United States
Environmental Protection
Agency

EPA 600/R-23/132 I July 2023 I www.epa.gov/research

Full-Scale Cybersecurity Build Out Plans and Cost Estimate

Office of Research and Development
Center For Environmental Solutions and Emergency Response

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Full-Scale Cybersecurity Build Out Plans and Cost Estimate

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Cincinnati, OH 45268

Interagency Agreement DW-89-92381801

Disclaimers/Notices

1.1 Disclaimers

The U.S. Environmental Protection Agency (EPA), through its Office of Research and Development, funded and managed the research described herein under Interagency Agreement DW-089-92528301 with the Department of Energy (DOE). It has been subjected to the Agency's review and approved for publication. Note that approval does not signify that the contents necessarily reflect the views of the Agency. Any mention of trade names, products, or services does not imply an endorsement by the U.S. Government or EPA. The EPA does not endorse any commercial products, services, or enterprises.

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Acknowledgments

This report is the result of the support of numerous individuals whose contribution is briefly described and acknowledged below.

On-Site Support
Stephen Reese, Idaho National Laboratory

Abbreviations

CESER	Center for Environmental Solutions and Emergency Response
DOE	Department of Energy
EPA	U.S. Environmental Protection Agency
EPDM	Ethylene Propylene Dieneterpolymer Membrane
ft-hd	foot of head
gpm	Gallons Per Minute
HMI	Human Machine Interface
HP	Horsepower
HSRP	Homeland Security Research Program
ICS	Industrial Control System
INL	Idaho National Laboratory
IoT	Internet of Things
mA	Milliamp
NPT	National Pipe Thread
ORD	Office of Research and Development
OT	Operational Technology
P and ID	Piping and Instrumentation Diagram
PLC	Programmable Logic Controller
psi	Pounds Per Square Inch
PTFE	Polytetrafluoroethylene
PVC	Poly Vinyl Chloride
rpm	Revolutions Per Minute
SCADA	Supervisory Control and Data Acquisition System
SS	Stainless Steel
VAC	Volts Alternating Current
VFD	Variable Frequency Drive
WSTB	Water Security Test Bed

1 Executive Summary

The Water Security Test Bed (WSTB) is a full-scale representation of a drinking water distribution pipe that conveys potable water. It is the product of a partnership between Idaho National Laboratory (INL) and the U.S. Environmental Protection Agency (EPA). Currently, the system consists of 450' of 8-inch diameter water main with pressurized tap water flowing through it. The system includes a premise plumbing room (connected to the water main through a 1-inch service connection) that houses water appliances found in a typical home (e.g., water heater, dishwasher, clothes washer). This combination allows testing of contamination scenarios that affect the municipal water utilities and home or business owners and decontamination techniques. The existing system has limited instrumentation and telemetry, and control of the system is performed manually.

To date, research at the test bed has focused on chemical and biological contamination scenarios (due to natural, accidental, or malicious acts) and benchmarking methods for decontamination/recovery from such scenarios. Going forward, planned full-scale research will focus on infrastructure resiliency and the impacts of cyber intrusions into a water utility's supervisory control and data acquisition systems (SCADA). Using at-scale demonstration will inform how utility owner/operators should prioritize their efforts to harden components or subsystems against cyber-attacks to make them more resilient. This report describes the plan for a full-scale cybersecurity test bed and the vision for future cybersecurity and water sector resilience research.

2 Introduction

The EPA's Homeland Security Research Program (HSRP) has partnered with the Idaho National Laboratory (INL) to build the Water Security Test Bed (WSTB) near Idaho Falls, Idaho. The centerpiece of the WSTB is an 8-inch diameter, cement-mortar-lined ductile iron drinking water pipe that had been taken out of service. The pipe was exhumed from the INL grounds and then oriented in the shape of a small drinking water distribution system. The WSTB has been fitted with service connections, a premise plumbing and appliance system, fire hydrants, and removable coupons (excised sample materials) to collect samples from the pipe inner surface.

Previously, experiments focused on decontamination of various contaminants that adhered to the inner surface of the 8-inch water pipe have been conducted at the WSTB. These experiments focused on simulating contamination of drinking water distribution pipes and determining the effectiveness of decontamination methods. On-site treatment of the contaminated water resulting from decontamination activities with mobile water treatment systems also took place. In future years, the EPA plans to enhance the site to include a full-scale cybersecurity test bed that includes additional water infrastructure such as tanks, pumps, and sensors that can be controlled via a Supervisory Control and Data Acquisition (SCADA) system. Conducting research on a full-scale test bed is important to the water sector since high impact cyber intrusions at water utilities have occurred recently. This full-scale system could be hacked and the impacts of the hack on water infrastructure and water quality assessed. Research will also be conducted on methods to quickly mitigate the impacts of a cyber intrusion. The following sections will lay out the plan for constructing the full-scale cybersecurity test bed, and the vision for its use in the future.

3 Near Term Development

Current development efforts are focused on installing the operational technology (OT) needed to establish a realistic control system and a representative control room from which an operator will control the system. With these upgrades, the system can also be operated (and attacked) remotely. A phased approach is proposed for these improvements. A detailed design and cost estimate for construction have been completed for the system. These designs are divided into Phase 1 and Phase 2, and both designs are ready for construction. The funding figures cited below are the costs to procure and install the system.

Phase 1 – Install the backbone of the Industrial Control System (ICS) (**$600k**)

- A control room with the requisite software, servers, human-machine interface (HMI)
- Power and communication wiring runs to connect the pipe infrastructure to a control room
- Programmable logic controllers (PLCs) and wiring panels to connect sensors, pump and valve controllers, etc., to the control room

If funding to build the complete test bed is not available, Phase 1 is an interim step that can demonstrate the capabilities of the test bed. At the conclusion of Phase 1, a test bed user will be able to sit in a control room (an on-site trailer) and see the operating status and data outputs from water quality sensors on a screen. Controllers for future pumps and valves will also be connected. The system will be connected to the internet via a fiber optic cable so that the system can be accessed (or hacked) from an off-site location.
Although the system can be hacked, only limited scenarios could be implemented at this point. Since water quality data from existing sensors will be sent to the control room, those sensors could be spoofed. For example, a hacker could make a chlorine reading appear to be zero when the hacker has added enough chlorine to exceed regulatory levels. Also, an automated flushing device attached to a fire hydrant could be opened and water released while it appears that the flusher is closed in the control room.

Phase 2 – Install a fully instrumented and automated tank and pump system (**$600k**)

- Two 5,000-gallon tanks and a variable frequency drive (VFD) pump (See Figure 1.)
- Associated infrastructure, e.g., secondary containment, piping, sensors, controllers, etc.

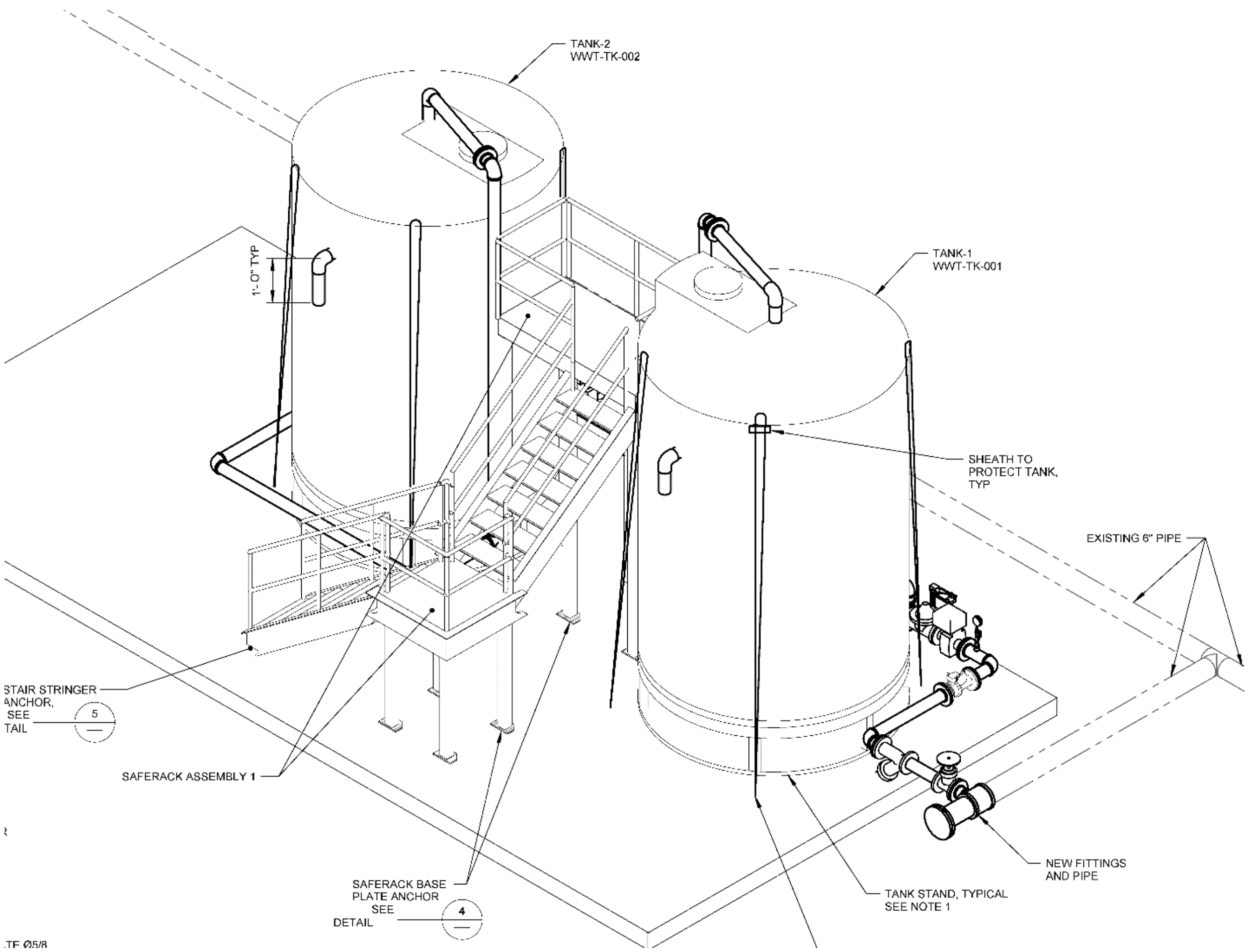


Figure 1: Isometric view of the planned tank and pump system. The pump is located on the back side of the tanks in this view.

Phase 2 would augment the capabilities established in Phase 1 with tanks, pumps, valves, and other full-scale infrastructure used in a water distribution system. A system user would see the operating status of these devices in the control room. With Phase 2 in place, higher impact cyber hacking scenarios could be implemented. For example, pumps could be manipulated to induce water hammer (a damaging high-pressure surge due to closing a valve quickly or stopping a pump quickly), which results in system damage, or a tank level could show a tank as half-full when it is overflowing. Mitigation countermeasures and safety systems put in place to prevent such events could also be evaluated.

3.1 Tasks and Timeline for Phase 1

One portion of Phase 1 is currently funded and underway

- Build the instrumentation cabinets that will hold the PLCs and associated power supplies – expected completion date October 2023

Phase 1 tasks to be completed when funding is in place (with expected time needed to complete in parentheses)

- Configure the ICS servers and PLC (2 months)
- Position the control room trailer and install control room equipment (2 months)
  - Grade, compact, gravel trailer location
  - Connect power, fiber optic line to trailer

    - Install servers, operator station (HMI)
    - Configure fiber connection between control room and INL laboratories in Idaho Falls
- Install PLC cabinets and power and communications lines (2 months)
    - Pour concrete pad for PLC cabinets
    - Trench and install power and communications runs
    - Mount PLC cabinets to pad
    - Connect and configure connections between PLC cabinets and control room
- System testing (one month)
- Initial experiments (two months)
    - Conduct an initial demonstration of physical impacts. Examples:
        - Spoof the chlorine meter to read normal chlorine levels while injecting sodium thiosulfate, that depletes chlorine levels, into the pipeline. This would simulate a combined cyber-physical attack to poison the water system.
        - Spoof the chlorine meter to read low chlorine levels, causing the automatic hydrant flusher to trigger – releasing/wasting treated water when it should not. See Figure 2.

Figure 2: Automatic fire hydrant flusher in action, ~225 gallons per minute (gpm).

3.2 Tasks and Timeline for Phase 2

Phase 2 tasks to be completed when funding is in place with time frames for completion.

- Procure components, equipment, material (3 months).

- Installation
  - Month 4
    - Prep ground and pour concrete pad.
    - Install and line secondary containment trench around the concrete pad.
  - Month 5
    - Install 2 × 5,000-gallon tanks and stair platform.
    - Install pump and VFD.
    - Install piping, valves, sensors.
  - Month 6
    - Pressure/leak test the system.
    - Configure and test sensors and controls (VFD, valve actuators)
    -

- Demonstration, months 7 and 8 – Conduct experiment to demonstrate a physical impact from a cyber intrusion. Examples include:
  - Overflow a tank, while spoofing the tank level sensors.
  - Run a tank dry by spoofing the level sensors or changing the valve assignments in the control room or both, so that the operator opens/closes the incorrect valve combination.
  - Attack the pump VFD to force a pump failure. (This would be a potentially destructive test, which may require replacing the pump).

4 Long Term Program Growth

Expansion in subsequent years will be driven by research priorities developed in cooperation with the water sector, private industry and governmental agencies focused on cybersecurity.

Areas expected to generate interest include:

1. Establish water system operator training programs and red/blue (bad hacker/good hacker or defender) challenge training.
2. Performance testing and evaluation of water system components, OT hardware, and OT software.
3. Adding wastewater processing and water treatment systems.
    a. Enables testing novel less energy intensive treatment processes.
    b. Enables testing cyber-physical vulnerabilities in these systems.
4. Adding a microgrid with local power generation.
    a. This feature would be integrated with the Power Grid Test Bed, which is co-located/encircles the WSTB.
    b. Enables testing of combined power and water system interdependencies.
    c. The local power source could be integrated into INL's Net Zero program and serve as a demonstration project for that program.
5. Adding wireless/3G/5G testing capabilities for Internet of Things (IoT) and remote sensing technologies.
    a. This system would be integrated with and augment the Wireless Test Bed, located nearby.
6. Finally, as the research portfolio grows, it will become necessary eventually to add infrastructure to support year-round (4-season) testing at the facility.

5 Cost Estimate for Phases 1 and 2

A formal cost estimate for installation of Phases 1 and 2 combined was completed in September 2021 (see Appendix A). The estimated cost range was $600k - $1M, with a target value (most probable cost) of $750k. The INL Cost Estimating office recommends using the high range value when setting expectations.

Based on significant cost inflation in 2021, an updated cost estimate was requested in March 2022. In addition to providing clarity on cost increases due to inflation, the cost estimate was broken into Phase 1 and Phase 2. The Phase 1 cost range was $350k - $550k, with a target value of $400k. Phase 2 costed at $400k - $525k, with a target value of $425k (see Appendix B). Note that in Appendix B, Option 1 refers to Phase 1, and Phase 2 is calculated by subtracting Option 1 from Option 3. (Option 2 was a middle alternative that gets a head start on the Phase 2 installation.)

Based on the March 2022 high end values of $550k and $525k and the unrelenting advance of inflation since, 10% has been added to the March 2022 costs for the values presented in this document: approximately $600k per phase.

6 Detailed Design for Phases 1 and 2

A detailed design of the ICS system and tank and pump hardware that will comprise the Phase 1 and 2 expansion was completed in 2021. The design included a piping and instrumentation diagram (P and ID); the electrical, controls, mechanical, and civil designs; and equipment and materials lists for procurement.

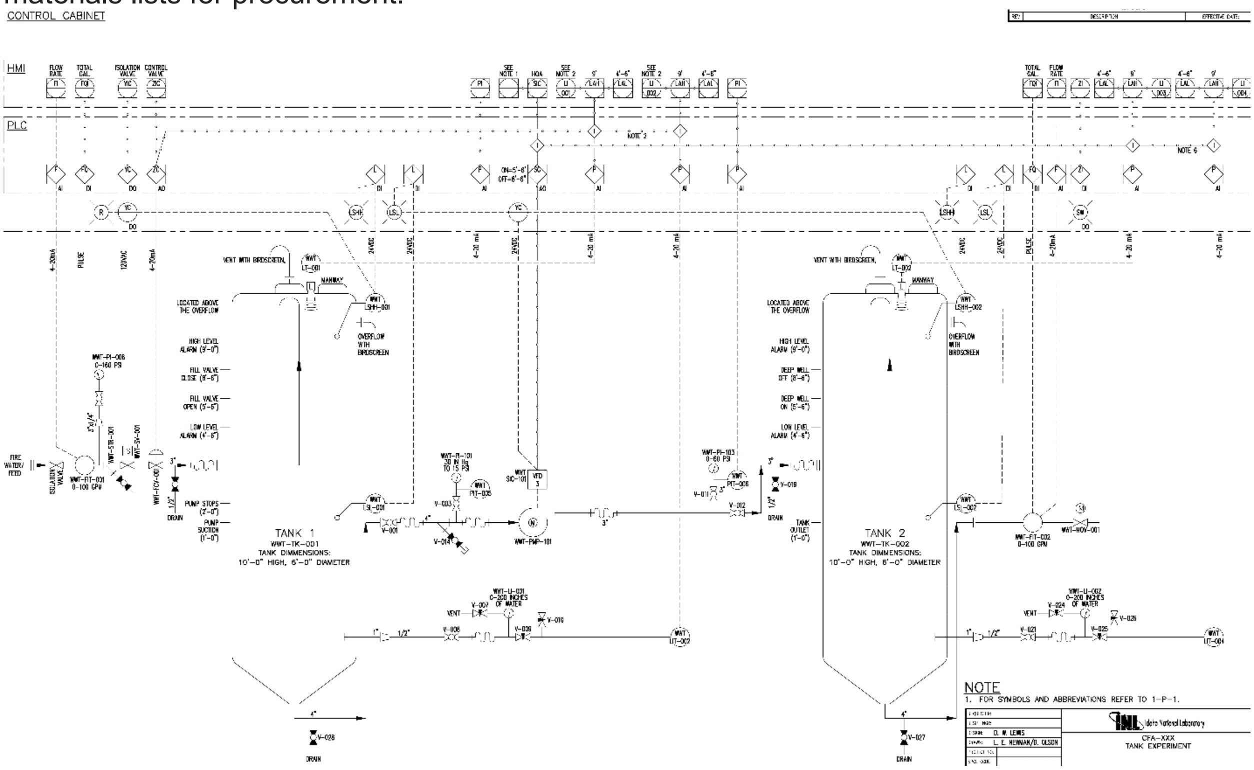


Figure 3: P and ID for the proposed system.

The first step in the design was to develop a P and ID for the system (Figure 3). The system is centered on two 5,000-gallon tanks connected by a pump. This system allows simulation of scenarios relevant to a municipal water distribution system through pumping water from tank 1 to tank 2. Tank 1 is filled by upstream line pressure via a feeder line from the existing WSTB pipe. Tank 2 empties to a lined trench that flows by gravity back to the existing WSTB catchment infrastructure.

The designed system represents a large, pilot scale water system. A control room with an operator station human machine interface (HMI) is connected to a PLC and the downstream sensors, controllers, and actuators. Those sensors and actuators control two tanks and a pump. From the control room, the operator can control moving water from the main pipeline to tank 1, from tank 1 to tank 2, and from tank 2 to the containment trench. The pump is controlled by a VFD, the tanks are fitted with level sensors, and valve positions are manipulated by actuators.

The detailed design of the electrical and mechanical systems and the civil works was completed in 2021. Civil design elements include:

- A grading and compaction plan for placement of the control room trailer;

- Grading, compaction, and concrete plan for the PLC control panels and the mechanical installation of tanks, pump, and piping;
- Plan for the secondary containment/drainage trench surround the mechanical installation; and
- Trenching plan for installation of power and communications wiring.

The mechanical design (see Figure 4) includes:

- Defining the major and minor components needed, e.g., pump, piping, fittings, stair platform, tanks;
- Layout of the system; and
- Analysis of stresses and loading, and associated design of supports and fasteners.

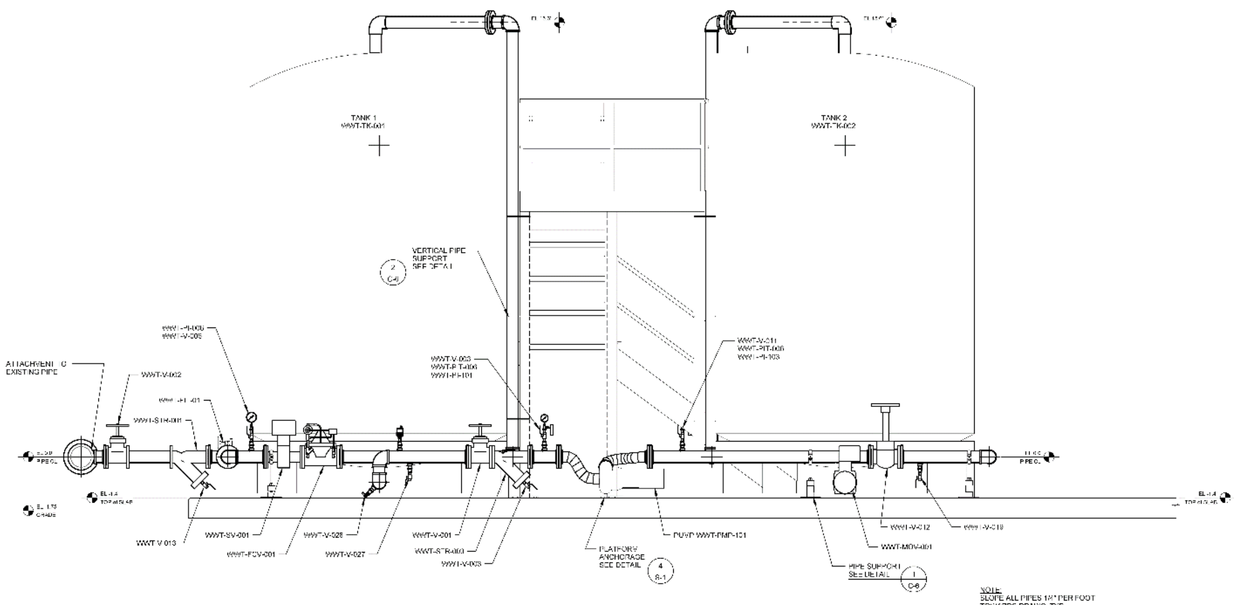


Figure 4: Physical layout of the tank-pump-tank system.

The electrical design (see Figure 5) includes:

- Power and communications connections between the control and the PLC panels;
- Power connections from the local power supply;
- Connection of fiber optic trunk line to the control room;
- Power and communications connections for sensors and motors on the mechanical installation; and
- Ancillary power connections on the WSTB pipeline.

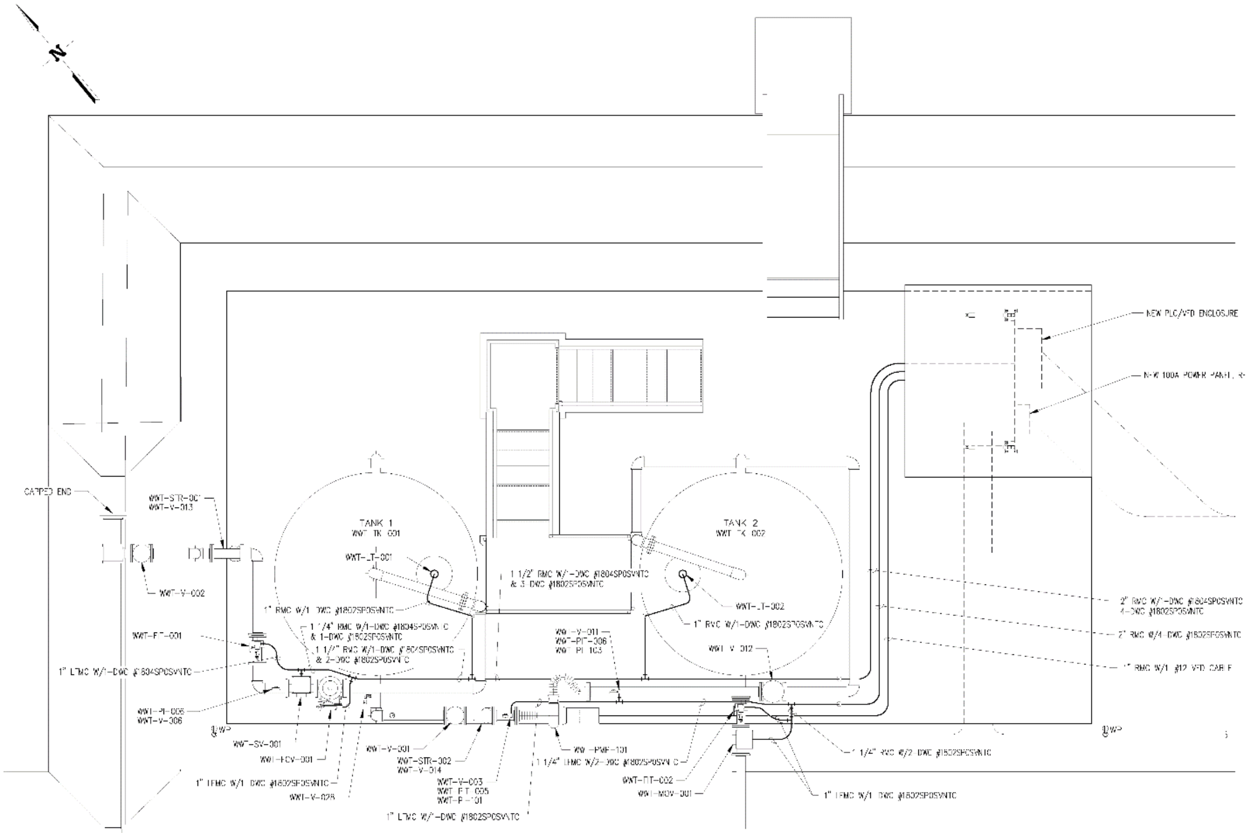


Figure 5: Overhead view of the system including sensor and controller interconnections.

See Appendix C for the complete P and ID diagram; see Appendix D for a list of major components to be procured; see Appendix E for the complete set of mechanical and civil drawings; see Appendix F for the complete set of electrical and controls drawings. As part of the design process, a subsurface investigation was conducted to inform excavation once installation commences. See Appendix G.

The system is designed to be completely controlled from the control room operator's station. From the operator station, sensor readings such as tank level and flow rate can be monitored, and settings can be adjusted, such as pumping rate and valve positioning.
In addition, there are controls/indicators on the system that are separate from, and redundant with, what would typically be present in a water system control room. These controls/indicators are present to maintain situational awareness and safety during testing designed to confuse or obfuscate the human machine interface. Examples of these features include:

- Independent level sensors in the tanks that are not part of the standard ICS interface.
- Manual pressure gauges on the pipe.
- Manually operated valves at key points on the system.

This combination provides an accurate representation of what is seen in the control room during normal and abnormal conditions while preserving the safety of research personnel and integrity of the installed equipment. There may be instances where destructive testing is deliberately undertaken. In those cases, the experiment design will include any necessary configuration changes to enable the potentially destructive outcome.

7 Summary

The purpose of this report is to document the following:

- A design for a full-scale water sector cyber security test bed, including costs estimates and detailed shovel-ready design drawings.
- Information on the type of cybersecurity research that could occur with this test bed.
- A vision for the type of long-term research that could occur at the cybersecurity test bed.

The design drawings presented here and construction of the instrumentation cabinets that will hold the PLCs (noted in the Phase 1 Tasks and Timeline section) have been funded by the EPA. It is expected that the EPA will supply funding for incremental progress in the Phase 1 in the coming years. However, fully funding one or both phases of the full-scale cybersecurity test bed will require partnership with other federal agencies and the private sector. The EPA is actively promoting cybersecurity research and building partnerships that could lead to construction and use of the test bed.

Appendix A – Formal Cost Estimate for Phases 1 & 2, September 2021

WSTB ISC Upgrades cost estimate, summary section only.pdf

Interoffice Memorandum

Idaho National Laboratory

Date: September 20, 2021

To: S. J. Reese, Manager

From: M. E. Bigler, Cost Estimator MARK BIGLER (Affiliate) Digitally signed by MARK BIGLER (Affiliate) Date: 2021.09.20 11:29:38 -06'00'

Subject: WSTB ICS upgrades

Per your request, Cost Estimating has prepared a cost estimate (Class 3) package for the above-mentioned subject.

The estimated cost range, including management reserve, is as follows:

Low end range value	$ 600,000
Class 3 point value	$ 750,000
High end range value	$1,000,000

Please note the following:

A. If this estimate is used to establish or request funding or to be used as a proposal for this project, it is recommended and a best practice that the high end range value be used.
B. Anticipated inflation allowances have been included in this estimate.
C. Per the requester, this work will be direct funded. Battelle Energy Alliance, LLC (BEA) adders for this type of funding are included in this estimate.
D. A draft of this cost estimate was sent to you on August 24, 2021. This allowed you to review, in detail, the scope, basis of estimates, assumptions, project risks, and the resources that make up this cost estimate. Comments from this review have been incorporated into this estimate to reflect a project team consensus of this document.

Refer to the cost estimate summary, detail, markup, and labor sheets with the cost breakdowns. Also included for your use is the cost estimate recapitulation sheet describing the basis, assumptions, risk identification, and other pertinent information used in development of this estimate.

This estimate is based on the information provided to this estimator as the scope of work to be completed. Any changes to the methodology used to prepare this estimate could have a significant effect on the cost estimate and should be reviewed by me. If you have any questions or comments, do not hesitate to contact me at (208) 526-2675 or e-mail Mark.Bigler@inl.gov.

SCOTT WASLEY (Affiliate)

Digitally signed by SCOTT WASLEY (Affiliate)
Date: 2021.09.28 11:00:33 -06'00'

Attachments

cc: Estimate File 3C01

Uniform File Code: 8309
Disposition Authority: A16-1.6-a
Retention Schedule: Cut off annually. Destroy 10 years after cutoff.

NOTE: Original disposition authority, retention schedule, and Uniform Filing Code applied by the sender may not be appropriate for all recipients. Make adjustments as needed.

BEA - Report 1 - Summary Report

Project Name: WSTB ICS upgrades
Project Location: CFA
Estimate Number: 3C01

Requester: S. R. Reese
Estimator: M. E. Bigler
Estimate Classification: Class 3

Charging Practice	Item Description	Estimate SubTotal With Subs Markups	Escalation Total	Management Reserve	Total Cost
TEC	**Total Estimated Cost**	**$633,362**	**-**	**$105,384**	**$738,746**
OPC	**Other Project Cost**	**$13,173**	**-**	**$1,054**	**$14,227**
	Totals	**$646,535**	**-**	**$106,438**	**$752,973**

	Remarks:
Type of Estimate: Class 3 Estimator: M. E. Bigler Checked By: Gary I Dansie (Affiliate) Digitally signed by Gary I Dansie (Affiliate) DN: C=US, E=Gary.Dansie@inl.gov, O="Battelle Energy Alliance, LLC", OU=Estimating, CN=Gary I Dansie (Affiliate) Date: 2021.09.20 11:44:57-06'00' Approved By: SCOTT WASLEY (Affiliate) Digitally signed by SCOTT WASLEY (Affiliate) Date: 2021.09.28 11:01:09 -06'00'	

BEA
9/20/2021 10:48AM

Idaho National Laboratory

FORMAL COST ESTIMATE SUPPORT DATA RECAPITULATION

Project Title:	WSTB ICS upgrades
Estimator:	M. E. Bigler
Date:	September 20, 2021
Estimate Type:	Class 3
File:	3C01

I. **PURPOSE:** *Brief description from the requester of the intent of how the estimate is to be used, i.e., for engineering study, comparative analysis, request for funding, proposal, etc.*

The purpose of this estimate is to identify resource levels that may be used to complete the scope of work as stated below. It is expected that this estimate will be used to provide a cost comparison with subcontractor cost proposals and to support the award of a subcontract.

II. **SCOPE OF WORK:** *Brief statement of the project's objective as discussed in the Functional and Operational Requirements (F&ORs). For traceability, the F&OR number should be listed. Thorough overview and description of the proposed project. Identify work to be accomplished, as well as any specific work to be excluded.*

A. **Objective:**
The objective of this work is to install an industrial control system (ICS) and hardware upgrades at the Water Security Test Bed (WSTB) at the Critical Infrastructure Test Range Complex (CITRC).

B. **Included:**
The scope of work required to achieve this objective includes the following:
1. Providing project and construction management oversight.
2. Project closeout.
3. Battelle Energy Alliance, LLC (BEA) procurement of all materials except for subcontracted concrete work.
4. Subcontracting the concrete portion of this project including the following:
   a. Part-time supervision.
   b. Concrete work – forms, rebar, pouring, concrete material, finishing, and sealing.
   c. Installation of the geomembrane (trench liner).
5. In-house craft work scope includes the following:
   a. Mechanical installation of tanks and piping.
   b. Electrical installation of above and below ground conduit, wiring, and equipment.
   c. Earthwork for concrete pads, electrical, drainage trench, and trailer base material.

C. **Excluded:**
Per the requester this scope of work specifically excludes the following:
1. Material cost for Tank #2.
2. Insulation on outside water piping. System shall be drained prior to freezing temperatures per drawings.
3. Developing the engineering and design documents.

III. **ESTIMATE METHODOLOGY:** *Overall methodology and rationale of how the estimate was developed, i.e., parametric, forced detail, bottom up, etc. Total dollars/hours and rough order of magnitude (ROM) allocations of the methodologies used to develop the cost estimate.*

A bottom up method was used in the development of this estimate, due to the uniqueness of the scope of work and lack of a parametric model to support the proposed scope of work. This method provides for a greater degree of detail to review than would be provided utilizing parametric modeling.

Estimate Methodology	ROM Percentage (%)
Project Team	40
Recorded Actuals	0
Parametric	0
Vendor Pricing	30
Other (e.g., RS Means)	30
TOTAL	**100**

IV. **BASIS OF THE ESTIMATE:** *Overall explanation of sources for resource quantities, pricing, and schedules.*

A. **Classification Basis**: *The source for the determination of the classification of the estimate or sections of the estimate when a rolling wave planning process is utilized. Source documents include the Idaho National Laboratory (INL) Cost Estimate Class Determination Matrix (Form 415.44) patterned after the Association for the Advancement of Cost Engineering (AACE) Recommended Practices (RP) and are driven by the Primary and Secondary Characteristics available at the time the estimate is completed.*

It has been determined by the cost estimator that the available data conforms to the characteristics for Class 3 estimates in accordance with the Idaho National Laboratory (INL) Cost Estimate Class Determination Matrix (Form 415.44).

B. **Cost Estimate Low and High Ends Range Basis:** *The source and basis for the development of the low and high ends of the cost estimate range.*

The low and high end range values were developed by the project team and this cost estimator.

C. **Quantification Basis:** *The source for the measurable quantities in the estimate that can be used in support of earned value management. Source documents may include drawings, design reports, engineers' notes, and other documentation upon which the estimate is originated.*

The requester provided final drawings developed by BEA engineering that were used to establish the activities and quantities for this estimate.

D. **Planning Basis:** *The source for the execution and strategies of the work that can be used to support the project execution plan, identification of long-lead items, acquisition strategy, schedules, market conditions, and other documentation upon which the estimate is originated.*

1. Per the requester:
   a. BEA will provide resources for all engineering, project management, and construction management resources.
   b. A subcontractor will install the trench liner.
   c. Subcontractors will install the concrete portion of the project. This work will be competitively bid within the local subcontracting community. Local subcontractors familiar with performing work for INL will install the concrete.
   d. This work will be performed during standard working hours and no premium time will be required for off-shift or weekend work.
   e. Work will be able to progress consecutively and will not require delays between work segments.
   f. The cost estimate does not consider or address funding or labor resource restrictions. Sufficient funding and labor resources will be available in a manner allowing optimum usage of that funding and resources as estimated.
2. Subcontractor markup rates are based on this estimator's judgment. These rates have been adjusted to reflect the anticipated market conditions.
3. The construction activities will begin in early fiscal year (FY) 2022. It is anticipated that the construction will be completed in 12 weeks. This is based on an average crew size of 4.

E. **Cost Basis:** *The source for the costing on the estimate that can be used in support of earned value management, funding profiles, and schedule of values. Sources may include published costing references, judgment, actual costs, preliminary quotes and/or other documentation upon which the estimate is originated.*

1. INL labor rates, adders, and burdens are based on the current published rates as provided by BEA Planning and Controls.
2. Craft labor rates are based on information provided by the "*INL Site Stabilization Agreement.*" Adders (such as FICA, SUTA, and federal insurances) are based on an interpretation by Cost Estimating.
3. The estimated annual escalation rate is based on an average of exponential regressions of four (4) different historical construction cost indices: RS Means Historical Cost Index, Engineering News Record (ENR), Construction Cost Index (CCI), ENR Building Cost Index (BCI), and Chemical Engineering Plant Cost Index (CEPCI). Five-year, ten-year, and fifty-year trends were developed to estimate the most likely annual escalation rate that has been used in this estimate. Inflationary and deflationary impacts will be addressed within the estimate and/or in management reserve.
4. Sales tax on materials is based on the current 6% rate charged by the State of Idaho.
5. Standard published industry references were used to help develop the estimated resources and their productivities and some material costs.
6. Preliminary vendor pricing was used to supply the remaining material costs.
7. Anticipated inflation allowances have been added to the estimate for specific materials pricing, per the project team. Percentages were obtained from the monthly commodity inflation tracking spreadsheet developed by INL.

V. **ESTIMATE QUALITY ASSURANCE:** *A listing of all estimate reviews that have taken place and the actions taken from those reviews.*

A. A draft of the cost estimate was sent to the requester on August 24, 2021. This allowed the requester to review and comment, in detail, on the perceived scope, basis of estimate, assumptions, project risks, and the resources that make up this cost estimate. Comments from this review have been incorporated into this estimate to reflect a project team consensus of this document.

B. An internal organizational check has been performed on this estimate with the purpose of checking the methodology approach used, discussing the document with the estimator, and ensuring the document has been reviewed and discussed with the requester, reflects a team consensus, has adequately documented the basis, assumptions, and risks to the project, and has mitigated those risks.

VI. **ASSUMPTIONS:** *Condition statements accepted or supposed true without proof of demonstration; statements adding clarification to scope. An assumption has a direct impact on total estimated cost.*

A. All work will be performed by BEA craft except the rebar, concrete, and trench liner.
B. All above ground electrical conduit is rigid steel.
C. Water piping will be ductile iron and polyvinyl chloride (PVC).
D. Pending requester preliminary/final funding determination, it is assumed that this scope of work is a capital asset project.

VII. **MANAGEMENT RESERVE (MR) GUIDELINE IMPLEMENTATION:**

Management Reserve Methodologies: *Explanation of methodology used in determining overall management reserve. Identify any specific drivers or items of concern and any inherent risks typical with this type of environment. Inflationary and deflationary impacts are addressed in this section.*

Per the project team, MR has been applied to this estimate for work that will be performed by BEA personnel and the subcontractors for the known unknowns. These MR rates were based upon risks identified by the project team and the cost estimator.

A. **Threats:** *Uncertain events that are potentially negative or reduce the probability that the desired outcome will happen.*

1. Final drawings were provided for this project, but not all data was provided. The estimated costs were based on the cost estimator's perceived idea as to the design requirements and project scope that will be required. Completion of the design may increase the costs due to requirements or needs not identified in the scope of this estimate.
2. This project is heavily dependent on copper, petroleum, and petroleum products. Competition for these commodities in today's environment due to global expansion uncertainty and project shortages affect the basic concepts of the supply and demand theories, thus increasing costs.
3. Preciseness in the bottom-up take-off's leaves little room if crews are unable to meet the estimated production rates. Factors could include, but are not limited to, changes to Integrated Safety Management requirements, equipment breakdowns, resource impacts, and/or availability.
4. More than normal adverse weather (cold, snow, rain, and wind) could cause losses in productivity or even stop the work. This loss in productivity or stoppage would still require for the operating contractor's forces to be compensated.

5. Subsurface investigations discovering areas that are impenetrable due to possible conflicts with unforeseen interferences, thus causing penetrations to be placed other than the anticipated path.
6. COVID-19 effects could cause material and labor production delays.

B. **Opportunities:** *Uncertain events that could improve the results or improve the probability that the desired outcome will happen.*

1. Well-planned-out work activities and scheduling by the subcontractors could result in increased production, thus producing lower bids and operating contractor oversight costs than what have been estimated.
2. Optimization of the design could reduce the utility runs, thus reducing the costs associated with those activities.

C. **Accepted Risks:** *Activities with a greater than 50% and less than 100% probability of occurrence have been accepted as part of this scope of work.*

None.

D. **Excluded Risks:** *Risks that have been identified and have a probability of occurrence but are specifically excluded from this estimate.*

None.

Note: Management reserve does not increase the overall accuracy of the estimate; it does, however, reduce the level of risk associated with the estimate. Management reserve is intended to cover the inadequacies in the complete project scope definition, estimating methods, and estimating data. Management reserve specifically excludes changes in project scope, unexpected work stoppages, (e.g., strikes, disasters, and earthquakes) and excessive and/or unexpected inflation or currency fluctuations. This estimate does not contain any contingencies and has not been evaluated to include any contingencies and has not been evaluated to include any of the risks that pertain to Department of Energy.

VIII. OTHER COMMENTS/CONCERNS SPECIFIC TO THE ESTIMATE:

None.

Appendix B – Informal Cost Estimate Update, March 2022

Mark Bigler 3/7/2022 e-mail

Option 1 refers to Phase 1, and Phase 2 is calculated by subtracting Option 1 from Option 3. (Option 2 was a middle alternative that gets a head start on the phase 2 installation)

From: Mark E. Bigler
To: Stephen J. Reese
Subject: 3C01 WSTB ICS upgrades - Options
Date: Monday, March 07, 2022 1:30:02 PM

Steve,

Here are the estimated costs for options 1,2, and 3:

Option 1: Low-$350,000 Point Value-$400,000, High-$550,000

Includes most of the electrical. I subtracted a few things around the tank.
Grading area for trailers.
2 small concrete pads for electrical.

Option 2: Low-$600,000 Point Value-$670,000, High-$900,000

Includes option 1 plus tank pad, all electrical, installation of 1 tank, stair platform, and trench around tanks.

Option 3: Low-$750,000 Point Value-$825,000, High-$1,075,000

Added one year of escalation to original estimate. Updated some of the pricing. Added 2 elec. enclosures.

We had 30% inflation already added onto the materials in the original estimate. I spot checked a few items and updated the pricing. I also added the 2 electrical enclosures I didn't have on the original estimate to all 3 options.

Thanks,

Mark

Mark Bigler
Cost Estimator
Battelle Energy Alliance, LLC
Office: 208-526-2675
Cell: 208-243-0956
Email: mark.bigler@inl.gov

Appendix C – Piping & Instrumentation Diagram

Tank Experiment P&ID, 03-26-2020.pdf

FMT-01-INL

REV	DESCRIPTION	EFFECTIVE DATE:

REVISIONS

NOTES

1. VFD DATA WILL BE COMMUNICATED TO THE HMI AND PLC VIA ETHERNET. THE FOLLOWING CONTROL MONITORING INFORMATION WILL BE INTERFACED THROUGH THE HMI:
   - HAND OFF AUTO SWITCH
   - RUN STATUS
   - PUMP RUNTIME
   - VFD FAULT/FAILURE
   - MOTOR TEMP (HIGH ALARM)
   - MOTOR CURRENT
   - MOTOR SPEED INDICATION

PROCESS NOTES

TANK 1

1. TANK 1 IS FILLED USING FIRE WATER VIA VALVES WWT-FCV-001 (FLOW CONTROL) AND WWT-SV-002 (ISOLATION).
2. THE PLC USES SIGNALS FROM WWT-PIT-001 AND WWT-PIT-002 TO DETERMINE TANK LEVEL BY AVERAGING THE TWO SIGNALS AND USING THAT VALUE AS THE CONTROL VARIABLE IN A PID. THE OUTPUT OF THE PID IS SENT TO WWT-FCV-001 AS A POSITION COMMAND. THE DESIRED TANK LEVEL IS SET VIA OPERATOR INPUT IN THE HMI.
3. ALARMS–
   LAH – ACTIVATES WHEN LEVEL EXCEEDS 9'.
   LAL – ACTIVATES WHEN LEVEL DROPS BELOW 4' 6".
   LALL – ACTIVATES WHEN LEVEL DROPS BELOW 2' AND PREVENTS WWT-PMP-101 FROM TURNING ON.
4. MECHANICAL FLOAT SWITCHES – THE FLOAT SWITCHES ACT AS FAIL SAFE DEVICES THAT FUNCTION INDEPENDENT OF THE PLC. WHEN A HIGH LEVEL IS DETECTED, A RED INDICATOR LIGHT ON THE CONTROL PANEL COMES ON AND POWER IS REMOVED TO WWT-SV-001. WHEN A LOW LEVEL IS DETECTED, A RED INDICATOR LIGHT ACTIVATES AND AN INTERLOCK PREVENTS WWT-PMP-101 FROM COMING ON (INDEPENDENT FROM THE PLC).

TANK 2

5. TANK 2 IS FILLED USING WWT-PMP-101.
6. THE PLC USES SIGNALS FROM WWT-PIT-003 AND WWT-PIT-004 TO DETERMINE TANK LEVEL BY AVERAGING THE TWO SIGNALS AND USING THAT VALUE AS THE CONTROL VARIABLE. WHEN THE LEVEL REACHES THE LOW LEVEL, THE PUMP IS TURNED ON USING A RAMP UP TO AVOID WATER HAMMER AND REMAINS ON UNTIL IT REACHES THE FULL LEVEL. THE DESIRED FULL TANK LEVEL AND LOW LEVEL IS SET VIA OPERATOR INPUT IN THE HMI.
7. ALARMS–
   LAH – ACTIVATES WHEN LEVEL EXCEEDS 9'.
   LAL – ACTIVATES WHEN LEVEL DROPS BELOW 4' 6".
   LALL – ACTIVATES WHEN LEVEL DROPS BELOW 2'.
8. MECHANICAL FLOAT SWITCHES – THE FLOAT SWITCHES ACT AS FAIL SAFE DEVICES THAT FUNCTION INDEPENDENT OF THE PLC. WHEN A HIGH LEVEL IS DETECTED, A RED INDICATOR LIGHT ON THE CONTROL PANEL COMES ON AND IS ALSO DISPLAYED IN THE HMI. IT ALSO PREVENTS THE PUMP FROM COMING ON. WHEN A LOW LEVEL IS DETECTED, A RED INDICATOR LIGHT ACTIVATES AND IS ALSO DISPLAYED IN THE HMI.

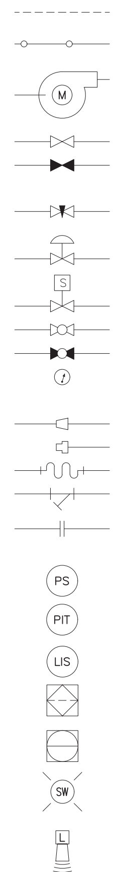
MAINTENANCE MODE:

9. ALL ACTIVE DEVICES CONTROLLED BY THE PLC/HMI CAN BE MANUALLY CONTROLLED VIA A MAINTENANCE SCREEN IN THE HMI.

ABBREVIATIONS

AI	ANALOG INPUT
AO	ANALOG OUTPUT
DI	DIGITAL INPUT
DO	DIGITAL OUTPUT
F	FLOW
FCV	FLOW CONTROL VALVE
FI	FLOW INDICATION
FIT	FLOW INDICATION TRANSMITTER
FQ	FLOW QUANTITY
FQI	FLOW QUANTITY INDICATION
FT	FLOW TRANSMITTER
GPM	GALLONS PER MINUTE
HDPE	HIGH DENSITY POLYETHYLENE
HMI	HUMAN MACHINE INTERFACE
HOA	HAND, OFF, AUTO
HSS	HOLLOW STRUCTURAL STEEL
HZ	HERTZ
IN.	INCH
IT	CURRENT TRANSMITTER
L	LEVEL
LAH	LEVEL ALARM HIGH
LAHH	LEVEL ALARM HIGH HIGH
LAL	LEVEL ALARM LOW
LALL	LEVEL ALARM LOW LOW
LIS	LEVEL INDICATOR SWITCH
LSH	LEVEL SWITCH HIGH
LSHH	LEVEL SWITCH HIGH HIGH
LSL	LEVEL SWITCH LOW
LT	LEVEL TRANSMITTER
MIN	MINIMUM
MOV	MOTOR OPERATED VALVE
P	PRESSURE
PI	PRESSURE INDICATOR
PIT	PRESSURE INDICATOR TRANSMITTER
PLC	PROGRAMMABLE LOGIC CONTROLLER
PMP	PUMP
PS	PRESSURE SWITCH
PSH	PRESSURE SWITCH HIGH
PSI	POUNDS PER SQUARE INCH
PSL	PRESSURE SWITCH LOW
SCH	SCHEDULE
SIC	SPEED INDICATOR CONTROL
SV	SOLENOID VALVE
TK	TANK
TYP	TYPICAL
V	VALVE
VFD	VARIABLE FREQUENCY DRIVE
WWT	WATER WORKS TESTBED
YC	STATE CONTROLLER (RELAY)
ZC	POSITION CONTROLLER

LEGEND



ELECTRICAL LEAD
DATA
PUMP/MOTOR
GATE VALVE
CLOSED GATE VALVE
NEEDLE VALVE
FLOW CONTROL VALVE
SOLENOID VALVE
FULL PORT BALL VALVE
CLOSED FULL PORT BALL VALVE
PRESSURE OR LIMIT INDICATOR
CONCENTRIC REDUCER
DRAIN CONNECTION
FLEXIBLE CONNECTION
STRAINER
FLANGE CONNECTION
PRESSURE SWITCH
PRESSURE INDICATOR TRANSMITTER
LEVEL INDICATOR SWITCH
PROGRAMMABLE LOGIC CONTROLLER
HUMAN MACHINE INTERFACE
PANEL MOUNT SWITCH/LIGHT COMBO
SONAR LEVEL DETECTOR

EQUIPMENT TAG

XX–XXX–XXX

SYSTEM ID FUNCTION UNIQUE IDENTIFIER

REQUESTER:	
RESP ENGR:	
DESIGN:	D. W. LEWIS
DRAWN:	L. E. NEWMAN
PROJECT NO.	
SPCL CODE	
FOR REVIEW/APPROVAL SIGNATURES SEE ECR NO.	
EFFECTIVE DATE:	XX/XX/2019

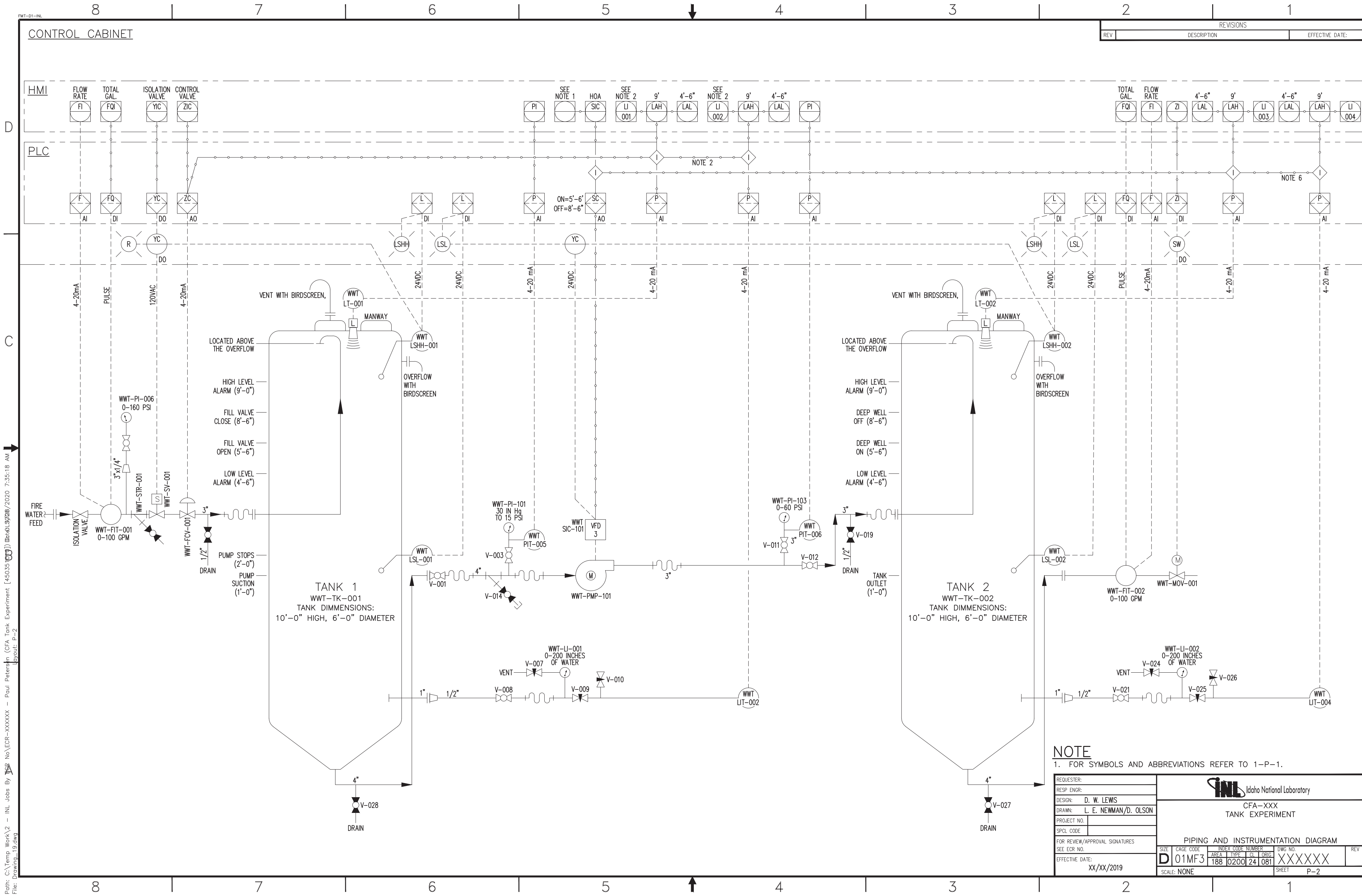
Idaho National Laboratory

CFA–XXX
TANK EXPERIMENT

SYMBOLS AND ABBREVIATIONS

SIZE	CAGE CODE	INDEX CODE NUMBER: AREA	TYPE	CL	ORIG	DWG NO.	REV
D	01MF3	188	0200	24	081	XXXXXX	

SCALE: NONE — SHEET P–1


CONTROL CABINET
HMI
PLC
REVISIONS
REV
DESCRIPTION
EFFECTIVE DATE:
FLOW RATE
TOTAL GAL
ISOLATION VALVE
CONTROL VALVE
SEE NOTE 1
HOA
SEE NOTE 2
NOTE 2
NOTE 6
ON=5'-6"
OFF=8'-6"
VENT WITH BIRDSCREEN,
MANWAY
LOCATED ABOVE THE OVERFLOW
HIGH LEVEL ALARM (9'-0")
FILL VALVE CLOSE (8'-6")
FILL VALVE OPEN (5'-6")
LOW LEVEL ALARM (4'-6")
OVERFLOW WITH BIRDSCREEN
PUMP STOPS (2'-0")
PUMP SUCTION (1'-0")
TANK 1
WWT-TK-001
TANK DIMMENSIONS:
10'-0" HIGH, 6'-0" DIAMETER
DEEP WELL OFF (8'-6")
DEEP WELL ON (5'-6")
TANK OUTLET (1'-0")
TANK 2
WWT-TK-002
TANK DIMMENSIONS:
10'-0" HIGH, 6'-0" DIAMETER
FIRE WATER FEED
WWT-FIT-001 0-100 GPM
WWT-PI-006 0-160 PSI
WWT-STR-001
WWT-SV-001
WWT-FCV-001
WWT-PI-101 30 IN Hg TO 15 PSI
WWT SIC-101
VFD 3
WWT-PMP-101
WWT-PI-103 0-60 PSI
WWT-FIT-002 0-100 GPM
WWT-MOV-001
WWT-LI-001 0-200 INCHES OF WATER
WWT-LI-002 0-200 INCHES OF WATER
DRAIN
VENT
NOTE
1. FOR SYMBOLS AND ABBREVIATIONS REFER TO 1-P-1.
REQUESTER:
RESP ENGR:
DESIGN: D. W. LEWIS
DRAWN: L. E. NEWMAN/D. OLSON
PROJECT NO.
SPCL CODE
FOR REVIEW/APPROVAL SIGNATURES SEE ECR NO.
EFFECTIVE DATE: XX/XX/2019
Idaho National Laboratory
CFA-XXX
TANK EXPERIMENT
PIPING AND INSTRUMENTATION DIAGRAM
SIZE D
CAGE CODE 01MF3
INDEX CODE NUMBER AREA 188 TYPE 0200 CI 24 ORIG 081
DWG NO. XXXXXX
SCALE: NONE
SHEET P-2

Appendix D – Procurement List of Major Components

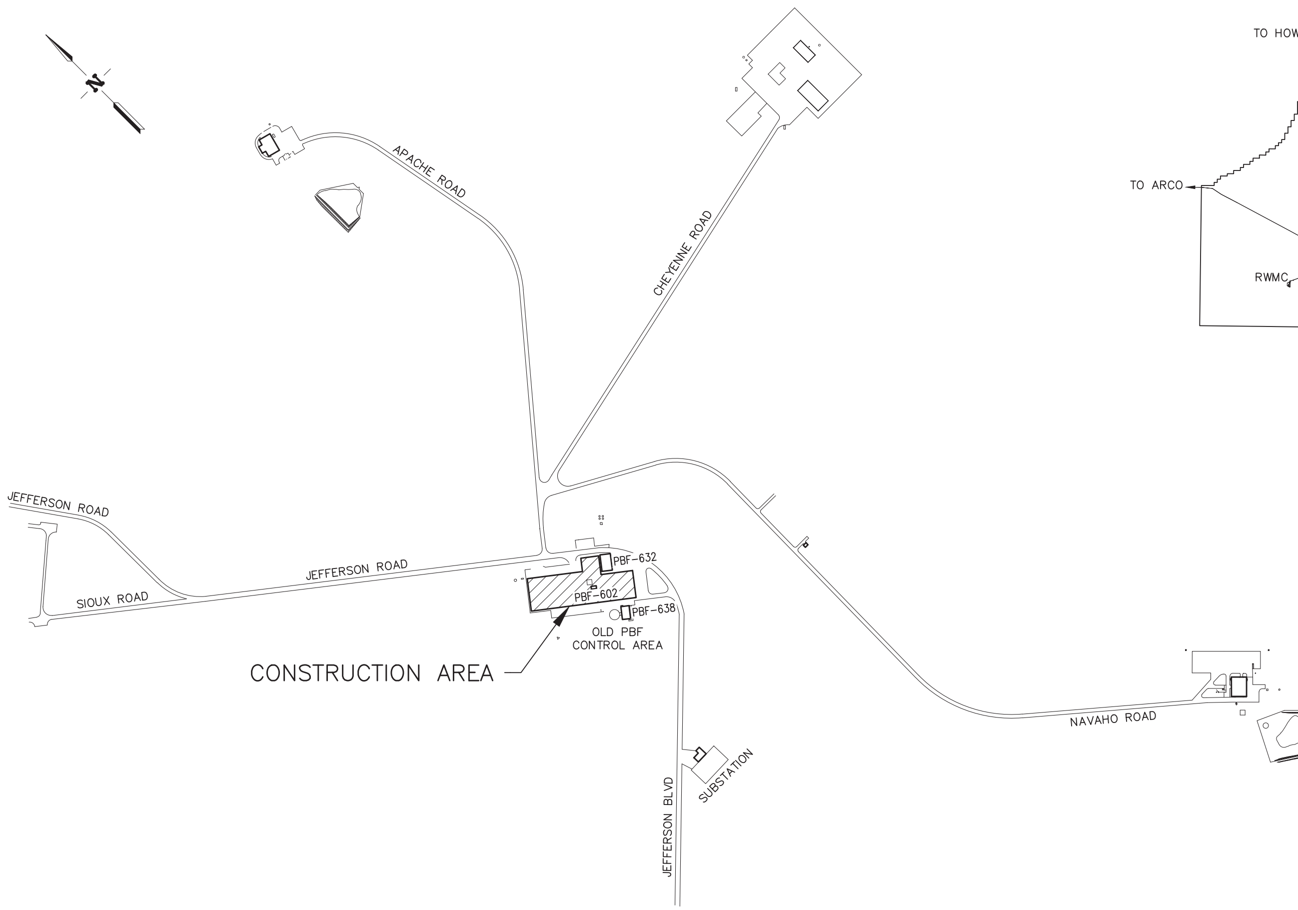
Note: Prices shown are 2021 prices.

Component ID	Mfg	Catalog #	Description	Price Each	Qty	Total Price
WWT-LT-001, WWT-LT-002	Rosemount	3102-L A 1 F RC G5	Ultrasonic Level transducer, 4-20ma, 2 relays, 1-36', 2"process mounting	$1,718	2	$3,436
WWT-LSHH-001, WWT-LSHH-002, WWT-LSL-001, WWT-LSL-002	Dwyer	L10-B-3-A	Float Switch, 1" NPT, 200psig, Brass w/ stainless float	$126	4	$504
WWT-SIC-001	Automation Direct	GS2-25PO	Variable Frequency Drive, 5hp, 230VAC, 3 phase Input, Modbus, RS-485	$384	1	$384
WWT-FIT-001	FloCat	MFE080D8110A055ER1401111S	Flow Magmeter, 3" flanges, 4-20ma, pulse, 120VAC 15' remote readout	$2,065	1	$2,065
WWT-FIT-002	FloCat	MFE100D8110A055ER1401111S	Flow Magmeter, 4" flanges, 4-20ma, pulse, 120VAC, 15' remote readout	$2,165	1	$2,165
WWT-LIT-002, WWT-LIT-004, WWT-PIT-005	Rosemount	3051C D2 A 22A1A S5 L4 M4 Q4	Diff Press. Transmitter, 4-20ma / Hart, with manifold, -250 to 250 in/wc	$3,284	3	$9,852
WWT-PIT-006	Rosemount	3051C D4 A 22A1A S5 L4 M4 Q4	Diff Press. Transmitter, 4-20ma / Hart, with manifold, -300 to 300 psi	$3,284	1	$3,284
	Rosemount	R305EC32B11L4	3 Valve manifold	$884	4	$3,536
	SQD	H322NRB	Disconnect Switch, 60 Amp, 230 VAC, 3Φ, NEMA 3R, Fusible	$245	1	$245
	Bussmann	FRNR-40	40 amp, 250VAC fuses, Time Delay	$7	6	$42
WWT-PMP-001	Goulds	6BF2G9BO	Model 3656 bronze fitted centrifugal pump, close-coupled, 1800 rpm, 2 HP 208V/3Φ motor, 200 GPM at 32 ft-hd	$2,758	1	$2,758
WWT-TK-001, WWT-TK-002	SNYDER	D8050200, D62473, D34701600	5000 GALLON SNYDER CONE BOTTOM TANK 18" MANWAY 102 diameter x 166" Height W/installed 4" SS BULKHEAD DRAIN FITTING, Painted Steel Stand for a 102" Diameter 15 Degree Cone Bottom Tank, and freight delivery charge.	$7,915	1	$7,915
WWT-SV-001	PLAST-O-MATIC	PS300EPW11-PV	3" NPT PVC 2-Way Solenoid Valve 120VAC EPDM PTFE PILOT OPERATED N/C	$1,550	1	$1,550
WWT-FCV-001	ASAHI AMERICA	2201030	3" ELECTRICALLY ACTUATED GLOBE VALVE, 120VAC AND 4-20mA, FLANGED PVC	$12,712	1	$12,712

WWT-MOV-001	ASAHI AMERICA	2902040	4" NPT ELECTRICAL ACTIVATED PVC BALL VALVE 120VAC	$1,604	1	$1,604
WWT-STR-001	Unknown	4417K71	3"NPT CAST IRON WYE-STRAINER, 80 MESH SCREEN, 400 psi @ 70° F	$234	1	$234
Platform Assembly 1	SafeRack	Custom quote	Stair and platform assembly for accessing the tops of the 5,000 gal. tanks	$17,925	1	$17,925
Geomembrane	DuraSkrim	Custom quote	Geomembrane that lines the trench and the exposed ground around the concrete slab	$2,640	1	$2,640
					Grand Total:	$72,851

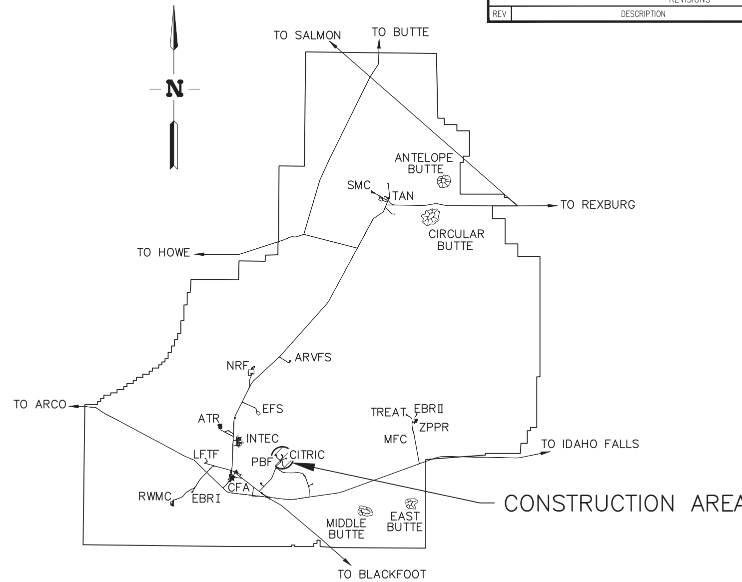
Appendix E – Mechanical and Civil Drawings

WSTB construction drawings – final, AFC_2021_WSTB_SET.pdf



CITRC AREA MAP

SCALE: 1"=300.0'



INL SITE MAP

SCALE: NONE

DRAWING INDEX

PAGE NO.	DWG NO.	SH NO.	REV	DRAWING TITLE
1	1007695	T-1		CITRC AREA MAP, INL SITE MAP AND DRAWING INDEX
2	1007696	C-1		SPECIFICATIONS, NOTES AND EQUIPMENT SCHEDULE
3	1007697	C-2		SITE PLAN
4	1007698	C-3		ENLARGED PLAN
5	1007699	C-4		SECTION
6	1007700	C-5		SECTIONS
7	1007701	C-6		DETAILS AND SECTION
8	1007702	C-7		PIPING AND INSTRUMENTATION DIAGRAM
9	1007703	S-1		ISOMETRIC VIEW, DETAILS AND PARTS LIST
10	1007704	E-1		GENERAL ELECTRICAL NOTES
11	1007705	E-2		ELECTRICAL SITE PLAN AND SECTION
12	1007706	E-3		ENLARGED ELECTRICAL SITE PLAN
13	1007707	E-4		ENLARGED INSTRUMENTATION PLAN
14	1007708	E-5		DETAIL AND SECTION
15	1007709	E-6		DETAIL
16	1007710	E-7		DETAILS AND PHOTO

REVISIONS

REV	DESCRIPTION	EFFECTIVE DATE:

FOR DRAWING INDEX SEE DRAWING NO. 1007695

SCALE: 1" = 300.0'

DESIGN PHASE: AFC

REQUESTER: S.J. REESE
RESP ENGR: L. GUILLEN
DESIGN: K.L. SPARROW
DRAWN: K.L. SPARROW
PROJECT NO. NA
SPCL CODE NA
FOR REVIEW/APPROVAL SIGNATURES SEE DCR NO. 688357
EFFECTIVE DATE: 7/23/2021

Idaho National Laboratory

CITRC

WATER TEST BED PROJECT

CITRC AREA MAP, INL SITE MAP AND DRAWING INDEX

SIZE D | CAGE CODE 01MF3 | INDEX CODE NUMBER: AREA 760, TYPE 0100, CI 01, ORIG 081 | DWG NO. 1007695 | REV 000A

SCALE: NOTED | SHEET T-1

FMT-01-INL, R-3, 3-2021

Path: C:\Users\OLSODB\Documents\HOMEWORK\2 - INL Jobs By ECR No\DCR-688357- Paul Petersen (CITRC Water Test Bed [4504311001]) Date: 7/22/2021 3:26:47 PM
File: 1007695.dwg Layout: Layout1

REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE:

SPECIFICATIONS

EARTHWORK

1. WORK INCLUDES
   - A. CLEARING AND GRUBBING AS REQUIRED.
   - B. EXCAVATING ALL MATERIALS ENCOUNTERED, OF EVERY DESCRIPTION, FOR COMPLETION OF WORK AS SHOWN ON THE DRAWINGS AND AS SPECIFIED HEREIN.
   - C. BACKFILLING OF ALL EXCAVATION
   - D. COMPACTING ALL BACKFILL AND SUBGRADE AS SPECIFIED HEREIN.
   - E. FINISH GRADING AND GRADING FOR SURFACE DRAINAGE.
   - F. BACKFILL AND FILL MATERIAL: "SATISFACTORY" SOIL MATERIALS FREE OF CLAY, ROCK, GRAVEL LARGER THAN 3 INCHES IN ANY DIMENSION, DEBRIS, WASTE, FROZEN MATERIALS, VEGETABLE AND OTHER DELETERIOUS MATTER. SELECT PIT RUN GRAVEL IS AVAILABLE AT THE LINCOLN BOULEVARD GRAVEL PIT.
   - G. AGGREGATE BASE OR LEVELING COURSE MATERIAL: NATURALLY OR ARTIFICIALLY GRADED MIXTURE OF 3/4 IN. MAXIMUM SIZE CRUSHED GRAVEL, CRUSHED STONE, NATURAL AND CRUSHED SAND. MATERIAL SHALL MEET THE REQUIREMENTS OF ITD SSHC SUBSECTION 703.04.

2. EXCAVATION
   - A. CLEARING AND GRUBBING: STRIP AND GRADE THE EXISTING WORK AREA AS SHOWN ON THE ATTACHED DRAWINGS. REMOVE BUILT UP TRENCHED AREAS, EXISTING STOCKPILES AND REUSE MATERIALS IF SUITABLE. REGRADE AND COMPACT THE ENTIRE AREA. REMOVE AND DISPOSE OF THE SPOIL BERM LOCATED ON THE NORTHWEST EDGE OF THE SITE. BACKFILL WITH COMPACTED FILL MATERIAL. STOCKPILING AND DISPOSAL: EXCAVATED MATERIAL THAT IS SUITABLE AND REQUIRED FOR BACKFILLING, GRADING OR TOPSOIL, SHALL BE PILED IN AN ORDERLY AND KEPT FREE FROM VEGETATION AND OTHER OBJECTIONABLE MATERIALS.

BACKFILL OR FILL

GENERAL:
THE EXCAVATIONS SHALL BE CLEARED OF ALL TRASH AND DEBRIS PRIOR TO BACKFILLING OR FILLING. ALL BACKFILL OR FILL MATERIAL SHALL BE FREE FROM TRASH, ORGANIC MATTER AND FROZEN PARTICLES. BACKFILLING OR FILLING SHALL BE DONE ONLY WHEN APPROVED BY THE CONTRACTOR.

CONCRETE SLAB:
BACKFILL OR FILL MATERIALS UNDER CONCRETE SLABS SHALL BE COMPACTED FILL MATERIAL, EXCEPT THAT THE LAST 6 IN. OF SUCH FILL SHALL BE COMPACTED LEVELING COURSE MATERIAL.

PLACEMENT:
CONCENTRATED DUMPING OF BACKFILL OR FILL MATERIAL INTO EXCAVATIONS WILL NOT BE PERMITTED. NO WATER SHALL BE USED FOR PLACING, SETTLING OR COMPACTING BACKFILL OR FILL EXCEPT TO OBTAIN OPTIMUM MOISTURE CONTENT. ALL MATERIAL MUST BE PLACED IN UNIFORM LAYERS NOT TO EXCEED 8". LOOSE MEASUREMENT AND BROUGHT UP SIMULTANEOUSLY AND EVENLY ON BOTH SIDES OF CONCRETE SLABS. SEE COMPACTION REQUIREMENTS.

COMPACTION:
ALL BACKFILL MATERIAL AND SURFACE PREP FOR THE CONCRETE SLAB SHALL BE COMPACTED. IF VIBRATORY PLATE COMPACTOR IS USED, LOOSE MEASUREMENT LIFTS OF BACKFILLED MATERIAL PRIOR TO COMPACTION SHALL BE NO MORE THAN 4" WITH A MINIMUM OF 3 PASSES. IF JUMPING JACK TYPE (RAMMER/TAMPER) COMPACTOR IS USED, LOOSE MEASUREMENT LIFTS OF BACKFILLED MATERIAL PRIOR TO COMPACTION SHALL BE NO MORE THAN 8" WITH A MINIMUM OF 3 PASSES, A VISUAL UNIFORM LEVEL OF COMPACTION SHALL BE ACHIEVED WITH EACH LIFT.

DRAINAGE SYSTEM

DRAINAGE PIPE AND FITTINGS: THE DRAINAGE PIPE AND FITTINGS SHALL BE HIGH-DENSITY POLYETHYLENE PIPE IN CONFORMANCE WITH ASTM F2648. PIPE SHALL BE JOINED USING BELL AND SPIGOT JOINTS CONFORMING TO ASTM F2648. JOINTS SHALL BE SOIL-TIGHT WITH GASKETS (IF USED) MEETING THE REQUIREMENTS OF ASTM F477.
INSTALL DRAINAGE SYSTEM STRUCTURES, PIPES AND ACCESSORIES TO LINES AND GRADES SHOWN ON THE DRAWINGS AND AS SPECIFIED BY THE MANUFACTURER.

FIELD QUALITY CONTROL

SURVEILLANCE WILL BE PERFORMED BY THE CONTRACTOR'S REPRESENTATIVE TO VERIFY COMPLIANCE OF THE WORK TO THESE DRAWINGS.

NOTES

1. CONCRETE TO BE CLASS 45 (4500 PSI).
2. CONCRETE TANK PAD SHALL HAVE SMOOTH TROWELED FINISH WITH CHAMFERED EDGES AS SHOWN.
3. THE CONCRETE MATERIALS AND ADMIXTURES SHALL COMPLY WITH ACI 301
4. MIX DESIGN: PREPARE DESIGN MIXES FOR EACH TYPE AND STRENGTH OF CONCRETE BY EITHER LABORATORY TRIAL BATCH OR FIELD EXPERIENCE METHODS AS SPECIFIED IN ACI 318 AND 301. THE SUBCONTRACTOR SHALL PROVIDE THE NECESSARY TESTING AND MONITORING TO QUALIFY PROPOSED MATERIALS AND ESTABLISH MIX DESIGNS. THE CONCRETE MIX SHALL CONTAIN A POZZOLAN (FLY ASH), MINIMUM AMOUNT SHALL BE 15% BY WEIGHT OF THE TOTAL CEMENTITIOUS MATERIALS UNLESS OTHERWISE APPROVED.
5. PROVIDE COPY OF MIX DESIGN WITH BATCH TICKET TO THE OPERATING CONTRACTORS REPRESENTATIVE AT TIME OF PLACEMENT.
6. REINFORCING BARS: ASTM A615, GRADE 60, DEFORMED. SPLICING OF REINFORCEMENT SHALL BE IN ACCORDANCE WITH ACI 318, CHAPTERS 7 AND 12. UNLESS OTHERWISE SPECIFIED, ALL SPLICES SHALL BE CLASS B TENSION SPLICES FOR REGULAR BARS.
7. THE MANUFACTURE AND DELIVERY, FORMING, PLACING AND CURING OF ALL CONCRETE SHALL CONFORM TO ACI 301. HAND-MIXED CONCRETE IS PROHIBITED. REMOVE FORMS AND PERFORM SURFACE REPAIRS ALSO IN ACCORDANCE WITH ACI 301.
8. ALL LOOSE MATERIAL ON THE COMPACTED / PREPARED SURFACE FOR CONCRETE SLAB REPLACEMENT GREATER THAN 1" IN SIZE SHALL BE REMOVED.
9. FOR CONCRETE PLACEMENT AND CURING, TEMPERATURE LIMITS SHALL BE IN ACCORDANCE WITH ACI-301.
10. COLD WEATHER PLACEMENT OF CONCRETE, AS DEFINED BY ACI, SHALL COMPLY WITH ACI-306.
11. IMMEDIATELY BEFORE CONCRETE PLACEMENT LIGHTLY FOG FORMS, BASE GRADE AND REBAR WITH WATER LEAVING NO STANDING WATER.
12. CONCRETE SHALL BE PLACED WITH A MAXIMUM 4" SLUMP.
13. WATER TEST BED PROJECT GEOMEMBRANE INSTALLATION INSTRUCTIONS SHALL BE USED AS GUIDANCE FOR SURFACE PREPARATION, UNDERLINER INSTALLATION, GEOMEMBRANE HANDLING, BALLASTING OF GEOMEMBRANE, SECURING GEOMEMBRANE TO CONCRETE SLAB, SEAM WELDING, AND SEAM TESTING.

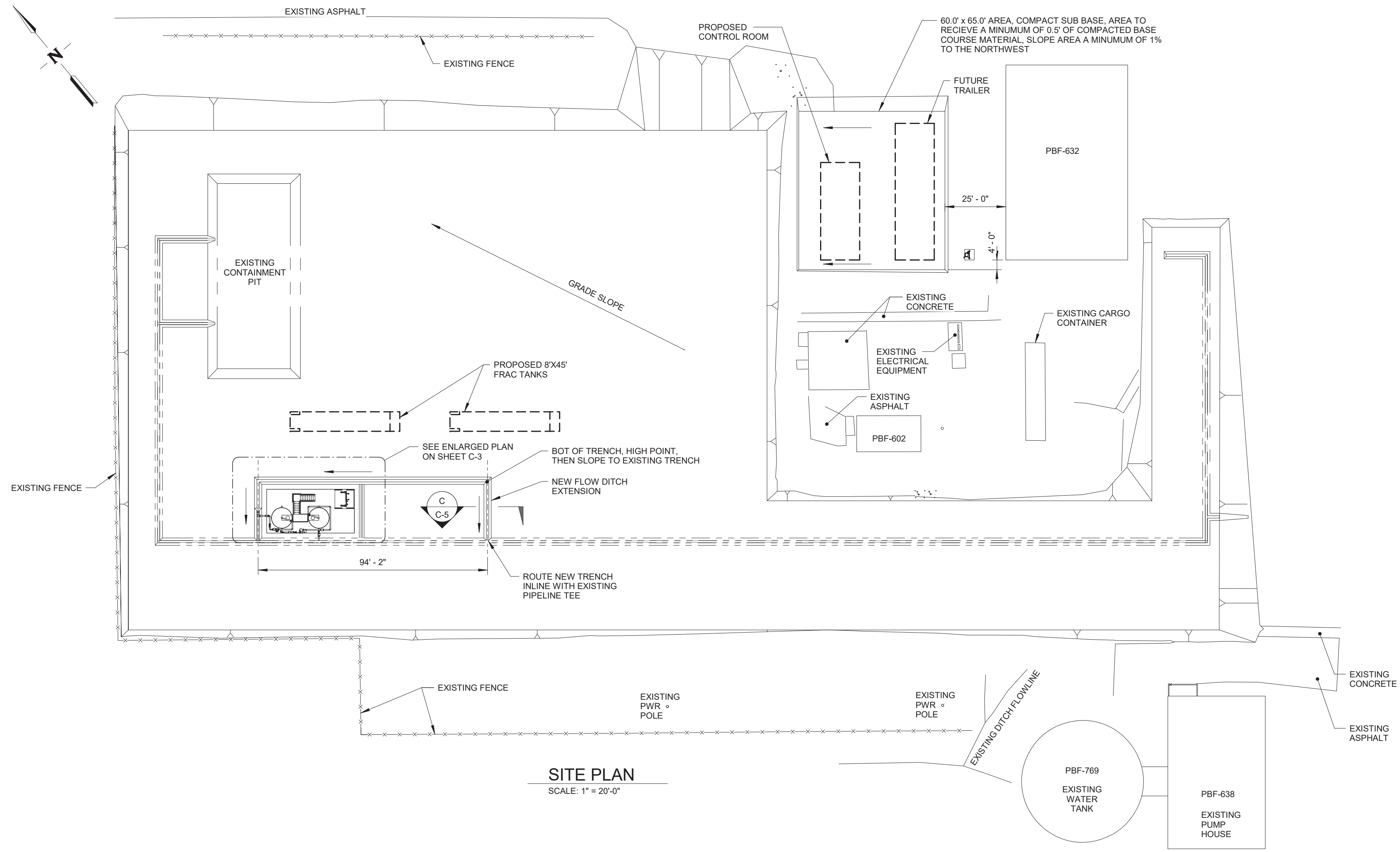
PIPING GENERAL NOTES

1. THE WORK REQUIRED CONSISTS OF PERFORMING ALL LABOR AND FURNISHING ALL MATERIALS, FIXTURES AND EQUIPMENT REQUIRED TO PROVIDE A COMPLETE INSTALLATION OF ALL PIPING SYSTEMS AS INDICATED IN THE APPROVED DRAWINGS. IT SHALL FURTHER INCLUDE FURNISHING AND INSTALLING ALL ASSOCIATED ITEMS REQUIRED FOR THE PROPER OPERATION OF ALL PIPING SYSTEMS EXCEPT AS IDENTIFIED ON THE SCHEDULE X.
2. DRAWINGS ARE DIAGRAMMATIC, CONTAINING INFORMATION TO A DEGREE OF DETAIL CONSISTENT WITH THEIR SCALE AND ADEQUATE TO CONVEY THE DESIGN INTENT. THE SUBCONTRACTOR IS RESPONSIBLE FOR VERIFICATION OF ALL FIELD DIMENSIONS, LOCATIONS AND CONDITIONS PRIOR TO THE PURCHASE OF ANY MATERIALS AND COMMENCEMENT OF WORK. NOTIFY THE CONSTRUCTION FIELD REPRESENTATIVE (CFR) OF ALL DISCREPANCIES THAT WILL AFFECT THE WORK FOR RESOLUTION.
3. ALL PIPING SHALL BE INSTALLED IN SUCH A MANNER THAT IT IS DRAINABLE SO AS TO AVOID DAMAGE FROM FREEZING. THE SYSTEM WILL NOT BE OPERATED DURING WINTER AND IS TO BE INSTALLED SO THAT IT CAN BE SHUTDOWN AND DRAINED PRIOR TO TEMPERATURES DROPPING BELOW FREEZING.
4. ALL EXISTING BUILDING AND SITE FEATURES NOT BEING ALTERED BY THIS PROJECT ARE TO BE PROTECTED FROM DAMAGE.
5. PROTECT ALL PIPING AND EQUIPMENT FROM FOREIGN MATERIAL CONTAMINATION DURING CONSTRUCTION.
6. PRIOR TO ASSEMBLY, PIPING/FITTINGS SHALL BE CLEANED AND VISUALLY FREE FROM GREASE, CUTTING OILS, LOOSE PARTICLES, CHIPS, AND OTHER MATERIALS NOT FORMING A PART OF THE FINISHED PRODUCT.
7. WHERE REDUCING FITTINGS (TEES, CROSSES, OR ELBOWS) ARE CALLED OUT ON THE DRAWINGS, REDUCERS MAY BE SUBSTITUTED TO ACHIEVE THE DESIRED SIZE IF THE CALLED-OUT FITTINGS ARE NOT EASILY AVAILABLE.
8. PERFORM IN-SERVICE LEAK TEST BY SUBJECTING THE PIPING TO NORMAL WORKING PRESSURE AND CHECK FOR EVIDENCE OF LEAKAGE AFTER 15 MINUTES.
9. EXTEND AND SECURE ALL PIPE EXITING DRAIN VALVES TO SOUTHWEST OR NORTHWEST EDGES OF NEW CONCRETE PAD.

PIPING EQUIPMENT SCHEDULE

COMPONENT ID	MANUFACTURE	CATALOG #	DESCRIPTION
WWT-AAV-001	CALEFFIE	5022	1/2 INCH MPT BRASS AUTOMATIC AIR VENT
WWT-FCV-001	ASAHI AMERICA	2201030	3" ELECTRICALLY ACTUATED GLOBE VAVLE, 120VAC AND 4-20mA, FLANGED PVC
WWT-FIT-001	FLOCAT	MFE100D8110A055ER14 01111S	FLOW MAGMETER 4" FLANGES, 4-20ma, PULSE, 120VAC 15' REMOTE READOUT
WWT-FIT-002	FLOCAT	MFE100D8110A055ER14 01111S	FLOW MAGMETER 4" FLANGES, 4-20ma, PULSE, 120VAC 15' REMOTE READOUT
WWT-MOV-001	ASAHI AMERICA	2902040	4" NPT ELECTRICAL ACTIVATED PVC BALL VALVE 120VAC
WWT-PI-006	FERGUSON	FNWG0160R	4 1/2" DIAM PRESSURE GAUGE, 1/4 INCH BRONZE MNPT BOTTOM MOUNT, 0-160PSI
WWT-PI-101	FERGUSON	421932	3 1/2" DIAM PRESSURE GAUGE, 1/4 INCH BRONZE MNPT BOTTOM MOUNT, 30 INHG-300PSI
WWT-PI-103	FERGUSON	FNWG0100R	4 1/2" DIAM PRESSURE GAUGE, 1/4 INCH BRONZE MNPT BOTTOM MOUNT, 0-100PSI
WWT-PMP-101	GOULDS	6BF2G9BO	MODEL 3656 BRONZE FITTED CENTRIFUGAL PUMP, CLOSE-COUPLED, 1800 RPM, 2 HP 208V MOTOR, 200 GPM AT 32 FT-HD
WWT-STR-001	ZURN	FSC	4 INCH DUCTILE IRON "Y" STRAINER, FLANGED CLASS 150
WWT-STR-002	ZURN	FSC	4 INCH DUCTILE IRON "Y" STRAINER, FLANGED CLASS 150
WWT-SV-001	PLAST-O-MATIC	PS300EPW11-PV	3" NPT PVC 2-WAY SOLENOID VALVE 120VAC EPDM PTFE PILOT OPERATED N/C
WWT-TK-001	SNYDER	8050200N_01	5,000 GALLON CONE BOTTOM P/W TANK W/ 4" TANK BULKHEAD FITTING ON BOTTOM PLUS STEEL STAND FOR 5000 GALLON CONE BOTTOM TANK
WWT-TK-002	SNYDER	8050200N_01	5,000 GALLON CONE BOTTOM P/W TANK W/ 4" TANK BULKHEAD FITTING ON BOTTOM PLUS STEEL STAND FOR 5000 GALLON CONE BOTTOM TANK
WWT-V-001	CLOW	F-6102	4 INCH, RESILIENT SEAT GATE VALVE, FLANGED
WWT-V-002	CLOW	F-6102	4 INCH, RESILIENT SEAT GATE VALVE, FLANGED
WWT-V-003	APOLLO	70-100 SERIES	1/2 INCH NPT THREADED BALL VALVE, BRONZE BODY
WWT-V-006	APOLLO	70-100 SERIES	1/2 INCH NPT THREADED BALL VALVE, BRONZE BODY
WWT-V-011	APOLLO	70-100 SERIES	1/2 INCH NPT THREADED BALL VALVE, BRONZE BODY
WWT-V-012	CRANE	FIGURE 143	4 INCH GLOBE VALVE, FLANGED, CLASS 150, OS&Y, BOLTED BONNET
WWT-V-013	APOLLO	70-100 SERIES	1/2 INCH NPT THREADED BALL VALVE, BRONZE BODY
WWT-V-014	APOLLO	70-100 SERIES	1/2 INCH NPT THREADED BALL VALVE, BRONZE BODY
WWT-V-019	APOLLO	70-100 SERIES	1/2 INCH NPT THREADED BALL VALVE, BRONZE BODY
WWT-V-027	APOLLO	70-100 SERIES	1/2 INCH NPT THREADED BALL VALVE, BRONZE BODY
WWT-V-028	APOLLO	70-100 SERIES	1/2 INCH NPT THREADED BALL VALVE, BRONZE BODY

FOR DRAWING INDEX SEE DRAWING NO. 1007695	REQUESTER: S.J. REESE	Idaho National Laboratory
NO SCALE	RESP ENGR: T.O. LYBBERT	CITRC
	DESIGN: T.O. LYBBERT	WATER SECURITY TEST BED PROJECT
	DRAWN: J.K. KOHLER	SPECIFICATIONS, NOTES AND EQUIPMENT SCHEDULE
	PROJECT NO. NA	SIZE D; CAGE CODE 01MF3; INDEX CODE NUMBER: AREA 760, TYPE 0100, CL 00, ORIG 081; DWG NO. 1007696; REV 000A
	SPCL CODE NA	SCALE: NONE
	FOR REVIEW/APPROVAL SIGNATURES SEE DCR NO. 688357	SHEET C-1
DESIGN PHASE: AFC	EFFECTIVE DATE: 7-23-2021	



SITE PLAN
SCALE: 1" = 20'-0"

REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE:

FOR DRAWING INDEX SEE DRAWING NO. 1007695

SCALE: 1" = 20'-0" (0, 10', 20', 40')

DESIGN PHASE: AFC

REQUESTER: S.J. REESE
RESP ENGR: T.O. LYBBERT
DESIGN: T.O. LYBBERT
DRAWN: J.K. KOHLER
PROJECT NO. NA
SPCL CODE NA
FOR REVIEW/APPROVAL SIGNATURES SEE DCR NO. 688357
EFFECTIVE DATE: 7-23-2021

Idaho National Laboratory

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WATER SECURITY TEST BED PROJECT

SITE PLAN

SIZE	CAGE CODE	INDEX CODE NUMBER AREA	TYPE	CL	ORIG	DWG NO.	REV
D	01MF3	760	0100	02	081	1007697	000A

SCALE: NOTED
SHEET C-2

3

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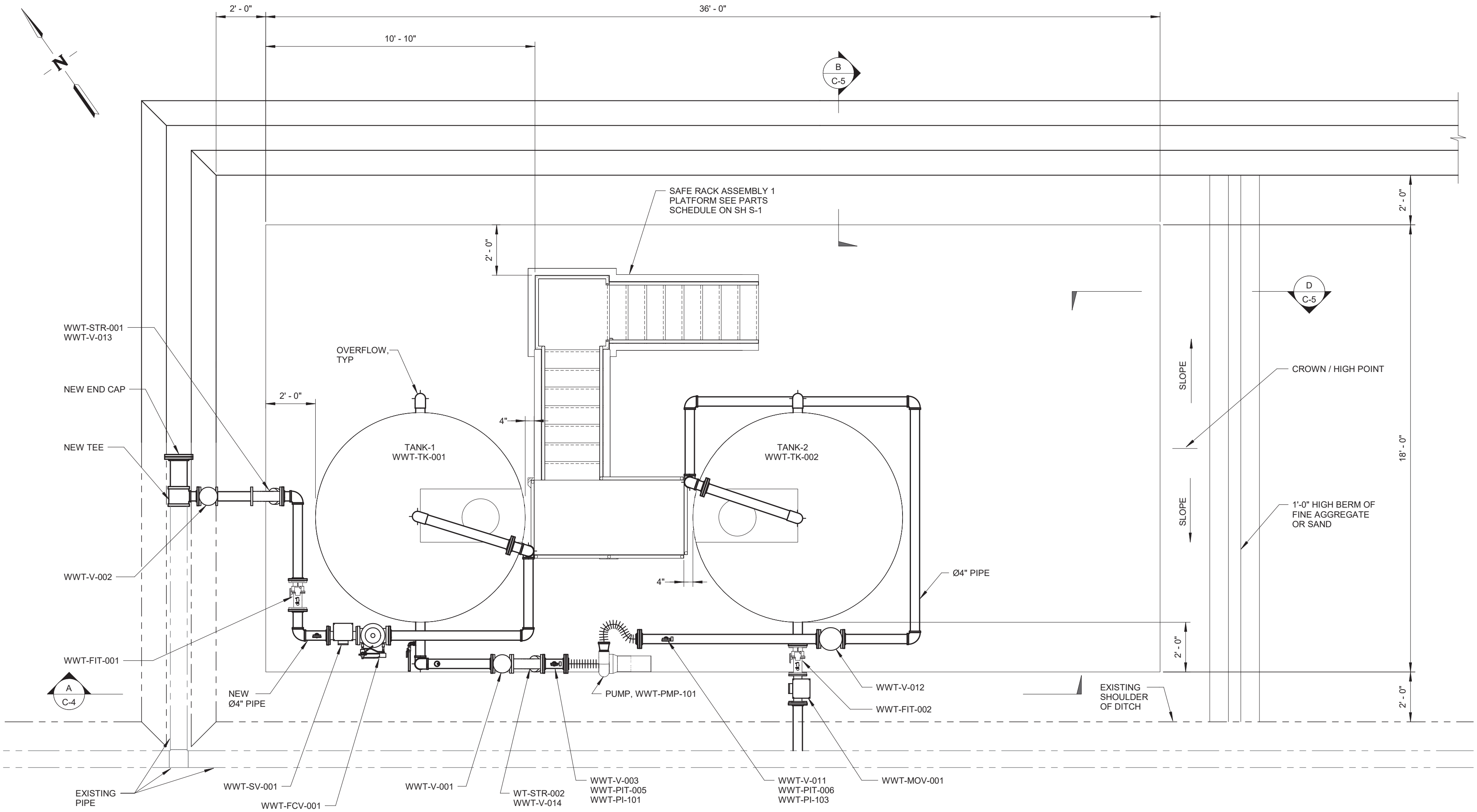

ENLARGED PLAN

SCALE: 1/2" = 1'-0"

REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE:

FOR DRAWING INDEX SEE DRAWING NO. 1007695

SCALE: 1/2" = 1'-0"

DESIGN PHASE: AFC

REQUESTER: S.J. REESE
RESP ENGR: T.O. LYBBERT
DESIGN: T.O. LYBBERT
DRAWN: J.K. KOHLER
PROJECT NO. NA
SPCL CODE NA
FOR REVIEW/APPROVAL SIGNATURES SEE DCR NO. 688357
EFFECTIVE DATE: 7-23-2021

Idaho National Laboratory

CITRC

WATER SECURITY TEST BED PROJECT

ENLARGED PLAN

SIZE	CAGE CODE	AREA	TYPE	CL	ORIG	DWG NO.	REV
D	01MF3	760	0100	02	081	1007698	000A

SCALE: 1/2"=1'-0" SHEET C-3

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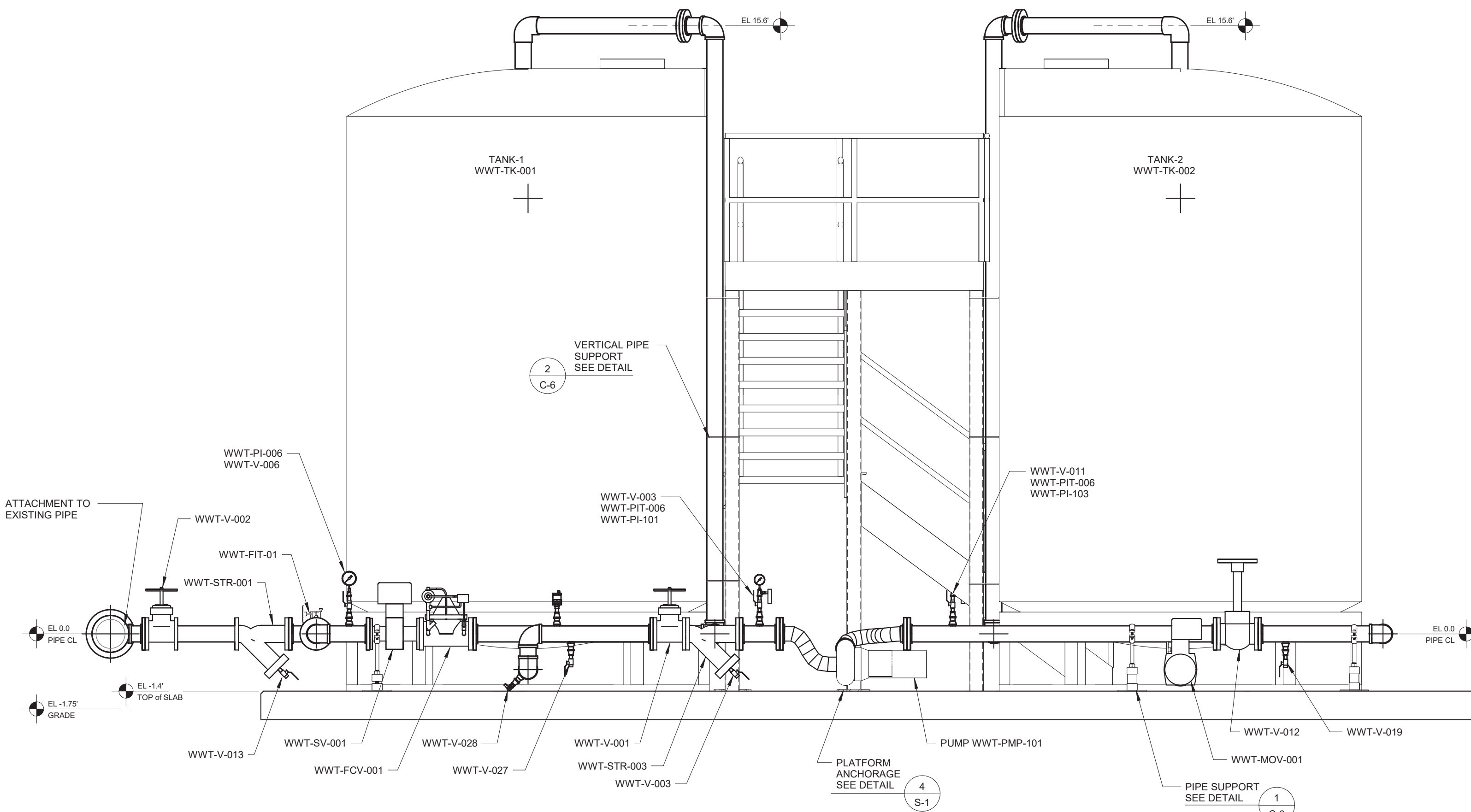


NOTE:
SLOPE ALL PIPES 1/4" PER FOOT
TOWARDS DRAINS, TYP.

A
C-3
SECTION
SCALE: 3/4" = 1'-0"

REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE:

FOR DRAWING INDEX SEE DRAWING NO. 1007695
SCALE: 3/4" = 1'-0"
DESIGN PHASE: AFC

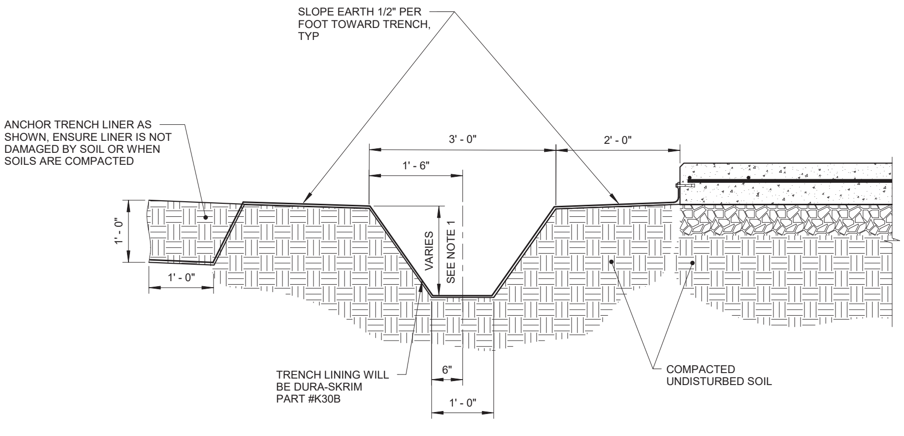
REQUESTER: S.J. REESE
RESP ENGR: D.W. LEWIS
DESIGN: D.W. LEWIS
DRAWN: J.K. KOHLER
PROJECT NO. NA
SPCL CODE NA
FOR REVIEW/APPROVAL SIGNATURES SEE DCR NO. 688357
EFFECTIVE DATE: 7-23-2021

Idaho National Laboratory
CITRC
WATER SECURITY TEST BED PROJECT
SECTION

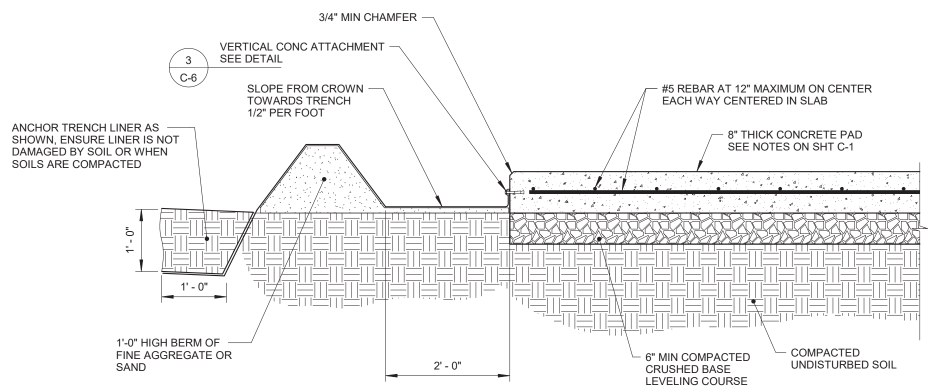
SIZE	CAGE CODE	AREA	TYPE	CL	ORIG	DWG NO.	REV
D	01MF3	760	0100	02	081	1007699	000A

SCALE: 3/4" = 1'-0"
SHEET C-4

REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE:



B C-3 **SECTION**
SCALE: 1" = 1'-0"



D C-3 **SECTION**
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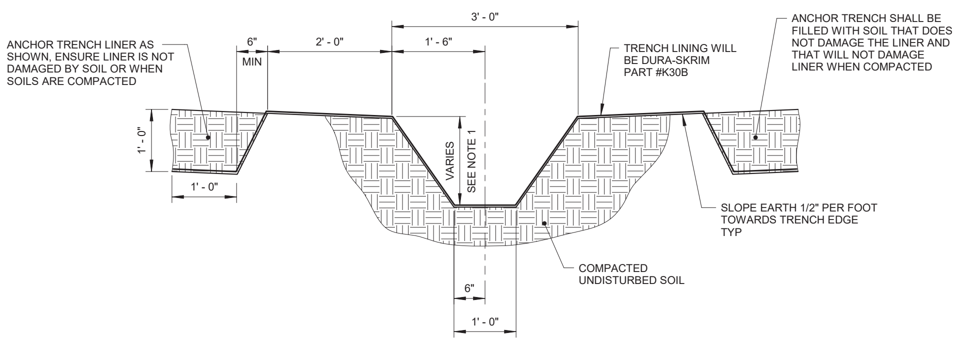


C C-2 **SECTION**
SCALE: 1" = 1'-0"

NOTE

1. NEW TRENCH DEPTH SHALL VARY TO MAINTAIN DRAINAGE BACK TO MAIN EXISTING TRENCH AS SHOWN ON SHEET C-2.

FOR DRAWING INDEX SEE DRAWING NO.	1007695
SCALE: 1" = 1'-0" (0, 1/2', 1', 2')	
DESIGN PHASE:	AFC
REQUESTER:	S.J. REESE
RESP ENGR:	T.O. LYBBERT
DESIGN:	T.O. LYBBERT
DRAWN:	J.K. KOHLER
PROJECT NO.	NA
SPCL CODE	NA
FOR REVIEW/APPROVAL SIGNATURES SEE DCR NO.	688357
EFFECTIVE DATE:	7-23-2021

Idaho National Laboratory
CITRC
WATER SECURITY TEST BED PROJECT
SECTIONS

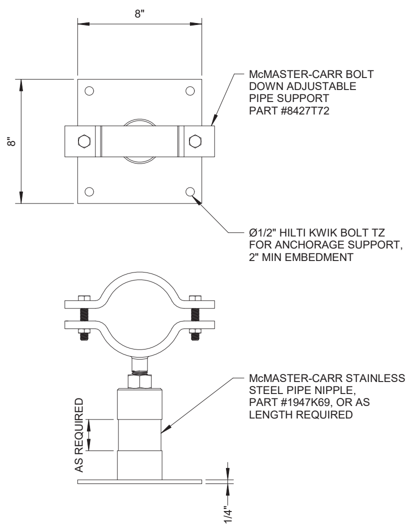
SIZE	CAGE CODE	AREA	TYPE	CL	ORIG	DWG NO.	REV
D	01MF3	760	0100	02	081	1007700	000A

SCALE: 1"=1'-0" SHEET C-5

Revit File: O:\Project Files\REVIT_START\REVIT_Projects\1007695_WSTB_PROJECT.rvt
Date: 7/23/2021 7:28:03 AM

REV	DESCRIPTION	EFFECTIVE DATE:

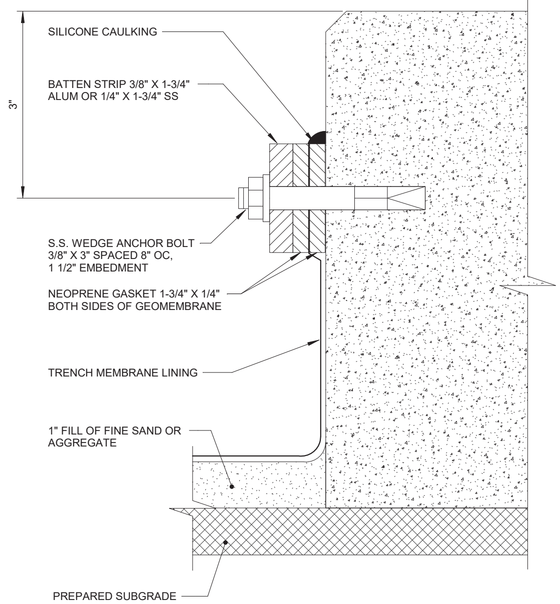
REVISIONS



PIPE SUPPORT

1 / C-4 DETAIL

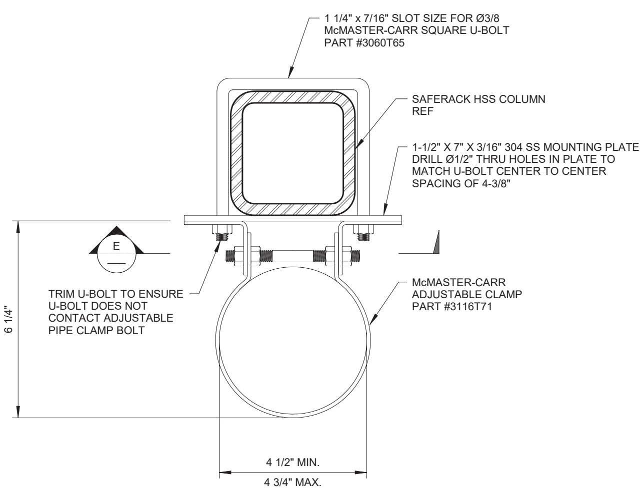
SCALE: 3" = 1'-0"



VERTICAL CONC ATTACHMENT

3 / C-5 DETAIL

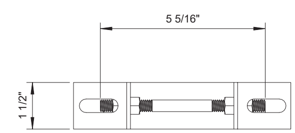
NTS



PIPE CLAMP

2 / C-4 DETAIL

SCALE: 6" = 1'-0"



E SECTION

SCALE: 6" = 1'-0"

FOR DRAWING INDEX SEE DRAWING NO. 1007695

SCALE: 3" = 1'-0"

SCALE: 6" = 1'-0"

DESIGN PHASE: AFC

REQUESTER:	S.J. REESE
RESP ENGR:	T.O. LYBBERT
DESIGN:	T.O. LYBBERT
DRAWN:	J.K. KOHLER
PROJECT NO.	NA
SPCL CODE	NA
FOR REVIEW/APPROVAL SIGNATURES SEE DCR NO.	688357
EFFECTIVE DATE:	7-23-2021

Idaho National Laboratory

CITRC

WATER SECURITY TEST BED PROJECT

DETAILS AND SECTION

SIZE	CAGE CODE	AREA	TYPE	CL	ORIG	DWG NO.	REV
D	01MF3	760	0100	02	081	1007701	000A

SCALE: NOTED — SHEET C-6

Revit File: O:\Project Files\REVIT_START\REVIT_Projects\1007695_WSTB_PROJECT.rvt
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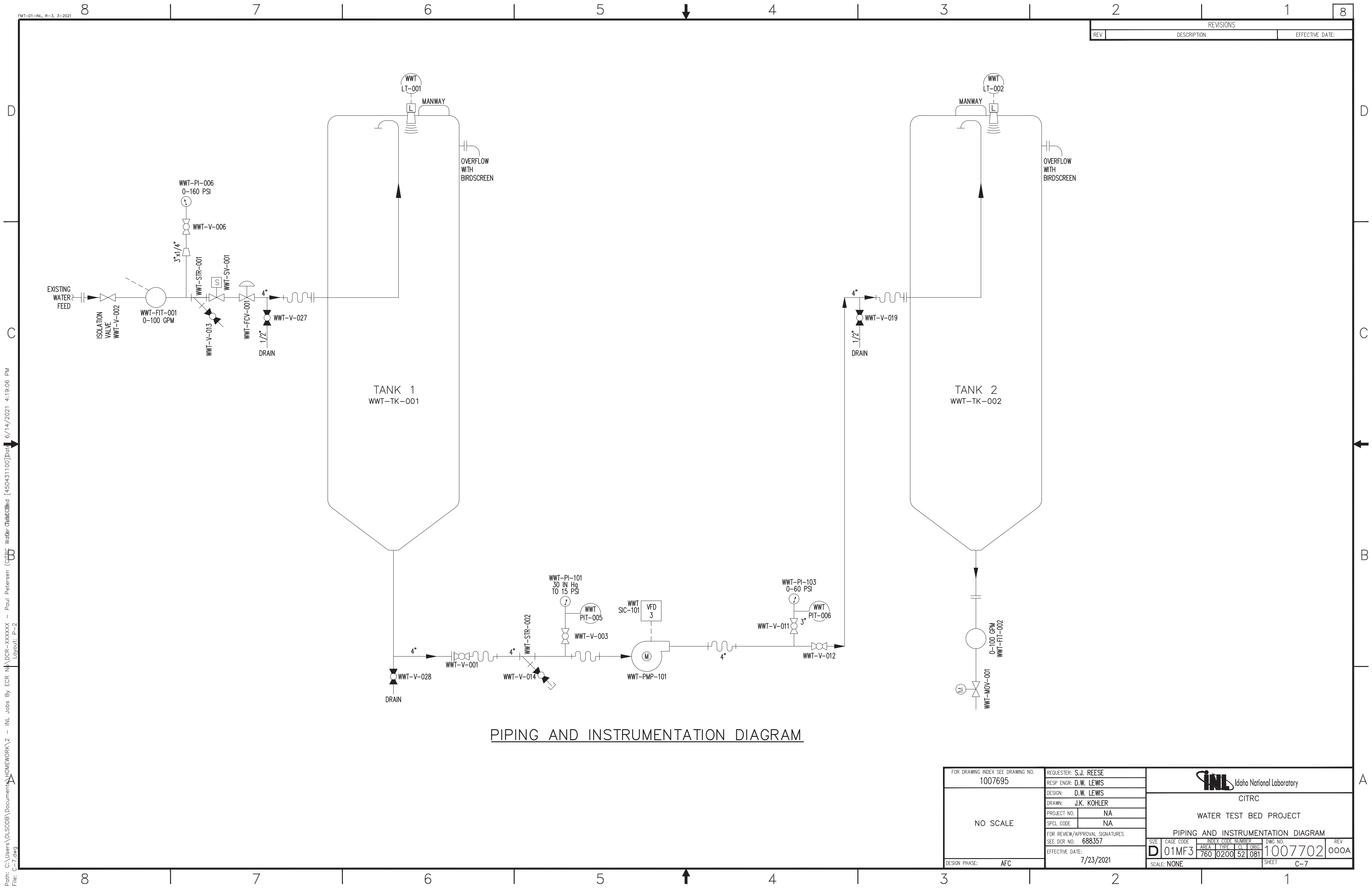
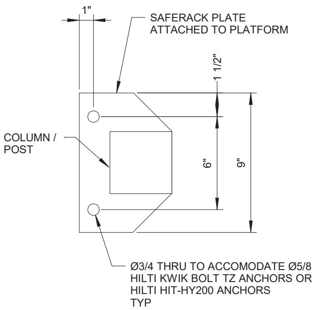
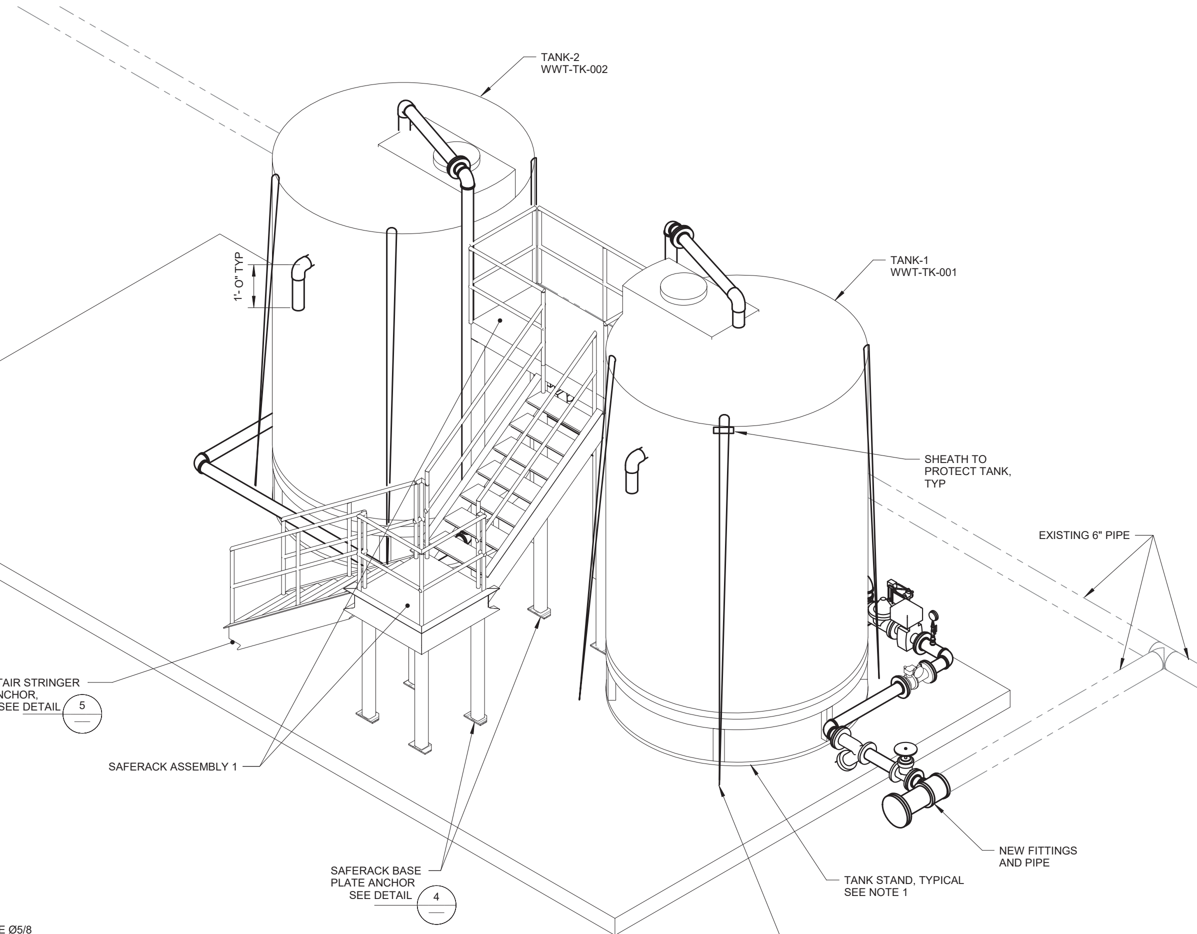

REVISIONS
REV
DESCRIPTION
EFFECTIVE DATE:
WWT LT-001
MANWAY
OVERFLOW WITH BIRDSCREEN
WWT LT-002
WWT-PI-006 0-160 PSI
WWT-V-006
3"x1/4"
WWT-STR-001
WWT-SV-001
EXISTING WATER FEED
ISOLATION VALVE WWT-V-002
WWT-FIT-001 0-100 GPM
WWT-V-013
WWT-FCV-001
4"
WWT-V-027
1/2"
DRAIN
WWT-V-019
TANK 1
WWT-TK-001
TANK 2
WWT-TK-002
WWT-PI-101 30 IN Hg TO 15 PSI
WWT PIT-005
WWT-V-003
WWT SIC-101
VFD 3
WWT-STR-002
WWT-V-001
WWT-V-014
WWT-PMP-101
WWT-V-028
WWT-PI-103 0-60 PSI
WWT PIT-006
WWT-V-011
WWT-V-012
0-100 GPM WWT-FIT-002
WWT-MOV-001
PIPING AND INSTRUMENTATION DIAGRAM
FOR DRAWING INDEX SEE DRAWING NO. 1007695
NO SCALE
DESIGN PHASE: AFC
REQUESTER: S.J. REESE
RESP ENGR: D.W. LEWIS
DESIGN: D.W. LEWIS
DRAWN: J.K. KOHLER
PROJECT NO. NA
SPCL CODE NA
FOR REVIEW/APPROVAL SIGNATURES SEE DCR NO. 688357
EFFECTIVE DATE: 7/23/2021
Idaho National Laboratory
CITRC
WATER TEST BED PROJECT
PIPING AND INSTRUMENTATION DIAGRAM
SIZE D
CAGE CODE 01MF3
INDEX CODE NUMBER AREA 760 TYPE 0200 CL 52 ORIG 081
DWG NO. 1007702
REV 000A
SCALE: NONE
SHEET C-7

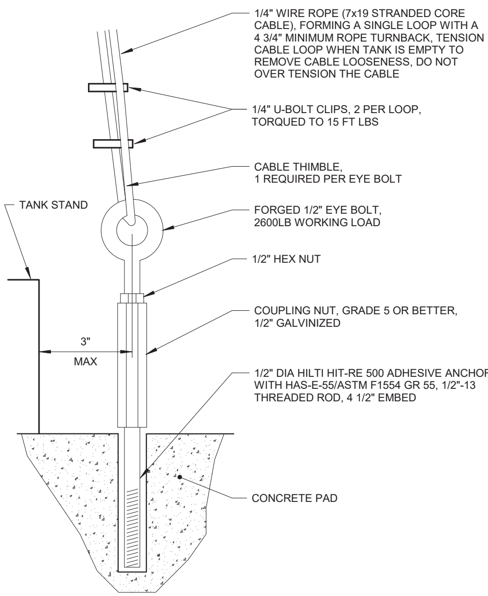
REV	DESCRIPTION	EFFECTIVE DATE:



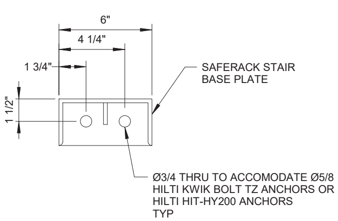
4 C-4 | 4 DETAIL
SCALE: 3" = 1'-0"



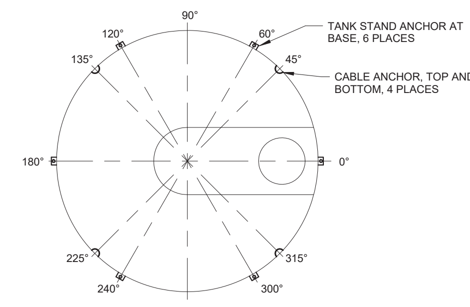
ISOMETRIC
NTS



6 DETAIL
SCALE: 6" = 1'-0"



5 DETAIL
SCALE: 3" = 1'-0"



TYPICAL TANK ANCHORING

7 DETAIL
NTS

SAFERACK PARTS SCHEDULE

ITEM	MANUFACTURER	PART #	DESCRIPTION	QTY
PLATFORM ASSEMBLY 1	SAFERACK	11394	ERECTASTEP-PLATFORM-A STANDARD	3
PLATFORM ASSEMBLY 1	SAFERACK	90006B	ERECTASTEP-STAIR-6-STEP-A-BASE	1
PLATFORM ASSEMBLY 1	SAFERACK	90004X	ERECTASTEP-STAIR-4-STEP-A-EXTENSION	1
PLATFORM ASSEMBLY 1	SAFERACK	55574	ERECTASTEP-PLATFORM-HANDRAIL-A	7
PLATFORM ASSEMBLY 1	SAFERACK	90013B	ERECTASTEP-TOWER-3-STEP-A-BASE	5
PLATFORM ASSEMBLY 1	SAFERACK	90014X	ERECTASTEP-TOWER-4-STEP-A-EXTENSION	5
PLATFORM ASSEMBLY 1	SAFERACK	90016X	ERECTASTEP-TOWER-6-STEP-A-EXTENSION	3
PLATFORM ASSEMBLY 1	SAFERACK	90003B	ERECTASTEP-STAIR-3-STEP-A-BASE	1

NOTE

1. THE SUBCONTRACTOR SHALL PLACE THE TANK STAND IN THE CORRECT LOCATION ON THE CONCRETE PAD, MARK THE ANCHOR LOCATIONS, MOVE THE TANK STAND, DRILL TO ACCOMMODATE 1/2" DIAMETER HVA ANCHORS AT 4 1/4" EMBEDMENT, SET THE ANCHORS AND THEN SECURE THE TANK STAND TO THE CONCRETE. SUBCONTRACT WILL THEN PLACE TANK ON STAND AND SECURE WITH CABLES AND ANCHORS AS SHOWN.

FOR DRAWING INDEX SEE DRAWING NO. 1007695
SCALE: 3" = 1'-0"
SCALE: 6" = 1'-0"
DESIGN PHASE: AFC

REQUESTER: S.J. REESE
RESP ENGR: T.O. LYBBERT
DESIGN: T.O. LYBBERT
DRAWN: J.K. KOHLER
PROJECT NO. NA
SPCL CODE NA
FOR REVIEW/APPROVAL SIGNATURES SEE DCR NO. 688357
EFFECTIVE DATE: 7-23-2021

INL Idaho National Laboratory
CITRC
WATER SECURITY TEST BED PROJECT
ISOMETRIC VIEW, DETAILS AND PARTS LIST

SIZE D | CAGE CODE 01MF3 | INDEX CODE NUMBER: AREA 760, TYPE 0100, CL 60, ORIG 081 | DWG NO. 1007703 | REV 000A
SCALE: NOTED | SHEET S-1

Revit File: O:\Project Files\REVIT_START\REVIT_Projects\1007695_WSTB_PROJECT.rvt
Date: 7/23/2021 7:28:20 AM

GENERAL ELECTRICAL NOTES

1. ALL WORK SHALL BE DONE IN ACCORDANCE WITH:
   NEC – NATIONAL ELECTRICAL CODE 2017
   NFPA-70E – STANDARD FOR ELECTRICAL SAFETY IN THE WORKPLACE 2018
   NEMA – NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
   NECA – NATIONAL ELECTRICAL CABLE ASSOCIATION

2. ALL ELECTRICAL EQUIPMENT AND DEVICES SHALL BE UL OR OTHER NATIONALLY RECOGNIZED TESTING LABORATORY LISTED/LABELED.

3. ARRANGE ELECTRICAL WORK IN A NEAT, WELL-ORGANIZED MANNER WITH CONDUIT AND SIMILAR SERVICES RUNNING PARALLEL WITH THE PRIMARY LINES OF THE BUILDING CONSTRUCTION.

RACEWAYS AND WIRE

4. ALL CONDUIT SHALL BE EMT FOR INTERNAL RUNS AND RMC FOR EXTERNAL RUNS, UNLESS OTHERWISE NOTED. CONDUIT SIZES SHOWN ARE MINIMUM SIZES REQUIRED. LARGER SIZE CONDUIT MAY BE INSTALLED TO FACILITATE CABLE INSTALLATION.

5. FURNISH, INSTALL, AND TERMINATE ALL CABLES, CONDUCTORS, AND DEVICES TO MAKE COMPLETE AND OPERATIONAL SYSTEMS.

6. WIRING SHALL BE AS FOLLOWS:
   A. WIRING MATERIALS, 600V:
   B. CONDUCTORS SHALL BE STRANDED FOR ALL SIZES OF WIRE AND CABLE.
   C. CONDUCTORS SHALL BE COPPER FOR ALL SIZES.
   D. WIRE INSULATION SHALL BE TYPE XHHW OR THWN-2 90°C FOR ALL CONDUCTORS UNLESS OTHERWISE NOTED.
   E. MINIMUM SIZE OF POWER CONDUCTORS SHALL BE NO. 12 FOR 20A CIRCUITS OR SMALLER AND NO. 10 FOR 30A CIRCUITS. DERATE CONDUCTORS PER NEC IF MULTIPLE CIRCUITS ARE RAN IN SINGLE RACEWAY.
   F. POWER CONDUCTORS SHALL BE COLOR-CODED AS INDICATED BELOW OR MATCH EXISTING FACILITY CONFIGURATION IF DIFFERENT:

CONDUCTOR CODE COLOR	
CONDUCTOR	240/120 VOLTS
PHASE A	BLACK
PHASE B	RED
NEUTRAL	WHITE
GROUND	GREEN

* FOR NEW CIRCUITS INSTALLED IN EXISTING PANELS ONLY, BLACK MAY BE USED FOR ANY PHASE CONDUCTOR, WHITE FOR NEUTRAL AND GREEN FOR GROUND.

7. WIRE #10 AWG AND SMALLER SHALL BE FURNISHED WITH CONTINUOUS COLORED INSULATION FOR ALL POWER, NEUTRAL, AND GROUND CONDUCTORS WHEN MULTIPLE CIRCUITS ARE INSTALLED TO IDENTIFY THE PHASE, NEUTRAL, OR EQUIPMENT GROUND WIRING.

8. PULL CONDUCTORS AT THE SAME TIME IF MORE THAN ONE IS BEING INSTALLED IN A RACEWAY. DO NOT EXCEED THE CONDUCTOR MANUFACTURER'S RECOMMENDED PULLING TENSION.

9. USE PULLING COMPOUND OR LUBRICANT WHERE NECESSARY. COMPOUND MUST NOT CAUSE THE CONDUCTOR OR INSULATION TO DETERIORATE.

10. USE PULLING METHODS INCLUDING FISH TAPE, CABLE, OR ROPE THAT CANNOT DAMAGE RACEWAY. ANY CONDUCTORS THAT REQUIRE MECHANICAL ASSISTANCE IN PULLING SHALL BE INSTALLED IN ACCORDANCE WITH IEEE 576.

11. PRIOR TO TERMINATING, TEST 600V RATED CABLES LONGER THAN 25'-0" FOR INSULATION RESISTANCE USING A 1000V MEGGER. ANY WIRE IDENTIFIED WITH LESS THAN 100 MEGOHMS TO GROUND SHALL BE REPLACED BEFORE PROCEEDING WITH THE TERMINATING PROCESS. LIST THE TESTED CONDUCTORS ON THE REQUIRED TEST DATA SHEET. TEST ALL CABLES FOR CONTINUITY. SUBMIT MEGGER AND CONTINUITY TEST RESULTS.

12. ELECTRICAL CONNECTIONS SHALL BE TORQUED AS SPECIFIED BY THE EQUIPMENT MANUFACTURER. IF THE MANUFACTURER DOES NOT PROVIDE A RECOMMENDED TORQUE VALUE, ELECTRICAL CONNECTIONS SHALL BE TORQUED ACCORDING TO UL 486A-486B. THE OPERATING CONTRACTOR REPRESENTATIVE RESERVES THE RIGHT TO WITNESS TORQUING OF ALL CONNECTIONS. SUBCONTRACTOR SHALL SUBMIT TORQUING REPORT.

13. COORDINATE WITH AHJ OR AHJ REPRESENTATIVE TO VERIFY COMPLIANCE WITH NEC AND WITH THE DRAWINGS.

CIRCUIT BREAKERS

14. CIRCUIT BREAKERS SHALL MEET THE REQUIREMENTS OF STANDARD NEMA AB 3 WITH INTEGRAL THERMAL AND INSTANTANEOUS MAGNETIC TRIP IN EACH POLE. CIRCUIT BREAKERS SHALL BE EQUIPPED WITH INDIVIDUALLY INSULATED, BRACED, AND PROTECTED CONNECTORS. THE FRONT FACES OF ALL CIRCUIT BREAKERS SHALL BE FLUSH WITH EACH OTHER. LARGE, PERMANENT, INDIVIDUAL CIRCUIT NUMBERS SHALL BE AFFIXED TO EACH BREAKER IN A UNIFORM POSITION. TRIPPED INDICATION SHALL BE CLEARLY SHOWN BY THE BREAKER HANDLE TAKING A POSITION BETWEEN "ON" AND "OFF". PROVISIONS FOR PADLOCKING THE BREAKER SHALL BE INCLUDED ON THE BREAKER.

15. INSTALL CIRCUIT BREAKERS AS INDICATED ON THE DRAWINGS AND IN ACCORDANCE WITH MANUFACTURER'S WRITTEN INSTRUCTIONS, APPLICABLE REQUIREMENTS OF NEC AND NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION'S "STANDARD OF INSTALLATION," AND COMPLYING WITH RECOGNIZED INDUSTRY PRACTICES TO ENSURE THAT PRODUCTS SERVE INTENDED FUNCTIONS.

16. PROVIDE ELECTRICAL CONNECTIONS WITHIN ENCLOSURES.

17. VISUALLY INSPECT AND TEST:

    A. INSPECT BREAKERS TO ENSURE THAT EQUIPMENT INSTALLATION CONFORMS TO NEC AND THE DRAWINGS. INSPECT TO VERIFY THAT THE CIRCUIT DIRECTORY HAS BEEN UPDATED TO SHOW NEW LOAD.

    B. PERFORM TEST OF THE CIRCUIT BREAKERS BY CLOSING BREAKER TO VERIFY PROPER CIRCUIT IS ENERGIZED AND THEN OPENING CIRCUIT BREAKER TO VERIFY CIRCUIT IS DE-ENERGIZED.

IDENTIFICATION

18. ADHESIVE MARKING LABELS FOR RACEWAY SHALL BE PRE-PRINTED, FLEXIBLE, SELF-ADHESIVE LABELS WITH LEGEND, IDENTIFYING SYSTEM TYPE, OR VOLTAGE AND PHASE.

19. GENERAL LABELS SHALL BE MADE FROM MATERIALS THAT ARE COMPATIBLE WITH THE APPLICATION.

20. EQUIPMENT LABEL(S) SHALL BE PLACED ON THE FRONT OF ELECTRICAL EQUIPMENT AND RECEPTACLES WITH 1/4" HIGH WHITE LETTERING ON BLACK PHENOLIC BACKGROUND STATING FED FROM INFORMATION IN AS VISIBLE A LOCATION AS POSSIBLE. USE SEPARATE LABELS TO IDENTIFY CAUTIONS OR DANGERS REQUIRED BY CODE AND AS DESIGNATED ON THE DRAWINGS.

21. CONDUIT LABELS SHALL BE COLOR CODED AND SIZED PER TABLE I AND II BELOW:

TABLE I CONDUIT LABEL COLORS		
POWER TYPE	BACKGROUND COLOR	LETTERING COLOR
NORMAL	ORANGE	BLACK

TABLE II CONDUIT LABEL SIZES	
RACEWAY OR CONDUIT SIZE (INCHES)	MINIMUM HEIGHT OF LETTERING (INCHES)
3/4 TO 1 1/4	1/2
1 1/2 TO 2	3/4
2 1/2 TO 4	1 1/4

22. FOR PANELBOARD, PROVIDE THE UPDATED CIRCUIT SCHEDULE (DIRECTORY) WITH DESCRIPTION AND IDENTIFICATION OF ITEMS CONTROLLED BY THE NEWLY INSTALLED BREAKERS OR EXISTING SPARE BREAKERS USED.

23. IDENTIFY CONDUIT WITH A LABEL ATTACHED PARALLEL TO OR ENCIRCLING THE CONDUIT. THE LABEL SHALL SHOW A LEGEND OF THE CONDUCTOR CHARACTERISTICS, INCLUDING THE FOLLOWING:
    A. HIGHEST VOLTAGE LEVEL CONTAINED WITHIN THE CONDUIT
    B. AC OR DC CURRENT
    C. PANEL AND CIRCUIT INFORMATION

    EXAMPLE CONDUIT LABEL: 240V, AC, PP1 CKTS 12/14

24. INSTALL LABELS AT CONVENIENT VIEWING LOCATIONS FREE OF OBSTRUCTIONS, INTERFERENCE FROM OPERATIONS AND MAINTENANCE EQUIPMENT, AND PER THESE NOTES.

25. INDIVIDUAL CIRCUIT BREAKERS IN A PANELBOARD SHALL BE CLEARLY IDENTIFIED BY A CIRCUIT NUMBER APPROPRIATE TO THE INDIVIDUAL PANELBOARD.

26. EACH CONDUCTOR OR CABLE SHALL BE CLEARLY IDENTIFIED AND LABELED IN ELECTRICAL PULL BOXES, CABINETS OR JUNCTION BOXES. ATTACH LABEL OR WIRE MARKER AS SPECIFIED IN THESE GENERAL NOTES.

27. CONDUITS SHALL BE LABELED WITHIN 3-FT OF THE POWER SOURCE EQUIPMENT, PULL BOXES, CABINETS OR JUNCTION BOXES, AND ADJACENT TO EACH SIDE OF ANY PENETRATION THROUGH FLOORS, WALLS, OR BULKHEADS. PLACE LABELS AT INTERVALS NOT TO EXCEED 20-FT ON STRAIGHT RUNS OF CONDUIT.

28. RACEWAYS AND CONDUIT SHALL BE LABELED AT LEAST ONCE IN EACH ROOM THROUGH WHICH THEY PASS. FOR EASE OF IDENTIFICATION, APPLY LABELS IN A CONVENIENT AND OBVIOUS LOCATION.

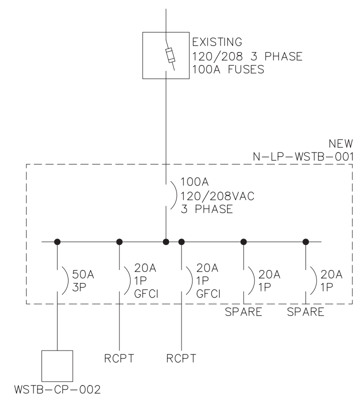
MISCELLANEOUS

29. UNLESS OTHERWISE SHOWN, FRAMING CHANNEL SHALL BE USED TO SUPPORT CONDUITS. THE MINIMUM SIZE BOLT USED FOR BOLTING FRAMING CHANNEL TO SUPPORT STRUCTURE SHALL BE 3/8".

AS-BUILT RED LINES

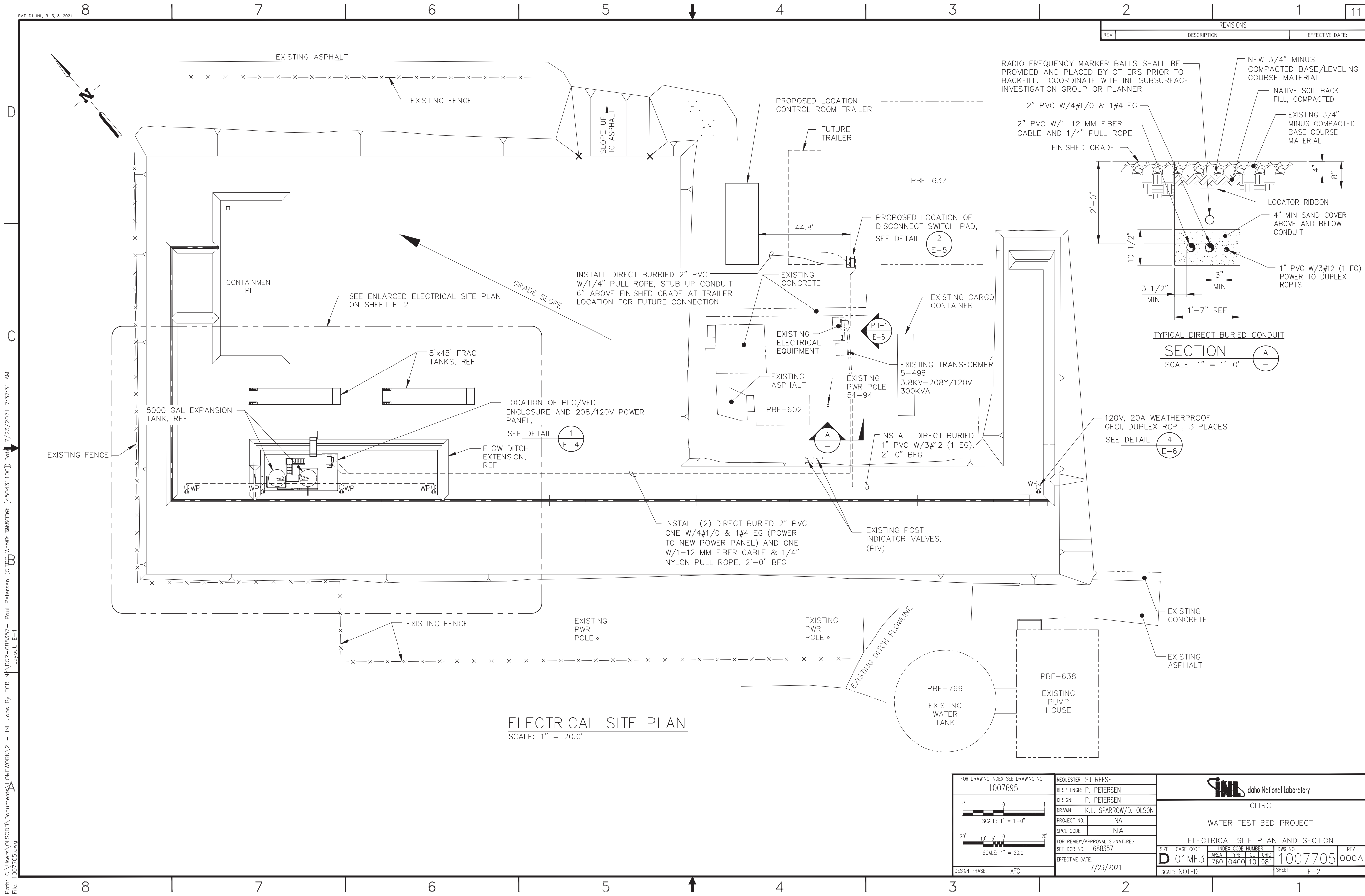
30. CLEARLY DEPICT ANY CHANGES/DEVIATIONS FROM THE DESIGN ON THE DRAWINGS AS RED-LINE MARKUPS AND PROVIDE TO PROJECT LEAD.

REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE:

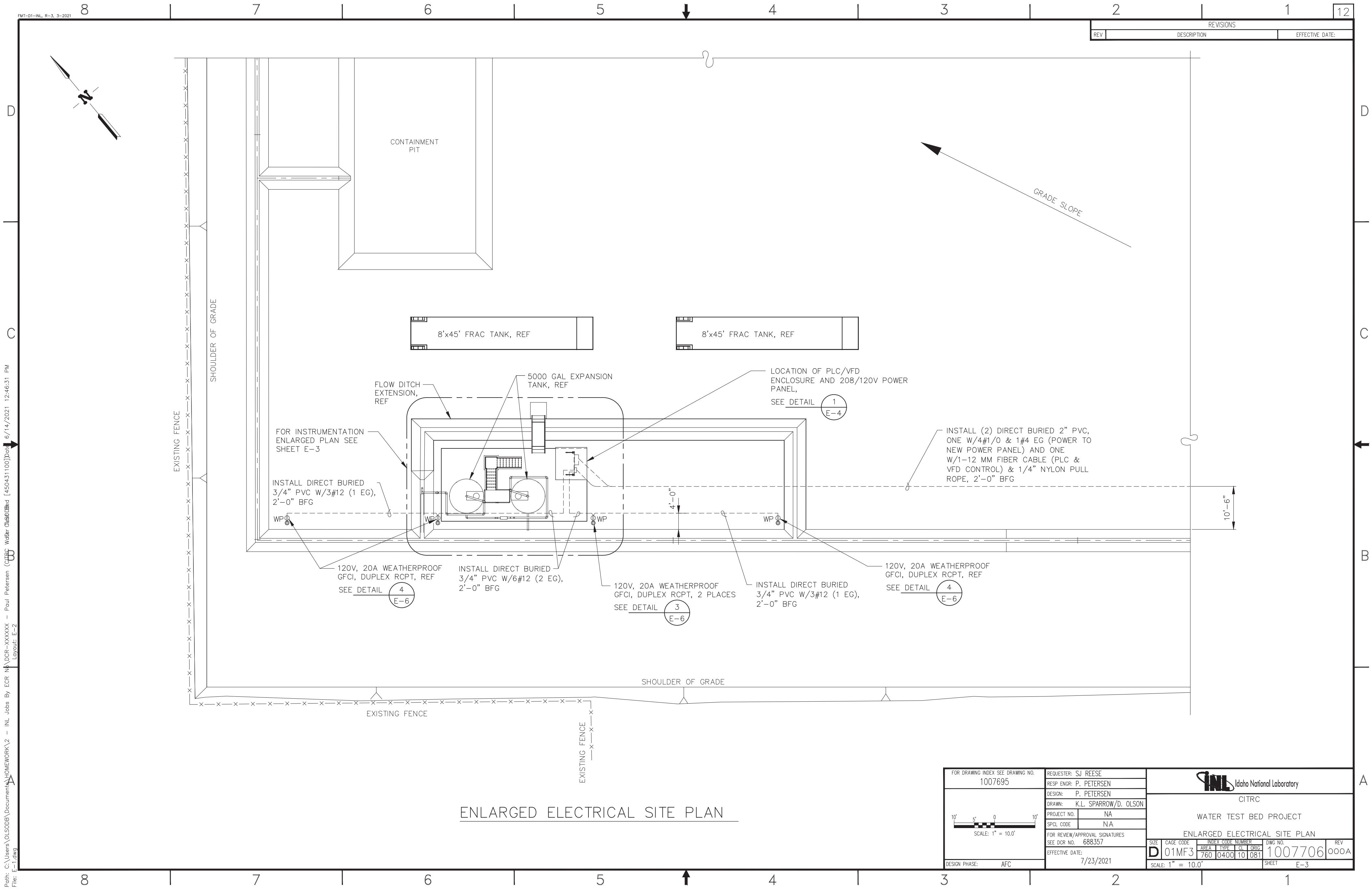


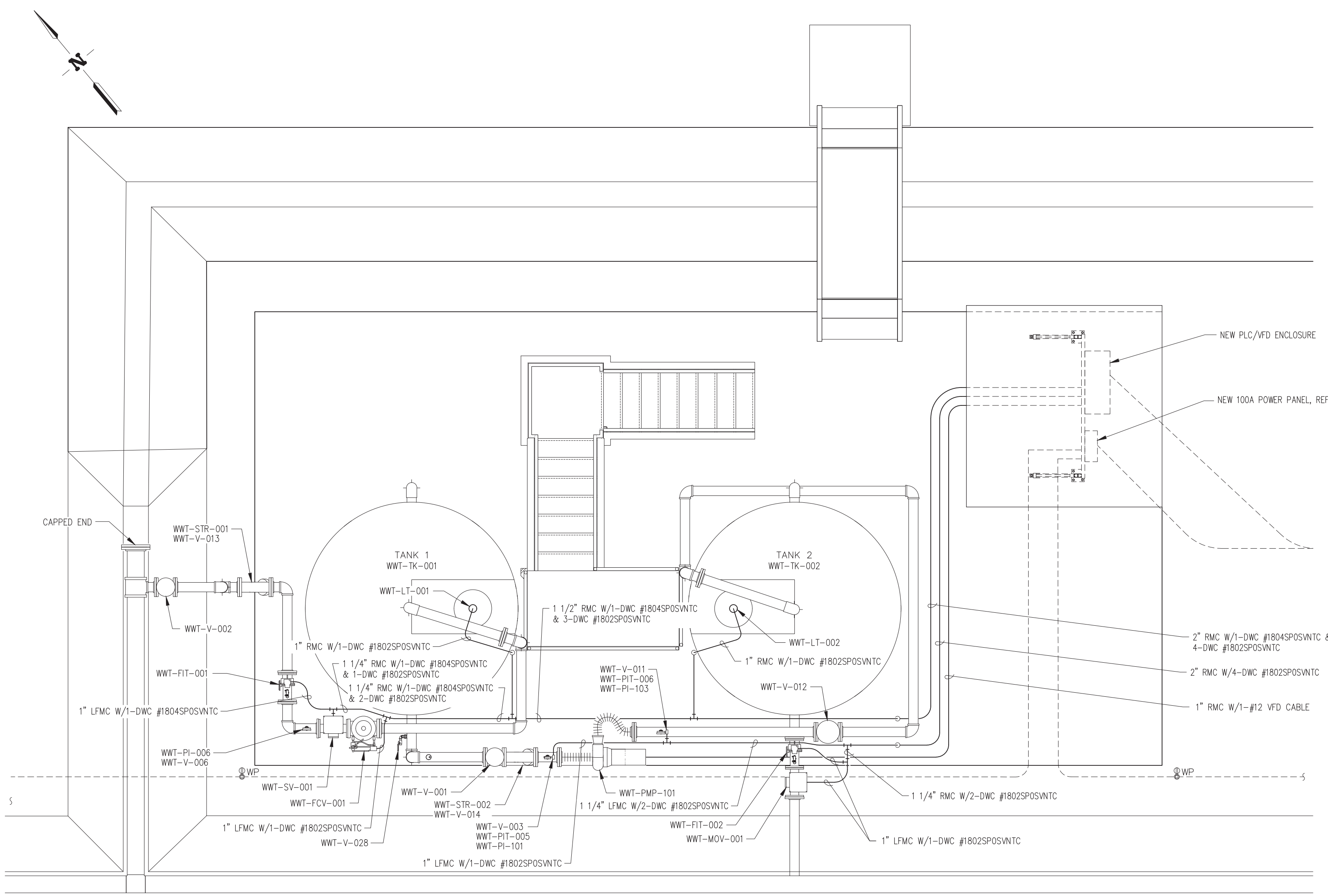
WSTB ONE LINE DIAGRAM

FOR DRAWING INDEX SEE DRAWING NO. 1007695	REQUESTER: SJ REESE	Idaho National Laboratory
SCALE: 1" = 1'-0"	RESP ENGR: P. PETERSEN	CITRC
SCALE: 1" = 20.0'	DESIGN: P. PETERSEN	WATER TEST BED PROJECT ELECTRICAL SITE PLAN AND SECTION AND ONE LINE DIAGRAM
	DRAWN: K.L. SPARROW/D. OLSON	
	PROJECT NO. NA	
	SPCL CODE NA	
	FOR REVIEW/APPROVAL SIGNATURES SEE DCR NO. 688357	SIZE D; CAGE CODE 01MF3; INDEX CODE NUMBER: AREA 760, TYPE 0400, CL 10, ORIG 081; DWG NO. 1007704; REV 000A
DESIGN PHASE: AFC	EFFECTIVE DATE: 7/23/2021	SCALE: NOTED; SHEET E-1



FMT-01-INL, R-3, 3-2021
REVISIONS
REV
DESCRIPTION
EFFECTIVE DATE:
EXISTING ASPHALT
EXISTING FENCE
SLOPE UP TO ASPHALT
PROPOSED LOCATION CONTROL ROOM TRAILER
FUTURE TRAILER
PBF-632
44.8'
PROPOSED LOCATION OF DISCONNECT SWITCH PAD, SEE DETAIL 2 E-5
CONTAINMENT PIT
GRADE SLOPE
SEE ENLARGED ELECTRICAL SITE PLAN ON SHEET E-2
INSTALL DIRECT BURRIED 2" PVC W/1/4" PULL ROPE, STUB UP CONDUIT 6" ABOVE FINISHED GRADE AT TRAILER LOCATION FOR FUTURE CONNECTION
EXISTING CONCRETE
EXISTING CARGO CONTAINER
EXISTING ELECTRICAL EQUIPMENT
PH-1 E-6
8'x45' FRAC TANKS, REF
EXISTING ASPHALT
EXISTING PWR POLE 54-94
EXISTING TRANSFORMER 5-496 3.8KV-208Y/120V 300KVA
PBF-602
5000 GAL EXPANSION TANK, REF
LOCATION OF PLC/VFD ENCLOSURE AND 208/120V POWER PANEL, SEE DETAIL 1 E-4
FLOW DITCH EXTENSION, REF
INSTALL DIRECT BURIED 1" PVC W/3#12 (1 EG), 2'-0" BFG
A –
120V, 20A WEATHERPROOF GFCI, DUPLEX RCPT, 3 PLACES SEE DETAIL 4 E-6
EXISTING FENCE
WP
INSTALL (2) DIRECT BURIED 2" PVC, ONE W/4#1/0 & 1#4 EG (POWER TO NEW POWER PANEL) AND ONE W/1-12 MM FIBER CABLE & 1/4" NYLON PULL ROPE, 2'-0" BFG
EXISTING POST INDICATOR VALVES, (PIV)
EXISTING FENCE
EXISTING PWR POLE
EXISTING PWR POLE
EXISTING DITCH FLOWLINE
EXISTING CONCRETE
EXISTING ASPHALT
PBF-769 EXISTING WATER TANK
PBF-638 EXISTING PUMP HOUSE
ELECTRICAL SITE PLAN
SCALE: 1" = 20.0'
RADIO FREQUENCY MARKER BALLS SHALL BE PROVIDED AND PLACED BY OTHERS PRIOR TO BACKFILL. COORDINATE WITH INL SUBSURFACE INVESTIGATION GROUP OR PLANNER
2" PVC W/4#1/0 & 1#4 EG
2" PVC W/1-12 MM FIBER CABLE AND 1/4" PULL ROPE
FINISHED GRADE
NEW 3/4" MINUS COMPACTED BASE/LEVELING COURSE MATERIAL
NATIVE SOIL BACK FILL, COMPACTED
EXISTING 3/4" MINUS COMPACTED BASE COURSE MATERIAL
4"
8"
2'-0"
LOCATOR RIBBON
4" MIN SAND COVER ABOVE AND BELOW CONDUIT
10 1/2"
1" PVC W/3#12 (1 EG) POWER TO DUPLEX RCPTS
3" MIN
3 1/2" MIN
1'-7" REF
TYPICAL DIRECT BURIED CONDUIT
SECTION A –
SCALE: 1" = 1'-0"
FOR DRAWING INDEX SEE DRAWING NO. 1007695
SCALE: 1" = 1'-0"
SCALE: 1" = 20.0'
DESIGN PHASE: AFC
REQUESTER: SJ REESE
RESP ENGR: P. PETERSEN
DESIGN: P. PETERSEN
DRAWN: K.L. SPARROW/D. OLSON
PROJECT NO. NA
SPCL CODE NA
FOR REVIEW/APPROVAL SIGNATURES SEE DCR NO. 688357
EFFECTIVE DATE: 7/23/2021
Idaho National Laboratory
CITRC
WATER TEST BED PROJECT
ELECTRICAL SITE PLAN AND SECTION
SIZE D CAGE CODE 01MF3 INDEX CODE NUMBER AREA 760 TYPE 0400 CL 10 ORIG 081 DWG NO. 1007705 REV 000A
SCALE: NOTED SHEET E-2
Path: C:\Users\OLSODB\Documents\HOMEWORK\2 - INL Jobs By ECR N\DCR-688357- Paul Petersen (CITRC Water Test Bed) [450431100]) Date: 7/23/2021 7:37:31 AM
File: 1007705.dwg Layout: E-1


REVISIONS
REV
DESCRIPTION
EFFECTIVE DATE:
N
CONTAINMENT PIT
GRADE SLOPE
EXISTING FENCE
SHOULDER OF GRADE
8'x45' FRAC TANK, REF
8'x45' FRAC TANK, REF
FLOW DITCH EXTENSION, REF
5000 GAL EXPANSION TANK, REF
LOCATION OF PLC/VFD ENCLOSURE AND 208/120V POWER PANEL,
SEE DETAIL 1 E-4
FOR INSTRUMENTATION ENLARGED PLAN SEE SHEET E-3
INSTALL (2) DIRECT BURIED 2" PVC, ONE W/4#1/0 & 1#4 EG (POWER TO NEW POWER PANEL) AND ONE W/1-12 MM FIBER CABLE (PLC & VFD CONTROL) & 1/4" NYLON PULL ROPE, 2'-0" BFG
INSTALL DIRECT BURIED 3/4" PVC W/3#12 (1 EG), 2'-0" BFG
WP
4'-0"
10'-6"
120V, 20A WEATHERPROOF GFCI, DUPLEX RCPT, REF
SEE DETAIL 4 E-6
INSTALL DIRECT BURIED 3/4" PVC W/6#12 (2 EG), 2'-0" BFG
120V, 20A WEATHERPROOF GFCI, DUPLEX RCPT, 2 PLACES
SEE DETAIL 3 E-6
INSTALL DIRECT BURIED 3/4" PVC W/3#12 (1 EG), 2'-0" BFG
120V, 20A WEATHERPROOF GFCI, DUPLEX RCPT, REF
SEE DETAIL 4 E-6
SHOULDER OF GRADE
EXISTING FENCE
EXISTING FENCE
ENLARGED ELECTRICAL SITE PLAN
FOR DRAWING INDEX SEE DRAWING NO. 1007695
SCALE: 1" = 10.0'
DESIGN PHASE: AFC
REQUESTER: SJ REESE
RESP ENGR: P. PETERSEN
DESIGN: P. PETERSEN
DRAWN: K.L. SPARROW/D. OLSON
PROJECT NO. NA
SPCL CODE NA
FOR REVIEW/APPROVAL SIGNATURES SEE DCR NO. 688357
EFFECTIVE DATE: 7/23/2021
Idaho National Laboratory
CITRC
WATER TEST BED PROJECT
ENLARGED ELECTRICAL SITE PLAN
SIZE D
CAGE CODE 01MF3
INDEX CODE NUMBER AREA 760 TYPE 0400 CL 10 ORIG 081
DWG NO. 1007706
REV 000A
SCALE: 1" = 10.0'
SHEET E-3



NOTES

1. ALL CONDUIT SHALL BE FIELD ROUTED APPROXIMATELY AS SHOWN TO INSTRUMENTS.
2. ALL WIRING SHALL BE DISTRIBUTION WIRE AND CABLE (DWC) COMPANY WIRING WITH PART NUMBERS AS SHOWN.
3. FOR P&ID OF SYSTEM SEE SHEET C-7.

ENLARGED INSTRUMENTATION PLAN

FOR DRAWING INDEX SEE DRAWING NO.	1007695
SCALE:	1" = 2.0'
DESIGN PHASE:	AFC
REQUESTER:	SJ REESE
RESP ENGR:	P. PETERSEN
DESIGN:	P. PETERSEN
DRAWN:	K.L. SPARROW/D. OLSON
PROJECT NO.	NA
SPCL CODE	NA
FOR REVIEW/APPROVAL SIGNATURES SEE DCR NO.	688357
EFFECTIVE DATE:	7/23/2021

Idaho National Laboratory

CITRC

WATER TEST BED PROJECT

ENLARGED INSTRUMENTATION PLAN

SIZE	CAGE CODE	AREA	TYPE	CL	ORIG	DWG NO.	REV
D	01MF3	760	0400	10	081	1007707	000A

SCALE: 1" = 2.0' SHEET E-4

REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE:

FMT-01-INL, R-3, 3-2021

13

File: E-3.dwg Path: C:\Work directory\CITRC Water Test Bed
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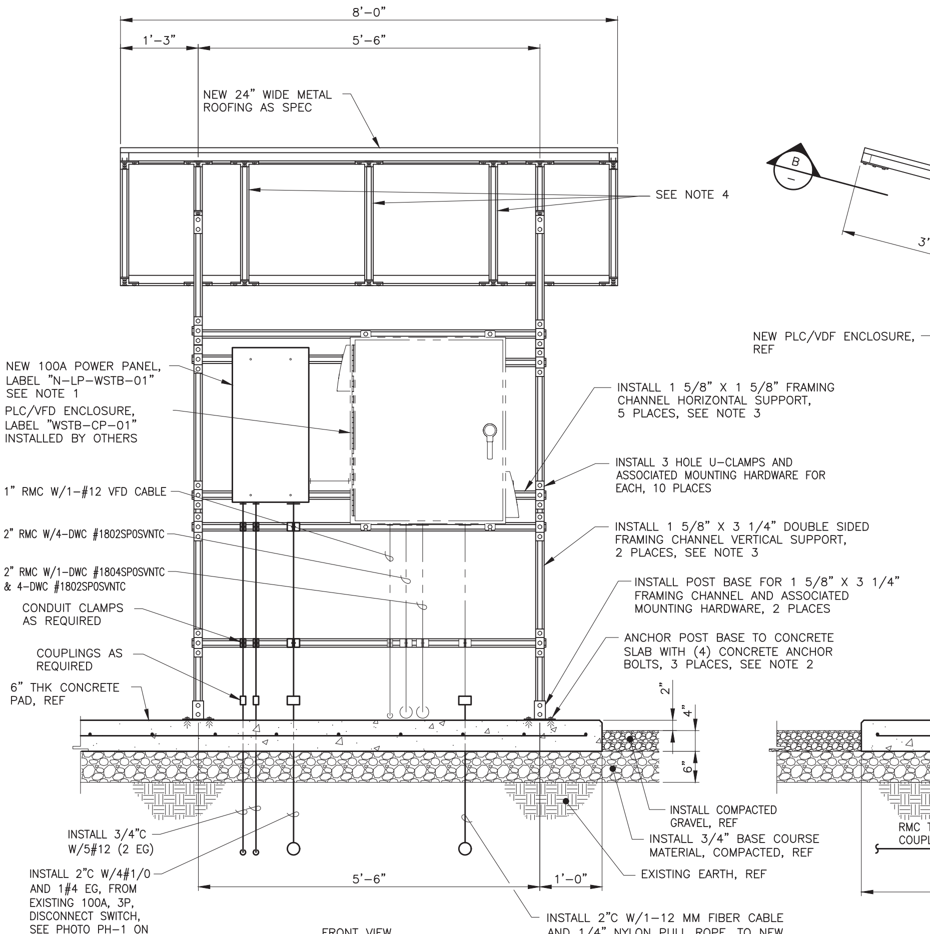
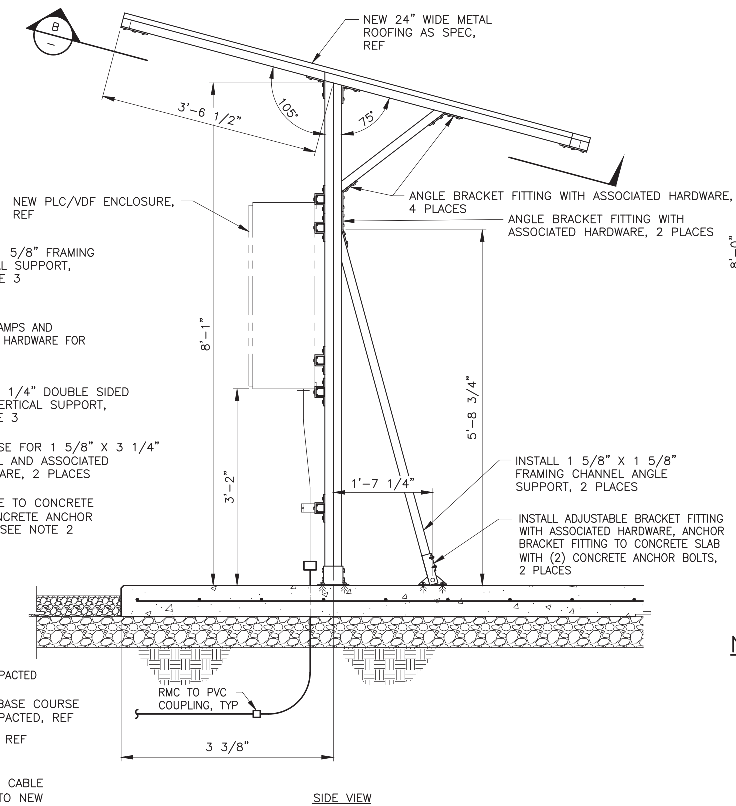
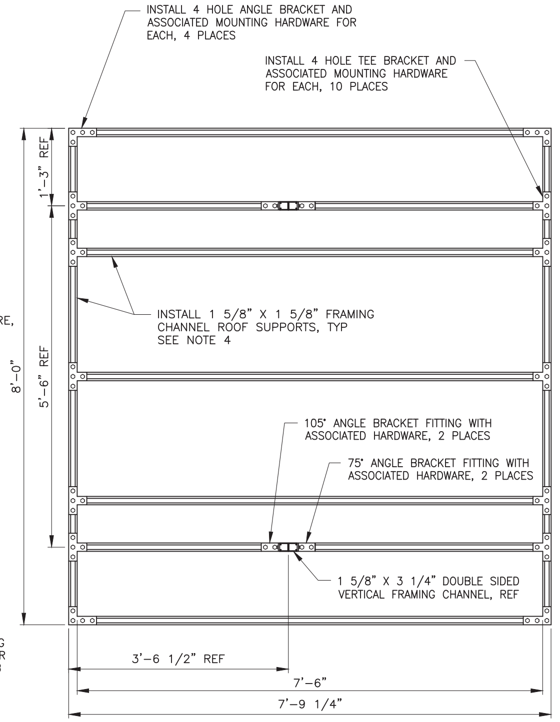
FMT-01-INL, R-3, 3-2021





DETAIL 1/E-1 1/E-2



SECTION B/–

REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE:

NOTES

1. NEW POWER PANEL SHALL BE 240/120V, 3ø, 4W, 100A, NEMA 3R WITH 27 SPACES, SQUARE D PART #QO327M100RB WITH GROUND BAR KIT PART #PK15GTA.
2. USE HILTI KWIK BOLT TZ 5/8" X 4 1/4" SS 304MC, INSTALLED PER MANUFACTURER'S INSTRUCTIONS, MINIMUM EMBEDMENT 3".
3. USE GALVANIZED OR PAINTED FRAMING CHANNEL, FITTINGS AND HARDWARE RATED FOR OUTDOOR USE. PAINT ANY EXPOSED CARBON STEEL TO MATCH CHANNEL COLOR (EPOXY OR GALVANIZED TOUCH UP).
4. SPACE AS REQUIRED FOR ATTACHING METAL ROOFING USING SELF TAPPING METAL ROOFING SCREWS.

FOR DRAWING INDEX SEE DRAWING NO. 1007695

SCALE: 1" = 1'-0"

DESIGN PHASE: AFC

REQUESTER: S.J. REESE
RESP ENGR: P. PETERSEN
DESIGN: P. PETERSEN
DRAWN: K.L. SPARROW/D. OLSON
PROJECT NO. NA
SPCL CODE NA
FOR REVIEW/APPROVAL SIGNATURES SEE DCR NO. 688357
EFFECTIVE DATE: 7/23/2021

Idaho National Laboratory

CITRC

WATER TEST BED PROJECT

DETAIL AND SECTION

SIZE	CAGE CODE	AREA	TYPE	CL	ORIG	DWG NO.	REV
D	01MF3	760	0400	10	081	1007708	000A

SCALE: 1" = 1'-0" SHEET E-5

14

Path: C:\Users\OLSODB\Documents\HOMEWORK\2 - INL Jobs By ECR No\DCR-688357- Paul Petersen (CITRC Water Test Bed [450431100]) Date: 6/28/2021 4:18:53 PM
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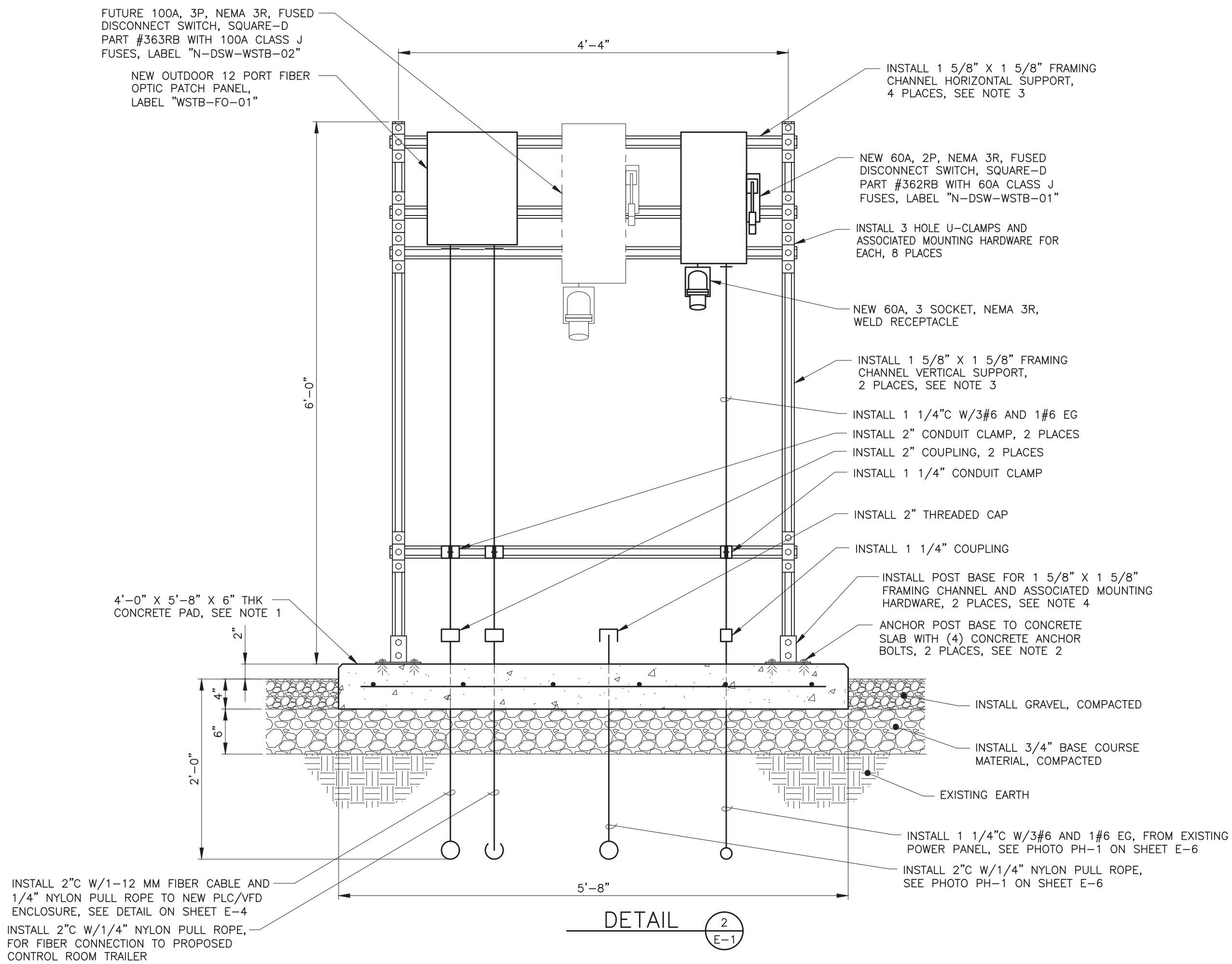
FMT-01-INL, R-3, 3-2021

15

REV	DESCRIPTION	EFFECTIVE DATE:
REVISIONS		



NOTES

1. CONCRETE SHALL BE 4000 PSI WITH #4 REBAR AT 12" O.C. EACH WAY CENTERED IN PAD. 1" CHAMFER ALL THE WAY AROUND TOP OF PAD. MINIMUM OF 3" CLEARANCE FROM REBAR TO EXPOSED EDGE OF CONCRETE.
2. USE HILTI KWIK BOLT TZ 5/8" X 4 1/4" SS 304MC, INSTALLED PER MANUFACTURER'S INSTRUCTIONS, MINIMUM EMBEDMENT 3".
3. USE GALVANIZED OR PAINTED FRAMING CHANNEL, FITTINGS AND HARDWARE RATED FOR OUTDOOR USE. PAINT ANY EXPOSED CARBON STEEL TO MATCH CHANNEL COLOR (EPOXY OR GALVANIZED TOUCH UP).
4. FRAMING CHANNEL SUPPORT STRUCTURE SHALL BE CENTERED ON 4'-0" X 5'-8" X 6" THICK CONCRETE PAD.

FOR DRAWING INDEX SEE DRAWING NO. 1007695	REQUESTER: S.J. REESE	Idaho National Laboratory
SCALE: 1 1/2" = 1'-0"	RESP ENGR: P. PETERSEN	CITRC
	DESIGN: P. PETERSEN	WATER TEST BED PROJECT
	DRAWN: K.L. SPARROW/D. OLSON	DETAIL
	PROJECT NO. NA	SIZE D; CAGE CODE 01MF3; INDEX CODE NUMBER: AREA 760, TYPE 0400, CL 10, ORIG 081; DWG NO. 1007709; REV 000A
	SPCL CODE NA	SCALE: 1 1/2" = 1'-0"; SHEET E-6
	FOR REVIEW/APPROVAL SIGNATURES SEE DCR NO. 688357	
DESIGN PHASE: AFC	EFFECTIVE DATE: 7/23/2021	

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FMT-D1-INL, R-3, 3-2021

16

REVISIONS		
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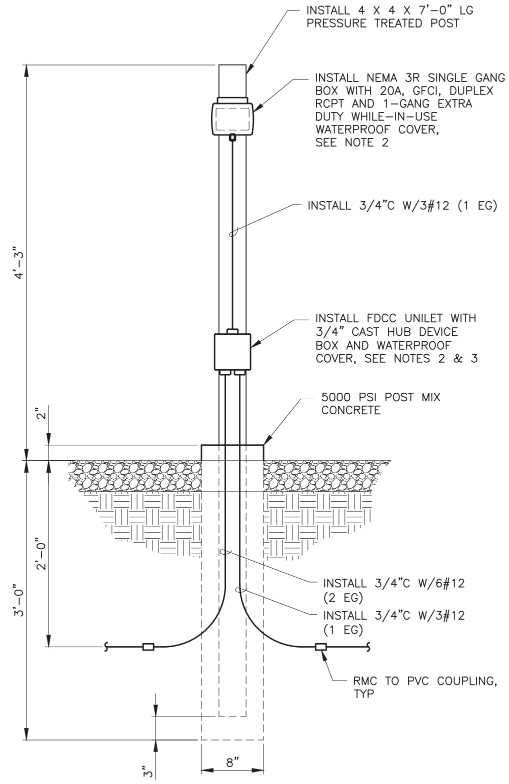
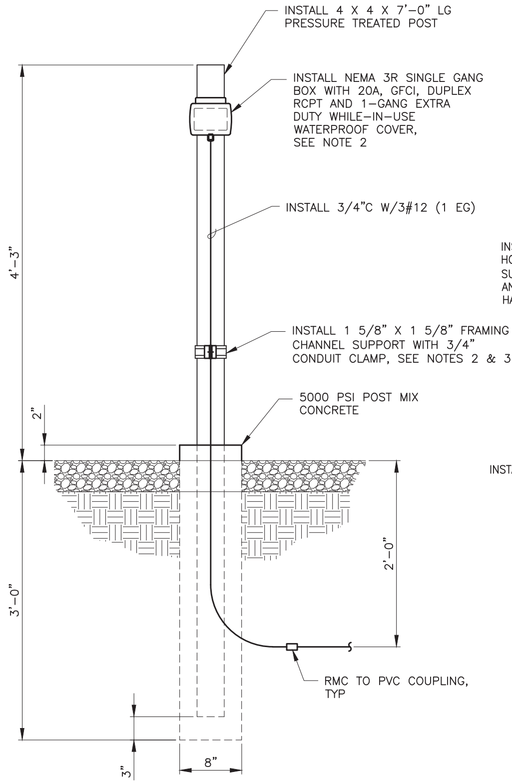


DETAIL 3 / E-2



DETAIL 4 / E-1, 4 / E-2

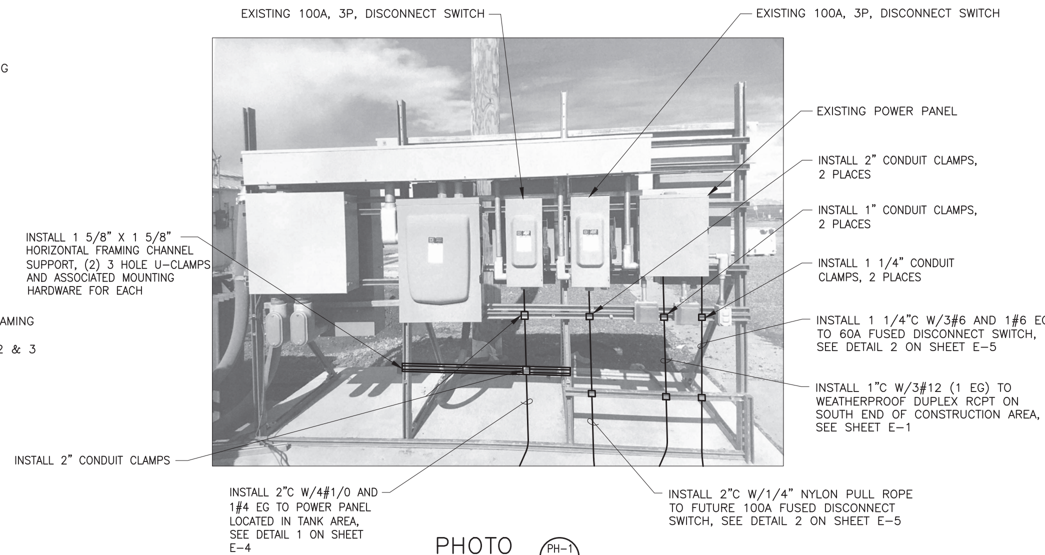


PHOTO PH-1 / E-1
NTS

NOTES

1. ALL NEWLY INSTALLED CONDUITS SHALL ROUTE ALONG TOP OF EXISTING CONDUIT PAD AND SECURED WITH CONDUIT CLAMPS PER NEC REQUIREMENTS. CONDUITS SHALL GO UNDERGROUND IMMEDIATELY AT EDGE OF PAD FOR REMAINDER OF RUN TO FINAL DESTINATION. USE WEATHERPROOF CONDULETS AT EDGE OF PAD MAKING TRANSITION TO UNDERGROUND.
2. ATTACH TO PRESSURE TREATED POST WITH 2" LONG GRABBER SCREWS, 2 PLACES, DIAGONALLY FOR BOXES.
3. USE GALVANIZED OR PAINTED FRAMING CHANNEL, FITTINGS AND HARDWARE RATED FOR OUTDOOR USE. PAINT ANY EXPOSED CARBON STEEL TO MATCH CHANNEL COLOR (EPOXY OR GALVANIZED TOUCH UP).

FOR DRAWING INDEX SEE DRAWING NO.	1007695
SCALE:	1 1/2" = 1'-0"
DESIGN PHASE:	AFC
REQUESTER:	S.J. REESE
RESP ENGR:	P. PETERSEN
DESIGN:	P. PETERSEN
DRAWN:	K.L. SPARROW/D. OLSON
PROJECT NO.	NA
SPCL CODE	NA
FOR REVIEW/APPROVAL SIGNATURES SEE DCR NO.	689188
EFFECTIVE DATE:	7/26/2021

Idaho National Laboratory

CITRC

WATER TEST BED PROJECT

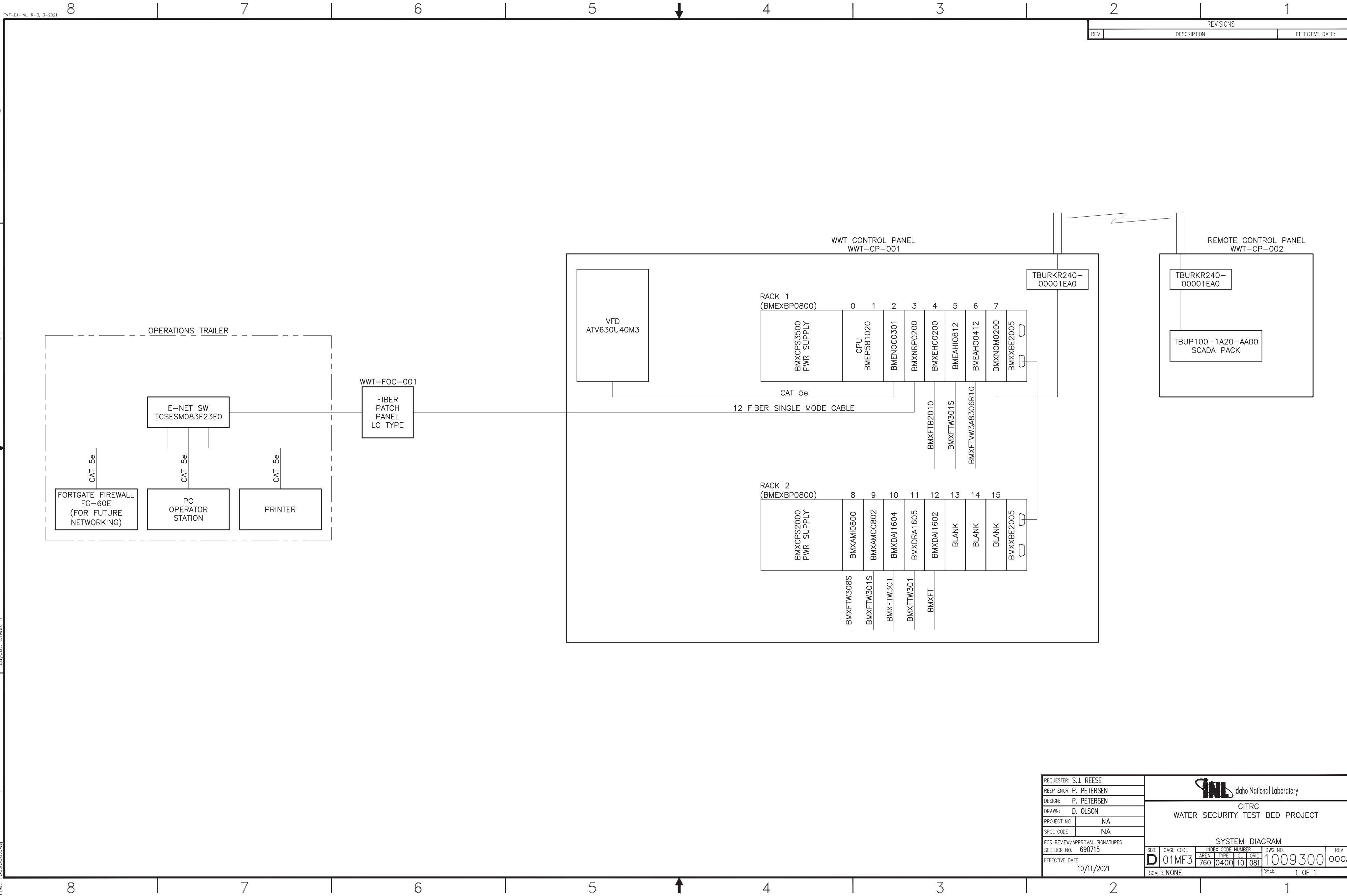
DETAILS AND PHOTO

SIZE	CAGE CODE	AREA	TYPE	CL	ORIG	DWG NO.	REV
D	01MF3	760	0400	10	081	1007710	000A

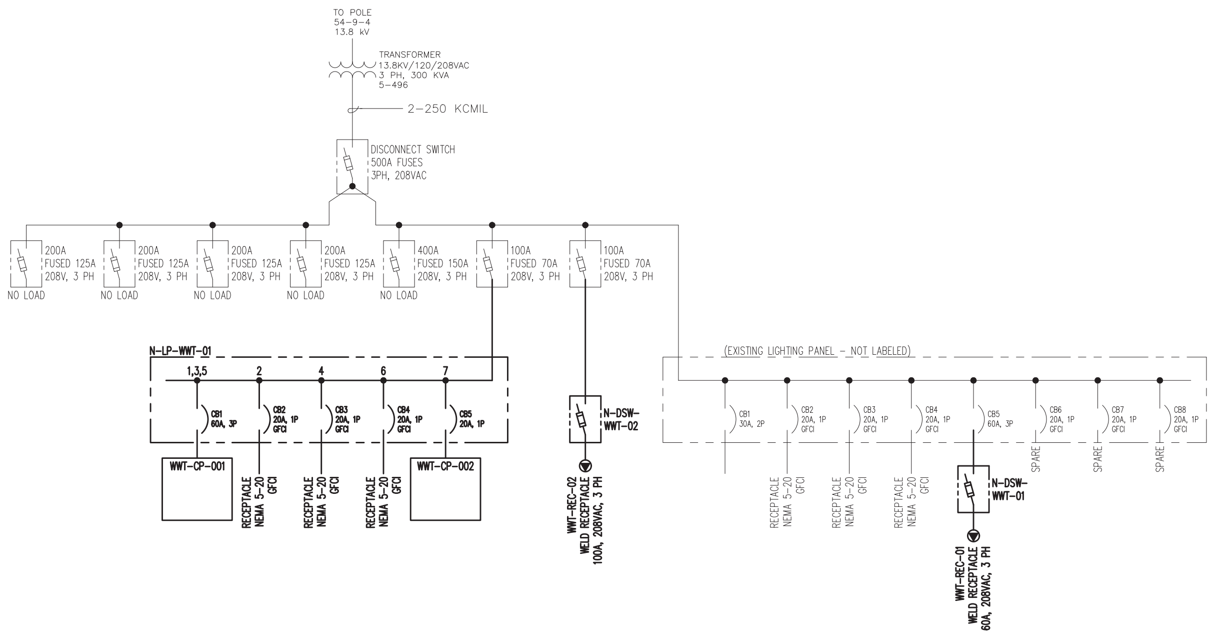
SCALE: 1 1/2" = 1'-0" SHEET E-7

Appendix F – Electrical and Control Drawings

Power & instrumentation wiring, 10-14-2021 – final, released drwgs.pdf


REVISIONS
REV
DESCRIPTION
EFFECTIVE DATE:
OPERATIONS TRAILER
E-NET SW
TCSESM083F23F0
CAT 5e
FORTGATE FIREWALL
FG-60E
(FOR FUTURE
NETWORKING)
PC
OPERATOR
STATION
PRINTER
WWT-FOC-001
FIBER
PATCH
PANEL
LC TYPE
WWT CONTROL PANEL
WWT-CP-001
VFD
ATV630U40M3
RACK 1
(BMEXBP0800)
0 1 2 3 4 5 6 7
BMXCPS3500
PWR SUPPLY
CPU
BMEP581020
BMENOC0301
BMXNRP0200
BMXEHC0200
BMEAHI0812
BMEAHO0412
BMXNOM0200
BMXXBE2005
CAT 5e
12 FIBER SINGLE MODE CABLE
BMXFTB2010
BMXFTW301S
BMXFTW3A8306R10
TBURKR240-
00001EA0
RACK 2
(BMEXBP0800)
8 9 10 11 12 13 14 15
BMXCPS2000
PWR SUPPLY
BMXAMI0800
BMXAMO0802
BMXDAI1604
BMXDRA1605
BMXDAI1602
BLANK
BLANK
BLANK
BMXXBE2005
BMXFTW308S
BMXFTW301S
BMXFTW301
BMXFTW301
BMXFT
REMOTE CONTROL PANEL
WWT-CP-002
TBURKR240-
00001EA0
TBUP100-1A20-AA00
SCADA PACK
REQUESTER: S.J. REESE
RESP ENGR: P. PETERSEN
DESIGN: P. PETERSEN
DRAWN: D. OLSON
PROJECT NO. NA
SPCL CODE NA
FOR REVIEW/APPROVAL SIGNATURES SEE DCR NO. 690715
EFFECTIVE DATE: 10/11/2021
Idaho National Laboratory
CITRC
WATER SECURITY TEST BED PROJECT
SYSTEM DIAGRAM
SIZE D
CAGE CODE 01MF3
INDEX CODE NUMBER AREA 760 TYPE 0400 CL 10 ORIG 081
DWG NO. 1009300
REV 000A
SCALE: NONE
SHEET 1 OF 1

REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE:



DARK LINES INDICATE ITEMS TO BE INSTALLED

REQUESTER:	S.J. REESE
RESP ENGR:	P. PETERSEN
DESIGN:	P. PETERSEN
DRAWN:	D. OLSON
PROJECT NO.	NA
SPCL CODE	NA
FOR REVIEW/APPROVAL SIGNATURES SEE DCR NO.	
EFFECTIVE DATE:	10/11/2021

Idaho National Laboratory

CITRC
WATER SECURITY TEST BED PROJECT

POWER ONE LINE DIAGRAM

SIZE	CAGE CODE	AREA	TYPE	CL	ORIG	DWG NO.	REV
D	01MF3	760	0400	10	081	1009301	000A

SCALE: NONE — SHEET 1 OF 1

Path: C:\Users\OLSODB\Documents\HOMEWORK\2 - INL Jobs By ECR No\DCR-690715- Paul Petersen (CITRC Water Test Bed - Cabinets [4504-1100]) Date: 10/11/2021 11:07:47 AM
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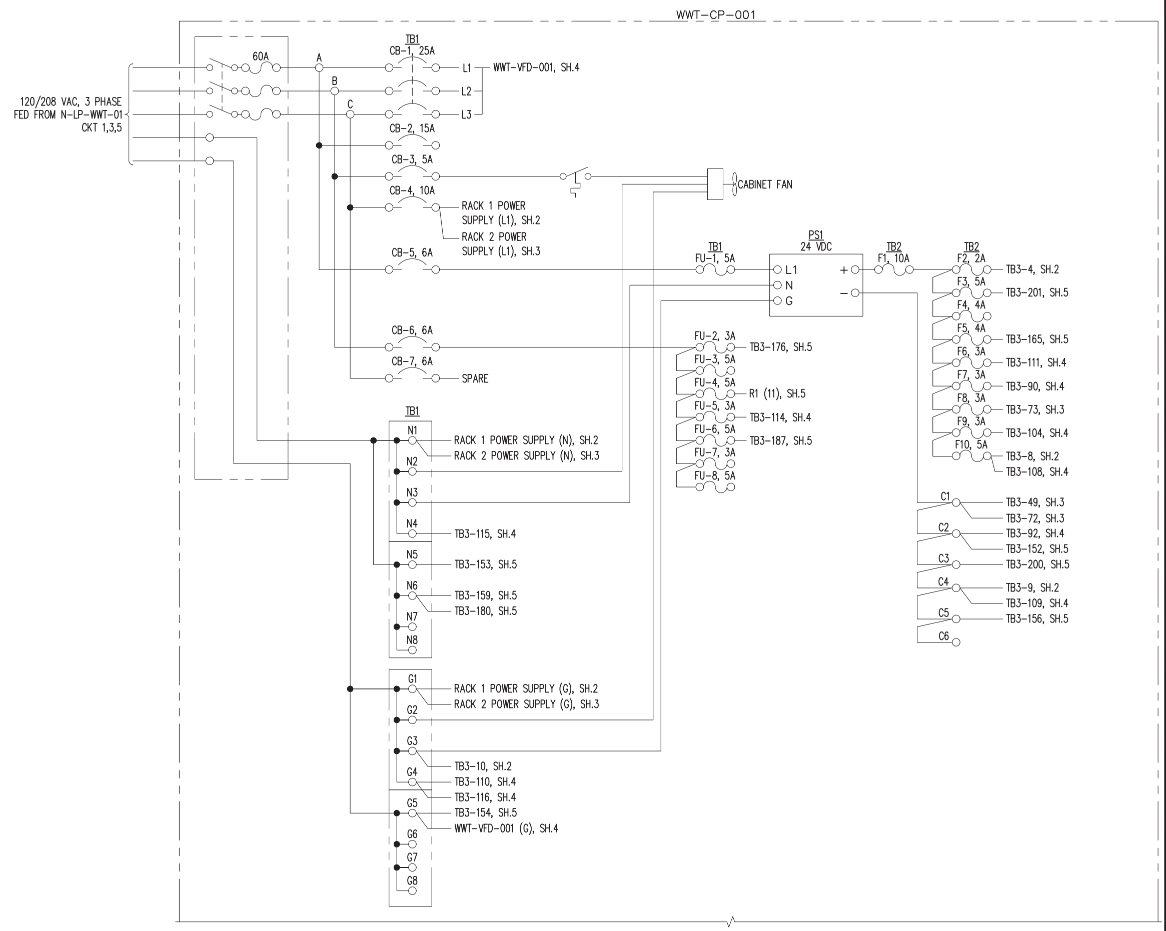

REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE:

REQUESTER:	S.J. REESE
RESP ENGR:	P. PETERSEN
DESIGN:	P. PETERSEN
DRAWN:	D. OLSON
PROJECT NO.	NA
SPCL CODE	NA
FOR REVIEW/APPROVAL SIGNATURES SEE DCR NO.	690715
EFFECTIVE DATE:	10/11/2021

Idaho National Laboratory

CITRC
WATER SECURITY TEST BED PROJECT

SCHEMATIC DIAGRAM

SIZE	CAGE CODE	AREA	TYPE	CL	ORIG	DWG NO.	REV
D	01MF3	760	0400	10	081	1009302	000A

SCALE: NONE — SHEET 1 OF 6

FMT-01-INL, R-3, 3-2021

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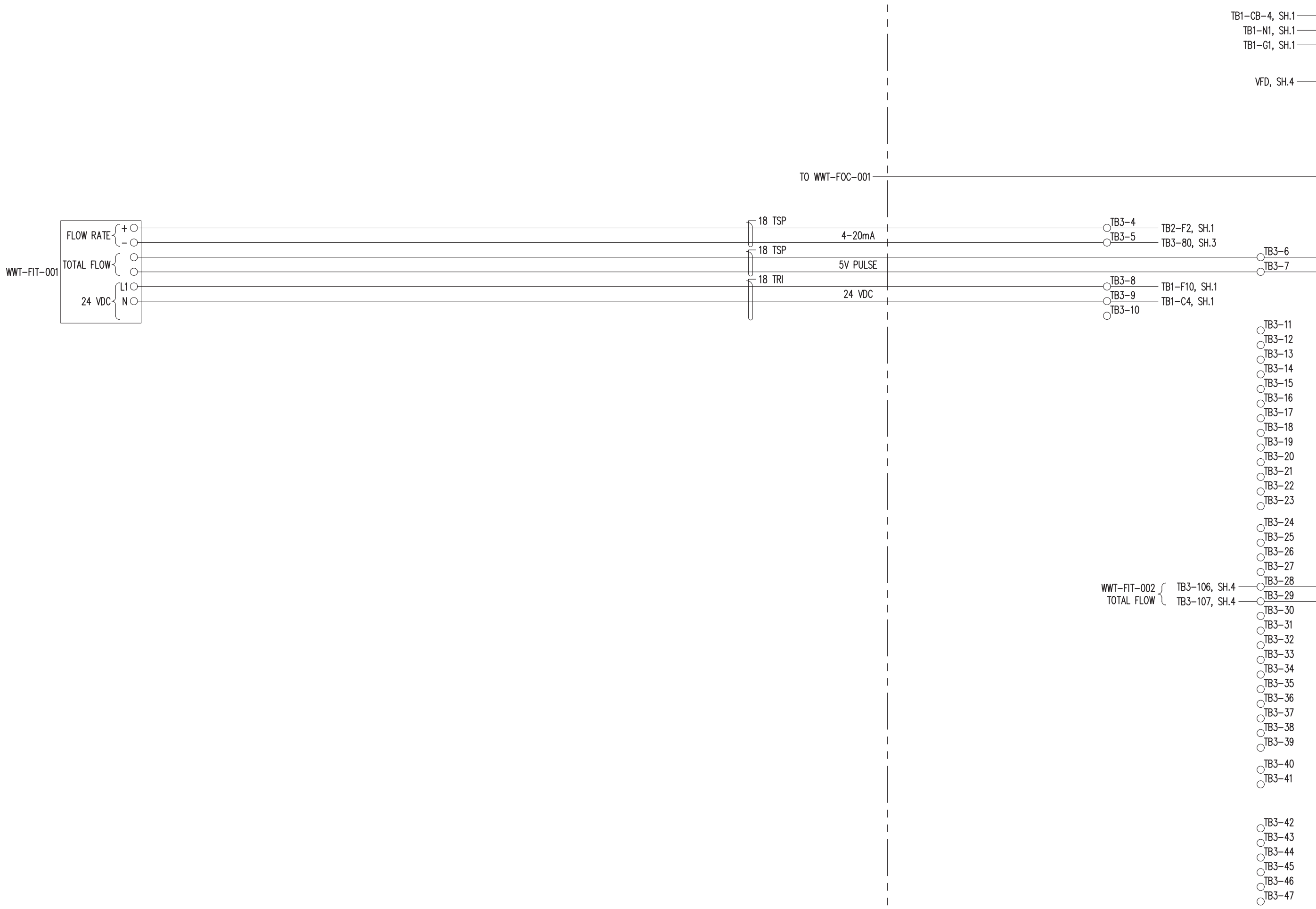
File: 1009302.dwg Layout: Sheet_1

FMT-D2-REV 5 (INL)

WWT-CP-001 – CONTINUED



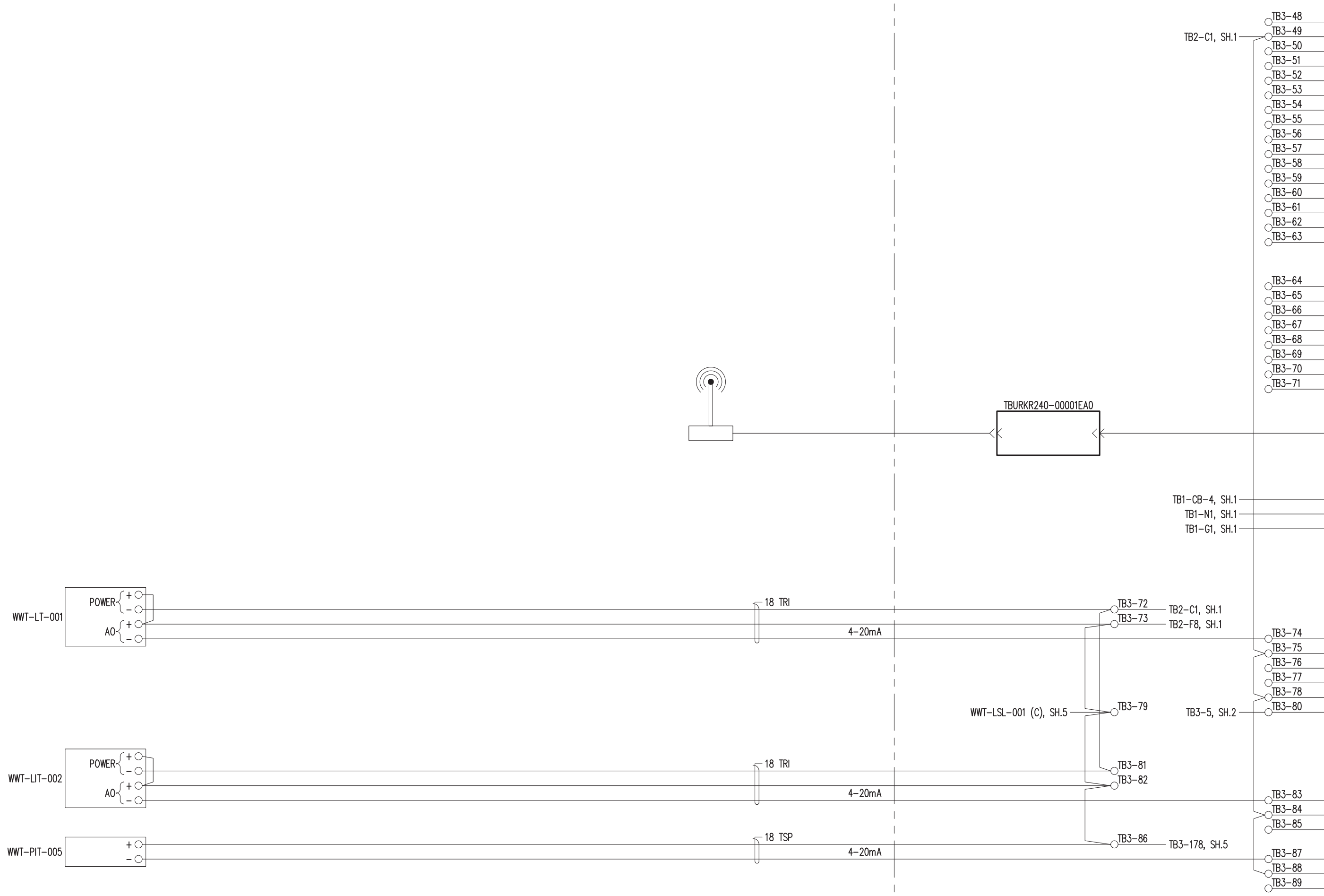
PLC

INSTR. TAG	SIGNAL TYPE	POSITION NO.	MODULE TYPE	MODULE TERM. NO.	NOTES
		PWR	BMXCPS2000	L1	
		PWR	BMXCPS2000	N	RACK 1 POWER SUPPLY
		PWR	BMXCPS2000	G	
	ETH	2	BMENOC0301	ETH1	ETHERNET COMM
	ETH	2	BMENOC0301	ETH2	ETHERNET COMM
	ETH	2	BMENOC0301	ETH3	ETHERNET COMM
	ETH	3	BMXNRP0200	ETH1	ETHERNET COMM
	ETH	3	BMXNRP0200	ETH2	ETHERNET COMM
	FIBER	3	BMXNRP0200	ETH1	ETHERNET FIBER
	FIBER	3	BMXNRP0200	ETH2	ETHERNET FIBER
		4	BMXEHC0200	CH0 (5)	TANK 1 – INLET TOTAL FLOW
		4	BMXEHC0200	CH0 (6)	TANK 1 – INLET TOTAL FLOW
		4	BMXEHC0200	CH0 (4)	SPARE
		4	BMXEHC0200	CH0 (5)	SPARE
		4	BMXEHC0200	CH0 (6)	SPARE
		4	BMXEHC0200	CH0 (7)	SPARE
		4	BMXEHC0200	CH0 (8)	SPARE
		4	BMXEHC0200	CH0 (9)	SPARE
		4	BMXEHC0200	CH0 (10)	SPARE
		4	BMXEHC0200	CH0 (11)	SPARE
		4	BMXEHC0200	CH0 (12)	SPARE
		4	BMXEHC0200	CH0 (13)	SPARE
		4	BMXEHC0200	CH0 (14)	SPARE
		4	BMXEHC0200	CH0 (15)	SPARE
		4	BMXEHC0200	CH0 (16)	SPARE
		4	BMXEHC0200	CH1 (1)	SPARE
		4	BMXEHC0200	CH1 (2)	SPARE
		4	BMXEHC0200	CH1 (3)	SPARE
		4	BMXEHC0200	CH1 (4)	SPARE
		4	BMXEHC0200	CH1 (5)	TANK 2 – OUTPUT TOTAL FLOW
		4	BMXEHC0200	CH1 (6)	TANK 2 – OUTPUT TOTAL FLOW
		4	BMXEHC0200	CH1 (7)	SPARE
		4	BMXEHC0200	CH1 (8)	SPARE
		4	BMXEHC0200	CH1 (9)	SPARE
		4	BMXEHC0200	CH1 (10)	SPARE
		4	BMXEHC0200	CH1 (11)	SPARE
		4	BMXEHC0200	CH1 (12)	SPARE
		4	BMXEHC0200	CH1 (13)	SPARE
		4	BMXEHC0200	CH1 (14)	SPARE
		4	BMXEHC0200	CH1 (15)	SPARE
		4	BMXEHC0200	CH1 (16)	SPARE
		4	BMXEHC0200	AUX (1)	SPARE
		4	BMXEHC0200	AUX (2)	SPARE
		4	BMXEHC0200	AUX (5)	SPARE
		4	BMXEHC0200	AUX (6)	SPARE
		4	BMXEHC0200	AUX (7)	SPARE
		4	BMXEHC0200	AUX (8)	SPARE
		4	BMXEHC0200	AUX (9)	SPARE
		4	BMXEHC0200	AUX (10)	SPARE

SIZE	CAGE CODE	AREA	TYPE	CL	ORIG	DWG NO.	REV
D	01MF3	760	0400	10	081	1009302	000A
SCALE: NONE						SHEET 2	

Path: C:\Users\OLSODB\Documents\HOMEWORK\2 – INL Jobs By ECR No\DCR-690715- Paul Petersen (CITRC Water Treatment – Cabinets [4504-11001]) Date: 10/11/2021 11:07:27 AM
File: 1009302.dwg Layout: Sheet_2

WWT-CP-001 – CONTINUED

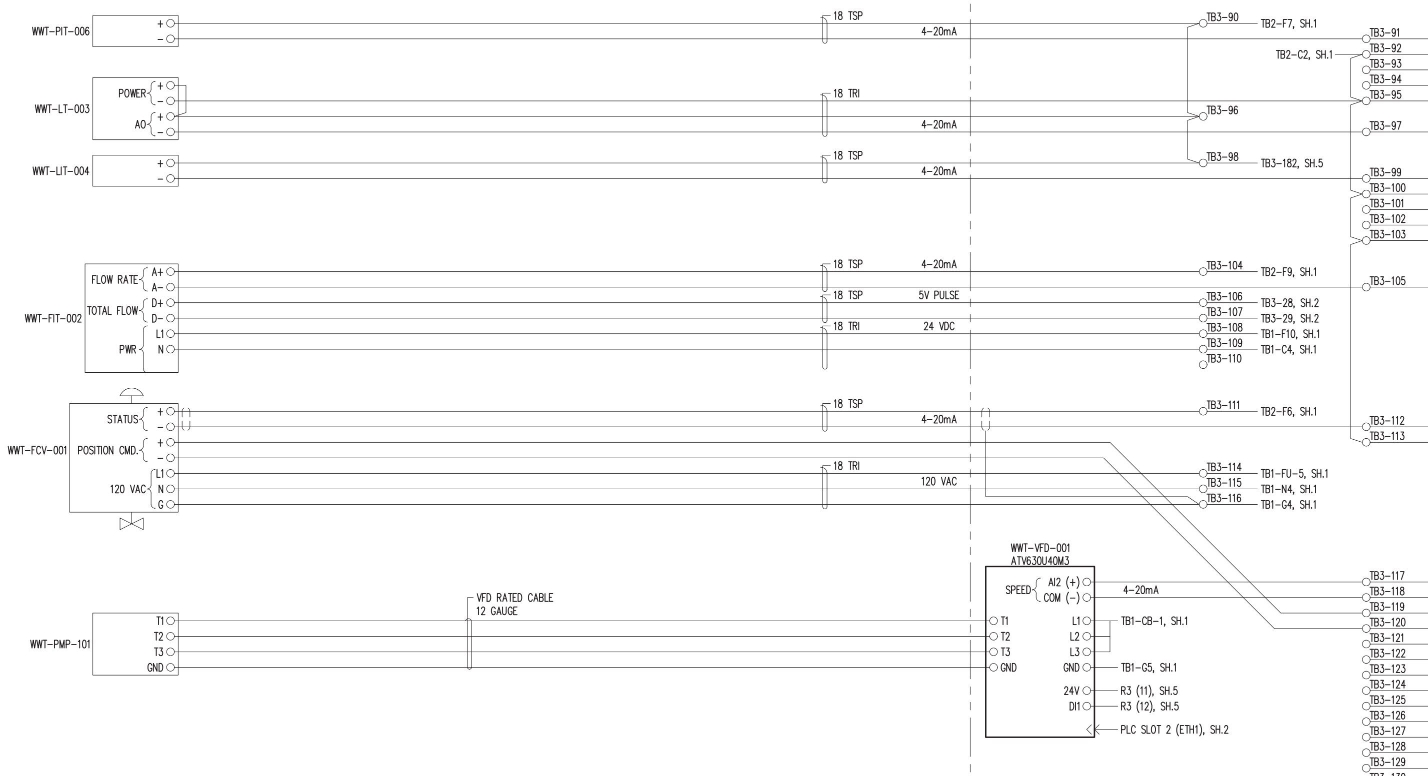


INSTR. TAG	SIGNAL TYPE	POSITION NO.	MODULE TYPE	MODULE TERM. NO.	NOTES
	CH 0	5	BMEAHI0812	3	SPARE
	CH RTN 0	5	BMEAHI0812	4	COMMON
	CH 1	5	BMEAHI0812	5	SPARE
	CH RTN 1	5	BMEAHI0812	6	SPARE
	CH 2	5	BMEAHI0812	7	SPARE
	CH RTN 2	5	BMEAHI0812	8	SPARE
	CH 3	5	BMEAHI0812	9	SPARE
	CH RTN 3	5	BMEAHI0812	10	SPARE
	CH 4	5	BMEAHI0812	11	SPARE
	CH RTN 4	5	BMEAHI0812	12	SPARE
	CH 5	5	BMEAHI0812	13	SPARE
	CH RTN 5	5	BMEAHI0812	14	SPARE
	CH 6	5	BMEAHI0812	15	SPARE
	CH RTN 6	5	BMEAHI0812	16	SPARE
	CH 7	5	BMEAHI0812	17	SPARE
	CH RTN 7	5	BMEAHI0812	18	SPARE
	CH 0	6	BMEAHO0412	1	SPARE
	CH RTN 0	6	BMEAHO0412	2	SPARE
	CH 1	6	BMEAHO0412	7	SPARE
	CH RTN 1	6	BMEAHO0412	8	SPARE
	CH 2	6	BMEAHO0412	11	SPARE
	CH RTN 2	6	BMEAHO0412	12	SPARE
	CH 3	6	BMEAHO0412	17	SPARE
	CH RTN 3	6	BMEAHO0412	18	SPARE
	RS232	7	BMXNOM0200	PORT 0	SERIAL COMM
	RS485	7	BMXNOM0200	PORT 0	SPARE
	RS485	7	BMXNOM0200	PORT 1	SPARE
		PWR	BMXCPS3500	L1	RACK 2 POWER SUPPLY
		PWR	BMXCPS3500	N	
		PWR	BMXCPS3500	G	
	II 0	8	BMXAMI0800	1	TANK 1 LEVEL
	COM 0	8	BMXAMI0800	2	COMMON
	VI 0	8	BMXAMI0800	3	SPARE
	VI 1	8	BMXAMI0800	4	SPARE
	COM 1	8	BMXAMI0800	5	COMMON
	II 1	8	BMXAMI0800	6	TANK 1 LOW LEVEL
	II 2	8	BMXAMI0800	7	TANK 2 LEVEL
	COM 2	8	BMXAMI0800	8	COMMON
	VI 2	8	BMXAMI0800	9	SPARE
	VI 3	8	BMXAMI0800	10	TANK 1 OUTLET PRESSURE
	COM 3	8	BMXAMI0800	11	COMMON
	II 3	8	BMXAMI0800	12	SPARE

SIZE	CAGE CODE	AREA	TYPE	CL	ORIG	DWG NO.	REV
D	01MF3	760	0400	10	081	1009302	000A

SCALE: NONE SHEET 3

WWT-CP-001 – CONTINUED



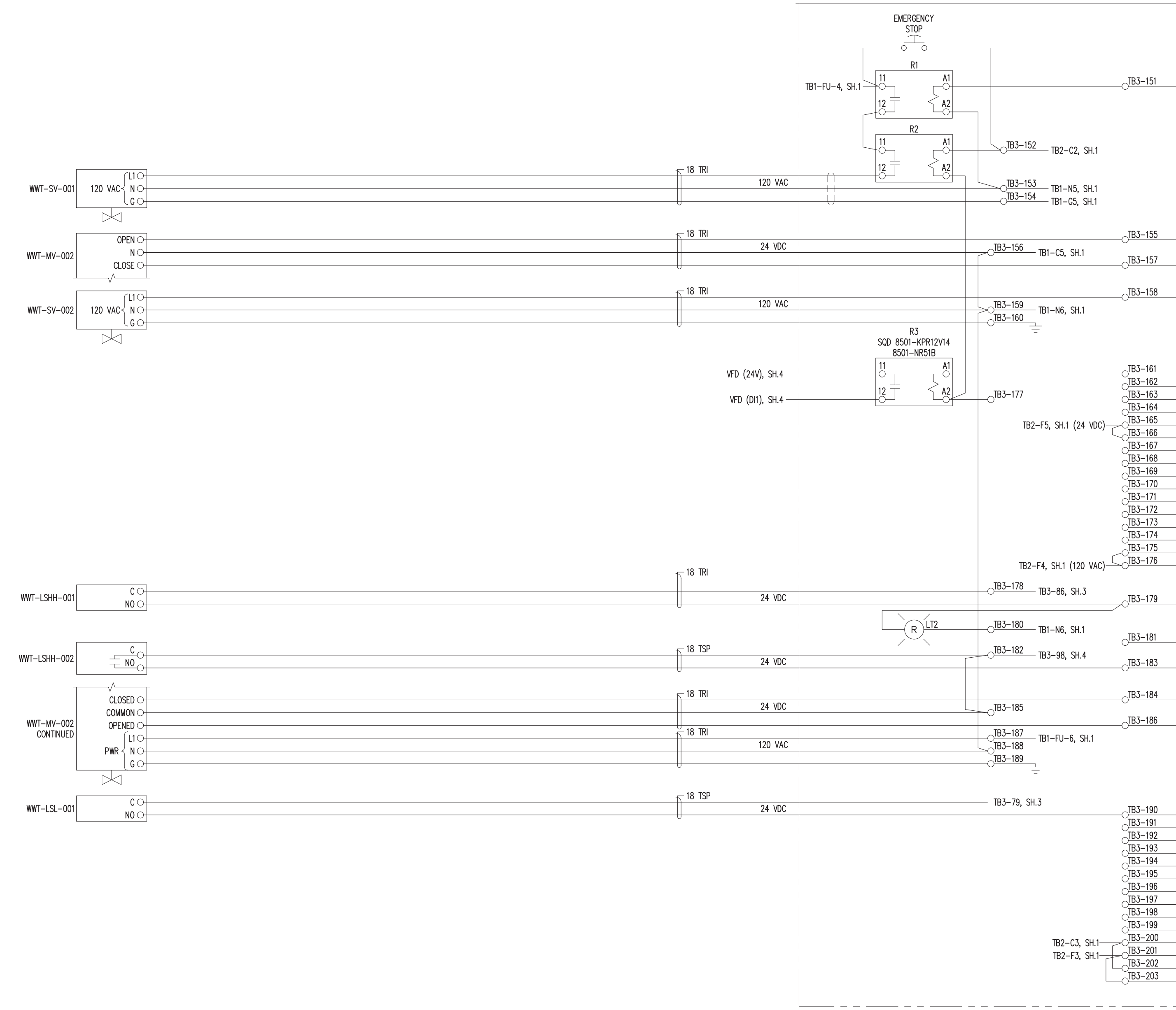
TERMINAL	INSTR. TAG	SIGNAL TYPE	POSITION NO.	MODULE TYPE	MODULE TERM. NO.	NOTES
TB3-91		II 4	8	BMXAMI0800	15	WWT-PMP-001 OUTLET PRESSURE
TB3-92		COM 4	8	BMXAMI0800	16	COMMON
TB3-93		VI 4	8	BMXAMI0800	17	SPARE
TB3-94		VI 5	8	BMXAMI0800	18	SPARE
TB3-95		COM 5	8	BMXAMI0800	19	COMMON
TB3-97		II 5	8	BMXAMI0800	20	TANK 2 LEVEL
TB3-99		II 6	8	BMXAMI0800	21	TANK 2 LEVEL
TB3-100		COM 6	8	BMXAMI0800	22	COMMON
TB3-101		VI 6	8	BMXAMI0800	23	SPARE
TB3-102		VI 7	8	BMXAMI0800	24	SPARE
TB3-103		COM 7	8	BMXAMI0800	25	COMMON
TB3-105		II 7	8	BMXAMI0800	26	TANK 2 OUTLET FLOW
TB3-112		I 0	9	BMXAMO0802	3	INLET CONTROL VALVE POSITION
TB3-113		COM 0	9	BMXAMO0802	4	COMMON
TB3-117		I 1	9	BMXAMO0802	5	WWT-PMP-101 SPEED
TB3-118		COM 1	9	BMXAMO0802	6	COMMON
TB3-119		I 2	9	BMXAMO0802	7	INLET CONTROL POS. CMD.
TB3-120		COM 2	9	BMXAMO0802	8	COMMON
TB3-121		I 3	9	BMXAMO0802	9	SPARE
TB3-122		COM 3	9	BMXAMO0802	10	SPARE
TB3-123		I 4	9	BMXAMO0802	11	SPARE
TB3-124		COM 4	9	BMXAMO0802	12	SPARE
TB3-125		I 5	9	BMXAMO0802	13	SPARE
TB3-126		COM 5	9	BMXAMO0802	14	SPARE
TB3-127		I 6	9	BMXAMO0802	15	SPARE
TB3-128		COM 6	9	BMXAMO0802	16	SPARE
TB3-129		I 7	9	BMXAMO0802	17	SPARE
TB3-130		COM 7	9	BMXAMO0802	18	SPARE
TB3-131		I 0	10	BMXDAI1604	1	SPARE
TB3-132		I 1	10	BMXDAI1604	2	SPARE
TB3-133		I 2	10	BMXDAI1604	3	SPARE
TB3-134		I 3	10	BMXDAI1604	4	SPARE
TB3-135		I 4	10	BMXDAI1604	5	SPARE
TB3-136		I 5	10	BMXDAI1604	6	SPARE
TB3-137		I 6	10	BMXDAI1604	7	SPARE
TB3-138		I 7	10	BMXDAI1604	8	SPARE
TB3-139		I 8	10	BMXDAI1604	9	SPARE
TB3-140		I 9	10	BMXDAI1604	10	SPARE
TB3-141		I 10	10	BMXDAI1604	11	SPARE
TB3-142		I 11	10	BMXDAI1604	12	SPARE
TB3-143		I 12	10	BMXDAI1604	13	SPARE
TB3-144		I 13	10	BMXDAI1604	14	SPARE
TB3-145		I 14	10	BMXDAI1604	15	SPARE
TB3-146		I 15	10	BMXDAI1604	16	SPARE
TB3-147		120V N	10	BMXDAI1604	17	SPARE
TB3-148		120V	10	BMXDAI1604	18	SPARE
TB3-149		120V N	10	BMXDAI1604	19	SPARE
TB3-150		120V	10	BMXDAI1604	20	SPARE

SIZE	CAGE CODE	AREA	TYPE	CI	ORIG	DWG NO.	REV
D	01MF3	760	0400	10	081	1009302	000A

SCALE: NONE   SHEET 4

FMT-D2-REV 5 (INL)

WWT-CP-001 – CONTINUED

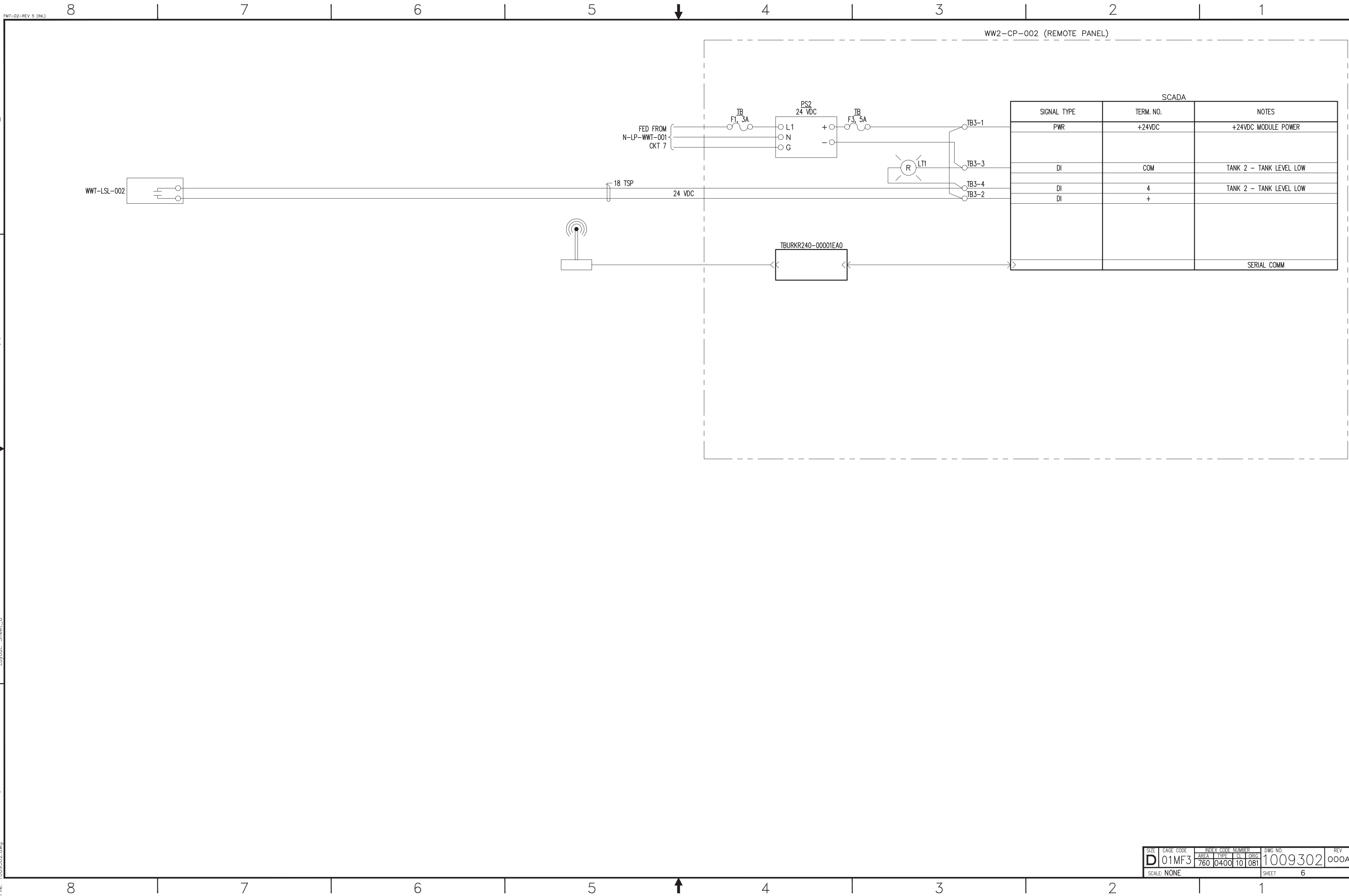


INSTR. TAG	SIGNAL TYPE	POSITION NO.	MODULE TYPE	MODULE TERM. NO.	NOTES
TB3-151	Q0	11	BMXDRA1605	1	INLET ISOLATION VALVE
TB3-155	Q1	11	BMXDRA1605	2	WWT-MV-002 – OPEN
TB3-157	Q2	11	BMXDRA1605	3	WWT-MV-002 – CLOSE
TB3-158	Q3	11	BMXDRA1605	4	TANK 2 OUTPUT ISOLATION VALVE OPEN/CLOSE
TB3-161	Q4	11	BMXDRA1605	5	WWT-PMP-101 ON/OFF
TB3-162	Q5	11	BMXDRA1605	6	SPARE
TB3-163	Q6	11	BMXDRA1605	7	SPARE
TB3-164	Q7	11	BMXDRA1605	8	SPARE
TB3-165	C0-7	11	BMXDRA1605	9	COMMON 0-7
TB3-166	C0-7	11	BMXDRA1605	10	COMMON 0-7
TB3-167	Q8	11	BMXDRA1605	11	SPARE
TB3-168	Q9	11	BMXDRA1605	12	SPARE
TB3-169	Q10	11	BMXDRA1605	13	SPARE
TB3-170	Q11	11	BMXDRA1605	14	SPARE
TB3-171	Q12	11	BMXDRA1605	15	SPARE
TB3-172	Q13	11	BMXDRA1605	16	SPARE
TB3-173	Q14	11	BMXDRA1605	17	SPARE
TB3-174	Q15	11	BMXDRA1605	18	SPARE
TB3-175	C8-15	11	BMXDRA1605	19	COMMON 8-15
TB3-176	C8-15	11	BMXDRA1605	20	COMMON 8-15
TB3-179	I0	12	BMXDAI1602	1	TANK 1 HIGH HIGH ALARM
TB3-181	I1	12	BMXDAI1602	2	SPARE
TB3-183	I2	12	BMXDAI1602	3	TANK 2 HIGH HIGH ALARM
	I3	12	BMXDAI1602	4	SPARE
TB3-184	I4	12	BMXDAI1602	5	WWT-MV-002 OPENED
TB3-186	I5	12	BMXDAI1602	6	WWT-MV-002 CLOSED
TB3-190	I6	12	BMXDAI1602	7	TANL 1 LOW LEVEL
TB3-191	I7	12	BMXDAI1602	8	SPARE
TB3-192	I8	12	BMXDAI1602	9	SPARE
TB3-193	I9	12	BMXDAI1602	10	SPARE
TB3-194	I10	12	BMXDAI1602	11	SPARE
TB3-195	I11	12	BMXDAI1602	12	SPARE
TB3-196	I12	12	BMXDAI1602	13	SPARE
TB3-197	I13	12	BMXDAI1602	14	SPARE
TB3-198	I14	12	BMXDAI1602	15	SPARE
TB3-199	I15	12	BMXDAI1602	16	SPARE
TB3-200	COM	12	BMXDAI1602	17	MODULE COMMON
TB3-201	24VDC+	12	BMXDAI1602	18	MODULE PWR
TB3-202	COM	12	BMXDAI1602	19	MODULE COMMON
TB3-203	24VDC+	12	BMXDAI1602	20	MODULE PWR

SIZE	CAGE CODE	INDEX CODE NUMBER AREA	TYPE	CL	ORIG	DWG NO.	REV
D	01MF3	760	0400	10	081	1009302	000A

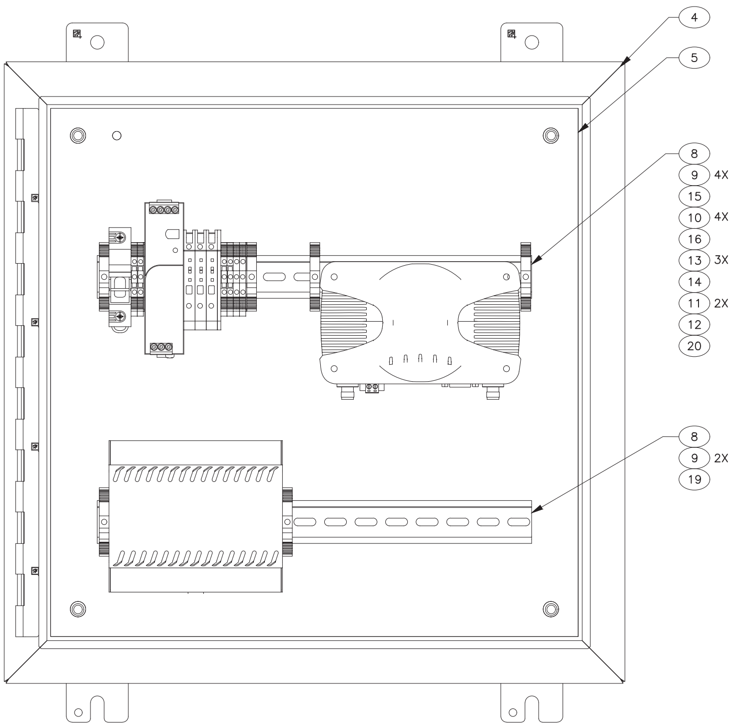
SCALE: NONE SHEET 5

Path: C:\Users\OLSODB\Documents\HOMEWORK\2 – INL Jobs By ECR No\DCR-690715- Paul Petersen (CITRC Waste Water Treatment) – Cabinets [4504 1100]) Date: 10/11/2021 11:07:27 AM
File: 1009302.dwg Layout: Sheet_5


FMT-D2-REV 5 (INL)
WW2-CP-002 (REMOTE PANEL)
SCADA
SIGNAL TYPE
TERM. NO.
NOTES
PWR
+24VDC
+24VDC MODULE POWER
DI
COM
TANK 2 - TANK LEVEL LOW
DI
4
TANK 2 - TANK LEVEL LOW
DI
+
SERIAL COMM
FED FROM
N-LP-WWT-001
CKT 7
TB
F1, 3A
PS2
24 VDC
L1
N
G
TB
F3, 5A
TB3-1
TB3-3
TB3-4
TB3-2
LT1
R
WWT-LSL-002
18 TSP
24 VDC
TBURKR240-00001EA0
SIZE D
CAGE CODE 01MF3
INDEX CODE NUMBER AREA 760 TYPE 0400 CL 10 ORIG 081
DWG NO. 1009302
REV 000A
SCALE: NONE
SHEET 6
File: 1009302.dwg
Layout: Sheet_6

FMT-01-INL, R-3, 3-2021

REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE:



−1 ASSEMBLY
DOOR REMOVED FOR CLARITY

	QTY REQD −1	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL/SPECIFICATION OR VENDOR NAME	ITEM NO.
	1	TBURKR240-00001EA0	2.4GHZ SERIAL RADIO	SCHNEIDER ELECTRIC	20
	1	TBUP100-1A20-AA00	SCADAPACK 100, COMES WITH 3 ANALOG INPUTS, 6 CONFIGURABLE DIGITAL I/O, 1 ACCUMULATOR	SCHNEIDER ELECTRIC	19
					18
					17
	1	1606-XLE120E	ESSENTIAL POWER SUPPLY, 24-28V DC, 120 W, 120/240V AC INPUT VOLTAGE	ALLEN-BRADLEY	16
	1	1492-FB1C30	FUSE HOLDER WITH 1 POLE, CLASS CC TYPE FUSES, 30A, PKG. QTY. 12	ALLEN-BRADLEY	15
	1	1492-N37	END BARRIER, BLACK	ALLEN-BRADLEY	14
	3	1492-H6	FINGER-SAFE TERMINAL BLOCKS, H-BLOCK,CODE 6,BLACK	ALLEN-BRADLEY	13
	2	1492-EBJ3	END BARRIER, GRAY	ALLEN-BRADLEY	12
	2	1492-JG3	TERMINAL BLOCK, ONE-CIRCUIT FEED-THROUGH GROUND BLOCK, GREEN/YELLOW STRIPE	ALLEN-BRADLEY	11
	4	1492-J3	TERMINAL BLOCK, ONE-CIRCUIT FEED-THROUGH BLOCK, GRAY	ALLEN-BRADLEY	10
	6	1492-EAJ35	END ANCHOR, DIN RAIL, NORMAL DUTY	ALLEN-BRADLEY	9
	2	DN-R35S1	DIN RAIL, SLOTTED, 15MM, 5.5MM HEIGHT	AUTOMATIONDIRECT	8
					7
					6
	1	A20P20G	PANEL FOR TYPE 3R; 4; 4X; 12 AND 13 ENCLOSURE, FITS 20X20, GALVANIZED, STEEL	HOFFMAN	5
	1	A20H20BLP3PT	CONTINUOUS HINGE WITH 3-POINT LATCH, TYPE 4, 20.00X20.00X8.00, GRAY, STEEL	HOFFMAN	4
					3
					2
		−1	WWT-CP-002 (REMOTE CABINET) ASSEMBLY		1

PARTS LIST CONTINUED

DIMENSIONING AND SYMBOLOGY PER ASME Y14.5 AND STD-10011
UNLESS OTHERWISE SPECIFIED
SURFACE ROUGHNESS 125√
DIMENSIONS AND TOLERANCES ARE IN INCHES
TOLERANCES: .X = ± .1
DECIMALS: .XX = ± .03
.XXX = ± .010
FRACTIONS ± 1/8
ANGULAR ± 2°
DO NOT SCALE DRAWING

REQUESTER: S.J. REESE
RESP ENGR: P. PETERSEN
DESIGN: P. PETERSEN
DRAWN: D. OLSON
PROJECT NO. NA
SPCL CODE NA
FOR REVIEW/APPROVAL SIGNATURES SEE DCR NO. 690715
EFFECTIVE DATE: 10/11/2021

Idaho National Laboratory

CITRC
WATER SECURITY TEST BED PROJECT

WWT-CP-002 (REMOTE CABINET) ASSEMBLY

SIZE	CAGE CODE	AREA	TYPE	CL	ORIG	DWG NO.	REV
D	01MF3	760	0400	10	081	1009303	000A

SCALE: NONE SHEET 1 OF 1

Path: C:\Users\OLSODB\Documents\HOMEWORK\2 - INL Jobs By ECR N\DCR-690715- Paul Petersen (CITRC Water Test Bed - Cabinets [4504 1100]) Date: 10/11/2021 11:06:55 AM
File: 1009303.dwg Layout: Sheet

REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE:

QTY REQD	-1	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL/SPECIFICATION OR VENDOR NAME	ITEM NO.
	3	FAZ-C6-1-SP	EATON MINIATURE SUPPLEMENTARY PROTECTOR, 6A, 277 VAC/48 VDC, 1-POLE, C CURVE, THERMAL MAGNETIC, 10KA SCCR	AUTOMATIONDIRECT	40
	1	FAZ-C5-1-SP	EATON MINIATURE SUPPLEMENTARY PROTECTOR, 5A, 277 VAC/48 VDC, 1-POLE, C CURVE, THERMAL MAGNETIC, 10KA SCCR	AUTOMATIONDIRECT	39
	1	FAZ-C15-1-SP	EATON MINIATURE SUPPLEMENTARY PROTECTOR, 15A, 277 VAC/48 VDC, 1-POLE, C CURVE, THERMAL MAGNETIC, 10KA SCCR	AUTOMATIONDIRECT	38
	1	BBEV-EC-3-2-01	EATON END CAP, PACKAGE OF 2. FOR USE WITH EATON BBUL SERIES 2-PHASE AND 3-PHASE BUSBARS	AUTOMATIONDIRECT	37
	1	BBUL25-3P-3M57-SP-01	EATON BUSBAR, 100A, 480 VAC	AUTOMATIONDIRECT	36
	3	BBUL-TEP-35-1	EATON BOX TYPE WIRING LUG, 115A, 1000 VAC/VDC	AUTOMATIONDIRECT	35
	1	FAZ-C50-3	EATON MINIATURE SUPPLEMENTARY PROTECTOR, 50A, 277 VAC/48 VDC, 3-POLE, C CURVE, THERMAL MAGNETIC, 10KA SCCR	AUTOMATIONDIRECT	34
	4	EPDB104	EDISON ENCLOSED POWER DISTRIBUTION BLOCK, 175A, 1-POLE	AUTOMATIONDIRECT	33
	1	CH60J3	EATON BUSSMANN SERIES CH MODULAR FUSE HOLDER, 600 VAC, 600 VDC, 60A, THREE-POLE	EATON	32
					31
					30
	1	BMXDAI1602	DISCRETE INPUT MODULE X80, 16 INPUTS, 24VAC/DC POSITIVE OR NEGATIVE	SCHNEIDER ELECTRIC	29
	1	BMXDRA1605	DISCRETE OUTPUT MODULE X80, 16 OUTPUTS, RELAY, 24 VDC OR 24...240 VAC	SCHNEIDER ELECTRIC	28
	1	BMXDAI1604	DISCRETE INPUT MODULE X80, 16 INPUTS, 100..120 VAC CAPACITIVE	SCHNEIDER ELECTRIC	27
	1	BMXAMO0802	ANALOG OUTPUT MODULE X80, 8 OUTPUTS	SCHNEIDER ELECTRIC	26
	1	BMXAMI0800	NON-ISOLATED ANALOG INPUT MODULE X80, 8 INPUTS, FAST SPEED	SCHNEIDER ELECTRIC	25
	1	BMXCPS2000	POWER SUPPLY MODULE X80, 100..240 VAC, 20 W	SCHNEIDER ELECTRIC	24
	2	BMXXBE2005	MODICON M340 AUTOMATION PLATFORM, X80 BACKPLANE EXTENDER KIT	SCHNEIDER ELECTRIC	23
	1	BMXNOM0200	SERIAL LINK MODULE WITH 2 RS-485/232 PORTS IN MODBUS AND CHARACTER MODE	SCHNEIDER ELECTRIC	22
	1	BMEAHO0412	ANALOG OUPUT MODULE X80, 4 OUTPUTS HART, CURRENT ISOLATED	SCHNEIDER ELECTRIC	21
	1	BMEAHI0812	ANALOG INPUT MODULE X80, 8 INPUTS HART, CURRENT ISOLATED	SCHNEIDER ELECTRIC	20
	1	BMXEHC0200	COUNTER MODULE, MODICON M340 AUTOMATION PLATFORM, HIGH SPEED 2 CHANNELS	SCHNEIDER ELECTRIC	19
	1	BMXNRP0200	FIBER CONVERTER MM/LC 2CH 100MB	SCHNEIDER ELECTRIC	18
	1	BMENOC0301	M580 ETHERNET/IP AND MODBUS TCP MODULE WITH 3 PORTS	SCHNEIDER ELECTRIC	17
	1	BMEP581020	PROCESSOR MODULE, MODICON M580, LEVEL 1, DISTRIBUTED	SCHNEIDER ELECTRIC	16
	1	BMXCPS3500	HIGH POWER AC 110/220 VAC POWER SUPPLY	SCHNEIDER ELECTRIC	15
	2	BMEXBP0800	RACK X80, 8 SLOTS, ETHERNET BACKPLANE	SCHNEIDER ELECTRIC	14
	1	TBURKR240-00001EA0	2.4GHZ SERIAL RADIO	SCHNEIDER ELECTRIC	13
	1	TBUP100-1A20-AA00	SCADAPACK 100, COMES WITH 3 ANALOG INPUTS, 6 CONFIGURABLE DIGITAL I/O, 1 ACCUMULATOR	SCHNEIDER ELECTRIC	12
	1	ATV630U40M3	ATV630 VARIABLE SPEED DRIVE IP21 11KW 240V	SCHNEIDER ELECTRIC	11
					10
					9
	2	9001KP35LRR31	PILOT LIGHT 28V 30MM TYPE K +OPTIONS	SCHNEIDER ELECTRIC	8
	1	AOFF118	OUTDOOR FILTER FAN AND EXHAUST PACKAGE	HOFFMAN	7
	1	ATEMNO	TEMPERATURE CONTROL SWITCH FOR FANS, 2.37X1.31X1.55, BLACK, PLASTIC	HOFFMAN	6
	1	A48P48G	PANEL FOR TYPE 3R; 4; 4X; 12 AND 13 ENCLOSURE, FITS 48X48, WHITE, STEEL	HOFFMAN	5
	1	A484812WFLP	CONTINUOUS HINGE 2-DOOR WITH HANDLE TYPE 12, 48.00X48.00X12.00, GRAY, STEEL	HOFFMAN	4
					3
					2
		-1	WWT-CP-001 ASSEMBLY		1

PARTS LIST CONTINUED

QTY REQD	-1	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL/SPECIFICATION OR VENDOR NAME	ITEM NO.
	AR	C2LG6	DUCT COVER, 2 W X 6' LENGTH, PVC, LIGHT GRAY	PANDUIT	53
	AR	F2X3LG6	WIRING DUCT, TYPE F NARROW SLOT, 2" W X 3" H, 6' LENGTH, PVC, LIGHT GRAY	PANDUIT	52
					51
	6	KN-EB4-10	KONNECT-IT SNAP-ON END BRACKET, 8MM WIDE	AUTOMATIONDIRECT	50
	3	KN-ECT6GRY-25	KONNECT-IT TERMINAL BLOCK END COVER, GRAY	AUTOMATIONDIRECT	49
	1	KN-ECF10	KONNECT-IT TERMINAL BLOCK END COVER, GRAY, FOR USE WITH KN-F10 SERIES TERMINAL BLOCKS	AUTOMATIONDIRECT	48
	209	KN-T12GRY	KONNECT-IT SINGLE-LEVEL TERMINAL BLOCK, ACCEPTS WIRE SIZE 26, 12 AWG, GRAY, 20A, 600V RATED	AUTOMATIONDIRECT	47
	18	KN-F10-10	KONNECT-IT FUSE TERMINAL BLOCK, ACCEPTS WIRE SIZE 26, 8 AWG, GRAY, 6.3A, 300V RATED	AUTOMATIONDIRECT	46
	AR	DN-R35S1	DIN RAIL, SLOTTED, 15MM, 5.5MM HEIGHT	AUTOMATIONDIRECT	45
					44
					43
	1	PSM24-180S	RHINO SWITCHING POWER SUPPLY, 24 VDC (ADJUSTABLE) OUTPUT, 7.5A, 180W, 120/240 VAC NOMINAL INPUT, 1-PHASE	AUTOMATIONDIRECT	42
	1	FAZ-C10-1-SP	EATON MINIATURE SUPPLEMENTARY PROTECTOR, 10A, 277 VAC/48 VDC, 1-POLE, C CURVE, THERMAL MAGNETIC, 10KA SCCR	AUTOMATIONDIRECT	41

PARTS LIST CONTINUED

DIMENSIONING AND SYMBOLOGY PER ASME Y14.5 AND STD-10011
UNLESS OTHERWISE SPECIFIED
SURFACE ROUGHNESS 125√
DIMENSIONS AND TOLERANCES ARE IN INCHES
TOLERANCES: .X = ± .1
DECIMALS: .XX = ± .03
.XXX = ± .010
FRACTIONS ± 1/8
ANGULAR ± 2°
DO NOT SCALE DRAWING

REQUESTER: S.J. REESE
RESP ENGR: P. PETERSEN
DESIGN: P. PETERSEN
DRAWN: D. OLSON
PROJECT NO. NA
SPCL CODE NA
FOR REVIEW/APPROVAL SIGNATURES SEE DCR NO. 690715
EFFECTIVE DATE: 10/11/2021

Idaho National Laboratory

CITRC
WATER SECURITY TEST BED PROJECT

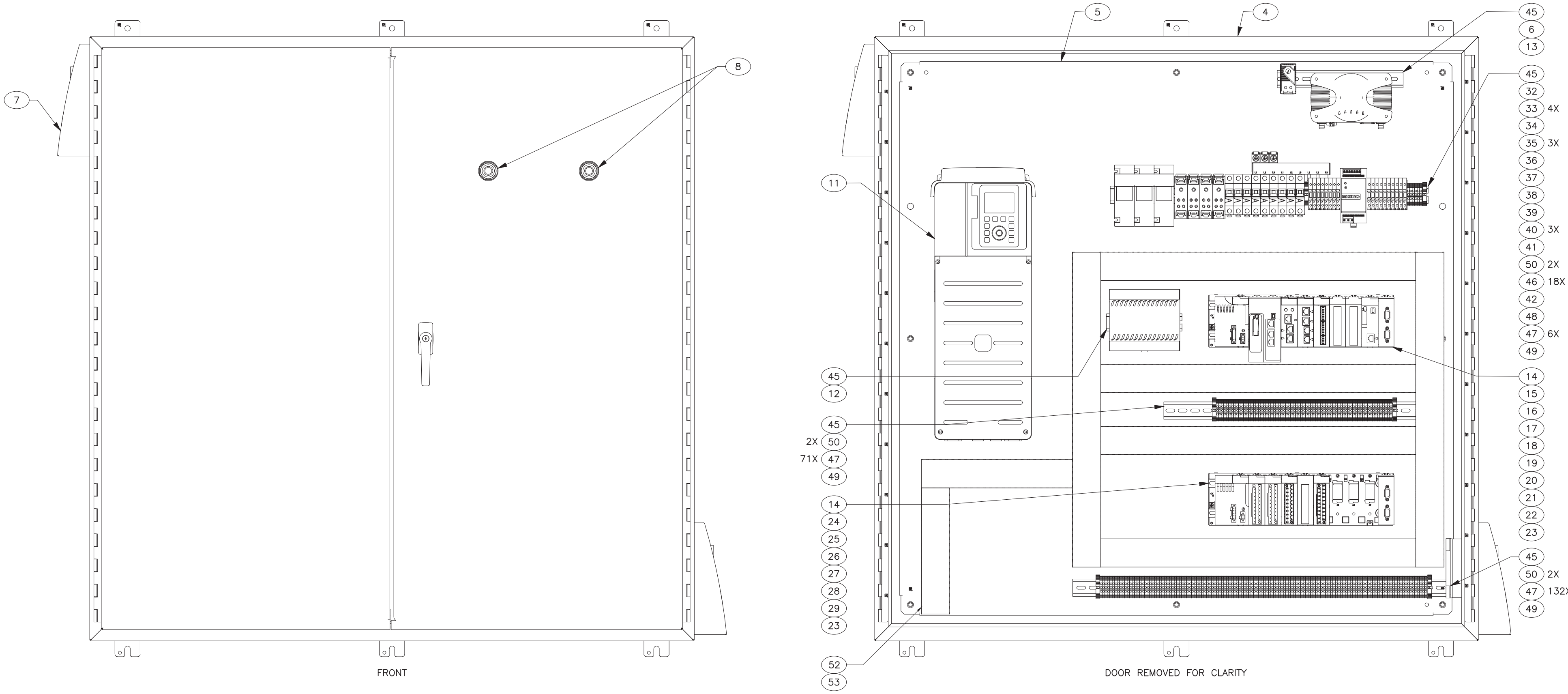
WWT-CP-001 ASSEMBLY

SIZE	CAGE CODE	INDEX CODE NUMBER: AREA	TYPE	CL	ORIG	DWG NO.	REV
D	01MF3	760	0400	10	081	1009304	000A

SCALE: NONE
SHEET 1 OF 2

Path: C:\Users\OLSODB\Documents\HOMEWORK\2 - INL Jobs By ECR No\DCR-690715- Paul Petersen (CITRC Water Test Bed - Cabinets [4504-1100]) - DONE Date: 10/12/2021 8:18:32 AM
File: 1009304.dwg Layout: Sheet_1

FMT-D2-REV 5 (INL)

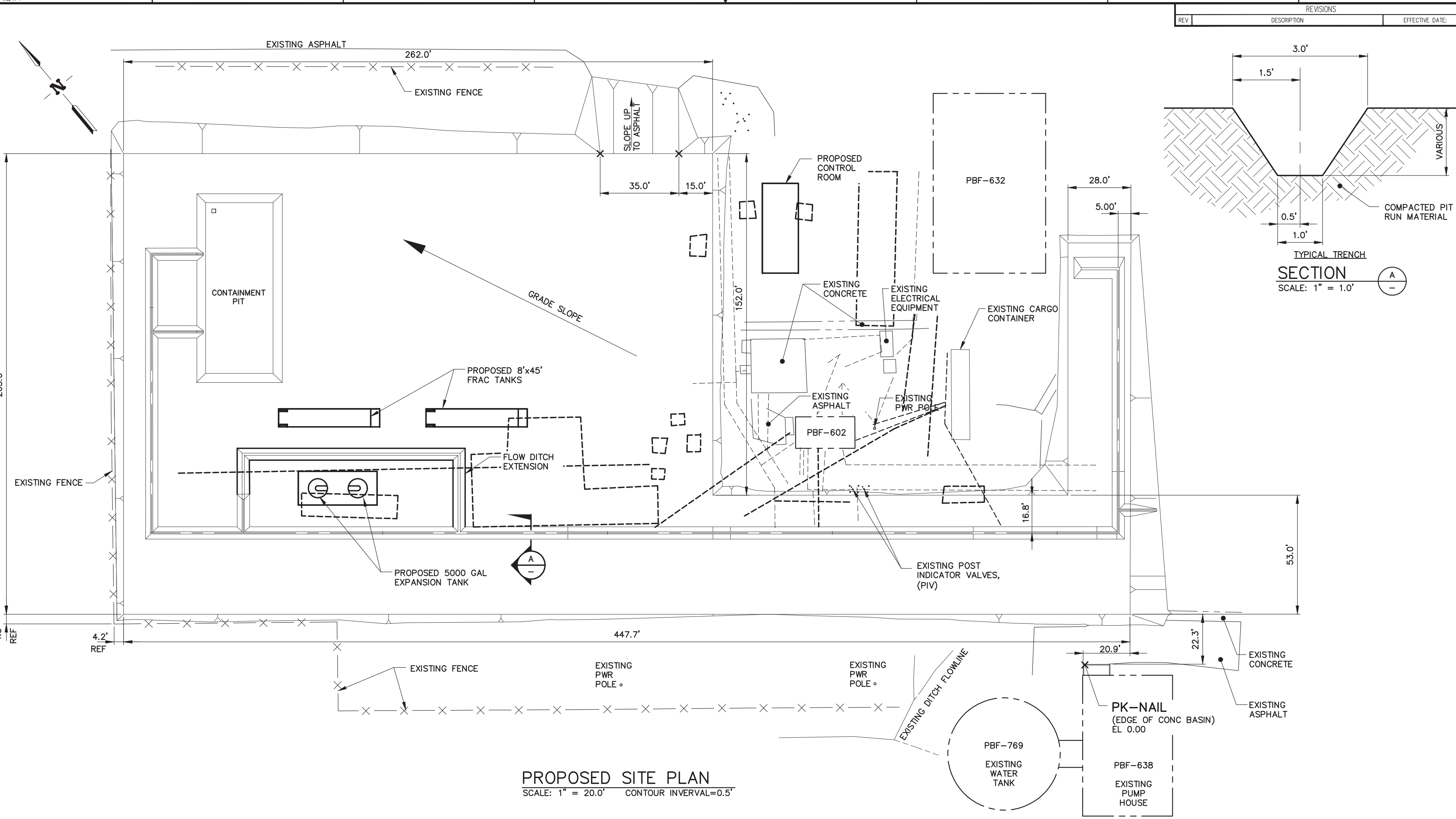


—1 ASSEMBLY

SIZE	CAGE CODE	INDEX CODE NUMBER AREA	TYPE	CL	ORIG	DWG NO.	REV
D	01MF3	760	0400	10	081	1009304	000A
SCALE: NONE						SHEET 2	

Path: C:\Users\OLSODB\Documents\HOMEWORK\2 - INL Jobs By ECR No\DCR-690715- Paul Petersen (CITRC Water Test Bed - Cabinets [4504-1100]) - DONE Date: 10/12/2021 8:18:32 AM
File: 1009304.dwg Layout: Sheet_2

Appendix G – Subsurface Investigation Maps



PROPOSED SITE PLAN
SCALE: 1" = 20.0' CONTOUR INVERVAL=0.5'

PRELIMINARY
NOT RELEASED - NOT APPROVED FOR CONSTRUCTION

SCALE: 1" = 20.0'

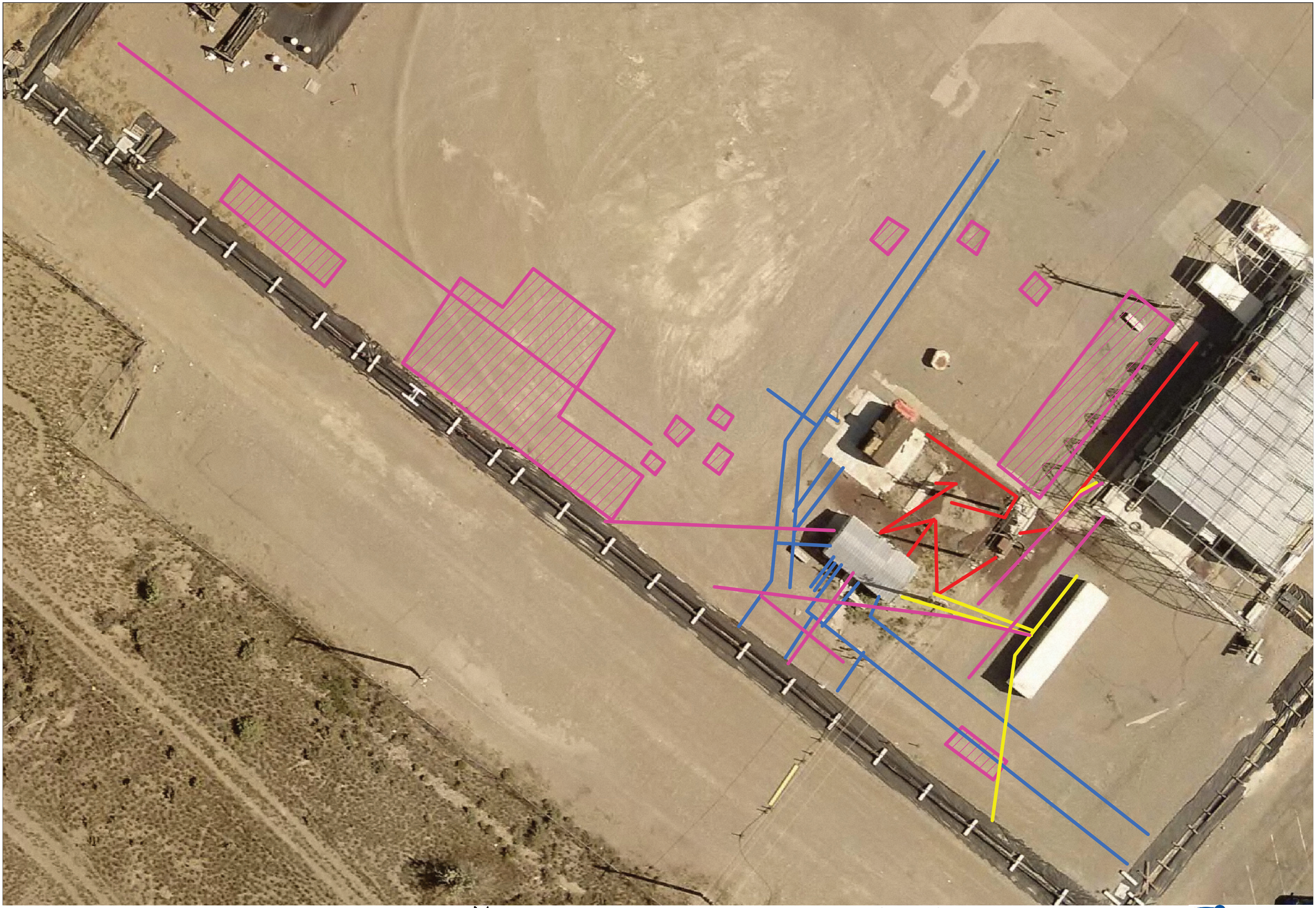
REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE:

REQUESTER:	SJ REESE
RESP ENGR:	
DESIGN:	
DRAWN:	CA BEHM
PROJECT NO.	NA
SPCL CODE	NA
FOR REVIEW/APPROVAL SIGNATURES SEE ECR NO.	
EFFECTIVE DATE:	

Idaho National Laboratory
CITRC
WATER TEST BED
PROPOSED SITE PLAN AND DETAIL

SIZE	CAGE CODE	AREA	TYPE	CL	ORIG	DWG NO.	REV
D	01MF3	760	0100	02	081	SKETCH-1	
SCALE: NOTED						SHEET 1 OF 1	

File: site_plan.dwg
Path: P:\CITRC\test_bed\2020
Layout Name: SK-1
Date: 11/09/20 - 10:24 A.M.
ID: ABE



Legend

Communication — Elecrtical — Area of Concern

Unknown Line — Water

N

0 3 6 12 18 Meters

0 10 20 40 60 Feet

Subsurface Investigation: Water Security Test Bed

GIS Analyst: Trent Armstrong
Date Drawn: 11/25/2020
Path: :\\projects2\esd\swo\PBF
File Name:PER_602.mxd

Idaho National Laboratory

United States
Environmental Protection
Agency

EPA 600/R-23/132 I July 2023 I

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