PURPOSE AND USE OF PROCESS INDUSTRY PRACTICES

In an effort to minimize the cost of process industry facilities, this Practice has been prepared from the technical requirements in the existing standards of major industrial users, contractors, or standards organizations. By harmonizing these technical requirements into a single set of Practices, administrative, application, and engineering costs to both the purchaser and the manufacturer should be reduced. While this Practice is expected to incorporate the majority of requirements of most users, individual applications may involve requirements that will be appended to and take precedence over this Practice. Determinations concerning fitness for purpose and particular matters or application of the Practice to particular project or engineering situations should not be made solely on information contained in these materials. The use of trade names from time to time should not be viewed as an expression of preference but rather recognized as normal usage in the trade. Other brands having the same specifications are equally correct and may be substituted for those named. All Practices or guidelines are intended to be consistent with applicable laws and regulations including OSHA requirements. To the extent these Practices or guidelines should conflict with OSHA or other applicable laws or regulations, such laws or regulations must be followed. Consult an appropriate professional before applying or acting on any material contained in or suggested by the Practice.

This Practice is subject to revision at any time.

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Data Form

ELSHT01-D – Self-Regulated Electric Heat Trace System Data Sheet (4 Pages)
ELSHT01-R – Self-Regulated Electric Heat Trace System Documentation Requirements Sheet
   (4 Pages)
1. **Scope**

This Practice provides the requirements for equipment, materials, and design services for electrical heat trace systems that use parallel-trace self-regulating type heat trace cable with ground braid. This Practice includes requirements for heat trace cable, monitor-control panel, junction boxes, and temperature sensors.

The following are not included in this Practice:

a. Series-resistance, mineral-insulated, inductance type, and impedance type heat tracing systems
b. Panelboards, circuit breakers, and field wiring of heat tracing system components
c. Installation of the equipment and materials provided
d. Insulation materials or installation

2. **References**

Applicable parts of the following Practices, industry codes and standards, and references shall be considered an integral part of this Practice. The edition in effect on the date of contract award shall be used, except as otherwise noted. Short titles are used herein where appropriate.

2.1 **Industry Codes and Standards**

- Institute of Electrical and Electronics Engineers (IEEE)
- National Fire Protection Association (NFPA)
  - NFPA 70 - *National Electrical Code (NEC)*

3. **Definitions**

*owner:* The party who owns the facility wherein the electric heat tracing system will be used

*purchaser:* The party who awards the contract to the supplier. The purchaser may be the owner or the owner’s authorized agent.

*supplier:* The party responsible for supplying the electric heat tracing system components

4. **Requirements**

4.1 **General**

4.1.1 Electric heat trace systems shall be designed and tested in accordance with purchaser’s *PIP ELSHT01-D* Data Sheet, *IEEE 515*, and applicable requirements of the *NFPA 70*.

4.1.2 See purchaser’s *PIP ELSHT01-D* Data Sheet for site conditions, available power supply, and related information.
4.1.3 Heat trace cable and associated components necessary for field installation of a complete operating system shall be provided.

4.1.4 All equipment and components shall be certified and labeled by a third party Nationally Recognized Testing Laboratory.

4.2 Heating Cable

4.2.1 Heating cable shall be suitable for the area classification and service temperatures specified on purchaser’s PIP ELSHT01-D Data Sheet.

4.2.2 Self-regulating heating cable shall be designed for a useful life of 20 years minimum with “power on” continuously, based on the useful life criteria of retention of at least 75% of rated power after 20 years of operation at the maximum published continuous exposure (i.e., maintain) temperature.

4.2.3 Cables shall be covered by metallic braid of tinned or nickel plated copper that provides nominal coverage of 80% and exhibits resistance of 0.005 ohm/ft maximum (0.016 ohm/meter).

4.2.4 Unless otherwise specified on purchaser’s PIP ELSHT01-D Data Sheet, braid shall be covered with corrosion resistant fluoropolymer external jacket.

4.2.5 Cables for lines entering buildings shall include sufficient length to heat trace the line two feet into the building interior.

4.2.6 Spiral wrapping of lines shall not be permitted.

4.2.7 Manufacturer’s supplied and approved junction boxes for termination of the heating cable shall be used, in accordance with the manufacturer’s installation instructions. Enclosures for power junction boxes shall be in accordance with purchaser’s PIP ELSHT01-D Data Sheet.

4.2.8 Cable shall be designed to permit being crossed over itself and cut to length in the field.

4.2.9 Unless otherwise specified on purchaser’s PIP ELSHT01-D Data Sheet, tees shall not be permitted in heating cable.

4.3 Control Panels

4.3.1 Enclosures for electronic controllers shall be as specified on the purchaser’s PIP ELSHT01-D Data Sheet.

4.3.2 Enclosures for electronic controllers installed in hazardous areas shall be as specified on the purchaser’s PIP ELSHT01-D Data Sheet.

4.3.3 Unless otherwise specified on purchaser’s PIP ELSHT01-D Data sheet, control panels shall have a front window for viewing control devices.

4.3.4 Wiring

4.3.4.1 Controller terminals shall be factory-wired to terminal blocks for incoming and exiting control wiring.

4.3.4.2 Dedicated terminal blocks for exiting RTD wiring shall be provided and separated from power and control terminal blocks.
4.3.4.3 All wiring shall be marked on each end with permanently printed wire markers, either heat-shrinkable or slip-on type. Adhesive-type wire labels shall not be permitted.

4.3.4.4 All wires, terminals, and devices shall be numbered and tagged in accordance with the power and control wiring diagrams.

4.3.4.5 All wiring shall be continuous from terminal to terminal without splicing.

4.3.4.6 Unless otherwise specified on purchaser’s PIP ELSHT01-D Data Sheet, wiring shall be stranded copper conductor with manufacturer standard flame-retardant, 600-volt, 75°C rated insulation.

4.3.4.7 Minimum conductor sizes shall be as follows:
   a. Power wiring, 12 AWG
   b. Control wiring, 14 AWG
   c. Signal wiring, 16 AWG

4.3.4.8 Terminal blocks shall be conveniently located and clearly marked.

4.3.4.9 Terminal blocks for control wire shall be screw type and accommodate the following:
   a. Maximum size 12 AWG wires
   b. Minimum of 10% spare control terminal points

4.3.4.10 Terminal blocks for power wiring terminations shall be designed for compression-type wire lugs.

4.4 Space Heaters

4.4.1 Unless otherwise specified on purchaser’s PIP ELSHT01-D Data Sheet, the heat tracing control panel shall be provided with space heaters to minimize condensation.

4.4.2 Unless otherwise specified on purchaser’s PIP ELSHT01-D Data Sheet, space heaters shall be powered as shown on purchaser’s wiring diagrams.

4.4.3 The heat tracing control panel shall be provided with a space heater rated at 240 volts.

4.4.4 Space heaters shall be sized to provide the required heat output operating on a 120 volt system.

4.4.5 Space heaters shall be provided with high temperature wiring within 6 inches (150 mm) of the heater terminals.

4.4.6 Space heaters shall be mounted on a stand-off insulator and provided with personnel protection from thermal burns.
4.4.7 If space heaters are powered by a separate external supply, a caution nameplate, as shown below, shall be provided on the door of each cubicle that contains space heaters.

**CAUTION**

**EXTERNAL POWER SOURCE**

4.4.8 Over-current protection and a disconnect for each space heater circuit shall be provided in each heat tracing control panel.

4.4.9 If specified on purchaser’s PIP ELSHT01-D Data Sheet, each space heater in the heat tracing control panel shall be controlled by a humidistat or thermostat.

4.4.10 If specified on purchaser’s PIP ELSHT01-D Data Sheet, the humidistat or thermostat shall be equipped with an ammeter and bypass switch.

4.5 Accessories

All components required for a complete operating system shall be provided. These include, but are not limited to, manufacturer’s heat tracing cable end kits, splice kits, tee kits, caution signs, attachment tape, etc.

4.6 Controls

4.6.1 Application Type

4.6.1.1 Electrical heat tracing application type shall be in accordance with purchaser’s PIP ELSHT01-D Data Sheet.

4.6.1.2 Systems for applications designated as “Freeze Protection” on the purchaser’s PIP ELSHT01-D Data Sheet shall be designed to maintain temperature above the minimum point specified on the purchaser’s PIP ELSHT01-D Data Sheet.

4.6.1.3 Systems for applications designated as “Process Maintenance” on the purchaser’s PIP ELSHT01-D Data Sheet shall be designed to maintain temperature within the band specified in the purchaser’s PIP ELSHT01-D Data Sheet.

4.6.2 Configurations

4.6.2.1 Controls shall be provided as specified on the purchaser’s PIP ELSHT01-D Data Sheet.

4.6.2.2 Thermostats shall have adjustable setpoint, NEMA 4X enclosure, and single-pole double-throw contact rated for 20A minimum at 120VAC.

4.6.2.3 Unless otherwise specified on purchaser’s PIP ELSHT01-D Data Sheet, RTDs shall be 3-wire, 100-ohm platinum, with NEMA 4X weather head with terminal blocks and stainless steel mounting hardware.
4.6.2.4 Electronic temperature controllers shall be capable of accepting multiple RTD inputs, and shall include the following features:

a. Enclosure as specified on the purchaser’s PIP ELSHT01-D Data Sheet.

b. Front panel indications: Power on, heat-trace alarm.

c. Minimum 40 character display to indicate system status alarm and temperatures from all temperature transmitters.

d. Automatic display of all alarm messages.

e. Integral ground-fault protection.

f. Dry contact for general alarm output; one for each circuit controlled.

g. On/Off and Proportional Integral Derivative (PID) control modes.

h. Communication capability as specified on the purchaser’s PIP ELSHT01-D Data Sheet.

4.6.3 Alarm Conditions

Dry contacts for general alarm outputs from electronic controllers shall actuate upon any of the following alarm conditions:

a. High and low temperatures

b. High and low heater current

c. Ground leakage current

d. Damaged RTD sensor

e. Power failure

4.6.4 Grouping

4.6.4.1 If two or more pipes join to form optional flow paths, each pipe shall be controlled independently.

4.6.4.2 If lines with a common service and common use are specified on the purchaser’s PIP ELSHT01-D Data Sheet in the comments section of the line listing, the lines may be grouped together for control from a common RTD.

4.6.4.3 If located in the same general geographic area, closed bypasses and dead end legs may be combined on a common controller.

4.7 Special Requirements

4.7.1 Piping systems conveying various fluids may be adversely affected by high temperatures. See purchaser’s PIP ELSHT01-D Data Sheet in the comments section of the line listing for special requirements for maximum temperature permitted for a piping system.

4.7.2 If specified on the purchaser’s PIP ELSHT01-D Data Sheet, an “end of line” indicating light shall be provided for each heat trace circuit.
4.8 Design
4.8.1 Design criteria shall be as specified on purchaser’s PIP ELSHT01-D Data Sheet.
4.8.2 Design margin shall be as specified on purchaser’s PIP ELSHT01-D Data Sheet.

4.9 Nameplates
4.9.1 Nameplates shall be provided on the outside of all enclosures and shall identify the service and equipment number in accordance with purchaser’s nameplate schedule.
4.9.2 Unless otherwise specified on purchaser’s PIP ELSHT01-D Data Sheet, nameplates shall be of an acrylic resin material and machine engraved, displaying black letters on a white background. Letter height shall be 1/4 inch (6.4 mm) minimum.
4.9.3 Unless otherwise specified on purchaser’s PIP ELSHT01-D Data Sheet, nameplates shall be attached to enclosures with stainless steel screws.

4.10 Inspection and Testing
4.10.1 Factory inspections and tests for self-regulating heater cables shall be performed in accordance with IEEE 515 test section and applicable manufacturer’s standards.
4.10.2 If specified on purchaser’s PIP ELSHT01-D Data Sheet, factory inspection and witnessed functional test for controllers shall be performed.

4.11 Shipping
4.11.1 Unless otherwise specified in the purchase order documents, preparation for shipment of equipment shall be in accordance with supplier’s standards.
4.11.2 The supplier shall be solely responsible for the adequacy of the shipment preparations, and shall ensure that materials handled by commercial carrier systems are received in excellent working condition.
4.11.3 Instructions for storage of equipment shall be attached to the equipment.
4.11.4 Removable elements or items shipped separately from the main equipment shall be clearly identified with proper description and location of installation.
4.11.5 Equipment shipped in more than one section or container shall have each section or container clearly identified with equipment description and section number.
4.11.6 Equipment shall be protected from weather elements and vibration during shipping and storage.
4.11.7 Each shipping section containing electronics shall have an impact indicator.
4.11.8 Removable elements or items shipped separately shall be shipped in weather-tight packaging, suitable for outdoor storage.

4.12 Documentation
4.12.1 Documentation shall be provided in accordance with purchaser’s PIP ELSHT01-R Documentation Requirements Sheet.
4.12.2 If PDF format is specified, searchable PDF format shall be provided.
4.12.3 Scanned PDF format shall not be permitted.

4.12.4 Unless otherwise specified on purchaser’s PIP ELSHT01-R Documentation Requirements Sheet, schematic diagrams shall be provided.

4.12.5 Unless otherwise specified on the purchaser’s PIP ELSHT01-R Documentation Requirements Sheet, final certified and as-built drawings shall be submitted in CAD .DWG format and searchable PDF format.

4.12.6 If specified on purchaser’s PIP ELSHT01-R Documentation Requirements Sheet, purchaser shall furnish drawing border CAD files and/or final drawing number assignments.

4.12.7 Purchaser shall provide CAD plot plans, equipment layouts, piping and conduit/cable tray plans for the existing facilities as required.

4.12.8 Drawings shall be provided for new conduits/trays, wiring, and installation details related to the heat tracing installation based on the information furnished by the purchaser.

4.12.9 A complete list of exceptions taken to the contract documents including specific paragraph numbers shall be provided with the quotation. If a list of exceptions is not provided, the quotation shall be considered in full compliance with the contract documents.

4.13 Conflict Resolution

Any conflicts between the reference documents shall be identified in writing to the purchaser for resolution. If resolving conflicts, the following order of precedence shall apply:

a. Purchase order

b. PIP ELSHT01-D Data Sheet and PIP ELSHT01-R Documentation Requirements Sheet

c. This Practice, PIP ELSHT01

d. Referenced standards
**SELF-REGULATED ELECTRIC HEAT TRACE SYSTEM**

**ASSOC. PIP: ELSHT01**

**DATA SHEET ELSHT01-D**

**PAGE 1 OF 4**

**JANUARY 2017**

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**DOCUMENT NO.**

**ALTERNATE DOCUMENT NO.**

**ISSUED FOR:**

- PROPOSAL
- PURCHASER
- AS BUILT

**FACILITY NAME/LOCATION:**

**ITEM NAME:**

**PURCHASER/LOCATION:**

**ITEM TAG NO.:**

**JOB NO.:**

**SERVICE:**

**PURCHASE ORDER NO.:**

**UNIT:**

**SUPPLIER/LOCATION:**

**P&ID NO.:**

**SUPPLIER ORDER/SEQUENTIAL NOS.:**

**DATA PROVIDED BY:**

- PURCHASER
- SUPPLIER
- SUPPLIER IF NOT BY PURCHASER

---

REFER TO PIP ELSHT01 FOR GENERAL REQUIREMENTS AND ELSHT01-R FOR DOCUMENTATION REQUIREMENTS.

APPLICABLE STATE AND LOCAL CODES: ___

---

**SYSTEM PARAMETERS (4.1.2):**

- VOLTS ___ PHASE ___ WIRE ___ HERTZ

**SERVICE CONDITIONS (4.1.2):**

- AMBIENT TEMPERATURE: MAX: ___ °C MIN: ___ °C ALTITUDE: ___ M
- HUMIDITY: MAX: ___% MIN: ___% MAX WIND SPEED: 
  - 120 MPH 
  - OTHER: ___ MPH
- OTHER:

**AREA CLASSIFICATION:**

- NONCLASSIFIED
- CLASSIFIED
  - CLASS: ___  DIVISION: ___  GROUP: ___
  - AUTO IGNITION TEMP: ___ °C OR T-RATING: ___
  - OTHER: ___

---

**HEATING CABLE (4.2):**

- EXTERNAL JACKET (4.2.4): 
  - FLUOROPOLYMER
  - POLYOLEFIN
  - OTHER: ___
- POWER JUNCTION BOXES (4.2.7):
  - ENCLOSED: 
    - NEMA 4
    - NEMA 4X
    - NEMA 12
    - OTHER: ___
  - NON-HAZARDOUS AREAS: 
    - STAINLESS STEEL
    - ALUMINUM
    - FIBER REINFORCED POLYESTER
    - OTHER: ___
  - HAZARDOUS AREAS: 
    - HINGED BOLT ON
    - SCREW ON
    - OTHER: ___
- TEES IN HEATING CABLE (4.2.9): 
  - PERMITTED
  - NOT PERMITTED

---

**CONTROL PANELS (4.3):**

- ENCLOSURE (4.3.1 & 4.6.2.4 A): 
  - NEMA 4
  - NEMA 4X
  - NEMA 12
  - OTHER: ___
  - STAINLESS STEEL
  - FIBERGLASS
  - OTHER: ___
- HAZARDOUS AREAS (4.3.2): 
  - PURGED
  - EXPLOSION PROOF
- FRONT PANEL (4.3.3): 
  - WINDOW
  - HMI
  - OTHER: ___
- WIRING TYPE (4.3.4): 
  - MFG STD
  - SIS
  - THWN
  - OTHER: ___

---

**SPACE HEATERS (4.4):**

- SPACE HEATERS (4.4.1): 
  - REQUIRED
  - NOT REQUIRED
- SPACE HEAT POWER (4.4.2): 
  - BY PURCHASER
  - BY SUPPLIER
- SPACE HEAT CONTROL (4.4.9 & 4.4.10): 
  - HUMIDISTAT
  - THERMOSTAT CONTROL
  - AMMETER
  - BYPASS SWITCH
  - OTHER: ___

---

**NO.**  **DATE**  **REVISION DESCRIPTION**  **BY**  **APPROVED**
### Controls (4.6):
- **Application Type (4.6.1):**
  - Freeze Protection
  - Process Maintenance
  - Other: 
- **Microprocessor Based Controller (4.6.2.1):**
  - Required
  - Not Required
  - Other: 
  - Temperature Sensing (4.6.2.1): 
    - Ambient Temp Sensing
    - Pipe Temp Sensing
  - Incoming 4-20 mA Signal
  - Other: 
- **Temperature Sensor (4.6.2.3):**
  - 100 Ohm Platinum
  - Other: 
- **Temperature Controller Communications Capability (4.6.2.4 H):**
  - Modbus
  - Ethernet
  - RS232
  - RS485
  - Other: 
  - Other: 

### Special Requirements (4.7):
- End of Line Indicating Light (4.7.2): 
  - Required
  - Not Required

### Design (4.8):
- Startup Temperature: 
- Heat Loss Safety Factor: 

### Nameplates (4.9):
- 1 Inch by 2.5 Inches (STD)
- Other: 
- White Tag / Black Letters
- Other: 
- 1/4 Inch Letters
- Other: 
- Engraved Plastic
- Other: 
- Stainless Steel Screws
- Silicone Based Adhesive
- Other: 

### Inspection and Testing (4.10):
- Factory Inspection and Witnessed Functional Test: 
  - Required
  - Not Required

### Other Requirements:
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**FREEZE PROTECTION (4.6.1.2 & 4.8)**

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<th>PIPE SIZE (IN)</th>
<th>INSULATION TYPE / THICKNESS (IN)</th>
<th>PIPE LENGTH (FT)</th>
<th>NO. OF VALVES</th>
<th>PROCESS OPERATION LIMIT TEMP</th>
<th>MAXIMUM INTERMITTENT EXPOSURE TEMP (°F)</th>
<th>MAINTENANCE MINIMUM TEMP (°F)</th>
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### PROCESS MAINTENANCE (4.6.3 & 4.7.1)

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ASSOC. PIP: ELSHT01
DOCUMENTATION REQUIREMENTS SHEET
ELSHT01-R

SELF-REGULATED ELECTRIC HEAT TRACE SYSTEM

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JANUARY 2017

<table>
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<th>DOCUMENT NO.</th>
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<td>ISSUED FOR:</td>
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<td>FACILITY NAME/LOCATION:</td>
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<td>ITEM NAME:</td>
<td>PURCHASER/LOCATION:</td>
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<td>ITEM TAG NO.:</td>
<td>JOB NO.:</td>
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<td>SERVICE:</td>
<td>PURCHASE ORDER NO.:</td>
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<tr>
<td>UNIT:</td>
<td>SUPPLIER/LOCATION:</td>
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<tr>
<td>P&amp;ID NO.:</td>
<td>SUPPLIER ORDER/ SERIAL NOS.:</td>
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1. SUBMITTAL OF DOCUMENTATION IS A CONDITION OF INVOICE PAYMENT. REFER TO CONTRACT OR PURCHASE ORDER.
2. PURCHASER REVIEW OF DOCUMENTATION SHALL NOT RELIEVE SUPPLIER OF RESPONSIBILITY.

INSTRUCTIONS:
1. COMPLETE AND RETURN THIS FORM WITH QUOTATION.
2. SUPPLIER SHALL SUBMIT DOCUMENTATION IN COMPLIANCE WITH DOCUMENTATION REQUIREMENTS SHEET(S) AS REGARDS TIMING, QUANTITY, AND FORM OF DOCUMENTATION.
3. EACH DOCUMENT SHALL SHOW THE PURCHASE ORDER NUMBER, JOB NUMBER, PLANT AREA NUMBER, AND ALL NECESSARY REFERENCES, NOTES, ETC.
4. DRAWING BORDER CAD FILES SHALL BE PROVIDED BY: □ MFG. STD. □ PURCHASER
5. FINAL DRAWING NUMBERS SHALL BE PROVIDED BY: □ MFG. STD. □ PURCHASER
6. ALL DRAWINGS AND DOCUMENTS SHALL BE BLACK ON WHITE WITH CLEAR IMAGE AND SUITABLE FOR REPRODUCTION. DRAWINGS AND DOCUMENTS SHALL SHOW INFORMATION FOR THIS PROJECT ONLY. PURCHASER, AT ITS SOLE DISCRETION, MAY ACCEPT STANDARD DATA IF APPLICABLE INFORMATION IS CLEARLY INDICATED AND NON-APPLICABLE INFORMATION IS CROSS-HATCHED OUT.
7. IF HARD COPY DATA BOOKS ARE REQUIRED, DATA SHALL BE PROVIDED ON THREE-HOLE PAPER AND BOUND IN HARD COVERS. UNLESS CLARITY IS ADVERSELY AFFECTED, DRAWINGS SHALL BE REDUCED TO SCALE ON 11-INCH BY 17-INCH PAPER. IF THE CLARITY OF REDUCED DRAWINGS IS ADVERSELY AFFECTED, LARGE DRAWINGS SHALL BE FOLDED AND PLACED IN HEAVY-DUTY, THREE-SIDED PLASTIC COVERS AND INSERTED INTO THE BINDERS.
8. SUPPLIER REPRESENTATIVE RESPONSIBLE FOR DOCUMENTATION:

NAME: _____
TITLE: _____
PHONE: _____

REMARKS:

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**ASSOC. PIP: ELSHT01**

**DOCUMENTATION REQUIREMENTS SHEET**

**ELSHT01-R**

**SELF-REGULATED ELECTRIC HEAT TRACE SYSTEM**

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<table>
<thead>
<tr>
<th>ITEM TAG NO.:</th>
<th>JOB NO.:</th>
<th>REV. DATE:</th>
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**DOCUMENT MEDIA LEGEND:**

| X = ORIGINAL | E1 = CD   | A = .DOC   |
| P0 = 841 X 1189 MM | E2 = DVD | B = .XLS |
| PF = FULL SIZE | P1 = 594 X 841 MM | E3 = EMAIL |
| PA = 8 ½ X 11 IN | P2 = 420 X 594 MM | E4 = DISK |
| PB = 11 X 17 IN | P3 = 297 X 420 MM | E5 = OTHER |
| PC = 17 X 22 IN | P4 = 210 X 297 MM | E = .DGN |
| PD = 22 X 34 IN | E1 = CD | A = .DOC |

**COLUMN DEFINITIONS:**

1. WITH BID: DOCUMENTS SHALL BE PROVIDED WITH PROPOSAL.
2. FOR REVIEW: DOCUMENTS SHALL BE PROVIDED FOR PURCHASER’S REVIEW AND AUTHORIZATION TO PROCEED BEFORE FABRICATION.
3. FINAL CERTIFIED: DOCUMENTS SHALL BE PROVIDED AS PART OF THE FINAL CERTIFIED DOCUMENT SUBMITTAL.

<table>
<thead>
<tr>
<th>DOCUMENTATION</th>
<th>WITH BID (SEE NOTE 1)</th>
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<tr>
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<td>1. SCHEMATIC DIAGRAMS</td>
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<tr>
<td>2. CALCULATIONS USING PURCHASER APPROVED HEAT TRACING PROGRAM</td>
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<td>3. DESCRIPTIONS OF HARDWARE AND SOFTWARE USED</td>
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<td>4. LAYOUT AND INSTALLATION DRAWINGS (SEE NOTE 2)</td>
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<td>5. SYSTEM DETAILS</td>
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<td>6. BILL OF MATERIALS (SEE NOTE 3)</td>
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<td>7. DESCRIPTIVE BULLETINS OF SUPPLIED EQUIPMENT</td>
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<td>8. DETAILS OF CONTROL SYSTEM</td>
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<td>9. ELECTRICAL POWER SUPPLIES REQUIRED</td>
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<td>10. LOCATIONS OF ELECTRICAL TIE-INS AT HEAT TRACING POWER DISTRIBUTION AND CONTROL PANELS.</td>
<td>X</td>
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<td>11. DETAILED ENGINEERING SCHEDULE STARTING AT RECEIPT OF PURCHASE ORDER.</td>
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<td>12. CONTROL PANEL DRAWINGS</td>
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<td>A. PHYSICAL ARRANGEENT &amp; STRUCTURAL DETAIL DRAWINGS (SEE NOTE 4)</td>
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<td>B. POWER &amp; CONTROL WIRING DIAGRAMS (SEE NOTE 5)</td>
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<td>13. ISOMETRICS (SEE NOTE 6)</td>
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<td>15. CIRCUIT TAG SCHEDULES</td>
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<td>16. FINAL DOCUMENTATION PACKAGE (SEE NOTE 7)</td>
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</table>
1. SYSTEM DESIGN INFORMATION PROVIDED WITH THE QUOTATION SHALL INCLUDE THE FOLLOWING:
   A. CIRCUIT IDENTIFICATION NUMBER
   B. MAINTAIN TEMPERATURE
   C. LINE SIZE AND INSULATION
   D. HEAT LOSS FOR PIPES, VALVES AND SUPPORTS
   E. AMOUNT AND TYPE OF HEATING CABLE REQUIRED
   F. HEATING CABLE SERVICE VOLTAGE
   G. HEATING CABLE POWER OUTPUTS AT THE MAINTAINING TEMPERATURE
   H. HEATING CABLE POWER STARTUP OUTPUTS AT THE MINIMUM AMBIENT TEMPERATURE
   I. MINIMUM AND MAXIMUM MAINTAIN TEMPERATURE VERSUS MINIMUM AND MAXIMUM AMBIENT TEMPERATURES
   J. HEAT TRACING POWER DISTRIBUTION PANEL SCHEDULE
   K. QUANTITY AND RATING OF EACH MAIN FEEDER CIRCUIT BREAKER AND ANY ADDITIONAL TRANSFORMERS SIZING

2. TYPICAL INSTALLATION DETAIL DRAWINGS INCLUDING THE FOLLOWING INFORMATION SHALL BE PROVIDED AS REQUIRED.
   A. INSTALLATION AND POSITIONING OF ALL COMPONENTS
   B. PROPER AMOUNTS OF TRACING FOR VALVES, PUMPS, FLANGES, FITTINGS, INSTRUMENTS, ETC
   C. JUNCTION BOX LAYOUTS
   D. MATERIAL SCHEDULE ON EACH DETAIL LISTING ALL COMPONENTS AND QUANTITIES USED

3. SYSTEM BILLS OF MATERIALS INCLUDING DESCRIPTIONS, QUANTITIES, AND RATINGS OF ALL COMPONENTS SHALL BE PROVIDED.

4. PHYSICAL ARRANGEMENT AND STRUCTURAL DETAIL DRAWINGS INCLUDING THE FOLLOWING INFORMATION SHALL BE PROVIDED FOR EACH CONTROL PANEL.
   A. ELEVATIONS, SECTIONS, FLOOR PLAN, AND BASE LAYOUT
   B. ARRANGEMENT AND MOUNTING OF ALL COMPONENTS ON FRONT OF PANEL, SWING DOOR, BACK PANEL, ETC.
   C. GROUND BUS AND LUGS LOCATIONS
   D. TERMINAL BLOCKS LOCATIONS
   E. PURGE SYSTEM LOCATION AND DETAILS, IF APPLICABLE
   F. CONDUIT ENTRIES LOCATIONS

5. POWER AND CONTROL WIRING DIAGRAMS SHOWING ALL INTERNAL WIRING CONNECTIONS FOR ALL ELECTRICAL AND INSTRUMENT COMPONENTS IN EACH CONTROL PANEL SHALL BE PROVIDED. ALL WIRES, TERMINALS, AND DEVICES SHALL BE NUMBERED AND TAGGED IN ACCORDANCE WITH THE POWER AND CONTROL WIRING DIAGRAMS.

6. HEAT TRACING ISOMETRIC LAYOUT DRAWINGS INCLUDING THE FOLLOWING INFORMATION SHALL BE PROVIDED FOR EACH LINE
   A. LOCATION OF LINE
   B. PIPING LINE NUMBERS AND DIMENSIONS
   C. VALVES, PUMPS, FLANGES, FITTINGS, INSTRUMENTS
   D. HEAT CIRCUIT NUMBER
   E. HEAT LOSS AND HEATER OUTPUT
   F. ELECTRICAL LOAD
   G. HEATER CATALOG NUMBERS
   H. HEATER TERMINATION POINTS
   I. DESIGN PARAMETERS
   J. INSULATION TYPE AND THICKNESS
   K. POSITIONS OF ALL COMPONENTS
   L. MATERIAL SCHEDULE LISTING ALL COMPONENTS AND QUANTITIES USED
   M. PANEL ID NUMBER
   N. ISOMETRICS SHALL BE SUFFICIENTLY DETAILED TO READILY ORIENT HEATERS, BOXES, RTDS, AND ANY OTHER EQUIPMENTS PROVIDED.
7. THE FOLLOWING DATA AND DOCUMENTATION SHALL BE PROVIDED WITH THE FINAL DOCUMENTATION PACKAGE:
   A. DETAILED LITERATURE COVERING ALL EQUIPMENT PROVIDED
   B. ELECTRIC HEATER CABLE DESCRIPTION DATA, INCLUDING PHYSICAL AND ELECTRICAL CHARACTERISTICS
      DIMENSIONS, WEIGHTS, ETC.
   C. RECOMMENDED PROCEDURES FOR HANDLING, INSTALLING, TERMINATING, AND SPLICING ELECTRIC HEATER
      CABLE
   D. COMPLETE INSTALLATION, OPERATING, AND MAINTENANCE MANUALS INCLUDING COMPONENTS
      DESCRIPTIVE LITERATURE AND INFORMATION ON HANDLING, INSTALLING, OPERATING, MAINTAINING, AND
      TROUBLESHOOTING THE EQUIPMENT
   E. RECOMMENDED PRICED SPARE PARTS LIST FOR STARTUP AND OPERATION FOR ONE YEAR
   F. REPORTS FOR TESTS PERFORMED IN ACCORDANCE WITH PIP ELSHT01 SECTION 4.10
   G. FINAL CERTIFIED COPIES OF ALL PROJECT DRAWINGS INCLUDING, BUT NOT LIMITED TO, LAYOUTS, PLOT
      PLANS, ISOMETRICS, PIPING PLANS, ELECTRICAL, POWER PLANS, P&ID'S, CONTROL SCHEMatics, WIRING
      DIAGRAMS, DATA SHEETS, SCHEDULES, AND BILLs OF MATERIAL