receipt of a copy of and having been informed about the Consent Decree entered between PRASA and The Puerto Rico Department of Health in the case ELA *et al.* v. AAA, Civil Action KPE 2006-0858 (904), and agrees to abide by the requirements therein applicable to the Work.

The Contractor acknowledges the receipt of a copy of and having been informed about the Consent Decree entered between PRASA and the Puerto Rico Environmental Protection Agency in the case *US v. PRASA,* Civil Action 3:10-cv- 01365-SEC, and agrees to abide by the requirements therein applicable to the Work.

The Contractor hereby certifies that as of the execution of this Contract it has filed income, sales and use (IVU for its acronym in Spanish) and property tax returns in the Commonwealth for the past five (5) years, or for as long as it has existed if less than five years. The Contractor also certifies that it does not have any outstanding debt with the Commonwealth in connection with income taxes (collected by the Department of the Treasury), real, or chattel property taxes (collected by the "Centro de Recaudación de Ingresos Municipales" ("CRIM"), unemployment insurance premiums, workers' compensation payments, or Social Security for chauffeurs (collected by the Department of Labor and Human Resources). The Contractor also certifies that it is in compliance with the requirements, if and as applicable, of the Administration for Children's Support ("ASUME" for its acronym in Spanish). In the event that the Contractor owes taxes or applicable fees to said government agencies, it agrees

that PRASA may withhold any monies due to the Contractor under this Contract to be applied to the payment and cancellation of said debt. A **Certificate of Eligibility from the General Services Administration** evidencing the above representations has been submitted to PRASA and shall be considered part of this Contract.

Section 8.09 Nondiscrimination

Contractor hereby certifies that it will not maintain or provide for their employees any facilities that are segregated, on the basis of race, color, creed and national origin. Contractor further agrees to not discriminate during the work to be undertaken under this Contract, on account of race, color, sex, marital status, sexual orientation, gender identity, birth, social origin or condition, or political or religious ideas, because of being a victim of domestic violence, physical or mental conditions. Every Puerto Rico government entity is required by law to adopt a public policy on matters such as, sexual harassment and controlled substances in work. It is the responsibility of the Contractor to learn of such policies, and if Contractor during the term of this Contract incurs in acts contrary to such policies, PRASA shall terminate this Contract immediately.

Section 8.10 Invoice

Both parties hereby declare that no public officer or employee has any direct or indirect interest in this Agreement or any other interest that may adversely affect this Agreement. All invoices must include the following certification:

> "Under penalty of absolute nullity, I hereby certify that none of the employees of the Puerto Rico Aqueduct and Sewer Authority is part or has interest in the earnings or benefits product of this Agreement upon which this invoice is based. If part or any interest in the earnings or benefits product of this Agreement should come forth, I certify that an official dispensation has been previously approved. I further certify that the only consideration in providing the goods and works (services) under this Agreement is the payment agreed with the agency's authorized representative and that the amount of this invoice is true and correct, and the construction works, and goods (services) invoiced have been completed and delivered (rendered), respectively, and have not been paid."

ARTICLE 9. CLAUSES REQUIRED BY LETTER NO. 001-2021 OF THE OGPe:

a. Interagency Services Clause: Both contracting parties recognize and agree that the contracted services may be provided to any entity of the Executive Branch with which the contracting entity performs an interagency agreement or by direct provision of the Chief of Staff. These services will be carried out under the same terms and conditions for hours of work and compensation set forth in this contract. For the purpose of this clause, the term "entity of the Executive Branch" includes all the agencies of the Government of Puerto Rico, as well as its instrumentalities and public corporations and the Office of the Governor.

b. Termination clause: The Office of the Chief of Staff shall have the power to terminate this contract at any time.

c. Contract Revision Policy of the Puerto Rico Financial Oversight and Management Board (FOMB): The contracting Parties recognize that the contractor has submitted the certification titled "Contractor's Certification Requirement" required in accordance with the FOMB's Contract

Revision Policy, effective on November 6, 2017, as amended on October 30th, 2020, signed by the Executive director of the Contractor (or other officer with equivalent position or authority to make such certifications). Signed copy of the Contractor's Certification Requirement is appended to this contract as Exhibit B.

ARTICLE 10. EFFECTIVE DATE

This Agreement shall become effective immediately upon and as of the date of signature by the Infrastructure Executive Director of the Puerto Rico Aqueduct and Sewer Authority, subject to compliance of Section 8.07 of this Agreement.

IN WITNESS WHEREOF, the parties hereto execute this Agreement on the date and at the place stated herein.

PUERTO RICO AQUEDUCT AND SEWER AUTHORITY	**CONTRACTOR:**
	Seal
By:	**By:**
Gabriel Morales Rodríguez	
Executive Director of Infrastructure	
Date: _____	**Date:** _____

A.9 ENDORSEMENTS

GUILARTE WATER TREATMENT PLANT REHABILITATION REHABILITATION (FAAST) ADJUNTAS, PUERTO RICO
CIP: 4-01-6012
BID NUMBER: 27-SP-026

Contractor is responsible for obtaining permits and/or endorsements that are required, except for the following:

AGENCY	DESCRIPTION	TOTAL # OF PAGES
Municipal Endorsement	Municipality of Adjuntas Endorsement	1
Department of Agriculture	Endorsement (2025-703271-SRU-303950)	1
OGPe – Department of Agriculture	Recommendation Letter (2025-703271-SRU-303950)	1
ICP-PAE	Programa de Arqueología y Etnohistoria (2026-703271-SRA-302608)	2
ICP-PPHE	Programa de Patrimonio Histórico Edificado (2026-703271-SRA-302608)	3
OGPe - PCL	Legal Pre-consultation (2026-703271-PCL-303454)	10

Gobierno Municipal Adjuntas
OFICINA DEL ALCALDE
Apartado 1009
Adjuntas, Puerto Rico 00601

Tels: (787) 829-5000
Ext. 208/213

Hon. José Hiram Soto Rivera
Alcalde

28 de octubre de 2026

Sr. Norberto Almodóvar Vélez
Secretario Auxiliar
Oficina Gerencial de Permisos
355 Avenida Roosevelt
Edificio Fomento Industrial
San Juan, PR 00918

RE: Sra. Yulianna de la Cruz Montañez, PE
Gerente de Pre-Contrucción
Programa de Mejoras Capitales
Proyecto Rehabilitación de PF Guilarte (FAASt/CIP 4-01-6012)
Bo. Guilarte, Carr. PR 131 KM 2.5
Adjuntas, PR 00601
Catastro 265-000-004-20

Estimado Sr. Almodóvar:

Notificamos que el Municipio de Adjuntas **no tiene objeción a que se realice el Proyecto de Rehabilitación de PF Guilarte (CIP 4-01-6012),** siempre y cuando cumpla con las leyes y reglamentos aplicables.

El proyecto propuesto no presenta conflictos y no afecta adversamente el uso del suelo ni la calificación aplicable al predio.

Sin otro particular a que referirme, quedo de usted.

Cordialmente,

José Hiram Soto Rivera
Alcalde

wimp

DEPARTAMENTO DE
AGRICULTURA
GOBIERNO DE PUERTO RICO

8 de septiembre de 2026

Ing. Miguel Manzano Rivera
Secretario Auxiliar Interino
Oficina de Gerencia de Permisos
Departamento de Desarrollo Económico
PO Box 41179
San Juan, Puerto Rico 00940-1179

Consulta: 2025-703271-SRU-303950
Proponente: Ing. Yulianna de la Cruz
Dueño: Autoridad de Acueductos y Alcantarillados

Propuesta: Rehabilitación de la planta de filtración Guilarte (FAASt)

Localización: Carr. PR-131 km 2.5, Bo. Guilarte, Adjuntas, P.R.

Uso Propuesto: Institucional

Descripción general de los terrenos y el área aledaña:
La finca se encuentra en un área de calificación A-G, clasificación SREP-A. Se propone la reparación y rehabilitación de la infraestructura y planta física de la planta de filtración Guilarte, luego de los daños ocasionados por el huracán María en el año 2017. El terreno donde se realizarán las reparaciones se encuentra previamente impactado por la planta de la AAA, la cual fue construida en el año 1995. Se realizará movimiento de tierra para parte de la construcción. Este proyecto redundará en beneficio del sector, del municipio y sus residentes. No se afectan actividades agrícolas, el proyecto se realizará conforme a los planos de mensura presentados por la AAA. A tenor con lo antes expuesto, este Departamento no tiene objeción a la consulta.

Recomendación del Departamento de Agricultura sobre la consulta:

No Objetado ____X____ **Objetado**_____

Agro. Alyra R. Camacho Ortiz
Oficina de Iniciativas para
la Preservación de Terrenos

Recomendaciones

Rehabilitación de PF Guilarte (CIP 4-01-6012)

Datos de Localización

De acuerdo a la información suministrada se propone una actividad: Público con Contratación Privada en:

Dirección Física

Carr. Carr. PR-131, Km 2.5, Bo. Barrio Guilarte, Adjuntas, Puerto Rico, 00601

Número(s) de Catastro

265-000-004-20

Calificación

Distrito(s) de Calificación: A-G

Distrito en el Mapa de Inundabilidad: X

Tipo de Suelo: To (54.2%), HmF2 (28.8%), HmE2 (8.4%), CdF (4.6%), MtF2 (4.1%)

Dueño

Autoridad de Acueductos y Alcantarillados de PR

Certificado por

Cabida

Cabida según escritura: 32464.62 metros cuadrados

Condiciones Especiales

Departamento de Agricultura no tiene objeción. Ver documento.
Departamento de Agricultura: Se incluyó carta al expediente digital con fecha 8 de septiembre de 2026. Favor de referirse a la comunicación para obtener los detalles.

Condiciones Generales

Esta recomendación es solamente aplicable a la situación de hechos y los datos según presentados y evaluados en el caso. La OGPe se reserva el derecho de reevaluar, variar o modificar el mismo en cualquier momento anterior a la emisión del permiso o la acción administrativa correspondiente por parte de la agencia solicitante o proponente cuando surja nueva información oficial específica estableciendo que el derecho aplicable o las condiciones ambientales en el predio han cambiado sustancialmente, o cuando la recomendación original se emitió bajo premisas falsas o fraudulentas.

Las vigencias de las diferentes agencias del proceso de recomendación serán las establecidas en los comunicados que estas emiten conforme a sus reglamentos.

Firma / Sellos

Fecha de Expedición:

10/SEP/2026

Lcda. Edmée Zeidan Cuebas
Secretaria Auxiliar

Edmee Zeidán Cuevas

Secretaria Auxiliar - OGPe

INSTITUTO DE CULTURA PUERTORRIQUEÑA
ICP
GOBIERNO DE PUERTO RICO

DIRECCIÓN EJECUTIVA
Melissa M. Santana I Directora Ejecutiva
msantana@icp.pr.gov

30 de septiembre de 2026

Solicitud Estudio Arqueológico Fase IB

Lcda. Edmeé Zeidan Cuebas
Secretaria Auxiliar
Oficina de Gerencia de Permisos
Departamento de Desarrollo Económico y Comercio
PO Box 41118
San Juan, Puerto Rico 00940

Proyecto: Rehabilitación de PF Guilarte (CIP 4-01-6012)
PR-131 KM. 2.5, Bo. Guilarte, Adjuntas
OGPe: 2026-703271-SRA-302608
ICP-PAE: AD-26-082

Estimada licenciada Zeidan Cuebas:

El Programa de Arqueología y Etnohistoria del Instituto de Cultura Puertorriqueña (ICP-PAE) ha evaluado los documentos recibidos a través de la Oficina de Gerencia de Permisos para el proyecto de referencia. La revisión y evaluación aquí hecha fue llevada a cabo de conformidad con lo dispuesto por la Ley Núm. 112 de 20 de julio de 1988, según enmendada, por la Ley 161-2009, según enmendada, y por la reglamentación aplicable.

Como resultado del proceso de evaluación realizado, se determina que existe una probabilidad significativa de que las actividades de desarrollo propuestas puedan impactar recursos arqueológicos asociados a la Hacienda Pietri (AD-13), conforme a lo dispuesto en la Ley Núm. 112, anteriormente citada.

Con el propósito de corroborar esta determinación y de atender cualquier impacto adverso al patrimonio arqueológico, el proponente deberá someter, para evaluación y determinación de esta agencia, una Evaluación Arqueológica **Fase IB,** la cual deberá integrar metodologías de excavación mediante trincheras y pozos de prueba, conforme a los estándares aplicables a este nivel de investigación.

INSTITUTO DE CULTURA PUERTORRIQUEÑA
ICP
GOBIERNO DE PUERTO RICO

DIRECCIÓN EJECUTIVA
Melissa M. Santana I Directora Ejecutiva
msantana@icp.pr.gov

La investigación requerida deberá concentrarse en la Sección 1: Área de estacionamiento propuesto, instalación del generador eléctrico y tanque de retrolavado, según se detalla en el **Registro de Fotos de Áreas a ser Excavadas**. Asimismo, el informe deberá incluir un análisis histórico-documental de la Hacienda Pietri y toda documentación complementaria pertinente, tales como fotografías aéreas, imágenes históricas, cartografía española u otros recursos que apoyen la interpretación cultural y espacial del área.

El informe deberá ser radicado ante el ICP-PAE en nuestras oficinas localizadas en la sede del ICP el Viejo San Juan, en original debidamente encuadernado y una copia digital en formato *PDF*, haciéndose el correspondiente pago administrativo de $200.00. Para cualquier duda sobre el procedimiento de pago, la parte proponente puede comunicarse con el señor Nathanael Aulet al siguiente correo electrónico naulet@icp.pr.gov. Recuerde acompañar los documentos a ser entregados con una hoja de trámite que indique el número de solicitud e información del proyecto de referencia, la hoja de servicios arqueológicos y el pago administrativo por radicación. Favor de incluir en la portada del informe el número de control de ICP-PAE y el número de caso de la OGPe.

Se apercibe a la parte proponente que no podrá llevarse a cabo ningún tipo de actividad de construcción, ni excavaciones en relación con el proyecto propuesto hasta concluir con los estudios arqueológicos necesarios y contar con la autorización final del ICP-PAE.

Cordialmente,

Melissa M. Santana
Directora Ejecutiva
Instituto de Cultura Puertorriqueña

Recomendaciones

Rehabilitación de PF Guilarte (CIP 4-01-6012)

Datos de Localización

De acuerdo a la información suministrada se propone una actividad: Público con Contratación Privada en:

Dirección Física

Carr. Carr. PR-131, Km 2.5, Bo. Barrio Guilarte, Adjuntas, Puerto Rico, 00601

Número(s) de Catastro

265-000-004-20

Dueño

Autoridad de Acueductos y Alcantarillados de PR

Certificado por

Calificación

Distrito(s) de Calificación: A-G

Distrito en el Mapa de Inundabilidad: X

Tipo de Suelo: To (54.2%), HmF2 (28.8%), HmE2 (8.4%), CdF (4.6%), MtF2 (4.1%)

Cabida

Cabida según escritura: 32464.62 metros cuadrados

Arqueología y Conservación Histórica

COMENTARIO FINAL DEL PROGRAMA DE PATRIMONIO HISTÓRICO EDIFICADO (PPHE) Y DEL PROGRAMA DE ARQUEOLOGÍA Y ETNOHISTORIA (PAE) DEL INSTITUTO DE CULTURA PUERTORRIQUEÑA (ICP):
PROYECTO: REHABILITACIÓN DE PF GUILARTE (CIP 4-01-6012)
DIRECCIÓN: PR-131, Km 2.5, Bo. Barrio Guilarte, Adjuntas Puerto Rico 00601
OGPe# 2026-703271-SRA-302608
CATRASTRO: 265-000-004-20
I.BASE LEGAL DE PPHE. Se emite el siguiente comentario al amparo de lo dispuesto por la Ley Núm. 374 de 14 de marzo de 1949, según enmendada, mejor conocida como Ley de Zonas Históricas, Antiguas o de Interés Turístico, por la Ley Núm. 3 de 2 de marzo de 1951, según enmendada, mejor conocida como Ley de Edificios y Estructuras de Valor Histórico o Artístico en Puerto Rico, por la Ley Núm. 89 de 21 de junio de 1955, según enmendada, mejor conocida como Ley Orgánica del Instituto de Cultura Puertorriqueña y por la Ley 161-2009, según enmendada, mejor conocida como Ley para la Reforma del Proceso de Permisos de Puerto Rico, y la reglamentación adoptada al amparo de esta última. Estas disposiciones le confieren jurisdicción al Instituto de Cultura Puertorriqueña (ICP) sobre los siguientes asuntos: 1. Edificios, lugares y zonas incluidas en el Registro de Sitios y Zonas Históricas de Puerto Rico de la Junta de Planificación - Ley Núm. 374 de 14 de marzo de 1949, ante; 2. Edificios, lugares y zonas declaradas históricas a través de legislación; 3. Plazas de recreo y edificios circundantes - Reglamento Conjunto para la Evaluación y Expedición de Permisos Relacionados al Desarrollo, Uso de Terrenos y Operación de Negocios (en adelante, “Reglamento Conjunto); 4. Propiedades localizadas en distritos calificados como “P” construidas previo a 1960 - Resoluciones JPE-25 y JPE-047 de la Junta de Planificación; 5. Propiedades localizadas en distritos de calificación “S-H” (Sitio Histórico) y “C-H” (Conservación Histórica) - Según el Reglamento Conjunto; 6. Propiedades elegibles a sitios históricos; propiedades de valor histórico que satisfacen los criterios de elegibilidad como sitios históricos para ser designada como tal individualmente – Reglamento Conjunto.
II. COMENTARIOS DE PPHE: NO OBJECION: De acuerdo con nuestros expedientes y la información provista: 1. La PF Guilarte es una planta convencional de filtración que fue construida alrededor de 1995 y tiene una capacidad de diseño de 0.4 MGD. La AAA, como parte del su Programa de Mejoras Capitales (PMC), propone el proyecto Rehabilitación de la PF Guilarte (FAASt) (CIP 4-01-6012). El objetivo del proyecto es atender los daños incurridos tras el paso del huracán María en el año 2017 y rehabilitar la infraestructura y planta física de la Planta de Filtración (PF) Guilarte. La AAA, además, busca rehabilitar la facilidad y sus componentes operacionales para asegurar el cumplimiento con las regulaciones

ambientales aplicables, alcanzar eficiencia operacional, y minimizar las interrupciones de servicio. 2. No está identificado como un Monumento Histórico declarado o un Sitio Histórico designado, según estos conceptos están definidos por el Tomo XII Glosario de la Junta de Planificación, parte III, definiciones M-55 y S-67 del Reglamento Conjunto. 3. No se localiza en una zona histórica designada o en Centro Urbano según estos conceptos están definidos por el Tomo XII Glosario de la Junta de Planificación, parte III, definiciones Z-12, Z-13 y C-71 del Reglamento Conjunto. 4. No se localiza en centro fundacional, entiéndase plaza de recreo y bloques circundantes. 5. No queda en otro lugar sujeto a la reglamentación sobre patrimonio edificado por parte del ICP-PPHE. 6. No presenta componentes visibles sobre la tierra con valor histórico evidente o potencial. 7. El proyecto o actividad que se propone no implica impacto adverso a recursos culturales pertenecientes al patrimonio histórico edificado conocidos. Luego de la evaluación de los documentos sometidos, se determina otorgar una NO OBJECIÓN a la consulta de construcción presentada. Este comentario, es PARCIAL, no incluye los elementos a ser evaluados por el Programa de Arqueología y Etnohistoria del ICP. La Ley 161-2009, según enmendada, Artículo19.6, enmienda las Secciones 2 y 3 de la Ley Núm. 112 de 20 de julio de 1988, según enmendada, conocida como “Ley de Protección del Patrimonio Arqueológico Terrestre de Puerto Rico”, a los fines de transferir al Instituto de Cultura Puertorriqueña toda facultad, deber u obligación referente a la evaluación para la otorgación o denegación de determinaciones finales o permisos, esto en coordinación con la Oficina de Gerencia de Permisos. Esta emisión de comentarios tiene vigencia de un (1) año a partir de su emisión.

III.BASE LEGAL DEL PAE: Ley Núm. 112 de 20 de julio de 1988, según enmendada, mejor conocida como Ley de Protección del Patrimonio Arqueológico Terrestre de Puerto Rico, particularmente conforme a la enmienda hecha por el Artículo 19.6 de la Ley 161-2009, según enmendada, mejor conocida como Ley para la Reforma del Proceso de Permisos de Puerto Rico, mediante el cual le fueron transferidas a la Oficina de Gerencia de Permisos (OGPe) del Departamento de Desarrollo Económico y al Instituto de Cultura Puertorriqueña (ICP) como entidad gubernamental concernida, toda facultad, deber y obligación para el trámite, evaluación, aprobación o denegatoria de determinaciones finales o permisos establecidos en dicha ley. Cónsono con lo anterior, el Reglamento Conjunto para la Evaluación y Expedición de Permisos Relacionados al Desarrollo, Uso de Terrenos y Operaciones de Negocios (en adelante, “Reglamento Conjunto”) vigente, establece, entre otras cosas, que: 1. Todo proyecto público o privado que conlleve movimiento de terreno, excavación, extracción de corteza terrestre o construcción, reconstrucciones o canalizaciones deberá contar con la recomendación del ICP sobre aspectos relacionados con la protección del patrimonio arqueológico e histórico de Puerto Rico. 2. Asimismo, dispone el Reglamento Conjunto que se requerirá la recomendación del ICP en todos los permisos relacionados con construcción, reconstrucción, trabajos de excavación, extracción o movimiento de tierras en lugar alguno del que haya documentación previa o indicios fidedignos de presencia de material arqueológico. Lo anterior, incluye los centros fundacionales de los municipios, entiéndase, la plaza de recreo y los bloques circundantes.

IV.COMENTARIO DE PAE: SOLICITUD ESTUDIO ARQUEÓLOGO FASE IB: El Programa de Arqueología y Etnohistoria del Instituto de Cultura Puertorriqueña (ICP-PAE) ha evaluado los documentos recibidos a través de la Oficina de Gerencia de Permisos para el proyecto Rehabilitación de PF Guilarte (CIP 4-01-6012) caso OGPe: 2026-703271-SRA-302608 en el municipio de Adjuntas. La revisión y evaluación aquí hecha fue llevada a cabo de conformidad con lo dispuesto por la Ley Núm. 112 de 20 de julio de 1988, según enmendada, por la Ley 161-2009, según enmendada, y por la reglamentación aplicable. Como resultado del proceso de evaluación realizado, se determina que existe una probabilidad significativa de que las actividades de desarrollo propuestas puedan impactar recursos arqueológicos asociados a la Hacienda Pietri (AD 13), conforme a lo dispuesto en la Ley Núm. 112, anteriormente citada. Con el propósito de corroborar esta determinación y de atender cualquier impacto adverso al patrimonio arqueológico, el proponente deberá someter, para evaluación y determinación de esta agencia, una Evaluación Arqueológica Fase IB, la cual deberá integrar metodologías de excavación mediante trincheras y pozos de prueba, conforme a los estándares aplicables a este nivel de investigación. La investigación requerida deberá concentrarse en la Sección 1: Área de estacionamiento propuesto, instalación del generador eléctrico y tanque de retrolavado, según se detalla en el Registro de Fotos de Áreas a ser Excavadas. Asimismo, el informe deberá incluir un análisis histórico documental de la Hacienda Pietri y toda documentación complementaria pertinente, tales como fotografías aéreas, imágenes históricas, cartografía española u otros recursos que apoyen la interpretación cultural y espacial del área. El informe deberá ser radicado ante el ICP-PAE en nuestras oficinas localizadas en la sede del ICP el Viejo San Juan, en original debidamente encuadernado y una copia digital en formato

Recomendaciones

Rehabilitación de PF Guilarte (CIP 4-01-6012)

PDF, haciéndose el correspondiente pago administrativo de $200.00. Para cualquier duda sobre el procedimiento de pago, la parte proponente puede comunicarse con el señor Nathanael Aulet al siguiente correo electrónico naulet@icp.pr.gov. Recuerde acompañar los documentos a ser entregados con una hoja de trámite que indique el número de solicitud e información del proyecto de referencia, la hoja de servicios arqueológicos y el pago administrativo por radicación. Favor de incluir en la portada del informe el número de control de ICP-PAE y el número de caso de la OGPe. Se apercibe a la parte proponente que no podrá llevarse a cabo ningún tipo de actividad de construcción, ni excavaciones en relación con el proyecto propuesto hasta concluir con los estudios arqueológicos necesarios y contar con la autorización final del ICP-PA

Condiciones Especiales

NINGUNA

Condiciones Generales

Firma / Sellos

Fecha de Expedición:

02/OCT/2026

Lcda. Edmée Zeidan Cuebas
Secretaria Auxiliar
Departamento de Desarrollo Económico y Comercio de Puerto Rico
Oficina de Gerencia de Permisos

Edmee Zeidán Cuevas

Secretaria Auxiliar - OGPe

CONTESTACIÓN A PRE-CONSULTA LEGAL

DESCRIPCIÓN Y LOCALIZACIÓN

De conformidad con las disposiciones contenidas en las leyes y reglamentos vigentes, se otorga la presente contestación a Pre-Consulta.

Dirección Física
Carr. PR-131 Km 2.5
Barrio Guilarte
Adjuntas, Puerto Rico

Número de catastro
265-000-004-20

Solicitante
Autoridad de Acueductos y Alcantarillados

Dueño
Autoridad de Acueductos y Alcantarillados

Proyecto
REHABILITACIÓN DE PF GUILARTE
(CIP 4-01-6012)

DATOS DE PRE-CONSULTA

Se presentó ante la consideración de la Oficina de Gerencia una preconsulta en la cual indicó lo siguiente:

"No. CIP: 4-01-6012 Municipio: Adjuntas
Proyecto: Rehabilitación de la PF Guilarte (FAASt)
Dirección: Carr. PR-131 Km. 2.5, Barrio Guilarte, Adjuntas, P.R.
Coordenadas: 18.172068, -66.77151

MEMORIAL DESCRIPTIVO

La Autoridad de Acueductos y Alcantarillados (AAA), como parte del su Programa de Mejoras Capitales (PMC), propone el proyecto Rehabilitación de la PF Guilarte (FAASt) (CIP 4-01-6012). El objetivo del proyecto es atender los daños incurridos tras el paso del huracán María en el año 2017 y rehabilitar la infraestructura y planta física de la Planta de Filtración (PF) Guilarte.

La PF Guilarte es una planta convencional de filtración que fue construida alrededor de 1995 y tiene una capacidad de diseño de 0.4 MGD. En adición a los daños incurridos en la infraestructura de la PF Guilarte, la misma presenta una serie de deficiencias operacionales. Por otro lado, la PF Guilarte también forma parte del acuerdo transaccional de la AAA con el Departamento de Salud de Puerto Rico y la Agencia de Protección Ambiental de los Estados Unidos (EPA, por sus siglas en inglés) dado a su historial de situaciones de incumplimiento con las reglamentaciones aplicables. Por tal razón, para atender las situaciones que afectan los procesos de la PF, el proyecto propuesto por la AAA busca rehabilitar la facilidad y sus componentes operacionales para asegurar el cumplimiento con las regulaciones ambientales aplicables, alcanzar eficiencia operacional, y minimizar las interrupciones de servicio. A tales efectos, se proponen las siguientes acciones:

1. *Reparación del Edificio de Operaciones.*
   a. *Se instalará una losa de concreto cuyas dimensiones son 6' (1.83m) de ancho y 13' (3.96m) de largo y su excavación tendrá una profundidad de aproximadamente 2' (0.61m).*
2. *La instalación de nuevos sistemas de tratamiento de agua, incluyendo:*
   a. *Metro de flujo*
   b. *Unidad de mezclado rápido*
   c. *Divisor de flujo*
   d. *Una Cámara de floculación de dos etapas*
      - *La base de la cámara de floculación tendrá un movimiento de tierra cuyas dimensiones son 8.13' (2.48m) de ancho, 11.52' (3.51m) de largo y una profundidad de 1' (0.30m) aproximadamente.*

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e. *Tanque de sedimentación*
f. *Dos nuevos filtros*
   - *El área de filtros requiere un movimiento de tierra cuyas dimensiones son 11.19' (3.41m) de ancho, 17.979' (5.48m) de largo y una profundidad de 3.52' (1.07m).*
   - *La cámara de válvulas de los filtros tendrá un movimiento de tierra cuyas dimensiones son 8.37' (2.55m) de ancho, 38.81' (11.83m) de largo y una profundidad de 1.97' (0.60m).*

3. *Rehabilitación del clear well existente.*
4. *Instalación de nuevo sistema de monitoreo continuo de muestras de agua.*
5. *Reemplazo de las bombas de retrolavado y las bombas de distribución de agua.*
6. *Construcción de nuevo tanque elevado de almacenamiento de agua de lavado.*
7. *Instalación de nuevo sistema eléctrico.*
8. *Instalación de nuevo generador de emergencia.*
9. *Instalación de nuevo equipo de controles e instrumentación.*
10. *Construcción de nuevo estacionamiento.*
11. *Construcción de muro de retención a lo largo de la sección Oeste y la sección Norte de las facilidades donde se cosntruirá un tanque elevado y nuevo estacionamiento.*
    a. *En la sección debajo del tanque elevado tendrá un movimiento de tierra cuyas dimensiones son 25.20' (7.68m) de ancho, 25.676' (7.83m) de largo y una profundidad de 5.20' (1.59m).*
    b. *En la sección al norte de las facilidades tendrá un movimiento de tierra cuyas dimensiones son 5.80' (1.77m) de ancho, 165.89' (50.56m) de largo y una profundidad de 9.12' (2.78m).*
    c. *En la sección del estacionamiento tendrá un movimiento de tierra cuyas dimensiones son 5.87' (1.790m) de ancho, 19.16' (5.84m) de largo y una profundidad de 9.12' (2.78m).*
12. *Construcción de varias tuberías de agua. El área superficial total de las trincheras es de 1,072.32 pies cuadrados (99.62 metros cuadrados). Sus trincheras están descritas a continuación:*
    a. *Construcción de tubería de 6" que tendrá un movimiento de tierra cuyas dimensiones son 2' (0.6m) de ancho, 49.21' (15m) de largo y una profundidad de 3.54' (1.08m).*
    b. *Construcción de tubería de 8" que tendrá un movimiento de tierra cuyas dimensiones son 2' (0.6m) de ancho, 44.26' (13.49m) de largo y una profundidad de 3.56' (1.085m).*
    c. *Construcción de tubería de 4" que tendrá un movimiento de tierra cuyas dimensiones son 2' (0.6m) de ancho, 196' (60m) de largo y una profundidad de 6.55' (1.996m).*
    d. *Construcción de tubería de 4" que tendrá un movimiento de tierra cuyas dimensiones son 3.71' (1.13m) de ancho, 39.73' (12.11m) de largo y una profundidad de 1.38' (0.42m).*
    e. *Construcción de tubería de 4" que tendrá un movimiento de tierra cuyas dimensiones son 1.51' (0.46m) de ancho, 21.91' (6.679m) de largo y una profundidad de 4.30' (1.31m).*
    f. *Construcción de tubería de 2" que tendrá un movimiento de tierra cuyas dimensiones son 1.51' (0.46m) de ancho, 75' (22.86m) de largo y una profundidad de 2.52' (0.767m).*
    g. *Construcción de tubería de 1.50" que tendrá un movimiento de tierra cuyas dimensiones son 1.51' (0.46m) de ancho, 92.10' (28.10m) de largo y una profundidad de 2.52' (0.767m).*
    h. *Construcción de tubería de 8" que tendrá un movimiento de tierra cuyas dimensiones son 2' (0.6m) de ancho, 58.40' (17.80m) de largo y una profundidad de 1.67' (0.51m).*
    i. *Construcción de tubería de 10" que tendrá un movimiento de tierra cuyas*

dimensiones son 2' (0.6m) de ancho, 191.60' (58.40m) de largo y una profundidad de 9.28' (9.28' (2.83m).

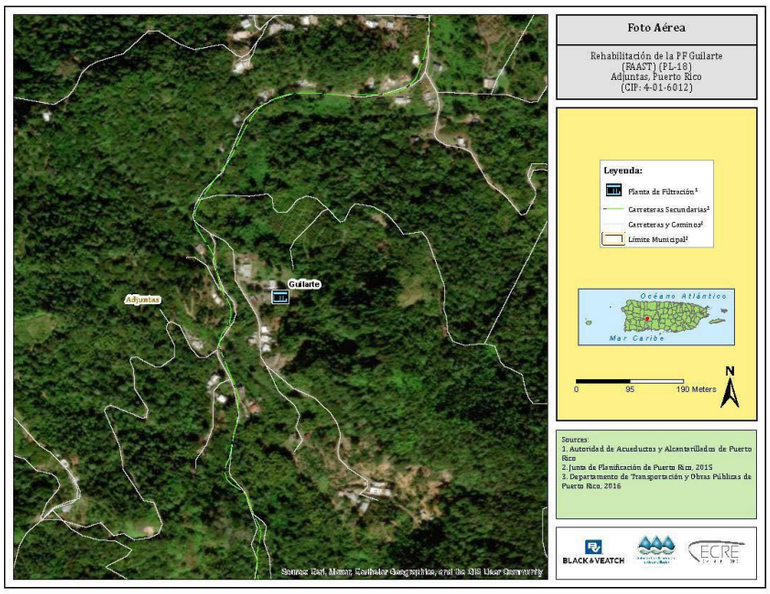

Figura 1: Figura aérea con localización del proyecto propuesto

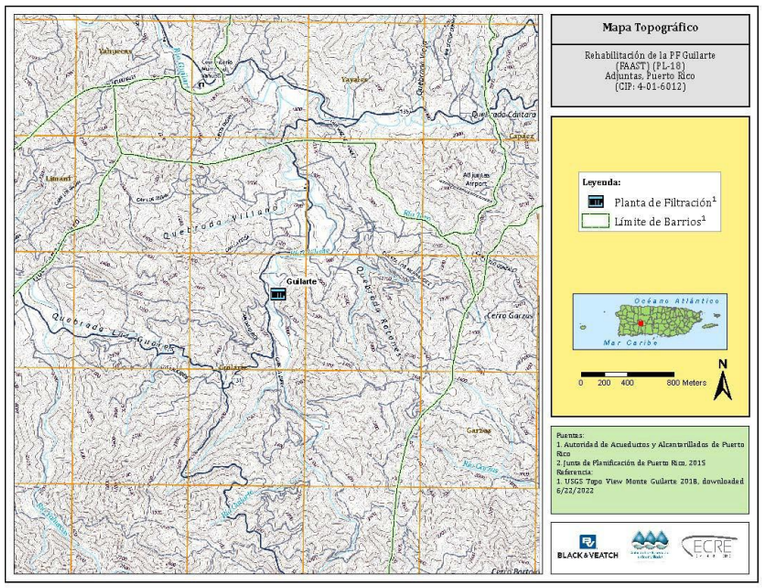

Figura 2: Mapa topográfico

Destacamos que las áreas de impacto antes descritas se mantienen en su mayoría dentro de la parcela previamente impactada por la construcción original de la planta donde se ha colocado relleno de material selecto para construcción. Este proyecto será financiado con fondos de la Agencia Federal de Manejo de Emergencias (FEMA, por sus siglas en inglés).
[…]".

En otro documento anejado en el expediente de la pre-consulta, se indica lo siguiente:

"SOLICITUD DE PCL

A través de esta Pre-Consulta Legal solicitamos a la Oficina de Gerencia de Permiso (OGPe) la evaluación del Proyecto: Rehabilitación de PF Guilarte (CIP 4-01-6012) y una autorización escrita en donde se exima de presentar un Permiso de Construcción, según definido en el Reglamento Conjunto para la Evaluación y Expedición de Permisos Relacionados al Desarrollo, Uso de Terrenos y Operación de Negocios, del 16 de junio de 2023.

CONTESTACIÓN A PRE-CONSULTA LEGAL

El proyecto es parte del Programa de Mejoras Capitales (PMC) de la AAA para detalles, favor de referirse al memorial explicativo, adjunto en este trámite; por lo cual se exime de presentar el permiso de Construcción (PCOC), según la Sección 3.2.4.3 Obras de Mejoras Públicas Exentas según el Reglamento Conjunto 2023, inciso (a,4,f) que establece:

- *Se exime de presentar permisos de construcción ante la OGPe a proyectos de mejoras públicas dentro del Programa de Mejoras Capitales de la AAA".*

DISPOSICIONES LEGALES Y REGLAMENTARIAS

Dispone el Artículo 1.5 de la Ley 161-2009, según enmendada, conocida como "Ley para la Reforma del Proceso de Permisos de Puerto Rico", que una Pre-Consulta es una "*[o]rientación que de solicitarse, será dada por la Oficina de Gerencia de Permisos, una Entidad Gubernamental Concernida o Municipio Autónomo con Jerarquía I a la V previo a la radicación de una solicitud para un proyecto propuesto. En la pre-consulta se identificarán las disposiciones legales y reglamentarias aplicables a tal acción, actividad o proyecto propuesto…*".

El 16 de junio de 2023, fue aprobado el Reglamento Conjunto para la Evaluación y Expedición de Permisos Relacionados al Desarrollo, Uso de Terrenos y Operación de Negocios, en adelante Reglamento Conjunto, el cual en el Tomo XII - Glosario de Términos, en el inciso P-136, define el concepto de Pre-consulta como una "*[o]rientación que, de solicitarse, será dada por la OGPe, una Entidad Gubernamental Concernida o Municipio Autónomo con Jerarquía I a la III previo a la radicación de una solicitud para un proyecto propuesto. En la pre-consulta se identificarán las disposiciones legales y reglamentarias aplicables a tal acción, actividad o proyecto propuesto, así como la información que conforme a ésta deberá, en su día, presentar el solicitante*".

La Sección 2.1.8.7 (a) del Reglamento Conjunto, supra, intitulada *Solicitud de Pre-Consulta* establece:

Sección 2.1.8.7 Servicios o Trámites

a. *Solicitud de Pre-Consulta:*
   1. *Cualquier persona que interese un permiso, licencia, certificaciones, autorizaciones, recomendaciones y cualquier trámite necesario o que incida de forma alguna en la operación de un negocio en Puerto Rico podrá solicitar a la OGPe o al Municipio Autónomo con Jerarquía de la I a la V, según aplique, una orientación en la cual se identificarán las disposiciones de ley y reglamentarias aplicables a tal acción, actividad o proyecto propuesto y la información que conforme a ésta deberá, en su día, presentar el solicitante.*
   2. *El solicitante podrá requerir, de la agencia que le provea una lista de los permisos o autorizaciones que, a tenor con las disposiciones de ley y reglamentarias aplicables, deberá obtener para poder comenzar la construcción u operación del proyecto.*
   3. *Los Gerentes de Permisos, el Director de la División de Evaluación de Cumplimiento Ambiental o sus representantes participarán en la evaluación de la Pre Consulta, según aplique a discreción del Secretario Auxiliar o del Director Regional de la OGPe.*
   4. *Como parte de la Pre-Consulta, el solicitante incluirá de manera escrita y detallada, como mínimo, la ubicación propuesta y una descripción del proyecto.*
   5. *La respuesta de la OGPe o del Municipio Autónomo con Jerarquía de la I a la V, según corresponda a la Pre-Consulta se hará por escrito y ésta, al igual que la información presentada por el solicitante estará disponible para examen por el público en el SUI, a menos que el solicitante reclame y justifique la confidencialidad de dichos documentos, por contener secretos de negocio que no pueden ser divulgados.*
   6. *El proceso Pre-Consulta solo será a los fines de aclarar, previo a la radicación de cualquier solicitud, los requisitos aplicables al proyecto y está sujeto al pago de los cargos aplicables.*
   7. *Cuando se reclame la confidencialidad de documentos se podrá requerir el pago de un*

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cargo adicional por el manejo del proceso.

8. *Aunque la Pre-Consulta pudiera incluir recomendaciones de la OGPe, este proceso no se considerará en ningún caso como una determinación final en cuanto a la aprobación o rechazo a la acción propuesta.*
9. *Si el peticionario ha solicitado una reunión como parte de la Pre-Consulta, en un término no mayor de cinco (5) días de la fecha de radicación, se le notificará al cliente los documentos requeridos.*
10. *Las solicitudes de Pre-Consultas incluidas en la Regla 3.2.4 (Obras Exentas de Permisos de Construcción) inciso (c) de este Reglamento incluirán lo siguiente:*
    a. *Memorial Explicativo que incluya:*
        1. *Datos de Localización*
        2. *Número de Catastro*
        3. *Pietaje*
        4. *Descripción detallada de los trabajos a realizar*
        5. *Materiales (cuando aplique)*
        6. *Volumen o Cantidad (cuando aplique)*
        7. *Calificación*
        8. *Croquis o fotos del área que se va a impactar*

    b. *Para cambio de paredes interiores croquis de la distribución existente y la propuesta.*

    c. *La OGPe o el Municipio Autónomo con Jerarquía de la I a la V se reserva el derecho de solicitar cualquier documento información adicional.*

En relación a obras sujetas a permisos de construcción, obras exentas de permiso de construcción y obras de mejoras públicas exentas de permiso de construcción, el Reglamento Conjunto establece lo siguiente:

Capítulo 3.2 Edificación y Conservación de Energía
Regla 3.2.1 Permisos de Construcción
Sección 3.2.1.1 Disposiciones Generales

a. *Se presentará una solicitud de Permiso de Construcción para toda obra que contemple una (1) o más de las siguientes actividades:*
    1. *Construcción*
    2. *Reconstrucción*
    3. *Remodelación*
    4. *Demolición*
    5. *Obras de urbanización*
    6. *Restauración*
    7. *Rehabilitación*
    8. *Ampliación*
    9. *Alteración*
b. *Además de, cumplir con los requisitos generales establecidos en la Regla 2.1.9 del Tomo II, para la presentación de solicitudes de servicio, toda solicitud de Permiso de Construcción deberá cumplir con los requisitos específicos de esta Regla.*
c. *Se autorizará permiso para la construcción de más de un (1) edificio por solar, siempre y cuando se cumpla con los parámetros del distrito en que ubica la propiedad y el estacionamiento requerido.*
d. *A la luz de la seguridad del público en general, la construcción, restauración, reconstrucción, ampliación, alteración, o remodelación de ascensores, equipos similares y relacionados a éstos, requieren de un Permiso de Construcción.*
e. *Las actividades de reconstrucción y remodelación no tendrán requisitos adicionales a los establecidos en la Sección 3.2.1.2 de este Capítulo.*
f. *El Permiso de Construcción culminará al someter el Informe Final de Obras. En aquellos casos en los que se añadan o modifiquen usos o licencias deberá proceder a presentar el Permiso Único.*

CONTESTACIÓN A PRE-CONSULTA LEGAL

Regla 3.2.4 Obras Exentas de Permisos de Construcción
Sección 3.2.4.1 Actividades Que No Se Consideran Obras de Construcción

a. *Como norma general, toda obra de construcción enlistada en la Regla 3.2.1 requiere la obtención de un Permiso de Construcción.*
b. *Las siguientes obras no se consideran obras de construcción y no requerirán un permiso de construcción, siempre y cuando no formen parte de otra obra o desarrollo mayor:*
    1. *Pintura de edificios o estructuras existentes.*
    2. *Sellado de techos.*
    3. *Trabajos de jardinería.*
    4. *Relleno de grietas, salideros y goteras en el edifico o estructura.*
    5. *Enlucido (empañetado) de obras de hormigón existentes.*
    6. *Instalación o cambio de losetas de piso, azulejos, cerámica o cualquier otra terminación de piso o pared.*
    7. *Instalación de acústicos y luminarias.*
    8. *Instalación, cambios o sustitución de puertas, ventanas o vitrinas.*
    9. *Instalación de equipos o su relocalización cuando no conlleven instalación de elementos estructurales, mecánicos, plomería o eléctrica;*
    10. *Instalación de equipos o elementos de cocinas y baños, cuando no conlleven instalación de elementos estructurales, mecánicos, plomería o eléctrica;*
    11. *Instalación de paredes de "gypsum board" y materiales similares, siempre y cuando no conlleven instalación de elementos estructurales, mecánicos, plomería o eléctrica.*
    12. *Instalación de rejas, verjas en "cyclone fence", "polyvinyl chloride" (pvc), metal, y materiales similares, siempre y cuando no conlleven instalación de elementos estructurales, mecánicos, plomería o eléctrica.*
    13. *Asfaltar calles, caminos o estacionamientos existentes.*
c. *Cuando la actividad se vaya a realizar en Sitios y Zonas Históricas así declaradas por la JP, el ICP o la Asamblea Legislativa, o en otras áreas especiales donde así se establezca mediante Reglamento o resolución, deberá obtener la autorización correspondiente del ICP, mediante una solicitud de recomendación de arqueología y conservación histórica (SRA).*

Sección 3.2.4.2 Obras de Carácter Menor Exentas

a. *Las siguientes obras estarán exentas de la presentación de un Permiso de Construcción siempre y cuando no formen parte de otra obra que requiera un Permiso de Construcción:*
    1. *Toda construcción, cuya elevación no excede un (1) metro, medido desde el nivel natural del terreno, siempre y cuando no represente un riesgo estructural, no conlleve construcción o instalación de vigas, varilla, columnas, aleros, elementos arquitectónicos, estructurales, soporte, carga o sostén;*
    2. *Verjas que se construyan conforme a las disposiciones de la Regla 8.3.2 de este Reglamento.*
    3. *Construcción o cambio de posición de divisiones interiores siempre y cuando no se creen unidades de vivienda adicionales a las existentes en el edificio, no se afecten medios de salida, elementos estructurales o mecánicos, y no se instalen o alteren tubos principales de descarga o ventilación de los sistemas de plomerías o instalen o alteren tubos principales de sistemas de distribución eléctrica y de telecomunicaciones;*
    4. *La sustitución de material viejo por material nuevo de la misma clase o parecido, tal como madera por madera, zinc por zinc, madera por cartón etcétera, en tabiques, techos y pisos. Esta disposición no cubre la sustitución de paredes de carga y de elementos de sostén de hormigón o de mampostería y aplica siempre y cuando no se afecten medios de salida, elementos mecánicos, y no se instalen o alteren tubos principales de descarga o ventilación de los sistemas de plomerías o instalen o alteren tubos principales de sistemas de distribución eléctrica y de telecomunicaciones;*
    5. *Instalación de cables, fibra óptica o tuberías para telecomunicaciones en servidumbres existentes y siempre y cuando no se afecten estructuras o infraestructura existente;*
    6. *Instalación de estructuras removibles para usos agrícolas donde existan las conexiones para la infraestructura necesaria para la operación en el predio;*

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7. *Cambios arquitectónicos en fachadas, siempre que no se introduzcan alteraciones estructurales, como: nuevas columnas, vigas, paredes de carga o nuevos aleros.*
8. *Sustituciones sencillas en sistemas de plomería, distribución eléctrica o telecomunicaciones - Cuando consistan en cambio o sustitución de equipo, tubos o aditamentos nuevos. Cualquier alteración en el sistema de plomería o electricidad que incluya la adición o modificación de tubos principales de descarga o ventilación o el cambio de posición de los existentes, requiere obtener un permiso.*
9. *Sustituciones sencillas en rótulos y anuncios - Aquellas que consistan en la sustitución de partes removibles de un rótulo o anuncio que haya sido diseñado para que se puedan efectuar estas sustituciones o la pintura de un rótulo o anuncio instalado que sea conforme a la reglamentación vigente.*
10. *Aquellas obras que, por disposición de alguna ley, estén exentas de un Permiso de Construcción.*

b. *Cuando la obra exenta se vaya a realizar en Sitios y Zonas Históricas así declaradas por la JP, el ICP o la Asamblea Legislativa, o en otras áreas especiales donde así se establezca mediante Reglamento o resolución, deberá además obtener la autorización correspondiente del ICP, mediante una solicitud de recomendación de arqueología y conservación histórica (SRA).*

c. *Deberá presentarse una Solicitud de Obra Exenta donde se detallen las obras propuestas para que la OGPe o el Municipio Autónomo con Jerarquía de la I a III determine si las mismas están consideradas exentas. El cual deberá incluir:*

1. *Memorial Explicativo que incluya como mínimo, la siguiente información:*
   a) *Materiales;*
   b) *Costo estimado de la obra;*
   c) *Descripción de la obra;*

d. *Las obras consideradas exentas de permiso bajo la presente Sección estarán sujetas al pago de arbitrios municipales, pero no aranceles.*

Regla 3.2.4 Obras Exentas de Permisos de Construcción
Sección 3.2.4.3 Obras de Mejoras Públicas Exentas

a. Se exime de presentar permisos de construcción ante la OGPe a proyectos de mejoras públicas de las entidades gubernamentales Entidades Gubernamentales Concernidas siempre que cumplan con lo siguiente:

[…]

4. AAA o AFI:

a) Presentar planos de construcción de acueductos rurales que cumplan con los requisitos para sistema de abasto de agua potable rural contenidos en la Regla 9.6.3 en el Tomo IX de este Reglamento,

b) Presentar planos de construcción de plantas de filtración, presas, líneas de transmisión, plantas de tratamiento de aguas negras, troncales sanitarias, descargas sanitarias, estaciones de bombas y eyectores neumáticos.

c) Se utilicen las mejores práctivasprácticas de diseño en la elaboración de los planos.

d) La consulta de ubicación haya sido previamente aprobada en los casos que se requiera, incluyendo la localización de las estructuras dentro del predio y los terrenos hayan sido adquiridos.

e) Se haya presentado un documento para cumplimiento ambiental, según sea el caso.

f) El proyecto a construir esté incluido en el Programa de Mejoras Capitales de la AAA.

g) Se someta antes de comenzar la construcción una copia de lo planos de construcción para los efectos de mantener al día el archivo de proyectos mejoras permanentes.

h) Se debe indicar el costo del proyecto, que haya fondos disponibles para su construcción y la procedencia de los mismos.

i) Presentar solicitud de permiso de construcción en caso de ser necesario.

j) Se obtenga los comentarios del DTOP en caso de instalación de tuberías dentro de la

servidumbre del sistema vial estatal.

k) Se presente los informes de inspección de obra certificado por un IOC conforme a la Regla 2.7.3 en el Tomo II de este Reglamento.

l) Será responsabilidad de la AAA velar por el cumplimiento de las condiciones antes indicadas.

Por otro lado, la Resolución JPE-2025-001, emitida el 12 de marzo de 2025 por la Junta de Planificación dispone:

> *"Tomando en consideración lo anteriormente expuesto, esta Junta de Planificación, conforme a la Orden Ejecutiva OE-2025-02, 03, 04, decretada por la Gobernadora de Puerto Rico, la Hon. Jennifer González Colón y por las facultades que le fueran concedidas por la Ley Núm. 75-1975, y la Ley Núm. 161-2009, según enmendadas, ACUERDA EXIMIR al Gobierno de Puerto Rico, a través de sus agencias y dependencias, LA Universidad de Puerto Rico los representantes autorizados de estas agencias, de cumplir con la obtención de un Permiso de Construcción y Permiso Único Incidental Operacional y Permisos Generales, a toda obra realizada o promovida para la reconstrucción, construcción, mitigación de infraestructura dañada total o parcialmente destruida por los estragos causados por el impacto de los eventos catastróficos de los pasados años. Las solicitudes de permisos así dispuestas, además, estarán sujetas al pago establecido de la contribución municipal. Estos trámites se radicarán de manera exclusiva en la Oficina de Gerencia de Permisos, que establecerá el proceso a seguir para implementar estas exenciones. Las agencias deberán cumplir con las condiciones impuestas por esta Resolución y por el trámite que la OGPe determine".*

El 8 de agosto de 2025, se enmendó el Artículo 9.11 de la Ley 161-2009, supra, para que disponga, en parte, lo siguiente:

> *"Artículo 9.11. - Obras Exentas. (23 L.P.R.A. § 9019j)*
> *[…]*
> *Toda obra que se vaya a llevar a cabo por cualquier agencia, corporación pública, instrumentalidad o municipios del Gobierno de Puerto Rico para reparar o reconstruir infraestructura afectada por eventos atmosféricos para reestablecerla al estado en que se encontraba previo a la ocurrencia de estos eventos, se considerará "Obra Exenta" para fines de este Artículo. El Reglamento Conjunto dispondrá el alcance de las obras sujetas a esta disposición. Disponiéndose, que aquellas modificaciones que vayan a realizarse para corregir cualquier defecto en diseño o para mejorar la resiliencia de la infraestructura ante evento atmosféricos o para cumplir con requerimientos de agencias del gobierno federal no serán consideradas alteraciones que impidan que dicha obra se considere "Obra Exenta" para fines de este Artículo y del Reglamento Conjunto".*

De otra parte, la Ley 107-2020, según enmendada, conocida como el "Código Municipal de Puerto Rico", establece lo siguiente en su Artículo 2.109:

> *Artículo 2.109 — Facultades para Imponer Contribuciones, Tasas, Tarifas y Otras*
>
> *Además de las que se dispongan en otras leyes, el municipio podrá imponer y cobrar contribuciones o tributos por los conceptos y en la forma que a continuación se establece:*
>
> *(a) Una contribución básica que no podrá exceder de seis por ciento (6%) sobre el valor tasado de la propiedad inmueble y de cuatro por ciento (4%) sobre el valor tasado de la propiedad mueble, no exenta o exonerada de contribución, ubicada dentro de sus límites territoriales y de conformidad con lo dispuesto en este Código.*
> *El municipio, mediante ordenanza aprobada por la Legislatura Municipal al efecto, podrá imponer la contribución sobre la propiedad a base de un porciento menor por el tipo de negocio o*

industria a que esté dedicada la propiedad o por la ubicación geográfica de la misma, cuando sea conveniente al interés público, para el desarrollo de cualquier actividad comercial o de cualquier zona especial de desarrollo y rehabilitación definida o establecida por ordenanza. Asimismo, el municipio podrá promulgar tipos escalonados o progresivos dentro del máximo y el mínimo, establecer tasas menores y exonerar del pago de la contribución sobre la propiedad para promover la inversión en el desarrollo y rehabilitación de áreas urbanas en deterioro o decadencia en el municipio, mediante mecanismos que permitan un tipo menor de contribución sobre la propiedad o una exención total o parcial de esta en función del cumplimiento de condiciones sobre inversión y otras análogas que el municipio establezca mediante ordenanza. Estos programas especiales serán por término fijo.

Hasta tanto un municipio adopte nuevas tasas contributivas básicas, las tasas que aplicarán serán las que resulten de la suma de las tasas adoptadas por cada uno de estos, bajo las disposiciones de ley aplicables, más el uno por ciento (1%) anual sobre el valor tasado de toda propiedad mueble y el tres por ciento (3%) sobre el valor tasado de toda propiedad inmueble en el municipio, no exentas o exoneradas de contribución, que anteriormente ingresaban al fondo general del Gobierno de Puerto Rico.

(b) Contribuciones adicionales especiales sobre la propiedad para el pago de empréstitos. La Autoridad de Asesoría Financiera y Agencia Fiscal (AAFAF), en su capacidad de fiduciario, remesará trimestralmente a los municipios los intereses devengados por los depósitos en los fondos de redención de la deuda municipal, que se nutren del producto de la contribución adicional especial sobre la propiedad (CAE).

(c) Contribuciones, derechos, licencias, arbitrios de construcción y otros arbitrios e impuestos, tasas y tarifas razonables dentro de los límites territoriales del municipio, compatibles con el Código de Rentas Internas y las leyes del Gobierno de Puerto Rico, incluyendo, sin que se entienda como una limitación, por el estacionamiento en vías públicas municipales, por la apertura de establecimientos comerciales, industriales y de servicios, por la construcción de obras y el derribo de edificios, por la ocupación, el uso y la intervención de vías públicas y servidumbres municipales y por el manejo de desperdicios.

Toda obra de construcción dentro de los límites territoriales de un municipio, realizada por una persona natural o jurídica privada, o que sea llevada a cabo por una persona natural o jurídica privada a favor o en representación de, o por contrato o subcontrato suscrito con una agencia pública o corporación pública o instrumentalidad del Gobierno estatal o municipal o del Gobierno federal, incluyendo aquella obra que no requiera la solicitud o expedición de un permiso, deberá pagar arbitrio de construcción correspondiente, previo al comienzo de la obra.

En estos casos se pagarán dichos arbitrios al municipio donde se lleve a cabo dicha obra, previo al comienzo de la obra. En aquellos casos donde surja una orden de cambio en la cual se autorice alguna variación al proyecto inicial se verificará si dicho cambio constituye una ampliación y, de así serlo, se computará el arbitrio que corresponda. En aquellas instancias en las que el cambio de orden que autorice una variación al proyecto inicial tenga el efecto de reducir el costo final del mismo, la persona que pagó arbitrios al municipio podrá solicitar un reembolso por la cantidad pagada en exceso. La solicitud de reembolso tendrá que hacerse dentro de los seis (6) meses prescriptivos siguientes a la fecha en que se aprobó el cambio de orden en los casos de obras públicas, o desde que concluya la obra en los casos en que la obra sea privada.

Tanto la Oficina de Gerencia de Permisos como la Oficina de Permisos Municipal, en el caso de municipios que tengan dicha oficina, solo podrán otorgar permisos de construcción a cualquier obra a ser realizada en un municipio que cumpla con los requisitos impuestos en este Capítulo. A tales fines, todo contratista deberá presentar una certificación emitida por el municipio como evidencia de haber pagado los arbitrios de construcción correspondientes.
[…]

CONTESTACIÓN A PRE-CONSULTA LEGAL

COMENTARIOS

Conforme a los hechos relatados por la Solicitante y las disposiciones previamente citadas, las obras a realizarse se encuentran entre las obras exentas de la obtención de un permiso de construcción, por encontrarse dentro del Plan de Mejoras Capitales de la AAA.

Se deberán someter los planos de la obra y complementar el expediente con los informes de inspección, conforme a la Sección 3.2.4.3(a)(4) del Reglamento Conjunto.

Es responsabilidad del Solicitante cumplir con la Política Pública Ambiental y con los Códigos de Construcción vigentes.

AVISO

Aunque esta Pre-Consulta pudiera incluir recomendaciones de la OGPe, este proceso no se considerará en ninguna circunstancia como una determinación final en cuanto a la aprobación o rechazo a la acción propuesta.

Los comentarios antes expuestos se limitan a los hechos particulares, según fueron presentados por el solicitante, y no se pueden interpretar como que son extensivos a cualquier otro caso, hechos o circunstancias presentes o futuros que no forman parte de la solicitud presentada. Esta Pre-Consulta no es de carácter vinculante.

FIRMAS Y SELLOS

FECHA DE EXPEDICIÓN
14 de agosto de 2026

Ing. Miguel Manzano Rivera
Secretario Auxiliar Interino
Departamento de Desarrollo Económico y Comercio de Puerto Rico
Oficina de Gerencia de Permisos

355 F. D. Roosevelt Ave. Hato Rey, PR 00919 | PO Box 362350, San Juan, PR 00936-2350 | 787.758.4747 | www.ddec.pr.gov

A.10 REPORTS

GUILARTE WATER TREATMENT PLANT REHABILITATION
REHABILITATION (FAAST) ADJUNTAS, PUERTO RICO
CIP: 4-01-6012
BID NUMBER: 27-SP-026

The following reports are included for the project:

COMPANY	DESCRIPTION	TOTAL # OF PAGES
IGS	ASBESTOS CONTAINING MATERIALS SURVEY	15
IGS	LEAD BASE PAINT SURVEY	33
CA Engineering	GEOTECHNICAL INVESTIGATION REPORT	96
CA Engineering	PARCEL PLAN	1
CA Engineering	TOPOGRAPHY AND BOUNDARY SURVEY & AS-BUILT DRAWINGS OF EXISTING FACILITIES	2

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ASBESTOS CONTAINING MATERIALS SURVEY

PF GUILARTE
ADJUNTAS P. R.



Prepared for:

PUERTO RICO AQUEDUCTS AND SEWER AUTHORITY (PRASA)

Prepared by:

INTEGRATED GLOBAL SOLUTIONS

JUNE 18, 2024

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VI. Methods of Building Inspections

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Appendix III. ACM Negative Certification

I. Summary

An environmental survey for Asbestos Containing Materials (ACM) was conducted by Integrated Global Solutions on 18, 2024, for PF Guilarte. PRASA facility located at Adjuntas P.R. The purpose of this survey included sampling and physical evaluations of suspicious ACM material and to identify ACM on the structure scheduled for demolition or renovation.

This survey report can help owners develop a plan for eliminating any asbestos hazards that were found and may aid in establishing ongoing asbestos containing materials maintenance and re-evaluation program, if needed.

NO ASBESTOS CONTAINING MATERIALS WERE FOUND AFTER PERFORMING VISUAL INSPECTIONS.

II. Introduction

An environmental survey for Asbestos Containing Materials (ACM) was conducted by Integrated Global Solutions on 18, 2024, for PF Guilarte. PRASA facility located at Adjuntas P.R. The asbestos investigation was conducted by Miguel A. Cortés Santiago an AHERA Certified Asbestos Building Inspector (License number ASB-0424-0144-SI)

III. General Background

Asbestos was used in the construction industry from 1900 to 1989. It is still used today in various products. The health effects of asbestos have been studied since the 1930's. More health studies have been conducted in asbestos than any other natural substance. The mere presence of asbestos containing materials does not necessarily constitute a health hazard. However, when these materials become disturbed from building renovation, maintenance, or other everyday activity that allows fibers to be released into the environment, then a potential hazard does exist.

The relationship between exposure level and health risk is very complex. Although this relationship is not completely understood, asbestos exposure has been associated with various types of lung diseases including a debilitating disease called asbestosis; a rare

cancer of the chest called mesothelioma; and cancers of the esophagus, stomach, colon and other organs. Asbestos is not fatal; it is, however, incurable. One who has it cannot breathe easily and physical activity becomes limited. Mesothelioma is 100% fatal, as there is no cure.

These diseases can be directly linked to the mineral of asbestos in the particle form that can be found in the lining of the lung and stomach, since the body cannot absorb these minerals. Tests have determined that asbestos can cause cancer, but scientists disagree on the amount of asbestos fibers that must be inhaled to cause cancer. The nose filters out all visible particles. Therefore, only microscopic fibers are the ones who cause the problem. Studies indicate different health effects resulting from exposure to chrysolite asbestos versus exposure to amphibole form of asbestos. The latter, which include tremolite, amosite, anthophyllite and crocidolite have more significant health impact than chrysolite.

Some scientists' studies concluded that the dimensions of the fiber which ones enter in the lung area, resulting in cancer. Long, thin fibers, greater than 8 microns in length and less than 0.25 microns in diameter show the highest potential of cancer development.

IV. National Emissions Standards for Hazardous Air Pollutants (NESHAP)

The EPA's rules concerning the application, removal and disposal of ACM, as well as manufacturing, spraying and fabricating of ACM were issued under the asbestos NESHAP regulation, under the 40 CFR 61 Subpart M on October 30, 1997. The asbestos NESHAP regulation governs asbestos demolition and renovation projects in all facilities. The NESHAP rule usually requires owners or operators to have all friable ACM removed before the building is demolished and may require its removal before renovation. If friable ACM shall be disturbed, the NESHAP rule may require appropriate work practice, or procedures for emission control. The rules state that any ACM which may become friable poses a potential hazard that should be addressed.

A revised NESHAP ruling released on November 20, 1990 (effective on February 20, 1991) which includes the responsibility of the owner, or operator, to "prior to commencement of the demolition or renovation, thoroughly inspect the affected facility or part of the facility where demolition or renovation operation will occur for the presence of asbestos, including Category I and Category II non-friable ACM" (40 CFR Part 61, National Emission Standard for Hazardous Air Pollutants, Asbestos NESHAP revision, Final Rule, November 20, 1990).

V. Project Description / Identification

This project consists of ACM survey for PF Guilarte. PRASA facility located at Adjuntas P.R.

VI. Method of Building Inspection

The visual inspection was conducted according to the condition of ACM in that location and the potential for material disturbance. The assessment scheme followed the recommendations by EPA as a result of the Asbestos Hazard Emergency Response Act and outlined in the 40 CFR Part 763.88 dated October 30, 1987, and amended by 40 CFR Part 61, NESHAP (40 CFR Part 61, National Emission Standard for Hazardous Air Pollutants, Asbestos NESHAP revision, Final Rule, November 20, 1990).

The functional space was visited and visually inspected to identify the location of any suspected ACM. An assessment was then made of the friability of suspected ACM by touching the material to determine if it could be pulverized, crumbled or reduced to powder by hand pressure. Upon completion of the suspect material and grouped into "homogenous sampling areas", i.e., areas which are uniform by color, texture, construction/application date and general appearance.

ACM was categorized as follow:

1. Category I, non-friable containing materials (ACM). This includes asbestos containing packings, gaskets, resilient floor covering and asphalt roofing products containing more than 1% asbestos.

2. Category II, non-friable ACM. This includes any materials, excluding Category I non-friable ACM containing more than 1% asbestos, that when dry cannot be crumbled, pulverized or reduced to powder by hand pressure.

3. Friable asbestos materials. This includes any material containing more than 1% asbestos that, when dry, can be crumbled, pulverized or reduced to powder by hand pressure.

Physical hazard assessment was performed based on AHERA regulations. This protocol provides separate analysis for three types of materials: surfacing, thermal insulation and miscellaneous. However, this protocol does not provide a means for relative ranking of individual hazards within the category. Therefore, a separate analysis was performed to assess hazard ranking which could be used for this type of material. The hazard assessment combines the level of potential disturbance with the current condition of ACM to indicate overall hazard potential.

The rankings of potential hazards range from 1-most hazardous to 7-least hazardous. The highest rank is reserved for ACM, which is significantly damaged. A review of the definition of “significant damage” reveals that the definitions are designed to identify ACBM, which is so extensively damaged or deteriorated, that requires immediate corrective action. Hazard rank 2-4 reflects ACBM, which is damaged as defined AHERA, with rank 2 indicating a “potential for significant damage” and rank 3 indicating a “potential for damage”. Hazard ranks 5-7 are reserved for ACBM currently in good condition, but with a range in the likelihood for future disturbance.

VII. Sampling Methods

An asbestos visual survey was conducted for suspected ACM for PF Guilarte. PRASA facility located at Adjuntas P.R.

VIII. Conclusions

NO ASBESTOS CONTAINING MATERIALS WERE FOUND AFTER PERFORMING VISUAL INSPECTIONS.

IX. Conditions, Limitations and Disclaimer

Integrated Global Solutions has performed this Asbestos Containing Materials Survey in a thorough and professional manner consistent with commonly accepted industry standards. The preparer cannot guarantee and does not warrant this evaluation has identified all adverse environmental factors and/or conditions affecting this property on the date of the survey.

The results reported and conclusions reached by the preparer are solely for the benefit of the owner. The results and opinions in this report, based solely on the conditions found at the property on the date of the survey, are valid only on that date. The preparer assumes no obligation to advise the owner of any changes in any real or potential lead base paint hazards all this facility beyond the date of the survey.

APPENDIX I. GENERAL VIEW OF INSPECTED STRUCTURE


1995

APPENDIX II. ACREDITATIONS

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ASB-0424-0144-SI
Número de Registro

4-abr-2025
Fecha de vencimiento

TARJETA DE REGISTRO
PARA LA REMOCION DE ASBESTO

Esta tarjeta autoriza a:

Miguel A. Cortés Santiago

Inspector

A trabajar en la remoción de asbesto en Puerto Rico. Esta persona **NO** es un empleado del DRNA.

Firma Autorizada - Departamento Recursos Naturales y Ambientales

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APPENDIX III. ACM NEGATIVE CERTIFICATION

GOBIERNO DE PUERTO RICO
OFICINA DEL GOBERNADOR
JUNTA DE CALIDAD AMBIENTAL

Área de Calidad de Agua

OGPe Oficina de Gerencia de Permisos

Forma PGC-009

CERTIFICACION DE NO PRESENCIA DE ASBESTO EN ESTRUCTURAS A DEMOLERSE

(Deberá completarse en letra de molde o impresa)

NUM. PERMISO: _____

Yo, Miguel A. Cortés Santiago (Nombre), mayor de edad, Soltero (Estado Civil), y vecino de Toa Alta (Municipio)

Dirección Postal P.O. Box 1164 Bayamón P.R. (Pueblo) 00960 (Zip Code)

Teléfonos: Residencial (787) 567-2123 Oficina (787) 693-7777 Ext._____
Fax (_____) _____-_____

Certifico que:

1. La estructura localizada en PF Guilarte, Adjuntas P.R., la cual será objeto de una demolición se encuentra libre de asbesto.
2. La información antes indicada es cierta y correcta.
3. Afirmo y reconozco las consecuencias de incluir y someter información falsa en este documento.
4. Para que así conste, firmo la presente certificación en Guaynabo (Municipio) de Puerto Rico, hoy día 18 de junio de 2024



_____
Firma y Sello del Profesional o
Firma del Inspector de Asbesto registrado por la JCA (Original)

Nota: Ingenieros o Arquitectos deberán someter evidencia de que se encuentra al día en el pago de sus cuotas de colegiación e Inspectores de Asbesto deberán someter evidencia de la tarjeta de registro provista por la JCA.

Dirección Física: Ave. Ponce de León 1308, Carr. Estatal 8838, Sector el Cinco, Río Piedras, PR 00926
Dirección Postal: Apartado 11488, Santurce, PR 00910-1488
Tel. (787) 767-8181 • Fax (787) 767-1962

PUERTO RICO VERDE



TARJETA DE REGISTRO
PARA LA REMOCION DE ASBESTO

Esta tarjeta autoriza a:

Miguel A. Cortés Santiago

Inspector

A trabajar en la remoción de asbesto en Puerto Rico. Esta persona **NO** es un empleado del DRNA.

ASB-0424-0144-SI
Número de Registro

4-abr-2025
Fecha de vencimiento

Firma Autorizada - Departamento Recursos Naturales y Ambientales

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LEAD BASED PAINT SURVEY

PF GUILARTE
ADJUNTAS P. R.



Prepared for:

PUERTO RICO AQUEDUCTS AND SEWER AUTHORITY (PRASA)

Prepared by:

INTEGRATED GLOBAL SOLUTIONS

JUNE 18, 2024

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Appendix III. Company and Inspector Credentials

Appendix IV. XRF PCS

Appendix V. Positive LBP Presence Pictures

I. Summary

An environmental survey for Lead Base Paint (LBP) components was conducted by Integrated Global Solutions on June 18, 2024, for PF Guilarte. PRASA facility located at Adjuntas P.R. The purpose of this survey was to identify LBP coating on the structures to be scheduled for demolition or renovation. The survey was conducted following applicable portions of the Housing Urban Development Guidelines. The scope of the survey included detection of LBP components if present in painted components and 100% testing of all surface's components if present in painted structures or appurtenances.

All the facility was tested. The survey, performed with an XRF instrument manufactured by Thermo Scientific, was conducted using 100% of testing.

The Lead Base Paint Inspection was performed to identify paint that contains lead above the allowable levels that could result in harm to construction personnel and workers, this survey report con help owners to develop a plan for eliminating any lead base paint hazards and re-evaluation program, if needed.

LEAD BASE PAINT COMPONENTS WERE FOUND AT THE TIME OF THIS SURVEY, SEE TABLE 1-1 FOR DETAILS.

TABLE 1.1

Reading #	Structure	Room	Sustrate	Color	Component & Location	Reading (mg/cm²)	Paint Condition	Measurement
24	PF Guilarte	Holding Tank	Metal	Yellow	Paint Handrail	1.20	Damaged	220 LF
25	PF Guilarte	Holding Tank	Metal	Yellow	Paint Handrail	1.50	Damaged	
26	PF Guilarte	Holding Tank	Metal	Yellow	Paint Handrail	1.30	Damaged	
27	PF Guilarte	Holding Tank	Metal	Yellow	Paint Handrail	1.30	Damaged	
32	PF Guilarte	Thickener	Metal	Yellow	Paint Handrail	1.50	Damaged	240 LF
33	PF Guilarte	Thickener	Metal	Yellow	Paint Handrail	1.70	Damaged	
34	PF Guilarte	Thickener	Metal	Yellow	Paint Handrail	1.30	Damaged	
35	PF Guilarte	Thickener	Metal	Yellow	Paint Handrail	1.60	Damaged	
56	PF Guilarte	Filters	Metal	Yellow	Paint Handrail	2.40	Damaged	130 LF
57	PF Guilarte	Filters	Metal	Yellow	Paint Handrail	2.00	Damaged	
58	PF Guilarte	Filters	Metal	Yellow	Paint Handrail	1.90	Damaged	

II. Introduction

An environmental survey for Lead Base Paint (LBP) Components was conducted by Integrated Global Solutions on June 18, 2024, for PF Guilarte. PRASA facility located at Adjuntas P.R. The scope of the survey included LBP testing of components for several structures which are scheduled to be demolished or remodeled.

The LBP investigation was conducted by Miguel A. Cortés Santiago, an EQB certified LBP inspector under license No. LBPW-26923-331. The credentials of Integrated Global Solutions, Inc. and of LBP inspector are attached in Appendix III.

III. Lead Based Paint Testing Methodology

The lead base paint testing protocol officially available at this time was published by HUD initially in 1990, revised in 1991 and finalized in 1995 (see above HUD reference). A revised Chapter 7 was published in 1997. In accordance with the new protocol, almost all surfaces present in the units have to be tested. The above guidelines were used to perform lead-based paint testing of this project.

The hazard level of lead in paint has been determined by the Department of Housing & Urban Development (HUD) to be 1.0 mg/cm2, as measured by an XRF or Atomic Absorption Spectroscopy (AAS), or 0.5% by weight (0r 5,000 ppm) as measured by

the AAS, or Inductive Coupled Plasma (ICP). The same level was adopted by EPA regulations published in 1992 under Title X.

The main steps involved in a multi-family inspection are:

- Select the painted area to be tested.
- Classify XRF and paint chip results.
- Collect and analyze paint chip samples, for inconclusive results.
- Classify paint chip results.
- Review and evaluate the data.

- Report findings.

IV. Testing Procedure

For this survey the painted components testing was performed with a Thermo Scientific XRF NITON XLp 300A fluorescent instrument (Serial number 117327). The instrument operates in two modes: standard mode and time corrected mode (Lead in Paint K+L variable reading time mode). The standard is a method selected for the NIST reference readings to ensure that the instrument is working according to the manufacturer performance characteristics sheet (PCS). The selected mode for sampling of components was time corrected mode (Lead in Paint variable reading time mode), which allows reference to the abatement level set 1.0 mg/cm2. The results are reported at a 95% confidence level and the quality of the testing verified according to the manufacturer recommendations.

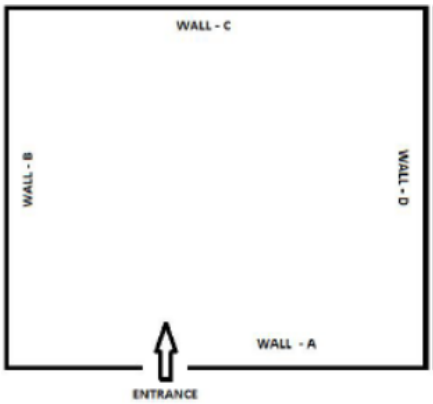
NOTE:

If the results of the surface analyzed by the XRF Spectrum Analyzer are less than 1.0 mg/cm2 it is considered negative.

If the results of the surface analyzed by the XRF Spectrum Analyzer are equal or greater than 1.0 mg/cm2 it is considered positive.

In case of inconclusive results, Paint Chip (sample of the past) will be analyzed at a certified laboratory and reported by weight of ppm.

Component sampling was conducted using a clockwise path for all spaces including exterior sides of selection as per the following figure:



V. Results

The results of the tested components are shown in Appendix II. A total of two hundred-nineteen (219) XRF readings were taken. LBP components were found at the time of this survey.

VI. Conclusions

LBP survey was conducted for PF Guilarte. PRASA facility located at Adjuntas P.R

LEAD BASE PAINT COMPONENTS WERE FOUND AT THE TIME THIS SURVEY

The LBP survey relates to surfaces accessible and not covered by rigid barriers. Should any hidden surfaces or components be present, they must be assumed to be painted with LBP or with positive results.

VII. Conditions and Limitations – Disclaimer

Integrated Global Solutions has performed this lead base paint survey in a thorough and professional manner consistent with commonly accepted industry standards. The preparer cannot guarantee and does not warrant that this evaluation has identified all adverse environmental factors and/or conditions affecting this property on the date of the survey. The results reported and conclusions reached by the preparer are solely for the benefit of the owner. The results and opinions in this report, based solely on the conditions found at the property on the date of the survey, are valid only on that

date. The preparer assumes no obligation to advise the owner of any changes in any real or potential lead base paint hazards all this facility beyond the date of the survey.

VIII. Recommendations

According to the PREQB lead regulations, prior to demolishing a structure containing lead base paint, the contaminated surfaces or substrates must be abated or removed. The waste generated has to be characterized to determine if the waste generated is hazardous or non-hazardous waste according to the regulation. The firm contracted to provide the abatement services must be certified and certified as abatement workers and supervisors by a training provider accredited by PREQB.

Miguel A. Cortés Santiago
PREQB Certified LBP Inspector
LBPW-26923-331

APPENDIX I. GENERAL VIEW OF INSPECTED STRUCTURE

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APPENDIX II. XRF DATA

XRF Form for Lead Base Paint Inspection

Customer Name:	*PRASA*	**Project Name:**	*PF Guilarte*
Contact:	*N/A*	**Total Samples:**	*219*
Phone / Fax/Email:	*N/A*	**Bldg/Structure:**	*Various*
Collected By:	*Miguel A. Cortés Santiago*	**Floor:**	*Ground*
Date:	*June 18, 2024*	**XRF Serial No.**	*Niton XLp- 300/ SN: 117327*
Project Description:	**LBP inspection**		

Reading #	Structure	Room	Sustrate	Color	Component & Location	Reading (mg/cm²)	Paint Condition	Measurement
1	**Calibration**					**0.900**		
2	**Calibration**					**0.900**		
3	**Calibration**					**1.200**		
4	PF Guilarte	Exterior	Metal	Green	Paint Gate	0.03	Fair	
5	PF Guilarte	Drying Beds	Concrete	Green	Paint Wall A	0.18	Fair	
6	PF Guilarte	Drying Beds	Concrete	Green	Paint Wall B	0.05	Fair	
7	PF Guilarte	Drying Beds	Concrete	Green	Paint Wall C	0.17	Fair	
8	PF Guilarte	Drying Beds	Concrete	Green	Paint Wall D	0.14	Fair	
9	PF Guilarte	Drying Beds	Metal	Black	Paint Column	0.25	Fair	
10	PF Guilarte	Drying Beds	Metal	Black	Paint Column	0.28	Fair	
11	PF Guilarte	Drying Beds	Metal	Black	Paint Column	0.11	Fair	
12	PF Guilarte	Drying Beds	Metal	Black	Paint Column	0.22	Fair	
13	PF Guilarte	Drying Beds	Metal	Black	Paint Column	0.28	Fair	
14	PF Guilarte	Drying Beds	Metal	Black	Paint Column	0.09	Fair	
15	PF Guilarte	Drying Beds	Metal	Black	Paint Column	0.19	Fair	
16	PF Guilarte	Drying Beds	Metal	Black	Paint Column	0.12	Fair	
17	PF Guilarte	Drying Beds	Metal	Black	Paint Column	0.17	Fair	
18	PF Guilarte	Drying Beds	Metal	Black	Paint Column	0.11	Fair	
19	PF Guilarte	Drying Beds	Metal	Black	Paint Column	0.24	Fair	

Substrate: Concrete (C), Ceramic (Ce), Metal (M), Brich (B), Wood (W), Plaster (P). Color: White (W) Brown (Br), Cream (Cr), Blue (Bl), Yellow (Y), Green (Gr), Gray (Gy), Pink (P)

XRF Form for Lead Base Paint Inspection

Customer Name:	*PRASA*	**Project Name:**	*PF Guilarte*
Contact:	*N/A*	**Total Samples:**	*219*
Phone / Fax/Email:	*N/A*	**Bldg/Structure:**	*Various*
Collected By:	*Miguel A. Cortés Santiago*	**Floor:**	*Ground*
Date:	*June 18, 2024*	**XRF Serial No.**	*Niton XLp- 300/ SN: 117327*
Project Description:	**LBP inspection**		

Reading #	Structure	Room	Sustrate	Color	Component & Location	Reading (mg/cm²)	Paint Condition	Measurement
20	PF Guilarte	Drying Beds	Metal	Black	Paint I Beams	0.01	Fair	
21	PF Guilarte	Drying Beds	Metal	Black	Paint I Beams	0.02	Fair	
22	PF Guilarte	Drying Beds	Metal	Black	Paint I Beams	0.19	Fair	
23	PF Guilarte	Drying Beds	Metal	No Paint	Rafters	0.02	Fair	
24	PF Guilarte	Holding Tank	Metal	Yellow	Paint Handrail	1.20	Damaged	220 LF
25	PF Guilarte	Holding Tank	Metal	Yellow	Paint Handrail	1.50	Damaged	
26	PF Guilarte	Holding Tank	Metal	Yellow	Paint Handrail	1.30	Damaged	
27	PF Guilarte	Holding Tank	Metal	Yellow	Paint Handrail	1.30	Damaged	
28	PF Guilarte	Holding Tank	Metal	Red	Paint Column	0.24	Damaged	
29	PF Guilarte	Holding Tank	Metal	Red	Paint I Beam	0.14	Damaged	
30	PF Guilarte	Holding Tank	Metal	Cream	Paint Crane Beam	0.18	Fair	
31	PF Guilarte	Thickener	Concrete	Green	Paint Base	0.13	Fair	
32	PF Guilarte	Thickener	Metal	Yellow	Paint Handrail	1.50	Damaged	240 LF
33	PF Guilarte	Thickener	Metal	Yellow	Paint Handrail	1.70	Damaged	
34	PF Guilarte	Thickener	Metal	Yellow	Paint Handrail	1.30	Damaged	
35	PF Guilarte	Thickener	Metal	Yellow	Paint Handrail	1.60	Damaged	
36	PF Guilarte	Thickener	Concrete	Green	Paint Raiser	0.07	Fair	
37	PF Guilarte	Thickener	Metal	Yellow	Paint Ladder	0.28	Fair	
38	PF Guilarte	Thickener	Metal	Yellow	Paint Catwalk	0.03	Fair	

Substrate: Concrete (C), Ceramic (Ce), Metal (M), Brich (B), Wood (W), Plaster (P). Color: White (W) Brown (Br), Cream (Cr), Blue (Bl), Yellow (Y), Green (Gr), Gray (Gy), Pink (P)

XRF Form for Lead Base Paint Inspection

Customer Name:	*PRASA*	**Project Name:**	*PF Guilarte*
Contact:	*N/A*	**Total Samples:**	*219*
Phone / Fax/Email:	*N/A*	**Bldg/Structure:**	*Various*
Collected By:	*Miguel A. Cortés Santiago*	**Floor:**	*Ground*
Date:	*June 18, 2024*	**XRF Serial No.**	*Niton XLp- 300/ SN: 117327*
Project Description:	**LBP inspection**		

Reading #	Structure	Room	Sustrate	Color	Component & Location	Reading (mg/cm²)	Paint Condition	Measurement
39	PF Guilarte	Thickener	Concrete	Green	Paint Tank Wall	0.26	Fair	
40	PF Guilarte	Thickener	Concrete	Green	Paint Uppertrim	0.17	Fair	
41	PF Guilarte	Thickener	Metal	Brown	Paint 4" Pipe	0.04	Fair	
42	PF Guilarte	Thickener	Metal	Brown	Paint 4" Elbow	0.07	Fair	
43	PF Guilarte	Sampling Point	Metal	No Paint	Column	0.05	Fair	
44	PF Guilarte	Sampling Point	Metal	No Paint	Column	0.30	Fair	
45	PF Guilarte	Sampling Point	Metal	No Paint	Beam	0.25	Fair	
46	PF Guilarte	Sampling Point	Metal	No Paint	Beam	0.09	Fair	
47	PF Guilarte	Sampling Point	Metal	Cream	Paint Wall	0.18	Fair	
48	PF Guilarte	Sampling Point	Concrete	Cream	Paint Low Wall	0.28	Fair	
49	PF Guilarte	Filters	Metal	Green	Paint Wall A	0.15	Fair	
50	PF Guilarte	Filters	Metal	Green	Paint Wall B	0.11	Fair	
51	PF Guilarte	Filters	Metal	Green	Paint Wall C	0.10	Fair	
52	PF Guilarte	Filters	Metal	Green	Paint Wall D	0.05	Fair	
53	PF Guilarte	Filters	Concrete	Green	Paint Column	0.25	Fair	
54	PF Guilarte	Filters	Concrete	Green	Paint Column	0.10	Fair	
55	PF Guilarte	Filters	Concrete	Green	Paint Column	0.15	Fair	
56	**PF Guilarte**	**Filters**	**Metal**	**Yellow**	**Paint Handrail**	**2.40**	**Damaged**	
57	**PF Guilarte**	**Filters**	**Metal**	**Yellow**	**Paint Handrail**	**2.00**	**Damaged**	**130 Lf**

Substrate: Concrete (C), Ceramic (Ce), Metal (M), Brich (B), Wood (W), Plaster (P). Color: White (W) Brown (Br), Cream (Cr), Blue (Bl), Yellow (Y), Green (Gr), Gray (Gy), Pink (P)

XRF Form for Lead Base Paint Inspection

Customer Name:	*PRASA*	**Project Name:**	*PF Guilarte*
Contact:	*N/A*	**Total Samples:**	*219*
Phone / Fax/Email:	*N/A*	**Bldg/Structure:**	*Various*
Collected By:	*Miguel A. Cortés Santiago*	**Floor:**	*Ground*
Date:	*June 18, 2024*	**XRF Serial No.**	*Niton XLp- 300/ SN: 117327*
Project Description:	**LBP inspection**		

Reading #	Structure	Room	Sustrate	Color	Component & Location	Reading (mg/cm²)	Paint Condition	Measurement
58	PF Guilarte	Filters	Metal	Yellow	Paint Handrail	1.90	Damaged	
59	PF Guilarte	Filters	Metal	Green	Paint 8" Pipe	0.20	Fair	
60	PF Guilarte	Filters	Metal	Green	Paint 8" Elbow	0.08	Fair	
61	PF Guilarte	Filters	Metal	Grey	Paint 4" Pipe	0.03	Fair	
62	PF Guilarte	Filters	Metal	Grey	Paint 4" Elbow	0.20	Fair	
63	PF Guilarte	Filters	Metal	Green	Paint 8" Pipe	0.22	Fair	
64	PF Guilarte	Filters	Metal	Green	Paint 8" Elbow	0.14	Fair	
65	PF Guilarte	Filters	Metal	Green	Paint 8" Tee	0.26	Fair	
66	PF Guilarte	Filters	Metal	Blue	Paint 6" Pipe	0.17	Fair	
67	PF Guilarte	Filters	Metal	Blue	Paint 6" Elbow	0.03	Fair	
68	PF Guilarte	Filters	Metal	Blue	Paint 6" Tee	0.02	Fair	
69	PF Guilarte	Filters	Metal	Blue	Paint Check Valve	0.19	Fair	
70	PF Guilarte	Filters	Concrete	Green	Paint Pipe Base	0.18	Fair	
71	PF Guilarte	Filters	Concrete	Green	Paint Pipe Base	0.04	Fair	
72	PF Guilarte	Filters	Concrete	Green	Paint Pipe Base	0.14	Fair	
73	PF Guilarte	Filters	Concrete	Green	Paint Pipe Base	0.05	Fair	
74	PF Guilarte	Filters	Concrete	Green	Paint Pipe Base	0.18	Fair	
75	PF Guilarte	Filters	Concrete	Green	Paint Pipe Base	0.08	Fair	
76	PF Guilarte	Filters	Concrete	Green	Paint Pipe Base	0.23	Fair	

Substrate: Concrete (C), Ceramic (Ce), Metal (M), Brich (B), Wood (W), Plaster (P). Color: White (W) Brown (Br), Cream (Cr), Blue (Bl), Yellow (Y), Green (Gr), Gray (Gy), Pink (P)

XRF Form for Lead Base Paint Inspection

Customer Name:	*PRASA*	**Project Name:**	*PF Guilarte*
Contact:	*N/A*	**Total Samples:**	*219*
Phone / Fax/Email:	*N/A*	**Bldg/Structure:**	*Various*
Collected By:	*Miguel A. Cortés Santiago*	**Floor:**	*Ground*
Date:	*June 18, 2024*	**XRF Serial No.**	*Niton XLp- 300/ SN: 117327*
Project Description:	**LBP inspection**		

Reading #	Structure	Room	Sustrate	Color	Component & Location	Reading (mg/cm²)	Paint Condition	Measurement
77	PF Guilarte	Filters	Concrete	Green	Paint Pipe Base	0.24	Fair	
78	PF Guilarte	Filters	Concrete	Green	Paint Pipe Base	0.14	Fair	
79	PF Guilarte	Filters	Metal	Blue	Paint 6" Pipe	0.18	Fair	
80	PF Guilarte	Filters	Metal	Blue	Paint 6" Pipe	0.21	Fair	
81	PF Guilarte	Filters	Metal	Blue	Paint 6" Pipe	0.07	Fair	
82	PF Guilarte	Filters	Metal	Blue	Paint 4" Pipe	0.10	Fair	
83	PF Guilarte	Filters	Metal	Blue	Paint 4" Pipe	0.23	Fair	
84	PF Guilarte	Filters	Metal	Blue	Paint 4" Tee	0.20	Fair	
85	PF Guilarte	Filters	Metal	Blue	Paint 4" Tee	0.26	Fair	
86	PF Guilarte	Filters	Metal	Blue	Paint Blower Box	0.23	Fair	
87	PF Guilarte	Filters	Metal	Blue	Paint Blower Box	0.29	Fair	
88	PF Guilarte	Filters	Metal	Blue	Paint	0.14	Fair	
89	PF Guilarte	Filters	Metal	Blue	Paint Backwash 6" Pipe	0.28	Fair	
90	PF Guilarte	Filters	Metal	Blue	Paint Backwash 6" Pipe	0.09	Fair	
91	PF Guilarte	Filters	Metal	Blue	Paint Valve	0.21	Fair	
92	PF Guilarte	Filters	Metal	Blue	Paint Valve	0.22	Fair	
93	PF Guilarte	Filters	Metal	Grey	Paint Pump Engine	0.16	Fair	
94	PF Guilarte	Filters	Metal	Cream	Paint Pump Engine	0.03	Fair	
95	PF Guilarte	Filters	Concrete	Green	Paint Pipe Base	0.09	Fair	

Substrate: Concrete (C), Ceramic (Ce), Metal (M), Brich (B), Wood (W), Plaster (P). Color: White (W) Brown (Br), Cream (Cr), Blue (Bl), Yellow (Y), Green (Gr), Gray (Gy), Pink (P)

XRF Form for Lead Base Paint Inspection

Customer Name:	*PRASA*	**Project Name:**	*PF Guilarte*
Contact:	*N/A*	**Total Samples:**	*219*
Phone / Fax/Email:	*N/A*	**Bldg/Structure:**	*Various*
Collected By:	*Miguel A. Cortés Santiago*	**Floor:**	*Ground*
Date:	*June 18, 2024*	**XRF Serial No.**	*Niton XLp- 300/ SN: 117327*

Project Description: LBP inspection

Reading #	Structure	Room	Sustrate	Color	Component & Location	Reading (mg/cm²)	Paint Condition	Measurement
96	PF Guilarte	Filters	Metal	Cream	Paint 6" Pipe	0.21	Fair	
97	PF Guilarte	Filters	Metal	Cream	Paint 6" Elbow	0.10	Fair	
98	PF Guilarte	Filters	Metal	Blue	Paint 6" Y	0.29	Fair	
99	PF Guilarte	Filters	Metal	Blue	Paint 6" Elbow	0.29	Fair	
100	PF Guilarte	Filters	Metal	Blue	Paint 6" Elbow	0.19	Fair	
101	PF Guilarte	Filters	Metal	Blue	Paint 6" Valve	0.26	Fair	
102	PF Guilarte	Filters	Metal	Blue	Paint 6" Valve	0.19	Fair	
103	PF Guilarte	Filters	Metal	Blue	Paint 6" Check Valve	0.09	Fair	
104	PF Guilarte	Filters	Metal	Blue	Paint 6" Check Valve	0.30	Fair	
105	PF Guilarte	Filters	Metal	Grey	Paint Pump Engine	0.16	Fair	
106	PF Guilarte	Filters	Metal	Grey	Paint Pump Engine	0.05	Fair	
107	PF Guilarte	Filters	Metal	Blue	Paint 2" Tee	0.10	Fair	
108	PF Guilarte	Filters	Metal	Blue	Paint 2" Pipe	0.22	Fair	
109	PF Guilarte	Filters	Metal	Yellow	Paint Handrail	0.03	Damaged	
110	PF Guilarte	Filters	Metal	Yellow	Paint Handrail	0.29	Damaged	
111	PF Guilarte	Filters	Metal	Yellow	Paint Handrail	0.09	Damaged	
112	PF Guilarte	Filters	Metal	Yellow	Paint Handrail	0.05	Damaged	
113	PF Guilarte	Filters	Metal	Yellow	Paint Handrail	0.28	Damaged	
114	PF Guilarte	Filters	Metal	Yellow	Paint Handrail	0.13	Damaged	

Substrate: Concrete (C), Ceramic (Ce), Metal (M), Brich (B), Wood (W), Plaster (P). Color: White (W) Brown (Br), Cream (Cr), Blue (Bl), Yellow (Y), Green (Gr), Gray (Gy), Pink (P)

XRF Form for Lead Base Paint Inspection

Customer Name:	*PRASA*	**Project Name:**	*PF Guilarte*
Contact:	*N/A*	**Total Samples:**	*219*
Phone / Fax/Email:	*N/A*	**Bldg/Structure:**	*Various*
Collected By:	*Miguel A. Cortés Santiago*	**Floor:**	*Ground*
Date:	*June 18, 2024*	**XRF Serial No.**	*Niton XLp- 300/ SN: 117327*
Project Description:	**LBP inspection**		

Reading #	Structure	Room	Sustrate	Color	Component & Location	Reading (mg/cm²)	Paint Condition	Measurement
115	PF Guilarte	Filters	Metal	Yellow	Paint Handrail	0.11	Damaged	
116	PF Guilarte	Filters	Metal	Yellow	Paint Handrail	0.23	Damaged	
117	PF Guilarte	Filters	Metal	Green	Paint Stairs	0.16	Fair	
118	PF Guilarte	Filters	Metal	Red	Paint Crane Beam	0.15	Damaged	
119	PF Guilarte	Filters	Metal	Green	Paint I Column	0.20	Fair	
120	PF Guilarte	Filters	Metal	Green	Paint I Column	0.03	Fair	
121	PF Guilarte	Filters	Metal	Green	Paint I Column	0.11	Fair	
122	PF Guilarte	Filters	Metal	Green	Paint Crane Beam	0.18	Fair	
123	PF Guilarte	Filters	Concrete	Green	Paint Base	0.04	Fair	
124	PF Guilarte	Generator Room	Concrete	Green	Paint Wall A	0.28	Fair	
125	PF Guilarte	Generator Room	Concrete	Green	Paint Wall B	0.09	Fair	
126	PF Guilarte	Generator Room	Concrete	Green	Paint Wall C	0.20	Fair	
127	PF Guilarte	Generator Room	Concrete	Green	Paint Wall D	0.17	Fair	
128	PF Guilarte	Generator Room	Metal	Green	Paint Door	0.25	Fair	
129	PF Guilarte	Generator Room	Metal	Green	Paint Door Frame	0.05	Fair	
130	PF Guilarte	Generator Room	Metal	White	Paint Louver	0.08	Fair	
131	PF Guilarte	Generator Room	Concrete	Green	Paint Overhang	0.19	Fair	
132	PF Guilarte	Generator Room	Concrete	Green	Paint Uppertrim	0.04	Fair	
133	PF Guilarte	Generator Room	Metal	White	Paint Louver	0.22	Fair	

Substrate: Concrete (C), Ceramic (Ce), Metal (M), Brich (B), Wood (W), Plaster (P). Color: White (W) Brown (Br), Cream (Cr), Blue (Bl), Yellow (Y), Green (Gr), Gray (Gy), Pink (P)

XRF Form for Lead Base Paint Inspection

Customer Name:	*PRASA*	**Project Name:**	*PF Guilarte*
Contact:	*N/A*	**Total Samples:**	*219*
Phone / Fax/Email:	*N/A*	**Bldg/Structure:**	*Various*
Collected By:	*Miguel A. Cortés Santiago*	**Floor:**	*Ground*
Date:	*June 18, 2024*	**XRF Serial No.**	*Niton XLp- 300/ SN: 117327*
Project Description:	**LBP inspection**		

Reading #	Structure	Room	Sustrate	Color	Component & Location	Reading (mg/cm²)	Paint Condition	Measurement
134	PF Guilarte	Generator Room	Metal	White	Paint Louver	0.11	Fair	
135	PF Guilarte	Generator Room	Metal	White	Paint Louver	0.02	Fair	
136	PF Guilarte	Generator Room	Concrete	Blue	Paint Wall A	0.09	Fair	
137	PF Guilarte	Generator Room	Concrete	Blue	Paint Wall B	0.28	Fair	
138	PF Guilarte	Generator Room	Concrete	Blue	Paint Wall C	0.05	Fair	
139	PF Guilarte	Generator Room	Concrete	Blue	Paint Wall D	0.25	Fair	
140	PF Guilarte	Generator Room	Concrete	Blue	Paint Ceiling	0.21	Damaged	
141	PF Guilarte	Fuel Tank	Concrete	Green	Paint Wall A	0.14	Fair	
142	PF Guilarte	Fuel Tank	Concrete	Green	Paint Wall B	0.27	Fair	
143	PF Guilarte	Fuel Tank	Concrete	Green	Paint Wall C	0.14	Fair	
144	PF Guilarte	Fuel Tank	Concrete	Green	Paint Wall D	0.13	Fair	
145	PF Guilarte	Fuel Tank	Metal	Red	Paint Fuel Tank	0.25	Fair	
146	PF Guilarte	Fuel Tank	Metal	Red	Paint Ladder	0.04	Fair	
147	PF Guilarte	Loading Area	Metal	Yellow	Paint Handrail	0.30	Damaged	
148	PF Guilarte	Loading Area	Metal	Yellow	Paint Handrail	0.20	Damaged	
149	PF Guilarte	Loading Area	Metal	Yellow	Paint Bumper Stop	0.03	Fair	
150	PF Guilarte	Loading Area	Metal	Yellow	Paint Bumper Stop	0.28	Fair	
151	PF Guilarte	Loading Area	Metal	Yellow	Paint Bumper Stop	0.19	Fair	
152	PF Guilarte	Operator Room	Concrete	Blue	Paint Wall A	0.24	Fair	

Substrate: Concrete (C), Ceramic (Ce), Metal (M), Brich (B), Wood (W), Plaster (P). Color: White (W) Brown (Br), Cream (Cr), Blue (Bl), Yellow (Y), Green (Gr), Gray (Gy), Pink (P)

XRF Form for Lead Base Paint Inspection

Customer Name:	*PRASA*	**Project Name:**	*PF Guilarte*
Contact:	*N/A*	**Total Samples:**	*219*
Phone / Fax/Email:	*N/A*	**Bldg/Structure:**	*Various*
Collected By:	*Miguel A. Cortés Santiago*	**Floor:**	*Ground*
Date:	*June 18, 2024*	**XRF Serial No.**	*Niton XLp- 300/ SN: 117327*
Project Description:	**LBP inspection**		

Reading #	Structure	Room	Sustrate	Color	Component & Location	Reading (mg/cm²)	Paint Condition	Measurement
153	PF Guilarte	Operator Room	Concrete	Green	Paint Wall A	0.09	Fair	
154	PF Guilarte	Operator Room	Concrete	Blue	Paint Wall B	0.24	Fair	
155	PF Guilarte	Operator Room	Concrete	Green	Paint Wall B	0.22	Fair	
156	PF Guilarte	Operator Room	Metal	White	Paint Window	0.04	Fair	
157	PF Guilarte	Operator Room	Metal	White	Paint Window	0.17	Fair	
158	PF Guilarte	Operator Room	Concrete	Green	Paint Overhang	0.28	Fair	
159	PF Guilarte	Operator Room	Concrete	Blue	Paint Wall C	0.23	Fair	
160	PF Guilarte	Operator Room	Metal	White	Paint Window	0.29	Fair	
161	PF Guilarte	Operator Room	Metal	White	Paint Window	0.06	Fair	
162	PF Guilarte	Operator Room	Metal	White	Paint Window	0.28	Fair	
163	PF Guilarte	Operator Room	Concrete	Blue	Paint Wall D	0.26	Fair	
164	PF Guilarte	Operator Room	Concrete	Green	Paint Wall D	0.09	Fair	
165	PF Guilarte	Operator Room	Metal	White	Paint Window	0.13	Fair	
166	PF Guilarte	Operator Room	Metal	White	Paint Window	0.18	Fair	
167	PF Guilarte	Operator Room	Metal	White	Paint Window	0.22	Fair	
168	PF Guilarte	Operator Room	Metal	Blue	Paint 2" Pipe	0.12	Fair	
169	PF Guilarte	Operator Room	Concrete	Blue	Paint Porch Wall C	0.08	Fair	
170	PF Guilarte	Operator Room	Concrete	Blue	Paint Porch Wall D	0.21	Fair	
171	PF Guilarte	Operator Room	Metal	White	Paint Window	0.10	Fair	

Substrate: Concrete (C), Ceramic (Ce), Metal (M), Brich (B), Wood (W), Plaster (P). Color: White (W) Brown (Br), Cream (Cr), Blue (Bl), Yellow (Y), Green (Gr), Gray (Gy), Pink (P)

XRF Form for Lead Base Paint Inspection

Customer Name:	*PRASA*	**Project Name:**	*PF Guilarte*
Contact:	*N/A*	**Total Samples:**	*219*
Phone / Fax/Email:	*N/A*	**Bldg/Structure:**	*Various*
Collected By:	*Miguel A. Cortés Santiago*	**Floor:**	*Ground*
Date:	*June 18, 2024*	**XRF Serial No.**	*Niton XLp- 300/ SN: 117327*
Project Description:	**LBP inspection**		

Reading #	Structure	Room	Sustrate	Color	Component & Location	Reading (mg/cm²)	Paint Condition	Measurement
172	PF Guilarte	Operator Room	Metal	White	Paint Door	0.01	Fair	
173	PF Guilarte	Operator Room	Metal	White	Paint Door Frame	0.13	Fair	
174	PF Guilarte	Operator Office	Metal	White	Paint Door	0.04	Fair	
175	PF Guilarte	Operator Office	Metal	White	Paint Door Frame	0.22	Fair	
176	PF Guilarte	Operator Office	Concrete	Blue	Paint Wall A	0.08	Fair	
177	PF Guilarte	Operator Office	Concrete	Blue	Paint Wall B	0.10	Fair	
178	PF Guilarte	Operator Office	Concrete	Blue	Paint Wall C	0.21	Fair	
179	PF Guilarte	Operator Office	Concrete	Blue	Paint Wall D	0.05	Fair	
180	PF Guilarte	Bathroom	Metal	White	Paint Door	0.07	Fair	
181	PF Guilarte	Bathroom	Metal	White	Paint Door Frame	0.06	Fair	
182	PF Guilarte	Bathroom	Concrete	Blue	Paint Wall A	0.16	Fair	
183	PF Guilarte	Bathroom	Concrete	Blue	Paint Wall B	0.13	Fair	
184	PF Guilarte	Bathroom	Concrete	Blue	Paint Wall C	0.16	Fair	
185	PF Guilarte	Bathroom	Concrete	Blue	Paint Wall D	0.16	Fair	
186	PF Guilarte	Bathroom	Ceramic	Cream	Tile Wall A	0.06	Fair	
187	PF Guilarte	Bathroom	Ceramic	Cream	Tile Wall B	0.23	Fair	
188	PF Guilarte	Bathroom	Ceramic	Cream	Tile Wall C	0.10	Fair	
189	PF Guilarte	Bathroom	Ceramic	Cream	Tile Wall D	0.30	Fair	
190	PF Guilarte	Bathroom	Ceramic	Cream	Tile Shower Curb	0.02	Fair	

Substrate: Concrete (C), Ceramic (Ce), Metal (M), Brich (B), Wood (W), Plaster (P). Color: White (W) Brown (Br), Cream (Cr), Blue (Bl), Yellow (Y), Green (Gr), Gray (Gy), Pink (P)

XRF Form for Lead Base Paint Inspection

Customer Name:	*PRASA*	**Project Name:**	*PF Guilarte*
Contact:	*N/A*	**Total Samples:**	*219*
Phone / Fax/Email:	*N/A*	**Bldg/Structure:**	*Various*
Collected By:	*Miguel A. Cortés Santiago*	**Floor:**	*Ground*
Date:	*June 18, 2024*	**XRF Serial No.**	*Niton XLp- 300/ SN: 117327*
Project Description:	LBP inspection		

Reading #	Structure	Room	Sustrate	Color	Component & Location	Reading (mg/cm²)	Paint Condition	Measurement
191	PF Guilarte	Bathroom	Ceramic	Cream	Tile Shower Floor	0.17	Fair	
192	PF Guilarte	Operator Lab	Concrete	Blue	Paint Wall A	0.27	Fair	
193	PF Guilarte	Operator Lab	Concrete	Blue	Paint Wall B	0.23	Fair	
194	PF Guilarte	Operator Lab	Concrete	Blue	Paint Wall C	0.23	Fair	
195	PF Guilarte	Operator Lab	Concrete	Blue	Paint Wall D	0.22	Fair	
196	PF Guilarte	Operator Lab	Concrete	Blue	Paint Ceiling	0.08	Fair	
197	PF Guilarte	Operator Lab	Ceramic	Brown	Tile Floor	0.09	Fair	
198	PF Guilarte	Supervisor Office	Metal	White	Paint Door	0.29	Fair	
199	PF Guilarte	Supervisor Office	Metal	White	Paint Door Frame	0.03	Fair	
200	PF Guilarte	Supervisor Office	No Access					
201	PF Guilarte	Chemical Room	Metal	White	Paint Door	0.11	Fair	
202	PF Guilarte	Chemical Room	Metal	White	Paint Door Frame	0.08	Fair	
203	PF Guilarte	Chemical Room	Concrete	Blue	Paint Wall A	0.04	Fair	
204	PF Guilarte	Chemical Room	Concrete	Blue	Paint Wall B	0.23	Fair	
205	PF Guilarte	Chemical Room	Concrete	Blue	Paint Wall C	0.13	Fair	
206	PF Guilarte	Chemical Room	Concrete	Blue	Paint Wall D	0.15	Fair	
207	PF Guilarte	Polymer Dike	Concrete	Blue	Paint Wall A	0.12	Fair	
208	PF Guilarte	Polymer Dike	Concrete	Blue	Paint Wall B	0.01	Fair	
209	PF Guilarte	Polymer Dike	Concrete	Blue	Paint Wall C	0.20	Fair	

Substrate: Concrete (C), Ceramic (Ce), Metal (M), Brich (B), Wood (W), Plaster (P). Color: White (W) Brown (Br), Cream (Cr), Blue (Bl), Yellow (Y), Green (Gr), Gray (Gy), Pink (P)

XRF Form for Lead Base Paint Inspection

Customer Name:	*PRASA*	**Project Name:**	*PF Guilarte*
Contact:	*N/A*	**Total Samples:**	*219*
Phone / Fax/Email:	*N/A*	**Bldg/Structure:**	*Various*
Collected By:	*Miguel A. Cortés Santiago*	**Floor:**	*Ground*
Date:	*June 18, 2024*	**XRF Serial No.**	*Niton XLp- 300/ SN: 117327*
Project Description:	**LBP inspection**		

Reading #	Structure	Room	Sustrate	Color	Component & Location	Reading (mg/cm²)	Paint Condition	Measurement
210	PF Guilarte	Chlorine Room	Metal	White	Paint Door	0.18	Fair	
211	PF Guilarte	Chlorine Room	Metal	White	Paint Door Frame	0.17	Fair	
212	PF Guilarte	Chlorine Room	Concrete	Blue	Paint Wall A	0.20	Fair	
213	PF Guilarte	Chlorine Room	Concrete	Blue	Paint Wall B	0.10	Fair	
214	PF Guilarte	Chlorine Room	Concrete	Blue	Paint Wall C	0.09	Fair	
215	PF Guilarte	Chlorine Room	Concrete	Blue	Paint Wall D	0.14	Fair	
216	PF Guilarte	Chlorine Room	Ceramic	Brown	Tile Floor	0.27	Fair	
217	**Calibration**					**1.00**		
218	**Calibration**					**1.10**		
219	**Calibration**					**1.10**		

Substrate: Concrete (C), Ceramic (Ce), Metal (M), Brich (B), Wood (W), Plaster (P). Color: White (W) Brown (Br), Cream (Cr), Blue (Bl), Yellow (Y), Green (Gr), Gray (Gy), Pink (P)

APPENDIX III. COMPANY AND INSPECTOR CREDENTIALS



GOBIERNO DE PUERTO RICO

Departamento de Recursos Naturales y Ambientales

Este certificado es otorgado a:

Integrated Global Solutions

Por haber cumplido con los requisitos establecidos en el Capítulo VI, Regla 127 del Reglamento para el Manejo Adecuado de Actividades de Pintura con Base de Plomo. Se le otorga esta certificación como **Firma** para llevar a cabo actividades relacionadas a Mitigación de Pintura con base de plomo en la jurisdicción de Puerto Rico.

Número de Certificado

LBPF-21623-028

Fecha de emisión: Agosto 13, 2023

Fecha de Expiración: Agosto 12, 2024

DRNA

José Roque Juliá
Jefe
División Desperdicios Tóxicos

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APPENDIX V. XRF PCS

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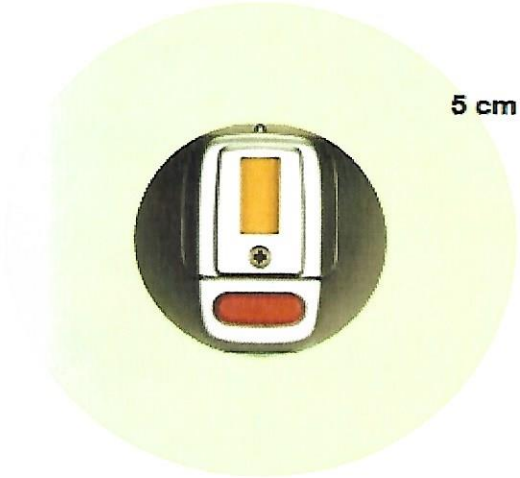
Thermo Scientific Portable XRF Analyzers
Isotope Radiation Survey Certificate

Instrument Model:	XLp 300A
Instrument S/N:	117327

Detector Model:	RadEye B20-ER
Detector S/N:	0213
Calibration Date:	4/5/2022



Dose rate (µrem/hr)* (100.0 µrem = 0.1 mrem = 1.0 µSv)	
Background	5 cm
11	0

*All recorded measurements are net above background.

• Dose rate measurements taken at 360°perpendicular to instrument with the shutter closed (i.e., sources in the shielded position.

** The survey results indicate that the dose rate does not exceed 0.05 milirem per hour at any point 5 cm [< 50 µrem/hr at 5 cm] from the surface of the device.

Conducted by: David Nop **Survey Date:** 9/13/2022 TODAY

Thermo Scientific 2 Radcliff Road Tewksbury MA 01876 +1 978-670-7460 www.thermoscientific.com/pai
Portable Analytical Instruments USA +1 978-670-7430 fax 800-875-1578 (toll free)

ThermoFisher SCIENTIFIC

Certificate of Calibration

Serial Number: 117327 Model: Niton XLp 300A Software: 5.2F-Dual Date of Q.C.: 9/13/2022
Resolution: 370.53 Escale: 4.53 Source: CD-109 Inspector: RC

K+L 20 Sec Readings

Std	L	Lerr	K	Kerr	DI	L Status	K Status
1.0 Surface Wood-1	1.00	0.10	1.00	0.40	1.1	OK	OK
1.0 Surface Wood-2	1.00	0.10	1.10	0.40	1.1	OK	OK
1.0 Buried Wood-1	1.00	0.10	1.00	0.40	2.2	OK	OK
1.0 Buried Wood-2	1.00	0.10	1.10	0.40	2.2	OK	OK
Blank Wood-1	0.00	0.02	0.30	0.34	1.0	OK	OK
Blank Wood-2	0.00	0.02	0.50	0.30	1.6	OK	OK
3.5 Surface Wood-1	3.60	0.20	3.50	0.50	1.2	OK	OK
3.5 Surface Wood-1	3.60	0.20	3.50	0.50	1.3	OK	OK
0.3 Surface Concrete-1	0.29	0.03	0.60	0.50	1.0	OK	OK
0.3 Surface Concrete-2	0.29	0.03	0.70	0.50	1.0	OK	OK
Steel-1	0.02	0.04	-0.02	0.54	8.3	OK	OK
Steel-2	0.05	0.08	-0.12	0.55	10.0	OK	OK
Pure Pb-1	10.10	2.00	82.30	2.60	1.7	OK	OK
Pure Pb-2	10.10	1.60	81.90	2.60	1.6	OK	OK
1.0 Surface Drywall-1	1.00	0.10	1.30	0.40	1.0	OK	OK
1.0 Surface Drywall-2	1.00	0.10	1.40	0.40	1.0	OK	OK

K+L 20 Sec Readings

Std	Time	Result	
Drywall-1	2.03	0.00	OK
Drywall-2	2.03	0.00	OK
French Plaster-1	2.71	0.00	OK
French Plaster-2	3.38	0.00	OK

This certificate is issued in accordance with Thermo Fisher Scientific factory specifications.
The measurements were found to be within specification limits at the time of manufacture and calibration.

Standards are traceable to National Institute of Standards & Technology (NIST) standards.

Signed:



Steve Introne
Director of Quality and Regulatory

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SEALED SOURCE LEAK TEST CERTIFICATE

Certificate # : **7274**

LEAK TEST LABORATORY INFORMATION			
COMPANY NAME	THERMO SCIENTIFIC PORTABLE ANALYTICAL INSTRUMENTS		
LICENSE NUMBER	MASSACHUSETTS 55-0238	CONTACT NAME/ASST.RSO	Jose Hernandez
ADDRESS	2 RADCLIFF ROAD	CONTACT NUMBER	978-513-3634
	TEWKSBURY MA 01876	FAX NUMBER	978-670-7411

A copy of certificate should be maintained for a minimum of 3 years and for inspection by the regulatory agency.

SAMPLE KIT INFORMATION

Sample ID # : N-7133

Sample date : 8/31/2022

SEALED SOURCE INFORMATION

Manufacturer : Eckert & Ziegler

Source model : XCd9.06

Source serial number : TR4894

Radioisotope : Cd-109

Assay Date : 11/15/2022

Activity (mCi) : 40

DEVICE/ANALYZER INFORMATION

Device make : Thermo Scientific Portable XRF Analyzers

Device model : XLp

Serial number : 117327

LEAK TEST RESULT:

Analysis of the above sample kit on date **8/31/2022** yield the following result:

☑ The analysis of the radioactive material of this leak test sample indicated the activity present is less than 0.005 uCi (or 185 Bq). The source may be used as authorized.

☐ Statistical analysis of the radioactive count data of this leak test sample indicated the activity present is greater than 0.005 uCi (or 185 Bq). This source should be considered leaking. Consult your device operations procedure; place this source in storage or quarantine area and make the required notification to your regulatory agency.

DEVICE/SOURCE LEAK TEST IS DUE ON OR BEFORE 2/28/2023

Leak test performed by: David Nop

Certified by: Ronald Cardarelli

Ronald Cardarelli, RSO, CN

Date: 8/31/2022

APPENDIX VI. POSITIVE LBP PRESENCE PICTURES

HOLDING TANK



READINGS #24, 25, 26, 27; METAL; YELLOW; HANDRAIL; APPROX. 220 LF

THICKENER



READINGS #32, 33, 34, 35; METAL; YELLOW; HANDRAIL; APPROX. 240 LF

FILTERS AREA



READINGS #56, 57, 58; METAL; YELLOW; HANDRAIL; APPROX. 130 LF

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REPORT

GEOTECHNICAL EVALUATION

NEW WASH WATER STORAGE TANK, NEW SLUDGE THICKENER, AND NEW FILTERS

GUILARTE WATER TREATMENT PLANT REHABILITATION (FAAST)

ADJUNTAS, PUERTO RICO

SB42-25-UT-ADJ



GEO | geotechnical engineering construction materials testing

GEOTECHNICAL EVALUATION

NEW WASH WATER STORAGE TANK, NEW SLUDGE THICKENER, AND NEW FILTERS

GUILARTE WATER TREATMENT PLANT REHABILITATION (LT2) (FAAST)

ADJUNTAS, PUERTO RICO

SB42-25-UT-ADJ

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Prepared for

CA Engineering, PSC
San Juan, PR

December 5, 2025

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Geotechnical engineering

Construction materials testing

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Re: Geotechnical Evaluation for
New Wash Water Storage Tank, New Sludge Thickener, and New Filters
Guilarte Water Treatment Plant Rehabilitation (LT2) (FAAST)
Adjuntas, PR

Dear engineer Ancalle:

We are submitting our report on the geotechnical evaluation for the referenced project. If you have any questions regarding this evaluation or require additional services, please do not hesitate to contact us. We would be pleased to meet with you or your representative for any explanation concerning this evaluation.

We thank you for giving us the opportunity to perform this study.

Cordially,
GEO-Engineering

Carlos E. Rodríguez Pérez, PhD, PE
Geotechnical Engineer

Enclosures

https://geoengineering1413.sharepoint.com/sites/GEO-Engineering/Shared Documents/ProjectsCurrent/SB42-25-UT-ADJ-CAEngineering-GuilarteWFP/9 Reporte/CAEngineering-GuilarteWFP-SB42-25-UT-ADJ.docx

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1.0 GENERAL PROJECT INFORMATION

1.1 Introduction

This report presents the results of the geotechnical evaluation performed for the construction of a New Wash Water Storage Tank, a New Sludge Thickener, and New Filters as part of the rehabilitation of the Guilarte Water Treatment Plant in Adjuntas, PR. Eng. Casiano Ancalle, from CA Engineering, PSC (CAE), San Juan, PR, the project designers, requested this evaluation on behalf of the project owner. Eng. Zoraima Dávila, Senior Project Engineer, from CAE, has been coordinating the project work with us.

The evaluation is based upon soil information obtained from two (2) SPT borings performed at the project site, a site reconnaissance, geologic information from the area, an aerial photointerpretation of the site, and laboratory test results. Information in conjunction with data submitted to this office by Eng. Dávila was also utilized.

1.2 Site and Project Description

The Guilarte Water Treatment Plant (GWTP) is located on the west central part of the Municipality of Adjuntas, PR (Fig. 1). The Guilarte River borders the plant area on the north, east, and south, while a municipal road borders the plant on the west side. State road PR-131

runs nearby west of the plant site. Figure 2 shows views of the plant area.

The project consists of the construction of a New Wash Water Storage Tank (NWWST), a New Sludge Thickener (NST), and New Filters (NF). Figure 3 shows the layout of the GWTP and the schematic location of the new project structures. Figure 2 shows views of the new project structure areas. Figure 3 also includes contour lines defining the existing topography of the plant area. After the fieldwork for the present geotechnical evaluation had been completed, the original concept of the project was modified by canceling the construction of a new holding tank and adding the construction of the NST.

The NWWST will consist of an approximately 18 ft by 18 ft and 35 ft tall structure containing a storage tank at the upper part and equipment and pipes within the structure. Figure 4 shows a plan view and cross-sections of the proposed NWWST. The structure will be founded on four square footings, approximately 9 ft wide. The NWWST will be constructed on an area located outside of the fenced lot of the existing plant (Figs. 2 and 3). The area grades to the northeast. As a result, there is a difference in elevation of approximately 3 to 4 ft where the structure will be built. Also, the area is at a lower elevation than the plant fenced area by about 1 to 4 ft. No information was provided on the FFE of the structure. However, based on the topographic information included in Fig. 3, fill and cuts may be required to level the structure footprint area.

The NST will consist of a circular structure approximately 24 ft in diameter and 24 ft tall. The structure will be founded on a concrete mat

embedded into the ground at a depth of approximately 4 ft. The structure will be constructed at the site of the existing sludge thickener (Figs. 2 and 3), which is smaller in size. Figure 5 shows cross-sections of the existing and new sludge thickeners. The area surrounding the existing sludge thickener is relatively flat.

The NF will consist of three new filters (Filters #1, #2, and #3) and equipment and pipes. Figure 6 shows a plan view and cross-sections of the proposed NF. The structure of the three filters will be rectangular, approximately 24 ft long by 7 ft wide and 9 ft tall. The NF will also include another rectangular structure for piping and equipment (Fig. 6). This structure will be approximately 34 ft long by 8 ft wide and it will be approximately 2.5 ft embedded within the ground. Both structures will be founded on concrete mats. Most of the area where the NF will be constructed contains equipment and piping and it is relatively flat. However, the area where the northern portion of the partially embedded structure will be constructed consists of a slope approximately 7 ft high (Fig. 3).

The plant general area is surrounded by descending slopes about 6 ft high (Fig. 3). Based on the site existing topography, thick fill was deposited to reach the present grade of the plant area. Underground utilities exist within the plant general area. The project areas have been subjected to previous earthwork for the construction of the existing plant.

2.0 SUBSOIL EXPLORATION

2.1 Site Geology

The following table summarizes information on the geology of the site, based on published information by the US Geological Survey (USGS). Figure 7 schematically shows the project site within the corresponding USGS geologic map.

Table 1 - USGS Geological Map Information

Quadrangle: Monte Guilarte	Map ID: I-1556	Published Date: 1984

Type of Deposits

Project area:	Lago Garzas and Anon Formations (TKga) (Tertiary/Cretaceous)
USGS Description:	Interbedded andesite lava flows and volcanoclastic breccia. Thickness: not available
Comments:	The geologic map does not include the presence of alluvial deposits at the project site, even though the plant general area is bordered on the north, east, and south by the Guilarte River. Thick fill and probably alluvial cobbles/boulders were found with the soil exploration performed at the site.

TKga
Lago Garzas and Anon Formations

Faults

☐ N/A	☒ Present Approx. location: 1,150 ft north of the plant site	☐ Prob. Active	☒ Prob. Inactive

2.2 Site Aerial Photointerpretation

The photointerpretation of a site is conducted by comparing aerial photographs taken of the area over a period of several years. These photographs show the broad physical characteristics of the area and help to identify site changes with time. The photointerpretation of a site has become an effective technique to recognize and better define features such as topography, sinkholes, drainage, physical changes made by man-earthmoving operations (cuts and fill), areas of instability, etc.

The evaluation of the general plant area was conducted using aerial photographs spanning a period of several years, from 1993 to 2024. The earliest available data on the site topography was obtained from a 1946 USGS topographic map of the Monte Guilarte general area (Fig. 8). According to this map, the general area where the GWTP was later constructed consisted of an alluvial terrace grading to the east. The general area was bordered on the north, east, and south by a meander of the Guilarte River. The map shows the presence of several structures in the general area. By 1946, the municipal road reaching the plant had not been constructed yet.

The geomorphological setting shown in Fig. 8 can also be observed in the aerial view of Fig. 9, which is an aerial photograph from 1993. By this year, some of the structures within the alluvial terrace shown in the topographic map of Fig. 8 had been demolished and the municipal road presently reaching the plant had been constructed. A bridge was constructed in this road to cross the Guilarte River.

By 2004, the plant had already been constructed (Fig. 10). However, the area of the NWWST was covered with vegetation. Based on the present topography, the construction of the plant required thick fill to raise the elevation of the plant general area.

Figure 11 shows an aerial view of the plant general area in 2017 after Hurricane María hit Puerto Rico. The view shows that the Guilarte River meanders in the plant general area and it is closer to the plant on the south and east sides. The river course contains boulders (as those shown in Fig. 2) and apparent rock outcrops. Based on these findings, it seems that the river meander was formed due to the presence of the rock, and the layer of the alluvial deposits in the alluvial terrace should be relatively thin. The aerial view of Fig. 11 also shows that an earthflow (type of landslide) occurred at the other side of the road near the entrance to the plant. The failed debris covered the road and part of the entrance to the plant. Earthflows may occurred again in this area which may affect again the plant entrance.

The existing geomorphology of the plant area can be better observed in the aerial view shown in Fig. 12, which is a LiDAR-derived Digital Terrain Model taken in 2018. As can be observed in this aerial view, the general area of the GWTP was raised with respect to its surroundings. Thick fill was deposited to reach the present ground elevation. The aerial view also shows that the area for the NWWST had been raised to a lower elevation than the rest of the plant site. Figure 13 presents an aerial view of the plant area in 2024.

Summarizing, the general area of the plant and the areas for the new structures were significantly raised for the plant construction. By comparing the aerial photographs, the plant general area has not undergone significant changes since the plant's construction. Taking into consideration that there were several structures at the site by 1946 (Fig. 8), there exists the possibility that debris and remnants of these structures may exist beneath the existing fill at the project areas.

2.3 Subsoil Conditions

A soil exploration program consisting of two SPT borings (B-1, B-2), accompanied with field and laboratory testing, was performed to obtain information on the subsoil conditions at the project areas. Figure 14 schematically shows the location of the SPT borings. The number and location of the borings was provided by CAE for the original layout of the project. However, as the project original layout was modified to the layout shown in Fig. 3 after the SPT borings had been performed, the tested locations were outside of the footprint areas of the project structures of Fig. 3. In addition, the area of the New Filters (NF) was not included in the original scope of work of this evaluation. As a result, no SPT borings were performed in this area.

The SPT borings were performed with a drill rig. Utility clearance was performed by others for each boring location. The depth of the borings was defined in the field taking into consideration the site reconnaissance, the presence of the underground utilities, and the accessibility to the boring locations. The borings reached refusal (N>50

bpf) due to the presence of boulders or rock. The following table shows the depth reached by the borings:

Table 2 - Summary of Boring Depths

Boring	Depth (ft)
B-1	10 (refusal)
B-2	10 (refusal)

Soil samples from the borings were recovered, identified in the field and laboratory, and subjected to laboratory testing. The recovered soil samples were described and classified following visual-manual procedures in accordance to ASTM D2488 Standard. Appendix 2 provides a brief description of the drilling and sampling procedures utilized. Appendix 4 presents the boring logs as well as field and laboratory test results.

The following table summarizes the fieldwork performed at the site for the subsoil exploration:

Table 3 - Summary of Fieldwork

Type of Test	Quantity
SPT Borings	2
Field reconnaissance	-

One type of materials was found with the borings performed at the project site:

Table 4 - Summary of Materials

Type of Material
Existing fill

Figure 15 shows a schematic soil profile obtained with the borings. The soil profile is a simplified representation of the subsoil and the layer boundaries found at the borings during the drilling operations. Detailed soil descriptions and engineering properties can be found in the attached boring logs.

The following table summarizes the type and approximate depths of the soil layers found with the SPT borings:

Table 5 - Summary of Soil Information from the SPT Borings

Soil Type	Description	Approx. Depth Range
Existing Fill	Recovered mainly as varicolored: • silty SAND (SM), sometimes with gravel • clayey SAND (SC), sometimes with gravel • probably boulder (broken by sampler) N-value: 6->75 bpf Relative density: loose to medium-dense	0 – 10 ft
Comments	The aforementioned depth range of the soil layers may vary at other project locations.	

The existing fill was mainly recovered as varicolored silty sand (SM) and clayey sand (SC), sometimes with gravel. The existing fill had a thickness of approximately 10 ft at the locations of the borings. The Standard Penetration Test (SPT) N-value of the existing fill was variable from 6 to more than 75 blows per foot (bpf), most of them from 6 to 24 bpf. The high N-values of more than 75 bpf were probably due to the presence of boulders/cobbles or in-situ rock. Based on the N-values, the fill seemed to have been subjected to variable compaction and, as a result, it has variable bearing characteristics, sometimes limited.

Thick fill of variable quality was found with the soil exploration

Several soil samples from those recovered with the SPT borings were subjected to laboratory testing to obtain the soil grain-size distribution, the liquid (LL) and plastic (PL) limits, and the plasticity index (PI). The following table shows the test results and the soil classification according to the ASTM D2487 Standard (Unified Soil Classification System, USCS):

Table 6 - Summary of Laboratory Test Results from Selected Soil Samples

Soil	Borings	Depth (ft)	USCS Class.	% Gravel	% Sand	% Fines	Atterberg Limits (%)		
							LL	PL	PI
Existing Fill	B-2	0-2	SC	26.7	46.8	26.5	33	23	10
	B-1	2-4	SM	35.1	45.7	19.2	34	24	10
	B-1	6-8	SC	14.4	44.3	41.3	41	25	16
	B-1	8-10	SC	10.5	43.5	46.0	41	25	16
	B-2	6-8	SM	12.7	58.1	29.2	34	24	10

According to these results, the tested existing fill included silty sand (SM) and clayey sand (SC), sometimes with gravel. The gravel content ranged from about 11 to 35 percent, while the fines content ranged from about 19 to 47 percent. The plasticity index (PI) ranged from 10 to 16 percent, indicating a fine soil with low to medium plasticity.

Groundwater

Not found while drilling the borings

Groundwater was not found while drilling borings. Deep observation wells would be required to reach the groundwater level. Taking into consideration the topographic conditions of the general area, temporary groundwater may appear at localized sectors of the existing fill, especially after periods of rainfall.

The specific conditions encountered at the SPT borings are indicated on the enclosed boring logs (see Appendix 4). The stratification or change lines shown in the logs and in the schematic soil profile of Fig. 15 are based upon visual-manual descriptions of the samples and information recorded on the field logs. For this reason, these lines are approximate and thus schematic. The in-situ transition between various soil/rock types may be gradual. The depths mentioned in the report refer to the existing ground surface at the time of opening the borings.

3.0 GEOTECHNICAL ASSESSMENT

3.1 Foundation Recommendations

The project consists of the construction of a New Wash Water Storage Tank (NWWST), a New Sludge Thickener (NST), and New Filters (NF) (Fig. 3).

The soil profile at the project areas includes the presence of a thick existing fill probably underlain by alluvial deposits (including the presence of cobbles /boulders) and/or in-situ rock. The existing fill seemed to have been subjected to variable compaction (sometimes poor) and, as a result, it has variable and limited bearing characteristics. Taking this into consideration, the existing fill within the footprint area of the structures, laterally enlarged 3 ft on each side, will have to be removed and replaced with new select compacted soil as provided in Section 3.2. The excavations may reach a depth of 8 to 10 ft in some sectors.

On the basis of the soil information obtained with the SPT borings, the excavations to remove the existing fill can be performed with regular equipment (e.g. bulldozers, backhoes, rippers, etc.) although with some difficulties in some sectors. However, there exist the possibility of encountering cobbles and/or boulders within the ground to be excavated that may require the use of jackhammers with compressors and/or large rippers to perform the excavation.

Also, some of the required excavations will be performed close to existing structures. The contractor shall take special care and provisions when performing these excavations to prevent causing damage to these structures.

3.1.1 New Wash Water Storage Tank

The New Wash Water Storage Tank (NWWST) will consist of a structure, approximately 18 ft by 18 ft and 35 ft tall, containing a storage tank at the upper part and equipment and pipes within the structure. The structure will be founded on four square footings, approximately 9 ft wide.

Taking into consideration that the existing fill underlying the structure area will be removed and replaced with select compacted soil, the structure can be founded on the proposed footings constructed within the new compacted fill.

q_{all} = 2.0 ksf
Allowable soil bearing capacity - footings

The footings can be designed for an allowable soil bearing capacity (q_{all}) of 2.0 ksf. A minimum depth of foundation (D_f) of 3 ft shall be provided to the footings. A minimum separation of approximately one footing width shall be established between adjacent footings to reduce the overlapping of applied stresses within the ground.

D_f = 3 ft
Minimum footing depth of foundation

The new structure shall be designed to sustain a total settlement of approximately 1.0 inches and the internal effects caused by a differential settlement (Δs) of approximately 0.5 inches that may tend to develop

between adjacent columns or footings. A site class D can be used for the structure seismic design.

Site Class D
Seismic design

The backfill for the excavation of the footings shall consist of the fill specified in Section 3.2 of this report. The fill shall be placed in layers 3 to 4 inches thick prior to compaction. Each layer shall be compacted to a minimum of 95 percent of its maximum dry density, based on results from Modified Proctor tests performed on representative samples of the soil to be used as fill. The compaction equipment shall consist of tampers, hand-rollers, or vibrating plates. Compaction with this type of equipment normally takes a great deal of time and effort, which should be considered by any bidding contractor.

3.1.2 New Sludge Thickener

The New Sludge Thickener (NST) will consist of circular structure approximately 24 ft in diameter and 24 ft tall. The structure will be founded on a concrete mat embedded into the ground at a depth of approximately 4 ft. The structure will be constructed at the site of the existing sludge thickener (Figs. 2 and 3), which is smaller in size and it will be demolished.

Taking into consideration that the existing fill underlying the structure area will be removed and replaced with select compacted soil, the structure can be founded on the proposed mat constructed within the new compacted fill.

q_{all} = 2.0 ksf
Allowable soil bearing capacity - mat

The mat can be designed for an allowable soil bearing capacity (q_{all}) of 2.0 ksf or a modulus of subgrade reaction (k) of 15 pci. A minimum depth of foundation (D_f) of 12 inches shall be provided to the concrete mat.

k = 15 pci
Modulus of subgrade reaction - mat

A friction coefficient (μ) of 0.42 can be used to estimate the lateral resistance along the concrete mat bottom. The structure and the concrete mat shall be designed to sustain a total settlement of approximately 1.0 inches and the internal effects caused by a differential settlement (Δs) of approximately 0.5 inches that may tend to develop between the mat center and edges. A site class D can be used for the structure seismic design.

Site Class D
Seismic design

Part of the NST structure will be below the ground surface. As a result, the buried portion of the structure walls will be subjected to lateral pressures imposed by the surrounding soil. As the structure will behave as a near-rigid structure, the walls will be partially or completely restrained. Based on this condition, a coefficient of earth pressures at rest (K_o) of 0.47 and a soil unit weight of 120 pcf can be used for the design of the buried portions of the structure walls.

3.1.3 New Filters

The New Filters (NF) will consist of three new filters (Filters #1, #2, and #3) and equipment and pipes. The structure of the three filters will be rectangular, approximately 24 ft long by 7 ft wide and 9 ft tall. The NF will also include another rectangular structure for piping and equipment. This structure will be approximately 34 ft long by 8 ft wide and it will be

approximately 2.5 ft embedded within the ground. Both structures will be founded on concrete mats.

As mentioned in Section 2.3, the area of the New Filters (NF) was not included in the original scope of work of this evaluation. As a result, no SPT borings were performed in this area. Based on the morphology of the site and the soil information from SPT boring B-2, it has been assumed that the area of the NF is also underlain by the existing fill found in boring B-2. Therefore, it is also recommended for this area to remove and replace the existing fill as recommended in Section 3.1. Taking this into consideration, the structures of the New Filters (NF) can be founded on the proposed mats to be constructed within the new compacted fill. The mats can be designed following the foundation recommendations provided for the mat of the New Sludge Thickener (NST).

It is recommended that before proceeding with the construction of the structure, we perform an SPT boring at this area to verify if the actual soil conditions underlying the area are similar to those assumed herein and if the foundation recommendations require modifications depending on the soil conditions found with the boring.

3.2 New Fill

Unless otherwise stated in this report, any fill or backfill required for the project shall consist of the soil specified as fill in Appendix 3. The soil

shall be placed and compacted, following the recommendations provided for fill in this appendix.

Due to the presence of nearby structures, the contractor shall verify which type of equipment to use for the compaction operations to prevent causing damage to the nearby structures (probably compaction equipment without vibration may have to be used in some project sectors).

3.3 Construction Considerations

The following considerations shall be taken into account for the construction of this project. Appendix 3 includes additional recommendations.

1. All earthwork operations in the project shall be conducted under our supervision.

2. All existing underlying utilities (in use or abandoned) shall be removed or relocated from the project loaded areas. Any underground utility not removed or relocated will be subjected to new pressures, which can result in damages to the utility and have an adverse effect on the new structures. The void left by these utilities shall be backfilled with compacted fill as specified in Section 3.2. If any utility has to remain beneath the project

loaded areas, the utility shall be isolated from the loaded areas by structural means.

3. One of our Geotechnical Engineers (or his representative) shall examine the bottom of any excavation to verify its conditions with respect to those obtained with the soil exploration program. Unless otherwise stated in this report, proof-rolling of the excavation bottom may be required depending on the exposed ground conditions (this shall be determined in the field during construction). Any detected soft soil spot, debris, remnants of buried foundations and other parts from previous structures, doubtful fill, or deleterious material within any excavation shall be removed and replaced with compacted fill, as specified in Section 3.2.

4. The project excavations shall be expedited to prevent disturbance of the foundation soils. All excavations shall be performed under dry conditions. The contractor shall take the required provisions to prevent seepage into and accumulation of water (e.g. runoff, percolating water, perched water) in all excavations. The contractor should take into consideration that perched (or running) and/or temporary groundwater may be found when performing the excavations.

5. Any water collected from the roof of any project structure shall be properly disposed of into the storm drainage system of the project. No roof water shall be discharged directly into the ground. The ground surface surrounding the project structures shall be covered with asphalt, or clay of low plasticity, or concrete and be

provided with sufficient gradient to allow runoff drainage away from any structure. No accumulation of water shall be allowed adjacent to any new structure.

6. No trees with a large, thick, superficial root system shall be planted or exist close to any structure. Any tree of this type shall be placed or exist at a minimum distance of 50 feet away from any structure.

7. The new utilities reaching the project structures shall have flexible connections due to the expected total and differential settlements.

8. This report is submitted for the project design, and it includes construction considerations that shall be reviewed by any bidding contractor. However, the bidding contractors shall not use this report as the only information to base their bid for the project. GEO-Engineering shall not be held responsible if the contractors use without limitations the information contained herein. Any bidding contractor should conduct a careful review of the geotechnical data and comments presented in this report. In addition, GEO-Engineering will not be responsible for the contractor's interpretation and conclusions made from this data. The bidding contractor shall visit the project site prior to submitting a bid to become acquainted with the actual site conditions.

9. The contractor shall take care to prevent damaging surrounding structures and utilities due to the construction operations. Claims are frequently presented by owners of properties located adjacent to project areas commonly based on vibration effects derived from the construction operations (especially those due to earthwork equipment). A notarization of an overall evaluation of the conditions of the nearby properties is recommended prior to starting the project construction.

10. The contractor will be solely and completely responsible for his method of construction, his method of excavation, the working conditions at the job site, and the project safety measures. This requirement applies continuously, and it is not limited to normal working hours.

    According to existing regulations, any excavation exceeding a depth of 5 ft must be shored, braced, or be cut with adequate slopes to provide safety to workers. The adequacy of the required shoring or bracing system or the inclination of the excavation walls and the stability of the complete excavation is a responsibility of the contractor.

11. The project owner or designer shall pre-qualify the contractors and/or subcontractors bidding for this project, since the performance of earthwork, the construction of foundations, and their associated activities are all specialized operations.

4.0 GENERAL COMMENTS

4.1 General Comments

1. This report has been prepared to evaluate the project site from a geotechnical point of view and provide geotechnical recommendations for the project design and construction.

2. The scope of this report is limited to the specific project and location described herein.

3. Our description and analysis of the project represent our understanding of the significant aspects relevant to soil/rock characteristics.

4. In the event that any changes in the project are made, we should be informed so that the changes can be reviewed, and the recommendations and conclusions of this report be modified as necessary in writing by us.

5. Geotechnical aspects of design and construction are specialized activities. As a result, we should be consulted and should participate in the preparation of the final design plans and specifications for the project. In addition, we recommend that we be authorized to review the project construction plans and specifications to confirm that the recommendations contained in this report have been interpreted in accordance with our intent. Without this review, we will not be held responsible for the misinterpretation of our data, our analysis, and/or our

recommendations, nor how these are or have been incorporated into the final design.

6. The analysis and recommendations submitted in this report are based upon data obtained from a soil exploration program performed at the site and from any other information discussed in the report. The report does not reflect any soil/rock variations, which may occur between the tested locations and other project locations. If variations appear evident, it will be necessary to re-evaluate the conclusions and recommendations after performing on-site observations during construction and noting the characteristics of the variations.

Submitted by,

GEO-Engineering



Carlos E. Rodríguez Pérez, PhD, PE
Geotechnical Engineer

December 5, 2025
SB42-25-UT-ADJ

https://geoengineering1413.sharepoint.com/sites/GEO-Engineering/Shared Documents/ProjectsCurrent/SB42-25-UT-ADJ-CAEngineering-GuilarteWFP/9 Reporte/CAEngineering-GuilarteWFP-SB42-25-UT-ADJ.docx

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HUBZone
SBA Certified

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Laboratory

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of Engineers®
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Laboratory

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FIGURES

FIGURE 1

Schematic Location of Plant Area – Adjuntas, PR



GEOTECHNICAL EVALUATION

NEW WASH WATER STORAGE TANK, NEW SLUDGE THICKENER, AND NEW FILTERS
GUILARTE WATER TREATMENT PLANT REHABILITATION (LT2) (FAAST)
ADJUNTAS, PR
SB42-25-UT-ADJ

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FIGURE 2

Views of Plant Area



GEOTECHNICAL EVALUATION

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GUILARTE WATER TREATMENT PLANT REHABILITATION (LT2) (FAAST)
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FIGURE 2
(Cont.)

Views of Plant Area



GEOTECHNICAL EVALUATION
NEW WASH WATER STORAGE TANK, NEW SLUDGE THICKENER, AND NEW FILTERS
GUILARTE WATER TREATMENT PLANT REHABILITATION (LT2) (FAAST)
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FIGURE 2
(Cont.)

Views of Plant Area



GEOTECHNICAL EVALUATION
NEW WASH WATER STORAGE TANK, NEW SLUDGE THICKENER, AND NEW FILTERS
GUILARTE WATER TREATMENT PLANT
REHABILITATION (LT2) (FAAST)
ADJUNTAS, PR
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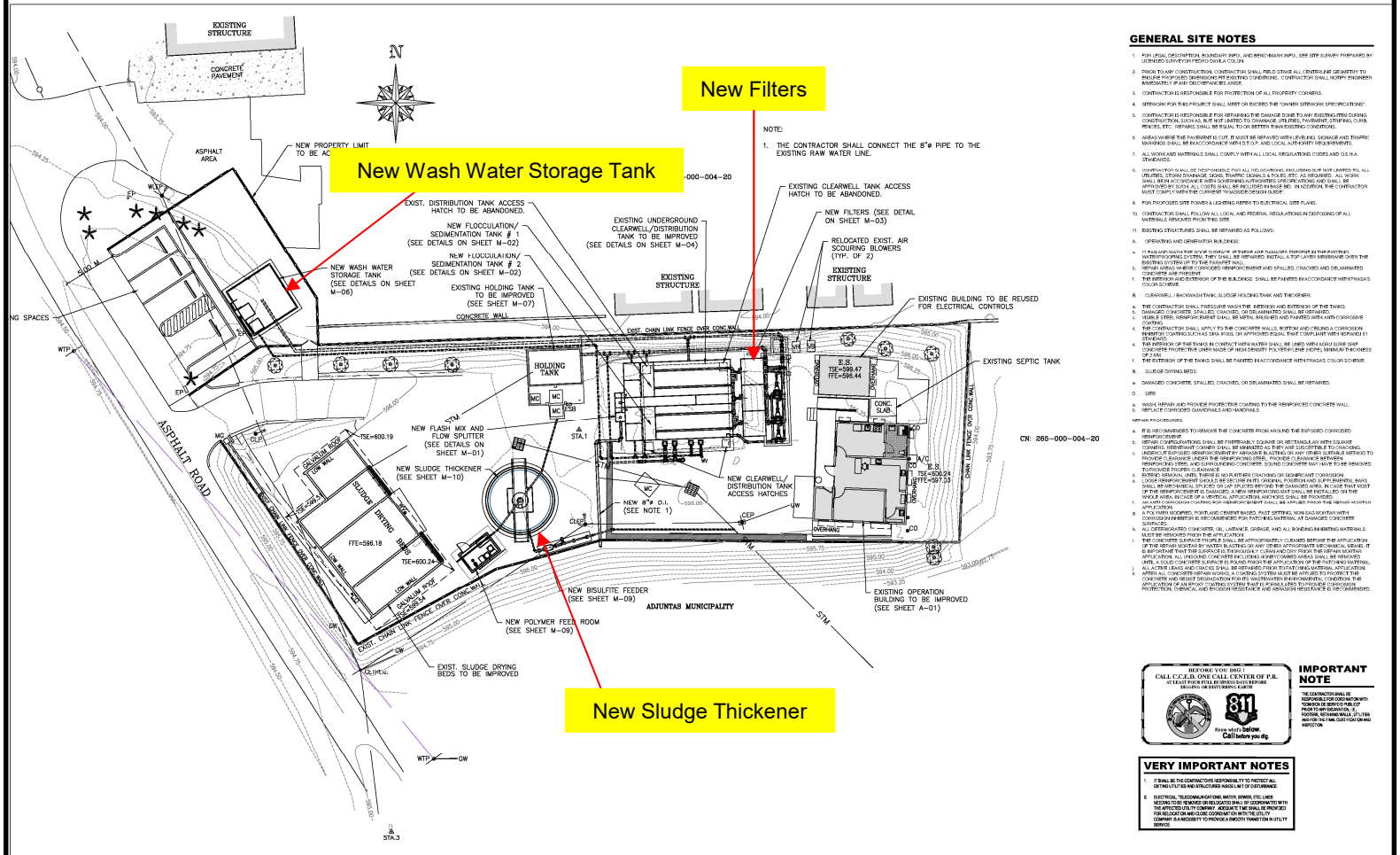
FIGURE 3

Plant Layout and Location of Project Structures



GEOTECHNICAL EVALUATION

NEW WASH WATER STORAGE TANK, NEW SLUDGE THICKENER, AND NEW FILTERS
GUILARTE WATER TREATMENT PLANT REHABILITATION (LT2) (FAAST)
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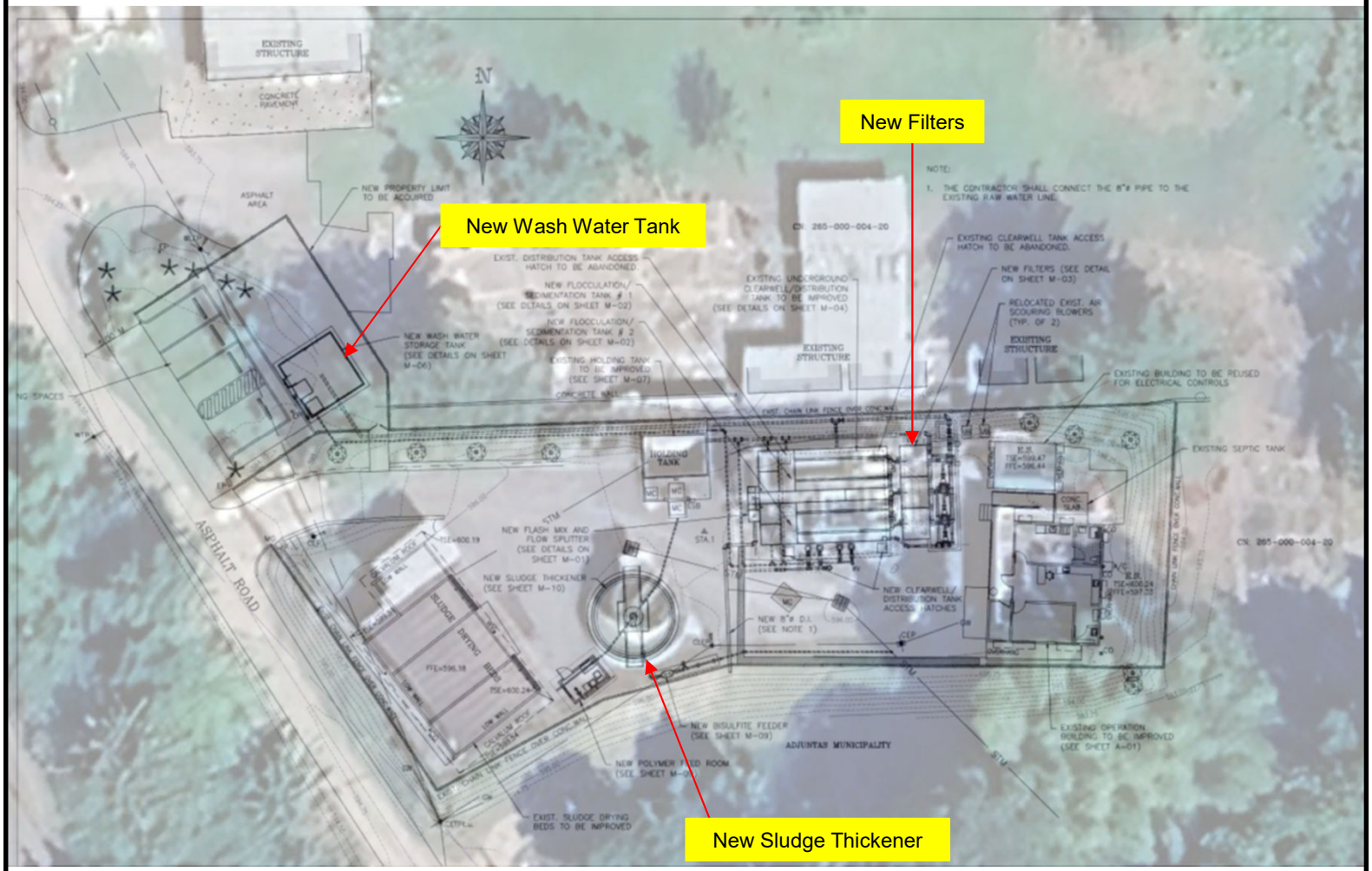
FIGURE 3
(Cont.)

Plant Layout and Location of Project Structures



GEOTECHNICAL EVALUATION
NEW WASH WATER STORAGE TANK, NEW SLUDGE THICKENER, AND NEW FILTERS
GUILARTE WATER TREATMENT PLANT REHABILITATION (LT2) (FAAST)
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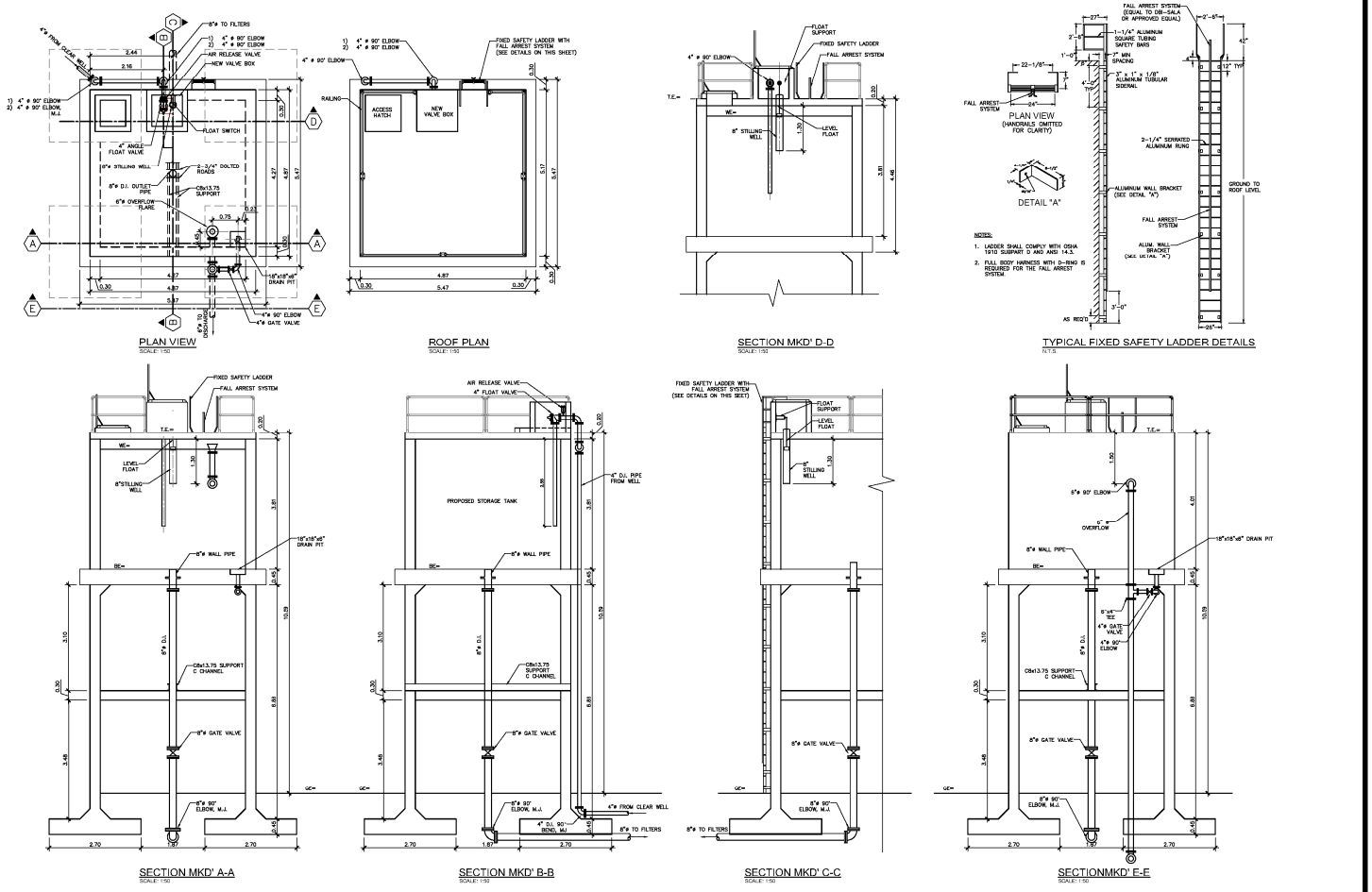
FIGURE 4

New Wash Water Storage Tank



GEOTECHNICAL EVALUATION

NEW WASH WATER STORAGE TANK, NEW SLUDGE THICKENER, AND NEW FILTERS
GUILARTE WATER TREATMENT PLANT REHABILITATION (LT2) (FAAST)
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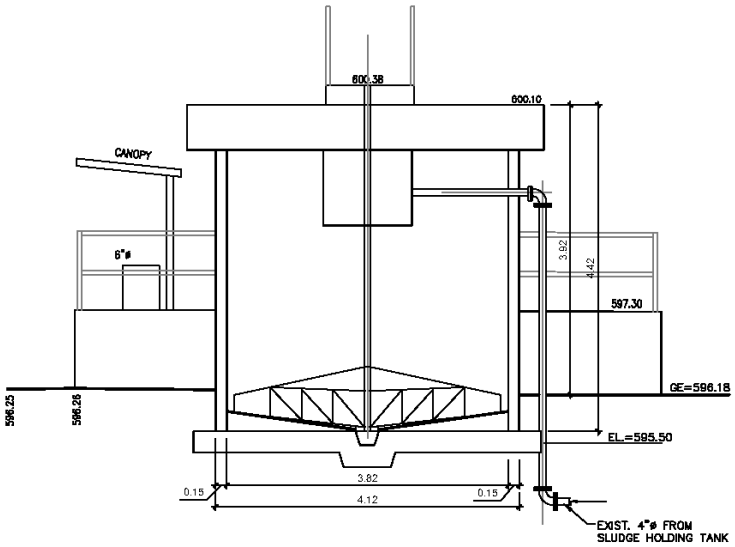
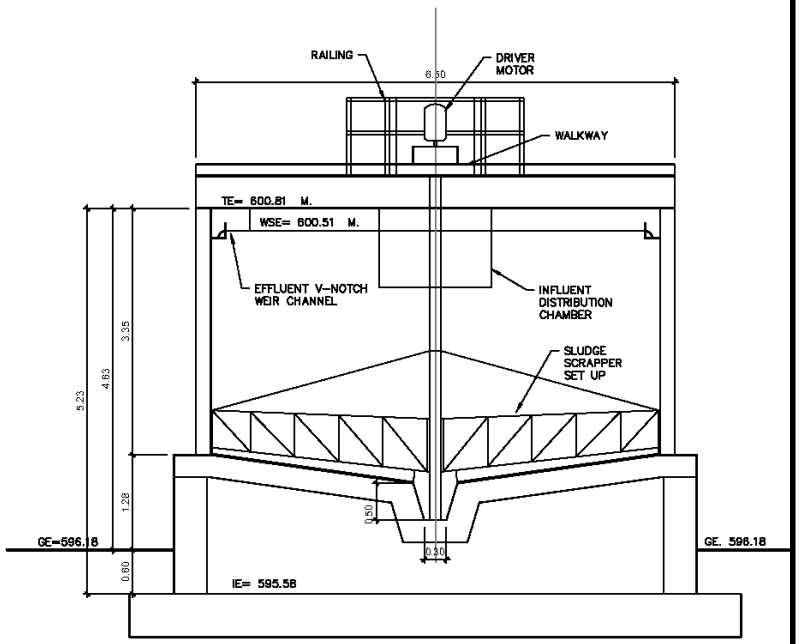
FIGURE 5

Existing and New Sludge Thickener



EXISTING SLUDGE THICKENER



NEW SLUDGE THICKENER

GEOTECHNICAL EVALUATION

NEW WASH WATER STORAGE TANK, NEW SLUDGE THICKENER, AND NEW FILTERS
GUILARTE WATER TREATMENT PLANT REHABILITATION (LT2) (FAAST)
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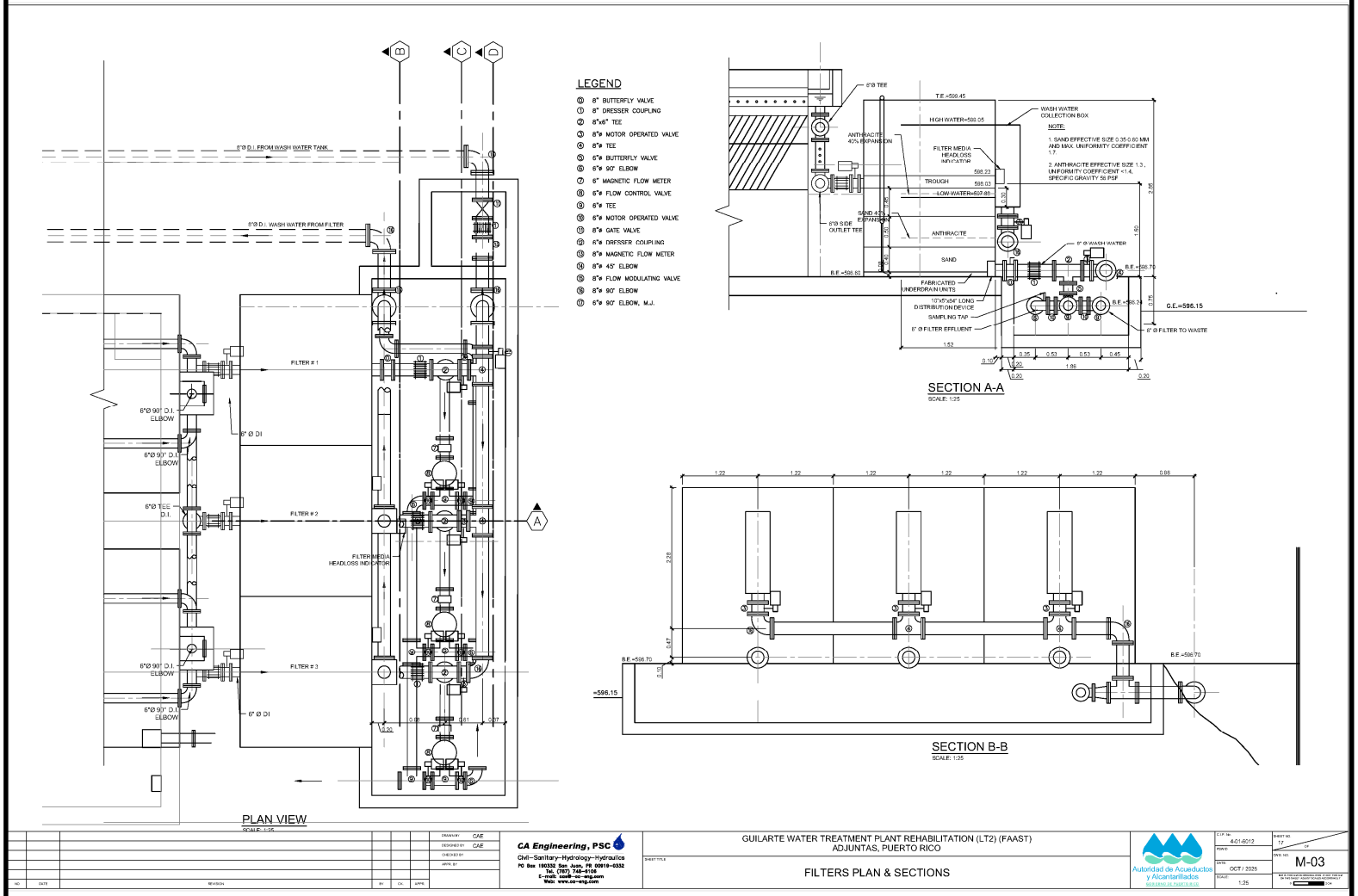
FIGURE 6

New Filters



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NEW WASH WATER STORAGE TANK, NEW SLUDGE THICKENER, AND NEW FILTERS
GUILARTE WATER TREATMENT PLANT REHABILITATION (LT2) (FAAST)
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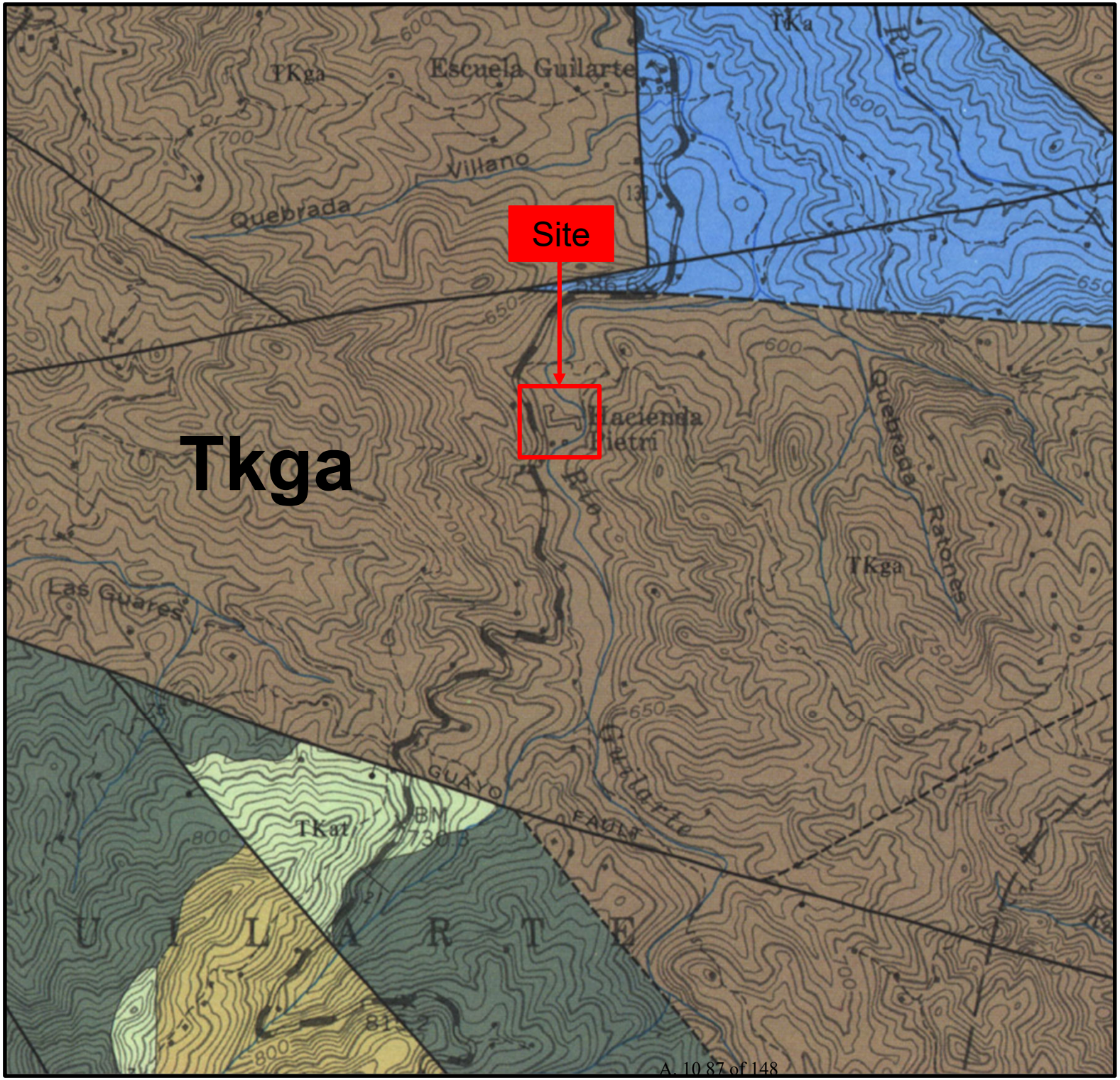
FIGURE 7

Schematic Location of Site on USGS Geologic Map (I-1556)



GEOTECHNICAL EVALUATION

NEW WASH WATER STORAGE TANK, NEW SLUDGE THICKENER, AND NEW FILTERS
GUILARTE WATER TREATMENT PLANT REHABILITATION (LT2) (FAAST)
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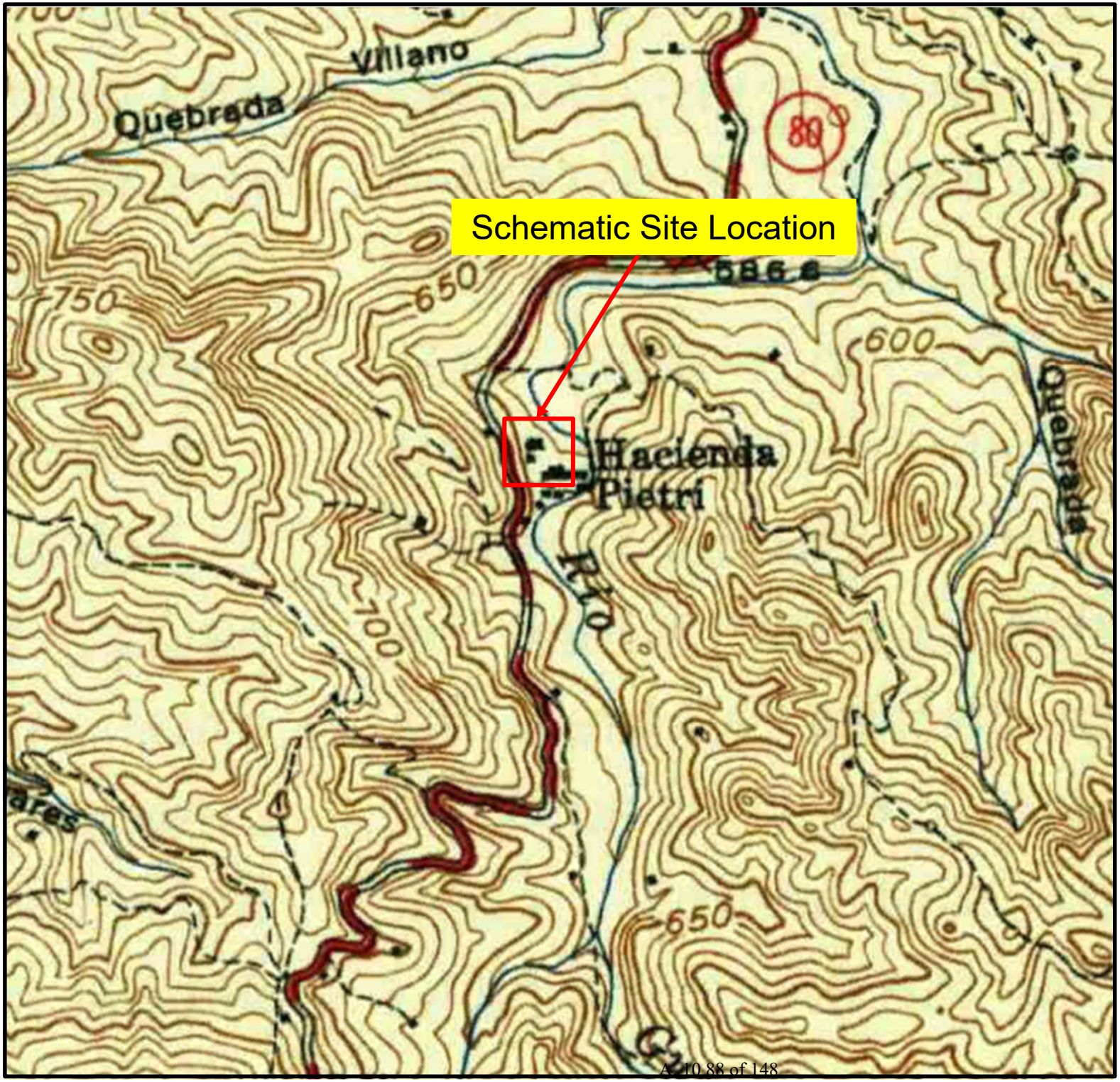
FIGURE 8

Portion of USGS Topographic Quadrangle - 1946



GEOTECHNICAL EVALUATION

NEW WASH WATER STORAGE TANK, NEW SLUDGE THICKENER, AND NEW FILTERS
GUILARTE WATER TREATMENT PLANT REHABILITATION (LT2) (FAAST)
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FIGURE 9

Aerial View of Plant Area - 1993



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FIGURE 10

Aerial View of Plant Area - 2004



GEOTECHNICAL EVALUATION

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FIGURE 11

Aerial View of
Project Area - 2017



GEOTECHNICAL EVALUATION
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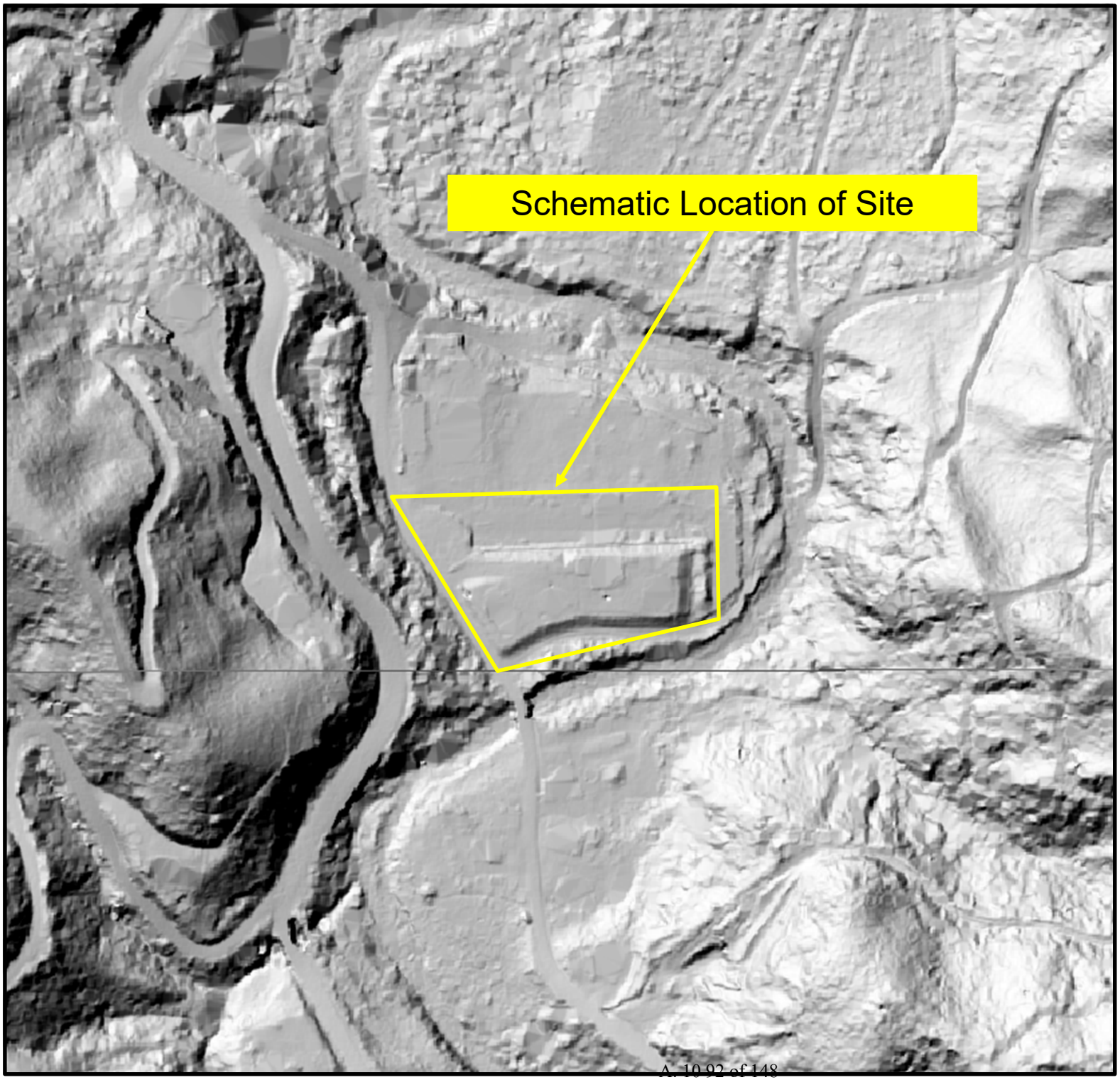

FIGURE 12

Plant Location on LiDAR Map (2018)

GEOTECHNICAL EVALUATION

NEW WASH WATER STORAGE TANK, NEW SLUDGE THICKENER, AND NEW FILTERS
GUILARTE WATER TREATMENT PLANT REHABILITATION (LT2) (FAAST)
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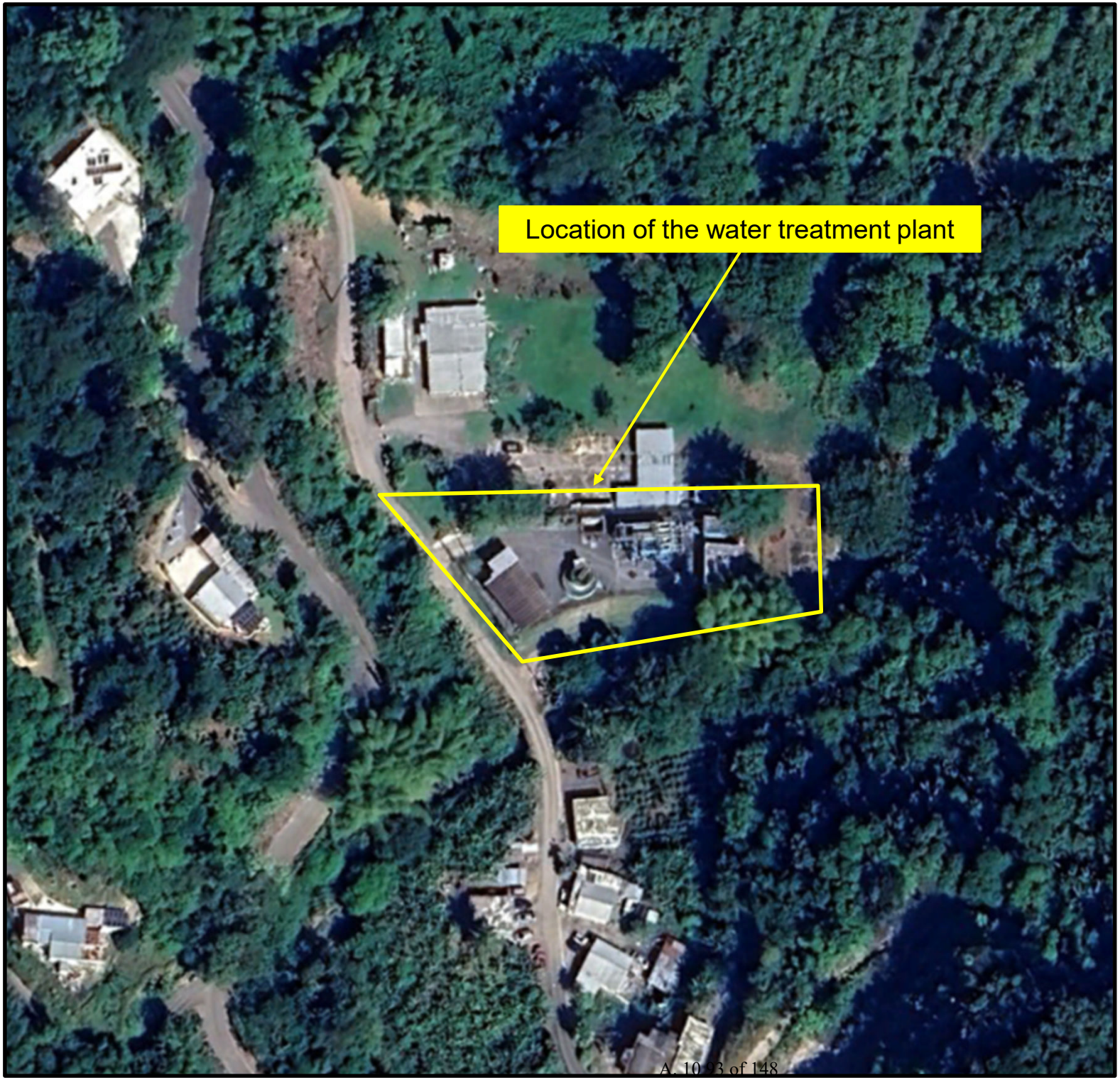
FIGURE 13

Aerial View of Plant Area - 2024



GEOTECHNICAL EVALUATION

NEW WASH WATER STORAGE TANK, NEW SLUDGE THICKENER, AND NEW FILTERS
GUILARTE WATER TREATMENT PLANT
REHABILITATION (LT2) (FAAST)
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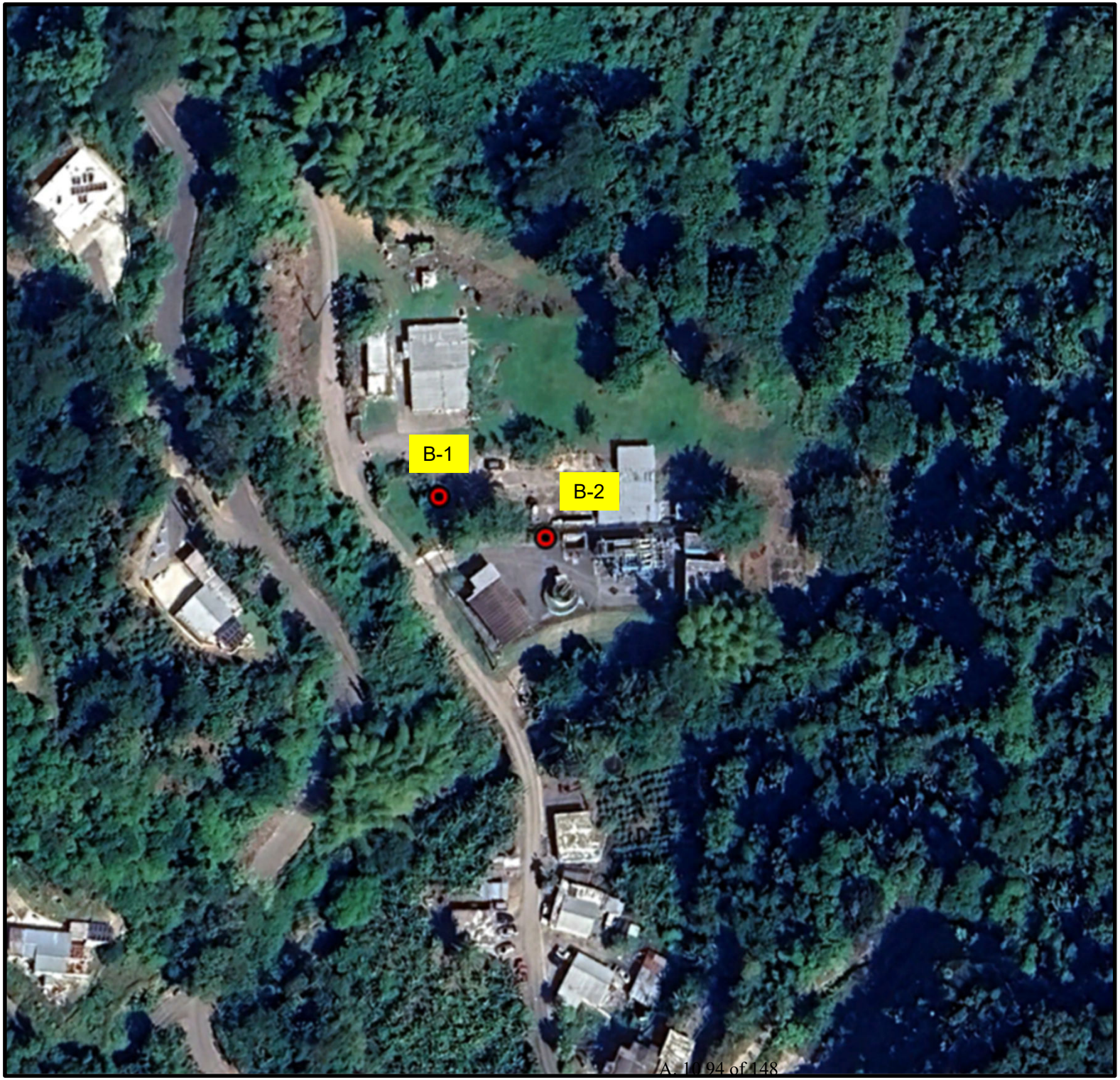
FIGURE 14

Schematic Location of SPT Borings



GEOTECHNICAL EVALUATION

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GUILARTE WATER TREATMENT PLANT
REHABILITATION (LT2) (FAAST)
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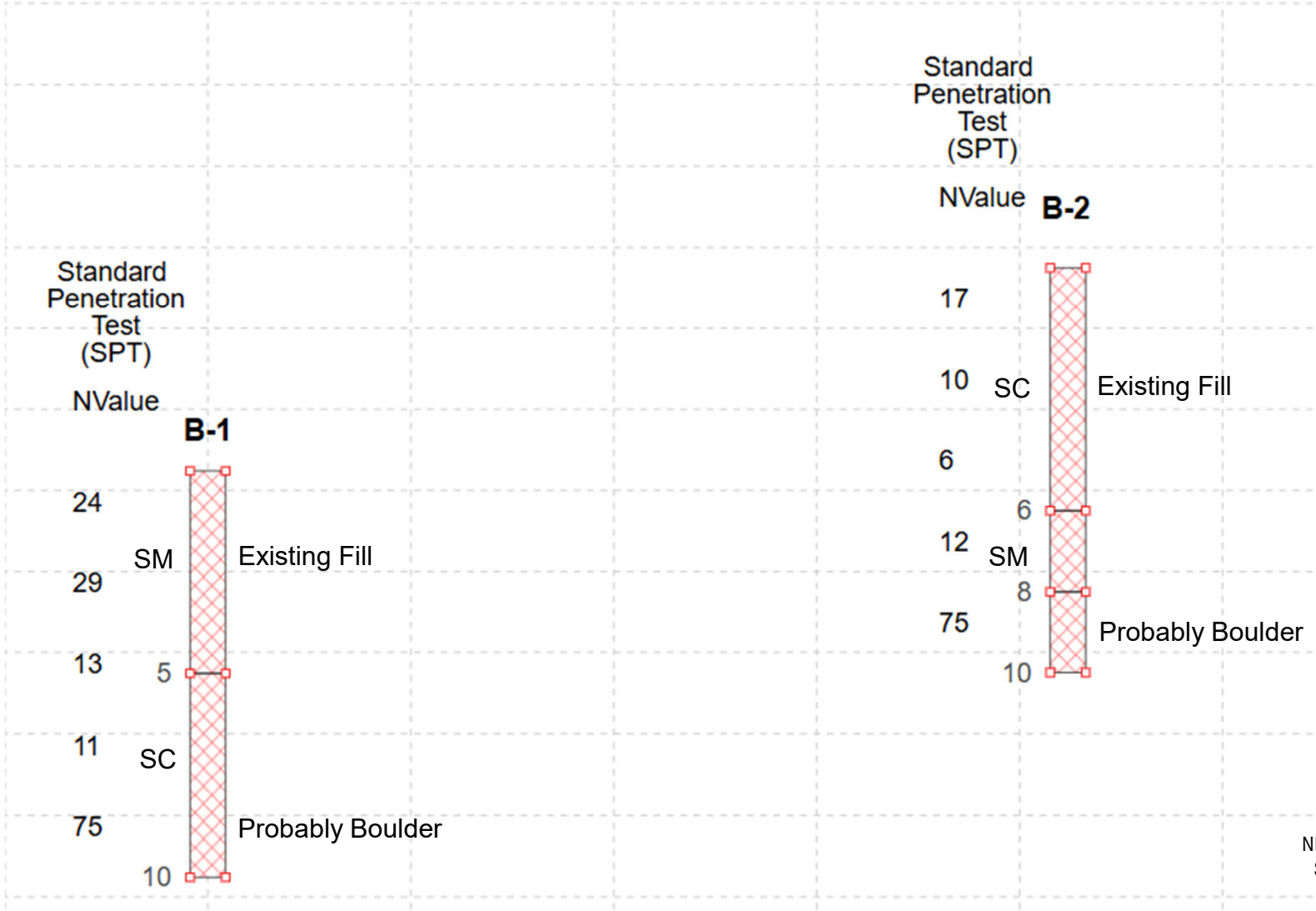
FIGURE 15

Schematic Soil Profile



GEOTECHNICAL EVALUATION

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GUILARTE WATER TREATMENT PLANT REHABILITATION (LT2) (FAAST)
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APPENDIX ONE

Standard Clause for Unanticipated Subsoil Conditions

A1.1 STANDARD CLAUSE FOR UNANTICIPATED SOIL CONDITIONS

This subsurface investigation has been performed by a Geotechnical Consultant, the results of which are contained in the Consultant's report. This report presents the Consultant conclusions on the subsurface conditions based on his interpretation of the data obtained in the investigation. The contractor acknowledges that he has reviewed the Consultant's report and any addenda. It is recognized that a subsurface investigation may not disclose all conditions as they actually exist and further, conditions may change, particularly groundwater conditions, between the time of the subsurface investigation and the construction time of the project. In recognition of these facts, the project contract should provide a means of equitable additional compensation for the contractor if adverse unanticipated conditions are encountered during construction and to provide a means of rebate to the owner if the conditions are more favorable than anticipated.

At any time during construction that the contractor encounters conditions that are different than those anticipated by the Geotechnical Consultant's report, he shall immediately (within 24 hours) bring this fact to the owner's attention. On the other hand, if the owner's representative on the construction site observes subsurface conditions which are different than those anticipated by the Consultant's report, he shall immediately (within 24 hours) bring this fact to the contractor's attention. Once a fact of unanticipated conditions has been brought to the attention of either the owner or the contractor, and the Consultant has concurred, immediate negotiations will be undertaken between the owner and the contractor to arrive at a change in contract for the additional work or reduction in work because of the unanticipated conditions.

APPENDIX TWO

Procedures Summary

A2.1 SAMPLING PROCEDURES AND SPLIT-BARREL SAMPLING

The borings are performed with a rotary-drilling rig provided with hollow-stem augers. Whenever possible, soil/rock samples are obtained from the borings using a 2 in O.D. thick-walled split-spoon sampler in accordance with ASTM Standards. Penetration resistance values are obtained by counting the number of blows required to drive the sampler into the subsoil by means of a 140 lbs hammer falling a distance of 30 inches. The number of blows required for penetration of 12 inches, after an initial seating of 6 inches, is termed the N-value of the Standard Penetration Test (SPT). This value is given in blows per foot (bpf) and used as an indication of the relative density of cohesionless soils (sand and gravel) and the consistency of cohesive soils (clayey soils). The N-value is also used to roughly establish the resistance to penetration of weathered and highly fractured rock. When the subsoil contains rock fragments, however, high N-values may be obtained due to the presence of the rock fragments, but this will not mean that the soil is dense or stiff. The soil/rock samples recovered from the borings are identified in the field and laboratory and subjected to testing.

N-Value and Soil Consistency and Unconfined Compressive Strength Correlations for Fine Grained Soils

N-value (bpf)	Consistency of Cohesive Soils	qu (tsf)
< 2	Very Soft	0 – 0.25
2 – 4	Soft	0.25 – 0.50
4 – 8	Medium	0.50 – 1.00
8 – 15	Stiff	1.00 – 2.00
15 – 30	Very Stiff	2.00 – 4.00
> 30	Hard	> 4.00

N-Value and Soil Consistency Correlations for Cohesionless Soils

N-value (bpf)	Relative Density of Cohesionless Soils
0 – 5	Very Loose
5 – 10	Loose
10 – 30	Medium
30 – 50	Dense
> 50	Very Dense

The soil samples recovered with this procedure are disturbed whereby the soil natural structure is destroyed.

A2.2 AUGER DRILLING

In this drilling procedure, continuous flight augers having open (hollow) or sealed stem are used to advance the boreholes. The open stem

allows the sampling tool to be used without removing the augers from the borehole. Hollow stem augers provide support to the sides of the borehole during sampling operations. Sealed stem augers are used in soils where the sides of the borehole can stand without collapsing.

A2.3 ROTARY DRILLING

In this procedure, a string of rods is rotated while continuous downward pressure is maintained through the rods on a tungsten carbide or diamond bit at the borehole bottom. Water is forced downward to cool the bit. To sample the rock, a core barrel is attached to the string of rods. This barrel is brought to the surface at intervals of 2 to 5 ft and the rock core removed. The quality of the rock is evaluated through the Rock Quality Designation value (RQD), which is defined as the ratio between the total length of rock pieces, 4 inches or longer, and the 5 ft length of the core run. The following correlation is used for the RQD:

RQD and Rock Quality Correlations for Rock Samples

RQD (%)	Rock Quality
90 – 100	Excellent
75 – 90	Good
50 – 75	Fair
25 – 50	Poor
0 – 25	Very Poor

A2.4 DYNAMIC CONE PENETROMETER

Dynamic Cone Penetration (DCP) testing is used to measure the strength of in-situ soil and the thickness and location of subsurface soil layers in shallow foundation soils and pavement layers. DCP testing is conducted by using a 0.625-in.-diam. steel rod with a steel cone attached to one end driven into the soil by means of the impact caused by the drop of a sliding dual mass hammer. The diameter of the cone is 0.16 in. larger than that of the rod to minimize the potential for frictional resistance along the length of the rod. The penetration resistance values are obtained by counting the number of blows required to drive the cone into the subsoil with the impact of the 17.6 lbs hammer falling a distance of 22.6 inches. The resulting penetration resistance is used to estimate soil properties and thickness of soil layers. ASTM Standard D6951 describes the standardized procedures for conducting DCP testing.

A2.5 DYNAMIC PROBING SUPER HEAVY

Super Heavy Dynamic Probing (DPSH-B) is an in-situ test where penetration resistance is measured by driving a solid cone into the ground. The test is performed in accordance with ISO 22476-2 and provides a continuous record of penetration for the depth of exploration. Probing involves the driving of a 90-degree metal cone into the ground using a series of steel rods. These rods are driven into the ground using a drop-hammer system that repeatedly lifts and releases a 140 pounds weigh onto the rods from a height of 30 inches, ensuring a constant energy input. The number of hammer blows required to drive the cone into the ground is recorded. Penetration resistance according to blows

per 12 inches and dynamic cone resistance (q_d) are obtained and a comparative assessment is made from which correlations with engineering parameters can be generated.

A2.6 LABORATORY TESTING

Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) ASTM D2488 - Soil samples are described according to their constituents, texture, and plasticity. Granular soils are coarse-grained soils (gravel and sand). Clays and silts are fine-grained soils, which possess (or may not as in the case of non-plastic silts) cohesion and plasticity.

Standard Test Methods for Lab Determination of Water Content of Soil ASTM D2216 - The water content of a soil is the ratio of the weight of water in a given soil mass to the weight of the dry soil. Water content is expressed in percentage.

Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils ASTM D4318 – These tests are utilized to characterize the fine-grained portion of a soil sample. The determined Liquid and Plastic limits are used in combination with the water content to express the relative consistency of the sample. Liquid and Plastic Limits as well as the Plasticity Index are expressed as a percentage.

Unconfined Compressive Strength (q_u) - This strength is determined by subjecting a cylindrical sample of cohesive soil to axial loading or by means of a hand penetrometer test, a test that has been carefully correlated with cylindrical tests results.

APPENDIX THREE

General Earthwork Recommendations

A3.1 GENERAL EARHTWORK RECOMMENDATIONS (WHERE APPLICABLE PER MAIN REPORT)

The construction of any fill should be made under strict controlled conditions, whereby the fill material shall be placed in layers and properly compacted to support the superimposed loads.

A3.1.1 Site Preparation

A3.1.1.1 Clearing and Grubbing

All trees, brush, stumps, logs and tree roots shall be removed and disposed of from the building areas.

A3.1.1.2 Stripping

Stripping will be conducted in all excavation and fill areas. Topsoil will be removed. Any artificial fill or rubbish, organic, or other deleterious material, such as concrete debris, encountered in the stripping operations will be removed to its full depth and be disposed of. Also, if soft spots of soil show up during construction, they will have to be removed.

Below are guidelines for estimating volumes of soil after extraction:

[*Table on following page*]

Swell Factors for Soils

Material Type*	Comparable Soil Group USCS	Swell Factor (%)*
Clay, Damp	CL, CH, ML, MH	67
Decomposed Rock		
50% Rock, 50% Earth	GW, GP, SW, SP	38%
25% Rock, 75% Earth	GM, GC	43%
Earth Loam, Damp	SM, SC	43%

*Reference, **FHWA Earthwork Design Exhibit 5.1**

A3.1.1.3 Repurposing of Excavated Soil

Material excavated as part of Clearing and Grubbing, Stripping operations and material required to be removed and replaced within the main body of the Geotechnical Report shall be removed from the project site, properly disposed, and cannot be used as fill at the project site. Any other excavated soil that has been mixed with material from any these operations shall not be used as fill within the project site. Any other soil excavated from within the project site that is intended to be used as fill within the project site shall comply with the specifications for fill provided in Section A3.1.2.

A3.1.1.4 Fill Areas

Prior to placing fill on any area, grading is to be performed as required to provide for drainage. Proof-rolling of the exposed excavated area may be required, depending on the soil exposed conditions.

A3.1.2 Placement and Preparation of Fill (where applicable)

Once the above recommendations are fulfilled, the filling operations to reach the final grade can be started. Adequate grading shall be provided at all times to avoid accumulation of run-off along the ground surface. Filling must be conducted so that no obstruction to drainage is created at any time. Sumps, if any, will be continuously maintained in effective operating conditions.

Unless otherwise specified in this report, any fill material to be placed above the groundwater level shall consist of **GW**, **GP**, **GM**, **GC**, or **SC** soil (based on the Unified Soil Classification system, USCS; approximately **A-2-4** or **A-2-6** soil, based on AASHTO Soil Classification System) **having a maximum fine content of 40 percent** and a **maximum plasticity index of 20 percent**. The SC soil will be probably more difficult to compact and it may require more time and passes of the compacting equipment to reach the desired compaction. The use of relatively clean sand shall be avoided. The specified material can also be used for a fill to be subjected to submergence, but the fraction of the soil passing the Sieve No. 200 shall not exceed 12 percent and the plasticity index shall not exceed 10 percent. Stones larger than six (6) inches shall be removed from the fill before compacting. The fill shall be distributed prior to compaction in layers not exceeding eight (8) to ten (10) inches thick (3 to 4 inches thick if compacted with tampers, hand rollers or vibrating plates, such as the backfill for the excavation of footings and of retaining walls), and uniformly compacted with a minimum degree of compaction of 95 percent (90% for parking areas)

of the fill material maximum dry density, as obtained from laboratory soil compaction tests made by the Modified Proctor Method on representative samples from the fill. Fill deposition shall start at the lowest contour line in a horizontal manner. Several passes of the compacting equipment will be required to reach the desired degree of compaction. An overlapping of approximately 30 percent should occur between passes to prevent segregation of the soil.

It will be the responsibility of the Resident Engineer to instruct the Geotechnical Engineer, retained by the project owner, to determine the optimum moisture content and the corresponding dry density of every type of fill material to be used by the contractor. This information will serve to properly evaluate the percentage of compaction attained by the fill material in the field.

Material incorporated in the fill, which is not in satisfactory condition, shall be subject to rejection and removed to the inspecting Geotechnical Engineer satisfaction.

The water content of each fill layer shall be suitable for compaction or shall be brought to a suitable condition by aeration or addition of water in a uniform manner. Previously approved compacted layers exposed to rainfall shall be brought to a suitable water content condition by aeration or scarification and re-tested, and re-compacted if necessary, prior to depositing a new soil layer.

Unless otherwise stated in the main report, the compaction of the fill can be performed with vibratory smooth rollers. However, the GC and SC fill containing 35 percent or more of clay may require sheepsfoot rollers to achieve the desired degree of compaction.

If the project construction operations are performed during or after rainy periods, difficult working conditions will be likely encountered to start the clearing and stripping operations of the topsoil of the area. Commonly, clayey and silty soils become sticky and soft when wet. The contractor should consider this in his bid for the project.

A3.1.3 Slopes (when applicable)

Unless otherwise specified in this report, all earth slopes (either on fill or cut) shall have a sloping ratio of 2:1 (Horizontal:Vertical, H:V). They shall be protected, as will be all permanent cuts, from the effects of erosion by placing, unless otherwise specified in this report, a suitable type of fixing grass or any open-mesh-type of fabric used in conjunction with either straw, mulch, wood pieces, or coconut fiber. Initial maintenance of the fill and cut slopes and their protection shall be continued until stabilization has been assured. It is possible that shallow slope failures or channels caused by erosion may develop in the slopes (either on fill or cut). These shall be promptly fixed to prevent progressive worsening that may lead to large slope failures.

Careful procedures shall be observed in the construction of any slope. All fill slopes shall be compacted to the required degree of compaction. The contractor shall take the required provisions to comply with this.

Otherwise, the slopes may undergo instability problems. One way to get proper compaction is to extend the compacted fill further than the area to be filled, and carefully cut the excess of fill after compaction. By so doing, the exposed face of the slope will consist of compacted soil.

Drainage paths (concrete or paved ditches) should be provided along the toe of the slopes at suitable gradient to drain surface water coming from the slopes. There exists the possibility that moisture or temporary groundwater due to runoff percolating at upper grounds may daylight at fill and/or cut slopes or at the ground surface close to the slope toe. If this condition develops, an intercepting deep drain will be required to collect this water before reaching any nearby structure.

Any relatively flat surface behind a slope shall be graded in such a way as to collect the runoff and conduct it to the storm drainage system of the project. No runoff from these areas shall be discharged onto any slope, nor shall water be allowed to pond on these surfaces or on any fill area.

Where fill will be deposited on the hillside of existing slopes, the slopes of the original ground, upon which the fill is to be placed, shall be plowed or scarified deeply, and where the slope ratio of the original ground is steeper than 5:1 (H:V), the bank shall be stepped or benched in accordance to the following criteria:

- For slopes of the original ground ranging from 1:1 to 5:1 (H:V), the maximum vertical spacing between benches shall be six (6) feet.

- For ground slopes ranging from 1:1 to 3:1 (H:V), the minimum bench width shall be six (6) feet; for slopes ranging 4:1 to 5:1 (H:V), the minimum bench width shall be eight (8) feet.

Unless otherwise specified in this report, high slopes (either in fill or cut) shall be constructed with terraces not less than 2 m wide and placed at a vertical spacing of about 5 to 6 m. A concrete gutter (swale) shall be installed at these terraces along the toe of the resulting slopes to intercept their runoff. This gutter shall be connected to the storm drainage system of the project.

APPENDIX FOUR
Boring Logs and Laboratory Results

TEST HOLE LOG: B-1

LOGGED BY: S. Franqui
REVIEWER: G. Martínez
ADDRESS: Monte Guilarte, Adjuntas PR
LONG: -66.77181
LAT: 18.17221
Foreman: I. Gonzalez
ELEVATION: 1950.48 ft
WATER DEPTH (FT): N/A
COMPLETION DEPTH (FT) 10
DATE: 2025-09-03

Depth FT	Depth M	Lithologic Description	Symbol	Boring Method	Samples	Blows 00" - 06"	Blows 06" - 12"	Blows 12" - 18"	Blows 18" - 24"	Standard Penetration Test (SPT)	Soil Classification	Atterberg Limits LL (%)	Atterberg Limits PI (%)	qu (tsf)	Moisture (%)
		Ground Surface EL 1950.48 ft													
0	0	Existing Fill silty SAND with gravel (SM); mostly fine- to coarse-grained sand, medium-dense; some silt; little hard angular fine- to coarse gravel; moist, dark brown		Auger (Solid-Stem) (2.25 in) Grizzly	1	5	15	9	7	24					8
3	1				2	13	15	14	6	29	SM	34	10		16
5		5 ft EL 1945.48 ft			3	7	7	6	6	13				1.00	20
7	2	clayey SAND (SC); mostly fine- to coarse-grained sand, medium-dense to very dense; some low to medium plasticity clay; few hard angular fine to coarse gravel; mottled, moist, yellowish brown to brown			4	5	5	6	5	11	SC	41	16		24
9		(Probably Boulder)			5	19	19	50/ 2"	-	>75	SC	41	16		17
10	3	10 ft EL 1940.48 ft Test Hole Terminated at 10 ft due to refusal of SPT Sampler and HSA													

RSLog / Boring Log Template / geo-engineering / avalle / November 19, 2025 08:14 AM

GEO geotechnical engineering construction materials testing

PROJECT TITLE: New Holding Tank and New Wash Water Storage Tank Improvements to Guilarte WFP
CLIENT: CA Engineering, PSC
PROJECT NO.: SB42-25-UT-ADJ
SHEET: 1 of 1

TEST HOLE LOG: B-2

LOGGED BY: S. Franqui
REVIEWER: G. Martínez
ADDRESS: Monte Guilarte, Adjuntas PR
LONG: -66.77158
LAT: 18.17213
Foreman: I. Gonzalez
ELEVATION: 1955.5 ft
WATER DEPTH (FT): N/A
COMPLETION DEPTH (FT) 10
DATE: 2025-09-03

Depth FT	Depth M	Lithologic Description	Symbol	Boring Method	Samples	Blows 00" - 06"	Blows 06" - 12"	Blows 12" - 18"	Blows 18" - 24"	Standard Penetration Test (SPT)	Soil Classification	Atterberg Limits LL (%)	Atterberg Limits PI (%)	qu (tsf)	Moisture (%)
		Ground Surface EL 1955.5 ft													
0	0	Fill Material		Auger (Solid-Stem) (2.25 in) Sol Solution - Grizzly	1	9	7	10	6	17	SC	33	10	1.00	14
1		clayey SAND with gravel (SC); mostly fine- to coarse-grained sand, medium-dense, some very stiff clay, little hard sub-angular gravel, moist, dark brown			2	6	6	4	4	10				2.75	11
2	1				3	3	4	2	4	6					10
6 ft EL 1949.5 ft															
7	2	silty SAND (SM); mostly fine- to coarse- grained sand, loose to medium-dense; some silt; few hard angular fine to coarse gravel, mottled, moist, grayish red			4	6	6	6	16	12	SM	34	10		10
8 ft EL 1947.5 ft															
9		(Probably Boulder)			5	50/ 2"	-	-	-	>75					
10 ft EL 1945.5 ft															
10	3	Test Hole Terminated at 10 ft due to refusal of SPT Sampler and HSA													
11															
12															
13	4														
14															
15															
16															
17	5														
18															
19															
20	6														
21															
22															
23	7														
24															
25															
26	8														
27															
28															
29															
30	9														
31															
32															

RSLog / Boring Log Template / geo-engineering / avalle / December 05, 2025 03:34 PM

GEO geotechnical engineering construction materials testing

PROJECT TITLE:
New Holding Tank and New Wash Water Storage Tank Improvements to Guilarte WFP

CLIENT:
CA Engineering, PSC

PROJECT NO.:
SB42-25-UT-ADJ

SHEET:
1 of 1

GEO | geotechnical engineering construction materials testing

Sample Soil Pickup

Report #: 001

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Field Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

FIELD DATA

No. of Samples / Sets: 3
Sample Source / Location: Boring / In-Situ
Boring No: B-1 **Depth (ft):** 2-4ft
Sample Description / Classification: 10YR 4/3 Dark Brown

SUMMARY OF WORK PERFORMED

LAB TEST SUMMARY

No	Test	Test Method	Status
001-L1	Sieve Test	ASTM D422 (Sieve)	Completed
001-L2	Atterberg (ASTM4318 / AASHTO T89 & 90)	ASTM D4318	Completed
001-L3	Wash 200 Analysis (ASTM D1140/D2216)	ASTM D1140	Completed

Note: All completed lab tests are attached below.

Report Copied to: Casiano Ancalle

Representative/Inspector: GEO FIELDTECH

CARLOS E. RODRÍGUEZ PÉREZ
INGENIERO LICENCIADO
LIC. #10034
PUERTO RICO

Carlos E Rodriguez

GEO-Engineering
Date Signed: 10/02/2025 05:54 PM

Notes: As requested, a representative from our company arrived on site as scheduled and performed the above test. These test results apply only to the specific locations noted and do not represent any other location. Reports may not be reproduced except in full, without permission.

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Sieve Test

Report #: 001-L1

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Sample Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

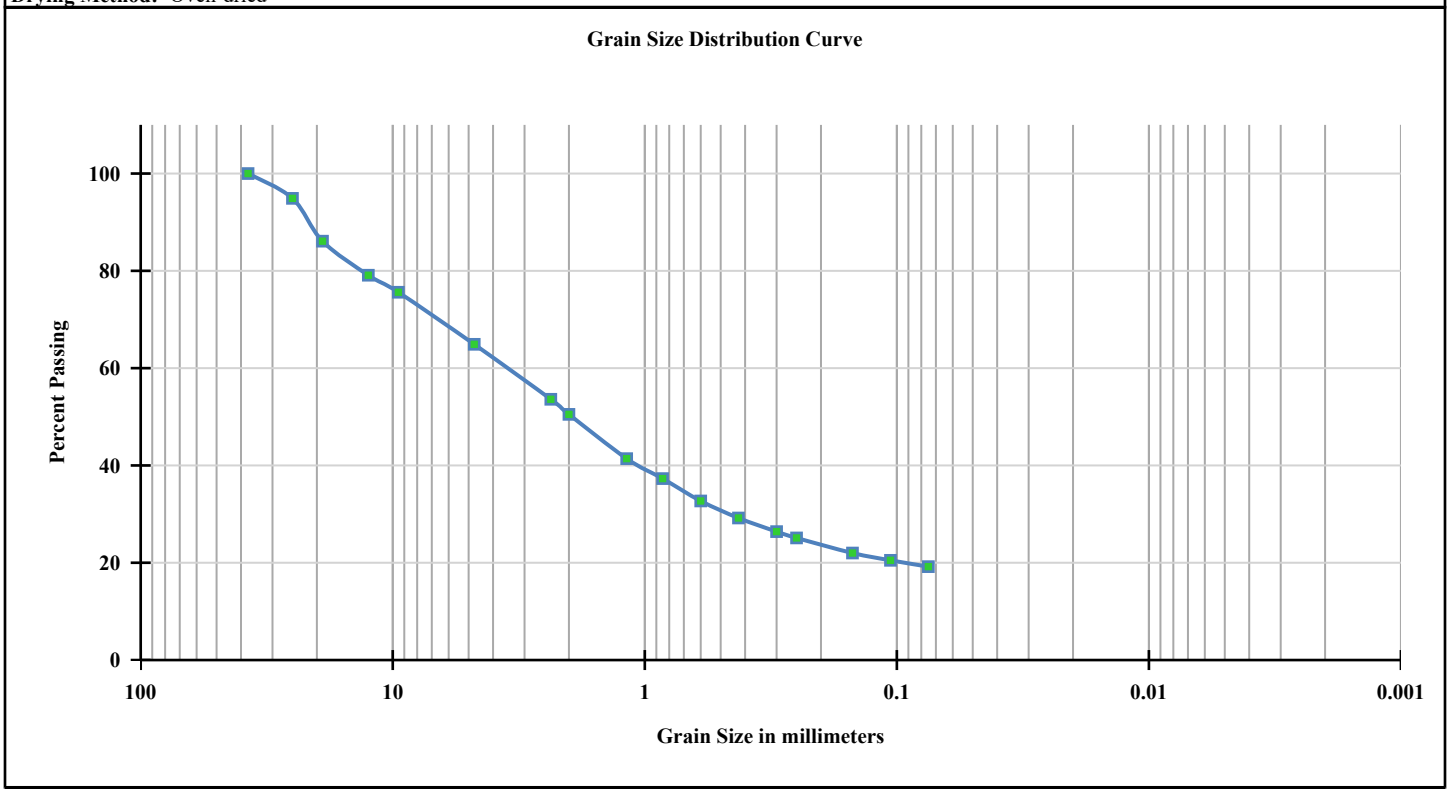
SAMPLE DATA

Boring No: B-1 **Depth (ft):** 2-4ft
Test Procedure: ASTM D422 (Sieve)
Sample Source / Location: Boring / In-Situ
Sample Description / Classification: 10YR 4/3 Dark Brown

SIEVE ANALYSIS AND TEST RESULTS

Tare Wt (g)	271.5	**Tare #**	108	**Moisture Content (%)**	19.08			**Dry Wt.+ Tare (g)**	747.4
Water Wt	19.08	**Wet Wt.+ Tare (g)**	838.2	**Dry Wt (g)**	475.9				
Sample Washed	X Yes ☐ No	**Dry Wt.+Tare after Wash**	656.9	**Weight of Soil After Wash**	385.4	**Wash Loss**	90.5	**Passing #200 from Wash**	19.02

Drying Method: Oven-dried



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Sieve Test

Report #: 001-L1

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Sample Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

Sieve Sizes	Wt. Retained (g)	% Retained	% Passing	Spec Limits
1-1/2 in (37.5mm)		0	100	
1 in (25mm)	24.4	5.1	94.9	
3/4 in (19mm)	66.3	13.9	86.1	
1/2 in (12.5mm)	99.5	20.9	79.1	
3/8 in (9.5mm)	116.2	24.4	75.6	
#4 (4.75mm)	167.1	35.1	64.9	
#8 (2.36mm)	220.8	46.4	53.6	
#10 (2mm)	235.7	49.5	50.5	
#16 (1.18mm)	278.7	58.6	41.4	
#20 (0.85mm)	298.4	62.7	37.3	
#30 (0.6mm)	320.5	67.3	32.7	
#40 (0.425mm)	336.8	70.8	29.2	
#50 (0.3mm)	350.3	73.6	26.4	
#60 (0.25mm)	356.3	74.9	25.1	
#100 (0.15mm)	371	78	22	
#140 (0.106mm)	378.4	79.5	20.5	
#200 (0.075mm)	384.7	80.8	19.2	

Material

% Gravel	% Sand	% Fines
35.1	45.7	19.2

Atterberg Limits

PL = 24 LL = 34 PI = 10

Coefficients

D_{60} = 3.71 D_{10} = Cc =
D_{30} = 0.46 Cu =

Soil Classification

USCS	AASHTO
USCS (ASTM D2487) : SM	A-2-4
Silty sand with gravel	

Report Copied to: Casiano Ancalle

Lab Representative: GEO LABTECH
Cert No: BN# 3242 / TN# 9687

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Notes: The results above apply only to the specific samples noted using the aforementioned test method(s) and do not represent any other sample. Reports may not be reproduced except in full without permission.

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Atterberg (ASTM4318 / AASHTO T89 & 90)

Report #: 001-L2

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Sample Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

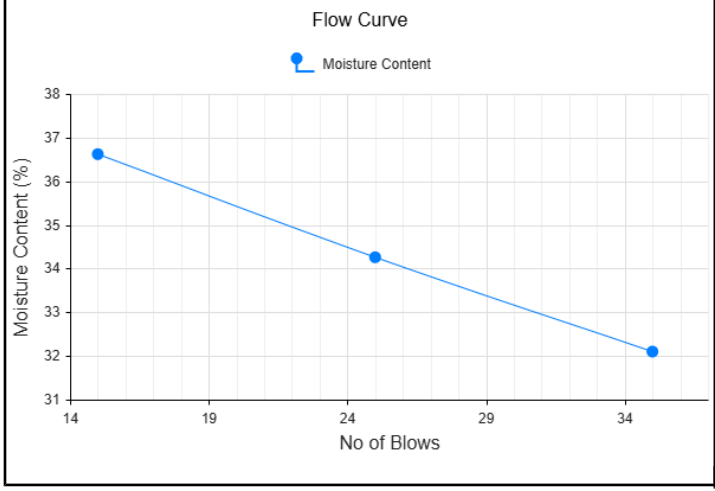
SAMPLE DATA

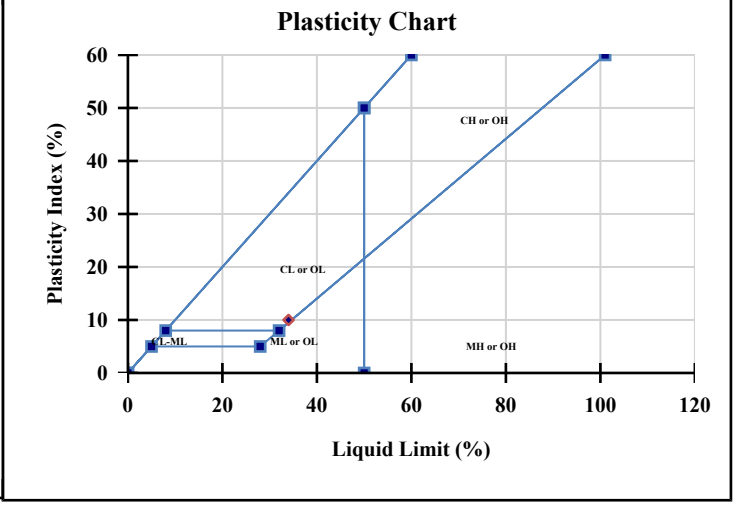
Test Procedure: ASTM D4318
Boring No: B-1 **Depth (ft):** 2-4ft
Sample Source / Location: Boring / In-Situ
Sample Description / Classification: 10YR 4/3 Dark Brown
Soil Description:
Specimen Preparation: Dry (Air) **Mixing Water:** Distilled
Method of Removing Particles > #40 sieve: Dry Sieved on No 40 Sieve

ASTM D4318 / AASHTO T89 & 90

	Liquid Limit (s)			Plastic Limit (s)	
	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2
Number of Blows	35	25	15		
Tare No.	6	14	16	32	33
Tare Mass (g)	31.19	31.58	31.24	31.26	31.42
Tare + Wet Soil (g)	53.95	53.33	55.9	41.37	41.64
Tare + Dry Soil (g)	48.42	47.78	49.29	39.41	39.61
Mass of Dry Soil (g)	17.23	16.2	18.05	8.15	8.19
Mass of Water (g)	5.53	5.55	6.61	1.96	2.03
Moisture Content (%)	32.1	34.26	36.62	24.05	24.79

Liquid Limit (LL): 34
Plastic Limit (PL): 24
Plasticity Index (PI): 10
Non-Plastic: [ ] Yes [X] No
Retained #40 Sieve (Estimate)(%):
Rolling Procedure: Hand Rolled
Liquid Limit Apparatus: Mechanical
Casa Grande Grooving Tool: Metal
Soil Classification:





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Atterberg (ASTM4318 / AASHTO T89 & 90)

Report #: 001-L2

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Sample Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

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Lab Representative: GEO LABTECH
Cert No: BN# 3242 / TN# 9687

Carlos E Rodriguez

GEO-Engineering
Date Signed: 10/02/2025 05:54 PM

Notes: The results above apply only to the specific samples noted using the aforementioned test method(s) and do not represent any other sample. Reports may not be reproduced except in full without permission.

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Wash 200 Analysis (ASTM D1140/D2216)

Report #: 001-L3

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Sample Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

SAMPLE DATA

Boring No: B-1 **Depth (ft):** 2-4ft
Sample Source / Location: Boring / In-Situ
Sample Description / Classification: 10YR 4/3 Dark Brown
Test Procedure: ASTM D1140

MOISTURE CONTENT & PERCENT FINES (ASTM D1140/D2216)

MOISTURE CONTENT & PERCENT FINES		
Pan #	108	
Pan Weight (g)	271.5	
MOISTURE CONTENT		
Wet Weight (g)	838.2	566.7
Original Dry Mass (g)	747.4	475.9
Moisture Percent (%)	19.08	
PERCENT FINES		
Dry Weight (g)	747.4	475.9
Dry Mass Retained on the (No. 200)	656.9	385.4
Percentage of material finer than the 75-µm (No 200) (%)	19.02	
Recorded according to ASTM D6026	☐	
Test Method	Method A (Non-cohesive Soils)	
Soaking Time (min)	120	
Test performed with the alternative method	☐	

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Lab Representative: GEO LABTECH
Cert No: BN# 3242 / TN# 9687

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Notes: The results above apply only to the specific samples noted using the aforementioned test method(s) and do not represent any other sample. Reports may not be reproduced except in full without permission.

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Sample Soil Pickup

Report #: 002

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Field Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

FIELD DATA

No. of Samples / Sets: 3
Sample Source / Location: Boring / In-Situ
Boring No: B-1 **Depth (ft):** 6-8ft
Sample Description / Classification: 10YR 3/6 Dark Yellowish Brown

SUMMARY OF WORK PERFORMED

LAB TEST SUMMARY

No	Test	Test Method	Status
002-L1	Sieve Test	ASTM D422 (Sieve)	Completed
002-L2	Atterberg (ASTM4318 / AASHTO T89 & 90)	ASTM D4318	Completed
002-L3	Wash 200 Analysis (ASTM D1140/D2216)	ASTM D1140	Completed

Note: All completed lab tests are attached below.

Report Copied to: Casiano Ancalle

Representative/Inspector: GEO FIELDTECH

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PUERTO RICO

Carlos E Rodriguez

GEO-Engineering
Date Signed: 10/02/2025 05:54 PM

Notes: As requested, a representative from our company arrived on site as scheduled and performed the above test. These test results apply only to the specific locations noted and do not represent any other location. Reports may not be reproduced except in full, without permission.

GEO | geotechnical engineering construction materials testing

Sieve Test

Report #: 002-L1

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

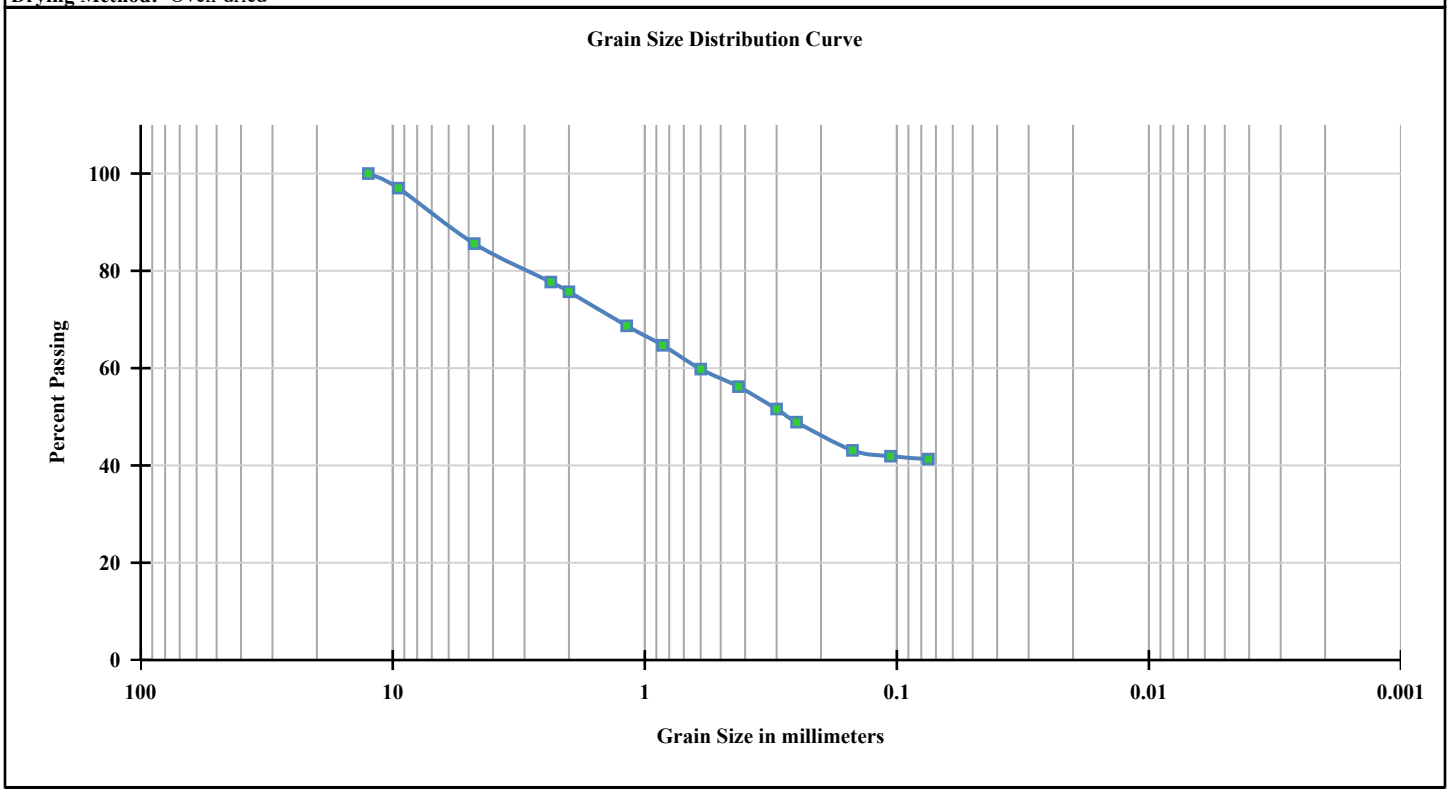
Report Date: 09/17/2025 **Sample Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

SAMPLE DATA

Boring No: B-1 **Depth (ft):** 6-8ft
Test Procedure: ASTM D422 (Sieve)
Sample Source / Location: Boring / In-Situ
Sample Description / Classification: 10YR 3/6 Dark Yellowish Brown

SIEVE ANALYSIS AND TEST RESULTS

Tare Wt (g)	108.6	**Tare #**	9021	**Moisture Content (%)**	27.18			**Dry Wt.+ Tare (g)**	240.3
Water Wt	27.18	**Wet Wt.+ Tare (g)**	276.1	**Dry Wt (g)**	131.7				
Sample Washed	X Yes ☐ No	**Dry Wt.+Tare after Wash**	185.7	**Weight of Soil After Wash**	77.1	**Wash Loss**	54.6	**Passing #200 from Wash**	41.46
Drying Method: Oven-dried									



GEO | geotechnical engineering construction materials testing

Sieve Test

Report #: 002-L1

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Sample Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

Sieve Sizes	Wt. Retained (g)	% Retained	% Passing	Spec Limits
1/2 in (12.5mm)		0	100	
3/8 in (9.5mm)	4	3	97	
#4 (4.75mm)	19	14.4	85.6	
#8 (2.36mm)	29.4	22.3	77.7	
#10 (2mm)	32	24.3	75.7	
#16 (1.18mm)	41.2	31.3	68.7	
#20 (0.85mm)	46.5	35.3	64.7	
#30 (0.6mm)	53	40.2	59.8	
#40 (0.425mm)	57.7	43.8	56.2	
#50 (0.3mm)	63.8	48.4	51.6	
#60 (0.25mm)	67.3	51.1	48.9	
#100 (0.15mm)	74.9	56.9	43.1	
#140 (0.106mm)	76.5	58.1	41.9	
#200 (0.075mm)	77.3	58.7	41.3	

Material

% Gravel	% Sand	% Fines
14.4	44.3	41.3

Atterberg Limits

PL = 25 LL = 41 PI = 16

Coefficients

D_{60} = 0.61 D_{10} = Cc =
D_{30} = Cu =

Soil Classification

USCS	AASHTO
USCS (ASTM D2487) : SC Clayey Sand	A-7-6

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Lab Representative: GEO LABTECH
Cert No: BN# 3242 / TN# 9687

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Carlos E Rodriguez

GEO-Engineering
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Atterberg (ASTM4318 / AASHTO T89 & 90)

Report #: 002-L2

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Sample Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

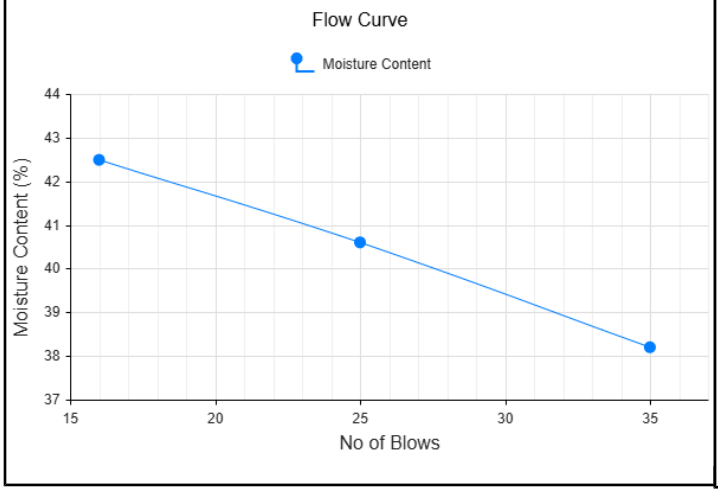
SAMPLE DATA

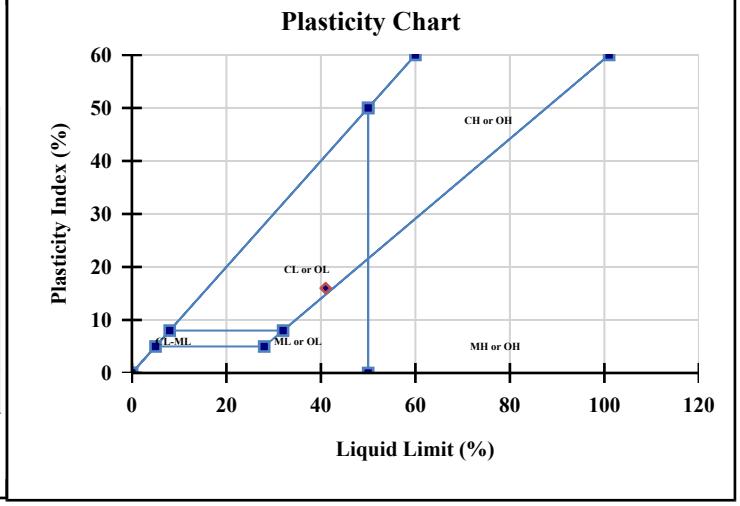
Test Procedure: ASTM D4318
Boring No: B-1 **Depth (ft):** 6-8ft
Sample Source / Location: Boring / In-Situ
Sample Description / Classification: 10YR 3/6 Dark Yellowish Brown
Soil Description:
Specimen Preparation: Dry (Air) **Mixing Water:** Distilled
Method of Removing Particles > #40 sieve: Dry Sieved on No 40 Sieve

ASTM D4318 / AASHTO T89 & 90

	Liquid Limit (s)			Plastic Limit (s)	
	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2
Number of Blows	35	25	16		
Tare No.	33	18	28	89	92
Tare Mass (g)	31.22	31.42	31.34	31.34	31.26
Tare + Wet Soil (g)	54.23	54.52	52.67	40.92	40.85
Tare + Dry Soil (g)	47.87	47.85	46.31	38.99	38.91
Mass of Dry Soil (g)	16.65	16.43	14.97	7.65	7.65
Mass of Water (g)	6.36	6.67	6.36	1.93	1.94
Moisture Content (%)	38.2	40.6	42.49	25.23	25.36

Liquid Limit (LL): 41
Plastic Limit (PL): 25
Plasticity Index (PI): 16
Non-Plastic: [ ] Yes [X] No
Retained #40 Sieve (Estimate)(%):
Rolling Procedure: Hand Rolled
Liquid Limit Apparatus: Mechanical
Casa Grande Grooving Tool: Plastic
Soil Classification:





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Atterberg (ASTM4318 / AASHTO T89 & 90)

Report #: 002-L2

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Sample Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

Lab Representative: GEO LABTECH
Cert No: BN# 3242 / TN# 9687



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Wash 200 Analysis (ASTM D1140/D2216)

Report #: 002-L3

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Sample Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

SAMPLE DATA

Boring No: B-1 **Depth (ft):** 6-8ft
Sample Source / Location: Boring / In-Situ
Sample Description / Classification: 10YR 3/6 Dark Yellowish Brown
Test Procedure: ASTM D1140

MOISTURE CONTENT & PERCENT FINES (ASTM D1140/D2216)

MOISTURE CONTENT & PERCENT FINES		
Pan #	9021	
Pan Weight (g)	108.6	
MOISTURE CONTENT		
Wet Weight (g)	276.1	167.5
Original Dry Mass (g)	240.3	131.7
Moisture Percent (%)	27.18	
PERCENT FINES		
Dry Weight (g)	240.3	131.7
Dry Mass Retained on the (No. 200)	185.7	77.1
Percentage of material finer than the 75-µm (No 200) (%)	41.46	
Recorded according to ASTM D6026	☐	
Test Method	Method A (Non-cohesive Soils)	
Soaking Time (min)	120	
Test performed with the alternative method	☐	

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Lab Representative: GEO LABTECH
Cert No: BN# 3242 / TN# 9687

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Sample Soil Pickup

Report #: 003

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Field Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

FIELD DATA

No. of Samples / Sets: 3
Sample Source / Location: Boring / In-Situ
Boring No: B-1 **Depth (ft):** 8-10ft
Sample Description / Classification: 10YR 4/4 Dark Yellowish Brown

SUMMARY OF WORK PERFORMED

LAB TEST SUMMARY

No	Test	Test Method	Status
003-L1	Sieve Test	ASTM D422 (Sieve)	Completed
003-L2	Atterberg (ASTM4318 / AASHTO T89 & 90)	ASTM D4318	Completed
003-L3	Wash 200 Analysis (ASTM D1140/D2216)	ASTM D1140	Completed

Note: All completed lab tests are attached below.

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Representative/Inspector: GEO FIELDTECH

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Notes: As requested, a representative from our company arrived on site as scheduled and performed the above test. These test results apply only to the specific locations noted and do not represent any other location. Reports may not be reproduced except in full, without permission.

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Sieve Test

Report #: 003-L1

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

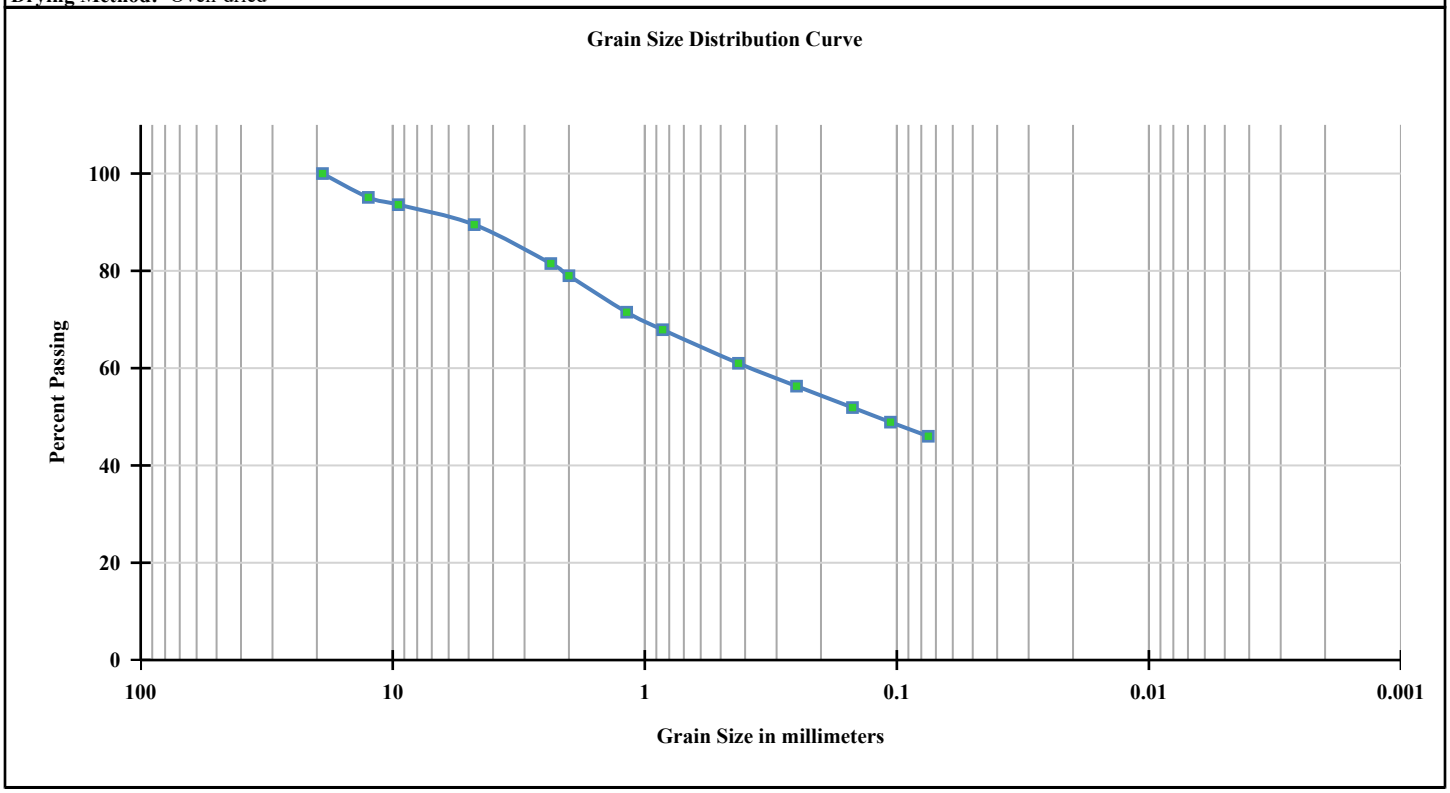
Report Date: 09/17/2025 **Sample Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

SAMPLE DATA

Boring No: B-1 **Depth (ft):** 8-10ft
Test Procedure: ASTM D422 (Sieve)
Sample Source / Location: Boring / In-Situ
Sample Description / Classification: 10YR 4/4 Dark Yellowish Brown

SIEVE ANALYSIS AND TEST RESULTS

Tare Wt (g)	108.4	**Tare #**	9013	**Moisture Content (%)**	10.70			**Dry Wt.+ Tare (g)**	219.6
Water Wt	10.70	**Wet Wt.+ Tare (g)**	231.5	**Dry Wt (g)**	111.2				
Sample Washed	X Yes ☐ No	**Dry Wt.+Tare after Wash**	168.4	**Weight of Soil After Wash**	60	**Wash Loss**	51.2	**Passing #200 from Wash**	46.04
Drying Method: Oven-dried									



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Sieve Test

Report #: 003-L1

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Sample Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

Sieve Sizes	Wt. Retained (g)	% Retained	% Passing	Spec Limits
3/4 in (19mm)		0	100	
1/2 in (12.5mm)	5.5	4.9	95.1	
3/8 in (9.5mm)	7.1	6.4	93.6	
#4 (4.75mm)	11.7	10.5	89.5	
#8 (2.36mm)	20.6	18.5	81.5	
#10 (2mm)	23.4	21	79	
#16 (1.18mm)	31.7	28.5	71.5	
#20 (0.85mm)	35.7	32.1	67.9	
#40 (0.425mm)	43.4	39	61	
#60 (0.25mm)	48.6	43.7	56.3	
#100 (0.15mm)	53.5	48.1	51.9	
#140 (0.106mm)	56.8	51.1	48.9	
#200 (0.075mm)	60	54	46	

Material

% Gravel	% Sand	% Fines
10.5	43.5	46

Atterberg Limits

PL = 25 **LL =** 41 **PI =** 16

Coefficients

D_{60} = 0.39 D_{10} = **Cc =**
D_{30} = **Cu =**

Soil Classification

USCS	AASHTO
USCS (ASTM D2487) : SC Clayey Sand	A-7-6

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Lab Representative: GEO LABTECH
Cert No: BN# 3242 / TN# 9687

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Atterberg (ASTM4318 / AASHTO T89 & 90)

Report #: 003-L2

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Sample Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

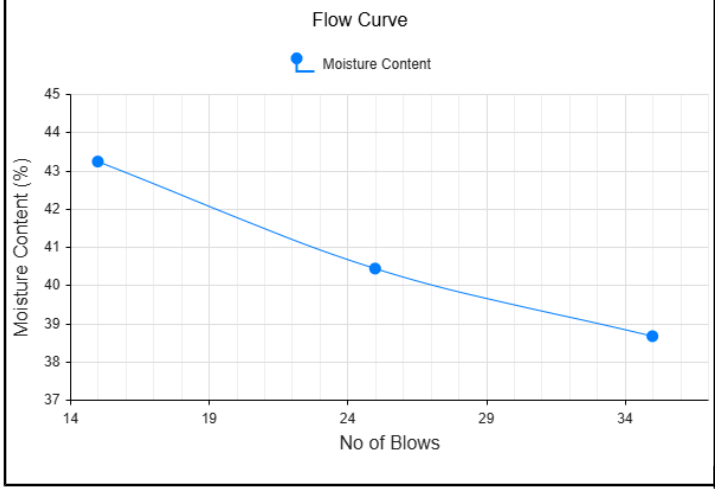
SAMPLE DATA

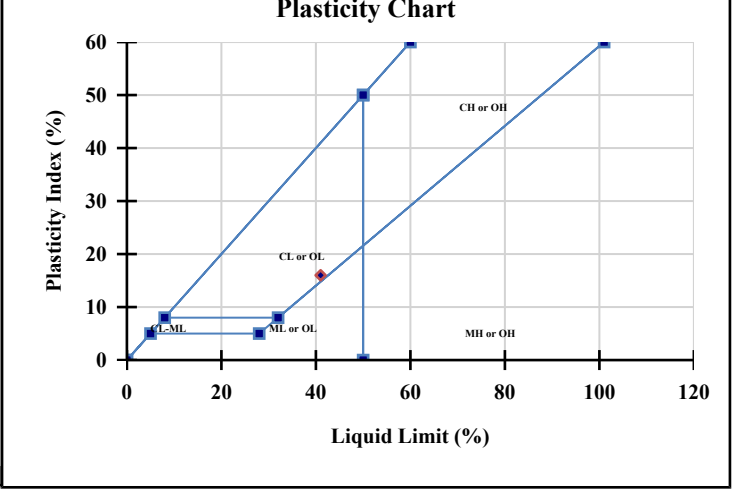
Test Procedure: ASTM D4318
Boring No: B-1 **Depth (ft):** 8-10ft
Sample Source / Location: Boring / In-Situ
Sample Description / Classification: 10YR 4/4 Dark Yellowish Brown
Soil Description:

ASTM D4318 / AASHTO T89 & 90

	Liquid Limit (s)			Plastic Limit (s)	
	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2
Number of Blows	35	25	15		
Tare No.	6	14	32	33	50
Tare Mass (g)	31.2	31.59	31.27	31.43	31.1
Tare + Wet Soil (g)	47.95	55.59	48.2	41.35	40.89
Tare + Dry Soil (g)	43.28	48.68	43.09	39.39	38.91
Mass of Dry Soil (g)	12.08	17.09	11.82	7.96	7.81
Mass of Water (g)	4.67	6.91	5.11	1.96	1.98
Moisture Content (%)	38.66	40.43	43.23	24.62	25.35

Liquid Limit (LL): 41
Plastic Limit (PL): 25
Plasticity Index (PI): 16
Non-Plastic: [ ] Yes [X] No
Retained #40 Sieve (Estimate)(%):
Soil Classification:





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Atterberg (ASTM4318 / AASHTO T89 & 90)

Report #: 003-L2

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Sample Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

Lab Representative: GEO LABTECH
Cert No: BN# 3242 / TN# 9687



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Wash 200 Analysis (ASTM D1140/D2216)

Report #: 003-L3

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Sample Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

SAMPLE DATA

Boring No: B-1 **Depth (ft):** 8-10ft
Sample Source / Location: Boring / In-Situ
Sample Description / Classification: 10YR 4/4 Dark Yellowish Brown
Test Procedure: ASTM D1140

MOISTURE CONTENT & PERCENT FINES (ASTM D1140/D2216)

MOISTURE CONTENT & PERCENT FINES		
Pan #	9013	
Pan Weight (g)	108.4	
MOISTURE CONTENT		
Wet Weight (g)	231.5	123.1
Original Dry Mass (g)	219.6	111.2
Moisture Percent (%)	10.7	
PERCENT FINES		
Dry Weight (g)	219.6	111.2
Dry Mass Retained on the (No. 200)	168.4	60
Percentage of material finer than the 75-µm (No 200) (%)	46.04	
Recorded according to ASTM D6026	☐	
Test Method	Method A (Non-cohesive Soils)	
Soaking Time (min)	120	
Test performed with the alternative method	☐	

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Lab Representative: GEO LABTECH
Cert No: BN# 3242 / TN# 9687

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Sample Soil Pickup

Report #: 004

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Field Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

FIELD DATA

No. of Samples / Sets: 3
Sample Source / Location: Boring / In-Situ
Boring No: B-2 **Depth (ft):** 0-2ft
Sample Description / Classification: 10YR 3/2 Very Dark Grayish Brown

SUMMARY OF WORK PERFORMED

LAB TEST SUMMARY

No	Test	Test Method	Status
004-L1	Sieve Test	ASTM D422 (Sieve)	Completed
004-L2	Atterberg (ASTM4318 / AASHTO T89 & 90)	ASTM D4318	Completed
004-L3	Wash 200 Analysis (ASTM D1140/D2216)	ASTM D1140	Completed

Note: All completed lab tests are attached below.

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Representative/Inspector: GEO FIELDTECH

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Sieve Test

Report #: 004-L1

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Sample Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

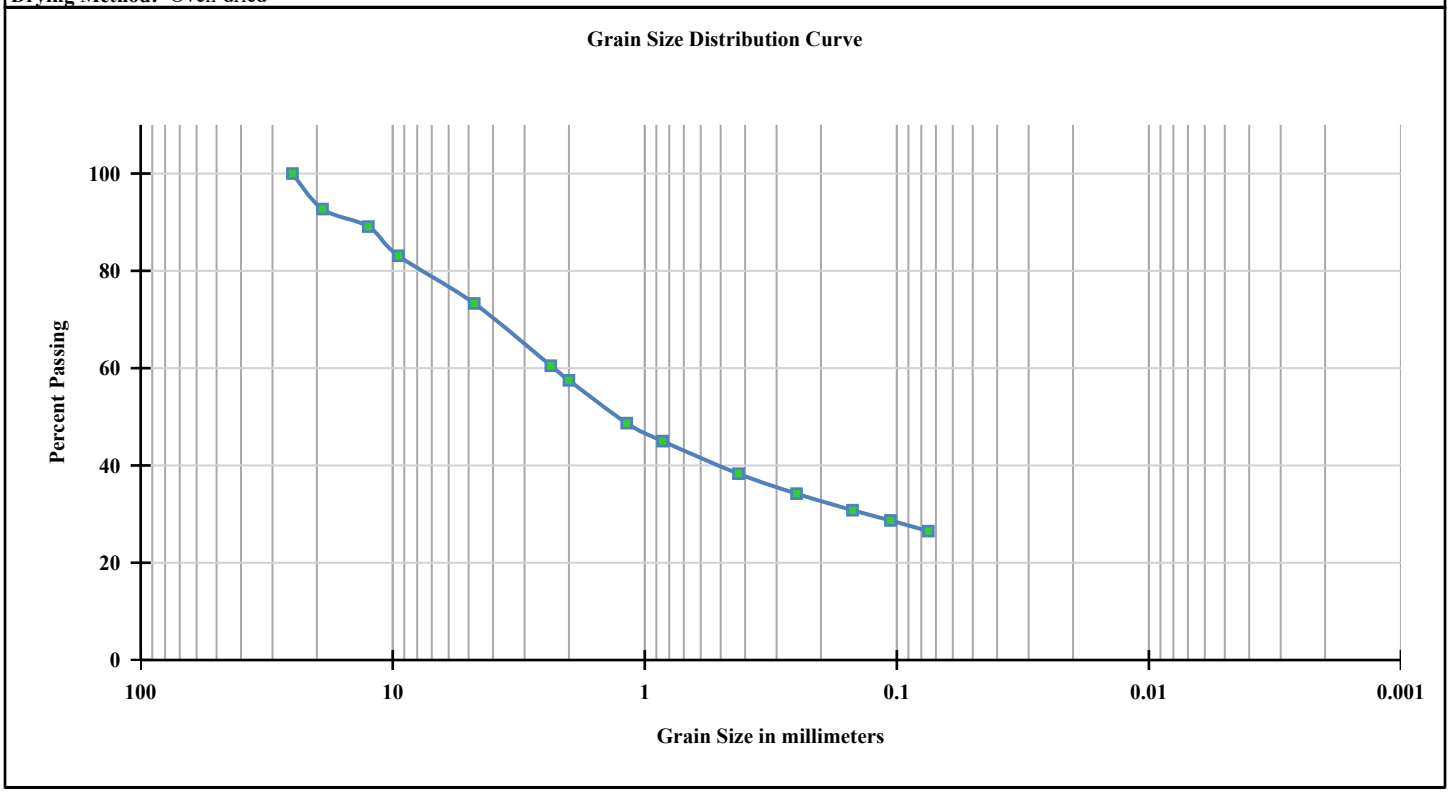
SAMPLE DATA

Boring No: B-2 **Depth (ft):** 0-2ft
Test Procedure: ASTM D422 (Sieve)
Sample Source / Location: Boring / In-Situ
Sample Description / Classification: 10YR 3/2 Very Dark Grayish Brown

SIEVE ANALYSIS AND TEST RESULTS

Tare Wt (g)	107	**Tare #**	9012	**Moisture Content (%)**	19.83			**Dry Wt.+ Tare (g)**	312.2
Water Wt	19.83	**Wet Wt.+ Tare (g)**	352.9	**Dry Wt (g)**	205.2				
Sample Washed	X Yes ☐ No	**Dry Wt.+Tare after Wash**	258.2	**Weight of Soil After Wash**	151.2	**Wash Loss**	54	**Passing #200 from Wash**	26.32

Drying Method: Oven-dried



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Sieve Test

Report #: 004-L1

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Sample Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

Sieve Sizes	Wt. Retained (g)	% Retained	% Passing	Spec Limits
1 in (25mm)		0	100	
3/4 in (19mm)	14.9	7.3	92.7	
1/2 in (12.5mm)	22.4	10.9	89.1	
3/8 in (9.5mm)	34.7	16.9	83.1	
#4 (4.75mm)	54.8	26.7	73.3	
#8 (2.36mm)	81	39.5	60.5	
#10 (2mm)	87.2	42.5	57.5	
#16 (1.18mm)	105.2	51.3	48.7	
#20 (0.85mm)	112.9	55	45	
#40 (0.425mm)	126.6	61.7	38.3	
#60 (0.25mm)	135.1	65.8	34.2	
#100 (0.15mm)	141.9	69.2	30.8	
#140 (0.106mm)	146.3	71.3	28.7	
#200 (0.075mm)	150.8	73.5	26.5	

Material

% Gravel	% Sand	% Fines
26.7	46.8	26.5

Atterberg Limits

PL = 23 **LL =** 33 **PI =** 10

Coefficients

D_{60} = 2.3 D_{10} = Cc =
D_{30} = 0.13 Cu =

Soil Classification

USCS	AASHTO
USCS (ASTM D2487) : SC	A-2-4
Clayey sand with gravel	

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Lab Representative: GEO LABTECH
Cert No: BN# 3242 / TN# 9687

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Atterberg (ASTM4318 / AASHTO T89 & 90)

Report #: 004-L2

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Sample Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

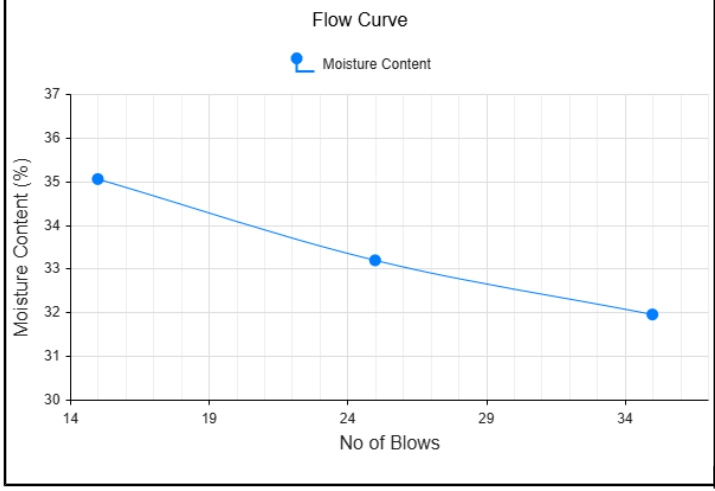
SAMPLE DATA

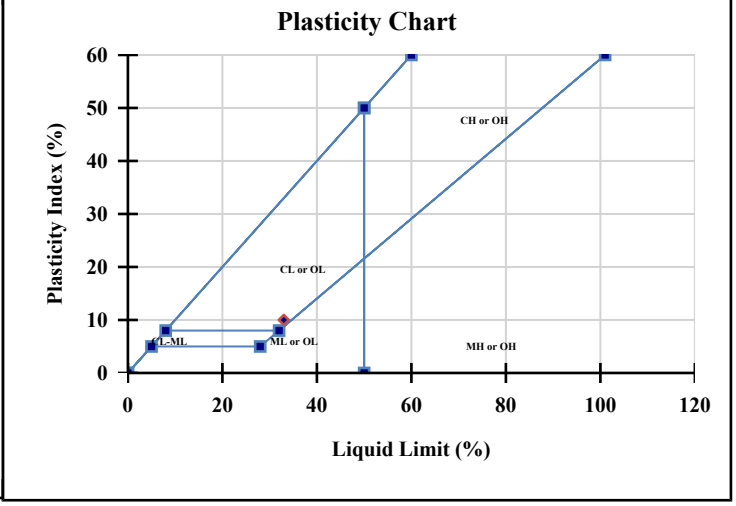
Test Procedure: ASTM D4318
Boring No: B-2 **Depth (ft):** 0-2ft
Sample Source / Location: Boring / In-Situ
Sample Description / Classification: 10YR 3/2 Very Dark Grayish Brown
Soil Description:
Specimen Preparation: Dry (Air) **Mixing Water:** Distilled
Method of Removing Particles > #40 sieve: Dry Sieved on No 40 Sieve

ASTM D4318 / AASHTO T89 & 90

	Liquid Limit (s)			Plastic Limit (s)	
	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2
Number of Blows	35	25	15		
Tare No.	58	62	81	87	88
Tare Mass (g)	31.52	31.03	31.28	31.13	31.43
Tare + Wet Soil (g)	55.35	56.31	53.55	40.86	41.73
Tare + Dry Soil (g)	49.58	50.01	47.77	39.04	39.81
Mass of Dry Soil (g)	18.06	18.98	16.49	7.91	8.38
Mass of Water (g)	5.77	6.3	5.78	1.82	1.92
Moisture Content (%)	31.95	33.19	35.05	23.01	22.91

Liquid Limit (LL): 33
Plastic Limit (PL): 23
Plasticity Index (PI): 10
Non-Plastic: [ ] Yes [X] No
Retained #40 Sieve (Estimate)(%):
Rolling Procedure: Hand Rolled
Liquid Limit Apparatus: Mechanical
Casa Grande Grooving Tool: Plastic
Soil Classification:





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GEO | geotechnical engineering construction materials testing

Atterberg (ASTM4318 / AASHTO T89 & 90)

Report #: 004-L2

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Sample Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

Lab Representative: GEO LABTECH
Cert No: BN# 3242 / TN# 9687



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Wash 200 Analysis (ASTM D1140/D2216)

Report #: 004-L3

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Sample Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

SAMPLE DATA

Boring No: B-2 **Depth (ft):** 0-2ft
Sample Source / Location: Boring / In-Situ
Sample Description / Classification: 10YR 3/2 Very Dark Grayish Brown
Test Procedure: ASTM D1140

MOISTURE CONTENT & PERCENT FINES (ASTM D1140/D2216)

MOISTURE CONTENT & PERCENT FINES		
Pan #	258.2	
Pan Weight (g)	107	
MOISTURE CONTENT		
Wet Weight (g)	352.9	245.9
Original Dry Mass (g)	312.2	205.2
Moisture Percent (%)	19.83	
PERCENT FINES		
Dry Weight (g)	312.2	205.2
Dry Mass Retained on the (No. 200)	258.2	151.2
Percentage of material finer than the 75-µm (No 200) (%)	26.32	
Recorded according to ASTM D6026	☐	
Test Method	Method A (Non-cohesive Soils)	
Soaking Time (min)	120	
Test performed with the alternative method	☐	

Report Copied to: Casiano Ancalle

Lab Representative: GEO LABTECH
Cert No: BN# 3242 / TN# 9687

CARLOS E. RODRÍGUEZ PÉREZ
INGENIERO
LICENCIADO
LIC. #10034
PUERTO RICO

Carlos E Rodriguez

GEO-Engineering
Date Signed: 10/02/2025 05:54 PM

Notes: The results above apply only to the specific samples noted using the aforementioned test method(s) and do not represent any other sample. Reports may not be reproduced except in full without permission.

GEO | geotechnical engineering construction materials testing

Sample Soil Pickup

Report #: 005

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Field Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

FIELD DATA

No. of Samples / Sets: 3
Sample Source / Location: Boring / In-Situ
Boring No: B-2 **Depth (ft):** 6-8ft
Sample Description / Classification: 10YR 4/2 Dark Grayish Brown

SUMMARY OF WORK PERFORMED

LAB TEST SUMMARY

No	Test	Test Method	Status
005-L1	Sieve Test	ASTM D422 (Sieve)	Completed
005-L2	Atterberg (ASTM4318 / AASHTO T89 & 90)	ASTM D4318	Completed
005-L3	Wash 200 Analysis (ASTM D1140/D2216)	ASTM D1140	Completed

Note: All completed lab tests are attached below.

Report Copied to: Casiano Ancalle

Representative/Inspector: GEO FIELDTECH

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GEO-Engineering
Date Signed: 10/02/2025 05:54 PM

Notes: As requested, a representative from our company arrived on site as scheduled and performed the above test. These test results apply only to the specific locations noted and do not represent any other location. Reports may not be reproduced except in full, without permission.

GEO | geotechnical engineering construction materials testing

Sieve Test

Report #: 005-L1

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

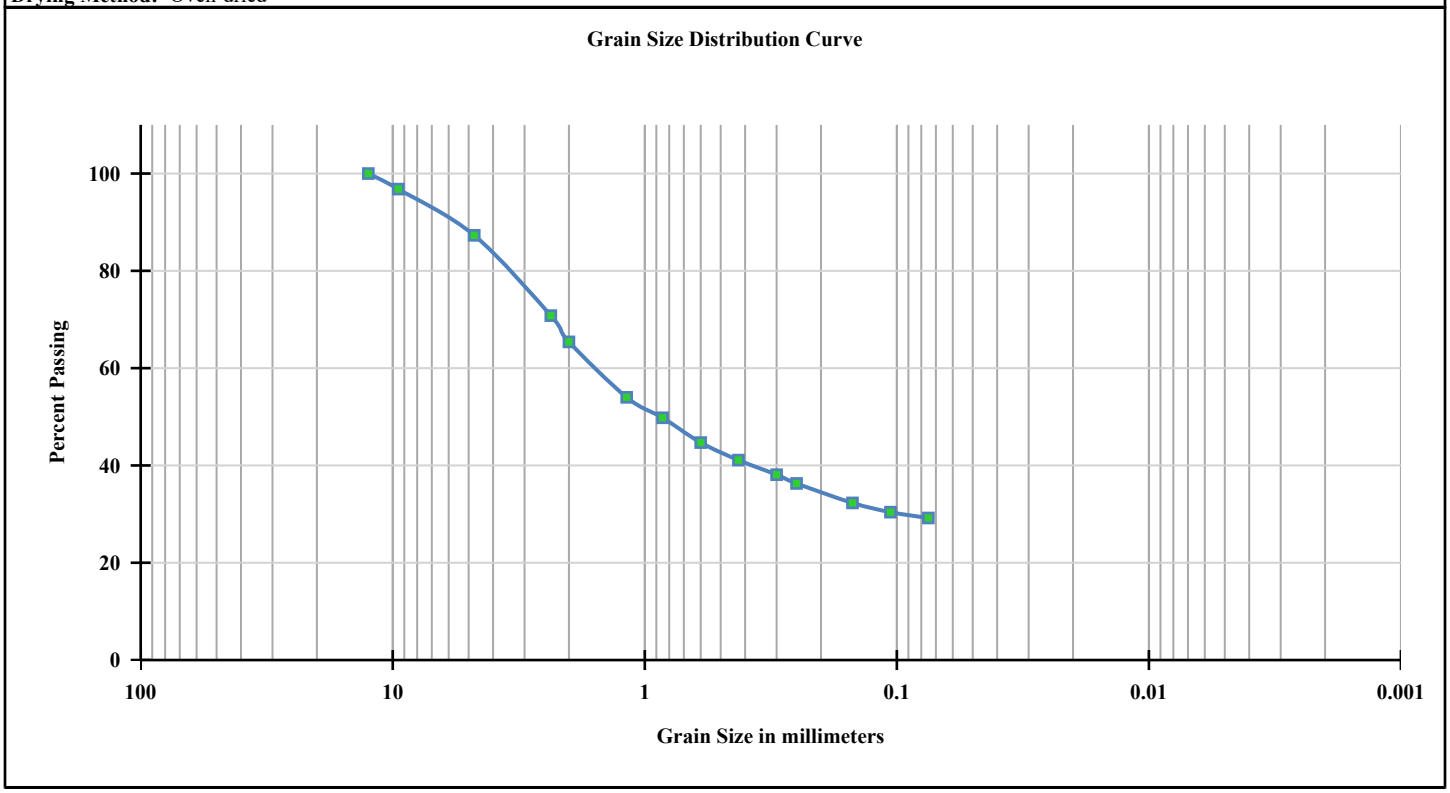
Report Date: 09/17/2025 **Sample Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

SAMPLE DATA

Boring No: B-2 **Depth (ft):** 6-8ft
Test Procedure: ASTM D422 (Sieve)
Sample Source / Location: Boring / In-Situ
Sample Description / Classification: 10YR 4/2 Dark Grayish Brown

SIEVE ANALYSIS AND TEST RESULTS

Tare Wt (g)	272.3	**Tare #**	145	**Moisture Content (%)**	20.93			**Dry Wt.+ Tare (g)**	790.6
Water Wt	20.93	**Wet Wt.+ Tare (g)**	899.1	**Dry Wt (g)**	518.3				
Sample Washed	X Yes ☐ No	**Dry Wt.+Tare after Wash**	639.7	**Weight of Soil After Wash**	367.4	**Wash Loss**	150.9	**Passing #200 from Wash**	29.11
Drying Method: Oven-dried									



GEO | geotechnical engineering construction materials testing

Sieve Test

Report #: 005-L1

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Sample Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

Sieve Sizes	Wt. Retained (g)	% Retained	% Passing	Spec Limits
1/2 in (12.5mm)		0	100	
3/8 in (9.5mm)	16.4	3.2	96.8	
#4 (4.75mm)	65.8	12.7	87.3	
#8 (2.36mm)	151.5	29.2	70.8	
#10 (2mm)	179.2	34.6	65.4	
#16 (1.18mm)	238.3	46	54	
#20 (0.85mm)	260.2	50.2	49.8	
#30 (0.6mm)	286.5	55.3	44.7	
#40 (0.425mm)	305.5	58.9	41.1	
#50 (0.3mm)	321	61.9	38.1	
#60 (0.25mm)	330	63.7	36.3	
#100 (0.15mm)	351	67.7	32.3	
#140 (0.106mm)	360.7	69.6	30.4	
#200 (0.075mm)	366.9	70.8	29.2	

Material

% Gravel	% Sand	% Fines
12.7	58.1	29.2

Atterberg Limits

PL = 24 **LL =** 34 **PI =** 10

Coefficients

D_{60} = 1.61 D_{10} = **Cc =**
D_{30} = 0.1 **Cu =**

Soil Classification

USCS	AASHTO
USCS (ASTM D2487) : SM	A-2-4
Silty Sand	

Report Copied to: Casiano Ancalle

Lab Representative: GEO LABTECH
Cert No: BN# 3242 / TN# 9687

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GEO-Engineering
Date Signed: 10/02/2025 05:54 PM

Notes: The results above apply only to the specific samples noted using the aforementioned test method(s) and do not represent any other sample. Reports may not be reproduced except in full without permission.

GEO | geotechnical engineering construction materials testing

Atterberg (ASTM4318 / AASHTO T89 & 90)

Report #: 005-L2

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Sample Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

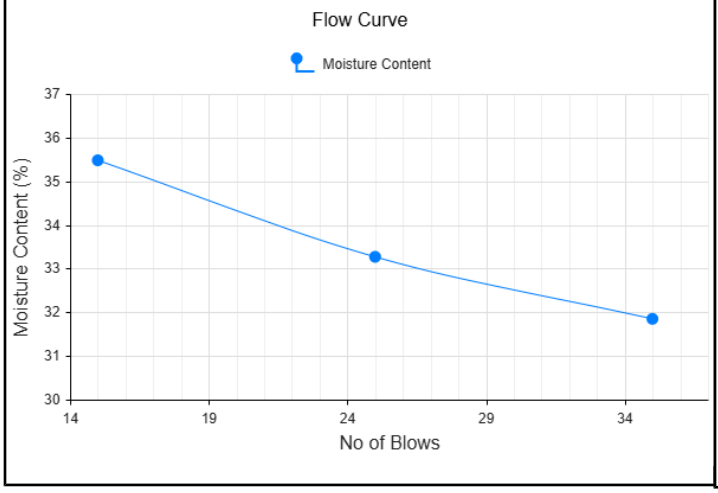
SAMPLE DATA

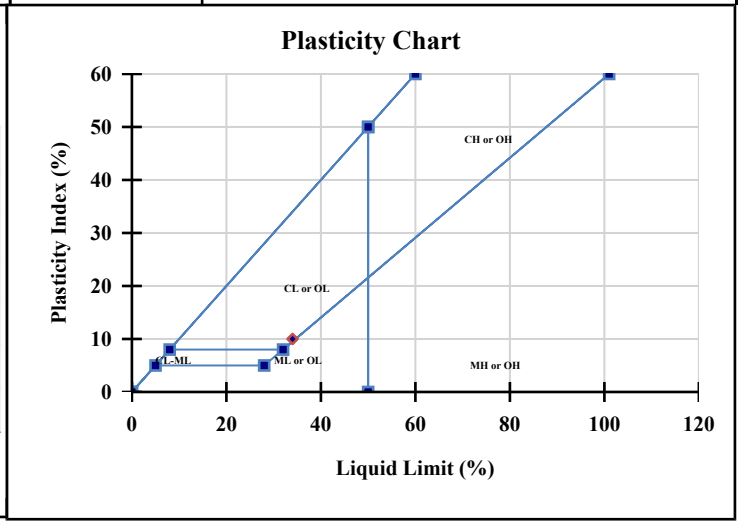
Test Procedure: ASTM D4318
Boring No: B-2 **Depth (ft):** 6-8ft
Sample Source / Location: Boring / In-Situ
Sample Description / Classification: 10YR 4/2 Dark Grayish Brown
Soil Description:
Specimen Preparation: Dry (Air) **Mixing Water:** Distilled
Method of Removing Particles > #40 sieve: Dry Sieved on No 40 Sieve

ASTM D4318 / AASHTO T89 & 90

	Liquid Limit (s)			Plastic Limit (s)	
	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2
Number of Blows	35	25	15		
Tare No.	47	50	62	81	87
Tare Mass (g)	31.24	31.09	31.03	31.27	31.12
Tare + Wet Soil (g)	55	59.41	57.34	41.55	40.88
Tare + Dry Soil (g)	49.26	52.34	50.45	39.54	38.98
Mass of Dry Soil (g)	18.02	21.25	19.42	8.27	7.86
Mass of Water (g)	5.74	7.07	6.89	2.01	1.9
Moisture Content (%)	31.85	33.27	35.48	24.3	24.17

Liquid Limit (LL): 34
Plastic Limit (PL): 24
Plasticity Index (PI): 10
Non-Plastic: [ ] Yes [X] No
Retained #40 Sieve (Estimate)(%):
Rolling Procedure: Hand Rolled
Liquid Limit Apparatus: Mechanical
Casa Grande Grooving Tool: Plastic
Soil Classification:





Report Copied to: Casiano Ancalle

GEO | geotechnical engineering construction materials testing

Atterberg (ASTM4318 / AASHTO T89 & 90)

Report #: 005-L2

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Sample Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

Lab Representative: GEO LABTECH
Cert No: BN# 3242 / TN# 9687



Carlos E Rodriguez

GEO-Engineering
Date Signed: 10/02/2025 05:54 PM

Notes: The results above apply only to the specific samples noted using the aforementioned test method(s) and do not represent any other sample. Reports may not be reproduced except in full without permission.

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Wash 200 Analysis (ASTM D1140/D2216)

Report #: 005-L3

Client: CA Engineering, PSC
Project: New Holding Tank and New Wash Water Storage Tank, Improvements to Guilarte WFP
Location: Adjuntas, Puerto Rico

Report Date: 09/17/2025 **Sample Date:** 09/17/2025
Project #: SB42-25-UT-ADJ

SAMPLE DATA

Boring No: B-2 **Depth (ft):** 6-8ft
Sample Source / Location: Boring / In-Situ
Sample Description / Classification: 10YR 4/2 Dark Grayish Brown
Test Procedure: ASTM D1140

MOISTURE CONTENT & PERCENT FINES (ASTM D1140/D2216)

MOISTURE CONTENT & PERCENT FINES		
Pan #	145	
Pan Weight (g)	272.3	
MOISTURE CONTENT		
Wet Weight (g)	899.1	626.8
Original Dry Mass (g)	790.6	518.3
Moisture Percent (%)	20.93	
PERCENT FINES		
Dry Weight (g)	790.6	518.3
Dry Mass Retained on the (No. 200)	639.7	367.4
Percentage of material finer than the 75-µm (No 200) (%)	29.11	
Recorded according to ASTM D6026	☐	
Test Method	Method A (Non-cohesive Soils)	
Soaking Time (min)	120	
Test performed with the alternative method	☐	

Report Copied to: Casiano Ancalle

Lab Representative: GEO LABTECH
Cert No: BN# 3242 / TN# 9687

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Date Signed: 10/02/2025 05:54 PM

Notes: The results above apply only to the specific samples noted using the aforementioned test method(s) and do not represent any other sample. Reports may not be reproduced except in full without permission.

NOTES

1- ALL DISTANCES AND ELEVATIONS ARE EXPRESSED IN METERS.

2- THE HORIZONTAL CONTROL IS REFERRED TO THE DATUM NAD 83 (2011) EPOCH 2010. THE COORDINATES ARE REFERRED TO THE LAMBERT PROJECTION ZONE 5200 PR/VI.

3- VERTICAL CONTROL IS REFERRED TO ORTHOMETRIC HEIGHT COMPUTED WITH GEOID18.

5- THIS DRAWING IS AN EXISTING CONDITIONS AND TOPOGRAPHIC SURVEY PLAN AND CAN BE ONLY USED AS SUCH.

6- THIS DRAWING DOES NOT CONSTITUTE A LAND BOUNDARY SURVEY PLAN AND CAN NOT BE USED AS SUCH.

7- THE CADASTRE NUMBERS AND NAMES OF THE NEIGHBORS WERE OBTAINED FROM THE CRIM VIRTUAL PAGE.

9- THIS DRAWING DEPICTS THE EXISTING CONDITIONS AT THE TIME WHEN THE SURVEY WAS PERFORMED.

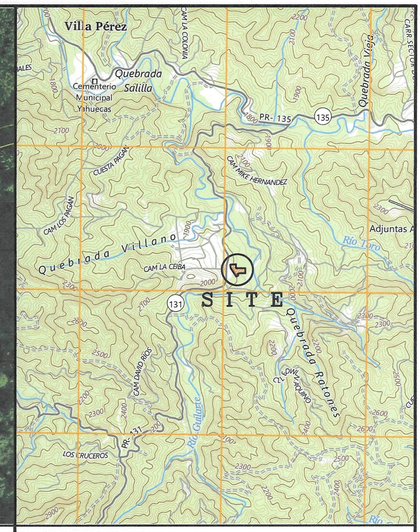
10- FIELDWORK WAS PERFORMED ON FEBRUARY 21, 2025.

11- THE EQUIPMENT TO GEOREFERENCE THIS SITE CONSISTED OF A TRIMBLE R-12i ANTENNA WITH A MAXIMUM PRECISION OF 8MM + AS 0.5 PPM RMS CONNECTED TO THE P.R. VRS NETWORK.

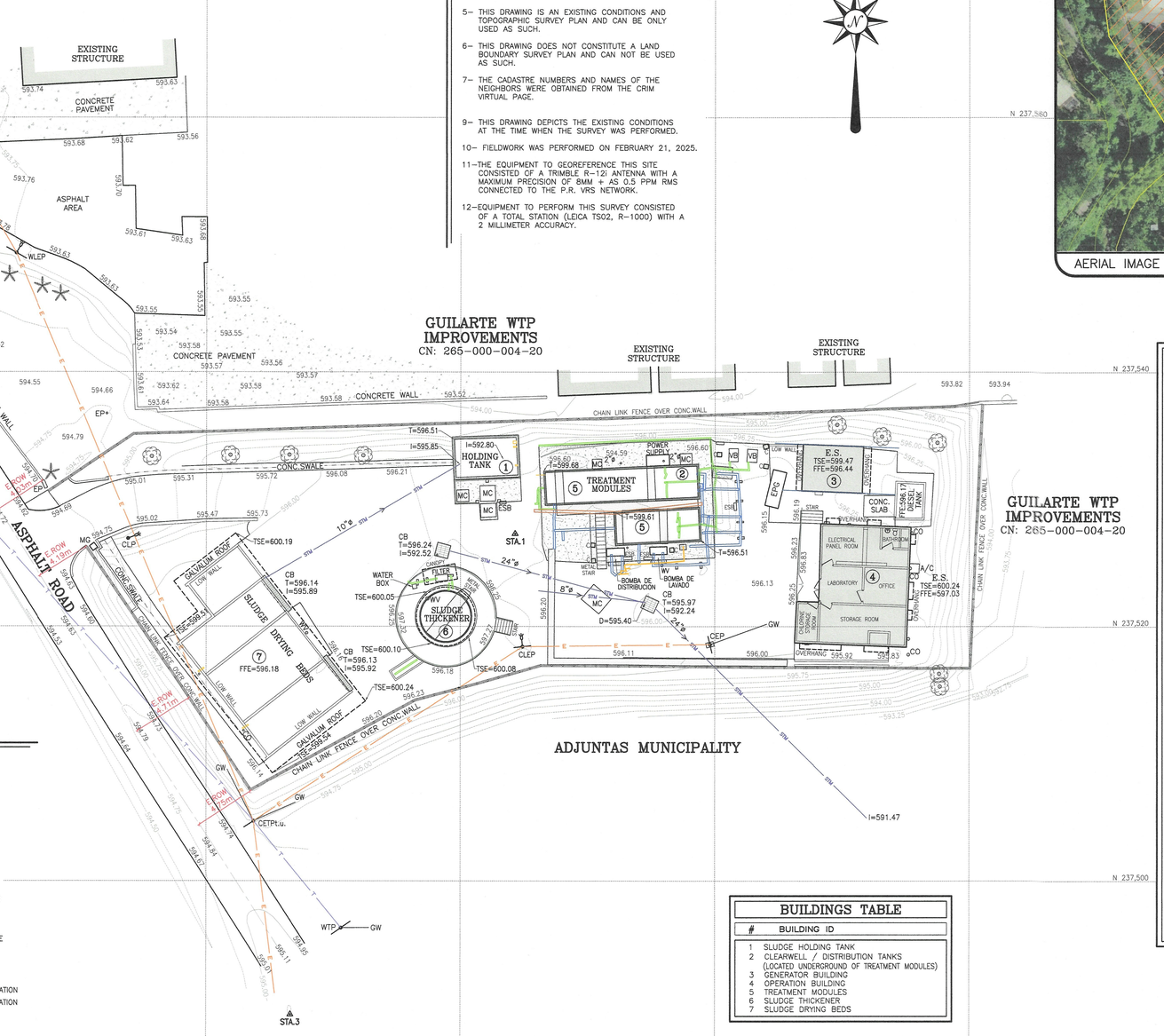
12- EQUIPMENT TO PERFORM THIS SURVEY CONSISTED OF A TOTAL STATION (LEICA TS02, R-1000) WITH A 2 MILLIMETER ACCURACY.

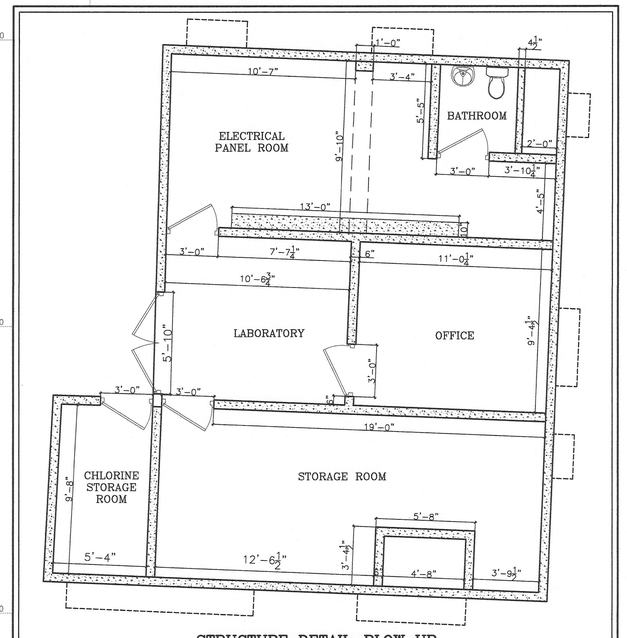


AERIAL IMAGE — NOT TO SCALE



LOCATION MAP — SCALE: 1:20,000





GUILARTE WTP IMPROVEMENTS
CN: 265-000-004-20

STRUCTURE DETAIL-BLOW UP
SCALE 1:50

LEGEND

	8"ø PIPE	B	BOLLARD
	6"ø PIPE	GV	GAS VALVE
	4"ø PIPE	CO	CLEAN OUT
	2"ø PIPE	FH	FIRE HYDRANT
	HANDRAIL	WM	WATER METER
	CHAIN LINK FENCE	WV	WATER VALVE
	IRON FENCE	RS	ROAD SIGN
E	OVERHEAD ELECTRIC POWER LINE	SC	STOP CAR
T	OVERHEAD TELEPHONE LINE	EP	ELECTRIC PEDESTAL
	CONTOUR INTERVAL 0.25M	C	COLUMN
	CONTOUR INTERVAL 1.00M	V.B	VACUM BLOWER
STM	STORM SEWER UNDERGROUND PIPE	ESB	ELECTRIC SWITCH BOX
	PALM TREE	MG	MOTOR GATE
	TREE	MC	METAL COVER
WTP	WOOD TELEPHONE POLE	P.CB	PIPES CONCRETE BASE
WLEP	WOOD LIGHT ELECTRIC POLE	CS	CONCRETE SLAB
CEP	CONCRETE ELECTRIC POLE	STA.5B ▲	CONTROL STATION
CETPt.u	CONCRETE ELECTRIC TELEPHONE POLE TRANSFORMER-UNDERGROUND	34.15	SPOT ELEVATION
		FFE=34.15	FINISHED FLOOR ELEVATION
CLP	CONCRETE LIGHT POLE	TSE=34.15	TOP STRUCTURE ELEVATION
CLEP	CONCRETE LIGHT ELECTRIC POLE	ID	IN DRAIN
GW	GUY WIRE	CB T=0.00 I=0.00	CATCH BASIN
		SSMH T=0.00 I=0.00	STORM SEWER MANHOLE
		E.S.	EXISTING STRUCTURE
		E.ROW 4.70m	EXISTING ROAD RIGHT OF WAY

BUILDINGS TABLE

#	BUILDING ID
1	SLUDGE HOLDING TANK
2	CLEARWELL / DISTRIBUTION TANKS (LOCATED UNDERGROUND OF TREATMENT MODULES)
3	GENERATOR BUILDING
4	OPERATION BUILDING
5	TREATMENT MODULES
6	SLUDGE THICKENER
7	SLUDGE DRYING BEDS

0MTS. 5MTS. 10MTS. 20MTS.

GRAPHIC SCALE 1:200

HORIZONTAL & VERTICAL CONTROL STATIONS

NORTHING	EASTING	ELEV.	DESCRIPTION
237527.283	164224.294	596.345	STA. 1 PK NAIL
237528.240	164194.332	594.961	STA. 2 PK NAIL
237489.506	164206.639	595.274	STA. 3 PK NAIL

TOPOGRAPHIC & AS-BUILT PLAN

GUILARTE WTP IMPROVEMENTS FACILITIES

STATE ROAD PR-131 KM 2.5 INTERIOR, GUILARTE WARD, ADJUNTAS, PUERTO RICO

DATE	REVISION

TELEPHONE: P.O. BOX 194523 (787)273-6702 SAN JUAN, P.R. 00919 - 4523
E-MAIL ALTAMIRA #594, CALLE ALDEBARAN
WEB PAGE SAN JUAN, P.R. 00920 - 4507
www.pjdccsp.com
PJDC

PEDRO J. DAVILA COLON — REGISTERED LAND SURVEYOR — PUERTO RICO — CERTIFY CORRECT

PEDRO J. DAVILA COLON
SURVEYOR, LIC. NO. 5383

FIELD WORK BY: V. MORALES, A. COTTO
CALCULATION BY: P. J. DAVILA, J. NIEVES
DRAWING BY: J. NIEVES
CADD DWG NAME: 1609-ALL.dwg
DATE: MARCH 27, 2025

SCALE: 1:200
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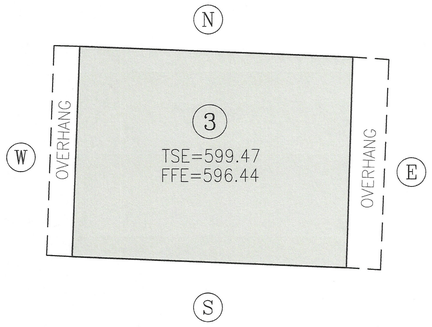
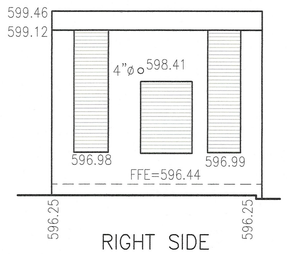
SHEET NO.: 01
OF: 02

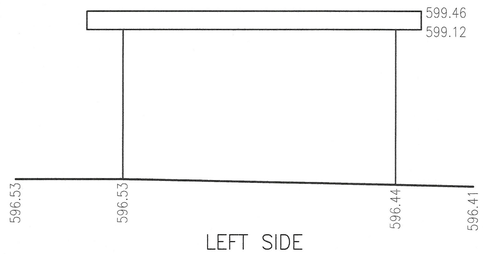
Save Date:12/4/2025 10:11 AM Path:\\terra\public\jnieves\job-1609\1609-all-rvsd.dwg By:jortiz

3 GENERATOR BUILDING

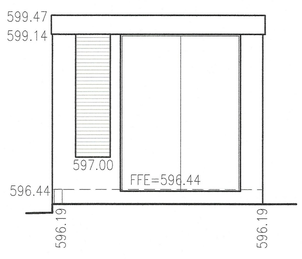




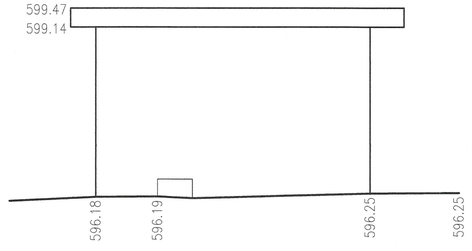
RIGHT SIDE
(SOUTH STRUCTURE ELEVATION)



LEFT SIDE
(NORTH STRUCTURE ELEVATION)

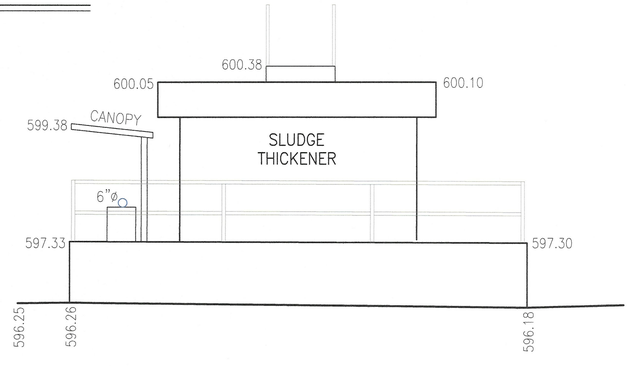


FRONT SIDE
(WEST STRUCTURE ELEVATION)

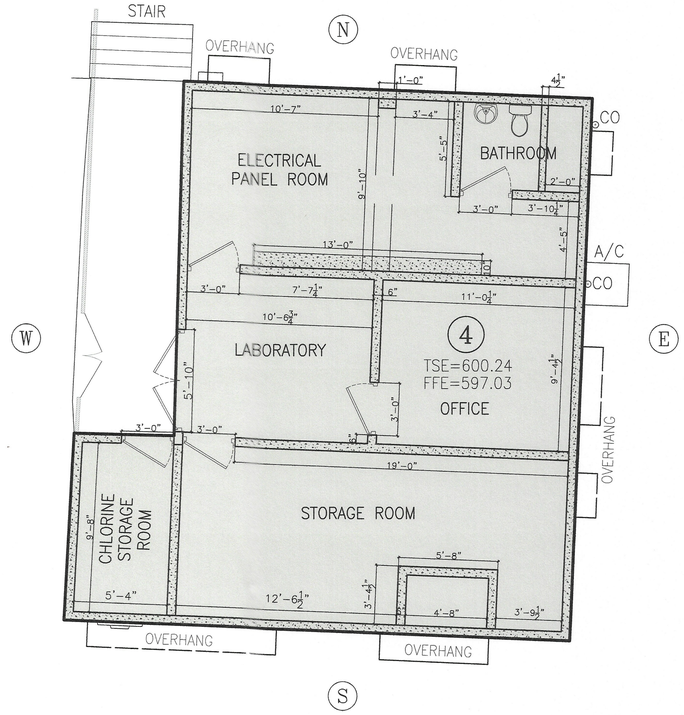


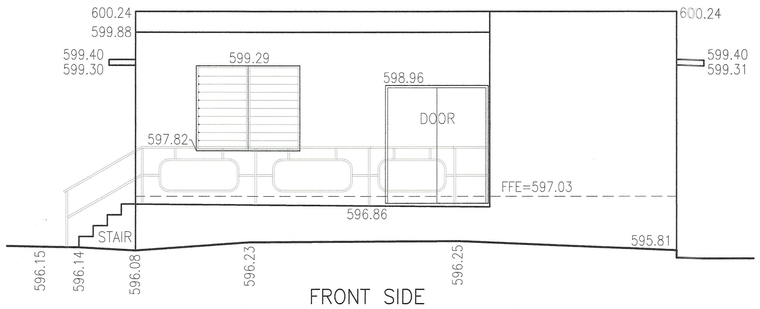
RIGHT SIDE
(SOUTHSTRUCTURE ELEVATION)

6 SLUDGE THICKENER

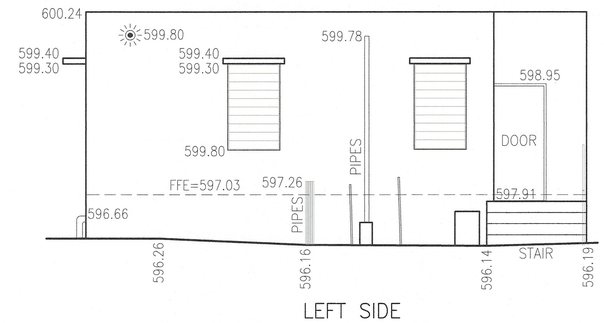


4 OPERATION BUILDING

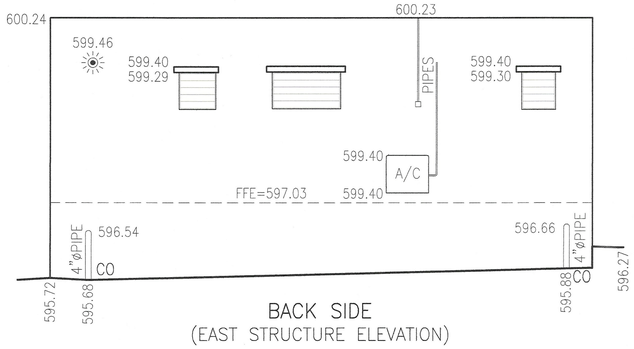




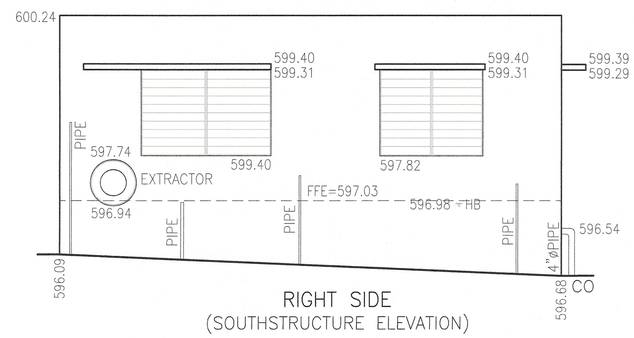
FRONT SIDE
(WEST STRUCTURE ELEVATION)



LEFT SIDE
(NORTH STRUCTURE ELEVATION)



BACK SIDE
(EAST STRUCTURE ELEVATION)



RIGHT SIDE
(SOUTHSTRUCTURE ELEVATION)

ELEVATION & FLOOR PLAN OF OPERATION BUILDING

GUILARTE WTP IMPROVEMENTS FACILITIES

STATE ROAD PR-131 KM 2.5 INTERIOR, GUILARTE WARD, ADJUNTAS, PUERTO RICO

DATE	REVISION

TELEPHONE: (787)273-6702
E-MAIL: pjdccsp@pjdccsp.com
WEB PAGE: www.pjdccsp.com
P.O. BOX 194523 SAN JUAN, P.R. 00919 - 4523
ALTAMIRA #594, CALLE ALDEBARAN SAN JUAN, P.R. 00920 - 4507
PJDC

PEDRO J. DAVILA COLON REGISTERED LAND SURVEYOR PUERTO RICO

CERTIFY CORRECT

PEDRO J. DAVILA COLON, SURVEYOR, LIC. NO. 4823

FIELD WORK BY: A. COTTO
CALCULATION BY: P. J. DAVILA, J. NIEVES
DRAWING BY: J. NIEVES
CADD DWG NAME: 1609-ALL.dwg
DATE: MARCH 27, 2025

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SHEET NO.: 02
OF: 02

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HORIZONTAL & VERTICAL CONTROL STATIONS

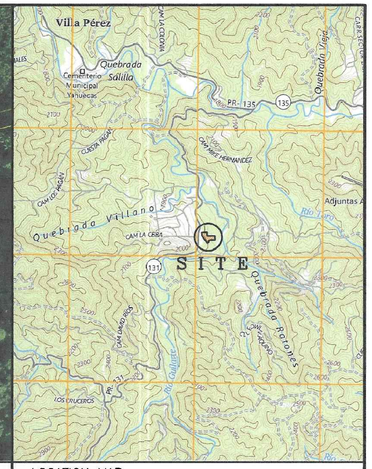
NORTHING	EASTING	ELEV.	DESCRIPTION
237527. 283	164224. 294	596. 345	STA. 1 PK NAIL
237528. 240	164194. 332	594. 961	STA. 2 PK NAIL
237489. 306	164206. 639	595. 274	STA. 3 PK NAIL

BUILDINGS TABLE

#	BUILDING ID
1	SLUDGE HOLDING TANK
2	CLEARWELL / DISTRIBUTION TANKS (LOCATED UNDERGROUND OF TREATMENT MODULES)
3	GENERATOR BUILDING
4	OPERATION BUILDING
5	TREATMENT MODULES
6	SLUDGE THICKENER
7	SLUDGE DRYING BEDS



AERIAL IMAGE — NOT TO SCALE



LOCATION MAP — SCALE: 1:20,000

PARCEL "A" ACQUISITION AREA (GUILARTE WTP)
1,688.3208 SQ. METERS
0.4296 CUERDAS

ADJUNTAS MUNICIPAL GOVERNMENT
CN: 265-000-004-20

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TO SITE ROAD PR-131 KM 2.5

ASPHALT ROAD

EXISTING STRUCTURE

CONCRETE PAVEMENT

ASPHALT AREA

CONCRETE WALL

CHAIN LINK FENCE OVER CONC.WALL

HOLDING TANK (1)

TREATMENT MODULES (5)

SLUDGE THICKENER (8)

SLUDGE DRYING BEDS (7)

GENERATOR ROOM

OPERATION ROOM

LABORATORY

STORAGE ROOM

OVERHANG

CONC. SLAB

BATHROOM

ELECTRICAL PANEL ROOM

METAL STAIR

BOMBA DE LAVADO

BOMBA DE DISTRIBUCION

WATER BOX

STA.1

STA.2

STA.3

W.EP

EP

WTP

GW

CEP

CETPt.u

CLEP

NOTES

1– ALL DISTANCES AND ELEVATIONS ARE EXPRESSED IN METERS.

2– THE HORIZONTAL CONTROL IS REFERRED TO THE DATUM NAD 83 (2011) EPOCH 2010. THE COORDINATES ARE REFERRED TO THE LAMBERT PROJECTION ZONE 5200 PR/VI.

3– VERTICAL CONTROL IS REFERRED TO ORTHOMETRIC HEIGHT COMPUTED WITH GEOID18.

4– **THE FOLLOWING REFERENCES WERE USED FOR THE PREPARATION OF THIS PLAN:**
- A. "SURVEYING AND TOPOGRAPHIC PLAN FOR SEGREGATION OF TRACK OF LAND PROPERTY OF THE MUNICIPAL GOVERNMENT BO.GUILARTE– ADJUNTAS, PR" MADE BY ENGINEER HERNAN GONZALEZ GONZALEZ, LIC. 9252
- B. EXISTING BOUNDARIES AND FENCES FOUND.

5– THIS DRAWING IS AN BOUNDARY, EXISTING CONDITIONS AND TOPOGRAPHIC SURVEY PLAN AND CAN BE ONLY USED AS SUCH.

6– THE CADASTRE NUMBERS AND NAMES OF THE NEIGHBORS WERE OBTAINED FROM THE CRIM VIRTUAL PAGE.

7– THIS DRAWING DEPICTS THE EXISTING CONDITIONS AT THE TIME WHEN THE SURVEY WAS PERFORMED.

8– FIELDWORK WAS PERFORMED ON FEBRUARY 21, 2025.

9– THE EQUIPMENT TO GEOREFERENCE THIS SITE CONSISTED OF A TRIMBLE R–121 ANTENNA WITH A MAXIMUM PRECISION OF 8MM + AS 0.5 PPM RMS CONNECTED TO THE P.R. VRS NETWORK.

10–EQUIPMENT TO PERFORM THIS SURVEY CONSISTED OF A TOTAL STATION (LEICA TS02, R–1000) WITH A 2 MILLIMETER ACCURACY.

0MTS. 5MTS. 10MTS. 20MTS.

GRAPHIC SCALE 1:200

PARCEL "A" – ACQUISITION AREA (GUILARTE WTP)

COURSE	BEARING	DISTANCE	PT#	NORTHING	EASTING	DESCRIPTION
1–2	N 33° 17' 43" W	8. 5761	1	237507. 2167	164203. 6361	TO ESTABLISH
2–3	N 32° 24' 02" W	9. 9124	2	237514. 3851	164198. 9282	TO ESTABLISH
3–4	N 31° 59' 07" W	9. 8875	3	237522. 7344	164193. 6168	TO ESTABLISH
4–5	N 32° 29' 40" W	15. 7227	4	237531. 1408	164188. 3794	TO ESTABLISH
5–6	N 57° 07' 49" E	14. 7585	5	237544. 4020	164179. 9329	TO ESTABLISH
6–7	S 32° 51' 54" E	20. 2413	6	237552. 4086	164192. 3236	TO ESTABLISH
7–8	N 87° 51' 25" E	6. 8288	7	237535. 4069	164203. 2078	TO ESTABLISH
8–9	N 88° 08' 07" E	35. 7078	8	237535. 6621	164210. 1259	TO ESTABLISH
9–10	N 87° 53' 18" E	12. 9497	9	237536. 8240	164245. 8147	TO ESTABLISH
10–11	N 83° 24' 49" E	8. 8732	10	237537. 3012	164258. 7536	TO ESTABLISH
11–12	S 02° 36' 19" W	9. 5643	11	237537. 5620	164261. 0138	TO ESTABLISH
12–13	S 02° 36' 16" W	11. 2970	12	237528. 0075	164260. 5791	TO ESTABLISH
13–14	N 89° 44' 10" W	15. 3624	13	237516. 7222	164260. 0557	TO ESTABLISH
14–15	N 89° 32' 23" W	18. 3120	14	237514. 7920	164244. 6935	TO ESTABLISH
15–16	S 74° 10' 00" W	5. 2775	15	237516. 9401	164226. 3721	TO ESTABLISH
16–17	S 75° 08' 38" W	5. 0099	16	237515. 5002	164221. 2948	TO ESTABLISH
17–1	S 61° 21' 44" W	14. 6037	17	237514. 2139	164216. 4523	TO ESTABLISH

Total Distance Traversed: 216.2919
AREA 1688. 3208 SQ. METERS = 0. 4296 CUERDAS

LEGEND

- 8"ø PIPE
- 6"ø PIPE
- 4"ø PIPE
- 2"ø PIPE
- HANDRAIL
- CHAIN LINK FENCE
- IRON FENCE
- OVERHEAD ELECTRIC POWER LINE
- OVERHEAD TELEPHONE LINE
- CONTOUR INTERVAL 0.25M
- CONTOUR INTERVAL 1.00M
- STORM SEWER UNDERGROUND PIPE
- PALM TREE
- TREE
- WTP WOOD TELEPHONE POLE
- WLEP WOOD LIGHT ELECTRIC POLE
- CEP CONCRETE ELECTRIC POLE
- CETPt.u CONCRETE ELECTRIC TELEPHONE POLE TRANSFORMER–UNDERGROUND
- CLP CONCRETE LIGHT POLE
- CLEP CONCRETE LIGHT ELECTRIC POLE
- GW GUY WIRE
- B BOLLARD
- GV GAS VALVE
- CO CLEAN OUT
- FH FIRE HYDRANT
- WM WATER METER
- WV WATER VALVE
- RS ROAD SIGN
- SC STOP CAR
- EP ELECTRIC PEDESTAL
- C COLUMN
- V.B VACUM BLOWER
- ES3 ELECTRIC SWITCH BOX
- MG MOTOR GATE
- MC METAL COVER
- P.CB PIPES CONCRETE BASE
- CS CONCRETE SLAB
- STA.58 ▲ CONTROL STATION
- 34.15 SPOT ELEVATION
- FFE=34.15 FINISHED FLOOR ELEVATION
- TSE=34.15 TOP STRUCTURE ELEVATION
- ID IN DRAIN
- CB T=0.00 I=0.00 CATCH BASIN
- SSMH T=0.00 I=0.00 STORM SEWER MANHOLE
- E.S. EXISTING STRUCTURE

PEDRO J. DAVILA COLON — REGISTERED LAND SURVEYOR — CERTIFY CORRECT — VERTO RICO

SURVEY, TOPOGRAPHIC & LAND ACQUISITION PLAN OF A TRACT OF LAND PROPERTY OF THE MUNICIPAL GOVERMENT OF ADJUNTAS
GUILARTE WTP IMPROVEMENTS FACILITIES
STATE ROAD PR–131 KM 2.5 INTERIOR, GUILARTE WARD, ADJUNTAS, PUERTO RICO

DATE	REVISION
DIC. 3, 2025	LARGEST ACQUISITION AREA
FEB. 11, 2025	PARCEL "A" LIMIT REVISED
JULY 22, 2026	PARCEL "A" LIMIT & TABLE REVISED

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PJDC

FIELD WORK BY: V. MORALES, A. COTTO
CALCULATION BY: P. J. DAVILA, J. NIEVES
DRAWING BY: J. NIEVES
CADD DWG NAME: 1809–ALL–Rvsd_Acqui–4.cwg
DATE: AUGUST 22, 2025

SCALE: 1:200
PLAN. NO.: JOB–1609
SHEET NO.: 01
OF: 01

NO	DATE	REVISION	BY	CK.	APPR.

DRAWN BY: CAE
DESIGNED BY: CAE
CHECKED BY:
APPR. BY:

Ancalle ENGINEERS
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GUILARTE WATER TREATMENT PLANT REHABILITATION (LT2) (FAAST)
ADJUNTAS, PUERTO RICO

SHEET TITLE
LAND ACQUISITION PLAN

Autoridad de Acueductos y Alcantarillados
GOBIERNO DE PUERTO RICO

C.I.P. No. 4-01-6012
PSWID
DATE: JUL / 2026
SCALE: N.T.S.

SHEET NO. 9 OF
DWG. NO. TS-03

BAR IS TWO CM ON ORIGINAL DWG. IF NOT TWO CM ON THIS SHEET, ADJUST SCALES ACCORDINGLY
0 2 CM