

NREL

FY19 LAB UPGRADES – VTIF

PROJECT MANAGER

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MECHANICAL/PLUMBING ENGINEER

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STRUCTURAL ENGINEER

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12499 W. Colfax
Lakewood, Colorado 80215

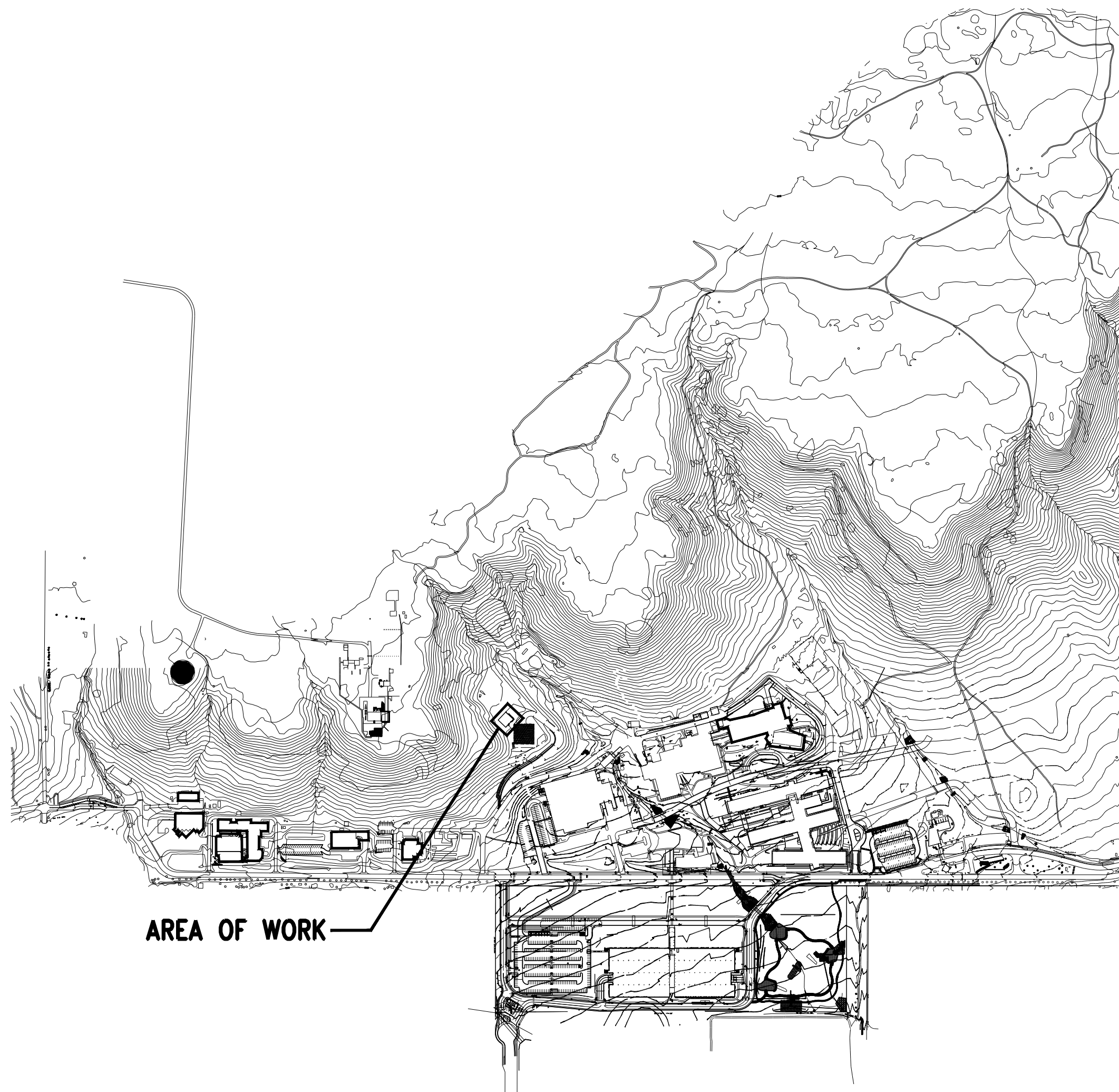
303.431.6100

SCOPE OF WORK

- PROVIDE AND INSTALL HEAT EXCHANGER AND PROCESS WATER LOOP FOR NEW WEATHEROMETER HEAT REJECTION LOOP
- PROVIDE NEW SUPPLY FAN FOR EXISTING EVAPORATIVE COOLER
- PROVIDE NEW CHILLER FOR NEW CHILLED WATER LOOP
- PROVIDE NEW CHILLED WATER COIL AND DUCT HEATER FOR CONDITIONING OF SPACE
- PROVIDE NEW EXHAUST FAN TO SUPPORT NEW WEATHEROMETER EQUIPMENT HEAT REJECTION
- PROVIDE NEW AIR COMPRESSOR FOR INCREASED COMPRESSED AIR CAPACITY
- PROVIDE STRUCTURAL SUPPORT FOR NEW EQUIPMENT
- PROVIDE POWER TO ALL NEW EQUIPMENT

APPLICABLE CODES

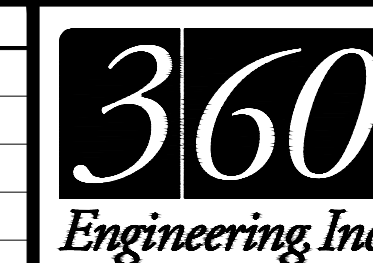
- 2015 INTERNATIONAL BUILDING CODE (IBC)
- 2015 INTERNATIONAL MECHANICAL CODE (IMC)
- 2015 INTERNATIONAL PLUMBING CODE (IPC)
- 2015 INTERNATIONAL FUEL AND GAS CODE (IFGC)
- 2015 INTERNATIONAL ENERGY CONSERVATION CODE (IECC)
- 2014 NATIONAL ELECTRICAL CODE (NEC)
- 2019 NATIONAL FIRE PROTECTION ASSOCIATION 13 (NFPA)
- 2019 NATIONAL FIRE PROTECTION ASSOCIATION 72 (NFPA)
- 2018 NATIONAL FIRE PROTECTION ASSOCIATION 101 (NFPA)



DRAWING INDEX

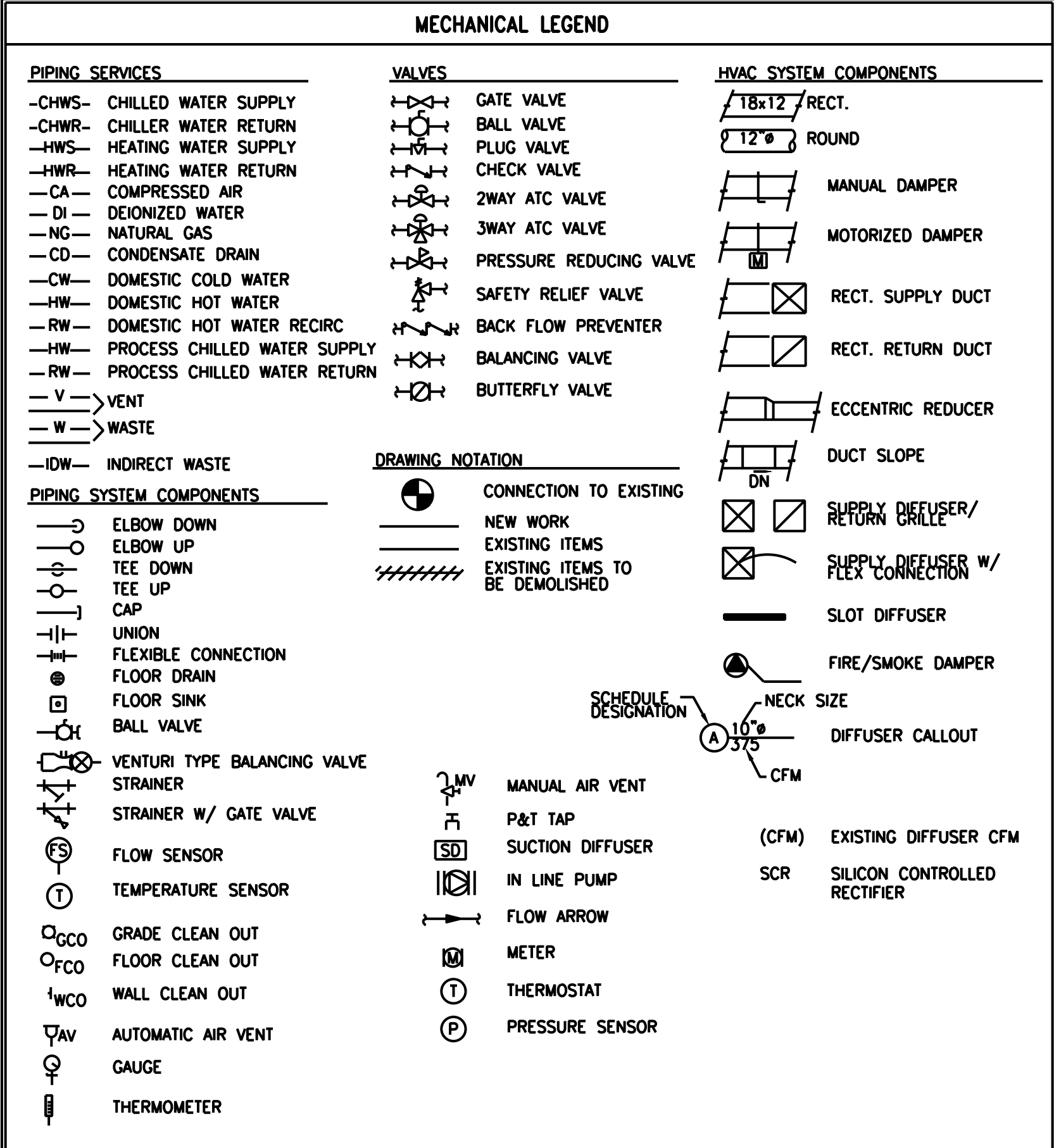
| DRAWING NO. PREFIX | DRAWING NO. | DISCIPLINE AND DRAWING DESCRIPTION | REV. |
|--------------------|-------------|--|------|
| PROJECT | | | |
| VTIF-011- | X-01 | COVER SHEET, SITE LOCATION AND DRAWING INDEX | 0 |
| MECHANICAL | | | |
| VTIF-011- | M-01 | MECHANICAL LEGEND AND NOTES | 0 |
| VTIF-011- | M-02 | MECHANICAL SCHEDULES | 0 |
| VTIF-011- | M-03 | MECHANICAL 1ST FLOOR DEMO PLAN | 0 |
| VTIF-011- | M-04 | MECHANICAL MEZZANINE DEMO FLOOR PLAN | 0 |
| VTIF-011- | M-05 | MECHANICAL 1ST FLOOR PLAN | 0 |
| VTIF-011- | M-06 | MECHANICAL MEZZANINE FLOOR PLAN | 0 |
| VTIF-011- | M-07 | MECHANICAL DETAILS | 0 |
| VTIF-011- | M-08 | SEQUENCE OF OPERATIONS | 0 |
| VTIF-011- | M-09 | SEQUENCE OF OPERATIONS | 0 |
| VTIF-011- | M-10 | CONTROL POINTS AND AIRFLOW SCHEMATICS | 0 |
| PIPING | | | |
| VTIF-011- | PP-01 | PIPING 1ST FLOOR PLAN | 0 |
| VTIF-011- | PP-02 | PIPING MEZZANINE FLOOR PLAN | 0 |
| PLUMBING | | | |
| VTIF-011- | PL-01 | PLUMBING 1ST FLOOR PLAN | 0 |
| VTIF-011- | PL-02 | PLUMBING MEZZANINE FLOOR PLAN | 0 |
| VTIF-011- | PL-03 | PLUMBING DETAILS | 0 |
| ELECTRICAL | | | |
| VTIF-011- | E-01 | ELECTRICAL LEGEND AND NOTES | 0 |
| VTIF-011- | E-02 | ELECTRICAL DEMO PLAN LEVEL 1 | 0 |
| VTIF-011- | E-03 | ELECTRICAL POWER PLAN LEVEL 1 | 0 |
| VTIF-011- | E-04 | ELECTRICAL DEMO ONE-LINE DIAGRAM | 0 |
| VTIF-011- | E-05 | ELECTRICAL ONE-LINE DIAGRAM | 0 |
| VTIF-011- | E-06 | ELECTRICAL SCHEDULES | 0 |
| STRUCTURAL | | | |
| VTIF-011- | S-01 | GENERAL NOTES | 0 |
| VTIF-011- | S-02 | SPECIAL INSPECTIONS | 0 |
| VTIF-011- | S-100 | 1ST FLOOR PLAN | 0 |
| VTIF-011- | S-200 | STEEL FRAMING DETAILS | 0 |

| NO. | REVISIONS | DATE | BY | APP'D. | BAE | NO. | REVISIONS | DATE | BY | APP'D. | BAE | FILE INFORMATION | ENGINEERING REVIEW | V.T.I.F. GENERAL | | |
|-----|-------------------------|----------|-----|--------|-----|-----|-----------|------|----|--------|-----|--|---|--|--|--|
| A | 50% REVIEW SET | 4/24/19 | TCM | DMD | . | . | . | . | . | . | . | USER: DMD DATE: 03/27/20 TIME: 10:30 XREF'S: 0 | DESIGNER: DMD APPROVAL: DMD DATE: 03/27/20 | V.T.I.F. GENERAL FY19 LAB UPGRADES – VTIF | | |
| B | 90% REVIEW SET | 10/18/19 | TCM | DMD | . | . | . | . | . | . | . | DWG. FILE: VTIF-011-X-01 LAYOUT: | ENGINEER: DMD CHECKED BY: DMD DATE: 03/27/20 | COVER SHEET, SITE LOCATION AND DRAWING INDEX | | |
| C | 91% REVIEW SET | 12/24/19 | BG | DMD | . | . | . | . | . | . | . | DWG. FOLDER: ACAD VERSION: 2010 | A/E APPROVED BY: - NREL APPROVED BY: - | DRAWING NO. PREFIX: VTIF-011 DRAWING NO.: X-01 REVISION NO.: 0 | | |
| D | 95% REVIEW SET | 02/17/20 | BG | DMD | . | . | . | . | . | . | . | PLATFORM: Microsoft Windows BORDER: ZBD2234D-3.DWG PLOT SCALE: 1" = 1" UNITS: ARCHITECTURAL | NREL PROJECT NO.: EX20193201 NREL WORK ORDER NO.: -- A/E PROJECT NO.: 19-027A | | | |
| 0 | ISSUED FOR CONSTRUCTION | 03/27/20 | BG | DMD | . | . | . | . | . | . | . | PLOT INFO.: NREL.STB | | | | |



NATIONAL RENEWABLE ENERGY LABORATORY
15013 Center Road, Golden, Colorado 80401-3393
Operated for the U.S. Department of Energy by the Alliance for Sustainable Energy, LLC





MECHANICAL NOTES

I. GENERAL

- A. ALL WORK SHALL BE IN ACCORDANCE WITH SMACNA STANDARDS AND SPECIFICATIONS AND 2015 INTERNATIONAL MECHANICAL CODE (IMC).
- B. THESE DRAWINGS ARE DIAGRAMMATIC IN NATURE AND NOT INTENDED TO SHOW ALL TRANSITIONS, OFFSETS, ETC. CONTRACTOR SHALL FIELD VERIFY EXISTING CONDITIONS AND PROVIDE ALL NECESSARY FITTINGS TO COMPLETE THE INTENT OF THE DRAWINGS. ANY DISCREPANCIES BETWEEN DRAWINGS AND FIELD CONDITIONS SHALL BE REPORTED TO NREL PROJECT MANAGER FOR RESOLUTION.
- C. COORDINATE SPACE REQUIREMENTS, SUPPORTS, AND INSTALLATION OF MECHANICAL WORK, WHICH ARE INDICATED DIAGRAMMATICALLY ON THE DRAWINGS. FOLLOW ROUTING SHOWN FOR PIPES AND DUCTS AS CLOSELY AS PRACTICABLE; PLACE RUNS PARALLEL WITH LINES OF BUILDING. UTILIZE SPACES EFFICIENTLY TO MAXIMIZE ACCESSIBILITY FOR OTHER INSTALLATIONS, FOR MAINTENANCE, AND FOR REPAIRS.
- D. COMPLY WITH MANUFACTURER'S INSTRUCTIONS INCLUDING EACH STEP IN SEQUENCE. SHOULD MANUFACTURER'S INSTRUCTIONS CONFLICT WITH THE DRAWINGS REQUEST CLARIFICATION FROM THE NREL PROJECT MANAGER BEFORE PROCEEDING.
- E. DUCT SIZES ARE INSIDE DIMENSION.
- F. CONTRACTOR SHALL REVIEW THESE DOCUMENTS CAREFULLY. CONTRACTOR SHALL CONTACT NREL CONTRACTING OFFICER, FOR RESOLUTION OF ANY DISCREPANCIES, OMISSIONS, OR CLARIFICATIONS, BEFORE BID DATE. IN THE EVENT THAT AN INTERPRETATION OF BID DOCUMENTS IS NECESSARY AFTER THE BID DATE, THE DECISION OF NREL SHALL BE FINAL AND BINDING.
- G. PRODUCT DELIVERY, STORAGE, AND HANDLING: PROVIDE EQUIPMENT AND PERSONNEL TO HANDLE PRODUCTS BY METHODS TO PREVENT DAMAGE. PROMPTLY INSPECT SHIPMENTS TO ENSURE THAT PRODUCTS ARE UNDAMAGED. STORE AND PROTECT PRODUCTS IN ACCORDANCE WITH MANUFACTURERS' INSTRUCTIONS.
- H. THE CONTRACTOR IS RESPONSIBLE FOR THE COSTS OF ALL CHANGE ORDERS, WHICH NREL AND ENGINEER HAVE NOT APPROVED IN WRITING PRIOR TO THE EXECUTION OF THE ASSOCIATED WORK.

II. EXECUTION:

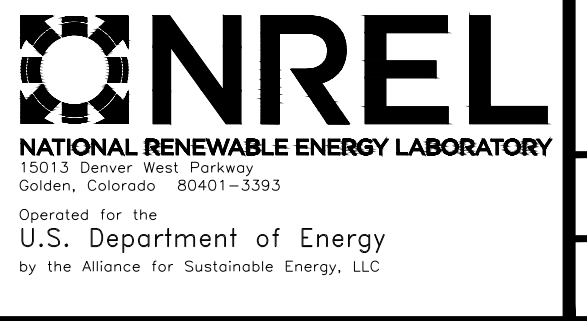
- A. TESTING AND BALANCING: CONTRACTOR SHALL PROVIDE START-UP TEST REPORTS FOR ALL NEW AND EXISTING EQUIPMENT SHOWN. CONTRACTOR SHALL PROVIDE AIRFLOW AND HYDRONIC TEST AND BALANCE DOCUMENTATION FOR ALL NEW AND EXISTING EQUIPMENT AS IDENTIFIED IN THE DRAWINGS.
- B. PROVIDE VOLUME DAMPERS AT ALL DIFFUSER TAKEOFFS.
- C. CONTRACTOR SHALL COORDINATE WORK WITH OTHER TRADES AND NOTIFY NREL PROJECT MANAGER IF ANY CONFLICTS OCCUR.
- D. MECHANICAL CONTRACTOR TO CHECK OPERATION AND CONDITION OF ALL MECHANICAL EQUIPMENT FOR THE PROJECT AND PREPARE A WRITTEN LIST OF ANY DEFICIENCIES IN EQUIPMENT OPERATION OR CONDITION. LIST SHALL BE SUBMITTED TO NREL TWO WEEKS AFTER THE AWARD OF THE CONTRACT.

GENERAL NOTES

1. ON DEMOLITION PLANS EXISTING MECHANICAL SYSTEMS TO BE REMOVED ARE SHOWN HEAVY LINE WEIGHT, AND CROSS HATCHED. EXISTING MECHANICAL SYSTEMS TO REMAIN ARE SHOWN LIGHT LINE WEIGHT. ON ALL OTHER PLANS NEW MECHANICAL SYSTEMS ARE SHOWN HEAVY LINE WEIGHT.
2. CONTRACTOR TO LOCATE EQUIPMENT REQUIRING MAINTENANCE SUCH THAT ALL ACCESS POINTS ARE SERVICEABLE
3. WORK UNDER THIS CONTRACT IS IN OCCUPIED SPACES, STORAGE ROOMS AND EQUIPMENT ROOMS. CONTRACTOR IS TO SCHEDULE AND COORDINATE HIS WORK AND ANY EXISTING EQUIPMENT DOWNTIME WITH NREL PRIOR TO BEGINNING WORK.
4. THE DRAWINGS INDICATE THE GENERAL ARRANGEMENT OF THE EXISTING EQUIPMENT LOCATIONS. EXISTING PIPE ROUTING AND EXISTING DUCT ROUTING. CONTRACTOR IS TO INSTALL NEW EQUIPMENT, DUCTS, AND PIPING IN LOCATIONS REQUIRED TO AVOID INTERFERENCE WITH EXISTING FACILITIES, EQUIPMENT, DUCTS AND PIPING. CONTRACTOR IS RESPONSIBLE FOR RAISING AND LOWERING EXISTING EQUIPMENT AND MAKING PROPER OFFSETS IN DUCTS AND PIPING TO AVOID CONFLICTS.
5. CONTRACTOR SHALL VISIT THE SITE BEFORE SUBMITTING BID, AND VERIFY DIMENSIONS AND EXISTING CONDITIONS RELATED TO HIS WORK.
6. ALL CUTTING, PATCHING AND CORE DRILLING FOR THE INSTALLATION OF NEW EQUIPMENT, DUCTS, HANGERS, ETC. SHALL BE HELD TO A MINIMUM AND BE ACCOMPLISHED IN A CAREFUL MANNER. ALL PATCHING SHALL MATCH EXISTING CONSTRUCTION, TEXTURE, AND FINISH AND BE DONE BY SKILLED CRAFTSMAN OF THE TRADES INVOLVED AT THE CONTRACTOR'S EXPENSE.
7. THE OWNER AND ENGINEER ARE NOT RESPONSIBLE FOR THE CONTRACTOR'S SAFETY PRECAUTIONS OR TO MEANS METHODS, TECHNIQUES, CONSTRUCTION SEQUENCES, OR PROCEDURES REQUIRED TO PERFORM HIS WORK. CONTRACTOR AND SUBS SHALL SUBMIT SAFETY PLANS TO NREL FOR APPROVAL.
8. ALL WORK SHALL BE INSTALLED IN ACCORDANCE WITH ALL APPLICABLE FEDERAL CODES, LOCAL CODES AND OWNER'S STANDARDS INDICATED BY THE CONSTRUCTION DOCUMENTS.
9. THESE DRAWINGS ARE THE PROPERTY OF THE UNITED STATES GOVERNMENT AND ARE NOT TO BE REPRODUCED OR DISTRIBUTED WITHOUT THE CONSENT OF THE U.S. DEPARTMENT OF ENERGY OR ITS AUTHORIZED AGENTS.
10. RECYCLE AS MUCH MATERIAL AS POSSIBLE.
11. THE INSTALLATION OR REMOVAL OF DUCTS, PIPES, AND EQUIPMENT MAY REQUIRE THE REMOVAL OF EXISTING WALLS AND CEILINGS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PATCHING AND REPAIRING THESE WALLS AND/OR CEILINGS SO THEY MATCH THE EXISTING.
12. PATCH OPENINGS (AIR TIGHT) IN DUCTS WHICH ARE TO REMAIN ACTIVE AND HAVE HAD A SECTION REMOVED. ALSO REPAIR DUCT INSULATION SO THAT IT IS CONTINUOUS.
13. ALL PIPING AND DUCTS INDICATED TO BE REMOVED UNDER THE CONTRACT SHALL BE REMOVED COMPLETELY TO POINTS OF CONNECTION AT THE MAINS OR BRANCHES AND CAPPED.
14. ALL FIXTURES AND EQUIPMENT REMOVED, AND NOT REUSED, ARE TO BE RETURNED TO OWNER.
15. CONTRACTOR TO COORDINATE THE LOCATION OF ALL DUCTWORK AND DIFFUSERS WITH REFLECTED CEILING PLAN AND STRUCTURE PRIOR TO BEGINNING WORK.



| REVISIONS | | | | | | REVISIONS | | | | | | FILE INFORMATION | | | | ENGINEERING REVIEW | | | V.T.I.F. | | |
|-----------|----------|-----|--------|-----|-----|-----------|----|--------|-----|---------------|-------------------|------------------|---------------|----------|----------|--------------------|-------------------|------------|--------------|--|--|
| NO. | DATE | BY | APP'D. | BAE | NO. | DATE | BY | APP'D. | BAE | USER: | DATE: | TIME: | XREF'S: | DESIGNER | APPROVAL | DATE | DRWING NO. PREFIX | DRWING NO. | REVISION NO. | | |
| A | 4/24/19 | TCM | DMD | . | . | . | . | . | . | DMD | 03/27/20 | 10:30 | 0 | DMD | DMD | 03/27/20 | VTIF-011 | M-01 | 0 | | |
| B | 10/18/19 | TCM | DMD | . | . | . | . | . | . | DWG. FILE: | VTIF-011-M-01 | LAYOUT: | | DMD | DMD | 03/27/20 | | | | | |
| C | 12/24/19 | BG | DMD | . | . | . | . | . | . | DWG. FOLDER: | | | | DMD | DMD | 03/27/20 | | | | | |
| D | 02/17/20 | BG | DMD | . | . | . | . | . | . | ACAD VERSION: | 2010 | | | DMD | DMD | 03/27/20 | | | | | |
| 0 | 03/27/20 | BG | DMD | . | . | . | . | . | . | PLATFORM: | Microsoft Windows | | | | | | | | | | |
| | | | | | | | | | | BORDER: | ZBD2234D-3.DWG | PLOT SCALE: | 1" = 1" | | | | | | | | |
| | | | | | | | | | | PLOT INFO.: | NREL.STB | UNITS: | ARCHITECTURAL | | | | | | | | |



| | | |
|--------------------------------|---------------------------|----------------------------|
| V.T.I.F. MECHANICAL | | |
| FY19 LAB UPGRADES - VTIF | | |
| MECHANICAL LEGEND AND NOTES | | |
| DRWING NO. PREFIX VTIF-011 | DRWING NO. M-01 | REVISION NO. 0 |
| NREL PROJECT NO. EX20193201 | NREL WORK ORDER NO. -- | A/E PROJECT NO. 19-027A |

| DUCT HEATER SCHEDULE | | | | | | | | | | | | | | | | | | |
|----------------------|--------------|----------|----------|---------|------------|--------------------------|-------------|-----------|------------|-------------|-------|----------------|----------|-------------|------------|-------------|-------|--------------|
| GENERAL | | | | | | GAS HEATING (@ 5,300 FT) | | | | ELECTRICAL | | | PHYSICAL | | | | NOTES | |
| TAG | MANUFACTURER | MODEL | LOCATION | HEATING | SERVICE | EAT DB [°F] | LAT DB [°F] | INPUT MBH | OUTPUT MBH | VOLTAGE [V] | PHASE | FREQUENCY [HZ] | FLA [A] | LENGTH [IN] | WIDTH [IN] | HEIGHT [IN] | | WEIGHT [LBS] |
| DH-2 | REZNOR | EEDU-400 | BAY | GAS | SUPPLY AIR | 0.0 | 59.5 | 400.0 | 267 | 115 | 1 | 60 | 2.0 | 45 | 38 | 36 | 328 | 1,2,3,4 |

NOTES:
1. PROVIDE WITH VIBRATION ISOLATORS
2. PROVIDE WITHOUT FINGER-BAFFELS
3. PROVIDE WITH E-3 (409) STAINLESS STEEL HEAT EXCHANGER
4. PROVIDE PROPER ORIFICE FOR HEATING AT 5,300 FT ASL. COORDINATE WITH MANUFACTURER

| FAN SCHEDULE | | | | | | | | | | | | | | |
|--------------|--------------|--------|----------|-----------------|---------------|----------------|-------------|-------------|-----------|-------------|---|------------|---------|---------|
| GENERAL | | | | | PERFORMANCE | | | | | ELECTRICAL | | | | NOTES |
| TAG | MANUFACTURER | MODEL | LOCATION | SERVICE | AIRFLOW [CFM] | ESP [IN. W.C.] | SPEED [RPM] | POWER [BHP] | SIZE [HP] | VOLTAGE [V] | Ø | FREQ. [HZ] | FLA [A] | |
| EC-1 | TWIN CITY | FC-DW | EC-1 | UNIT SUPPLY FAN | 7500 | 2.55 | 1008 | 5.11 | 7 1/2 | 460 | 3 | 60 | - | 5 |
| EF-2 | GREENHECK | USF-16 | WALL | EXHAUST | 3900 | 0.75 | 1671 | 1.41 | 2 | 208 | 3 | 60 | 7.5 | 1,2,3,4 |

NOTES:
1. INTERCONNECT TO BUILDING MANAGEMENT SYSTEM
2. PROVIDE WITH BACKDRAFT DAMPER
3. PROVIDE WITH BIRD SCREEN
4. UNIT WEIGHT DOES NOT INCLUDE ACCESSORIES
5. FAN REPLACEMENT OF EXISTING FAN IN EVAPORATIVE COOLER EC-1. CONTRACTOR TO VERIFY INSTALLATION CONFIGURATION PRIOR TO ORDERING. PROVIDE NEW VFD FOR EC-1 FOR CONTROLLABLE TURNDOWN TO 5000 CFM

| COOLING COIL SCHEDULE | | | | | | | | | | | | | | | | | | | | | |
|-----------------------|--------------|-------------------------|----------|--------------|-------------|-----------|-----------------|----------------|----------|----------|-----------------|-------------|-------------|----------------|-----------------|----------------|-------------|------------|-------------|-------|--------------|
| GENERAL | | | | | | FLUID | | | | AIR | | | | | | PHYSICAL | | | | NOTES | |
| TAG | MANUFACTURER | MODEL | LOCATION | SERVICE | ARRANGEMENT | SOLUTION | FLOW RATE [GPM] | P.D. [FT W.C.] | EWT [°F] | LWT [°F] | FLOW RATE [CFM] | EAT DB [°F] | EAT WB [°F] | LAT [IN. W.C.] | P.D. [IN. W.C.] | CAPACITY [MBH] | LENGTH [IN] | WIDTH [IN] | HEIGHT [IN] | | WEIGHT [LBS] |
| CC-1 | TRANE | DD1B42066G0GB080HABA0AB | BAY | MAIN COOLING | 10-ROW | 30% PROP. | 23 | 2.17 | 49.0 | 58.4 | 7500 | 63.3 | 60.0 | 55.1 | 0.37 | 99.65 | 80 1/8 | 18 1/2 | 43 1/2 | 893 | 1 |

NOTES:
1. PROVIDE WITH 3-WAY VALVE

| PUMP SCHEDULE | | | | | | | | | | | |
|---------------|------------------|--------|---------|-------------|------------|------------|-------------|-------|----------------|-------|------------|
| GENERAL | | | | PERFORMANCE | | ELECTRICAL | | | | NOTES | |
| TAG | MANUFACTURER | MODEL# | SYSTEM | FLOW [GPM] | HEAD [FT.] | POWER [HP] | VOLTAGE [V] | PHASE | FREQUENCY [HZ] | | SIZE [RPM] |
| P-1 | BELL AND GOSSETT | PL-30 | PROCESS | 5 | 22 | 1/12 | 115 | 1 | 60 | 2650 | 1,2 |

NOTES:
1. PROVIDED WITH ISOLATION VALVE FLANGES ON EITHER SIDE OF THE PUMP
2. PROVIDE WITH CIRCUIT SETTER BALANCE VALVE.

| HEAT EXCHANGER SCHEDULE | | | | | | | | | | | | | | | | |
|-------------------------|--------------|----------|---------|------|-------------|-----|------------|------------|-----------|-----|------------|------------|-----------|---------------|--------|-------|
| TAG | MANUFACTURER | MODEL# | SERVES | MBH | SOURCE SIDE | | | | LOAD SIDE | | | | MATERIAL | SIZE LxWxH | WEIGHT | NOTES |
| | | | | | EWT | LWT | FLOW (GPM) | PRESS DROP | EWT | LWT | FLOW (GPM) | PRESS DROP | | | | |
| HX-1 | ALFA LAVAL | AQ1L-PFG | PROCESS | 77.0 | 49 | 59 | 16.3 | 8.2 PSI | 94 | 63 | 5 | 0.7 PSI | ALLOY 304 | 15.9x7.5x31.1 | 151 | 1,2,3 |

NOTES:
1. 30% PROPYLENE GLYCOL SOURCE SIDE
2. 100% WATER LOAD SIDE
3. INSULATE

| GRILLES, REGISTERS, AND DIFFUSERS SCHEDULE | | | | | | | |
|--|--------------|-----------|----------|----------|-----------|-----------|-------|
| TAG | MANUFACTURER | MODEL | SERVICE | MATERIAL | FACE SIZE | NECK SIZE | NOTES |
| A | PRICE | 80-SERIES | TRANSFER | ALUMNIUM | 12x12" | - | 1,2 |

NOTES:
1. COORDINATE COLOR AND FINISH PRIOR TO ORDERING.
2. PROVIDE WITH SURFACE MOUNTING KIT.

| AIR COOLED CHILLER SCHEDULE | | | | | | | | | | | | | | | | | | |
|-----------------------------|--------------|----------------------------------|----------|----------|----------------|----------------|----------------|-----------|-------|------------|---------|----------|--------------|-------------|--------------|---------------|---------|-------|
| GENERAL | | | | | PERFORMANCE | | | | | ELECTRICAL | | | | PHYSICAL | | | | NOTES |
| TAG | MANUFACTURER | MODEL | EWT [°F] | LWT [°F] | MAX FLOW [GPM] | MIN FLOW [GPM] | P.D. [FT W.C.] | VOLT. [V] | PHASE | FREQ. [HZ] | MCA [A] | MOCP [A] | LENGTH [IN.] | WIDTH [IN.] | HEIGHT [IN.] | WEIGHT [LBS.] | | |
| CH-1 | MULTISTACK | ASM020WCHSAB-A2I-CD----A--EA-JDA | 59 | 49 | 52.3 | 33.6 | 12.89 | 460 | 3 | 60 | 73.00 | 100 | 130 | 42 | 63-5/8 | 3650 | 1,2,3,4 | |

NOTES:
1. UNIT PROVIDED WITH INTEGRAL PUMPS.
2. UNIT PROVIDED WITH INTEGRAL 60 GALLON BUFFER TANK
3. UNIT PERFORMANCE SELECTED FOR 30% GLYCOL CHILLED WATER CONCENTRATION
4. PROVIDE MANUFACTURER'S INTERNAL CONTROLS WITH SINGLE POINT DDC CONNECTION TO CAMPUS BAS

| MISCELLANEOUS HVAC EQUIPMENT SCHEDULE | | | | | | |
|---------------------------------------|------------------------|--------------|-----------|---------------|--------|-------|
| TAG | DESCRIPTION | MANUFACTURER | MODEL# | SYSTEM | WEIGHT | NOTES |
| AS-1 | DIRT AND AIR SEPARATOR | ARMSTRONG | DAS-2-R-N | CHILLED WATER | 81 | 1,4,5 |
| PF-1 | CHEMICAL POT FEEDER | GRISWOLD | FB-2 | CHILLED WATER | 26 | 2,3 |
| PF-2 | CHEMICAL POT FEEDER | GRISWOLD | FB-2 | PROCESS WATER | 26 | 2,3 |
| ET-1 | EXPANSION TANK | ARMSTRONG | AX-60V | CHILLED WATER | 700 | 1,5 |

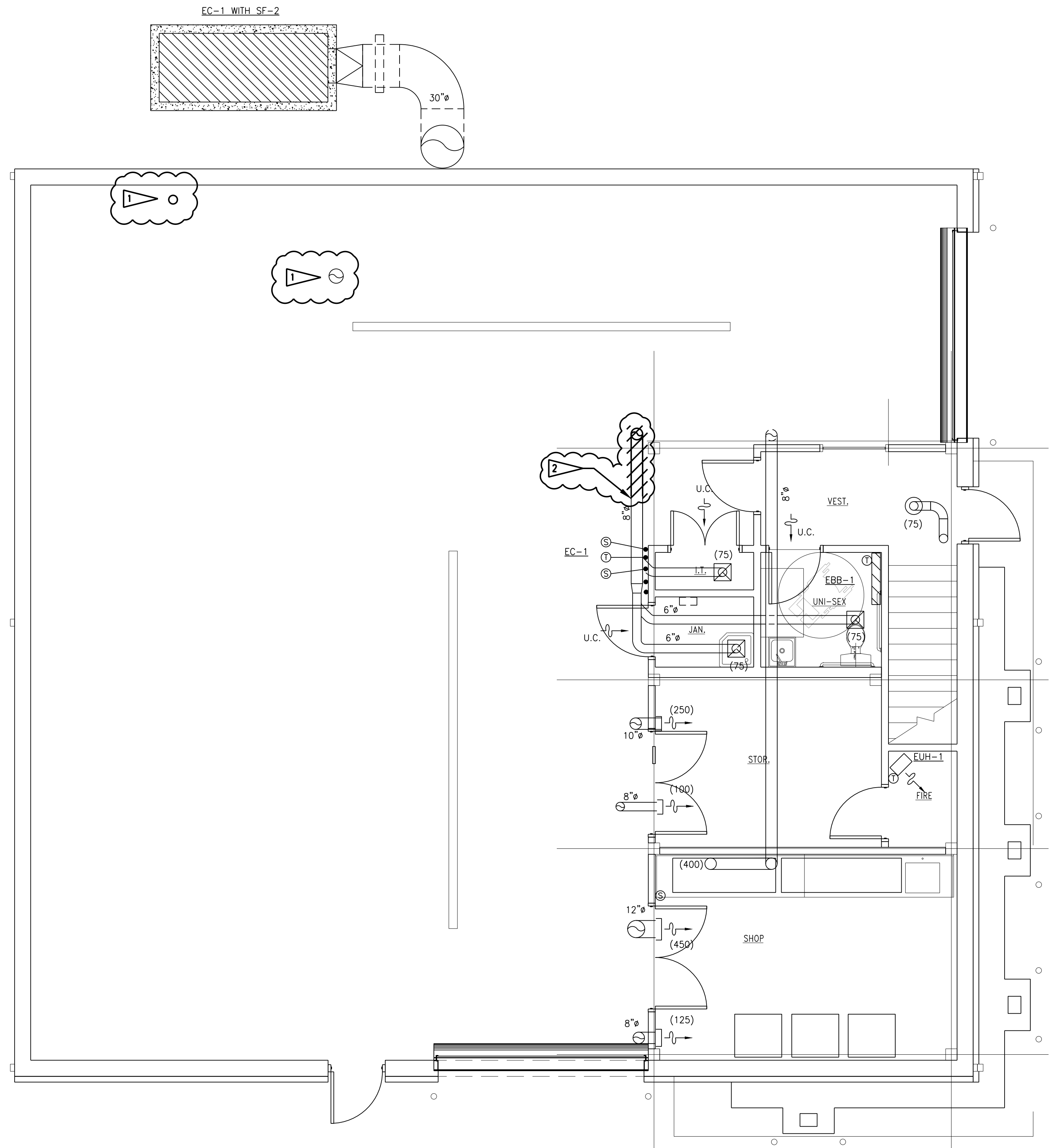
NOTES:
1. ASME RATED.
2. WITH STRAINER.
3. 2 GALLON FUNNEL PACKAGE.
4. PROVIDE WITH CLEARANCE AT BOTTOM FOR CARTRIDGE REMOVAL.
5. PROVIDE CORROSION RESISTANT COATING FOR OUTDOOR USE.

| AIR COMPRESSOR UNIT SCHEDULE | | | | | | | | | | |
|------------------------------|----------------|----------|-------------|------------------|----------------|------------|-------------|-------|------------|-------|
| GENERAL | | | PERFORMANCE | | | ELECTRICAL | | | | NOTES |
| TAG | MANUFACTURER | MODEL | FLOW [SCFM] | MAX PRESS. [PSI] | TANK [GALLONS] | POWER [HP] | VOLTAGE [V] | PHASE | FREQ. [HZ] | |
| CP-1 | INGERSOLL RAND | 2475N7.5 | 24.0 | 175 | 80 | 7.5 | 208 | 3 | 60 | 1,2,3 |

NOTES:
1. PROVIDE WITH VIBRATION ISOLATION
2. PROVIDE WITH AIR DRYER (PNEUMATECH AD-25 OR EQUIVALENT).
3. PROVIDE WITH EXTERNAL PRV AT EQUIPMENT SET TO 125 PSI.

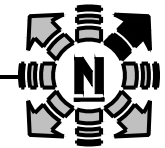
| NO. | REVISIONS | | | | | | FILE INFORMATION | | | | ENGINEERING REVIEW | | 360 Engineering Inc. | NREL NATIONAL RENEWABLE ENERGY LABORATORY | V.T.I.F. MECHANICAL | | |
|-----|-------------------------|----------|-----|--------|-----|-----|-----------------------------|---------------------|----------------------|----------|--------------------|----------|----------------------|---|---------------------|-----------------|--------------------|
| | REVISIONS | DATE | BY | APP'D. | BAE | NO. | REVISIONS | DATE | BY | APP'D. | BAE | DESIGNER | | | APPROVAL | DATE | DRAWING NO. PREFIX |
| A | 50% REVIEW SET | 4/24/19 | TCM | DMD | . | . | USER: DMD | DATE: 03/27/20 | TIME: 10:30 | XREFS: 0 | DESIGNER | DMD | 03/27/20 | VTIF-011 | M-02 | 0 | |
| B | 90% REVIEW SET | 10/18/19 | TCM | DMD | . | . | DWG. FILE: VTIF-011-M-02 | LAYOUT: | | | ENGINEER | DMD | 03/27/20 | NREL PROJECT NO. | NREL WORK ORDER NO. | A/E PROJECT NO. | |
| C | 91% REVIEW SET | 12/24/19 | BC | DMD | . | . | DWG. FOLDER: | | | | CHECKED BY | DMD | 03/27/20 | EX20193201 | -- | 19-027A | |
| D | 95% REVIEW SET | 02/17/20 | BC | DMD | . | . | ACAD VERSION: 2010 | | | | A/E APPROVED BY | -- | -- | | | | |
| 0 | ISSUED FOR CONSTRUCTION | 03/27/20 | BC | DMD | . | . | PLATFORM: Microsoft Windows | | | | NREL APPROVED BY | -- | -- | | | | |
| . | . | . | . | . | . | . | BORDER: ZBD2234D-3.DWG | PLOT SCALE: 1" = 1" | UNITS: ARCHITECTURAL | | BLDG. AREA ENG. | -- | -- | | | | |
| . | . | . | . | . | . | . | PLOT INFO.: NREL.STB | | | | | | | | | | |





- KEY NOTES:**
- 1 CAREFULLY REMOVE EXISTING EXHAUST SNORKEL DROP. SPIRAL DUCT TO BE REUSED.
 - 2 DEMOLISH SECTION OF EXHAUST DUCTWORK TO PROVIDE CLEARANCE FOR NEW STRUCTURAL SUPPORT BEAM.

VTIF FIRST FLOOR MECHANICAL DEMO PLAN
 1/4" = 1'-0"

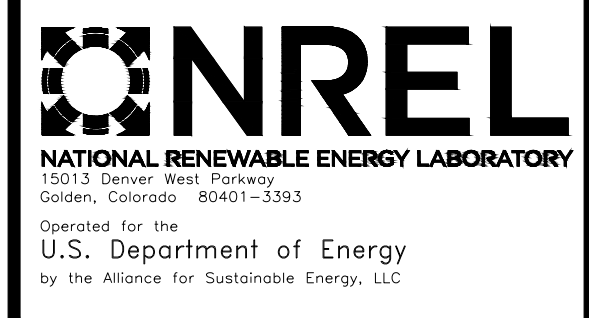


| NO. | REVISIONS | DATE | BY | APP'D. | BAE | NO. |
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| A | 50% REVIEW SET | 4/24/19 | TCM | DMD | . | . |
| B | 90% REVIEW SET | 10/18/19 | TCM | DMD | . | . |
| C | 91% REVIEW SET | 12/24/19 | BG | DMD | . | . |
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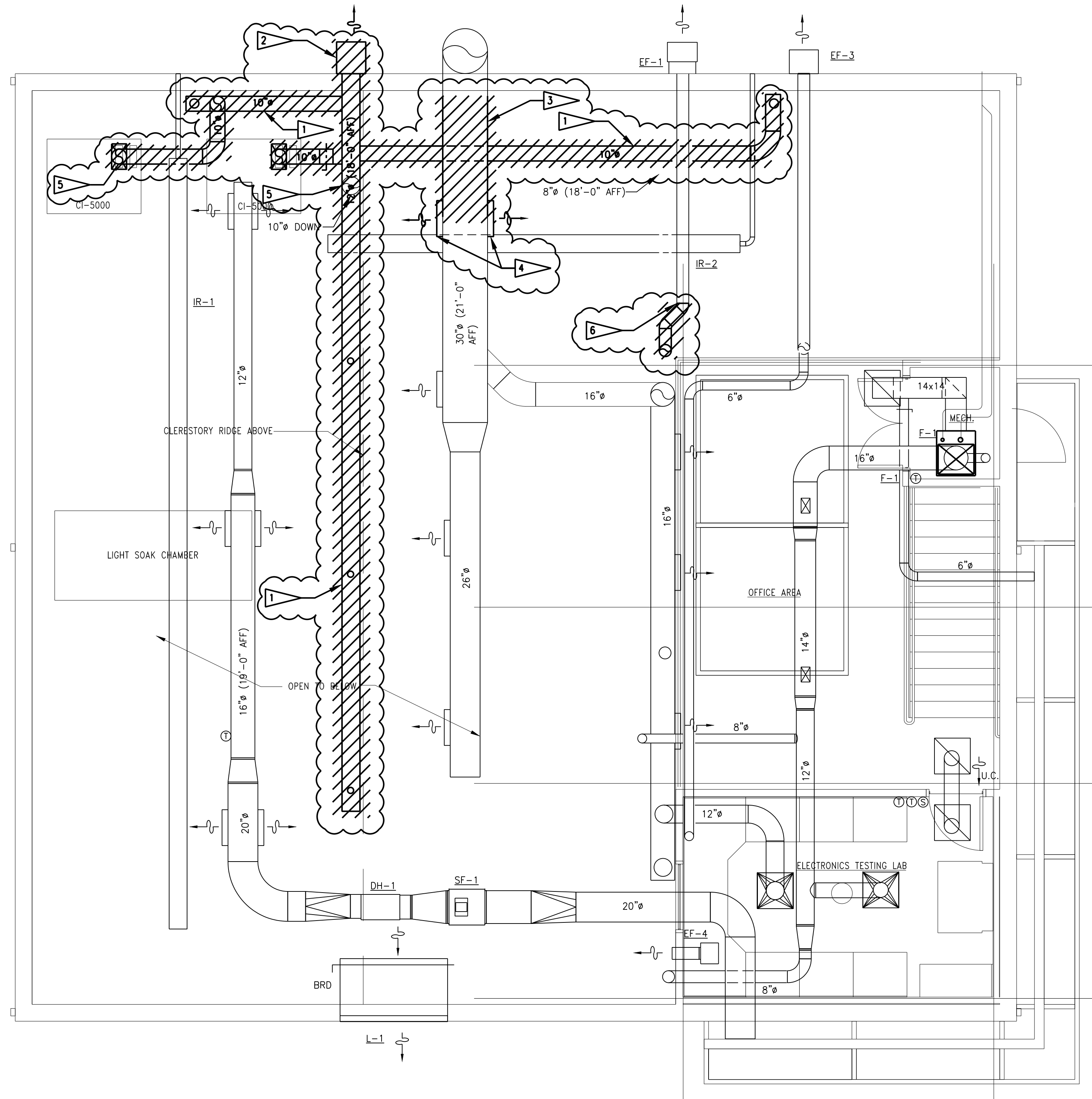
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| FILE INFORMATION | | | |
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| DWG. FILE: | VTIF-011-M-03 | TIME: | 10:30 |
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| PLATFORM: | Microsoft Windows | | |
| BORDER: | ZBD2234D-3.DWG | PLOT SCALE: | 1" = 1" |
| PLOT INFO.: | NREL.STB | UNITS: | ARCHITECTURAL |

| ENGINEERING REVIEW | | |
|--------------------|-----|---------------|
| DESIGNER | DMD | APPROVAL DATE |
| ENGINEER | DMD | 03/27/20 |
| CHECKED BY | DMD | 03/27/20 |
| A/E APPROVED BY | - | - |
| NREL APPROVED BY | - | - |
| BLDG. AREA ENG. | - | - |

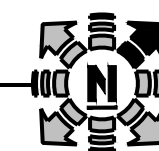


| V.T.I.F. MECHANICAL | | |
|--------------------------------|---------------------|-----------------|
| FY19 LAB UPGRADES - VTIF | | |
| MECHANICAL 1ST FLOOR DEMO PLAN | | |
| DRAWING NO. PREFIX | DRAWING NO. | REVISION NO. |
| VTIF-011 | M-03 | 0 |
| NREL PROJECT NO. | NREL WORK ORDER NO. | A/E PROJECT NO. |
| EX20193201 | -- | 19-027A |

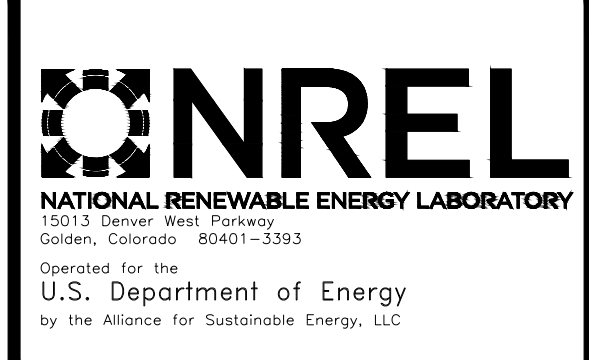


- KEY NOTES:**
- 1 DEMOLISH EXISTING EXHAUST DUCTWORK ASSOCIATED WITH EXISTING EF-2.
 - 2 DEMOLISH EXHAUST FAN 2. EXISTING EXTERIOR WALL PENETRATION TO BE SEALED AND REPAIRED TO MATCH EXISTING.
 - 3 DEMOLISH SECTION OF SUPPLY DUCT FOR COOLING COIL INSTALLATION.
 - 4 REMOVED DUCT MOUNTED GRILLE FOR RELOCATION.
 - 5 CAREFULLY REMOVE EXISTING SPIRAL DUCT DROPS. SPIRAL DUCT TO BE REUSED FOR CONNECTION OF NEW HOODS TO NEW MAIN DUCTWORK.
 - 6 DEMOLISH SECTION OF EXHAUST DUCTWORK TO PROVIDE CLEARANCE FOR NEW STRUCTURAL SUPPORT BEAM.

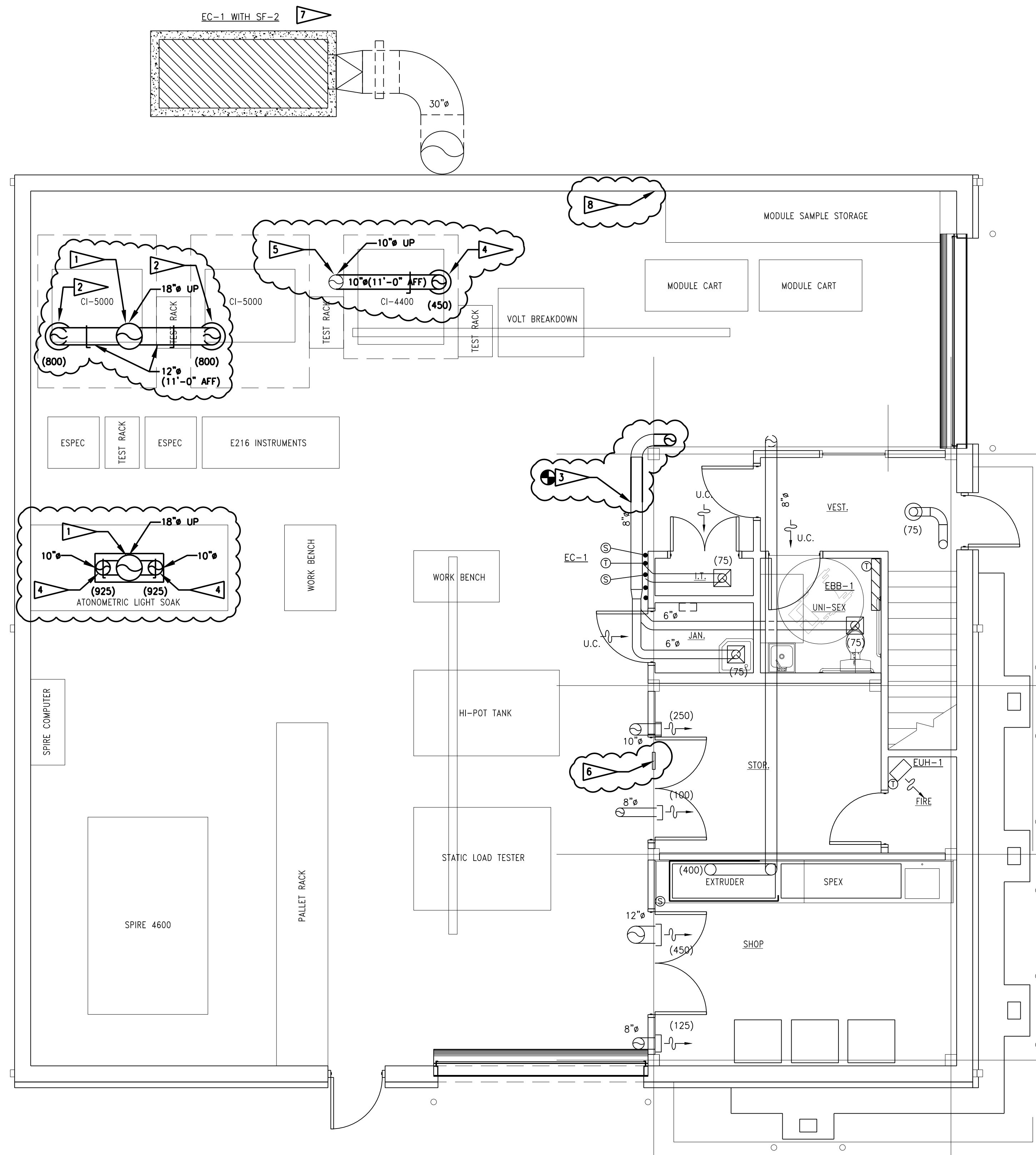
VTIF MEZZANINE MECHANICAL DEMO PLAN
1/4" = 1'-0"



| REVISIONS | | | | | | REVISIONS | | | | | | FILE INFORMATION | | | | ENGINEERING REVIEW | | | DRAWING INFORMATION | | |
|-----------|-------------------------|----------|-----|--------|-----|-----------|-----------|------|----|--------|-----|------------------|-------------------|---------------------|----------------------|--------------------|----------|----------|---------------------|---------------------|-----------------|
| NO. | REVISIONS | DATE | BY | APP'D. | BAE | NO. | REVISIONS | DATE | BY | APP'D. | BAE | USER: | DATE: | TIME: | XREF'S: | DESIGNER | APPROVAL | DATE | DRAWING NO. PREFIX | DRAWING NO. | REVISION NO. |
| A | 50% REVIEW SET | 4/24/19 | TCM | DMD | . | . | . | . | . | . | . | DMD | 03/27/20 | 10:30 | 4 | DMD | DMD | 03/27/20 | VTIF-011 | M-04 | 0 |
| B | 90% REVIEW SET | 10/18/19 | TCM | DMD | . | . | . | . | . | . | . | DWG. FILE: | | | | DMD | DMD | 03/27/20 | | | |
| C | 91% REVIEW SET | 12/24/19 | BC | DMD | . | . | . | . | . | . | . | DWG. FOLDER: | | | | DMD | DMD | 03/27/20 | | | |
| D | 95% REVIEW SET | 02/17/20 | BC | DMD | . | . | . | . | . | . | . | ACAD VERSION: | 2010 | | | | | | | | |
| 0 | ISSUED FOR CONSTRUCTION | 03/27/20 | BC | DMD | . | . | . | . | . | . | . | PLATFORM: | Microsoft Windows | | | | | | | | |
| . | . | . | . | . | . | . | . | . | . | . | . | BORDER: | ZBD2234D-3.DWG | PLOT SCALE: 1" = 1" | UNITS: ARCHITECTURAL | NREL APPROVED BY | - | - | NREL PROJECT NO. | NREL WORK ORDER NO. | A/E PROJECT NO. |
| . | . | . | . | . | . | . | . | . | . | . | . | PLOT INFO: | NREL.STB | | | | | | EX20193201 | -- | 19-027A |

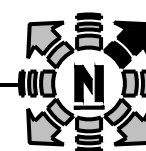


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| V.T.J.F. MECHANICAL | | |
| FY19 LAB UPGRADES - VTIF | | |
| MECHANICAL MEZZANINE FLOOR DEMO PLAN | | |
| DRAWING NO. PREFIX | DRAWING NO. | REVISION NO. |
| VTIF-011 | M-04 | 0 |
| NREL PROJECT NO. | NREL WORK ORDER NO. | A/E PROJECT NO. |
| EX20193201 | -- | 19-027A |



- KEY NOTES:**
- 1 PROVIDE NEW EXHAUST DUCTWORK.
 - 2 CONNECT 12" DUCT TO NREL PROCURED EXISTING CANOPY HOOD. PROVIDE WITH 45 DEGREE DUCTWORK DROP TO EQUIPMENT.
 - 3 CONNECT NEW DUCTWORK TO EXISTING DUCTWORK AT THIS LOCATION.
 - 4 CONNECT 10" DUCT TO NREL PROCURED CANOPY HOOD. REUSE EXISTING SPIRAL DUCTWORK DROPS WHERE POSSIBLE. PROVIDE WITH 45 DEGREE DUCTWORK DROP TO EQUIPMENT.
 - 5 REUSE EXISTING SPIRAL DUCTWORK FOR CONNECTION OF NEW EXHAUST DUCTWORK TO NEW EQUIPMENT HOOD.
 - 6 PROVIDE AND INSTALL NEW DOOR MOUNTED TRANSFER GRILLE (TAG-A) ABOVE EXISTING KICK GUARD.
 - 7 PROVIDE NEW SUPPLY FAN AND VFD FOR EC-1.
 - 8 PROVIDE NEW WALL MOUNTED VFD IN THIS LOCATION. MAINTAIN ALL MANUFACTURER RECOMMENDED CLEARANCES..

VTIF FIRST FLOOR MECHANICAL PLAN
1/4" = 1'-0"

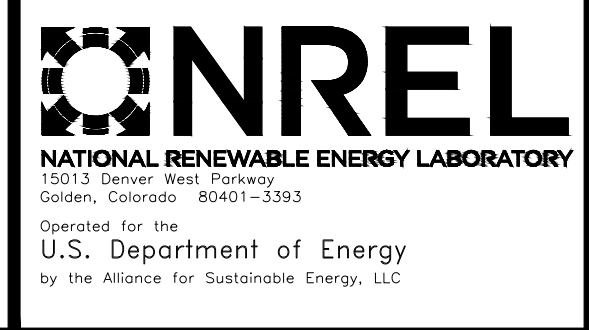


| NO. | REVISIONS | DATE | BY | APP'D. | BAE | NO. |
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| A | 50% REVIEW SET | 4/24/19 | TCM | DMD | . | . |
| B | 90% REVIEW SET | 10/18/19 | TCM | DMD | . | . |
| C | 91% REVIEW SET | 12/24/19 | BG | DMD | . | . |
| D | 95% REVIEW SET | 02/17/20 | BG | DMD | . | . |
| 0 | ISSUED FOR CONSTRUCTION | 03/27/20 | BG | DMD | . | . |

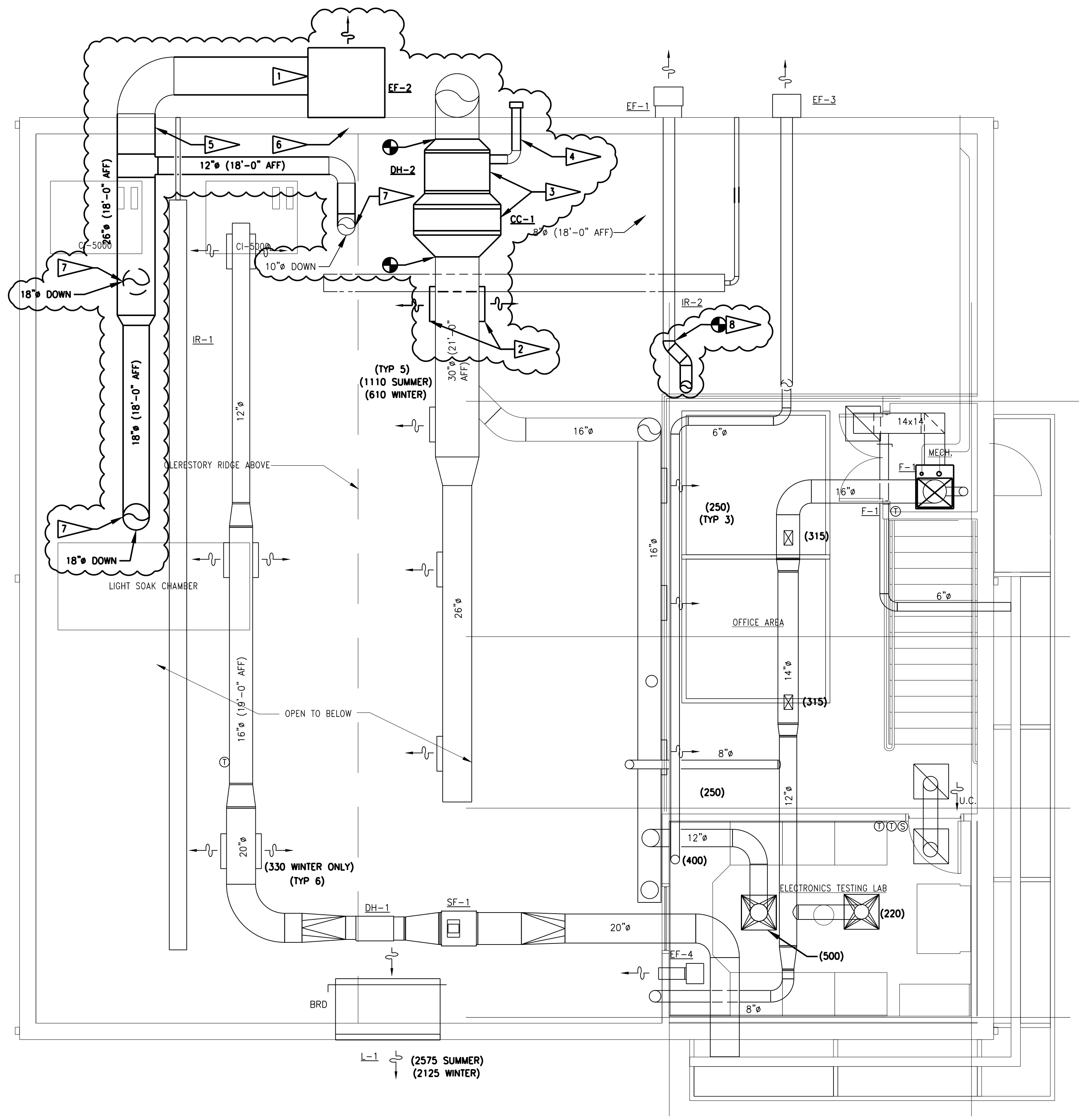
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| FILE INFORMATION | | | |
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| USER: | DMD | DATE: | 03/27/20 |
| DWG. FILE: | VTIF-011-M-05 | TIME: | 10:30 |
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| ACAD VERSION: | 2010 | XREF'S: | 4 |
| PLATFORM: | Microsoft Windows | | |
| BORDER: | ZBD2234D-3.DWG | PLOT SCALE: | 1" = 1" |
| PLOT INFO: | NREL.STB | UNITS: | ARCHITECTURAL |

| ENGINEERING REVIEW | | |
|--------------------|-----|---------------|
| DESIGNER | DMD | APPROVAL DATE |
| ENGINEER | DMD | 03/27/20 |
| CHECKED BY | DMD | 03/27/20 |
| A/E APPROVED BY | - | - |
| NREL APPROVED BY | - | - |
| BLDG. AREA ENG. | - | - |

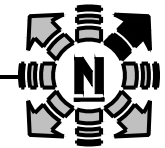


| V.T.I.F. MECHANICAL | | |
|---------------------------|---------------------|-----------------|
| FY19 LAB UPGRADES - VTIF | | |
| MECHANICAL 1ST FLOOR PLAN | | |
| DRAWING NO. PREFIX | DRAWING NO. | REVISION NO. |
| VTIF-011 | M-05 | 0 |
| NREL PROJECT NO. | NREL WORK ORDER NO. | A/E PROJECT NO. |
| EX20193201 | -- | 19-027A |



- KEY NOTES:**
- 1 PROVIDE AND INSTALL NEW EXHAUST FAN, EF-2. SEE STRUCTURAL DRAWINGS FOR SUPPORT INFORMATION.
 - 2 INSTALL RELOCATED GRILLES IN DUCT.
 - 3 PROVIDE AND INSTALL NEW COOLING COIL, CC-1 AND NEW DUCT HEATER, DH-2, INLINE IN EXISTING SUPPLY DUCT. PROVIDE TRANSITIONS FROM DUCT TO COIL FACE.
 - 4 ROUTE 6" VENT OUT OF BUILDING. INSTALL VENT PER MANUFACTURER REQUIREMENTS AND DETAIL 4/M-07.
 - 5 PROVIDE NEW WALL PENETRATION FOR NEW 26" ROUND DUCT FROM NEW EXHAUST FAN, EF-2. CENTER DUCT BETWEEN METAL STRUCTURAL SUPPORTS, NO DIAGONAL CROSSES TO BE CUT. REFER TO DETAIL 3/M-07 FOR DUCT PENETRATION.
 - 6 SEAL EXISTING WALL PENETRATIONS.
 - 7 EXHAUST DUCTWORK TO BE PROVIDED WITH 45 DEGREE DROP FROM MAIN TO EQUIPMENT.
 - 8 CONNECT NEW DUCTWORK TO EXISTING DUCTWORK AT THIS LOCATION.

VTIF MEZZANINE MECHANICAL PLAN
1/4" = 1'-0"

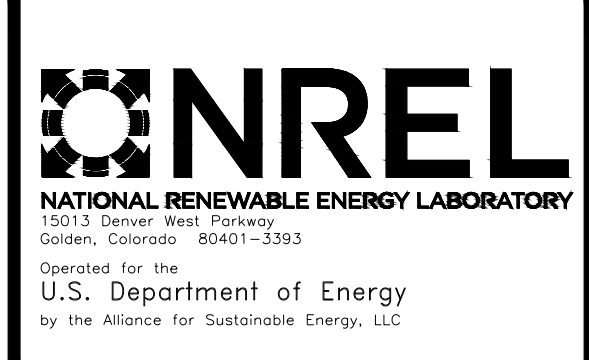


| NO. | REVISIONS | DATE | BY | APP'D. | BAE | NO. |
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| A | 50% REVIEW SET | 4/24/19 | TCM | DMD | . | . |
| B | 90% REVIEW SET | 10/18/19 | TCM | DMD | . | . |
| C | 91% REVIEW SET | 12/24/19 | BG | DMD | . | . |
| D | 95% REVIEW SET | 02/17/20 | BG | DMD | . | . |
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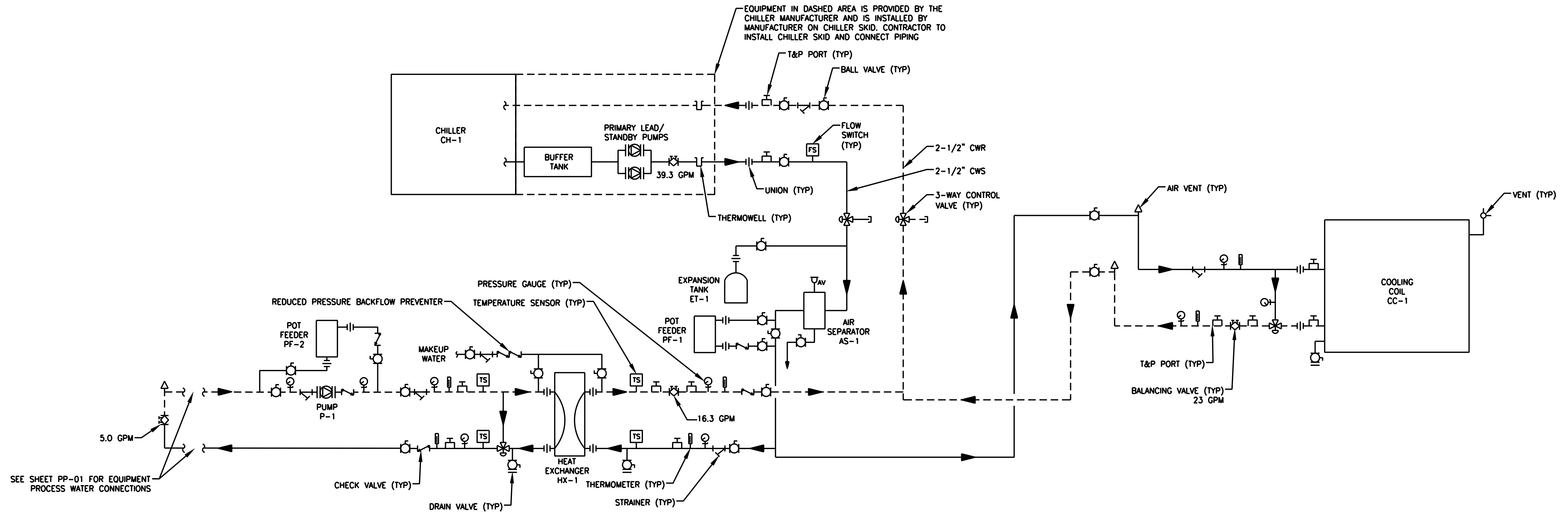
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| FILE INFORMATION | | | |
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| USER: | DMD | DATE: | 03/27/20 |
| DWG. FILE: | VTIF-011-M-06 | TIME: | 10:30 |
| DWG. FOLDER: | | LAYOUT: | |
| ACAD VERSION: | 2010 | XREF'S: | 4 |
| PLATFORM: | Microsoft Windows | | |
| BORDER: | ZBD2234D-3.DWG | PLOT SCALE: | 1" = 1" |
| PLOT INFO: | NREL.STB | UNITS: | ARCHITECTURAL |

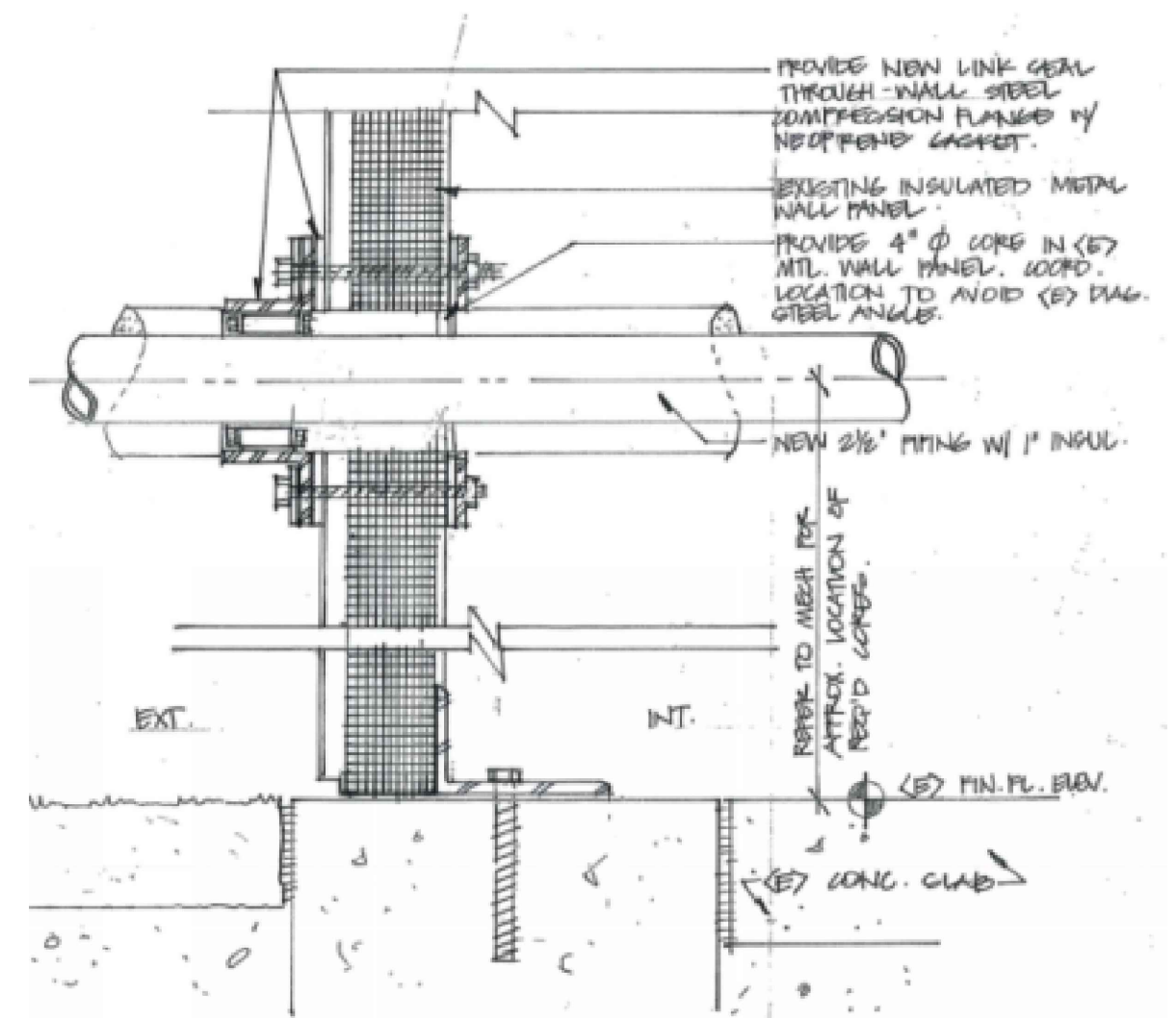
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| ENGINEER | DMD | 03/27/20 |
| CHECKED BY | DMD | 03/27/20 |
| A/E APPROVED BY | - | - |
| NREL APPROVED BY | - | - |
| BLDG. AREA ENG. | - | - |



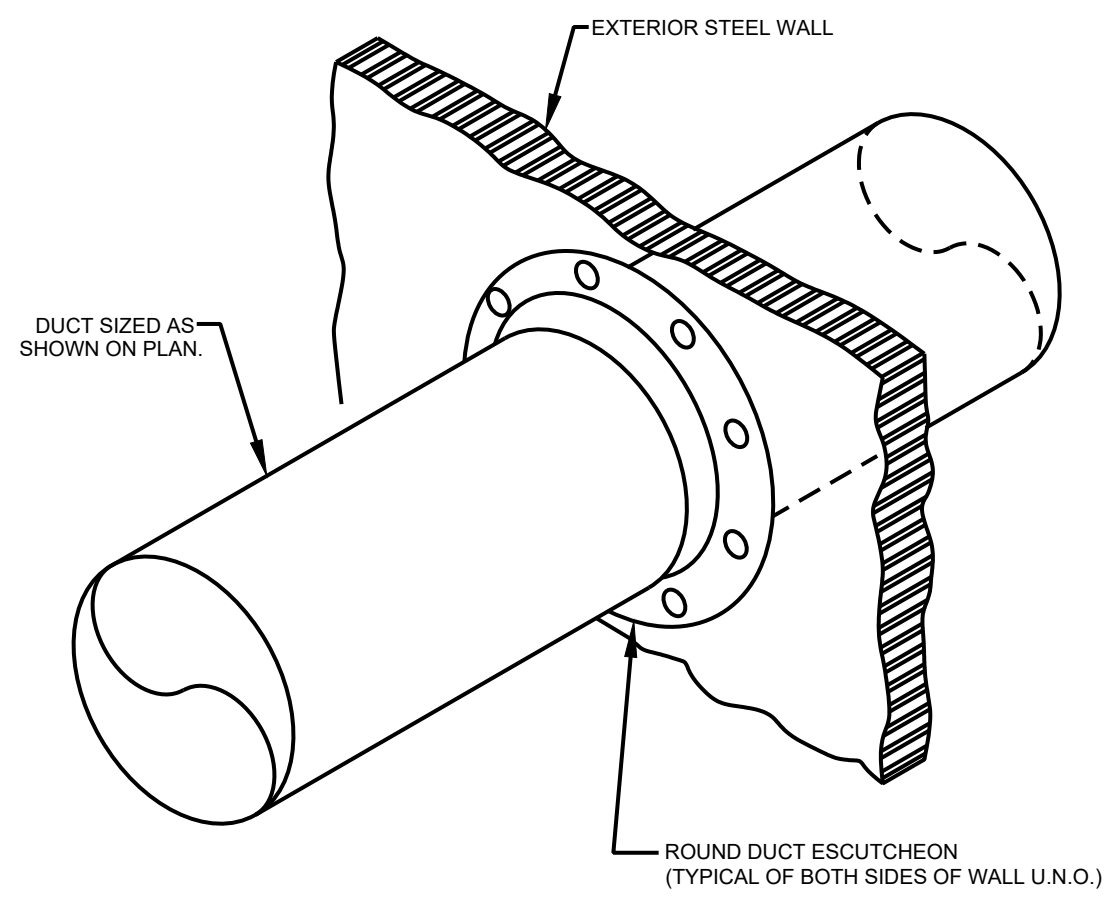
| V.T.I.F. MECHANICAL | | |
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| FY19 LAB UPGRADES - VTIF | | |
| MECHANICAL MEZZANINE FLOOR PLAN | | |
| DRAWING NO. PREFIX | DRAWING NO. | REVISION NO. |
| VTIF-011 | M-06 | 0 |
| NREL PROJECT NO. | NREL WORK ORDER NO. | A/E PROJECT NO. |
| EX20193201 | -- | 19-027A |



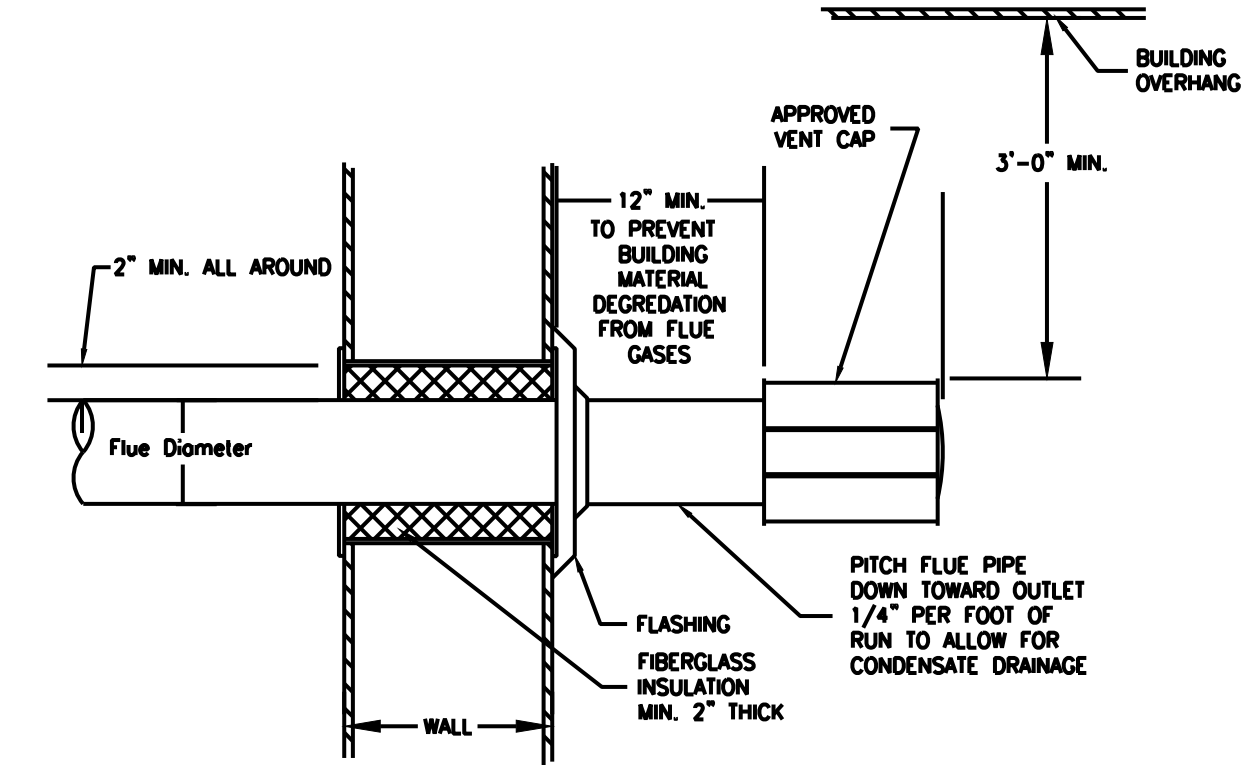
1 HYDRONIC FLOW DIAGRAM
SCALE: NONE



2 PIPE THROUGH EXTERIOR WALL DETAIL
SCALE: NONE



3 DUCT THROUGH EXTERIOR WALL DETAIL
SCALE: NONE



4 FLUE VENT TERMINATION DETAIL
SCALE: NONE



| NO. | REVISIONS | DATE | BY | APP'D. | BAE | NO. | REVISIONS | DATE | BY | APP'D. | BAE |
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| B | 90% REVIEW SET | 10/18/19 | TCM | DMD | . | . | . | . | . | . | . |
| C | 91% REVIEW SET | 12/24/19 | BC | DMD | . | . | . | . | . | . | . |
| D | 95% REVIEW SET | 02/17/20 | BC | DMD | . | . | . | . | . | . | . |
| 0 | ISSUED FOR CONSTRUCTION | 03/27/20 | BC | DMD | . | . | . | . | . | . | . |

| FILE INFORMATION | ENGINEERING REVIEW |
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| DATE: 03/27/20 | APPROVAL: DMD |
| TIME: 10:30 | DATE: 03/27/20 |
| XREF'S: 0 | ENGINEER: DMD |
| DWG. FILE: VTIF-011-M-07 | CHECKED BY: DMD |
| LAYOUT: | DATE: 03/27/20 |
| DWG. FOLDER: | A/E APPROVED BY: - |
| ACAD VERSION: 2010 | NREL APPROVED BY: - |
| PLATFORM: Microsoft Windows | BLDG. AREA ENG.: |
| BORDER: ZBD2234D-3.DWG | |
| PLOT SCALE: 1" = 1" | |
| UNITS: ARCHITECTURAL | |
| PLOT INFO: NREL.STB | |

| ENGINEERING REVIEW | APPROVAL | DATE |
|---------------------|----------|----------|
| DESIGNER: DMD | | 03/27/20 |
| ENGINEER: DMD | | 03/27/20 |
| CHECKED BY: DMD | | 03/27/20 |
| A/E APPROVED BY: - | | - |
| NREL APPROVED BY: - | | - |
| BLDG. AREA ENG.: | | |



| V.T.I.F. MECHANICAL | | |
|--------------------------|---------------------|-----------------|
| FY19 LAB UPGRADES - VTIF | | |
| MECHANICAL DETAILS | | |
| DRAWING NO. PREFIX | DRAWING NO. | REVISION NO. |
| VTIF-011 | M-07 | 0 |
| NREL PROJECT NO. | NREL WORK ORDER NO. | A/E PROJECT NO. |
| EX20193201 | -- | 19-027A |

CHILLER:

THE CHILLER PLANT SHALL BE CONNECTED TO THE EXISTING BAS SYSTEM. THE BAS SYSTEM SHALL PROVIDE ENABLE/DISABLE SIGNALS TO THE CHILLER PLANT. THE CHILLER PLANT SHALL CONTROL THE COMPRESSORS AND PUMPS AS NOTED BELOW. THE CHILLER PLANT SHALL PROVIDES ALARMS TO THE BAS SYSTEM AS NOTED BELOW.

CHILLER – RUN CONDITIONS:
THE CHILLER SHALL BE ENABLED TO RUN WHENEVER:

- THE CHILLED WATER LOOP SUPPLY WATER TEMPERATURE IS GREATER THAN 51°F (ADJ.).
- TO PREVENT SHORT CYCLING, THE CHILLER SHALL RUN FOR AND BE OFF FOR MINIMUM ADJUSTABLE TIMES (BOTH USER DEFINABLE), UNLESS SHUTDOWN ON SAFETIES OR OUTSIDE AIR CONDITIONS.

THE CHILLER SHALL RUN SUBJECT TO ITS OWN INTERNAL SAFETIES AND CONTROLS.

CHILLED WATER PUMP:
THE CHILLED WATER PUMPS SHALL OPERATE IN A LEAD/STANDBY FASHION AS DETERMINED BY THE CHILLER'S OWN INTERNAL CONTROLS. THE PUMPING SYSTEM SHALL RUN CONTINUOUSLY WHEN CHILLER IS ENABLED.

ALARMS SHALL BE PROVIDED AS FOLLOWS:

- CHILLED WATER PUMP FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
- CHILLED WATER PUMP RUNNING IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.

CHILLER:
THE CHILLER SHALL BE ENABLED BY A USER ADJUSTABLE TIME AFTER PUMP STATUS IS PROVEN ON. THE CHILLER SHALL THEREFORE HAVE A USER ADJUSTABLE DELAY ON START.

THE DELAY TIME SHALL BE SET APPROPRIATELY TO ALLOW FOR ORDERLY CHILLED WATER SYSTEM START-UP, SHUTDOWN AND SEQUENCING.

ALARMS SHALL BE PROVIDED AS FOLLOWS:

- CHILLER FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
- CHILLER RUNNING IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.
- CHILLER RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT.

CHILLED WATER SUPPLY TEMPERATURE – SETPOINT RESET:
THE CHILLED WATER SUPPLY TEMPERATURE SETPOINT SHALL RESET USING A TRIM AND RESPOND ALGORITHM BASED ON COOLING REQUIREMENTS.

CHILLED WATER TEMPERATURE MONITORING:
THE FOLLOWING TEMPERATURES SHALL BE MONITORED:

- CHILLED WATER SUPPLY.
- CHILLED WATER RETURN.

ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH CHILLED WATER SUPPLY TEMP: IF THE CHILLED WATER SUPPLY TEMPERATURE IS GREATER THAN 65°F (ADJ.).
- LOW CHILLED WATER SUPPLY TEMP: IF THE CHILLED WATER SUPPLY TEMPERATURE IS LESS THAN 45°F (ADJ.).

EVAPORATIVE COOLER

RUN CONDITIONS – SCHEDULED:
THE UNIT SHALL RUN CONTINUOUSLY.

ALARM SHALL BE PROVIDED AS FOLLOWS:

- FILTER CHANGE REQUIRED: FILTER HAS BEEN IN USE FOR MORE THAN 2200 HR (ADJ.).

THE UNIT SHALL MAINTAIN:

- A 75°F (ADJ.) COOLING SETPOINT
- A 70°F (ADJ.) HEATING SETPOINT.

ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH ZONE TEMP: IF THE ZONE TEMPERATURE IS GREATER THAN THE COOLING SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).
- LOW ZONE TEMP: IF THE ZONE TEMPERATURE IS LESS THAN THE HEATING SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).

ZONE SETPOINT ADJUST:
THE OCCUPANT SHALL BE ABLE TO ADJUST THE ZONE TEMPERATURE HEATING AND COOLING SETPOINTS AT THE ZONE SENSOR BY A MARGIN OF +/- 2 DEG F.

ZONE OPTIMAL START:
THE UNIT SHALL USE AN OPTIMAL START ALGORITHM FOR MORNING START-UP. THIS ALGORITHM SHALL MINIMIZE THE UNOCCUPIED WARM-UP OR COOL-DOWN PERIOD WHILE STILL ACHIEVING COMFORT CONDITIONS BY THE START OF SCHEDULED OCCUPIED PERIOD.

FREEZE PROTECTION:
THE UNIT SHALL SHUT DOWN AND GENERATE AN ALARM UPON RECEIVING A FREEZESTAT STATUS.

SUPPLY FAN:
THE SUPPLY FAN SHALL RUN ANYTIME THE UNIT IS COMMANDED TO RUN. THE FAN VFD SHALL DEFAULT TO THE BALANCED FREQUENCY TO PROVIDE 7,500 CFM OF SUPPLY AIR. THE SUPPLY FAN SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME, UNLESS SHUTDOWN ON SAFETIES.

ALARMS SHALL BE PROVIDED AS FOLLOWS:

- SUPPLY FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
- SUPPLY FAN IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.

DIRECT EVAPORATIVE COOLING SECTION:
THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND STAGE ON THE SPRAY PUMP ON RISING TEMPERATURE TO MAINTAIN ITS COOLING SETPOINT. THE SUPPLY FAN SHALL RUN FOR A USER DEFINABLE TIME (DEFAULT TO 600 SEC DELAY ON STOP, ADJ.) AFTER THE SPRAY PUMP IS DISABLED ON UNIT SHUTDOWN IN ORDER TO DRY OUT THE EVAPORATIVE MEDIA.

THE EVAPORATIVE COOLING SHALL BE ENABLED WHENEVER:

- OUTSIDE AIR TEMPERATURE IS GREATER THAN 60°F (ADJ.).
- AND OUTSIDE AIR WETBULB IS LESS THAN 58°F (ADJ.).
- AND THE ZONE TEMPERATURE IS ABOVE COOLING SETPOINT.
- AND THE ZONE HUMIDITY IS LESS THAN 60% (ADJ.).
- AND THE SUPPLY FAN STATUS IS ON.

EVAPORATIVE COOLER (CON'T)

SUMP CONTROL:
THE CONTROLLER SHALL DRAIN AND FILL THE SUMP AS FOLLOWS:
• FREEZE PROTECTION
IF THE OUTSIDE AIR TEMPERATURE DROPS BELOW 40°F (ADJ), THE EVAPORATIVE COOLER SUMP SHALL OPEN THE DRAIN VALVE AND CLOSE THE FILL VALVE. IF THE OUTSIDE AIR TEMPERATURE RISES BACK ABOVE 55°F (ADJ.), THE CONTROLLER SHALL ACTIVATE THE FILL VALVE AND CLOSE THE DRAIN VALVE.

ALARMS SHALL BE PROVIDED AS FOLLOWS:

- SPRAY PUMP FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
- SPRAY PUMP IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.

COOLING COIL VALVE:
THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND MODULATE THE COOLING COIL VALVE TO MAINTAIN ITS COOLING SETPOINT.

THE COOLING SHALL BE ENABLED WHENEVER:

- THE EVAPORATIVE COOLING IS UNABLE TO COOL.
- AND THE ZONE TEMPERATURE IS ABOVE COOLING SETPOINT.
- AND THE FAN STATUS IS ON.

THE COOLING COIL VALVE SHALL OPEN TO 50% (ADJ.) WHENEVER THE FREEZESTAT IS ON.

GAS HEATING STAGES:
THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND STAGE THE HEATING TO MAINTAIN THE ZONE HEATING SETPOINT. TO PREVENT SHORT CYCLING, THERE SHALL BE A USER DEFINABLE (ADJ.) DELAY BETWEEN STAGES, AND EACH STAGE SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.

THE HEATING SHALL BE ENABLED WHENEVER:

- OUTSIDE AIR TEMPERATURE IS LESS THAN 65°F (ADJ.).
- AND THE ZONE TEMPERATURE IS BELOW HEATING SETPOINT.
- AND THE FAN STATUS IS ON.

WHEN THE UNIT IS IN HEATING MODE, A SIGNAL SHALL BE SENT TO THE VFD TO REDUCE CFM TO 5,000.

DISCHARGE AIR TEMPERATURE:
THE CONTROLLER SHALL MONITOR THE DISCHARGE AIR TEMPERATURE.

ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH DISCHARGE AIR TEMP: IF THE DISCHARGE AIR TEMPERATURE IS GREATER THAN 120°F (ADJ.).
- LOW DISCHARGE AIR TEMP: IF THE DISCHARGE AIR TEMPERATURE IS LESS THAN 40°F (ADJ.).

ZONE HUMIDITY:
THE CONTROLLER SHALL MONITOR THE ZONE HUMIDITY.

ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH ZONE HUMIDITY: IF THE ZONE HUMIDITY IS GREATER THAN A USER DEFINABLE AMOUNT (ADJ.)
- LOW ZONE HUMIDITY: IF THE ZONE HUMIDITY IS LOWER THAN A USER DEFINABLE AMOUNT (ADJ.).

| NO. | REVISIONS | | | | | | REVISIONS | | | | | | FILE INFORMATION | | | | ENGINEERING REVIEW | | | 360 Engineering Inc. | NREL NATIONAL RENEWABLE ENERGY LABORATORY | V.T.I.F. MECHANICAL | | |
|-----|-------------------------|----------|-----|--------|-----|-----|-----------|----|--------|-----|---------------|-------------------|---------------------|----------------------|------------------|----------|--------------------|--------------------|-------------|-------------------------|--|---------------------|--|--|
| | NO. | DATE | BY | APP'D. | BAE | NO. | DATE | BY | APP'D. | BAE | USER: | DATE: | TIME: | XREF'S: | DESIGNER | APPROVAL | DATE | DRAWING NO. PREFIX | DRAWING NO. | | | REVISION NO. | | |
| A | 50% REVIEW SET | 4/24/19 | TCM | DMD | . | . | . | . | . | . | DMD | 03/23/20 | 10:30 | 0 | DMD | DMD | 03/27/20 | VTIF-011 | M-08 | 0 | | | | |
| B | 90% REVIEW SET | 10/18/19 | TCM | DMD | . | . | . | . | . | . | DWG. FILE: | | | | DMD | DMD | 03/27/20 | | | | | | | |
| C | 91% REVIEW SET | 12/24/19 | BG | DMD | . | . | . | . | . | . | DWG. FOLDER: | | | | DMD | DMD | 03/27/20 | | | | | | | |
| D | 95% REVIEW SET | 02/17/20 | BG | DMD | . | . | . | . | . | . | ACAD VERSION: | 2010 | | | | | | | | | | | | |
| 0 | ISSUED FOR CONSTRUCTION | 03/27/20 | BG | DMD | . | . | . | . | . | . | PLATFORM: | Microsoft Windows | | | | | | | | | | | | |
| . | . | . | . | . | . | . | . | . | . | . | BORDER: | ZBD2234D-3.DWG | PLOT SCALE: 1" = 1" | UNITS: ARCHITECTURAL | NREL APPROVED BY | - | - | | | | | | | |
| . | . | . | . | . | . | . | . | . | . | . | PLOT INFO.: | NREL.STB | | | | | | | | | | | | |
| . | . | . | . | . | . | . | . | . | . | . | | | | | | | | | | | | | | |



EXHAUST FAN – ON/OFF

RUN CONDITIONS – INTERLOCKED:

THE FAN(S) EF 2 SHALL BE INTERLOCKED TO RUN WHENEVER EVAPORATIVE COOLER EC-1 RUNS UNLESS SHUTDOWN ON SAFETIES.

FAN:

THE FAN SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.

FAN STATUS:

THE CONTROLLER SHALL MONITOR THE FAN STATUS.

ALARMS SHALL BE PROVIDED AS FOLLOWS:

- FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
- FAN IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.

PROCESS WATER LOOP PUMP

PROCESS CHILLED WATER PUMP SYSTEM – RUN CONDITIONS:

THE PROCESS WATER PUMP SHALL BE ENABLED CONTINUOUSLY.

TO PREVENT SHORT CYCLING, THE PROCESS CHILLED WATER PUMP SYSTEM SHALL RUN FOR AND BE OFF FOR MINIMUM ADJUSTABLE TIMES (BOTH USER DEFINABLE).

ALARMS SHALL BE PROVIDED AS FOLLOWS:

- FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
- RUNNING IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.

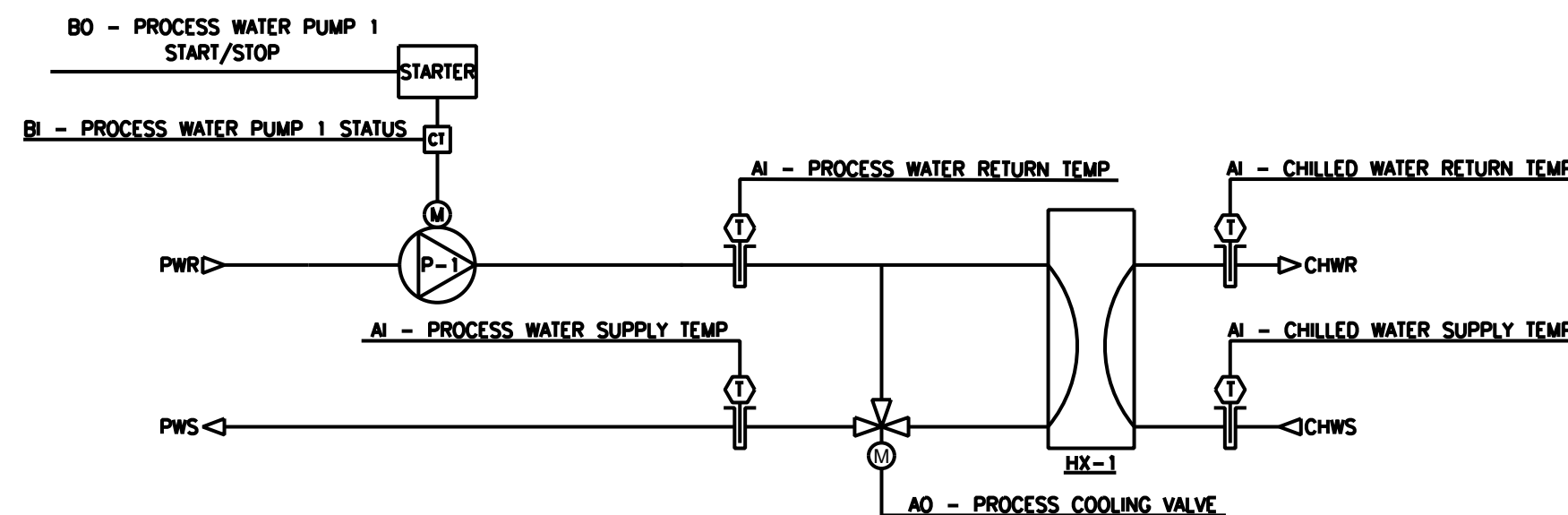
HEAT EXCHANGER

LOAD SIDE AND SOURCE SIDE SUPPLY AND RETURN TEMPERATURES SHALL BE MONITORED.

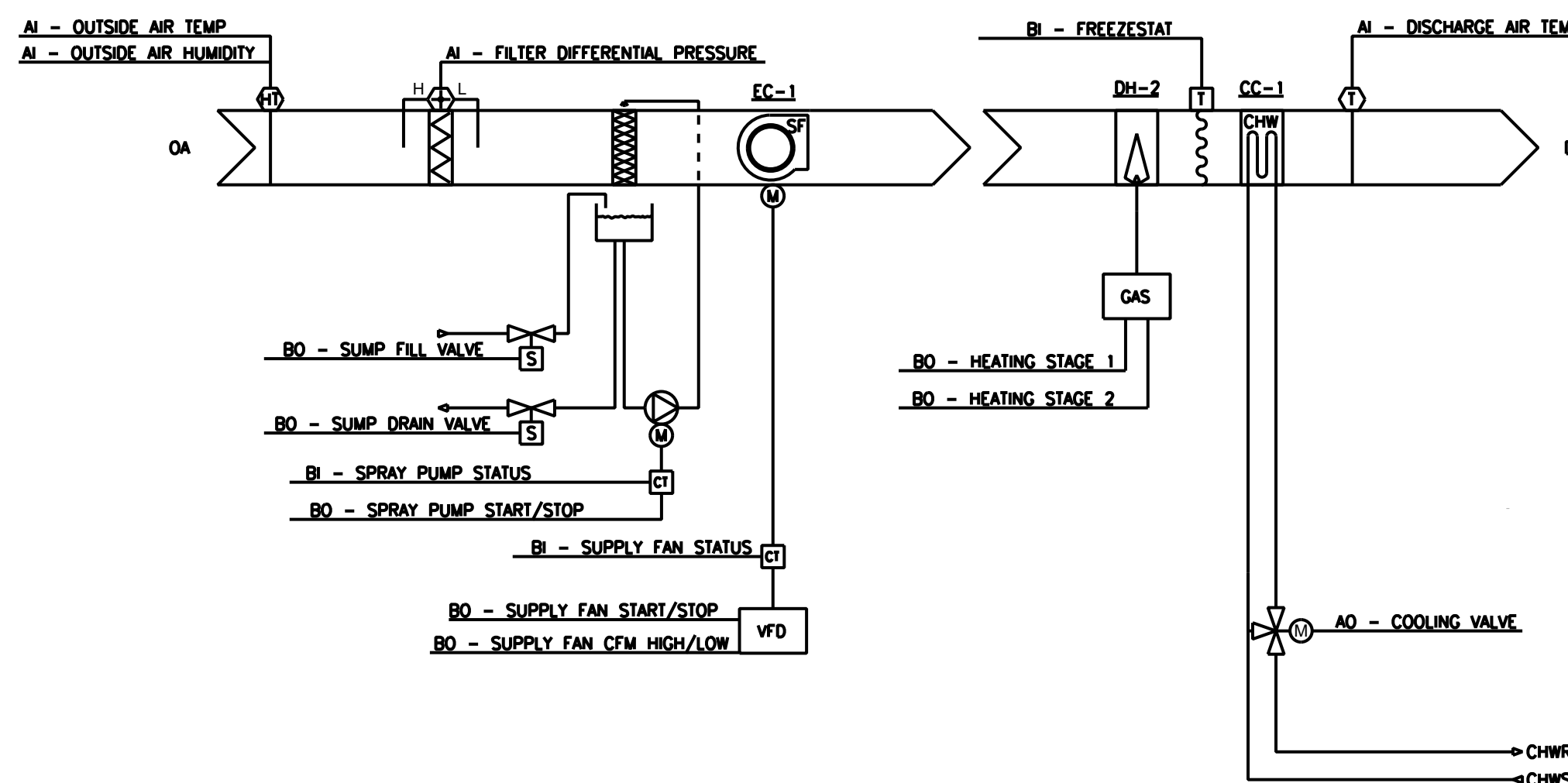
3-WAY CONTROL VALVE SHALL MODULATE TO CONTROL THE LOAD SIDE SUPPLY TEMPERATURE TO 63°F (ADJ.)

ALARMS SHALL BE PROVIDED AS FOLLOWS:

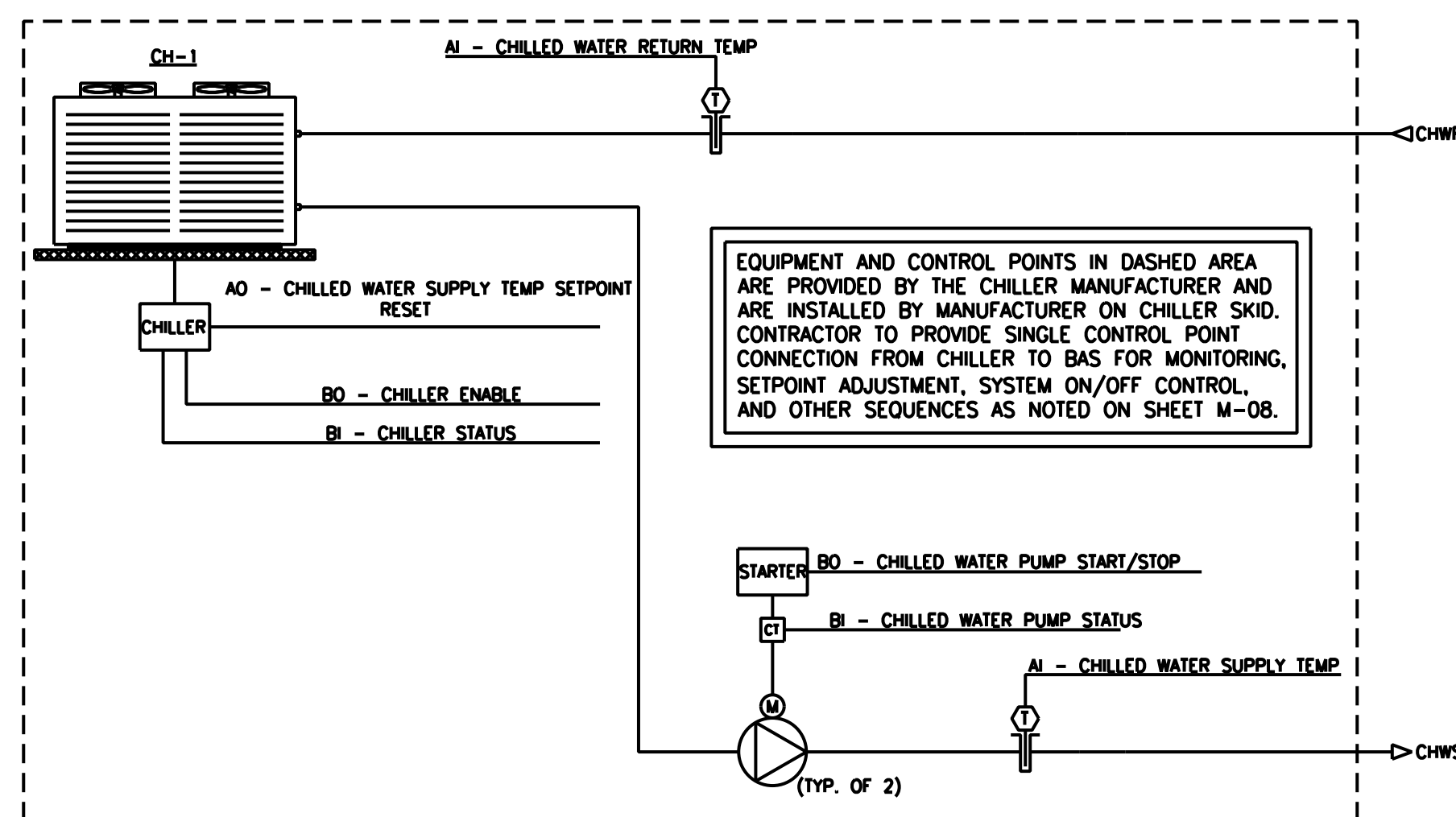
- HIGH LOAD LEAVING WATER TEMP: IF THE LEAVING WATER TEMPERATURE IS GREATER THAN 68°F (ADJ.).
- LOW LOAD LEAVING WATER TEMP: IF THE LEAVING WATER TEMPERATURE IS LESS THAN 58°F (ADJ.).
- HIGH SOURCE LEAVING WATER TEMP: IF LEAVING WATER TEMPERATURE IS GREATER THAN 64°F (ADJ.).
- LOW SOURCE LEAVING WATER TEMP: IF LEAVING WATER TEMPERATURE IS LESS THAN 54° F (ADJ.).



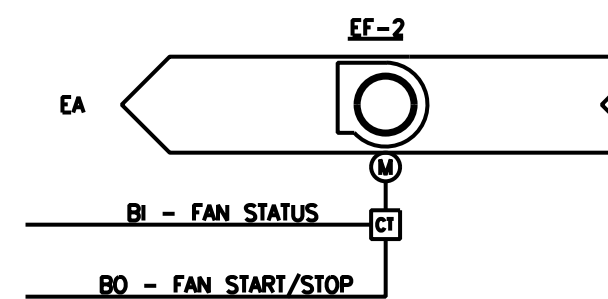
1 PROCESS WATER SYSTEM CONTROL DIAGRAM
SCALE: NONE



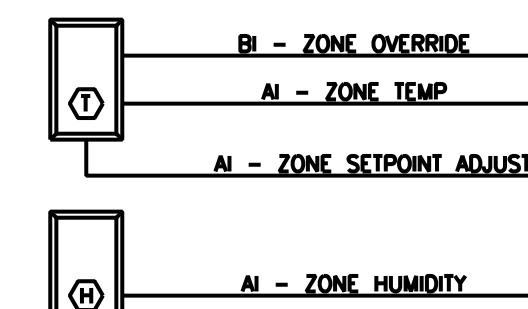
3 EVAPORATIVE COOLER CONTROL DIAGRAM
SCALE: NONE



4 CHILLER CONTROL DIAGRAM
SCALE: NONE



2 EXHAUST FAN CONTROL DIAGRAM
SCALE: NONE



| NO. | REVISIONS | DATE | BY | APP'D. | BAE | NO. | REVISIONS | DATE | BY | APP'D. | BAE |
|-----|-------------------------|----------|-----|--------|-----|-----|-----------|------|----|--------|-----|
| A | 50% REVIEW SET | 4/24/19 | TCM | DMD | . | . | . | . | . | . | . |
| B | 90% REVIEW SET | 10/18/19 | TCM | DMD | . | . | . | . | . | . | . |
| C | 91% REVIEW SET | 12/24/19 | BG | DMD | . | . | . | . | . | . | . |
| D | 95% REVIEW SET | 02/17/20 | BG | DMD | . | . | . | . | . | . | . |
| 0 | ISSUED FOR CONSTRUCTION | 03/27/20 | BG | DMD | . | . | . | . | . | . | . |

| FILE INFORMATION | | | | ENGINEERING REVIEW | | | |
|------------------|-------------------|-------------|---------------|--------------------|-----|-----------|----------|
| USER: | DMD | DATE: | 03/27/20 | DESIGNER: | DMD | APPROVAL: | |
| DWG. FILE: | VTIF-011-M-09 | TIME: | 10:30 | ENGINEER: | DMD | DATE: | 03/27/20 |
| DWG. FOLDER: | | LAYOUT: | | CHECKED BY: | DMD | | 03/27/20 |
| ACAD VERSION: | 2010 | | | A/E APPROVED BY: | - | | - |
| PLATFORM: | Microsoft Windows | | | NREL APPROVED BY: | - | | - |
| BORDER: | ZBD2234D-3.DWG | PLOT SCALE: | 1" = 1" | BLDG. AREA ENG. | - | | - |
| PLOT INFO: | NREL.STB | UNITS: | ARCHITECTURAL | | | | |

751 Pine Ridge Rd. Suite 360
Golden, CO 80403
303.942.2050
19427A
DMD

NATIONAL RENEWABLE ENERGY LABORATORY
15013 Denver West Parkway
Golden, Colorado 80401-3393
Operated for the
U.S. Department of Energy
by the Alliance for Sustainable Energy, LLC

V.T.I.F. MECHANICAL
FY19 LAB UPGRADES – VTIF

SEQUENCE OF OPERATIONS

| | | |
|--------------------------------|---------------------------|----------------------------|
| DRAWING NO. PREFIX VTIF-011 | DRAWING NO. M-09 | REVISION NO. 0 |
| NREL PROJECT NO. EX20193201 | NREL WORK ORDER NO. -- | A/E PROJECT NO. 19-027A |



EVAPORATIVE COOLER, CHILLED WATER COIL, AND DUCT HEATER CONTROL DIAGRAM

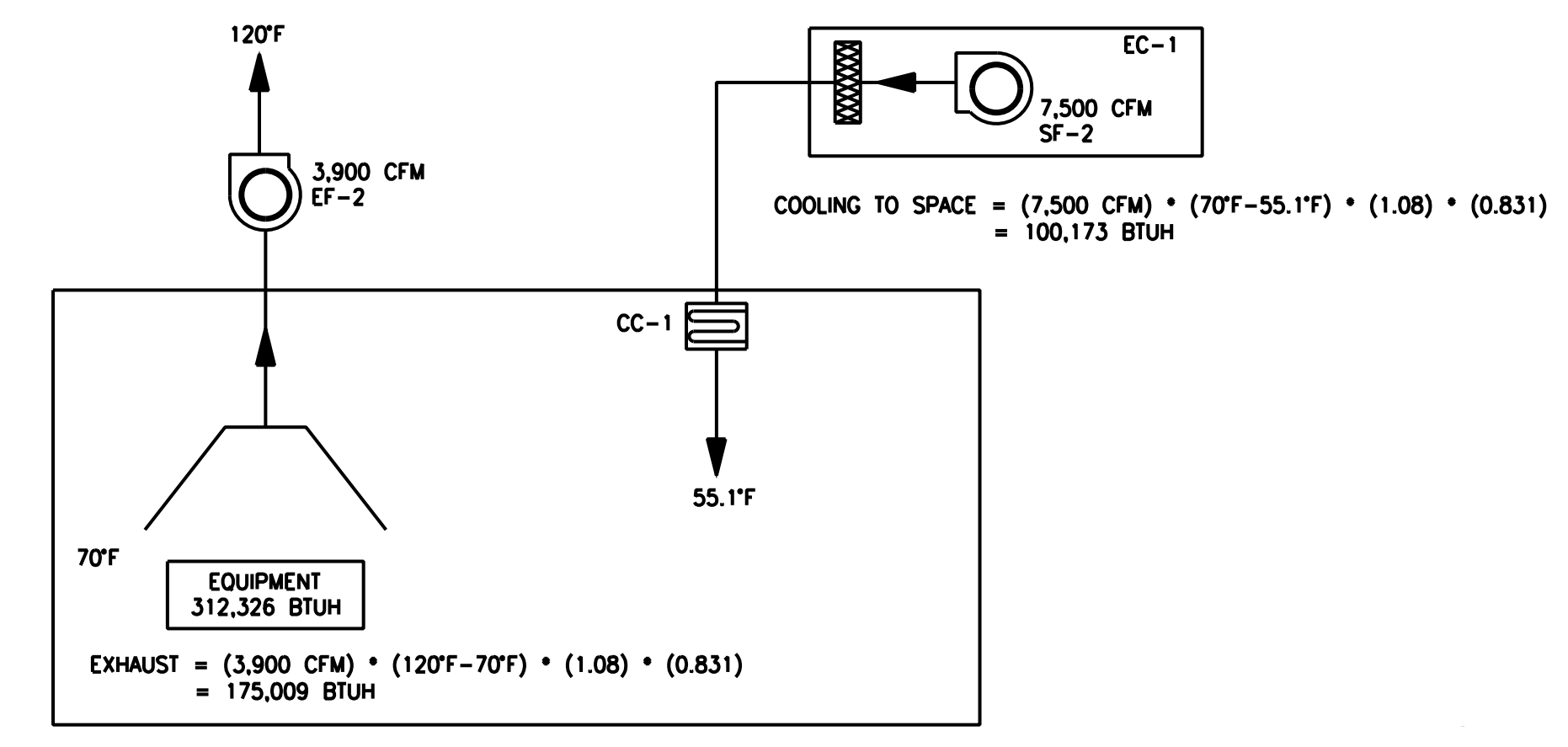
| Point Name | Hardware Points | | | | Software Points | | | | | | | Show On Graphic | |
|------------------------------|-----------------|---------------------|----------|----------|-----------------|---------------------|----------|----------|-----------|-----------|-----------|-----------------|--|
| | AI | AO | BI | BO | AV | BV | Loop | Sched | Trend | Alarm | | | |
| Filter Differential Pressure | x | | | | | | | | x | | | x | |
| Outside Air Temp | x | | | | | | | | x | | | x | |
| Outside Air Humidity | x | | | | | | | | x | | | x | |
| Discharge Air Temp | x | | | | | | | | x | | | x | |
| Zone Temperature | x | | | | | | | | x | | | x | |
| Zone Setpoint (ADJ.) | x | | | | | | | | x | | | x | |
| Zone Humidity | x | | | | | | | | x | | | x | |
| Cooling Valve | | x | | | | | | | x | | | x | |
| Spray Pump Status | | | x | | | | | | x | | | x | |
| Supply Fan Status | | | x | | | | | | x | | | x | |
| Freeze/Stat | | | x | | | | | | x | | x | x | |
| Zone Override | | | x | | | | | | x | | | x | |
| Chiller Status | | | x | | | | | | x | | | x | |
| Sump Fill Valve | | | | x | | | | | x | | | x | |
| Sump Drain Valve | | | | x | | | | | x | | | x | |
| Spray Pump Start/Stop | | | | x | | | | | x | | | x | |
| Supply Fan Start/Stop | | | | x | | | | | x | | | x | |
| Supply Fan High/Low | | | | x | | | | | x | | | x | |
| Heating Stage 1 | | | | x | | | | | x | | | x | |
| Heating Stage 2 | | | | x | | | | | x | | | x | |
| Chiller Enable/Disable | | | | x | | | | | x | | | x | |
| Supply Air Temp Setpoint | | | | | x | | | | x | | | x | |
| Emergency Shutdown | | | | | | x | | | x | | x | x | |
| Schedule | | | | | | | | | x | | | | |
| Spray Pump - Failure | | | | | | | | | | | x | | |
| Spray Pump In Hand | | | | | | | | | | | x | | |
| Supply Fan - Failure | | | | | | | | | | | x | | |
| Supply Fan In Hand | | | | | | | | | | | x | | |
| Filter Change Required | | | | | | | | | | | x | | |
| High Supply Air Temp | | | | | | | | | | | x | | |
| High Zone Temp | | | | | | | | | | | x | | |
| High Zone Humidity | | | | | | | | | | | x | | |
| Low Supply Air Temp | | | | | | | | | | | x | | |
| Low Zone Temp | | | | | | | | | | | x | | |
| Low Zone Humidity | | | | | | | | | | | x | | |
| Totals | 7 | 1 | 5 | 8 | 1 | 1 | 0 | 1 | 22 | 19 | 22 | | |
| | | Total Hardware (20) | | | | Total Software (38) | | | | | | | |

EXHAUST FAN CONTROL POINTS LIST (EF-2)

| Point Name | Hardware Points | | | | Software Points | | | | | | | Show On Graphic | |
|-----------------|-----------------|--------------------|----------|----------|-----------------|--------------------|----------|----------|----------|----------|----------|-----------------|--|
| | AI | AO | BI | BO | AV | BV | Loop | Sched | Trend | Alarm | | | |
| Fan Status | | | x | x | | | | | x | | | x | |
| EF-2 Start/Stop | | | | | | | | | x | | | x | |
| Schedule | | | | | | | | | x | | | | |
| EF-2 In Hand | | | | | | | | | | | x | | |
| EF-2 Failure | | | | | | | | | | | x | | |
| Totals | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 2 | 2 | 2 | | |
| | | Total Hardware (2) | | | | Total Software (5) | | | | | | | |

PROCESS WATER PUMP CONTROL POINTS LIST

| Point Name | Hardware Points | | | | Software Points | | | | | | | Show On Graphic | |
|---------------------------------|-----------------|--------------------|----------|----------|-----------------|---------------------|----------|----------|----------|----------|----------|-----------------|--|
| | AI | AO | BI | BO | AV | BV | Loop | Sched | Trend | Alarm | | | |
| Chilled Water Return Temp | x | | | | | | | | x | | | x | |
| Chilled Water Supply Temp | x | | | | | | | | x | | | x | |
| Process Water Return Temp | x | | | | | | | | x | | | x | |
| Process Water Supply Temp | x | | | | | | | | x | | | x | |
| Process Cooling Valve | | x | | | | | | | x | | | x | |
| Process Water Pump 1 Status | | | x | | | | | | x | | | x | |
| Process Water Pump 1 Start/Stop | | | | x | | | | | x | | | x | |
| High Chilled Water Supply Temp | | | | | | | | | | | x | | |
| High Process Water Supply Temp | | | | | | | | | | | x | | |
| Low Chilled Water Supply Temp | | | | | | | | | | | x | | |
| Low Process Water Supply Temp | | | | | | | | | | | x | | |
| Pump In Hand | | | | | | | | | | | x | | |
| Pump - Failure | | | | | | | | | | | x | | |
| Totals | 4 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 7 | 6 | 7 | | |
| | | Total Hardware (7) | | | | Total Software (13) | | | | | | | |

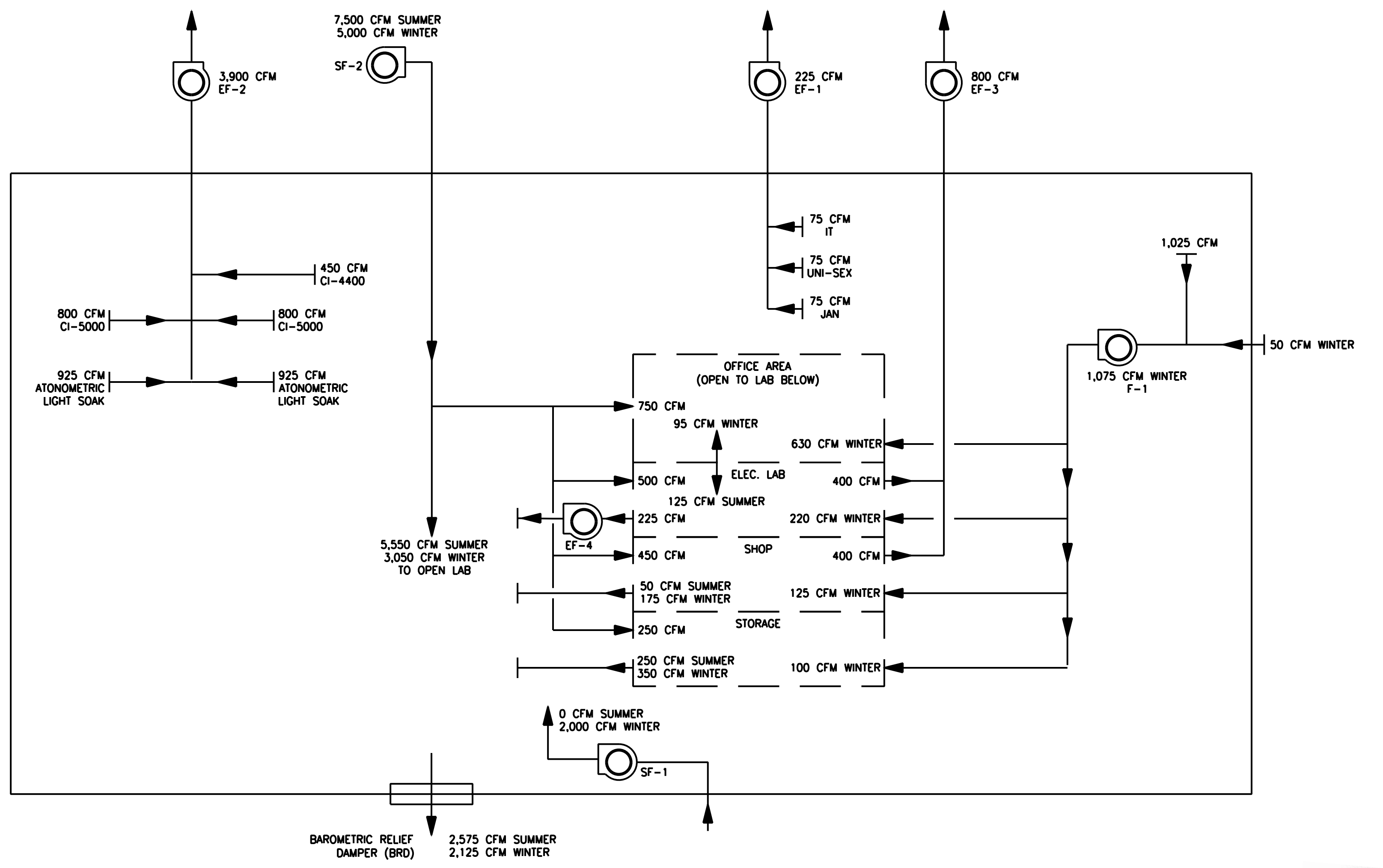


1 VTIF HEAT LOAD CALCULATION DIAGRAM
SCALE: NONE

VTIF Seasonal Airflow Schematic

| Summer Time: | | | | | |
|--------------|-----------------|----------------|--------------------|---------------------|--------------------|
| Equipment | Outside Air CFM | Supply Air CFM | Return Airflow CFM | Exhaust Airflow CFM | Relief Airflow CFM |
| SF-1 | 0 | 0 | 0 | 0 | 0 |
| SF-2 | 7500 | 7500 | 0 | 0 | 0 |
| EF-1 | 0 | 0 | 0 | 225 | 0 |
| EF-2 | 0 | 0 | 0 | 3900 | 0 |
| EF-3 | 0 | 0 | 0 | 800 | 0 |
| F-1 | 0 | 0 | 0 | 0 | 0 |
| BRD | 0 | 0 | 0 | 0 | 2575 |
| TOTAL | 7500 | 7500 | 0 | 4925 | 2575 |

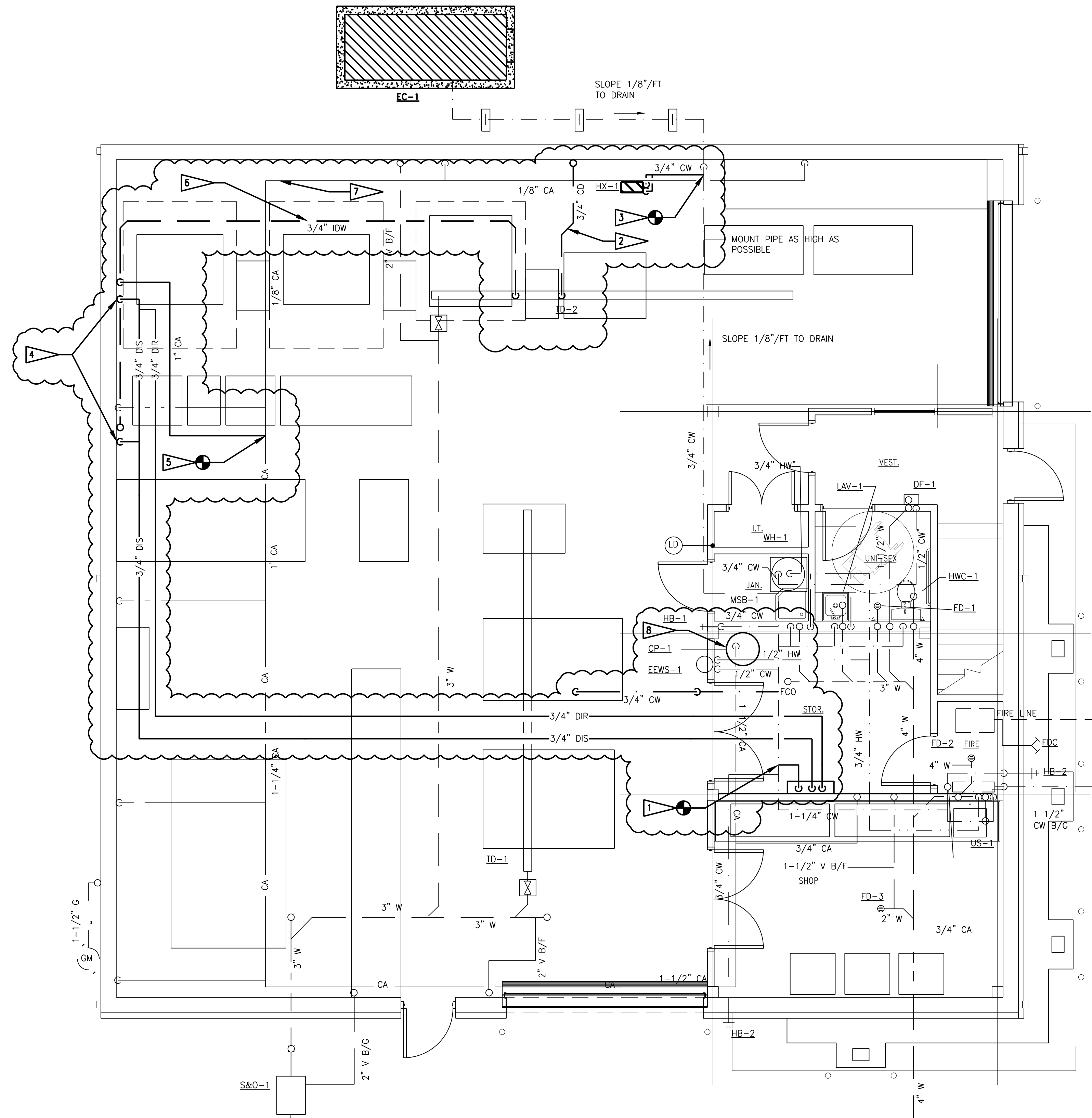
| Winter Time: | | | | | |
|--------------|-----------------|----------------|--------------------|---------------------|--------------------|
| Equipment | Outside Air CFM | Supply Air CFM | Return Airflow CFM | Exhaust Airflow CFM | Relief Airflow CFM |
| SF-1 | 2000 | 2000 | 0 | 0 | 0 |
| SF-2 | 5000 | 5000 | 0 | 0 | 0 |
| EF-1 | 0 | 0 | 0 | 225 | 0 |
| EF-2 | 0 | 0 | 0 | 3900 | 0 |
| EF-3 | 0 | 0 | 0 | 800 | 0 |
| F-1 | 50 | 1075 | 1025 | 0 | 0 |
| BRD | 0 | 0 | 0 | 0 | 2125 |
| TOTAL | 7050 | 8075 | 1025 | 4925 | 2125 |



2 VTIF AIRFLOW SCHEMATIC
SCALE: NONE

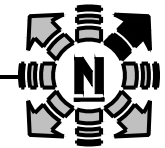
| NO. | REVISIONS | DATE | BY | APP'D. | BAE | NO. | REVISIONS | DATE | BY | APP'D. | BAE | FILE INFORMATION | ENGINEERING REVIEW | 360 Engineering Inc. | NREL NATIONAL RENEWABLE ENERGY LABORATORY | V.T.I.F. MECHANICAL |
|-----|-------------------------|----------|----|--------|-----|-----|-----------|------|----|--------|-----|---|--|----------------------|---|---------------------|
| C | 91% REVIEW SET | 12/24/19 | BG | DMD | | | | | | | | USER: DMD DATE: 03/27/20 TIME: 10:30 XREF'S: 0 | DESIGNER: DMD APPROVAL: DATE: 03/27/20 | | | |
| D | 95% REVIEW SET | 02/17/20 | BG | DMD | | | | | | | | DWG. FILE: VTIF-011-M-09 LAYOUT: | ENGINEER: DMD CHECKED BY: DMD DATE: 03/27/20 | | | |
| O | ISSUED FOR CONSTRUCTION | 03/27/20 | BG | DMD | | | | | | | | DWG. FOLDER: ACAD VERSION: 2010 PLATFORM: Microsoft Windows | A/E APPROVED BY: NREL APPROVED BY: BLDG. AREA ENG. | | | |
| | | | | | | | | | | | | BORDER: ZBD2234D-3.DWG PLOT SCALE: 1" = 1" UNITS: ARCHITECTURAL | | | | |
| | | | | | | | | | | | | PLOT INFO: NREL.STB | | | | |



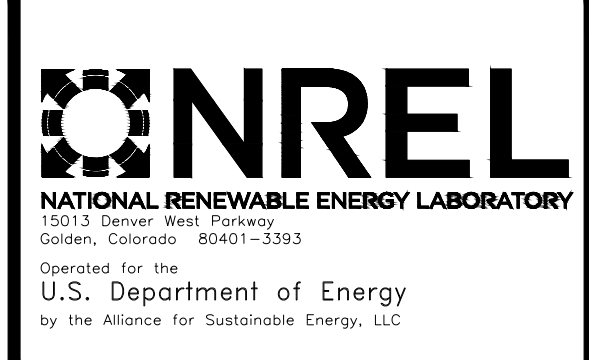


- KEY NOTES:**
- 1 CONNECT NEW 3/4" CW LINE TO EXISTING CW LINE. PROVIDE BALL VALVE FOR ISOLATION. ROUTE TO LOCATION SHOWN FOR CONNECTION TO DI SYSTEM INCLUDED WITH ADD ALTERNATE #1.
 - 2 ROUTE 3/4" INDIRECT WASTE LINE FROM COIL ABOVE ALONG WALL AND FLOOR. TERMINATE AT EXISTING TRENCH DRAIN. PROVIDE WITH TRIP GUARD OVER PIPE ROUTED ON FLOOR.
 - 3 ROUTE 3/4" MAKE UP WATER LINE TO CONNECTIONS AT HEAT EXCHANGER, HX-1. CONNECT TO EXISTING 3/4" CW LINE. PROVIDE WITH REDUCED PRESSURE BACK FLOW PREVENTER.
 - 4 ROUTE 3/4" DIS LINE DOWN WALL AND TERMINATE WITH ASSEMBLY PER DETAIL 2/PL-03.
 - 5 CONNECT NEW 1" CA TO EXISTING CA LINE. ROUTE DOWN ALONG WALL AND TERMINATE WITH BALL VALVE AND PRESSURE REGULATOR VALVE. SEE DETAIL 1/PL-03.
 - 6 NREL TO PROVIDE 3/4" INDIRECT WASTE LINE FROM ESPEC UNITS ALONG WALL AND FLOOR. TERMINATE AT EXISTING TRENCH DRAIN.
 - 7 DEMOLISH AND REROUTE EXISTING CA LINE DOWNSTREAM FROM THIS POINT. LOWER AS NEEDED TO PROVIDE CLEARANCE TO NEW DUCTWORK AND NEW EQUIPMENT. ROUTE TIGHT TO WALL AND AS HIGH AS POSSIBLE.
 - 8 PROVIDE AND INSTALL NEW AIR COMPRESSOR.

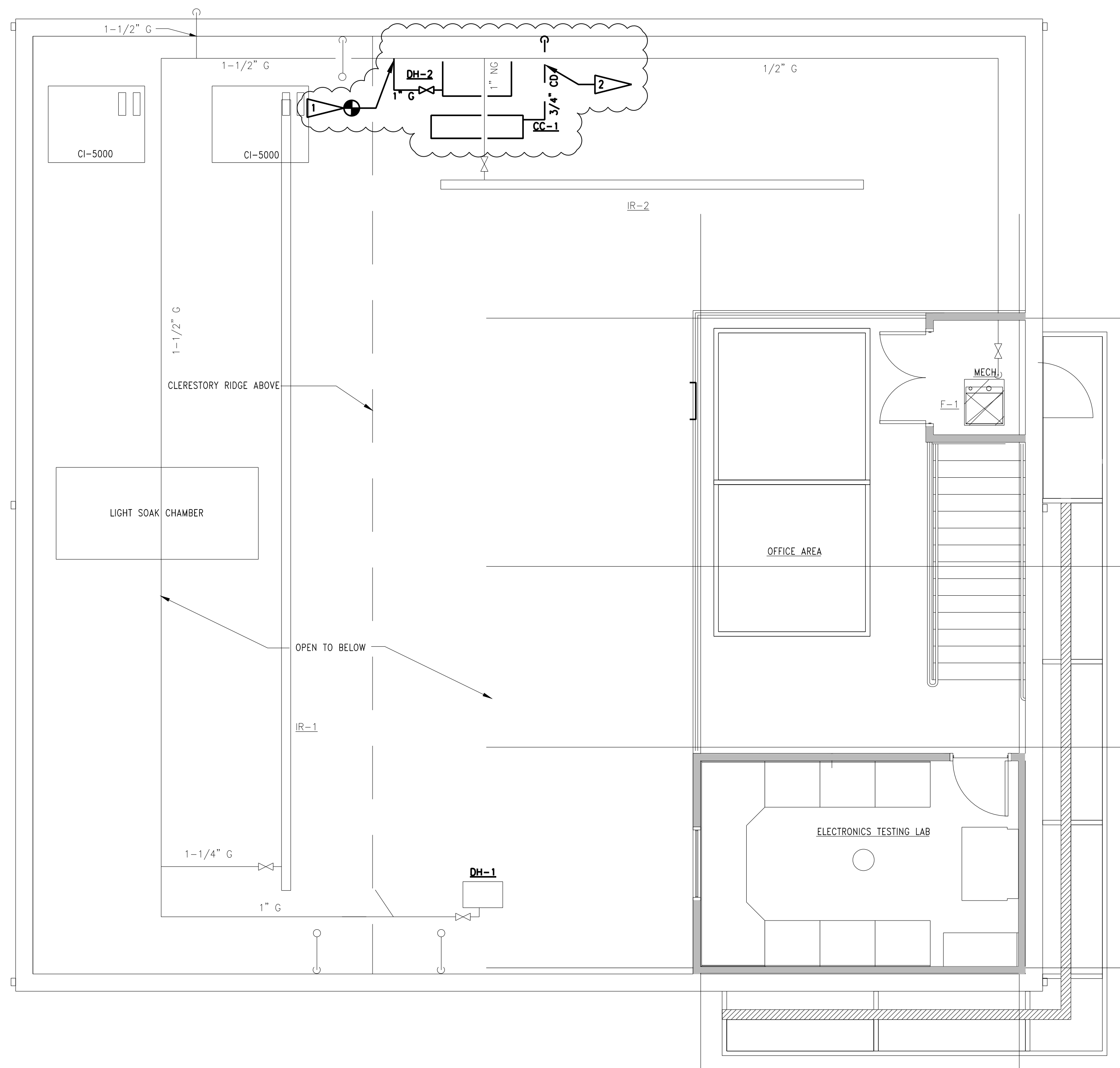
VTIF FIRST FLOOR PLUMBING PLAN
1/4" = 1'-0"



| REVISIONS | | | | | REVISIONS | | | | | FILE INFORMATION | | | | ENGINEERING REVIEW | | | DRAWING NO. PREFIX VTIF-011 | DRAWING NO. PL-01 | REVISION NO. 0 |
|-----------|----------|-----|--------|-----|-----------|------|----|--------|-----|-----------------------------|---------------------|-------|---------|--------------------|----------|----------|---------------------------------------|-----------------------------|--------------------------|
| NO. | DATE | BY | APP'D. | BAE | NO. | DATE | BY | APP'D. | BAE | USER: | DATE: | TIME: | XREF'S: | DESIGNER | APPROVAL | DATE | | | |
| A | 4/24/19 | TCM | DMD | | | | | | | DMD | 03/27/20 | 10:30 | 2 | DMD | DMD | 03/27/20 | EX20193201 | -- | 19-027A |
| B | 10/18/19 | TCM | DMD | | | | | | | DWG. FILE: | | | | DMD | DMD | 03/27/20 | | | |
| C | 12/24/19 | BC | DMD | | | | | | | DWG. FOLDER: | | | | DMD | DMD | 03/27/20 | | | |
| D | 02/17/20 | BC | DMD | | | | | | | ACAD VERSION: 2010 | | | | DMD | DMD | 03/27/20 | | | |
| 0 | 03/27/20 | BC | DMD | | | | | | | PLATFORM: Microsoft Windows | | | | | | | | | |
| | | | | | | | | | | BORDER: ZBD2234D-3.DWG | PLOT SCALE: 1" = 1" | | | | | | | | |
| | | | | | | | | | | PLOT INFO: NREL.STB | | | | | | | | | |



| | | | |
|-----------------------------------|-------|----------|--|
| V.T.I.F. FY19 LAB UPGRADES - VTIF | | PLUMBING | |
| PLUMBING 1ST FLOOR PLAN | | | |
| VTIF-011 | PL-01 | 0 | |
| EX20193201 | -- | 19-027A | |



- KEY NOTES:**
- 1. CONNECT NEW 1" GAS LINE TO EXISTING 1-1/2" GAS LINE. ROUTE TO DUCT HEATER, DH-2.
 - 2. PROVIDE NEW 3/4" CONDENSATE DRAIN FROM CC-1, DOWN TO FLOOR BELOW.

GAS LINE CALCULATION:

INFRARED HEATER (IR-1) (EXISTING): 240.67 CFH (● ALT.)
 INFRARED HEATER (IR-2) (EXISTING): 180.50 CFH (● ALT.)
 DUCT HEATER (DH-1) (EXISTING): 150.42 CFH (● ALT.)
 FURNACE (F-1) (EXISTING): 48.13 CFH (● ALT.)
 DUCT HEATER (DH-2): 481.34 CFH (● ALT.)

TOTAL LOAD: 1101.06 CFH
 TOTAL DEVELOPED LENGTH: 158'
 AVAILABLE GAS PRESSURE: LESS THAN 2.0 PSI

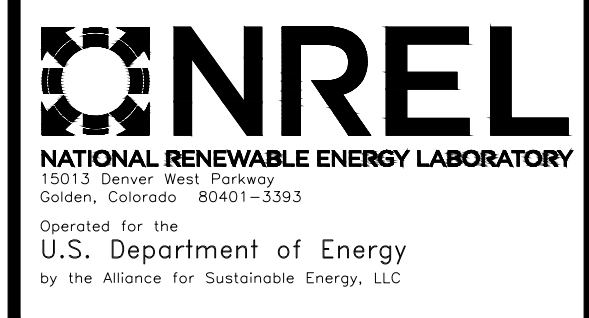
2015 IFGC TABLE 402.4(3), FOR INITIAL SUPPLY PRESSURE OF GREATER THAN 8.0 IN W.C.
 MAIN GAS LINE REQUIRED = 1-1/4" SCHEDULE 40
 EXISTING MAIN GAS LINE = 1-1/2" SCHEDULE 40

NOTE: CALCULATIONS ARE BASED ON 14 IN W.C. AT EXISTING METER. CONTRACTOR TO CONTACT ENGINEER FOR REVISED PIPE SIZING IF INSTALLED METER PRESSURE IS LESS THAN DESIGN PARAMETER OF 14 IN W.C.

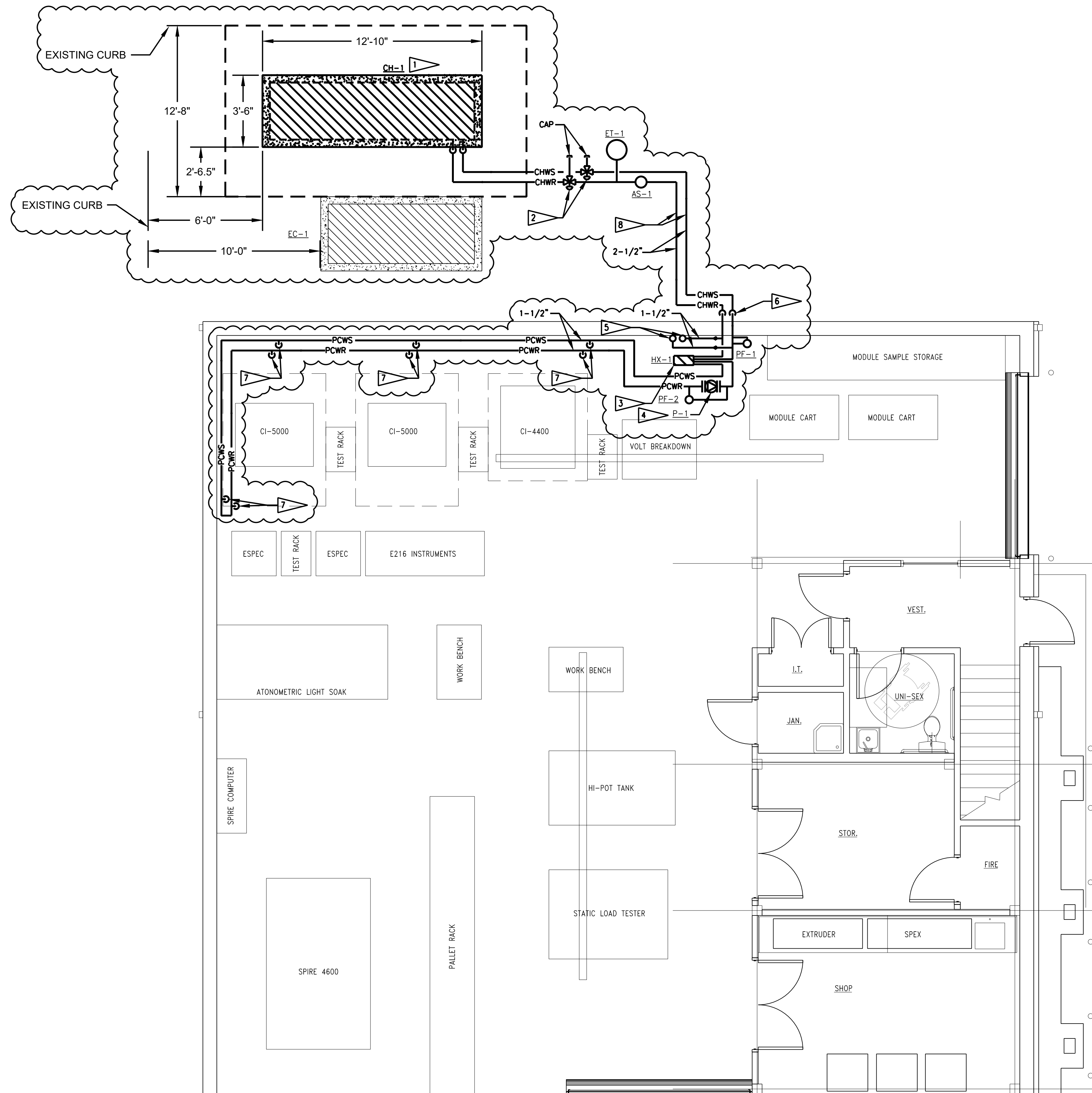
VTIF MEZZANINE PLUMBING PLAN
 1/4" = 1'-0"



| REVISIONS | | | | | | REVISIONS | | | | | | FILE INFORMATION | | | | ENGINEERING REVIEW | | | DRAWING NO. PREFIX | | | DRAWING NO. | | | REVISION NO. | | |
|-----------|----------|-----|--------|-----|-----|-----------|----|--------|-----|-----------------------------|---------------------|------------------|-----------|-----|----------|--------------------|------|------------|--------------------|---------|------------------|---------------------|-----------------|--|--------------|--|--|
| NO. | DATE | BY | APP'D. | BAE | NO. | DATE | BY | APP'D. | BAE | NO. | DATE | BY | APP'D. | BAE | DESIGNER | APPROVAL | DATE | VTIF-011 | PL-02 | 0 | NREL PROJECT NO. | NREL WORK ORDER NO. | A/E PROJECT NO. | | | | |
| A | 4/24/19 | TCM | DMD | . | . | . | . | . | . | USER: DMD | DATE: 02/17/20 | TIME: 10:30 | XREF'S: 2 | | DMD | 03/27/20 | | EX20193201 | -- | 19-027A | | | | | | | |
| B | 10/18/19 | TCM | DMD | . | . | . | . | . | . | DWG. FILE: VTIF-011-PL-02 | | | | | DMD | 03/27/20 | | | | | | | | | | | |
| C | 12/24/19 | BG | DMD | . | . | . | . | . | . | DWG. FOLDER: | | | | | DMD | 03/27/20 | | | | | | | | | | | |
| D | 02/17/20 | BG | DMD | . | . | . | . | . | . | ACAD VERSION: 2010 | | | | | | | | | | | | | | | | | |
| 0 | 03/27/20 | BG | DMD | . | . | . | . | . | . | PLATFORM: Microsoft Windows | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | BORDER: ZBD2234D-3.DWG | PLOT SCALE: 1" = 1" | | | | | | | | | | | | | | | | |
| | | | | | | | | | | PLOT INFO: NREL.STB | | | | | | | | | | | | | | | | | |



| | | |
|-------------------------------|---------------------|-----------------|
| V.T.I.F. PLUMBING | | |
| FY19 LAB UPGRADES - VTIF | | |
| PLUMBING MEZZANINE FLOOR PLAN | | |
| DRAWING NO. PREFIX | DRAWING NO. | REVISION NO. |
| VTIF-011 | PL-02 | 0 |
| NREL PROJECT NO. | NREL WORK ORDER NO. | A/E PROJECT NO. |
| EX20193201 | -- | 19-027A |



- KEY NOTES:**
- 1 PROVIDE NEW CONCRETE PAD AND NEW AIR COOLED CHILLER, CH-1. CHILLER IS PROVIDED WITH INTEGRAL PUMPS.
 - 2 PROVIDE 3 WAY DIVERTING CONTROL VALVES. VALVES WILL BE INITIALLY DEACTIVATED, AND ARE INTENDED FOR FUTURE FREE COOLER CONNECTION.
 - 3 PROVIDE AND INSTALL NEW PLATE AND FRAME HEAT EXCHANGER, HX-1. PROVIDE WITH 1-1/4" CWS, CWR, PCS, AND PCR CONNECTIONS.
 - 4 PROVIDE AND INSTALL INLINE PUMP, P-1.
 - 5 1-1/2" CWS/CWR UP TO COOLING COIL ABOVE.
 - 6 PIPE DROP TO GROUND LEVEL. COORDINATE LOCATION TO NOT CLASH WITH EXISTING PANELS ON EXTERIOR WALL. ROUTE PIPE THROUGH EXTERIOR WALL PER DETAIL 2/M-07.
 - 7 PIPE DROP TO PROCESS WATER CONNECTION ASSEMBLY.
 - 8 PIPING TO ROUTE UNDERNEATH POWER CONVERTERS.

VTIF FIRST FLOOR PIPING PLAN
 1/4" = 1'-0"

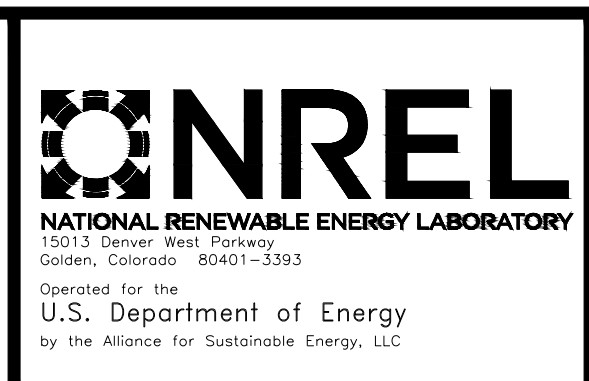
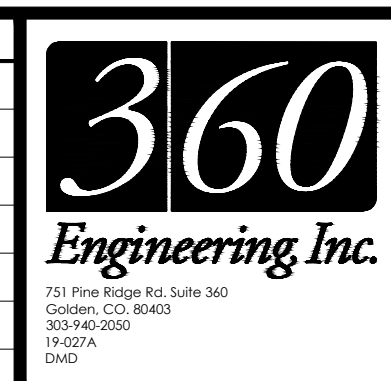


| NO. | REVISIONS | DATE | BY | APP'D. | BAE | NO. |
|-----|-------------------------|----------|-----|--------|-----|-----|
| A | 50% REVIEW SET | 4/24/19 | TCM | DMD | . | . |
| B | 90% REVIEW SET | 10/18/19 | TCM | DMD | . | . |
| C | 91% REVIEW SET | 12/24/19 | BG | DMD | . | . |
| D | 95% REVIEW SET | 02/17/20 | BG | DMD | . | . |
| 0 | ISSUED FOR CONSTRUCTION | 03/27/20 | BG | DMD | . | . |

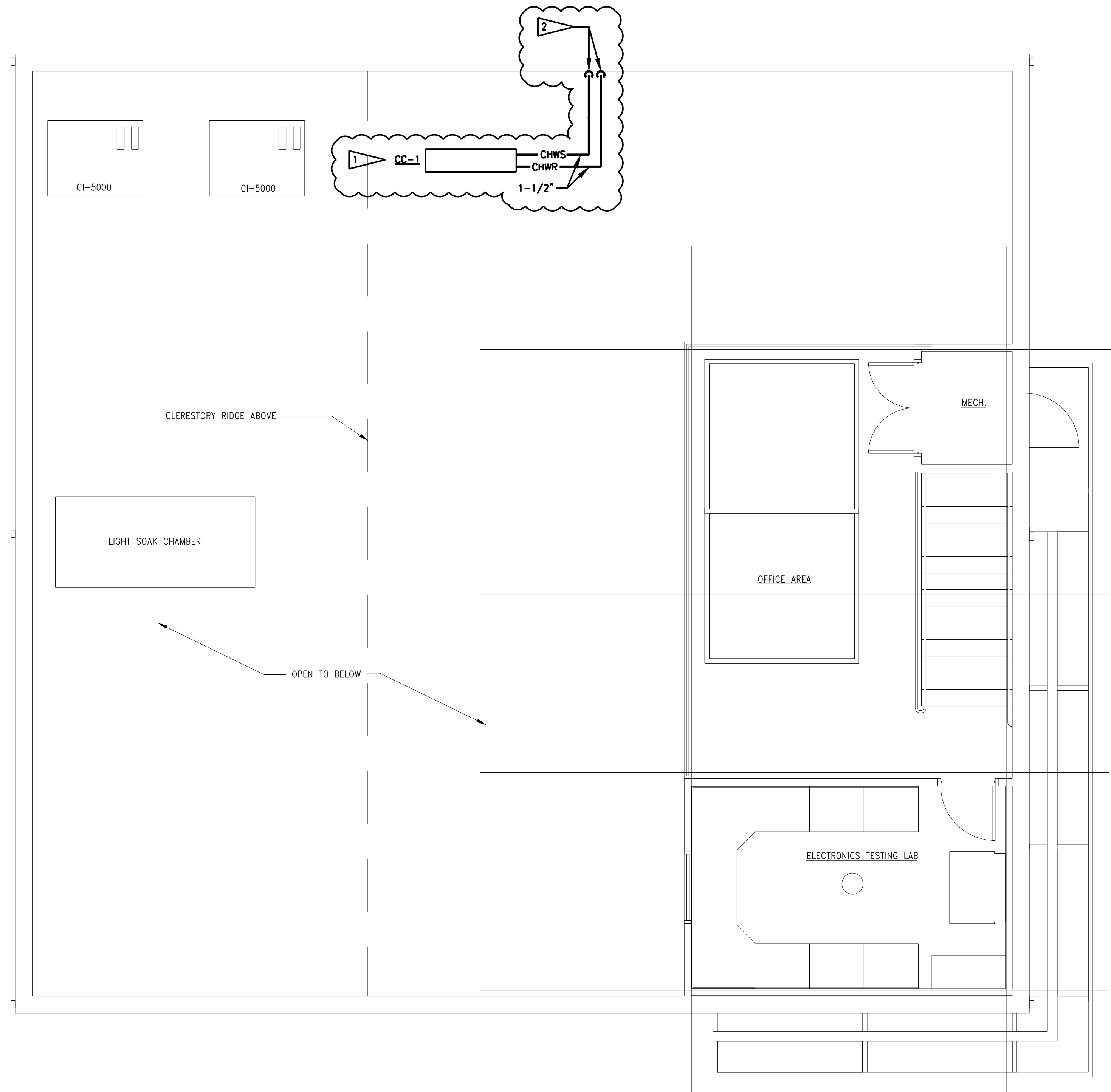
| NO. | REVISIONS | DATE | BY | APP'D. | BAE | NO. |
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| . | . | . | . | . | . | . |
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| . | . | . | . | . | . | . |

| FILE INFORMATION | | | |
|------------------|-------------------|-------------|---------------|
| USER: | DMD | DATE: | 03/27/20 |
| DWG. FILE: | VTIF-011-PP-01 | TIME: | 10:30 |
| DWG. FOLDER: | | LAYOUT: | |
| ACAD VERSION: | 2010 | XREF'S: | 2 |
| PLATFORM: | Microsoft Windows | | |
| BORDER: | ZBD2234D-3.DWG | PLOT SCALE: | 1" = 1" |
| PLOT INFO: | NREL.STB | UNITS: | ARCHITECTURAL |

| ENGINEERING REVIEW | | |
|--------------------|-----|---------------|
| DESIGNER | DMD | APPROVAL DATE |
| ENGINEER | DMD | 03/27/20 |
| CHECKED BY | DMD | 03/27/20 |
| A/E APPROVED BY | - | - |
| NREL APPROVED BY | - | - |
| BLDG. AREA ENG. | - | - |

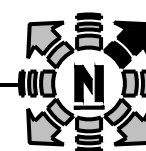


| V.T.I.F. PIPING | | |
|--------------------------|---------------------|-----------------|
| FY19 LAB UPGRADES - VTIF | | |
| PIPING 1ST FLOOR PLAN | | |
| DRAWING NO. PREFIX | DRAWING NO. | REVISION NO. |
| VTIF-011 | PP-01 | 0 |
| NREL PROJECT NO. | NREL WORK ORDER NO. | A/E PROJECT NO. |
| EX20193201 | -- | 19-027A |

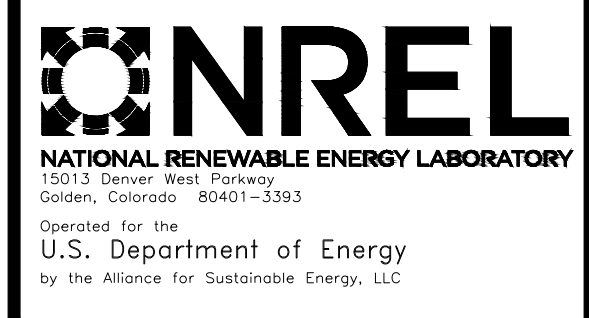


- KEY NOTES:**
- 1 PROVIDE AND INSTALL NEW COOLING COIL, CC-1. REF: M-06 FOR CONNECTION TO MECHANICAL SYSTEM.
 - 2 1-1/2" CWS/CWR DOWN TO MAINS BELOW.

VTIF MEZZANINE PIPING PLAN
1/4" = 1'-0"



| NO. | REVISIONS | DATE | BY | APP'D. | BAE | NO. | REVISIONS | DATE | BY | APP'D. | BAE | FILE INFORMATION | | | | ENGINEERING REVIEW | | | | | | |
|-----|-------------------------|----------|-----|--------|-----|-----|-----------|------|----|--------|-----|------------------|-------------------|-------------|----------|--------------------|---------------|---------|----------|------------------|------|----------|
| | | | | | | | | | | | | USER: | DATE: | TIME: | XREF'S: | DESIGNER | APPROVAL | DATE | ENGINEER | APPROVAL | DATE | |
| A | 50% REVIEW SET | 4/24/19 | TCM | DMD | . | . | . | . | . | . | . | USER: | DMD | DATE: | 03/27/20 | TIME: | 10:30 | XREF'S: | 2 | DESIGNER | DMD | 03/27/20 |
| B | 90% REVIEW SET | 10/18/19 | TCM | DMD | . | . | . | . | . | . | . | DWG. FILE: | VTIF-011-PP-02 | LAYOUT: | | | | | | ENGINEER | DMD | 03/27/20 |
| C | 91% REVIEW SET | 12/24/19 | BG | DMD | . | . | . | . | . | . | . | DWG. FOLDER: | | | | | | | | CHECKED BY | DMD | 03/27/20 |
| D | 95% REVIEW SET | 02/17/20 | BG | DMD | . | . | . | . | . | . | . | ACAD VERSION: | 2010 | | | | | | | A/E APPROVED BY | - | - |
| 0 | ISSUED FOR CONSTRUCTION | 03/27/20 | BG | DMD | . | . | . | . | . | . | . | PLATFORM: | Microsoft Windows | | | | | | | NREL APPROVED BY | - | - |
| . | . | . | . | . | . | . | . | . | . | . | . | BORDER: | ZBD2234D-3.DWG | PLOT SCALE: | 1" = 1" | UNITS: | ARCHITECTURAL | | | | | |
| . | . | . | . | . | . | . | . | . | . | . | . | PLOT INFO: | NREL.STB | | | | | | | BLDG. AREA ENG. | - | - |



| | | | | |
|-----------------------------|---------------------|--------------------------|--|--------|
| V.T.I.F. | | FY19 LAB UPGRADES - VTIF | | PIPING |
| PIPING MEZZANINE FLOOR PLAN | | | | |
| DRAWING NO. PREFIX | DRAWING NO. | REVISION NO. | | |
| VTIF-011 | PP-02 | 0 | | |
| NREL PROJECT NO. | NREL WORK ORDER NO. | A/E PROJECT NO. | | |
| EX20193201 | -- | 19-027A | | |

| ABBREVIATIONS | | | |
|---------------|----------------------------------|-------|------------------------------------|
| A | AMPS | MH | MANHOLE |
| AC | ALTERNATING CURRENT | MTD | MOUNTED |
| A.C. | ABOVE COUNTER | MTS | MANUAL TRANSFER SWITCH |
| AFF | ABOVE FINISHED FLOOR | N | NEUTRAL |
| AFG | ABOVE FINISHED GRADE | NC | NORMALLY CLOSED |
| AHU | AIR HANDLING UNIT | NIC | NOT IN CONTRACT |
| AIC | AMPERE INTERRUPTING CAPACITY | NO | NORMALLY OPEN |
| AF | AMP FRAME | NTS | NOT TO SCALE |
| AT | AMP TRIP | PDU | POWER DISTRIBUTION UNIT |
| ATS | AUTO TRANSFER SWITCH | PF | POWER FACTOR |
| B | BATTERY | Ø/PH. | PHASE |
| BKR | BREAKER | PT | POTENTIAL TRANSFORMER |
| C | CONDUIT | PVC | POLYVINYL CHLORIDE |
| CKT | CIRCUIT | R | ROOF |
| CT | CURRENT TRANSFORMER | RL | RELOCATE |
| D | DEMOLISH | RM | ROOM |
| E | EXISTING | RT | RAIN TIGHT |
| EC | ELECTRICAL CONTRACTOR | RTU | ROOF TOP UNIT |
| EF | EXHAUST FAN | SCA | SHORT CIRCUIT AVAILABLE |
| EOL | END OF LINE RESISTOR | SRG | SIGNAL REFERENCE GRID |
| EM | EMERGENCY | ST | SHUNT TRIP |
| EMT | ELEC. METALLIC TUBING | SW | SWITCH |
| EPO | EMERGENCY POWER OFF | TS | TEST SWITCH |
| EX | EXPLOSION PROOF | TTB | TELEPHONE TERMINAL BOARD |
| F | FUSE | TTC | TELEPHONE TERMINAL CABINET |
| FA | FIRE ALARM | TVSS | TRANSIENT VOLTAGE SURGE SUPPRESSOR |
| F.B.O | FURNISHED BY NREL | UG | UNDERGROUND |
| FCU | FAN COIL UNIT | UPS | UNINTERRUPTABLE POWER SUPPLY |
| G | GROUND | V | VOLTS |
| GFI | GROUND FAULT CIRCUIT INTERRUPTER | VAC | VOLTS ALTERNATING CURRENT |
| GRC | GALVANIZED RIGID CONDUIT | VDC | VOLTS DIRECT CURRENT |
| HP | HORSE POWER | VFD | VARIABLE FREQUENCY DRIVE |
| HV | HIGH VOLTAGE (480V) | W | WALL MOUNTED AT 42" |
| IG | ISOLATED GROUND | WHM | WATTHOUR METER |
| KV | KILOVOLT | WP | WEATHER PROOF |
| KVA | KILOVOLT AMPERE | | |
| KW | KILOWATT | | |
| LV | LOW VOLTAGE (208V) | | |
| MC | MECHANICAL CONTRACTOR | | |
| MCC | MOTOR CONTROL CENTER | | |
| MDP | MAIN DISTRIBUTION PANEL | | |
| MDS | MAIN DISTRIBUTION SWITCHBOARD | | |
| MG | MOTOR GENERATOR | | |

| ONE LINE DIAGRAM | |
|------------------|------------------------------|
| | TRANSFER SWITCH |
| | CIRCUIT BREAKER |
| | BATTERY BANK |
| | PANELBOARD |
| | TRANSFORMER |
| | RECTIFIER |
| | DISCONNECT |
| | FUSED DISCONNECT |
| | GENERATOR |
| | FUSED SWITCH |
| | FUSE |
| | CURRENT TRANSFORMER (CT'S) |
| | POWER MONITOR |
| | CONNECTION POINT |
| | GROUND |
| | DRAW OUT |
| | COIL |
| | NORMALLY CLOSED CONTACT |
| | NORMALLY OPEN CONTACT |
| | PUSHBUTTON |
| | RESISTOR |
| | DOWN GUY AND ANCHOR |
| | MANHOLE |
| | WEATHERHEAD SERVICE ENTRANCE |
| | PAD MOUNTED TRANSFORMER |
| | POTENTIAL TRANSFORMER |
| | FEEDER SCHEDULE |

| GROUNDING LEGEND | |
|------------------|-------------------------------------|
| | GROUND ROD & COMPRESSION CONNECTION |
| | GROUND ROD WITH INSPECTION WELL |
| | MECHANICAL EQUIPMENT BOND |
| | COMPRESSION TYPE GROUND CONNECTION |

| POWER DEVICES | |
|---------------|--|
| | DUPLEX RECEPTACLE |
| | DOUBLE DUPLEX RECEPTACLE |
| | GROUND FAULT INTERRUPTER RECEPTACLE (EQUIPMENT) GROUND FAULT INTERRUPTER RECEPTACLE (PERSONNEL) |
| | SPECIAL PURPOSE OUTLET |
| | FLOOR RECEPTACLE (QUAD) |
| | CEILING RECEPTACLE |
| | MULTI-OUTLET ASSEMBLY (WIRE MOLD) |
| | PULL BOX |
| | JUNCTION BOX |
| | METER |
| | MOTOR- NUMBER INDICATES HORSEPOWER |
| | DAMPEN |
| | CIRCUIT BREAKER DISCONNECT |
| | NON-FUSED DISCONNECT |
| | FUSED DISCONNECT |
| | MOTOR STARTER OR CONTACTOR |
| | COMBINATION STARTER/DISCONNECT |
| | THERMAL OVERLOAD SWITCH |
| | MANUAL MOTOR STARTER DISCONNECT SWITCH |
| | THERMOSTAT |
| | RELAY |
| | SOLENOID |
| | PUSHBUTTON |
| | PANELBOARD |
| | COMMUNICATION ENCLOSURE |
| | MOTOR CONTROL CENTER |
| | TELEPHONE OUTLET |
| | DATA OUTLET |
| | COMBINATION DATA/TELECOM OUTLET |
| | PLYWOOD BACKBOARD |
| | GROUND BUS |
| | CAMERA |
| | PHOTOEYE |
| | HORN FOR PA SYSTEM |
| | SPEAKER |

| RACEWAY LEGEND | |
|----------------|---|
| | HOMERUN TO PANEL: NUMBER OF ARROWS INDICATES THE NUMBER OF CIRCUITS |
| | UNDERGROUND CONDUIT (NEW) |
| | UNDERGROUND CONDUIT (EXISTING) |
| | CONTINUATION |
| | CAP |
| | RACEWAY TURNED DOWN |
| | RACEWAY TURNED UP |
| | EXISTING CONDUIT TO BE REMOVED |

| LIGHTING DEVICES | |
|------------------|--|
| | 2' x 4' LIGHTING FIXTURE (a) = SWITCH DESIGNATION A = FIXTURE TYPE (SEE FIXTURE SCHEDULE) CPH3-3 = CIRCUIT NUMBER |
| | 1' x 8' LIGHTING FIXTURE |
| | BATTERY PACK EMERGENCY FIXTURE |
| | WALL MOUNTED FIXTURE |
| | CEILING/SURFACE MOUNTED FIXTURE ON UNSWITCHED CIRCUIT |
| | EXIT SIGN |
| | JUNCTION BOX |
| | CONDUIT IDENTIFICATION REFERENCE |
| | SWITCH IDENTIFICATION REFERENCE |
| | SINGLE POLE SWITCH a = DEVICE SWITCHED DESIGNATION |
| | DOUBLE POLE SWITCH |
| | THREE WAY SWITCH |
| | FOUR WAY SWITCH |
| | OCCUPANCY SENSOR WALL SWITCH WITH POWER PACKS, AS NOTED. |
| | DIMMING SWITCH WITH ASSOCIATED DEVICES, AS NOTED. |
| | WALL OR CEILING MOUNTED OCCUPANCY OR PHOTOCELL SENSOR WITH POWER PACK(S), AS NOTED |

| SECURITY & FIRE ALARM DEVICES | |
|-------------------------------|---|
| | DOOR SWITCH |
| | MAGNETIC DOOR LOCK |
| | MAGNETIC DOOR RELEASE BUTTON |
| | CARD READER (K W/KEYPAD) |
| | DOOR ALARM CONTACTS (BALANCED MAGNETIC SWITCH TYPE) TOUCH BAR |
| | SECURITY SYSTEM CONTROL PANEL |
| | HANDICAP DOOR SWITCH - OUTSIDE |
| | HANDICAP DOOR SWITCH - INSIDE |
| | HANDICAP DOOR OPERATOR |
| | FIRE ALARM CONTROL PANEL |
| | FIRE ALARM ANNUNCIATOR PANEL |
| | FACP DIALER |
| | MANUAL PULL STATION (WP) INDICATES WEATHERPROOF DEVICE TYP. |
| | DETECTOR (P = PHOTOELECTRIC SMOKE), (D = DUCT DETECTOR SMOKE), (H = HYDROGEN), (CO = CARBON MONOXIDE) |
| | HEAT DETECTOR (135°F RATE OF RISE) |
| | REMOTE TEST SWITCH (DUCT DETECTOR) |
| | HORN WITH ADA STROBE UNIT |
| | WEATHERPROOF OUTSIDE HORNSTROBE UNIT |
| | TRANSIENT PROTECTORS |
| | STROBE UNIT |
| | END-OF-LINE RESISTOR |
| | MAGNETIC DOOR HOLDER |
| | REMOTE INDICATOR LIGHT |
| | SPRINKLER FLOW SWITCH |
| | SPRINKLER TAMPER SWITCH |

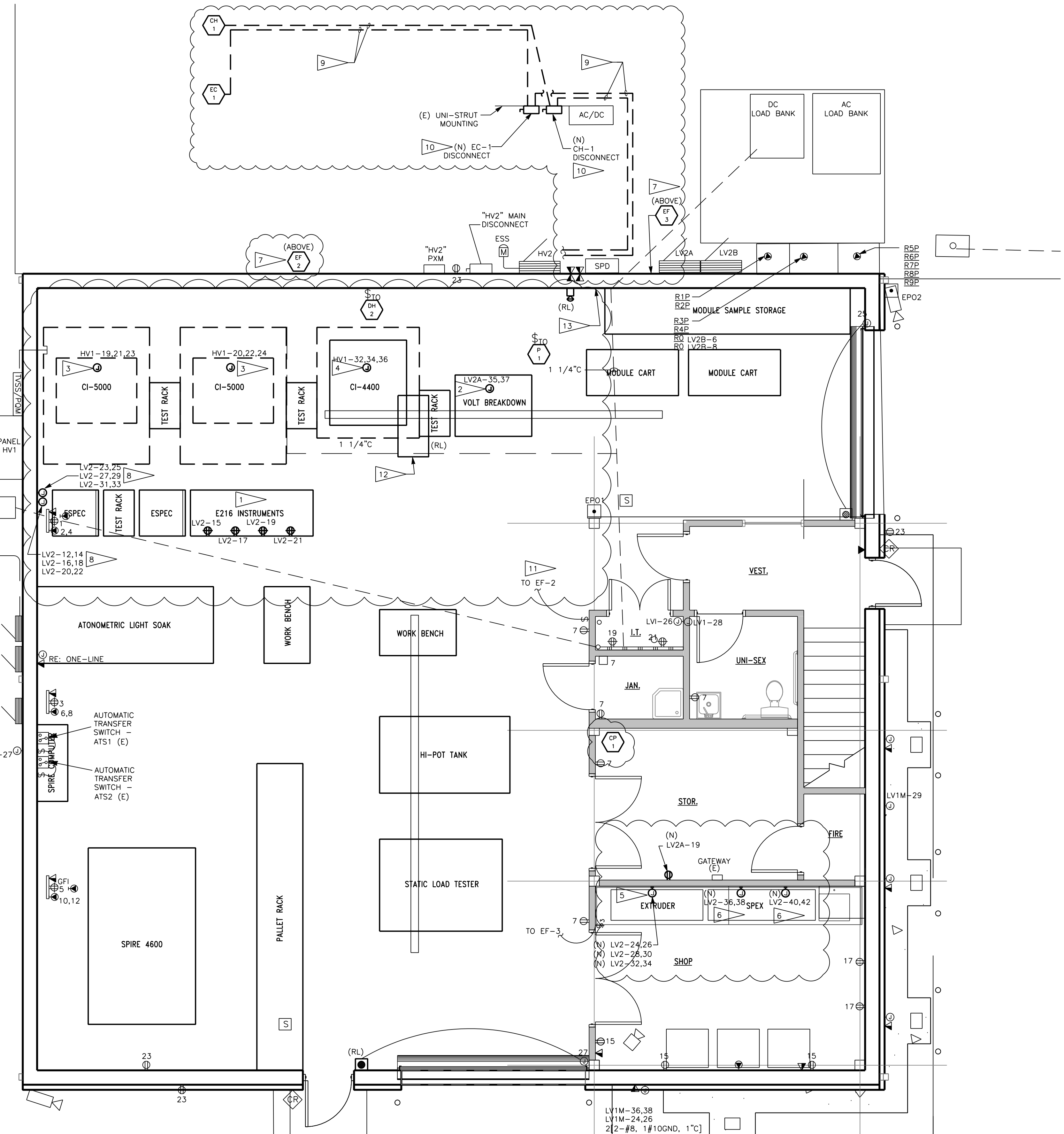
- ALL EQUIPMENT IS EXISTING TO REMAIN, UNLESS OTHERWISE NOTED.
- COORDINATE ANY NEW CONDUIT ROUTING IN FIELD WITH REGARDS TO OTHER TRADES. CONCEAL CONDUIT WHERE POSSIBLE AND ROUTE PARALLEL/PERPENDICULAR TO EXISTING STRUCTURE AND EQUIPMENT.
- ALL ELECTRICAL WORK SHALL BE IN ACCORDANCE WITH NREL CONSTRUCTION AND SAFETY GUIDELINES, POLICIES, PROCEDURES, AND THE 2017 EDITION OF THE NATIONAL ELECTRIC CODE (NEC).
- CONTRACTOR SHALL REFERENCE SPECIFICATIONS FOR CONSTRUCTION MATERIALS AND INSTALLATION PROCEDURES. SPECIFICATIONS ARE A PART OF THE CONSTRUCTION DOCUMENTS. SHOULD ANY CONFLICT ARISE BETWEEN THE DRAWINGS AND SPECIFICATIONS, SUCH CONFLICT SHALL BE BROUGHT TO THE ATTENTION OF THE ARCHITECT/ENGINEER FOR RESOLUTION.
- THESE DRAWINGS ARE DIAGRAMMATIC IN CHARACTER AND DO NOT NECESSARILY SHOW MATERIALS FOR A COMPLETE INSTALLATION. CONFIRM FINAL LOCATIONS OF DEVICES WITH OWNER PRIOR TO INSTALLATION.
- ALL PENETRATIONS THROUGH FIRE SEPARATION WALLS ARE TO BE SEALED WITH UL LISTED/FM APPROVED SEALANT TO MAINTAIN SEPARATION RATING.
- LOCATIONS AND INFORMATION FOR EXISTING ELECTRICAL DEVICES, EQUIPMENT, AND CIRCUITRY SHOWN ON THESE PLANS ARE APPROXIMATE. THIS INFORMATION IS DERIVED FROM FIELD OBSERVATIONS AND RECORD DRAWINGS THAT WERE AVAILABLE AT THE TIME THESE DRAWINGS WERE ISSUED FOR PUBLICATION. THE CONTRACTOR IS TO VERIFY ACTUAL FIELD CONDITIONS PRIOR TO STARTING WORK. IF SIGNIFICANT DISCREPANCIES ARE FOUND THAT CANNOT BE EASILY DEALT WITH, CONTACT NREL PROJECT MANAGER.
- ALL RECEPTACLES WITHIN 6' LATERALLY OF A SINK EDGE OR OTHER WATER SOURCE SHALL BE GFI RATED.
- ALL PANELBOARDS SHALL BE COMPLETELY DE-ENERGIZED WHEN COVERS ARE REMOVED. IF DE-ENERGIZING A PANELBOARD AFFECTS AREAS OUTSIDE THE DESIGNATED AREA OF WORK, THE DOWNTIME SHALL BE SCHEDULED WITH THE NREL PROJECT MANAGER A MINIMUM OF TWO WEEKS IN ADVANCE, LIMITED AS MUCH AS IS FEASIBLE, AND SHALL BE SCHEDULED FOR AFTER HOURS.
- CONTRACTOR TO PLACE COPY OF UPDATED PANEL SCHEDULE IN PANEL DOOR AND PROVIDE NREL WITH ANY REDLINES FOR AS-BUILT DRAWING UPDATES.
- ELECTRICAL CONTRACTOR TO PROVIDE ARC FLASH CALCULATIONS AND ASSOCIATED EQUIPMENT LABELS FOR ALL NEW DISCONNECTS, PANELBOARDS, SWITCHBOARDS ETC. PER NREL REQUIREMENTS.
- CLOUDED AREAS REPRESENT SCOPE OF WORK FOR THIS PROJECT.
- ELECTRICAL CONTRACTOR TO REVIEW ALL ARCHITECTURAL, STRUCTURAL, AND MECHANICAL DRAWINGS AND SPECIFICATIONS FOR CONDITIONS WHICH MIGHT AFFECT ELECTRICAL DESIGN.
- ALL ELECTRICAL MATERIALS SHALL BE ACCEPTABLE FOR INSTALLATION ONLY IF LABELED OR LISTED AND ACCEPTED BY THE AUTHORITY HAVING JURISDICTION.
- LABEL ALL NEW OR MODIFIED RECEPTACLES, SWITCHES, BACKBOXES, J-BOXES, AND CONDUIT RACEWAYS WITH PANEL AND CIRCUIT DESIGNATION OR ORIGINATING EQUIPMENT INFORMATION.



| NO. | REVISIONS | DATE | BY | APP'D. | BAE | NO. | REVISIONS | DATE | BY | APP'D. | BAE | FILE INFORMATION | | | | ENGINEERING REVIEW | | V.T.I.F. | ELEC | | |
|-----|-------------------------|----------|-----|--------|-----|-----|-----------|------|----|--------|-----|------------------|-------------------|-------------|----------|--------------------|---------------|----------|------|------|------|
| | | | | | | | | | | | | DESIGNER | APPROVAL | DATE | DATE | DESIGNER | APPROVAL | | | DATE | DATE |
| A | 50% REVIEW SET | 04/24/19 | TPK | PKD | . | . | | | | | | USER: | TPK | DATE: | 03/27/20 | TIME: | 15:39 | XREF'S: | 0 | | |
| B | 90% REVIEW SET | 10/18/19 | TPK | PKD | . | . | | | | | | DWG. FILE: | VTIF-011-E01 | LAYOUT: | | | | | | | |
| C | 91% REVIEW SET | 12/20/19 | TPK | JEB | . | . | | | | | | DWG. FOLDER: | | | | | | | | | |
| D | 95% REVIEW SET | 02/17/20 | TPK | JEB | . | . | | | | | | ACAD VERSION: | 2019 | | | | | | | | |
| 0 | ISSUED FOR CONSTRUCTION | 03/27/20 | TPK | JEB | . | . | | | | | | PLATFORM: | Microsoft Windows | | | | | | | | |
| . | . | . | . | . | . | . | | | | | | BORDER: | ZBD22340-3.DWG | PLOT SCALE: | 1" = 1" | UNITS: | ARCHITECTURAL | | | | |
| . | . | . | . | . | . | . | | | | | | PLOT INFO.: | NREL.STB | | | | | | | | |



| | | | | | |
|------------------------------|---------------------|-----------------|-------------------|--|--|
| V.T.I.F. | | | FY19 LAB UPGRADES | | |
| VTIF-011 | | | VTIF | | |
| ELECTRICAL LEGENDS AND NOTES | | | | | |
| DRAWING NO. PREFIX | DRAWING NO. | REVISION NO. | | | |
| VTIF-011 | E-01 | 0 | | | |
| NREL PROJECT NO. | NREL WORK ORDER NO. | A/E PROJECT NO. | | | |
| EX20193201 | -- | 19-027A | | | |



GENERAL NOTES

- ALL EQUIPMENT SHOWN IS EXISTING TO REMAIN UNLESS OTHERWISE NOTED.
- ALL SCOPE ON THIS SHEET IS "BASE BID".

DETAIL NOTES

- PROVIDE (4) DEDICATED 120V, 20-AMP QUAD-PLEX RECEPTACLES AT BENCH ADJACENT TO ESPEC EQUIPMENT. COORDINATE EXACT LOCATION AT BACK PANEL. INSTRUMENT BENCH IN FIELD PRIOR TO ROUGH-IN. CIRCUIT AS INDICATED.
- PROVIDE (1) 208V, 1-PHASE, 20-AMP ELECTRICAL CONNECTION (2#12, 1#12G, 3/4" C) TO VOLTAGE BREAKDOWN TESTER EQUIPMENT. COORDINATE EXACT LOCATION IN FIELD. VERIFY ELECTRICAL CONNECTION REQUIREMENTS WITH MANUFACTURER'S INSTALLATION INSTRUCTIONS.
- EQUIPMENT CONNECTION SHALL BE INSTALLED UNDER PREVIOUS PHASE/SCOPE OF WORK AND IS NOTED FOR REFERENCE ONLY. 480V/3PH, 60-AMP HUBBELL IEC NON-METALLIC HEAVY DUTY WATER-TIGHT PIN AND SLEEVE 3-POLE, 4-PIN RECEPTACLE AT C1-5000 EQUIPMENT FOR CORD AND PLUG CONNECTION. PROVIDE (1) 480V/3PH, 60-AMP ELECTRICAL CONNECTION (3#4, 1#10G, 1" C).
- EQUIPMENT CONNECTION SHALL BE INSTALLED UNDER PREVIOUS PHASE/SCOPE OF WORK AND IS NOTED FOR REFERENCE ONLY. 480V/3PH, 60-AMP HUBBELL IEC NON-METALLIC HEAVY DUTY WATER-TIGHT PIN AND SLEEVE 3-POLE, 4-PIN RECEPTACLE AT EACH C1-4400 EQUIPMENT FOR CORD AND PLUG CONNECTION. PROVIDE (1) 480V/3PH, 60-AMP ELECTRICAL CONNECTION (3#4, 1#10G, 1" C). CIRCUIT AS INDICATED.
- PROVIDE (1) 40A, 208V/1PH (2#8, 1#10G, 3/4" C), (1) 30A, 208V/1PH (2#10, 1#10G, 3/4" C), AND (1) 20A, 120V/1PH (2#12, 1#12G, 3/4" C) FOR EXTRUDER EQUIPMENT ELECTRICAL CONNECTIONS. COORDINATE EXACT LOCATION AND CONNECTION REQUIREMENTS WITH MANUFACTURER'S INSTALLATION INSTRUCTIONS.
- PROVIDE (1) 20A, 208V/1PH (2#12, 1#12G, 3/4" C) ELECTRICAL CONNECTION FOR SUNTEST CPS EQUIPMENT. COORDINATE EXACT LOCATION AND CONNECTION REQUIREMENTS WITH MANUFACTURER'S INSTALLATION INSTRUCTIONS.
- EQUIPMENT INDICATED SHALL BE LOCATED ON ABOVE MEZZANINE LEVEL. EC SHALL COORDINATE EXACT EQUIPMENT CONNECTION LOCATION WITH MECHANICAL CONTRACTOR IN FIELD.

DETAIL NOTES

- PROVIDE WALL MOUNTED JUNCTION BOX FOR (3) 20A, 208V/1PH (2#12, 1#12G, 3/4" C) ELECTRICAL CONNECTIONS FOR EACH ESPEC EQUIPMENT. COORDINATE EXACT LOCATION AND CONNECTION REQUIREMENTS WITH MANUFACTURER'S INSTALLATION INSTRUCTIONS.
- EC SHALL ROUTE NEW CHILLER AND EVAPORATIVE CONDENSER ELECTRICAL CONDUIT ABOVE GRADE ALONG NEW CHILLER RACKING. PIPING AND IN SAME SUPPORT RACKING. EC SHALL ROUTE CONDUIT FROM PANEL "HV2" AND SURFACE MOUNT ALONG BUILDING EXTERIOR WALL TO ABOVE GRADE RACKING LOCATION. CONDUIT ROUTING SHALL BE ROUTED ABOVE GRADE TO EQUIPMENT DISCONNECTS AS REQUIRED TO AVOID ALL EXISTING EQUIPMENT CLEARANCES AS SHOWN. EC SHALL COORDINATE EXACT ROUTING AND REQUIREMENTS IN-FIELD WITH MECHANICAL CONTRACTOR PRIOR TO COMMENCING WORK.
- EQUIPMENT DISCONNECT SHALL BE MOUNTED ON EXISTING UNI-STRUT SUPPORTS. COORDINATE EXACT LOCATIONS AND MOUNTING HARDWARE REQUIREMENTS IN-FIELD WITH EXISTING SUPPORTS PRIOR TO ROUGH-IN.
- RE-USE EXISTING EF-2 EQUIPMENT DISCONNECT AS NECESSARY. REFER TO MECHANICAL EQUIPMENT SCHEDULE FOR ADDITIONAL INFORMATION.
- EC SHALL RELOCATE EXISTING HIGH-BAY LIGHTING FIXTURE AND UNI-STRUT MOUNTING HARDWARE TO ADJACENT STRUCTURAL TRUSS BAY AS SHOWN. EC SHALL MAINTAIN ALL EXISTING CIRCUITING AND CONTROLS CONNECTIONS, AND EXTEND EXISTING CONDUIT/WIRING TO NEW FIXTURE LOCATION AS REQUIRED.
- APPROXIMATE LOCATION OF EC-1 FAN VFD EQUIPMENT (PROVIDED BY MECHANICAL CONTRACTOR). EC SHALL CONNECT EQUIPMENT CIRCUIT THROUGH VFD AS REQUIRED. EC SHALL COORDINATE EXACT LOCATION AND CONNECTION REQUIREMENTS WITH MECHANICAL CONTRACTOR IN-FIELD PRIOR TO ROUGH-IN.

| KEY | DESCRIPTION | VOLTS | PH | LOAD HP, W, A | MCCP/MFS | BRANCH CIRCUIT (WIRE AND CONDUIT) | DISCONNECT | CIRCUIT NUMBER | NOTES |
|------|----------------|---------|----|------------------|----------|-----------------------------------|-------------|----------------|-------------|
| CH 1 | CHILLER | 480 | 3 | 73 MCA | 100A | 4#1, 1#8G, 1-1/2" C | 100A/3P | HV2 | |
| P 1 | PUMP | 120 | 1 | 1/12 HP | 15A | 2#12, 1#12G, 3/4" C | 20A/1P-\$10 | LV2A-31 | RE: #1/E-05 |
| CP 1 | AIR COMPRESSOR | 208/240 | 1 | 7.5 HP | 80A | 3#3, 1#8G, 1-1/4" C | 60A/2P | LV2A-10,12 | |
| EC 1 | ECONOMIZER FAN | 480 | 3 | 7.5 HP 11 FLA | 20A | 3#12, 1#12G, 3/4" C | 30A/3P | HV2 | 1 |
| EF 1 | EXHAUST FAN | 208 | 3 | 2 HP 7.8 FLA | 15A | 3#12, 1#12G, 3/4" C | 30A/3P | LV2A-21,23,25 | RE: #1/E-05 |
| DH 2 | DUCT HEATER | 120 | 1 | 2.0 FLA | 20A | 2#12, 1#12G, 3/4" C | 20A/1P | LV2A-33 | 2 |

- GENERAL NOTES:**
- ALL CONDUCTORS ARE COPPER THHN, UNLESS OTHERWISE NOTED.
 - REFER TO MECHANICAL PLANS FOR SPECIFIC EQUIPMENT LOCATIONS AND REQUIREMENTS.
 - PRIOR TO ROUGH-IN, COORDINATE ALL MECHANICAL EQUIPMENT POWER AND CONNECTION REQUIREMENTS WITH MECHANICAL CONTRACTOR'S FINAL SHOP DRAWINGS.
 - PROVIDE ALL 120V CONTROL WIRING, REFER TO SPECIFICATIONS FOR FURTHER CONTROL WIRING CLARIFICATION.
 - FOR ANY VAV SYSTEM COORDINATE POWER REQUIREMENTS WITH MECHANICAL CONTRACTOR AND PROVIDE 120V CONNECTIONS AT EACH VAV BOX, OR AT CENTRAL CONTROL PANEL LOCATION(S) AS REQUIRED. IF EXACT QUANTITIES AND LOCATIONS FOR CONTROL PANELS ARE NOT KNOWN AT BID TIME, E.C. IS TO INCLUDE ONE 120V CONNECTION AT EACH VAV DEVICE IN THE BASE BID PRICE AND PROVIDE A CREDIT DURING CONSTRUCTION IF LESS CONNECTIONS ARE REQUIRED.
 - EXTERIOR DISCONNECT SWITCHES ARE TO BE PROVIDED AS NEMA 3R EQUIPMENT UNLESS OTHERWISE NOTED.
 - PROVIDE WEATHERPROOF 120 VOLT GFCI RECEPTACLES WITHIN 25' OF ALL ROOFTOP HEATING, VENTILATING, AND AIR CONDITIONING EQUIPMENT. CIRCUIT TO SPARE CIRCUIT ON NEAREST 120V PANELBOARD OR AS INDICATED ON PLANS.
 - PROVIDE DUCT DETECTION ON ALL RETURN AIR SYSTEMS OF 2,000 CFM OR GREATER, AND FOR ALL SUPPLY AIR SYSTEMS 15,000 CFM OR GREATER, INCLUDING THOSE SYSTEMS SERVING MULTIPLE FLOORS. PROVIDE ADDITIONAL DUCT DETECTORS AND INSTALL REMOTE INDICATOR LIGHTS AS REQUIRED BY LOCAL AUTHORITY HAVING JURISDICTION.
 - FOR ANY BOILER MECHANICAL SYSTEM, E.C. IS TO PROVIDE AN EMERGENCY PUSHBUTTON OFF AND ANY CONTROL WIRING REQUIRED. COORDINATE EXACT REQUIREMENTS WITH MECHANICAL CONTRACTOR AND EQUIPMENT PRIOR TO INSTALLATION.
 - EC TO PROVIDE HAND/OFF/AUTO STARTERS FOR ALL MOTORS WHEN NOT INDICATED AS TO BE PROVIDED BY THE MECHANICAL CONTRACTOR ON THE MECHANICAL PLANS. SIZE OF STARTER TO BE BASED UPON SIZE OF MOTOR HORSEPOWER INDICATED.
- SPECIFIC NOTES:**
- NEW FAN EQUIPMENT AND ELECTRICAL CONNECTION TO REPLACE EXISTING IN EVAPORATIVE COOLER EC-1. EC SHALL CONNECT CIRCUIT THROUGH VFD EQUIPMENT (PROVIDE BY MECHANICAL CONTRACTOR). VERIFY EXACT REQUIREMENTS WITH MECHANICAL CONTRACTOR PRIOR TO ROUGH-IN.
 - EC SHALL PROVIDE NEW DISCONNECT FOR CONNECTION TO NEW EXHAUST FAN TO REPLACE EXISTING IN THE SAME LOCATION. VERIFY REQUIREMENTS WITH MECHANICAL CONTRACTOR PRIOR TO ROUGH-IN.



VTIF - ELECTRICAL POWER PLAN - LEVEL 1
SCALE: 1/8" = 1'-0"

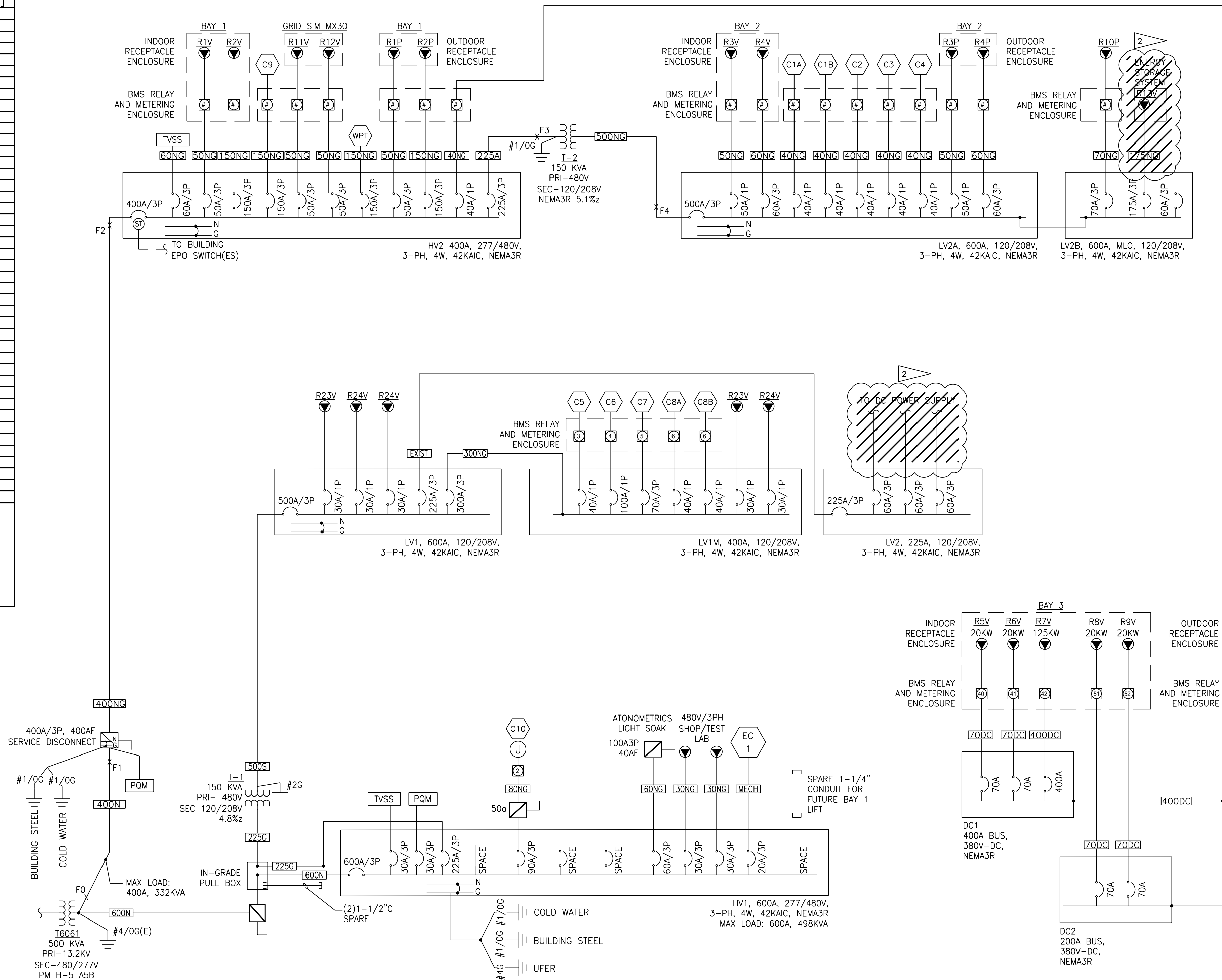
| REVISIONS | | | | | REVISIONS | | | | | FILE INFORMATION | | | | ENGINEERING REVIEW | | V.T.I.F. | | | | | |
|-----------|-------------------------|----------|-----|--------|-----------|-----|-----------|------|----|------------------|-----|---------------|-------------------|---------------------|----------------------|-------------------|-----------|----------|---------------------|----------------------|------------------|
| NO. | REVISIONS | DATE | BY | APP'D. | BAE | NO. | REVISIONS | DATE | BY | APP'D. | BAE | USER: | DATE: | TIME: | XREF'S: | DESIGNER: | APPROVAL: | DATE: | DRAWING NO. PREFIX: | DRAWING NO.: | REVISION NO.: |
| A | 50% REVIEW SET | 04/24/19 | TPK | PKD | . | . | . | . | . | . | . | TPK | 03/27/20 | 15:39 | 0 | TPK | TPK | 03/27/20 | VTIF-011 | E-03 | 0 |
| B | 90% REVIEW SET | 10/18/19 | TPK | PKD | . | . | . | . | . | . | . | DWG. FILE: | VTIF-011-E03 | | | JEB | JEB | 03/27/20 | | | |
| C | 91% REVIEW SET | 12/20/19 | TPK | JEB | . | . | . | . | . | . | . | DWG. FOLDER: | | | | JEB | JEB | 03/27/20 | | | |
| D | 95% REVIEW SET | 02/17/20 | TPK | JEB | . | . | . | . | . | . | . | ACAD VERSION: | 2019 | | | JEB | JEB | 03/27/20 | | | |
| 0 | ISSUED FOR CONSTRUCTION | 03/27/20 | TPK | JEB | . | . | . | . | . | . | . | PLATFORM: | Microsoft Windows | | | | | | | | |
| | | | | | | | | | | | | BORDER: | ZBD2234D-3.DWG | PLOT SCALE: 1" = 1" | UNITS: ARCHITECTURAL | NREL APPROVED BY: | | | NREL PROJECT NO.: | NREL WORK ORDER NO.: | A/E PROJECT NO.: |
| | | | | | | | | | | | | PLOT INFO.: | NREL.STB | | | BLDG. AREA ENG.: | | | EX20193201 | -- | 19-027A |



| | | |
|---------------------|----------------------|------------------|
| DRAWING NO. PREFIX: | DRAWING NO.: | REVISION NO.: |
| VTIF-011 | E-03 | 0 |
| NREL PROJECT NO.: | NREL WORK ORDER NO.: | A/E PROJECT NO.: |
| EX20193201 | -- | 19-027A |

| FEEDER SCHEDULE | | | |
|----------------------------------|-------------------------------|-----------|-------------------------------|
| KEY/ AMPS | FEEDER CONDUIT AND CONDUCTORS | KEY/ AMPS | FEEDER CONDUIT AND CONDUCTORS |
| SERVICE ENTRANCE FEEDERS | | | |
| 400N | 2[4#3/0, 2" C] | 30S | 4#10, 1#8G, 3/4" C |
| 600N | 2[4#350, 3" C] | 50S | 4#6, 1#8G, 1-1/4" C |
| 800N | 2[4#500, 3-1/2" C] | 100S | 4#1, 1#6G, 1-1/2" C |
| 1000N | 3[4#400, 3-1/2" C] | 150S | 4#1/0, 1#6G, 2" C |
| 1200N | 4[4#350, 3" C] | 250S | 4#250, 1#2G, 3" C |
| 1600N | 5[4#400, 3-1/2" C] | 400S | 2[4#3/0, 1#2G, 2" C] |
| 2000N | 6[4#400, 3-1/2" C] | 500S | 2[4#250, 1#1/0G, 3" C] |
| 2500N | 7[4#500, 3-1/2" C] | 800S | 2[4#500, 1#2/0G, 3-1/2" C] |
| 3000N | 8[4#500, 3-1/2" C] | 1000S | 3[4#400, 1#4/0G, 3-1/2" C] |
| 3500N | 10[4#500, 3-1/2" C] | 1600S | 5[4#400, 1#350G, 3-1/2" C] |
| 4000N | 11[4#500, 3-1/2" C] | 2500S | 7[4#500, 1#500G, 3-1/2" C] |
| SDS XFMR FEEDERS (NOTE 1) | | | |
| 20NG | 4#12, #12G, 3/4" C | 20G | 3#12, #12G, 3/4" C |
| 30NG | 4#10, #10G, 3/4" C | 30G | 3#10, #10G, 3/4" C |
| 40NG | 4#8, #10G, 1" C | 40G | 3#8, #10G, 1" C |
| 50NG | 4#6, #10G, 1-1/4" C | 50G | 3#6, #10G, 1" C |
| 60NG | 4#4, #10G, 1-1/4" C | 60G | 3#4, #10G, 1" C |
| 70NG | 4#4, #8G, 1-1/4" C | 70G | 3#4, #8G, 1-1/4" C |
| 80NG | 4#3, #8G, 1-1/4" C | 80G | 3#3, #8G, 1-1/4" C |
| 90NG | 4#2, #8G, 1-1/2" C | 90G | 3#2, #8G, 1-1/4" C |
| 100NG | 4#1, #8G, 1-1/2" C | 100G | 3#1, #8G, 1-1/2" C |
| 110NG | 4#1, #6G, 2" C | 110G | 3#1, #6G, 1-1/2" C |
| 125NG | 4#1/0, #6G, 2" C | 125G | 3#1/0, #6G, 1-1/2" C |
| 150NG | 4#1/0, #6G, 2" C | 150G | 3#1/0, #6G, 1-1/2" C |
| 175NG | 4#2/0, #6G, 2" C | 175G | 3#2/0, #6G, 2" C |
| 200NG | 4#3/0, #6G, 2-1/2" C | 200G | 3#3/0, #6G, 2" C |
| 225NG | 4#4/0, #4G, 2-1/2" C | 225G | 3#4/0, #4G, 2" C |
| 250NG | 4#250, #4G, 2-1/2" C | 250G | 3#250, #4G, 2-1/2" C |
| 300NG | 4#350, #4G, 3" C | 300G | 3#350, #4G, 2-1/2" C |
| 350NG | 4#500, #3G, 3-1/2" C | 350G | 3#500, #3G, 3" C |
| 400NG | 2[4#3/0, #3G, 2-1/2" C] | 400G | 2[3#3/0, #3G, 2" C] |
| 450NG | 2[4#4/0, #2G, 2-1/2" C] | 450G | 2[3#4/0, #2G, 2" C] |
| 500NG | 2[4#250, #2G, 3" C] | 500G | 2[3#250, #2G, 2-1/2" C] |
| 600NG | 2[4#350, #1G, 3" C] | 600G | 2[3#350, #1G, 2-1/2" C] |
| 700NG | 2[4#500, #1/0G, 3-1/2" C] | 700G | 2[3#500, #1/0G, 3" C] |
| 800NG | 2[4#500, #1/0G, 3-1/2" C] | 800G | 2[3#500, #1/0G, 3" C] |
| 1000NG | 3[4#400, #2/0G, 3-1/2" C] | 1000G | 3[3#400, #2/0G, 3" C] |
| 1200NG | 4[4#350, #3/0G, 3" C] | 1200G | 4[3#350, #3/0G, 3" C] |
| 1600NG | 5[4#400, #4/0G, 3-1/2" C] | 1600G | 5[3#400, #4/0G, 3" C] |
| 2000NG | 6[4#400, #250G, 3-1/2" C] | 2000G | 6[3#400, #250G, 3" C] |
| GROUNDING CONDUCTORS | | | |
| G8 | 1#8, 3/4" C | MECH | SEE MECH SCHEDULE |
| G6 | 1#6, 3/4" C | XFMR | SEE XFMR SCHEDULE |
| G4 | 1#4, 3/4" C | | |
| G10 | 1-1/0, 3/4" C | | |
| G20 | 1-2/0, 3/4" C | | |
| G30 | 1-3/0, 3/4" C | | |
| DC CONDUCTORS | | | |
| 30DC | 2#10, #10G, 3/4" C | | |
| 60DC | 2#4, #10G, 1" C DC | | |
| 70DC | 2#4, #8G, 1-1/4" C | | |
| 200DC | 2#3/0, #6G, 2" C | | |
| 400DC | 2[2#3/0, #3G, 2" C] | | |
| ABBREVIATIONS | | | |
| | | | |

- NOTES:
1. FEEDER FOR SECONDARY OF SEPARATELY DERIVED SYSTEM (SDS). GROUND SIZE PER NEC 250.66.
 2. ALL CONDUCTORS ARE SINGLE CONDUCTOR COPPER THWN UNLESS NOTED OTHERWISE. AMPACITY BASED ON NEC TABLE 310.16.
 3. ALL CONDUITS ARE EMT UNLESS NOTED OTHERWISE, FILL RATIOS BASED ON NEC ANNEX C TABLE C1.



AC ONE-LINE DIAGRAM
NTS

DC ONE-LINE DIAGRAMS
NTS

GENERAL NOTES
1. XX.

DETAIL NOTES
1. R14V VEHICLE CHARGING RECEPTACLES SHALL BE DEMOLISHED AS REQUIRED TO ACCOMMODATE NEW CONSTRUCTION AND EQUIPMENT INSTALLATION.
2. SHOWN FOR REFERENCE ONLY. EQUIPMENT DEMOLISHED DURING PREVIOUS PHASE BY OTHERS. REFER TO ELECTRICAL DEMOLITION PLAN, SHEET E02, FOR ADDITIONAL INFORMATION.



| REVISIONS | | | | | REVISIONS | | | | | FILE INFORMATION | | | ENGINEERING REVIEW | | | V.T.I.F. | | | |
|-----------|-------------------------|----------|-----|--------|-----------|-----------|------|----|--------|------------------|-------------------|-------------|--------------------|-----------|-----------|----------|---------------------|-------------|--------------|
| NO. | REVISIONS | DATE | BY | APP'D. | NO. | REVISIONS | DATE | BY | APP'D. | USER: | DATE: | TIME: | XREF'S: | DESIGNER: | APPROVAL: | DATE: | DRAWING NO. PREFIX: | DRAWING NO. | REVISION NO. |
| A | 50% REVIEW SET | 04/24/19 | TPK | PKD | . | . | . | . | . | TPK | 03/27/20 | 15:39 | 0 | TPK | TPK | 03/27/20 | VTIF-011 | E-04 | 0 |
| B | 90% REVIEW SET | 10/18/19 | TPK | PKD | . | . | . | . | . | DWG. FILE: | | | | PKD | PKD | 03/27/20 | | | |
| C | 91% REVIEW SET | 12/20/19 | TPK | JEB | . | . | . | . | . | DWG. FOLDER: | | | | | | | | | |
| D | 95% REVIEW SET | 02/17/20 | TPK | JEB | . | . | . | . | . | ACAD VERSION: | 2019 | | | | | | | | |
| 0 | ISSUED FOR CONSTRUCTION | 03/27/20 | TPK | JEB | . | . | . | . | . | PLATFORM: | Microsoft Windows | | | | | | | | |
| . | . | . | . | . | . | . | . | . | . | BORDER: | ZBD2234D-3.DWG | PLOT SCALE: | 1" = 1" | | | | | | |
| . | . | . | . | . | . | . | . | . | . | PLOT INFO.: | NREL.STB | UNITS: | ARCHITECTURAL | | | | | | |



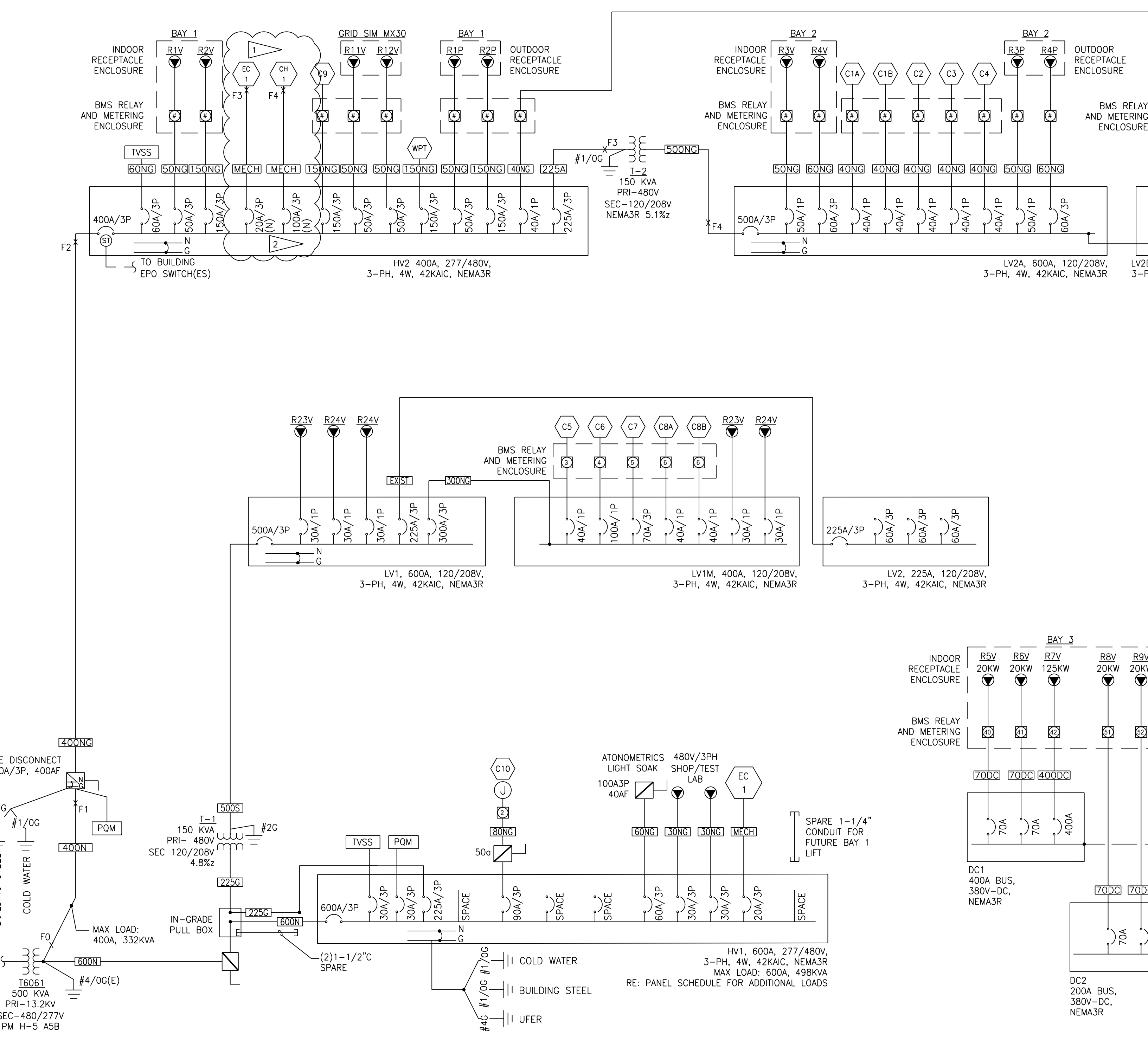
| | | |
|----------------------------------|----------------------|------------------|
| V.T.I.F. ELEC | | |
| FY19 LAB UPGRADES | | |
| VTIF | | |
| ELECTRICAL DEMO ONE-LINE DIAGRAM | | |
| DRAWING NO. PREFIX: | DRAWING NO.: | REVISION NO.: |
| VTIF-011 | E-04 | 0 |
| NREL PROJECT NO.: | NREL WORK ORDER NO.: | A/E PROJECT NO.: |
| EX20193201 | -- | 19-027A |

| FEEDER SCHEDULE | | | |
|---------------------------------|-------------------------------|----------|-------------------------------|
| KEY/AMPS | FEEDER CONDUIT AND CONDUCTORS | KEY/AMPS | FEEDER CONDUIT AND CONDUCTORS |
| SERVICE ENTRANCE FEEDERS | | | |
| 400N | 2[4#3/0, 2" C] | 30S | 4#10, 1#8G, 3/4" C |
| 600N | 2[4#350, 3" C] | 50S | 4#6, 1#8G, 1-1/4" C |
| 800N | 2[4#500, 3-1/2" C] | 100S | 4#1, 1#6G, 1-1/2" C |
| 1000N | 3[4#400, 3-1/2" C] | 150S | 4#1/0, 1#6G, 2" C |
| 1200N | 4[4#350, 3" C] | 250S | 4#250, 1#2G, 3" C |
| 1600N | 5[4#400, 3-1/2" C] | 400S | 2[4#3/0, 1#2G, 2" C] |
| 2000N | 6[4#400, 3-1/2" C] | 500S | 2[4#250, 1#1/0G, 3" C] |
| 2500N | 7[4#500, 3-1/2" C] | 800S | 2[4#500, 1#2/0G, 3-1/2" C] |
| 3000N | 8[4#500, 3-1/2" C] | 1000S | 3[4#400, 1#4/0G, 3-1/2" C] |
| 3500N | 10[4#500, 3-1/2" C] | 1600S | 5[4#400, 1#350G, 3-1/2" C] |
| 4000N | 11[4#500, 3-1/2" C] | 2500S | 7[4#500, 1#500G, 3-1/2" C] |
| EQUIPMENT FEEDERS | | | |
| 20NG | 4#12, #12G, 3/4" C | 20G | 3#12, #12G, 3/4" C |
| 30NG | 4#10, #10G, 3/4" C | 30G | 3#10, #10G, 3/4" C |
| 40NG | 4#8, #10G, 1" C | 40G | 3#8, #10G, 1" C |
| 50NG | 4#6, #10G, 1-1/4" C | 50G | 3#6, #10G, 1" C |
| 60NG | 4#4, #10G, 1-1/4" C | 60G | 3#4, #10G, 1" C |
| 70NG | 4#4, #8G, 1-1/4" C | 70G | 3#4, #8G, 1-1/4" C |
| 80NG | 4#3, #8G, 1-1/4" C | 80G | 3#3, #8G, 1-1/4" C |
| 90NG | 4#2, #8G, 1-1/2" C | 90G | 3#2, #8G, 1-1/4" C |
| 100NG | 4#1, #8G, 1-1/2" C | 100G | 3#1, #8G, 1-1/2" C |
| 110NG | 4#1, #6G, 2" C | 110G | 3#1, #6G, 1-1/2" C |
| 125NG | 4#1/0, #6G, 2" C | 125G | 3#1/0, #6G, 1-1/2" C |
| 150NG | 4#1/0, #6G, 2" C | 150G | 3#1/0, #6G, 1-1/2" C |
| 175NG | 4#2/0, #6G, 2" C | 175G | 3#2/0, #6G, 2" C |
| 200NG | 4#3/0, #6G, 2-1/2" C | 200G | 3#3/0, #6G, 2" C |
| 225NG | 4#4/0, #4G, 2-1/2" C | 225G | 3#4/0, #4G, 2" C |
| 250NG | 4#250, #4G, 3" C | 250G | 3#250, #4G, 2-1/2" C |
| 300NG | 4#350, #4G, 3" C | 300G | 3#350, #4G, 2-1/2" C |
| 350NG | 4#500, #3G, 3-1/2" C | 350G | 3#500, #3G, 3" C |
| 400NG | 2[4#3/0, 1#3G, 2-1/2" C] | 400G | 2[3#3/0, 1#3G, 2" C] |
| 450NG | 2[4#4/0, 1#2G, 2-1/2" C] | 450G | 2[3#4/0, 1#2G, 2" C] |
| 500NG | 2[4#250, 1#2G, 3" C] | 500G | 2[3#250, 1#2G, 2-1/2" C] |
| 600NG | 2[4#350, 1#1G, 3" C] | 600G | 2[3#350, 1#1G, 2-1/2" C] |
| 700NG | 2[4#500, 1#1/0G, 3-1/2" C] | 700G | 2[3#500, 1#1/0G, 3" C] |
| 800NG | 2[4#500, 1#1/0G, 3-1/2" C] | 800G | 2[3#500, 1#1/0G, 3" C] |
| 1000NG | 3[4#400, 1#2/0G, 3-1/2" C] | 1000G | 3[3#400, 1#2/0G, 3" C] |
| 1200NG | 4[4#350, 1#3/0G, 3" C] | 1200G | 4[3#350, 1#3/0G, 3" C] |
| 1600NG | 5[4#400, 1#4/0G, 3-1/2" C] | 1600G | 5[3#400, 1#4/0G, 3" C] |
| 2000NG | 6[4#400, 1#250G, 3-1/2" C] | 2000G | 6[3#400, 1#250G, 3" C] |
| GROUNDING CONDUCTORS | | | |
| G8 | 1#8, 3/4" C | MECH | SEE MECH SCHEDULE |
| G6 | 1#6, 3/4" C | XFMR | SEE XFMR SCHEDULE |
| G4 | 1#4, 3/4" C | | |
| G10 | 1-1/0, 3/4" C | | |
| G20 | 1-2/0, 3/4" C | | |
| G30 | 1-3/0, 3/4" C | | |
| DC CONDUCTORS | | | |
| 30DC | 2#10, 1#10G, 3/4" C | | |
| 60DC | 2#4, 1#10G, 1" DC | | |
| 70DC | 2#4, 1#8G, 1-1/4" C | | |
| 200DC | 2#3/0, 1#6G, 2" C | | |
| 400DC | 2[2#3/0, 1#3G, 2" C] | | |

NOTES:
 1. FEEDER FOR SECONDARY OF SEPARATELY DERIVED SYSTEM (SDS). GROUND SIZE PER NEC 250.66.
 2. ALL CONDUCTORS ARE SINGLE CONDUCTOR COPPER THWN UNLESS NOTED OTHERWISE. AMPACITY BASED ON NEC TABLE 310.16.
 3. ALL CONDUITS ARE EMT UNLESS NOTED OTHERWISE, FILL RATIOS BASED ON NEC ANNEX C TABLE C1.

| FAULT CURRENT CALCULATION SCHEDULE | | | | | | | | | | | | | | | | |
|------------------------------------|----------------------|-----------------|----------------|----------------|-------|-----------|--------------------|-------------------------|------------------|---------------|---------|--------------------|------------------------|-------------------------------|---------------|-------|
| POINT | LOCATION DESCRIPTION | LENGTH (L) (ft) | VOLTAGE (EL-L) | VOLTAGE (EL-N) | PHASE | WIRE SIZE | CONDUCTOR MATERIAL | CONDUCTOR TYPE | CONDUIT MATERIAL | VOLTAGE CLASS | C VALUE | # OF PARALLEL RUNS | Isc AVAILABLE UPSTREAM | Isc AT EQUIP (13ph) OR (LL-L) | LET THRU (LT) | POINT |
| F0 | UTILITY XFMR | | | | | | | | | | | | | 33,400 | -- | F0 |
| F1 | MAIN DISCONNECT | 47 | 480 | 277 | 3 | 3X | COPPER | THREE SINGLE CONDUCTORS | NONMAGNETIC | 600V | 13923 | 2 | 33,400 | 27,754 | ---- | F1 |
| F2 | HV2 | 10 | 480 | 277 | 3 | 3X | COPPER | THREE SINGLE CONDUCTORS | NONMAGNETIC | 600V | 13923 | 2 | 27,754 | 26,791 | ---- | F2 |
| F3 | EC-1 | 110 | 480 | 277 | 3 | 12 | COPPER | THREE SINGLE CONDUCTORS | NONMAGNETIC | 600V | 617 | 1 | 26,791 | 1,469 | ---- | F3 |
| F4 | CH-1 | 100 | 480 | 277 | 3 | 1 | COPPER | THREE SINGLE CONDUCTORS | NONMAGNETIC | 600V | 7493 | 1 | 26,791 | 11,698 | ---- | F4 |

NOTES:
 1. ALL CALCULATIONS WERE DONE USING BUSMAN "POINT-TO-POINT" METHOD.
 2. REFER TO PLANS FOR ASSUMED UTILITY TRANSFORMER SIZE UTILIZED FOR CALCULATIONS.
 3. TRANSFORMER IMPEDANCES USED IN THE CALCULATIONS WERE TAKEN FROM EATON'S PUBLISHED IMPEDANCES FOR DOE 2016 DRY-TYPE TRANSFORMERS.
 4. CONDUCTOR LENGTHS INDICATED IN THIS SCHEDULE ARE FOR THE PURPOSES OF FAULT CURRENT CALCULATIONS ONLY. THESE LENGTHS ASSUME WORST CASE SHORTEST DISTANCE CONDITIONS AND SHOULD NOT BE UTILIZED BY THE ELECTRICAL CONTRACTOR FOR BIDDING PURPOSES. THE ELECTRICAL CONTRACTOR SHALL BE RESPONSIBLE FOR ESTIMATING AND MEASURING ACTUAL FIELD CONDITION LENGTHS AS PART OF THE BID PROCESS.



AC ONE-LINE DIAGRAM
NTS

DC ONE-LINE DIAGRAMS
NTS

GENERAL NOTES
 1. REFER TO ELECTRICAL PANEL SCHEDULES, SHEET E06, FOR ADDITIONAL INFORMATION.
 2. ALL NEW CIRCUIT BREAKERS INSTALLED AT EXISTING PANELS SHALL MATCH EXISTING BREAKER MANUFACTURER, TYPE, AND AIC RATING.

DETAIL NOTES
 1. PROVIDE NEW ELECTRICAL CONDUIT AND WIRING FOR NEW MECHANICAL EQUIPMENT CONNECTION AS SHOWN, REFER TO ELECTRICAL POWER PLAN AND MECHANICAL EQUIPMENT SCHEDULE, SHEET E-03, FOR ADDITIONAL INFORMATION.
 2. PROVIDE NEW CIRCUIT BREAKERS IN EXISTING PANEL 'HV2' AT EXISTING UN-USED BUSSED SPACE(S) AS INDICATED.

| REVISIONS | | | | | REVISIONS | | | | | FILE INFORMATION | | | | ENGINEERING REVIEW | | | |
|-----------|-------------------------|----------|-----|--------|-----------|-----------|------|----|--------|------------------|--------------------|---------------------|---------|--------------------|-----------|-------|--|
| NO. | REVISIONS | DATE | BY | APP'D. | NO. | REVISIONS | DATE | BY | APP'D. | USER: | DATE: | TIME: | XREF'S: | DESIGNER: | APPROVAL: | DATE: | |
| A | 50% REVIEW SET | 04/24/19 | TPK | PKD | . | . | . | . | . | TPK | 03/27/20 | 15:39 | 0 | TPK | 03/27/20 | | |
| B | 90% REVIEW SET | 10/18/19 | TPK | PKD | . | . | . | . | . | DWG. FILE: | VTIF-011-E05 | | | PKD | 03/27/20 | | |
| C | 91% REVIEW SET | 12/20/19 | TPK | JEB | . | . | . | . | . | DWG. FOLDER: | | | | PKD | 03/27/20 | | |
| D | 95% REVIEW SET | 02/17/20 | TPK | JEB | . | . | . | . | . | CHECKED BY: | ACAD VERSION: 2019 | | | PKD | 03/27/20 | | |
| 0 | ISSUED FOR CONSTRUCTION | 03/27/20 | TPK | JEB | . | . | . | . | . | PLATFORM: | Microsoft Windows | | | | | | |
| . | . | . | . | . | . | . | . | . | . | BORDER: | ZBD22340-3.DWG | PLOT SCALE: 1" = 1" | | | | | |
| . | . | . | . | . | . | . | . | . | . | PLOT INFO.: | NREL.STB | | | | | | |

AEDESIGN
Integrated Lighting and Electrical Solutions
100 W. 13th Street #205 | Denver, CO 80202 | 303.736.3634
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NREL
NATIONAL RENEWABLE ENERGY LABORATORY
15013 Denver East Parkway
Golden, Colorado 80401-3393
Operated for the U.S. Department of Energy
by the Alliance for Sustainable Energy, LLC

V.T.I.F. ELEC
FY19 LAB UPGRADES
VTIF
ELECTRICAL ONE-LINE DIAGRAM

| | | |
|--------------------------------|---------------------------|----------------------------|
| DRAWING NO. PREFIX VTIF-011 | DRAWING NO. E-05 | REVISION NO. 0 |
| NREL PROJECT NO. EX20193201 | NREL WORK ORDER NO. -- | A/E PROJECT NO. 19-027A |



| (E) PANEL 'HV1' | | | | | | | | | | | | | | |
|---|----------|---------|----------------------------|--------------------|------|------|-----|---------------------------|------|--|----------------------------|---------|----------|---------|
| VOLTAGE L-L: 480 | | | | LOCATION: EXTERIOR | | | | BUS RATING: 600 AMPS | | MAIN CB: 600 A/3P | | | | |
| TYPE: 3PH/4W | | | | MOUNTING: SURFACE | | | | FED FROM: MAIN DISCONNECT | | AIC RATING: FULLY RATED AT LEAST EQUAL TO: 42K AIC | | | | |
| NOTES: | | | | EXISTING, NEMA 3R | | | | | | | | | | |
| CIR. NO. | CCT TYPE | LOAD VA | LOAD DESCRIPTION (NOTE N#) | CIRCUIT BREAKER | | | BUS | CIRCUIT BREAKER | | | LOAD DESCRIPTION (NOTE N#) | LOAD VA | CCT TYPE | CIR NO. |
| | | | | POLE | TRIP | TYPE | | TYPE | TRIP | POLE | | | | |
| 1 | | | 50A RECEPTACLE | 3 | 50 | | A | 30 | 3 | | CHARGER BAY #2 | | | 2 |
| 3 | | | --- | --- | --- | | B | --- | --- | | --- | | | 4 |
| 5 | | | --- | --- | --- | | C | --- | --- | | --- | | | 6 |
| 7 | | | TVSS | 3 | 30 | | A | 30 | 3 | | CHARGER BAY #4 | | | 8 |
| 9 | | | --- | --- | --- | | B | --- | --- | | --- | | | 10 |
| 11 | | | --- | --- | --- | | C | --- | --- | | --- | | | 12 |
| 13 | | | PQM METER | 3 | 30 | | A | 30 | 3 | | WELDER | | | 14 |
| 15 | | | --- | --- | --- | | B | --- | --- | | --- | | | 16 |
| 17 | | | --- | --- | --- | | C | --- | --- | | --- | | | 18 |
| 19 | E | 4000 | C1-5000 (N3) | 3 | 60 | | A | 60 | 3 | | C1-5000 (N3) | 4000 | E | 20 |
| 21 | E | 4000 | --- | --- | --- | | B | --- | --- | | --- | 4000 | E | 22 |
| 23 | E | 4000 | --- | --- | --- | | C | --- | --- | | --- | 4000 | E | 24 |
| 25 | | | CHARGER 10 | 3 | 90 | | A | 125 | 3 | | SPARE | | | 26 |
| 27 | | | --- | --- | --- | | B | --- | --- | | --- | | | 28 |
| 29 | | | --- | --- | --- | | C | --- | --- | | --- | | | 30 |
| 31 | | | EC-1 | 3 | 20 | | A | 60 | 3 | | C1-4400 (N3) | 4000 | E | 32 |
| 33 | | | --- | --- | --- | | B | --- | --- | | --- | 4000 | E | 34 |
| 35 | | | --- | --- | --- | | C | --- | --- | | --- | 4000 | E | 36 |
| 37 | | | XFMR 'T1' | 3 | 225 | | A | --- | --- | | NOT A SPACE | | | 38 |
| 39 | | | --- | --- | --- | | B | --- | --- | | NOT A SPACE | | | 40 |
| 41 | | | --- | --- | --- | | C | --- | --- | | NOT A SPACE | | | 42 |
| CCT TYPE: L=LIGHTING, R=RECEPTACLE, M=MOTOR, LM=LARGEST MOTOR, E=EQUIPMENT, KE=KITCHEN EQUIPMENT, S=SUBFEED PANEL | | | | | | | | | | | | | | |
| CB TYPE: GFCI=5mA GROUND FAULT CIRCUIT INTERRUPTER, GFEP=30mA GROUND FAULT PROTECTION FOR EQUIPMENT, AFCI=ARC FAULT CIRCUIT INTERRUPTER | | | | | | | | | | | | | | |
| CAFCI=COMBINATION ARC FAULT & 5mA GROUND FAULT CIRCUIT INTERRUPTER, ST=SHUNT TRIP, HT#=#HANDLE TIE WITH GROUPING # | | | | | | | | | | | | | | |
| HC=HANDLE CLAMP FOR LOCKING IN ON/OFF POSITION, LOCK=PERMANENTLY LOCKABLE BREAKER | | | | | | | | | | | | | | |
| CCT TYPE: LOAD MULT DEMAND LOAD | | | | | | | | | | | | | | |
| LIGHTING: 0 1.25 0 VA | | | | | | | | | | | | | | |
| RECEPTACLE: 0 1.0 0 VA | | | | | | | | | | | | | | |
| OVER 10K: 0 0.5 0 VA | | | | | | | | | | | | | | |
| MOTOR: 0 1.0 0 VA | | | | | | | | | | | | | | |
| LGST MOTOR: 0 1.25 0 VA | | | | | | | | | | | | | | |
| EQUIPMENT: 36000 1.0 36000 VA | | | | | | | | | | | | | | |
| KITCH EQUIP: 0 0 0 VA | | | | | | | | | | | | | | |
| SUBFEED PNL: 0 1.0 0 VA | | | | | | | | | | | | | | |
| TOTAL CONNECTED LOADS | | | | | | | | | | | | | | |
| VA 12000 12000 12000 | | | | | | | | | | | | | | |
| TOTAL DEMANDED LOADS | | | | | | | | | | | | | | |
| VA 12000 12000 12000 | | | | | | | | | | | | | | |
| AMPS 43 43 43 | | | | | | | | | | | | | | |
| TOTAL ON PANEL: 36 KVA 43 AMPS | | | | | | | | | | | | | | |
| NOTES: | | | | | | | | | | | | | | |
| A. REFER TO OVERALL LOAD SUMMARY, SHEET E06, FOR PANEL LOAD JUSTIFICATION. | | | | | | | | | | | | | | |
| N1. EXISTING LOAD ON EXISTING CIRCUIT BREAKER. | | | | | | | | | | | | | | |
| N2. NEW LOAD ON EXISTING CIRCUIT BREAKER. | | | | | | | | | | | | | | |
| N3. NEW LOAD ON NEW CIRCUIT BREAKER. CIRCUIT BREAKER TYPE AND AIC RATING TO MATCH EXISTING. | | | | | | | | | | | | | | |

| (E) PANEL 'LV2A' | | | | | | | | | | | | | | | |
|---|----------|---------|----------------------------|--------------------|-----------------|------|------|------------------------------|-----------------|--|------|----------------------------|---------|----------|---------|
| VOLTAGE L-L: 208 | | | | LOCATION: EXTERIOR | | | | BUS RATING: 600 AMPS | | MAIN CB: 500 A/3P (RELAY #19) | | | | | |
| TYPE: 3PH/4W | | | | MOUNTING: SURFACE | | | | FED FROM: 150KVA TRANSFORMER | | AIC RATING: FULLY RATED AT LEAST EQUAL TO: 10K AIC | | | | | |
| NOTES: | | | | EXISTING, NEMA 3R | | | | | | | | | | | |
| CIR. NO. | CCT TYPE | LOAD VA | LOAD DESCRIPTION (NOTE N#) | RELAY | CIRCUIT BREAKER | | | BUS | CIRCUIT BREAKER | | | LOAD DESCRIPTION (NOTE N#) | LOAD VA | CCT TYPE | CIR NO. |
| | | | | | POLE | TRIP | TYPE | | TYPE | TRIP | POLE | | | | |
| 1 | S | 380 | PANEL LV2B | 20 | 3 | 225 | | A | 40 | 2 | 28 | C3-PARK POD CHRGR | 3100 | E | 2 |
| 3 | S | 680 | --- | | --- | --- | | B | --- | --- | | --- | 3100 | E | 4 |
| 5 | S | 360 | --- | | --- | --- | | C | 40 | 2 | 29 | C4-CNTRL MOD CHRGR | 3100 | E | 6 |
| 7 | | | BUSSED SPACE | | | | | A | --- | --- | | --- | 3100 | E | 8 |
| 9 | E | 4600 | R3F-(FUTURE) | 21 | 50 | 2 | | B | 80 | 3 | | AIR COMPRESSOR (CP-1) | 4800 | M | 10 |
| 11 | E | 4600 | --- | | --- | --- | | C | --- | --- | | (N3) | 4800 | M | 12 |
| 13 | E | 5700 | R4F-(FUTURE) | 22 | 60 | 3 | | A | --- | --- | | BUSSED SPACE | | | 14 |
| 15 | E | 5700 | --- | | --- | --- | | B | 50 | 2 | 31 | R4V-VMF CHARGE REC | 4600 | E | 16 |
| 17 | E | 5700 | --- | | --- | --- | | C | --- | --- | | --- | 4600 | E | 18 |
| 19 | R | 180 | RECEPT - STORAGE (N3) | 20 | 1 | | | A | 60 | 3 | 32 | R3P-BACK PD CH. REC | 5700 | E | 20 |
| 21 | M | 916 | EF-2 (N3) | 20 | 3 | | | B | --- | --- | | --- | 5700 | E | 22 |
| 23 | M | 916 | --- | | --- | --- | | C | --- | --- | | --- | 5700 | E | 24 |
| 25 | M | 916 | --- | | --- | --- | | A | 50 | 3 | 33 | R4P-BACK PD CH. REC | 4600 | E | 26 |
| 27 | | | BUSSED SPACE | | | | | B | --- | --- | | --- | 4600 | E | 28 |
| 29 | | | BUSSED SPACE | | | | | C | --- | --- | | --- | 4600 | E | 30 |
| 31 | M | 250 | PUMP P-1 (N3) | 15 | 1 | | | A | --- | --- | | BUSSED SPACE | | | 32 |
| 33 | E | 250 | DUCT HEATER DH-2 (N3) | 20 | 1 | | | B | 40 | 2 | 34 | C1-AV DUAL STN CHRGR | 3100 | E | 34 |
| 35 | E | 1500 | VOLT BREAKDOWN (N3) | 20 | 2 | | | C | --- | --- | | --- | 3100 | E | 36 |
| 37 | E | 1500 | --- | | --- | --- | | A | 40 | 2 | 35 | C1-AV DUAL STN CHRGR | 3100 | E | 38 |
| 39 | E | 3100 | C2-LEV. EV GRN CHRGR | 27 | 40 | 2 | | B | --- | --- | | --- | 3100 | E | 40 |
| 41 | E | 3100 | --- | | --- | --- | | C | --- | --- | | BUSSED SPACE | | | 42 |
| CCT TYPE: L=LIGHTING, R=RECEPTACLE, M=MOTOR, LM=LARGEST MOTOR, E=EQUIPMENT, KE=KITCHEN EQUIPMENT, S=SUBFEED PANEL | | | | | | | | | | | | | | | |
| CB TYPE: GFCI=5mA GROUND FAULT CIRCUIT INTERRUPTER, GFEP=30mA GROUND FAULT PROTECTION FOR EQUIPMENT, AFCI=ARC FAULT CIRCUIT INTERRUPTER | | | | | | | | | | | | | | | |
| CAFCI=COMBINATION ARC FAULT & 5mA GROUND FAULT CIRCUIT INTERRUPTER, ST=SHUNT TRIP, HT#=#HANDLE TIE WITH GROUPING # | | | | | | | | | | | | | | | |
| HC=HANDLE CLAMP FOR LOCKING IN ON/OFF POSITION, LOCK=PERMANENTLY LOCKABLE BREAKER | | | | | | | | | | | | | | | |
| CCT TYPE: LOAD MULT DEMAND LOAD | | | | | | | | | | | | | | | |
| LIGHTING: 0 1.25 0 VA | | | | | | | | | | | | | | | |
| RECEPTACLE: 180 1.0 180 VA | | | | | | | | | | | | | | | |
| OVER 10K: 0 0.5 0 VA | | | | | | | | | | | | | | | |
| MOTOR: 12598 1.0 12598 VA | | | | | | | | | | | | | | | |
| LGST MOTOR: 0 1.25 0 VA | | | | | | | | | | | | | | | |
| EQUIPMENT: 100650 1.0 100650 VA | | | | | | | | | | | | | | | |
| KITCH EQUIP: 0 0 0 VA | | | | | | | | | | | | | | | |
| SUBFEED PNL: 1420 1.0 1420 VA | | | | | | | | | | | | | | | |
| TOTAL CONNECTED LOADS | | | | | | | | | | | | | | | |
| VA 28526 44246 42076 | | | | | | | | | | | | | | | |
| TOTAL DEMANDED LOADS | | | | | | | | | | | | | | | |
| VA 28526 44246 42076 | | | | | | | | | | | | | | | |
| AMPS 238 369 351 | | | | | | | | | | | | | | | |
| TOTAL ON PANEL: 115 KVA 319 AMPS | | | | | | | | | | | | | | | |
| NOTES: | | | | | | | | | | | | | | | |
| N1. EXISTING LOAD ON EXISTING CIRCUIT BREAKER. | | | | | | | | | | | | | | | |
| N2. NEW LOAD ON EXISTING CIRCUIT BREAKER. | | | | | | | | | | | | | | | |
| N3. NEW LOAD ON NEW CIRCUIT BREAKER. CIRCUIT BREAKER TYPE AND AIC RATING TO MATCH EXISTING. | | | | | | | | | | | | | | | |

| LOAD SUMMARY | | | |
|--|-----------|----------------|--|
| EXISTING PANEL 'HV2' (400A, 480/277V, 3PH, 4W) | | | |
| EXISTING LOAD ON 'HV2' (NOTE 1)(NOTE 2) | 111 KVA | 133.5 AMPS | |
| NEW CH-1 | 60.62 KVA | 73.0 AMPS | |
| NEW EC-1 | 9.13 KVA | 11.0 AMPS | |
| NEW LOAD ON 'LV2A' | 16.03 KVA | 12.0 AMPS | |
| NET TOTAL LOAD AT 480/277V, 3PH | 197 KVA | 236.7 AMPS(**) | |
| (**)NEW LOAD IS LESS THAN 400A FEEDER TO PANEL, THEREFORE PANEL IS JUSTIFIED. | | | |
| EXISTING PANEL 'LV1' (600A, 208/120V, 3PH, 4W; 500A/3P MAIN CIRCUIT BREAKER) | | | |
| EXISTING LOAD ON 'LV1' (NOTE 1) | 145 KVA | 402.5 AMPS | |
| NEW LOAD ON 'LV2' | 32 KVA | 87.4 AMPS | |
| REMOVED LOAD ON 'LV2' | -30 KVA | -83.3 AMPS | |
| NET TOTAL LOAD AT 208/120V, 3PH | 147 KVA | 406.6 AMPS(**) | |
| (**)NEW LOAD IS LESS THAN 500A MAIN BREAKER, THEREFORE PANEL IS JUSTIFIED. | | | |
| EXISTING PANEL 'HV1' (600A, 480/277V, 3PH, 4W) | | | |
| EXISTING LOAD ON 'HV1' (NOTE 1) | 243 KVA | 292.3 AMPS | |
| NEW LOAD ON 'HV1' | 36 KVA | 43.3 AMPS | |
| NET LOAD ON 'LV1' | 2 KVA | 1.8 AMPS | |
| NET TOTAL LOAD AT 480/277V, 3PH | 281 VA | 337.4 AMPS(**) | |
| (**)NEW LOAD IS LESS THAN 600A FEEDER TO PANEL, THEREFORE PANEL IS JUSTIFIED. | | | |
| NOTES: | | | |
| 1. EXISTING DEMAND LOAD TAKEN FROM PREVIOUS ENGINEER'S DRAWINGS | | | |
| 2. EXISTING CUSTOM PANELBOARD INCLUDES RELAY DEVICES FOR MONITORING AND CONTROL OF EACH CIRCUIT. EXISTING CONTROL/METERING SYSTEM TO MONITOR LOAD TO ENSURE THAT TOTAL LOAD ON PANEL DOES NOT EXCEED 400-AMPS. | | | |

| (E) PANEL 'LV2' | | | | | | | | | | | | | | | |
|---|-----|------|----------------------------|--------------------|-----------------|------|------|-----------------|-----------------|--|------|----------------------------|---------|----------|---------|
| VOLTAGE L-L: 208 | | | | LOCATION: EXTERIOR | | | | BUS RATING: 225 | | MAIN CB: 225 | | | | | |
| TYPE: 3PH/4W | | | | MOUNTING: SURFACE | | | | FED FROM: LV1 | | AIC RATING: FULLY RATED AT LEAST: (EXISTING) | | | | | |
| NOTES: | | | | EXISTING, NEMA 3R | | | | | | | | | | | |
| CIR. NO. | CCT | LOAD | LOAD DESCRIPTION (NOTE N#) | RELAY | CIRCUIT BREAKER | | | BUS | CIRCUIT BREAKER | | | LOAD DESCRIPTION (NOTE N#) | LOAD VA | CCT TYPE | CIR NO. |
| | | | | | POLE | TRIP | TYPE | | TYPE | TRIP | POLE | | | | |
| 1 | | | DC POWER SUPPLY (N4) | | 3 | 60 | | A | 60 | 3 | | DC POWER SUPPLY (N4) | | | 2 |
| 3 | | | --- | | --- | --- | | B | --- | --- | | --- | | | 4 |
| 5 | | | --- | | --- | --- | | C | --- | --- | | --- | | | 6 |
| 7 | | | DC POWER SUPPLY (N4) | | 3 | 60 | | A | 20 | 2 | | VEHICLE LIFT (N1) | 1000 | E | 8 |
| 9 | | | --- | | --- | --- | | B | --- | --- | | --- | 1000 | E | 10 |
| 11 | | | --- | | --- | --- | | C | 20 | 2 | | ESPEC EQUIP CKT (N3) | 1250 | E | 12 |
| 13 | R | 360 | RECEPT - CHARGE STAT. (N1) | 20 | 1 | | | A | --- | --- | | --- | 1250 | E | 14 |
| 15 | E | 1000 | QUAD RECEPT - E216 (N3) | 20 | 1 | | | B | 20 | 2 | | ESPEC EQUIP CKT (N3) | 1250 | E | 16 |
| 17 | E | 1000 | QUAD RECEPT - E216 (N3) | 20 | 1 | | | C | --- | --- | | --- | 1250 | E | 18 |
| 19 | E | 1000 | QUAD RECEPT - E216 (N3) | 20 | 1 | | | A | 20 | 2 | | ESPEC EQUIP CKT (N3) | 1250 | E | 20 |
| 21 | E | 1000 | QUAD RECEPT - E216 (N3) | 20 | 1 | | | B | --- | --- | | --- | 1250 | E | 22 |
| 23 | E | 1250 | ESPEC EQUIP CKT (N3) | 20 | 2 | | | C | 40 | 2 | | EXTRUDER CKT #1 (N3) | 2000 | E | 24 |
| 25 | E | 1250 | --- | | --- | --- | | A | --- | --- | | --- | 2000 | E | 26 |
| 27 | E | 1250 | ESPEC EQUIP CKT (N3) | 20 | 2 | | | B | 30 | 2 | | EXTRUDER CKT #2 (N3) | 1250 | E | 28 |
| 29 | E | 1250 | --- | | --- | --- | | C | --- | --- | | --- | 1250 | E | 30 |
| 31 | E | 1250 | ESPEC EQUIP CKT (N3) | 20 | 2 | | | A | 20 | 2 | | EXTRUDER CKT #3 (N3) | 1000 | E | 32 |
| 33 | E | 1250 | --- | | --- | --- | | B | --- | --- | | --- | 1000 | E | 34 |
| 35 | | | BUSSED SPACE | | | | | C | 20 | 2 | | SUNTEST CPS EQUIP (N3) | 1000 | E | 36 |
| 37 | | | BUSSED SPACE | | | | | A | --- | --- | | --- | 1000 | E | 38 |
| 39 | | | BUSSED SPACE | | | | | B | 20 | 2 | | SUNTEST CPS EQUIP (N3) | 1000 | E | 40 |
| 41 | | | BUSSED SPACE | | | | | C | --- | --- | | --- | 1000 | E | 42 |
| CCT TYPE: L=LIGHTING, R=RECEPTACLE, M=MOTOR, LM=LARGEST MOTOR, E=EQUIPMENT, KE=KITCHEN EQUIPMENT, S=SUBFEED PANEL | | | | | | | | | | | | | | | |
| CB TYPE: GFCI=5mA GROUND FAULT CIRCUIT INTERRUPTER, GFEP=30mA GROUND FAULT PROTECTION FOR EQUIPMENT, AFCI=ARC FAULT CIRCUIT INTERRUPTER | | | | | | | | | | | | | | | |
| CAFCI=COMBINATION ARC FAULT & 5mA GROUND FAULT CIRCUIT INTERRUPTER, ST=SHUNT TRIP, HT#=#HANDLE TIE WITH GROUPING # | | | | | | | | | | | | | | | |
| HC=HANDLE CLAMP FOR LOCKING IN ON/OFF POSITION, LOCK=PERMANENTLY LOCKABLE BREAKER | | | | | | | | | | | | | | | |
| CCT TYPE: LOAD MULT DEMAND LOAD | | | | | | | | | | | | | | | |
| LIGHTING: 0 1.25 0 VA | | | | | | | | | | | | | | | |
| RECEPTACLE: 360 1.0 360 VA | | | | | | | | | | | | | | | |
| OVER 10K: 0 0.5 0 VA | | | | | | | | | | | | | | | |
| MOTOR: 0 1.0 0 VA | | | | | | | | | | | | | | | |
| LGST MOTOR: 0 1.25 0 VA | | | | | | | | | | | | | | | |
| EQUIPMENT: 33500 1.0 33500 VA | | | | | | | | | | | | | | | |
| KITCH EQUIP: 0 0 0 VA | | | | | | | | | | | | | | | |
| SUBFEED PNL: 0 1.0 0 VA | | | | | | | | | | | | | | | |
| TOTAL CONNECTED LOADS | | | | | | | | | | | | | | | |
| VA 11360 11250 11250 | | | | | | | | | | | | | | | |
| TOTAL DEMANDED LOADS | | | | | | | | | | | | | | | |
| VA 11360 11250 11250 | | | | | | | | | | | | | | | |
| AMPS 95 94 94 | | | | | | | | | | | | | | | |
| TOTAL ON PANEL: 34 KVA 94 AMPS | | | | | | | | | | | | | | | |
| NOTES: | | | | | | | | | | | | | | | |
| N1. EXISTING LOAD ON EXISTING CIRCUIT BREAKER. | | | | | | | | | | | | | | | |
| N2. NEW LOAD ON EXISTING CIRCUIT BREAKER. | | | | | | | | | | | | | | | |
| N3. NEW LOAD ON NEW CIRCUIT BREAKER. CIRCUIT BREAKER TYPE AND AIC RATING TO MATCH EXISTING. | | | | | | | | | | | | | | | |
| N4. EXISTING LOAD TO BE REMOVED DURING PREVIOUS PHASE. REFER TO ELECTRICAL DEMO PLAN FOR MORE INFORMATION. EC SHALL VERIFY THAT REMOVED LOAD HAS MADE EXISTING BREAKER SPARE AND UPDATE | | | | | | | | | | | | | | | |

| DESIGN CRITERIA | GENERAL NOTES CONT'D | CONCRETE NOTES | STEEL NOTES |
|---|---|---|---|
| <p>1) CODES AND STANDARDS:</p> <p>1A) GENERAL DESIGN</p> <ul style="list-style-type: none"> INTERNATIONAL BUILDING CODE 2015 <p>2) SEISMIC LOADS</p> <ul style="list-style-type: none"> SEISMIC DESIGN CATEGORY = B RISK CATEGORY = II EARTHQUAKE IMPORTANCE FACTOR, $I_e = 1.00$ MAPPED SPECTRAL RESPONSE ACCELERATION, $S_s = 23.70\% g$ MAPPED SPECTRAL RESPONSE ACCELERATION, $S_1 = 6.20\% g$ DESIGN SPECTRAL RESPONSE COEFFICIENT, $SD_s = 0.253$ DESIGN SPECTRAL RESPONSE COEFFICIENT, $SD_1 = 0.099$ SOIL SITE CLASS = D <p>3) WIND LOADS</p> <ul style="list-style-type: none"> RISK CATEGORY = II BASIC ULTIMATE WIND SPEED, $V_{ult} = 150$ mph BASIC NOMINAL WIND SPEED, $V_{asd} = 120$ mph EXPOSURE CATEGORY = C <p>4) PROPOSED WORK DOES NOT EFFECT THE EXISTING LATERAL LOAD RESISTING SYSTEM</p> <p>5) GRAVITY LOADS</p> <ul style="list-style-type: none"> SEE DRAWINGS FOR MAXIMUM EQUIPMENT DESIGN WEIGHTS | <p>5) <u>OSHA STANDARDS:</u></p> <p>5A) THE STRUCTURE IS DESIGNED TO FUNCTION AS A UNIT UPON COMPLETION. NOTHING SHOWN ON THE STRUCTURAL DRAWINGS SHALL BE CONSTRUED AS ELIMINATING THE NEED FOR THE CONTRACTOR TO COMPLY WITH ALL OSHA REQUIREMENTS.</p> <p>6) <u>CONSTRUCTION ENGINEERING:</u></p> <p>6A) THE STRUCTURE DEFINED ON THE CONTRACT DOCUMENTS HAS BEEN DESIGNED ONLY FOR LOADS ANTICIPATED ON THE STRUCTURE DURING ITS SERVICE LIFE. PROVIDE ALL REQUIRED ENGINEERING AND OTHER MEASURES TO ACHIEVE THE MEANS, METHODS, AND SEQUENCES OF WORK. SUCH ENGINEERING MAY INCLUDE, BUT IS NOT LIMITED TO:</p> <ul style="list-style-type: none"> LAYOUT DESIGN FOR FORMWORK DESIGN OF CONCRETE MIXES WELD PROCEDURES SURVEYING TO VERIFY CONSTRUCTION TOLERANCES EVALUATION OF TEMPORARY CONSTRUCTION LOADS ON STRUCTURE DUE TO EQUIPMENT AND MATERIALS STRUCTURAL ENGINEERING TO RESIST ANY OTHER LOADS NOT IDENTIFIED ON DESIGN DRAWINGS <p>7) <u>COORDINATION:</u></p> <p>7A) STRUCTURAL DRAWINGS ARE NOT STAND-ALONE DOCUMENTS AND ARE INTENDED TO BE USED IN CONJUNCTION WITH CIVIL, MECHANICAL, ELECTRICAL, AND DRAWINGS FROM OTHER DISCIPLINES. THE CONTRACTOR SHALL COORDINATE ALL REQUIREMENTS OF THE CONTRACT DOCUMENTS INTO SHOP DRAWINGS AND WORK.</p> <p>7B) COORDINATE DIMENSIONS WITH DRAWINGS FROM OTHER DISCIPLINES AND FIELD CONDITIONS PRIOR TO SHOP DRAWING SUBMITTAL.</p> | <p>1) GENERAL:</p> <p>1A) ALL WORK SHALL CONFORM WITH ACI 301, LATEST EDITION UNLESS NOTED OTHERWISE IN DRAWINGS OR PROJECT SPECIFICATIONS.</p> <p>1B) DETAIL BARS IN ACCORDANCE WITH THE DRAWINGS, PROJECT SPECIFICATIONS, AND ACI PUBLICATION SP-66 (2004): "ACI DETAILING MANUAL"</p> <p>2) REINFORCING MATERIALS:</p> <ul style="list-style-type: none"> TYPICAL REINFORCING: ASTM A615, $F_y = 60$ ksi, $F_u = 90$ ksi WELDED AND FIELD BENT REINFORCING: ASTM A706, $F_y = 60$ ksi, $F_u = 80$ ksi WELDED WIRE REINFORCING, SMOOTH: ASTM A1064, $F_y = 65$ ksi, $F_u = 75$ ksi <p>3) REINFORCING FABRICATION:</p> <p>3A) NO SPLICING OF REINFORCEMENT IS PERMITTED EXCEPT AS NOTED ON DRAWINGS. MAKE BARS CONTINUOUS AROUND CORNERS. WHERE PERMITTED, SPLICES MAY BE MADE BY CONTACT LAPS.</p> <p>3B) MISCELLANEOUS REINFORCING REQUIREMENTS:</p> <ul style="list-style-type: none"> PROVIDE ADDITIONAL BARS OR STIRRUPS REQUIRED TO SECURE REINFORCING IN PLACE DURING CONCRETE PLACEMENT. MAKE ALL REINFORCING BAR BENDS IN THE FABRICATOR'S SHOP UNLESS NOTED. NO WELDING OF REINFORCING PERMITTED UNLESS NOTED ON DRAWINGS. WHERE PERMITTED, PERFORM WELDING IN ACCORDANCE WITH AWS D1.4, LATEST EDITION. <p>4) STRUCTURAL CONCRETE MIX REQUIREMENTS:</p> <p>4A) EXTERIOR SLAB ON GRADE</p> <ul style="list-style-type: none"> 28-DAY MINIMUM STRENGTH: 5,000 PSI NORMAL-WEIGHT CONCRETE MAX WATER-CEMENT RATIO: 0.40 MAX AGGREGATE SIZE: 1 INCH TOTAL AIR CONTENT: 6% +/- 1.5% MAXIMUM CHLORIDE ION: 0.15 <p>5) PLACING REINFORCEMENT:</p> <p>5A) PROVIDE CLEAR COVER TO REINFORCEMENT AS FOLLOWS:</p> <ul style="list-style-type: none"> 3" MINIMUM FOR CONCRETE SURFACES CAST AGAINST EARTH 2" MINIMUM FOR CONCRETE SURFACES EXPOSED TO WEATHER <p>5B) SEE ACI 318 FOR REINFORCEMENT PLACING TOLERANCES AND ACI 117 FOR ADDITIONAL REQUIREMENTS</p> <p>5C) PROVIDE ACCESSORIES NECESSARY TO PROPERLY SUPPORT REINFORCING AND WELDED WIRE FABRIC AT POSITIONS SHOWN ON PLANS. ALL REINFORCING, DOWELS, BOLTS, AND EMBEDDED PLATES SHALL BE SET AND TIED IN PLACE BEFORE THE CONCRETE IS POURED. "WET-SETTING" INTO PREVIOUSLY PLACED CONCRETE IS NOT PERMITTED.</p> <p>6) PROVIDE CONTROL JOINTS ONLY WHERE INDICATED ON PLAN</p> | <p>1) <u>CONNECTIONS:</u></p> <p>1A) PROVIDE CONNECTIONS AS SHOWN IN THE DETAILS HEREIN.</p> <p>2) <u>WELDING REQUIREMENTS:</u></p> <p>2A) WELDERS: HAVE IN POSSESSION CURRENT EVIDENCE OF PASSING THE APPROPRIATE AWS. QUALIFICATION TESTS.</p> <p>2B) MINIMUM WELDS: AISC SPECIFICATION, NOT LESS THAN 3/16" FILLET, CONTINUOUS UNLESS OTHERWISE NOTED.</p> <p>2C) WELD SIZES AND LENGTHS CALLED FOR ON THE DRAWINGS ARE THE NET EFFECTIVE REQUIRED. INCREASE WELD SIZE IF GAPS EXIST AT THE FAYING SURFACE.</p> <p>2D) WELD SIZES SHALL BE AS SHOWN UNLESS A GREATER SIZE IS REQUIRED BY ANSI/AISC 360-10 TABLES J2.3 AND J2.4.</p> <p>2E) ALL GROOVE WELDS SHALL BE COMPLETE PENETRATION UNLESS NOTED.</p> <p>2F) FIELD WELDING SYMBOLS INDICATE SEQUENCE CONSIDERED DURING DESIGN. THE CONTRACTOR SHALL REQUEST APPROVAL FROM THE ENGINEER TO MODIFY WELD INSTALLATION LOCATION INDICATED ON THE DOCUMENTS:</p> <ul style="list-style-type: none"> FROM SHOP TO FIELD FROM FIELD TO SHOP <p>2G) DEFORMED ANCHOR STUDS (DAS) AND HEADED ANCHOR STUDS (HAS / HDAS) SHALL BE SHOP OR FIELD WELDED AT CONTRACTOR'S OPTION UNLESS NOTED OTHERWISE</p> <p>3) <u>STRUCTURAL STEEL MATERIALS AND INSTALLATION:</u></p> <p>3A) UNLESS INDICATED OTHERWISE, SNUG TIGHTEN ALL JOINTS AS DEFINED BY AISC</p> <p>3B) SEE SPECIFICATIONS FOR STEEL MATERIALS.</p> <p>3C) ALL EXTERIOR STEEL SHALL BE HOT DIPPED GALVANIZED.</p> <p>4) <u>STEEL GRATING</u></p> <p>4A) STEEL GRATING TYPE AND SIZE AS INDICATED ON DRAWINGS</p> <p>4B) INSTALLATION</p> <ul style="list-style-type: none"> INSTALL GRATING PER INSTALLATION GUIDELINES OF NAAMM MBG 531 "METAL BAR GRATING MANUAL". FIT EXPOSED CONNECTIONS ACCURATELY TO FORM TIGHT JOINTS. USE MANUFACTURER'S STANDARD ANCHOR CLIPS AND HOLD-DOWN FASTENERS FOR BOLTED CONNECTIONS <p>4C) SUBMITTALS</p> <ul style="list-style-type: none"> SUBMIT SHOP DRAWINGS AND PRODUCT DATA FOR GRATING, FASTENERS, AND FINISH. |

| GENERAL NOTES |
|---|
| <p>1) <u>GENERAL:</u></p> <p>1A) ENGINEER: REFERENCES ON THE STRUCTURAL DRAWINGS TO 'ENGINEER' MEAN THE STRUCTURAL ENGINEER OF RECORD. OTHER ENTITIES ARE SPECIFICALLY NOTED AS 'CONTRACTOR'S ENGINEER', 'MECHANICAL ENGINEER', ETC.</p> <p>1B) THESE NOTES SUPPLEMENT THE SPECIFICATIONS, WHICH SHALL BE REFERENCED FOR ADDITIONAL REQUIREMENTS.</p> <p>1C) UNDERGROUND UTILITIES: LOCATE EXISTING UTILITIES AND NOTIFY ENGINEER OF EXISTING UTILITIES OR SUBGRADE CONDITIONS WHICH INTERFERE WITH WORK.</p> <p>2) <u>EXISTING STRUCTURES:</u></p> <p>2A) CONTRACT DOCUMENTS HAVE BEEN PREPARED USING AVAILABLE DRAWINGS AND SITE OBSERVATION AS PERMITTED BY ACCESS RESTRICTIONS DURING DESIGN.</p> <p>2B) DURING CONSTRUCTION, THE CONTRACTOR MAY ENCOUNTER EXISTING CONDITIONS WHICH ARE NOT KNOWN OR ARE AT VARIANCE WITH PROJECT DOCUMENTATION. CONTRACTOR SHALL NOTIFY THE ENGINEER OF ALL CONDITIONS NOT PER THE CONTRACT DOCUMENTS. EXAMPLES INCLUDE:</p> <ul style="list-style-type: none"> SIZES OR DIMENSIONS OTHER THAN THOSE SHOWN DAMAGE OR DETERIORATION TO MATERIALS AND COMPONENTS CONDITIONS OF INSTABILITY OR LACK OF SUPPORT ITEMS NOTED AS EXISTING ON THE DRAWINGS BUT NOT FOUND IN THE FIELD <p>2C) PREPARE DIMENSIONAL DRAWINGS OF ALL DISCOVERED ITEMS.</p> <p>2D) CONTRACTOR SHALL FIELD VERIFY ALL EXISTING STRUCTURAL CONDITIONS PRIOR TO SUBMITTING SHOP DRAWINGS.</p> <p>2E) CONTRACTOR SHALL MAKE ALLOWANCE FOR THE RESOLUTION OF SUCH DISCOVERIES IN THE CONSTRUCTION SCHEDULE.</p> <p>3) <u>USE OF DRAWINGS:</u></p> <p>3A) DO NOT SCALE DRAWINGS.</p> <p>3B) DETAILS ON DRAWINGS TAKE PRECEDENCE OVER GENERAL NOTES AND TYPICAL DETAILS.</p> <p>3C) DETAILS NOTED TYPICAL APPLY TO ALL SIMILAR CONDITIONS. WHERE NO SPECIFIC DETAILS ARE SHOWN, CONSTRUCTION SHALL CONFORM TO SIMILAR WORK ELSEWHERE ON THE PROJECT.</p> <p>3D) WHERE DISCREPANCIES OCCUR BETWEEN PLANS, DETAILS, GENERAL NOTES AND SPECIFICATIONS:</p> <ul style="list-style-type: none"> CONTACT THE ENGINEER PRIOR TO PROCEEDING WITH CONSTRUCTION THE MORE STRINGENT REQUIREMENTS SHALL GOVERN FOR BIDDING / PRICING <p>4) <u>SUBMITTALS AND SUBSTITUTIONS:</u></p> <p>4A) SUBMITTALS: REFER TO SPECIFICATIONS FOR DETAILED REQUIREMENTS.</p> <ul style="list-style-type: none"> IF THE CONTRACTOR REQUESTS A CHANGE FROM THE STRUCTURAL DRAWINGS, IT SHALL BE APPROVED AND DESIGNED BY MARTIN/MARTIN, INC. PRIOR TO SUBMITTING SHOP DRAWINGS. VARIATION SHALL BE INDICATED ON THE SHOP DRAWINGS. CONTRACTOR SHALL COMPENSATE MARTIN/MARTIN, INC. FOR MAKING THE CHANGE. CONSTRUCTION DOCUMENTS SHALL NOT BE REPRODUCED FOR USE IN SUBMITTALS ALL SHOP DRAWINGS SHALL REFERENCE THE STRUCTURAL DRAWING NUMBER AND DETAIL USED TO PREPARE THE SUBMITTAL <p>4B) SUBSTITUTIONS: ENGINEER'S APPROVAL SHALL BE SECURED FOR ALL SUBSTITUTIONS</p> <p>4C) NONCONFORMANCE: NOTIFY ENGINEER OF CONDITIONS NOT CONSTRUCTED PER THE CONTRACT DOCUMENTS PRIOR TO PROCEEDING WITH CORRECTIVE WORK. SUBMIT PROPOSED REPAIR TO THE ARCHITECT FOR ACCEPTANCE. CONTRACTOR SHALL COMPENSATE MARTIN/MARTIN, INC. FOR DESIGNING THE REPAIR.</p> |

| FOUNDATION NOTES |
|---|
| <p>1) DESIGN CRITERIA:</p> <p>NO GEOTECHNICAL REPORT WAS PROVIDED FOR THIS PROJECT. FOUNDATION DESIGN RELIES UPON CODE MINIMUM DESIGN CRITERIA.</p> <p>2) FOOTINGS:</p> <p>2A) FOOTING DESIGN CRITERIA:</p> <ul style="list-style-type: none"> MAXIMUM TOTAL LOAD BEARING PRESSURE = 1500 PSF ULTIMATE COEFFICIENT OF FRICTION TO RESIST LATERAL LOADS = 0.30 |

| FOUNDATION NOTES |
|--|
| <p>5) PLACING REINFORCEMENT:</p> <p>5A) PROVIDE CLEAR COVER TO REINFORCEMENT AS FOLLOWS:</p> <ul style="list-style-type: none"> 3" MINIMUM FOR CONCRETE SURFACES CAST AGAINST EARTH 2" MINIMUM FOR CONCRETE SURFACES EXPOSED TO WEATHER <p>5B) SEE ACI 318 FOR REINFORCEMENT PLACING TOLERANCES AND ACI 117 FOR ADDITIONAL REQUIREMENTS</p> <p>5C) PROVIDE ACCESSORIES NECESSARY TO PROPERLY SUPPORT REINFORCING AND WELDED WIRE FABRIC AT POSITIONS SHOWN ON PLANS. ALL REINFORCING, DOWELS, BOLTS, AND EMBEDDED PLATES SHALL BE SET AND TIED IN PLACE BEFORE THE CONCRETE IS POURED. "WET-SETTING" INTO PREVIOUSLY PLACED CONCRETE IS NOT PERMITTED.</p> <p>6) PROVIDE CONTROL JOINTS ONLY WHERE INDICATED ON PLAN</p> |

| STEEL NOTES |
|---|
| <p>1) <u>CONNECTIONS:</u></p> <p>1A) PROVIDE CONNECTIONS AS SHOWN IN THE DETAILS HEREIN.</p> <p>2) <u>WELDING REQUIREMENTS:</u></p> <p>2A) WELDERS: HAVE IN POSSESSION CURRENT EVIDENCE OF PASSING THE APPROPRIATE AWS. QUALIFICATION TESTS.</p> <p>2B) MINIMUM WELDS: AISC SPECIFICATION, NOT LESS THAN 3/16" FILLET, CONTINUOUS UNLESS OTHERWISE NOTED.</p> <p>2C) WELD SIZES AND LENGTHS CALLED FOR ON THE DRAWINGS ARE THE NET EFFECTIVE REQUIRED. INCREASE WELD SIZE IF GAPS EXIST AT THE FAYING SURFACE.</p> <p>2D) WELD SIZES SHALL BE AS SHOWN UNLESS A GREATER SIZE IS REQUIRED BY ANSI/AISC 360-10 TABLES J2.3 AND J2.4.</p> <p>2E) ALL GROOVE WELDS SHALL BE COMPLETE PENETRATION UNLESS NOTED.</p> <p>2F) FIELD WELDING SYMBOLS INDICATE SEQUENCE CONSIDERED DURING DESIGN. THE CONTRACTOR SHALL REQUEST APPROVAL FROM THE ENGINEER TO MODIFY WELD INSTALLATION LOCATION INDICATED ON THE DOCUMENTS:</p> <ul style="list-style-type: none"> FROM SHOP TO FIELD FROM FIELD TO SHOP <p>2G) DEFORMED ANCHOR STUDS (DAS) AND HEADED ANCHOR STUDS (HAS / HDAS) SHALL BE SHOP OR FIELD WELDED AT CONTRACTOR'S OPTION UNLESS NOTED OTHERWISE</p> <p>3) <u>STRUCTURAL STEEL MATERIALS AND INSTALLATION:</u></p> <p>3A) UNLESS INDICATED OTHERWISE, SNUG TIGHTEN ALL JOINTS AS DEFINED BY AISC</p> <p>3B) SEE SPECIFICATIONS FOR STEEL MATERIALS.</p> <p>3C) ALL EXTERIOR STEEL SHALL BE HOT DIPPED GALVANIZED.</p> <p>4) <u>STEEL GRATING</u></p> <p>4A) STEEL GRATING TYPE AND SIZE AS INDICATED ON DRAWINGS</p> <p>4B) INSTALLATION</p> <ul style="list-style-type: none"> INSTALL GRATING PER INSTALLATION GUIDELINES OF NAAMM MBG 531 "METAL BAR GRATING MANUAL". FIT EXPOSED CONNECTIONS ACCURATELY TO FORM TIGHT JOINTS. USE MANUFACTURER'S STANDARD ANCHOR CLIPS AND HOLD-DOWN FASTENERS FOR BOLTED CONNECTIONS <p>4C) SUBMITTALS</p> <ul style="list-style-type: none"> SUBMIT SHOP DRAWINGS AND PRODUCT DATA FOR GRATING, FASTENERS, AND FINISH. |

| STRUCTURAL DRAWING LIST | |
|-------------------------|------------------|
| SHEET NUMBER | SHEET TITLE |
| S-01 | GENERAL NOTES |
| S-02 | QADC |
| S-100 | PLAN AND DETAILS |
| S-200 | DETAILS |

| NO. | REVISIONS | DATE | BY | APP'D. | BAE | NO. |
|-----|-------------------------|----------|----|--------|-----|-----|
| C | 91% REVIEW SET | 12/24/19 | . | . | . | |
| D | 95% REVIEW SET | 02/17/20 | . | . | . | |
| 0 | ISSUED FOR CONSTRUCTION | 03/27/20 | . | . | . | |
| . | . | . | . | . | . | |
| . | . | . | . | . | . | |
| . | . | . | . | . | . | |
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| REVISIONS | DATE | BY | APP'D. | BAE |
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| FILE INFORMATION | | | | ENGINEERING REVIEW | | |
|------------------------------|----------------------|----------------|------------|--------------------|----------|----------|
| USER: MM | DATE: 02/17/20 | TIME: 1:00 AM | XREF'S: -- | DESIGNER | APPROVAL | DATE |
| DWG. FILE: NRELVTIF S-01.dwg | LAYOUT: -- | | | ENGINEER | NEL | 03/27/20 |
| DWG. FOLDER: | | | | CHECKED BY | EAJ | 03/27/20 |
| ACAD VERSION: 2013 | | | | A/E APPROVED BY | -- | -- |
| PLATFORM: Microsoft Windows | | | | NREL APPROVED BY | -- | -- |
| BORDER: NREL TITLEBLOCK.dwg | PLOT SCALE: AS NOTED | UNITS: DECIMAL | | BLDG. AREA ENG. | -- | -- |
| PLOT INFO: NREL.CTB | | | | | | |

MARTIN/MARTIN
CONSULTING ENGINEERS
1617 Cole Boulevard
Golden, Colorado 80401-3393

NREL
National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, Colorado 80401-3393
Operated for the
U.S. Department of Energy
by Midwest Research Institute • Battelle • Bechtel

| V.T.I.F. | | STRUCTURAL |
|--------------------------|---------------------|-----------------|
| FY19 LAB UPGRADES - VTIF | | |
| GENERAL NOTES | | |
| DRAWING NO. PREFIX | DRAWING NO. | REVISION NO. |
| VTIF-011 | S-01 | D |
| NREL PROJECT NO. | NREL WORK ORDER NO. | A/E PROJECT NO. |
| EX20193201 | -- | 19.1697 |



| STRUCTURAL CONCRETE SPECIAL INSPECTIONS | | | |
|---|------------|--------------------|--|
| ITEM | FREQUENCY | STANDARD | CRITERIA |
| REINFORCING STEEL | | | |
| - DURING PLACEMENT | P | ACI 301-16 3.2-3.3 | VERIFY GRADE, FINISH, SIZE, BAR QUANTITY, LOCATION, SPACING, COVER, HOOK LENGTHS, SPLICE LENGTH, SPLICE LOCATIONS, BEND DIAMETERS, COATING, SURFACE CONDITION, AND SUPPORT |
| - PRIOR TO PLACEMENT OF CONCRETE | 100% | | |
| - WELDING | C | AWS D1.4 | VERIFY ASTM A706 REINFORCING STEEL |
| - FIELD BENDING | P | ACI 301-16 3.3.2.8 | -- |
| BOLTS AND EMBEDMENTS | | | |
| - PRIOR TO PLACEMENT OF CONCRETE | 100% | -- | VERIFY TYPE, FINISH, DIAMETER, LENGTH, QUANTITY, EMBEDMENT LENGTH, SPACING AND EDGE DISTANCES. VERIFY USE OF PLACING TEMPLATE WHERE SPECIFIED |
| - WELDING | -- | -- | INSPECT PER THE STRUCTURAL STEEL TABLE |
| CONCRETE | | | |
| - MIX DESIGN | EACH TRUCK | -- | VERIFY USE OF APPROVED DESIGN MIXTURE FOR EACH TRUCK LOAD |
| - FORMWORK PRIOR TO PLACEMENT OF CONCRETE | P | ACI 301-16 2.2-2.3 | INSPECT FIRST POUR OF EACH TYPE (GRADE BEAM, COLUMN, STRUCTURAL SLAB, SLAB-ON-DECK, ETC.) |
| - PLACEMENT OF CONCRETE | C | ACI 301-16 5.3.2 | -- |
| - CURING | P | ACI 301-16 5.3.6 | -- |

| POST-INSTALLED ANCHORS/REINFORCING STEEL SPECIAL INSPECTIONS | | | |
|--|-------------|---------------|---|
| ITEM | FREQUENCY | STANDARD | CRITERIA |
| EXPANSION ANCHORS, SLEEVE ANCHORS, SCREW ANCHORS | | | |
| - PRIOR TO START OF WORK | -- | ICC-ES REPORT | REVIEW CONTRACTOR'S INSTALLATION PROCEDURE |
| - PRIOR TO INSTALLATION OF ANCHOR | EACH ANCHOR | ICC-ES REPORT | VERIFY TYPE, DIAMETER, LENGTH, FINISH, AND BASE MATERIAL. VERIFY SOLID GROUTED AREA AROUND ANCHORS IN GROUTED MASONRY. VERIFY MAXIMUM IMPACT WRENCH TORQUE RATING FOR SCREW ANCHORS |
| - DURING INSTALLATION OF ANCHOR | C | ICC-ES REPORT | CONTINUOUS INSPECTION REQUIRED REGARDLESS IF PERIODIC INSPECTION IS PERMITTED BY ICC-ES REPORT. VERIFY HOLE DIMENSIONS, HOLE CLEANING, ANCHOR EMBEDMENT, EDGE DISTANCES AND SPACING |
| - AFTER INSTALLATION OF ATTACHED ASSEMBLY | 100% VISUAL | -- | VERIFY NUMBER, EDGE DISTANCES, AND ANCHOR FLUSH WITH AND PERPENDICULAR TO THE RECEIVING SURFACE |

| POST-INSTALLED ANCHORS/REINFORCING STEEL TESTING | | | |
|--|-----------|----------|--|
| ITEM | FREQUENCY | STANDARD | CRITERIA |
| EXPANSION ANCHORS, SLEEVE ANCHORS, SCREW ANCHORS | | | |
| - TORQUE TEST | 100% | -- | TEST ANCHOR WITH CALIBRATED TORQUE WRENCH TO 100% OF THE INSTALLATION TORQUE NOTED IN ICC-ES REPORT. ATTAIN SPECIFIED TORQUE WITHIN 1/2 TURN OF THE NUT. |

| STRUCTURAL STEEL INSPECTIONS | | | |
|---|-----------------|---------------------|---|
| ITEM | INSPECTION TASK | STANDARD | CRITERIA/REMARKS |
| - PRIOR TO FABRICATION OR ERECTION | PERFORM | AISC 360, CHAPTER N | REVIEW MATERIAL TEST REPORTS AND CERTIFICATIONS FOR STRUCTURAL STEEL, FASTENERS, ANCHOR RODS, HEADED STUD ANCHORS |
| PRIOR TO WELDING | | | |
| - REVIEW MANUFACTURER CERTIFICATIONS FOR WELDING CONSUMABLES AND WELDING PROCEDURE SPECIFICATIONS | PERFORM | AISC 360, CHAPTER N | - |
| - FIT UP OF WELDS, INCLUDING JOINT GEOMETRY, AND CONFIGURATIONS AND FINISH OF ACCESS HOLES | OBSERVE | AISC 360, CHAPTER N | - |
| - MATERIAL IDENTIFICATION | OBSERVE | AISC 360, CHAPTER N | - |
| - WELDER IDENTIFICATION SYSTEM | OBSERVE | AISC 360, CHAPTER N | - |
| DURING WELDING | | | |
| - USE OF QUALIFIED WELDERS | OBSERVE | AISC 360, CHAPTER N | - |
| - CONTROL AND HANDLING OF WELDING CONSUMABLES | OBSERVE | AISC 360, CHAPTER N | - |
| - NO WELDING OVER CRACKED TACK WELDS | OBSERVE | AISC 360, CHAPTER N | - |
| - ENVIRONMENTAL CONDITIONS, AND WPS FOLLOWED | OBSERVE | AISC 360, CHAPTER N | - |
| - WELDING TECHNIQUES - SINGLE PASS WELDS | OBSERVE | AISC 360, CHAPTER N | - |
| - WELDING TECHNIQUES - MULTI-PASS WELDS | OBSERVE | AISC 360, CHAPTER N | - |
| AFTER WELDING | | | |
| - WELDS CLEANED | OBSERVE | AISC 360, CHAPTER N | - |
| - SIZE, LENGTH, AND LOCATION OF WELDS | PERFORM | AISC 360, CHAPTER N | - |
| - WELDS MEET VISUAL ACCEPTANCE CRITERIA | PERFORM | AISC 360, CHAPTER N | WHERE INSPECTOR OBSERVES QUESTIONABLE WELDS, NON-DESTRUCTIVE TESTING SHALL BE PERFORMED |
| - ARC STRIKES | PERFORM | AISC 360, CHAPTER N | - |
| - K-AREA | PERFORM | | - |
| - REPAIR ACTIVITIES | PERFORM | | - |
| PRIOR TO BOLTING | | | |
| - REVIEW MANUFACTURER CERTIFICATIONS FOR FASTENER MATERIALS | PERFORM | AISC 360, CHAPTER N | - |
| - FASTENERS MARKS IN ACCORDANCE WITH ASTM REQUIREMENTS | OBSERVE | AISC 360, CHAPTER N | - |
| - PROPER FASTENERS AND BOLTING PROCEDURE SELECTED FOR JOINT DETAIL | OBSERVE | AISC 360, CHAPTER N | - |
| - CONNECTING ELEMENTS MEET REQUIREMENTS, INCLUDING HOLE REPARATION AND FAYING SURFACE | OBSERVE | AISC 360, CHAPTER N | - |
| - PRE-INSTALLATION VERIFICATION TESTING | OBSERVE | AISC 360, CHAPTER N | NOT APPLICABLE FOR SNUG TIGHT JOINTS |
| - PROPER STORAGE FOR FASTENER COMPONENTS | OBSERVE | AISC 360, CHAPTER N | - |
| DURING BOLTING | | | |
| - FASTENERS PLACED IN ALL HOLES AND POSITIONED AS REQUIRED | OBSERVE | AISC 360, CHAPTER N | - |


QUALITY ASSURANCE GENERAL NOTES
STATEMENT OF STRUCTURAL SPECIAL INSPECTIONS AND TESTING

1. GENERAL:
 - A. SCOPE OF WORK
 - THE OWNER WILL ENGAGE A QUALIFIED INSPECTION AND TESTING AGENCY(S) TO PERFORM SPECIAL INSPECTIONS AND TESTING FOR ALL STRUCTURAL MEMBERS AND ASSEMBLIES AS NOTED HEREIN.
 - SPECIAL INSPECTIONS ARE IN ADDITION TO INSPECTIONS BY THE AUTHORITY HAVING JURISDICTION REQUIRED BY IBC 2015 SECTION 110.
 - REFER TO THE SPECIFICATIONS FOR REPORTING AND PROCEDURAL REQUIREMENTS FOR QUALITY ASSURANCE AND QUALITY CONTROL.
 - REFER TO ARCH/MECH/ELEC/CIVIL SPECIFICATIONS AND DRAWINGS FOR ADDITIONAL SPECIAL INSPECTION AND TESTING THAT MAY BE REQUIRED.
 - SPECIAL INSPECTIONS AND TESTING ARE APPLICABLE TO ALL REVISIONS AND/OR FUTURE WORK ADDED BY AMENDMENTS TO THESE DOCUMENTS.
 - B. DEFINITIONS
 - SPECIAL INSPECTOR: THE AGENCY ENGAGED BY THE OWNER AND APPROVED BY THE AUTHORITY HAVING JURISDICTION TO ACT AS THE DESIGNATED REPRESENTATIVE TO PERFORM INSPECTIONS.
 - SPECIAL INSPECTION: INSPECTION PERFORMED BY THE SPECIAL INSPECTOR ACCORDING TO IBC 2015 SECTION 1704 TO ENSURE COMPLIANCE WITH APPROVED CONSTRUCTION DOCUMENTS AND REFERENCED STANDARDS.
 - (P) PERIODIC INSPECTION: THE PART-TIME OR INTERMITTENT OBSERVATION BY THE SPECIAL INSPECTOR OF WORK BEING PERFORMED. SPECIAL INSPECTOR SHALL BE PRESENT IN THE AREA WHERE THE WORK IS BEING PERFORMED. OBSERVATION OF ALL WORK (100% VISUAL) SHALL BE MADE AT THE COMPLETION OF THE WORK.
 - (C) CONTINUOUS INSPECTION: THE FULL-TIME OBSERVATION BY THE SPECIAL INSPECTOR OF WORK BEING PERFORMED. SPECIAL INSPECTOR SHALL BE PRESENT IN THE AREA WHERE THE WORK IS BEING PERFORMED. OBSERVATION OF ALL WORK (100% VISUAL) SHALL BE MADE AT THE COMPLETION OF THE WORK.
 - C. DEFICIENCIES IN WORK
 - CORRECT DEFICIENCIES IN WORK THAT TESTS AND INSPECTIONS INDICATE DO NOT COMPLY WITH THE CONTRACT DOCUMENTS AND REFERENCED STANDARDS.
 - ALL COST OF ADDITIONAL TESTING AND/OR INSPECTIONS FOR CORRECTIVE WORK SHALL BE BORNE BY THE CONTRACTOR.
2. SHOP FABRICATIONS:
 - A. GENERAL
 - PERFORM INSPECTIONS AND TESTING FOR ALL SHOP FABRICATED STRUCTURAL MEMBERS AND ASSEMBLIES AS NOTED HEREIN. SPECIAL INSPECTOR SHALL PERFORM SPECIAL INSPECTIONS AND TESTING UNLESS THE FABRICATOR IS REGISTERED AND APPROVED BY THE AUTHORITY HAVING JURISDICTION TO PERFORM SUCH WORK WITHOUT SPECIAL INSPECTION OR FABRICATION HAS A CURRENT ICC-ES EVALUATION REPORT.
 - SPECIAL INSPECTOR SHALL VERIFY THE FABRICATOR MAINTAINS AND FOLLOWS DETAILED SHOP FABRICATION AND QUALITY CONTROL PROCEDURES, UNLESS FABRICATOR IS REGISTERED AND APPROVED.
 - AT THE COMPLETION OF FABRICATION, THE APPROVED FABRICATOR SHALL SUBMIT A CERTIFICATE OF COMPLIANCE TO THE AUTHORITY HAVING JURISDICTION ACCORDING TO IBC 2015 SECTION 1704.2.5.1
 - APPROVED FABRICATORS MAY PERFORM TESTING NOTED HEREIN EXCEPT THAT NONDESTRUCTIVE TESTING (NDT) SHALL ONLY BE PERFORMED BY PERSONNEL WITH QUALIFICATIONS THAT MEET OR EXCEED THE CRITERIA OF AWS D1.1 SUBCLAUSE 6.14.6 AND AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT) SNT-TC-1A OR ASNT CP-189.
 - B. SHOP FABRICATIONS INCLUDED
 - SHOP FABRICATED STRUCTURAL STEEL.


| NO. | REVISIONS | DATE | BY | APP'D. | BAE | NO. |
|-----|-------------------------|----------|----|--------|-----|-----|
| C | 91% REVIEW SET | 12/24/19 | . | . | . | |
| D | 95% REVIEW SET | 02/17/20 | . | . | . | |
| O | ISSUED FOR CONSTRUCTION | 03/27/20 | . | . | . | |
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| FILE INFORMATION | | | | ENGINEERING REVIEW | |
|------------------|---------------------|-------------|----------|--------------------|----------|
| USER: | DATE: | TIME: | XREF'S: | DESIGNER | APPROVAL |
| MM | 02/17/20 | 1:00 AM | -- | NEL | 03/27/20 |
| DWG. FILE: | NRELVTIF S-02.dwg | LAYOUT: | -- | ENGINEER | 03/27/20 |
| DWG. FOLDER: | | | | CHECKED BY | EAJ |
| ACAD VERSION: | 2013 | | | A/E APPROVED BY | -- |
| PLATFORM: | Microsoft Windows | | | NREL APPROVED BY | -- |
| BORDER: | NREL TITLEBLOCK.dwg | PLOT SCALE: | AS NOTED | BLDG. AREA ENG. | -- |
| PLOT INFO: | NREL.CTB | UNITS: | DECIMAL | | |



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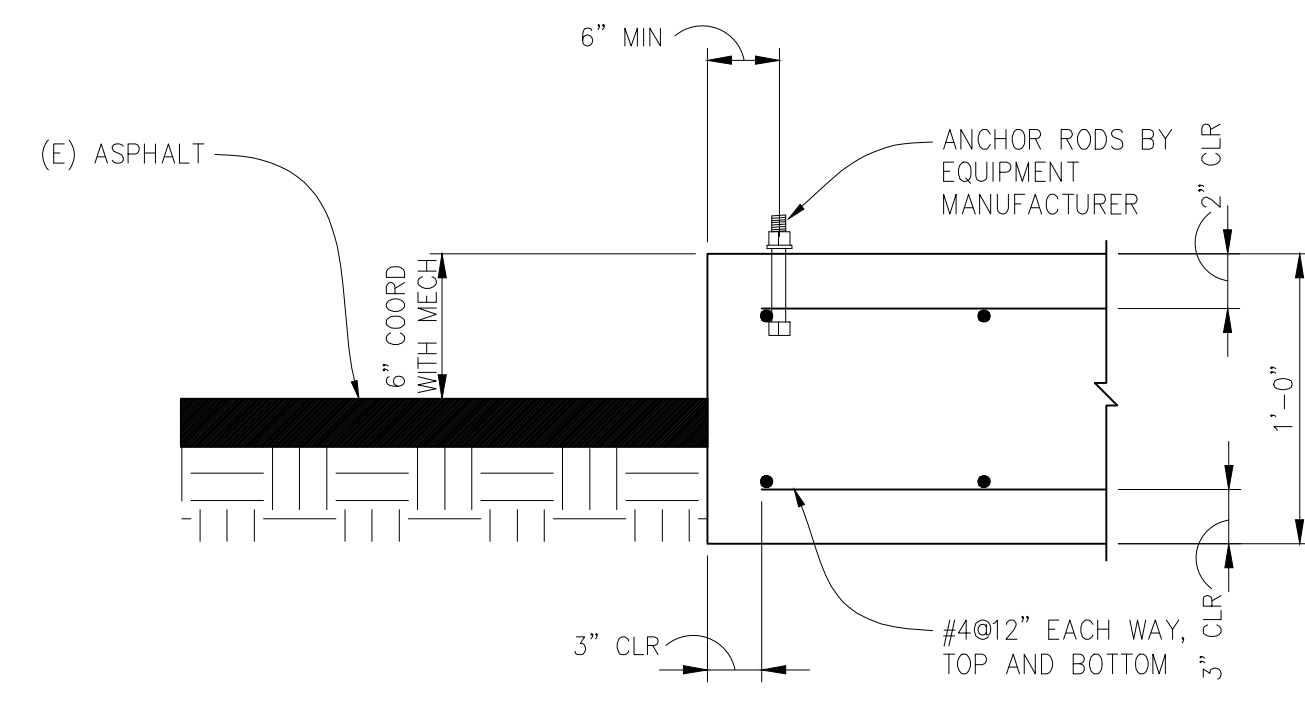
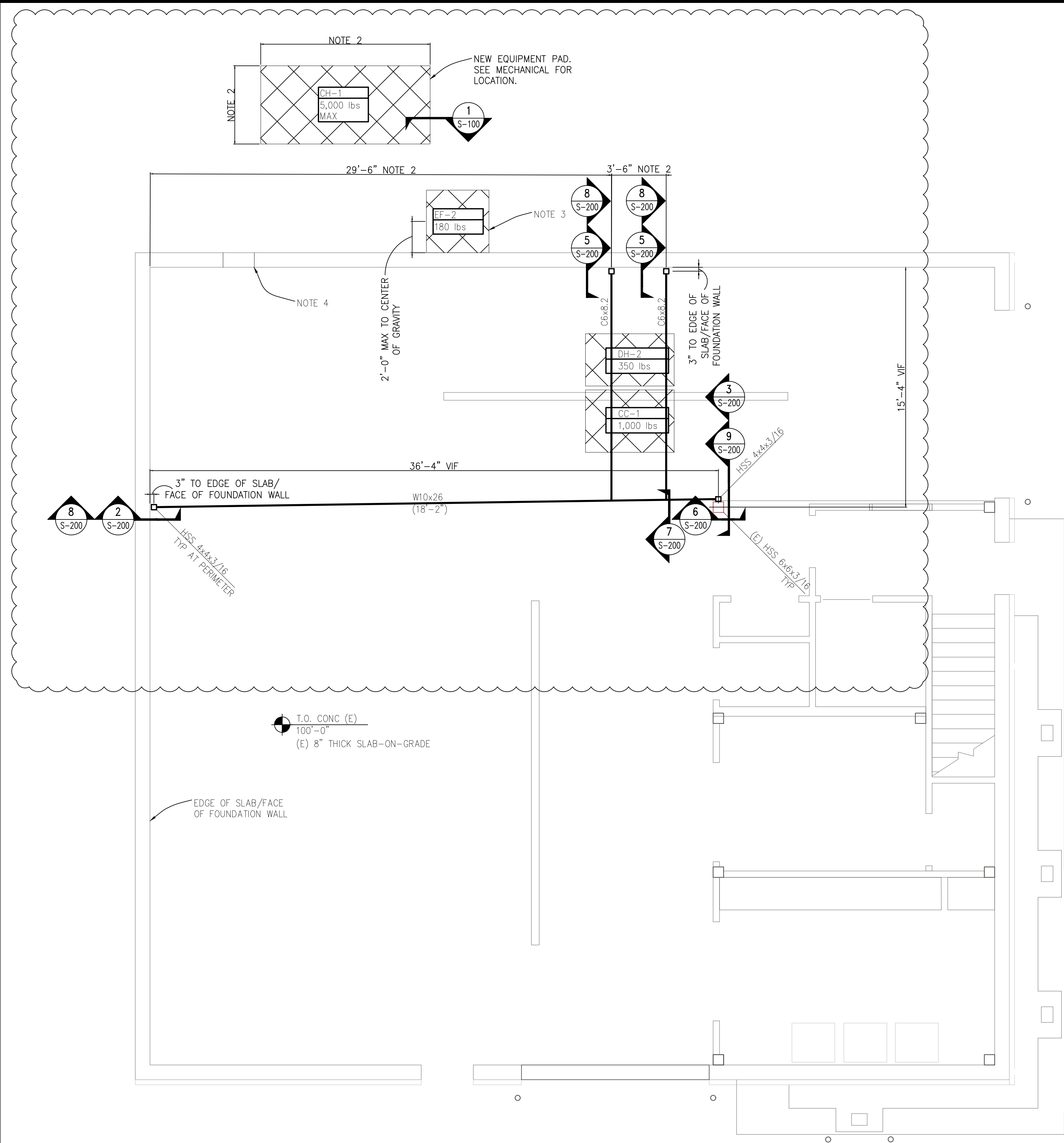
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V.T.I.F. STRUCTURAL
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SPECIAL INSPECTIONS

| | | |
|--------------------------------|---------------------------|----------------------------|
| DRAWING NO. PREFIX VTIF-011 | DRAWING NO. S-02 | REVISION NO. D |
| NREL PROJECT NO. EX20193201 | NREL WORK ORDER NO. -- | A/E PROJECT NO. 19.1697 |





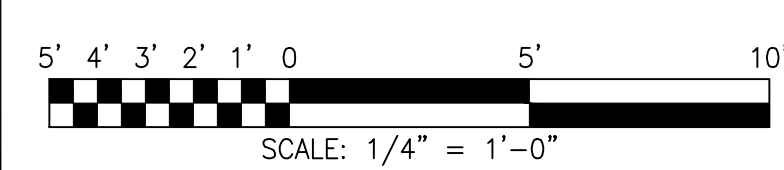
1 TYPICAL EXTERIOR EQUIPMENT PAD
 S-100 3/4" = 1'-0"

PLAN

SCALE: 1/4" = 1'-0"

PLAN NOTES:

1. NEW EXTERIOR MECHANICAL PAD IS INDEPENDENT OF EXISTING PADS.
2. COORDINATE DIMENSIONS WITH MECHANICAL AND EQUIPMENT MANUFACTURER.
3. PROVIDE STEEL FRAME SYSTEM, SUCH AS UNI-STRUT TO MOUNT EQUIPMENT TO EXISTING EQUIPMENT SUPPORT FRAMES. SUBMIT PROPOSED LAYOUT AND MEMBERS FOR REVIEW.
4. NEW WALL PENETRATIONS SEE MECHANICAL. DO NOT CUT EXISTING WALL STEEL FRAME INCLUDING HORIZONTAL AND DIAGONAL STEEL ANGLES. PROVIDE FLASHING AROUND NEW PENETRATIONS.
5. TOP OF STEEL ELEVATION = 18'-0" UNLESS NOTED OTHERWISE PER MECHANICAL.



| REVISIONS | | | | | | REVISIONS | | | | | | FILE INFORMATION | | | | ENGINEERING REVIEW | | | DRAWING INFORMATION | | |
|-----------|-------------------------|----------|----|--------|-----|-----------|-----------|------|----|--------|-----|------------------|---------------------|-------------|----------|--------------------|----------|----------|---------------------|-------------|--------------|
| NO. | REVISIONS | DATE | BY | APP'D. | BAE | NO. | REVISIONS | DATE | BY | APP'D. | BAE | USER: | DATE: | TIME: | XREF'S: | DESIGNER | APPROVAL | DATE | DRAWING NO. PREFIX | DRAWING NO. | REVISION NO. |
| C | 91% REVIEW SET | 12/24/19 | . | . | . | | | | | | | MM | 02/17/20 | 1:00 AM | 2 | NEL | NEL | 03/27/20 | VTIF-011 | S-100 | D |
| D | 95% REVIEW SET | 02/17/20 | . | . | . | | | | | | | NRELVTIF | S-100.dwg | LAYOUT: | - | NEL | NEL | 03/27/20 | VTIF-011 | S-100 | D |
| O | ISSUED FOR CONSTRUCTION | 03/27/20 | . | . | . | | | | | | | G:ISCHLAGETER | | | | EAJ | EAJ | 03/27/20 | VTIF-011 | S-100 | D |
| . | . | . | . | . | . | | | | | | | ACAD VERSION: | 2013 | | | - | - | | VTIF-011 | S-100 | D |
| . | . | . | . | . | . | | | | | | | PLATFORM: | Microsoft Windows | | | - | - | | VTIF-011 | S-100 | D |
| . | . | . | . | . | . | | | | | | | BORDER: | NREL TITLEBLOCK.dwg | PLOT SCALE: | AS NOTED | | | | VTIF-011 | S-100 | D |
| . | . | . | . | . | . | | | | | | | PLOT INFO.: | NREL.CTB | UNITS: | DECIMAL | | | | VTIF-011 | S-100 | D |
| . | . | . | . | . | . | | | | | | | | | | | | | | VTIF-011 | S-100 | D |

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1ST FLOOR PLAN

| | | |
|--------------------|---------------------|-----------------|
| DRAWING NO. PREFIX | DRAWING NO. | REVISION NO. |
| VTIF-011 | S-100 | D |
| NREL PROJECT NO. | NREL WORK ORDER NO. | A/E PROJECT NO. |
| EX20193201 | -- | 19.1697 |

