

**NC Department of Natural and Cultural Resources
Fort Fisher Aquarium – Renovation & Expansion
Phase 1
SCO ID #17-18042-02A**

The following items supersede the Bulletin #1 For Construction documents dated 12 December 2025 and shall become a part of those documents with full force and effect, as though set forth therein.

Where any article, division or subparagraph of the original contract documents or other addenda is supplemented herein, the provisions of the original documents shall remain in effect. All the supplemental provisions shall be considered as added thereto. Where any such article, division or subparagraphs are amended, voided or superseded thereby, the provisions of such article, division or subparagraph not so specifically amended, voided or superseded shall remain in effect.

It will be the responsibility of the Construction Manager to call such clarifications, additions to and changes in the plans and specifications to the attention of subcontractors concerned. The Designer in no way assumes any responsibility for notifying any subcontractor, material dealers or others not having received the original contract documents.

CHANGES TO THE DOCUMENTS:

GENERAL

1. Items revised to achieve agreed to cost reductions have been clouded on the drawing sheets.

CHANGES TO THE SPECIFICATIONS:

1. Section 012300 ALTERNATES
 - a. REVISE Alternate No. 3 – Alternate scope increased to include raising adjacent sunken-floor area and adding the wire curtain system as noted on the drawings.
2. Section 092900 GYPSUM BOARD

- a. Paper faced interior gypsum board varieties added for wallboard, ceiling board & moisture & mold resistant board.
- 3. Section 111600 MANUAL, GALVANIZED HOIST + CRANE EQUIPMENT
 - a. Replaces previous section that called for motorized hoist with stainless steel equipment.
- 4. Section 170405 CONNECTOR PLUGS & GAUGES KIT
 - a. Added new spec section.
- 5. Section 170410 PRESSURE GAUGES
 - a. Updated installation requirement locations.
 - b. Eliminated compound gauges for the substitution of connector plugs at all compound gauge locations.
 - c. Eliminated large filter pressure gauges for the substitution of connector plugs at these locations.
- 6. Section 170430 TEMPERATURE DEVICES
 - a. Eliminated thermometers. These are now included in connector plug and gauge kit.
- 7. Section 170476 PRESSURE TRANSDUCERS
 - a. Revised indicating gauge requirements for the substitution of connector plugs.
- 8. Section 170480 FLOAT SWITCHES
 - a. Added new specification section for level float switch for NPDES pump pit
- 9. Section 235216 CONDENSING BOILERS
 - a. Added new spec section
- 10. Section 236423.13 AIR-COOLED SCROLL WATER CHILLERS
 - a. Revised per the cooling plant narrative

CHANGES TO THE DRAWINGS:

Revisions to the drawings as noted to comply with items agreed to in the Value Engineering (VE) log attached:

- 1. G-1.11: TITLE SHEET
 - a. Added new sheets.
- 2. G-1.21 A: APPENDIX B – MAIN BUILDING
 - a. Updated plumbing fixture count per base bid.
- 3. G-1.22 A: APPENDIX B – GENERATOR BUILDING
 - a. Updated structure info.
- 4. G-1.22 B: APPENDIX B – GENERATOR BUILDING
 - a. Updated mech info.
- 5. G-1.23 A: APPENDIX B – PUMP BUILDING
 - a. Deleted chiller pump building info, updated pump building structure info.
- 6. G-1.23 B: APPENDIX B – PUMP BUILDING
 - a. Updated mech info.
- 7. G-1.24 A: APPENDIX B – BOILER BUILDING
 - a. New appendix B.
- 8. G-1.24 B: APPENDIX B – BOILER BUILDING
 - a. New appendix B.
- 9. G-1.31: FIRST FLOOR LIFE SAFETY PLAN
 - a. Updated plan to reflect changes to southeast wing, generator building, boiler building, chiller platform, and pump building.
- 10. G-1.31 C: FIRST FLOOR LIFE SAFETY – SOUTHEAST WING AND MECH BLDGs
 - a. Updated plans to reflect changes to southeast wing, generator building, and pump building.
 - b. Removed chiller building plan.
 - c. Added boiler building plan.
- 11. AD-1.11: FIRST FLOOR DEMO PLAN
 - a. Added demolition notes to boiler building (existing generator building).
- 12. AD-1.21 B: FIRST FLOOR DEMO PLAN – MAIN ENTRY & TOUCH TANK
 - a. Added note for base bid demolition at bathrooms 104 and 105.
- 13. AD-1.22 A: SECOND FLOOR DEMO PLAN – CAPE FEAR

- a. Existing doors to remain (automatic sliding doors removed from demo scope).
- 14. AP-1.11: 1ST FLOOR PHASING PLAN
 - a. Updated plan to reflect changes to southeast wing, generator building, boiler building, chiller platform, and pump building.
- 15. A-1.1: SITE PLAN
 - a. Updated plan to reflect changes to southeast wing, generator building, boiler building, chiller platform, and pump building.
 - b. Removed parallel bus parking and bike path rerouting along Loggerhead Rd.
- 16. A-2.11: FIRST FLOOR PLAN
 - a. Updated plan to reflect changes to southeast wing, generator building, boiler building, chiller platform, and pump building.
 - b. Extended alternate #3 cloud to include raised floor area in front of cape fear shoals tank.
 - c. Extended alternate #8 cloud.
- 17. A-2.12: SECOND FLOOR PLAN
 - a. Updated plan to reflect changes to southeast wing, generator building, boiler building, chiller platform, and pump building.
 - b. Extended alternate #8 cloud.
- 18. A-2.14: ROOF PLAN
 - a. Updated plan to reflect changes to southeast wing, generator building, boiler building, chiller platform, and pump building.
 - b. Extended alternate #8 cloud.
- 19. A-2.21 A: FIRST FLOOR PLAN – CAPE FEAR SHOALS
 - a. Extended alternate #3 cloud to include raised floor area in front of cape fear shoals tank.
- 20. A-2.21 B: FIRST FLOOR PLAN – TOUCH & SHARK TANK
 - a. Reconfigured some floor drains.
- 21. A-2.21 C: FIRST FLOOR PLAN – SOUTHEAST WING
 - a. Removed gendered changing rooms and single family restroom in favor of four single occupancy restrooms.
 - b. Extended the alternate #8 outdoor classroom roof.
 - c. Reconfigured outdoor classroom stepped seating, stairs, and ramp.
 - d. Moved stair wall slightly west to align with column G.6/E14.
- 22. A-2.21 D: FIRST FLOOR PLAN – MAIN ENTRY & MECH BUILDINGS
 - a. Broke out base bid plan for bathrooms R121 and R122.
 - b. Reduced width of generator building north access platform.
 - c. Flipped stair orientation at pump building.
 - d. Reduced size of chiller platform and removed prefab pump building.
 - e. Added plan for boiler building (existing generator building).
- 23. A-2.22 A: SECOND FLOOR PLAN – CAPE FEAR SHOALS
 - a. Existing doors to remain (automatic sliding doors removed from demo scope).
- 24. A-2.22 B: SECOND FLOOR PLAN – TOUCH & SHARK TANK
 - a. Updated room and door tag numbers.
- 25. A-2.22 C: SECOND FLOOR PLAN – SOUTHEAST WING
 - a. Extended the alternate #8 outdoor classroom roof.
 - b. Updated mech/restroom roof.
 - c. Moved stair wall slightly west to align with column G.6/E14.
- 26. A-2.23 A: THIRD FLOOR PLAN – SHARK TANK
 - a. Removed FRP gates and bridge platform from south side of tank.
 - b. Replaced roll up door E301-B with a double door, and replaced the telescoping, electric hoist and crane with a fixed, manual hoist and crane.
 - c. Adjusted trench drain location near hoist and crane door.
- 27. A-2.23 B: THIRD FLOOR PLAN – SOUTHEAST WING
 - a. Moved stair wall slightly west to align with column G.6/E14.
- 28. A-2.24 A: ROOF PLAN – SHARK & MECH BLDGs
 - a. Moved stair wall slightly west to align with column G.6/E14.
 - b. Updated plans to reflect changes to generator building, chiller platform, and pump building.

29. A-3.21 C: FIRST FLOOR – RCP – SOUTHEAST WING
 - a. Extended the alternate #8 outdoor classroom roof.
 - b. Updated ACT ceilings for restrooms.
30. A-3.21 D: FIRST FLOOR – RCP – MAIN ENTRY & MECH BLDGs
 - a. Broke out base bid plan for bathrooms R121 and R122.
 - b. Added plan for boiler building (existing generator building).
31. A-3.22 B: SECOND FLOOR – RCP – TOUCH & SHARK TANK
 - a. Salt storage and mixing room to have a manual hoist and crane.
 - b. Updated room number for the library/conference room.
32. A-3.23 A: THIRD FLOOR – RCP – SHARK TANK
 - a. Replaced the telescoping, electric hoist and crane with a fixed, manual hoist and crane.
33. A-4.11 A: FIRST FLOOR – ENLARGED FLOOR PLANS
 - a. Updated plan for southeast wing restrooms.
34. A-5.11: OVERALL EXTERIOR ELEVATIONS
 - a. Updated elevations to reflect changes to southeast wing, generator building, chiller platform, and pump building.
 - b. Extended the alternate #8 outdoor classroom roof.
 - c. Replaced roll up door E301-B with a double door.
35. A-5.21: BUILDING ELEVATIONS – SOUTHEAST WING
 - a. Removed gendered changing rooms and single family restroom in favor of four single occupancy restrooms.
 - b. Extended the alternate #8 outdoor classroom roof.
 - c. Reconfigured outdoor classroom stepped seating, stairs, and ramp.
36. A-5.22: BUILDING ELEVATIONS – SHARK TANK
 - a. Replaced roll up door E301-B with a double door.
37. A-5.23: BUILDING ELEVATIONS – RENOVATIONS AND GENERATOR BUILDING
 - a. Reduced width of generator building north access platform.
38. A-6.22: STAIRS AND ELEVATORS
 - a. Added slope annotations.
39. A-6.25: STAIRS AND ELEVATORS
 - a. Reduced width of chiller platform stairs.
40. A-6.26: STAIRS AND ELEVATORS
 - a. Reduced width of generator building north access platform.
 - b. Flipped stair orientation at pump building.
41. A-6.31: TOILET ELEVATIONS
 - a. Removed gendered changing rooms and single family restroom in favor of four single occupancy restrooms.
42. A-7.3: WALL SECTIONS
 - a. Replaced the telescoping, electric hoist and crane with a fixed, manual hoist and crane.
43. A-8.11: TOUCH TANK DETAILS
 - a. Replaced marine grade plywood backup with CDX.
44. A-8.12: FIBERGLASS TANK DETAILS
 - a. Replaced marine grade plywood backup with CDX.
45. A-8.22: PLAN DETAILS
 - a. Moved stair wall slightly west to align with column G.6/E14.
46. A-8.40: TYPICAL ROOF DETAILS
 - a. New sheet.
47. A-9.1: FINISH SCHEDULE
 - a. Updated schedule to reflect updates at southeast wing restrooms and boiler building.
48. A-9.3: DOOR SCHEDULE
 - a. Changed many interior doors from aluminum frames to HM frames.
 - b. Replaced roll up door E301-B with a double door.
 - c. Updated flood proofing door schedule per changes at southeast wing restrooms and boiler building.
49. S-111B: FOUNDATION PLAN – TOUCH & SHARK TANK

- a. Updated notes
 - b. Added pile forces
 - c. Updated foundations
 - d. Updated wall types
50. S-112B: FOUNDATION PLAN – SHARK TANK PARTIAL ENLARGED PLAN
- a. Added notes
 - b. Updated reinforcing types (galvanized vs black)
51. S-114C: FOUNDATION PLAN – SOUTHEAST WING
- a. Updated overall foundation plan
52. S-121B: FIRST FLOOR FRAMING PLAN –TOUCH & SHARK TANK
- a. Updated wall types
 - b. Updated member callouts
53. S-122B: FIRST FLOOR SLAB REINFORCEMENT PLAN –TOUCH & SHARK TANK
- a. Updated housekeeping pads
54. S-125C: FIRST FLOOR FRAMING PLAN –SOUTHEAST WING
- a. Updated overall slab plan
 - b. Updated sections
55. S-126C: FIRST FLOOR SLAB REINFORCEMENT PLAN –SOUTHEAST WING
- a. Updated slab reinforcing
56. S-131B: SECOND FLOOR SLAB REINFORCEMENT PLAN –TOUCH & SHARK TANK
- a. Updated slab callouts
57. S-140B: FRAMING PLAN UNDER SHALLOW TANKS AT SHARK TANK
- a. Updated wall types
58. S-150B: THIRD FLOOR FRAMING PLAN –TOUCH & SHARK TANK
- a. Updated wall types
59. S-160B: ROOF FRAMING PLAN –TOUCH & SHARK TANK
- a. Updated wall types
 - b. Updated beam types
 - c. Updated member callouts
60. S-161B: ROOF REINFORCEMENT PLAN –TOUCH & SHARK TANK
- a. Updated slab types
 - b. Updated beam alignment
61. S-162C: ROOF FRAMING PLAN –SOUTHEAST WING
- a. Updated framing plan
62. S-170: FRAMING PLAN –CONNECTOR AREA
- a. Updated slab types
 - b. Updated beam types
63. S-200B: FRAMING PLAN –ENLARGED PARTIAL PLANS
- a. Updated wall types
 - b. Updated foundation dimensions
 - c. Updated housekeeping pads
64. S-201B: FRAMING PLAN –ENLARGED PARTIAL PLANS
- a. Updated housekeeping pads
65. S-205B: SHARK TANK SKIMMER FRAMING PLANS & DETAILS
- a. Updated rebar details
66. S-206B: TOUCH TANK SKIMMER FRAMING PLANS & DETAILS
- a. Updated rebar and angle information
 - b. Added waterstops
67. S-220D: SLAB & ROOF PLANS – MECHANICAL BUILDING
- a. Updated stair framing plan
 - b. Revised rebar details
 - c. Updated connection details
68. S-221E: CHILLER PLATFORM FRAMING PLAN
- a. Updated platform plan & details
69. S-221F: BOOSTER PUMP FRAMING PLAN

- a. Updated platform
- 70. S-301: TYPICAL FOUNDATION DETAILS
 - a. Updated slab schedule
- 71. S-302: PILE CAP DETAILS
 - a. Revised pile cap details
- 72. S-303: PILE CAP DETAILS
 - a. Added new sheet
- 73. S-304: SHARK TANK PARATIAL ENLARGED PLAN – PILE FORCES
 - a. Added new sheet
- 74. S-305: FOUNDATION ENLARGED PARATIAL PLAN – MAX PILE LOADS
 - a. Added new sheet
- 75. S-400: SALT MIXING AREA PLANS AND SECTIONS
 - a. Updated rebar and angle information
- 76. S-403: SECTIONS AT SHARK TANK
 - a. Updated rebar and angle information
- 77. S-410: SECTIONS
 - a. Added section
- 78. S-411: SECTIONS
 - a. Updated beam location
- 79. S-412: SECTIONS AT SOUTHEAST ADDITION
 - a. Updated/Added section
- 80. S-500: FIRST FLOOR SECTIONS
 - a. Updated reinforcing types (galvanized vs black)
 - b. Added waterstops
- 81. S-501: FIRST FLOOR SECTIONS
 - a. Updated reinforcing types (galvanized vs black)
- 82. S-502: FIRST FLOOR SECTIONS
 - a. Updated reinforcing types (galvanized vs black)
 - b. Updated rebar details
- 83. S-503: SOUTHEAST WING - FIRST FLOOR SECTIONS
 - a. Updated rebar details
 - b. Deleted section
- 84. S-506: SOUTHEAST WING - ROOF SECTIONS
 - a. Updated/edited sections
- 85. S-510: SECOND FLOOR SECTIONS
 - a. Updated reinforcing types (galvanized vs black)
 - b. Updated connection details
- 86. S-601: STRUCTURAL SCHEDULES
 - a. Updated reinforcing types (galvanized vs black)
- 87. S-602: STRUCTURAL SCHEDULES
 - a. Updated reinforcing types (galvanized vs black)
 - b. Added wall types
- 88. S-603: LOAD BEARING CMU WALL ELEVATIONS
 - a. Updated wall elevations
- 89. F-0.1: FIRE PROTECTION GENERAL NOTES AND DETAILS
 - a. Air compressor changed from 3 HP to 5 HP
 - b. Dry riser work shown in Detail A moved to Base Bid.
- 90. F-2.21B: FIRST FLOOR FIRE PROTECTION PLAN – TOUCH & SHARK TANK
 - a. Dry pipe shown east of Corridor R109 all the way to the Outdoor Classroom moved to Base Bid
- 91. F-2.21C: FIRST FLOOR FIRE PROTECTION PLAN – SOUTHEAST WING
 - a. Revised sprinkler head and piping layout based on expanded Outdoor Classroom and Single Occupancy Changing Rooms
- 92. PD1.21B — FIRST FLOOR DEMO PLAN – MAIN ENTRY & TOUCH TANK
 - a. Plumbing demolition base plan has been revised.

- 93. PS2.21C — SOUTHEAST WING – WASTE/VENT
 - a. Sanitary piping revised to reflect updated base plan converting gang restrooms to individual restrooms.
- 94. PS2.21D — MAIN ENTRY & MECH BLDG – WASTE/VENT
 - a. Plumbing demolition plan revised to reflect updated base plan.
- 95. PS2.22B — TOUCH AND SHARK TANK – WASTE/VENT
 - a. Sanitary waste and drain piping revised.
- 96. PS2.22C — SOUTHEAST WING – WASTE/VENT
 - a. Roof plan revised to reflect stormwater system updates.
- 97. PS2.23B — SHARK TANK – WASTE/VENT
 - a. Sanitary waste and drain piping revised.
- 98. PW2.21C — SOUTHEAST WING – DOMESTIC WATER
 - a. Domestic water piping revised to reflect updated restroom layout.
- 99. P-4.11 — ENLARGED PLANS – WASTE/VENT & DOMESTIC WATER
 - a. Enlarged plans revised to reflect domestic water and sanitary waste updates for individual restroom layout.
- 100. P-6.11 — PLUMBING RISER DIAGRAMS (GENERAL)
 - a. Riser diagrams revised to reflect updated restroom layout.
- 101. MD1.21: FIRST FLOOR DEMO PLAN
 - a. Base bid work in bathrooms and IT added and isolated
- 102. MD2.21 B: FIRST FLOOR DEMO PLAN – MAIN ENTRY & TOUCH TANK – HYDRONICS
 - a. Existing generator bldg plan added
- 103. MH2.11: FIRST FLOOR PLAN – HVAC
 - a. Updated enlarged plan callouts
- 104. MH2.21 C: FIRST FLOOR PLAN – SOUTHEAST WING – HVAC
 - a. FCU-19, DHC-19, PV3, L6, L13 removed. Other HVAC items removed per floor plan change.
 - b. EUH1/2/3/4, PV13/14/15/16, L19 added.
- 105. MH2.21 D: FIRST FLOOR PLAN – MAIN ENTRY & MECH BLDNG – HVAC
 - a. Added base bid main entry plans
 - b. Moved pump room support equipment to existing generator bldg.
 - c. Chiller platform update.
 - d. Relocated DHP-12.
- 106. MH2.23 B: THIRD FLOOR PLAN – SHARK TANK – HVAC
 - a. Replaced sections of metal duct with fabric duct.
- 107. MH3.21 C: FIRST FLOOR – RCP – SOUTHEAST WING – HVAC
 - a. Added PV13/14/15/16 & EUH1/2/3/4.
 - b. Removed other HVAC items.
- 108. MH3.21 D: FIRST FLOOR – RCP – MAIN ENTRY & MECH BLDNG – HVAC
 - a. Added existing generator bldg view 2
 - b. added thermostat locations
 - c. Added base bid main entry plans.
- 109. MP2.21 B: FIRST FLOOR PLAN – TOUCH AND SHARK TANK – HYDRONICS
 - a. Added SRK-HEX001-001 tag
- 110. MP2.21 C: FIRST FLOOR PLAN – SOUTHEAST WING – HYDRONICS
 - a. FCU-19, DHC-19 removed.
 - b. Piping modified per floor plan change.
- 111. MP2.21 D: FIRST FLOOR PLAN – MAIN ENTRY, MECH SITE PLAN AND FUEL OIL SYSTEM
NARRATIVE – HYDRONICS
 - a. Base bid note added
- 112. MP2.21 F: CHILLER PLATFROM – HYDRONICS
 - a. Updated chiller platform equipment and piping
 - b. Relocated pumps.
- 113. MP2.21 G: CHILLER PLATFORM AND PUMP BUILDING - HYDRONICS SECTIONS AND 3D
VIEWS
 - a. Updated chiller platform and added central plant (existing generator building) views.

- 114. M-6.1: MECHANICAL SCHEDULES
 - a. Added boiler & electric heater schedule
 - b. ACCH: ACCH-1/2 modified to new unit. ACCH-3 added. Notes updated
 - c. DAH/DHP: DAH-10/DAH-10 unit location updated, Note 4 updated
 - d. PV: Removed PV3. Added PV12/13/14/15.
 - e. Pumps: Removed ACCHP-1/2, HRCHP-1, HRHWP-1. Added PCHWP-1/2, PHRWP-1/2, BP-1/2.
 - f. Note 2 edited.
 - g. HRCH: Schedule removed
- 115. M-6.2: MECHANICAL SCHEDULES
 - a. FCU-19, DHC-19, L6, L13 removed. L19 added
- 116. M-7.1: MECHANICAL CONTROLS
 - a. Remove chiller heater system controls
 - b. Add chiller and boiler controls
- 117. M-7.2: MECHANICAL CONTROLS
 - a. Remove chiller heater system controls
 - b. Add chiller and boiler controls
- 118. M-7.9: MECHANICAL CONTROLS
 - a. Removed FCU-19 controls
- 119. M-8.3: MECHANICAL CHILLED AND HOT WATER PIPING FLOW DIAGRAM
 - a. Updated chilled and hot water plant piping flow diagram
- 120. M-8.4: MECHANICAL ISOMETRICS
 - a. Updated isometric
- 121. M-8.6: CHILLED WATER PIPING FLOW DIAGRAM - BUILDING LOOP
 - a. New Sheet - chilled water piping flow diagram - building loop
- 122. M-8.7: HEATING HOT WATER PIPING FLOW DIAGRAM - BUILDING LOOP
 - a. New Sheet - heating hot water piping flow diagram - building loop
- 123. E-0.1: ELECTRICAL SYMBOLS AND ABBREVIATIONS
 - a. Updated Legend Symbols and Descriptions
- 124. ED1.01: SITE DEMO PLAN
 - a. Revised note for Site Lighting
- 125. ED1.21 B - FIRST FLOOR DEMO PLAN - MAIN ENTRY & TOUCH TANK – POWER
 - a. Base bid work in bathrooms and IT added and isolated
- 126. ED2.21 B - FIRST FLOOR DEMO PLAN - MAIN ENTRY, TOUCH TANK, AND GENERATOR BUILDING - LIGHTING
 - a. Base bid work in bathrooms and IT added and isolated
- 127. ED6.1 - EXISTING SERVICE 1 OF 2 - 208/120V SINGLE LINE DIAGRAM – DEMOLITION
 - a. Updated and made clarifications to Riser
- 128. ED6.2 - EXISTING SERVICE 2 OF 2 -480/277 VOLT SINGLE LINE DIAGRAM - DEMOLITION
 - a. Updated and made clarifications to Riser
- 129. E-2.11 - FIRST FLOOR PLAN
 - a. Existing generator bldg plan added
- 130. EP1.01 - ELECTRICAL SITE PLAN
 - a. Boiler Bldg (existing generator bldg.) added,
 - b. updated Mech Platform and UG Conduits
- 131. EP2.21 A – FIRST FLOOR PLAN – CAPE FEAR SHOALS – POWER
 - a. Updated general notes
- 132. EP2.21 B: FIRST FLOOR PLAN – TOUCH AND SHARK TANK – POWER
 - a. Updated general notes
 - b. updated LSS Equip
 - c. Hoist made Future and Existing Well pump added
- 133. EP2.21 C: FIRST FLOOR PLAN – SOUTHEAST WING – POWER
 - a. Updated general notes
 - b. updated floor plan per Changing Rm revisions
- 134. EP2.21 D: FIRST FLOOR PLAN – MAIN ENTRY, GENERATOR BUILDING, CHILLER PLATFROM – POWER

- a. Updated general notes
- b. Added base bid to main entry plans
- c. Moved pump room electrical equipment to Boiler Bldg (existing generator bldg.)
- d. Chiller platform update.
- 135. EP2.22 A - SECOND FLOOR PLAN - CAPE FEAR SHOALS – POWER
- a. Updated general notes
- 136. EP2.22 B: SECOND FLOOR PLAN – TOUCH AND SHARK TANK – POWER
- a. Updated general notes
- 137. EP2.22 C: SECOND FLOOR PLAN – SOUTHEAST WING– POWER
- a. Updated general notes
- 138. EP2.23 A - THIRD FLOOR PLAN - SOUTHEAST WING – POWER
- a. Updated general notes
- 139. EP2.23 B - THIRD FLOOR PLAN - SHARK TANK – POWER
- a. Updated general notes
- 140. EP3.21 A - FIRST FLOOR PLAN - CAPE FEAR SHOALS - HVAC POWER
- a. Updated general notes
- 141. EP3.21 B: FIRST FLOOR PLAN – TOUCH AND SHARK TANK – HVAC POWER
- a. Updated general notes
- 142. EP3.21 C: FIRST FLOOR PLAN – SOUTHEAST WING– HVAC POWER
- a. Updated general notes
- b. updated floor plan per Changing Rm revisions
- 143. EP3.21 D: FIRST FLOOR PLAN – MAIN ENTRY, BOOSTER PUMP BLDG & MECH BLDG – HVAC POWER
- a. Updated general notes
- b. Added base bid to main entry plans
- c. Added Boiler Building (existing generator bldg.) and moved pump room mechanical equipment to Boiler Bldg
- d. Chiller platform removed from sheet
- e. DHP-12 moved at water booster pump building.
- 144. EP3.21 E: FIRST FLOOR PLAN – FRESHWATER HABITAT– HVAC POWER
- a. Updated general notes
- 145. EP3.22 A - SECOND FLOOR PLAN - CAPE FEAR SHOALS - HVAC POWER
- a. Updated general notes
- 146. EP3.22 B: SECOND FLOOR PLAN – TOUCH AND SHARK TANK – HVAC POWER
- a. Updated general notes
- 147. EP3.22 C: SECOND FLOOR PLAN – SOUTHEAST WING – HVAC POWER
- a. Updated general notes
- 148. EP3.23 A - THIRD FLOOR PLAN - SOUTHEAST WING - HVAC POWER
- a. Updated general notes
- 149. EP3.23 B: THIRD FLOOR PLAN – SHARK TANK – HVAC POWER
- a. Updated general notes
- 150. EP3.24 B - ROOF PLANS - SHARK TANK - HVAC POWER
- a. Updated general notes
- 151. EP4.01: ELECTRICAL ENLARGED MAIN ENTRY & PUMP BUILDING PLANS
- a. Updated general notes
- 152. EP4.02: ELECTRICAL ENLARGED PLANS 1ST FLOOR PUMP PIT, WORKSHOP, LIFE SUPPORT SYSTEMS
- a. Updated general notes and LSS equipment
- 153. EP4.03: ELECTRICAL ENLARGED PLANS 2ND FLOOR SUPPORT AREA AND CORAL MEZZ
- a. Updated general notes and LSS equipment
- 154. EP4.04: ELECTRICAL ENLARGED PLANS 2ND AND 3RD FLOORS
- a. Updated general notes and LSS equipment
- 155. EL1.21 A - FIRST FLOOR - CAPE FEAR SHOALS – LIGHTING
- a. Updated general notes
- 156. EL1.21 B: FIRST FLOOR – TOUCH & SHARK TANK – LIGHTING

- a. Updated general notes
- 157. EL1.21 C: FIRST FLOOR – SOUTHEAST WING – LIGHTING
 - a. Updated general notes
 - b. updated floor plan and lights per Changing Rm revisions
- 158. EL1.21 D - FIRST FLOOR - MAIN ENTRY, CHILLER PLATFORM, PUMP AND GENERATOR BUILDINGS – LIGHTING
 - a. Updated general note
 - b. Added Boiler Building (existing generator bldg.)
 - c. added lighting in Boiler Bldg and to Chiller platform.
- 159. EL1.21 E - FIRST FLOOR - FRESHWATER HABITAT - LIGHTING
 - a. Updated general notes
- 160. EL1.22 A - SECOND FLOOR - CAPE FEAR SHOALS - LIGHTING
 - a. Updated general notes
- 161. EL1.22 B - SECOND FLOOR - TOUCH AND SHARK TANK - LIGHTING
 - a. Updated general notes
- 162. EL1.22 C - SECOND FLOOR - SOUTHEAST WING - LIGHTING
 - a. Updated general notes
- 163. EL1.23 A - THIRD FLOOR - SOUTHEAST WING - LIGHTING
 - a. Updated general notes
- 164. EL1.23 B: THIRD FLOOR – SHARK TANK – LIGHTING
 - a. Updated general notes
- 165. E-5.4: ELECTRICAL DETAILS
 - a. Updated ductbank detail
- 166. E-5.7: PLACARD AND PLACARD MAP
 - a. Updated placard information for Boiler Building
- 167. E-6.1: SINGLE LINE DIAGRAM (1 OF 2)
 - a. Updated and made clarifications to Riser
- 168. E-6.2: SINGLE LINE DIAGRAM (2 OF 2)
 - a. Updated and made clarifications to Riser
- 169. E-6.3: ELECTRICAL SCHEDULES AND ELEVATIONS
 - a. Updated Schedules
- 170. E-6.4: ELECTRICAL PANELSCHEDULES
 - a. Updated Schedules
- 171. E-6.5: ELECTRICAL PANELSCHEDULES
 - a. Updated Schedules
- 172. E-6.6: ELECTRICAL PANELSCHEDULES
 - a. Updated Schedules
- 173. E-6.9: ELECTRICAL PANELSCHEDULES
 - a. Updated Schedules
- 174. E-6.10: ELECTRICAL PANELSCHEDULES
 - a. Updated Schedules
- 175. E-6.12: ELECTRICAL PANELSCHEDULES
 - a. Updated Schedules
- 176. E-6.14: SYSTEM GROUND RISER
 - a. Updated Ground Riser
- 177. E-6.15: ELECTRICAL WIRING DIAGRAM AND FIRST RESPONDERS RISER
 - a. Updated Fuel system block diagram
- 178. E-6.16: LIGHT FIXTURE SCHEDULE, ENERGY COMPLIANCE AND NON-CORROSIVE RM'S SCHEDULE
 - a. Updated LFS
- 179. E-6.17 - TELECOM RISER
 - a. Renamed Telecom riser to Boiler Bldg
- 180. E-6.18: MECHANICAL EQUIPMENT CONNECTIONS SCHEDULE
 - a. Updated Schedule
- 181. E-6.19: ELECTRICAL EQUIPMENT CONNECTION SCHEDULE

- a. Updated Schedule
- 182. LT-004: PANEL SCHEDULE
 - a. Updates to alternate #8.
- 183. LT-201: OVERALL RCP – LEVEL 1
 - a. Updates to alternate #8.
- 184. LT-312: ENLARGED RCP – LEVEL 1 – VIEWING AREA, TEACHING ROOM, AND OUTDOOR CLASSROOM
 - a. Updates to alternate #8.
- 185. FA2.21: FIRST FLOOR - SOUTHEAST WING - FIRE ALARM
 - a. Updated FA layout and updated floor plan per Changing Rm revisions
- 186. FA2.21 D: FIRST FLOOR -MAIN ENTRY & BOILER BUILDING - FIRE ALARM
 - a. Added base bid FA informatino to main entry plans and added Boiler Bldg FA
 - b. Removed chiller platform from sheet.
- 187. FA6.1: FUNCTIONAL FIRE ALARM RISER DIAGRAM
 - a. Updated FA Riser
 - b. renamed (X)Generator Bldg to Boiler Building
- 188. LS0.01: SHEET INDEX
 - a. New sheet added LS9.00 for SRK carbon filter fabrication drawing with reduced 5' dia vessel
- 189. LS0.03: EQUIPMENT SCHEDULES
 - a. Updated SRK filter pump -002 for future procurement
 - b. Updated SRK carbon filter pump for use with 5' dia carbon filter. Is a smaller model and smaller HP motor
 - c. Updated REC fractionator and sand filter pumps (REC-PFIL02-001, REC-PFIL02-002, & REC-PFRC01-001) for future procurement
 - d. Updated spare MDM pumps for future procurement
 - e. Upsized drain down pump SWD-PDRN01-001 in NPDES lift
 - f. moved deaeration tower schedule to LS0.07 for space
- 190. LS0.04: EQUIPMENT SCHEDULES
- 191. Updated TOU, SRK, & REC fractionator ozone generators and backflow prevention devices for future procurement.
- 192. LS0.06: EQUIPMENT SCHEDULES
 - a. Updated SRK sand filter -002 for future procurement
 - b. Updated SRK carbon filter to be 5' diameter instead of 8' diameter and fabrication sheet reference. 3. Updated REC drum filters REC-FDR001-001 & -002 for future procurement 4. Updated REC sand filters REC-FSV048-001 & -002 for future procurement
- 193. LS0.07: EQUIPMENT SCHEDULES
 - a. Updated REC ozone fractionator REC-OFRC24-001 for future procurement.
 - b. Updated PBA CO2 equipment for future procurement
 - c. moved deaeration tower schedule from LS0.03 to LS0.07 for space.
- 194. LS0.09: CONTROL NOTES
 - a. Added pH control note pH/1 for clarity.
 - b. Add float switch control note SW/1 for new high water level alarm monitroing to NPDES Pump Pit.
 - c. Updated notes, PU/13, PU/14, V/1, V/6, V/7, V/8, V/9, & V/10 for future use
- 195. LS0.10 CONTROL SCHEDULES
 - a. Updated points list for future devices.
 - b. Added NPDES drain pit level float switch to points list
 - c. Updated ACS wiring note W to be future installed
 - d. Added new wiring note Y for ACS to level float switch wiring
- 196. LS0.41A-TOU: TOUCH TANK EXHIBIT AND HOLDING - PIPING AND INSTRUMENTATION DIAGRAM
 - a. Updated TOU automated saltwater makeup fill valve and piping to be future installed. Contractor to install caps to allow future installation.
- 197. LS0.41B-TOU: TOUCH TANK EXHIBIT AND HOLDING - PIPING AND INSTRUMENTATION DIAGRAM
 - a. Updated TOU fractionator ozone supply and offgas to destruct to be future installed. ORP monitoring TOU-ORPM01-003 to be future
 - b. Gauges swapped with connector plugs

198. LS0.41C-TOU: TOUCH TANK EXHIBIT AND HOLDING - PIPING AND INSTRUMENTATION DIAGRAM
- a. Updated tower offgas destruct piping and ORP sample line to be future installed including ORPs TOU-ORPM01-001 and TOU-ORPM01-002. BLVs and capped connections required to allow future connections. Vent at top of tower to stay with a goose neck termination for air flow
 - b. Pressure and temperature gauges swapped with connector plugs
199. LS0.42B-SRK: SAND TIGER SHARK EXHIBIT AND HOLDING - PIPING AND INSTRUMENTATION DIAGRAM
- a. Updated both SRK fractionator ozone supply and SRK fractionator ORPS 003 & 004 to be future installed.
 - b. Updated SRK fractionator flow meters 008 & 009 to be future installed
 - c. Updated SRK filter pump -002 and associated valves and equipment to be future installed. 8" blind flange to allow connection in future
 - d. Gauges swapped with connector plugs
200. LS0.42C-SRK: SAND TIGER SHARK EXHIBIT AND HOLDING - PIPING AND INSTRUMENTATION DIAGRAM
- a. Updated sand filter -002 and associated valves and piping to be future installed. 8" blind flange on BWD and 8" cap on supply header to allow connections in future.
 - b. Updated carbon filter piping and valve to 4"
 - c. Gauges swapped with connector plugs with the exception of pressure gauges on inlet and outlet of ozone injector.
201. LS0.42D-SRK: SAND TIGER SHARK EXHIBIT AND HOLDING - PIPING AND INSTRUMENTATION DIAGRAM
- a. Updated TOU fractionator offgas connection to be future installed
 - b. Updated carbon filter to 5' diameter. Associated piping updated to 4"
 - c. Gauges swapped with connector plugs
202. LS0.43A-LCR: LIVE CORAL - PIPING AND INSTRUMENTATION DIAGRAM
- a. Updated TOU tower offgas destruct connection to be future installed
 - b. Gauges swapped with connector plugs
203. LS0.43B-LCR: LIVE CORAL - PIPING AND INSTRUMENTATION DIAGRAM
- a. Pressure and temperature gauges swapped with connector plugs
204. LS0.44A-AQC: AQUACULTURE - PIPING AND INSTRUMENTATION DIAGRAM
- a. Gauges swapped with connector plugs
205. LS0.45A-PBA: PIABA - PIPING AND INSTRUMENTATION DIAGRAM
- a. Updated CO2 injection to be future installed.
 - b. Pressure and temperature gauges swapped with connector plugs
206. LS0.46A-HTT: HOLDING TOUCH TANK SYSTEM - PIPING AND INSTRUMENTATION DIAGRAM
- a. Gauges swapped with connector plugs with the exception of the pressure gauge on air blower discharge
207. LS0.47A-HC1: CORAL GROWING HOLDING TANK SYSTEM 1 - PIPING AND INSTRUMENTATION
- a. Pressure and temperature gauges swapped with connector plugs
208. LS0.47B-HC2: CORAL GROWING HOLDING TANK SYSTEM 2 - PIPING AND INSTRUMENTATION
- a. Pressure and temperature gauges swapped with connector plugs
209. LS0.53A-REC: BACKWASH RECOVERY - PIPING AND INSTRUMENTATION DIAGRAM
- a. Updated SRK carbon filter backwash pipe size to 4"
 - b. Gauges swapped with connector plugs
 - c. Recovery system modifications and future items set up dirty basin for moving water to NPDES discharge, setting up clean basin to act as supplemental saltwater makeup storage for Shark, and setting up the intermediate basin to act either as an extension to dirty or an extension to clean depending on how the operator decides to run.
 - d. Reroute clean and intermediate basin overflow connection to NPDES instead of to dirty basin.
210. LS0.53B-REC: BACKWASH RECOVERY - PIPING AND INSTRUMENTATION DIAGRAM
- a. Gauges swapped with connector plugs
 - b. Recovery system modifications and future items set up dirty basin for moving water to NPDES discharge, setting up clean basin to act as supplemental saltwater makeup storage for Shark, and

- setting up the intermediate basin to act either as an extension to dirty or an extension to clean depending on how the operator decides to run
211. LS0.54A-FMU: FRESHWATER MAKEUP - PIPING AND INSTRUMENTATION DIAGRAM
 - a. Gauges swapped with connector plugs.
 - b. Reduced FWM piping and valves from 4" to 3" from supply loop to Saltwater storage tank and saltwater mixing basin.
 - c. Future bws piping and 4" cap to allow future recovery filters connection
 212. LS0.55A-SMU: SALTWATER MAKEUP - PIPING AND INSTRUMENTATION DIAGRAM
 - a. Added level float switch to NPDES lift pit
 - b. Gauges swapped with connector plugs.
 - c. Reduced FWM piping from 4" to 3" from supply loop to Saltwater storage tank and saltwater mixing basin.
 - d. Recovery BWD piping made future with cap to allow future connection.
 - e. Pump down piping from dirty recovery basin to NPDES for recovery system operation modifications.
 213. LS0.56A-ROF: REVERSE OSMOSIS/ DI FRESHWATER SYSTEM - PIPING AND INSTRUMENTATION DIAGRAM
 - a. Gauges swapped with connector plugs
 214. LS0.57A-ROS: REVERSE OSMOSIS/ DI SALTWATER SYSTEM - PIPING AND INSTRUMENTATION DIAGRAM
 - a. Gauges swapped with connector plugs
 215. LS0.58A-CRO: COLD REVERSE OSMOSIS SYSTEM - PIPING AND INSTRUMENTATION DIAGRAM
 - a. Gauges swapped with connector plugs
 216. LS0.59A-GEN: GENERAL OZONE SYSTEM - PIPING AND INSTRUMENTATION DIAGRAM
 - a. Updated TOU and SRK fractionator ozone generation for future installation
 - b. Fixed off-page connector for clarity
 217. LS3.00: ENLARGED LSS PLAN - BELOW GRADE - EL. 0' TO 10.33'
 - a. SRK carbon filter bwd piping reduced from 6" to 4". 2. Reduced FWM piping from 4" to 3" from supply loop to saltwater mixing basin.
 218. LS3.01: ENLARGED LSS PLAN - BELOW GRADE - EL. -5.0' TO 0.83'
 - a. Added level float switch in NPDES lift pit
 219. LS3.02: ENLARGED LSS PLAN - BELOW GRADE - EL. -1.0' TO 10.0'
 - a. Reduced FWM piping from 4" to 3" from supply loop to saltwater mixing basin.
 220. LS3.11: ENLARGED LSS PLAN - PUMP PIT AND BELOW GRADE - EL. 0.83' TO 6.75'
 - a. Reduced FWM piping from 4" to 3" from supply loop to Saltwater storage tank and saltwater mixing basin.
 - b. Recovery system modifications and future items set up dirty basin for moving water to NPDES discharge, setting up clean basin to act as supplemental saltwater makeup storage for Shark, and setting up the intermediate basin to act either as an extension to dirty or an extension to clean depending on how the operator decides to run.
 - c. EQ cross connection b/w clean and intermediate basins with drain, valves, and flanges.
 - d. Fractionator pump and piping future.
 - e. New section 3/LS5.09 call out.
 - f. Future connections and capped locations for future tie ins
 221. LS3.13: ENLARGED LSS PLAN - PUMP PIT AND BELOW GRADE - EL. 0.83' TO 6.75'
 - a. Recovery system modifications and future items set up dirty basin for moving water to NPDES discharge, setting up clean basin to act as supplemental saltwater makeup storage for Shark, and setting up the intermediate basin to act either as an extension to dirty or an extension to clean depending on how the operator decides to run.
 - b. EQ cross connection b/w dirty and intermediate basins with valve, and flanges.
 - c. Updated REC sandfilter pumps REC-PFIL002-001 &-002 and piping to future.
 - d. New section 3/LS5.09 call out.
 - e. REC dirty basin sight gauge and section 2/LS5.01 relocated.
 - f. REC dirty basin overflow relocated.
 222. LS3.18: ENLARGED LSS PLAN - BELOW GRADE - EL. -1.17' TO 7.25'

- a. Add new section call out for clarity.
- 223. LS3.21: ENLARGED LSS PLAN - PUMP PIT CEILING PLAN AND BELOW GRADE - EL. 6.75' TO 10.33'
 - a. Reduced fwm piping from 4" to 3" from supply loop to Saltwater storage tank and saltwater mixing basin.
 - b. New section 3/LS5.09 call out.
 - c. REC fractionator pipe shown as future
- 224. LS3.23: ENLARGED LSS PLAN - PUMP PIT CEILING PLAN AND BELOW GRADE - EL. 6.75' TO 10.33'
 - a. REC sandfilter piping future.
 - b. New section 3/LS5.09 call out.
 - c. REC dirty basin sight gauge and section 2/LS5.01 relocated.
 - d. REC dirty basin overflow relocated.
 - e. Rerouted clean and intermediate basin overflow connection to additional NPDES standpipe instead of to dirty basin.
 - f. Piping from REC-PFIL01-002 pump to future Drum filter -002 future.
- 225. LS3.28: ENLARGED LSS PLAN - LOWER LEVEL - EL. 7.25' TO 11.33'
 - a. TOU ORP sample line to be future installed including ORPs TOU-ORPM01-001 and TOU-ORPM01-002. BLVs and capped connections required to allow future connections.
 - b. Add new section #2 and new section call out for clarity.
- 226. LS3.30: ENLARGED LSS PLAN - 1ST FLOOR - EL. 10.33' TO 18.33'
 - a. Updated SRK carbon filter to be 5' diameter instead of 8' diameter. Filter piping and valves to be 4"
 - b. Updated SRK filter -002 and pump -002 and related piping to be future installed
- 227. LS3.31: ENLARGED LSS PLAN - 1ST FLOOR - EL. 10.33' TO 18.33'
 - a. Updated SRK carbon filter piping and valves to be 4".
 - b. Reduced fwm piping from 4" to 3" from supply loop to Saltwater storage tank and saltwater mixing basin.
 - c. Updated REC sand filters 001 &-002 and related piping & valves to be future installed
 - d. Updated REC FRC piping as future.
 - e. Notes and capped connections to allow future pipe tie ins.
 - f. New section 3/LS5.09 call out.
- 228. LS3.32: ENLARGED LSS PLAN - 1ST FLOOR - EL. 10.0' TO 18.33'
 - a. Updated SRK filter pump -002 and associated piping, valves and equipment to be future installed. 8" blind flanges required on BWD and valve at pump suction for future installation
- 229. LS3.33: ENLARGED LSS PLAN - 1ST FLOOR - EL. 10.33' TO 18.33'
 - a. SRK Current effects generators relocated to back wall with corresponding notes and tags.
 - b. Updated REC sand filter-002 and related piping & valves to be future installed.
 - c. Notes and capped connections to allow future pipe tie ins.
 - d. New section 3/LS5.09 call out.
 - e. REC dirty basin sight gauge and section 2/LS5.01 relocated.
 - f. REC dirty basin overflow relocated.
 - g. Rerouted clean and intermediate basin overflow connection to additional NPDES standpipe instead of to dirty basin.
 - h. Piping from REC-PFIL01-002 pump to future Drum filter -002 future.
- 230. LS3.38: ENLARGED LSS PLAN - 1ST FLOOR - EL. 11.33' TO 17.83'
 - a. TOU ORP sample line to be future installed including ORPs TOU-ORPM01-001 and TOU-ORPM01-002. BLVs and capped connections required to allow future connections.
 - b. Add new section call out for clarity.
- 231. LS3.40: ENLARGED LSS PLAN - 2ND FLOOR ADMIN - EL. 18.33' TO 27.44'
 - a. Updated SRK carbon filter to be 5' diameter instead of 8' diameter filter. Filter piping and valves to be 4"
 - b. Updated SRK filter -002 and associated piping, valves, and equipment to be future installed
- 232. LS3.41: ENLARGED LSS PLAN - 2ND FLOOR ADMIN - EL. 18.36' TO 23.94'
 - a. Updated SRK carbon filter piping to be 4".

- b. Reduced fwm piping from 4" to 3" from supply loop to Saltwater storage tank and saltwater mixing basin.
 - c. Updated REC sand filters 001 &-002 and related piping & valves to be future installed.
 - d. Updated REC FRC piping as future.
 - e. New section 3/LS5.09 call out.
233. LS3.42: ENLARGED LSS PLAN - 2ND FLOOR ADMIN - EL. 18.33' TO 27.44'
- a. Updated SRK filter pump -002 and associated piping, valves and equipment to be future installed
234. LS3.43: ENLARGED LSS PLAN - 2ND FLOOR ADMIN - EL. 18.36' TO 24.86'
- a. Updated REC sand filter-002 and related piping & valves to be future installed.
 - b. Notes and capped connections to allow future pipe tie ins.
 - c. New section 3/LS5.09 call out.
 - d. REC dirty basin sight gauge and section 2/LS5.01 relocated.
 - e. Rerouted clean and intermediate basin overflow connection to additional NPDES standpipe instead of to dirty basin. Dirty basin pump down drain piping connected to NPDES standpipe
 - f. Updated REC sand filter BWD piping to future.
235. LS3.46: ENLARGED LSS PLAN - 2ND FLOOR ADMIN - EL. 16.5' TO 26.69'
- a. Updated TOU Automated makeup fill valve and piping to be future installed
236. LS3.47: ENLARGED LSS PLAN - 2ND FLOOR ADMIN - EL. 18.36' TO 26.69'
- a. Updated PBA CO2 equipment to be future installed. Pipe caps required to allow future connections
237. LS3.51: ENLARGED LSS PLAN - 2ND FLOOR ADMIN CEILING PLAN - EL. 23.94' TO 34.78'
- a. Updated REC fractionator piping as future.
 - b. Updated REC OFG and VNT piping from future REC ozone destruct as future.
 - c. Updated drum filters and associated backwash skids as future.
 - d. REC-RSR-PVC-4 Piping from REC-PFIL01-002 pump to future Drum filter -002 as future.
 - e. New section 3/LS5.09 call out.
238. LS3.53: ENLARGED LSS PLAN - 2ND FLOOR ADMIN CEILING PLAN - EL. 24.86' TO 34.78'
- a. Updated REC offgas destruct and REC OFG and VNT piping from future ozone destruct as future.
 - b. Updated drum filters as future
 - c. Piping from REC-PFIL01-001 pump to future
 - d. Drum filter -001 to be rerouted to NPDES for pumping down dirty recovery basin. Piping is REC-RSR-PVC-4 to right before drum inlet connection and turns and becomes REC-DRN-PVC-4 to NPDES standpipe
 - e. New section 3/LS5.09 call out.
 - f. REC dirty basin sight gauge and section 2/LS5.01 relocated.
239. LS3.58: ENLARGED LSS PLAN - 2ND FLOOR ADMIN CEILING PLAN - EL. 26.44' TO 34.28'
- a. Added section #2/LS3.68 for clarity.
240. LS3.59: ENLARGED LSS CEILING PLAN - CYLINDERS - EL. 10.83' TO 19.36'
241. LS3.61: ENLARGED LSS PLAN - 3RD FLOOR - EL. 34.78' TO 41.73'
- a. Updated TOU fractionator ORP TOU-ORPM01-004 to be future installed.
 - b. Updated SRK fractionator flow meters SRK-FMO001-008 and SRK-FMO001-009 to be future installed.
 - c. Updated REC fractionator REC-OFRC24-001 and related piping, valves, instrumentation to be future.
242. LS3.68: ENLARGED LSS PLAN - 3RD FLOOR - EL. 34.28' TO 50.46'
- a. Updated TOU tower offgas destruct connection and valve to be future installed. TOU vent at top of tower to stay with a goose neck termination for air flow
 - b. Added section #2 for clarity.
243. LS3.71: ENLARGED LSS PLAN - 3RD FLOOR CEILING PLAN - EL. 41.75' TO 45.17'
- a. Updated SRK fractionator ORPs SRK-ORPM001-003 and SRK-ORPM001-004 to be future installed.
 - b. Updated REC fractionator REC-OFRC24-001 and related piping, valves, instrumentation to be future.
244. LS3.81: ENLARGED LSS PLAN - 3RD FLOOR CEILING PLAN - EL. 45.17' TO 52.54'

- a. Updated TOU fractionator and REC fractionator offgas destruct connections to be future installed.
 - b. Updated REC fractionator potable water connections to be future installed.
245. LS5.01: SECTIONS
- a. SECTION #1 Updated TOU automated makeup fill valve to be future installed. 2" Capped connections required to allow future connections.
 - b. Section #2 added EQ piping connection between dirty and intermediate basins. Sight gauge and pressure transducer piping reconfigured.
 - c. Section #3 Pump down piping from dirty recovery basin to NPDES for recovery system operation modifications. Rerouted clean and intermediate basin overflow connection to additional NPDES standpipe instead of to dirty basin.
 - d. Section #5 Rerouted clean and intermediate basin overflow connection to additional NPDES standpipe instead of to dirty basin. Updated REC offgas destruct and REC OFG and VNT piping from future ozone destruct as future.
246. LS5.02: SECTIONS
- a. Section #4 removed outdated note.
 - b. Section #6 Updated REC-VNT piping from future REC ozone destruct as future.
247. LS5.03: SECTIONS
- a. Section #1 Reduced fwm piping from 4" to 3" from supply loop to Saltwater storage tank and saltwater mixing basin. Updated Future REC sand filter piping to future
 - b. Section #4 Updated REC-VNT piping from future REC ozone destruct as future.
248. LS5.04: SECTIONS
- a. Section #1 and #2 Updated REC sand filters 001 & -002 and related piping & valves to be future installed
 - b. Notes and capped connections to allow future pipe tie ins.
 - c. SECTION #3 Added level float switch to NPDES lift pit.
 - d. Tag smp pipe for clarity in section #7. Reduced fwm piping from 4" to 3" from supply loop to Saltwater storage tank.
249. LS5.05: SECTIONS
- a. SECTION #3 Updated TOU tower ORP sample line to be future installed
250. LS5.06: SECTIONS
- a. Section 5 Updated future piping. 2. Section 7 Updated piping to future REC sandfilters as future and BWS piping and connection
251. LS5.07: SECTIONS
- a. Section #1 & 2 Reduced FWM piping from 4" to 3" from supply loop to saltwater mixing basin.
 - b. Section #3 Recovery system modifications and future items set up dirty basin for moving water to NPDES discharge, setting up clean basin to act as supplemental saltwater makeup storage for Shark, and setting up the intermediate basin to act either as an extension to dirty or an extension to clean depending on how the operator decides to run. EQ cross connection b/w clean and intermediate basins with drain, valves, and flanges. Fractionator pump and piping future.
 - c. Updated REC sandfilter discharge piping to future. Updated drum filters and backwash skids as future. Piping from REC-PFIL01-001 pump to future Drum filter -001 to be rerouted to NPDES for pumping down dirty recovery basin. Piping is REC-RSR-PVC-4 to right before drum inlet connection and turns and becomes REC-DRN-PVC-4 to NPDES standpipe. . REC-RSR-PVC-4 Piping from REC-PFIL01-002 pump to future Drum filter -002 as future
252. LS5.08: SECTIONS
- a. Section #1 tagged EQ pipe and manway for clarification
 - b. Section #2 TOU ORP sample line to be future installed including ORPs TOU-ORPM01-001 and TOU-ORPM01-002. BLVs and capped connections required to allow future connections.
 - c. Reduced fwm piping from 4" to 3" from supply loop to Saltwater storage tank.
253. LS5.09: SECTIONS
- a. SECTION #1 Updated SRK carbon filter piping to be 4". Updated REC-VNT piping from future REC ozone destruct as future.
 - b. New section #3 to clarify interior basin piping
254. LS6.01: ISOMETRICS

- a. ISO #1 Update TOU makeup fill valve and piping to be future installed.
 - b. ISO #3 Updated carbon filter to 5' diameter and downsized associated piping, valves, and equipment.
255. LS6.02: ISOMETRICS
- a. ISO #1 Updated TOU fractionator offgas destruct connection and TOU orp TOU-ORPM001-003 to be future installed
 - b. ISO #2 Updated SRK fractionator ORPs SRK-ORPM001-003 and SRK-ORPM001-004 to be future installed. Updated SRK fractionator flow meters SRK-FMO001-008 and SRK-FMO001-009 to be future installed
 - c. ISO #3 Reduced fwm piping from 4" to 3" from supply loop to Saltwater storage tank and Saltwater Mixing basin. Updated future REC sand filters and piping
 - d. ISO #4 Updated SRK fractionator flow meters SRK-FMO001-008 and SRK-FMO001-009 to be future installed. Updated REC fractionator REC-OFRC24-001 and related piping, valves, instrumentation to be future
 - e. ISO #5 Updated PBA CO2 equipment to be future installed. Connected disconnected FWM piping and tagged for clarification.
256. LS6.03: ISOMETRICS
- a. Iso #1 updated REC-OFG piping from future REC ozone destruct as future.
 - b. ISO #6. tag pipe for clarity
257. LS6.04: ISOMETRICS
- a. ISO #1 Updated PBA CO2 equipment to be future installed.
 - b. ISO #2 & #3 Updated REC sandfilter discharge piping to future. Updated drum filters and backwash skids as future. Piping from REC-PFIL01-001 pump to future Drum filter -001 to be rerouted to NPDES for pumping down dirty recovery basin. Piping is REC-RSR-PVC-4 to right before drum inlet connection and turns and becomes REC-DRN-PVC-4 to NPDES standpipe. REC-RSR-PVC-4 Piping from REC-PFIL01-002 pump to future Drum filter -002 as future.
 - c. ISO #3 Reduced fwm piping from 4" to 3" from supply loop to Saltwater storage tank and Saltwater Mixing basin.
258. LS6.05: ISOMETRICS
- a. Iso #1 updated REC-OFG piping from future REC ozone destruct as future.
259. LS6.06: ISOMETRICS
- a. ISO #2 Updated drum filter as future. Piping from REC-PFIL01-001 pump to future Drum filter -001 to be rerouted to NPDES for pumping down dirty recovery basin. Piping is REC-RSR-PVC-4 to right before drum inlet connection and turns and becomes REC-DRN-PVC-4 to NPDES standpipe.
 - b. ISO #4 Updated PBA CO2 equipment to be future installed. Install 0.5" pvc caps to allow future connections
260. LS8.04: DETAILS
- a. Updated tank pressure level sensor detail to use connector plugs for pressure reading
261. LS8.05: DETAILS
- a. Updated pump details to utilize gauge connector plugs for pressure reading
262. LS9.00: 60" DIA. - FILTER FABRICATION
- a. Added new sheet of 60" filter fabrication for reduced SRK carbon filter diameter vessel
263. LS9.02: 48" DIA. - FILTER FABRICATION
- a. Clarified recovery filters are future
264. LS9.03: 96" DIA. - FILTER FABRICATION
- a. Removed SRK carbon filter from fabrication sheet.
 - b. Clarified SRK-FSV096-002 filter is future
265. LS9.16: ROF-TNK060-001 - TANK FABRICATION
- a. Updated fab sheet connection table and section to show interior flange on #F to match plans
266. LS9.17: ROS-TNK060-001 - TANK FABRICATION
- a. Updated fab sheet connection table and section to show interior flange on #H to match plans
267. LS9.18: CRO-TNK060-001 - TANK FABRICATION
- a. Updated fab sheet connection table and section to show interior flanges on #E & #F to match plans

- 268. C-0: OVERALL SITE PLAN
- 269. I-1: INVENTORY SITE PLAN
- 270. C-1: DEMOLITION & TREE REMOVAL PLAN
- 271. C-2.0: GRADING, DRAINAGE, & EROSION CONTROL PLAN
- 272. C-2.1: GRADING, DRAINAGE, & EROSION CONTROL PLAN
- 273. C-2.2: DRAINAGE AREA PLAN (PH1 & PH2)
- 274. C-3: WETLAND IMPACT PLAN
- 275. C-4: UTILITY PLAN
- 276. C-5: LAYOUT PLAN
- 277. L-1.00: OVERALL SITE PLAN – BASE BID
- 278. L-1.01: OVERALL SITE PLAN – BASE BID & ALTERNATE
- 279. L-1.21: LANDSCAPE / HARDSCAPE DEMOLITION PLAN - BASE BID & ALTERNATE
- 280. L-1.32: MATERIALS PLAN – EAST ENTRANCE
- 281. L-1.33: MATERIALS PLAN: ALTERNATES
- 282. L-1.34: MATERIALS PLAN: ALTERNATES
- 283. L-1.42 LAYOUT PLAN – EAST ENTRANCE
- 284. L-1.43: LAYOUT PLAN – ALTERNATES
- 285. L-1.44: LAYOUT PLAN – ALTERNATES
- 286. L-1.52: GRADING PLAN – EAST ENTRANCE
- 287. L-1.53: GRADING PLAN – ALTERNATES
- 288. L-1.54: GRADING PLAN – ALTERNATES
- 289. L-1.60: PLANTING PLAN – ENTRY PLAZA
- 290. L-1.62: PLANTING PLAN – EAST ENTRANCE
- 291. L-1.63: PLANTING PLAN – ALTERNATES
- 292. L-1.64: PLANTING PLAN – ALTERNATES
- 293. L-1.70: IRRIGATION PLAN – BASE BID
- 294. L-1.80: SOILS PLAN – BASE BID & ALTERNATE
- 295. L-502: DETAILS
- 296. L-503: DETAILS
- 297. L-506: DETAILS

ATTACHMENTS:

Value Engineering Log

Heating Plant Narrative

Cooling Plant Narrative

End of Bulletin Number Two

VALUE ENGINEERING LOG

Fort Fisher Aquarium - Final Accepted VE

April 13, 2026

Construction Documents: Value Analysis Spreadsheet

Item	Description	Accepted Value	Status (A, P, or D)	VE Description / Assumptions	Undo with Additional Funding
0300 / 3160	Concrete & Deep Foundations				
01	Structural Galv. Rebar Revised Locations Markup		A	Standard rebar in applicable locations in lieu of galvanized rebar.	
02	WWM ILO Rebar at Southeast Addition SOG		A	Welded Wire Mesh in applicable locations at the southeast addition slab on grade in lieu of rebar.	
03	Sand ILO Flowable Fill Beneath Touch Tank		A	Flowable fill located beneath the touch tank and shark tank changed to sand.	
04	Move/Shrink Pile Caps at the Existing Building		A	Deep foundations located where the existing building and new shark tank expansion building connects posed constructability concern. Pile caps shrunk and moved away from area of concern.	
	Concrete & Deep Foundations Subtotal				
400	Masonry				
01	Reject Bids & Self Perform - No Design Change		A	C&T rejected all masonry bids and will be self performing scope.	
	Masonry Subtotal				
500	Structural Steel				
01	Remove AISC for Phase I - No Design Change		A	AISC certification removed from phase 1 construction due to not being needed. AISC certification remains for phase 2 construction.	
02	Reduce Width of Generator Platform		A	Plan north generator stairs and landing reduced from 8' to 5'. Plan south generator stairs and landing reduced from 5' to 4'.	VE Item to be reverted back to original designed width of generator platform with additional funding.
03	1st Floor Crane to be Manual Chain Operation ILO Motorized		A	Hoisting crane located at the 1st floor saltwater makeup to be manual chain operated in lieu of motorized.	Hoisting crane located at the 1st floor saltwater makeup to be reverted back to original design.
04	Telescoping Crane to be Galv. Steel ILO Stainless Steel (Hoist Beam)		A	Fixed crane located at the 3rd floor shark tank to be galvanized in lieu of stainless steel.	
05	Fixed Crane ILO Telescoping		A	Hoisting crane located at the 3rd floor shark tank to be a fixed galvanized steel beam in lieu of telescoping crane.	
	Structural Subtotal				
750	Roofing				
	Roofing Subtotal				

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April 13, 2026

Construction Documents: Value Analysis Spreadsheet

Item	Description	Accepted Value	Status (A, P, or D)	VE Description / Assumptions	Undo with Additional Funding
724	Exterior Skin				
	Exterior Skin Subtotal				
810	Openings				
01	Falcon Hardware ILO of Spec'd		A	All door hardware to be Falcon in lieu of specified hardware.	
02	Floodproofing Doors Credit (extra doors added to base bid) - No Design Change		A	Miss counted door credit received from floodproof doors subcontractor.	
03	HM Frames ILO of Aluminum at Allowable Locations		A	Where applicable, aluminum door frames revised to be hollow metal.	
04	Existing Automatic Doors to Remain		A	Existing automatic door 246-A located at the freshwater habitat / saltwater gallery entrance to remain in lieu of being removed and replaced.	Pending additional funding, existing automatic door 246-A to be replaced with a new automatic sliding door.
05	Powder Coated Overhead Doors ILO of Stainless Steel		A	All overhead coiling doors to be powder coated in lieu of stainless steel.	
	Openings Subtotal				
900	Interior Finishes				
01	CDX ILO Marine Grade Plywood		A	Back of house areas to be concrete curb with CDX plywood and FRP up to 8' in lieu of marine grade plywood. Drywall from 8' beyond. Transition strip to be verified.	
02	Paper Faced Mold / Mildew board ILO Glass Mat		A	All glass mat per the drawings to be replaced with paper faced mold/mildew board.	
03	Low Bidder Credit - No Design Change (Total Value carried in base bid, allocated to alternates)		A	Sealed Concrete subcontractor carried sealed concrete floors & epoxy coated floors within identified alternate areas. Base bid reduced to allocate alternate pricing.	
	Interior Finish Subtotal				
1000	Specialties				
01	Remove Roller Shades		A	All roller shades removed from the project.	Roller shades to remain in the project where specified with additional funding.
02	Dock Bumpers Credit (Scope Doubled Up) - No Design Change		A	(2) subcontractors both carried dock bumpers in base bid price. Doubled up scope removed from miscellaneous specialties subcontractor.	
	Specialties Subtotal				

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Construction Documents: Value Analysis Spreadsheet

Item	Description	Accepted Value	Status (A, P, or D)	VE Description / Assumptions	Undo with Additional Funding
1334	Theming / FRP				
01	Remove FRP Shark Gate and Platform from South Wing		A	FRP platform, railings, shark gate, and dive ladder removed from south wing tank located at the third floor of the shark tank.	With additional funding, full FRP platform and gates scope to remain in project.
	Theming & FRP Subtotal				
1700	LSS				
01	Switch Pressure Gauges, Compound Gauges, and Temperature Gauges with Pete's Plugs		A		Gauges to be reverted to automated original design with additional funds.
02	Eliminate Spare MDM Pump - No Design Change		A		Per original warranty requirements, spare MDM pump to remain.
03	LSS Low Voltage to Electrical - Final Value Pending Accepted VE's - No Design Change		A	LSS low voltage scope moved to electrical contractor scope of work. Value to be updated based on finalized LSS drawings and updated controls scope.	
04	Allocate Controls to Alternate (Credit Back) - No Design Change		A	LSS controls subcontractor carried exotic aquatic modifications within base bid. Base bid reduced to allocate to alternate 3 work.	
05	TOU - Ozone to be Future		A	Touch tank ozone to be installed at a later date.	All for future indicated items to be as originally designed and scheduled.
06	SRK - Sand Filters to be Future - One Filter & Associated Pumps		A	Piping to be ran for all sand filters. 7th sand filter piping location to receive valve/cap for future sand filter to be added.	All for future indicated items to be as originally designed and scheduled.
07	REC - Remove Saltwater Recovery System		A	All 3 basins to remain. Updated design and costs pending per Aquarium requests.	
08	SRK - Ozone Delivery into Fractionators to be Removed		A		All for future indicated items to be as originally designed and scheduled.
09	SRK - Flow Meters to VFDs at the Fractionators to be Removed		A		All for future indicated items to be as originally designed and scheduled.
10	SRK - 5' dia. Carbon Filter ILO 8' dia.		A	Carbon filter for the shark tank reduced from 8' diameter to 5'.	

Fort Fisher Aquarium - Final Accepted VE

April 13, 2026

Construction Documents: Value Analysis Spreadsheet

Item	Description	Accepted Value	Status (A, P, or D)	VE Description / Assumptions	Undo with Additional Funding
11	TOU - Remove Actuated Valve & Associated Piping at Saltwater Makeup		A		All for future indicated items to be as originally designed and scheduled.
12	PIA - CO2 Side Stream to be Future		A	Piaba tank CO2 side stream to be installed at a later date.	All for future indicated items to be as originally designed and scheduled.
13	ADD - High Water Level Alarm Monitoring to NPDES Pump Pit		A	A high water alarm for monitoring has been added to the NPDES pump pit.	
	LSS Subtotal				
2100	Sprinkler				
	Sprinkler Subtotal				
2200	Plumbing				
	Plumbing Subtotal				
2300	HVAC				
01	Using Aquatherm (PPR) pipe and fittings for the underground hydronic piping 4"-10" (heating water & chilled water preinsulated)		A	Approved alternate hydronic piping manufacturer in lieu of specified.	
02	Using Aquatherm (PPR) pipe and fittings for the above ground hydronic piping 4"-10"		A	Approved alternate hydronic piping manufacturer in lieu of specified.	
03	Standard brass control valves with a stainless steel stem ILO CPVC control valves		A		
04	Alternate AHU - Petra		A	Approved alternate air handler unit manufacturer in lieu of specified manufacturer.	
05	Sock Duct ILO of Sheetmetal in BOH areas at Shark Tank		A	Sock duct in lieu of sheetmetal duct located in back of house areas of the 3rd floor shark tank.	
06	Release Equipment by July 2026 - No Design Change		A	C&T to release HVAC equipment procurement early and store on site.	

Fort Fisher Aquarium - Final Accepted VE

April 13, 2026

Construction Documents: Value Analysis Spreadsheet

Item	Description	Accepted Value	Status (A, P, or D)	VE Description / Assumptions	Undo with Additional Funding
07	Boiler ILO Heat Recovery Chiller 3 230-ton Chillers & 2 Boilers: (\$195,683)		A	<p>Existing generator building located plan south of the facility to be converted to house (2) Fulton boilers, (6) pumps, (6) VFDs, and all associated equipment/piping. Thus, removing (1) heat recovery chiller, reducing the chiller platform, and removing the prefabricated building. Per a sitewalk conducted on 3.18.26 with CBHF:</p> <ul style="list-style-type: none"> - All louvers, propellor fan, and exhaust/misc. penetrations to be removed and replaced with CMU infill. - Existing concrete stairs outside the generator building to be removed. - Existing house keeping pad to be extended. - Lighting, ceiling paint, and exterior paint to be updated. - For the intake openings, (1) will be removed and infilled with CMU and (1) to be converted into an overhead roll up door. Confirmation forthcoming. - Piping penetrations to be coordinated for locations. - (1-2) Floor drains, domestic water service, and (1) 2-ton ductless split system to be included in final design. - The existing fuel oil pump serving the boiler to be relocated to the main existing mechanical room located on the south side of the aquarium. 	
	HVAC Subtotal				
2600	Electrical				
01	C&T Electrical BIM Requirements Waived. Racks of conduits 2 or more/All conduit 1-1/2" and larger/All Grounding/ Telecommunications/All Hangers-Supports/Access doors - No Design Change		A	C&T subcontract BIM requirements waived for electrical subcontractor.	
	Electrical Subtotal				
3100	Site Work				
01	Grading / Cut & Fill Coordination Credit - No Design Change		A	Through coordination between subcontractors, excessive grading at the shark tank deep foundations has been reduced.	
	Site Work Subtotal				

Fort Fisher Aquarium - Final Accepted VE

April 13, 2026

Construction Documents: Value Analysis Spreadsheet

Item	Description	Accepted Value	Status (A, P, or D)	VE Description / Assumptions	Undo with Additional Funding
3291	Landscape				
01	Division 32 - Landscape/Hardscape Design to Allowance: \$500,000		A	Landscapes & hardscapes to be redesigned to a specified \$500,000 allowance.	Full landscape and hardscapes design to be reverted to original design.
	Landscaping Subtotal				
	General / Alternates				
01	Revised SE Addition Outdoor Classrooms / Changing Rooms		A	Southeast outdoor classroom revised to (4) single occupancy restrooms, sidewalk access to the teaching room, ADA accessible ramp, and stepped concrete seating facing wetland areas.	Outdoor classroom and associated changing rooms to be as originally designed.
02	Elevated floor at Cape Fear Shoals Allocated to Exotic Aquatics Alternate - No Design Change		A	Elevated floor demolition and concrete fill located at the existing cape fear shoals and exotic aquatics areas allocated to alternate 3 exotic aquatics renovations scope of work.	
	General / Alternates Subtotal				
	Accepted Value Analysis Total				

Fort Fisher Aquarium - Final Accepted VE

April 13, 2026

Construction Documents: Value Analysis Spreadsheet

Item	Description	Accepted Value	Status (A, P, or D)	VE Description / Assumptions	Undo with Additional Funding
Alternate 2 - Main Entry & Bathroom Renovations					
01	Falcon Hardware ILO of Spec'd		A	All door hardware to be Falcon in lieu of specified hardware. Carried from base bid.	
02	New HVAC Controls Proposal Post Bid - Credit - No Design Change		A	Subcontractor received cheaper controls proposal post bid opening.	
03	Bathroom Renovations Only & Sealed Concrete ILO Reinstalling Existing Brick Pavers		A	Main ticketing entry, lobby and bathroom renovations alternate revised to bathroom renovations only. Existing brick pavers are to be removed and replaced with 5" concrete slab and sealed concrete. Bathroom facelift includes new partitions (including porcelain toilets), accessories, and ceiling tile. All existing MEP are to remain as is.	To be reverted back to original design minus the brick paver reinstall.
Alternate 2 Subtotal					
Alternate 5B - Touch Tank Restroom Renovations					
01	New HVAC Controls Proposal Post Bid - Credit - No Design Change		A	Subcontractor received cheaper controls proposal post bid opening.	
Alternate 5B Subtotal					
Alternate 6 - Main Parking & Bus Lot Renovations					
Alternate 6 Subtotal					
Alternate 9 - EPSS Generator					
Alternate 9 Subtotal					
Alternates Accepted Value Analysis Total					

HEATING PLANT NARRATIVE

HEATING PLANT ALTERNATE – DESIGN NARRATIVE FOR PRICING

1. PURPOSE

This narrative describes the proposed Heating Plant Alternate to replace the heating portion of the original combined chiller-heater system.

This alternate is intended to:

- Reduce first cost
- Decouple heating from cooling plant capacity
- Maintain N+1 redundancy for heating
- Retain existing building secondary heating water distribution

This narrative is provided to assist contractors in preparing a comparable pricing proposal.

2. OVERVIEW OF PROPOSED HEATING PLANT

The proposed heating plant consists of:

- (2) Fuel oil fired condensing boilers
- (2) Primary boiler pumps (redundant)
- (2) Heat recovery pumps (redundant)
- (3) Air cooled heat recovery chillers located on the existing chiller platform
- Existing secondary building heating water distribution pumps (unchanged)

The heating plant will operate with:

- Heat recovery chillers as primary heating source when available
- Boilers as trim and backup heat
- Secondary distribution loop serving the building remaining unchanged

3. BOILERS

Equipment

- Quantity: 2
- Capacity: 2,000,000 MBH each
- Type: Fuel oil fired condensing boilers
- Redundancy: N+1 (one boiler capable of serving design heating load; second unit redundant)

Location

Boilers will be located in the existing generator building that will be vacated upon completion of the new generator building.

The following will also be located within the existing generator building:

- Primary boiler pumps
- Heat recovery pumps
- Associated VFDs and controls

Real estate within this building may be constrained. Contractors shall anticipate tight layout conditions. Stacked in-line pump arrangements may be required depending on final equipment layout.

No pump sizing has been completed at this time. Contractors shall carry reasonable allowances for pump horsepower and VFDs consistent with a 4,000,000 MBH total installed boiler capacity system.

4. HEAT RECOVERY CHILLERS

Equipment Option 1

- (4) Air cooled heat recovery chillers
- Basis of design: Trane CGAM
- Capacity: 130 tons each

Equipment Option 2

- (3) Air cooled heat recovery chillers
- Basis of design: Trane ACSA
- Capacity: 230 tons each

These units will be located on the existing chiller platform consistent with the prior design concept.

The heat recovery chillers will provide primary heating energy prior to boiler staging.

5. PRIMARY HEATING WATER PIPING

Boiler Primary Loop

Primary heating water piping will originate in the existing generator building.

Piping will:

- Route through the existing chiller building wall
- Run below grade to the chiller platform
- Interconnect with the heat recovery chiller piping per the heating plant flow diagram

Heat Recovery Loop

Heat recovery piping will:

- Route from the existing generator building
- Travel below grade to the chiller platform
- Connect to each of the three heat recovery chillers per the flow diagram

Contractors shall include:

- Below-grade piping
- Wall penetrations and sleeves
- Insulation and jacketing appropriate for underground routing
- Excavation, backfill, and restoration

Routing distances shall be assumed similar to those shown in the original design concept.

6. SECONDARY BUILDING HEATING WATER DISTRIBUTION

The existing building secondary heating water distribution system shall remain unchanged.

Specifically:

- Existing heating water distribution pumps remain
- Existing differential pressure control remains
- Existing building-side flow rates remain
- Existing terminal connections remain

This alternate does not modify the building distribution loop.

The heating plant will tie into the secondary loop at the same connection points as the prior design.

Contractors shall not include rework of the building-side secondary distribution unless required for tie-in.

7. PUMPING ARRANGEMENT

Primary Boiler Pumps

- Redundant configuration
- VFD driven
- Located in existing generator building

Heat Recovery Pumps

- Redundant configuration
- VFD driven
- Located in existing generator building

Pump selections have not yet been finalized.

Contractors shall include reasonable allowances for:

- Pump bodies
- Motors
- VFDs
- Isolation valves
- Check valves
- Strainers
- Controls integration

Space constraints may require vertical stacked in-line pump configurations.

8. CONTROLS INTENT

The heating plant shall operate as follows:

1. Upon call for heating, secondary distribution pumps operate (existing system).

2. Heat recovery chillers shall be enabled first when available.
3. Boilers shall stage as required to maintain heating water supply temperature.
4. Heating water supply temperature shall be reset based on outdoor air temperature (as shown in sequence).
5. N+1 redundancy shall be maintained for boiler plant.

This alternate eliminates simultaneous heating/cooling arbitration logic required in the original combined plant.

9. SCOPE DIFFERENCES FROM ORIGINAL DESIGN

This heating plant alternate:

- Removes heating capacity dependence on chiller-heater simultaneous operation
- Removes interdependent heating/cooling staging logic
- Adds dedicated boiler plant
- Retains heat recovery chillers for primary heat contribution
- Maintains existing secondary distribution unchanged
- Concentrates pumps and boilers within existing generator building

Cooling plant modifications are not included in this narrative and will be issued separately.

10. CONTRACTOR PRICING ASSUMPTIONS

Contractors shall include:

- Two 2,000,000 MBH fuel oil condensing boilers
- Associated flues and fuel oil connections
- Redundant primary boiler pumps and drives
- Redundant heat recovery pumps and drives
- Below-grade heating water and heat recovery piping between buildings
- Chiller platform heat recovery connections
- Controls integration with existing BAS
- Structural evaluation of generator building floor for new equipment

Contractors may provide value engineering suggestions for:

- Pump configurations
- Equipment layout optimization
- Piping routing alternatives
- Fuel oil storage integration

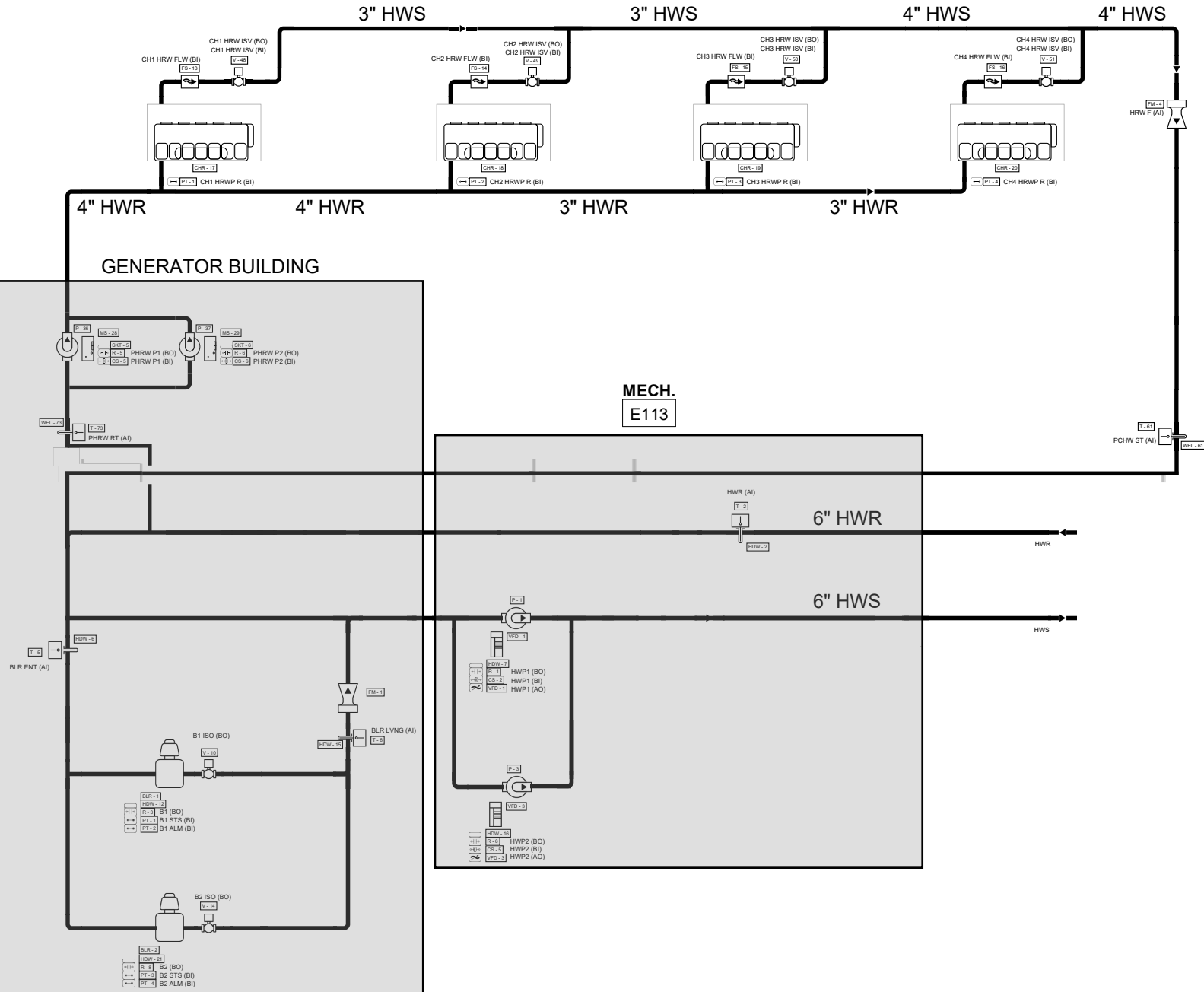
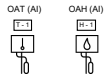
11. SUMMARY

This heating plant alternate:

- Maintains N+1 redundancy
- Retains heat recovery as primary energy source
- Adds conventional boiler trim
- Preserves existing building secondary loop
- Simplifies overall plant interdependence

This narrative is intended to allow contractors to directly compare the cost of this heating plant alternate to the original integrated chiller-heater system.

Flow Diagram: HEATING PLANT SYSTEM



SEQUENCE OF OPERATION: HEATING PLANT SYSTEM

SYSTEM GENERAL DESCRIPTION:

The heating plant system controller provides stand-alone control or control from an optional higher level Building Automation System (BAS). The heating plant control system shall monitor and control the system's condensing boiler(s), heating water distribution pump(s), heat recovery pump(s), chiller heat recovery isolation valves, and associated control devices as shown on the heating plant flow diagram, in the heating plant points list, and as detailed in the sequence of operation listed below. The heating plant system consists of a primary/secondary loop supplying heating water to the facility. Heat recovery from 3 or 4 air cooled chillers shall be utilized as a first stage heat source to preheat heating water in series upstream of the boiler return header. The heating system includes flow metering capabilities for the building supply loop. The manifolded heating water distribution pumps are configured as lead/lag control. The factory boiler system controller shall provide stand-alone control or BAS workstation control of the heating water supply temperature setpoint (adjustable). The maximum heating water leaving temperature shall be limited to 130°F.

HEATING SYSTEM ENABLE/DISABLE:

The heating system shall be enabled/disabled by the heating plant controller as requested by the BAS human interface panel or the BAS time of day schedule. When enabled, the system shall enable the lead heating water distribution pump and enable heat recovery operation when available. Boilers shall be enabled only as required to maintain the heating water distribution system supply temperature setpoint after heat recovery has been utilized. The heating plant is disabled when all boilers are disabled, heat recovery is disabled, and there is not an active heating water distribution pump request. When the plant is disabled, the heating water distribution pumps shall be commanded off except as required by freeze protection, and heat recovery pumps shall be commanded off with all chiller heat recovery isolation valves commanded closed.

HOT WATER RESET (HEATING WATER SUPPLY TEMPERATURE RESET):

The heating water distribution system supply temperature setpoint shall be linearly reset from 95°F (adj.) to 130°F (adj.) as the outside air temperature falls from 60°F (adj.) to 0°F (adj.). The maximum heating water supply temperature setpoint shall be limited to 130°F. Adjustable parameters shall be provided for reset endpoints and outdoor air breakpoints.

HEAT RECOVERY SYSTEM GENERAL OPERATION (SERIES UPSTREAM OF BOILERS):

Heating water return from the building shall be routed through the heat recovery circuit in series upstream of the boiler return header such that heat recovery, when enabled, preheats the heating water return prior to entry into the boilers. The heat recovery chillers shall be connected in parallel to common heat recovery headers. Each chiller shall be provided with a two-position heat recovery isolation valve and flow proof device. Heat recovery pumps shall be provided in a lead/lag configuration with variable frequency drives to maintain differential pressure across the heat recovery headers and to provide required minimum flow through active chiller heat recovery bundles. Heat recovery shall be the first stage heating source, and boilers shall provide trim and backup heating.

HEAT RECOVERY ENABLE/DISABLE:

When the heating plant is enabled, heat recovery shall be enabled when at least 1 chiller reports heat recovery available and heating water distribution pump operation is proven. Upon a heat recovery enable condition, the BAS shall enable the lead heat recovery pump and command open the heat recovery isolation valve(s) for any chiller(s) that are enabled for heat recovery. If provided, a heat recovery bypass valve shall be commanded closed whenever at least 1 chiller heat recovery isolation valve is commanded open, and the bypass valve shall be commanded open when no chillers are enabled for heat recovery. Heat recovery shall be disabled upon loss of all heat recovery available signals, loss of required pump proof, or a heat recovery alarm condition that inhibits operation.

HEAT RECOVERY PUMP CONTROL (DP CONTROL):

The heat recovery pumps shall be configured as lead/lag and shall be controlled by VFD to maintain a differential pressure setpoint measured across the heat recovery supply and return headers (adjustable). The BAS shall modulate the operating heat recovery pump speed to maintain the differential pressure setpoint as chiller heat recovery isolation valves open and close. Upon a lead heat recovery pump failure, the BAS shall annunciate an alarm and start the lag heat recovery pump. Heat recovery pumps shall include minimum run time and minimum off time of 10 minutes (adj.), except that safeties shall override and stop the pumps as required.

CHILLER HEAT RECOVERY ISOLATION VALVES AND FLOW PROOF:

Each heat recovery chiller shall be provided with a two-position isolation valve. The BAS shall command the isolation valve open when the associated chiller is enabled in heat recovery mode and heat recovery pump operation is proven. The BAS shall command the isolation valve closed when the associated chiller is not enabled in heat recovery mode or when the heat recovery pumps are disabled. Each chiller shall prove flow via flow switch or equivalent device. The BAS shall require flow proof prior to enabling heat recovery operation for that chiller. If flow proof is not established within 60 seconds (adj.) after commanding the isolation valve open and enabling the heat recovery pump(s), the BAS shall annunciate an alarm and disable heat recovery enable to that chiller until the condition is corrected and the alarm is reset.

MINIMUM HEAT RECOVERY FLOW REQUIREMENT:

The heat recovery pumping and control strategy shall be arranged to provide not less than GPM through each active chiller heat recovery bundle (design). The BAS shall utilize differential pressure control and valve positioning status to satisfy this requirement, and commissioning shall verify minimum flow to each active chiller. Where flow measurement is provided, the BAS shall alarm upon low flow below the minimum required for an active chiller.

BOILER CONTROL (CONDENSING BOILERS, TRIM AND BACKUP):

The boiler lead/lag sequence shall be based on a weekly schedule. From the system controller or a BAS workstation, an operator shall be able to manually change the lead/lag sequence. The boilers shall operate as trim and backup heat sources after heat recovery has been utilized. When the heating plant is enabled, the lead boiler shall be enabled when heat recovery is unavailable, or when heat recovery is enabled and operating but is insufficient to maintain the heating water distribution system supply

temperature setpoint. Heat recovery shall be considered insufficient when the heat recovery pump(s) are at 100% speed for 10 minutes (adj.) and the heating water distribution system supply temperature remains more than 3°F (adj.) below the active setpoint. Upon a call for boiler operation, the BAS shall enable the lead boiler and the associated boiler primary pump (if provided). Once the lead boiler is enabled, the add sequence of additional boilers shall be disabled for a period of 30 minutes (adj.). Additional boilers shall be enabled if the heating water distribution system supply temperature remains more than 5°F (adj.) below the active setpoint for 10 minutes (adj.) while the lead boiler is enabled and at high fire (or maximum capacity command) for 10 minutes (adj.). The last boiler enabled shall be disabled when the heating water distribution system supply temperature rises more than 2°F (adj.) above the active setpoint for 10 minutes (adj.) and the boiler minimum runtime has been satisfied. Additional boilers shall be disabled in reverse order using the same criteria. Each boiler shall include a minimum on time of 15 minutes (adj.) and minimum off time of 15 minutes (adj.). If an active boiler signals a failure alarm, the system controller shall enable the next available boiler, signal an alarm, and continue operation as available. When a boiler failure exists, lead/lag automation shall be disabled and the currently running boiler shall become the lead boiler. Once the problem is corrected, the operator shall be able to clear the alarm failure from the system controller or BAS workstation, which shall re-enable the lead/lag sequence.

HEATING WATER DISTRIBUTION PUMP START/STOP:

The system shall start a heating water distribution pump through a contact closure of the pump VFD run-enable contacts. When the heating plant is enabled, the BAS shall enable the lead heating water distribution pump. The heating water distribution pumps may operate continuously when required by freeze protection or low limit conditions. The lag pump shall be enabled upon lead pump failure or manual selection. If the distribution pumps are controlled to differential pressure (where provided), the BAS shall modulate pump speed to maintain the system differential pressure setpoint.

HEATING WATER DISTRIBUTION PUMP STATUS:

The system shall detect heating water pump run status by a VFD current switch or run status input.

HEATING WATER DISTRIBUTION PUMP FAILURE:

If the lead start/stop relay is enabled and the current switch status is off for more than 30 seconds (adj.), the system shall annunciate a heating water pump failure alarm to the BAS workstation and start the lag pump. When a pump failure exists, lead/lag automation shall be disabled and the currently running pump becomes the lead pump. Once the problem has been corrected, the operator shall be able to clear the alarm failure from the BAS controller or BAS workstation, which shall re-enable the lead/lag sequence.

FREEZE PROTECTION:

When the outdoor air temperature falls below 35°F (adj.), the heating water distribution pump shall operate continuously to provide heating water circulation to all associated hot water coils. If the heating water supply temperature falls below 100°F (adj.) during unoccupied periods, the heating plant shall enable, if disabled, and heat recovery and/or boilers shall operate as required to maintain the heating water supply temperature setpoint subject to all safeties and interlocks. In the event that a hydronic

airside type equipment initiates a low limit alarm, the heating system shall enable, if disabled, and provide heating medium circulation to the equipment.

CARBON MONOXIDE DETECTOR:

The carbon monoxide detector shall monitor the boiler room for high levels of CO. If the CO level rises above 50 ppm (adj.), then an alarm shall be signaled to the heating system controller or BAS workstation.

BOILER EMERGENCY SHUTDOWN SWITCH:

If the boiler emergency shutdown switch has been activated, the boilers are to shut down immediately and an alarm shall be signaled to the heating system controller or BAS workstation. Heat recovery operation shall be disabled unless explicitly permitted by the owner's safety requirements and applicable code requirements.

POINTS LIST: HEATING PLANT SYSTEM

BLR ESTOP – Boiler Emergency Shutdown Switch – BI – Alarm
B1 ALM – Boiler 1 Alarm – BI – Alarm
B1 CMD – Boiler 1 Enable Command – BO
B1 ISO – Boiler 1 Isolation Valve – BO
B1 STS – Boiler 1 Status – BI
B2 ALM – Boiler 2 Alarm – BI – Alarm
B2 CMD – Boiler 2 Enable Command – BO
B2 ISO – Boiler 2 Isolation Valve – BO
B2 STS – Boiler 2 Status – BI

BLR ENT – Boiler Loop Entering Temperature – AI – High/Low Alarm
BLR LVNG – Boiler Loop Leaving Temperature – AI – High Alarm

BP1 CMD – Boiler Pump 1 Start/Stop – BO
BP1 STS – Boiler Pump 1 Status – BI
BP2 CMD – Boiler Pump 2 Start/Stop – BO
BP2 STS – Boiler Pump 2 Status – BI

CO – Carbon Monoxide Sensor – AI – High Alarm

HW DP – Heating Water Differential Pressure – AI – High/Low Alarm

HWP1 SPD – Heating Water Pump 1 Speed – AO
HWP1 CMD – Heating Water Pump 1 Start/Stop – BO
HWP1 STS – Heating Water Pump 1 Status – BI
HWP1 FAIL – Heating Water Pump 1 Failure – BI – Alarm

HWP2 SPD – Heating Water Pump 2 Speed – AO
HWP2 CMD – Heating Water Pump 2 Start/Stop – BO
HWP2 STS – Heating Water Pump 2 Status – BI
HWP2 FAIL – Heating Water Pump 2 Failure – BI – Alarm

HWR – Heating Water Return Temperature – AI – Low Alarm
HWS – Heating Water Supply Temperature – AI – High Alarm

OAT – Outdoor Air Temperature – AI – Low Alarm
OAH – Outdoor Air Humidity – AI

B LEAD – Boiler Lead Designation – SF
HWP LEAD – Heating Water Pump Lead Designation – SF

HW RES HL – Heating Water Reset High Limit – SF
HW RES LL – Heating Water Reset Low Limit – SF
HWS SP – Heating Water Supply Temperature Setpoint – SF
OAT ENA SP – Outside Air Temperature Enable Setpoint – SF

HEAT RECOVERY SYSTEM POINTS

HEAT RECOVERY PUMPS

HRP1 CMD – Heat Recovery Pump 1 Start/Stop – BO
HRP1 SPD – Heat Recovery Pump 1 Speed – AO
HRP1 STS – Heat Recovery Pump 1 Status – BI

HRP1 FAIL – Heat Recovery Pump 1 Failure – BI – Alarm

HRP2 CMD – Heat Recovery Pump 2 Start/Stop – BO

HRP2 SPD – Heat Recovery Pump 2 Speed – AO

HRP2 STS – Heat Recovery Pump 2 Status – BI

HRP2 FAIL – Heat Recovery Pump 2 Failure – BI – Alarm

HRP LEAD – Heat Recovery Pump Lead Designation – SF

HEAT RECOVERY DIFFERENTIAL PRESSURE

HR DP – Heat Recovery Differential Pressure – AI – Low Alarm

HR DP SP – Heat Recovery Differential Pressure Setpoint – SF

HEAT RECOVERY HEADER TEMPERATURES

HR SUP – Heat Recovery Supply Temperature (to Boilers) – AI – High Alarm

HR RET – Heat Recovery Return Temperature (from Building HWR) – AI

HEAT RECOVERY BYPASS (IF PROVIDED)

HR BPV CMD – Heat Recovery Bypass Valve Command – BO

HR BPV STS – Heat Recovery Bypass Valve Status – BI

PER CHILLER HEAT RECOVERY POINTS

(Repeat for CH1, CH2, CH3, CH4 as applicable)

CH1 HR AVAIL – Chiller 1 Heat Recovery Available – BI

CH1 HR ISO CMD – Chiller 1 Heat Recovery Isolation Valve Command – BO

CH1 HR ISO STS – Chiller 1 Heat Recovery Isolation Valve Status – BI

CH1 HR FLW – Chiller 1 Heat Recovery Flow Proof – BI – Alarm

CH2 HR AVAIL – Chiller 2 Heat Recovery Available – BI

CH2 HR ISO CMD – Chiller 2 Heat Recovery Isolation Valve Command – BO

CH2 HR ISO STS – Chiller 2 Heat Recovery Isolation Valve Status – BI

CH2 HR FLW – Chiller 2 Heat Recovery Flow Proof – BI – Alarm

CH3 HR AVAIL – Chiller 3 Heat Recovery Available – BI

CH3 HR ISO CMD – Chiller 3 Heat Recovery Isolation Valve Command – BO

CH3 HR ISO STS – Chiller 3 Heat Recovery Isolation Valve Status – BI

CH3 HR FLW – Chiller 3 Heat Recovery Flow Proof – BI – Alarm

CH4 HR AVAIL – Chiller 4 Heat Recovery Available – BI

CH4 HR ISO CMD – Chiller 4 Heat Recovery Isolation Valve Command – BO

CH4 HR ISO STS – Chiller 4 Heat Recovery Isolation Valve Status – BI

CH4 HR FLW – Chiller 4 Heat Recovery Flow Proof – BI – Alarm

HEAT RECOVERY CONTROL LOGIC FLAGS

HR ENABLE – Heat Recovery Enable Status – SF

HR ACTIVE – Heat Recovery Active – SF

HR INSUFF – Heat Recovery Insufficient (Boiler Enable Condition) – SF

HR FLOW – Heat Recovery Header Flow Meter – AI – Low Alarm

COOLING PLANT NARRATIVE

CHILLED WATER PLANT ALTERNATE – DESIGN NARRATIVE FOR PRICING

1. PURPOSE

This narrative describes the proposed Chilled Water Plant Alternate to replace the cooling portion of the original combined chiller-heater system.

This alternate is intended to:

- Reduce first cost
- Simplify plant interdependence
- Maintain N+1 redundancy
- Retain existing building secondary chilled water distribution

This narrative is provided to assist contractors in preparing a comparable pricing proposal.

2. OVERVIEW OF PROPOSED CHILLED WATER PLANT

The proposed cooling plant consists of:

- (3) Air-cooled chillers
- Primary chilled water pumps (redundant)
- Existing secondary chilled water distribution pumps (unchanged)
- Primary/secondary piping configuration

The alternate replaces the prior design of:

- (4) 130-ton Trane CGAM chillers

With:

- (3) 230-ton Trane ACSA air-cooled chillers

The intent is to maintain N+1 redundancy while reducing overall equipment count and simplifying plant operation.

3. CHILLERS

Equipment

- Quantity: 3
- Capacity: 230 tons each
- Basis of Design: Trane ACSA
- Type: Air-cooled chillers
- Total Installed Capacity: 690 tons

Redundancy

The plant shall provide N+1 redundancy defined as:

With the largest chiller out of service, the remaining two chillers shall be capable of maintaining design chilled water supply temperature at design ambient conditions without load shedding.

Location

Chillers shall be located on a **new chiller platform**, consistent with the original design concept.

The chiller platform was required under the original design and remains required under this alternate.

It is anticipated that:

- The platform size may be reduced under the original (4) 130-ton configuration due to smaller individual unit footprints.
- The platform size would likely remain similar to the originally planned platform under the (3) 230-ton configuration due to larger individual unit dimensions.

Contractor shall confirm final platform sizing based on selected equipment dimensions and required service clearances.

Contractors shall include:

- Structural support
- Platform framing
- Access and service clearance provisions
- Electrical distribution to each unit

4. PRIMARY CHILLED WATER PIPING

The chilled water plant shall utilize a primary/secondary configuration.

Primary chilled water piping shall:

- Interconnect all three chillers
- Include isolation valves at each chiller
- Include flow proof and differential pressure monitoring per flow diagram
- Tie into the existing primary/secondary decoupler arrangement

Primary piping routing shall follow the previous design intent shown in the uploaded flow diagram.

Contractors shall include:

- Chiller headers
- Isolation valves
- Check valves
- Strainers as required
- Instrumentation connections
- Insulation

5. PRIMARY CHILLED WATER PUMPS

Primary chilled water pumps shall:

- Be arranged in a lead/lag configuration
- Be VFD controlled
- Be located in the remaining generator building (same building housing the heating plant primary pumps)

This consolidates primary mechanical equipment within the existing generator building and eliminates the need for pump installation at the chiller platform.

Pump sizing has not yet been finalized.

Contractors shall include reasonable allowances for:

- Pump bodies
- Motors
- VFDs
- Isolation valves
- Check valves
- BAS integration

Primary pump configuration shall support full flow through operating chillers and allow isolation of non-operating chillers.

6. SECONDARY BUILDING CHILLED WATER DISTRIBUTION

The existing building secondary chilled water distribution system shall remain unchanged and remain in its current location as shown in the present design.

Specifically:

- Existing secondary chilled water pumps remain
- Existing differential pressure control remains
- Existing building-side flow rates remain
- Existing terminal connections remain

This alternate does not modify the building distribution loop.

The chilled water plant will tie into the secondary loop at the same connection points as the prior design.

Contractors shall not include rework of the building-side secondary distribution unless required for tie-in.

7. PUMP ENCLOSURE BUILDING AT CHILLER PLATFORM

Under the original design, a building or enclosure was planned at the chiller platform to house primary chilled water pumps and associated equipment.

Under this alternate:

- Primary pumps are relocated to the remaining generator building.
- The enclosure building at the chiller platform is likely unnecessary.

Contractor shall review and confirm whether the pump enclosure building at the chiller platform can be removed from pricing under this alternate configuration.

8. CONTROLS INTENT

The chilled water plant shall operate as follows:

1. Upon a call for cooling, the lead primary chilled water pump shall start.
2. The lead chiller shall be enabled.
3. Additional chillers shall stage based on chilled water supply temperature and load demand.
4. Chillers shall operate in a lead/lag rotation sequence.
5. Chiller isolation valves shall open prior to chiller enable.
6. Secondary chilled water pumps shall operate under differential pressure control (existing system).
7. Chilled water supply temperature shall be maintained at the design setpoint as shown in sequence.

This alternate eliminates:

- Heating/cooling simultaneous arbitration logic
- Dual-duty condenser heating logic
- Capacity coupling with the heating plant

The cooling plant operates as a dedicated cooling-only system.

9. SCOPE DIFFERENCES FROM ORIGINAL DESIGN

This chilled water plant alternate:

- Reduces chiller quantity from four (4) to three (3)
- Increases individual chiller capacity
- Maintains N+1 redundancy
- Eliminates cooling capacity dependence on heat recovery operation
- Eliminates dual-mode chiller operation
- Simplifies staging logic
- Relocates primary chilled water pumps to the generator building
- Eliminates need for pump enclosure building at chiller platform (subject to contractor confirmation)
- Retains existing secondary distribution pumps

Heating plant modifications are addressed under separate narrative.

10. CONTRACTOR PRICING ASSUMPTIONS

Contractors shall include:

- Three 230-ton air-cooled chillers
- Primary chilled water pumps and VFDs located in remaining generator building
- New chiller platform
- Chiller platform piping and headers
- Isolation valves and instrumentation per diagram
- Electrical feeds to chillers and pumps
- BAS integration consistent with provided points list

- Structural verification of chiller platform sizing

Contractor shall review and confirm whether the chiller platform pump enclosure building may be deleted from this alternate.

Contractors may provide value engineering suggestions for:

- Pump configuration
- Header optimization
- Platform layout optimization
- Electrical distribution efficiency

11. SUMMARY

This chilled water plant alternate:

- Maintains N+1 redundancy
- Simplifies plant architecture
- Removes interdependence with heating plant
- Consolidates primary pumps into generator building
- Eliminates platform pump enclosure building
- Retains building secondary distribution
- Reduces equipment count

This narrative is intended to allow contractors to directly compare the cost of this chilled water plant alternate to the original integrated chiller-heater system.

Sequence of Operation: COOLING PLANT SYSTEMS

System General Description:

The cooling plant control system shall monitor and control the system's chiller(s), pump(s), and control valves as shown on the cooling plant flow diagram, in the cooling plant points list and as detailed in the sequence of operation listed below.

The cooling plant system consists of air-cooled chiller(s) with its piping configuration arranged as a primary / secondary loop supplying chilled water to the facility.

The manifolded chilled water distribution pumps are configured as lead / lag control.

Cooling Plant System Enable/Disable:

The cooling plant system shall be enabled/disabled by the cooling plant controller as requested by the Building Automation System (BAS) operator interface panel or the BAS time of day schedule. The cooling plant control system shall start and stop the chilled water pumps and chillers based upon system load.

When the cooling plant system is enabled the system shall enable the lead secondary chilled water pump to start based on a call for cooling from the BAS. When flow status for the pump is proven, the system shall report running status to the BAS.

When the cooling plant system is enabled the system shall send an enable signal to the lead chiller. Upon receiving the enable signal the chiller shall send a chilled water pump request signal to the control system to enable the chilled water pumping sequence.

When the cooling plant system is enabled, the system shall respond to a chilled water pump request from any system chiller. The system shall command the associated chilled water isolation valve open and enable the lead primary chilled water pump to start. As additional chillers make chilled water pump requests, open the associated chilled water isolation valve and enable the next (lag) primary chilled water pump to start.

The cooling plant is disabled when all chillers are disabled and there is not an active chilled water pump request. When the plant is disabled, the chilled water pumps shall be commanded off and the chiller isolation valves shall be closed.

Chiller Staging:

Chillers shall operate in a lead/lag sequence, so that the last chiller enabled is the first to be disabled. The cooling plant system shall initiate the start of the next chiller in the sequence whenever the chilled water load, as determined by the system supply water temperature, is not met for 20 minutes (adj.). The system shall initiate the shut down of the next chiller in the sequence whenever excess chilled water capacity exists, as determined by percent run load amps, for 20 minutes (adj.). Chiller lead/lag sequence order shall be based on a round robin logic. (Round robin logic example: 1-2-3, then 2-3-1, then 3-1-2, then 1-2-3, etc.).

The chiller sequence order can be rotated on a schedule. Chiller rotations shall be programmed to occur at one of the following operator-defined intervals:

NEVER: Chillers shall always have the same sequence number.

DAY OF WEEK: Chillers shall rotate on a user-specified day and time once per week.

FIXED NUMBER OF DAYS: Chillers shall rotate after the number of days specified has elapsed.

RUN HOURS: Chillers rotate to attempt to even out the amount of time each chiller runs. When any chiller reaches the user-defined run hours setpoint (which is measured only from the last rotation), the system controller can re-sequence the chillers, if necessary, to put the chiller with the least total run hours into a higher-use position in the sequence.

ROTATIONAL INPUT: Chillers shall rotate when the specified reference commands them to rotate.

From the BAS operator interface, an operator shall be able to manually change the lead/lag sequence or request any chiller to be unavailable which would remove it from the rotation sequence.

Chiller Isolation Valves:

Chiller isolation valves shall prevent the flow of fluid through non-operating chillers. When the system receives a chiller water pump request from a chiller, the chiller isolation valve shall be controlled to 100% open. Chiller isolation valve stroke time shall be (60-120) seconds (adj.) to reduce operating chiller flow transients. When the valve is confirmed to be 100% open the system shall start the respective chilled water pump. If the chiller's isolation valve is not confirmed open after (valve stroke time plus 60 sec) 180 seconds (adj.), the system shall annunciate a chiller isolation valve failure alarm to the BAS operator interface.

Primary Chilled Water Pump Commands:

When the chilled water system is enabled, the system shall start a chilled water pump through a contact closure of the pumps motor starter enable contacts. The system shall detect primary chilled water pump run status by a current switch.

The manifolded primary chilled water pumps shall operate in a lead/lag sequence that shall be rotated on a weekly schedule. The rotation sequence shall be based on calculated run time with the pump having the least run time designated as lead, the pump with the next lowest run time shall be the second in the sequence (or lag pump) and so on. From the BAS operator interface, an operator shall be able to manually change the lead/lag sequence or request any pump to be unavailable which would remove it from the rotation sequence.

Primary Chilled Water Pump Failure:

If the lead start/stop relay is enabled and the pump's running status is off for more than 30 seconds (adj.), the system shall annunciate a chilled water pump failure alarm to the BAS and start the next pump in the sequence. Once the problem has been corrected, the operator shall be able to clear the alarm failure from the BAS operator interface or by manually overriding the pump on. This shall re-enable the lead/standby sequence.

Secondary Chilled Water Pump Commands:

The system shall start a secondary chilled water pump through a contact closure of the pump's variable speed drive run-enable contacts. The system shall detect secondary chilled water pump run status by a variable speed drive current switch.

The secondary chilled water pump(s) lead/lag sequence shall be rotated on a weekly schedule. The rotation sequence shall be based on calculated run time with the pump having the least run time designated as lead, the pump with the next lowest run time shall be the second in the sequence (or lag pump) and so on. From the BAS operator interface, an operator shall be able to manually change the lead/lag sequence or request any pump to be unavailable which would remove it from the rotation sequence.

If the chilled water system differential pressure falls 0.5 psig (adj.) below setpoint and the lead pump is at 100% (adj.) for more than 5 minutes (adj.), the next pump in the sequence shall start. If the pump speed control output is below 65% (adj.) for more than 5 minutes (adj.), the last operating pump in the sequence shall be disabled.

Secondary Chilled Water Pump Speed:

The system shall monitor the secondary chilled water system differential pressure sensor. When the pump variable speed drive is enabled, the system shall control the analog speed signal that is sent to the variable speed drives of operating pumps to maintain a chilled water system differential pressure setpoint of 15 psig (adj.).

Secondary Chilled Water Pump Failure:

If the lead start/stop relay is enabled and the pump's running status is off for more than 30 seconds (adj.), the system shall annunciate a secondary chilled water pump failure alarm to the BAS and start the lag pump. When a secondary chilled water pump failure exists, lead/lag/standby automation shall be disabled and the currently running pump becomes the lead pump. Once the problem has been corrected, the operator shall be able to clear the alarm failure from the BAS operator interface. This shall re-enable the lead/lag/standby sequence.

Optimized Distribution Pump Differential Pressure Control:

The system shall monitor the chilled water system differential pressure sensor. The system shall control the chilled water pump(s) variable speed drive to maintain the chilled water system differential pressure to its setpoint. The BAS shall monitor the position of all chilled water control valves served by the cooling plant. At chilled water system startup, the chilled water system pressure setpoint shall be set to the system design value of XX psi (adj). In all cases the distribution pump(s) differential pressure setpoint shall be bound between a minimum of 30 psi (adj) and a maximum of the system design value.

The setpoint control shall be based on ASHRAE Guideline 36 "Trim and Respond Logic": At a frequency of once every 10 minutes (adj), the control system shall calculate requests for cooling based on the criteria shown below:

1) The air handler unit (AHU) other equipment served by the cooling plant has been running in a Cooling Mode for 15 minutes (adj).

2) If an AHU's (or other equipment) chilled water valve is greater than 95%, send 1 request until the chilled water valve is less than 70%.

3) If an AHU's (or other equipment) chilled water valve is serving a critical load (i.e data center) , send 2 requests (adj) if an AHU's chilled water valve is greater than 95%, send 1 request when the chilled water valve is between 80% and 95%. Send zero requests when the chilled water valve is less than 65%.

4) Else if the chilled water valve is less than 95%, send 0 requests.

The BAS shall default to ignoring the first 2 requests (adj).

(Note: At startup set Ignore value to at least 40% of the number of AHUs served).

When (Requests greater than Ignores) the system shall respond by adjusting the chilled water pump differential pressure setpoint upward by $((\text{Requests} - \text{Ignores}) * (3) \text{ psi})$ (adj), but no larger than 10 psi (adj). When requests are equal to, or less than Ignores, the setpoint shall be reset downward by 2 psi (adj).

POINTS LIST: COOLING PLANT SYSTEM (4-CHILLER OPTION)

CHILLERS

(Repeat for CH1, CH2, CH3, CH4)

CH1 FLW – Chiller 1 Chilled Water Flow Proof – BI – Alarm
CH1 ISO CMD – Chiller 1 Chilled Water Isolation Valve Command – BO
CH1 ISO STS – Chiller 1 Chilled Water Isolation Valve Status – BI
CH1 DP – Chiller 1 Chilled Water Differential Pressure – AI – High/Low Alarm
CH1 CMD – Chiller 1 Enable Command – BO
CH1 STS – Chiller 1 Status – BI
CH1 ALM – Chiller 1 General Alarm – BI – Alarm

CH2 FLW – Chiller 2 Chilled Water Flow Proof – BI – Alarm
CH2 ISO CMD – Chiller 2 Chilled Water Isolation Valve Command – BO
CH2 ISO STS – Chiller 2 Chilled Water Isolation Valve Status – BI
CH2 DP – Chiller 2 Chilled Water Differential Pressure – AI – High/Low Alarm
CH2 CMD – Chiller 2 Enable Command – BO
CH2 STS – Chiller 2 Status – BI
CH2 ALM – Chiller 2 General Alarm – BI – Alarm

CH3 FLW – Chiller 3 Chilled Water Flow Proof – BI – Alarm
CH3 ISO CMD – Chiller 3 Chilled Water Isolation Valve Command – BO
CH3 ISO STS – Chiller 3 Chilled Water Isolation Valve Status – BI
CH3 DP – Chiller 3 Chilled Water Differential Pressure – AI – High/Low Alarm
CH3 CMD – Chiller 3 Enable Command – BO
CH3 STS – Chiller 3 Status – BI
CH3 ALM – Chiller 3 General Alarm – BI – Alarm

CH4 FLW – Chiller 4 Chilled Water Flow Proof – BI – Alarm
CH4 ISO CMD – Chiller 4 Chilled Water Isolation Valve Command – BO
CH4 ISO STS – Chiller 4 Chilled Water Isolation Valve Status – BI
CH4 DP – Chiller 4 Chilled Water Differential Pressure – AI – High/Low Alarm
CH4 CMD – Chiller 4 Enable Command – BO
CH4 STS – Chiller 4 Status – BI
CH4 ALM – Chiller 4 General Alarm – BI – Alarm

PRIMARY CHILLED WATER SYSTEM

PCHW SUP – Primary Chilled Water Supply Temperature – AI – Low Alarm
PCHW RET – Primary Chilled Water Return Temperature – AI – High Alarm
PCHW FLW – Primary Chilled Water Flow Meter – AI – Low Alarm

PCHWP1 CMD – Primary Chilled Water Pump 1 Start/Stop – BO
PCHWP1 STS – Primary Chilled Water Pump 1 Status – BI
PCHWP1 FAIL – Primary Chilled Water Pump 1 Failure – BI – Alarm

PCHWP2 CMD – Primary Chilled Water Pump 2 Start/Stop – BO
PCHWP2 STS – Primary Chilled Water Pump 2 Status – BI
PCHWP2 FAIL – Primary Chilled Water Pump 2 Failure – BI – Alarm

PCHWP1 SPD – Primary Chilled Water Pump 1 Speed – AO
PCHWP2 SPD – Primary Chilled Water Pump 2 Speed – AO

PCHWP LEAD – Primary Chilled Water Pump Lead Designation – SF

SECONDARY CHILLED WATER SYSTEM

SCHW SUP – Secondary Chilled Water Supply Temperature – AI – Low Alarm
SCHW RET – Secondary Chilled Water Return Temperature – AI – High Alarm
SCHW DP – Secondary Chilled Water Differential Pressure – AI – High/Low Alarm
SCHW FLW – Secondary Chilled Water Flow Meter – AI

SCHWP1 CMD – Secondary Chilled Water Pump 1 Start/Stop – BO
SCHWP1 STS – Secondary Chilled Water Pump 1 Status – BI
SCHWP1 FAIL – Secondary Chilled Water Pump 1 Failure – BI – Alarm
SCHWP1 SPD – Secondary Chilled Water Pump 1 Speed – AO

SCHWP2 CMD – Secondary Chilled Water Pump 2 Start/Stop – BO
SCHWP2 STS – Secondary Chilled Water Pump 2 Status – BI
SCHWP2 FAIL – Secondary Chilled Water Pump 2 Failure – BI – Alarm
SCHWP2 SPD – Secondary Chilled Water Pump 2 Speed – AO

SCHWP3 CMD – Secondary Chilled Water Pump 3 Start/Stop – BO
SCHWP3 STS – Secondary Chilled Water Pump 3 Status – BI
SCHWP3 FAIL – Secondary Chilled Water Pump 3 Failure – BI – Alarm
SCHWP3 SPD – Secondary Chilled Water Pump 3 Speed – AO

SCHWP LEAD – Secondary Chilled Water Pump Lead Designation – SF

SYSTEM LEVEL POINTS

CHW SUP SP – Chilled Water Supply Temperature Setpoint – SF
OAT ENA SP – Outdoor Air Temperature Enable Setpoint – SF

OAT – Outdoor Air Temperature – AI – Low Alarm
OAH – Outdoor Air Humidity – AI

CHW PLT EN – Chiller Plant Enable – BO

CHW LEAD – Chiller Lead Designation – SF

BAS COM – BAS Communication Status – BI – Communication Fail

CONTROL LOGIC FLAGS

CHW ENABLE – Cooling Plant Enable Status – SF
CHW ACTIVE – Cooling Plant Active – SF
CHW DEM – Cooling Demand Active – SF