

**Brookhaven National Laboratory
Plant Engineering - E&CS Division
Engineering Change Notice Form**

PROJECT: CCWF II

JOB No. 11705

ECN Title: Trane Chiller Remote Starter

ECN No. 56

Affected Documents: Specification 15652, Giffels Submittal 72145; E.W. Howell submittal 15652-004

Requested Change (Attach sketch if applicable): Clarify interconnection requirements for Chillers 600CHL-5, -6, remote starters based on Trane shop drawing submittals.

Requested by: E.W. Howell; prepared by John P. Perkins, PE

Date: 22-Oct-10

Resolution: Refer to attachments: Approved Trane shop drawings, w/ highlights; GE 4kV GE Limitamp Starter w/ highlights; Example GE shop drawings (similar application); BNL Supplemental Instructions and drawing mark-ups.

Approvals: A/E or Proj. Eng.:

Project Coordinator:

Manager:

Date:

Date:

Date:

Contractor shall take the following action:

- Await change order from P&PM
- Proceed with change as described
- Provide cost proposal for change as described

Distribution: E. W. Howell
E&U
O&M
NSLS II

Giffels
MPO
DOE
ECN File

PPM



REMOTE MOUNTED MOTOR STARTER, BY OTHERS
FOR CH530/ADAPTIVIEW CENTRIFUGAL CHILLERS

1.0 SCOPE

1.1 **Purpose** - This Specification provides the information required for others to build a starter that is compatible with Trane centrifugal chiller compressor motors and controls. This Specification also provides information for installation and setup of the Trane controls interfacing with the motor starter. Adherence to this Specification is highly recommended to ensure proper field connections and functionality of the chiller. Trane assumes no responsibility for the design, construction, compatibility, installation, start up and long term support, and will not maintain records or drawings on the resulting starter.

1.2 **Applicability** - This motor starter Specification applies to Trane direct drive centrifugal chillers with CH530/AdaptiView™ control panels, for all motor voltages. The CH530/AdaptiView™ control panel is located on the chiller. It contains the Starter Module (1A23) which provides motor control, monitoring and protection. Typically, these starters are direct shipped to the job site and field installed.

2.0 APPLICABLE DOCUMENTS

All documents listed in this Section are the latest revision.

2.1 Referenced Documents

Trane

All Trane referenced electrical documentation can be found on the Trane service intranet at <http://tranenet.lax1.lbu.technicalsupport/home/TracerCH530:SchematicsAndConnections.asp> or http://tranenet.lax1.lbu.technicalsupport/home/TracerAdaptiViewcontrol.tracer_adaptiview.htm for released Trane wiring diagrams.

2.2 Industry

- CSA C22.2 No. 14 - Industrial Control Equipment for Use in Ordinary (Non-Hazardous) Locations
- IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code)
- IEC 60470 - High-Voltage alternating current contactors and contactor-based motor-starters
- IEC 60694 - Common Specifications for high-voltage switchgear and control gear standards
- NEC - National Electrical Code
- NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
- NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts
- NEMA ICS 3 - Industrial Control and Systems Factory-built Assemblies Part 2 Medium Voltage Controllers Rated 2001 to 7200 Volts AC
- UL 508 - Standard for Industrial Control Equipment
- UL 347 - Standard for High Voltage Industrial Control Equipment

REVIEWED FOR SUBMISSION
SUBMISSION # 15652-004
E.W. HOWELL CO., LLC

"FOR INFO ONLY"
TWA 4/20/08

| GIFFELS PROFESSIONAL ENGINEERING | |
|--|-----------------|
| The contractor is responsible for complying fully with the contract documents. Submittals are reviewed by GIFFELS PROFESSIONAL ENGINEERING for functional requirements only. | |
| Action Code | Checked by/Date |
| A. Approved | EP 9-8-09 |
| B. Approved Except As Noted; resubmittal not required | |
| C. Not Approved; correct and resubmit | |

ENGINEERING SPECIFICATION

Trane
La Crosse, Wisconsin



No. S6516-0513
Rev. H
Date May 2008
Page 2

2.3 Related Documents

None.

3.0 GENERAL REQUIREMENTS AND RECOMMENDATIONS

Note: Throughout this document when the word "should" or "recommended" is used, this is a recommendation by Trane for good practice. When the word "shall" or "requirement" is used, this is a requirement specified by Trane to ensure reliable and safe operation.

- 3.1 **Construction** - Construction, individual components, wiring, and testing of the starter should comply when applicable with the National Electrical Code (NEC), the National Electrical Manufacturers Association (NEMA) Standards 250, ICS 2 and ICS 3, Underwriters Laboratories Inc. (UL) Standard UL 508 and UL 347, Canadian Standards Association (CSA) Standard C22.2 No. 14 and / or International Standard (IEC) 60470.
- 3.2 **Components** - All components should be selected to have ratings that are equal to or exceed the values to which they will be subjected. Power carrying components used in the motor circuit should have current ratings based on the intended service as defined on the Purchase Order. All components should be UL recognized for industrial control in compliance with UL 508 and UL 347 as applicable.
- 3.3 **Environmental** - The recommended operating ambient temperature range for the motor starter is +32° to +104°F (0° to +40°C). The non-operating ambient temperature range is -40° to +158°F (-40° to +70°C). The relative humidity, non-condensing, over these temperature ranges is 5% to 95%. The temperature rise of all components should not exceed the values defined by UL, IEC and by NEMA. Starters should be capable of operating at sea level to 6,000 feet elevation.
- 3.4 **Enclosure** - The motor starter enclosure should be either a minimum IEC IP3X or a minimum NEMA 1 ventilated general purpose box with a hinged door and locking type retaining latches.
- 3.5 **Terminal Labeling** - All components, terminal points, and customer interface points shall be clearly labeled with the proper identification as shown on applicable Trane drawings listed in this document.
- 3.6 **Voltage Ratings** - This specification covers all Trane system voltages 208 to 13800 Volts 50 & 60 Hz.. Utilization range shall include ±10% from the nominal with short time dips (0-30 seconds) to 85% of nominal under running conditions.
- 3.7 **Power Supply Interface** - Provisions should be made to terminate customer-supplied incoming wiring within the starter enclosure. These termination points should be sized based on the NEC for the load requirements. They should be compatible with either copper or aluminum wire.
- 3.8 **Motor Supply Interface** - Same as "Power Supply Interface", Section 3.7, except that only copper wire shall be used to terminate to chiller motor terminal studs.
- 3.9 **Starter Control Terminal Block** - The starter shall contain a terminal block sized based on interface wiring loads listed in Sections 4.2.1 and 4.2.2. Refer to Appendix F for control termination points between the starter and Trane CH530/AadaptiView control panel.

(continued)

ENGINEERING SPECIFICATION

Trane
La Crosse, Wisconsin



No. S6516-0513
Rev. H
Date May 2008
Page 3

- 3.10 **Internal Starter Wiring** - All wires should be copper only. Wire should be sized in accordance with NEC, IEC, or applicable UL standard. All control wiring should be red in color, except ground wires, which should be green/ yellow. Wire that is used in circuits that remain energized when the main disconnect is open, should be yellow. Each wire should be identified with a number at the point of termination at each end. Where shielded wire is required, the shield shall be grounded at only one end.
- 3.11 **Transition Type Starters** - All transition type starters shall be closed transition. Transition shall be initiated only by the Trane CH530/AdaptiView™ control panel. Reference Appendix G for more detail
- 3.12 **Motor Protection** - All motor protection and operating functions (i.e. overload, load limiting, phase failure, phase imbalance, phase loss and power loss) are performed by the Trane CH530/AdaptiView controls. Any supplemental motor protection controls that are provided by the starter manufacturer shall be set to operate after the Trane CH530/AdaptiView™ trip point has been reached.
- 3.13 **Wiring Diagrams** - It is recommended that schematic and field wiring diagrams be included with the starter.
- 3.14 **Agency** - It is recommended that the starter have a third party listing.
- 3.15 **Starter Nameplate** - It is recommended that the starter panel be identified with a nameplate. The nameplate should show the following:
- Starter model number
 - Manufacturer's name
 - Line voltage, frequency, phase
 - Rated load current
 - Maximum starter locked rotor current
 - Starter serial number
 - Starter Short Circuit Rating

(continued)

ENGINEERING SPECIFICATION

Trane
La Crosse, Wisconsin



No. S6516-0513
Rev. H
Date May 2008
Page 4

→ 3.16

Required Purchased Parts - The following table contains the parts or devices necessary to assemble a motor starter to interface with the CH530/AdaptiView controls. Reference Trane drawings listed in this document for device designations. See listed applicable specification section in the table for detailed information on device or part.

| Required Parts - Reference Trane Schematics Listed in this Document | Wye Delta | Starter Type | | | Applicable Specification Section |
|---|-----------|-------------------------|-----------------------|--|----------------------------------|
| | | Low Voltage Solid State | Medium Voltage X-line | Medium Voltage Auto Transformer, Primary Reactor | |
| 5KVA → 5T5; 4KVA control power transformer | X | X | X | X | 5.0 |
| 5F1,2,3,4; Primary & Secondary 5T5 Fusing | X | X | X | X | 5.0 |
| 5A10-Aux; Solid state interlock relay | | X | | | 6.4 |
| 5X1; Terminal Block | X | X | X | X | 4.2 |
| 5K11 or 5A10; interlock relay | X | | X | X | 6.1 |
| 5K12-Aux; Start relay interlock | X | | X | X | 6.2 |
| 5K13-Aux; Run Relay interlock | X | | | X | 6.3 |
| 5CT1, 5CT2, 5CT3 → 5T1, 2, 3; Primary CT's | X | X | X | X | 7.0 |
| 5CT4, 5CT5, 5CT6 → 5T6, 7, 8; Secondary CT's | X | X | X | X | 7.0 |
| 5CT5 → 5T9; Primary PT(s) EXISTING | | | X | X | 8.0 |
| 5T17, 18, 19; Secondary PT's | X | X | X | X | 8.0 |

4.0 TRANE CH530/ADAPTIVIEW™ CONTROL INTERFACE WIRING

4.1 **Starter Control Circuit** - The Trane CH530/AdaptiView™ control panel will contain the starter module (1A23) and shall control the starter during motor starting, running, and shutdown. For more detailed operation description refer to Appendix A. A "Start" push-button is not permitted. The starting circuit must be pilot relay operated. Chiller safeties must not be bypassed. Control of the starter must reside within the CH530/AdaptiView™ control panel. An emergency stop button on the starter is permitted. These options involving circuiting intended to stop the compressor under distress shall interrupt the pilot relay coil circuit within the starter.

4.2 **Circuits** - NEC defined Class 1 and Class 2 control wiring is required between the Starter and Trane CH530/AdaptiView™ control panel (reference applicable Trane connection diagrams for specific requirements).

ENGINEERING SPECIFICATION

Trane
La Crosse, Wisconsin



No. S6516-0513
Rev. H
Date May 2008
Page 5

4.2.1 Class I Circuits, 1 phase 120VAC - The following are the worst case (load & conductor quantity) required conductors and their required ampacities. Use this information for wire count and conductor sizing for connecting the Trane CH530/AdaptiView control panel and the starter control.

- (3) 4000VA 115 VAC 1 phase control power (1A, 2A, GND)
- (2) 3/4 HP 1 Phase 11.7A FLA 115VAC (9A, 10A)
- (3) Max load rating, CH530/AdaptiView™ output contacts are 120/ 240VAC 50/60Hz pilot duty rated.; 7.2A resistive, 1/3HP, 2.88 Amp inductive, 43.2 amps inrush, 1 phase (15A, 16A, 18A)
- (2) Circuit protected at 20 Amp 115VAC 1 phase (3B, 13A)
- (3) 120 VAC 3 phase Potential transformer control signal - applies to Industrial chillers only (from 5T9 to 1S1)
- (4) 125 VDC 10A (1K1, 1K2)

4.2.2 Class 2 Circuits, 30 Volts or Less - The following are the worst case required conductors. Recommended #16 AWG minimum. These circuits must be run in conduit separate from other control wiring >30 VAC. Use this information for wire count for connecting the Trane CH530/AdaptiView control panel and the starter control.

- (6) CTs (Current Transformers) (5CT14, 15, 16) 5CT4, 5CT5, 5CT6 - SECONDARY
 - (6) PTs (Potential Transformers) ((5T17, 18, 19 wire #237-#241) 5CT1, 5CT2, 5CT3 - PRIMARY
 - (2) Solid State starter fault relay applies to solid state starters only (5A10-K1)
- Refer to Appendix "C" and "F" for conductor size based on distance to control panel.

5.0 CONTROL POWER TRANSFORMER

5.1 Trane Standard CH530/AdaptiView Control Power Transformer (5T5) - A ⁵4 KVA control power transformer line voltage primary to 115V 60 Hz, 110VAC 50Hz secondary shall be furnished in the starter. Primary fusing shall be selected per NEC. Secondary Fuse 5F4 shall be 40A. The purpose of this transformer is to supply power to the CH530/AdaptiView™ control system and starter controls. When it is not possible to install the control power transformer in the starter, a separate power supply may be used, (e.g. customer supplied power to the control circuit), provided the connection, isolation, and fusing is as shown on the starter/CH530/AdaptiView™ interconnecting wiring drawings.

~~5.2~~ Trane Industrial (optional) CH530/AdaptiView Control Power Transformer - Trane chillers shipped as "Industrial Chillers" with the "Control Power transformer" option will have a unit mounted 4KVA control power transformer, 460 VAC primary 115 VAC 60 Hz, 110 VAC 50Hz secondary, mounted on the chiller frame. Other voltages 208 to 600VAC are available as special. This option deletes the requirement for the 4KVA transformer listed in section 5.1. In this case, the starter control power is sourced from the Trane CH530/AdaptiView control panel. This control circuit consisting of 3 conductors is protected, by the Trane CH530/AdaptiView control panel, at 20 A mp 115VAC 1 phase.

6.0 INTERLOCKS - The following electrical interlock contacts are required. Reference Trane wiring diagrams for component identifiers used in this section. All interlock contacts shall be compatible with 120V control circuitry. Special contact requirements are noted below. For a more detailed operation description refer to Appendix A.

6.1 Oil Pump Interlock - A normally open contact of the interlock relay (5K11, 5A10, 5S2) rated at 3/4 hp at 115VAC 1 phase shall be wired to terminals 5X1-7 and 5X1-8. This contact shall be closed whenever power is applied to the motor.

ENGINEERING SPECIFICATION

Trane
La Crosse, Wisconsin



No. S6516-0513
Rev. H
Date May 2008
Page 6

- 6.2 **Pilot Relay Interlock** - Wye Delta, Autotransformer, Primary reactor, and Across the line starters shall utilize a normally open contact on the 5K12 start contactor to be used to energize the 5K11 pilot relay per the applicable interconnecting wiring diagram. Solid state starters shall utilize a normally open contact on the 5A10 starter to be used to energize a pilot relay per the applicable interconnecting wiring diagram.
- 6.3 **Proof-of-Transition or Up-To-Speed Interlock** - All starters except across-the-line require a normally-open contact of the 5K13 run contactor (5A10 for Solid State) to be wired to terminals 5X1-3 and 5X1-14. Contacts shall be silver. For solid-state starters, an output that indicates the motor is "up to speed" shall be used.
- 6.4 **Starter Fault Interlock** - The solid state starter shall have an additional set of silver contacts to activate the starter fault input wired to 1A24 terminals J2-1 and J2-2. This normally open set of contacts shall be powered closed for normal operation, and shall open on fault detection by the solid state starter or on power loss.
- 7.0 **CURRENT TRANSFORMERS** - A total of six current transformers are required for the Trane control system, three primary and three secondary. UL does not permit Trane to UL list the control panel unless the Trane current transformers are used. **PROPER PHASING and POLARITY CONNECTIONS ARE REQUIRED** as shown on Trane drawings or the chiller will not operate.

(continued)

ENGINEERING SPECIFICATION

Trane
La Crosse, Wisconsin



No. S6516-0513
Rev. H
Date May 2008
Page 7

7.1 **Primary Current Transformers (ST1, ST2 and ST3)** - Three primary current transformers are required, one per phase, and should be located in the starter. The output of these primary current transformers must be between 2.4 and 3.6 amps at full load, and must not be used to drive any auxiliary equipment such as amp meters or monitoring packages. The neutrals (ground) required for these CTs, and CTs used for other devices such as amp meters, must be separate by running a different ground wire for each CT system. Purchase these transformers from the local Trane Parts Center. Order by Trane part number and description (ratio). For accuracy, burden and insulation rating, see Appendix B.

| Compressor RLA Range | CT Ratio | Primary turns | Trane Part No. | Quantity (Total No. Required) | TechView CTMS |
|----------------------|----------|---------------|----------------|-------------------------------|---------------|
| 8.0 to 11.9 | 50:5 | 3 | TRR01288 | 3 | 12.0 |
| 12.0 to 17.9 | 50:5 | 2 | TRR01288 | 3 | 18.0 |
| 18.0 to 23.9 | 75:5 | 2 | TRR01289 | 3 | 27.0 |
| 24.0 to 35.9 | 50:5 | 1 | TRR01288 | 3 | 36.0 |
| 36.0 to 47.9 | 75:5 | 1 | TRR01289 | 3 | 54.0 |
| 48.0 to 72.0 | 100:5 | 1 | TRR01287 | 1 | 72.0 |
| 60.0 to 90.0 | 250:5 | 2 | TRR00449 | 3 | 90.0 |
| 72.0 to 108.0 | 150:5 | 1 | TRR00448 | 3 | 108.0 |
| 86.4 to 129.6 | 180:5 | 1 | TRR00448 | 3 | 129.6 |
| 96.0 to 144.0 | 200:5 | 1 | TRR00448 | 3 | 144.0 |
| 120 to 180 | 250:5 | 1 | TRR00449 | 3 | 180.0 |
| 144 to 216 | 300:5 | 1 | TRR00449 | 3 | 216.0 |
| 168 to 252 | 350:5 | 1 | TRR00449 | 3 | 252.0 |
| 192 to 288 | 400:5 | 1 | TRR00450 | 3 | 288.0 |
| 240 to 360 | 500:5 | 1 | TRR00450 | 3 | 360.0 |
| 288 to 432 | 600:5 | 1 | TRR00450 | 3 | 432.0 |
| 336 to 504 | 700:5 | 1 | TRR00451 | 3 | 504.0 |
| 384 to 576 | 800:5 | 1 | TRR00451 | 3 | 576.0 |
| 480 to 720 | 1000:5 | 1 | TRR00451 | 3 | 720.0 |
| 576 to 864 | 1200:5 | 1 | TRR00499 | 3 | 864.0 |
| 720 to 1080 | 1500:5 | 1 | TRR00499 | 3 | 1080.0 |
| 864 to 1296 | 1800:5 | 1 | TRR00453 | 3 | 1296.0 |
| 1008 to 1512 | 2100:5 | 1 | TRR00453 | 3 | 1512.0 |
| 1200 to 1800 | 2500:5 | 1 | TRR00453 | 3 | 1800.0 |

CTMS = (CT Rating x 3.6) / (Number of Primary Turns x 5.0)

* MODEL CVHF 1300 RLA-113.7

(continued)

ENGINEERING SPECIFICATION

Trane
La Crosse, Wisconsin



No. S6516-0513
Rev. H
Date May 2008
Page 8

- 7.2 Secondary Current Transformers (SCT4, SCT5, and SCT6) - Three secondary current transformers are required, one per phase, these should be located in the starter, and must not be used to drive any auxiliary equipment such as amp meters or monitoring packages. The brown lead of the secondary current transformer shall be connected to the X1 terminal of the primary transformer. Purchase these secondary transformers from the local Trane Service Agency or Trane supplier. Order by Trane part number TRR-975. Refer to Appendix C for recommended maximum wire lengths from secondary current transformers to starter module in the CH530/AdaptiView™ panel. Grounding of the secondary CT or PT circuit may cause damage to the starter module.
- 7.3 Industrial Chiller Option "Supplementary Motor Protection" - Trane chillers shipped as "Industrial Chillers" with the "Supplementary Motor Protection" option will not require the primary and secondary current transformers listed in Sections 7.0, 7.1, and 7.2. The SMP panel contains required CT's which are pre-wired to the Trane CH530/AdaptiView starter module from the Trane factory.
- 8.0 **POTENTIAL TRANSFORMERS - POTENTIAL TRANSFORMERS (PT) ARE REQUIRED** - For applications 600V and below a single stage of three potential transformers are required, one per phase. Two stages of potential transformers are required for voltages above 600V. PTs should be located in the starter. It is recommended that the PT's not be used to drive any auxiliary equipment such as monitoring packages. **PROPER PHASING and POLARITY CONNECTIONS ARE REQUIRED** as shown on Trane drawings or the chiller will not operate. Reference Appendix E for maximum wire lengths.
- ~~8.1~~ Six Hundred Volts and Below 50/60 Hz - Three potential transformers (ST17, ST18, & ST19), Trane part number TRR-713 or equivalent are required. Refer to Appendix D. Grounding of the secondary CT or PT circuit may cause damage to the starter module.
- 8.2 Greater than 600 Volts 50/60 Hz - Two stages of potential transformers are required as follows:
- 8.2.1 Second Stage Potential Transformers (ST17, ST18 and ST19) - Use three PT's, Trane part number TRR-976 or equivalent. See Appendix D for specifications. Grounding of the secondary CT or PT circuit may cause damage to the starter module.

(continued)

ENGINEERING SPECIFICATION

Trane
La Crosse, Wisconsin



No. S6516-0513
Rev. H
Date May 2008
Page 9

8.2.2

First Stage Potential Transformers - See the following tables in this section for *Recommended* first stage transformers. Select the appropriate PT for the application voltage from the chart below. The allowable PT Primary Voltage Ratings, are shown below. Alternative first stage potential transformers are acceptable if transformer complies to minimum specifications listed in Appendix D and applicable application specification and local standards.

60 Hz First Stage potential transformers

5T9



| Nominal System Line Volts | Quantity (Number per stage) | PT Secondary Side (Volts) @ Rated PT Primary | Recommended PT (Trane part no. &/or vendor model & style no.) |
|---------------------------|-----------------------------|--|---|
| 2400 | 1 | 120 | Cutler-Hammer model 3PT3-45, style 5275C11H01 |
| 3300 | 1 | 120 | Cutler-Hammer model 3PT3-45, style 5275C11H24 |
| 4160 | 1 | 120 | Cutler-Hammer model 3PT3-45, style 5275C11H02 |
| 4800 | 3 | 120 | Cutler-Hammer model 3PT3-45, style 5275C11H03 |
| 6600 | 3 | 120 | TRR-01317 |
| 7200 | 3 | 120 | Cutler-Hammer model PT3-60, style 7875A15H06 |
| 13200 | 3 | 120 | ABB Type VIZ-11, Catalog Number 7525A67G10 |
| 13800 | 3 | 120 | ABB Type VIZ-11, Catalog Number 7525A67G10 |

50 Hz First Stage potential transformers

| Nominal System Line Volts | Quantity (Number per stage) | PT Secondary Side (Volts) @ Rated PT Primary | Recommended PT (Trane part no. &/or vendor model & style no.) |
|---------------------------|-----------------------------|--|---|
| 3300 | 1 | 110 | Cutler-Hammer model 3PT3-45, style 5275C11H04 |
| 4160 | 1 | 110 | Cutler-Hammer model 3PT3-45, style 5275C11H22 |
| 6600 | 3 | 120 | TRR-01166 |
| 7200 | 3 | 120 | TRR-01303 |
| 10000 | 3 | 120 | ABB Type VIZ-11, Catalog Number 7525A67G08 |
| 11000 | 3 | 120 | ABB Type VIZ-11, Catalog Number 7525A67G08 |

8.3

TechView Voltage Transformer Ratio "VTRA" - The VTRA is required to be calculated. For chillers with line voltage 600VAC and less (using TRR-713), the VTRA = 20. For chillers with line voltage greater than 600VAC, VTRA= Primary PT ratio X 4 (TRR-976 ratio of 600 to 30VAC). Example, 4200 to 120 transformer with TRR-976; VTRA = 35 x 4 = 135.

(continued)

ENGINEERING SPECIFICATION

Trane
La Crosse, Wisconsin



No. S6516-0513
Rev. H
Date May 2008
Page 10

8.4

Industrial Chiller Option - Trane chillers with line voltage greater than 600VAC shipped with the "Industrial Chiller" option will not require the secondary potential transformers listed in section 8.0, 8.1 and 8.2. The Trane CH530/AdaptiView panel contains the required secondary PT's which are pre-wired from the Trane factory. The first stage secondary (120 VAC 3 phase) is required to terminate to the Trane CH530/AdaptiView control panel IS1 (3 pole disconnect). Reference applicable Trane industrial chiller drawings.

← SECONDARY PT'S ARE NOT IN TRANE C/P

9.0

OPTIONAL EQUIPMENT - When optional parts are used, they shall be located in such a manner as to not obstruct the workings of the system and not interfere with the routing of wiring. When options are required, they should be specified on the starter purchase order.

9.1

Power Factor Correction Capacitor (PFCC) - Contact Trane for the maximum PFCC size for each compressor circuit. The PFCC's should be connected to the load side of the start or run contactor. The contactor will then serve as a disconnect for both the motor and the PFCC's when the motor is off. As an alternate, the PFCC's may have a separate *isolation* contactor that has its coil wired in parallel with the start or run contactor coil. PFCC's and current transformers (CT's) must be wired so that the total amp draw is reflected in the CT output. Refer to Figure 1. For solid state starters, the PFCC contact should be wired in parallel with the SA1 at Speed Input, to terminal 5X1-14 and neutral. When PFCCs are connected downstream of the primary current transformers the capacitor leads must be routed through the primary CT's as shown in Figure 1.

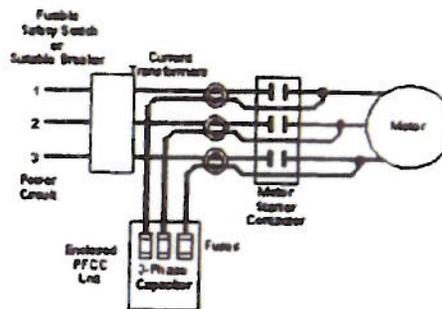


Figure 1

9.2

Additional Motor Protection - If any additional motor protection is required to shut down the compressor motor it shall be connected to the starter *interlock circuit*. Reference terminal 5X1-4 on applicable Trane drawings. Any additional motor protection which mimics the Trane CH530/AdaptiView motor protection shall be set such that its trip point will trip after the Trane CH530/AdaptiView motor protection trip point.

(continued)



Appendix Index

| Appendix | Description |
|-----------------|---|
| A | CH530/AdaptiView OPERATION |
| B | PRIMARY CURRENT TRANSFORMER ACCURACY, BURDEN AND INSULATION RATING DATA |
| C | MAXIMUM RECOMMENDED CURRENT TRANSFORMER WIRE LENGTHS |
| D | PRIMARY CURRENT TRANSFORMER DIMENSIONS |
| E | TRANE POTENTIAL TRANSFORMERS ACCURACY, BURDEN, AND INSULATION RATING DATA |
| F | MAXIMUM RECOMMENDED POTENTIAL TRANSFORMER WIRE LENGTHS |
| G | INTERCONNECTING WIRING |
| H | GENERIC STARTER CONTROL LADDER LOGIC |
| I | VACUUM CIRCUIT BREAKER SCHEMATIC |



APPENDIX A
CH530/AdaptiView OPERATION

- A.1 **General** - The starter is used to stop and start the motor of a compatible Trane centrifugal water chiller. Starter operation is governed by the control panel (CH530/AdaptiView™) located on the chiller. When cooling is required, the CH530/AdaptiView™ executes a series of prestart checks. If all prestart criteria are met, the CH530/AdaptiView™ sends "start" and "transition" signals to the starter. The run signal to the starter is maintained through the Stop Relay. When cooling is no longer required, or an emergency shutdown is required, the CH530/AdaptiView™ terminates operation via the Stop Relay.

(For this discussion, starters are divided into three categories: solid-state, across-the-line, and transitioning. "Transitioning" starters include wye-delta, auto-transformer, and primary-reactor types.)

- A.1.1 **Oil Pump Interlock** - All starters shall provide an interlock with the oil pump on the chiller. The purpose of this interlock is to power the oil pump on the chiller in the event that a starter failure, such as welded contacts, keeps the chiller motor running after the CH530/AdaptiView™ interrupts the run signal.

The Oil Pump Interlock shall be a contact closure indicating that power is applied to the motor. Regardless of starter type, the Oil Pump Interlock shall be connected to Terminals 5X1-7 and 5X1-8.

- A.1.2 **Interlock Relay** - The Interlock Relay (5K11), which assures proper shutdown in the event of a power loss, is a control relay that energizes when a set of contacts on the main contactor (5K12) closes. When the Interlock Relay energizes, it closes a set of contacts to *interlock* the main contactor with Terminal 5X1-4, thus interlocking that contactor with the Stop Relay.

On solid-state starters, the Interlock Relay may be replaced by a contact closure signal (5A10-AUX) from the solid-state starter module; the starter module shall initiate this signal as soon as it receives a "start" signal. If a contact closure signal is not available from the solid-state starter module, a control relay shall be added to meet this requirement. The Interlock Relay shall be energized by the "start" signal (5X1-5) and de-energized by the Stop Relay (5X1-4).

- A.1.3 **Transition Interlock** - Solid-state and transitioning types of starters shall include a Transition Interlock. The CH530/AdaptiView control panel monitors the amperage draw of the motor to determine the appropriate time to send a transition signal. After the transition signal is sent, the CH530/AdaptiView requires proof that transition was successfully completed. This interlock provides a feedback signal to the CH530/AdaptiView™ that indicates transition is complete and that the motor is connected to the line in the normal run configuration.

The Transition Interlock for transitioning starters shall be an auxiliary set of normally -open contacts on the run contactor; these contacts shall close when transition is complete. For solid-state starters, the Transition Interlock shall be a contact closure indicating that the motor is fully up to speed (end of ramp). For both transitioning and solid-state types of starters, the Transition Interlock shall be connected to Terminals 5X1-3 and 5X1-14.

- A.2 **Sequence Of Operation By Starter Type** - The following descriptions assume that the contactors are powered directly from the chiller control panel (CH530/AdaptiView™). A pilot relay shall be used for any contactor coil that is not compatible with the CH530/AdaptiView™ contact ratings and control voltage.

(continued)



→ A.2.1 Across-The-Line Starters - When cooling is required and the prestart checks are complete, the CH530/AdaptiView™ closes the Stop Relay (at J10, Module 1A23). The Start Relay (at J8, Module 1A23) then closes for a short period of time, sending control power through Terminal 5X1-5 to the 5K12 main contactor and connecting the chiller to the line. A set of normally-open contacts on 5K12 shall close to energize Interlock Relay 5K11. Closure of the 5K11 contacts shall connect the main contactor (5K12) to the Stop Relay at Terminal 5X1-4. The Start Relay (at J8) then opens leaving the start signal connected through the interlock circuit.

When cooling is no longer needed, the CH530/AdaptiView™ opens the Stop Relay (J10, Module 1A23), interrupting the control signal to 5K12.

~~A.2.2 Solid-State Starters - When cooling is required and the prestart checks are complete, the CH530/AdaptiView™ closes the Stop Relay (at J10, Module 1A23). The Start Relay (at J8, Module 1A23) then closes for a short period of time, sending control power through Terminal 5X1-5 and providing the "start" signal to the solid-state starter (SSS) control. The SSS control shall immediately energize a set of contacts (5A10) to interlock the SSS control with the Stop Relay Terminal 5X1-4 (See Interlock Relay, section A.1.2). The Start Relay (at J8) then opens leaving the start signal connected to the SSS through the interlock circuit.~~

~~When cooling is no longer needed, the CH530/AdaptiView™ opens the Stop Relay (at J10, Module 1A23), interrupting the control signal to 5A10.~~

~~A.2.3 "Transitioning Starters" - When cooling is required and the pre-start checks are complete, the CH530/AdaptiView™ closes the Stop Relay (at J10, Module 1A23). The Start Relay (at J8, Module 1A23) then closes for a short period of time, sending control power through Terminal 5X1-5 to the 5K12 start contactor and connecting the chiller to the line in the starting configuration. This shall close a set of auxiliary contacts on the 5K12 contactor to energize Interlock Relay 5K11. Closure of the 5K11 contacts shall connect the 5K12 contactor to Stop Relay at Terminal 5X1-4. The Start Relay (at J8) then opens leaving the start signal connected through the interlock circuit.~~

~~The CH530/AdaptiView™ monitors the amperage draw of the motor. When the motor amperage drops below 85% of RLA, the Run Relay (at J6, Module 1A23) closes to provide control power to Terminal 5X1-10. This signal shall be used to switch the starter from the "start" mode to the "run" mode. As described in Section A.1.3, a normally-open set of auxiliary contacts on the "run" contactor (5K13) shall close to indicate that transition is complete.~~

~~When cooling is no longer required, the CH530/AdaptiView™ opens the Stop Relay (at J10, Module 1A23); this shall interrupt the control signal to 5K12 and de-energize the chiller motor.~~

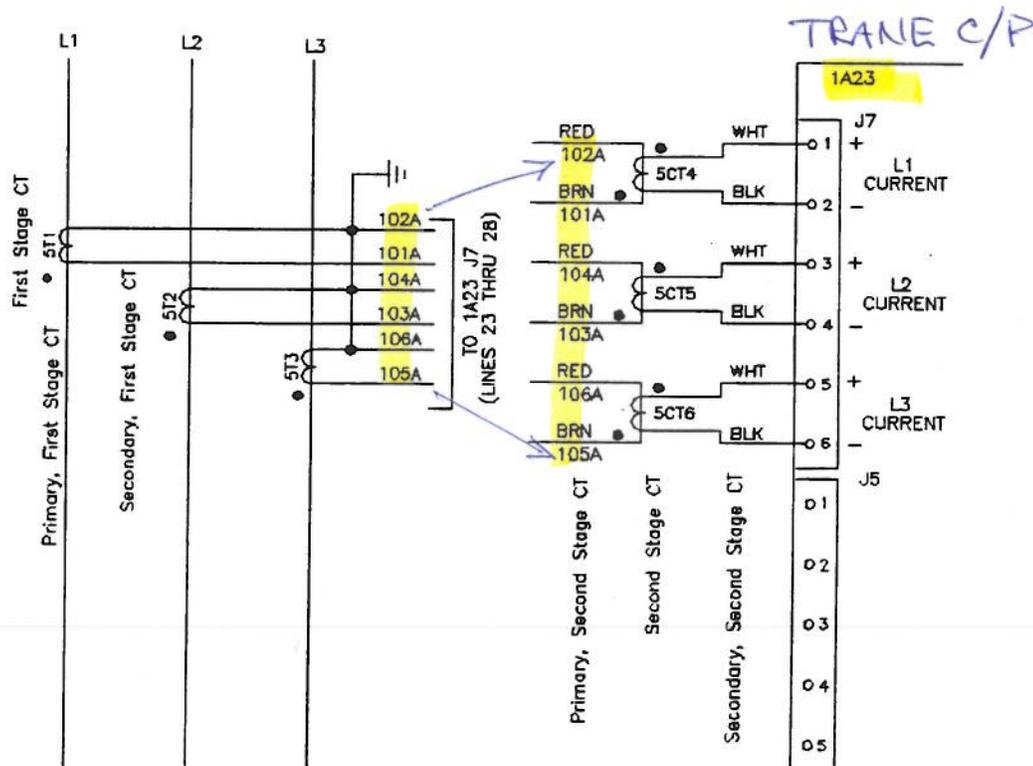
A.2.4 "Circuit Breaker Control" - A typical Vacuum circuit breaker has a motor charged spring type stored energy closing mechanism. Closing the breaker charges the accelerating springs. The Trane CH530/AdaptiView controls will energize a shunt trip coil to release the accelerating springs and open the breaker. This requires a reliable source of control power for the breaker to function as a protective device. Typical DC control schematic is shown in Appendix I.



**APPENDIX B
PRIMARY CURRENT TRANSFORMER
ACCURACY, BURDEN AND INSULATION RATING DATA**

| Trane Part Number | Burden - VA at 60 Hz (For Customer Supplied CTs these are the Minimum Burdens required to work with the Trane CH530/AdaptiView Starter Module) |
|-------------------|--|
| → TRR-448 | 2.5 |
| TRR-449 | 5.0 |
| TRR-450 | 12.5 |
| TRR-451 | 25.0 |
| TRR-499 | 25.0 |
| TRR-450 | 50.0 |
| TRR-1287 | 2.5 |
| TRR-1288 | 2.5 |
| TRR-1289 | 2.5 |

Accuracy: ±1%, from 10% to 100% of rating
Insulation Class: 0.6KV BIL (Basic Insulation Level), 10KV Full Wave



GE 4KV STARTER

(continued)



**APPENDIX C
MAXIMUM RECOMMENDED CURRENT TRANSFORMER WIRE LENGTHS**

This table describes the maximum recommended wire length for the second stage CT secondary leads in a dual CT system. These CT leads are connected to the Trane Starter Module 1A23 J7-1-6 or to 1X2 in the chiller control panel:

| Wire AWG(mm ²) | Maximum Wire Length Secondary CT Leads | |
|-------------------------------|--|--------|
| | Feet | Meters |
| 8(10) | 1362.8 | 415.5 |
| 10(6) | 856.9 | 261.2 |
| 12(4) | 538.9 | 164.3 |
| 14(2.5) | 338.9 | 103.3 |
| 16(1.5) | 213.1 | 65.0 |
| 17(1) | 169.1 | 51.5 |
| 18(0.75) | 134.1 | 40.9 |
| 20(0.5) | 84.3 | 25.7 |

- Note: 1. Wire lengths are for copper conductors only.
2. Wire lengths are total "one way" distance that the CT can be from the Starter module.

ENGINEERING SPECIFICATION

Trane
La Crosse, Wisconsin



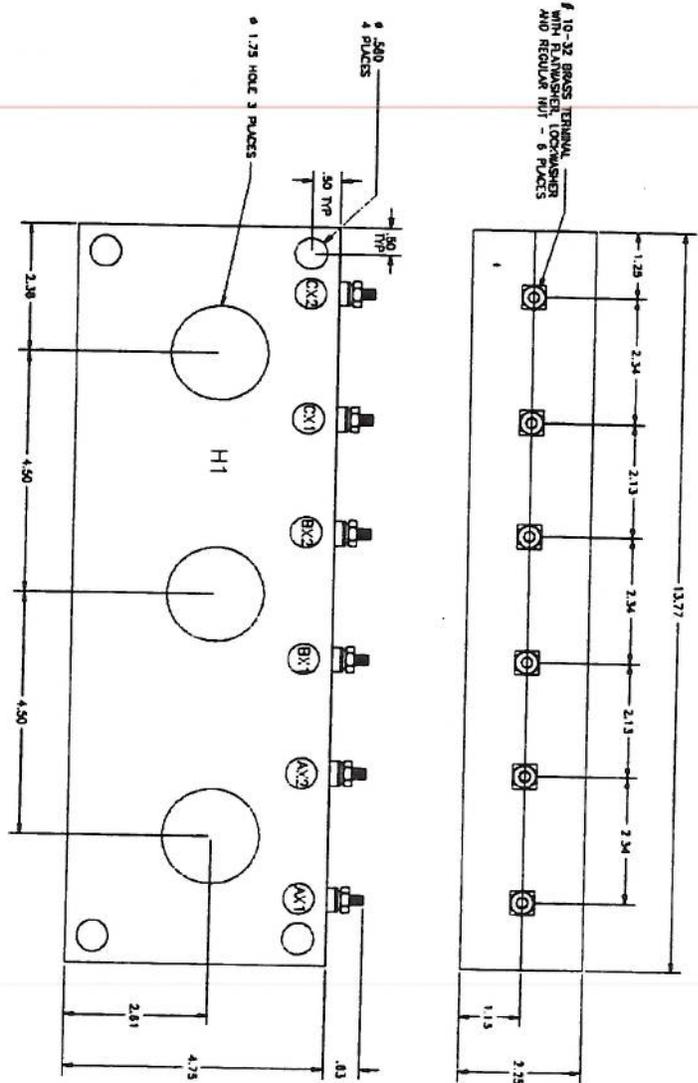
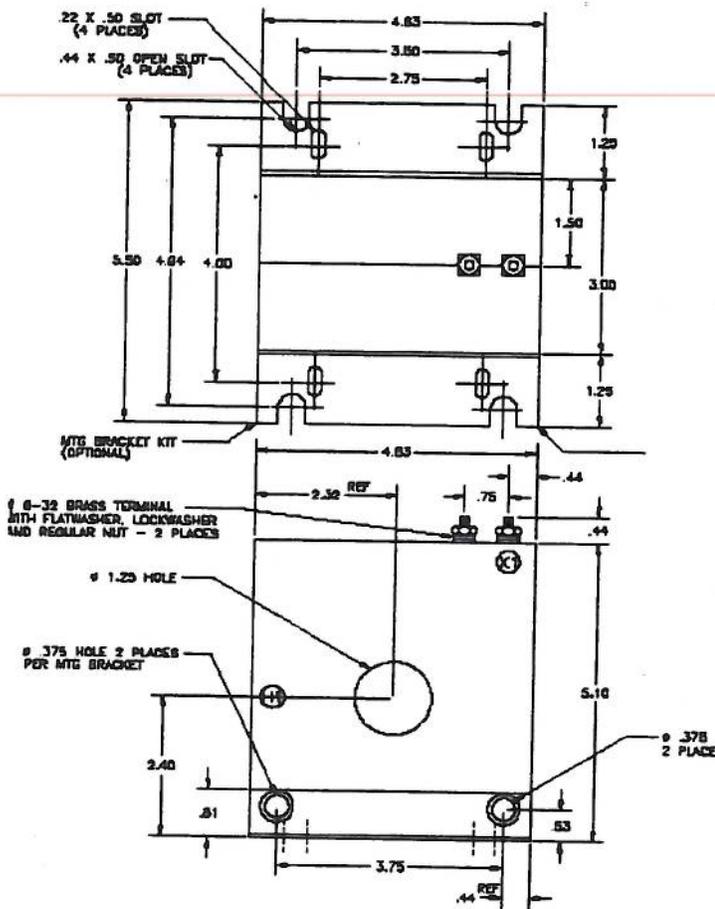
No. S6516-0513
Rev. H
Date May 2008
Page 16

APPENDIX D
Primary current transformer dimensions

| CT part number | Reference View |
|--|----------------|
| TRR001288, TRR001289 | A |
| TRR001287 | B |
| TRR00448, TRR00449, TRR00450, TRR00451, TRR00499 | C |
| TRR00453 | D |

View A

View B



(continued)

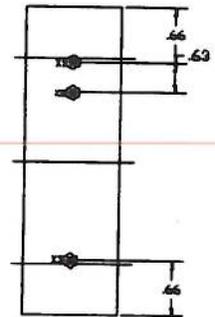
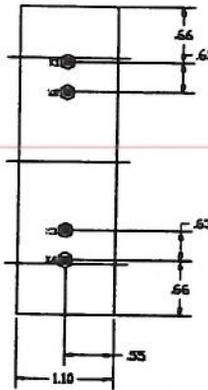
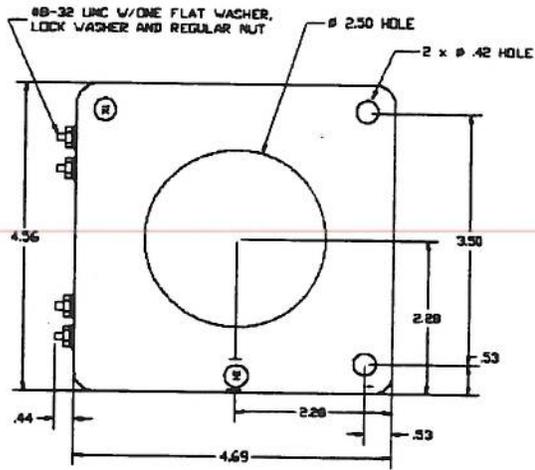
ENGINEERING SPECIFICATION

Trane
La Crosse, Wisconsin

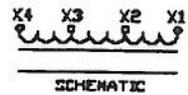
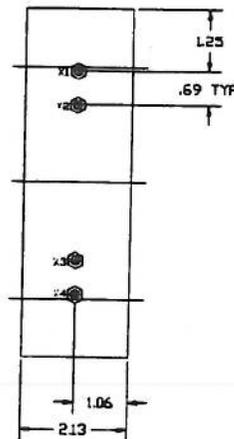
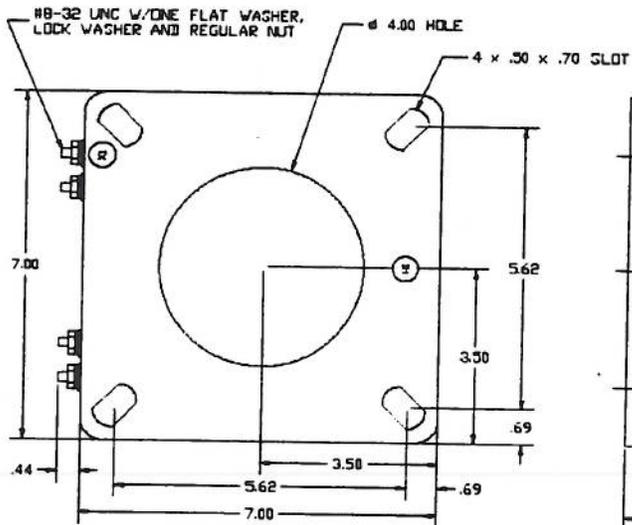


No. S6516-0513
Rev. H
Date May 2008
Page 17

→ **View C**



View D



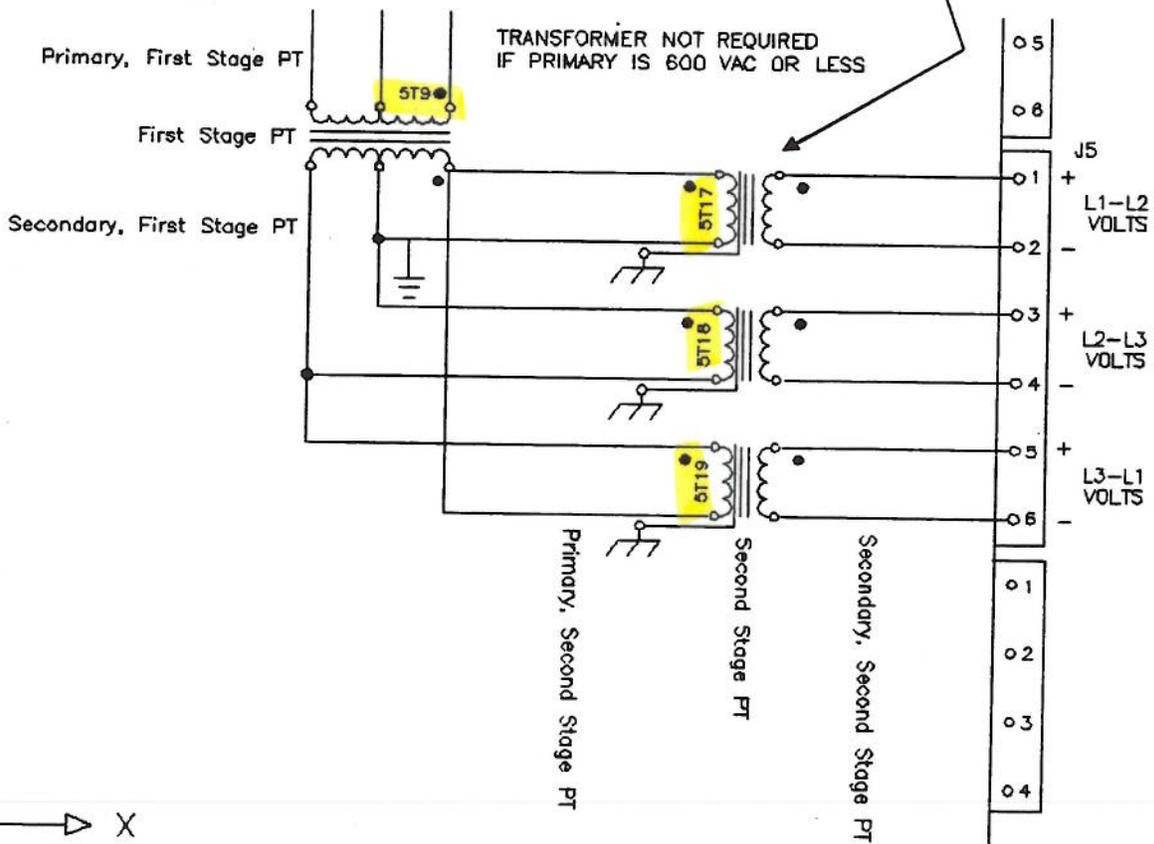
(continued)



APPENDIX E
TRANE POTENTIAL TRANSFORMERS
ACCURACY, BURDEN, AND INSTALLATION RATING DATA

For Part No. TRR-713 (Applications 600 volts or below):
 Burden resistor: 10Kohm +/- 1% load
 Accuracy: 0.5% over the input voltage range of 190-633 volts @ 50/60 Hz
 Output: at 600VAC input, 30 VAC output; 20:1 ratio
 Temperature insulation rating: Class B, 130 Degrees C

For Part No. TRR-976 (Second Stage for Applications over 600 volts):
 Burden resistor: 10Kohm +/- 10% load
 Accuracy: 0.3% over specified primary input voltage range @ 50/60 Hz
 Output: at 120VAC input, 30 VAC output; 4:1 ratio
 Temperature insulation rating: Class B, 130 Degrees C



X

(continued)



**APPENDIX F
MAXIMUM RECOMMENDED POTENTIAL TRANSFORMER WIRE LENGTHS**

The maximum recommended wire length for PT's (Secondary) in a single PT system (600 volts or less). This is the maximum conductor length allowed between the PT and Trane CH530/AdaptiView starter module 1A23 J5-1 to 6:

| Wire Gauge | Max Lead Length(ft) | Max Lead Length (m) |
|------------|---------------------|---------------------|
| 8 | 5339 | 1627 |
| 10 | 3357 | 1023 |
| 12 | 2112 | 643 |
| 14 | 1328 | 404 |
| 16 | 835 | 254 |
| 17 | 662 | 201 |
| 18 | 525 | 160 |
| 20 | 330 | 100 |
| 21 | 262 | 79 |
| 22 | 207 | 63 |

The maximum recommended wire length for PT leads in a dual PT system (greater than 600 volts). This is the maximum conductor length allowed for the primary and secondary leads of the second stage PT and Trane CH530/AdaptiView starter module 1A23 J5-1 to 6:

| Wire Gauge | Max Wire Length Primary (ft) | Max Wire Length Primary (m) | Max Wire Length Secondary (ft) | Max Wire Length Secondary (m) |
|------------|------------------------------|-----------------------------|--------------------------------|-------------------------------|
| 8 | 3061 | 933 | 711 | 217 |
| 10 | 1924 | 586 | 447 | 136 |
| 12 | 1211 | 369 | 281 | 85 |
| 14 | 761 | 232 | 177 | 53 |
| 16 | 478 | 145 | 111 | 33 |
| 17 | 379 | 115 | 88 | 26 |
| 18 | 301 | 91 | 70 | 21 |
| 20 | 189 | 57 | 44 | 13 |
| 21 | 150 | 45 | 34 | 10 |
| 22 | 119 | 36 | 27 | 8 |

Note: These wire lengths are for copper conductors only.

Note: The above lengths are maximum round trip wire lengths. The maximum distance the PT can be located from the Starter module is 1/2 of the listed value.

(continued)



APPENDIX G - Interconnecting wiring

The following table lists the CH530/AdaptiView control panel terminations, their maximum acceptable wire size and the associated starter panel termination points.

Trane Standard CH530/AdaptiView Control Panel Terminations

| Wire # or Device Designation | Trane CH530/AdaptiView control panel termination point | Trane terminal; <i>Maximum</i> Acceptable Wire Size | Starter panel termination point |
|---|--|---|---------------------------------|
| 1A*, 2A*, GND | 1X1-1, 1X1-12, 1X1-GND | #8 AWG | 5X1-1, 5X1-12, 5X1-GND |
| 9A*, 10A* | 1A7 J2-4, J2-2 | #14 AWG | 5X1-7, 5X1-8 |
| 15A*, 16A*, 18A* | 1A23 J10-1, J8-1, J6-1 | #14 AWG | 5X1-4, 5X1-5, 5X1-10 |
| 3B* | 1X1-3 | #10 AWG | 5X1-3 |
| 13A* | 1A23 J12-2 | #14 AWG | 5X1-14 |
| From 5T6, 5T7, 5T8 wire 101B to 106B | 1A23 J7 1-6 | #14 AWG | 5X1-19 to 5X1-24 |
| From 5T17, 18, 19 wire 236B to 241B | 1A23 J5 1-6 | #14 AWG | 5X1-25 to 5X1-30 |
| 5S1*, 5S2* | 1X1-5, 1X1-6 | #10 AWG | NA |
| 5A10-K1 | 1A24 J2-1, 2 | #14 AWG | 5X1-11, 5X1-12 |
| All remaining CH530/AdaptiView LLID terminals | 1A5, 1A6, 1A8, 1A9, 1A11, 1A13-1A20 | #14 AWG | NA |

* Tapped Control Conductors

Trane Industrial (optional) CH530/AdaptiView Control Panel Terminations

| Wire # or Device Designation | Trane CH530/AdaptiView control panel termination point | Trane terminal; <i>Maximum</i> Acceptable Wire Size | Starter panel termination point |
|---|--|---|---------------------------------|
| 1A*, 2A*, GND | 1X1-1, 1X1-12, 1X1-GND | #8 AWG | 5X1-1, 5X1-12, 5X1-GND |
| 9A*, 10A* | 1A7 J2-4, J2-2 | #14 AWG | 5X1-7, 5X1-8 |
| 13A*, 15A*, 16A*, 18A* | 1X2-1, 2, 3, 4 | #10 AWG | 5X1-14, 5X1-4, 5X1-5, 5X1-10, |
| 3B* | 1X1-3 | #10 AWG | 5X1-3 |
| 1K1; wire 28B, 29B | 1X2-15, 16 | #10 AWG | 5X1-15, 16 |
| 1K2; wire 30B, 31B | 1X2-17,18 | #10 AWG | 5X1-17, 18 |
| 5T6, 5T7, 5T8; wire 101B to 106B | 1X2-19 thru 24 | #10 AWG | 5X1-19 to 5X1-24 |
| 5T9; wire 216A, 217A, 218A | 1S1-1L1, 3L2, 5L3 | #8 AWG | 5T9 |
| 5T17, 18, 19; wire 236B to 241B | 1X2-25 thru 30 | #10 AWG | 5X1-25 to 5X1-30 |
| 5S1*, 5S2* | 1X1-5, 1X1-6 | #10 AWG | NA |
| 5A10-K1 | 1A24 J2-1, 2 | #14 AWG | 5X1-11, 5X1-12 |
| All remaining CH530/AdaptiView LLID terminals | 1A5, 1A6, 1A8, 1A9, 1A11, 1A13-1A20 | #14 AWG | NA |

*Tapped Conductors

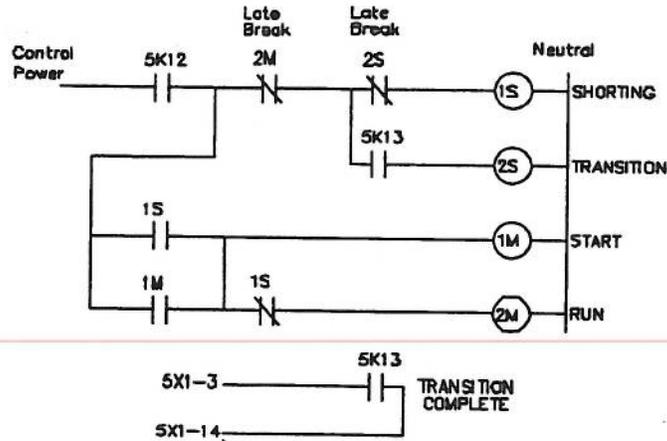
- Note: Not all wires/ devices are used on every starter type. Reference the specific schematic for requirements

(continued)



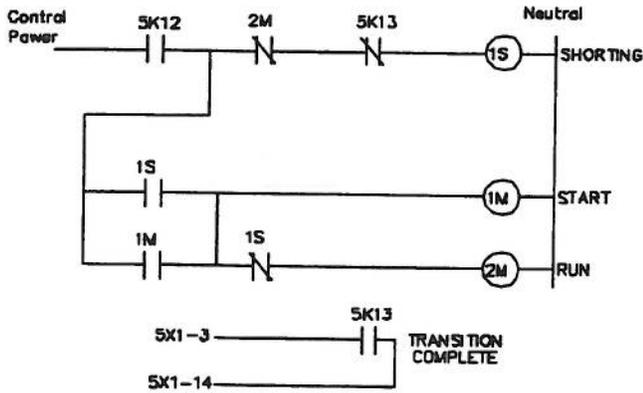
APPENDIX H
GENERIC STARTER CONTROL LADDER LOGIC

WYE DELTA



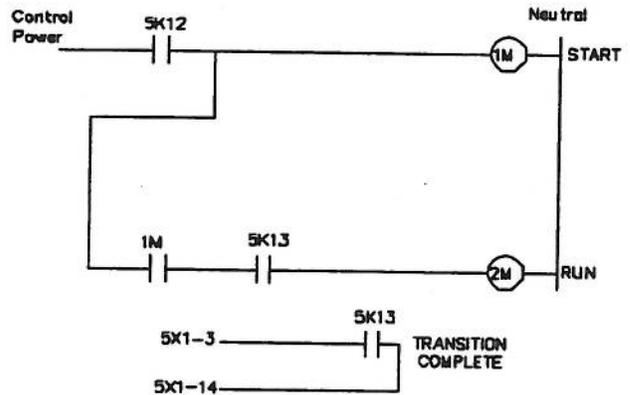
5K12 - START CONTROL CONTACT SEE 2309-2033
5K13 - TRANSITION TO RUN CONTROL CONTACT SEE 2309-2033

AUTO-TRANSFORMER



5K12 - START CONTROL CONTACT SEE 2309-2034
5K13 - TRANSITION TO RUN CONTROL CONTACT SEE 2309-2034

PRIMARY REACTOR



5K12 - START CONTROL CONTACT SEE 2309-2034
5K13 - TRANSITION TO RUN CONTROL CONTACT SEE 2309-2034

ENGINEERING SPECIFICATION

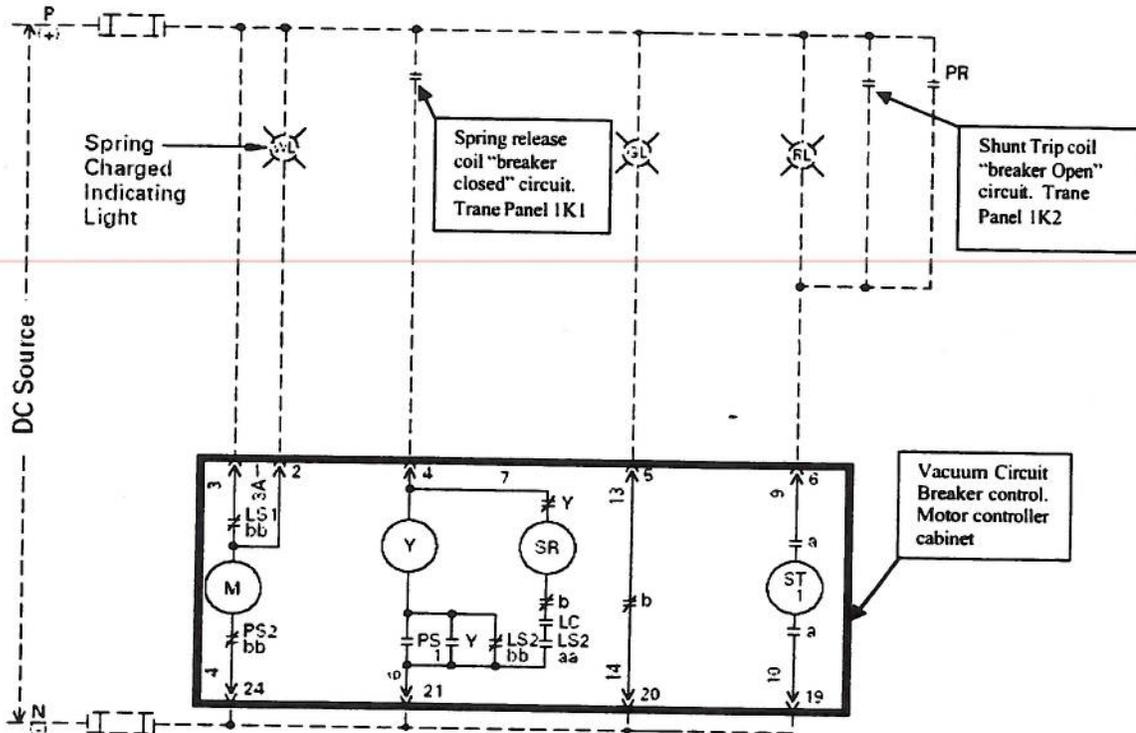
Trane
La Crosse, Wisconsin



No. S6516-0513
Rev. H
Date May 2008
Page 22

APPENDIX I- VACUUM CIRCUIT BREAKER SCHEMATIC

The following schematic is a typical interface with the Trane CH530/**AdaptiView** industrial controls configured with "Customer Vacuum Circuit Breaker" option. See 2309-8025 thru 8032 or 2311-0496 thru 2311-0503 for CH530/**AdaptiView** control interface.



Legend:

- Y - Anti Pump Relay
- SR - Spring Release Coil (Coil)
- M - Spring Charge Motor
- ST - Shunt Trip
- PR - Protective Relay
- Λ - Secondary Disconnect

Operation:

- LS1 - Open until springs are fully charged.
- aa - Closed until springs are fully charged.
- LS2 - Open until springs are fully charged.
- aa - Closed until springs are fully charged.
- LS2 - Closed until mechanism is reset.
- bb - Open until mechanism is reset.
- PS1 - Open in all except between "Test" and "Connected" positions.
- PS2 - Closed in all except between "Test" and "Connected" positions.

Timing Chart



ENGINEERING SPECIFICATION

Trane
La Crosse, Wisconsin



No. S6516-0513
Rev. H
Date May 2008
Page 23

REVISION RECORD

REVISION A

Initial Release
WS007639 (LBU CR #9354); April 16, 2001; J. Duga

REVISION B

WS008487 (LBU CR #10117); October 30, 2001; J. Duga

REVISION C

WS012180 (LBU CR #10578); September 11, 2002; J. Duga

REVISION D

WS018333 (LBU CR #11278); August, 2004; M. Wettstein

REVISION E

WS021832 (LBU CR #11566); January, 2005; E. Sanders

REVISION F

WS027884 (LBU CR #12168); J. Aiken

REVISION G

ECO-0001984 (LAX015116); J. Aiken

REVISION H

ECO-0008075 (LAX104091); J. Ziemer

Field Wiring - Centrifugal Water Chillers
Item: A1, A2 Qty: 2 Tag(s): CHL-5, CHL-6

| | | | | | |
|---|---|--|--|---|---|
| <p>⚠ WARNING HAZARDOUS VOLTAGE! UNKOWN TO ALL ELECTRIC POWER INCLUDING THE MOST UNEXPECTED AND FOLLOW LOCK OUT AND TAG PROCEDURES BEFORE SERVICING. INSURE THAT ALL MOTOR CAPACITORS HAVE DISCHARGED STORED VOLTAGE. UNITS WITH VARIABLE SPEED DRIVE REFER TO DRIVE INSTRUCTIONS FOR CAPACITOR DISCHARGE FAILURE TO DO THE ABOVE BEFORE SERVICING COULD RESULT IN DEATH OR SERIOUS INJURY.</p> | <p>⚠ AVERTISSEMENT TOUSIEN DANGEREUX CACHER TOUS LES TENSORS ET OUVRIER LES SECTIONNER A DISTANCE. PUIS SERVIS LES PRESSIONS DE VERIFICATION ET DES ETIQUETTES AVANT TOUTE INTERVENTION. VERIFIER QUE TOUTES LES CONDENSATEURS SONT VIDEES SANS RECHARGE. POUR LE CAS D'UNITES EQUIPEES DE VITESSES VARIABLES A VERIFIER VISIBLES, SE REPORTER AUX INSTRUCTIONS DE L'OPERATION POUR RECHARGER LES CONDENSATEURS. NE PAS SERVICER CEE UNITE SI LE PROPRIETAIRE N'EST PAS PRESENTE ET SI LES BARRIERS SONT POURSUIVRE ETRE MONTES.</p> | <p>⚠ ADVERTENCIA VOLTAGE PELIGROSO INCONOCIDA TODA LA ENERGIA ELECTRICA, INCLUIDO LAS RECONEXIONES SUAVES Y SIDA LOS PROCEDIMIENTOS DE CERRAR Y ETIQUETAR ANTES DE PROCEDER AL SERVICIO. VERIFICAR QUE TODOS LOS CONDENSADORES HAYAN SIDO RECARGADOS EL VOLTAJE ALMOCENADO PARA LAS UNIDADES CON LAS DE SECCION DE VOLTAJE VARIABLE. CONSULTAR LAS INSTRUCCIONES PARA LA RECARGA DEL CONDENSADOR. SI NO REALIZA LO ANTERIORMENTE MENCIONADO, PODRIA OCASIONAR LA MUERTE O SERIAS LESIONES PERSONALES.</p> | <p>CAUTION USE COPPER CONDUCTORS ONLY! UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT OTHER TYPES OF CONDUCTORS. FAILURE TO DO SO MAY CAUSE DAMAGE TO THE EQUIPMENT</p> | <p>ATTENTION UTILISER QUE DES CONDUCTEURS EN CUIVRE! LES TERMINES DE L'UNITE NE SONT PAS CONÇUS POUR RECEVOIR D'AUTRES TYPES DE CONDUCTEURS. L'UTILISATION DE TOUT AUTRE CONDUCTEUR PEUT ENDOMMAGER L'ÉQUIPEMENT.</p> | <p>PRECAUCIÓN UTILICE ÚNICAMENTE CONDUCTORES DE COBRE! LOS TERMINALES DE LA UNIDAD NO ESTÁN DISEÑADOS PARA ACEPTAR OTROS TIPOS DE CONDUCTORES. SI NO LO HACE, PUEDE OCASIONAR SERIOS DAÑOS AL EQUIPO.</p> |
|---|---|--|--|---|---|

* CONNECTION DIAGRAMS ARE AVAILABLE AT THE WEBPAGE SHOWN IN THE MECHANICAL SPECIFICATIONS SECTION OF THIS SUBMITTAL.

NOTES:

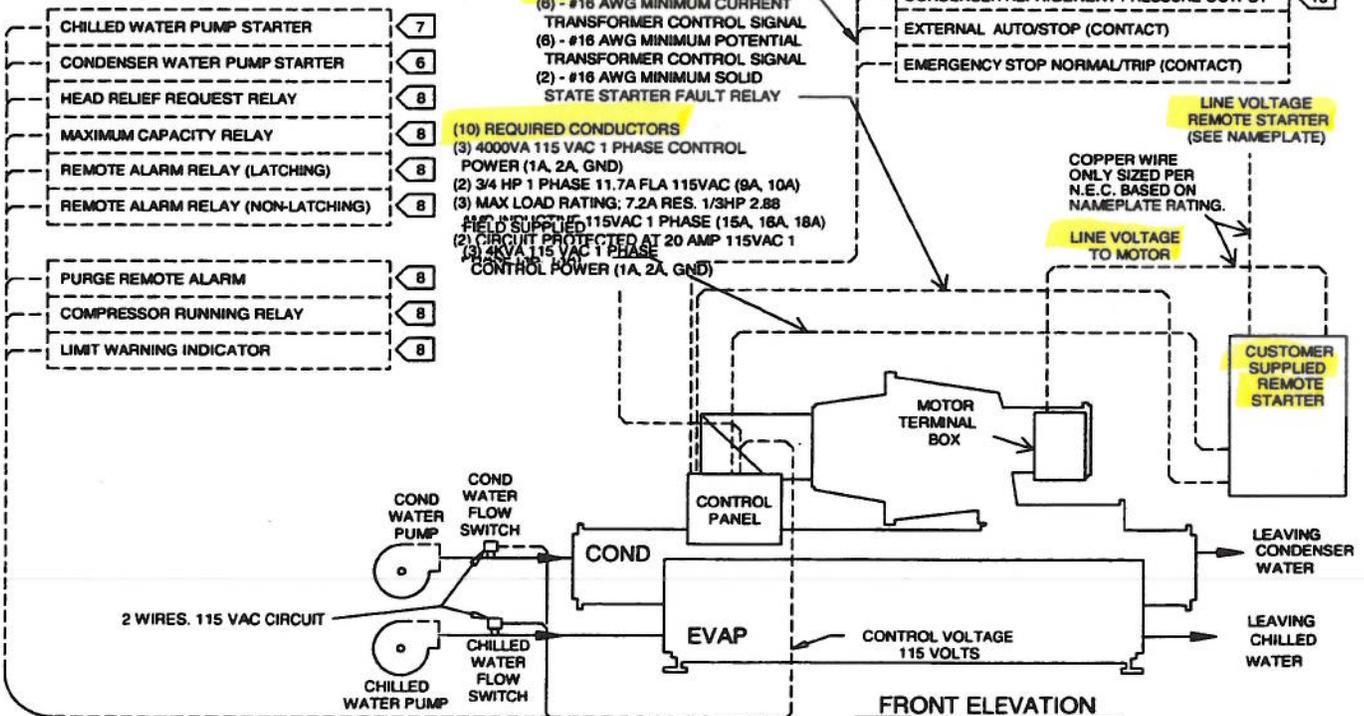
1. DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS. CHECK SALES ORDER TO DETERMINE IF WIRING IS REQUIRED FOR SPECIFIC OPTIONS.
2. CAUTION - DO NOT ENERGIZE UNIT UNTIL CHECK-OUT AND START-UP PROCEDURES HAVE BEEN COMPLETED.

REQUIRED

3. ALL CUSTOMER CONTROL CIRCUIT WIRING MUST HAVE A MINIMUM RATING OF 150 VOLTS.
4. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE (NEC), STATE AND LOCAL REQUIREMENTS. OUTSIDE THE UNITED STATES, OTHER COUNTRIES APPLICABLE NATIONAL AND/OR LOCAL REQUIREMENTS SHALL APPLY.
5. EVAPORATOR AND CONDENSER FLOW SWITCHES ARE REQUIRED. THEY MUST BE INSTALLED AND WIRED TO THE TRANE PANEL BY THE INSTALLING CONTRACTOR. PURCHASE OF SWITCHES FROM TRANE IS OPTIONAL.

- 6 2 WIRES, 115 VAC CIRCUIT, SEPARATE POWER SUPPLY IS REQUIRED. MINIMUM CONTACT RATING AT 115 VAC - 2.88 INDUCTIVE 1/3 H.P. (.25 KW) AT 115 VAC REQUIRED.
- 7 2 WIRES, 115 VAC CIRCUIT, SEPARATE POWER SUPPLY IS REQUIRED. CONTACTS ARE N.O. CONTACT RATING - 2.88 INDUCTIVE 1/3 H.P. (.25 KW) AT 115 VAC OPTIONAL.
- 8 2 OR 3 WIRES (N.O. &/OR N.C.), 115 VAC CIRCUIT, SEPARATE 115 VAC POWER SUPPLY IS REQUIRED. CONTACTS ARE NO/NC RATINGS - 2.88 INDUCTIVE 1/3 H.P. (.25 KW) AT 115 VAC.
- 9 2-10V OR 4-20ma INPUT (2 WIRES)
- 10 2-10V OR 4-20ma OUTPUT (2 WIRES)
- 12 SHIELDED PAIR, 30 VOLT OR LESS CIRCUIT. MAX LENGTH 1500 FT. BELDON TYPE 8760 RECOMMENDED. (2 WIRES)

THE UNIT CONTROL PANEL (CH.530) SUPPLIES A CONTACT OUTPUT TO CONTROL THE CUSTOMER SUPPLIED DEVICES SHOWN BELOW. MAXIMUM FUSE SIZE PER DEVICE - 15 AMPS.



Field Wiring - Centrifugal Water Chillers
Item: A1, A2 Qty: 2 Tag(s): CHL-5, CHL-6

⚠ WARNING
HAZARDOUS VOLTAGE!
 DISCONNECT ALL ELECTRIC POWER INCLUDING REMOTE DISCONNECTS AND FOLLOW LOCK OUT AND TAG PROCEDURES BEFORE SERVICING. INSURE THAT ALL MOTOR CAPACITORS HAVE DISCHARGED STORED VOLTAGE. LINES WITH VARIABLE SPEED DRIVE, REFER TO DRIVE INSTRUCTIONS FOR CAPACITOR DISCHARGE. FAILURE TO DO THE ABOVE BEFORE SERVICING COULD RESULT IN DEATH OR SERIOUS INJURY.

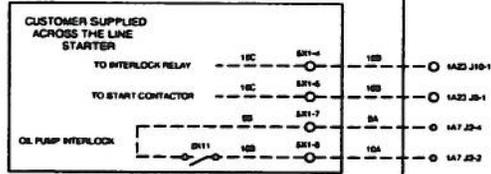
⚠ AVERTISSEMENT
TENSION DANGEREUSE!
 COUPUR TOUTES LES TENSIONS ET SUIVRE LES PROCEDURES A RASSEMBLER PUIS SUIVRE LES PROCEDURES DE VERROUILLAGE ET DE TAG (SUIVRE AVANT TOUTE INTERVENTION). VÉRIFIER QUE TOUTES LES CONDENSATEURS DES MOTEURS SONT DÉCHARGÉS. SANS LE CAS, SUIVRE LES INSTRUCTIONS DES INSTRUMENTS A VITESSE VARIABLE. SE REPORTER AUX INSTRUCTIONS DE L'INSTRUMENT POUR DÉCHARGER LES CONDENSATEURS. NE PAS SÉRIER LES DESSERVICES DE PRÉCAUTION PEUT ENTRAINER DES BLESSURES GRAVES PEUVANT ÊTRE MORTELLES.

⚠ ADVERTENCIA
VOLTAJE PELIGROSO!
 DESCONECTE TODA LA ENERGIA ELECTRICA, INCLUIDO LAS DESCONEXIONES REMOTAS Y SIGA LOS PROCEDIMIENTOS DE CERRAR Y ETIQUETAR ANTES DE PROCEDER AL SERVICIO. VERIFICAR QUE TODOS LOS CAPACITORES DEL MOTOR SINTAN DESCARGADOS EL VOLTAJE ALMACENADO PARA LAS UNIDADES CON F.C. SE REPORTEN DE VOLTAJES VARIABLES. CONSULTE LAS INSTRUCCIONES PARA LA RECARGA DEL CONDENSADOR. SI NO REALIZA LO AUTODIAGNOSTICAMENTE, PUEDE CAUSAR LA MUERTE O SERIAS LESIONES PERSONALES.

CAUTION
 USE COPPER CONDUCTORS ONLY!
 UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT OTHER TYPES OF CONDUCTORS.
 FAILURE TO DO SO MAY CAUSE DAMAGE TO THE EQUIPMENT.

ATTENTION
 N'UTILISER QUE DES CONDUCTEURS EN CUIVRE!
 LES BORNES DE LA UNITÉ NE SONT PAS CONÇUES POUR RECEVOIR AUTRES TYPES DE CONDUCTEURS.
 L'UTILISATION DE TOUT AUTRE CONDUCTEUR PEUT ENDOMMAGER L'ÉQUIPEMENT.

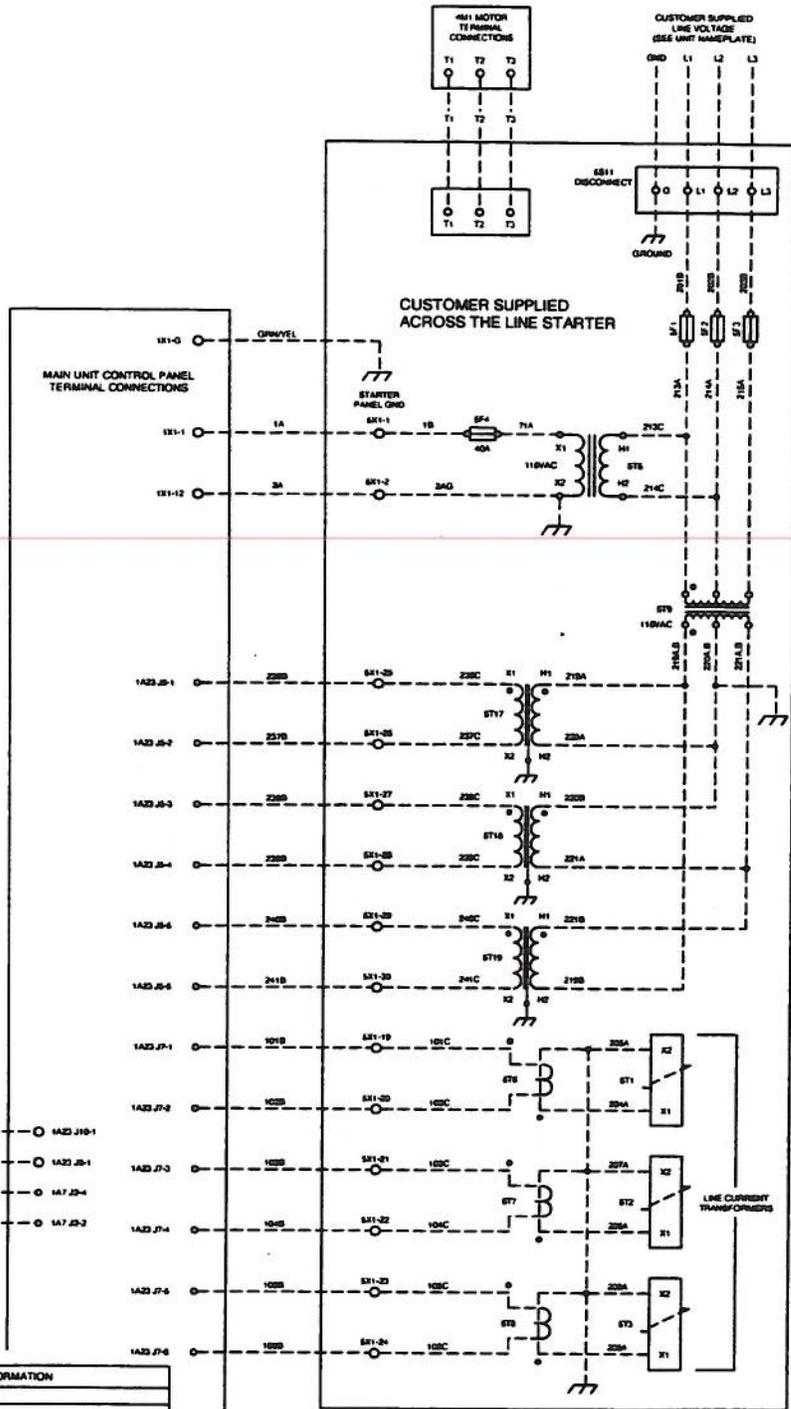
PRECAUCIÓN
 ÚTILICE ÚNICAMENTE CONDUCTORES DE COBRE!
 LAS TERMINALES DE LA UNIDAD NO ESTÁN DISEÑADAS PARA ACEPTAR OTROS TIPOS DE CONDUCTORES.
 SI NO LO HACE, PUEDE CAUSAR DAÑO AL EQUIPO.



- DEVICE PREFIX CODE**
- 1 = MAIN UNIT CONTROL PANEL DEVICE
 - 2 = REMOTE MOUNTED DEVICE
 - 4 = UNIT MOUNTED DEVICE
 - 3 = CUSTOMER PROVIDED DEVICE

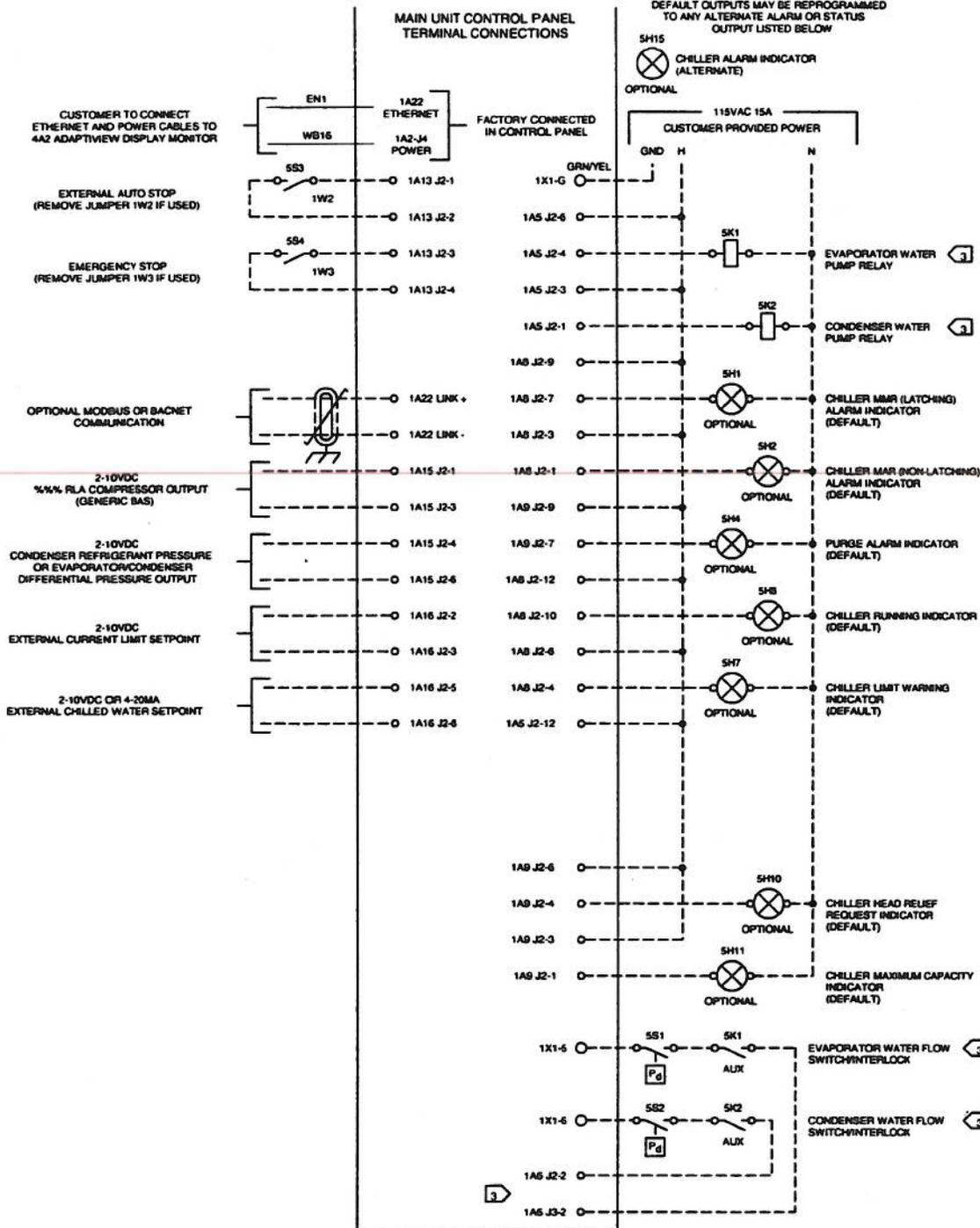
| WIRE NO OR DEVICE | FIELD WIRING CIRCUIT SELECTION INFORMATION |
|----------------------------|---|
| SUPPLY AND MOTOR LEADS | SEE NAMEPLATE MINIMUM CIRCUIT AMPACITY |
| 3A* | 1000VA AT 115VAC, 8 AWG MAX WIRE SIZE |
| 3A* AND GROUND | 1000VA AT 115VAC, 8 AWG MAX WIRE SIZE (WITHOUT OPTS) |
| 3A* AND GROUND | CIRCUIT PROTECTED AT 20A, 115VAC 1PH, 10 AWG MAX WIRE SIZE (WITH OPTS) |
| 3A* AND 10A* | PUMP MOTOR, 1PH 3A HP 11.7 FULL LOAD AMPS AT 115VAC, 14 AWG MAX WIRE SIZE |
| 12B*, 10B* AND 10B* | CONTACT RATING 2.0BA INDUCTIVE, 1/2 HP, 0.250VA AT 115VAC, 14 AWG MAX WIRE SIZE |
| 10B THRU 10B | SEE TRANE SPECIFICATION 8814-8B13 APPENDIX C, 14 AWG MAX WIRE SIZE |
| 23B THRU 24B | SEE TRANE SPECIFICATION 8814-8B13 APPENDIX F, 14 AWG MAX WIRE SIZE |
| 8B1*, 8B2* AND 2B* | CIRCUIT PROTECTED AT 20A, 115VAC 1PH, 10 AWG MAX WIRE SIZE |
| 8B3 THRU 8B | 24VDC, 125MA RESISTIVE LOAD, 14 AWG MAX WIRE SIZE |
| ** REMAINING LLD TERMINALS | CONTACT RATING 2.0BA INDUCTIVE, 1/2 HP, 0.250VA AT 115VAC, 14 AWG MAX WIRE SIZE |

* TAPPED CONTROL CONDUCTORS



- NOTES:**
- DASHED LINES INDICATE FIELD WIRING BY OTHERS. WIRE NUMBERS SHOWN ARE RECOMMENDED BY TRANE. REFER TO THE AS-BUILT SCHEMATIC DIAGRAM TO DETERMINE WHICH OPTIONS ARE PRESENT ON THE UNIT.
 - DO NOT ROUTE LOW VOLTAGE (20V) WITH CONTROL VOLTAGE (115V) AND DO NOT POWER UNIT UNITS. CHECK-OUT AND START-UP PROCEDURES HAVE BEEN COMPLETED.
 - ALL CUSTOMER SUPPLIED CHILLED-WATER FLOW CIRCUITRY SHOWN. REFER TO THE AS-BUILT SCHEMATIC DIAGRAM TO DETERMINE WHICH WATER FLOW DISPLAY OPTION IS PRESENT ON THE UNIT. WHEN REQUIRED, EVAPORATOR AND CONDENSER WATER FLOW SWITCHES MUST CONTACT CONTACTS. THE SEPARATE FLOW SWITCHES ARE TO BE RUN IN SERIES WITH SEPARATE AUX CONTACTS FOR THE EVAPORATOR AND CONDENSER PUMPS. THEY MUST BE INSTALLED AND WIRING TO THE TRANE MAIN UNIT CONTROL PANEL BY THE INSTALLING CONTRACTOR. THE PURCHASE OF FLOW SWITCHES FROM TRANE IS OPTIONAL.

Field Wiring - Centrifugal Water Chillers
Item: A1, A2 Qty: 2 Tag(s): CHL-5, CHL-6



| | | |
|---|--|---|
| <p>⚠ WARNING HAZARDOUS VOLTAGE! DISCONNECT ALL ELECTRIC POWER INCLUDING REMOTE DISCONNECTS AND FOLLOW LOCK OUT AND TAG PROCEDURES BEFORE SERVICING. INSURE THAT ALL MOTOR CAPACITORS HAVE DISCHARGED STORED VOLTAGE. UNITS WITH VARIABLE SPEED DRIVE REFER TO DRIVE INSTRUCTIONS FOR CAPACITOR DISCHARGE. FAILURE TO DO THE ABOVE BEFORE SERVICING COULD RESULT IN DEATH OR SERIOUS INJURY.</p> | <p>⚠ AVERTISSEMENT TENSION DANGEREUSE COUPER TOUS LES TENSIONS ET DIVER LES DISCONNECTS À DISTANCE, PUIS SUIVRE LES PROCÉDURES DE VERROUILLAGE ET TAG (STRATÉGIE D'ARRÊT TOTAL INDISPENSABLE). VÉRIFIER QUE TOUTES LES CONDENSATEURS DES UNITÉS À VITESSE VARIABLE SE DÉCHARGENT À VITESSE VARIABLE. SE RÉFÉRER AUX INSTRUCTIONS DE L'ÉQUIPEMENT POUR RÉSULTER LES CONDENSATEURS. NE PAS S'OPÉRER CES UNITÉS SI PROTECTION PEUT ÊTRE DÉTACHÉE SANS PERMETTRE C'EST NECESSAIRE.</p> | <p>⚠ ADVERTENCIA VOLTAJE PELIGROSO DESCONECTE TODA LA CORRIENTE ELÉCTRICA, INCLUIDO LOS DESCONECTORES REMOTOS Y SIGA LAS PRECEDENTES DE CERRAR Y ETIQUETAR ANTES DE PROCEDER AL SERVICIO. ASEGURESE DE QUE TODOS LOS CONDENSADORES DE LAS UNIDADES SE DESCARGAN EL VOLTAJE ALTERNATIVO PARA LAS UNIDADES CON LAS SE DEBE DESTRUIRSE POR LA SEGURIDAD EL CONDENSADOR. SI NO REALIZA LO ANTERIORMENTE MENCIONADO, PODRÁ OCURRIR LA MUERTE O SERIOS LESIONES PERSONALES.</p> |
|---|--|---|

| | | |
|---|---|--|
| <p>CAUTION USE COPPER CONDUCTORS ONLY! UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT OTHER TYPES OF CONDUCTORS. FAILURE TO DO SO MAY CAUSE DAMAGE TO THE EQUIPMENT.</p> | <p>ATTENTION UTILISER QUE DES CONDUCTEURS EN CUivre LES TERMINES DE LA UNITE NE SONT PAS CONÇUS POUR RECEVOIR AUTRES TYPES DE CONDUCTEURS. L'UTILISATION DE TOUT AUTRE CONDUCTEUR PEUT ENDOMMAGER L'ÉQUIPEMENT.</p> | <p>PRECAUCIÓN UTILICE OBRACAMENTE CONDUCTORES DE COBRE LAS TERMINALES DE LA UNIDAD NO ESTÁN DISEÑADAS PARA ACEPTAR OTROS TIPOS DE CONDUCTORES. SI NO LO HACE, PUEDE OCURRIR SERIOS DAÑO AL EQUIPO.</p> |
|---|---|--|

ECN-56, Rev.0, dated 22-Oct-10

BNL Supplemental Instructions for Remote Starter Installation

Electrical Contractor to perform the following for completing the installation of the Trane Chiller remote starter control circuitry between the GE 4kV starter and Trane Control panel. This work is to be performed for both Chillers 5 and 6 (600-CHL-5, -6):

Attached is Trane Engineering Specification No. S6516-0513, Rev. H, dated May, 2008, pages 1 to 23; issued under E.W. Howell Submittal 15652-004, which provides the scope of work and component/ wiring specifications for interconnection of remote starter.

Also attached are drawing mark-ups using 3-separate groups of circuit wiring diagrams (CWD); two from GE and one from Trane. The 3 sketch Groups are as follows:

1. GE Diagram No. 340B6168, Sh. 4, 4B, As-built 4kV Starter CWD and panel layout drawings (2-pages total),
2. GE Diagram No. 339B9700, Sh. 3, 3A, 3B, 3C, 3D, CWD and panel layout drawings marked-up by GE, along with Trane 1-Line, marked-up by GE along with the Trane BOM (7-pages total),
3. Trane 2311-0562, Rev. B, Sheet 1 of 1, CWD (1-page total),

Field sketches in Group 1 contain the as-built GE 4kV starter. Field sketches in Group 2 are the GE modified sketches showing the Trane components and internal starter wiring.

However, Group 2 is not based on as-built GE CWD. Not all component numbers match.

Field sketch for Group 3 is a BNL modified Trane CWD showing internal wiring of the Trane control panel (C/P).

General Work Instructions

Refer to attached 3 field sketch groups, along with equipment tables and engineering information from both Trane and GE.

NOTE- EC should refer to **ladder marks** added to the right-hand column for all 3 field sketch groups. The numbering is continuous throughout the ECN package.

GE 4kV Limitamp Upper Control Cabinet:

Provide and install COMPONENTS listed in attached Engineering Specification S6516-0513, Section 3.16, Required Purchased Parts.

EC to verify CT' and PT's with Trane and relay components w/ GE.

Refer to field sketches:

Group 1; GE Diagram No. 340B6168, Sh. 4, 4B; As-built 4kV Starter CWD and panel layout drawings (2-pages total),

Group 2; GE Diagram No. 339B9700, Sh. 3, 3A, 3B, 3C, 3D; Marked-up by GE along with Trane 1-Line, marked-up by GE and Trane BOM (7-pages total),

| Description of Work | Drawing Reference Line/ Notes |
|---|---|
| EC to provide/ install 5T1, 5T2, and 5T3, primary CT's; Trane P/N TRC #TRR-448 "doughnut" style CT devices on feeder cables. | G2, Line 56-21 NOTE- Verify POLARITY and MATCH PHASE w/ 4kV feeders. |
| Modify existing swing-out, heavy gauge steel back plate to mount secondary PT's, CT's and Terminal Blocks. | NOTE- rails are behind swing-out panel to mount additional back plate, as needed. |
| Provide/ install 5CT4, 54CT4, and 5CT4, secondary CT's; Trane P/N TRC #TRR-975. EC to mount secondary CT's on back plate. | G2, Line 56-19, 56-20 |
| Provide/ install 6-point Shorting Terminal Block for terminating CT's. | G2, Line 56-29 |
| Provide/ install PT's 5T17, 18, 19, secondary PT's; mount on back plate, | G2, Line 56-16 |
| NOTE- primary GE PT's, along with terminal blocks, located in separate cabinet above SWGR-600-2 Main Breakers. | |
| Provide/ install 12-point terminal block for terminating PT's and other control wiring, (NOTE- there are open terminal points.) | G2, Line 56-29 (G1, Line 56-9) |
| Provide/ install replacement CPT: 5kVA, 4160VAC x 115VAC, | G1, Line 56-4 |
| Provide/ install replacement 2FU fuses with 5E for replacement CPT, | G1, Line 56-3 |
| Provide/ install 5T9 | G3 Line 56-44 |
| Provide/ install fuses 5F1, 5F2, 5F3, (3A) | G2, Line 56-16, G3 Line 56-44 |
| EC to provide/ install relays CPIX, 5K11 and 5kVA control power transformer (CPT) as a replacement for existing 2kVA CPT. | G2, Lines 56-33, 56-34, 56-31; G1, Line 56-4, respectively. |
| Provide/ install 120V control circuitry between Trane C/P and GE Starter Cabinet, | G2, Line56-17, 56-22 |
| Provide/ install 30A J-Type fuse (6FU) for 120V control circuitry to Trane C/P | G2, Line56-17 |
| Provide/ install relay 5K11, then wire as shown in Group 2 field sketches, | G2, Line 56-23, 56-26 |
| Provide/ install relay CPIX, then wire as shown in Group 2 field sketches, | G2, Line 56-25 |

Conductor Routing and Separation:

EC to provide/ install circuitry listed in attached Engineering Specification S6516-0513, Section 4.2.1, Class 1, Section 4.2.2, Class 2 Circuits. Wire sizes based on Appendix G, for Industrial Application. NOTE- requirement for spare conductors in each conduit.

| Description of Work | Drawing Reference Line/ Notes |
|--|--|
| Route 2- 1" conduit for circuitry from GE 4kV Limitamp Upper Cabinet to the Trane C/P. 1. 12 x #12AWG Low-Voltage, 2. 2 x #10AWG 115V Control Voltage, w/ 1 #12AWG Gnd, | G3, Line 56-43, 56-47 EC to provide following spares: 1. Include 8 spare #12AWG, 2. Include 8 spare #12AWG, |
| EC must observe separation of circuitry for <30V and 120V conductors. All circuitry for CT's and PT's is considered as low voltage, <30V, and should be routed accordingly. | G3, Line 56-46 Note 2 on Drawing. |

Trane Control Panel:

EC to connect circuits per the Trane Connection Diagram, Unit Field Wiring, 2311-0562, Sh. 1 of 1, Rev. B., Marked-up for ECN-56, Rev. 0.

| | |
|---|--------------------------------------|
| EC to route 120V control to Trane C/P | G3, Line 56-44 |
| Provide/ install 5F4 (30A) in Trane CWD, with fuse blocks. Same as 6FU in GE CWD. | G2, Line 56-44 G3, Line 56-17 |
| EC to route low voltage (<30V) wiring (CT and PT circuitry) separately from the 120V control wiring. NOTE- LV wire routing is specifically identified on the Trane C/P. | G3, Line 56-46 Note 2 on Drawing. |
| EC to connect CT and PT circuitry within Trane C/P to terminal blocks. | G3, Line 56-45, 56-46 |
| EC to provide/ install relay interlocks listed in attached Engineering Specification S6516-0513, Section 6.1, Oil Pump Interlock, including interlock relay 5K11. | G3, Line 56-48 |

Attachments:

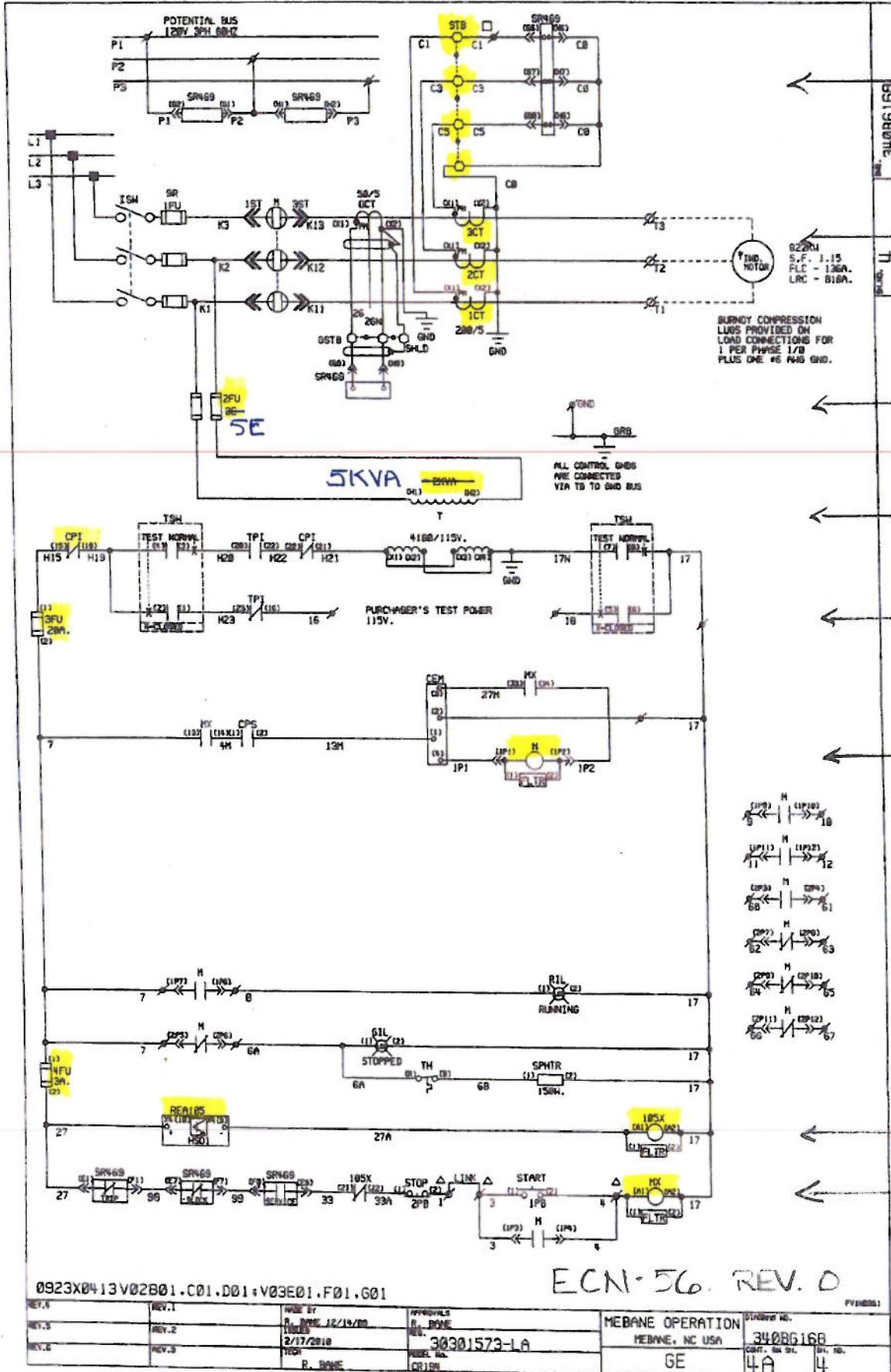
Trane Engineering Specification S6516-0513, Rev. H, dated May, 2008 (pages 1- 23 of 23)

Trane Field Wiring- Centrifugal Water Chillers, Tag(s): CHL-5, CHL-6 (pages 22- 24 of 29)

GE-Trane Connection Diagram 339B9700, Sh. 3, 3A, 3B, 3C, 3D., Marked-up by GE along with Trane 1-Line, marked-up by GE and Trane BOM (7-pages total)

Trane Connection Diagram, Unit Field Wiring, 2311-0562, Sh. 1 of 1, Rev. B., Marked-up for ECN-56, Rev. 0, dated 22-Oct-2010 (1-page total)

Bulk Specific



56-1

56-2

56-3

56-4

56-5

56-6

56-7

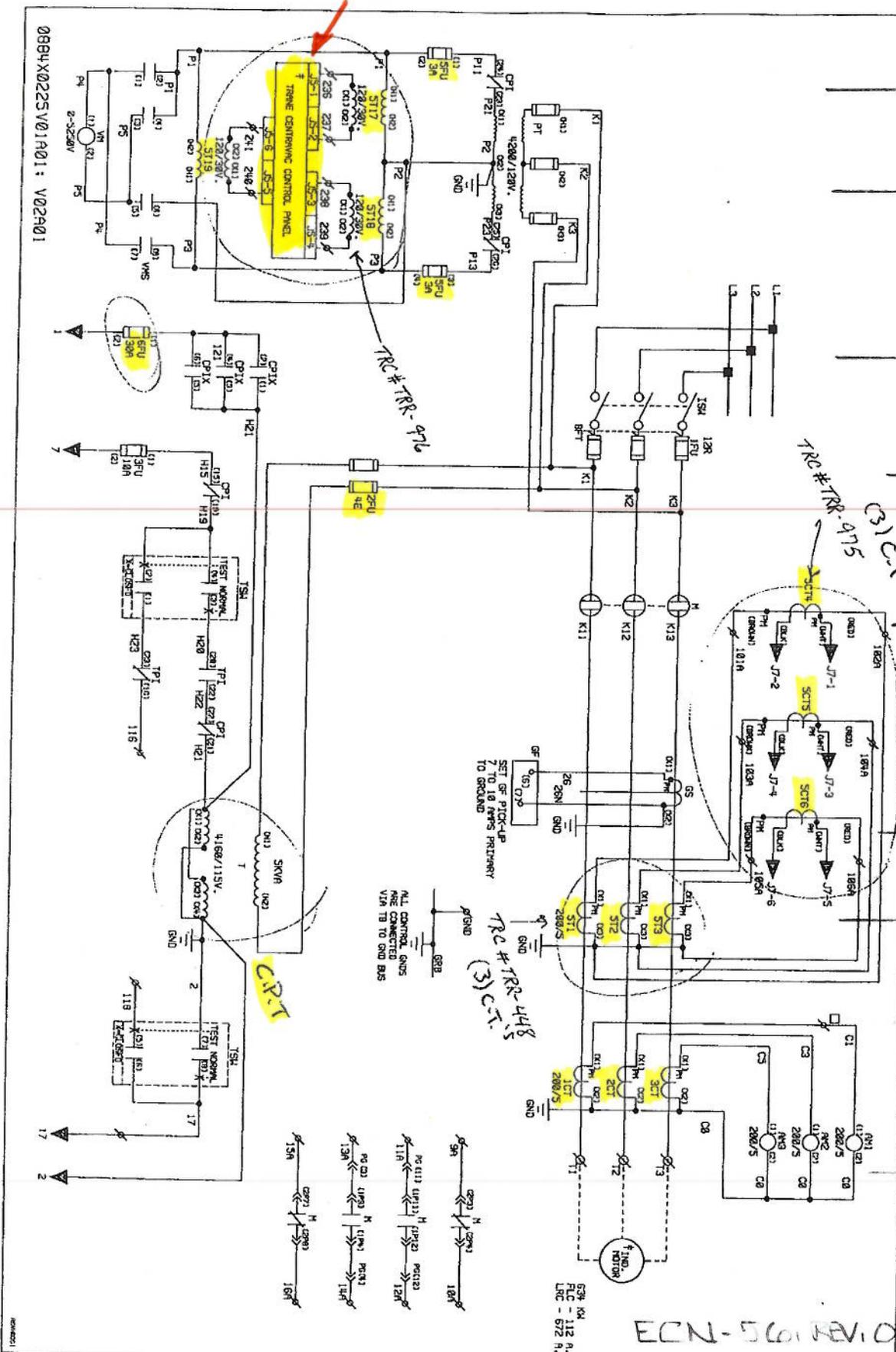
56-8

0923X0413V02801.C01.D01:V03E01.F01.G01

ECN-56 REV. 0

| | | | | |
|--------|--------|------------------|-------------|-------------|
| REV. 4 | REV. 1 | DATE BY | APPROVED | DRAWING NO. |
| REV. 5 | REV. 2 | 12/14/00 R. BONE | R. BONE | 34086168 |
| REV. 6 | REV. 3 | 2/17/2010 | 30301573-LA | GE 4A 4 |
| | | P. BONE | CRJ/SN | |

G1



0894X0225V01R01: V02A01

56-15
 56-16
 56-17
 56-18
 56-19
 56-20
 56-21
 56-22

SET OF PICK-UP TO 7 TO 8 PINS FORWARD TO GROUND

ALL CONTROL GND'S ARE CONNECTED VIA TB TO GND BUS

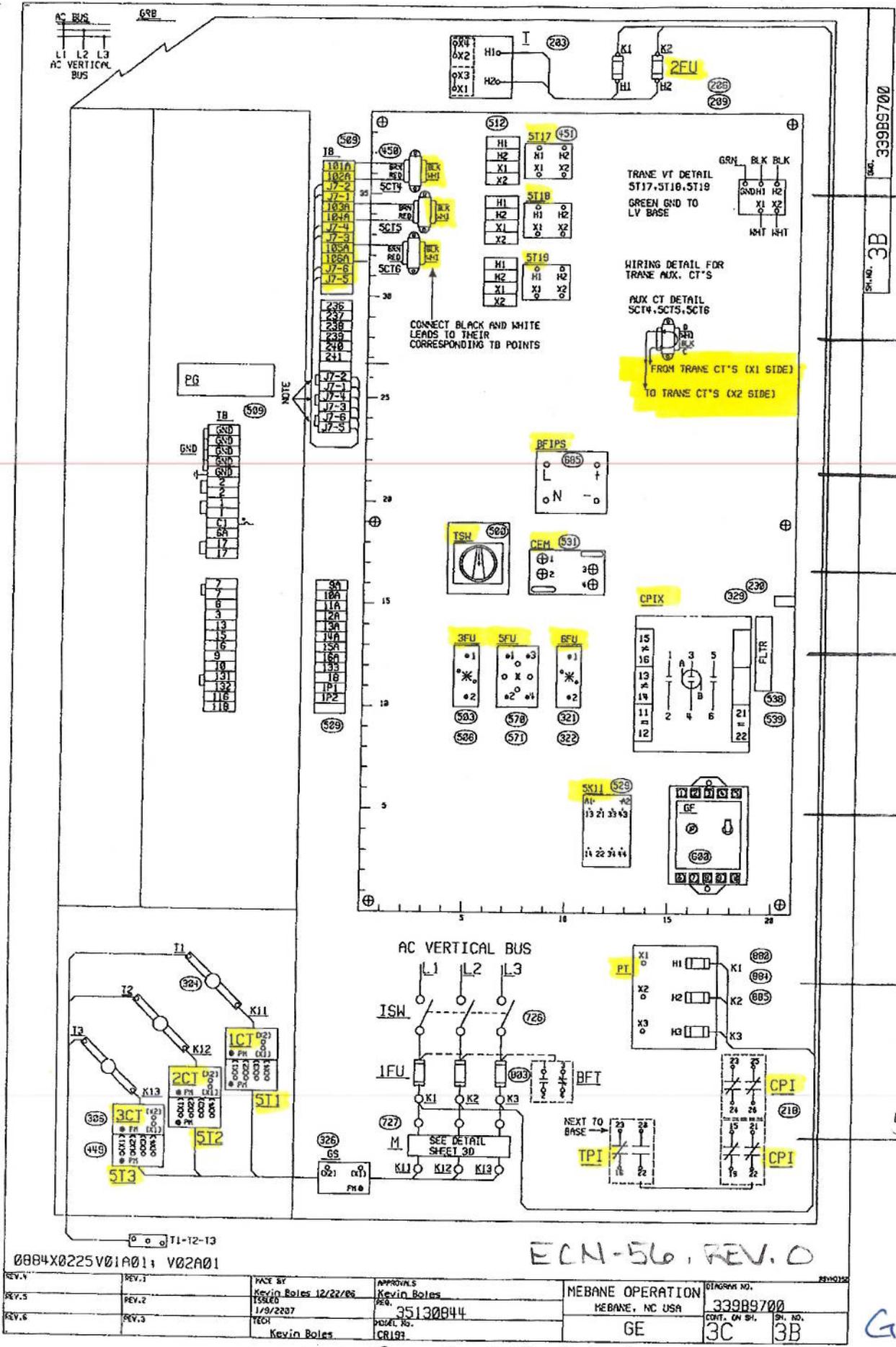
53R K04
 FLC - 112 A
 LRC - 672 A

ECN-560 REV. 0

| | | | | | |
|------------------------------------|--------------------------------------|------------------|---------------------|------------------------------------|-------------------------|
| REV. 1 | REV. 2 | REV. 3 | REV. 4 | REV. 5 | REV. 6 |
| MADE BY Kevin Boles 12/22/85 | APPROVALS Kevin Boles 05130844 | DATE 1/9/2287 | PROJECT NO. 0819 | MEBANE OPERATION MEBANE, NC USA | DRAWING NO. 339B9700 |
| | | | | GE | CONT. ON SH. 3A |
| | | | | | SH. NO. 3 |

GE for similar installation

G2



33989700
3B

56-29

56-30

56-31

56-32

56-33

56-34

56-35

56-36

0884X0225V01A01; V02A01

ECN-56, REV. 0

| | | | | | |
|--------|--------|----------------------|-------------|------------------|-----------------|
| REV. 4 | REV. 1 | DATE BY | APPROVALS | MEBANE OPERATION | DIAGRAM NO. |
| REV. 5 | REV. 2 | Kevin Boles 12/22/06 | Kevin Boles | MEBANE, NC USA | 33989700 |
| REV. 6 | REV. 3 | 1/9/2207 | 35130844 | GE | CONT. ON SH. 3B |
| | | TECH | CR121 | | SH. NO. 3B |

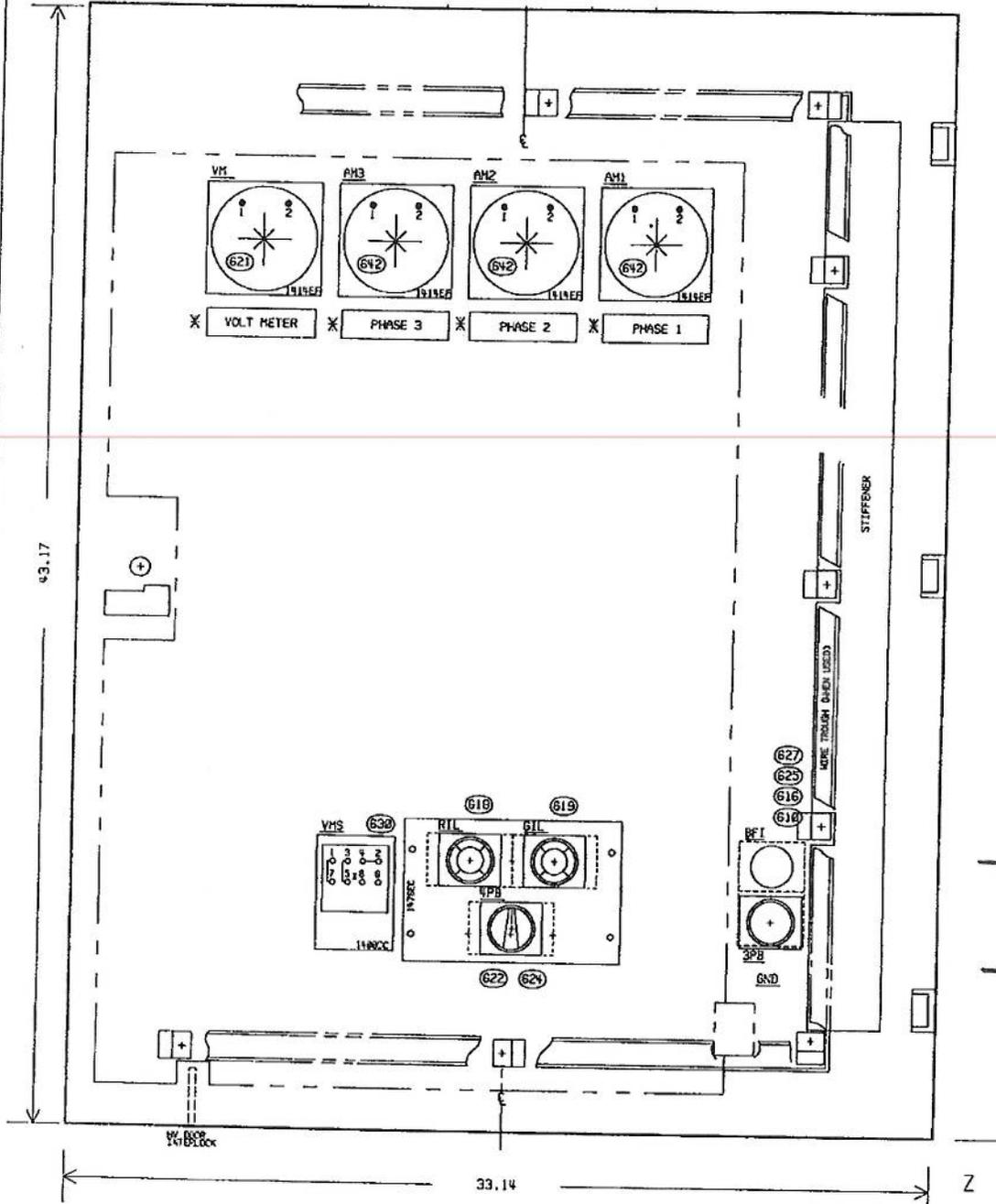
G2

GE Simular Installation

34W 1HI LV DOOR - STD AIR OR VACUUM
BACK VIEW

* MOUNTED ON OUTSIDE OF LV DOOR.

1/4" SCALE



DR. NO. 339B9700
3C

56-37

56-38

56-39

VPB DETAIL
P3 19
S4 22
(L) (R)
(REAR VIEW)

RIL DETAIL
1 2

GIL DETAIL
1 2

ECN-56, REV. 0

| | | | | | |
|--------|--------|------------------------|--------------------------|------------------------------------|-------------------------|
| REV. 4 | REV. 1 | MADE BY Kevin Boles | APPROVALS Kevin Boles | MEBANE OPERATION MEBANE, NC USA | DIAGRAM NO. 339B9700 |
| REV. 5 | REV. 2 | ISSUED 1/9/2227 | REQ. 35130844 | GE | CONT. ON SH. 3D |
| REV. 6 | REV. 3 | TECH Kevin Boles | CR NO. CR194 | | SH. NO. 3C |

G2

GE Similar Installation

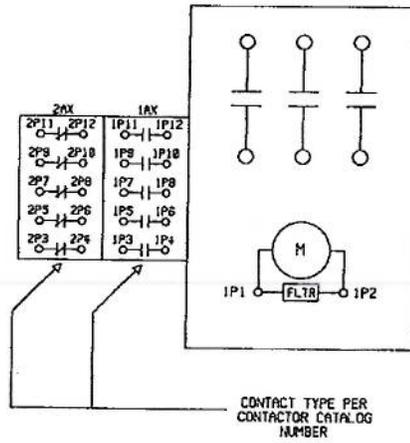
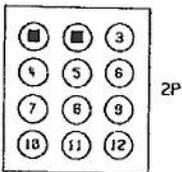
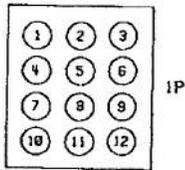
NOMENCLATURE:

1. K-CONTACTOR
2. R-CONTACTOR
3. P-PIN CONNECTOR
4. AX-AUX. CONTACTS

NOTES:

1. AUXILIARY CONTACT BLOCK 1 (IAX) IS STANDARD. 2AX, 3AX, AND 4AX ARE OPTIONAL AND ARE WIRED AS SHOWN WHEN ORDERED.
2. PINS MARKED WITH '■' ARE UNUSED.

SH. NO. 3D
 Dwg. 33989700



CONTACT TYPE PER CONTACTOR CATALOG NUMBER

56-40

56-41

56-42

0884X0225V01A01: V02A01

ECN-56. REV. 0

| | | | | | |
|--------|--------|---------------------------------|--------------------------|------------------|-------------------------|
| REV. 4 | REV. 1 | MADE BY Kevin Boles 12/22/05 | APPROVALS Kevin Boles | MEBANE OPERATION | DIAGRAM NO. 33989700 |
| REV. 3 | REV. 2 | ISSUED 1/3/2007 | REV. 35130844 | MEBANE, NC USA | CONT. OR SH. FL |
| REV. 2 | REV. 3 | TECH. Kevin Boles | MODEL NO. CR194 | GE | SH. NO. 3D |

G2

GE Similar Installation

