

Waste Treatment Plant Project



2016 Supply Chain Collaboration Event

C&I Challenges









Gary Hickman – C&I Responsible Engineer for 9+ Years

Starting Point

- This is intended to be a very collaborative session
- Bechtel and WTP cannot succeed if vendors do not succeed
- This dovetails with other sessions
 - Vendor Submittals
 - Electrical Challenges

Opening Questions of/from Vendors

- Who is here?
- What do you supply?
- What experience do you have with commercial nuclear projects?
- What experience do you have with government (DOE) nuclear projects?
- What experience do you have with Bechtel?
- What experience do you have with the WTP project?
- What issues do you see in working with Bechtel National Incorporated on WTP?

Presentation Summary

VIT PLOS

- Common Language
- Describe WTP C&I Procurement Process
- Common Struggles
 - ASME B31.3
 - Maintaining NEMA Ratings
 - Differences between Electrical and C&I Color Coding
 - Software
 - Vendor Submittals
 - Tagging/Labeling
- Questions?

Common Language

VIT PLANT

- C&I vs I&C
- Q vs CM
- Safety vs Non-Safety
- Safety Significant vs Safety Class (SS vs SC)
- Packaged vs Discrete
- Equipment Qualification (EEQ and ESQ)
- Commercial Grade Dedication (CGD)
- Material Requisition (MR)
- Purchase Order (PO)

WTP Procurement Process – From the Technical Perspective



Material Requisition for Quote

- Scope
 - Line Items
- Technical Requirements
 - Datasheet
 - Specifications
 - \circ General
 - Dedicated Equipment
 - Drawings
 - Technical Notes
 - Supplier Deviation Disposition Request (SDDR)
- Submittals
- Quality Verification Documents (QVD)
- Witness and Hold Points

WTP Procurement Process – From the Technical Perspective



- Pre-Award Technical Evaluation
- Material Requisition for Purchase
- Post Award Technical Evaluation
- Submittals
 - Permission to Proceed
- Fabrication
 - Witness and Hold Points
- Shipment/QVD

Common Struggles with both Discrete and Packaged Equipment – ASME B31.3 1996



- ASME B31.3 is the Piping Standard for 99% of this project
- What are the alternatives for devices?
 - Unlisted Components
 - At times, Vendor Standards
- When does it apply?
 - When ASME B31.3 says it does
 - Per Section 322.3.1 ASME B31.3 does not apply to instruments
 - Section 300.2 piping components "include...in-line portions of instruments..."

Common Struggles with both Discrete and Packaged Equipment – ASME B31.3



- Remote Mounted Instruments
 - Example Pressure Transmitter
 - Not Subject to ASME B31.3
 - Designed and manufactured to some standard Maximum Allowable Working Pressure (MAWP)





Common Struggles with both Discrete and Packaged Equipment – ASME B31.3



- Insertion Instruments
 - Example thermowells, thermal flowmeters, or pitot tubes
 - Pipe vs the instrument



Common Struggles with both Discrete and Packaged Equipment – ASME B31.3

VIT PRIVE VIT PRIVE * FRANT

In Line Instrument

- Instrument acts as the primary flow path
- Pipe equivalent is subject to ASME B31.3
- Inserted portions vendor standards



Maintaining NEMA Ratings



Common Ratings

- Discrete and Packaged Components NEMA 4X
 - Type 4X
 - Indoor and Outdoor
 - Protects personnel
 - Protects equipment
 - Windblown Dust
 - Water/Rain, sleet, snow, splashing water
 - Directed Water hose
- Discrete and Packaged Equipment NEMA 12
 - o **Type 12**
 - Indoor use
 - Protects personnel
 - Protects equipment
 - Solid objects dirt, dust, fibers
 - Some protection from water dripping and light splashing

Maintaining NEMA Ratings



- Discrete and Packaged Equipment NEMA 1
 - Type 1
 - Indoor Use
 - Protection of personnel
 - Some protection against solid foreign objects (falling dirt)

NEMA Rating Error Example





Differences between Electrical and C&I Color Coding



- Control Panels/Annunciators/HMI Screens follow the color scheme found in 24590-WTP-3PS-JQ07-T0001 Engineering Specification for Instrumentation Packaged Equipment, Section 3.3.5
 - Green = Running, ON, Normal
 - Red = Stopped, OFF, Alarm
 - Yellow = Transition, Indeterminate, Force
 - Cyan (Light Blue) = Manual Operation
 - Purple = Local Control (HMI displays
 - Clear = Local Control (local panels)
- Switches, motor starters, electrical distribution equipment follow the color scheme found in 24590-WTP-3PS-EKP0-T0001, Engineering Specification Electrical Requirements for Packaged Equipment, Sections 5.1.4.5 and 5.1.5.2
 - Green = Motor is stopped or switch / circuit breaker is open
 - Red = Motor is running or switch / circuit breaker is closed
 - Amber = Motor is tripped

Software



- Driven by our contract with DOE
- Called for in our Quality Assurance Manual (QAM)
- Applies to:
 - Unique programmed devices
 - Non-Modifiable, Configurable Software
- Software Lifecycle Document
- Compatibility with our Control System

Vendor Submittals



- The paper is at least as important as the hardware
- Attention to detail
 - Meets the requirement
 - Incorporates the comments
 - Consistent across the order

Example of Lack of Consistency





Wiring Diagram



Tagging/Labeling



- Everything must match
- Datasheet other documents physical tag
 - Be careful on the front end with the submittals
 - Make sure the physical tag matches exactly



Questions/Comments?



Waste Treatment Plant Project



2016 Supply Chain Collaboration Event

Electrical & Control Supply Chain Challenges @ WTP







Agenda



- 1. National Recognized Testing Laboratory
 - What is an NRTL?
 - What is an OSHA Recognized Standard
 - NRTL Limitations
 - Preliminary versus Final Field Evaluation; AHJ can verify the installation
 - UL 508A

2. Grounding Requirements

- Grounding Screws
- Marking of Ground Termination
- Color coding
- Safety vs Instrument Grounding
- 3. Enclosure Type (Rating) Integrity
 - Door devices
 - Hubs & Cable Connectors
 - Air Conditioners and Filters

Agenda (Cont)



4. Lens Colors

- Motor Controller, Power and Similar Enclosures
- Operator, Human Interface and Annunciators Enclosures
- 5. Questions / Discussion

Review For Understanding - Terms



- AHJ Authority Having Jurisdiction
- Approved Acceptable to the Electrical AHJ
- CE Certified in Europe products with this marking alone are not Approved by OSHA for use in the US nor by the WTP Electrical AHJ
- C & I Controls & Instrumentation
- CSA Canadian Standards Association
- DPEM Electrical Disciple Engineering Manager
- Field Evaluated Equipment or device is evaluated by a qualified NRTL
- Labeled Tested and marked with a label from an NRTL
- Listed Tested, marked with a label, and placed on a list as meeting certain applicable standards by a NRTL
- NEMA National Electrical Manufacturer's Association
- NRTL Nationally Recognized Testing Laboratory
- OSHA Occupational Safety and Health Administration
- SQR Supplier Quality Representative
- RE Responsible Engineer
- UL Underwriter's Laboratories





Nationally Recognized Testing Laboratory (NRTL)



- Also known as a NRTL
- Their purpose is to review electrical products for safety, and assure that the product meets US Standards, before the product is placed into use
- NRTLs that test, list, label, or field evaluate electrical products for use in the United States must first be Approved by OSHA, which is a Division of the US Department of Labor
- NRTLs review electrical products for safety such as your home toaster, hair dryer, smoke detector, circuit breaker, etc., <u>and</u> <u>electrical equipment for use at WTP</u>
- Electrical AHJs look for the NRTL Label on products used here at WTP
- Listing, Labeling, or Field Evaluation by a properly qualified OSHA-Approved NRTL provides a basis for the WTP Electrical AHJ to Approve the equipment for use on the Project

NRTL (Cont.)



- The advantage to manufacturers of having their electrical equipment and components NRTL Listed and Labeled or Field Evaluated is that their equipment is very likely to be Approved by the WTP Electrical AHJ
- All electrical equipment installed and used on the WTP Project must be approved by the Electrical AHJ



OSHA Recognized Standards

- Nationally Recognized Testing Laboratories must be Approved by OSHA to test to OSHA electrical product standards
- The United States Dept. of Labor, Occupational Safety and Health Administration (OSHA) has adopted specific product standards for Electrical Safety in the United States
- Therefore, every NRTL that tests, lists, labels, or field evaluates electrical products for use in the United States must be recognized by OSHA, and then test, list, label, or field evaluate electrical products for use in the U.S. to the OSHA Recognized Standard(s)
- NRTLs can only test, list, label, or field evaluate electrical products in the categories that OSHA has approved them for

Approval and Use of Listed Products



- All electrical equipment must be installed and used in accordance with the manufacturer's instructions included within the listing and labeling. This requirement is found in NEC Section 110-3(b).
- Example, you would not use a standard porcelain light fixture – normally installed in a garage at home – in a shower. The standard light fixture is not designed, manufactured, nor Listed by an NRTL for use in a wet location with splashing water.

NRTL Labeling & Listing Requirements on the WTP Project



- The 1999 NEC (National Electrical Code) is the adopted electrical code standard for the WTP project
- NEC Article 110 Requirements for Electrical Installations
 - A. General
 - 110-2. Approval. The conductors and equipment required or permitted by this Code shall be acceptable <u>only if approved</u>

Approved = Acceptable to the Authority Having Jurisdiction (AHJ).

If an electrical product is Listed, the AHJ will normally accept it, because a NRTL has verified that it meets certain national (US) product standards.

RPP / WTP Electrical AHJ



 The Electrical AHJ is responsible for enforcing the requirements of electrical codes or standards, and for approving equipment, materials, installations, or procedures. This covers electrical installations in buildings and outdoors, and electrical wiring on mechanical equipment for the WTP Project.

Primary Method of Approval



- NRTL Listing and Labeling is the <u>Primary Method of</u> <u>Approval</u> by the Electrical AHJ
- If Listed products or components are available to the supplier, then the supplier needs to use Listed products or components, unless an Exception is approved by the WTP AHJ. These exceptions require justification.

















The answer is – NO. If the marking is not found on the inside or outside of the enclosure – or on the door, whether inside or outside, it is not Listed and would not be Approved by the Electrical AHJ



One of the marks above shown on the right is required to meet OSHA NRTL requirements – as it has the "US", or "NRTL" on the product below the CSA marking – located at the 4:00 o'clock or 8:00 o'clock position on the product label. The blue colored CSA label in the middle of this illustration does <u>not</u> have "US" or "NRTL" included on the label, and indicates that the product has not been tested to meet US Standards













Packaged Equipment

We would look for a UL Label as a Listed Safety Switch

Or, the equipment included on this skid could be Field Evaluated by an NRTL at the vendor facility as a complete unit type piece of equipment





We would look for a UL508A Label (sticker) inside





Field Evaluations



- Field Evaluations have generally two types, preliminary and final
- Preliminary field evaluations are performed at the vendor facility by the NRTL of the completed product, before shipment of the product to WTP
- The preliminary field evaluation is performed in order to verify that the product meets OSHA requirements for electrical safety
- If the product passes the preliminary field evaluation, it will be labeled by the NRTL, and can then be shipped to WTP
- And, if the product is not changed in any way, no further NRTL evaluation is needed
- The WTP Electrical AHJ will accept responsibility for reviewing the final assembly and installation of the equipment in the field at the WTP construction site

Field Evaluations (Cont.)



- If, during the NRTL preliminary field evaluation of the equipment, discrepancies are found, they will be noted in a NRTL Field Evaluation Report, and required to be corrected before the NRTL will place their label on the equipment
- The vendor will then be required to correct all discrepancies, and contact the NRTL for another evaluation
- If all of the discrepancies are corrected, the NRTL will place their final field evaluation label on the product
- The NRTL Final Field Evaluation Report is now made a vendor submittal, which will be routed to the WTP Electrical AHJ for review and Approval
- If the Electrical AHJ reviews and Approves the NRTL Final Field Evaluation Report, the NRTL field evaluation labeled product is ready for shipment to WTP

UL 508A Standard



- UL 508A is the Standard for Industrial Control Panels (ICP)
- Industrial control panels are used to control electrical, mechanical, and C & I equipment that perform industrial processes, such as motors, heaters, robotics, temperature and pressure transmitters, and a wide variety of other tasks
- The industrial control panels used at WTP must meet the UL 508A Standard for their design, and permit safe operation by WTP personnel
- Examples of UL 508A non-compliances are:
 - 1. Improper ground screws
 - 2. Lack of separation different classes of wiring
 - 3. Non-compliant disconnect switches
 - 4. Inaccurate or incomplete electrical rating labels
 - 5. Incomplete / insufficient marking





Grounding Requirements

Ground Screws







Sheet Metal Screw vs. Machine Screw

250.8 Grounding and Bonding Connections





All connections must be properly tightened!



Grounding is Important



Green is the required color for equipment grounding wires / conductors

Isolated equipment grounding conductors require 3 yellow stripes on a green conductor, used for instrumentation



Wire Separation









Enclosure Type (Rating) Integrity



NEMA Types 1, 3R, 4, 4X, 12, 13 are predominant ones used

- Type 1 = Indoor
- Type 3R = Raintight, but not dust-tight or gasketed
- Type 4 = Outdoor Weathertight & Gasketed
- Type 4X = Outdoor Weathertight & Gasketed & Corrosion Resistant Stainless Steel, or Non-Metallic
- Type 12 = Dust-tight
- Type 13 = Oil-tight
- The components (switches, push-buttons, pilot lights, meters, gauges, etc.) installed through the door of the enclosure must maintain the integrity of the overall enclosure rating.





Enclosure Rating and Integrity



- Conduit hubs and cable connectors must maintain the integrity of the enclosure as well
- Air conditioners and filters must be NRTL Listed for the enclosure type used, and must also maintain the integrity of the enclosure





Lens Colors

Lens Colors



- Switches, motor starters, and electrical distribution equipment follow the color scheme found in 24590-WTP-3PS-EKP0-T0001, Engineering Specification Electrical Requirements for Packaged Equipment, Sections 5.1.4.5 and 5.1.5.2.
 - Green = Motor stopped or switch / circuit breaker is open
 - Red = Motor is running or switch / circuit breaker is closed
 - Amber = Motor is tripped
- 2. Control Panels, Annunciators, and HMI Screens follow the color scheme found in 24590-WTP-3PS-JQ07-T0001, Engineering Specification for Instrumentation Packaged Systems, Section 3.3.5
 - Green = Running, Opened, ON
 - Red = Stopped, Closed, OFF, Alarm
 - Yellow = Transition, Indeterminate, Force
 - Cyan (Light blue) = Manual operation
 - Purple = Local control (HMI Displays)
 - Clear = Local control (local panels)

Pilot / Operator Indicating Lights - Lens Colors







Bechtel specifications contain Specific color requirements for Pilot device lenses





Questions / Discussion

Other Issues we've had at WTP



- High WTP Project Standards for NRTL & NEC Compliance
- Applying NEC Code requirements to equipment wiring
- The skill set of vendor's electrical staff
- NRTL not recognized by OSHA to evaluate the vendor's equipment to specific OSHA Recognized Standards
- Misunderstanding of NRTL requirements
- UL 508A Standard not followed
- Vendors need to provide wire bending space in their enclosure – particularly where large wires are involved
- Disconnecting Means where there is more than one circuit supplying the equipment, additional rules apply
- Marking of components outdoor and inside control panels

Summary



- 1. National Recognized Testing Laboratory
 - What is an NRTL?
 - What is an OSHA Recognized Standard
 - NRTL Limitations
 - Preliminary versus Final Field Evaluation; AHJ can verify the installation
 - UL 508A

2. Grounding Requirements

- Grounding Screws
- Marking of Ground Termination
- Color coding
- Safety vs Instrument Grounding
- 3. Enclosure Type (Rating) Integrity
 - Door devices
 - Hubs & Cable Connectors
 - Air Conditioners and Filters

Summary (Cont.)



4. Lens Colors

- Motor Controller, Power and Similar Enclosures
- Operator, Human Interface and Annunciators Enclosures
- 5. Questions / Discussion

Test For Understanding



AHJ stands for:

- (a) Authority Having Justification
- (b) Authority Having Jurisdiction
- (c) American Having Jurisdiction
- (d) Anyone Having Justification

NRTL stands for:

- (a) Nationally Rated Testing License
- (b) Nationally Recognized Testing License
- (c) Nationally Recognized Testing Laboratory
- (d) Nationally Rated Testing Laboratory



Approved (per NFPA 70, NEC) stands for:

- (a) Acceptable to the Electrical AHJ
- (b) Warrants Good Housekeeping Seal of Approval
- (c) Meets vendor approval with RE signing off as okay
- (d) Acceptable to the SQR and RE

CE stands for:

- (a) Certified Electrical
- (b) Critically Evaluated and found to be exceptional
- (c) Certified Everywhere (for Everyone's use)
- (d) Certified for Europe, and does not meet WTP Electrical Standards because it is not tested by an NRTL.

Test For Understanding

VIT PLOS

CE Certification alone:

- (a) Does not meet OSHA nor WTP Project standards
- (b) Is not acceptable to the Electrical AHJ
- (c) Meets European Standards, but not US standards
- (d) All of the above

AHJ Role:

- (a) Approval of electrical equipment
- (b) Acts as a Testing Laboratory
- (c) Uses OSHA Rules as a guideline
- (d) All of the above

Test For Understanding



The Primary Method of Approval for electrical and electrical / mechanical equipment for use at the WTP site is:

- (a) Left to the suppliers discretion
- (b) Left to the Responsible engineer's discretion
- (c) Listing and Labeling by an OSHA approved NRTL
- (d) Field evaluation by an NRTL

Electrical and electrical / mechanical equipment for use at the WTP site:

- (a) Must meet project NRTL Listing and Labeling requirements before shipment, be NRTL Field Evaluated, or have Special AHJ approval before shipment
- (b) The WTP project will pay for Field Evaluation at the jobsite
- (c) Must be tested and Approved by the AHJ
- (d) All of the above



Regarding electrical equipment, the purpose of an NRTL is to:

- (a) Increase consumer confidence in purchasing electrical materials and equipment
- (b) Test, List, and Label electrical equipment and materials
- (c) Be licensed to evaluate equipment to standards
- (d) Provide licensed ratings for electrical equipment

If NRTL Listed and Labeled electrical materials, equipment, parts, or components are available, the vendor (supplier):

- (a) May choose to provide Listed and Labeled products
- (b) Must install products with a CE mark
- (c) Must provide, install and use NRTL Listed and Labeled products
- (d) Has the option to choose what they believe meets the project specifications

Test For Understanding



Special Approval by the WTP Electrical AHJ for electrical and electrical / mechanical equipment for use at the WTP site is:

- (a) The Primary Method of Approval for such equipment
- (b) Is reserved for one-of-a kind or specialized equipment where there is no Listed and Labeled product available for purchase, and requires documentation submitted to the AHJ for Approval
- (c) Requires permission by the Electrical AHJ
- (d) Answers (b) and (c).

Design Engineers, Responsible Engineers, Supplier Quality personnel, Procurement, Electrical and / Mechanical Engineering and Technical staff must be aware of :

- (a) The WTP Project OSHA requirement for NRTL Listed and Labeled equipment
- (b) Work together to assure that NRTL Listed and Labeled equipment is provided by the vendor absolutely whenever and wherever possible, or require OSHA NRTL Field Evaluation.
- (c) Know how to recognize equipment that complies with the OSHA requirement for NRTL Listed and Labeled
- (d) All of the above