

December 22, 2010

Kansas Department of Administration 900 WS Jackson Street, Suite 600 Topeka, KS 66612

Attn: George Werth

Subject: Summary of work performed on electrical distribution system in the Docking Building.

Dear Mr. Werth:

Capital Electric Construction was contracted to perform maintenance and cleaning of the 13.2kV electrical distribution system in the Docking Building. The work was started on Wednesday, November 24 and completed on Saturday, November 27. This report summarizes our findings.

To perform our work, power to the Docking building was turned off and maintenance to the Main Electrical gear and bus riser took place. During this maintenance, several medium voltage (M.V). switches were cleaned and repaired along with the main riser bus that runs the length and height of the building. The protective metal covers on the bus were removed where assessable and the electrical bus was visually inspected and cleaned. Included with this report are several photos of different items of concern that need varying degrees of attention.

Below is a list of our concerns:

- Nameplates on the equipment indicate that the gear was manufactured/installed
 in the mid 1950's. This makes this equipment between 50 and 60 years old. It is
 generally expected that electrical gear has a life expectancy of 15-30 years.
 Many factors affect the life expectancy, including ambient temperature,
 environmental conditions, electrical load (and the characteristics of the load) on
 the equipment, maintenance, and other factors. Assuming all of these factors
 have been ideal, the gear would still be considered to have out-lived its normal
 life expectancy.
- 2. Many of the sections of the bus are inaccessible. This means that these sections have never been cleaned or maintained. Routine maintenance is not possible on these sections. There was an extreme amount of dust/dirt accumulation in all areas of the system. We were able to clean many of the areas, but these particular areas could not be accessed, so they remain with over 50 years of dirt accumulation. The presence of the dust/dirt and in some areas oil and moisture



could lead to tracking (unwanted current flow from phase to phase or phase to ground). The result of this could potentially be severe damage to the equipment and building, and also potential safety risk to people in the building. An electrical outage affecting the entire building could also result.

The age of the electrical equipment is such that replacement parts are unavailable or difficult to find. Repairs may require custom fabrication, which could require extensive engineering or re-engineering.

The gear is 13.2kV. Any maintenance or repairs requires special equipment, tools, and training.

5. The gear is very open in design and allows air flow into the bus duct thru the M.V. switches. With these transformer housings being in the air handler rooms and the elevator exhaust ports feeding into these rooms the accumulation is much more than normal. The bus is covered and has taped joints but those tape joints are showing some tracking and age. To re-tape these joints would extend the life of the bus but would be very labor intensive and require a very lengthy outage to do so.

6. Transformer TRN-0015 has bus that is wrapped in 20,000v electrical blanket and extremely close to the access points of the transformer housing. It is possible that during the removal of the transformer housing covers that the bus could become exposed and cause significant hazards to the personnel working on the gear. Due to the nature of these pieces of electrical gear every precaution should be taken to protect any personnel inspecting these items. A detailed safety agenda should be followed and all personnel should adhere to any and all PPE requirements of NFPA 70e. An arc flash incident is highly possible with gear of this nature if the proper precautions are not followed extensively. The consequences of an arc flash in this gear and in these confined locations would be very server and would likely result in death to the personnel working on the gear. It is highly recommended that only qualified and trained personnel have access to this gear for maintenance purposes.

7. As mentioned above the M.V. switches are open into the bus area. These had varying degrees of dust and dirt accumulation as well. These however can be de-energized and maintenance performed on a regular basis to extend their life span. While energized a visual inspection of these switches and of the transformers would be recommended along with an IR scan on a routine maintenance schedule. With the exception of one transformer this is recommended.

8. An arc flash study is recommended for this and all electrical gear in the Docking building. This would include the proper labeling of the arc hazard and calorie requirements onto all electrical doors.

9. It was also observed during the maintenance that some of the fuses were not seated properly and that the switches were not engaging fully. The only reason this had not been an issue was due to the amount of load on these switches. If these had additional load on them when not fully seated it would result in arcing and heating issues.

10. It was noted on the first and basement floors that the wires feeding off the load side of the switches have corrosion developing at the insulators holding them in place. These were cleaned and re-taped but this is not a permanent fix and



these should be replaced in the near future before the insulation breaks down to the point of failure.

11. Mechanical mechanisms in some of the MV switches have failed. These are a safety mechanism that keeps the door of the enclosure closed when the switch is in the energized state. Because these could not be repaired, we were forced to install padlocks on the doors as the only means of safety. Signage should be installed on these switches to alert personnel of the danger.

SUMMARY

We believe the electrical distribution system in the Docking Building is nearing the failure point, and we recommend a complete replacement of the system.

- Insulation in the system is deteriorating and may fail.
- The equipment is obsolete and replacement parts are not available.
- · Safety mechanisms are failing.

I have attached the Emerson Test Report for the switches and equipment that were tested during the project. Their report includes additional recommendations.

Please contact me if there are any questions or additional information is required.

Thank you.

Mark Hurshman Capital Electric



Electrical Reliability Services, Inc. Kansas City Area Office

> 348 N.W. Capital Drive Lee's Summit, MO 64086 T (816) 525-7156 F (816) 524-3274

December 6, 2010

Capital Electric P.O. Box 410079 Kansas City, MO 64141

Attention: Mr. Mark Hurshman

Subject: Electrical Equipment Maintenance Test Report

Reference No. 3126895

Dear Mr. Hurshman:

Enclosed is the subject test report as prepared by our lead field engineer. It was our pleasure to be of service to you on this project. If you have any questions, or if we can be of further assistance, please do not hesitate to call.

Sincerely,

Electrical Reliability Services, Inc

Bob Ross

Service Center Manager

Enclosures



Electrical Reliability Services, Inc. Kansas City Area Office

> 348 N.W. Capital Drive Lee's Summit, MO 64086 T (816) 525-7156 F (816) 524-3274

Electrical Equipment Maintenance Test Report

At

DOCKING STATE OFFICE BLDG Topeka, KS

for

Capital Electric P.O.Box 410079 Kansas City, MO 64141

Attention: Mr. Mark Hurshman Order No: PO#196031, JOB#56763

Reference No.

3126895

Submitted By:

David Duncan Field Engineer

December 6, 2010

Reviewed By:

Bob Ross Service Center Manager

1 PURPOSE

- 1.1 The equipment and components listed in Section 3.0 of this report have been inspected and tested to help assure their proper and safe operation. Defective or marginal equipment can be identified, repaired, replaced or scheduled for future repairs without costly or unexpected interruptions during normal operating periods.
- 1.2 The test results are particularly valuable when kept for comparison with past and future maintenance test results. This historic database enables one to predict the probability of equipment failure and thus schedule facility production and financial budgets to accommodate preventive maintenance or repair rather than breakdown maintenance.

Reference No.3126895

2 SUMMARY

- 2.1 This project was initiated by Mr. Mark Hurshman with Capital Electric. All testing was performed by Electrical Reliability Services Field Engineers David Duncan and Charles Howell on Saturday, November 27, 2010.
- 2.2 Please refer to Section 5 "Results and Recommendations" for complete details of the testing.

Reference No.3126895

Page 2

3 **EQUIPMENT TESTED AND INSPECTED**

- 3.1
- **Three (3)** medium voltages disconnect switches, S&C, SM-5, and 400 Amp. **Seventeen (17)** medium voltages disconnect switches, electrical engineering equipment co, S.O. # 50542, 300 Amp. 3.2

Reference No.3126895

4 PROCEDURES

- 4.1 Medium Voltage Air Switches
 - 4.1.1 Visual and Mechanical Inspection
 - .1 Compared equipment nameplate data with drawings and specifications.
 - .2 Inspected for physical damage, proper installation, required area clearances, anchorage and grounding. Cleaned interior, insulators, arc chutes and interphase barriers.
 - .3 Performed mechanical operator tests in accordance with manufacturer's instructions. Cleaned and lubricated contacts and mechanism as applicable. Confirmed correct application of manufacturer's recommended lubricants.
 - .4 Checked contact alignment, wipe and pressure.
 - .5 Inspected for correct phase barrier materials and installation.
 - .6 Checked fuse linkage and element for proper holder and current rating. Recorded fuse data.
 - .7 Verified tightness of accessible bolted electrical connections by calibrated torque-wrench method.
 - .8 Verified that fuse sizes and types were in accordance with drawings and power system studies.
 - Inspected all indicating and control devices for correct operation.
 - .10 Tested all interlocking systems for correct operation and sequencing. Checked key interlock for proper operation and proper key distribution.
 - .11 Verified arc interrupter operation.

Reference No.3126895

4.1.2 Electrical Tests

- ,1 Performed contact resistance test across each switch blade and fuse link.
- .2 Measured fuse resistance.
- .3 Performed insulation-resistance tests on each pole, phase-tophase and phase-to-ground with switch closed and across each open pole for one minute.

Reference No.3126895

Page 5

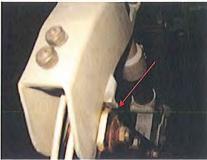
5 RESULTS AND RECOMMENDATIONS

- 5.1 The following is a list of problems discovered during this testing project along with any corrective action that was made by Electrical Reliability Services. Those corrections beyond the scope of the project that require your additional corrective action are in bolded text.
 - 5.1.1 If the equipment tested in Section 3 is not discussed in this section, the results of the tests indicate the equipment to be satisfactory.
- 5.2 Feeder #10 A phase contact resistance was found to be higher than the other two phases and was outside of NETA contact resistance tolerances. This could cause contact heating of the other two phases, deterioration, and eventual failure of the switch. This problem was corrected at time of testing by ERS personnel. No further action required at this time.
- 5.3 Feeders 9 &10 automatic transfer operator could not be tested because of customer restrictions. Because of the age, condition, and unavailability of repair parts the customer did not want the transfer mechanism operated. The customer is aware of the deficiencies with the ATS System and is attempting to have it repaired or replaced.
 - It is recommended that the ATS System should be tested once repairs have been made. Electrical Reliability Services would be pleased offer this service.
- 5.4 Riser #7 B phase contact resistance was found to be higher than the other two phased and was outside of NETA contact resistance tolerances. This could cause contact heating of the other two phases, deterioration, and eventual failure of the switch. This problem was corrected at time of testing. No further action required at this time.

- 5.5 During the outage for Capital Electric Inc. to perform low voltage retrofits, on down stream equipment, it was discovered that a large percentage of the transformer disconnects were not closing fully. The cause of the problems was found to be the mechanical door interlocks which are bent out of shape. State of Kansas personnel directed Electrical Reliability Services personnel to remove the interlocking mechanism and State of Kansas personnel would install locks and signs to adjust for the safety issues.
- 5.6 During the inspection of Medium Voltage Air Switch LUCS 18, on the (14th) floor it was discovered that the moving contacts were not fully engaging the stationary contact. This could cause contact heating, deterioration, and eventual failure of the switch. Electrical Reliability Services personnel corrected this condition. This same condition was found at the following locations:

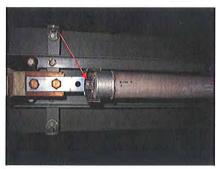
LUCS 17, on the (14th) floor LUCS 16, on the (12th) floor LUCS 15, on the (11th) floor LUCS 14, on the (10th) floor LUCS 9, on the (9th) floor LUCS 10, on the (8th) floor LUCS 11, on the (7th) floor LUCS 12, on the (6th) floor LUCS 13, on the (5th) floor LUCS 5, on the (3th) floor The pictures below are examples of this condition. The left picture is the before adjustment picture and the right picture is after corrections were made.





- It is recommended that all the switches be cleaned and tested.

 Electrical Reliability Services would be please to provide this service.
- 5.7 LUCS 5, on the (3rd) floor was found with the B phase fuse improperly inserted into the fuse clip. This could cause overheating, premature aging of the fuse and unscheduled outages. Capital Electric Personnel were to correct this problem before restoring service. The left picture is the line side of the fuse and the right picture is load side of the fuse.





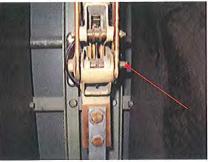
5.8 LUCS 5, on the (3rd) floor was found with the C phase fuse improperly inserted into the fuse clip. This could cause overheating, premature aging of the fuse and unscheduled outages. Capital Electric Personnel were to correct this problem before restoring service. The left picture is the load side of the fuse and the right picture is line side of the fuse.





- 5.9 LUCS 3, on the (1st) floor was found with the knife blades fully penetrating the stationary contacts. However the C phase knife switch was found to be missing a nut and cup washer on the line and load side of the switch. This could cause contact heating, deterioration, and eventual failure of the switch. This problem was corrected before restoring utility power by Capital Electric personnel. The left picture is the moving portion of the switch, and the right picture is the elbow or pivot part of the switch. No further mechanical action required at this time.
 - It is suggested that a complete cleaning and maintenance test be performed at the next scheduled outage. Electrical Reliability Services would be pleased offer this service.





Ross, Bob [NETPWR/ERS/LEE']

Subject:

FW: Docking M.V. switches

Importance:

High

----Original Message----

From: White, Ben [mailto:bwhite@capitalelectric.com]

Sent: Friday, November 26, 2010 9:32 AM To: Steele, George [FM]; Flowers, Clifford [FM]

Cc: Werth, George [FM]; Lour, Mike [FM]; Howell, Chuck [NETPWR/ERS/LEE']; Hurshman, Mark

Subject: RE: Docking M.V. switches

Importance: High

Gentlemen this is to document our earlier conversation today in which the door latches were discussed. As directed we will have Emerson Reliability Services remove the door latch mechanism from the throw rod so as to allow complete operation of the switches off the Bus Duct riser only. These components will be placed in the bottom of the cabinets for future needs if it is desired to repair and reattach these at a later date.

In cleaning these switches we noticed the knife blades not fully engaged. During further inspection it was noted that the latch rods have been bent during operation and are obstructing the switches from engaging fully and properly. These latch rods are part of the mechanism that holds the door shut while in the energized state. These will be removed off all these common disconnect switches on the Bus riser so no further issues arise in the event of operating these switches.

It is understood that you will have padlocks in place that only allow Authorized personnel access to these when the switch when they are in the closed position. In addition signage will be placed on all these disconnects to signify this modification and the hazards involved with opening these while energized. I would also suggest signage being added that signifies the proper PPE require to open these switches and the proper CAL requirement for Arc Flash.

Your response to this email will serve as our authorization to perform this work.

Thanks, Ben White Capital Electric Construction Company Service Division 816-215-6691 (cell)

From: Steele, George [FM] [mailto:George.Steele@da.ks.gov]

Sent: Thu 11/25/2010 4:50 PM

To: White, Ben; Hurshman, Mark; Flowers, Clifford [FM]

Cc: Werth, George [FM]; Lour, Mike [FM]

Subject: RE: Docking M.V. switches

We agree with having Emerson look at, repair and modify all switches off the Buss Duct on a Time and Material Basis.

George Steele 900 SW Jackson, Suite 600 Topeka, KS 66612 785-296-4693 Cell 785-215-5709

----Original Message----

From: White, Ben [mailto:bwhite@capitalelectric.com]

Sent: Thursday, November 25, 2010 4:17 PM

To: Steele, George [FM]; Hurshman, Mark; Flowers, Clifford [FM]

Subject: Docking M.V. switches

Gentlemen this is to confirm our earlier conversations today about the Switches that are not engaging as they should feeding the transformers on each floor off the Bus Duct run.

We will as discussed remove the safety latch that holds the doors closed while energized. It is understood that the padlock on the door handle will become the safety and labeling will be attached to the doors to identify the voltage hazard. As discussed this is being done so that it can be verified that the knife switches have engaged the switch fully.

Secondly we will have Emerson Reliability Services look at and repair or modify all the switches off the Bus Duct run we have been working on to verify the functionality of all the switches. They will make the necessary adjustments to the two switches in the penthouse.

All this work is on a T&M basis. Please respond to this email as our work authorization.

Thanks, Ben White Capital Electric Construction Company Service Division 816-215-6691 (cell)



MEDIUM VOLTAGE AIR SWITCH TEST REPORT

CAPITAL ELECTRIC						JOB NUMBER: 3126895			
	915 SW HARRISON ST				ENGINEER:	DD	DATE: 11/26/2010		
WITCHGEAR DESIGNATION:				. 7			CALIBRATIC		40
MAIN ATS			RISER NO #	MEPLATE		45/1280	-	05/26/20	110
MANUFACTURER:		TYPE:		STYLE/SERIA			CURRENT R	ATING:	VOLTAGE RATIN
S & C			N/A		CD28082		SYSTEM VO	ITAGE:	15K
S & C, SM-5, (CAT NO 1	32400R4	1. 14.4 KV. 2	50E. TC	C NO. 153	-4	OTOTEM VO	13.8 K	v
				INSPECTION					
CHECK PO	TNIC		CONDITION	NOTES		CHECK POIN	Т	CONDITION	NOTES
HYSICAL DAMAGE			Α		CONTACT	ALIGNME	NT	Α	
LEANLINESS			С		CONTACT	WIPE		Α	
ECHANICAL OPERATO	R		N/A	(1)	CONTACT	PRESSU	RE	Α	
AIN CONTACTS			Α		PHASE BARRIERS			Α	
RC CONTACTS			Α		HARDWARE TIGHTNESS		NESS	Α	
RC CHUTES			N/A		FUSE HOLDERS			Α	
RC INTERRUPTER SEQ	UENCE		Α		INTERLOCKS			A	
			ELE	CTRICAL	TESTS				
				A-P	HASE	B-PF	IASE	C-	PHASE
ONTACT RESISTANCE	IN MILLION	HMS		0.37	3/.112	0.832	2/.118	.184/139	
JSE RESISTANCE IN M	ILLIOHMS			0.	410	0.3	76 0.386		
ISULATION RESISTANCE			SWITCH	CLOSED				SWITCH OPEN	
TEST IN GIGOHMS	A-Gnd	B-Gnd	C-Gnd	A-B	B-C	C-A	Α	В	С
		3.045		(4)	(4)	ar 34	Astro		6200



MEDIUM VOLTAGE AIR SWITCH TEST REPORT

	3126895	JOB NUMBE		CAPITAL ELECTRIC						
11/26/2010		DATE:	CH DD TEST EQUIP. ASSET NO. CAL			915 SW HARRISON ST ATION: [FEEDER IDENTIFICATION:			918 R DESIGNATION:	OCATION: SWITCHGEAR
	05/26/201		5/1280	41-0104	9	FEEDER#0	1		MAIN ATS	ı
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	13.8 KV		4		50E, TCC NSPECTIO		32400R4	AT NO 1	& C, SM-5, C	S &
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	A	.181		CONTACT		c				LEANLINES
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	A			PHASE BA	(1)	A		•		AIN CONTA
	A	VESS	HARDWARE TIGHTNESS			A	1		5 5 5 5 5	RC CONTA
	A	1200	FUSE HOLDERS			N/A		-		RC CHUTE
	A		INTERLOCKS			A		LIENCE	RUPTER SEQ	7 - F - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1
			INTERLOCKS			A		OLNOL	TOT TEN DEQ	INO IIVI EIXII
				ESTS	CTRICAL T	ELEC				
SE	C-P	IASE	B-PH		A-PH					
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5 0.391		85	0.369 0.385		0.3			LLIOHMS	STANCE IN MI	JSE RESIS
1	SWITCH OPEN				CLOSED	SWITCH			RESISTANCE	ISULATION I
С	В	Α	C-A	B-C	A-B	C-Gnd	B-Gnd	A-Gnd	GIGOHMS	
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MEDIUM VOLTAGE AIR SWITCH TEST REPORT

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		5 SW HARRISON ST			СН	DD	11/26/2010)10
SWITCHGEAR DESIGNATION:				40	The state of		CALIBRATI		
MAIN ATS			FEEDER #	TU MEPLATE		45/1280		05/26/20)10
MANUFACTURER:		TYPE:		STYLE/SERI/			CURRENT	RATING:	VOLTAGE RATING
S&C			N/A		CD28082		The second second	400	15K
USE INFORMATION:	DAT NO	1001000		SEAF TO	0.110 450		SYSTEM VO		
S & C, SM-5, (SAT NO	132400R		INSPECTI		-4		13.8 K	V
CHECK P	OINT		1			alleak pali			7.24
	OINT		CONDITION	NOTES	1	CHECK POIN	W	CONDITION	NOTES
HYSICAL DAMAGE			Α		CONTAC	T ALIGNMI	=NT	Α	
CLEANLINESS			С		CONTAC.	TWIPE		Α	
MECHANICAL OPERATO	R		N/A	(1)	CONTACT	T PRESSU	RE	Α	
IAIN CONTACTS			A		PHASE BARRIERS		Α		
RC CONTACTS			Α		HARDWARE TIGHTNESS		Α		
RC CHUTES			N/A		FUSE HOLDERS			Α	
RC INTERRUPTER SEC	UENCE		Α		INTERLOCKS			Α	
			ELE	CTRICAL	TESTS				
				A-P	HASE	B-P	HASE	C-	PHASE
ONTACT RESISTANCE	IN MILLIO	HMS	(2)	0.584/.144		0.23	234/.123 0.232/.14		32/.143
USE RESISTANCE IN M	ILLIOHMS			0.:	338 0.339		339	0.346	
SULATION RESISTANCE			SWITCH	CLOSED				SWITCH OPEN	
TEST IN GIGOHMS	A-Gnd	B-Gnd	C-Gnd	A-B	B-C	C-A	Α	В	С
0 5000 VOLTS	245./9	228.3	178.3	443	275	418	3381	3065	3265
OTE					1				-200
OTE 1:) TRANSFER OPERATION	N COULD N	OT BE VERIF	IED DO TO CUST	OMER REST	RICTIONS. CU	STOMER DIE	NOT WANT	TRANFER SWITE	CH OPERATED.
SWITCH INTERLINKS									
OTE 2:) "A" PHASE KNIFE SW	/ITCH HAS H	GHER RESIS	STANCE THAN OT	HER TWO P	HASES ERS.C	OBBECTED	илти а шет	MENT TO VALLE	CMITCH
OTE 3:) CABLES & ARRESTO						OMMEGIED		MENT TO KIMILE	SWITCH.
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	A = ACC	EPTABLE	R = NEEDS REP	AIR C=C	ORRECTED	N/A = NOT	APPLICABLE		



Electrical Reliability Services Project Status Report / Work Authorization

CLIENT	CAPITAL ELECTRIC	JOB NO.	3126895		
PROJECT	915 SW HARRISON ST.	ENGINEER	CH/DD	DATE	11/26/2010

THIS DOCUMENT IS INTENDED TO PROVIDE PRELIMINARY INFORMATION AS TO THE STATUS OF THIS PROJECT. A FORMAL REPORT WILL BE SUBMITTED AT THE PROJECT COMPLETION.

- THE FOLLOWING ITEMS REQUIRE REPLACEMENT, REPAIR AND/OR ADJUSTMENT:
- THE FOLLOWING TESTS AND/OR INSPECTIONS ARE REQUIRED PRIOR TO PROJECT COMPLETION:
- THE FOLLOWING WORK IS AUTHORIZED:

VISUAL INSPECTION AND REMOVAL OF INTER	
(SEE E-MAIL) AS PER BEN WHITE ON FLOORS	
OPEN MAIN SWITCHS IN BASEMENT FOR VIS	UAL INSPECTION BY CUSTOMER.
LCUS "18" 14TH FLOOR-REMOVAL OF INTERL	OCK & AJUSTED SWITCH HANDLE- PHOTOS
LCUS "17" 14TH FLOOR-REMOVAL OF INTERL	
LCUS "16" 12 FLOOR- REMOVAL OF INTERLO	
LCUS "15" 11TH FOOR-REMOVAL OF INTERLO	OCK & AJUSTED SWITCH HANDLE-PHOTOS
LCUS "14" 10TH FLOOR- REMOVAL OF INTERI	
LCUS "9" 9TH FLOOR-REMOVAL OF INTERLO	CK & AJUSTED SWITCH HANDLE-PHOTOS
LCUS "10" 8TH FLOOR-REMOVAL OF INTERLO	OCK
LCUS "11" 7TH FLOOR-REMOVAL OF INTERL	OCK & AJUSTED SWITCH HANDLE-PHOTOS
LCUS "12" 6TH FLOOR-REMOVAL OF INTERLO	OCK\
LCUS "13" 5TH FLOOR REMOVAL OF INTERLO	ALCOHOL DE LA CONTRACTOR DEL LA CONTRACTOR DE LA CONTRACT
LCUS "8" 3TH FLOOR NO REMOVAL REQUIRE	ED, SWITCH RETOR-FITED WITH NEW SW
LCUS "7" 3TH FLOOR REMOVAL OF INTERLO	CK
LCUS "6" 3TH FLOOR REMOVAL OF INTERLO	
LCUS "5" 2TH FLOOR REMOVAL OF INTERLO	CK & AJUSTED SWITCH HANDLE-PHOTOS
FUSE B&C ARE MISALIGNED IN HOL	DER - SEE PHOTOS
LCUS "4" 2TH FLOOR REMOVAL OF INTERLO	
LCUS "3" 1ST FLOOR REMOVAL OF INTERLO	
NUTS AND WASHERS ON PIVOT POI	NT & TENTION POINT - PHOTOS
LCUS "2" BASEMENT-REMOVAL OF INTERLO	CK
CUSTOMER SIGNATURE	AUTHORIZATION NO.
N/A	SEE EMAIL

PINK COPY - CUSTOMER

© 2006 Electrical Reliability Services

WHITE COPY - FILE

PAGE __1 OF __1



Electrical Reliability Services, Inc. Kansas City Area Office 1012 "B" N.E. Jib Court Lee's Summit, MO 64064

T (816) 795-7795 F (816) 795-7798

Thermographic Survey Report

at

Docking State Office Building Topeka, KS

for

Ace Electric 223 Southeast 53rd Street Topeka, KS 66609

Attention: Mr. Steve Jones

Reference No.

3029129

Submitted By:

Paul Ekermans Field Engineer

November 1, 2005

Reviewed By:

Bob Ross

Service Center Manager

1 PURPOSE

1.1 The purpose of infrared inspections is to provide information relative to the physical condition of the electrical distribution system. Loose and poor connections, unbalanced loads, and loose bus joints can be located. These conditions are characterized by increased resistance and accompanied by a temperature rise, which is detected by infrared scanning. The survey was performed while the system was loaded, representative of a "normal" workday.

2 SUMMARY

- 2.1 This project was initiated by Mr. Steve Jones with Ace Electric. The Survey was performed by Electrical Reliability Services Field Engineer Paul Ekermans on Tuesday, October 25, 2005.
- 2.2 Please refer to Section 5 "Results and Recommendations" for complete details of the testing.

3 EQU 3.1	Please refer to				vev equinme	nt data shee	et.
3.1	· lease relei to	the attaon	sa alomog	, aprilo cui	o, oquipino		
			-				

4 PROCEDURES

4.1 Infrared Inspection

4.1.1 Visual and Mechanical Inspection

- .1 Contractor personnel removed all equipment covers to allow visual access to current carrying conductors.
- .2 Visually inspected physical, electrical and mechanical condition of all components for potentially dangerous conditions.
- .3 Scanned each load current carrying piece of equipment using an infrared camera.
- .4 Documented problem areas with a still photograph to clarify problem identification and location.
- .5 Contractor personnel reinstalled covers to all equipment.
- .6 Identified inaccessible and/or unobservable areas and/or equipment.

4.1.2 Electrical Tests

- .1 Recorded instantaneous current measurements of all safely accessible problem areas. This data can be utilized for determining the equipment load during the infrared inspection.
- .2 Verified actual temperature of problem areas relative to reference temperatures noted during thermographic survey.

5 RESULTS AND RECOMMENDATIONS

- 5.1 The following is a list of problems discovered during this testing project along with any corrective action that was made by Electrical Reliability Services.

 Those corrections beyond the scope of the project that require your additional corrective action are in bolded text.
 - 5.1.1 If the equipment tested in Section 3 is not discussed in this section, the results of the tests indicate the equipment to be satisfactory.
- 5.2 Main switchboard circuit breaker DSOB Chiller #1 was found with a higher than normal operating temperature on the C-phase circuit breaker contact. A higher operating temperature indicates a higher contact resistance and high resistance contacts can cause contact failure due to overheating and also may provide an ignition source to any flammable substance.
 - It is recommended that the switch contact be inspected, cleaned and checked for sufficient contact pressure according to manufacturer's specifications.
- 5.3 Chiller #1 control panel was found with a higher than normal operating temperature at the main circuit breaker load side A & B phase conductor terminations. A higher operating temperature indicates a higher resistance and high resistance terminations can cause insulation and/or termination failure due to overheating and also may provide an ignition source to any flammable substance.
 - It is recommended that the conductor terminations be inspected, cleaned and tightened to the manufacturer's torque specifications.
- 5.4 Chiller #3 was found with a higher than normal operating temperature at the control power fuse F4 line side fuse clip. A higher operating temperature indicates a higher resistance and high resistance fuse clips can cause fuse and/or fuse clip failure due to overheating and also may provide an ignition source to any flammable substance.
 - It is recommended that the fuse and fuse clip be inspected, cleaned and checked for sufficient clip tension according to the manufacturer's specifications and replaced if necessary.

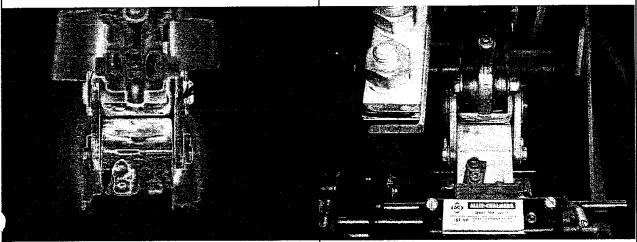


INFRARED SCAN PHOTOGRAPH SHEET

Electrical Reliability Services

CLIENT:		JOB NUMBER:		
ACE ELECTRIC		3029129		
LOCATION:		DATE:		
ROBERT DOCKING STATE BUILDIN	ROBERT DOCKING STATE BUILDING, TOPEKA, KS			
TEST EQUIPMENT / ASSET NO.:	ENGINEER:	REFERENCE REPORT SECTION:		
MICRON MICROSCAN 7515/4102033	Paul Ekermans	5,2		

EQUIPMENT PHOTOGRAPHS



EQUIPMENT IDENTIFICATION:

DSOB CHILLER #1

CHILLER ROOM

OBJECT TEMPERATURE: REFERENCE TEMPERATURE.:

CIRCUIT BREAKER C-PHASE CONTACT

120F

109F

COMMENTS:

Main switchboard circuit breaker DSOB Chiller #1 was found with a higher than normal operating temperature on the C-phase circuit breaker contact. A higher operating temperature indicates a higher contact resistance and high resistance contacts can cause contact failure due to overheating and also may provide an ignition source to any flammable substance.

RECOMMENDATIONS:

It is recommended that the switch contact be inspected, cleaned and checked for sufficient contact pressure according to manufacturer's specifications.

CURRENT MEASUREMENTS IN AMPERES:	VOLTAGE DROP READINGS IN MILLIVOLTS:
Aph: N/A Bph: N/A Cph: N/A	Aph: N/A Bph N/A Cph: N/A

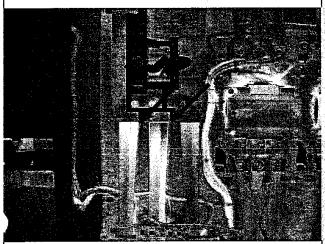


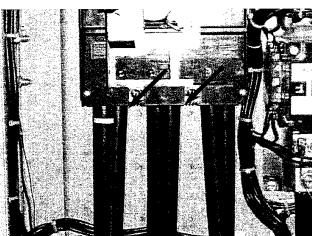
INFRARED SCAN PHOTOGRAPH SHEET

Electrical Reliability Services

CLIENT:		JOB NUMBER:			
ACE ELECTRIC		3029129			
LOCATION:		DATE:			
ROBERT DOCKING STATE BUILDIN	ROBERT DOCKING STATE BUILDING, TOPEKA, KS				
TEST EQUIPMENT / ASSET NO.:	ENGINEER:	REFERENCE REPORT SECTION:			
MICRON MICROSCAN 7515/4102033	Paul Ekermans	5.2			

EQUIPMENT PHOTOGRAPHS





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EQUIPMENT IDENTIFICATION:	LOCATION:	
CHILLER #1 CONTROL PANEL	NTROL PANEL CHILLER ROOM	
ITEM:	OBJECT TEMPERATURE:	REFERENCE TEMPERATURE.:
CIRCUIT BREAKER WIRE TERMINATIONS	118F	110F

COMMENTS:

Chiller #1 control panel was found with a higher than normal operating temperature at the main circuit breaker load side A & B phase conductor terminations. A higher operating temperature indicates a higher resistance and high resistance terminations can cause insulation and/or termination failure due to overheating and also may provide an ignition source to any flammable substance.

RECOMMENDATIONS:

It is recommended that the conductor terminations be inspected, cleaned and tightened to the manufacturer's torque specifications.

·		
CURRENT MEASUREMENTS IN AMPERES:	VOLTAGE DROP READINGS IN MILLIVOLTS:	
Aph: N/A Bph: N/A Cph: N/A	Aph: N/A Bph N/A Cph: N/A	



INFRARED SCAN PHOTOGRAPH SHEET

Electrical Reliability Services

CLIENT:			JOB NUMBER:		
	ACE ELECTRIC		3029129		
LOCATION:			DATE:		
ROBER1	ROBERT DOCKING STATE BUILDING, TOPEKA, KS				
TEST EQUIPMENT / ASSET	FNO.:	ENGINEER:	REFERENCE REPORT SECTION:		
MICRON MIC	ROSCAN 7515/4102033	Paul Ekermans	5.2		

EQUIPMENT PHOTOGRAPHS

EQUIPMENT IDENTIFICATION:

CHILLER #3 CONTROL PANEL

ITEM:

OBJECT TEMPERATURE:

REFERENCE TEMPERATURE.:

REFERENCE TEMPERATURE.:

128F

COMMENTS:

Chiller #3 was found with a higher than normal operating temperature at the control power fuse F4 line side fuse clip. A higher operating temperature indicates a higher resistance and high resistance fuse clips can cause fuse and/or fuse clip failure due to overheating and also may provide an ignition source to any flammable substance.

RECOMMENDATIONS:

It is recommended that the fuse and fuse clip be inspected, cleaned and checked for sufficient clip tension according to the manufacturer's specifications and replaced if necessary.

CURRENT	MEASUREMENT	S IN AMPERES:		VOLTAGE DROP READINGS IN MILLIVOLTS:					
Aph:	17 Bph:	N/A Cph:	N/A	Aph:	1.2 Bph	N/A Cph:	N/A		



THERMOGRAPHIC SURVEY EQUIPMENT DATA SHEET

- Strain.				SURVEY LO	CATION								DATAGI	SHEET NO
CLIENT: ACE ELECTRIC						15 S.W	. HAR	RISON,	TOPE		eti JÖB NUMBER: SHI 3029129			
SWITCHGEAR BUILDING: ROBERT DOCKING STATE BUILDING				915 S.W. HARRISON, TOPEKA, KS, 66601 SYSTEM VOLTAGE (V): 440V										
SWITCHGEAR LOCATION: CHILLER ROOM				SURVEY EQUIPMENT ASSET NO: CALIBRATIC							CALIBRATION 05/10			
EQUIPMENT IDENTIFICATION /	ITEM DATA		LOAD CURRENT (A)			VOLTAGE DROP (mV)		РНОТО NO.		OBJECT	REMARKS	CON-		
CIRCUIT DESIGNATION	TYPE*	MFG	RATING	Α	В	С	Α	В	С	INFRARED	DIGITAL	TEMP (°F):	KEWAKKS	DITIO
MAIN 440V BUS	SWBD	A-C	3000A											Α
DSOB CHILLER #1	CB	A-C	600A	N/A	N/A	N/A	N/A	N/A	N/A	1	1	120/109	C-PHASE (B-PHASE INACCESS)	М
DSOB CHILLER #1	СВ	A-C	600A										(B-PHASE INACCESSABLE)	Α
DSOB CHILLER #1	СВ	A-C	600A										(B-PHASE INACCESSABLE)	Α
CHILLER #1	CTRI	TRANE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2	2	118/110	A&B-PHASE LOAD SIDE TERM.	N
CHILLER #2		TRANE		74//	1071	14//	1,777	14// 1	11//	 		110/110	AGD-I TIAGE EGAD GIDE TERMI.	A
CHILLER #3	-	TRANE		17	N/A	N/A	1.2	N/A	N/A	3	3	268/128	LINE SIDE FUSE CLIP	M
		110111	74,74		1077	11// 1	 '	14//1	13//3	l - ×	<u> </u>	200/120	ENVE SIDE 1 GGE GEN	141
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ACCEPTABLE AT THE TIME OF THE SURVEY A			IMPROPER (MULTIPLE) CONDUCTOR TERMINATION H							FLAMMABLE MATERIALS IN EQUIPMENT ROOM O				
EQUIPMENT IS OFF/NO LOAD CONDITION B				IMPROPER SIZED OVERCURRENT DEVICE						EXCESSIVE DIRT AND DUST ACCUMULATION				
EQUIPMENT IS INACCESSIBLE C NO EQUIPMENT IDENTIFICATION D				IMPROPER SIZED CONDUCTOR J OVERLOAD CONDITION K							STORAGE IN EQUIPMENT WORKING SPACE INSUFFICIENT CONDUCTOR BRACING		Q R	
NO CONDUCTOR IDENTIFICATION E				UNBALANCED LOAD CONDITION L							UNUSED OPENING IN EQUIPMENT	S		
NO/INCOMPLETE FEEDER IDENTIFICATION F UNIDENTIFIED NEUTRAL/GROUND CONDUCTOR G				HIGH RESISTANCE FQUIPMENT CONTACT M HIGH RESISTANCE CONDUCTOR CONNECTION N							MIS-MATCHED TYPE FUSES DEFECTIVE HARDWARE	T		
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LOCHNER BWR Division

Study of:

Docking State Office Building Electrical Upgrade

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TMA #1667
Submitted to:

Kansas Department of Administration

February 11, 2011

KANSAS DEPARTMENT OF ADMINISTRATION

DOCKING STATE OFFICE BUILDING ELECTRICAL UPGRADE STUDY

TMA #1667



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2335 East Crawford Street | Salina, Kansas 67401-3713 | P 785.827.3603 | F 785.827.3029

engineering | planning | architecture



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KANSAS DEPARTMENT OF ADMINISTRATION Docking State Office Building Electrical Upgrade Study TMA #1667

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KANSAS DEPARTMENT OF ADMINISTRATION Docking State Office Building Electrical Upgrade Study TMA #1667

1. EXECUTIVE SUMMARY

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The existing 13,200 Volt (13.2 kV) electrical equipment, located in the basement and routed up the center core of the building, is antiquated and has become unsafe due to limited maintenance and years of accumulated dust and contaminants. Installed when the building was constructed in 1954, this equipment has remained out of sight and out of mind. Recent cleaning and maintenance of the equipment and copper bus duct has uncovered many operational and safety concerns chief among these being the following:

- Parts of the bus duct could not be accessed to clean, however visual inspection did show it to have a significant amount of dust/dirt on the bus bars. Additionally, the bus duct is not a sealed system so building air continues to deposit dust and dirt on all parts of it including those that were recently cleaned.
- The 13.2 kV switches, located on each floor to supply step-down transformers, are
 in a state of disrepair and are obsolete (cannot be repaired). This combined with
 their dangerous location makes their use unsafe and possibly life threatening to
 maintenance personnel.
- The 13.2 kV distribution system is showing signs of a major short circuit to ground potential. This was seen in transformers where the insulation had partially melted or burnt off electrical conductors.

If any of the above conditions leads to a failure, it will likely result in either an explosion, fire or both. This compounded with the fact the building lacks a fire suppression system makes it imperative that replacement of the distribution system begin as soon as possible.

A total of six options were investigated to replace the existing system with a modern, low maintenance electrical distribution system that will provide years of reliable and safe service. All the options investigated looked to replace the 13.2 kV distribution system with a 480 Volt distribution system which is the standard in office buildings. The 480 Volt system will be both easier and safer to maintain. To accomplish this, all the options look

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at placing transformers on the outside of the building or near the electrical service entrance. These transformers reduce the 13.2 kV power that Westar provides down to 480 Volt which is then distributed throughout the building.

The top three options are included in this executive summary. The options and estimated costs are as follows:

- Option 2: New substation transformers, located below grade, on the south end of the building, in the old cooling tower areaway with overhead bus duct routed to a new 480 Volt electrical switchgear in the sub-basement, also located on the south end of the building. A new ductbank will be constructed on the west side of Harrison Street to 10th Street and then extended west to the existing south areaway. The transformers and bus duct will be installed in an existing areaway and concealed out of view. New 480 Volt transformers will be installed on each floor to transform the voltage down to 120 Volts for convenience use. Cost \$7,150,000.
- Option 4: New switchgear and step-down transformers, located at the north end of the building in the basement. The 13.2 kilovolt primary electrical feeders will be routed into the building from Westar Energy and connected to 3,750 kVA transformers to convert the voltage to 480 Volts. There will be two transformers, one on each end of the line-up, feeding into 480 Volt switchgear that supplies the transformers located on each floor to convert the voltage to 120 Volts for convenience use. Cost \$7,100,000.
- Option 5: New substation transformers, located at below grade in a new electrical vault, on the north side of building with overhead bus duct routed in a new utility tunnel to new 480 Volt electrical switchgear in the basement, on the north end of the building. New 480 Volt transformers will be installed on each floor to transform the voltage down to 120 Volts for convenience use. Cost \$6,400,000.

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Our recommendation is to select Option 5 to provide an electrical vault dedicated to the electrical equipment and providing direct access into the basement space. This will require the minimum exterior excavation and will keep the electrical supply close to the Westar Energy manhole at 9th and Harrison. The disadvantage is the need to convert additional space in the basement area to electrical equipment space and the modifications required to the ceilings to route the new 480 Volt bus duct from the north end of the building to the mechanical equipment located on the south end.

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Page 3



2. INTRODUCTION AND HISTORY

2.1 Purpose of Study

The purpose of this report is to determine the feasibility of upgrading the electrical distribution system within the Docking State Office Building. This upgrade would remove the existing 15 kV distribution system from within the facility and replace with a 480/277 Volt system. Various options to accomplish this task were investigated and are summarized in this report.

2.2 History

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The existing electrical distribution system consists of electrical switchgear, rated for 15 kV, located in the northeast corner of the basement. Cabling, carrying 13.2 kV, is routed from a Westar Energy manhole in the northeast corner of Harrison and 9th Street. A recently constructed ductbank, containing three (3) 6-inch conduits, is routed from this manhole to the electrical room in the basement of the building. Two separate circuits (#9 and #10) are routed in this ductbank and supply electrical power to the 15 kV electrical switchgear. Of the two circuits, Circuit #10 is the preferred circuit and is normally utilized to supply power to the building.

Each of the electrical circuits feeds into the automatic throw-over switch in the switchgear. The automatic throw-over switch allows the switchgear to be fed from one of the two electrical feeder circuits. Typical operation is to have Circuit #10, from Westar Energy, supplying power to the switchgear through the automatic throw-over switch allows for energizing of the switchgear line-up.

If the preferred circuit is lost, the system is designed to automatically, if so selected, disconnect from the failed utility feeder and switch the "automatic throw-over switch" to energize the switchgear from the alternate source. With the current operation of operating only on Circuit #10, the loss of Circuit #10 would cause the system to disconnect from Circuit #10 and close the Circuit #9 switch to re-energize the switchgear from this source.

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From the switchgear, which is operating at 13.2 kV, the electricity is distributed throughout the building with either 15 kV cable or 15 kV bus duct. Three of the electrical loads are fed with #2 AWG, 15 kV cable (CCM-1, CCM-2, and LCUS No. 1). The medium voltage switches, controlling these feeders, are contained in the medium voltage (15 kV) switchgear in the northeast corner of the basement. The remainder of the electrical loads is connected to a 15 kV electrical bus duct that is routed from the northeast corner of the basement, to the east of the north-south corridor, northeast of the bank of elevators, to the electrical room located north of the elevator banks, on the basement level. This 15 kV bus duct is then routed vertically through the building to the penthouse. At each floor, except at the sub-basement and fourth floor, at least one tap is made to this vertical bus. The tap is routed to a medium voltage switch which feeds a 300kVA step-down transformer to convert the 13.2 kV to 120/208 volt. The 120/208 volt is considered the utilization voltage of each floor. The chillers and other large electrical loads are operated on 480 volts and are supplied by a 13.2 kV to 480 volt step-down transformer.

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3. EXISTING CONDITIONS

3.1 Site Investigation

During the period of November 24th to November 27th, 2010, Capital Electric was on site to perform routine maintenance on the 15 kV system in the facility. During this time, the electrical power to the building was turned "off" and the system was inspected, cleaned, and repaired. A copy of this report is included in Appendix A of this report. The findings of the report included excessive dust/dirt accumulation on the electrical gear and 15 kV bus duct, medium voltage switches not fully engaged, medium voltage fuses improperly installed, taped joints on the 15 kV bus duct needing repair, equipment out of adjustment and not fully engaged, transformer windings dangerously close to metal enclosures, and corrosion developing on insulators, just to name a few.

3.1.1 Dangers and Concerns

The dangers presented with the existing equipment include the possibility for an arc to be started with the displacement of the existing dust. Refer to Photographs 1 and 2 for pictorial representation of the extent of dirt/dust accumulation. The dust itself is explosive. If an electrical arc is started due to the conductivity of the dust particles, the addition of the fault electrical current could lead to an explosion in the electrical bus duct causing sever damage to the electrical equipment and harm to any personnel in the area.



Photograph 1: 15 kV Vertical Copper Bus (Side view)



Photograph 2: 15 kV Copper Bus (Bottom view)

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Docking State Office Building Electrical Upgrade Study

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In addition to the unsafe conditions discovered during the maintenance, the existing electrical distribution system is over 50 years old. The normal life of such electrical equipment is 20 - 30 years. Also, the existing equipment is now obsolete and finding parts is not only difficult and expensive, but in some instances may be impossible. This would require remanufacturing of some parts are substantial expense.

3.2 Present Building Electrical Loading

Historical loading information was provided by Westar Energy for the last three year's usage on the Docking State Office Building. The peak demand electrical loading of this facility was 3,168 kW/kVA recorded in June of 2009. The data provided by Westar Energy is included in Appendix B. The demand loading for a building is defined as the maximum electrical loading for a facility, over a 15 minute period. Based upon the rough square footage of the building, this equates to approximately 10 watts per square foot, which is typical for an office building loading.

This peak loading is used to determine the size of electrical equipment required to supply adequate power to the building. This value is used in developing options for possible upgrades.

Combining the existing electrical peak loading with the desire for a redundant electrical supply system, the step-down transformers to convert the incoming Westar Energy supplied 13.2 kV to 480/277 Volts will require a minimum of two (2) 3,750 kVA transformers. The maximum size of transformer that Westar Energy is able to provide is rated at only 2,500 kVA. Therefore, in order to meet the redundancy request, the state will be required to purchase and maintain the step-down transformers.

3.3 Building Layout

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A site plan and the building floor plans are included in Appendix C to provide information on the existing building layout and electrical arrangement. Sheet E601 shows the existing one-line diagram of the 13.2kV distribution system and the major electrical loads. The main electrical gear is located in the northeast corner of the basement level. The

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Docking State Office Building Electrical Upgrade Study

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distribution system is routed vertically through the center core of the building, directly north of the north bank of elevators. The mechanical equipment such as chillers, and pumps, are located in the south end of the building on the basement and sub-basement levels.

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Docking State Office Building Electrical Upgrade Study

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4. ELECTRICAL UPGRADE OPTIONS

4.1 Option 1

Replace existing switchgear with new, exterior mounted pad mounted transformers on the north side of the building and new 480 volt switchgear in basement.

This option involves the installation of two (2) new, 3,750 kVA, 13.2kV-480Y/277 Volt pad mounted transformers on the north side of the building. See Photograph 3, below, for approximate area for new transformers. The existing electrical, primary voltage feed is routed in a ductbank from a manhole at the northeast corner of Harrison and 9th Street. This ductbank consists of three (3) 6-inch conduits, concrete encased. To supply the new pad mounted transformers, a new ductbank, consisting of three (3) 6-inch conduits (two for conductors and one spare) would be routed from an intersecting point with the existing ductbank, where a new manhole would be installed, to the new transformers location.



Photograph 3: North Side Docking State Office Building

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The new primary conductors would be installed by Westar Energy from the manhole to the pad mounted transformers. Final electrical connections would also be performed by Westar Energy.

The secondary voltage of the transformers would be 480Y/277 Volts with a full load rating of 4,510 Amps, each. This would allow the entire load of the Docking State Office Building to be supplied by just one of the transformers, providing total redundancy. To carry the 4,510 full load amps, either conduit with conductors or weatherproof bus duct would be required, rated for a minimum of 5,000 Amps.

To place adequate raceway and conductors underground to carry the 5,000 Amps would require 44 conduits (Refer to calculations in Appendix D). The large number of conduits is required due to the derating effect from mutual heating from multiple conduits placed in a ductbank. A viable alternative is to install 5,000 Amp weatherproof ductbank from the transformers to the new electrical switchboard. Being that the electrical bus duct cannot be installed underground, an overhead routing from the secondary of the pad mounted transformers would be required. Support structures would be required to be placed along the route of the bus duct from the pad mounted transformers to the exterior of the building, on the north side of the drive.

Once routed to the exterior wall of the building, the 5,000 Amp bus duct would be routed vertically to below grade, into a small vault to allow for penetration of the basement wall, and then the 5,000 Amp bus ducts would be routed horizontally into the basement level and the new electrical switchgear room. This new electrical room would be created directly west across the hallway from the existing electrical room on the north end of the basement, next to the tunnel entrance. The new electrical room, the current auditorium, would need



Photograph 4: North End Basement Hallway

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to be expanded to the west to allow for the installation of the electrical switchgear.

Photograph 4 shows the existing electrical room door to the right, the existing doors to the tunnel in the center, and the existing door to the auditorium on the left.

The new switchgear would be rated for 5,000 Amps at 480Y/277 Volts. This gear, placed on a housekeeping pad, would consist of metering cabinets on each end to allow for Westar Energy's use. Next to the metering cabinets would be the main, 5,000 Amp switch, one for each of the feeds from the pad mounted transformers. One would be identified Circuit #9 and one Circuit #10. The main switch on each end would then feed distribution panels, rated at 5,000 Amps. In the middle of the new switchgear would be an automated tie-breaker. This tie-breaker would allow for the automatic connection of the two halves of the switchgear, to allow it to be fed from either of the two feeder circuits. The existing switchgear is presently connected to Circuit #10 (preferred source). With the new switchgear, both of the circuits from Westar Energy would be energized to allow for heating of the pad mounted transformers and thereby preventing condensation in the transformer.

Upon the loss of one of the feeder circuits, the switchgear would open the lost feeder circuit and automatically close the tie-breaker to allow for the entire switchgear to be fed from the remaining feeder circuit. Upon restoration of service to the affected feeder circuit, a manual or automatic retransfer shall occur to separate the two halves of the switchgear and the restored feeder circuit reconnected to half of the switchgear.

From the new electrical switchgear, 480 Volt feeders would be routed to the existing electrical loads within the facility. Connection to the existing CCM-1 and CCM-2, both located in the basement, shall each be fed with new 2,000 Amp, 480 Volt bus duct. LCUS No.1, also located in the basement, would be fed with conduit and wire adequate to supply 500 Amps to the LCUS. To supply the individual LCUS units located on the various floors, two (2) 2,500 Amp, 480 Volt bus ducts would be routed vertically through the building, with plug-in taps on each floor where existing loads exist. New 300 kVA step-down transformers would be installed on each floor to convert the voltage from 480 Volt 02/11/2011



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to 120/208 Volts to allow for utilization on each floor. The secondary of the 300 kVA transformers would be connected to distribution panelboards. These distribution panelboards would be reconnected to existing building loads.

Refer to Appendix E for a Riser Diagram of Option 1.

4.2 Option 2

Replace existing switchgear with new, exterior mounted substation transformers on the south side of the building in the existing areaway and new 480 volt switchgear in basement.

This option involves the installation of two (2) new, 3,750 kVA, 13.2 kV-480Y/277 Volt substation transformers in the existing areaway on the south side of the building. Photographs 5 and 6, below, show the existing areaway at the south end of the building. The existing electrical, primary voltage feed is routed in a ductbank from a manhole at the northeast corner of Harrison and 9th Street, into the north side of the building. This ductbank consists of three (3) 6-inch conduits, concrete encased. To supply the substation transformers, a new ductbank, consisting of three (3) 6-inch conduits (two for conductors and one spare) would be routed from an intersecting location with the existing ductbank. A new manhole would be installed at this location and the ductbank would extend to the new transformers location. A new manhole would also be required along the route due to the length of the raceway routing.



Photograph 5: South Side of DSOB Areaway



Photograph 6: DSOB South Areaway

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The new primary conductors would be installed by Westar Energy from the manhole to the pad mounted transformers. Final electrical connections would also be performed by Westar Energy.

The secondary voltage of the transformers would be 480Y/277 Volts with a full load rating of 4,510 Amps, each. This would allow the entire load of the Docking State Office Building to be supplied by just one of the transformers, providing total redundancy. To carry the 4,510 full load amps, weatherproof bus duct would be required, rated for a minimum of 5,000 Amps.

With the transformers placed in the existing areaway, the primary conductors would be routed overhead to the transformers from the new ductbank. The secondary weatherproof bus duct would be routed overhead, into the subbasement level to the new 480 Volt switchgear. The new gear would be located in the subbasement level where existing chillers are proposed to be removed as part of a chiller renovation project. The chillers will need to be removed to make a viable option. The switchgear would be enclosed in a 2-hour enclosure with two exits.

The new switchgear would be rated for 5,000 Amps at 480Y/277 Volts. This gear, placed on a housekeeping pad, would consist of metering cabinets on each end to allow for Westar Energy's use. Next to the metering cabinets would be the main, 5,000 Amp switch, one for each of the feeds from the pad mounted transformers. One would be identified Circuit #9 and one Circuit #10. The main switch on each end would then feed distribution panels, rated at 5,000 Amps. In the middle of the new switchgear would be an automatic tie-breaker. This tie-breaker would allow for the automatic connection of the two halves of the switchgear, to allow it to be fed from either of the two feeder circuits. The existing switchgear is presently connected to Circuit #10 (preferred source). With the new switchgear, both of the circuits from Westar Energy would be energized to allow for heating of the pad mounted transformers and thereby preventing condensation in the transformer.

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Upon the loss of one of the feeder circuits, the switchgear would open the lost feeder circuit and automatically close the tie-breaker switch to allow for the entire switchgear to be fed from the remaining feeder circuit. Upon restoration of service to the affected feeder circuit, a manual or automatic retransfer shall occur to separate the two halves of the switchgear and the restored feeder circuit reconnected to half of the switchgear.

From the new electrical switchgear, 480 Volt feeders would be routed to the existing electrical loads within the facility. Connection to the existing CCM-1 and CCM-2, both located in the basement, shall each be fed with new 2,000 Amp, 480 Volt bus duct. LCUS No.1, also located in the basement, would be fed with conduit and wire adequate to supply 500 Amps to the LCUS. To supply the individual LCUS units located on the various floors, two (2) 2,500 Amp, 480 Volt bus ducts would be routed vertically through the building, with plug-in taps on each floor where existing loads exist. New 300 kVA stepdown transformers would be installed on each floor to convert the voltage from 480 Volt to 120/208 Volts to allow for utilization on each floor. The secondary of the 300 kVA transformers would be connected to distribution panelboards. These distribution panelboards would be reconnected to existing building loads.

Refer to Appendix E for a Riser Diagram of Option 2.

4.3 Option 3

Construct new Westar Energy Ductbank along the east side of Harrison Street to the intersection of 10th Street.

This option involves the extension of the Westar Energy ductbank along the east side of Harrison Street from the existing manhole at the intersection of 9th and Harrison to the 10th and Harrison intersection. At this location, a new manhole would be installed and a three (3) 6-inch conduit ductbank would be constructed to the west to feed the new exterior transformers in the existing south areaway.

The extension of the existing Westar Energy ductbank would allow for expanding of the Westar underground distribution system and allow the ability to serve future loads east 02/11/2011

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of 10th and Harrison. The extension of the ductbank would be performed by Westar and reimbursed by the state of Kansas.

4.4 Option 4

Replace existing switchgear with new double-ended switchgear in basement at north end of building, including transformers.

This option involves the installation of the new 13.2kV to 480/277 Volt transformers in the basement. The transformers would be part of a new 5,000 Amp electrical line-up. A new ductbank with three (3) 6-inch conduits would be routed from an intersecting point along the existing ductbank a new manhole would be installed. Two (2) of the conduits would be utilized for feeder circuits 9 and 10 from Westar Energy. The ductbank would extend to the exterior wall of the Docking State Office Building, at the basement level, on the north end of the building. The raceway would enter the building in the space that is currently the auditorium. This room would be converted into a new electrical room and would require some modifications.

The switchgear would consist of a medium voltage switch (15kV) on each end, feeding a 3,750 kVA step-down transformer to convert from 13.2kV to 480/277 Volt. On the secondary of the step-down transformer would be connected half of the 480 Volt switchgear. The gear would have an automatic tie-breaker switch in the middle. Each half of the switchgear would be fed with one of the feeder circuits (9 or 10) from Westar Energy. Upon the loss of one of the feeder circuits, the corresponding main switch would open and the automatic tie-breaker would close to allow for operation of the entire 480 Volt switchgear from one feeder circuit. Upon the restoration of the feeder circuit, the automatic tie-breaker would open and the corresponding main switch would close to restore power to each half of the switchgear. Normal operation would be to utilize both feeders to allow for energizing of the 13.2kV to 480/277 Volt transformers to prevent condensation buildup.

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From the new electrical switchgear, 480 Volt feeders would be routed to the existing electrical loads within the facility. Connection to the existing CCM-1 and CCM-2, all located in the basement, shall each be fed with new 2,000 Amp, 480 Volt bus duct. LCUS No.1, also located in the basement, would be fed with conduit and wire adequate to supply 500 Amps to the LCUS. To supply the individual LCUS units located on the various floors, two (2) 2,500 Amp, 480 Volt bus ducts would be routed vertically through the building, with plug-in taps on each floor where existing loads exist. New 300 kVA step-down transformers would be installed on each floor to convert the voltage from 480 Volt to 120/208 Volts to allow for utilization on each floor. The secondary of the 300 kVA transformers would be connected to distribution panelboards. These distribution panelboards would be reconnected to existing building loads.

Refer to Appendix E for a Riser Diagram of Option 4.

4.5 Option 5

Replace existing switchgear with new, below grade mounted substation transformers located in an electrical vault, on the north side of the building and new 480 volt switchgear in basement.



Photograph 7: North Side Docking State Office Building

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This option involves the installation of two (2) new, 3,750 kVA, 13.2kV-480Y/277 Volt substation transformers on the north side of the building. See Photograph 7 for approximate area for new transformers and vault. The existing electrical, primary voltage feed is routed in a ductbank from a manhole at the northeast corner of Harrison and 9th Street. This ductbank consists of three (3) 6-inch conduits, concrete encased. To supply the new substation transformers, a new ductbank, consisting of three (3) 6-inch conduits (two for conductors and one spare) would be routed from a new manhole that is installed at the intersection with the existing ductbank.

The new primary conductors would be installed by Westar Energy from the manhole to the substation transformers. Final electrical connections would also be performed by Westar Energy.

The secondary voltage of the transformers would be 480Y/277 Volts with a full load rating of 4,510 Amps, each. This would allow the entire load of the Docking State Office Building to be supplied by just one of the transformers, providing total redundancy. To carry the 4,510 full load amps, either conduit with conductors or weatherproof bus duct would be required, rated for a minimum of 5,000 Amps.

A new 5,000 Amp weatherproof ductbank from the transformers to the new electrical switchboard would be routed from the electrical vault to the new switchgear room in the basement. To allow for ready access to the bus duct, the new vault would be install directly on the outside of the basement wall.

Once routed through the exterior wall of the basement, the connection would be made to the new switchgear in the new electrical switchgear room. This new electrical room would be created

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Photograph 8: North End Basement Hallway

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directly west across the hallway from the existing electrical room on the north end of the basement, next to the tunnel entrance. The new electrical room, the current auditorium, would need to be expanded to the west to allow for the installation of the electrical switchgear.

Photograph 8 shows the existing electrical room door to the right, the existing doors to the tunnel in the center, and the existing door to the auditorium on the left.

The new switchgear would be rated for 5,000 Amps at 480Y/277 Volts. This gear, placed on a housekeeping pad, would consist of metering cabinets on each end to allow for Westar Energy's use. Next to the metering cabinets would be the main, 5,000 Amp switch, one for each of the feeds from the pad mounted transformers. One would be identified Circuit #9 and one Circuit #10. The main switch on each end would then feed distribution panels, rated at 5,000 Amps. In the middle of the new switchgear would be an automated tie-breaker. This tie-breaker would allow for the automatic connection of the two halves of the switchgear, to allow it to be fed from either of the two feeder circuits. The existing switchgear is presently connected to Circuit #10 (preferred source). With the new switchgear, both of the circuits from Westar Energy would be energized to allow for heating of the pad mounted transformers and thereby preventing condensation in the transformer.

Upon the loss of one of the feeder circuits, the switchgear would open the lost feeder circuit and automatically close the tie-breaker to allow for the entire switchgear to be fed from the remaining feeder circuit. Upon restoration of service to the affected feeder circuit, a manual or automatic retransfer shall occur to separate the two halves of the switchgear and the restored feeder circuit reconnected to half of the switchgear.

From the new electrical switchgear, 480 Volt feeders would be routed to the existing electrical loads within the facility. Connection to the existing CCM-1 and CCM-2, both located in the basement, shall each be fed with new 2,000 Amp, 480 Volt bus duct. LCUS No.1, also located in the basement, would be fed with conduit and wire adequate to supply 500 Amps to the LCUS. To supply the individual LCUS units located on the various 02/11/2011

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floors, two (2) 2,500 Amp, 480 Volt bus ducts would be routed vertically through the building, with plug-in taps on each floor where existing loads exist. New 300 kVA step-down transformers would be installed on each floor to convert the voltage from 480 Volt to 120/208 Volts to allow for utilization on each floor. The secondary of the 300 kVA transformers would be connected to distribution panelboards. These distribution panelboards would be reconnected to existing building loads.

Refer to Appendix E for a Riser Diagram of Option 5.

4.6 Option 6

Replace existing switchgear with new, exterior mounted substation transformers on the southeast side of the building in the existing areaway and new 480 volt switchgear in basement.

This option involves the installation of two (2) new, 3,750 kVA, 13.2 kV-480Y/277 Volt substation transformers in the existing areaway on the southeast side of the building. A proposed chiller renovation project will need to be completed to remove the existing



Photograph 9: Southeast Areaway

cooling towers in this areaway to make room for the transformers. Photograph 9 shows the existing areaway at the southeast corner of the building. The existing electrical,

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primary voltage feed is routed in a ductbank from a manhole at the northeast corner of Harrison and 9th Street. This ductbank consists of three (3) 6-inch conduits, concrete encased. To supply the new substation transformers, a new ductbank, consisting of three (3) 6-inch conduits (two for conductors and one spare) would be routed from a new manhole installed at an intersecting location with the existing ductbank. A new manhole would also be required due to the length of the raceway routing.

The new primary conductors would be installed by Westar Energy from the manhole to the substation transformers. Final electrical connections would also be performed by Westar Energy.

The secondary voltage of the transformers would be 480Y/277 Volts with a full load rating of 4,510 Amps, each. This would allow the entire load of the Docking State Office Building to be supplied by just one of the transformers, providing total redundancy. To carry the 4,510 full load amps, weatherproof bus duct would be required, rated for a minimum of 5,000 Amps.

With the transformers placed in the existing areaway, the primary conductors would be routed overhead to the transformers from the new ductbank. The secondary weatherproof bus duct would be routed overhead, into the basement level to the new 480 Volt switchgear. The new gear would be located in the subbasement level where existing chillers are proposed to be removed as part of a chiller renovation project. The switchgear would be enclosed in a 2-hour enclosure with two exits.

The new switchgear would be rated for 5,000 Amps at 480Y/277 Volts. This gear, placed on a housekeeping pad, would consist of metering cabinets on each end to allow for Westar Energy's use. Next to the metering cabinets would be the main, 5,000 Amp switch, one for each of the feeds from the pad mounted transformers. One would be identified Circuit #9 and one Circuit #10. The main switch on each end would then feed distribution panels, rated at 5,000 Amps. In the middle of the new switchgear would be an automatic tie-breaker. This tie-breaker would allow for the automatic connection of the two halves of the switchgear, to allow it to be fed from either of the two feeder 02/11/2011



circuits. The existing switchgear is presently connected to Circuit #10 (preferred source). With the new switchgear, both of the circuits from Westar Energy would be energized to allow for heating of the pad mounted transformers and thereby preventing condensation in the transformer.

Upon the loss of one of the feeder circuits, the switchgear would open the lost feeder circuit and automatically close the tie-breaker switch to allow for the entire switchgear to be fed from the remaining feeder circuit. Upon restoration of service to the affected feeder circuit, a manual or automatic retransfer shall occur to separate the two halves of the switchgear and the restored feeder circuit reconnected to half of the switchgear.

From the new electrical switchgear, 480 Volt feeders would be routed to the existing electrical loads within the facility. Connection to the existing CCM-1 and CCM-2, both located in the basement, shall each be fed with new 2,000 Amp, 480 Volt bus duct. LCUS No.1, also located in the basement, would be fed with conduit and wire adequate to supply 500 Amps to the LCUS. To supply the individual LCUS units located on the various floors, two (2) 2,500 Amp, 480 Volt bus ducts would be routed vertically through the building, with plug-in taps on each floor where existing loads exist. New 300 kVA stepdown transformers would be installed on each floor to convert the voltage from 480 Volt to 120/208 Volts to allow for utilization on each floor. The secondary of the 300 kVA transformers would be connected to distribution panelboards. These distribution panelboards would be reconnected to existing building loads.

Refer to Appendix E for a Riser Diagram of Option 6.

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5. REVIEW OF OPTIONS

5.1 Option 1

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Replace existing switchgear with new, exterior pad mounted transformers on the north side of the building and new 480 volt switchgear in basement.

Refer to Site Plan, in Appendix C, for a proposed location for the pad mounted transformers. The ductbank would be installed from a new manhole installed at an intersecting location with the existing ductbank on the south side of 9th Street. The transformers would need to be placed on approximately 10-foot square concrete pads, for support. The primary conductors will be routed underground from the existing Westar Energy manhole at the northeast corner of 9th and Harrison.

On the secondary of the transformers, the use of conduit and wiring to route the 5,000 Amps, at 480 Volts, is not a viable option. Please refer to the Appendix D for calculations for a 44 duct underground ductbank. The mutual heating from adjacent conduits greatly limits the current carrying capacity of the ductbank conductors. Therefore, the only viable option is the use of 5,000 Amp weatherproof bus duct. The bus duct would need to be routed overhead as the bus duct cannot be installed underground. From the secondary of each transformer the bus duct would be routed on a support structure to allow the bus duct to get to the outside wall of the north end of the building. The bus duct would be routed vertically, on the north end of the building, down into a new small vault area that extends below the ceiling of the basement level. The bus duct would enter the basement exterior wall through a new small vault to prevent burial in earth.

The existing auditorium in the basement is too small for the installation of the new electrical gear. The existing interior wall would need to be removed and a new wall, another column line west, would need to be constructed. Per the National Electrical Code (NEC) two emergency exits are required from this room. Some modifications may need to be made at the corridor door to allow for an outward swinging door into the

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hallway. A second exit door could be installed either at the west end of the new room or into the room to the south.

The new transformers and overhead weatherproof bus duct will be exposed on the north side of the building which may not be an ascetically pleasing view from the Capitol.

5.2 Option 2

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Replace existing switchgear with new, exterior mounted substation transformers on the south side of the building in the existing areaway and new 480 volt switchgear in basement.

Refer to Site Plan, in Appendix C, for a proposed location for the outdoor mounted transformers. The new ductbank will be routed from a new manhole installed at an intersection location with the existing ductbank, located in the eastbound lane of 9th Street. From this location, a ductbank would be routed on the west side of Harrison Street, to the south end of the building. Here the ductbank would travel west to the existing areaway where cooling towers were originally housed. The primary conductors will be routed underground from the existing Westar Energy manhole at the northeast corner of 9th and Harrison to the south areaway.

There is a large amount of ductbank to be installed to get the underground electrical service to this location. Along Topeka Boulevard there is an existing 12.5kV overhead electrical line. The disadvantages to utilizing this circuit to supply power to the building are two fold. The first is that the line is overhead and is susceptible to squirrels, trees, and lightning strikes. The second is that there is only one circuit thereby not allow for a redundant feed.

Placing the transformers in the existing areaway allows for the transformers to be placed outside of the building, yet placing them in an area that is not visible at grade level. The heat from the transformers is kept out of the building so the building cooling load would be less than the existing.

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Routing of the 5,000 Amp overhead weatherproof bus duct from the transformers into the building can also be contained below grade level. All supports are below grade and the exterior wall penetrations are below grade, but not underground.

The placement of the 480 Volt switchgear on the south end of the building puts the electrical gear closer to the larger loads, thereby eliminating the need to route 2,000 Amp bus duct from the north end of the building to the large electrical loads on the south end of the building.

5.3 Option 3

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Construct new Westar Energy Ductbank along the east side of Harrison Street to the intersection of 10th Street.

The existing underground electrical network, around the Capitol complex, does not currently extend south to the 10th and Harrison intersection. As an option to installing a three (3) 6-inch conduit ductbank along the west side of Harrison from 9th to 10th, another possible option is have Westar Energy install a ductbank meeting their requirements, along the east side of Harrison, extending the existing underground network. This will allow for future load expansion to the east of this location.

With this option, a larger ductbank, than what is required to feed the new building transformers located in the south areaway, will be required to be built.

5.4 Option 4

Replace existing switchgear with new double-ended switchgear in basement at north end of building, including transformers.

As indicated in Option 1, the new switchgear could be installed in the area of the existing auditorium. This option, however, adds the new 13.2kV to 480/277 Volt transformers to this line-up. This allows the ductbank to be built along the north side of the Docking State Office Building and the ductbank would enter the building below grade, thereby not being visible and somewhat unsightly.

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The transformers would add heat to this area and the need for cooling/ventilation would need to be addressed.

The biggest concern is being able to place the transformers in the basement room. The transformers are approximately 5-feet wide and 8-feet long. This becomes a problem to navigate the transformer through the building. The transformer is 102-inches tall and would require the removal of lighting fixtures, smoke detectors, and the opening of several doorways to allow for passage. Additionally, each transformer weighs approximately 10 tons. The existing floor design of the basement hallway will not support this great of a load without shoring up the floor from below. Photograph 10 shows one of the doorways that would need to be opened to make room for the transformers. Additionally, the existing lighting fixture, exit sign, and fire alarm annunciator would need to be removed to allow for passage of the 102-inch tall transformer.



Photograph 10: North-South Hallway, Basement Level, Looking North

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5.5 Option 5

Provide new transformers in new vault at north end of building.

To help conceal the new transformers, a new vault would be constructed, outside of the basement wall, to allow for the placement of the transformers. A new ductbank would be routed to the new vault and then new weatherproof bus duct would be routed between the vault and the electrical switchgear, located in the basement. With the new vault, the transformers would be placed below grade and not visible from street level. Also, the weatherproof bus duct would be routed below grade out of sight.

5.6 Option 6

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Replace existing switchgear with new, exterior mounted substation transformers on the southeast side of the building in the existing areaway and new 480 volt switchgear in basement.

Refer to Site Plan, in Appendix C, for a proposed location for the outdoor mounted substation transformers. The new ductbank will be routed from a new manhole installed at an intersection location with the existing ductbank, located in the eastbound lane of 9th Street. From this location, a ductbank would be routed on the west side of Harrison Street, to the southeast corner of the building. Here the ductbank would travel west to the existing areaway where cooling towers were originally housed. The primary conductors will be routed underground from the existing Westar Energy manhole at the northeast corner of 9th and Harrison to the southeast areaway.

As described in Option 2, there is a large amount of ductbank to be installed to get the underground electrical service to this location. Along Topeka Boulevard there is an existing 12.5kV overhead electrical line. The disadvantages to utilizing this circuit to supply power to the building are two fold. The first is that the line is overhead and is susceptible to squirrels, trees, and lightning strikes. The second is that there is only one circuit thereby not allow for a redundant feed.

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Placing the transformers in the existing areaway allows for the transformers to be placed outside of the building, yet placing them in an area that is not visible at grade level. The heat from the transformers is kept out of the building so the building cooling load would be less than the existing.

Routing of the 5,000 Amp overhead weatherproof bus duct from the transformers into the building can also be contained below grade level. All supports are below grade and the exterior wall penetrations are below grade, but not underground.

The placement of the 480 Volt switchgear on the south end of the building puts the electrical gear closer to the larger loads, thereby eliminating the need to route 2,000 Amp bus duct from the north end of the building to the large electrical loads on the south end of the building. It also eliminate the need to disturb ceilings from the north end of the building to south of the elevator lobby.

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6. PROJECT APPROACH

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Upgrading of the existing electrical system while the building is occupied will require careful planning and execution. The existing electrical system will need to remain energized until all of the existing electrical building loads are transferred to the new electrical distribution system. The first step will be to place the new transformers and switchgear in place. With any of the investigated options, a new electrical room is required. A new switchgear room will allow for the new switchgear to be placed and new distribution bus duct and cable to be routed and readied for connection to the existing motor control centers and new step-down transformers and distribution panels with minimal utility interruptions.

The existing 480 Volt motor control center (MCC) will be modified to remove the existing step-down transformer and connect to the existing MCC bus. The existing 120/208 Volt MCC will have a new 1,500 kVA transformer installed to convert from 480 Volt to 120/208 Volt.

The new vertical bus ducts will be routed vertically through the building. Once installed each existing power station consisting of a step-down transformer and distribution panel will be replaced with new transformers and electrical distribution panels. Existing loads will be transferred to the new panels after hours to limit disruption in the building.

Once all of the existing building loads have been transferred to the new electrical distribution system, the existing 15 kV switchgear, cable runs, and vertical bus will be removed.

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7. SUSTAINABILITY

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H. W. Lochner, Inc. is committed to designing projects with sustainability in mind. This project will have salvageable materials, such as copper bus and wiring and metal enclosures that will be removed from the building as part of the demolition work. The new equipment, consisting of metal enclosures, copper bus duct, copper wiring, copper wound transformers, and new concrete, are all recyclable materials that, once they have served their useful life, can be removed and recycled for reuse. The need to keep the building operational does not allow for the existing material to be reused in the new electrical construction.

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KANSAS DEPARTMENT OF ADMINISTRATION

Docking State Office Building Electrical Upgrade Study

TMA #1667

8. ESTIMATED CONSTRUCTION COSTS

The costs for each option were assembled to provide a basic order of magnitude. A 30% contingency has been added to each option to cover any unforeseen construction expenses that will only become known during the design portion of the project. The source of the costs varies from Westar Energy, Square D Schneider Electric, to RSMeans Electrical Cost Data 2011. Backup information is available in the Appendix H for the demolition and construction portion of the project. The estimates below also include costs for design and construction administration, estimated at 10% of total construction costs.

Option 1 - \$6,400,000

Option 2 - \$7,150,000

Option 3 - \$8,000,000

Option 4 - \$7,100,000

Option 5 - \$6,400,000

Option 6 - \$7,050,000

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9. CONCLUSION

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9.1 Summary

Several options were identified and investigated to determine a general approach and basic order of magnitude cost for the electrical upgrade. The age of the existing equipment along with the potential operational hazards of routing metal enclosed, open copper bussing, through the building and vertically through the floors without firestopping at each floor, antiquated equipment, and limited replacement part necessitates the upgrade of the electrical distribution system with new, state-of-the-art equipment.

Refer to Appendix E for a Proposed Line-up of the new electrical distribution system. The placement of the transformers varies depending upon the option presented, but the basic system layout is represented.

The placing of pad mounted transformers on the front lawn (north side) of the building, along with overhead 5,000 Amp weatherproof bus duct makes for an unappealing visual arrangement. However, install a new electrical vault on the north end of the building will allow an accessible location for the new substation transformers and the ability to conceal them from grade level view. Access into the basement level is simplified and reduces the length of 5,000 Amp weatherproof bus duct required to be routed from the transformer secondaries to the 480 Volt switchgear.

Installing new 3,750 kVA, 13.2kV to 480/277 Volt transformers with main-tie-main 480 Volt switchgear in the new electrical room in the basement allows for a confined electrical distribution system arrangement. However, physically installing the new transformers, with a weight of nearly 10 tons provides a structural obstacle as well as the physical dimensions of a 5-foot x 8-foot footprint, with a 102-inch overall height provides a maneuverability obstacle to bringing the transformers in the overhead door near the dock and then transporting down the hallways to the north end of the basement. At least three (3) hallway doorways will need to be modified to slip the transformer in the

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KANSAS DEPARTMENT OF ADMINISTRATION

Docking State Office Building Electrical Upgrade Study

TMA #1667

building and structural bracing will be required to roll the transformers on the basement floor.

Installing the new 3,750 kVA transformers in the south areaway, which previously housed cooling towers, or the southeast areaway, which currently is housing cooling towers, allows for placement by crane from an exterior location. The transformers, while still outside of the building, are concealed below the grate cover from view. The new 480 Volt switchgear can be installed in a new electrical room in the south end of the building, closer to the larger electrical loads (CCM1 and CCM2) thereby reducing the required length, and cost, of 2,000 Amp, 480 Volt bus duct. In order to install the new switchgear in the sub-basement level, the proposed chiller renovation project, that will remove the cooling towers from the southeast areaway and the chillers from the sub-basement level of the building, will need to be completed prior to start of electrical upgrade.

If the transformers and new switchgear are located in the south or southeast areaways, Westar has expressed the desire to extend their existing ductbank system to the corner of the 10th and Harrison. From this point, a new ductbank would be extended to the south areaway. This approach varies from Option 2 in the fact that the north-south ductbank will be built by Westar to Westar standards on the east side of the Harrison and the state would only build the ductbank from the 10th Street and Harrison Street intersection manhole, to the west. The state would not need to build the ductbank on the west side of Harrison Street. This approach allows the utility to extend its underground network and the new transformers can be hidden from sight. This also keeps the electrical and mechanical equipment in the utility part of the building and frees up space for storage, meeting, or office space.

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Page 32



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KANSAS DEPARTMENT OF ADMINISTRATION
Docking State Office Building Electrical Upgrade Study

APPENDIX A: CAPITAL ELECTRIC REPORT

Appendices



December 22, 2010

Kansas Department of Administration 900 WS Jackson Street, Suite 600 Topeka, KS 66612

Attn: George Werth

Subject: Summary of work performed on electrical distribution system in the Docking Building.

Dear Mr. Werth:

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Capital Electric Construction was contracted to perform maintenance and cleaning of the 13.2kV electrical distribution system in the Docking Building. The work was started on Wednesday, November 24 and completed on Saturday, November 27. This report summarizes our findings.

To perform our work, power to the Docking building was turned off and maintenance to the Main Electrical gear and bus riser took place. During this maintenance, several medium voltage (M.V). switches were cleaned and repaired along with the main riser bus that runs the length and height of the building. The protective metal covers on the bus were removed where assessable and the electrical bus was visually inspected and cleaned. Included with this report are several photos of different items of concern that need varying degrees of attention.

Below is a list of our concerns:

- Nameplates on the equipment indicate that the gear was manufactured/installed
 in the mid 1950's. This makes this equipment between 50 and 60 years old. It is
 generally expected that electrical gear has a life expectancy of 15-30 years.
 Many factors affect the life expectancy, including ambient temperature,
 environmental conditions, electrical load (and the characteristics of the load) on
 the equipment, maintenance, and other factors. Assuming all of these factors
 have been ideal, the gear would still be considered to have out-lived its normal
 life expectancy.
- 2. Many of the sections of the bus are inaccessible. This means that these sections have never been cleaned or maintained. Routine maintenance is not possible on these sections. There was an extreme amount of dust/dirt accumulation in all areas of the system. We were able to clean many of the areas, but these particular areas could not be accessed, so they remain with over 50 years of dirt accumulation. The presence of the dust/dirt and in some areas oil and moisture



could lead to tracking (unwanted current flow from phase to phase or phase to ground). The result of this could potentially be severe damage to the equipment and building, and also potential safety risk to people in the building. An electrical outage affecting the entire building could also result.

The age of the electrical equipment is such that replacement parts are unavailable or difficult to find. Repairs may require custom fabrication, which could require extensive engineering or re-engineering.

 The gear is 13.2kV. Any maintenance or repairs requires special equipment, tools, and training.

5. The gear is very open in design and allows air flow into the bus duct thru the M.V. switches. With these transformer housings being in the air handler rooms and the elevator exhaust ports feeding into these rooms the accumulation is much more than normal. The bus is covered and has taped joints but those tape joints are showing some tracking and age. To re-tape these joints would extend the life of the bus but would be very labor intensive and require a very lengthy outage to do so.

6. Transformer TRN-0015 has bus that is wrapped in 20,000v electrical blanket and extremely close to the access points of the transformer housing. It is possible that during the removal of the transformer housing covers that the bus could become exposed and cause significant hazards to the personnel working on the gear. Due to the nature of these pieces of electrical gear every precaution should be taken to protect any personnel inspecting these items. A detailed safety agenda should be followed and all personnel should adhere to any and all PPE requirements of NFPA 70e. An arc flash incident is highly possible with gear of this nature if the proper precautions are not followed extensively. The consequences of an arc flash in this gear and in these confined locations would be very server and would likely result in death to the personnel working on the gear. It is highly recommended that only qualified and trained personnel have access to this gear for maintenance purposes.

7. As mentioned above the M.V. switches are open into the bus area. These had varying degrees of dust and dirt accumulation as well. These however can be de-energized and maintenance performed on a regular basis to extend their life span. While energized a visual inspection of these switches and of the transformers would be recommended along with an IR scan on a routine maintenance schedule. With the exception of one transformer this is recommended.

 An arc flash study is recommended for this and all electrical gear in the Docking building. This would include the proper labeling of the arc hazard and calorie requirements onto all electrical doors.

9. It was also observed during the maintenance that some of the fuses were not seated properly and that the switches were not engaging fully. The only reason this had not been an issue was due to the amount of load on these switches. If these had additional load on them when not fully seated it would result in arcing and heating issues.

10. It was noted on the first and basement floors that the wires feeding off the load side of the switches have corrosion developing at the insulators holding them in place. These were cleaned and re-taped but this is not a permanent fix and

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these should be replaced in the near future before the insulation breaks down to the point of failure.

11. Mechanical mechanisms in some of the MV switches have failed. These are a safety mechanism that keeps the door of the enclosure closed when the switch is in the energized state. Because these could not be repaired, we were forced to install padlocks on the doors as the only means of safety. Signage should be installed on these switches to alert personnel of the danger.

SUMMARY

We believe the electrical distribution system in the Docking Building is nearing the failure point, and we recommend a complete replacement of the system.

- Insulation in the system is deteriorating and may fail.
- The equipment is obsolete and replacement parts are not available.
- · Safety mechanisms are failing.

I have attached the Emerson Test Report for the switches and equipment that were tested during the project. Their report includes additional recommendations.

Please contact me if there are any questions or additional information is required.

Thank you.

Mark Hurshman Capital Electric



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Electrical Reliability Services, Inc. Kansas City Area Office

348 N.W. Capital Drive Lee's Summit, MO 64086 T (816) 525-7156 F (816) 524-3274

December 6, 2010

Capital Electric P.O. Box 410079 Kansas City, MO 64141

Attention: Mr. Mark Hurshman

Subject:

Electrical Equipment Maintenance Test Report

Reference No. 3126895

Dear Mr. Hurshman:

Enclosed is the subject test report as prepared by our lead field engineer. It was our pleasure to be of service to you on this project. If you have any questions, or if we can be of further assistance, please do not hesitate to call.

Sincerely,

Electrical Reliability Services, Inc

Bob Ross

Service Center Manager

Enclosures



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Electrical Reliability Services, Inc. Kansas City Area Office

348 N.W. Capital Drive Lee's Summit, MO 64086 T (816) 525-7156 F (816) 524-3274

Electrical Equipment Maintenance Test Report

At

DOCKING STATE OFFICE BLDG Topeka, KS

for

Capital Electric P.O.Box 410079 Kansas City, MO 64141

Attention: Mr. Mark Hurshman Order No: PO#196031, JOB#56763

Reference No.

3126895

Submitted By:

David Duncan Field Engineer

December 6, 2010

Reviewed By:

Bob Ross Service Center Manager

1 PURPOSE

- 1.1 The equipment and components listed in Section 3.0 of this report have been inspected and tested to help assure their proper and safe operation. Defective or marginal equipment can be identified, repaired, replaced or scheduled for future repairs without costly or unexpected interruptions during normal operating periods.
- 1.2 The test results are particularly valuable when kept for comparison with past and future maintenance test results. This historic database enables one to predict the probability of equipment failure and thus schedule facility production and financial budgets to accommodate preventive maintenance or repair rather than breakdown maintenance.

Reference No.3126895

110 TO UNK 2 SUMMARY 2.2 details of the testing.

- This project was initiated by Mr. Mark Hurshman with Capital Electric. All testing was performed by Electrical Reliability Services Field Engineers David Duncan and Charles Howell on Saturday, November 27, 2010.
- Please refer to Section 5 "Results and Recommendations" for complete

Reference No.3126895

3 **EQUIPMENT TESTED AND INSPECTED** Three (3) medium voltages disconnect switches, S&C, SM-5, and 400 Amp. Seventeen (17) medium voltages disconnect switches, electrical engineering equipment co, S.O. # 50542, 300 Amp. 3.2 1 1 13 111 in in 1 13 1 1 1 Reference No.3126895 -1.7 Page 3 1 23

4 PROCEDURES

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- 4.1 Medium Voltage Air Switches
 - 4.1.1 Visual and Mechanical Inspection
 - .1 Compared equipment nameplate data with drawings and specifications.
 - .2 Inspected for physical damage, proper installation, required area clearances, anchorage and grounding. Cleaned interior, insulators, arc chutes and interphase barriers.
 - .3 Performed mechanical operator tests in accordance with manufacturer's instructions. Cleaned and lubricated contacts and mechanism as applicable. Confirmed correct application of manufacturer's recommended lubricants.
 - .4 Checked contact alignment, wipe and pressure.
 - .5 Inspected for correct phase barrier materials and installation.
 - .6 Checked fuse linkage and element for proper holder and current rating. Recorded fuse data.
 - .7 Verified tightness of accessible bolted electrical connections by calibrated torque-wrench method.
 - .8 Verified that fuse sizes and types were in accordance with drawings and power system studies.
 - .9 Inspected all indicating and control devices for correct operation.
 - .10 Tested all interlocking systems for correct operation and sequencing. Checked key interlock for proper operation and proper key distribution.
 - .11 Verified arc interrupter operation.

Reference No.3126895

4.1.2 Electrical Tests

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- .1 Performed contact resistance test across each switch blade and fuse link.
- .2 Measured fuse resistance.
- .3 Performed insulation-resistance tests on each pole, phase-tophase and phase-to-ground with switch closed and across each open pole for one minute.

Reference No.3126895

5 RESULTS AND RECOMMENDATIONS

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- 5.1 The following is a list of problems discovered during this testing project along with any corrective action that was made by Electrical Reliability Services. Those corrections beyond the scope of the project that require your additional corrective action are in bolded text.
 - 5.1.1 If the equipment tested in Section 3 is not discussed in this section, the results of the tests indicate the equipment to be satisfactory.
- 5.2 Feeder #10 A phase contact resistance was found to be higher than the other two phases and was outside of NETA contact resistance tolerances. This could cause contact heating of the other two phases, deterioration, and eventual failure of the switch. This problem was corrected at time of testing by ERS personnel. No further action required at this time.
- 5.3 Feeders 9 &10 automatic transfer operator could not be tested because of customer restrictions. Because of the age, condition, and unavailability of repair parts the customer did not want the transfer mechanism operated. The customer is aware of the deficiencies with the ATS System and is attempting to have it repaired or replaced.
 - It is recommended that the ATS System should be tested once repairs have been made. Electrical Reliability Services would be pleased offer this service.
- 5.4 Riser #7 B phase contact resistance was found to be higher than the other two phased and was outside of NETA contact resistance tolerances. This could cause contact heating of the other two phases, deterioration, and eventual failure of the switch. This problem was corrected at time of testing. No further action required at this time.

Reference No.3126895

- 5.5 During the outage for Capital Electric Inc. to perform low voltage retrofits, on down stream equipment, it was discovered that a large percentage of the transformer disconnects were not closing fully. The cause of the problems was found to be the mechanical door interlocks which are bent out of shape. State of Kansas personnel directed Electrical Reliability Services personnel to remove the interlocking mechanism and State of Kansas personnel would install locks and signs to adjust for the safety issues.
- 5.6 During the inspection of Medium Voltage Air Switch LUCS 18, on the (14th) floor it was discovered that the moving contacts were not fully engaging the stationary contact. This could cause contact heating, deterioration, and eventual failure of the switch. Electrical Reliability Services personnel corrected this condition. This same condition was found at the following locations:

LUCS 17, on the (14th) floor LUCS 16, on the (12th) floor LUCS 15, on the (11th) floor LUCS 14, on the (10th) floor LUCS 9, on the (9th) floor LUCS 10, on the (8th) floor LUCS 11, on the (7th) floor LUCS 12, on the (6th) floor LUCS 13, on the (5th) floor LUCS 5, on the (3th) floor

Reference No.3126895

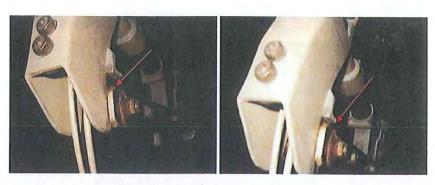
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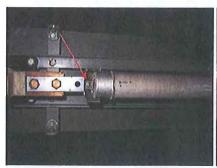
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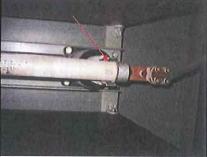
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The pictures below are examples of this condition. The left picture is the before adjustment picture and the right picture is after corrections were made.



- It is recommended that all the switches be cleaned and tested.
 Electrical Reliability Services would be please to provide this service.
- 5.7 LUCS 5, on the (3rd) floor was found with the B phase fuse improperly inserted into the fuse clip. This could cause overheating, premature aging of the fuse and unscheduled outages. Capital Electric Personnel were to correct this problem before restoring service. The left picture is the line side of the fuse and the right picture is load side of the fuse.

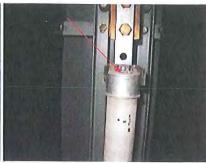




5.8 LUCS 5, on the (3rd) floor was found with the C phase fuse improperly inserted into the fuse clip. This could cause overheating, premature aging of the fuse and unscheduled outages. Capital Electric Personnel were to correct this problem before restoring service. The left picture is the load side of the fuse and the right picture is line side of the fuse.

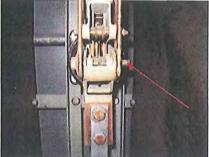


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- 5.9 LUCS 3, on the (1st) floor was found with the knife blades fully penetrating the stationary contacts. However the C phase knife switch was found to be missing a nut and cup washer on the line and load side of the switch. This could cause contact heating, deterioration, and eventual failure of the switch. This problem was corrected before restoring utility power by Capital Electric personnel. The left picture is the moving portion of the switch, and the right picture is the elbow or pivot part of the switch. No further mechanical action required at this time.
 - It is suggested that a complete cleaning and maintenance test be performed at the next scheduled outage. Electrical Reliability Services would be pleased offer this service.





Reference No.3126895

Ross, Bob [NETPWR/ERS/LEE']

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FW: Docking M.V. switches

Importance:

High

-----Original Message-----

From: White, Ben [mailto:bwhite@capitalelectric.com]

Sent: Friday, November 26, 2010 9:32 AM To: Steele, George [FM]; Flowers, Clifford [FM]

Cc: Werth, George [FM]; Lour, Mike [FM]; Howell, Chuck [NETPWR/ERS/LEE']; Hurshman, Mark

Subject: RE: Docking M.V. switches

Importance: High

Gentlemen this is to document our earlier conversation today in which the door latches were discussed. As directed we will have Emerson Reliability Services remove the door latch mechanism from the throw rod so as to allow complete operation of the switches off the Bus Duct riser only. These components will be placed in the bottom of the cabinets for future needs if it is desired to repair and reattach these at a later date.

In cleaning these switches we noticed the knife blades not fully engaged. During further inspection it was noted that the latch rods have been bent during operation and are obstructing the switches from engaging fully and properly. These latch rods are part of the mechanism that holds the door shut while in the energized state. These will be removed off all these common disconnect switches on the Bus riser so no further issues arise in the event of operating these switches.

It is understood that you will have padlocks in place that only allow Authorized personnel access to these when the switch when they are in the closed position. In addition signage will be placed on all these disconnects to signify this modification and the hazards involved with opening these while energized. I would also suggest signage being added that signifies the proper PPE require to open these switches and the proper CAL requirement for Arc Flash.

Your response to this email will serve as our authorization to perform this work.

Thanks, Ben White Capital Electric Construction Company Service Division 816-215-6691 (cell)

From: Steele, George [FM] [mailto:George.Steele@da.ks.gov]

Sent: Thu 11/25/2010 4:50 PM

To: White, Ben; Hurshman, Mark; Flowers, Clifford [FM]

Cc: Werth, George [FM]; Lour, Mike [FM]

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Subject: RE: Docking M.V. switches

We agree with having Emerson look at, repair and modify all switches off the Buss Duct on a Time and Material Basis.

George Steele 900 SW Jackson, Suite 600 Topeka, KS 66612 785-296-4693 Cell 785-215-5709

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----Original Message----

From: White, Ben [mailto:bwhite@capitalelectric.com]

Sent: Thursday, November 25, 2010 4:17 PM

To: Steele, George [FM]; Hurshman, Mark; Flowers, Clifford [FM]

Subject: Docking M.V. switches

Gentlemen this is to confirm our earlier conversations today about the Switches that are not engaging as they should feeding the transformers on each floor off the Bus Duct run.

We will as discussed remove the safety latch that holds the doors closed while energized. It is understood that the padlock on the door handle will become the safety and labeling will be attached to the doors to identify the voltage hazard. As discussed this is being done so that it can be verified that the knife switches have engaged the switch fully.

Secondly we will have Emerson Reliability Services look at and repair or modify all the switches off the Bus Duct run we have been working on to verify the functionality of all the switches. They will make the necessary adjustments to the two switches in the penthouse.

All this work is on a T&M basis. Please respond to this email as our work authorization.

Thanks, Ben White Capital Electric Construction Company Service Division 816-215-6691 (cell)



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MEDIUM VOLTAGE AIR SWITCH TEST REPORT

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		CAPITAL	ELECTRIC				o o o o o o o o o o o o o o o o o o o	312689	5	
OCATION:	45.004.11				ENGINEER:		DATE:			
SWITCHGEAR DESIGNATION	15 SW HA		ENTIFICATION:		TEST EQU	DD P. ASSET NO.	CALIBRATI	11/26/2010		
MAIN ATS			RISER NO #	ŧ 7		45/1280	05/26/2010			
MANUFACTURER:		TYPE:		MEPLATE						
S&C			N/A	STYLE/SERIA	CD29092		CURRENT RATING:		VOLTAGE RATI	
USE INFORMATION:				CD28082			400 1 SYSTEM VOLTAGE:			
S & C, SM-5,	CAT NO	132400R	4, 14.4 KV, 2	250E, TC	C NO. 153	-4		13.8 K\	/	
			y .	INSPECTION	NC					
CHECK F	OINT		CONDITION	NOTES		CHECK POIN	r	CONDITION	NOTES	
PHYSICAL DAMAGE			Α		CONTAC	T ALIGNME	NT	Α		
CLEANLINESS			С		CONTACT WIPE			Α		
MECHANICAL OPERATOR			N/A	(1)	CONTACT PRESSURE			Α		
MAIN CONTACTS		Α		PHASE BARRIERS			Α			
RC CONTACTS		Α		HARDWARE TIGHTNESS			Α			
RC CHUTES	N/A		FUSE HOLDERS			A				
RC INTERRUPTER SEC	A		INTERLOCKS			A				
70-400					1	7115		_ ^		
			ELEC	CTRICAL T	ESTS					
					ASE	B-PH	ASE	C-P	HASE	
ONTACT RESISTANCE	IN MILLIO	HMS		0.373/.112 0.832/			/.118		1/139	
USE RESISTANCE IN M	ILLIOHMS	1		0.410 0.3			0.386			
ISULATION RESISTANCE			SWITCH C	SWITCH CLOSED			SWITCH OPEN			
TEST IN GIGOHMS	A-Gnd	B-Gnd	C-Gnd	A-B	B-C	C-A	Α	В	C	
0 5000 VOLTS	2.953	3.045	3.099	745			A	7	- ()	
	Z.900	3.043	3 099	(4)	(4)	(4)	7040	6150	6200	



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MEDIUM VOLTAGE AIR SWITCH TEST REPORT

CLIENT:	Reliability Ser	vices										
			CAPITAL	ELECTRIC		JOB NOW			B NUMBER:			
LOCATION:						ENGINEER: DATE:			3126895 E:			
SWITCHGEA	9' AR DESIGNATION	15 SW H	ARRISON FEEDER ID	N ST DENTIFICATION:		CH TEST EQU	DD	CALIBRAT	11/26/2010 CALIBRATION DATE:			
	MAIN ATS			FEEDER#				- CALIBIONI	05/26/2010			
MANUFACTU	IDED:		Les inte		MEPLATE	DATA			03/20/2010			
MANUTACIO	S&C		TYPE:	ALLA	STYLE/SERIA			CURRENT	CURRENT RATING:			
FUSE INFOR				N/A	CD28082			SYSTEM VOLTAGE:				
S	& C, SM-5,	CAT NO	132400R	4, 14.4 KV,	250E, TC	C NO. 153	3-4		13.8 K	V		
					INSPECTI		-		10.01			
	CHECK P	OINT		CONDITION	NOTES		CHECK POIN	IT	CONDITION	NOTES		
PHYSICAL	DAMAGE			Α		CONTAC	T ALIGNME	ENT	A			
CLEANLIN	ESS			С		CONTAC	T WIPE		A			
MECHANIC	AL OPERATO	R		N/A	(1)	CONTAC	T PRESSU	RE	A			
MAIN CON.	TACTS			Α		PHASE BARRIERS			A			
ARC CONTACTS				Α		HARDWARE TIGHTNESS			Α			
ARC CHUTES N					The state of the s	FUSE HOLDERS			A			
ARC INTER	ARC INTERRUPTER SEQUENCE					INTERLOCKS			Α			
				ELE	CTRICAL T	ESTS						
					A-PHASE B-PH.			IASE C-PHASE				
	RESISTANCE				0.135 0.1			0.101				
USE RESI	STANCE IN M	ILLIOHMS			0.3	0.369 0.38			85 0.391			
	RESISTANCE			SWITCH	CLOSED			SWITCH OPEN		PEN		
IESTIN	GIGOHMS	A-Gnd	B-Gnd	C-Gnd	A-B	B-C	C-A	Α	В	С		
	VOLTS	178.5	192.8	177.9	335.2	310.8	470	2779	2983	3181		
77.0												
	ISFER OPERATIO						STOMER DID	NOT WANT				
	CH INTERLINKS H					RS						
JIE Z:) CABL	ES & ARRESTOR	S WERE DIS	CONNECT F	OR TESTING PUR	RPOSES.							
		A = ACC	EPTABLE	R = NEEDS REPA	AIR C = CC	DRRECTED	N/A = NOT A	PPLICABLE				



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MEDIUM VOLTAGE AIR SWITCH TEST REPORT

		JOB NUMBER:									
LOCATION:			ELECTRIC		ENGINEE	R:	DATE:	3126895 DATE:			
9' SWITCHGEAR DESIGNATION	15 SW H	ARRISON	I ST ENTIFICATION:		CH	DD	11/26/2010 CALIBRATION DATE:				
MAIN ATS		, ceberrie	FEEDER #	10			CALIBRAT				
		A 11 2 2 2 2	FEEDER # 10 41-01045/1280 NAMEPLATE DATA.					05/26/2010			
MANUFACTURER:		TYPE:		STYLE/SER	AL NUMBER:		CURRENT RATING: VO		VOLTAGE RATIN		
USE INFORMATION:	_		N/A		CD28082	2	400 SYSTEM VOLTAGE:		15K		
S & C, SM-5,	CAT NO	132400R	4, 14.4 KV,	250E, TO	C NO. 15	3-4	O'O'LIII V	13.8 K	,		
				INSPECT				TOIO IX			
СНЕСК Р	OINT		CONDITION	NOTES		CHECK POIN	T	CONDITION	NOTES		
PHYSICAL DAMAGE			Α		CONTAC	T ALIGNME	NT	A			
LEANLINESS			С		CONTAC	TWIPE		A			
MECHANICAL OPERATO		N/A	(1)	CONTACT PRESSURE			A				
AIN CONTACTS		Α		PHASE BARRIERS			A				
RC CONTACTS		A		HARDWARE TIGHTNESS				_			
RC CHUTES		N/A		FUSE HOLDERS			A				
RC INTERRUPTER SEC		A		INTERLOCKS			A				
					INTERCORS			A			
			ELE	CTRICAL	TESTS						
A BASE AND TO SERVICE A SERVICE AS A SERVICE				A-P	HASE	В-РН	ASE	C-P	HASE		
ONTACT RESISTANCE			(2) 0.584/		4/.144	1/.144 0.234		0.23	2/.143		
JSE RESISTANCE IN MI	LLIOHMS			0.:	338	0.339		0.346			
SULATION RESISTANCE			SWITCH	CLOSED			SWITCH OPEN		EN		
TEST IN GIGOHMS	A-Gnd	B-Gnd	C-Gnd	A-B	B-C	C-A	Α	В	С		
FAAA MALTA	245./9	228.3	178.3	443	275	418	3381	3065	0005		
DTE									3265		



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Electrical Reliability Services Project Status Report / Work Authorization

CLIENT	CAPITAL ELECTRIC	JOB NO.	3126895		
PROJECT	915 SW HARRISON ST.	ENGINEER	CH/DD	DATE	11/26/2010
THIS DOCU PROJECT.	JMENT IS INTENDED TO PROVIDE P A FORMAL REPORT WILL BE SUBM	RELIMINARY INFOR	MATION AS TO T	HE STATU	S OF THIS
Г	THE FOLLOWING ITEMS REQUIRE	E REPLACEMENT, R	EPAIR AND/OR A	DJUSTME	NT:
Б	THE FOLLOWING TESTS AND/OR COMPLETION:	INSPECTIONS ARE	REQUIRED PRIC	R TO PRO	JECT
∀	THE FOLLOWING WORK IS AUTH	ORIZED:			
VISUAL IN	NSPECTION AND REMOVAL O	F INTERLOCK AF	RM PER CUST	OMER R	EQUEST
(SEE E-M	AIL) AS PER BEN WHITE ON F	LOORS 1-14			
OPEN MA	IN SWITCHS IN BASEMENT F	OR VISUAL INSP	ECTION BY CI	JSTOME	R.
LCUS "18	" 14TH FLOOR-REMOVAL OF I	NTERLOCK & AJ	USTED SWITC	CH HAND	LE- PHOTOS
LCUS "17	" 14TH FLOOR-REMOVAL OF I	NTERLOCK & AJ	USTED SWITC	CH HAND	LE-PHOTOS
LCUS "16'	" 12 FLOOR- REMOVAL OF IN	TERLOCK-PHOT	OS		
LCUS "15"	' 11TH FOOR-REMOVAL OF IN	TERLOCK & AJU	ISTED SWITCH	HANDL	E-PHOTOS
LCUS "14'	' 10TH FLOOR- REMOVAL OF	INTERLOCK & A.	JUSTED SWIT	CH HANE	DLE-PHOTOS
LCUS "9"	9TH FLOOR-REMOVAL OF IN	TERLOCK & AJU:	STED SWITCH	HANDLI	E-PHOTOS
LCUS "10'	'8TH FLOOR-REMOVAL OF IN	NTERLOCK			
LCUS "11"	' 7TH FLOOR-REMOVAL OF I	NTERLOCK & AJ	USTED SWITC	CH HAND	LE-PHOTOS
LCUS "12'	' 6TH FLOOR-REMOVAL OF IN	NTERLOCK\			
LCUS "13	" 5TH FLOOR REMOVAL OF IN	TERLOCK -PHO	TOS		
LCUS "8"	3TH FLOOR NO REMOVAL RE	QUIRED, SWITC	H RETOR-FIT	ED WITH	NEW SW
LCUS "7" :	3TH FLOOR REMOVAL OF INT	ERLOCK	27.15.1 27.1 77.1		
	3TH FLOOR REMOVAL OF INT				
LCUS "5"	2TH FLOOR REMOVAL OF INT	TERLOCK & AJUS	STED SWITCH	HANDLE	-PHOTOS
	FUSE B&C ARE MISALIGNED	IN HOLDER - SEI	E PHOTOS	THE WITE	1110100
LCUS "4"	2TH FLOOR REMOVAL OF INT	TERLOCK	-1110100		
LCUS "3"	1ST FLOOR REMOVAL OF INT	ERLOCK - C PH	ASE OF SWITC	CH IS MIS	SSING
1	NUTS AND WASHERS ON PIVO	OT POINT & TEN	TION POINT	PHOTOS	201140
LCUS "2"	BASEMENT-REMOVAL OF INT	ERLOCK	Ontr	. 110100	
	CUSTOMER SIGNATURE		AUTHOR	IZATION N	0
NIZA	Caracher and Anna Anna	0.5 - 3 - 4		-AIION N	·.
N/A		SEE EI	MAIL		

PINK COPY - CUSTOMER

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WHITE COPY - FILE

PAGE __1 OF __1



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KANSAS DEPARTMENT OF ADMINISTRATION
Docking State Office Building Electrical Upgrade Study

APPENDIX B: WESTAR ENERGY USAGE

k:\2010 0343-KDFM-DOCKINGELECTRICAL\0]\WPC\REPORTS\03 STUDY-KDOA-DSOB-ELCTUPGRADE.DOC 1/18/2011

Appendices

Bill Constant: 8800 DOCKING STATE OFFC 915 SW HARRISON ST TOPEKA KS

METER NUMBER:

2285030

RATE CODE: 345

BILL CONSTANT:

8800

REV CLASS:

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MANUFACTURER:

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RELATED :

IRREG USE CD:

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PHASE :

MTR LOC: 52

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BASEMENT S

			ACT		ADJ	BLG
DATE	DAYS	USE	DEM	PF%	DEM	DEM
11/24/10	30	774400	0	.25 100	2200	2394
10/25/10	31	880000	0	.25 100	2200	2394
09/24/10	30	1012000	0	.31 100	2728	2728
08/25/10	29	1100000		0.3 100	2640	2640
07/27/10	32	1161600	9	0.3 100	2640	2640
06/25/10	30	1082400	0	.32 100	2816	2816
05/26/10	29	888800		0.3 100	2640	2693
04/27/10	29	880000	0	.31 100	2728	2728
03/29/10	31	853600	0	.27 100	2376	2693
02/26/10	29	809600	0	.26 100	2288	2693
01/28/10	30	853600	0.	.26 100	2288	2693
12/29/09	35	932800	0.	.27 100	2376	2693
11/24/09	32	915200	0.	.28 100	2464	2693
10/23/09	29	915200	0.	.27 100	2376	2693
09/24/09	30	1073600	0.	.33 100	2904	2904
08/25/09	29	1179200	0.	.33 100	2904	2904
07/27/09	32	1293600	0.	.33 100	2904	2904
06/25/09	29	1135200	0.	.36 100	3168	3168
05/27/09	30	1064800	0.	.31 100	2728	2728
04/27/09	31	1003200	0.	31 100	2728	2728
03/27/09	29	968000	0.	31 100	2728	2728
02/26/09	29	959200	(0.3 100	2640	2640
01/28/09	30	968000	0.	29 100	2552	2552
12/29/08	35	1064800	0.	28 100	2464	2468
11/24/08	32	1073600	0.	29 100	2552	2552
10/23/08	29	1056000	0.	29 100	2552	2552
09/24/08	30	1152800	0.	32 100	2816	2816
08/25/08	31	1293600	0.	33 100	2904	2904
07/25/08	30	1284800	0.	33 100	2904	2904
06/25/08	29	1170400	0.	32 100	2816	2816
05/27/08	32	1161600	0.	32 100	2816	2816
04/25/08	29	1047200	(0.3 100	2640	2768
03/27/08	29	1020800	0.	29 100	2552	2768
02/27/08	29	976800	0.	26 100	2288	2768
01/29/08	32	1029600	0.	28 100	2464	2768



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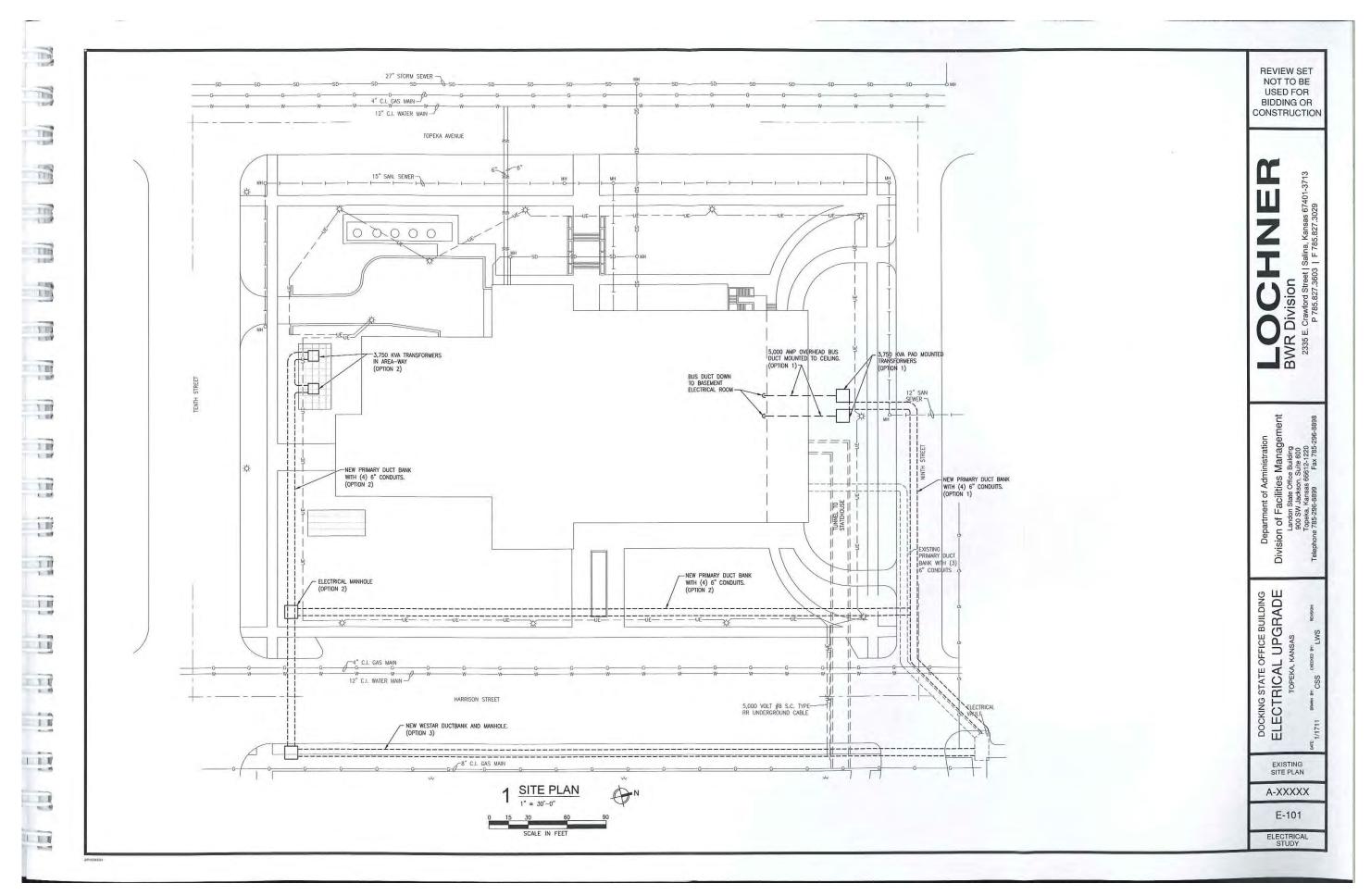
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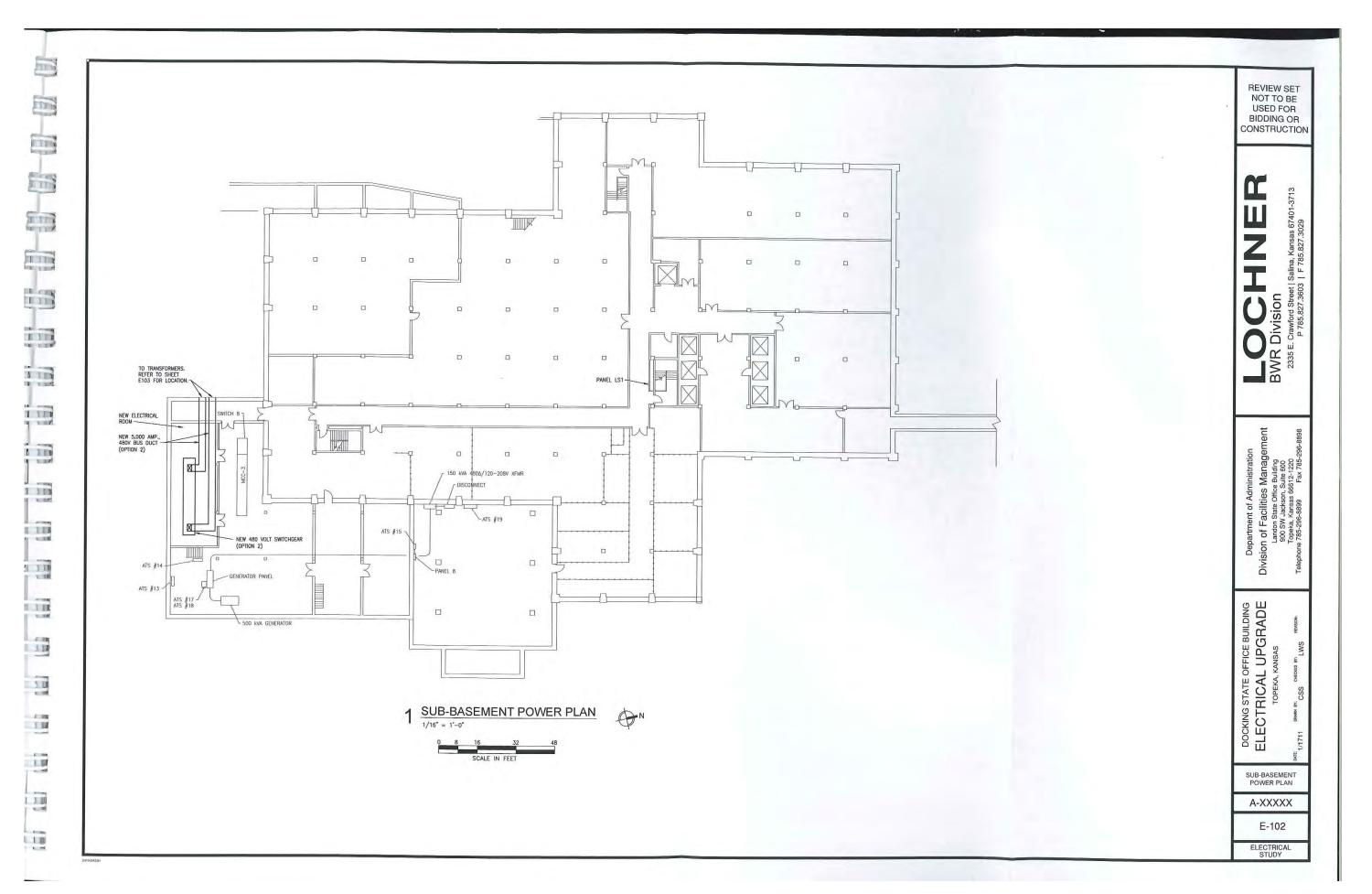
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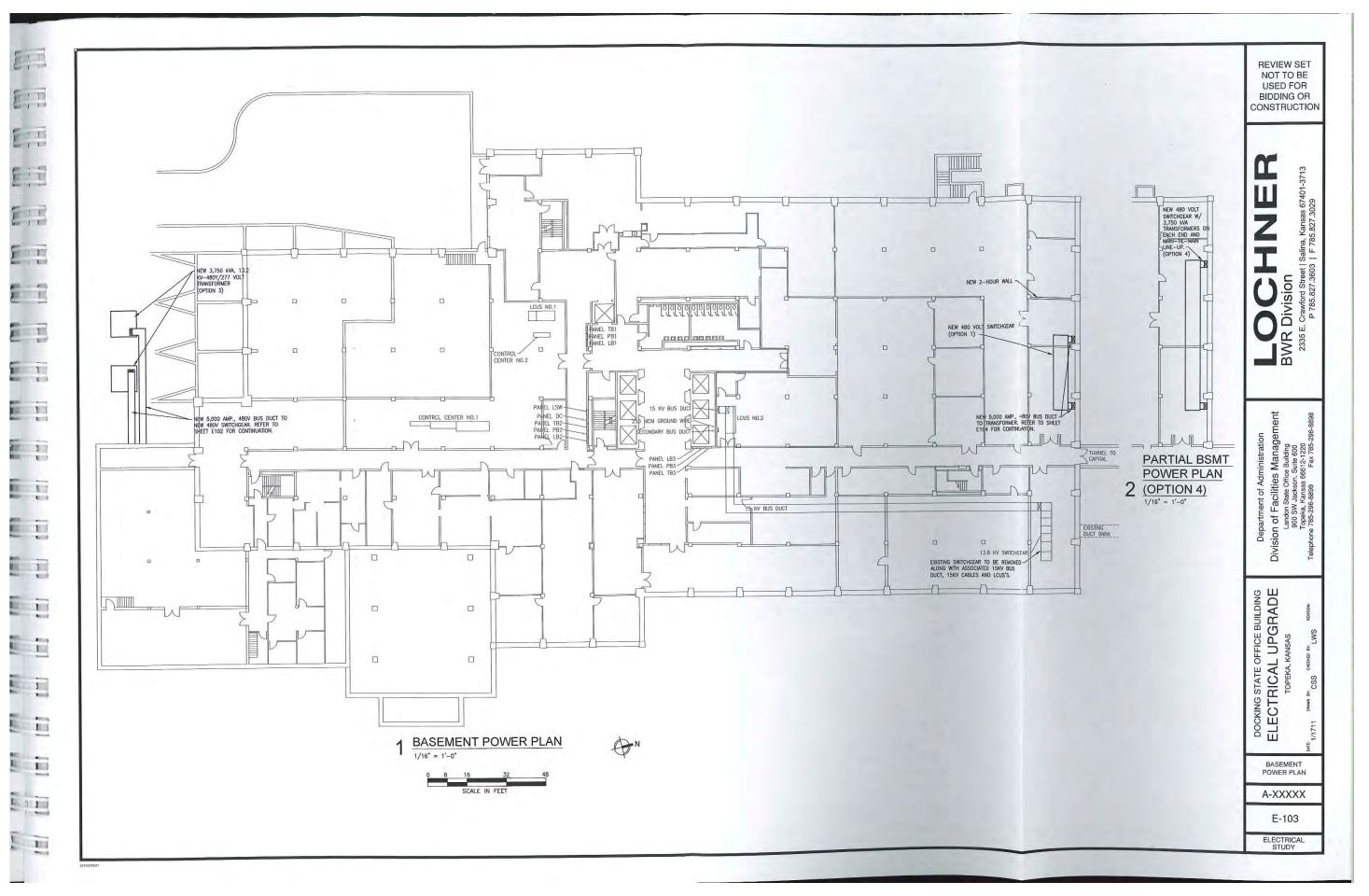
KANSAS DEPARTMENT OF ADMINISTRATION
Docking State Office Building Electrical Upgrade Study

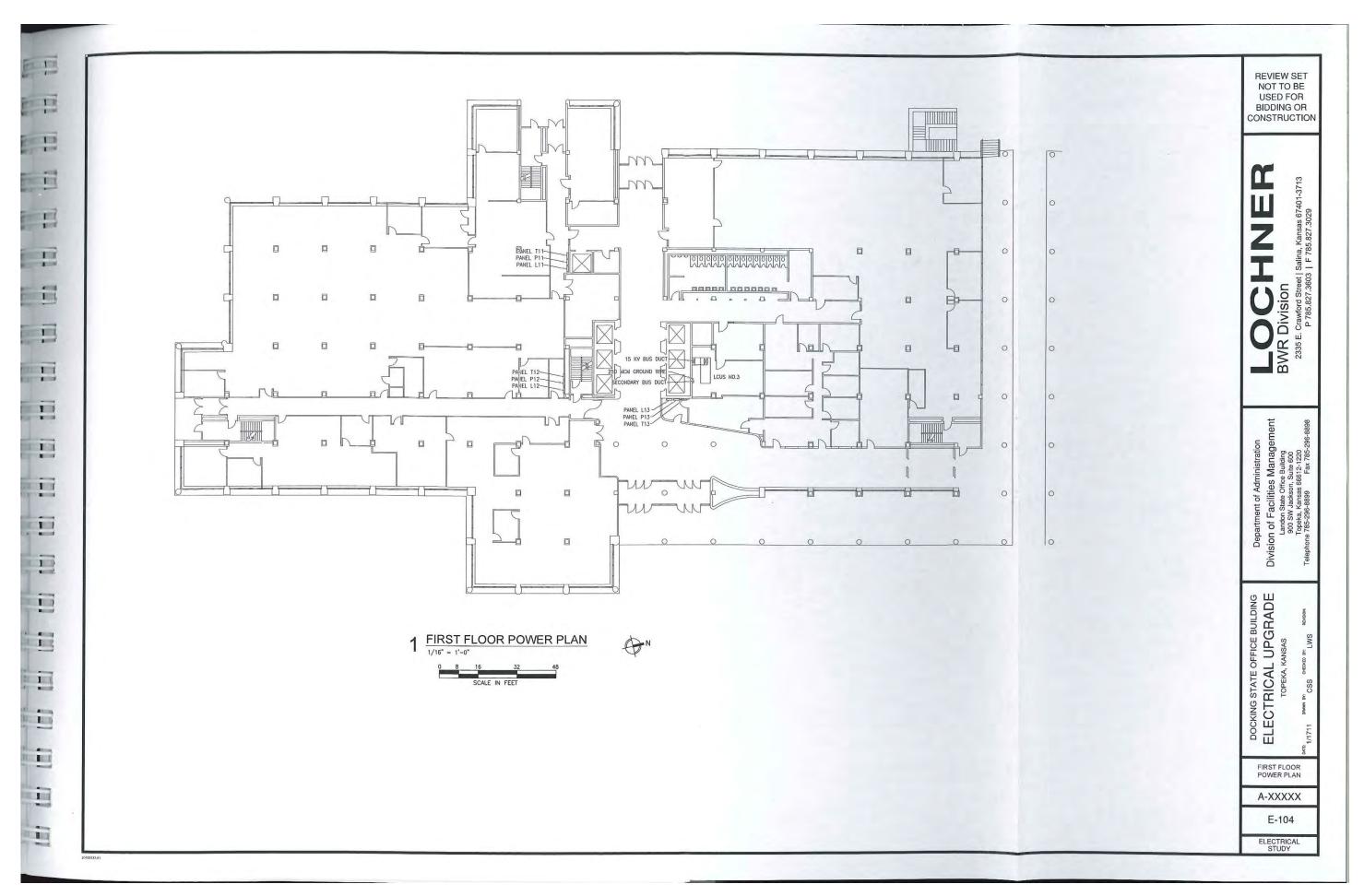
APPENDIX C: SITE PLAN, FLOOR PLANS & ONE-LINE DIAGRAM

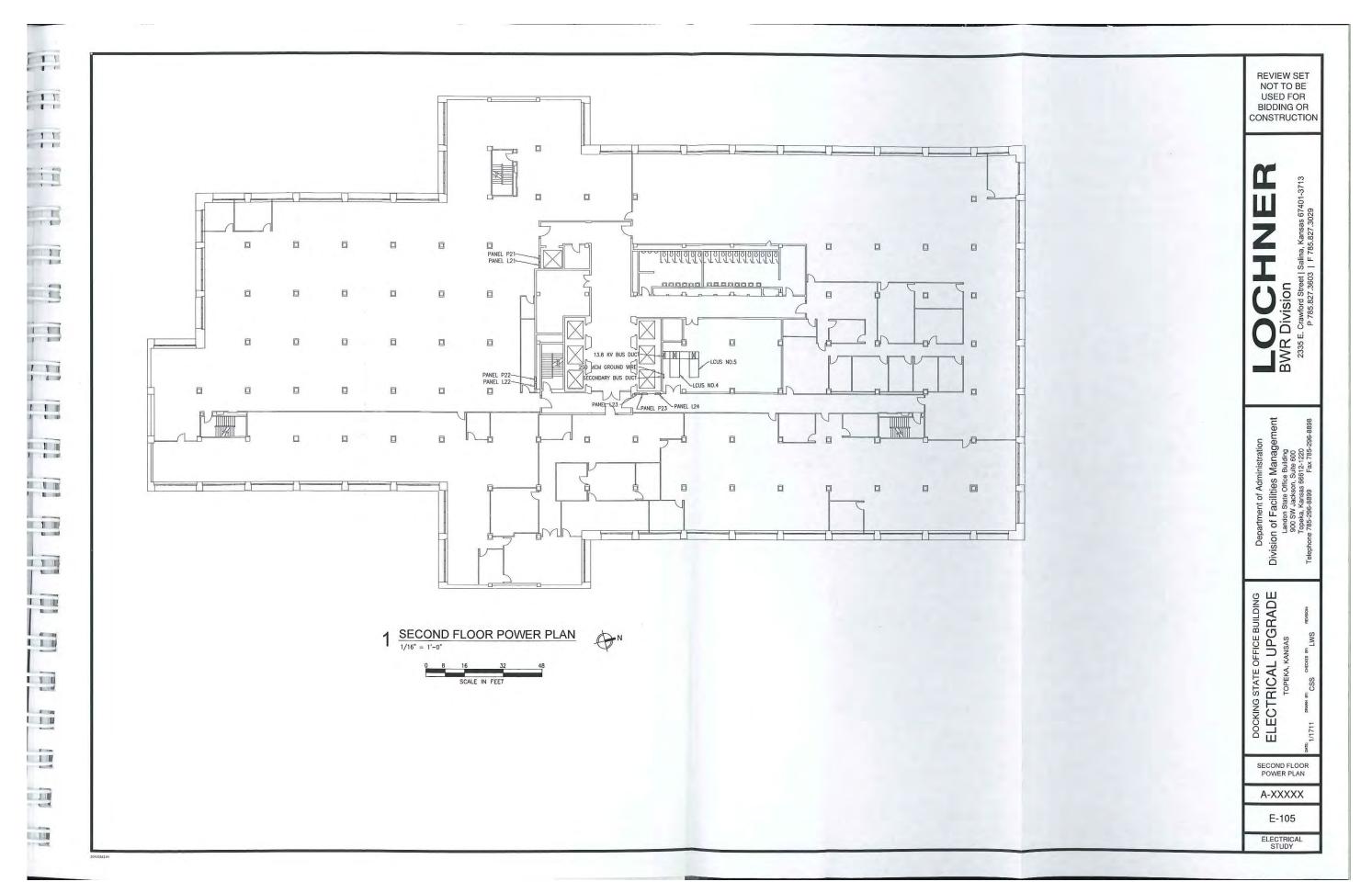
Appendices

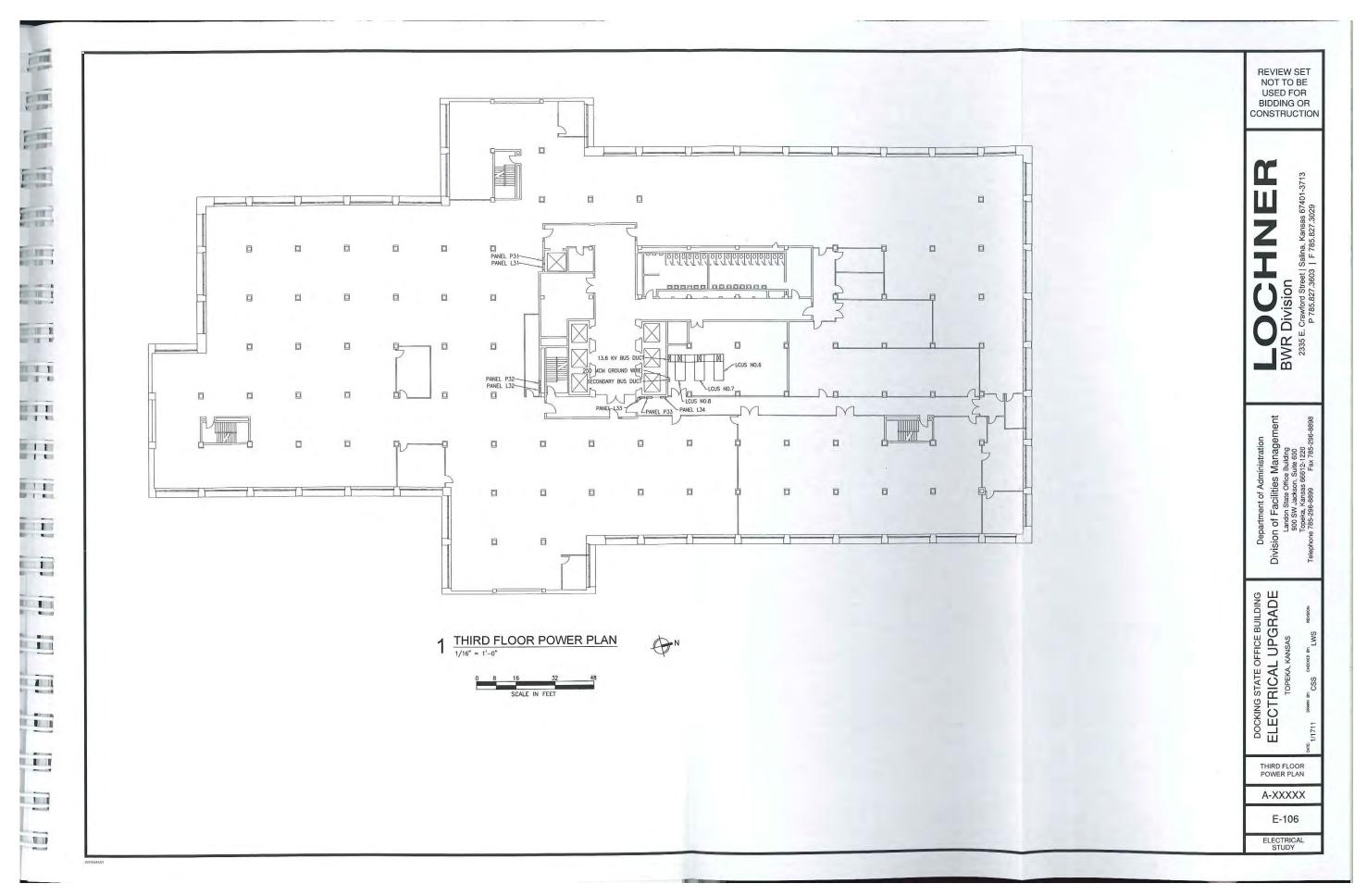


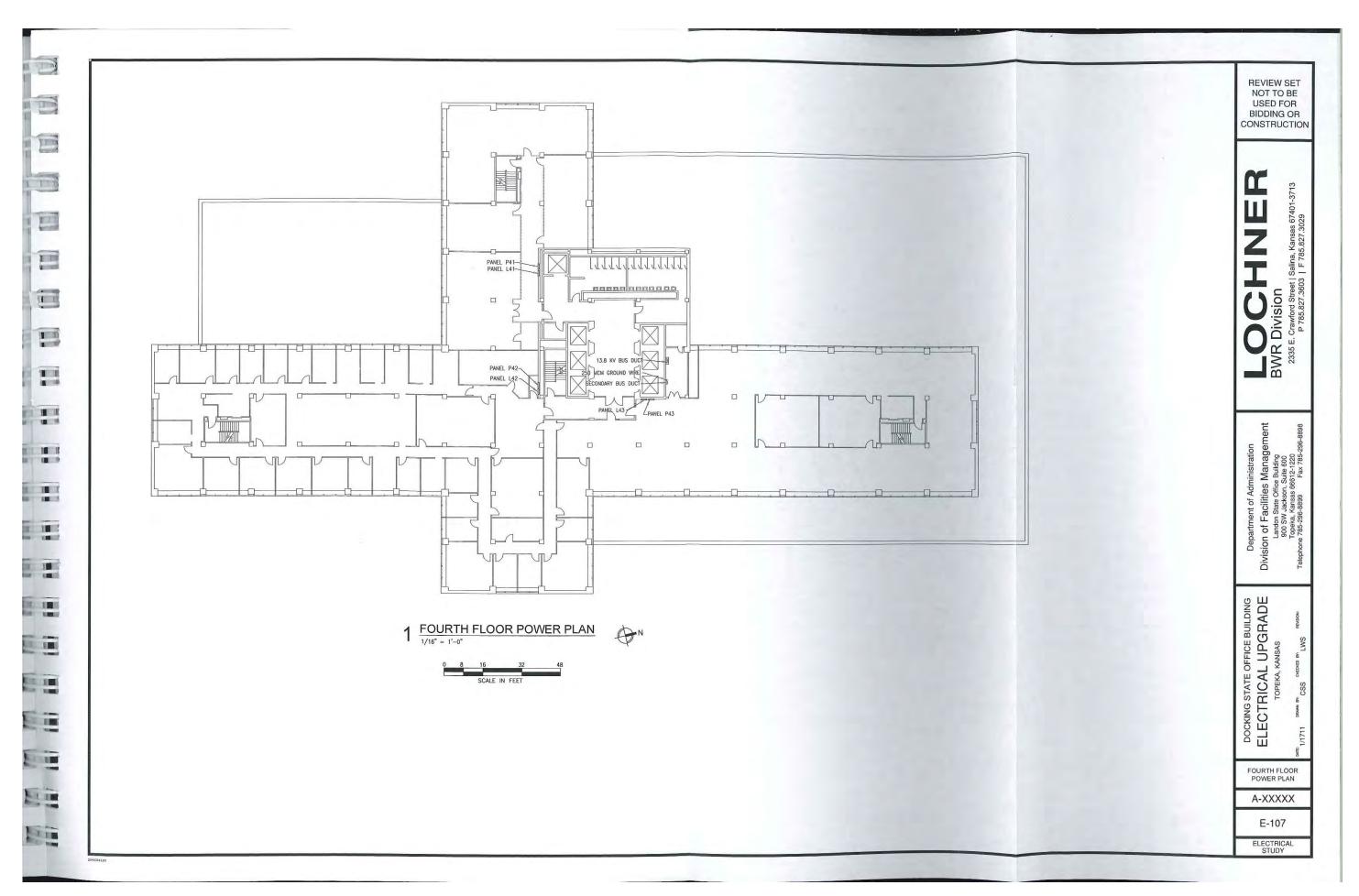


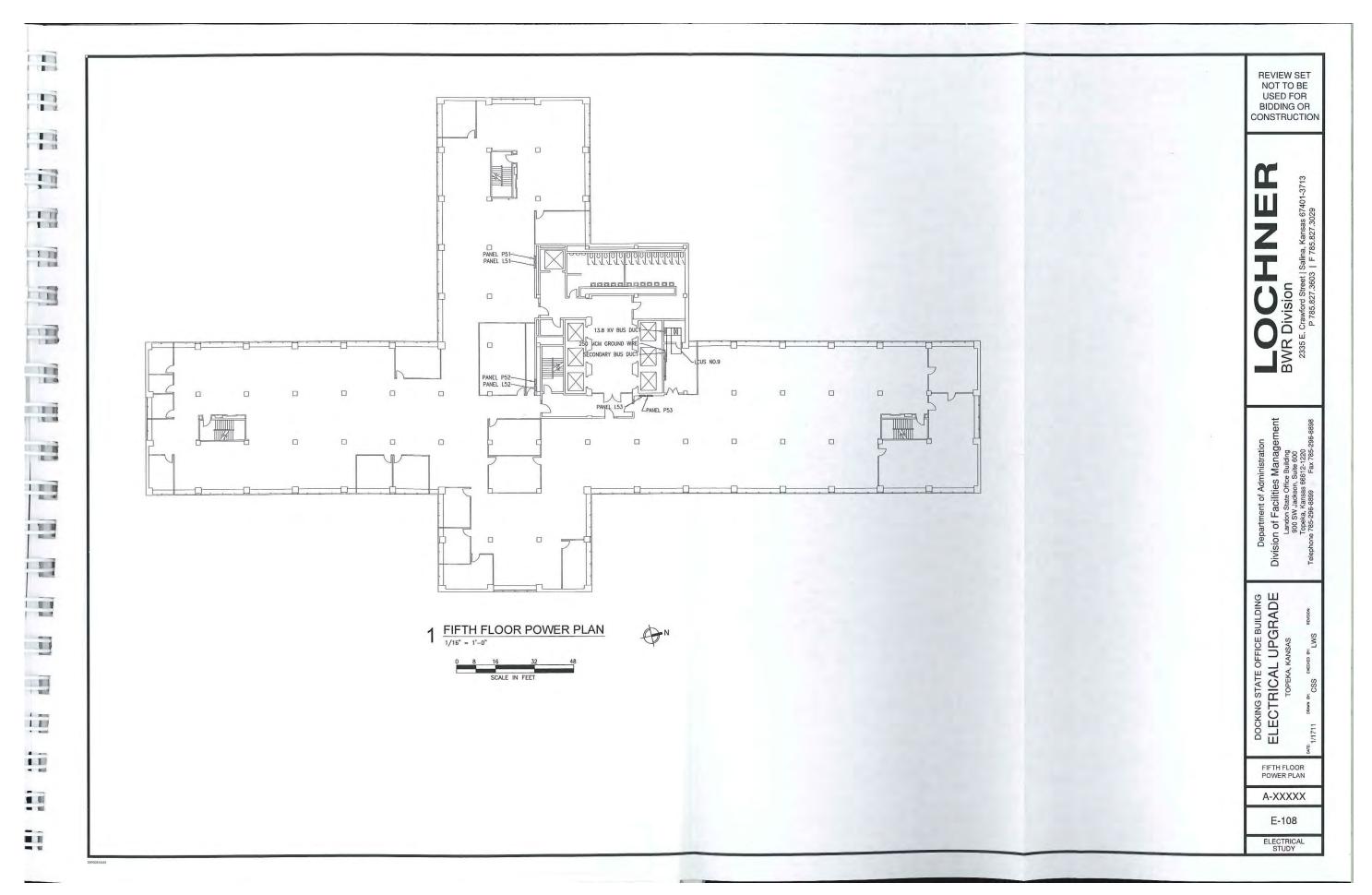


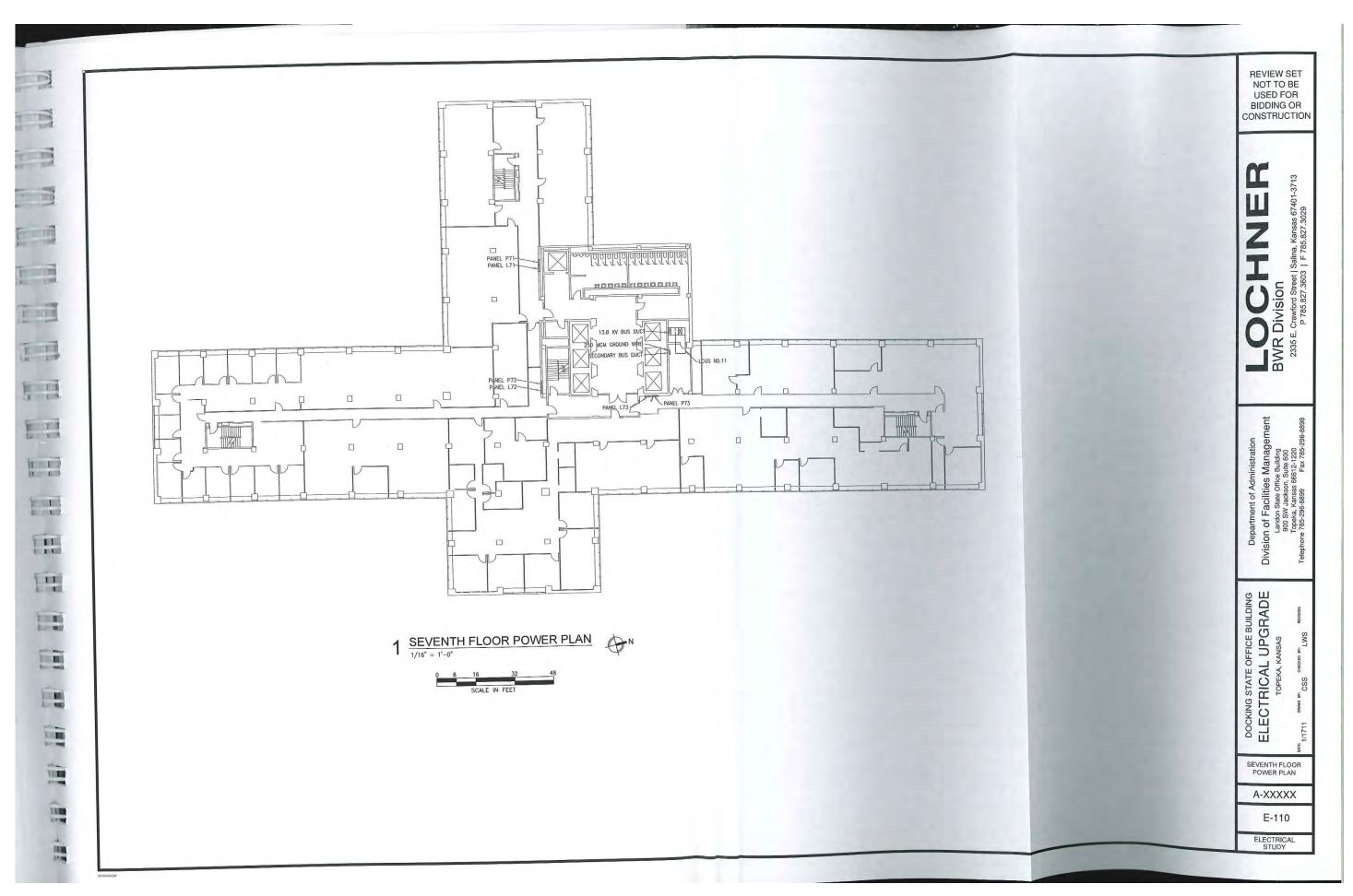


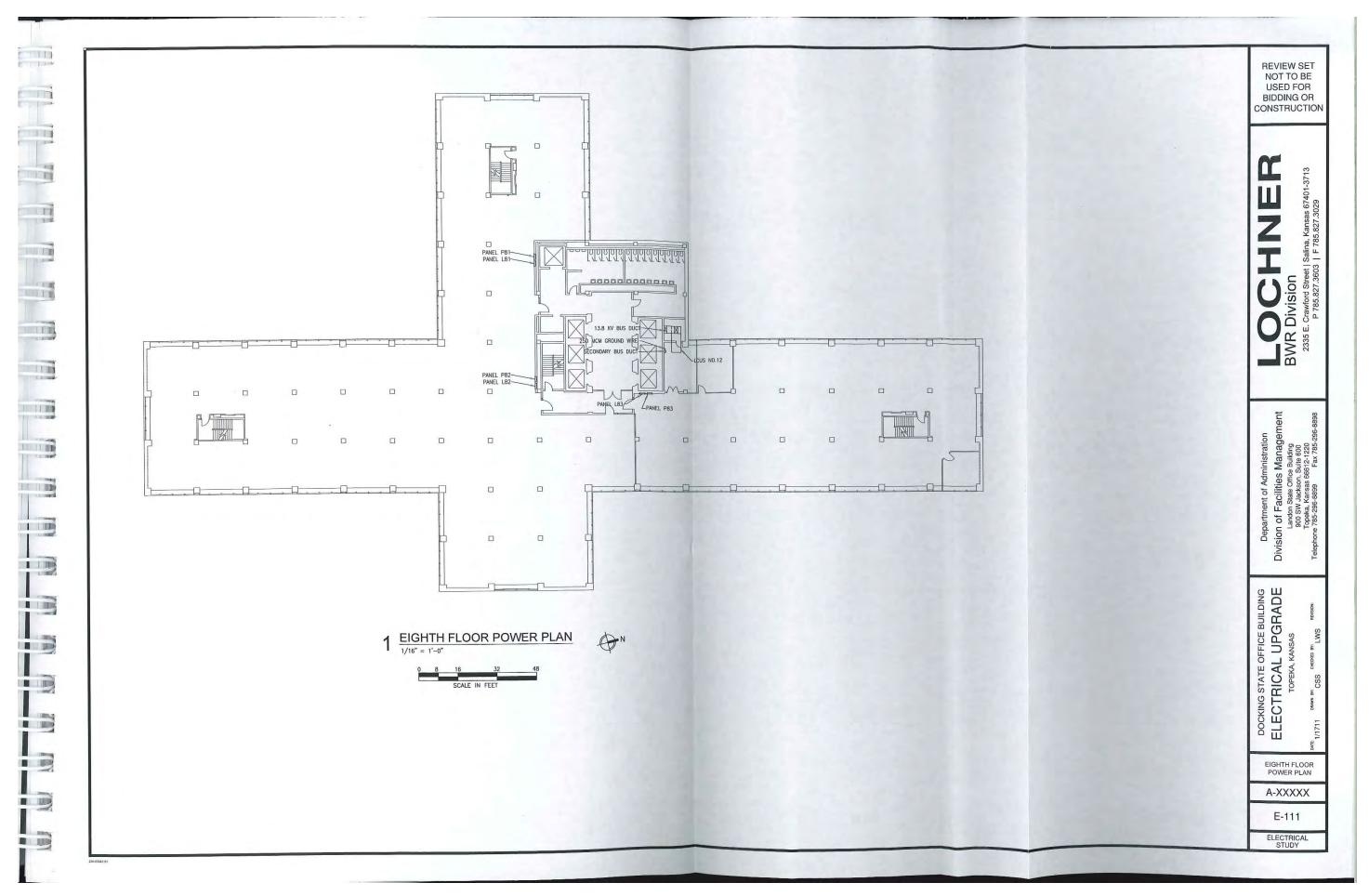


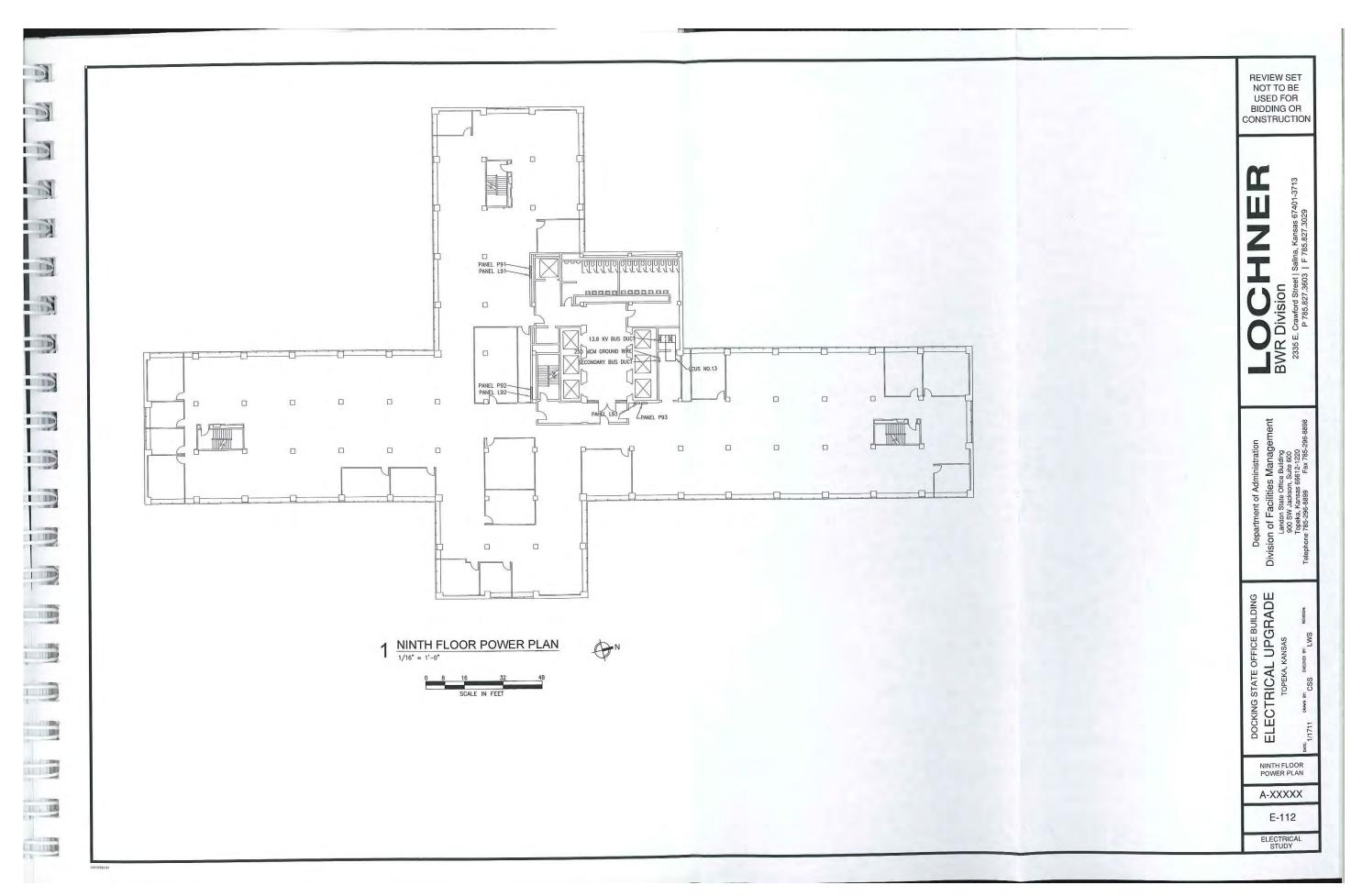


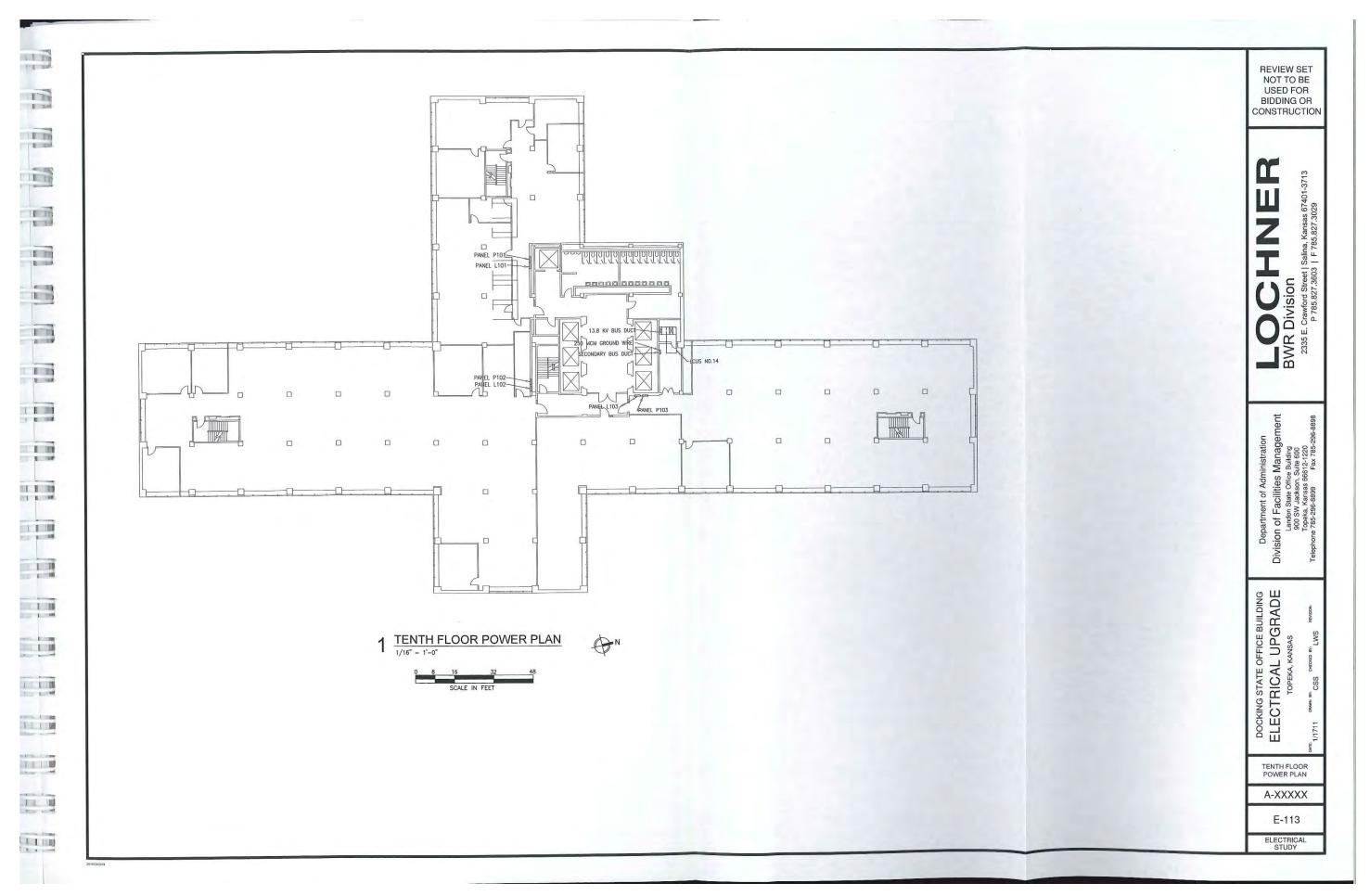


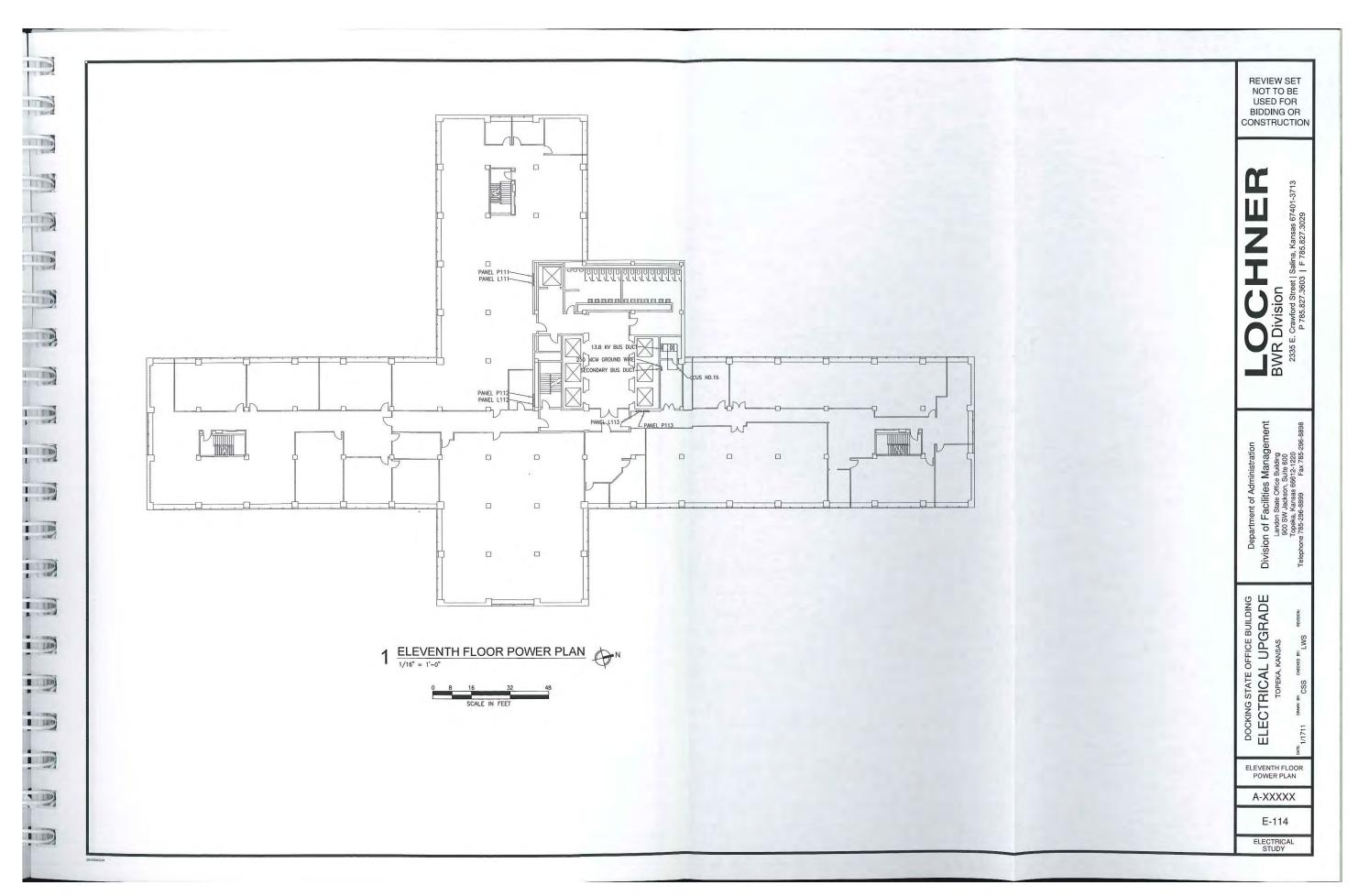


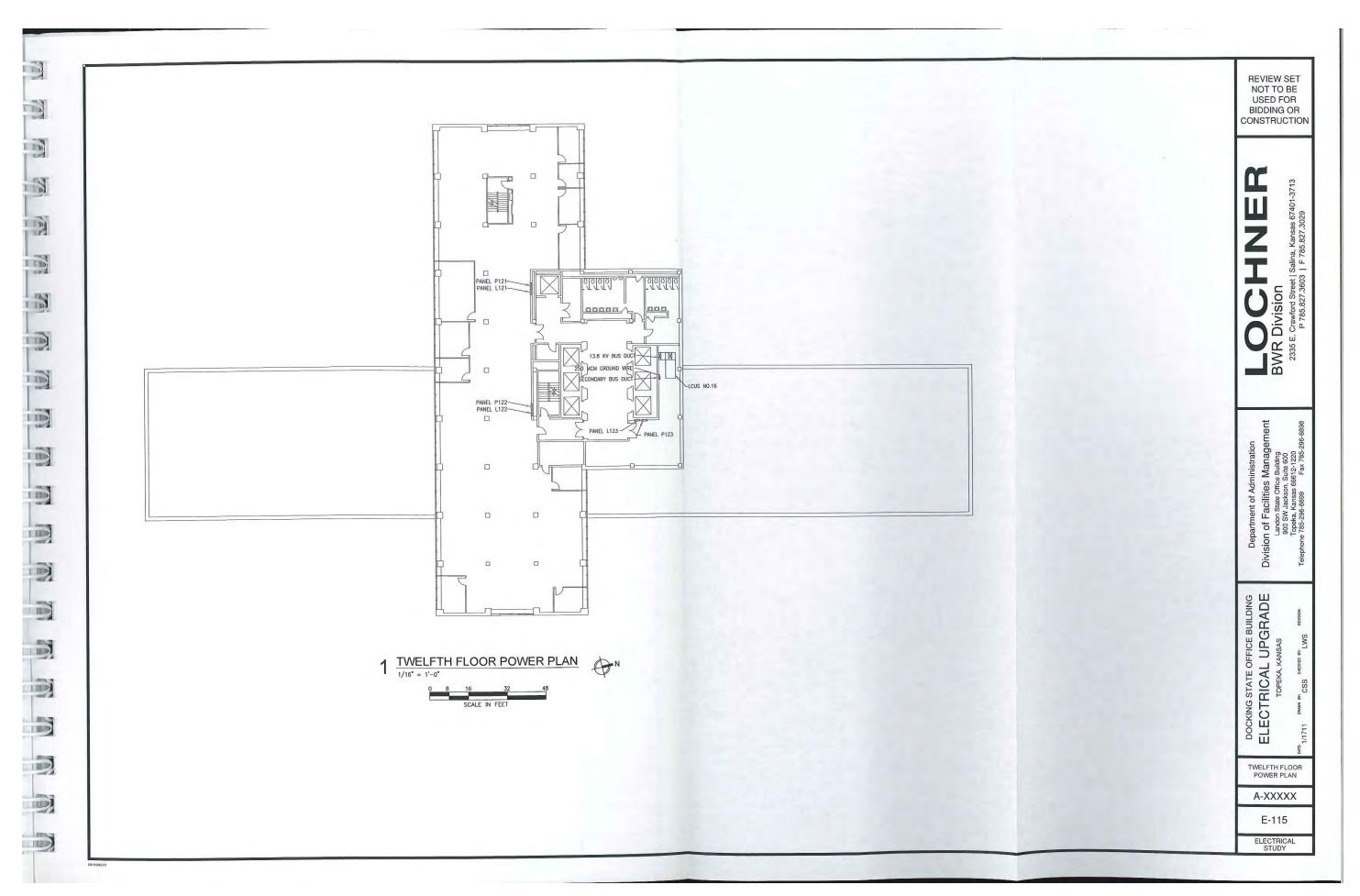


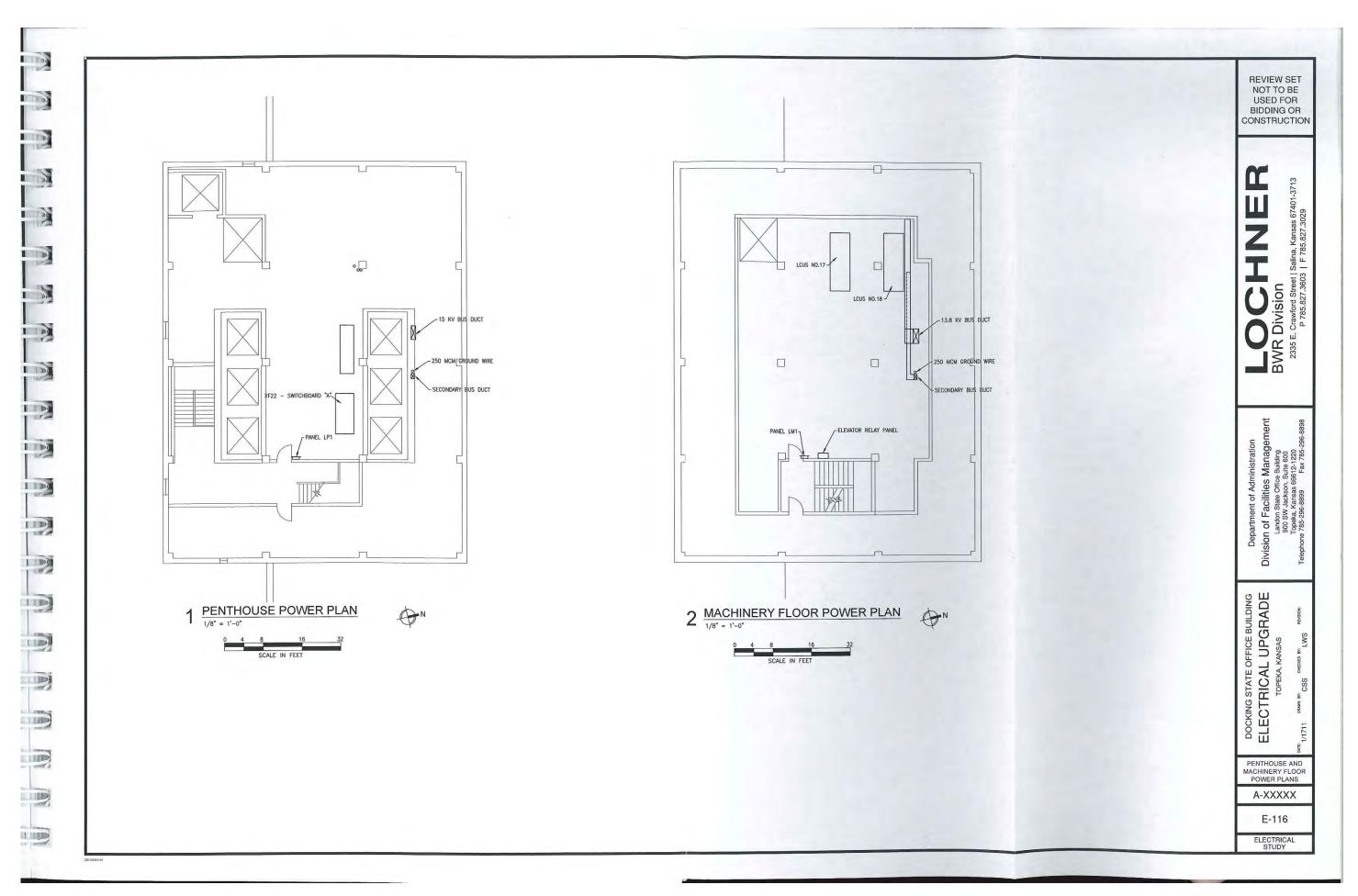


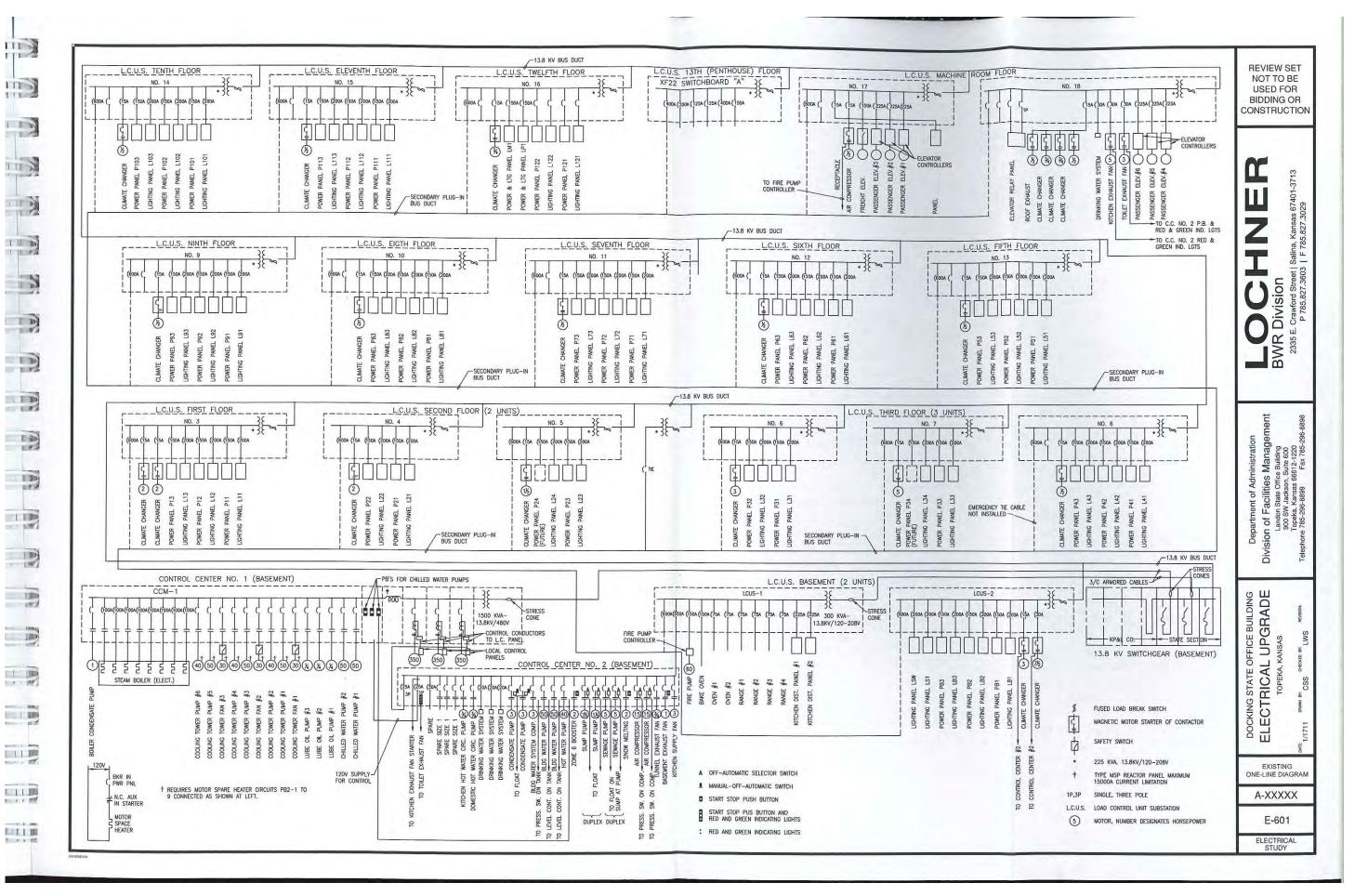














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KANSAS DEPARTMENT OF ADMINISTRATION
Docking State Office Building Electrical Upgrade Study

APPENDIX D: AMPCALC

Appendices

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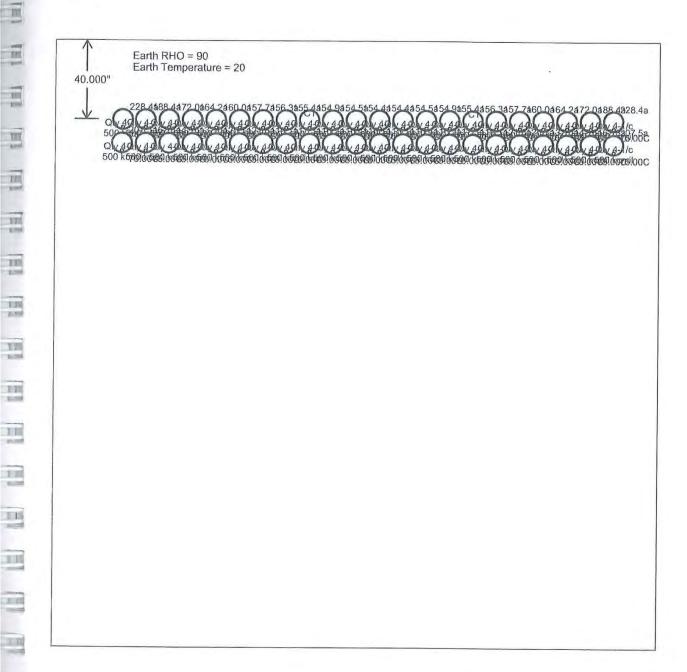
Page 1 of 26

AmpCalc - Cable Ampacity Calculations for Underground & Aerial Installations
Version 4.00, Rev 16 (c) Copyright 1986-2011 Calcware Company Katy, Texas

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0



1/11/2011 8:26:50 AM

Page 2 of 26

AmpCalc - Cable Ampacity Calculations for Underground & Aerial Installations
Version 4.00, Rev 16 (c) Copyright 1986-2011 Calcware Company Katy, Texas

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

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Calculation Method:

Distinct AMPACITY calculated for each position in the system based on user specified conductor temperature.

Summary of Neher-McGrath Calculation Results:

No.	ldentifier	System		y Coord	-	e Cable Siz	e Sys kV	' Temp	Amps	Rac	Watts/ft
1		1	0.000	0.000	4-1/c	500 kcmil		75.00		_	_
2		1	7.500	0.000	4-1/c	500 kcmil		75.00	228.4	27.42	5.719
3		1	15.000	0.000	4-1/c	500 kcmil	L. Contraction	75.00		27.42	3.893
4		1	22.500	0.000	4-1/c	500 kcmil		75.00	172.0	27.42	3.243
5		1	30.000	0.000	4-1/c	500 kcmil	0.48	75.00	164.2	27.42	2.956
6		1	37.500	0.000	4-1/c	500 kcmil	0.48	75.00	160.0	27.42	2.809
7		1	45.000	0.000	4-1/c	500 kcmil	0.48	75.00	157.7	27.42	2.726
8		1	52.500	0.000	4-1/c	500 kcmil	0.48	75.00	156.3	27.42	2.678
9	C1	1	60.000	0.000	4-1/c	500 kcmil	0.48	75.00	155.4	27.42	2.648
10		1	67.500	0.000	4-1/c	500 kcmil	0.48	75.00	154.9	27.42	2.630
11		1	75.000	0.000	4-1/c	500 kcmil	0.48	75.00	154.5	27.42	2.619
12		1	82.500	0.000	4-1/c	500 kcmil	0.48	75.00	154.4	27.42	2.615
13		1	90.000	0.000	4-1/c	500 kcmil	0.48	75.00	154.4	27.42	2.615
14		1	97.500	0.000	4-1/c	500 kcmil	0.48		154.5	27.42	2.619
15		1	105.000	0.000	4-1/c	500 kcmil	0.48	75.00 75.00	154.9	27.42	2.630
16	C1	1	112.500	0.000	4-1/c	500 kcmil	0.48	75.00	155.4	27.42	2.648
17		1	120.000	0.000	4-1/c	500 kcmil	0.48	75.00	156.3	27.42	2.678
18		1	127.500	0.000	4-1/c	500 kcmil	0.48	75.00	157.7	27.42	2.726
19		1	135.000	0.000	4-1/c	500 kcmil	0.48	75.00	160.0	27.42	2.809
20		1	142.500	0.000	4-1/c	500 kcmil	0.48	75.00	164.2	27.42	2.956
21		1	150.000	0.000	4-1/c	500 kcmil	0.48	75.00	172.0	27.42	3.243
22		1	157.500	0.000	4-1/c	500 kcmil	0.48		188.4	27.42	3.893
23		1	0.000	-7.500	4-1/c	500 kcmil	0.48	75.00	228.4	27.42	5.719
24		1	7.500	-7.500	4-1/c	500 kcmil		75.00	207.5	27.42	4.722
25		1	15.000	-7.500	4-1/c	500 kcmil	0.48	75.00	162.8	27.42	2.908
26		1	22.500	-7.500		500 kcmil	0.48	75.00	142.6	27.42	2.230
27		1	30.000	-7.500		500 kemil	0.48	75.00	132.0	27.42	1.910
28		1	37.500	-7.500			0.48	75.00	125.7	27.42	1.734
29		1	45.000	-7.500		500 kcmil	0.48	75.00	121.8	27.42	1.626
0		1	52.500	-7.500		500 kcmil	0.48	75.00	119.1	27.42	1.556
1		1	60.000	-7.500	-	500 kcmil	0.48	75.00	117.3	27.42	1.510
2		1	67.500			500 kcmil		75.00	116.2	27.42	1.480
_		-	07,000	-7.500	4-1/c	500 kcmil	0.48	75.00	115.4	27.42	1.462

Program Serial Number: 203400552 Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

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Calculation Method:

Distinct AMPACITY calculated for each position in the system based on user specified conductor temperature.

Summary of Neher-McGrath Calculation Results:

No.	Identifier	System	x Coord	ulation Res							
33		1		y Coord	Qty-Ty	oe Cable Siz	e Svs kV	Temp	1	_	
34		1	75.000	-7.500	4-1/c		1	1		Rac	Watts/fi
35		1	82.500	-7.500	4-1/c	500 kcmil	1	75.00		27.42	1.453
-		1	90.000	-7.500	4-1/c		-	75.00	115.1	27.42	1.453
36		1	97.500	-7.500		500 kcmil		75.00	115.4	27.42	1.462
37		1	105.000	-7.500	4-1/c	500 kcmil		75.00	116.2	27.42	
38		1	112.500		4-1/c	500 kcmil	0.48	75.00	117.3		1.480
39		1	120.000	-7.500	4-1/c	500 kcmil	0.48	75.00	119.1	27.42	1.510
10		1		-7.500	4-1/c	500 kcmil	0.48	75.00		27.42	1.556
1			127.500	-7.500	4-1/c	500 kcmil	0.48		121.8	27.42	1.626
2		1	135.000	-7.500	4-1/c	500 kcmil	0.48	75.00	125.7	27.42	1.734
3		1	142.500	-7.500	4-1/c	500 kcmil		75.00	132.0	27.42	1.910
4		1	150.000	-7.500			0.48	75.00	142.6	27.42	2.230
+		1	157.500	-7.500	200	500 kcmil	0.48	75.00	162.8	27.42	2.908
	stem Innut			1,000	4-1/c	500 kcmil	0.48	75.00	207.5	27.42	4.722

User System Input Data

For System #1 of 1	
Underground system filename Type of underground system Number of cable positions in system	0 Direct Buried Conduits
stance from earth's surface to	44
The man resistivity (PLO)	40.000
arth temperature (degrees C)	90
(4091663 C)	20

Cable Position Input Data:

No. Identifier x Coord # & Type Cable Library Cable Size Shield Sys kV Duct Library 1/c Spc Spec Temp System y Coord Cond. Library Volume Rated kV Config Sys Freq Nom. Size LF% Spec Amps
--

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

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Cable Position Input Data:

No	Identif	er x Co		# & Type	Cable Librar	v Cable C	la a	Obj. 1	1			
140	Syste	n y Co		Cond.	Library Volun						/ 1/c Sp	Spec Tem
		0.0		4-1/c		-	_	Config	Sys Fre	q Nom. Size	LF%	
1	11	0.0		Copper	NEC1_600	500 kcm	nil	None	0.48	NEC PVC		[75.000]
		7.5			THHW	0.60	-	Equil.	60	6	100	5000.0
2	1	0.0		4-1/c	NEC1_600	500 kcm		None	0.48	NEC PVC		[75.000]
		15.0		Copper	THHW	0.60		Equil.	60	6	100	5000.0
3	11	0.00		4-1/c	NEC1_600	500 kcm	nil	None	0.48	NEC_PVC		[75.000]
		22.5	_	Copper	THHW	0.60		Equil.	60	6	100	5000.0
4	1	0.00		4-1/c	NEC1_600	500 kcm	il	None	0.48	NEC PVC		[75.000]
			_	Copper	THHW	0.60		Equil.	60	6	1-100-	5000.0
5	1	30.0		4-1/c	NEC1_600	500 kcm	il I	None	0.48	NEC PVC	-	[75.000]
				Copper	THHW	0.60	1	Equil.	60	6	100	5000.0
6	1	37.50		4-1/c	NEC1_600	500 kcmi	il I	Vone	0.48	NEC PVC	100	[75,000]
		0.00		Copper	THHW	0.60	E	quil.	60	6	1-100	5000.0
7	1	45.00		4-1/c	NEC1_600	500 kcmi	1 1	None	0.48	NEC PVC	100	[75.000]
-		0.00		opper	THHW	0.60	TE	quil.	60	6	1-100-	5000.0
8		52.50		4-1/c	NEC1_600	500 kcmil	1 1	lone	0.48	NEC PVC	100	
-	1	0.00	-	opper	THHW	0.60		quil.	60	6	100	[75.000]
9	_C1	60.00		4-1/c	NEC1_600	500 kcmil	1	lone	0.48	NEC PVC	100	5000.0
	1	0.000		opper	THHW	0.60		quil.	60	6	1-100-	[75.000]
10-		67.50		4-1/c	NEC1_600	500 kcmil		one	0.48	NEC_PVC	100	5000.0
-	1	0.000	-	opper	THHW	0.60		quil.	60		1-100-+	[75.000]
11-		75.00		1-1/c	NEC1_600	500 kcmil	-	one	0.48	6 NEC DVC	100	5000.0
+	1	0.000		opper	THHW	0.60		guil.	60	NEC_PVC		[75.000]
2		82.500		-1/c	NEC1 600	500 kcmil		one	0.48	6	100	5000.0
+	1	0,000	_	ppper	THHW	0.60	7	quil.	60	NEC_PVC		[75.000]
3-		90.000	4	-1/c	NEC1_600	500 kcmil		one		6	100	5000.0
	1	0.000	Co	pper	THHW	0.60		quil.	0.48	NEC_PVC		[75.000]
4.		97.500			NEC1_600	500 kcmil				6	100	5000.0
	1	0.000		pper	THHW	0.60		one uil.	0.48	NEC_PVC		[75.000]
5		105.000			NEC1_600	500 kcmil			60	6	100	5000.0
	1	0.000		pper	THHW	0.60	No			NEC_PVC		[75.000]
6	C1_	112.500			VEC1_600		Eq		60	6	100	5000.0
	1	0.000		pper	THHW	500 kcmil	No			NEC_PVC	1	75.000]
7		120.000			NEC1_600	0.60	Eq		60	6	100	5000.0
	1	0.000		oper	THHW	500 kcmil	No		0.48	VEC_PVC	- [75.000]
3		127.500				0.60	Equ		60	6	100	5000.0
, [-	1	0.000		pper	THHW		No			NEC_PVC	- [75.000]
		3,000	Look	hei	ITITIVV	0.60	Equ	ail.	60	6	100 -	5000.0

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

IN IN IN

Cable Position Input Data:

	Identifier			T 6 11 11	-			S.E.		
No.	System							Duct Library	1/c Spc	Spec Temp
	System	y Coord		Library Volume	e Rated kV	Config	Sys Fred	Nom. Size	TLF%	Spec Amps
19		135.000		NEC1_600	500 kcmil	None	0.48	NEC_PVC		[75.000]
-	1	0.000	Copper		0.60	Equil.	60	6	1-100-	5000.0
20		142.500		NEC1_600	500 kcmil	None	0.48	NEC PVC		[75.000]
	1	0.000	Copper		0.60	Equil.	60	6	100	5000.0
21		150.000		NEC1_600	500 kcmil	None	0.48	NEC PVC	,,,,	[75.000]
	1	0.000	Copper	THHW	0.60	Equil.	60	6	100	5000.0
22		157.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC PVC	100	[75.000]
_	1	0.000	Copper	THHW	0.60	Equil.	60	6	100	5000.0
23		0.000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC PVC	1.00	[75.000]
-	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
24		7.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC PVC	-	[75.000]
	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
25		15.000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC PVC	100	[75.000]
	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
26		22.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC PVC	100	[75.000]
-	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
27 -		30.000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC PVC	100	[75.000]
-	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
28		37.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC PVC	100	[75.000]
-	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
29		45.000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC PVC	100	[75.000]
_	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
30		52.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC PVC	100	[75.000]
-	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100-	5000.0
31 -		60,000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC PVC	100	[75.000]
	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
2		67.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC PVC		[75.000]
	1	-7.500	Copper	THHW		Equil.	60	6	100	5000.0
3		75.000	4-1/c	NEC1_600		None		NEC PVC		[75.000]
-	1	-7.500	Copper	THHW		Equil.	60	6	100-	5000.0
4		82.500	4-1/c	NEC1_600		None		NEC_PVC		
-	1	-7.500	Copper	THHW		Equil.	60	6	100	[75.000] 5000.0
5		90.000	4-1/c	NEC1_600		None		NEC_PVC		
	1	-7.500	Copper	THHW		Equil.	60	6	100	[75.000]
6		97.500	4-1/c			None		NEC PVC	100	5000.0
	1		Copper	THHW		Equil.	60		- 100	75.000]
					0.00	-quii.	UU	6	100	5000.0

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO Filename: 0

Cable Position Input Data:

No.	Identifie System			e Cable Librar Library Volum	+			V Duet Lib		
37	1	105.000 -7.500	4-1/c	NEC1_600	ne Rated k		ig Sys Fr	eq Nom. Size	1/c Sp	Spec Arr
38		112.500	4-1/c	NEC1 600	0.60 500 kcm	Equi	1. 60	NEC_PVC	100	[75.000
39		-7.500 120.000	Copper 4-1/c	THHW NEC1_600	0.60	Equil	60	NEC_PVC 6	1-100	5000.0
40 -		-7.500 127.500	Copper 4-1/c	THHW NEC1_600	0.60 500 kcmil	Equil.	60	NEC_PVC 6	100	5000.0 [75.000
1		-7.500 135.000	Copper 4-1/c	THHW NEC1_600	0.60 500 kcmil	Equil.	60	NEC_PVC 6	100	5000.0
2		142.500	Copper 4-1/c	THHW NEC1_600	0.60 500 kcmil	Equil.	<u>0.48</u> 60	NEC_PVC 6	100	5000.0
3		150.000	Copper 4-1/c	THHW NEC1_600	0.60	None Equil,	60	NEC_PVC		5000.0 [75.000]
			Copper	THHW	500 kcmil 0.60	None Equil.	0.48	NEC_PVC	100	5000.0 [75.000]
ution	1 .	-7.500 C	onno-		500 kcmil 0.60	None	0.40	NEC_PVC	100	5000.0 75.000]
cket	ed value i	s user spe	cified inn	THHW are user input s ut variable which	etpoints and	do not	necosa	6	100 1	5000.0

Caution - Specified Temp and Amps are user input setpoints and do not necessarily represent a correct solution. Bracketed value is user specified input variable which may be held constant in optional calculation.

Voltage	Drop	Calculations.
---------	------	---------------

No.	Identifier	Length (ft.)	Amps/Conducto	or PF (%	//	Ohms/10	00 feet/Cond.	Volt De	0= 1:01
2		80	228.4	100.000		Resistanc	e Reactance	-	op (+%) se (-%)
3		80	188.4	100.000	9	0.0274	0.0292	0.181	-
4		80	172.0	100.000	-3	0.0274	0.0292	0.149	OK
5		80	164.2	100.000	-49	0.0274	0.0292	0.136	OK
6		80	160.0	100.000	9	0.0274	0.0292	0.130	OK
7		80	157.7	100.000	-49	0.0274	0.0292	0.127	OK
8		80	156.3	100.000	9	0.0274	0.0292	0.125	OK
9	C1	80	155.4	100.000	-49	0.0274	0.0292	0.124	OK
0	-	80	154.9	100.000	Lag Lag	0.0274	0.0292	0.123	OK
1		80	451-	100.000	Lag	0.0274	0.0292	0.123	OK
2		80	AFI.	100.000	Lag	0.0274	0.0292	0.122	OK
3	-	80	154.4	100.000	Lag	0.0274	0.0292	0.122	ОК
		80	151 -	100.000	Lag	0.0274	0.0292	0.122	ОК
					-49	0.0274	0.0292	0.122	ОК

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

No.	Identifier	alculations:	10	J 22 1		Onms/1000	feet/Cond.	Volt Dro	op (+%
14	identifier	1	Amps/Conducto			Resistance	Reactance	or Rise	
15		80	154.9	100.000		0.0274	0.0292	0.123	OF
16	04	80	155.4	100.000	Lag	0.0274	0.0292	0.123	OH
17	C1	80	156.3	100.000	Lag	0.0274	0.0292	0.124	OK
		80	157.7	100.000	Lag	0.0274	0.0292	0.125	OK
18		80	160.0	100.000	Lag	0.0274	0.0292	0.127	OK
19		80	164.2	100.000	Lag	0.0274	0.0292	0.130	OK
20		80	172.0	100.000	Lag	0.0274	0.0292	0.136	OK
21		80	188.4	100.000	Lag	0.0274	0.0292	0.149	OK
22		80	228.4	100.000	Lag	0.0274	0.0292	0.143	OK
23		80	207.5	100.000	Lag	0.0274	0.0292	0.164	OK
24		80	162.8	100.000	Lag	0.0274	0.0292	0.129	OK
25		80	142.6	100.000	Lag	0.0274	0.0292	0.113	OK
26		80	132.0	100.000	Lag	0.0274	0.0292	0.105	OK
27		80	125.7	100.000	Lag	0.0274	0.0292	0.100	OK
28		80	121.8	100.000	Lag	0.0274	0.0292	0.096	OK
29		80	119.1	100.000	Lag	0.0274	0.0292	0.094	OK
30		80	117.3	100.000	Lag	0.0274	0.0292	0.093	OK
31		80	116.2	100.000	Lag	0.0274	0.0292	0.093	-
2		80	115.4	100.000	Lag	0.0274	0.0292	0.092	OK
3		80	115.1	100.000	Lag	0.0274	0.0292	0.091	OK
4		80	115.1	100.000	Lag	0.0274	0.0292	0.091	OK
5		80		100.000	Lag	0.0274	0.0292		OK
6		80	1.3.2.152	100.000	Lag	0.0274	0.0292	0.091	OK
7		80	117.3	100.000	Lag	0.0274	0.0292	0.092	OK
8		80		100.000	Lag	0.0274	0.0292	0.093	OK
9		80		100.000	Lag	0.0274	0.0292	0.094	OK
0		80		100.000	Lag	0.0274	0.0292	0.096	OK
1		80		100.000	Lag	0.0274		0.100	OK
2		80		100.000	Lag		0.0292	0.105	OK
3		80		100.000	Lag		0.0292	0.113	OK
1		80		100.000	Lag		0.0292	0.129	OK OK

Load Flow Calculations:

No. Identifier	Volta	Current/Phase			Los	1 100/1			
System	Mag	Deg	Amps	Deg	PF (%)	kVA	d Flow P	1	kW Loss

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AmpCalc - Cable Ampacity Calculations for Underground & Aerial Installations

Version 4.00, Rev 16 (c) Copyright 1986-2011 Calcware Company Katy, Texas

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

Load Flow Calculations:

No.	Identifier		Volt	age	Curren	t/Phase		Lo	ad Flow Po	wer	kW Loss
	System		Mag	Deg	Amps	Deg	PF (%)	kVA	kW	kVAR	kVAR Loss
1		Source>	480.0	0.00			100.0 Unity	189.9	189.9	0.4	0.343
	1	Load>	479.1	-0.11	228.4	-0.11	100.0 Lag	189.5	189.5	0.0	0.365
2		Source>	480.0	0.00	=, .,		100.0 Unity	156.6	156.6	0.2	0.234
_	1	Load>	479.3	-0.09	188.4	-0.09	100.0 Lag	156.4	156.4	0.0	0.249
3		Source>	480.0	0.00			100.0 Unity	143.0	143.0	0.2	0.195
	1	Load>	479.3	-0.08	172.0	-0.08	100.0 Lag	142.8	142.8	0.0	0.207
4		Source>	480.0	0.00			100.0 Unity	136.5	136.5	0.2	0.177
	1	Load>	479.4	-0.08	164.2	-0.08	100.0 Lag	136.3	136.3	0.0	0.189
5		Source>	480.0	0.00			100.0 Unity	133.0	133.0	0.2	0.169
	1	Load>	479.4	-0.08	160.0	-0.08	100.0 Lag	132.9	132.9	0.0	0.179
6		Source>	480.0	0.00			100.0 Unity	131.1	131.1	0.2	0.164
	1	Load>	479.4	-0.08	157.7	-0.08	100.0 Lag	130.9	130.9	0.0	0.174
7		Source>	480.0	0.00			100.0 Unity	129.9	129.9	0.2	0.161
	1	Load>	479.4	-0.08	156.3	-0.08	100.0 Lag	129.7	129.7	0.0	0.171
8		Source>	480.0	0.00			100.0 Unity	129.2	129.2	0.2	0.159
-	1	Load>	479.4	-0.07	155.4	-0.07	100.0 Lag	129.0	129.0	0.0	0.169
9	_C1	Source>	480.0	0.00			100.0 Unity	128.7	128.7	0.2	0.158
	1	Load>	479.4	-0.07	154.9	-0.07	100.0 Lag	128.6	128.6	0.0	0.168
10		Source>	480.0	0.00	1000		100.0 Unity	128.5	128.5	0.2	0.157
-	1	Load>	479.4	-0.07	154.5	-0.07	100.0 Lag	128.3	128.3	0.0	0.167
11		Source>	480.0	0.00	30407.0		100.0 Unity	128.4	128.4	0.2	0.157
-	1	Load>	479.4	-0.07	154.4	-0.07	100.0 Lag	128.2	128.2	0.0	0.167
12		Source>	480.0	0.00		1.1.	100.0 Unity	128.4	128.4	0.2	0.157
-	1	Load>	479.4	-0.07	154.4	-0.07	100.0 Lag	128.2	128.2	0.0	0.167
13		Source>	480.0	0.00			100.0 Unity	128.5	128.5	0.2	0.157
-	_ 1		479.4	-0.07	154.5	-0.07	100.0 Lag	128.3	128.3	0.0	0.167
14		Source> Load>	480.0	0.00	454.0	0.07	100.0 Unity	128.7	128.7	0.2	0.158
+	1		479.4	-0.07	154.9	-0.07	100.0 Lag	128.6	128.6	0.0	0.168
15-		Source> Load>	480.0	0.00	455.4	0.07	100.0 Unity	129.2	129.2	0.2	0.159
-			479.4	-0.07	155.4	-0.07	100.0 Lag	129.0	129.0	0.0	0.169
16-		Source> Load>	480.0	0.00	1500	0.00	100.0 Unity	129.9	129.9	0.2	0.161
+	1		479.4	-0.08	156.3		100.0 Lag	129.7	129.7	0.0	0.171
17		Source> Load>	480.0	0.00	1577		100.0 Unity	131.1	131.1	0.2	0.164
-	-		479.4	-0.08	157.7	-0.08	100.0 Lag	130.9	130.9	0.0	0.174
18-		Source>	480.0	0.00	400.0	0.00	100.0 Unity	133.0	133.0	0.2	0.169
		LUdu>	479.4	-0.08	160.0	-0.08	100.0 Lag	132.9	132.9	0.0	0.179

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AmpCalc - Cable Ampacity Calculations for Underground & Aerial Installations
Version 4.00, Rev 16 (c) Copyright 1986-2011 Calcware Company Katy, Texas

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

Load Flow Calculations:

No.	Identifier		Volt	age	Curren	t/Phase		Lo	ad Flow Po	wer	kW Loss
140,	System		Mag	Deg	Amps	Deg	PF (%)	kVA	kW	kVAR	kVAR Loss
19		Source>	480.0	0.00			100.0 Unity	136.5	136.5	0.2	0.177
10	1	Load>	479.4	-0.08	164.2	-0.08	100.0 Lag	136.3	136.3	0.0	0.189
20		Source>	480.0	0.00			100.0 Unity	143.0	143.0	0.2	0.195
20	1	Load>	479.3	-0.08	172.0	-0.08	100.0 Lag	142.8	142.8	0.0	0.207
21		Source>	480.0	0.00			100.0 Unity	156.6	156.6	0.2	0.234
	1	Load>	479.3	-0.09	188.4	-0.09	100.0 Lag	156.4	156.4	0.0	0.249
22		Source>	480.0	0.00			100.0 Unity	189.9	189.9	0.4	0.343
	1	Load>	479.1	-0.11	228,4	-0.11	100.0 Lag	189.5	189.5	0.0	0.365
23		Source>	480.0	0.00			100.6 Unity	172.5	172.5	0.3	0.283
	1	Load>	479.2	-0.10	207.5	-0.10	100.0 Lag	172.2	172.2	0.0	0.301
24		Source>	480.0	0.00			100.0 Unity	135.4	135.4	0.2	0.174
	1	Load>	479.4	-0.08	162.8	-0.08	100.0 Lag	135.2	135.2	0.0	0.186
25		Source>	480.0	0.00			100.0 Unity	118.5	118.5	0.1	0.134
	1	Load>	479.5	-0.07	142.6	-0.07	100.0 Lag	118.4	118.4	0.0	0.142
26		Source>	480.0	0.00			100.0 Unity	109.7	109.7	0.1	0.115
	1	Load>	479.5	-0.06	132.0	-0.06	100.0 Lag	109.6	109.6	0.0	0.122
27		Source>	480.0	0.00			100.0 Unity	104.5	104.5	0.1	0.104
_	1	Load>	479.5	-0.06	125.7	-0.06	100.0 Lag	104.4	104.4	0.0	0.111
28		Source>	480.0	0.00			100.0 Unity	101.2	101.2	0.1	0.098
-	1	Load>	479.5	-0.06	121.8	-0.06	100.0 Lag	101.1	101.1	0.0	0.104
29		Source>	480.0	0.00			100.0 Unity	99.0	99.0	0.1	0.093
-	1	Load>	479.5	-0.06	119.1	-0.06	100.0 Lag	98.9	98.9	0.0	0.099
30		Source>	480.0	0.00			100.0 Unity	97.6	97.6	0.1	0.091
-	1	Load>	479.6	-0.06	117.3	-0.06	100.0 Lag	97.5	97.5	0.0	0.096
31 -		Source>	480.0	0.00			100.0 Unity	96.6	96.6	0.1	0.089
+	1	Load>	479.6	-0.06	116.2	-0.06	100.0 Lag	96.5	96.5	0.0	0.094
32		Source>	480.0	0.00			100.0 Unity	96.0	96,0	0.1	0.088
+	1	Load>	479.6	-0.06	115.4	-0.06	100.0 Lag	95.9	95.9	0.0	0.093
33 -		Source>	480.0	0.00	1	10000	100.0 Unity	95.7	95.7	0.1	0.087
+	1	Load>	479.6	-0.06	115.1	-0.06	100.0 Lag	95.6	95.6	0.0	0.093
34 -		Source>	480.0	0.00			100.0 Unity	95.7	95.7	0.1	0.087
+	1	Load>	479.6	-0.06	115.1		100.0 Lag	95.6	95.6	0.0	0.093
35 -		Source>	480.0	0.00			100.0 Unity	96.0	96,0	0.1	0.088
+	1	Load>	479.6	-0.06	115.4		100.0 Lag	95.9	95.9	0.0	0.093
36		Source>	480.0	0.00			100.0 Unity	96.6	96.6	0.1	0.089
	1	Load>	479.6	-0.06	116.2	-0.06	100.0 Lag	96.5	96.5	0.0	0.094

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AmpCalc - Cable Ampacity Calculations for Underground & Aerial Installations
Version 4.00, Rev 16 (c) Copyright 1986-2011 Calcware Company Katy, Texas

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

Load Flow Calculations:

No.	Identifier		Volt	age	Current	/Phase		Loa	ad Flow Po	wer	kW Loss
140.	System		Mag	Deg	Amps	Deg	PF (%)	kVA	kW	kVAR	kVAR Loss
37	·i	Source> Load>	480.0 479.6	0.00	117.3	-0.06	100.0 Unity 100.0 Lag	97.6 97.5	97.6 97.5	0.1	0.091
38	<u>-</u>	Source> Load>	480.0 479.5	-0.06	119.1	-0.06	100.0 Unity 100.0 Lag	99.0	99.0	0.1	0.093
39	1	Source> Load>	480.0 479.5	0.00	121.8	-0.06	100.0 Unity 100.0 Lag	101.2	101.2	0.1	0.098
40	1	Source> Load>	480.0 479.5	0.00	125.7	-0.06	100.0 Unity 100.0 Lag	104.5	104.5	0.1	0.104
41	1	Source> Load>	480.0 479.5	-0.06	132,0	-0.06	100.0 Unity 100.0 Lag	109.7	109.7	0.1	0.115
42	1	Source> Load>	480.0 479.5	0.00	142.6	-0.07	100.0 Unity	118.5	118.5	0.1	0.134
43	1	Source> Load>	480.0	0.00	162.8	-0.08	100.0 Unity 100.0 Lag	135.4	135.4	0.2	0.174
44	1	Source> Load>	480.0 479.2	0.00	207.5	-0.10	100.0 Unity 100.0 Lag	172.5	172.5	0.3	0.283

Duct Fill Data and Calculations:

No.	Identifier System	Ph Qty	Ph Size Ph OD	Neut Qty	Neut Size Neut OD	Grd Qty Grd Type	Grd Size Grd OD	Duct ID	Allowable Fill %	Actual Fill %	Jam Ratio
1	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
2		4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
3	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
4	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
5	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
6	1	4	500 kcmil 1.003	0 -		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
7	1	4	500 kcmil 1.003	0 -		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

Duct Fill Data and Calculations:

No.	Identifier System	Ph Qty	Ph Size Ph OD	Neut Qty	Neut Size Neut OD	Grd Qty Grd Type	Grd Size Grd OD	Duct ID	Allowable Fill %	Actual Fill %	Jam Ratio
8	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
9	C1 1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
10	····i	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
11	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
12	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
13	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
14-	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
15-	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
16-	<u>C1</u>	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
17-	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
18-	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
19-	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
20 -	1	4	500 kcmil 1.003	0 -		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
21 -	1	4	500 kcmil 1.003	0 -		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
22	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
23	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
4	1	4	500 kcmil 1.003	0		1 :	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
5	1	4	500 kcmil 1.003	0		1 :	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

Duct Fill Data and Calculations:

No	Identifier System		11 -1 -1 -1	- Neut Qty	Neut Size Neut OD	Grd Qty Grd Type	Grd Size		Allowable Fill %	Actual Fill %	Jam
26	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2	Ratio
27	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	OK 30,2	n/a
28	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	OK 30.2	n/a
29	11	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	- 6.000	40.0	OK 30.2	n/a
30	1	4	500 kcmil 1.003	0 -	Ii	1 Insulated	3/0 AWG 2.620	- 6.000	40.0	OK 30.2	n/a
31	1	4	500 kcmil 1.003	0 -		1 Insulated	3/0 AWG 2.620	6.000	40.0	OK 30.2	n/a
32 -	1	4	500 kcmil 1.003	0 -			3/0 AWG 2.620	6.000	40.0	OK 30.2	n/a
33 -	1	4	500 kcmil 1.003	0 -		1 ;	3/0 AWG 2.620	6.000	40.0	OK 30.2 OK	n/a
14	1	4	500 kcmil 1.003	0		1 3 Insulated	3/0 AWG 2.620	6.000	40.0	30.2	n/a
5-	1	4	500 kcmil 1.003	0		1 3 Insulated	3/0 AWG 2.620	6.000	40.0	OK 30.2	n/a
6	1	4	500 kcmil 1.003	0			/0 AWG 2.620	6.000	40.0	OK 30.2	n/a
7	1	4	500 kcmil 1.003	0		1 3	/0 AWG 2.620	6.000	40.0	OK 30.2	n/a
3	1	4	500 kcmil 1.003	0			0 AWG 2.620	6.000	40.0	OK 30.2	n/a
	1	4 -	500 kcmil 1.003	0			0 AWG 2.620	6.000	40.0		n/a
)	1	4 -	500 kcmil 1.003	0		1 3/	0 AWG 2.620	6.000	40.0		n/a
	1	1	500 kcmil 1.003	0			0 AWG 2.620	6.000	40.0		n/a
	1		500 kcmil 1.003	0		_ 1 _ 3/0	2.620	6.000	40.0		n/a
	1	4	500 kcmil 1.003	0	In	1 3/0	AWG	6.000	40.0	OK 30.2 1	n/a

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

Duct Fill Data and Calculations:

No.	Identifier System	Ph Qty	1 11100	Neut Qty	Neut Size Neut OD	Grd Qty Grd Type	Grd Size Grd OD	Duct ID	Allowable Fill %	Actual Fill	Jam Ratio
44	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a

Cable Library Volume Data:

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No	Identifier System	y	Type	Temp Shield?	SIC	DF	Ins RHO	CU res	ks	3/c
1		NEC1_600	1/c		SIC exp		Jac RHO	AL res	kp	configuration
1	1	THHW	0.600	75 No	0.000	0.000	500	10.371	1.000	
2		NEC1 600	1/c		0.0000	0.0000	0	17.002	1.000	-
2	1	THHW	0.600	75 No	0.000	0.000	500	10.371	1.000	
3	Land a second	NEC1 600	1/c	75	0.0000	0.0000	0	17.002	1.000	*
J	1	THHW	0.600	No	0.000	0.000	500	10.371	1.000	
4	11123	NEC1_600	1/c	75	0.0000	0.0000	0	17.002	1.000	-
4	1	THHW	0.600	No	0.000	0.000	500	10.371	1.000	
5		NEC1_600	1/c	75	0.0000	0.0000	0	17.002	1.000	7
٥	1	THHW	0.600	No	0.000	0.000	500	10.371	1.000	
6		NEC1_600	1/c	75	0.0000	0.0000	0	17.002	1.000	-
٦	1	THHW	0.600	/3 No	0.000	0.000	500	10.371	1.000	
7		NEC1_600	1/c	75	0.0000	0.0000	0	17.002	1.000	
1	1	THHW	0.600	No	0.000	0.000	500	10.371	1.000	
8 -	13.1-1 -	NEC1_600	1/c		0.0000	0.0000	0	17.002	1.000	-
3	1	THHW	0.600	75 No	0.000	0.000	500	10.371	1.000	
9 -	C1	NEC1_600	1/c	75	0.0000	0.0000	0	17.002	1.000	-
1	1	THHW	0.600		0.000	0.000	500	10.371	1.000	
0	100	NEC1_600	1/c	No	0.0000	0.0000	0	17.002	1.000	-
1	1	THHW	0.600	75	0.000	0.000	500	10.371	1.000	
1 -		NEC1_600	1/c	No	0.0000	0.0000	0	17.002	1.000	-
1	1	THHW	0.600	75	0.000	0.000	500	10.371	1.000	
2		NEC1 600	1/c	No	0.0000	0.0000	0	17.002	1.000	
-	1-1-	THHW	0.600	75	0.000	0.000	500	10.371	1.000	
		NEC1_600	1/c	No	0.0000	0.0000	0	17.002	1.000	-
3	1	THHW	0.600	- 75 - No	0.000	0.000	500	10.371	1.000	
		NEC1_600	1/c	No	0.0000	0.0000	0		1.000	-
	1			75	0.000	0.000	500		1.000	
		1,111100	0.600	No	0.0000	0.0000			1.000	+

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

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Cable Library Volume Data:

No.	Identifier		Туре	Temp	SIC	DF	Ins RHO	CU res	ks	3/c
	System	Lib Volume	kV	Shield?	SIC exp	DF exp	Jac RHO	AL res	kp	configuration
15		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	1
	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	-
16	C1	NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	-
17		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	-
18		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	-
19		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	-
20		NEC1_600	1/c	75	0.000	0.000	500	10.371		
	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
21		NEC1_600	1/c	75	0.000	0.000	500			
	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	5-
22		NEC1_600	1/c	75	0.000	0.000	500		1.000	
	1	THHW	0.600	No	0.0000	0.0000	0	10.371	1.000	1+
23		NEC1 600	1/c	75	0.000	0.000	500	17.002	1.000	
.0	1	THHW	0.600	No	0.0000	0.0000	0	10.371	1.000	-
24		NEC1_600	1/c	75	0.000	0.000	500	17.002	1.000	
.4	1	THHW	0.600	No	0.0000	0.0000	0	10.371	1.000	2 1
5 -	1.79.09	NEC1_600	1/c	75	0.000	0.000		17.002	1.000	
.5	1	THHW	0.600	No	0.0000	0.0000	500	10.371	1.000	-
6		NEC1_600	1/c	75	0.000	0.000	0	17.002	1.000	
01.	1	THHW	0.600	No	0.0000	0.0000	500	10.371	1.000	-
7		NEC1_600	1/c	75	0.000		0	17.002	1.000	
1	1	THHW	0.600	No No	0.0000	0.000	500	10.371	1.000	-
		NEC1 600	1/c	75		0.0000	0	17.002	1.000	
8	1	THHW	0.600	No	0.000	0.000	500	10.371	1.000	
		NEC1_600	1/c		0.0000	0.0000	0	17.002	1.000	
9 -	1	THHW	0.600	75	0,000	0.000	500	10.371	1.000	
1		NEC1_600		No	0.0000	0.0000	0	17.002	1.000	
0	1	THHW	1/c	75	0.000	0.000	500	10.371	1.000	
+			0.600	No	0.0000	0.0000	0	17.002	1.000	-
	1	NEC1_600	1/c	75	0.000	0.000	500	10.371	1,000	
+		THHW	0.600	No	0.0000	0.0000		17.002	1.000	-
2		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
Tr		THHW	0.600	No	0.0000	0.0000		17.002	1.000	· · ·

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AmpCalc - Cable Ampacity Calculations for Underground & Aerial Installations
Version 4.00, Rev 16 (c) Copyright 1986-2011 Calcware Company Katy, Texas

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

Cable Library Volume Data:

No.	Identifier	Cable Library	Туре	Temp	SIC	DF	Ins RHO	CU res	ks	3/c
	System	Lib Volume	kV	Shield?	SIC exp	DF exp	Jac RHO	AL res	kp	configuration
33		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	-
34		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	* *
35		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	-
36		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
3.7	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	-
37		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
-	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	-
38		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
-	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	-
39		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
-	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	- 1
40		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
-	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
41		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
42		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
-	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	~
43		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	- 1
44		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	-

Cable Library Size Data - Basic Cable Data Format:

No.	Identifier	Cable Size	Cable	1/c OD	Insulation		Cone	ductor	CU lay F	Shield Th.	. Shield Rdc
	System	Odpio Oizo	OD	I''C OB	thickness	thickness	kcmil	Diameter			Calc Yse?
1		500 kcmil	1.003		0.0950	0.000	500.00	0.813	1.0228		-
	1				0.0000	0.000	000.00	0.010	1.0206		-
2		500 kcmil	1.003	-	0.0950	0.000	500.00	0.813	1.0228	-,	-
	1		13000		1000	0.000	000.00	0.013	1.0206		-
3		500 kcmil	500 kcmil 1.003	03 -	0.0950	0.000	500.00	0.813	1.0228		
	1				0,000	0,000	00,000	0.013	1.0206	-	-

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

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Cable Library Size Data - Basic Cable Data Format:

No	Identifier	Cable Size	Cable	1/c OD	Insulation		Con	ductor	CU lay F	Shield Th.	Shield Rdd
	System		OD		thickness	thickness	kcmil	Diameter		Shield Dia.	Calc Yse?
4	1	500 kcmil	1.003		0.0950	0.000	500.00	0.813	1.0228		
5	1	500 kcmil	1.003	-	0.0950	0.000	500.00	0.813	1.0228		
6	1	500 kcmil	1.003	-	0.0950	0.000	500,00	0.813	1.0228		
7	1	500 kcmil	1.003	17-1	0.0950	0.000	500.00	0.813	1.0228		
8	1	500 kcmil	1.003	-	0.0950	0.000	500.00	0.813	1.0228		
9	C1 1	500 kcmil	1.003	-	0.0950	0.000	500.00	0.813	1.0228		
10	1	500 kcmil	1.003	-	0.0950	0.000	500.00	0.813	1.0206		
11	1	500 kcmil	1.003		0.0950	0.000	500.00	0.813	1.0228		
12	1	500 kcmil	1.003	14	0.0950	0.000	500.00	0.813	1.0228		
3-	1	500 kcmil	1.003	-	0.0950	0.000	500.00	0.813	1.0228		
4-	1	500 kcmil	1.003		0.0950	0.000	500.00	0.813	1.0228		
5-	1	500 kcmil	1.003	-	0.0950	0.000	500.00	0.813	1.0206		
6-	<u>C1</u>	500 kcmil	1.003	•	0.0950	0.000	500.00	0.813	1.0206		
7-		500 kcmil	1.003		0.0950	0.000	500.00	0.813	1.0206 1.0206		
8 -	1	500 kcmil	1.003	-	0,0950	0.000	500.00	0.813	1.0206 1.0228 1.0206		-
9	1	500 kcmil	1.003	7	0.0950	0.000	500.00	0.813	1.0228		
0	1	500 kcmil	1.003	-	0.0950	0.000	500.00	0.813	1.0206		-
1		500 kcmil	1.003	- 1	0.0950	0.000	500.00	0.813	1.0206 1.0228 1.0206		

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

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Cable Library Size Data - Basic Cable Data Format:

No.	Identifie		Cable	1/c OD	Insulation	Jacket	Con	ductor	CU lay F	Shield Th.	Shield Rdo
_	System		OD	170 00	thickness	thickness	kcmil	Diameter		Shield Dia.	
22	1	500 kcmil	1.003	-	0.0950	0.000	500.00	0.813	1.0228		
23	1	500 kcmil	1.003		0.0950	0.000	500.00	0.813	1.0208		
24	1	500 kcmil	1.003	-	0.0950	0.000	500.00	0.813	1.0206		
25	1	500 kcmil	1.003	-	0.0950	0.000	500.00	0.813	1.0228		
26	1	500 kcmil	1.003	1	0.0950	0.000	500.00	0.813	1.0228		
27	1	500 kcmil	1.003	1	0.0950	0.000	500.00	0.813	1.0228		
28	1	500 kcmil	1.003		0.0950	0.000	500.00	0.813	1.0228		
29	1	500 kcmil	1.003	+	0.0950	0.000	500.00	0.813	1.0228		
30 -	1	500 kcmil	1.003	-	0.0950	0.000	500.00	0.813	1.0228		
31	1	500 kcmil	1.003	12	0.0950	0.000	500.00	0.813 -	1.0228		
32 -	1	500 kcmil	1.003	*	0.0950	0.000	500.00	0.813	1.0228		
3 -	<u>-</u>	500 kcmil	1.003	7-	0.0950	0.000	500.00	0.813 -	1.0228		
4	1	500 kcmil	1.003	-	0.0950	0.000	500.00	0.813	1.0228		
5	1	500 kcmil	1.003	-7	0.0950	0.000	500.00	0.813	1.0228		
6	11	500 kcmil	1.003	¥	0.0950	0.000	500.00		1.0228		
7	1	500 kcmil	1.003	9	0.0950	0.000	500.00	0.813	1.0228		
3	1	500 kcmil	1.003	*	0.0950	0.000	500.00	0.813	1.0228		
9	1	500 kcmil	1.003		0.0950	0.000	500.00	0.813	1.0208		

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

Cable Library Size Data - Basic Cable Data Format:

No.	Identifier	Cable Size	Cable	1/c OD	Insulation		Con	ductor	CU lay F	Shield Th.	Shield Rdc
	System	Odbio Oizo	OD	INC OB	thickness	thickness	kcmil	Diameter			Calc Yse?
40		500 kcmil	1.003	1.2	0.0950	0.000	500.00	0.813	1.0228		
	1				La Code a	DATE OF	988.	5.575	1.0206		-
41		500 kcmil	1.003		0.0950	0.000	500.00	0.813	1.0228	-	
	1		0.000				000.00	00 0.613	1.0206	1	-
42		500 kcmil	1.003	-	0.0950	0.000	500.00	0.813	1.0228		÷.
	11		4,100,000			0,000	000,00	0.010	1.0206		
43		500 kcmil	1.003		0.0950	0.000	500.00	0.813	1.0228	-	•
	1	The second second	21325		712777	0.000	000,00	0.010	1.0206		
44	4	500 kcmil	00 kcmil 1.003		0.0950	0.000	500.00	0.813	1.0228		-
	1	1000	P. C. C. C.			2.000	0.813	1.0206	-		

Duct Library Data

V 200				li ==-		Duct			Co	vering
No.	Identifier	System	Duct Library	Туре	RHO	Nominal Size	ID	Thickness	RHO	Thickness
1		1	NEC_PVC	Nmet	650	6.00	6.00	0.280	0	0.000
2		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
3		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
4		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
5		1	NEC_PVC	Nmet	650	6.00	6.00	0.280	0	0.000
6		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
7		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
8		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
9	C1	1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
10		1	NEC_PVC	Nmet	650	6.00	6.00	0.280	0	0.000
11		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
12		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
13		1	NEC_PVC	Nmet	650	6.00	6.00	0.280	0	0.000
14		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
15		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
16	C1	1	NEC_PVC	Nmet	650	6.00	6.00	0.280	0	0.000
17		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
18		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
19		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
20		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
21		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000

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Version 4.00, Rev 16 (c) Copyright 1986-2011 Calcware Company Katy, Texas

Program Serial Number: 203400552

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Filename: 0

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Duct Library Data

NI-I	1-1					Duct			Co	vering
	Identifier	System	Duct Library	Type	RHO	Nominal Size	ID	Thickness	RHO	Thickness
22		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
23		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
24		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
25		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
26		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
27		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
28		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
29		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
30	_	1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
31		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
32		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
33		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
34		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
35		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
36		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
37		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
38		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
39		1	NEC PVC	Nmet	650	0.00	6.00	0.280	0	0.000
40		1	NEC PVC	Nmet	650	0.00	6.00	0.280	0	0.000
41		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
42		1	NEC PVC	Nmet	650	0.00	6.00	0.280	0	
43		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
14		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000

CALCULATION RESULTS - Table 1 of 3

No.	Identifier	System	Temp	Amps	# Cond.	Loss Fac.	Watts/ft	Rac	Rdc	Wd	Dtd
1		1	75.000	228.4	4	1.000	5.719	27.419	25.800	0.0000	0.000
2		1	75.000	188.4	4	1.000	3.893	27.419	25.800	0.0000	0.000
3		1	75.000	172.0	4	1.000	3.243	27.419	25.800	0.0000	0.000
4		1	75.000	164.2	4	1.000	2.956	27.419	25.800	0.0000	0.000
5		1	75.000	160.0	4	1.000	2.809	27.419	25.800	0.0000	0.000
6		1	75.000	157.7	4	1.000	2.726	27.419	25.800	0.0000	0.000
7		1	75.000	156.3	4	1.000	2.678	27.419	25.800	0.0000	0.000
8		1	75.000	155.4	4	1.000	2.648	27.419	25.800	0.0000	0.000
9	C1	1	75.000	154.9	4	1.000	2.630	27.419	25.800	0.0000	0.000

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AmpCalc - Cable Ampacity Calculations for Underground & Aerial Installations
Version 4.00, Rev 16 (c) Copyright 1986-2011 Calcware Company Katy, Texas

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Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

CALCULATION RESULTS - Table 1 of 3

No.	Identifier	System	Temp	Amps	# Cond.	Loss Fac.	Watts/ft	Rac	Rdc	Wd	Dtd
10		1	75.000	154.5	4	1.000	2.619	27.419	25.800	0.0000	0.000
11		1	75,000	154.4	4	1.000	2.615	27.419	25.800	0.0000	0.000
12		1	75.000	154.4	4	1.000	2.615	27.419	25.800	0.0000	0.000
13		1	75.000	154.5	4	1.000	2.619	27.419	25.800	0.0000	0.000
14		1	75.000	154.9	4	1.000	2.630	27.419	25.800	0.0000	0.000
15		1	75.000	155.4	4	1.000	2.648	27.419	25.800	0.0000	0.000
16	C1	1	75.000	156.3	4	1.000	2.678	27.419	25.800	0.0000	0.000
17		1	75.000	157.7	4	1.000	2.726	27,419	25.800	0.0000	0.000
18		1	75.000	160.0	4	1.000	2.809	27.419	25.800	0.0000	0.000
19		1	75.000	164.2	4	1.000	2.956	27.419	25.800	0.0000	0.000
20		1	75.000	172.0	4	1.000	3.243	27.419	25.800	0.0000	0.000
21		1	75.000	188.4	4	1.000	3.893	27.419	25.800	0.0000	0.000
22		1	75.000	228.4	4	1.000	5.719	27.419	25.800	0.0000	0.000
23		1	75.000	207.5	4	1.000	4.722	27.419	25.800	0.0000	0.000
24		1	75.000	162.8	4	1.000	2.908	27.419	25.800	0.0000	0.000
25		1	75.000	142.6	4	1.000	2.230	27.419	25.800	0.0000	0.000
26		1	75.000	132.0	4	1.000	1.910	27.419	25.800	0.0000	0.000
27		1	75,000	125.7	4	1.000	1.734	27.419	25.800	0.0000	0.000
28	- Control of the Cont	1	75.000	121.8	4	1.000	1.626	27.419	25.800	0.0000	0.000
29		1	75.000	119.1	4	1.000	1.556	27.419	25.800	0.0000	0.000
30		1	75.000	117.3	4	1.000	1.510	27.419	25.800	0.0000	0.000
31		1	75.000	116.2	4	1.000	1.480	27.419	25.800	0.0000	0.000
32		1	75.000	115.4	4	1.000	1.462	27.419	25.800	0.0000	0.000
33		1	75.000	115.1	4	1.000	1.453	27.419	25.800	0.0000	0.000
34		1	75.000	115.1	4	1.000	1.453	27.419	25.800	0.0000	0.000
35		1	75.000	115.4	4	1.000	1.462	27.419	25.800	0.0000	0.000
36		1	75.000	116.2	4	1.000	1.480	27.419	25.800	0.0000	0.000
37		1	75.000	117.3	4	1.000	1.510	27.419	25.800	0.0000	0.000
38		1	75.000	119.1	4	1.000	1.556	27.419	25.800	0.0000	0.000
39		1	75.000	121.8	4	1.000	1.626	27.419	25.800	0.0000	0.000
40		1	75.000	125.7	4	1.000	1.734	27.419	25.800	0.0000	0.000
41		1	75.000	132.0	4	1.000	1.910	27.419	25.800	0.0000	0.000
42		1	75.000	142.6	4	1.000	2.230	27.419	25.800	0.0000	0.000
43		1	75.000	162.8	4	1.000	2.908	27.419	25.800	0.0000	0.000
14		1	75,000	207.5	4	1.000	4.722	27.419	25.800	0.0000	0.000

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Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

CALCULATION RESULTS - Table 2 of 3

No.	Identifier	System	Yp	Qp	Spacing	GF1	GF2	Ri	Rj	Rsd	Rcap	Rd
1		1	0.0000	1.0000	1.003		-	0.5473	0.0000	6.552	14.298	1.206
2		1	0.0000	1.0000	1.003	0.1.4.s	-	0.5473	0.0000	6.552	14.298	1.206
3		1	0.0000	1.0000	1.003		-	0.5473	0.0000	6.552	14.298	1.206
4		1	0.0000	1.0000	1.003	113	-	0.5473	0.0000	6.552	14.298	1.206
5		1	0.0000	1.0000	1.003	-	-	0.5473	0.0000	6.552	14.298	1.206
6		1	0.0000	1.0000	1.003	-	-	0.5473	0.0000	6,552	14.298	1.206
7		1	0.0000	1.0000	1.003	-	-	0.5473	0.0000	6.552	14.298	1.206
8		1	0.0000	1.0000	1.003	-	-	0.5473	0.0000	6.552	14.298	1.206
9	C1	1	0.0000	1.0000	1.003	-	-	0.5473	0.0000	6.552	14.298	1.206
10		1	0.0000	1.0000	1.003	-1	-	0.5473	0.0000	6.552	14.298	1.206
11		1	0.0000	1.0000	1.003	-	-	0.5473	0.0000	6.552	14.298	1.206
12		1	0.0000	1.0000	1.003		14	0.5473	0.0000	6.552	14.298	1.206
13		1	0.0000	1.0000	1.003		4.	0.5473	0.0000	6.552	14.298	1.206
14		1	0.0000	1.0000	1.003			0.5473	0.0000	6.552	14.298	1.206
15		1	0.0000	1.0000	1.003		4	0.5473	0.0000	6.552	14.298	1.206
16	C1	1	0.0000	1.0000	1.003	-	-	0.5473	0.0000	6.552	14.298	1.206
17		1	0.0000	1.0000	1.003	-		0.5473	0.0000	6.552	14.298	1.206
18		1	0.0000	1.0000	1.003	+	-	0.5473	0.0000	6.552	14.298	1.206
19		1	0.0000	1.0000	1.003	4		0.5473	0.0000	6.552	14.298	1.206
20		1	0.0000	1.0000	1.003	-		0.5473	0.0000	6.552	14.298	1.206
21		1	0.0000	1.0000	1.003	-	-	0.5473	0.0000	6.552	14.298	1.206
22		1	0.0000	1.0000	1.003	-	-	0.5473	0.0000	6.552	14.298	1.206
23		1	0.0000	1.0000	1.003	-	-	0.5473	0.0000	6.552	14.620	1.206
24		1	0.0000	1.0000	1.003	4	-	0.5473	0.0000	6.552	14.620	1.206
25		1	0.0000	1.0000	1.003	-	14	0.5473	0.0000	6.552	14.620	1.206
26		1	0.0000	1.0000	1.003	-	4 4	0.5473	0.0000	6.552	14.620	1.206
27		1	0.0000	1.0000	1.003	-		0.5473	0.0000	6.552	14.620	1.206
28		1	0.0000	1.0000	1.003	-		0.5473	0.0000	6.552	14.620	1.206
29		1	0.0000	1.0000	1.003	-	1	0.5473	0.0000	6.552	14.620	1.206
30		1	0.0000	1.0000	1.003	4	4	0.5473	0.0000	6.552	14.620	1.206
31		1	0.0000	1.0000	1.003	-	-	0.5473	0.0000	6.552	14.620	1.206
32		1	0.0000	1.0000	1.003	-	-	0.5473	0.0000	6.552	14.620	1.206
33		1	0.0000	1.0000	1.003	-	-	0.5473	0.0000	6.552	14.620	1.206
34		1	0.0000	1.0000	1.003	- ·		0.5473	0.0000	6.552	14.620	1.206
35		1	0.0000	1.0000	1.003	-	-	0.5473	0.0000	6.552	14.620	1.206
36		1	0.0000	1.0000	1.003	-		0.5473	0.0000	6.552	14.620	1.206

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

CALCULATION RESULTS - Table 2 of 3

No.	Identifier S	System	Yp	Qp	Spacing	GF1	GF2	Ri	Rj	Rsd	Rcap	Rd
37		1	0.0000	1.0000	1.003	-	-	0.5473	0.0000	6.552	14.620	1.206
38		1	0.0000	1.0000	1.003	-	-	0.5473	0.0000	6.552	14.620	1.206
39		1	0.0000	1.0000	1.003	140	1-2	0.5473	0.0000	6.552	14.620	1.206
40		1	0.0000	1.0000	1.003	-	-	0.5473	0.0000	6.552	14.620	1.206
41		1	0.0000	1.0000	1.003	-	-	0.5473	0.0000	6.552	14.620	1.206
42		1	0.0000	1.0000	1.003	-	-	0.5473	0.0000	6.552	14.620	1.206
43		1	0.0000	1.0000	1.003	-		0.5473	0.0000	6.552	14.620	1.206
44		1	0.0000	1.0000	1.003	-	-	0.5473	0.0000	6.552	14.620	1.206

CALCULATION RESULTS - Table 3 of 3

No.	Identifier	System	Yc	Ycs	Ycp	Shld X	Ys	Ysc	Yse	Qs
1		1 1	0.0628	0.0163	0.0464	-	-	-	-	1.0000
2		1	0.0628	0.0163	0.0464	-	(-)		+	1.0000
3		1	0.0628	0.0163	0.0464	1-	- 2-	-	-	1.0000
4		1	0.0628	0.0163	0.0464		-	4	-	1.0000
5		1	0.0628	0.0163	0.0464	-	-	- 1		1.0000
6		1	0.0628	0.0163	0.0464		+	-		1.0000
7		1	0.0628	0.0163	0.0464	-	- F		-	1.0000
8		1	0.0628	0.0163	0.0464	-	+	-	·+·	1.0000
9	C1	1	0.0628	0.0163	0,0464		-			1.0000
10		1	0.0628	0.0163	0.0464	-	-	L	-	1.0000
11		1	0.0628	0.0163	0.0464	-		Le -	-	1.0000
12		1	0.0628	0.0163	0.0464	-	-	-	-	1.0000
13		1	0.0628	0.0163	0.0464		-	-	-	1.0000
14		1	0.0628	0.0163	0.0464	-	-	-	-	1.0000
15		1	0.0628	0.0163	0.0464	-	-	-	-	1.0000
16	C1	1	0.0628	0.0163	0.0464	-	-	-	-	1.0000
17		1	0.0628	0.0163	0.0464	-	7.		-	1.0000
18	A-10-1	1	0.0628	0.0163	0.0464	- "	1 -	-	12	1.0000
19		1	0.0628	0.0163	0.0464	4	1	-	-	1.0000
20		1	0.0628	0.0163	0.0464	-	14	-	-	1.0000
21		1	0.0628	0.0163	0.0464			-	-	1.0000
22		1	0.0628	0.0163	0.0464	-	12-	. 1191	-	1.0000
23		1	0.0628	0.0163	0.0464	120	-	-	-	1.0000
24		1	0.0628	0.0163	0.0464	4		-	-	1.0000

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Filename: 0

CALCULATION RESULTS - Table 3 of 3

No.	Identifier	System	Yc	Ycs	Ycp	Shld X	Ys	Ysc	Yse	Qs
25		1	0.0628	0.0163	0.0464	-		1 -		
26		1	0.0628	0.0163	0.0464				-	1.0000
27		1	0.0628	0.0163	0.0464	-	-			1.0000
28		1	0.0628	0.0163	0.0464	-		-	-	1.0000
29		1	0.0628	0.0163	0.0464	-	-	-		1.0000
30		1	0.0628	0.0163	0.0464			-	7.	1.0000
31		1	0.0628	0.0163	0.0464			-	7	1.0000
32		1	0.0628	0.0163	0.0464	-	-	- 1	-	1.0000
33		1	0.0628	0.0163	0.0464	-	-		-	1.0000
34		1	0.0628	0.0163		- 1	- F	-	-	1.0000
35		1	0.0628		0.0464	-	-	-	-	1.0000
36		1	0.0628	0.0163	0.0464	-	•	-		1.0000
37		1		0.0163	0.0464		-	+	-	1.0000
38		1	0.0628	0.0163	0.0464		-	-	-	1.0000
19		-1-1	0.0628	0.0163	0.0464		-	7	-	1.0000
0		1	0.0628	0.0163	0.0464	-	-	-	-	1.0000
		1	0.0628	0.0163	0.0464		- 1	-	-	1.0000
1		1	0.0628	0.0163	0.0464	-	-	-	-	1.0000
2		1	0.0628	0.0163	0.0464		-		-	1.0000
3		1	0.0628	0.0163	0.0464	-		~	-	1.0000
4		1	0.0628	0.0163	0.0464	-	-		-	1.0000

Variable Label	Description	IV.
# Cond	Number of conductors (not cables) at position	Units
1/c OD	For 3/c Cable, outside diameter of 1/c portion	
1/c Spacing	Equivalent phase spacing for 1/c cables at different positions	Inches
3/c Configuration	Type of 3/c cable, round or sector	Inches
Actual Fill %	Actual conduit fill	
AL lay F	Lay factor for aluminum conductor	%
AL Res	Aluminum electrical resistivity	
Allowable Fill %	Allowable conduit fill according to limits set by user or NEC defaults	Cir mils ohms/ft
Amps	Calculated or specified current on a per conductor basis	%
Cable Lib	Cable data library descriptor	Amperes
Cable OD	Cable overall outside diameter	
Cable Size	Cable size designation	Inches
Cable Type	Cable type,1/c or 3/c	
Concrete thermal resistivity (RHO)	Concrete thermal resistivity	
Cond.	Conductor Material, Copper or Aluminum	Deg C-cm/watt
Conductor Diameter	Conductor diameter	Inches

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Filename: 0

Variable Label	Description	Units
Config	Cable configuration, non-applicable, equilateral, cradled or mixed	1
CU lay F	Lay factor for copper conductor	
CU Res	Copper electrical resistivity	Cir mile abma
Current Mag	Magnitude of current used in load flow calculations	Cir mils ohms
Current Deg	Phase angle of current used in load flow calculations	Amps Degrees
Dissipation Factor	Insulation dissipation factor, (DF), overall DF = DF x $e^{(DF Exp \times Temp)}$	Degrees
Dissipation Factor Exponent	Insulation dissipation factor exponent, overall DE = DE v e^(DE Exp v Tomo)	
Distance from earth's surface to ori	igin Vertical distance from earth's surface to prigin of coordinate system	Inches
Dist, top of ductbank to earth's surf	face Vertical distance from top of ductbank concrete envelope to earth's surface	Inches
Dtd	Increment of conductor temperature rise due to dielectric losses	Deg C
Duct ID	Duct Inner diameter	
Duct Library	Duct data library descriptor	Inches
Duct RHO	Duct material thermal resistivity	D 01
Duct Thickness	Duct wall thickness	Deg C-cm/wa
Duct Type	Whether duct material is Non-magnetic, Steel or Iron	Inches
Ductbank Geometric Factor	Calculated ductbank geometric factor	
Ductbank Height	Height of ductbank concrete envelope	
Ductbank Width	Width of ductbank concrete envelope	Inches
dx	Ficticious diameter at which the effect of loss factor commences	Inches
Earth temperature	Earth ambient temperature	Inches
Earth thermal resistivity (RHO)	Earth thermal resistivity	Deg C
GF1	Geometric factor for 3/c cable applying to insulation resistance	Deg C-cm/wa
GF2	Geometric factor for 3/c cable applying to insulation resistance	
Grd OD	Overall outer diameter of ground cables at position	
Grd Qty	Quantity of ground cables at position (needed only for conduit fill calculations)	Inches
Grd Size	Size of ground cables at position (needed only for conduit fill calculations)	
Grd Type	Whether ground cables are insulated or bare	
dentifier	Cable position identifies assistant by	
ns RHO	Cable position identifier assigned by user	
nsulation Thickness	Thermal resistivity of insulation	Deg C-cm/wat
pf	Cable insulation thickness	Inches
pf Exp	Insulation power factor, overall lpf = lpf x e^(lpf Exp x Temp)	
Jac RHO	Insulation power factor exponent, overall lpf = lpf x e^(lpf Exp x Temp)	
Jacket Thickness	Cable jacket thermal resistivity	Deg C-cm/wat
Jam Ratio	Cable jacket thickness	Inches
comil	Ratio of duct ID to cable OD, to be OK for 3 cables must be < 2.8 or > 3.2	
KP	Conductor area	Thou, circ mils
KS .	Conductor proximity effect factor	
XV	Conductor skin effect factor	
:VA	Rated cable line-to-line kilovolts	kilovolts
VAR	Circuit three phase load flow kilovoltamperes for all cables at position	kVA
	Circuit three phase load flow kilovars for all cables at position	kVAR
VAR Loss	Total Circuit three phase kilovars losses for all cables at position	kVAR
W	Circuit three phase load flow kilowatt for all cables at position	kW
W Loss	Total Circuit three phase kilowatt losses for all cables at position	kW
ength	Circuit length, (one-way distance for dc as well as ac)	Feet
F%	Load factor	%
ib Volume	Cable Library data volume tag	
OG10(Fd)	Log (base 10) of distance product factor	
oss Fac	Loss factor	
leut OD	Overall outer diameter of neutral cables at position	Inches

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Filename: 0

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Variable Label	Description	Units
Neut Qty	Quantity of neutral cables at position (needed only for condult fill calculations)	
Neut Size	Size of neutral cables at position	
No.	Cable position number not including inactive positions	
Nom. Size	Nominal duct size	Inches
Number of cable positions in system	Number of active cable positions in system calculation	munes
PF %	Load Power Factor, (for voltage drop calcs)	%
Ph OD	Overall outer diameter of phase cables at position	Inches
Ph Qty	Quantity of phase cables at position	inches
Ph Size	Size of phase cables at position	
Qp	Loss ratio = Losses in (Conductor + Shield + Duct) / Conductor	_
Qs	Loss ratio = Losses in (Conductor + Shield) / Conductor	
Qty-Type	Quantity and type (1/c or 3/c) of cables at position	
Rac	Conductor ac resistance at conductor specified or rated temperature	
Rated kV	Cable line-to-line kilovolt rating	microhms/foc
Rcap	Overall thermal resistance between conductor & ambient	kilovolts
Rd	Duct thermal resistance	Thermal ohm
Rdc	Conductor dc resistance at conductor specified or rated temperature	Thermal ohm
Reactance	Conductor ac reactance used for voltage drop calcs	microhms/foo
Rep	Thermal resistance at interface zone between cable or conduit surface & ambient air	ohms/1000 fe
Resistance	Conductor ac resistance used for voltage drop calcs	Thermal ohm
Ri	Insulation thermal resistance	ohms/1000 fe
Rj	Cable Jacket thermal resistance	Thermal ohm-
Rsd	Thermal resistance between cable exterior and duct interior	Thermal ohm-
Shield	Cable shielded? Yes or No	Thermal ohm-
Shield	Shield grounding. No shield Shield the	
Shield Dia	Shield grounding, No shield, Shield w/1 end grd or Shield w/2 end grd Shield mean diameter	
Shield Rdc	Shield dc resistance	Inches
Shield Th	Shield thickness	microhms/foot
Shld X		Inches
SIC	Mutual reactance conductor to shield	Microhms/foot
SIC Exp	Insulation Specific Inductive capacitance (SIC), SIC = SIC x e^(SIC exp x Temp)	
Size	Insulation SIC exponent, overall SIC = SIC x e^(SIC exp Temp)	
Spacing	Cable size designation	
Specified Amps	Spacing between conductors in the same phase group	Inches
Specified Temp	Specified conductor current	Amperes
sys Freq	Specified conductor temperature	Deg C
sys ried	Applied power frequency in cable	Hertz
ystem	Applied cable line-to-line kilovolts	kilovolts
emp	Number of system (assigned in order entered)	MIOVOILS
53.5	Calculated or specified total conductor temperature	Deg C
hermal Factor	Factor specifying relative heating at each cable position	Dog C
ype of underground system	Type of underground system, ductbank or direct buried	
nderground system filename	Path and *.ugs filename where underground system data stored	-
ollage Mag	Source or load voltage magnitude in load flow calcs	Valte
Ollage Deg	Source or load voltage phase angle in load flow calcs	Volts
oft Drop (+%) or Rise (-%)	Voltage drop or rise across circuit length, = 100 x (Vsource-Vload) / Vsource	Degrees
attorit	Total cable watts loss per foot	%
d	Cable dielectric loss	Watts/foot
Coord	Position x coordinate	Watts/foot
Coord	Position y coordinate	Inches
	ncrement of Rac/Rdc ratio due to conductor effects = Ycs+Ycp	Inches

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AmpCalc - Cable Ampacity Calculations for Underground & Aerial Installations
Version 4.00, Rev 16 (c) Copyright 1986-2011 Calcware Company Katy, Texas
Program Serial Number: 203400552

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Variable Label	Description	
Ycp	Increment of Rac/Rdc ratio due to conductor proximity effect	Units
CS	Increment of Rac/Rdc ratio due to conductor skin effect	
(p (s	Increment of Rac/Rdc ratio due to pine or conduit leases	
'sc	Increment of Rac/Rdc ratio due to total shield losses = Va. LV	
'se	increment of Rac/Rdc ratio due to circulating currents in abid.	
	Increment of Rac/Rdc ratio due to eddy currents in the shield	



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Docking State Office Building Electrical Upgrade Study

APPENDIX E: ONE-LINE/RISER DIAGRAMS

Appendices

PROPOSED LINE-UP (MAIN-TIE-MAIN)

NO SCALE

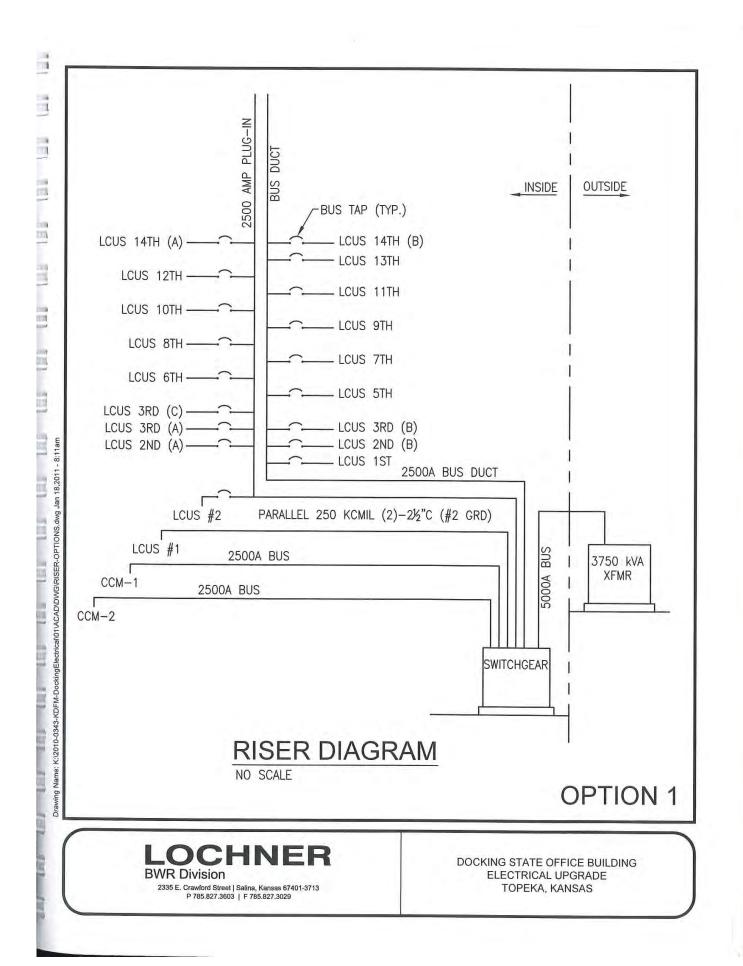
LOCHNER BWR Division

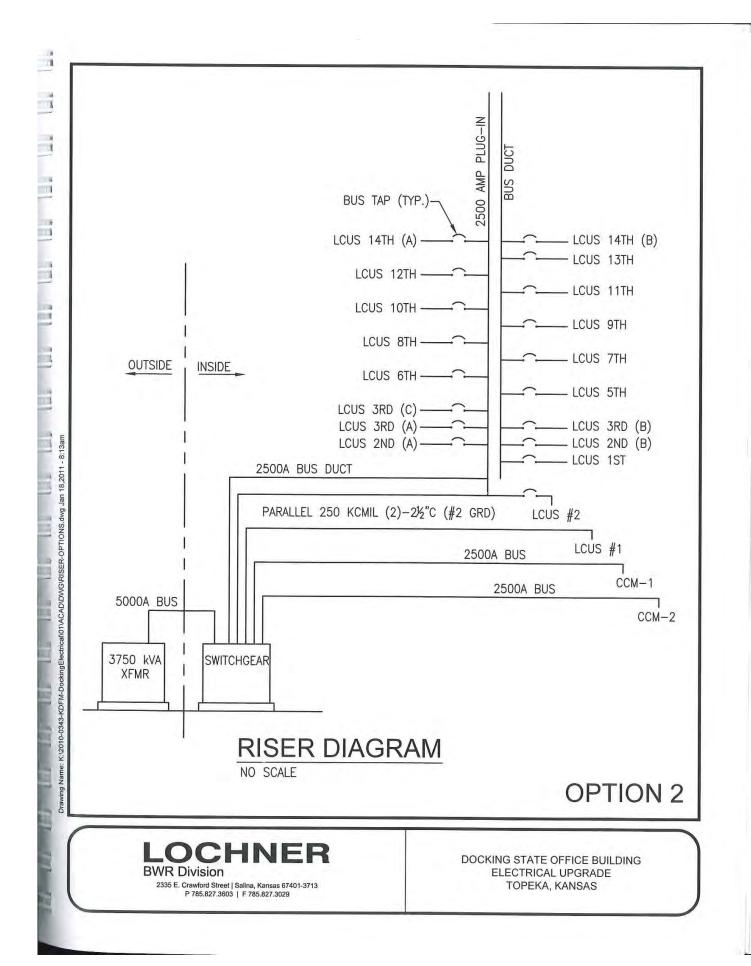
2335 E. Crawford Street | Salina, Kansas 67401-3713 P 785.827.3603 | F 785.827.3029 DOCKING STATE OFFICE BUILDING ELECTRICAL UPGRADE TOPEKA, KANSAS

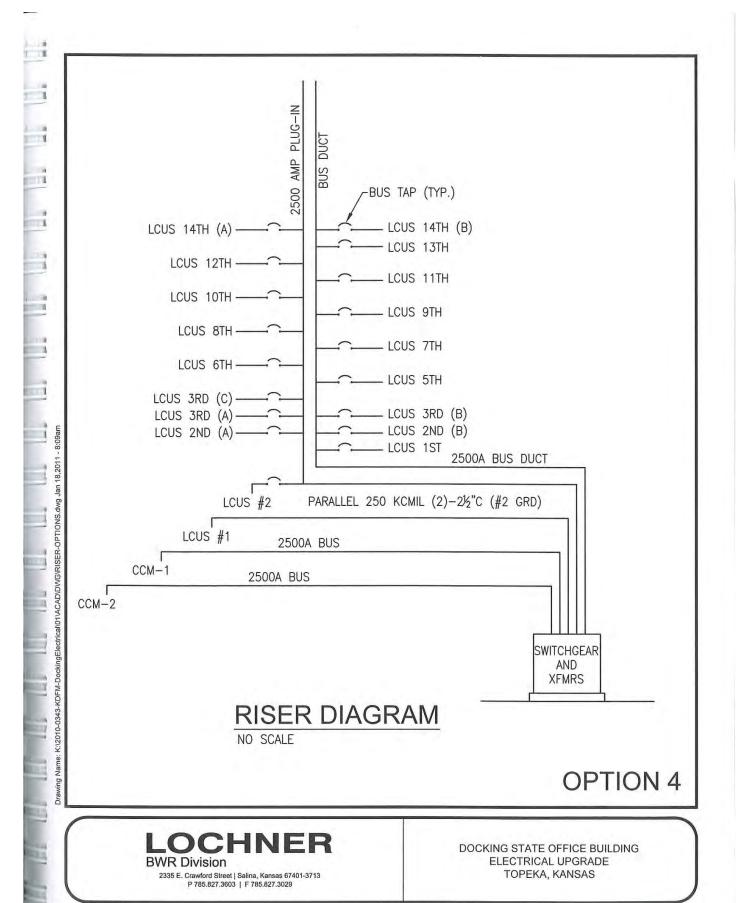
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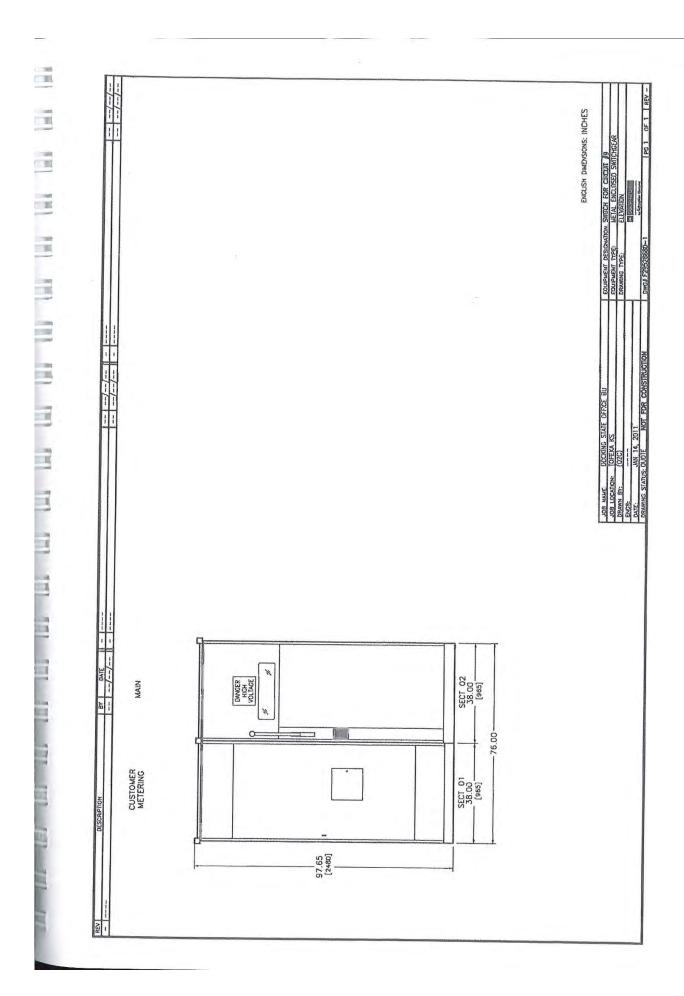


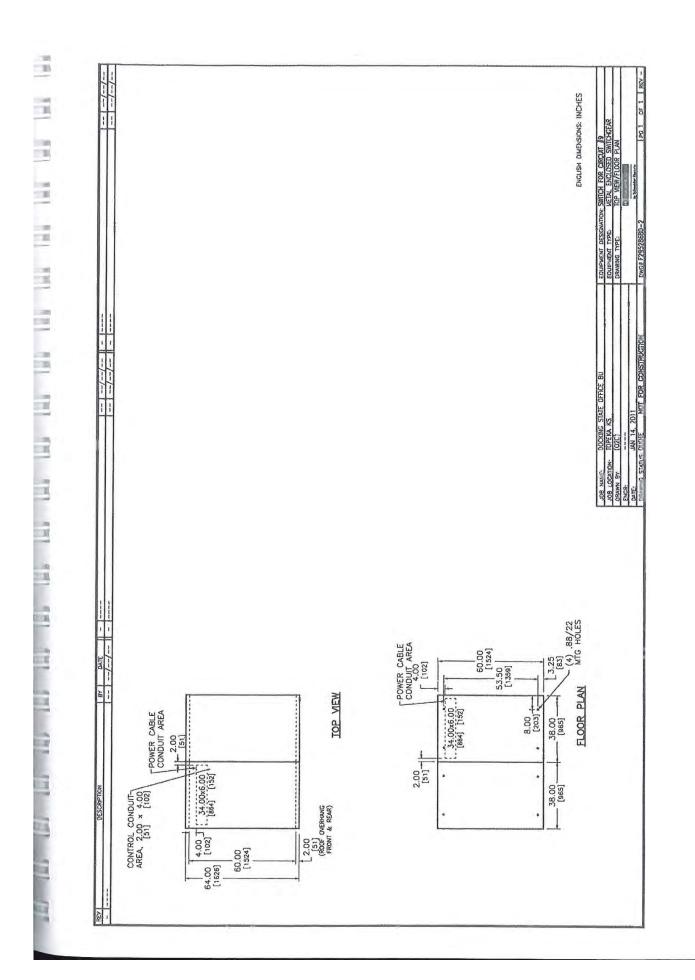
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APPENDIX F: OPTION 1 - TRANSFORMER AND SWITCHGEAR SHOP DRAWINGS

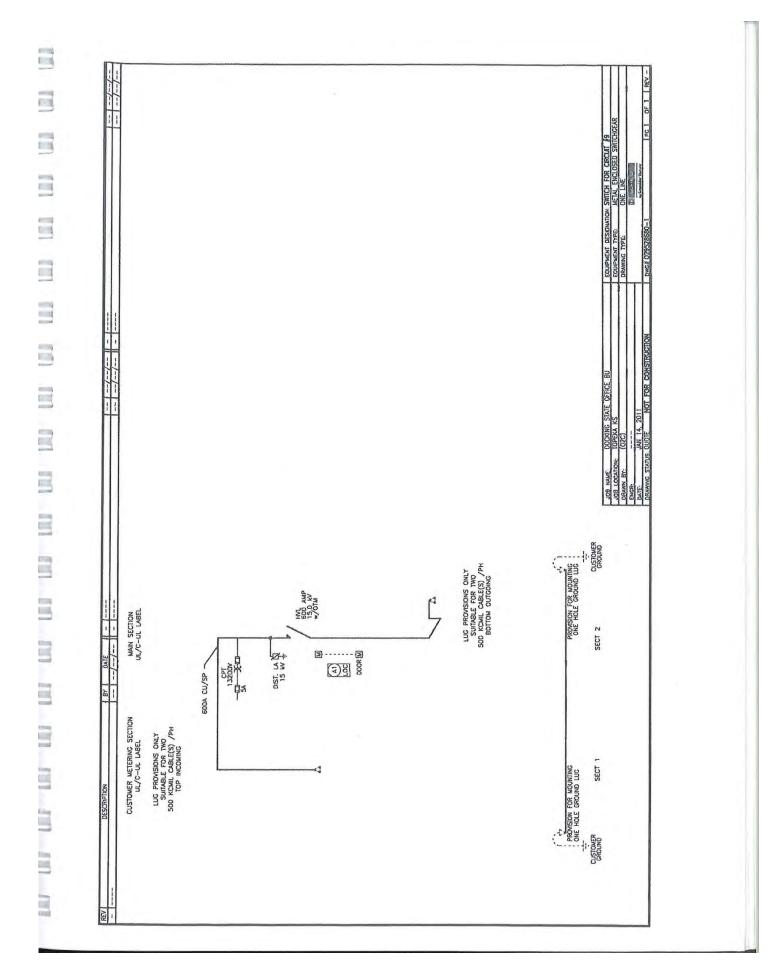
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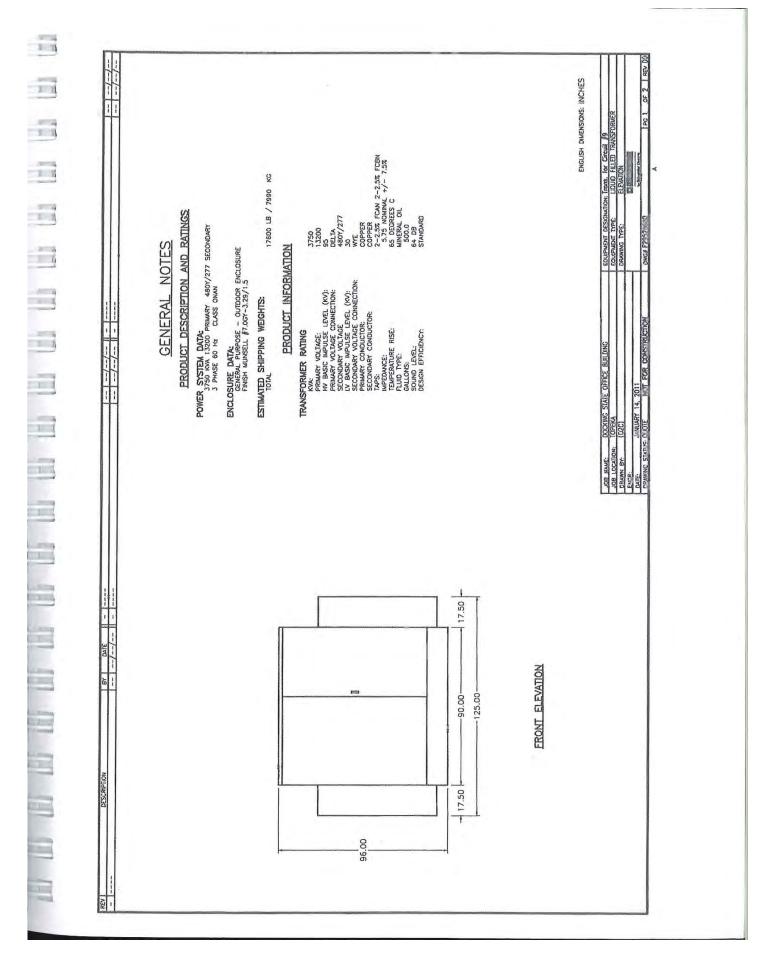
Appendices

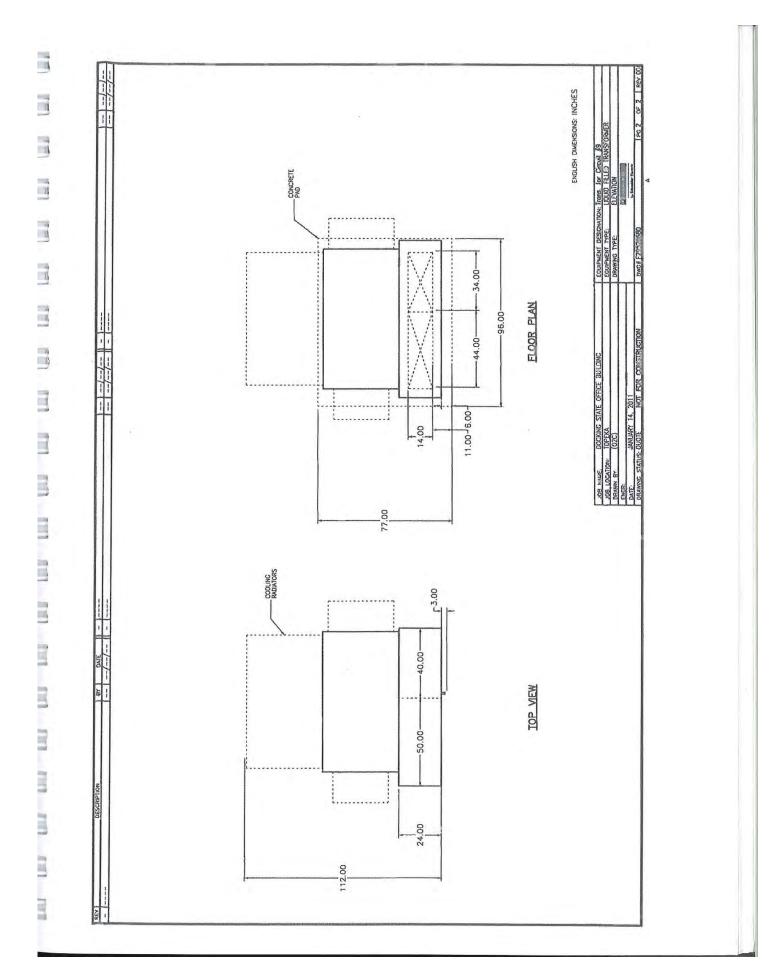


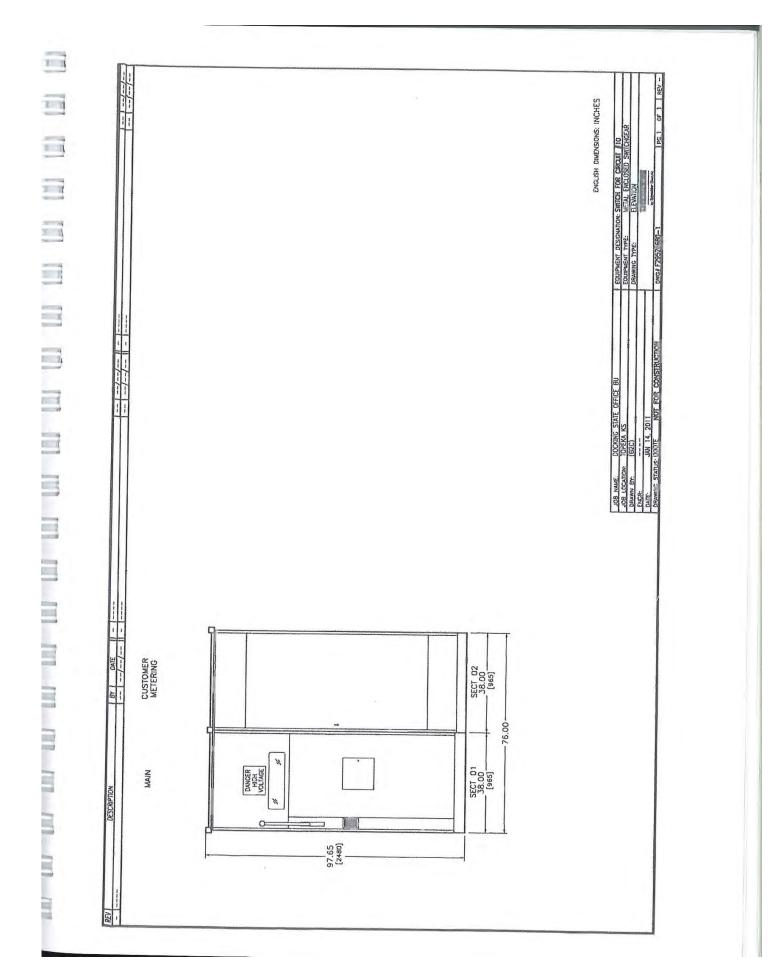


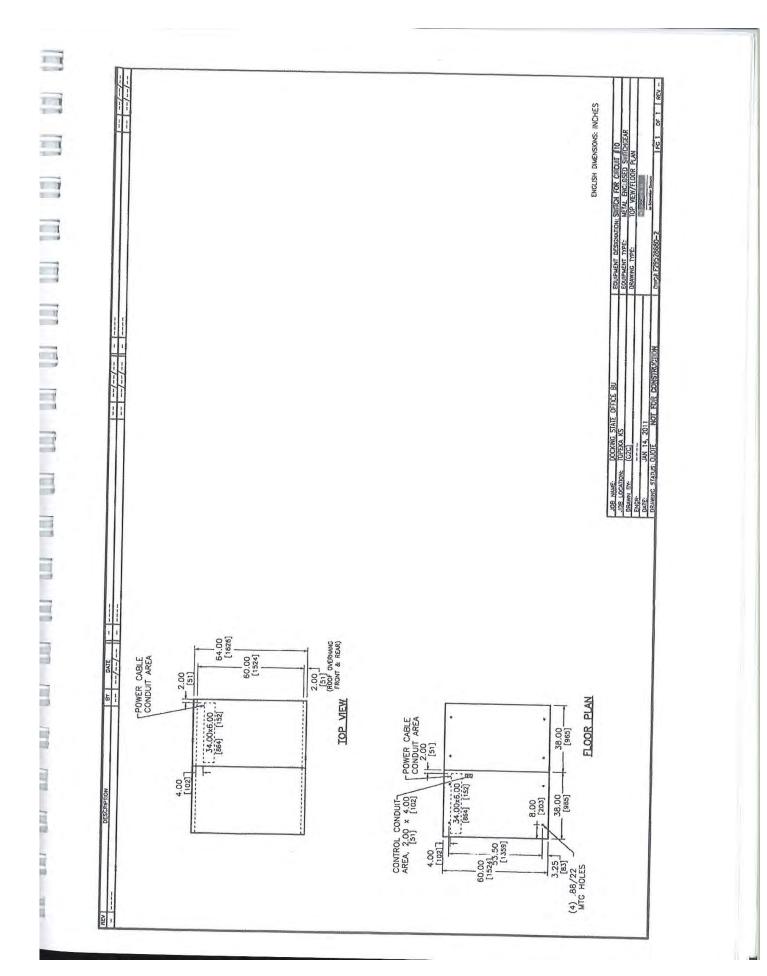
-/	BLOCKS ARE SOUME D COUPRESSION SOLDERIESS BOX LUG (TIPE 9080GR6), NSTRACTION BILLETIN. OPTIONS/ACCESSORIES. IST OF MISL GENERAL OPTIONS. LET OF MISL GENERAL OPTIONS.	JOB MAME: DOCKING STATE OFFICE BU EQUIPMENT DESIGNATION: SMITCH FOR CROUIT /9 JOB LOCATION: TOPECA KS (EQUIPMENT TYPE: METAL ENGLOSED SMITCHGEAR
DESCRIPTION BT DATE	GENERAL NOTES: PRODUCT DESCRIPTION AND RATINGS: 13200 VOLTS, 3 PAYER, 3 WHE WYE SOUDLY GROUNDED 15.0 KW MAXMAN VOLTAGE FREGUENCY 15.0 KW MAXMAN (25 kM 5/m) 16.0 KW CAPPER FREGUENCY	LOW VOLIAGE WIRE LEMMINIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL





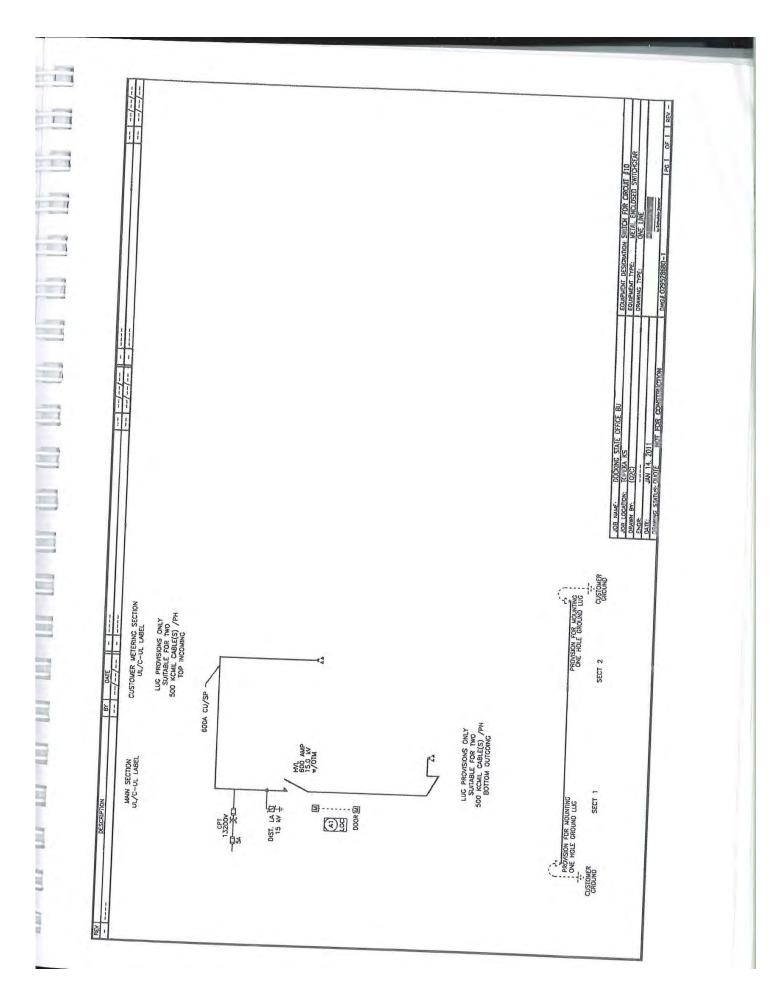


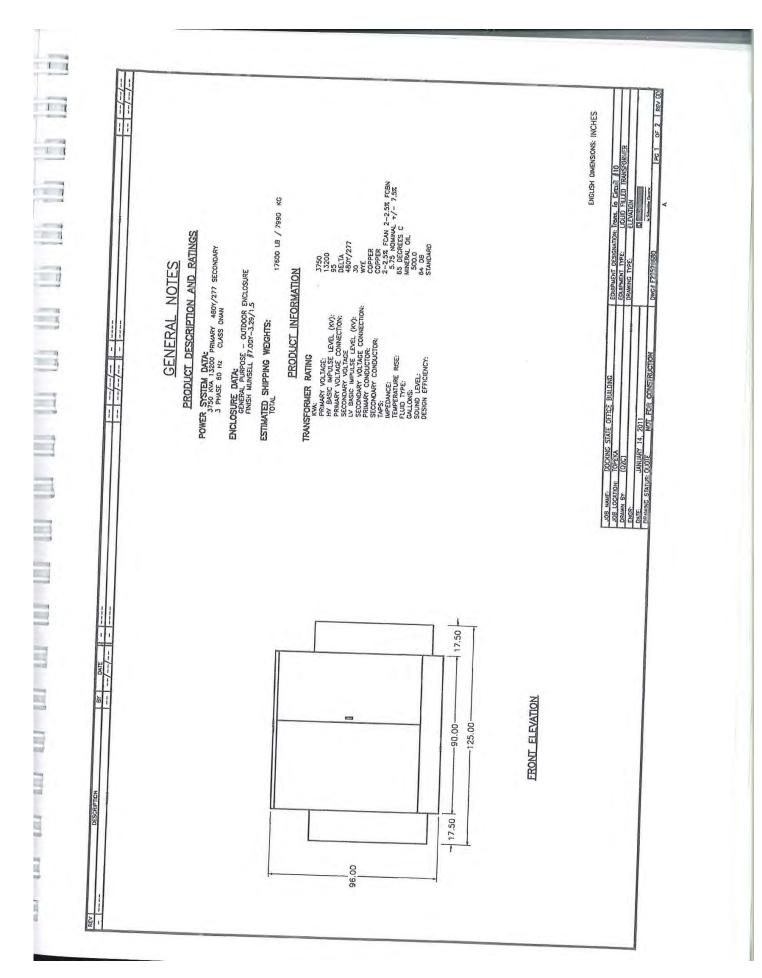


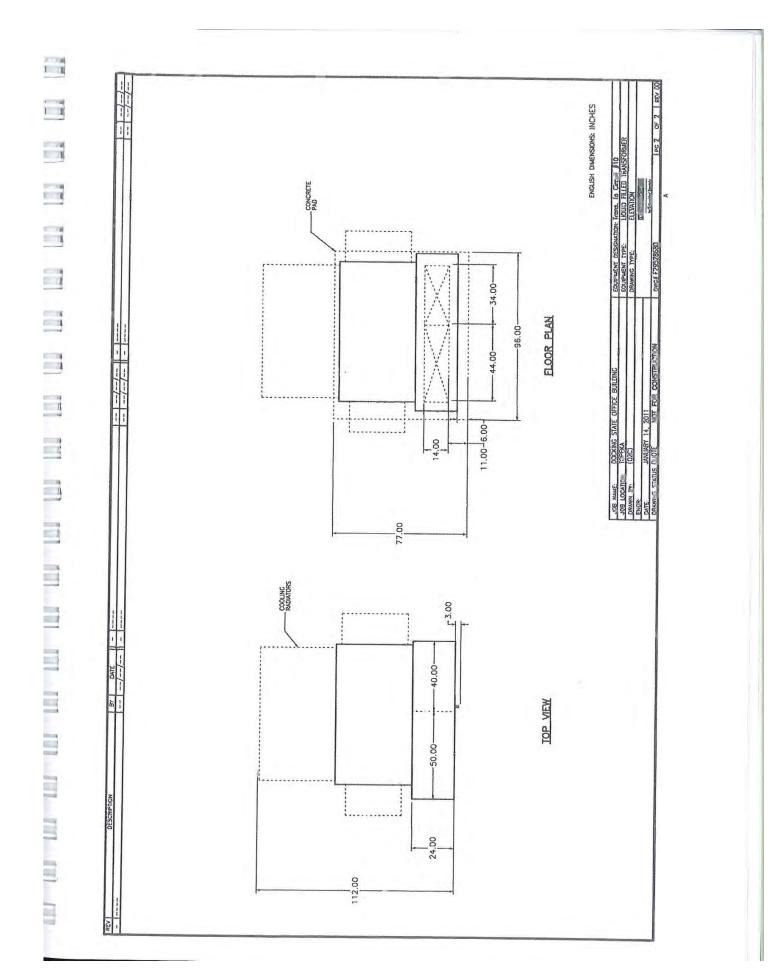


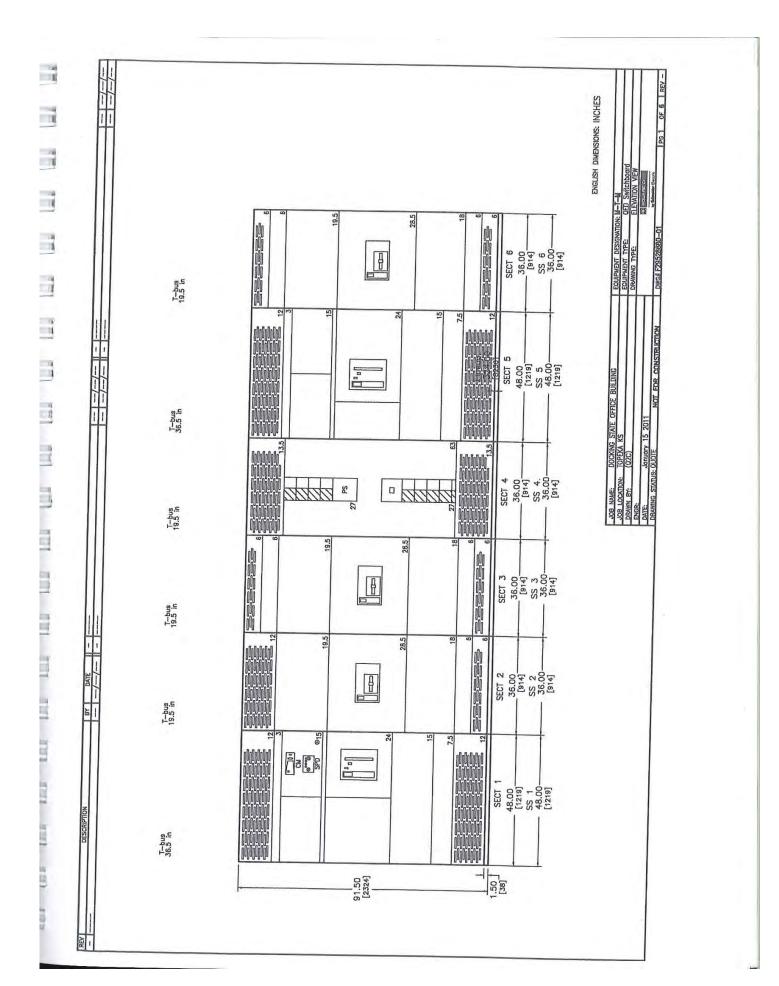
Tr Schoolder Burns BLOCKS ARE SOUARE D COMPRESSION SOLDERLESS BOX LUG (TYPE 9080GR6), FUSE BLOCK (9080GF6).
INSTRUCTION BULLETIN: OWG 679528FT7-1 STRIP HEATERS
LIST OF MISC. STRIKTHIRE OPTIONS NOT FOR CONSTRUCTION LIST OF MISC. GENERAL OPTIONS: LIST OF MISC, ACCESSORIES OPTIONS/ACCESSORIES: TOP CABLE ENTRY: ENTRY THRU TOP TO BE PUNCHED DURING INSTALLATION IN GENERAL AREA SHOWN ON TOP VIEW, IF APPLICABLE. RECOMMENDED POWER CABLE ENTRY AREA, 6" x 34" (152 x 864) AS SHOWN ON TOP VIEW.

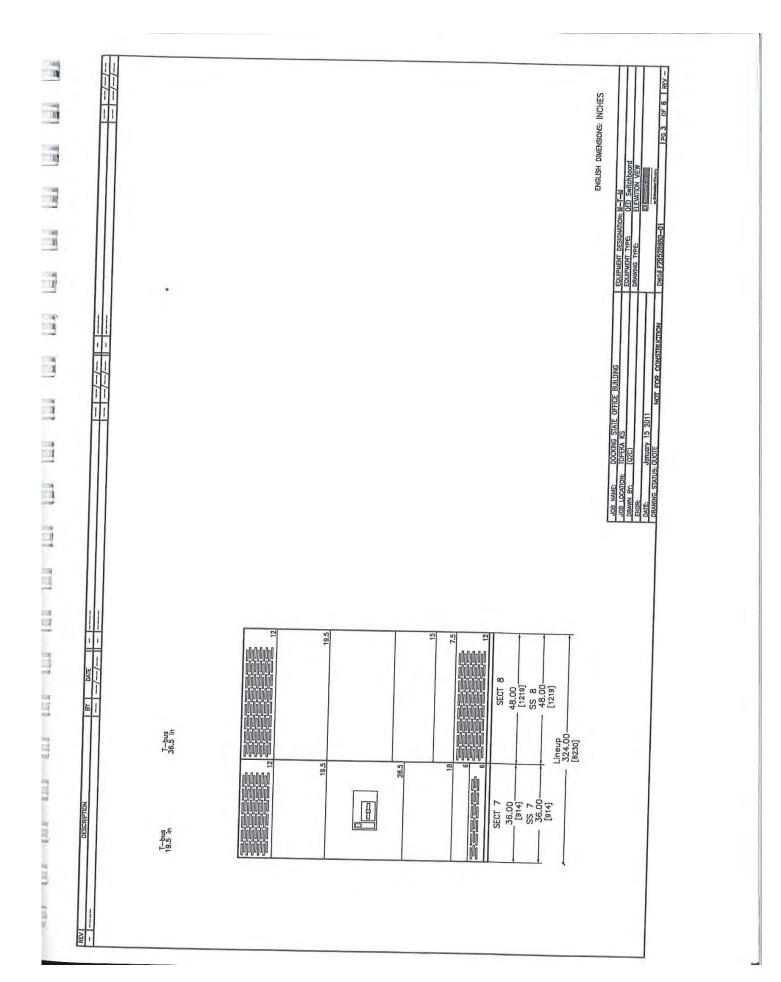
BOTTOM CABLE ENTRY: BOTTOMS ARE OPEN. RECOMMENDED POWER CABLE ENTRY AREA, 6" x 34" (152 x 864) AS SHOWN ON FLOOR PLAN. SWITCHGEAR SECTIONS ARE FURNISHED WITH LIFTING ANGLES AND ARE SHIPPED ON SKIDS.
ROLLERS OR FORKLIFT SHALL ONLY BE USED WITH SKID IN PLACE.
APPROXIMATE WEIGHT: 2372 LBS 1078 KG
SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). THIS EQUIPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. #14 AWG, TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED #12 AWG, TYPE SIS HEATER CONTROL WIRING WIRE LABELING. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUCS (STYLE 25009—XXXXX). TERMINAL 13200 VOLTS, 3 PHASE, 3 WIRE WYE SOLIDLY GROUNDED EPOXY BUS SUPPORTS SILVER PLATED COPPER GROUND BUS 40 kA Asym (25 kA Sym) MAIN BUS BRACING TYPE 3R OUTDOOR NON-WALKIN CONSTRUCTION GODA COPPER, SILVER PLATED MAIN BUS PRODUCT DESCRIPTION AND RATINGS: CATEGORY "B" ENCLOSURE ANSI ∯61 FINISH FRONT TYPE JR REMOVED FOR CLARITY FRONT AND REAR ACCESS IS AVAILABLE 1.5 kva - 120 vac control power BUS SYSTEM DATE: 15.0 kV MAXIMUM VOLTAGE RATING 95 kV BIL, 60 HERTZ FREQUENCY PRODUCT INFORMATION: PADLOCK PROVISIONS GENERAL NOTES ENCLOSURE DATA: CODE STANDARDS: CONTROL WIRING HANDING:

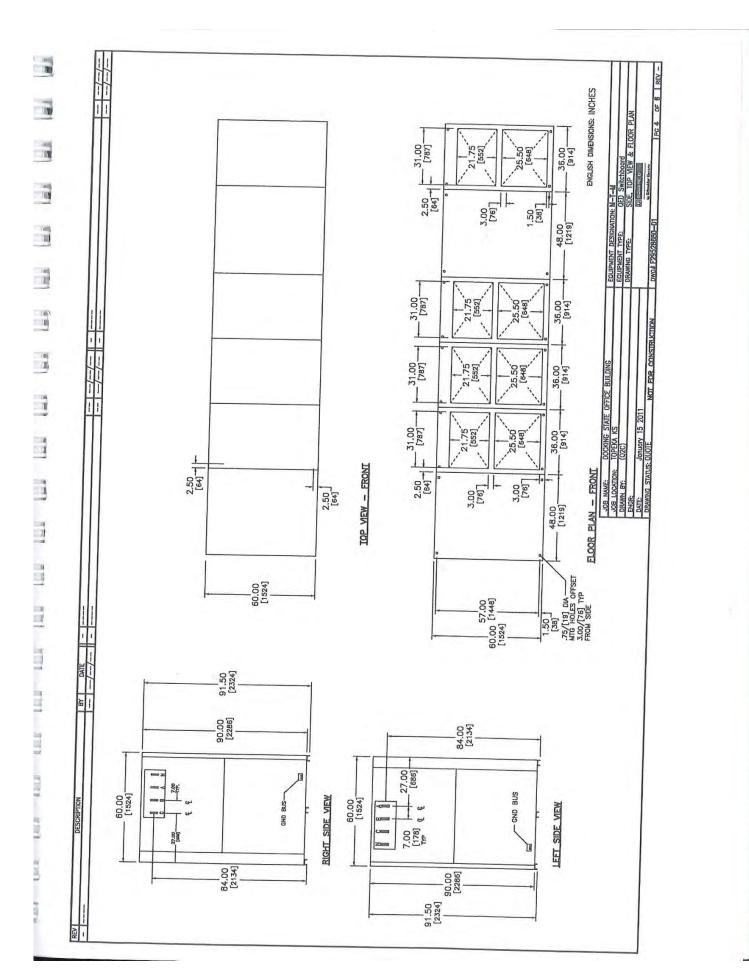


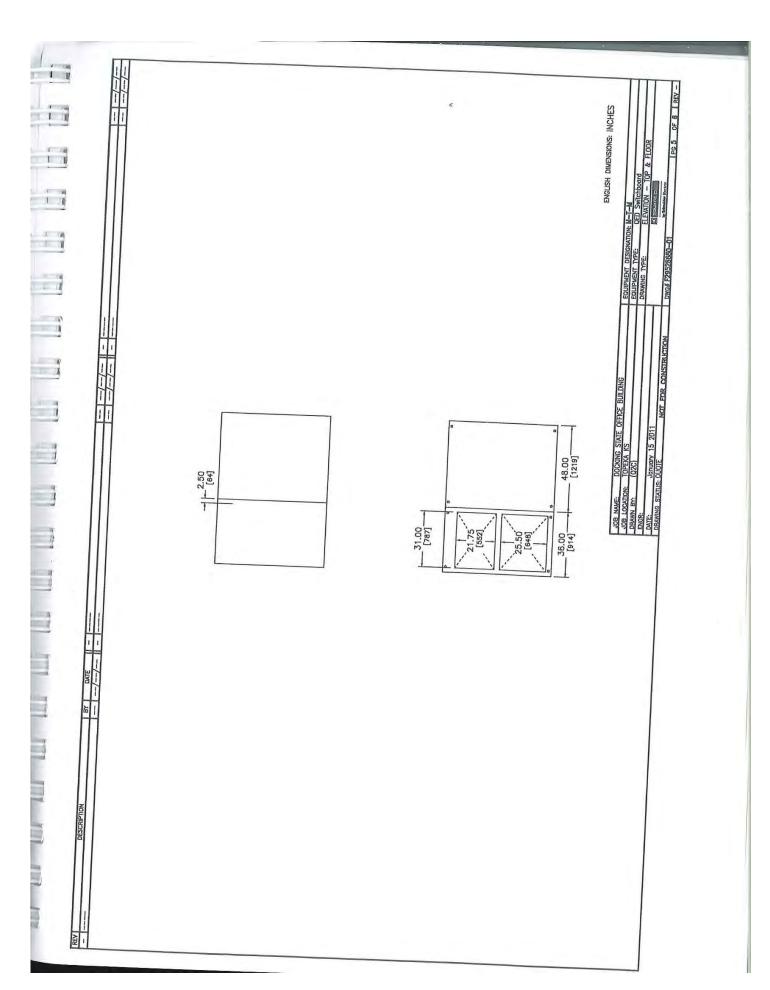


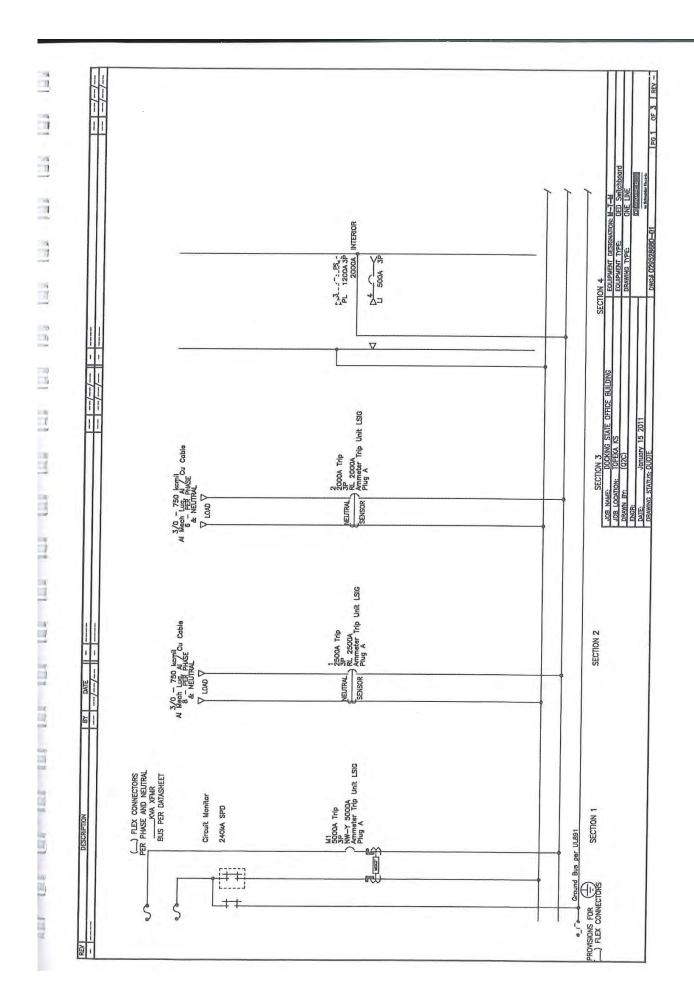












// //			CM Circuit Monitor		or Ground Fault	MCH Spring Charging Mator	MAN SOLUT TO	max shunt Inp Second	Ura 8 Form C Breaker Aux Contacts	PLA Padlock Attachment-Fixed	PLC PLC Autotransfer Scheme	SDE1 Over Current Trip Switch	SPD Surge Protection Device	UC2 Modified Differential Ground Fault	XF Closing Coil	D Switchboard AEDULE Switchboard Success D Freedom Eneror PROVE PROVINGE D FROM DEST OF 3 REV —
		ACCESSORIES			I	E1,0FB,UC2,MCH,MX1,MX2,XF,PLA					PLC, COM, SDE1, OFB, UC2, MCH MY1, LIVE VE PLA	VI Ji Iventus Cont			500 - 750 kemil PLC COM SDE1 OE9 1/22	BULDING EQUIPMENT DESIGNATION: M-T-M EQUIPMENT TYPE. SCHEDULE DRAWING TYPE. SCHEDULE DRAWING TYPE. SCHEDULE DRAWING TYPE. SCHEDULE DRAWING TYPE. SCHEDULE
	AMATION AMATION	Y NEUT. WIRE RANGE	-	CN	1	500 - 750 kcmil	3/0 - 750 kcmil	-	250	-		3/0 - 750 kcmil	3/0 - 750 kcmil		-	JOB NAME: DOCKING STATE OFFICE B 209 LOCATION: TOPFICA KS DRAWN BT: (Q20) BDAN: BDAN: January 15 2011 DRAWNS STATUS, Q1,010F
OFD-2 SWITCHERA	LUG INFORMATION	PHASE	XFMR			300 - 750 kcmil	3/0 750 Kemil	3/0 - /30 kcmil	3/0 - 500 kcmil	- 0/4	+	2	3/0		500 - 750 kemil -	JOB NAS JOB 1GC DEANN E PHORE PAIR: DEANNING
STYLE	N/P	9			+	ν α α	- 1				-	_	No ON	1	No	
PY DATE/	DESIGNATION															
Ш	d#	1	1	1	di	n.	a.	a	a.	0	0	0	1	-		
	FUSE/	,	1	1		-LSIG 3P	-LSIG 3P	- 3p	B 1	_	LSIG 3P		'	OF CIP	200	
	TRIP FI	-	-	1	5000A A-LSIG	2500A A-LSIG	2000A A-LSIG			SOOOA A-	NOA A-	NOA A-	'	5000A A-1 SIC		
NO.								(12)		A 500	30% 20C	30% 250	- un			
		Incoming Connection	Circuit Monitor	240kA SPD	NW 5000A Plug A	RL 2500A Plug A	RL 2000A Plug A	4		NW 5000A Plug A	RIZDOOA Plug A 100% 2000A A-LSIG	RL2500A Plug A 100% 2500A A-LSIG	Incoming Connection	NW SOODA Plug A		
	GMD HEIGHT	1	1		1	1	1 3	=	7.5 in		1	1	1	1		
$\Pi + 1$		1	,	1	E,	- 0	v ,	7		밀	9	w	1	MZ		



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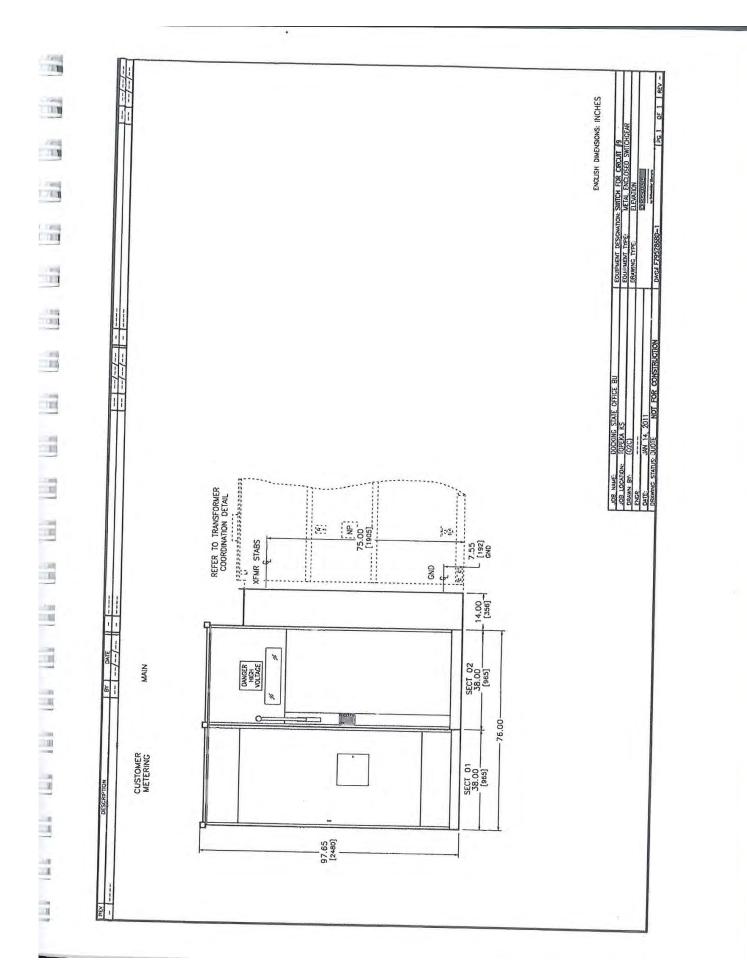
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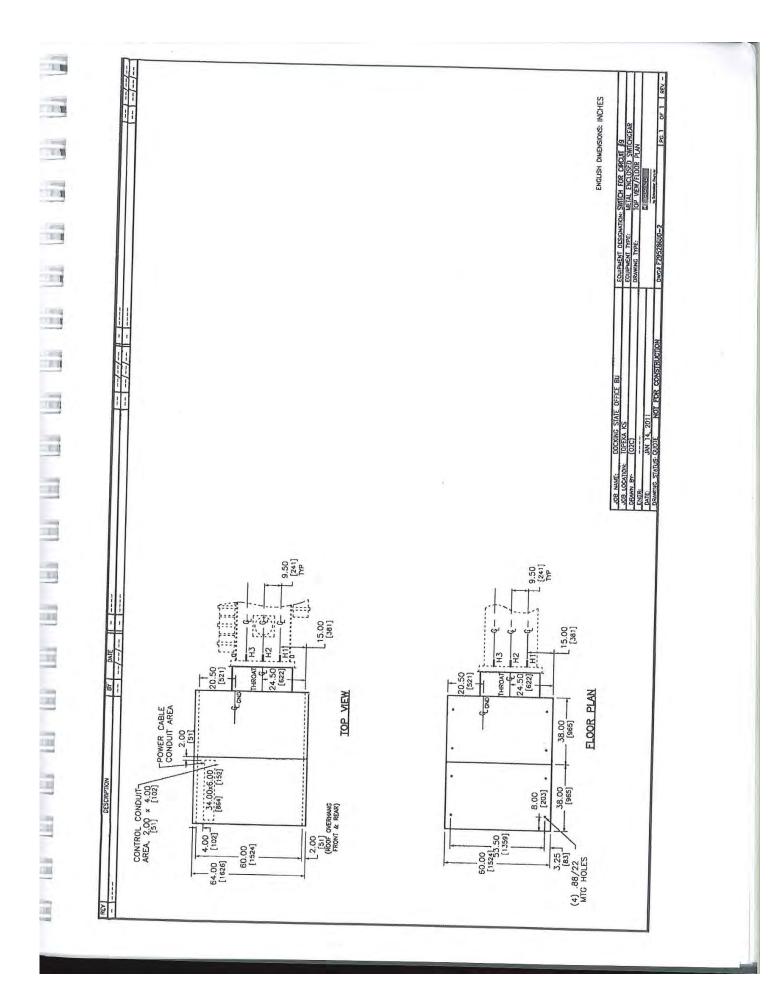
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APPENDIX G: OPTION 2 - TRANSFORMER AND SWITCHGEAR SHOP DRAWINGS

Appendices





PG 1 OF 1 REV -EQUIPMENT TYPE: METAL ENCLOSED SWITCE DRAWING TYPE: GENERAL NOTES DWC# F29528680-3 LIST OF MISC. STRUCTURE OFTIONS: JOB NAME. DOCKING STATE OFFICE BU JOB LOCKING: 10PEK KS ROWE: (2020) AND DATE: JM 18, 2011 PARMING STAUS QUOTE: POR COMSTRUCTION LIST OF MISC, CENERAL OPTIONS. LIST OF MISC, ACCESSORIES INSTRUCTION BULLETIN OPTIONS/ACCESSORIES: STRIP HEATERS TOP CABLE ENTRY: ENTRY THRU TOP TO BE: PUNCHED DURING INSTALLATION IN GENERAL AREA SHOWN ON TOP VIEW, IF APPLICABLE. RECOMMENDED POWER CABLE. ENTRY AREA, 6" X 34" (152 X 864) AS SHOWN ON TOP VIEW. SWITCHGEAR SECTIONS ARE FURNISHED WITH LIFTING ANGLES AND ARE SHIPPED ON SKIDS. ROLLERS OR FORKLIFT SHALL ONLY BE USED WITH SKID IN PLACE. APPROXIMATE WEIGHT: 2372 LBS 1078 KG LOW VOLTACE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL BLOCKS ARE SQUARE D COMPRESSION SOLDERLESS BOX LUG (TYPE 9080GRB), FUSE BLOCK (9080GFB). WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). THIS EQUIPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. PRODUCT INFORMATION: #14 AWG, TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED #12 AWG, TYPE SIS HEATER CONTROL WIRING 13200 VOLTS, 3 PHASE, 3 WIRE WYE SOLIDLY GROUNDED TYPE 3R OUTDOOR NON-WALKIN CONSTRUCTION SILVER PLATED COPPER GROUND BUS 40 ka Asym (25 ka Sym) main BUS BRACING ENGLOSSURE DATA: SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG 600A COPPER, SILVER PLATED MAIN BUS PRODUCT DESCRIPTION AND RATINGS: FRONT TYPE 3R REMOVED FOR CLARITY FRONT AND REAR ACCESS IS AVAILABLE 15.0 kV MAXIMUM VOLTAGE RATING 95 kV BIL, 60 HERTZ FREOUENCY 1.5 kVA - 120 VAC CONTROL POWER BMS. SYSTEM DATK. CATECORY 'B' ENCLOSURE EPOXY BUS SUPPORTS PADLOCK PROVISIONS GENERAL NOTES: CODE STANDARDS: ANSI #61 FINISH CONTINUE WISHIES WIRE LABELING TERMINATIONS HANDING:

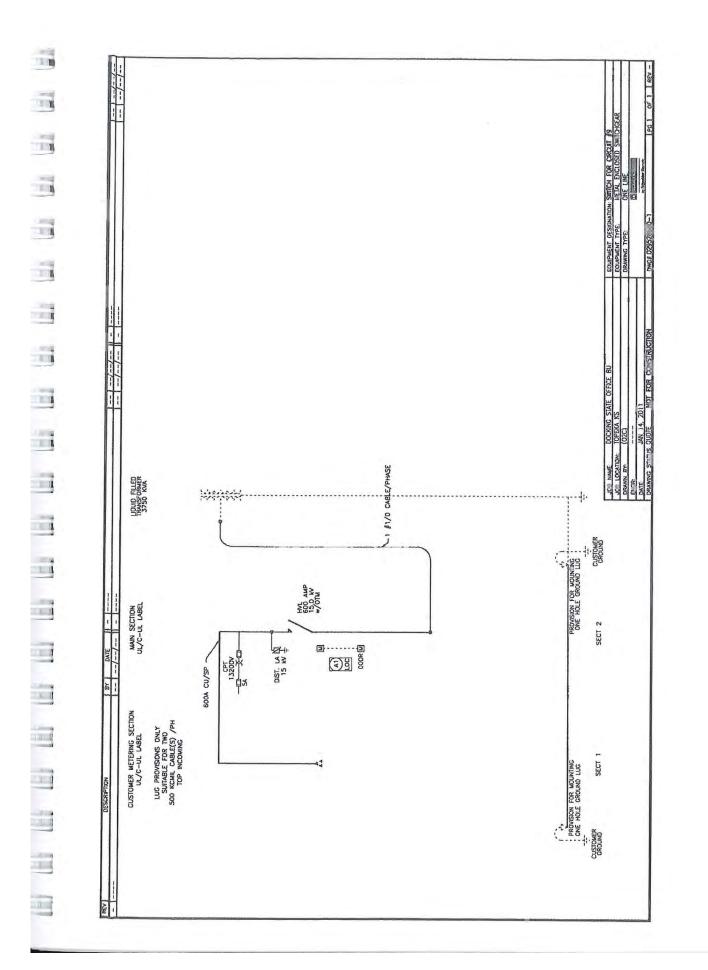
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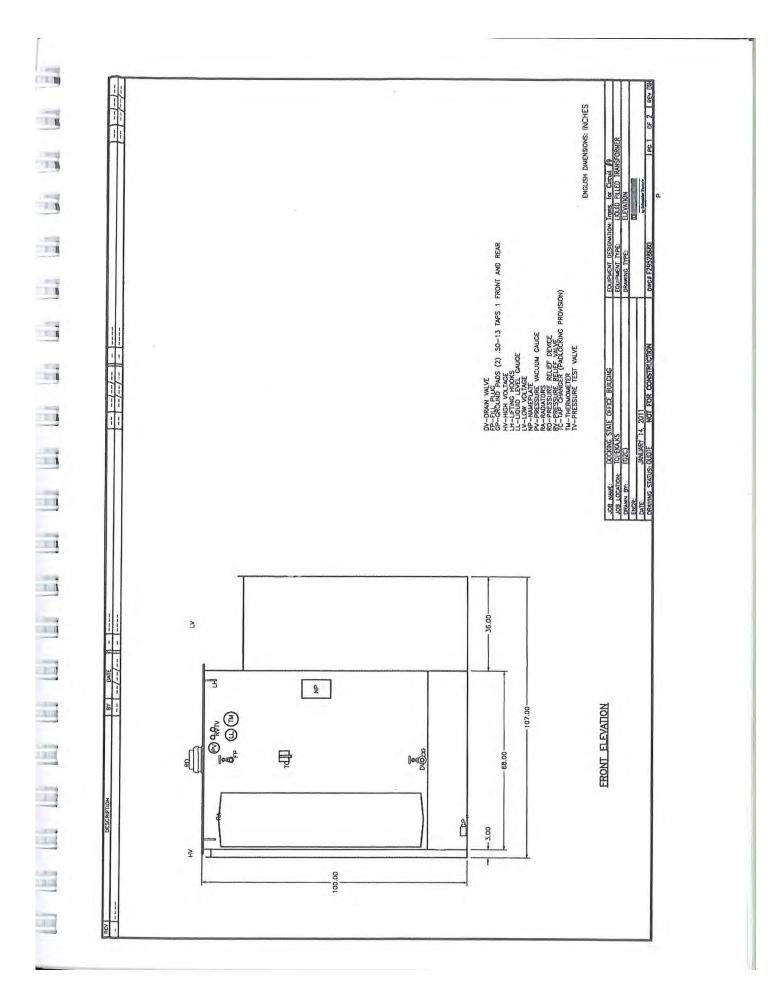
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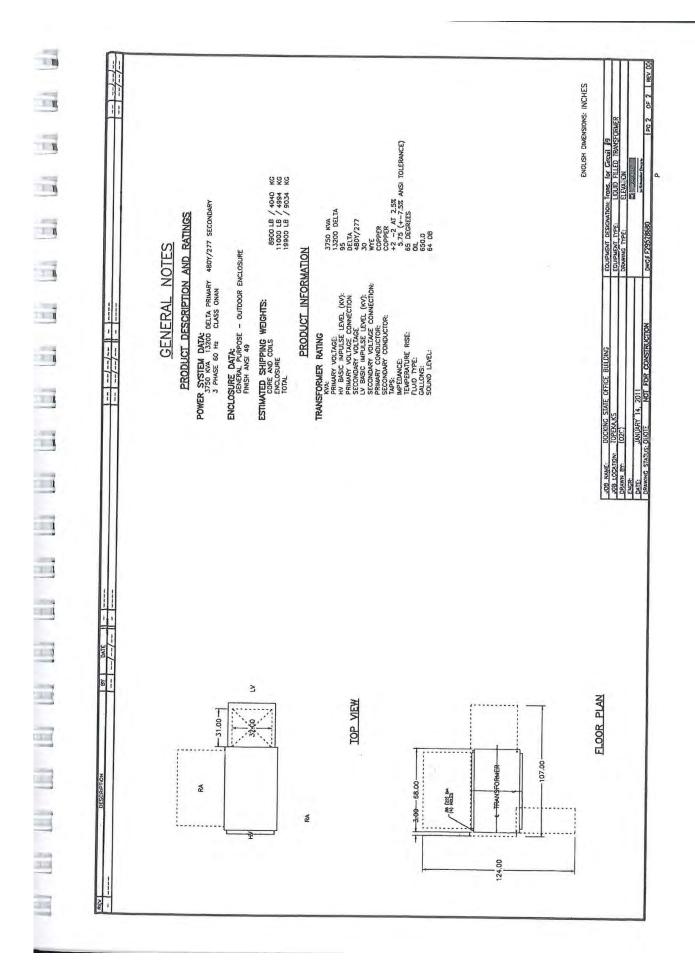
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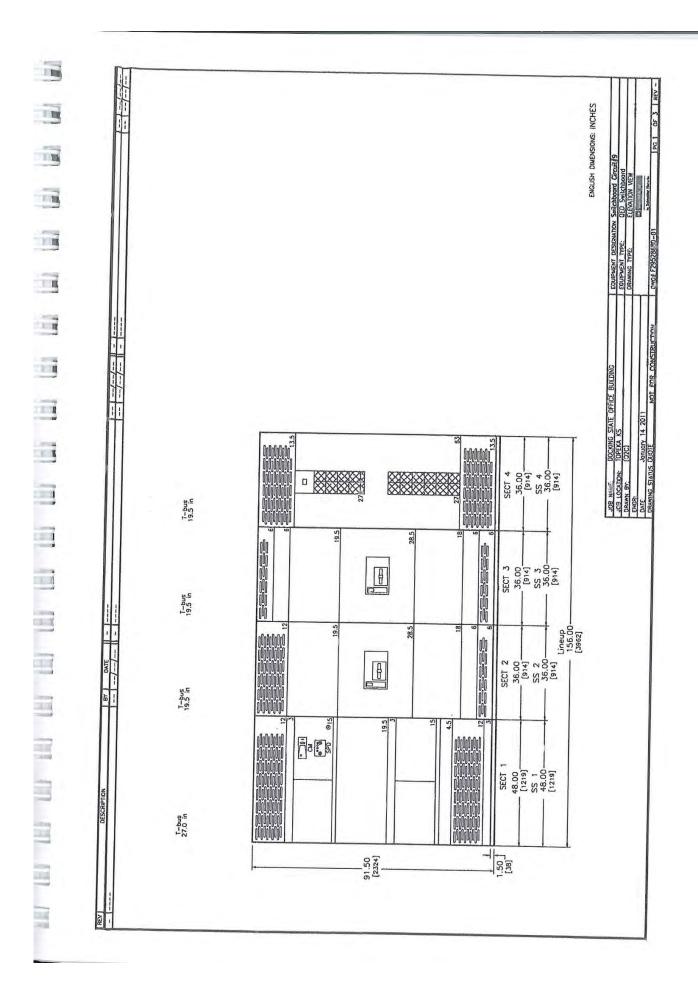
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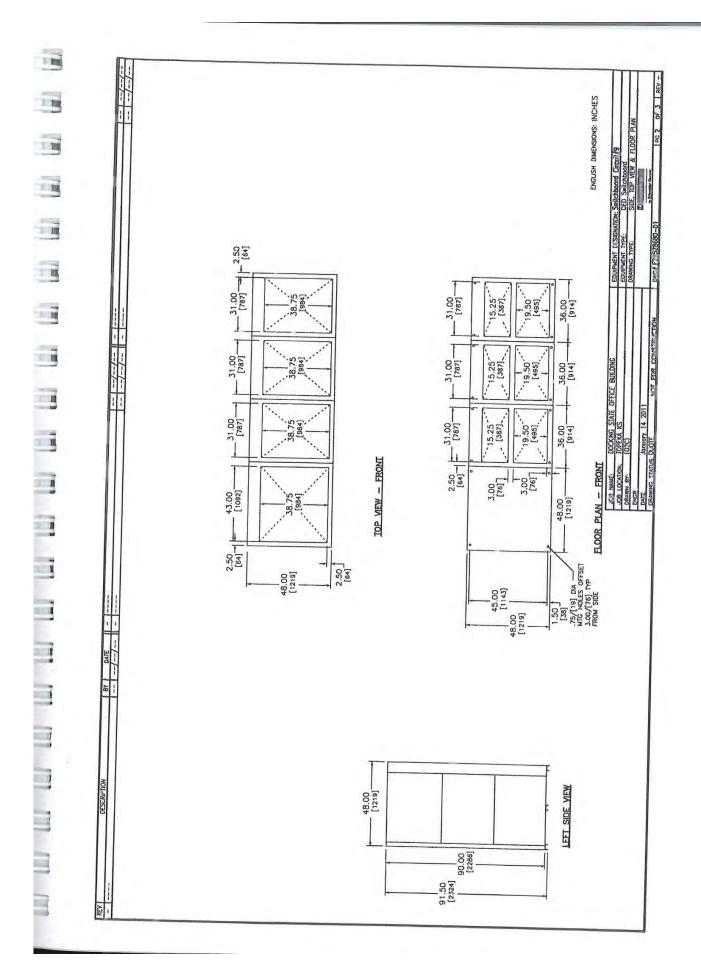
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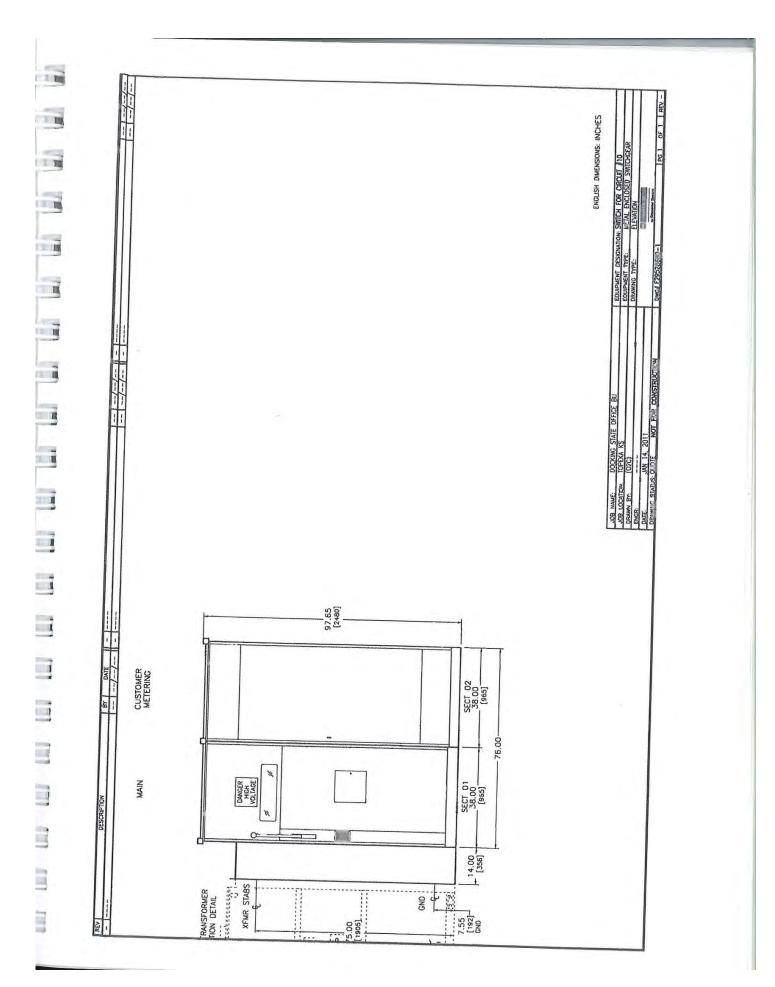


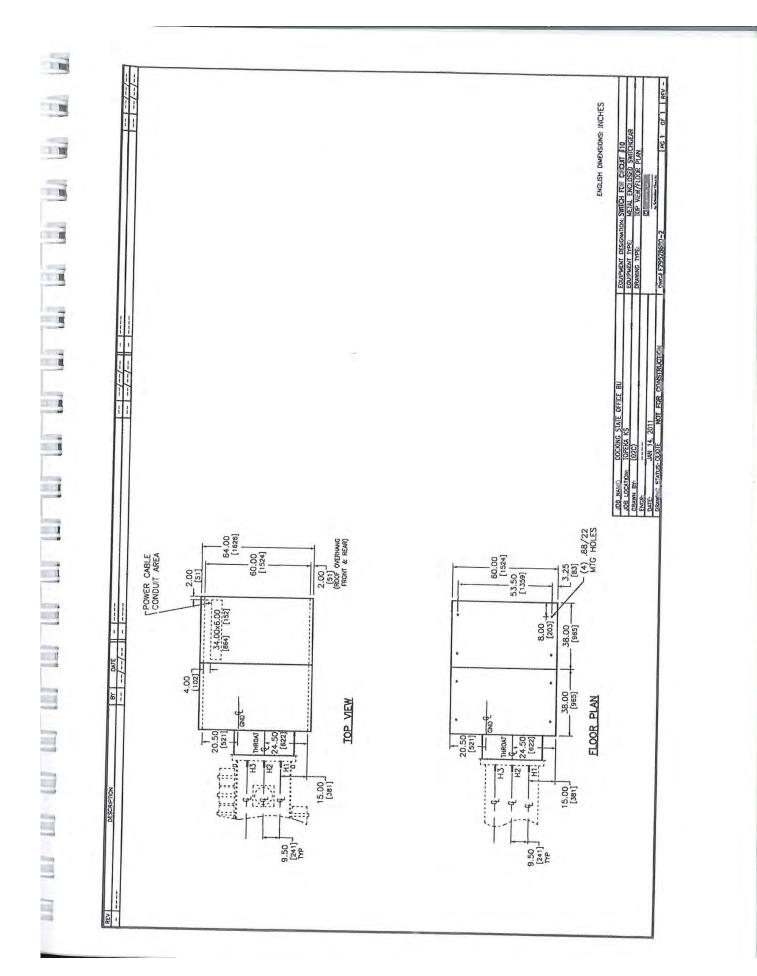












PG 1 0F 1 REV -EQUIPMENT TYPE: WETAL ENCLOSED SWITCHGEAR
DRAWING TYPE: GENERAL NOTES mm1 F7047E780-3 LIST OF MISC. STRUCTURE OPTIONS: 288 MAME: DOCKING STATE OFFICE BU
DAS LOCATION. (107E/A KS
DASMA BY: (107E)

DATE: JAN 14, 2011

BRAWNIG, STATUS, UNOTE NOT FOR CY INTRUCTION LIST OF MISC, CENERAL OPTIONS: LIST OF MISC. ACCESSORIES INSTRUCTION BULLETINE OPTIONS/ACCESSORIES: STRIP HEATERS TOP CABLE ENTRY: ENTRY THRU TOP TO BE PUNCHED DURING INSTALLATION IN GENERAL AREA SHOWN ON TOP VIEW, IF APPLICABLE. RECOMMENDED POWER CABLE ENTRY AREA, 6" X 34" (152 X 864) AS SHOWN ON TOP VIEW. SWITCHGEAR SECTIONS ARE FURNISHED WITH LIFTING ANGLES AND ARE SHIPPED ON SKIDS.
ROLLERS OR FORKLIFT SHALL ONLY BE USED WITH SKID IN PLACE.
APPROXIMATE WEIGHT: 2372 LBS 1078 KG
CODE. STANDARDS. LOW VOLTACE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL BLOCKS ARE SCUARE D. COMPRESSION SOLDERLESS BOX LUG (TYPE 908DGRB). DATE --/--WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). THIS EQUIPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. #14 AWG, TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED #12 AWG, TYPE SIS HEATER CONTROL WIRING 13200 VOLIS, 3 PHASE, 3 WIRE WYE SOLIDLY GROUNDED 15.0 KV MAXIMUM VOLIAGE RATING 95 KV BIL, 60 HERTZ FREOJENCY à EPOXY BUS SUPPORTS SILVER PLATED COPPER GROUND BUS 40 kA Asym (25 kA Sym) MAIN BUS BRACING TYPE 3R OUTDOOR NON-WALKIN CONSTRUCTION 600A COPPER, SILVER PLATED MAIN BUS PRODUCT DESCRIPTION AND RATINGS: FRONT TYPE 3R REMOVED FOR CLARITY FRONT AND REAR ACCESS IS AVAILABLE 1.5 kVA - 120 VAC CONTROL POWER CATEGORY "B" ENCLOSURE ANSI #61 FINISH FUSE BLOCK (9080GF6). PRODUCT INFORMATION: PADLOCK PROVISIONS BLE SYSTEM DATA GENERAL NOTES: ENCLOSURE DATA: CONTROL WIRING WIRE LABELING HANDING.

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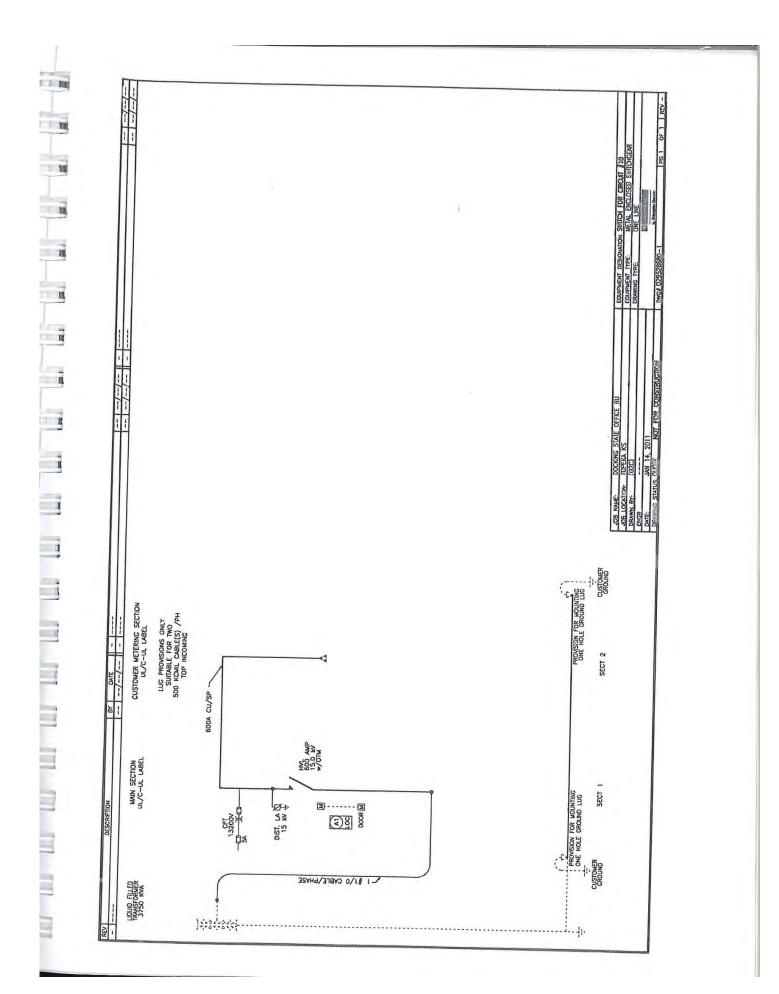
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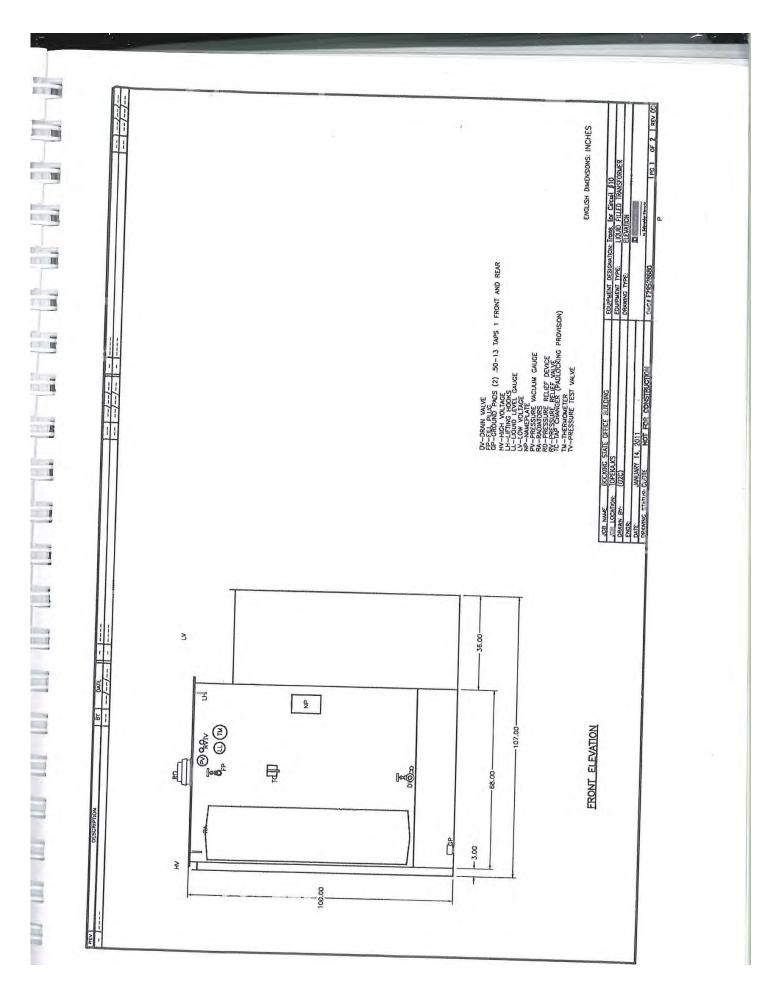
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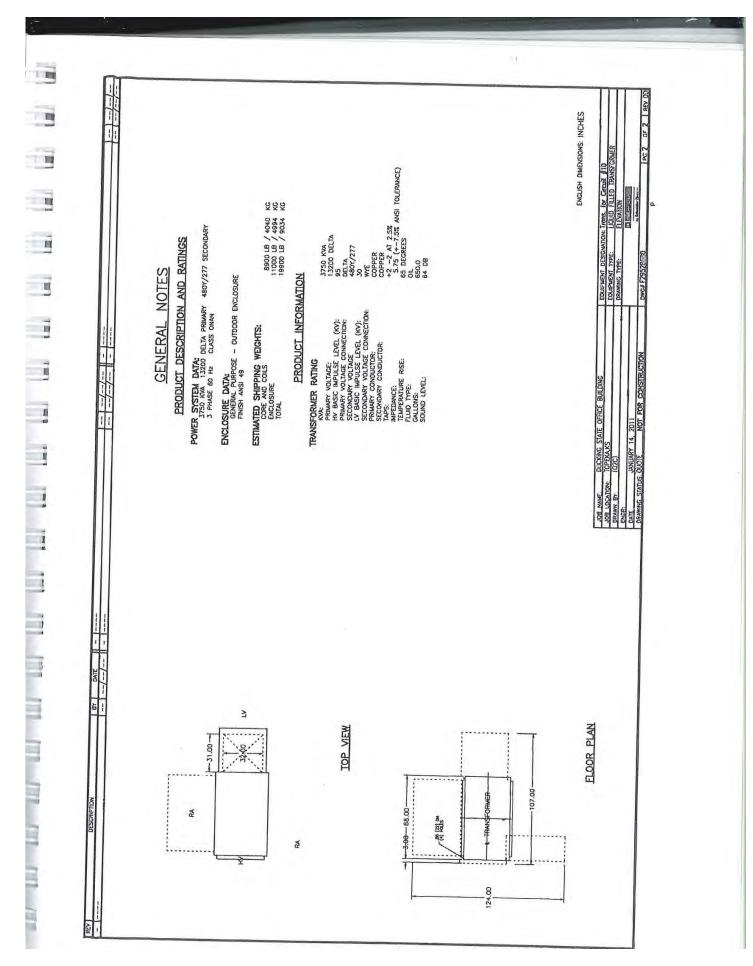
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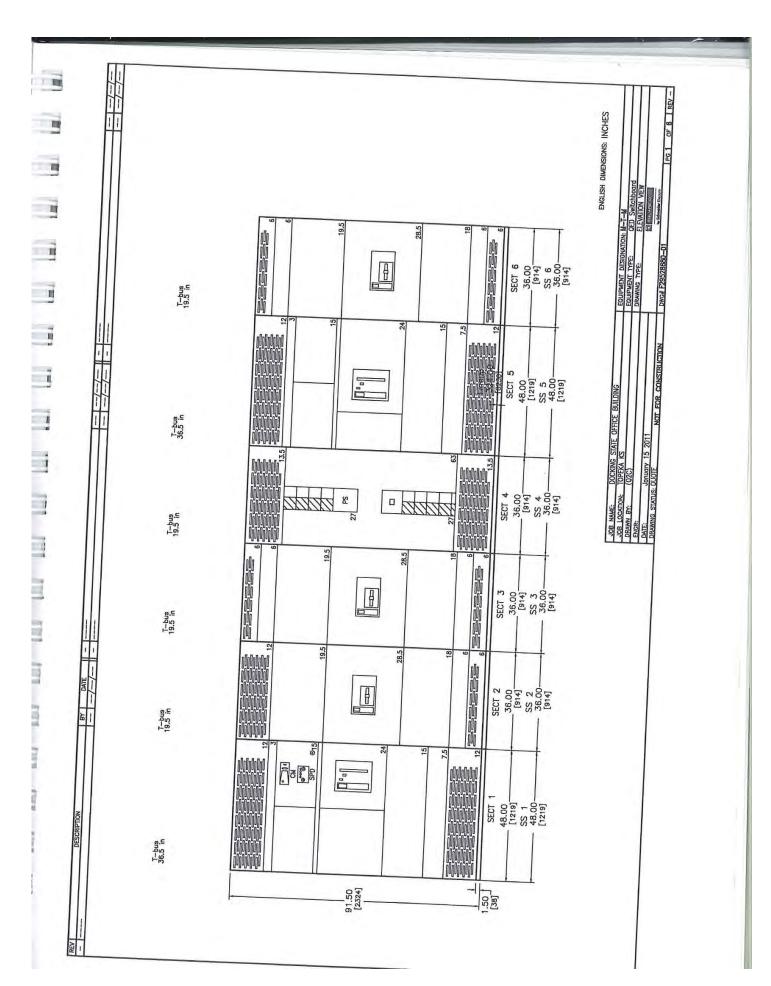
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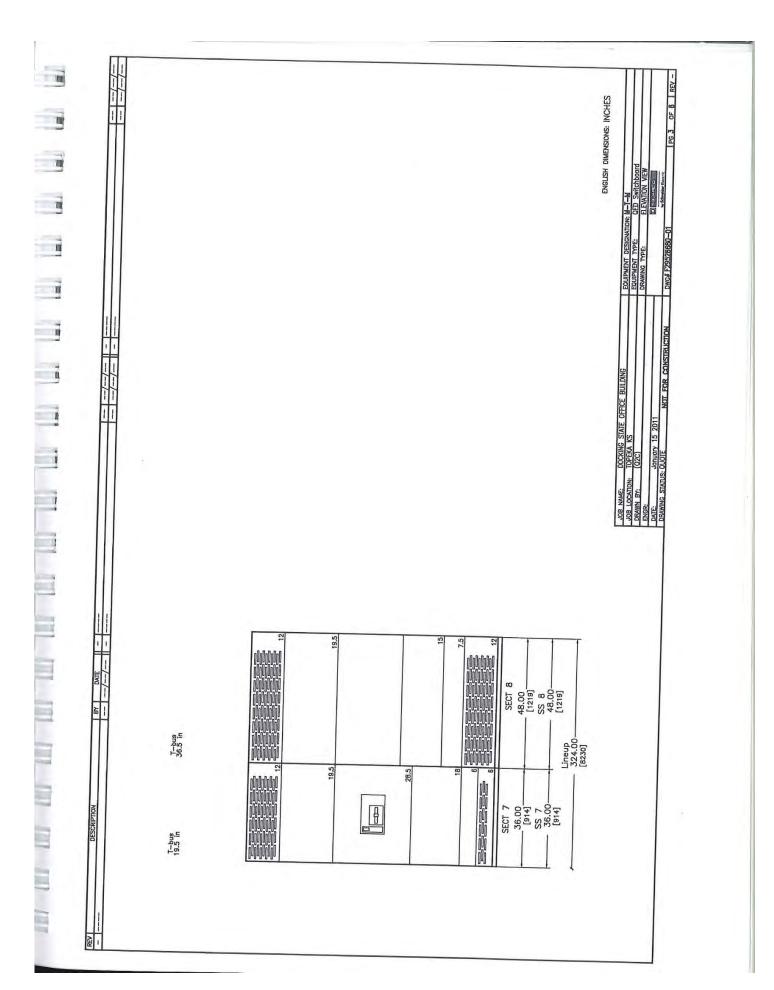
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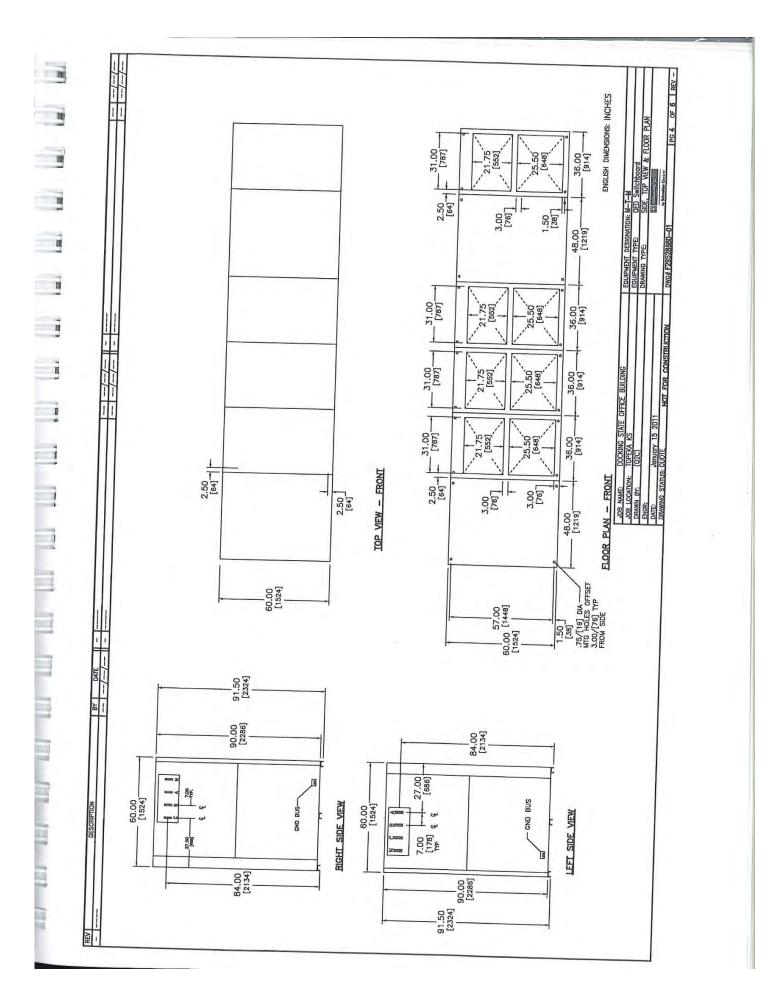


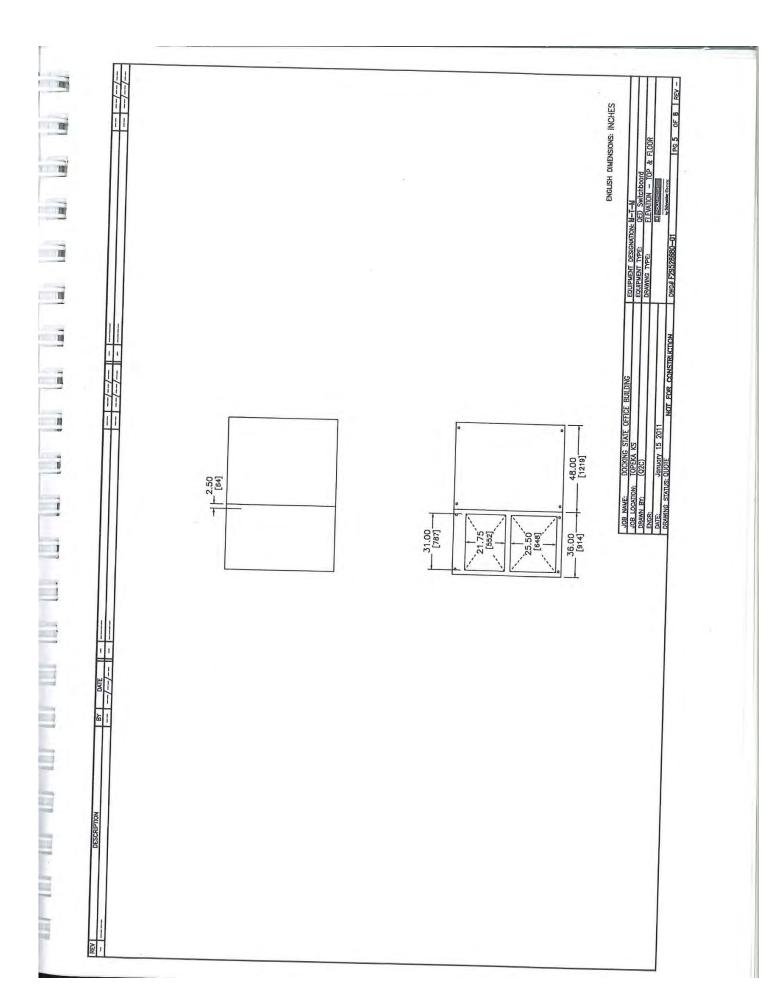


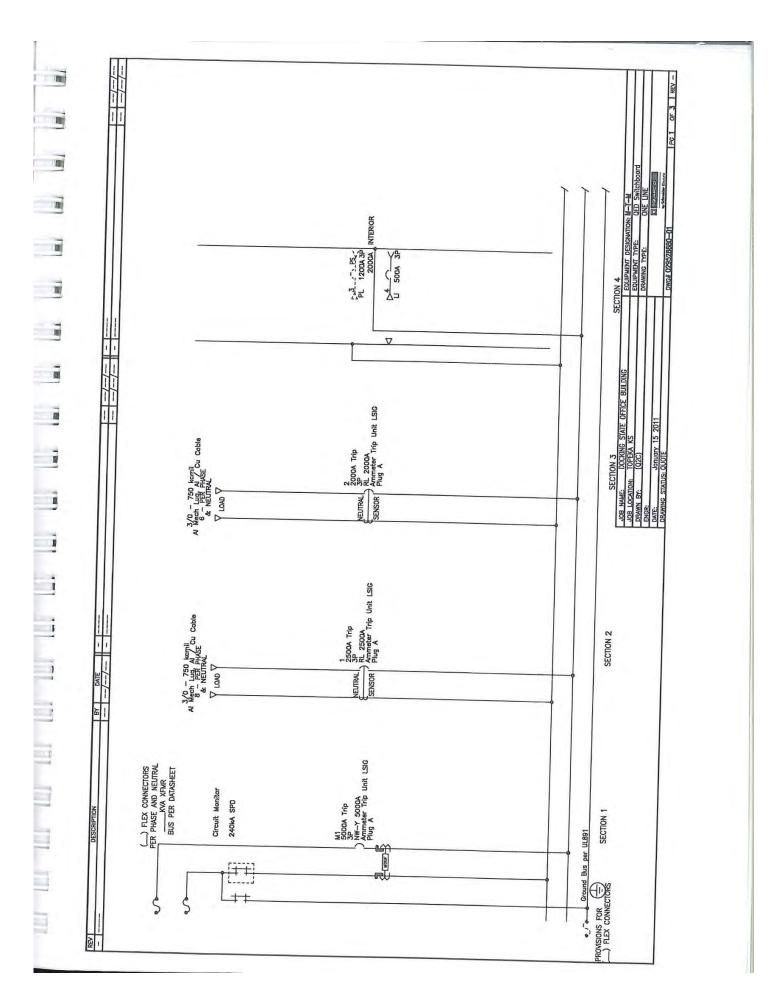


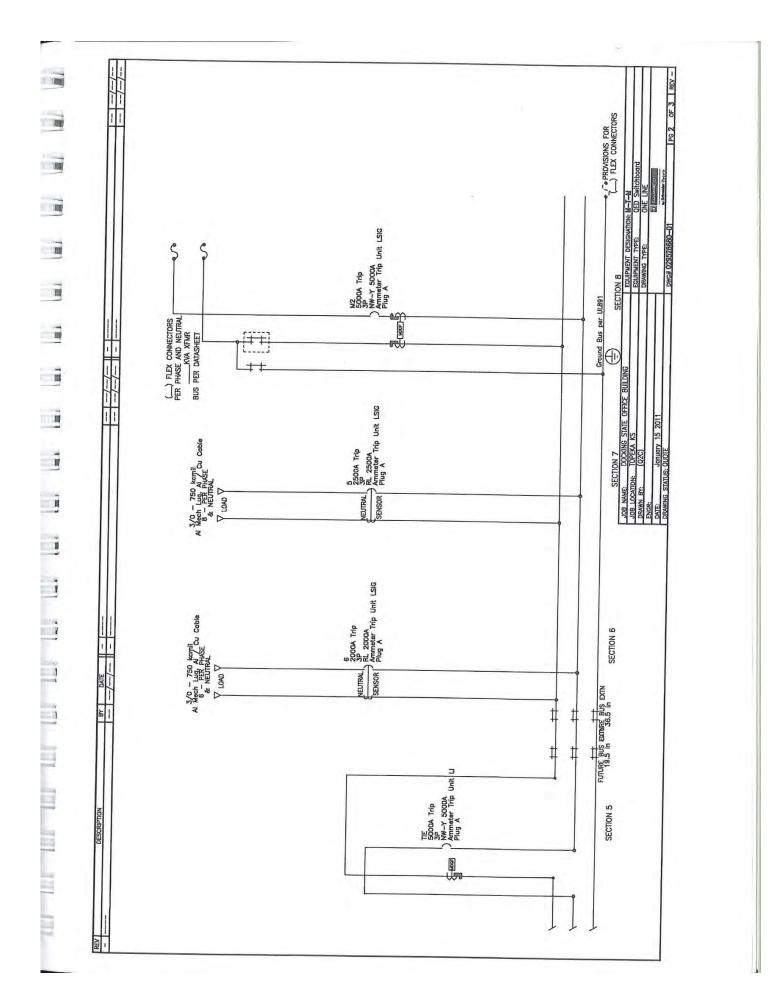












//					Contacts	Pa			and Foult			
	LEGEND	รบร	ing Motor	gcond	8 Form C Breaker Aux Contacts	Padlock Attachment-Fixed	Over Current Trin Switch	Surge Protection Device	Modified Differential Ground Foult			
-111	LEG Circuit Monitor	COM Communications GF Ground Fault	MCH Spring Charging Motor MX1 Shunt Trip	Shunt Trip Second	orm C Br	Autotran	Current	ge Protect	ified Diffe	Closing Coil		
Ш	CM	GF GP	MCH Spr MX1 Shr		0F8 8 F	PIC PIC	SDE1 Ove	SPD Sur	UC2 Mod			EQUIPHENT DESIGNATION: M-T-M
						Ī	T					ESIGNATION
			A,				PLA				집	OUPHENT D
	RIES		SPU PLC,COM,SDE1,OFB,UC2,MCH,MX1,MX2,XF,PLA				PLC,COM,SDE1,OFB,UCZ,MCH,MX1,MXZ,XF,PLA				PLC,COM,SDE1,OFB,UC2,MCH,MX1,MX2,XF,PLA	<u> </u>
	ACCESSORIES		CZ,MCH,M				CZ,MCH,M)				22,MCH,MX	
			JE1,0FB,U				E1,0FB,U				E1,0FB,UC	DING
/		. ™	LC,COM,SI	GF,COM,PLA	L'WON'L	PLA	LC,COM,SE	GF,COM,PLA	GF,CDM,PLA		C,COM,SE	<u>DOOKING, STATE OFFICE BUILDING</u>
	RANGE		100		0111				750 kemil G			S STATE O
Ш	T. WIRE	1	500 – 750 kcmil	3/0 - 750 kcmil	250 - 600 kcmil	250 - 600 kcmil		0 - 750	3/0 - 750	1	- 750 kcmil	DOCKIN
	NED—2 SWITCHBOARD LUG INFORMATION OTY PHASE WIRE RANGE OTY NEUT. WIRE RANGE	1	+	3/0	-	2 25	-	-	+	-	200	JOB NAME: DOCKING STATE OF
Ш	SWITCHBOARD LUG INFORMAT WIRE RANGE OTT		750 kcmil	kcmil	komil	kamil		kemil	kcmil	1,100	Kcmii	
	SWIT LU SE WIRE XEAR	1 1	11	3/0 - 750 kcmil	3/0 - 500 kcmil	4/0 - 500kamil	1	0 - 750 kcmil		XFMR	1 /30	
	QED—2	1 1	++	+	4 3/	2 4/	-	-	8 3/0	1 1	-	
-	Щ ≥ 1	1 1	2 2	2 2	No	N _o	2	2 :	2	1 2	2	
	ER STY							1				
DATE/	POWER								1		h	
<u></u>		1 1										
	4 1	1 1	Sic 3p			-	5 P					
	TRIP FUSE/	1 1	5000A A-LSIG 2500A A-LSIG	2000A A-LSIG		500A -	DOA A-I SIC	NOA A-L		SOOOA A-LSIG		
IPTION		-	3 A 50 9 A 25	9 A 20	(12)		1002 2001	100% 250	tion			
DESCRIPTION	DEVICE/FRAME RATING Incoming Connection	Circuit Monitor 240kA SPD	NW 5000A Plug A RL 2500A Plug A	RL 2000A Plug A	PL (PS)	NW SOODA Plus A	RI2000A Piug A 1002 2000A A-I SIG	RL2500A Plug A 100% 2500A A-LSIG	Incoming Connection	NW 5000A Plug A		
		Circ 24	NW 56	RL 20			RL2000A	RL2500A	Incomin	NW 50		
	CKT GMD NO HEIGHT	1 1	1 TM 1	1	9 17	11 - 311	_	1	1	1		



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KANSAS DEPARTMENT OF ADMINISTRATION

Docking State Office Building Electrical Upgrade Study

TMA #1667

APPENDIX H: ENGINEER'S OPINION OF PROBABLE PROJECT COSTS

Appendices

STATEMENT OF PROBABLE CO	NA I KI	JCHO				SHEET	OF
PROJECT				2-2-2011		1	
Electrical Upgrade					BASIS FOR E	ESTIMATE	
LOCATION							
Docking State Office Building		A (Preliminary de					
ARCHITECT ENGINEER						B (Preliminary d	lesign) - 65%
Lochner/BWR Division						C (Final design)	
					X OTHE	R (Specify) - Stud	dy Phase
DRAWING NO. / SECTION: ELECTRICAL		ESTIMA				CHECKED BY	
LLEGIRICAL			LWS				
22	QUAN	TITY	MA	TERIAL	1	ABOR	
SUMMARY Ontion 1	NO.	UNIT	PER UNIT	TOTAL	PER UNIT	TOTAL	TOTAL
Option 1	UNITS	MEAS.		TOTAL	I LIC OINTI	TOTAL	COST
Ductbank Construction	1	LS	50000	\$50,000	0	\$0	\$50,00
Manhole	1	LS	7500	\$7,500	7500	\$7,500	\$15,00
3,750 kVA, 13.2kV-480Y Xfmr*	2	EA	0	\$0	7100	\$14,200	\$14,20
Xfmr Pad	2	EA	800	\$1,600	200	\$400	\$2,00
Ceiling Modifications	1	LS	40000	\$40,000		\$0	\$40,00
5,000 Amp Copper Bus	90	LF	1500	\$135,000	300	\$27,000	\$162,00
Bus Supports	4	EA	600	\$2,400	600	\$2,400	\$4,80
	1					+2,100	Ψ+,00
Wall Penetration	2	EA	750	\$1,500	400	\$800	\$2,30
						Ψ000	Ψ2,30
5,000 Amp Elbow	8	EA	5000	\$40,000	625	\$5,000	\$45,00
						ψ5,000	Ψ+0,00
5,000 Amp double-ended Swgr.	. 1	LS	700000	\$700,000	15000	\$15,000	\$715,00
CUS No. 1 Feed	330	LF	70	\$23,100	70	\$23,100	\$46,20
2,500 Amp Copper Bus	1300	LF	630	\$819,000	150	\$195,000	\$1,014,00
2,500 Amp Elbow	19	EA	2550	\$48,450	500	\$9,500	\$57,95
600 Amp Plug-in Unit	18	EA	3825	\$68,850	900	\$16,200	\$85,05
Fire Stop Floor	26	EA	750	\$19,500	225	\$5,850	\$25,35
300 kVA, 480V-208Y Dry Type	19	EA	25000	\$475,000	3500	\$66,500	\$541,50
Modify MCC 1	1	LS	5000	\$5,000	5000	\$5,000	\$10,00
Distribution Panelboard	19	EA	8000	\$152,000	1000	\$19,000	\$171,00
Rerouting of existing Circuits	19	LS	3000	\$57,000	3000	\$57,000	\$171,00
Vestar Charges	1	LS	100000	\$100,000	0	\$0	\$100,00
oad Switchover (After Hours)	19	EA	5000	\$95,000	U	\$0	
Room Modifications	1	LS	50000	\$50,000	0	\$0	\$95,000 \$50,000
				430,000	U	ΦU	φου,υ0
ubtotal							\$3,360,350
5% O'head & Profit							\$840,088
ubtotal							\$4,200,438
0% Contingency							\$1,260,13
							Ψ1,200,13
OTAL					-		
OTAL				d with Switch			\$5,460,569

STATEMENT OF PROBABLE CO	JNSTRI	UCTIO				SHEET	OF
PROJECT				2-2-2011		1	
Electrical Upgrade					BASIS FOR	ESTIMATE	
LOCATION							
Docking State Office Building		A (Preliminary d					
	_ CODE	E B (Preliminary of	lesign) - 65%				
ARCHITECT ENGINEER Lochner/BWR Division					_ CODE	E C (Final design)	
			CALL COLUMN TO THE COLUMN TO T		X OTHE	R (Specify) - Stu-	dy Phase
DRAWING NO. / SECTION:	El EGEDIGI.					CHECKED BY	
LLLOTRICAL		L	LWS	Marie Control			
1	QUAN		MA	TERIAL		LABOR	
SUMMARY	NO.	UNIT	PER UNIT	TOTAL	PER UNIT	TOTAL	TOTAL
Option 2	UNITS	MEAS.	. alt of the	TOTAL	TER UNII	TOTAL	COST
Ductbank Construction	1	LS	300000	\$300,000	0	\$0	\$300,00
Manhole	2	LS	7500	\$15,000	7500	\$15,000	\$30,00
3,750 kVA, 13.2kV-480Y Xfmr*	2	EA	0	\$0	7100	\$14,200	\$14,20
Xfmr Pad	2	EA	800	\$1,600	200	\$400	\$2,00
						Ψ100	Ψ2,00
5,000 Amp Copper Bus	200	LF	1500	\$300,000	300	\$60,000	\$360,00
Bus Supports	6	EA	600	\$3,600	600	\$3,600	\$7,20
						φο,σσσ	Ψ1,20
Wall Penetration	2	EA	750	\$1,500	400	\$800	\$2,30
				7.0,1000	100	φοσο	φ2,50
5,000 Amp Elbow	8	EA	5000	\$40,000	625	\$5,000	¢45.00
				ψ10,000	020	φ5,000	\$45,00
5,000 Amp double-ended Swgr.	1	LS	700000	\$700,000	15000	\$15,000	\$715,00
LCUS No. 1 Feed	270	LF	70	\$18,900	70	\$18,900	\$37,80
2,500 Amp Copper Bus	1200	LF	630	\$756,000	150	\$180,000	\$936,00
2,500 Amp Elbow	20	EA	2550	\$51,000	500	\$10,000	
300 Amp Plug-in Unit	18	EA	3825	\$68,850	900	\$16,000	\$61,00
Fire Stop Floor	26	EA	750	\$19,500	225	\$5,850	\$85,05
300 kVA, 480V-208Y Dry Type	19	EA	25000	\$475,000	3500		\$25,35
Modify MCC 1	1	LS	5000	\$5,000	5000	\$66,500	\$541,50
Distribution Panelboard	19	EA	8000	\$152,000	1000	\$5,000	\$10,00
Rerouting of existing Circuits	19	LS	3000	\$57,000	1750	\$19,000	\$171,00
Vestar Charges	1	LS	200000	\$200,000		\$33,250	\$90,25
Room Addition	1	LS	60000	\$60,000	0	\$0	\$200,00
oad Switchover (After Hours)	19	EA	5000	\$95,000	0	\$0	\$60,00
()	,,,		0000	ψ90,000	0	\$0	\$95,00
							many indicates in the control of the
Subtotal							00 707
5% O'head & Profit							\$3,788,65
Subtotal							\$947,16
0% Contingency	-						\$4,735,81
sgariaj							\$1,420,74
OTAL							
				d with Switch			\$6,156,55

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STATEMENT OF PROBABLE CO	MOINC	CHO	the state of the s	-2-2011	SHEET OF 1			
PROJECT				2 2011	BASIS FOR I			
Electrical Upgrade								
LOCATION					CODE	A (Preliminary des	sign) - 35%	
Docking State Office Building		B (Preliminary de	(20)					
ARCHITECT ENGINEER		C (Final design)	sign) ob 70					
Lochner/BWR Division						R (Specify) - Study	Phase	
DRAWING NO. / SECTION:		ESTIMAT	OR.		71 01111	CHECKED BY	y I nuoc	
ELECTRICAL			LWS			CARDON DA		
	QUAN	TITY	MAT	TERIAL		LABOR		
SUMMARY	NO.	UNIT		4.3.21	Airconn		TOTAL	
Option 3	UNITS	MEAS.	TOTAL	PER UNIT	TOTAL	COST		
Ductbank Construction	1	LS	175000	\$175,000	0	\$0	\$175,00	
				7	-		Ψ110,00	
3,750 kVA, 13.2kV-480Y Xfmr*	2	EA	0	\$0	7100	\$14,200	\$14,20	
Xfmr Pad	2	EA	200	\$400	200	\$400	\$80	
						1		
5,000 Amp Copper Bus	220	LF	1500	\$330,000	300	\$66,000	\$396,00	
Bus Supports	6	EA	600	\$3,600	600	\$3,600	\$7,20	
Wall Penetration	2	EA	750	\$1,500	390	\$780	\$2,28	
							- I mil denin	
5,000 Amp Elbow	8	EA	5000	\$40,000	625	\$5,000	\$45,00	
5,000 Amp double-ended Swgr.	1	LS	700000	\$700,000	15000	\$15,000	\$715,00	
LCUS No. 1 Feed	270	LF	70	\$18,900	70	\$18,900	\$37,80	
2,500 Amp Copper Bus	1200	LF	630	\$756,000	150	\$180,000	\$936,00	
2,500 Amp Elbow	20	EA	2550	\$51,000	500	\$10,000	\$61,00	
600 Amp Plug-in Unit	18	EA	3825	\$68,850	900	\$16,200	\$85,05	
Fire Stop Floor	26	EA	750	\$19,500	225		\$25,35	
300 kVA, 480V-208Y Dry Type	19	EA	24900	\$473,100	3500	\$66,500	\$539,60	
Modify MCC 1	1	LS	5000	\$5,000	5000	\$5,000	\$10,00	
Distribution Panelboard	19	EA	8000	\$152,000	1000	\$19,000	\$171,00	
Rerouting of existing Circuits	19	LS	3000	\$57,000	3000		\$114,00	
Westar Charges	1	LS	800000	\$800,000	0	\$0	\$800,00	
Room Addition	1	LS	60000	\$60,000	0	\$0	\$60,00	
Load Switchover (After Hours)	19	EA	5000	\$95,000		\$0	\$95,00	
Subtotal							\$4,290,28	
25% O'head & Profit							\$1,072,57	
Subtotal							\$5,362,85	
30% Contingency							\$1,608,85	
55.5 Contangonoy							Ψ1,000,00	
	1 1							
TOTAL	(1.11)						\$6,971,70	

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^{*} Material Price Included with Switchboard

STATEMENT OF PROBABLE CO	DNSTRU	JCTI01	And the second s				OF	
A STATE OF THE STA			2	2-2-2011		1		
PROJECT					BASIS FOR I	ESTIMATE		
Electrical Upgrade								
LOCATION	_ CODE	A (Preliminary des	sign) - 35%					
Docking State Office Building	_ CODE	B (Preliminary de	esign) - 65%					
ARCHITECT ENGINEER	_ CODE	C (Final design)						
Lochner/BWR Division					X OTHE	R (Specify) - Stud	y Phase	
DRAWING NO. / SECTION:			CHECKED BY					
ELECTRICAL			LWS					
	QUAN	TITY	MA	TERIAL		LABOR		
SUMMARY	NO,	UNIT	PER UNIT	TOTAL	PER UNIT	TOTAL	TOTAL	
Option 4	UNITS	MEAS.	PER UNII	TOTAL	PER UNII	TOTAL	COST	
Ductbank Construction	1	LS	75000	\$75,000	0	\$0	\$75,00	
3,750 kVA, 13.2kV-480Y Xfmr*	2		0	\$0	20000	\$40,000	\$40,00	
Ceiling Modifications	1	LS	40000	\$40,000		\$0	\$40,00	
Floor Shoring	1	LS	350000	\$350,000	0	\$0	\$350,00	
Hallway Modifications	1	LS	150000	\$150,000	0	\$0	\$150,00	
Wall Penetration	2	EA	750	\$1,500	300	\$600	\$2,10	
5,000 Amp double-ended Swgr.	1	LS	800000	\$800,000	15000	\$15,000	\$815,0	
LCUS No. 1 Feed		330	LF	70	\$23,100	70		\$46,20
2,500 Amp Copper Bus	1300	LF	630	\$819,000	150	\$195,000	\$1,014,0	
2,500 Amp Elbow	19	EA	2550	\$48,450	500	\$9,500	\$57,9	
300 Amp Plug-in Unit	18	EA	3825	\$68,850	900	\$16,200	\$85,0	
Fire Stop Floor	26	EA	750	\$19,500	225	\$5,850	\$25,3	
300 kVA, 480V-208Y Dry Type	19	EA	25000	\$475,000	3500		\$541,5	
Modify MCC 1	1	LS	5000	\$5,000	5000	\$5,000	\$10,0	
Distribution Panelboard	19	EA	8000	\$152,000	1000		\$171,0	
Rerouting of existing Circuits	19		3000	\$57,000	1750		\$90,2	
Westar Charges	1	LS	100000	\$100,000	0		\$100,0	
Load Switchover (After Hours)	19	EA	5000	\$95,000		\$0	\$95,0	
Room Modifications	1	LS	65000	\$65,000	0		\$65,0	
Subtotal							\$3,773,4	
25% O'head & Profit							\$943,3	
Subtotal							\$4,716,7	
30% Contingency							\$1,415,0	
TOTAL								
TOTAL				ed with Swite		1	\$6,131,7	

STATEMENT OF PROBABLE CC	.,0110	2.101		2-2-2011		SHEET (DF
PROJECT					BASIS FOR E	ESTIMATE	
Electrical Upgrade							
LOCATION					_ CODE	A (Preliminary des	sign) - 35%
Docking State Office Building					_ CODE	B (Preliminary de	sign) - 65%
ARCHITECT ENGINEER					_ CODE	C (Final design)	
Lochner/BWR Division					X OTHE	R (Specify) - Study	y Phase
DRAWING NO. / SECTION:		ESTIMAT	OR			CHECKED BY	
ELECTRICAL			LWS				
	QUAN	TITY	MA	TERIAL		LABOR	
SUMMARY	NO.	UNIT	PER UNIT	TOTAL	PER UNIT	TOTAL	TOTAL
Option 5	UNITS	MEAS.	FERONII	TOTAL	PER UNII	TOTAL	COST
Ductbank Construction	1	LS	40000	\$40,000		\$0	\$40
Manhole	1	LS	7500	\$7,500	7500	\$7,500	\$15
3,750 kVA, 13.2kV-480Y Xfmr*	2	EA	0	\$0	7100	\$14,200	\$14
Xfmr Vault	1	LS	70000	\$70,000	20000	\$20,000	\$90
Ceiling Modifications	1	LS	40000	\$40,000		\$0	\$40
5,000 Amp Copper Bus	60	LF	1500	\$90,000	300	\$18,000	\$108
Bus Supports	6	EA	600	\$3,600	600	\$3,600	\$7
Wall Penetration	1	EA	800	\$800	350	\$350	\$1
							and the second sections
5,000 Amp Elbow	8	EA	5000	\$40,000	625	\$5,000	\$45
5,000 Amp double-ended Swgr.	1	LS	700000	\$700,000	15000	\$15,000	\$715
LCUS No. 1 Feed	330	LF	70	\$23,100	70	\$23,100	\$46
2,500 Amp Copper Bus	1300	LF	630	\$819,000	150	\$195,000	\$1,014
2,500 Amp Elbow	19	EA	2550	\$48,450	500	\$9,500	\$57
600 Amp Plug-in Unit	18	-	3825	\$68,850	900	\$16,200	\$85
Fire Stop Floor	26		750	\$19,500	225		\$25
300 kVA, 480V-208Y Dry Type	19		25000	\$475,000	3500		\$541
Modify MCC 1	1	LS	5000	\$5,000	5000		\$10
Distribution Panelboard	19		8000	\$152,000	1000		\$171
Rerouting of existing Circuits	19		3000	\$57,000	3000		\$114
Westar Charges	1		100000	\$100,000	0	4.	\$100
Load Switchover (After Hours)	19		5000	\$95,000		\$0	\$95
Room Modifications	1	LS	50000	\$50,000	0	\$0	\$50
Subtotal			7				\$3,385
25% O'head & Profit						1	\$846
Subtotal			1				\$4,232
30% Contingency							\$1,269
				-			
TOTAL							\$5,501

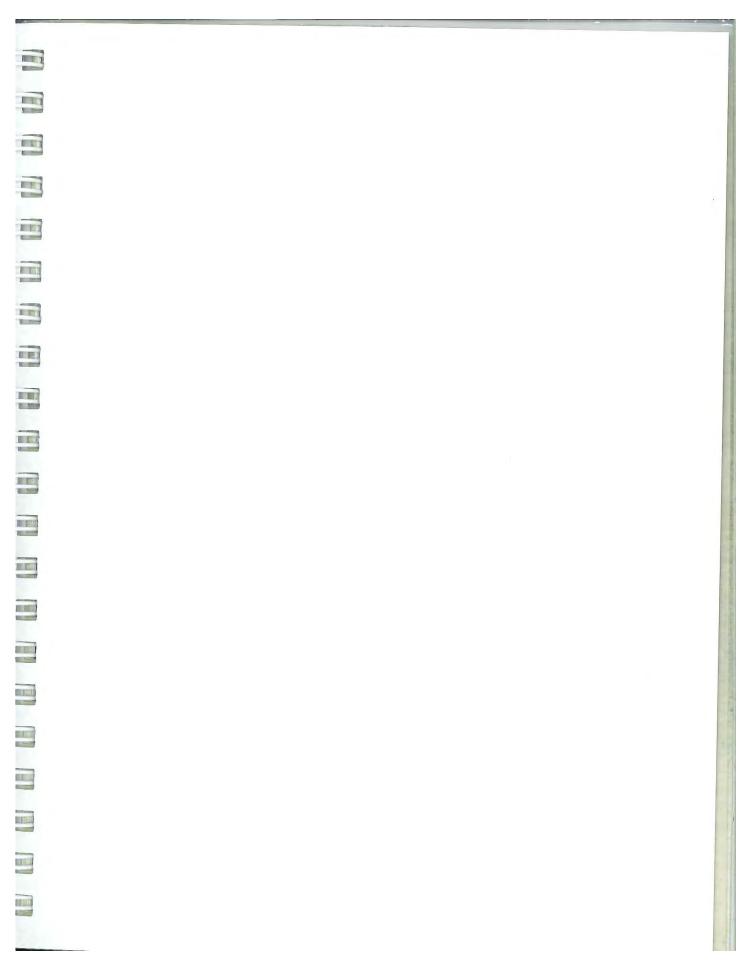
STATEMENT OF PROBABLE CO	Motic	CHO		2-2-2011		SHEET 1	OF
PROJECT					BASIS FOR		
Electrical Upgrade					1000		
LOCATION Docking State Office Building		A (Preliminary de B (Preliminary de					
ARCHITECT ENGINEER						EC (Final design)	sign) - 0576
Lochner/BWR Division					The second secon	ER (Specify) - Stud	v Phace
DRAWING NO. / SECTION:		ESTIMAT	OR		31 01111	CHECKED BY	y i nusc
ELECTRICAL			LWS			1	
	QUAN	TITY	MA	ΓERIAL		LABOR	
SUMMARY	NO.	UNIT	PER UNIT	TOTAL	PER UNIT	TOTAL	TOTAL
Option 6	UNITS	MEAS.	TERONII	TOTAL	PER UNII	TOTAL	COST
Ductbank Construction	1	LS	250000	\$250,000	0	\$0	\$250,00
Manhole	2	LS	7500	\$15,000	7500	\$15,000	\$30,00
3,750 kVA, 13.2kV-480Y Xfmr*	2	EA	0	\$0	7100	\$14,200	\$14,20
Xfmr Pad	2	EA	800	\$1,600	200	\$400	\$2,00
5,000 Amp Copper Bus	160	LF	1500	\$240,000	300	\$48,000	\$288,00
Bus Supports	6	EA	600	\$3,600	600	\$3,600	\$7,20
	Ů		000	ψ0,000	000	ψ5,000	φ1,20
Wall Penetration	2	EA	750	\$1,500	400	\$800	\$2,30
Floor Supports	1	LS	50000	\$50,000		\$0	\$50,00
5,000 Amp Elbow	8	EA	5000	\$40,000	625	\$5,000	\$45,00
5.000 A				2000 000	27000		
5,000 Amp double-ended Swgr.	1	LS	700000	\$700,000	15000	\$15,000	\$715,00
LCUS No. 1 Feed	270	LF	70	\$18,900	70	\$18,900	\$37,80
2,500 Amp Copper Bus	1200	LF	630	\$756,000	150	\$180,000	\$936,00
2,500 Amp Elbow	20	EA	2550	\$51,000	500	\$10,000	\$61,00
600 Amp Plug-in Unit Fire Stop Floor	18	EA	3825	\$68,850	900	\$16,200	\$85,05
300 kVA, 480V-208Y Dry Type	26	EA	750	\$19,500	225	\$5,850	\$25,35
Modify MCC 1	19	EA LS	25000	\$475,000	3500	\$66,500	\$541,50
Distribution Panelboard	19	EA	5000	\$5,000	5000	\$5,000	\$10,00
Rerouting of existing Circuits	19	LS	8000 3000	\$152,000 \$57,000	1000 3000		\$171,00
Westar Charges	19	LS	200000	\$200,000	3000	\$57,000	\$114,00
Room Addition	1	LS	60000	\$60,000	0	\$0 \$0	\$200,00
Load Switchover (After Hours)	19	EA	5000	\$95,000	0	\$0	\$60,00 \$95,00
- Codd Gwitonover (Arter Flours)	13	LA	3000	ψ90,000		φυ	φ95,00
Subtotal							\$3,740,40
25% O'head & Profit							\$935,10
Subtotal							\$4,675,50
30% Contingency							\$1,402,68
TOTAL				d with Swite			\$6,078,1

Form BWR 2008

^{*} Material Price Included with Switchboard

STATEMENT OF PROBABLE	CONSTRU	JCTIO1		DATE PREPARED 2-2-2011		SHEET 1	OF 1	
PROJECT Electrical Upgrade					BASIS FOR	ESTIMATE		
LOCATION Docking State Office Building					CODE A (Preliminary design) - 35% CODE B (Preliminary design) - 65% CODE C (Final design) X OTHER (Specify) - Study Phase			
ARCHITECT ENGINEER Lochner/BWR Division								
DRAWING NO. / SECTION: ELECTRICAL		ESTIMAT	ror LWS		CHECKED BY			
	QUAN	TITY	MATERIAL		LABOR			
Demolition Summary	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	TOTAL COST	
300 kVA Transformer	19	EA	0	\$0	1750	\$33,250	\$33,250	
15 kV Bus Duct	360	LF	0	\$0	100		\$36,000	
1,500 kVA Transformer	2	EA	0	\$0	3500		\$7,000	
15 kV Cable	1100	LF	0	\$0	1	7.11.00	\$1,100	
15 kV Switchgear	1	LS	0	\$0	10000		\$10,000	
Distribution Panel Patch Floor Openings	19 13	EA EA	125	\$0	750		\$14,250	
- atom rison openinge	10	LA	120	\$1,625	250	\$3,250	\$4,875	
Working in Occupied Building	1	LS	10000	\$10,000	60000	\$60,000	\$70,000	
Subtotal							\$176,475	
25% O'head & Profit							\$44,119	
Subtotal							\$220,594	
30% Contingency							\$66,178	
TOTAL							\$286,772	

Form BWR 2008



Docking State Office Building Electrical Equipment Assessment

February 28, 2003

General

Introduction

The Docking State Office Building was built in 1957. The majority of the existing electrical equipment is original to the building. Due to the age of this equipment, concern has been expressed regarding its reliability and safety. A recent fire in a motor control center in the basement was attributed to faulty electrical equipment. Due to these concerns the Division of Facilities Management resolved to have an Electrical Equipment Condition Analysis performed on all of the major electrical distribution equipment in the building.

The Electrical Equipment Condition Analysis is to be performed in two phases. Phase One is an Equipment Condition Assessment. This phase is broken down further into two distinct parts. The first part is to include a visual inspection and assessment of the equipment. Nameplate data is to be recorded and photos taken of each item. Notes are to be recorded regarding the equipment's physical appearance, alignment, any corrosion, and any code violations that are observed. The availability of spare parts for each piece of equipment is also to be verified.

The second part of the Equipment Condition Assessment involves preparing specifications for mechanical, infrared and hypot testing of the equipment. Cost estimates for the testing are also to be prepared. This report summarizes the findings of the Equipment Condition Assessment.

Phase Two of the Electrical Equipment Condition Analysis will involve preparing a Master Plan for making repairs or replacement of the equipment assessed in Phase One. The Master Plan will include an analysis of the testing results, a prioritized list of equipment to be repaired or replaced, equipment replacement options, construction costs, logistics involved in replacing the equipment such as office space allocation, and a construction schedule. The final scope of Phase Two will not be determined until Phase One is completed

Objectives

The objectives of the project were to:

- 1. Evaluate code compliance of the existing equipment and it's installation.
- 2. Determine the availability of spare parts for the equipment.
- 3. Assess the equipment's overall condition.

Equipment

The equipment to be included in the assessment was limited to that with a primary electrical voltage of 208V and above. This assessment was also limited to equipment that was accessible and visible. The items to be inspected included:

- Transformers
- Switchgear
- Switchboards
- Bus Ducts

- Motor Control Centers
- Automatic Transfer Switches
- Disconnects
- Emergency Generators

Equipment Inspection

A visual inspection of the electrical equipment in the Docking State Office Building was conducted. Notes and observations regarding each piece of equipment were recorded on survey data sheets. A separate survey data sheet was utilized for each piece of equipment. The survey data sheets and photographs are organized in this report by building floor location. A summary of these observations is provided below.

<u>Transformers</u>

Transformer #CCM-1 is a Allis Chalmers 1500KVA, 13200-480/277V. Its date of manufacture is unknown but the transformer was rewound approximately 1980 or 22 years ago. It was recently megged and checked by KCP&L and the condition was acceptable.

Transformer #TRN-0001 is a Westinghouse 1500KVA, 12470, 480/277V. Its date of manufacture is 1968. It's shows typical wear for a transformer of this age. It is installed temporarily on wooden platforms.

Transformer #TRN-0009 is a Westinghouse 1500KVA, 13800, 480/277V. Its date of manufacture is 1969. It's shows typical wear for a transformer of this age.

There is a 300KVA, 13200/208V transformer on every floor with the exception of the 2nd, 3rd, 4th and 14th floors. The 2nd floor has three transformers, including the backup transformer listed below. The 3rd floor has three transformers and the 4th floor has none. The 4th floor transformer is located on the 3rd floor due to roof entry to other portions of the building. The 14th floor has two transformers. All transformers, although in Allis Chalmers enclosures, were replaced approximately 20 years ago; the exception is the fourteenth floor, on which neither has been replaced.

There is a 300KVA 13200/208V backup transformer on the 2nd floor that serves the building's 208V bus duct. It can be mechanically connected on any given floor. This is a newer unit than the rest, approx. 20 years old, and has been used very little.

Switchgear

The 13200V switchgear is an S & C model. There are 6 sections. Date of manufacture is unknown. There is typical wear for the age, but corrosion is minimal.

Disconnects

There is a 13.8KV disconnect on every transformer package. They are original Allis Chalmers disconnects supplied with the package transformer units. They are all 15 amp disconnects with the exception of the backup unit on the 2nd floor which is rated at 50 amps. We were only able to open the enclosure of one of these units. There was minimal deterioration and very little corrosion observed for a unit of this age.

Switchboards

There is a 208V switchboard on every transformer package. They are original Allis Chalmers switchboards supplied with the package transformer units, with the exception of the backup unit on the 2nd floor. They all have main breakers but are not labeled as to size. We observed numerous panels missing and several panels were cut out and modified to accept newer style breakers.

Motor Control Centers

MCC #1 is a new Seimans 480V unit. This equipment was being installed during our assessment. This unit replaced an older motor control center that was destroyed by fire.

MCC-00004 is a 480V Westinghouse motor control center with no nameplates or sizes. It is approximately 50 years old with considerable dust and dirt.

MCC-00016 is a 208V Square D motor control center. It has no serial number or rated size. The age is unknown and considerable dust and dirt was observed in all compartments

Automatic Transfer Switches

All of the Automatic Transfer Switches in the building are in the process of being replaced, with the exception of the 13.2KV transfer switch at the feeder entry into the building. DFM has purchased new Zenith units to replace the original ones, several of which have already been installed.

Docking State Office Building Electrical Cost Testing Estimate

Preliminary Design

Item	Description	Qty.	Unit	Unit	Total
No.	-	-		Cost	Cost
1	13.2kv Switch gear	6	EA	\$274	\$1,644
2	13.2kv ATS	1	EA	274	274
3	13200-480V Transformer	3	EA	548	1,644
4	13200-208V Transformer	17	EA	548	9,316
5	13.2kv Disconect	17	EA	274	4,658
6	208V Switchboard	17	EA	274	4,658
7	480V MCC	2	EA	1,108	2,216
8	208V MCC	2	EA	1,108	2,216
9	MCC 480V Centravac Breaker	3	EA	274	822
10	208V ATS	15	EA	274	4,110
11	150 KVA Transformer	1	EA	274	274
12	13.2kv Bus Duct	1300	FT	5	6,500
14	208V Bus Duct	1300	FT	5	6,500
	Subtotal				\$44,832
	OH & P	49%			22,102
	Contingengy	20%			8,966
	TOTAL				\$75,901

On August 13, 2002 an electrical fire at the Docking State Office Building in Topeka prompted an immediate evacuation of the building. Fortunately, the fire was confined to one area in the basement of the building and no one was hurt. It did however destroy the motor control center that provided power to the building's air conditioning equipment. On the morning of the fire, Kansas Division of Facilities Management personnel called DRG for assistance. Within hours a DRG employee was on site helping to assess the damage and get temporary power to critical systems in the building.

The fire brought to the State's attention the need for a complete inspection and analysis of all of the major electrical equipment in this facility. DRG had provided a proposal for such a study more than a year prior to the fire. After making some minor changes to the scope of work, DRG was given the notice-to-proceed on this very important project.

The Docking State Office Building is a 14-story office building located immediately west of the Kansas State Capitol. Approximately 2,700 people work in the Docking building.

Executive Summary

The Kansas Division of Facilities Management retained Delich, Roth & Goodwillie P.A. Engineers to perform an equipment assessment for all of the major electrical equipment in the Docking State Office Building. The first part of the assessment included a visual inspection and assessment of each piece of equipment. The second part of the assessment involved preparation of specifications for future testing of the equipment. This report is a summary of our findings from the inspection, and the aforementioned specifications.

Overall Condition

Most of the equipment in the building is approximately 50 years old, and visually in good condition with minimal corrosion observed. Maintenance has not been performed in most cases and is strongly warranted. The bus ducts were not inspected due to steel plating surrounding the bus. It is suggested that an infrared test be performed on the bus ducts during Phase 2 of this project.

Code Violations Observed

<u>Equipment</u>	<u>Floors</u>	NEC Code
Disconnect	Basement, 1, 2, 3, 6, 9, 10, 12	110-26(a)
Disconnect	7 & 11	110-26(a) & 110-26(d)
Switchboard	Basement, 5	110-26(a)
Switchboard	2 & 12	110-26(a) & 110-12(a)
Switchboard	3,5,8,10,11	110-12(a)
Automatic Trans. Switch	Basement (5 Locations)	110-26(a)

Spare Parts Availability

<u>Equipment</u>	Manufacturer	Yes/No
Switchgear	S&C	Yes
Disconnect	S&C	Yes
Disconnect	Allis Chalmers	No
Disconnect	Gould ITE	Yes
Disconnect	G & W	No
Disconnect	ITE Imperial	Yes
Transformer	Allis Chalmers	No
Transformer	Westinghouse	Yes
Transformer	FPT	Yes
Transformer	Brown Boveri Electric	No
Transformer	Niagra	Yes
Transformer	SB	No
Transformer	AED	No
Switchboard	Allis Chalmers	No
Switchboard	Gould ITE	Yes
Switchboard	ITE Imperial	No
Switchboard	Westinghouse	Yes
Motor Control Center	Square D	Yes
Motor Control Center	Siemans	Yes
Motor Control Center	Westinghouse	Yes
Automatic Transfer Switch	Zenith	No

Kansas Division of Facilities Management DSOB Electrical Equipment Assessment Executive Summary - 1

Basement	1 st Floor	2 nd Floor	3 rd Floor	4 th Floor	5 th Floor	6 th Floor	7 th Floor
8 th Floor	9 th Floor	10 th Floor	11 th Floor	12 th Floor	13 th Floor	14 th Floor	
Basement	1 st Floor	2 nd Floor	3 rd Floor	4 th Floor	5 th Floor	6 th Floor	7 th Floor
8 th Floor	9 th Floor	10 th Floor	11 th Floor	12 th Floor	13 th Floor	14 th Floor	
Basement	1 st Floor	2 nd Floor	3 rd Floor	4 th Floor	5 th Floor	6 th Floor	7 th Floor
8 th Floor	9 th Floor	10 th Floor	11 th Floor	12 th Floor	13 th Floor	14 th Floor	
Basement	1 st Floor	2 nd Floor	3 rd Floor	4 th Floor	5 th Floor	6 th Floor	7 th Floor
8 th Floor	9 th Floor	10 th Floor	11 th Floor	12 th Floor	13 th Floor	14 th Floor	
Basement	1 st Floor	2 nd Floor	3 rd Floor	4 th Floor	5 th Floor	6 th Floor	7 th Floor
8 th Floor	9 th Floor	10 th Floor	11 th Floor	12 th Floor	13 th Floor	14 th Floor	

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Executive Summary

General

Basement

1st Floor

2nd Floor

3rd Floor

4th Floor

5th Floor

6th Floor

7th Floor

8th Floor

9th Floor

10th Floor

11th Floor

12th Floor 13th Floor

14th Floor

Equipment Manufacturers

Specifications

Automatic Transfer Switch: No Number, 14th Floor Mechanical Room (Elevator #2)

Date: 10/16/02

	Photo#	3790		
Х	Item	Inspection Activity	NEC Reference	Comments
x	1.	Check name plate data.		Zenith SN 1314316.1.3 480V 225A Model # ZTSL22EX-4
X	2.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	30" live front to live front. Violates NEC Code 110(a).
X	3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	OK
X	4.	Check adequacy of access to working space.	110-26(c)	OK
X	5.	Verify that working spaces have adequate illumination.	110-26(d)	ОК
X	6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	ОК
X	7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	ОК
x	8.	Check for availability of replacement parts.		Parts are available
х	9.	Check for age and deterioration of equipment.		2 yrs old (new condition)

Disconnect: 13200V 15amp LCUS-2, Basement - North Mechanical Room

Photo #3498

X	Item	Inspection Activity	NEC Reference	Comments
X	1.	Check name plate data.		No label. Part of transformer package (see transformer LCUS 2 (TRN-00018)). Transformer has been replaced. Old tag has been removed and new tag installed in its place.
X	2.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	Code violation (32" live front to live front. 20" to 6" to 8" pipes) Violates NEC Code 110-26(a).
X	3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	Some storage boxes and chairs are in the area.
X	4.	Check adequacy of access to working space.	110-26(c)	OK
X	5.	Verify that working spaces have adequate illumination.	110-26(d)	OK
X	6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Unable to open enclosure
X	7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to open enclosure
X	8.	Check for availability of replacement parts.		Equipment no longer made. Manufacturer out of business. Replacement parts not found.
X	9.	Check for age and deterioration of equipment.		50 yrs old, deterioration is minimal.

^{*} Grounded with 4/0 cable, routed with 13.2v buss duct.

Disconnect: 13200V 15amp LCUS 3 (TRN-00021) 1st Floor N Mechanical Room Photo # 3501

X	Item	Inspection Activity	NEC Reference	Comments
X	1.	Check name plate data.		None. Part of transformer package and tag has been removed A/C Allis Chalmers Cabinets
X	2.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.		Live front to pipes at handle, 18". Violates NEC Code 110-26(a).
X	3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	Ok
X	4.	Check adequacy of access to working space.	110-26(c)	OK
X	5.	Verify that working spaces have adequate illumination.	110-26(d)	OK
X	6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Unable to open enclosure.
X	7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to open enclosure.
X	8.	Check for availability of replacement parts.		Equipment no longer made. Manufacturer out of business. Replacement parts not found.
X	9.	Check for age and deterioration of equipment.		50 yrs old, deterioration minimal.

^{*} Grounded with 4/0 cable, routed with 13.2v buss duct.

Disconnect: 13200V 15amp LCUS 5 (TRN-00028) 2nd Floor N Mechanical Room Photo # 3504

X	Item	Inspection Activity	NEC Reference	Comments
X	1.	Check name plate data.		Not available, part of package, nameplate removed whem the transformer was replaced.
X	2.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	18" to pipes live front, very limited space in all areas. Violates NEC Code 110-26(a).
X	3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	ОК
X	4.	Check adequacy of access to working space.	110-26(c)	ОК
X	5.	Verify that working spaces have adequate illumination.	110-26(d)	ОК
X	6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Unable to open enclosure
X	7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to open enclosure
X	8.	Check for availability of replacement parts.		Equipment no longer made. Manufacturer out of business. Replacement parts not found.
X	9.	Check for age and deterioration of equipment.		50 yrs old, deterioration minimal.

^{*} Grounded with 4/0 cable, routed with 13.2v buss duct.

Disconnect: 13200V 15 amp LCUS 4 (TRN-00025) 2nd Floor N Mechanical Room
Photo # 3507

		Photo # 3507			
X	Item	Inspection Activity	NEC Reference	Comments	
X	1.	Check name plate data.		None, part of package, Nameplate removed when transformer was replaced	
X	2.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	OK	
X	3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	OK	
X	4.	Check adequacy of access to working space.	110-26(c)	OK	
X	5.	Verify that working spaces have adequate illumination.	110-26(d)	OK	
X	6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Unable to open enclosure	
X	7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to open enclosure	
X	8.	Check for availability of replacement parts.		Equipment no longer made. Manufacturer out of business. Replacement parts not found.	
X	9.	Check for age and deterioration of equipment.		50yrs old, Deterioration minimal.	

^{*} Grounded with 4/0 cable, routed with 13.2v buss duct.

Disconnect: 13200V 50A (TRN-00026) 2nd Floor N Mechanical Room
Photo # 3510

Χ	Item	Inspection Activity	NEC Reference	Comments
X	1.	Check name plate data.		Unit installed as backup for any 208V transfomer through 208V bus duct Gould ITE Switchboard Mains 600A Voltage 13200 Delta 3phase/3W SO 17-36252-1 Install Manual 5-82
X	2.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	OK
X	3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	OK
X	4.	Check adequacy of access to working space.	110-26(c)	Ok
X	5.	Verify that working spaces have adequate illumination.	110-26(d)	OK
X	6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Unable to open enclosure
X	7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to open enclosure
X	8.	Check for availability of replacement parts.		Replacement Parts are available.
X	9.	Check for age and deterioration of equipment.		20 yrs old, Minimal deterioration

^{*} Grounded with 4/0 cable, routed with 13.2KV buss duct.

Disconnect: 13200V 15A LCUS 6 (TRN-00030) 3rd Floor N Mechanical Room Photo # 3513

Photo # 3513				
Item	Inspection Activity	NEC Reference	Comments	
1.	Check name plate data.		None, part of package. Nameplate removed when transformer was replaced	
2.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	OK	
3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	west wall is wire mesh with paper storage on other side	
4.	Check adequacy of access to working space.	110-26(c)	ОК	
5.	Verify that working spaces have adequate illumination.	110-26(d)	ОК	
6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Unable to open enclosure	
7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to open enclosure	
8.	Check for availability of replacement parts.		Equipment no longer made. Manufacturer out of business. Replacement parts not found.	
9.	Check for age and deterioration of equipment.		50 yrs old, minimal deterioration.	
	1. 2. 3. 4. 5. 6. 7.	1. Check name plate data. 2. Verify adequate working clearances, dedicated spaces, and headroom around equipment. 3. Verify that working space or dedicated space is not used for storage. 4. Check adequacy of access to working space. 5. Verify that working spaces have adequate illumination. 6. Check for broken or damaged parts and contamination by foreign materials. 7. Check for proper use and ratings of splices and terminations. 8. Check for availability of replacement parts.	Item Inspection Activity NEC Reference 1. Check name plate data. 2. Verify adequate working clearances, dedicated spaces, and headroom around equipment. 110-26(a), 110-26(b), 110-26(b), 110-26(f) 3. Verify that working space or dedicated space is not used for storage. 110-26(b) 4. Check adequacy of access to working space. 110-26(c) 5. Verify that working spaces have adequate illumination. 110-26(d) 6. Check for broken or damaged parts and contamination by foreign materials. 110-12(c) 7. Check for proper use and ratings of splices and terminations. 110-14(a), 110-14(b) 8. Check for availability of replacement parts.	

^{*} Grounded with 4/0 cable, routed with 13.2v buss duct.

Disconnect: 13200V 15A LCUS 7 (TRN-00032) 3rd Floor N. Mechanical Room
Photo # 3516

		Photo # 3516			
X	Item	Inspection Activity	NEC Reference	Comments	
X	1.	Check name plate data.		None, part of package. Nameplate removed when transformer was replaced.	
X	2.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	OK	
x	3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	OK	
x	4.	Check adequacy of access to working space.	110-26(c)	OK	
x	5.	Verify that working spaces have adequate illumination.	110-26(d)	OK	
x	6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Unable to open enclosure.	
x	7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to open enclosure.	
x	8.	Check for availability of replacement parts.		Equipment no longer made. Manufacturer out of business. Rplacement parts not found.	
x	9.	Check for age and deterioration of equipment.		50 yrs old, minimal deterioration.	

^{*} Grounded with 4/0 cable, routed with 13.2v buss duct.

Disconnect: 13200V 15A LCUS 8 (TRN-00031) 3rd Floor N Mechanical Room (Serves 4th Floor)

Photo # 3519

Date: 9/10/02

X	Item	Inspection Activity	NEC Reference	Comments
X	1.	Check name plate data.		Nameplate was removed when transformer was replaced.
X	2.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	Less than 12" to pipes at disc. Live front less than 24" for enclosure door
X	3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	OK
X	4.	Check adequacy of access to working space.	110-26(c)	OK
X	5.	Verify that working spaces have adequate illumination.	110-26(d)	OK
X	6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Unable to open enclosure
X	7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to open enclosure
X	8.	Check for availability of replacement parts.		Equipment no longer made. Manufacturer out of business. Replacement parts not found.
X	9.	Check for age and deterioration of equipment.		50 yrs old, minimal deterioration.

^{*} Grounded with 4/0 cable, routed with 13.2v buss duct.

Disconnect: 13200V 15A LCUS 13 (TRN-00033) 5th Floor Mechanical Room
Photo # 3521

		Photo # 3521			
X	Item	Inspection Activity	NEC Reference	Comments	
X	1.	Check name plate data.		None, part of package. Nameplate removed when transformer was replaced	
X	2.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	Less than 18" from pipe to disc. handle. Violates NEC Code 110-26(a).	
x	3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	OK	
X	4.	Check adequacy of access to working space.	110-26(c)	OK	
x	5.	Verify that working spaces have adequate illumination.	110-26(d)	OK	
x	6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Unable to open enclosure.	
x	7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to open enclosure.	
X	8.	Check for availability of replacement parts.		Equipment no longer made. Manufacturer out of business. Replacement parts not found.	
x	9.	Check for age and deterioration of equipment.		50 yrs old, minimal deterioration.	

^{*} Grounded with 4/0 cable, routed with 13.2v buss duct.

Disconnect: 13200V 15A LCUS-12 (TRN-00035) 6th Floor Mechanical Room
Photo # 3524

	Photo # 3524				
X	Item	Inspection Activity	NEC Reference	Comments	
X	1.	Check name plate data.		None. Part of transformer package. Nameplate removed when transformer was replaced.	
X	2.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	Less than 18" to disc handle from pipe. Violates NEC Code 110-26(a).	
X	3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	OK	
X	4.	Check adequacy of access to working space.	110-26(c)	OK	
X	5.	Verify that working spaces have adequate illumination.	110-26(d)	OK	
X	6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Unable to open enclosure	
X	7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to open enclosure	
X	8.	Check for availability of replacement parts.		Equipment no longer made. Manufacturer out of business. Replacement parts not found.	
X	9.	Check for age and deterioration of equipment.		50 yrs old, minimal deterioration.	

^{*} Grounded with 4/0 cable, routed with 13.2v buss duct.

Disconnect: 13200V 15A LCUS-11 (TRN-00037) 7th Floor Mechanical Room Photo # 3527

Χ	Item	Inspection Activity	NEC Reference	Comments
X		Check name plate data.		None. Part of transformer package. Nameplate was removed when transformer was replaced.
X	2.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	Less than 18" from pipe to disc. handle. Violates NEC Code 110-26(a).
X	3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	ОК
X	4.	Check adequacy of access to working space.	110-26(c)	OK
X	5.	Verify that working spaces have adequate illumination.	110-26(d)	No lighting in Disconnect area. Violates NEC Code 110-26(d).
X	6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Unable to open enclosure
х	7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to open enclosure
х	8.	Check for availability of replacement parts.		Equipment no longer made. Manufacturer out of business. Replacement parts not found.
X	9.	Check for age and deterioration of equipment.		50 yrs old, minimal deterioration.

^{*} Grounded with 4/0 cable, routed with 13.2v buss duct.

Disconnect: 13200V 15A LCUS-10 (TRN-00039) 8th Floor Mechanical Room
Photo # 3590

X	Item	Inspection Activity	NEC Reference	Comments
X	1.	Check name plate data.		None. Part of transformer package. Nameplate was removed when transformer was replaced.
X	2.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	Less than 18" to pipe
X	3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	OK
X	4.	Check adequacy of access to working space.	110-26(c)	OK
X	5.	Verify that working spaces have adequate illumination.	110-26(d)	No lighting in disconnect area.
X	6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Unable to open enclosure.
X	7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to open enclosure.
X	8.	Check for availability of replacement parts.		Equipment no longer made. Manufacturer out of business. Replacement parts not found.
X	9.	Check for age and deterioration of equipment.		50 yrs old, minimal deterioration.

^{*} Grounded with 4/0 cable, routed with 13.2v buss duct.

Disconnect: 13200V 15A LCUS-9 (TRN-00041) 9th Floor Mechanical Room Photo # 3593

X	Item	Inspection Activity	NEC Reference	Comments
X	1.	Check name plate data.		None,part of transformer package, nameplate removed when transformer was replaced.
X	2.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	Less than 19" from disc. Handle to pipe
X	3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	OK
X	4.	Check adequacy of access to working space.	110-26(c)	OK
X	5.	Verify that working spaces have adequate illumination.	110-26(d)	No lighting in disconnect area.
X	6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Unable to open enclosure.
X	7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to open enclosure.
X	8.	Check for availability of replacement parts.		Equipment no longer made. Manufacturer out of business. Replacement parts not found.
X	9.	Check for age and deterioration of equipment.		50 yrs old, minimal deterioration.

^{*} Grounded with 4/0 cable, routed with 13.2v buss duct.

Disconnect: 13200V 15A LCUS-14 (TRN-00060) 10th Floor Mechanical Room Photo # 3535

Χ	Item	Inspection Activity	NEC Reference	Comments
X		Check name plate data.		Part of transformer package and Nameplate was removed when transformer was replaced.
X	2.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	Less than 18" to pipe from disc. Violates NEC Code 110-26(a).
X	3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	ОК
X	4.	Check adequacy of access to working space.	110-26(c)	OK
X	5.	Verify that working spaces have adequate illumination.	110-26(d)	OK
X	6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Unable to open enclosure.
X	7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to open enclosure.
X	8.	Check for availability of replacement parts.		Equipment no longer made. Manufacturer ou of business. Replacement parts not found.
X	9.	Check for age and deterioration of equipment.		50 yrs old, minimal deterioration.

^{*} Grounded with 4/0 cable, routed with 13.2v buss duct.

Disconnect: LCUS-15 (TRN-00061) 11th Floor Mechanical Room Photo # 3538

V	Item	Photo # 3538	NEC Reference	Comments
^	ILEIII	Inspection Activity	NEC Reference	
X	1.	Check name plate data.		Part of transformer package, namplate was removed when transformer was replaced.
X	2.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	Less than 18" from pipe to disconnect. Violates NEC Code 110-26(a).
	3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	OK
X	4.	Check adequacy of access to working space.	110-26(c)	OK
X	5.	Verify that working spaces have adequate illumination.	110-26(d)	No lighting in disconnect area. Violates NEC Code 110-26(d).
X	6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Unable to open enclosure
X	7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to open enclosure
X	8.	Check for availability of replacement parts.		Equipment no longer made. Manufacturer out of business. Replacement parts not found.
X	9.	Check for age and deterioration of equipment.		50 yrs old. Minimal deterioration.

^{*} Grounded with 4/0 cable, routed with 13.2v buss duct.

Disconnect: 13200V LCUS-16 (TRN-00043) 12th Floor Mechanical Room Photo # 3542, 3543, 3544

Χ	Item	Inspection Activity	NEC Reference	Comments
X	1.	Check name plate data.		Part of a Package, nameplate was removed when transformer was replaced.
X	2.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	Disconnect handle less than 18" from pipes. Door won't open, 24" to 13.2 buss duct. Violates NEC Code 110-26(a).
X	3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	OK
X	4.	Check adequacy of access to working space.	110-26(c)	OK
	5.	Verify that working spaces have adequate illumination.	110-26(d)	OK
X	6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Dirty, but very little corrosion
X	7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to determine
X	8.	Check for availability of replacement parts.		Equipment no longer made. Manufacturer out of business. Replacement parts not found.
X	9.	Check for age and deterioration of equipment.		50 yrs old, minimal deterioration.

^{*} Grounded with 4/0 cable, routed with 13.2v buss duct.

Disconnect: 13800V MDP-00039 13th Floor Mechanical Room
Photo # 3549

		Photo # 3549			
X	Item	Inspection Activity	NEC Reference	Comments	
X	1.	Check name plate data.		G&W Electric Specialty 3500 S. 127th St Blue Island IL	
X	2.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	ОК	
X	3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	OK	
X	4.	Check adequacy of access to working space.	110-26(c)	OK	
X	5.	Verify that working spaces have adequate illumination.	110-26(d)	OK	
X	6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Enclosed unit with oil	
	7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)		
	8.	Check for availability of replacement parts.			
X	9.	Check for age and deterioration of equipment.		50 yrs	

^{*} Grounded with 4/0 cable, routed with 13.2v buss duct.

Disconnect: MDP-00042 (XF-22)Secondary Disconnect, 13th Floor Mechanical Room Photo # 3548

Х	Item	Inspection Activity	NEC Reference	Comments
X	1.	Check name plate data.		ITE Imperial Corporation 120/208 3phase-4W SO 17-41220-1 Oct 1976
X	2.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	OK
X	3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	OK
X	4.	Check adequacy of access to working space.	110-26(c)	OK
X	5.	Verify that working spaces have adequate illumination.	110-26(d)	ОК
X	6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Unable to determine
X	7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to determine
X	8.	Check for availability of replacement parts.		Replacement Parts are available.
X	9.	Check for age and deterioration of equipment.		27 years old, Minimal deterioration.

^{*} Grounded with 4/0 cable, routed with 13.2v buss duct.

Disconnect: 13200V LCUS-18 (TRN-00059) 14th Floor Mechanical Room
Photo # 3553

	Pnoto # 3553						
X	Item	Inspection Activity	NEC Reference	Comments			
x	1.	Check name plate data.		Original Transformer (Package)Tag Allis Chalmers, Pittsburg, PA 225KVA SN 2887379 13800 208/120			
X	2.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	OK			
X	3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	OK			
X	4.	Check adequacy of access to working space.	110-26(c)	OK			
X	5.	Verify that working spaces have adequate illumination.	110-26(d)	No lighting above or around disconnect			
X	6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Unable to open enclosure			
X	7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to open enclosure			
X	8.	Check for availability of replacement parts.		Equipment no longer made. Manufacturer out of business. Replacment parts not found.			
X	9.	Check for age and deterioration of equipment.		50 yrs old, minimal deterioration.			

Date: 9/11/02

^{*} Grounded with 4/0 cable, routed with 13.2V buss duct.

Disconnect: 13200V LCUS 17 (TRN-00058) 14th Floor Mechanical Room Photo # 3556

W	PNOTO # 3556						
Х	Item	Inspection Activity	NEC Reference	Comments			
X	1.	Check name plate data.		Original Transformer (Package) Tag Allis Chalmers 225KVA SN 2887381 13800 208/120			
X	2.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	OK			
X	3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	OK			
X	4.	Check adequacy of access to working space.	110-26(c)	OK			
X	5.	Verify that working spaces have adequate illumination.	110-26(d)	No lighting above disconnect			
X	6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Unable to open enclosure			
X	7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to open enclosure			
X	8.	Check for availability of replacement parts.		Equipment no longer made. Manufacturer out of business. Replacement parts not found.			
X	9.	Check for age and deterioration of equipment.		50 yrs old, minimal deterioration.			

Date: 9/11/02

^{*} Grounded with 4/0 cable, routed with 13.2V buss duct.

Disconnect: MDP-00005 DSOB-SB23 to Transformer 00009
Photo # 3489

		Photo # 3489			
X	Item	Inspection Activity	NEC Reference	Comments	
X	1.	Check name plate data.		Westinghouse 3 phase Disc. Switch Max volts 15000 Max Int Cur Rat 600 amps SN WER 75691 SO WER 7569	
X	2.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	OK	
X	3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	ОК	
X	4.	Check adequacy of access to working space.	110-26(c)	ОК	
X	5.	Verify that working spaces have adequate illumination.	110-26(d)	ОК	
X	6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Unable to open enclosure	
X	7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to open enclosure	
X	8.	Check for availability of replacement parts.		Replacement kits are available.	
X	9.	Check for age and deterioration of equipment.		50 yrs old, minimal deterioration.	

Date: 9/11/02

^{*} Grounded with 4/0 cable, routed with 13.2V buss duct.

Disconnect: CCM-1 (B) Basement mezzanine
Photo # 3469

Item Inspection Activity NEC Reference Comments S&C Electric Company, Chicago IL S&C Metal Enclosed Switchgear Cat # CD-409512 13.8V Duty cycle fault closing amps 40000 Duty cycle fault closing amps 40000 Duty cycle fault closing amps 40000 NK 110-26(a), 110-26(b) OK 110-26(b) OK NK OK OK OK OK OK OK	Photo # 3469						
X 1. Check name plate data. Check name plate data. Check name plate data. Check name plate data. X 2. Verify adequate working clearances, dedicated spaces, and headroom around equipment. X 3. Verify that working space or dedicated space is not used for storage. X 4. Check adequacy of access to working space. X 5. Verify that working spaces have adequate illumination. X 6. Check for broken or damaged parts and contamination by foreign materials. X 7. Check for proper use and ratings of splices and terminations. S&C Metal Enclosed Switchgear Cat # CD-409512 13.8V Duty cycle fault closing amps 40000 OK 110-26(a), 110-26(b) OK 110-26(b) OK 110-26(c) Unable to open enclosure 110-12(c) Inable to open enclosure The plane of the proper use and ratings of splices and terminations. 110-14(a), 110-14(b) Replacement parts are available	item Ins	item Ins	spection Activity	NEC Reference			
X 2. Verify adequate working clearances, dedicated spaces, and headroom around equipment. 110-26(a), 110-26(b), 110-26(f) OK X 3. Verify that working space or dedicated space is not used for storage. 110-26(b) OK X 4. Check adequacy of access to working space. 110-26(c) OK X 5. Verify that working spaces have adequate illumination. 110-26(d) OK X 6. Check for broken or damaged parts and contamination by foreign materials. 110-12(c) Unable to open enclosure X 7. Check for proper use and ratings of splices and terminations. 110-14(a), 110-14(b) Replacement parts are available	1. Ch	1. Ch	heck name plate data.		S&C Metal Enclosed Switchgear Cat # CD-409512 13.8V		
X 3. Verify that working space or dedicated space is not used for storage. 110-26(b) X 4. Check adequacy of access to working space. 110-26(c) X 5. Verify that working spaces have adequate illumination. 110-26(d) X 6. Check for broken or damaged parts and contamination by foreign materials. 110-12(c) X 7. Check for proper use and ratings of splices and terminations. 110-14(a), 110-14(b) Replacement parts are available	/	/		110-26(e),	OK		
 X 4. Check adequacy of access to working space. X 5. Verify that working spaces have adequate illumination. X 6. Check for broken or damaged parts and contamination by foreign materials. X 7. Check for proper use and ratings of splices and terminations. X 110-14(a), 110-14(b) X Replacement parts are available 	3. Ve	3. Ve	erify that working space or dedicated space is not used for storage.	110-26(b)	OK		
 X 5. Verify that working spaces have adequate illumination. X 6. Check for broken or damaged parts and contamination by foreign materials. X 7. Check for proper use and ratings of splices and terminations. X 110-12(c) Unable to open enclosure X 110-14(a), 110-14(b) Replacement parts are available 	4. Ch	4. Ch	heck adequacy of access to working space.	110-26(c)	OK		
 X 6. Check for broken or damaged parts and contamination by foreign materials. X 7. Check for proper use and ratings of splices and terminations. X 110-12(c) Unable to open enclosure 110-14(a), 110-14(b) Replacement parts are available 	5. Ve	5. Ve	erify that working spaces have adequate illumination.	110-26(d)	OK		
X 7. Check for proper use and ratings of splices and terminations. 110-14(a), 110-14(b) Replacement parts are available	6. Ch	6. Ch	heck for broken or damaged parts and contamination by foreign materials.	110-12(c)	Unable to open enclosure		
	7. Ch	7. Ch	heck for proper use and ratings of splices and terminations.		Unable to open enclosure		
	8. Ch	8. Ch	heck for availability of replacement parts.		Replacement parts are available		
X 9. Check for age and deterioration of equipment.	9. Ch	9. Ch	heck for age and deterioration of equipment.		20 yrs old		

MCC: MCC-00010 Basement Mezzanine (operates centrvac #1)

Photo # 3480, 3483

Х	Item	Inspection Activity	NEC Reference	Comments
x	1.	Check name plate data.		Allis Chalmers Type RC-216B HP 300 30 440 volt SN 2-1468-24540 Part # 14-224-853
X	2.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	OK
X	3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	ОК
X	4.	Check adequacy of access to working space.	110-26(c)	ОК
X	5.	Verify that working spaces have adequate illumination.	110-26(d)	ОК
X	6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Unable to determine
X	7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to determine
х	8.	Check for availability of replacement parts.		Replacement parts are not available. Retrofit replacement kits are available.
X	9.	Check for age and deterioration of equipment.		Breaker will not trip when trip button is pressed. Opened bottom door and breaker should have tripped. Typical dirt & debris. Last cleaned 1988

^{*} Grounded with 4/0 cable, routed with 13.2v buss duct.

MCC: MCC-00013 Basement Mezzanine (operates central HVAC #3)

Photo #3481

Х	Item	Inspection Activity	NEC Reference	Comments
x	1.	Check name plate data.		Allis chalmers Type RC-216B HP 300 3 phase 440 volt 60 cycle SN 2-1468-24540 Part # 14-224-853
X	2.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	OK
X	3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	ОК
X	4.	Check adequacy of access to working space.	110-26(c)	ОК
X	5.	Verify that working spaces have adequate illumination.	110-26(d)	ОК
X	6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Unable to open enclosure
X	7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to determine
X	8.	Check for availability of replacement parts.		Replacement parts not available. Retrofit kits are available.
X	9.	Check for age and deterioration of equipment.		Breaker won't reset after trippingtakes 2-3 times to reset. 50 yrs old.

^{*} Grounded with 4/0 cable, routed with 13.2v buss duct.

MCC: MCC-0014 Basement Mezznine (Operates Centravac #2) Date: 9/9/02

Photo # 3482

Χ	Item	Inspection Activity	NEC Reference	Comments
X	1.	Check name plate data.		Allis Chalmers Type ARC-216B HP 300 3 phase 440 volt 60 cycles SN # 2-1468-24540 Part # 14-224-853
X	2.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	OK
X	3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	ОК
X	4.	Check adequacy of access to working space.	110-26(c)	ОК
X	5.	Verify that working spaces have adequate illumination.	110-26(d)	ОК
х	6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Unable to open enclosure
х	7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to open enclosure
х	8.	Check for availability of replacement parts.		Replacement parts not available. Retrofit kits are available.
х	9.	Check for age and deterioration of equipment.		50 yrs old

^{*} Grounded with 4/0 cable, routed with 13.2V buss duct.

Working normally. Question on ACC(3) which centravac goes to which breaker? Need to label accordingly.

Disconnect: Boiler Disc. 800A
Photo # 3485 Date: 9/9/02

	14	Pnoto # 3485		
X	Item	Inspection Activity	NEC Reference	Comments
x	1.	Check name plate data.		Square D Panel Board 480V Cat # 4590-8 El Series 800 amps 3 pahse Door cat #QMB0367-W Series El Hi-cap fuses time delay current limiting
X		Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	OK
X	3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	OK
X	4.	Check adequacy of access to working space.	110-26(c)	ОК
X	5.	Verify that working spaces have adequate illumination.	110-26(d)	OK
X	6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	working normally
X	7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	OK
X	8.	Check for availability of replacement parts.		Replacement parts are available
X	9.	Check for age and deterioration of equipment.		Approx. 10 yrs old

^{*} Grounded with 4/0 cable, routed with 13.2v buss duct.

Disconnect: LCUS-1 (TRN-00015) (Disconnect not labeled) at Center Mezzanine Photo # 3474

X	Item	Inspection Activity	NEC Reference	Comments
X	1.	Check name plate data.		S&C Cat # CD-409512 Volt 13.8 Fused at 600v
X	2.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	3'-8" front clearance
X	3.	Verify that working space or dedicated space is not used for storage.	110-26(b)	ОК
X	4.	Check adequacy of access to working space.	110-26(c)	OK
X	5.	Verify that working spaces have adequate illumination.	110-26(d)	OK
X	6.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Unable to open enclosure
X	7.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to open enclosure
X	8.	Check for availability of replacement parts.		Replacement parts are available
X	9.	Check for age and deterioration of equipment.		Approx. 10 yrs old

^{*} Grounded with 4/0 cable, routed with 13.2V buss duct.

Emergency Distribution Panel: MCC-0007
Photo # 3496, 3497

X	Item	Inspection Activity	NEC Reference	Comments
X	1.	Nameplate Data	700-5	No serial number Westinghouse SO KC-36831 IT.11 120/208Y 3phase 4W 1200 amp
X	2.	Verfiy that power sources are suitable and capable of supplying the load within 10 seconds and maintaining the load for at least 1 1/2 hours.	700-12	Yes
X	3.	Verify that generators, if used, have on-site fuel adequate for at least 2 hours of operation and that fuel pumps, if any, are supplied by emergency power.	700-12(b)	Yes
	4.	Verify that unit equipment, if used, is fixed in place and connected to the same circuit that supplies normal lighting to the area, ahead of any local switches.	700-12(e)	Yes
X	5.	Verify that transfer equipment is automatic, identified for emergency use, equipped with means for bypass, electrically operated, and mechanically held.	700-6	Yes
X	6.	Verify that transfer equipment supplies only emergency loads.	700-6(d)	Yes
	7.	Verify that audible and visual signals are provided as required. (Automatic disconnection of emergency systems on ground faults is not required.)	700-7, 700-26	N/A
X	8.	Check for signs at service equipent indicating emergency system type and location, and for signs at grounding locations indicating sources connected.	700-8	No signs
X	9.	Check boxes and enclosures for permanent identification as components of the emergency sytem.	700-9(a)	labeled with paper tags
X	10.	Verify that emergency wiring is entirely independent of other wiring, except as specifically permitted for common enclosures, fixtures, and boxes.	700-9(b)	Yes
X	11.	Verify that testing is conducted as required and that a written schedule and record for periodic testing and maintenance is provided.	700-4	All compartments are dirty. No maintenance provided.

Motor Control Center: MCC-00016 208V Fed from 550 amp breaker in LCUS-1 dist panel
Photo # 3477 Typ, bucket #3478, 3479

		Photo # 3477, Typ. bucket #3478, 3479		
X	Item	Inspection Activity	NEC Reference	
x	1.	Check name plate data.		Square D Class 8938 208V Type WE 122FA2166 Diagram 306097-A1, 306097-Sa
x	2.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Inspected all compartments (but one) main centravac control locked in off position with keyed lock. All compartments dirty, dusty, some have foreign debris. Several compartments have wire ??? and splices.
X	3.	Verify that unused openings are closed.	110-12(a)	OK
X	4.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to determine
X	5.	Check temperature ratings of terminations.	110-14(c)	Unable to determine
X	6.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	OK
X	7.	Verify that working space or dedicated space is not use for storage.	110-26(b)	OK
X	8.	Check adequacy of access to working space.	110-26(c)	OK
X	9.	Verify that working spaces have adequate illumination.	110-26(d)	ОК
x	10.	Check labeling and identification.		Need work on labeling. Several labels are not current.
x	11.	Check for availability of replacement parts.		Replacement Parts are available
X	12.	Check for age and deterioration of equipment.		Equipment is dirty, does not look as though it has a maint. program. All compartments have dust, dirt and foreign debris. Age is Unknown.

Switchboard: 208V LCUS-10 (TRN-00039) 8th Floor Mechanical Room Photo # 3532

V	14.0	Photo # 3532	NEO D. C	Comments
X	Item	Inspection Activity	NEC Reference	Comments
X	1.	Check name plate data.		Nametag removed when transformer was replaced.
X	2.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Dirty No maintenance for 5 years.
X	3.	Verify that unused openings are closed.	110-12(a)	One panel missing
x	4.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to determine
x	5.	Check temperature ratings of terminations.	110-14(c)	Unable to determine
x	6.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	ОК
X	7.	Verify that working space or dedicated space is not use for storage.	110-26(b)	ОК
X	8.	Check adequacy of access to working space.	110-26(c)	ОК
x	9.	Verify that working spaces have adequate illumination.	110-26(d)	ОК
x	10.	Check labeling and identification.		ОК
x	11.	Check for availability of replacement parts.		Equipment no longer made. Manufacturer out of business. Replacement parts not found.
x	12.	Check for age and deterioration of equipment.		50 yrs old, minimal deterioration.
			L	<u> </u>

Date: 9/10/02

^{*}Grounded with 4/0 cable, routed with 13.2v buss duct

CCM-1 (A) No. 5 AC Elec Boiler Bank; No. 6 Kitchen water & Sewer, elevator

Date: Switchgear: exhaust fan, No. 7 Bus Duct Riser --Building through 14th floor Photo# 3472 9/9/2002

X	Item	Inspection Activity	NEC Reference	Comments
X	1.	Check name plate data.		S&C Cat # CD28102 Volts 15000
X	2.	Check for broken or damaged parts and contamination by foreign materials.	110-12(c)	Unable to open enclosure. Western Resources provides maintenance.
X	3.	Verify that unused openings are closed.	110-12(a)	OK
X	4.	Check for proper use and ratings of splices and terminations.	110-14(a), 110-14(b)	Unable to determine
X	5.	Check temperature ratings of terminations.	110-14(c)	Unable to determine
X	6.	Verify adequate working clearances, dedicated spaces, and headroom around equipment.	110-26(a), 110-26(e), 110-26 (f)	OK
X	7.	Verify that working space or dedicated space is not use for storage.	110-26(b)	OK
X	8.	Check adequacy of access to working space.	110-26(c)	OK
X	9.	Verify that working spaces have adequate illumination.	110-26(d)	OK
X	10.	Check labeling and identification.		Labels should be engraved (Now tape)
X	11.	Check for availability of replacement parts.		Replacement parts available
X	12.	Check for age and deterioration of equipment.		Age is unknown

Transformer: No Label--Heat Plant fed from Statehouse Chiller MC0004
Photo #3495

Y	Item	Inspection Activity	NEC Reference	Comments
X	1.	Nameplate Data	NEO NEIGIGIA	Westinghouse 150KVA SN 84F33985 Style V48M28F49N 480V 208/120 Model DT-3
	2.	Verify that overcurrent protection for transormers over 600 volts is provided and properly sized.	Table 450-3(a)	N/A
X	3.	Verify that overcurrent protection for transormers 600 volts or less is provided and properly sized.	Table 450-3(b)	OK
X	4.	Verify that overcurrent protection is provided for transformer primary conductors.	240-4, 240-21, 240-100	OK
X	5.	Verify that overcurrent protection is provided for transformer secondary conductors.	240-4, 240-21 240-100	OK
X	6.	Check transformer installations for adequate ventilation and spacing from walls and obstructions.	450-9	ОК
X	7.	Check transformers for ready access or proper installation in the open or in hollow spaces.	450-13	ОК
X	8.	Check indoor dry-type transformers for separation from combustibles or, based on ratings, installation in fire-resistant rooms or vaults.	450-21	ОК



Picture #3535

Disconnect for LCUS-14 (TRN-00060) 13200V 15A 10th Floor Mech. Room



Picture #3536

Transformer LCUS-14 (TRN-00069) 300kva 13200V 208Y/120 10th Floor Mech. Room



Picture #3537

Switchboard for LCUS-14 (TRN-00060) 208V 10th Floor Mech. Room



Picture #3538

Disconnect for LCUS-15 (TRN-00061) 13200V 15A 11th Floor Mech. Room



Picture #3538

Transformer LCUS-15 (TRN-00061)
300kva
13200V
208Y/120
11th Floor Mech. Room



Picture #3540

Switchboard for LCUS-15 (TRN-00061) 208V 11th Floor Mech. Room



Picture #3541

Switchboard for LCUS-15 (TRN-00061) Continued 208V 11th Floor Mech. Room



Picture #3544

Disconnect for LCUS-16 (TRN-00043) 13200V 15A 12th Floor Mech. Room



Picture #3542

Disconnect for LCUS-16 (TRN-00043) Continued 13200V 15A 12th Floor Mech. Room



Picture #3543

Disconnect for LCUS-16 (TRN-00043) Continued 13200V 15A 12th Floor Mech. Room



Picture #3545

Transformer LCUS-16 (TRN-00043) 300kva 13200V 208Y/120 12th Floor Mech. Room



Picture #3547

Switchboard for LCUS-16 (TRN-00043) 208V 12th Floor Mech. Room



Picture #3549

Disconnect MDP-00039 13800V 15A 13th Floor Mech. Room



Picture #3550

Transformer TRN-00046 300kva 13800V 208Y/120 13th Floor Mech. Room



Picture #3548

Disconnect MDP-00042 208V 13th Floor Mech. Room



Picture #3552

Switchboard for LCUS-18 208V 13th Floor Mech. Room



Picture # 3789

Automatic Transfer Switch (No number) (Freight Elevator) 600V Rating, 208V 200A 13th Floor-Freight Elevator Head House



Picture #3553

Disconnect for LCUS-18 (TRN-00059) 13200V 15A 14th Floor Mech. Room



Picture #3554

Transformer LCUS-18 (TRN-00059) 225kva 13800V 208Y/120 14th Floor Mech. Room



Picture #3555

Switchboard LCUS-18 (TRN-00059) 208V 14th Floor Mech. Room



Picture #3556

Disconnect for LCUS-17 (TRN-00058) 13200V 15A 14th Floor Mech. Room



Picture #3557

Transformer LCUS-17 (TRN-00058)
225kva
13800V
208Y/120
14th Floor Mech. Room



Picture #3557

Switchboard for LCUS-17 (TRN-00058) 208V 14th Floor Mech. Room



Picture # 3790

Automatic Transfer Switch (No number)
(Elevator #2)
480V rating, 208V
225A
14th Floor Mech. Room



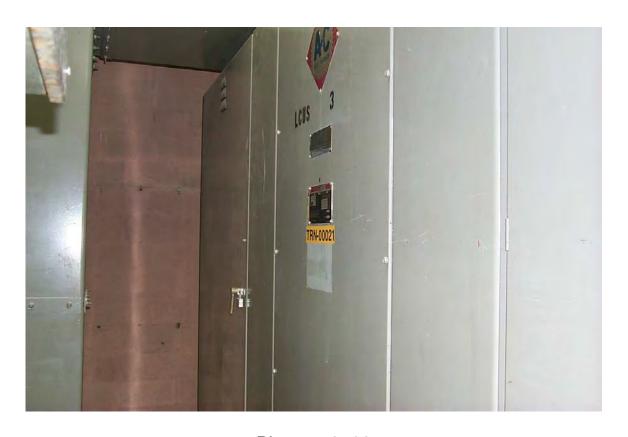
Picture # 3791

Automatic Transfer Switch ATS-17 (Elevator # 5) 480V Rating, 208V 225A 14th Floor Mech. Room



Picture #3501

Disconnect for LCUS-3 (TRN-00021) 13200V 15A 1st Floor- North Mech. Room



Picture #3502

Transformer LCUS-3 (TRN-00021)
300kva
13200V
208Y/120
1st Floor- North Mech. Room



Picture #3503

Switchboard for LCUS-3 (TRN-00021) 208V 1st Floor-North Mech. Room



Picture #3504

Disconnect for LCUS-5 (TRN-00028) 13200V 15A 2nd Floor-North Mech. Room



Picture #3503

Transformer LCUS-5 (TRN-00028)
300kva
13200V
208Y/120
2nd Floor-North Mech. Room



Picture #3506

Switchboard for LCUS-5 (TRN-00028) 208V 2nd Floor-North Mech. Room



Picture #3507

Disconnect for LCUS-4 (TRN-00024) 13200V 15A 2nd Floor-North Mech. Room



Picture #3508

Transformer LCUS-4 (TRN-00024)
300kva
13200V
208Y/120
2nd Floor-North Mech. Room



Picture #3509

Switchboard for LCUS-4 (TRN-00024) 208V 2nd Floor-North Mech. Room



Picture #3510

Disconnect for TRN-00026 13200V 15A 2nd floor-North Mech. Room



Picture #3511

Transformer TRN-00026 300kva 13200V 208Y/120 2nd Floor-North Mech. Room



Picture #3512

Switchboard for TRN-00026 208V 600A 2nd Floor-North Mech. Room



Picture #3513

Disconnect for LCUS-6 (TRN-00030) 13200V 15A 3rd Floor-North Mech. Room



Picture #3514

Transformer LCUS-6 (TRN-00030) 300kva 13200V 208Y/120 3rd Floor-North Mech. Room



Picture # 3515

Switchboard for LCUS-6 (TRN-00030) 208V 3rd Floor-North Mech. Room



Picture # 3516

Disconnect for LCUS-7 (TRN-00032) 13200V 15A 3rd Floor-North Mech. Room



Picture #3517

Transformer LCUS-7 (TRN-00032) 13200V 208Y/120 3rd Floor-North Mech. Room



Picture #3518

Switchboard for LCUS-7 (TRN-00032) 208V 3rd Floor-North Mech. Room



Picture #3519

Disconnect for LCUS-8 (TRN-00031) 13200V 15A 3rd Floor-North Mech. Room



Picture # 3787

Transformer LCUS-8 (TRN-00031)
300kva
13200V
208Y/120
3rd Floor-North Mech. Room



Picture #3520

Switchboard for LCUS-8 (TRN-00031) 208V 3rd Floor-North Mech. Room



Picture # 3521

Disconnect for LCUS-13 (TRN-00033) 13200V 15A 5th Floor-North Mech. Room



Picture #3522

Transformer LCUS-13 (TRN-00033) 300kva 13200V 208Y/120 5th Floor-North Mech. Room



Picture #3523

Switchboard for LCUS-13 (TRN-00033) 208V 5th Floor-North Mech. Room



Picture #3524

Disconnect for LCUS-12 (TRN-00035) 13200V 15A 6th Floor-North Mech. Floor



Picture #3525

Transformer LCUS-12 (TRN-00035)
300kva
13200V
208Y/120
6th Floor-North Mech. Room



Picture #3526

Switchboard for LCUS-12 (TRN-00035) 208V 6th Floor-North Mech. Room



Picture #3527

Disconnect for LCUS-11 (TRN-00037) 13200V 15A 7th Floor-North Mech. Room



Picture #3528
Transformer LCUS-11 (TRN-00037)
300kva
13200V
208Y/120
7th Floor-North Mech. Room



Picture #3529

Switchboard for LCUS-11 (TRN-00037) 208V 7th Floor-North Mech. Room



Picture #3530

Disconnect for LCUS-10 (TRN-00039) 13200V 15A 8th Floor Mech. Room



Picture #3531

Transformer LCUS-10 (TRN-00039) 300kva 13200V 208Y/120 8th Floor Mech. Room



Picture #3532

Switchboard for LCUS-10 (TRN-00039) 208V 8th Floor Mech. Room



Picture #3533

Disconnect for LCUS-9 (TRN-00041) 13200V 15A 9th Floor Mech. Room



Picture #3534

Transformer LCUS-9 (TRN-00041)
300kva
13200V
208Y/120
9th Floor Mech. Room



Picture # 3788

Switchboard for LCUS-9 (TRN-00041) 208V 9th Floor Mech. Room



Picture #3471

Automatic Transfer Switch 15000V 400A Basement-North Electrical Room



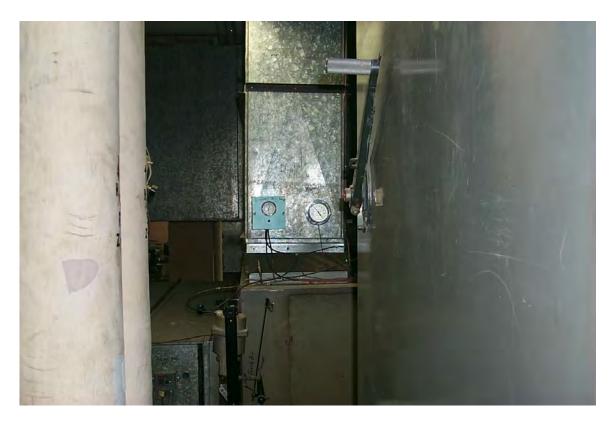
Picture #3472

Switchgear CCM-1 (A) 4 Sections 15000V Bay 3, Bay 6, Bay 7 Basement-North Electrical Room



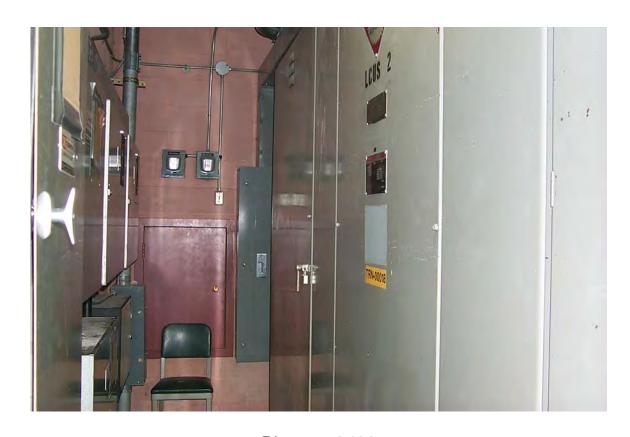
Picture #3473

Switchgear CCM-1 (A) Continued 15000V, 200A Bay-9 Basement-North Electrical Room



Picture #3498

Disconnect for LCUS-2 (TRN-00018) 13200V Basement-North Mech. Room



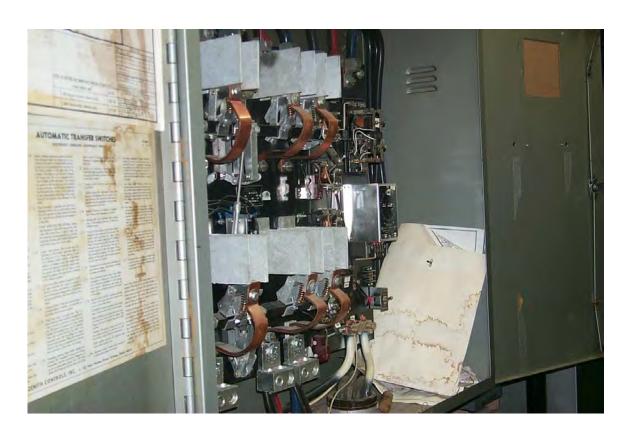
Picture #3499

Transformer LCUS-2 (TRN-00018)
300kva
13200V
208Y/120
Basement-North Mech. Room



Picture #3500

Switchboard for LCUS-2 (TRN-00018) 208V Basement-North Mech. Room



Picture # 3782

Automatic Transfer Switch (No number)
(Lighting LB-3)
250V Rating, 208V
200A
Basement-North Mech. Room



Picture # 3783

Automatic Transfer Switch (No number)
(Stairway Lights)
208V
100A
Basement-North Mech. Room



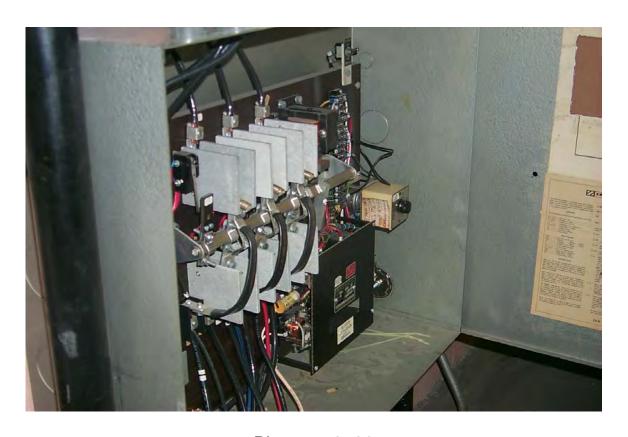
Picture # 3787

Automatic Transfer Switch ATS-10 (Air Hand. Unit #2) 480V Rating, 208V 40A Basement-North Mech. Room



Picture # 3785

Automatic Transfer Switch ATS-11
(Air Hand. Unit #1)
480V Rating, 208V
40A
Basement-North Mech. Room



Picture # 3786

Automatic Transfer Switch (No Number) (Emergency Lights, Lobbies/Restrooms) 208V 100A Basement-North Mech. Room



Picture #3474

Disconnect for LCUS-1 (TRN-00015) 13800V Basement-Center Mezzanine



Picture #3475

Transformer LCUS-1 (TRN-00015)
300kva
13200V
208Y/120
Basement-Center Mezzanine



Picture #3476

Switchboard for LCUS-1 (TRN-00015) 208V Basement-Center Mezzanine



Picture #3477

Motor Control Center MCC-00016 208V Basement-Center Mezzanine



Picture #3478

Motor Control Center MCC-00016 (Continued) 208V Basement-Center Mezzanine



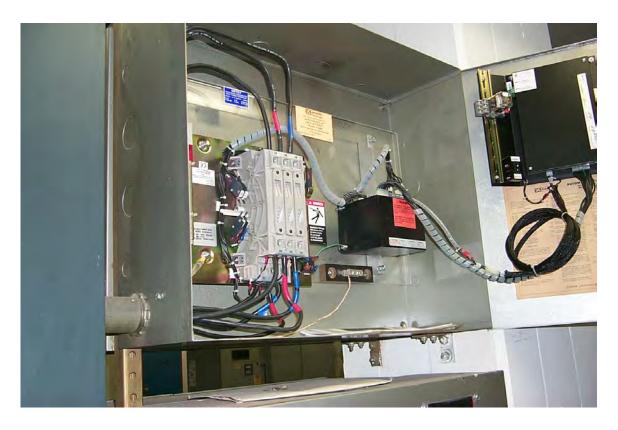
Picture #3776

Automatic Transfer Switch ATS-2 (Sump Pump)
208V
40A
Basement Mezzanine



Picture # 3778

Automatic Transfer Switch ATS-1 (Aux. Hot Water Pump) 208V 225A Basement Mezzanine



Picture # 3779

Automatic Transfer Switch ATS-3 (Air Comp. #1 and #2) 208V 100A Basement Mezzanine



Picture # 3780

Automatic Transfer Switch ATS-4 (Sewage Lift Pump) 208V 80A Basement Mezzanine



Picture # 3781

Automatic Transfer Switch ATS-5 (Condensate Pump P2/Emergency Feed Pump) 208V 40A Basement Mezzanine



Picture #3496

Motor Control Center MCC-00007 208V Basement-Statehouse Chiller Room



Picture #3497

Motor Control Center MCC-00007 (Continued) 208V Basement-Statehouse Chiller Room



Picture #3486

Transformer TRN-00011 1500kva 12470V 480/277 Basement



Picture #3487

Transformer TRN-00011 (Continued)
1500kva
12470V
480/277
Basement



Picture #3469

Disconnect CCM-1 (B) 13800V Basement-Mezzanine



Picture #3470

Transformer CCM-1 1500kva 13800V 480/277V Basement-Mezzanine



Picture #3480

Breaker MCC-00010 480V 50A Basement-Mezzanine



Picture #3483

Breaker MCC-00010 (Continued) 480V 50A Basement-Mezzanine



Picture #3481

Breaker MCC-00013 480V 50A Basement-Mezzanine



Picture #3482

Breaker MCC-00014 480V 50A Basement-Mezzanine



Picture #3484

Motor Control Center MCC-1

Basement-Mezzanine



Picture #3485

Disconnect for Boiler 480V 800A Basement-Mezzanine



Picture #3489

Disconnect MDP-00005 (DSOB-SB23) 13200V 60A Basement-Statehouse Chiller Room



Picture #3488

Transformer MDP-00005 (DSOB-SB23)
1500kva
13800V
480Y/277
Basement-Statehouse Chiller Room



Picture #3490

Switchboard for MDP-00005 (DSOB-SB23) 480V 1500A Basement-Statehouse Chiller Room



Picture #3491

Transformer MDP-00005 (DSOB-SB23)
112.5kva
480V
208Y/120
Basement-Statehouse Chiller Room



Picture #3493

Motor Control Center MCC-00004 480V Basement-Statehouse Chiller Room



Picture #3494

Motor Control Center MCC-00004 (continued) 480V Basement-Statehouse Chiller Room



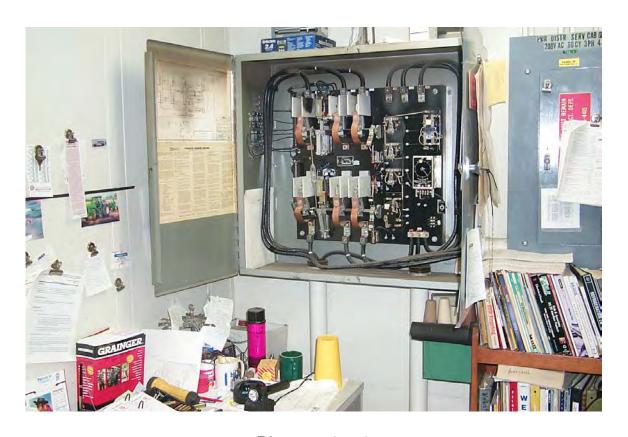
Picture #3495

Transformer to Heat Plant 150kva 480V 208Y/120 Basement-Heat Plant



Picture #3492

Switchboard 208V Basement-Statehouse Chiller Room



Picture #3773

Automatic Transfer Switch for Panel B Lighting 208V 200A Basement-Statehouse Chiller area



Picture #3774

Automatic Transfer Switch (No number)
208V
600A
Basement Distribution System-Heat Plant



Picture # 3771

Air Compressor
Automatic Transfer Switch
480V
40A
Basement-Statehouse Chiller Room



Picture #3772

Sump Pump
Automatic Transfer Switch
480V
40A
Basement-Statehouse Chiller Room

AUTOMATIC TRANSFER SWITCHES

Maintenance Testing Guidelines

The following information is a guide for maintenance services. Consult specific instruction manuals and drawings for detailed installation and operating procedures. Automatic Transfer Switches should be installed, operated, and maintained by qualified personnel as defined by OSHA 29CFR1910 subpart 5. These instructions do not cover all details, variations, or combinations of the equipment, its installation, checkout, and safe operation. Care must be exercised to comply with local, state, and national regulations, as well as safety practices for this class of equipment.

Prior To Testing

- Procure and review all drawing associated with the equipment being tested.
- Study all instructional documents (Operation and Maintenance Manuals) applicable to the equipment.
- Obtain a copy of the appropriate test form to record test results.
- Verify suitability and accuracy of equipment to be used for testing.
- Record all existing equipment settings as well as settings resulting from any necessary adjustments.

Necessary Equipment

- Personnel Protective Equipment (PPE)
- RMS Multimeter
- Torque Wrench
- Ductor
- Megger (1,000 volt)
- Megger (5,000 volt with selectable voltages)
- Phase Rotation Meter

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Revised On: 2/10/16

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DO NOT ATTEMPT TO INSTALL OR WORK ON EQUIPMENT WHILE IT IS ENERGIZED



Always verify that no voltage is present before proceeding with testing. Assume all circuits are energized. Confirm primary sources of power are disconnected, tagged, and locked out. Always follow all local, state, and national regulations including OSHA requirements and generally accepted safety procedures.

Inspection and Test Procedures

Visual and Mechanical Inspection

- 1. Inspect physical and mechanical condition.
- 2. Lubrication
 - **2.1.** Verify appropriate contact lubricant on moving current-carrying parts.
 - **2.2.** Verify appropriate lubrication on moving and sliding surfaces.
- 3. Verify that manual transfer warnings are attached and visible.
- **4.** Verify tightness of all control connections.
- 5. Inspect all bolted electrical connections for high resistance using one of the following methods:
 - **5.1.** Use of low-resistance ohmmeter in accordance with Step 2 of the "Electrical Tests" section of this document.
 - **5.2.** Verify tightness of accessible bolted electrical connections by calibrated torquewrench method in accordance with manufacturer's published data or Table 2.
 - **5.3.** Perform thermographic survey in accordance with the "Thermographic Survey Procedures" section of this document.
- **6.** Perform manual transfer operation.
- 7. Verify positive mechanical interlocking between normal and alternate sources.

Electrical Tests

- 1. Perform a contact-resistance test.
- 2. Perform resistance measurements through all bolted connections with a low-resistance ohmmeter, if applicable, in accordance with Step 5 of the "Visual and Mechanical Inspection" section of this document.
- **3.** Perform insulation-resistance tests, phase-to-phase and phase-to-ground, with switch in both source positions.
- **4.** Verify settings and operation of control devices.
- **5.** Calibrate and set all relays and timers in accordance with <u>Protective Relays: Maintenance Testing Guidelines.</u>
- **6.** 6.Perform automatic transfer tests:
 - **6.1.** Simulate loss of normal power.
 - **6.2.** Return to normal power.
 - **6.3.** Simulate loss of emergency power.
 - **6.4.** Simulate all forms of single-phase conditions.
- 7. Verify correct operation and timing of the following functions:
 - **7.1.** Normal source voltage-sensing relays.
 - **7.2.** Engine start sequence.
 - **7.3.** Time delay upon transfer.
 - **7.4.** Alternate source voltage-sensing relays.
 - **7.5.** Automatic transfer operation.
 - **7.6.** Interlocks and limit switch function.

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- **7.7.** Time delay and retransfer upon normal power restoration.
- **7.8.** Engine cool down and shutdown feature.

Test Values

- 1. Compare bolted connection resistances to values of similar connections.
- Bolt-torque levels shall be in accordance with Table 2 unless otherwise specified by manufacturer.
- 3. Microhm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values that deviate from adjacent poles or similar switches by more than 25 percent of the lowest value.
- **4.** Insulation-resistance test voltages and minimum values shall be in accordance with Table 3.

Thermographic Survey Procedures

- 1. Visual and Mechanical Inspection
 - **1.1.** Inspect physical, electrical, and mechanical condition.
 - **1.2.** Remove all necessary covers prior to thermographic inspection.
- 2. Equipment to be inspected shall include all current-carrying devices.
- **3.** Provide report including the following:
 - **3.1.** Discrepancies.
 - **3.2.** Temperature difference between the area of concern and the reference area.
 - **3.3.** Cause of temperature difference.
 - 3.4. Areas inspected. Identify inaccessible and/or unobservable areas and/or equipment.
 - **3.5.** Identify load conditions at time of inspection.
 - **3.6.** Provide photographs and/or thermograms of the deficient area.
- 4. Test Parameters
 - **4.1.** Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1°C at 30°C.
 - **4.2.** Equipment shall detect emitted radiation and convert detected radiation to visual signal.
 - **4.3.** Thermographic surveys should be performed during periods of maximum possible loading but not less than 40 percent of rated load of the electrical equipment being inspected. Refer to ANSI/NFPA 70B, Section 18-16 (Infrared Inspection).
- **5.** Test Results: Suggested actions based on temperature can be found in Table 1.

After Testing

- Finish recording data on the test form, completely filling in all the appropriate blocks.
- Remove all test equipment and tools used during testing. Replace all barriers and covers, close all doors, and secure all latches.

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TABLE 1
Thermographic Survey
Suggested Actions Based on Temperature Rise

Temperature difference (ΔT) based on comparisons between similar components under similar loading.	Temperature difference (ΔT) based upon comparisons between component and ambient air temperatures.	Recommended Action
1°C - 3°C	0°C - 10°C	Possible deficiency; warrants investigation
4°C - 15°C	11°C - 20°C	Indicates probable deficiency; repair as time permits
	22°C - 40°C	Monitor continuously until corrective measures can be accomplished
> 16°C	> 40°C	Major discrepancy; repair immediately

Temperature specifications vary depending on the exact type of equipment. Even in the same class of equipment (i.e., cables) there are various temperature ratings. Heating is generally related to the square of the current; therefore, the load current will have a major impact on ΔT . In the absence of consensus standards for ΔT , the values in this table will provide reasonable guidelines.

TABLE 2
US Standard
Bolt Torques for Bus Connections
Heat-Treated Steel - Cadmium or Zinc Plated

Grade	SAE 1 & 2	SAE 5	SAE 7	SAE 8
Minimum Tensile (P.S.I.)	64K	105K	133K	150K
Bolt Diameter In Inches		Torque (Foo	t Pounds)	
1/4	4.0	5.6	8.0	8.4
5/16	7.2	11.2	15.2	17.6
3/8	12.0	20.0	27.2	29.6
7/16	19.2	32.0	44.0	48.0
1/2	29.6	48.0	68.0	73.6
9/16	42.4	70.4	96.0	105.6
5/8	59.2	96.0	133.6	144.0
3/4	96.0	160.0	224.0	236.8
7/8	152.0	241.6	352.0	378.4
1.0	225.6	372.8	528.0	571.2

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TABLE 2 (cont.)

Bolt Torques for Bus Connections Silicon Bronze Fasteners* Torque (Foot-Pounds)

Bolt Diameter in Inches	Nonlubricated	Lubricated
5/16	15	10
3/8	20	14
1/2	40	25
5/8	55	40
3/4	70	60

^{*} Bronze alloy bolts shall have a minimum tensile strength of 70,000 pounds per square inch.

TABLE 2
Aluminum Alloy Fasteners**
Torque (Foot Pounds)

Bolt Diameter in Inches	Lubricated
5/16	8.0
3/8	11.2
1/2	20.0
5/8	32.0
3/4	48.0

^{**} Aluminum alloy bolts shall have a minimum tensile strength of 55,000 pounds per square inch.

TABLE 2
Bolt Torques for Bus Connections
Stainless Steel Fasteners***
Torque (Foot Pounds)

Bolt Diameter in Inches	Uncoated
5/16	14
3/8	25
1/2	45
5/8	60
3/4	90

^{***} Bolts, cap screws, nuts, flat washers, locknuts: 18-8 alloy. Belleviille washers: 302 alloy.

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TABLE 3 Insulation Resistance Tests on Electrical Apparatus and Systems

Maximum Rating of Equipment in Volts	Minimum Test Voltage, dc in Volts	Recommended Minimum Insulation Resistance in Megohms
250	500	25
600	1,000	100
5,000	2,500	1,000
8,000	2,500	2,000
15,000	2,500	5,000
25,000	5,000	20,000
35,000	15,000	100,000
46,000	15,000	100,000
69,000	15,000	100,000

In the absence of consensus standards dealing with insulation-resistance tests, the NETA Technical Committee suggests the above representative values. See Table 4 for temperature correction factors.

Actual test results are dependent on the length of the conductor being tested, the temperature of the insulating material, and the humidity of the surrounding environment at the time of the test. In addition, insulation resistance tests are performed to establish a trending pattern and a deviation from the baseline information obtained during maintenance testing enabling the evaluation of the insulation for confined use.

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TABLE 4
Insulation Resistance Conversion Factors
For Conversion of Test Temperature to 20°C

Temp	erature	Multiplier	
င့	°F	Apparatus Containing Immersed Oil Insulations	Apparatus Containing Solid Insulations
0	32	0.25	0.40
5	41	0.36	0.45
10	50	0.50	0.50
15	59	0.75	0.75
20	68	1.00	1.00
25	77	1.40	1.30
30	86	1.98	1.60
35	95	2.80	2.05
40	104	3.95	2.50
45	113	5.60	3.25
50	122	7.85	4.00
55	131	11.20	5.20
60	140	15.85	6.40
65	149	22.40	8.70
70	158	31.75	10.00
75	167	44.70	13.00
80	176	63.50	16.00

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METAL-ENCLOSED BUSWAYS

Maintenance Testing Guidelines

The following information is a guide for maintenance services. Consult specific instruction manuals and drawings for detailed installation and operating procedures. Metal Enclosed Busways should be installed, operated, and maintained by qualified personnel as defined by OSHA 29CFR1910 subpart 5. These instructions do not cover all details, variations, or combinations of the equipment, its installation, checkout, and safe operation. Care must be exercised to comply with local, state, and national regulations, as well as safety practices for this class of equipment.

Prior To Testing

- Procure and review all drawing associated with the equipment being tested.
- Study all instructional documents (Operation and Maintenance Manuals) applicable to the equipment.
- Obtain a copy of the appropriate test form to record test results.
- Verify suitability and accuracy of equipment to be used for testing.
- Record all existing equipment settings as well as settings resulting from any necessary adjustments.

Necessary Equipment

- Personnel Protective Equipment (PPE)
- RMS Multimeter
- Torque Wrench
- Ductor
- Megger (5,000 volt with selectable voltages)

File: busduct Revision: 0.0 Revised On: 2/10/16

DO NOT ATTEMPT TO INSTALL OR WORK ON EQUIPMENT WHILE IT IS ENERGIZED



Always verify that no voltage is present before proceeding with testing. Assume all circuits are energized. Confirm primary sources of power are disconnected, tagged, and locked out. Always follow all local, state, and national regulations including OSHA requirements and generally accepted safety procedures.

Inspection and Test Procedures

Visual and Mechanical Inspection

- 1. Inspect busway for physical damage and evidence of corona.
- 2. Inspect for appropriate bracing, suspension, alignment, and enclosure ground.
- 3. Inspect all bolted electrical connections for high resistance using one of the following methods:
 - **3.1.** Use of low-resistance ohmmeter in accordance with Step 3 of the "Electrical Tests" section of this document.
 - **3.2.** Verify tightness of accessible bolted electrical connections and bus joints by calibrated torque-wrench method in accordance with manufacturer's published data or Table 2.
 - **3.3.** Perform thermographic survey in accordance with the "Thermographic Survey Procedures" section of this document.
- **4.** Confirm physical orientation in accordance with manufacturer's labels to insure adequate cooling.
- 5. Examine outdoor busway for removal of "weep-hole" plugs, if applicable, and the correct installation of joint shield.
- 6. Inspect and clean all ventilating openings.

Electrical Tests

- **1.** Measure insulation resistance of each busway, phase-to-phase and phase-to-ground for one minute, in accordance with Table 3.
- 2. Perform an overpotential test on each busway, phase-to-ground with phases not under test grounded, in accordance with Table 4. Where no dc test value is shown in Table 14, ac value shall be used. The test voltage shall be applied for one minute.
- **3.** Perform resistance measurements through all bolted connections and bus joints with a low-resistance ohmmeter, if applicable, in accordance with Step 3 of the "Visual and Mechanical Inspection" section of this document.
- **4.** Verify operation of busway heaters.

Test Values

- Compare bolted connection resistances and bus joint resistances to values of similar connections.
- 2. Bolt-torque levels shall be in accordance with Table 2 unless otherwise specified by manufacturer.
- 3. Microhm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values which deviate from similar bus joints and connections by more than 25 percent of the lowest value.

4. Insulation-resistance test voltages and resistance values shall be in accordance with manufacturer's specifications or Table 3. Minimum resistance values are for a nominal 1000-foot busway run or megohms for 1000 feet. For busway runs over 1000 feet, derate accordingly by the formula:

R_{1000ft} = Measured Resistance X Length of Run/1000

Values of insulation resistance less than this table or manufacturer's minimum should be investigated. Overpotential tests should not proceed until insulation-resistance levels are raised above minimum values.

5. The insulation shall withstand the overpotential test voltage applied.

Thermographic Survey Procedures

- 1. Visual and Mechanical Inspection
 - **1.1.** Inspect physical, electrical, and mechanical condition.
 - **1.2.** Remove all necessary covers prior to thermographic inspection.
- 2. Equipment to be inspected shall include all current-carrying devices.
- **3.** Provide report including the following:
 - 3.1. Discrepancies.
 - **3.2.** Temperature difference between the area of concern and the reference area.
 - **3.3.** Cause of temperature difference.
 - 3.4. Areas inspected. Identify inaccessible and/or unobservable areas and/or equipment.
 - **3.5.** Identify load conditions at time of inspection.
 - 3.6. Provide photographs and/or thermograms of the deficient area.
- 4. Test Parameters
 - **4.1.** Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1°C at 30°C.
 - **4.2.** Equipment shall detect emitted radiation and convert detected radiation to visual signal.
 - **4.3.** Thermographic surveys should be performed during periods of maximum possible loading but not less than 40 percent of rated load of the electrical equipment being inspected. Refer to ANSI/NFPA 70B, Section 18-16 (Infrared Inspection).
- **5.** Test Results: Suggested actions based on temperature can be found in Table 1.

After Testing

- Finish recording data on the test form, completely filling in all the appropriate blocks
- Remove all test equipment and tools used during testing. Replace all barriers and covers, close all doors, and secure all latches.

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TABLE 1
Thermographic Survey
Suggested Actions Based on Temperature Rise

Temperature difference (ΔT) based on comparisons between similar components under similar loading.	Temperature difference (ΔT) based upon comparisons between component and ambient air temperatures.	Recommended Action
1°C - 3°C	0°C - 10°C	Possible deficiency; warrants investigation
4°C - 15°C	11°C - 20°C	Indicates probable deficiency; repair as time permits
	22°C - 40°C	Monitor continuously until corrective measures can be accomplished
> 16°C	> 40°C	Major discrepancy; repair immediately

Temperature specifications vary depending on the exact type of equipment. Even in the same class of equipment (i.e., cables) there are various temperature ratings. Heating is generally related to the square of the current; therefore, the load current will have a major impact on ΔT . In the absence of consensus standards for ΔT , the values in this table will provide reasonable guidelines.

TABLE 2
US Standard
Bolt Torques for Bus Connections
Heat-Treated Steel - Cadmium or Zinc Plated

Grade	SAE 1 & 2	SAE 5	SAE 7	SAE 8
Minimum Tensile (P.S.I.)	64K	105K	133K	150K
Bolt Diameter In Inches		Torque (Foo	t Pounds)	
1/4	4.0	5.6	8.0	8.4
5/16	7.2	11.2	15.2	17.6
3/8	12.0	20.0	27.2	29.6
7/16	19.2	32.0	44.0	48.0
1/2	29.6	48.0	68.0	73.6
9/16	42.4	70.4	96.0	105.6
5/8	59.2	96.0	133.6	144.0
3/4	96.0	160.0	224.0	236.8
7/8	152.0	241.6	352.0	378.4
1.0	225.6	372.8	528.0	571.2

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TABLE 2 (cont.)

Bolt Torques for Bus Connections Silicon Bronze Fasteners* Torque (Foot-Pounds)

Bolt Diameter in Inches	Nonlubricated	Lubricated
5/16	15	10
3/8	20	14
1/2	40	25
5/8	55	40
3/4	70	60

^{*} Bronze alloy bolts shall have a minimum tensile strength of 70,000 pounds per square inch.

TABLE 2
Aluminum Alloy Fasteners**
Torque (Foot Pounds)

Bolt Diameter in Inches	Lubricated
5/16	8.0
3/8	11.2
1/2	20.0
5/8	32.0
3/4	48.0

^{**} Aluminum alloy bolts shall have a minimum tensile strength of 55,000 pounds per square inch.

TABLE 2
Bolt Torques for Bus Connections
Stainless Steel Fasteners***
Torque (Foot Pounds)

Bolt Diameter in Inches	Uncoated
5/16	14
3/8	25
1/2	45
5/8	60
3/4	90

^{***} Bolts, cap screws, nuts, flat washers, locknuts: 18-8 alloy. Belleviille washers: 302 alloy.

TABLE 3
Insulation Resistance Tests on
Electrical Apparatus and Systems

Maximum Rating of Equipment in Volts	Minimum Test Voltage, dc in Volts	Recommended Minimum Insulation Resistance in Megohms
250	500	25
600	1,000	100
5,000	2,500	1,000
8,000	2,500	2,000
15,000	2,500	5,000
25,000	5,000	20,000
35,000	15,000	100,000
46,000	15,000	100,000
69,000	15,000	100,000

In the absence of consensus standards dealing with insulation-resistance tests, the NETA Technical Committee suggests the above representative values. See Table 5 for temperature correction factors.

Actual test results are dependent on the length of the conductor being tested, the temperature of the insulating material, and the humidity of the surrounding environment at the time of the test. In addition, insulation resistance tests are performed to establish a trending pattern and a deviation from the baseline information obtained during maintenance testing enabling the evaluation of the insulation for confined use.

TABLE 4

Metal-Enclosed Bus Dielectric Withstand Test Voltages

Type of Bus	Rated kV	Maximum Test Voltage, kV	
		ac	dc
Isolated Phase for Generator Leads	24.5 29.5 34.5	37.0 45.0 60.0	52.0
Isolated Phase for Other than Generator Leads	15.5 25.8 38.0	37.0 45.0 60.0	52.0
Nonsegregated Phase	0.635 4.76 15.0 25.8 38.0	1.6 14.2 27.0 45.0 60.0	2.3 20.0 37.0 63.0
Segregated Phase	15.5 25.8 38.0	37.0 45.0 60.0	52.0 63.0
DC Bus Duct	0.3 0.8 1.2 1.6 3.2	1.6 2.7 3.4 4.0 6.6	2.3 3.9 4.8 5.7 9.3

Derived from ANSI-IEEE C37.23-1987, Tables 3A, 3B, 3C, 3D and paragraph 6.4.2. The table includes a 0.75 multiplier with fractions rounded down.

NOTE: The presence of the column headed "dc" does not imply any requirement for a dc withstand test on ac equipment. This column is given as a reference only for those using dc tests and represents values believed to be appropriate and approximately equivalent to the corresponding power frequency withstand test values specified for each class of bus.

Direct current withstand tests are recommended for flexible bus to avoid the loss of insulation life that may result from the dielectric heating that occurs with rated frequency withstand testing.

Because of the variable voltage distribution encountered when making dc withstand tests and variances in leakage currents associated with various insulation systems, the manufacturer should be consulted for recommendations before applying dc withstand tests to this equipment.

TABLE 5
Insulation ResistanceConversion Factors
For Conversion of Test Temperature to 20°C

Temperature		Multiplier		
°C	°F	Apparatus Containing Immersed Oil Insulations	Apparatus Containing Solid Insulations	
0	32	0.25	0.40	
5	41	0.36	0.45	
10	50	0.50	0.50	
15	59	0.75	0.75	
20	68	1.00	1.00	
25	77	1.40	1.30	
30	86	1.98	1.60	
35	95	2.80	2.05	
40	104	3.95	2.50	
45	113	5.60	3.25	
50	122	7.85	4.00	
55	131	11.20	5.20	
60	140	15.85	6.40	
65	149	22.40	8.70	
70	158	31.75	10.00	
75	167	44.70	13.00	
80	176	63.50	16.00	

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Electrical Equipment Testing Specifications

ENGINE GENERATORS

Maintenance Testing Guidelines

The following information is a guide for maintenance services. Consult specific instruction manuals and drawings for detailed installation and operating procedures. Engine Generators should be installed, operated, and maintained by qualified personnel as defined by OSHA 29CFR1910 subpart 5. These instructions do not cover all details, variations, or combinations of the equipment, its installation, checkout, and safe operation. Care must be exercised to comply with local, state, and national regulations, as well as safety practices for this class of equipment.

Prior To Testing

- Procure and review all drawing associated with the equipment being tested.
- Study all instructional documents (Operation and Maintenance Manuals) applicable to the equipment.
- Obtain a copy of the appropriate test form to record test results.
- Verify suitability and accuracy of equipment to be used for testing.
- Record all existing equipment settings as well as settings resulting from any necessary adjustments.

Necessary Equipment

- Personnel Protective Equipment (PPE)
- RMS Multimeter
- RMS Ammeter
- Torque Wrench
- Ductor
- Megger (1,000 volt)
- Megger (5,000 volt with selectable voltages)
- Vibration Tester

File: generator Revision: 0.0 Revised On: 2/10/16

DO NOT ATTEMPT TO INSTALL OR WORK ON EQUIPMENT WHILE IT IS ENERGIZED



Always verify that no voltage is present before proceeding with testing. Assume all circuits are energized. Confirm primary sources of power are disconnected, tagged, and locked out. Always follow all local, state, and national regulations including OSHA requirements and generally accepted safety procedures.

Inspection and Test Procedures

NOTE: The prime mover is not addressed in these specifications.

Visual and Mechanical Inspection

- 1. Inspect physical and mechanical condition.
- 2. Inspect correct anchorage and grounding.

Electrical and Mechanical Tests

- 1. Perform an insulation-resistance test on generator winding with respect to ground in accordance with ANSI/IEEE Standard 43. Calculate polarization index.
- Test protective relay devices in accordance with <u>Protective Relays: Maintenance Testing Guidelines.</u>
- **3.** Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other features as applicable.
- **4.** Perform vibration test for each main bearing cap.
- **5.** Conduct performance test in accordance with NFPA Standard 110.
- **6.** Verify correct functioning of governor and regulator.

Test Values

- 1. Polarization index values shall be in accordance with ANSI/IEEE Standard 43.
- 2. Vibration levels shall be in accordance with manufacturer's published data and compared to baseline data.
- Performance tests shall conform to manufacturer's published data and ANSI/NFPA Standard 110.

After Testing

- Finish recording data on the test form, completely filling in all the appropriate blocks.
- Remove all test equipment and tools used during testing. Replace all barriers and covers, close all doors, and secure all latches.

File: generator Page 2 of 2

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GROUNDING SYSTEMS

Maintenance Testing Guidelines

The following information is a guide for maintenance services. Consult specific instruction manuals and drawings for detailed installation and operating procedures. Grounding Systems should be installed, operated, and maintained by qualified personnel as defined by OSHA 29CFR1910 subpart 5. These instructions do not cover all details, variations, or combinations of the equipment, its installation, checkout, and safe operation. Care must be exercised to comply with local, state, and national regulations, as well as safety practices for this class of equipment.

Prior To Testing

- Procure and review all drawing associated with the equipment being tested.
- Study all instructional documents (Operation and Maintenance Manuals) applicable to the equipment.
- Obtain a copy of the appropriate test form to record test results.
- Verify suitability and accuracy of equipment to be used for testing.
- Record all existing equipment settings as well as settings resulting from any necessary adjustments.

Necessary Equipment

- Personnel Protective Equipment (PPE)
- RMS Multimeter
- Torque Wrench
- RMS Ammeter
- Ground Resistance Tester
- Megger (1,000 volt)
- Megger (5,000 volt with selectable voltages)
- Test Leads and Test Rods
- Earth Megger

File: grounding Revision: 0.0 Revised On: 2/10/16

DO NOT ATTEMPT TO INSTALL OR WORK ON EQUIPMENT WHILE IT IS ENERGIZED



Always verify that no voltage is present before proceeding with testing. Assume all circuits are energized. Confirm primary sources of power are disconnected, tagged, and locked out. Always follow all local, state, and national regulations including OSHA requirements and generally accepted safety procedures.

Inspection and Test Procedures

Visual and Mechanical Inspection

- 1. Verify ground system.
- **2.** Electrical Tests
 - **2.1.** Perform fall-of-potential test or alternative in accordance with IEEE Standard 81 on the main grounding electrode or system.
 - **2.2.** Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.

Test Values

- 1. The resistance between the main grounding electrode and ground should be no greater than five ohms for commercial or industrial systems and one ohm or less for generating or transmission station grounds unless otherwise specified by the owner. (Reference ANSI/IEEE Standard 142)
- 2. Investigate point-to-point resistance values which exceed 0.5 ohm.

After Testing

- Finish recording data on the test form, completely filling in all the appropriate blocks.
- Remove all test equipment and tools used during testing. Replace all barriers and covers, close all doors, and secure all latches.

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LOW-VOLTAGE POWER CIRCUIT BREAKERS

Maintenance Testing Guidelines

The following information is a guide for maintenance services. Consult specific instruction manuals and drawings for detailed installation and operating procedures. Low-Voltage Power Circuit Breakers should be installed, operated, and maintained by qualified personnel as defined by OSHA 29CFR1910 subpart 5. These instructions do not cover all details, variations, or combinations of the equipment, its installation, checkout, and safe operation. Care must be exercised to comply with local, state, and national regulations, as well as safety practices for this class of equipment.

Prior To Testing

- Procure and review all drawing associated with the equipment being tested.
- Study all instructional documents (Operation and Maintenance Manuals) applicable to the equipment.
- Obtain a copy of the appropriate test form to record test results.
- Verify suitability and accuracy of equipment to be used for testing.
- Record all existing equipment settings as well as settings resulting from any necessary adjustments

Necessary Equipment

- Personnel Protective Equipment (PPE)
- RMS Multimeter
- Torque Wrench
- Ductor
- Megger (1,000 volt)
- Single Phase High Current Test Source with Timer
- Trip Unit Test Set

DO NOT ATTEMPT TO INSTALL OR WORK ON EQUIPMENT WHILE IT IS ENERGIZED



Always verify that no voltage is present before proceeding with testing. Assume all circuits are energized. Confirm primary sources of power are disconnected, tagged, and locked out. Always follow all local, state, and national regulations including OSHA requirements and generally accepted safety procedures.

File: low voltage CB Revision: 0.0 Revised On: 2/10/16

Inspection and Test Procedures

Visual and Mechanical Inspection

- 1. Inspect physical and mechanical condition.
- **2.** Inspect anchorage, alignment, and grounding. Inspect arc chutes. Inspect moving and stationary contacts for condition, wear, and alignment.
- 3. Verify that all maintenance devices are available for servicing and operating the breaker.
- **4.** Verify that primary and secondary contact wipe and other dimensions vital to satisfactory operation of the breaker are correct.
- 5. Perform all mechanical operator and contact alignment tests on both the breaker and its operating mechanism.
- **6.** Inspect all bolted electrical connections for high resistance using one of the following methods:
 - **6.1.** Use of low-resistance ohmmeter in accordance with Step 3 of the "Electrical Tests" section of this document.
 - **6.2.** Verify tightness of accessible bolted electrical connections by calibrated torquewrench method in accordance with manufacturer's published data or Table 2.
 - **6.3.** Perform thermographic survey in accordance with the "Thermographic Survey Procedures" section of this document.
- 7. Verify cell fit and element alignment.
- **8.** Verify racking mechanism.
- 9. Thoroughly clean unit prior to testing unless as-found and as-left tests are required.
- 10. 1Lubrication
 - **10.1.** Verify appropriate contact lubricant on moving current-carrying parts.
 - **10.2.** Verify appropriate lubrication on moving and sliding surfaces.

Electrical Tests

- 1. Perform a contact-resistance test.
- **2.** Perform an insulation-resistance test at 1000 volts dc from pole-to-pole and from each pole-to-ground with breaker closed and across open contacts of each phase.
- **3.** Inspect all bolted electrical connections for high resistance using one of the following methods:
 - **3.1.** Use of low-resistance ohmmeter in accordance with Step 6 of the "Visual and Mechanical Inspection" section of this document.
 - **3.2.** Verify tightness of accessible bolted electrical connections by calibrated torquewrench method in accordance with manufacturer's published data or Table 2.
 - **3.3.** Perform thermographic survey in accordance with the "Thermographic Survey Procedures" section of this document.
- **4.** Perform an insulation-resistance test at 1000 volts dc on all control wiring. For units with solid-state components, follow manufacturer's recommendations. (Option1)
- 5. Make adjustments for the final settings in accordance with the coordination study supplied by owner.
- **6.** Determine minimum pickup current by primary current injection.
- **7.** Determine long-time delay by primary current injection.
- **8.** Determine short-time pickup and delay by primary current injection.
- 9. Determine ground-fault pickup and delay by primary current injection.
- 10. Determine instantaneous pickup value by primary current injection.
- 11. Verify the calibration of all functions of the trip unit by means of secondary injection.
- **12.** Activate auxiliary protective devices, such as ground-fault or undervoltage relays, to insure operation of shunt trip devices. Check the operation of electrically-operated breakers in their cubicles.
- **13.** Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and antipump function.

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14. Verify operation of charging mechanism.

Test Values

- 1. Compare bolted connection resistances to values of similar connections.
- Bolt-torque levels shall be in accordance with Table 2 unless otherwise specified by manufacturer.
- 3. Microhm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values which deviate from adjacent poles or similar breakers by more than 25 percent of the lowest value.
- **4.** Circuit breaker insulation resistance shall be in accordance with Table 3.
- **5.** Control wiring insulation resistance shall be a minimum of two megohms.
- **6.** Trip characteristics of breakers shall fall within manufacturer's published time-current tolerance bands.

Thermographic Survey Procedures

- 1. Visual and Mechanical Inspection
 - **1.1.** Inspect physical, electrical, and mechanical condition.
 - **1.2.** Remove all necessary covers prior to thermographic inspection.
- 2. Equipment to be inspected shall include all current-carrying devices.
- **3.** Provide report including the following:
 - 3.1. Discrepancies.
 - **3.2.** Temperature difference between the area of concern and the reference area.
 - **3.3.** Cause of temperature difference.
 - **3.4.** Areas inspected. Identify inaccessible and/or unobservable areas and/or equipment.
 - **3.5.** Identify load conditions at time of inspection.
 - **3.6.** Provide photographs and/or thermograms of the deficient area.
- 4. Test Parameters
 - **4.1.** Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1°C at 30°C.
 - **4.2.** Equipment shall detect emitted radiation and convert detected radiation to visual signal.
 - **4.3.** Thermographic surveys should be performed during periods of maximum possible loading but not less than 40 percent of rated load of the electrical equipment being inspected. Refer to ANSI/NFPA 70B, Section 18-16 (Infrared Inspection).
- **5.** Test Results: Suggested actions based on temperature can be found in Table 1.

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After Testing

- Finish recording data on the test form, completely filling in all the appropriate blocks.
- Remove all test equipment and tools used during testing. Replace all barriers and covers, close all doors, and secure all latches.

TABLE 1
Thermographic Survey
Suggested Actions Based on Temperature Rise

Temperature difference (ΔT) based on comparisons between similar components under similar loading.	Temperature difference (ΔT) based upon comparisons between component and ambient air temperatures.	Recommended Action
1°C - 3°C	0°C - 10°C	Possible deficiency; warrants investigation
4°C - 15°C	11°C - 20°C	Indicates probable deficiency; repair as time permits
	22°C - 40°C	Monitor continuously until corrective measures can be accomplished
> 16°C	> 40°C	Major discrepancy; repair immediately

Temperature specifications vary depending on the exact type of equipment. Even in the same class of equipment (i.e., cables) there are various temperature ratings. Heating is generally related to the square of the current; therefore, the load current will have a major impact on ΔT . In the absence of consensus standards for ΔT , the values in this table will provide reasonable guidelines.

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TABLE 2
US Standard

Bolt Torques for Bus Connections Heat-Treated Steel - Cadmium or Zinc Plated

Grade	SAE 1 & 2	SAE 5	SAE 7	SAE 8
Minimum Tensile (P.S.I.)	64K	105K	133K	150K
Bolt Diameter In Inches		Torque (Foo	ot Pounds)	
1/4	4.0	5.6	8.0	8.4
5/16	7.2	11.2	15.2	17.6
3/8	12.0	20.0	27.2	29.6
7/16	19.2	32.0	44.0	48.0
1/2	29.6	48.0	68.0	73.6
9/16	42.4	70.4	96.0	105.6
5/8	59.2	96.0	133.6	144.0
3/4	96.0	160.0	224.0	236.8
7/8	152.0	241.6	352.0	378.4
1.0	225.6	372.8	528.0	571.2

TABLE 2

Bolt Torques for Bus Connections Silicon Bronze Fasteners* Torque (Foot-Pounds)

Bolt Diameter in Inches	Nonlubricated	Lubricated
5/16	15	10
3/8	20	14
1/2	40	25
5/8	55	40
3/4	70	60

^{*} Bronze alloy bolts shall have a minimum tensile strength of 70,000 pounds per square inch.

File: low voltage CB

TABLE 2 (cont.) Aluminum Alloy Fasteners** Torque (Foot Pounds)

Bolt Diameter in Inches	Lubricated
5/16	8.0
3/8	11.2
1/2	20.0
5/8	32.0
3/4	48.0

^{**} Aluminum alloy bolts shall have a minimum tensile strength of 55,000 pounds per square inch.

TABLE 2
Bolt Torques for Bus Connections
Stainless Steel Fasteners***
Torque (Foot Pounds)

Bolt Diameter in Inches	Uncoated
5/16	14
3/8	25
1/2	45
5/8	60
3/4	90

^{***} Bolts, cap screws, nuts, flat washers, locknuts: 18-8 alloy. Belleviille washers: 302 alloy.

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TABLE 3 Insulation Resistance Tests on Electrical Apparatus and Systems

Maximum Rating of Equipment in Volts	Minimum Test Voltage, dc in Volts	Recommended Minimum Insulation Resistance in Megohms
250	500	25
600	1,000	100
5,000	2,500	1,000
8,000	2,500	2,000
15,000	2,500	5,000
25,000	5,000	20,000
35,000	15,000	100,000
46,000	15,000	100,000
69,000	15,000	100,000

In the absence of consensus standards dealing with insulation-resistance tests, the NETA Technical Committee suggests the above representative values. See Table 4 for temperature correction factors.

Actual test results are dependent on the length of the conductor being tested, the temperature of the insulating material, and the humidity of the surrounding environment at the time of the test. In addition, insulation resistance tests are performed to establish a trending pattern and a deviation from the baseline information obtained during maintenance testing enabling the evaluation of the insulation for confined use.

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TABLE 4 **Insulation ResistanceConversion Factors** For Conversion of Test Temperature to 20°C

Temp	erature	Multiplier	
°	°F	Apparatus Containing Immersed Oil Insulations	Apparatus Containing Solid Insulations
0	32	0.25	0.40
5	41	0.36	0.45
10	50	0.50	0.50
15	59	0.75	0.75
20	68	1.00	1.00
25	77	1.40	1.30
30	86	1.98	1.60
35	95	2.80	2.05
40	104	3.95	2.50
45	113	5.60	3.25
50	122	7.85	4.00
55	131	11.20	5.20
60	140	15.85	6.40
65	149	22.40	8.70
70	158	31.75	10.00
75	167	44.70	13.00
80	176	63.50	16.00

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LOW-VOLTAGE CABLES, 600 VOLT MAXIMUM

Maintenance Testing Guidelines

The following information is a guide for maintenance services. Consult specific instruction manuals and drawings for detailed installation and operating procedures. Low-Voltage Cables should be installed, operated, and maintained by qualified personnel as defined by OSHA 29CFR1910 subpart 5. These instructions do not cover all details, variations, or combinations of the equipment, its installation, checkout, and safe operation. Care must be exercised to comply with local, state, and national regulations, as well as safety practices for this class of equipment.

Prior To Testing

- Procure and review all drawing associated with the equipment being tested.
- Study all instructional documents (Operation and Maintenance Manuals) applicable to the equipment.
- Obtain a copy of the appropriate test form to record test results.
- Verify suitability and accuracy of equipment to be used for testing.
- Record all existing equipment settings as well as settings resulting from any necessary adjustments.

Necessary Equipment

- Personnel Protective Equipment (PPE)
- RMS Multimeter
- Torque Wrench
- Ductor
- Megger (5,000 volt with selectable voltages)
- Hi-Pot Tester
- Phase Rotation Meter

File: low-voltage cable Page 1 of 5

Revision: 0.0 Revised On: 2/10/16

DO NOT ATTEMPT TO INSTALL OR WORK ON EQUIPMENT WHILE IT IS ENERGIZED



Always verify that no voltage is present before proceeding with testing. Assume all circuits are energized. Confirm primary sources of power are disconnected, tagged, and locked out. Always follow all local, state, and national regulations including OSHA requirements and generally accepted safety procedures.

Inspection and Test Procedures

Visual and Mechanical Inspection

- 1. Inspect exposed sections of cables for physical damage and evidence of overheating.
- 2. Inspect all bolted electrical connections for high resistance using one of the following methods:
 - **2.1.** Use of low-resistance ohmmeter in accordance with Step 2 of the "Electrical Tests" section of this document.
 - **2.2.** Verify tightness of accessible bolted electrical connections by calibrated torquewrench method in accordance with manufacturer's published data or Table 2.
 - **2.3.** Perform thermographic survey in accordance with the "Thermographic Survey Procedures" section of this document.
- 3. Inspect compression-applied connectors for correct cable match and indentation.

Electrical Tests

- 1. Perform insulation-resistance tests on each cable phase-to-phase and phase-to-ground. Applied potential to be 1000 volts dc for one minute.
- 2. Perform resistance measurements through all bolted connections with a low-resistance ohmmeter, if applicable, in accordance with Step 5 of the "Visual and Mechanical Inspection" section of this document.

Test Values

- 1. Compare bolted connection resistances to values of similar connections.
- Bolt-torque levels shall be in accordance with Table 1 unless otherwise specified by the manufacturer.
- 3. Microhm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values which deviate from similar connections by more than 25 percent of the lowest value.
- **4.** Minimum insulation-resistance values should be comparable to previously obtained results but not less than two megohms.
- 5. Investigate deviations between adjacent phases.

Thermographic Survey Procedures

- 1. Visual and Mechanical Inspection
 - **1.1.** Inspect physical, electrical, and mechanical condition.
 - **1.2.** Remove all necessary covers prior to thermographic inspection.
- **2.** Equipment to be inspected shall include all current-carrying devices.
- **3.** Provide report including the following:

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- 3.1. Discrepancies.
- **3.2.** Temperature difference between the area of concern and the reference area.
- **3.3.** Cause of temperature difference.
- 3.4. Areas inspected. Identify inaccessible and/or unobservable areas and/or equipment.
- **3.5.** Identify load conditions at time of inspection.
- **3.6.** Provide photographs and/or thermograms of the deficient area.
- 4. Test Parameters
 - **4.1.** Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1°C at 30°C.
 - **4.2.** Equipment shall detect emitted radiation and convert detected radiation to visual signal.
 - **4.3.** Thermographic surveys should be performed during periods of maximum possible loading but not less than 40 percent of rated load of the electrical equipment being inspected. Refer to ANSI/NFPA 70B, Section 18-16 (Infrared Inspection).
- **5.** Test Results: Suggested actions based on temperature can be found in Table 1.

After Testing

- Finish recording data on the test form, completely filling in all the appropriate blocks.
- Remove all test equipment and tools used during testing. Replace all barriers and covers, close all doors, and secure all latches.

TABLE 1 Thermographic Survey Suggested Actions Based on Temperature Rise

Temperature difference (ΔT) based on comparisons between similar components under similar loading.	Temperature difference (ΔT) based upon comparisons between component and ambient air temperatures.	Recommended Action
1°C - 3°C	0°C - 10°C	Possible deficiency; warrants investigation
4°C - 15°C	11°C - 20°C	Indicates probable deficiency; repair as time permits
	22°C - 40°C	Monitor continuously until corrective measures can be accomplished
> 16°C	> 40°C	Major discrepancy; repair immediately

Temperature specifications vary depending on the exact type of equipment. Even in the same class of equipment (i.e., cables) there are various temperature ratings. Heating is generally related to the square of the current; therefore, the load current will have a major impact on ΔT . In the absence of consensus standards for ΔT , the values in this table will provide reasonable guidelines.

File: low-voltage cable

TABLE 2
US Standard
Bolt Torques for Bus Connections
Heat-Treated Steel - Cadmium or Zinc Plated

Grade	SAE 1 & 2	SAE 5	SAE 7	SAE 8
Minimum Tensile (P.S.I.)	64K	105K	133K	150K
Bolt Diameter In Inches		Torque (Foo	ot Pounds)	
1/4	4.0	5.6	8.0	8.4
5/16	7.2	11.2	15.2	17.6
3/8	12.0	20.0	27.2	29.6
7/16	19.2	32.0	44.0	48.0
1/2	29.6	48.0	68.0	73.6
9/16	42.4	70.4	96.0	105.6
5/8	59.2	96.0	133.6	144.0
3/4	96.0	160.0	224.0	236.8
7/8	152.0	241.6	352.0	378.4
1.0	225.6	372.8	528.0	571.2

TABLE 2
Bolt Torques for Bus Connections
Silicon Bronze Fasteners*
Torque (Foot-Pounds)

Bolt Diameter in Inches	Nonlubricated	Lubricated
5/16	15	10
3/8	20	14
1/2	40	25
5/8	55	40
3/4	70	60

 $^{^{\}star}$ Bronze alloy bolts shall have a minimum tensile strength of 70,000 pounds per square inch.

File: low-voltage cable

TABLE 2 (cont.) Aluminum Alloy Fasteners** Torque (Foot Pounds)

Bolt Diameter in Inches	Lubricated
5/16	8.0
3/8	11.2
1/2	20.0
5/8	32.0
3/4	48.0

^{**} Aluminum alloy bolts shall have a minimum tensile strength of 55,000 pounds per square inch.

TABLE 2
Bolt Torques for Bus Connections
Stainless Steel Fasteners***
Torque (Foot Pounds)

Bolt Diameter in Inches	Uncoated
5/16	14
3/8	25
1/2	45
5/8	60
3/4	90

^{***} Bolts, cap screws, nuts, flat washers, locknuts: 18-8 alloy. Belleviille washers: 302 alloy.

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LOW-VOLTAGE MOTOR CONTROL STARTERS

Maintenance Testing Guidelines

The following information is a guide for maintenance services. Consult specific instruction manuals and drawings for detailed installation and operating procedures. Low-Voltage Motor Control Starters should be installed, operated, and maintained by qualified personnel as defined by OSHA 29CFR1910 subpart 5. These instructions do not cover all details, variations, or combinations of the equipment, its installation, checkout, and safe operation. Care must be exercised to comply with local, state, and national regulations, as well as safety practices for this class of equipment.

Prior To Testing

- Procure and review all drawing associated with the equipment being tested.
- Study all instructional documents (Operation and Maintenance Manuals) applicable to the equipment.
- Obtain a copy of the appropriate test form to record test results.
- Verify suitability and accuracy of equipment to be used for testing.
- Record all existing equipment settings as well as settings resulting from any necessary adjustments.

Necessary Equipment

- Personnel Protective Equipment (PPE)
- RMS Multimeter
- Torque Wrench
- Single Phase Variable Power Supply
- Ductor
- Megger (1,000 volt)
- Phase Rotation Meter

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Revision: 0.0 Revised On: 2/10/16

DO NOT ATTEMPT TO INSTALL OR WORK ON EQUIPMENT WHILE IT IS ENERGIZED



Always verify that no voltage is present before proceeding with testing. Assume all circuits are energized. Confirm primary sources of power are disconnected, tagged, and locked out. Always follow all local, state, and national regulations including OSHA requirements and generally accepted safety procedures.

Inspection and Test Procedures

Visual and Mechanical Inspection

- 1. Inspect physical and mechanical condition.
- 2. Inspect contactors.
 - **2.1.** Verify mechanical operation.
 - **2.2.** Inspect and adjust contact gap, wipe, alignment, and pressure in accordance with manufacturer's published data.
- **3.** Motor-Running Protection
 - **3.1.** Compare overload element rating with motor full-load current rating to verify correct sizing.
 - **3.2.** If power-factor correction capacitors are connected on the load side of the overload protection, include the effect of the capacitive reactance in determining appropriate overload element size.
 - **3.3.** If motor-running protection is provided by fuses, verify correct fuse rating considering motor characteristics and power-factor correction capacitors.
- **4.** Inspect all bolted electrical connections for high resistance using one of the following methods:
 - **4.1.** Use of low-resistance ohmmeter in accordance with Step 1 of the "Electrical Tests" section of this document.
 - **4.2.** Verify tightness of accessible bolted electrical connections by calibrated torquewrench method in accordance with manufacturer's published data or Table 2.
 - **4.3.** Perform thermographic survey in accordance with the "Thermographic Survey Procedures" section of this document.
- 5. Thoroughly clean unit prior to testing unless as-found and as-left tests are required.
- 6. Lubrication
 - **6.1.** Verify appropriate contact lubricant on moving current-carrying parts.
 - **6.2.** Verify appropriate lubrication on moving and sliding surfaces.

Electrical Tests

- 1. Perform resistance measurements through all bolted connections with a low-resistance ohmmeter, if applicable, in accordance with Step 4 of the "Visual and Mechanical Inspection" section of this document.
- **2.** Measure insulation resistance of each combination starter, phase-to-phase and phase-to-ground, with the starter contacts closed and the protective device open. Test voltage shall be in accordance with Table 3. Refer to manufacturer's published data for devices with solid-state components.
- **3.** Perform an insulation-resistance test at 1000 volts dc on all control wiring. For units with solid-state components, follow manufacturer's recommendations. (Optional)
- **4.** Test the motor overload relay elements by injecting primary current through the overload circuit and monitoring trip time of the overload element.

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- **5.** NOTE: Test times for thermal trip units will, in general, be longer than manufacturer's curve if single-pole testing is performed. Optionally test with all poles in series for time test and each pole separately for comparison. (Refer to ANSI/NEMA ICS 2, Part 4.)
- **6.** Test circuit breakers in accordance with <u>Low-Voltage Insulated Case/Molded Case Circuit Breakers</u>.
- 7. Perform operational tests by initiating control devices.

Test Values

- 1. Compare bolted connection resistances to values of similar connections.
- 2. Bolt-torque levels shall be in accordance with Table 2 unless otherwise specified by manufacturer.
- 3. Microhm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values that deviate from similar connections by more than 25 percent of the lowest value.
- **4.** Insulation-resistance values shall be in accordance with Table 3.
- **5.** Control wiring insulation test resistance shall be a minimum of two megohms.
- **6.** Overload trip times shall be in accordance with manufacturer's published data.

Thermographic Survey Procedures

- 1. Visual and Mechanical Inspection
 - **1.1.** Inspect physical, electrical, and mechanical condition.
 - **1.2.** Remove all necessary covers prior to thermographic inspection.
- 2. Equipment to be inspected shall include all current-carrying devices.
- **3.** Provide report including the following:
 - **3.1.** Discrepancies.
 - **3.2.** Temperature difference between the area of concern and the reference area.
 - **3.3.** Cause of temperature difference.
 - 3.4. Areas inspected. Identify inaccessible and/or unobservable areas and/or equipment.
 - **3.5.** Identify load conditions at time of inspection.
 - **3.6.** Provide photographs and/or thermograms of the deficient area.
- 4. Test Parameters
 - **4.1.** Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1°C at 30°C.
 - **4.2.** Equipment shall detect emitted radiation and convert detected radiation to visual signal.
 - **4.3.** Thermographic surveys should be performed during periods of maximum possible loading but not less than 40 percent of rated load of the electrical equipment being inspected. Refer to ANSI/NFPA 70B, Section 18-16 (Infrared Inspection).
- **5.** Test Results: Suggested actions based on temperature can be found in Table 1.

After Testing

- Finish recording data on the test form, completely filling in all the appropriate blocks.
- Remove all test equipment and tools used during testing. Replace all barriers and covers, close all doors, and secure all latches.

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TABLE 1
Thermographic Survey
Suggested Actions Based on Temperature Rise

Temperature difference (ΔT) based on comparisons between similar components under similar loading.	Temperature difference (ΔT) based upon comparisons between component and ambient air temperatures.	Recommended Action
1°C - 3°C	0°C - 10°C	Possible deficiency; warrants investigation
4°C - 15°C	11°C - 20°C	Indicates probable deficiency; repair as time permits
	22°C - 40°C	Monitor continuously until corrective measures can be accomplished
> 16°C	> 40°C	Major discrepancy; repair immediately

Temperature specifications vary depending on the exact type of equipment. Even in the same class of equipment (i.e., cables) there are various temperature ratings. Heating is generally related to the square of the current; therefore, the load current will have a major impact on ΔT . In the absence of consensus standards for ΔT , the values in this table will provide reasonable guidelines.

TABLE 2
US Standard
Bolt Torques for Bus Connections
Heat-Treated Steel - Cadmium or Zinc Plated

Grade	SAE 1 & 2	SAE 5	SAE 7	SAE 8
Minimum Tensile (P.S.I.)	64K	105K	133K	150K
Bolt Diameter In Inches		Torque (Foo	t Pounds)	
1/4	4.0	5.6	8.0	8.4
5/16	7.2	11.2	15.2	17.6
3/8	12.0	20.0	27.2	29.6
7/16	19.2	32.0	44.0	48.0
1/2	29.6	48.0	68.0	73.6
9/16	42.4	70.4	96.0	105.6
5/8	59.2	96.0	133.6	144.0
3/4	96.0	160.0	224.0	236.8
7/8	152.0	241.6	352.0	378.4
1.0	225.6	372.8	528.0	571.2

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TABLE 2 (cont.)

Bolt Torques for Bus Connections Silicon Bronze Fasteners* Torque (Foot-Pounds)

Bolt Diameter in Inches	Nonlubricated	Lubricated
5/16	15	10
3/8	20	14
1/2	40	25
5/8	55	40
3/4	70	60

^{*} Bronze alloy bolts shall have a minimum tensile strength of 70,000 pounds per square inch.

TABLE 2
Aluminum Alloy Fasteners**
Torque (Foot Pounds)

Bolt Diameter in Inches	Lubricated
5/16	8.0
3/8	11.2
1/2	20.0
5/8	32.0
3/4	48.0

^{**} Aluminum alloy bolts shall have a minimum tensile strength of 55,000 pounds per square inch.

TABLE 2
Bolt Torques for Bus Connections
Stainless Steel Fasteners***
Torque (Foot Pounds)

Bolt Diameter in Inches	Uncoated
5/16	14
3/8	25
1/2	45
5/8	60
3/4	90

^{***} Bolts, cap screws, nuts, flat washers, locknuts: 18-8 alloy. Belleviille washers: 302 alloy.

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TABLE 3 Insulation Resistance Tests on Electrical Apparatus and Systems

Maximum Rating of Equipment in Volts	Minimum Test Voltage, dc in Volts	Recommended Minimum Insulation Resistance in Megohms
250	500	25
600	1,000	100
5,000	2,500	1,000
8,000	2,500	2,000
15,000	2,500	5,000
25,000	5,000	20,000
35,000	15,000	100,000
46,000	15,000	100,000
69,000	15,000	100,000

In the absence of consensus standards dealing with insulation-resistance tests, the NETA Technical Committee suggests the above representative values. See Table 4 for temperature correction factors.

Actual test results are dependent on the length of the conductor being tested, the temperature of the insulating material, and the humidity of the surrounding environment at the time of the test. In addition, insulation resistance tests are performed to establish a trending pattern and a deviation from the baseline information obtained during maintenance testing enabling the evaluation of the insulation for confined use.

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TABLE 4 **Insulation Resistance Conversion Factors** For Conversion of Test Temperature to 20°C

Tem	perature	Multiplier	
ů	°F	Apparatus Containing Immersed Oil Insulations	Apparatus Containing Solid Insulations
0	32	0.25	0.40
5	41	0.36	0.45
10	50	0.50	0.50
15	59	0.75	0.75
20	68	1.00	1.00
25	77	1.40	1.30
30	86	1.98	1.60
35	95	2.80	2.05
40	104	3.95	2.50
45	113	5.60	3.25
50	122	7.85	4.00
55	131	11.20	5.20
60	140	15.85	6.40
65	149	22.40	8.70
70	158	31.75	10.00
75	167	44.70	13.00
80	176	63.50	16.00

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LOW-VOLTAGE MOTOR CONTROL CENTERS

Maintenance Testing Guidelines

The following information is a guide for maintenance services. Consult specific instruction manuals and drawings for detailed installation and operating procedures. Low-Voltage Motor Control Centers should be installed, operated, and maintained by qualified personnel as defined by OSHA 29CFR1910 subpart 5. These instructions do not cover all details, variations, or combinations of the equipment, its installation, checkout, and safe operation. Care must be exercised to comply with local, state, and national regulations, as well as safety practices for this class of equipment.

Prior To Testing

- Procure and review all drawing associated with the equipment being tested.
- Study all instructional documents (Operation and Maintenance Manuals) applicable to the equipment.
- Obtain a copy of the appropriate test form to record test results.
- Verify suitability and accuracy of equipment to be used for testing.
- Record all existing equipment settings as well as settings resulting from any necessary adjustments.

Necessary Equipment

- Personnel Protective Equipment (PPE)
- RMS Multimeter
- Torque Wrench
- Ductor
- Megger (1,000 volt)

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Revision: 0.0 Revised On: 2/10/16

DO NOT ATTEMPT TO INSTALL OR WORK ON EQUIPMENT WHILE IT IS ENERGIZED



Always verify that no voltage is present before proceeding with testing. Assume all circuits are energized. Confirm primary sources of power are disconnected, tagged, and locked out. Always follow all local, state, and national regulations including OSHA requirements and generally accepted safety procedures.

Inspection and Test Procedures

- **1.** Refer to <u>Switchgear and Switchboard Assemblies: Maintenance Testing Guidelines</u> for appropriate inspections and tests of the motor control center bus.
- **2.** Refer to <u>Low-Voltage Air Switches: Maintenance Testing Guidelines</u> for appropriate inspections and tests of the motor control center switches.
- 3. Refer to Low-Voltage Insulated Case/Molded Case Circuit Breakers: Maintenance Testing Guidelines and Low-Voltage Power Circuit Breakers: Maintenance Testing Guidelines for appropriate inspections and tests of the motor control center circuit breakers.
- **4.** Refer to <u>Low-Voltage Motor Control Starters: Maintenance Testing Guidelines</u> for appropriate inspections and tests of the motor control center starters.

After Testing

- Finish recording data on the test form, completely filling in all the appropriate blocks.
- Remove all test equipment and tools used during testing. Replace all barriers and covers, close all doors, and secure all latches.

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MEDIUM-VOLTAGE CABLES, 69 KV VOLT MAXIMUM

Maintenance Testing Guidelines

The following information is a guide for maintenance services. Consult specific instruction manuals and drawings for detailed installation and operating procedures. Medium-Voltage Cables should be installed, operated, and maintained by qualified personnel as defined by OSHA 29CFR1910 subpart 5. These instructions do not cover all details, variations, or combinations of the equipment, its installation, checkout, and safe operation. Care must be exercised to comply with local, state, and national regulations, as well as safety practices for this class of equipment.

Prior To Testing

- Procure and review all drawing associated with the equipment being tested.
- Study all instructional documents (Operation and Maintenance Manuals) applicable to the equipment.
- Obtain a copy of the appropriate test form to record test results.
- Verify suitability and accuracy of equipment to be used for testing.
- Record all existing equipment settings as well as settings resulting from any necessary adjustments.

Necessary Equipment

- Personnel Protective Equipment (PPE)
- RMS Multimeter
- Torque Wrench
- Ductor
- Megger (5,000 volt with selectable voltages)
- Hi-Pot Tester
- Phase Rotation Meter

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Revision: 0.0 Revised On: 2/10/16

DO NOT ATTEMPT TO INSTALL OR WORK ON EQUIPMENT WHILE IT IS ENERGIZED



Always verify that no voltage is present before proceeding with testing. Assume all circuits are energized. Confirm primary sources of power are disconnected, tagged, and locked out. Always follow all local, state, and national regulations including OSHA requirements and generally accepted safety procedures.

Inspection and Test Procedures

Visual and Mechanical Inspection

- Inspect exposed sections of cables for physical damage and evidence of overheating and corona.
- **2.** Inspect terminations and splices for evidence of overheating and corona.
- 3. Inspect all bolted electrical connections for high resistance using one of the following methods:
 - **3.1.** Use of low-resistance ohmmeter in accordance with Step 3 of the "Electrical Tests" section of this document.
 - **3.2.** Verify tightness of accessible bolted electrical connections by calibrated torquewrench method in accordance with manufacturer's published data or Table 1.
 - **3.3.** Perform thermographic survey in accordance with the "Thermographic Survey Procedures" section of this document.
- **4.** Inspect compression-applied connectors for correct cable match and indentation.
- **5.** Inspect for shield grounding, cable support, and termination.
- **6.** Verify that visible cable bends meet or exceed ICEA and/or manufacturer's minimum allowable bending radius.
- 7. Inspect fireproofing in common cable areas, if specified.
- **8.** If cables are terminated through window-type current transformers, make an inspection to verify that neutral and ground conductors are correctly placed and that shields are correctly terminated for operation of protective devices.

Electrical Tests

- 1. Perform a shield-continuity test on each power cable by ohmmeter method.
- 2. Perform an insulation-resistance test utilizing a megohmmeter with a voltage output of at least 2500 volts. Individually test each conductor with all other conductors and shields grounded. Test duration shall be one minute.
- **3.** Perform resistance measurements through all bolted connections with a low-resistance ohmmeter, if applicable, in accordance with Step 3 of the "Visual and Mechanical Inspection" section of this document.
- **4.** Perform a dc high-potential test on all cables. Adhere to all precautions and limits as specified in the applicable NEMA/ICEA Standard for the specific cable. Perform tests in accordance with ANSI/IEEE Standard 400. Test procedure shall be as follows, and the results for each cable test shall be recorded as specified herein. Test voltages shall not exceed 60 percent of cable manufacturer's factory test value or the maximum test voltage in Table 2.
 - **4.1.** Insure that the input voltage to the test set is regulated.
 - **4.2.** Current-sensing circuits in test equipment shall measure only the leakage current associated with the cable under test and shall not include internal leakage of the test equipment.
 - **4.3.** Record wet- and dry-bulb temperatures or relative humidity and temperature.
 - **4.4.** Test each section of cable individually.

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- **4.5.** Individually test each conductor with all other conductors grounded. Ground all shields.
- **4.6.** Terminations shall be adequately corona-suppressed by guard ring, field reduction sphere, or other suitable methods as necessary.
- **4.7.** Insure that the maximum test voltage does not exceed the limits for terminators specified in ANSI/IEEE Standard 48 or manufacturer's specifications.
- **4.8.** Apply a dc high-potential test in at least five equal increments until maximum test voltage is reached. No increment shall exceed the voltage rating of the cable. Record dc leakage current at each step after a constant stabilization time consistent with system charging current.
- **4.9.** Raise the conductor to the specified maximum test voltage and hold for five minutes. Record readings of leakage current at 30 seconds and one minute and at one minute intervals thereafter.
- **4.10.** Reduce the conductor test potential to zero and measure residual voltage at discrete intervals.
- **4.11.** Apply grounds for a time period adequate to drain all insulation stored charge.

Test Values

- 1. Compare bolted connection resistances to values of similar connections.
- Bolt-torque levels shall be in accordance with Table 1 unless otherwise specified by manufacturer.
- 3. Microhm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values which deviate from similar connections by more than 25 percent of the lowest value.
- **4.** Shielding must exhibit continuity. Investigate resistance values in excess of ten ohms per 1000 feet of cable.
- **5.** Graphic plots may be made of leakage current versus step voltage at each increment and leakage current versus time at final test voltages.
- **6.** The step voltage slope should be reasonably linear.
- Capacitive and absorption current should decrease continually until steady state leakage is approached.
- **8.** Compare test results to previously obtained results.

Thermographic Survey Procedures

- 1. Visual and Mechanical Inspection
 - **1.1.** Inspect physical, electrical, and mechanical condition.
 - **1.2.** Remove all necessary covers prior to thermographic inspection.
- **2.** Equipment to be inspected shall include all current-carrying devices.
- **3.** Provide report including the following:
 - **3.1.** Discrepancies.
 - **3.2.** Temperature difference between the area of concern and the reference area.
 - **3.3.** Cause of temperature difference.
 - 3.4. Areas inspected. Identify inaccessible and/or unobservable areas and/or equipment.
 - **3.5.** Identify load conditions at time of inspection.
 - **3.6.** Provide photographs and/or thermograms of the deficient area.
- 4. Test Parameters
 - **4.1.** Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1°C at 30°C.
 - **4.2.** Equipment shall detect emitted radiation and convert detected radiation to visual signal.

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- **4.3.** Thermographic surveys should be performed during periods of maximum possible loading but not less than 40 percent of rated load of the electrical equipment being inspected. Refer to ANSI/NFPA 70B, Section 18-16 (Infrared Inspection).
- **5.** Test Results: Suggested actions based on temperature can be found in Table 1.

After Testing

- Finish recording data on the test form, completely filling in all the appropriate blocks.
- Remove all test equipment and tools used during testing. Replace all barriers and covers, close all doors, and secure all latches.

TABLE 1
Thermographic Survey
Suggested Actions Based on Temperature Rise

Temperature difference (ΔT) based on comparisons between similar components under similar loading.	Temperature difference (ΔT) based upon comparisons between component and ambient air temperatures.	Recommended Action
1°C - 3°C	0°C - 10°C	Possible deficiency; warrants investigation
4°C - 15°C	11°C - 20°C	Indicates probable deficiency; repair as time permits
	22°C - 40°C	Monitor continuously until corrective measures can be accomplished
> 16°C	> 40°C	Major discrepancy; repair immediately

Temperature specifications vary depending on the exact type of equipment. Even in the same class of equipment (i.e., cables) there are various temperature ratings. Heating is generally related to the square of the current; therefore, the load current will have a major impact on ΔT . In the absence of consensus standards for ΔT , the values in this table will provide reasonable guidelines.

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TABLE 2

US Standard Bolt Torques for Bus Connections Heat-Treated Steel - Cadmium or Zinc Plated

Grade	SAE 1 & 2	SAE 5	SAE 7	SAE 8
Minimum Tensile (P.S.I.)	64K	105K	133K	150K
Bolt Diameter In Inches		Torque (Foo	t Pounds)	
1/4	4.0	5.6	8.0	8.4
5/16	7.2	11.2	15.2	17.6
3/8	12.0	20.0	27.2	29.6
7/16	19.2	32.0	44.0	48.0
1/2	29.6	48.0	68.0	73.6
9/16	42.4	70.4	96.0	105.6
5/8	59.2	96.0	133.6	144.0
3/4	96.0	160.0	224.0	236.8
7/8	152.0	241.6	352.0	378.4
1.0	225.6	372.8	528.0	571.2

TABLE 2
Bolt Torques for Bus Connections
Silicon Bronze Fasteners*
Torque (Foot-Pounds)

Bolt Diameter in Inches	Nonlubricated	Lubricated
5/16	15	10
3/8	20	14
1/2	40	25
5/8	55	40
3/4	70	60

^{*} Bronze alloy bolts shall have a minimum tensile strength of 70,000 pounds per square inch.

File: med-voltage cable

TABLE 2 (cont.) Aluminum Alloy Fasteners** Torque (Foot Pounds)

Bolt Diameter in Inches	Lubricated
5/16	8.0
3/8	11.2
1/2	20.0
5/8	32.0
3/4	48.0

^{**} Aluminum alloy bolts shall have a minimum tensile strength of 55,000 pounds per square inch.

TABLE 2
Bolt Torques for Bus Connections
Stainless Steel Fasteners***
Torque (Foot Pounds)

Bolt Diameter in Inches	Uncoated
5/16	14
3/8	25
1/2	45
5/8	60
3/4	90

^{***} Bolts, cap screws, nuts, flat washers, locknuts: 18-8 alloy. Belleviille washers: 302 alloy.

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TABLE 3
Medium-Voltage Cables
Maximum Maintenance Test Voltages (kV, dc)

Insulation Type	Rated Cable Voltage	Insulation Level	Test Voltage kV, dc
Elastomeric:	5 kV	100%	19
Butyl and Oil Base	5 kV	133%	19
	15 kV	100%	41
	15 kV	133%	49
	25 kV	100%	60
Elastomeric:	5 kV	100%	19
EPR	5 kV	133%	19
	8 kV	100%	26
	8 kV	133%	26
	15 kV	100%	41
	15 kV	133%	49
	25 kV	100%	60
	25 kV	133%	75
	28 kV	100%	64
	35 kV	100%	75
Polyethylene	5 kV	100%	19
(see Note 4)	5 kV	133%	19
	8 kV	100%	26
	8 kV	133%	26
	15 kV	100%	41
	15 kV	133%	49
	25 kV	100%	60
	25 kV	133%	75
	35 kV	100%	75

Derived from ANSI/IEEE Standard 141-1993 Table 12-9 and by factoring the applicable ICEA/NEMA Standards by 75% as recommended in Section 18-9.2.4 of NFPA 70B, 1994 Edition *Electrical Equipment Maintenance*.

File: med-voltage cable

TABLE 3 - NOTES

NOTE 1: Selection of test voltage for in-service cables depends on many factors. The owner should be consulted and/or informed of the intended test voltage prior to performing the test.

Caution should be used in selecting the maximum test voltage and performing the test since cable failure during the test will require repair or replacement prior to re-energizing.

NOTE 2: AEIC C55 and C56 list test voltages approximately 20 percent higher than the ICEA values for the first five years of service. These values are based on 65 percent of the factory test voltages. A reduction to 40 percent is recommended for a cable in service longer than five years.

NOTE 3: ANSI/IEEE 400-1991 specifies much higher voltages than either the ICEA or the AEIC. These voltages overstress cables and are intended to find marginal cable during shutdown to avoid in-service failures. These test voltages should not be used without the concurrence of the owner. If the cable is still in warranty, the cable manufacturer should be consulted for their concurrence. (See the Standard for a discussion of the pros and cons of high direct-voltage tests.)

NOTE 4: See Electric Power Research Institute Report, EPRI TR-101245, "Effect of DC Testing on Extruded Cross-Linked Polyethylene Insulated Cables." DC high potential testing of **aged** XLPE-insulated cable in wet locations may reduce remaining life.

File: med-voltage cable Page 8 of 8

MEDIUM-VOLTAGE MOTOR CONTROL STARTERS

Maintenance Testing Guidelines

The following information is a guide for maintenance services. Consult specific instruction manuals and drawings for detailed installation and operating procedures. Medium-Voltage Motor Control Starters should be installed, operated, and maintained by qualified personnel as defined by OSHA 29CFR1910 subpart 5. These instructions do not cover all details, variations, or combinations of the equipment, its installation, checkout, and safe operation. Care must be exercised to comply with local, state, and national regulations, as well as safety practices for this class of equipment.

Prior To Testing

- Procure and review all drawing associated with the equipment being tested.
- Study all instructional documents (Operation and Maintenance Manuals) applicable to the equipment.
- Obtain a copy of the appropriate test form to record test results.
- Verify suitability and accuracy of equipment to be used for testing.
- Record all existing equipment settings as well as settings resulting from any necessary adjustments.

Necessary Equipment

- Personnel Protective Equipment (PPE)
- RMS Multimeter
- Torque Wrench
- Ductor
- Megger (1,000 volt)
- Megger (5,000 volt with selectable voltages)
- Single Phase Variable Power Supply
- Vacuum Bottle Tester (if required)

File: med-voltage MC starters

Revision: 0.0 Revised On: 2/10/16

DO NOT ATTEMPT TO INSTALL OR WORK ON EQUIPMENT WHILE IT IS ENERGIZED



Always verify that no voltage is present before proceeding with testing. Assume all circuits are energized. Confirm primary sources of power are disconnected, tagged, and locked out. Always follow all local, state, and national regulations including OSHA requirements and generally accepted safety procedures.

Inspection and Test Procedures

Visual and Mechanical Inspection

- Inspect physical, electrical, and mechanical condition, including evidence of moisture and/or corona.
- Inspect all bolted electrical connections for high resistance using one of the following methods:
 - **2.1.** Use of low-resistance ohmmeter in accordance with Step 1 of the "Electrical Tests" section of this document.
 - **2.2.** Verify tightness of accessible bolted electrical connections by calibrated torquewrench method in accordance with manufacturer's published data or Table 2.
 - **2.3.** Perform thermographic survey in accordance with the "Thermographic Survey Procedures" section of this document.
- 3. Test all electrical and mechanical interlock systems for correct operation and sequencing.
- **4.** Verify correct barrier and shutter installation and operation.
- **5.** Exercise all active components and confirm correct operation of all indicating devices.
- **6.** Inspect contactors.
 - **6.1.** Verify mechanical operation.
 - **6.2.** Inspect and adjust contact gap, wipe, alignment, and pressure in accordance with manufacturer's published data.
- 7. Compare overload protection rating with motor nameplate to verify correct size. Set adjustable or programmable devices according to the protective device coordination study.
- **8.** Thoroughly clean unit prior to testing unless as-found and as-left tests are required.
- 9. Lubrication
 - **9.1.** Verify appropriate contact lubricant on moving current-carrying parts.
 - **9.2.** Verify appropriate lubrication on moving and sliding surfaces.

Electrical Tests

- 1. Perform resistance measurements through all bolted connections with a low-resistance ohmmeter, if applicable, in accordance with Step 2 of the "Visual and Mechanical Inspection" section of this document.
- **2.** Perform system function tests at 1000 volts dc on all control wiring. For units with solid-state components, follow manufacturer's recommendations.
- **3.** Perform system function test in accordance with "General System Tests" section of this document.
- **4.** Test control power transformers:
 - **4.1.** Perform insulation-resistance tests. Perform measurements from winding-to-winding and each winding-to-ground. Test voltages shall be in accordance with Table 2 unless otherwise specified by manufacturer.
 - **4.2.** Verify correct function of control transfer relays located in switchgear with multiple power sources.

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- **5.** Perform insulation-resistance tests on contactor(s), phase-to-ground, phase-to-phase, and across the open contacts for one minute in accordance with Table 3.
- **6.** Perform an overpotential test in accordance with manufacturer's published data. If manufacturer has no recommendation for this test, it shall be in accordance with Table 2.
- 7. Perform vacuum bottle integrity test (overpotential), if applicable, across each vacuum bottle with the contacts in the open position in strict accordance with manufacturer's published data. Do not exceed maximum voltage stipulated for this test.
- **8.** Perform a contact-resistance test.
- 9. Measure blowout coil circuit resistance.
- 10. Measure resistance of power fuses.
- 11. Energize contactor using an auxiliary source. Adjust armature to minimize operating vibration where applicable.
- **12.** Test motor overload relay elements by injecting primary current through overload circuit and monitoring trip time of the overload element.
- 13. NOTE: Test times for thermal trip units will, in general, be longer than manufacturer's curve if single-pole testing is performed. Optionally test with all poles in series for time test and each pole separately for comparison.
- **14.** Test ground-fault protection by injecting primary current through sensor. Confirm pickup level and timing.
- **15.** If solid-state or microprocessor-type protective relaying is used, test in accordance with <u>Protective Relays: Maintenance Testing Guidelines.</u>
- **16.** Verify operation of cubicle space heater.

Test Values

- 1. Compare bolted connection resistances to values of similar connections.
- Bolt-torque values shall be in accordance with Table 2 unless otherwise specified by manufacturer.
- 3. Microhm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values that deviate from similar connections by more than 25 percent of the lowest value.
- **4.** Starter insulation resistance shall be in accordance with Table 3.
- **5.** Control wiring insulation resistance shall be a minimum of two megohms.
- **6.** The insulation shall withstand the overpotential test voltage applied.
- 7. Resistance values shall not deviate by more than 15 percent between identical fuses.
- **8.** Overload trip times shall be in accordance with manufacturer's published data.

Thermographic Survey Procedures

- 1. Visual and Mechanical Inspection
 - **1.1.** Inspect physical, electrical, and mechanical condition.
 - **1.2.** Remove all necessary covers prior to thermographic inspection.
- **2.** Equipment to be inspected shall include all current-carrying devices.
- **3.** Provide report including the following:
 - **3.1.** Discrepancies.
 - **3.2.** Temperature difference between the area of concern and the reference area.
 - **3.3.** Cause of temperature difference.
 - 3.4. Areas inspected. Identify inaccessible and/or unobservable areas and/or equipment.
 - **3.5.** Identify load conditions at time of inspection.
 - **3.6.** Provide photographs and/or thermograms of the deficient area.
- 4. Test Parameters
 - **4.1.** Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1°C at 30°C.

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- **4.2.** Equipment shall detect emitted radiation and convert detected radiation to visual signal.
- **4.3.** Thermographic surveys should be performed during periods of maximum possible loading but not less than 40 percent of rated load of the electrical equipment being inspected. Refer to ANSI/NFPA 70B, Section 18-16 (Infrared Inspection).
- **5.** Test Results: Suggested actions based on temperature can be found in Table 1.

After Testing

- Finish recording data on the test form, completely filling in all the appropriate blocks.
- Remove all test equipment and tools used during testing. Replace all barriers and covers, close all doors, and secure all latches.

TABLE 1
Thermographic Survey
Suggested Actions Based on Temperature Rise

Temperature difference (ΔT) based on comparisons between similar components under similar loading.	Temperature difference (ΔT) based upon comparisons between component and ambient air temperatures.	Recommended Action	
1°C - 3°C	0°C - 10°C	Possible deficiency; warrants investigation	
4°C - 15°C	11°C - 20°C	Indicates probable deficiency; repair as time permits	
	22°C - 40°C	Monitor continuously until corrective measures can be accomplished	
> 16°C	> 40°C	Major discrepancy; repair immediately	

Temperature specifications vary depending on the exact type of equipment. Even in the same class of equipment (i.e., cables) there are various temperature ratings. Heating is generally related to the square of the current; therefore, the load current will have a major impact on ΔT . In the absence of consensus standards for ΔT , the values in this table will provide reasonable guidelines.

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TABLE 2

US Standard Bolt Torques for Bus Connections Heat-Treated Steel - Cadmium or Zinc Plated

Grade	SAE 1 & 2	SAE 5	SAE 7	SAE 8
Minimum Tensile (P.S.I.)	64K	105K	133K	150K
Bolt Diameter In Inches		Torque (Foo	ot Pounds)	
1/4	4.0	5.6	8.0	8.4
5/16	7.2	11.2	15.2	17.6
3/8	12.0	20.0	27.2	29.6
7/16	19.2	32.0	44.0	48.0
1/2	29.6	48.0	68.0	73.6
9/16	42.4	70.4	96.0	105.6
5/8	59.2	96.0	133.6	144.0
3/4	96.0	160.0	224.0	236.8
7/8	152.0	241.6	352.0	378.4
1.0	225.6	372.8	528.0	571.2

TABLE 2
Bolt Torques for Bus Connections
Silicon Bronze Fasteners*
Torque (Foot-Pounds)

Bolt Diameter in Inches	Nonlubricated	Lubricated
5/16	15	10
3/8	20	14
1/2	40	25
5/8	55	40
3/4	70	60

^{*} Bronze alloy bolts shall have a minimum tensile strength of 70,000 pounds per square inch.

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TABLE 2 (cont.) Aluminum Alloy Fasteners** Torque (Foot Pounds)

Bolt Diameter in Inches	Lubricated
5/16	8.0
3/8	11.2
1/2	20.0
5/8	32.0
3/4	48.0

^{**} Aluminum alloy bolts shall have a minimum tensile strength of 55,000 pounds per square inch.

TABLE 2
Bolt Torques for Bus Connections
Stainless Steel Fasteners***
Torque (Foot Pounds)

Bolt Diameter in Inches	Uncoated
5/16	14
3/8	25
1/2	45
5/8	60
3/4	90

^{***} Bolts, cap screws, nuts, flat washers, locknuts: 18-8 alloy. Belleviille washers: 302 alloy.

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TABLE 3 Insulation Resistance Tests on Electrical Apparatus and Systems

Maximum Rating of Equipment in Volts	Minimum Test Voltage, dc in Volts	Recommended Minimum Insulation Resistance in Megohms
250	500	25
600	1,000	100
5,000	2,500	1,000
8,000	2,500	2,000
15,000	2,500	5,000
25,000	5,000	20,000
35,000	15,000	100,000
46,000	15,000	100,000
69,000	15,000	100,000

In the absence of consensus standards dealing with insulation-resistance tests, the NETA Technical Committee suggests the above representative values. See Table 5 for temperature correction factors.

Actual test results are dependent on the length of the conductor being tested, the temperature of the insulating material, and the humidity of the surrounding environment at the time of the test. In addition, insulation resistance tests are performed to establish a trending pattern and a deviation from the baseline information obtained during maintenance testing enabling the evaluation of the insulation for confined use.

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TABLE 4
Switchgear Low-Frequency Withstand Test Voltages

Type of Switchgear	Rated Maximum Voltage	Voltage Maximum Test Voltage kV	
	(kV) (rms)	ac	dc
LV (Low-Voltage Power Circuit Breaker Switchgear)	.254/.508/.635	1.6	2.3
MC	4.76	14.0	20.0
(Metal-Clad Switchgear)	8.25	27.0	37.0
	15.0	27.0	37.0
	38.0	60.0	+
SC	15.5	37.0	+
(Station-Type Cubicle	38.0	60.0	+
Switchgear)	72.5	120.0	+
MEI	4.76	14.0	20.0
(Metal-Enclosed	8.25	19.0	27.0
Interrupter Switchgear)	15.0	27.0	37.0
	15.5	37.0	52.0
	25.8	45.0	+
_	38.0	60.0	+

Derived from ANSI/IEEE C37.20.1-1993, Paragraph 5.5, Standard for Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear, C37.20.2-1993, Paragraph 5.5, Standard for Metal-Clad and Station-Type Cubicle Switchgear and C37.20.3-1993, Paragraph 5.5, Standard for Metal-Enclosed Interrupter Switchgear, and includes 0.75 multiplier with fraction rounded down.

The column headed "DC" is given as a reference only for those using dc tests to verify the integrity of connected cable installations without disconnecting the cables from the switchgear. It represents values believed to be appropriate and approximately equivalent to the corresponding power frequency withstand test values specified for voltage rating of switchgear. The presence of this column in no way implies any requirement for a dc withstand test on ac equipment or that a dc withstand test represents an acceptable alternative to the low-frequency withstand tests specified in this specification, either for design tests, production tests, conformance tests, or field tests. When making dc tests, the voltage should be raised to the test value in discrete steps and held for a period of one minute.

Because of the variable voltage distribution encountered when making dc withstand tests, the manufacturer should be contacted for recommendations before applying dc withstand tests to the switchgear. Voltage transformers above 34.5kV should be disconnected when testing with dc. Refer to ANSI/IEEE C57-13-1978 (R1987) *IEEE Standard Requirements for Instrument Transformers* [10], Section 8 and, in particular 8.8.2, (the last paragraph) which reads "Periodic kenotron tests should not be applied to transformers of higher than 34.5 kV voltage rating."

+ Consult Manufacturer

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TABLE 5 **Insulation Resistance Conversion Factors** For Conversion of Test Temperature to 20°C

Tem	perature	Multiplier	
°C	°F	Apparatus Containing Immersed Oil Insulations	Apparatus Containing Solid Insulations
0	32	0.25	0.40
5	41	0.36	0.45
10	50	0.50	0.50
15	59	0.75	0.75
20	68	1.00	1.00
25	77	1.40	1.30
30	86	1.98	1.60
35	95	2.80	2.05
40	104	3.95	2.50
45	113	5.60	3.25
50	122	7.85	4.00
55	131	11.20	5.20
60	140	15.85	6.40
65	149	22.40	8.70
70	158	31.75	10.00
75	167	44.70	13.00
80	176	63.50	16.00

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MEDIUM-VOLTAGE MOTOR CONTROL CENTERS

Maintenance Testing Guidelines

The following information is a guide for maintenance services. Consult specific instruction manuals and drawings for detailed installation and operating procedures. Medium-Voltage Motor Control Centers should be installed, operated, and maintained by qualified personnel as defined by OSHA 29CFR1910 subpart 5. These instructions do not cover all details, variations, or combinations of the equipment, its installation, checkout, and safe operation. Care must be exercised to comply with local, state, and national regulations, as well as safety practices for this class of equipment.

Prior To Testing

- Procure and review all drawing associated with the equipment being tested.
- Study all instructional documents (Operation and Maintenance Manuals) applicable to the equipment.
- Obtain a copy of the appropriate test form to record test results.
- Verify suitability and accuracy of equipment to be used for testing.
- Record all existing equipment settings as well as settings resulting from any necessary adjustments.

Necessary Equipment

- Personnel Protective Equipment (PPE)
- RMS Multimeter
- Torque Wrench
- Ductor
- Megger (1,000 volt)
- Megger (5,000 volt with selectable voltages)

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Revision: 0.0 Revised On: 2/10/16

DO NOT ATTEMPT TO INSTALL OR WORK ON EQUIPMENT WHILE IT IS ENERGIZED



Always verify that no voltage is present before proceeding with testing. Assume all circuits are energized. Confirm primary sources of power are disconnected, tagged, and locked out. Always follow all local, state, and national regulations including OSHA requirements and generally accepted safety procedures.

Inspection and Test Procedures

- **1.** Refer to <u>Switchgear and Switchboard Assemblies: Maintenance Testing Guidelines</u> for appropriate inspections and tests of the motor control center bus.
- 2. Refer to <u>Medium-Voltage Air Switches: Maintenance Testing Guidelines</u> for appropriate inspections and tests of the motor control center switches.
- 3. Refer to Medium-Voltage Air Circuit Breakers: Maintenance Testing Guidelines and Medium-Voltage Oil Circuit Breakers: Maintenance Testing Guidelines, Medium-Voltage Vacuum Circuit Breakers: Maintenance Testing Guidelines, or Medium-Voltage SF₆ Circuit Breakers: Maintenance Testing Guidelines for appropriate inspections and tests of the motor control center circuit breakers.
- **4.** Refer to Medium-Voltage Motor Control Starters: Maintenance Testing Guidelines for appropriate inspections and tests of the motor control center starters.

After Testing

- Finish recording data on the test form, completely filling in all the appropriate blocks.
- Remove all test equipment and tools used during testing. Replace all barriers and covers, close all doors, and secure all latches.

File: med-voltage MCC Page 2 of 2

LOW-VOLTAGE INSULATED CASE/MOLDED CASE CIRCUIT BREAKERS

Maintenance Testing Guidelines

The following information is a guide for maintenance services. Consult specific instruction manuals and drawings for detailed installation and operating procedures. Low-Voltage Insulated Case/Molded Case Circuit Breakers should be installed, operated, and maintained by qualified personnel as defined by OSHA 29CFR1910 subpart 5. These instructions do not cover all details, variations, or combinations of the equipment, its installation, checkout, and safe operation. Care must be exercised to comply with local, state, and national regulations, as well as safety practices for this class of equipment.

Prior To Testing

- Procure and review all drawing associated with the equipment being tested.
- Study all instructional documents (Operation and Maintenance Manuals) applicable to the equipment.
- Obtain a copy of the appropriate test form to record test results.
- Verify suitability and accuracy of equipment to be used for testing.
- Record all existing equipment settings as well as settings resulting from any necessary adjustments.

Necessary Equipment

- Personnel Protective Equipment (PPE)
- RMS Multimeter
- Torque Wrench
- Ductor
- Megger (1,000 volt)

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Revision: 0.0 Revised On: 2/10/16

DO NOT ATTEMPT TO INSTALL OR WORK ON EQUIPMENT WHILE IT IS ENERGIZED



Always verify that no voltage is present before proceeding with testing. Assume all circuits are energized. Confirm primary sources of power are disconnected, tagged, and locked out. Always follow all local, state, and national regulations including OSHA requirements and generally accepted safety procedures.

Inspection and Test Procedures

Visual and Mechanical Inspection

- 1. Inspect circuit breaker for correct mounting.
- **2.** Operate circuit breaker to insure smooth operation.
- **3.** Inspect case for cracks or other defects.
- **4.** Inspect all bolted electrical connections for high resistance using one of the following methods:
 - **4.1.** Use of low-resistance ohmmeter in accordance with Step 3 of the "Electrical Tests" section of this document.
 - **4.2.** Verify tightness of accessible bolted electrical connections by calibrated torquewrench method in accordance with manufacturer's published data or Table 2.
 - **4.3.** Perform thermographic survey in accordance with the "Thermographic Survey Procedures" section of this document.
- 5. Inspect mechanism contacts and arc chutes in unsealed units.

Electrical Tests

- 1. Perform a contact-resistance test.
- 2. Perform an insulation-resistance test at 1000 volts dc from pole-to-pole and from each pole-to-ground with breaker closed and across open contacts of each phase.
- **3.** Perform resistance measurements through all bolted connections with a low-resistance ohmmeter, if applicable, in accordance with Step 4 of the "Visual and Mechanical Inspection" section of this document.
- **4.** Perform insulation resistance test at 1000 volts dc on all control wiring. For units with solid-state components, follow manufacturer's recommendations.
- **5.** Perform long-time delay time-current characteristic tests by passing 300 percent rated current through each pole separately unless series testing is required to defeat ground fault functions.
- **6.** Determine short-time pickup and delay by primary current injection.
- 7. Determine ground-fault pickup and time delay by primary current injection.
- **8.** Determine instantaneous pickup current by primary injection using run-up or pulse method.
- **9.** Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and antipump function.
- 10. Verify the calibration of all functions of the trip unit by means of secondary injection.

Test Values

- 1. Compare bolted connection resistances to values of similar connections.
- **2.** Bolt-torque levels shall be in accordance with Table 2 unless otherwise specified by manufacturer.
- 3. Microhm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available,

File: molded case CB Page 2 of 8

- investigate any values which deviate from adjacent poles or similar breakers by more than 25 percent of the lowest value.
- **4.** Circuit breaker insulation resistance shall be in accordance with Table 3.
- **5.** Control wiring insulation resistance shall be a minimum of two megohms.
- **6.** Trip characteristic of breakers shall fall within manufacturer's published time-current characteristic tolerance band, including adjustment factors.
- 7. For molded-case circuit breakers all trip times shall fall within Table 4. Circuit breakers exceeding specified trip time at 300 percent of pickup shall be tagged defective.
- **8.** For molded-case circuit breakers instantaneous pickup values shall be within values shown in Table 5.

Thermographic Survey Procedures

- 1. Visual and Mechanical Inspection
 - **1.1.** Inspect physical, electrical, and mechanical condition.
 - **1.2.** Remove all necessary covers prior to thermographic inspection.
- 2. Equipment to be inspected shall include all current-carrying devices.
- **3.** Provide report including the following:
 - 3.1. Discrepancies.
 - **3.2.** Temperature difference between the area of concern and the reference area.
 - **3.3.** Cause of temperature difference.
 - 3.4. Areas inspected. Identify inaccessible and/or unobservable areas and/or equipment.
 - **3.5.** Identify load conditions at time of inspection.
 - 3.6. Provide photographs and/or thermograms of the deficient area.
- 4. Test Parameters
 - **4.1.** Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1°C at 30°C.
 - **4.2.** Equipment shall detect emitted radiation and convert detected radiation to visual signal.
 - **4.3.** Thermographic surveys should be performed during periods of maximum possible loading but not less than 40 percent of rated load of the electrical equipment being inspected. Refer to ANSI/NFPA 70B, Section 18-16 (Infrared Inspection).
- **5.** Test Results: Suggested actions based on temperature can be found in Table 1.

After Testing

- Finish recording data on the test form, completely filling in all the appropriate blocks.
- Remove all test equipment and tools used during testing. Replace all barriers and covers, close all doors, and secure all latches.

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TABLE 1
Thermographic Survey
Suggested Actions Based on Temperature Rise

Temperature difference (ΔT) based on comparisons between similar components under similar loading.	Temperature difference (ΔT) based upon comparisons between component and ambient air temperatures.	Recommended Action
1°C - 3°C	0°C - 10°C	Possible deficiency; warrants investigation
4°C - 15°C	11°C - 20°C	Indicates probable deficiency; repair as time permits
	22°C - 40°C	Monitor continuously until corrective measures can be accomplished
> 16°C	> 40°C	Major discrepancy; repair immediately

Temperature specifications vary depending on the exact type of equipment. Even in the same class of equipment (i.e., cables) there are various temperature ratings. Heating is generally related to the square of the current; therefore, the load current will have a major impact on ΔT . In the absence of consensus standards for ΔT , the values in this table will provide reasonable guidelines.

TABLE 2
US Standard
Bolt Torques for Bus Connections
Heat-Treated Steel - Cadmium or Zinc Plated

Grade	SAE 1 & 2	SAE 5	SAE 7	SAE 8
Minimum Tensile (P.S.I.)	64K	105K	133K	150K
Bolt Diameter In Inches		Torque (Foo	t Pounds)	
1/4	4.0	5.6	8.0	8.4
5/16	7.2	11.2	15.2	17.6
3/8	12.0	20.0	27.2	29.6
7/16	19.2	32.0	44.0	48.0
1/2	29.6	48.0	68.0	73.6
9/16	42.4	70.4	96.0	105.6
5/8	59.2	96.0	133.6	144.0
3/4	96.0	160.0	224.0	236.8
7/8	152.0	241.6	352.0	378.4
1.0	225.6	372.8	528.0	571.2

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TABLE 2 (cont.)

Bolt Torques for Bus Connections Silicon Bronze Fasteners* Torque (Foot-Pounds)

Bolt Diameter in Inches	Nonlubricated	Lubricated
5/16	15	10
3/8	20	14
1/2	40	25
5/8	55	40
3/4	70	60

^{*} Bronze alloy bolts shall have a minimum tensile strength of 70,000 pounds per square inch.

TABLE 2
Aluminum Alloy Fasteners**
Torque (Foot Pounds)

Bolt Diameter in Inches	Lubricated
5/16	8.0
3/8	11.2
1/2	20.0
5/8	32.0
3/4	48.0

^{**} Aluminum alloy bolts shall have a minimum tensile strength of 55,000 pounds per square inch.

TABLE 2
Bolt Torques for Bus Connections
Stainless Steel Fasteners***
Torque (Foot Pounds)

Bolt Diameter in Inches	Uncoated
5/16	14
3/8	25
1/2	45
5/8	60
3/4	90

^{***} Bolts, cap screws, nuts, flat washers, locknuts: 18-8 alloy. Belleviille washers: 302 alloy.

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TABLE 3 Insulation Resistance Tests on Electrical Apparatus and Systems

Maximum Rating of Equipment in Volts	Minimum Test Voltage, dc in Volts	Recommended Minimum Insulation Resistance in Megohms
250	500	25
600	1,000	100
5,000	2,500	1,000
8,000	2,500	2,000
15,000	2,500	5,000
25,000	5,000	20,000
35,000	15,000	100,000
46,000	15,000	100,000
69,000	15,000	100,000

In the absence of consensus standards dealing with insulation-resistance tests, the NETA Technical Committee suggests the above representative values. See Table 6 for temperature correction factors.

Actual test results are dependent on the length of the conductor being tested, the temperature of the insulating material, and the humidity of the surrounding environment at the time of the test. In addition, insulation resistance tests are performed to establish a trending pattern and a deviation from the baseline information obtained during maintenance testing enabling the evaluation of the insulation for confined use.

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TABLE 4

Molded-Case Circuit Breakers Values for Inverse Time Trip Test (At 300% of Rated Continuous Current of Circuit Breaker)

Range of Rated Continuous Current Amperes	Maximum Trip Time in Seconds For Each Maximum Frame Rating*	
	≤ 250V	251 - 600V
0-30	50	70
31-50	80	100
51-100	140	160
101-150	200	250
151-225	230	275
226-400	300	350
401-600		450
601-800		500
801-1000		600
1001-1200		700
1201-1600		775
1601-2000		800
2001-2500		850
2501-5000		900

Reproduction of Table 5-3 from NEMA Standard AB4-1991.

TABLE 5
Instantaneous Trip Setting Tolerances for Field
Testing of Marked Adjustable Trip Circuit Breakers

	Tolerances of High and Low Settings	
Ampere Rating	High	Low
≤ 250	+ 40% - 25%	+ 40% - 30%
> 250	± 25%	± 30%

Reproduction of Table 5-4 from NEMA publication AB4-1991.

For circuit breakers with nonadjustable instantaneous trips, tolerances apply to the manufacturer's published trip range, i.e., +40 percent on high side, -30 percent on low side.

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^{*} For integrally fused circuit breakers, trip times may be substantially longer if tested with the fuses replaced by solid links (shorting bars).

TABLE 6
Insulation Resistance Conversion Factors
For Conversion of Test Temperature to 20°C

Tem	perature	Multiplier	
°C	°F	Apparatus Containing Immersed Oil Insulations	Apparatus Containing Solid Insulations
0	32	0.25	0.40
5	41	0.36	0.45
10	50	0.50	0.50
15	59	0.75	0.75
20	68	1.00	1.00
25	77	1.40	1.30
30	86	1.98	1.60
35	95	2.80	2.05
40	104	3.95	2.50
45	113	5.60	3.25
50	122	7.85	4.00
55	131	11.20	5.20
60	140	15.85	6.40
65	149	22.40	8.70
70	158	31.75	10.00
75	167	44.70	13.00
80	176	63.50	16.00

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SWITCHGEAR AND SWITCHBOARD ASSEMBLIES

Maintenance Testing Guidelines

The following information is a guide for maintenance services. Consult specific instruction manuals and drawings for detailed installation and operating procedures. Switchgear and Switchboard Assemblies should be installed, operated, and maintained by qualified personnel as defined by OSHA 29CFR1910 subpart 5. These instructions do not cover all details, variations, or combinations of the equipment, its installation, checkout, and safe operation. Care must be exercised to comply with local, state, and national regulations, as well as safety practices for this class of equipment.

Prior To Testing

- Procure and review all drawing associated with the equipment being tested.
- Study all instructional documents (Operation and Maintenance Manuals) applicable to the equipment.
- Obtain a copy of the appropriate test form to record test results.
- Verify suitability and accuracy of equipment to be used for testing.
- Record all existing equipment settings as well as settings resulting from any necessary adjustments.

Necessary Equipment

- Personnel Protective Equipment (PPE)
- Ductor
- Phase rotation meter
- RMS Multimeter
- Single phase high current source
- Torque Wrench
- Megger
- Thermometer

DO NOT ATTEMPT TO INSTALL OR WORK ON EQUIPMENT WHILE IT IS ENERGIZED



Always verify that no voltage is present before proceeding with testing. Assume all circuits are energized. Confirm primary sources of power are disconnected, tagged, and locked out. Always follow all local, state, and national regulations including OSHA requirements and generally accepted safety procedures.

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Inspection and Test Procedures

Visual and Mechanical Inspection

- 1. Compare equipment nameplate data with latest one-line diagram when available.
- Inspect physical, electrical, and mechanical condition including evidence of moisture or corona.
- **3.** Verify appropriate anchorage, required area clearances, physical damage, and correct alignment.
- **4.** Verify that fuse and/or circuit breaker sizes and types correspond to drawings and coordination study as well as to the circuit breaker's address for microprocessor-communication packages.
- **5.** Verify that current and voltage (potential) transformer ratios correspond to drawings.
- **6.** Inspect all bus connections for high resistance using one of the following methods:
 - **6.1.** Use of low-resistance ohmmeter in accordance with Step 3 of the "Electrical Tests" section of this document.
 - **6.2.** Verify tightness of accessible bolted electrical connections by calibrated torquewrench method in accordance with manufacturer's published data or Table 2.
 - **6.3.** Perform thermographic survey in accordance with the "Thermographic Survey Procedures" section of this document.
- 7. Confirm correct operation and sequencing of electrical and mechanical interlock systems.
 - **7.1.** Attempt closure on locked-open devices. Attempt to open locked-closed devices.
 - **7.2.** Make key exchange with devices operated in off-normal positions.
- **8.** Thoroughly clean unit prior to testing unless as-found and as-left tests are required.
- **9.** Inspect insulators for evidence of physical damage or contaminated surfaces.
- **10.** Verify correct barrier and shutter installation and operation.
- 11. Lubrication
 - **11.1.** Verify appropriate contact lubricant on moving current-carrying parts.
 - **11.2.** Verify appropriate lubrication on moving and sliding surfaces.
- 12. Exercise all active components.
- 13. Inspect all mechanical indicating devices for correct operation.
- 14. Verify that filters are in place and/or vents are clear.
- **15.** Test operation, alignment, and penetration of instrument transformer withdrawal disconnects, current-carrying and grounding, in accordance with Instrument Transformers: Maintenance Testing Guidelines. Inspect for control power transformers.
 - **15.1.** Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
 - **15.2.** Verify that primary and secondary fuse ratings or circuit breakers match drawings.
 - **15.3.** Verify correct functioning of drawout disconnecting and grounding contacts and interlocks

Electrical Tests

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- Perform tests on all instrument transformers in accordance with <u>Instrument Transformers</u>: <u>Maintenance Testing Guidelines</u>.
- **2.** Perform ground-resistance tests in accordance with <u>Grounding Systems: Maintenance Testing Guidelines.</u>
- **3.** Perform resistance measurements through all bus joints with a low-resistance ohmmeter, if applicable, in accordance with Step 6 of the "Visual and Mechanical Inspection" section of this document.
- **4.** Perform insulation-resistance tests on each bus section, phase-to-phase and phase-to-ground for one minute in accordance with Table 3.

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- 5. Perform an overpotential test on each bus section, each phase to ground with phases not under test grounded, in accordance with manufacturer's published data. If manufacturer has no recommendation for this test, it shall be in accordance with Table 4. The test voltage shall be applied for one minute. Refer to Step 4 of the "Test Values" section of this document before performing test.
- **6.** Perform insulation-resistance tests at 1000 volts dc on all control wiring. For units with solid-state components, follow manufacturer's recommendations.
- Perform system function tests in accordance with the "General System Function Tests" section of this document.
- 8. Control Power Transformers
 - **8.1.** Perform insulation-resistance tests. Perform measurements from winding-to-winding and each winding-to-ground. Test voltages shall be in accordance with Table 3 unless otherwise specified by manufacturer.
 - **8.2.** Verify correct function of control transfer relays located in switchgear with multiple power sources.
- **9.** Voltage (Potential) Transformers
 - **9.1.** Perform insulation-resistance tests. Perform measurements from winding-to-winding and each winding-to-ground. Test voltages shall be in accordance with Table 3 unless otherwise specified by manufacturer.
 - **9.2.** Verify secondary voltages.
- 10. Verify operation of switchgear/switchboard heaters.

Test Values

- 1. Compare bus connection resistances to values of similar connections.
- 2. Bolt-torque levels shall be in accordance with Table 2 unless otherwise specified by manufacturer.
- 3. Microhm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values that deviate from similar bus by more than 25 percent of the lowest value.
- **4.** Insulation-resistance values for bus, control wiring, and control power transformers shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 3. Values of insulation resistance less than this table or manufacturer's minimum should be investigated. Overpotential tests should not proceed until insulation-resistance levels are raised above minimum values.
- 5. The insulation shall withstand the overpotential test voltage applied.

Thermographic Survey Procedures

- 1. Visual and Mechanical Inspection
 - **1.1.** Inspect physical, electrical, and mechanical condition.
 - **1.2.** Remove all necessary covers prior to thermographic inspection.
- 2. Equipment to be inspected shall include all current-carrying devices.
- **3.** Provide report including the following:
 - 3.1. Discrepancies.
 - **3.2.** Temperature difference between the area of concern and the reference area.
 - **3.3.** Cause of temperature difference.
 - 3.4. Areas inspected. Identify inaccessible and/or unobservable areas and/or equipment.
 - **3.5.** Identify load conditions at time of inspection.
 - **3.6.** Provide photographs and/or thermograms of the deficient area.

4. Test Parameters

- **4.1.** Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1°C at 30°C.
- **4.2.** Equipment shall detect emitted radiation and convert detected radiation to visual signal.
- **4.3.** Thermographic surveys should be performed during periods of maximum possible loading but not less than 40 percent of rated load of the electrical equipment being inspected. Refer to ANSI/NFPA 70B, Section 18-16 (Infrared Inspection).
- **5.** Test Results: Suggested actions based on temperature can be found in Table 1.

General System Function Tests

- 1. Perform system function tests upon completion of equipment tests as previously defined in this document. It is the purpose of system function tests to prove the correct interaction of all sensing, processing, and action devices.
- 2. Implementation
 - **2.1.** Develop test parameters for the purpose of evaluating performance of all integral components and their functioning as a complete unit within design requirements.
 - **2.2.** Perform these tests:
 - **2.2.1.** Verify the correct operation of all interlock safety devices for fail-safe functions in addition to design function.
 - **2.2.2.** Verify the correct operation of all sensing devices, alarms, and indicating devices.

After Testing

- Finish recording data on the test form, completely filling in all the appropriate blocks.
- Remove all test equipment and tools used during testing. Replace all barriers and covers, close all doors, and secure all latches.

TABLE 1
Thermographic Survey
Suggested Actions Based on Temperature Rise

Temperature difference (ΔT) based on comparisons between similar components under similar loading.	Temperature difference (ΔT) based upon comparisons between component and ambient air temperatures.	Recommended Action
1°C - 3°C	0°C - 10°C	Possible deficiency; warrants investigation
4°C - 15°C	11°C - 20°C	Indicates probable deficiency; repair as time permits
	22°C - 40°C	Monitor continuously until corrective measures can be accomplished
> 16°C	> 40°C	Major discrepancy; repair immediately

Temperature specifications vary depending on the exact type of equipment. Even in the same class of equipment (i.e., cables) there are various temperature ratings. Heating is generally related to the square of the current; therefore, the load current will have a major impact on ΔT . In the absence of consensus standards for ΔT , the values in this table will provide reasonable guidelines.

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TABLE 2
US Standard
Bolt Torques for Bus Connections
Heat-Treated Steel - Cadmium or Zinc Plated

Grade	SAE 1 & 2	SAE 5	SAE 7	SAE 8
Minimum Tensile (P.S.I.)	64K	105K	133K	150K
Bolt Diameter In Inches		Torque (Foot Pounds)		
1/4	4.0	5.6	8.0	8.4
5/16	7.2	11.2	15.2	17.6
3/8	12.0	20.0	27.2	29.6
7/16	19.2	32.0	44.0	48.0
1/2	29.6	48.0	68.0	73.6
9/16	42.4	70.4	96.0	105.6
5/8	59.2	96.0	133.6	144.0
3/4	96.0	160.0	224.0	236.8
7/8	152.0	241.6	352.0	378.4
1.0	225.6	372.8	528.0	571.2

TABLE 2
Bolt Torques for Bus Connections
Silicon Bronze Fasteners*
Torque (Foot-Pounds)

Bolt Diameter in Inches	Nonlubricated	Lubricated
5/16	15	10
3/8	20	14
1/2	40	25
5/8	55	40
3/4	70	60

^{*} Bronze alloy bolts shall have a minimum tensile strength of 70,000 pounds per square inch.

TABLE 2 (cont.) Aluminum Alloy Fasteners** Torque (Foot Pounds)

Bolt Diameter in Inches	Lubricated
5/16	8.0
3/8	11.2
1/2	20.0
5/8	32.0
3/4	48.0

^{**} Aluminum alloy bolts shall have a minimum tensile strength of 55,000 pounds per square inch.

TABLE 2
Bolt Torques for Bus Connections
Stainless Steel Fasteners***
Torque (Foot Pounds)

Bolt Diameter in Inches	Uncoated
5/16	14
3/8	25
1/2	45
5/8	60
3/4	90

^{***} Bolts, cap screws, nuts, flat washers, locknuts: 18-8 alloy. Belleviille washers: 302 alloy.

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TABLE 3
Insulation Resistance Tests on
Electrical Apparatus and Systems

Maximum Rating of Equipment in Volts	Minimum Test Voltage, dc in Volts	Recommended Minimum Insulation Resistance in Megohms
250	500	25
600	1,000	100
5,000	2,500	1,000
8,000	2,500	2,000
15,000	2,500	5,000
25,000	5,000	20,000
35,000	15,000	100,000
46,000	15,000	100,000
69,000	15,000	100,000

In the absence of consensus standards dealing with insulation-resistance tests, the NETA Technical Committee suggests the above representative values. See Table 5 for temperature correction factors.

Actual test results are dependent on the length of the conductor being tested, the temperature of the insulating material, and the humidity of the surrounding environment at the time of the test. In addition, insulation resistance tests are performed to establish a trending pattern and a deviation from the baseline information obtained during maintenance testing enabling the evaluation of the insulation for confined use.

TABLE 4
Switchgear Low-Frequency Withstand Test Voltages

Type of Switchgear	chgear Rated Maximum Voltage Maximum Test Volta		st Voltage kV
	(kV) (rms)	ас	dc
LV (Low-Voltage Power Circuit Breaker Switchgear)	.254/.508/.635	1.6	2.3
MC	4.76	14.0	20.0
(Metal-Clad Switchgear)	8.25	27.0	37.0
	15.0	27.0	37.0
	38.0	60.0	+
SC	15.5	37.0	+
(Station-Type Cubicle	38.0	60.0	+
Switchgear)	72.5	120.0	+
MEI	4.76	14.0	20.0
(Metal-Enclosed	8.25	19.0	27.0
Interrupter Switchgear)	15.0	27.0	37.0
	15.5	37.0	52.0
	25.8	45.0	+
	38.0	60.0	+

Derived from ANSI/IEEE C37.20.1-1993, Paragraph 5.5, Standard for Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear, C37.20.2-1993, Paragraph 5.5, Standard for Metal-Clad and Station-Type Cubicle Switchgear and C37.20.3-1993, Paragraph 5.5, Standard for Metal-Enclosed Interrupter Switchgear, and includes 0.75 multiplier with fraction rounded down.

The column headed "DC" is given as a reference only for those using dc tests to verify the integrity of connected cable installations without disconnecting the cables from the switchgear. It represents values believed to be appropriate and approximately equivalent to the corresponding power frequency withstand test values specified for voltage rating of switchgear. The presence of this column in no way implies any requirement for a dc withstand test on ac equipment or that a dc withstand test represents an acceptable alternative to the low-frequency withstand tests specified in this specification, either for design tests, production tests, conformance tests, or field tests. When making dc tests, the voltage should be raised to the test value in discrete steps and held for a period of one minute.

Because of the variable voltage distribution encountered when making dc withstand tests, the manufacturer should be contacted for recommendations before applying dc withstand tests to the switchgear. Voltage transformers above 34.5kV should be disconnected when testing with dc. Refer to ANSI/IEEE C57-13-1978 (R1987) *IEEE Standard Requirements for Instrument Transformers* [10], Section 8 and, in particular 8.8.2, (the last paragraph) which reads "Periodic kenotron tests should not be applied to transformers of higher than 34.5 kV voltage rating."

+ Consult Manufacturer

TABLE 5
Insulation Resistance Conversion Factors
For Conversion of Test Temperature to 20°C

Temperature		Multiplier		
°C	°F	Apparatus Containing Immersed Oil Insulations	Apparatus Containing Solid Insulations	
0	32	0.25	0.40	
5	41	0.36	0.45	
10	50	0.50	0.50	
15	59	0.75	0.75	
20	68	1.00	1.00	
25	77	1.40	1.30	
30	86	1.98	1.60	
35	95	2.80	2.05	
40	104	3.95	2.50	
45	113	5.60	3.25	
50	122	7.85	4.00	
55	131	11.20	5.20	
60	140	15.85	6.40	
65	149	22.40	8.70	
70	158	31.75	10.00	
75	167	44.70	13.00	
80	176	63.50	16.00	

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SMALL DRY TYPE TRANSFORMERS < 600 VOLT (167 KVA SINGLE-PHASE, 500 KVA THREE-PHASE, AND SMALLER) Maintenance Testing Guidelines

The following information is a guide for maintenance services. Consult specific instruction manuals and drawings for detailed installation and operating procedures. Dry Type Transformers should be installed, operated, and maintained by qualified personnel as defined by OSHA 29CFR1910 subpart 5. These instructions do not cover all details, variations, or combinations of the equipment, its installation, checkout, and safe operation. Care must be exercised to comply with local, state, and national regulations, as well as safety practices for this class of equipment.

Prior To Testing

- Procure and review all drawing associated with the equipment being tested.
- Study all instructional documents (Operation and Maintenance Manuals) applicable to the equipment.
- Obtain a copy of the appropriate test form to record test results.
- Verify suitability and accuracy of equipment to be used for testing.
- Record all existing equipment settings as well as settings resulting from any necessary adjustments.

Necessary Equipment

- Personnel Protective Equipment (PPE)
- TTR Meter
- RMS Multimeter
- Torque Wrench
- Megger
- Power Factor Test Set (if required)
- Dissipation Factor Tester (if required)

DO NOT ATTEMPT TO INSTALL OR WORK ON EQUIPMENT WHILE IT IS ENERGIZED



Always verify that no voltage is present before proceeding with testing. Assume all circuits are energized. Confirm primary sources of power are disconnected, tagged, and locked out. Always follow all local, state, and national regulations including OSHA requirements and generally accepted safety procedures.

File: xfmr 600v and below

Revision: 0.0 Revised On: 2/10/16

Inspection and Test Procedures

Visual and Mechanical Inspection

- 1. Inspect physical and mechanical condition.
- 2. Thoroughly clean unit prior to testing unless as-found and as-left tests are required.
- 3. Inspect all bolted electrical connections for high resistance using one of the following methods:
 - **3.1.** Use of low-resistance ohmmeter in accordance with Step 1 of the "Electrical Tests" section of this document.
 - **3.2.** Verify tightness of accessible bolted electrical connections by calibrated torquewrench method in accordance with manufacturer's published data or Table 2.
 - **3.3.** Perform thermographic survey in accordance with the "Thermographic Survey Procedures" section of this document.

Electrical Tests

- Perform resistance measurements through all bolted connections with a low-resistance ohmmeter, if applicable, in accordance with Step 3.1 of the "Visual and Mechanical Inspection" section of this document.
- 2. Perform insulation-resistance tests winding-to-winding and each winding-to-ground with test voltage in accordance with Table 3. Calculate polarization index.
- **3.** Perform turns ratio tests at the designated tap position.
- **4.** Verify that as-left tap connections are as specified.

Test Values

- 1. Compare bolted connection resistances to values of similar connections.
- Bolt-torque levels shall be in accordance with Table 1 unless otherwise specified by manufacturer.
- 3. Microhm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values which deviate from similar connections by more than 25 percent of the lowest value.
- **4.** Insulation-resistance test values at one minute should not be less than values recommended in Table 3. Results shall be temperature corrected in accordance with Table 4.
- **5.** The polarization index should be compared to previously obtained results.
- **6.** Turns-ratio test results should not deviate more than one-half percent from either the adjacent coils or the calculated ratio.

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Thermographic Survey Procedures

- 1. Visual and Mechanical Inspection
 - **1.1.** Inspect physical, electrical, and mechanical condition.
 - **1.2.** Remove all necessary covers prior to thermographic inspection.
- 2. Equipment to be inspected shall include all current-carrying devices.
- **3.** Provide report including the following:
 - **3.1.** Discrepancies.
 - **3.2.** Temperature difference between the area of concern and the reference area.
 - **3.3.** Cause of temperature difference.
 - **3.4.** Areas inspected. Identify inaccessible and/or unobservable areas and/or equipment.
 - **3.5.** Identify load conditions at time of inspection.
 - **3.6.** Provide photographs and/or thermograms of the deficient area.
- 4. Test Parameters
 - **4.1.** Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1°C at 30°C.
 - **4.2.** Equipment shall detect emitted radiation and convert detected radiation to visual signal.
 - **4.3.** Thermographic surveys should be performed during periods of maximum possible loading but not less than 40 percent of rated load of the electrical equipment being inspected. Refer to ANSI/NFPA 70B, Section 18-16 (Infrared Inspection).
- **5.** Test Results: Suggested actions based on temperature can be found in Table 1.

After Testing

- Finish recording data on the test form, completely filling in all the appropriate blocks
- Remove all test equipment and tools used during testing. Replace all barriers and covers, close all doors, and secure all latches.

TABLE 1 Thermographic Survey Suggested Actions Based on Temperature Rise

Temperature difference (ΔT) based on comparisons between similar components under similar loading.	Temperature difference (ΔT) based upon comparisons between component and ambient air temperatures.	Recommended Action
1°C - 3°C	0°C - 10°C	Possible deficiency; warrants investigation
4°C - 15°C	11°C - 20°C	Indicates probable deficiency; repair as time permits
	22°C - 40°C	Monitor continuously until corrective measures can be accomplished
> 16°C	> 40°C	Major discrepancy; repair immediately

Temperature specifications vary depending on the exact type of equipment. Even in the same class of equipment (i.e., cables) there are various temperature ratings. Heating is generally related to the square of the current; therefore, the load current will have a major impact on ΔT . In the absence of consensus standards for ΔT , the values in this table will provide reasonable guidelines.

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TABLE 2
US Standard
Bolt Torques for Bus Connections
Heat-Treated Steel - Cadmium or Zinc Plated

Grade	SAE 1 & 2	SAE 5	SAE 7	SAE 8
Minimum Tensile (P.S.I.)	64K	105K	133K	150K
Bolt Diameter In Inches		Torque (Foot Pounds)		
1/4	4.0	5.6	8.0	8.4
5/16	7.2	11.2	15.2	17.6
3/8	12.0	20.0	27.2	29.6
7/16	19.2	32.0	44.0	48.0
1/2	29.6	48.0	68.0	73.6
9/16	42.4	70.4	96.0	105.6
5/8	59.2	96.0	133.6	144.0
3/4	96.0	160.0	224.0	236.8
7/8	152.0	241.6	352.0	378.4
1.0	225.6	372.8	528.0	571.2

TABLE 2
Bolt Torques for Bus Connections
Silicon Bronze Fasteners*
Torque (Foot-Pounds)

Bolt Diameter in Inches	Nonlubricated	Lubricated
5/16	15	10
3/8	20	14
1/2	40	25
5/8	55	40
3/4	70	60

 $^{^{\}star}$ Bronze alloy bolts shall have a minimum tensile strength of 70,000 pounds per square inch.

File: xfmr 600v and below

TABLE 2 (cont.) Aluminum Alloy Fasteners** Torque (Foot Pounds)

Bolt Diameter in Inches	Lubricated
5/16	8.0
3/8	11.2
1/2	20.0
5/8	32.0
3/4	48.0

^{**} Aluminum alloy bolts shall have a minimum tensile strength of 55,000 pounds per square inch.

TABLE 2
Bolt Torques for Bus Connections
Stainless Steel Fasteners***
Torque (Foot Pounds)

Bolt Diameter in Inches	Uncoated
5/16	14
3/8	25
1/2	45
5/8	60
3/4	90

^{***} Bolts, cap screws, nuts, flat washers, locknuts: 18-8 alloy. Belleviille washers: 302 alloy.

File: xfmr 600v and below Page 5 of 6

TABLE 3
Transformer Insulation-Resistance

		Recommended Minimum Insulation Resistance in Megohms	
Transformer Coil Rating Type in Volts	Minimum dc Test Voltage	Liquid Filled	Dry
0 - 600	1000	100	500
601 - 5000	2500	1000	5000
5001 - 15000	5000	5000	25000

In the absence of consensus standards, the NETA Technical Committee suggests the above representative values. NOTE: Since insulation resistance depends on insulation rating (kV) and winding capacity (kVA), values obtained should be compared to manufacturer's published data.

TABLE 4
Insulation ResistanceConversion Factors
For Conversion of Test Temperature to 20°C

Temperature		Multiplier	
°C	°F	Apparatus Containing Immersed Oil Insulations	Apparatus Containing Solid Insulations
0	32	0.25	0.40
5	41	0.36	0.45
10	50	0.50	0.50
15	59	0.75	0.75
20	68	1.00	1.00
25	77	1.40	1.30
30	86	1.98	1.60
35	95	2.80	2.05
40	104	3.95	2.50
45	113	5.60	3.25
50	122	7.85	4.00
55	131	11.20	5.20
60	140	15.85	6.40
65	149	22.40	8.70
70	158	31.75	10.00
75	167	44.70	13.00
80	176	63.50	16.00

File: xfmr 600v and below Page 6 of 6

LARGE DRY TYPE TRANSFORMERS > 600 VOLT AND < 600 VOLT

(> 167 KVA SINGLE-PHASE AND 500 KVA THREE-PHASE)

Maintenance Testing Guidelines

The following information is a guide for maintenance services. Consult specific instruction manuals and drawings for detailed installation and operating procedures. Dry Type Transformers of all voltages should be installed, operated, and maintained by qualified personnel as defined by OSHA 29CFR1910 subpart 5. These instructions do not cover all details, variations, or combinations of the equipment, its installation, checkout, and safe operation. Care must be exercised to comply with local, state, and national regulations, as well as safety practices for this class of equipment.

Prior To Testing

- Procure and review all drawing associated with the equipment being tested.
- Study all instructional documents (Operation and Maintenance Manuals) applicable to the equipment.
- Obtain a copy of the appropriate test form to record test results.
- Verify suitability and accuracy of equipment to be used for testing.
- Record all existing equipment settings as well as settings resulting from any necessary adjustments.

Necessary Equipment

- Personnel Protective Equipment (PPE)
- RMS Multimeter
- Torque Wrench
- TTR Meter
- Megger (5,000 volt with selectable voltages)
- Power Factor Test Set (if required)
- Dissipation Factor Tester (if required)

File: xfmr over 600v

Revision: 0.0

Revised On: 2/10/16

DO NOT ATTEMPT TO INSTALL OR WORK ON EQUIPMENT WHILE IT IS ENERGIZED



Always verify that no voltage is present before proceeding with testing. Assume all circuits are energized. Confirm primary sources of power are disconnected, tagged, and locked out. Always follow all local, state, and national regulations including OSHA requirements and generally accepted safety procedures.

Inspection and Test Procedures

Visual and Mechanical Inspection

- Inspect physical, electrical, and mechanical condition including evidence of moisture, corona, or brittleness.
- 2. Verify that control and alarm settings on temperature indicators are as specified.
- 3. Verify that cooling fans operate.
- **4.** Inspect all bolted electrical connections for high resistance using one of the following methods:
 - **4.1.** Use of low-resistance ohmmeter in accordance with Step 2 of the "Electrical Tests" section of this document.
 - **4.2.** Verify tightness of accessible bolted electrical connections by calibrated torquewrench method in accordance with manufacturer's published data or Table 1.
 - **4.3.** Perform thermographic survey in accordance with the "Thermographic Survey Procedures" section of this document.
- **5.** Perform specific inspections and mechanical tests as recommended by manufacturer.
- **6.** Verify that resilient mounts are free and that any shipping brackets have been removed.
- 7. Verify that the core, frame, and enclosure are grounded.
- **8.** Verify the presence of transformer surge arresters.
- **9.** Thoroughly clean unit prior to testing unless as-found and as-left tests are required.
- **10.** Verify that as-left tap connections are as specified.

Electrical Tests

- **1.** Perform insulation-resistance tests winding-to-winding and each winding-to-ground, with test voltage in accordance with Table 2. Calculate polarization index.
- 2. Perform resistance measurements through all bolted connections with a low-resistance ohmmeter, if applicable, in accordance with Step 4 of the "Visual and Mechanical Inspection" section of this document.
- **3.** Perform power-factor or dissipation-factor tests in accordance with the test equipment manufacturer's published data.
- **4.** Perform turns-ratio tests at the designated tap position.
- **5.** Perform an excitation-current test on each phase.
- **6.** Measure the resistance of each winding at the designated position.
- **7.** Measure core insulation-resistance at 500 volts dc if core is insulated and if the core ground strap is removable.
- **8.** Perform an overpotential test on all high- and low-voltage windings-to-ground. NOTE: Field dielectric tests may be warranted in specific circumstances. However periodic dielectric tests are not recommended because of the severe stress imposed on the insulation. (ANSI/IEEE C57.12.91, Section 10.2.)
- **9.** Verify correct secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.

Test Values

File: xfmr over 600v Page 2 of 7

- 1. Compare bolted connection resistances to values of similar connections.
- Bolt-torque levels shall be in accordance with Table 1 unless otherwise specified by manufacturer.
- 3. Microhm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values which deviate from similar connections by more than 25 percent of the lowest value.
- **4.** Insulation-resistance test values at one minute should not be less than values recommended in Table 2. Results shall be temperature corrected in accordance with Table 3
- **5.** The polarization index should be compared to previously obtained results.
- **6.** Turns-ratio test results should not deviate more than one-half percent from either the adjacent coils or the calculated ratio.
- 7. C_H and C_L dissipation-factor/power-factor values will vary due to support insulators and bus work utilized on dry transformers. The following should be expected on C_{HL} power factors:

Power Transformers: two percent or less

Distribution Transformers: five percent or less

- **8.** Consult transformer manufacturer's or test equipment manufacturer's data for additional information.
- Winding-resistance test results should compare within one percent of previously obtained results after factoring in temperature correction.
- **10.** Typical excitation current test data pattern for three-legged core transformer is two similar current readings and one lower current reading.
- 11. Core insulation resistance values should be comparable to previously obtained results but not less than one megohm at 500 volts dc.
- **12.** AC overpotential test shall not exceed 65 percent of factory test voltage for one minute duration.

DC overpotential test shall not exceed 100 percent of the factory rms test voltage for one minute duration. The insulation shall withstand the overpotential test voltage applied.

Thermographic Survey Procedures

- 1. Visual and Mechanical Inspection
 - **1.1.** Inspect physical, electrical, and mechanical condition.
 - **1.2.** Remove all necessary covers prior to thermographic inspection.
- **2.** Equipment to be inspected shall include all current-carrying devices.
- **3.** Provide report including the following:
 - 3.1. Discrepancies.
 - **3.2.** Temperature difference between the area of concern and the reference area.
 - **3.3.** Cause of temperature difference.
 - 3.4. Areas inspected. Identify inaccessible and/or unobservable areas and/or equipment.
 - **3.5.** Identify load conditions at time of inspection.
 - **3.6.** Provide photographs and/or thermograms of the deficient area.
- 4. Test Parameters
 - **4.1.** Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1°C at 30°C.
 - **4.2.** Equipment shall detect emitted radiation and convert detected radiation to visual signal.
 - **4.3.** Thermographic surveys should be performed during periods of maximum possible loading but not less than 40 percent of rated load of the electrical equipment being inspected. Refer to ANSI/NFPA 70B, Section 18-16 (Infrared Inspection).
- **5.** Test Results: Suggested actions based on temperature can be found in Table 1.

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After Testing

- Finish recording data on the test form, completely filling in all the appropriate blocks.
- Remove all test equipment and tools used during testing. Replace all barriers and covers, close all doors, and secure all latches.

TABLE 1
Thermographic Survey
Suggested Actions Based on Temperature Rise

Temperature difference (ΔT) based on comparisons between similar components under similar loading.	Temperature difference (ΔT) based upon comparisons between component and ambient air temperatures.	Recommended Action
1°C - 3°C	0°C - 10°C	Possible deficiency; warrants investigation
4°C - 15°C	11°C - 20°C	Indicates probable deficiency; repair as time permits
	22°C - 40°C	Monitor continuously until corrective measures can be accomplished
> 16°C	> 40°C	Major discrepancy; repair immediately

Temperature specifications vary depending on the exact type of equipment. Even in the same class of equipment (i.e., cables) there are various temperature ratings. Heating is generally related to the square of the current; therefore, the load current will have a major impact on ΔT . In the absence of consensus standards for ΔT , the values in this table will provide reasonable guidelines.

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TABLE 2
US Standard
Bolt Torques for Bus Connections
Heat-Treated Steel - Cadmium or Zinc Plated

Grade	SAE 1 & 2	SAE 5	SAE 7	SAE 8
Minimum Tensile (P.S.I.)	64K	105K	133K	150K
Bolt Diameter In Inches		Torque (Foot Pounds)		
1/4	4.0	5.6	8.0	8.4
5/16	7.2	11.2	15.2	17.6
3/8	12.0	20.0	27.2	29.6
7/16	19.2	32.0	44.0	48.0
1/2	29.6	48.0	68.0	73.6
9/16	42.4	70.4	96.0	105.6
5/8	59.2	96.0	133.6	144.0
3/4	96.0	160.0	224.0	236.8
7/8	152.0	241.6	352.0	378.4
1.0	225.6	372.8	528.0	571.2

TABLE 2
Bolt Torques for Bus Connections
Silicon Bronze Fasteners*
Torque (Foot-Pounds)

Bolt Diameter in Inches	Nonlubricated	Lubricated
5/16	15	10
3/8	20	14
1/2	40	25
5/8	55	40
3/4	70	60

 $^{^{\}star}$ Bronze alloy bolts shall have a minimum tensile strength of 70,000 pounds per square inch.

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TABLE 2 (cont.) Aluminum Alloy Fasteners** Torque (Foot Pounds)

Bolt Diameter in Inches	Lubricated
5/16	8.0
3/8	11.2
1/2	20.0
5/8	32.0
3/4	48.0

^{**} Aluminum alloy bolts shall have a minimum tensile strength of 55,000 pounds per square inch.

TABLE 2
Bolt Torques for Bus Connections
Stainless Steel Fasteners***
Torque (Foot Pounds)

Bolt Diameter in Inches	Uncoated
5/16	14
3/8	25
1/2	45
5/8	60
3/4	90

^{***} Bolts, cap screws, nuts, flat washers, locknuts: 18-8 alloy. Belleviille washers: 302 alloy.

File: xfmr over 600v Page 6 of 7

TABLE 3 Transformer Insulation-Resistance

		Recommended Minimum Insulation Resistance in Megohms	
Transformer Coil Rating Type in Volts	Minimum dc Test Voltage	Liquid Filled	Dry
0 - 600	1000	100	500
601 - 5000	2500	1000	5000
5001 - 15000	5000	5000	25000

In the absence of consensus standards, the NETA Technical Committee suggests the above representative values. NOTE: Since insulation resistance depends on insulation rating (kV) and winding capacity (kVA), values obtained should be compared to manufacturer's published data.

TABLE 4
Insulation ResistanceConversion Factors
For Conversion of Test Temperature to 20°C

Tempe	erature	Multiplier	
°	°F	Apparatus Containing Immersed Oil Insulations	Apparatus Containing Solid Insulations
0	32	0.25	0.40
5	41	0.36	0.45
10	50	0.50	0.50
15	59	0.75	0.75
20	68	1.00	1.00
25	77	1.40	1.30
30	86	1.98	1.60
35	95	2.80	2.05
40	104	3.95	2.50
45	113	5.60	3.25
50	122	7.85	4.00
55	131	11.20	5.20
60	140	15.85	6.40
65	149	22.40	8.70
70	158	31.75	10.00
75	167	44.70	13.00
80	176	63.50	16.00

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APPENDIX A: CAPITAL ELECTRIC REPORT

Appendices



December 22, 2010

Kansas Department of Administration 900 WS Jackson Street, Suite 600 Topeka, KS 66612

Attn: George Werth

Subject: Summary of work performed on electrical distribution system in the Docking Building.

Dear Mr. Werth:

Capital Electric Construction was contracted to perform maintenance and cleaning of the 13.2kV electrical distribution system in the Docking Building. The work was started on Wednesday, November 24 and completed on Saturday, November 27. This report summarizes our findings.

To perform our work, power to the Docking building was turned off and maintenance to the Main Electrical gear and bus riser took place. During this maintenance, several medium voltage (M.V). switches were cleaned and repaired along with the main riser bus that runs the length and height of the building. The protective metal covers on the bus were removed where assessable and the electrical bus was visually inspected and cleaned. Included with this report are several photos of different items of concern that need varying degrees of attention.

Below is a list of our concerns:

- Nameplates on the equipment indicate that the gear was manufactured/installed
 in the mid 1950's. This makes this equipment between 50 and 60 years old. It is
 generally expected that electrical gear has a life expectancy of 15-30 years.
 Many factors affect the life expectancy, including ambient temperature,
 environmental conditions, electrical load (and the characteristics of the load) on
 the equipment, maintenance, and other factors. Assuming all of these factors
 have been ideal, the gear would still be considered to have out-lived its normal
 life expectancy.
- 2. Many of the sections of the bus are inaccessible. This means that these sections have never been cleaned or maintained. Routine maintenance is not possible on these sections. There was an extreme amount of dust/dirt accumulation in all areas of the system. We were able to clean many of the areas, but these particular areas could not be accessed, so they remain with over 50 years of dirt accumulation. The presence of the dust/dirt and in some areas oil and moisture



could lead to tracking (unwanted current flow from phase to phase or phase to ground). The result of this could potentially be severe damage to the equipment and building, and also potential safety risk to people in the building. An electrical outage affecting the entire building could also result.

The age of the electrical equipment is such that replacement parts are unavailable or difficult to find. Repairs may require custom fabrication, which could require extensive engineering or re-engineering.

The gear is 13.2kV. Any maintenance or repairs requires special equipment, tools, and training.

5. The gear is very open in design and allows air flow into the bus duct thru the M.V. switches. With these transformer housings being in the air handler rooms and the elevator exhaust ports feeding into these rooms the accumulation is much more than normal. The bus is covered and has taped joints but those tape joints are showing some tracking and age. To re-tape these joints would extend the life of the bus but would be very labor intensive and require a very lengthy outage to do so.

6. Transformer TRN-0015 has bus that is wrapped in 20,000v electrical blanket and extremely close to the access points of the transformer housing. It is possible that during the removal of the transformer housing covers that the bus could become exposed and cause significant hazards to the personnel working on the gear. Due to the nature of these pieces of electrical gear every precaution should be taken to protect any personnel inspecting these items. A detailed safety agenda should be followed and all personnel should adhere to any and all PPE requirements of NFPA 70e. An arc flash incident is highly possible with gear of this nature if the proper precautions are not followed extensively. The consequences of an arc flash in this gear and in these confined locations would be very server and would likely result in death to the personnel working on the gear. It is highly recommended that only qualified and trained personnel have access to this gear for maintenance purposes.

7. As mentioned above the M.V. switches are open into the bus area. These had varying degrees of dust and dirt accumulation as well. These however can be de-energized and maintenance performed on a regular basis to extend their life span. While energized a visual inspection of these switches and of the transformers would be recommended along with an IR scan on a routine maintenance schedule. With the exception of one transformer this is recommended.

 An arc flash study is recommended for this and all electrical gear in the Docking building. This would include the proper labeling of the arc hazard and calorie requirements onto all electrical doors.

9. It was also observed during the maintenance that some of the fuses were not seated properly and that the switches were not engaging fully. The only reason this had not been an issue was due to the amount of load on these switches. If these had additional load on them when not fully seated it would result in arcing and heating issues.

10. It was noted on the first and basement floors that the wires feeding off the load side of the switches have corrosion developing at the insulators holding them in place. These were cleaned and re-taped but this is not a permanent fix and



these should be replaced in the near future before the insulation breaks down to the point of failure.

11. Mechanical mechanisms in some of the MV switches have failed. These are a safety mechanism that keeps the door of the enclosure closed when the switch is in the energized state. Because these could not be repaired, we were forced to install padlocks on the doors as the only means of safety. Signage should be installed on these switches to alert personnel of the danger.

SUMMARY

We believe the electrical distribution system in the Docking Building is nearing the failure point, and we recommend a complete replacement of the system.

- Insulation in the system is deteriorating and may fail.
- The equipment is obsolete and replacement parts are not available.
- · Safety mechanisms are failing.

I have attached the Emerson Test Report for the switches and equipment that were tested during the project. Their report includes additional recommendations.

Please contact me if there are any questions or additional information is required.

Thank you.

Mark Hurshman Capital Electric



Electrical Reliability Services, Inc. Kansas City Area Office

> 348 N.W. Capital Drive Lee's Summit, MO 64086 T (816) 525-7156 F (816) 524-3274

December 6, 2010

Capital Electric P.O. Box 410079 Kansas City, MO 64141

Attention: Mr. Mark Hurshman

Subject: Electrical Equipment Maintenance Test Report

Reference No. 3126895

Dear Mr. Hurshman:

Enclosed is the subject test report as prepared by our lead field engineer. It was our pleasure to be of service to you on this project. If you have any questions, or if we can be of further assistance, please do not hesitate to call.

Sincerely,

Electrical Reliability Services, Inc

Bob Ross

Service Center Manager

Enclosures



Electrical Reliability Services, Inc. Kansas City Area Office

> 348 N.W. Capital Drive Lee's Summit, MO 64086 T (816) 525-7156 F (816) 524-3274

Electrical Equipment Maintenance Test Report

At

DOCKING STATE OFFICE BLDG Topeka, KS

for

Capital Electric P.O.Box 410079 Kansas City, MO 64141

Attention: Mr. Mark Hurshman Order No: PO#196031, JOB#56763

Reference No.

3126895

Submitted By:

David Duncan Field Engineer

December 6, 2010

Reviewed By:

Bob Ross Service Center Manager

1 PURPOSE

- 1.1 The equipment and components listed in Section 3.0 of this report have been inspected and tested to help assure their proper and safe operation. Defective or marginal equipment can be identified, repaired, replaced or scheduled for future repairs without costly or unexpected interruptions during normal operating periods.
- 1.2 The test results are particularly valuable when kept for comparison with past and future maintenance test results. This historic database enables one to predict the probability of equipment failure and thus schedule facility production and financial budgets to accommodate preventive maintenance or repair rather than breakdown maintenance.

Reference No.3126895

2 SUMMARY

- 2.1 This project was initiated by Mr. Mark Hurshman with Capital Electric. All testing was performed by Electrical Reliability Services Field Engineers David Duncan and Charles Howell on Saturday, November 27, 2010.
- 2.2 Please refer to Section 5 "Results and Recommendations" for complete details of the testing.

Reference No.3126895

Page 2

3 **EQUIPMENT TESTED AND INSPECTED**

- 3.1
- **Three (3)** medium voltages disconnect switches, S&C, SM-5, and 400 Amp. **Seventeen (17)** medium voltages disconnect switches, electrical engineering equipment co, S.O. # 50542, 300 Amp. 3.2

Reference No.3126895

4 PROCEDURES

- 4.1 Medium Voltage Air Switches
 - 4.1.1 Visual and Mechanical Inspection
 - Compared equipment nameplate data with drawings and specifications,
 - .2 Inspected for physical damage, proper installation, required area clearances, anchorage and grounding. Cleaned interior, insulators, arc chutes and interphase barriers.
 - .3 Performed mechanical operator tests in accordance with manufacturer's instructions. Cleaned and lubricated contacts and mechanism as applicable. Confirmed correct application of manufacturer's recommended lubricants.
 - .4 Checked contact alignment, wipe and pressure.
 - .5 Inspected for correct phase barrier materials and installation.
 - .6 Checked fuse linkage and element for proper holder and current rating. Recorded fuse data.
 - .7 Verified tightness of accessible bolted electrical connections by calibrated torque-wrench method.
 - .8 Verified that fuse sizes and types were in accordance with drawings and power system studies.
 - .9 Inspected all indicating and control devices for correct operation.
 - .10 Tested all interlocking systems for correct operation and sequencing. Checked key interlock for proper operation and proper key distribution.
 - .11 Verified arc interrupter operation.

Reference No.3126895

4.1.2 Electrical Tests

- ,1 Performed contact resistance test across each switch blade and fuse link.
- .2 Measured fuse resistance.
- .3 Performed insulation-resistance tests on each pole, phase-tophase and phase-to-ground with switch closed and across each open pole for one minute.

Reference No.3126895

Page 5

5 RESULTS AND RECOMMENDATIONS

- 5.1 The following is a list of problems discovered during this testing project along with any corrective action that was made by Electrical Reliability Services. Those corrections beyond the scope of the project that require your additional corrective action are in bolded text.
 - 5.1.1 If the equipment tested in Section 3 is not discussed in this section, the results of the tests indicate the equipment to be satisfactory.
- 5.2 Feeder #10 A phase contact resistance was found to be higher than the other two phases and was outside of NETA contact resistance tolerances. This could cause contact heating of the other two phases, deterioration, and eventual failure of the switch. This problem was corrected at time of testing by ERS personnel. No further action required at this time.
- 5.3 Feeders 9 &10 automatic transfer operator could not be tested because of customer restrictions. Because of the age, condition, and unavailability of repair parts the customer did not want the transfer mechanism operated. The customer is aware of the deficiencies with the ATS System and is attempting to have it repaired or replaced.
 - It is recommended that the ATS System should be tested once repairs have been made. Electrical Reliability Services would be pleased offer this service.
- 5.4 Riser #7 B phase contact resistance was found to be higher than the other two phased and was outside of NETA contact resistance tolerances. This could cause contact heating of the other two phases, deterioration, and eventual failure of the switch. This problem was corrected at time of testing. No further action required at this time.

- 5.5 During the outage for Capital Electric Inc. to perform low voltage retrofits, on down stream equipment, it was discovered that a large percentage of the transformer disconnects were not closing fully. The cause of the problems was found to be the mechanical door interlocks which are bent out of shape. State of Kansas personnel directed Electrical Reliability Services personnel to remove the interlocking mechanism and State of Kansas personnel would install locks and signs to adjust for the safety issues.
- 5.6 During the inspection of Medium Voltage Air Switch LUCS 18, on the (14th) floor it was discovered that the moving contacts were not fully engaging the stationary contact. This could cause contact heating, deterioration, and eventual failure of the switch. Electrical Reliability Services personnel corrected this condition. This same condition was found at the following locations:

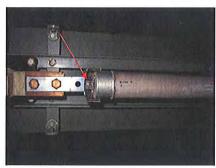
LUCS 17, on the (14th) floor LUCS 16, on the (12th) floor LUCS 15, on the (11th) floor LUCS 14, on the (10th) floor LUCS 9, on the (9th) floor LUCS 10, on the (8th) floor LUCS 11, on the (7th) floor LUCS 12, on the (6th) floor LUCS 13, on the (5th) floor LUCS 5, on the (3th) floor The pictures below are examples of this condition. The left picture is the before adjustment picture and the right picture is after corrections were made.

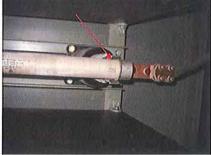




- It is recommended that all the switches be cleaned and tested.

 Electrical Reliability Services would be please to provide this service.
- 5.7 LUCS 5, on the (3rd) floor was found with the B phase fuse improperly inserted into the fuse clip. This could cause overheating, premature aging of the fuse and unscheduled outages. Capital Electric Personnel were to correct this problem before restoring service. The left picture is the line side of the fuse and the right picture is load side of the fuse.





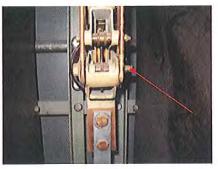
5.8 LUCS 5, on the (3rd) floor was found with the C phase fuse improperly inserted into the fuse clip. This could cause overheating, premature aging of the fuse and unscheduled outages. Capital Electric Personnel were to correct this problem before restoring service. The left picture is the load side of the fuse and the right picture is line side of the fuse.





- 5.9 LUCS 3, on the (1st) floor was found with the knife blades fully penetrating the stationary contacts. However the C phase knife switch was found to be missing a nut and cup washer on the line and load side of the switch. This could cause contact heating, deterioration, and eventual failure of the switch. This problem was corrected before restoring utility power by Capital Electric personnel. The left picture is the moving portion of the switch, and the right picture is the elbow or pivot part of the switch. No further mechanical action required at this time.
 - It is suggested that a complete cleaning and maintenance test be performed at the next scheduled outage. Electrical Reliability Services would be pleased offer this service.





Reference No.3126895

Ross, Bob [NETPWR/ERS/LEE']

Subject:

FW: Docking M.V. switches

Importance:

High

----Original Message----

From: White, Ben [mailto:bwhite@capitalelectric.com]

Sent: Friday, November 26, 2010 9:32 AM To: Steele, George [FM]; Flowers, Clifford [FM]

Cc: Werth, George [FM]; Lour, Mike [FM]; Howell, Chuck [NETPWR/ERS/LEE']; Hurshman, Mark

Subject: RE: Docking M.V. switches

Importance: High

Gentlemen this is to document our earlier conversation today in which the door latches were discussed. As directed we will have Emerson Reliability Services remove the door latch mechanism from the throw rod so as to allow complete operation of the switches off the Bus Duct riser only. These components will be placed in the bottom of the cabinets for future needs if it is desired to repair and reattach these at a later date.

In cleaning these switches we noticed the knife blades not fully engaged. During further inspection it was noted that the latch rods have been bent during operation and are obstructing the switches from engaging fully and properly. These latch rods are part of the mechanism that holds the door shut while in the energized state. These will be removed off all these common disconnect switches on the Bus riser so no further issues arise in the event of operating these switches.

It is understood that you will have padlocks in place that only allow Authorized personnel access to these when the switch when they are in the closed position. In addition signage will be placed on all these disconnects to signify this modification and the hazards involved with opening these while energized. I would also suggest signage being added that signifies the proper PPE require to open these switches and the proper CAL requirement for Arc Flash.

Your response to this email will serve as our authorization to perform this work.

Thanks, Ben White Capital Electric Construction Company Service Division 816-215-6691 (cell)

From: Steele, George [FM] [mailto:George.Steele@da.ks.gov]

Sent: Thu 11/25/2010 4:50 PM

To: White, Ben; Hurshman, Mark; Flowers, Clifford [FM]

Cc: Werth, George [FM]; Lour, Mike [FM]

Subject: RE: Docking M.V. switches

We agree with having Emerson look at, repair and modify all switches off the Buss Duct on a Time and Material Basis.

George Steele 900 SW Jackson, Suite 600 Topeka, KS 66612 785-296-4693 Cell 785-215-5709

----Original Message----

From: White, Ben [mailto:bwhite@capitalelectric.com]

Sent: Thursday, November 25, 2010 4:17 PM

To: Steele, George [FM]; Hurshman, Mark; Flowers, Clifford [FM]

Subject: Docking M.V. switches

Gentlemen this is to confirm our earlier conversations today about the Switches that are not engaging as they should feeding the transformers on each floor off the Bus Duct run.

We will as discussed remove the safety latch that holds the doors closed while energized. It is understood that the padlock on the door handle will become the safety and labeling will be attached to the doors to identify the voltage hazard. As discussed this is being done so that it can be verified that the knife switches have engaged the switch fully.

Secondly we will have Emerson Reliability Services look at and repair or modify all the switches off the Bus Duct run we have been working on to verify the functionality of all the switches. They will make the necessary adjustments to the two switches in the penthouse.

All this work is on a T&M basis. Please respond to this email as our work authorization.

Thanks, Ben White Capital Electric Construction Company Service Division 816-215-6691 (cell)



MEDIUM VOLTAGE AIR SWITCH TEST REPORT

	rices	ΑΡΙΤΑΙ	ELECTRIC				OB NUMBER: 3126895			
	5 SW HA	RRISON	ST		ENGINEER:	DD	DATE: 11/26/2010			
WITCHGEAR DESIGNATION:		Charlest A. S. Total	NTIFICATION:	TEST EQUIP. ASSET NO.						
MAIN ATS		RISER NO#	MEPLATE		45/1280	-	05/26/20	110		
MANUFACTURER:		TYPE:		STYLE/SERIA			CURRENT RATING: VOLTAGE RATII			
S & C USE INFORMATION:			N/A		CD28082		400 SYSTEM VOLTAGE:		15K	
S & C, SM-5, C	CAT NO 1	32400R4	. 14.4 KV. 2	50E. TC	C NO. 153	-4	OTOTEM VO	13.8 K	v	
				INSPECTION						
CHECK PO	TNIC		CONDITION	NOTES		CHECK POIN	Т	CONDITION	NOTES	
HYSICAL DAMAGE			Α		CONTACT	ALIGNME	NT	Α		
LEANLINESS			С		CONTACT	WIPE		Α		
ECHANICAL OPERATO	R		N/A	(1)	CONTACT	PRESSU	RE	Α		
AIN CONTACTS			Α		PHASE BA	ARRIERS		Α		
RC CONTACTS			Α		HARDWA	RE TIGHT	NESS	Α		
RC CHUTES			N/A		FUSE HOI	LDERS		Α		
ARC INTERRUPTER SEQUENCE			Α		INTERLOCKS			A		
			ELE	CTRICAL	TESTS					
				A-P	HASE	B-PF	IASE	C-	PHASE	
ONTACT RESISTANCE	IN MILLION	HMS		0.373/.112 0.83		0.832	2/.118 .184/1		34/139	
JSE RESISTANCE IN M	ILLIOHMS			0.410 0.3			376 0.386			
ISULATION RESISTANCE		SWITCH			CLOSED			SWITCH OPEN		
TEST IN GIGOHMS	A-Gnd	B-Gnd	C-Gnd	A-B	B-C	C-A	Α	В	С	
		3.045		(4)	(4)	ar 30.	Autori		15 S. S. C. E.	



MEDIUM VOLTAGE AIR SWITCH TEST REPORT

		JOE			OB NUMBER: 3126895				
915 SW H	ST ENTIFICATION:		CH TEST EQUIP	DD	11/26/2010 CALIBRATION DATE:				
MAIN ATS			09	41-0104	45/1280		05/26/20	10	
			NAMEPLATE DATA STYLE/SERIAL NUM N/A CD2				URRENT RATING:		
ATION:	I Tanada		122		SYSTEM VOLTAGE:				
& C, SM-5, CAT NO	132400R4	4, 14.4 KV,	250E, TCC INSPECTION	Branch Branch	.4		13.8 K	V	
CHECK POINT		CONDITION	NOTES	-	CHECK POIN	T	CONDITION	NOTES	
DAMAGE		A	NOTES	CONTACT		242	A	NOTES	
SS		C		CONTACT	W		A		
AL OPERATOR		N/A	(1)		A 200 A 200	RE	A		
ACTS		A	(1)	CONTACT PRESSURE PHASE BARRIERS			A		
I K. K. T		A		HARDWARE TIGHTNESS			A		
RC CONTACTS RC CHUTES				FUSE HOLDERS			A	-	
RUPTER SEQUENCE		N/A A		INTERLOCKS			A		
		^		IIII	, to				
		EUE	CTRICAL T	ESTS					
			A-PH		B-PI	IASE	C-	PHASE	
RESISTANCE IN MILLI	SMHC		0.135		0.1	122		0.101	
STANCE IN MILLIOHM	S		0.369 0.			385 0.391			
RESISTANCE	SWITCH			CLOSED			SWITCH OPEN		
GIGOHMS A-Gnd	B-Gnd	C-Gnd	A-B	B-C	C-A	Α	В	С	
VOLTS 178.5	192.8	177.9	335.2	310.8	470	2779	2983	3181	
GIGOHMS A-Gnd	192.8 NOT BE VERIF	C-Gnd 177.9 FIED DO TO CUSTED FOR TESTING	A-B 335.2 TOMER RESTE	310.8	470	2779	B 2983		



MEDIUM VOLTAGE AIR SWITCH TEST REPORT

Electrical Reliability Sen	vices						IJOB NUMBI	· R·		
		APITAL	ELECTRIC		312689			95		
OCATION:		ENGINEER	:	DATE:						
	5 SW HA				СН	DD		11/26/2010		
SWITCHGEAR DESIGNATION:		FEEDER ID	ENTIFICATION:	40	The state of		CALIBRATI			
MAIN ATS			FEEDER #	TU MEPLATE		45/1280		05/26/20	110	
MANUFACTURER:		TYPE:					CURRENT RATING: VOLTAGE RATIN			
S&C			N/A		CD28082		400		15K	
USE INFORMATION:	DAT NO	1001000						SYSTEM VOLTAGE:		
S & C, SM-5, (SAT NO	132400R		INSPECTI		-4		13.8 K	V	
CHECK P	OINT		1			alleak pali			7	
	OINT		CONDITION	NOTES	1	CHECK POIN	W	CONDITION	NOTES	
HYSICAL DAMAGE			Α		CONTAC	T ALIGNMI	ENT	Α		
CLEANLINESS			С		CONTAC.	TWIPE		Α		
MECHANICAL OPERATO	R		N/A	(1)	CONTACT	T PRESSU	RE	Α		
IAIN CONTACTS			A		PHASE BA	PHASE BARRIERS				
RC CONTACTS			Α		HARDWARE TIGHTNESS			Α		
RC CHUTES		N/A		FUSE HO	LDERS		Α			
RC INTERRUPTER SEC	UENCE		Α		INTERLOCKS			Α		
			ELE	CTRICAL	TESTS					
				A-PHASE B-PH		HASE	HASE C-PHASE			
ONTACT RESISTANCE	IN MILLIO	HMS	(2)	0.584/.144		0.23	4/.123	0.232/.143		
USE RESISTANCE IN M	ILLIOHMS			0.338 0			339 0.346		.346	
SULATION RESISTANCE			SWITCH CLOSED				SWITCH OF		PEN	
TEST IN GIGOHMS	A-Gnd	B-Gnd	C-Gnd	A-B	B-C	C-A	Α	В	С	
0 5000 VOLTS	245./9	228.3	178.3	443	275	418	3381	3065	3265	
OTE										
OTE 1:) TRANSFER OPERATION	N COULD N	OT BE VERIF	IED DO TO CUST	OMER REST	RICTIONS. CU	STOMER DIE	NOT WANT	TRANFER SWITE	CH OPERATED.	
SWITCH INTERLINKS										
OTE 2:) "A" PHASE KNIFE SW	/ITCH HAS H	GHER RESIS	STANCE THAN OT	HER TWO P	HASES ERS.C	OBBECTED	илти а шет	MENT TO VALLE	емлтен	
OTE 3:) CABLES & ARRESTO						OMMEGIED		MENT TO KIMILE	OWITOII.	
on on one continue of o	NO TIENE DI	JOONNEOT I	OK ILOIMO I O	NI OOLO.						
	A = ACC	EPTABLE	R = NEEDS REP	AIR C=C	ORRECTED	N/A = NOT	APPLICABLE			



Electrical Reliability Services Project Status Report / Work Authorization

CLIENT	CAPITAL ELECTRIC	JOB NO.	3126895		
PROJECT	915 SW HARRISON ST.	ENGINEER	CH/DD	DATE	11/26/2010

THIS DOCUMENT IS INTENDED TO PROVIDE PRELIMINARY INFORMATION AS TO THE STATUS OF THIS PROJECT. A FORMAL REPORT WILL BE SUBMITTED AT THE PROJECT COMPLETION.

- THE FOLLOWING ITEMS REQUIRE REPLACEMENT, REPAIR AND/OR ADJUSTMENT:
- THE FOLLOWING TESTS AND/OR INSPECTIONS ARE REQUIRED PRIOR TO PROJECT COMPLETION:
- THE FOLLOWING WORK IS AUTHORIZED:

VISUAL INSPECTION AND REMOVAL OF INTERL	OCK ARM PER CUSTOMER REQUEST
(SEE E-MAIL) AS PER BEN WHITE ON FLOORS 1	
OPEN MAIN SWITCHS IN BASEMENT FOR VISUA	AL INSPECTION BY CUSTOMER.
LCUS "18" 14TH FLOOR-REMOVAL OF INTERLO	CK & AJUSTED SWITCH HANDLE- PHOTOS
LCUS "17" 14TH FLOOR-REMOVAL OF INTERLO	CK & AJUSTED SWITCH HANDLE-PHOTOS
LCUS "16" 12 FLOOR- REMOVAL OF INTERLOCK	K-PHOTOS
LCUS "15" 11TH FOOR-REMOVAL OF INTERLOC	K & AJUSTED SWITCH HANDLE-PHOTOS
LCUS "14" 10TH FLOOR- REMOVAL OF INTERLO	CK & AJUSTED SWITCH HANDLE-PHOTOS
LCUS "9" 9TH FLOOR-REMOVAL OF INTERLOCK	(& AJUSTED SWITCH HANDLE-PHOTOS
LCUS "10" 8TH FLOOR-REMOVAL OF INTERLOC	K
LCUS "11" 7TH FLOOR-REMOVAL OF INTERLO	CK & AJUSTED SWITCH HANDLE-PHOTOS
LCUS "12" 6TH FLOOR-REMOVAL OF INTERLOC	:K\
LCUS "13" 5TH FLOOR REMOVAL OF INTERLOC	K-PHOTOS
LCUS "8" 3TH FLOOR NO REMOVAL REQUIRED,	SWITCH RETOR-FITED WITH NEW SW
LCUS "7" 3TH FLOOR REMOVAL OF INTERLOCK	
LCUS "6" 3TH FLOOR REMOVAL OF INTERLOCK	
LCUS "5" 2TH FLOOR REMOVAL OF INTERLOCK	(& AJUSTED SWITCH HANDLE-PHOTOS
FUSE B&C ARE MISALIGNED IN HOLD	ER - SEE PHOTOS
LCUS "4" 2TH FLOOR REMOVAL OF INTERLOCK	
LCUS "3" 1ST FLOOR REMOVAL OF INTERLOCK	C - C PHASE OF SWITCH IS MISSING
NUTS AND WASHERS ON PIVOT POINT	F & TENTION POINT - PHOTOS
LCUS "2" BASEMENT-REMOVAL OF INTERLOCK	
CUSTOMER SIGNATURE	AUTHORIZATION NO.
N/A	SEE EMAIL

PINK COPY - CUSTOMER

© 2006 Electrical Reliability Services

WHITE COPY - FILE

PAGE __1 OF __1



APPENDIX B: WESTAR ENERGY USAGE

Bill Constant: 8800 DOCKING STATE OFFC 915 SW HARRISON ST TOPEKA KS

METER NUMBER:2285030RATE CODE:345BILL CONSTANT:8800REV CLASS:3MANUFACTURER:28RELATED:YIRREG USE CD:3PHASE:3

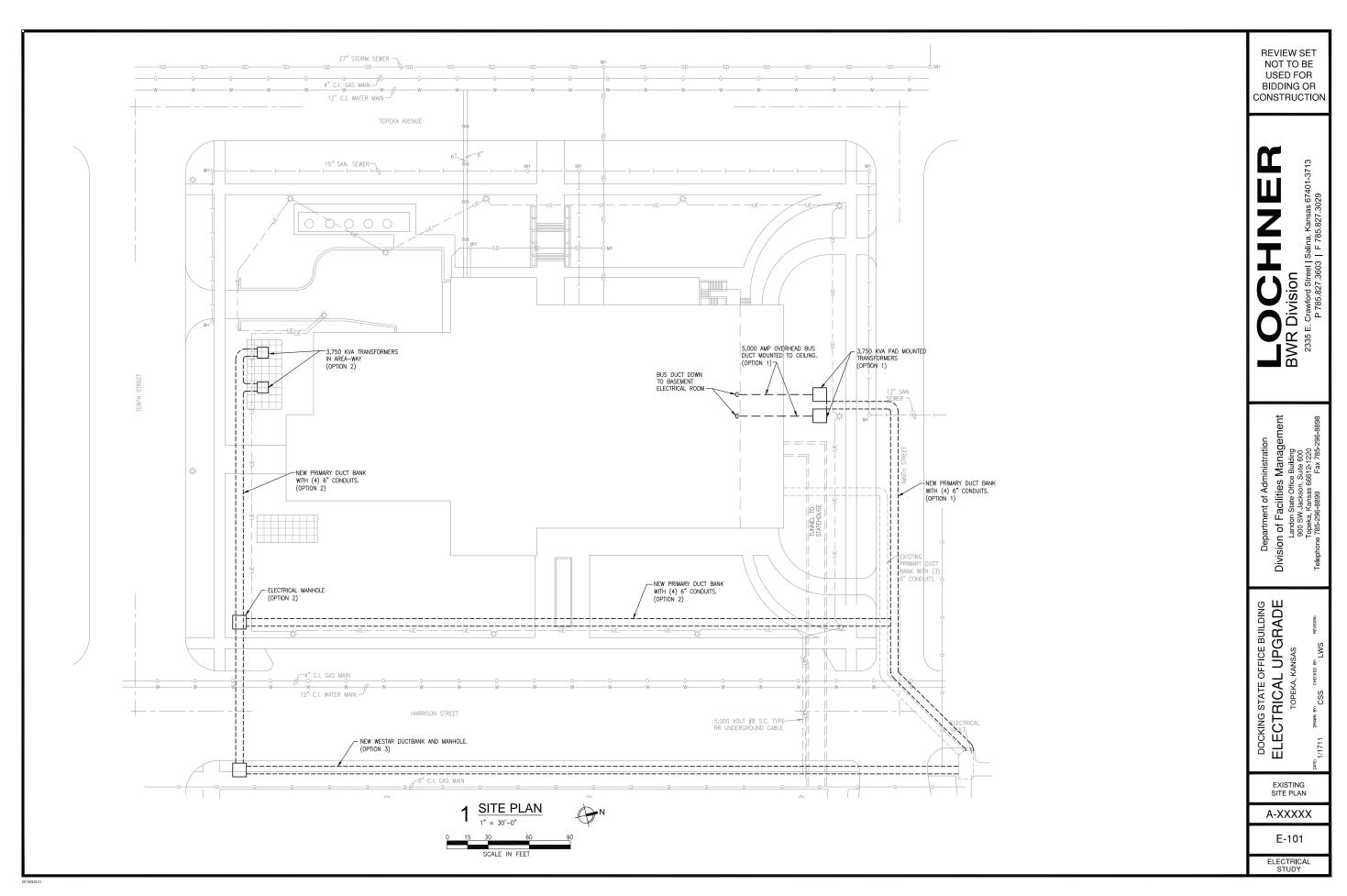
MTR LOC: 52 BASEMENT S WALL

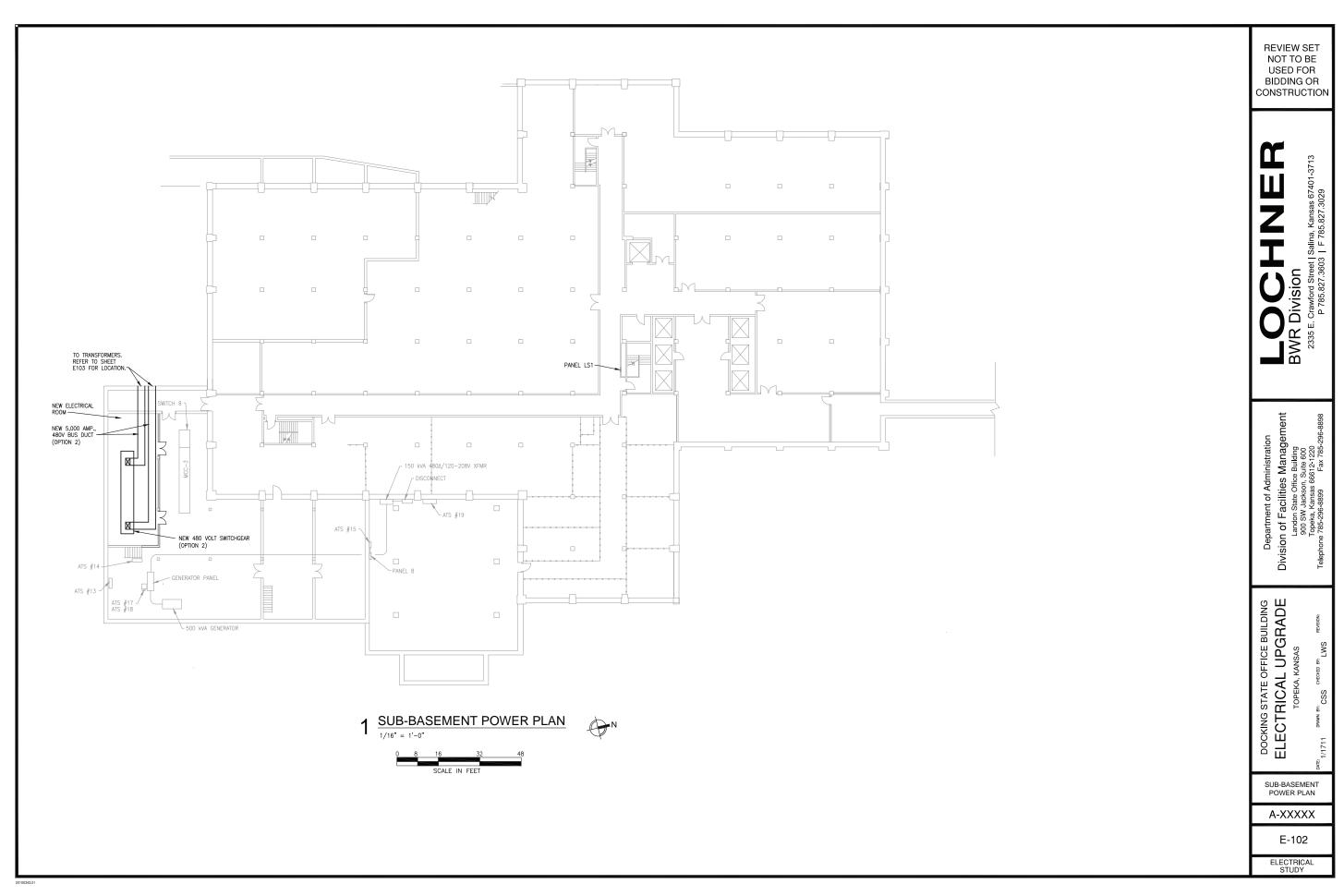
					ACT			ADJ	BLG	
S	DATE	DAYS		USE	DEM	PF%		DEM	DEM	
	11/24/10		30	774400		0.25	100	2200	2394	
	10/25/10		31	880000		0.25	100	2200	2394	
	09/24/10		30	1012000		0.31	100	2728	2728	
	08/25/10		29	1100000		0.3	100	2640	2640	
	07/27/10		32	1161600		0.3	100	2640	2640	
	06/25/10		30	1082400		0.32	100	2816	2816	
	05/26/10		29	888800		0.3	100	2640	2693	
	04/27/10		29	880000		0.31	100	2728	2728	
	03/29/10		31	853600		0.27	100	2376	2693	
	02/26/10		29	809600		0.26	100	2288	2693	
	01/28/10		30	853600		0.26	100	2288	2693	
	12/29/09		35	932800		0.27	100	2376	2693	
	11/24/09		32	915200		0.28	100	2464	2693	
	10/23/09		29	915200		0.27	100	2376	2693	
	09/24/09		30	1073600		0.33	100	2904	2904	
	08/25/09		29	1179200		0.33	100	2904	2904	
	07/27/09		32	1293600		0.33	100	2904	2904	
	06/25/09		29	1135200		0.36	100	3168	3168	
	05/27/09		30	1064800		0.31	100	2728	2728	
	04/27/09		31	1003200		0.31	100	2728	2728	
	03/27/09		29	968000		0.31	100	2728	2728	
	02/26/09		29	959200		0.3	100	2640	2640	
	01/28/09		30	968000		0.29	100	2552	2552	
	12/29/08		35	1064800		0.28	100	2464	2468	
	11/24/08		32	1073600		0.29	100	2552	2552	
	10/23/08		29	1056000		0.29	100	2552	2552	
	09/24/08		30	1152800		0.32	100	2816	2816	
	08/25/08		31	1293600		0.33	100	2904	2904	
	07/25/08		30	1284800		0.33	100	2904	2904	
	06/25/08		29	1170400		0.32	100	2816	2816	
	05/27/08		32	1161600		0.32	100	2816	2816	
	04/25/08		29	1047200		0.3	100	2640	2768	
	03/27/08		29	1020800		0.29	100	2552	2768	
	02/27/08		29	976800		0.26	100	2288	2768	
	01/29/08		32	1029600		0.28	100	2464	2768	

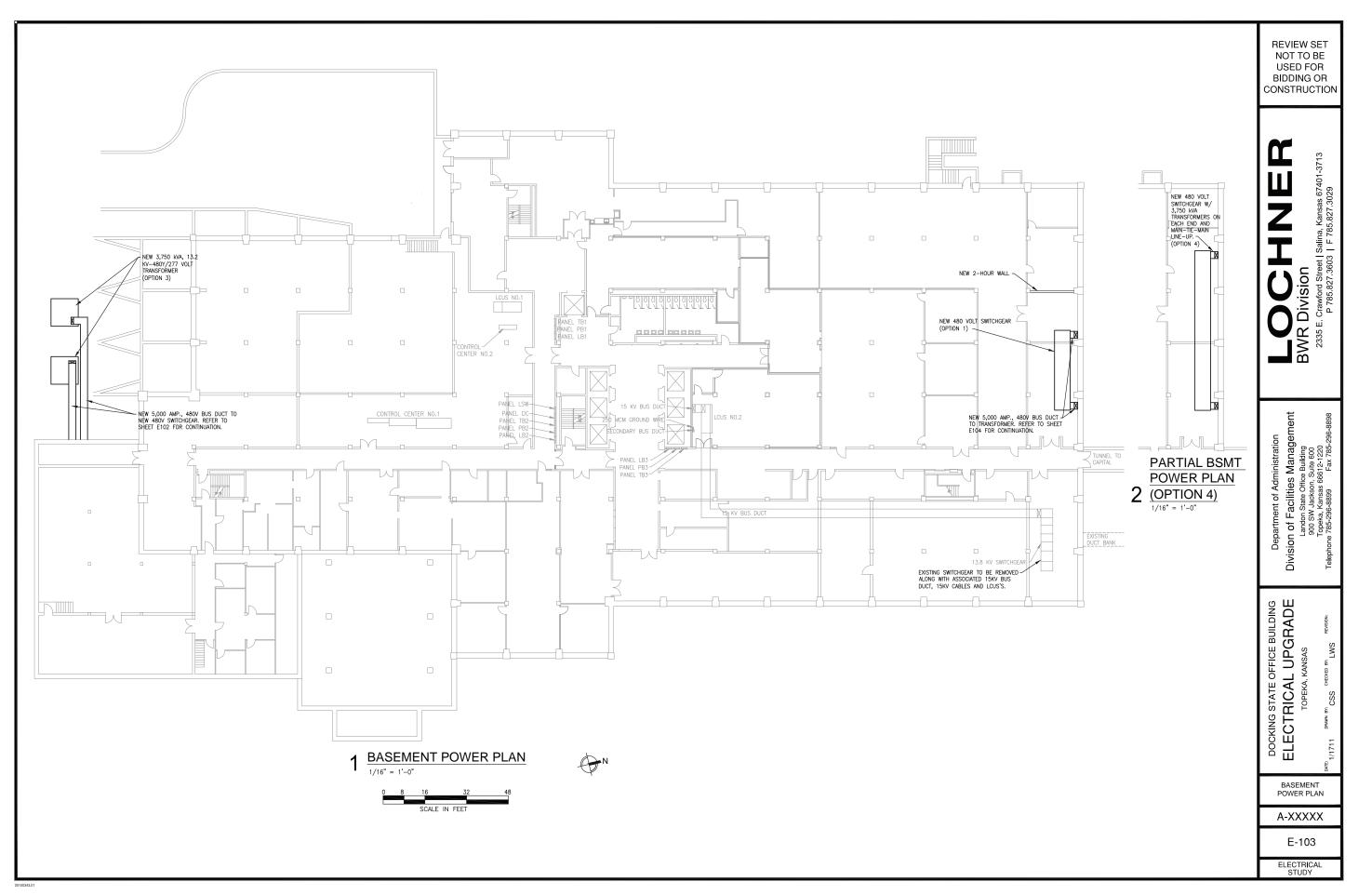


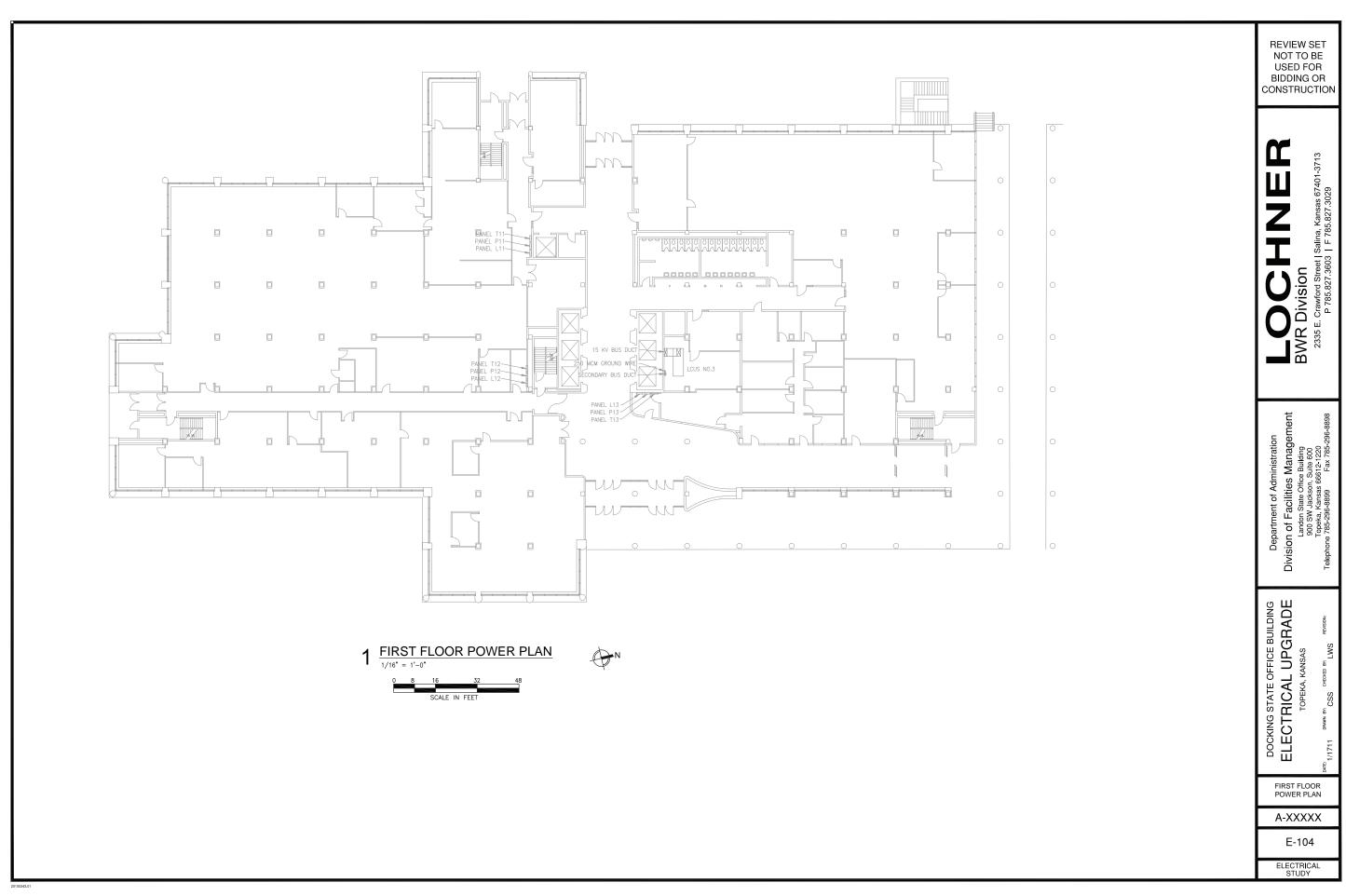
APPENDIX C: SITE PLAN, FLOOR PLANS & ONE-LINE DIAGRAM

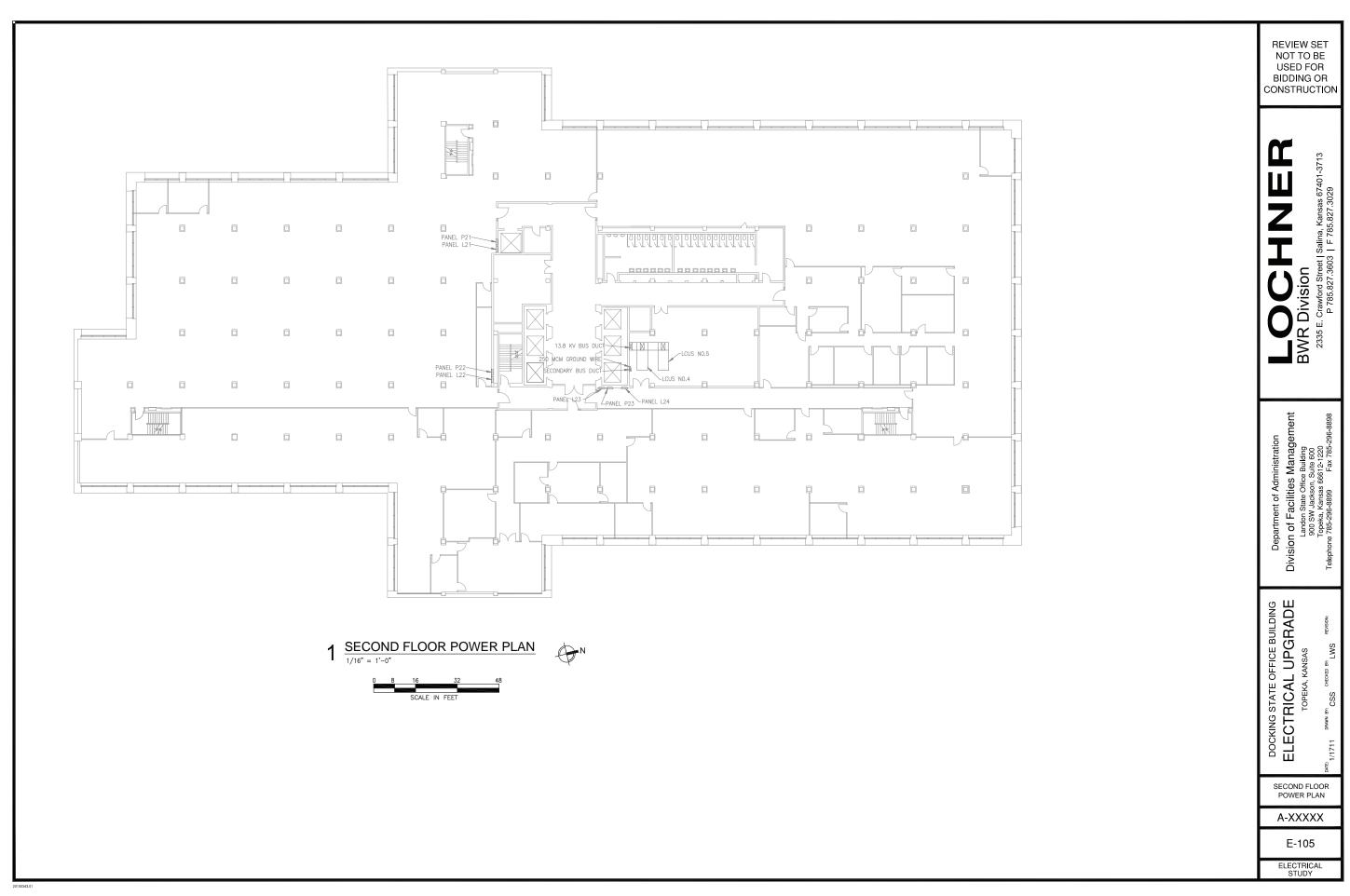
Appendices

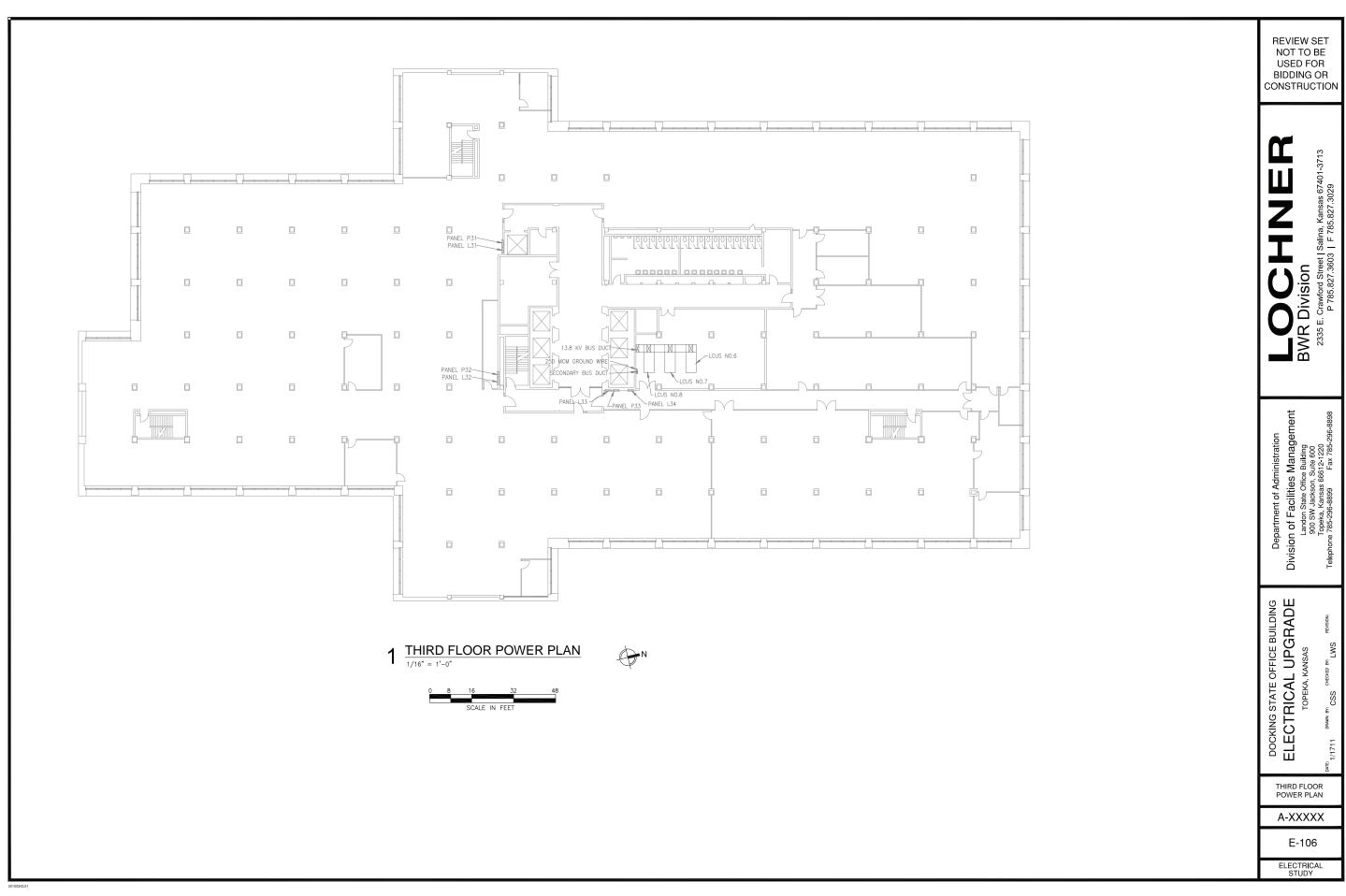


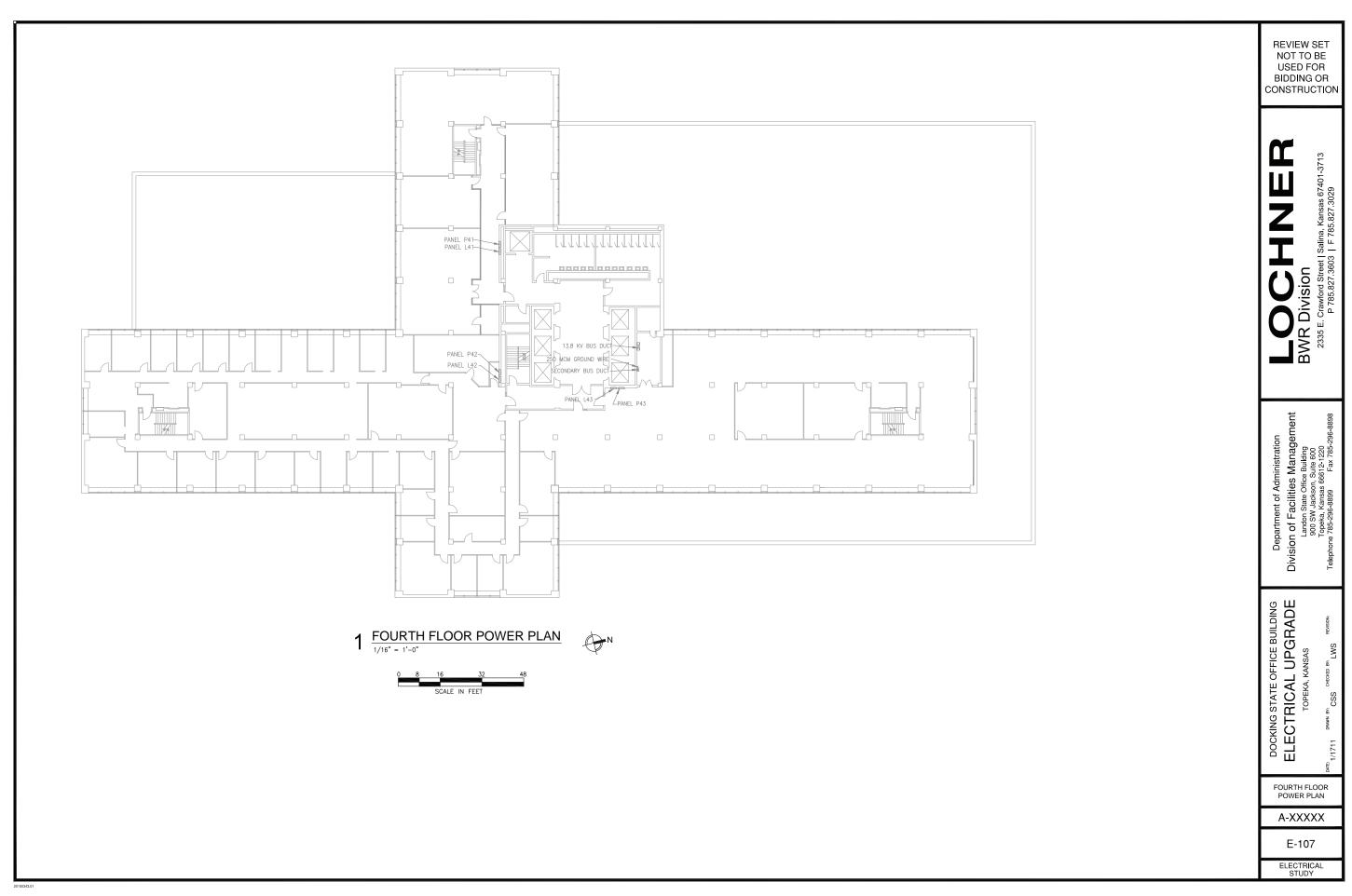


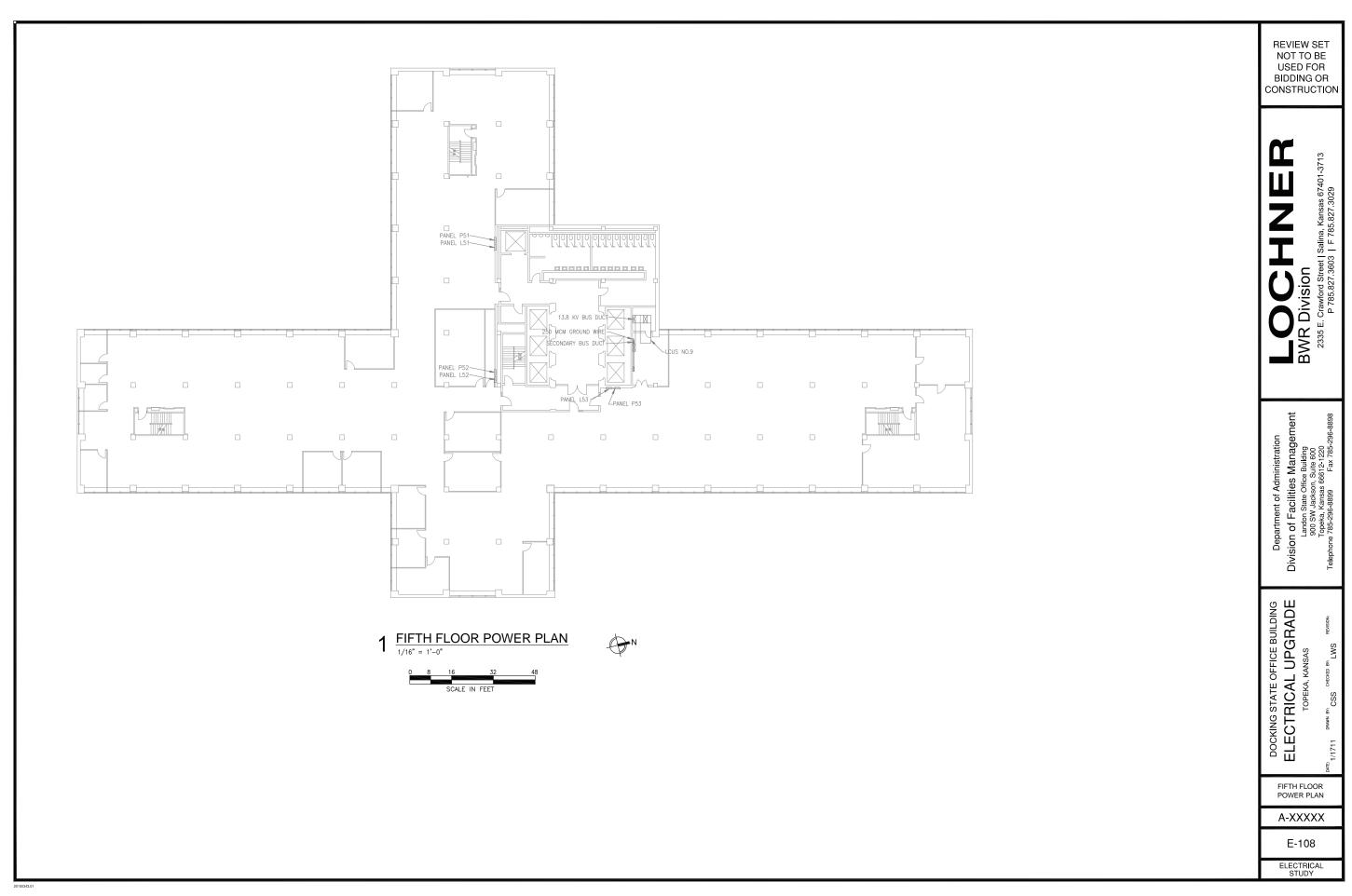


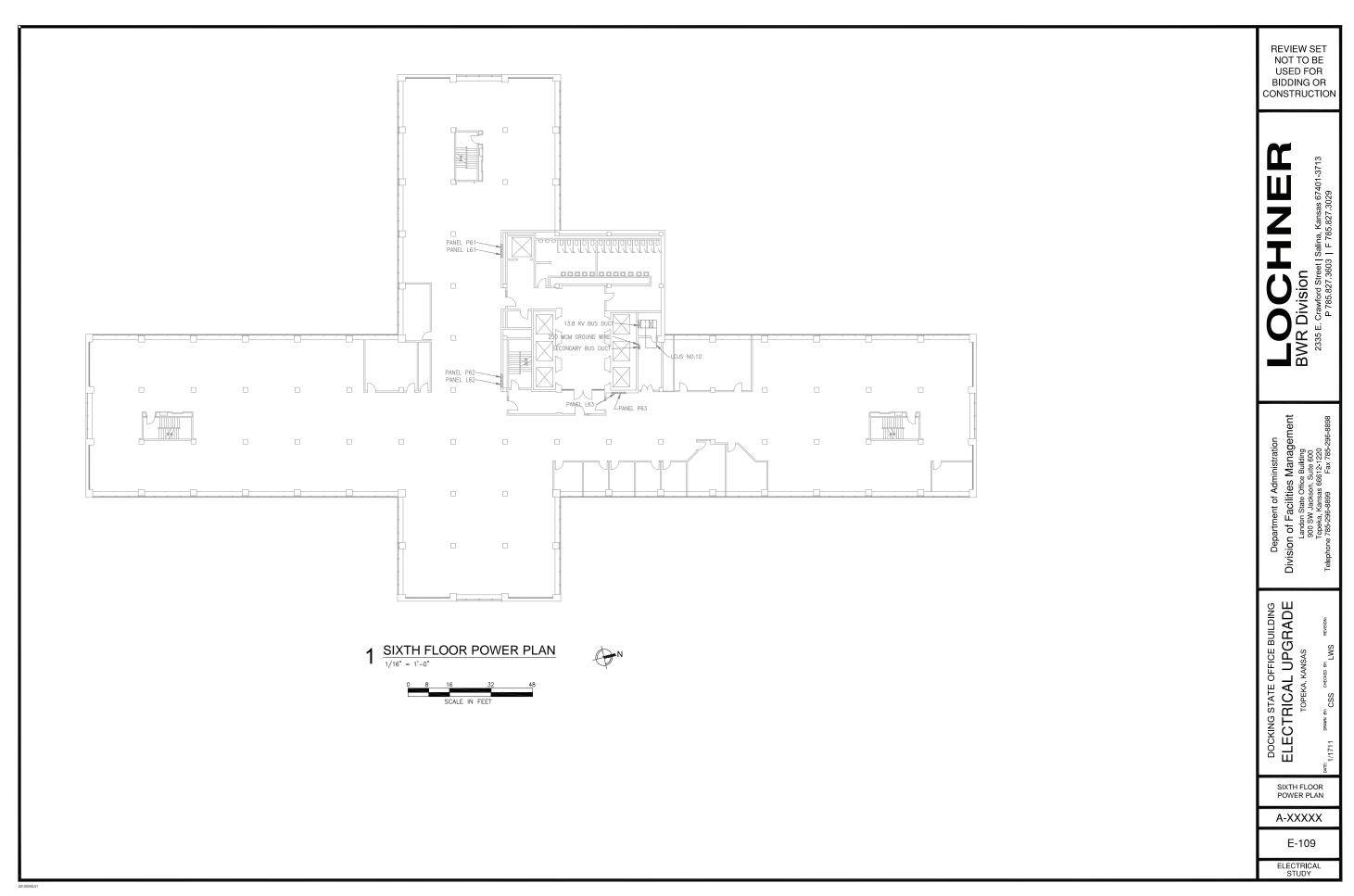






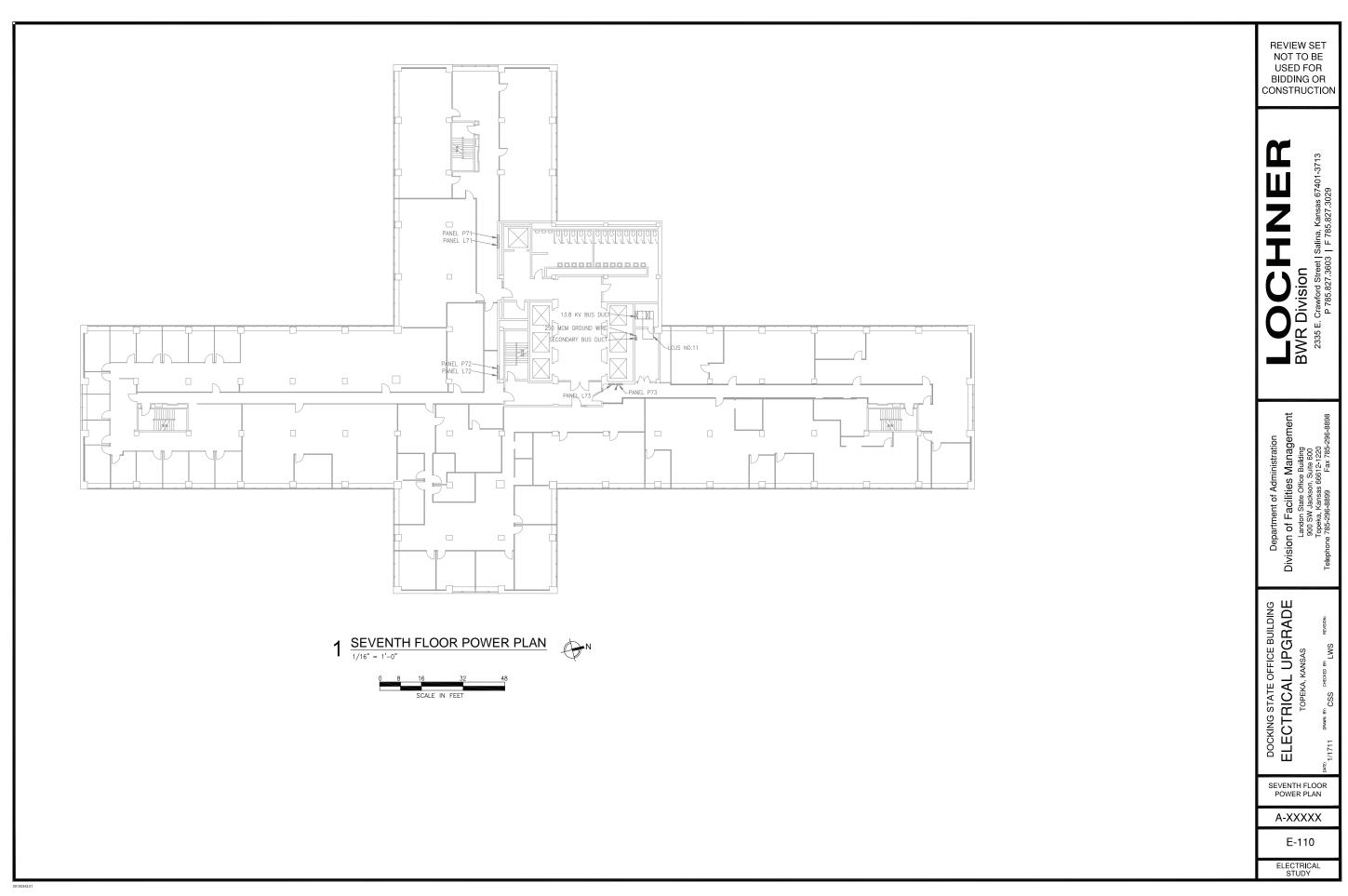


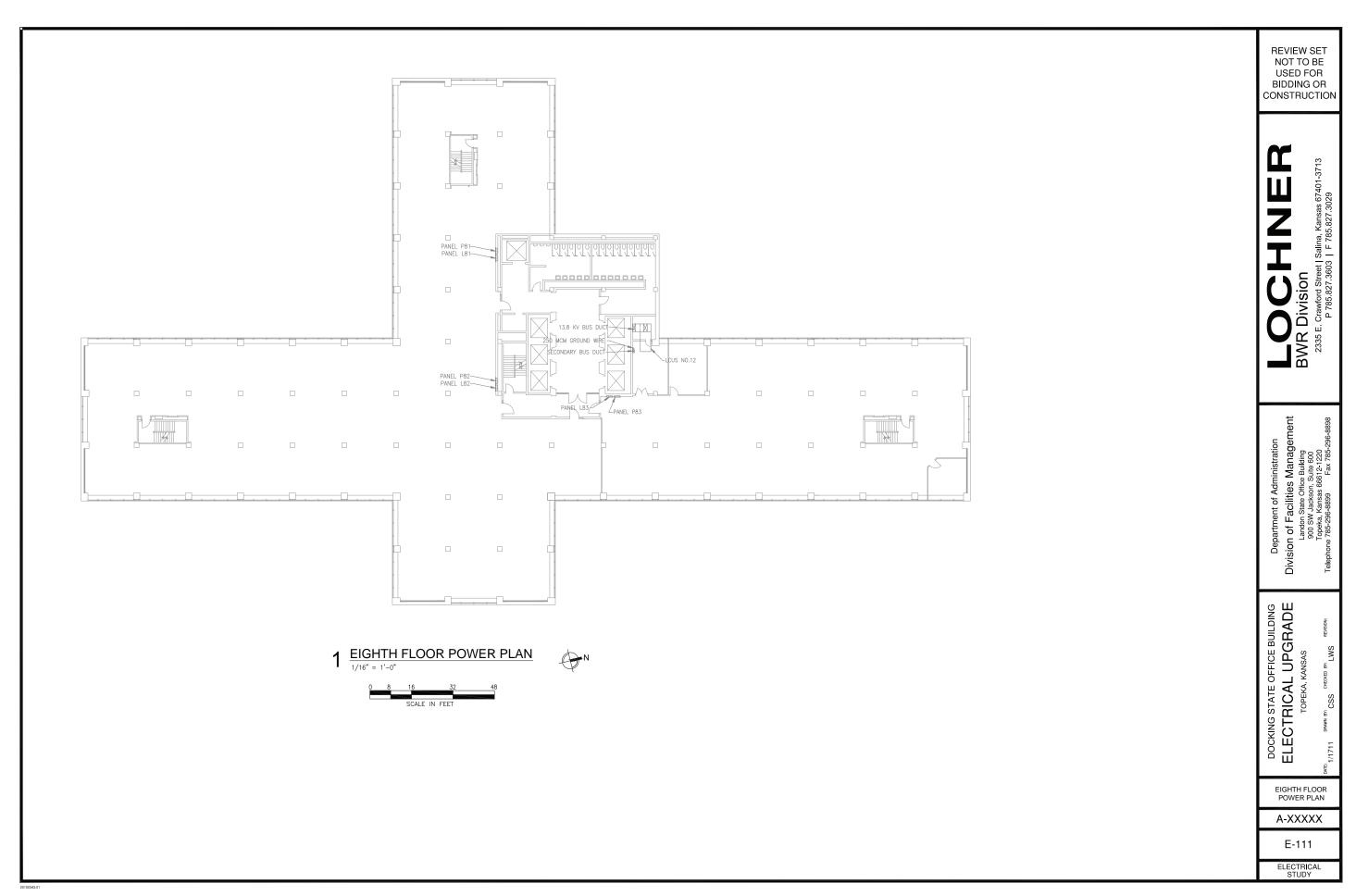




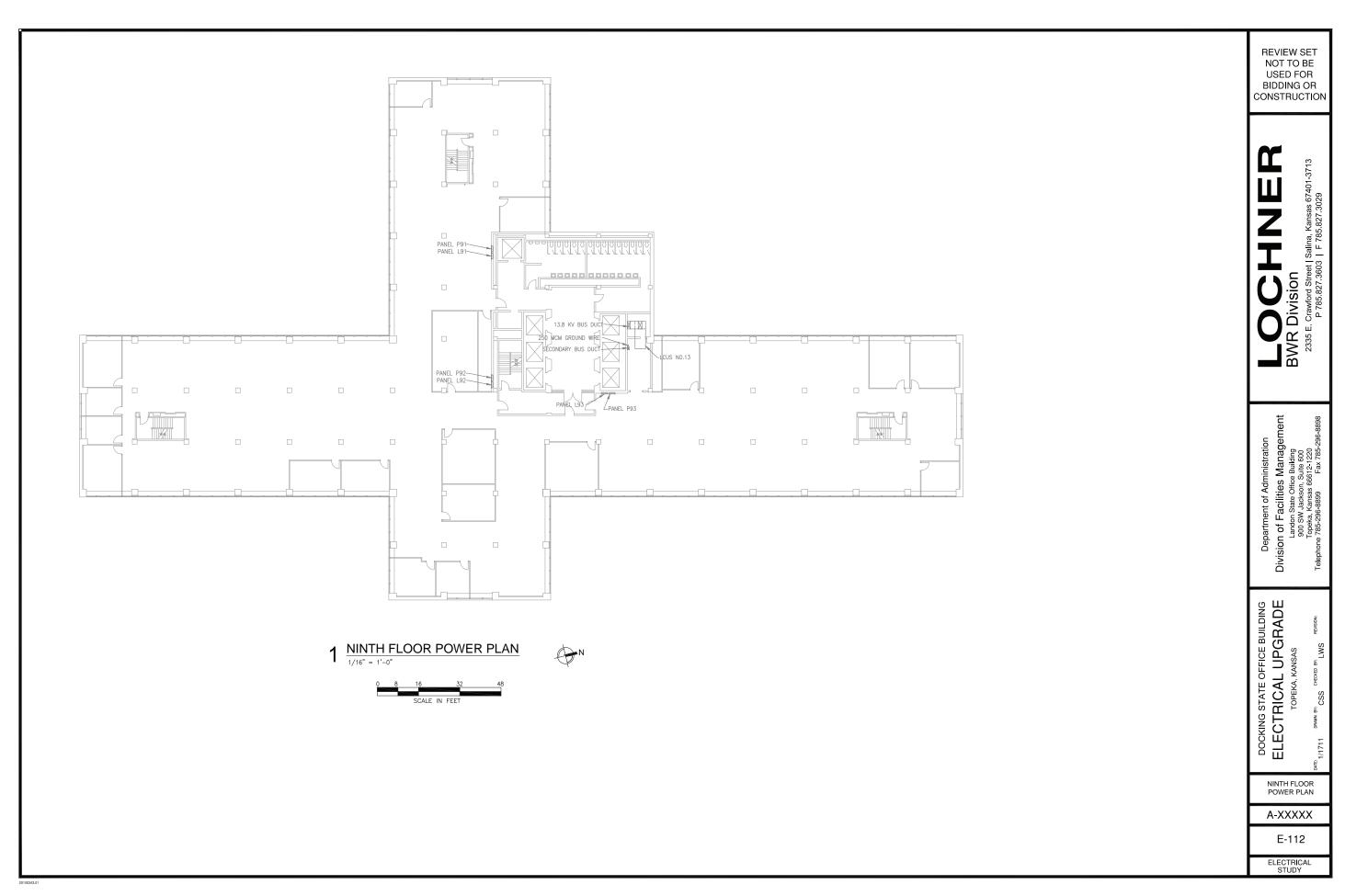
JCSBC 2-2-2016

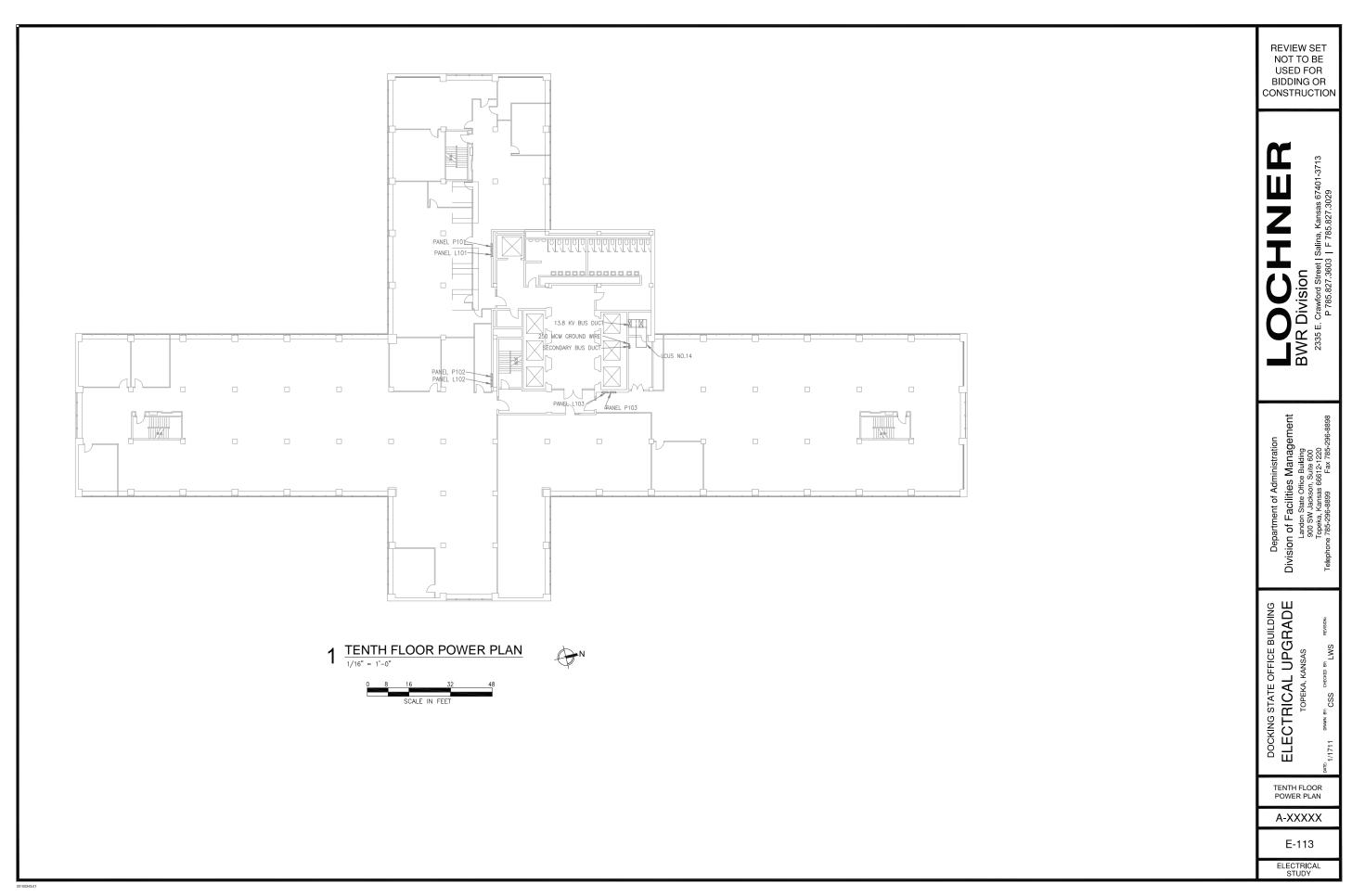
Att.6.--464

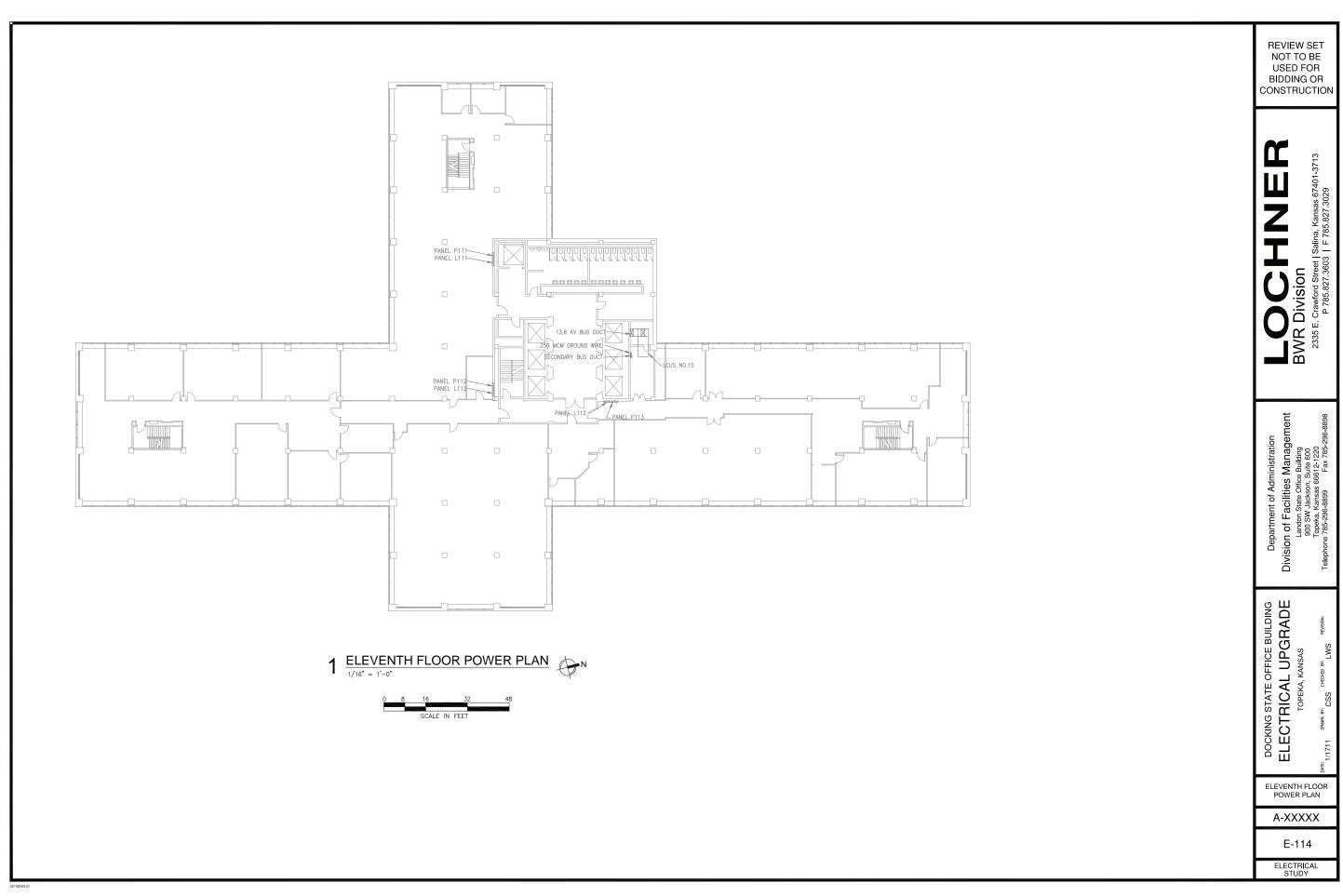


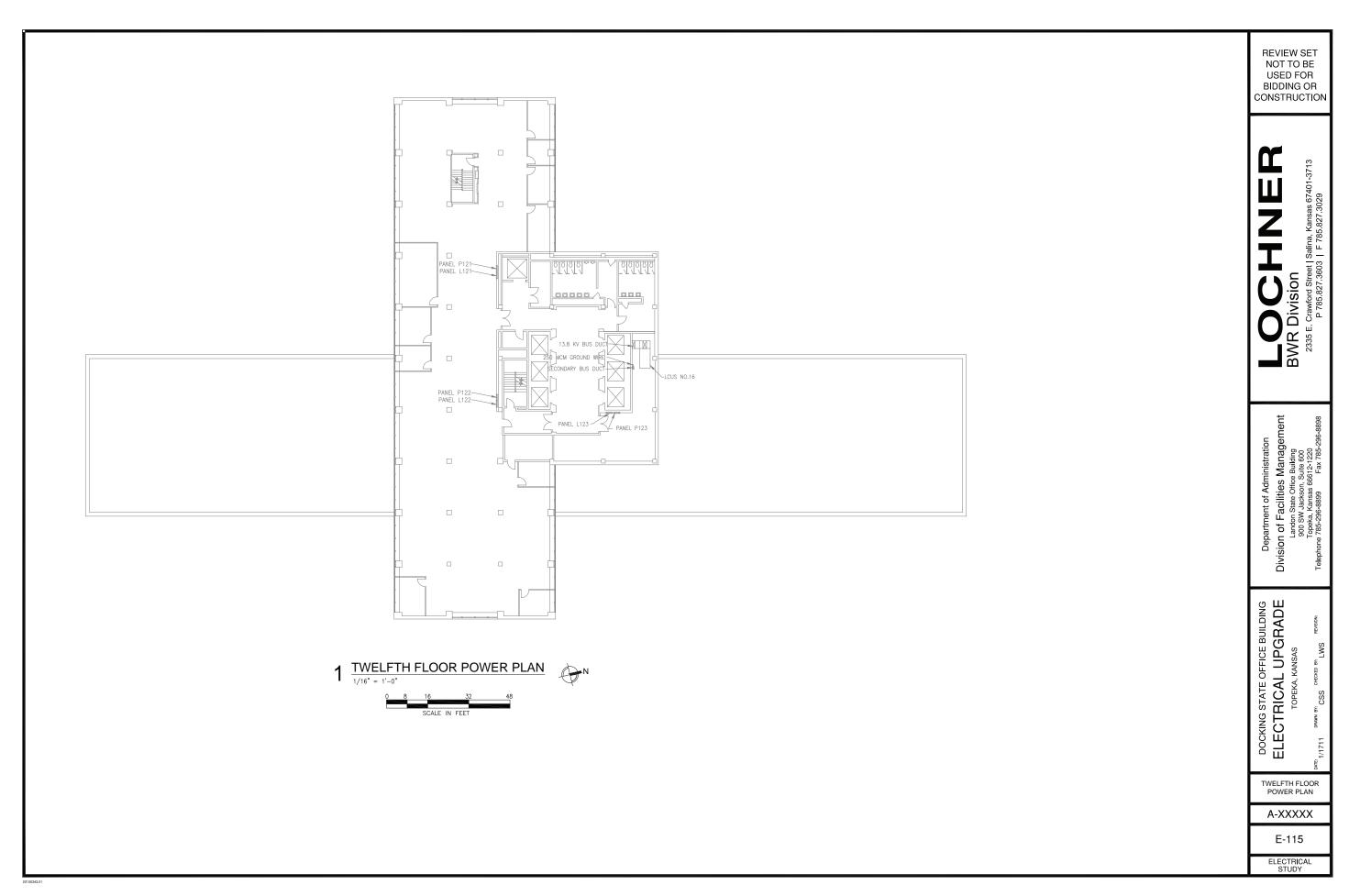


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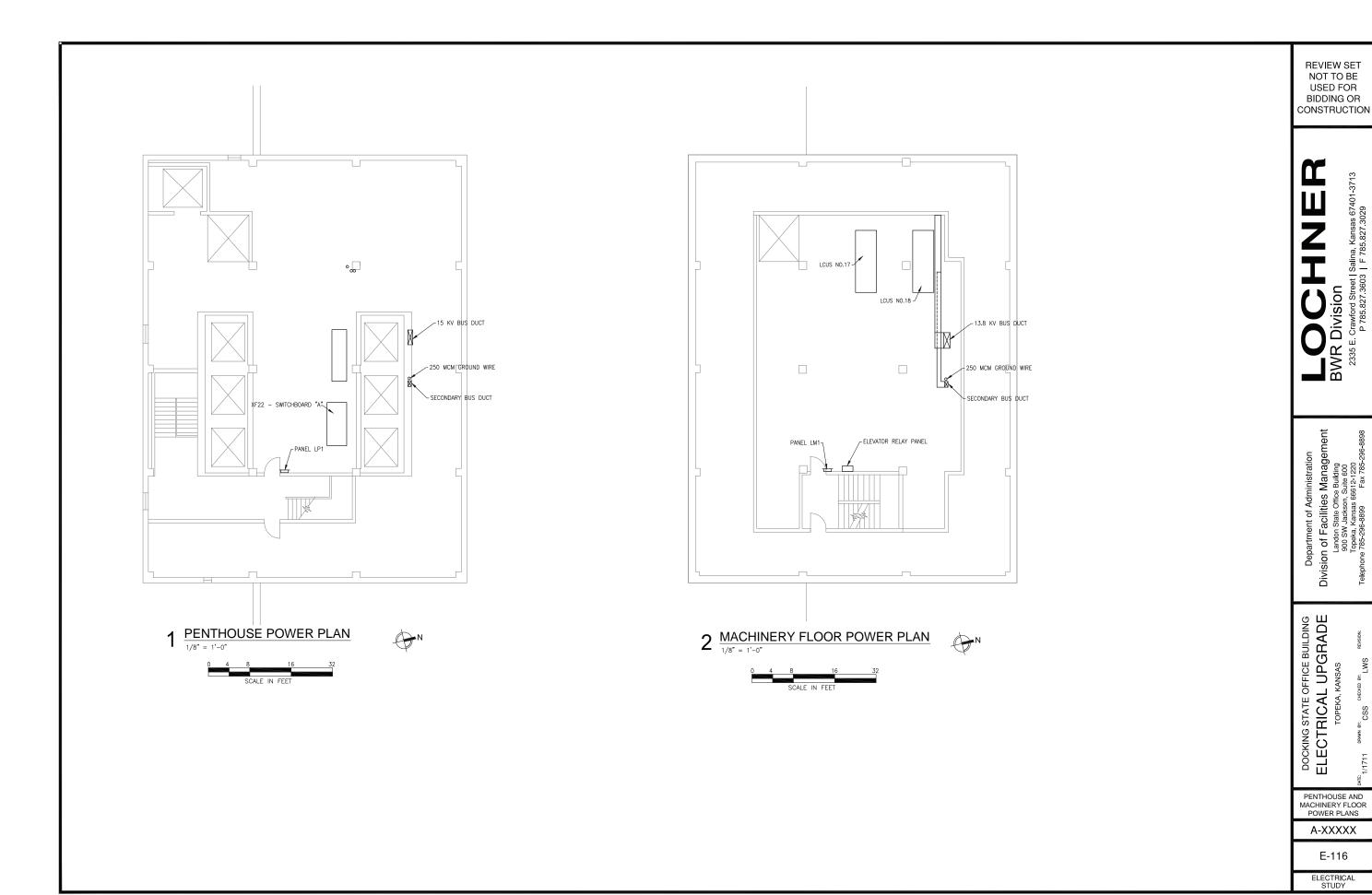


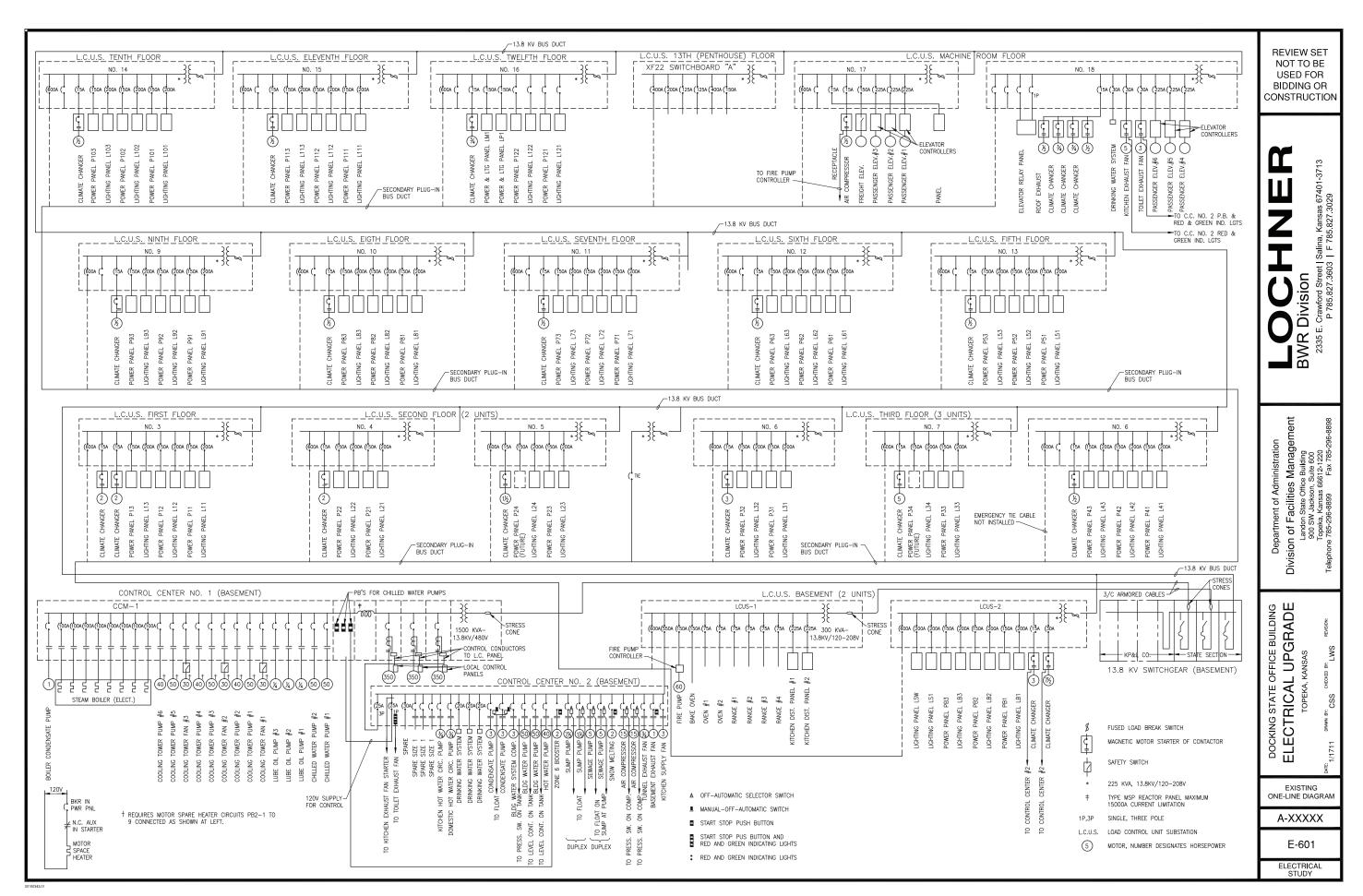






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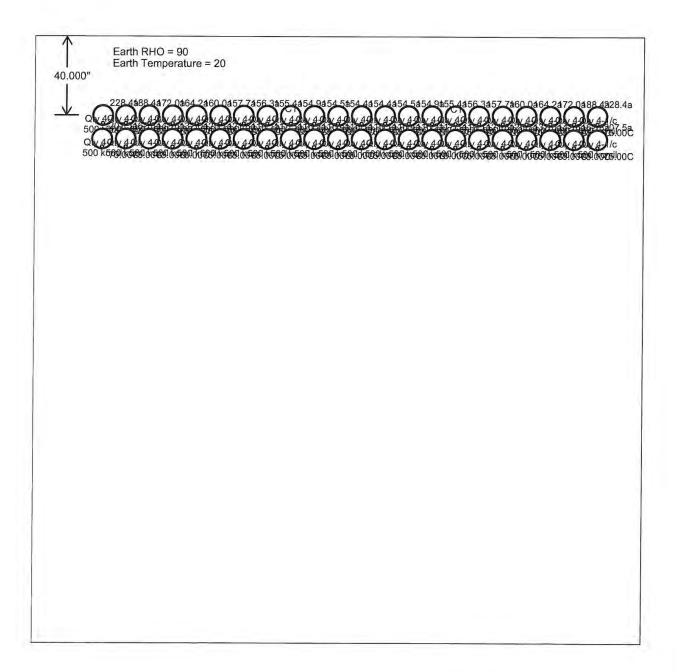
APPENDIX D: AMPCALC

Appendices

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0



1/11/2011 8:26:50 AM Page 2 of 26

AmpCalc - Cable Ampacity Calculations for Underground & Aerial Installations

Version 4.00, Rev 16 (c) Copyright 1986-2011 Calcware Company Katy, Texas

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

Calculation Method:

Distinct AMPACITY calculated for each position in the system based on user specified conductor temperature.

Summary of Neher-McGrath Calculation Results:

No.	Identifier	System	x Coord	y Coord	Qty-Type	Cable Size	Sys kV	Temp	Amps	Rac	Watts/ft
1		1	0.000	0.000	4-1/c	500 kcmil	0.48	75.00	228.4	27.42	5.719
2		1	7.500	0.000	4-1/c	500 kcmil	0.48	75.00	188.4	27.42	3.893
3		1	15.000	0.000	4-1/c	500 kcmil	0.48	75.00	172.0	27.42	3.243
4		1	22.500	0.000	4-1/c	500 kcmil	0.48	75.00	164.2	27.42	2.956
5		1	30.000	0.000	4-1/c	500 kcmil	0.48	75.00	160.0	27.42	2.809
6		1	37.500	0.000	4-1/c	500 kcmil	0.48	75.00	157.7	27.42	2.726
7		1	45.000	0.000	4-1/c	500 kcmil	0.48	75.00	156.3	27.42	2.678
8		1	52.500	0.000	4-1/c	500 kcmil	0.48	75.00	155.4	27.42	2.648
9	C1	1	60.000	0.000	4-1/c	500 kcmil	0.48	75.00	154.9	27.42	2.630
10		1	67.500	0.000	4-1/c	500 kcmil	0.48	75.00	154.5	27.42	2.619
11		1	75.000	0.000	4-1/c	500 kcmil	0.48	75.00	154.4	27.42	2.615
12		1	82.500	0.000	4-1/c	500 kcmil	0.48	75.00	154.4	27.42	2.615
13		1	90.000	0.000	4-1/c	500 kcmil	0.48	75.00	154.5	27.42	2.619
14		1	97.500	0.000	4-1/c	500 kcmil	0.48	75.00	154.9	27.42	2.630
15		1	105.000	0.000	4-1/c	500 kcmil	0.48	75.00	155.4	27.42	2.648
16	C1	1	112.500	0.000	4-1/c	500 kcmil	0.48	75.00	156.3	27.42	2.678
17		1	120.000	0.000	4-1/c	500 kcmil	0.48	75.00	157.7	27.42	2.726
18		1	127.500	0.000	4-1/c	500 kcmil	0.48	75.00	160.0	27.42	2.809
19		1	135.000	0.000	4-1/c	500 kcmil	0.48	75.00	164.2	27.42	2.956
20		1	142.500	0.000	4-1/c	500 kcmil	0.48	75.00	172.0	27.42	3.243
21		1	150.000	0.000	4-1/c	500 kcmil	0.48	75.00	188.4	27.42	3.893
22		1	157.500	0.000	4-1/c	500 kcmil	0.48	75.00	228.4	27.42	5.719
23		1	0.000	-7.500	4-1/c	500 kcmil	0.48	75.00	207.5	27.42	4.722
24		1	7.500	-7.500	4-1/c	500 kcmil	0.48	75.00	162.8	27.42	2.908
25		1	15.000	-7.500	4-1/c	500 kcmil	0.48	75.00	142.6	27.42	2.230
26		1	22.500	-7.500	4-1/c	500 kcmil	0.48	75.00	132.0	27.42	1.910
27		1	30.000	-7.500	4-1/c	500 kcmil	0.48	75.00	125.7	27.42	1.734
28		1	37.500	-7.500	4-1/c	500 kcmil	0.48	75.00	121.8	27.42	1.626
29		1	45.000	-7.500	4-1/c	500 kcmil	0.48	75.00	119.1	27.42	1.556
30		1	52.500	-7.500	4-1/c	500 kcmil	0.48	75.00	117.3	27.42	1.510
31		1	60.000	-7.500	4-1/c	500 kcmil	0.48	75.00	116.2	27.42	1.480
32		1	67.500	-7.500	4-1/c	500 kcmil	0.48	75.00	115.4	27.42	1.462

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

Calculation Method:

Distinct AMPACITY calculated for each position in the system based on user specified conductor temperature.

Summary of Neher-McGrath Calculation Results:

No.	Identifier	System	x Coord	y Coord	Qty-Type	Cable Size	Sys kV	Temp	Amps	Rac	Watts/ft
33		1	75.000	-7.500	4-1/c	500 kcmil	0.48	75.00	115.1	27.42	1.453
34		1	82.500	-7.500	4-1/c	500 kcmil	0.48	75.00	115.1	27.42	1.453
35		1	90.000	-7.500	4-1/c	500 kcmil	0.48	75.00	115.4	27.42	1.462
36		1	97.500	-7.500	4-1/c	500 kcmil	0.48	75.00	116.2	27.42	1.480
37		1	105.000	-7.500	4-1/c	500 kcmil	0.48	75.00	117.3	27.42	1.510
38		1	112.500	-7.500	4-1/c	500 kcmil	0.48	75.00	119.1	27.42	1.556
39		1	120.000	-7.500	4-1/c	500 kcmil	0.48	75.00	121.8	27.42	1.626
40		1	127.500	-7.500	4-1/c	500 kcmil	0.48	75.00	125.7	27.42	1.734
41		1	135.000	-7.500	4-1/c	500 kcmil	0.48	75.00	132.0	27.42	1.910
42		1	142.500	-7.500	4-1/c	500 kcmil	0.48	75.00	142.6	27.42	2.230
43		1	150.000	-7.500	4-1/c	500 kcmil	0.48	75.00	162.8	27.42	2.908
44		1	157.500	-7.500	4-1/c	500 kcmil	0.48	75.00	207.5	27.42	4.722

User System Input Data

0	
Direct Burie	d Conduits
44	
40.000	
90	
20	
	40.000 90

Cable Position Input Data:

10000										
No	Identifier	x Coord	# & Type	Cable Library Library Volume	Cable Size	Shield	Sys kV	Duct Library	1/c Spc	Spec Temp
140.	System	y Coord	Cond.	Library Volume	Rated kV	Confia	Svs Frea	Nom. Size	LF%	Spec Amps

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

Cable Position Input Data:

No.	Identifier		# & Type		Cable Size			Duct Library		Spec Temp
10.	System	y Coord	Cond.	Library Volume	Rated kV	Config	Sys Freq	Nom. Size	LF%	Spec Amps
1		0.000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC	7.30	[75.000]
20	1	0.000	Copper	THHW	0.60	Equil.	60	6	100	5000.0
2		7.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC	3.5	[75.000]
_	1	0.000	Copper	THHW	0.60	Equil.	60	6	100	5000.0
3	100000	15.000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC	4.32	[75.000]
3	1	0.000	Copper	THHW	0.60	Equil.	60	6	100	5000.0
4		22.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC	Wife.	[75.000]
4	1	0.000	Copper	THHW	0.60	Equil.	60	6	100	5000.0
5		30.000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC		[75.000]
_	1	0.000	Copper	THHW	0.60	Equil.	60	6	100	5000.0
6		37.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC	(Seast)	[75.000]
J	1	0.000	Copper	THHW	0.60	Equil.	60	6	100	5000.0
7		45.000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC	7747	[75.000]
•	1	0.000	Copper	THHW	0.60	Equil.	60	6	100	5000.0
8		52.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC		[75.000]
	1	0.000	Copper	THHW	0.60	Equil.	60	6	100	5000.0
9	C1	60.000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC		[75.000]
	1 —	0.000	Copper	THHW	0.60	Equil.	60	6	100	5000.0
10		67.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC		[75.000]
	1	0.000	Copper	THHW	0.60	Equil.	60	6	100	5000.0
11		75.000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC		[75.000]
	1	0.000	Copper	THHW	0.60	Equil.	60	6	100	5000.0
12		82.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC		[75.000]
-	1	0.000	Copper	THHW	0.60	Equil.	60	6	100	5000.0
13		90.000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC		[75.000]
-	1	0.000	Copper	THHW	0.60	Equil.	60	6	100	5000.0
14		97.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC	0.52	[75.000]
	1	0.000	Copper	THHW	0.60	Equil.	60	6	100	5000.0
15		105.000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC		[75.000]
10	1	0.000	Copper	THHW	0.60	Equil.	60	6	100	5000.0
16	C1	112.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC		[75.000]
, ,	1	0.000	Copper	THHW	0.60	Equil.	60	6	100	5000.0
17		120.000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC		[75.000]
	1	0.000	Copper	THHW	0.60	Equil.	60	6	100	5000.0
18		127.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC		[75.000]
.0	1	0.000	Copper	THHW	0.60	Equil.	60	6	100	5000.0

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

Cable Position Input Data:

Car	1,000 - 31-7-50-7			Coble Library	Coble Size	Chiold	Cup leV	Dust Library	1/2 522	Casa Tama
No.	Identifier		# & Type		Cable Size			Duct Library		Spec Temp
	System	y Coord	Cond.	Library Volume	Rated kV		Sys Freq	Nom, Size	LF%	Spec Amps
19		135.000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC	1150	[75.000]
7	1	0.000	Copper	THHW	0.60	Equil.	60	6	100	5000.0
20		142.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC		[75.000]
Fï	1	0.000	Copper	THHW	0.60	Equil.	60	6	100	5000.0
21		150.000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC		[75.000]
-	1	0.000	Copper	THHW	0.60	Equil.	60	6	100	5000.0
22		157.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC		[75.000]
70	1	0.000	Copper	THHW	0.60	Equil.	60	6	100	5000.0
23		0.000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC	12.5	[75.000]
	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
24		7.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC		[75.000]
- '	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
25		15.000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC	- 1	[75.000]
20	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
26		22.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC	5.5.5	[75.000]
20	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
27		30.000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC	1250	[75.000]
21	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
28		37.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC		[75.000]
	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
29		45.000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC		[75.000]
23	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
30	55535561	52.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC	(t- i i	[75.000]
30	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
31		60.000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC	linge.	[75.000]
31	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
32		67.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC		[75.000]
32	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
33 -		75.000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC PVC	(capul	[75.000]
33 [1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
34 -	22.00	82.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC		[75.000]
54	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
25		90.000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC PVC	16.75	[75.000]
35 -	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
20		97.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC PVC	104.0	[75.000]
36	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

Cable Position Input Data:

No.	Identifier	x Coord	# & Type	Cable Library	Cable Size	Shield	Sys kV	Duct Library	1/c Spc	Spec Temp
NO.	System	y Coord	Cond.	Library Volume	Rated kV	Config	Sys Freq	Nom. Size	LF%	Spec Amps
37		105.000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC	1,211	[75.000]
37	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
38		112.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC		[75.000]
30	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
39		120.000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC	1	[75.000]
39	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
40	100000	127.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC	1.20	[75.000]
40	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
41		135.000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC	1.5	[75.000]
41	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
42		142.500	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC		[75.000]
42	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
43	500553355	150.000	4-1/c	NEC1_600	500 kcmil	None	0.48	NEC_PVC	10	[75.000]
43	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0
44	ادهتاددد	157.500	4-1/c	NEC1_600	500 kcmil	None	0,48	NEC_PVC	may .	[75.000]
44	1	-7.500	Copper	THHW	0.60	Equil.	60	6	100	5000.0

Caution - Specified Temp and Amps are user input setpoints and do not necessarily represent a correct solution. Bracketed value is user specified input variable which may be held constant in optional calculation.

Volta	ge Drop Ca	alculations:				Ohms/1000	feet/Cond.	Volt Drop	(+%)
No.	Identifier	Length (ft.)	Amps/Conductor	PF (%)		Resistance	Reactance	or Rise	(-%)
1		80	228.4	100.000	Lag	0.0274	0.0292	0.181	OK
2		80	188.4	100.000	Lag	0.0274	0.0292	0.149	OK
3		80	172.0	100.000	Lag	0.0274	0.0292	0.136	OK
4		80	164.2	100.000	Lag	0.0274	0.0292	0.130	OK
5		80	160.0	100.000	Lag	0.0274	0.0292	0.127	ОК
6		80	157.7	100.000	Lag	0.0274	0.0292	0.125	OK
7		80	156.3	100.000	Lag	0.0274	0.0292	0.124	OK
8		80	155.4	100.000	Lag	0.0274	0.0292	0.123	ОК
9	C1	80	154.9	100.000	Lag	0.0274	0.0292	0.123	OK
10		80	154.5	100.000	Lag	0.0274	0.0292	0.122	OK
11		80	154.4	100.000	Lag	0.0274	0.0292	0.122	ОК
12		80	154.4	100.000	Lag	0.0274	0.0292	0.122	OK
13		80	154.5	100.000	Lag	0.0274	0.0292	0.122	OK

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

Volta	Itage Drop Calculations:					Ohms/1000	feet/Cond.		
No.	Identifier	Length (ft.)	Amps/Conductor	PF (%)		Resistance	Reactance	or Rise	(-%)
14		80	154.9	100.000	Lag	0.0274	0.0292	0.123	OK
15		80	155.4	100.000	Lag	0.0274	0.0292	0.123	OK
16	C1	80	156.3	100.000	Lag	0.0274	0.0292	0.124	OK
17		80	157.7	100.000	Lag	0.0274	0.0292	0.125	OK
18		80	160.0	100.000	Lag	0.0274	0.0292	0.127	OK
19		80	164.2	100.000	Lag	0.0274	0.0292	0.130	OK
20		80	172.0	100.000	Lag	0.0274	0.0292	0.136	OK
21		80	188.4	100.000	Lag	0.0274	0.0292	0.149	OK
22		80	228.4	100.000	Lag	0.0274	0.0292	0.181	OK
23		80	207.5	100.000	Lag	0.0274	0.0292	0.164	OK
24		80	162.8	100.000	Lag	0.0274	0.0292	0.129	OK
25		80	142.6	100.000	Lag	0.0274	0.0292	0.113	OK
26		80	132.0	100.000	Lag	0.0274	0.0292	0.105	OK
27		80	125.7	100.000	Lag	0.0274	0.0292	0.100	OK
28		80	121.8	100.000	Lag	0.0274	0.0292	0.096	OK
29		80	119.1	100.000	Lag	0.0274	0.0292	0.094	ОК
30		80	117.3	100.000	Lag	0.0274	0.0292	0.093	OK
31		80	116.2	100.000	Lag	0.0274	0.0292	0.092	OK
32		80	115.4	100.000	Lag	0.0274	0.0292	0.091	OK
33		80	115.1	100.000	Lag	0.0274	0.0292	0.091	OK
34		80	115.1	100.000	Lag	0.0274	0.0292	0.091	ОК
35		80	115.4	100.000	Lag	0.0274	0.0292	0.091	OK
36		80	116.2	100.000	Lag	0.0274	0.0292	0.092	OK
37		80	117.3	100.000	Lag	0.0274	0.0292	0.093	ОК
38		80	119.1	100.000	Lag	0.0274	0.0292	0.094	ОК
39		80	121.8	100.000	Lag	0.0274	0.0292	0.096	ОК
40		80	125.7	100.000	Lag	0.0274	0.0292	0.100	ОК
41		80	132.0	100.000	Lag	0.0274	0.0292	0.105	ОК
42		80	142.6	100.000	Lag	0.0274	0.0292	0.113	ОК
43		80	162.8	100.000	Lag	0.0274	0.0292	0.129	ОК
44		80	207.5	100.000	Lag	0.0274	0.0292	0.164	ОК

Load Flow Calculations:

No. Identifier	Volta	Current	Current/Phase			Load Flow Power			
System	Mag	Deg	Amps	Deg	PF (%)	kVA	kW	kVAR	kVAR Loss

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

Load Flow Calculations:

No.	Identifier		Volta	age	Current	t/Phase			ad Flow Po	wer	kW Loss
INO.	System		Mag	Deg	Amps	Deg	PF (%)	kVA	kW	kVAR	kVAR Loss
1	1	Source> Load>	480.0 479.1	0.00	228.4	-0.11	100.0 Unity 100.0 Lag	189.9 189.5	189.9 189.5	0.4	0.343
2	1	Source> Load>	480.0 479.3	0.00	188.4	-0.09	100.0 Unity 100.0 Lag	156.6 156.4	156.6 156.4	0.2	0.234
3	1	Source> Load>	480.0 479.3	0.00	172.0	-0.08	100.0 Unity	143.0 142.8	143.0	0.2	0.195 0.207
4	1	Source> Load>	480.0 479.4	0.00	164.2	-0.08	100.0 Unity 100.0 Lag	136.5	136.5 136.3	0.2	0.177
5	1	Source> Load>	480.0 479.4	0.00	160.0	-0.08	100.0 Unity 100.0 Lag	133.0	133.0	0.2	0.169 0.179
6	1	Source> Load>	480.0 479.4	0.00	157.7	-0.08	100.0 Unity	131.1	131.1	0.2	0.164
7	1	Source> Load>	480.0 479.4	0.00	156.3	-0.08	100.0 Unity 100.0 Lag	129.9 129.7	129.9	0.2	0.161
8	1	Source>	480.0 479.4	0.00	155.4	-0.07	100.0 Unity 100.0 Lag	129.2	129.2	0.2	0.159 0.169
9	C11	Source> Load>	480.0 479.4	0.00	154.9	-0.07	100.0 Unity 100.0 Lag	128.7 128.6	128.7 128.6	0.2	0.158
10	1	Source> Load>	480.0 479.4	0.00	154.5	-0.07	100.0 Unity 100.0 Lag	128.5 128.3	128.5 128.3	0.2	0.157
11	1	Source> Load>	480.0 479.4	0.00	154.4	-0.07	100.0 Unity 100.0 Lag	128.4	128.4 128.2	0.2	0.157
12	1	Source> Load>	480.0 479.4	0.00	154.4	-0.07	100.0 Unity 100.0 Lag	128.4 128.2	128.4 128.2	0.2	0.157 0.167
13	1	Source> Load>	480.0 479.4	0.00	154.5	-0.07	100.0 Unity 100.0 Lag	128.5 128.3	128.5 128.3	0.2	0.157 0.167
14	1	Source> Load>	480.0 479.4	0.00 -0.07	154.9	-0.07	100.0 Unity 100.0 Lag	128.7 128.6	128.7 128.6	0.2	0.158 0.168
15	1	Source> Load>	480.0 479.4	0.00	155.4	-0.07	100.0 Unity 100.0 Lag	129.2	129.2 129.0	0.2	0.159 0.169
16	<u>C1</u>	Source> Load>	480.0 479.4	0.00	156.3	-0.08	100.0 Unity 100.0 Lag	129.9 129.7	129.9 129.7	0.2	0.161
17	1	Source> Load>	480.0 479.4	0.00	157.7	-0.08	100.0 Unity 100.0 Lag	131.1	131.1	0.2	0.164 0.174
18	1	Source> Load>	480.0 479.4	0.00	160.0	-0.08	100.0 Unity 100.0 Lag	133.0	133.0	0.2	0.169

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

Load Flow Calculations:

No.	Identifier		Volta	age	Current	/Phase		Loa	ad Flow Po	wer	kW Loss
140.	System		Mag	Deg	Amps	Deg	PF (%)	kVA	kW	kVAR	kVAR Loss
19	1	Source> Load>	480.0 479.4	0.00	164.2	-0.08	100.0 Unity 100.0 Lag	136.5 136.3	136.5 136.3	0.2	0.177 0.189
20	1	Source> Load>	480.0 479.3	0.00	172.0	-0.08	100.0 Unity	143.0 142.8	143.0 142.8	0.2	0.195
21	1	Source> Load>	480.0 479.3	0.00	188.4	-0.09	100.0 Unity 100.0 Lag	156.6 156.4	156.6 156.4	0.2	0.234
22	1	Source> Load>	480.0 479.1	0.00	228.4	-0.11	100.0 Unity 100.0 Lag	189.9 189.5	189.9 189.5	0.4	0.343
23	1	Source> Load>	480.0 479.2	0.00	207.5	-0.10	100.0 Unity	172.5 172.2	172.5 172.2	0.3	0.283
24	1	Source> Load>	480.0 479.4	0.00	162.8	-0.08	100.0 Unity 100.0 Lag	135.4	135.4	0.2	0.174
25	1	Source> Load>	480.0 479.5	0.00	142.6	-0.07	100.0 Unity 100.0 Lag	118.5	118.5	0.1	0.134
26	1	Source> Load>	480.0 479.5	0.00	132.0	-0.06	100.0 Unity	109.7	109.7	0.1	0.115
27	1	Source> Load>	480.0 479.5	0.00	125.7	-0.06	100.0 Unity	104.5	104.5	0.1	0.104
28	1	Source> Load>	480.0 479.5	0.00	121.8	-0.06	100.0 Unity 100.0 Lag	101.2	101.2	0.1	0.098
29	1	Source> Load>	480.0 479.5	0.00	119.1	-0.06	100.0 Unity 100.0 Lag	99.0	99.0	0.1	0.093
30 -	1	Source> Load>	480.0 479.6	0.00	117.3	-0.06	100.0 Unity 100.0 Lag	97.6 97.5	97.6 97.5	0.1	0.091
31-	1	Source> Load>	480.0 479.6	0.00	116.2	-0.06	100.0 Unity 100.0 Lag	96.6 96.5	96.6 96.5	0.1	0.089
32-	1	Source> Load>	480.0 479.6	0.00	115.4	-0.06	100.0 Unity 100.0 Lag	96.0 95.9	96.0 95.9	0.1	0.088
33	1	Source> Load>	480.0 479.6	0.00	115.1		100.0 Unity 100.0 Lag	95.7 95.6	95.7 95.6	0.1	0.087
34	1	Source> Load>	480.0 479.6	0.00	115,1	-0.06	100.0 Unity	95.7 95.6	95.7 95.6	0.1	0.087
35	1	Source> Load>	480.0 479.6	0.00	115.4		100.0 Unity 100.0 Lag	96.0 95.9	96.0 95.9	0.1	0.088
36	1	Source> Load>	480.0 479.6	0.00	116.2		100.0 Unity 100.0 Lag	96.6 96.5	96.6 96.5	0.1	0.089

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

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Load Flow Calculations:

No.	Identifier	, and a	Volta	age	Current	/Phase		Loa	ad Flow Po	wer	kW Loss
NO.	System		Mag	Deg	Amps	Deg	PF (%)	kVA	kW	kVAR	kVAR Loss
37	1	Source> Load>	480.0 479.6	0.00	117.3	-0.06	100.0 Unity 100.0 Lag	97.6 97.5	97.6 97.5	0.1	0.091 0.096
38	1	Source> Load>	480.0 479.5	0.00	119.1	-0.06	100.0 Unity 100.0 Lag	99.0 98.9	99.0 98.9	0.1	0.093
39	1	Source> Load>	480.0 479.5	0.00	121.8	-0.06	100.0 Unity 100.0 Lag	101.2 101.1	101.2 101.1	0.1	0.098 0.104
40	1	Source> Load>	480.0 479.5	0.00	125.7	-0.06	100.0 Unity 100.0 Lag	104.5 104.4	104.5 104.4	0.1	0.104 0.111
41	1	Source> Load>	480.0 479.5	0.00	132.0	-0.06	100.0 Unity 100.0 Lag	109.7	109.7	0.1	0.115
42	1	Source> Load>	480.0 479.5	0.00	142.6	-0.07	100.0 Unity 100.0 Lag	118.5 118.4	118.5 118.4	0.1	0.134 0.142
43	1	Source> Load>	480.0 479.4	0.00	162.8	-0.08	100.0 Unity 100.0 Lag	135.4 135.2	135.4 135.2	0.2	0.174
44	1	Source> Load>	480.0 479.2	0.00	207.5	-0.10	100.0 Unity 100.0 Lag	172.5 172.2	172.5 172.2	0.3	0.283

Duct Fill Data and Calculations:

No.	Identifier System	Ph Qty	Ph Size Ph OD	Neut Qty	Neut Size Neut OD	Grd Qty Grd Type	Grd Size Grd OD	Duct ID	Allowable Fill %	Actual Fill %	Jam Ratio
1	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
2	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
3	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
4	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
5	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
6	1	4	500 kcmil 1,003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
7	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a

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Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

Duct Fill Data and Calculations:

No.	Identifier System	Ph Qty	Ph Size Ph OD	Neut Qty	Neut Size Neut OD	Grd Qty Grd Type	Grd Size Grd OD	Duct ID	Allowable Fill %	Actual Fill %	Jam Ratio
8	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
9	<u>C1</u>	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
10	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
11	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
12	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
13	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
14	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
15	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
16	C1 1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
17	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
18	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
19	1	4	500 kcmil 1.003	0	iu-	1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
20	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
21	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
22	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
23	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
24	1	4	500 kcmil 1.003	0	<u>-</u>	1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
25	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a

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Single user license for Bucher, Willis & Ratliff, Kansas City, MO

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Duct Fill Data and Calculations:

No.	Identifier System	Ph Qty	Ph Size Ph OD	Neut Qty	Neut Size Neut OD	Grd Qty Grd Type	Grd Size Grd OD	Duct ID	Allowable Fill %	Actual Fill %	Jam Ratio
26	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
27	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
28	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
29	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
30	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
31	1	4	500 kcmil 1.003	0	7	1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
32	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
33	1	4	500 kcmil 1.003	0	33437454	1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
34	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
35	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
36	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
37	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
38	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
39	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
40	1	4	500 kcmil 1.003	0		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
41	1	4	500 kcmil 1.003	0 -		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
42	1	4	500 kcmil 1.003	0 -		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a
43	1	4	500 kcmil 1.003	0 -		1 Insulated	3/0 AWG 2.620	6.000	40.0	30.2 OK	n/a

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Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

Duct Fill Data and Calculations:

No.	Identifier System	Ph Qty	Ph Size Ph OD	Neut Qty	Neut Size Neut OD	Grd Qty Grd Type		Duct ID	Allowable Fill %	Actual Fill %	Jam Ratio
44	LE: 1353	1	500 kcmil	0	0.216020	1	3/0 AWG	6.000	40.0	30.2	n/a
77	1	3	1.003	0		Insulated	2.620	0.000	40.0	OK	

Cable Library Volume Data:

No.	Identifier	Cable Library	Туре	Temp	SIC	DF	Ins RHO	CU res	ks	3/c
-	System	Lib Volume	kV	Shield?	SIC exp	DF exp	Jac RHO	AL res	kp	configuration
1		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	17.
(9)	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
2		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
-	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
3		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
_	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
4		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
-	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
5		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
J	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	_
6	Sewie S.	NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
Ü	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
7	120302	NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
8		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
٥	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
9	C1	NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
9	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
10	00000	NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
10	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
11		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
11	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
12		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
12	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
13	10 m to 1	NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	.,,,
13	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	-
14		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
14	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	

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Cable Library Volume Data:

No.	Identifier	Cable Library	Type	Temp	SIC	DF	Ins RHO	CU res	ks	3/c
V O.	System	Lib Volume	kV	Shield?	SIC exp	DF exp	Jac RHO	AL res	kp	configuration
15	1023333	NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
10	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
16	C1	NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
10	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
17		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	- 2
18		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
10	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	-
19		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
13	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	No. 2012
20	Jackson	NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
20	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	-
21	TRAC	NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
21	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	- 7
22		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
23		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	12.
23	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
24		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
24	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
25	1000000	NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
20	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
26		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
20	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
27	770-04	NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
21	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	-7
28	TOTO SEE	NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
20	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	5 - 1
29	77	NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
29	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
30	33533	NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	T A
30	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
31		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
31	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
20	1.00	NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
32	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	

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Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

Cable Library Volume Data:

No.	Identifier		Туре	Temp	SIC	DF	Ins RHO	CU res	ks	3/c
	System	Lib Volume	kV	Shield?	SIC exp	DF exp	Jac RHO	AL res	kp	configuration
33		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
00	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
34		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
04	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
35		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	T -5- 8
55	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
36		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
50	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
37	55555	NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
31	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	· · · · ·
38	NG64666	NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
30	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	-
39		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
00	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
40		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
70	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	7
41	1	NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
71	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
42		NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
42	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	- LA -
43	2545366	NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
45	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	
44	00000	NEC1_600	1/c	75	0.000	0.000	500	10.371	1.000	
74	1	THHW	0.600	No	0.0000	0.0000	0	17.002	1.000	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

Cable Library Size Data - Basic Cable Data Format:

	310 =10141	OILO DUILO	-4010	-4010 00	ita i Oillia						
No.	Identifier	Cable Size	Cable	1/0 00	Insulation	Jacket thickness	Con	ductor	CU lay F	Shield Th.	Shield Rdc
NO.	System	Cable Size	OD	I/C OD	thickness	thickness	kcmil	Diameter	AL lay F	Shield Dia.	Calc Yse?
1		500 kcmil	1.003		0.0950	0.000	500.00	0.813	1.0228	الروالا	
13	1	JOO KCITIII	KCMII 1.003 - 0.0950 0.000 500.00 (0.013	1.0206		2				
2		500 kcmil	1.003		0.0950	0.000	500.00	0.813	1.0228		
_	1	JOO KCIIIII	1.000		0.0300	0.000	300.00	0.013	1.0206		-
3	3 5	500 kcmil	500 kcmil 1.003	.003 -	- 0.0950	0.000	500.00	0.813	1.0228		1.15
3			1.003		0.0900	0.000	500.00	0.010	1.0206	4	-1-1

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

Cable Library Size Data - Basic Cable Data Format:

No.	Identifier	Cable Size	Cable	1/c OD	Insulation			ductor		Shield Th.	
	System	000.000.00	OD		thickness	thickness	kcmil	Diameter	AL lay F	Shield Dia.	Calc Yse?
4	1	500 kcmil	1.003	[6]	0.0950	0.000	500.00	0.813	1.0228 1.0206	:	
5	1	500 kcmil	1.003	-	0.0950	0.000	500.00	0.813	1.0228 1.0206		
6	1	500 kcmil	1.003	1-5	0.0950	0.000	500.00	0.813	1.0228 1.0206		
7	1	500 kcmil	1.003	4	0.0950	0.000	500.00	0.813	1.0228 1.0206		wij.
8	1	500 kcmil	1.003	4	0.0950	0.000	500.00	0.813	1.0228 1.0206		
9	<u>C1</u> 1	500 kcmil	1.003	3	0.0950	0.000	500.00	0.813	1.0228 1.0206		
10	1	500 kcmil	1.003	4	0.0950	0.000	500.00	0.813	1.0228 1.0206		
11	1	500 kcmil	1.003	127	0.0950	0.000	500.00	0.813	1.0228 1.0206		
12	1	500 kcmil	1.003	4	0.0950	0.000	500.00	0.813	1.0228 1.0206		
13	1	500 kcmil	1.003	14	0.0950	0.000	500.00	0.813	1.0228 1.0206		
14	1	500 kcmil	1.003	64	0.0950	0.000	500.00	0.813	1.0228 1.0206		
15	1	500 kcmil	1.003	4	0.0950	0.000	500.00	0.813	1.0228 1.0206		
16	C1 1	500 kcmil	1.003	4	0.0950	0.000	500.00	0.813	1.0228 1.0206		
17	1	500 kcmil	1.003	2	0.0950	0.000	500.00	0.813	1.0228 1.0206		
18	1	500 kcmil	1.003	74	0.0950	0.000	500.00	0.813	1.0228 1.0206		
19	1	500 kcmil	1.003		0.0950	0.000	500.00	0.813	1.0228 1.0206		
20	1	500 kcmil	1.003	ı.	0.0950	0.000	500.00	0.813	1.0228		
21	1	500 kcmil	1.003		0.0950	0.000	500.00	0.813	1.0228 1.0206		

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

Cable Library Size Data - Basic Cable Data Format:

No.	Identifier	Cable Size	Cable	1/c OD	Insulation	The state of the s	Con	ductor		Shield Th.	
INO.	System	Cable Size	OD	1/6 00	thickness	thickness	kcmil	Diameter	AL lay F	Shield Dia.	Calc Yse?
22	1	500 kcmil	1.003	-	0.0950	0.000	500.00	0.813	1.0228 1.0206		
23	1	500 kcmil	1.003	-	0.0950	0.000	500.00	0.813	1.0228 1.0206		
24	1	500 kcmil	1.003	15	0.0950	0.000	500.00	0.813	1.0228 1.0206		
25	1	500 kcmil	1.003	-	0.0950	0.000	500.00	0.813	1.0228 1.0206		
26	1	500 kcmil	1.003	-	0.0950	0.000	500.00	0.813	1.0228 1.0206		
27	1	500 kcmil	1.003	÷	0.0950	0.000	500.00	0.813	1.0228 1.0206		
28	1	500 kcmil	1.003	i ė	0.0950	0.000	500.00	0.813	1.0228 1.0206		
29	1	500 kcmil	1.003	-	0.0950	0.000	500.00	0.813	1.0228 1.0206		
30	1	500 kcmil	1.003	E)	0.0950	0.000	500.00	0.813	1.0228 1.0206		
31	1	500 kcmil	1.003	4.1	0.0950	0.000	500.00	0.813	1.0228		
32	1	500 kcmil	1.003		0.0950	0.000	500.00	0.813	1.0228		
33	1	500 kcmil	1.003	ė	0.0950	0.000	500.00	0.813	1.0228 1.0206		
34	1	500 kcmil	1.003	15	0.0950	0.000	500.00	0.813	1.0228 1.0206		
35	1	500 kcmil	1.003	5-0	0.0950	0.000	500.00	0.813	1.0228		
36	1	500 kcmil	1.003	141	0.0950	0.000	500.00	0.813	1.0228		
37	1	500 kcmil	1.003	Te I	0.0950	0.000	500.00	0.813	1.0228 1.0206		
38	1	500 kcmil	1.003	13	0.0950	0.000	500.00	0.813	1.0228 1.0206		
39		500 kcmil	1.003	-	0.0950	0.000	500.00	0.813	1.0228		

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

Cable Library Size Data - Basic Cable Data Format:

No.	Identifier	Cable Size	Cable	1/c OD	Insulation	Jacket	Con	ductor	CU lay F	Shield Th.	Shield Rdd
INO.	System	Cable Size	OD	1/6 00	thickness	thickness	kcmil	Diameter	AL lay F	Shield Dia.	Calc Yse?
40		500 kcmil	1.003		0.0950	0.000	500.00	0.813	1.0228	333-03	-
	1	OOO KOITIII	1.000		0.0000	0.000	000.00	0.010	1.0206	1-2	2
41		500 kcmil	1.003		0.0950	0.000	500.00	0.813	1.0228		0.5
71	1	JOO KOITIII	1.000		0.0000	0.000	500.00	0.010	1.0206	- 1	
42		500 kcmil	1.003	1 1	0.0950	0.000	500.00	0.813	1.0228		
72	1	500 KCIIII	1.003	100.5	0.0330	0.000	500.00	0.013	1.0206	23,724	9
43		500 kcmil	1.003	100	0.0950	0.000	500.00	0.813	1.0228		
70	1	300 KCIIII	1.000		0.0000	0.000	500.00	0.013	1.0206	111111	
44		500 kcmil	500 kemil 1 003	1.003	0.0950	0.000	500.00	0.813	1.0228	0.03-0.0	Late State
77	1		1.003	-			500.00	0.013	1.0206	-	

Duct Library Data

						Duct			Co	vering
No.	Identifier	System	Duct Library	Туре	RHO	Nominal Size	ID	Thickness	RHO	Thickness
1		1	NEC_PVC	Nmet	650	6.00	6.00	0.280	0	0.000
2		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
3		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
4		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
5		1	NEC_PVC	Nmet	650	6.00	6.00	0.280	0	0.000
6		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
7		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
8		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
9	C1	1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
10		1	NEC_PVC	Nmet	650	6.00	6.00	0.280	0	0.000
11	1 1	1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
12		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
13		1	NEC_PVC	Nmet	650	6.00	6.00	0.280	0	0.000
14		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
15		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
16	C1	1	NEC_PVC	Nmet	650	6.00	6.00	0.280	0	0.000
17		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
18		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
19		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
20		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
21		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000

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 AmpCalc - Cable Ampacity Calculations for Underground & Aerial Installations

 Version 4.00, Rev 16 (c) Copyright 1986-2011
 Calcware Company
 Katy, Texas

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

Duct Library Data

						Duct			Co	vering
No.	Identifier	System	Duct Library	Туре	RHO	Nominal Size	ID	Thickness	RHO	Thickness
22		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
23		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
24		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
25		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
26	Limi	1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
27		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
28		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
29		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
30		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
31		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
32		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
33		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
34		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
35		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
36		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
37		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
38		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
39		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
40		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
41		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
42		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
43		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000
44		1	NEC_PVC	Nmet	650	0.00	6.00	0.280	0	0.000

CALCULATION RESULTS - Table 1 of 3

No.	Identifier	System	Temp	Amps	# Cond.	Loss Fac.	Watts/ft	Rac	Rdc	Wd	Dtd
1		1	75.000	228.4	4	1.000	5.719	27.419	25.800	0.0000	0.000
2		1	75.000	188.4	4	1.000	3.893	27,419	25.800	0.0000	0.000
3		1	75.000	172.0	4	1.000	3.243	27.419	25.800	0.0000	0.000
4		1	75.000	164.2	4	1.000	2.956	27.419	25.800	0.0000	0.000
5		1	75.000	160.0	4	1.000	2.809	27.419	25.800	0.0000	0.000
6		1	75.000	157.7	4	1.000	2.726	27.419	25.800	0.0000	0.000
7		1	75.000	156.3	4	1.000	2.678	27.419	25.800	0.0000	0.000
8		1	75.000	155.4	4	1.000	2.648	27.419	25.800	0.0000	0.000
9	C1	1	75.000	154.9	4	1.000	2.630	27.419	25.800	0.0000	0.000

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Single user license for Bucher, Willis & Ratliff, Kansas City, MO

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CALCULATION RESULTS - Table 1 of 3

No.	Identifier	System	Temp	Amps	# Cond.	Loss Fac.	Watts/ft	Rac	Rdc	Wd	Dtd
10		1	75.000	154.5	4	1.000	2.619	27.419	25.800	0.0000	0.000
11		1	75.000	154.4	4	1.000	2.615	27.419	25.800	0.0000	0.000
12		1	75.000	154.4	4	1.000	2.615	27.419	25.800	0.0000	0.000
13		1	75.000	154.5	4	1.000	2.619	27.419	25.800	0.0000	0.000
14		1	75.000	154.9	4	1.000	2.630	27.419	25.800	0.0000	0.000
15		1	75.000	155.4	4	1.000	2.648	27.419	25.800	0.0000	0.000
16	C1	1	75.000	156.3	4	1.000	2.678	27,419	25.800	0.0000	0.000
17		1	75.000	157.7	4	1.000	2.726	27.419	25.800	0.0000	0.000
18		1	75.000	160.0	4	1.000	2.809	27.419	25.800	0.0000	0.000
19		1	75.000	164.2	4	1.000	2.956	27.419	25.800	0.0000	0.000
20		1	75.000	172.0	4	1.000	3.243	27.419	25.800	0.0000	0.000
21		1	75.000	188.4	4	1.000	3.893	27.419	25.800	0.0000	0.000
22		1	75.000	228.4	4	1.000	5.719	27.419	25.800	0.0000	0.000
23		1	75.000	207.5	4	1.000	4.722	27.419	25.800	0.0000	0.000
24		1	75.000	162.8	4	1.000	2.908	27.419	25.800	0.0000	0.000
25		1	75.000	142.6	4	1.000	2.230	27.419	25.800	0.0000	0.000
26		1	75.000	132.0	4	1.000	1.910	27.419	25.800	0.0000	0.000
27		1	75.000	125.7	4	1.000	1.734	27.419	25.800	0.0000	0.000
28		1	75.000	121.8	4	1.000	1.626	27.419	25.800	0.0000	0.000
29		1	75.000	119.1	4	1.000	1.556	27.419	25.800	0.0000	0.000
30		1	75.000	117.3	4	1.000	1.510	27.419	25.800	0.0000	0.000
31		1	75.000	116.2	4	1.000	1.480	27.419	25.800	0.0000	0.000
32		1	75.000	115.4	4	1.000	1.462	27.419	25.800	0.0000	0.000
33		1	75.000	115.1	4	1.000	1.453	27.419	25.800	0.0000	0.000
34		1	75.000	115.1	4	1.000	1.453	27.419	25.800	0.0000	0.000
35		1	75.000	115.4	4	1.000	1.462	27.419	25.800	0.0000	0.000
36		1	75.000	116.2	4	1.000	1.480	27.419	25.800	0.0000	0.000
37		1	75.000	117.3	4	1.000	1.510	27.419	25.800	0.0000	0.000
38		1	75.000	119.1	4	1.000	1.556	27.419	25.800	0.0000	0.000
39		1	75.000	121.8	4	1.000	1.626	27.419	25.800	0.0000	0.000
40		1	75.000	125.7	4	1.000	1.734	27.419	25.800	0.0000	0.000
41		1	75.000	132.0	4	1.000	1.910	27.419	25.800	0.0000	0.000
42		1	75.000	142.6	4	1.000	2.230	27.419	25.800	0.0000	0.000
43		1	75.000	162.8	4	1.000	2.908	27.419	25.800	0.0000	0.000
44		1	75.000	207.5	4	1.000	4.722	27.419	25.800	0.0000	0.000

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

CALCULATION RESULTS - Table 2 of 3

No.	Identifier	System	Yp	Qp	Spacing	GF1	GF2	Ri	Rj	Rsd	Rcap	Rd
1		1	0.0000	1.0000	1.003	1.50	l o∉c t.	0.5473	0.0000	6.552	14.298	1.206
2		1	0.0000	1.0000	1.003		10-	0.5473	0.0000	6.552	14.298	1.206
3		1	0.0000	1.0000	1.003	14.		0.5473	0.0000	6.552	14.298	1.206
4		1	0.0000	1.0000	1.003	4	A	0.5473	0.0000	6.552	14.298	1.206
5		1	0.0000	1.0000	1.003	-	-	0.5473	0.0000	6.552	14.298	1.206
6		1	0.0000	1.0000	1.003		- 1	0.5473	0.0000	6.552	14.298	1.206
7		1	0.0000	1.0000	1.003	.	÷	0.5473	0.0000	6.552	14.298	1.206
8		1	0.0000	1.0000	1.003	-6	-	0.5473	0.0000	6.552	14.298	1.206
9	C1	1	0.0000	1.0000	1.003	*	-	0.5473	0.0000	6.552	14.298	1.206
10		1	0.0000	1.0000	1.003			0.5473	0.0000	6.552	14.298	1.206
11		1	0.0000	1.0000	1.003		+	0.5473	0.0000	6.552	14.298	1.206
12		1	0.0000	1.0000	1.003	-		0.5473	0.0000	6.552	14.298	1.206
13		1	0.0000	1.0000	1.003		- ,-	0.5473	0.0000	6.552	14.298	1.206
14		1	0.0000	1.0000	1.003			0.5473	0.0000	6.552	14.298	1.206
15		1	0.0000	1.0000	1.003	-		0.5473	0.0000	6.552	14.298	1.206
16	C1	1	0.0000	1.0000	1.003	-		0.5473	0.0000	6.552	14.298	1.206
17		1	0.0000	1.0000	1.003	147	_	0.5473	0.0000	6.552	14.298	1.206
18		1	0.0000	1.0000	1.003	- 4		0.5473	0.0000	6.552	14.298	1.206
19		1	0.0000	1.0000	1.003		- 4	0.5473	0.0000	6.552	14.298	1.206
20		1	0.0000	1.0000	1.003	-	13	0.5473	0.0000	6.552	14.298	1.206
21		1	0.0000	1.0000	1.003	-	-	0.5473	0.0000	6.552	14.298	1.206
22		1	0.0000	1.0000	1.003	-		0.5473	0.0000	6.552	14.298	1.206
23		1	0.0000	1.0000	1.003	-		0.5473	0.0000	6.552	14.620	1.206
24		1	0.0000	1.0000	1.003		-	0.5473	0.0000	6.552	14.620	1.206
25		1	0.0000	1.0000	1.003	i o-o	-	0.5473	0.0000	6.552	14.620	1.206
26		1	0.0000	1.0000	1.003	T.D+C 1	-	0.5473	0.0000	6.552	14.620	1.206
27		1	0.0000	1.0000	1.003	-	#0	0.5473	0.0000	6.552	14.620	1.206
28		1	0.0000	1.0000	1.003	- 12	r Tr.Eyr	0.5473	0.0000	6.552	14.620	1.206
29		1	0.0000	1.0000	1.003	-	3	0.5473	0.0000	6.552	14.620	1.206
30		1	0.0000	1.0000	1.003		r.	0.5473	0.0000	6.552	14.620	1.206
31		1	0.0000	1.0000	1.003	18	THE	0.5473	0.0000	6.552	14.620	1.206
32		1	0.0000	1.0000	1.003	192-1	1 marri	0.5473	0.0000	6.552	14.620	1.206
33		1	0.0000	1.0000	1.003	-	11.77	0.5473	0.0000	6.552	14.620	1.206
34		1	0.0000	1.0000	1.003	1-17	i vi	0.5473	0.0000	6.552	14.620	1.206
35		1	0.0000	1.0000	1.003	- 1 <u>-</u>	- Y + Y	0.5473	0.0000	6.552	14.620	1.206
36		1	0.0000	1.0000	1.003		1 7/2/01	0.5473	0.0000	6.552	14.620	1.206

Program Serial Number: 203400552

Single user license for Bucher, Willis & Ratliff, Kansas City, MO

Filename: 0

CALCULATION RESULTS - Table 2 of 3

No.	Identifier	System	Yp	Qp	Spacing	GF1	GF2	Ri	Rj	Rsd	Rcap	Rd
37		1	0.0000	1.0000	1.003	4	20	0.5473	0.0000	6.552	14.620	1.206
38		1	0.0000	1.0000	1.003	7.4	1. 1./1	0.5473	0.0000	6.552	14.620	1.206
39		1	0.0000	1.0000	1.003	1	100	0.5473	0.0000	6.552	14.620	1.206
40		1	0.0000	1.0000	1.003	1.4	5	0.5473	0.0000	6.552	14.620	1.206
41		1	0.0000	1.0000	1.003	14	i A	0.5473	0.0000	6.552	14.620	1.206
42		11	0.0000	1.0000	1.003	1 341	-	0.5473	0.0000	6.552	14.620	1.206
43		1	0.0000	1.0000	1.003	1142	4	0.5473	0.0000	6.552	14.620	1.206
44		1	0.0000	1.0000	1.003	P-3-11	1 1 1 2 1	0.5473	0.0000	6.552	14.620	1.206

CALCULATION RESULTS - Table 3 of 3

No.	Identifier	System	Yc	Ycs	Ycp	Shld X	Ys	Ysc	Yse	Qs
1		1	0.0628	0.0163	0.0464		-	1 × =		1.0000
2		1	0.0628	0.0163	0.0464	118.11	7.8	(i _ , -, -	-	1.0000
3		1	0.0628	0.0163	0.0464	1.4-1.1	- AT 1	Y	-	1.0000
4		1	0.0628	0.0163	0.0464	1.5.	14.	100	-	1.0000
5		1	0.0628	0.0163	0.0464	1.90	34	-	-	1.0000
6		1	0.0628	0.0163	0.0464	112.1		100		1.0000
7		1	0.0628	0.0163	0.0464			128		1.0000
8		1	0.0628	0.0163	0.0464	¥	(a)	3 (44)	14	1.0000
9	C1	1	0.0628	0.0163	0,0464	-	-	1 (4	14	1.0000
10		1	0.0628	0.0163	0.0464		e e digita	2-1-1-1	112	1.0000
11		1	0.0628	0.0163	0.0464		+	1000		1.0000
12		1	0.0628	0.0163	0.0464		-		10 To	1.0000
13		1	0.0628	0.0163	0.0464		-	I TO		1.0000
14		1	0.0628	0.0163	0.0464		697 - 77	1-1-1-	encière i	1.0000
15		1	0.0628	0.0163	0.0464	- 1	-	1 4 1	3,5	1.0000
16	C1	1	0.0628	0.0163	0.0464		-	-		1.0000
17		1	0.0628	0.0163	0.0464			1. 7-	4	1.0000
18		1	0.0628	0.0163	0.0464		4	- 1	47	1.0000
19		1	0.0628	0.0163	0.0464					1.0000
20		1	0.0628	0.0163	0.0464	- C-1	10-	-	-	1.0000
21		1	0.0628	0.0163	0.0464			-	(4)	1.0000
22		1	0.0628	0.0163	0.0464	- C.		T GO LT	3-3	1.0000
23		1	0.0628	0.0163	0.0464	12.0	1.4	1-16-3		1.0000
24		1	0.0628	0.0163	0.0464	4	14.61	4		1.0000

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Single user license for Bucher, Willis & Ratliff, Kansas City, MO

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CALCULATION RESULTS - Table 3 of 3

No.	Identifier	System	Yc	Ycs	Ycp	Shld X	Ys	Ysc	Yse	Qs
25		1	0.0628	0.0163	0.0464		- 4	*	- 1	1.0000
26		1	0.0628	0.0163	0.0464	-			_	1.0000
27		1	0.0628	0.0163	0.0464	13-			-	1.0000
28		1	0.0628	0.0163	0.0464		- 3			1.0000
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34		1	0.0628	0.0163	0.0464	10000	- 14	1		1.0000
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38		1	0.0628	0.0163	0.0464				-	1.0000
39		1	0.0628	0.0163	0.0464		-			1.0000
40		1	0.0628	0.0163	0.0464	1000		-	-	1.0000
41		1	0.0628	0.0163	0.0464				-	1.0000
42		1	0.0628	0.0163	0.0464	4 1		1-1-1	- 1	1.0000
43		1	0.0628	0.0163	0.0464	10-01	102	1.6	li à T	1.0000
44		1	0.0628	0.0163	0,0464	13017	4	1.0	-	1.0000

Variable Label	Description	Units
# Cond	Number of conductors (not cables) at position	
1/c OD	For 3/c Cable, outside diameter of 1/c portion	Inches
1/c Spacing	Equivalent phase spacing for 1/c cables at different positions	Inches
3/c Configuration	Type of 3/c cable, round or sector	
Actual Fill %	Actual conduit fill	%
AL lay F	Lay factor for aluminum conductor	
AL Res	Aluminum electrical resistivity	Cir mils ohms/ft
Allowable Fill %	Allowable conduit fill according to limits set by user or NEC defaults	%
Amps	Calculated or specified current on a per conductor basis	Amperes
Cable Lib	Cable data library descriptor	
Cable OD	Cable overall outside diameter	Inches
Cable Size	Cable size designation	
Cable Type	Cable type,1/c or 3/c	
Concrete thermal resistivity (RHO)	Concrete thermal resistivity	Deg C-cm/watt
Cond.	Conductor Material, Copper or Aluminum	
Conductor Diameter	Conductor diameter	Inches

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Variable Label	Description	Units
Config	Cable configuration, non-applicable, equilateral, cradled or mixed	
CU lay F	Lay factor for copper conductor	
CU Res	Copper electrical resistivity	Cir mils ohms/f
Current Mag	Magnitude of current used in load flow calculations	Amps
Current Deg	Phase angle of current used in load flow calculations	Degrees
Dissipation Factor	Insulation dissipation factor, (DF), overall DF = DF x e^(DF Exp x Temp)	
Dissipation Factor Exponent	Insulation dissipation factor exponent, overall DF = DF x e^(DF Exp x Temp)	
Distance from earth's surface to or		Inches
Dist. top of ductbank to earth's surf		Inches
Dtd	Increment of conductor temperature rise due to dielectric losses	Deg C
Duct ID	Duct Inner diameter	Inches
Duct Library	Duct data library descriptor	III.G. (GG
Duct RHO	Duct material thermal resistivity	Deg C-cm/watt
Duct Thickness	Duct wall thickness	Inches
Duct Type	Whether duct material is Non-magnetic, Steel or Iron	morroo
Ductbank Geometric Factor	Calculated ductbank geometric factor	
Ductbank Height	Height of ductbank concrete envelope	Inches
Ductbank Width	Width of ductbank concrete envelope	Inches
dx	Ficticious diameter at which the effect of loss factor commences	Inches
Earth temperature	Earth ambient temperature	Deg C
Earth thermal resistivity (RHO)	Earth thermal resistivity	Deg C-cm/watt
GF1	Geometric factor for 3/c cable applying to insulation resistance	Deg C-cili/watt
GF2	Geometric factor for 3/c cable applying to institution resistance	
Grd OD	Overall outer diameter of ground cables at position	Inches
Grd Qty	Quantity of ground cables at position (needed only for conduit fill calculations)	inches
Grd Size		
Grd Type	Size of ground cables at position	_
Identifier	Whether ground cables are insulated or bare	
Ins RHO	Cable position identifier assigned by user	De- 0 (
The state of the s	Thermal resistivity of insulation	Deg C-cm/watt
Insulation Thickness	Cable insulation thickness	Inches
lpf	Insulation power factor, overall lpf = lpf x e^(lpf Exp x Temp)	
Ipf Exp	Insulation power factor exponent, overall lpf = lpf x e^(lpf Exp x Temp)	
Jac RHO	Cable jacket thermal resistivity	Deg C-cm/watt
Jacket Thickness	Cable jacket thickness	Inches
Jam Ratio	Ratio of duct ID to cable OD, to be OK for 3 cables must be < 2.8 or > 3.2	
kcmil	Conductor area	Thou. circ mils
kp	Conductor proximity effect factor	
ks	Conductor skin effect factor	
kV	Rated cable line-to-line kilovolts	kilovolts
kVA	Circuit three phase load flow kilovoltamperes for all cables at position	kVA
kVAR	Circuit three phase load flow kilovars for all cables at position	kVAR
kVAR Loss	Total Circuit three phase kilovars losses for all cables at position	kVAR
kW	Circuit three phase load flow kilowatt for all cables at position	kW
kW Loss	Total Circuit three phase kilowatt losses for all cables at position	kW
Length	Circuit length, (one-way distance for dc as well as ac)	Feet
LF%	Load factor	%
Lib Volume	Cable Library data volume tag	
LOG10(Fd)	Log (base 10) of distance product factor	
Loss Fac	Loss factor	
Neut OD	Overall outer diameter of neutral cables at position	Inches

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AmpCalc - Cable Ampacity Calculations for Underground & Aerial Installations

Version 4.00, Rev 16 (c) Copyright 1986-2011 Calcware Company Katy, Texas

Program Serial Number: 203400552

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Filename: 0

Variable Label	Description	Units
Neut Qty	Quantity of neutral cables at position (needed only for conduit fill calculations)	
Neut Size	Size of neutral cables at position	
No.	Cable position number not including inactive positions	
Nom. Size	Nominal duct size	Inches
Number of cable positions in system	Number of active cable positions in system calculation	
PF %	Load Power Factor, (for voltage drop calcs)	1%
Ph OD	Overall outer diameter of phase cables at position	Inches
Ph Qty	Quantity of phase cables at position	III.GA.GA
Ph Size	Size of phase cables at position	
Qp	Loss ratio = Losses in (Conductor + Shield + Duct) / Conductor	
Qs	Loss ratio = Losses in (Conductor + Shield) / Conductor	
Qty-Type	Quantity and type (1/c or 3/c) of cables at position	
Rac	Conductor ac resistance at conductor specified or rated temperature	microhms/foot
Rated kV	Cable line-to-line kilovolt rating	kilovolts
Rcap	Overall thermal resistance between conductor & ambient	Thermal ohm-ft
Rd	Duct thermal resistance	Thermal ohm-ft
Rdc	Conductor do resistance at conductor specified or rated temperature	microhms/foot
Reactance	Conductor ac reactance used for voltage drop calcs	ohms/1000 feet
Rep	Thermal resistance at interface zone between cable or conduit surface & ambient air	Thermal ohm-ft
Resistance	Conductor ac resistance used for voltage drop calcs	ohms/1000 feet
Ri	Insulation thermal resistance	Thermal ohm-ft
Rj	Cable Jacket thermal resistance	Thermal ohm-ft
Rsd	Thermal resistance between cable exterior and duct interior	Thermal ohm-ft
Shield	Cable shielded? Yes or No	Thermal offin-te
Shield	Shield grounding, No shield, Shield w/1 end grd or Shield w/2 end grd	+
Shield Dia	Shield mean diameter	Inches
Shield Rdc	Shield dc resistance	microhms/foot
Shield Th	Shield thickness	Inches
Shid X	Mutual reactance conductor to shield	Microhms/foot
SIC	Insulation Specific Inductive capacitance (SIC), SIC = SIC x e^(SIC exp x Temp)	WIIGIOTHTIS/100t
SIC Exp	Insulation SIC exponent, overall SIC = SIC x e^(SIC exp Temp)	
Size	Cable size designation	+
Spacing	Spacing between conductors in the same phase group	Inches
Specified Amps	Specified conductor current	Amperes
Specified Temp	Specified conductor temperature	Deg C
Sys Freq	Applied power frequency in cable	Hertz
Sys kV	Applied cable line-to-line kilovolts	kilovolts
System	Number of system (assigned in order entered)	KIIOVOILS
Temp	Calculated or specified total conductor temperature	DonC
Thermal Factor	Factor specifying relative heating at each cable position	Deg C
	Type of underground system, ductbank or direct buried	
Type of underground system Underground system filename	Path and *.ugs filename where underground system data stored	
Voltage Mag	Source or load voltage magnitude in load flow calcs	17-14-
		Volts
Voltage Deg	Source or load voltage phase angle in load flow calcs	Degrees
Volt Drop (+%) or Rise (-%)	Voltage drop or rise across circuit length, = 100 x (Vsource-Vload) / Vsource	%
Watts/ft	Total cable watts loss per foot	Watts/foot
Wd	Cable dielectric loss	Watts/foot
x Coord	Position x coordinate	Inches
y Coord	Position y coordinate	Inches
Yc	Increment of Rac/Rdc ratio due to conductor effects = Ycs+Ycp	

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Filename: 0

Variable Label	Description	Units
Ycp	Increment of Rac/Rdc ratio due to conductor proximity effect	
Ycs	Increment of Rac/Rdc ratio due to conductor skin effect	
Yp	Increment of Rac/Rdc ratio due to pipe or conduit losses	
Ys	Increment of Rac/Rdc ratio due to total shield losses = Ysc + Yse	
Ysc	Increment of Rac/Rdc ratio due to circulating currents in shield	10
Yse	Increment of Rac/Rdc ratio due to eddy currents in the shield	



APPENDIX E: ONE-LINE/RISER DIAGRAMS

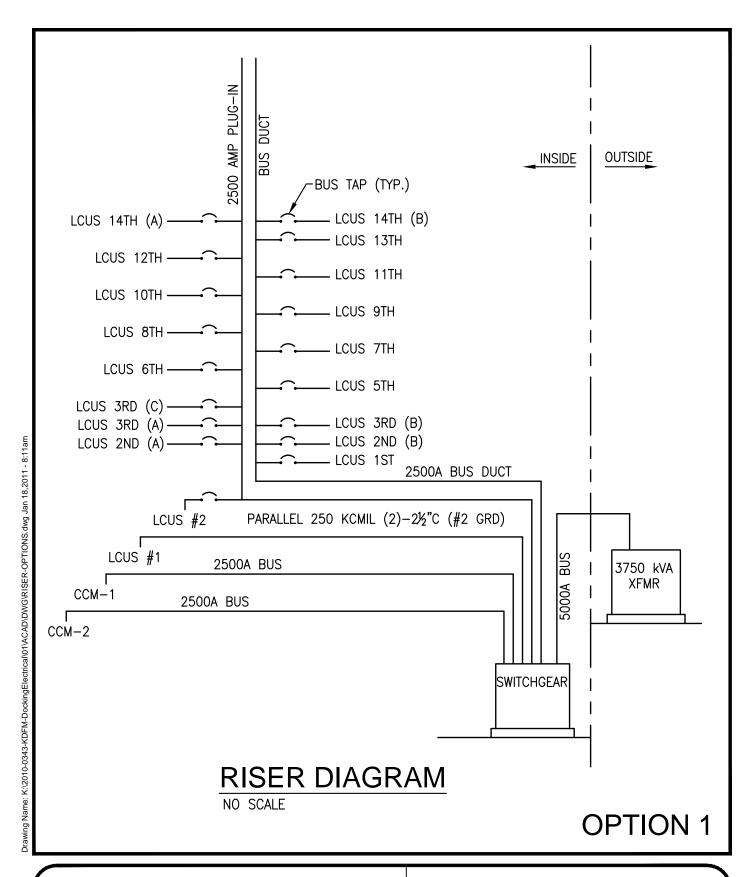
(1) RISER UP BLDG TO FEED 300 kVA XFMR, 480A-208Y POWER STATIONS.

PROPOSED LINE-UP (MAIN-TIE-MAIN)

NO SCALE

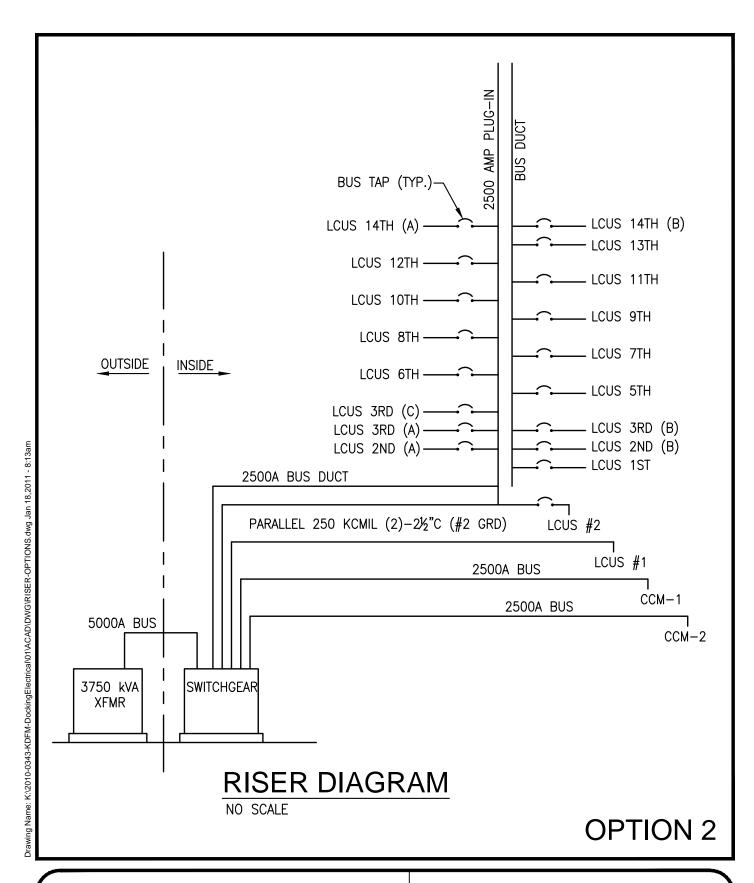
LOCHNER BWR Division

2335 E. Crawford Street | Salina, Kansas 67401-3713 P 785.827.3603 | F 785.827.3029



LOCHNER

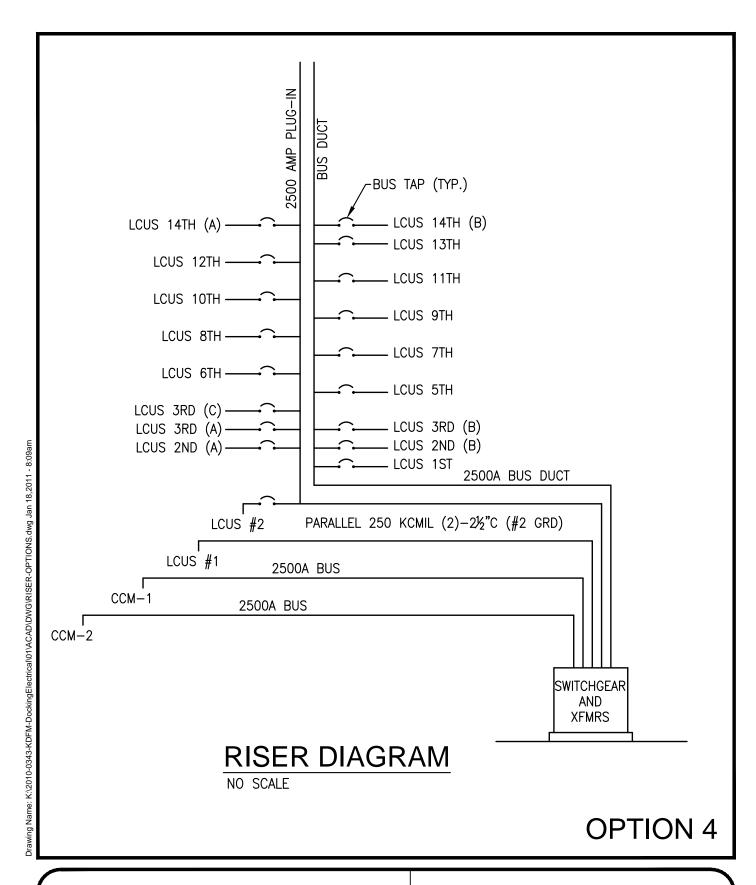
2335 E. Crawford Street | Salina, Kansas 67401-3713 P 785.827.3603 | F 785.827.3029



LOCHNER

BWR Division

2335 E. Crawford Street | Salina, Kansas 67401-3713 P 785.827.3603 | F 785.827.3029

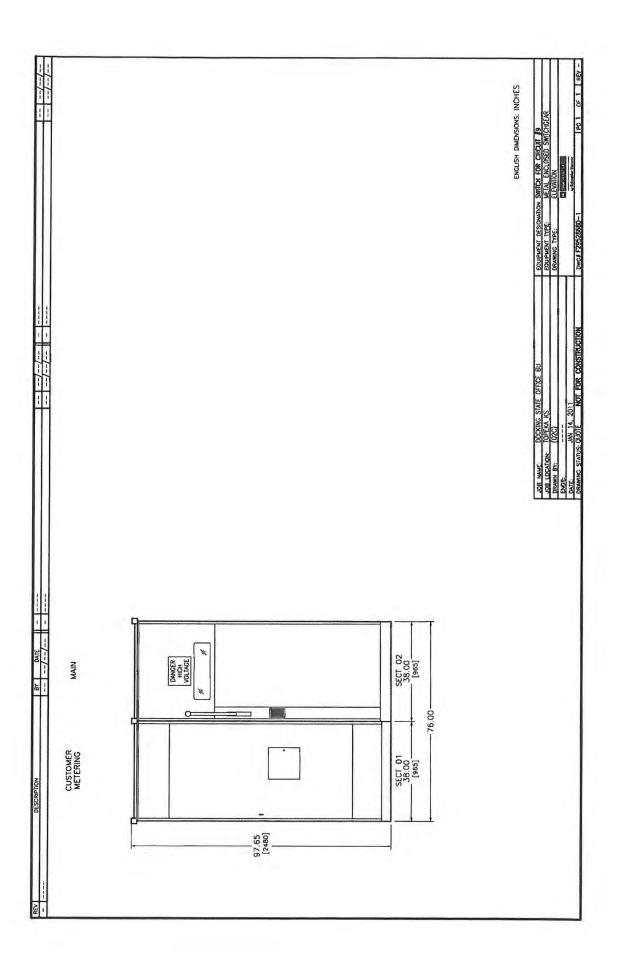


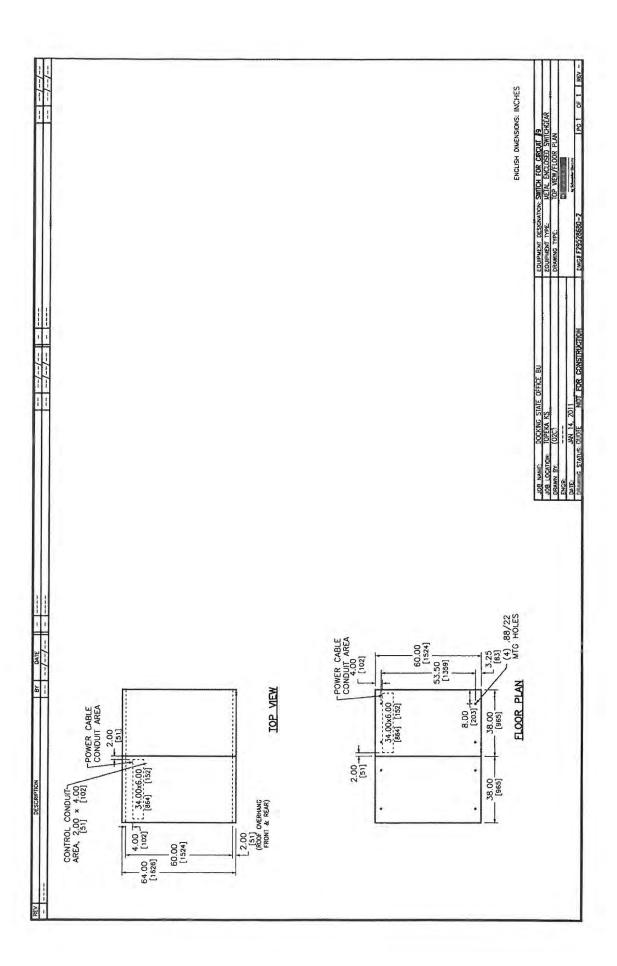
BWR Division

2335 E. Crawford Street | Salina, Kansas 67401-3713 P 785.827.3603 | F 785.827.3029

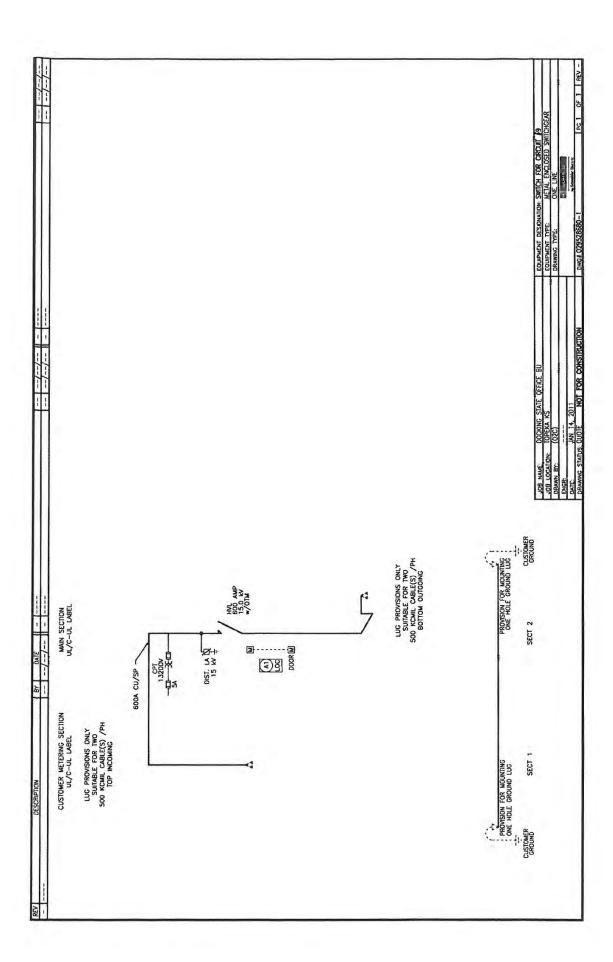


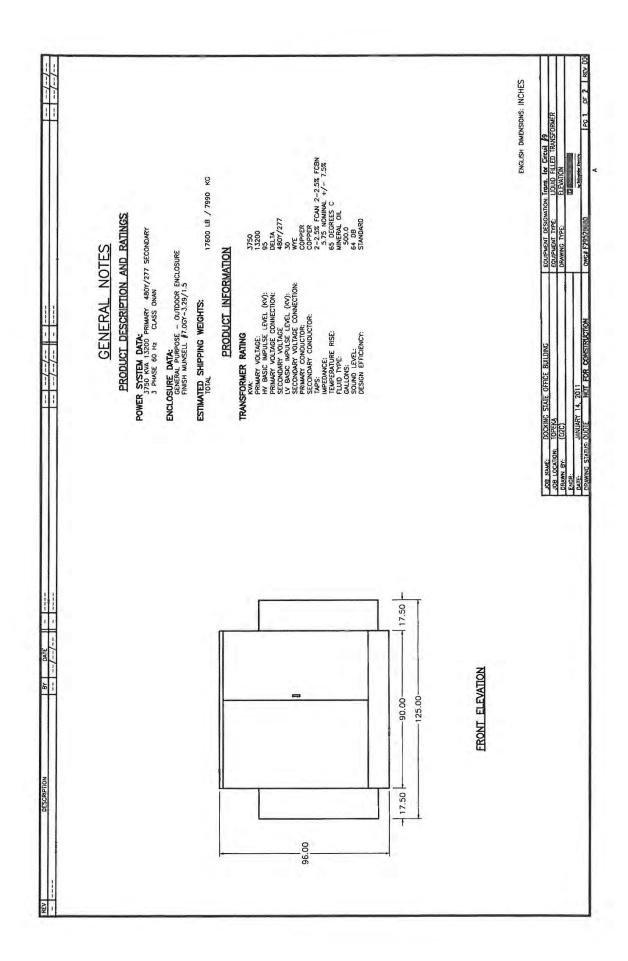
APPENDIX F: OPTION 1 - TRANSFORMER AND SWITCHGEAR SHOP DRAWINGS

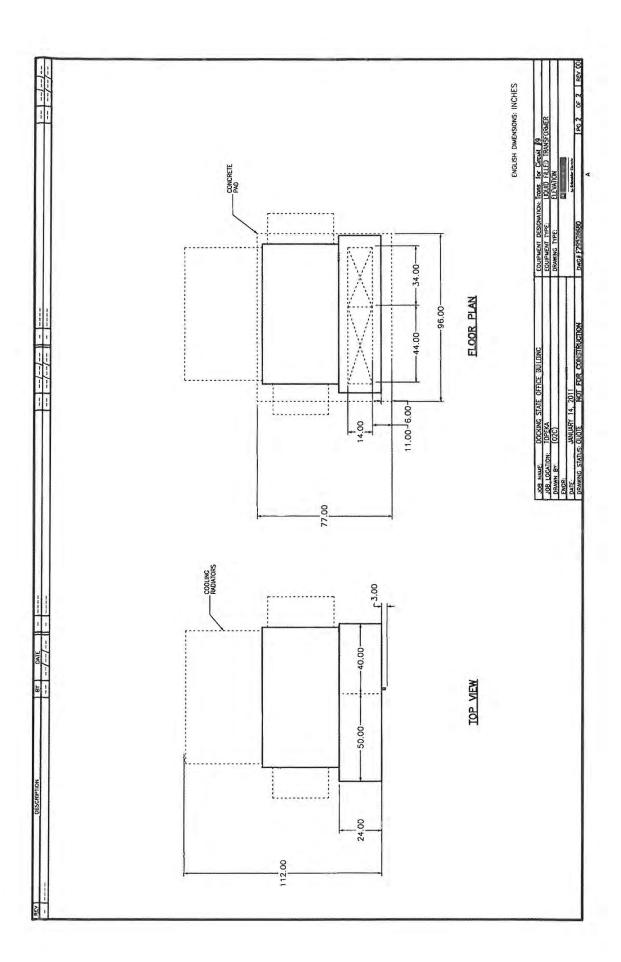


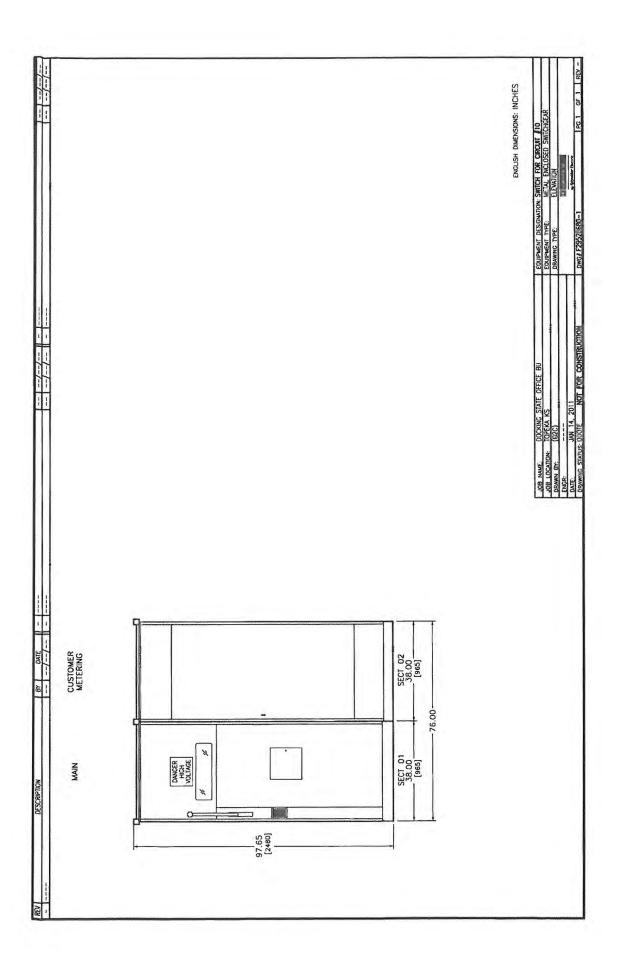


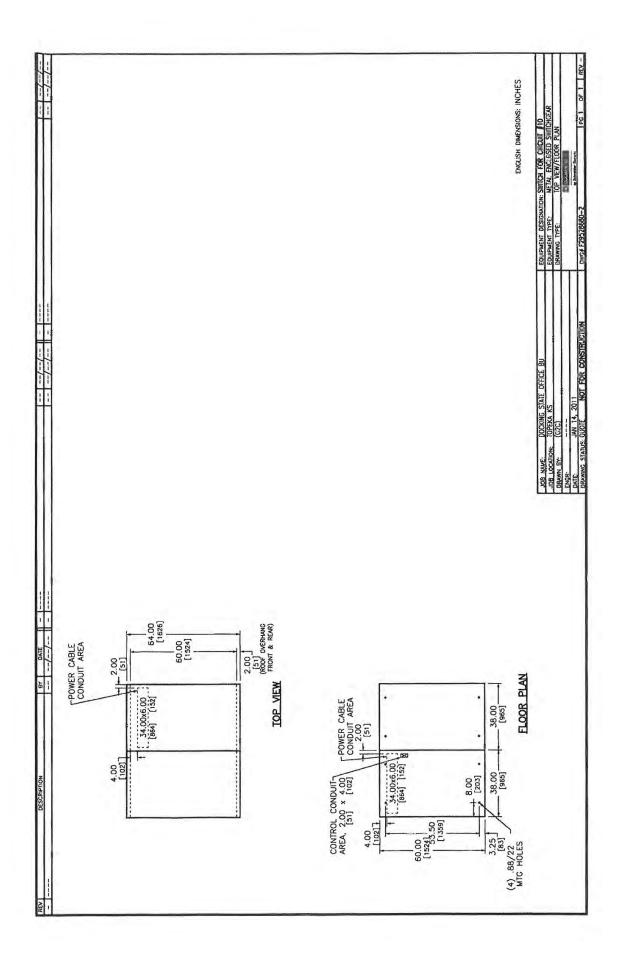
IN CARROLL AREA SHOWN ON 10° MEW, IN APPLICABLE. BUTTON AREA, 6" A ST SHOWN ON 10° MEW, IN APPLICABLE. G" X 34" (122 X 864) AS SHOWN ON 10° MEW. BOTTON CABLE ENTIR: 80TO AS REC OPEN RECOMMENDED POWER CABLE ENTRY AREA, G" X 34" (122 X 864) AS SHOWN ON 10° MEW. SWITCHCEAR SECTIONS ARE PURNISHED WITH LUTING ANGLES AND ARE SHIPPED ON SKIOS. ROUGHES STANDARD. THE CONTROL WITHOUT STATE IS 10.78 KG CONTROL WENCE. 1272 LBS 10.78 KG CONTROL WITHOUT STATE ON 10° MEW. FIRST AND THE STANDARD. GATE AND THE STANDARD. FIRST AND THE STANDARD WITHOUT OR THE UNITED STATES. RODUCT INFORMATION. FIRST AND THE STANDARD WITHOUT OR THE UNITED STATES. CONTROL WITHOUT STANDARD WITHOUT WITHOUT WITHOUT OFFICIAL DESTINATION WARRING (ORIGIN –DESTINATION). TERMINATOR OFFI ELUGS (STATE 23009—XXXXX). TERMINAL		BLOCKS ARE SOUARE D COMPRESSION SOLDERLESS BOX LUG (TYPE 9080GR6), FUSE BLOCK (9080GF6). INSTRUCTION BULLETIN: OPTIONS/ACCESSORIES: LIST OF MISG. CENERAL OPTIONS: LIST OF MISG. CENERAL OPTIONS:	LUG (TYPE 9080GR6),
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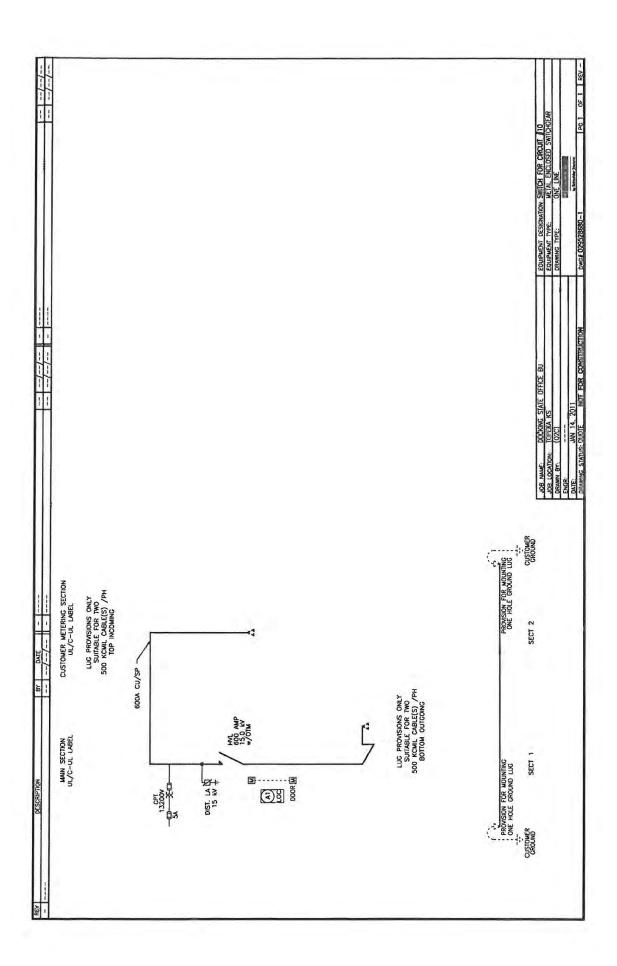


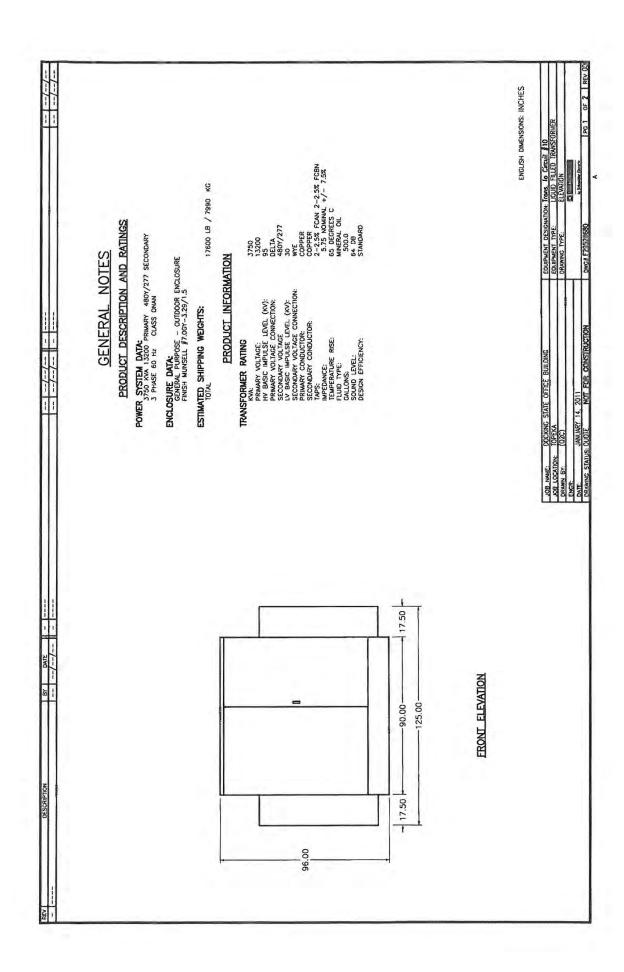


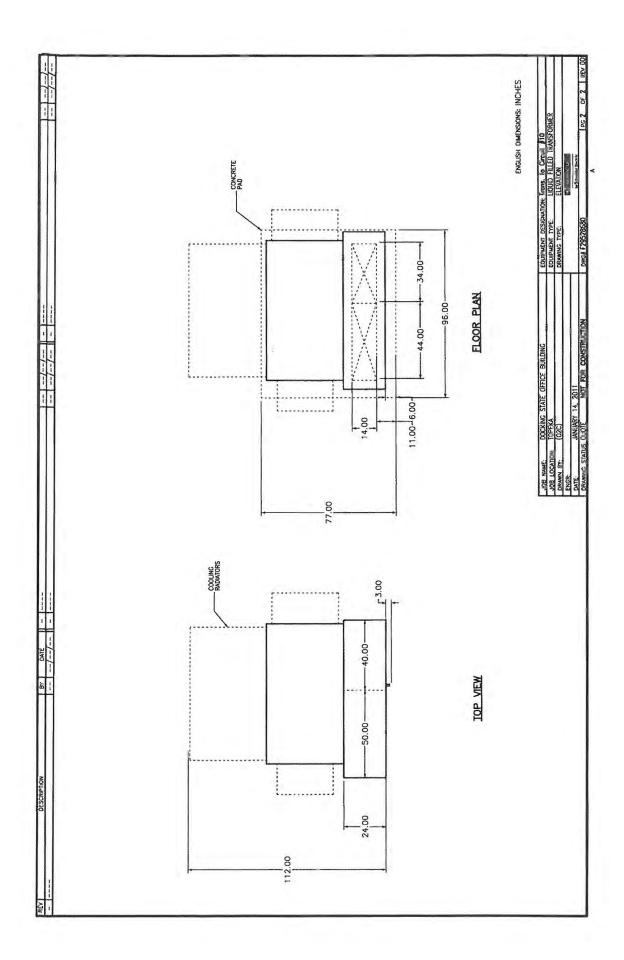


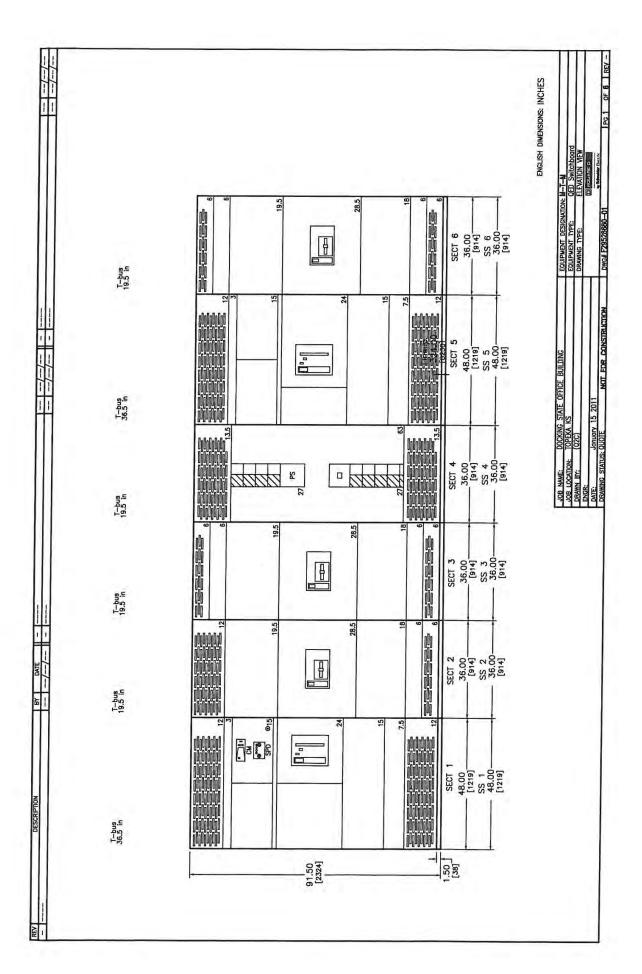


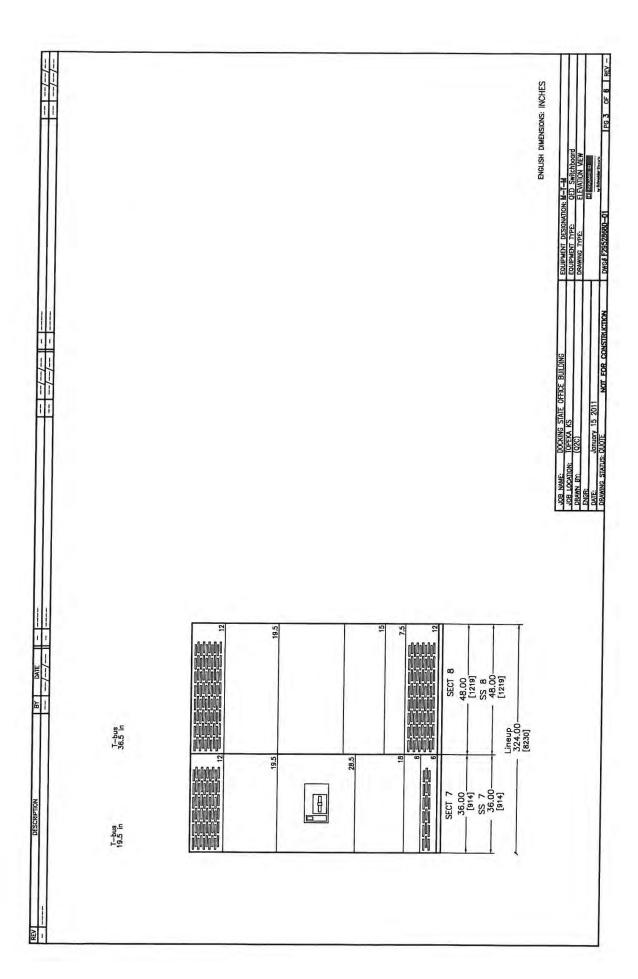
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 | THIS EQUIPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. SOUTED, WIRNA, CONTROL WIRNA, #14 AWG, TYPE SIS CONTROL WIRNA, #12 AWG, TYPE SIS CONTROL WIRNA #12 AWG, TYPE SIS HATER CONTROL WIRNA #12 AWG, TYPE SIS HATER CONTROL WIRNA WIRE SHALL BE LABELED TERMINATONAS. | THIS EQUIPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. SCATROL WIRING. #14 ANG. TYPE SIS CONTROL WIRING. UNLESS OTHERWISE SPECIFIED #12 ANG. TYPE SIS CONTROL WIRING. #18 ANG. TYPE SIS CONTROL WIRING. WIRE SHAELING. WIRES SHAELING. WIRES SHAELING. TERMINATONAS. | THIS EQUIPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. RODUCT INFORMATION: CONTROL WIRING. # 14 AWG. TYPE SIS CONTROL WIRING. # 12 AWG. TYPE SIS CONTROL WIRING. # 12 AWG. TYPE SIS CONTROL WIRING. # 15 AWG. TYPE SIS HALLER CONTROL WIRING. # 16 AWG. TYPE SIS HALLER WIRES SHALL BE LAGELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). * TRAINANTANAS. | THIS COUPLENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. SOOLICT INFORMATION: CONTROL WIRING, UNLESS OTHERWISE SPECIFIED #12 ANG, TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED WIRE LABELING. WIRING LABELING. WIRING LABELING. WIRING LABELING. WIRING LABELING. | THIS EQUIPMENT BEARS THE UL USTING MARK FOR THE UNITED STATES. THIS EQUIPMENT BEARS THE UL USTING MARK FOR THE UNITED STATES. CONTROL WRING. # 14 ANG, TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED # 12 ANG, TYPE SIS CONTROL WIRING WIRE LABELING. WIREL LABELING. WIREL LABELING. WIREL LABELING.
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 | THIS EQUIPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. SCATICAL WIRMS. 414 ANG, THE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED # 12 ANG, THE SIS HEATER CONTROL WIRING WIRE LABELING. WIRE SHALL BE LABELING. | THIS EQUIPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. SCATICAL WIRMS. 414 ANG, TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED # 12 ANG, TYPE SIS CONTROL WIRING WIRE LABERIA. WRES SHALL BE LABERIA. | THIS EQUIPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. SRODUCT INFORMATION: CONTROL WIRING. #14 ANG. THE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED #12 ANG. THE SIS CONTROL WIRING #18 ANG. THE SIS CONTROL WIRING #18 ELABELING. WIRE LABELING. WIRES SHALL BE LABELED WITH DESTINATION J. | THIS FOURMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. SONTROL WEING. \$\frac{\pmathra{1}}{2} \text{1.4 ANG, TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED \$\frac{\pmathra{1}}{2} 2 ANG, TYPE SIS CONTROL WIRING WIRE LABELING. WIRE SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN-DESTINATION). | THIS EQUIPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. SCONTROL WIRHING. JI A ANG. TYPE SIS CONTROL WIRHING, UNLESS OTHERWISE SPECIFIED JI 2 ANG. TYPE SIS
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 | THIS EQUIPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. RODUCT INFORMATION: CONTROL WIRING: # 14 AWG, TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED # 12 AWG, TYPE SIS HEATER CONTROL WIRING WIRE LABELING: | THIS COUNTENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. RODUCT INFORMATION: CONTROL WIRING. #14 AWG, TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED #12 AWG, TYPE SIS HEATER CONTROL WIRING. WIRE LABELING. | THIS EQUIPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. CONTROL WIRING. #14 AWG. TYPE SIS CONTROL WIRING. UNIVESS OTHERWISE SPECIFIED. #12 AWG. TYPE SIS HEATER CONTROL WIRING. WIRE LABELING. | THIS EQUIPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. CONTROL WIRING. #14 AWG. TYPE SIS CONTROL WIRING. UNIVESS OTHERWISE SPECIFIED #12 AWG. TYPE SIS HEATER CONTROL WIRING. WIRE LABELING. | THIS EQUIPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. SOUTOL INFORMATION: CANTROL WIRING. # 14 AWG. TYPE SIS CONTROL WIRING. UNLESS OTHERWISE SPECIFIED # 12 AWG. TYPE SIS CONTROL WIRING. WIRE LABELING.
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UNITED STATES. SOUTOL INFORMATION: CANTROL WIRING. # 14 AWG. TYPE SIS CONTROL WIRING. UNLESS OTHERWISE SPECIFIED # 12 AWG. TYPE SIS CONTROL WIRING. WIRE LABELING. |
| MIRES SPALL BE USECLED WITH DESTINATION MARGINE, CONDUCTORS OF THE STATE OF THE PROPERTY (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUCS (STYLE 25009—XXXXX). TERMINAL | MAL. DOCKWIS STATE OFFICE BU | NAL. DOCKING STATE OFFICE BU | NAL. DOCKAS STATE OFFICE BU | NAL. MOTOR CTATE OFFICE BIT | NAL. | NAL. | MIRES SPALL BE LYGELED WITH DESTINATION MAKENING (SMILL BE) LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUCS (SPLIE 25009—XXXXX). TERMINAL
 | MIRES SPALL BE USECLED WITH DESTINATION MARKING (WINDING CONTINUAL). IEMINATIONS: LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009-XXXXX). TERMINAL. | MIRES STRAIL BE LOCKELD WITH DESTINATION MARKING (STRUCT CLEAR FOR ALL BE UNINSULATED RING TYPE LUCS (STYLE 25009—XXXXX). TERMINAL | MIRES SPACE BE USCLED WITH DESIDATION MAKENING (STRUCTURE) SHALL BE LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | WIRES SPALL BE USCLED WITH DESTINATION MARKING (SMISHINATION) WARNING (SMISHINATIONS) WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUCS (STYLE 25009—XXXXX). TERMINAL | SCATROL WIRING. CONTROL WIRING. #14 ANG. TYPE SIS CONTROL WIRING. UNLESS OTHERWISE SPECIFIED #12 ANG. TYPE SIS HEATER CONTROL WIRING WIRE LABELING.
 | NIROL WIRNG, UNLESS OTHERWISE SPECI
STER CONTROL WIRNG | S ITE OL LISHING MARKS FOR THE UNITED SHIELD SHIELD SHIELD WIRING. UNITENG | S THE UL LISTING MARK FOR THE UNITED THE UL LISTING MARK FOR THE UNITED TATEL WIRING, UNLESS OTHERWISE SPECI- CATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED MIROL WIRING, UNLESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRING, UNLESS OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED THE ULL LISTING MARK FOR THE UNITED SPECIFIES OTHERWISE SPECIFIER CONTROL WIRING
 | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNO, UNITESS OTHERWISE SPECIATER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED WITCOL WIRING, UNLESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED MITCOL WIRING, UNLESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED STREET OF LISTING WIRING SPECIFIER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRDL WIRNG, UNLESS OTHERWISE SPECIATER CONTROL WIRING
 | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIATIER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIATER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED MIRIOL WIRNOL UNIESS OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED MIROL WIRNG, UNLESS OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED MIROL WIRNG, UNLESS OTHERWISE SPECI-
 | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIATER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIATER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIATER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIATER CONTROL WIRNG
 | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIATER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIATER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIATER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIATER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIATER CONTROL WIRNG
 | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIFIER CONTROL WIRING | 5 THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIFIER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED MIRIOL WIRNOL UNIESS OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED MIRIOL WIRNOL UNIESS OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED MIROL WIRNG, UNLESS OTHERWISE SPECI-
 | S THE UL LISTING MARK FOR THE UNITED THE ULL LISTING MARK FOR THE UNITED STER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED THE ULL LISTING MARK FOR THE UNITED STER CONTROL WIRING | 5 THE UL LISTING MARK FOR THE UNITED THE UNITED WIRDL WIRNG, UNLESS OTHERWISE SPECIFIER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRDL WIRNG, UNLESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED STREET OF LISTING WIRING SPECIFIER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED STREET OF LISTING WIRING SPECIFIER CONTROL WIRING
 | S THE UL LISTING MARK FOR THE UNITED MARKOL WIRING, UNLESS OTHERWISE SPECIATIER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED MITCOL WIRING, UNLESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED WITCOL WIRING, UNLESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED WITCOL WIRING, UNLESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED MIROL WIRING, UNIESS OTHERWISE SPECIATER CONTROL WIRING
 | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL, UNITESS OTHERWISE SPECIATER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL, UNLESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIATER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL, UNLESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL, UNITESS OTHERWISE SPECIATER CONTROL WIRNG
 | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNO, UNITESS OTHERWISE SPECIATER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNO, UNITESS OTHERWISE SPECIATER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNO, UNITESS OTHERWISE SPECIATER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED MIROL WIRING, UNIESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED MIROL WIRING,
UNIESS OTHERWISE SPECIATER CONTROL WIRING |
| WIRES SHALL BE LABELED WITH DESTINATION JASRUNG (ORIGIN—DESTINATION). TERMINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | ESTINATION). NAL. DOCKING STATE OFFICE BU | ESTINATION). NAL. DOCKING STATE OFFICE BU | ESTINATION). NAL. TORR MANE: DOCKING STATE OFFICE BU | NAL NOTINE STATE OFFICE BIT | ESTINATION).
NAL | ESTINATION). NAL. | WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). IEBUINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUCS (STYLE 25009—XXXXX). TERMINAL
 | WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). IERUINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL. | WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). IEMINATIONS: LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL | WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). IEMINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUCS (STYLE 25009—XXXXXX). TERMINAL | WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). IERMINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | SOUT INFORMATION: CONTROL WIRING. WIRING #14 ANG. TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED #12 ANG. TYPE SIS HEATER CONTROL WIRING WIRE LABELING.
 | NATROL WIRING, UNLESS OTHERWISE SPECI
SATER CONTROL WIRING | NITE OF LESSING MARKS FOR THE DIVILED SATERY OF LESSING OF LESS OF LERWISE SPECIAL WIRING | S THE UL LISTING MARK FOR THE UNITED STREET OF THE UNITED WIRNO, UNLESS OTHERWISE SPECIALRE CONTROL WIRNO. | S THE UL LISTING MARK FOR THE UNITED NIROL WIRING, UNLESS OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED STATED WIRING, UNLESS OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED STATES OF THE UNITED STATES OTHERWISE SPECIAL STER CONTROL WIRING
 | S THE UL LISTING MARK FOR THE UNITED STATES OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED STATES OF THE WIRD STATES OTHERWISE SPECIALIFIER CONTROL WIRING | S THE UL USTING MARK FOR THE UNITED STATEMENT OF THE UNITED WIRNG, UNLESS OTHERWISE SPECIALIFIC CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED STATES OF THE UNITED WIRNG, UNLESS OTHERWISE SPECIALRE CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED WIRDL WIRNG, UNLESS OTHERWISE SPECI-
 | S THE UL LISTING MARK FOR THE UNITED MIROL WIRING, UNLESS OTHERWISE SPECI | S THE UL LISTING MARK FOR THE UNITED STATES OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED STRONG THE UNITED WIRNG, UNLESS OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED STRONG THE UNITED WIRNG, UNLESS OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED STRONG THE UNITED WIRNG, UNLESS OTHERWISE SPECI-
 | S THE UL LISTING MARK FOR THE UNITED STATES OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED STATES OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED STATES OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED STATES OTHERWISE SPECI-
 | S THE UL LISTING MARK FOR THE UNITED STATES OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED STATES OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED STATES OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED STATES OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED STATES OTHERWISE SPECI-
 | S THE UL LISTING MARK FOR THE UNITED STATES OF THE UNITED WIRING, UNLESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED STRONG THE UNITED WIRNG, UNLESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED STRONG THE UNITED WIRNG, UNLESS OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED STRONG THE UNITED WIRNG, UNLESS OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED STRONG THE UNITED WIRNG, UNLESS OTHERWISE SPECI-
 | S THE UL LISTING MARK FOR THE UNITED STREAM LINES OTHERWISE SPECI
DATER COMTROL WIRING | S THE UL LISTING MARK FOR THE UNITED STREET OTHERWISE SPECIETER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED STATES OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED WIRDL WIRNG, UNLESS OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNG, UNLESS OTHERWISE SPECIETER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED STATEMENT OF THE WIRDS. WIRNG, UNLESS OTHERWISE SPECIALIFIER CONTROL WIRING.
 | 5 THE UL USTING MARK FOR THE UNITED STATEMENT OF THE UNITED WIRNG, UNLESS OTHERWISE SPECIALIFIC CONTROL WIRNG | S THE UL USTING MARK FOR THE UNITED STATEMENT OF THE UNITED WIRNG, UNLESS OTHERWISE SPECIALIFIC CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED STATEMENT OF THE WIRDS. WIRING SPECIFIER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED STATEMENT OF THE WIRDS. WIRING SPECIFIER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED STATES OF THE UNITED WIRING, UNLESS OTHERWISE SPECIATER CONTROL WIRING
 | S THE UL LISTING MARK FOR THE UNITED MIROL WIRNG, UNLESS OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED MITTOL WIRING, UNLESS OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED MITOL WIRING, UNLESS OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED MIROL WIRING, UNLESS OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED MIROL WIRNG, UNLESS OTHERWISE SPECI-
 | S THE UL LISTING MARK FOR THE UNITED STATES OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED STATES OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED STATES OTHERWISE SPECI- | S THE UL LISTING MARK FOR THE UNITED STATEMENT OF THE WIRING UNLESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED STATES OF THE
UNITED WIRING, UNLESS OTHERWISE SPECIATER CONTROL WIRING |
| WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). TERMINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | NAL. DOCKWIG STATE OFFICE BU | NAL. DOCKING STATE OFFICE BU | NAL. DOCKAG STATE OFFICE BU | WAL. NOTING STATE OFFICE BI | ESTINATION). | ESTINATION). | WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). IERMINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TIPE LUCS (STYLE 25009—XXXXX). TERMINAL
 | WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). IEMINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL. | WRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). IEBAINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REDUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL | WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). TERMINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN-DESTINATION). IERAINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | SCOUCT INFORMATION: CONTROL WIRING. #14 AWG. TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED #12 AWG. TYPE SIS HEATER CONTROL WIRING
 | NIROL WIRNG, UNLESS OTHERWISE SPECI
EXTER CONTROL WIRNG | ONTROL WIRING, UNLESS OTHERWISE SPECI | S THE UL LISTING MARK FOR THE UNITED THE UNITED DATEOL WIRING, UNLESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED MIROL WIRING, UNLESS OTHERWISE SPECI- CATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIALIER CONTROL WIRING
 | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIALISE CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED DATE OF THE UNITED STATE OF THE WIRING, UNITESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED STATEMENT OF THE WIRING, UNLESS OTHERWISE SPECIAL WIRING | S THE UL LISTING MARK FOR THE UNITED STREET OF LISTING WIRING, UNLESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED STREET OF LISTING WARK FOR THE SWIEL SPECIAL WIRING. UNLESS OTHERWISE SPECIALER CONTROL WIRING
 | S THE UL LISTING MARK FOR THE UNITED MIROL WIRNG, UNLESS OTHERWISE SPECI | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIALIFIER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRD. WIRNG, UNLESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRD. WIRNG, UNLESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRD. WIRNG, UNLESS OTHERWISE SPECIATER CONTROL WIRING
 | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIALIFIER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIALIFIER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIALIFIER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIALIFIER CONTROL WIRNG
 | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIALIFIER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIALIFIER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIALIFIER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIALIFIER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIALIFIER CONTROL WIRNG
 | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRDOL WIRNG, UNLESS OTHERWISE SPECIALIFIER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRD. WIRNG, UNLESS OTHERWISE SPECIAL SATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRD. WIRNG, UNLESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRD. WIRNG, UNLESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRD. WIRNG, UNLESS OTHERWISE SPECIATER CONTROL WIRING
 | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRD. UNLESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRD. UNLESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRD. UNLESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED STREET OF LISTING WARK FOR THE SWIEL SPECIAL WIRING. UNLESS OTHERWISE SPECIALER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED STREET OF LISTING WARK FOR THERWISE SPECIAL WIRING, UNLESS OTHERWISE SPECIALER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED STATEMENT OF LINESS OTHERWISE SPECIAL WIRING, UNLESS OTHERWISE SPECIALER CONTROL WIRING
 | S THE UL LISTING MARK FOR THE UNITED STATEMENT OF THE UNITED SATER CONTROL WIRING. | S THE UL LISTING MARK FOR THE UNITED STATEMENT OF THE WIRING, UNLESS OTHERWISE SPECIAL WIRING | S THE UL LISTING MARK FOR THE UNITED PARTIES OFFERMISE SPECIAL WIRING, UNLESS OTHERWISE SPECIAL SATER CONIROL WIRING | S THE UL LISTING MARK FOR THE UNITED PARTIES OFFERMISE SPECIAL WIRING, UNLESS OTHERWISE SPECIAL SATER CONIROL WIRING | S THE UL LISTING MARK FOR THE UNITED STATEMENT ON TROL WIRING, UNLESS OTHERWISE SPECIATER CONTROL WIRING
 | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIALIFIER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIALIFIER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIALIFIER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIALIFIER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIALIFIER CONTROL WIRNG
 | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIALISE CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIALISE CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIALISE CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED MIROL WIRNG, UNLESS OTHERWISE SPECIATER CONTROL WIRNG | S THE UL LISTING MARK FOR THE UNITED STATEMENT ON TROL
WIRING, UNLESS OTHERWISE SPECIATER CONTROL WIRING |
| WRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). IERUINATONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REDURED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | ESTINATION). NAL. LOB MANE: DOCKMG STATE OFFICE BU | ESTINATION). NAL. JOB JAME: DOCKING STATE OFFICE BU | ESTINATION). NAL. TORNAME: DOCKING STATE OFFICE BU | ESTINATION). NAL | ESTINATION). | ESTINATION). NAL | WRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN-DESTINATION). IEMUNATIONS LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL
 | WRES SHALL BE LABELED WITH DESTINATION WARKING (ORIGIN—DESTINATION). IEBUINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | WRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). TERUNATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUCS (STYLE 25009—XXXXX). TERMINAL | WRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN-DESTINATION). IEMINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL | WRES SHALL BE LABELED WITH DESTINATION WARKING (ORIGIN—DESTINATION). IEMINATIONS. LOW VOLIAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | RODUCT INFORMATION: CONTROL WIRING, WIRING, UNLESS OTHERWISE SPECIFIED #14 ANG, TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED #12 ANG, TYPE SIS HEAFER CONTROL WIRING
 | DATROL WIRING, UNLESS OTHERWISE SPECI
SATER CONTROL, WIRING | S THE OL LISTING MARKS FOR THE UNITED STATES OF THE CONTED. SATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED STATES THE UNITED WIRNOL WIRNG. UNLESS OTHERWISE SPECIALISES CONTROL WIRNG. | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIFIER CONTROL, WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRNOL WIRNG, UNLESS OTHERWISE SPECIFIER CONTROL, WIRNG | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRDL WIRNG, UNLESS OTHERWISE SPECIATER CONTROL, WIRNG
 | S THE UL LISTING MARK FOR THE UNITED JAIROL WIRING, UNLESS OTHERWISE SPECIATION, WIRING | S THE UL LISTING MARK FOR THE UNITED JAIROL WIRING, UNLESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED JAIROL WIRING, UNLESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED JATROL WIRING, UNLESS OTHERWISE SPECISMER CONTROL, WIRING. | 5 THE UL LISTING MARK FOR THE UNITED JATROL WIRING, UNLESS OTHERWISE SPECISMER CONTROL, WIRING.
 | S THE UL LISTING MARK FOR THE UNITED STATE OF THE UNITED PAIROL WIRING, UNLESS OTHERWISE SPECI SAIER CONTROL, WIRING | S THE UL LISTING MARK FOR THE UNITED STATE OF THE UNITED DATROL WIRING, UNLESS OTHERWISE SPECIFIER CONTROL, WIRING | S THE UL LISTING MARK FOR THE UNITED STREET OF THE UNITED DATROL WIRING, UNLESS OTHERWISE SPECIFIER CONTROL, WIRING | 5 THE UL LISTING MARK FOR THE UNITED STREET OF THE UNITED DATROL WIRING, UNLESS OTHERWISE SPECIFIER CONTROL, WIRING | 5 THE UL LISTING MARK FOR THE UNITED STREET OF THE UNITED DATROL WIRING, UNLESS OTHERWISE SPECIFIER CONTROL, WIRING
 | S THE UL LISTING MARK FOR THE UNITED STATE OF THE UNITED DATROL WIRING, UNLESS OTHERWISE SPECIFIER CONTROL, WIRING | S THE UL LISTING MARK FOR THE UNITED STATE OF THE UNITED DATROL WIRING, UNLESS OTHERWISE SPECIFIER CONTROL, WIRING | S THE UL LISTING MARK FOR THE UNITED STATE OF THE UNITED DATROL WIRING, UNLESS OTHERWISE SPECIFIER CONTROL, WIRING | S THE UL LISTING MARK FOR THE UNITED STATE OF THE UNITED DATROL WIRING, UNLESS OTHERWISE SPECIFIER CONTROL, WIRING
 | S THE UL LISTING MARK FOR THE UNITED STATE OF THE UNITED DATROL WIRING, UNLESS OTHERWISE SPECIFIER CONTROL, WIRING | S THE UL LISTING MARK FOR THE UNITED STATE OF THE UNITED DATROL WIRING, UNLESS OTHERWISE SPECIFIER CONTROL, WIRING | S THE UL LISTING MARK FOR THE UNITED STATE OF THE UNITED DATROL WIRING, UNLESS OTHERWISE SPECIFIER CONTROL, WIRING | S THE UL LISTING MARK FOR THE UNITED STATE OF THE UNITED DATROL WIRING, UNLESS OTHERWISE SPECIFIER CONTROL, WIRING | S THE UL LISTING MARK FOR THE UNITED STATE OF THE UNITED DATROL WIRING, UNLESS OTHERWISE SPECIFIER CONTROL, WIRING
 | S THE UL LISTING MARK FOR THE UNITED STREET OF THE UNITED DATROL WIRING, UNLESS OTHERWISE SPECIFIER CONTROL, WIRING | 5 THE UL LISTING MARK FOR THE UNITED STREET OF THE UNITED DATROL WIRING, UNLESS OTHERWISE SPECIFIER CONTROL, WIRING | S THE UL LISTING MARK FOR THE UNITED STREET OF THE UNITED DATROL WIRING, UNLESS OTHERWISE SPECIFIER CONTROL, WIRING | S THE UL LISTING MARK FOR THE UNITED STREET OF THE UNITED DATROL WIRING, UNLESS OTHERWISE SPECIFIER CONTROL, WIRING | 5 THE UL LISTING MARK FOR THE UNITED STREET OF THE UNITED DATROL WIRING, UNLESS OTHERWISE SPECIFIER CONTROL, WIRING
 | S THE UL LISTING MARK FOR THE UNITED DATROL WIRING, UNLESS OTHERWISE SPECIFARE CONTROL, WIRING. | S THE UL LISTING MARK FOR THE UNITED DATROL WIRING, UNLESS OTHERWISE SPECIFIER CONTROL, WIRING. | S THE UL LISTING MARK FOR THE UNITED JATROL WIRING, UNLESS OTHERWISE SPECISMER CONTROL, WIRING. | 5 THE UL LISTING MARK FOR THE UNITED JATROL WIRING, UNLESS OTHERWISE SPECISMER CONTROL, WIRING. | S THE UL LISTING MARK FOR THE UNITED JATROL WIRING, UNLESS OTHERWISE SPECISMER CONTROL, WIRING. | S THE UL LISTING MARK FOR THE UNITED THE UNITED WIRDL WIRNG, UNLESS OTHERWISE SPECIATER CONTROL, WIRNG
 | S THE UL LISTING MARK FOR THE UNITED JAIROL WIRING, UNLESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED JAIROL WIRING, UNLESS OTHERWISE SPECIATER CONTROL WIRING | S THE UL LISTING MARK FOR THE UNITED JAIROL WIRING, UNLESS OTHERWISE SPECI SAIER CONTROL, WIRING | S THE UL LISTING MARK FOR THE UNITED JAIROL WIRING, UNLESS OTHERWISE SPECI SAIER CONTROL, WIRING | S THE UL LISTING MARK FOR THE UNITED JAIROL WIRING, UNLESS OTHERWISE SPECIATER CONTROL, WIRING
 | S THE UL LISTING MARK FOR THE UNITED JATROL WIRING, UNLESS OTHERWISE SPECIATER CONTROL, WIRING | S THE UL LISTING MARK FOR THE UNITED JATROL WIRING, UNLESS OTHERWISE SPECIATER CONTROL, WIRING | S THE UL LISTING MARK FOR THE UNITED STATE OF THE UNITED STATES OTHERWISE SPECIATER CONTROL, WIRING | S THE UL LISTING MARK FOR THE UNITED JATROL WIRING, UNLESS OTHERWISE SPECIATER CONTROL, WIRING | S THE UL LISTING MARK FOR THE UNITED JATROL WIRING, UNLESS OTHERWISE SPECIATER CONTROL, WIRING
 | S THE UL LISTING MARK FOR THE UNITED JAIROL WIRING, UNLESS OTHERWISE SPECIATION, WIRING | S THE UL LISTING MARK FOR THE UNITED JAIROL WIRING, UNLESS OTHERWISE SPECIATION, WIRING | S THE UL LISTING MARK FOR THE UNITED JAIROL WIRING, UNLESS OTHERWISE SPECIATION, WIRING | S THE UL LISTING MARK FOR THE UNITED JAIROL WIRING, UNLESS OTHERWISE SPECIATER CONTROL, WIRING | S THE UL LISTING MARK FOR THE UNITED JAIROL WIRING,
UNLESS OTHERWISE SPECIATER CONTROL, WIRING |
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| # 14 ANG, THE SIS HEATER CONTROL WRING WIRE LABELING WIRES SHALL BE LABELED WITH DESTINATION WARRING (ORIGIN-DESTINATION). TEMINATIONS: LOW VOLINGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING THPE LUGS (STYLE 25009-XXXXX). TERMINAL | ESTINATION). NAL. DOCKING STATE OFFICE BU | ESTINATION). NAL. LOB IMME: DOCKING STATE OFFICE BU | ESTINATION). NAL. TITRE MANE: DOCKING STATE OFFICE BU | ESTINATION). NAL. | ESTINATION). | ESTINATION). | # 17 ANG, THE SIS HEATER CONTROL WINNG WIRE LABELING. WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). TERMINATIONS (WHERE REQUIRED) SHALL BE LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL
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| # 14 AWG, TYPE SIS CONTROL WIRING. # 12 AWG, TYPE SIS HEATER CONTROL WIRING # 2 AWG, TYPE SIS HEATER CONTROL WIRING # 3 AWG, TYPE SIS HEATER CONTROL WIRING # 3 AWG, TYPE SIS HEATER CONTROL WIRING # 3 AWG, TYPE SIS HEATER CONTROL WARKING (ORIGIN-DESTINATION). ***IFFAINATIONS** ***LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE ***UNINSULATED RING TYPE LUGS (STYLE 25009-XXXXX). TERMINAL | ESTINATION). SAL. LOB MANE: DOCKWIG STATE OFFICE BU | ESTINATION). SAL. JOB JAME: DOCKING STATE OFFICE BU | TED ESTINATION). NAL TOR MANE: DOCKMG STATE OFFICE BU | SETIMATION). NAL. NOTING STATE OFFICE BIT | TED ESTINATION). | TED ESTINATION). | # 14 AWG, TYPE SIS CONTROL WIRING. # 12 AWG, TYPE SIS HEATER CONTROL WIRING # 2 AWG, TYPE SIS HEATER CONTROL WIRING # 3 AWG, TYPE SIS HEATER CONTROL WIRING # 3 AWG, TYPE SIS HEATER # 3 AWG, TYPE LUGS (STYLE 25009—XXXXX). TERMINAL UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL
 | # 14 AWG, TYPE SIS CONTROL WIRING. UNLESS OTHERWISE SPECIFIED # 12 AWG, TYPE SIS HEATER CONTROL WIRING WIREL JABLING. WIRES SHALL BE LABELED WITH DESTINATION LARKING (ORIGIN—DESTINATION). IEMINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL | # 14 AWG, TYPE SIS CONTROL WIRING. # 12 AWG, TYPE SIS HEATER CONTROL WIRING ## EACH ELABELING WIRES SHALL BE LABELED WITH DESTINATION WARKING (ORIGIN—DESTINATION). ## TEMINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUCS (STYLE 25009—XXXXXX). TERMINAL | # 14 AWG, TYPE SIS CONTROL WIRING. # 12 AWG, TYPE SIS HEATER CONTROL WIRING ## LEADING ## CONTROL WIRING ## CONTROL WIRING ## CONTROL WIRING ## CONTROL OF | # 14 AWG, TYPE SIS CONTROL WIRING. # 12 AWG, TYPE SIS HEATER CONTROL WIRING # 15 AWG, TYPE SIS HEATER CONTROL WIRING WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). IEMINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | RODUCT INFORMATION:
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 | S THE UL LISTING MARK FOR THE UNITED | S THE UL LISTING MARK FOR THE UNITED | 5 THE UL LISTING MARK FOR THE UNITED | S THE UL LUSTING MARK FOR THE UNITED | S THE UL LISTING MARK FOR THE UNITED
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| #14 AWG, TYPE SIS CONTROL WIRING. UNLESS OTHERWISE SPECIFIED #12 AWG, TYPE SIS HEATER CONTROL WIRING WIRE LABELING. WIRES SHALL BE LABELED WITH DESTINATION JARKING (ORIGIN—DESTINATION). IEMINITARIAS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | SETIMATION). NAL. LOB MANE. DOCKMG STATE OFFICE BU | SETINATION). SETINATION). NAL. JOB JAME: DOCKING STATE OFFICE BU | SETIMATION). NAL. TORNAM: DOCKAG STATE OFFICE BU | SSTIMATION). NAL | NAL | NED ESTINATION). | #14 AWG, TYPE SIS CONTROL WIRING #12 AWG, TYPE SIS HEATER CONTROL WIRING WIRE IABELING WIRES SHALL BE LABELED WITH DESTINATION WARGING (ORIGIN-DESTINATION). IEMINATIONS LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009-XXXXX). TERMINAL
 | #14 AWG, TYPE SIS CONTROL WIRING. UNLESS OTHERWISE SPECIFIED #12 AWG, TYPE SIS HEATER CONTROL WIRING WIRE SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). IEMINATIONS. LOW VOLIAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | #14 AWG, TYPE SIS CONTROL WIRING. UNLESS OTHERWISE SPECIFIED #12 AWG, TYPE SIS HEATER CONTROL WIRING #18 LABING. WIRES HABLE BE LABELED WITH DESTINATION WARKING (ORIGIN—DESTINATION). ITEMIENSHALL BE LABELED WITH DESTINATION WARKING (ORIGIN—DESTINATION). ITEMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL | #14 AWG, TYPE SIS CONTROL WIRING. UNLESS OTHERWISE SPECIFIED #12 AWG, TYPE SIS HEATER CONTROL WIRING WIRES SHALL BE LABELED WITH DESTINATION WARKING (ORIGIN-DESTINATION). ITEMINATIONS LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LLUGS (STYLE 25009-XXXXX). TERMINAL | #14 AWG, TYPE SIS CONTROL WIRING. UNLESS OTHERWISE SPECIFIED #12 AWG, TYPE SIS HEATER CONTROL WIRING WRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). IEMINATIONS. LOW VOLINGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | RODUCT INFORMATION:
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 | | א יחב טר באנואט אאמא דטא יחב טאוובט | S THE UL LISTING MARK FOR THE UNITED | S THE UL LISTING MARK FOR THE UNITED | S THE UL LISTING MARK FOR THE UNITED | S THE UL LUSTING MARK FOR THE UNITED
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| #14 AWG, TYPE SIS CONTROL WIRING. UNITESS OTHERWISE SPECIFIED #12 AWG, TYPE SIS HEATER CONTROL WIRING WIRE LABELING. WRETS SHALL BE UBBLED WITH DESTINATION WARKING (ORIGIN—DESTINATION). IFMINIATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | ESTINATION). NAL. DOCKAG STATE OFFICE BU | SETIMATION). SALL JOB JAME: DOCKING STATE OFFICE BU | SETINATION). NAL. TORNAME: DOCKING STATE OFFICE BU | ESTINATION). NAL | FED ESTINATION). | TED ESTINATION). | # 12 AWG, TYPE SIS CONTROL WIRING. UNLESS OTHERWISE SPECIFIED # 12 AWG, TYPE SIS HEATER CONTROL WIRING WRES SHALL BE LABELED WITH DESTINATION WARKING (ORIGIN—DESTINATION). IFRUINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL
 | #14 AWG, TYPE SIS CONTROL WIRING. UNIESS OTHERWISE SPECIFIED #12 AWG, TYPE SIS HEATER CONTROL WIRING WIRES SHALL BE LABELING. WIRES SHALL BE LABELING. TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | #14 AWG, TYPE SIS CONTROL WIRING. WIRE LABEING. WIRE LABEING. WIRES SHALL BE LABEING. WIRES SHALL BE LABEING WITH DESTINATION WARKING (ORIGIN—DESTINATION). IEMINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL. | #14 AWG, TYPE SIS CONTROL WIRING. UNLESS OTHERWISE SPECIFIED #12 AWG, TYPE SIS HEATER CONTROL WIRING WIRE LABLING. WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN-DESTINATION). IEMINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LLUGS (STYLE 25009—XXXXXX). TERMINAL | #14 AWG, TYPE SIS CONTROL WIRING. UNLESS OTHERWISE SPECIFIED #12 AWG, TYPE SIS HEATER CONTROL WIRING WIRE LABELING. WRES SHALL BE LABELED WITH DESTINATION WARKING (ORIGIN—DESTINATION). TEMINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | RODUCT INFORMATION:
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| #14 AWG, TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED #12 AWG, TYPE SIS HEATER CONTROL WIRING WIRE LABELING. WIRES SHALL BE LABELED WITH DESTINATION JUARKING (ORIGIN-DESTINATION). TEMINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | SETINATION). NAL. DOCKING STATE OFFICE BU | SETINATION). NAL. JOB JAME: DOCKING STATE OFFICE BU | SETINATION). NAL. TORNAME: DOCKNG STATE OFFICE BU | SSTINATION). NAL | TED ESTINATION). | JED SETINATION). NAL | #14 AWG, TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED #12 AWG, TYPE SIS HEATER CONTROL WIRING WIRE LABELING. WRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). TERMINATORS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL
 | #14 AWG, TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED #12 AWG, TYPE SIS HEATER CONTROL WIRING WIRE LABELING. WIRES SHALL BE LABELED WITH DESTINATION WARKING (ORIGIN—DESTINATION). IEMINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | #14 AWG, TYPE SIS CONTROL WIRING. UNLESS OTHERWISE SPECIFIED #12 AWG, TYPE SIS HEATER CONTROL WIRING WIRE LABELING. WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN-DESTINATION). IEMINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUCS (STYLE 25009—XXXXXX). TERMINAL | #14 AWG, TYPE SIS CONTROL WIRING. #12 AWG, TYPE SIS HEATER CONTROL WIRING WIRE LABELING. WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). IEMINATIONS: LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUCS (STYLE 25009—XXXXXX). TERMINAL | #14 AWG, TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED #12 AWG, TYPE SIS HEATER CONTROL WIRING WIRE LABELING. WIRES SHALL BE LABELED WITH DESTINATION WARKING (ORIGIN—DESTINATION). ITEMINATIONS. LOW VOLINGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | RODUCT INFORMATION:
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| #14 AWA, TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED #12 AWA, TYPE SIS HEATER CONTROL WIRING #IRE LABELING. WIRES SHALL BE LABELING. TERMINATION WARKING (ORIGIN—DESTINATION). TERMINATIONS LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | SESTINATION). NAL. DOCKING STATE OFFICE BU | SESTINATION). NAL. SOR NAME: DOCKING STATE OFFICE BU | SESTINATION). NAL. TITRE MANE: DOCKWIS STATE OFFICE BU | SETINATION). NAL. | TED ESTINATION). | TED ESTINATION). | # 4 AWG, TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED # 12 AWG, TYPE SIS CONTROL WIRING # 12 AWG, TYPE SIS CONTROL WIRING # 12 AWG, TYPE SIS HEATER CONTROL WIRING # 12 AWG, TYPE SIS HEATER CONTROL WIRING # 12 AWG, TYPE SIS HEATER # 12 AWG, TYPE LUCS (STYLE 25009—XXXXX). TERMINAL. UNINSULATED RING TYPE LUCS (STYLE 25009—XXXXXX).
 | # # A WAG, TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED # # A WAG, TYPE SIS CONTROL WIRING ## I A WAG, TYPE SIS CONTROL WIRING ## I A AWG, TYPE SIS HEATER CONTROL WIRING ## I A AWG, TYPE SIS HEATER CONTROL WIRING ### I AMENIA OF TYPE LUCS (STYLE 25009—XXXXX). TERMINAL UNINSULATED RING TYPE LUCS (STYLE 25009—XXXXX). TERMINAL | # 4 AWG, TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED # 1 AWG, TYPE SIS CONTROL WIRING # 1 AWG, TYPE SIS HATER CONTROL WIRING # 2 AWG, TYPE SIS HALE BE WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). *********************************** | # 14 AWG, TYPE SIS CONTROL WIRING. UNLESS OTHERWISE SPECIFIED # 12 AWG, TYPE SIS CONTROL WIRING # 18 ABELING WIRE SHALLING WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN-DESTINATION). IERMINATORIS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | # 14 ANG. THE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED # 12 ANG. THE SIS HEATER CONTROL WIRING # 12 ANG. THE SIS HEATER CONTROL WIRING # 12 ANG. THE SIS HEATER CONTROL WIRING # 12 ANG. THE LABLING. # 12 ANG. THE LABLING. # 12 ANG. THE SIS HEATER CONTROL WIRING (ORIGIN—DESTINATION). # 14 ANG. THE LUGS (STYLE 25009—XXXXXX). TERMINAL. | PRODUCT INFORMATION:
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| ACATROL WRING. # 14 AWG, TYPE SIS CONTROL WIRING. # 12 AWG, TYPE SIS HEATER CONTROL WIRING. WRES SHALL BE LABELED WITH DESTINATION WARKING (ORIGIN—DESTINATION). IEMINATORIES LOW VOLTAGE WIRE TERMINATIONS (WHERE RECURED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL. | SETIMATION). NAL. DOCKWIG STATE OFFICE BU | SETINATION). STATE OFFICE BU | SETIMATION). NAL. TORNAM: DOCKING STATE OFFICE BU | SETIMATION). NAL. | JED ESTINATION). | JED ESTINATION). | # 14 AWG, TYPE SIS CONTROL WIRING. UNLESS OTHERWISE SPECIFIED # 12 AWG, TYPE SIS HEATER CONTROL WIRING # 18 AWG, TYPE SIS HEATER CONTROL WIRING # 18 AWG, TYPE SIS HEATER CONTROL WIRING # 18 AWG, TYPE SIS HEATER # WIRES SHALL BE LABELED WITH DESTINATION WARKING (ORIGIN-DESTINATION). # IERMINATIONS # IERMINATIONS (WHERE REQUIRED) SHALL BE # LUGS (STYLE 25009-XXXXX). TERMINAL.
 | CONTROL WEING: #14 AWG, TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED #12 AWG, TYPE SIS HEATER CONTROL WIRING WIRE SHALL BE LABELED WITH DESTINATION WARKING (ORIGIN—DESTINATION). IEAUMANDORS: LOW YOL/AGE WIRE TERMINATIONS (WHERE RECURED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL. | CONTROL WERNS: # 14 AWG, TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED # 12 AWG, TYPE SIS HEATER CONTROL WIRING # 18 AWG, TYPE SIS HEATER CONTROL WIRING # 18 AWG, TYPE SIS HEATER WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). ### TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | CONTROL WIRING. # 14 ANG. TYPE SIS CONTROL WIRING. # 12 ANG. TYPE SIS HEATER CONTROL WIRING # 12 ANG. TYPE SINATION WARKING (ORIGIN—DESTINATION). # 12 ANG. TYPE LUGS (STYLE 25009—XXXXX). TERMINAL. UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXXX). | CONTROL WIRING. # 14 AWG, TYPE SIS CONTROL WIRING. # 12 AWG, TYPE SIS CONTROL WIRING. # 12 AWG, TYPE SIS HEATER CONTROL WIRING. # 12 AWG, TYPE SIS CONTROL WIRING. # 14 AWG, TYPE SIS CONTROL WIRING. # 15 AWG, TYPE SIS CO | PRODUCT INFORMATION: | | S INE UL LISIMO MAKA FOR INE UNITED
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 | SMIRTING STULL MEUCHI: 22/2 LBS 10/8 NU | SHIPPING STULL I WEIGHT 22/2 LBS 10/8 NG | SHIPTING SPLIT I WEIGHT: 25/2 LB3 10/8 NU | SAME STALL I WELGHT: 22/2 LBS 10/2 Nu | SAIRTING STILL WEIGHT: 23/2 LBS 10/8 No
 | SAINTAINE STATE SAIN LES IVE NO | SAILFINE SPEEL REGALL: 23.7 LBS 10.6 No | SAILFINE SPEEL REGALL: 23.7 LBS 10.6 No | SAME STALL I WELCHT: 22/2 LBS 10/6 NO | SAIFTING STELL I WELGHT: 22/2 LBS 10/8 NG
 | SAIFTING STELL I WELGHT: 23/2 LBS 10/8 NG | SHIPTING SOLIT I WEIGHT 25/Z LES 10/2 NU | SHIPTING SPLIT I WEIGHT: 25/2 LB3 10/8 NU |
| SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG COCK. STANDARDS THIS COLIVAMENT BLASS THE UL LISTING MARK FOR THE UNITED STATES. TRODUCT INCOMENT BLASS THE UL LISTING MARK FOR THE UNITED STATES. CONTROL WRING. #14 ANG. TYPE SIS CONTROL WIRING. UNLESS OTHERWISE SPECIFIED #12 ANG. TYPE SIS HEATER CONTROL WIRING. WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). TERMINATIONS: UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL. | THE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). ENTRY CONTROL WIRING THE LUGS (STYLE 25009-XXXXX). TERMINAL THE LUGS (STYLE 25009-XXXXX). | THE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). LED WITH DESTINATION STALL BE WHINATIONS (WHERE REQUIRED) SHALL BE THE LUGS (STYLE 25009-XXXXX). TERMINAL | STHE UL LISTING MARK FOR THE UNITED STATES. SHEDL WIRING, UNLESS OTHERWISE SPECIFIED SATER CONTROL WIRING LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). RAINATIONS (WHERE REQUIRED) SHALL BE TYPE LUGS (STYLE 25009-XXXXX). TERMINAL | 5 THE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). ENTRY CONTROL WIRING TERMINAL TERMINAL TOTAL TOTAL | 5 THE UL LISTING MARK FOR THE UNITED STATES. MATROL WIRING, UNLESS OTHERWISE SPECIFIED SATER CONTROL WIRING LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). RAWINATIONS (WHERE REQUIRED) SHALL BE THE LUGS (STYLE 25009—XXXXX). TERMINAL | STHE UL LISTING MARK FOR THE UNITED STATES. ANTROL WIRING, UNLESS OTHERWISE SPECIFIED SATER CONTROL WIRING ED WITH DESTINATION MARKING (ORIGIN—DESTINATION). ANIMATIONS (WHERE REQUIRED) SHALL BE THPE LUGS (STYLE 25009—XXXXX). TERMINAL | SHIPPING SPLIT I WEIGHT: 23/2 LBS 10/28 KG CODE STATUBLES THIS EQUIPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. THOSE COURTOL WIRING. #12 AWG, TYPE SIS HEATER CONTROL WIRING. #12 AWG, TYPE SIS HEATER CONTROL WIRING. WRETS SHALL BE LABELING. WRETS SHALL BE LABELING. LOW YOLT/AGE WIRE TERMINATIONS (WHERE RECURED) SHALL BE UNINSULATED RING TYPE LUCS (STYLE 25009—XXXXXX). TERMINAL. | SHIPPING SPLIT I WEIGHT: 23/2 LBS 1078 KG GOVE STANDARDS THIS COLUMENT BEAS THE UL LISTING MARK FOR THE UNITED STATES. TROUGLI INCORMATION: CONTROL WEING: #14 ANG. TYPE SIS CONTROL WIRING. #12 ANG. TYPE SIS HEATER CONTROL WIRING. WIRE LABELING. WIRES SHALL BE LABELING. WIRES SHALL BE LABELING. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE LOW VOLTAGE WIRE LUCS (STYLE 25009—XXXXX). TERMINAL.
 | SHIPPING SPLIT I WEIGHT: 2372 LBS 1078 KG COCKINGL WIRNES THIS COULDMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. RODUCT INCORMATION: COCKINGL WIRNES # 14 AMO. TYPE SIS CONTROL WIRING # 12 AMO. TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG COCKET INFORMATION: RODUCT INFORMATION: CONTINUE WINNER. #114 AWG, TYPE SIS CONTROL WIRING. WREE LABELING. WREE SHALL BE LABELED WITH DESTINATION WARKING (ORIGIN—DESTINATION). ITEMINATIONS: LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL. | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG COCK STANDARDS THIS FOUNDAMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. THIS SOUPLEMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. TOWNTOL WEIGHT OF THE ULUST OF THE UNITED STATES. # 14 A ANG, TYPE SIS HEATER CONTROL WIRING. UNITESS OTHERWISE SPECIFIED # 12 ANG, TYPE SIS HEATER CONTROL WIRING. WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). TERMINATIONS LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | WEIGHT: 2372 LBS 1078 KG | WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG CODE STANDARDS.
 | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG CODE STANDARDS | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG CODE STANDARGS. | SHIPMING SPUT I WEIGHT: 23/2 LBS 1078 KG
CODE STANDARDS | SHIPPING SPUT IN WEIGHT: 23/2 LBS 10/8 KG | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG
 | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLT 1 WEIGHT: 23.72 LBS 1078 KG | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG | CHIPPING SPIT 1 WEIGHT 2372 BY 1078 KG |
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 | SHIPPING SPIT 1 WEIGHT 2372 1BS 1078 KG | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 107B KG | SHIPPING SPLIT I WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG
 | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLIT I WEIGHT: 2372 LBS 1078 KG | SHIPPING SPUT I WEIGHT: 23/2 LBS 10/8 KG | SHIPPING SPUT IN WEIGHT: 23/2 LBS 10/8 KG
 | SHIPPING SPUT IN WEIGHT: 23/2 LBS 10/8 KG | SHIPMING SPUT IN WEIGHT: 23/2 LBS 10/8 KG | SHIPMING SPUT IN WEIGHT: 23/2 LBS 10/8 KG | SHIPPING SPLIT I WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLIT I WEIGHT: 23/2 LBS 1078 KG
 | SHIPMING SPLIT I WEIGHT: 23/2 LBS 10/8 KG | SHIPPING SPLIT I WEIGHT: 23/2 LBS 1078 KG | SHIPPING SPLIT I WEIGHT: 2372 LBS 1078 KG |
| SHIPPING SPLIT 1 WEIGHT: 2372 LBS 107B KG CONF. STANDARDS. THIS COUPMENT BEARS THE UL LISTING WARK FOR THE UNITED STATES. THOUGHT INCOMENT DIAG. CONTROL WIRING. LANG, TYPE SIS CONTROL WIRING. WIRE LABLING. WIRE SHALL BE LABELED WITH DESTINATION WARKING (ORIGIN—DESTINATION). TERMINATIONS: UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL. | STHE UL LISTING MARK FOR THE UNITED STATES. SHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL. WIRING LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). ENTRY CONTROL WIRING THE LUGS (STYLE 25009-XXXXX). TERMINAL THE LUGS (STYLE 25009-XXXXXX). | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL. WIRING LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). LED WITH DESTINATION STALL BE NAME LUGS (STYLE 25009-XXXXX). TERMINAL LUGS (STYLE 25009-XXXXX). | STHE UL LISTING MARK FOR THE UNITED STATES. SHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL. WIRING ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). ED WITH DESTINATION WARKING (ORIGIN-DESTINATION). SAMINATIONS (WHERE REQUIRED) SHALL BE TYPE LUGS (STYLE 25009-XXXXX). TERMINAL | STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING. ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). ETHE LUCS (STYLE 25009-XXXXX). TERMINAL. | STHE UL LISTING MARK FOR THE UNITED STATES. MIROL WIRING, UNLESS OTHERWISE SPECIFIED SATER CONTROL WIRING LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). MARKATIONS (WHERE REDUIRED) SHALL BE THE LUCS (STYLE 25009—XXXXX). TERMINAL | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. MATROL WIRING, UNLESS OTHERWISE SPECIFIED SATER CONTROL WIRING SANIMATION MARKING (ORIGIN—DESTINATION). MAINATIONS (WHERE REQUIRED) SHALL BE THPE LUGS (STYLE 25009—XXXXX). TERMINAL | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG CONE STANDAGES. THE SOLUMENT BEAS THE UL LISTING MARK FOR THE UNITED STATES. SCANTBOL WEIGHT CONTROL WIRTHO, UNLESS OTHERWISE SPECIFIED #12 ANG, TYPE SIS CONTROL WIRTHO, UNLESS OTHERWISE SPECIFIED #12 ANG, TYPE SIS HEATER CONTROL WIRTHOW, UNLESS OTHERWISE SPECIFIED #12 ANG, TYPE SIS HEATER CONTROL WIRTHOW, UNLESS OTHERWISE (ORIGIN—DESTINATION). TEQUINATIONS LOW VOLTAGE WIRE TERMINATIONS (WHERE RECURED) SHALL BE UNINSULATED RING TYPE LUCS (STYLE 25009—XXXXXX). TERMINAL
 | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG GONE STANDARDS. THIS COLOUMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. THOUGH IN THE STANDARD STATES. GONTROL WIRING. #14 A MIG. THE SIS CONTROL WIRING. #12 AMIG. THE SIS CONTROL WIRING. #18 A MIG. THE SIS CONTROL WIRING. #18 A MIG. THE SIS CONTROL WIRING. #18 A MIG. THE SIS HEAVIER CONTROL WIRING. #18 A MIG. THE SIS HEAVIER CONTROL WIRING. #18 A MIG. THE SIS HEAVIER CONTROL WIRING. #18 A MIG. THE LUCS (STYLE 25009—XXXXX). TERMINAL. LUNINSULATED RING THE LUCS (STYLE 25009—XXXXX). TERMINAL. | SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CODE STANDARDS THIS EQUIPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. RODUCT INFORMATION: CALINGL WIRING. CALINGL WIRING. LIST ANG. TYPE SIS CONTROL WIRING. WIREL JABLING. WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). IEBUINATIONS: (WHERE REDUIRED) SHALL BE LOW VOLTAGE WIRE TERMINATIONS (WHERE REDUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL | SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CONFIGURATION. CONTROL WIRING. MILE SOUIPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. RODUCT INFORMATION. CONTROL WIRING. MILE SHEATER CONTROL WIRING. MILE SHEATER CONTROL WIRING. WIRES SHEAL BE LABELED WITH DESTINATION MARKING (ORIGIN-DESTINATION). TERMINATIONS (WHERE REQUIRED) SHALL BE LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TIPE LUGS (STYLE 25009-XXXXX). TERMINAL | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 107B KG CONE STANDANDS. THIS FOULPWENT BEARS THE UL LISTING WARK FOR THE UNITED STATES. THOUSE COUPAND BEARS THE UL LISTING WARK FOR THE UNITED STATES. CONTROL WEINS. # 14 AWG, TYPE SIS CONTROL WIRING. # 12 AWG, TYPE SIS CONTROL WIRING. WIRE LABELING. WIRE LABELING. WIRE SHALL BE LABELED WITH DESTINATION WARKING (ORIGIN—DESTINATION). TEMINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | WEIGHT: 2372 LBS 1078 KG
 | WEGHT: 2372 LBS 1078 KG | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG CODE STANDARDS. | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG CODE STANDAGGS. | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG CODE STANDAGES | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG CODE STANDARDS | SHIPPING SPLIT I WEIGHT: 2372 LBS 1078 KG
 | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLT 1 WEIGHT: 2372 LBS 1078 KG | AHIDDING APITT WERTHT 2372 - PA 1078 KG
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 | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLIT I WEIGHT: 2372 LBS 107B KG | SHIPPING SPLIT I WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLIT I WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLIT I WEIGHT: 2372 LBS 1078 KG
 | SHIPPING SPLIT I WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLIT I WEIGHT: 2372 LBS 1078 KG | SHIPPING STUT 1 WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLIT I WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLIT I WEIGHT: 2372 LBS 1078 KG
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| SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CONE STANDARDS. THIS EQUIVARNI BEARS THE UL LISTING MARK FOR THE UNITED STATES. THIS EQUIVARNI BEARS THE UL LISTING MARK FOR THE UNITED STATES. THANG. THE SIS CONTROL WIRING. ## 14 ANG, THE SIS CONTROL WIRING. WIRE LABEING. WIRE SHALL BE LABELING. WIRES SHALL BE LABEING THE REQUIRED) SHALL BE LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING THPE LUGS (STYLE 25009—XXXXX). TERMINAL | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). ED WITH DESTINATION WARKING (ORIGIN-DESTINATION). AMINATIONS (WHERE REQUIRED) SHALL BE TYPE LUGS (STYLE 25009-XXXXX). TERMINAL | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL. WIRING LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). LED WITH DESTINATION STATL BE NAME LUGS (STYLE 25009-XXXXX). TERMINAL LOGS (STYLE 25009-XXXXX). | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING EED WITH DESTINATION MARKING (ORIGIN-DESTINATION). EED WITH DESTINATION WARKING (ORIGIN-DESTINATION). THE LUGS (STYLE 25009-XXXXX). TERMINAL THE LUGS (STYLE 25009-XXXXXX). | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING SATER CONTROL WIRING SATER CONTROL WIRING WHERE REQUIRED) SHALL BE THE LUCS (STYLE 25009—XXXXX). TERMINAL | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING LED WITH DESTINATION MARKING (ORIGIN—DESTINATION). SAMINATIONS (WHERE REQUIRED) SHALL BE THE LUCS (STYLE 25009—XXXXX). TERMINAL. | SHE, 2372 LBS 1078 KG STHE UL LISTING MARK FOR THE UNITED STATES. ANTROL WIRING, UNLESS OTHERWISE SPECIFIED SATER CONTROL WIRING ED WITH DESTINATION MARKING (ORIGIN—DESTINATION). ANIMATIONS (WHERE REQUIRED) SHALL BE TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CODE STANDARDS. THIS COUNDENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. THOUSENLY WEING. CONTROL WEING. #14 ANG. TYPE SIS CONTROL WIRING. #12 ANG. TYPE SIS CONTROL WIRING. #18 ANG. TYPE SIS CONTROL WIRING. WIRES SHALL BE LABELING. WIRES SHALL BE LABELING. WIRES SHALL BE LABELING. LOW YOLTAGE WIRE TERMINATIONS (WHERE RECURED) SHALL BE LOW YOLTAGE WIRE TERMINATIONS (WHERE RECURED) SHALL BE UNINSULATED RING TYPE LUCS (STYLE 25009-XXXXX). TERMINAL
 | SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CODE STANDARDS. THIS EQUIPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. HODUCT INCORMATION: COKINGL WIRING, UNLESS OTHERWISE SPECIFIED #14 ANG, TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED #12 ANG, TYPE SIS HEATER CONTROL WIRING WIRES SHALL BE LABELING. WIRES SHALL BE LABELING. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUCS (STYLE 25009—XXXXX). TERMINAL | SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CODE STANDAGES. THIS FOURNENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. RODUCT INFORMATION: CONTING WIRING. MILL ARIG. TYPE SIS CONTROL WIRING. WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). IEBUINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REDURED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL | SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CODE_STANDAGES. THIS FOURNENT BEARS THE UL LISTING WARK FOR THE UNITED STATES. RODUCT_INFORMATION. CONTROL_WIRING. #12 ANG. TYPE SIS CONTROL_WIRING. #12 ANG. TYPE SIS HEATER CONTROL_WIRING. WIRE SHELLING. WIRE SHELLING. WIRE SHELLING. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL | SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CONE_STANDAGES. THIS FOUNDMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. THIS FOUNDMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. TODUCT INCOMMATION. CONTROL WRING. #14 AWG. TYPE SIS CONTROL WIRING. #12 AWG. TYPE SIS CONTROL WIRING. WIRE LABELING. WIRE LABELING. WIRE SHALL BE LABELING. UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL. | WEIGHT: 2372 LBS 1078 KG
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 | WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG CODE STANDAGGS | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG CODE STANDAGES. | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG CODE STANDAGGS | SHIPPING SPLIT I WEIGHT: 2372 LBS 1078 KG CODE STANDARDS | SHIPPING SPLIT I WEIGHT: 2372 LBS 1078 KG
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 | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLIT I WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLIT 1 WEGHT: 2372 LBS 1078 KG | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG
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| SHIPPING SPLIT I WEGHT: 2372 LBS 1078 KG COCK_STANDAGES. THIS FOUNDWIN BEARS THE UL LISTING MARK FOR THE UNITED STATES. THOUSE THE COLUMNING WARK FOR THE UNITED STATES. THOUSE THE SIS CONTROL WIRING. # 12 ANG, TYPE SIS CONTROL WIRING WIRE LABEING. WIRE SHALL BE LABEING. WIRES SHALL BE LABEING. UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL. | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING EED WITH DESTINATION MARKING (ORIGIN-DESTINATION). ENTRY CONTROL WIRING ENTRY CONTROL WIRING ENTRY CONTROL WIRING ENTRY CONTROL STATE BE THE LUGS (STYLE 25009-XXXXX). TERMINAL | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL. WIRING LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). LED WITH DESTINATION STATE BE THE LUGS (STYLE 25009-XXXXX). TERMINAL LOGS (STYLE 25009-XXXXX). | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING EED WITH DESTINATION MARKING (ORIGIN-DESTINATION). EED WITH DESTINATION WARKING (ORIGIN-DESTINATION). THE LUGS (STYLE 25009-XXXXX). TERMINAL THEN MAKE. DOCKING STATE OFFICE BUTTONS (STATE OFFICE BUTTONS (STYLE 25009-XXXXXX)). | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING SATER CONTROL WIRING WITH DESTINATION MARKING (ORIGIN-DESTINATION). SAMINATIONS (WHERE REQUIRED) SHALL BE THE LUCS (STYLE 25009—XXXXX). TERMINAL. | STHE UL LISTING MARK FOR THE UNITED STATES. NATROL WIRING, UNLESS OTHERWISE SPECIFIED SATER CONTROL WIRING LED WITH DESTINATION MARKING (ORIGIN—DESTINATION). SANIMATIONS (WHERE REQUIRED) SHALL BE TYPE LUCS (STYLE 25009—XXXXX). TERMINAL. | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING. LED WITH DESTINATION MARKING (ORIGIN—DESTINATION). SAUNATIONS (WHERE REQUIRED) SHALL BE THPE LUGS (STYLE 25009—XXXXX). TERMINAL | SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CODE STANDARDS. THIS EQUIPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. THIS EQUIPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. GONTROL WERNER. # 14 A MIG. TYPE SIS CONTROL WIRING. # 12 AMG. TYPE SIS CONTROL WIRING. # 12 AMG. TYPE SIS CONTROL WIRING. # 12 AMG. TYPE SIS HEATER CONTROL WIRING. WIRES SHALL BE LABELING. WIRES SHALL BE LABELING. WIRES SHALL BE LOSE (STYLE 25009-XXXXX). TERMINAL. UNINSULATED RING TYPE LUCS (STYLE 25009-XXXXXX). TERMINAL.
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| SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CODE_STANDAGES. THIS FOURNENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. RODUCT INFORMATION: CANTROL WIRING, UNIESS OTHERWISE SPECIFIED #12 AWG, TYPE SIS CONTROL WIRING, UNIESS OTHERWISE SPECIFIED #12 AWG, TYPE SIS HEATER CONTROL WIRING WIRE LABELING. WIRES SHALL BE LABELING. UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL. | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING EED WITH DESTINATION MARKING (ORIGIN-DESTINATION). EED WITH DESTINATION WARKING (ORIGIN-DESTINATION). AMINATIONS (WHERE REQUIRED) SHALL BE TYPE LUGS (STYLE 25009-XXXXX). TERMINAL | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING. ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). ED WITH DESTINATION WARKING (ORIGIN-DESTINATION). ENTRY ELUGS (STYLE 25009-XXXXX). TERMINAL THE LUGS (STYLE 25009-XXXXX). | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). ED WITH DESTINATION WARKING (ORIGIN-DESTINATION). THE LUGS (STYLE 25009-XXXXX). TERMINAL THE LUGS (STYLE 25009-XXXXX). | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SAIR CONTROL WIRING SAIR CONTROL WIRING SAIR SECURIOD SHALL BE THE LUCS (STYLE 25009—XXXXX). TERMINAL. THE LUCS (STYLE 25009—XXXXXX). | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. MITROL WIRING, UNLESS OTHERWISE SPECIFIED SATER CONTROL WIRING SANIMATION WARKING (ORIGIN—DESTINATION). SANIMATIONS (WHERE REQUIRED) SHALL BE TYPE LUCS (STYLE 25009—XXXXX). TERMINAL | SHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. ANTROL WIRING, UNLESS OTHERWISE SPECIFIED SATER CONTROL WIRING ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). SAMINATIONS (WHERE REQUIRED) SHALL BE TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL | SHIPPING SPUT 1 WEIGHT: 2372 LBS 1078 KG CODE STANDAGES. RODUCT INFORMATION. COURTOL WRING. #1 A MY. THE ESS CONTROL WIRING. UNIESS OTHERWISE SPECIFIED #1 A MY. THE SIS HEATER CONTROL WIRING. WIRE LABELING. WIRES SHALL BE LABELED WITH DESTINATION LARKING (ORIGIN-DESTINATION). TERMINATIONS: LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING THPE LLUGS (STYLE 25009—XXXXX). TERMINAL
 | SHIPPING SPLIT 1 WEGHT: 2372 LBS 1078 KG. GODE STANDARDS. THIS COUPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. RODUCT INFORMATION: CANTOL WIRING. LAWAR, TYPE SIS CONTROL WIRING. WIRE LABELING. WIRES SHALL BE LAGELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). IEMUNATIONS: LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUCS (STYLE 25009—XXXXX). TERMINAL. | SHIPPING SPLIT 1 WEGHT: 2372 LBS 1078 KG SODE STANDARDS. THIS COUPLENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. RODUCT INFORMATION: CONTROL WIRING, UNIVERS OTHERWISE SPECIFIED # 12 ANG, TYPE SIS CONTROL WIRING, UNIVERS OTHERWISE SPECIFIED # 12 ANG, TYPE SIS CONTROL WIRING, UNIVERS SPECIFIED # 12 ANG, TYPE SIS HATER CONTROL WIRING WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN-DESTINATION). TEAUNATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REDUINED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009-XXXXXX). TERMINAL | SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CONESTIMINATES. RODUCT INFORMATION: CONTROL WRING. #14 AWG. TYPE SIS CONTROL WIRING. UNLESS OTHERWISE SPECIFIED #12 AWG. TYPE SIS CONTROL WIRING. #18 A A AWG. TYPE SIS CONTROL WIRING. #18 A A A A A A A A A A A A A A A A A A A | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG CODE STANDAGES. THIS FOURWANT BEARS THE UL LISTING WARK FOR THE UNITED STATES. RODUCT INFORMATION. CANTOL WRING. #12 AWG, TYPE SIS CONTROL WIRING. WIRE LABELING. WIRES SHALL BE LABELING. WIRES SHALL BE LABELING. UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL. UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL. | WEIGHT: 2372 LBS 1078 KG
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| SHIPPING SPLIT 1 WEGHT: 2372 LBS 1078 KG GODE STANDARDS. THIS FOURWENT BEARS THE UL LISTING WARK FOR THE UNITED STATES. RODUCT INFORMATION: CANTOL WRING. ACTION WINNER, DATE SIS CONTROL WIRING. WIRE LABELING. WIRE SHALL BE LABELING. WIRES SHALL BE LABELED WITH DESTINATION JUNISHINGTON.). IEMUINATORIS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL. | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING. EED WITH DESTINATION MARKING (ORIGIN-DESTINATION). EED WITH DESTINATION WARKING (ORIGIN-DESTINATION). ANIMATIONS (WHERE REQUIRED) SHALL BE TYPE LUGS (STYLE 25009-XXXXX). TERMINAL. | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING. ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). ED WITH DESTINATION WARKING (ORIGIN-DESTINATION). ENTRY ELUGS (STYLE 25009-XXXXX). TERMINAL THE LUGS (STYLE 25009-XXXXXX). | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING SATER CONTROL WIRING ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). ENTRY DESTINATION (WHERE REQUIRED) SHALL BE TYPE LUGS (STYLE 25009-XXXXX). TERMINAL. | SHE UL LISTING MARK FOR THE UNITED STATES. SHE UL LISTING MARK FOR THE UNITED STATES. MIROL WIRING, UNLESS OTHERWISE SPECIFIED JATER CONTROL WIRING WITH DESTINATION MARKING (ORIGIN—DESTINATION). SAMINATIONS (WHERE REQUIRED) SHALL BE THE LUCS (STYLE 25009—XXXXX). TERMINAL. | SHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. JATER CONTROL WIRING. JATER CONTROL WIRING SANIMATION MARKING (ORIGIN-DESTINATION). AMINATIONS (WHERE REQUIRED) SHALL BE TYPE LUCS (STYLE 25009—XXXXX). TERMINAL. | SHE UL LISTING WARK FOR THE UNITED STATES. STHE UL LISTING WARK FOR THE UNITED STATES. STER CONTROL WIRING. LED WITH DESTINATION WARKING (ORIGIN-DESTINATION). SANINATIONS (WHERE REQUIRED) SHALL BE THE LUGS (STYLE 25009—XXXXX). TERMINAL | SHIPPING SPLIT I WEIGHT: 2372 LBS 1078 KG GODE STANDARDS. THIS COURMENT BEARS THE UL LISTING WARK FOR THE UNITED STATES. RODUCT INFORMATION: CONTROL WRING. #112 ANG, TYPE SIS CONTROL WIRING. WIRE LABELING. WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN-DESTINATION). TERMINATIONS: LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LLUGS (STYLE 25009—XXXXX). TERMINAL
 | SHIPPING SPLIT I WEGHT: 2372 LBS 1078 KG SODE STANDARDS. THIS FOURHENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. RODUCT INFORMATION. CONTROL WIRING, UNLESS OTHERWISE SPECIFIED # 12 ANG, TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED # 12 ANG, TYPE SIS HATTER CONTROL WIRING WIRES SHALL BE LABELING. WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). IEMUNATIONS LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG SODE STANDARDS THIS FOUR-MENTS THIS FOUR-MENTS RODUCT INFORMATION: CONTROL WIRING, UNIVERS OTHERWISE SPECIFIED # 12 AWG, TYPE SIS CONTROL WIRING, UNIVERS OTHERWISE SPECIFIED # 12 AWG, TYPE SIS HATER CONTROL WIRING WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN-DESTINATION). TERMINATIONS LOW VOLTAGE WIRE TERMINATIONS (WHERE REDUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009-XXXXXX). TERMINAL | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG CONE STANDARDS THIS FOUR-MENTS THIS FOUR-MENTS RODUCT INFORMATION: CONTROL WRING. UNLESS OTHERWISE SPECIFIED #12 ANG. TYPE SIS CONTROL WIRING. UNLESS OTHERWISE SPECIFIED #12 ANG. TYPE SIS CONTROL WIRING. #13 ANG. TYPE SIS CONTROL WIRING. #14 ANG. TYPE SIS CONTROL WIRING. #15 ANG. TYPE SIS CONTROL WIRING. #16 ANG. TYPE SIS HATTER CONTROL WIRING. #17 ANG. TYPE SIS HATTER CONTROL WIRING. #18 ANG. TYPE SINATION WARKING (ORIGIN-DESTINATION). **INRES SHALL BE LABELED WITH DESTINATION WARKING (ORIGIN-DESTINATION). **INRES SHALL BE LABELED WITH DESTINATION SHALL BE LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUCS (STYLE 25009-XXXXX). TERMINAL. | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG CODE STANDARDS THIS FOURMENT BEARS THE UL LISTING WARK FOR THE UNITED STATES. RODUCT INFORMATION: CANTROL WIRING. # 12 AWG, TYPE SIS CONTROL WIRING. WIRES SHALL BE LABELING. WIRES SHALL BE LABELING. WIRES SHALL BE LABELING. UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL. | WEIGHT: 2372 LBS 1078 KG
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| SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG SONE STANDARDS. THIS FOURMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. RODUCT INFORMATION: CANTOL WRING. ACMINGL WRING. UNILESS OTHERWISE SPECIFIED #12 AWG. TYPE SIS CONTROL WIRING. WIRES SHALL BE LABELING. WIRES SHALL BE LABELING. UNINSULATED RING TYPE LUGS (STYLE 25009-XXXXX). TERMINAL. | SHE 2372 LBS 1078 KG STHE UL LISTING MARK FOR THE UNITED STATES. SHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). ED WITH DESTINATION WARKING (ORIGIN-DESTINATION). ANIMATIONS (WHERE REQUIRED) SHALL BE TYPE LUGS (STYLE 25009-XXXXX). TERMINAL. | SHE 2372 LBS 1078 KG STHE UL LISTING MARK FOR THE UNITED STATES. SATEN CONTROL WIRING. ED WITH DESTINATION WARKING (ORIGIN-DESTINATION). ED WITH DESTINATION WARKING (ORIGIN-DESTINATION). ENTRY CONTROL WIRING ENTRY C | SHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). AMINATIONS (WHERE REQUIRED) SHALL BE TYPE LUGS (STYLE 25009-XXXXX). TERMINAL. | SHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. MIRROL WIRING, UNITESS OTHERWISE SPECIFIED SATER CONTROL WIRING EED WITH DESTINATION MARKING (ORIGIN—DESTINATION). SAMINATIONS (WHERE REQUIRED) SHALL BE THE LUCS (STYLE 25009—XXXXXX). TERMINAL. | SHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING. LED WITH DESTINATION MARKING (ORIGIN—DESTINATION). SANIMATIONS (WHERE REQUIRED) SHALL BE TYPE LUGS (STYLE 25009—XXXXX). TERMINAL. | SHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING. LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). SANINATIONS (WHERE REQUIRED) SHALL BE THE LUGS (STYLE 25009—XXXXX). TERMINAL | SHIPPING SPLIT I WEIGHT: 2372 LBS 1078 KG GONE STANDARDS. THIS COURNENT BEARS THE UL LISTING WARK FOR THE UNITED STATES. RODUCT INFORMATION: CONTROL WRING. #112 ANG, TIPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED #12 ANG, TIPE SIS HEALER CONTROL WIRING WIRE LABELING. WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN-DESTINATION). ITEMINATIONS LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TIPE LLUGS (STYLE 25009—XXXXX). TERMINAL | SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CODE STANDARDS THIS COUPLENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. RODUCT INFORMATION. CONTROL WIRING, UNLESS OTHERWISE SPECIFIED #112 ANG, TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED #12 ANG, TYPE SIS HEATER CONTROL WIRING WIRES SHALL BE LABELING. WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). IEMUNATIONS LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL
 | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG CODE_STANDARDS. THIS FOUR-MENTS. RODUCT INFORMATION: CONTROL WIRING. LINESS OTHERWISE SPECIFIED # 12 AWG. TYPE SIS CONTROL WIRING. LINESS OTHERWISE SPECIFIED # 12 AWG. TYPE SIS HEATER CONTROL WIRING. WIRES SHALE LE LABELING. WIRES SHALE LE LABELING. LOW VOLTAGE WIRE TERMINATIONS (WHERE REDUINED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL. | SHIPPING SPLIT I WEIGHT: 2372 LBS 1078 KG CONE STANDARTS. RODUCT INFORMATION: CONTROL WRING. CONTROL WRING. #12 ANG. TYPE SIS CONTROL WIRING. UNLESS OTHERWISE SPECIFIED #12 ANG. TYPE SIS CONTROL WIRING. #12 ANG. TYPE SIS HEATER CONTROL WIRING. WINES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN-DESTINATION). IEMINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE LUM VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL. | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG CODE STANDAGES. THIS FOURMENT BEARS THE UL LISTING WARK FOR THE UNITED STATES. RODUCT INFORMATION: CANTROL WIRING. # 12 AWG. TYPE SIS CONTROL WIRING. UNILESS OTHERWISE SPECIFIED # 12 AWG. TYPE SIS HEATER CONTROL WIRING. WIRES SHALL BE LABELING. WIRES SHALL BE LABELING. UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL. | WEIGHT: 2372 LBS 1078 KG
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| SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CONE STANDAGES. THIS FOUNDENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. RODUCT INFORMATION: CANTOL WRING. CONTROL WRING. UNLESS OTHERWISE SPECIFIED # 12 ANG, TYPE SIS CONTROL WIRING. WIRE LABELING. WIRE LABELING. WIRE SHALL BE USELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). IEMUINATIONS LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL, WIRING EED WITH DESTINATION MARKING (ORIGIN-DESTINATION). EED WITH DESTINATION WARKING (ORIGIN-DESTINATION). AMINATIONS (WHERE REQUIRED) SHALL BE TYPE LUGS (STYLE 25009-XXXXX). TERMINAL | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING. EED WITH DESTINATION MARKING (ORIGIN-DESTINATION). EED WITH DESTINATION MARKING (ORIGIN-DESTINATION). EACH TO STATE 25009-XXXXX). TERMINAL TO BE LUCS (STYLE 25009-XXXXX). | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING. EED WITH DESTINATION MARKING (ORIGIN-DESTINATION). EED WITH DESTINATION WARKING (ORIGIN-DESTINATION). THE LUGS (STYLE 25009-XXXXX). TERMINAL. THE LUGS (STYLE 25009-XXXXX). | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). SAMINATIONS (WHERE REQUIRED) SHALL BE THE LUCS (STYLE 25009—XXXXX). TERMINAL. | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. MITROL WIRING, UNLESS OTHERWISE SPECIFIED SATER CONTROL WIRING SANIMATION MARKING (ORIGIN—DESTINATION). SANIMATIONS (WHERE REQUIRED) SHALL BE TYPE LUCS (STYLE 25009—XXXXX). TERMINAL | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. STER CONTROL WIRING. LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). SAUNATIONS (WHERE REQUIRED) SHALL BE TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | SHEPING SPLIT 1 WEIGHT, 2372 LBS 107B KG CODE STANDARDS. THIS COULDMANT BEARS THE UL LISTING MARK FOR THE UNITED STATES. HODUCT INCOMMATION: COURTON WRING. #14 AMG. TYPE SIS CONTROL WIRING, UNITESS OTHERWISE SPECIFIED #12 AMG. TYPE SIS HEATER CONTROL WIRING, UNITESS OTHERWISE SPECIFIED #12 AMG. TYPE SIS HEATER CONTROL WIRING, UNITESS OTHERWISE SPECIFIED #12 AMG. TYPE SIS HEATER CONTROL WIRING, UNITESS OTHERWISE (ORIGIN—DESTINATION). TEAUNATIONS LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL.
 | SHEPING SPLIT 1 WEIGHT, 2372 LBS 1078 KG CODE STANDARDS. THIS COUPAND BEARS THE UL LISTING MARK FOR THE UNITED STATES. **RODUCT INFORMATION:** CANTROL WIRING. **LA ANG. TYPE SIS CONTROL WIRING. **MIRE LABELING. WIRES SHALL BE LABELING. WIRES SHALL BE LABELING. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUCS (STYLE 25009—XXXXX). TERMINAL. | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 107B KG CONCERNIATION. CONCITION WRITED STATES. RODUCT INFORMATION. CONTROL WRITED. # A MIG. TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED # 12 ANG, TYPE SIS CONTROL WIRING WIRES SHALL BE LABELING. WIRES SHALL BE LABELING. LOW VOLTAGE WIRE TERMINATIONS (WHERE REDUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009-XXXXXX). TERMINAL | SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG GODE STANDARDS. THIS COUPLENT BEARS THE UL USTING MARK FOR THE UNITED STATES. RODUCT INFORMATION: CONTROL WRING. #12 ANG. TYPE SIS CONTROL WIRING. UNLESS OTHERWISE SPECIFIED #12 ANG. TYPE SIS CONTROL WIRING. #18 ANG. TYPE SIS CONTROL WIRING. #18 ANG. TYPE SIS CONTROL WIRING. #18 ENDING THE CONTROL WIRING. WIRE SHALL BE UABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). IEMENSTALL BE UABELED LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUCS (STYLE 25009—XXXXX). TERMINAL. | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 107B KG CONE. STANDAGES. THIS FOURNENT BEARS THE UL LISTING MARK FOR THE UNIED STATES. RODUCT INFORMATION. CONTROL WRING. I LANG. THE SIS CONTROL WIRING. WIRE LABELING. WIRES SHALL BE LABELING. WIRES SHALL BE LABELING. U.OW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING THE LUGS (STYLE 25009—XXXXXX). TERMINAL. | WEIGHT: 2372 LBS 1078 KG
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| SHIPPING SPLIT I WEGHT: 2372 LBS 107B KG CODE_STANDAGES. THIS FOUNDAMID BANS THE UL LISTING MARK FOR THE UNITED STATES. THIS FOUNDAMIDUA. CONTROL WIRING. I A MAY. THE SIS CONTROL WIRING. WIRE LABEING. WIRE SHALL BE USELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). IEMINATIONS. UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL. | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING. ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). ED WITH DESTINATION WARKING (ORIGIN-DESTINATION). ANIMATIONS (WHERE REQUIRED) SHALL BE TYPE LUGS (STYLE 25009-XXXXX). TERMINAL | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). LED WITH DESTINATION SHALL BE NAMINATIONS (WHERE REQUIRED) SHALL BE TYPE LUGS (STYLE 25009-XXXXX). TERMINAL LOGS (STYLE 25009-XXXXX). | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING. LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). ED WITH DESTINATION WARKING (ORIGIN-DESTINATION). THE LUGS (STYLE 25009-XXXXX). TERMINAL. THE LUGS (STYLE 25009-XXXXX). | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). SAMINATIONS (WHERE REQUIRED) SHALL BE THE LUCS (STYLE 25009—XXXXX). TERMINAL. | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. MITROL WIRING, UNLESS OTHERWISE SPECIFIED SATER CONTROL WIRING SANIMATION MARKING (ORIGIN—DESTINATION). SANIMATIONS (WHERE REQUIRED) SHALL BE TYPE LUCS (STYLE 25009—XXXXX). TERMINAL | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING. LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). SAUNATIONS (WHERE REQUIRED) SHALL BE THPE LUGS (STYLE 25009—XXXXX). TERMINAL | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 107B KG CODE STANDARDS. THIS EQUIPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. THOSE CONTROL WIRING. SOUTH OF THE SIS CONTROL WIRING. #14 ANG. TYPE SIS CONTROL WIRING. #15 ANG. TYPE SIS HEATER CONTROL WIRING. WIRES SHALL BE LABELING. WIRES SHALL BE LABELING. WIRES SHALL BE LABELING. UNINSULATED RING TYPE LUCS (STYLE 25009-XXXXX). TERMINAL.
 | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 107B KG CODE STANDARDS. THIS FOURWARD BLARS THE UL LISTING MARK FOR THE UNITED STATES. **RODUCT INFORMATION: **CANTROL WIRING.** #14 AMO. TYPE SIS CONTROL WIRING. #12 AMO. TYPE SIS CONTROL WIRING. #18 AMO. TYPE SIS CONTROL WIRING. **ITEMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUCS (STYLE 25009—XXXXX). TERMINAL. | SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CONE STANDAGES. THIS COULDMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. CONTROL WIRING. CONTROL WIRING. UNIVESS OTHERWISE SPECIFIED # 14 AWG, TYPE SIS CONTROL WIRING. # 12 ARMG, | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 107B KG CODE_STANDAGES. THIS COURMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. RODUCT_INFORMATION. CONTROL_WRING. #12 ANG, TYPE SIS CONTROL_WIRING. WIRE LABLING. WIRE LABLING. WIRE LABLING. WIRE LABLING. WIRE COUNTROL WIRING (ORIGIN—DESTINATION). IEMINATONS: (WHERE REQUIRED) SHALL BE LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CODE_STANDARGS. THIS FOURNENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. RODUCT INFORMATION. CONTROL WIRING. LATA AND THE SIS CONTROL WIRING. #12 AND, THE SIS CONTROL WIRING. WIRE LABELING. WIRE SHALL BE LABELING. WIRES SHALL BE LABELING. UNINSULATED RING THE REQUIRED) SHALL BE UNINSULATED RING THE LUGS (STALE 25009—XXXXXX). TERMINAL. | WEIGHT: 2372 LBS 1078 KG | WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG CODE STANDAGGS.
 | SHIPPING SPLIT I WEIGHT: 2372 LBS 1078 KG CODE STANDARTS: | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG CODE STANDARDS. | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG CODE STANDARDS | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLIT 1 WEIGHT, 2372 LBS 1078 KG
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 | SHIPPING SPLIT I WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLIT I WEIGHT: 2372 LBS 1078 KG | SHEPHIC SPLIT I WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLIT I WEIGHT: 2372 LBS 1078 KG
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| SHIPPING SPLIT I WEGHT: 2372 LBS 1078 KG COCK_STANDAGES. THIS FOUNDWIN BEARS THE UL LISTING MARK FOR THE UNITED STATES. THOUSE THE SOLVEN BEARS THE UL LISTING MARK FOR THE UNITED STATES. TANKE LABELING. WIRE LABELING. WIRE SHALL BE USELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). TERMINATIONS: (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL. | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). ED WITH DESTINATION WARKING (ORIGIN-DESTINATION). AMINATIONS (WHERE REQUIRED) SHALL BE TYPE LUGS (STYLE 25009-XXXXX). TERMINAL | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL. WIRING LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). LED WITH DESTINATION STATE BE THE LUGS (STYLE 25009-XXXXX). TERMINAL LOGS (STYLE 25009-XXXXX). | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL, WIRING EED WITH DESTINATION MARKING (ORIGIN-DESTINATION). EED WITH DESTINATION WARKING (ORIGIN-DESTINATION). THE LUGS (STYLE 25009-XXXXX). TERMINAL. THEN MAKE. DOCKING STATE OFFICE BUTTONS (STATE OFFICE BUTTONS). | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING SATER CONTROL WIRING WITH DESTINATION MARKING (ORIGIN-DESTINATION). SAMINATIONS (WHERE REQUIRED) SHALL BE THE LUCS (STYLE 25009—XXXXX). TERMINAL. | STHE UL LISTING MARK FOR THE UNITED STATES. NATROL WIRING, UNLESS OTHERWISE SPECIFIED SATER CONTROL WIRING LED WITH DESTINATION MARKING (ORIGIN—DESTINATION). SANIMATIONS (WHERE REQUIRED) SHALL BE TYPE LUCS (STYLE 25009—XXXXX). TERMINAL. | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING. LED WITH DESTINATION MARKING (ORIGIN—DESTINATION). SAUNATIONS (WHERE REQUIRED) SHALL BE THPE LUGS (STYLE 25009—XXXXX). TERMINAL | SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CODE STANDARDS. THIS EQUIPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. THIS EQUIPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. GONTROL WERNER. # 14 A MIG. TYPE SIS CONTROL WIRING. # 12 AMG. TYPE SIS CONTROL WIRING. # 12 AMG. TYPE SIS CONTROL WIRING. # 12 AMG. TYPE SIS HEATER CONTROL WIRING. WIRES SHALL BE LABELING. WIRES SHALL BE LABELING. WIRES SHALL BE LOSE (STYLE 25009-XXXXX). TERMINAL. UNINSULATED RING TYPE LUCS (STYLE 25009-XXXXXX). TERMINAL.
 | SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CODE STANDAGES. THIS FOUNDANT BEARS THE UL LISTING MARK FOR THE UNITED STATES. HODUCT INCORMATION: CONTROL WIRNS, UNLESS OTHERWISE SPECIFIED. #14 AND, TYPE SIS CONTROL WIRNG, UNLESS OTHERWISE SPECIFIED. #12 AND, TYPE SIS CONTROL WIRNG, UNLESS OTHERWISE SPECIFIED. #12 AND, TYPE SIS CONTROL WIRNG WIRES SHALL BE LABELING. WHERS SHALL BE LABELING. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUCS (STYLE 25009—XXXXX). TERMINAL | SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CODE_STANDAGES. THIS FOURNENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. CONTIGOL WIRING. CONTIGOL WIRING. UNILESS OTHERWISE SPECIFIED # 14 ANG. TYPE SIS CONTROL WIRING. # 12 ANG. TYPE SIS CONTROL WIRING. # 12 ANG. TYPE SIS HATER CONTROL WIRING. WIRES SHALL BE LABELED. UNINSULATED RING TYPE LUGS (STYLE 25009-XXXXXX). TERMINAL. | SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CONE STANDAGES. THIS FOURWENT BEARS THE UL LISTING WARK FOR THE UNITED STATES. RODUCT INFORMATION. CONTROL WIRING. UNITESS OTHERWISE SPECIFIED #12 ANG, TYPE SIS CONTROL WIRING. #12 ANG, TYPE SIS CONTROL WIRING. WIRE LABEING. WIRE LABEING. WIRE STAIL BE LABELED WITH DESTINATION WARKING (ORIGIN—DESTINATION). IEMINATONAS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CODE_STANDARDS. THIS FOURNENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. RODUCT INFORMATION. CONTROL WRING. LATE AND THE SIS CONTROL WIRING. #14 AND THE SIS HEATER CONTROL WIRING. WIRE LABELING. WIRE SHALL BE LABELING. WIRES SHALL BE LABELING. U.OW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL. | WEIGHT: 2372 LBS 1078 KG
 | WEIGHT: 2372 LBS 1078 KG | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG CODE STANDAGGS | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG CODE STANDAGES: | SHIPPING SPLIT I WEIGHT: 2372 LBS 1078 KG CODE STANDAGGS. | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG CODE STANDARDS: | SHIPPING SPLIT I WEIGHT: 2372 LBS 1078 KG
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| SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CONE STANDARDS. THIS EQUIVALIN'S BEARS THE UL LISTING MARK FOR THE UNITED STATES. THIS EQUIVALIN'S BEARS THE UL LISTING MARK FOR THE UNITED STATES. TOWARD AND THE SIS CONTROL WIRING. # 12 ANG, TYPE SIS CONTROL WIRING. WIRE LABEING. WIRE SHALL BE LABEING. WIRES SHALL BE LABEING WHERE REQUIRED) SHALL BE LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009-XXXXX). TERMINAL | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). ED WITH DESTINATION WARKING (ORIGIN-DESTINATION). AMINATIONS (WHERE REQUIRED) SHALL BE TYPE LUGS (STYLE 25009-XXXXX). TERMINAL | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL. WIRING LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). LED WITH DESTINATION STATL BE NAME LUGS (STYLE 25009-XXXXX). TERMINAL LOGS (STYLE 25009-XXXXX). | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING EED WITH DESTINATION MARKING (ORIGIN-DESTINATION). EED WITH DESTINATION WARKING (ORIGIN-DESTINATION). THE LUGS (STYLE 25009-XXXXX). TERMINAL THE LUGS (STYLE 25009-XXXXXX). | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING SATER CONTROL WIRING SATER CONTROL WIRING WHERE REQUIRED) SHALL BE THE LUCS (STYLE 25009—XXXXX). TERMINAL | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING LED WITH DESTINATION MARKING (ORIGIN—DESTINATION). SAMINATIONS (WHERE REQUIRED) SHALL BE THE LUCS (STYLE 25009—XXXXX). TERMINAL. | SHE, 2372 LBS 1078 KG STHE UL LISTING MARK FOR THE UNITED STATES. ANTROL WIRING, UNLESS OTHERWISE SPECIFIED SATER CONTROL WIRING ED WITH DESTINATION MARKING (ORIGIN—DESTINATION). ANIMATIONS (WHERE REQUIRED) SHALL BE TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CODE STANDARDS. THIS COUNDENT BLARS THE UL LISTING MARK FOR THE UNITED STATES. THOUSENLY WEING. CONTROL WEING. #14 ANG. TYPE SIS CONTROL WIRING. #12 ANG. TYPE SIS CONTROL WIRING. #18 ANG. TYPE SIS CONTROL WIRING. *18 ANG. TYPE SIS CONTROL WIRING. | SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CODE STANDARDS. THIS EQUIPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. HODUCT INCORMATION: GOTTOM WIRNS. #14 AND TYPE SIS CONTROL WIRING. #12 AND, TYPE SIS CONTROL WIRING. #18 AND TYPE SIS CONTROL WIRING. #18 AND TYPE SIS HEATER CONTROL WIRING. #18 AND TYPE SIS HEATER CONTROL WIRING. #18 AND TYPE SIS HEATER CONTROL WIRING. #18 AND TYPE SIS CONTROL WIRING. #18 AND TYPE SIS ON THE STANDARD WARKING. #18 AND TYPE THE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUCS (STYLE
25009—XXXXX). TERMINAL. | SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CODE STANDARDS. THIS FOURWANT BEARS THE UL LISTING MARK FOR THE UNITED STATES. RODUCT INFORMATION: CONTING WIRING. UNIVESS OTHERWISE SPECIFIED # 12 AWG. TYPE SIS CONTROL WIRING. ## 12 AWG. TYPE SIS CONTROL WIRING. ## 12 AWG. TYPE SIS HATER CONTROL WIRING. ## 12 AWG. TYPE SIS C | SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CODE_STANDAGES. THIS FOURNENT BEARS THE UL LISTING WARK FOR THE UNITED STATES. RODUCT_INFORMATION. CONTROL_WIRING. #12 ANG. TYPE SIS CONTROL_WIRING. #12 ANG. TYPE SIS HEATER CONTROL_WIRING. #18 ANG. TYPE SIS HEATER CONTROL_WIRING. #18 ANG. TYPE SIS HEATER CONTROL WIRING. #18 TEMINATIONS (WHERE REQUIRED) SHALL BE LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL. | SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CONE_STANDAGES. THIS FOUNDMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. THIS FOUNDMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. TODUCT INCOMMATION. CONTROL WRING. #14 AWG. TYPE SIS CONTROL WIRING. #12 AWG. TYPE SIS CONTROL WIRING. WIRE LABELING. WIRE LABELING. WIRE SHALL BE LABELING. UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL. | WEIGHT: 2372 LBS 1078 KG
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 | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 1078 KG CONE STANDAGES. THIS COLORMANT BEARS THE UL LISTING MARK FOR THE UNITED STATES. THOUGHNANT BEARS THE UL LISTING MARK FOR THE UNITED STATES. GONTROL WIRING. #14 A MIG. THE SIS CONTROL WIRING. #18 A MIG. THE ELABELING. WHEES SHALL BE LABELING. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE LUNINSULATED RING TYPE LUCS (STYLE 25009—XXXXX). TERMINAL. | SHIPPING SPLIT 1 WEGHT: 2372 LBS 107B KG CODE STANDARDS THIS EQUIPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. RODUCT INFORMATION: CALINGL WIRING. CALINGL WIRING. LIST ANG. TYPE SIS CONTROL WIRING. WIREL JABLING. WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). IEBUINATIONS: (WHERE REQUIRED) SHALL BE LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL | SHIPPING SPLIT 1 WEGHT: 2372 LBS 1078 KG CONE STANDARDS. THIS FOURNENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. RODUCT INFORMATION. CONTROL WIRING. AT A MIG. TYPE SIS CONTROL WIRING. #12 ANG. TYPE SIS CONTROL WIRING. #18 ANG. TYPE SIS HEATER CONTROL WIRING. **IREMINATIONS (WHERE REQUIRED) SHALL BE LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | SHIPPING SPLIT 1 WEIGHT: 2372 LBS 107B KG CONE STANDANDS. THIS FOULPWENT BEARS THE UL LISTING WARK FOR THE UNITED STATES. THOUSE COUPAND BEARS THE UL LISTING WARK FOR THE UNITED STATES. CONTROL WEINS. # 14 AWG, TYPE SIS CONTROL WIRING. # 12 AWG, TYPE SIS CONTROL WIRING. WIRE LABELING. WIRE LABELING. WIRE SHALL BE LABELED WITH DESTINATION WARKING (ORIGIN—DESTINATION). TEMINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | WEIGHT: 2372 LBS 1078 KG
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| SAFETING STULL I WEIGHT 2372 LBS 1078 NG SOURCE INFORMATION. COUNTROL WRING. #14 A AWG, TYPE SIS CONTROL WIRING. UNLESS OTHERWISE SPECIFIED #12 ANG, TYPE SIS HEATER CONTROL WIRING. WIRES SHALL BE LABELING. WIRES SHALL BE LABELING. WIRES SHALL BE LABELING. UNINSULATED RING TYPE LUCS (STYLE 25009—XXXXX). TERMINAL. | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). RAINATIONS (WHERE REDURED) SHALL BE NPE LUGS (STYLE 25009-XXXXX). TERMINAL | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). RAINATIONS (WHERE REQUIRED) SHALL BE THE LUGS (STYLE 25009-XXXXX). TERMINAL. | STHE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). ENTRY DESTINATIONS (WHERE REQUIRED) SHALL BE TYPE LUGS (STYLE 25009-XXXXX). TERMINAL. | STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). AMINATIONS (WHERE REQUIRED) SHALL BE TYPE LUGS (STYLE 25009-XXXXX). TERMINAL. | THE UL LISTING MARK FOR THE UNITED STATES. ANTROL WIRING, UNLESS OTHERWISE SPECIFIED SATER CONTROL WIRING ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). AMINATIONS (WHERE REQUIRED) SHALL BE THE LUGS (STYLE 25009—XXXXX). TERMINAL | STHE UL LISTING MARK FOR THE UNITED STATES. WHENC, UNLESS OTHERWISE SPECFFED WITHOL WIRING, UNLESS OTHERWISE SPECFFED ED WITH DESTINATION MARKING (ORIGIN—DESTINATION). ED WITH DESTINATION MARKING (ORIGIN—DESTINATION). WHERE REQUIRED) SHALL BE TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | SHIPTING STOLL IN BLOCK IN THE UNITED STATES. THIS COUPLEMENT EARS THE UL USTING MARK FOR THE UNITED STATES. THIS COUPLEMENT CONTROL WIRING. #14 AWG. THE SIS CONTROL WIRING. #12 AWG. THE SIS CONTROL WIRING. WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). IERUMANDORS. LOW VOLTAGE WIRE TERMINATIONS (WHERE RECURED) SHALL BE UNINSULATED RING THE LUCS (STYLE 25009—XXXXXX). TERMINAL.
 | SHIPTING STUIL IN BLOOKE STATE LES TOTA NO. SOCKE STANDARDS. THIS COUPLEANT BEARS THE UL LISTING MARK FOR THE UNITED STATES. THIS COUPLENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. CONTROL WIRING. UNITESS OTHERWISE SPECIFIED. # 12 ANG. TYPE SIS HEATER CONTROL WIRING. WIRE LABELING. WIRES SHALL BE LABELING. WIRES SHALL BE LABELING. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STALE 25009-XXXXX). TERMINAL | SMETRING SHOUT I WELGHT: 23/2 LES 10/8 NG SOOKE STANDARDS THIS COLORMAN BEAS THE UL LISTING MARK FOR THE UNITED STATES. THE SOUTH INCOME AND THE CONTROL WIRTHOUT WARNING, UNLESS OTHERWISE SPECIFIED # 14 AND TYPE SIS CONTROL WIRTHOUT WARNING (ORIGIN—DESTINATION). TEAMINATIONS LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUCS (STYLE 25009—XXXXXX). TERMINAL | SAMPTING STALL IN PLOCATE LAS TO A NO. SOCIETAL WINNERS. THIS COUPLING HE LO LESTING MARK FOR THE UNITED STATES. RODUCT INFORMATION. CANTROL WINNERS. #12 ANG, TYPE SIS CONTROL WIRING. #12 ANG, TYPE SIS CONTROL WIRING. #12 ANG, TYPE SIS HEATER CONTROL WIRING. WREES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). IEAUINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXXX). TERMINAL. | SHIPTING STULL I WEIGHT: 2372 LBS 1078 NG CONCITC INFORMATION: CONTROL WRING. #14 A ANG, TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED #12 ANG, TYPE SIS HEATER CONTROL WIRING WIRES SHALL BE LABELED WITH DESTINATION WARKING (ORIGIN—DESTINATION). TERMINATIONS LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | WEIGHT: Z3/Z LBS 10/8 KG
 | WEIGHT: 23/2 LBS 10/8 KG | SHIPING SHULL I WEIGHT: 23/2 LBS 10/8 KG. | SMIPNIG SPLIL I WEIGHT: 23/2 LBS 10/8 KG CODE STANDARDS | CODE STANDARDS. | SAIPMENS SPILL WEIGHT: 23/2 LBS 10/8 KG.
CODE STAINMENS. | SAIFWAN SPILL I WEIGHT 2.2/Z LBS 10/B KG.
 | SHIPPING SPLIT I WEIGHT: 23/2 LBS 10/8 KU | SHIPPING SPLI I WEGH: 23/2 LBS 10/8 KG | SHIPPING SPLIT I WEIGHT: 23/2 LBS 10/8 KG | SHIPPING SPULL WEIGHT 23/2 LBS 10/8 KG | | |
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 | SMIPHOUS SHULL WEIGHT: 23/2 LBS 10/8 KG. | SHIPMOS SHILL I WELGHT: 23/2 LBS 10/8 KG | SAIPTING STUT I WEIGHT: 23/2 LBS 10/8 KG | SAHINING SHILL I WEIGHT: 23/2 LBS 10/8 KG | SHIPMS SHILL I WEIGHT: 23/2 LBS 10/8 KG
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| THIS COURTED. WHENES THE UL USTING MARK FOR THE UNITED STATES. THIS COURTED. WHENES. # 14 A AWG, TYPE SIS CONTROL WIRING, UNITESS OTHERWISE SPECIFIED # 12 AWG, TYPE SIS HEATER CONTROL WIRING, UNITESS OTHERWISE SPECIFIED # 12 AWG, TYPE SIS HEATER CONTROL WIRING WIRES SHALL BE UBBELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). TERMINATIONS. LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINSULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | STHE UL LISTING MARK FOR THE UNITED STATES. WIRNOL WIRNOL UNLESS OTHERWISE SPECIFIED SATER CONTROL WIRNOG ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). NAINATIONS (WHERE REQUIRED) SHALL BE THE LLUGS (STYLE 25009-XXXXX). TERMINAL | STHE UL LISTING MARK FOR THE UNITED STATES. WIRNOL WIRNOL UNLESS OTHERWISE SPECIFIED SATER CONTROL WIRING ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). WHERE REQUIRED) SHALL BE WHY DESTINATIONS (WHERE REQUIRED) SHALL BE TYPE LUGS (STYLE 25009—XXXXX). TERMINAL | THE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). RAINATIONS (WHERE REDURED) SHALL BE THE LLOSS (STYLE 25009-XXXXX). TERMINAL | THE UL LISTING MARK FOR THE UNITED STATES. STHE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). SAHINATIONS (WHERE REQUIRED) SHALL BE SHALL BE TYPE LUGS (STYLE 25009-XXXXX). TERMINAL. | THE UL LISTING MARK FOR THE UNITED STATES. SATER CONTROL WIRING. LED WITH DESTINATION MARKING (ORIGIN-DESTINATION). HED WITH DESTINATION WARKING (ORIGIN-DESTINATION). TEMMINATIONS (WHERE REQUIRED) SHALL BE THE LUCS (STYLE 25009-XXXXX). TERMINAL | STHE UL LISTING MARK FOR THE UNITED STATES. MIRNOL WIRNOL UNILESS OTHERWISE SPECIFIED SATER CONTROL WIRNG ED WITH DESTINATION MARKING (ORIGIN-DESTINATION). SAINMATIONS (WHERE REQUIRED) SHALL BE TYPE LUGS (STYLE 25009-XXXXX). TERMINAL | THIS COUPLER'S THE UL LISTING MARK FOR THE UNIED STATES. THIS COUPLENENT BEARS THE UL LISTING MARK FOR THE UNIED STATES. ACANTRAL WIRNAG. #12 ANG. TYPE SIS CONTROL WIRNAG. UNLESS OTHERWISE SPECIFED #12 ANG. TYPE SIS CONTROL WIRNAG. WRETS SHALL BE LABELED WITH DESTINATION WARKING (ORIGIN—DESTINATION). TEAUNATOM'S. LOW VOLTAGE WIRE TERMINATIONS (WHERE RECOURED) SHALL BE UNINSULATED RING TYPE LUCS (STYLE 25009—XXXXXX). TERMINAL.
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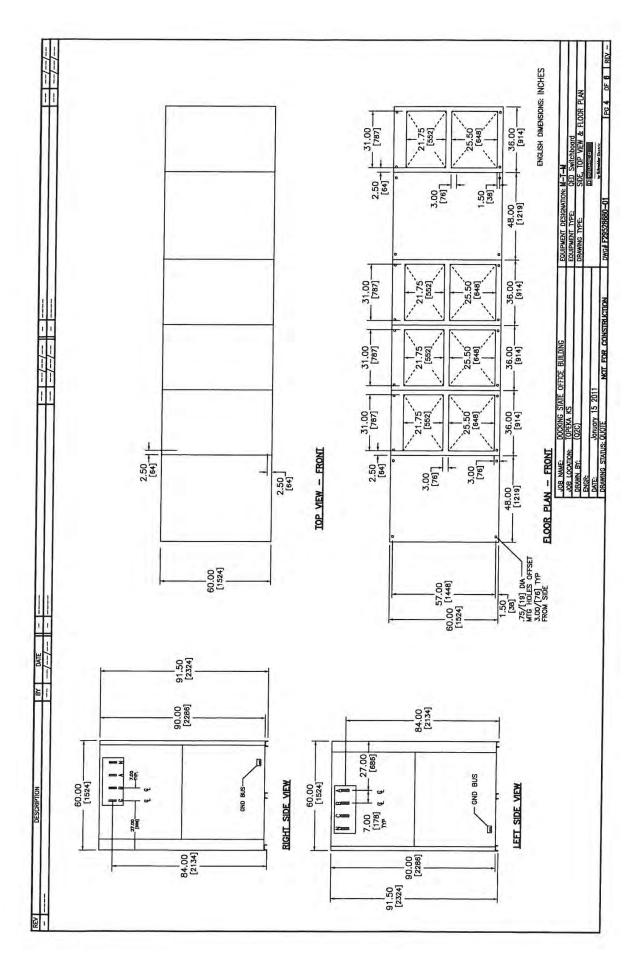


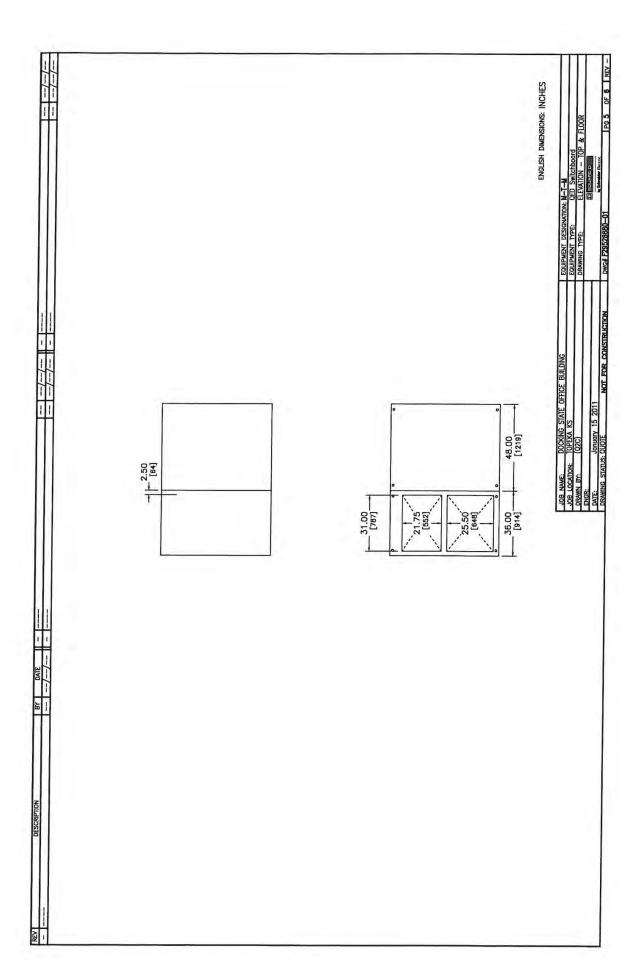


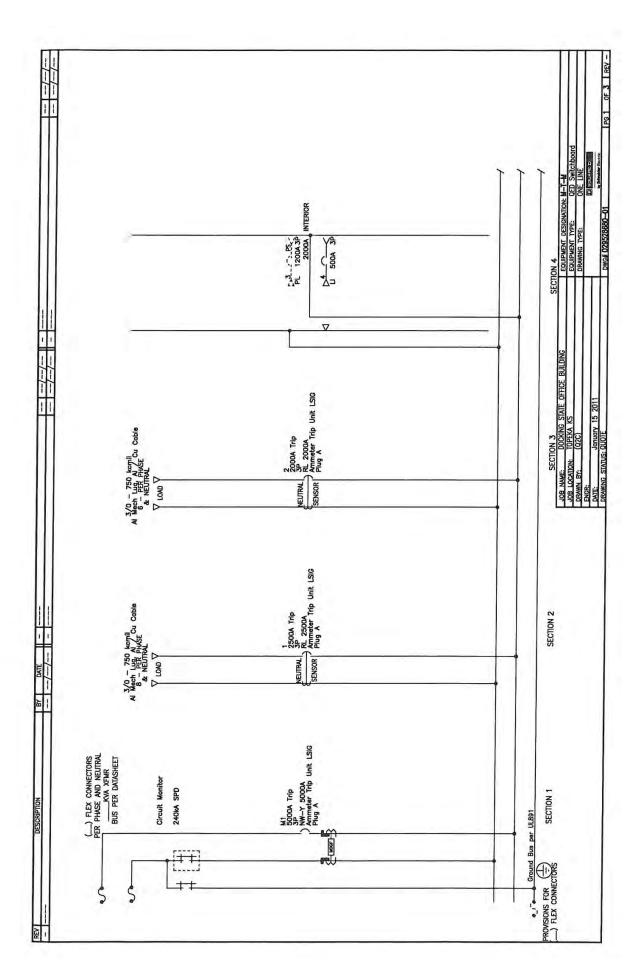


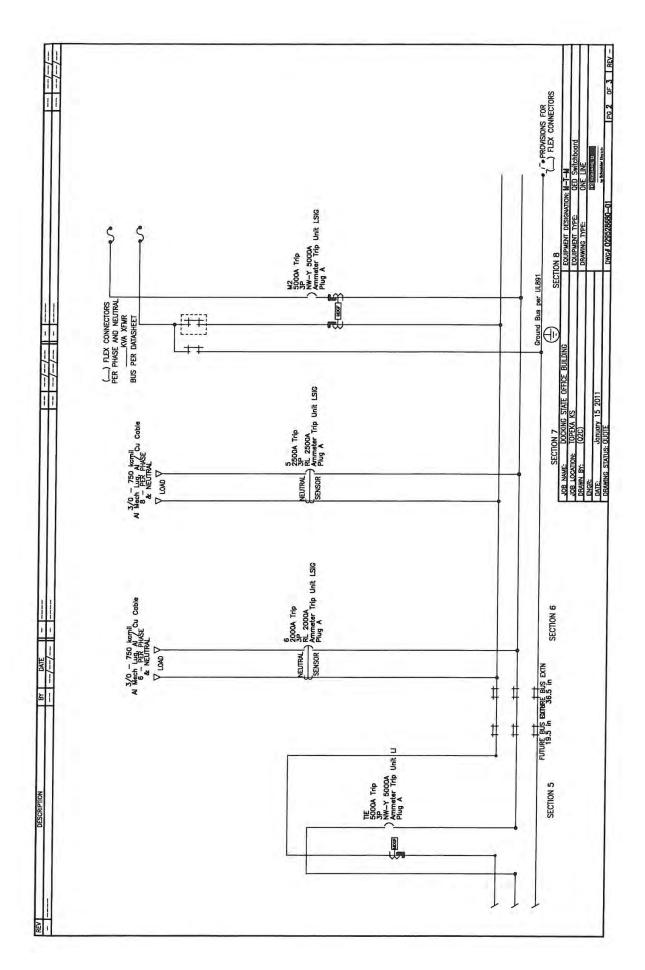










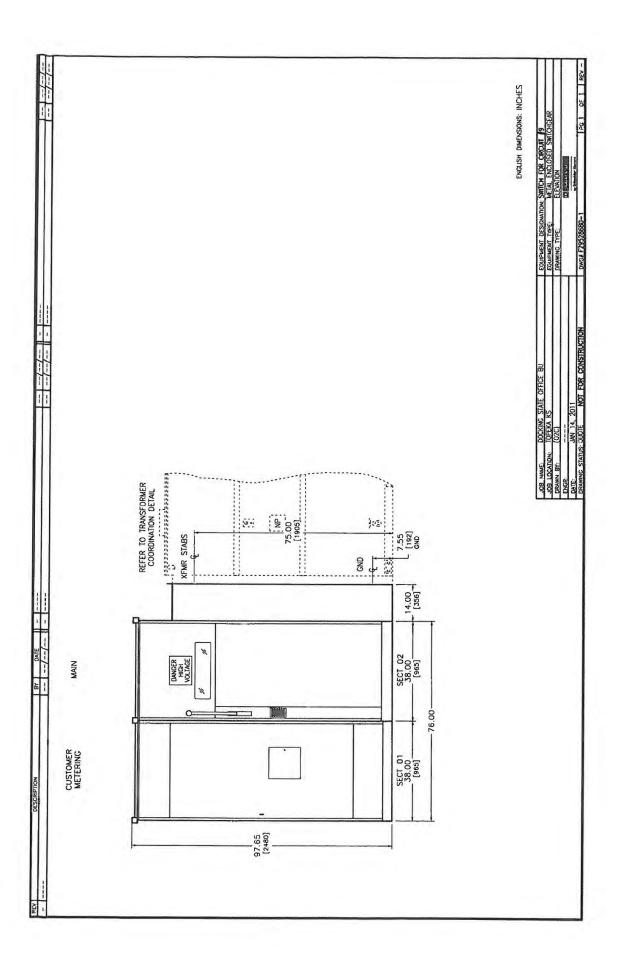


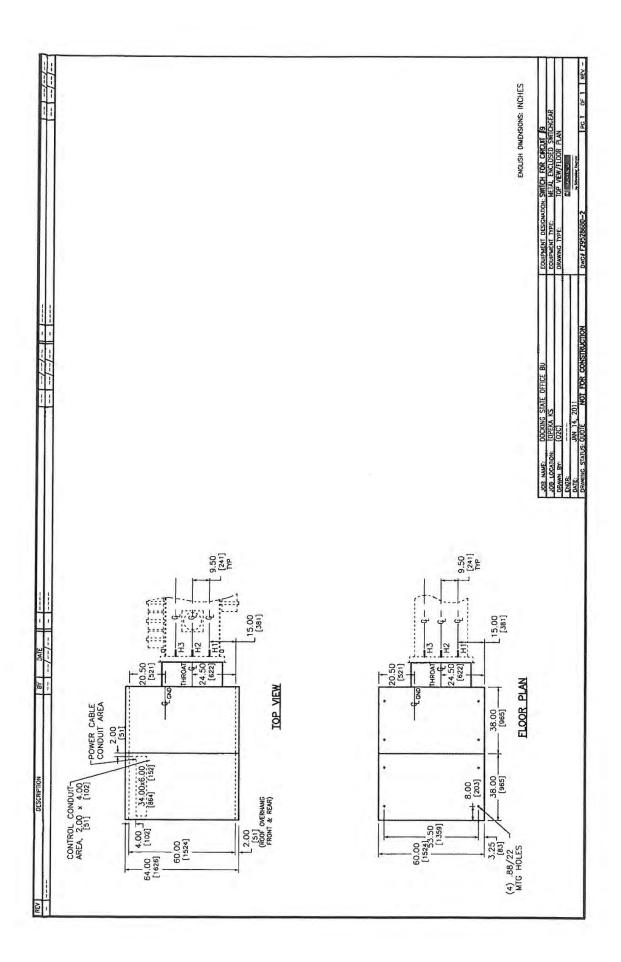
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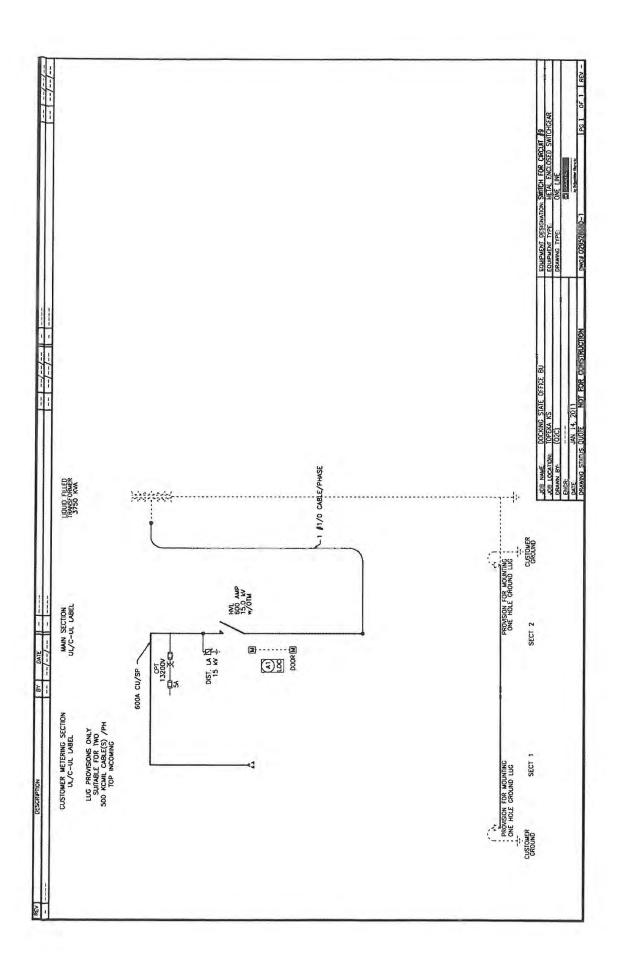
APPENDIX G: OPTION 2 - TRANSFORMER AND SWITCHGEAR SHOP DRAWINGS

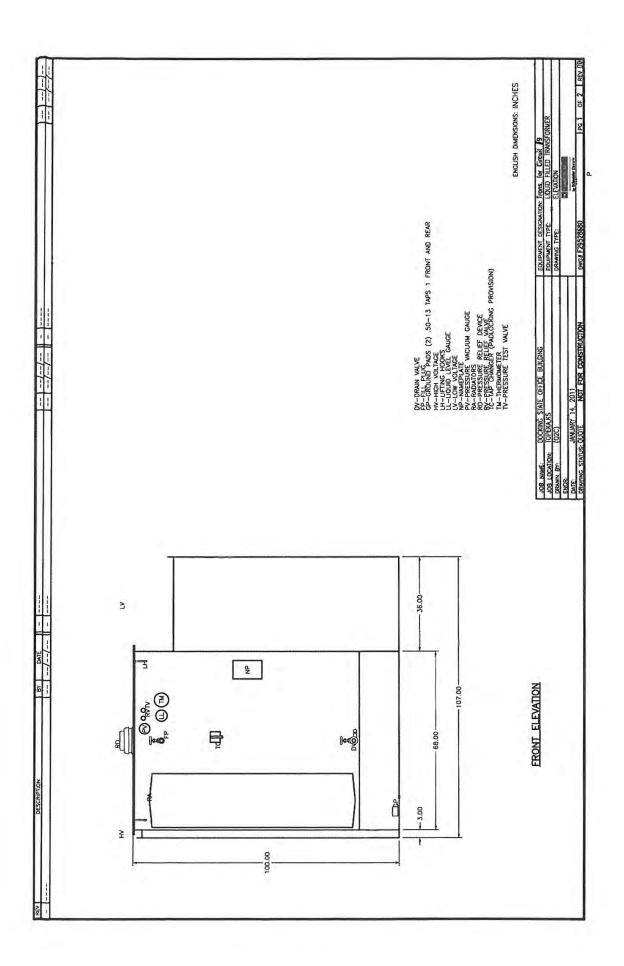
Appendices

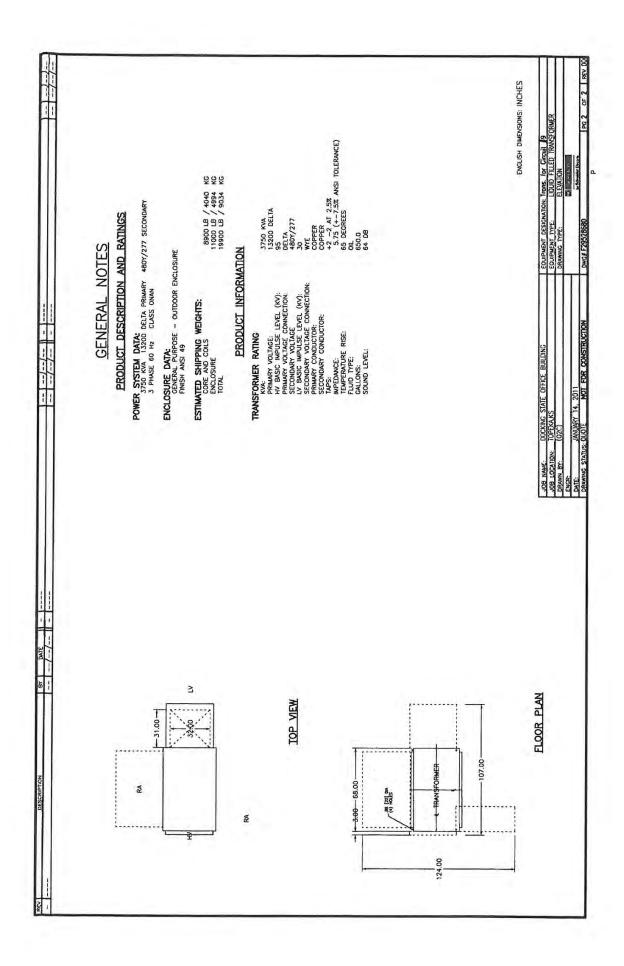


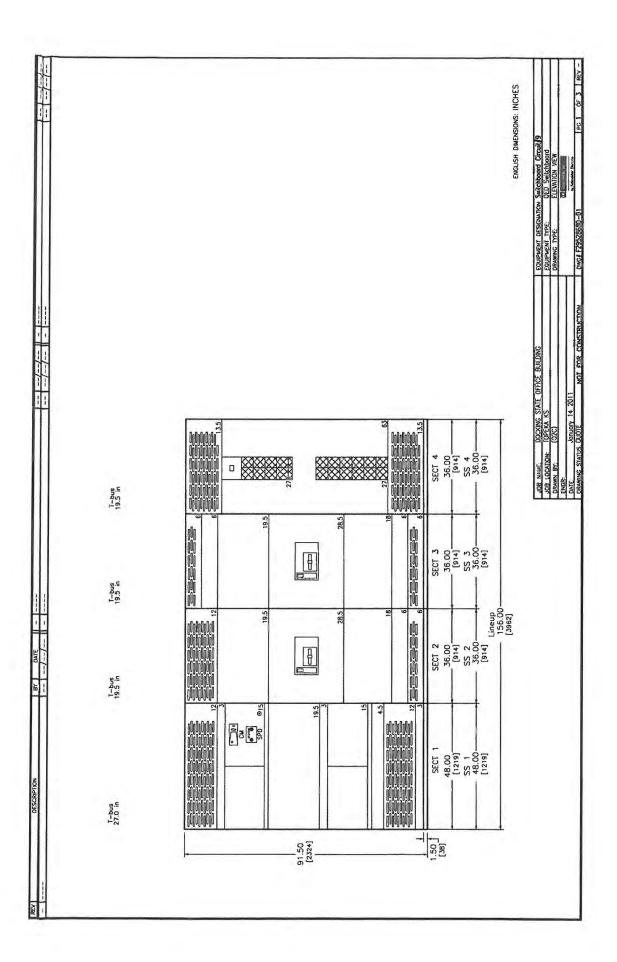


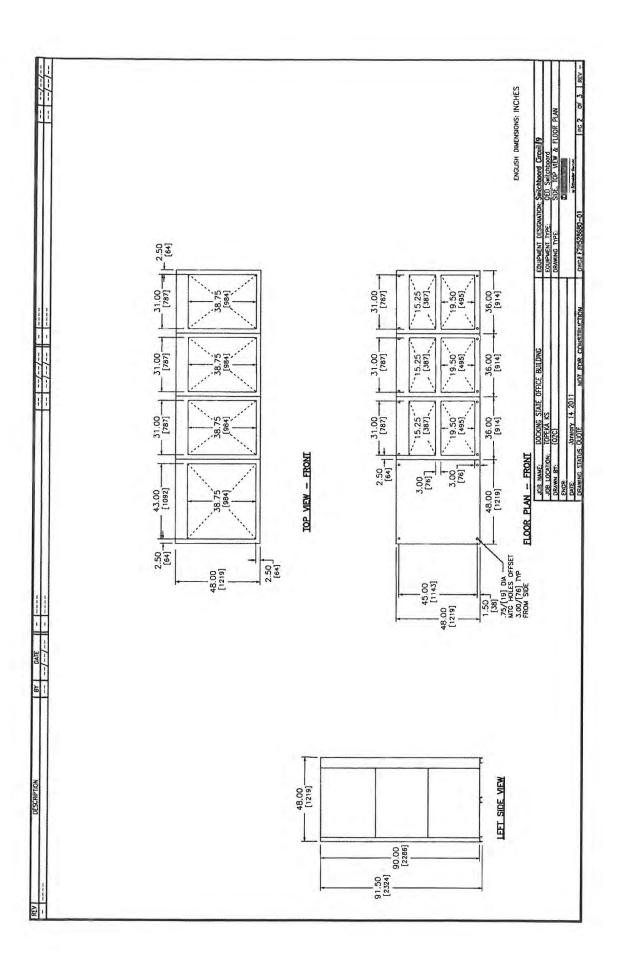
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JOB NAME: DOCKING STATE OFFICE BU EQUIPMENT DESIGNA JOB LOCATION: TOPER KS LADB LOCATION: TOPER DARWING TYPE: FUND:	S THE UL LISTING MARK FOR THE UNITED		
JOB NAME: DOCKING STATE OFFICE BU LOB LOCATION: TOPERA KS LOBER TOPERATIONS TOPERATIONS TOPERATIONS TOPERATIONS TO TOPERATIO	CONTROL WISHNS:		
JR6), JOB NAME: DOCKING STATE OFFICE BU EQUIPMENT OFFICE BU EQUIPMENT OFFICE BU EQUIPMENT TYPE: DRAWN BY: 102C) ENGEN BY: 102C) ENGER THE	#14 AWG, TYPE SIS COMTROL WIRING, UNLESS OTHERWISE SPECIFIED #12 AWG, TYPE SIS HEATER CONTROL WIRING WITE LABILING.		
S (TYPE 90BOORB), JOB NAME: DOCKING STATE OFFICE BU EQUIPMENT DESIGNA LOBB LOCKTON: TOPETA KS DORWING TYPE: DORWING TYPE: DOKNING TYPE:	WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN—DESTINATION). ITERLINATIONS.		
E OUFICE BU EQUIPMENT OESIGNA COUPMENT TYPE: DRAWING TYPE:	LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE. UNINISULATED RING TYPE LUGS (STYLE 25009-XXXXX). TERMINAL BLOCKS ARE SQUARE D COMPRESSION SOLDERLESS BOX LUG (TYPE 9080GR6), FUSE BLOCK (9080GF6).		
E. OFFICE BU ECUIPMENT DESIGNA EQUIPMENT TYPE: DRAWING TYPE:			
CIVILLY DISTRICT		DOCKING STATE OFFICE BU EQUIPMENT DESIGNATION (FOLKA KS) (OOF KE ACCOUNTY TYPE: 100 COUNTY	METAL ENCLOSED SWITCHGEAR CENERAL MOTES
		7,757	जिल्ला मिलान

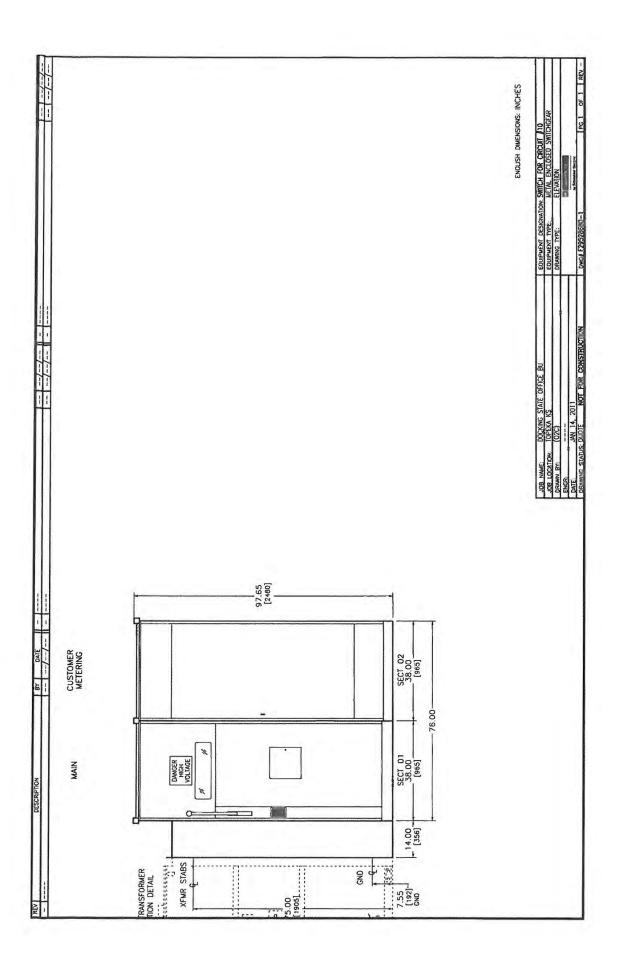


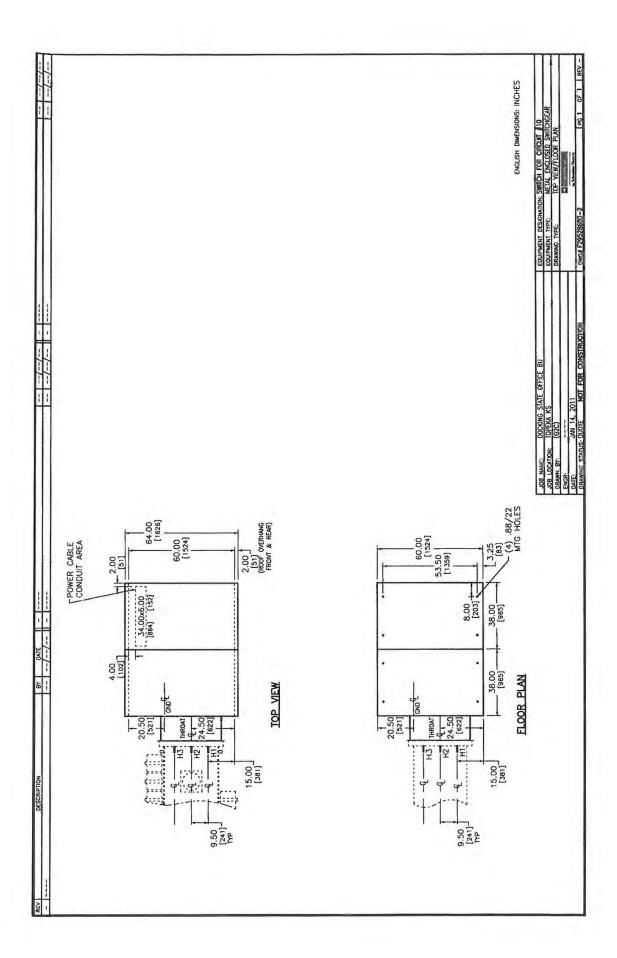




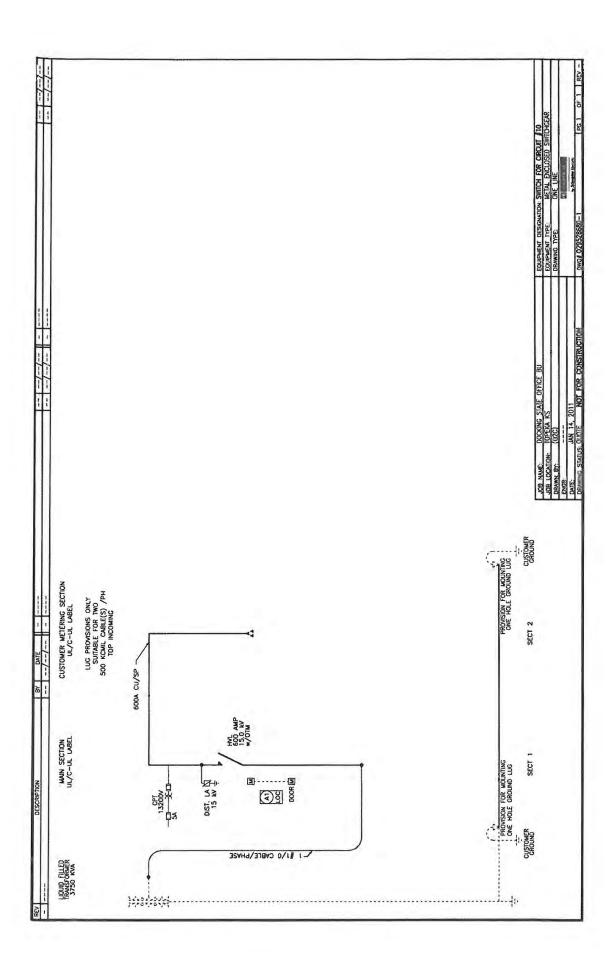


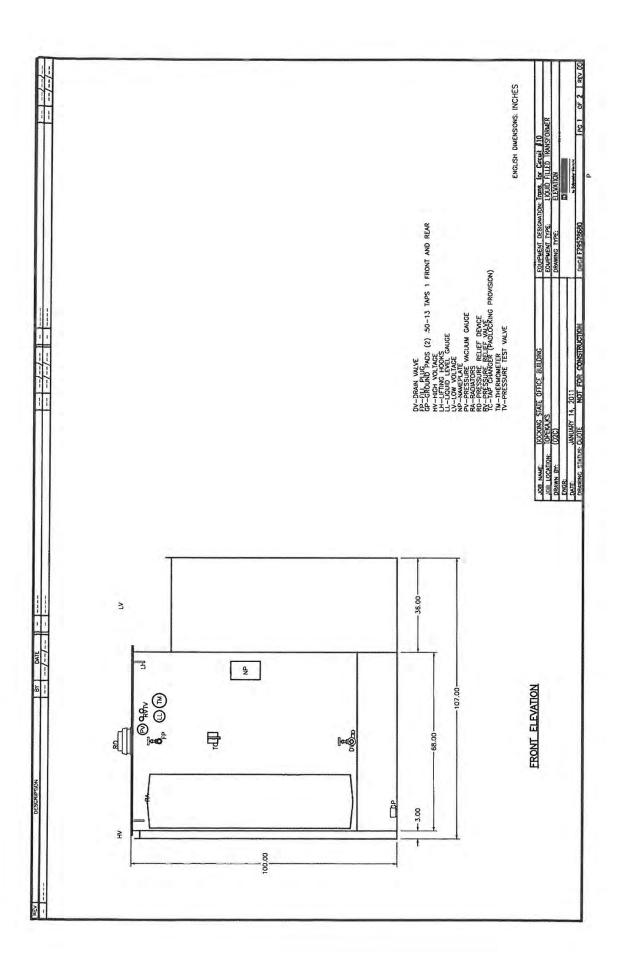


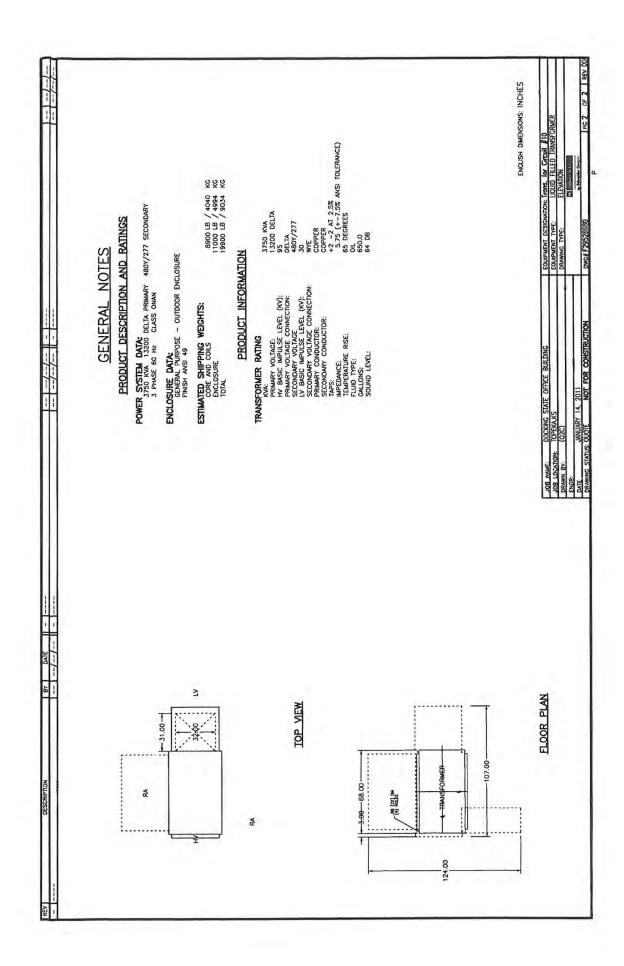


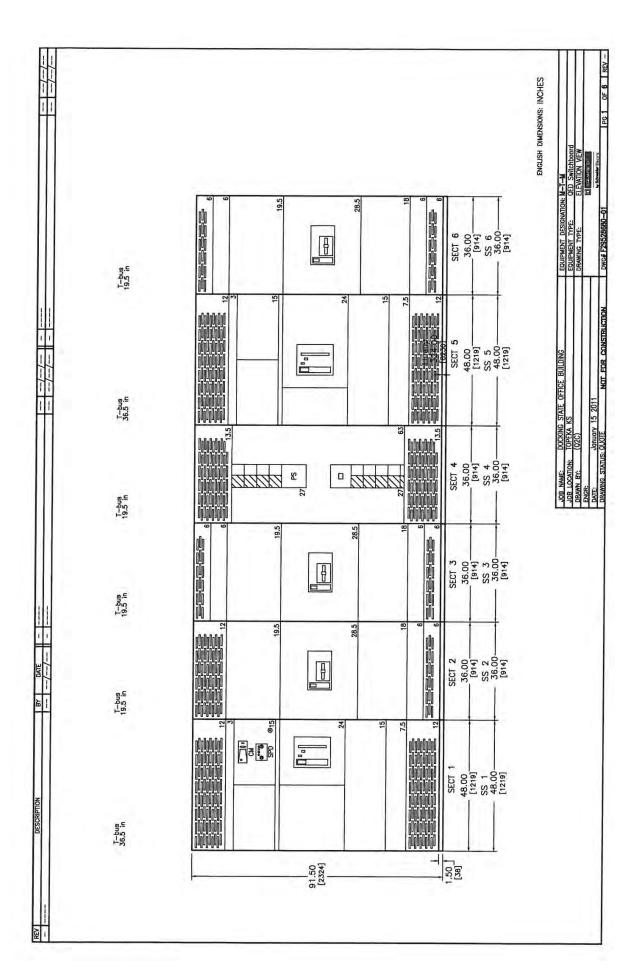


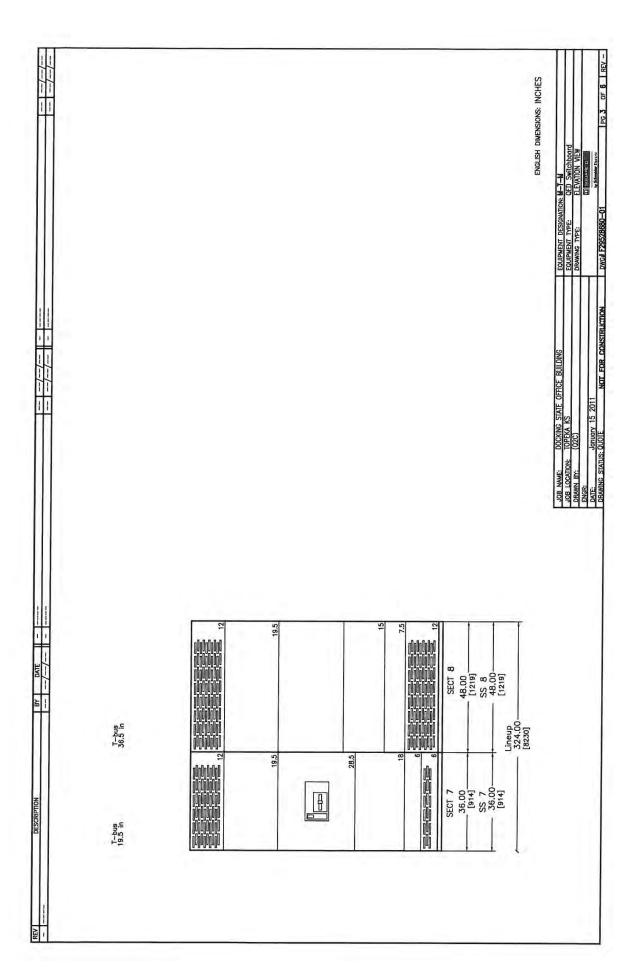
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GENERAL NOTES:		
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FREEDY LESCHITCH AND RAINES.	Salara Anna Anna Anna Anna Anna Anna Anna A	
13200 VOLTS, 3 PHASE, 3 WIRE WYE SOLIDLY GROUNDED	OF HONS/ACCESSORIES:	
15.0 KV MAXIMUM VOLTAGE RATING	LIST OF MISC. ACCESSORIES:	
35 KV BIL, 60 HERTZ FREQUENCY	STRIP HEATERS	
BUS SYSTEM DATA	LIST OF MISC. STRUCTURE OPTIONS:	
600A COPPER SILVER PLATED MAIN RUS	LIST OF MISC. GENERAL OPTIONS:	
EPOXY BUS SUPPORTS		
SILVER PLATED COPPER GROUND BUS		
40 KA ASYM (25 KA SYM) MAIN BUS BRACING		
ENCLOSURE DATA:		
TYPE 3R OUTDOOR NON-WALKIN CONSTRUCTION		
CATEGORY "B" ENCLOSURE		
ANSI #61 FINISH		
FROM TYPE SR REMOVED FOR CLARITY		
PADLOCK PROVISIONS		
TOP CABLE ENTRY: ENTRY THRU TOP TO BE PUNCHED DURING INSTALLATION		
IN GENERAL AREA SHOWN ON TOP VIEW, IF APPLICABLE. RECOMMENDED POWER CABLE		
ENTRY AREA, 6" X 34" (152 X 864) AS SHOWN ON TOP VIEW. HANDLING:		
SWITCHGEAR SECTIONS ARE FURNISHED WITH LIFTING ANGLES AND ARE SHIPPED ON SKIDS.		
ROLLERS OR FORKLIFT SHALL ONLY BE USED WITH SKID IN PLACE.		
APPROXIMATE WEIGHT: 2372 LBS 1078 KG		
CODE STANDARDS.		
THIS EQUIPMENT BEARS THE UL LISTING MARK FOR THE UNITED STATES. PRODUCT_INFORMATION:		
CONTROL WIRING		
#14 AWG, TYPE SIS CONTROL WIRING, UNLESS OTHERWISE SPECIFIED #12 AWG, TYPE SIS HEATER CONTROL WIRING WIRE LASELING.		
WIRES SHALL BE LABELED WITH DESTINATION MARKING (ORIGIN-DESTINATION). IERMINATIONS .		
LOW VOLTAGE WIRE TERMINATIONS (WHERE REQUIRED) SHALL BE UNINISULATED RING TYPE LUGS (STYLE 25009—XXXXX). TERMINAL BLOCKS ARE SQUARE D COMPRESSION SOLDERLESS BOX LUG (TYPE 9080GR6), FUSE BLOCK (9080GF6).		
	JOB NAME: DOCKING SIGIE OFFICE BU JOB LOCATION: TOPERA KS CRAWN BY: (02C)	EQUIPAGNT DESIGNATION: SMITCH FOR CINCUIT FLO EQUIPAGNT TYPE: WETAL ENCLOSED SWITCHGEAR DRAWING TYPE: GÖNERAL NOTES
	DATE: JAN 14, 2011	P. Stondar Strott

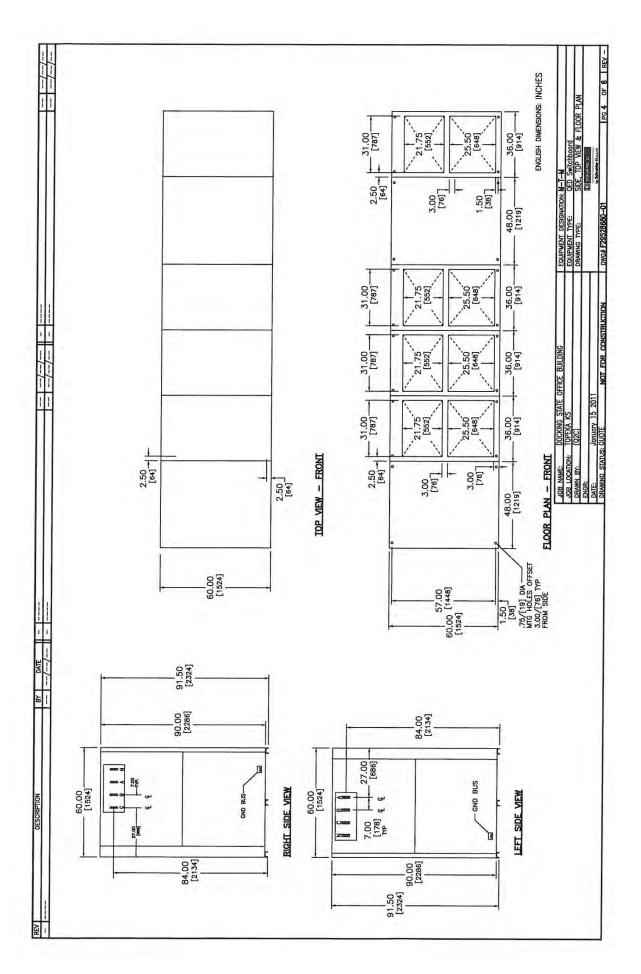


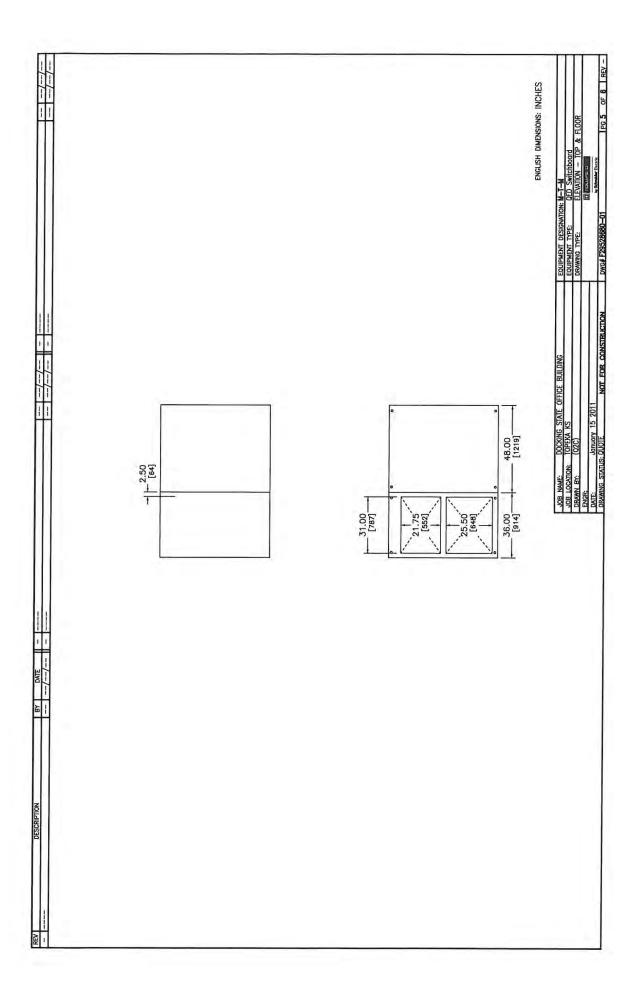


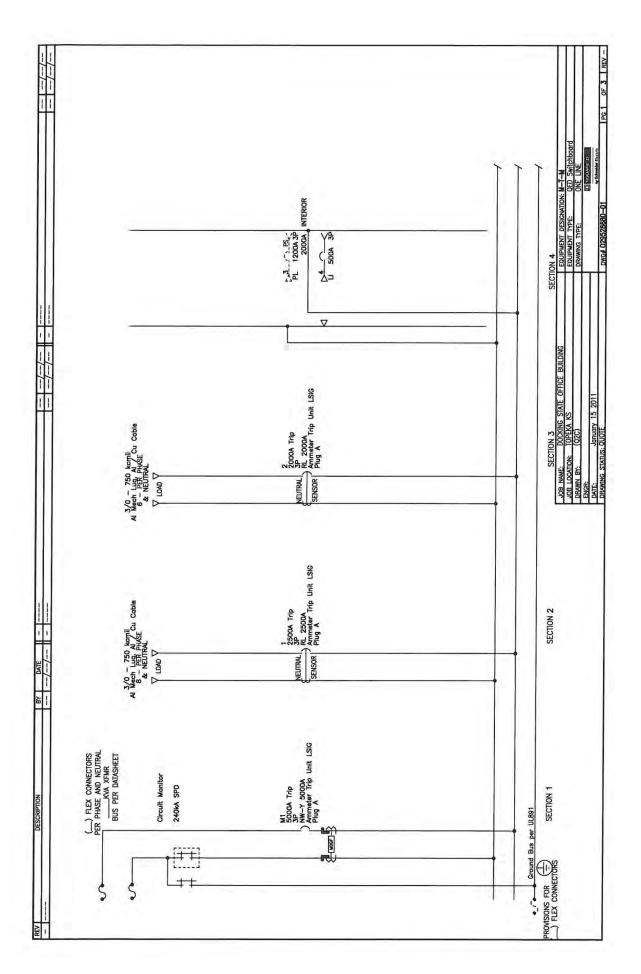


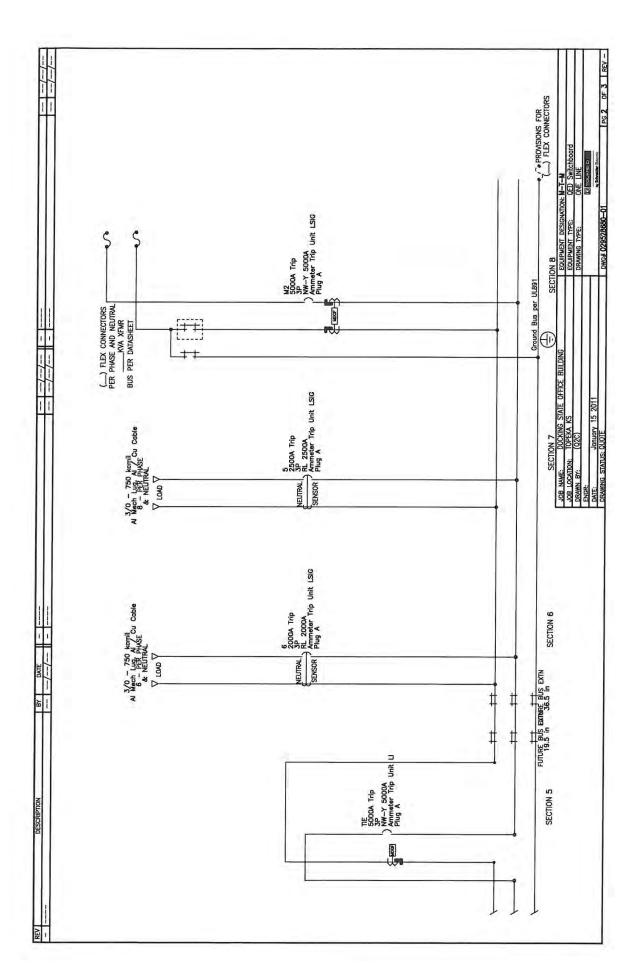












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-/		LEGEND	Circuit Monitor	COM Communications	Ground Fault	MCH Spring Charging Motor	int Trip	Shunt Trip Second	8 Form C Breaker Aux Contacts	Padlock Attachment-Fixed	PLC Autotransfer Scheme	Over Current Trip Switch	Surge Protection Device	Modified Differential Ground Fault	Closing Coil	
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		Call Control of	ACCESSORIES		CM	SPO	PLC,COM,SDE1,OFB,UCZ,MCH,MX1,MX2,XF,PLA	GF,COM,PLA	GF,COM,PLA		PLA.	PLC,COM,SDE1,OFB,UCZ,MCH,MX1,MXZ,XF,PLA	GF,COM,PLA	GF,COM,PLA		PLC,COM,SDE1,OFB,UCZ,MCH,MX1,MX2,XF,PLA
		NO	EUT. WIRE RANGE	1	ı	ı	500 - 750 kcmil P		3/0 - 750 kcmil G		250 - 600 kcmil P		3/0 - 750 kcmil G	3/0 - 750 kcmil G	1	500 - 750 kemil P
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)-2 SWITCHBOARD	LUG INFORMATION	OTY PHASE WIRE RANGE OTY NEUT. WIRE RANGE	XFMR	1	Ŧ	500 - 750 kcmil	3/0 - 750 kcmil	3/0 - 750 kcmil	3/0 - 500 kcmil	4/0 - 500kcmil	1	3/0 - 750 kcmil	3/0 - 750 kcmil	XFMR	500 - 750 kcmil
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DESCRIPTION		DEVICE/FRAME		Incoming Connection	Circuit Monitor	240kA SPD	NW 5000A Plug A	RL 2500A Plug A	RL 2000A Plug A	PL (PS)	п	NW 5000A Plug A	RI2000A Plug A 100% 2000A A-LSIG	RL2500A Plug A 100% 2500A	Incoming Connection	NW 5000A Plug A 5000A A-LSIG
		GMD	HEIGHT	£	r	ī	1	1	Ţ	9 in	7.5 in	t	1	ı	£	A.
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APPENDIX H: ENGINEER'S OPINION OF PROBABLE PROJECT COSTS

Appendices

STATEMENT OF PROBABLE (SHEET OF					
PROJECT Electrical Upgrade	BASIS FOR ESTIMATE CODE A (Preliminary design) - 35% CODE B (Preliminary design) - 65%						
LOCATION Docking State Office Building							
ARCHITECT ENGINEER Lochner/BWR Division		EC (Final design) R (Specify) - Study	Phase				
DRAWING NO. / SECTION: ELECTRICAL	ESTIMA	TOR LWS			CHECKED BY		
	QUAN	TITY	MA	TERIAL		LABOR	
SUMMARY Demolition	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	TOTAL COST
300 kVA Transformer	19	EA	0	\$0	1586	\$30,134	\$30,134
15 kV Bus Duct	360	LF	0	\$0	100	\$36,000	\$36,000
1,500 kVA Transformer	2	EA	0	\$0	3253	\$6,506	\$6,506
15 kV Cable	1100	LF	0	\$0	0.785	\$864	\$864
15 kV Switchgear	1	LS	0	\$0	10000	\$10,000	\$10,000
Distribution Panel	19	EA	0	\$0	750	\$14,250	\$14,250
Patch Floor Openings	13	EA	125	\$1,625	250	\$3,250	\$4,875
Working in Occupied Building	1	LS	10000	\$10,000	50000	\$50,000	\$60,000
Subtotal							\$162,629
25% O'head & Profit							\$40,657
Subtotal							\$203,286
15% Continegency							\$30,493
TOTAL	1						\$233,779

STATEMENT OF PROBABLE CO	NSTRU	JCTIO1	and the second second second second	ATE PREPARED		SHEET (OF 1	
PROJECT				112011	BASIS FOR			
Electrical Upgrade								
LOCATION					_ CODE	A (Preliminary de	sign) - 35%	
Docking State Office Building					_ CODE	B (Preliminary de	sign) - 65%	
ARCHITECT ENGINEER					_ CODE	C (Final design)		
Lochner/BWR Division					X OTHE	R (Specify) - Stud	y Phase	
DRAWING NO. / SECTION:		ESTIMA				CHECKED BY		
ELECTRICAL			LWS					
	QUAN	TITY	MATERIAL			LABOR		
SUMMARY	NO.	UNIT	PER UNIT	TOTAL	PER UNIT	TOTAL	TOTAL	
Option 1	UNITS	MEAS.					COST	
Ductbank Construction	1	LS	500000	\$500,000		\$0	\$500,000	
3,750 kVA, 13.2kV-480Y Xfmr*	2	EA	0	\$0	7100	\$14,200	\$14,200	
Xfmr Pad	2	EA	800	\$1,600	200	\$400	\$2,000	
5,000 Amp Copper Bus	200	LF	1500	\$300,000	300	\$60,000	\$360,000	
Bus Supports	6	EA	600	\$3,600	600	\$3,600	\$7,200	
Wall Penetration	2	EA	750	\$1,500	390	\$780	\$2,280	
wall refletiation		LA	750	\$1,500	390	\$700	φ2,200	
5,000 Amp Elbow	8	EA	5000	\$40,000	625	\$5,000	\$45,000	
5,000 Amp double-ended Swgr.	1	LS	700000	\$700,000	15000	\$15,000	\$715,000	
LCUS No. 1 Feed	330	LF	70	\$23,100	52	\$17,160	\$40,260	
2,500 Amp Copper Bus	1300	LF	630	\$819,000	101	\$131,300	\$950,300	
2,500 Amp Elbow	19	EA	2550	\$48,450	445	\$8,455	\$56,905	
600 Amp Plug-in Unit	18	EA	3825	\$68,850	895	\$16,110	\$84,960	
Fire Stop Floor	26	EA	735	\$19,110	224	\$5,824	\$24,934	
300 kVA, 480V-208Y Dry Type	19	EA	24900	\$473,100	3500	\$66,500	\$539,600	
Distribution Panelboard	19	EA	8000	\$152,000	1000	\$19,000	\$171,000	
Rerouting of existing Circuits	19		3000	\$57,000	1750	\$33,250	\$90,250	
Westar Charges	1	LS	100000	\$100,000	0	\$0	\$100,000	
Load Switchover (After Hours)	19	EA	5000	\$95,000		\$0	\$95,000	
Room Modifications	1	LS	50000	\$50,000	0	\$0	\$50,000	
Cubtotal							\$2 040 OOC	
Subtotal	-						\$3,848,889	
25% O'head & Profit							\$962,222 \$4,811,111	
Subtotal		-						
15% Contingency			1				\$721,667	
TOTAL							\$5,532,778	

^{*} Material Price Included with Switchboard

STATEMENT OF PROBABLE CO	ONSTRU	JCTIO	N COSTS	DATE PREPARED 1-12-2011		SHEET 1	OF 1
PROJECT Electrical Upgrade		BASIS FOR ESTIMATE					
LOCATION Docking State Office Building						A (Preliminary de	
ARCHITECT ENGINEER						B (Preliminary d C (Final design)	esign) - 65%
Lochner/BWR Division						R (Specify) - Stud	ly Phase
DRAWING NO. / SECTION: ELECTRICAL	ESTIMA	TOR LWS			CHECKED BY		
	QUAN	TITY	MATERIAL			LABOR	
Option 2	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	TOTAL COST
Ductbank Construction	1	LS	1E+06	\$1,000,000	0	\$0	\$1,000,000
3,750 kVA, 13.2kV-480Y Xfmr*	2	EA	0	\$0	7100	\$14,200	\$14,200
Xfmr Pad	2	EA	800	\$1,600	200	\$400	\$2,000
				4.,000		ψ,00	42,000
5,000 Amp Copper Bus	220	LF	1500	\$330,000	300	\$66,000	\$396,000
Bus Supports	6	EA	600	\$3,600	600	\$3,600	\$7,200
Wall Penetration	2	EA	750	\$1,500	390	\$780	\$2,280
5,000 Amp Elbow	8	EA	5000	\$40,000	625	\$5,000	\$45,000
5,000 Amp double-ended Swgr.	1	LS	700000	\$700,000	15000	\$15,000	\$715,000
LCUS No. 1 Feed	270	LF	70	\$18,900	52	\$14,040	\$32,940
2,500 Amp Copper Bus	1200	LF	630	\$756,000	101	\$121,200	\$877,200
2,500 Amp Elbow	20	EA	2550	\$51,000	445	\$8,900	\$59,900
600 Amp Plug-in Unit	18	EA	3825	\$68,850	895	\$16,110	\$84,960
Fire Stop Floor	26	EA	735	\$19,110	224	\$5,824	\$24,934
300 kVA, 480V-208Y Dry Type	19	EA	24900	\$473,100	3500	\$66,500	\$539,600
Distribution Panelboard	19	EA	8000	\$152,000	1000	\$19,000	\$171,000
Rerouting of existing Circuits	19		3000	\$57,000	1750	\$33,250	\$90,250
Westar Charges	1	LS	200000	\$200,000	0	\$0	\$200,000
Room Addition	_ 1	LS	60000	\$60,000	0	\$0	\$60,000
Load Switchover (After Hours)	19	EA	5000	\$95,000		\$0	\$95,000
Subtotal							\$4,417,464
25% O'head & Profit	1						\$1,104,366
Subtotal					1		\$5,521,830
15% Contingency							\$828,275
TOTAL			_				\$6,350,105

^{*} Material Price Included with Switchboard

STATEMENT OF PROBABLE CO	NSTRU	JCTIO)		ATE PREPARED		SHEET 1	OF 1				
PROJECT Electrical Upgrade		BASIS FOR ESTIMATE									
LOCATION Docking State Office Building	Docking State Office Building										
ARCHITECT ENGINEER Lochner/BWR Division		C (Final design) R (Specify) - Stud	ly Phase								
DRAWING NO. / SECTION: ELECTRICAL	ESTIMA"	ror LWS			CHECKED BY						
SUMMARY Option 3	QUAN NO. UNITS	UNIT	MA PER UNIT	TERIAL TOTAL	PER UNIT	LABOR TOTAL	TOTAL				
Ductbank Construction	1	MEAS.	400000	\$400,000	0	\$0	\$400,000				
3,750 kVA, 13.2kV-480Y Xfmr*	2	EA	0	\$0	7100	\$14,200	\$14,200				
Xfmr Pad	2	EA	800	\$1,600	200	\$400	\$2,000				
5,000 Amp Copper Bus Bus Supports	220 6	LF EA	1500 600	\$330,000 \$3,600	300 600	\$66,000 \$3,600	\$396,000 \$7,200				
Wall Penetration	2	EA	750	\$1,500	390	\$780	\$2,280				
5,000 Amp Elbow	8	EA	5000	\$40,000	625	\$5,000	\$45,000				
5,000 Amp double-ended Swgr.	1	LS	700000	\$700,000	15000	\$15,000	\$715,000				
LCUS No. 1 Feed 2,500 Amp Copper Bus	270 1200	LF LF	70 630	\$18,900 \$756,000	52 101	\$14,040 \$121,200	\$32,940 \$877,200				
2,500 Amp Elbow 600 Amp Plug-in Unit	20 18	EA EA	2550 3825	\$51,000 \$68,850	445 895	\$8,900 \$16,110	\$59,900 \$84,960				
Fire Stop Floor 300 kVA, 480V-208Y Dry Type	26 19	EA EA	735 24900	\$19,110 \$473,100	224 3500	\$5,824 \$66,500	\$24,934 \$539,600				
Distribution Panelboard Rerouting of existing Circuits	19 19	EA LS	8000	\$152,000	1000 1750	\$19,000	\$171,000				
Westar Charges Room Addition	1	LS	800000	\$57,000 \$800,000	0	\$33,250 \$0	\$90,250 \$800,000				
Load Switchover (After Hours)	1 19	LS EA	5000	\$60,000 \$95,000	0	\$0 \$0	\$60,000 \$95,000				
Subtotal							\$4,417,464				
25% O'head & Profit Subtotal							\$1,104,366 \$5,521,830				
15% Contingency							\$828,275				
TOTAL							\$6,350,105				

^{*} Material Price Included with Switchboard

STATEMENT OF PROBABLE CO	ONSTRU	CTION	A STATE OF THE STATE OF THE STATE OF	-14-2011		SHEET (OF 1		
PROJECT			13	14 2011	BASIS FOR E				
Electrical Upgrade					BASIS FOR I	STIMATE			
LOCATION					CODE A (Preliminary design) - 35%				
Docking State Office Building						B (Preliminary de			
ARCHITECT ENGINEER						C (Final design)	33 gH) 03 70		
Lochner/BWR Division					and the second	R (Specify) - Stud	v Phase		
DRAWING NO. / SECTION:		ESTIMAT	TOR			CHECKED BY	, i i i i i i i i i i i i i i i i i i i		
ELECTRICAL			LWS		CHECKED B I				
	QUAN	TITY	MATERIAL		1	ABOR			
SUMMARY	NO.	UNIT	A. A. Trans		Nan Zan	L COM	TOTAL		
Option 4	UNITS	MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	COST		
Ductbank Construction	1	LS	575000	\$575,000	0	\$0	\$575,000		
3,750 kVA, 13.2kV-480Y Xfmr*	2	EA	0	\$0	20000	\$40,000	\$40,000		
Floor Shoring	1	LS	500000	\$500,000	0	\$0	\$500,000		
Hallway Modifications	1	LS	150000	\$150,000	0	\$0	\$150,000		
Wall Penetration	2	EA	750	\$1,500	300	\$600	\$2,100		
5,000 Amp double-ended Swgr.	1	LS	800000	\$800,000	15000	\$15,000	\$815,000		
LCUS No. 1 Feed	330	LF	70	\$23,100	52	\$17,160	\$40,260		
2,500 Amp Copper Bus	1300	LF	630	\$819,000	101	\$131,300	\$950,300		
2,500 Amp Elbow	19	EA	2550	\$48,450	445	\$8,455	\$56,905		
600 Amp Plug-in Unit	18	EA	3825	\$68,850	895	\$16,110	\$84,960		
Fire Stop Floor	26	EA	735	\$19,110	224	\$5,824	\$24,934		
300 kVA, 480V-208Y Dry Type	19	EA	24900	\$473,100	3500	\$66,500	\$539,600		
Distribution Panelboard	19	EA	8000	\$152,000	1000	\$19,000	\$171,000		
Rerouting of existing Circuits	19	LS	3000	\$57,000	1750	\$33,250	\$90,250		
Westar Charges	1	LS	100000	\$100,000	0	\$0	\$100,000		
Load Switchover (After Hours)	19	EA	5000	\$95,000		\$0	\$95,000		
Room Modifications	1	LS	60000	\$60,000	0	\$0	\$60,000		
Subtotal			- A				\$4,295,309		
25% O'head & Profit							\$1,073,827		
Subtotal							\$5,369,136		
15% Contingency							\$805,370		
TOTAL				d with Swit			\$6,174,507		

^{*} Material Price Included with Switchboard



Study of:

Docking State Office Building Electrical Upgrade



Submitted to:
Kansas Department of
Administration

FOR REVIEW ONLY

January 18, 2011

KANSAS DEPARTMENT OF ADMINISTRATION

DOCKING STATE OFFICE BUILDING ELECTRICAL UPGRADE STUDY

FOR REVIEW ONLY

Project No. 2010-0343.01



2335 East Crawford Street | Salina, Kansas 67401-3713 | P 785.827.3603 | F 785.827.3029

engineering | planning | architecture



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APPENDIX H: ENGINEER'S OPINION OF PROBABLE PROJECT COSTS

FOR REVIEW ONLY



1. INTRODUCTION AND HISTORY

1.1 Purpose of Study

The purpose of this report is to determine the feasibility of upgrading the electrical distribution system within the Docking State Office Building. This upgrade would remove the existing 15 kV distribution system from within the facility and replace with a 480/277 Volt system. Various options to accomplish this task were investigated and are summarized in this report.

1.2 History

The existing electrical distribution system consists of electrical switchgear, rated for 15 kV, located in the northeast corner of the basement. Cabling, carrying 13.2 kV, is routed from a Westar Energy manhole in the northeast corner of Harrison and 9th Street. A recently constructed ductbank, containing three (3) 6-inch conduits, is routed from this manhole to the electrical room in the basement of the building. Two separate circuits (#9 and #10) are routed in this ductbank and supply electrical power to the 15 kV electrical switchgear. Of the two circuits, Circuit #10 is the preferred circuit and is normally utilized to supply power to the building.

Each of the electrical circuits feeds into the automatic throw-over switch in the switchgear. The automatic throw-over switch allows the switchgear to be fed from one of the two electrical feeder circuits. Typical operation is to have Circuit #10, from Westar Energy, supplying power to the switchgear through the automatic throw-over switch allows for energizing of the switchgear line-up.

If the preferred circuit is lost, the system is designed to automatically, if so selected, disconnect from the failed utility feeder and switch the "automatic throw-over switch" to energize the switchgear from the alternate source. With the current operation of operating only on Circuit #10, the loss of Circuit #10 would cause the system to disconnect from Circuit #10 and close the Circuit #9 switch to re-energize the switchgear from this source.



From the switchgear, which is operating at 13.2 kV, the electricity is distributed throughout the building with either 15 kV cable or 15 kV bus duct. Three of the electrical loads are fed with #2 AWG, 15 kV cable (CCM-1, CCM-2, and LCUS No. 1). The medium voltage switches, controlling these feeders, are contained in the medium voltage (15 kV) switchgear in the northeast corner of the basement. The remainder of the electrical loads is connected to a 15 kV electrical bus duct that is routed from the northeast corner of the basement, to the east of the north-south corridor, northeast of the bank of elevators, to the electrical room located north of the elevator banks, on the basement level. This 15 kV bus duct is then routed vertically through the building to the penthouse. At each floor, except at the sub-basement and fourth floor, at least one tap is made to this vertical bus. The tap is routed to a medium voltage switch which feeds a 300kVA step-down transformer to convert the 13.2 kV to 120/208 volt. The 120/208 volt is considered the utilization voltage of each floor. The chillers and other large electrical loads are operated on 480 volts and are supplied by a 13.2 kV to 480 volt step-down transformer.



2. EXISTING CONDITIONS

2.1 Site Investigation

During the period of November 24th to November 27th, 2010, Capital Electric was on site to perform routine maintenance on the 15 kV system in the facility. During this time, the electrical power to the building was turned "off" and the system was inspected, cleaned, and repaired. A copy of this report is included in Appendix A of this report. The findings of the report included excessive dust/dirt accumulation on the electrical gear and 15 kV bus duct, medium voltage switches not fully engaged, medium voltage fuses improperly installed, taped joints on the 15 kV bus duct needing repair, equipment out of adjustment and not fully engaged, transformer windings dangerously close to metal enclosures, and corrosion developing on insulators, just to name a few.

2.1.1 Dangers and Concerns

The dangers presented with the existing equipment include the possibility for an arc to be started with the displacement of the existing dust. The dust itself is explosive. If an electrical arc is started due to the conductivity of the dust particles, the addition of the fault electrical current, could lead to an explosion in the electrical bus duct, causing sever damage to the electrical equipment and harm to any personnel in the area.

In addition to the unsafe conditions discovered during the maintenance, the existing electrical distribution system is over 50 years old. The normal live of such electrical equipment is 20 - 30 years. Also, the existing equipment is now obsolete and finding parts is not only difficult and expensive, but in some instances may be impossible. This would require remanufacturing of some parts are substantial expense.

2.2 Present Building Electrical Loading

Historical loading information was provided by Westar Energy for the last three year's usage on the Docking State Office Building. The peak demand electrical loading of this facility was 3,168 kW/kVA recorded in June of 2009. The data provided by Westar Energy is included in Appendix B. The demand loading for a building is defined as the maximum



electrical loading for a facility, over a 15 minute period. Based upon the rough square footage of the building, this equates to approximately 10 watts per square foot, which is typical for an office building loading.

This peak loading is used to determine the size of electrical equipment required to supply adequate power to the building. This value is used in developing options for possible upgrades.

Combining the existing electrical peak loading with the desire for a redundant electrical supply system, the step-down transformers to convert the incoming Westar Energy supplied 13.2 kV to 480/277 Volts will require a minimum of two (2) 3,750 kVA transformers. The maximum size of transformer that Westar Energy is able to provide is rated at only 2,500 kVA. Therefore, in order to meet the redundancy request, the state will be required to purchase and maintain the step-down transformers.

2.3 Building Layout

A site plan and the building floor plans are included in Appendix C to provide information on the existing building layout and electrical arrangement. Sheet E601 shows the existing one-line diagram of the 13.2kV distribution system and the major electrical loads.



3. ELECTRICAL UPGRADE OPTIONS

3.1 Option 1

Replace existing switchgear with new, exterior mounted pad mounted transformers on the north side of the building and new 480 volt switchgear in basement.



Photograph 1: North Side Docking State Office Building

This option involves the installation of two (2) new, 3,750 kVA, 13.2kV-480Y/277 Volt pad mounted transformers on the north side of the building. See Photograph 1 for approximate area for new transformers. The existing electrical, primary voltage feed is routed in a ductbank from a manhole at the northeast corner of Harrison and 9th Street. This ductbank consists of three (3) 6-inch conduits, concrete encased. To supply the new pad mounted transformers, a new ductbank, consisting of four (4) 6-inch conduits (two for conductors and two spares) would be routed from the existing manhole to the new transformers location.

The new primary conductors would be installed by Westar Energy from the manhole to the pad mounted transformers. Final electrical connections would also be performed by Westar Energy.



The secondary voltage of the transformers would be 480Y/277 Volts with a full load rating of 4,510 Amps, each. This would allow the entire load of the Docking State Office Building to be supplied by just one of the transformers, providing total redundancy. To carry the 4,510 full load amps, either conduit with conductors or weatherproof bus duct would be required, rated for a minimum of 5,000 Amps.

To place adequate raceway and conductors underground to carry the 5,000 Amps would require 44 conduits (Refer to calculations in Appendix D). The large number of conduits is required due to the derating effect from mutual heating from multiple conduits placed in a ductbank. A viable alternative is to install 5,000 Amp weatherproof ductbank from the transformers to the new electrical switchboard. Being that the electrical bus duct cannot be installed underground, an overhead routing from the secondary of the pad mounted transformers would be required. Support structures would be required to be placed along the route of the busduct from the pad mounted transformers to the underside of the second floor above the north drive.

Once routed to the exterior wall of the first floor, a penetration of the building exterior would be required to enter into the building and then the 5,000 Amp bus ducts would be routed vertically into the basement level and the new electrical switchgear room. This

new electrical room would be created directly west across the hallway from the existing electrical room on the north end of the basement, next to the tunnel entrance. The new electrical room, the current auditorium, would need to be expanded to the west to allow for the installation of the electrical switchgear.

Photograph 2 shows the existing electrical room door to the right, the existing doors to the tunnel in the center, and the existing door to the auditorium on the left.



Photograph 2: North End Basement Hallway



The new switchgear would be rated for 5,000 Amps at 480Y/277 Volts. This gear, placed on a housekeeping pad, would consist of metering cabinets on each end to allow for Westar Energy's use. Next to the metering cabinets would be the main, 5,000 Amp switch, one for each of the feeds from the pad mounted transformers. One would be identified Circuit #9 and one Circuit #10. The main switch on each end would then feed distribution panels, rated at 5,000 Amps. In the middle of the new switchgear would be an automated tie-breaker. This tie-breaker would allow for the automatic connection of the two halves of the switchgear, to allow it to be fed from either of the two feeder circuits. The existing switchgear is presently connected to Circuit #10 (preferred source). With the new switchgear, both of the circuits from Westar Energy would be energized to allow for heating of the pad mounted transformers and thereby preventing condensation in the transformer.

Upon the loss of one of the feeder circuits, the switchgear would open the lost feeder circuit and automatically close the tie-breaker to allow for the entire switchgear to be fed from the remaining feeder circuit. Upon restoration of service to the affected feeder circuit, a manual or automatic retransfer shall occur to separate the two halves of the switchgear and the restored feeder circuit reconnected to half of the switchgear.

From the new electrical switchgear, 480 Volt feeders would be routed to the existing electrical loads within the facility. Connection to the existing CCM-1 and CCM-2, both located in the basement, shall each be fed with new 2,000 Amp, 480 Volt bus duct. LCUS No.1, also located in the basement, would be fed with conduit and wire adequate to supply 500 Amps to the LCUS. To supply the individual LCUS units located on the various floors, two (2) 2,500 Amp, 480 Volt bus ducts would be routed vertically through the building, with plug-in taps on each floor where existing loads exist. New 300 kVA stepdown transformers would be installed on each floor to convert the voltage from 480 Volt to 120/208 Volts to allow for utilization on each floor. The secondary of the 300 kVA transformers would be connected to distribution panelboards. These distribution panelboards would be reconnected to existing building loads.

Refer to Appendix E for a Riser Diagram of Option 1.



3.2 **Option 2**

Replace existing switchgear with new, exterior mounted substation transformers on the south side of the building in the existing areaway and new 480 volt switchgear in



Photograph 3: South Side of DSOB Areaway

basement.

This option involves the installation of two (2) new, 3,750 kVA, 13.2 kV-480Y/277 Volt substation transformers in the existing areaway on the south side of the building. Photographs 3 and 4 show the existing areaway at the south end of the building. The existing electrical, primary voltage feed is routed in a ductbank from a manhole at the northeast corner of Harrison and 9th Street. This ductbank consists of three (3) 6-inch



Page 8



conduits, concrete encased. To supply the new pad mounted transformers, a new ductbank, consisting of four (4) 6-inch conduits (two for conductors and two spares) would be routed from the existing manhole to the new transformers location. A new manhole would also be required due to the length of the raceway routing.

The new primary conductors would be installed by Westar Energy from the manhole to the pad mounted transformers. Final electrical connections would also be performed by Westar Energy.

The secondary voltage of the transformers would be 480Y/277 Volts with a full load rating of 4,510 Amps, each. This would allow the entire load of the Docking State Office Building to be supplied by just one of the transformers, providing total redundancy. To carry the 4,510 full load amps, weatherproof bus duct would be required, rated for a minimum of 5,000 Amps.

With the transformers placed in the existing areaway, the primary conductors would be routed overhead to the transformers from the new ductbank. The secondary weatherproof bus duct would be routed overhead, into the subbasement level to the new 480 Volt switchgear. The new gear would be located in the subbasement level where existing chillers are being removed. The switchgear would be enclosed in a 2-hour enclosure with two exits.

The new switchgear would be rated for 5,000 Amps at 480Y/277 Volts. This gear, placed on a housekeeping pad, would consist of metering cabinets on each end to allow for Westar Energy's use. Next to the metering cabinets would be the main, 5,000 Amp switch, one for each of the feeds from the pad mounted transformers. One would be identified Circuit #9 and one Circuit #10. The main switch on each end would then feed distribution panels, rated at 5,000 Amps. In the middle of the new switchgear would be an automatic tie-breaker. This tie-breaker would allow for the automatic connection of the two halves of the switchgear, to allow it to be fed from either of the two feeder circuits. The existing switchgear is presently connected to Circuit #10 (preferred source). With the new switchgear, both of the circuits from Westar Energy would be energized to



allow for heating of the pad mounted transformers and thereby preventing condensation in the transformer.

Upon the loss of one of the feeder circuits, the switchgear would open the lost feeder circuit and automatically close the tie-breaker switch to allow for the entire switchgear to be fed from the remaining feeder circuit. Upon restoration of service to the affected feeder circuit, a manual or automatic retransfer shall occur to separate the two halves of the switchgear and the restored feeder circuit reconnected to half of the switchgear.

From the new electrical switchgear, 480 Volt feeders would be routed to the existing electrical loads within the facility. Connection to the existing CCM-1 and CCM-2, both located in the basement, shall each be fed with new 2,000 Amp, 480 Volt bus duct. LCUS No.1, also located in the basement, would be fed with conduit and wire adequate to supply 500 Amps to the LCUS. To supply the individual LCUS units located on the various floors, two (2) 2,500 Amp, 480 Volt bus ducts would be routed vertically through the building, with plug-in taps on each floor where existing loads exist. New 300 kVA stepdown transformers would be installed on each floor to convert the voltage from 480 Volt to 120/208 Volts to allow for utilization on each floor. The secondary of the 300 kVA transformers would be connected to distribution panelboards. These distribution panelboards would be reconnected to existing building loads.

Refer to Appendix E for a Riser Diagram of Option 2.

3.3 Option **3**

Construct new Westar Energy Ductbank along the east side of Harrison Street to the intersection of 10th Street.

This option involves the extension of the Westar Energy ductbank along the east side of Harrison Street from the existing manhole at the intersection of 9th and Harrison to the 10th and Harrison intersection. At this location, a new manhole would be installed and a four (4) 6-inch conduit ductbank would be constructed to the west to feed the new exterior transformers in the existing south areaway.



The extension of the existing Westar Energy ductbank would allow for expanding of the Westar underground distribution system and allow the ability to serve future loads east of 10th and Harrison. The extension of the ductbank would be performed by Westar.

3.4 Option 4

Replace existing switchgear with new double-ended switchgear in basement at north end of building, including transformers.

This option involves the installation of the new 13.2kV to 480/277 Volt transformers in the basement. The transformers would be part of a new 5,000 Amp electrical line-up. A new ductbank with four (4) 6-inch conduits would be routed from the existing manhole at the intersection of 9th and Harrison. Two (2) of the conduits would be utilized for feeder circuits 9 and 10 from Westar Energy. The ductbank would extend to the exterior wall of the Docking State Office Building, at the basement level, on the north end of the building. The raceway would enter the building in the space that is currently the auditorium. This room would be converted into a new electrical room and would require some modifications.

The switchgear would consist of a medium voltage switch (15kV) on each end, feeding a 3,750 kVA step-down transformer to convert from 13.2kV to 480/277 Volt. On the secondary of the step-down transformer would be connected half of the 480 Volt switchgear. The gear would have an automatic tie-breaker switch in the middle. Each half of the switchgear would be fed with one of the feeder circuits (9 or 10) from Westar Energy. Upon the loss of one of the feeder circuits, the corresponding main switch would open and the automatic tie-breaker would close to allow for operation of the entire 480 Volt switchgear from one feeder circuit. Upon the restoration of the feeder circuit, the automatic tie-breaker would open and the corresponding main switch would close to restore power to each half of the switchgear. Normal operation would be to utilize both feeders to allow for energizing of the 13.2kV to 480/277 Volt transformers to prevent condensation buildup.



From the new electrical switchgear, 480 Volt feeders would be routed to the existing electrical loads within the facility. Connection to the existing CCM-1 and CCM-2, all located in the basement, shall each be fed with new 2,000 Amp, 480 Volt bus duct. LCUS No.1, also located in the basement, would be fed with conduit and wire adequate to supply 500 Amps to the LCUS. To supply the individual LCUS units located on the various floors, two (2) 2,500 Amp, 480 Volt bus ducts would be routed vertically through the building, with plug-in taps on each floor where existing loads exist. New 300 kVA stepdown transformers would be installed on each floor to convert the voltage from 480 Volt to 120/208 Volts to allow for utilization on each floor. The secondary of the 300 kVA transformers would be connected to distribution panelboards. These distribution panelboards would be reconnected to existing building loads.

Refer to Appendix E for a Riser Diagram of Option 4.

3.5 **Option 5**

Replace existing 15kV switchgear with new at north end of basement.

This option consists of installing new 15kV switchgear in the existing auditorium. A new ductbank with four (4) 6-inch conduits would be routed from the existing manhole at the intersection of 9th and Harrison. Two (2) of the conduits would be utilized for feeder circuits 9 and 10 from Westar Energy. The other two (2) conduits would be spare for future use. The ductbank would extend to the exterior wall of the Docking State Office Building, at the basement level, on the north end of the building. The raceway would enter the building in the space that is currently the auditorium. This room would be converted into a new electrical room and would require some modifications.

The new gear would consist of 15kV switches for the two feeder circuits, 9 and 10, from Westar Energy. The switchgear would consist of four (4) 15kV switches to supply power to CCM-1, CCM-2, and LCUS No. 1, all located in the basement, and a 15kV bus duct to supply power to the other floors. New 15kV cable would be utilized to provide power to the basement level large electrical loads. A new 15kV bus duct would be routed from the new electrical room south to the existing electrical room to the north of the elevator



banks. To the north of the elevator banks, a new vertical 15kV bus duct would be routed up the building to supply power to the individual floors. At each floor, except fourth, the 15kV bus duct would be tapped and connected to a 300 kVA step-down transformers via a medium voltage switch. The 13.2kV to 120/208 Volt step-down transformer would feed a new distribution panelboard to supply utilization power to the corresponding floor of the building.

The new 15kV switchgear would contain an automatic transfer (throw-over) switch to allow one feeder to supply power to the entire switchgear. Normal operation would be to have the feeder circuit #10 switch closed and feeder circuit #9 open. Upon loss of feeder circuit #10, the automatic throw-over would disconnect from feeder circuit #10 and connect to feeder circuit #9 to re-energize the 15kV switchgear. Upon the restoration of feeder circuit #10, the automatic throw-over can automatically, or manually, be reconnected to feeder circuit #10 and disconnected from feeder circuit #9.



4. REVIEW OF OPTIONS

4.1 Option 1

Replace existing switchgear with new, exterior mounted pad mounted transformers on the north side of the building and new 480 volt switchgear in basement.

Refer to Site Plan, in Appendix C, for a proposed location for the pad mounted transformers. The ductbank would be routed parallel to the existing ductbank along the north side of 9th Street. The transformers would need to be placed on approximately 10-foot square concrete pads, for support. The primary conductors will be routed underground from the existing Westar Energy manhole at the northeast corner of 9th and Harrison.

On the secondary of the transformers, the use of conduit and wiring to route the 5,000 Amps, at 480 Volts, is not a viable option. Please refer to the Appendix D for calculations for a 44 duct underground ductbank. The mutual heating from adjacent conduits greatly limits the current carrying capacity of the ductbank conductors. Therefore, the only viable option is the use of 5,000 Amp weatherproof bus duct. The bus duct would need to be routed overhead as the bus duct cannot be installed underground. From the secondary of each transformer the bus duct would be routed on a support structure to allow the bus duct to get to the ceiling under the second floor overhang. At this point the bus duct could be supported from the structure above. The bus duct would need to penetrate the building exterior wall above grade. Therefore, the bus duct will enter the first floor interior space and a new chase would need to be built to enclose the bus duct until it reaches the floor level.

The existing auditorium in the basement is too small for the installation of the new electrical gear. The existing interior wall would need to be removed and a new wall, another column line west, would need to be constructed. Per the National Electrical Code (NEC) two emergency exits are required from this room. Some modifications may need to be made at the corridor door to allow for an outward swinging door into the



hallway. A second exit door could be installed either at the west end of the new room or into the room to the south.

The new transformers and overhead weatherproof bus duct will be exposed on the north side of the building which may not be an ascetically pleasing view from the Capitol.

4.2 Option 2

Replace existing switchgear with new, exterior mounted substation transformers on the south side of the building in the existing areaway and new 480 volt switchgear in basement.

Refer to Site Plan, in Appendix C, for a proposed location for the outdoor mounted transformers. The new ductbank will be routed from the existing manhole at the intersection of 9th and Harrison. From this location, a ductbank would be routed on the west side of Harrison Street, to the south end of the building. Here the ductbank would travel west to the existing areaway where cooling towers were originally housed. The primary conductors will be routed underground from the existing Westar Energy manhole at the northeast corner of 9th and Harrison to the south areaway.

There is a large amount of ductbank to be installed to get the underground electrical service to this location. Along Topeka Boulevard there is an existing 12.5kV overhead electrical line. The disadvantages to utilizing this circuit to supply power to the building are two fold. The first is that the line is overhead and is susceptible to squirrels, trees, and lightning strikes. The second is that there is only one circuit thereby not allow for a redundant feed.

Placing the transformers in the existing areaway allows for the transformers to be placed outside of the building, yet placing them in an area that is not visible at grade level. The heat from the transformers is kept out of the building so the building cooling load would be less than the existing.



Routing of the 5,000 Amp overhead weatherproof bus duct from the transformers into the building can also be contained below grade level. All supports are below grade and the exterior wall penetrations are below grade, but not underground.

The placement of the 480 Volt switchgear on the south end of the building puts the electrical gear closer to the larger loads, thereby eliminating the need to route 2,000 Amp bus duct from the north end of the building to the large electrical loads on the south end of the building.

4.3 **Option 3**

Construct new Westar Energy Ductbank along the east side of Harrison Street to the intersection of 10th Street.

The existing underground electrical network, around the Capitol complex, does not currently extend south to the 10th and Harrison intersection. As an option to installing a four (4) 6-inch conduit ductbank along the west side of Harrison from 9th to 10th, another possible option is to install a ductbank meeting Westar Energy's requirements, along the east side of Harrison, extending the existing underground network. This will allow for future load expansion to the east of this location.

With this option, a larger ductbank, than what is required to feed the new building transformers located in the south areaway, will be required to be built.

4.4 Option 4

Replace existing switchgear with new double-ended switchgear in basement at north end of building, including transformers.

As indicated in Option 1, the new switchgear could be installed in the area of the existing auditorium. This option, however, adds the new 13.2kV to 480/277 Volt transformers to this line-up. This allows the ductbank to be built along the north side of the Docking State Office Building and the ductbank would enter the building below grade, thereby not being visible and somewhat unsightly.



The transformers would add heat to this area and the need for cooling/ventilation would need to be addressed.

The biggest concern is being able to place the transformers in the basement room. The transformers are approximately 5-feet wide and 8-feet long. This becomes a problem to navigate the transformer through the building. The transformer is 102-inches tall and would require the removal of lighting fixtures, smoke detectors, and the opening of several doorways to allow for passage. Additionally, each transformer weighs approximately 10 tons. The existing floor design of the basement hallway will not support this great of a load without shoring up the floor from below. Photograph 5 shows one of the doorways that would need to be opened to make room for the transformers. Additionally, the existing lighting fixture, exit sign, and fire alarm annunciator would need to be removed to allow for passage of the 102-inch tall transformer.

4.5 **Option 5**

Replace existing 15kV switchgear with new at north end of basement.



Photograph 5: DSOB South Areaway



With this option, all new 15kV switchgear, cabling, and unit substations would be replaced with new. The existing ductbank would be modified to route the 15kV cables to the new electrical equipment location. The 13.2kV would be routed into the building underground from the existing manhole at 9th and Harrison to the building basement. The only transformers required in the building would be to step-down from 13.2kV to either 480 or 120/208 Volt for utilization. Due to the higher voltage level, the size of the cabling and bus duct would be smaller as they are routed through the building.

Unfortunately, the new 15kV bus duct construction is not much different now than it was 50 years ago. The bus duct, rather than being a "sandwiched" construction as it would be for 600 Volt, is a metal enclosed bus duct, very similar to the existing. The main difference is the that copper bus bars are insulated the entire length thereby eliminating the concern over contact with energized bus or the arcing and tracking that is currently a concern with the exposed copper bus bars in the 15kV bus duct.

A disadvantage is that 13.2kV will be routed through the building and the same concern that applies now with not having trained personnel to service and maintain this equipment, would still exist.

An estimated construction cost is not provided for this alternative.



5. ESTIMATED CONSTRUCTION COSTS

The costs for each option were assembled to provide a basic order of magnitude. A 15% contingency has been added to each option to cover any unforeseen construction expenses that will only become known during the design portion of the project. The source of the costs varies from Westar Energy, Square D Schneider Electric, to RSMeans Electrical Cost Data 2011. Backup information is available in the Appendix H. These estimates do not include expenses for design or construction administration.

Option 1 - \$5,850,000

Option 2 - \$6,650,000

Option 3 - \$6,650,000

Option 4 - \$6,450,000

Option 5 - Not Priced



6. CONCLUSION

6.1 Summary

Several options were identified and investigated to determine a general approach and basic order of magnitude cost for the electrical upgrade. The age of the existing equipment along with the potential operational hazards of routing metal enclosed, open copper bussing, through the building and vertically through the floors without firestopping at each floor necessitates the upgrade of the electrical distribution system with new, state-of-the-art equipment.

Refer to Appendix E for a Proposed Line-up of the new electrical distribution system. The placement of the transformers varies depending upon the option presented, but the basic system layout is represented.

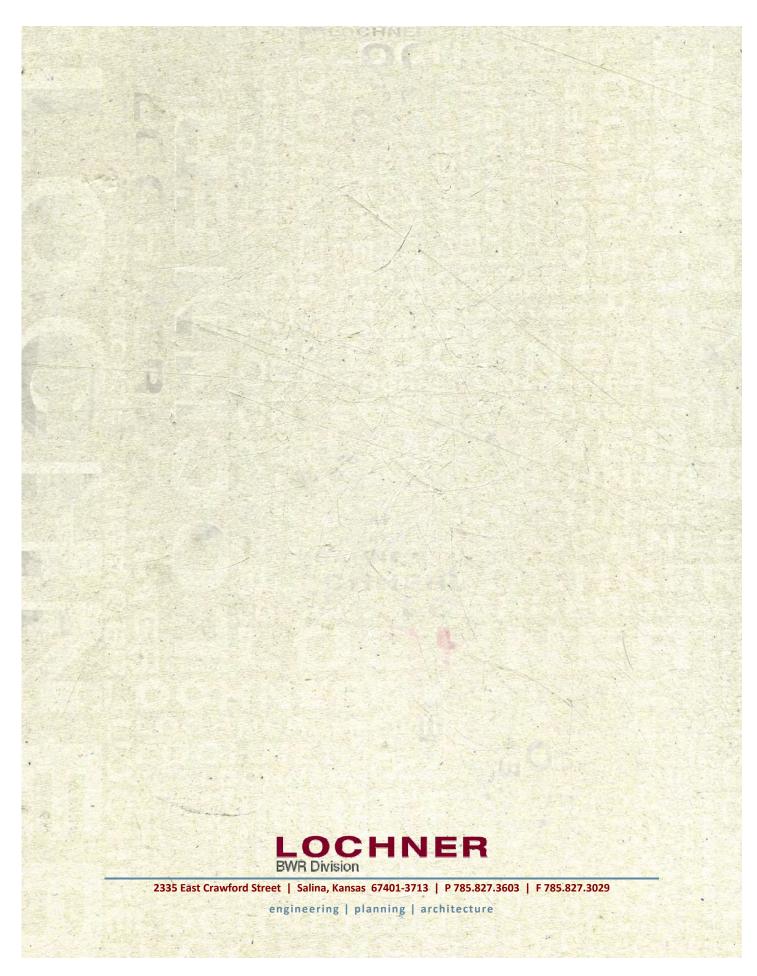
The placing of pad mounted transformers on the front lawn (north side) of the building, along with overhead 5,000 Amp weatherproof bus duct makes for an unappealing visual arrangement. Additionally, the 5,000 Amp bus ducts would need to be supported from the bottom of the second floor deck over the drive area, and interior space would need to be occupied by the vertical bus duct run to the basement and concealed in a new utility chase.

Installing new 3,750 kVA, 13.2kV to 480/277 Volt transformers with main-tie-main 480 Volt switchgear allows for a confined electrical distribution system arrangement. However, physically installing the new transformers, with a weight of nearly 10 tons provides a structural obstacle as well as the physical dimensions of a 5-foot x 8-foot footprint, with a 102-inch overall height provides a maneuverability obstacle to bringing the transformers in the overhead door near the dock and then transporting down the hallways to the north end of the basement. At least three (3) hallway doorways will need to be modified to slip the transformer in the building and structural bracing will be required to roll the transformers on the basement floor. Additionally, permanent structural modifications will be required in the new electrical room to support the weight of the transformers.



Installing the new 3,750 kVA transformers in the south areaway, which originally housed cooling towers, allows for placement by crane from an exterior location. The transformers, while still outside of the building, are concealed below the grate cover from view. The new 480 Volt switchgear can be installed in a new electrical room in the south end of the building, closer to the larger electrical loads (CCM1 and CCM2) thereby reducing the required length, and cost, of 2,000 Amp, 480 Volt bus duct.

If the transformers and new switchgear are located in the south areaway, Westar has expressed the desire to extend their existing ductbank system to the corner of the 10th and Harrison. From this point, a new ductbank would be extended to the south areaway. This approach varies from Option 2 in the fact that the north-south ductbank will be built by Westar to Westar standards on the east side of the Harrison and the state would only build the ductbank from the 10th Street and Harrison Street intersection manhole, to the west. The state would not need to build the ductbank on the west side of Harrison Street. This approach allows the utility to extend its underground network and the new transformers can be hidden from sight. This also keeps the electrical and mechanical equipment in the utility part of the building and frees up space for storage, meeting, or office space.







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Page 1

10th. Floor Mech.

Tag ID 1480 Distribution Panel Single Front (>= 400 amp) Equipment Type
Distribution Panel Single Front (>= 400 amp)

Serial # 997326

Manufacturer square d Model U/O



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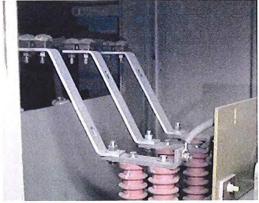
Tag ID 1481 5-15kV Dry Transformers <= 500 kVA

VA Equipment Type
5-15kV Dry Transformers <= 500 kVA

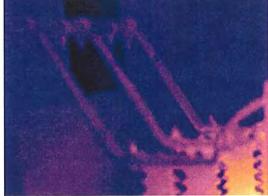
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Federal Pacific

Model 50662-001



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11th. Floor Mech.

1482 Distribution Panel Single Front (>= 400 amp)

Equipment Type Distribution Panel Single Front (>= 400 amp)

997326

Manufacturer square d Model U/O



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1483 5-15kV Dry Transformers <= 500 kVA

Equipment Type
5-15kV Dry Transformers <= 500 kVA

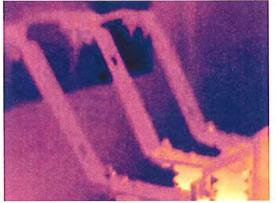
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Manufacturer
Federal Pacific

Model 50662-003



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Page 3

12th. Floor Mech.

1484 Distribution Panel Single Front (>= 400 amp)

Equipment Type Distribution Panel Single Front (>= 400 amp)

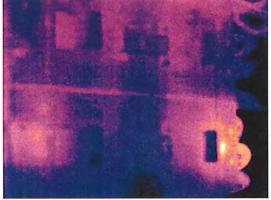
997319

square d

Model U/O



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1485 5-15kV Dry Transformers <= 500 kVA

Equipment Type
5-15kV Dry Transformers <= 500 kVA

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Manufacturer niagra

Model 49951



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Page 4

r _{ag ID} 1486-A Phase 5-15k\	V Dry Transformers <= 500 kVA	Equipment Type 5-15kV Dry Transformers <= 500 k\
Serial # gm238446	Manufacturer sola basic	^{Model} 1755406t00
gm238446	sola basic	1755406t00

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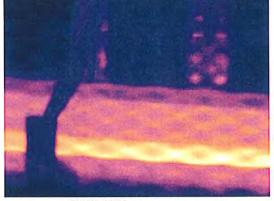
1486-B Phase 5-15kV Dry Transformers <= 500 kVA 5-15k

Equipment Type
5-15kV Dry Transformers <= 500 kVA

n238446

Manufacturer sola basic ^{Model} 1755406t00





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13th Floor Mech.

Tag ID 1486-C Phase 5-15kV Dry Transformers <= 500 kVA

Equipment Type
5-15kV Dry Transformers <= 500 kVA

gm238446

Manufacturer sola basic ^{Model} 1755406t00







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1487 DISTRIBUTION SWITCHBOARD Multi Cover (Per Section)

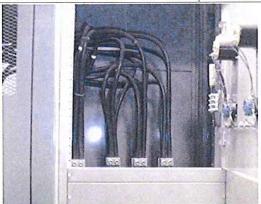
Equipment Type

DISTRIBUTION SWITCHBOARD Multi Cover (Per Section)

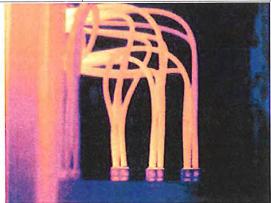
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Manufacturer ITE

17-41220-1



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13th Floor Mech.

Tag ID

1488 DISTRIBUTION SWITCHBOARD Multi Cover (Per Section)

| Manufacturer

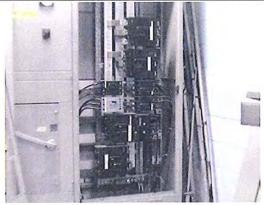
Equipment Type

DISTRIBUTION SWITCHBOARD Multi Cover (Per Section)

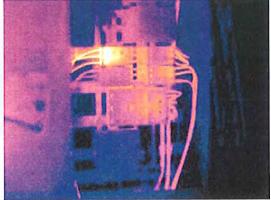
Serial #

Manufacturer ITE

Model 17-41220-1



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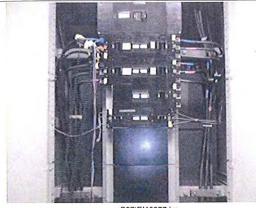
14th Floor Mech.

1489 Distribution Panel Single Front (>= 400 amp)

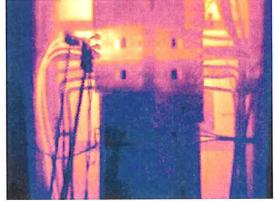
Equipment Type Distribution Panel Single Front (>= 400 amp)

Serial # 997318

Manufacturer square d Model U/O



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1490 Distribution Panel Single Front (>= 400 amp)

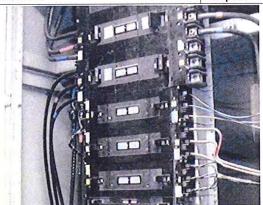
Equipment Type

Distribution Panel Single Front (>= 400 amp)

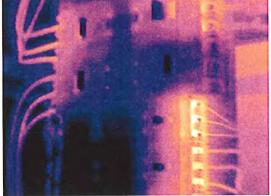
J[#] J9350

Manufacturer square d

U/O



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Serial #

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Lynn Electric, Inc. 785-843-5079 785-749-5810 Fax



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14th Floor Mech.

1491 5-15kV Dry Transformers <= 500 kVA

Manufacturer

allis chalmers

Equipment Type

5-15kV Dry Transformers <= 500 kVA

2887380



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1492 5-15kV Dry Transformers <= 500 kVA

Manufacturer

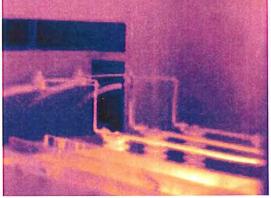
allis chalmers

Equipment Type 5-15kV Dry Transformers <= 500 kVA

2887379



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2110	1 1001	IVICUII.

1459 5-15kV Dry Transformers <= 500 kVA

5-15kV Dry Transformers <= 500 kVA

u/o

Manufacturer Federal Pacific

50150-003

Equipment Type





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1460 Distribution Panel Single Front (>= 400 amp)

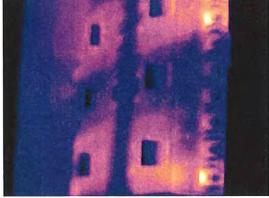
Equipment Type Distribution Panel Single Front (>= 400 amp)

J7326

Manufacturer square d



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2nd Floor Mech.

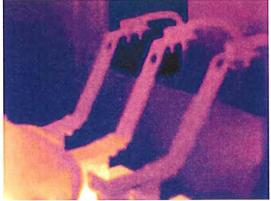
1461 5-15kV Dry Transformers <= 500 kVA

Equipment Type 5-15kV Dry Transformers <= 500 kVA

Serial # u/o

Manufacturer Federal Pacific Model 50150-002





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1462 Distribution Panel Single Front (>= 400 amp)

Equipment Type Distribution Panel Single Front (>= 400 amp)

J[#] J7326

Manufacturer square d



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3rg	. FI	loor	M	ech.

Tag ID
1463 5-15kV Dry Transformers <= 500 kVA
| Manufacturer

Equipment Type 5-15kV Dry Transformers <= 500 kVA

Model
50662-005

Serial # u/o

Manufacturer Federal Pacific







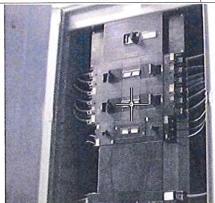
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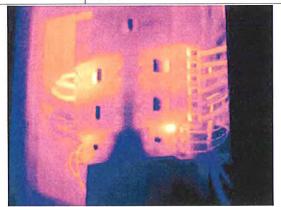
Distribution Panel Single Front (>= 400 amp)

J# J9370

Manufacturer square d



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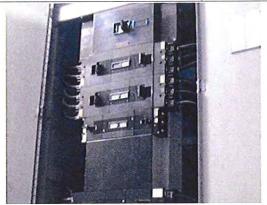
3rd. Floor Mech.

1465 Distribution Panel Single Front (>= 400 amp)

Equipment Type Distribution Panel Single Front (>= 400 amp)

Serial # 997318

Manufacturer square d Model U/O



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1466 5-15kV Dry Transformers <= 500 kVA

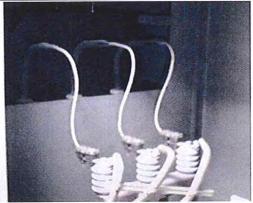
Manufacturer

Equipment Type
5-15kV Dry Transformers <= 500 kVA

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niagra

Model 51131



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3rd. Floor Mech.

1467 Distribution Panel Single Front (>= 400 amp)

Equipment Type Distribution Panel Single Front (>= 400 amp)

Serial # 997318

Manufacturer square d Model U/O



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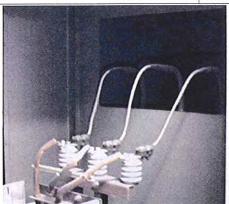
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Equipment Type
5-15kV Dry Transformers <= 500 kVA

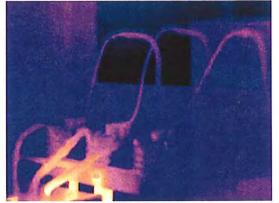
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Manufacturer niagra

Model 51132



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3rd. Floor Mech.

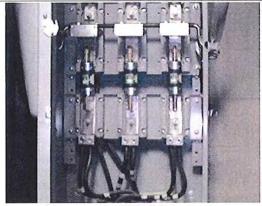
Tag ID 1469 Individual Disconnect Switch

Equipment Type Individual Disconnect Switch

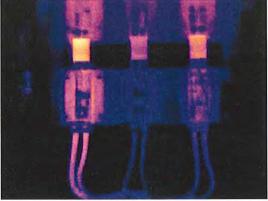
Serial # u/o

Manufacturer ITE

Model jn-425



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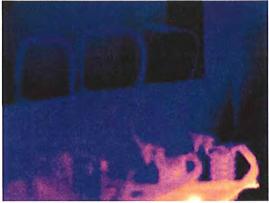
Equipment Inventory - Short Form with Images

Page 15

5th. Floor Mech.		
Tag ID 1470 5-15kV Dry Trar	nsformers <= 500 kVA	5-15kV Dry Transformers <= 500 kVA
Serial # U/O	Manufacturer niagra	^{Model} 51134

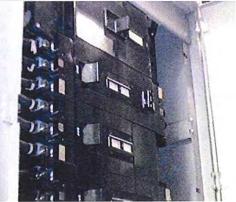


S37\EI19898.jpg



S37\BIR19898.jpg

1471 Distribution Panel Single Front (>= 400 amp)		Equipment Type Distribution Panel Single Front (>= 400 am	
J [†] 7326	Manufacturer square d	Model U/O	



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State of Kansas Docking Building - BAS207472JW

?2, 2009

Equipment Inventory - Short Form with Images

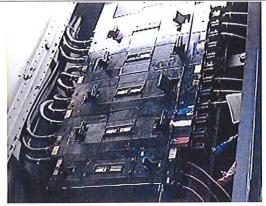
Page 16

6th. Floor Mech.

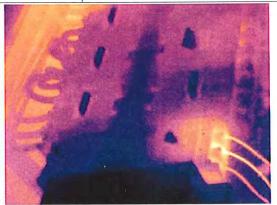
Tag ID
1472 Distribution Panel Single Front (>= 400 amp)

Equipment Type
Distribution Panel Single Front (>= 400 amp)

Serial # 997318 Manufacturer square d Model U/O



S37\EI19901.jpg



S37\BIR19901.jpg

1473 5-15kV Dry Transformers <= 500 kVA

Equipment Type
5-15kV Dry Transformers <= 500 kVA

1/#

Manufacturer niagra Model 51130



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State of Kansas Docking Building - BAS207472JW

?2, 2009

Equipment Inventory - Short Form with Images

Page 17

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1474 5-15kV Dry Transformers <= 500 kVA

Equipment Type 5-15kV Dry Transformers <= 500 kVA

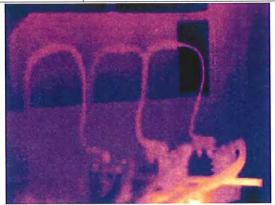
Model
51133

u/o

Manufacturer niagra



S37\EI19902.jpg



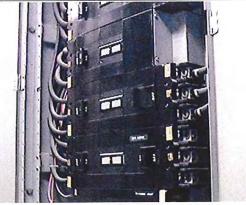
S37\BIR19902.jpg

1475 Distribution Panel Single Front (>= 400 amp)

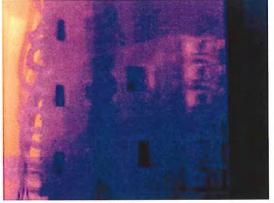
Equipment Type Distribution Panel Single Front (>= 400 amp)

ار 97318

Manufacturer square d



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State of Kansas Docking Building - BAS207472JW

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Equipment Inventory - Short Form with Images

Page 18

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1476 Distribution Panel Single Front (>= 400 amp)

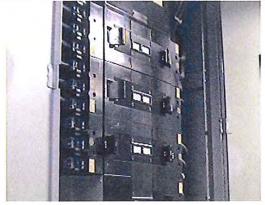
Equipment Type

Distribution Panel Single Front (>= 400 amp)

997318

10

Manufacturer square d Model U/O



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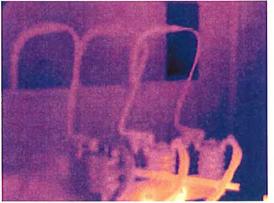
Tag ID
1477 5-15kV Dry Transformers <= 500 kVA

Manufacturer niagra Equipment Type
5-15kV Dry Transformers <= 500 kVA

Model 51129



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Equipment Inventory - Short Form with Images

Page 19

9th. Floor Mech.

Tag ID 1478 Distribution Panel Single Front (>= 400 amp) Equipment Type
Distribution Panel Single Front (>= 400 amp)

Serial # 997326

Manufacturer square d Model U/O



S37\EI19907.jpg



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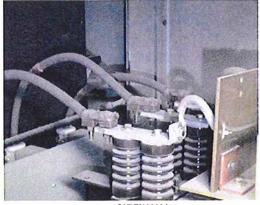
1479 5-15kV Dry Transformers <= 500 kVA

Equipment Type
5-15kV Dry Transformers <= 500 kVA

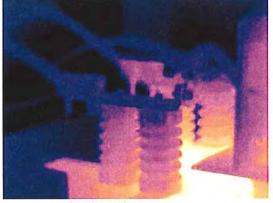
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Manufacturer Federal Pacific

50150-001



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2, 2009

Equipment Inventory - Short Form with Images

Page 20

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Tag ID
1457 5-15kV Dry Transformers <= 500 kVA
| Manufacturer

Equipment Type 5-15kV Dry Transformers <= 500 kVA

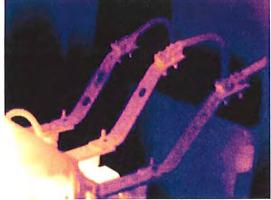
Serial # u/o

Manufacturer Federal Pacific

50150-004



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1458 Distribution Panel Single Front (>= 400 amp)

Equipment Type Distribution Panel Single Front (>= 400 amp)

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Manufacturer square d

999370



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Equipment Inventory - Short Form with Images

Page 21

Basement Air Handler Room

1445 Distribution Panel Single Front (>= 400 amp)

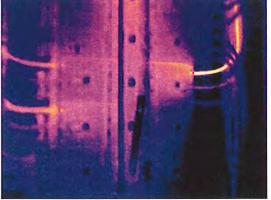
Equipment Type Distribution Panel Single Front (>= 400 amp)

Serial #

Manufacturer square d Model 3256-4



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1446 5-15kV Dry Transformers <= 500 kVA

Manufacturer

Equipment Type 5-15kV Dry Transformers <= 500 kVA

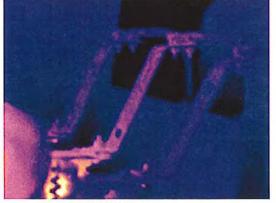
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Federal Pacific

50662-004



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Equipment Inventory - Short Form with Images ?2, 2009

Page 22

Basement Air Handler Room

1447 Distribution Panel Single Front (>= 400 amp)

| Manufacturer | Manufacturer |

Equipment Type

Serial # u/o

square d





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22, 2009 Equipment Inventory - Short Form with Images Page 23

Main Switch Gear Tag ID 1448 5-15kV Switchgear Equipment Type 5-15kV Switchgear Serial # cd-109102 Manufacturer S & C Electric Company Model cd-389002



Tag ID 1449 5-15kV Switchgear	5-15kV Switchgear		Equipment Type 5-15kV Switchgear	
J# J-109102	S & C Electric Compa		^{Model} cd-389002	



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22, 2009 Equipment Inventory - Short Form with Images Page 24

Main Switch Gear			
Tag ID 1450 5-15kV Switchgear		uipment Type 5-15kV Switchgear	
Serial # cd-109102	S & C Electric Compar	Model cd-389002	



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1451 5-15kV Switchgear		Equipment Ty 5-15k	Уре / Switchgear	
J-109102	S & C Electric Comp	any	Model cd-389002	



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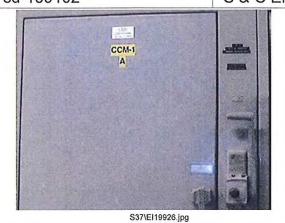




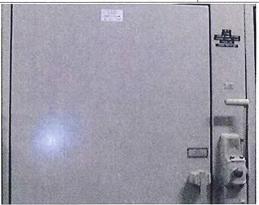
State of Kansas Docking Building - BAS207472JW

22, 2009 Equipment Inventory - Short Form with Images Page 25

Main Switch Gear Tag ID 1452 5-15kV Switchgear Serial # cd-109102 Manufacturer S & C Electric Company Serial # cd-389002



1453 5-15kV Switchgear	Equipm 5-1	_{Туре} kV Switchgear	
J-109102	S & C Electric Company	Model cd-389002	



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Main Switch GearTag ID
1454 5-15kV SwitchgearEquipment Type
5-15kV SwitchgearSerial #
cd-1091025-15kV SwitchgearS & C Electric CompanyModel
cd-389002



1455 5-15kV Switchgear		Equipment Type 5-15kV Switchgear	
7# (-109102	S & C Flectric Compa	model cd-389002	



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State of Kansas Docking Building - BAS207472JW

2, 2009	Equipment Inventory - Short Form with Images	Page 27
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Main Switch Gear		
Tag ID 1456 5-15kV Switchg		guipment Type 5-15kV Switchgear
Serial # cd-109102	Manufacturer S & C Electric Compai	ny cd-389002



S37\EI19922.jpg





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Page 28

Mezzanine

1427 Motor Control Center (Per vertical section)

Motor Control Center (Per vertical section)

Equipment Type

306097-a1

Manufacturer square d

wk122fa2166



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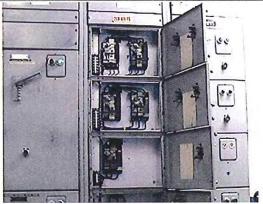
1428 Motor Control Center (Per vertical section)

| Equipment Type | Motor Control Center (Per vertical section)

J6097-a1

Manufacturer square d

wk122fa2166



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Equipment Inventory - Short Form with Images

Page 29

Mezzanine

1429 Motor Control Center (Per vertical section)

Serial # Manufacturer

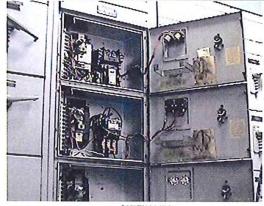
Equipment Type

Motor Control Center (Per vertical section)

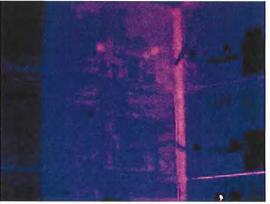
306097-a1

square d

wk122fa2166



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1430 Motor Control Center (Per vertical section)

Equipment Type

Motor Control Center (Per vertical section)

J6097-a1

Manufacturer square d

wk122fa2166



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State of Kansas Docking Building - BAS207472JW

?2, 2009

Equipment Inventory - Short Form with Images

Page 30

Mezzanine

1431 Motor Control Center (Per vertical section)

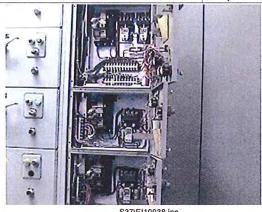
Equipment Type

Motor Control Center (Per vertical section)

306097-a1

Manufacturer square d

wk122fa2166







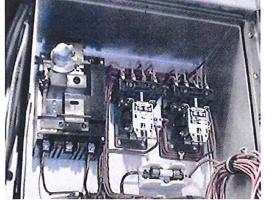
S37\BIR19938.jpg

1432 Motor Control Center (Per vertical section)

J6097-a1

Manufacturer square d Equipment Type Motor Control Center (Per vertical section)

wk122fa2166



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State of Kansas Docking Building - BAS207472JW

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Equipment Inventory - Short Form with Images

Page 31

ezz	

1433 5-15kV Dry Transformers <= 500 kVA

Equipment Type
5-15kV Dry Transformers <= 500 kVA

t862853606-2

Manufacturer allis chalmers

10873



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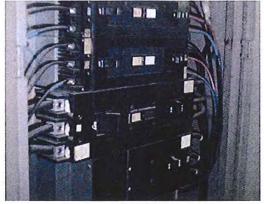


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Tag ID 1434 Distribution Panel Single Front (>= 400 amp) Equipment Type
Distribution Panel Single Front (>= 400 amp)

J62853606-2

Manufacturer square d



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Equipment Inventory - Short Form with Images

Page 32

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1435 Motor Control Center (Per vertical section)

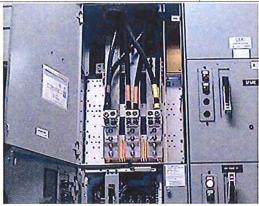
Equipment Type

Motor Control Center (Per vertical section)

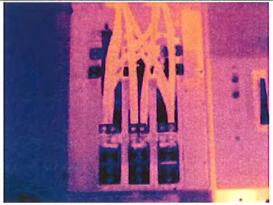
Serial #

Manufacturer sieman

89bfu2g9q001



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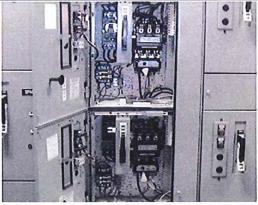
1436 Motor Control Center (Per vertical section)

Equipment Type

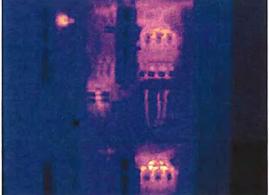
. 0

Manufacturer sieman Motor Control Center (Per vertical section)

| Model | 89bfu2g9q001



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State of Kansas Docking Building - BAS207472JW

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Equipment Inventory - Short Form with Images

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Mezzanine

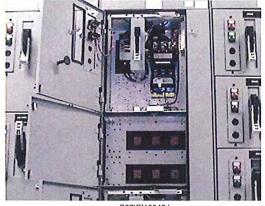
1437 Motor Control Center (Per vertical section)

Equipment Type

Motor Control Center (Per vertical section)

Serial # U/O Manufacturer sieman

89bfu2g9q001



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1438 Motor Control Center (Per vertical section)

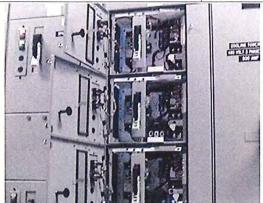
Equipment Type

Motor Control Center (Per vertical section)

. '#

Manufacturer sieman

89bfu2g9q001



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1439 Motor Control Center (Per vertical section)

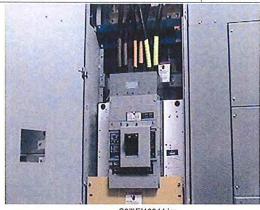
Equipment Type

Motor Control Center (Per vertical section)

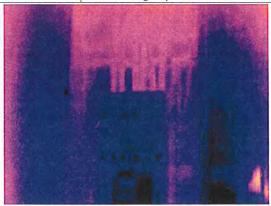
u/o

sieman

89bfu2g9q001



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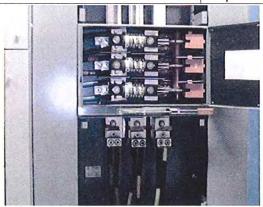
Tag ID 1440 Motor Control Center (Per vertical section) Equipment Type

Motor Control Center (Per vertical section) Manufacturer

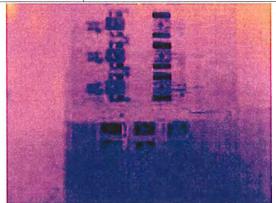
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State of Kansas Docking Building - BAS207472JW

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Equipment Inventory - Short Form with Images

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Mezzanine

Tag ID

1441 Switchgear - Incoming Main Service (Per Section)

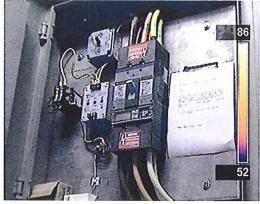
Equipment Type

Switchgear - Incoming Main Service (Per Section)

2-1468-24540

Manufacturer allis chalmers

arc-216b



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1442 Switchgear - Incoming Main Service (Per Section)

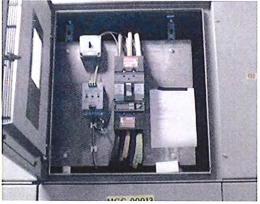
Equipment Type

Switchgear - Incoming Main Service (Per Section)

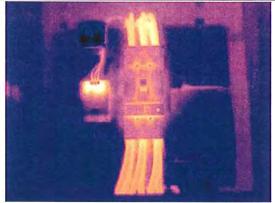
1468-24540

allis chalmers

arc-216b



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Equipment Inventory - Short Form with Images

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Mezzanine

Tag ID

1443 Switchgear - Incoming Main Service (Per Section)

Manufacturer

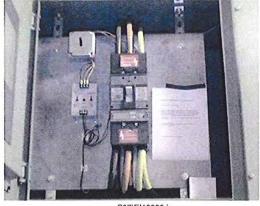
Equipment Type

Switchgear - Incoming Main Service (Per Section)

Serial # 2-1468-24540

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allis chalmers arc-216b



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1444 5-15kV Dry Transformers <= 500 kVA

Manufacturer allis chalmers Equipment Type

5-15kV Dry Transformers <= 500 kVA

2887383

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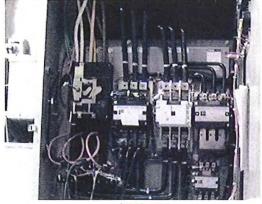
Mezzanine

chiller 1 MCC: Motor Starters

U/O

Manufacturer **Cutler Hammer** Equipment Type
MCC: Motor Starters

U/O



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Tag ID chiller 2 MCC: Motor Starters

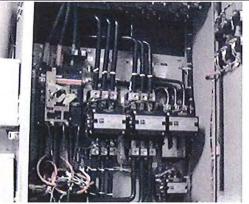
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Manufacturer

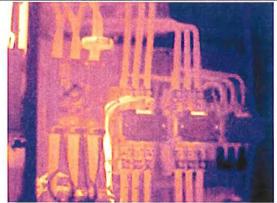
Cutler Hammer

Equipment Type
MCC: Motor Starters

Model U/O



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State of Kansas Docking Building - BAS207472JW

2, 2009

Equipment Inventory - Short Form with Images

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Mezzanine

Tag ID

chiller 3 MCC: Motor Starters

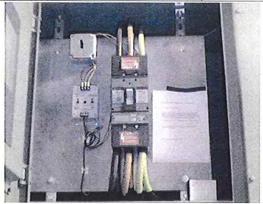
Serial # U/O

Manufacturer

Cutler Hammer

Equipment Type
MCC: Motor Starters

Model U/O



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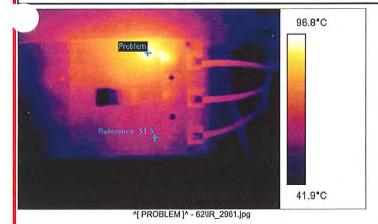
	State of K	ansas Docking E	Building	- BAS20	7472JW				
3/2008	Infrai	ed Inspecti	on Re	eport	Sheet	ţ	Page 2A		
Clint Gottsch	alk	10th. Flo	or Mecl	ղ.					
Tag ID 1480 Distribut	tion Panel Sing	le Front (>= 400	amp)	Equipment Distrib		I Single F	Front (>= 400 amp)		
1100 Diotribu		ity Criteria for		the state of the s	The second second		Tone (* 400 drip)		
Normal		Alert		Severe			Critical		
Less Than	4.1C 4.	1C to 8.0C	8.0	C to 15	.0C	Great	er Than 15.0C		
Reference Te	mperature	Problem Temp	perature			nce Te	mperature		
51.6C		86.8C			35.2C				
<i>Nariables</i>	Problem Pole	Current Rating (Amps)	Current Rating (Amps) Current Draw (Amps) THDC (%Th			THD-F)	Voltage Drop (Volts)		
Phase A	breaker 11	70	16		6		.323		
Phase B	breaker 11	70	23		7		.010		
Phase C	breaker 11	70	22		7		.002		
Problem De	scription	X	Immediate	Hazard	⊠c	ustomer No	otified Immediately		
Recommendations For Repair Repair Equipment Replace Equipment Deenergize circiuit, inspect and repair contacts as a matched set if applicable, or install properly rated replacement breaker.									
Problem Correct	cted	☐ Tightened/Torq	ued Connec	tion	☐ Cor	roded/Disc	olored		
Overloaded Cir	cuit	Excessive Curre	ent Harmon	ics	☐ Stri	oped/Cross	s-threaded Hardware		
	oblem ce: 51 5	96.8°C							
	62\IR_2961.jpg				62/D	C_2962.jpg			

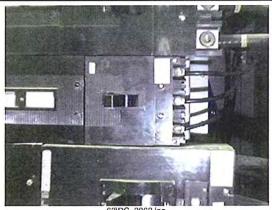




State of Kansas Docking Building - BAS207472JW

Infrared Inspection Report Sheet Page 2B 13/2008 hnician Clint Gottschalk 10th. Floor Mech. Equipment Type 1480 Distribution Panel Single Front (>= 400 amp) Distribution Panel Single Front (>= 400 amp) Consequences if Not Corrected X Equipment Failure X Fire Hazard X Safety Hazard X Power/Business Interruption Additional loading and continued exposure to this condition will more than likely accelerate a failure of this device. Corrective Actions Fixed During Visit ☐ Contractor Will Correct X Customer Will Correct ☐ Estimate Required









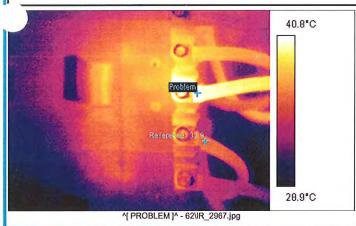
Clint Gottschalk Tag ID 1482 Distribution Panel Single Front (>= 400 amp) Severity Criteria for Similar Comparisons Normal Less Than 4.1C Reference Temperature 33.9C Location 11th. Floor Mech. Equipment Type Distribution Panel Single Front (>= 400 amp) Equipment Type Distribution Panel Single Front (>= 400 amp) Severity Criteria for Similar Comparisons Normal Alert Severe Critical 8.0C to 15.0C Greater Than 15.0C Reference Temperature Jifference Temperature 40.4C		State of Ka	ansas Docking E	Building	- BAS20	7472JW			
Clint Gottschalk 11th, Floor Mech.		Infrar		on Re	eport	Sheet		Page 3A	
1482 Distribution Panel Single Front (>= 400 amp) Distribution Panel Single Front (>= 400 amp) Severity Criteria for Similar Comparisons	Clint Gottscha	alk		or Mecl	h.				
Severity Criteria for Similar Comparisons Normal Alert Severe Critical	Tag ID 1482 Distribut	tion Panel Singl	e Front (>= 400	amp)	- The state of the state of		l Single F	Front (>= 400 amp)	
Normal Alert Severe Critical								(
Reference Temperature 33.9C 40.4C 6.4C Nariables Problem Pole Current Rating (Amps) Current Draw (Amps) THDC (%THD-F) Voltage Drop (Volts Phase A breaker 9 150 30 34 .002 Phase B breaker 9 150 32 32 .008 Problem Description Immediate Hazard Customer Notified Immediately "_b_" Phase breaker contact is displaying abnormal thermal pattern compared to "_a_" and "_c_" Phase contacts. Recommendations For Repair Properly torque connections on a preventative basis. Temperature Difference Temperature 6.4C Voltage Drop (Volts Voltage Drop (Volts Dog Drop (Volts AB 14 .009 Problem Description Immediate Hazard Customer Notified Immediately "_b_" Phase breaker contact is displaying abnormal thermal pattern compared to "_a_" and "_c_" Phase contacts. Recommendations For Repair Repair Equipment Properly torque connections on a preventative basis. Replace Equipment AB Customer Notified Immediately "_b_" Phase Contacts Replace Equipment Stripped/Cross-threaded Hardware 40.8°C 40.8°C	Normal	the second secon					Tall.		
33.9C	The State of the S								
Avariables Problem Pole Current Rating (Amps) Current Draw (Amps) THDC (%THD-F) Voltage Drop (Volts) Phase A breaker 9 150 30 34 .002 Phase B breaker 9 150 48 14 .009 Phase C breaker 9 150 32 32 .008 Problem Description © Immediate Hazard © Customer Notified Immediately "_b_" Phase breaker contact is displaying abnormal thermal pattern compared to "_a_" and "_c_" Phase contacts. Recommendations For Repair Recommendations For Repair Properly torque connections on a preventative basis.□□ © Problem Corrected © Tightened/Torqued Connection © Corroded/Discolored © Corroded/Discolored © Stripped/Cross-threaded Hardware 40.8°C 28.9°C ### August Problem Corrected ### Corroded/Discolored ### Corroded/Disc		mperature		perature		CHARLES THE STREET	nce Tei	mperature	
Phase A breaker 9 150 30 34 .002 Phase B breaker 9 150 48 14 .009 Phase C breaker 9 150 32 32 .008 Problem Description © Immediate Hazard © Customer Notified Immediately "_b_" Phase breaker contact is displaying abnormal thermal pattern compared to "_a_" and "_c_" Phase contacts. Recommendations For Repair Recommendations For Repair Properly torque connections on a preventative basis.□□ © Problem Corrected © Tightened/Torqued Connection © Corroded/Discolored © Stripped/Cross-threaded Hardware 40.8°C 40.8°C 28.9°C © Immediate Hazard © Customer Notified Immediately © Customer Notified								e Makester 1935/95	
Phase B breaker 9 150 48 14 .009 Phase C breaker 9 150 32 32 .008 Problem Description ☑ Immediate Hazard ☑ Customer Notified Immediately "_b_" Phase breaker contact is displaying abnormal thermal pattern compared to "_a_" and "_c_" Phase contacts. Recommendations For Repair ☑ Repair Equipment ☑ Replace Equipment Properly torque connections on a preventative basis. □ ☑ Problem Corrected ☑ Tightened/Torqued Connection ☐ Corroded/Discolored ☐ Overloaded Circuit ☑ Excessive Current Harmonics ☐ Stripped/Cross-threaded Hardware	The state of the s	100000000000000000000000000000000000000			aw (Amps)		HD-F)	Voltage Drop (Volts)	
Problem Description ☑ Immediate Hazard ☑ Customer Notified Immediately "_b_" Phase breaker contact is displaying abnormal thermal pattern compared to "_a_" and "_c_" Phase contacts. Recommendations For Repair ☑ Repair Equipment □ Replace Equipment □ Properly torque connections on a preventative basis. □ ☑ Problem Corrected □ Overloaded Circuit ☑ Excessive Current Harmonics □ Stripped/Cross-threaded Hardware 40.8°C □ 28.9°C						-		-	
Problem Description □ Immediate Hazard □ Customer Notified Immediately □ b □ Phase breaker contact is displaying abnormal thermal pattern compared to □ a □ and □ c □ Phase contacts. Recommendations For Repair □ Repair Equipment □ Replace Equipment □ Properly torque connections on a preventative basis. □ □ □ Overloaded Circuit □ Overloaded Circuit □ Corroded/Discolored □ Overloaded Circuit □ Stripped/Cross-threaded Hardware									
"_b_" Phase breaker contact is displaying abnormal thermal pattern compared to "_a_" and "_c_" Phase contacts. Recommendations For Repair	Phase C	breaker 9	150	32		32		.008	
Recommendations For Repair Properly torque connections on a preventative basis. Year Problem Corrected Tightened/Torqued Connection Corroded/Discolored Overloaded Circuit Excessive Current Harmonics Stripped/Cross-threaded Hardware 40.8°C 28.9°C 28.0°C 28.0°C 28.0°C 28.0°C 28.0°C 28.0	,								
Overloaded Circuit Excessive Current Harmonics Stripped/Cross-threaded Hardware 40.8°C Reference 339 28.9°C			preventative bas	is.□□					
40.8°C Problem Reference 13 s. 28.9°C	□ Problem Correct □ Problem Cor	cted		ued Connec	ction	Cor	roded/Disc	olored	
Problem Reference 19 9 28.9°C	Overloaded Cir	cuit	X Excessive Curre	ent Harmon	ics	Strip	oped/Cross	s-threaded Hardware	
2000 0000		Problem Reference 37.9				Over 3			

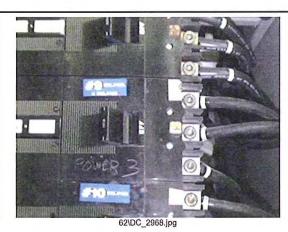


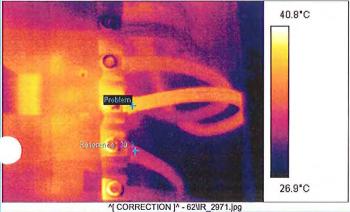


State of Kansas Docking Building - BAS207472JW

Infrared Inspection Report Sheet 03/2008 Page 3B chnician 11th. Floor Mech. Clint Gottschalk Equipment Type 1482 Distribution Panel Single Front (>= 400 amp) Distribution Panel Single Front (>= 400 amp) Consequences if Not Corrected X Fire Hazard X Safety Hazard X Equipment Failure X Power/Business Interruption Additional loading and continued exposure to this condition will more than likely accelerate a failure of this device. Corrective Actions X Fixed During Visit ☐ Contractor Will Correct Customer Will Correct ■ Estimate Required









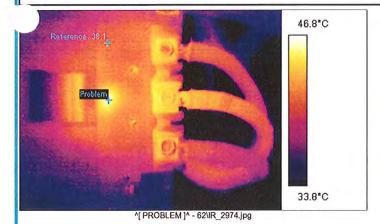


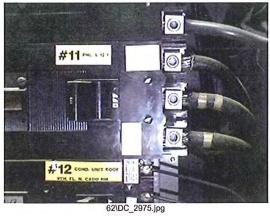
12/2009		Cansas Docking E	diraing	DAOZO	1412000		
3/2008 chnician	Infra	red Inspecti	on Re	eport	Sheet		Page 4A
Clint Gottsch	alk	12th. Flo	or Mecl				
Tag ID 1484 Distribu	tion Panel Sing	gle Front (>= 400	amp)	Equipment Distrib		l Single F	Front (>= 400 amp)
	Sever	rity Criteria for	Similar	Compa	arisons		
Norma	the same of the sa	Alert		Severe			Critical
Less Than		.1C to 8.0C		C to 15			ter Than 15.0C
Reference Te	mperature	Problem Temp	perature			nce le	mperature
38.1C	1	44.0C			5.9C		AND AND EAST
Variables	Problem Pole	Current Rating (Amps)		aw (Amps)	THDC (%T	HD-F)	Voltage Drop (Volts)
Phase A	breaker 11	+					.002
Phase C	breaker 11 breaker 11	175	46		21		.014
		175	40		17		.002
Problem De	scription		Immediate	Hazard	□ Cı	stomer N	otified Immediately
replacement bre		pair contacts as a r	natorica s	ост арр	iloabic, of	iiistaii p	
☐ Problem Corrected ☐ Tightened/Torqued Connection ☐ Corroded/Discolored							
residin conta	cted	☐ Tightened/Torqu	ued Connec	tion	Corr	oded/Disc	
Overloaded Cir		☐ Tightened/Torqu					





73/2008	Infrared In	spection Re	eport She	eet Page 4
Clint Gottschalk		ocation 12th. Floor Mec	h.	
$T_{ag\ ID}$ 1484 Distribution F	anel Single Front	(>= 400 amp)	Equipment Type Distribution F	Panel Single Front (>= 400 amp)
Consequences if	Not Corrected			
	X Fire Hazard			
Additional loading and device.	continued exposure			
Additional loading and	continued exposure	to this condition wi		∑ Power/Business Interruption ely accelerate a failure of this ☐ Estimate Required









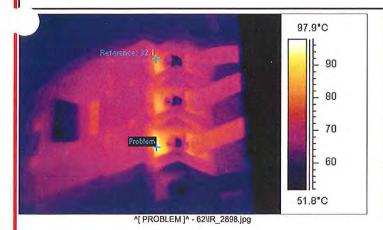
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3/2008 chnician		nnar	eu I	nspecti			Jueer		Page 5A	
Clint Gottscha	alk			2nd Floo	r Mech.		-			
1460 Distribut	ion Pan	el Single	e Fro	nt (>= 400	amp)	Equipment Distribu		el Single F	ront (>= 400 amp)	
		Severi	ty Cr	iteria for S	Similar	Compa	risons			
Normal						Severe			Critical	
Less Than 4	4.1C	4.1	1C to			C to 15			er Than 15.0C	
Reference Te	mperatu	ire		olem Temp	perature)	A STATE OF THE PARTY OF THE PAR	nce Tei	mperature	
82.1C			99.0	C			16.9C			
Nariables	Problem Po	ole	Curren	t Rating (Amps)	Current Dr	aw (Amps)	THDC (%1	THD-F)	Voltage Drop (Volts)	
Phase A	breaker 5		200		83		18.6		.059	
Phase B	breaker 5		200		88.6		20		.039	
Phase C	breaker 5		200		117.3		17.9		.055	
Problem De					Immediate				otified Immediately	
Heat Related Problem. Total Current Harmonic Distortion levels are at a high percent on each phase.										
Recommend	dations l	For Ren	nair	□	Repair Equ	inmont	Пр	eplace Equ	inment	
install harmonic					Repair Equ	притепс		epiace Equ	pment	
	0									
Problem Correct	eted		☐ Tightened/Torqued Connection			ction	Corroded/Discolored			
Overloaded Circ	cuit		X	Excessive Curre	ent Harmon	nics	□ Stri	pped/Cross	-threaded Hardware	
	oun									
				97.9°C	1	OF WA	3			
				37.5 C					3	
Referen	ce: 82.1			90	1 10					
	- 12			E 30				•		
ALC: NO	1			80				Lat	T and the	
	100					#5		16		
				70				LOP	1	
No. of London	Problem					and the		The state of		
				- 60				And P	4	
S. C. V. Line and										
W = 100				51.8°C		The same of		100	Wash.	
	62\IF	R_2898.jpg		30		#6**	62\D	C_2899.jpg		





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Infrared Inspection Report Sheet 03/2008 Page 5B 2nd Floor Mech. chnician Clint Gottschalk Equipment Type 1460 Distribution Panel Single Front (>= 400 amp) Distribution Panel Single Front (>= 400 amp) Consequences if Not Corrected X Equipment Failure X Fire Hazard X Safety Hazard X Power/Business Interruption Advanced heat stress could occur on all electrical equipment, conductors and transformers. Corrective Actions ☐ Fixed During Visit ☐ Contractor Will Correct X Customer Will Correct ☐ Estimate Required









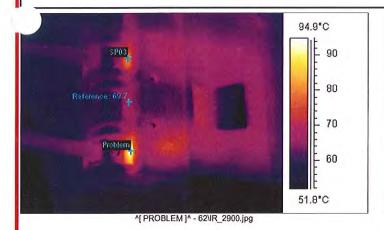
Maria Carlos		Kansas Docking E			And the second second		To the second second
)3/2008 chnician	Infra	red Inspecti	on Re	eport	Sheet		Page 6A
Clint Gottscha	alk	2nd Floo	r Mech.				
Tag ID 1460 Distribut	tion Panel Sinc	ale Front (>= 400	amp)	Equipment Distrib		Single F	Front (>= 400 amp)
TTOO BIOLING		rity Criteria for				omg.o.	тен (тее атр)
Normal	THE RESERVE OF THE PERSON NAMED IN COLUMN 1	Alert		Severe			Critical
Less Than	4.1C 4	.1C to 8.0C	8.0	C to 15	.0C	Great	er Than 15.0C
Reference Te	mperature	Problem Temp	perature			nce Tei	mperature
69.7C		95.0C			25.3C		
<i>Nariables</i>	Problem Pole	Current Rating (Amps)	Current Dr.	aw (Amps)	THDC (%TH	HD-F)	Voltage Drop (Volts)
Phase A	breaker 4	200	200 25.9 20.4				.304
Phase B	breaker 4	200	15.4		25.9		.005
Phase C	breaker 4	200	29.4		10.8		.436
Problem De	scription	X	Immediate	Hazard	⊠ Cu	stomer No	otified Immediately
	A STATE OF THE PARTY OF THE PAR	epair □ epair contacts as a r	Repair Equ			place Equ install p	
Problem Correct	cted	☐ Tightened/Torq	ued Connec	ction	Corre	oded/Disc	olored
Overloaded Cir	cuit	X Excessive Curre	ent Harmon	ics	☐ Strip	ped/Cross	-threaded Hardware
SP03 Reference: 69.7 Problem		94.9°C				- (3)	





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Infrared Inspection Report Sheet 73/2008 Page 6B chnician 2nd Floor Mech. Clint Gottschalk Equipment Type 1460 Distribution Panel Single Front (>= 400 amp) Distribution Panel Single Front (>= 400 amp) Consequences if Not Corrected X Power/Business Interruption X Equipment Failure X Safety Hazard X Fire Hazard Additional loading and continued exposure to this condition will more than likely accelerate a failure of this device. Corrective Actions ☐ Fixed During Visit □ Contractor Will Correct X Customer Will Correct ■ Estimate Required





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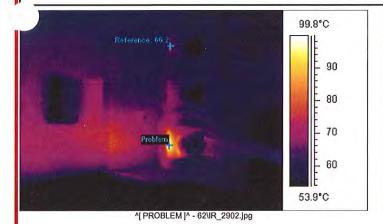
13/2008	Infrar	ed Inspecti	on Report	Sheet	Page 7A
Clint Gottscha		Location 2nd Floo			
Tag ID			Equipment		Front (>= 400 amp)
1400 Distribu		le Front (>= 400 ity Criteria for a			-1011t (>= 400 amp)
Normal	Severi	Alert	Severe		Critical
Less Than 4	4.1C 4.	1C to 8.0C	8.0C to 15		er Than 15.0C
Reference Te	mperature	Problem Temp	perature	Difference Te	mperature
66.2C		101.0C		34.8C	
Nariables	Problem Pole	Current Rating (Amps)	Current Draw (Amps)	THDC (%THD-F)	Voltage Drop (Volts)
Phase A	breaker 7	150	26.6	21.5	.002
Phase B	breaker 7	150	28	18	.01
Phase C	breaker 7	150	33	29	.238
Problem De	scription	×	Immediate Hazard		otified Immediately
		pair pair contacts as a r	Repair Equipment matched set if app	☑ Replace Equilicable, or install p	
Problem Correct	cted	☐ Tightened/Torq	ued Connection	Corroded/Disc	colored
Overloaded Cir	cuit	X Excessive Curr	ent Harmonics	Stripped/Cros	s-threaded Hardware
Ref	erence: 66.2	99.8°C 99.8°C 90 80 70 53.9°C	#7		





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Infrared Inspection Report Sheet 03/2008 Page 7B 2nd Floor Mech. *z*chnician Clint Gottschalk Equipment Type 1460 Distribution Panel Single Front (>= 400 amp) Distribution Panel Single Front (>= 400 amp) Consequences if Not Corrected X Fire Hazard X Power/Business Interruption X Equipment Failure X Safety Hazard Additional loading and continued exposure to this condition will more than likely accelerate a failure of this device. Corrective Actions ☐ Fixed During Visit ☐ Contractor Will Correct ■ Estimate Required









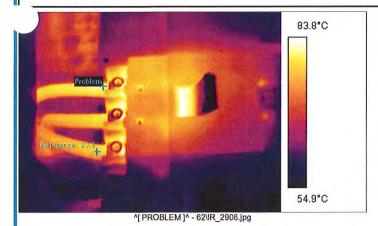
3/2008	1 22	Infrar	ed l	nspecti	on Re	eport	Sheet		Page 8A	
Clint Gottscha	alk			2nd Floo	r Mech					
Tag ID 1462 Distribut	tion Par	el Sinal	e Froi	nt (>= 400	amp)	Equipment Distrib		l Single F	ront (>= 400 amp)	
TIOL BIOLIDA	are are			iteria for				renigion	, on (, , , , , , , , , , , , , , , , , ,	
Normal			Alei	The second secon		Severe			Critical	
Less Than 4	4.1C	4.	1C to	8.0C	8.0	C to 15	.0C	Greate	er Than 15.0C	
Reference Te	mperati	ıre	W	olem Temp	perature		Difference Temperatur		nperature	
73.1C				С			5.0C	Market 1	NAME OF STREET	
Nariables	Problem P	ole	Curren	t Rating (Amps)	Current Dr	aw (Amps)	THDC (%T	HD-F)	Voltage Drop (Volts)	
Phase A	breaker 2		200		106		17		.042	
Phase B	breaker 2		200		104		16		.037	
Phase C	breaker 2		200		105		18		.01	
Problem De	Problem Description									
Heat Related Problem. High total current harmonic distortion percentage.										
Recommendations For Repair Repair Equipment Replace Equipment										
Install Harmonic	THE RESERVE THE PARTY OF THE PA		all	<u> </u>	Repair Equ	iipment	ЦК	epiace Equi	pment	
motan marmorne	, i iliciini	,								
Problem Correct	cted			Tightened/Torq	ued Conne	ction	Corr	oded/Disco	plored	
Overloaded Circ	cuit		X	Excessive Curre	ent Harmor	nics	☐ Strip	ped/Cross-	threaded Hardware	
网络 35-种翻		ALC: NO	734	83.8°C						
Maria American								5.45 (0.45)		
國馬克 翻				4	-	ALC:		4	\$	
Million and the		1			-		2			
Problem		4			,		O O		10	
AND SERVICE AND ADDRESS.					-8	Her		3 (
No.					1	ME	110		C	
Reference 73.1							1 0	0.0		
†							Marie		100 100 1 100 1	
							. 0			
				54.9°C		1	0			
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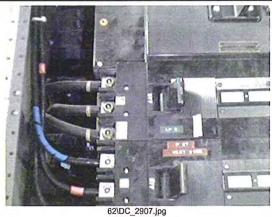




State of Kansas Docking Building - BAS207472JW

Infrared Inspection Report Sheet 13/2008 Page 8B ^{Location} 2nd Floor Mech. chnician Clint Gottschalk Equipment Type 1462 Distribution Panel Single Front (>= 400 amp) Distribution Panel Single Front (>= 400 amp) Consequences if Not Corrected X Equipment Failure X Fire Hazard X Safety Hazard X Power/Business Interruption Harmonic distortion can cause heat stress on electrical equipment, conductors, and transformers. Corrective Actions ☐ Fixed During Visit ☐ Contractor Will Correct X Customer Will Correct ☐ Estimate Required







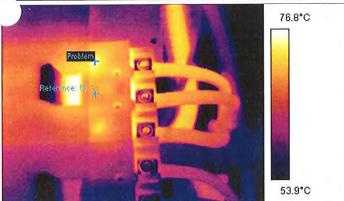


Normal Less Than 4 Reference Ten 66.1C Nariables Phase A Phase B Phase C Problem Des	Sever Sever 1.1C 4 mperature Problem Pole breaker 5 breaker 5 breaker 5	Location 2nd Floor 2nd F	amp) Equipment Distribution Similar Compassion Severe 8.0C to 15	ution Panel Single F prisons	Front (>= 400 amp) Critical ter Than 15.0C mperature Voltage Drop (Volts)				
Normal Less Than 4 Reference Ten 66.1C Nariables Phase A Phase B Phase C Problem Des	Sever Sever 1.1C 4 mperature Problem Pole breaker 5 breaker 5 breaker 5	Alert Alert 1C to 8.0C Problem Temp 75.3C Current Rating (Amps) 225 225	Similar Compa Severe 8.0C to 15 Derature Current Draw (Amps) 91 80	oc Great Difference Te 9.2C THDC (%THD-F)	Critical ter Than 15.0C mperature Vollage Drop (Volts)				
Normal Less Than 4 Reference Ten 66.1C Nariables Phase A Phase B Phase C Problem Des	Sever Sever 1.1C 4 mperature Problem Pole breaker 5 breaker 5 breaker 5	Alert Alert 1C to 8.0C Problem Temp 75.3C Current Rating (Amps) 225 225	Similar Compa Severe 8.0C to 15 Derature Current Draw (Amps) 91	Difference Te 9.2C THDC (%THD-F)	Critical ter Than 15.0C mperature Vollage Drop (Volts)				
Less Than 4 Reference Ten 66.1C Nariables Phase A Phase B Phase C Problem Des	Problem Pole breaker 5 breaker 5 breaker 5	Alert .1C to 8.0C Problem Temp 75.3C Current Rating (Amps) 225 225	Severe 8.0C to 15 Derature Current Draw (Amps) 91 80	OC Great Difference Te 9.2C THDC (%THD-F) 17	ter Than 15.0C mperature Vollage Drop (Volts)				
Reference Terro 66.1C Nariables Phase A Phase B Phase C Problem Des	Problem Pole breaker 5 breaker 5 breaker 5	Problem Temp 75.3C Current Rating (Amps) 225 225	Current Draw (Amps) 91 80	Difference Te 9.2C THDC (%THD-F) 17	Voltage Drop (Volts)				
Phase B Phase C Problem Des	Problem Pole breaker 5 breaker 5 breaker 5	75.3C Current Rating (Amps) 225 225	Current Draw (Amps) 91 80	9.2C THDC (%THD-F)	Vollage Drop (Volts)				
Nariables Phase A Phase B Phase C Problem Des	breaker 5 breaker 5 breaker 5 Scription	Current Rating (Amps) 225 225	91 80	THDC (%THD-F)					
Phase A Phase B Phase C Problem Des	breaker 5 breaker 5 breaker 5 Scription	225 225	91 80	17					
Phase B Phase C Problem Des	breaker 5 breaker 5 scription	225	80		024				
Phase C Problem Des	breaker 5 Scription			20	1024				
Problem Des	scription	225	74		.048				
				18	.001				
Heat Related Pro	oblem, The tota		Immediate Hazard		otified Immediately				
Heat Related Problem, The total harmonic current distortion is at a high percentage.									
Recommend	lations For Re	pair 🛛	Repair Equipment	Replace Equ	uipment				
		r find a replacementilure of the contacts		ing contacts. Mill	ivolt				
Problem Correct	ted	☐ Tightened/Torq	ued Connection	☐ Corroded/Disc	colored				
Overloaded Circ	cuit	X Excessive Curre	ent Harmonics	☐ Stripped/Cros	s-threaded Hardware				
Problem Reference: (th.)		76.8°C							





03/2008	Infrared Ins	pection Re	port She	et Page 9
Clint Gottschalk		ation nd Floor Mech.		
Tag ID 1462 Distribution F	anel Single Front (>= 400 amp)	Equipment Type Distribution F	anel Single Front (>= 400 amp)
Consequences if	Not Corrected			
X Equipment Failure		X Safety H	azard	X Power/Business Interruption
Corrective Action			The Court of the C	П
Corrective Action	Contractor Will Corn	ect X Custom	er Will Correct	Estimate Required











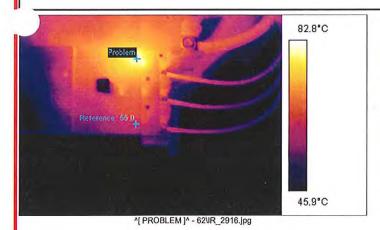
		ansas Docking E			
3/2008	Infrar	ed Inspecti	on Report	Sheet	Page 10A
Clint Gottscha	alk	3rd. Floo	or Mech.		
Tag ID 1464 Distribut	tion Panel Singl	e Front (>= 400	amp) Equipment	_{Туре} ution Panel Single F	ront (>= 400 amp)
1404 Blottibut		ty Criteria for			ion (* 400 amp)
Normal		Alert	Severe		Critical
Less Than 4		1C to 8.0C	8.0C to 15	.0C Great	er Than 15.0C
Reference Te	mperature	Problem Temp	perature	Difference Tel	mperature
55.0C		75.5C		20.5C	
Nariables	Problem Pole	Current Rating (Amps)	Current Draw (Amps)	THDC (%THD-F)	Voltage Drop (Volts)
Phase A	7	70	22	8	.172
Phase B	7	70	20	9	.033
Phase C	7	70	21	9	.04
Problem De	scription	X	Immediate Hazard	☐ Customer No.	otified Immediately
	Control of the Contro	pair 🗵	Repair Equipment matched set if app	☑ Replace Equ licable, or install p	
Problem Correct	eted	☐ Tightened/Torqu	ued Connection	Corroded/Disc	olored
Overloaded Circ	cuit	Excessive Curre	ent Harmonics	Stripped/Cross	-threaded Hardware
Proble Reference: 66		82.8°C		62\DC 2917.jpg	





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Infrared Inspection Report Sheet 03/2008 Page 10B chnician 3rd. Floor Mech. Clint Gottschalk Equipment Type 1464 Distribution Panel Single Front (>= 400 amp) Distribution Panel Single Front (>= 400 amp) Consequences if Not Corrected X Fire Hazard X Safety Hazard X Equipment Failure X Power/Business Interruption Additional loading and continued exposure to this condition will more than likely accelerate a failure of this device. Corrective Actions ☐ Fixed During Visit ☐ Contractor Will Correct X Customer Will Correct ☐ Estimate Required







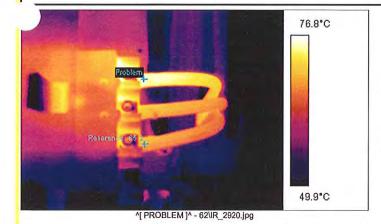


3/2008	1	nfrar	ed I	nspecti	on Re	eport	Sheet		Page 11A	
Clint Gottscha	alk			3rd. Floo	r Mech					
1465 Distribut	tion Pan	el Sinal	e Fron	nt (>= 400	amp)	Equipment Distrib		I Single F	ront (>= 400 amp)	
	200			iteria for						
Normal			Alei	rt		Severe			Critical	
Less Than 4			1C to			C to 15			er Than 15.0C	
Reference Te	mperatu	re		olem Temp	perature			nce Ter	nperature	
65.2C				C.			10.0C			
Nariables	Problem Po	le	Curren	t Rating (Amps)	Current Draw (Amps)		THDC (%T	HD-F)	Voltage Drop (Volts)	
Phase A	breaker 5		200		104		18		.045	
Phase B	breaker 5		200		81		19		.031	
Phase C	breaker 5		200		86		18		.023	
Problem De	scription			X	Immediate	Hazard	⊠ Cı	ustomer No	tified Immediately	
Heat Related Problem, Unbalanced loads are occuring. Harmonics are also at near to high percentage										
levels										
Recommend	dations F	or Rer	nair	X	Repair Equ	inment	Пве	eplace Equi	oment	
Balance loads t					rtopan Equ	.pmon		spiaco Equi	pinioni	
2.741.742.444.4										
Problem Correct	cted			Tightened/Torq	ued Connec	ction	Cor	roded/Disco	olored	
Overloaded Cir	cuit		X	Excessive Curr	ent Harmon	ics	☐ Strip	ped/Cross	threaded Hardware	
_										
				76.8°C						
Maria de la companya										
Prot	blem						300			
A STATE OF		7			100		MF SE			
					1			0		
	1									
Referencer	65.2	-						(0)		
CARL NO.	-							0		
					literal literal		17	1		
	1 2			49.9°C	25			9		
	62\IR	2920.jpg				F - 186	62\D	C 2921.lpq		





03/2008	Infrared Ins	spection Re	port She	eet	Page 11
Johnician Clint Gottschalk		Brd. Floor Mech			
^{ag ID} 1465 Distribution I	Panel Single Front	(>= 400 amp)	Equipment Type Distribution F	Panel Single Front (>=	400 amp)
Consequences is	Not Corrected				
X Equipment Failure	X Fire Hazard	X Safety ⊢	azard	X Power/Business	Interruption
Corrective Action	7S ☐ Contractor Will Cor			☐ Estimate Require	







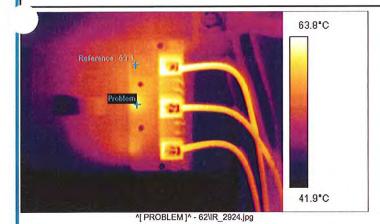


13/2008		Infrar	ed Ir	nspecti	on Re	eport	Sheet		Page 12A
Clint Gottsch	alk			3rd. Floc	r Mech				
Tag ID 1467 Distribu	tion Pan	el Sinal	e Fron	t (>= 400	amp)	Equipment Distrib		I Single F	ront (>= 400 amp)
1467 Distribution Panel Single Front (>= 400 amp) Distribution Panel Single Front (>= 400 amp) Severity Criteria for Similar Comparisons									
Normal			Alen	THE RESERVE OF THE PERSON NAMED IN		Severe			Critical
Less Than	Less Than 4.1C 4.1C to 8.0C 8.0C to 15.0C Greater Than 15.0C								
Reference Te	mperatu	ire		lem Temp	perature			nce Tei	mperature
53.1C			60.20	<u> </u>			7.0C		
/Variables	Problem Po	ole	Current	Rating (Amps)	Current Dr.	aw (Amps)	THDC (%T	HD-F)	Voltage Drop (Volts)
Phase A	breaker 11		50		22		4		.038
Phase B	breaker 11		50		21		4		.042
Phase C	breaker 11		50		22		4		.047
Problem De	scription	1			Immediate	Hazard	⊠ Cu	ustomer No	tified Immediately
Heat Related Pro	oblem. Pit	ting insid	e the b	reaker is fo	rming do	to the ag	e and co	nstant lo	ad on this breaker.
Recommend	dations	For Rep	air	X	Repair Equ	ipment	⊠ Re	eplace Equ	ipment
Excersise break replaced.	er #11 to	prevent p	oitting fr	om produci	ng intern	ally. Insp	ect contac	cts to see	e if they need
Problem Corre	cted		ΧT	ightened/Torq	qued Connection			olored	
Overloaded Cir	cuit		□ E	xcessive Curre	ent Harmon	ics	Strip	oped/Cross	-threaded Hardware
Reference: 53	**************************************	2924.jpg	1	63.8°C			62(1)	C 2925.jpg	





03/2008	Infrared In	spection Re	eport She	et Page 12B				
Clint Gottschalk		ocation 3rd. Floor Mech.						
1467 Distribution Panel Single Front (>= 400 amp) Equipment Type Distribution Panel Single Front (>= 400 amp) Di								
Consequences if	Not Corrected							
	Fire Hazard	☐ Safety H	lazard	X Power/Business Interruption				
Corrective Action	າຮ							
Fixed During Visit	☐ Contractor Will Co	rrect X Custome	er Will Correct	Estimate Required				







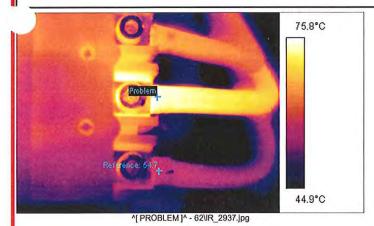


03/2008		Infrar	ed Inspec	ction	n Re	port	Sheet		Page 13A
Clint Gottsch	alk		5th. Fl	oor N	1ech.				
Tag ID 1471 Distribu	tion Pan	el Sinal	e Front (>= 40	00 am	(ar	Equipment Distribu		l Single F	ront (>= 400 amp)
1471 Distribution Panel Single Front (>= 400 amp) Distribution Panel Single Front (>= 400 amp) Severity Criteria for Similar Comparisons									
Norma		L. Park	Alert			Severe			Critical
Less Than			1C to 8.0C			C to 15			er Than 15.0C
Reference Te	mperatu	ire	Problem Tel	mpera	ature			nce Ter	nperature
54.7C			74.3C				19.6C		以外が生物を決断を設置
Nariables	Problem Po	ole	Current Rating (Am	ps) Cur	rent Dra	w (Amps)	THDC (%T	HD-F)	Voltage Drop (Volts)
Phase A	breaker 7		200	78			19		.021
Phase B	breaker 7		200	85			15		.066
Phase C	breaker 7		200	65			18		.031
Problem De	scription	1		⊠ Imm	ediate l	Hazard	⊠ Cı	ıstomer No	tified Immediately
Recommendations For Repair									
breaker with a no	cted		☑ Tightened/T					oded/Disco	
Overloaded Cir	cuit		Excessive C	Current H	łarmoni	cs	X Strip	ped/Cross	-threaded Hardware
Fele	Problem	2937.jpg	75.8°C				62\D0	6 2938,jpg	





73/2008	Intrared I	nspection Re	eport She	eet Page 13B
Clint Gottschalk		5th. Floor Mech.		
7ag ID 1471 Distribution F	Panel Single Fro	nt (>= 400 amp)	Equipment Type Distribution P	anel Single Front (>= 400 amp)
Consequences if	Not Corrected			
X Equipment Failure	X Power/Business Interruption			
Unwanted bussiness	loss and a fire haz	zard.		
Corrective Action	is			
Fixed During Visit	☐ Contractor Will (Correct X Custome	er Will Correct	☐ Estimate Required
We did torque all the control threaded.	onnection points o	f the breaker, we stro	ngly believe tha	at the B phase lug is cross







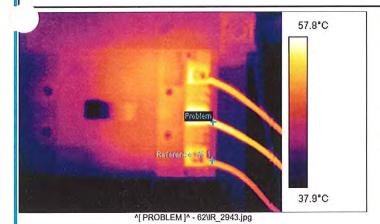


3/2008		Infrar	ed Ins	pecti	on Re	eport	Sheet		Page 14A
Clint Gottscha	alk			_{ation} th. Floc	r Mech.				
Tag ID 1472 Distribut	tion Par	el Sinal	e Front (>= 400	amp)	Equipment Distrib	,,	l Single F	ront (>= 400 amp)
TTT BIOTIES	ion r ar		ty Crite			-		a onigio i	ione (ioo amp)
Normal			Alert			Severe			Critical
Less Than 4	4.1C	4.	1C to 8.0			C to 15	.0C	Great	er Than 15.0C
Reference Te	mperati	ıre		n Tem	perature		Control of the contro	nce Ter	mperature
48.1C			54.6C				6.4C		高级能力的
Nariables	Problem P	ole	Current Rat	ling (Amps)	Current Dr	aw (Amps)	THDC (%1	HD-F)	Voltage Drop (Volts)
Phase A	breaker 1	1	70		20		5		.003
Phase B	breaker 1	1	70		21		7		.039
Phase C	breaker 1	1	70		20		5		.004
Problem De	scriptio	n			Immediate	Hazard	X C	ustomer No	tified Immediately
Circuit #_11_B p	hase cor	tact has	a tempera	ture rise	greater t	han 10 d	egrees C	over the	ambient air
surrounding it un	der norm	al operat	ing condit	ions.					
Recommend	dations	For Rer	air	X	Repair Equ	inment	Пв	eplace Equi	ipment
									ontacts internally
for possible dam		0.0							,
Problem Correct	cted		☐ Tight	tened/Torq	ued Connec	ction	☐ Cor	roded/Disco	olored
Overloaded Circ	cuit		☐ Exce	ssive Curr	ent Harmon	ics	Stripped/Cross-threaded Hardware		
			_				_	•	
		2015		57.8°C		No.			
								172	
		11							
								(8)	
		Problem		44	糖	2			11/2
		FIODE		900		8	THE R.	lin	
		- 10		ren	68	in the			
	Refere	nce # 1							
Company of the last		-							
				37.9°C					
	62\J	R_2943.jpg					62\D	C_2944.jpg	





13/2008	Infrared Ins	spection Re	eport She	et Page 14E		
Clint Gottschalk		Sth. Floor Mech				
Tag ID 1472 Distribution F	anel Single Front	nt (>= 400 amp) Equipment Type Distribution Panel Single Front (>				
Consequences if	Not Corrected					
X Equipment Failure	Fire Hazard	X Safety H	lazard	X Power/Business Interruption		
Corrective Action	is					
Fixed During Visit	Contractor Will Cor	rect X Custom	er Will Correct	Estimate Required		









State of Kansas Docking Building - BAS207472JW

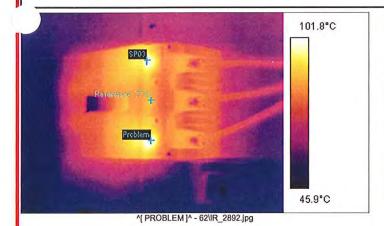
3/2008	Infrar	ed Inspecti	on Report	Sheet	Page 15A			
Clint Gottscha	alk	1st Floor	r Air Handler R	oom				
Tag ID 1458 Distribut	tion Panel Sing	e Front (>= 400	amp) Equipment	<i>Туре</i> ution Panel Single F	Front (>= 400 amp)			
		ity Criteria for						
Normal		Alert	Severe	DAR.	Critical			
Less Than		1C to 8.0C	8.0C to 15	The same of the sa	er Than 15.0C			
Reference Te	mperature	Problem Temp	perature	Difference Te	mperature			
77.8C	le le le	101.7C	la sa	24.0C				
Nariables	Problem Pole	Current Rating (Amps)		THDC (%THD-F)	Voltage Drop (Volts)			
Phase A	Breaker #8	70	18	5.1	.187			
Phase B	Breaker #8	70	23	5	.035			
Phase C	Breaker #8	70	21.5	4.1	.367			
Problem De	scription	X	Immediate Hazard		otified Immediately			
Recommend	dations For Rep	oair 🖂	Repair Equipment		uinment			
Deenergize circiu replacement brea		oair contacts as a r	natched set if app	licable, or install p	roperly rated			
Problem Correct	cted	☐ Tightened/Torq	ued Connection	Corroded/Disc	olored			
Overloaded Circ	cuit	Excessive Curre	ent Harmonics	Stripped/Cross	s-threaded Hardware			
Overloaded Circuit Excessive Current Harmonics Stripped/Cross-threaded Hardware 101.8°C Research Frobles 62UR 2892.jpg 62UC 2893.jpg								





State of Kansas Docking Building - BAS207472JW

Infrared Inspection Report Sheet Page 15B 03/2008 chnician Clint Gottschalk 1st Floor Air Handler Room 1458 Distribution Panel Single Front (>= 400 amp) Distribution Panel Single Front (>= 400 amp) Consequences if Not Corrected X Fire Hazard X Safety Hazard X Power/Business Interruption X Equipment Failure Additional loading and continued exposure to this condition will more than likely accelerate a failure of this device. Corrective Actions ☐ Fixed During Visit X Customer Will Correct ■ Estimate Required ☐ Contractor Will Correct









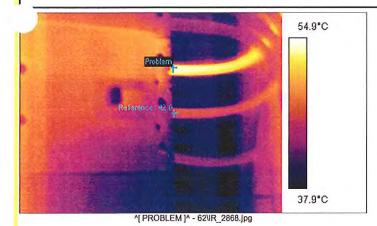
13/2008	Infi	rared I	nspecti	on Re	eport	Sheet		Page 16A	
Clint Gottscha			Baseme						
Tag ID 1445 Distribut	tion Panel S	ingle Fro	nt (>= 400	amp)	Equipment Distribu		el Sinale F	ront (>= 400 amp)	
THE BIGHTON			iteria for						
Normal		Alei			Severe			Critical	
Less Than 4		4.1C to			C to 15.			er Than 15.0C	
	Reference Temperature			perature			nce Ter	nperature	
42.0C		52.4				10.4C			
Nariables	Problem Pole		t Rating (Amps)	-	aw (Amps)	THDC (%)	THD-F)	Voltage Drop (Volts)	
Phase A	breaker 10	100		14.2		24.7		.004	
Phase B	breaker 10	100		11.1		42.5		.005	
Phase C	breaker 10	100		45		20		.016	
Problem De	scription		X	Immediate	Hazard	⊠c	ustomer No	tified Immediately	
Deenergize circi replacement bre	Recommendations For Repair								
Properly balance			Tightened/Torq	ued Connec	otion	☐ Cor	roded/Disco	plored	
Overloaded Cir	cuit	\boxtimes	X Excessive Current Harmonics				Stripped/Cross-threaded Hardware		
Re	Problem oference 42.0		54.9°C			I SALVA	C 2869.jpg		

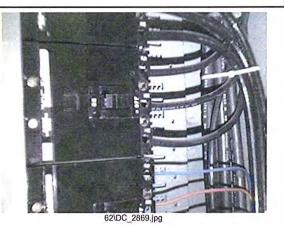




State of Kansas Docking Building - BAS207472JW

Infrared Inspection Report Sheet 03/2008 Page 16B Clint Gottschalk Basement Air Handler Room Equipment Type 1445 Distribution Panel Single Front (>= 400 amp) Distribution Panel Single Front (>= 400 amp) Consequences if Not Corrected X Fire Hazard X Equipment Failure X Safety Hazard X Power/Business Interruption Additional loading and continued exposure to this condition will more than likely accelerate a failure of this device. Corrective Actions ☐ Fixed During Visit Contractor Will Correct X Customer Will Correct ☐ Estimate Required







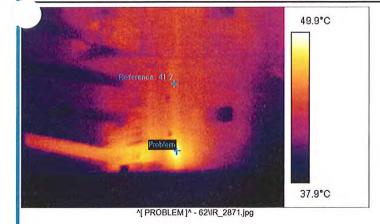


Infrai alk tion Panel Sing		nt Air Handler I	Room	Page 17A					
	Baseme								
tion Panel Sing	J- Fu /> - 400	Faujoment							
tion i and onig	le Front (>= 400			Front (>= 400 amp)					
Severity Criteria for Similar Comparisons									
	Alert			Critical					
4.1C 4.	1C to 8.0C	8.0C to 15	.0C Grea	ter Than 15.0C					
mperature	Problem Temp	perature	Difference Te	mperature					
	47.5C		6.4C						
Problem Pole	Current Rating (Amps)	Current Draw (Amps)	THDC (%THD-F)	Voltage Drop (Volts)					
breaker 17	100	0	0	Unable to Obtain					
breaker 10	100	4	65.5	Unable to Obtain					
breaker 10	100	27	14.6	Unable to Obtain					
scription		Immediate Hazard		lotified Immediately					
Recommendations For Repair									
cted	▼ Tightened/Torq	ued Connection	Corroded/Disc	☐ Corroded/Discolored					
cuit	X Excessive Curr	ent Harmonics	Stripped/Cross-threaded Hardware						
ference: 41.2 _g	49.9°C								
	Problem Pole breaker 17 breaker 10 breaker 10 escription aker contact is dis	4.1C to 8.0C Imperature	4.1C to 8.0C 8.0C to 15 Imperature Problem Temperature 47.5C Problem Pole Current Rating (Amps) Current Draw (Amps) breaker 17 100 0 breaker 10 100 4 breaker 10 100 27 ESCription Immediate Hazard aker contact is displaying abnormal thermal pattern contact is displaying abnormal thermal pattern contact in the saker. Althorough Temperature 47.5C Repair Equipment 19.00 Adations For Repair Immediate Hazard 20.00 Adations For Repair Immediate Hazard 20.00	### A 1 C to 8.0 C #### B 20 C to 15.0 C #### Grapher ature					





03/2008	Infrared In	ispection Re	∍port She	et Page 17B
Clint Gottschalk		Basement Air H	andler Room	
1447 Distribution F	anel Single Fron	t (>= 400 amp)	Equipment Type Distribution Page	anel Single Front (>= 400 amp)
Consequences if	Not Corrected			
	☐ Fire Hazard	☐ Safety H	lazard	X Power/Business Interruption
Additional loading and device.	continued exposure	to this condition wi	I more than like	ely accelerate a failure of this
Corrective Action	1S			
Fixed During Visit	Contractor Will Co	orrect X Custom	er Will Correct	Estimate Required







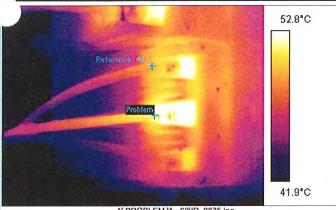


73/2008	li	nfrar	ed I	nspecti	on Re	eport	Sheet		Page 18A
Clint Gottscha	alk			Baseme	nt Air H	andler F	Room		
Tag ID 1447 Distribut	ion Pane	el Sinal	e Fron	nt (>= 400	amp)	Equipment Distribu		el Sinale F	ront (>= 400 amp)
				iteria for					(
Normal	t		Severe			Critical			
Less Than 4			IC to	STEPS OF THE PURPOSE		C to 15.			er Than 15.0C
Reference Temperature				olem Temp	perature)		nce Tei	mperature
49.1C			51.1				2.0C		
/Variables	Problem Pol	е	Current	t Rating (Amps)	Current Dr		THDC (%)		Voltage Drop (Volts)
Phase A	breaker 6		30		Not Applic		Not Applic		Not Applicable
Phase B	breaker 6		30		Not Applic		Not Applic		Not Applicable
Phase C	breaker 6		30		Not Applic	able	Not Applic	cable	Not Applicable
Problem De				X	Immediate	Hazard	⊠c	ustomer No	otified Immediately
Recommendations For Repair Repair Equipment Replace Equipment Tighten and Torque connection									
X Problem Correct	eted		\boxtimes	Tightened/Torq	ued Conne	ction	☐ Corroded/Discolored		
Overloaded Cir	cuit			Excessive Curre	ent Harmor	nics	Stripped/Cross-threaded Hardware		
Ref	Problem	2875.jpg		52.8°C		-	62/1	C 2876.jpg	

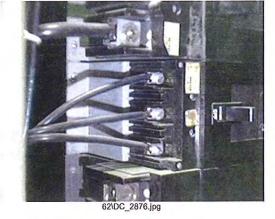


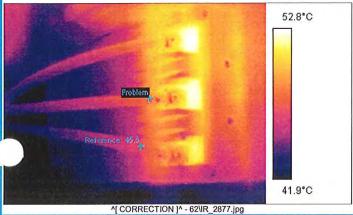


03/2008	Infrared Ins		port She	et Page 18B		
Clint Gottschalk		Basement Air Handler Room				
1447 Distribution Pa	anel Single Front	Equipment Type Distribution Pa	anel Single Front (>= 400 amp)			
Consequences if	Not Corrected					
X Equipment Failure	X Fire Hazard		lazard	☒ Power/Business Interruption		
		*				
Corrective Actions	S					
Fixed During Visit	Contractor Will Cor	ect Custom	er Will Correct	☐ Estimate Required		
Properly torqued conn	ections to the break	er.				













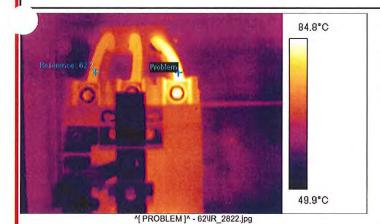
Infrared Inspection Deport Sheet						
13/2008 Infrared Inspection Report Sheet Page Location Location Location Location						
Clint Gottscha	alk	Mezzani	ne Equipment	Type		
		Per vertical secti	on) Motor	Control Center (Pe	r vertical section)	
		ity Criteria for				
Normal		Alert	Severe		Critical	
Less Than 4		1C to 8.0C	8.0C to 15		ter Than 15.0C	
Reference Te. 62.2C	mperature	Problem Temp 83.4C	Derature	Difference Te	emperature	
Variables	Problem Location	Current Rating (Amps)	Current Draw (Amps)	THDC (%THD-F)	Voltage Drop (Volts)	
Phase A	water pump #1	200	57	3.8	.004	
Phase B	water pump #1	200	57	3.8	.003	
Phase C	water pump #1	200	58	3.5	.108	
Problem De			Immediate Hazard		lotified Immediately and "_A_" Phase	
Deenergize circion replacement brea	aker.	pair contacts as a r			properly rated	
Problem Correct	oted	☐ Tightened/Torq	ued Connection	☐ Corroded/Dis	colored	
Overloaded Cir	cuit	Excessive Curr	ent Harmonics	Stripped/Cros	Stripped/Cross-threaded Hardware	
84.8°C Reference 62 Problem						

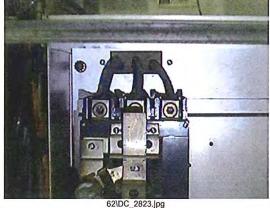




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Infrared Inspection Report Sheet 03/2008 Page 19B *chnician* Mezzanine Clint Gottschalk Equipment Type 1427 Motor Control Center (Per vertical section) Motor Control Center (Per vertical section) Consequences if Not Corrected X Equipment Failure X Fire Hazard X Safety Hazard X Power/Business Interruption Additional loading and continued exposure to this condition will more than likely accelerate a failure of this device. Corrective Actions ☐ Fixed During Visit ☐ Contractor Will Correct X Customer Will Correct ☐ Estimate Required









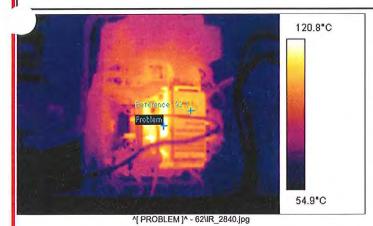
03/2008	1919 (4)	Infrar	ed I	nspecti	on Re	eport	Sheet		Page 20A
Clint Gottscha	alk			Mezzani	ne				
Tag ID 1432 Motor C		enter (F	Per ve	rtical secti	on)	Equipment Motor (nter (Per	vertical section)
1432 1010101 0	Ontroi C		1	iteria for				inter (Fer	vertiçai section)
Normal		Ocven	Alei	NAME AND ADDRESS OF TAXABLE PARTY.	Jiiiiiai	Severe	11100110		Critical
Less Than		4.		8.0C	8.0	C to 15	.0C	Great	er Than 15.0C
Reference Te		ıre	Prok	blem Temp	erature		Differe	nce Ter	mperature
92.1C			116.	.0C			24.0C	Q = 100	
/Variables	Problem Lo	ocation	Curren	t Rating (Amps)	Current Dr.	aw (Amps)	THDC (%T	HD-F)	Voltage Drop (Volts)
Phase A	exhaust		Unable	e to Obtain	Unable to	Obtain	Unable to	Obtain	.09
Phase B	exhaust		Unable	e to Obtain	Unable to	Obtain	Unable to	Obtain	.09
Phase C	exhaust		Unable	e to Obtain	Unable to	Obtain	Unable to	Obtain	.08
Problem De	scription	7		X	Immediate	Hazard	XI C	ustomer No	otified Immediately
Heat Related Pr			acts ar						,
				9-11-5					
Recommend	dations	For Rep	air		Repair Equ	ipment	⊠ R	eplace Equ	ipment
Replace this cor		•				•			
Problem Corrected		☐ Tightened/Torqued Connection			Corroded/Discolored				
Overloaded Cir	□ Overloaded Circuit □ Excessive C		Excessive Curr	ent Harmon	ics	☐ Strip	ped/Cross	-threaded Hardware	
			_						
	100	400		120.8°C			· Ball		
				120.8 C				200	
						3	1	ho .	
								H U	
	Section 1				68	10		0	
		-			48		-18	GII \	1 6
No. 100	Fererence 9	2.0			540	6 0	100		
	Problem	1000			N.		. 1	1 2 68	12. W
		-				3 6			
	7				- F	1			
		100		W WA		11	1	TE HE	
	D. S. S. S.						1		
				54.9°C				S)	
	62\/	R_2840.jpg					62\D	C_2841.jpg	

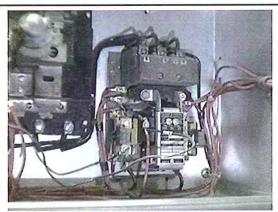




State of Kansas Docking Building - BAS207472JW

Infrared Inspection Report Sheet 03/2008 Page 20B Jchnician Mezzanine Clint Gottschalk Equipment Type 1432 Motor Control Center (Per vertical section) Motor Control Center (Per vertical section) Consequences if Not Corrected X Fire Hazard X Power/Business Interruption X Equipment Failure X Safety Hazard Corrective Actions ☐ Fixed During Visit ☐ Contractor Will Correct X Customer Will Correct ☐ Estimate Required









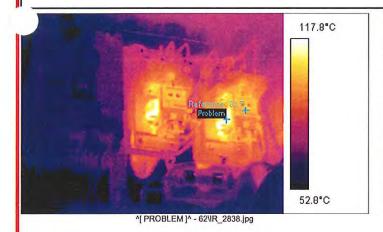
3/2008		Infrar	ed In	specti	on R	leport :	Sheet	0 = 11	Page 21A
Clint Gottscha			1	Location Mezzani					
Tag ID					Equipment		/D.		
1432 Motor Control Center (Per vertical section) Motor Control Center (Per Severity Criteria for Similar Comparisons					nter (Per	vertical section)			
Normal	(Severi	Alert		SIIIIIIa	Severe	IIISUIIS	EM NE	Critical
Less Than 4	1.1C	4.	1C to 8		8.	0C to 15.	.0C	Great	er Than 15.0C
Reference Te				lem Temp					mperature
83.7C			112.1				28.4C		
/Variables	Problem Lo	cation	Current	Rating (Amps)	Current l	Draw (Amps)	THDC (%1	HD-F)	Voltage Drop (Volts)
Phase A	tunnel exh	aust	Unable	to Obtain	Unable t	to Obtain	Unable to	Obtain	.09
Phase B	tunnel exh	aust	Unable t	to Obtain	Unable t	to Obtain	Unable to	Obtain	.08
Phase C	tunnel exh	aust	Unable	to Obtain	Unable t	to Obtain	Unable to	Obtain	.08
Problem De	scription)		X	Immediat	te Hazard	⊠c	ustomer No	otified Immediately
Heat Related Pr			cts are						
Recommend	dations l	For Rer	nair	П	Repair E	nuinment	XI R	eplace Equ	inment
Replace this cor		or riop	, can		rtopair L	quipmont		opiaco =qa	.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
Problem Correct	ted		П	ightened/Torq	ued Conn	ection	☐ Cor	roded/Disc	olored
Overloaded Circ	cuit		ПΕ	xcessive Curr	ent Harmo	onics	Stripped/Cross-threaded Hardware		
			_				_		
The second	117.8°C								
/ F 180									
		- Eigh							· ·
** - · ·		4 12	ALC:			40	1		
1 - 6							0		SMAN 9
		Reference 6	4					مالم.	
	151	•					H.	123	
7.7	1		6.00				0	Vint	D. I
	100	1					1/0		
	W /S							No.	
				52.8°C					
	62\F	R_2838.jpg					62\0	C_2839.jpg	





State of Kansas Docking Building - BAS207472JW

Infrared Inspection Report Sheet Page 21B 03/2008 Location Mezzanine Johnician Clint Gottschalk Equipment Type 1432 Motor Control Center (Per vertical section) Motor Control Center (Per vertical section) Consequences if Not Corrected X Fire Hazard X Equipment Failure X Safety Hazard X Power/Business Interruption Corrective Actions ☐ Fixed During Visit ☐ Contractor Will Correct X Customer Will Correct ☐ Estimate Required







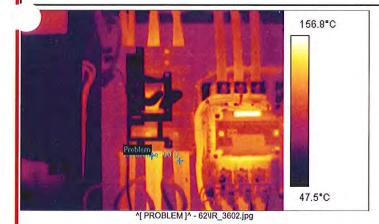


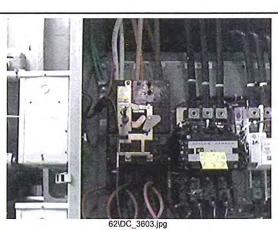
)3/2008	Infr	ared Inspec	tion Report	Sheet	Page 22A	
chnician Clint Gottscha		Location Mezzai			3,	
Tag ID Equipment Type						
chiller 1 MCC: Motor Starters Severity Criteria for Similar Comparisons					5	
Normal		Alert	Severe	the same of the sa	Critical	
Less Than		4.1C to 8.0C	8.0C to 15		ter Than 15.0C	
Reference Te	mperature	Problem Ten	nperature	Difference Te	mperature	
96.0C		112.2C		16.2C		
Nariables	Contactor Size	Current Rating (Amp	s) Current Draw (Amps)	THDC (%THD-F)	Voltage Drop (Volts)	
Phase A	Unable to Obtain	600	230	4.8	.83	
Phase B	Unable to Obtain	600	218	4.7	1.17	
Phase C	Unable to Obtain	600	228	4.3	.9	
Problem De	scription		Immediate Hazard		otified Immediately	
contact and elevated contact resistance is confirmed by millivolt measurements. Recommendations For Repair Deenergize circiuit, inspect and repair contacts as a matched set if applicable, or install properly rated replacement breaker.						
Problem Correct Overloaded Cir			rqued Connection	☐ Corroded/Disc	colored s-threaded Hardware	
47.5°C 62\IR 3602.jpg 62\IC 3603.jpg						





03/2008	Infrared Ins	spection Report Sh	Page 22B
Clint Gottschalk		Mezzanine	
chiller 1 MCC: Motor Starters		Equipment Type MCC: Mo	otor Starters
Consequences i	f Not Corrected		
	X Fire Hazard	X Safety Hazard	X Power/Business Interruption
device.		to this condition will more than li	kely accelerate a failure of this
Corrective Action	18		
☐ Fixed During Visit	☐ Contractor Will Cor	rect X Customer Will Correct	☐ Estimate Required







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Lynn Electric, Inc. 785-843-5079 785-749-5810 Fax



State of Kansas Docking Building - BAS207472JW SUMMARY PAGE

PAG	EQUIPMENT TYPE	LOCATION	LBBOD	IDEEMANDI	DIEE
FAG	EQUIFIVENT TYPE	LOCATION	PROB.	REF/AMB	DIFF.
2	Distribution Panel Single Front (>= 400 amp)	10th. Floor Mech.	86.8C	51.6C	35.2C
3	Distribution Panel Single Front (>= 400 amp)	11th. Floor Mech.	40.4C	33.9C	6.4C
4	Distribution Panel Single Front (>= 400 amp)	12th. Floor Mech.	44.0C	38.1C	5.9C
5	Distribution Panel Single Front (>= 400 amp)	2nd Floor Mech.	99.0C	82.1C	16.9C
6	Distribution Panel Single Front (>= 400 amp)	2nd Floor Mech.	95.0C	69.7C	25.3C
7	Distribution Panel Single Front (>= 400 amp)	2nd Floor Mech.	101.0C	66.2C	34.8C
8	Distribution Panel Single Front (>= 400 amp)	2nd Floor Mech.	78.1C	73.1C	5.0C
9	Distribution Panel Single Front (>= 400 amp)	2nd Floor Mech.	75.3C	66.1C	9.2C
10	Distribution Panel Single Front (>= 400 amp)	3rd. Floor Mech.	75.5C	55.0C	20.5C
11	Distribution Panel Single Front (>= 400 amp)	3rd. Floor Mech.	75.2C	65.2C	10.0C
12	Distribution Panel Single Front (>= 400 amp)	3rd. Floor Mech.	60.2C	53.1C	7.0C
13	Distribution Panel Single Front (>= 400 amp)	5th. Floor Mech.	74.3C	54.7C	19.6C
14	Distribution Panel Single Front (>= 400 amp)	6th. Floor Mech.	54.6C	48.1C	6.4C
15	Distribution Panel Single Front (>= 400 amp)	1st Floor Air Handler Room	101.7C	77.8C	24.0C
16	Distribution Panel Single Front (>= 400 amp)	Basement Air Handler Room	52.4C	42.0C	10.4C
17	Distribution Panel Single Front (>= 400 amp)	Basement Air Handler Room	47.5C	41.2C	6.4C
18	Distribution Panel Single Front (>= 400 amp)	Basement Air Handler Room	51.1C	49.1C	2.0C
19	Motor Control Center (Per vertical section)	Mezzanine	83.4C	62.2C	21.3C
20	Motor Control Center (Per vertical section)	Mezzanine	116.0C	92.1C	24.0C
21	Motor Control Center (Per vertical section)	Mezzanine	112.1C	83.7C	28.4C
22	MCC: Motor Starters	Mezzanine	112.2C	96.0C	16.2C

Severe





		oblems Report -	Including A	All Images	Page 1
Clint Gottschalk		11th. Floor Mec	h.		
Tag ID 1482 Distribution P	anel Single Fron	it (>= 400 amp)	Equipment Type Distribution I	Panel Single Front (>= 40	00 amp)
Problem Descript	ion - ALERT	☐ Immediate	Hazard		diately
THDC%F (At the point in a commercial building			% in an industr	ial building or greater t	han 20%
		Tatm=20 Dst=0.0 FOV 2 11:52:38 AM -40 - +12 62\lr_2965.jpg			
Consequences if	Not Corrected				
	Fire Hazard	☐ Safety H	łazard	X Power/Business Inte	erruption
Not only will this cause voltage distortion that woperations.					
Recommendation	s For Repair	X Repair Equ	ipment	Replace Equipment	
Investigate non-linear lo that will allow a reductio				itigation method(s) to o	employ
Corrective Actions	3			Problem Corrected	
Fixed During Visit	Contractor Will C	orrect X Custom	er Will Correct	☐ Estimate Required	





		Report - Includin	g All Images Page 2
Clint Gottschalk	Location 12th. F	Floor Mech.	
^{Tag ID} 1484 Distribution Panel S	Single Front (>= 40	00 amp) Equipment Ty, Distributi	pe ion Panel Single Front (>= 400 amp)
Problem Description - /	ALERT	☐ Immediate Hazard	☐ Customer Notified Immediately
THDC%F (At the point of comin a commercial building. (IEE		ater than 5% in an indu	ustrial building or greater than 20%
	The state of the s	÷1 33. 31 20 st=0.0 FOV 24 M -40 - +120 e=0.32 °C	9
Consequences if Not C	Corrected		
X Equipment Failure	re Hazard	☐ Safety Hazard	☒ Power/Business Interruption
Not only will this cause increasion voltage distortion that will escaperations.			
Recommendations For	Repair		Replace Equipment
Investigate non-linear loads d that will allow a reduction of th			er mitigation method(s) to employ
Corrective Actions			Problem Corrected
Fixed During Visit C	ontractor Will Correct		





		blems Report - Includ	ing All Images Page 3
Clint Gottschalk		ocation 13th Floor Mech.	
Tag ID 1486-A Phase 5-18	5kV Dry Transform	ners <= 500 kVA Equipment 5-15k	_{Туре} V Dry Transformers <= 500 kVA
Problem Descript		☑ Immediate Hazard	☑ Customer Notified Immediately
There is possible resi	n residue beneath t	he phase coils.	
Consequences if	Not Corrected	62\DC_2984.jpg	
☐ Equipment Failure	☐ Fire Hazard		☑ Power/Business Interruption
Recommendation	s For Repair	Repair Equipment	☐ Replace Equipment
		esting would be able to dete ther deterioration occurs to	rmine the state that the coils are in. this transformer.
Corrective Action	S		Problem Corrected
Fixed During Visit	Contractor Will Con	rrect X Customer Will Corre	ect
		4-	





		ms Report - Includii	ng All Images Page 4
Clint Gottschalk	Locatio.	n Floor Mech.	
Tag ID 1486-A Phase 5-15k\	Dry Transformers	<= 500 kVA Equipment T	^{ype} / Dry Transformers <= 500 kVA
Problem Description	r - CRITICAL	Immediate Hazard	▼ Customer Notified Immediately
Ultrasonic Anomaly, Ther arcing on the 3rd phase of			ong sound of unwanted internal coils.
		62\DC_2985.jpg	
Consequences if No	ot Corrected		
X Equipment Failure	X Fire Hazard	X Safety Hazard	☑ Power/Business Interruption
Recommendations I		Repair Equipment	☐ Replace Equipment
Proper megger testing or	n all phase coils.		
Corrective Actions			Problem Corrected
Fixed During Visit	Contractor Will Correct		ct Estimate Required





		ems Report - Including	All Images Page 5
Clint Gottschalk	13	^{tion} 8th Floor Mech.	
^{Tag ID} 1486-B Phase 5-15	kV Dry Transforme	rs <= 500 kVA Equipment Type 5-15kV D	o Dry Transformers <= 500 kVA
Problem Descripti	on - CRITICAL		☐ Customer Notified Immediately
		her decibal level and a strong the 1st and 2nd phase coils.	g sound of unwanted internal
		62\DC_2985.jpg	
Consequences if I	Vot Corrected		
	X Fire Hazard	X Safety Hazard	X Power/Business Interruption
Recommendations			Replace Equipment
Proper megger testing	on all phase coils to	determine deterioration.	
O			
Corrective Actions			Problem Corrected
☐ Fixed During Visit	Contractor Will Correct	ct X Customer Will Correct	☐ Problem Corrected ☐ Estimate Required





	tem Problems Report -	Including All Images Pag	ge 6
Clint Gottschalk	13th Floor Mech	1.	
Tag ID 1486-B Phase 5-15kV Dry	Fransformers <= 500 kVA	Equipment Type 5-15kV Dry Transformers <= 500 kVA	
Problem Description - CF	RITICAL Immediate	Hazard	
There is possible resin residue			
	62\DC_2984.jpg		
Consequences if Not Cor			-
X Equipment Failure X Fire F	lazard X Safety H	lazard	n
Recommendations For R			-
Further coil testing must be done It must be addressed immediatel	. Megger testing would be ab y before further deterioration o	ole to determine the state that the coils are occurs to this transformer.	in.
Corrective Actions		Problem Corrected	
☐ Fixed During Visit ☐ Contr	actor Will Correct 🗵 Custome	er Will Correct	





03, 2008 Equi		ems Report - Includi	ng All Images Page 7
Clint Gottschalk	Location 131	th Floor Mech.	
^{Tag ID} 1486-C Phase 5-1	5kV Dry Transformer	s <= 500 kVA Equipment 7 5-15k\	^{Гуре} / Dry Transformers <= 500 kVA
Problem Descript	ion - CRITICAL		☑ Customer Notified Immediately
		er decibal level and a stro he 1st and 2nd phase coi	ong sound of unwanted internal
Consequences if	Not Corrected	62\DC_2985.jpg	
	X Fire Hazard	X Safety Hazard	▼ Power/Business Interruption
Recommendation Proper megger testing		☑ Repair Equipment determine deterioration.	☑ Replace Equipment
Corrective Action	S		Problem Corrected
Fixed During Visit	Contractor Will Correct	☐ Customer Will Corre	ect





		ms Report - Includi	ng All Images Page 8
Clint Gottschalk	Locatio 13t	h Floor Mech.	
Tag ID 1488 DISTRIBUTION	SWITCHBOARD Multi Cov	er (Per Section) Equipment T	ype TION SWITCHBOARD Multi Cover (Per Section)
Problem Descrip	tion - CRITICAL		☐ Customer Notified Immediately
Ultrasonic Anomaly, the cleaned immidiatly.	e contacts of breaker #1	1 are displaying very high	n decibal levels and need to be
Consequences if	Not Corrected	62\DC_2990.jpg	3
	X Fire Hazard	X Safety Hazard	X Power/Business Interruption
Recommendation	ns For Repair	Repair Equipment	Replace Equipment
Inspect and clean the "replace immediately".	contacts of this breaker,	If the breaker appears to	be in bad condition internally,
Corrective Action	ns —		Problem Corrected
Fixed During Visit	Contractor Will Correct		ct Estimate Required





03, 2008 Equipment Item P	roblems Report - Including	All Images Page 9
ીnician Clint Gottschalk	13th Floor Mech.	
1486-C Phase 5-15kV Dry Transfo	ormers <= 500 kVA Equipment Type 5-15kV Dr	ry Transformers <= 500 kVA
Problem Description - ALERT	Immediate Hazard	☐ Customer Notified Immediately
There is possible resin residue beneat		
Consequences if Not Corrected		
	X Safety Hazard	▼ Power/Business Interruption
Recommendations For Repair		Replace Equipment
Further coil testing must be done. Meggi It must be addressed immediately before		
Corrective Actions		Problem Corrected
☐ Fixed During Visit ☐ Contractor Will	Correct X Customer Will Correct	Estimate Required





03, 2008 Equipment Item Pr	oblems Report - Includi	ng All Images Page 10
Jhnician Clint Gottschalk	13th Floor Mech.	
Tag ID 1488 DISTRIBUTION SWITCHBOARD Mul	ti Cover (Per Section) Equipment 7	Type JTION SWITCHBOARD Multi Cover (Per Section)
Problem Description - ALERT		A CONTRACTOR OF THE PROPERTY O
Millivolt drop is greater than 50% deviatio	Immediate Hazard	Customer Notified Immediately
Maintenance Testing Specification) or 10	0 millivolts at full load, which is	defined as 80% of a device rating.
The state of the s	Tatm=20 Dst=0.0 FOV 24	8 °C
Consequences if Not Corrected		
	Safety Hazard	☑ Power/Business Interruption
Recommendations For Repair Deenergize device, clean, repair, or repla manufacturer specifications.	☑ Repair Equipment ce defective items as necessa	☑ Replace Equipment ry and torque connection to
Corrective Actions		Problem Corrected
Fixed During Visit Contractor Will C	Correct Customer Will Corre	ct Estimate Required





es esse Equi	nmant Itam Dre	blama Danaut	Including	All Images	
hnician		blems Report -		All images	Page 11
Clint Gottschalk		14th Floor Mech			
Tag ID 1490 Distribution P	anel Single Fron	t (>= 400 amp)	Equipment Type Distribution F	Panel Single Front (>:	= 400 amp)
Problem Descript	ion - CRITICAL		Hazard	Customer Notified Im	nmediately
Parallel conductors sn	naller than 1/0 are	installed improperl	y. 2002 NEC	310.4	
		62\dc_2995.jpg			
Consequences if	Not Corrected				
	X Fire Hazard	☐ Safety H	lazard	Power/Business	Interruption
A failure of one condu	ctor may result in t	he overheating and	d failure of the	e other.	
Recommendation	s For Repair	Repair Equ	ipment	X Replace Equipment	
Remove and reinstall p					
Corrective Actions	3			Problem Correct	ted
Fixed During Visit	Contractor Will Co	orrect X Custome	er Will Correct	Estimate Requir	





03, 2008 Equ	<u>ipment Item Problen</u>	to respons moradin	ng All Images Page 12
Clint Gottschalk	Location 14th	Floor Mech.	
ag ID 1490 Distribution F	Panel Single Front (>=	400 amp) Equipment Ty	pe ion Panel Single Front (>= 400 amp)
Problem Descrip	tion - ALERT	☐ Immediate Hazard	☐ Customer Notified Immediately
Multiple conductors u	inder one lug on a breake	er or fused disconnect.	
0		32\DC_2995.jpg	
	☐ Fire Hazard	☐ Safety Hazard	X Power/Business Interruption
Consequences if		a caroty riazara	Z r onon basiness interruption
☑ Equipment Failure This may cause overlo		vice resulting in prematu	re operation and unscheduled
☑ Equipment Failure This may cause overlo	ading of the protective de	vice resulting in prematu ☑ Repair Equipment	re operation and unscheduled. Replace Equipment
☑ Equipment Failure This may cause overlointerruptions. Recommendation	ading of the protective dev		
☑ Equipment Failure This may cause overlointerruptions. Recommendation	ading of the protective development		





<u> </u>	A STANDARD SANDARD SAN			The same of the sa	
03, 2008 Equ	pment Item Pro		Including	g All Images	Page 13
Clint Gottschalk		ocation 2nd Floor Mech.			
Tag ID 1460 Distribution F	Panal Single Front	t (>= 400 amp)	Equipment Type		100
				on Panel Single Front (>= 400 amp)
Problem Descrip			Hazard		Immediately
Current phase imbala	nce is greater than	20%.	_		
		atm=20 Dst=0.0 FOV 246:47 PM -40 - +120			
Consequences if	Not Corrected				
	X Fire Hazard	☒ Safety H	azard	X Power/Busines	ss Interruption
If there are non-linear or return currents on the		em, the heating char	acteristics v	vill be amplified due	to 60 hZ
Recommendation	s For Repair	X Repair Equi	ipment	Replace Equipment	
Investigate load distri					
Corrective Action	S			Problem Corre	ected
Fixed During Visit	Contractor Will Co	rrect X Custome	er Will Correct	☐ Estimate Requ	





	oment Item Probl		Including	All Images	Page 14
Clint Gottschalk	2r	nd Floor Mech			
Tag ID 1460 Distribution Pa	anel Single Front (>	>= 400 amp)	Equipment Type Distribution	Panel Single Front (>= 4	00 amp)
Problem Descripti	on - ALERT	☐ Immediate			
THDC%F (At the point of in a commercial building		s greater than 59	% in an industi		
		1=20 Dst=0.0 FOV 2 47 PM -40 - +120 62\lfr_2896.jpg	THE RESERVE OF THE PERSON NAMED IN		
Consequences if I	Not Corrected				
	Fire Hazard	☐ Safety H	lazard	X Power/Business Int	erruption
Not only will this cause i voltage distortion that w operations.	이번 경영이 되어 되었다. 역사 교육 시간 중에 가장 이 경우 경투하는 이번 기계하다				
Recommendations	s For Repair		ipment	Replace Equipment	
Investigate non-linear lo that will allow a reduction				nitigation method(s) to	employ
Corrective Actions				Problem Corrected	
Fixed During Visit	Contractor Will Correct	ct 🗵 Custom	er Will Correct	Estimate Required	





03, 2008 Equ	ipment Item Probler	ns Report -	Including	All Images	Page 15
chnician Clint Gottschalk	Location				7 430 10
Tag ID			Equipment Type		
1460 Distribution F	Panel Single Front (>=	400 amp)	Distribution	n Panel Single Front	(>= 400 amp)
Problem Descript	tion - ALERT	☐ Immediate	Hazard		d Immediately
THDC%F (At the point in a commercial building	of common coupling) is g g. (IEEE 519-1992)	greater than 5%	6 in an indus	strial building or gr	eater than 20%
	Trefl=20 Tatm=2 11/ 6/08 1:46:47				
Consequences if	Not Corrected				
	Fire Hazard	☐ Safety H	azard	X Power/Busin	ness Interruption
	increased heating at the vill escape the facility onto				
Recommendation	s For Repair	X Repair Equ	ipment	Replace Equipme	ent
	oads downstream in the formation of the THDC%F to ma	facility to deter	mine proper		
Corrective Action	S			Problem Co	rrected
☐ Fixed During Visit	Contractor Will Correct		er Will Correct	☐ Estimate Re	
				W 1 1 2	





03, 2008 Equipment Item P	roblems Report - Including All Images Page 16
াnician Clint Gottschalk	3rd. Floor Mech.
Tag ID 1465 Distribution Panel Single Fro	ont (>= 400 amp) Equipment Type Distribution Panel Single Front (>= 400 amp)
Problem Description - CRITICA	
Current phase imbalance is greater that	
	*1 50.3 73 41 Tatm=20 Dst=0.0 FOV 24 4:38:54 PM -40 - +120 e=0.32 °C 62\lightarrow 62\lightarrow 12918.jpg
Consequences if Not Corrected	
	☒ Safety Hazard ☒ Power/Business Interruption
If there are non-linear devices on this system. return currents on the neutral conductor.	stem, the heating characteristics will be amplified due to 60 hZ
Recommendations For Repair	
Investigate load distribution and redistr	ibute to allow for reduction of neutral return currents.
Corrective Actions	☐ Problem Corrected
Fixed During Visit Contractor Will	Correct 🗵 Customer Will Correct 🔲 Estimate Required





03, 2008 Equi	pment Item Probl		 Including 	All Images	Page 17
Clint Gottschalk	Loca 3r	d. Floor Mech			
^{Tag ID} 1465 Distribution P	anel Single Front (>= 400 amp)	Equipment Type Distribution	Panel Single Front (>=	400 amp)
Problem Descript	ion - ALERT	☐ Immediate	Hazard		ediately
THDC%F (At the point in a commercial buildin		is greater than 5°	% in an industr	rial building or greater	than 20%
	AND DESCRIPTION OF THE PERSON NAMED IN COLUMN 2 IN COL	1=20 Dst=0.0 FOV 2 :54 PM -40 - +120 62\tir_2918.jpg			
Consequences if	Not Corrected				
☑ Equipment Failure	Fire Hazard	☐ Safety I	Hazard	▼ Power/Business Ir	terruption
Not only will this cause voltage distortion that woperations.					
Recommendation	s For Repair	Repair Equ	uipment	Replace Equipment	
Investigate non-linear lothat will allow a reduction	oads downstream in th	e facility to deter	mine proper m	nitigation method(s) to	employ
Corrective Action	S			☐ Problem Corrected	
Fixed During Visit	Contractor Will Corre	ct X Custom	er Will Correct	☐ Estimate Required	





	pment Item Prol		Including A	All Images	Page 18
Clint Gottschalk		3rd. Floor Mech			
Tag ID 1469 Individual Dis	connect Switch		Equipment Type Individual	Disconnect Switch	1
Problem Descript	ion - ALERT	☐ Immediate	Hazard	Customer Notified Imme	ediately
Missing insulated fitting AWG or larger entering					ictors 4
		62\DC_2928.jpg			
Consequences if	Not Corrected				
X Equipment Failure	Fire Hazard	☐ Safety H	łazard	X Power/Business Int	erruption
Chaffing of the conduct material to contact cond			ition were to de	egrade and allow the o	conductor
Recommendation	s For Repair		ipment	Replace Equipment	
Deenergize the circuit(s and return to operation.), remove conductor	r(s), install properly	/ sized fittings/l	bushings, reinstall cor	nductors
Corrective Actions	3			Problem Corrected	
Fixed During Visit	Contractor Will Corn	rect X Custom	er Will Correct	☐ Estimate Required	





	oblems Report - Including	All Images Page 19
্নিnician Clint Gottschalk	3rd. Floor Mech.	
Tag ID 1469 Individual Disconnect Switch	Equipment Type Individual	Disconnect Switch
Problem Description - ALERT	☐ Immediate Hazard	X Customer Notified Immediately
Current phase imbalance is greater tha	n 20%.	
The Control of the Co	*1 40.9 61 40 Tatm=20 Dst=0.0 FOV 24 10:33:32 AM -40 - +120 e=0.32 °C	
Consequences if Not Corrected		
		X Power/Business Interruption
If there are non-linear devices on this sys return currents on the neutral conductor.	tem, the heating characteristics will	be amplified due to 60 hZ
Recommendations For Repair		Replace Equipment
Investigate load distribution and redistri	bute to allow for reduction of neu	ral return currents.
Corrective Actions		Problem Corrected
Fixed During Visit Contractor Will C	Correct X Customer Will Correct	Estimate Required





	ipment Item Probler		cluding All Images Page 20
Clint Gottschalk	Location Bas	ement Air Hand	
Tag ID 1445 Distribution F	Panel Single Front (>=		wipment Type Distribution Panel Single Front (>= 400 amp)
Problem Descrip		Immediate Haz	
THDC%F (At the point in a commercial building		greater than 5% in	an industrial building or greater than 20%
		0 Dst=0.0 FOV 24 PM -40 - +120 e=0	*1 42.2 48 34 0.32 °C
Consequences if	Not Corrected		
X Equipment Failure	Fire Hazard	☐ Safety Hazar	rd Nower/Business Interruption
			, but it can cause excessive levels of Ition system and affect neighboring
Recommendation	ns For Repair		ent Replace Equipment
	oads downstream in the fonds on of the THDC%F to ma		e proper mitigation method(s) to employ
Corrective Action	S		Problem Corrected
Fixed During Visit	Contractor Will Correct	X Customer W	





03, 2008 Equipment Item P	Location	· incluain	g All Images Page 22			
Clint Gottschalk Basement Air Handler Room						
Tag ID 1445 Distribution Panel Single Front (>= 400 amp) Equipment Type Distribution Panel Single Front (>= 400 amp)						
Problem Description - ALERT						
Current phase imbalance is greater than 20%.						
	Tatm=20 Dst=0.0 FOV 2 2:50:15 PM -40 - +120 62\ir_2866.jpg					
☐ Equipment Failure ☐ Fire Hazard		Hazard	X Power/Business Interruption			
If there are non-linear devices on this sy- return currents on the neutral conductor.	stem, the heating cha					
Recommendations For Repair Investigate load distribution and redist	☑ Repair Equ ribute to allow for rec		Replace Equipment eutral return currents.			
Corrective Actions			Problem Corrected			
☐ Fixed During Visit ☐ Contractor Will	Correct X Custom	er Will Correct	Estimate Required			





		blems Report -	Including	g All Images	Page 23	
Clint Gottschalk						
Tag ID 1445 Distribution Par	Tag ID 1445 Distribution Panel Single Front (>= 400 amp) Equipment Type Distribution Panel Single Front (>= 400 amp)					
Problem Descriptio	n - ALERT	☐ Immediate	Hazard	☐ Customer Notified In	nmediately	
Missing insulated fittings/ AWG or larger entering a					nductors 4	
Consequences if N	ot Corrected	62\DC_2870.jpg				
	Fire Hazard	☐ Safety H		X Power/Business		
Chaffing of the conductor material to contact condu			tion were to	degrade and allow th	ne conductor	
Recommendations	For Repair		ipment	Replace Equipment		
Deenergize the circuit(s), and return to operation.	remove conducto	r(s), install properly	sized fitting	s/bushings, reinstall	conductors	
Corrective Actions				☐ Problem Correct	ted	
Fixed During Visit	Contractor Will Co	rrect X Custom	er Will Correct	Estimate Requi	red	





	Item Problem	s Report	 Including A 	All Images Page 21
Clint Gottschalk	Location Base	ment Air H	landler Room	1
Tag ID 1447 Distribution Panel Si	nglo Front />-	100 amp)	Equipment Type	and Chala Front (s. 400)
		7		anel Single Front (>= 400 amp)
Problem Description - C			Hazard 2	Customer Notified Immediately
Current phase imbalance is gr	Trefl=20 Tatm=20 11/ 5/08 3:35:30 F	The second secon		
		62\ir_2873.jpg		
Consequences if Not Co				
		☐ Safety I		X Power/Business Interruption
If there are non-linear devices or return currents on the neutral co		heating cha	racteristics will b	oe amplified due to 60 hZ
Recommendations For F		Repair Equ		Replace Equipment
Investigate load distribution ar	nd redistribute to	allow for red	duction of neutr	ral return currents.
Corrective Actions				Problem Corrected
Fixed During Visit Con	tractor Will Correct		er Will Correct	Estimate Required





03, 2008 Equipment Item Problems Report - Including All Images Page 24
Clint Gottschalk Discription Location Basement Air Handler Room
Tag ID 1447 Distribution Panel Single Front (>= 400 amp) Equipment Type Distribution Panel Single Front (>= 400 amp)
Problem Description - ALERT ☐ Immediate Hazard ☐ Customer Notified Immediately
THDC%F (At the point of common coupling) is greater than 5% in an industrial building or greater than 20% in a commercial building. (IEEE 519-1992)
##
Consequences if Not Corrected
Image: Superior of the properties of the
Not only will this cause increased heating at the main transformer, but it can cause excessive levels of voltage distortion that will escape the facility onto the utility distribution system and affect neighboring operations.
Recommendations For Repair
Investigate non-linear loads downstream in the facility to determine proper mitigation method(s) to employ that will allow a reduction of the THDC%F to managable levels.
Corrective Actions
☐ Fixed During Visit ☐ Contractor Will Correct ☐ Contractor Will Correct ☐ Estimate Required





03, 2008 Equ	ipment Item Pro	blems Report	- Including	g All Images	Page 25
Clint Gottschalk		Location Mezzanine			
Tag ID 1432 Motor Contro	l Center (Per ver	tical section)	Equipment Type Motor Cor	e ntrol Center (Per vertic	cal section)
Problem Descrip	tion - CRITICAL		e Hazard	☐ Customer Notified	Immediately
Ultrasonic Anomaly, The surrounding it. Wave fi	ne decibals are at hi le-007	gh levels on this o	ontactor in co	mparison to the oth	er contactors
		62\dc_2841.jpg			
Consequences if X Equipment Failure	Not Corrected X Fire Hazard	V Cafety	Uosard	⊠ P/P'	an Internalistan
Equipment Failure		X Safety	Hazard	∑ Power/Busine	ss Interruption
Recommendation Replace this contacto		☐ Repair Ed	uipment		t
Corrective Action ☐ Fixed During Visit	S Contractor Will Co	orrect 🛛 Custon	ner Will Correct	☐ Problem Corre	
		_	The state of the s	Senta sectorists (1) (2.5)	





03, 2008 Equi	ment Item Pro		Including	All Images	Page 26
Clint Gottschalk		^{ocation} Mezzanine			
1432 Motor Control	Center (Per verti	ical section)	Equipment Type Motor Cont	rol Center (Per vertical s	ection)
Problem Description	on - CRITICAL		Hazard		nediately
Ultrasonic Anomaly, The Wave file-008	e decibal level of thi	s contactor is far gı	reater than th	e contactors surround	ing it.
		62\dc_2839.jpg			
Consequences if N	Not Corrected				
X Equipment Failure	X Fire Hazard		azard	X Power/Business Ir	nterruption
Recommendations Replace this contactor.	For Repair	Repair Equ	ipment		
Corrective Actions	☐ Contractor Will Corn	rect 🛛 Custome	er Will Correct	☐ Problem Corrected	
	Contractor Will Cor	rect 🛛 Custome	er Will Correct		





03, 2008 Equi		olems Report - Includi	ng All Images Page 27
Clint Gottschalk		dezzanine	
chiller 1 MCC: Moto	or Starters	Equipment T	^{ype} Motor Starters
Problem Descript	ion - <mark>CRITICAL</mark>	Immediate Hazard	
THDC%F (At the point in a commercial buildin	of common coupling) g. (IEEE 519-1992)	is greater than 5% in an ind	
Canaguanaa ii	1/20/09 9:38	m=20 Dst=0.0 FOV 24	06 C
Consequences if	Fire Hazard	Safety Hazard	X Power/Business Interruption
Not only will this cause	ncreased heating at	the main transformer, but it o	can cause excessive levels of stem and affect neighboring
Recommendation	s For Repair	X Repair Equipment	Replace Equipment
Investigate non-linear lo that will allow a reductio	ads downstream in the northead of the THDC%F to	ne facility to determine prope managable levels.	er mitigation method(s) to employ
Corrective Actions	3		Problem Corrected
Fixed During Visit	Contractor Will Corre	ect X Customer Will Correc	





Equipment Item Problem Count Summary

Agreement: BAS207472JW

Site Name: State of Kansas Docking Building Site Visit Dates: 11/3/2008 - 11/4/2008 Site Visit Status: Completed

quipment Item Description / Equipment Type istribution Panel Single Front (>= 400 amp) / Distribution Panel	Problem Count
The transfer of the state of th	
. " . " P 16' 1 F . (100) / D'. ("	
stribution Panel Single Front (>= 400 amp) / Distribution Panel	1 Problem Found None Corrected
ngle Front (>= 400 amp)	
15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers	
선거의 가지 않는데 그리고 있는데 그리고 있는데 그 그 그리고 있는데 그리고 있는데 그리고 있는데 그리고 있다.	
stribution Panel Single Front (>= 400 amp) / Distribution Panel	2 Problems Found 1 Corrected
ngle Front (>= 400 amp)	
그렇게 맞지 않는 사람들이 많으면 하고 하다 내려가 되었다. 그 사람들이 되어 있었다. 그 나는 그는 그는 그는 그는 그를 가지 않는 것이라고 있다면 하는 것이다.	
= 500 kVA	
stribution Panel Single Front (>= 400 amp) / Distribution Panel	2 Problems Found None Corrected
ngle Front (>= 400 amp)	
= 500 kVA	
	Oliver to down it and above
그 마다가 되었다면 하는 것이 되었다. 그 사람들은 아이는 그 사람들이 그 사람들이 되었다면 하게 되었다. 그는 사람들이 되었다면 하다 하는 것이다.	2 Problems Found None Corrected
	2 Dualilance Found None Competed
[연극하다] 이 발생하다 [14] 남편의 18일 역사 18일 인사 18일 (14) - "역사 18일 인사 18일 인사 18일 (14) 대학자들은 사용하는 사용하는 사용하는 사용이 1명 (14) 18	2 Problems Found None Corrected
	2 Problems Found None Corrected
	2 1 100 tollio 1 otilita 1 tollo contesto
ISTRIBUTION SWITCHBOARD Multi Cover (Per Section)	
ISTRIBUTION SWITCHBOARD Multi Cover (Per Section) /	2 Problems Found None Corrected
[18] [18] [18] [18] [18] [18] [18] [18]	
ngle Front (>= 400 amp)	
[17] [18] [18] [18] [18] [18] [18] [18] [18	
STRIBUTION SWITCHBOARD Multi Cover (Fer Section)	
intellection Panal Simple Front (>= 400 cmm) / Distribution Panal	
istribution Panel Single Front (>= 400 amp) / Distribution Panel	2 Problems Found None Corrected
	2 Troblems Found Trone Convents
15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers	
= 500 kVA	
15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers	
= 500 kVA	
15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers	
istribution Panel Single Front (>= 400 amp) / Distribution Panel	6 Problems Found None Corrected
ingle Front (>= 400 amp)	
15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers	
ingle Front (>= 400 amp) 15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers = 500 kVA istribution Panel Single Front (>= 400 amp) / Distribution Panel	2 Problems Found None Corrected
	15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers = 500 kVA istribution Panel Single Front (>= 400 amp) / Distribution Panel Ingle Front (>= 400 amp) 15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers = 500 kVA istribution Panel Single Front (>= 400 amp) / Distribution Panel Ingle Front (>= 400 amp) 15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers = 500 kVA 15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers = 500 kVA 15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers = 500 kVA 15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers = 500 kVA 15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers = 500 kVA 15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers = 500 kVA 15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers = 500 kVA 15TRIBUTION SWITCHBOARD Multi Cover (Per Section) / ISTRIBUTION SWITCHBOARD Multi Cover (Per Secti





Equipment Item Problem Count Summary

Agreement: BAS207472JW

Site Name: State of Kansas Docking Building Site Visit Dates: 11/3/2008 - 11/4/2008 Site Visit Status: Completed

Location Within Facility Equip Tag ID	Equipment Item Description / Equipment Type	Problem Count
Equip Tag 1D	Equipment tem Description? Equipment 1750	
2nd Floor Mech.		
DP_401_NEW_3	Distribution Panel Single Front (>= 400 amp) / Distribution Panel	
	Single Front (>= 400 amp)	
SWB_MUL_NEW_	DISTRIBUTION SWITCHBOARD Multi Cover (Per Section)	
OWD MILL NEW	DISTRIBUTION SWITCHBOARD Multi Cover (Per Section) DISTRIBUTION SWITCHBOARD Multi Cover (Per Section) /	
SWB_MUL_NEW_	DISTRIBUTION SWITCHBOARD Multi Cover (Per Section)	
CWD MIII NEW	DISTRIBUTION SWITCHBOARD Multi Cover (Per Section) DISTRIBUTION SWITCHBOARD Multi Cover (Per Section) /	
SWB_MUL_NEW_	DISTRIBUTION SWITCHBOARD Multi Cover (Per Section)	
SWB MUL NEW	DISTRIBUTION SWITCHBOARD Multi Cover (Per Section)	
SWB_MOE_NEW_	DISTRIBUTION SWITCHBOARD Multi Cover (Per Section)	
SWB MUL NEW	DISTRIBUTION SWITCHBOARD Multi Cover (Per Section) /	
OWB_MOB_NEW_	DISTRIBUTION SWITCHBOARD Multi Cover (Per Section)	
SWB MUL NEW	DISTRIBUTION SWITCHBOARD Multi Cover (Per Section) /	
	DISTRIBUTION SWITCHBOARD Multi Cover (Per Section)	
TRD1_5_NEW_3	5-15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers	
	<= 500 kVA	
3rd. Floor Mech.		
1463	5-15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers	
	<= 500 kVA	A Lotte State Stat
1464	Distribution Panel Single Front (>= 400 amp) / Distribution Panel	1 Problem Found None Corrected
	Single Front (>= 400 amp)	
1465	Distribution Panel Single Front (>= 400 amp) / Distribution Panel	3 Problems Found None Corrected
	Single Front (>= 400 amp)	
1466	5-15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers	
1467	<= 500 kVA Distribution Panel Single Front (>= 400 amp) / Distribution Panel	1 Problem Found None Corrected
1467	Single Front (>= 400 amp)	1 1 tobiciii 1 ouild 1 tolic corrected
1468	5-15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers	
1408	<= 500 kVA	
1469	Individual Disconnect Switch / Individual Disconnect Switch	2 Problems Found None Corrected
1102		
5th. Floor Mech.		
1470	5-15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers	
1470	<= 500 kVA	
1471	Distribution Panel Single Front (>= 400 amp) / Distribution Panel	1 Problem Found None Corrected
	Single Front (>= 400 amp)	
6th. Floor Mech.	, and , and , and ,	
1472	Distribution Panel Single Front (>= 400 amp) / Distribution Panel	1 Problem Found None Corrected
1472	Single Front (>= 400 amp)	Experience and a surface and and any and
1473	5-15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers	
2112	<= 500 kVA	
7th, Floor Mech.		
1474	5-15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers	
4-17-1	<= 500 kVA	
1475	Distribution Panel Single Front (>= 400 amp) / Distribution Panel	
2207082	Single Front (>= 400 amp)	
8th. Floor Mech.	A STATE OF THE STA	
out, Ploof Miccil.		



Location Within Facility

Lynn Electric, Inc. 785-843-5079 785-749-5810 Fax



Equipment Item Problem

Count Summary

Agreement: BAS207472JW

Site Name: State of Kansas Docking Building Site Visit Dates: 11/3/2008 - 11/4/2008

Site Visit Status: Completed

Equip Tag ID	Equipment Item Description / Equipment Type	Problem Count
8th. Floor Mech.		
1476	Distribution Panel Single Front (>= 400 amp) / Distribution Panel	
1477	Single Front (>= 400 amp) 5-15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers <= 500 kVA	
9th. Floor Mech.		
1478	Distribution Panel Single Front (>= 400 amp) / Distribution Panel	
1479	Single Front (>= 400 amp) 5-15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers <= 500 kVA	
1st Floor Air Handler Ro	nom	
1457	5-15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers	
	<= 500 kVA	The same and the same
1458	Distribution Panel Single Front (>= 400 amp) / Distribution Panel	1 Problem Found None Corrected
DP_401_NEW_2	Single Front (>= 400 amp) Distribution Panel Single Front (>= 400 amp) / Distribution Panel	
	Single Front (>= 400 amp)	
Proment Air Handler R		4 Droblems Found None Corrected
145	Distribution Panel Single Front (>= 400 amp) / Distribution Panel Single Front (>= 400 amp)	4 Problems Found None Corrected
1446	5-15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers	
1447	<= 500 kVA Distribution Panel Single Front (>= 400 amp) / Distribution Panel Single Front (>= 400 amp)	4 Problems Found 1 Corrected
Main Switch Gear		
1448	5-15kV Switchgear / 5-15kV Switchgear	
1449	5-15kV Switchgear / 5-15kV Switchgear	
1450	5-15kV Switchgear / 5-15kV Switchgear	
1451	5-15kV Switchgear / 5-15kV Switchgear	
1452	5-15kV Switchgear / 5-15kV Switchgear	
1453	5-15kV Switchgear / 5-15kV Switchgear	
1454	5-15kV Switchgear / 5-15kV Switchgear	
1455	5-15kV Switchgear / 5-15kV Switchgear	
1456	5-15kV Switchgear / 5-15kV Switchgear	
DSSO_5_NEW_1	5-15kV Disconnects (Open) / 5-15kV Disconnects (Open)	
DSSO_5_NEW_2	5-15kV Disconnects (Open) / 5-15kV Disconnects (Open)	
DSSO_5_NEW_3	5-15kV Disconnects (Open) / 5-15kV Disconnects (Open)	





Equipment Item Problem Count Summary

Agreement: BAS207472JW

Site Name: State of Kansas Docking Building Site Visit Dates: 11/3/2008 - 11/4/2008

Site Visit Status: Completed

Location Within Facility Equip Tag ID	Equipment Item Description / Equipment Type	Problem Count
Main Switch Gear DSSO_5_NEW_4	5-15kV Disconnects (Open) / 5-15kV Disconnects (Open)	
DSSO_5_NEW_5	5-15kV Disconnects (Open) / 5-15kV Disconnects (Open)	
DSSO_5_NEW_6	5-15kV Disconnects (Open) / 5-15kV Disconnects (Open)	
DSSO_5_NEW_7	5-15kV Disconnects (Open) / 5-15kV Disconnects (Open)	
DSSO_5_NEW_8	5-15kV Disconnects (Open) / 5-15kV Disconnects (Open)	
DSSO_5_NEW_9	5-15kV Disconnects (Open) / 5-15kV Disconnects (Open)	
TRD1_5_NEW_1	5-15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers <= 500 kVA	
Mezzanine		
1427	Motor Control Center (Per vertical section) / Motor Control Center	1 Problem Found None Corrected
	(Per vertical section)	
1428	Motor Control Center (Per vertical section) / Motor Control Center	
	(Per vertical section)	
1429	Motor Control Center (Per vertical section) / Motor Control Center	
1430	(Per vertical section) Motor Control Center (Per vertical section) / Motor Control Center	
1431	(Per vertical section) Motor Control Center (Per vertical section) / Motor Control Center	
1432	(Per vertical section) Motor Control Center (Per vertical section) / Motor Control Center	4 Problems Found None Corrected
1433	(Per vertical section) 5-15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers	
	<= 500 kVA	
1434	Distribution Panel Single Front (>= 400 amp) / Distribution Panel Single Front (>= 400 amp)	
1435	Single Front (>= 400 amp) Motor Control Center (Per vertical section) / Motor Control Center	
1436	(Per vertical section) Motor Control Center (Per vertical section) / Motor Control Center	
1437	(Per vertical section) Motor Control Center (Per vertical section) / Motor Control Center	
	(Per vertical section) Motor Control Center (Per vertical section) / Motor Control Center	
1438		
1439	(Per vertical section) Motor Control Center (Per vertical section) / Motor Control Center	
1440	(Per vertical section) Motor Control Center (Per vertical section) / Motor Control Center	
1441	(Per vertical section) Switchgear - Incoming Main Service (Per Section) / Switchgear -	
1442	Incoming Main Service (Per Section) Switchgear - Incoming Main Service (Per Section) / Switchgear -	
.443	Incoming Main Service (Per Section) Switchgear - Incoming Main Service (Per Section) / Switchgear - Incoming Main Service (Per Section)	





Equipment Item Problem Count Summary

Agreement: BAS207472JW

Site Name: State of Kansas Docking Building Site Visit Dates: 11/3/2008 - 11/4/2008

Site Visit Status: Completed

Location Within Facility		
Equip Tag ID	Equipment Item Description / Equipment Type	Problem Count
Mezzanine		
1444	5-15kV Dry Transformers <= 500 kVA / 5-15kV Dry Transformers <= 500 kVA	
SWG_MAIN_NEW	Switchgear - Incoming Main Service (Per Section) / Switchgear - Incoming Main Service (Per Section)	
TRD2_5_NEW_1	5-15kV Dry Transformers 501-5000 kVA / 5-15kV Dry	
TRD2_5_NEW_2	Transformers 501-5000 kVA 5-15kV Dry Transformers 501-5000 kVA / 5-15kV Dry	
	Transformers 501-5000 kVA	0.0 11 0 121 0 11
chiller 1	MCC: Motor Starters / MCC: Motor Starters	2 Problems Found None Corrected
chiller 2	MCC: Motor Starters / MCC: Motor Starters	
chiller 3	MCC: Motor Starters / MCC: Motor Starters	





EDS Component Problem Summary

State of Ka	insas [ocking Building	g		BAS	3207472JW
Tag ID			Customer Id	entification		
	Date	Category		Problem Description		
Location:	10th.	Floor Mech				
1480		Distribution	Panel Single	Front (>= 400 amp)		Repaired
11/03/08	HEA	T and	"_a_" Phase "_b_" and "_ millivolt mea	breaker contact is displaying abnormal th c_" Phase contacts and elevated contact r surements.	ermal pattern compared to esistance is confirmed by	
Location:	11th.	Floor Mech				
1482		Distribution	Panel Single	Front (>= 400 amp)		Repaired
11/03/08	BEN	CHMARK VAL		the point of common coupling) is greater eater than 20% in a commercial building.		
11/03/08	HEA			breaker contact is displaying abnormal the _" Phase contacts.	ermal pattern compared to	X
Location:	12th.	Floor Mech				
1484		Distribution	Panel Single	Front (>= 400 amp)		Repaired
11/03/08	BEN	CHMARK VAL	THDC%F (A	the point of common coupling) is greater eater than 20% in a commercial building.		
11/03/08	HEA			breaker contact is displaying abnormal the _" Phase contacts.	ermal pattern compared to	
cation:	13th	Floor Mech.				
1486-A Ph	ase	5-15kV Dry	Transformers	<= 500 kVA		Repaired
11/03/08		sformer		ible resin residue beneath the phase coils	3.	
11/03/08	ULTE	RASONIC		omaly, There is a signifigant higher decil anted internal arcing on the 3rd phase co hase colls.		
1486-B Ph	ase	5-15kV Dry	Transformers			Repaired
11/03/08		sformer	_	ible resin residue from the phase coils inc	dicating possible failure.	
11/03/08	ULTI	RASONIC		omaly, There is a signifigant higher decib anted internal arcing on the 3rd phase co se coils.		
1486-C Ph	ase	5-15kV Dry	Transformers	<= 500 kVA		Repaired
11/03/08	ULTF	RASONIC	Ultrasonic And sound of unvalued and 2nd pha	omaly, There is a signifigant higher decib ranted internal arcing on the 3rd phase co se coils.	al level and a strong il in comparison to the 1st	
11/03/08	Trans	sformer	There is pos	ible resin residue beneath the phase coils	3,	
1488		DISTRIBUT	ION SWITCH	BOARD Multi Cover (Per Section)		Repaired
11/03/08	ULTE	RASONIC		omaly, the contacts of breaker #11 are di ed to be cleaned immidiatly.	splaying very high decibal	
11/03/08	BEN	CHMARK VAL	adjacent pole	is greater than 50% deviation of the lowe s (2001 NETA Maintenance Testing Spec hich is defined as 80% of a device rating.	ification) or 100 millivolts	
The second secon	Critical equired	- Immediate a	ttention		Alert - Needs attention time permits!	as

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EDS Component Problem Summary

State of Kan	sas Do	ocking Building	9		BAS	207	472JV
Tag ID			Customer lo				
C	Date	Category		Problem Descriptio	n		
Location: 1	4th F	loor Mech.					
1490		Distribution	Panel Single	Front (>= 400 amp)		Re	paired
11/03/08	COND	UCTOR SIZE	Parallel cond	luctors smaller than 1/0 are installed in	nproperly. 2002 NEC 310.4		
11/03/08	CONN	IECTIONS	Multiple con	ductors under one lug on a breaker or f	used disconnect.		
Location: 2	nd F	loor Mech.					
1460		Distribution	Panel Single	Front (>= 400 amp)		Rei	paired
11/03/08	HEAT		"_a_" and "_	breaker contact is displaying abnormal b_" Phase contact and elevated tance is confirmed by millivolt measure			
11/03/08	HEAT		patterns con	c_" Phase breaker contacts are display pared to "_b_" Phase contact and element in the masurements.			
11/03/08	HEAT		Heat Related percent on e	l Problem. Total Current Harmonic Dis ach phase.	tortion levels are at a high		
11/03/08	BENC	HMARK VAL	Current phas	e imbalance is greater than 20%.			
11/03/08	BENC	HMARK VAL		t the point of common coupling) is grea reater than 20% in a commercial buildi			
11/03/08	BENC	HMARK VAL		t the point of common coupling) is greater than 20% in a commercial buildi			
1462		Distribution	Panel Single	Front (>= 400 amp)		Rep	oaired
11/03/08	HEAT		Heat Related percentage.	Problem, The total harmonic current of	listortion is at a high		
	HEAT	"	Heat Related	Problem. High total current harmonic	distortion percentage.		
	ird. F	loor Mech.					
1464		Distribution		Front (>= 400 amp)		Rep	paired
11/03/08	HEAT		"_a_" Phase "_b_" and "_ millivolt mea	breaker contact is displaying abnorma c_" Phase contacts and elevated conta surements.	thermal pattern compared to ct resistance is confirmed by		
1465		Distribution	Panel Single	Front (>= 400 amp)		Rep	paired
11/03/08	BENC	HMARK VAL	Current phas	e imbalance is greater than 20%.			
11/03/08	HEAT			Problem, Unbalanced loads are occur percentage levels	ing. Harmonics are also at		
11/03/08	BENC	HMARK VAL		the point of common coupling) is greater than 20% in a commercial buildi			
1467		Distribution I		Front (>= 400 amp)		Rep	paired
11/03/08	HEAT			Problem. Pitting inside the breaker is d on this breaker.	forming do to the age and		
1469		Individual Di	sconnect Swi	tch		Rep	oaired
	itical -	· Immediate a	ttention	Severe - Attention required within the next 30-90 days!	Alert - Needs attention time permits!	as	

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EDS Component Problem Summary

State of Ka	insas l	Docking Building			BAS	S207472JW
Tag ID			Customer lo			
	Date	Category		Problem Descriptio	n	
Location:	3rd.	Floor Mech.				
1469		Individual Di	isconnect Sw	itch		Repaired
11/03/08	CON	NECTIONS	ungrounded	lated fittings/bushings (2002 NEC 300. conductors 4 AWG or larger entering a ushings installed.		
11/03/08	BEN	CHMARK VAL	Current phas	se imbalance is greater than 20%.		
Location:	5th. l	Floor Mech.	tir ,			
1471	.1	Distribution I	Panel Single	Front (>= 400 amp)		Repaired
11/03/08	HEA		Circuit #_7_	has a temperature rise greater that 10 ing it under normal operating	degrees C over the ambient	
Location:	6th. I	Floor Mech.				
1472		Distribution I	Panel Single	Front (>= 400 amp)		Repaired
11/03/08	HEA		Circuit #_11	B phase contact has a temperature risplent air surrounding it under normal op		İ
Location:	1st F	loor Air Han	dler Room			
8		Distribution I	Panel Single	Front (>= 400 amp)		Repaired
11/03/08	HEA	T	patterns com	c_"Phase breaker contacts are displayi pared to the "_b_" Phase contact and by millivolt measurements.	ng abnormal thermal elevated contact resistance	
Location:	Base	ment Air Hai	ndler Roon	n		
1445		Distribution I	Panel Single	Front (>= 400 amp)		Repaired
11/03/08	BEN	CHMARK VAL		t the point of common coupling) is greater than 20% in a commercial buildi		
11/03/08	HEA	Т		breaker contact is displaying abnormal b_" Phase contacts.	thermal pattern compared to	
11/03/08	CON	NECTIONS	ungrounded	lated fittings/bushings (2002 NEC 300. conductors 4 AWG or larger entering a ushings installed.		
11/03/08	BEN	CHMARK VAL	Current phas	se imbalance is greater than 20%.		
1447			Panel Single I	Front (>= 400 amp)		Repaired
11/03/08	-	CHMARK VAL		se imbalance is greater than 20%.		
11/03/08			building or g	t the point of common coupling) is grea reater than 20% in a commercial buildi	ng. (IEEE 519-1992)	
11/03/08	HEA		"_b_" and "_a	breaker contact is displaying abnormal a_" Phase contact.	thermal pattern compared to	
11/03/08	HEA		Heat Related	Problem		X
Location:	Mezz	anine				
- 1-		•		No.		
	Critical equire	- Immediate at d!	tention	Severe - Attention required within the next 30-90 days!	Alert - Needs attention time permits!	as
ГGO-119 (1	/1/05)				©2005 TEGG	Corporation





EDS Component Problem Summary

paired
paired
paired
paired
paired
paired
•

	Critical - Immediate attention required!	Severe - Attention required within the next 30-90 days!	Alert - Needs attention as time permits!
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