January 12, 2016
BOARD OF COUNTY COMMISSIONERS
ORANGE COUNTY, FLORIDA
IFB Y16-716-CC, Addendum No.3

ORANGE COUNTY COURTHOUSE GENERATOR FUEL DELIVERY SYSTEM RETROFIT & MASTER CONTROLLER UPGRADE

Bid Opening Date: January 19, 2016 at 2:00p.m.

This addendum is hereby incorporated into the bid documents of the project referenced above. The following items are clarifications, corrections, additions, deletions and/or revisions to, and shall take precedence over, the original documents. Underlining indicates additions, deletions are indicated by ~~strikethrough~~.

A. The bid opening date remains January 19, 2016 at 2:00p.m.

B. Attached with this addendum, for informational purposes only, are schematic drawings related to the Courthouse generator fuel delivery system. Those schematic drawings are paralleling AC, DC1-DC3, paralleling wiring diagram, PLC I/O, totalizer AC2, DC3, totalizer wiring diagram, basement fuel pump point schedule, and CEPS one line diagram.

C. All other terms and conditions of the IFB remain the same.

D. The Proposer shall acknowledge receipt of this addendum by completing the applicable section in the solicitation or by completion of the acknowledgement information on the addendum. Either form of acknowledgement must be completed and returned not later than the date and time for receipt of the proposal.

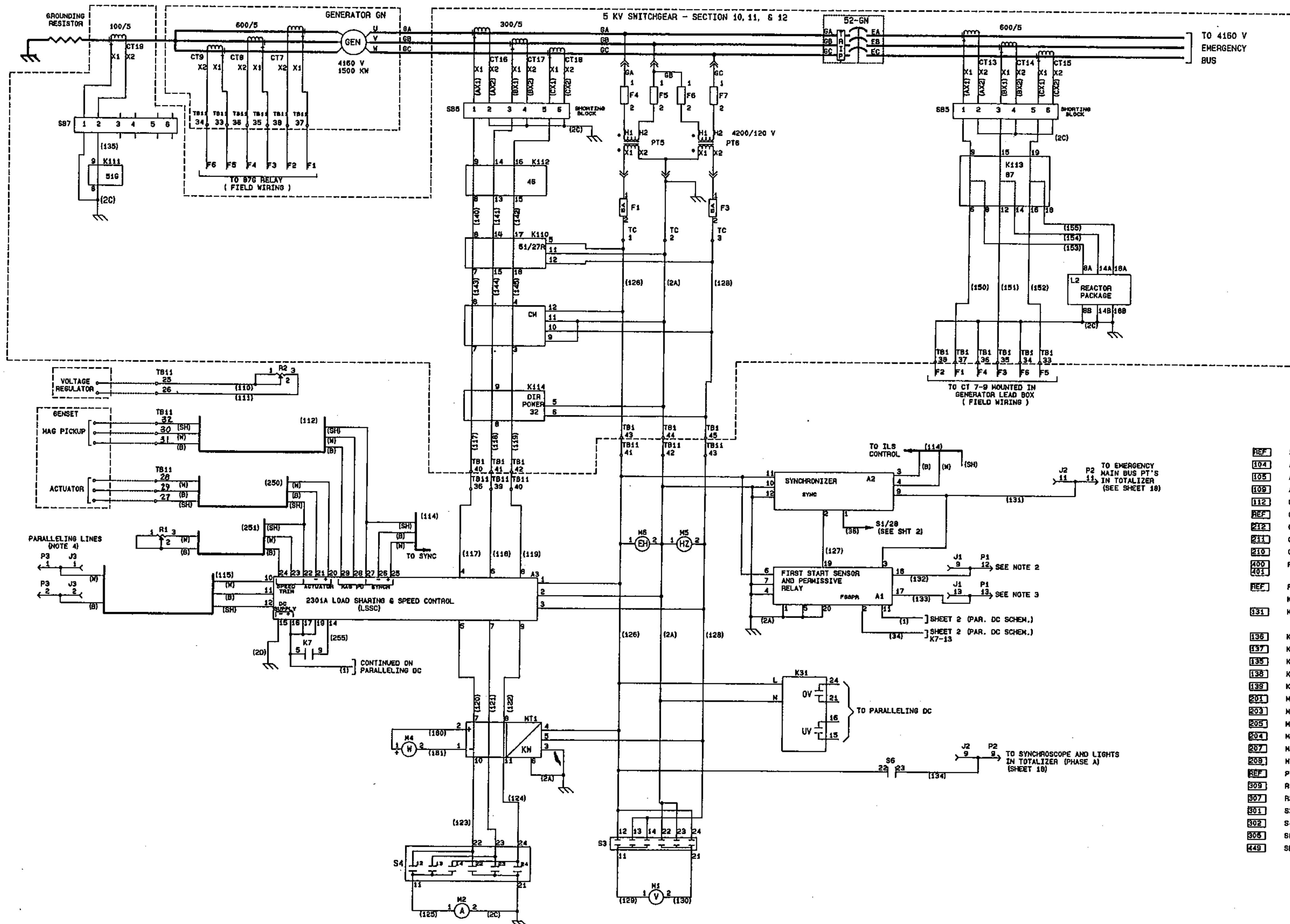
Receipt acknowledged by:

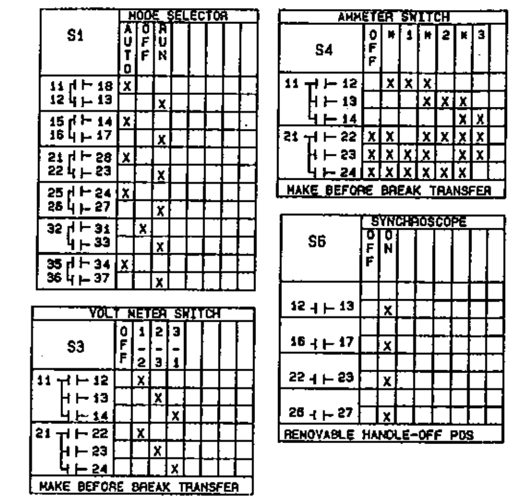
______________________________ Authorized Signature	__________________________ Date Signed

____
Title

____
Name of Firm

ER No.	Ltr	No.	Revision	Zone	Dr	Chkr	Approved	Date
—	A	1	ENGINEERING RELEASE	—	RJT	TO	RJT	10-11-95
71,726	B	1	RECORD RELEASE	—	RJT	DO	TPN	12-07-95





REF	52-G1, 2, 3	GENERATOR CIRCUIT BREAKERS	
104	A1	FIRST START SENSOR & PERMISSIVE RELAY	
105	A2	SYNCHRONIZER	
109	A3	ISOCHRONOUS LOAD SHARING CONTROL (ILS)	
112	CM	CIRCUIT MONITOR	
REF	CT7-9	CT 600:5 RATIO (ON GENSET)	
212	C13-15	CT 600:5 RATIO	
211	CT16-18	CT 300:5 RATIO	
210	CT19	CT 100:5 RATIO	
400 401	F1, 3	10A. FUSES (BY SQUARE D)	
REF	F4-F7	FUSES (BY SQUARE D)	
	K7	52G AUX RELAY (SEE SHT 2)	
131	K31	GENERATOR OVER/UNDERVOLTAGE RELAY	
136	K110	OVER-CURRENT WITH VOLTAGE RESTRAINT RELAY 51/27R	
137	K111	GROUND OVERCURRENT RELAY 51G	
135	K112	NEG SEQ OVERCURRENT RELAY 46	
138	K113	GEN DIFFERENTIAL RELAY 87	
139	K114	REVERSE POWER RELAY 32	
201	M1	VOLTMETER	
203	M2	AMMETER	
205	M4	WATTMETER	
204	M5	FREQUENCY METER - 55-65 HZ SCALE	
207	M6	ENGINE HOUR METER	
208	MT1	WATT TRANSDUCER	
REF	PT5, 6	POTENTIAL TRANSFORMER (BY SQUARE D)	
309	R1	FREQUENCY ADJUST POTENTIOMETER	
307	R2	VOLTAGE ADJUST POTENTIOMETER	
301	S3	VOLTMETER SWITCH - 4 POSITION	
302	S4	AMMETER SWITCH - 4 POSITION	
306	S6	SYNCHROSCOPE SWITCH	
449	SB5, 6, 7	SHORTING TERMINAL BLOCK	

FILENAME: PACOCH
PLOTTED: 10-10-95

Do Not Scale Print

Tolerances unless otherwise specified

Third Angle Projection

This document is the property of Onan Corporation. It contains proprietary and confidential information which must not be duplicated, used or disclosed other than as expressly authorized by Onan Corporation or its representative.

For interpretation of dimensioning and tolerancing, see ANSI Y14.5M-1982

	Name	Date
Dr	R. J. THAYER	10-11-95
Chkr / Mfg	D. OLENE	10-11-95
Approved	RJ Thayer	10/11/95

Model first used on: DSPS 6000R/4278

Cummins Onan

Minneapolis, Minnesota 55432

Title: SCHEMATIC DIAGRAM (PARALLELING AC)

Dwg No. 625-3228 Sheet 5 of 19 Dwg Size D

86C731 3-89

ORANGE COUNTY GOVERNMENT FACILITIES MANAGEMENT TECHNICAL REVIEW FORM

PROJECT TITLE:	Generator Fuel Delivery Retrofit
PROJECT NUMBER:	100045190
PROJECT A/E:	ATKINS
A/E PROJECT MANAGER:	Geary F. Heinrich
CAPITAL PROJECTS MANAGER:	Sam Shine
DOCUMENTS DATED:	5/29/2015
REVIEWER'S NAME	Carlos J. Cuevas
DATE REVIEWED:	6/16/2015
___ % **TECHNICAL REVIEW**	90%

No. of Comment w/Initials	Sheet or Section Number	**Comments** Identify location by Detail Number or Article and Section Number.	**Designer's Responses** Indicate where and how the item is addressed on the Plans and in the Project Manual.
1 - CJC	E-101	Pump Load Summary should read	
		Pump H/P 1/3 Amps 5.2	
2 - CJC	E-101	Hex Note 4 should read "Fuel Pump Control"	
3 - CJC	E-101	Existing Generator Paralleling Switchgear	
		Top to Bottom; Master Control, G1, G2, G3	
4 - CJC	P-101	Primary objective discussed during system	
		survey was to re-direct the fuel return to the	
		day tanks; Not the replacement of fuel pumps.	

COMMISSIONING REPORT

ORANGE COUNTY COURTHOUSE

GENERATOR CONTROL

4/4/14

By:

Mark A. Escott, P.E., LEED AP, C x A

SGM Engineering
935 Lake Baldwin Lane
Orlando Florida 32814
(407) 767-5188

SGM ENGINEERING INC
MEP CONSULTING ENGINEERS

935 Lake Baldwin Lane
Orlando, FL 32814
(407) 767-5188
(407) 767-5772 fax
www.sgmengineering.com

1991 - 2014
23
YEARS OF EXCELLENCE
SGM ENGINEERING

Table of Contents

Project Summary:

SGM has been contracted to provide retro-commissioning services to determine the current conditions of the Generators Master Control System at the OC Courthouse, 425 N. Orange Ave, and provide recommendations for the correction of any deficiencies found, upgrading to the latest technology, compliance with current codes, modification from analog controls to digital controls, to provide a reliable and accurate system.

The 1995 Cummins/Onan generator master controller, located on the 3rd level of the CEP building in room E303 that looks out to the 3 generators, has been identified to be at the end of its useful lifecycle due to parts that are no longer available. This master controller synchronizes the (3) 1500KW/1875KVA, 2400/4160V, 3 phase Cummins/Onan standby generators (Model # 1500DFMB) and the Onan Detector 12 Genset freestanding control panel.

Generator Master Controller Description:

The master controller is constructed of discrete analog devices that are all hard wired together. The settings must all be manually adjusted and require periodic readjustment, which is a tedious and time consuming process. The controller is tied to the Power Monitoring and Control System (PMCS) through a programmable logic controller located in the master/totalizer section of the Master controller.

The master controller includes the following meters and switches in the generator sections for all 3 generators:

1. AC Voltmeters (5K volt scale)
2. Voltmeter selector switch
3. Frequency meter
4. AC amp meter (300A Scale)
5. Amp meter selector switch
6. AC Wattmeter, 2500KW scale
7. Circuit breaker control switch with red (closed) and green (open) position lights
8. Running time meters
9. frequency control potentiometer
10. Voltage adjustment potentiometer
11. Generator control 3 position switch Auto/Off/Run. With Green (auto mode) and Red (not in auto) indicating lights
12. Synchroscope selector switch 2 position Off/On.
13. Lamp test push button per section
14. Demand mode standby light
15. Generator running status light
16. Cool down period status light
17. Trouble pilot lights
    a. Low DC voltage
    b. Low engine temperature
    c. Hi engine temperature
    d. Low oil pressure
    e. Fail to synchronize
    f. Low fuel in the day tank
18. Alarm pilot lights
    a. Low coolant level
    b. Loss of field
    c. High engine temperature shut down
    d. Low oil pressure shut sown
    e. Reverse power
    f. Breaker failure

19. Woodward Load sharing & Speed control
20. Onan Scynchronizer
21. Onan Paralleling Control

22. Relays, time delays, intelligent relays

The following are all in the Master/Totalizer control section

1. PLC
2. Relays
3. Manual lead generator synchronizing selector switch in the master section
4. System test on/off
5. Load restore on/off
6. Load demand mode on/off
7. Under frequency reset
8. Alarm Silence reset
9. Feeder breaker switch local/remote
10. Load pick up
11. Lamp test button
12. Synchroscope meter (phase angle between bus and incoming set)
13. Voltage (on emergency bus) meter (0-5250V scale)
14. Voltmeter switch
15. Total load amperage meter (0-1200A scale)
16. Ammeter switch
17. Load KW meter (0-6000 KW scale)
18. Frequency Meter (55-65 Hz)
19. Indicators
    a. System test
    b. Load demand mode
    c. Load pick up
    d. Utility #1 Available
    e. Utility #2 Available
    f. Low fuel main tank
20. Alarm indicators
    a. Emergency bus under frequency
    b. Utility #1 Failure
    c. Utility #2 Failure
    d. Load Shed
    e. Controller malfunction
    f. Control power failure
    g. Sync Lamps

The generator breakers and protective relays are located in a separate piece of switchgear located on the second floor.

Control Sequence Summary

Upon loss of the normal power source, opening SES 52-I1 and 53-I2 at the same time, or opening SES 52F1 and 52-F4 at the same time, the controller initiates an automatic start sequence for all three generators independently. The first generator set to achieve 90% of the normal voltage and frequency setting is connected to the bus via the power monitoring and control breakers. The other generators are then prevented from connection at this time. The second and third generators are then brought to set voltage and frequency with their respective synchronizer controlling to cause synchronization with the bus. Upon achieving synchronization with the bus, the generator breakers will close and connect the generators to the bus one at a time.

Within 10 seconds of normal power loss, the highest priority emergency loads are connected to the bus. The remaining loads are then connected to the bus in priority sequence. With the system running in the emergency mode, the microprocessor will continually monitor the total load on the bus. If the total load on the bus can be safely carried by fewer generators than are on line, the controller will automatically shut down Generators in a sequence to allow the remaining units on the bus to operate closer to rated capacity. This limits fuel consumption, injector fouling and wear on the system. Upon sensing that the bus reserve capacity is being reached, or on failure of an operating generator, the idle unit will automatically be started, paralleled and connected to the bus.

Upon a failure of any generator, the controls will automatically initiate disconnect, shutdown and lock out of the failed generator. Loads will be reduced automatically upon this failure in priority sequence to avoid overloading the emergency bus.

When the normal power source is restored, the loads will be retransferred to the normal source and the generators will be disconnected from the emergency bus. The generators will continue to run for a 15 min cool down period and then shut down. The controls will automatically reset to prepare for the next power failure.

The PMCS is responsible for preventing paralleling the generators with utility power. The control system is also capable of operation in the manual mode through the intervention of an operator. The control system is capable of multiple safety shut downs to protect the generators from damage. The alarms are noted in the description section.

Findings:

- The controller is a very well built control panel with very neat craftsmanship with good layout and spacing of items.
- There is no code violations with respect to the generator master controller noted.
- The original construction specifications for the project had no provisions for the guarantee of spare parts for the system. No spare parts are currently stocked on site at the facility.
- The ammeters, voltmeters, watt meters, frequency meters (Yokogawa) are all standard products with readily available replacement parts. The functionality of which would not affect the operation of the generators, but would provide incorrect information to any manual operators.
- The pilot lights (Siemens) for indicating, alarm or trouble notification are all standard products with readily available replacement parts. The functionality of which would not affect the operation of the generators, but would provide incorrect information to any manual operators. There are a few currently not operating that would require lamp replacement, but this is a minor cost item.
- The selector switches (Electroswitch) are all standard products with readily available replacement parts. The functionality of which would not affect the automatic operation of the generators, but would prevent manual operators from being able to view or control the desired items. There are a couple of switches missing their operating handles, but these could be replaced for very minimal cost.
- The control relays (Diversified, Westinghouse, Basler) are all standard products with readily available replacement parts, but not necessarily a stock item for distributors and may take a day or two to procure. Most of these relays are required for the proper operation in the automatic mode. Relays have a useful life of a 100,000 cycles electrically and 1,000,000 mechanically. The relays are 19 years old and are subject to possible failure at this point. Likely it would only limit one generator during the outage and would have no major effect on the operation of the emergency power system, but would increase the amount of load items that may need to be shed from the emergency power system.
- The Load sharing & speed control module (Woodward 2301A), synchronizer (Onan 300-2015), and paralleling control module (Onan 300-2014) are all specialized parts and not readily available. The parts are currently available for purchase but we have been told that they are no longer manufactured. The parts are approximately $600, $1,100, and $1,000 respectively.
- The proposed new controllers are anticipated to be manufactured for the next 15 years with spare parts available for an additional 10 to 15 years. Replacement parts would be circuit boards that could be replaced very quickly to get the system back in operation if a failure occurs.

SGM Engineering, Inc. · MEP Consulting Engineers
935 Lake Baldwin Lane, Orlando FL 32814
(407) 767-5188 · (407) 767-5772 (Fax)

Conclusions and Recommendations

- The controller is a very unique and specialized control enclosure. Very few repair technicians in the state would have the skills and ability to repair such a complex system. The trouble shooting time would be excessive.
- Most items that would fail would only eliminate one generator and not the complete ability of the emergency power system.
- The Generator Master controller is outdated and has many individual components that are not the latest technology. In order to properly maintain the present controller, many spare parts need be purchased for replacements at this time before any existing distributor stock is depleted. This would require the purchase of approximately $15, 000 in maintenance stock. Repairs would be very expensive if needed.
- We recommend the replacement of the control system with the latest digital control and networking technology (DMCS1000 Master and PCC3300 at each genset) to improve the performance, accuracy, reliability, cost of Ownership and ease of operator interface. The new system would reduce the number of individual components required and provide for on board diagnostics with troubleshooting fault codes. The new system would include remote HMI controllers in the doors of the old generator controller as well as at the PCC 3300 at each genset. Two 32 point annunciators would be provided in the doors of each generator section of the old generator controller to indicate NFPA 110 and extended faults. This would provide the most reliable system for the Courthouse for years to come and make the maintenance far more user friendly with the menu driven structure. The replacement would utilize the existing master controller enclosure and provide for all identical originally designed functionality as far as load shedding/sharing, sequencing, paralleling, metering, alarms and controllability. This replacement has been budgeted at $200,000 from Cummins/Onan and can be performed without a complete shutdown. Only one genset at a time would need to be removed from the system during the installation. This pricing includes an exact functional replacement of what is existing. This would continue to use hard wired inputs to the PLC as is presently done. A complete estimate and description for the replacement has already been provided to the Owner from Onan/Cummins.
- The system is also capable of modbus control. This would eliminate the hard wired inputs and outputs from the PLC and utilize Modbus control. The PLC would then be connected to the network or a single PC via Ethernet cables. This would allow the county to utilize their network for remote access and control. This would allow the County to view alarms as soon as they occur and could be set to deliver to an e-mail or phone. We would not recommend remotely controlling the generator for safety reasons and would have that functionality password restricted. All ability to change or modify parameters of the control could be password restricted to allow the Owner to determine the level of access

they choose for each person or department. We anticipate the additional of this remote access to be $8,000 including a copy of the software and programming.

- We recommend the inclusion of a spare parts availability guarantee in the specifications for the new controllers. We would recommend 25 years, but the Owner should determine the required years.

acg
AABC Commissioning Group

Annual Membership Certificate

Awarded to

SGM Engineering, Inc.

as a member in good standing of the AABC Commissioning Group for the year

2013

This member has met all requirements for membership and is entitled to all rights and privileges of ACG certification. This certificate is renewable on an annual basis and expires December 31, 2013.

Mark Leafstedt, P.E., *President*

Ray Bert, *Executive Director*

acg
AABC Commissioning Group

hereby certifies that

Mark Escott, P.E.

SGM Engineering, Inc.

has demonstrated the requisite knowledge and understanding of the building commissioning process as presented in the ACG Commissioning Guideline and passed the necessary examination to be awarded this certificate in recognition of his qualifications as an ACG

Certified Commissioning Authority

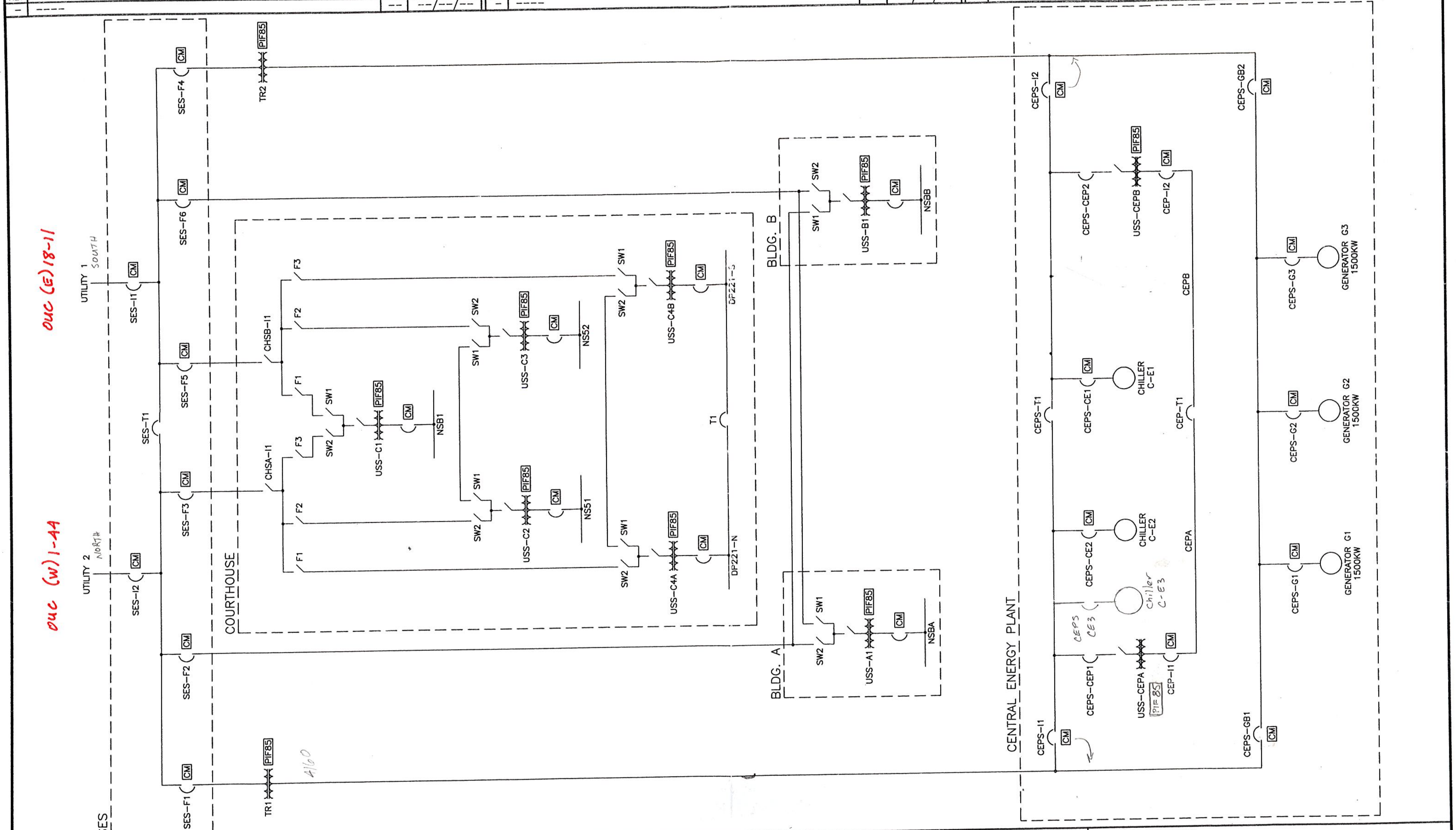
This registration number 110-608 and this certificate, valid only for the year 2014, are renewable on an annual basis after examination of the agency's record for the preceding year.

CERTIFIED COMMISSIONING AUTHORITY · acg AABC Commissioning Group · CxA

W. Joseph Helm, P.E., *President*

Ray Bert, *Executive Director*

REV	DESCRIPTION	BY	DATE
-	----	--	--/--/--



PMO ENGINEERING SERVICES – PROJECTS

CHECKED BY: ---
CHECKED DATE: ---
PLANT LOCATION: P48 (ENG SVCS – PROJECTS)

JOB NAME: ORANGE COUNTY COURTHOUSE COMPLEX
JOB LOCATION: ORLANDO, FL.
DRAWN BY: R. FISHER
ENGR: BRIAN REAGAN
DATE: JANUARY 7, 2008
DRAWING STATUS: AS BUILT

EQUIPMENT DESIGNATION: –
EQUIPMENT TYPE: –
DRAWING TYPE: ONE LINE DIAGRAM

SQUARE D
Schneider Electric

DWG# 022236827-005-01 PG 1 OF 1 REV –

III.EMERGENCY LOAD MANAGEMENT SYSTEM

A. General

1. The ELMS PLC (programmable logic controller hereafter referred to as simply PLC) located in the Central Energy Plant on Level 2 in the Main Switchgear Room is the focal point of all automatic system operation. The PLC system architecture used for this application utilizes two PLC processors having "hot backup" option with 12 racks of remote I/O. In this arrangement, 2 PLC processors each execute the same control program at the same time. If one processor halts, the other processor continues to operate providing control for the facility. Redundant communications circuits to the remote I/O racks are also provided. By having one PLC program for the facility, coordination of the various control functions is assured. The transfer interface system will transfer control of the I/O system to the backup processor should the primary processor shut down for any reason. The system does not require fixed primary or backup designations. If a fault condition occurs in the primary processor, control is automatically transferred to the backup. The failed primary assumes a failed backup status. The fault can then be corrected in the failed backup and activated to operational backup without interupting control operations.

2. Pilot lights on the front of the PLC enclosure indicate the following:

   ELMS Not in Automatic (red)
   Manual Return to Utility Selected
   (amber)
   PLC Running (green)
   PLC Battery Low (red)

3. The PMCS/ELMS Personal Computer Workstation (PCW) is located in the Central Energy Plant Fire Command Room. The PCW provides access to interactive graphic one-line diagrams, all metering parameters, real-time alarms, event logging, and trending capability using Square D PowerLogic application software. Interactive one-lines are provided for each medium-voltage switchgear and each unit substation. Status screens are provided for the ELMS and for the generators. Numerous alarms are also configured. The PCW has the capability to perform manual control operations via the mouse or keyboard.

4. Square D PowerLogic CM2250 Circuit Monitors provide local display as well as PLC and pew remote monitoring of circuit metering and historical data.

5. Square D Model 85 transformer forced air cooling system with PIF-85 PowerLogic interface provides local display as well as PLC and PCW remote monitoring of transformer coil temperatures, fan status, and alarms.

6. Square D PIF-3 PowerLogic interfaces provide PMCS connection to MicroLogic trip units in secondary main and tie circuit breakers in each of the unit substations.

B. Definition of Terms

1. ELMS

Emergency Load Management System

2. ELMS PLC

Emergency Load Management System Programmable Logic Controller. Provides monitoring and control functions necessary to control power distribution system during utility power failures. Redundant PLC processors are located in an enclosure in the CEP.

3. PMCS

Power Monitoring and Control System.

4. 43ELMS

Manual/Automatic selector switch on door of ELMS PLC enclosure.

5. 43RTU

Manual/Automatic selector switch located on the door of the ELMS PLC enclosure. Used to select Manual or Automatic return to utility power.

6. 43SES

Manual/Automatic selector switch on door of Bay 5 of SES service entrance switchgear.

7. BAS

Building Automation System provided by others. Provides control of motor loads for heating, ventilating, air conditioning, and smoke control.

8. Auto Mode Ready

ELMS is ready for automatic power transfer and load shed/re-add per PLC program which performs the logic described in the Sequence of Operations; requires 43ELMS in <u>Automatic</u> and no Auto Mode Failure.

9. Auto Mode Failure

43ELMS in <u>Automatic</u> when one or more of the following conditions occur:

- SES, CHSA, CHSB, or CEPS control power lost.
- Generators not available in automatic.
- SES or CEPS circuit breakers not racked into the "connected" cell position.
- Overcurrent trip and lockout on SES, CHSA, CHSB, or CEPS.
- SES, CHSA, CHSB, or CEPS switches or circuit breakers receive a close or trip signal from PLC but fail to operate within 0.5 second.
- Paralleling between utility and generator occurred.

10. Manual mode

43ELMS is in <u>Manual</u> which stops the ELMS portion of the PLC program and leaves devices in their existing position. The SES automatic transfer function will still be active if 43SES is in <u>Automatic</u>. CEPS circuit breakers and CHSA switches can then be controlled locally. Generators can be manually started (with manual crank button) and stopped and generator circuit breakers can be closed and tripped with their local control switch if the Generator Master Control Switch is placed in <u>Manual</u> position.

11. Loss of utility power

Undervoltage and/or negative phase sequence for a period of time equal to the ANSI device 27 and/or 47 relay settings (factory set to 7 seconds) at SES circuit breakers 11 and 12.

12. Utility power available

Balanced three-phase 12.47kV utility voltage as sensed by 27 and 47 relays for a period of time equal to PLC programmed time delay.

13. Generator on line

Closure of generator circuit breaker as sensed by PLC via generator control system dry contact input. Generator circuit breakers are controlled by the generator controls independent of the ELMS PLC.

14. Generator not available

Generator not available for any reason, including, but not limited to:

- Circuit breaker not in connected position
- Low oil pressure
- High water temperature
- Overs peed
- Overcrank
- Underfrequency/Undervoltage/Overvoltage
- Overcurrent
- Circuit breaker failure to close
- Emergency stop
- Manual control switch trip
- Generator Master Control Switch not in Automatic

15. Mechanical operation of switchgear

Non-electrical close or trip of circuit breakers or switches via mechanism spring charging handle and/or drawout element push buttons.

16. Remote manual control

Control of circuit breakers, switches, or lighting contactors by User-initiated commands from the PMCS personal computer workstation.

a. Design Considerations
b. System Startup
c. Single Utility Outage Sequence of Operations
d. Double Utility Outage Sequence of Operations
e. Generator Load Test Sequence of Operations

C. Design Considerations

1. Anti-Paralleling Interlocks

   a. Hard-wired and PLC-based anti-paralleling interlocks are provided to prevent paralleling the two utility services, to prevent paralleling the emergency generators with the utility, and to prevent paralleling between unit substation transformer secondaries.

   b. PLC logic will not allow either remote manual control or automatic closing of any of the 15kV or 5kV circuit breakers or switches if closure will cause paralleling.

   c. If paralleling of utility and generator does occur for any reason, SES-11 and/or SES-12, SES-T1, and SES-F1 and/or SES-F4 will trip immediately via hard-wired trip circuit interlocks.

   d. Utility/generator paralleling causes Auto Mode Failure; to restore normal automatic operation, 43ELMS must be switched to Manual and the paralleling condition cleared.

   e. If paralleling of utility sources occurs, SES-T1, SES-11, and SES-12 will trip immediately via hard-wired trip circuit interlocks and PLC logic.

   f. If paralleling of sources occurs at the low-voltage substations, the substation tie breaker T1 will trip immediately via hard-wired trip circuit interlock.

   g. If the PLC is disabled for any reason (loss of 120V AC UPS power, halted via keyswitch or programming software, or hardware failure) or if DC control power is lost, the only means of closing the 15kV and 5kV circuit breakers or switches is mechanical. Protective relay tripping and local control switch tripping functions remain intact as long as DC control power is available at the switchgear.

   h. Mechanical operation of the medium-voltage circuit breakers can defeat antiparalleling interlocks momentarily. Therefore, mechanical operation of switchgear should be employed only in an emergency when either the PLC is disabled or DC control power is lost.

2. Control Power

   a. SES, CEPS, CHSA, and CHSB switchgear control power is 125VDC from a dedicated battery system, battery charger, and DC panel.

   b. PLC control power for the ELMS PLC and the remote input/output racks is 120V AC from the nearest UPS.

   c. Program memory for the PLC is retained upon loss of power by batteries in the PLC power supply and in the PLC processor itself. "Battery Low" alarm will appear at the PCW if either battery needs replacement. Battery replacement is easily done with normal 120VAC applied and must be done within two weeks of the alarm occurrence. Batteries will retain memory for one year minimum.

   d. Contactors receive 120VAC UPS control power from the PLC enclosure that controls that particular contactor.

   e. PCW power is 120VAC from UPS-CEP. The AUTOEXEC.BAT and WIN.INI files in the PCW automatically start up the PowerLogic System Manager software in scheduled update sampling mode, so restoration of power following an outage will cause PCW to resume alarm and status monitoring.

   f. Circuit Monitor and transformer fan cooling package for each substation receive 120VAC UPS power from the UPS located nearest to the substation. Loss of control power at these locations will be detected by communications checks but will not cause system failure because the Circuit Monitor metered data is not critical to ELMS generator load control.

3. Interface with Fire Alarm System

   a. Fire alarm signal input to PLC is logged but is not used in the control logic. The Building Automation System will control the starting and stopping of smoke control equipment during a fire alarm condition

4. Communications Reliability

   a. The redundant PLC processors communicate with the remote input/output racks via redundant dedicated communications circuits operating at 62.5K baud. Communications cable is Belden 8723 dual twisted pair, shielded for noise immunity. For maximum reliability, these communications circuits should be routed differently from enclosure to enclosure to minimize the chances that both circuits would be physically damaged at the same time. Communications faults are detected by the PLC and reported via the PCW. If a communications fault is detected, the PLC will continue to operate using the remaining functional circuit and attempt to re-establish communications on the faulted circuit.

   b. The PLC regularly performs communication checks to the generator output Circuit Monitors because generator loading information forms the basis for load shed/re-add decision-making within the PLC logic. If this communication link fails while the generator is providing power, the PLC will shed all BAS loads and an alarm will appear at the PCW. The system will not go to Auto Mode Failure, however, and will retransfer the load back to the utility when voltage is available. To reset the loss of generator output communications alarm, 43ELMS must be switched to <u>Manual</u> and back to <u>Automatic</u> after the cause of communications loss is fixed.

   c. Although the SY/NET LAN is capable of operating at 500K baud, the network communications is more resistant to external noise if operated at 62.5K baud. This network speed will provide adequate data throughput for this application.

   d. Surge protection is provided for the SY/NET LAN cabling run between buildings.

   e. Surge protection is provided for the remote I/O cabling run between buildings.

5. Medium-Voltage Circuit Breaker Control

   a. Control switch operation of the circuit breakers in SES can be done only with the 43SES selector switch in <u>Manual</u> position. Switching 43SES to <u>Manual</u> causes Auto Mode Failure.

   b. Control switch operation of the circuit breakers in CEPS can be done only with the locql Manual/Automatic selector switch in <u>Manual</u> position. Switching to <u>Manual</u> causes Auto Mode Failure.

   c. If any circuit breaker or switch in SES, CHSA, CHSB, or CEPS receive a PLC close or trip signal but fail to operate within 10 seconds, system goes to Auto Mode Failure and alarm appears at PCW. The cause of the failure must be fixed and 43ELMS must be switched to <u>Manual</u> and back to <u>Automatic</u> to restore the device for subsequent automatic operation.

   d. All protective relaying and associated control circuit wiring is independent of PLC. Any protective trip lockout condition (overcurrent, short circuit, current imbalance, engine or generator failure, etc.) requires manual operator reset of the associated lockout device. Subsequent automatic operation of the breaker or switch after correction of the fault requires the lockout device to be manually reset. <u>This must be done with 43SES in Manual to prevent unexpected automatic operation.</u>

   e. Overcurrent lockout condition on SES-11 or SES-12 implies SES bus fault which trips associated SES-F1 or SES-F4 and SES-T1 via hard-wired interlock to prevent utility or generator from attempting to feed the faulted bus.

f. Abnormal utility voltage always trips SES-11 and/or SES-12 via hard-wired trip regardless of 43ELMS switch position or PLC status. 43SES must be in Manual for automatic transfer control to function.

g. Generator underfrequency protective trip and lockout occurs at 55 Hz for 10 second duration. ELMS program will attempt to avert protective trip by shedding all loads at 58 Hz for 3 second duration; alarm appears at PCW. If this successfully averts protective trip, automatic ELMS load control will resume. Underfrequency load shed occurrence should be investigated and remedied at the next available maintenance opportunity.

h. The undervoltage relays in SES will cause SES-11 and SES-12 to trip upon loss of utility voltage (after a time delay of 7 seconds). When both SES-11 and SES-12 are open or racked out, a generator start signal is made to the generator controls independent of the PLC or the position of 43ELMS.

i. If 43ELMS is in Manual, such as for maintenance, when utility power is lost, SES-11 and SES-12 will open and the generators will start and parallel the same as if 43ELMS were in Automatic, but the remainder of the automatic load add sequence will not be done.

j. To prevent damage due to rapid switching between un-synchronized sources, PLC logic requires a dead bus time delay of 1 second to 20 seconds (default of 2 seconds) between application of utility power and generator power, and vice versa. This applies to manual remote control and to automatic control.

6. Interface with Building Automation System

The BAS receives load shed signals from the ELMS PLC via 4-20mA analog output and 3 dry contact closures. The analog output indicates the capacity (in kW) available on the generator bus for the BAS to add motor loads. The signal is calibrated such that 4mA represents a bus overload of 3000kW, 10mA represents OkW available capacity, and 20mA represents 5000kW available. One contact closure indicates that the BAS should shed all load under its control immediately. The second contact closure indicates that the BAS may add the f:mergency Power Loads under its control. The third contact closure indicates that the BAS should add the normal power loads per its control program and regulate the load according to the capacity available per the analog signal.

7. Interface with Generator Controls

a. A generator start signal is sent when both SES-11 and SES-12 are open or racked out or when SES-F1 and SES-F4 are open or racked out. This is hardwired from circuit breaker MOC and TOC contacts at the SES switchgear to the generator controls at CEPS switchgear. Removal of the generator start signal causes the generator to cool down and shut down under control of the generator controls.

b. The status of the generator sets and paralleling switchgear is collected by means of remote I/O racks located in the CEPS switchgear. Control of the circuit breakers in CEPS, with the exception of the generator circuit breakers, is also accomplished by the ELMS PLC through these racks.

D. System Startup

1. Normal Power Switchgear Configuration:
   Sudden and unexpected equipment operation could occur if 43ELMS is placed in Automatic when the switchgear is in some configuration other than "normal power switchgear configuration" as described below. Startup should therefore be done with 43ELMS in Manual. With PLC key switch in Run and normal ELMS 120VAC UPS control power applied, switchgear can then be placed in normal power switchgear configuration from the local control switches at the gear.

Normal Power Switchgear Configuration:

Circuit Breaker/Switch	Status
SES-I1	Closed
SES-I2	Closed
SES-T1	Open
SES-F1	Closed
SES-F2	Closed
SES-F3	Closed
SES-F4	Closed
SES-F5	Closed
SES-F6	Closed
CHSA-I1	Closed
CHSA-F1	Closed
CHSA-F2	Closed
CHSA-F3	Closed
CHSB-I1	Closed
CHSB-F1	Closed
CHSB-F2	Closed
CHSB-F3	Closed
CEPS-I1	Closed
CEPS-I2	Closed
CEPS-T1	Open
CEPS-GB1	Open
CEPS-GB2	Open
CEPS-CE1	Closed
CEPS-CE2	Closed
CEPS-CE3	Closed
CEPS-CEP1	Closed
CEPS-CEP2	Closed
Utility 1	Available
Utility 2	Available
Generators	Shutdown but available in Automatic Mode
43SES	Automatic Position

To place ELMS in Automatic Mode, turn 43ELMS to Automatic. The SYSTEM NOT IN AUTO light on the door of the ELMS PLC enclosure should turn off. If this does not occur, an alarm indicating the cause of the failure will appear at the PCW.

E. "Single Utility Outage" Sequence of Operation

The following sequences apply when 43RTU is in <u>Automatic</u>. If 43RTU is in <u>Manual</u>, the ELMS will initiate return to utility when the Return-to-Utility pushbutton on the door of the ELMS PLC enclosure is depressed regardless of the time that the utility voltage has been available.

1. Loss of Utility 1

   a. When Utility 1 voltage drops below set point of undervoltage relays in SES, the undervoltage time delay relay is activated. If the voltage remains out of tolerance for 7 seconds, the time delay relay output will trip SES-11.

   b. The PLC will immediately close SES-T1 if interlock and lockout conditions are met.

   c. After the Utility 1 voltage returns to normal for a preset time (1 to 60 minutes, default of 30 minutes), SES-T1 will be opened.

   d. After a dead bus time delay (1 to 20 seconds, default of 2 seconds), SES-11 will be closed.

2. Loss of Utility 2

   a. When Utility 2 voltage drops below set point of undervoltage relays in SES, the undervoltage time delay relay is activated. If the voltage remains out of tolerance for 7 seconds, the time delay relay output will trip SES-12.

   b. The PLC will immediately close SES-T1 if interlock and lockout conditions are met.

   c. After the Utility 2 voltage returns to normal for a preset time (1 to 60 minutes, default of 30 minutes), SES-T1 will be opened.

   d. After a dead bus time delay (1 to 20 seconds, default of 2 seconds), SES-12 will be closed.

F. "Double Utility Outage" Sequence of Operation

The following sequence applies when 43RTU is in Automatic. If 43RTU is in Manual, the ELMS will initiate return to utility when the Return-to-Utility pushbutton on the door of the ELMS PLC enclosure is depressed as long as one utility source voltage is within tolerance.

1. Loss of utility voltage is detected by the undervoltage relays in SES. After a time delay of 7 seconds, SES-11 and 12 are opened by SES control.

2. ELMS program is initiated when SES-11 and 12 are both open or racked out. (Both utility sources lost.)

3. The following 15kV and 5kV breakers and switches are then opened with no intentional time delay:

   SES-F2
   SES-F6
   CEPS-CE1
   CEPS-CE2
   CEPS-CE3
   CEPS-CEP1
   CEPS-CEP2
   CHSA-F1
   CHSA-F2
   CHSA-F3
   CHSB-F1
   CHSB-F2
   CHSB-F3

4. All lighting contactors are opened, the BAS is signaled to shed all loads, and the elevators are signaled that operation will be on emergency power.

5. As soon as the first generator comes on line, the following devices will close in sequence.

   a. Priority 1 - At least 1 generator on line

Circuit Breaker/Switch	Equipment Served	Time Delay from First Generator On Line
CEPS-GB1	TR1	3 seconds
CEPS-GB2	TR2	6 seconds
CEPS-CEP2	USS-CEPB	9 seconds
CHSA-F2	USS-C2	12 seconds
CHSA-F1	USS-C4A	15 seconds
SES-F2	USS-A1	18 seconds

   b. Priority 2 - At least 2 generators on line

Circuit Breaker/Switch	Equipment Served	Time Delay from First Generator On Line
CHSB-F1, CHSA-F3, CHSB-F3, BAS EM	USS-C1, USS-C4B	24 seconds
CHSB-F2	USS-C3	27 seconds
SES-F6, CEPS-CEP1	USS-B1, USS-CEPB	30 seconds

   c. Priority 3 - At least 3 generators on line

   The BAS is signaled to add normal power loads according to its programmed sequence and the capacity signal provided by the ELMS.

6. Dynamic load pickup and load shed sequence begins and continues throughout the generator run cycle. Operator may at his discretion, and with the aid of PCW screen display, open or close lighting contactors via remote manual control. If the load exceeds the shed point, PLC will compensate by deducting load elsewhere.

7. The total of the Circuit Monitor kW values from the three generator breakers (G1, G2 and G3) are averaged with the total of the Circuit Monitor kW values for CEPS-GB1 and CEPSGB2 over a 6 second period (updated every 2 seconds) to determine Power Delivered (PD) at the PLC.

8. The maximum power available (MPA) is calculated by multiplying the number of generators on line by 1500kW.

9. The Maximum Power Target (MPT) is calculated as 200 kW below the MPA.

10. The Shed Point (SP) is calculated as 100kW below the MPA.

11. Power Delivered is compared with MPT to determine if the next load step can be added. If the PD and load to be added exceeds MPT the next load step will not be added.

12. If the PD exceeds the SP for 10 seconds or more the last load step added will be shed. The PLC will continue to shed loads in this manner until the PD is below the SP.

13. After all PLC load steps are added, the BAS will be allowed to begin adding load. The BAS will be considered to be the last load step. If the load on the generator bus exceeds the SP for 10 seconds or more, the BAS will be signaled to shed all load immediately.

14. If communications between the PLC and the Circuit Monitors fails, then the BAS Normal Power Loads and all other Priority 3 loads will be shed.

15. If one generator fails, then all BAS, Priority 4, and Priority 3 loads will be shed. If the generator returns, then loads will be added as normal. If the generator does not return the system will continue to operate in this configuration until the utility power is restored and the Return to Utility sequence begins.

16. If two generators fail, then all BAS, Priority 4, Priority 3, and Priority 2 loads will be shed. If a generator returns, then loads will be added as normal.

17. If all three generators fail then all loads will be shed and the system will return to utility power, if available, regardless of how long utility power has been available. System goes into AUTO MODE FAIL.

18. When both utility sources return to normal for an adjustable stabilization period (1 to 60 minutes, default setting of 30 minutes) the elevators are sent a pre-transfer signal, and the BAS is signaled to shed all loads. Automatic return to utility will not be initiated until both utility sowces are available. Before the closing of SES-11 and SES-12, CEPS-GB1 and CEPS-GB2 are opened along with the other 15kV and 5kV breakers and switches as follows:

    SES-F2
    SES-F6
    CEPS-CEP1
    CEPS-CEP2
    CHSA-F1
    CHSA-F2
    CHSA-F3
    CHSB-F1
    CHSB-F2
    CHSB-F3

19. Once all the 15kV and 5kV breakers and switches are open, SES-11 and SES-12 are closed after a 2 second dead bus time delay.

20. The following breakers will then be automatically closed:

Circuit Breaker/ Switch	Time Delay From Closure of SES-I1 and SES-I2
CEPS-CEP1	8 seconds
CEPS-CEP2	8 seconds
CHSA-F1	12 seconds
CHSA-F3	12 seconds
SES-F2	16 seconds
SES-F6	16 seconds
CHSA-F2	16 seconds
CHSB-F2	16 seconds
CHSB-F1	20 seconds
CHSB-F3	20 seconds
CEPS-CE1	24 seconds
CEPS-CE2	48 seconds
CEPS-CE3	72 seconds

21. The lighting contactors will then be closed in groups at 1 second intervals until all contactors are closed.

22. The system is immediately reset to be ready for the next power outage

G. "Generator Load Test" Sequence of Operations

The following sequence applies when 43RTU is in Automatic. If 43RTU is in Manual, the ELMS will initiate return to utility when the Return-to-Utility pushbutton on the door of the ELMS PLC enclosure is depressed as long as one utility source voltage is within tolerance.

This feature allows Generator Load Test to be done by isolating the Central Energy Plant from utility power and running the CEP loads on the generators. If a double utility power outage occurs, the curtailment or generator test would be aborted and the ELMS control would take over. After the utility power returns, the system would return to utility power. Generator load demand control is included.

1. The process is started from the PMCS computer by turning ON the Generator Load Test or Utility Curtailment.
2. The generators would be started and allowed to parallel to the bus.
3. A pre-transfer signal is sent to the elevators fed from CEP and they would be signaled to operate on emergency power.
4. SES-F1, SES-F4, CEPS-CEP1, CEPS-CEP2, CEPS-CE1, CEPS-CE2, and CEPS-CE3 would be opened.
5. CEPS-GB1 would be closed after 3 second delay.
6. CEPS-GB2 would be closed after 3 second delay.
7. CEPS-CE1 would be closed after 3 second delay.
8. CEPS-CE2 would be closed after 3 second delay.
9. CEPS-CE3 would be closed after 3 second delay.
10. The User or BAS must then restart the chillers and other loads.
11. If Load Demand Control is ON and the load on the three generators does not require three generators, one or two of the generators would shut down. If Load Demand Control is OFF, all three generators would share the load regardless of amount of load.
12. The User must initiate the return to utility power from the PMCS computer by turning the Generator Load Test or Utility Curtailment OFF.
13. An elevator pre-transfer signal would be sent.
14. CEPS-GB1, CEPS-BG2, CEPS-CEP1, CEPS-CEP2, CEPS-CE1, CEPS-CE2, and CEPSCE3 would be opened.
15. SES-F1 would be closed after 3 second delay.
16. SES-F4 would be closed after 3 second delay.
17. CEPS-CF1 would be closed after 3 second delay.
18. CEPS-CE2 would be closed after 3 second delay.
19. CEPS-CE3 would be closed after 3 second delay.
20. The User or BAS must then restart the chillers and other loads.

H. Remote Manual Control

Remote Manual Control of medium-voltage switches and circuit breakers, selected low-voltage circuit breakers, and lighting contactors will be possible from the PCW. These control functions are password-protected and will consist of a two-step procedure. First, the User must "turn on" the Remote Manual Control function. This is analogous to switching a selector switch from Automatic to Manual. Automatic control is suspended while Remote Manual Control is active. The second step will be to control the selected device.

1. Medium-Voltage Switches and Circuit Breakers

   All of the medium-voltage switches and circuit breakers controlled by the ELMS will have the capability for Remote Manual Control. The Manual/Automatic selector switch located at the power distribution equipment must be in Automatic position for control via the PMCS. If the selector switch is in Manual position, remote manual and automatic control are disabled. Hard-wired and PLC-based interlocks will prevent closing of a circuit breaker or switch if doing so will cause paralleling.

2. Lighting Contactors

   All lighting contactors controlled by the ELMS will have the capability for Remote Manual Control.

I. System Testing

1. Functional Test

   Testing of the ELMS consists of a functional test. With the ELMS in Automatic, pull the fuses in the circuit serving the undervoltage relays in SES. This simulates a utility power failure. The system will then operate as described above. Fuses can be pulled for one service to simulate a single utility failure or from both services to simulate a double utility failure.

2. Generator No Load Test

   A generator no load test can be initiated from the PCW.

J. Adjustable Time Delay and Setpoint

Item	Min	Max	Default	Resolution	Register	Setting
CEPS Bus 1 Dead Bus Time Delay	1 see	20 see	2 see	0.1 see	1007	20
CEPS Bus 2 Dead Bus Time Delay	1 see	20 see	2 see	0.1 see	1008	20
F1/GB1 Up Time	1 min	15 min	15 min	0.1 min	1009	150
F4/GB2 Up Time	1 min	15 min	15 min	0.1 min	1010	150
Minimum Generator Run Time	1 min	15 min	15 min	0.1 min	1011	150
SES Bus 1 Dead Bus Time Delay	1 see	20 see	2 see	0.1 see	1012	20
SES Bus 2 Dead Bus Time Delay	1 see	20 see	2 see	0.1 see	1013	20
Source 1 Up Time	1 min	15 min	15 min	0.1 min	1014	150
Source 2 Up Time	1 min	15 min	15 min	0.1 min	1015	150

If the User attempts to enter a value outside of the acceptable range, the program will use the default value.

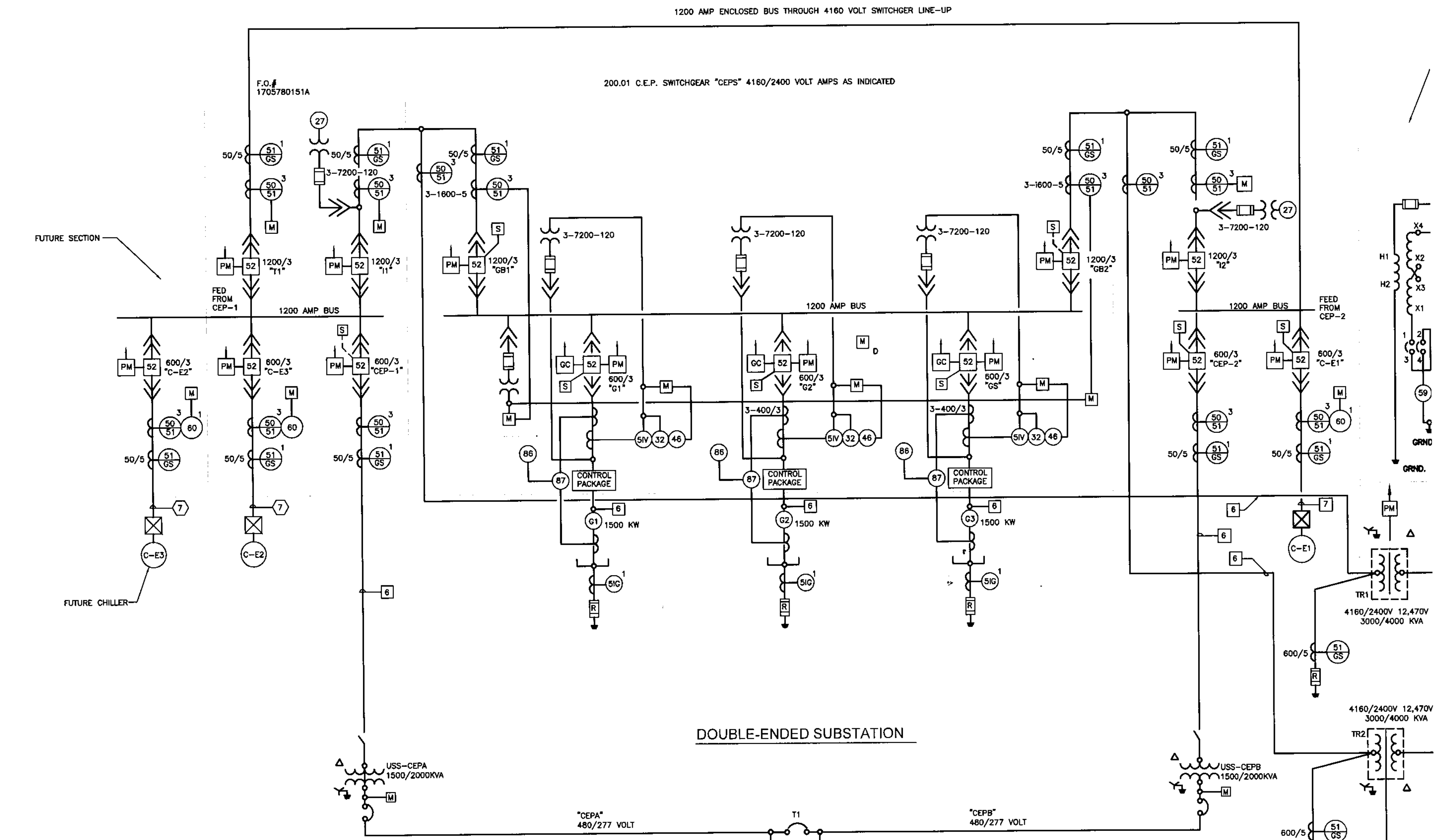
NOTES

- If one utility fails during automatic RTU to two good sources, the system will revert to double utility failure status.
- If all three digital outputs to the BAS are off, the BAS should operate as on utility power.
- The Operator can override the ELMS to allow the BAS to Add Loads regardless of the number of generators on line. Normally, all three generators must be on line for normal BAS loads to be added. The capacity available on the generator bus is still valid.
- Resound alarm or automatic reset of Remote Control function? Other alarms, conditions every day at midnight, alarms are suppressed for 1 minute. As long as SMS is on line and sampling and "sees" the alarm go off and back on, it will resound the alarm.
- Switching SES/ELMS/EPS? To manual and back to auto during ELMS operation resets ELMS to start over.
- Protective relay trips produce a momentary contact closure for tripping the circuit breaker. System Manager is not fast enough to catch these events. Therefore, auxilliary relays have been provided in SES and CEPS which will latch in these events. They must be reset from System Manager control outputs. All relays in SES are reset as a group and all relays in CEPS are reset as a group.
- Both utility feeds must be on before D/S automatically returns to utility? If program is changed to allow RTU with 1 good source, auto mode fail should not be triggered by "close failure occurred".
- In Auto Mode, if a breaker that is supposed to be open is closed manually, the PLC will immediately trip it. If a breaker that is supposed to be closed is opened manually the PLC will lockout automatic *closing* of that breaker until reset by switching 43ELMS to MANUAL position. Manual closing of a breaker is not detected and does not cause the breaker operation to be locked out because it is assumed that the operator desires the breaker to be closed as soon as possible. The breaker would be closed automatically when the sequence calls for it and interlocks are satisfied. If the breaker was opened manually, it is assumed that it was opened for a reason, and the PLC will not automatically close it.
- SES Main- Tie-Main logic is not active for generator power. This is because we cannot predict the load that would be put on TR1 or TR2 if carrying the entire facility.
- System Test Mode sends start signal to generators. They should start and parallel to the bus. CEPS-GB1 and CEPS-GB2 will remain open. The System Test is a No Load test.
- CEPS cell switch inputs were not provided.
- If a generator feeder trips or doesn't close to SES, the PLC will not automatically close SES- T1. The decision about whether or not to close the tie, or to add load to the remaining feeder in some other way, must be made by the Operator.
- Routine that handles CEPS power failure could also be used for Peak Shaving and generator load test.
- USS-CEP does not have provisions for Transfer Inhibit during operation of Drum 1. Time delay for transfer should be set to 30 seconds. (Or CEPS-CEP1 and CEPS-CEP2 turned on closer together in the sequence of Drum 1.)
- How to handle startup on normal power?
- Load restore keyswitch after Underfrequency load shed? Reset from computer? Both are available in the pic program.
- When to require 43ELMS reset? When to allow computer reset?
    - 43ELMS Reset
        - SES 86 Lockout in Software
        - CEPS 86 Lockout in Software
        - CM Read Failure
        - SES Paralleling
        - CEP Paralleling
        - Utility/Generator Paralleling
        - Auto Mode Failure
        - All Circuit Breaker Close Failures
        - All Circuit Breaker Trip Failures
        - SES Circuit Breaker Manual Operation
        - CEPS Circuit Breaker Manual Operation
        - Under Frequency Load Shed

- ELMS Not In Automatic Alarm in SMS will resound at midnight each day. Cause of alarm should appear in the alarm list. This was done so that the ELMS would not be left in MANUAL or with a fault unintentionally.
- From plant testing of SES: auto RTU - auto mode light comes on when mains close, timer on 12 resets to 0, drum stops.
- If SES has a single utility failure and the tie closes, upon return to utility, if a close failure is detected for the main being closed, the tie will reclose and remain closed until the fail to close alarm is reset by turning 43SES? To MANUAL and back to AUTOMATIC. All SES fail to close and fail to trip alarms are reset by toggling 43SES Manual/Automatic.
- CEPS and CHSA/B fail to close and fail to trip alarms are cleared by toggling 43 ELMS
- Once a drum is activated, it will stay activated until RTU is complete or 43ELMS is switched to Manual. If Manual mode is switched off by some other input (43SES for example) the drum will pause. It will resume operation when system is placed back in automatic .

TROUBLESHOOTING NOTES

- Pay attention to the alarms in System Manager.
- The 43ELMS switch performs a master reset function in the PLC program when switched to Manual.
- Control Sequence 1 controls the system during a Double Utility Outage.
- If the Control Sequence 1 is on
- Priority 1 starts at step 1
- Priority 2 starts at step 7
- Priority 3 starts at step 14
- Priority 3 ends at step 14
- IO Failures - if power is lost to one of the I/O racks, the primary processor will halt and will be unavailable as a backup until the problem with the I/O rack is corrected and the processor is restarted by turning the PLC processor keyswitch to Halt and then to Run.
- The processor that was backup will take over as the primary processor and will continue to control the system. Some of the I/O racks are deemed essential to the automatic control function. For that reason, if any of those racks fail, the program will halt automatic control. Those racks are Rack 1, Rack 2, Rack 11, and Rack 12.
- If there is a known problem with a UPS serving any of the PLC racks, it is recommended that the system be operated on a single processor.



AR LEGEND:

DISPLAY MONITOR.

OWER MONITOR CONTROL SYSTEM CONTROLLER

ENERATOR CONTROL

MONITOR POINT.

CURRENT RELAY.

TVE SEQUENCE CURRENT RELAY.

FEEDER SCHEDULE

1	(2) SETS 3-250 MCM 15KV – 1-350 MCM GRND IAC CABLE IN CABLE TRAY.
3	(2) SETS 3-250 MCM 15KV – 1-250 MCM GRND – 6 DEG C.
5	3 #4/0 15KV – 1 #4/0 GRND – 4 DEG C
6	(2) SETS 4-350 MCM 15KV – 1-350 MCM GRND – 6 DEG C.
7	SEE MOTOR AND EQUIPMENT CONNECTION SCHEDULE IN THE CENTRAL ENERGY PLANT.
10	(2) SETS 3-250 MCM 15KV – 4 DEG C.

BUS CONNECTION TO MAIN BUS IN 'SES' LINE-UP

DER -18)

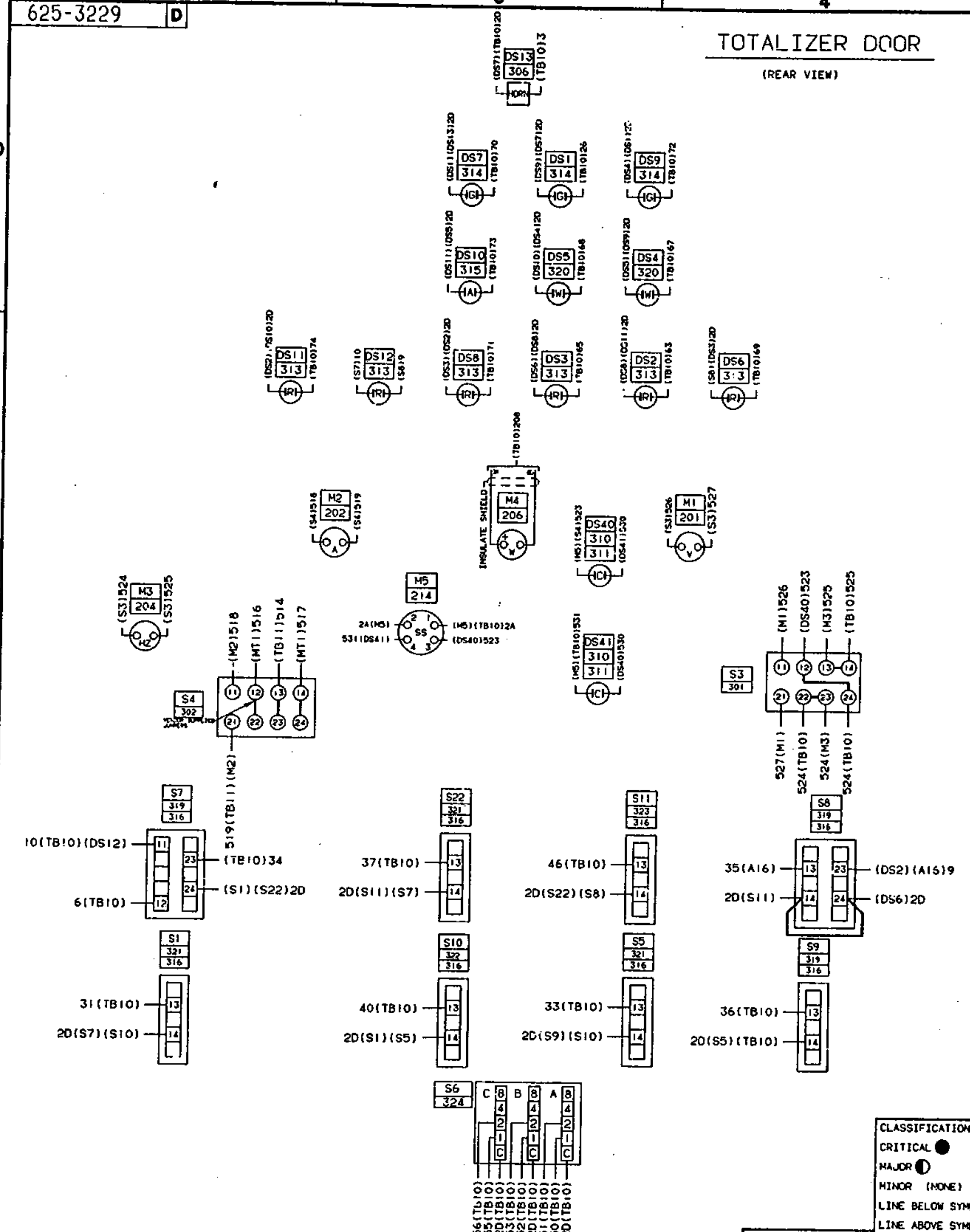
		Software				Digital Controller Information						Panel Information					Intermediate Device					Field Device				
Tag	Point Type	System Name	Object Name	Expanded ID	Display Units	DC Type	N2 Trunk	N2 Addr	Cable Destination Bay/Terminal	Module Type	Termination	Panel	Panel Location	Slot Number	Reference Drawing	Cable Number	Wiring/Tubing	Termination In	Device	Termination Out	Location	Wiring/Tubing	Terminations	Device	Location	Ref Detail
						DX9100						EN-8	Basement													
						DX9100	1	26				EN-8	Basement													
AI-1						DX9100	1	26	AI-1			EN-8	Basement			8-26-AI-1										
AI-2						DX9100	1	26	AI-2			EN-8	Basement			8-26-AI-2										
AI-3						DX9100	1	26	AI-3			EN-8	Basement			8-26-AI-3										
AI-4						DX9100	1	26	AI-4			EN-8	Basement			8-26-AI-4										
AI-5						DX9100	1	26	AI-5			EN-8	Basement			8-26-AI-5										
AI-6						DX9100	1	26	AI-6			EN-8	Basement			8-26-AI-6										
AI-7						DX9100	1	26	AI-7			EN-8	Basement			8-26-AI-7										
AI-8						DX9100	1	26	AI-8			EN-8	Basement			8-26-AI-8										
AO-1						DX9100	1	26	AO-1			EN-8	Basement			8-26-AO-1										
AO-2						DX9100	1	26	AO-2			EN-8	Basement			8-26-AO-2										
AO-9						DX9100	1	26	AO-9			EN-8	Basement			8-26-AO-9										
AO-10						DX9100	1	26	AO-10			EN-8	Basement			8-26-AO-10										
AO-11						DX9100	1	26	AO-11			EN-8	Basement			8-26-AO-11										
AO-12						DX9100	1	26	AO-12			EN-8	Basement			8-26-AO-12										
AO-13						DX9100	1	26	AO-13			EN-8	Basement			8-26-AO-13										
AO-14						DX9100	1	26	AO-14			EN-8	Basement			8-26-AO-14										
DI-1						DX9100	1	26	DI-1			EN-8	Basement			8-26-DI-1										
DI-2						DX9100	1	26	DI-2			EN-8	Basement			8-26-DI-2										
DI-3						DX9100	1	26	DI-3			EN-8	Basement			8-26-DI-3										
DI-4						DX9100	1	26	DI-4			EN-8	Basement			8-26-DI-4										
DI-5		FUEL-SYS	FP1-A	Fuel Oil Pump 1 Failure	Normal Alarm	DX9100	1	26	DI-5		DI#.COM	EN-8	Basement			8-26-DI-5						'2/18	Device dependent Contact (NO)			D70
DI-6		FUEL-SYS	FP2-A	Fuel Oil Pump 2 Failure	Normal Alarm	DX9100	1	26	DI-6		DI#.COM	EN-8	Basement			8-26-DI-6						'2/18	Device dependent Contact (NO)			D70
DI-7		FUEL-SYS	FP3-A	Fuel Oil Pump 3 Failure	Normal Alarm	DX9100	1	26	DI-7		DI#.COM	EN-8	Basement			8-26-DI-7						'2/18	Device dependent Contact (NO)			D70
DI-8		FUEL-SYS	FP4-A	Fuel Oil Pump 4 Failure	Normal Alarm	DX9100	1	26	DI-8		DI#.COM	EN-8	Basement			8-26-DI-8						'2/18	Device dependent Contact (NO)			D70
DO-3		FUEL-SYS	FP5-A	Fuel Oil Pump 5 Failure	Normal Alarm	DX9100	1	26	DO-3		DI#.COM	EN-8	Basement			8-26-DO-3						'2/18	Device dependent Contact (NO)			D70
DO-4						DX9100	1	26	DO-4			EN-8	Basement			8-26-DO-4										
DO-5						DX9100	1	26	DO-5			EN-8	Basement			8-26-DO-5										
DO-6						DX9100	1	26	DO-6			EN-8	Basement			8-26-DO-6										
DO-7						DX9100	1	26	DO-7			EN-8	Basement			8-26-DO-7										
DO-8						DX9100	1	26	DO-8			EN-8	Basement			8-26-DO-8										
						XT9100						EN-8	Basement													
						XT9100	1	27				EN-8	Basement													
XT1DI1		FUEL-SYS	FP5-A	Fuel Oil Pump 5 Failure	Normal Alarm	XP9105CO	1	27	DI-1		DI#.COM	EN-8	Basement			8-27A-DI-1						'2/18	Device dependent Contact (NO)			XP40
XT1DI2		PLT-MISC	BP1LS-A	Booster Pump Low Sys	Normal Alarm	XP9105CO	1	27	DI-2		DI#.COM	EN-8	Basement			8-27A-DI-2						'2/18	Device dependent Contact (NO)			XP40
XT1DI3		PLT-MISC	BP1HS-A	Booster Pump High Sys	Normal Alarm	XP9105CO	1	27	DI-3		DI#.COM	EN-8	Basement			8-27A-DI-3						'2/18	Device dependent Contact (NO)			XP40
XT1DI4		PLT-MISC	BPLSC-A	Booster Pump Low Suc.	Normal Alarm	XP9105CO	1	27	DI-4		DI#.COM	EN-8	Basement			8-27A-DI-4						'2/18	Device dependent Contact (NO)			XP40
XT1DI5						XP9105CO	1	27	DI-5			EN-8	Basement			8-27A-DI-5										
XT1DI6						XP9105CO	1	27	DI-6			EN-8	Basement			8-27A-DI-6										
XT1DI7						XP9105CO	1	27	DI-7			EN-8	Basement			8-27A-DI-7										
XT1DI8		PLT-MISC	SPHL-A	Sump Pump High Level	Normal Alarm	XP9105CO	1	27	DI-8		DI#.COM	EN-8	Basement			8-27A-DI-8						'2/18	Device dependent Contact (NO)			XP40
XT2DI1						XP9105NC	1	27	DI-1			EN-8	Basement			8-27B-DI-1										
XT2DI2						XP9105NC	1	27	DI-2			EN-8	Basement			8-27B-DI-2										
XT2DI3		PLT-MISC	SEHL-A	Sewage Eject High Level	Normal Alarm	XP9105NC	1	27	DI-3		DI#.COM	EN-8	Basement			8-27B-DI-3						'2/18	Device dependent Contact (NO)			XP40
XT2DI4						XP9105NC	1	27	DI-4			EN-8	Basement			8-27B-DI-4										
XT2DI5		SF-E2	SMD-S	Smoke Damper Status	Closed Open	XP9105NC	1	27	DI-5		DI#.COM	EN-8	Basement			8-27B-DI-5						'2/18	Device dependent Contact (NO)			XP40
XT2DI6						XP9105NC	1	27	DI-6			EN-8	Basement			8-27B-DI-6										
XT2DI7						XP9105NC	1	27	DI-7			EN-8	Basement			8-27B-DI-7										
XT2DI8						XP9105NC	1	27	DI-8			EN-8	Basement			8-27B-DI-8										

625-3229 D

ER NO	LTR	NO	REVISION	ZONE	DR	CHKR	APPROVED	DATE
-	A	1	ENGINEERING RELEASE	-	DO	TC	RJT	8-18-95
71,726	B	1	RECORD RELEASE	-	TB	JA	TV	11-30-95

TOTALIZER DOOR

(REAR VIEW)



CADAM DWG

CLASSIFICATION OF CHARACTERISTICS
CRITICAL ●
MAJOR ◐
MINOR (NONE)
LINE BELOW SYMBOL ● APPLIES TO UPPER LIMIT
LINE ABOVE SYMBOL ● APPLIES TO LOWER LIMIT
NO LINE WITH SYMBOL APPLIES TO BOTH LIMITS

APPROVED N/A
DATE 8-18-95

DO NOT SCALE PRINT

TOLERANCE UNLESS OTHERWISE SPECIFIED

THIRD ANGLE PROJECTION

	NAME	DATE
DR	D. OLENE	8-18-95
CHKR B / MFG D	T. O'BRIEN	9-1-95
APPROVED	R. THAYER	9-1-95

OSPS 6000R/427B

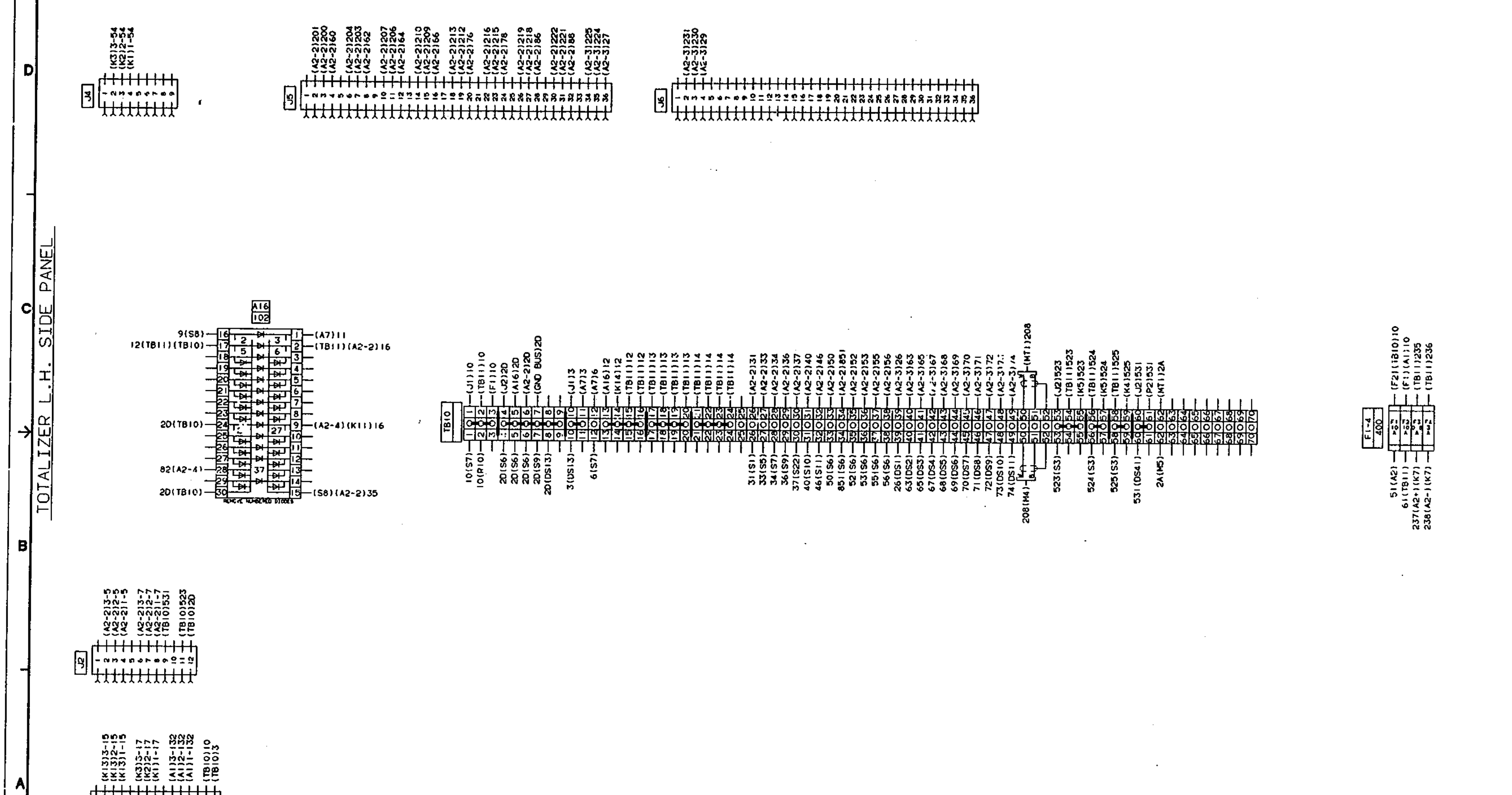
Onan

MINNEAPOLIS, MINNESOTA 55432

TITLE WIRING DIAGRAM (TOTALIZER DOOR)

DWG NO 625-3229 D

625-3229 D



CADAM DWG

CLASSIFICATION OF CHARACTERISTICS
CRITICAL ●
MAJOR ◐
MINOR (NONE)
APPROVED N/A
DATE 8-18-95
LINE BELOW SYMBOL APPLIES TO UPPER LIMIT
LINE ABOVE SYMBOL APPLIES TO LOWER LIMIT
NO LINE WITH SYMBOL APPLIES TO BOTH LIMITS

DO NOT SCALE PRINT

	Name	Date
DR	D. OLENE	8-18-95
CHKR	T. O'BRIEN	9-5-95
APPROVED	R. THAYER	9-5-95

Model first used on: OSPS 6000R/427B

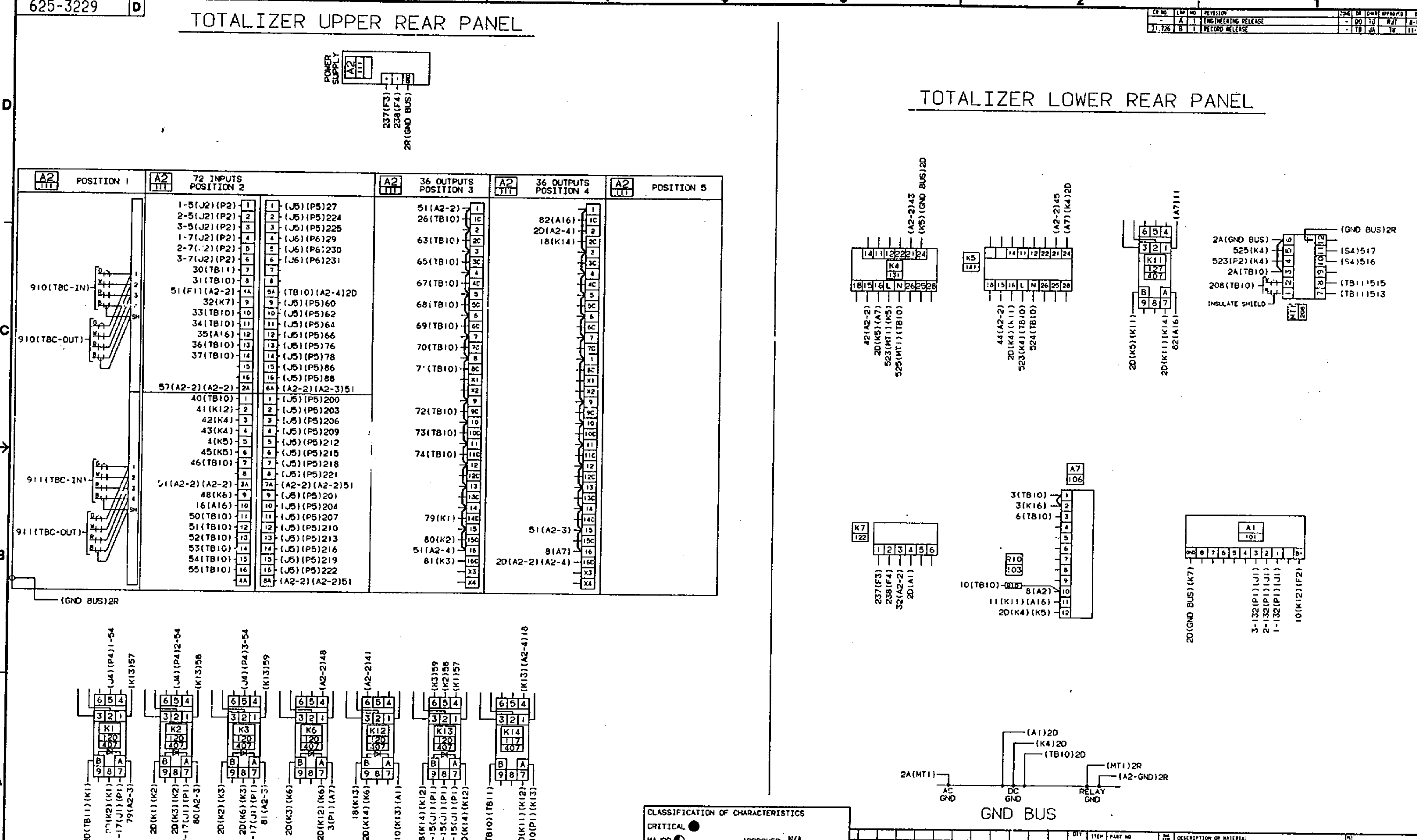
Onan

MINNEAPOLIS, MINNESOTA 55432

WIRING DIAGRAM (TOTALIZER LH SIDE PNL)

625-3229 6-37 D

625-3229 D



ER NO	LTR	NO	REVISION	ZONE	DR	CHKR	APPROVED	DATE
-	A	1	ENGINEERING RELEASE	-	DO	TJ	RJT	8-11-95
71,726	B	1	RECORD RELEASE	-	TB	JA	TW	11-30-95

CLASSIFICATION OF CHARACTERISTICS
CRITICAL
MAJOR
MINOR (NONE)
LINE BELOW SYMBOL APPLIES TO UPPER LIMIT
LINE ABOVE SYMBOL APPLIES TO LOWER LIMIT
NO LINE WITH SYMBOL APPLIES TO BOTH LIMITS

APPROVED N/A
DATE 8-18-95

CADAM DWG

DO NOT SCALE PRINT

DR D. OLENE 8-18-95
CHKR T. O'BRIEN 9-5-95
APPROVED R. THAYER 9-5-95

0SPS 6000R/427B

Onan

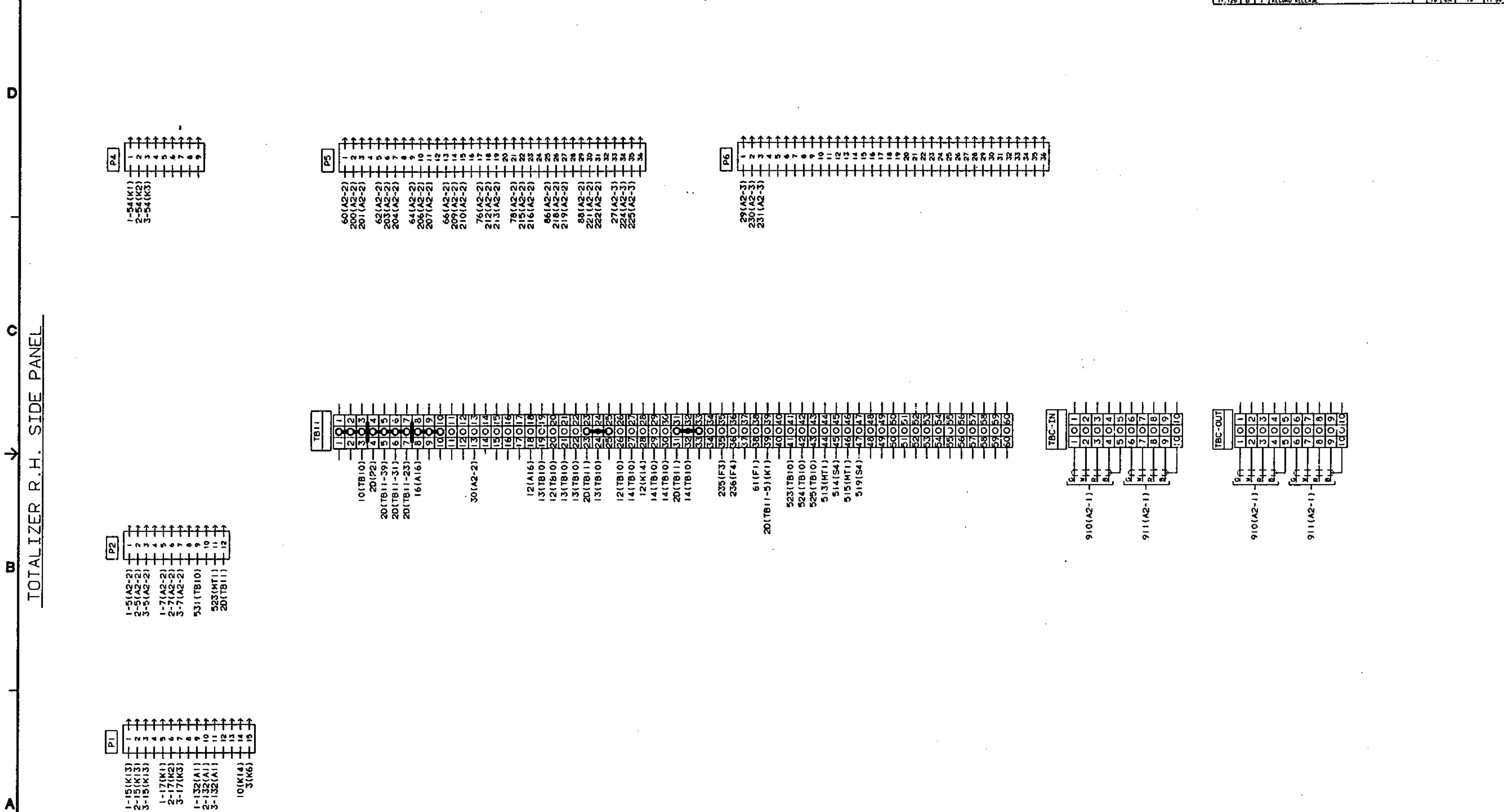
MINNEAPOLIS, MINNESOTA 55432

WIRING DIAGRAM (TOT UPR REAR PNL)

625-3229 7 of 31 D

625-3229 D

CR NO	LTR	NO	REVISION	ZONE	DR	CHKR	APPROVED	DATE
-	A	1	ENGINEERING RELEASE	-	DO	TO	RJT	8-18-95
77,726	B	1	RECORD RELEASE	-	TB	JA	TW	11-30-95



CLASSIFICATION OF CHARACTERISTICS
CRITICAL ●
MAJOR ◐
MINOR (NONE)
APPROVED N/A
DATE 8-18-95
LINE BELOW SYMBOL ● APPLIES TO UPPER LIMIT
LINE ABOVE SYMBOL ● APPLIES TO LOWER LIMIT
NO LINE WITH SYMBOL APPLIES TO BOTH LIMITS

CADAM DWG

DO NOT SCALE PRINT

TOLERANCE UNLESS OTHERWISE SPECIFIED

	NAME	DATE
DR	D. OLENE	8-18-95
CHKR	T. O'BRIEN	9-5-95
APPROVED	R. THAYER	9-5-95

MODEL FIRST USED ON: DSPS 6000R/427B

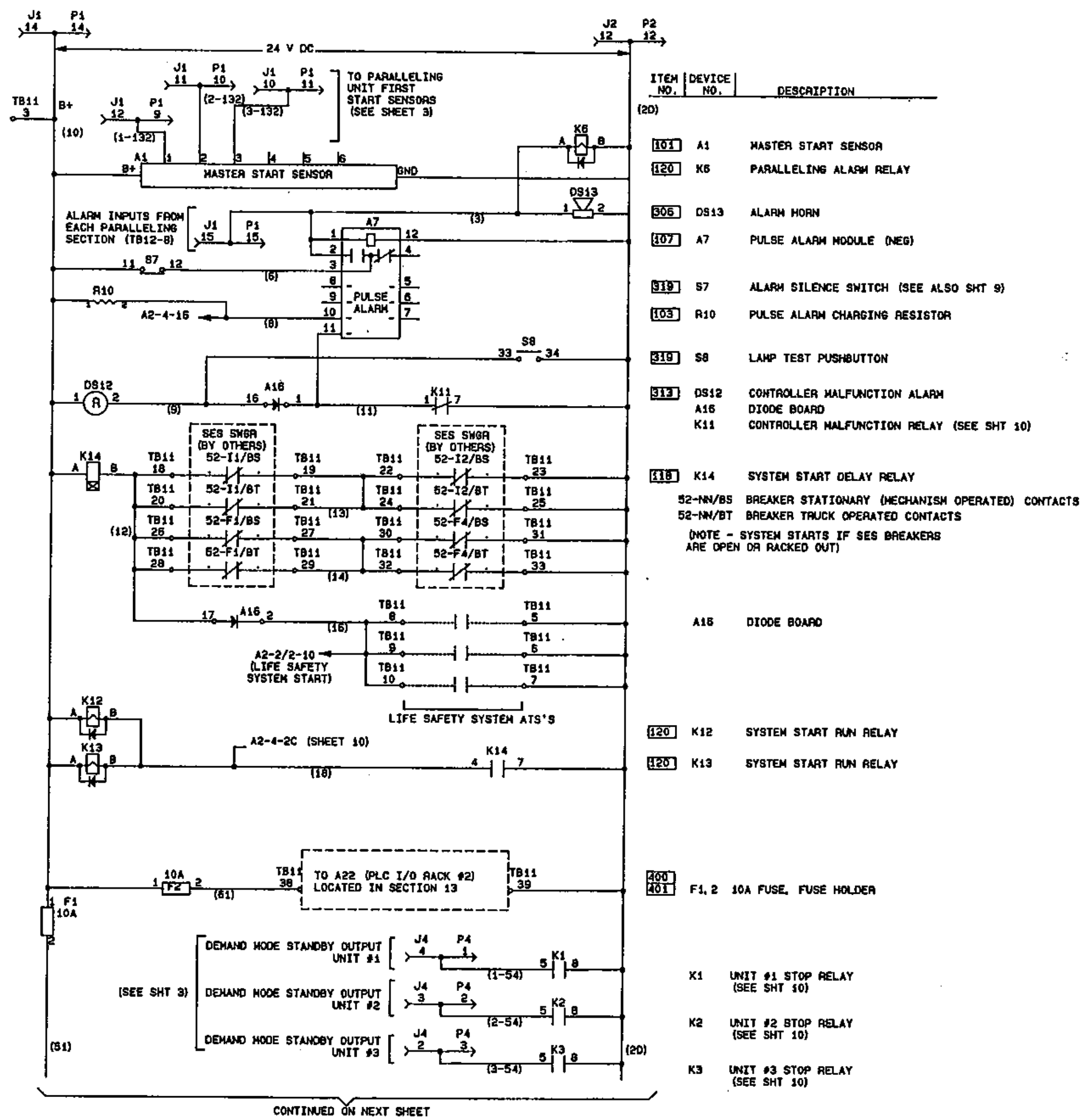
Onan

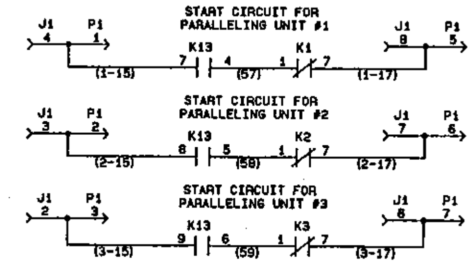
MINNEAPOLIS, MINNESOTA 55432

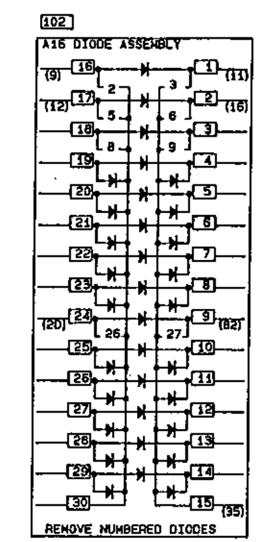
TITLE: WIRING DIAGRAM (TOT RH SIDE PNL)

DWG NO 625-3229 SHEET 8 of 37 SIZE D

ER No.	Ltr	No.	Revision	Zone	Dr	Chkr	Approved	Date
—	A	1	ENGINEERING RELEASE	—	RJT	RR	RBJT	10-11-95
71,726	B	1	RECORD RELEASE	—	RJT	DD	TPW	12-7-95







FILENAME: TDC30CH
PLOTTED: 12-04-95

Do Not Scale Print

Third Angle Projection

Dr	Name	Date
Dr	R. Traver	10-11-95
Chk	D. Olsen	10-11-95
Approved	R. Traver	10-11-95

Model first used on: OSPS 6000R/427B

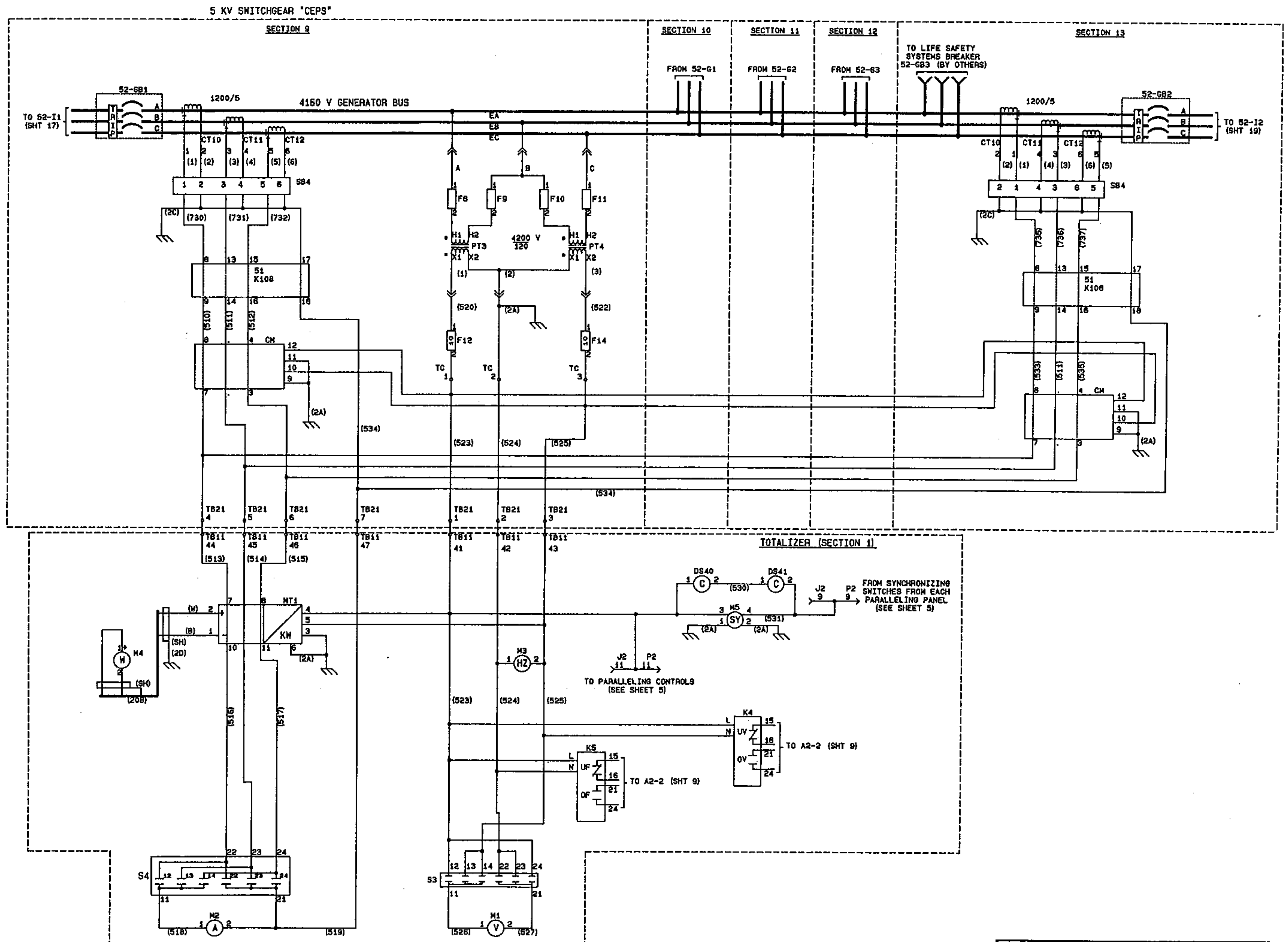
Onan — Minneapolis, Minnesota 55432

SCHEMATIC DIAGRAM (TOTALIZER DC3)

Dwg No. 625-3228 Sheet 8 of 19 Dwg Size D

B8C131 3-89

ER No.	Ltr	No.	Revision	Zone	Dr	Chkr	Approved	Date
—	A	1	ENGINEERING RELEASE	--	RJT	TO	AT	10-11-9
71,726	B	1	RECORD RELEASE	--	RJT	DO	TPW	12-07-9



ANMETER SWITCH								
S4	OFF	*	1	*	2	*	3	
11 – 12		X	X	X				
13				X	X	X		
14						X	X	
21 – 22	X	X		X	X	X	X	
23	X	X	X	X		X	X	
24	X	X	X	X	X	X		
MAKE BEFORE BREAK TRANSFER								

VOLTMETER SWITCH								
S3					OFF	1-2	2-3	3-1
11 – 12						X		
13							X	
14								X
21 – 22						X		
23							X	
24								X

	112	CM	CIRCUIT MONITOR
	213	CT10-12	1200:5 CURRENT TRANSFORMER
310	311	DS40, 41	SYNCHRONIZING LAMPS
	REF	F8-11	PT FUSES (BY SQUARE D)
400	401	F12-14	FUSES - 10A
	131	K4	EMERGENCY BUS UNDER/OVERVOLTAGE RELAY
	141	K5	EMERGENCY BUS UNDER/OVERFREQUENCY RELAY
	132	K10B	TIME OVERCURRENT RELAY (3 PH & GND)
	201	M1	VOLTMETER
	202	M2	AMMETER
	204	M3	FREQUENCY METER
	206	M4	WATTMETER
	214	M5	SYNCHROSCOPE
	208	MT1	WATT TRANSDUCER
	REF	PT3, 4	GENERATOR BUS PT'S
	301	S3	VOLTMETER SWITCH - 4 POSITION
	302	S4	AMMETER SWITCH - 4 POSITION
	449	SB4	SHORTING BLOCK

FILENAME: TAC20CH
PLOTTED: 10-10-95

Do Not Scale Print

Tolerances unless otherwise specified

Third Angle Projection

This document is the property of Onan Corporation. It contains proprietary and confidential information which must not be duplicated, used or disclosed other than as expressly authorized by Onan Corporation or its representative.

For interpretation of dimensioning and tolerancing, see ANSI Y14.5M-1982

	Name	Date
Dr	R. J. THAYER	10-11-95
Chkr / Mfg	D. OLENE	10-11-95
Approved	RJ Thayer	10/11/95

Model first used on: OSPS 6000R/427B

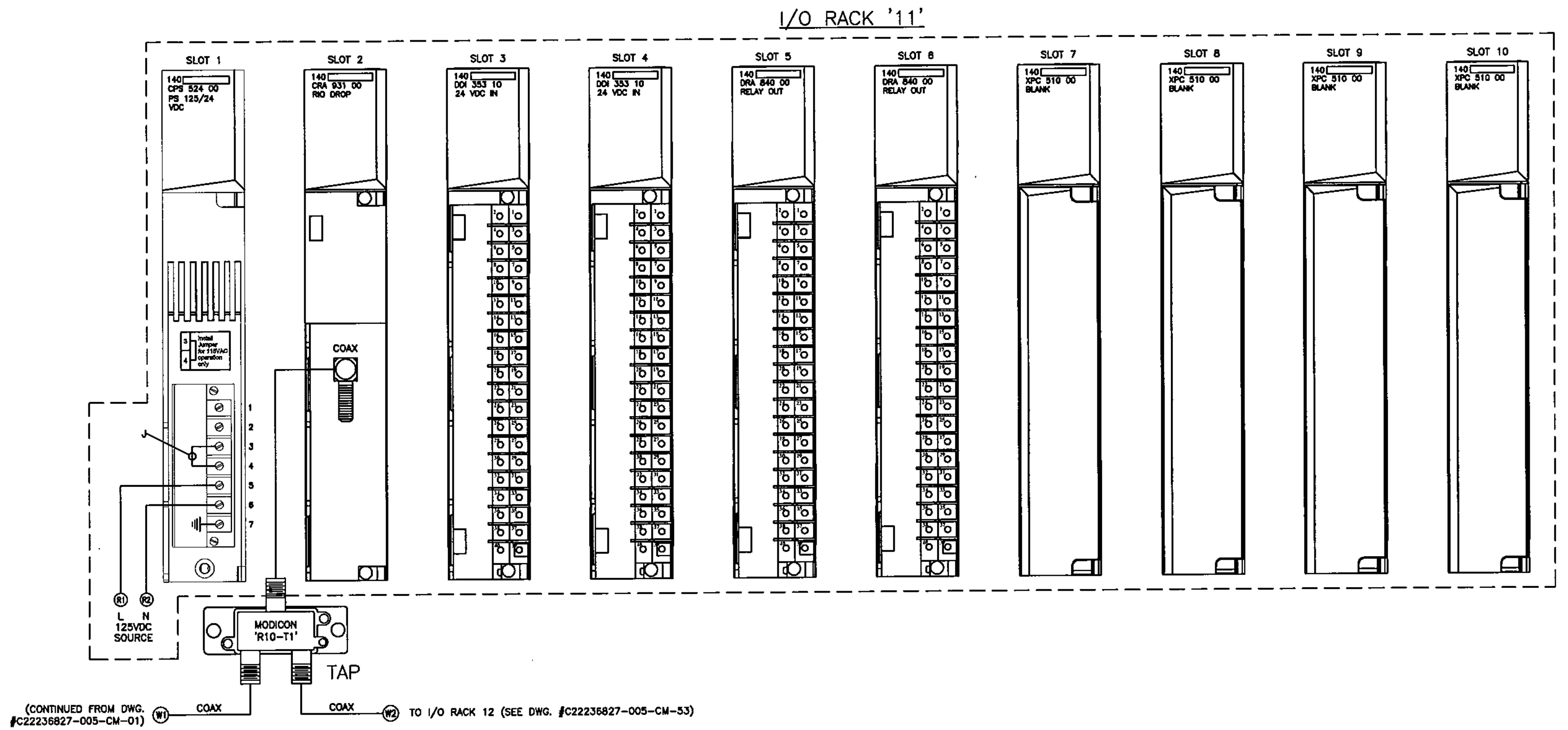
Cummins Onan

Minneapolis, Minnesota 55432

Title: SCHEMATIC DIAGRAM (TOTALIZER AC2)

Dwg No. 625-3228 Sheet 18/19 Dwg Size D

REV	DESCRIPTION	BY	DATE
–	----	--	--/--/--



PMO ENGINEERING SERVICES – PROJECTS

CHECKED BY: ---
CHECKED DATE: ---
PLANT LOCATION: P48 (ENG SVCS – PROJECTS)

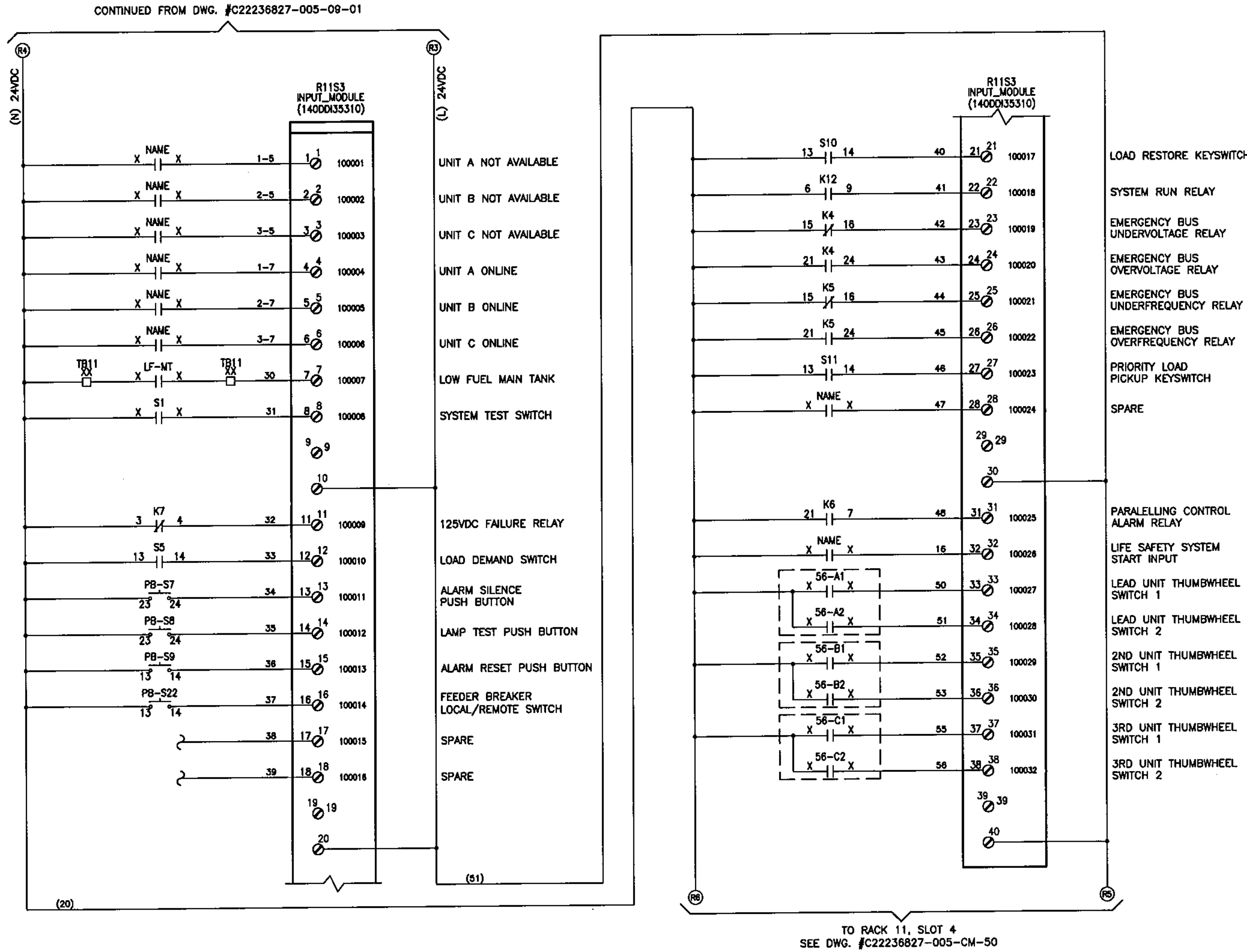
JOB NAME: ORANGE COUNTY COURTHOUSE COMPLEX
JOB LOCATION: ORLANDO, FL.
DRAWN BY: R. FISHER
ENGR: BRIAN REAGAN
DATE: JANUARY 7, 2008
DRAWING STATUS: AS BUILT

EQUIPMENT DESIGNATION: –
EQUIPMENT TYPE: –
DRAWING TYPE: RACK LAYOUT & COMMUNICATIONS WIRING – RACK 11

SQUARE D
Schneider Electric

DWG# C22236827-005-CM | PG 48 OF – | REV –

REV	DESCRIPTION	BY	DATE								
-	----	--	--/--/--	-	----	--	--/--/--	-	----	--	--/--/--
				-	----	--	--/--/--	-	----	--	--/--/--



QUANTUM I/O DC INPUT 24VDC 4X8 SINK MODULE

140 DDI 353 10 24VDC DIGITAL INPUT

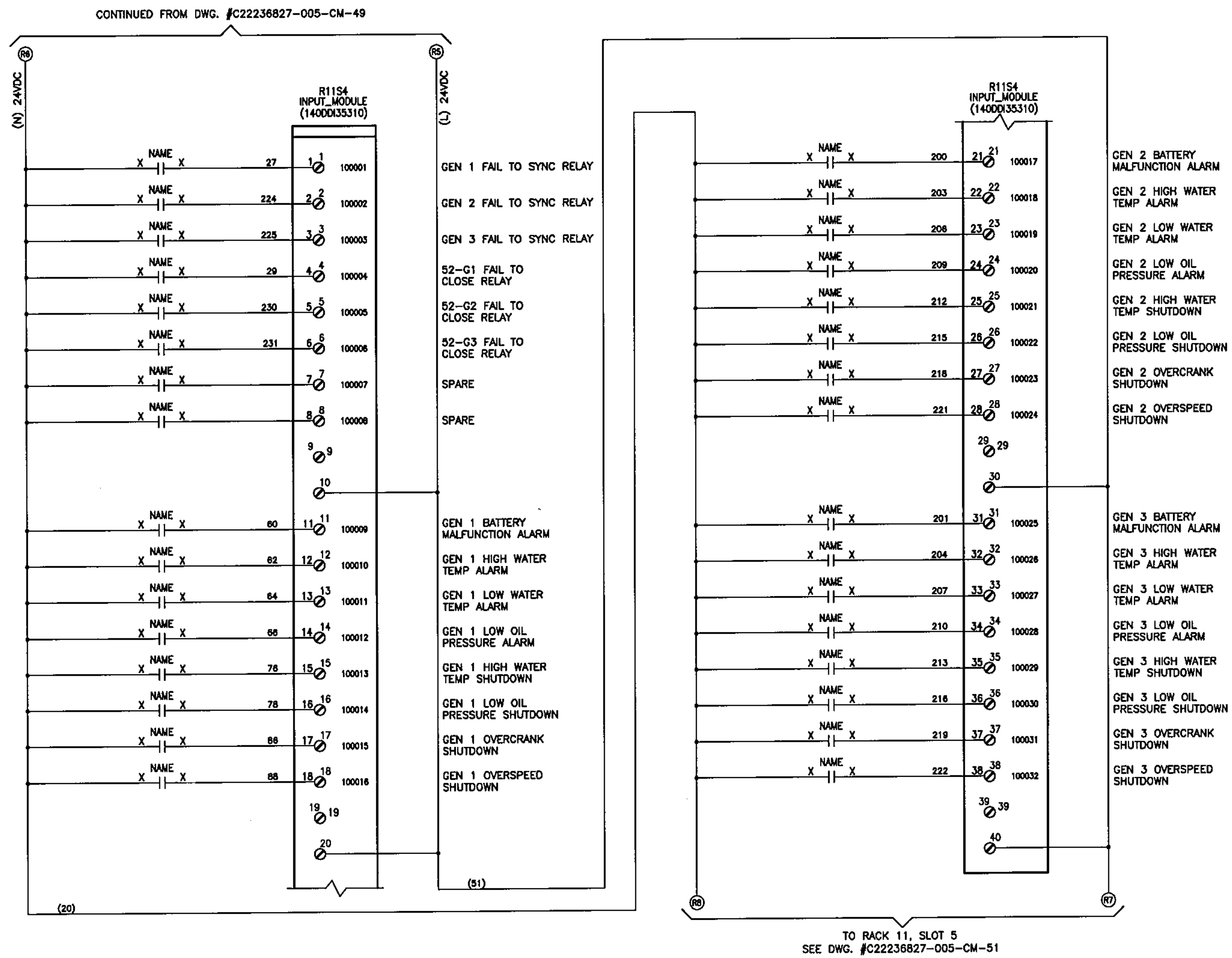
PMO ENGINEERING SERVICES – PROJECTS

CHECKED BY:	---
CHECKED DATE:	---
PLANT LOCATION:	P48 (ENG SVCS – PROJECTS)
JOB NAME:	ORANGE COUNTY COURTHOUSE COMPLEX
JOB LOCATION:	ORLANDO, FL.
DRAWN BY:	R. FISHER
ENGR:	BRIAN REAGAN
DATE:	JANUARY 7, 2008
DRAWING STATUS:	AS BUILT
EQUIPMENT DESIGNATION:	–
EQUIPMENT TYPE:	–
DRAWING TYPE:	PLC DIGITAL INPUT MODULE – RACK 11, SLOT 3

SQUARE D
Schneider Electric

DWG# C22236827-005-CM | PG 49 | OF – | REV –

REV	DESCRIPTION	BY	DATE	-	----	--	--/--/--	-	----	--	--/--/--
-	----	--	--/--/--	-	----	--	--/--/--	-	----	--	--/--/--



QUANTUM I/O DC INPUT 24VDC 4X8 SINK MODULE

140 DDI 353 10 24VDC DIGITAL INPUT

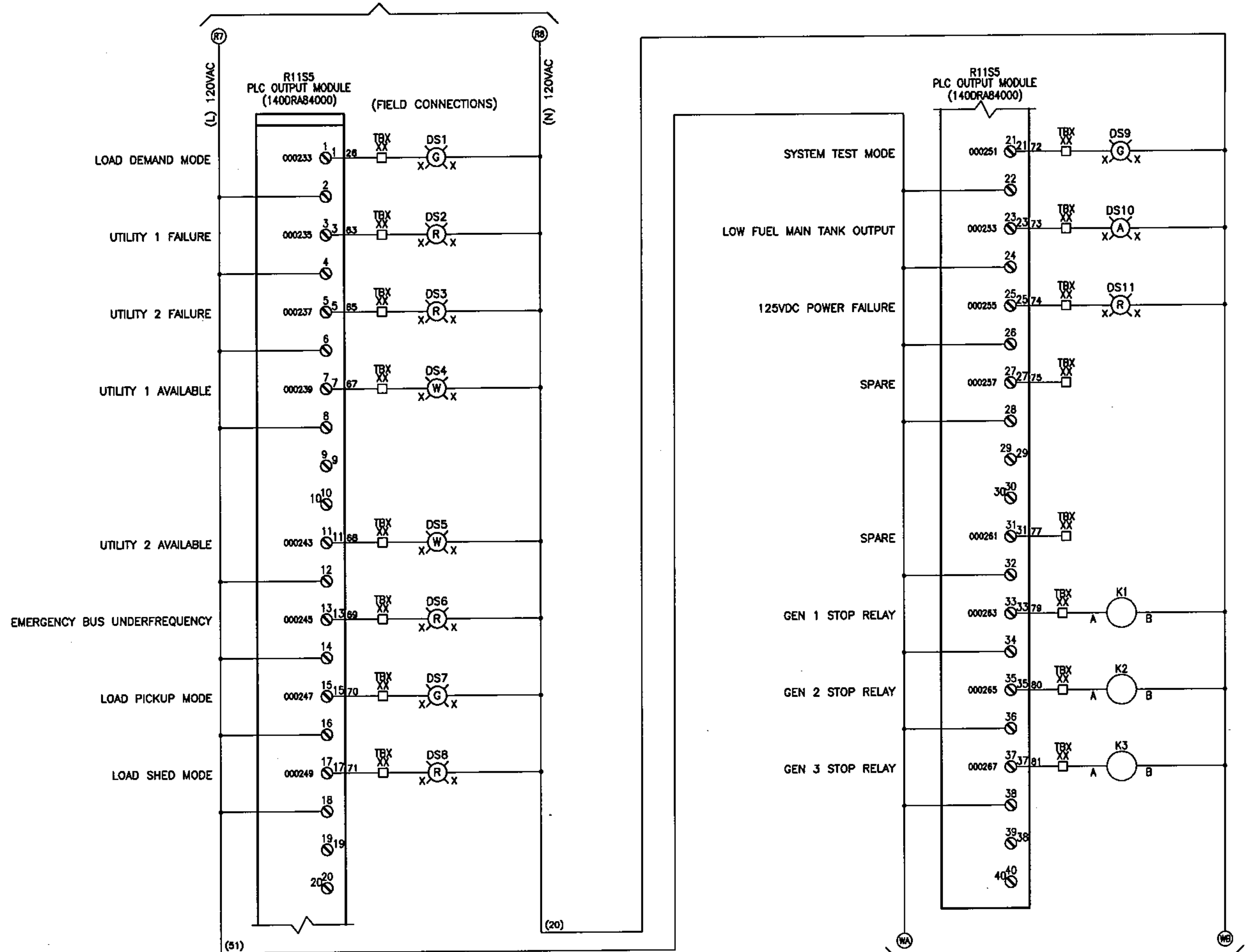
PMO ENGINEERING SERVICES – PROJECTS

CHECKED BY:	---
CHECKED DATE:	---
PLANT LOCATION:	P48 (ENG SVCS – PROJECTS)
JOB NAME:	ORANGE COUNTY COURTHOUSE COMPLEX
JOB LOCATION:	ORLANDO, FL.
DRAWN BY:	R. FISHER
ENGR:	BRIAN REAGAN
DATE:	JANUARY 7, 2008
DRAWING STATUS:	AS BUILT
EQUIPMENT DESIGNATION:	–
EQUIPMENT TYPE:	–
DRAWING TYPE:	PLC DIGITAL INPUT MODULE – RACK 11, SLOT 4

SQUARE D
Schneider Electric

REV	DESCRIPTION	BY	DATE	-	----	--	--/--/--	-	----	--	--/--/--
-	----	--	--/--/--	-	----	--	--/--/--	-	----	--	--/--/--

CONTINUED FROM DWG. #C22236827-005-CM-50



TO RACK 11, SLOT 6
SEE DWG. #C22236827-005-CM-52

QUANTUM I/O RELAY OUTPUT 16X1 NORMALLY OPEN MODULE

140 DRA 840 00 (CONFIGURED AS DRY CONTACTS)

PMO ENGINEERING SERVICES – PROJECTS

CHECKED BY: ---
CHECKED DATE: ---
PLANT LOCATION: P48 (ENG SVCS – PROJECTS)

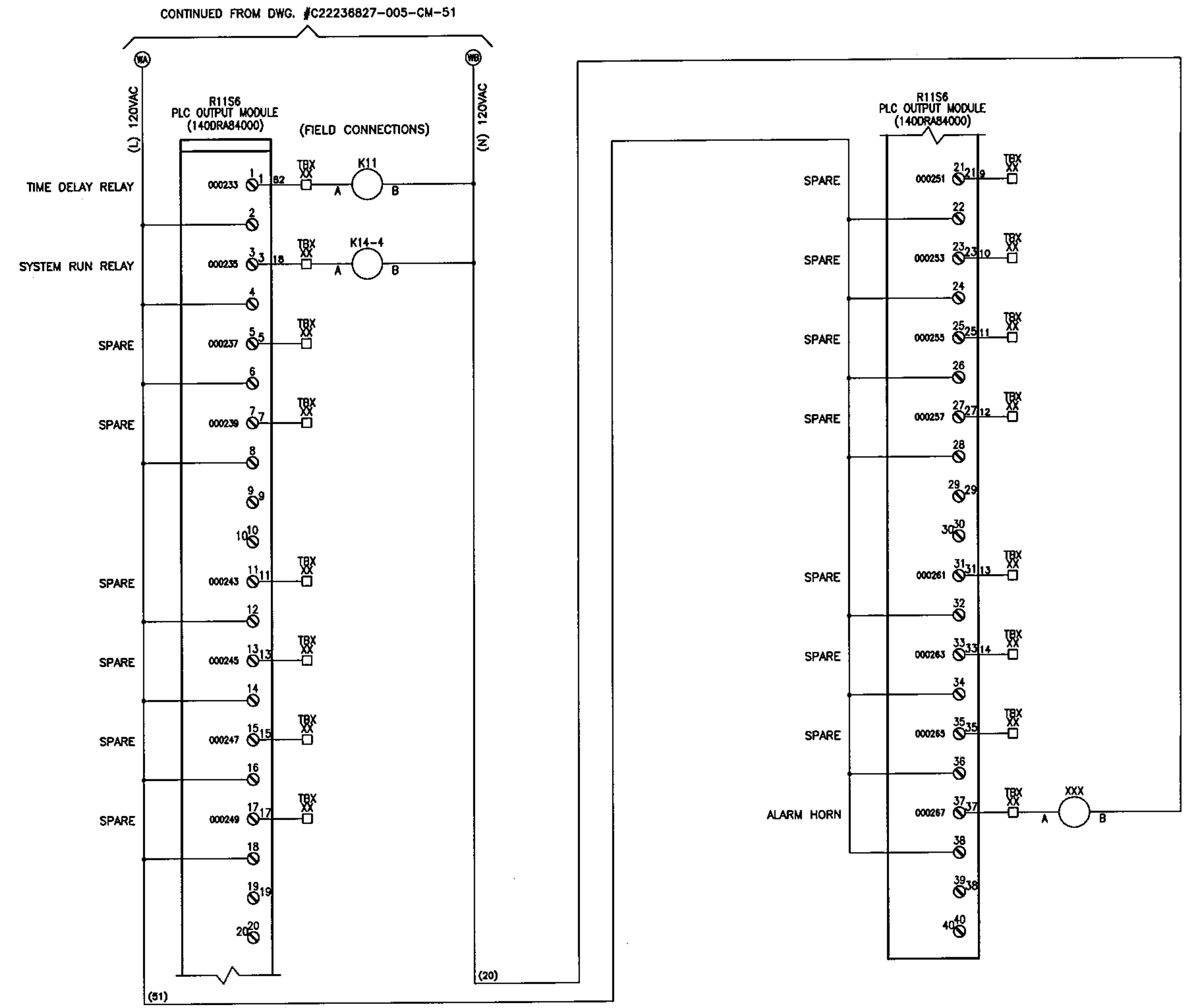
JOB NAME: ORANGE COUNTY COURTHOUSE COMPLEX
JOB LOCATION: ORLANDO, FL.
DRAWN BY: R. FISHER
ENGR: BRIAN REAGAN
DATE: JANUARY 7, 2008
DRAWING STATUS: AS BUILT

EQUIPMENT DESIGNATION: –
EQUIPMENT TYPE: –
DRAWING TYPE: PLC RELAY OUTPUT MODULE – RACK 11, SLOT 5

SQUARE D
Schneider Electric

DWG# C22236827-005-CM | PG 51 | OF – | REV –

REV	DESCRIPTION	BY	DATE									
–	----	--	--/--/--	–	----	--	--/--/--	–	----	--	--/--/--	
				–	----	--	--/--/--	–	----	--	--/--/--	



QUANTUM I/O RELAY OUTPUT 16X1 NORMALLY OPEN MODULE

140 DRA 840 00 (CONFIGURED AS DRY CONTACTS)

PMO ENGINEERING SERVICES – PROJECTS

CHECKED BY: ---
CHECKED DATE: ---
PLANT LOCATION: P48 (ENG SVCS – PROJECTS)

JOB NAME: ORANGE COUNTY COURTHOUSE COMPLEX
JOB LOCATION: ORLANDO, FL.
DRAWN BY: R. FISHER
ENGR: BRIAN REAGAN
DATE: JANUARY 7, 2008
DRAWING STATUS: AS BUILT

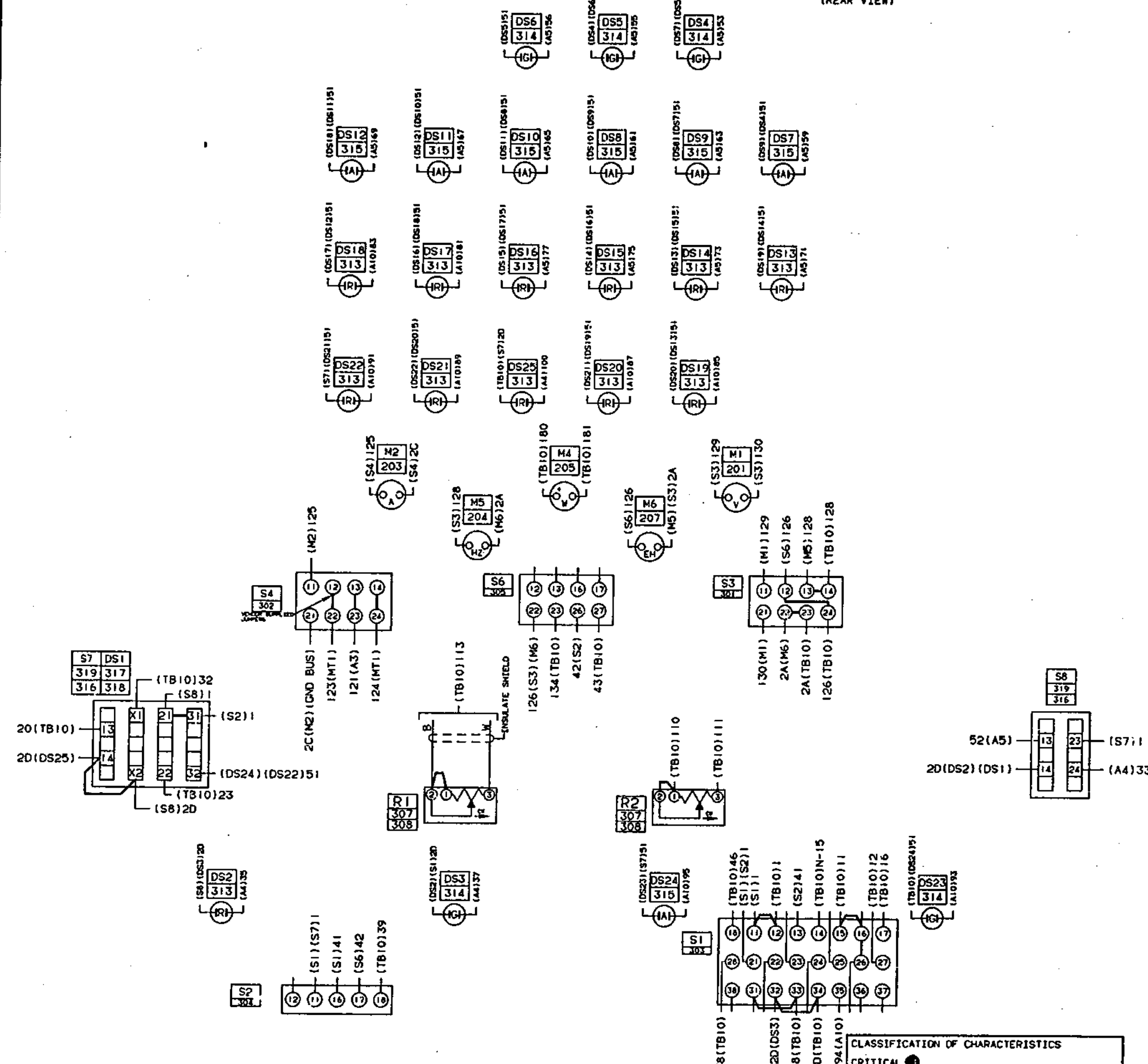
EQUIPMENT DESIGNATION: –
EQUIPMENT TYPE: –
DRAWING TYPE: PLC RELAY OUTPUT MODULE – RACK 11, SLOT 6

SQUARE D
Schneider Electric

DWG# C22236827-005-CM | PG 52 OF – | REV –

625-3229 D

PARALLELING DOOR
(REAR VIEW)



CLASSIFICATION OF CHARACTERISTICS	
CRITICAL	
MAJOR	APPROVED N/A
MINOR (NONE)	DATE 8-18-95
LINE BELOW SYMBOL APPLIES TO UPPER LIMIT	
LINE ABOVE SYMBOL APPLIES TO LOWER LIMIT	
NO LINE WITH SYMBOL APPLIES TO BOTH LIMITS	

CADAM DWG

DO NOT SCALE PRINT

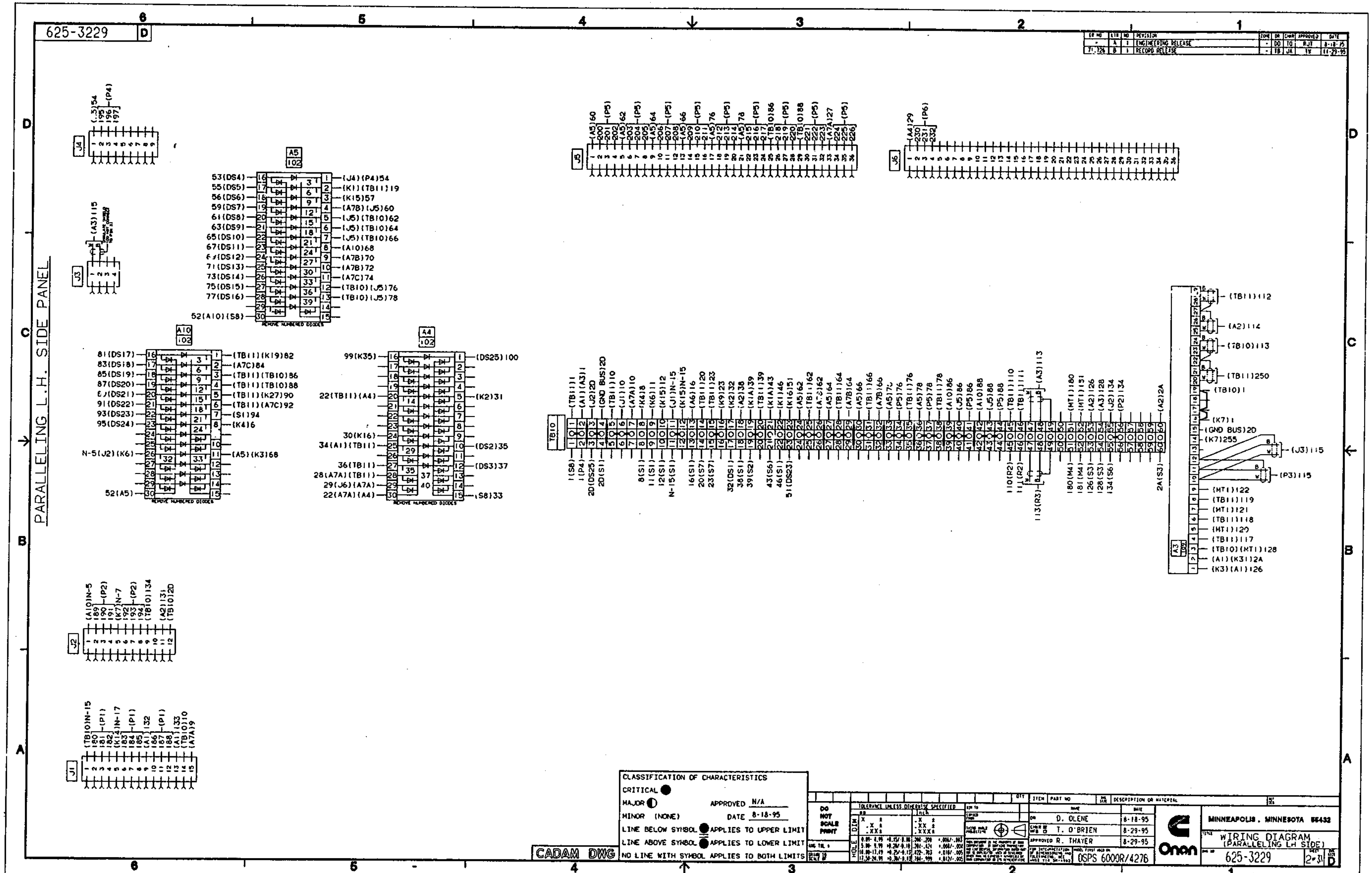
	NAME	DATE
DR	D. OLENE	8-18-95
CHKR / MFG	T. O'BRIEN	8-18-95
APPROVED	T. O'BRIEN	8-18-95

MODEL FIRST USED ON: OSPS 6000R/427B

Onan — MINNEAPOLIS, MINNESOTA 55432

TITLE: WIRING DIAGRAM (PARALLELING DOOR)

DWG NO: 625-3229 SHEET 1 of 1 SIZE D

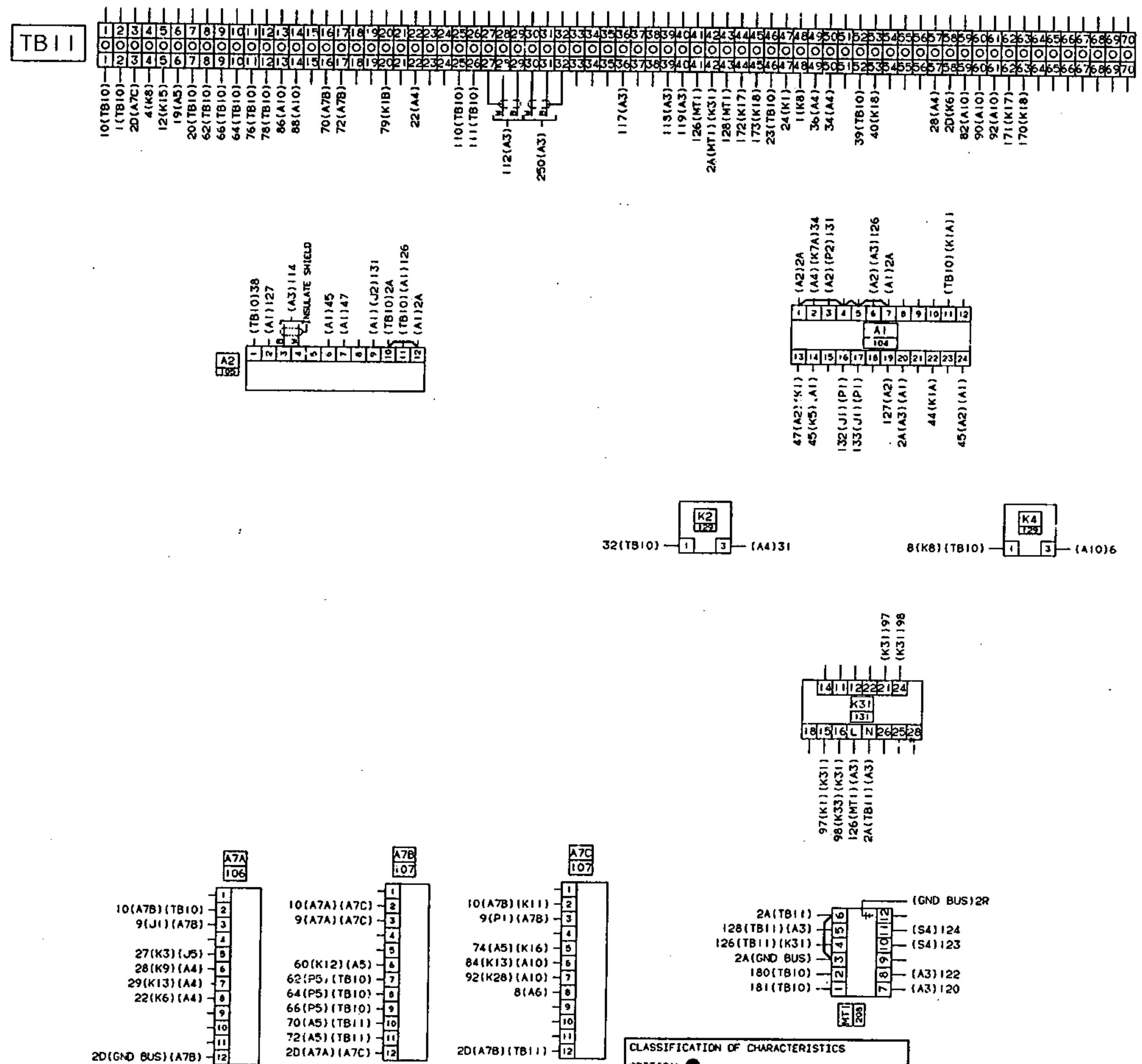


625-3229 D
PARALLELING L.H. SIDE PANEL
ENGINEERING RELEASE 8-18-95
RECORD RELEASE 11-29-95
J4
J3
J2
J1
A5 102
A10 102
A4 102
REMOVE NUMBERED DIODES
J5
J6
TB10
A3
CLASSIFICATION OF CHARACTERISTICS
CRITICAL
MAJOR
MINOR (NONE)
APPROVED N/A
DATE 8-18-95
LINE BELOW SYMBOL APPLIES TO UPPER LIMIT
LINE ABOVE SYMBOL APPLIES TO LOWER LIMIT
NO LINE WITH SYMBOL APPLIES TO BOTH LIMITS
CADAM DWG
DO NOT SCALE PRINT
D. OLENE 8-18-95
T. O'BRIEN 8-29-95
R. THAYER 8-29-95
OSPS 6000R/4276
Onan
MINNEAPOLIS, MINNESOTA 55432
WIRING DIAGRAM (PARALLELING LH SIDE)
625-3229
2 of 3
D

625-3229 D

PARALLELING UPPER REAR PANEL

ER NO	LTR	NO	REVISION	ZONE	DR	CHKR	APPROVED	DATE
-	A	1	ENGINEERING RELEASE	-	DO	TO	RJ	8-18-95
11,726	B	1	RECORD RELEASE	-	TB	JR	JV	11-30-95



CLASSIFICATION OF CHARACTERISTICS
CRITICAL
MAJOR
MINOR (NONE)
APPROVED N/A
DATE 8-18-95
LINE BELOW SYMBOL APPLIES TO UPPER LIMIT
LINE ABOVE SYMBOL APPLIES TO LOWER LIMIT
NO LINE WITH SYMBOL APPLIES TO BOTH LIMITS

CADAM DWG

DO NOT SCALE PRINT

	NAME	DATE
DR	D. OLENE	8-18-95
CHECKED	T. O'BRIEN	8-29-95
APPROVED	T. O'BRIEN	8-29-95

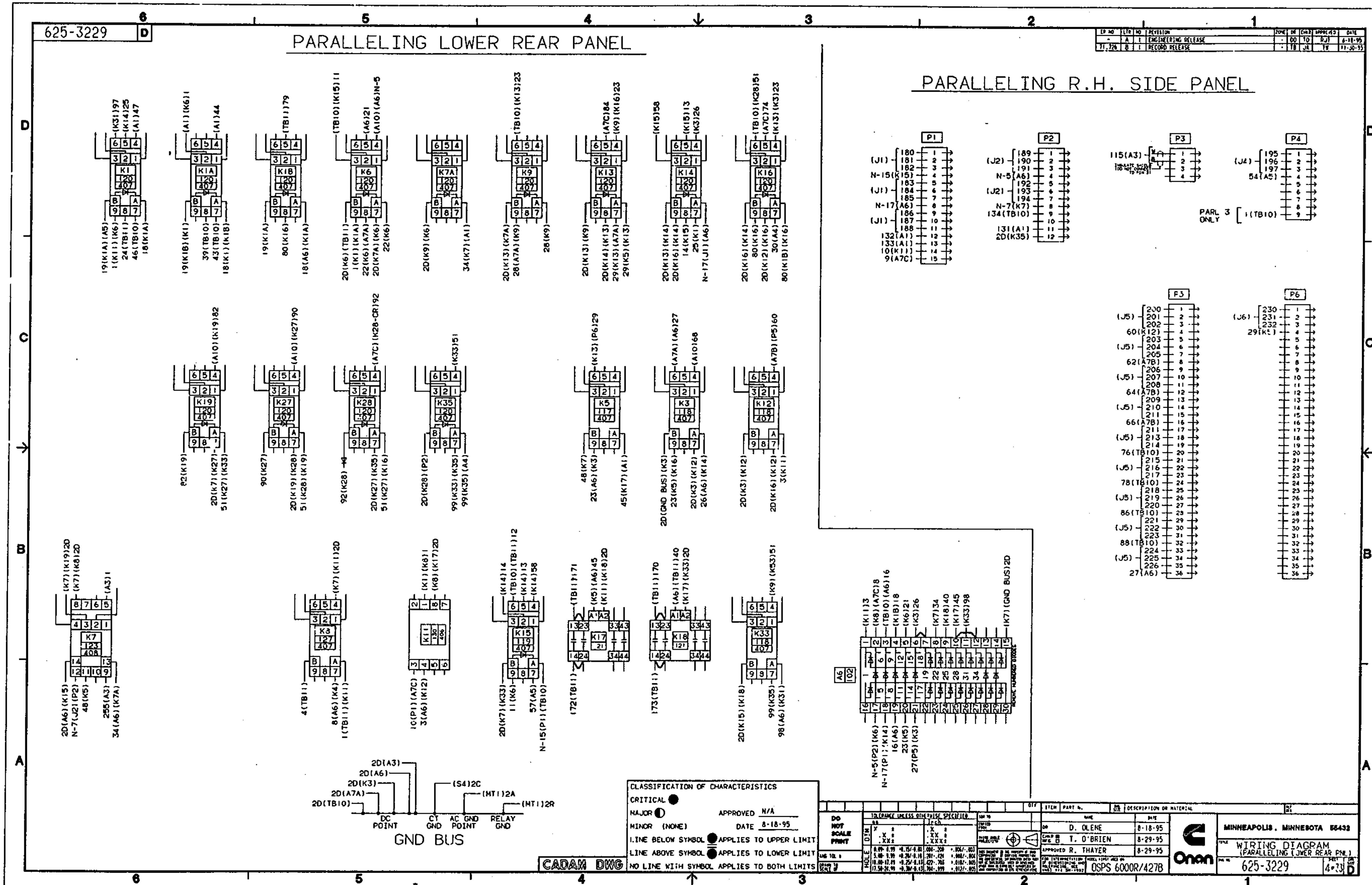
OSPS 6000R/4278

Onan

MINNEAPOLIS, MINNESOTA 55432

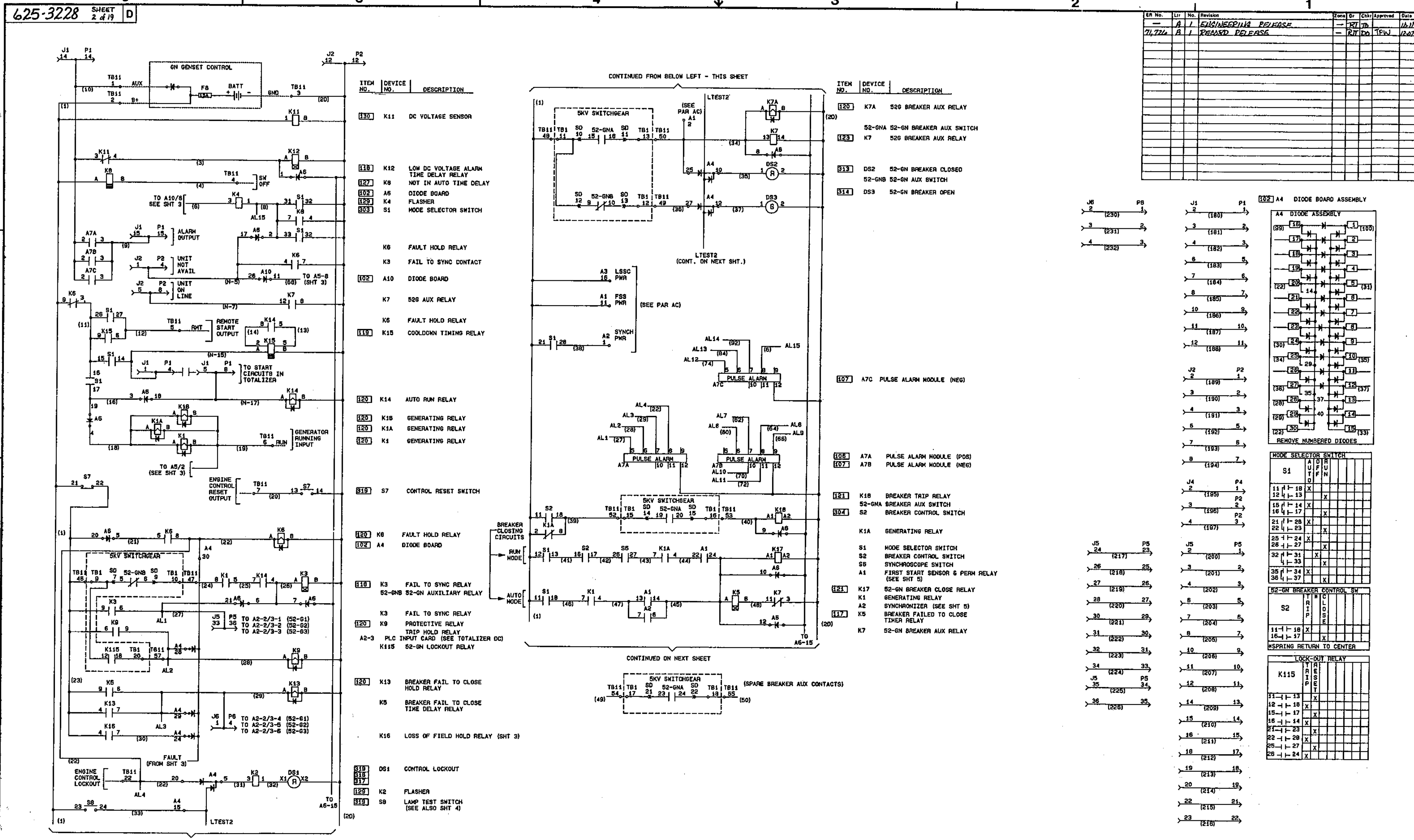
WIRING DIAGRAM (PARALLELING UPPER REAR PNL)

625-3229 D



625-3229 D
PARALLELING LOWER REAR PANEL
PARALLELING R.H. SIDE PANEL
P1
P2
P3
P4
P5
P6
K1
K1A
K1B
K6
K7A
K9
K13
K14
K16
K19
K27
K28
K35
K5
K3
K12
K7
K8
K11
K15
K17
K18
K33
A6
GND BUS
DC POINT
CT GND
AC GND POINT
RELAY GND
PARL 3 ONLY
CLASSIFICATION OF CHARACTERISTICS
CRITICAL
MAJOR
MINOR (NONE)
APPROVED N/A
DATE 8-18-95
LINE BELOW SYMBOL APPLIES TO UPPER LIMIT
LINE ABOVE SYMBOL APPLIES TO LOWER LIMIT
NO LINE WITH SYMBOL APPLIES TO BOTH LIMITS
CADAM DWG
DO NOT SCALE PRINT
D. OLENE 8-18-95
T. O'BRIEN 8-29-95
R. THAYER 8-29-95
Onan
MINNEAPOLIS, MINNESOTA 55432
WIRING DIAGRAM (PARALLELING LOWER REAR PNL)
625-3229
D

625-3228 SHEET 2 of 19 D



ER No.	Ltr	No.	Revision	Zone	Dr	Chkr	Approved	Date
—	A	1	ENGINEERING RELEASE	—	RJT	TD		10-11-95
71,726	B	1	REVISED RELEASE	—	RJT	DO	TPW	12-07-95

Do Not Scale Print

Third Angle Projection

Dr R.J. THAYER 10-11-95
Chkd D. OLSON 10-11-95
Approved R.J. Thayer 10-11-95

Model first used on OSPS 6000R/427B

Minneapolis, Minnesota 55432

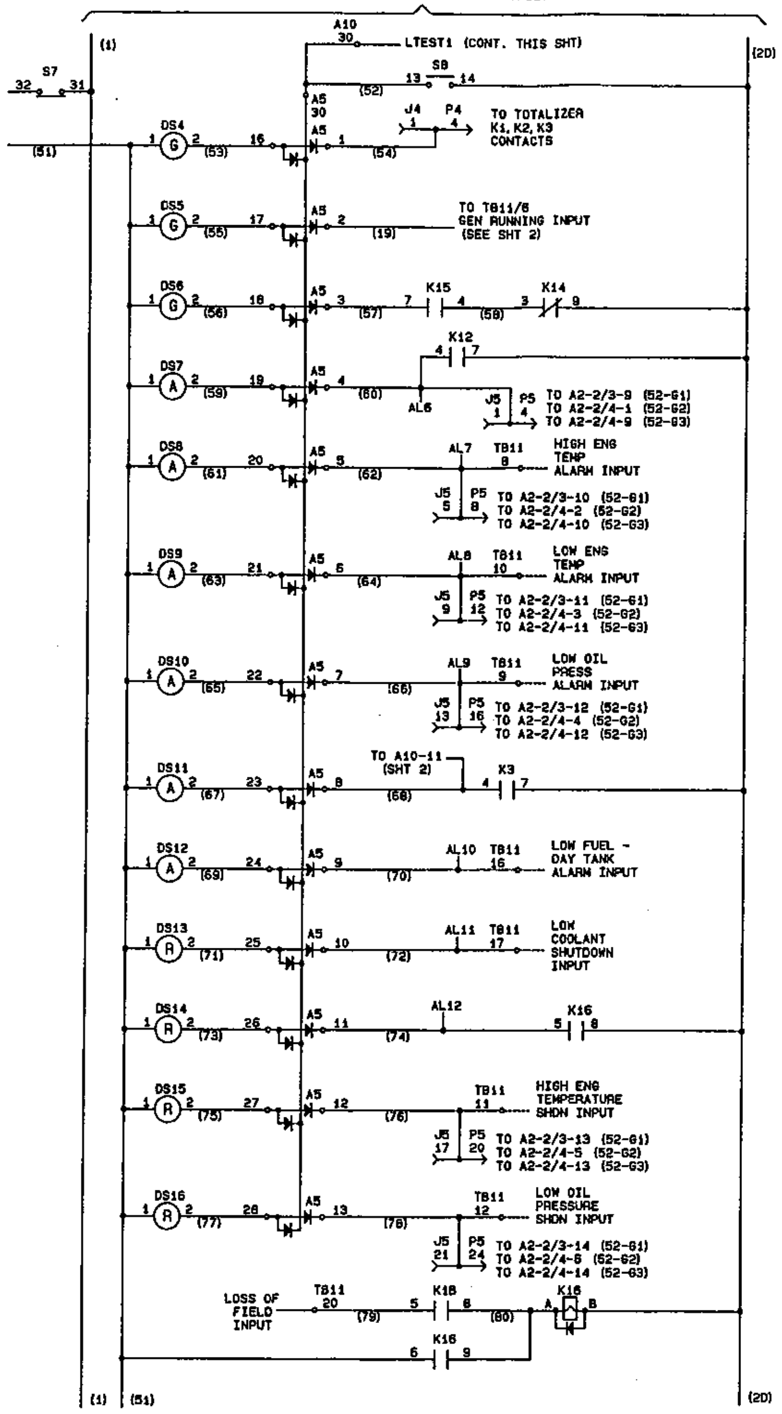
Title SCHEMATIC DIAGRAM (PARALLELING DC)

Dwg No. 625-3228 Sheet 2 of 19 Dwg Size D

Onan

ER No.	Ltr	No.	Revision	Zone	Dr	Chk	Approval	Date
—	A	1	ENGINEERING RELEASE	—	RJT	TS		10-11-95
71,226	B	1	REDRAW RELEASE	—	RJT	DS	TPW	12-17-95

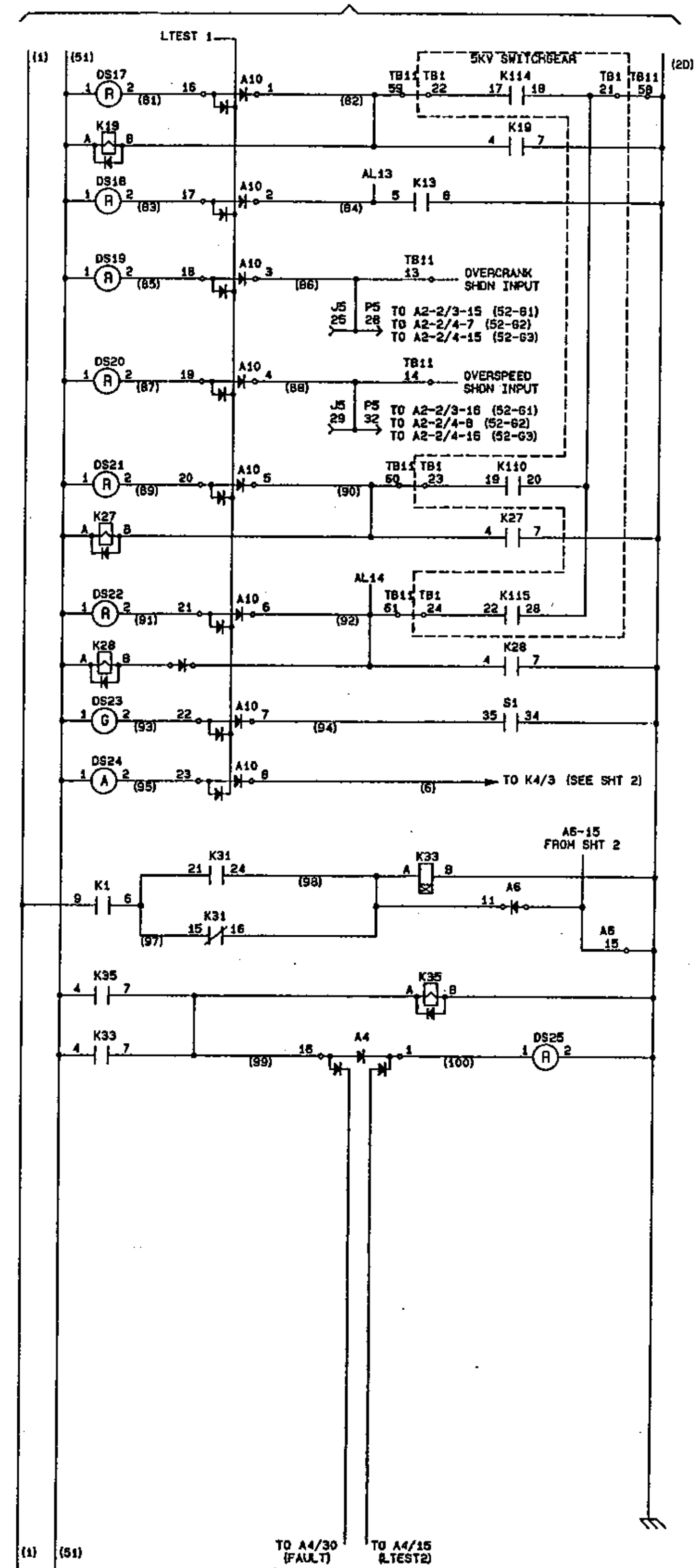
CONTINUED FROM PREVIOUS SHEET



CONTINUED ABOVE RIGHT

ITEM NO.	DEVICE NO.	DESCRIPTION
	S8	LAMP TEST SWITCH (SEE ALSO SHT 3)
	A5	DIODE BOARD
	S7	CONTROL RESET SWITCH (SEE SHT 3)
314	DS4	DEMAND MODE STANDBY
314	DS5	GENERATOR RUNNING
314	DS6	COOLDOWN PERIOD
	K15	COOLDOWN TIMER (SEE SHT 3)
	K14	AUTO RUN RELAY (SEE SHT 3)
315	DS7	LOW DC VOLTAGE
	K12	LOW DC ALARM TIME DELAY RELAY (SEE SHT 3)
	A2-3	PLC INPUT CARD (SEE TOTALIZER DC)
315	DS8	HIGH ENGINE TEMPERATURE
315	DS9	LOW ENGINE TEMPERATURE
315	DS10	LOW OIL PRESSURE ALARM
315	DS11	FAIL TO SYNCH
	K3	FAIL TO SYNCH TIME DELAY RELAY (SEE SHT 2)
315	DS12	LOW FUEL - DAY TANK
313	DS13	LOW COOLANT
313	DS14	LOSS OF FIELD
	K16	LOSS OF FIELD HOLD RELAY
308	DS15	HI ENG TEMP SHUTDOWN
313	DS16	LOW OIL PRESS SHUTDOWN
	K18	GENERATING RELAY (SHT 2)
120	K16	LOSS OF FIELD HOLD RELAY

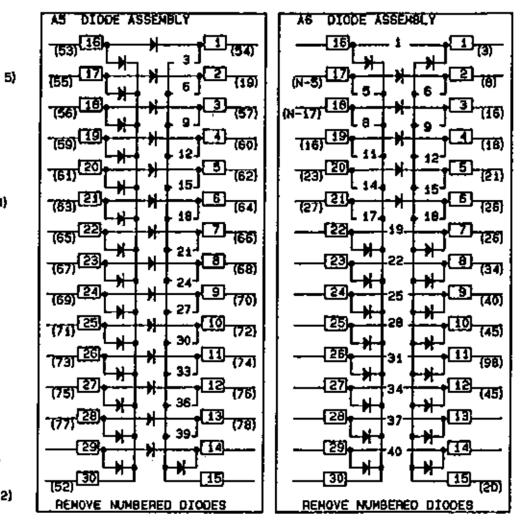
CONTINUED FROM BELOW LEFT

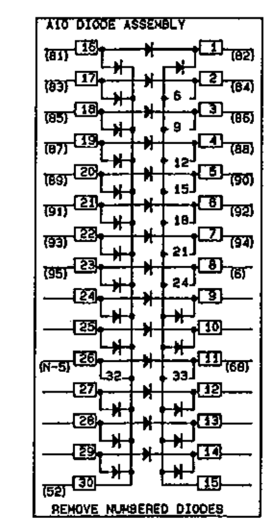


(SEE PREVIOUS SHT)

ITEM NO.	DEVICE NO.	DESCRIPTION
313	DS17	REVERSE POWER
	K114	REVERSE POWER RELAY (SEE SHT 5)
120	K19	REVERSE POWER HOLD RELAY
313	DS18	BREAKER FAIL TO CLOSE
	K13	BKR FAIL TO CLOSE HOLD RELAY (SEE SHT 2)
313	DS19	OVERCRANK
313	DS20	OVERSPEED
313	DS21	OVERCURRENT
	K110	RELAY OVERCURRENT (SEE SHT 5)
120	K27	OVERCURRENT HOLD RELAY
313	DS22	LOCKOUT RELAY TRIP
	K115	86 LOCKOUT RELAY (SEE SHT 4)
120	K28	PROTECTIVE RELAY TRIP HOLD
314	DS23	AUTOMATIC MODE
315	DS24	NOT IN AUTO
	K31	OVER/UNDER VOLT RELAY (SEE SHT 5)
118	K33	VOLTAGE FAILURE DELAY RELAY
	K1	GENERATOR RUNNING (SEE SHT 2)
120	K35	VOLTAGE FAILURE HOLD RELAY
313	DS25	VOLTAGE FAILURE

102 A5, A6, A10 DIODE BOARD





FILENAME: PDC20CH
PLOTTED: 12-04-95

Do Not Scale Print

Dr R J THAYER 10-11-95
Chk 10-11-95
Approved 10-11-95
Model first used on OSPS 6000R/4278

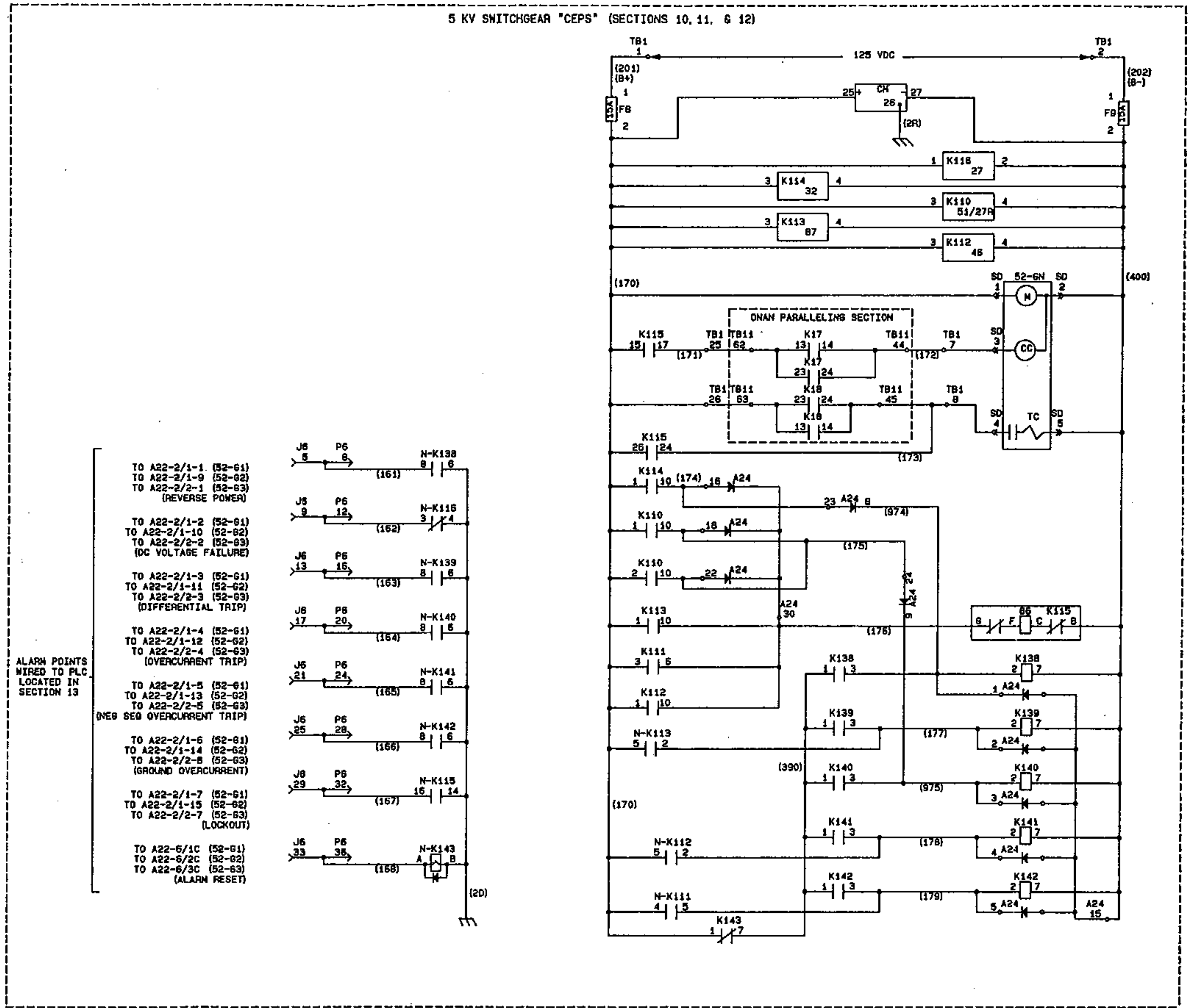
Onan

Minneapolis, Minnesota 55432

SCHEMATIC DIAGRAM (PARALLELING DC2)

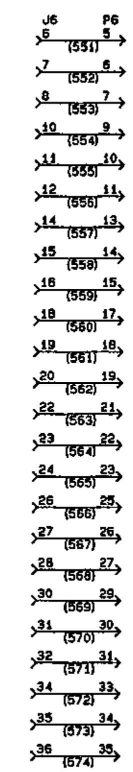
Dwg No. 625-3228 Sheet 3 of 19 Size D

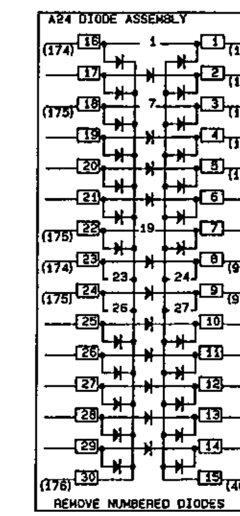
ER No.	Ltr	No.	Revision	Zone	Dr	Chkr	Approved	Date
—	A	1	ENGINEERING RELEASE	—	RJT	D.		10-11-95
71,726	B	1	RECORD RELEASE	—	RJT	DO	TPN	12-07-95



GENERATOR BREAKER CONTROL
(52-G1, G2, & G3)

410 / 411	F8, F9	FUSE 15 A
	CM	CIRCUIT MONITOR (SHT 5)
122	K118	DC UNDERVOLTAGE RELAY
	K114	REVERSE POWER RELAY 32 (SEE SHT 5)
	K110	OVER-CURRENT WITH VOLTAGE RESTRAINT RELAY 51/27R (SEE SHT 5)
	K113	GEN DIFFERENTIAL RELAY 87 (SEE SHT 5)
	K112	NEGATIVE SEQUENCE OVERCURRENT RELAY (SEE SHT 5)
	52-GN	GENERATOR POWER CIRCUIT BREAKER
	K115	LOCKOUT RELAY (SEE SHT 2 FOR CONTACT CHART)
	K17	52-GN CLOSE RELAY (SEE SHT 2)
	K18	52-GN TRIP RELAY (SEE SHT 2)
134	K115	LOCKOUT RELAY
115	K138	REVERSE POWER HOLD RELAY
116	K139	DIFFERENTIAL HOLD RELAY
116	K140	OVERCURRENT HOLD RELAY
116	K141	NEG SEQ OVERCURRENT HOLD RELAY
116	K142	GROUND OVERCURRENT HOLD RELAY
120	K143	ALARM RESET RELAY
	K111	GROUND OVERCURRENT RELAY 51G (SEE SHT 5)





FILENAME: PDC30CH
PLOTTED: 12-04-95

Do Not Scale Print

Tolerances unless otherwise specified

Third Angle Projection

This document is the property of Onan Corporation. It contains proprietary and confidential information which must not be duplicated, used or disclosed other than as expressly authorized by Onan Corporation or its representative.

For interpretation of dimensioning and tolerancing, see ANSI Y14.5M-1982

Name	Date
Dr RJ THAYER	10-11-95
Chkr/Mfg D OLSEN	10-11-95
Approved RJ Thayer	10-11-95

Model first used on: OSPS 6000R/427B

Cummins Onan — Minneapolis, Minnesota 55432

Title: SCHEMATIC DIAGRAM (PARALLELING DC3)

Dwg No. 625-3228 Sheet 4 of 19 Dwg Size D