GENERAL

This addendum forms a part of the Contract Documents and modifies the original Bidding Documents dated July 25, 2025, and consists of pages AD1-1 through AD1-5, Specifications Section 1.2. The following changes, additions and/or deletions shall be made to the following documents: all other conditions shall remain the same.

ITEM NO. I – CONTRACT DOCUMENTS

ANNOUNCEMENT TO PREQUALIFIED BIDDER
SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

1. CHANGE Bid deadline to **August 18, 2025, at 2 p.m.**

ITEM NO. II – SPECIFICATIONS

1. SECTION 1.2 - TITLE OF SECTION Summary of Work
   SECTION B – TITLE OF SECTION Work to Be Performed by The Contractor
   Page 4, Item h., Paragraph 1

ITEM NO. III – CLARIFICATIONS

1. Question: Are there restrictions for country of origin on piping/support materials on this project? If so, please provide.

   Answer: There are no restrictions on country of origin for piping/support materials.

2. Question: Please provide information on the reroute of fire sprinkler and duct work that is the contractor's responsibility.

   Answer: See page 4 of Summary of Work document, section 1.2, B, 11, s & t. Temporary relocation of fire sprinkler piping and/or HVAC vent if necessary. Project does not require a permanent reroute of the fire sprinkler or duct work. Relocation would be temporary and determined by contractor if rigging to install equipment interferes with fire sprinkler piping or HVAC vent.

3. Question: Is the inside of the HRSG a permit required confined space? (Yes)

   Answer: See UCDH Policy and Procedure 1626. P&P 1626 follows Cal-OSHA standards 8 CCR 5156-5158 in regard to classifying a Confined spaces into three categories. Non-Permit Confined Space, Permit-Required Confined Space- Alternate Entry Procedures, and Permit-Required Confined Space-Comprehensive Procedures.

   Per the policy the HRSG is considered a Permit-Required Confined Space-Alternate Entry Procedures. Procedures include atmosphere testing prior to entry and continues forced air ventilation.

   The Ammonia UST is considered a Permit-Required Confined Space-Comprehensive procedure and will require a rescue system, continuous air monitoring, continuous ventilation, etc.

4. Question: Please provide the existing ammonia tank drawing

   Answer: See attached document labeled UCD Ammonia Tank Details.

5 Question: Will the Urea tank come pre-insulated? If not, please provide the insulation specifications.

Answer: Tank does not come insulated per Fueltech drawing 1294P-M02-02-R0 Note 2. The tank is not required to be insulated as it is located in a climate-controlled room.

6. Question: Will the Decomposition Chamber come pre-insulated? If not, please provide the insulation specifications.

Answer: Per FuelTech Drawing 1294P-M04-10-GA-R1, Decomp Chamber needs 6 inches of insulation. Per FuelTech Drawing 1294P-M02-04-R1, note 2, All insulation is provided and installed by others. Contractor to provide and install insulation for the Decomp Chamber per attached FuelTech Decomp Chamber Insulation document.

7. Question: Are we to supply EJ-001 on line 515? If so, please provide the specification.

Answer: The expansion joint EJ-001 and EJ-002 shall be procured and installed by the Contractor. Please reference the Valtech Engineering EJs document attached.

8. Question: Are we to supply FI-2253 on line 512? If so, please provide the specification.

Answer: Reference Note 1 on drawing M127.

9. Question: Are we to supply EJ-1907 on line 504? If so, please provide the specification.

Answer: Reference Note 1 on drawing M126. See attached 1294P Ship Loose List - Technics.

10. Question: Will the pipe supports shown on Drawing S002 be supplied? If not, can you please provide the Lisega reference drawing 55-3-77618 for 5PS1. Also please provide all loads, movements, etc. for support #5PS1, 6PS1, and 6PS3.

Answer: The pipe supports shall be procured and installed by the Contractor. Please reference the Lisega Quote attached.

11. Question: Do any of the existing equipment or piping that needs to be demolished contain lead paint or asbestos?

Answer: Construction on the Central Plant started in 1995 and completed in 1998. Asbestos in pipe insulation was banned in 1975 and the use of lead paint was banned in 1978. Recently a partial hazardous assessment was completed for the plant and did not reveal any asbestos or lead paint. A specific hazard assessment is planned to be completed on the specific area of work for this project prior to work starting. Results will be shared with the awarded contractor. Abatement of any discovered asbestos or lead will be the responsibility of the contractor.

12. Question: Will traffic control be required on 49th Street for the lane closure to remove and install the equipment in the Cogen Emission Equipment Room?

Answer: Awarded contractor to coordinate lane closure with the city of Sacramento if necessary. Lane closure would require traffic control.

13. Question: Will traffic control be required on 49th Street for the lane closure to remove and install the equipment in the Cogen Emission Equipment Room?

Answer: See section 1.2, B, 19 of revised Summary of Work document.

14. Question: We were unable to find plans/isometrics for lines 510 and 511, can you please provide information on this scope? (How many feet of tubing, etc.)

    Answer: Lines 510 & 511 are 3/8" SS Tubing which will be field routed. The lines originate at the heater module and terminate at the blower module. Reference M106 for the location of the skids.

15. Question: Can you please provide an MSDS for the ammonia? We would like to confirm the SDS on what will be left in the existing underground tank.

    Answer: See attached document labeled Airgas Aqua Ammonia SDS.

16. Question: Does UC Davis have any temporary power needs that would need to be supplied by the contractor during the outage?

    Answer: No

17. Question: Is it acceptable for the bidding contractor to submit commercial clarifications to the agreement with the contractor's proposal?

    Answer: Yes

18. Question: Table 4 on drawing M103 calls for 2.5-18" 150# 316SS pipe to be EFW, Schedule 10S, but BOM's on drawings M117, M119 and M120 describe 4", 6" and 8" pipe as Seamless Schedule 40S. Please advise, does the BOM supersede the specification table?

    Answer: The Bill of Materials on the isometric drawings are the governing requirement.

19. Question: Regarding pressure test fluid on the line list, some lines call for using water while others call for Nitrogen. For the lines calling for water, would it be acceptable to test with Nitrogen instead? This could reduce or eliminate drying time during the outage window.

    Answer: No. Test per instructions.

20. Question: Please specify the number of days and working hours anticipated for outage support for all trades (Electrical, Boilermaker, Pipefitter, etc.)

    Answer: See section 1.2, B, 19 of revised Summary of Work document.

21. Question: Per the drawings and our recent job walk, there appears to be a discrepancy regarding the location of existing conduit stub-up ID 73P3071J. The drawings show it coming up at the south wall; however, during the site visit, there was no 1 1/2" conduit at that wall. We believe it currently comes up directly at the existing skid. If the new skid has a larger footprint, this conduit may need to be reworked or relocated to avoid interference. Please advise on the intended location and if any modifications are expected.

    Answer: The present understanding is that conduit 73P3071J stubs-up at the south wall as shown on drawing E403. Conduit is shown on drawing M201D, DEMO View B. It is the third conduit from the left.

22. Question: Drawing E098 shows a new 200A circuit breaker to be added in 73-MCC-0236. However, for 73-MCC-0235, it appears to show only an existing breaker, with no new breaker identified. Please confirm whether we are to provide a new circuit breaker for MCC-0235 as well, and if so, please provide the required specifications.

    Answer: The existing 70A breaker in MCC-235 bucket 2F will be re-used for this project. A new breaker is not required.

23. Question: We saw 1 qty, 480V connection during the job walk. We assume that is the construction power is available for the contractor to use during the outage, please confirm. If so, are there more connections, and where are they?

    Answer: Contractor can use the 480VAC welding receptical in the Cogen Room. Receptical is rated at 60 Amps. There are limited 120V recepticles in the area of work for contractor use.

24. Question: Is catalyst disposal our responsibility? It states that demo material is contractor responsibility but I'm not sure if they are including this material as well.

    Answer: Yes

25. Question: Is calls for Meritech document for installing the CO catalyst but I have not seen that drawing

    Answer: See attached document labeled Miratech CO Catalyst Installation Procedure..

26. Question: How was the existing double stack of SCR catalyst installed, this came up during our meeting, Russell S. disclosed that they had added another row of catalyst because they had underestimated the size of the unit.

    Answer: There is a layer of SCR catalyst clamped to the original SCR catalyst via a frame with all-thread at the sides. Layer is estimated at 14 inches thick. See document labeled SCR Layer Photos.

27. Question: For bidding purposes, should we assume the FuelTek skid is a complete unit, including factory-installed conduit and wiring for all devices and equipment mounted on the skid that are feed by the Panels mounted on the skid? During the job walk, we observed devices mounted on the skid that did not appear to have conduit or wiring installed. However, per the cable schedule, these devices are shown to be fed from the new PLC mounted on the skid. It is uncertain whether some of the factory work was done. Should we assume it was completed, or can you confirm what conduits and wire are included from the factory and what still needs to be ran as far as any devices or equipment being fed from the factory mounted panels on the skid.

    Answer: See sheet 1294P-E02-21, 1294P-E03-08, and 1294P-E04-07. Items in the "Cabling By" column marked "OTHERS" are the responsibility of the contractor to supply. See sheets E-1.0 through E-2.4 for more information.

28. Question: What is the HRSG paint spec or owner specifications for touch up we will need this after nozzles are installed and structural members are added/removed.

    Answer: See attached CO Duct D Assembly document, note 8 for paint specification

29. Question: Is there an MOP for the cleaning of ammonia tanks?

    Answer: Please follow the UCDH Ammonia-Urea Specifications_230921 for guidance.

30. Question: Would you guys be able to provide me with a device list and what devices already have conduit and wire to them from the factory. On the job walk I noticed a few items on the skid in which had no conduit and wire yet. For example there were two AOV's with wire hanging out, I believe these are feed from the provided PLC panel.

Answer: The wiring of the two valves is clearly labeled as 'Wiring by others' on the schematic, Interconnection Drawings and Cable List provided in our electrical drawings package Please reference Fuel Tech Doc:1294P-M03-01-GA-R3 for the parts list. Please reference drawing Fuel Tech Urea Equipment Plans for cabling and conduit and referred to drawing 1294-E02-03 for cabling from skid to skid that will need to be supplied by OEM.

DocuSigned by:
Dmoro Foster
91EE525405J440E...

Dmoro Foster – Project Manager
Facilities Planning & Development
UC Davis Health

SECTION 011000

SUMMARY OF WORK

PART 1 - GENERAL

1.1 PROJECT DESCRIPTON

A. Briefly, and without force and effect upon the contract documents, the work on the contract can be summarized as follows:

B. The Urea Conversion Project (Project) at the UC Davis Medical Center Central Plant (Plant) involves the following work as an overview.
   1. Removal of existing ammonia equipment inside the ammonia room.
   2. Removal of existing ammonia supply piping, valves, and instrumentation from the ammonia room to the last flange just before the ammonia distribution header outside the HRSG.
   3. Removal of existing Ammonia Injection Grid (AIG) manifold and distribution piping.
   4. Removal of AIG lance assemblies from within the Heat Recovery Steam Generator (HRSG).
   5. Patching of existing AIG piping penetrations through HRSG shell and liner.
   6. Removal of the existing CO catalyst modules from within the HRSG.
   7. Removal of the existing Selective Catalytic Reduction (SCR) catalyst modules from within the HRSG.
   8. Temporary removal of building window, frame, and wall at the ammonia room to allow the removal of existing ammonia equipment and installation of the new urea equipment.
   9. Installation of new urea equipment. The urea equipment (by FuelTech) has already been delivered to the project site.
   10. Restoration of the building window, frame, and wall at the ammonia room after the new urea equipment is placed inside the ammonia room.
   11. Installation of new mechanical and electrical items, interconnections and supports.
   12. Installation of new ammonia/air mixture supply piping and supports to the new ammonia distribution grid.
   13. Installation of new AIG Manifold and distribution piping (materials provided by SCR Solutions).
   14. Fabrication of new AIG Piping penetrations through HRSG shell and liner.
   15. Installation of new AIG lance assemblies and flow straightener duct (materials provided by SCR Solutions).
   16. Installation of new CO catalyst modules and support structures (materials provided by SCR Solutions).
   17. Installation of new SCR catalyst modules and support structures (materials provided by SCR Solutions).
   18. Evacuate and clean the existing underground ammonia tank.
   19. Application of epoxy coating to cover the internal of the underground ammonia tank.

C. Furnish labor, equipment, tools, and construction materials for construction of the project in full compliance with the design drawings and the specifications.

D. It is not the intent to specify herein all the details of the Contractors work scope. The Contractor shall bear the responsibility of ensuring that the work is in accordance with all applicable codes, standards, drawings, and specifications.

E. Contractor shall not proceed with any construction work which is "On Hold" until the "On Hold" is released for construction.

F. Contractor's price shall include an allowance of plus or minus 18 inches for final location of grounding grid pigtail stub ups, piping stub ups and electrical conduit stub ups.

G. Provide mechanical and electrical interconnection testing.

1.2 SUMMARY OF WORK

A. WORK TO BE PERFORMED BY THE OWNER
   1. The Owner shall be responsible for the following items.
      a. Clear storage and loose items inside the ammonia room.
      b. Shutoff and isolate ammonia supply from underground tank to ammonia room.
      c. Evacuation and flushing of residual ammonia between tank, ammonia room, and ammonia line up to HRSG ammonia injection grid.
      d. Air, nitrogen or water purge between tank, ammonia room, and ammonia line up to HRSG ammonia injection grid. Drain non-potable water supply line.
      e. Depressurization of IA (instrument air) supply line at the ammonia room.
      f. Lockout/Tagout (LOTO) as needed.
      g. Design, installation, and commissioning of the Distributed Control System addition for controlling the PLC based Ultra NH3 flow control system will be performed by a third-party controls contractor.
      h. Temporary relocation of fire sprinkler piping if necessary.
      i. Temporarily Relocation of HVAC vent if necessary.
      j. Coordinate with UCDH Fire Prevention office to temporarily disable fire sprinkler system in Ammonia Room and establish fire watch plan approved by Owner. Contractor to give a 5-business day notice to UCDH prior to removal of fire sprinkler piping. Contractor responsible for temporary removal and reinstallation of fire sprinkler piping if required.
      k. Third-party inspection for California Building Code related testing and inspections including special inspections as required by the California Building Code. The Contractor shall coordinate with the Owner for scheduling the thirty-party testing and inspections with a minimum of one (1) week advance notice.
      l. Construction power, water, and air at source.
      m. Provide space for a Contractor provided construction trailer within the utility yard.
      n. Provide 2 parking spaces inside the Central Plant Utility Yard for use by the Contractor. For additional parking places on campus, the Contractor will need to utilize the parking kiosks. More details to be provided to the awarded contractor.
      o. Disposal of flush water.
      p. Hot work and confined space permits.
      q. Wiring terminations at the DCS cabinet just outside of the ammonia room (north side).

B. WORK TO BE PERFORMED BY THE CONTRACTOR

   1. Refer to drawings Appendix for a listing of engineer’s design drawings that cover the work in this contract. The Contractor shall be aware that Owner furnished equipment vendor drawings are also included in the design package as the Contractor will also need to refer to the vendor drawings for a complete project.
   2. The Contractor shall provide typical submittals required for performance of the work for Owner’s review and approval, including but not limited to:
      a. Calculations/Engineering Data
      b. Product Data
      c. Vendor Drawings
      d. Samples
      e. Certificates
      f. Test Reports
      g. Catalog Data
      h. Demolition Plans and Procedures

i. As-builts

3. The Contractor should be aware that the FuelTech and SCR Solutions equipment/material is currently onsite. The Owner will locate an outdoor location as the temporary laydown area for this equipment and material.
4. The Contractor shall be responsible for receiving and unloading all project equipment and materials that is not already on site. The Contractor shall be responsible for loading, transporting, and unloading of all equipment and materials from temporary laydown area to the construction area for erection and installation.
5. All necessary construction, lifting equipment, including adequate rigging equipment, shall be provided by the Contractor. The Contractor shall be liable for any damage (that is caused by the Contractor) to the equipment until the equipment is installed at the plant and turned over to the Owner.
6. Any necessary temporary power distribution system, power distribution center with associated aboveground conduits, cables, and other necessary equipment shall be supplied and installed by the Contractor outside the 480V 60A welding circuit already available within the UCDH Central Plant. The Contractor shall supply, install, and connect all additional temporary conduit, 480V distribution cabling, etc. for a complete temporary power distribution system.
7. The Owner will provide 2 parking spaces inside the Central Plant Utility Yard for use by the contractor. For additional parking places on campus, the contractor will need to utilize the parking kiosks. More details to be provided to the awarded contractor. The Owner will also provide space for a contractor provided construction trailer within the utility yard.
8. Contractor to provide Porta-Johns for its own labor and subcontractors.
9. Contractor to provide confined space hole watches and rescue teams as applicable.
10. Contractor to provide temporary fencing if necessary.
11. Demolition/removal of the following items.
    a. Removal of existing ammonia vaporizer skid, associated housekeeping pad and adjacent housekeeping pad (inside the ammonia room).
    b. Removal of existing ammonia expansion tank and housekeeping pad (inside the ammonia room).
    c. Removal of existing ammonia suction pump skid and housekeeping pad (inside the ammonia room).
    d. Removal of PA speaker and reinstallation of PA speaker above the ammonia room entrance door.
    e. Instrumentations and associated conduits (inside the ammonia room).
    f. Wall mounted electrical pull boxes and disconnect switches.
    g. Removal of ammonia leak detector and reinstallation of such detector near the NW corner of the ammonia room.
    h. Controls and Instrumentation wiring and conduit from the ammonia room to the DCS cabinet located just outside the ammonia room (North side).
    i. Miscellaneous supports for the removed items.
    j. Above ground cables and conduits as shown on the demolition drawings and illustrations.
    k. Cables located in existing underground conduit, which is being re-used, shall be fully removed to make the conduit available for new cables.
    l. Underground cables or wires which originate from the demo equipment shall be removed from the demo equipment to the next termination point, unless otherwise noted.
    m. Conduits rising from below ground which are no longer being used shall be capped flush with the finish grade with a male threaded fitting.
    n. Removal of interconnecting piping as necessary to allow removal of equipment.
    o. Contractor shall pay special attention to protect and save the existing grounding pigtails/wires that are attached to the existing equipment that will be removed. All existing grounding pigtails/wires will be reused and extended for the installation of the new equipment.
    p. Other miscellaneous mechanical, electrical, and structural items surrounding and adjacent to the HRSG as shown in the demolition drawings.
    q. Overhead Lights. (Note: Overhead lighting circuit(s) to be extended to walls for new wall mounted lighting.)

r. Remove the existing DENOX PLC and Display to allow room for the installation of the new FuelTech remote panel with power and ethernet cable to the FuelTech PLC in the ammonia room.
s. Temporary relocation of fire sprinkler piping if necessary.
t. Temporarily Relocation of HVAC vent if necessary.
u. Demolition of AIG / SCR components:
    1) Remove existing CO catalyst modules and all module retainer bars.
    2) Remove SCR catalyst access doors on roof.
    3) Remove existing SCR catalyst modules.
    4) Demolish existing exterior AIG piping and supports.
    5) Demolish existing AIG harps and lances inside SCR duct.
    6) Cut existing lance support pockets to within 1/2" of liner. Stuff lance support pockets with insulation and cap 1/8" plate. Note that several lance support pockets must be removed at casing.
    7) Remove existing AIG casing penetrations and repair casing holes.
    8) Remove/Relocate existing casing stiffeners as shown on drawings.

12. During the demolition phase, some of the existing equipment/systems adjacent to the work area may be in service. Contractor shall walkdown these equipment/systems to fully understand the locations and operating service boundary.
13. For the demolition of the existing equipment, Contractor shall verify equipment and work areas have been de-energized, disconnected, depressurized, drained, cleared, emptied, etc. prior to demolition.
14. Contractor shall work with the owner to investigate, save, and protect the piping and conduit that are remaining inside the ammonia room. These piping and conduit may remain active and energized during the entire construction period.
15. Cover and protect floor drain inside the ammonia room during the construction period.
16. Contractor shall minimize cutting of existing equipment skids (and other loose devices) and remove them as whole unit in case the equipment needs to be reused.
17. All removed items/equipment shall be stored at the laydown yard properly for a period of 1 month after the demolition is complete. After that, Contractor shall arrange and provide dumpsters and trucking for off-haul and disposal of all demolition items. Contractor shall coordinate with Owner regarding scheduling for transportation of the demolition items.
18. De-terminate electrical connections and interconnecting piping as necessary to allow removal of equipment.
19. Contractor shall include the following constraints in planning of the demolition and installation work:
    a. Total Cogen Unit Outage for this project will be 21 days or less. The FuelTech equipment installation phase by the Contractor shall be completed by the end of the 17th day. The FuelTech startup and commissioning team will begin the startup and commissioning process at the beginning of the 18th day.
    b. Contractor shall obtain all necessary construction permits.
    c. Contractor shall coordinate its work with other construction contractors scheduled for the outage who will be working at the same time.
    d. Contractor to stage all equipment prior to Cogeneration Unit Shutdown.
    e. Contractor to remove Ammonia Room Wall and Window prior to Cogeneration Unit Shutdown.
    f. Contractor to staff the job to meet the 21-day Cogen Unit Outage window including the use of 12-hour shifts, weekend work, and night shifts. Outage work to include demolition, installation, and offline commissioning of equipment. Outage work to also include cleaning, prepping, and coating the Underground Storage Tank.
    g. Online commissioning to take place immediately after installation and offline commissioning.
    h. The Plant will be shut down on **October 5th, 2025**. Demolition work may only begin with Owner's approval and after the Plant completes LOTO, equipment isolation, selection of electrical determinations, and other clearances on **October 6th, 2025**.
    i. Contractor shall pay **$2500** per day as liquidated damages for each calendar day the Cogen Unit is not able to return to normal operations (Substantial Completion) past the 21-day

outage period and as a result of Contractor's work performance.

j. It is expected that new installation work will begin after demolition is complete, unless otherwise approved by the Owner.
k. If Contractor is not able to support a October 6th, 2025 demolition start date a new date can be proposed provided it is not past October 20th, 2025.
l. Contractor to provide three days of onsite startup and commissioning support once the Cogen Unit is placed back online.

20. Furnish and install new concrete housekeeping foundations for the following equipment:
    a. Decomposition Chamber and Structure
    b. Metering and Heater Module
    c. Blower Module
    d. 4,500 gallon storage tank with seismic restraint system
21. Contractor shall remove the building wall, frame, and window to allow adequate room for the removal of existing equipment and the installation of the new equipment. Contractor shall secure the open wall during the time period that the window and wall is removed.
22. Once the new concrete housekeeping foundations are cured and up to design strength, Contractor can place the new equipment onto the new concrete housekeeping foundations.
23. After equipment is placed inside the ammonia room, Contractor shall re-install the building wall, frame, and window.
24. Installation of the following Owner furnished equipment (refer to detailed vendor drawings which show in greater detail the equipment installation work):
    a. Decomposition chamber and the associated structural support
    b. Metering and heater module
    c. Blower module
    d. 4,500 gallon urea storage tank
    e. Manual and control valves (i.e., numbered valves indicated on P&ID's. The Contractor shall furnish and install all required valves not furnished by the vendor)
    f. Vendor provided loose ship items including instrumentations, piping, tubing, enclosures, etc.
    g. Relocation of the previously demolished Ammonia Leak Detector to the North wall.
    h. Relocation of the previously demolished PA speaker to the West wall above the entrance doorway.
    i. New FuelTech remote panel at the existing DENOX box, with power and ethernet cable to the FuelTech PLC at the ammonia room.
25. Installation of the following Contractor furnished equipment:
    a. Any necessary valves as indicated on the P&IDs not furnished by the vendor.
    b. Instrumentation tubing, fittings, manifolds, supports, and valves.
    c. Piping, fittings, other miscellaneous supports, and other piping components to complete the piping system.
    d. New urea fill piping at the PG&E metering yard. The new urea piping will tee into the existing ammonia piping.
    e. Piping and equipment system thermal insulation (including stainless steel insulation covers) for all piping and equipment with surface temperature equal to and above 140 °F. Insulation shall comply with specifications.
    f. Two (2) 480V MCC Buckets equipped with breakers and door operators. 480V MCCs are located in the Plant Operations Building.
    g. Two (2) NEMA 4X pull boxes for power wiring.
    h. One (1) NEMA 4X interface terminal board enclosure for controls and instrumentation.
    i. One (1) 120V panelboard single pole breaker for controls power. Panelboard is located adjacent to the ammonia room.
    j. Four (4) new wall mounted LED lights. Two (2) new lights on the South wall and two (2) new lights on the North wall. Lights to be powered from existing lighting room lighting circuits.
    k. Galvanized rigid conduit, flexible conduit, conduit fittings, and equipment bushings.
    l. Cable trays, wireways and associated fittings, supports and hardware.
    m. Junction or pull boxes necessary for a complete electrical raceway system.
    n. Cables and wires for low voltage power, instrumentation, controls, and communication systems.

o. Low voltage cable termination lugs and terminals.
p. Wire labeling and cable marking devices. Labeling to include landing location and source location on each conductor.
q. Ground bus extension(s) and ground tails.
r. Any other miscellaneous electrical equipment or minor materials necessary for a complete system or as shown on the design drawings.

26. Furnish and install concrete-embedded anchor bolts with nuts and washers, and other embedded metal as shown on the drawings.
27. Furnish, install, pressure test, water flush, clean, and leak test piping for the following piping systems:
    a. Instrument Air supply to blower valves.
    b. Air supply from blower module to metering and heater module.
    c. Ammonia/air mixture to ammonia injection grid.
    d. Heated air supply to decomposition chamber.
    e. Ammonia supply to injector.
    f. Atomizing air supply to injector.
    g. Instrument air supply to metering module.
    h. Urea solution supply to metering and heater module.
    i. Other piping system that comes with the Owner furnished equipment.
    j. Secondary urea fill connecting piping at the PG&E yard area.

(NOTE: THE ABOVE PIPING SHALL BE FURNISHED, INSTALLED, AND TESTED IN ACCORDANCE WITH ASME B31.1 POWER PIPING CODE).

28. Furnish and install the new grounding pigtails to tie-in to existing grounding to all Owner furnished equipment.
29. Furnish and install drilled-in type anchor bolts.
30. Furnish and install all grout materials.
31. Except where noted on the project drawings, the Contractor shall install, and terminate all cables.
32. Cable, Raceway and Termination Schedules: The cable and raceway schedules are furnished as an aid to the identification and installation of cables, conduits, and cable trays, etc. Not all project cables or raceways are reflected in the cable and raceway schedule. Some cables and raceways are shown on the project drawings in schematic or diagrammatic formats (e.g., communications, lighting, grounding). Except where noted on the project drawings, the Contractor shall be responsible for the supply and installation of these field-routed cables and raceways.
33. A computer-generated termination schedule in excel format will be furnished later as an aid to terminating wires and cables.
34. Receive and Maintain Electrical Equipment: Contractor shall be responsible for receiving, receipt inspection and testing (where required) of electrical components and equipment furnished by the Owner.
35. Where additional dress-out of equipment is required, (e.g., connection of shipping sections of switchgear and MCCs, etc.) the Contractor shall perform this work and perform it in accordance with the manufacturer's instructions.
36. Contractor shall be responsible for proper maintenance of this equipment during pre-installation storage and after installation until Owner's acceptance.
37. Provide electrical testing (megger, point-to-point, etc.) for newly installed items (Owner furnished or Contractor furnished) based on industry standards.
38. Grounding System: Contractor shall furnish and install all above ground cables, fittings, and devices to extend and complete the plant grounding and lightning protection systems. The locations of the ground taps to the grid are shown on the referenced grounding drawings.
39. Wherever above ground activities of the Contractor damage or cut the underground portion of the ground grid or taps to the ground grid, the Contractor shall repair, or replace, the damaged area in consultation with, and with the approval of, the Plant Manager.
40. Installation, point to point wire check, and instrument loop check of all instrumentation. The

Contractor shall also assist the startup with all instrument calibration and commissioning.

41. Furnish, install, and/or repair site concrete slab-on-grade/surfacing as necessary around new foundation area.
42. Contractor shall furnish and perform final painting including but is not limited to all non-insulated steel piping, plastic piping, pipe, and conduit supports, vents, electrical panels, panel supports, equipment, touchup of shop applied coatings damaged during construction and miscellaneous items associated with construction. Contractor shall also apply touch-up painting (provided by Owner) to the Owner furnished equipment as necessary.
43. The Contractor shall provide flushing of all fluid pipelines to assure cleanliness of piping systems.
44. The Contractor shall provide the following work at the existing underground storage tank:
    a. Draining of residual ammonia.
    b. Cleaning of tank walls.
    c. Prep tank walls for coating per coating manufacturer instructions.
    d. Coat tank per manufacturer instructions.
45. Contractor shall remove all Contractors' construction trailers and conduct final site cleanup.
46. Contractor shall provide the necessary safety essentials, including rescue team, to perform the scope of work described herein.
47. Contractor shall provide security, including temporary fencing, temporary closure of building opening (with plywood or other adequate material) and/or security guards, to protect the plant during the construction period when the wall, frame, and window at the ammonia room are removed.
48. AIG and SCR Installation work:
    a. CO catalyst replacement
        1) Install gasket on CO catalyst modules following manufacturer’s instructions.
        2) Install CO catalyst modules inside existing CO catalyst frame.
        3) Install new catalyst retainer blocks. Retainer blocks are to be welded to existing frame. Protect catalyst face from weld spatter.
        4) Install new bolted catalyst retainer bars. Bars are slotted to allow for minor variations in frame.
    b. SCR catalyst replacement
        1) Install new SCR catalyst retainer bolt assemblies by welding new coupling nuts to existing SCR catalyst frame.
        2) Install downstream seal track in sections matching existing liner plates.
        3) Assemble new catalyst retainer bars and bolt assemblies. Catalyst retainer bars are unique Left/Right and are shipped in two pieces to be field welded on site. Leave catalyst retainer bars loose.
        4) Install new SCR catalyst modules onto existing pedestals. Gasket is pre-installed on downstream face by manufacturer.
        5) Snug-tighten new catalyst retainer bolts and install top seal bar. Install strap bolt assemblies (snug), then tighten new catalyst retainer bolts.
    c. AIG external piping
        1) Install new casing penetrations and new casing stiffeners.
        2) Install new AIG header and supports, aligning to and mating with AIG header piping designed by others.
        3) Install new AIG external piping and supports. Piping is shipped in spools with field trim allowance to allow for adjustment to site conditions. Install piping from bottom to top; Do Not make final field welds before assembling AIG harps.
        4) Perform field welds to new AIG harp headers inside unit,and finalize AIG harp position within unit.
        5) Make final field weld on external piping and seal weld casing penetration flange.
    d. AIG lances, harps, and baffle plates
        1) Install lance and baffle casing support plates. Make minimal cuts in liner to reduce amount of required liner repairs. Re-insulate all affected areas and install liner cover plates. Repair liner plates as required.
        2) Install horizontal baffles.

3) Cut liner holes for new AIG piping penetrations. Patch liners as required. Cut new liner holes tight to penetrating pipe, as access will prevent the installation of cover plates on the penetrating pipes.
4) Install AIG harps after making field welds to penetrating AIG piping.
5) Finish installation of AIG and baffle plates.

1.3 GENERAL INFORMATION

A. OWNER, ARCHITECH, AND ENGINEER DEFINED

1. Owner and Project Site Street Address:
   UCDMC CENTRAL PLANT
   4840 2ND AVE
   SACRAMENTO, CA 95817
   PROJECT MANAGER: Thomas Kaiser tkaiser@health.ucdavis.edu

2. Architect for Building Wall and Frame Removable/Restoration Details:
   HGA
   1200 R STREET
   SACRAMENTO, CA 95811

3. BOP Engineering Design:

   IEC CORPORATION
   8775 FOLSOM BLVD. SUITE 110
   SACRAMENTO, CA 95826

   AIG and Ammonia Distribution Header Engineering Design and Material Supply:

   SCR Solutions
   24 East Main Street
   PO BOX 5142
   Clinton, NJ 08809

4. Third-Party Inspection Services: TBD

1.4 Appendix List

Appendix A – Urea Conversion Drawing Package (BLD-01444)
Appendix B – AIG/SCR Catalyst Retrofit Drawing Package (2023-0181 DA01)
Appendix C – Owner Supplied FuelTech Equipment
Appendix D – Underground Tank Cleaning/Epoxy Coating

END OF SECTION

FUEL TECH™
Technology for a renewed environment ™

Project : 1294P
:Data Date: 2023-08-09
Author: A. Topacio

Ship Loose List
Technics

LINE	CLIENT TAG #	FTEK TAG #	DRAWING	COMPONENT TYPE	LOCATION	CONNECTION SIZE	CONNECTION TYPE	DESCRIPTION	MANUFACTURER PART NO.	MFG	SUPPLIER
1		TNK-UE-1900		TAG	UREA STORAGE TANK	N/A	N/A	1 X SS TAG WITH FTEK STANDARD ETCHING WITH "TNK-UE-1900"	N/A	N/A	
2		HV-UE-1904	M02-02	VALVE-MANUAL	UREA STORAGE TANK	1"	FNPT	SS NPT BALL VALVE - LOCKING HANDLE (DESIGN PRESSURE IS UNDER 50 PSIG)	F-T80-SS-1.0"		ACCURATE VALVE
3		HV-UE-1905	M02-02	VALVE-MANUAL	UREA STORAGE TANK DRAIN VALVE	2"	FLANGED	SS FLANGED BALL VALVE - LOCKING HANDLE (DESIGN PRESSURE IS UNDER 50 PSIG)	2.0" F-150-SS-FFG-L-50		ACCURATE VALVE
4		EJ-UE-1907	M02-02	EXPANSION JOINT	UREA STORAGE TANK SUPPLY	1"	MNPT	1" X 12" CORRUGATED SS HOSE W/ MNPT ENDS	1" X 12" CORRUGATED SS HOSE W/ MNPT ENDS	GOODING RUBBER	GOODING RUBBER
5		LIT-UE-1910	M02-02	LEVEL TRANSMITTER	UREA STORAGE TANK LEVEL	1/4"	FNPT	PRESSURE INDICATING TRANSMITTER, MEASUREING RANGE -0.125…2.5 bar	PN2296	IFM EFECTOR	JMI
6		TE-UE-1911	M02-02	THERMOCOUPLE	UREA STORAGE TANK	1"	FLANGED	TEMPERATURE ELEMENT,TYPE K, 16" U, UNGROUNDED, 1" FLANGED, ALUMINUM SCREW COVER HEAD, INCL. THERMOWELL	K48U-SF410R11808-SL-8HN31	PYROMATION	JMI
7		LSH-UE-1912	M02-02	LEVEL SWITCH	UREA STORAGE TANK OVERFLOW SWITCH	1/2"	NPT	POINT LEVEL SENSOR DETECTOR, 1/2" NPT, 18 TO 30 VDC	LMC500	IFM EFECTOR	JMI
8		FIT-DA-2253	M03-01	INSTRUMENT	DILUTION AIR FLOW METER	3/4"	MNPT	THERMAL MASS FLOW METER, 6" PROBE LENGTH, 0-770 SCFM RANGE, 4-20mA OUTPUT, WITH 3/4" MNPT X 3/4" TUBE COMPRESSION ADAPTER	FT1-06I-DD-P1	FOX	JMI
9		DC-DAG-2251		TAG	DECOMPOSITION CHAMBER	N/A	N/A	1 X SS TAG WITH FTEK STANDARD ETCHING WITH "DC-DAG-2251"	N/A	N/A	FUEL TECH
10		HV-IA-2200	M03-01	VALVE-MANUAL	ISOLATION VALVE INJECTOR HOSE (AIR)	1/2"	COMPRESSION	2 PIECE 316 SS BALL VALVE, 1000 PSI, -65 F TO 350 F, 2 FERRULE TUBE CONN. TEFLON SEALS	MP-SBVI1210-S8-BH	MAKO	ACCURATE VALVE
11		HV-UE-2205	M03-01	VALVE-MANUAL	ISOLATION VALVE INJECTOR HOSE (LIQUID)	1/4"	COMPRESSION	2 PIECE 316 SS BALL VALVE, 1000 PSI, -65 F TO 350 F, 2 FERRULE TUBE CONN. TEFLON SEALS	SBV210-S4-BH	MAKO	ACCURATE VALVE
12			M03-01	EQUIPMENT	INJECTOR HOSE (AIR)	1/2"	MNPT	SS HOSE ASSEMBLY, 48" LONG W/ 1/2" MNPT ENDS	SS HOSE ASSEMBLY, 48" LONG W/ 1/2" MNPT ENDS	GOODING RUBBER	GOODING RUBBER
13			M03-01	EQUIPMENT	INJECTOR HOSE (LIQUID)	1/4"	MNPT	SS HOSE ASSEMBLY, 48" LONG W/ 1/4" MNPT ENDS	SS HOSE ASSEMBLY, 48" LONG W/ 1/4" MNPT ENDS	GOODING RUBBER	GOODING RUBBER
14		INJ-UE-2254	M03-01	EQUIPMENT	ULTRA INJECTOR	1/2" AIR 1/2" LIQ 1-1/2" DECOMP	AIR: FNPT LIQ: FNPT DECOMP: 150# FLG	INJECTOR LANCE	1294P-INJECTOR	LECHLER	LECHLER
15		TE-DAG-2250	M03-01	INSTRUMENT	DECOMPOSITION CHAMBER INLET TEMPERATURE ELEMENT	1/2"	NPT	TEMPERATURE ELEMENT, TYPE K, UNGROUDED, 1/4" 316SS SHEATH, 1/2 NPT PROCESS CONN., 6" SHEATH LENGTH, Al SCREW HEAD COVER	K48U-006-00-8PN431	PYROMATION	JMI
16		TE-DAG-2245	M03-01	INSTRUMENT	DECOMPOSTION CHAMBER SURFACE TEMP AT CATALYST INLET	1/2"	NPT	TYPE K THERMOCOUPLE, SINGLE ELEMENT UNGROUNDED, ALUMINUM SCREW COVER HEAD, 1/4" SHEATH DIA., SPRING LOADED, 8-1/4" PROBE LENGTH	K48U-008(1/4)-SL-8HN31	PYROMATION	JMI
17		TE-DAG-2246	M03-01	INSTRUMENT	DECOMPOSITION CHAMBER DISCHARGE TEMPERATURE ELEMENT	1/2"	NPT	TEMPERATURE ELEMENT, TYPE K, UNGROUDED, 1/4" 316SS SHEATH, 1/2 NPT PROCESS CONN., 6" SHEATH LENGTH, Al SCREW HEAD COVER	K48U-006-00-8PN431	PYROMATION	JMI
18			M03-02	CONTROL PANEL	BLOWER MODULE CONTROL PANEL	N/A	N/A	36" X 34.67" (INCLUDES AC UNIT) X 16.80" CABINET	N/A	N/A	N/A

SAFETY DATA SHEET

Aqua Ammonia (20-30%)

Section 1. Identification

GHS product identifier : Aqua Ammonia (20-30%)

Other means of identification : Aqua Ammonia, Ammonium Hydroxide

Product type : Liquid.

Product use : Synthetic/Analytical chemistry.

Synonym : Aqua Ammonia, Ammonium Hydroxide

SDS # : 001195

Supplier's details : Airgas USA, LLC and its affiliates
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253
Inside the US: 1-800-424-9300 (Chemtrec, 24 hours)
Outside the US: 1-703-527-3887 (Chemtrec, 24 hours)

24-hour telephone : Airgas Emergency Response Center 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : ACUTE TOXICITY (oral) - Category 4
ACUTE TOXICITY (inhalation) - Category 4
SKIN CORROSION - Category 1B
SERIOUS EYE DAMAGE - Category 1
SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Respiratory tract irritation) - Category 3
AQUATIC HAZARD (ACUTE) - Category 1

GHS label elements

Hazard pictograms :

Signal word : Danger

Hazard statements : Harmful if swallowed or if inhaled.
Causes severe skin burns and eye damage.
May cause respiratory irritation.
Very toxic to aquatic life.

Precautionary statements

General : Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand.

Prevention : Wear protective gloves, protective clothing and eye or face protection. Use only outdoors or in a well-ventilated area. Avoid release to the environment. Avoid breathing vapor. Do not eat, drink or smoke when using this product. Wash thoroughly after handling.

Response : Collect spillage. IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER or doctor. IF SWALLOWED: Immediately call a POISON CENTER or doctor. Rinse mouth. Do NOT induce vomiting. IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water. Immediately call a POISON CENTER or doctor. Wash contaminated clothing before reuse. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or doctor.

Storage : Store locked up. Store in a well-ventilated place. Keep container tightly closed.

Section 2. Hazards identification

Disposal : Dispose of contents and container in accordance with all local, regional, national and international regulations.

Hazards not otherwise classified : None known.

Section 3. Composition/information on ingredients

Substance/mixture : Mixture

Other means of identification : Aqua Ammonia, Ammonium Hydroxide

Product code : 001195

Ingredient name	%	CAS number
Ammonium Hydroxide	100	1336-21-6
Water	70 - 80	7732-18-5
Ammonia	20 - 30	7664-41-7

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Get medical attention immediately. Call a poison center or physician. Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Chemical burns must be treated promptly by a physician.

Inhalation : Get medical attention immediately. Call a poison center or physician. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband. In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.

Skin contact : Get medical attention immediately. Call a poison center or physician. Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Wash contaminated clothing thoroughly with water before removing it, or wear gloves. Continue to rinse for at least 10 minutes. Chemical burns must be treated promptly by a physician. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : Get medical attention immediately. Call a poison center or physician. Wash out mouth with water. Remove dentures if any. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Stop if the exposed person feels sick as vomiting may be dangerous. Do not induce vomiting unless directed to do so by medical personnel. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Chemical burns must be treated promptly by a physician. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : Causes serious eye damage.

Inhalation : Harmful if inhaled. May cause respiratory irritation.

Section 4. First aid measures

Skin contact : Causes severe burns.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion : Harmful if swallowed.

Over-exposure signs/symptoms

Eye contact : Adverse symptoms may include the following:
pain
watering
redness

Inhalation : Adverse symptoms may include the following:
respiratory tract irritation
coughing

Skin contact : Adverse symptoms may include the following:
pain or irritation
redness
blistering may occur

Ingestion : Adverse symptoms may include the following:
stomach pains

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.

Specific treatments : No specific treatment.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media : None known.

Specific hazards arising from the chemical : In a fire or if heated, a pressure increase will occur and the container may burst. This material is very toxic to aquatic life. Fire water contaminated with this material must be contained and prevented from being discharged to any waterway, sewer or drain.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
nitrogen oxides

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Do not breathe vapor or mist. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). Water polluting material. May be harmful to the environment if released in large quantities. Collect spillage.

Methods and materials for containment and cleaning up

Small spill : Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble. Alternatively, or if water-insoluble, absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.

Large spill : Stop leak if without risk. Move containers from spill area. Approach release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see Section 13). Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilled product. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Do not get in eyes or on skin or clothing. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Avoid release to the environment. Do not ingest. Empty containers retain product residue and can be hazardous. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Do not reuse container. Do not breathe vapor or mist.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Store locked up. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination. See Section 10 for incompatible materials before handling or use.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
Ammonium Hydroxide Water Ammonia	None. None. **California PEL for Chemical Contaminants (*Table AC-1*) (United States).** PEL: 25 ppm 8 hours. STEL: 35 ppm 15 minutes. **ACGIH TLV (United States, 1/2022). [Ammonia]** TWA: 25 ppm 8 hours. TWA: 17 mg/m³ 8 hours. STEL: 35 ppm 15 minutes. STEL: 24 mg/m³ 15 minutes. **OSHA PEL 1989 (United States, 3/1989). [Ammonia]** STEL: 35 ppm 15 minutes. STEL: 27 mg/m³ 15 minutes. **NIOSH REL (United States, 10/2020). [AMMONIA]** TWA: 25 ppm 10 hours. TWA: 18 mg/m³ 10 hours. STEL: 35 ppm 15 minutes. STEL: 27 mg/m³ 15 minutes. **OSHA PEL (United States, 5/2018). [Ammonia]** TWA: 50 ppm 8 hours. TWA: 35 mg/m³ 8 hours. **CAL OSHA PEL (United States, 5/2018).** STEL: 27 mg/m³ 15 minutes. STEL: 35 ppm 15 minutes. TWA: 18 mg/m³ 8 hours. TWA: 25 ppm 8 hours.

Biological exposure indices

No exposure indices known.

Appropriate engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: chemical splash goggles and/or face shield. If inhalation hazards exist, a full-face respirator may be required instead.

Skin protection

Section 8. Exposure controls/personal protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use.

Section 9. Physical and chemical properties

Appearance

Physical state : Liquid.

Color : Clear liquid. Ammonia vapor is clear or fog-like.

Odor : Pungent.

Odor threshold : 5 ppm

pH : 11.6 for 1.7% NH3 soln. in water

Melting point : Approx. -110 dF (30% soln.)

Boiling point : 81 dF (30% soln.)

Critical temperature : Not available.

Flash point : Not available.

Evaporation rate : Not available.

Flammability (solid, gas) : Aqua soln. is not flammable; Ammonia vapor is flammable @16-25% ammonia concentration in air.

Lower and upper explosive (flammable) limits : Lower: 16%
Upper: 25%

Vapor pressure : 720 mm Hg @ 80 dF (30% soln.)

Vapor density : Relative Vapor Density: 0.6 (ammonia) [Air = 1]

Gas Density (lb/ft ^{3}) : 0.0481

Relative density : Specific Gravity (SG): 0.8974 (29.4% @ 60 deg. F)

Solubility in water : Not available.

Partition coefficient: n-octanol/water : Not applicable.

Auto-ignition temperature : 651°C (1203.8°F)

Decomposition temperature : Not available.

Flow time (ISO 2431) : Not available.

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Section 10. Stability and reactivity

Conditions to avoid : Do not cut, weld, braze, drill, grind, or heat vessels.

Incompatible materials : No specific data.

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
ammonium hydroxide ammonia	LD50 Oral LC50 Inhalation Gas.	Rat Rat	350 mg/kg 7338 ppm	- 1 hours

Irritation/Corrosion

Product/ingredient name	Result	Species	Score	Exposure	Observation
ammonium hydroxide	Eyes - Severe irritant Eyes - Severe irritant	Rabbit Rabbit	- -	0.5 minutes 1 mg 250 ug	- -

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Name	Category	Route of exposure	Target organs
ammonium hydroxide	Category 3	-	Respiratory tract irritation

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : Causes serious eye damage.

Inhalation : Harmful if inhaled. May cause respiratory irritation.

Skin contact : Causes severe burns.

Section 11. Toxicological information

Ingestion : Harmful if swallowed.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : Adverse symptoms may include the following:
pain
watering
redness

Inhalation : Adverse symptoms may include the following:
respiratory tract irritation
coughing

Skin contact : Adverse symptoms may include the following:
pain or irritation
redness
blistering may occur

Ingestion : Adverse symptoms may include the following:
stomach pains

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Route	ATE value
Oral Inhalation (gases)	500 mg/kg 4500 ppm

Section 12. Ecological information

Toxicity

Product/ingredient name	Result	Species	Exposure
ammonium hydroxide ammonia	Acute LC50 37 ppm Fresh water Acute EC50 29.2 mg/l Marine water Acute LC50 2080 µg/l Fresh water Acute LC50 0.53 ppm Fresh water Acute LC50 300 µg/l Fresh water Chronic NOEC 0.204 mg/l Marine water	Fish - *Gambusia affinis* - Adult Algae - *Ulva fasciata* - Zoea Crustaceans - *Gammarus pulex* Daphnia - *Daphnia magna* Fish - *Hypophthalmichthys nobilis* Fish - *Dicentrarchus labrax*	96 hours 96 hours 48 hours 48 hours 96 hours 62 days

Section 12. Ecological information

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
WATER	-1.38	-	Low

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN2672	UN2672	UN2672	UN2672	UN2672
UN proper shipping name	Ammonia solution	AMMONIA SOLUTION	AMONIACO EN SOLUCION	AMMONIA SOLUTION	Ammonia solution
Transport hazard class(es)	8 	8 	8 	8 	8 
Packing group	III	III	III	III	III
Environmental hazards	Yes.	Yes.	Yes. The environmentally hazardous substance mark is not required.	Yes.	Yes. The environmentally hazardous substance mark is not required.

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Additional information

Section 14. Transport information

DOT Classification : This product is not regulated as a marine pollutant when transported on inland waterways in sizes of ≤5 L or ≤5 kg or by road, rail, or inland air in non-bulk sizes, provided the packagings meet the general provisions of §§ 173.24 and 173.24a.
Reportable quantity 1000 lbs / 454 kg [2493.4 gal / 9438.7 L]. Package sizes shipped in quantities less than the product reportable quantity are not subject to the RQ (reportable quantity) transportation requirements.
Limited quantity Yes.
Packaging instruction Exceptions: 154. Non-bulk: 203. Bulk: 241.
Quantity limitation Passenger aircraft/rail: 5 L. Cargo aircraft: 60 L.
Special provisions 336, IB3, IP8, T7, TP2

TDG Classification : Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.40-2.42 (Class 8), 2.7 (Marine pollutant mark).
The marine pollutant mark is not required when transported by road or rail.
Explosive Limit and Limited Quantity Index 5
Passenger Carrying Road or Rail Index 5

IMDG : The marine pollutant mark is not required when transported in sizes of ≤5 L or ≤5 kg.
Emergency schedules F-A, _S-B_

IATA : The environmentally hazardous substance mark may appear if required by other transportation regulations.
Quantity limitation Passenger and Cargo Aircraft: 5 L. Packaging instructions: 852. Cargo Aircraft Only: 60 L. Packaging instructions: 856. Limited Quantities - Passenger Aircraft: 1 L. Packaging instructions: Y841.
Special provisions A64, A803

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to IMO instruments : Not available.

Section 15. Regulatory information

U.S. Federal regulations :

TSCA 8(a) CDR Exempt/Partial exemption: Not determined

Clean Water Act (CWA) 311: Ammonium Hydroxide; ammonia

Clean Air Act (CAA) 112 regulated toxic substances: ammonia

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

Name	%	EHS	SARA 302 TPQ		SARA 304 RQ	
			(lbs)	(gallons)	(lbs)	(gallons)
ammonia	20 - 30	Yes.	500	-	100	-

Section 15. Regulatory information

SARA 304 RQ : 400 lbs / 181.6 kg [997.4 gal / 3775.5 L]

SARA 311/312

Classification : Refer to Section 2: Hazards Identification of this SDS for classification of substance.

SARA 313

	Product name	CAS number	%
Form R - Reporting requirements	Ammonium Hydroxide ammonia	1336-21-6 7664-41-7	100 20 - 30
Supplier notification	Ammonium Hydroxide ammonia	1336-21-6 7664-41-7	100 20 - 30

SARA 313 notifications must not be detached from the SDS and any copying and redistribution of the SDS shall include copying and redistribution of the notice attached to copies of the SDS subsequently redistributed.

State regulations

Massachusetts : The following components are listed: AMMONIUM HYDROXIDE; HOUSEHOLD AMMONIA; AMMONIUM WATER; AMMONIA

New York : The following components are listed: Ammonium hydroxide; Ammonia

New Jersey : The following components are listed: AMMONIUM HYDROXIDE; AMMONIA

Pennsylvania : The following components are listed: AMMONIUM HYDROXIDE; AMMONIA

California Prop. 65

This product does not require a Safe Harbor warning under California Prop. 65.

International regulations

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol

Not listed.

Stockholm Convention on Persistent Organic Pollutants

Not listed.

Rotterdam Convention on Prior Informed Consent (PIC)

Not listed.

UNECE Aarhus Protocol on POPs and Heavy Metals

Not listed.

Inventory list

Australia : All components are listed or exempted.

Canada : All components are listed or exempted.

China : All components are listed or exempted.

Eurasian Economic Union : **Russian Federation inventory**: Not determined.

Japan : **Japan inventory (CSCL)**: All components are listed or exempted.
Japan inventory (ISHL): Not determined.

New Zealand : All components are listed or exempted.

Philippines : All components are listed or exempted.

Republic of Korea : All components are listed or exempted.

Taiwan : All components are listed or exempted.

Thailand : All components are listed or exempted.

Turkey : Not determined.

United States : All components are active or exempted.

Viet Nam : All components are listed or exempted.

Section 16. Other information

Hazardous Material Information System (U.S.A.)

Health	/	3
Flammability		0
Physical hazards		0

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings and the associated label are not required on SDSs or products leaving a facility under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered trademark and service mark of the American Coatings Association, Inc.

The customer is responsible for determining the PPE code for this material. For more information on HMIS® Personal Protective Equipment (PPE) codes, consult the HMIS® Implementation Manual.

National Fire Protection Association (U.S.A.)

Reprinted with permission from NFPA 704-2001, Identification of the Hazards of Materials for Emergency Response Copyright ©1997, National Fire Protection Association, Quincy, MA 02269. This reprinted material is not the complete and official position of the National Fire Protection Association, on the referenced subject which is represented only by the standard in its entirety.

Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Classification	Justification
ACUTE TOXICITY (oral) - Category 4	Expert judgment
ACUTE TOXICITY (inhalation) - Category 4	Expert judgment
SKIN CORROSION - Category 1B	Expert judgment
SERIOUS EYE DAMAGE - Category 1	SKIN CORROSION/ IRRITATION
SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Respiratory tract irritation) - Category 3	Calculation method
AQUATIC HAZARD (ACUTE) - Category 1	Calculation method

History

Date of printing : 4/16/2024

Date of issue/Date of revision : 4/16/2024

Date of previous issue : 4/10/2024

Version : 0.12

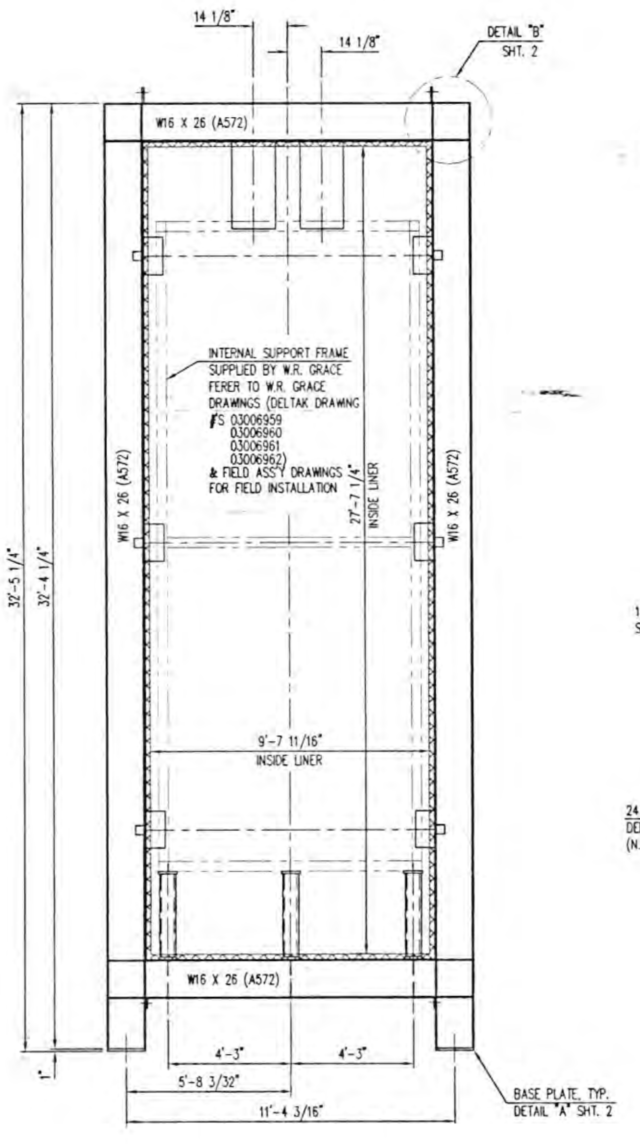
Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

References : Not available.

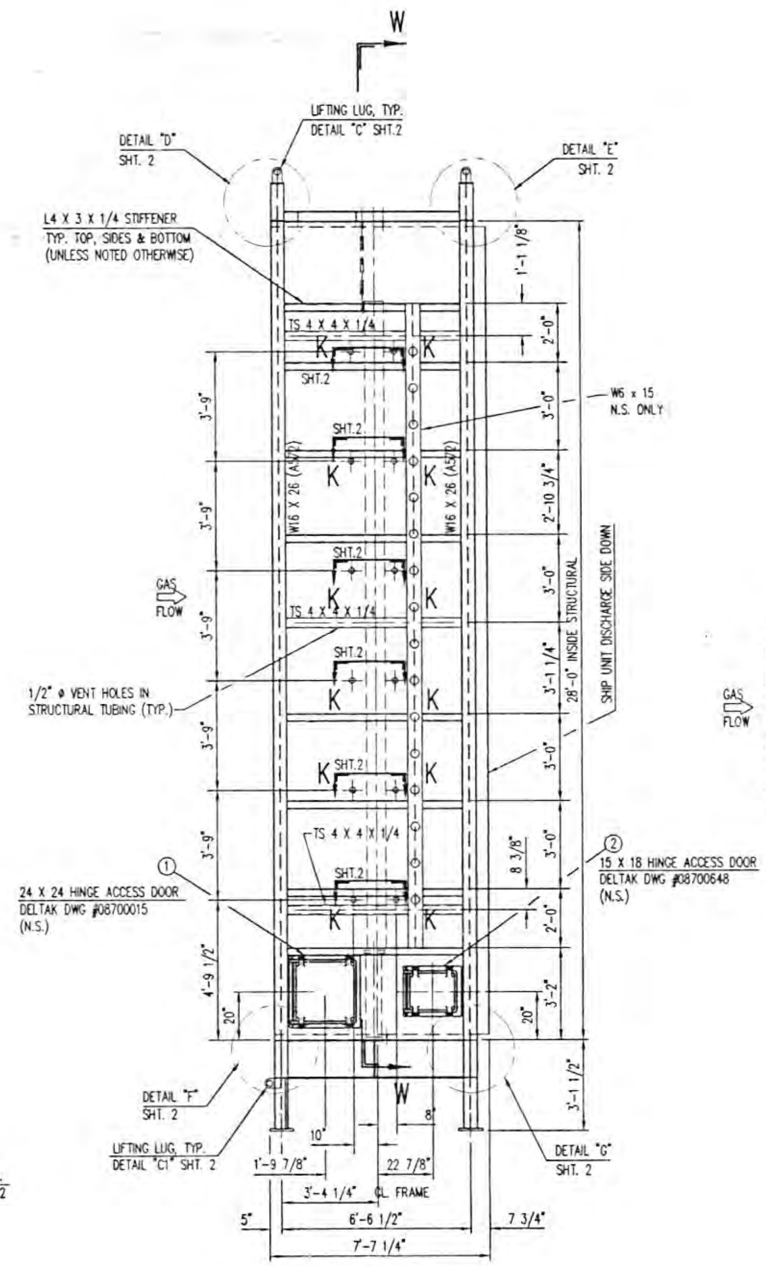
Section 16. Other information

Notice to reader

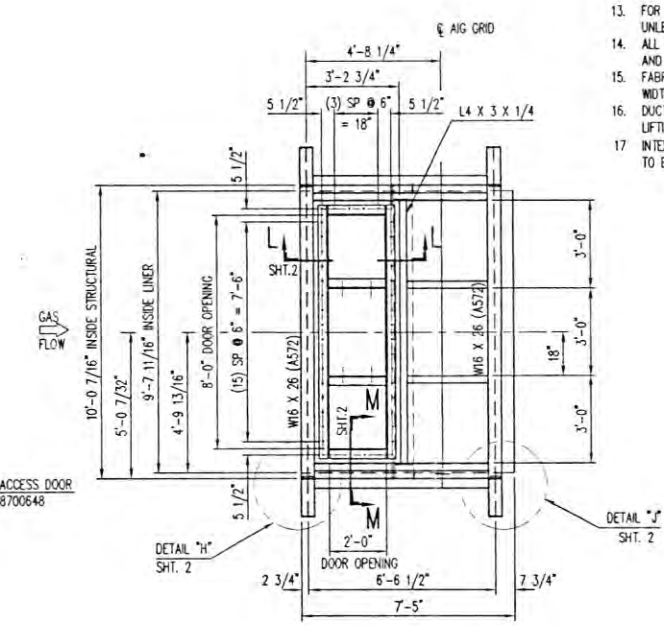
To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.



GAS INLET VIEW
GAS OUTLET VIEW SIMILAR



SIDE VIEW



PLAN VIEW

NOTES:

1. ALL WELDING SHALL BE IN ACCORDANCE WITH AWS D1.1 INCLUDING WELDING PROCEDURES AND WELDER QUALIFICATIONS.
   ALL WELDS ARE 3/16" FILLET UNLESS NOTED OTHERWISE.
2. OUTER CASING 1/4" C.S. PLATE.
3. OUTER CASING, GAS FLANGES, AND STRUCTURAL TO BE WELDED GAS TIGHT, CONTINUOUS WELDS. CASING STIFFENERS - TOP AND BOTTOM STIFFENERS TO BE CONTINUOUSLY WELDED BOTH SIDES, SIDE STIFFENERS TO BE CONTINUOUSLY WELDED TOP AND SKIP WELDED BOTTOM.
4. COLUMN AND BEAM STRUCTURAL MEMBERS TO BE A572 MATERIAL, TUBULAR STRUCTURE SECTIONS TO BE A-500 GR. B, ALL OTHER STRUCTURAL MEMBERS TO BE A36.
5. CASING DESIGN PRESSURE 20" W.C.
6. ALL OUTER CASING SEAMS SHALL BE DESIGNED TO LIE UNDER A STRUCTURAL STIFFENER SO THAT NO OUTER CASING SEAMS ARE VISIBLE.
7. WHEREVER WATER CAN ACCUMULATE ON THE DUCTWORK, PROVIDE 1/2" DRAINAGE HOLES.
8. EXTERIOR SURFACES OF DUCTWORK SHALL BE SANDBLASTED TO SSPC-SP-6, AND PRIMED WITH ONE SHOP COAT OF CARBOLINE "CARBO-WELD D11 HS" (2.5 MILS DFT).
9. INSULATION: 2" - 8#/C.F. 2300° F CERAMIC WOOL TO BE INSTALLED IN A MINIMUM OF TWO LAYERS WITH STAGGERED SEAMS. 12 GA. 409 S.S. INNER LINER SHALL BE PER SPEC. NO. 06000159.
10. PROVIDE LIFTING LUGS FOR SHIPPING AND ERECTION.
11. STENCIL THE FOLLOWING INFORMATION WITH 2" HIGH LETTERS IN A HIGHLY VISIBLE LOCATION:
    DELTAK JOB. NO.: G95002
    CO DUCT "D"
    ——→ GAS FLOW
    CUSTOMER P.O. NO.: D-88580-000
12. WEIGHT OF ASSEMBLED DUCT =
    WEIGHT OF CATALYST AND FRAME = 13,800 LBS.
    TOTAL WEIGHT = 31,400 LBS.
13. FOR ANGLES WITH UNEQUAL LEGS, LONG LEG TO BE WELDED TO CASING UNLESS NOTED OTHERWISE.
14. ALL STRUCTURAL WELD CONNECTIONS ARE FULL PENETRATION AT FLANGES AND 3/16" FILLET WELDS AT WEBS.
15. FABRICATOR TO SUBMIT SHIPPING CLEARANCE DIMENSIONS, FOR HEIGHT, WIDTH, AND LENGTH.
16. DUCT ARE TO BE ADEQUATELY BLOCKED AND BRACED FOR LIFTING, SHIPPING & TURNING.
17. INTERNAL CATALYST AND SUPPORT STRUCTURE BY W.R. GRACE CO. TO BE FIELD INSTALLED.

(1) UNIT REQ'D

CUSTOMER: UNIVERSITY OF CALIFORNIA MEDICAL CENTER
CUSTOMER P.O. NO.: D-88580-000
FOR: UCD-MC CENTERAL PLANT
A/C 934900
SECTION 15559-HRSG SYSTEM
ARTICLE 1.11.1, 2, 11, 17, 18, 20, 21

STANDARD PROJECTION

JOB NO. G95002

FRACTIONS: ±1/16"
DECIMALS: ±.010"
ANGLES: ±1°
OR AS OTHERWISE STATED

CO DUCT "D"
ASSEMBLY

DELTAK®
A UNIT OF JASON INCORPORATED
MINNEAPOLIS, MINNESOTA

DWN RTZ/J 10/6/95	PROJ 11/1/95	USED ON 2557-32.40
CKD 11/2/95	DES 11/2/95	
APPR	STR	NUMBER 04029707 SHEET 1 OF 4 REV
SCALE 3/8" = 1'-0"		

ORIGINAL

DRAWING NO.	REVISION	DESCRIPTION
1294P–E01–01	0	MASTER DRAWING LIST
1294P–E01–02	0	SYMBOLS
1294P–E01–03	0	ELECTRICAL ONE LINE DIAGRAM
1294P–E01–04	0	DATA COMMUNICATION DIAGRAM
1294P–E02–01	0	PLC PANEL CABINET LAYOUT
1294P–E02–02	0	PLC PANEL LAYOUT
1294P–E02–03	0	PLC PANEL SCHEMATIC – SHEET 1
1294P–E02–04	0	PLC PANEL SCHEMATIC – SHEET 2
1294P–E02–05	0	PLC PANEL SCHEMATIC – SHEET 3
1294P–E02–06	0	PLC PANEL SCHEMATIC – SHEET 4
1294P–E02–07	0	PLC PANEL SCHEMATIC – SHEET 5
1294P–E02–08	0	PLC PANEL SCHEMATIC – SHEET 6
1294P–E02–09	0	PLC PANEL SCHEMATIC – SHEET 7
1294P–E02–10	0	PLC PANEL SCHEMATIC – SHEET 8
1294P–E02–11	0	PLC PANEL SCHEMATIC – SHEET 9
1294P–E02–12	0	PLC PANEL SCHEMATIC – SHEET 10
1294P–E02–13	0	PLC PANEL SCHEMATIC – SHEET 11
1294P–E02–14	0	PLC PANEL SCHEMATIC – SHEET 12
1294P–E02–15	0	PLC PANEL FUTURE
1294P–E02–16	0	PLC PANEL FUTURE
1294P–E02–17	0	PLC PANEL BILL OF MATERIAL
1294P–E02–18	0	PLC PANEL INTERCONNECTION W/D – SHEET 1
1294P–E02–19	0	PLC PANEL INTERCONNECTION W/D – SHEET 2
1294P–E02–20	0	PLC PANEL INTERCONNECTION W/D – SHEET 3
1294P–E02–21	0	PLC PANEL CABLE LISTING
1294P–E03–01	0	HEATER PANEL CABINET LAYOUT
1294P–E03–02	0	HEATER PANEL PANEL LAYOUT
1294P–E03–03	0	HEATER PANEL SCHEMATIC – SHEET 1
1294P–E03–04	0	HEATER PANEL SCHEMATIC – SHEET 2
1294P–E03–05	0	HEATER PANEL FUTURE
1294P–E03–06	0	HEATER PANEL BILL OF MATERIAL
1294P–E03–07	0	HEATER PANEL INTERCONNECTION W/D
1294P–E03–08	0	HEATER PANEL CABLE LISTING

DRAWING NO.	REVISION	DESCRIPTION
1294P–E04–01	0	BLOWER PANEL CABINET LAYOUT
1294P–E04–02	0	BLOWER PANEL PANEL LAYOUT
1294P–E04–03	0	BLOWER PANEL SCHEMATIC – SHEET 1
1294P–E04–04	0	BLOWER PANEL FUTURE
1294P–E04–05	0	BLOWER PANEL BILL OF MATERIAL
1294P–E04–06	0	BLOWER PANEL INTERCONNECTION W/D
1294P–E04–07	0	BLOWER PANEL CABLE LISTING

NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

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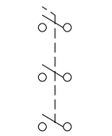
Technologies to enable clean efficient energy
FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

ULTRA 20 CONTROL PANEL
DRAWING LIST

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO. 1294P–E01–01



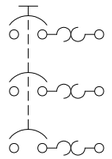
THREE PHASE
DISCONNECT
SWITCH

GROUND FAULT
INTERRUPTED
CIRCUIT BREAKER

CABLE PIN CONNECTION
(EXAMPLE SHOWS PIN 1)

CIRCUIT BREAKER

FUSE

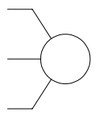


THREE PHASE
MOTOR PROTECTOR WITH
ADJUSTABLE SOLID STATE
SHORT CIRCUIT/OVERLOAD
PROTECTION

GROUND
INDICATES CONNECTION
TO GROUND BAR

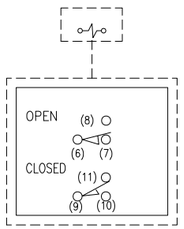
ISOLATED AND DEDICATED
INSTRUMENT GROUND
FOR SHIELDS

RECEPTACLE



THREE PHASE
MOTOR

TRANSFORMER



AIR OPERATED
VALVE

PILOT LIGHT

THREE-PRONG
PLUG

RELAY OR
CONTACTOR COIL

NORMALLY OPEN
CONTACT

NORMALLY CLOSED
CONTACT

RESISTOR

MUSHROOM HEAD
PUSHBUTTON
– NORMALLY CLOSED

PUSHBUTTON
– NORMALLY OPEN

PUSHBUTTON
– NORMALLY CLOSED

TWO POSITION
SELECTOR SWITCH

THREE POSITION
SELECTOR SWITCH

NORMALLY CLOSED
PRESSURE SWITCH
– OPENS ON RISING
PRESSURE

NORMALLY OPEN
PRESSURE SWITCH
– CLOSES ON RISING
PRESSURE

NORMALLY OPEN
HELD CLOSED
PRESSURE SWITCH
– OPENS ON FALLING
PRESSURE

PROCESS SIGNAL
FROM FIELD

SCHEMATIC DESTINATION
LINE REFERENCE

SCHEMATIC
LINE REFERENCE

PUMP

HEATER

NORMALLY OPEN
TIMED CLOSE
TIMER RELAY CONTACT

NORMALLY OPEN
TIMED OPEN
TIMER RELAY CONTACT

NORMALLY OPEN
TEMPERATURE SWITCH
– CLOSES ON RISING
TEMPERATURE

NORMALLY CLOSED
HELD OPEN
TEMPERATURE SWITCH
– CLOSES ON FALLING
TEMPERATURE

SOLENOID VALVE

DIP SWITCH

DIODE

LIMIT SWITCH
NORMALLY OPEN

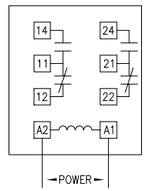
LIMIT SWITCH
NORMALLY OPEN
HELD CLOSED

LIMIT SWITCH
NORMALLY CLOSED

LIMIT SWITCH
NORMALLY CLOSED
HELD OPEN

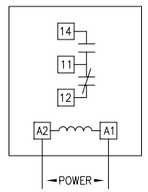
FLOW SWITCH
NORMALLY OPEN

2-POLE RELAY TERMINAL DIAGRAM



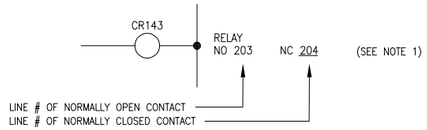
ALLEN-BRADLEY PART NO.: 700-HK32XX-4

1-POLE RELAY TERMINAL DIAGRAM



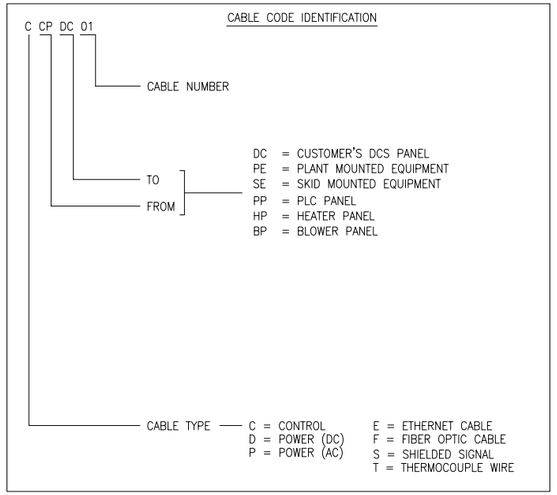
ALLEN-BRADLEY PART NO.: 700-HK36XX-4

CONTROL RELAY CROSS-REFERENCE



NOTE 1: NUMBER DISPLAYED NEXT TO RELAYS WITHIN THE TEXT DESCRIPTION REFERS TO THE LINE NUMBERS THAT IDENTIFY THE LOCATION OF THE AUXILIARY CONTACTS. THESE CROSS REFERENCES ALWAYS REFER TO LOCATIONS ON THE SCHEMATIC DRAWINGS OF THE CURRENT PANEL. IF MORE THAN ONE SCHEMATIC DRAWING EXISTS FOR A PARTICULAR PANEL THEN 100 SERIES NUMBERS REFER TO SHEET 1, 200 SERIES NUMBERS REFER TO SHEET 2, ETC.

CABLE CODE IDENTIFICATION



WIRE TYPE

MTW (MACHINE TOOL WIRE) – COPPER WIRE WITH PVC OR PVC/NYLON THERMOPLASTIC INSULATION RATED 600V & 60C (194F) DRY LOCATION.

BELDEN #8719 FOR 1 PAIR/2 CONDUCTOR #16 SHIELDED CABLE WITH POLYETHYLENE INSULATION AND PVC JACKET RATED 300V & 60C (140F).

BELDEN #8618 FOR 3 CONDUCTORS #16 SHIELDED CABLE WITH POLYETHYLENE INSULATION AND PVC JACKET RATED 300V & 60C (140F).

WIRE SIZES

POWER – MOTORS/HEATERS – #12 MINIMUM
CONTROL – #14 MINIMUM OR EQUIPMENT MANUFACTURER'S RECOMMENDATION.
SIGNAL – #16 MINIMUM.

WIRE COLORS

GREEN W/YELLOW STRIP – EQUIPMENT GROUNDING CONDUCTOR
WHITE – GROUNDED AC
RED – UNGROUNDED AC (120VAC)
BLACK – UNGROUNDED HIGH VOLTAGE (230VAC, 480VAC, DC MOTOR FIELD & ARMATURE)
WHITE W/BLUE STRIP – GROUNDED DC
BLUE – UNGROUNDED DC
ORANGE OR YELLOW– UNGROUNDED CONDUCTORS THAT REMAIN ENERGIZED WHEN THE MAIN DISCONNECT IS OFF.
SHIELDED SIGNAL CABLE – BLACK (–), CLEAR (+) OR BLACK (–), RED (+)
T/C – RED (–), OTHER COLOR (+)
RTD – RED (SIGNAL), BLACK (–), CLEAR (+)

SCHEMATIC TAGS

AC	AIR CONDITIONER
AH	ALARM HORN
ATF	FILTER
CB	CIRCUIT BREAKER
CON	CONTACTOR
CR	CONTROL RELAY
DS	DISCONNECT SWITCH
ES	ETHERNET SWITCH
FIT	FLOW INDICATING TRANSMITTER
FS	FLOW SWITCH
FT	FLOW TRANSMITTER
FU	FUSE
HTR	HEATER
LIT	LEVEL INDICATING TRANSMITTER
LS	LIMIT SWITCH
LT	LIGHT
M	MOTOR
MOV	MOTOR OPERATED VALVE
MP	MOTOR PROTECTOR
OIT	OPERATOR INTERFACE TERMINAL
PB	PUSHBUTTON
PBLT	ILLUMINATED PUSHBUTTON
PCV	PRESSURE CONTROL VALVE
PDB	POWER DISTRIBUTION BLOCK
PLC	PLC COMPONENT
PIT	PRESSURE INDICATING TRANSMITTER
PS	POWER SUPPLY
PS	PRESSURE SWITCH
PT	PRESSURE TRANSMITTER
PV	PANELVIEW
RECP	RECEPTACLE
SOL	SOLENOID VALVE
SS	SELECTOR SWITCH
ST	FLAME SCANNER
SUP	SURGE SUPPRESSSOR
T / XF	TRANSFORMER
TB	TERMINAL BLOCK
T/C	THERMOCOUPLE
TR	TIME DELAY RELAY
TIT	TEMPERATURE INDICATING TRANSMITTER
TS	TEMPERATURE SWITCH
VFD	VARIABLE FREQUENCY DRIVE
V	VALVE

MASTER TERMINAL BLOCK LEGEND

LEGEND

NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

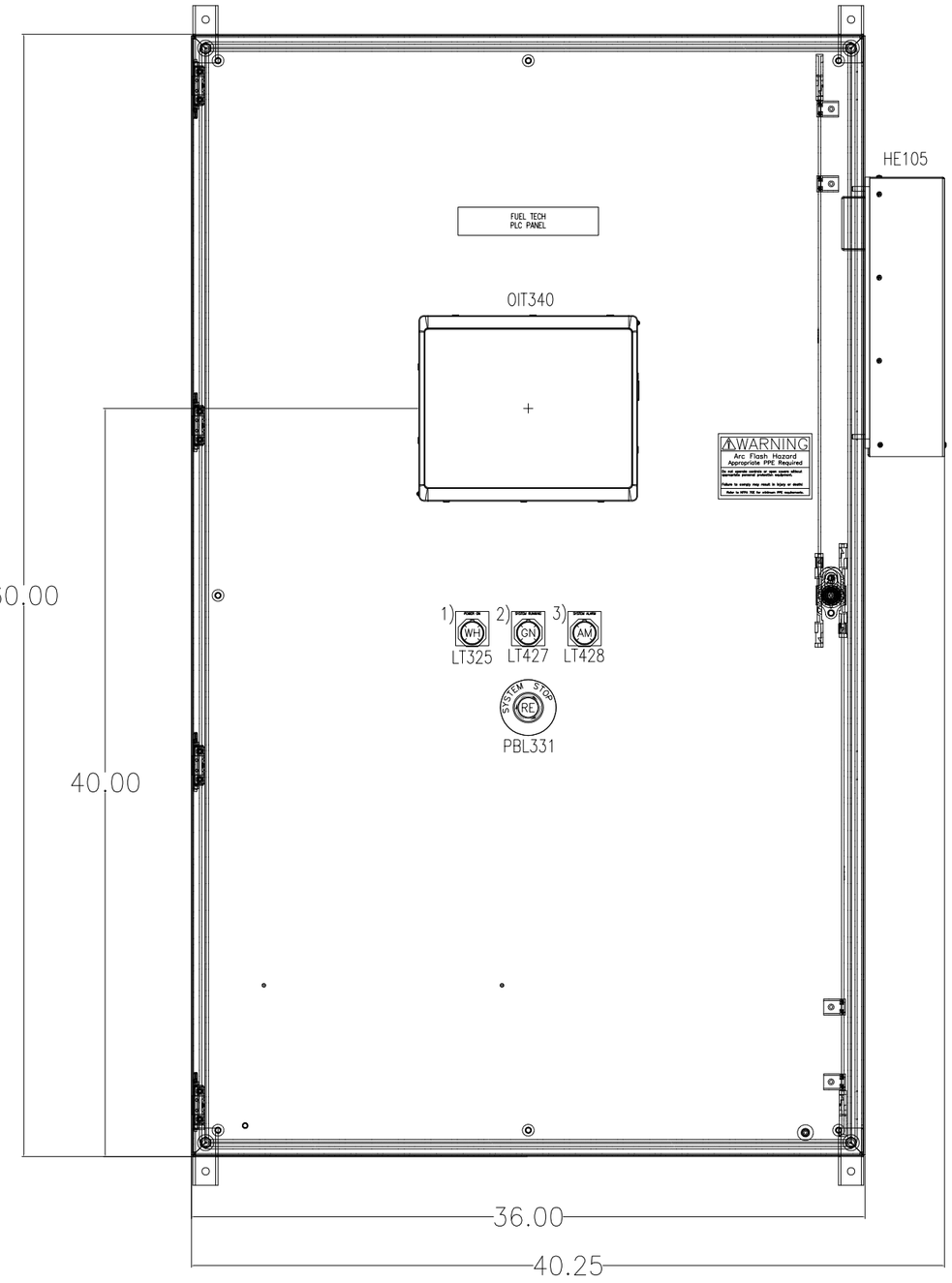
FUEL TECH
Technologies to enable clean efficient energy
FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

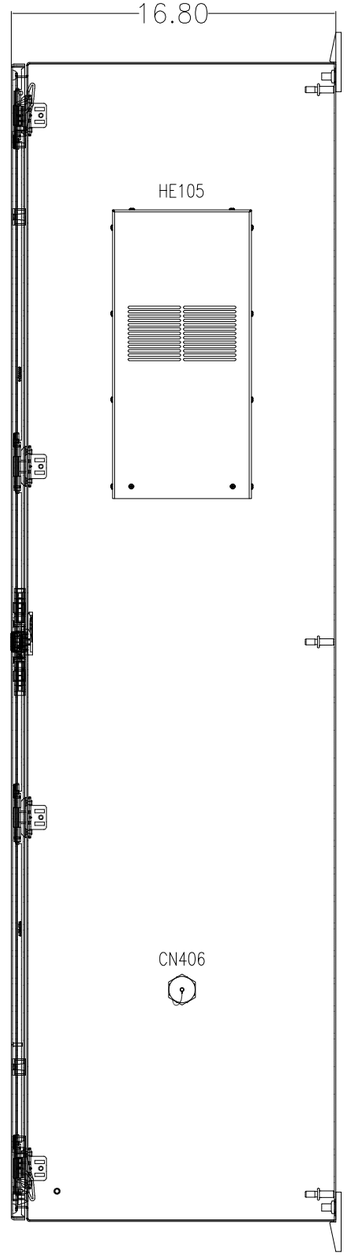
ULTRA 20 CONTROL PANEL
SYMBOLS

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO.
1294P-E01-02

FRONT VIEW



RIGHT SIDE VIEW



THT-19-413-1-PR

The Industrial Control Company, Inc.
BETTER THINKING, INSIDE THE BOX.
N56 W24842 Corporate Circle Sussex, WI 53089

120 VOLTS N/A FLA (LARGEST MOTOR)
60 CYCLES 9.1 FLA (TOTAL)
1 PHASE 1294P-E02 DRWG. NO.
TYPE 4 ENCLOSURE

Fuse ID	Mfg	Fuse# or Equivalent	Volts
FU502-642	BUSSMANN	AGC-1/2-R	250
FU429-433	BUSSMANN	MDL-2-R	250

USE COPPER CONDUCTORS ONLY

PART ID	PART NUMBER	TORQUE (IN/LB)	TEMP (C)
CB103	1489-M1C300	17.7	90
TB's	1492-J4	9.0	90
TB's	1492-J24	9.0	90
TB's	1492-JTC3K	3.5-5.3	90
TB's	1492-JG3	4.5-7.1	90
GND BAR	PK12GTA	20 (14-10GA)	90
GND BAR	PK12GTA	25 (8GA)	90
GND BAR	PK12GTA	35 (6-4GA)	90

USE COPPER CONDUCTORS ONLY

PART ID	PART NUMBER	TORQUE (IN/LB)	TEMP (C)
GND LUG	L70	35 (14-10GA)	90
GND LUG	L70	40 (8GA)	90
GND LUG	L70	45 (4-6GA)	90

THT-19-435-1-HFC

WARNING

RISK OF FIRE OR ELECTRICAL SHOCK

THE OPENING OF THE BRANCH-CIRCUIT PROTECTIVE DEVICE MAY BE AN INDICATION THAT A FAULT CURRENT HAS BEEN INTERRUPTED. ALL CURRENT-CARRYING PARTS AND OTHER COMPONENTS PROTECTED BY THIS DEVICE SHOULD BE EXAMINED AND REPLACED IF DAMAGED. IF BURNOUT OF A CURRENT ELEMENT OF AN OVERLOAD RELAY OCCURS, THE COMPLETE OVERLOAD RELAY MUST BE REPLACED.

99454

WARNING
Arc Flash Hazard
Appropriate PPE Required
Do not operate controls or open covers without appropriate personal protection equipment.
Failure to comply may result in injury or death!
Refer to NFPA 70E for minimum PPE requirements.

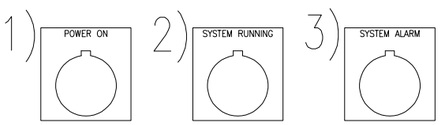
NAMEPLATE SCHEDULE

LAM-7.50-1.50-902

FUEL TECH
PLC PANEL

LP-30MM-ESTOP

LP-30MM-902



NOTES:
1) CENTERLINE OF HMI (OIT340) IS 52" ABOVE GRADE.

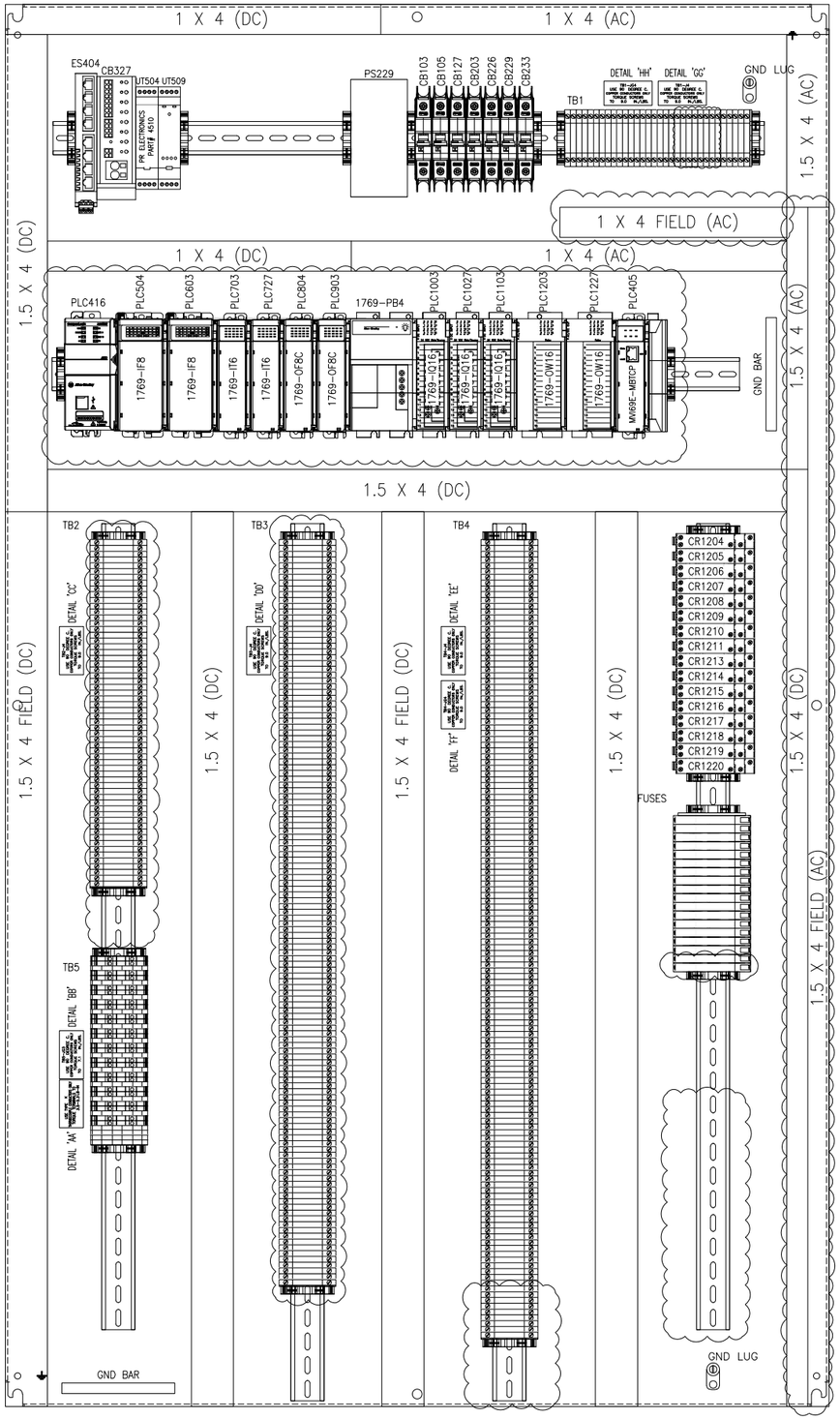
NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

FUEL TECH
Technologies to enable clean efficient energy
FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

PLC PANEL
CABINET LAYOUT

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE SIZE: D
DRAWING NO. 1294P-E02-01



DETAIL 'AA'

USE TYPE K THERMOCOUPLE CONDUCTORS ONLY
TORQUE TERMINALS TO 3.5–5.3 LB–IN

DETAIL 'BB'

TB5–JG3
USE 90 DEGREE C. COPPER CONDUCTORS ONLY
TORQUE SCREWS TO 7.1 IN./LBS.

DETAIL 'CC'

TB2–J4
USE 90 DEGREE C. COPPER CONDUCTORS ONLY
TORQUE SCREWS TO 9.0 IN./LBS.

DETAIL 'DD'

TB3–J4
USE 90 DEGREE C. COPPER CONDUCTORS ONLY
TORQUE SCREWS TO 9.0 IN./LBS.

DETAIL 'EE'

TB4–J4
USE 90 DEGREE C. COPPER CONDUCTORS ONLY
TORQUE SCREWS TO 9.0 IN./LBS.

DETAIL 'FF'

TB4–JG4
USE 90 DEGREE C. COPPER CONDUCTORS ONLY
TORQUE SCREWS TO 9.0 IN./LBS.

DETAIL 'GG'

TB1–J4
USE 90 DEGREE C. COPPER CONDUCTORS ONLY
TORQUE SCREWS TO 9.0 IN./LBS.

DETAIL 'HH'

TB1–JG4
USE 90 DEGREE C. COPPER CONDUCTORS ONLY
TORQUE SCREWS TO 9.0 IN./LBS.

FUSES

FU429
FU430
FU431
FU432
FU433
FU502
FU507
FU514
FU519
FU527
FU532
FU537
FU542
FU603
FU608
FU613
FU618
FU1109

18 @ 1492-H5

120VAC TB1

1	1041
2	1041
3	1041
4	1041
5	1041
6	N
7	N
8	N
9	N
10	1051
11	N
12	GND
13	1271
14	N
15	GND
16	2031
17	N
18	GND
19	2261
20	4381
21	4391
22	4401
23	4411
24	4421
25	4431
26	4441
27	4451
28	SPARE
29	SPARE
30	SPARE
31	SPARE
32	SPARE

29 @ 1492-J4
*3 @ 1492-JG4

24VDC TB2

1	2332
2	2332
3	2332
4	2332
5	2332
6	2333
7	2333
8	2333
9	2333
10	2333
11	2333
12	2333
13	2333
14	2333
15	2333
16	2333
17	2333
18	2333
19	2333
20	2333
21	2333
22	2333
23	2333
24	2333
25	2333
26	2333
27	2333
28	2333
29	2333
30	2333
31	2333
32	2333
33	2333
34	2333
35	2333
36	2333
37	2333
38	3271
39	3271
40	3401
41	4271
42	4281
43	4292
44	4302
45	4312
46	4322
47	4332
48	4341
49	4351
50	4361
51	4371
52	SPARE
53	SPARE
54	SPARE
55	SPARE
56	SPARE
57	SPARE
58	SPARE
59	SPARE
60	SPARE

60 @ 1492-J4

DIGITAL TB3

1	3311
2	3311
3	3311
4	3311
5	3311
6	3311
7	3311
8	3311
9	3311
10	3311
11	3311
12	3311
13	3311
14	3311
15	3311
16	3311
17	3311
18	3311
19	3311
20	3311
21	3311
22	3311
23	3311
24	3311
25	3311
26	3311
27	3311
28	3311
29	3311
30	3311
31	3311
32	3311
33	3311
34	3311
35	3311
36	3311
37	3311
38	3311
39	3311
40	3311
41	3311
42	3311
43	3311
44	3311
45	3361
46	I07/00
47	I07/01
48	I07/02
49	I07/03
50	I07/04
51	I07/05
52	I07/06
53	I07/07
54	I07/08
55	I07/09
56	I07/10
57	I07/11
58	I07/12
59	I07/13
60	I07/14
61	I07/15
62	I08/00
63	I08/01
64	I08/02
65	I08/03

DIGITAL TB3 CONT.

66	I08/04
67	I08/05
68	I08/06
69	I08/07
70	I08/08
71	I08/09
72	I08/10
73	I08/11
74	I08/12
75	I08/13
76	I08/14
77	I08/15
78	I09/00
79	I09/01
80	I09/02
81	I09/03
82	I09/04
83	I09/05
84	I09/06
85	I09/07
86	I09/08
87	I09/09
88	I09/10
89	I09/11
90	I09/12
91	I09/13
92	I09/14
93	I09/15
94	O10/08
95	O11/00
96	O11/01
97	O11/02
98	O11/03
99	O11/04
100	O11/05
101	O11/06
102	O11/07
103	O11/08
104	O11/09
105	O11/10
106	O11/11
107	O11/12
108	O11/13
109	O11/14
110	O11/15
111	12131
112	SPARE
113	SPARE
114	SPARE
115	SPARE
116	SPARE
117	SPARE
118	SPARE
119	SPARE
120	SPARE
121	SPARE
122	SPARE
123	SPARE
124	SPARE
125	SPARE
126	SPARE
127	SPARE
128	SPARE
129	SPARE
130	SPARE

130 @ 1492-J4

ANALOG TB4

1	5051
2	5061
3	SHLD
4	5101
5	5111
6	SHLD
7	5141
8	I01/2+
9	I01/2-
10	2333
11	SHLD
12	5191
13	I01/3+
14	I01/3-
15	2333
16	SHLD
17	5271
18	I01/4+
19	I01/4-
20	2333
21	SHLD
22	5321
23	I01/5+
24	I01/5-
25	2333
26	SHLD
27	5371
28	I01/6+
29	I01/6-
30	2333
31	SHLD
32	5421
33	I01/7+
34	I01/7-
35	2333
36	SHLD
37	6031
38	I02/0+
39	I02/0-
40	2333
41	SHLD
42	6081
43	I02/1+
44	I02/1-
45	2333
46	SHLD
47	6131
48	I02/2+
49	I02/2-
50	2333
51	SHLD
52	6181
53	I02/3+
54	I02/3-
55	2333
56	SHLD
57	I02/4+
58	I02/4-
59	SHLD
60	I02/5+
61	I02/5-
62	SHLD
63	I02/6+
64	I02/6-
65	SHLD
66	I02/7+
67	I02/7-
68	SHLD
69	O05/0+
70	O05/0-
71	8081
72	SHLD
73	O05/1+
74	O05/1-
75	8121
76	SHLD
77	O05/2+
78	O05/2-
79	SHLD
80	O05/3+
81	O05/3-
82	SHLD
83	O05/4+
84	O05/4-
85	SHLD

ANALOG TB4 CONT.

86	O05/5+
87	O05/5-
88	SHLD
89	O05/6+
90	O05/6-
91	SHLD
92	O05/7+
93	O05/7-
94	SHLD
95	O06/0+
96	O06/0-
97	SHLD
98	O06/1+
99	O06/1-
100	SHLD
101	O06/2+
102	O06/2-
103	SHLD
104	O06/3+
105	O06/3-
106	SHLD
107	O06/4+
108	O06/4-
109	SHLD
110	O06/5+
111	O06/5-
112	SHLD
113	O06/6+
114	O06/6-
115	SHLD
116	O06/7+
117	O06/7-
118	SHLD
119	SPARE
120	SPARE
121	SHLD
122	SPARE
123	SPARE
124	SHLD
125	SPARE
126	SPARE
127	SHLD
128	SPARE
129	SPARE
130	SHLD
131	SPARE
132	SPARE
133	SHLD
134	SPARE
135	SPARE
136	SHLD
137	SPARE
138	SPARE

100 @ 1492-J4
**38 @ 1492-JG4

T/C TB5

1	I03/0+ **
2	I03/0- **
3	SHLD ***
4	I03/1+ **
5	I03/1- **
6	SHLD ***
7	I03/2+ **
8	I03/2- **
9	SHLD ***
10	I03/3+ **
11	I03/3- **
12	SHLD ***
13	I03/4+ **
14	I03/4- **
15	SHLD ***
16	I03/5+ **
17	I03/5- **
18	SHLD ***
19	I04/0+ **
20	I04/0- **
21	SHLD ***
22	I04/1+ **
23	I04/1- **
24	SHLD ***
25	I04/2+ **
26	I04/2- **
27	SHLD ***
28	I04/3+ **
29	I04/3- **
30	SHLD ***
31	I04/4+ **
32	I04/4- **
33	SHLD ***
34	I04/5+ **
35	I04/5- **
36	SHLD ***
37	SHLD ***
38	SHLD ***
39	SHLD ***
40	SHLD ***
41	SHLD ***

**12 @ 1492-JTC3K
***15@ 1492-JG3

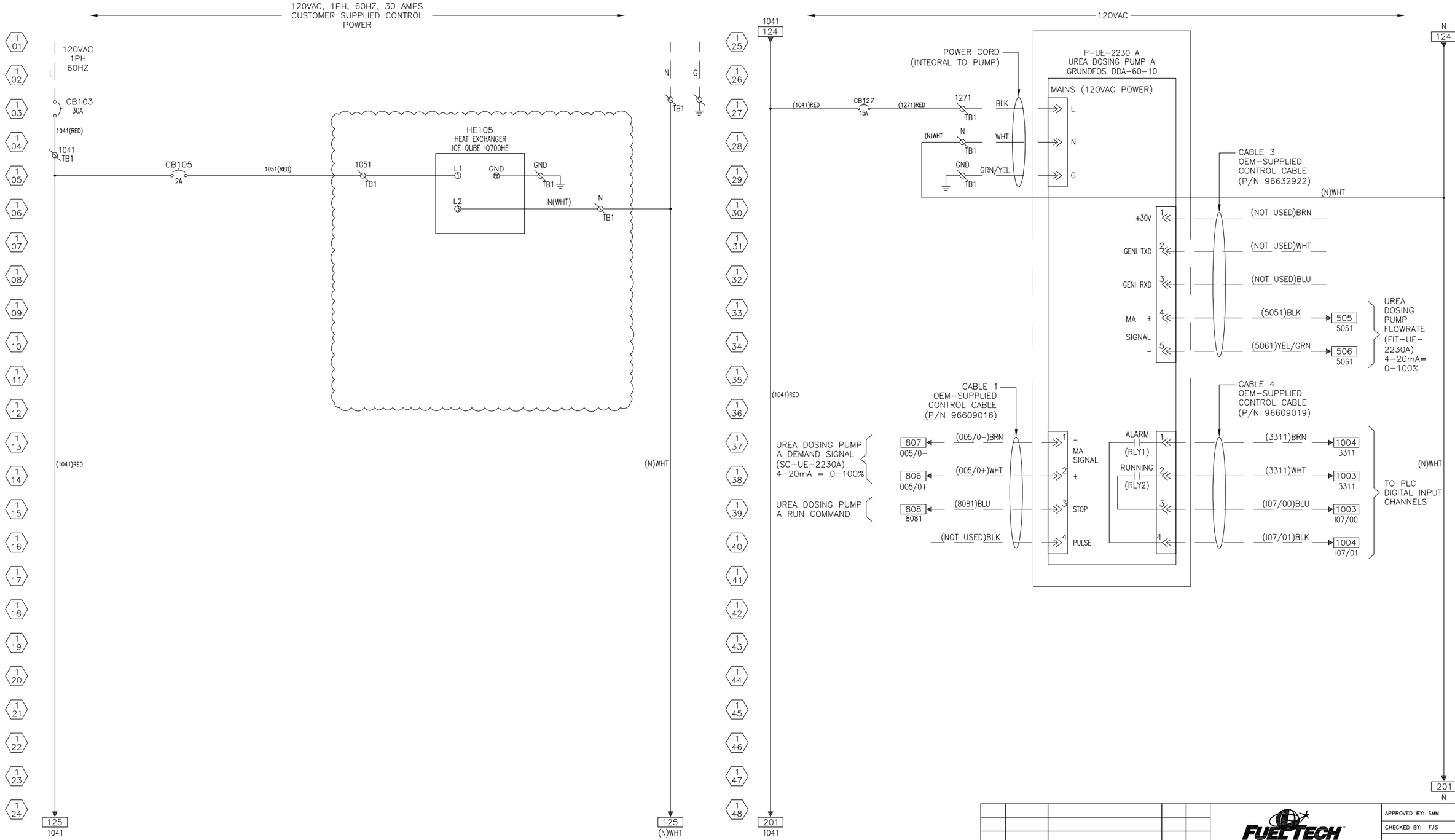
NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

PLC PANEL
PANEL LAYOUT

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO. 1294P-E02-02



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0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

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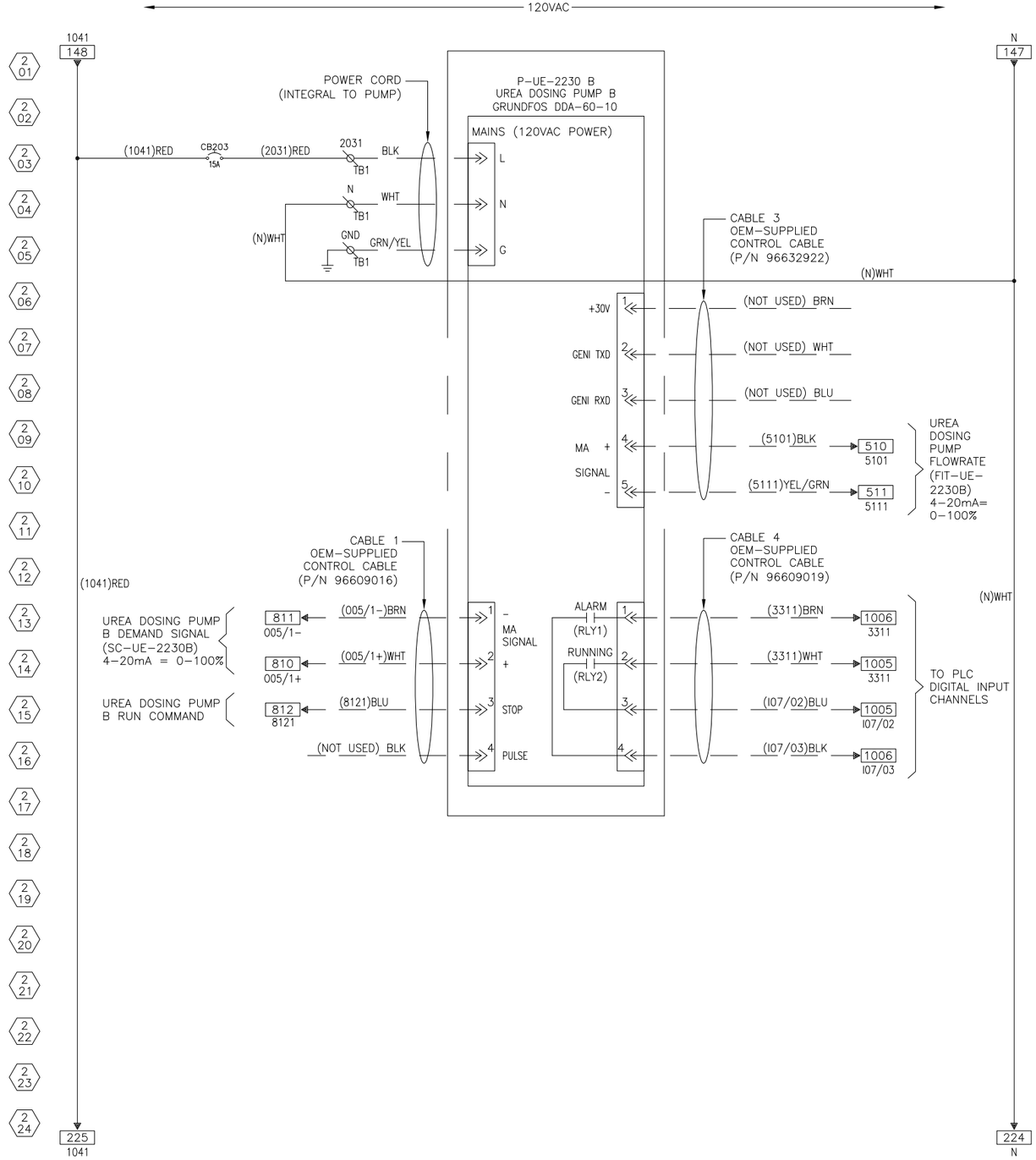
Technologies to enable clean efficient energy
FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

PLC PANEL
SCHEMATIC SHEET 1 OF 12

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO. 1294P-E02-03



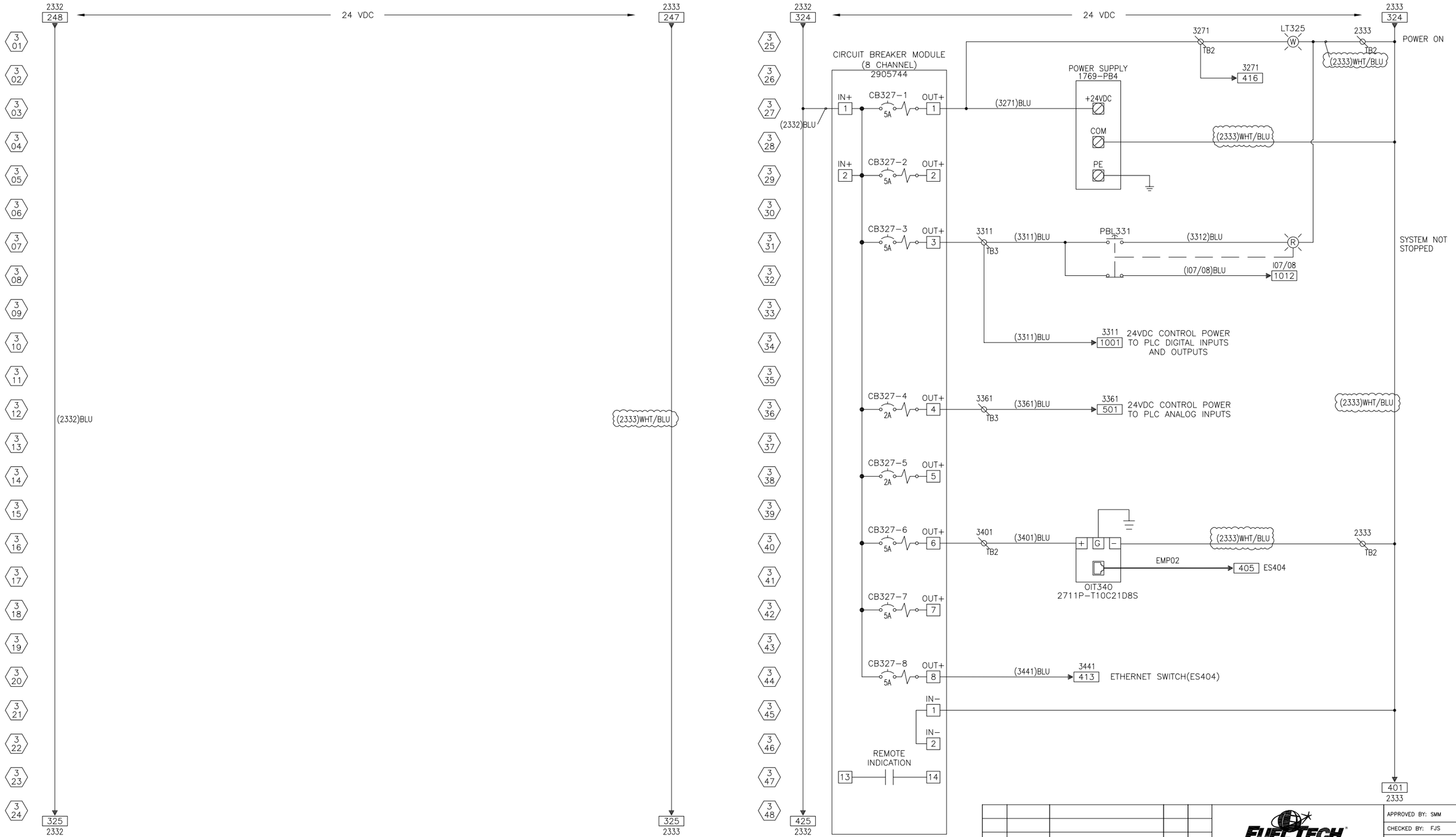
NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

PLC PANEL
SCHEMATIC SHEET 2 OF 12

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO. 1294P-E02-04



NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

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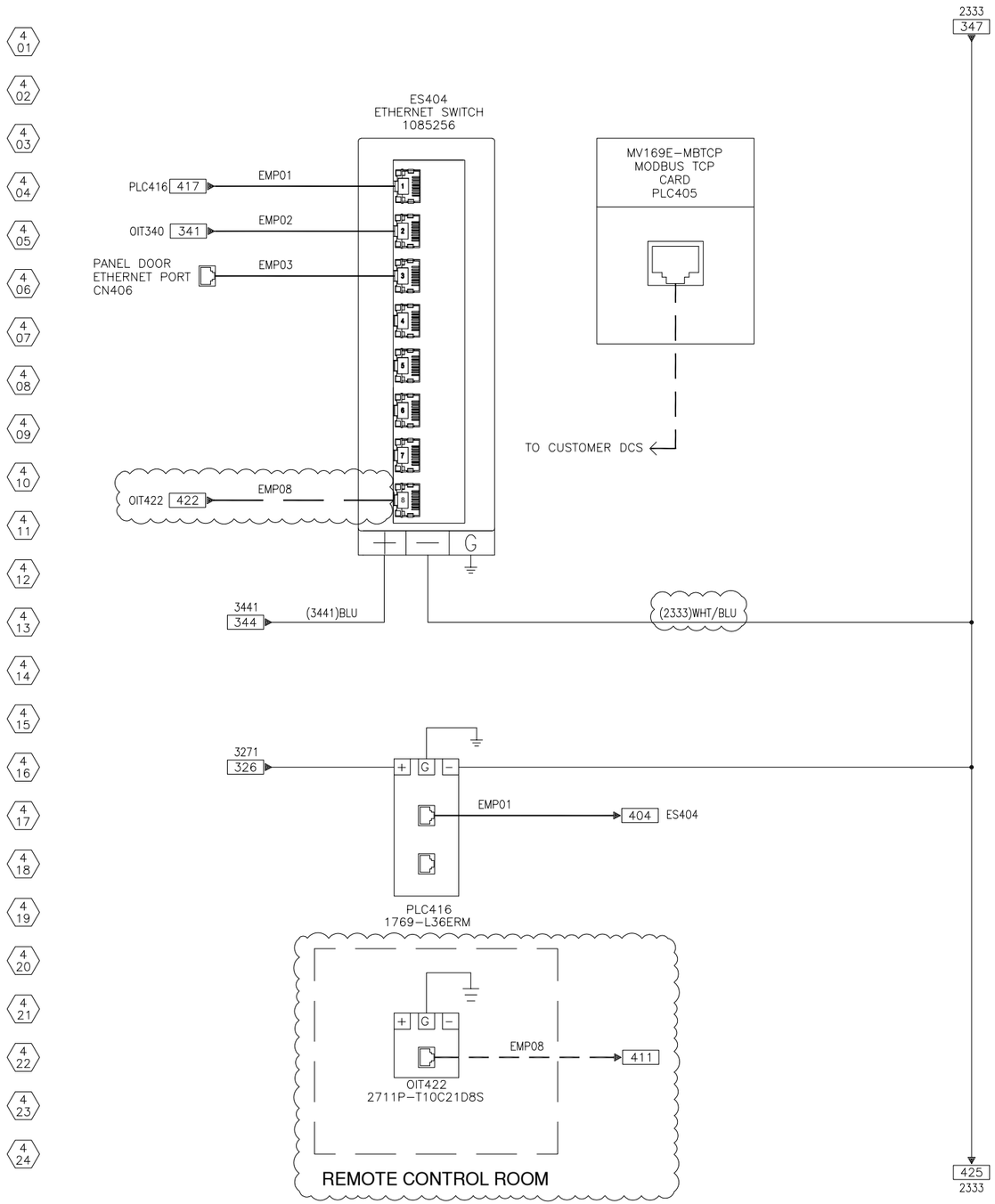
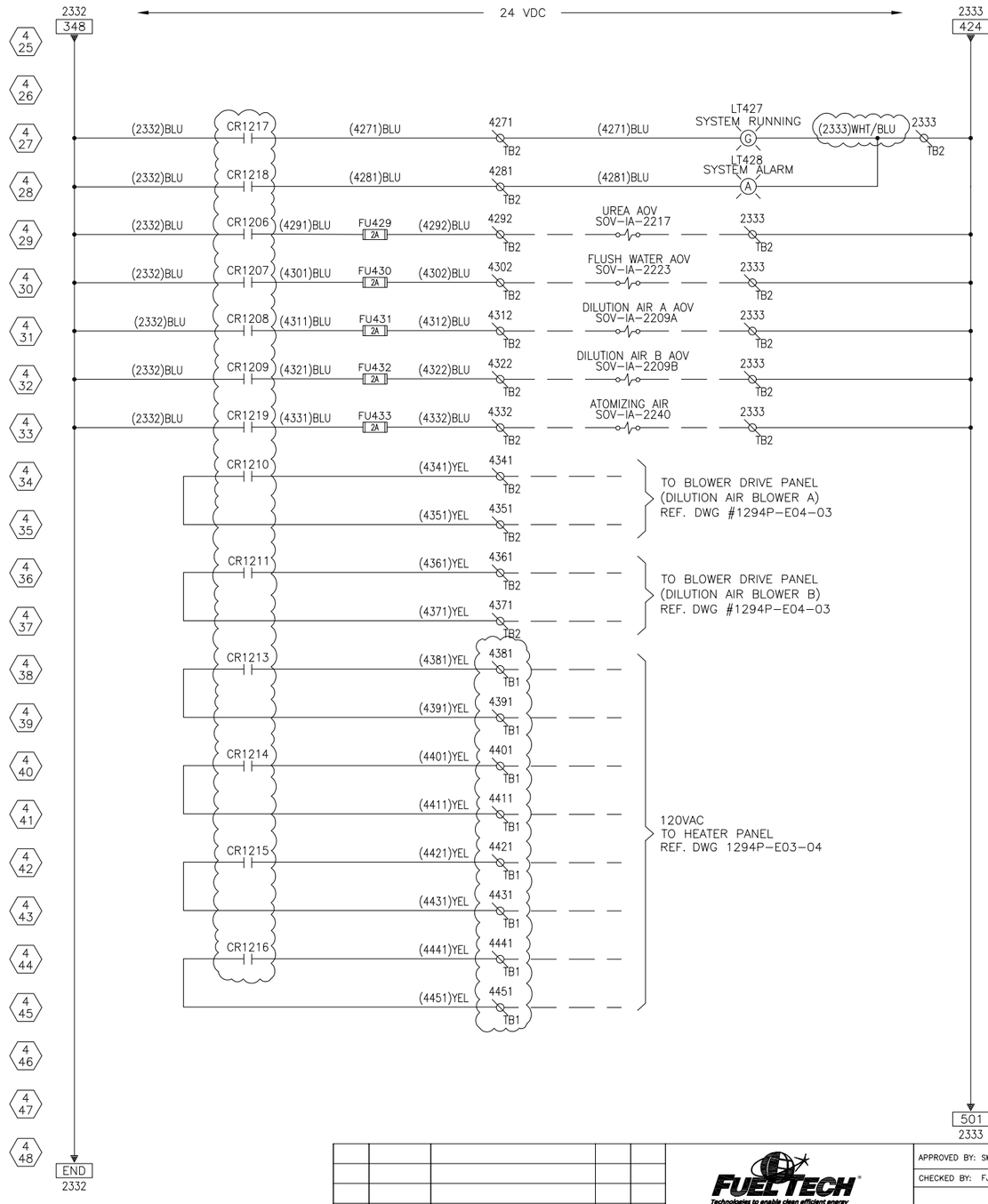
UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

PLC PANEL
SCHEMATIC SHEET 3 OF 12

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO. 1294P-E02-05





NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

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FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
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PLC PANEL
SCHEMATIC SHEET 4 OF 12

APPROVED BY: SMM
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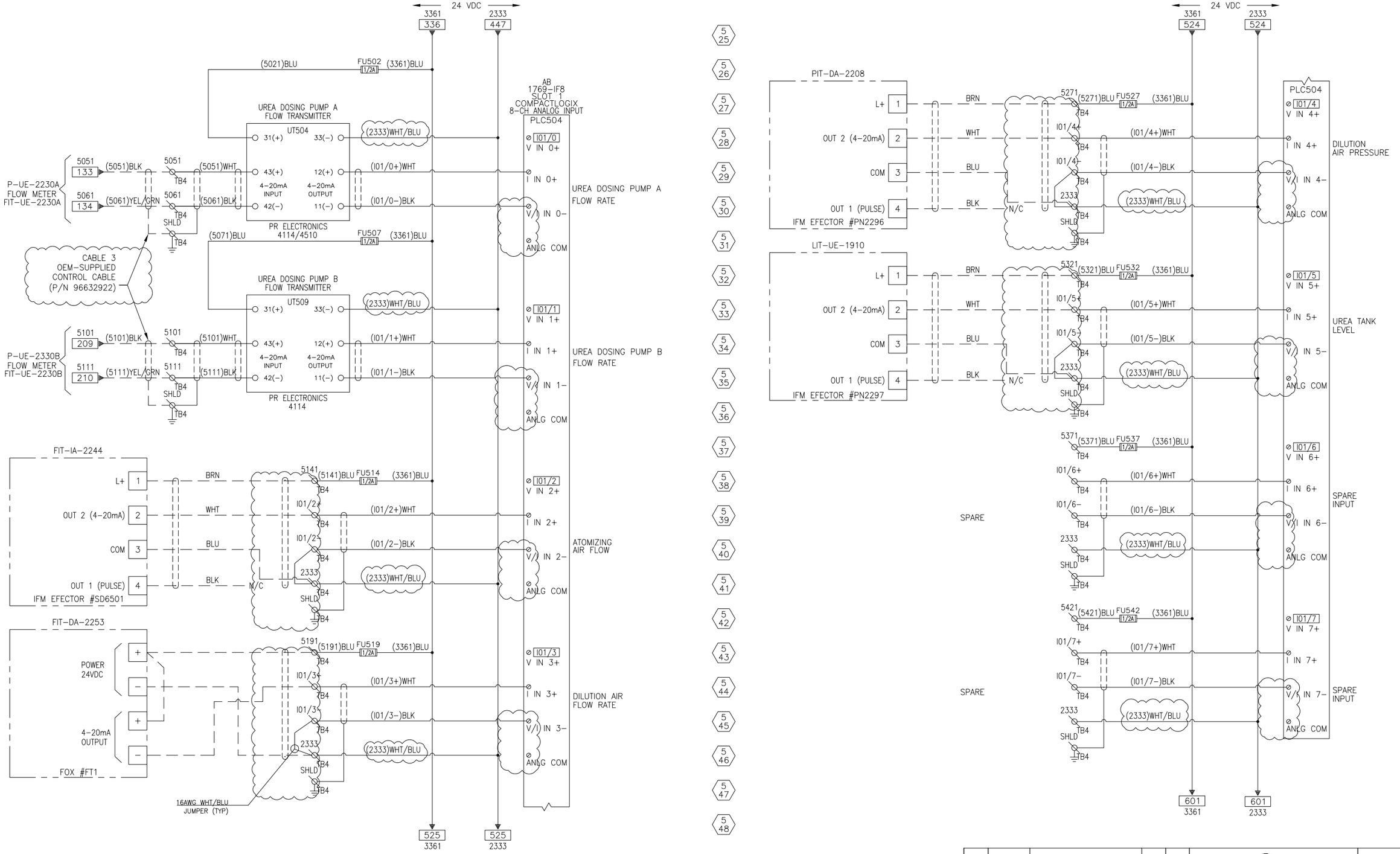
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO. 1294P-E02-06



ELECTRICAL CONDUCTOR DESIGNATIONS

——— INTERNAL TO CONTROL PANEL

– – – – EXTERNAL TO CONTROL PANEL

NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

FUEL TECH
Technologies to enable clean efficient energy
FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
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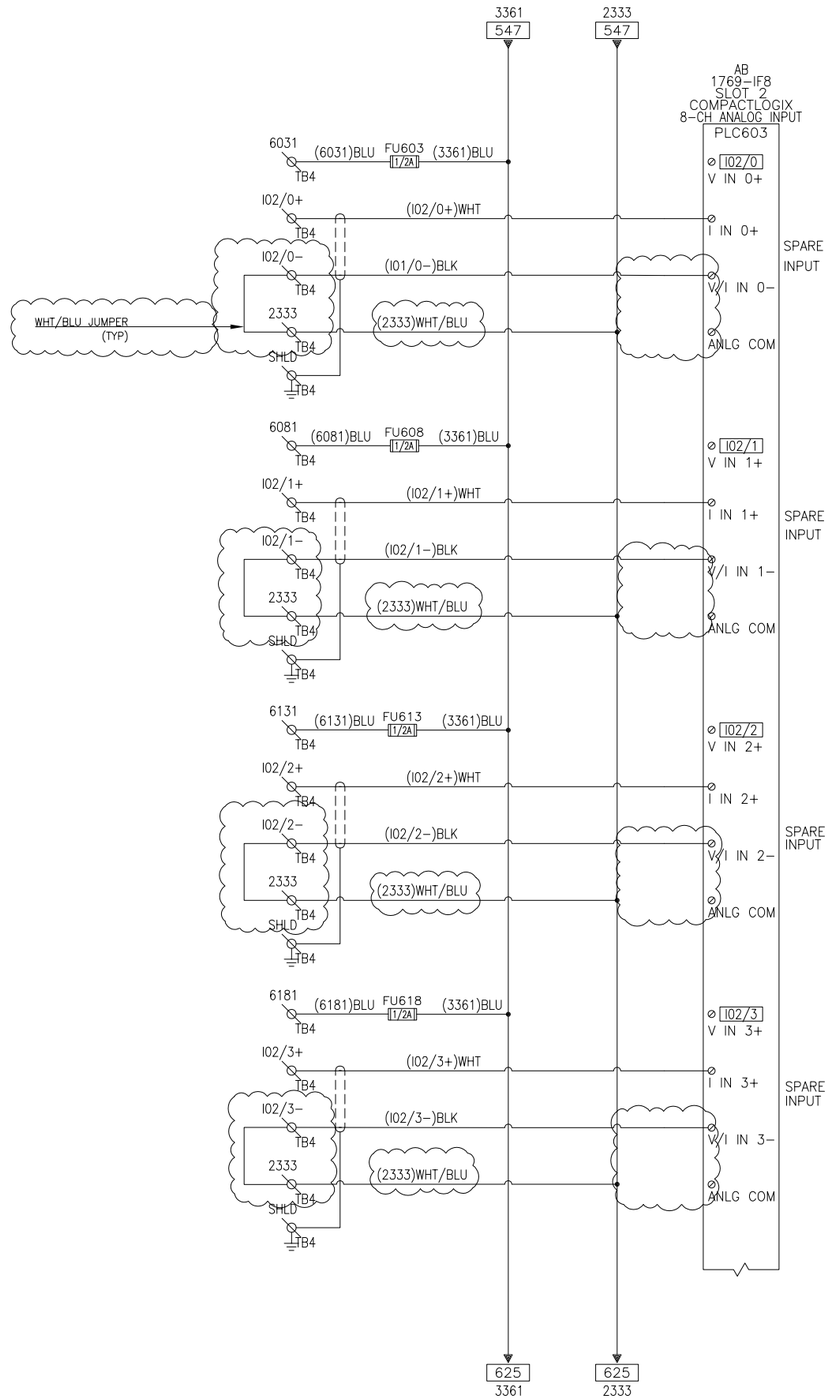
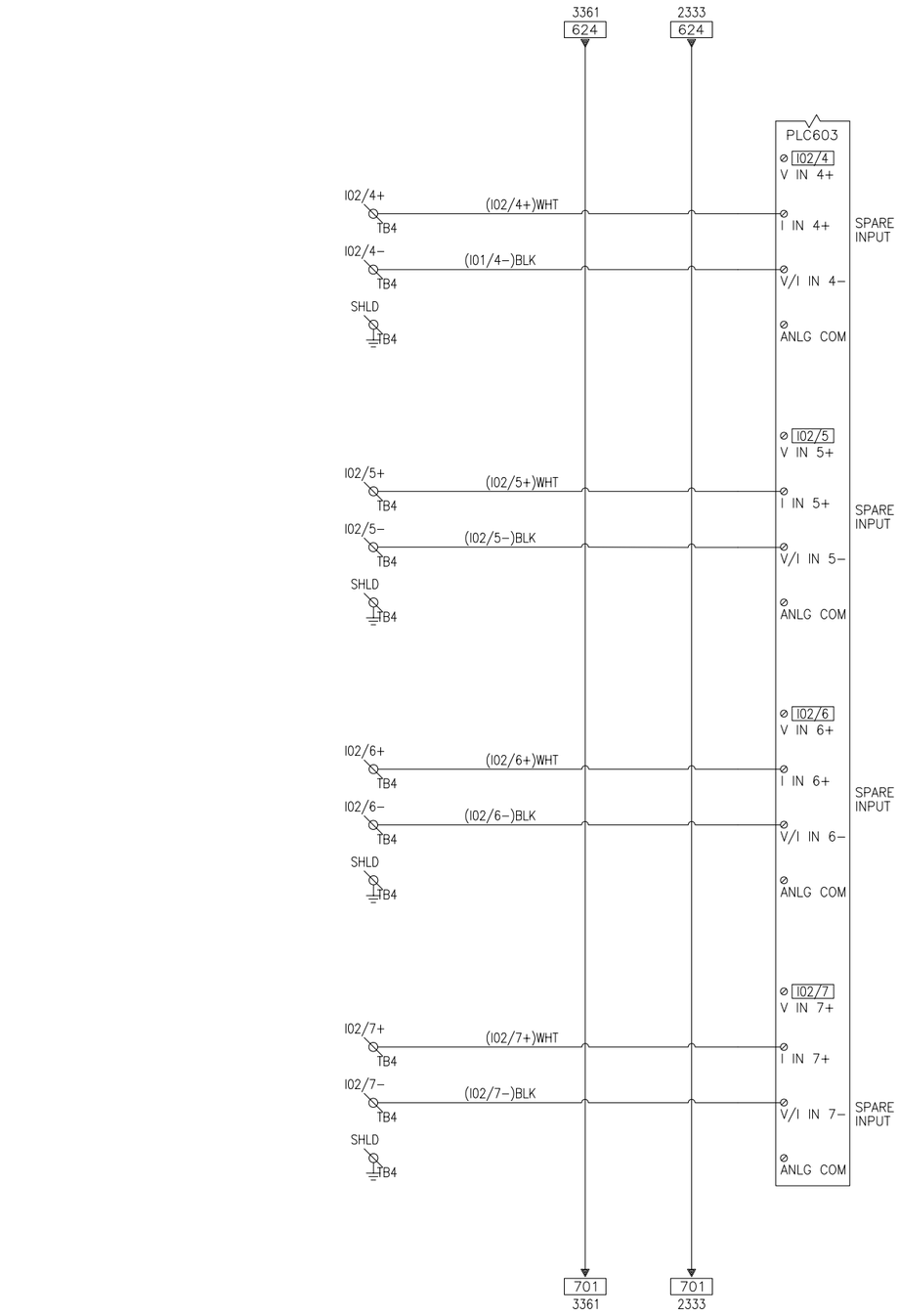
PLC PANEL
SCHEMATIC SHEET 5 OF 12

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO.
1294P–E02–07





INTERNAL TO CONTROL PANEL

EXTERNAL TO CONTROL PANEL

NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

FUEL TECH
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UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

PLC PANEL
SCHEMATIC SHEET 6 OF 12

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
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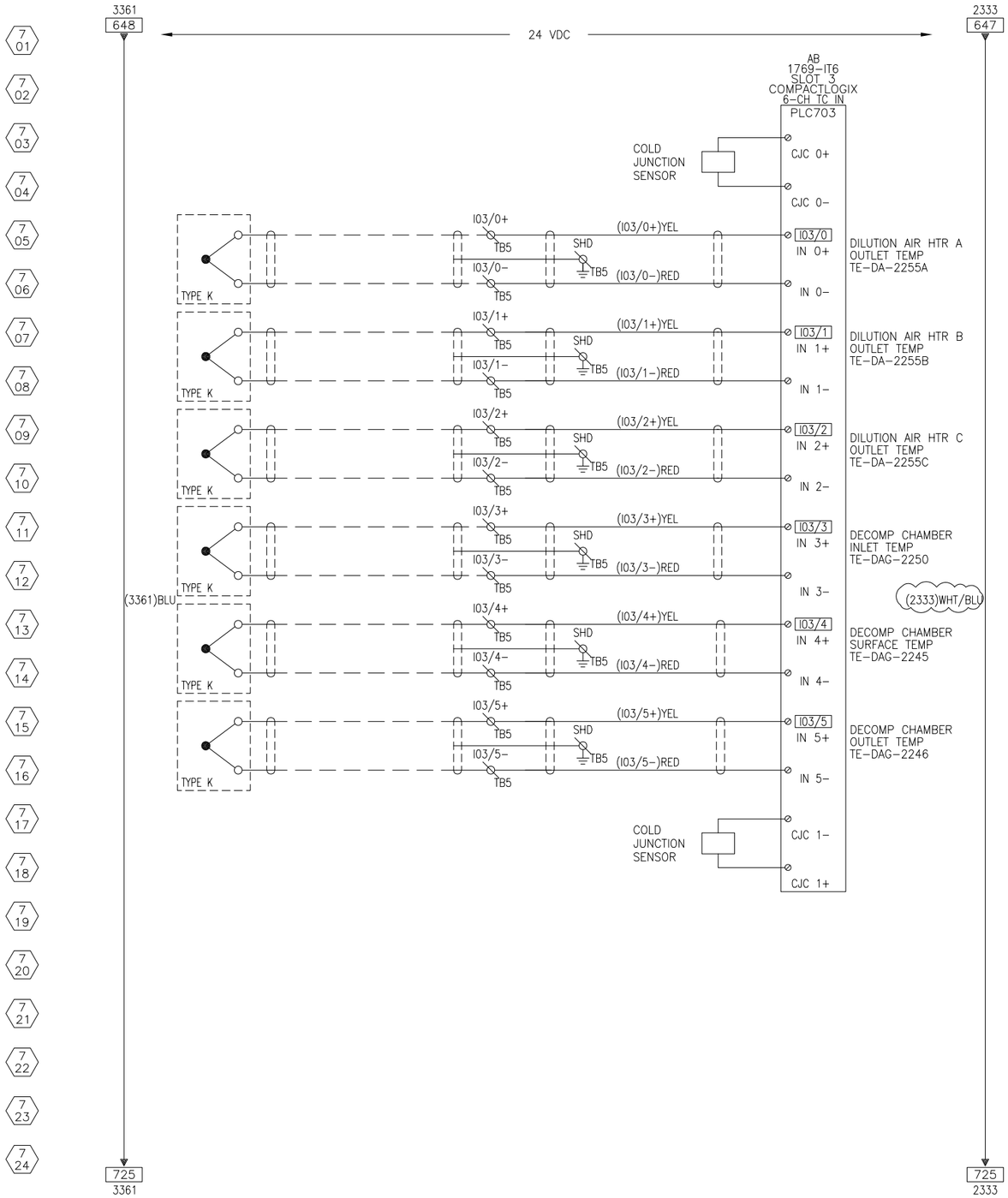

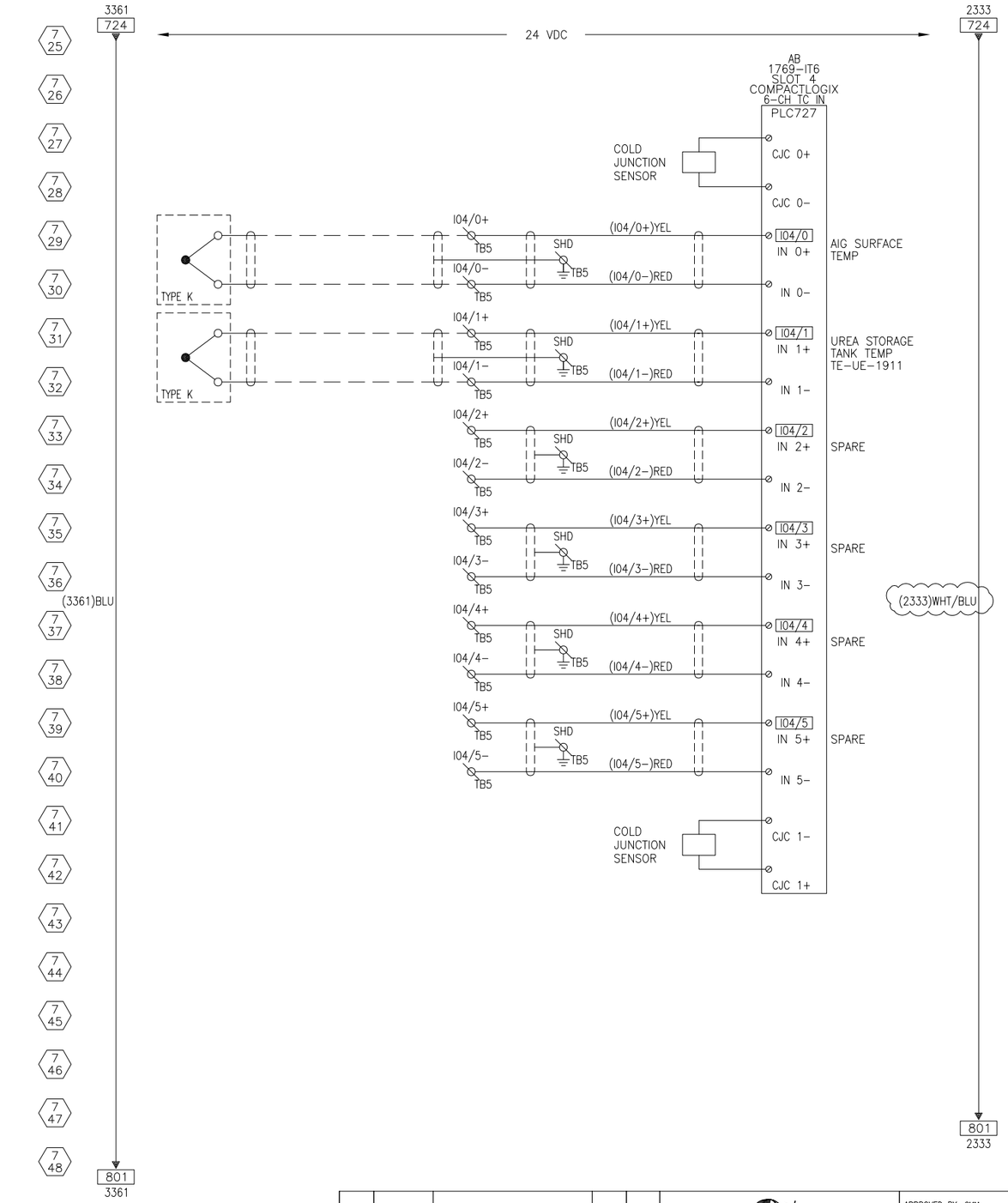

ELECTRICAL CONDUCTOR DESIGNATIONS

———— INTERNAL TO CONTROL PANEL

– — – — – EXTERNAL TO CONTROL PANEL

NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

FUEL TECH
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FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

PLC PANEL
SCHEMATIC SHEET 7 OF 12

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
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SIZE: D
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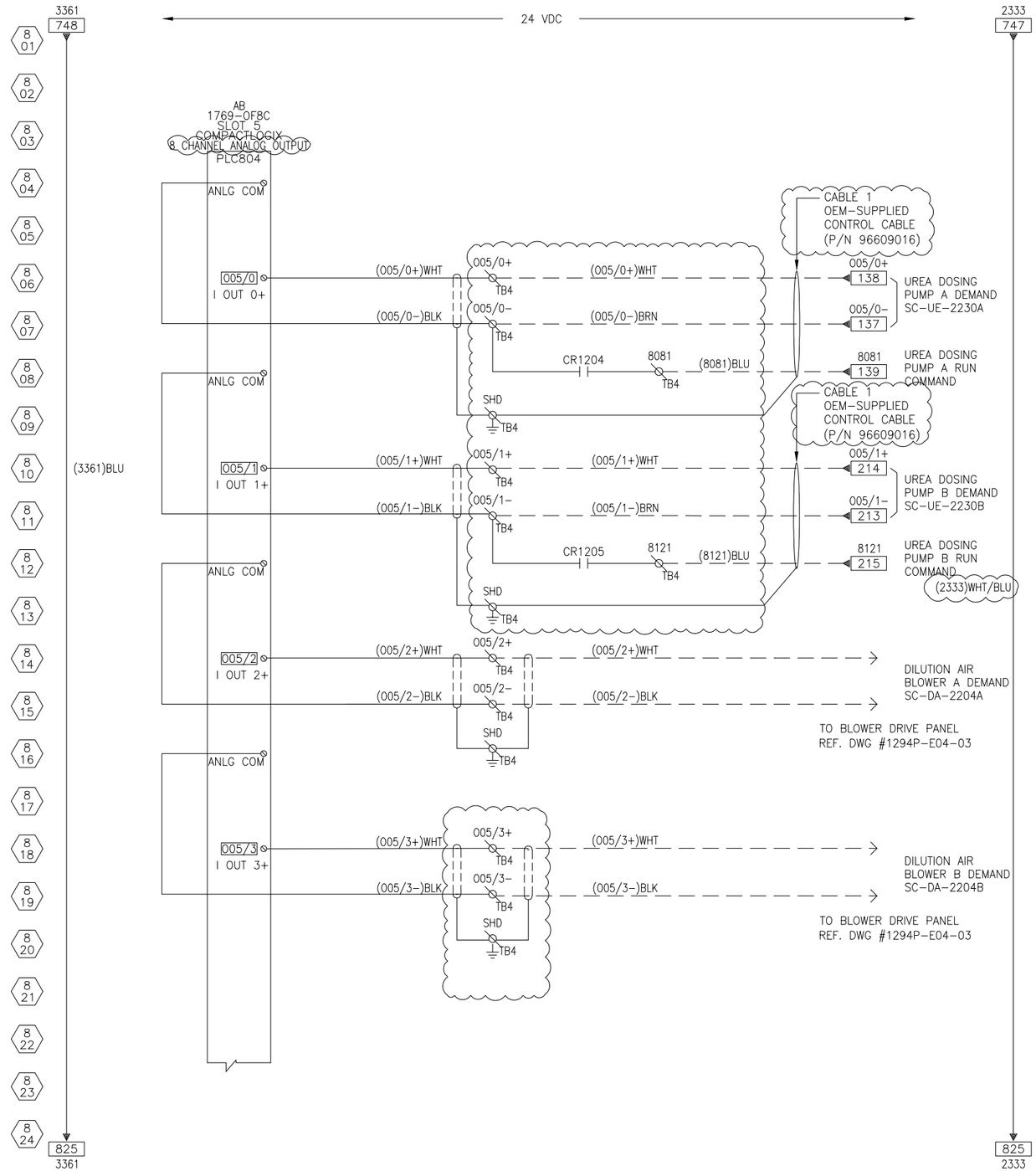
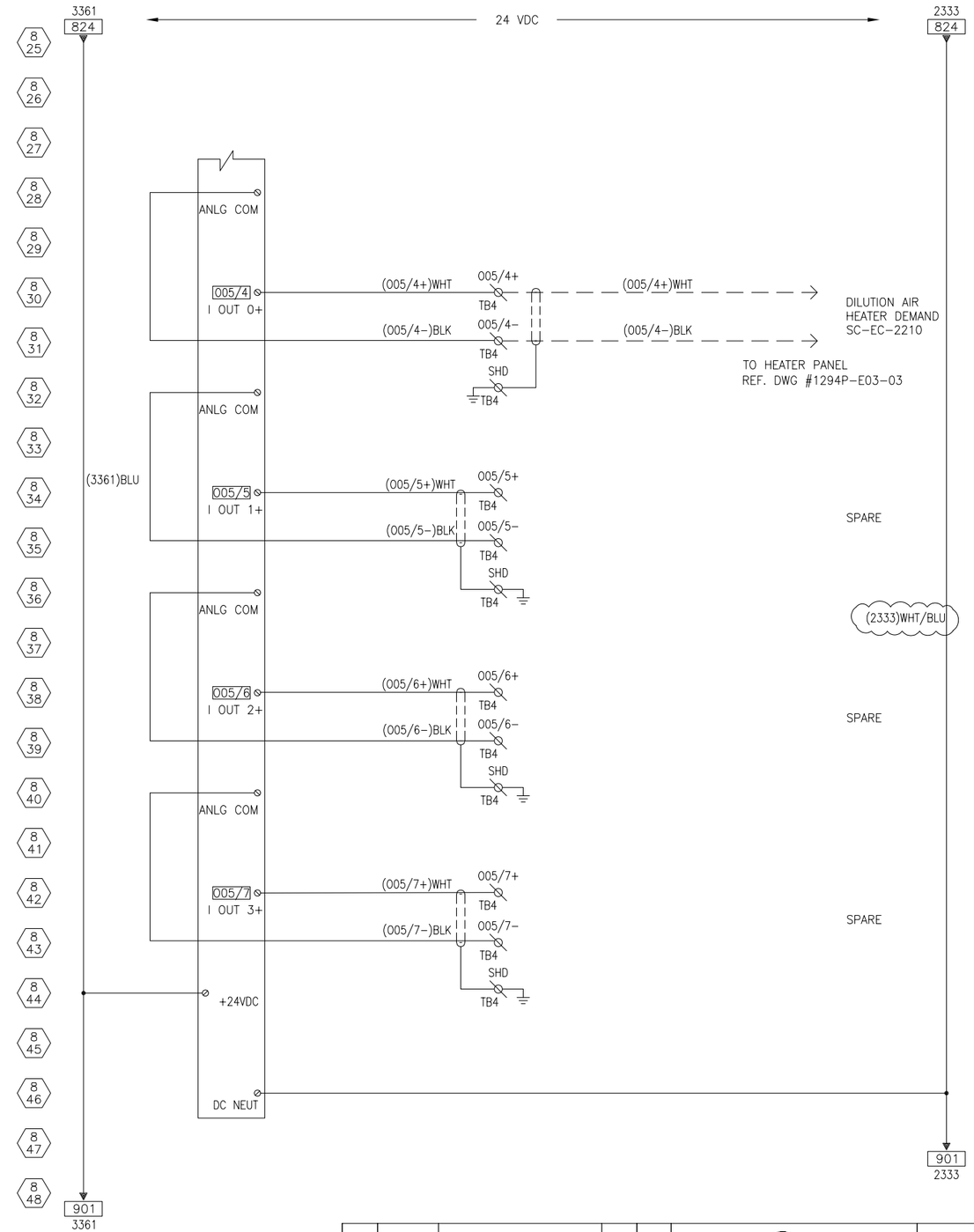
1294P-E02-09





ELECTRICAL CONDUCTOR DESIGNATIONS

———— INTERNAL TO CONTROL PANEL

– — – — – EXTERNAL TO CONTROL PANEL

NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

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UC DAVIS MEDICAL CENTER
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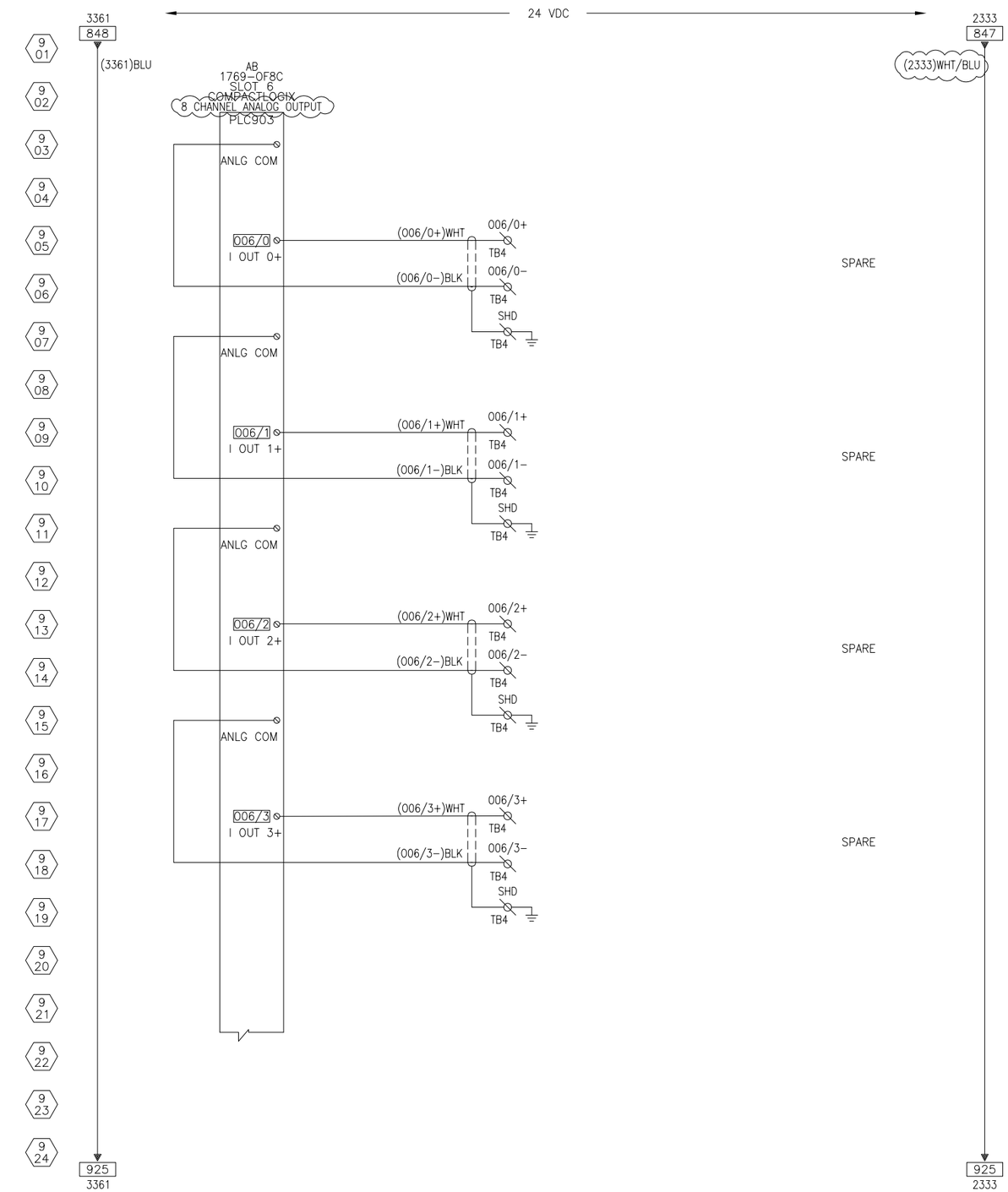
PLC PANEL
SCHEMATIC SHEET 8 OF 12

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO.
1294P-E02-10



NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
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FUEL TECH
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UC DAVIS MEDICAL CENTER
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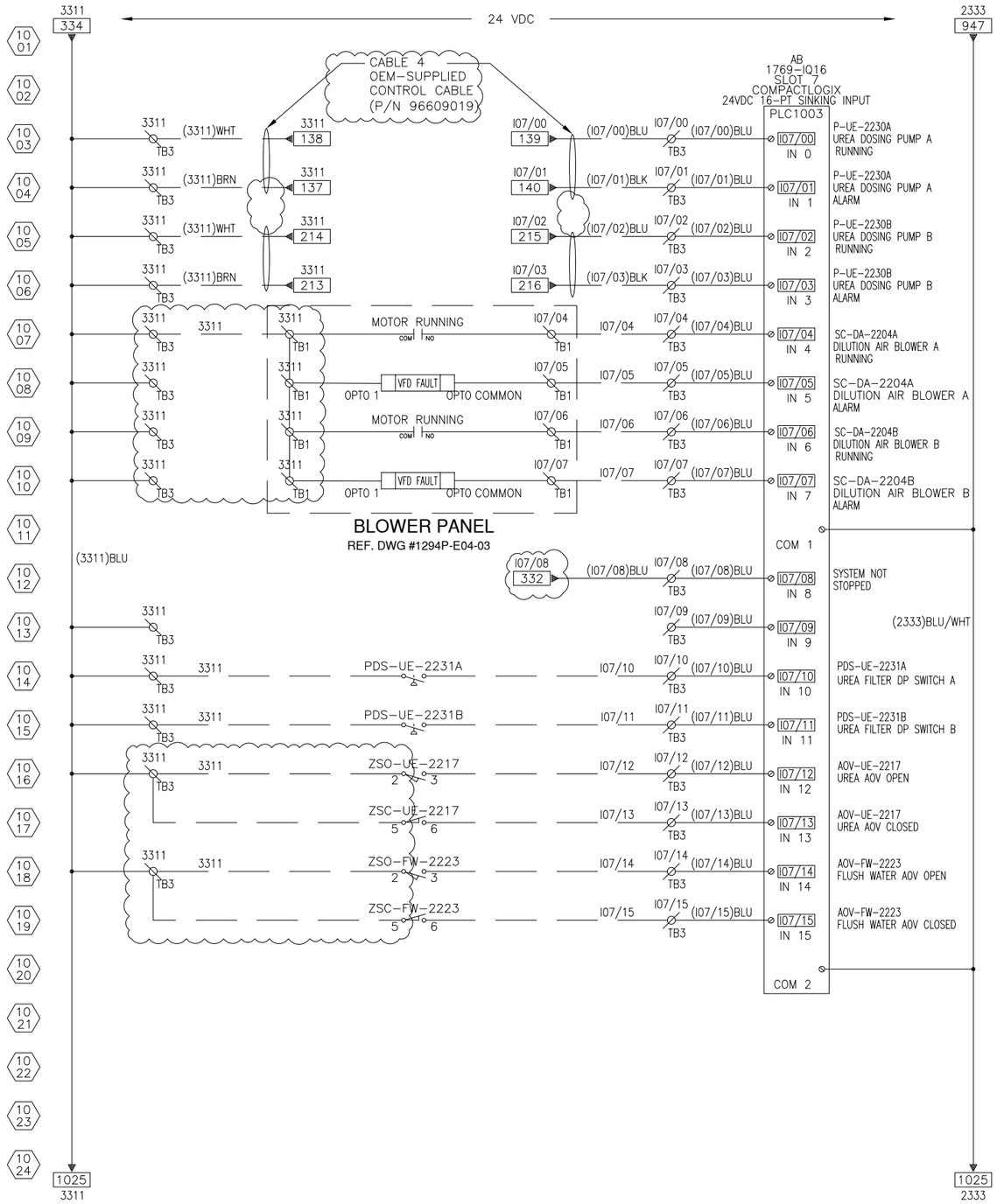
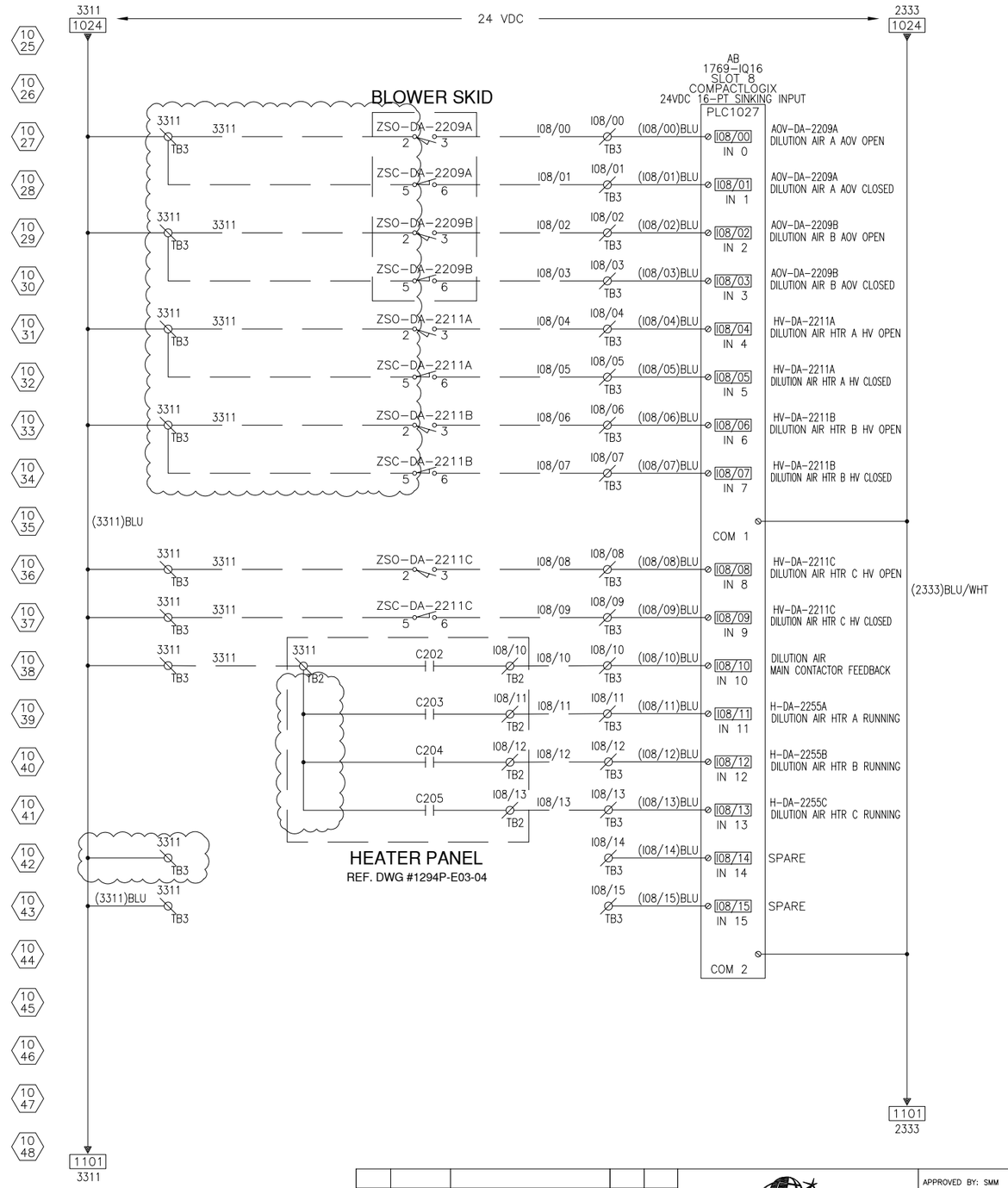
PLC PANEL
SCHEMATIC SHEET 9 OF 12

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO. 1294P-E02-11





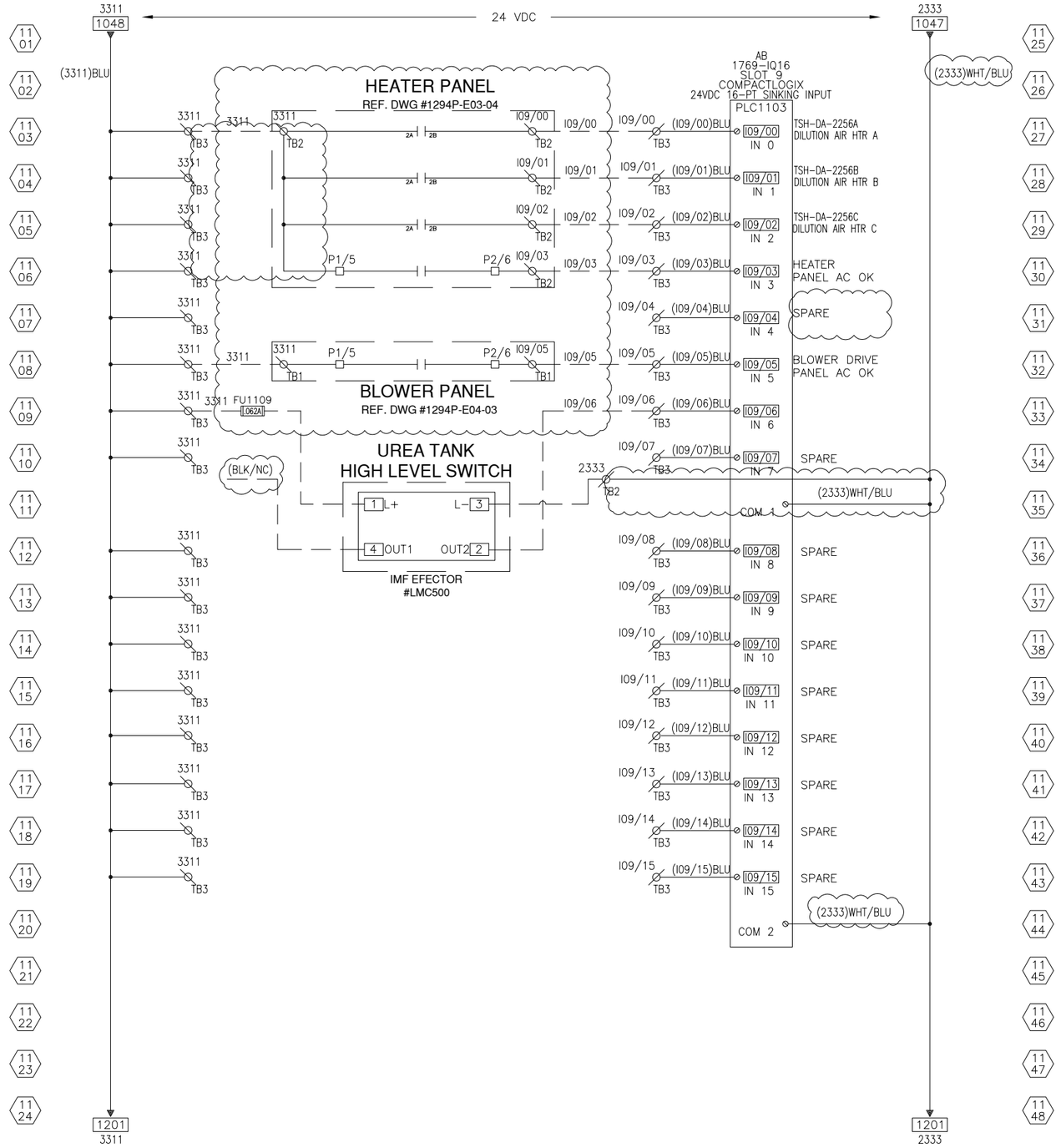
NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

FUEL TECH
Technologies to enable clean efficient energy
FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

PLC PANEL
SCHEMATIC SHEET 10 OF 12

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO.
1294P-E02-12



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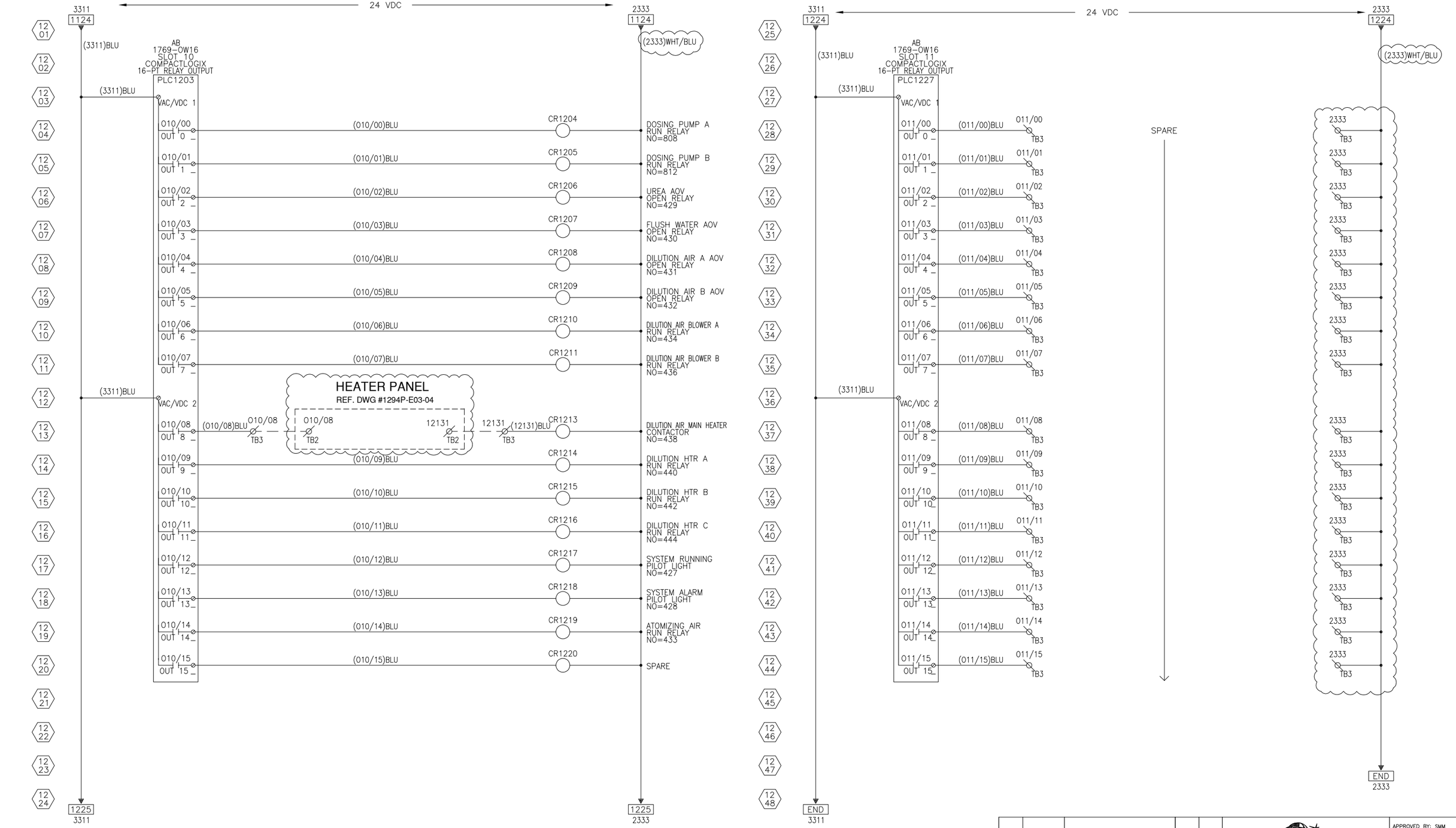
UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

PLC PANEL
SCHEMATIC SHEET 11 OF 12

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO. 1294P-E02-13



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FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
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PLC PANEL
SCHEMATIC SHEET 12 OF 12

APPROVED BY: SMM
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DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO.
1294P-E02-14

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UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

PLC PANEL
FUTURE

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO. 1294P-E02-15

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UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

PLC PANEL
FUTURE

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO. 1294P-E02-16

DEVICE ID	PART NUMBER	DESCRIPTION	MANUFACTURER	QTY
CB103	1489-M1C300	CIRCUIT BREAKER, 30A, 1-POLE480Y/277V AC/48V DC, UL489	AB	1
CB105	1489-M1D020	CIRCUIT BREAKER, 2A, 1-POLE480Y/277V AC/48V DC, UL489	AB	1
CB127,CB203	1489-M1C150	CIRCUIT BREAKER, 15A, 1-POLE480Y/277V AC/48V DC, UL489	AB	2
CB226,CB229,CB233	1489-M1D050	CB, 5A, 1-POLE, D-TRIP CURVE480Y/277V AC/48V DC, UL489	AB	3
CB327(1-8)	2905744	MULTI-CHANNEL CIRCUIT BREAKER,(X8) 24VDC LOADS ONLY	PHOENIX	1
CN406	IAEBHC5E	BULKHEAD COUPLER CAT5ERJ45F TO RJ45F W/CAP PANDUIT	PANDUIT	1
CR1204-CR1220	700-HKM6Z24-3-4	GP SLIM LINE RELAY 24VDC COILSPDT W/IND & MAN OVERRIDE	AB	16
CR1204-CR1221	700-HN221	RELAY SOCKETFOR HKM SPDT RELAY	AB	16
ES404	1085256	ETHERNET SWITCH (8) RJ4510/100 MBPS, 24VDC DIN MTG	PHOENIX	1
FU429-433	MDL-2-R	FUSE, 1/4 X 1-1/4 , 2A, 250VTIME DELAY, NON-INDICATING	BUSSMANN	5
FU502-618	AGC-1/2-R	FUSE, 1/4 X 1-1/4, 1/2A, 250VFAST-ACTING, NON-INDICATING	BUSSMANN	12
FU1109	0312.062	FUSE, CLASS 3AG, .062AMP, 250V AC, FAST ACTING	LITTELFUSE	1
FU'S	1492-H5	TERMINAL FUSE BLOCK, BLACK1/4 X 1-1/4, LED INDICATOR	AB	18
FU'S	1492-MS8X12-ENG	MARKER CARD, TERMINAL BLOCKENGRAVED 56/CARD, RELAY/FUSE	AB	A/R
GND BAR'S	PK12GTA	LOAD CENTER EQUIPMENT GROUNDBAR ASSY	SCHNEIDER ELECTRIC	2
GND LUG'S	L70	GROUND LUG, 14 SOL-4 STRANDED1 CONDUCTOR	T&B	2
HE105	IQ700HE-CF-120-GY-N4	HEAT EXCHANGER 5.7 WATTS/DEG F120/1/60, 0.24 A TYPE 4	ICEQUBE	1
LT325	800H-QRH2W	PILOT LIGHT, WHITE, LED, 30MM12-130V AC/DC, NEMA 4/4X/13	AB	1
LT427	800H-QRH2G	PILOT LIGHT, GREEN, LED, 30MM12-130V AC/DC, NEMA 4/4X/13	AB	1
LT428	800H-QRH2A	PILOT LIGHT, AMBER, LED, 30MM12-130V AC/DC, NEMA 4/4X/13	AB	1
OIT340	2711P-T10C21D8S-FUELTECH	PANELVIEW PLUS 7 STANDARD HMITOUCH SCREEN, 10.4 INCH COLOR	AB	1
PBL331	800H-FRXTQH2RA1	PUSH-PULL/TW-REL, ILL RED LEDMUSHROOM HEAD, 12-130V AC/DC	AB	1
PLC	1769-ECR	PLC, COMPACTLOGIX, RIGHT ENDCAP, 1769	AB	1
PLC703, 727	1769-IT6-FUELTECH	PLC, COMPACTLOGIX/MICROLOGIX1500, TEMPERATURE INPUT MODULE	AB	2
PLC	1769-PB4	PLC, COMPACTLOGIX 1769POWER SUPPLY	AB	1
PLC1003,1027,1103	1769-IQ16	PLC, COMPACTLOGIX 176916 DIGITAL INPUTS	AB	3
PLC1203,PLC1227	1769-OW16	PLC, COMPACTLOGIX 1769/MICROLOGIX 1500, 16 CONTACT OUTPUTS	AB	2
PLC405	MVI69E-MBTCP-FUELTECH	COMMUNICATION MODULE, TCP/IPCOMPACTLOGIX, MODBUS	PROSOFT	1
PLC416	1769-L36ERM	COMPACT LOGIX L3 CONTROLLER3MB, DUAL ETHERNET	AB	1
PLC504,PLC603	1769-IF8-FUELTECH	PLC, COMPACTLOGIX 17698 ANALOG INPUTS	AB	2
PLC804,903	1769-OF8C	PLC, COMPACTLOGIX 1769/MICROLOGIX 1500, 8 ANALOG OUTPUTS	AB	2
PS229	BAE0113	PWR SUP, 24VDC, 1-PHASE240W, ALLIED PN: 72135112	BALLUFF	1
TB1,TB2,TB3,TB4	1492-EBJ3	END BARRIER, TERMINAL BLOCKGRAY, USED ON 1492-J	AB	6
TB1,TB2,TB3,TB4	1492-J4	TERMINAL BLOCK, GRAY, SCREW35A, 600V AC/DC, 22 - 10 AWG	AB	319
TB1,TB2,TB3,TB4	1492-M6X12-ENG	MARKER CARD, TERMINAL BLOCKENGRAVED, 120/CARD, 1492-J	AB	A/R
TB1,TB4	1492-JG4	TERMINAL BLOCK, GRN/YEL, SCREW22 - 10 AWG, GROUND	AB	41
TB's	1492-CJLJ6-10	JUMPER, 10-POLEPUSH-IN CENTER JUMPER	AB	12
TB5	1492-JG3	TERMINAL BLOCK, GRN/YEL, SCREW22 - 12 AWG, FEED-THRU GROUND	AB	15
TB5	1492-JTC3K	TERMINAL BLOCK, GRAY, SCREW30 - 12 AWG, K THERMOCOUPLE	AB	12
TB5	1492-M5X12-ENG	MARKER CARD, TERMINAL BLOCKENGRAVED, 144/CARD	AB	A/R
FU's	1492-N37	END BARRIER, TERMINAL BLOCKBLACK, 1.96 X 2.81 X .11	AB	14
UT504,UT509	4114	UNIVERSAL XMTR, 2-RELAYSRTD/TC/OHM/POT/MA/V DIN MTG	PR ELECTRONICS	2
UT504	4510	DISPLAY/PROGRAMMING FRONT	PR ELECTRONICS	1
	8760	CABLE, 1 PAIR, 18 AWG, PAIREDSHIELDED, 300 VOLTS, PVC GRAY	BELDEN	A/R
	99452	LABEL, ARC FLASH WARNING LABEL	BRADY	1
	1492-EAJ35	END ANCHOR, TERMINAL BLOCKNORMAL DUTY	AB	23
	3112A	THERMOCOUPLE CABLE, TYPE KX, 20AWG, 1 PAIR	ANIXTER	A/R
	98.300.1800.0	DIN RAIL SLOTTED, WIELAND35MM X 7.5MM X 2M	WIELAND	A/R
	C1.5WH6	COVER, PANEL CHANNEL, WHITE1.5 INCH DUCT COVER	PANDUIT	A/R
	C1WH6	COVER, PANEL CHANNEL, WHITE1 INCH DUCT COVER	PANDUIT	A/R
	CMFK	MOUNTING KIT, ENCLOSURESTEEL, ZINC PLATE	HOFFMAN	1
	CP6036	SUB PANEL, 58.20 X 34.20STEEL, WHITE FINISH	HOFFMAN	1
	CSD603616M104	MOD ENCLOSURE PER DWGCSD603616M104	HOFFMAN	1
	G1.5X4WH6	PANEL CHANNEL, 1.5X4 WHITE	PANDUIT	A/R
	G1X4WH6	PANEL CHANNEL, 1X4 WHITE	PANDUIT	A/R
	LAM-2.50-1.00-902	LAMACOID, 2.50 W X 1.00 HWHITE W/BLACK TEXT	ICC	3
	LAM-7.50-1.50-902	LAMACOID 7.5 X 1.50WHITE W/BLACK TEXT	ICC	1
	LP-30MM-902	LEGEND PLATE, 30MM, WHITEW/BLACK TEXT	ICC	4
	MOSE4VAP-BK-003	3 FT CAT 5E CABLE, 600VSHIELDED, BLK, RJ45/RJ45	ANIXTER	1
	MOSE4VAP-BK-010	10 FT CAT 5E CABLE, 600VSHIELDED, BLK, RJ45/RJ45	ANIXTER	2
	THT-19-435-1-PR	LABEL, SPEC/FUSE/TORQUEENGRAVED, SILVER, 3 X 2	ICC	9
	THT-19-439-HFC	LABEL, WARNING - RISK OF FIREOR ELECTRICAL SHOCK	ICC	1
	THT-5-435-10-PR	LABEL, ID, ENGRAVEDSILVER, 1 X 0.5	ICC	A/R

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UC DAVIS MEDICAL CENTER
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PLC PANEL
BILL OF MATERIAL

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO. 1294P-E02-17

FROM CUSTOMER

OTHERS
PPEPP01

GND LUG

LINE CB103 LOAD

TB1

1	1041
2	1041
3	1041
4	1041
5	1041
6	N
7	N
8	N
9	N
10	1051
11	N
12	GND
13	1271
14	N
15	GND
16	2031
17	N
18	GND
19	2261

TB1

1	2261
10	N

FTI PPPHP01

HEATER PANEL
REF. DWG #1294P-E03-07

HEATER PANEL
REF. DWG #1294P-E03-07

TB2

5	2332
6	2333
7	2333
8	2333
9	2333
10	2333
11	2333
12	2333
43	4292
44	4302
45	4312
46	4322
47	4332
48	4341
49	4351
50	4361
51	4371
52	4381
53	4391
54	4401
55	4411
56	4421
57	4431
58	4441
59	4451

FTI DPPHP01

TB2

10	2332
13	2333

OTHERS CPPSE12 — REFER TO DWG# 1294P-E02-19 FOR CONTINUATION

FTI CPPSE05
FTI CPPSE06
OTHERS CPPSE07
OTHERS CPPSE08
FTI CPPSE13

REFER TO DWG# 1294P-E02-20 FOR CONTINUATION

OTHERS CPPBP01 — REFER TO DWG# 1294P-E02-19 FOR CONTINUATION

FTI CPPHP01
FTI CPPHP02
FTI CPPHP03
FTI CPPHP04

4381	1	2261
4401	2	2261
4421	3	2261
4441	4	2261
4391	5	2261
4411	6	2020
4431	7	2030
4451	8	2040
	9	2050

TB1

HEATER PANEL
REF. DWG #1294P-E03-07

FTI PPPSE01
FTI PPPSE02

TB4

1	5051	(5051)BLK
2	5061	(5061)YEL/GRN
3	SHLD	SHLD
4	5101	(5101)BLK
5	5111	(5111)YEL/GRN
6	SHLD	SHLD
7	5141	(5141)BRN
8	I01/2+	(I01/2+)WHT
9	I01/2−	(I01/2−)BLU
10	2333	(NC)BLK
11	SHLD	
12	5191	5191
13	I01/3+	I01/3+
14	I01/3−	NC
15	2333	2333
16	SHLD	SHLD
17	5271	(5271)BRN
18	I01/4+	(I01/4+)WHT
19	I01/4−	(I01/4−)BLU
20	2333	(NC)BLK
21	SHLD	
22	5321	(5321)BRN
23	I01/5+	(I01/5+)WHT
24	I01/5−	(I01/5−)BLU
25	2333	NC
26	SHLD	

FTI SPPSE02
FTI SPPSE04
FTI SPPSE05
OTHERS SPPSE06
FTI SPPSE07
OTHERS SPPSE08

REFER TO DWG# 1294P-E02-20 FOR CONTINUATION

69	005/0+	(005/0+)WHT
70	005/0−	(005/0−)BRN
71	8081	(8081)BLU
72	SHLD	SHLD
73	I05/1+	(I05/1+)WHT
74	I05/1−	(I05/1−)BRN
75	8121	(8121)BLU
76	SHLD	SHLD
77	005/2+	(005/2+)WHT
78	005/2−	(005/2−)BLK
79	SHLD	SHLD
80	005/3+	(005/3+)WHT
81	005/3−	(005/3−)BLK
82	SHLD	SHLD
83	005/4+	(005/4+)WHT
84	005/4−	(005/4−)BLK
85	SHLD	SHLD

FTI SPPSE01
FTI SPPSE03
OTHERS SPPBP01
OTHERS SPPBP02
FTI SPPHP01

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UC DAVIS MEDICAL CENTER
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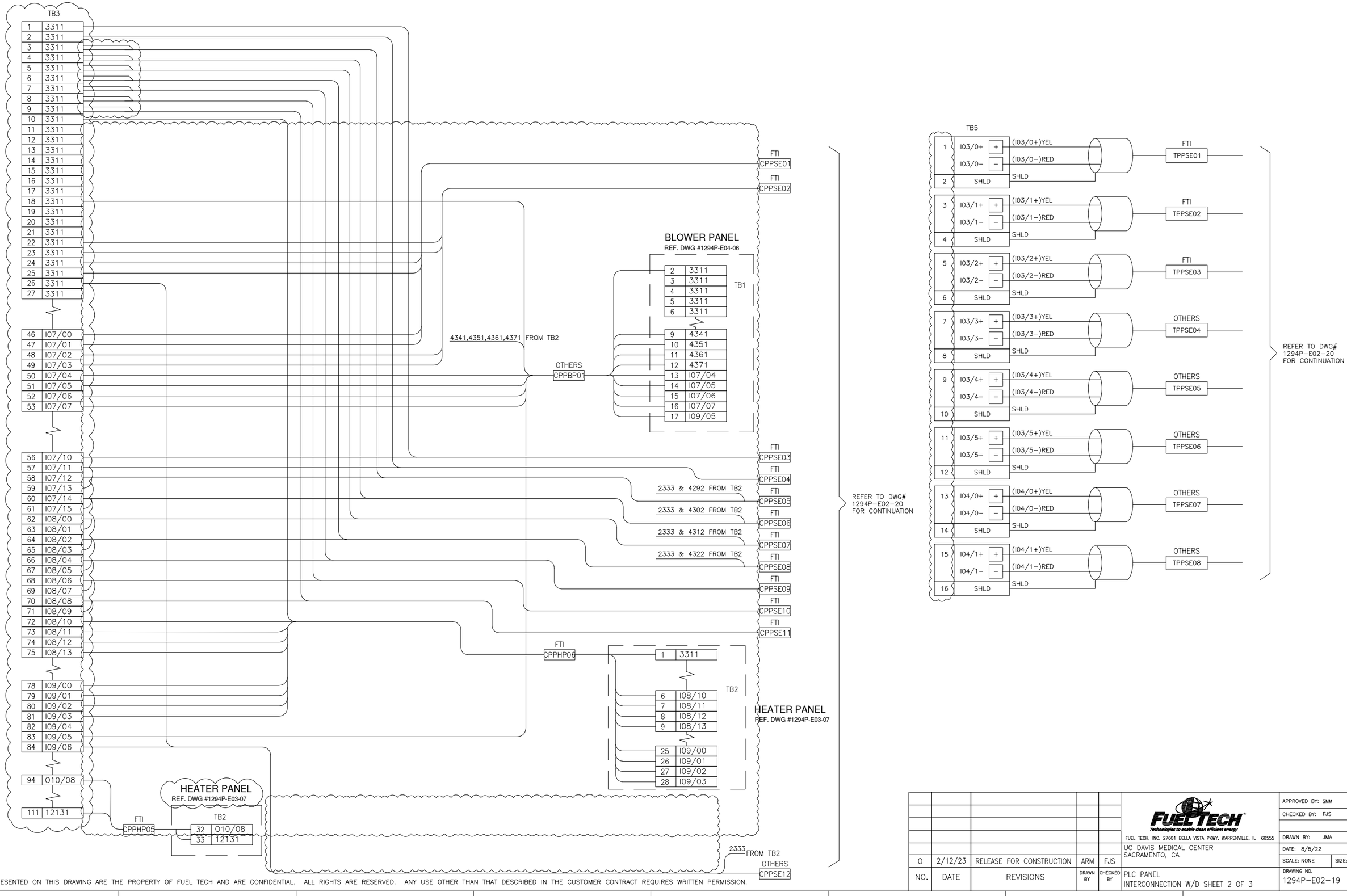
PLC PANEL
INTERCONNECTION W/D SHEET 1 OF 3

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE SIZE: D
DRAWING NO. 1294P-E02-18



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UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

PLC PANEL
INTERCONNECTION W/D SHEET 2 OF 3

APPROVED BY: SMM
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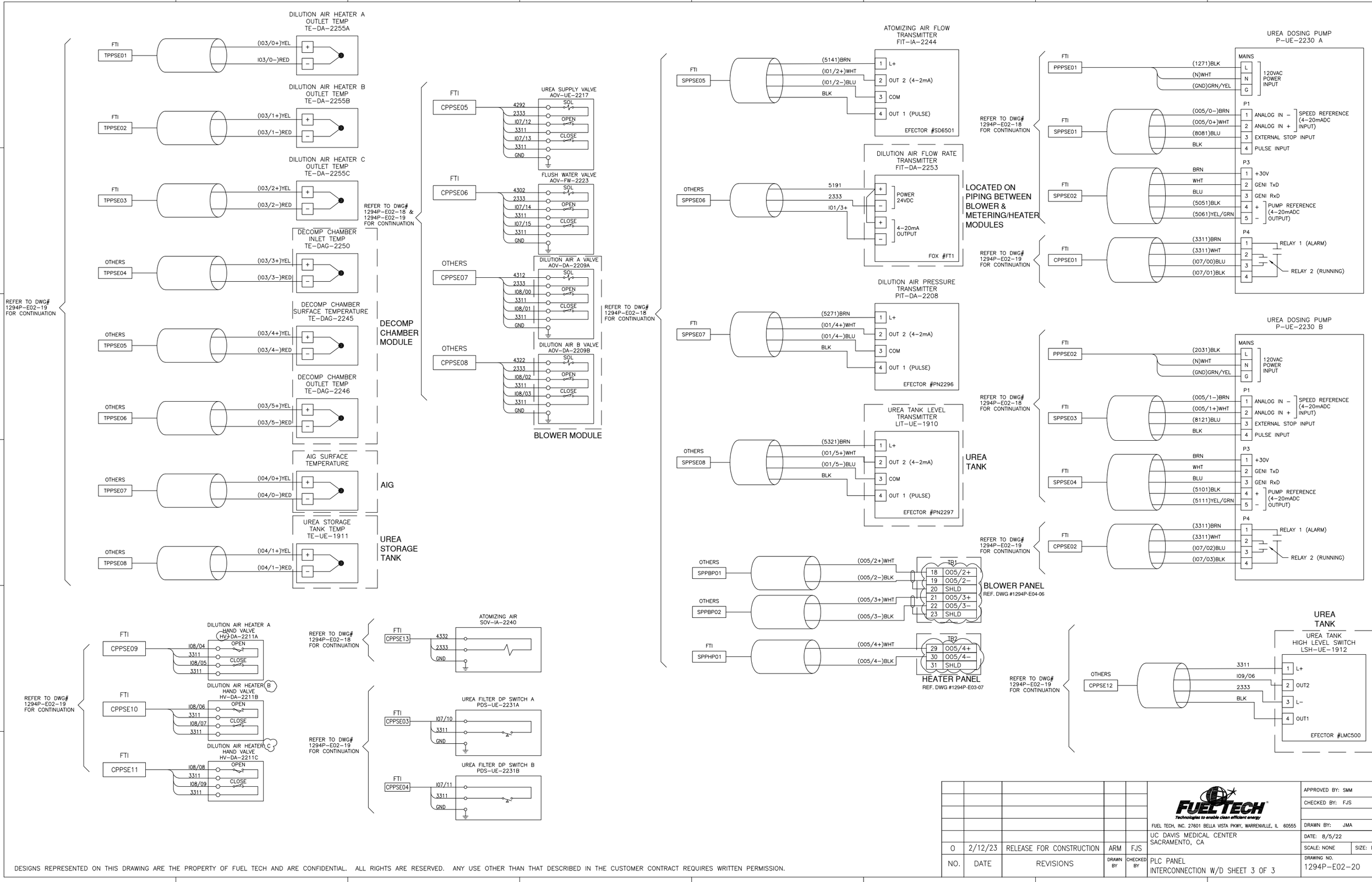
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE SIZE: D
DRAWING NO. 1294P-E02-19



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UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

PLC PANEL
INTERCONNECTION W/D SHEET 3 OF 3

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO. 1294P-E02-20

INTERCONNECT CABLE/WIRE LIST

CABLE NO.	NO. COND.	WIRE SIZE	FROM		TO		WIRE NUMBERS	CABLING BY
			LOCATION	DEVICE	LOCATION	DEVICE		
PPEPP01	2 + 1	CLIENT–DEFINED	CLIENT	120VAC,1PH,60HZ SOURCE	PLC PANEL	CB103, TB1, GND	L N GND	OTHERS
PPPHP01	2 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB1	HEATER PANEL	TB1	2261 N	FTI
DPPHP01	2 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB2	HEATER PANEL	TB2	2332 2333	FTI
PPPSE01	2 + 1	#14 AWG 600V 90C MIN + #14 AWG GND	PLC PANEL	TB1	P-UE-2230 A	UREA DOSING PUMP A	1271 N GND	FTI
PPPSE02	2 + 1	#14 AWG 600V 90C MIN + #14 AWG GND	PLC PANEL	TB1	P-UE-2230 B	UREA DOSING PUMP B	2031 N GND	FTI
SPPHP01	2 WIRE CABLE	#16 AWG SIGNAL SHIELDED	PLC PANEL	TB4	HEATER PANEL	TB2	005/4+ 005/4– SHLD	FTI
SPPBP01	2 WIRE CABLE	#16 AWG SIGNAL SHIELDED	PLC PANEL	TB4	BLOWER PANEL	TB1	005/2+ 005/2– SHLD	OTHERS
SPPBP02	2 WIRE CABLE	#16 AWG SIGNAL SHIELDED	PLC PANEL	TB4	BLOWER PANEL	TB1	005/3+ 005/3– SHLD	OTHERS
SPPSE01	4 WIRE CABLE	#16 AWG SIGNAL SHIELDED	PLC PANEL	TB4	P-UE-2230 A	UREA DOSING PUMP A	005/0– 005/0+ 8081 SHLD	FTI
SPPSE02	5 WIRE CABLE	#16 AWG SIGNAL SHIELDED	PLC PANEL	TB4	P-UE-2230 A	UREA DOSING PUMP A	5051 5061 SHLD	FTI
SPPSE03	4 WIRE CABLE	#16 AWG SIGNAL SHIELDED	PLC PANEL	TB4	P-UE-2230 B	UREA DOSING PUMP B	005/1– 005/1+ 8121 SHLD	FTI
SPPSE04	5 WIRE CABLE	#16 AWG SIGNAL SHIELDED	PLC PANEL	TB4	P-UE-2230 B	UREA DOSING PUMP B	5101 5111 SHLD	FTI
SPPSE05	4 WIRE CABLE	#16 AWG SIGNAL SHIELDED	PLC PANEL	TB4	FIT-IA-2244	ATOMIZING AIR FLOW TRANSMITTER	5141 I01/2+ I01/2– NC	FTI
SPPSE06	3 WIRE CABLE	#16 AWG SIGNAL SHIELDED	PLC PANEL	TB4	FIT-DA-2253	DILUTION AIR FLOW RATE TRANSMITTER	5191 I01/3+ 2333 SHLD	OTHERS
SPPSE07	4 WIRE CABLE	#16 AWG SIGNAL SHIELDED	PLC PANEL	TB4	PIT-DA-2208	DILUTION AIR PRESSURE TRANSMITTER	5271 I01/4+ I01/4– NC	FTI
SPPSE08	4 WIRE CABLE	#16 AWG SIGNAL SHIELDED	PLC PANEL	TB4	LIT-UE-1910	UREA TANK LEVEL TRANSMITTER	5321 I01/5+ I01/5– NC	OTHERS
CPPSE01	4 WIRE CABLE	#16 AWG 600V 90C MIN	PLC PANEL	TB3	P-UE-2230 A	UREA DOSING PUMP A	I07/00 3311 I07/01 3311	FTI
CPPSE02	4 WIRE CABLE	#16 AWG 600V 90C MIN	PLC PANEL	TB3	P-UE-2230 B	UREA DOSING PUMP B	I07/02 3311 I07/03 3311	FTI
CPPSE03	2 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB3	PDS-UE-2231A	UREA FILTER DP SWITCH A	I07/10 3311	FTI
CPPSE04	2 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB3	PDS-UE-2231B	UREA FILTER DP SWITCH B	I07/11 3311	FTI
CPPSE05	7 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB2 & TB3, GND	AOV-UE-2217	UREA SUPPLY VALVE	4292 2333 I07/12 3311 I07/13 GND	FTI
CPPSE06	7 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB2 & TB3, GND	AOV-FW-2223	FLUSH WATER VALVE	4302 2333 I07/14 3311 I07/15 GND	FTI
CPPSE07	7 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB2 & TB3, GND	AOV-DA-2209A	DILUTION AIR A VALVE	4312 2333 I08/00 3311 I08/01 GND	OTHERS
CPPSE08	7 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB2 & TB3, GND	AOV-DA-2209B	DILUTION AIR B VALVE	4322 2333 I08/02 3311 I08/03 GND	OTHERS
CPPSE09	4 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB3	HV-DA-2211A	DILUTION AIR HEATER A HAND VALVE	I08/04 3311 I08/05	FTI
CPPSE10	4 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB3	HV-DA-2211B	DILUTION AIR HEATER B HAND VALVE	I08/06 3311 I08/07	FTI
CPPSE11	4 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB3	HV-DA-2211C	DILUTION AIR HEATER C HAND VALVE	I08/08 3311 I08/09	FTI
CPPSE12	4 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB2 & TB3	LSH-UE-1912	UREA TANK HIGH LEVEL SWITCH	3311 I09/06 2333 NC	OTHERS
CPPSE13	3 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB2	SOV-IA-2240	ATOMIZING AIR VALVE	4332 2333 GND	FTI
CPPHP01	2 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB2	HEATER PANEL	TB1	4381 4391	FTI
CPPHP02	2 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB2	HEATER PANEL	TB1	4401 4411	FTI
CPPHP03	2 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB2	HEATER PANEL	TB1	4421 4431	FTI
CPPHP04	2 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB2	HEATER PANEL	TB1	4441 4451	FTI
CPPHP05	2 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB3	HEATER PANEL	TB2	010/08 12131	FTI
CPPHP06	9 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB3	HEATER PANEL	TB2	I08/10 3311 I08/11 I08/12 I08/13 I09/00 I09/01 I09/02 I09/03	FTI
CPPBP01	10 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB2 & TB3	BLOWER PANEL	TB1	I07/04 3311 I07/05 I07/06 I07/07 I09/05 4341 4351 4361 4371	OTHERS
TPPSE01	1 PR 20AWG SHLD CABLE	TYPE KX THERMOCOUPLE WIRE 20 AWG MIN	PLC PANEL	TB5	TE-DA-2255A	DILUTION AIR HEATER A OUTLET TEMP	I03/0+ I03/0– SHLD	FTI
TPPSE02	1 PR 20AWG SHLD CABLE	TYPE KX THERMOCOUPLE WIRE 20 AWG MIN	PLC PANEL	TB5	TE-DA-2255B	DILUTION AIR HEATER B OUTLET TEMP	I03/1+ I03/1– SHLD	FTI
TPPSE03	1 PR 20AWG SHLD CABLE	TYPE KX THERMOCOUPLE WIRE 20 AWG MIN	PLC PANEL	TB5	TE-DA-2255C	DILUTION AIR HEATER B OUTLET TEMP	I03/2+ I03/2– SHLD	FTI
TPPSE04	1 PR 20AWG SHLD CABLE	TYPE KX THERMOCOUPLE WIRE 20 AWG MIN	PLC PANEL	TB5	TE-DAG-2250	DECOMP CHAMBER INLET TEMP	I03/3+ I03/3– SHLD	OTHERS
TPPSE05	1 PR 20AWG SHLD CABLE	TYPE KX THERMOCOUPLE WIRE 20 AWG MIN	PLC PANEL	TB5	TE-DAG-2245	DECOMP CHAMBER SURFACE TEMP	I03/4+ I03/4– SHLD	OTHERS
TPPSE06	1 PR 20AWG SHLD CABLE	TYPE KX THERMOCOUPLE WIRE 20 AWG MIN	PLC PANEL	TB5	TE-DAG-2246	DECOMP CHAMBER OUTLET TEMP	I03/5+ I03/5– SHLD	OTHERS
TPPSE07	1 PR 20AWG SHLD CABLE	TYPE KX THERMOCOUPLE WIRE 20 AWG MIN	PLC PANEL	TB5		AIG SURFACE TEMP	I04/0+ I04/0– SHLD	OTHERS
TPPSE08	1 PR 20AWG SHLD CABLE	TYPE KX THERMOCOUPLE WIRE 20 AWG MIN	PLC PANEL	TB5	TE-UE-1911	UREA STORAGE TANK TEMP	I04/1+ I04/1– SHLD	OTHERS

NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

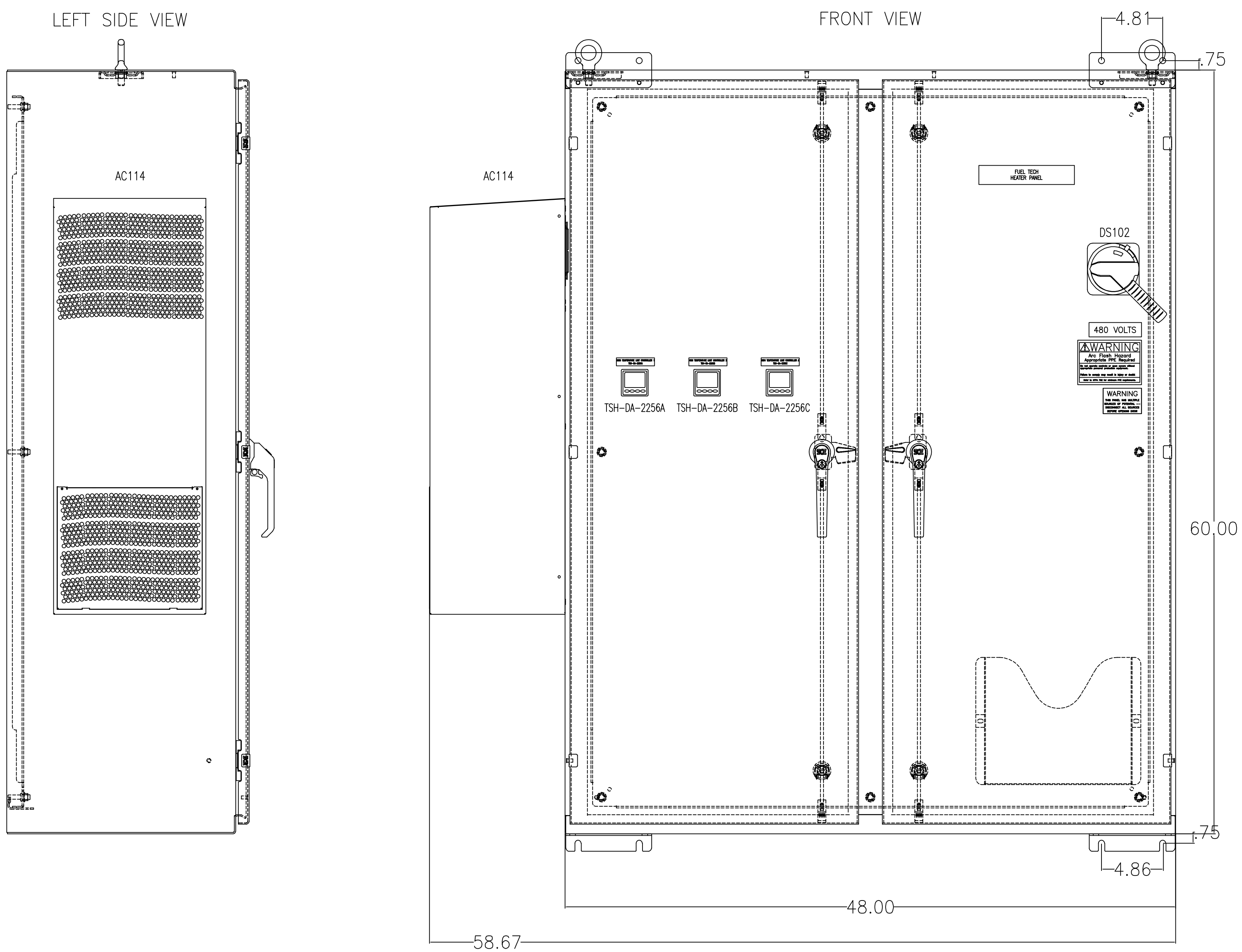
FUEL TECH
Technologies to enable clean efficient energy

FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

PLC PANEL
CABLE LISTING

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE SIZE: D
DRAWING NO. 1294P–E02–21



NAMEPLATE SCHEDULE

THT-19-413-1-PR

The Industrial Controls Company, Inc.
BETTER THINKING. INSIDE THE BOX.
N56 W24842 Corporate Circle Sussex, WI 53089
480 VOLTS 145.9 FLA (TOTAL)
60 CYCLES N/A FLA (LARGEST MOTOR)
3 PHASE 1294-E03 DRWG. NO.
SHORT CIRCUIT CURRENT 100 kA RMS
SYMMETRICAL, 480 V MAXIMUM
TYPE 4 ENCLOSURE

Fuse ID	Mfg.	Fuse# or Equivalent	Volts
FU102	LITTELFUSE	JTD200ID	600
FU105	LITTELFUSE	JTD150ID	600
FU114-115	LITTELFUSE	KLDR4	600
FU128A-142B	LITTELFUSE	JLS45	600

USE COPPER CONDUCTORS ONLY

PART ID	PART NUMBER	TORQUE (IN/LB)	TEMP (C)
DS102	194R-TL1	275	90
TB's	1492-J6	14.2	90
TB's	1492-J4	9.0	90
TB's	1492-JG4	9.0	90
TB's	1492-JTC3K	3.5-5.3	90
GND BAR	PK12GTA	20 (14-10GA)	90
GND BAR	PK12GTA	25 (8GA)	90
GND BAR	PK12GTA	35 (6-4GA)	90

USE COPPER CONDUCTORS ONLY

PART ID	PART NUMBER	TORQUE (IN/LB)	TEMP (C)
GND LUG	L70	35 (14-10GA)	90
GND LUG	L70	40 (8GA)	90
GND LUG	L70	45 (4-6GA)	90

THT-19-435-1-HFC

WARNING
RISK OF FIRE OR ELECTRICAL SHOCK
THE OPENING OF THE BRANCH-CIRCUIT PROTECTIVE DEVICE MAY BE AN INDICATION THAT A FAULT CURRENT HAS BEEN INTERRUPTED. ALL CURRENT- CARRYING PARTS AND OTHER COMPONENTS PROTECTED BY THIS DEVICE SHOULD BE EXAMINED AND REPLACED IF DAMAGED. IF BURNOUT OF A CURRENT ELEMENT OF AN OVERLOAD RELAY OCCURS, THE COMPLETE OVERLOAD RELAY MUST BE REPLACED.

99454

⚠WARNING
Arc Flash Hazard
Appropriate PPE Required
Do not operate controls or open covers without appropriate personal protection equipment.
Failure to comply may result in injury or death!
Refer to NFPA 70E for minimum PPE requirements.

THT-19-439-M

WARNING
THIS PANEL HAS MULTIPLE SOURCES OF POTENTIAL -- DISCONNECT ALL SOURCES BEFORE OPENING DOOR

152371
480 VOLTS

LAM-7.50-1.50-902

FUEL TECH
HEATER PANEL

LAM-2.50-1.50-902

HIGH TEMPERATURE LIMIT CONTROLLER 1
TSH-DA-2256A

HIGH TEMPERATURE LIMIT CONTROLLER 2
TSH-DA-2256B

HIGH TEMPERATURE LIMIT CONTROLLER 3
TSH-DA-2256C

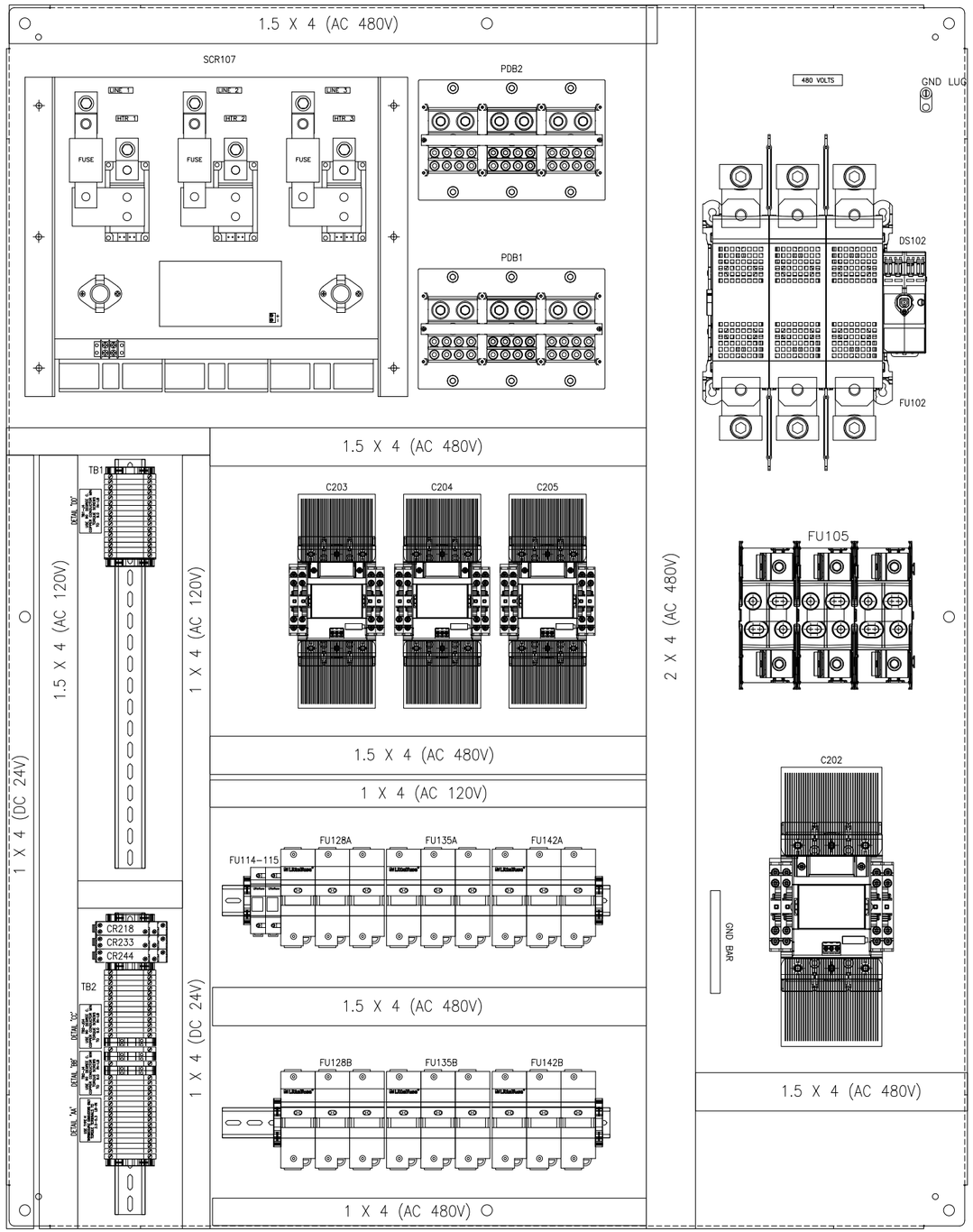
NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCITON	ARM	FJS

FUEL TECH — Technologies to enable clean efficient energy
FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

HEATER PANEL
CABINET LAYOUT

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO. 1294P-E03-01



	120VAC TB1
1	2261
2	2261
3	2261
4	2261
5	2261
6	2020
7	2030
8	2040
9	2050
10	N
11	N
12	N
13	N
14	N
15	SPARE
16	SPARE
17	SPARE

17 @ 1492-J4

	24VDC TB2	
1	3311	
2	3311	
3	3311	
4	3311	
5	3311	
6	I08/10	
7	I08/11	
8	I08/12	
9	I08/13	
10	2332	
11	2332	
12	2332	
13	2333	
14	2333	
15	2333	
16	2160	*
	2170	*
17	SHLD	**
18	2290	*
	2300	*
19	SHLD	**
20	2400	*
	2410	*
21	SHLD	**
22	3311	
23	3311	
24	3311	
25	I09/00	
26	I09/01	
27	I09/02	
28	I09/03	
29	O05/4+	
30	O05/4-	
31	SHLD	**
32	O10/08	
33	12131	
34	SPARE	
35	SPARE	
36	SPARE	
37	SPARE	

30 @ 1492-J4
*3 @ 1492-JTC3K
**4 @ 1492-JG4

44315

480 VOLTS

THT–17–413–3–PR

DETAIL 'AA'

USE TYPE K THERMOCOUPLE CONDUCTORS ONLY TORQUE TERMINALS TO 3.5–5.3 LB–IN

DETAIL 'BB'

TB2–J4 USE 90 DEGREE C. COPPER CONDUCTOR MIN TORQUE SCREWS TO 9.0 IN–LB

DETAIL 'CC'

TB2–JG4 USE 90 DEGREE C. COPPER CONDUCTOR MIN TORQUE SCREWS TO 9.0 IN–LB

DETAIL 'DD'

TB1–J4 USE 90 DEGREE C. COPPER CONDUCTOR MIN TORQUE SCREWS TO 9.0 IN–LB

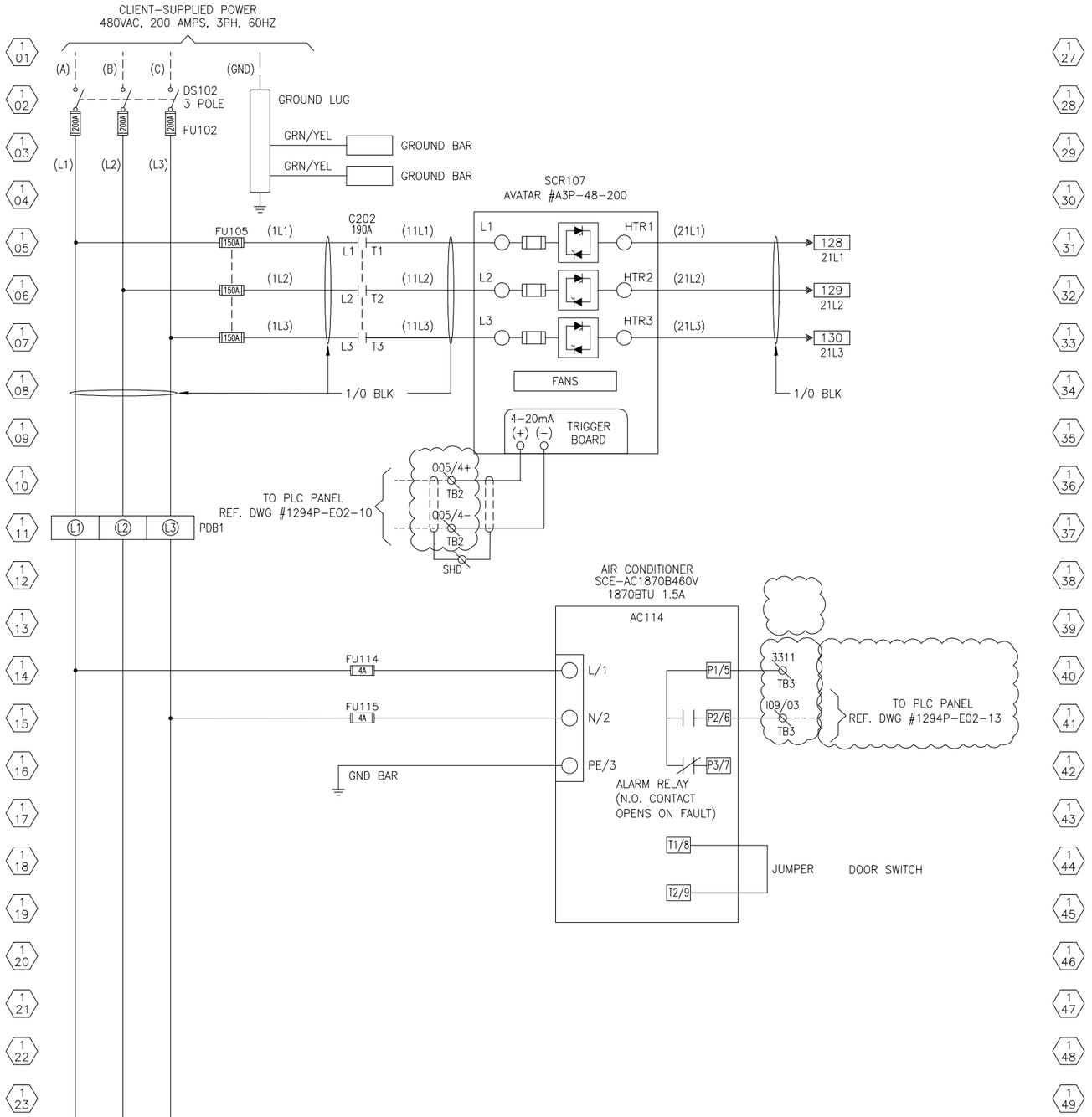
NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

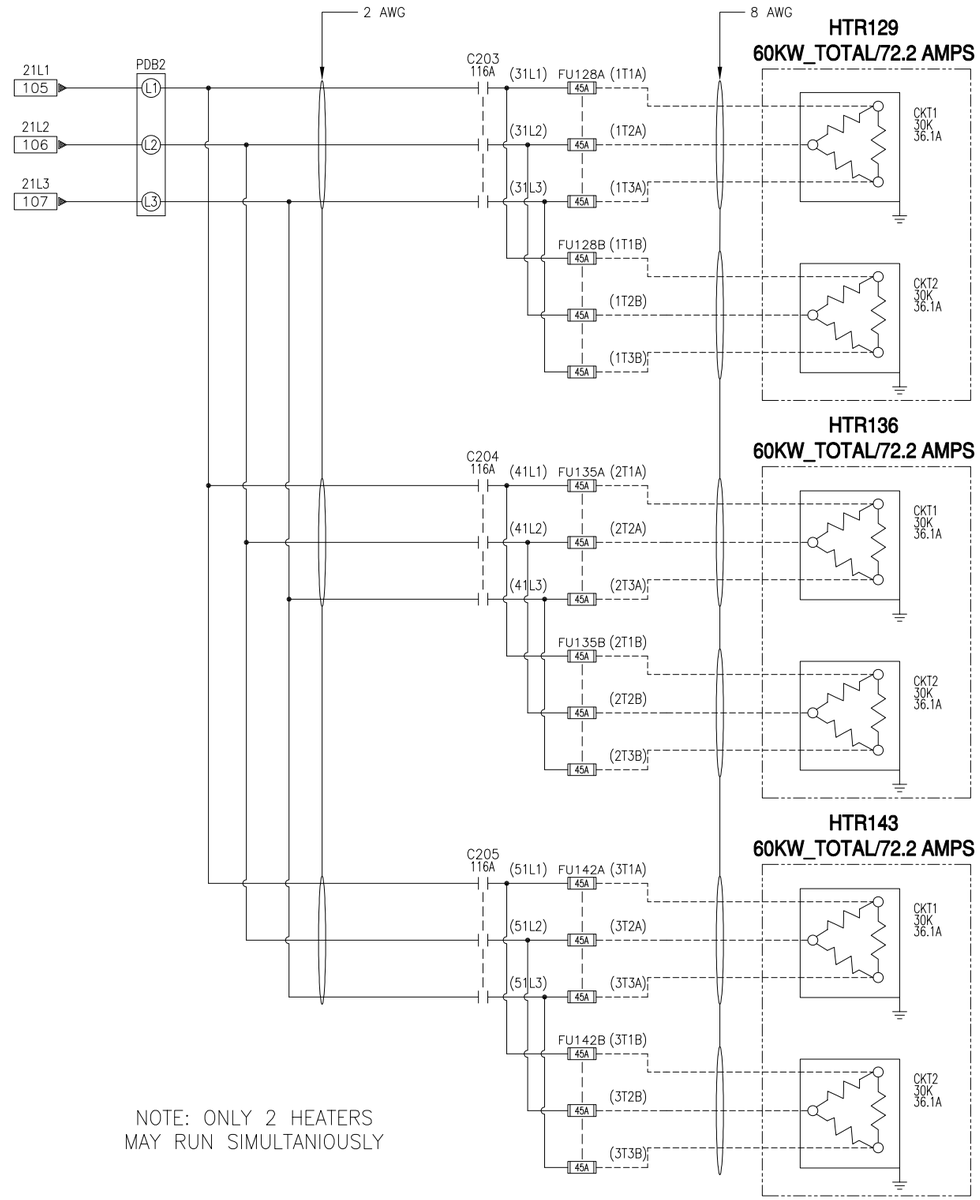
FUEL TECH
Technologies to enable clean efficient energy
FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

HEATER PANEL
PANEL LAYOUT

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO. 1294P–E03–02





NOTE: ONLY 2 HEATERS
MAY RUN SIMULTANIOUSLY

TERMINAL BLOCK NOTE

○ POWER PANEL TERMINAL BLOCK

⊘ PLC PANEL TERMINAL BLOCK

ELECTRICAL CONDUCTOR DESIGNATIONS

——— INTERNAL TO CONTROL PANEL

– — – — – EXTERNAL TO CONTROL PANEL

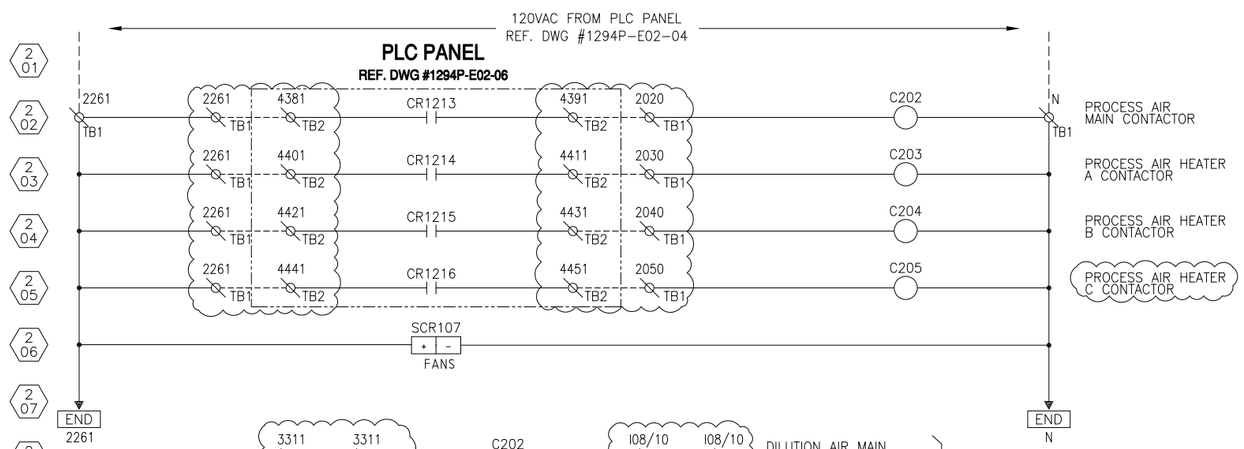
NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

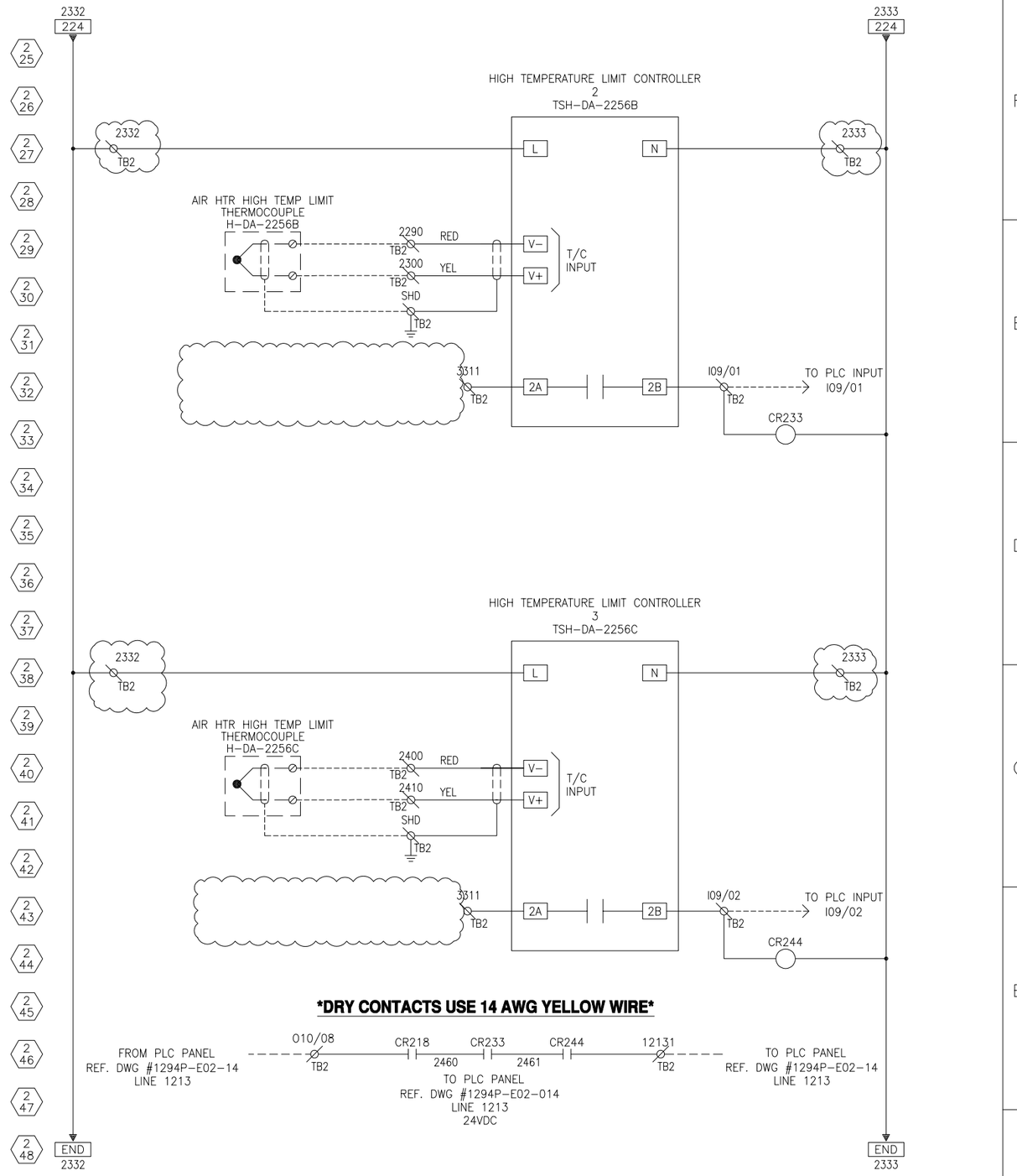
FUEL TECH
Technologies to enable clean efficient energy
FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

HEATER PANEL
SCHEMATIC SHEET 1 OF 2

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE:
SIZE: D
DRAWING NO.
1294P-E03-03





ELECTRICAL CONDUCTOR DESIGNATIONS

———— INTERNAL TO CONTROL PANEL

– — — — — EXTERNAL TO CONTROL PANEL

NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

FUEL TECH
Technologies to enable clean efficient energy
FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

HEATER PANEL
SCHEMATIC SHEET 2 OF 2

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO.
1294P-E03-04

INTENTIONALLY BLANK
(FOR FUTURE USE IF NEEDED)

NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

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FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

HEATER PANEL
FUTURE

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO.
1294P-E03-05

DEVICE ID	PART NUMBER	DESCRIPTION	MANUFACTURER	QTY
AC114	SCE-AC1870B460V	AC, 1870 BTUH, TYPE 3R/4/12460/1/60 1.5A RUN, 5.0A START	SAGINAW	1
C202	100-E190KD11	CONTACTOR, 190A, 100-250V AC50/60HZ, 100-250V DC, 1NO 1NC	AB	1
C203-205	100-E116KD11	CONTACTOR, 116A 100-250V 50/60HZ 3-P 1NO-1NC AUX W/LUGS	AB	3
C203-205	100-ETS146L	TERMINAL SHROUD FOR100-E116 THRU 100-E146	AB	6
CR218-244	700-HKM6Z24-3-4	GP SLIM LINE RELAY 24VDC COILSPDT W/IND & MAN OVERRIDE	AB	3
CR218-244	700-HN221	RELAY SOCKETFOR HKM SPDT RELAY	AB	3
DS102	194R-HM4E	OPERATING HANDLE, ROTARYRED/YEL TYPE 1/3R/12/4/4X	AB	1
DS102	194R-J200-1753	DISCONNECT, FUSED, J TYPE200A	AB	1
DS102	194R-LNC31	TERMINAL SHROUDS, USED ON200A UL FUSED SWITCHES	AB	2
DS102	194R-R8	DISCONNECT OPERATING SHAFT22.8" 100A-400A DISC SWITCHES	AB	1
DS102	194R-TL1	TERMINAL LUGS, 300MCM, KITUL200A FUSED SWITCHES, 3-PACK	AB	2
FU102	JTD200ID	FUSE, CLASS J, 200A TIME-DELAY600V AC/500V DC, INDICATING	LITTELFUSE	3
FU105	CVRI-J-60200-M	FUSE COVER, 1-POLE, WITH BFIUSED ON JM60200-XMW16	BUSSMANN	3
FU105	JM60200-3CR	FUSE BLOCK, 3-POLE, 200 AMPSCLASS J	EATON	1
FU105	JTD150ID	FUSE, CLASS J, 150A TIME-DELAY600V AC/300V DC, INDICATING	LITTELFUSE	3
FU114-115	KLDR4	FUSE, CLASS CC, 4 AMPS, 600V,TIME-DELAY, NON-INDICATING	LITTELFUSE	2
FU114-115	LPSC002ID	FUSE HOLDER, 2-POLE, 30ACLASS CC, 600V AC/DC WBFI	LITTELFUSE	1
FU128A-142B	JLS45	FUSE, CLASS J, 45A, 600V AC, FAST-ACTING, NON-INDICATING	LITTELFUSE	18
FU128A-142B	LFPSJ60-3ID	FUSE HOLDER, 3 POLE, CLASS J60A, FINGER SAFE; 200 KA	LITTELFUSE	6
GND BAR	PK12GTA	LOAD CENTER EQUIPMENT GROUNDBAR ASSY	SCHNEIDER ELECTRIC	2
GND LUG	L70	GROUND LUG, 14 SOL-4 STRANDED1 CONDUCTOR	T&B	1
PDB1,PDB2	1492-PD3287	PDB, 3-POLE 760ALN:(2)500-#6 LD:(8) #2-#14	AB	2
SCR107	A3P-48-200	SCR POWER CONTROLLER, 480V200A, 3-PHASE, 4-20 MA INPUT	AVATAR INSTRUMENTS	1
TB1,TB2	1492-CJJ8-10	JUMPER, TERMINAL BLOCK 10-POLEINSULATED, 8MM SCREW CENTER	AB	4
TB1,TB2	1492-J4	TERMINAL BLOCK, GRAY, SCREW35A, 600V AC/DC, 22 - 10 AWG	AB	47
TB1,TB2	1492-EBJ3	END BARRIER, TERMINAL BLOCKGRAY, USED ON 1492-J	AB	2
TB1,TB2	1492-M6X12-ENG	MARKER CARD, TERMINAL BLOCKENGRAVED, 120/CARD, 1492-J	AB	A/R
TB2	1492-JG4	TERMINAL BLOCK, GRN/YEL, SCREW22 - 10 AWG, GROUND	AB	4
TB2	1492-JTC3K	TERMINAL BLOCK, GRAY, SCREW30 - 12 AWG, K THERMOCOUPLE	AB	3
TB2	1492-M8X5-ENG	MARKER CARD, TERMINAL BLOCKENGRAVED, 160/CARD, 1492-J/-L	AB	A/R
TSH-DA-2256A THRU C	3216I/FM/VL/LR + MORE	HIGH LIMIT TEMP CONTROLLER1/16 DIN, FM APPROVED	EUROTHERM	3
	1492-EAJ35	END ANCHOR, TERMINAL BLOCKNORMAL DUTY	AB	9
	152371	LABEL, 480V, VOLTAGE LABEL1.125 X 4.125 , BLACK ON ORG	ICC	1
	44315	LABEL, 480V, VOLTAGE LABEL0.5 X 2.25 , BLACK ON ORANGE	ICC	1
	8760	CABLE, 1 PAIR, 18 AWG, PAIREDSHIELDED, 300 VOLTS, PVC GRAY	BELDEN	A/R
	98.300.1800.0	DIN RAIL SLOTTED, WIELAND35MM X 7.5MM X 2M	WIELAND	A/R
	99454	LABEL, WARNING LABELARC FLASH, 3.5 H X 5 W	BRADY	1
	C1.5WH6	COVER, PANEL CHANNEL, WHITE1.5 INCH DUCT COVER	PANDUIT	A/R
	C1WH6	COVER, PANEL CHANNEL, WHITE1 INCH DUCT COVER	PANDUIT	A/R
	G1.5X4WH6	PANEL CHANNEL, 1.5X4 WHITE	PANDUIT	A/R
	G1X4WH6	PANEL CHANNEL, 1X4 WHITE	PANDUIT	A/R
	SCE-60EL4818LPPLM102	MOD ENCLOSURE PER DWGSCE-60EL4818LPPLM102	SAGINAW	1
	SCE-60P48	SUB PANEL, 56 X 44 X 0.88STEEL, PAINTED WHITE	SAGINAW	1
	THT-19-435-1-PR	LABEL, SPEC/FUSE/TORQUEENGRAVED, SILVER, 3 X 2	ICC	5
	THT-19-439-HFC	LABEL, WARNING - RISK OF FIREOR ELECTRICAL SHOCK	ICC	1
	THT-19-439-M	LABEL, WARNING - THIS PANELHAS MULTIPLE SOURCES	ICC	1
	THT-5-435-10-PR	LABEL, ID, ENGRAVEDSILVER, 1 X 0.5	ICC	A/R
	THT-80-427-5-PR	LABEL, SELF-LAM SMALLENGRAVED, 0.5 X 0.75	ICC	A/R
	THT-9-427-10-PR	LABEL, SELF LAM (LARGE)ENGRAVED, 1 X 1.4375	ICC	A/R

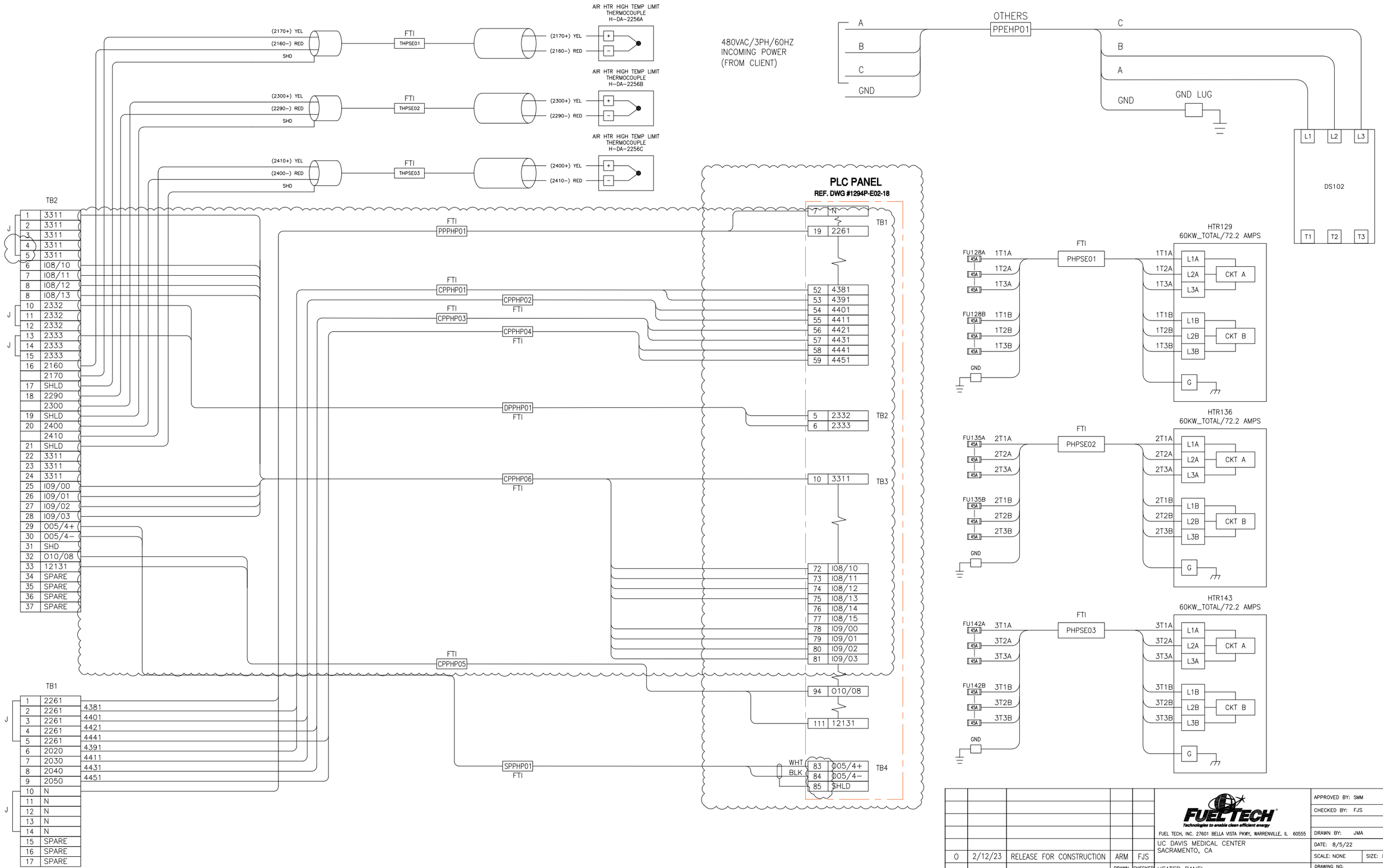
NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

FUEL TECH
Technologies to enable clean efficient energy
FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

HEATER PANEL
BILL OF MATERIAL

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO. 1294P-E03-06



NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

FUEL TECH
Technologies to enable clean efficient energy
FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

HEATER PANEL
INTERCONNECTION W/D

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO.
1294P-E03-07

INTERCONNECT CABLE/WIRE LIST

CABLE NO.	NO. COND.	WIRE SIZE	FROM		TO		WIRE NUMBERS	CABLING BY
			LOCATION	DEVICE	LOCATION	DEVICE		
PPEHP01	CLIENT–DEFINED	CLIENT–DEFINED	CLIENT	480VAC,3PH,60HZ SOURCE	HEATER PANEL	DS102	A B C GND	OTHERS
PHPSE01	6+1	#8 AWG 600V 90C MIN + #10 AWG GND	HEATER PANEL	FU128A, FU128B	HTR129	H–PA–2255A	1T1A 1T2A 1T3A 1T1B 1T2B 1T3B GND	FTI
PHPSE02	6+1	#8 AWG 600V 90C MIN + #10 AWG GND	HEATER PANEL	FU135A, FU135B	HTR136	H–PA–2255B	2T1A 2T2A 2T3A 2T1B 2T2B 2T3B GND	FTI
PHPSE03	6+1	#8 AWG 600V 90C MIN + #10 AWG GND	HEATER PANEL	FU142A, FU142B	HTR142	H–PA–2255C	3T1A 3T2A 3T3A 3T1B 3T2B 3T3B GND	FTI
PPPHP01	2 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB1	HEATER PANEL	TB1	2261 N	FTI
DPPHP01	2 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB2	HEATER PANEL	TB2	2332 2333	FTI
CPPHP01	2 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB2	HEATER PANEL	TB1	4381 4391	FTI
CPPHP02	2 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB2	HEATER PANEL	TB1	4401 4411	FTI
CPPHP03	2 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB2	HEATER PANEL	TB1	4421 4431	FTI
CPPHP04	2 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB2	HEATER PANEL	TB1	4441 4451	FTI
CPPHP05	2 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB3	HEATER PANEL	TB2	12131 O10/08	FTI
CPPHP06	9 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB3	HEATER PANEL	TB2	3311 I08/10 I08/11 I08/12 I08/13 I09/00 I09/01 I09/02 I09/03	FTI
THPSE01	1 PR 20 AWG SHLD CABLE	TYPE KX THERMOCOUPLE WIRE 20 AWG MIN	HEATER PANEL	TB2	H–DA–2256A	AIR HTR HIGH TEMP LIMIT THERMOCOUPLE	2170+ 2160– SHLD	FTI
THPSE02	1 PR 20 AWG SHLD CABLE	TYPE KX THERMOCOUPLE WIRE 20 AWG MIN	HEATER PANEL	TB2	H–DA–2256B	AIR HTR HIGH TEMP LIMIT THERMOCOUPLE	2300+ 2290– SHLD	FTI
THPSE03	1 PR 20 AWG SHLD CABLE	TYPE KX THERMOCOUPLE WIRE 20 AWG MIN	HEATER PANEL	TB2	H–DA–2256C	AIR HTR HIGH TEMP LIMIT THERMOCOUPLE	2410+ 2400– SHLD	FTI
SPPHP01	2 WIRE CABLE	#16 AWG SIGNAL SHIELDED	PLC PANEL	TB4	HEATER PANEL	TB2	005/4+ 005/4– SHLD	FTI

NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
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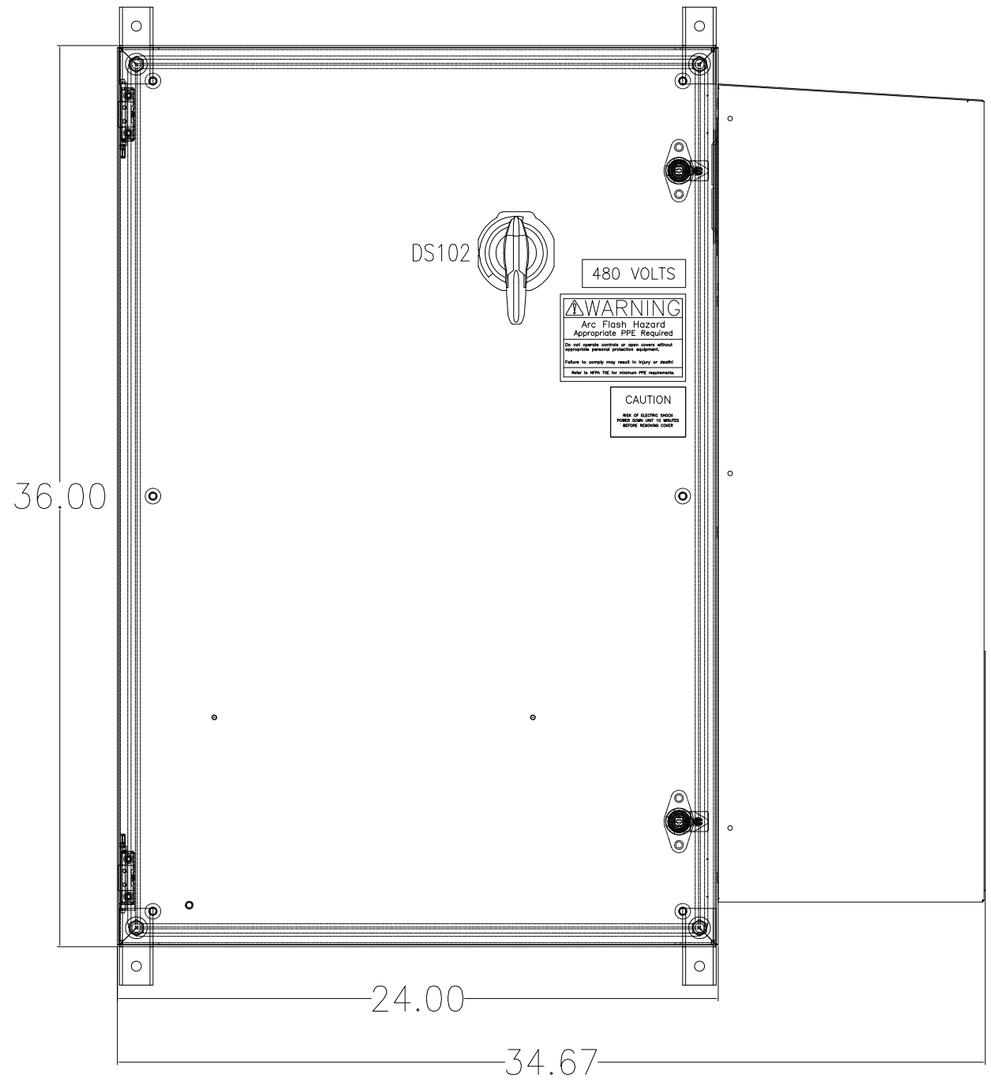
UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

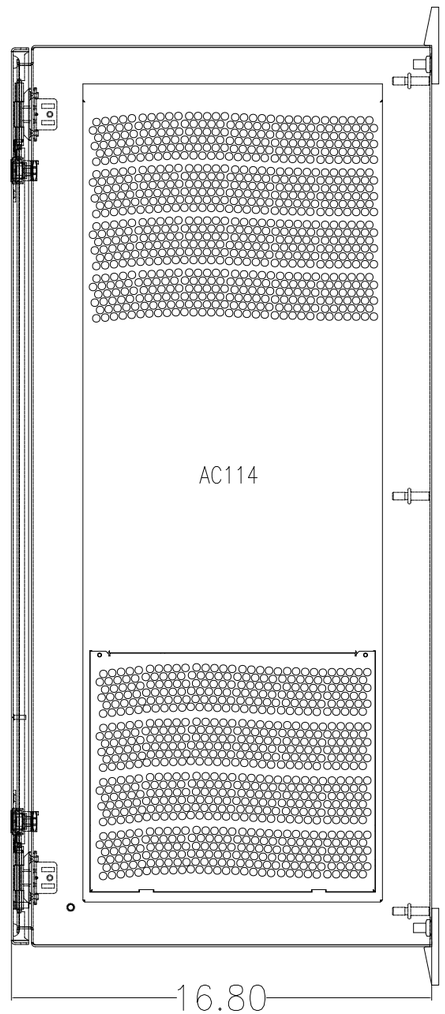
HEATER PANEL
CABLE LISTING

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO. 1294P–E03–08

FRONT VIEW



RIGHT SIDE VIEW



THT-19-413-1-PR

The Industrial Controls Company, Inc.
BETTER THINKING. INSIDE THE BOX.
N56 W24842 Corporate Circle Sussex, WI 53089
480 VOLTS 38.3 FLA (TOTAL)
60 CYCLES N/A FLA (LARGEST MOTOR)
3 PHASE 1294-E04 DRWG. NO.
SHORT CIRCUIT CURRENT 50 kA RMS
SYMMETRICAL, 480 V MAXIMUM
TYPE 4 ENCLOSURE

Fuse ID	Mfg.	Fuse# or Equivalent	Volts
FU102	LITTELFUSE	JTD60ID	600
FU114-115	LITTELFUSE	KLDR4	600

USE COPPER CONDUCTORS ONLY

PART ID	PART NUMBER	TORQUE (IN/LB)	TEMP (C)
DS102	194R-J60-1753	35	90
TB's	1492-J4	9.0	90
TB's	1492-JG4	9.0	90
TB's	1492-J6	14.2	90
GND BAR	PK12GTA	20 (14-10GA)	90
GND BAR	PK12GTA	25 (8GA)	90
GND BAR	PK12GTA	35 (6-4GA)	90

USE COPPER CONDUCTORS ONLY

PART ID	PART NUMBER	TORQUE (IN/LB)	TEMP (C)
GND LUG	L70	35 (14-10GA)	90
GND LUG	L70	40 (8GA)	90
GND LUG	L70	45 (4-6GA)	90

THT-19-435-1-HFC

WARNING
RISK OF FIRE OR ELECTRICAL SHOCK

THE OPENING OF THE BRANCH-CIRCUIT PROTECTIVE DEVICE MAY BE AN INDICATION THAT A FAULT CURRENT HAS BEEN INTERRUPTED. ALL CURRENT- CARRYING PARTS AND OTHER COMPONENTS PROTECTED BY THIS DEVICE SHOULD BE EXAMINED AND REPLACED IF DAMAGED. IF BURNOUT OF A CURRENT ELEMENT OF AN OVERLOAD RELAY OCCURS, THE COMPLETE OVERLOAD RELAY MUST BE REPLACED.

99454

WARNING
Arc Flash Hazard
Appropriate PPE Required
Do not operate controls or open covers without appropriate personal protection equipment.
Failure to comply may result in injury or death!
Refer to NFPA 70E for minimum PPE requirements.

THT-19-439-DC

CAUTION

RISK OF ELECTRIC SHOCK
POWER DOWN UNIT 10 MINUTES
BEFORE REMOVING COVER

THT-19-439-M

WARNING

THIS PANEL HAS MULTIPLE SOURCES OF POTENTIAL -- DISCONNECT ALL SOURCES BEFORE OPENING DOOR

152371

480 VOLTS

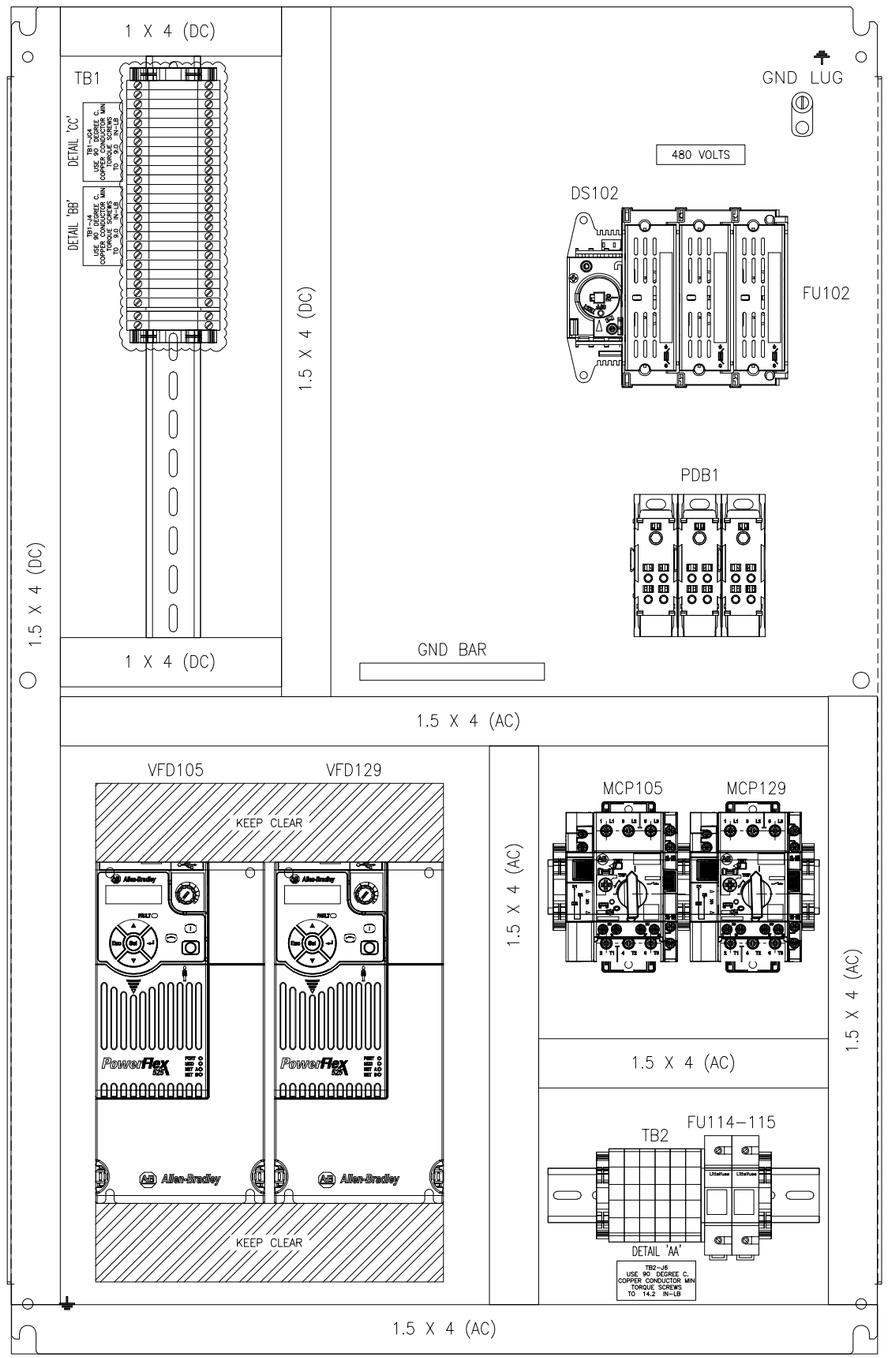
NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

FUEL TECH
Technologies to enable clean efficient energy
FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

BLOWER PANEL
CABINET LAYOUT

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO. 1294P-E04-01



	24VDC TB1	
1	2333	
2	3311	
3	3311	
4	3311	
5	3311	
6	3311	
7	3311	
8	3311	
9	4341	
10	4351	
11	4361	
12	4371	
13	I07/04	
14	I07/05	
15	I07/06	
16	I07/07	
17	I09/05	
18	O05/2+	
19	O05/2-	
20	SHLD	**
21	O05/3+	
22	O05/3-	
23	SHLD	**
24	SHLD	**
25	SPARE	
26	SPARE	
27	SPARE	
28	SPARE	

25 @ 1492-J4

3 @ 1492-JG4

	HIGH VOLTAGE TB2	
1	1T1	*
2	1T2	*
3	1T3	*
4	2T1	*
5	2T2	*
6	2T3	*

*6 @ 1492-J6

44315

480 VOLTS

THT-17-413-3-PR

DETAIL 'AA'

TB2-J6
USE 90 DEGREE C.
COPPER CONDUCTOR MIN
TORQUE SCREWS
TO 14.2 IN-LB

DETAIL 'BB'

TB1-J4
USE 90 DEGREE C.
COPPER CONDUCTOR MIN
TORQUE SCREWS
TO 9.0 IN-LB

DETAIL 'CC'

TB1-JG4
USE 90 DEGREE C.
COPPER CONDUCTOR MIN
TORQUE SCREWS
TO 9.0 IN-LB

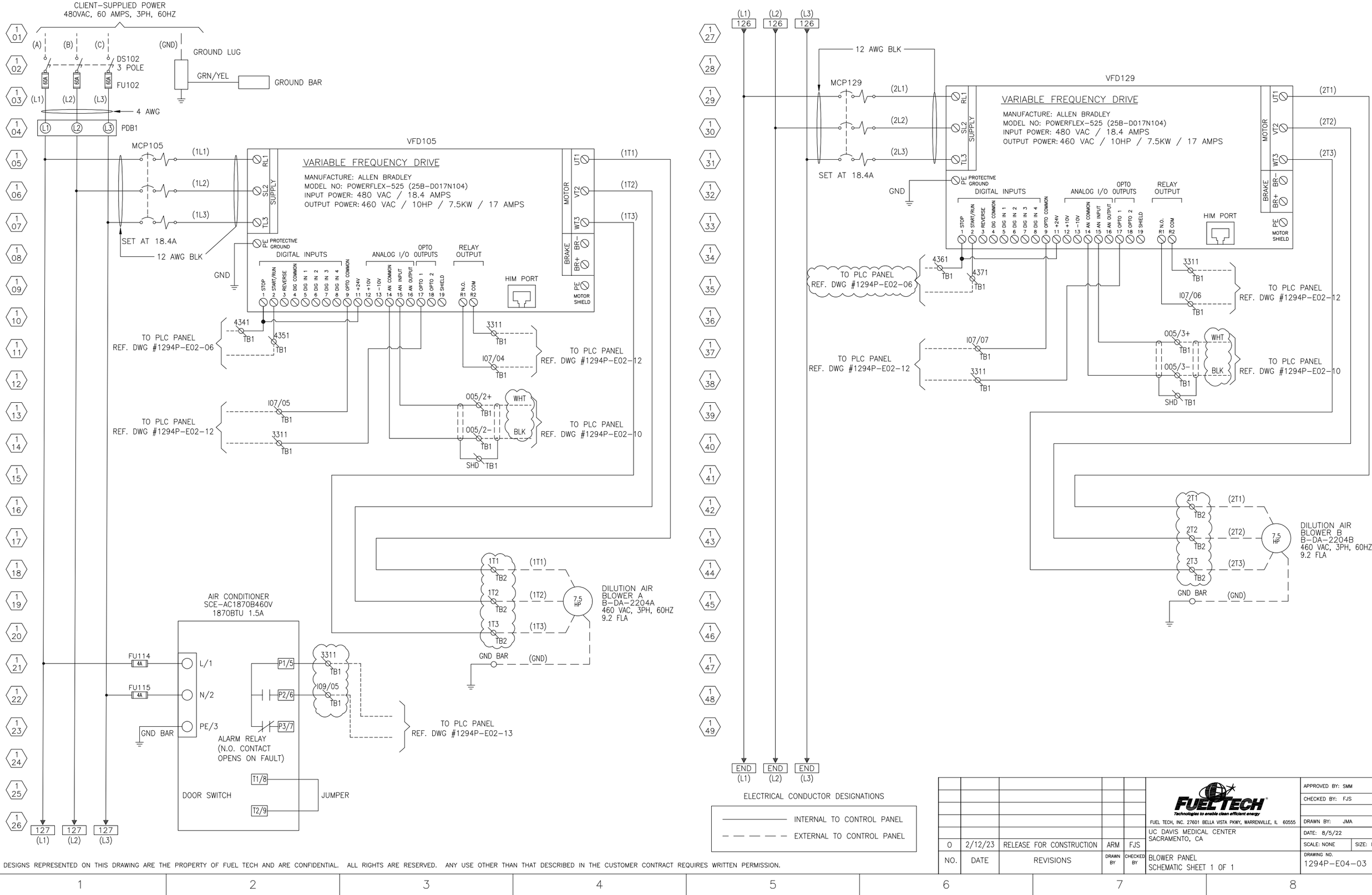
NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

FUEL TECH
Technologies to enable clean efficient energy
FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

BLOWER PANEL
PANEL LAYOUT

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO. 1294P-E04-02



NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

FUEL TECH
Technologies to enable clean efficient energy
FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

BLOWER PANEL
SCHEMATIC SHEET 1 OF 1

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO.
1294P-E04-03

INTENTIONALLY BLANK
(FOR FUTURE USE IF NEEDED)

NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

FUEL TECH
Technologies to enable clean efficient energy
FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

BLOWER PANEL
FUTURE

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO.
1294P-E04-04

DEVICE ID	PART NUMBER	DESCRIPTION	MANUFACTURER	QTY
AC114	SCE-AC1870B460V	AC, 1870 BTUH, TYPE 3R/4/12460/1/60 1.5A RUN, 5.0A START	SAGINAW	1
DS102	194R-J60-1753	DISCONNECT SWITCH, FUSIBLE, 3-POLE, 60A, THRU-DOOR ROTARY	AB	1
DS102	194R-PY	OPERATING HANDLE, DISCONNECTSWITCH, THRU-DOOR ROTARY	AB	1
DS102	194R-S2	OPERATING SHAFT, DISCONNECT SWITCH, 21 LONG, USED ON 194R-R	AB	1
FU102	JTD60ID	FUSE, CLASS J, 60A TIME-DELAY600V AC/300V DC, INDICATING	LITTELFUSE	3
FU114-115	KLDR4	FUSE, CLASS CC, 4 AMPS, 600V,TIME-DELAY, NON-INDICATING	LITTELFUSE	2
FU114-115	LPSC002ID	FUSE HOLDER, 2-POLE, 30ACLASS CC, 600V AC/DC WBFI	LITTELFUSE	1
GND BAR	PK12GTA	LOAD CENTER EQUIPMENT GROUNDBAR ASSY	SCHNEIDER ELECTRIC	1
GND LUG	L70	GROUND LUG, 14 SOL-4 STRANDED1 CONDUCTOR	T&B	1
MCP105,MCP129	140MT-D9E-C25	MCP, 18-25A, FRAME D	AB	2
PDB1	EPBCP45	PWR DIST BLOCK, 1-POLE, 200 AMPS, 1 LINE SIDE OPENING PER PO	MARATHON SP	3
TB1	1492-CJJ8-10	JUMPER, TERMINAL BLOCK 10-POLEINSULATED, 8MM SCREW CENTER	AB	1
TB1	1492-J4	TERMINAL BLOCK, GRAY, SCREW35A, 600V AC/DC, 22 - 10 AWG	AB	25
TB1	1492-JG4	TERMINAL BLOCK, GRN/YEL, SCREW22 - 10 AWG, GROUND	AB	3
TB1,TB2	1492-EAJ35	END ANCHOR, TERMINAL BLOCKNORMAL DUTY	AB	7
TB1,TB2	1492-EBJ3	END BARRIER, TERMINAL BLOCKGRAY, USED ON 1492-J	AB	3
TB1,TB2	1492-M6X12-ENG	MARKER CARD, TERMINAL BLOCKENGRAVED, 120/CARD, 1492-J	AB	1
TB2	1492-J6	TERMINAL BLOCK, GRAY, SCREW50A, 600V AC/DC, 22 - 8 AWG	AB	6
VFD105,VFD129	25B-D017N104	VFD, POWERFLEX 525, 480 VAC3-PHASE, 17 AMPS, FRAME C	AB	2
	8760	CABLE, 1 PAIR, 18 AWG, PAIREDSHIELDED, 300 VOLTS, PVC GRAY	BELDEN	A/R
	152371	LABEL, 480V, VOLTAGE LABEL1.125 X 4.125 , BLACK ON ORG	ICC	1
	44315	LABEL, 480V, VOLTAGE LABEL0.5 X 2.25 , BLACK ON ORANGE	ICC	1
	99454	LABEL, WARNING LABELARC FLASH, 3.5 H X 5 W	BRADY	1
	1492-M8X5-ENG	MARKER CARD, TERMINAL BLOCKENGRAVED, 160/CARD, 1492-J/-L	AB	A/R
	98.300.1800.0	DIN RAIL SLOTTED, WIELAND35MM X 7.5MM X 2M	WIELAND	A/R
	C1.5WH6	COVER, PANEL CHANNEL, WHITE1.5 INCH DUCT COVER	PANDUIT	A/R
	C1WH6	COVER, PANEL CHANNEL, WHITE1 INCH DUCT COVER	PANDUIT	A/R
	CP3624	SUB PANEL, 34.20 X 22.20STEEL, WHITE FINISH	HOFFMAN	1
	CSD362416M100	ENCLOSURE PER MOD DWGCSD362416	HOFFMAN	1
	CMFK	WALL MOUNTING HARDWARE KIT	HOFFMAN	1
	G1.5X4WH6	PANEL CHANNEL, 1.5X4 WHITE	PANDUIT	A/R
	G1X4WH6	PANEL CHANNEL, 1X4 WHITE	PANDUIT	A/R
	THT-19-435-1-PR	LABEL, SPEC/FUSE/TORQUEENGRAVED, SILVER, 3 X 2	ICC	3
	THT-19-439-DC	LABEL CAUTION RISK OF ELECTRICSHOCK POWER DOWN UNIT 10 MIN	ICC	1
	THT-19-439-HFC	LABEL, WARNING - RISK OF FIREOR ELECTRICAL SHOCK	ICC	1
	THT-19-439-M	LABEL, WARNING - THIS PANELHAS MULTIPLE SOURCES	ICC	1
	THT-5-435-10-PR	LABEL, ID, ENGRAVEDSILVER, 1 X 0.5	ICC	A/R
	THT-80-427-5-PR	LABEL, SELF-LAM SMALLENGRAVED, 0.5 X 0.75	ICC	A/R
	THT-9-427-10-PR	LABEL, SELF LAM (LARGE)ENGRAVED, 1 X 1.4375	ICC	A/R

NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

FUEL TECH
Technologies to enable clean efficient energy
FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

BLOWER PANEL
BILL OF MATERIALS

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO. 1294P-E04-05

480VAC/3PH/60HZ
INCOMING POWER
(FROM CLIENT)

A
B
C
GND

OTHERS
PPEBP01

C
B
A
GND

GND LUG

L1 L2 L3
DS102
T1 T2 T3

TB2

1	1T1
2	1T2
3	1T3

1T1
1T2
1T3
GND

FTI
PBPSE01

DILUTION AIR BLOWER A
B-DA-2204A
MOTOR

1T1 → T1
1T2 → T2
1T3 → T3
GND → G

4	2T1
5	2T2
6	2T3

2T1
2T2
2T3
GND

FTI
PBPSE02

DILUTION AIR BLOWER B
B-DA-2204B
MOTOR

2T1 → T1
2T2 → T2
2T3 → T3
GND → G

PLC PANEL

REF. DWG #1294P-E02-18

TB1

1	2333
2	3311
3	3311
4	3311
5	3311
6	3311
7	3311
8	3311
9	4341
10	4351
11	4361
12	4371
13	I07/04
14	I07/05
15	I07/06
16	I07/07
17	I09/05
18	005/2+
19	005/2-
20	SHLD
21	005/3+
22	005/3-
23	SHLD
24	SHLD
25	SPARE
26	SPARE
27	SPARE
28	SPARE

J

OTHERS CPPBP01 → 4341
OTHERS CPPBP02 → 4351

4341
4351
4361
4371

TB2

48	4341
49	4351
50	4361
51	4371

OTHERS CPPBP03 → 3311
OTHERS CPPBP04 → 3311
OTHERS CPPBP05 → 3311
OTHERS CPPBP06 → 3311
OTHERS CPPBP07 → I07/04, I07/05, I07/06, I07/07

TB3

18	3311
19	3311
20	3311
21	3311
27	3311
50	I07/04
51	I07/05
52	I07/06
53	I07/07
83	I09/05

OTHERS SPPBP01 → (005/2+)WHT, (005/2-)BLK
OTHERS SPPBP02 → (005/3+)WHT, (005/3-)BLK

TB4

77	005/2+
78	005/2-
79	SHLD
80	005/3+
81	005/3-
82	SHLD

NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

FUEL TECH
Technologies to enable clean efficient energy
FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

BLOWER PANEL
INTERCONNECTION W/D

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO. 1294P-E04-06

INTERCONNECT CABLE/WIRE LIST

CABLE NO.	NO. COND.	WIRE SIZE	FROM		TO		WIRE NUMBERS	CABLING BY
			LOCATION	DEVICE	LOCATION	DEVICE		
PPEBP01	2 + 1	CLIENT–DEFINED	CLIENT	480VAC,3PH,60HZ SOURCE	BLOWER PANEL	DS102	A B C GND	OTHERS
PBPSE01	3+1	#12 AWG 600V 90C MIN	BLOWER PANEL	TB2	B-DA-2204A	DILUTION AIR BLOWER A	1T1 1T2 1T3 GND	FTI
PBPSE02	3+1	#12 AWG 600V 90C MIN	BLOWER PANEL	TB2	B-DA-2204B	DILUTION AIR BLOWER B	2T1 2T2 2T3 GND	FTI
CPPBP01	2 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB2	BLOWER PANEL	TB1	4341 4351	OTHERS
CPPBP02	2 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB2	BLOWER PANEL	TB1	4361 4371	OTHERS
CPPBP03	2 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB3	BLOWER PANEL	TB1	3311 107/04	OTHERS
CPPBP04	2 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB3	BLOWER PANEL	TB1	3311 107/05	OTHERS
CPPBP05	2 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB3	BLOWER PANEL	TB1	3311 107/06	OTHERS
CPPBP06	2 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB3	BLOWER PANEL	TB1	3311 107/07	OTHERS
CPPBP07	2 WIRE CABLE	#14 AWG 600V 90C MIN	PLC PANEL	TB3	BLOWER PANEL	TB1	3311 109/05	OTHERS
SPPBP01	2 WIRE CABLE	#16 AWG SIGNAL SHIELDED	PLC PANEL	TB4	BLOWER PANEL	TB1	005/2+ 005/2– SHLD	OTHERS
SPPBP02	2 WIRE CABLE	#16 AWG SIGNAL SHIELDED	PLC PANEL	TB4	BLOWER PANEL	TB1	005/3+ 005/3– SHLD	OTHERS

NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	2/12/23	RELEASE FOR CONSTRUCTION	ARM	FJS

FUEL TECH
Technologies to enable clean efficient energy
FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

BLOWER PANEL
CABLE LISTING

APPROVED BY: SMM
CHECKED BY: FJS
DRAWN BY: JMA
DATE: 8/5/22
SCALE: NONE
SIZE: D
DRAWING NO. 1294P–E04–07

CUSTOMER APPROVAL

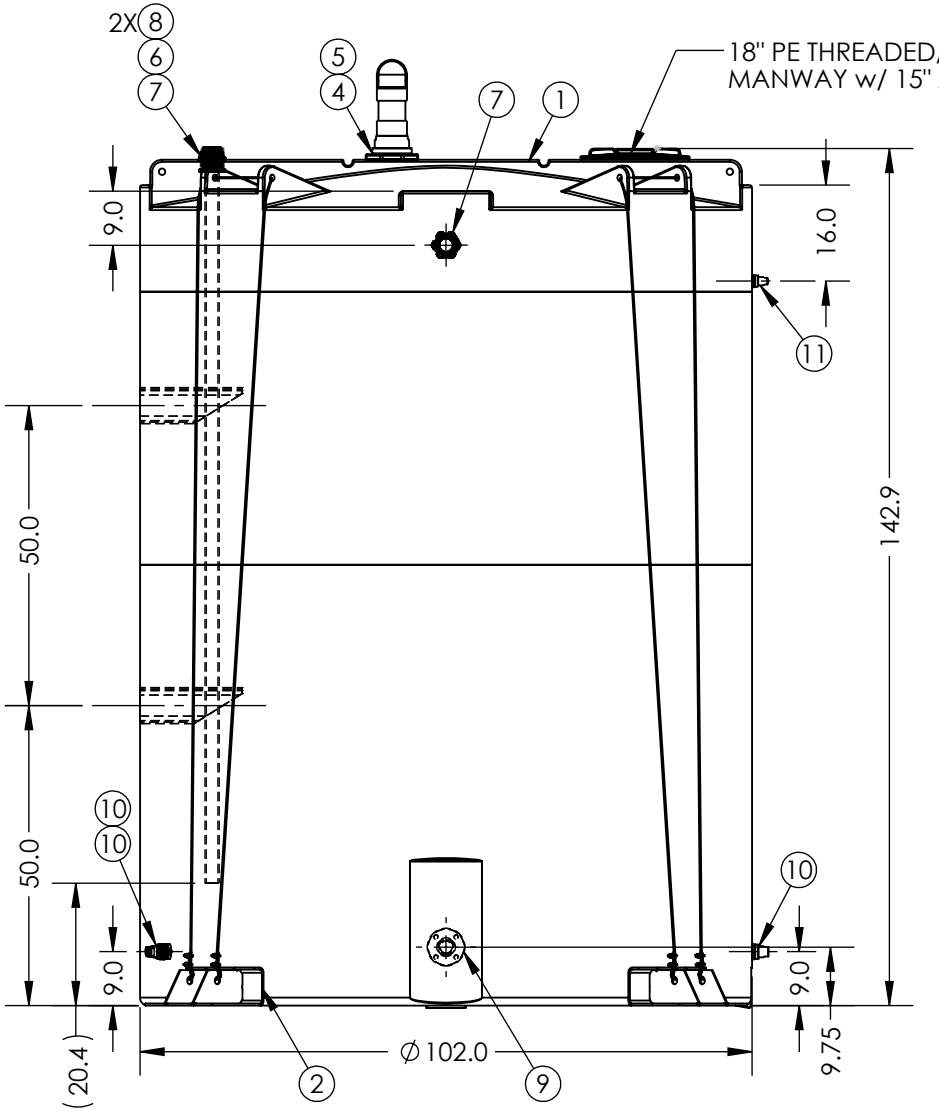
☒ APPROVED FOR PRODUCTION AS DRAWN.

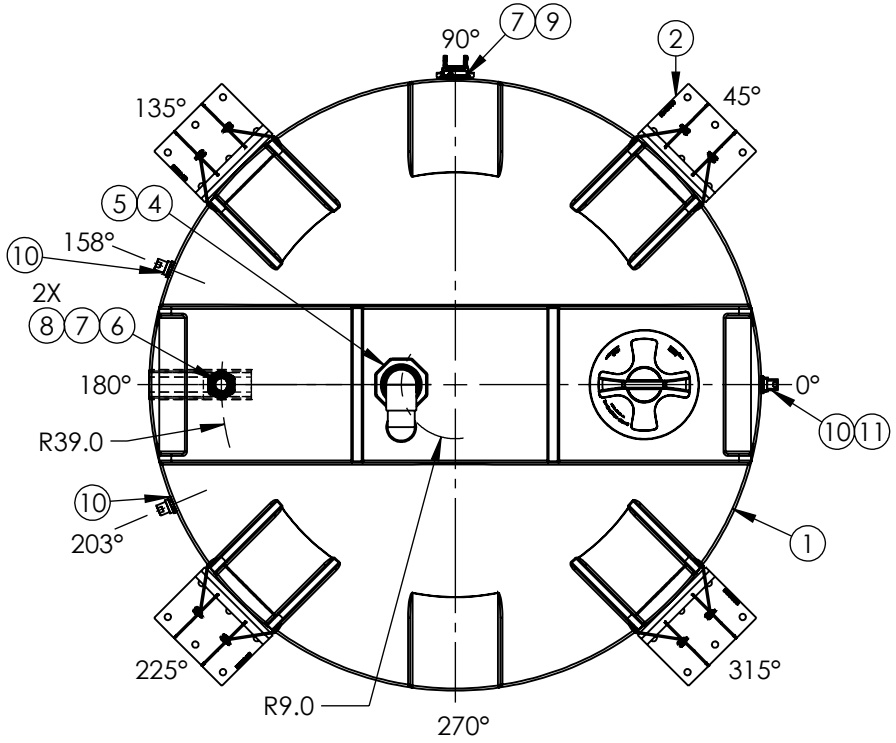
☐ REVISE AS NOTED & RESUBMIT FOR APPROVAL.

SIGNATURE: _____

DATE: April 24, 2023

DRAWING IS NOT VALID UNLESS SIGNED





ITEM NO.	QTY.	PART NUMBER	DESCRIPTION	SHOWN	TANK CONFIG.
11	1	34200066	FITTING PVC 1/2IN BH SXT HYWD	YES	YES
10	3	34200179	FTG PVC 1IN BH SXT EPDM HYWD	YES	YES
9	1	34700041	ASM FTG PVC 2IN SLB W/EPDM	YES	YES
8	2	34701162	ASM SUPPORT PE 1IN-4IN PIPE WELDED	YES	YES
7	2	34200015	FTG PVC 2IN BH SXT EPDM	YES	YES
6	10FT	34200050	PIPE PVC 2IN SCH 80	YES	YES
5	1	34700901	ASM SCREEN 1-6IN INSECT U-VENT	NO	YES
4	1	34700260	ASM U-VENT PVC 4IN W/BH & EPDM	YES	YES
3	1	00000174	PROTECTIVE PLASTIC 4000-7500(90" & 102")	NO	YES
2	1	34700314	ASM SEISMIC GS 4500 X 102 1.9 SG	YES	NO
1	1	7420200N97201	ASM TK 4500VNT X 102 HD/NAT 1.9	YES	YES

***ALL EXTERNAL PIPING MUST BE INDEPENDENTLY SUPPORTED.**
***ONLY BASE FITTINGS TO BE LEFT INSTALLED AT TIME OF SHIPMENT PER SII PROCEDURE.**
***TANKS ORDERED WITH FOAM INSULATION WILL HAVE AN INCREASED DIAMETER OF 4-6 INCHES.**
***Consult Snyder's Guidelines for Use and Installation prior to delivery.**
Available on-line at http://www.snyderindustriestanks.com/Technical
ALL DIMENSIONS ARE IN INCHES, NOMINAL, & SUBJECT TO CHANGE WITHOUT NOTICE.
ALL DIMENSIONS ON ROTATIONAL MOLDED PARTS ARE SUBJECT TO A ± 3% TOLERANCE.

CUSTOMER: HIP - WOODRIDGE IL

CUSTOMER NO: 023W2541

DO NOT SCALE | DRAWN BY: BH

STATUS: Released

SII SNYDER INDUSTRIES® A BRAND OF TANK HOLDING CORP.

(402) 467-5221
www.snydernet.com

TITLE: **ASM TK 4500VNT X 102 HD/NAT 1.9**

REVISION: E

SHEET: 1 OF 1

PART NO.: **7420200N972**

ENG. ID.: **A024040**

POWER SOURCE
480VAC, 200 AMPS,
3 PHASE, 60HZ
(BY OTHERS)

METERING / HEATER MODULE

HEATER CONTROL PANEL

ENCLOSURE SIZE: 60" x 48" x 18"

DS102
3 POLE
200A

FU102
CLASS J
200A x3

PDB1

FU105
CLASS J
150A x3

FU114/115
CLASS J
4A x2

C202

SCR107
3 PHASE
3 LEG
200A MAX

AC114
AIR
CONDITIONER
1870 BTU

PDB2

C203

C204

C205

FU128A
CLASS J
45A x3

FU128B
CLASS J
45A x3

FU135A
CLASS J
45A x3

FU135B
CLASS J
45A x3

FU142A
CLASS J
45A x3

FU142B
CLASS J
45A x3

CIRCUIT #1
30KW
480VAC, 3 PH
36.1 AMPS

CIRCUIT #2
30KW
480VAC, 3 PH
36.1 AMPS

DILUTION AIR HEATER
H-DA-2255A
60KW, 480VAC, 3 PH, 72.2 AMPS

CIRCUIT #1
30KW
480VAC, 3 PH
36.1 AMPS

CIRCUIT #2
30KW
480VAC, 3 PH
36.1 AMPS

DILUTION AIR HEATER
H-DA-2255B
60KW, 480VAC, 3 PH, 72.2 AMPS

CIRCUIT #1
30KW
480VAC, 3 PH
36.1 AMPS

CIRCUIT #2
30KW
480VAC, 3 PH
36.1 AMPS

DILUTION AIR HEATER
H-DA-2255C
60KW, 480VAC, 3 PH, 72.2 AMPS

POWER SOURCE
480VAC, 60 AMPS, 3 PHASE, 60HZ
(BY OTHERS)

BLOWER MODULE

BLOWER CONTROL PANEL

ENCLOSURE SIZE: 36" x 24" x 16"

DS102
3 POLE
60A

FU102
CLASS J
60A x3

MCP105
3 POLE
18-25A

MCP129
3 POLE
18-25A

FU114/115
CLASS J
4A x2

VFD105
10HP/7.5KW
17 AMPS

VFD129
10HP/7.5KW
17 AMPS

AC121
AIR
CONDITIONER
1870 BTU

TB

TB

7.5HP

DILUTION AIR BLOWER
B-DA-2204A
480VAC, 3 PH, 9.2 FLA

7.5HP

DILUTION AIR BLOWER
B-DA-2204B
480VAC, 3 PH, 9.2 FLA

NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
1	01/26/23	SPLIT HEATER & BLOWER PANEL	FJS	SMM

FUEL TECH
Technologies to enable clean efficient energy

FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

ULTRA SYSTEM
ELECTRICAL ONE LINE DIAGRAM

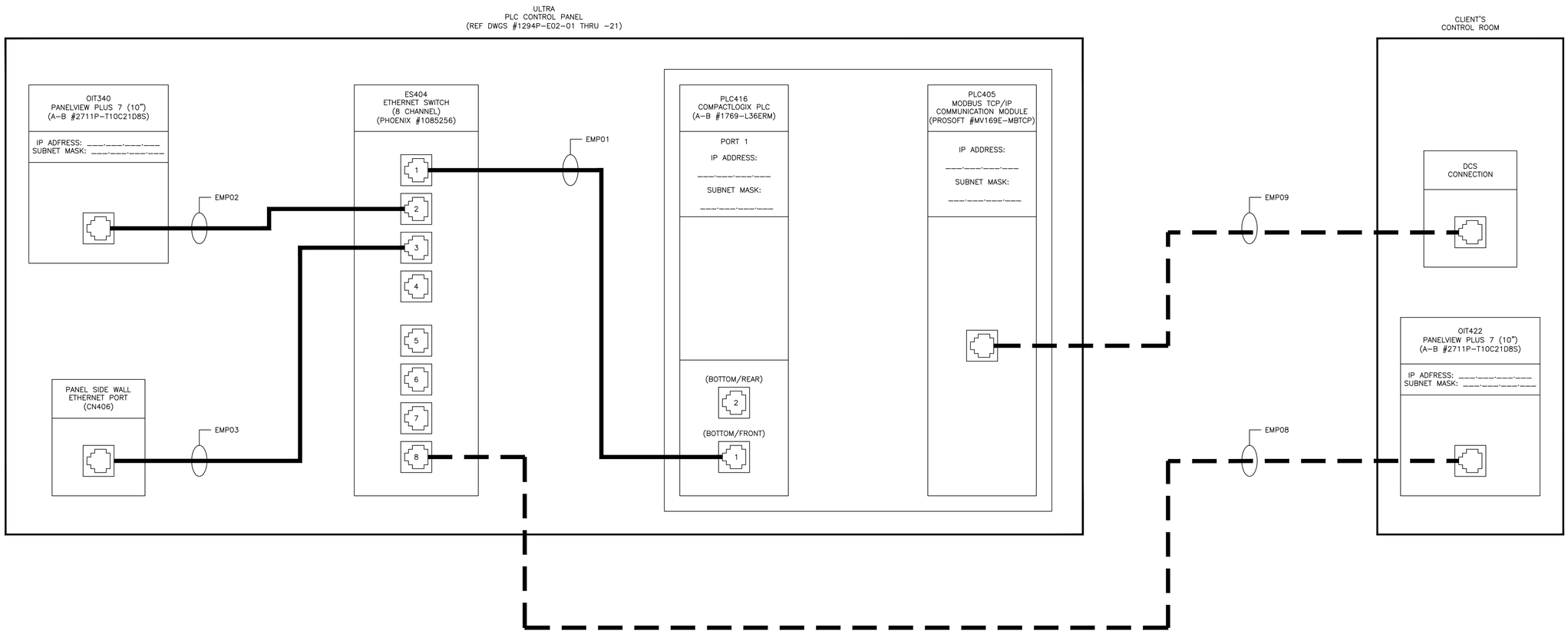
APPROVED BY: S MAYHEW

DRAWN BY: F SZEKELY

DATE: 10/27/22

SCALE: SIZE: D

DRAWING NO.
1294P-E01-03



NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	02/02/23	INITIAL DESIGN	FJS	SMM

FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER
SACRAMENTO, CA

ULTRA SYSTEM
DATA COMMUNICATIONS DIAGRAM

APPROVED BY: S MAYHEW

DRAWN BY: F SZEKELY

DATE: 02/02/23

SCALE: SIZE: D

DRAWING NO.
1294P-E01-04

INSTRUMENT IDENTIFICATION TABLE

	FIRST LETTER		SUCCEEDING LETTERS		
	MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER, COMBUSTION		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
C	CONDUCTIVITY			CONTROL	CLOSED
D	DENSITY	DIFFERENTIAL			DIVERT
E	VOLTAGE		SENSOR (PRIMARY ELEMENT)		
F	FLOW RATE	RATIO (FRACTION)			FORWARD
G	USER'S CHOICE		GLASS, VIEWING DEVICE		GAUGE
H	HAND				HIGH, OPEN
I	CURRENT (ELECTRIC)		INDICATE		
J	POWER	SCAN			
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT		LOW, CLOSED
M	USER'S CHOICE	MOMENTARY			MIDDLE, INTERMEDIATE
N	USER'S CHOICE		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
O	USER'S CHOICE		ORIFICE, RESTRICTION		OPEN
P	PRESSURE, VACUUM		POINT (TEST) CONNECTION		
Q	QUANTITY	INTEGRATE, TOTALIZE			
R	RADIATION		RECORD		REVERSE
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION, MECHANICAL ANALYSIS			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL		
X	UNCLASSIFIED	X AXIS	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT, STATE OR PRESENCE	Y AXIS		RELAY, COMPUTE, CONVERT	
Z	POSITION, DIMENSION	Z AXIS		DRIVER, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	

SYSTEM CODES

AA – ANHYDROUS AMMONIA
AHC – ACOUSTIC HORN CLEANER
AW – AQUEOUS AMMONIA (19%)
CA – COMBUSTION AIR
CW – COOLING WATER
DW – DILUTION WATER
DA – DILUTION AIR
FW – FLUSH WATER
DAG – DILUTE AMMONIA GAS
HA – HERT AIR
IA – INSTRUMENT AIR
NG – NATURAL GAS
OFA – SECONDARY/TERTIARY AIR
OIL – OIL
PA – PRIMARY AIR
PC – PULVERIZED COAL
PW – PROCESS WATER
SA – SERVICE AIR
SB – SOOT BLOWER
UE – UREA (SOLUTION)
UED – UREA PRILL, DRY
FG – FLUE GAS
OX – OXYGEN

COMPONENT TAGGING

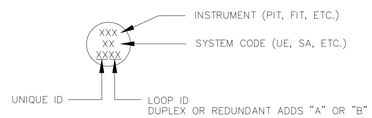
XX – AAA – XXX – XX XX X

- XX: UNIT (OPT'L)
- AAA: DEVICE/EQUIP/COMPONENT
- XXX: SYSTEM (UE/DW)
- XX XX X: EXAMPLE: 01–P–UE–0101A
  - OPTIONAL FOR DUPLEX/REDUNDANT "A", "B" OR SERIES
  - LOOP
  - UNIQUE ID

DEVICE/EQUIPMENT INITIALS

AC – ACCUMULATOR
AG – AGITATOR/MIXER
AH – SONIC HORN
B – BLOWER
DI – DIAPHRAGM ISOLATOR
EJ – EXPANSION JOINT
FIL – FILTER
H – HEATER
TDL – TUNABLE DIODE LASER
PRB – PROBE
PD – PULSATION DAMPENER
INJ – INJECTOR
LPA – LARGE PARTICLE ASH SCREEN
M – MOTOR
MX – STATIC MIXER
P – PUMP
SCW – SCREW CONVEYOR
SIL – SILENCER
STR – STRAINER
TNK – TANK
CYC – CYCLONE
C – COMPRESSOR
V – VESSEL

INSTRUMENT TAGGING



VALVE CODES

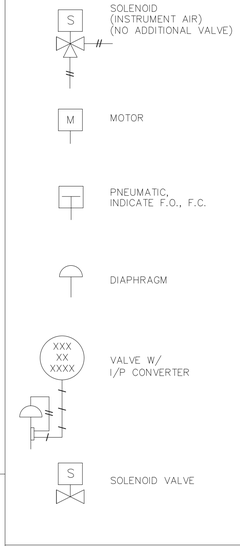
SYM – DEFINITION

AOV – AIR–OPERATED VALVE
BPRV – BACK PRESSURE REGULATOR VALVE
CV – CHECK VALVE
FCV – FLOW CONTROL VALVE
HV – HAND VALVE
MOV – MOTOR–OPERATED VALVE
NC – NORMALLY CLOSED
PCV – PRESSURE CONTROL VALVE
PRV – PRESSURE REGULATOR VALVE
ROV – ROTARY VALVE
RV – RELIEF VALVE
SOV – SOLENOID–OPERATED VALVE
VB – VACUUM BREAKER

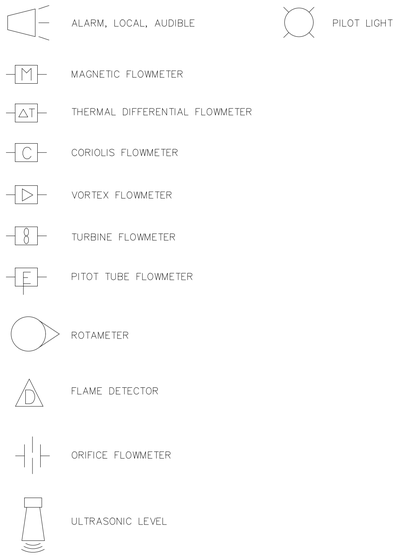
VALVE SYMBOLS

TYPE	OPEN	CLOSED
BALL		
GATE		
GLOBE		
PLUG		
NEEDLE		
BUTTERFLY		NC
KNIFE GATE		
PRESSURE RELIEF		
CHECK		
3–WAY		
4–WAY		
ROTARY		
PRESSURE REGULATOR (INTERNAL, DOWNSTREAM)		
PRESSURE REGULATOR (INTERNAL, BACKPRESSURE)		
VACUUM RELIEF		
2–WAY MANIFOLD	2–WAY	
3–WAY MANIFOLD	3–WAY	
5–WAY MANIFOLD	5–WAY	
PRESSURE UNLOADING REGULATOR		

CONTROL VALVE ACTUATORS



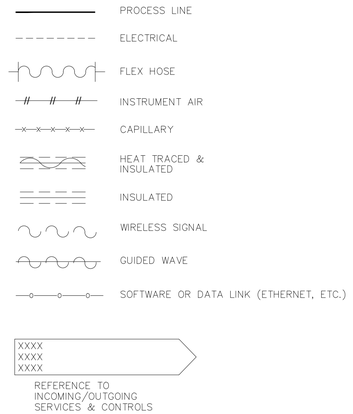
INSTRUMENT SYMBOLS



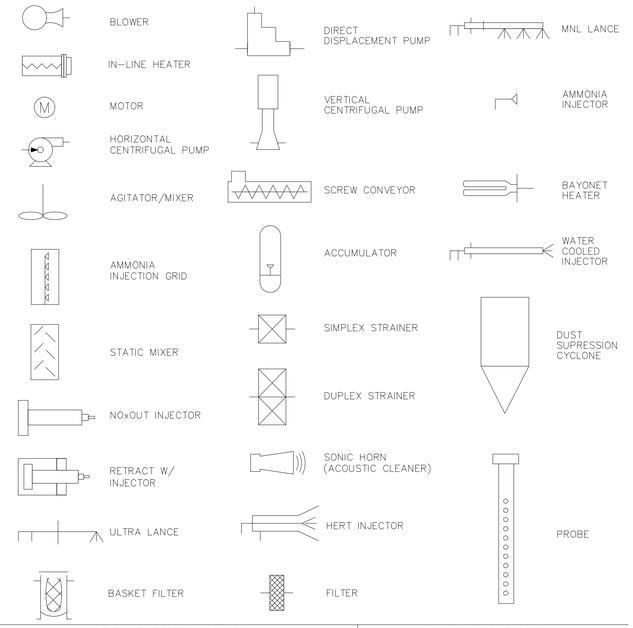
INSTRUMENTS

	FIELD MOUNT	PRIMARY LOCATION NORMALLY ACCESSIBLE TO OPERATOR	AUXILIARY LOCATION NORMALLY ACCESSIBLE TO OPERATOR	PRIMARY LOCATION NORMALLY INACCESSIBLE TO OPERATOR	AUXILIARY LOCATION NORMALLY INACCESSIBLE TO OPERATOR
DISCRETE					
SHARED DISP. SHARED CONTROL					

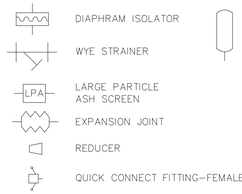
LINE SYMBOLS



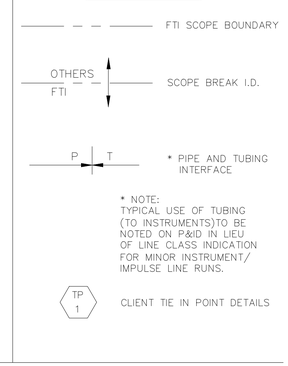
EQUIPMENT



PIPING SPECIALTIES



MISC. SYMBOLS



PIPE LINE CLASS

XX – XXX – XXX
- XXX: LINE CLASS
- XXX: SERVICE (SYSTEM)
- XX: SIZE (PIPE OR TUBE)

LINE CLASS:

SS1	SCH. 10S, GR. 304L, WITH 150# CLASS FITTINGS
SS2	SCH. 40S, GR. 304L, WITH 150# CLASS FITTINGS
SS3	SCH. 40S, GR. 304L, WITH 300# CLASS FITTINGS
SS4	SCH. 40S, GR. 316L, WITH 150# CLASS FITTINGS
SS5	SCH. 40S, GR. 316L, WITH 300# CLASS FITTINGS
CS1	SCH. 40, CARBON STEEL, 150# CLASS FITTINGS
CS2	SCH. 80, CARBON STEEL, 150# CLASS FITTINGS
CS3	SCH. 40, CARBON STEEL, 300# CLASS FITTINGS
CS4	SCH. 80, CARBON STEEL, 300# CLASS FITTINGS
TB1	TUBING, 316L, 0.9mm (0.035") WALL THICKNESS
TB2	TUBING, 316L, 1.2mm (0.049") WALL THICKNESS
TB3	TUBING, POLYURETHANE, 0.063" WALL THICKNESS
FRP1	SCH. 40 FRP PIPE
DUCT	DUCTWORK CONFORMING TO + XX/– XX PRESSURE RATING
CPVC	SCH. 80 CPVC
PVC	SCH. 80 PVC

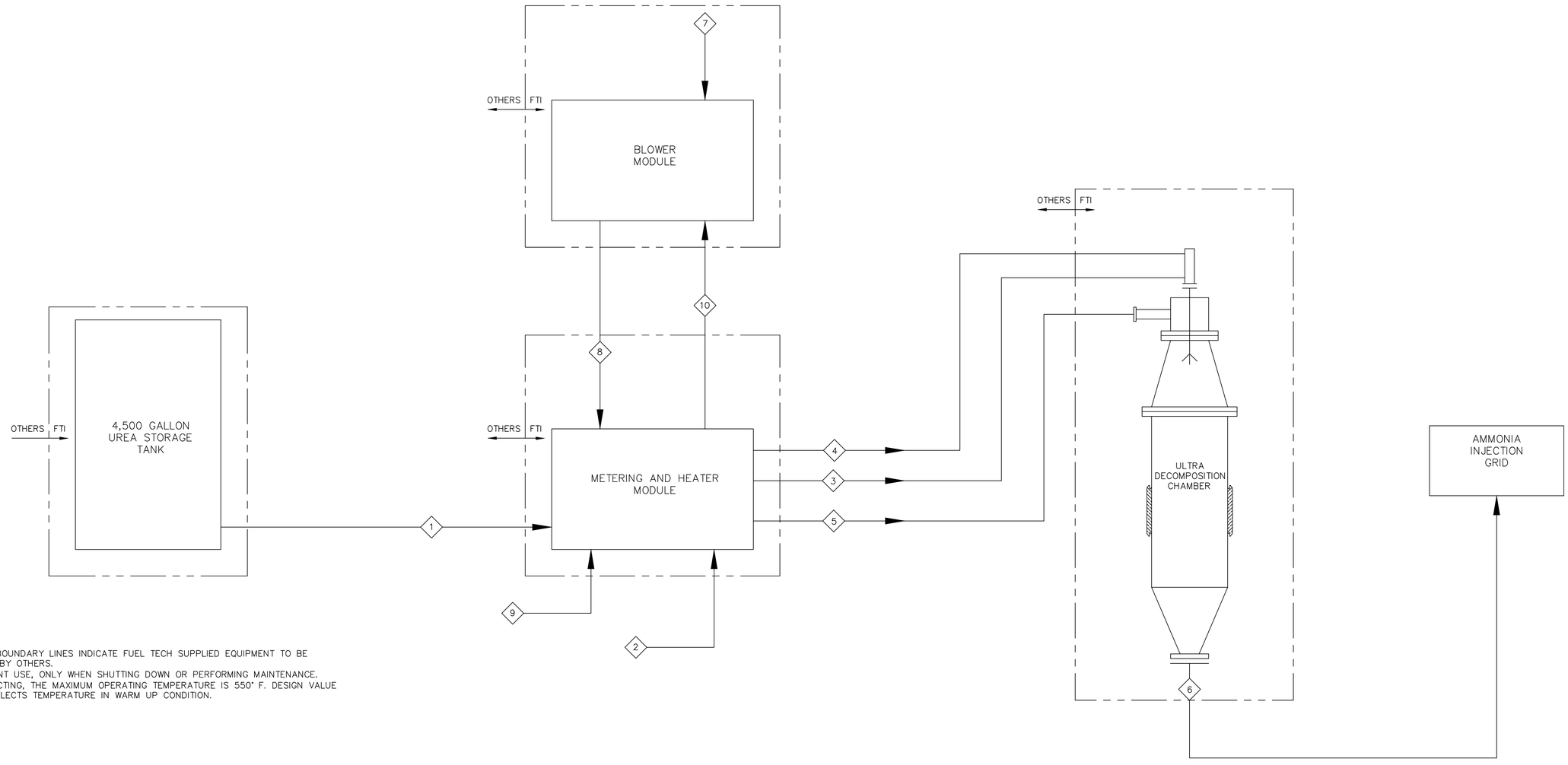
NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	03/16/23	ISSUED FOR FABRICATION	MEH	JM

FUEL TECH
Technologies to enable clean efficient energy
FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER

LEGEND AND GENERAL NOTES

APPROVED BY: K. KRAUSE
CHECKED BY: A. TOPACIO
DRAWN BY: M. HARTMAN
DATE: 6/20/2022
SCALE: NONE | SIZE: D
DRAWING NO. 1294P–M02–01–R0



NOTES

1) PHANTOM BOUNDARY LINES INDICATE FUEL TECH SUPPLIED EQUIPMENT TO BE INSTALLED BY OTHERS.
2) INTERMITTENT USE, ONLY WHEN SHUTTING DOWN OR PERFORMING MAINTENANCE.
3) WHILE INJECTING, THE MAXIMUM OPERATING TEMPERATURE IS 550° F. DESIGN VALUE SHOWN REFLECTS TEMPERATURE IN WARM UP CONDITION.

Line number		1	2	3	4	5	6	7	8	9	10
Service		Urea Solution to Metering	Insrument Air Supply to Metering Module	Atomizing Air Supply to Injector	Chemical Supply to Injector	Heated Air Supply to Decomposition Chamber	NH3/Air Mixture to AIG	Ambient Air Supply to Blower Module	Air Supply from Blower Module to Metering and Heater Module	Flush Water	Instrument Air Supply to Blower Valves
Line size	inches	1.0	0.5	0.50	0.25	6.0	6.0	N/A	4.0	0.50	0.375
Schedule	#	40	40	0.049"	0.035"	10	10	N/A	10	40	0.063"
Material		304SS	304SS	316SS	316SS	304SS	304SS	N/A	304SS	304SS	Poly
Design Pressure	psig	10	100	100	100	37 IN WC	37 IN WC	Ambient	37 IN WC	75	100
Operating Pressure (norm.)	psig	3	80	50	10	22 IN WC	17 IN WC	Ambient	29 IN WC	5-50	80
Design temperature	F	40-120	40-120	40-120	40-120	925	925	90	90	100	40-120
Operating temperature (norm.)	F	60	70	70	60	850	550	40 - 90	40 - 90	70	70
Design Flow	gph (scfm)	11.6	(17)	(15)	11.6	(390)	(453)	(390)	(390)	11.6	(1)
Flow (norm.)	gph (scfm)	2 - 11.6	(17)	(15)	2 - 11.6	(390)	(415-455)	(390)	(390)	8.0	(0)
Notes							3			2	2

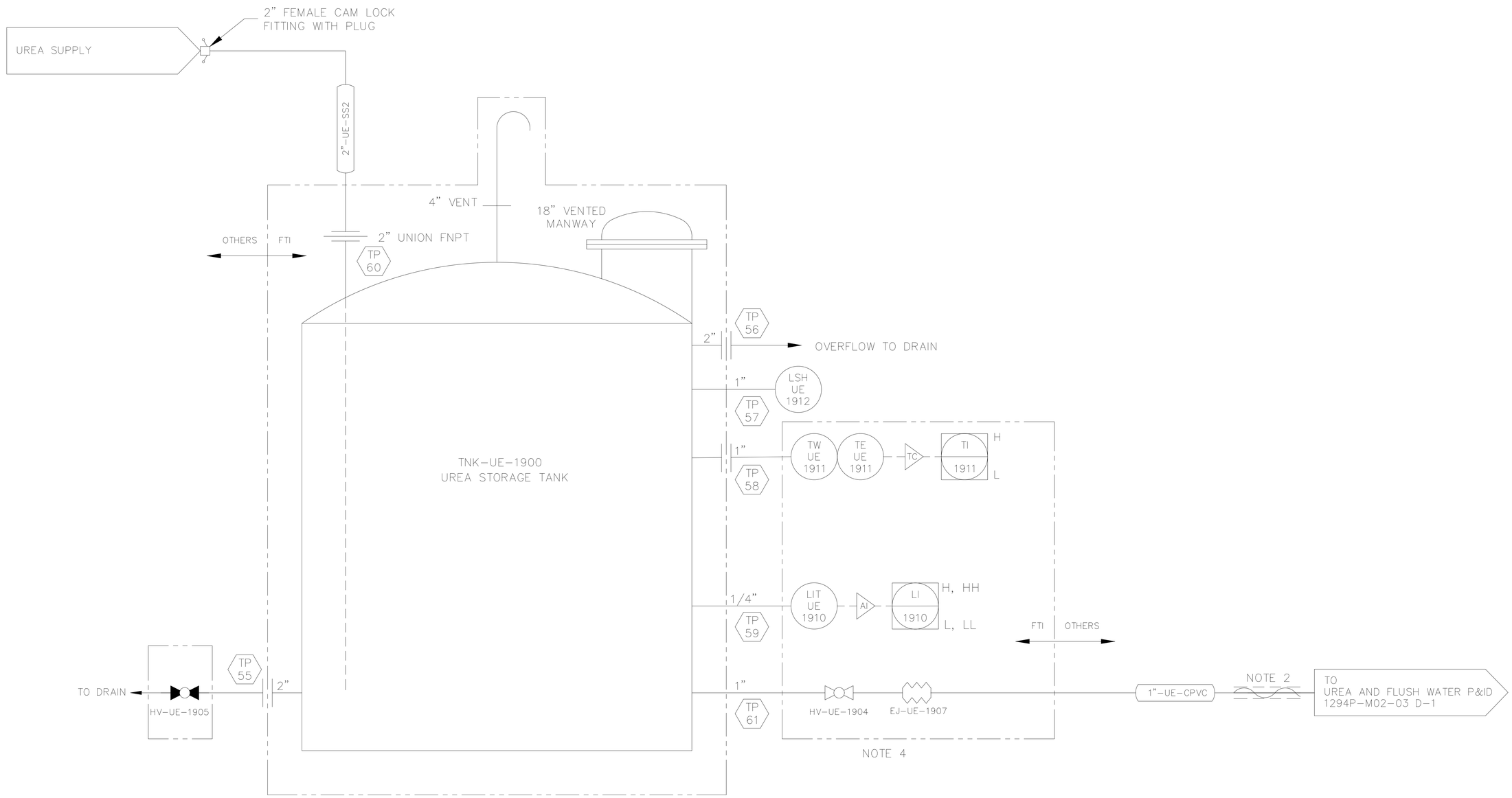
NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	03/16/23	ISSUED FOR FABRICATION	MEH	JM

FUEL TECH
Technologies to enable clean efficient energy™
FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER

ULTRA SYSTEM
PROCESS FLOW DIAGRAM

APPROVED BY: K. KRAUSE
CHECKED BY: A. TOPACIO
DRAWN BY: M. HARTMAN
DATE: 7/22/2022
SCALE: NONE SIZE: D
DRAWING NO. 1294P-M01-01-R0



NOTES:

1. UREA REAGENT MUST BE KEPT ABOVE 20°F IF USING 32% DEF AND ABOVE 40°F IF USING 40% DEF.
2. HEAT-TRACE & INSULATE BY OTHERS IF REQUIRED.
3. ALL VALVES, EQUIPMENT, AND INSTRUMENTS ON THIS DRAWING ARE PROVIDED BY FUEL TECH AND SHIPPED LOOSE. OTHERS TO PROVIDE PIPE, TUBE, FITTINGS, GASKETS, FLANGE FASTENERS, INSTALLATIONS AND WIRING SUPPORTS.
4. EQUIPMENT LOCATED WITHIN PHANTOM BOUNDARY LINES INDICATES FUEL TECH SUPPLIED EQUIPMENT TO BE INSTALLED BY OTHERS.
5. NO FORCES ARE ALLOWED ON TIE-IN FLANGES. CUSTOMER MUST PROVIDE ADEQUATE PIPE SUPPORTS AT ALL TIE-IN LOCATIONS PRIOR TO CONNECTING WITH FTI MODULES.
6. UREA FILL INTERNAL PIPE PROVIDED BY TANK SUPPLIER, MANUFACTURER'S STANDARD (SHIPPED LOOSE).
7. UREA CONCENTRATION MUST BE 32.5% OR 40%.

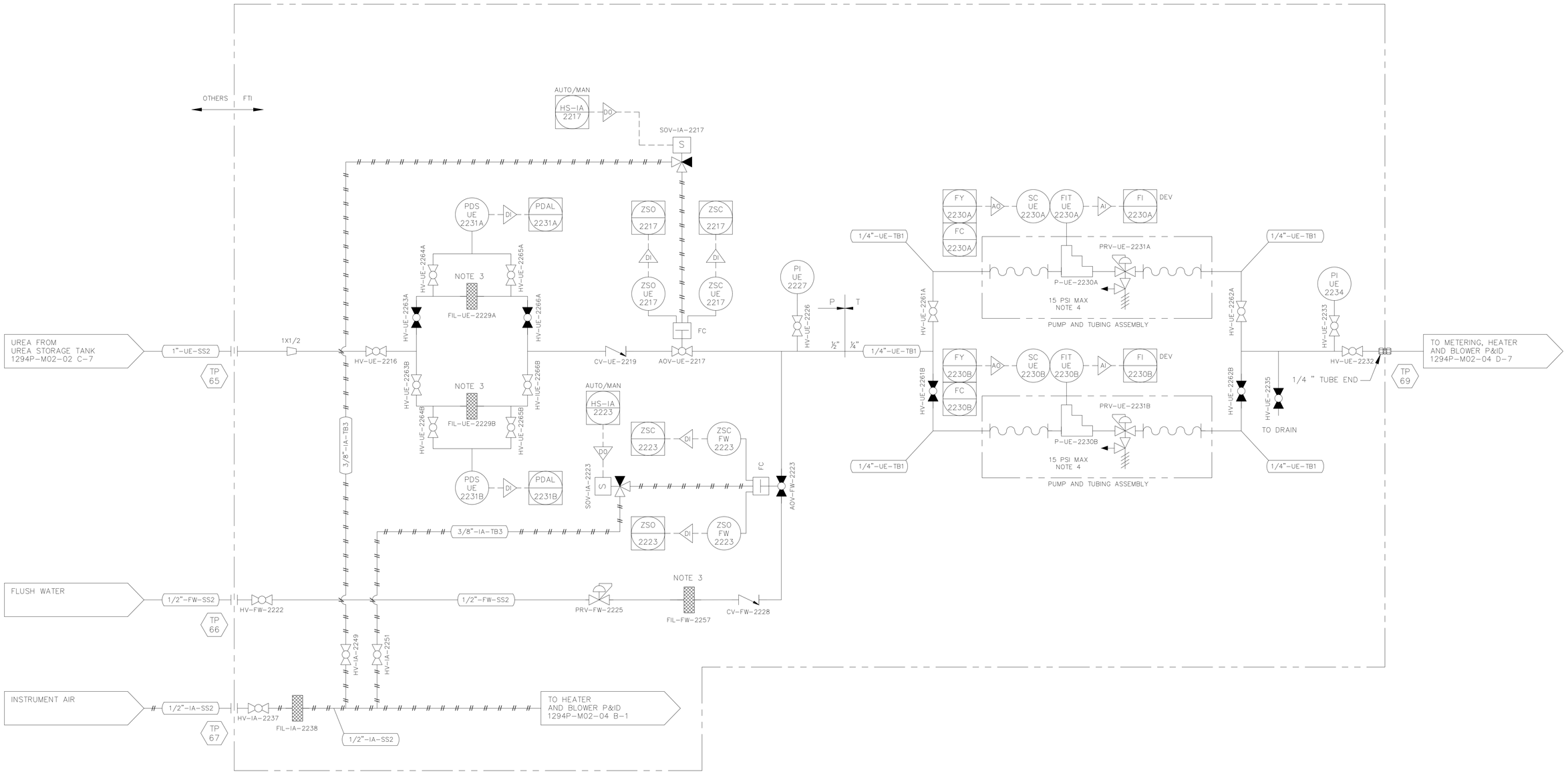
NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	03/16/23	ISSUED FOR FABRICATION	MEH	JM

FUEL TECH
Technologies to enable clean efficient energy
FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER

ULTRA SYSTEM
UREA STORAGE TANK P&ID

APPROVED BY: K. KRAUSE
CHECKED BY: A. TOPACIO
DRAWN BY: M. HARTMAN
DATE: 6/28/2022
SCALE: NONE
SIZE: D
DRAWING NO. 1294P-M02-02-R0



NOTES:

1. N/A.
2. N/A.
3. LIQUID FILTERS TO PROVIDE A FILTRATION RATING OF 5 MICRONS.
4. PUMP ASSEMBLY INCLUDES CHECK AND PRESSURE REGULATOR ON DOWNSTREAM DISCHARGE AS WELL AS A BYPASS LINE FOR PUMP PROTECTION. PUMP ASSEMBLY INLET AND OUTLET CONNECTIONS ARE MADE WITH A SHORT PIECE OF POLY TUBING. SEE GA DRAWING FOR ADDITIONAL DETAILS.
5. N/A.
6. NO FORCES ARE ALLOWED ON TIE-IN FLANGES. CUSTOMER MUST PROVIDED ADEQUATE PIPE SUPPORTS AT ALL TIE-IN LOCATIONS PRIOR TO CONNECTING WITH FTI MODULES.
7. N/A.

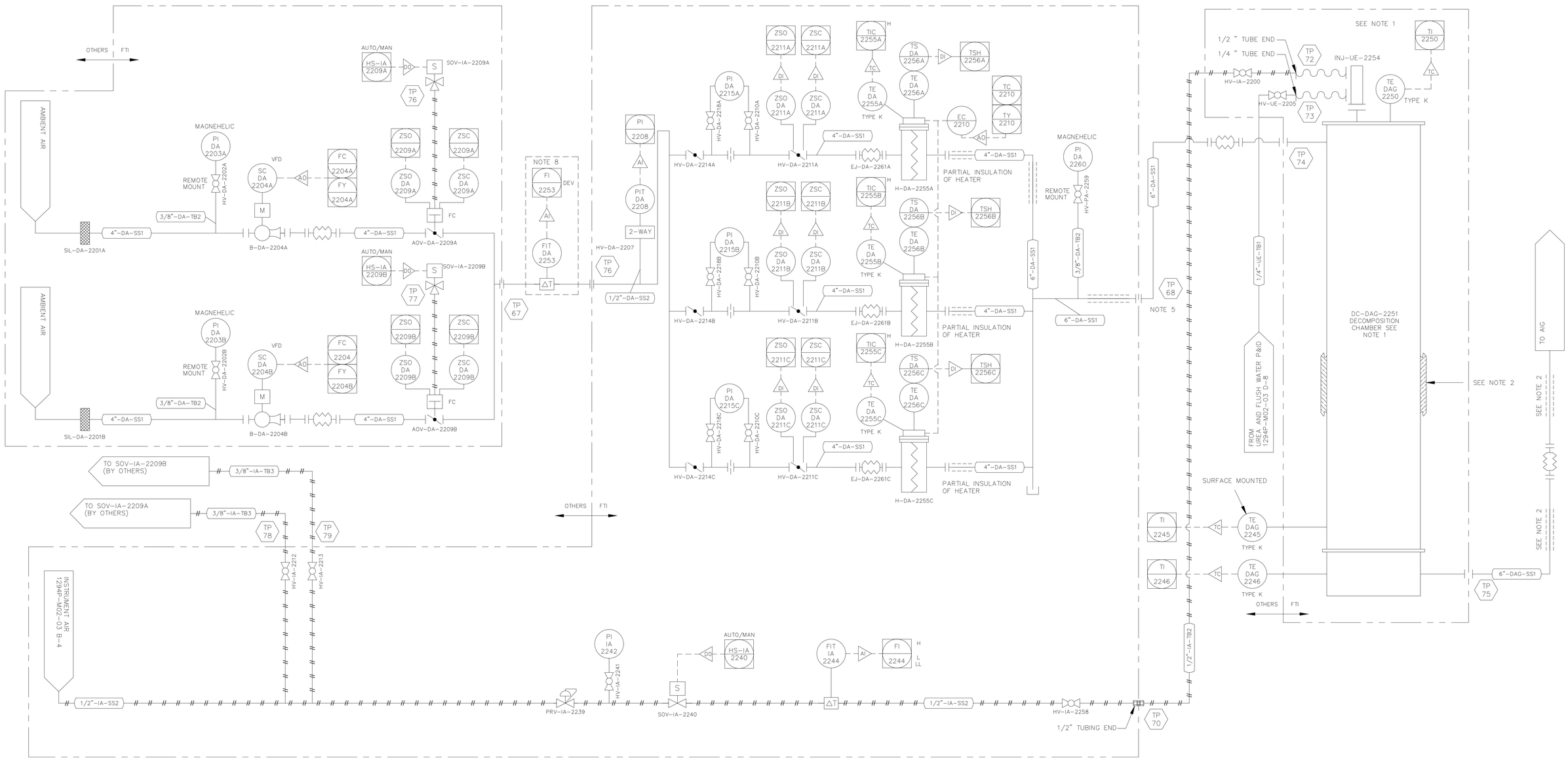
NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
0	03/16/23	ISSUED FOR FABRICATION	MEH	JM

FUEL TECH
Technologies to enable clean efficient energy
FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

UC DAVIS MEDICAL CENTER

ULTRA SYSTEM
UREA AND FLUSH WATER P&ID

APPROVED BY: K. KRAUSE
CHECKED BY: A. TOPACIO
DRAWN BY: M. HARTMAN
DATE: 6/28/2022
SCALE: NONE
SIZE: D
DRAWING NO. 1294P-M02-03-R0



NOTES:
1. EQUIPMENT SUPPLIED BY FUEL TECH AND INSTALLED BY OTHERS.
2. ALL INSULATION IS PROVIDED AND INSTALLED BY OTHERS. CONSULT FUEL TECH INC. FOR TEMPERATURE TO MAINTAIN WHEN DESIGNING INSULATION TYPE AND THICKNESS.
3. N/A.
4. N/A.
5. SYSTEM DESIGNED FOR MAXIMUM OF 50' BETWEEN THE MODULE AND THE DECOMPOSITION CHAMBER. LARGER RUNS TO BE EVALUATED BY ENGINEERING.
6. NO FORCES ARE ALLOWED ON TIE-IN FLANGES. CUSTOMER MUST PROVIDED ADEQUATE PIPE SUPPORTS AT ALL TIE-IN LOCATIONS PRIOR TO CONNECTING WITH FTI MODULES.
7. TE-DA-2255 A/B/C AND TE-DA-2256A/B/C ARE INTEGRAL TO THE HEATERS. NO PHYSICAL TAGS WILL APPEAR FOR THESE DEVICES.
8. FIT-DA-2253 IS SHIPPED LOOSE. IT IS INSTALLED IN THE FIELD. UPSTREAM AND DOWNSTREAM DIAMETER SHALL BE IN ACCORDANCE TO MANUFACTURERS REQUIREMENTS.

NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
1	03/16/23	ISSUED FOR FABRICATION	MH	AT
0	03/01/23	INITIAL ISSUE	MH	SC

FUEL TECH
Technologies to enable clean efficient energy
FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

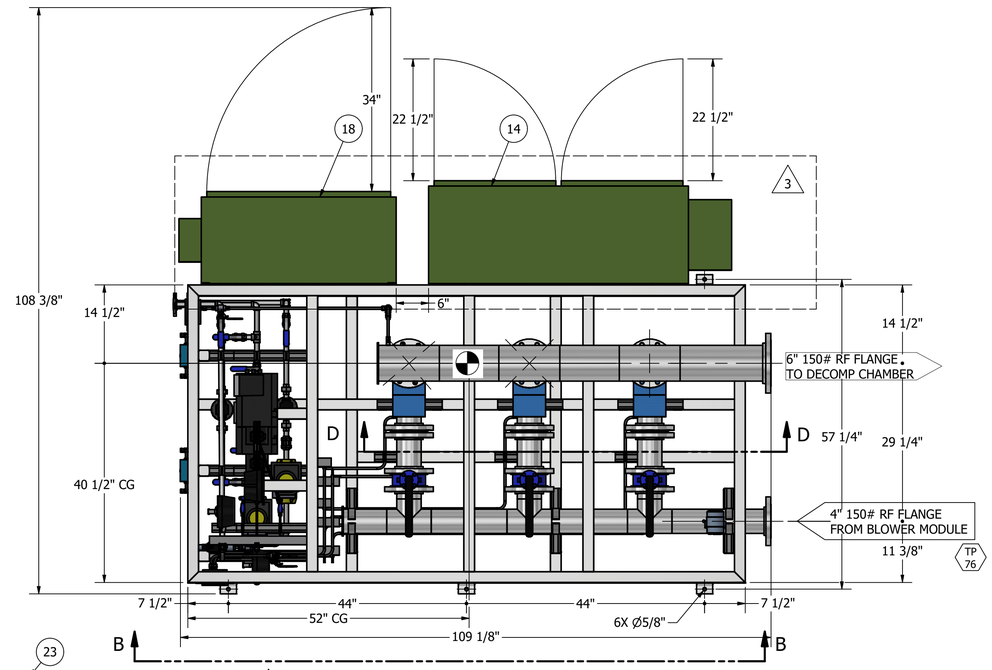
UC DAVIS MEDICAL CENTER

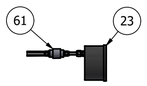
ULTRA SYSTEM
HEATER MODULE AND BLOWER MODULE P&ID

APPROVED BY: K. KRAUSE
CHECKED BY: A. TOPACIO
DRAWN BY: M. HARTMAN
DATE: 3/01/2023
SCALE: NONE
SIZE: D
DRAWING NO. 1294P-M02-04-R1

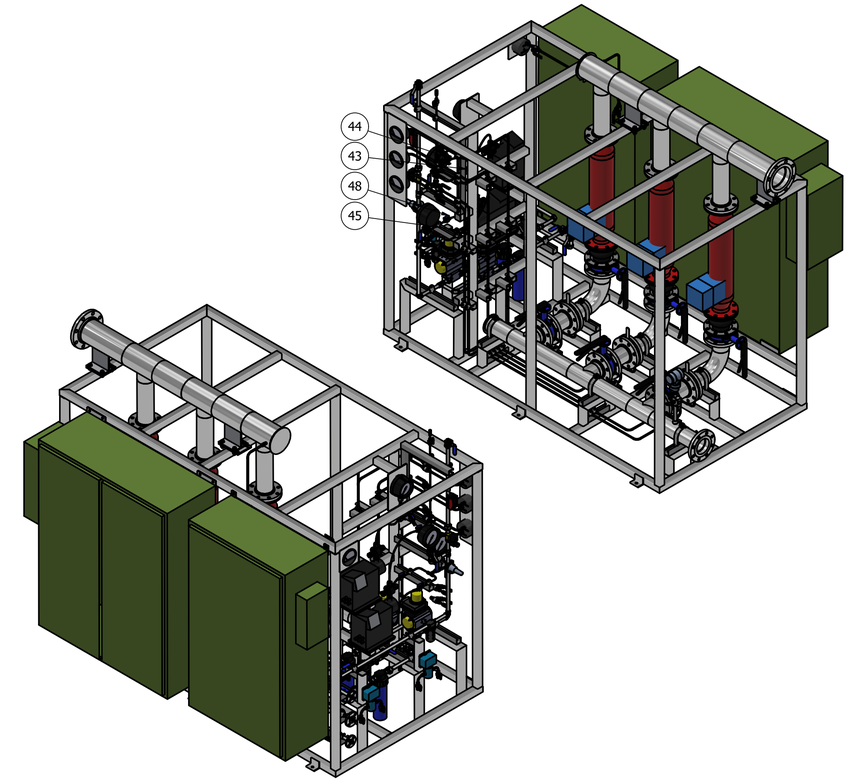
PARTS LIST

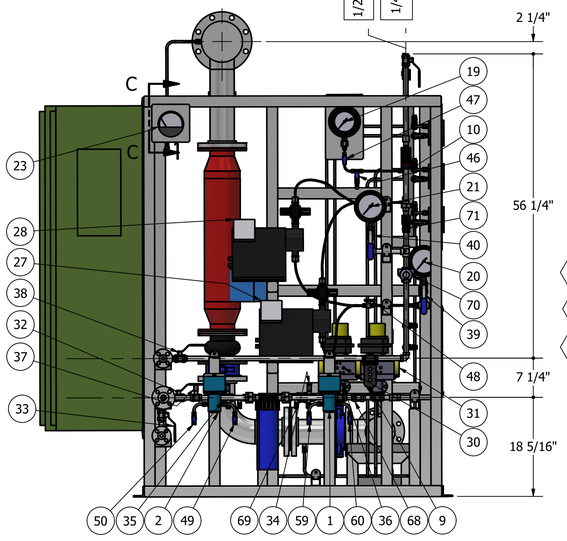
ITEM	TAG	DESCRIPTION
1	PDS-UE-2231B	DIFFERENTIAL PRESSURE SWITCH 1/4" FNPT HIGH/LOW
2	PDS-UE-2231A	DIFFERENTIAL PRESSURE SWITCH 1/4" FNPT HIGH/LOW
3	EJ-DA-2261A	EXPANSION JOINT 4"
4	EJ-DA-2261B	EXPANSION JOINT 4"
5	EJ-DA-2261C	EXPANSION JOINT 4"
6	FIL-UE-2229B	FILTER 1/2"
7	FIL-FW-2257	FILTER 1/2"
8	FIL-UE-2229A	FILTER 1/2"
9	FIL-IA-2238	FILTER 1/2"
10	FIT-IA-2244	FLOW METER 1/2"
11	H-DA-2255C	HEATER 4" X 4"
12	H-DA-2255A	HEATER 4" X 4"
13	H-DA-2255B	HEATER 4" X 4"
14		HEATER PANEL 60" x 58" x 18"
15	OR-DA-2224C	ORIFICE PLATE 4" X 2 1/2" BORE
16	OR-DA-2224A	ORIFICE PLATE 4" X 2 1/2" BORE
17	OR-DA-2224B	ORIFICE PLATE 4" X 2 1/2" BORE
18		PLC PANEL 60" x 36" x 16"
19	PI-UE-2234	PRESSURE GAUGE 1/2"
20	PI-UE-2227	PRESSURE GAUGE 1/2"
21	PI-IA-2242	PRESSURE GAUGE 1/2"
22	PI-DA-2215A	PRESSURE GAUGE 1/8" MAGNEHELIC
23	PI-DA-2260	PRESSURE GAUGE 1/8" MAGNEHELIC
24	PI-DA-2215C	PRESSURE GAUGE 1/8" MAGNEHELIC
25	PI-DA-2215B	PRESSURE GAUGE 1/8" MAGNEHELIC
26	PIT-DA-2208	PRESSURE TRANSMITTER
27	P-UE-2230B	PUMP 1/4" DOSING
28	P-UE-2230A	PUMP 1/4" DOSING
29	HV-DA-2207	VALVE 2 WAY 1/2"
30	AOV-FW-2223	VALVE AOV 1/2"
31	AOV-UE-2217	VALVE AOV 1/2"
32	HV-UE-2216	VALVE BALL 1/2"
33	HV-FW-2222	VALVE BALL 1/2"
34	HV-UE-2266A	VALVE BALL 1/2"
35	HV-UE-2263A	VALVE BALL 1/2"
36	HV-UE-2266B	VALVE BALL 1/2"
37	HV-UE-2263B	VALVE BALL 1/2"
38	HV-IA-2237	VALVE BALL 1/2"
39	HV-UE-2226	VALVE BALL 1/2"
40	HV-IA-2241	VALVE BALL 1/2"
41	HV-IA-2258	VALVE BALL 1/2"
42	HV-UE-2232	VALVE BALL 1/4" COMP
43	HV-UE-2262A	VALVE BALL 1/4" COMP
44	HV-UE-2262B	VALVE BALL 1/4" COMP
45	HV-UE-2261A	VALVE BALL 1/4" COMP
46	HV-UE-2235	VALVE BALL 1/4" COMP
47	HV-UE-2233	VALVE BALL 1/4" COMP
48	HV-UE-2261B	VALVE BALL 1/4" COMP
49	HV-UE-2265A	VALVE BALL 3/8" COMP
50	HV-UE-2264A	VALVE BALL 3/8" COMP
51	HV-DA-2218A	VALVE BALL 3/8" COMP
52	HV-DA-2218C	VALVE BALL 3/8" COMP
53	HV-DA-2218B	VALVE BALL 3/8" COMP
54	HV-DA-2210B	VALVE BALL 3/8" COMP
55	HV-DA-2210C	VALVE BALL 3/8" COMP
56	HV-IA-22451	VALVE BALL 3/8" COMP
57	HV-IA-2249	VALVE BALL 3/8" COMP
58	HV-DA-2210A	VALVE BALL 3/8" COMP
59	HV-UE-2264B	VALVE BALL 3/8" COMP
60	HV-UE-2265B	VALVE BALL 3/8" COMP
61	HV-PA-2259	VALVE BALL 3/8" COMP
62	HV-DA-2211B	VALVE BUTTERFLY 4"
63	HV-DA-2211A	VALVE BUTTERFLY 4"
64	HV-DA-2214B	VALVE BUTTERFLY 4"
65	HV-DA-2214A	VALVE BUTTERFLY 4"
66	HV-DA-2214C	VALVE BUTTERFLY 4"
67	HV-DA-2211C	VALVE BUTTERFLY 4"
68	CV-UE-2219	VALVE CHECK 1/2"
69	CV-FW-2228	VALVE CHECK 1/2"
70	PRV-IA-2239	VALVE PRV 1/2"
71	SOV-IA-2240	VALVE SOLENOID 1/2"



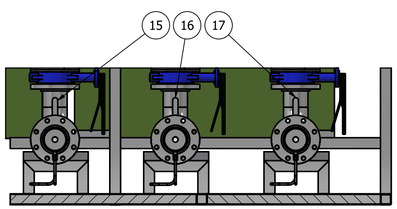


SECTION C-C

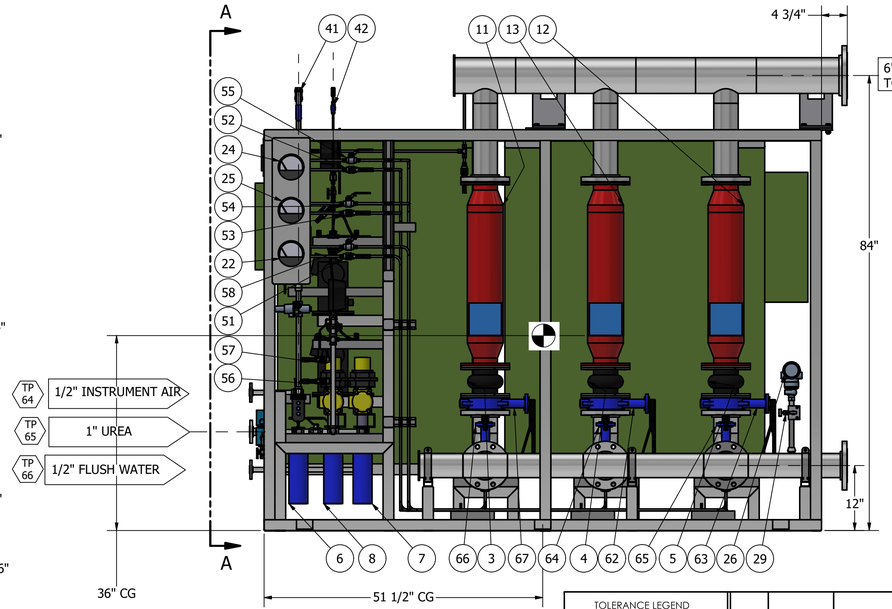




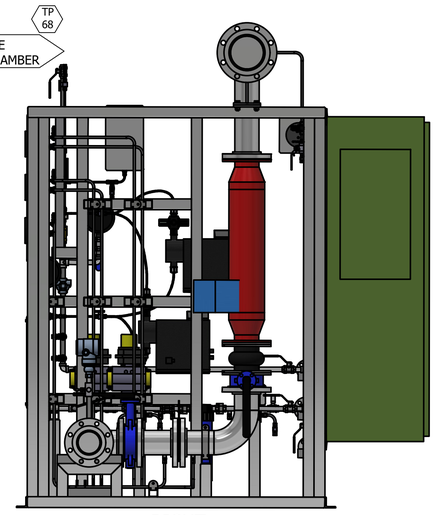
VIEW A-A
LEFT



SECTION D-D



VIEW B-B
FRONT



RIGHT

ESTIMATED WEIGHT IS 2,700#

NOTE: NO FORCES ARE ALLOWED ON TIE-IN FLANGES. CUSTOMER MUST PRIVIDE ADEQUATE PIPE SUPPORTS AT ALL TIE-IN LOCATIONS PRIOR TO CONNECTING WITH FUEL TECH PIPING MODULES.

TOLERANCE LEGEND (UNLESS NOTED)					
.XX = ± .03"					
.XXX = ± .010"	3	1/12/23	ISSUE FOR FABRICATION	DG	AT
FRACTIONS = ± 1/8"	2	11/17/22	CLIENT COMMENTS/TIE POINTS	DG	AT
ANGLES = ± 3°	1	9/22/22	CLIENT COMMENTS/TIE POINTS	DG	AT
CUSTOMER TIE - INS = ± 1/4"	NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY

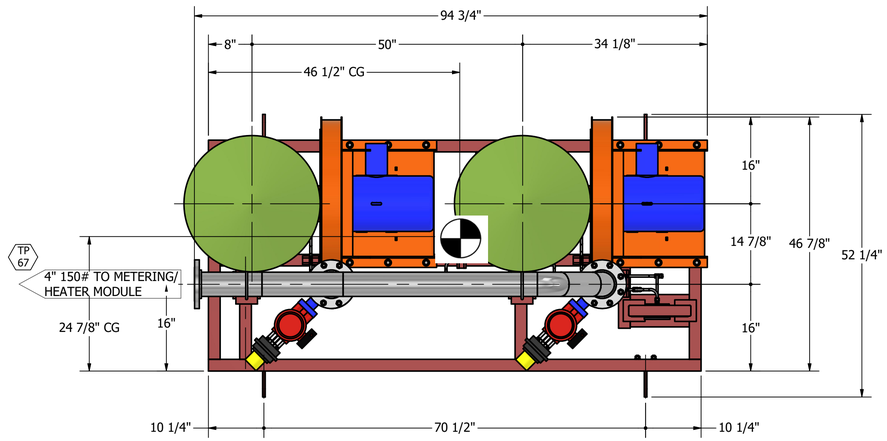
FUEL TECH™
Technologies to enable clean efficient energy
FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

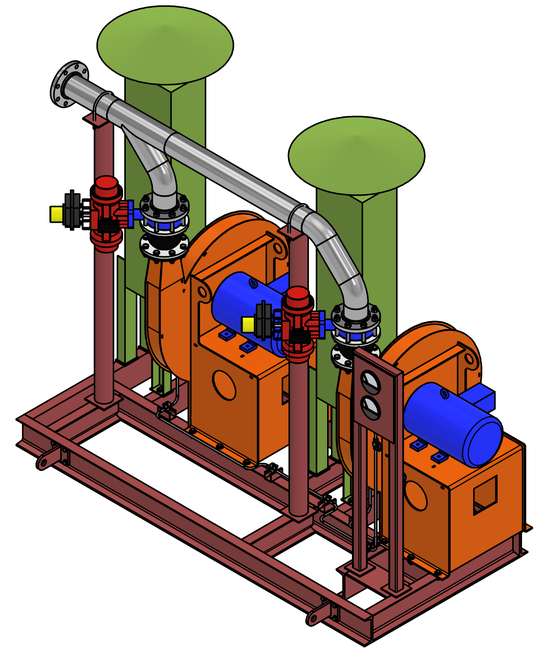
UC DAVIS MEDICAL CENTER

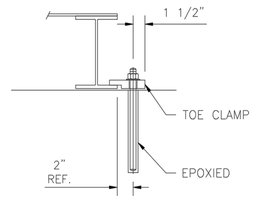
ULTRA SYSTEM
METERING AND HEATER MODULE

APPROVED BY:	K. KRAUSE
CHECKED BY:	A. TOPACIO
DRAWN BY:	D. GHILARDI
DATE:	7/29/22
SCALE:	NONE
SIZE:	D
DRAWING NO.	1294P-M03-01-GA-R3

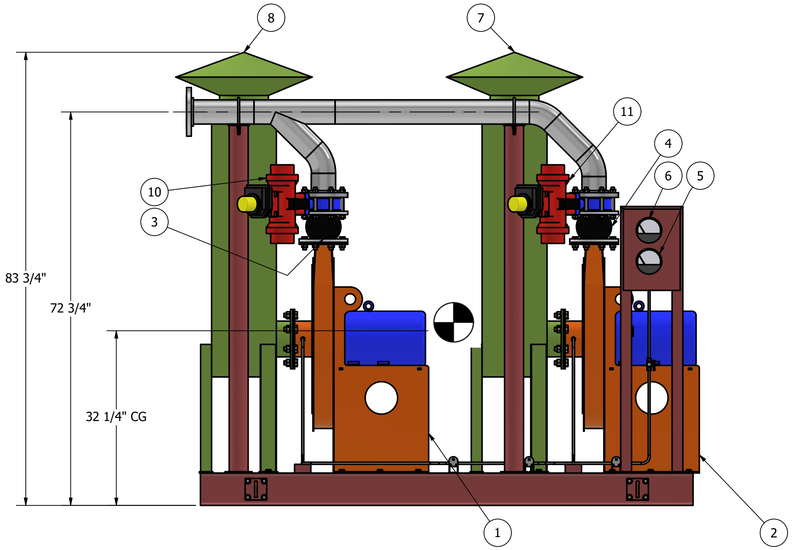
PARTS LIST		
ITEM	TAG	DESCRIPTION
1	B-DA-2204A	BLOWER 4"
2	B-DA-2204B	BLOWER 4"
3		EXPANSION JOINT 4"
4		EXPANSION JOINT 4"
5	PI-DA-2203B	PRESSURE GAUGE 1/8" MAGNEHELIC
6	PI-DA-2203A	PRESSURE GAUGE 1/8" MAGNEHELIC
7	SIL-DA-2201B	SILENCER
8	SIL-DA-2201A	SILENCER
9		SUPPORT FRAME 1294P-M03-02-FRM
10	AOV-DA-2209A	VALVE AUTOMATIC ON/OFF 4"
11	AOV-DA-2209B	VALVE AUTOMATIC ON/OFF 4"
12	HV-DA-2202B	VALVE BALL 3/8" COMP
13	HV-DA-2202A	VALVE BALL 3/8" COMP

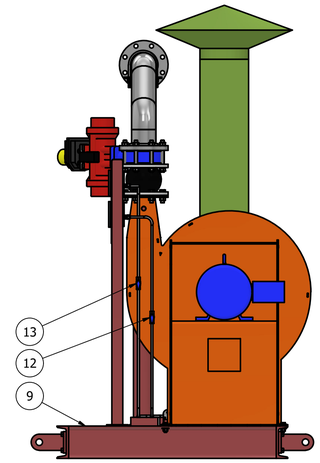






TYPICAL ANCHORAGE EXAMPLE





FULL ASSEMBLY WEIGHT IS 2,300 LBS
BLOWER W/MOTOR WEIGHT IS 428 LBS EACH
MOTOR WEIGHT IS 165 LBS EACH
SILENCER WEIGHT IS 175 LBS EACH

PRIME SUPPORT FRAME WITH ONE COAT OF RUST INHIBITING PRIMER AND APPLY ONE TOP COAT OF GRAY EXTERIOR ENAMEL.

TOLERANCE LEGEND (UNLESS NOTED)	NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY
.XX = ± .03"					
.XXX = ± .010"	3	1/19/23	ISSUE FOR FABRICATION	DG	AT
FRACTIONS = ± 1/8"	2	10/10/22	ADDED CENTER OF GRAVITY	DG	AT
ANGLES = ± 3°	1	9/26/22	CLIENT COMMENTS	DG	AT
CUSTOMER TIE - INS = ± 1/4"					

FUEL TECH™
Technologies to enable clean efficient energy
FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555

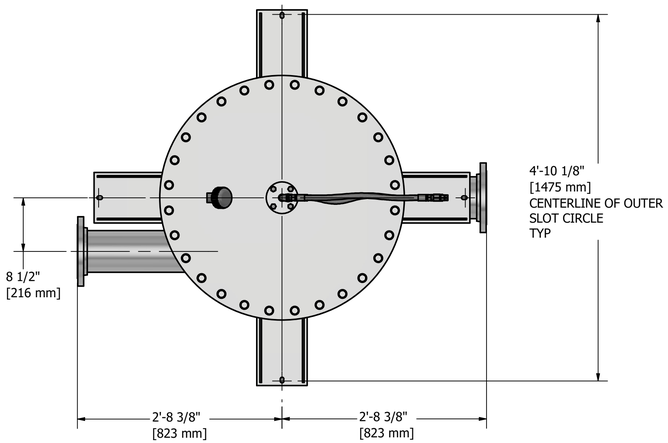
UC DAVIS MEDICAL CENTER

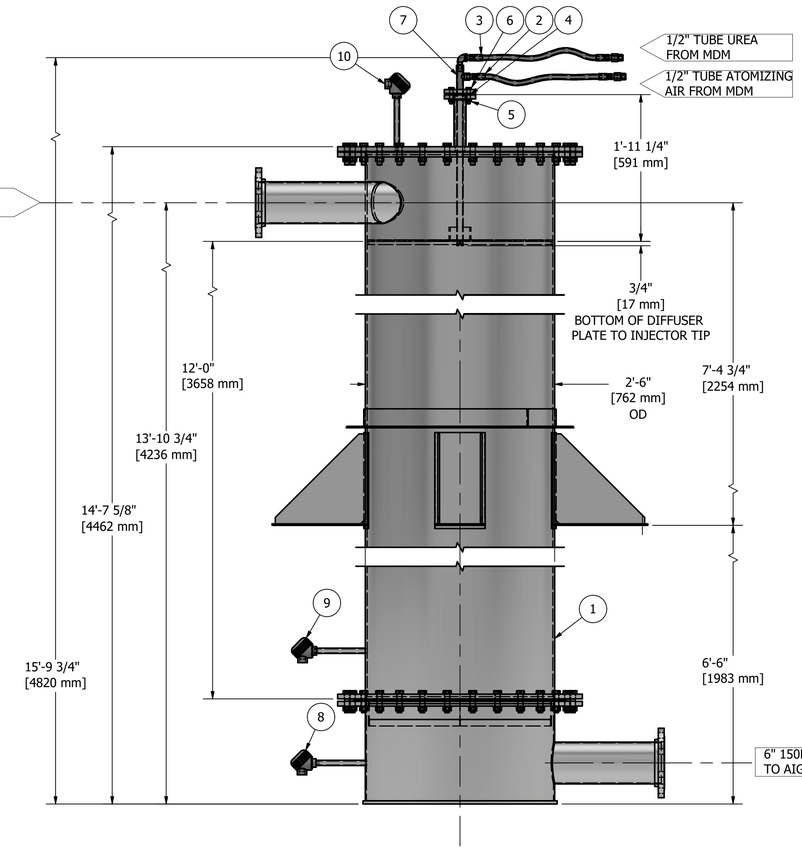
ULTRA SYSTEM BLOWER MODULE

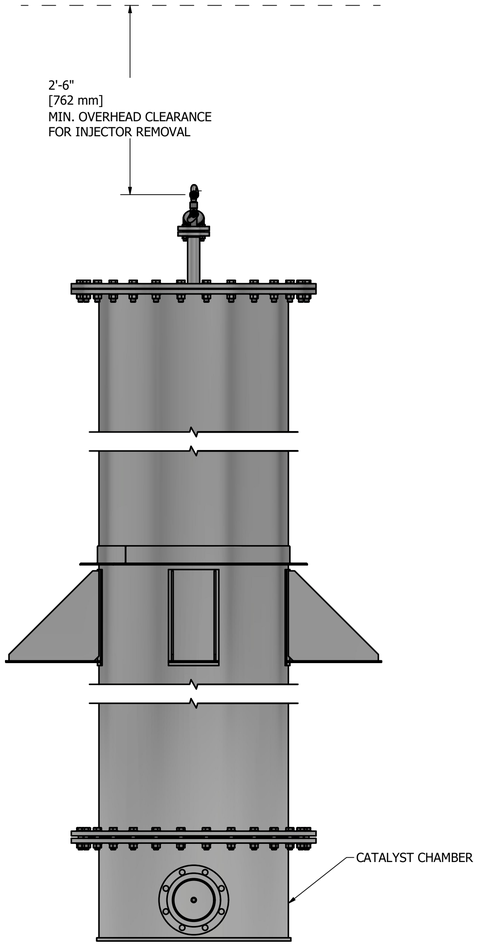
APPROVED BY: K. KRAUSE
CHECKED BY: A. TOPACIO
DRAWN BY: D. GHILARDI
DATE: 8/12/22
SCALE: NONE SIZE: D
DRAWING NO. 1294P-M03-02-GA-R3

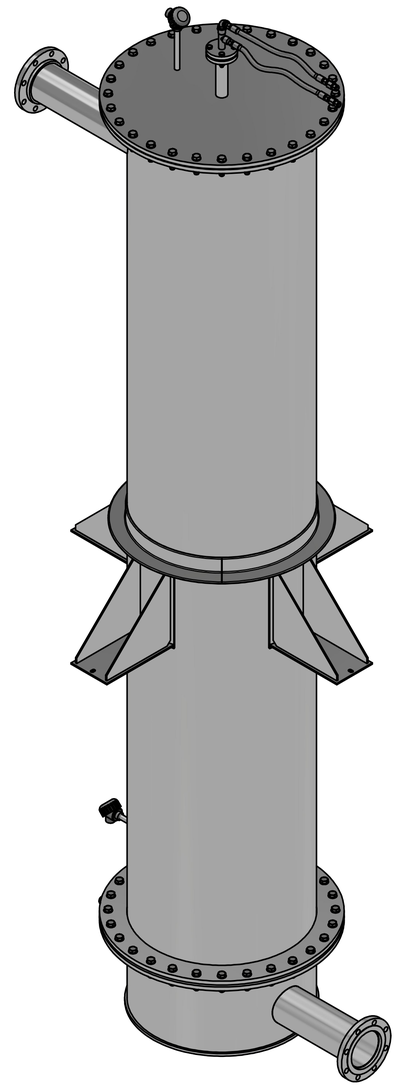
PARTS LIST			
ITEM	ITEM QTY	TAG	DESCRIPTION
1	1	DC-DAG-2251	DECOMPOSITION CHAMBER
2	1		FLEX HOSE - AIR
3	1		FLEX HOSE - UREA
4	1		GASKET 1 1/2" 150# KLINGER C-4401
5	4		HEX NUT 1/2" 18-8SS
6	4		HHCS 1/2" X 2 1/4" 18-8SS
7	1	INJ-UE-2254	INJECTOR
8	1	TE-DAG-2246	THERMOCOUPLE 1/2" FNPT
9	1	TE-DAG-2245	THERMOCOUPLE 1/2" FNPT
10	1	TE-DAG-2250	THERMOCOUPLE 1/2" MNPT

SHIP ITEMS LOOSE







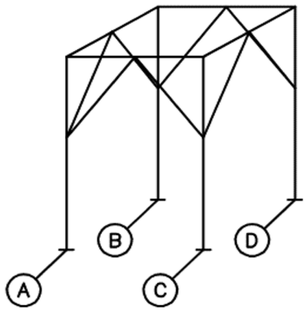


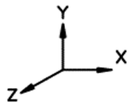
NOTES:
1. ESTIMATED WEIGHT 2000 LBS [907 KGS].

TOLERANCE LEGEND (UNLESS NOTED)						FUEL TECH™ Technologies to enable clean efficient energy FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555
.XX = ± .03"						
.XXX = ± .010"						
FRACTIONS = ± 1/8"						UC DAVIS MEDICAL CENTER
ANGLES = ± 3°	0	8/9/23	ISSUE FOR FABRICATION	DG	AT	
CUSTOMER TIE - INS = ± 1/4"	NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY	ULTRA SYSTEM DECOMPOSITION CHAMBER ASSEMBLY GENERAL ARRANGEMENT

APPROVED BY:	K. KRAUSE
CHECKED BY:	A. TOPACIO
DRAWN BY:	D. GHILARDI
DATE:	8/9/22
SCALE:	NONE
SIZE:	D
DRAWING NO.	1294P-M04-01-GA-R0

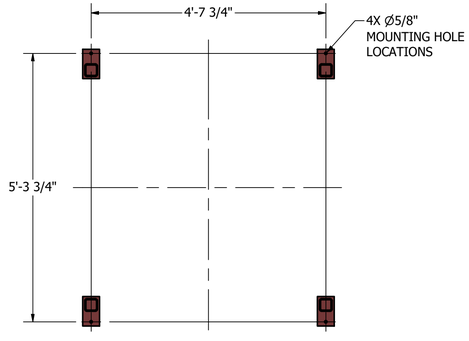
PARTS LIST		
ITEM	ITEM QTY	DESCRIPTION
1	1	DECOMPOSITION CHAMBER ASSEMBLY
2	4	HEX NUT 1/2" 18-8SS
3	4	HEX NUT JAM 1/2" 18-8SS
4	4	HHCS 1/2" X 1 3/4" 18-8SS
5	1	SUPPORT STRUCTURE
6	8	WASHER FLAT 1/2" 18-8SS



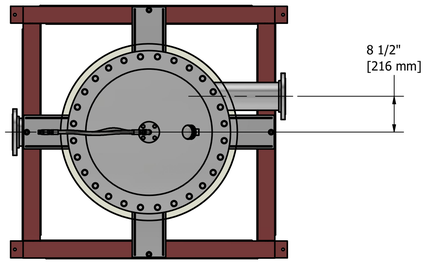


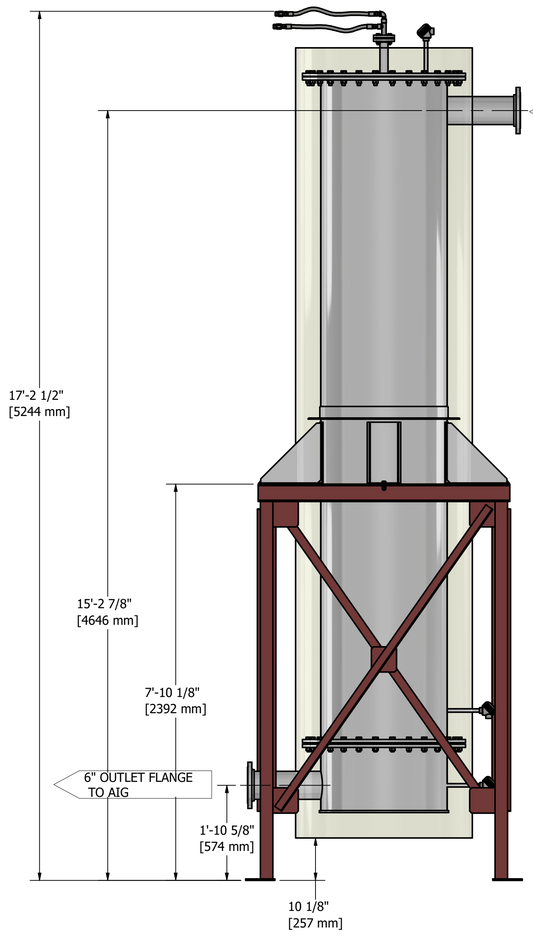
Load Table

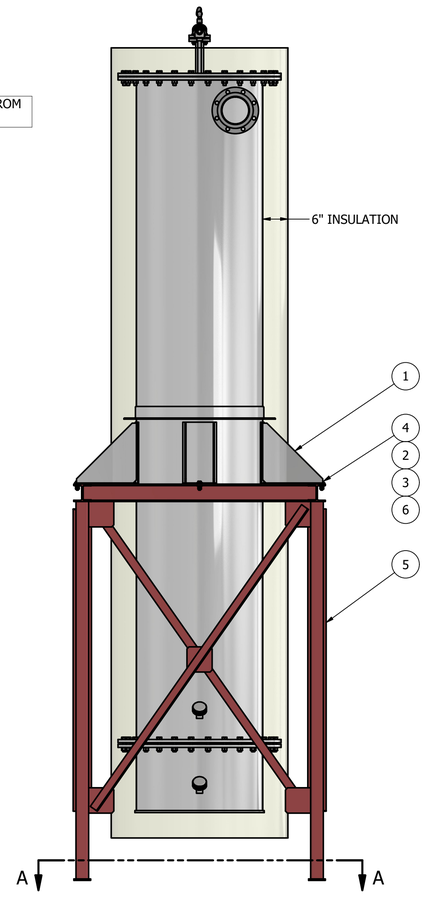
	Axis	Dead Load (kips)	Seismic +/- Vert. (kips)	Seismic +/- X (kips)	Seismic +/- Z (kps)
A	X	0.01	0.00	0.16	0.16
	Y	-0.77	0.08	0.77	0.59
	Z	0.01	0.00	0.00	0.16
B	X	0.01	0.00	0.16	0.16
	Y	-0.77	0.08	0.77	0.59
	Z	-0.01	0.00	0.00	0.16
C	X	-0.01	0.00	0.16	0.16
	Y	-0.77	0.08	0.77	0.59
	Z	0.01	0.00	0.00	0.16
D	X	-0.01	0.00	0.16	0.16
	Y	-0.77	0.08	0.77	0.59
	Z	-0.01	0.00	0.00	0.16

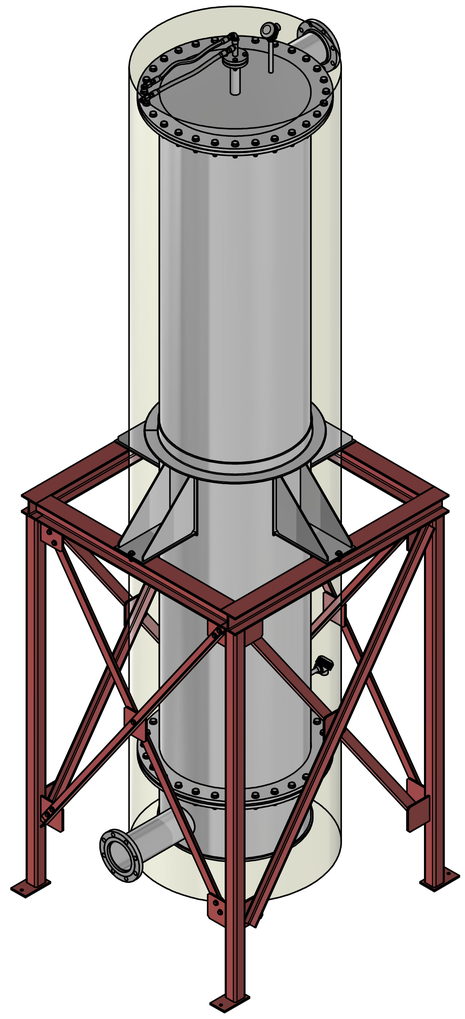


SECTION A-A









NOTES:
1. ESTIMATED WEIGHT = 2,800LBS

PRIME SUPPORT FRAME WITH ONE COAT OF RUST INHIBITING PRIMER AND APPLY ONE TOP COAT OF GRAY EXTERIOR ENAMEL.

TOLERANCE LEGEND (UNLESS NOTED)						FUEL TECH™ Technologies to enable clean efficient energy	APPROVED BY: K.KRAUSE
							CHECKED BY: A. TOPACIO
.XX = ± .03"							DRAWN BY: D. GHILARDI
.XXX = ± .010"						FUEL TECH, INC. 27601 BELLA VISTA PKWY, WARRENVILLE, IL 60555	
FRACTIONS = ± 1/8"	1	1/3/23	ISSUE FOR FABRICATION	DG	AT	UC DAVIS MEDICAL CENTER	DATE: 8/16/22
ANGLES = ± 3°	0	8/16/22	ADDED LOAD TABLE	DG	AT		SCALE: NONE SIZE: D
CUSTOMER TIE - INS = ± 1/4"	NO.	DATE	REVISIONS	DRAWN BY	CHECKED BY	ULTRA SYSTEM DECOMPOSITION CHAMBER AND SUPPORT STRUCTURE GENERAL ARRANGEMENT	DRAWING NO. 1294P-M04-10-GA-R1

Application of Thermal Insulation & Lagging

ULTRA 5 &10 Decomposition Chamber

Effective Date: 21-Mar-2025

AUTHORSHIP

Prepared by: Eric Eichler — Date: 21-Mar-2025
Sr Manager, Project Engineering

GUIDELINE APPROVAL

The following are responsible for reviewing and approving the technical content of this guideline.

Approved by: _____ Rev 0
VP, Worldwide Engineering)

Approved by: _____ Rev 0
(Sr. Manager, Project Engineering)

Approved by: _____ Rev 0
(Director, Project Engineering)

Approved by: _____

Approved by: _____

NOTICE: All Modifications to this Document require new reviews, approvals, and sequential advancement of the Revision Number (i.e. new cover page) with proper updating into the Best Practices directory with adequate announcement of the revision within FTI.

1.0 SUMMARY OF GUIDELINE

The purpose of this Fuel Tech Project Execution Guideline is to provide guidance for Project Execution personnel along with instructions to installation contractors regarding the shop application (or field installation) of thermal insulation & lagging. Use of the guidelines provided will result in consistent and adequate insulation work across the range of components & systems in Fuel Tech's product line.

2.0 INSTRUCTIONS

Note that this document (**Guideline 2.2.1.15H**) is specifically intended to be used with the **ULTRA 5 & ULTRA 10 Decomposition Chambers**. Other components will have their own separate guideline document.

Note that this document provides specific guidance for the thickness and type of insulation for a Decomposition Chamber based on its typical application. In other special situations, please refer to the separate Fuel Tech Work Instruction 2.2.1.3, which can be used for the following tasks:

- Estimate heat losses
- Determine required insulation thickness
- Size electric heat tracing for freeze protection

3.0 INSULATION SPECIFICATION GOALS

The goal of this document is to provide the following information for both the thermal insulation and protective lagging systems:

1. Convey the Scope of the specification, including the work boundaries.
2. Provide the General Conditions, including the packaging requirements.
3. Specify the Materials to be installed.
4. Stipulate the Application methods.

If all of the defining information is provided for the four (4) Goals above, Fuel Tech expects that substantial advantages will be gained.

- The specification will eliminate misunderstandings that could impact or delay the project during installation, start up, and commissioning.
- The specification will allow for a faster bidding process, along with an easier evaluation of the bids since all potential suppliers will be proposing the same work.
- The specification can function as part of the contract for the work.
- The specification can be used as historical reference material for future work.
- The specification can be used at the insulator shop or jobsite to monitor the work during installation, even by non-experts in the insulation field.

4.0 SCOPE OF INSULATION & LAGGING

The boundaries of the ULTRA 5 & 10 Decomposition Chamber are shown in the example sketch below. A complete drawing (full size) of the exact decomposition chamber equipment marked with the boundaries and special notations will be issued as an attachment to the specification.

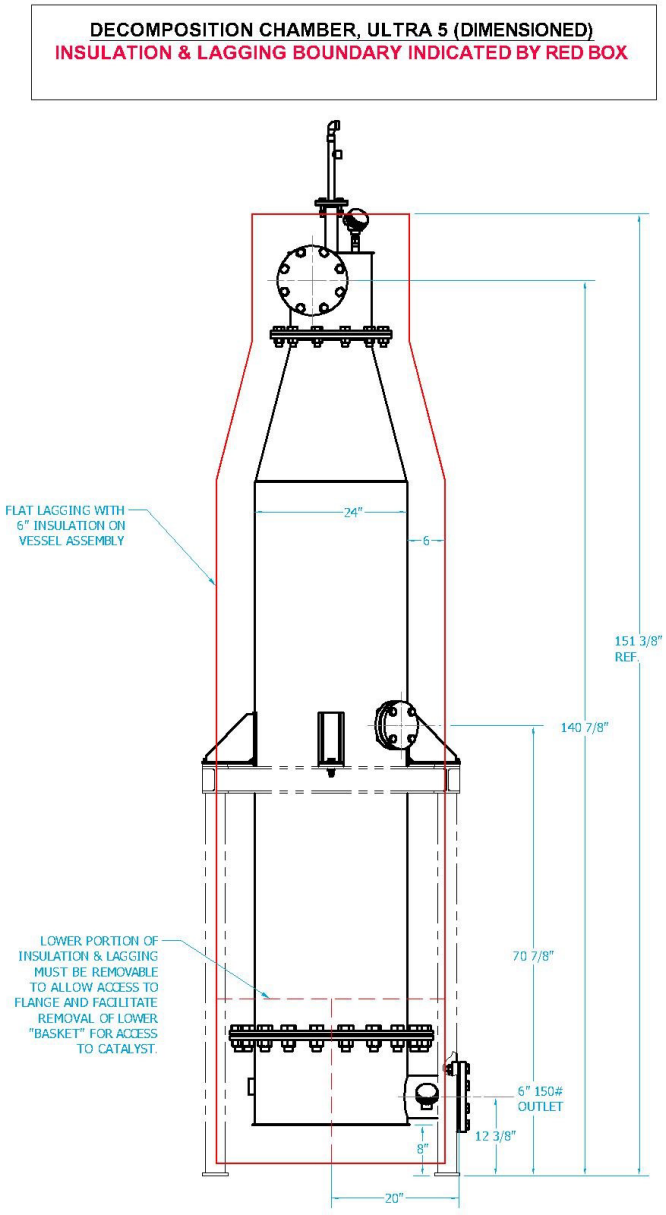


Fig. 1 – Example Drawing: ULTRA 5 Decomposition Chamber Insulation Boundaries

A description of the Insulation & Lagging boundaries is as follows:

- Insulation & Lagging to be installed on all sides of the Decomposition Chamber.
- The insulation & lagging boundary will include the areas around the support flanges and instrument penetrations.
- The insulation & lagging needs to encompass the inlet & outlet transition sections to a point within 4" (100mm) of the Inlet & Outlet Pipe Flange faces. The insulation is held back 4" in this area to provide for enough space for the connection bolts during the site installation.
- No vertical lagging cap is to be installed on the end of the insulated area near the Inlet & Outlet Pipe Flanges. The field installed lagging & insulation will continue from the exposed end.
- The bottom section of the insulation and lagging must be applied with clear joints and with reusable, modular sections which can be removed to access the large flange in order to allow for entry to the catalyst "basket".

5.0 GENERAL CONDITIONS

The Decomposition Chamber will be field installed (by others) at an industrial site as part of an Air Pollution Control system. The final location is an outdoor installation. The ambient conditions will include full weather exposure during year round operation. All lagging must be designed to eliminate water intrusion and accumulation via the use of sloped surfaces, overlapping seams, and high temperature silicone caulking.

The expected operating conditions of the decomposition vessel are as follows (exact operating conditions for the specific equipment will be verified by Fuel Tech):

Process:	Hot Process Gas
Inlet Temperature:	850°F (454°C)
Outlet Temperature:	550°F (288°C)
Internal Pressure:	1.2 PSIG (8.3 kPa)
Materials of Construction:	304 S.S. fabricated chamber, supported by mild steel structure.

The estimated weight of the Ultra 5 Decomposition Chamber is as follows (exact weights for the specific equipment will be verified by Fuel Tech):

Decomposition Chamber:	2,050 Lb. (930 kg.)
Estimated Insulation/Lagging Weight:	630 Lb. (286 kg.)
Total Finished Weight:	2,680 Lb. (1,216 kg.)

The shipping arrangements of the decomposition chamber (as received from the fabricator), will need to be verified for each project. An example is as follows:

Typ. Packaging:	Due to the very large size of the typical decomposition vessel (over 13.5' long), the assembly will be shipped laying down on wooden cribbing.
Handling:	The vessel will incorporate allowances for handling via forklift or by crane using appropriate lifting straps.
Shipment:	Due to its large size, the decomposition chamber will be shipped on a flatbed truck with proper tarping or weather protection.

6.0 MATERIALS SPECIFICATION

Thermal Insulation Materials (ALL LAYERS):

Type:	Mineral Wool Blanket
Mfg.:	Owens Corning, Johns-Manville (or equal, as approved by Fuel Tech).
Style:	Thermafiber Industrial (or equal, as approved by Fuel Tech).
Classification Temp.:	1200°F (650°C) Minimum
Density:	8 Lb./Ft^3 (128 kg/M^3)
Thickness:	2" (50mm)
Board Size:	24" x 48" (or similar) (600 x 1200mm) Boards Note: The use of mandrel-wound half circle (preformed & slit) insulation sections for large pipe sizes is also permitted.
Total Thickness:	6" (200mm), Applied in (3) staggered layers on all sides.

Insulation Installation Materials (INNER LAYERS):

Metal Wire:	Annealed & Galvanized Iron Wire, 16 Ga. (1.5mm)

Insulation Installation Materials (OUTER LAYER):

Metal Strapping:	304 S.S., ½" x 24 Ga. (12mm x 0.6mm) with stainless steel staple clips.

Lagging Materials:

Type:	Flat Aluminum Lagging
Style:	Smooth Finish
Material:	Aluminum, A-3003 or A-3105, H-14 Temper, 0.040" (1 mm) Thk.
Edges:	Finished with formed (calendered) and beaded safety edges, with seams overlapping by 2" (50 mm).

Lagging Installation Materials:

Screws:	14 Ga. x 1" long, Type AB point self-tapping or Tek self-drilling. Screws to be zinc-plated, hex head, with neoprene washer bonded to a pan-shaped stainless steel washer (min. 20 Ga.).
Escutcheon Plates:	"Rosette" seal plates constructed of 0.040" lagging material, cut to fit tightly around all lagging penetrations. Includes 1/2" (12mm) finished (folded) safety edges.
Caulking:	RTV Silicone Sealant, Silver Color, rated for a minimum of 350°F (177°C) operating conditions.

7.0 APPLICATION METHODS SPECIFICATION

7.1 Thermal Insulation Application:

1) Insulation is to be installed on all sides and top and bottom of the decomposition chamber.

2) The insulation installer shall not weld plates or anchors to the chamber walls.

3) The insulation needs to encompass the inlet & outlet transition sections to a point within 4" (100mm) of the Inlet & Outlet Pipe Flange faces. The insulation is held back 4" in this area to provide for enough space for the connection bolts during the site installation.

4) For the multi-layer insulation, the insulation panels (blankets) are to be wrapped around the diameter of the chamber and secured. For all inner layers, the insulation is secured with galvanized iron wire to be stretched and bound at vertical pitch intervals of approx. 12" (300mm). For the outer layer, the insulation is secured with stainless steel strapping to be stretched and mechanically fastened at vertical pitch intervals of approx. 12" (300mm). This will result in (2) fastening wraps on each 24" (600mm) insulation panel.

5) The head-on joints of all layers must be tight and closely matched. Staples are to be used to secure the joint closed.

6) The stagger between the insulation joints (both vertical & horizontal joints) should be a minimum of 6" (150mm) for all layers.

7) All insulation pieces must be firmly butted together with no gaps. Loose batts of ceramic fiber are to be used to fill all spaces around protruding Instrument ports, Stiffening ribs, Lifting lugs, Support Legs, Nameplate Bracket, etc.

8) Allow for sections of removeable insulation for any flanged instrument port which does not protrude beyond the outer lagging. At least one additional spare port is located near the top of the chamber, below the injection nozzles.

7.2 Protective Lagging Application:

1) Lagging is to be installed on all sides of the decomposition chamber.

2) The lagging installer shall not weld plates or anchors to the chamber walls. .

3) All lagging must be installed for an outdoor application and the joints must be sealed from rain intrusion. The lagging sheets must always be mounted in a “weatherboard” style with overlaps in the direction of slope to shed water. .

4) All lagging panels and curved sections are to have formed (calendered) and beaded safety edges for rigidity, with seams overlapping by 2” (50 mm). Install with screws at a spacing of approx. 6” (150mm) with sealant.

5) Joints in the lagging shall be staggered a minimum of 6” (150mm) from the joints in the outer layer of insulation.

6) The lagging needs to encompass the inlet & outlet transition sections to a point within 4” (100mm) of the Inlet & Outlet Pipe Flange faces. The lagging is held back 4” in this area to provide for enough space for the connection bolts during the site installation. No vertical lagging caps are to be installed on the end of the insulated area. The field installed lagging & insulation will continue from the exposed end.

7) Provide removable escutcheon plates (“rosettes”) with 1/2” (12mm) finished (folded) safety edges around all lagging penetrations (Support Legs, Lifting lugs, Nameplates, Instrument Ports, etc.). Install with screws & sealant and caulk the joints against water intrusion.

8) Allow for sections of removeable lagging for any flanged instrument port which does not protrude beyond the outer lagging.

7.3 Fuel Tech Field Inspections:

There will be four inspection hold points for verification of the insulation and lagging. Due to the schedules and travel time, Fuel Tech may elect to conduct some of these inspections under “virtual conditions”; conducted via photographs taken of the work by the installer and submitted to Fuel Tech for approval before the work can proceed. These hold points will be as follows:

1) Fuel Tech Initial Inspection: After the decomposition chamber is erected in the field. The material specifications for all insulation & lagging materials will be verified.

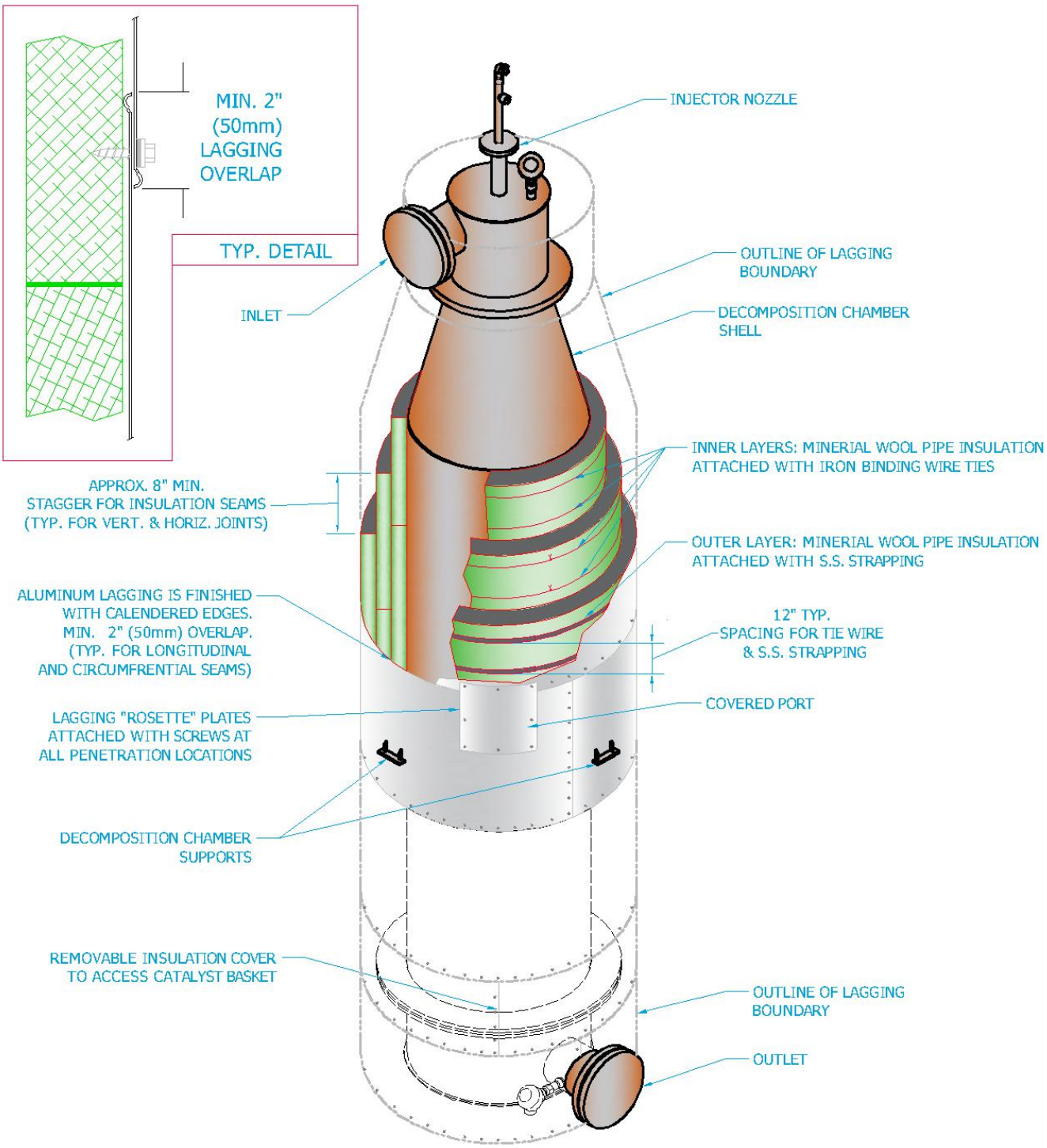
2) Fuel Tech Follow-up Inspection: After the 1st layer of insulation is complete, but before the 2nd layer is fully finished. In addition to the general quality of work, Fuel Tech's inspection will focus on the seams and overlaps between the insulation blankets, binding wire installation, and the presence of any gaps.

3) Fuel Tech Follow-up Inspection: After installation of final layer of insulation. In addition to the general quality of work, the inspection will focus on insulation strapping installation, stagger of seams, and overlap of layers. In addition, the application of the thermal break ceramic paper on the screwing strips will be verified.

4) Fuel Tech Final Work Inspection: Final inspection at completion of work. In addition to the general quality of work, Fuel Tech's inspection will focus on the installation of lagging (especially sloped sections on the top surfaces), seal plates, edge flashing, and the presence of caulked seams to prevent water intrusion.

8.0 ATTACHMENTS

1) Reference Sketch 2.2.1.15B (Decomposition Chamber Insulation Method)
2) Reference Photograph #1– Uninsulated Decomp. Chamber (As Shipped)



FUEL TECH REF. SKETCH 2.2.1.15B (ULTRA 5) (DECOMPOSITION CHAMBER INSULATION METHOD)

Ref. Photo #1 –Uninsulated ULTRA 10 Decomposition Chamber (As Shipped)

9.0 REVISION BLOCK

REVISIONS			
Rev	Approval	Detail	
0		Initial Release	
#			

QUOTATION

LISEGA Inc
370 East Dumplin Valley Road
Kodak, TN 37764
Tel: (865) 940-5200

DATE March 2, 2023

TO:

ATTN:
PH:
E-MAIL:

LISEGA QUOTATION NO: 32934 (Addendum 1)
LISEGA PROJECT ID: 23B-30413
CUSTOMER INQUIRY NO: IEC / UCD

PAYMENT TERMS: Net 30 days after shipment.	**QUOTATION & SHIPMENT VALIDITY:** Quotation price is valid for 30 days. Quoted shipment is valid for 7 days.	**SHIPPING TERMS OF SALE:** Ex Works, Kodak, TN (Pre-Paid and Add) (Not included in quotation price)	**ESTIMATED SHIPPING WEIGHT: 327 pounds** (pallets & supports)
SPECIFICATION: See Below	**SHIPMENT:** Drawings – Attached Material - 3 weeks after receipt of PO (or after drawing approval if applicable).	**PRICING FIRMNESS:** Pricing is firm based upon a complete release to proceed within the validity and shipment of hangers within the quoted shipment schedule.	**LABOR & MATERIAL: Yes**

ITEM	QUANTITY	SCOPE OF SUPPLY	PRICE (US DOLLARS)
1	LOT	Scope of Supply is based upon drawings provided with the RFQ for two (2) variable spring supports w/ PTFE load flanges and one (1) variable spring hanger with stainless steel clamp. See attachments to confirm items to be supplied.	**$1,215.00 TOTAL**

Attachments: Price Breakdown, (3) LICAD Drawings, LISEGA Terms & Conditions

Exceptions/Clarifications:

1. This quotation is based upon furnishing LISEGA's standard products/material in accordance with B31.1, B31.3, MSS-SP58, along with LISEGA's standard coatings/finishes, manufacturing procedures and tolerances.

2. Material Test Reports are not included in this quotation. A Certificate of Compliance can be provided for an additional charge of $120.00 per shipment.

3. To meet the quoted ship date above and offer our most competitive price, this quotation is based upon supplying LISEGA stock materials with the following coatings:
   - LISEGA's standard finish of electro galvanizing on variable spring casings and all threaded hanger hardware.
   - Spring coils are provided with our standard baked epoxy coating.
   - Weld-on attachments are provided with one coat of our standard weldable primer.
   - Stainless steel clamp is provided raw finish, no additional coating.

4. Our Quotation is based upon stock materials subject to prior sale.

Commercial questions should be directed to the Regional Sales Manager and Technical questions to the Estimator below.

Regional Sales Manager:	Fritz Hornbogen	Contact Info:	Tel: 404-386-2232	E-Mail: fritz.hornbogen@us.lisega.com

SQF 01/2010

THIS QUOTATION IS BASED ON THE ATTACHED LISEGA TERMS AND CONDITIONS

Erik Perry
Estimator
(865) 940-5324
e-mail: erik.perry@us.lisega.com

Cathy Loveday
Estimating Supervisor
(865) 940-5322
e-mail: cathy.loveday@us.lisega.com

cc: A. Witte, F. Hornbogen, T. Hester, File

Attachment 1

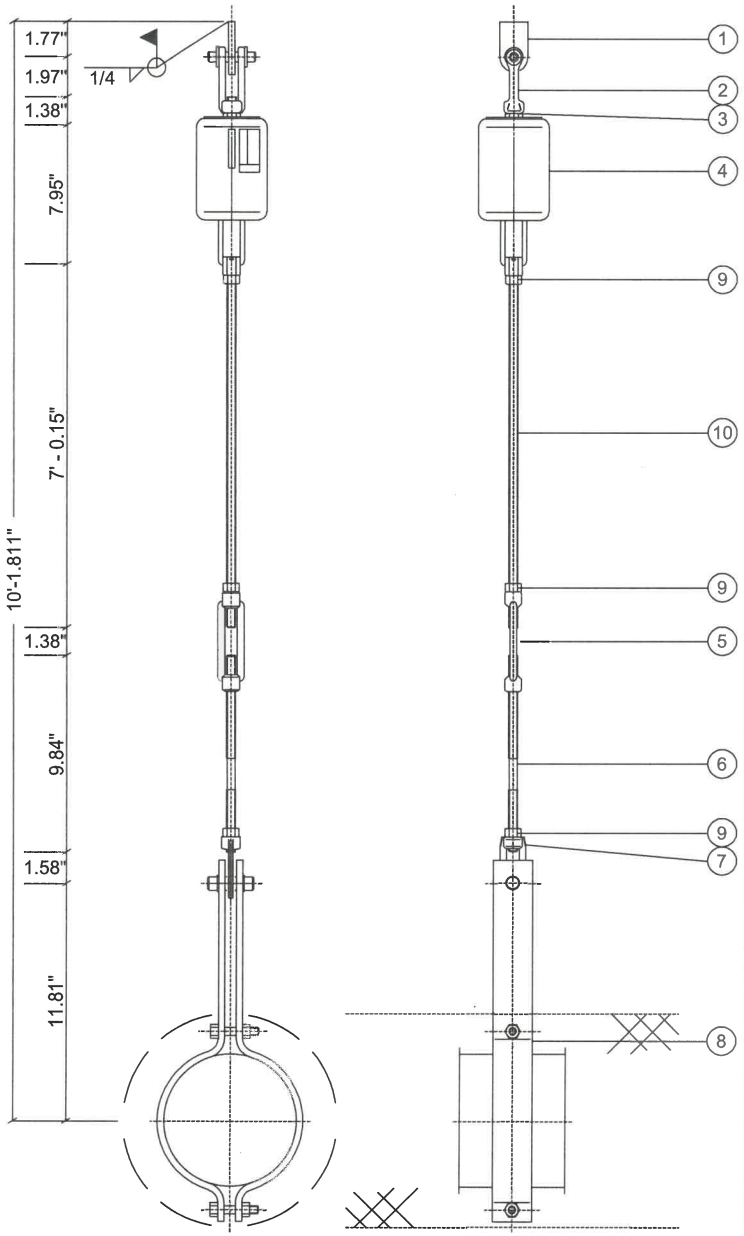
LISEGA Quotation No. 32934
Addendum 1

Price Breakdown

Hanger Mark	Quantity	Price/Each	Total
5PS1	1	$ 570.00	$ 570.00
6PS1	1	$ 250.00	$ 250.00
6PS3	1	$ 395.00	$ 395.00

Grand Total	$ 1,215.00

Itemized pricing is based upon the supply of total quantities quoted and shall not to be construed as separate offerings. LISEGA's pricing is based upon the overall cost to provide the entire scope of supply quoted. Any additions, deletions or modifications to existing scope of supply will likely alter the individual pricing of all quoted items.



PRELIMINARY

Pos.	Description	Type	[inch]	Qty.	lbs	Material
10	Threaded rod	672523	(84.1)	1	3.77	Carbon Steel
9	Hexagonal nut	632918	1/2"	3	0.13	Carbon Steel
8	Three bolt clamp	2-L189SS-6	D6.63	1	7.89	A240-T304
7	Eye nut	602922		1	0.22	Carbon Steel
6	Tie rod l/r	652123		1	0.44	Carbon Steel
5	Turnbuckle	622922		1	0.44	Carbon Steel
4	Variable spring hanger	211128		1	4.63	
3	Threaded stud	672123	1.4	1	0.07	Carbon Steel
2	Clevis with pin	612922		1	0.44	Carbon Steel
1	Weld-on eye plate	752112		1	0.29	Carbon Steel
					18.32	

5PS1

Input F(H) =	226 lbs
F(H) =	238 lbs
F(C) =	272 lbs
F(P) =	272 lbs
later.=	0.00 inch
horiz.=	0.00 inch
vert.=	0.36 inch
Ø OD =	6.63 inch
Insul=	2.00 inch
Temp.=	925 °F
ΔF =	14 %
Spring rate =	95.135 #/in
tot Tvl =	1.97 inch
Preset=	1.85 inch
tri Tvl =	0.36 inch
Tvl res dn/up=	0.12/1.50 inch

Customer :
IEC
Plant / System :
UCD
Ammonia
P.O. N° :

Order no.:

LISEGA Offer N°:
0-8-0 0

LICAD Dwg.- N° Rev.
55-3-77618

N & T Consulting
Angel Tse
Drawing N° :
5PS1

Project manager 30/12/1899
Angel Tse

Checked:

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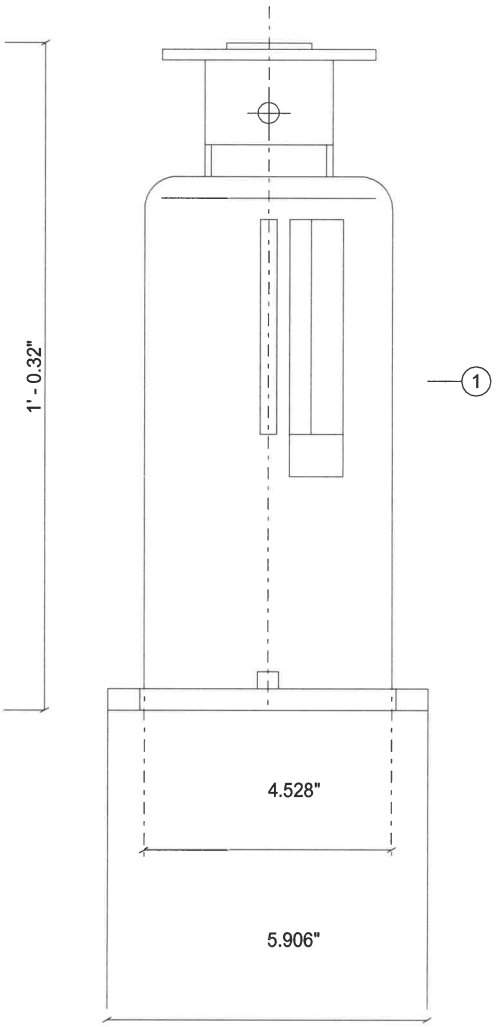
Vers. 10.3.0.81
Standard Supports 2020 US



Pos.	Description	Type	[inch]	Qty	lbs	Material
2	Preset cost	919202		1	0.00	
1	Spring support with Slide	292216		1	16.75	
					16.75	

6PS1

Input F(H) =	456 lbs
F(H) =	456 lbs
F(C) =	349 lbs
F(P) =	349 lbs
later.=	0.00 inch
horiz.=	0.00 inch
vert.=	-1.13 inch
Ø OD =	6.63 inch
Insul=	2.00 inch
Temp.=	925 °F
ΔF =	24 %
Spring rate =	95.135 #/in
tot Tvl =	3.94 inch
Preset=	1.69 inch
tri Tvl =	-1.13 inch
Tvl res dn/up=	1.14/1.69 inch

Customer :
IEC
Plant / System :
UCD
Ammonia
P.O. N° :

Order no.:

Project manager 02/03/2023

LISEGA

LISEGA Offer N°:
32934-8-0 0

LICAD Dwg.- N° Rev.
356-3-41196

Lisega
Erik Perry
Drawing N° :
6PS1

Checked:

Z:\Erik Perry\NT Consulting\32934\ - Project : Default

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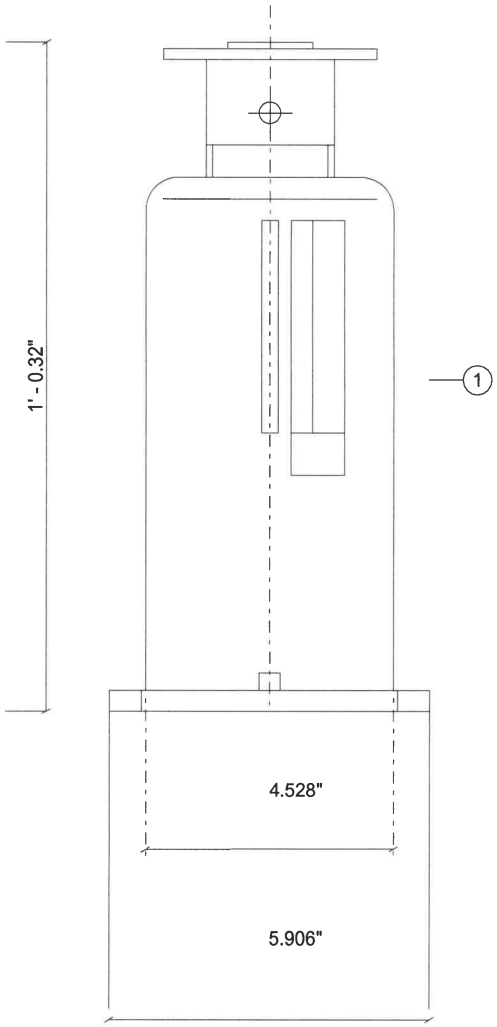
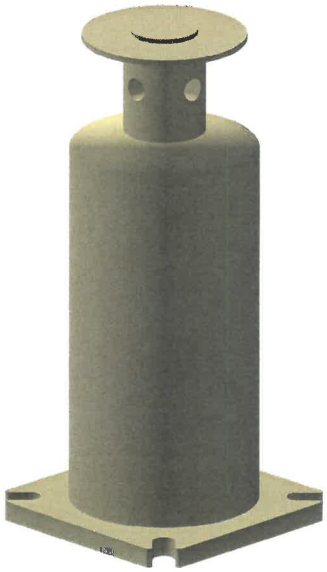
Vers. 11.1.0.125
Standard Supports 2020 US





2	**Preset cost**	**919202**		**1**	**0.00**	
1	**Spring support with Slide**	**293216**		**1**	**18.52**	
					18.52	

Pos.	Description	Type	[inch]	Qty	lbs	Material

6PS3

Input F(H) =	1016 lbs
F(H) =	1016 lbs
F(C) =	1084 lbs
F(P) =	1084 lbs
later.=	0.00 inch
horiz.=	0.00 inch
vert.=	0.36 inch
Ø OD =	0.00 inch
Insul=	2.00 inch
Temp.=	32 °F
ΔF =	7 %
Spring rate =	190.270 #/in
tot Tvl =	3.94 inch
Preset=	3.70 inch
tri Tvl =	0.36 inch
Tvl res dn/up=	0.24/3.35 inch

LISEGA

Customer :
IEC
Plant / System :
UCD
Ammonia
P.O. N° :

Order no.:

LISEGA Offer N°:
32934-8-0 0

LICAD Dwg.- N° Rev.
357-3-41196

Lisega
Erik Perry
Drawing N° :
6PS3

Project manager 02/03/2023

Checked:

Z:\Erik Perry\NT Consulting\32934\ - Project : Default

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Vers. 11.1.0.125
Standard Supports 2020 US

LISEGA Inc. Terms and Conditions of Sale

1. **TERMS OF CONTRACT:** Any contract entered into between the parties is expressly made subject to the terms and conditions stated herein. None of the terms and conditions contained herein may be added to, modified, superseded or otherwise altered except by Seller, and all orders received by Seller shall be governed only by the terms and conditions contained herein, notwithstanding any terms and conditions which may be found in any purchase order, release order, or any other form issued by the Buyer. Seller hereby objects to said terms and conditions and notifies Buyer that they are rejected.

2. **DELIVERY:** Unless otherwise specified on the face hereof, all deliveries are in accordance with International Commercial Terms (INCOTERMS) prevailing at the time of shipment. Shipment will be made in accordance with instructions issued by Seller's traffic department. Upon delivery of goods covered hereunder to carrier, Buyer assumes risk of all loss and damage resulting from any cause whatsoever. Shipping dates are approximate and are not guaranteed. Seller reserves the right to ship and invoice for a quantity of goods which may vary up to ten percent over or under the quantity specified and Buyer agrees to accept delivery and pay for such revised quantity and consider the shipment to be complete. Any defect in quality or delays in delivery shall not affect the balance hereof. Partial deliveries shall be accepted by the Buyer and paid for at contract prices and terms. Seller may deliver the goods ordered hereunder in advance of the delivery date and shall be entitled to a prompt payment of invoices in accordance with the clause entitled "INVOICING AND PAYMENT."

All goods shipped will be carefully examined, counted and packed. Claims for shortages must be submitted within ten (10) days of receipt.

3. **WARRANTY:** Seller warrants for a period of two (2) years from time of commencement of commercial operation, 8,000 operating hours, or five (5) years after shipment, whichever is less, that all products upon delivery to Buyer are free from defects in workmanship and material and shall conform to the specifications. If any product is defective in material or workmanship or fails to meet the requirement of the order, Buyer shall promptly inform Seller and return each product for correction or replacement in their original containers. Seller's liability for such rejected products being limited solely to the cost of transportation expenses in returning the goods to the Buyer plus the responsibility of repairing or replacing such returned products.

This warranty does not extend to any of our products which fail to operate by reason of improper installation, use not in accordance with Seller's descriptive literature and/or specifications, application, or inspection, or have been subject to misuse, neglect, or accident, or have been repaired or substantially altered outside of our factory.

THE WARRANTIES SET FORTH IN THIS CLAUSE ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER STATUTORY, EXPRESS OR IMPLIED, AND THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND ALL OTHER WARRANTIES ARISING FROM COURSE OF DEALING OR USAGE OF TRADE ARE HEREBY EXCLUDED. The remedies provided herein are Buyer's sole and exclusive remedies for any failure of Seller to comply with its warranty obligations. Correction of the nonconformities in the manner and for the period of time provided herein shall constitute complete fulfillment of Seller's obligations regarding defective articles, whether the claims by the Buyer are based in contract, in tort (including negligence) or otherwise.

For special order goods fabricated in accordance with buyer's specifications this warranty applies only to compliance with specifications. There is no warranty with regard to performance.

4. **PRICES AND DESIGNS:** All prices and designs are subject to change without notice. Prices are in US dollars, Ex Works, Point of Shipment, excluding packaging, unless otherwise agreed to by the parties.

5. RETURNS: Returns will not be honored without a prior return authorization from Seller. Material authorized to be returned must be received in first class condition or a reconditioning charge will be assessed. A forty percent (40%) restocking charge will be assessed for returned goods as well as transportation charges not paid for by Buyer. Special order goods that cannot be sold in the normal course of Seller's business may not be returned.

6. INVOICING AND PAYMENT TERMS: Payment of invoices is net 30 days from the date of invoice, unless otherwise agreed. All payments are to be in US dollars.

7. TAXES: All taxes applicable to the goods shall be in addition to the purchase price unless Buyer, in advance of invoicing, provides Seller with an exemption certificate.

8. **DAMAGE LIMITATION:** Neither seller nor any of its manufacturers or suppliers will be liable to Buyer for lost revenues, lost profits or other special, incidental, indirect or consequential damage or for loss, damage or expense directly or indirectly arising from Buyer's or any other party's use of or inability to use the goods or software either separately or in combination with other equipment or for commercial loss of any kind whether or not seller has been advised of the possibility of such damage or loss nor shall any recovery against seller, whether in contract, tort including negligence, strict liability or otherwise be greater in amount than the purchase price of the specific goods, software or services sold. The Seller shall not be liable for any damages to persons or property caused directly or indirectly by the fault or negligence of Buyer, owner or their affiliates, agents or employees.

9. **PROPRIETARY INFORMATION; CONFIDENTIALITY:** Buyer shall treat all information furnished by Seller in connection with this order or performance hereunder as confidential and shall not disclose or use any such information for any purposes other than performance under this order without the express written permissions of Seller. For purposes of this Clause, "information" includes but is not limited to parts, equipment, tools, gauges, patterns, drawings, specifications, instructions, methods, processes, concepts, manuals, data (whether in human or machine-readable form), or other documents.

10. PATENTS, COPYRIGHTS, TRADEMARKS: Seller does not by reason of this contract grant to the Buyer any licenses under any patent, copyright or trademark heretofore obtained by Seller unless clearly an item of delivery under this order and for which Seller has been separately compensated.

11. **FORCE MAJEURE/AVAILABILITY OF RAW MATERIALS:** Seller shall not be liable for delays in delivery or failure to manufacture or deliver due to causes beyond its reasonable control, including but not limited to acts of God, acts of Buyer, acts of civil or military authorities, fires, floods, strikes, epidemic, war, riot, delays in transportation or car shortages, or inability to obtain necessary labor, materials, components or services through Seller's usual and regular sources at usual and regular prices. In any such event Seller may, without notice to Buyer, at any time and from time to time postpone the delivery dates under this contract or make partial delivery or cancel all of any portion of this or any other contract with Buyer without further liability to Buyer. Cancellation of any part of this order shall not affect Seller's right to payment for any product delivered hereunder.

12. **CHANGES:** Any changes in Buyer's drawings, specifications or quantities required by the Buyer may be made only after an equitable adjustment, mutually negotiated by and between both parties, reduced to writing and signed by both parties.

13. **ASSIGNMENT AND SUBCONTRACTING**: All or any part of these Terms and Conditions may be assigned or subcontracted by Seller in its sole discretion. All rights of Seller hereunder shall inure to the benefit of its successors and assigns; all obligations of Buyer shall bind the heirs, legal representatives, successors and assigns of Buyer. This agreement shall not be assigned by the Buyer in whole or in part without Seller's written consent. If more than one person executed this agreement as Buyer, the covenants, conditions, obligations and liabilities of such persons under the agreement shall be joint and several.

14. **PARAGRAPHING:** Numbering and headings of paragraphs are provided for convenience in referencing and shall not be used to interpret this order.

15. **INDEPENDENT CONTRACTOR:** In the event that the Buyer performs or participates in services or activities (including pre-shipment testing) in connection with the goods hereunder on the property of Seller or Seller's customers or suppliers, Buyer agrees that all such services or activities shall be on an independent contractor basis and that Buyer's employees or subcontractors performing such services or activities shall not be considered agents of, servants or employees of Seller.

16. **NON WAIVER:** The Seller's waiver of a breach of or a default under any of the provisions of these Terms, or its failure, on one or more occasions, to enforce any of the provisions of these Terms or to exercise any right or privilege hereunder, shall not be construed as a waiver of any subsequent breach or default, or as a waiver of any such provisions, rights, or privileges hereunder.

17. **GOVERNING LAW**: The parties agree that the provisions of the United Nations Convention on Contracts for the International Sale of Goods (CISG) shall not govern this order. All matters regarding this order shall be interpreted in accordance with the laws of the State of Tennessee, and any controversy that cannot be settled directly shall be settled by arbitration in accordance with the rules then prevailing of the American Arbitration Association. Sevier County, TN shall be the venue and jurisdiction for the resolution of all disputes hereunder.

18. **TITLE; RISK OF LOSS:** Title to all or any part of the products that are to become the property of Buyer pursuant to these Terms and Conditions shall pass to the Buyer, and Buyer shall assume all risk of loss of or damage to the products at the time of Seller's delivery of the products to the carrier for shipment (or upon delivery of such products to Buyer at Seller's facility); provided however, that Buyer hereby grants to Seller a security interest in all such products after passage of title thereto as security for all payments to be made by Buyer and the performance in full by Buyer of its other obligations under these Terms together with the right, without liability and with or without notice to Buyer, to repossess such products in the event of default with respect to any such obligations. These Terms shall constitute a security agreement and with respect to such security interest and by its acceptance of these Terms Buyer authorizes Seller to sign and file on behalf of Buyer any financing statements or other documents which may be necessary to perfect such security interest, and Buyer agrees to sign any such documents and take any such actions as Seller may reasonably request with respect to perfection and/or enforcement of such security interest.

19. **ENTIRE AGREEMENT:** This contract constitutes the entire agreement between the parties relating to the sale of the goods/ provision of services described herein and no addition to or modification of any provision upon the face or reverse of this contract shall be binding upon Seller unless made in writing and signed by a duly authorized representative of Seller.

CO Catalyst System
Installation Procedure

TABLE OF CONTENTS

INDEX OF TERMS

Ambient temperature – Surrounding air temperature

Catalyst - A substance that changes the rate of a chemical reaction but emerges from the process unchanged

CO – Carbon monoxide

CO_2 – Carbon dioxide

CO module – A canister containing catalyzed metal substrate.

COC – Carbon Monoxide Catalyst

CPSI – Cells per square inch, the measure of substrate cell density

DRE – Destruction and removal efficiency

Frame – Support structure upon which the catalyst modules are mounted

G's- Acceleration of a mass of one pound resulting in one pound force

HRSG – Heat Recovery Steam Generator

Monel nut – nut made of Monel metal that allows easy removal after being in service on a stainless steel bolt or stud.

NMNEHC – Non-methane, non-ethane hydrocarbon

NO- Nitric Oxide

NO_2 – Nitrogen Dioxide

O_2 – Oxygen

PPM – Parts per million

PPMVD – Parts per million by volume, dry

SCFH – Standard cubic feet per hour

SCM – Standard cubic meter

SO_2 – Sulfur dioxide

SO_3 – Sulfur trioxide

Space Velocity – The volume (in cubic feet) of gas flowing through one cubic foot of catalyst in one hour, expressed as 1/hr

Substrate – A high temperature, stainless steel, multi-cellular monolithic structure onto which the catalyst is applied

UHC – Unburned hydrocarbons

VOC – Volatile organic compounds – EPA Definition - 40 CFR Ch. 1, Subpart F - Procedural Requirements, Section 51.100 – Definitions, Paragraph (S) - VOCs, Subparagraph (1) states, "**(S)** any compound of carbon, ***excluding*** carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions. **(1)** This includes any such organic compound ***other than the following***, which have been determined to have negligible photochemical reactivity: ***methane; ethane***; methylene chloride, (dichloromethane); 1,1,1-trichloroethane, (methyl chloroform); etc."

1.0 CATALYST PRE-INSTALLATION REQUIREMENTS

The MIRATECH **Oxidation Catalyst system** is designed to be simple and robust, but precautions should be taken when starting up the system for the first time. The following items should be checked prior to system start-up:

1. Inspect the duct liner up-stream of the Oxidation Catalyst system to ensure against loose insulation being accidentally released onto/into the catalyst.
2. Verify that no loose objects or trash are present in the duct upstream of the catalyst.
3. Inspect the frame, duct liner and expansion joints to be sure they are installed correctly.
4. Inspect the frame for any damage done during field erection.
5. Check that the frame has proper expansion allowance.
6. Examine for proper bent seal plate installation and look for any bypass potential.

2.0 START-UP, INSTALLATION AND INSPECTION

2.1 Initial Turbine Firing and Inspection

TO AVOID CATALYST CONTAMINATION, IT IS RECOMMENDED THAT THE CATALYST MODULES BE INSTALLED IN THE SUPPORT STRUCTURE AFTER INITIAL TURBINE FIRING.

For the Oxidation Catalyst system, the objectives of the initial start-up procedure are to burn off any paints, oils, and coatings on the turbine, duct, HRSG, and frame that could contaminate the catalyst, and to uniformly heat the frame assembly. The internal frame is an intricately welded fabrication; therefore uniform initial heat-up is necessary. Stresses induced during fabrication are relieved over time at elevated temperatures. The internal tube frame will undergo vertical and horizontal thermal expansion as the exhaust

gas temperature increases. The changes in temperature exercise the expansion joint system as well as other system components. At the time of initial turbine firing, the following steps are recommended:

1. Inspect all access doors for proper sealing.
2. Follow turbine manufacturers pre-start-up/start-up procedures.
3. Start the engine and attain synchronous idle conditions.
4. Maintain these conditions until the catalyst support frame is uniformly heated.
5. Increase the turbine power slowly through the time when maximum output is achieved.

The MIRATECH catalyst system is designed to operate, to the largest degree possible, in the same thermal environment as the duct and HRSG; however, during initial exhaust gas release to the catalyst system, extra precaution should be taken to reduce thermal shock and possible distortion. If the catalyst is not dry when the initial exhaust gas is released, any moisture on the catalyst would flash into steam and cause irreparable damage to the catalyst. A gradual temperature increase with a dry catalyst is optimal. As with all equipment exposed to the extreme temperatures of gas turbine exhaust, it is desirable to minimize thermal shock, temperature spikes, excursions and unnecessary thermal cycling.

After initial start-up, check the following items:

1. Check the duct liner for buckled or loose plates.
2. Check the frame for cracks or broken parts.
3. Check the expansion seals for buckled or binding components.
4. Check that the bent seal plates are intact.
5. Check the frame integrity; look for bent/buckled items, frame position within the HRSG, etc.

2.2 Catalyst Installation – Vertical Column Type Frame

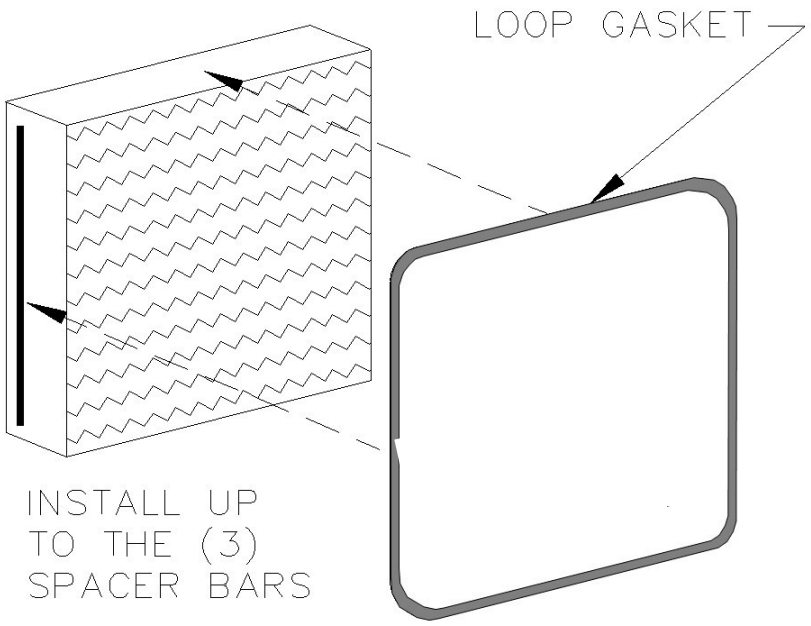
After commissioning, inspection, and the initial turbine firing, the catalyst modules can be installed. Refer to frame fabricator's documentation for installation instructions for their design. A MIRATECH field representative should observe and inspect the initial installation of catalyst modules and test coupons.

The components needed for the catalyst installation are as follows:

1. Catalyst modules
2. Fiberglass loop gasket
3. Tuck Tool
4. Catalyst Retainer (by others)

Begin the catalyst installation in the top bay of the catalyst support frame. Installing the catalyst from top bay to the bottom bay will help to prevent damage to the catalyst substrate during assembly.

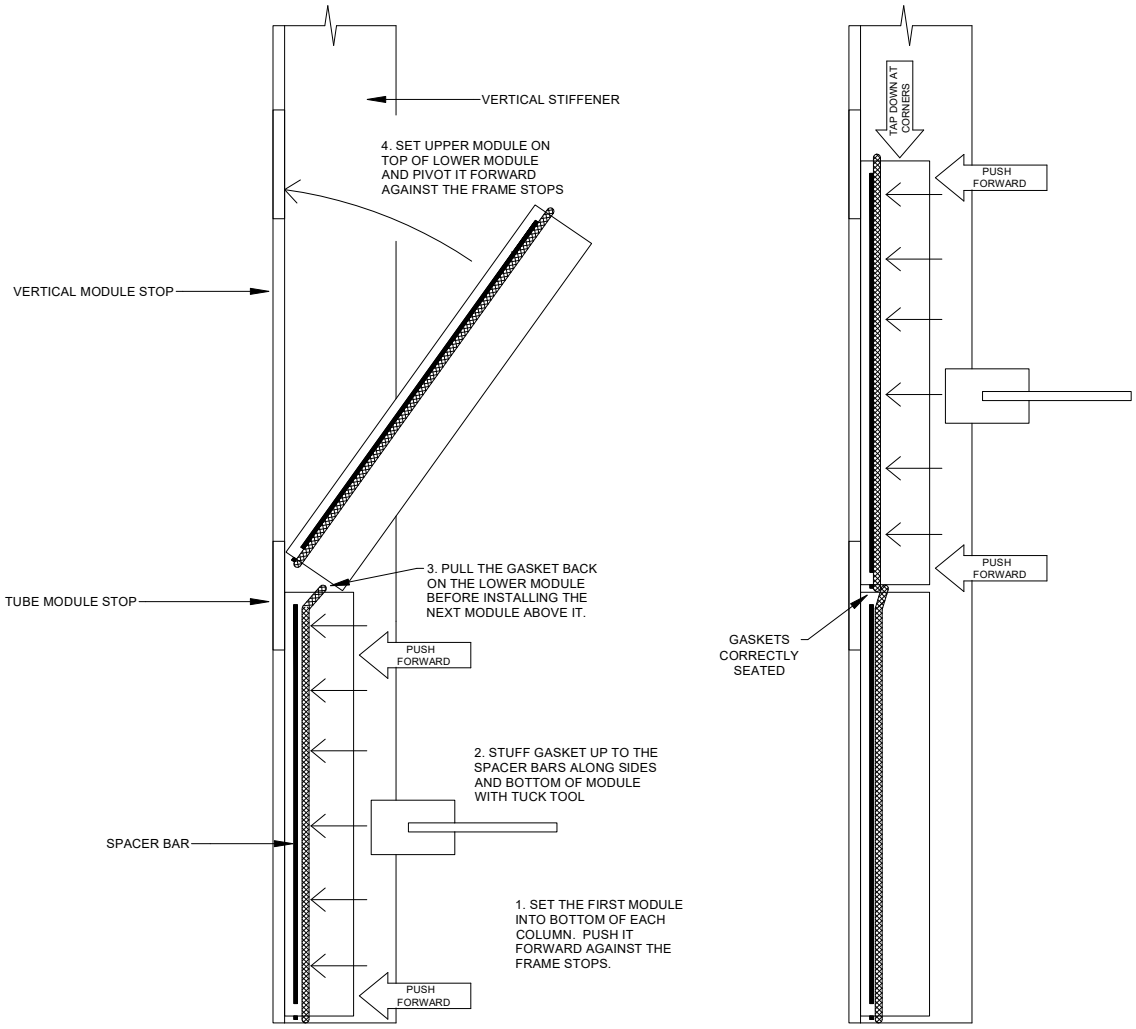
The catalyst modules are assembled into the vertical bays with the square bar spacers at the sides and bottom of the modules. The downstream face of the module, the face closest to the spacer bars, is seated into the frame and pressed back against the module stops. Place one loop gasket around each module, making sure that the overlap of the gasket ends is on the top center of the module. The gasket should be seated against the spacer bar using the tuck tool.



Visually inspect the seal with a flashlight. If the gasket is not seated properly, gas will bypass the catalyst. Readjust gasket as needed until seated properly.

Next, install the remaining bottom catalyst modules into the internal frame similarly to the steps listed above. Once the bottom row is complete, continue stacking modules and installing gasket. Ensure that all modules are seated squarely against the module stops.

Slightly pull the gasket back across the top of the module, as shown below, so that the next module will be installed correctly. When positioning the 2nd row of modules, make sure that the loop gasket on each of the top modules is seated in front, (downstream), of the gasket on the bottom module as shown below. The gaskets must not set on top of each other as this will make installation of the last module extremely difficult.



When correctly seated, the spacer bar, and not the loop gaskets, will be visible between the stacked modules when viewed from the downstream side of the catalyst. Use the provided tuck tool to securely seat the gasket between the frame and the catalyst modules. Continue this process until the appropriate number of modules are installed in each column. Inspect for any visible gaps around the gasket which will cause exhaust gas bypass leakage and degrade catalytic performance.

Install the top module in each column in the same manner, however, a prying tool or chisel may be required, in order to open the gap between the top of the

module and the horizontal frame member. This may be necessary in order to obtain enough clearance when pivoting the module forward into place. Be careful to not damage the module itself when prying. After the last module in each stack is set in place tuck the gasket around the module using the tuck tool.

Install the column seal gasket between each top module and the horizontal frame member. A rope gasket is used and inserted across the width of the module several times. Move the gasket into position with the tuck tool, taking care to not tear the gasket. The gap is properly sealed when the tuck tool requires slight hammer force to bottom out against the module face. Visually inspect the seal with a flashlight. Gas will bypass the catalyst if the gasket is not seated properly.

Install catalyst module retainers per the frame fabricator's instruction. An example of one style of retainer is shown in figure 3.

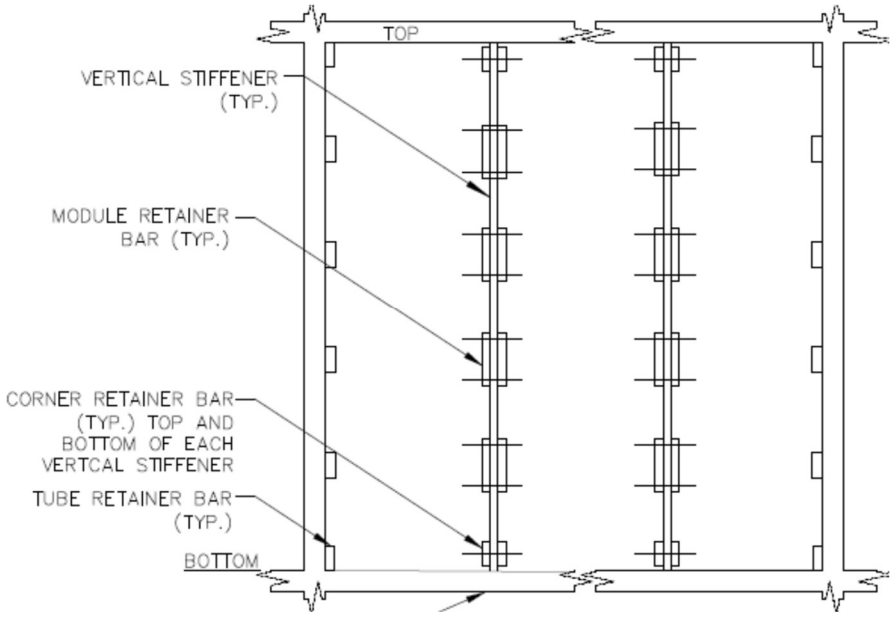


Figure 1: Module Retainer Location Example

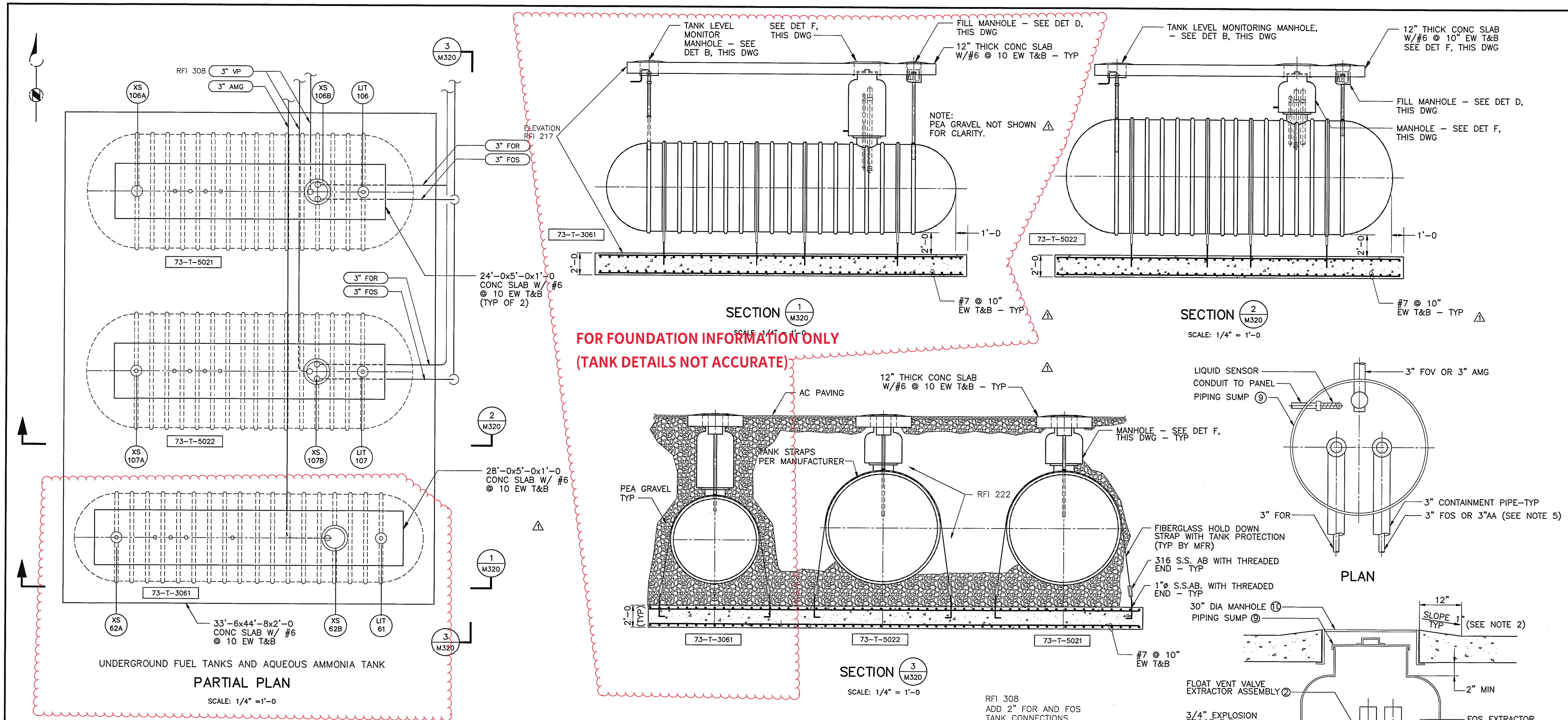
Once the catalyst modules have been completely installed and prior to re-starting the system, the following should be checked:

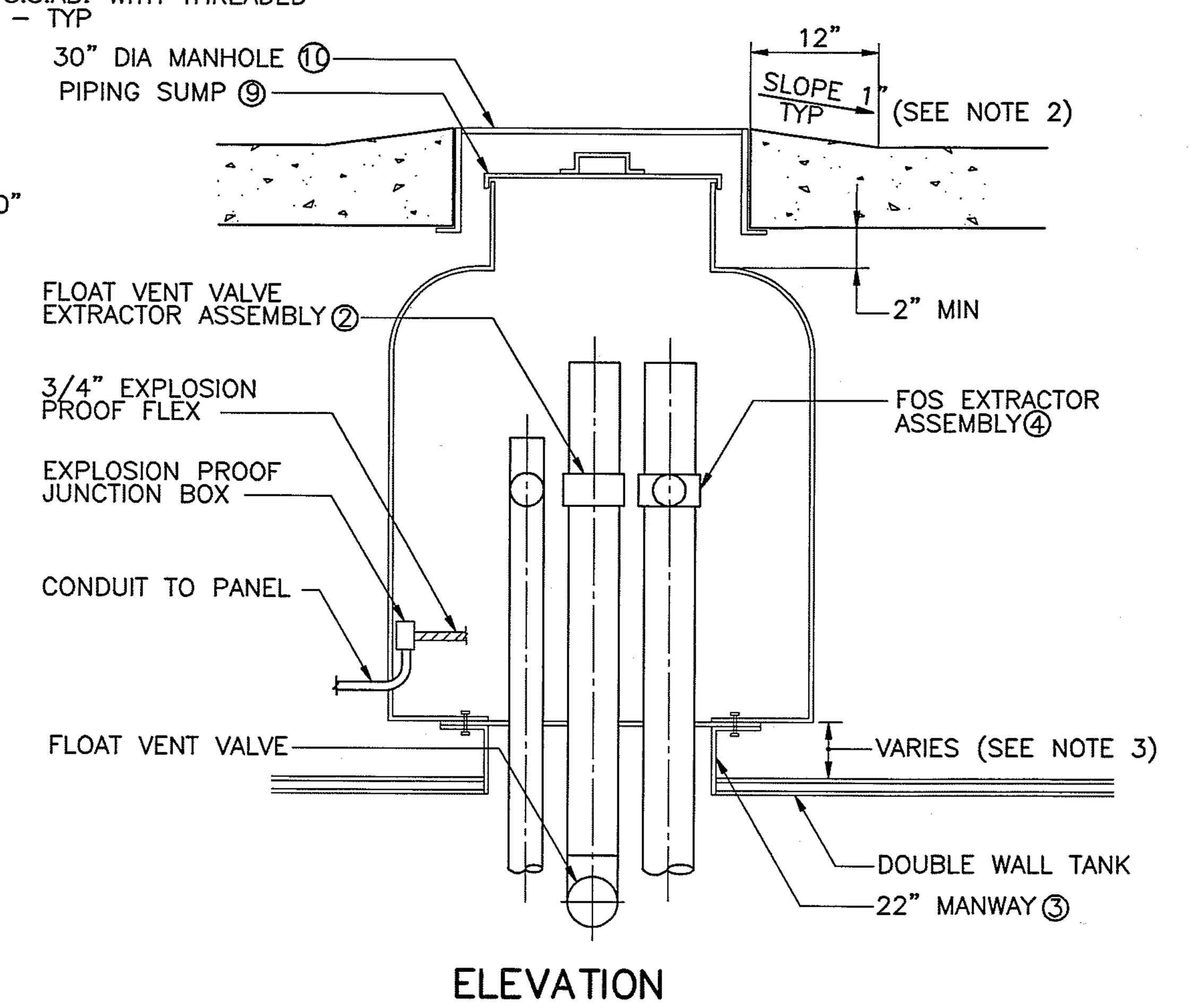
1. Check for proper seal installation from the downstream side of the frame, looking for even placement of the gasket between the modules and frame.
2. Any gaps (corner, sides) should be eliminated to prevent bypass.
3. Inspect the seal plates that seal the frame against the HRSG liner for any gaps or bypass.

2.3 Final Inspection

Once the catalyst has been installed, the turbine will likely be started and operated at normal operating temperature for testing and data gathering. It is worthwhile, if the opportunity arises, to inspect the Oxidation Catalyst system again after this period of operation. The following items should be checked:

1. Examine the gaskets on the frame for gaps/potential bypass.
2. Examine the catalyst to ensure that debris has not blocked off the catalyst surface.
3. Check seal plates where the frame and duct liner meet to ensure they are tight against the frame with no room for bypass.





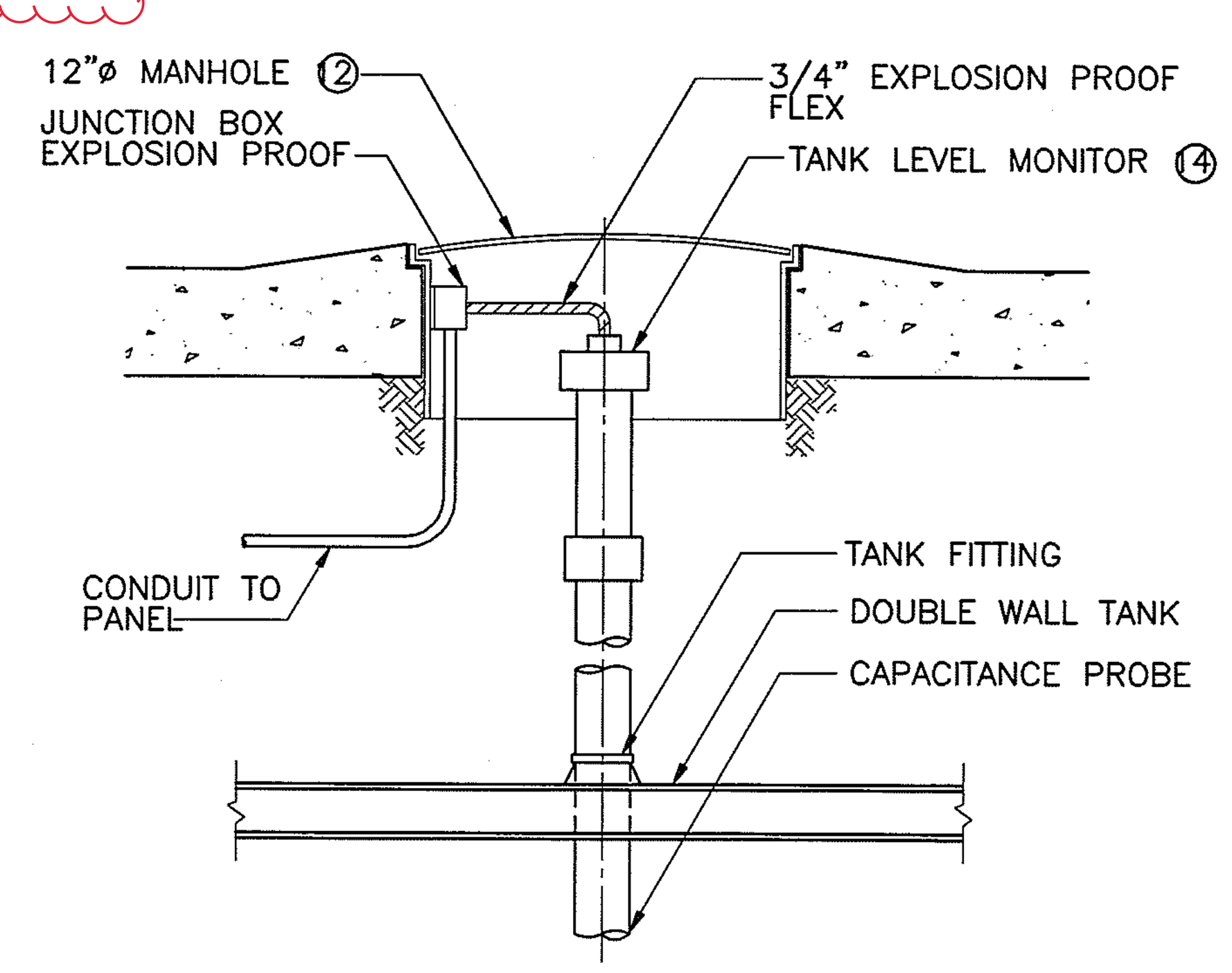
MANHOLE

DETAIL F M320

NO SCALE

GENERAL NOTES:

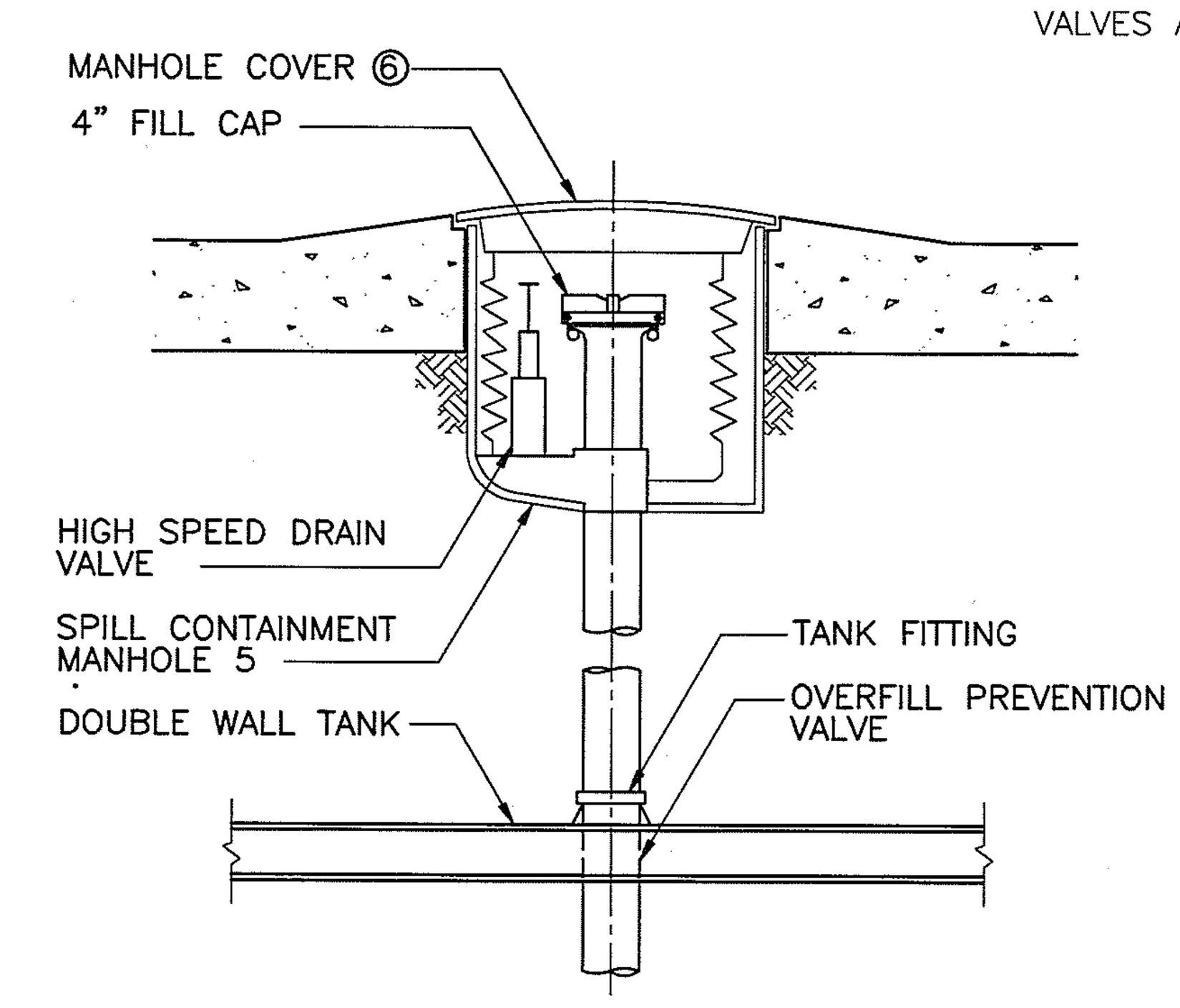
1. THE BID PACKAGE 28 CONCRETE/REBAR AND GENERAL WORKS TRADE CONTRACTOR SHALL BE RESPONSIBLE FOR EXCAVATION FOR UNDERGROUND FUEL TANKS SHOWN ON DWG M302.
2. THE BID PACKAGE 29 MECHANICAL TRADE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL BACKFILL MATERIALS AND BACKFILL OPERATIONS SHOWN ON M320.
3. THIS BID PACKAGE 29 MECHANICAL TRADE CONTRACTOR IS ALSO RESPONSIBLE FOR FURNISHING, INSTALLING AND SUPERVISION OF ALL TANK HOLE DOWNS, MANHOLES AND MISCELLANEOUS ACCESSORIES AND PLACEMENT.



TANK LEVEL MONITOR MANHOLE

DETAIL B M320

NO SCALE



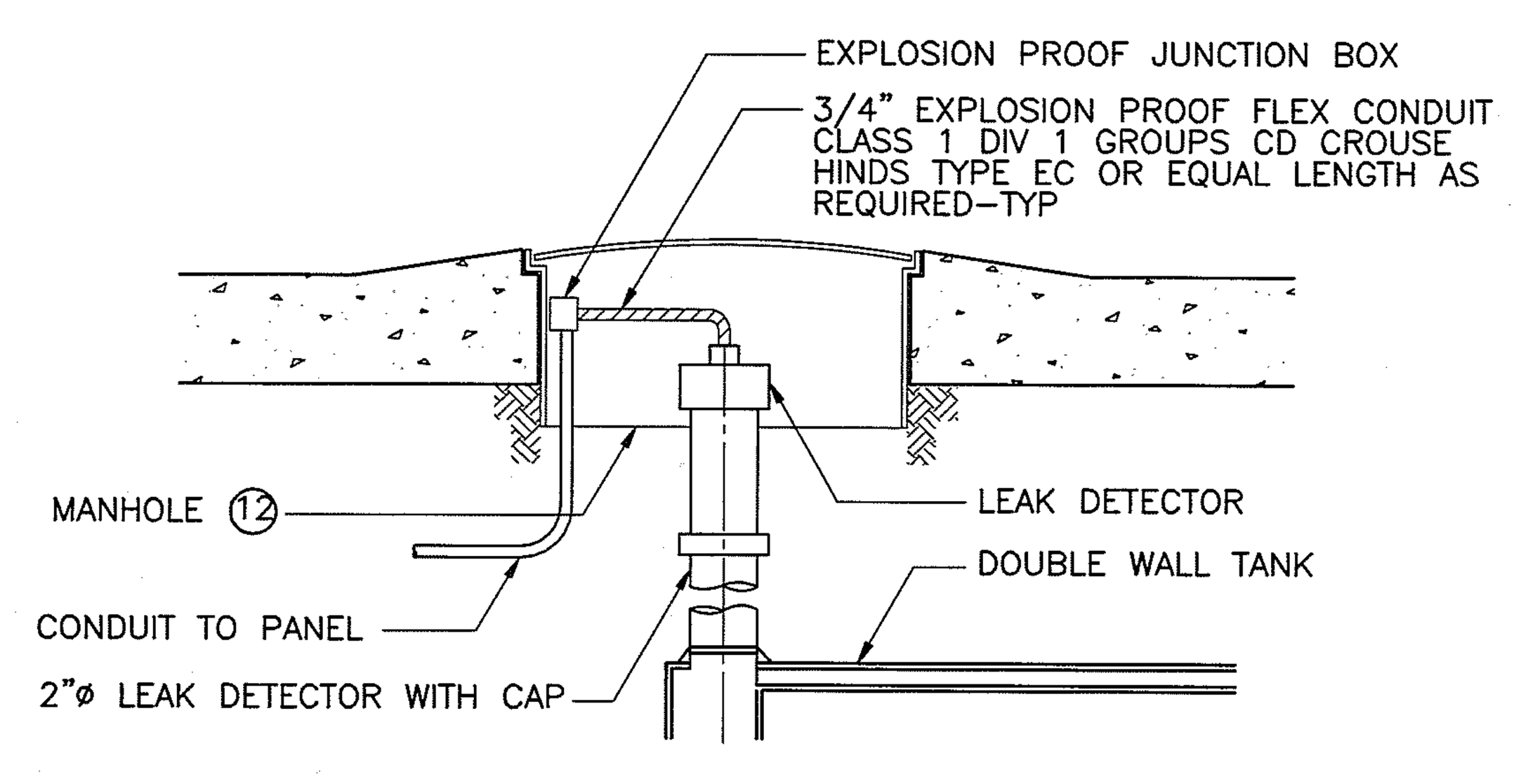
FILL MANHOLE

DETAIL D M320

NO SCALE

NOTES:

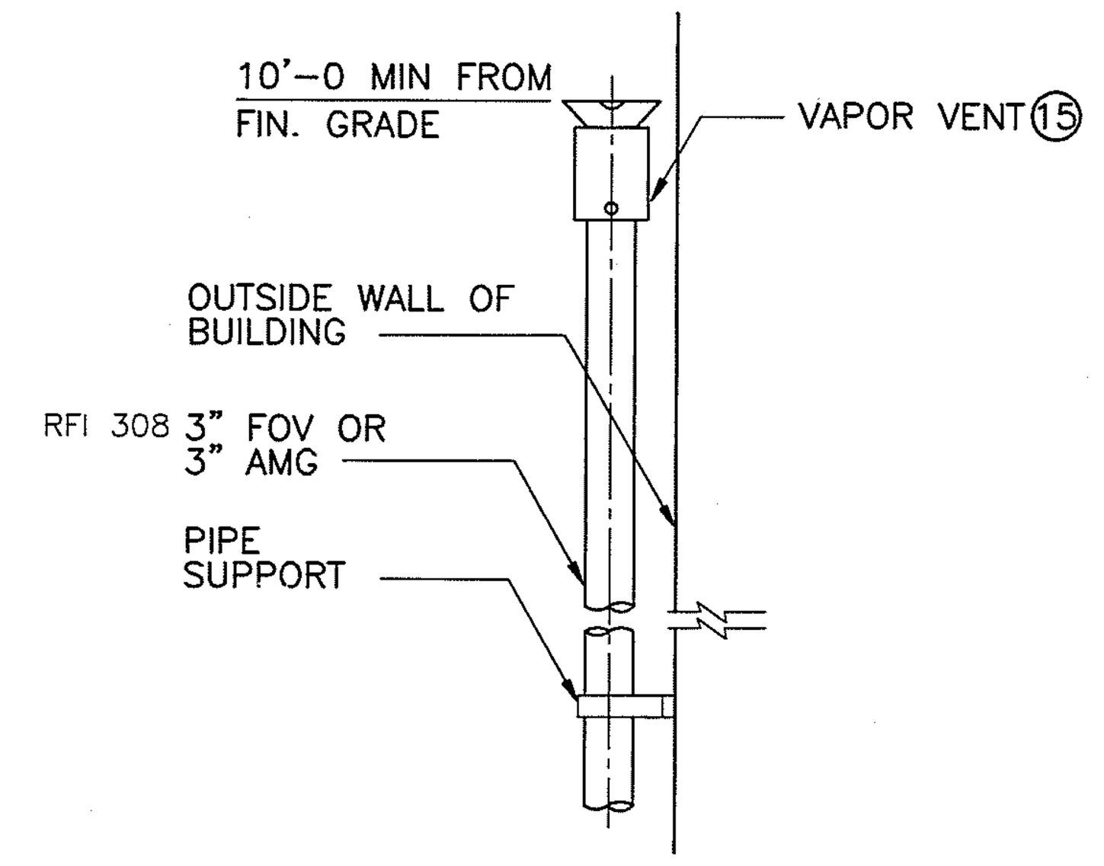
1. PIPING UNDER BUILDING SHALL BE ENCASED IN CONCRETE.
2. SLOPE CONCRETE AS SHOWN FOR MANHOLES.
3. ADJUST PIPING SUMP HEIGHT AS NECESSARY.
4. PROVIDE CONDUIT SEALS PER ELECTRICAL DWGS
5. SLOPE ALL PIPING 1/4" PER FOOT TO TANK.
6. REFER TO PRCESS SCHEMATIC DRAWINGS P107 AND P110 FOR TANK VALVING REQUIREMENTS.



ANNULAR SPACE MONITOR MANHOLE

DETAIL A M320

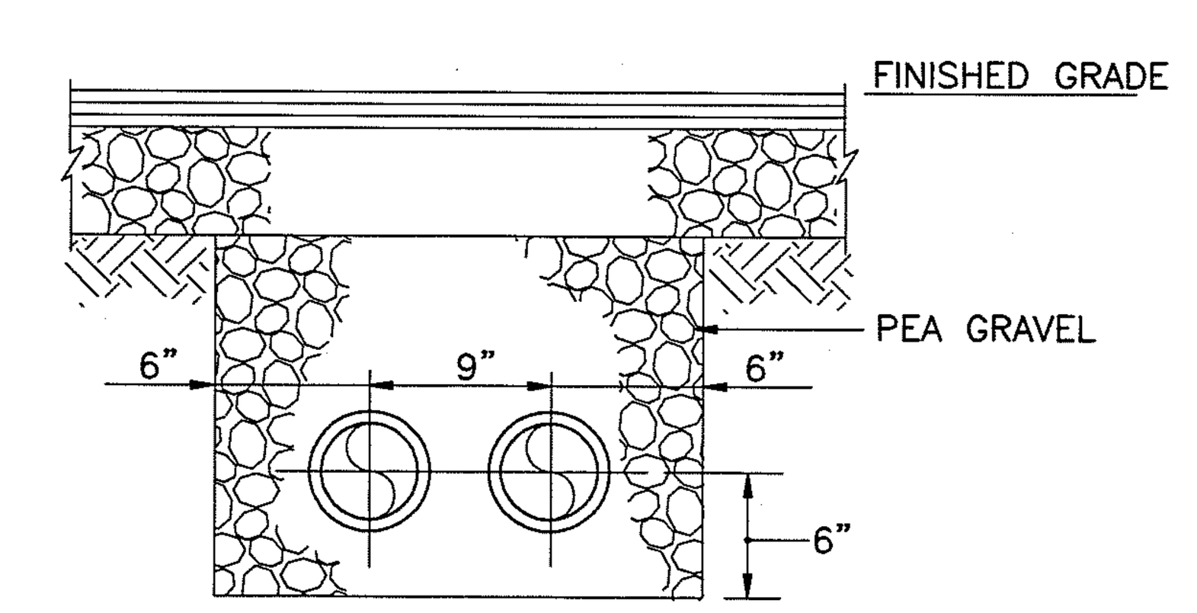
NO SCALE



FUEL OIL OR AQUEOUS AMMONIA VENT

DETAIL C M320

NO SCALE



(SEE NOTE 1)

TYPICAL PIPE TRENCH

DETAIL E M320

NO SCALE

ITEM	DESCRIPTION	MODEL NUMBER
1	OVERFILL PREVENTION VALVE	EMCO WHEATON A1100
2	4"X4" X 2" FLOAT VENT VALVE EXTRACTOR ASSEMBLY	EMCO WHEATON A79, OPW 233MSDL-0120, OR EQUAL
3	2" FLOAT VENT VALVE	EMCO WHEATON A75, OPW 54V, OR EQUAL
4	FOS EXTRACTOR ASSEMBLY W/4" CAP	EMCO WHEATON A677-003, OR EQUAL
5	SPILL CONTAINMENT MANHOLE	15 GAL GRADE LEVEL MANHOLE WITH INTERNAL HIGH SPEED DRAIN VALVE, EBW 705-15, OR EQUAL
6	COVER	CAST ALUMINUM MANHOLE COVER
7	1 1/2" FOOT VALVE	EMCO WHEATON A439-005, OPW 86, OR EQUAL
8	NOT USED	
9	48" DIA. FRP PIPING SUMP WITH MANWAY COVERS AND 24" SUMP LID	MODERN WELDING OR EQUAL
10	30" MANHOLE FRAME AND COVER	CNI 230-RSG OR EQUAL
11	NOT USED	
12	12" MANHOLE WITH 18" MINIMUM SKIRT	OPW 104-GWO-1000 OR EQUAL
13	FUEL STORAGE TANK	REFER TO SPECIFICATIONS SECTION 13236
14	TANK LEVEL MONITOR	VEEDER-ROOT TLS-350 CAPACITANCE PROBE, OR EQUAL
15	VAPOR VENT	EMCO WHEATON A4103, OPW-23, OR EQUAL

LINE IS 2 INCHES AT FULL SIZE — IF NOT 2" SCALE ACCORDINGLY

M73320 42/81/98 TMP/GD

UCD MC
UC DAVIS MEDICAL CENTER
2315 STOCKTON BLVD. – SACRAMENTO, CA. 95817

CONSULTANT LOGO
BROWN AND CALDWELL

ENGINEER | ARCHITECT

STATE FIRE MARSHALL

UCD FIRE DEPT | OSHPD

REVIEW & APPROVAL

DEPARTMENT(S)

ARCHITECT OR ENGINEER OF RECORD | PROJECT MANAGER: J. BARTLETT

DESIGNED BY: T. MOSSINGER | DRAWN BY: MBCHAVES

REV	DESCRIPTION	BY	CHK	DATE
1	ADDENDUM 1	CEC/EO	TGM	12/95
2	ADDENDUM CHANGE	TGM	JLB	04/96
3				
4				

RECORD DRAWING

THIS RECORD DRAWING WAS PREPARED USING INFORMATION REPORTED TO BROWN AND CALDWELL. THE INFORMATION WAS NOT INDEPENDENTLY FIELD VERIFIED. THIS DRAWING CANNOT BE RELIED UPON AS AN EXACT REPRESENTATION OF ACTUAL CONDITIONS.

ACCOUNT NO.: A/C 934900
OSHPD NO.: HS-940671-34
BUILDING: BUILDING 73
FLOOR:
PROJECT TITLE: CENTRAL PLANT
SHEET TITLE: MAINTENANCE YARD PARTIAL PLAN, SECTIONS, AND DETAILS

SCALE:	JOB NO.	DATE:	SHEET NO.
AS SHOWN	1440	12/95	M320

UCDMC DRAWING NO. | REVISION

COMPUTER FILE NUMBER: M73320 | SHEET | OF

erkins Welding, Inc.

C[illegible]ation—Acknowledgement

] 8524 Florin Road
Sacramento, CA 95828
)-826-8265 or 916-383 5413
.ax # 916-383-0610

[X] 135 J. Mason Circle
Concord, CA 94520
800-822-8265 or 510-687-4950
Fax # 510-687-4953

№ 5647

IITTED TO	DATE 4-18-96	DATE OF PLANS
ET	JOB NAME/LOCATION CENTRAL PLANT REPLACEMENT	
STATE AND ZIP CODE	BID PACKAGE #29 DAVIS, CA	
IE / JOB PHONE	PROJECT MANAGER	

HEREBY SUBMIT THE FOLLOWING:

M	QTY	DESCRIPTION
		DIESEL FUEL STORAGE TANKS
		TANK #73-T-5021 & #73-T-5022
1	2	JOOR 15,000 gallon PLASTEEL DOUBLEWALL COMPOSITE, 113" dia. x 30'-3" OAL, U/L 1746 structural and corrosion w/H-20 axle load approvals, Stainless Steel straps with isolation stripa only, 1) 24" U/L access mahway with standard bolts and nuts, 1) 49" containment collar, striker plates, lifting lugs, 30 year internal and external warranty for corrosion.
		AQUEOUS AMMONIA STORAGE TANK
		TANK #73-T-3061
1	1	JOOR 10,000 gallon PLASTEEL DOUBLEWALL CONPOSITE, 113"dia x 20'-3" OAL U/L 1746 structural and corrosion w/H-20 axle load approvals, Stainless Steel straps with isolation strips only, 1) 24" U/L access manway woth standard bolts and nuts, 1) 43" containment collar, striker plates, lifting lugs, 30 year internal and external warranty for corrosion.
	*	ANCHOR BOLTS BY OTHERS
	**	STRUCTURAL CALCS QUOTED UPON REQUEST
		FREIGHT for the above tanks delivered not unloaded
		* CONTINUED *

MARKS

IVERY
PPROX 4 to 6 WEEKS

IMS
AC Net / 30

ll material is guaranteed to be as specified. All work shall be completed in a workmanlike manner ccording to standard practices. Any alteration or deviation from above specifications involving extra osts will be executed only upon written orders, and will become an extra charge over and above the mount set forth above. We shall not be responsible for delays caused by strikes, accidents, or other ontingencies beyond our control. Owner to carry fire, tornado and other necessary insurance. Our rs are fully covered by Workman's Compensation Insurance.

AUTHORIZED SIGNATURE
Megan O'Connell Megan O'Connell

Sales Tax NOT included in this quotation. Price guaranteed for 30 days or

CCEPTANCE OF PROPOSAL

above prices, specifications, terms and conditions are satisfactory and are hereby accepted. are authorized to do the work as specified. Payment will be made as outlined above.

e of Acceptance

SIGNATURE

PURCHASE ORDER NUMBER

JOOR
Manufacturing Co.
Escondido,California

C.A. Butts and Associates
2431 Royal Oaks Drive
Alamo,California 94507

To: **Perkins Welding**
Attn: Megan O'Connell

November 7, 1996
From: Alan Butts

Project: UC***DAVIS*** **Medical Center**

The following is in response to your fax of November 1, 1996 on the above mentioned project and comments from **Brown and Caldwell.**

Plasteel DWC, 15K tanks:

1. As specified and as quoted, **Joor Mfg. Co.** will supply straps of 316 stainless steel with isolation strips only. All other hold down hardware is to be supplied by others. **Note:** Lifting lugs are never fabricated of stainless steel, on a carbon steel tank.
2. See the attached information regarding "Anti-Flotation/Anti-Buoyancy", "Tank Buoyancy Data", "Hold Down Assembly Detail". This information is to assist in the structural calculations by others. Structural or anchoring techniques are site specific.
6. Anchor bolts and all other hold down hardware is supplied by others. **Joor Mfg. Co.** to supply straps and isolation strips only.
7. Please note submittal drawings, states: item 4. striker plates under all fittings in primary tank.

Plasteel DWC, 10K tank:

1. See above item 1.
2. See above item 2.
6. See above item 6.
7. See above item 7.
8. Based on our review of information supplied to us by manufacturers and refiners of Aqua Ammonia and large scale users of the same product, we believe the carbon steel tank to be compatible with the above product.

Tel: 510.831.0908 Fax: 510.743.8247 Page: 510.274.7385

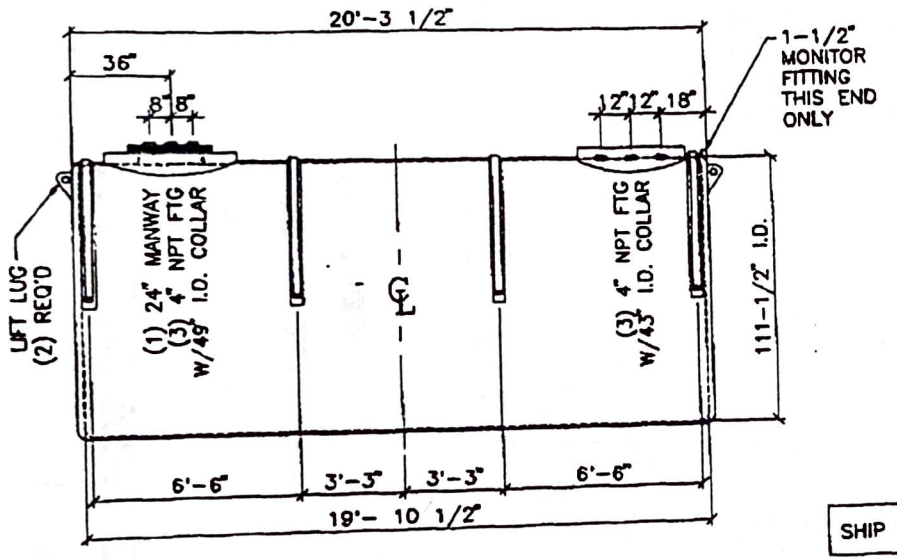
(cont'd)

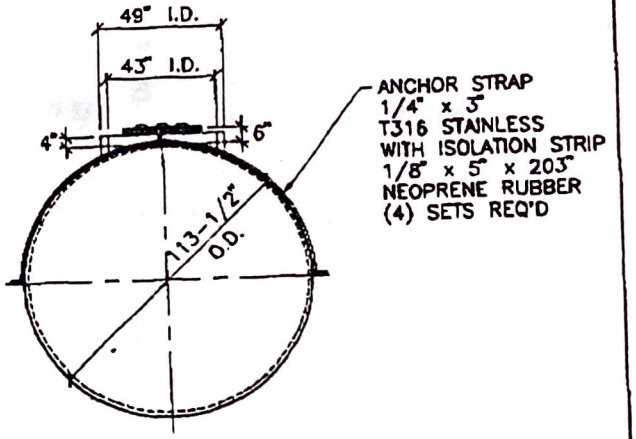
8. **Joor Mfg.** does not assume liability for compatibility of the many products stored in steel tanks, known and unknown. The final responsibility regarding compatibility is the "Owners and Operators", as defined in the **EPA Federal Register** section on compatibility.(attached)

   Attached is copy of a letter from **Unocal Corporation** regarding aqua ammonia service, on one of many tank projects supplied to **Southern California Edison Company.**

Any questions or additional information required, please don't hesitate to contact me.

Many Thanks





SHIP WITH CAST IRON PLUGS

NOTES:

1) TANK TO CARRY U.L. TYPE II COMPOSITE LISTING LABEL & L.A.F.D. LABEL
2) EXTERIOR TO BE JOOR PLASTEEL FRP PER UL 1746.
3) MONITOR VENTING NOT REQUIRED.
4) STRIKER PLATES UNDER ALL FITTINGS IN PRIMARY TANK.
5) SHIP TANK WITH CAST IRON PLUGS IN ALL THREADED FITTINGS.
6) SHIPPING WEIGHT ≈13,700 lbs.

REVISIONS		
	JOOR MANUFACTURING INC.	1189 INDUSTRIAL AVENUE ESCONDIDO, CALIFORNIA 92029 TELEPHONE (619) 745-0971 FAX (619) 746-8515
	SCALE: 9/32"=1' APPROVED BY:	DRAWN BY: TASC
	DATE: 6/12/96	REV: -
	10,000 GALLON DOUBLE WALL PLASTEEL COMPOSIT TANK	
0	PERKINS WELDING/UC MEDICAL - DAVIS	NO: PW-UCD1 SH 1 OF 1


3-26-97
QC CHECKED BY
FINAL INSPECTION
DATE 5-15-97
CALIFORNIA WATER RESOURCE BOARD
ENG STANDARD USED - UL 58/1746
NOM DIAMETER (FT) - 9'5"
NOM CAPACITY (GAL) - 10,000
SECONDARY CNTNMT - 360 DEGREES
USEABLE CAP. (GAL) - 10,081
DESIGN PRESSURE - ZERO PSIG.
MAX OPERATING TEMP - 150 DEGREE
CONSTR. MATERIALS - STEEL + FRP
YEAR MANUFACTURED - 1997
MANUFACTURED BY - JOOR MFG.


PLASTEEL
COMPOSIT
DOUBLE-WALL
ESCONDIDO CA
UL#L297851
GAL. 10,000
TYPE SPE. DW.
L.A.F.D 44703
READ INSTRUCTIONS IN
PLASTEEL BOX B
BEFORE INSTALLATION

Document Number: OP-AIS-2023-07 **Number of Document Sheets**: 12

UC Davis Medical Center

Central Energy Plant

Document Title: Specification/Procedure

Ammonia-Urea Tank Cleaning

REVISION	ISSUE OR REVISION DESCRIPTION	CHKD BY	DATE	APPD BY	DATE
01	Initial Procedure	C. Arechiga	7/19/23	Russell Smith and Patrick Dackins	--
02	Revised	C. Arechiga	8/18/23	Russell Smith and Patrick Dackins	9/21/23

1.0 PURPOSE

To define a procedure and the specifications to safely remove aqueous ammonia from the Underground Storage Tank (UST) at UC Davis Medical Center (UCDMC) Central Energy Plant (CEP) and prepare the UST for the introduction of urea into the UST for the CEP.

2.0 SCOPE

This document describes the procedure and essential specifications for removing remaining material from the UST as well as for cleaning and preparing the UST surface for the urea coating. This procedure contains the necessary steps to complete the UST cleaning and surface preparation, along with technical guidance. The health and safety of UCDMC personnel, contractor personnel, and the surrounding community were the first consideration in preparation of this document. Expectations and requirements of UCDMC personnel and the contractor for securing the safety and health of personnel and the community are included in the specifications.

UCDMC personnel responsibilities include contractor selection, management, and oversight during all required tasks for this project. Contractor personnel responsibilities include adherence to this specification for all tasks described herein for this project. A detailed risk assessment table needs to be developed by the contractor in their Health and Safety (H&S) Plan that considers every task and subtask which identifies possible hazards in each task and a mitigation plan.

All parties are responsible for safety and communicating any concerns throughout the project.

3.0 FACILITY INFORMATION

Below is a list of UCDMC CEP site specific facility information/specifications:

- The UST is in a pea gravel base.
- The UST is 150 degrees Fahrenheit design temperature.
- The UST is 111.5 inches ID (Inner Diameter).
- The UST is approximately 48 inches below ground level.
- 2-Inch camlocks on both liquid fill and vapor recovery.
- Aqua is at 29% ammonia, boiling point 85 degrees Fahrenheit.
- The UST is zero pounds per square inch gauge (PSIG) design pressure when above ground due to flat heads.
- Approximately 1,200 gallons remain in the UST after usable material is extracted.
- Approximately 160-inch column lift is needed (5.9 PSIG suction needed to overcome static head).
- Boiling point of 29% aqua ammonia is approximately 85 degrees Fahrenheit.

4.0 CONTRACTOR HEALTH AND SAFETY REQURIEMENTS

The Contractor will be responsible for the following items:

1. Written Hazard Communication Plan

The Contractor will have a written Hazard Communication Plan as required in Title 8 of the California Code of Regulations (CCR), section 5194.

An additional hazard communication plan specific to the project will include how the Contractor will inform their employees on:

- Hazards associated with aqueous ammonia and other chemicals to be used, and
- Location and access to safety data sheets

UCDMC will provide the Contractor access to safety data sheets for chemicals present onsite.

The Contractor shall provide training to their employees on specific hazards on aqueous ammonia and other chemicals used on the project as outlined in 8 CCR 5194.

2. Contractor Health and Safety Program

The Contractor must have a Health and Safety Program that meets the requirements in 8 CCR 5192(b). Elements of this program shall include, but not limited to:

- Program Organizational Structure
- A Site Specific H&S Plan
- Health and Safety training program
- Medical Surveillance
- Project specific activities and procedures referencing the Health and Safety program
- Workplan

3. Contractor Site Specific H&S Plan

The Contractor shall prepare a site specific H&S Plan. The site specific H&S Plan will include these elements that address the project activities:

- Organization and Responsibilities
- Risk based assessment for each task and subtask. The risk assessment shall include physical and health hazards for each task.
- Personal Protective Equipment (PPE)
- Pre-activity safety briefings
- Decontamination
- Emergency Response Plan

UCDMC requires the Contractor's Site Health and Safety Supervisor to conduct regular inspections during all on site contractor activities.

5.0 EMERGENCY RESPONSE CONSIDERATIONS

1. Ammonia Liquid Spill - An ammonia liquid spill could occur due to a ruptured hose, broken fitting, improperly secured fitting, and/or not ensuring that the hose is properly drained prior to disconnecting it. To help mitigate any release, a CEP staff member will always be monitoring the cleaning operation. If a leak is detected, all cleaning operations will be stopped and equipment will be shut down to minimize the release. A drain-blocker pad will always be in place over the storm drain by the maintenance yard gate to prevent spills from migrating to the storm drain system. A chemical spill kit, absorbent pads, booms, and oil dry are available to help contain any spills. These abatement materials are located on the shelves in front of auxiliary boiler #2 and on the racks (oil dry) north of the gas turbine generator. Reasonable efforts should be made to keep an ammonia spill from migrating outside of the CEP utility yard. If a spill does migrate outside the utility yard, emergency response procedures and notifications should be made as detailed in the Hazardous Material Business Plan, CalARP Risk Management Plan (RMP), and UCDH policy 1612 – Response to Hazardous Substance Spills. If an ammonia spill gets into the storm drains or street gutter, CEP policy #507 - Sacramento County Wastewater System Slug Control Plan will also need to be implemented.

2. Ammonia Vapor Release - An ammonia vapor release could occur due to a ruptured hose, broken fitting, or an improperly secured fitting. To help mitigate any vapor release a CEP staff member will always be monitoring the cleaning operations. The staff member will be carrying an ammonia gas detector. Wind direction can be determined by the 3 local windsocks placed around the CEP utility yard. If the ammonia gas detector reaches 35 ppm outside the exclusion zone work area all personnel will be evacuated from the UST and operations will stop until the cause of the vapor release can be identified. If the cause of the vapor cannot be remedied, the ammonia UST manhole cover should be reinstalled.

6.0 SITE PREPARATION ACTIVITIES (PREREQUISITIES)

1. A pre-job safety conference will be held between CEP personnel and the Contractor before the project begins to review the Site-Specific H&S Plan.
2. CEP personnel will confirm that the UST level probe has been removed and a cover has been installed over the opening and ensure an appropriate seal to prevent escape of ammonia vapors.
3. As required in the UCDMC Health and Safety plan, CEP personnel will follow UCDMC health and safety procedures and wear PPE and respirators when required by UCDMC procedures.
4. The CEP staff member monitoring the UST cleaning will be trained on the shutdown of equipment and emergency response procedures in case of a chemical release.
5. CEP staff shall set up a 25-foot caution-taped zone around the UST entry point and equipment holding ammonia waste until the cleaning operation is complete and the manhole cover has been reinstalled.
6. CEP staff will place the “drain-blocker” drain cover over the storm drain inlet near the maintenance yard gate prior to the start of the cleaning process. The drain cover is stored in the safety equipment locker, mounted on the wall, above the storm drain inlet.
7. The Contractor shall set up chemical containment booms to surround all trucks and storage tanks.
8. CEP staff will verify that all roll up doors and exterior outer doors to the CEP are closed before cleaning begins.
9. The Control Room Operator will ensure that all economizers for the CEP are closed and that the break room and personnel space air handler are shut off during the UST cleaning.
10. The Control Room Operator will ensure that security camera #1, labeled “Back Yard” is monitoring operations for the entire duration of the process.
11. All CEP personnel within the 25-foot exclusion zone must don their respirator before entering this zone during cleaning operations.
12. During the cleaning operations a CEP staff member will be present to monitor the Contractor outside the 25-foot exclusion zone. This operator will use a portable ammonia gas detector to monitor for ammonia vapors.
13. The CEP staff member monitoring the Contractor will establish communications with the Control Room Operator.
14. All reasonable accommodations should be made to ensure that UST cleaning operations take place after business hours (Weekends or between the hours of 5:00 PM to 6:00 AM)

7.0 TASK 1 DRAIN THE UST, 73-T-3061

7.1 Task Description

UCDMC CEP personnel will ensure that the UST operations are set up and isolated prior to conducting UST draining activities. The Contractor shall implement pre-draining activities such as

equipment set up and conduct a pre-check of the supplied air equipment. Any perimeter controls will be put in place for gates, walkways, etc. Contractor pumps ammonia out of UST.

7.2 Critical Steps

1. CEP staff will verify ammonia system is shut down.
2. CEP staff will apply Lockout/Tagout ("LOTO") to the ammonia system. LOTO must include ammonia pump disconnect, two valves after pre filter in the ammonia room, and the expansion tank discharge valve.
3. CEP staff will close ammonia pump discharge valve and open recirculation line to UST manhole cover.
4. CEP staff will connect diaphragm pump discharge to pre-filter housing in the ammonia room and diaphragm pump suction to two 55-gallon drums of demineralized water.
5. CEP staff will slowly open air to diaphragm pump allowing water to flow into the ammonia pipe system from the pre-filter housing back to the tank until all water is used.
6. CEP staff will close air to the pump and close inlet valve to pre-filter housing.
7. CEP staff will disconnect pump hose from pre-filter housing.
8. CEP staff will unwire ammonia pump.
9. CEP staff will remove ammonia pump recirculation and discharge piping from the manhole cover and install cap on the line leading to the building.
10. CEP staff will disconnect vapor piping from manhole cover.
11. Contractor shall implement an air-tight connection during the pumping process to contain aqueous ammonia vapors. This connection will be using either a camlock fitting or some other type of air-tight connection.
12. Contractor will provide a 2-inch schedule 40 pipe, as a closed system, and connect it to the existing 2-inch camlock with ball valve on the vapor recovery line.
13. Contractor shall connect all hoses to truck.
14. Contractor shall verify all chemical contaminants, drain-blockers, booms, spill kits, and windsocks are in place.
15. Contractor must obtain clearance from the CEP Superintendent before pumping begins.
16. CEP staff will initiate and/or pump to minimal operations level or until the ammonia level is below the intake (approximately 1,200 gallons will remain at the bottom of the UST), and then will be locked out.
    a. Note: Existing state conditions creates 160 plus inches of lift to remove existing materials from the bottom of the UST.
17. Contractor shall pump ammonia out of UST.
    a. Contractor shall pump out residual aqueous ammonia using centrifugal pump. Use a centrifugal pump along with a 160-inch-long, 1-1/2-inch schedule 40 pipe stinger with built in venturi/ejector with food valve and inlet screen, connected to a jet pump and primed with water. This eliminates the need to pressurize the UST and allows a standard 2-inch chemical hose to complete the closed system vapor recovery. A vacuum breaker shall be installed to ensure pumping operations do not apply a negative pressure to the UST.
    b. Contractor shall use a centrifugal pump with a standard 1-1/2-inch stinger and a 5.0 PSIG nitrogen or carbon dioxide gas blanket to pressurize the UST and effectively force the ammonium hydroxide to ground level and use standard liquid pumping operations.
    c. Note: the cargo tank/Intermediate Bulk Container (IBC) vapor lines with need to be vented back to the UST to provide a closed system.

7.3 Equipment Requirements

Contractor shall provide the following equipment:

1. Tank pressure gauges (both vacuum and pressure) and temperature gauges need to be supplied by the Contractor to ensure the UST is neither under or over pressurized or operational temperature limits are not exceeded.
2. The Contractor and any UCDMC personnel will be required to wear PPE for each person which may include goggles, air purifying respirator (APR), and/or self-contained breathing apparatus (SCBA) while operating in the exclusion zone. PPE specifications for each task will be identified in the contractor H&S plan.
3. If entering the UST, the Contractor must provide all confined space and recovery equipment and training for all personnel involved with the confined space operation.
4. Backup generator capable of powering all Contractor-supplied equipment.
5. High-volume ventilation fan as back up to dilute ammonia vapors.
6. All pumping equipment (pumps, hoses, stinger, etc.) required to handle all liquid transfer and vapor recovery systems to complete a closed loop transfer operation. Existing UST outlets are 2-inch male camlock fittings.
7. Safety cones and spill containment (booms or basin).
8. All required power or hand tools to complete all installation and teardown operations.
9. 1,500-gallon or larger capacity cargo tank compatible with 29% ammonia hydroxide or IBCs with an aggregate capacity of at least 1,500 gallons.
10. Forklift, if IBCs are used for loading or unloading from the transport vehicle.
11. All pumping and stingers to access the bottom of the UST.
12. At least 100 gallons of citric acid (other alternatives are hydrogen peroxide, baking soda, or acetic acid/non-distilled vinegar) to be used for neutralizing and treating any spilled ammonium hydroxide solution.
13. Four hand held ammonia gas detection monitors with alarms. The monitors shall be capable of detecting up to at least 200 ppm.
14. Hazard materials identification and shipping papers.
    a. Contractor is responsible to prepare all shipping papers to comply with U.S. Department of Transportation (DOT) shipping requirements.

7.4 Safety Precautions

1. NO VACUUM PUMP OR COMPRESSOR WILL BE USED. Pulling any amount of vacuum on the product will easily boil off releasing ammonia gas. This was previously demonstrated when a Contractor used a vacuum tanker with carbon filters to scrub the vacuum pump exhaust and immediately saturated the filters and released ammonia gas.

8.0 TASK 2 DILUTE RESIDUAL AQUA AMMONIA AND DRAIN

8.1 Task Description

UCDMC CEP personnel will ensure that the UST operations are set up and isolated prior to conducting UST diluting and draining activities. The contractor shall implement pre-draining activities such as equipment set up and conduct a pre-check of the supplied air equipment. Any perimeter controls will be put in place for gates, walkways, etc. Contractor shall dilute and pump ammonia out of UST.

8.2 Critical Steps

1. Once the ammonium hydroxide level in the UST is below the existing submersible pump (73-P-3066) inlet, CEP staff will refill the UST with water to fill the UST.
2. CEP will confirm diluted residuals of aqueous ammonia to be at or below 3% ammonium hydroxide solution by using an ammonia single gas detector, then discharge the collected dilution to the CEP wastewater treatment system. If further dilution is needed, additional water will be injected into the pump discharge to further dilute the discharge to wastewater system acceptable limits.
3. Once the liquid pumping is completed by the Contractor, either low temperature steam (around 130-150 degrees Fahrenheit) or a water mist shall be introduced to the UST to condense and dilute the ammonia vapor pressure to zero PSIG before any lines are disconnected. Please note that the vacuum breaker shall be installed and still in the system to eliminate implosion of the UST.
4. Contractor shall provide a DOT Specification cargo tank with a capacity of at least 1,500 gallons and a design pressure of 25 PSIG or greater, or multiple IBCs UN Specification with at least a 10 PSIG working pressure and means of providing a closed loop vapor return to the UST with a total aggregate capacity of at least 1,200 gallons plus 5% outage, for removing/transferring ammonia from the UST.
    a. Note: IBCs will be designed to keep all tanks under pressure to minimize the amount of ammonia that volatilizes and keep the system closed so that fugitive vapors are controlled.
5. Contractor shall install secondary containment (e.g., bermed area) for both the cargo tank or IBCs, and a portable generator (as backup power for the ventilation fans and transfer pump if needed). Facility will provide electrical power, but Contractor is responsible for power cords and emergency shutdown capabilities.
6. Contractor will use and install a cast iron or steel jet pump configuration with venturi and foot valve inside of the UST. (All plumbing materials, hoses, pipes, and fitting shall all be appropriate for aqua ammonia service, i.e., no brass, copper, galvanized materials). Hoses will be installed from UST to pump, pump to cargo tank (or IBCs), then vapor return to form a closed system while transferring product.
7. The drop piping venturi/foot valve should be plastic, steel, or other material compatible with the aqueous ammonia. The need for essentially no suction lift has been demonstrated by the existing tank system design where a submersible pump is used for normal operations to eliminate pump cavitation created by the vapor pressure of the product. The jet pump setup would be to build a coaxial venturi and foot valve assembly that will fit into a 2-inch schedule 40 pipe as a closed system and will enter via the 2-inch camlock with ball valve from the existing vapor recovery line.
8. During all pumping and cleaning operations, the UST tank pressure and temperatures needs to be monitored by the Contractor to ensure operations do not over pressurize or collapse the UST.
9. Contractor shall implement an air-tight connection during the pumping process to contain aqueous ammonia vapors. This connection will be using either a camlock fitting or some other type of air-tight connection.
10. Contractor will provide a 2-inch schedule 40 pipe, as a closed system, and connect it to the existing 2-inch camlock with ball valve on the vapor recovery line.
11. Contractor shall prime the cast iron or steel jet pump before the evacuation. Residual aqueous ammonia will be pumped out as much as possible via the stainless-steel dual diaphragm pump and into the stainless-steel IBCs.
12. As a general practice, the Contractor will extract the remaining recoverable product and complete a vapor test for the remaining vapors in the UST.

8..3 Equipment Requirements

1. Tank pressure gauges (both vacuum and pressure) and temperature gauges need to be supplied by the contractor to ensure the UST is neither under or over pressurized or operational temperature limits are not exceeded.
2. The Contractor and any UCDMC personnel will be required to wear PPE for each person which may include goggles, air purifying respirator (APR), and/or self-contained breathing apparatus (SCBA) while operating in the exclusion zone. PPE specifications for each task will be identified in the contractor health and safety plan.
3. If entering the UST, the Contractor must provide all confined space and recovery equipment and training for all personnel involved with the confined space operation.
4. Backup generator capable of powering all Contractor-supplied equipment.
5. High-volume ventilation fan as back up to dilute ammonia vapors.
6. All pumping equipment (pumps, hoses, stinger, etc.) required to handle all liquid transfer and vapor recovery systems to complete a closed loop transfer operation. Existing UST outlets are 2-inch male camlock fittings.
7. Safety cones and spill containment (booms or basin).
8. All required power or hand tools to complete all installation and teardown operations.
9. 1,500-gallon or larger capacity cargo tank compatible with 29% ammonia hydroxide or IBCs with an aggregate capacity of at least 1,500 gallons.
10. Forklift, if IBCs are used for loading or unloading from the transport vehicle.
11. All pumping and stingers to access the bottom of the UST.
12. At least 100 gallons of citric acid (other alternatives are hydrogen peroxide, baking soda, or acetic acid/non-distilled vinegar) to be used for neutralizing and treat any spilled ammonium hydroxide solution.
13. Four hand held ammonia gas detection monitors with alarms.
14. Hazard materials identification and shipping papers.
    a. Contractor is responsible to prepare all shipping papers to comply with U.S. Department of Transportation (DOT) shipping requirements.

8.4 Safety Precautions

1. **NO VACUUM PUMP OR COMPRESSOR WILL BE USED**. Pulling any amount of vacuum on the product will easily boil off releasing ammonia gas. This was previously demonstrated when a contractor used a vacuum tanker with carbon filters to scrub the vacuum pump exhaust and immediately saturated the filters and released ammonia gas.

9.0 TASK 3 CLEAN AND PREPARE THE UST FOR A UREA COATING

9.1 Task Description

Contractor will clean and prepare the UST in preparation for the Urea coating.

9.2 Critical Steps

1. Manway interferences will be displaced and manways will remain sealed with four bolts in preparation for confined space entry operations.
2. Ensure UST will be isolated from the vapor recovery line and/or pump discharge to ensure proper Lock-out/Tag-out.

3. Confined space entry primary and secondary teams will be staged and entry and egress will be designated based on site conditions and weather pattern.
4. Contractor will provide potential plume modeling and movement based on the current weather station data.
5. In preparation for confined space entry, initial atmospheric testing of the UST interior for aqueous ammonia vapors and oxygen levels will be taken, and measurements will be continued at specified frequency.
6. The primary team will unbolt the last of the manway access and the opening will be dusted with water from a pressure washer aerosol system to begin vapor laydown.
7. As a backup option and if needed, the UST will be flooded with dilute citric acid solution to react with the ammonia remaining in the UST. This process will generate a low heat condition.
8. The Contractor will use a remote multi directional spray ball cleaner to clean the inside walls of the UST to remove residual aqueous ammonia.
9. A vacuum truck will be used to recover rinse water and any recoverable solutions from the low end of the UST.
10. Vacuum pump needs to be pulled to complete vacuum (zero pounds per square inch absolute [PSIA]), and then vacuum pump is shut down and will remain off before starting evacuation procedure and during any evacuation.
11. Monitoring of the UST will be conducted to ensure no vacuum is imposed on the UST that could collapse the UST. Any air entering the UST should be saturated with steam or water mist to avoid explosive mixture and escape of ammonia vapor.
12. It is recommended to water purge at least two complete fillings and pump off the rinse water, and to conduct a live steam, low-pressure four-hour purge. This will force the ammonia out of the carbon steel and collapse any remaining ammonia vapor. Note: Monitor temperature to make sure the 150 degrees Fahrenheit tank design temperature is not exceeded, along with the design pressure and vacuum.
13. The remaining pH and ammonia levels will be checked prior to removal of the manway. Use of misting fans with vinegar or other neutralizing media can be used to minimize/eliminate ammonia vapors.
14. The Contractor will advance cleaning the interior as they proceed to remove the bulk of source materials.
15. The cleaning process will continue to remove the residual from the UST in preparation for tank re-use.
16. Rinse water will be recovered and staged in 275-gallon totes for sampling and disposal coordination.
17. Cleaning activities of the UST will be monitored at all times by CEP staff.
18. Any additional effluent generated will be evaluated by UCDMC Environmental health and Safety (EH&S) for metals and pH will not be discharged to the Publicly Owned Treatment Works (POTW). Water will only be discharged upon approval of EH&S.
19. Contractor completes cleaning of ammonia UST.
20. Contractor disconnects hoses from truck.
21. Contractor verifies all solid ammonia waste is properly stored in containers and ready to be transported to UCDMC hazardous waste yard.

22. Contractor to reinstall manhole cover using portable hoist (cherry picker) and chain fall. Contractor to ensure new gasket is correctly installed
23. CEP Staff will connect vapor piping to manhole cover.
24. Contractor shall move truck off site.
25. CEP staff will install recirculation and discharge piping on manhole cover.
26. CEP staff will confirm air monitor reads less than 10 PPM above manhole cover area.
27. CEP staff will wire ammonia pump.
28. CEP staff will release LOTO on ammonia system if not required by other work activities.

9..3 Equipment Requirements

Contractor shall provide the following equipment:

1. Tank pressure gauges (both vacuum and pressure) and temperature gauges will be supplied by the contractor to ensure the UST is neither under or over pressurized or operational temperature limits are not exceeded.
2. PPE for each person including goggles, APR, and/or SCBA while operating in the exclusion zone.
3. If entering the UST, the Contractor must provide all confined space and recovery equipment and training for all personnel involved with the confined space operation.
4. Backup generator capable of powering all Contractor supplied equipment.
5. High volume ventilation fan as back up to dilute ammonia vapors.
6. All pumping equipment (pumps, hoses, stinger, etc.) required to handle all liquid transfer and vapor recovery systems to complete a closed loop transfer operation. Existing UST outlets are 2-inch male camlock fittings.
7. Safety cones and spill containment (booms or basin).
8. All required power or hand tools to complete all installation and teardown operations.
9. 1,500 gallon or larger capacity cargo tank compatible with 29% ammonia hydroxide or IBCs with an aggregate capacity of at least 1,500 gallons.
10. Forklift, if IBCs are used and need to be loaded or unloaded from the transport vehicle.
11. All pumping and stingers to access the bottom of the UST.
12. At least 100 gallons of citric acid (other alternatives would be hydrogen peroxide, baking soda or acetic acid non-distilled vinegar) to be used for neutralizing and treat any spilled ammonium hydroxide solution.
13. Four Ammonia gas detection monitors with alarms.

9.4 Safety Precautions

1. The liquid pump used to transfer the aqua can be electric, gasoline powered, or a truck PTO (power take-off) shaft driving the liquid pump. When using a pump, it should be kept in mind that the vapor pressure of the aqua ammonia is about equal to atmospheric pressure and that any suction pressure will cause the ammonia vapor to come out of solution and vapor lock will occur. System should be designed so that the pump is as near to the hose connection as possible and that the hose length required will be as short as possible, twenty feet or less.

10.0 TASK 4 CONFIRM UST READINESS AND PROJECT CLOSEOUT

10.1 Task Description

Contractor will apply the Urea coating and confirm UST is mechanically set up to accept product for future operations.

10.2 Critical Steps

1. Immediately before applying spray coat, a stripe coat will be added to all welds and edges to assure adequate protection of these areas.
2. Coating will be applied to specified thickness.
3. The ventilation system shall be capable of preventing the solvent vapor concentration from reaching the lower explosion limit for the solvents used. User should test and monitor exposure levels to ensure all personnel are below guidelines.
4. Precautionary measures for potential fire and explosion hazards will be implemented. The product contains less than 1% volatile components; however, vapors are heavier than air and can travel long distances, ignite, and flash back.

10. 3 Equipment Requirements

1. UST pressure gauges (both vacuum and pressure) and temperature gauges shall be supplied by the Contractor to ensure the UST is neither under or over pressurized or operational temperature limits are not exceeded.
2. PPE for each person including goggles, APR, and/or SCBA while operating in the exclusion zone.
3. If entering the UST, the Contractor shall provide all confined space and recovery equipment and training for all personnel involved with the confined space operation.
4. Backup generator capable of powering all Contractor supplied equipment.
5. Safety cones and spill containment (booms or basin).
6. All required power or hand tools to complete all installation and teardown operations.
7. Four ammonia gas detection monitors with alarms.

10.4 Safety Precautions

1. Eliminate all ignition sources. Keep away from sparks and open flames. All electrical equipment and installations should be made and grounded in accordance with the National Electric Code. In areas where explosion hazards exist, workers should be required to use non-ferrous tools and wear conductive and non-sparking shoes.

11.0 REFERENCES

11.1 Process & Instrumentation Drawings (P&IDs)

- M73320, M320 – Central Plant
- Ammonia UST, 73-T-3061

11.2 Equipment Manuals

- Submersible Pump, 73-P-3066
- Ammonia UST, 73-T-3061

11.3 Operation Manual UCDH Central Energy Plant Procedures

- UCDH P&P #1612 – Response to Hazardous Substances Spills
- CP P&P #1612 - Sacramento County Wastewater System Slug Control Plan
- UCDH P&P #1626 – Confined Space Program
- CP P&P #502 – Equipment Safety/Best Safe Work Practices
- CP P&P #207 – Ammonia Maintenance Training
- California Accidental Release Prevention Risk Management Plan (CalARP RMP)

12.0 APPENDICES

APPENDIX A (*include any necessary UCDMC procedures that would be needed for the bid package)*

END OF SPECIFICATION

UCDAVIS HEALTH

Confined Space Program

I. SETTING

Medical Center

II. PURPOSE

A. The purpose of this program is to protect employees and contractors at the University of California, Davis Health (UCDH) from exposure to the hazards encountered during entry into confined spaces. Entry into confined spaces is necessary for many functions, including inspection, cleaning, repairing, sampling, demolition, maintenance and construction.

B. The objectives of the Confined Space Program are to:

1. Define responsibilities for each department in which work in confined spaces may occur.

2. Prepare and maintain an inventory of “permit-required confined spaces.”

3. As practical, establish processes for declassifying spaces to “non-permit” entry conditions to minimize the need for “permit entry”

4. Provide signage and instructions to employees.

5. Establish training requirements

6. Define entry requirements.

C. This program is designed to comply with Cal-OSHA standards (Title 8 California Code of Regulations [8 CCR]): General Industry Safety Orders (8 CCR 5156-5158); Electrical Safety Orders; and the Telecommunications Safety Orders. Other Cal-OSHA standards may also apply, including Injury and Illness Prevention Program, Airborne Contaminants (including Carcinogens), Respiratory Protection, Hot Pipelines and Surfaces, Lockout/Tagout, Flammable and Combustible Liquids, and Guarding of Machines and Equipment.

III. SCOPE

This program applies to all departments having employees who may enter confined spaces as part of their job duties, as well as those departments who manage construction operations where contractors or their employees may enter confined spaces. Entry and classification procedures apply to UCDH employees or if entry must be coordinated between both UCDH and contractor employees. Entry by contractors must be in accordance with their confined space program.

IV. DEFINITIONS

A. Acceptable entry conditions--the conditions that must exist in a permit space to allow entry and to ensure that employees involved with a permit-required confined space entry can safely enter into and work within the space.

B. Attendant--an individual stationed outside one or more permit spaces who monitors the authorized entrants and who performs all attendant's duties assigned in the employer's permit space program.

C. Authorized entrant--an employee who is authorized by the employer to enter a permit space.

D. Blanking or blinding--the absolute closure of a pipe, line or duct by the fastening of a solid plate (such as a spectacle blind or a skillet blind) that completely covers the bore and that is capable of withstanding the maximum pressure of the pipe, line or duct with no leakage beyond the plate.

E. Confined space--a space that has all of the following characteristics:

1. Is large enough and so configured that an employee can bodily enter and perform assigned work; and

2. Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry.); and

3. Is not designed for continuous employee occupancy.

F. Double block and bleed--the closure of a line, duct, or pipe by closing and locking or tagging two in-line valves and by opening and locking or tagging a drain or vent valve in the line between the two closed valves.

G. Emergency--any occurrence (including any failure of hazard control or monitoring equipment) or event internal or external to the permit space that could endanger entrants.

H. Engulfment--the surrounding and effective capture of a person by a liquid or finely divided (flowable) solid substance that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction or crushing.

I. Entry--the action by which a person passes through an opening into a permit-required confined space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space.

J. Entry permit (permit)--the written or printed document that is provided by the employer to allow and control entry into a permit space.Entry supervisor--the person (such as the employer, foreman or crew chief) responsible for determining if acceptable entry conditions are present at a permit space where entry is planned, for authorizing entry and overseeing entry operations, and for terminating entry as required by this section.

Note: An entry supervisor also may serve as an attendant or as an authorized entrant, as long as that person is trained and equipped as required by this section for each role he or

she fills. Also, the duties of entry supervisor may be passed from one individual to another during the course of an entry operation.

K. Hazardous atmosphere--an atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue (that is, escape unaided from a permit space), injury or acute illness from one or more of the following causes:

1. Flammable gas, vapor or mist in excess of 10 percent of its lower flammable limit (LFL).

2. Airborne combustible dust at a concentration that meets or exceeds its LFL.

   Note: This concentration may be approximated as a condition in which the dust obscures vision at a distance of 5 feet (1.52 M) or less.

3. Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent.

4. Atmospheric concentration of any substance for which a dose is published in 8 CCR 5075-5085 for Radiation and Radioactivity or a permissible exposure limit is published in 8 CCR 5155 for Airborne contaminants and which could result in employee exposure in excess of its dose or permissible exposure limit.

   Note: An atmospheric concentration of any substance that is not capable of causing death, incapacitation, impairment of ability to self-rescue, injury or acute illness due to its health effects is not covered by this provision.

5. Any other atmospheric condition that is immediately dangerous to life or health.

   Note: For air contaminants for which a dose is not published in 8 CCR 5075-5085 for Radiation and Radioactivity or a permissible exposure limit is not published in 8 CCR 5155 for Airborne contaminants, other sources of information such as: Material Safety Data Sheets that comply with 8 CCR 5194, published information and internal documents can provide guidance in establishing acceptable atmospheric conditions.

L. Hot work permit--the written authorization from the Fire Marshal's Office to perform operations (for example, riveting, welding, cutting, burning and heating) capable of providing a source of ignition.

M. Immediately dangerous to life or health (IDLH)--any condition that poses an immediate or delayed threat to life or that would cause irreversible adverse health effects or that would interfere with an individual's ability to escape unaided from a permit space.

Note: Some materials (examples--hydrogen fluoride gas and cadmium vapor), may produce immediate transient effects that, even if severe, may pass without medical attention, but are followed by sudden, possibly fatal collapse 12-72 hours after exposure. The victim "feels normal" from recovery from transient effects until collapse. Such materials in hazardous quantities are considered to be "immediately" dangerous to life or health.

N. Inerting--the displacement of the atmosphere in a permit space by a noncombustible gas (such as nitrogen) to such an extent that the resulting atmosphere is noncombustible.

Note: This procedure produces an IDLH oxygen-deficient atmosphere.

O. Isolation--the process by which a permit space is removed from service and completely protected against the release of energy and material into the space by such means as: blanking or blinding; misaligning or removing sections of lines, pipes or ducts; a double block and bleed system; lockout or tagout of all sources of energy; or blocking or disconnecting all mechanical linkages.

P. Line breaking--the intentional opening of a pipe, line or duct that is or has been carrying flammable, corrosive or toxic material, an inert gas, or any fluid at a volume, pressure or temperature capable of causing injury.

Q. Non-permit confined space--a confined space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm.

R. Oxygen deficient atmosphere--an atmosphere containing less than 19.5 percent oxygen by volume.

S. Oxygen enriched atmosphere--an atmosphere containing more than 23.5 percent oxygen by volume.

T. Permit-required confined space (permit space) --a confined space that has one or more of the following characteristics:

1. Contains or has a potential to contain a hazardous atmosphere (see “L”, above).

2. Contains a material that has the potential for engulfing an entrant.

3. Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or

4. Contains any other recognized serious safety or health hazard.

U. Permit-required confined space program (permit space program) --the employer's overall program for controlling, and, where appropriate, for protecting employees from, permit space hazards and for regulating employee entry into permit spaces.

V. Permit system--the employer's written procedure for preparing and issuing permits for entry and for returning the permit space to service following termination of entry.

W. Prohibited condition--any condition in a permit space that is not allowed by the permit during the period when entry is authorized.

X. Rescue service--the personnel designated to rescue employees from permit spaces.

Y. Retrieval system--the equipment (including a retrieval line, chest or full-body harness, wristlets, if appropriate, and a lifting device or anchor) used for non-entry rescue of persons from permit spaces.

Z. Testing--the process by which the hazards that may confront entrants of a permit space are identified and evaluated. Testing includes specifying the tests that are to be performed in the permit space. If electronic or thermal equipment is used to perform such tests, and the

possibility exists of an explosive substance or a hazardous atmosphere due to flammable gases and vapors, then the testing equipment must be approved for use in such explosive or flammable conditions as required by 8 CCR 2540.2.

Note: Testing enables employers both to devise and implement adequate control measures for the protection of authorized entrants and to determine if acceptable entry conditions are present immediately prior to, and during, entry.

V. POLICY

A. The Environmental Health and Safety Office (EH&S) is responsible for:

1. Preparing and maintaining a written confined space program which complies with the applicable Cal-OSHA requirements.

2. Assisting managers and supervisors in determining appropriate instrumentation and testing methods for detecting unsafe atmospheres.

3. Providing instruction and direction for situations in which safe entry conditions cannot be ensured through the entry procedures contained in Sections VI. A. 1 and VI. A. 2 of this Administrative Policy

4. Working with managers and supervisors to identify permit-required confined spaces.

5. Coordinating operations in situations where more than one department is performing or managing work in confined spaces.

6. Performing periodic audits of Program implementation.

B. Managers and supervisors are responsible for:

1. Informing exposed employees and other employees in the area of permit spaces by posting signs that read" Danger - Permit Required Confined Space - Do Not Enter", or by other equally effective means such as training.

2. Controlling work activities in confined spaces that are not designated "Permit-Required" to ensure that materials are not used, or operations performed that could introduce physical or atmospheric hazards within the space.

3. Notifying EH&S of any proposed work (such as cleaning, painting, welding) that could introduce hazards into a space not designated as "Permit-Required."

4. Identifying and maintaining an inventory of permit-required confined spaces that their employees may have reason to enter.

5. Ensuring that all employees who may have reason to enter a permit-required confined space have been instructed to not enter unless all precautions required by this Program have been taken. All Permit Confined Spaces must have signage such as "DANGER - PERMIT CONFINED SPACE, DO NOT ENTER" or other equally effective means of identifying the existence of the permit confined space, its location and the danger posed by the space.

6. Incorporating the procedures required by this Program into written standard operating procedures to be followed by the employees they manage or supervise.

7. Ensuring that all affected employees have received proper training on entry into both permit-required and non-permit confined spaces.

8. Providing instrumentation for testing the atmosphere of confined spaces that is appropriate for the potential exposures, is properly maintained and calibrated and ensuring that employees are properly trained in its use.

9. Notifying EH&S of situations where more than one department is performing or managing work in confined spaces.

10. Notifying EH&S of any situations in which safe entry conditions cannot be ensured through the entry procedures contained in Sections VI. A. 1 and VI. A. 2 of this Policy (e.g., any proposed permit-required space entry).

C. Departments that hire contractors are responsible for:

1. Notifying contractors of all permit-required confined spaces in their designated work areas and that entry is allowed only through compliance with a program meeting the requirements of General Industry Safety Orders 8 CCR 5157, 5158, Electrical Safety Order 8 CCR 2943, or Telecommunications Safety Order 8 CCR 8616, depending on which section applies to the contractor.

2. Ensuring that all bid specifications involving work in permit-required confined spaces contain language requiring the contractor to adhere to this requirement.

3. Notifying the contractor of the elements, including the hazards identified and UCDH experience with the space, that make the space in question a permit-required confined space.

4. Apprizing the contractor of the precautions or procedures that UCDH has implemented for the protection of employees in or near permit spaces where contractor personnel will be working.

5. Notify EH&S of any situations where UCDH personnel and contractor personnel will be working in or near permit-required confined spaces, so that operations can be coordinated.

6. Debriefing the contractor at the conclusion of the entry operations regarding the permit-required confines space program followed and regarding any hazards confronted or created in the spaces during entry operations.

D. UCDH Employees are responsible for:

1. Observing and obeying all “Permit-Required Confined Space - Do Not Enter” warning signs and postings.

2. Observing and obeying all warning signs, postings and barriers for permit-required confined spaces in which work is being performed.

3. Contacting EH&S with any concerns regarding work being performed in any confined spaces.

4. Observing UCD policy and procedure pertaining to confined spaces.

5. Completion of an assigned training class or program as directed by supervision as described in the confined space program

VI. PROCEDURES

A. The Confined Space Program establishes procedures for three categories of confined spaces, based on the degree of hazard they present:

1. Non-Permit Confined Spaces are defined as low-hazard spaces that do not contain physical hazards capable of causing death or serious injury, or, with respect to atmospheric hazards, do not have the potential to contain any hazard capable of causing death or serious physical harm. Examples of low hazard non-permit-required confined spaces include pits or vaults that do not have actual or potential atmospheric hazards, building crawl spaces and ceiling plenums.

2. Permit-Required Confined Space - Alternate Entry Procedures are spaces it where it has been demonstrated through monitoring and inspection data (and documented) that the only hazard posed is an actual or potential hazardous atmosphere, and that the space can be maintained safe through continuous forced air ventilation alone. The following procedures must be followed if using the “alternate entry procedures”:

   a. Testing and verification that the space is safe for entry must be documented (see Attachment 3 - Certificate of Safe Entry – Alternate Entry Procedures).

   b. If a hazardous atmosphere is detected:

      1) Each employee must leave the space immediately.

      2) The reason for the hazardous atmosphere must be determined.

      3) Measures must be taken to ensure a safe atmosphere before re-entry.

3. Permit-Required Confined Space - Comprehensive Procedures. Where an atmosphere free of dangerous air contamination, oxygen enrichment and/or oxygen deficiency cannot be ensured through the Alternate Procedures in Paragraph VI.A.2, above, the following procedure applies:

   a. EH&S must be notified before work in the confined space begins.

   b. EH&S will evaluate the hazards of the space, and, if UCDH employees will enter the space, EH&S will establish the means, procedures, and practices necessary for safe operations, in accordance with applicable regulations.

   c. EH&S will prepare a permit, specifying safe entry conditions (see Attachment 4, Confined Space Entry Permit. Work may proceed after verification that all safe entry conditions required by the permit have been provided.

Note: unless unusual circumstances require otherwise, UCDH personnel will enter confined spaces only under non-permit entry and alternative-entry procedures, as the technical support required for permit entries is not readily available at UCDH.

B. Electrical Manholes and Underground Vaults require the following additional entry precautions:

1. Another employee must be stationed at the surface as long as workers are in the structure.

2. The automatic circuit recloser on the circuit being worked must be made non-automatic, when:

   a. Operating energized oil-type switches from inside the structure.

   b. Splicing energized underground cable.

   c. Patching energized lead cable.

   d. Relocating energized underground cable or equipment (other than minor cable movements for additional clearance or routine maintenance such as cleaning cable, fireproofing, replacing cable support blocks, etc.).

   e. Filtering or replacing oil in energized underground equipment.

   f. The supervisor in charge deems it necessary for the safety of the employees doing the work.

3. Where newly installed, rebuilt or modified cable or equipment is being energized for the first time, the automatic circuit recloser on the circuit involved must be made non-automatic.

C. Telecommunications Manholes and Underground Vaults require the following additional entry precautions:

1. A person with basic first-aid training (current Red Cross First Aid training, or equivalent) must be immediately available to render assistance if there is reason to believe a hazard exists due to:

   a. Vehicle or pedestrian traffic, not adequately controlled by barriers or warning signs.

   b. Unusual water hazards.

   c. Manholes jointly occupied with power utilities.

   d. Where flammable or combustible gas vapors have been initially detected at an explosive level.

   e. Where toxic or otherwise hazardous substances are used in quantities that could be hazardous.

f. Where open flames are used.

g. Where hazardous substances: e.g. pesticides, herbicides, etc. are encountered.

h. Extended night work in manholes (except where constant voice communication is maintained with other persons who can render ready assistance).

Note: Emergency trouble work may be performed without assistance, provided it can be performed safely.

2. The manhole or unvented vault must be continuously ventilated with fresh air while occupied under any of the following conditions:

a. Where flammable or combustible gas vapors have been initially detected and subsequently reduced to a safe level by ventilation.

b. Where organic solvents are used.

c. Where open flame torches are used.

d. Where open to vehicular traffic and/or exposed to seepage of gasoline or gases.

e. Where a toxic gas or oxygen deficiency has been found.

D. Confined spaces not presently included in Attachment 1 - Inventory of Permit-Required Confined Spaces, or those created as a result of new buildings or installations, are to be evaluated for hazards that may require them to be included in the inventory. The evaluations are to be made by the responsible department together with EH&S.

E. Confined space entries when both UCDH and contractor employees will be involved. The contracting department will notify EH&S. Procedures must be developed and implemented to coordinate entry operations.

F. Reclassifying non-permit spaces to permit spaces. Non-permit spaces can become hazardous if chemical cleaners, paints or solvents are used in them, or if welding is done. Therefore, any proposed work of this type in a non-permit-required confined space must be reported to EH&S for their evaluation. Normally low-hazard spaces could also become hazardous due to a leak or spill of a hazardous material. In that event, exit the space immediately and reclassify the space.

G. Reclassifying a “Permit-Required Confined Space” to a “Non-Permit Space”

A “Permit-Required Confined Space” may be reclassified to a “Non-Permit Space” provided the space poses no actual or potential atmospheric hazards and if all hazards in the space are eliminated without entry into the space. The following procedures must be followed:

1. Justification for reclassification must be documented (see Attachment 2: Certificate of Safe Entry - Reclassification of Permit-Required Confined Space to Non-Permit

Space, which must be made available to each employee entering the space) and approved by EH&S prior to any entry into the space.

2. If hazards arise within a space reclassified to a “non-permit space”, employees must exit the space. The space must then be reevaluated and reclassified if necessary.

VII. REVIEWED BY

Kaila Benton-Vitz*
Jason Nietupski
Kristi Mirich
Kevin Long
Safety Committee
HR Policy Administrator

INVENTORY OF PERMIT-REQUIRED CONFINED SPACES
UC Davis Health

Department Responsible	Space / Location	Refer to Note(s):
Central Plant	Diesel (15,000 gal) Underground Tank - Fill /Vent Access	B
	Ammonia (26%) Underground Tank - Fill / Vent Access	B
	Sodium Hypochlorite Tank	B
	Chemical Storage Tanks	B
	Cooling Tower Sumps (4)	A
	Cooling Tower Drift Eliminator Access	A
	Demineralized and RO Water Tanks	A
	Heat Recovery Steam Generator and Exhaust	B
	Steam Drum	B
	Auxiliary Boilers	B
	Heating and Chill Water Expansion Tanks	A
	Wastewater Sump #4	B
	Electrical Manholes - 12kV Distribution System	B, D
	Electrical Vaults - Buildings 93, 95, 96	B, D
Fleet Service Maintenance	Car Wash Sump	B
	Street Sweeper Enclosure	A
	Underground Fuel Storage Tanks (3) - access to monitors	B
Plant Operations and Maintenance	Wastewater Lift Stations - Wet Wells (All)	C
	Domestic Hot Water Tanks	A
	Steam Manholes and Vaults	C
	Sewer / Storm Drain Manholes	C
Telecommunications	Telecommunications Manholes	B, E
	Telecommunications Vaults	B, E

Notes:

A. If all physical hazards can be eliminated without entry into space, and if the space poses no actual or potential atmospheric hazards, these spaces may be reclassified to a non-permit space - See Procedure V1. A. 1.

B. If the only hazard posed is an actual or potential hazardous atmosphere, and if the space can be maintained safe through continuous forced air ventilation alone, "alternate entry procedures" may be used - See Procedure V1. A. 2.

C. EH&S approval must be obtained before entry is allowed - See Procedure V. A. 3.

D. The additional precautions in Procedure V1. B. must be followed for entry into electrical manholes and vaults.

E. The additional precautions in Procedure V1. C. must be followed for entry into telecommunications manholes and vaults.

Certificate of Safe Entry - Alternate Entry Procedures

All answers to the following questions must be "Yes" to allow entry. DO NOT ENTER THE CONFINED SPACE TO ANSWER ANY QUESTIONS!

Confined Space Description/Location:

1. Is it safe to open/remove the entrance cover? _____
2. Is a temporary barrier in place to protect the opening? _____
3. Is the confined space atmosphere for the following tested in the order listed and found to be safe? _____ (Record every 30 minutes) (Does the personal gas alarm monitor meet established requirements?)_____

Oxygen level (O2) 19.5% - 23.5%

_____

Less than 10% of the LFL

_____

Carbon Monoxide (CO) level less than 5 ppm

_____

Toxic Air Contaminants approximately background or zero

_____

4. Do the work areas where employees will be in the space have direct, forced ventilation? _____
5. Is the air supply for the forced air ventilation obtained from a clean source? _____
6. Have the employees entering the space completed necessary training? _____

Entrant Name_____ Signature_____ Date_____

Entrant Name_____ Signature_____ Date_____

Supervisor Name _____ Signature_____ Date_____

EH&S Approval

Name_____Signature_____Date_____

Valtech Engineering

Quotation

Company Address	6387 Nancy Ridge Rd Suite B San Diego, CA 92121 USA	Work Reference	V-25934
		Revision	None
Phone	(888) 372-2205	Customer Ref	6 Inch Expansion Joints
Prepared By	Michelle Harman	Account Name	N & T Consulting - Livermore, CA
Email	mharman@valtechengineering.com	Contact Name	Angel Tse
Created Date	3/29/2023	Phone	(510) 388-6035
Expiration Date	4/29/2023	Email	angel@nandtconsulting.com
Bill To Name	N & T Consulting - Livermore, CA	Ship To Name	UC Davis

Quotation Notes

Lead Time: 5-7 Weeks after order and drawing approval.
Freight to Site: Prepay and add.
Payment Terms: Net 30 days
Due to tooling size Valtech Engineering may utilize subcontract manufacture.

Part	Revision	Line Item Description	Quantity	Sales Price	Total Price
14544	NONE	Line 6. 6" ND expansion joint with internal liner.	1.00	$2,193.00	$2,193.00
14543	NONE	Line 5. 6" ND expansion joint with internal liner.	1.00	$1,928.00	$1,928.00

Total Price	$4,121.00
Grand Total	$4,121.00

Quote Acceptance Information

Signature Michelle Harman
Name
Title
Date

Valtech Engineering General Terms and Conditions of Sale

These General Terms and Conditions of Sale ("Terms") apply to all deliveries of products and services ("Products") from Valtech Engineering LLC or its Affiliates (each of which is referred to as "Valtech Engineering") to any customer ("Customer"). In these Terms "Affiliate" shall mean any entity that directly or indirectly through one or more intermediaries, controls, is controlled by or is under common control by Valtech Engineering LLC at such time.

No terms and conditions other than these Terms shall be binding upon Valtech Engineering and the Customer unless agreed in writing by both Valtech Engineering and Customer. All terms and conditions contained in any prior communication which are different from or in addition to the Terms shall not be binding on Valtech Engineering unless otherwise expressly agreed in writing by both Valtech Engineering and Customer.

1. **Intellectual Property.**

At the initial quotation stage, the design package including: all drawings, calculations, and engineered solutions belong solely to Valtech Engineering and is not to be shared without written consent from an Officer of Valtech Engineering. The design package becomes the property of the owner/operator after the accepted purchase of the designed part(s).

2. **Confirmation of order.**

Valtech Engineering shall not be deemed to have accepted an order until a formal sales order acknowledgment acceptance of the Customer's purchase order by Valtech Engineering is received by Customer.

3. **Terms of delivery.**

The Products are quoted ex works, and do not include packaging, duties, storage unless otherwise specified. If the Customer does not provide written instructions, Valtech Engineering may deliver the Products to Customer, at the risk and expense of Customer, by a transport method chosen by Valtech Engineering. Unless otherwise agreed in writing, Valtech Engineering may make delivery in installments. All installments will be separately invoiced and paid as billed without regard to subsequent deliveries. Failure to pay any installment when due will excuse Valtech Engineering from making all future deliveries.

4. **Shipment Delay.**

If Valtech Engineering does not ship on the promised date, Customer is entitled to request a reasonable, revised shipment date in writing without undue delay. No claims can be made by the Customer because of the delay.

5. **Price.**

Prices for Products do not include taxes or duties. Valtech Engineering reserves the right to adjust accepted prices for non - delivered Products in the event of alterations in rates of exchange, variations in costs of materials, a sub-supplier's price increases, changes in wages, state requisitions or similar conditions over which Valtech Engineering has no or limited control. If the purchaser wishes changes to be made to the order or specifications, the cost of such changes shall be charged to the purchaser as a submitted revision to the original order acknowledgment.

6. **Packing.**

Cost of special boxing, export boxing, cartage or transfer expenses will be added to the invoice unless charges are shown to be included in the prices quoted.

7. **Terms of payment.**

Invoices are payable in full 30 days following the invoice date unless other payments terms are agreed to in writing between Valtech Engineering and the Customer, subject to approval and continuance of approval of credit by Valtech Engineering. In the event that Valtech Engineering does not approve credit to the Customer, or if at any time Valtech Engineering reverses its prior approval of credit for any reason, terms of payment shall be C.O.D., or immediate partial, or full advance payment, or a combination of the foregoing methods, all as Valtech Engineering may then, or thereafter from time to time, elect or specify. ***All payments shall be in U.S. dollars.***

8. **Proprietary information and confidentiality.**

Any non-public information, including but not limited to: calculations, drawings, descriptions and any other technical documents which Valtech Engineering makes available to the Customer ("Confidential Information") shall remain the property of Valtech Engineering and shall be treated as confidential by Customer and its representatives and must not, without the written consent of Valtech Engineering, be copied, reproduced, or transferred to third parties or be used for other purposes than those intended when the Confidential Information was made available. Confidential Information shall

be returned upon Valtech Engineering's request.

9. **Fabrication.**

Valtech Fabrication is the primary manufacturing facility for Valtech Engineering designed equipment. Valtech Engineering reserves the right to utilize alternate subcontract manufacture when tooling and/or capacity allows for subcontracting to provide an equivalent product more economically or expeditiously.

10. **Alterations.**

Valtech Engineering reserves the right to make, without notice to Customer, alterations to a Product that do not materially affect agreed specifications or the Product's form, fit or function.

11. **Limited warranty new parts.**

Valtech Engineering's liability is limited to defects and shortcomings which appear within a period of 18 months from delivery, or 12 months after installation, whichever occurs first. This warranty shall be voided if the article in question is improperly installed, applied, operated or maintained; subjected to overload, misuse, negligence or an accident; or repaired or altered outside of the Valtech Engineering factory or by anyone other than an authorized Valtech Engineering service partner under direction of Valtech Engineering. Products manufactured by others, but supplied by Valtech Engineering as part of a Valtech Engineering Product, are not warranted by Valtech Engineering, and Customer's sole recourse if any such product should fail shall be under the warranty, if any, of such other manufacturer.

Customer's sole and exclusive remedy against Valtech Engineering and Valtech Engineering's only obligation, for breach of warranty, shall be, at Valtech Engineering's option, the repair or replacement (with either a refurbished or new Product) of any Product that on Valtech Engineering's examination is found to be defective at the time of delivery due to faulty workmanship and/or defective material, but only if the Customer submits a claim in writing to Valtech Engineering within the warranty period. When making a warranty claim, the Customer must forward the Product to Valtech Engineering in a manner to be agreed upon between Customer and Valtech Engineering with a description of the reason for returning the Product. Freight and insurance will be paid by the Customer. If Valtech Engineering determines that the Product is not defective due to faulty workmanship and/or defective material or that the warranty has been voided, the Product shall be returned to the Customer if the Customer requests. In such case, freight and insurance shall be paid by the Customer. If Valtech Engineering ascertains that the Product is defective due to faulty workmanship and/or defective material, Valtech Engineering shall send the repaired Product or a replacement Product to the Customer. Valtech Engineering may choose the method of delivery and will pay freight and insurance.

The Customer is responsible for repackaging Products returned in suitable packing material to prevent damage in transit. Valtech Engineering may elect to provide service personnel at Customer's premises to affect Product repair or replacement covered by the terms of the warranty. Travel time and travel expenses will be billed to the Customer until a valid warranty has been determined.

12. **Limited warranty field services.**

Valtech Engineering's liability for onsite field service repairs and installations is limited to defects and shortcomings which appear within a period of 6 months after repair unless otherwise agreed in writing. Field service work which is quoted as 'best effort' will be performed as 'best effort' and there is no implied warranty for such work.

13. **Disclaimer of warranties.**

Except for the warranties stated above, the products are supplies 'as is, where is, and with all faults'. Valtech Engineering disclaims all other warranties with respect to the products, either express or implied, arising by operation of law, course of dealing, usage of trad or otherwise, including but not limited to the implied warranties of merchantability and fitness for a particular purpose.

14. **Indemnification.**

Customer shall indemnify, defend and hold Valtech Engineering harmless from all claims, including but not limited to all claims filed by third parties, for injuries, harms, losses or damages of any kind, (a) caused by or resulting from, (i) the Product after it has been delivered, (ii) the improper use, repair, maintenance or operation of the Product by Customer, (iii) the failure of Customer to adequately train personnel in the operation of the Product, or (iv) the Customer's failure to comply with applicable laws or regulations or (b) to products manufactured by the Customer or to products of which the Customer's products form a part. The Customer consents to the jurisdiction of any court or arbitral tribunal in which any third-party files a claim for injuries, harms, losses or damages allegedly caused by any Product sold to Customer.

15. **Limitation of liability.**

In no event shall Valtech Engineering be liable for any consequential, punitive, or exemplary damages or losses arising out of any breach of warranty, faulty product, delay in delivery of the product, product liability, failure to warn, recall or otherwise, irrespective of the cause, including but not limited to, loss of production, loss of profit, and loss of goodwill.

16. **Notice of claims.**

Claims or complaints as to defects and/or delay in delivery of the Products or other claims shall be submitted in writing by Customer to Valtech Engineering without undue delay.

17. **Export.**

Customer is hereby advised and put on notice that Products may be subject to export controls and regulations of the United States, another country of manufacture or a country of transshipment, and export may require a valid export license. Valtech Engineering' acceptance of Customer's order and delivery of the Products is expressly conditioned on compliance by Customer with all applicable export controls. Valtech Engineering is under no obligation to sell or deliver the Products until all required export licenses have been granted. No Products sold to Customer may be exported unless such export complies fully with all applicable export regulations. Customer shall be responsible for obtaining all required export licenses and for all expenses of obtaining such licenses.

18. **Force Majeure.**

Valtech Engineering is entitled to cancel orders or suspend or delay delivery of Products and will not be liable for such cancellation, suspension, or any non- delivery, faulty or delayed delivery which partly or wholly is caused by circumstances beyond Valtech Engineering' control, including, but not limited to, riots, civil unrest, war, terrorism, fire, insurrection, requisition, seizure, embargo or defects or delays in deliveries by sub-contractors, strikes, lockouts, lack of transportation, scarcity of materials, accidents in product testing, and insufficient supplies of energy. Any of Customer's contractual rights are suspended or become void in any such circumstances referred to in this clause. Customer is not entitled to any kind of damages or to make a claim whatsoever in case of cancellation or delayed delivery due to such circumstances.

19. **Partial invalidity.**

If one or more of the terms and conditions in these Terms or any part of a term is deemed invalid, unenforceable, illegal or inoperable, the validity, enforceability, legality or operability of all further terms and conditions shall not be affected or diminished thereby.

20. **Disputes.**

Any dispute between the parties concerning or arising from (a) a purchase of a Product or (b) any damages, injuries, losses, or harms allegedly caused by any Product shall be decided under California law. The Parties may refer the enforcement of any arbitral award to any competent court. English shall be the language to be used in the arbitration proceeding unless otherwise agreed between the parties. The arbitration proceedings and the arbitral award shall be confidential and involved persons on both sides are pledged to secrecy.

OPERATING DESIGN DATA			
FLOWING MEDIA	HEATED AIR		
FLOW MEDIA TEMPERATURE	925 F		
	PRESSURE	DUCT TEMPERATURE	BELLOWS TEMPERATURE
DESIGN CONDITION	1.33 PSIG	925 F	925 F
UPSET CONDITION	-	-	-
OPERATING CONDITION	-	-	-
AXIAL COMPRESSION	0.5 INCHES		
AXIAL EXTENSION	0.0 INCHES		
LATERAL (IN-PLANE)	0.5 INCHES		
LATERAL (OUT-OF-PLANE)	0.0 INCHES		
RESULTANT LATERAL	0.5 INCHES		
ANGULAR	0.0 DEGREES		
TORSIONAL	0.0 DEGREES		
AXIAL PRESET	0.0 INCHES		
LATERAL PRESET	0.0 INCHES		
ANGULAR PRESET	0.0 DEGREES		
AXIAL SPRING RATE	418 LBS/IN		
LATERAL SPRING RATE	568 LBS/IN		
ANGULAR SPRING RATE	N/A IN-LBS/DEG		
TORSIONAL SPRING RATE	N/A IN-LBS/DEG		
DESIGN CYCLE LIFE	3000 EJMA		
PRESSURE THRUST	57 LBS		
FLOW VELOCITY	80 FT/S		
MDMT	-20 F		
CORROSION ALLOWANCE	0.0 INCHES ON INTERNAL ALLOY SURFACES.		
DRY UNIT WEIGHT	10 LBS		
-	-		

REVISIONS			
REV	BY	DATE	DESCRIPTION
-	-	-	-

GENERAL NOTES:
1. DESIGNED AND FABRICATED IN ACCORDANCE WITH THE 10TH EDITION OF THE EXPANSION JOINT MANUFACTURERS ASSOCIATION (EJMA).
2. MTR'S ARE REQUIRED ON ALL PRESSURE CONTAINING MATERIALS.
3. ALL WELDING IN ACCORDANCE WITH ASME SEC IX.
4. PART SHALL HAVE (2) FLOW ARROWS 180 DEG APART.
5. BELLOWS IS PUNCH FORMED WITH A FINAL REROLL PROCESS.
6. EXPANSION JOINT IS NOT DESIGNED TO CARRY PRESSURE THRUST.
7. SHIPPING BARS ARE REQUIRED. PAINT YELLOW AND TAG: "REMOVE AFTER INSTALLATION AND BEFORE SYSTEM PRESSURE TEST."
8. NO PAINT.
9. ASSEMBLY SHALL BE CLEAN AND FREE OF ALL LOOSE MATTER.
10. ASSEMBLY SHALL BE PACKAGED AND PROTECTED FOR SHIPPING TO AND STORAGE AT THE JOB SITE. ENDS SHALL BE CLOSED AND INTERNAL DESICCANT USED. BOXING IS REQUIRED.
11. MAXIMUM ALLOWABLE UNDER CUT IS ZERO WITH NO EVIDENT IMPERFECTIONS.

TESTING NOTES:
1. VISUAL TEST OF ALL WELDS.
2. AIR AND SOAP BUBBLE LEAK CHECK USING SHOP AIR ON ONE SIDE OF WELD AND SOAP SOLUTION ON THE OTHER SIDE PER IV-ATB-01 (HPBT). NO INTERNAL PRESSURE TEST WITH CLOSED ENDS.

CLARIFICATIONS:
1. NONE.

EXCEPTIONS:
1. NONE.

QTY: 1

TAG: LINE 5
CUSTOMER: N AND T CONSULTING
END USER: UC DAVIS
SITE LOCATION: DAVIS, CA

MANUFACTURING TOLERANCES (UNLESS OTHERWISE SPECIFIED)		
0-42" ±0.125" (0-1067 ±3.2)	42.125"-82" ±0.188" (1068-2083 ±4.8)	OVER 82" ±0.250" (OVER 2083 ±6.4)
ANGULAR ±2.0 DEGREES	ROUNDNESS ±0.188" (4.8)	CONCENTRICITY ±0.125" (3.2)

TITLE: 6" ND EXPANSION JOINT WITH INTERNAL LINER

DESIGNER: MOC
DATE: 3-14-23

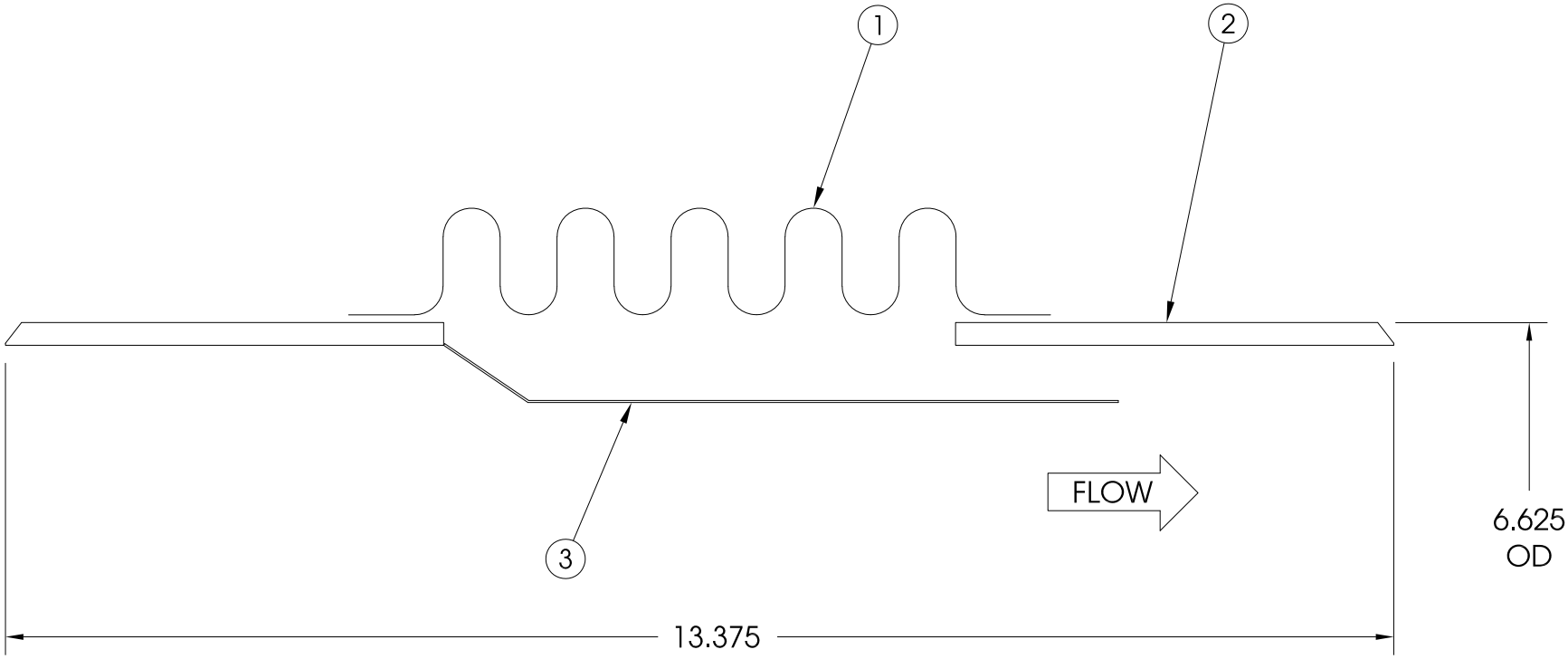
valtech engineering
6387 NANCY RIDGE DRIVE
SAN DIEGO, CA, 92121
PHONE: (888) 372 - 2205
VALTECHENGINEERING.COM

WORK REFERENCE: V-25934

SIZE	INCH (mm)	PART NUMBER	REV	SHEET
A		14543	-	1 OF 2

BILL OF MATERIALS

ITEM	QTY	MATERIAL	DESCRIPTION
1	1	A240-304	BELLOWS - 0.025 THK X 6.625 ID X 8.125 OD X 1 PLY X 11 CONVS X 7.75 Lb X 21.375 DL
2	2	A312-TP304	PIPE - 6"-SCH 10S (0.134 WALL) X 3 L
3	1	A240-304	LINER - 0.048 THK X 5.125 OD X 7.875 L
4	-	-	-
5	-	-	-
6	-	-	-
7	-	-	-
8	-	-	-
9	-	-	-
10	-	-	-
11	-	-	-
12	-	-	-
13	-	-	-
14	-	-	-
15	-	-	-



TAG: LINE 5
CUSTOMER: N AND T CONSULTING
END USER: UC DAVIS
SITE LOCATION: DAVIS, CA

MANUFACTURING TOLERANCES (UNLESS OTHERWISE SPECIFIED)

0-42" ±0.125" (0-1067 ±3.2)	42.125"-82" ±0.188" (1068-2083 ±4.8)	OVER 82" ±0.250" (OVER 2083 ±6.4)
ANGULAR ±2.0 DEGREES	ROUNDNESS ±0.188" (4.8)	CONCENTRICITY ±0.125" (3.2)

TITLE: 6" ND EXPANSION JOINT WITH INTERNAL LINER

DESIGNER: MOC

DATE: 3-14-23

valtech engineering
6387 NANCY RIDGE DRIVE
SAN DIEGO, CA, 92121
PHONE: (888) 372 - 2205
VALTECHENGINEERING.COM

WORK REFERENCE: V-25934

SIZE	INCH (mm)	PART NUMBER	REV	SHEET
A		14543	-	2 OF 2

Single Unreinforced Bellows Calculation

Customer: UC DAVIS
Work Reference: V-25934
Drawing: 14543 REV NONE

Date: 3/14/23
Designer: MOC
Item Number: 1

Designed in accordance with the 10th Edition of the Expansion Joint Manufacturers Association (EJMA).

Inputs:

Internal Pressure:	1.33	psig
External Pressure:	N/A	psig
Temperature:	925.0	F
Bellows ID (Db):	6.625	IN.
Bellows OD:	8.125	IN.
Convs (N):	11	
Thickness (t):	0.025	IN.
Plies (n):	1	
Skirt Length (Lt):	0.500	IN.
Roll:	0.300	IN.
Bellows Length (Lb):	7.750	IN.
Bellows Pitch (q):	0.705	IN.

Materials:

Bellows P No 8: A240-304

Bellows Sa @ Ambient:	20000	psi
Bellows Sa @ Temp:	14450	psi
Bellows Su @ Ambient:	70000	psi
Bellows Su @ Temp:	56300	psi
Bellows E @ Ambient:	28300000	psi
Bellows E @ Temp:	23325000	psi

Bellows Efficiency: 1
Finished Condition: As Rolled

Movements: (Concurrent)

Axial Compression:	0.500	IN.
Axial Extension:	0.000	IN.
Lat in-plane comp:	0.500	IN.
Lat out-plane comp:	0.000	IN.
Lat in-plane ext:	0.000	IN.
Lat out-plane ext:	0.000	IN.
Ang in-plane comp:	0.000	DEG
Ang out-plane comp:	0.000	DEG
Ang in-plane ext:	0.000	DEG
Ang out-plane ext:	0.000	DEG

Solved Variables:

Convolution Height (w):	0.725	IN.
Effective Area:	42.7	$IN.^2$
Pressure Thrust:	57	Lbs
Cp:	0.6069	
Cf:	1.4793	
Cd:	1.8602	
exc:	0.045	IN.
exe:	0.000	IN.
ey res comp:	0.139	IN.
ey res ext:	0.000	IN.
etheta res comp:	0.000	IN.
etheta res ext:	0.000	IN.
Moment of Inertia:	0.027	$IN.^4$
Eq. Pipe Wall Thickness:	0.338	IN.
Developed Length:	21.375	IN.
Bellows Weight:	3.2	Lbs

Results:

Calcs performed at 1.33 psig internal pressure.

	Design Stress:		Allowable:	Max Pressure
S1=	145 psi	≤	14450 psi	133 psig
S2=	81 psi	≤	14450 psi	236 psig
S3=	20 psi			
S4=	378 psi			
S3 + S4=	398 psi	≤	43350 psi	145 psig
S5=	2595 psi			
S6=	210508 psi			
St=	213382 psi			

Squirm Pressure = 86 psig ≥ 1 psig
Max Safe Operating Pressure = 86 psig *(Lowest of S1, S2's, S3, S4 or squirm.)*

EJMA Cycles (fc = 1.0) = 4247 ≥ 3000 Required (Primary Cycles)

Bottom out = 2.026 IN. ≤ 3.6 IN. Max.

Spring Rates:		Max Movement:	Max Force:	Max Moment:
Axial	418 Lbs/IN.	0.500 IN.	209 Lbs	
Lateral	568 Lbs/IN.	0.500 IN.	284 Lbs	1177 IN.-Lbs
Angular	50 IN-Lbs/deg	0.000 DEG		0 IN.-Lbs
Torsional	43873 IN-Lbs/deg			

Max Torsional = 0.1419 DEG

Duct/Pipe Under Internal Pressure Calculation

Customer: UC DAVIS
Work Reference: V-25934
Drawing: 14543 REV NONE

Date: 3/14/23
Designer: MOC
Item Number: 2

Designed in accordance with the ASME B31.3-2020 Edition.

Inputs:

Pressure (P):	1.33	psig	(0.09 kg/cm²)
Temperature:	925.0	F	(496.1 C)
Y (Table 304.1.1):	0.4		
Efficiency (E):	1.00		
Duct OD (D):	6.625	IN.	(168.3 mm)
Thickness (T):	0.134	IN.	(3.4 mm)
Corrosion Allowance (CA):	0.000	IN.	(0 mm)
Mill Under Tolerance (mu):	0.017	IN.	(0.4 mm)
Weld Undercut (wu):	0.000	IN.	(0 mm)

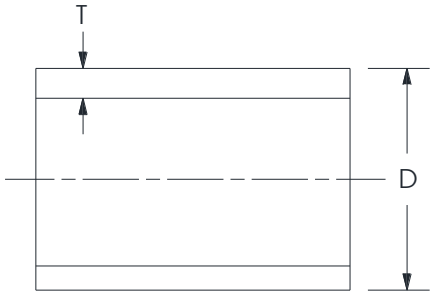
Materials:

Duct/Pipe: A312-TP304

Sa @ Ambient:	16700	psi	(115.14 N/mm²)
Sa @ Temp:	12450	psi	(85.84 N/mm²)

Start of time-dependent properties: 950.0 F (510 C)
(Table 302.3.5, note (b) Per ASME Sec IID
"NOTES TIME-DEPENDANT PROPERTIES Txx")

Sketch:



Calculations/Results:

Duct (per 304.1.2)

Tcr = 950 F - 50 F = 900 F (482.2 C)
W = 1 From Table 302.3.5

$$\text{t minimum} = \frac{\text{P} \cdot \text{D}}{2 \cdot (\text{Sa@temp} \cdot \text{E} \cdot \text{W} + \text{P} \cdot \text{Y})} + \text{CA} + \text{mu} + \text{wu}$$

t minimum < Thickness (T)
0.017 IN. < 0.134 IN. (0.4 mm < 3.4 mm)

Single Liner Clearance Calculation

Customer: UC DAVIS
Work Reference: V-25934
Drawing: 14543 REV NONE

Date: 3/14/23
Designer: MOC
Item Number: 3

Designed in accordance with the ASME B31.3-2020 Edition and EJMA 10th Edition, section 4.10.3.

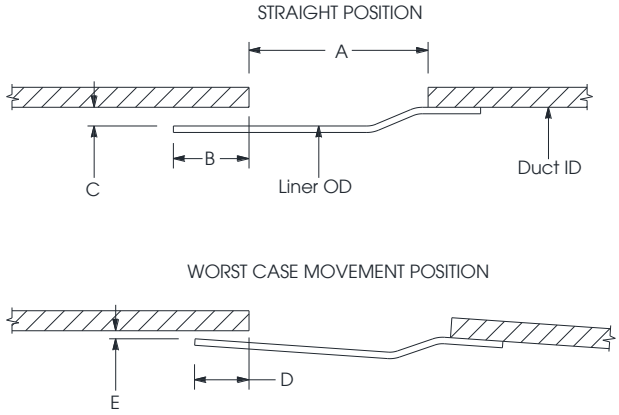
Inputs:

Duct ID:	6.357	IN.	(161.5 mm)
Liner OD:	5.125	IN.	(130.2 mm)
Liner Gap (A):	7.375	IN.	(187.3 mm)
Liner Overlap (B):	0.500	IN.	(12.7 mm)
Minimum Liner Clearance:	0.062	IN.	(1.6 mm)
Minimum Liner Overlap:	0.500	IN.	(12.7 mm)
Liner Material:	A240-304		
Liner Thickness:	0.048	IN.	(1.2 mm)
Liner Temperature:	925.0	F	(496.1 C)
Modulus E @ 300 F (Esc):	27000000	psi	(186.2 kN/mm²)
Modulus E @ Temp. (Esh)	23325000	psi	(160.8 kN/mm²)

Movements:

Compression:	-0.500	IN.	(-12.7 mm)
Extension:	0.000	IN.	(0 mm)
Lateral:	0.500	IN.	(12.7 mm)
Angular (α):	0.000	deg	

Sketch:



Clearance Check Calculations:

$$AB = \frac{A}{2} + B \qquad CD = \frac{\text{Liner OD}}{2} \cdot \tan(\alpha) \qquad EF = AB - CD \qquad GH = \cos(\alpha) \cdot EF$$

$$IJ = \sin(\alpha) \cdot EF \qquad KL = \frac{\frac{\text{Liner OD}}{2}}{\cos(\alpha)} \qquad D = GH - \frac{A + \text{Axial}}{2} \cdot \tan(\alpha) \qquad E = \frac{\text{Duct ID} - 2 \cdot (KL - IJ)}{2} \cdot \tan(\alpha) - \text{Lateral}$$

Clearance Check Results:

Suggested Liner Length = 8.875 IN.

For all cases: D ≥ Minimum Liner Overlap and E ≥ Minimum Liner Clearance

Case 1: Positive Angular with Compression:
D = 1 IN. (25.4 mm) ≥ 0.5 IN. (12.7 mm)
E = 0.116 IN. (2.9 mm) ≥ 0.062 IN. (1.6 mm)

Case 2: Negative Angular with Compression
D = 1 IN. (25.4 mm) ≥ 0.5 IN. (12.7 mm)
E = 0.116 IN. (2.9 mm) ≥ 0.062 IN. (1.6 mm)

Case 3: Positive Angular with Extension:
D = 0.5 IN. (12.7 mm) ≥ 0.5 IN. (12.7 mm)
E = 0.116 IN. (2.9 mm) ≥ 0.062 IN. (1.6 mm)

Case 4: Negative Angular with Extension
D = 0.5 IN. (12.7 mm) ≥ 0.5 IN. (12.7 mm)
E = 0.116 IN. (2.9 mm) ≥ 0.062 IN. (1.6 mm)

Liner Thickness Calculations:

Cl = (Lsl / 18.0)^0.5
Cl = 1.0

Cv = (Vmax / 100)^0.5
Cv = 1.0

Ct = Esc / Esh
Ct = 27000000 / 23325000 = 1.158

ts = Cl x Cv x Ct x ts,min
ts = 1 x 1 x 1.158 x 0.036 IN. = 0.042 IN.

Liner Thk. = 0.048 IN. (1.2 mm) > 0.042 IN. (1.1 mm) = ts,min

OPERATING DESIGN DATA			
FLOWING MEDIA	AMMONIA / AIR MIXTURE		
FLOW MEDIA TEMPERATURE	925 F		
	PRESSURE	DUCT TEMPERATURE	BELLOWS TEMPERATURE
DESIGN CONDITION	1.33 PSIG	925 F	925 F
UPSET CONDITION	-	-	-
OPERATING CONDITION	-	-	-
AXIAL COMPRESSION	0.25 INCHES		
AXIAL EXTENSION	0.25 INCHES		
LATERAL (IN-PLANE)	0.6 INCHES		
LATERAL (OUT-OF-PLANE)	0.0 INCHES		
RESULTANT LATERAL	0.6 INCHES		
ANGULAR	0.0 DEGREES		
TORSIONAL	0.0 DEGREES		
AXIAL PRESET	0.0 INCHES		
LATERAL PRESET	0.0 INCHES		
ANGULAR PRESET	0.0 DEGREES		
AXIAL SPRING RATE	853 LBS/IN		
LATERAL SPRING RATE	859 LBS/IN		
ANGULAR SPRING RATE	N/A IN-LBS/DEG		
TORSIONAL SPRING RATE	N/A IN-LBS/DEG		
DESIGN CYCLE LIFE	3000 EJMA		
PRESSURE THRUST	57 LBS		
FLOW VELOCITY	92 FT/S		
MDMT	-20 F		
CORROSION ALLOWANCE	0.0 INCHES ON INTERNAL ALLOY SURFACES.		
DRY UNIT WEIGHT	11 LBS		
-	-		

REVISIONS			
REV	BY	DATE	DESCRIPTION
-	-	-	-

GENERAL NOTES:
1. DESIGNED AND FABRICATED IN ACCORDANCE WITH THE 10TH EDITION OF THE EXPANSION JOINT MANUFACTURERS ASSOCIATION (EJMA).
2. MTR'S ARE REQUIRED ON ALL PRESSURE CONTAINING MATERIALS.
3. ALL WELDING IN ACCORDANCE WITH ASME SEC IX.
4. PART SHALL HAVE (2) FLOW ARROWS 180 DEG APART.
5. BELLOWS IS PUNCH FORMED WITH A FINAL REROLL PROCESS.
6. EXPANSION JOINT IS NOT DESIGNED TO CARRY PRESSURE THRUST.
7. SHIPPING BARS ARE REQUIRED. PAINT YELLOW AND TAG: "REMOVE AFTER INSTALLATION AND BEFORE SYSTEM PRESSURE TEST."
8. NO PAINT.
9. ASSEMBLY SHALL BE CLEAN AND FREE OF ALL LOOSE MATTER.
10. ASSEMBLY SHALL BE PACKAGED AND PROTECTED FOR SHIPPING TO AND STORAGE AT THE JOB SITE. ENDS SHALL BE CLOSED AND INTERNAL DESICCANT USED. BOXING IS REQUIRED.
11. MAXIMUM ALLOWABLE UNDER CUT IS ZERO WITH NO EVIDENT IMPERFECTIONS.

TESTING NOTES:
1. VISUAL TEST OF ALL WELDS.
2. AIR AND SOAP BUBBLE LEAK CHECK USING SHOP AIR ON ONE SIDE OF WELD AND SOAP SOLUTION ON THE OTHER SIDE PER IV-ATB-01 (HPBT). NO INTERNAL PRESSURE TEST WITH CLOSED ENDS.

CLARIFICATIONS:
1. NONE.

EXCEPTIONS:
1. NONE.

QTY: 1

TAG: LINE 6
CUSTOMER: N AND T CONSULTING
END USER: UC DAVIS
SITE LOCATION: DAVIS, CA

MANUFACTURING TOLERANCES (UNLESS OTHERWISE SPECIFIED)		
0-42" ±0.125" (0-1067 ±3.2)	42.125"-82" ±0.188" (1068-2083 ±4.8)	OVER 82" ±0.250" (OVER 2083 ±6.4)
ANGULAR ±2.0 DEGREES	ROUNDNESS ±0.188" (4.8)	CONCENTRICITY ±0.125" (3.2)

TITLE: 6" ND EXPANSION JOINT WITH INTERNAL LINER

DESIGNER: MOC
DATE: 3-14-23

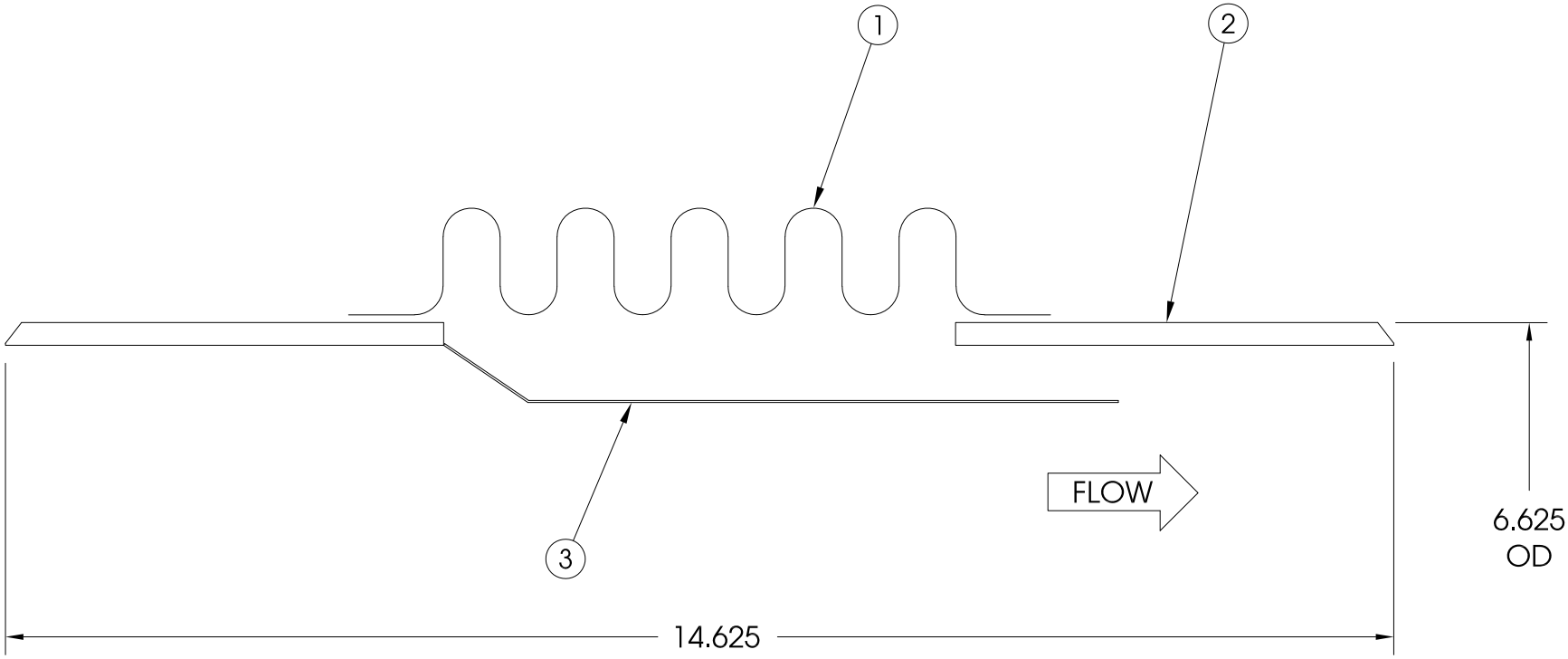
valtech engineering
6387 NANCY RIDGE DRIVE
SAN DIEGO, CA, 92121
PHONE: (888) 372 - 2205
VALTECHENGINEERING.COM

WORK REFERENCE: V-25934

SIZE	INCH (mm)	PART NUMBER	REV	SHEET
A		14544	-	1 OF 2

BILL OF MATERIALS

ITEM	QTY	MATERIAL	DESCRIPTION
1	1	A240-304	BELLOWS - 0.025 THK X 6.625 ID X 8.125 OD X 2 PLY X 12 CONVS X 9.0 Lb X 23 DL
2	2	A312-TP304	PIPE - 6"-SCH 40 (0.280 WALL) X 3 L
3	1	A240-304	LINER - 0.048 THK X 5.0 OD X 9.375 L
4	-	-	-
5	-	-	-
6	-	-	-
7	-	-	-
8	-	-	-
9	-	-	-
10	-	-	-
11	-	-	-
12	-	-	-
13	-	-	-
14	-	-	-
15	-	-	-



TAG: LINE 6
CUSTOMER: N AND T CONSULTING
END USER: UC DAVIS
SITE LOCATION: DAVIS, CA

MANUFACTURING TOLERANCES (UNLESS OTHERWISE SPECIFIED)

0-42" ±0.125" (0-1067 ±3.2)	42.125"-82" ±0.188" (1068-2083 ±4.8)	OVER 82" ±0.250" (OVER 2083 ±6.4)
ANGULAR ±2.0 DEGREES	ROUNDNESS ±0.188" (4.8)	CONCENTRICITY ±0.125" (3.2)

TITLE: 6" ND EXPANSION JOINT WITH INTERNAL LINER

DESIGNER: MOC

DATE: 3-14-23

valtech engineering
6387 NANCY RIDGE DRIVE
SAN DIEGO, CA, 92121
PHONE: (888) 372 - 2205
VALTECHENGINEERING.COM

WORK REFERENCE: V-25934

SIZE	INCH (mm)	PART NUMBER	REV	SHEET
A		14544	-	2 OF 2

Single Unreinforced Bellows Calculation

Customer: UC DAVIS
Work Reference: V-25934
Drawing: 14544 REV NONE

Date: 3/14/23
Designer: MOC
Item Number: 1

Designed in accordance with the 10th Edition of the Expansion Joint Manufacturers Association (EJMA).

Inputs:

Internal Pressure:	1.33	psig
External Pressure:	N/A	psig
Temperature:	925.0	F
Bellows ID (Db):	6.625	IN.
Bellows OD:	8.125	IN.
Convs (N):	12	
Thickness (t):	0.025	IN.
Plies (n):	2	
Skirt Length (Lt):	0.500	IN.
Roll:	0.300	IN.
Bellows Length (Lb):	9.000	IN.
Bellows Pitch (q):	0.750	IN.

Materials:

Bellows P No 8: A240-304

Bellows Sa @ Ambient:	20000	psi
Bellows Sa @ Temp:	14450	psi
Bellows Su @ Ambient:	70000	psi
Bellows Su @ Temp:	56300	psi
Bellows E @ Ambient:	28300000	psi
Bellows E @ Temp:	23325000	psi

Bellows Efficiency: 1
Finished Condition: As Rolled

Movements: (Concurrent)

Axial Compression:	0.250	IN.
Axial Extension:	0.250	IN.
Lat in-plane comp:	0.600	IN.
Lat out-plane comp:	0.000	IN.
Lat in-plane ext:	0.000	IN.
Lat out-plane ext:	0.000	IN.
Ang in-plane comp:	0.000	DEG
Ang out-plane comp:	0.000	DEG
Ang in-plane ext:	0.000	DEG
Ang out-plane ext:	0.000	DEG

Solved Variables:

Convolution Height (w):	0.700	IN.
Effective Area:	42.7	$IN.^2$
Pressure Thrust:	57	Lbs
Cp:	0.5843	
Cf:	1.4788	
Cd:	1.9524	
exc:	0.021	IN.
exe:	0.021	IN.
ey res comp:	0.126	IN.
ey res ext:	0.000	IN.
etheta res comp:	0.000	IN.
etheta res ext:	0.000	IN.
Moment of Inertia:	0.055	$IN.^4$
Eq. Pipe Wall Thickness:	0.406	IN.
Developed Length:	22.939	IN.
Bellows Weight:	6.9	Lbs

Results:

Calcs performed at 1.33 psig internal pressure.

	Design Stress:		Allowable:	Max Pressure
S1=	73 psi	≤	14450 psi	264 psig
S2=	45 psi	≤	14450 psi	428 psig
S3=	10 psi			
S4=	170 psi			
S3 + S4=	179 psi	≤	43350 psi	321 psig
S5=	2633 psi			
S6=	196371 psi			
St=	199129 psi			

Squirm Pressure = 152 psig ≥ 1 psig
Max Safe Operating Pressure = 152 psig *(Lowest of S1, S2's, S3, S4 or squirm.)*

EJMA Cycles (fc = 1.0) = 5839 ≥ 3000 Required (Primary Cycles)

Bottom out = 1.767 IN. ≤ 3.9 IN. Max.

Spring Rates:		Max Movement:	Max Force:	Max Moment:
Axial	853 Lbs/IN.	0.250 IN.	213 Lbs	
Lateral	859 Lbs/IN.	0.600 IN.	515 Lbs	2385 IN.-Lbs
Angular	101 IN-Lbs/deg	0.000 DEG		0 IN.-Lbs
Torsional	81492 IN-Lbs/deg			

Max Torsional = 0.1528 DEG

Duct/Pipe Under Internal Pressure Calculation

Customer: UC DAVIS
Work Reference: V-25934
Drawing: 14544 REV NONE

Date: 3/14/23
Designer: MOC
Item Number: 2

Designed in accordance with the ASME B31.3-2020 Edition.

Inputs:

Pressure (P):	1.33	psig	(0.09 kg/cm²)
Temperature:	925.0	F	(496.1 C)
Y (Table 304.1.1):	0.4		
Efficiency (E):	1.00		
Duct OD (D):	6.625	IN.	(168.3 mm)
Thickness (T):	0.280	IN.	(7.1 mm)
Corrosion Allowance (CA):	0.000	IN.	(0 mm)
Mill Under Tolerance (mu):	0.035	IN.	(0.9 mm)
Weld Undercut (wu):	0.000	IN.	(0 mm)

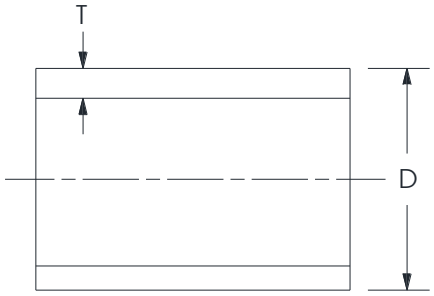
Materials:

Duct/Pipe: A312-TP304

Sa @ Ambient:	16700	psi	(115.14 N/mm²)
Sa @ Temp:	12450	psi	(85.84 N/mm²)

Start of time-dependent properties: 950.0 F (510 C)
(Table 302.3.5, note (b) Per ASME Sec IID
"NOTES TIME-DEPENDANT PROPERTIES Txx")

Sketch:



Calculations/Results:

Duct (per 304.1.2)

Tcr = 950 F - 50 F = 900 F (482.2 C)
W = 1 From Table 302.3.5

$$\text{t minimum} = \frac{\text{P} \cdot \text{D}}{2 \cdot (\text{Sa@temp} \cdot \text{E} \cdot \text{W} + \text{P} \cdot \text{Y})} + \text{CA} + \text{mu} + \text{wu}$$

t minimum < Thickness (T)
0.035 IN. < 0.28 IN. (0.9 mm < 7.1 mm)

Single Liner Clearance Calculation

Customer: UC DAVIS
Work Reference: V-25934
Drawing: 14544 REV NONE

Date: 3/14/23
Designer: MOC
Item Number: 3

Designed in accordance with the ASME B31.3-2020 Edition and EJMA 10th Edition, section 4.10.3.

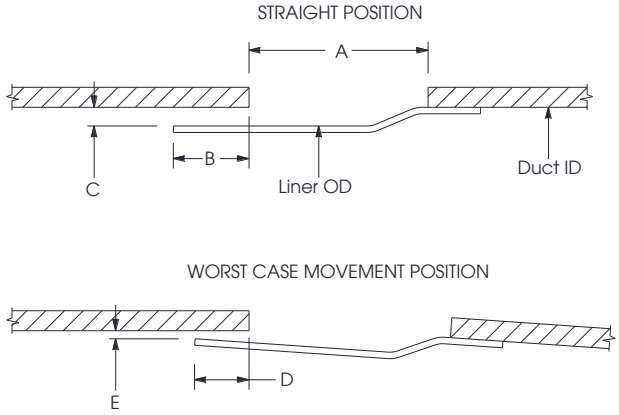
Inputs:

Duct ID:	6.357	IN.	(161.5 mm)
Liner OD:	5.000	IN.	(127 mm)
Liner Gap (A):	8.625	IN.	(219.1 mm)
Liner Overlap (B):	0.750	IN.	(19.1 mm)
Minimum Liner Clearance:	0.062	IN.	(1.6 mm)
Minimum Liner Overlap:	0.500	IN.	(12.7 mm)
Liner Material:	A240-304		
Liner Thickness:	0.048	IN.	(1.2 mm)
Liner Temperature:	925.0	F	(496.1 C)
Modulus E @ 300 F (Esc):	27000000	psi	(186.2 kN/mm²)
Modulus E @ Temp. (Esh)	23325000	psi	(160.8 kN/mm²)

Movements:

Compression:	-0.250	IN.	(-6.4 mm)
Extension:	0.250	IN.	(6.4 mm)
Lateral:	0.600	IN.	(15.2 mm)
Angular (α):	0.000	deg	

Sketch:



Clearance Check Calculations:

$$AB = \frac{A}{2} + B \qquad CD = \frac{\text{Liner OD}}{2} \cdot \tan(\alpha) \qquad EF = AB - CD \qquad GH = \cos(\alpha) \cdot EF$$

$$IJ = \sin(\alpha) \cdot EF \qquad KL = \frac{\frac{\text{Liner OD}}{2}}{\cos(\alpha)} \qquad D = GH - \frac{A + \text{Axial}}{2} \cdot \tan(\alpha) \qquad E = \frac{\text{Duct ID} - 2 \cdot (KL - IJ)}{2} \cdot \tan(\alpha) - \text{Lateral}$$

Clearance Check Results:

Suggested Liner Length = 10.375 IN.

For all cases: D ≥ Minimum Liner Overlap and E ≥ Minimum Liner Clearance

Case 1: Positive Angular with Compression:
D = 1 IN. (25.4 mm) ≥ 0.5 IN. (12.7 mm)
E = 0.079 IN. (2 mm) ≥ 0.062 IN. (1.6 mm)

Case 2: Negative Angular with Compression
D = 1 IN. (25.4 mm) ≥ 0.5 IN. (12.7 mm)
E = 0.079 IN. (2 mm) ≥ 0.062 IN. (1.6 mm)

Case 3: Positive Angular with Extension:
D = 0.5 IN. (12.7 mm) ≥ 0.5 IN. (12.7 mm)
E = 0.079 IN. (2 mm) ≥ 0.062 IN. (1.6 mm)

Case 4: Negative Angular with Extension
D = 0.5 IN. (12.7 mm) ≥ 0.5 IN. (12.7 mm)
E = 0.079 IN. (2 mm) ≥ 0.062 IN. (1.6 mm)

Liner Thickness Calculations:

Cl = (Lsl / 18.0)^0.5
Cl = 1.0

Cv = (Vmax / 100)^0.5
Cv = 1.0

Ct = Esc / Esh
Ct = 27000000 / 23325000 = 1.158

ts = Cl x Cv x Ct x ts,min
ts = 1 x 1 x 1.158 x 0.036 IN. = 0.042 IN.

Liner Thk. = 0.048 IN. (1.2 mm) > 0.042 IN. (1.1 mm) = ts,min