

Document Title: Keystone XL Pipeline-Grassy Creek Pump Station MV

Metering Cabinet Refurb Databook

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CODE 1: Work may proceed.



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Date: 10/16/2020

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And Test Plan (RFS-ITP)

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Prepared By: _____

Prepared for: _____



Project Information:

Project Reference:

20-T262-1082

Project Title:

TC Energy Keystone XL (KXL) Pipeline

Document Title:

**MV Metering Cabinet (MC)
Ready for Service – Inspection & Test Plan (RFS-ITP)**

1	29June2020	Updated as per TC's mark-ups/comments		BT	TH	TH
0	15June2020	First Issue		BT	TH	TH
Rev	Date	Description		By	Checked	Approved
Division Shermco Engineering - Regina		Orig. Author/Department Brad Temple / Engineering		Project/Bid No. 20-T262-1082		
Document Title MV Metering Cabinet (MC) - Ready for Service – Inspection & Test Plan (RFS-ITP)		TC Energy Document No. 25472-101-V2A-EMM0-W0001		Shermco Document No. T262-1082-TCP-MC-RFSITP		Rev 1

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1. Recommendations and Scope

Each cabinet has been refurbished based on the previously identified deficiencies documented in each individual report. The following document details the recommended “Ready for Service – Inspection & Test Plan” (RFS-ITP) that would be executed at the storage facility prior to handing the cabinets over to TC-Energy’s pre-commissioning team.

Details of each of the processes and procedures can be found within Section-4 “MV Metering Cabinet Inspection and Test Plan Matrix”. The Metering Cabinet(s) are not permitted to be placed into service until all “Acceptance Criteria” is met in Section-4.

2. Definitions

Definitions defined within the Inspection and Test Plan Matrix on the following pages:

Test Definitions:

CWT	Customer Witness Test	(Specific testing process completed with customer present)
FAT	Factory Acceptance Test	(Internal testing performed by the individual equipment supplier at their factories)
SAT	Site/Storage Acceptance Test	(Specific testing process completed at the site or storage facility)

Status Point Definitions:

H	Hold Point	(Inspection or testing point required)
R	Review Point	(Review of record/certificate only)
S	Surveillance Point	(Random attendance, no signature required)
W	Witness Point	(Attendance expected & signature to proceed only if in attendance)

3. List of Applicable Stations

Table-1 below shows the applicable stations that contain the metering cabinets (along with the quantity of motors/pumps used at that station) along with any status comments.

TABLE-1

#	Station Name	Station Country	Station Province/State	Number of Motors/Pumps (after expan.)	Comments/Station Status
1	PS-1 Hardisty B (for EES-10)	Canada	Alberta	3	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
2	PS-1 Hardisty B(for EES-11)	Canada	Alberta	3	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
3	PS-2 Lakesend East	Canada	Alberta	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
4	PS-3 Monitor South	Canada	Alberta	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
5	PS-4 Oyen South	Canada	Alberta	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
6	PS-5 Blindoss South	Canada	Alberta	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
7	PS-6 Fox Valley	Canada	Saskatchewan	5	Shermco – Regina Service Center, Regina, SK
8	PS-7 Piapot	Canada	Saskatchewan	5	Shermco – Regina Service Center, Regina, SK
9	PS-8 Grassy Creek	Canada	Saskatchewan	5	Shermco – Regina Service Center, Regina, SK
10	PS-9 Phillips	United States	Montana	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
11	PS-10 Valley	United States	Montana	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
12	PS-11 Fort Peck	United States	Montana	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
13	PS-12 Circle	United States	Montana	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
14	PS-13 Prairie	United States	Montana	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
15	PS-14 Fallon	United States	Montana	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
16	PS-15 Harding	United States	South Dakota	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
17	PS-16 Buffalo	United States	South Dakota	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
18	PS-17 Faith	United States	South Dakota	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
19	PS-18 Haakon	United States	South Dakota	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
20	PS-19 Murdo	United States	South Dakota	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
21	PS-20 Winner	United States	South Dakota	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
22	PS-21 Colome	United States	South Dakota	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
23	PS-22 O'Neill (orig Atkinson)	United States	Nebraska	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
24	PS-23 Oakdale (orig Ericsson)	United States	Nebraska	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
25	PS-23B Leigh	United States	Nebraska	3	New Station being added, no RFS-ITP
26	PS-24 Bellwood (orig Fullerton/Central City)	United States	Nebraska	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
27	PS-25 Milford (orig Fairmont/Exter)	United States	Nebraska	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
28	PS-26 Steele City B	United States	Nebraska	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
29	PS-27 Riley	United States	Kansas	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
30	PS-29 Burns	United States	Kansas	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
31	PS-32 Cushing South	United States	Oklahoma	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
32	PS-33 Cromwell	United States	Oklahoma	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
33	PS-34 Tupelo	United States	Oklahoma	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
34	PS-35 Bryan	United States	Oklahoma	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
35	PS-36 Delta	United States	Texas	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
36	PS-37 Winnsboro	United States	Texas	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
37	PS-38 Lake Tyler	United States	Texas	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
38	PS-39 Lufkin	United States	Texas	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
39	PS-40 Corrigan	United States	Texas	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
40	PS-41 Liberty	United States	Texas	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP

4. MV Metering Cabinet Inspection and Test Plan Matrix

Project Information:		Representative Sign-off:		Customer Representative Sign-off:	
Project Name: _____		Name: _____		Name: _____	
Project #: _____		Title: _____		Title: _____	
Customer Project #: _____ Customer Contract #: _____		Date: _____		Date: _____	
Pump Sta. #/Name: _____		Signature: _____		Signature: _____	
MC Tag# & Serial#: _____					

Legend (for "Type" and "Verification Point")													
Test Type:		CWT=Customer Witness Point			SAT=Storage Acceptance Test			FAT=Factory Acceptance Test					
Verification Point:		H=Hold Point			R=Review Point			S=Surveillance Point			W=Witness Point		
Item #	Verification/Test Activity	Type			Acceptance Criteria						Verify Point		
		SAT	FAT	CWT	Requirement	Acceptance/NA/Comment		Shermco	Customer	Cust 3 rd	Factory		
						"☑" Indicates complete and accepted "NA" indicates not applicable Comments struck through (ex. Comment) indicates a comment that has been resolved							
TC Energy Keystone XL Project –MV Metering Cabinet (MC) RFS-ITP Processes													
1.0 MV Metering Cabinet (MC) RFS-ITP Process 1: Physical/Mechanical Inspection & Refurbishment Activities (Executed at storage facility)													
1.1	Compare unit's nameplate with drawings/specification.	X			Verify that the information on the nameplate matches what is required from the specification.				H	RS			
1.2	Inspect the physical and mechanical condition of each compartment in the metering cabinet. - Termination points - Opening/Closing of cabinet doors - Push/Pull of instrument transformer drawers - Condition of the buses & insulated surfaces - Condition of grounding connections - Condition of shorting connections	X			Ensure that no grounding or shorting connections will not be problematic and will work as intended. Validate no physical abnormalities exist. Where abnormalities are identified, photos shall be taken for record and engineering review. Ensure the deficiencies noted from the previous inspection reports have been repaired.	Refer to inspection report to view the previously noted deficiencies.		H	RS				
1.3	Clean the meter cabinet. - Vacuum and wipe all compartments. - Wipe (dry rag) all insulation surfaces. Use of denatured alcohol is permitted if dry rag cannot clean insulation surfaces. - Contacts or any current carrying surfaces should be cleaned with an abrasive cloth or fine Scotch-Brite product in combination with an approved contact cleaner and contact lubricator.	X			Validate the unit is clean. - No unnecessary debris - No buildup of dirt, soil, sand, or soot is allowed inside any of the compartments	Do not use any solvents that may leave residue afterwards.		H	RS				
1.4	Install and test functional operation of the kirk-key interlock system. Clean up any mess caused from installation.	X			Verify that the metering cabinet doors cannot open unless the kirk-key interlock system allows the metering cabinet doors to open.				H	RS			

1.5	Install, modify, and function test Terminal Block TB1 as per the wiring diagram. Clean up any mess caused from installation/modification.	X		Verify that the installation is correct as per the wiring diagram and that any future interconnections can be made. Ensure the receptacle wiring is modified as per the wiring diagram. Take a photo after installation & modifications are completed.	For 127-PIAPT-B0-JIT-01 & 128-GRSSY-B0-JIT-01, ensure the barrier is placed between the UPS and normal power sources on the TB1 terminal block. For 127-PIAPT-B0-JIT-01 & 128-GRSSY-B0-JIT-01, affix lamacoid tags saying "WARNING THIS CABINET CONTAINS MULTIPLE POWER SOURCES" to the cabinet doors at a suitable height to be seen.	H	RS		
1.6	Install the Isolated Neutral Bus Bar as per the wiring diagram and general assembly drawings. Clean up any mess caused from installation.	X		Verify that the installation is correct as per the wiring diagram and general assembly drawings. Take a photo after installation is completed.		H	RS		
1.7	Compare Current Transformer nameplate data with drawings and specifications.	X		Verify that the information on the nameplate matches what is required from the specification. Ensure the turns ratio on the nameplate matches the specification.		H	RS		
1.8	Inspect the physical condition of each Current Transformer. - Condition of termination points - Condition of the case - Condition of wires - Mounting and alignment of each unit in the instrument drawer	X		Validate no physical abnormalities exist. Where abnormalities are identified, photos shall be taken for record and engineering review. Verify that adequate clearances exist between primary and secondary wires.		H	RS		
1.9	Check that the connections for each current transformer are correct. Reference design drawings and specification documents.	X		Verify that the connections are correct, and that intended CT ratio will be used.		H	RS		
1.10	Check the tightness of all bolted electrical connections related to the Current Transformers.	X		Verify that no loose connections exist.		H	RS		
1.11	Compare Potential Transformer nameplate data with drawings and specifications.	X		Verify that the information on the nameplate matches what is required from the specification. Ensure the turns ratio on the nameplate matches the specification.		H	RS		
1.12	Inspect the physical condition of each Potential Transformer. - Condition of termination points - Condition of the case - Condition of wires - Mounting and alignment of each unit in the instrument drawer	X		Validate no physical abnormalities exist. Where abnormalities are identified, photos shall be taken for record and engineering review. Verify that adequate clearances exist between primary and secondary wires.		H	RS		
1.13	Check that the connections for each Potential Transformer are correct. Reference design drawings and specification documents.	X		Verify that the connections are correct, and that intended turns ratio will be used.		H	RS		
1.14	Check the tightness of all bolted electrical connections related to the Potential Transformers.	X		Verify that no loose connections exist.		H	RS		
1.15	Inspect the physical condition of the Power Meter Socket. - Visibly shorted connections - Visibly grounded - Condition of the case/enclosure - Condition of the meter connections - Condition of wires - Condition of test switches - Mounting and alignment	X		Validate no physical abnormalities exist. Where abnormalities are identified, photos shall be taken for record and engineering review.		H	RS		

General Comments to Section 1.0

- Any refurbishment activities that require bolted connections need to be appropriately torqued. Apply torque marks when confirmed proper torque to bolt.
 - Attach bolt torque reports to the final/filled-out ITP
- This procedure is to be completed in full before any electrical testing is to take place.

Legend (for "Type" and "Verification Point")													
Test Type:		CWT=Customer Witness Point			SAT=Storage Acceptance Test			FAT=Factory Acceptance Test					
Verification Point:		H=Hold Point			R=Review Point			S=Surveillance Point			W=Witness Point		
Item #	Verification/Test Activity	Type			Acceptance Criteria							Verify Point	
		SAT	FAT	CWT	Requirement	Acceptance/NA/Comment			Shermco	Customer	Cust 3 rd	Factory	
"☑" Indicates complete and accepted "NA" indicates not applicable Comments struck through (ex. Comment) indicates a comment that has been resolved													
TC Energy Keystone XL Project –MV Metering Cabinet (MC) RFS-ITP Processes													
2.0 MV Metering Cabinet (MC) RFS-ITP Process 2: Electrical Testing (Executed at storage facility)													
2.1	Perform a ductor/contact-resistance tests on each bus bar.	X			Verify that the test value for each bus is less than 10μΩ.	Test resistance values above 10μΩ will be further examined. Reasons for poor test results could be, - Loose Connections - Improper tension on bolted joints - Eroded contact surfaces - Contaminated or corroded contacts			H	RS			
2.2	Perform an insulation-resistance test of each Current Transformer. - Apply 1000V DC Primary to ground for 1 minute - Apply 1000V DC Secondary to ground for 1 minute	X			Refer to ANSI/NETA ATS Table 100.5 for minimum insulation resistance values. Confirm that the test resistance value is above the minimum insulation resistance stated.				H	RS			
2.3	Perform polarity testing on each Current Transformer.	X			Verify that the polarity of the Current Transformer matches the polarity markings on the unit.				H	RS			
2.4	Perform a ratio verification test on each Current Transformer.	X			Verify that the nameplate ratio matches the test results.	Ratio error should be minimal. Refer to IEEE C57.13 or manufacturer's documentation if large error exists.			H	RS			
2.5	Perform an excitation test on each Current Transformer.	X			Verify that the Current Transformer reaches saturation during the test. Compare the test results between each Current Transformer and previous test results.	Operating and saturation (knee point) regions should be clearly identified in test results to prove accuracy rating and that no shorted windings exist. Refer to IEEE C57.13.1 or manufacturer's documentation for more information.			H	RS			
2.6	Measure the current circuit burden of each Current Transformer.	X			Verify that each burden matches the labeled transformer rating.				H	RS			
2.7	Perform a dielectric withstand test on the primary winding with the secondary grounded for each Current Transformer.	X			Apply voltage in accordance to either the manufacturer's data or ANSI/NETA ATS Table 100.9. Unit passes the test if there is no evidence of distress or insulation failure after the test is completed.	Do not proceed if any distress or insulation failure is observed as a result of the test.			H	RS			
2.8	Perform power-factor or dissipation-factor tests on each Current Transformer.	X			Confirm that power-factor or dissipation-factor values compare to the manufacturer's data.	In the absence of manufacturer data, use the test equipment manufacturer's data instead.			H	RS			

2.9	Check to see that each Current Transformer's secondary circuits are grounded.	X		Confirm that each Current Transformer's secondary circuit is grounded and that there is only one grounding point.	Refer to grounding location specified by the engineer in the project drawings. Refer to ANSI/IEEE C57.13.3.	H	RS		
2.10	Perform an insulation-resistance test on each Potential Transformer. • Winding-to-winding • Winding-to-ground	X		Refer to ANSI/NETA ATS Table 100.5 for minimum insulation resistance values. Confirm that the test resistance value is above the minimum insulation resistance stated.		H	RS		
2.11	Perform polarity testing on each Potential Transformer.	X		Verify that the polarity of the Potential Transformer matches the polarity markings (H1-X1 relationship) on the unit.		H	RS		
2.12	Perform a ratio verification test for each tap setting on each Potential Transformer.	X		Verify that the nameplate ratios match the test results.	Ratio error should be minimal. Refer to IEEE C57.13 or manufacturer's documentation if large error exists.	H	RS		
2.13	Measure the voltage circuit burden of each Potential Transformer.	X		Verify that each burden matches the labeled transformer rating.		H	RS		
2.14	Perform a dielectric withstand test on the primary winding with the secondary grounded for each Potential Transformer.	X		Apply voltage in accordance to either the manufacturer's data or ANSI/NETA ATS Table 100.9. Unit passes the test if there is no evidence of distress or insulation failure after the test is completed.	Do not proceed if any distress or insulation failure is observed as a result of the test.	H	RS		
2.15	Perform power-factor or dissipation-factor tests on each Potential Transformer.	X		Confirm that power-factor or dissipation-factor values compare to the manufacturer's data.	In the absence of manufacturer data, use the test equipment manufacturer's data instead.	H	RS		
2.16	Check to see that each Potential Transformer's secondary circuits are grounded.	X		Confirm that each Potential Transformer's secondary circuit is grounded and that there is only one grounding point.	Refer to grounding location specified by the engineer in the project drawings. Refer to ANSI/IEEE C57.13.3.	H	RS		
2.17	Perform an insulation resistance test on the isolated neutral bus bar. • Apply 1000V DC for 1 minute	X		Refer to ANSI/NETA ATS Table 100.1 for minimum insulation resistance values. Confirm that the test resistance value is above the minimum insulation resistance stated.		H	RS		
2.18	Perform a ductor test on the isolated neutral bus bar.	X		Verify that the test value for each bus is less than 10μΩ.	Test resistance values above 10μΩ will be further examined. Reasons for poor test results could be, • Loose Connections • Improper tension on bolted joints • Eroded contact surfaces • Contaminated or corroded contacts	H	RS		
2.19	Check to see if the heaters are functioning properly. Check the functionality of the thermostats.	X		Verify that they can be energized and produce heat. Verify that the thermostats are operational.	Heaters should turn on when the thermostat set point is below ambient temperature. Heaters should turn off when the thermostat set point is above ambient temperature.	H	RS		

General Comments to Section 2.0

-If the Metering Cabinet(s) are deemed to have failed any of the Acceptance Testing Criteria, they would be considered non-serviceable

- Components will need to be refurbished or be completely replaced in attempt to pass the Acceptance Testing Criteria.
- Once components have been refurbished/replaced, retest the Metering Cabinet(s) with the same procedure.

-Any bolted connections that were taken off for electrical testing need to be appropriately torqued when reattached. Apply torque marks when confirmed proper torque to bolt.

-As-Built drawings need to be signed/stamped.

-Record all test result on test sheets and attach the final/filled-out ITP. Test equipment logs & calibration certificates to be attached too.

Legend (for "Type" and "Verification Point")															
Test Type:		CWT=Customer Witness Point			SAT=Storage Acceptance Test			FAT=Factory Acceptance Test							
Verification Point:		H=Hold Point		R=Review Point		S=Surveillance Point			W=Witness Point						
Item #	Verification/Test Activity	Type			Acceptance Criteria						Verify Point				
		SAT	FAT	CWT	Requirement	Acceptance/NA/Comment			Shermco	Customer	Cust 3 rd	Factory			
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TC Energy Keystone XL Project –MV Metering Cabinet (MC) RFS-ITP Processes															
3.0 MV Metering Cabinet (MC) RFS-ITP Process 3: Prepare for Storage (Executed at storage facility)															
3.1	Have a CSA Inspection done on the Metering Cabinet.	X			The metering cabinet needs to comply with CSA standards. The CSA inspector will provide a certificate/permit. That certificate/permit needs to demonstrate that the metering cabinet is "CSA Approved".					H	RS				
3.2	Determine where the Metering Cabinet is going to be stored. Create a moving plan on how each Metering Cabinet will be moved safely to the storage location outside.	X			Communicate moving plan to team members.					H	RS				
3.3	Use a lift-truck/crane to move the Metering Cabinet outside for storage.	X			Ensure the storage location is accessible to temporary power. Temporary power is needed to run the heaters.					H	RS				
3.4	Connect temporary power to enable the heaters.	X			Verify that the heaters are operational at the storage location.					H	RS				
General Comments to Section 3.0															
-Proceed with Section 3.0 when section 1.0 & 2.0 are completed.															
-Metering Cabinets are to remain in storage until further notice.															
-While in storage monthly inspections need to be performed and documented.															
• Check the heaters															
• General visual inspection															
-Prepare shipment and include applicable documentation (MSDS, Storage/Installation/Maintenance manuals, ect) when each unit is requested to be shipped.															
-Record all test result on test sheets and attach the final/filled-out ITP. Test equipment logs & calibration certificates to be attached too.															

----- End of Document -----

Document Title: Keystone XL Pipeline-Grassy Creek Pump Station MV

Metering Cabinet Three Line Diagram

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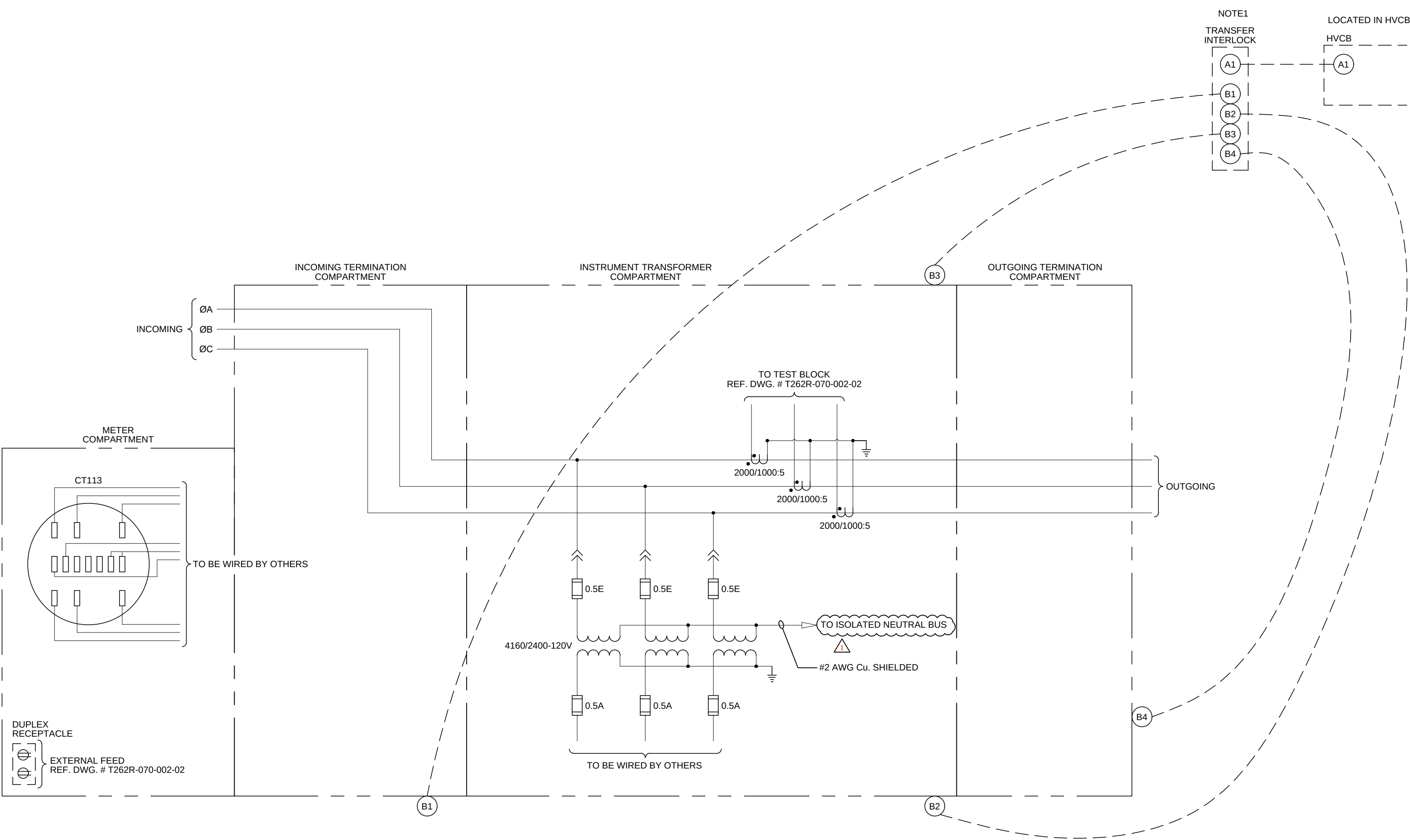
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1	30-Jun-2020	Fixed Cover Page	Shermco Industries



NOTES:

1. INTERLOCK KEY SCHEME:

INITIAL CONDITION:

HVCB IS CLOSED WITH KEY "A" CAPTIVE IN ITS RESPECTIVE KEY INTERLOCK. METERING CABINET COMPARTMENTS ARE LOCKED CLOSED WITH NO KEYS PRESENT IN THEIR RESPECTIVE KEY INTERLOCKS. THE 5-KEY TRANSFER INTERLOCK HAS FOUR "B" KEYS CAPTIVE IN ITS SECONDARY CYLINDER POSITIONS.

TO HAVE ACCESS TO METERING CABINET COMPARTMENTS:

1. OPEN HVCB
2. TURN KEY "A" ON LO INTERLOCK ON HVCB TO LOCK OPEN. KEY "A" IS NOW FREE.
3. INSERT KEY "A" IN THE 5-KEY TRANSFER INTERLOCK AND TURN. KEYS "B" ARE NOW FREE.
4. USE THE "B" KEYS TO UNLOCK THE METERING COMPARTMENT'S DOORS.

REVERSE SEQUENCE TO RESTORE SERVICE.

ISSUED FOR
CONSTRUCTION

NO.	DRAWING REFERENCES	REV	REVISION DESCRIPTION	DRAWN	DATE	CHKD	APPD	CLIENT			BY	DRAWN	DESIGNED	CLIENT
		B	ISSUED FOR CONSTRUCTION	DL	04/02/2013	TD					EJP		TD	TCPL
		1	FIELD CHANGES	HW	29/06/2020	BT	SM				DATE	11/06/2012	11/06/2012	
											CHECKED	APPROVED	CLIENT APPD.	TITLE
											TD			KEYSTONE XL PIPELINE-GRASSY CREEK PUMP STATION
											11/06/2012			MV METERING CABINET
											SCALE	NTS		THREE LINE DIAGRAM
											PROJECT NO.	20-T262R-1082		DWG. NO.
														T262R-050-001-02
														REV
														1

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Metering Cabinet Wiring Diagram

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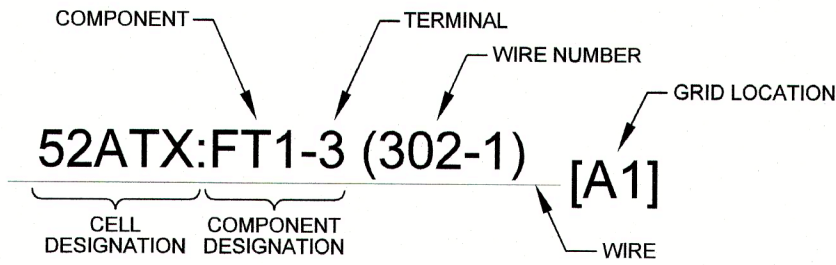
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0	15-Jun-2020	First Issue with Referbishment Update	Shermco Industries
1	30-Jun-2020	Fixed Cover Page	Shermco Industries

LEGEND

WIRE NUMBERING

100-199 - POWER CIRCUITS (DC)
200-299 - CT CIRCUITS
300-399 - PT CIRCUITS
400-499 - TRIP/CONTROL CIRCUITS
500-599 - INDICATION CIRCUITS
600-699 - POWER CIRCUITS (AC)
700-799 - COMMUNICATIONS

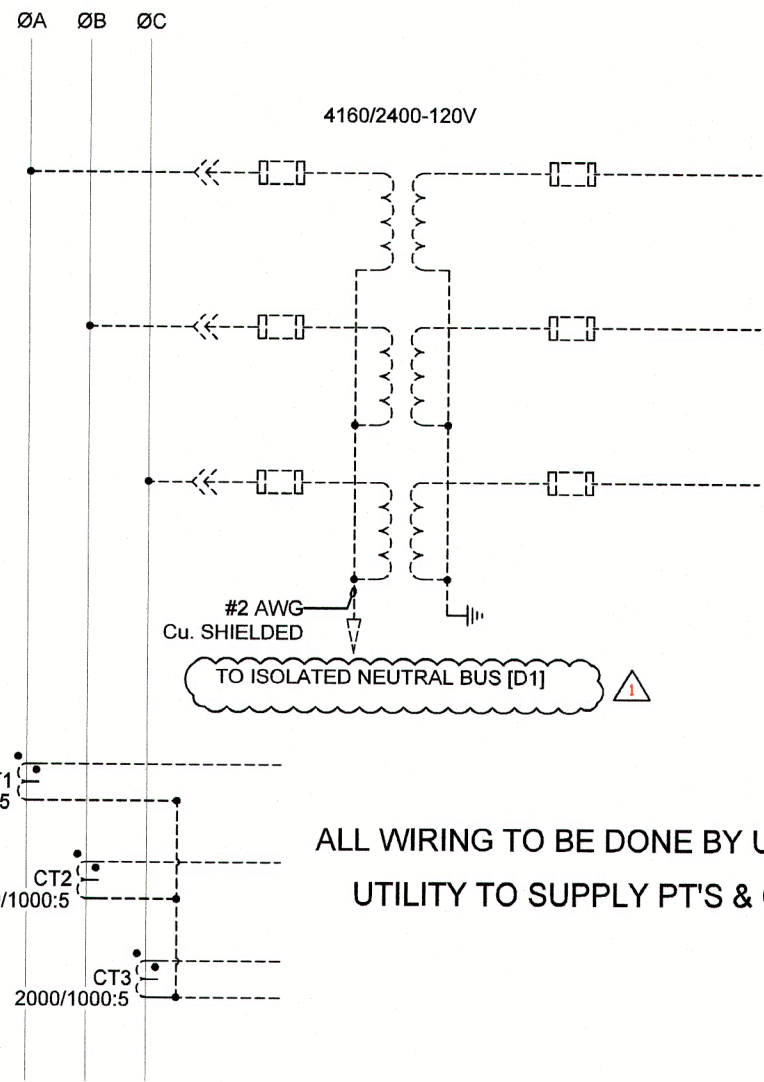
EXAMPLE WIRE LABEL



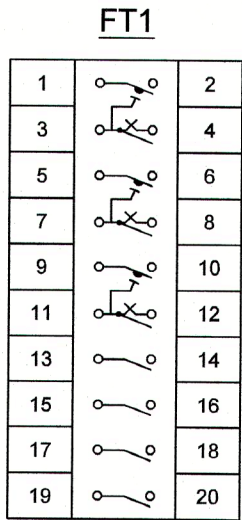
NOTES

1. INSTALL MINIMUM 40 CM ABOVE THE BOTTOM PANEL

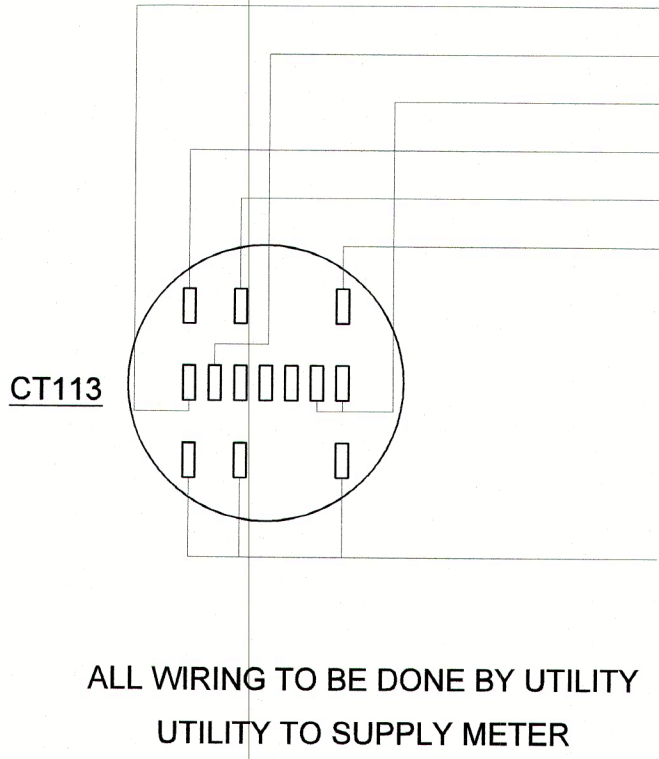
ISSUED FOR APPROVAL



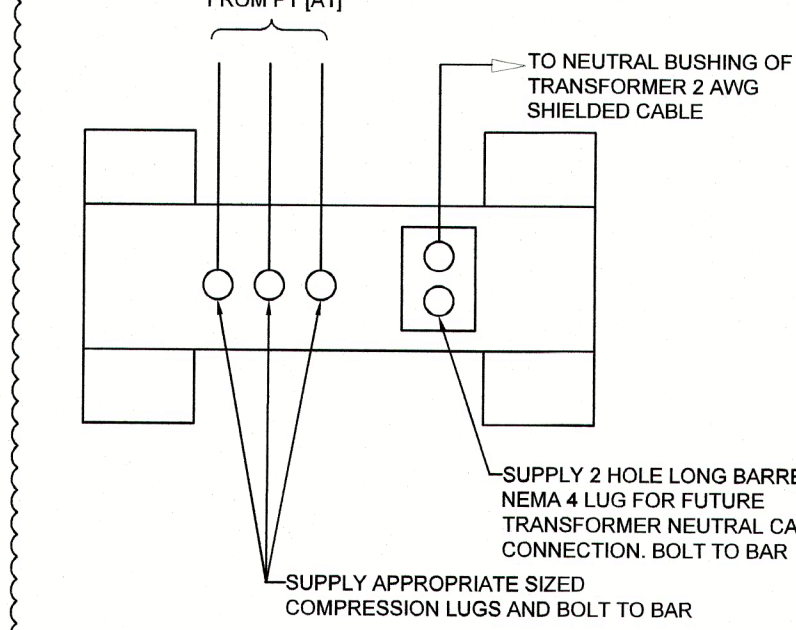
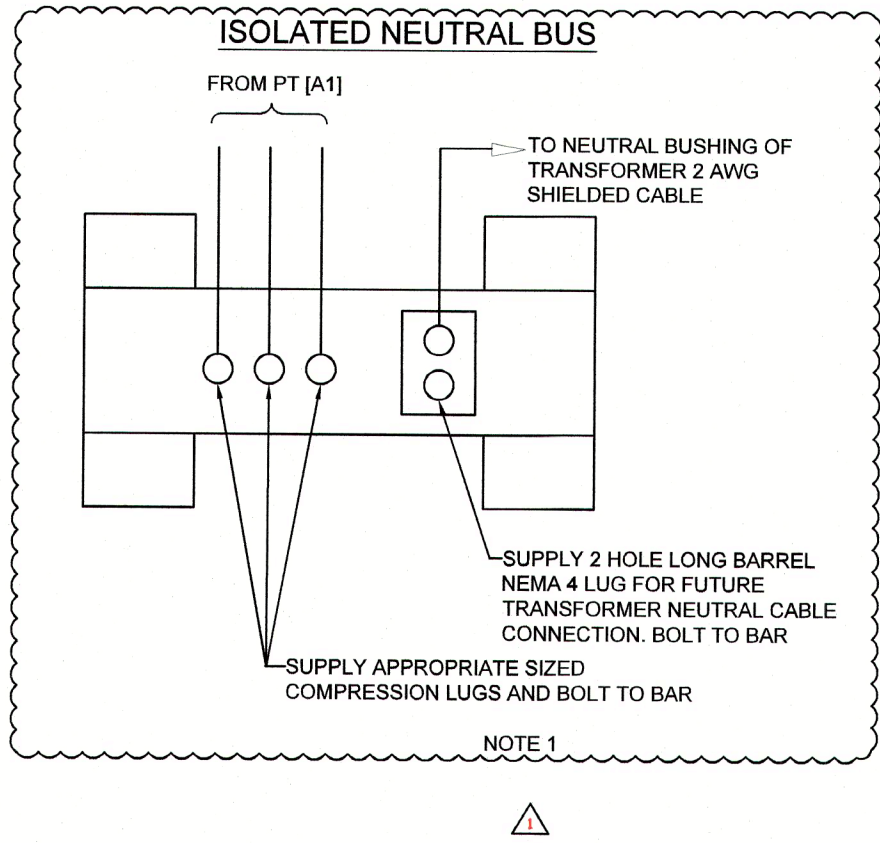
ALL WIRING TO BE DONE BY UTILITY
UTILITY TO SUPPLY PT'S & CT'S



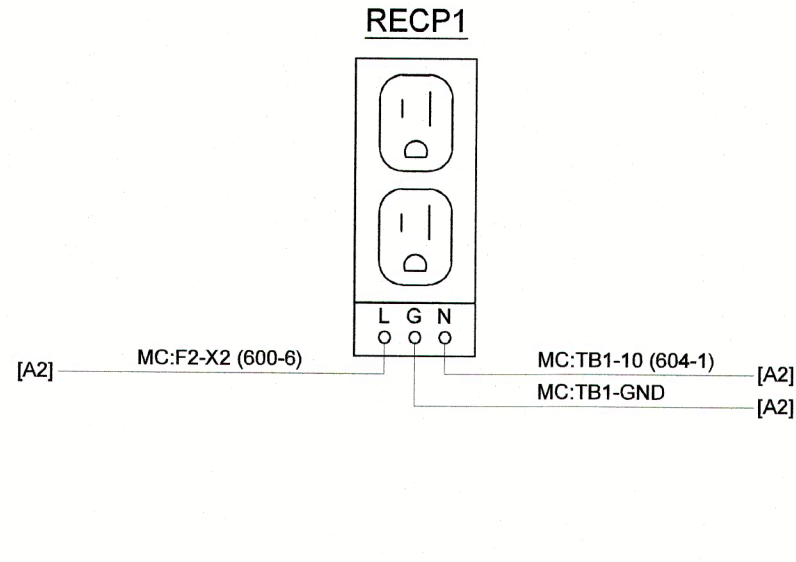
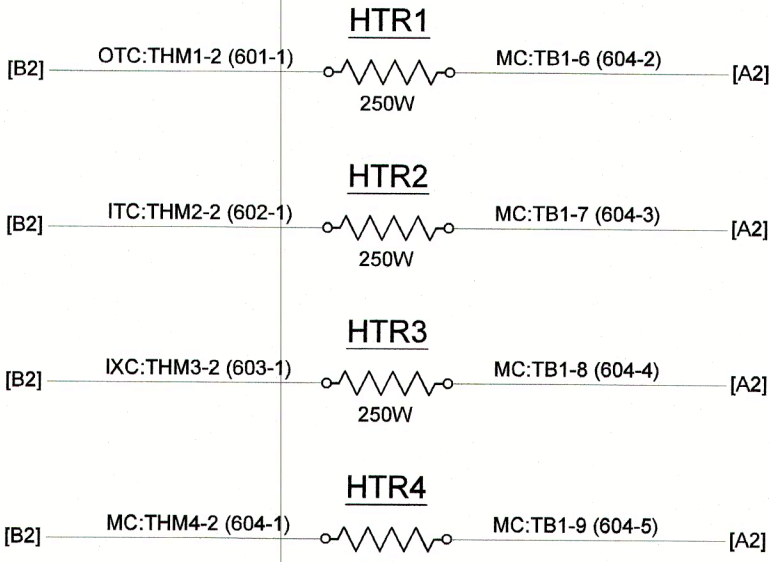
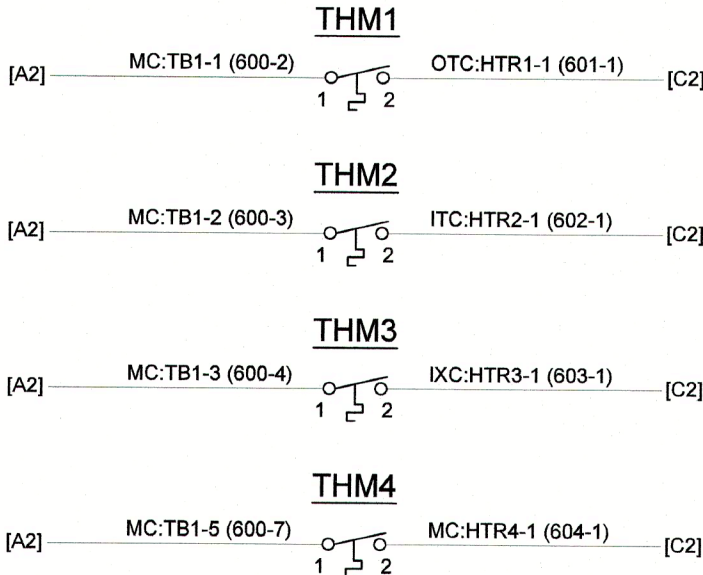
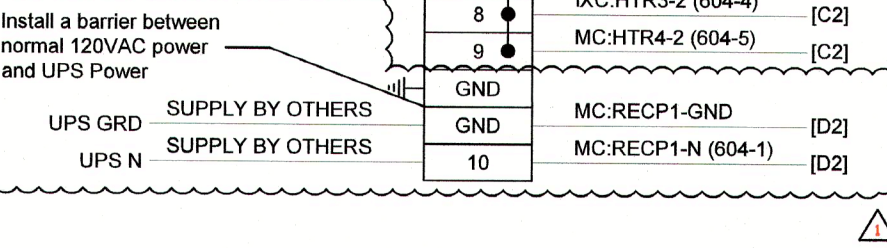
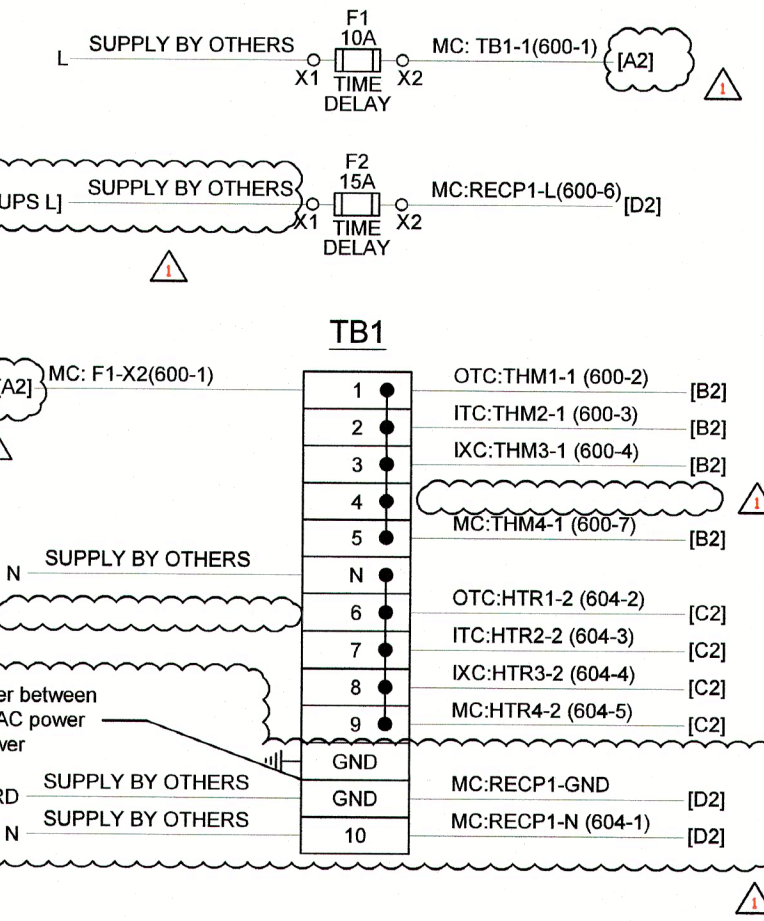
ALL WIRING TO BE DONE BY UTILITY
UTILITY TO SUPPLY FT BLOCK



ALL WIRING TO BE DONE BY UTILITY
UTILITY TO SUPPLY METER



NOTE 1



A2

B2

C2

D2

E2

A3

B3

C3

D3

E3

NO.	DRAWING REFERENCES	REV	REVISION DESCRIPTION	DRAWN	DATE	CHKD	APPD	CLIENT
		1	FIELD CHANGE	HW	15/06/2020	BT	SM	



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BY	DRAWN	DESIGNED
DATE	11/06/2012	11/06/2012
CHECKED	APPROVED	CLIENT APPD.
TD	11/06/2012	
SCALE	NTS	
PROJECT NO.	20-T262R-1082	

CLIENT	TCPL
TITLE	KEYSTONE XL PIPELINE-GRASSY CREEK PUMP STATION MV METERING CABINET WIRING DIAGRAM
DWG. NO.	T262R-070-002-02

REV

Document Title: Keystone XL Pipeline MV Metering Cabinet

General Layout

Document Number: 25472-101-V2A-EMM0-W0008

Revision Number: 1

PO Number: 4500249594

Material Requisition Number: 06, 07, & 08 EA

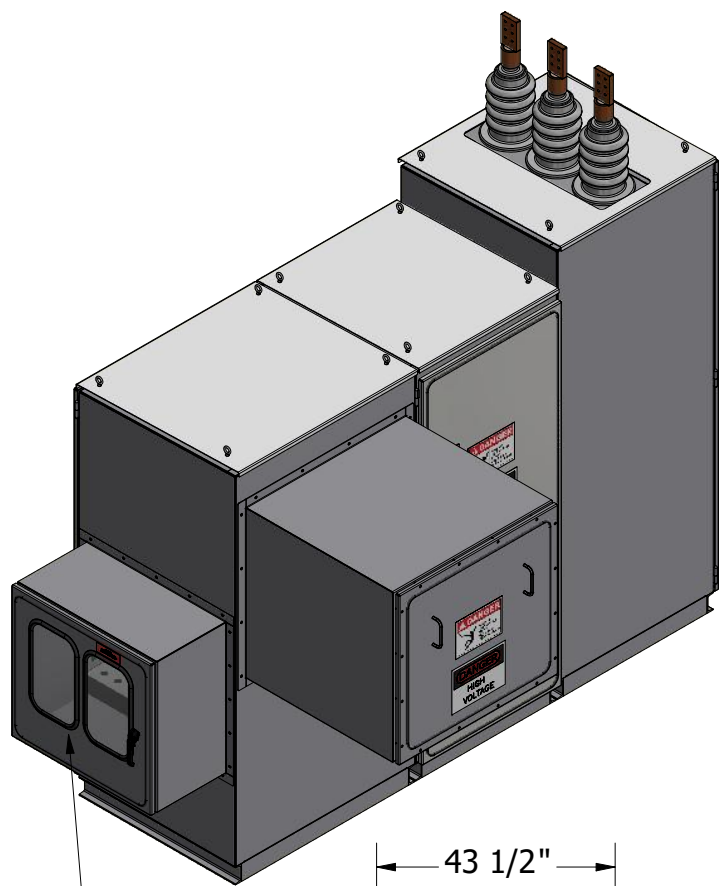
Applicable Tag#: 126-FXVLY-B0-JIT-01, 127-PIAPT-B0-JIT-01, 128-GRSSY-B0-JIT-01



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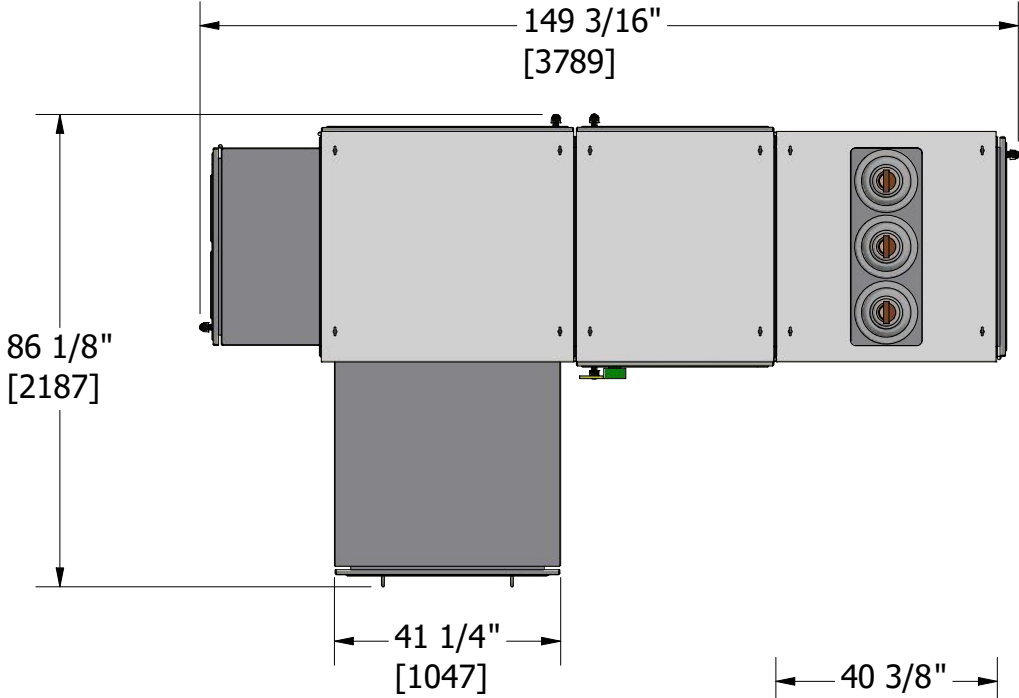
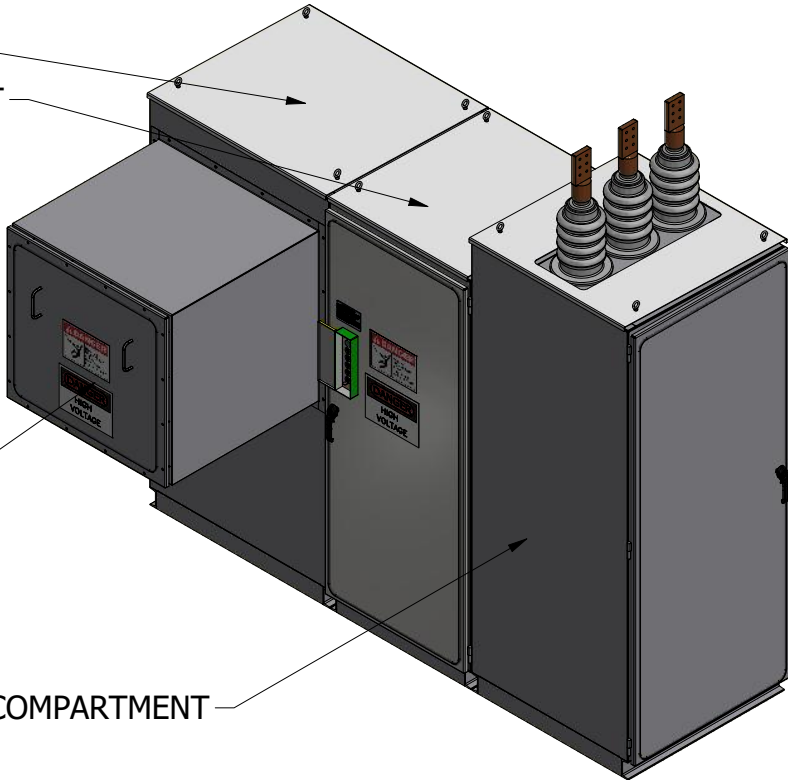
Supplier Rev.	Rev Date DD-MMM-YYYY	Reason for Issue	Supplier Name
0	22-Jun-2020	First Issue with Referbishment Update	Shermco Industries
1	04-Aug-2020	Added Placement of Lamicoid Labels on Doors	Shermco Industries



INCOMING COMPARTMENT
INSTRUMENT TRANSFORMER COMPARTMENT

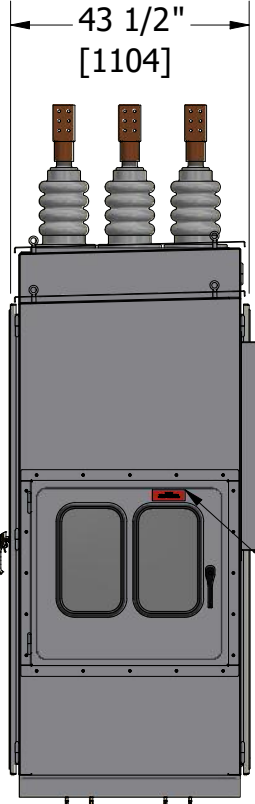
INCOMING HOOD

OUTGOING COMPARTMENT



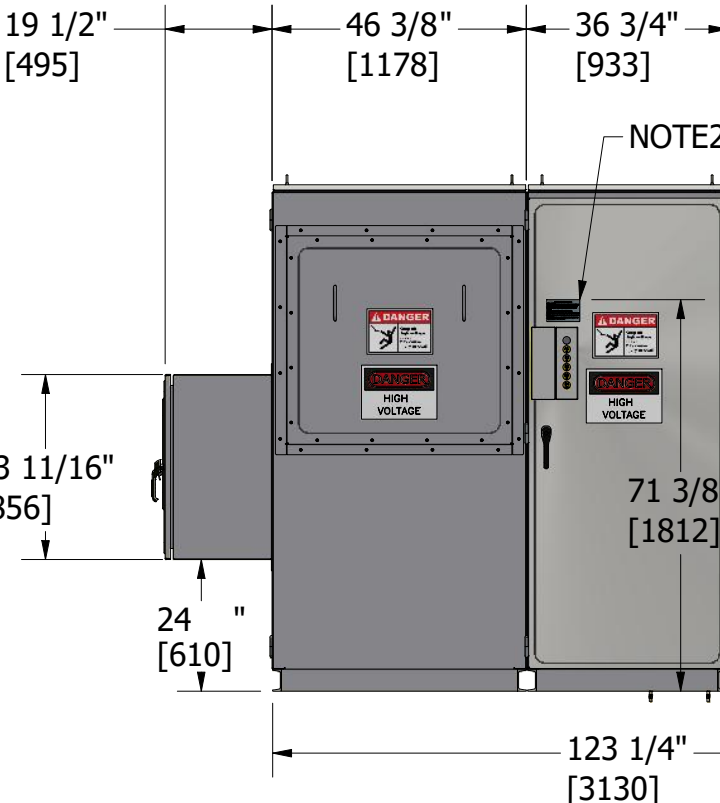
METERING
COMPARTMENT

APPROX. WEIGHT:
4200 LBS



SIDE VIEW

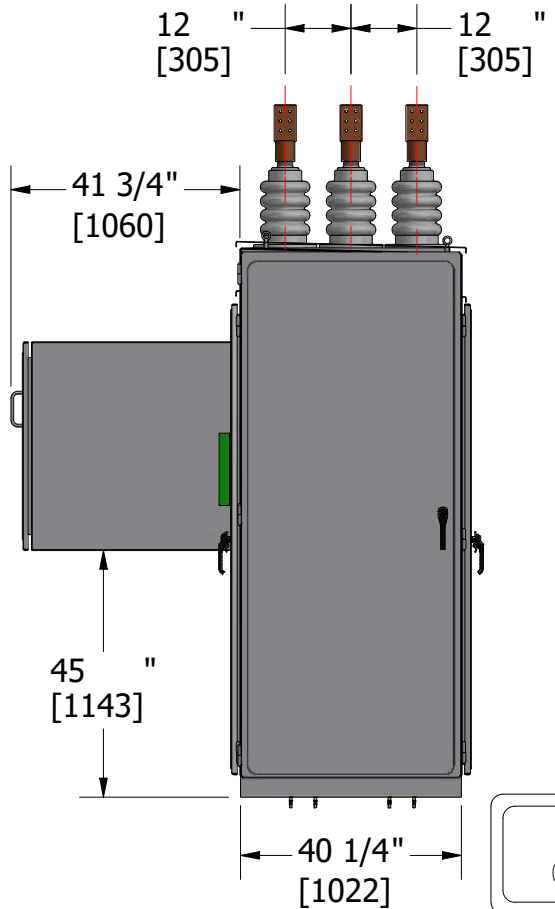
NOTE1



NOTE2

100
[2540]

126 1/8"
[3204]



ISSUED FOR
CONSTRUCTION

NOTES FOR REV 6:

1. 127-PIAPT-BO-JIT-01 AND 128-GRSSY-BO-JIT-01 WILL HAVE THIS LAMICOID (6"X2"):
2. LAMICOID (6"X4") WITH THE OPERATING INSTRUCTIONS FOR THE KIRK KEY INTERLOCKING SYSTEM BOTH HERE AND AT THE SF6 BREAKER.

126-FXVLY-BO-JIT-01
127-PIAPT-BO-JIT-01
128-GRSSY-BO-JIT-01



MANUFACTURE	DRAWN	DESIGNED
KS	HW	BT
	2020-08-04	2020-08-04
CHECKED	APPROVED	CLIENT APPD.
BT	BT	
APPROX. WEIGHT	N/A	
SCALE		
PROJECT NO.	20-T262-1082	

CLIENT
TRANSCANADA PIPELINE

TITLE
KEYSTONE XL PIPELINE
MV METERING CABINET GENERAL LAYOUT

DWG. NO. T262R-475-13-01

REV
06

Document Title: Keystone XL Pipeline MV Metering Cabinet

General Layout – No Doors

Document Number: 25472-101-V2A-EMM0-W0009

Revision Number: 0

PO Number: 4500249594

Material Requisition Number: 06, 07, & 08 EA

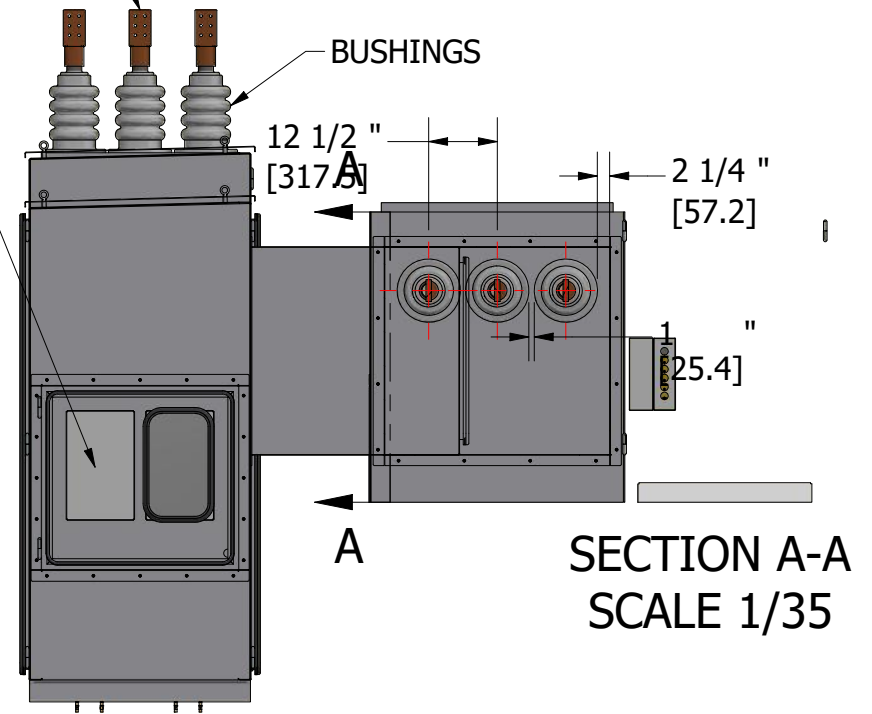
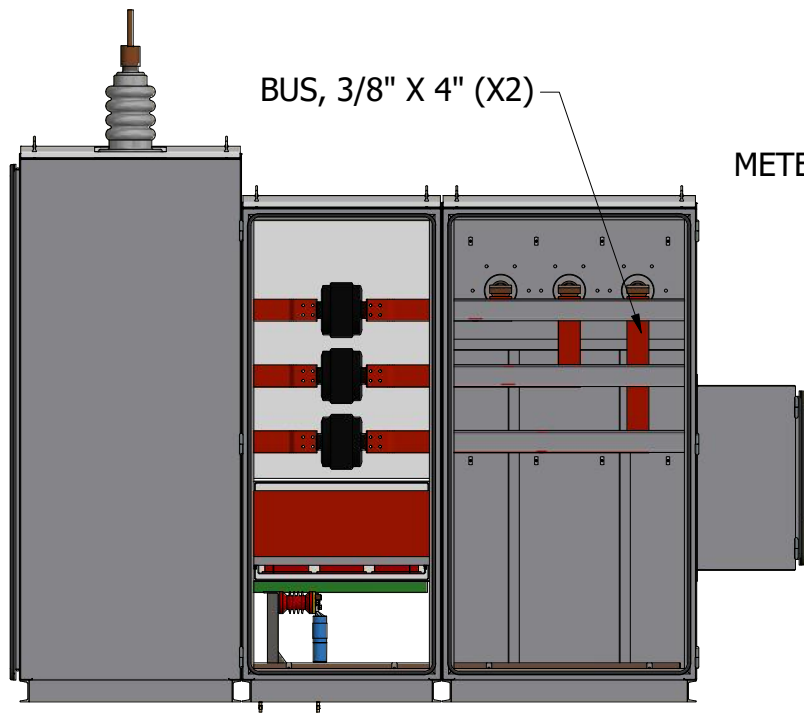
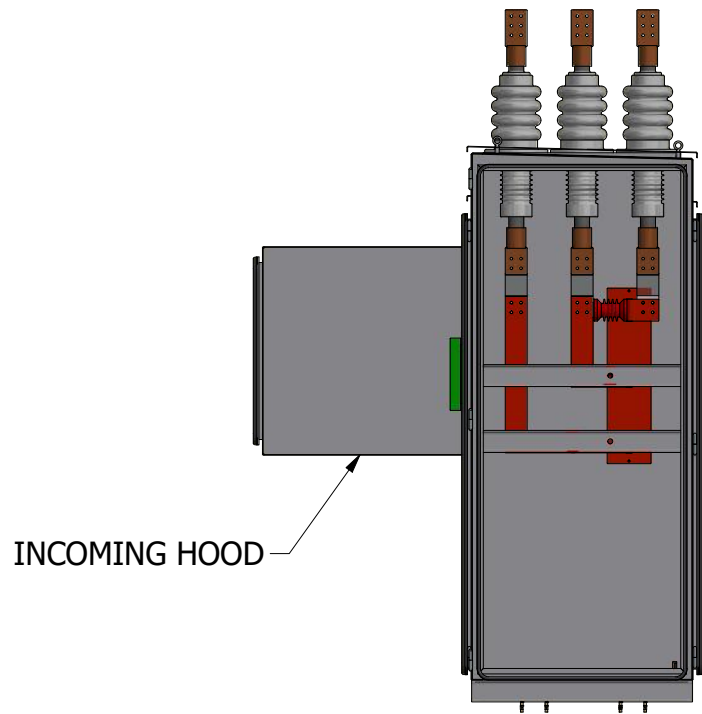
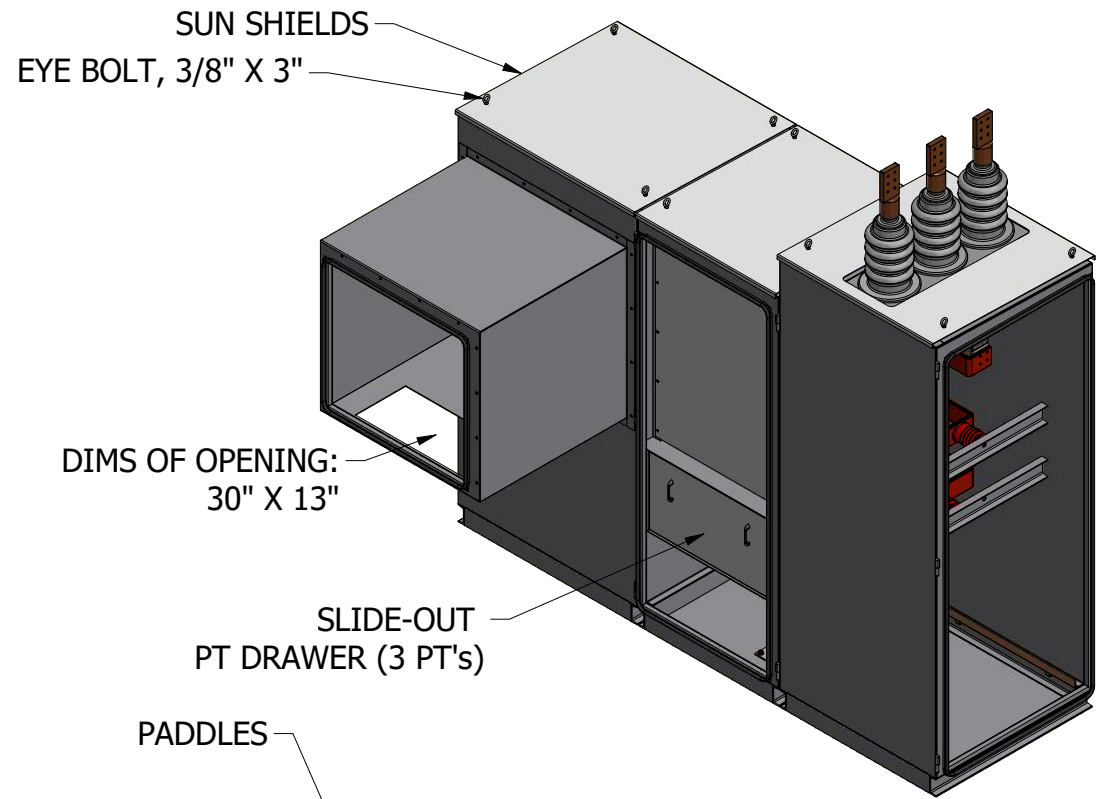
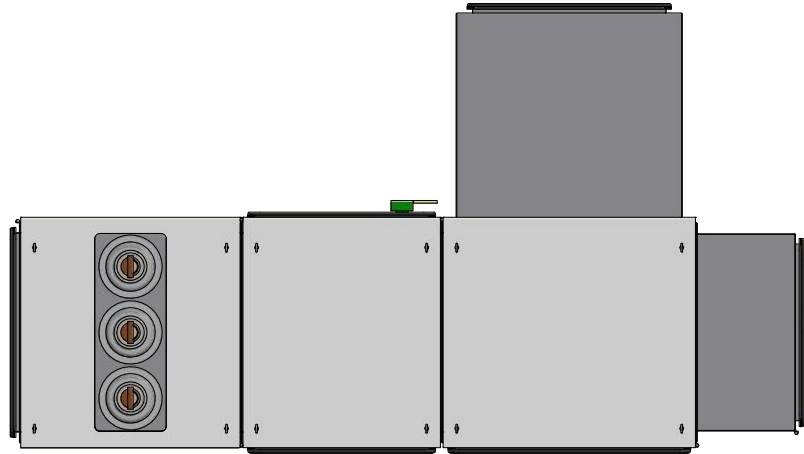
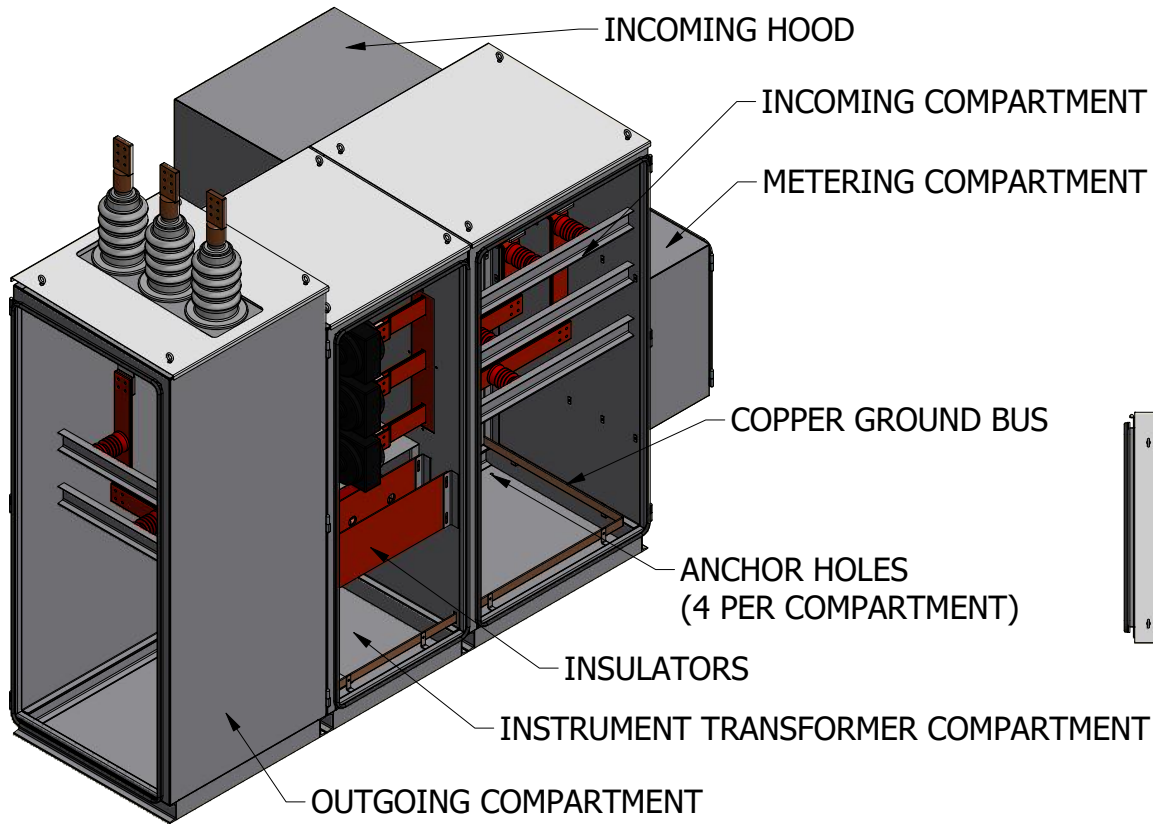
Applicable Tag#: 126-FXVLY-B0-JIT-01, 127-PIAPT-B0-JIT-01, 128-GRSSY-B0-JIT-01



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Supplier Rev.	Rev Date DD-MMM-YYYY	Reason for Issue	Supplier Name
0	22-Jun-2020	First Issue with Referbishment Update	Shermco Industries



ISSUED FOR
CONSTRUCTION

DOORS AND COVERS
REMOVED FOR CLARITY

126-FXVLY-B0-JIT-01
127-PIAPT-B0-JIT-01
128-GRSSY-B0-JIT-01

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MANUFACTURE	DRAWN	DESIGNED
KS	HW	BT
	2020-06-08	2020-06-08
CHECKED	APPROVED	CLIENT APPD.
BT	BT	
APPROX. WEIGHT	N/A	
SCALE		
PROJECT NO.	20-T262-1082	

CLIENT	TRANSCANADA PIPELINE	
TITLE	KEYSTONE XL PIPELINE MV METERING CABINET GENERAL LAYOUT - NO DOORS	
DWG. NO.	T262R-475-13-02	

REV
3

Document Title: Keystone XL Pipeline MV Metering Cabinet

Footprint Layout

Document Number: 25472-101-V2A-EMM0-W0010

Revision Number: 0

PO Number: 4500249594

Material Requisition Number: 06, 07, & 08 EA

Applicable Tag#: 126-FXVLY-B0-JIT-01, 127-PIAPT-B0-JIT-01, 128-GRSSY-B0-JIT-01

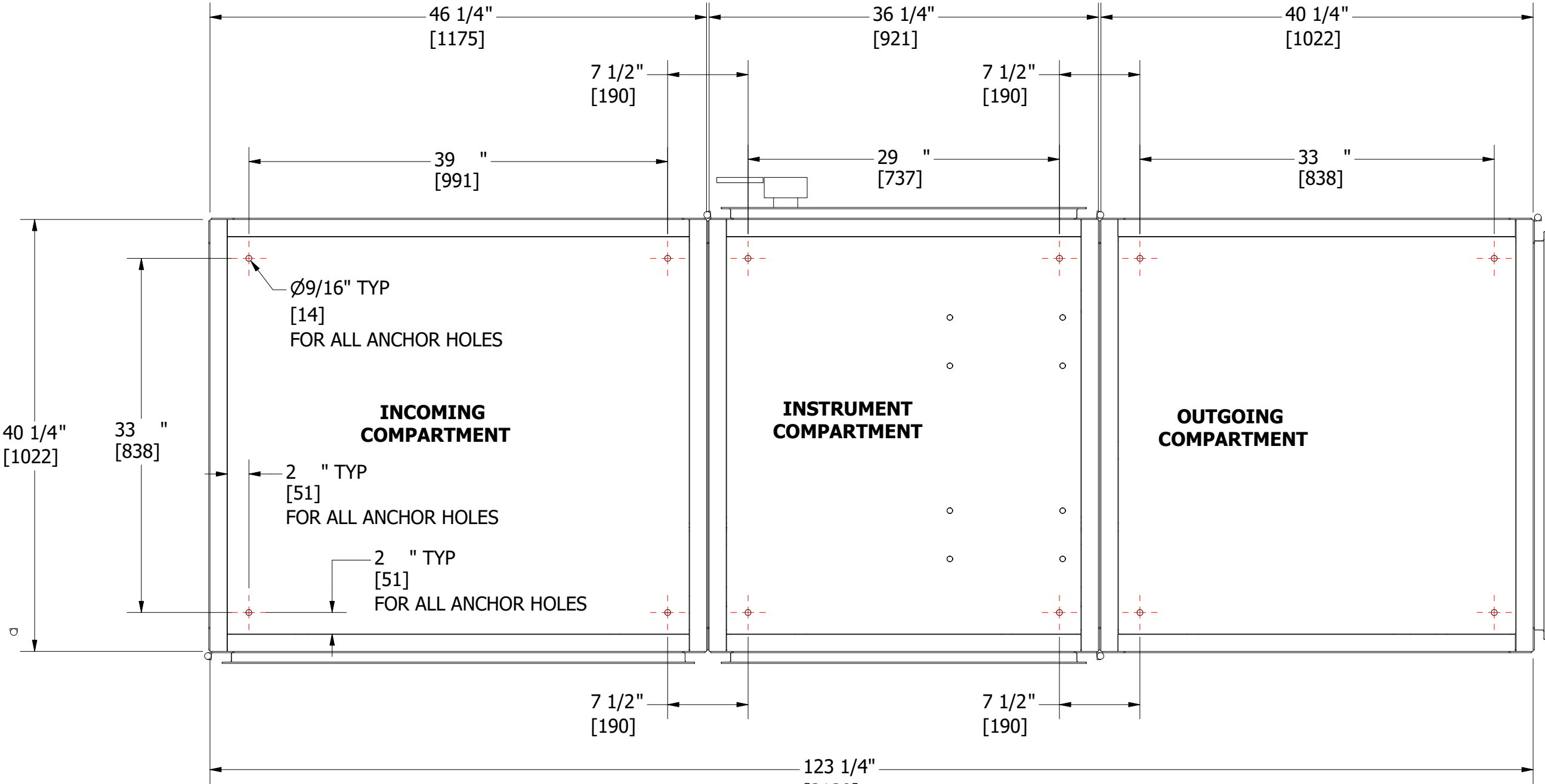


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Supplier Rev.	Rev Date DD-MMM-YYYY	Reason for Issue	Supplier Name
0	22-Jun-2020	First Issue with Referbishment Update	Shermco Industries

NOTE:
ALL OTHER COMPONENTS HIDDEN
TO ONLY SHOW FOOTPRINT



BOTTOM VIEW
SCALE 3/32



MANUFACTURE	DRAWN	DESIGNED
KS	HW	BT
	2020-06-08	2020-06-08
CHECKED	APPROVED	CLIENT APPD.
BT	BT	
APPROX. WEIGHT	N/A	
SCALE		
PROJECT NO.	20-T262-1082	

CLIENT	TRANSCANADA PIPELINE	
TITLE	KEYSTONE XL PIPELINE MV METERING CABINET FOOTPRINT LAYOUT	
DWG. NO.	T262R-475-13-03	



Document Title: Keystone XL Pipeline MV Metering Cabinet

General Layout – Neutral Bus

Document Number: 25472-101-V2A-EMM0-W0011

Revision Number: 0

PO Number: 4500249594

Material Requisition Number: 06, 07, & 08 EA

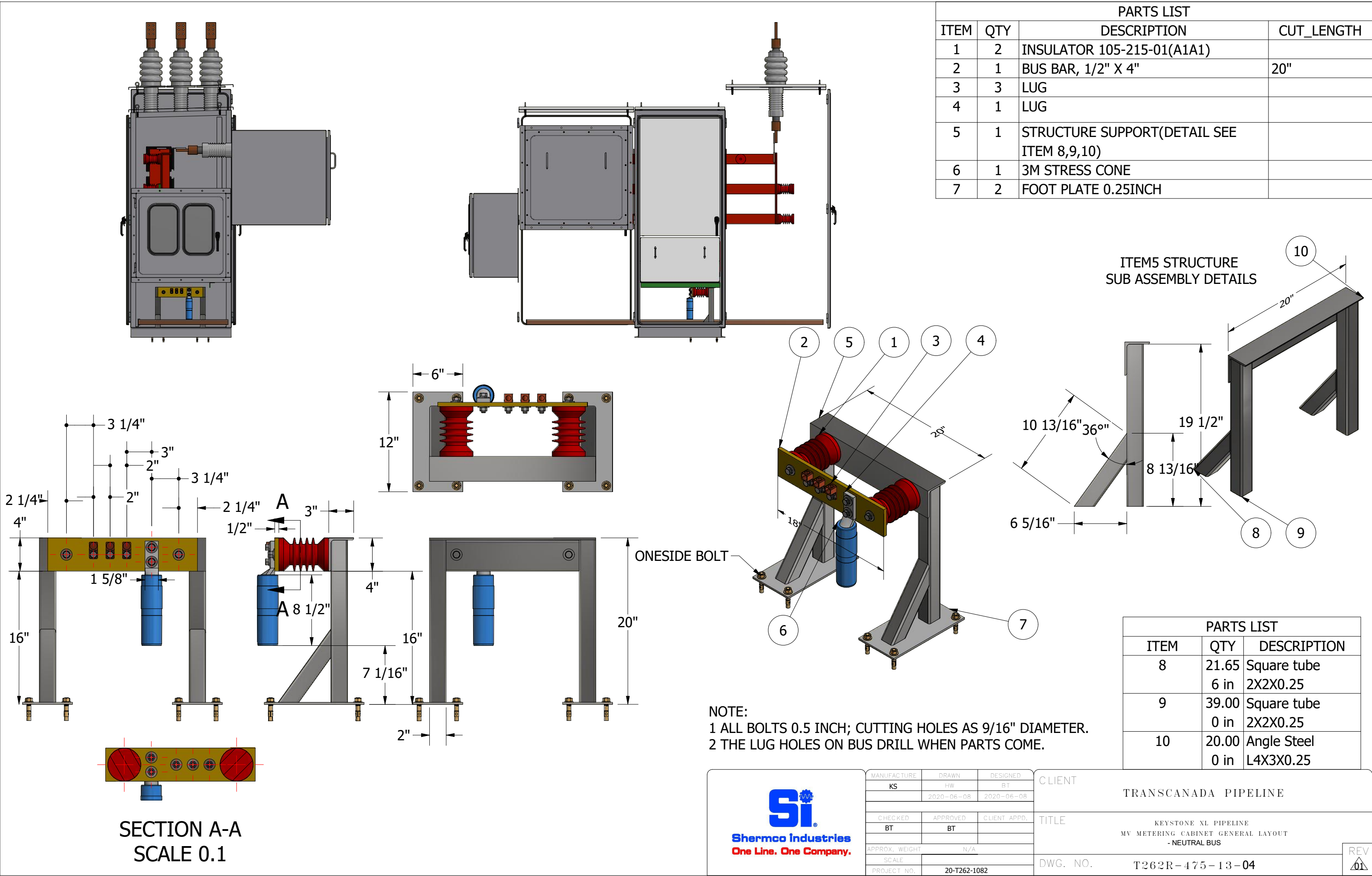
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Supplier Rev.	Rev Date DD-MMM-YYYY	Reason for Issue	Supplier Name
0	22-Jun-2020	First Issue with Referbishment Update	Shermco Industries



Document Title: Keystone XL Pipeline Typical MV Metering Cabinet

Bill of Materials

Document Number: 25472-101-V2A-EMM0-W0012

Revision Number: 0

PO Number: 4500249594

Material Requisition Number: 06, 07, & 08 EB

Applicable Tag#: 126-FXVLY-B0-JIT-01, 127-PIAPT-B0-JIT-01, 128-GRSSY-B0-JIT-01



Shermco Industries

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Supplier Rev.	Rev Date DD-MMM-YYYY	Reason for Issue	Supplier Name
0	22-Jun-2020	First Issue with Referbishment Update	Shermco Industries



Keystone XL Pipeline Typical MV Metering Bill of Material

TC Energy

Shermco Doc No: T262R-475-13-05

TC Energy Doc No: 25472-101-V2A-EMMO-W0012

PO No: 4500249594

Date: June.22/2020

MATERIAL			
ITEM NO.	DESCRIPTION/MANUFACTURE	CATALOG/MODEL NUMBER	QTY
1	Custom made enclosures – MEC Fab Shop	MEC-MVMC-12	1
2	Current Transformers (Utility Supplied)	TBD	1
3	Potential Transformers (Utility Supplied)	TBD	1
4	ABB Test Block	774B430G20	1
5	4" x ¼" tin plated copper bus bar	N/A	1
6	15 kV epoxy insulators	150-215-09	1
7	15 kV insulating boots	N/A	1
8	15 kV porcelain bushings – 4000 Amp rated	N/A	1
9	6 hole NEMA pattern lugs – 4000 Amp rated	N/A	1
10	PT drawer	TBD	3
11	4' x 8" x ¼" glastic sheet	N/A	1
12	13 jaw meter socket	CSE TSU13	1
13	Heatrex 125V 250W space heaters	565004	1
14	Honeywell thermostats	CT410A1001	1
15	100M roll of #10 SIS switchboard Wire	6KL-1001F-09	1
16	100M roll of #14 SIS switchboard Wire	6KL-1401F-10	1
17	Mis shop supplies and grade 8 hardware	N/A	1
18	#8 PT cable 7500 Volt 150 degree C	NB0802B-02	1
19	3M 15 kV bus bar insulation	BBI-7A	1
20	2" x ¼" tin plated ground busbar	N/A	1
21	Ground ball stud	HTG21721	1
22	Ball stud cover	SAL21236	1
23	15 kV epoxy insulators	105-215-01 (A1A1)	2
24	4" x ½" tin plated copper bus bar	N/A	1
25	Burndy Aluminum Set Screw Lug, 14-2 AWG	KA2U	3
26	Steel Footplate, ¼"	N/A	2
27	Square tube steel, 2"x ¼" x 12"	N/A	2
28	Square tube steel, 2"x ¼" x 20"	N/A	2
29	Angle Steel Plate, 3" x ¼" x 20"	N/A	1
30	Superior Interlock–Transfer Interlock (B-1088)	S105662YOD	1

Document Title: Grassy Creek Signed ITP – [Metering Cabinet (MC) Ready
for Service – Inspection and Test Plan (RFS-ITP)]

Document Number: 25472-101-V2A-EMM0-W0015

Revision Number: 1

PO Number: 4500249594

Material Requisition Number: 08 VX

Applicable Tag#: 128-GRSSY-B0-JIT-01



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Canada, S4K 0A2
(306) 949-8131

Supplier Rev.	Rev Date DD-MMM-YYYY	Reason for Issue	Supplier Name
0	27-Aug-2020	First Issue	Shermco Industries
1	3-Sept-2020	Minor Edits	Shermco Industries



TC Energy
Keystone XL Pipeline – Grassy Creek Metering Cabinet Refrurbishment ITP & Test Data
20-T262-1082
Revision 0

Prepared By:
Brad Temple, EIT
Electrical Engineer

Shermco Industries Canada Inc.
1033 Kearns Crescent
P.O. Box 995
Regina, Saskatchewan S4P 3B2
Telephone: (306) 949-8131 Fax: (306) 522-918

Contents

Inspection & Test Plan

Photos

Potential Transformer Tests

Current Transformer Tests

Test Sheets – Inspection & Test Plan

Test Equipment - Calibration Certificates

Inspection & Test Plan

Prepared By:

Prepared for:



Project Information:

Project Reference:

20-T262-1082

Project Title:

TC Energy Keystone XL (KXL) Pipeline

Document Title:

**MV Metering Cabinet (MC)
Ready for Service – Inspection & Test Plan (RFS-ITP)**

1	29June2020	Updated as per TC's mark-ups/comments	BT	TH	TH
0	15June2020	First Issue	BT	TH	TH
Rev	Date	Description	By	Checked	Approved
Division Shermco Engineering - Regina		Orig. Author/Department Brad Temple / Engineering	Project/Bid No. 20-T262-1082		
Document Title MV Metering Cabinet (MC) - Ready for Service – Inspection & Test Plan (RFS-ITP)		TC Energy Document No. 25472-101-V2A-EMM0-W0001	Shermco Document No. T262-1082-TCP-MC-RFSITP		Rev 1

Grassy Creek

Table Of Contents

1.	Recommendations and Scope	2
2.	Definitions	2
3.	List of Applicable Stations	3
4.	Inspection and Test Plan Matrix	4

1. Recommendations and Scope

Each cabinet has been refurbished based on the previously identified deficiencies documented in each individual report. The following document details the recommended "Ready for Service – Inspection & Test Plan" (RFS-ITP) that would be executed at the storage facility prior to handing the cabinets over to TC-Energy's pre-commissioning team.

Details of each of the processes and procedures can be found within Section-4 "MV Metering Cabinet Inspection and Test Plan Matrix". The Metering Cabinet(s) are not permitted to be placed into service until all "Acceptance Criteria" is met in Section-4.

2. Definitions

Definitions defined within the Inspection and Test Plan Matrix on the following pages:

Test Definitions:

CWT	Customer Witness Test	(Specific testing process completed with customer present)
FAT	Factory Acceptance Test	(Internal testing performed by the individual equipment supplier at their factories)
SAT	Site/Storage Acceptance Test	(Specific testing process completed at the site or storage facility)

Status Point Definitions:

H	Hold Point	(Inspection or testing point required)
R	Review Point	(Review of record/certificate only)
S	Surveillance Point	(Random attendance, no signature required)
W	Witness Point	(Attendance expected & signature to proceed only if in attendance)

3. List of Applicable Stations

Table-1 below shows the applicable stations that contain the metering cabinets (along with the quantity of motors/pumps used at that station) along with any status comments.

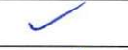
TABLE-1

#	Station Name	Station Country	Station Province/State	Number of Motors/Pumps (after expan.)	Comments/Station Status
1	PS-1 Hardisty B (for EES-10)	Canada	Alberta	3	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
2	PS-1 Hardisty B (for EES-11)	Canada	Alberta	3	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
3	PS-2 Lakesend East	Canada	Alberta	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
4	PS-3 Monitor South	Canada	Alberta	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
5	PS-4 Oyen South	Canada	Alberta	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
6	PS-5 Blindoss South	Canada	Alberta	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
7	PS-6 Fox Valley	Canada	Saskatchewan	5	Shermco – Regina Service Center, Regina, SK
8	PS-7 Piapot	Canada	Saskatchewan	5	Shermco – Regina Service Center, Regina, SK
9	PS-8 Grassy Creek	Canada	Saskatchewan	5	Shermco – Regina Service Center, Regina, SK
10	PS-9 Phillips	United States	Montana	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
11	PS-10 Valley	United States	Montana	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
12	PS-11 Fort Peck	United States	Montana	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
13	PS-12 Circle	United States	Montana	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
14	PS-13 Prairie	United States	Montana	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
15	PS-14 Fallon	United States	Montana	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
16	PS-15 Harding	United States	South Dakota	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
17	PS-16 Buffalo	United States	South Dakota	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
18	PS-17 Faith	United States	South Dakota	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
19	PS-18 Haakon	United States	South Dakota	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
20	PS-19 Murdo	United States	South Dakota	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
21	PS-20 Winner	United States	South Dakota	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
22	PS-21 Colome	United States	South Dakota	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
23	PS-22 O'Neill (orig Atkinson)	United States	Nebraska	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
24	PS-23 Oakdale (orig Ericsson)	United States	Nebraska	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
25	PS-23B Leigh	United States	Nebraska	3	New Station being added, no RFS-ITP
26	PS-24 Bellwood (orig Fullerton/Central City)	United States	Nebraska	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
27	PS-25 Milford (orig Fairmont/Exter)	United States	Nebraska	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
28	PS-26 Steele City B	United States	Nebraska	5	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
29	PS-27 Riley	United States	Kansas	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
30	PS-29 Burns	United States	Kansas	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
31	PS-32 Cushing South	United States	Oklahoma	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
32	PS-33 Cromwell	United States	Oklahoma	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
33	PS-34 Tupelo	United States	Oklahoma	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
34	PS-35 Bryan	United States	Oklahoma	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
35	PS-36 Delta	United States	Texas	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
36	PS-37 Winnsboro	United States	Texas	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
37	PS-38 Lake Tyler	United States	Texas	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
38	PS-39 Lufkin	United States	Texas	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
39	PS-40 Corrigan	United States	Texas	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP
40	PS-41 Liberty	United States	Texas	4	No substation equipment at this site, no MV Metering Cabinet RFS-ITP

4. MV Metering Cabinet Inspection and Test Plan Matrix

Project Information:		Representative Sign-off:		Customer Representative Sign-off:	
Project Name:	Metering cabinet Refurbishment	Name:	Brad Temple	Name:	
Project #:	20-T262-1082	Title:	Junior Engineer (EIT)	Title:	
Customer Project #:	4500249594	Date:	July 31st / 2020	Date:	
Pump Sta. #/Name:	Garassy Creek (PS08)	Signature:	<i>[Signature]</i>	Signature:	
MC Tag# & Serial#:	128-GRSSY-30-JIT-01				

Legend (for "Type" and "Verification Point")										
Test Type:		CWT=Customer Witness Point		SAT=Storage Acceptance Test		FAT=Factory Acceptance Test				
Verification Point:		H=Hold Point		R=Review Point		S=Surveillance Point		W=Witness Point		
Item #	Verification/Test Activity	Type			Acceptance Criteria			Verify Point		
		SAT	FAT	CWT	Requirement	Acceptance/NA/Comment		Shermco	Customer	Cust 3rd
"I" Indicates complete and accepted "NA" indicates not applicable Comments struck through (ex. Comment) indicates a comment that has been resolved										
TC Energy Keystone XL Project –MV Metering Cabinet (MC) RFS-ITP Processes										
1.0 MV Metering Cabinet (MC) RFS-ITP Process 1: Physical/Mechanical Inspection & Refurbishment Activities (Executed at storage facility)										
1.1	Compare unit's nameplate with drawings/specification.	X			Verify that the information on the nameplate matches what is required from the specification.			H	RS	
1.2	Inspect the physical and mechanical condition of each compartment in the metering cabinet. - Termination points - Opening/Closing of cabinet doors - Push/Pull of instrument transformer drawers - Condition of the buses & insulated surfaces - Condition of grounding connections - Condition of shorting connections	X			Ensure that no grounding or shorting connections will not be problematic and will work as intended. Validate no physical abnormalities exist. Where abnormalities are identified, photos shall be taken for record and engineering review. Ensure the deficiencies noted from the previous inspection reports have been repaired.	Refer to inspection report to view the previously noted deficiencies. Tray Door latches fixed		H	RS	
1.3	Clean the meter cabinet. - Vacuum and wipe all compartments. - Wipe (dry rag) all insulation surfaces. Use of denatured alcohol is permitted if dry rag cannot clean insulation surfaces. - Contacts or any current carrying surfaces should be cleaned with an abrasive cloth or fine Scotch-Brite product in combination with an approved contact cleaner and contact lubricator.	X			Validate the unit is clean. - No unnecessary debris - No buildup of dirt, soil, sand, or soot is allowed inside any of the compartments	Do not use any solvents that may leave residue afterwards. 		H	RS	
1.4	Install and test functional operation of the kirk-key interlock system. Clean up any mess caused from installation.	X			Verify that the metering cabinet doors cannot open unless the kirk-key interlock system allows the metering cabinet doors to open.			H	RS	

1.5	Install, modify, and function test Terminal Block TB1 as per the wiring diagram. Clean up any mess caused from installation/modification.	X		Verify that the installation is correct as per the wiring diagram and that any future interconnections can be made. Ensure the receptacle wiring is modified as per the wiring diagram. Take a photo after installation & modifications are completed.	For 127-PIAPT-BO-JIT-01 & 128-GRSSY-BO-JIT-01, ensure the barrier is placed between the UPS and normal power sources on the TB1 terminal block. For 127-PIAPT-BO-JIT-01 & 128-GRSSY-BO-JIT-01, affix lamacoid tags saying "WARNING THIS CABINET CONTAINS MULTIPLE POWER SOURCES" to the cabinet doors at a suitable height to be seen.	H	RS		
1.6	Install the Isolated Neutral Bus Bar as per the wiring diagram and general assembly drawings. Clean up any mess caused from installation.	X		Verify that the installation is correct as per the wiring diagram and general assembly drawings. Take a photo after installation is completed.		H	RS		
1.7	Compare Current Transformer nameplate data with drawings and specifications.	X		Verify that the information on the nameplate matches what is required from the specification. Ensure the turns ratio on the nameplate matches the specification.		H	RS		
1.8	Inspect the physical condition of each Current Transformer. - Condition of termination points - Condition of the case - Condition of wires - Mounting and alignment of each unit in the instrument drawer	X		Validate no physical abnormalities exist. Where abnormalities are identified, photos shall be taken for record and engineering review. Verify that adequate clearances exist between primary and secondary wires.		H	RS		
1.9	Check that the connections for each current transformer are correct. Reference design drawings and specification documents.	X		Verify that the connections are correct, and that intended CT ratio will be used.		H	RS		
1.10	Check the tightness of all bolted electrical connections related to the Current Transformers.	X		Verify that no loose connections exist.		H	RS		
1.11	Compare Potential Transformer nameplate data with drawings and specifications.	X		Verify that the information on the nameplate matches what is required from the specification. Ensure the turns ratio on the nameplate matches the specification.		H	RS		
1.12	Inspect the physical condition of each Potential Transformer. - Condition of termination points - Condition of the case - Condition of wires - Mounting and alignment of each unit in the instrument drawer	X		Validate no physical abnormalities exist. Where abnormalities are identified, photos shall be taken for record and engineering review. Verify that adequate clearances exist between primary and secondary wires.		H	RS		
1.13	Check that the connections for each Potential Transformer are correct. Reference design drawings and specification documents.	X		Verify that the connections are correct, and that intended turns ratio will be used.		H	RS		
1.14	Check the tightness of all bolted electrical connections related to the Potential Transformers.	X		Verify that no loose connections exist.		H	RS		
1.15	Inspect the physical condition of the Power Meter Socket. - Visibly shorted connections - Visibly grounded - Condition of the case/enclosure - Condition of the meter connections - Condition of wires - Condition of test switches - Mounting and alignment	X		Validate no physical abnormalities exist. Where abnormalities are identified, photos shall be taken for record and engineering review.		H	RS		

General Comments to Section 1.0

- Any refurbishment activities that require bolted connections need to be appropriately torqued. Apply torque marks when confirmed proper torque to bolt.
 - Attach bolt torque reports to the final/filled-out ITP
- This procedure is to be completed in full before any electrical testing is to take place.

loose parts shipping list

-Antenna

- Touch up paint (1 Quart)
- 1 spare insulation block for PT connector

Parts need replacing

- Incoming C-Phase insulating boot ~~was~~ cracked
- PT Fiberglass stabs holder broken

Notes

Torqued to 75 lbs

Parts Replaced

- Insulating Boot (Phase C)
- Insulation block for PT connector

Legend (for "Type" and "Verification Point")												
Test Type:		CWT=Customer Witness Point			SAT=Storage Acceptance Test			FAT=Factory Acceptance Test				
Verification Point:		H=Hold Point			R=Review Point			S=Surveillance Point				
								W=Witness Point				
Item #	Verification/Test Activity	Type			Acceptance Criteria				Verify Point			
		SAT	FAT	CWT	Requirement	Acceptance/NA/Comment			Shermco	Customer	Cust 3 rd	Factory
					"X" Indicates complete and accepted "NA" indicates not applicable Comments struck through (ex. Comment) indicates a comment that has been resolved							
TC Energy Keystone XL Project –MV Metering Cabinet (MC) RFS-ITP Processes												
2.0 MV Metering Cabinet (MC) RFS-ITP Process 2: Electrical Testing (Executed at storage facility)												
2.1	Perform a ductor/contact-resistance tests on each bus bar.	X			Verify that the test value for each bus is less than 10μΩ.	Test resistance values above 10μΩ will be further examined. Reasons for poor test results could be, - Loose Connections - Improper tension on bolted joints - Eroded contact surfaces - Contaminated or corroded contacts			H	RS		
2.2	Perform an insulation-resistance test of each Current Transformer. - Apply 1000V DC Primary to ground for 1 minute - Apply 1000V DC Secondary to ground for 1 minute	X			Refer to ANSI/NETA ATS Table 100.5 for minimum insulation resistance values. Confirm that the test resistance value is above the minimum insulation resistance stated.				H	RS		
2.3	Perform polarity testing on each Current Transformer.	X			Verify that the polarity of the Current Transformer matches the polarity markings on the unit.				H	RS		
2.4	Perform a ratio verification test on each Current Transformer.	X			Verify that the nameplate ratio matches the test results.	Ratio error should be minimal. Refer to IEEE C57.13 or manufacturer's documentation if large error exists.			H	RS		
2.5	Perform an excitation test on each Current Transformer.	X			Verify that the Current Transformer reaches saturation during the test. Compare the test results between each Current Transformer and previous test results.	Operating and saturation (knee point) regions should be clearly identified in test results to prove accuracy rating and that no shorted windings exist. Refer to IEEE C57.13.1 or manufacturer's documentation for more information.			H	RS		
2.6	Measure the current circuit burden of each Current Transformer.	X			Verify that each burden matches the labeled transformer rating.				H	RS		
2.7	Perform a dielectric withstand test on the primary winding with the secondary grounded for each Current Transformer.	X			Apply voltage in accordance to either the manufacturer's data or ANSI/NETA ATS Table 100.9. Unit passes the test if there is no evidence of distress or insulation failure after the test is completed.	Do not proceed if any distress or insulation failure is observed as a result of the test.			H	RS		
2.8	Perform power-factor or dissipation-factor tests on each Current Transformer.	X			Confirm that power-factor or dissipation-factor values compare to the manufacturer's data.	In the absence of manufacturer data, use the test equipment manufacturer's data instead.			H	RS		

2.9	Check to see that each Current Transformer's secondary circuits are grounded.	X		Confirm that each Current Transformer's secondary circuit is grounded and that there is only one grounding point.	Refer to grounding location specified by the engineer in the project drawings. Refer to ANSI/IEEE C57.13.3. ✓	H	RS		
2.10	Perform an insulation-resistance test on each Potential Transformer. • Winding-to-winding • Winding-to-ground	X		Refer to ANSI/NETA ATS Table 100.5 for minimum insulation resistance values. Confirm that the test resistance value is above the minimum insulation resistance stated.	✓	H	RS		
2.11	Perform polarity testing on each Potential Transformer.	X		Verify that the polarity of the Potential Transformer matches the polarity markings (H1-X1 relationship) on the unit.	✓	H	RS		
2.12	Perform a ratio verification test for each tap setting on each Potential Transformer.	X		Verify that the nameplate ratios match the test results.	Ratio error should be minimal. Refer to IEEE C57.13 or manufacturer's documentation if large error exists. ✓	H	RS		
2.13	Measure the voltage circuit burden of each Potential Transformer.	X		Verify that each burden matches the labeled transformer rating.	✓	H	RS		
2.14	Perform a dielectric withstand test on the primary winding with the secondary grounded for each Potential Transformer.	X		Apply voltage in accordance to either the manufacturer's data or ANSI/NETA ATS Table 100.9. Unit passes the test if there is no evidence of distress or insulation failure after the test is completed.	Do not proceed if any distress or insulation failure is observed as a result of the test. ✓	H	RS		
2.15	Perform power-factor or dissipation-factor tests on each Potential Transformer.	X		Confirm that power-factor or dissipation-factor values compare to the manufacturer's data.	In the absence of manufacturer data, use the test equipment manufacturer's data instead. ✓	H	RS		
2.16	Check to see that each Potential Transformer's secondary circuits are grounded.	X		Confirm that each Potential Transformer's secondary circuit is grounded and that there is only one grounding point.	Refer to grounding location specified by the engineer in the project drawings. Refer to ANSI/IEEE C57.13.3. ✓	H	RS		
2.17	Perform an insulation resistance test on the isolated neutral bus bar. • Apply 1000V DC for 1 minute	X		Refer to ANSI/NETA ATS Table 100.1 for minimum insulation resistance values. Confirm that the test resistance value is above the minimum insulation resistance stated.	✓	H	RS		
2.18	Perform a ductor test on the isolated neutral bus bar.	X		Verify that the test value for each bus is less than 10μΩ.	Test resistance values above 10μΩ will be further examined. Reasons for poor test results could be, • Loose Connections • Improper tension on bolted joints • Eroded contact surfaces • Contaminated or corroded contacts ✓	H	RS		
2.19	Check to see if the heaters are functioning properly. Check the functionality of the thermostats.	X		Verify that they can be energized and produce heat. Verify that the thermostats are operational.	Heaters should turn on when the thermostat set point is below ambient temperature. Heaters should turn off when the thermostat set point is above ambient temperature. ✓	H	RS		

General Comments to Section 2.0

-If the Metering Cabinet(s) are deemed to have failed any of the Acceptance Testing Criteria, they would be considered non-serviceable

- Components will need to be refurbished or be completely replaced in attempt to pass the Acceptance Testing Criteria.
- Once components have been refurbished/replaced, retest the Metering Cabinet(s) with the same procedure.

-Any bolted connections that were taken off for electrical testing need to be appropriately torqued when reattached. Apply torque marks when confirmed proper torque to bolt.

-As-Built drawings need to be signed/stamped.

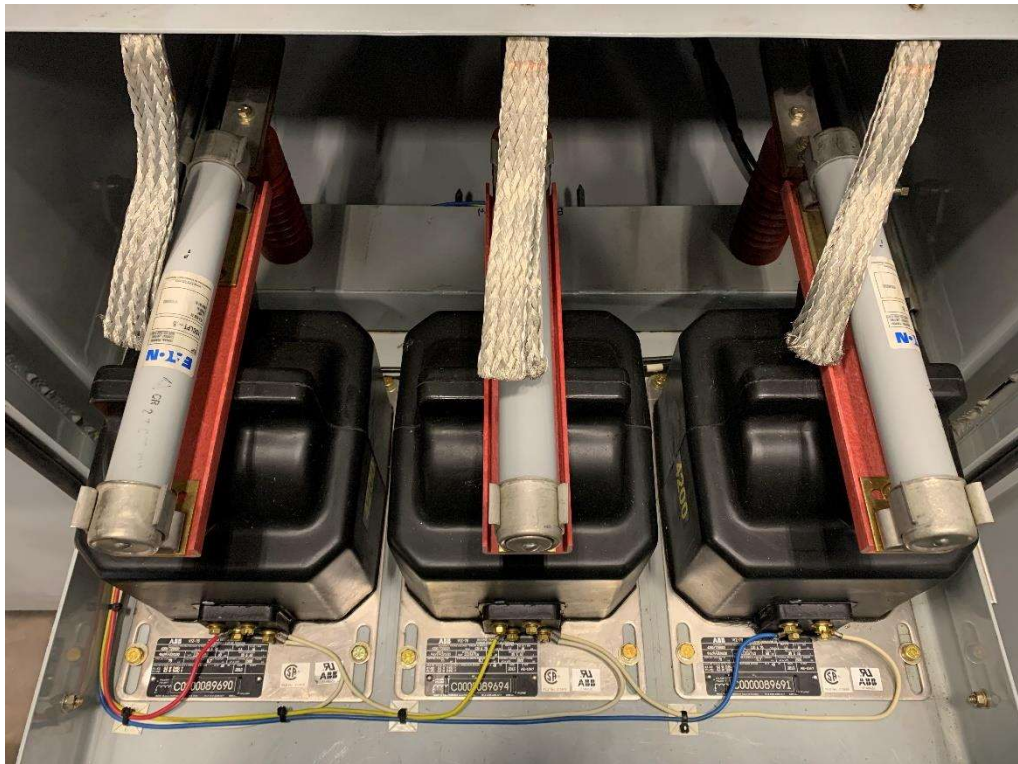
-Record all test result on test sheets and attach the final/filled-out ITP. Test equipment logs & calibration certificates to be attached too.

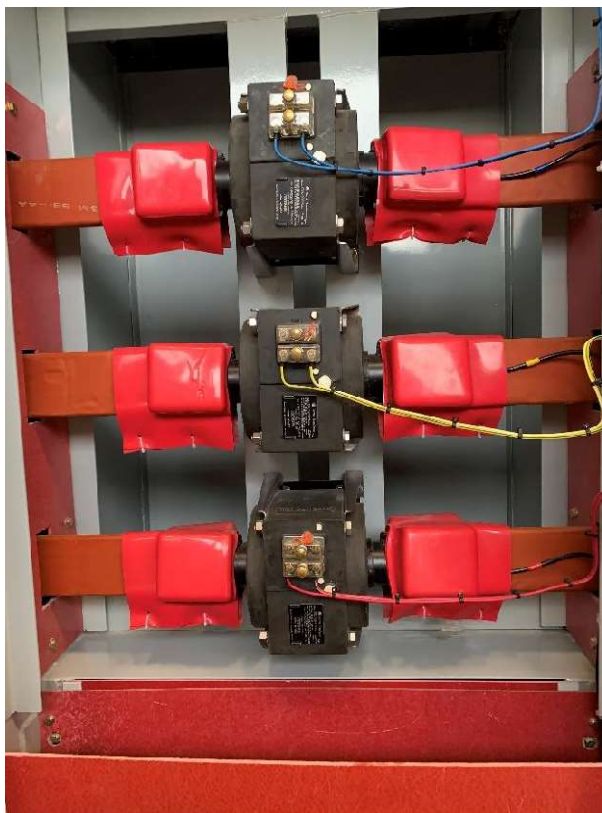
Parts Replaced
-PT fuse (Phase B)

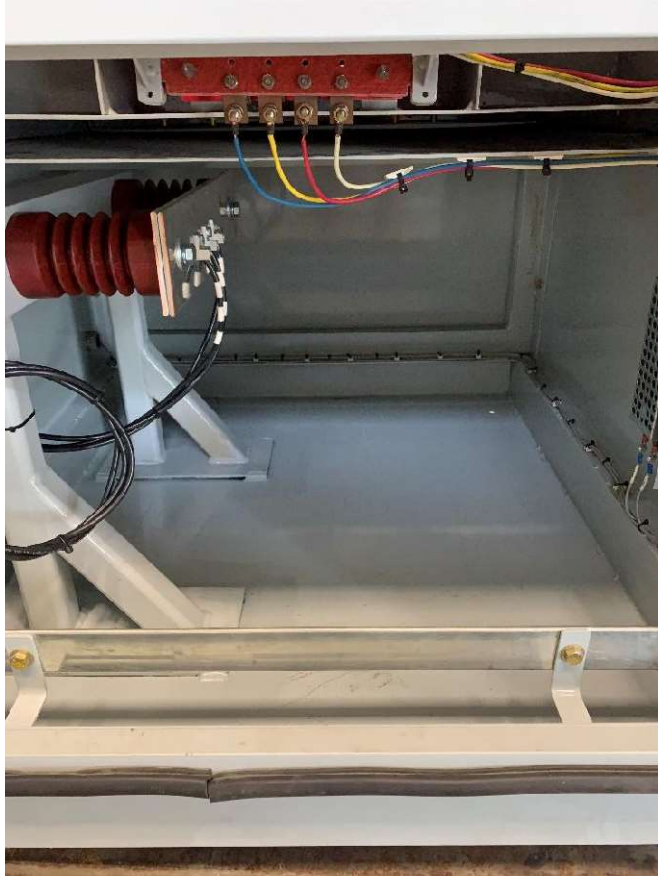
Legend (for "Type" and "Verification Point")														
Test Type:		CWT=Customer Witness Point			SAT=Storage Acceptance Test			FAT=Factory Acceptance Test						
Verification Point:		H=Hold Point			R=Review Point			S=Surveillance Point			W=Witness Point			
Item #	Verification/Test Activity	Type			Acceptance Criteria						Verify Point			
		SAT	FAT	CWT	Requirement	Acceptance/NA/Comment			Shermco	Customer	Cust 3 rd	Factory		
						"☑" Indicates complete and accepted "NA" indicates not applicable Comments struck through (ex. Comment) indicates a comment that has been resolved								
	TC Energy Keystone XL Project –MV Metering Cabinet (MC) RFS-ITP Processes													
3.0	MV Metering Cabinet (MC) RFS-ITP Process 3: Prepare for Storage (Executed at storage facility)													
3.1	Have a CSA Inspection done on the Metering Cabinet.	X			The metering cabinet needs to comply with CSA standards. The CSA inspector will provide a certificate/permit. That certificate/permit needs to demonstrate that the metering cabinet is "CSA Approved".	✓			H	RS				
3.2	Determine where the Metering Cabinet is going to be stored. Create a moving plan on how each Metering Cabinet will be moved safely to the storage location outside.	X			Communicate moving plan to team members.	✓			H	RS				
3.3	Use a lift-truck/crane to move the Metering Cabinet outside for storage.	X			Ensure the storage location is accessible to temporary power. Temporary power is needed to run the heaters.	✓			H	RS				
3.4	Connect temporary power to enable the heaters.	X			Verify that the heaters are operational at the storage location.	✓			H	RS				
General Comments to Section 3.0														
-Proceed with Section 3.0 when section 1.0 & 2.0 are completed.														
-Metering Cabinets are to remain in storage until further notice.														
-While in storage monthly inspections need to be performed and documented.														
- Check the heaters - General visual inspection														
-Prepare shipment and include applicable documentation (MSDS, Storage/Installation/Maintenance manuals, ect) when each unit is requested to be shipped.														
-Record all test result on test sheets and attach the final/filled-out ITP. Test equipment logs & calibration certificates to be attached too.														

----- End of Document -----

Photos









VOLTAGE RATING - 6.9kV
CURRENT RATING - 3000A
FREQUENCY - 60Hz

PROJECT NUMBER - 20-T262R-477
EQ SPEC - 25742-101-3PS-3M00 W0001
MANUFACTURE DATE - 01/2013
SERIAL NO. - 12477-01

SOLD TO: TRANSCANADA
KEYSTONE PIPELINE
LIMITED PARTNERSHIP
STATION: PS-3 GRASSY CREEK



MANUFACTURED IN REGINA, SK. CANADA



Potential Transformer Tests



Report Source PotentialTransformer**Session Test Date** 28-Jul-20 1:02:00 PM**Nameplate - Voltage Transformer**

Company	TCE	Serial Number	11316712
Location	GRASSY CREEK	Special ID	C0000089690
Division		Circuit Designation	PHASE A
Manufacturer	ABB (ASEA-Brown Boveri)	Class	
Year Manufactured	2013	Type	PotentialTransformer
Mfr Location	USA	Insulation Type	
Catalog/Style	9629A02G30	Weight	*
Impedance	*	BIL	75 kV
Oil Volume	*	VA Rating	1500
kV	4.2,0.12,0.07		

Administration

Test Date	28-Jul-20	Test Time:	1:02 PM	Weather	Indoors
Air Temperature	25.9°C	Apparatus Temperature	26°C	Humidity	35.983 %
Tester	Thomas Sawchyn	Work Order		Date Last Tested	28-Jul-20
Verified		Test Set Type	M4100	Date Retested	
Verification Date		Set Top Serial #	11120768	Reason	
Last Sheet #		Test Set Model	M4100	Travel Time	
Purchase Order		Ins. Book #		Duration	
Copies		Sheet #		Crew Size	

Overall Tests

Insulation System	Test kV	mA	Watts	Corr. Fr	PF [%]	PF*TCF [%]	Cap (pF)	FRANK™	Manual
CH1+CH2+CHX+CHY	4.198	1.927	0.775	1	4.065	4.065	510.677	Good	Good
CH1+CH2+CHX+CHY	1.999	1.921	0.725	1	3.797	3.797	509.145	Good	Good
CH1+1/2*(CHX+CHY)	4.199	0.398	0.261	1	6.489	6.489	105.451	Good	Good
CH2+1/2*(CHY+CHX)	4.199	1.523	0.442	1	2.889	2.889	403.812	Good	Good
lex	4.199	42.675	262.917	1	61.609	61.609	-8918.360	Good	Good
lex	4.198	42.666	262.863	1	61.609	61.609	-8915.391	Good	Good

Supplemental Tests

Insulation System	Test kV	mA	Watts	Corr. Fr	PF [%]	PF*TCF [%]	Cap (pF)	FRANK™	Manual
CHX	*	*	*	*	*	*	*		
CHY	*	*	*	*	*	*	*		
CH1	*	*	*	*	*	*	*		
CH2	*	*	*	*	*	*	*		



Report Source PotentialTransformer**Session Test Date** 28-Jul-20 12:48:18 PM**Nameplate - Voltage Transformer**

Company	TCE	Serial Number	11316716
Location	GRASSY CREEK	Special ID	C0000089694
Division		Circuit Designation	PHASE B
Manufacturer	ABB (ASEA-Brown Boveri)	Class	
Year Manufactured	2013	Type	PotentialTransformer
Mfr Location	USA	Insulation Type	
Catalog/Style	9629A02G30	Weight	*
Impedance	*	BIL	75 kV
Oil Volume	*	VA Rating	1500
kV	4.2,0.12,0.07		

Administration

Test Date	28-Jul-20	Test Time:	12:48 PM	Weather	Indoors
Air Temperature	26.6°C	Apparatus Temperature	26°C	Humidity	35.495 %
Tester	Thomas Sawchyn	Work Order		Date Last Tested	28-Jul-20
Verified		Test Set Type	M4100	Date Retested	
Verification Date		Set Top Serial #	11120768	Reason	
Last Sheet #		Test Set Model	M4100	Travel Time	
Purchase Order		Ins. Book #		Duration	
Copies		Sheet #		Crew Size	

Overall Tests

Insulation System	Test kV	mA	Watts	Corr. Fr	PF [%]	PF*TCF [%]	Cap (pF)	FRANK™	Manual
CH1+CH2+CHX+CHY	4.198	1.794	0.766	1	4.297	4.297	475.471	Good	
CH1+CH2+CHX+CHY	2.000	1.789	0.718	1	4.023	4.023	474.193	Good	
CH1+1/2*(CHX+CHY)	4.199	0.404	0.268	1	6.565	6.565	106.891	Good	
CH2+1/2*(CHY+CHX)	4.199	1.383	0.411	1	2.961	2.961	366.588	Good	
lex	4.199	42.668	262.943	1	61.625	61.625	-8910.620	Good	
lex	4.199	42.652	262.915	1	61.642	61.642	-8904.841	Good	

Supplemental Tests

Insulation System	Test kV	mA	Watts	Corr. Fr	PF [%]	PF*TCF [%]	Cap (pF)	FRANK™	Manual
CHX	*	*	*	*	*	*	*		
CHY	*	*	*	*	*	*	*		
CH1	*	*	*	*	*	*	*		
CH2	*	*	*	*	*	*	*		



Nameplate - Voltage Transformer

Company	TCE	Serial Number	11316713
Location	GRASSY CREEK	Special ID	C0000089693
Division		Circuit Designation	PHASE C
Manufacturer	ABB (ASEA-Brown Boveri)	Class	
Year Manufactured	2013	Type	PotentialTransformer
Mfr Location	USA	Insulation Type	
Catalog/Style	9629A02G30	Weight	*
Impedance	*	BIL	75 kV
Oil Volume	*	VA Rating	1500
kV	4.2,0.12,0.07		

Administration

Test Date	28-Jul-20	Test Time:	11:37 AM	Weather	Indoors
Air Temperature	25.1°C	Apparatus Temperature	25°C	Humidity	35.983 %
Tester	Thomas Sawchyn	Work Order		Date Last Tested	28-Jul-20
Verified		Test Set Type	M4100	Date Retested	
Verification Date		Set Top Serial #	11120768	Reason	
Last Sheet #		Test Set Model	M4100	Travel Time	
Purchase Order		Ins. Book #		Duration	
Copies		Sheet #		Crew Size	

Overall Tests

Insulation System	Test kV	mA	Watts	Corr. Fr	PF [%]	PF*TCF [%]	Cap (pF)	FRANK™	Manual
CH1+CH2+CHX+CHY	4.199	1.834	0.781	1	4.318	4.318	486.049	Good	Good
CH1+CH2+CHX+CHY	1.999	1.828	0.722	1	3.978	3.978	484.590	Good	Good
CH1+1/2*(CHX+CHY)	4.191	0.436	0.592	1	5.382	5.382	113.018	Good	Good
CH2+1/2*(CHY+CHX)	4.199	1.422	0.388	1	2.711	2.711	376.969	Good	Good
lex	4.220	42.229	268.292	1	63.532	63.532	-8650.040	Good	
lex	4.198	42.662	262.813	1	61.604	61.604	-8915.100		

I_{EX} is not critical for this test

Supplemental Tests

Insulation System	Test kV	mA	Watts	Corr. Fr	PF [%]	PF*TCF [%]	Cap (pF)	FRANK™	Manual
CHX	*	*	*	*	*	*	*		
CHY	*	*	*	*	*	*	*		
CH1	*	*	*	*	*	*	*		
CH2	*	*	*	*	*	*	*		

Current Transformer Tests



Vanguard Instruments Company, Inc.

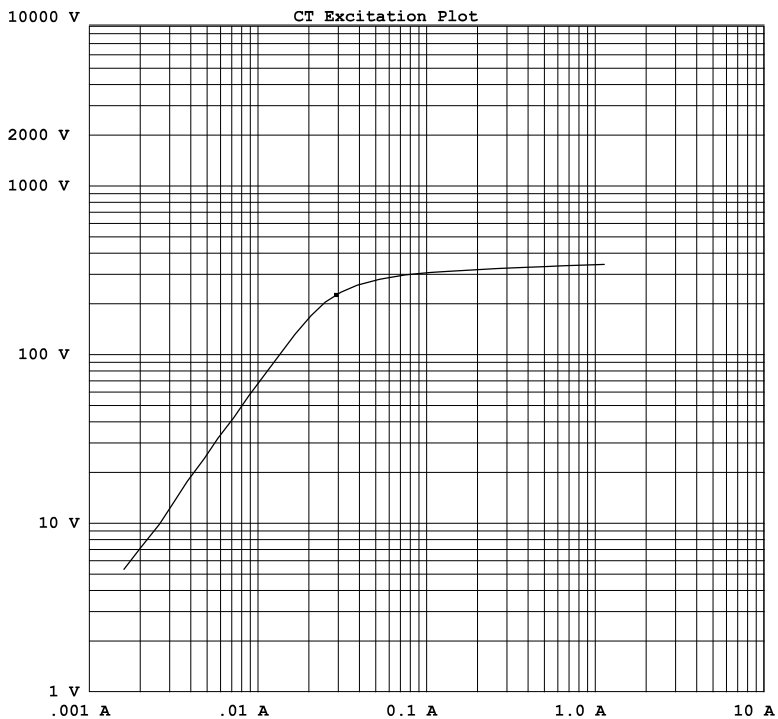
www.vanguard-instruments.com

FILENAME: Grassy Creek A Phase.plan
DATE: 07/28/20 08:49:16
COMPANY: TC Energy
STATION: Grassy Creek
CIRCUIT: Metering Cabinet A P

MFR: GE
MODEL: JCM-4
SN: 7561117
OPERATOR: BH
COMMENTS:

TEST # 1: X3-X4
TEST NOTES: Megger test: >2.2G O
KNEE TYPE: IEEE 30 Deg
FREQUENCY: 60 Hz

IEEE 30	IEEE 45	IEC 10/50	NP-RATIO: 2000/5.0	Ex V[Volts]: 157.400	Phase Angle:0.06°
Vkp[Volts]: 225.40	Vkp[Volts]: 179.16	Vkp[Volts]: 261.16	M-RATIO: 400.036	Ex I[Amps]: 0.020	In Phase
Ikp[Amps]: 0.0292	Ikp[Amps]: 0.0216	Ikp[Amps]: 0.0406	% ERROR: 0.0089	Winding Res: 665.23 milliohms	



CT DATA POINTS

POINT	CUR(A)	VTG(V)	Z(OHM)	POINT	CUR(A)	VTG(V)	Z(OHM)	POINT	CUR(A)	VTG(V)	Z(OHM)
1	0.0016	5.32	3325.00	14	0.0250	204.32	8172.80	27	0.8766	340.08	387.95
2	0.0020	7.12	3560.00	15	0.0310	234.24	7556.13	28	1.1290	343.32	304.09
3	0.0026	9.88	3800.00	16	0.0388	258.16	6653.61				
4	0.0032	13.52	4225.00	17	0.0522	279.12	5347.13				
5	0.0038	17.76	4673.68	18	0.0574	284.56	4957.49				
6	0.0048	24.20	5041.67	19	0.0742	296.52	3996.23				
7	0.0058	32.04	5524.14	20	0.0882	301.96	3423.58				
8	0.0072	42.44	5894.44	21	0.1068	307.40	2878.28				
9	0.0088	56.84	6459.09	22	0.1316	311.24	2365.05				
10	0.0110	76.60	6963.64	23	0.2616	323.72	1237.46				
11	0.0136	101.48	7461.76	24	0.3562	328.08	921.06				
12	0.0166	132.20	7963.86	25	0.4984	333.00	668.14				
13	0.0206	169.76	8240.78	26	0.6636	336.24	506.69				

GRAPH POINTS

POINT	CUR(A)	VTG(V)	Z(OHM)	POINT	CUR(A)	VTG(V)	Z(OHM)
1	0.0010	3.30	3300.00	12	0.2000	317.80	1589.00
2	0.0020	7.10	3550.00	13	0.4000	329.60	824.00
3	0.0040	19.00	4750.00	14	0.5000	333.00	666.00
4	0.0050	25.80	5160.00	15	0.8000	338.70	423.37
5	0.0080	49.60	6200.00	16	1.0000	341.70	341.70
6	0.0100	67.60	6760.00				
7	0.0200	164.10	8205.00				
8	0.0400	260.00	6500.00				
9	0.0500	275.70	5514.00				
10	0.0800	298.80	3735.00				
11	0.1000	305.40	3054.00				



FILENAME: Grassy Creek A Phase.plan

DATE: 07/28/20 08:49:16

COMPANY: TC Energy

STATION: Grassy Creek

CIRCUIT: Metering Cabinet A P

MFR: GE

MODEL: JCM-4

SN: 7561117

OPERATOR: BH

COMMENTS:

TEST # 1: X3-X4

TEST NOTES: Megger test: >2.2G O

KNEE TYPE: IEEE 30 Deg

FREQUENCY: 60 Hz

IEEE 30	IEEE 45	IEC 10/50	NP-RATIO: 2000/5.0	Ex V[Volts]: 157.400	Phase Angle:0.06°
Vkp[Volts]: 225.40	Vkp[Volts]: 179.16	Vkp[Volts]: 261.16	M-RATIO: 400.036	Ex I[Amps]: 0.020	In Phase
Ikp[Amps]: 0.0292	Ikp[Amps]: 0.0216	Ikp[Amps]: 0.0406	% ERROR: 0.0089	Winding Res: 665.23 milliohms	

CT DATA POINTS

POINT	CUR(A)	VTG(V)	Z(OHM)	POINT	CUR(A)	VTG(V)	Z(OHM)	POINT	CUR(A)	VTG(V)	Z(OHM)
1	0.0016	5.32	3325.00	14	0.0250	204.32	8172.80	27	0.8766	340.08	387.95
2	0.0020	7.12	3560.00	15	0.0310	234.24	7556.13	28	1.1290	343.32	304.09
3	0.0026	9.88	3800.00	16	0.0388	258.16	6653.61				
4	0.0032	13.52	4225.00	17	0.0522	279.12	5347.13				
5	0.0038	17.76	4673.68	18	0.0574	284.56	4957.49				
6	0.0048	24.20	5041.67	19	0.0742	296.52	3996.23				
7	0.0058	32.04	5524.14	20	0.0882	301.96	3423.58				
8	0.0072	42.44	5894.44	21	0.1068	307.40	2878.28				
9	0.0088	56.84	6459.09	22	0.1316	311.24	2365.05				
10	0.0110	76.60	6963.64	23	0.2616	323.72	1237.46				
11	0.0136	101.48	7461.76	24	0.3562	328.08	921.06				
12	0.0166	132.20	7963.86	25	0.4984	333.00	668.14				
13	0.0206	169.76	8240.78	26	0.6636	336.24	506.69				

RCF(10%)=N/A, RCF(100%)=N/A

Class B-0.1 Metering N/A Bmag=0.10, Br=0.09, Bi=0.04, Btot=0.884, Vsec(10%)=0.442, Vsec(100%)=4.422

Interpolated 100% Point not found. Point#1=not found, Point#2=found

Interpolated 10% Point not found. Point#1=not found, Point#2=found

RCF(10%)=N/A, RCF(100%)=N/A

Class B-0.2 Metering N/A Bmag=0.20, Br=0.18, Bi=0.09, Btot=0.977, Vsec(10%)=0.489, Vsec(100%)=4.887

Interpolated 100% Point not found. Point#1=not found, Point#2=found

Interpolated 10% Point not found. Point#1=not found, Point#2=found

RCF(10%)=N/A, RCF(100%)=1.000

Class B-0.5 Metering N/A Bmag=0.50, Br=0.45, Bi=0.22, Btot=1.262, Vsec(10%)=0.631, Vsec(100%)=6.312

Interpolated 100% vsec 6.312 (VtgPt1 5.32 VtgPt2 7.12) (Ipt1 0.0016 Ipt2 0.0020) I 0.0018 (PhsPt1 0.00 PhsPt2 0.00 Phs 0.00)

Interpolated 10% Point not found. Point#1=not found, Point#2=found

RCF(10%)=N/A, RCF(100%)=1.000

Class B-0.9 Metering N/A Bmag=1.00, Br=0.90, Bi=0.44, Btot=1.749, Vsec(10%)=0.874, Vsec(100%)=8.743

Interpolated 100% vsec 8.743 (VtgPt1 7.12 VtgPt2 9.88) (Ipt1 0.0020 Ipt2 0.0026) I 0.0024 (PhsPt1 0.00 PhsPt2 0.00 Phs 0.00)

Interpolated 10% Point not found. Point#1=not found, Point#2=found

RCF(10%)=N/A, RCF(100%)=1.000

Class B-1.8 Metering N/A Bmag=2.00, Br=1.80, Bi=0.87, Btot=2.736, Vsec(10%)=1.368, Vsec(100%)=13.680

Interpolated 100% vsec 13.680 (VtgPt1 13.52 VtgPt2 17.76) (Ipt1 0.0032 Ipt2 0.0038) I 0.0032 (PhsPt1 0.00 PhsPt2 0.00 Phs 0.00)

Interpolated 10% Point not found. Point#1=not found, Point#2=found



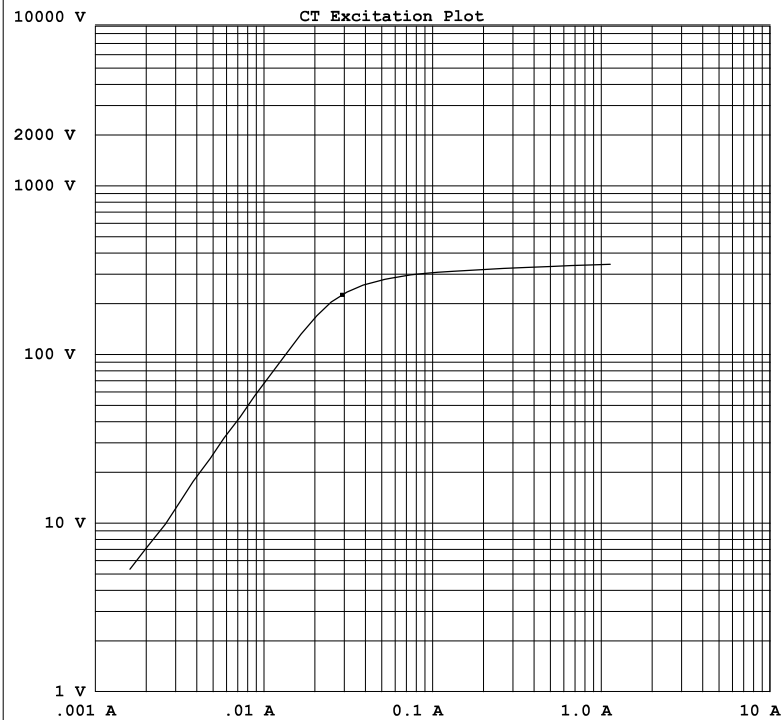
FILENAME: Grassy Creek A Phase.plan
DATE: 07/28/20 08:49:16
COMPANY: TC Energy
STATION: Grassy Creek
CIRCUIT: Metering Cabinet A P

MFR: GE
MODEL: JCM-4
SN: 7561117
OPERATOR: BH
COMMENTS:

SUMMARY REPORT
KNEE TYPE: IEEE 30 Deg
FREQUENCY: 60 Hz

Test	Tap	IEEE30 (V/I)	IEEE45 (V/I)	IEC 10/50 (V/I)	NP-Ratio	M-Ratio	% Error	Phase Angle	Winding Res
8	X3-X4	225.40/0.0292	179.16/0.0216	261.16/0.0406	2000/5.0	400.036	0.009 %	0.06° [In Ø]	665.23 m-ohms

Test Notepad



Summary Metering Class CT Report

Test terminals: X3-X4

Accuracy Class: N/A B-0.1
RCF(10%)=N/A, RCF(100%)=N/A

Accuracy Class: N/A B-0.2
RCF(10%)=N/A, RCF(100%)=N/A

Accuracy Class: N/A B-0.5
RCF(10%)=N/A, RCF(100%)=1.000

Accuracy Class: N/A B-0.9
RCF(10%)=N/A, RCF(100%)=1.000

Accuracy Class: N/A B-1.8
RCF(10%)=N/A, RCF(100%)=1.000



FILENAME: Grassy Creek A Phase.plan
DATE: 07/28/20 08:49:16
COMPANY: TC Energy
STATION: Grassy Creek
CIRCUIT: Metering Cabinet A P

MFR: GE
MODEL: JCM-4
SN: 7561117
OPERATOR: BH
COMMENTS:

TEST PLAN
TEST NOTES: Megger test: >2.2G O
KNEE TYPE: IEEE 30 Deg
FREQUENCY: 60 Hz

	Nameplate Ratio	Ratio Test	Excitation Test	Winding Res Test	Excitation Voltage (V)	Excitation Current (A)	Note
X3-X4	2000/5.0	[X]	[X]	[X]	300.00	1.00	Megger test: >2.2G O
Burden Test	[]						
Insulation Test	[]						

- Insulation test completed with Megger
- Burden test results found in "Test Sheets" section of report



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FILENAME: Grassy Creek B Phase.plan

DATE: 07/28/20 08:51:34

COMPANY: TC Energy

STATION: Grassy Creek

CIRCUIT: Metering Cabinet B P

MFR: GE

MODEL: JCM-4

SN: 7561113

OPERATOR: BH

COMMENTS:

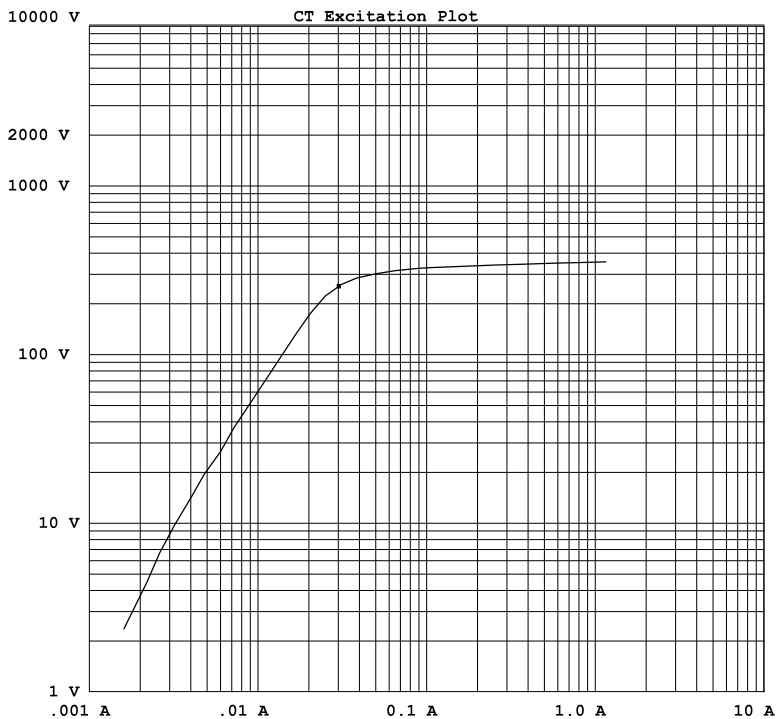
TEST # 1: X3-X4

TEST NOTES: Megger Test: >2.2G O

KNEE TYPE: IEEE 30 Deg

FREQUENCY: 60 Hz

IEEE 30	IEEE 45	IEC 10/50	NP-RATIO: 2000/5.0	Ex V[Volts]: 170.300	Phase Angle:0.04°
Vkp[Volts]: 254.24	Vkp[Volts]: 211.08	Vkp[Volts]: 271.84	M-RATIO: 399.948	Ex I[Amps]: 0.020	In Phase
Ikp[Amps]: 0.0302	Ikp[Amps]: 0.0240	Ikp[Amps]: 0.0346	% ERROR: 0.0131	Winding Res: 648.27 milliohms	



CT DATA POINTS

POINT	CUR (A)	VTG (V)	Z (OHM)	POINT	CUR (A)	VTG (V)	Z (OHM)
1	0.0016	2.36	1475.00	14	0.0250	222.28	8891.20
2	0.0022	4.48	2036.36	15	0.0314	261.44	8326.11
3	0.0026	6.64	2553.85	16	0.0388	285.12	7348.45
4	0.0032	9.72	3037.50	17	0.0506	302.52	5978.66
5	0.0040	14.12	3530.00	18	0.0644	314.48	4883.23
6	0.0048	19.48	4058.33	19	0.0758	319.92	4220.58
7	0.0060	26.64	4440.00	20	0.0914	325.36	3559.74
8	0.0072	37.00	5138.89	21	0.1068	328.64	3077.15
9	0.0088	49.92	5672.73	22	0.2552	340.08	1332.60
10	0.0110	69.80	6345.45	23	0.3966	344.40	868.38
11	0.0136	96.32	7082.35	24	0.5852	348.24	595.08
12	0.0168	132.64	7895.24	25	0.8524	352.04	413.00
13	0.0204	175.20	8588.24	26	1.1534	354.76	307.58

GRAPH POINTS

POINT	CUR (A)	VTG (V)	Z (OHM)	POINT	CUR (A)	VTG (V)	Z (OHM)
1	0.0010	1.50	1500.00	12	0.2000	335.80	1679.00
2	0.0020	3.80	1900.00	13	0.4000	344.50	861.25
3	0.0040	14.10	3525.00	14	0.5000	346.50	693.00
4	0.0050	20.70	4140.00	15	0.8000	351.30	439.13
5	0.0080	43.50	5437.50	16	1.0000	353.40	353.40
6	0.0100	60.80	6080.00				
7	0.0200	170.50	8525.00				
8	0.0400	286.90	7172.50				
9	0.0500	301.60	6032.00				
10	0.0800	321.40	4017.50				
11	0.1000	327.20	3272.00				



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FILENAME: Grassy Creek B Phase.plan

DATE: 07/28/20 08:51:34

COMPANY: TC Energy

STATION: Grassy Creek

CIRCUIT: Metering Cabinet B P

MFR: GE

MODEL: JCM-4

SN: 7561113

OPERATOR: BH

COMMENTS:

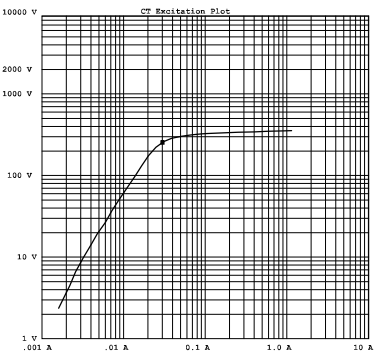
TEST # 1: X3-X4

TEST NOTES: Megger Test: >2.2G O

KNEE TYPE: IEEE 30 Deg

FREQUENCY: 60 Hz

IEEE 30	IEEE 45	IEC 10/50	NP-RATIO: 2000/5.0	Ex V[Volts]: 170.300	Phase Angle:0.04°
Vkp[Volts]: 254.24	Vkp[Volts]: 211.08	Vkp[Volts]: 271.84	M-RATIO: 399.948	Ex I[Amps]: 0.020	In Phase
Ikp[Amps]: 0.0302	Ikp[Amps]: 0.0240	Ikp[Amps]: 0.0346	% ERROR: 0.0131	Winding Res: 648.27 milliohms	



CT DATA POINTS

POINT	CUR (A)	VTG (V)	Z (OHM)	POINT	CUR (A)	VTG (V)	Z (OHM)
1	0.0016	2.36	1475.00	14	0.0250	222.28	8891.20
2	0.0022	4.48	2036.36	15	0.0314	261.44	8326.11
3	0.0026	6.64	2553.85	16	0.0388	285.12	7348.45
4	0.0032	9.72	3037.50	17	0.0506	302.52	5978.66
5	0.0040	14.12	3530.00	18	0.0644	314.48	4883.23
6	0.0048	19.48	4058.33	19	0.0758	319.92	4220.58
7	0.0060	26.64	4440.00	20	0.0914	325.36	3559.74
8	0.0072	37.00	5138.89	21	0.1068	328.64	3077.15
9	0.0088	49.92	5672.73	22	0.2552	340.08	1332.60
10	0.0110	69.80	6345.45	23	0.3966	344.40	868.38
11	0.0136	96.32	7082.35	24	0.5852	348.24	595.08
12	0.0168	132.64	7895.24	25	0.8524	352.04	413.00
13	0.0204	175.20	8588.24	26	1.1534	354.76	307.58

RCF(10%)=N/A, RCF(100%)=1.000

Class B-0.1 Metering N/A Bmag=0.10, Br=0.09, Bi=0.04, Btot=0.864, Vsec(10%)=0.432, Vsec(100%)=4.321

Interpolated 100% vsec 4.321 (VtgPt1 2.36 VtgPt2 4.48) (Ipt1 0.0016 Ipt2 0.0022) I 0.0022 (PhsPt1 0.00 PhsPt2 0.00 Phs 0.00)

Interpolated 10% Point not found. Point#1=not found, Point#2=found

RCF(10%)=N/A, RCF(100%)=1.000

Class B-0.2 Metering N/A Bmag=0.20, Br=0.18, Bi=0.09, Btot=0.957, Vsec(10%)=0.479, Vsec(100%)=4.786

Interpolated 100% vsec 4.786 (VtgPt1 4.48 VtgPt2 6.64) (Ipt1 0.0022 Ipt2 0.0026) I 0.0023 (PhsPt1 0.00 PhsPt2 0.00 Phs 0.00)

Interpolated 10% Point not found. Point#1=not found, Point#2=found

RCF(10%)=N/A, RCF(100%)=1.000

Class B-0.5 Metering N/A Bmag=0.50, Br=0.45, Bi=0.22, Btot=1.242, Vsec(10%)=0.621, Vsec(100%)=6.212

Interpolated 100% vsec 6.212 (VtgPt1 4.48 VtgPt2 6.64) (Ipt1 0.0022 Ipt2 0.0026) I 0.0025 (PhsPt1 0.00 PhsPt2 0.00 Phs 0.00)

Interpolated 10% Point not found. Point#1=not found, Point#2=found

RCF(10%)=N/A, RCF(100%)=1.000

Class B-0.9 Metering N/A Bmag=1.00, Br=0.90, Bi=0.44, Btot=1.729, Vsec(10%)=0.865, Vsec(100%)=8.645

Interpolated 100% vsec 8.645 (VtgPt1 6.64 VtgPt2 9.72) (Ipt1 0.0026 Ipt2 0.0032) I 0.0030 (PhsPt1 0.00 PhsPt2 0.00 Phs 0.00)

Interpolated 10% Point not found. Point#1=not found, Point#2=found

RCF(10%)=N/A, RCF(100%)=1.000

Class B-1.8 Metering N/A Bmag=2.00, Br=1.80, Bi=0.87, Btot=2.717, Vsec(10%)=1.358, Vsec(100%)=13.584

Interpolated 100% vsec 13.584 (VtgPt1 9.72 VtgPt2 14.12) (Ipt1 0.0032 Ipt2 0.0040) I 0.0039 (PhsPt1 0.00 PhsPt2 0.00 Phs 0.00)

Interpolated 10% Point not found. Point#1=not found, Point#2=found



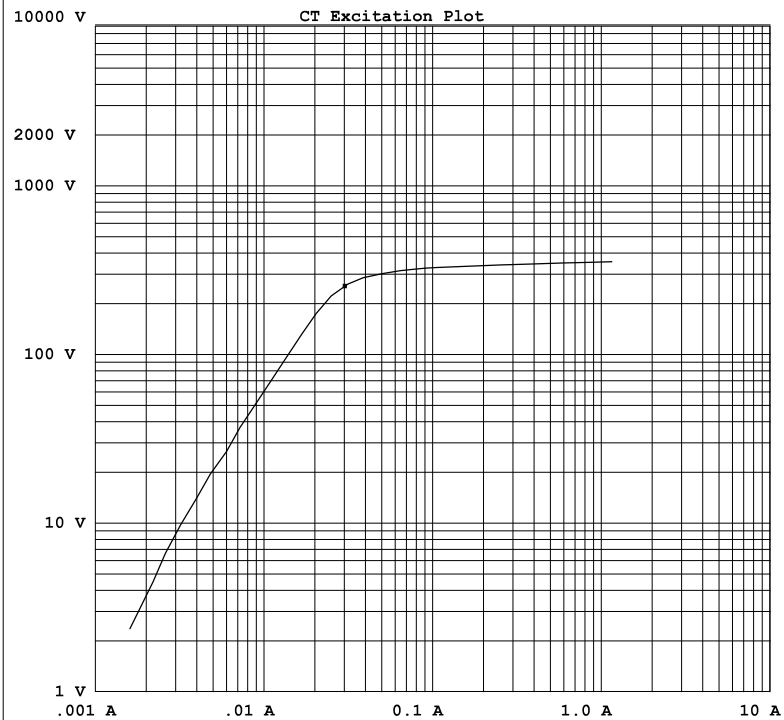
FILENAME: Grassy Creek B Phase.plan
DATE: 07/28/20 08:51:34
COMPANY: TC Energy
STATION: Grassy Creek
CIRCUIT: Metering Cabinet B P

MFR: GE
MODEL: JCM-4
SN: 7561113
OPERATOR: BH
COMMENTS:

SUMMARY REPORT
KNEE TYPE: IEEE 30 Deg
FREQUENCY: 60 Hz

Test	Tap	IEEE30 (V/I)	IEEE45 (V/I)	IEC 10/50 (V/I)	NP-Ratio	M-Ratio	% Error	Phase Angle	Winding Res
8	X3-X4	254.24/0.0302	211.08/0.0240	271.84/0.0346	2000/5.0	399.948	0.013 %	0.04° [In Ø]	648.27 m-ohms

Test Notepad



Summary Metering Class CT Report

Test terminals: X3-X4

Accuracy Class: N/A B-0.1
RCF(10%)=N/A, RCF(100%)=1.000

Accuracy Class: N/A B-0.2
RCF(10%)=N/A, RCF(100%)=1.000

Accuracy Class: N/A B-0.5
RCF(10%)=N/A, RCF(100%)=1.000

Accuracy Class: N/A B-0.9
RCF(10%)=N/A, RCF(100%)=1.000

Accuracy Class: N/A B-1.8
RCF(10%)=N/A, RCF(100%)=1.000



FILENAME: Grassy Creek B Phase.plan
DATE: 07/28/20 08:51:34
COMPANY: TC Energy
STATION: Grassy Creek
CIRCUIT: Metering Cabinet B P

MFR: GE
MODEL: JCM-4
SN: 7561113
OPERATOR: BH
COMMENTS:

TEST PLAN
TEST NOTES: Megger Test: >2.2G O
KNEE TYPE: IEEE 30 Deg
FREQUENCY: 60 Hz

	Nameplate Ratio	Ratio Test	Excitation Test	Winding Res Test	Excitation Voltage (V)	Excitation Current (A)	Note
X3-X4	2000/5.0	[X]	[X]	[X]	300.00	1.00	Megger Test: >2.2G O
Burden Test	[]						
Insulation Test	[]						

- Insulation test completed with Megger
- Burden test results found in "Test Sheets" section of report



FILENAME: Grassy Creek C Phase.plan

DATE: 07/28/20 08:54:08

COMPANY: TC Energy

STATION: Grassy Creek

CIRCUIT: Metering Cabinet C P

MFR: GE

MODEL: JCM-4

SN: 7561114

OPERATOR: BH

COMMENTS:

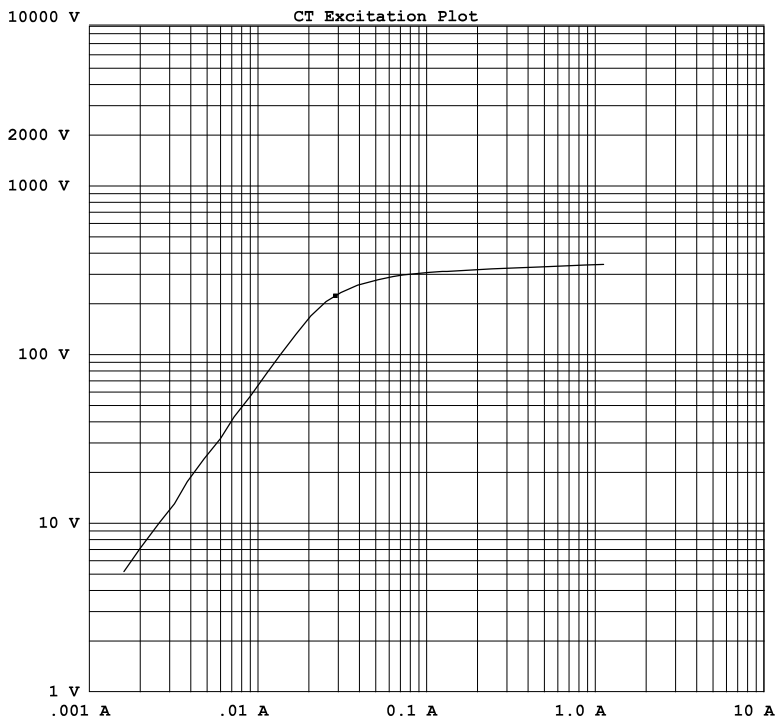
TEST # 1: X3-X4

TEST NOTES:

KNEE TYPE: IEEE 30 Deg

FREQUENCY: 60 Hz

IEEE 30	IEEE 45	IEC 10/50	NP-RATIO: 2000/5.0	Ex V[Volts]: 155.400	Phase Angle:0.06°
Vkp[Volts]: 223.16	Vkp[Volts]: 179.12	Vkp[Volts]: 258.64	M-RATIO: 399.944	Ex I[Amps]: 0.019	In Phase
Ikp[Amps]: 0.0288	Ikp[Amps]: 0.0216	Ikp[Amps]: 0.0394	% ERROR: 0.0141	Winding Res: 659.96 milliohms	



CT DATA POINTS

POINT	CUR(A)	VTG(V)	Z(OHM)	POINT	CUR(A)	VTG(V)	Z(OHM)	POINT	CUR(A)	VTG(V)	Z(OHM)
1	0.0016	5.16	3225.00	14	0.0254	206.76	8140.16	27	0.8668	339.52	391.69
2	0.0020	7.12	3560.00	15	0.0310	233.16	7521.29	28	1.1214	343.32	306.15
3	0.0026	10.08	3876.92	16	0.0390	257.64	6606.15				
4	0.0032	13.04	4075.00	17	0.0514	278.56	5419.46				
5	0.0038	17.64	4642.11	18	0.0632	290.00	4588.61				
6	0.0048	24.12	5025.00	19	0.0724	296.52	4095.58				
7	0.0060	31.84	5306.67	20	0.1032	306.88	2973.64				
8	0.0072	42.72	5933.33	21	0.1240	311.24	2510.00				
9	0.0090	56.72	6302.22	22	0.1320	311.76	2361.82				
10	0.0112	76.84	6860.71	23	0.2424	322.64	1331.02				
11	0.0136	100.12	7361.76	24	0.3372	327.00	969.75				
12	0.0168	132.48	7885.71	25	0.4722	331.36	701.74				
13	0.0206	169.48	8227.18	26	0.6394	335.72	525.05				

GRAPH POINTS

POINT	CUR(A)	VTG(V)	Z(OHM)	POINT	CUR(A)	VTG(V)	Z(OHM)
1	0.0010	3.20	3200.00	12	0.2000	318.50	1592.50
2	0.0020	7.10	3550.00	13	0.4000	329.00	822.50
3	0.0040	18.90	4725.00	14	0.5000	332.10	664.20
4	0.0050	25.40	5080.00	15	0.8000	338.40	423.00
5	0.0080	48.90	6112.50	16	1.0000	341.50	341.50
6	0.0100	65.90	6590.00				
7	0.0200	163.60	8180.00				
8	0.0400	259.30	6482.50				
9	0.0500	276.20	5524.00				
10	0.0800	299.10	3738.75				
11	0.1000	305.80	3058.00				



FILENAME: Grassy Creek C Phase.plan

DATE: 07/28/20 08:54:08

COMPANY: TC Energy

STATION: Grassy Creek

CIRCUIT: Metering Cabinet C P

MFR: GE

MODEL: JCM-4

SN: 7561114

OPERATOR: BH

COMMENTS:

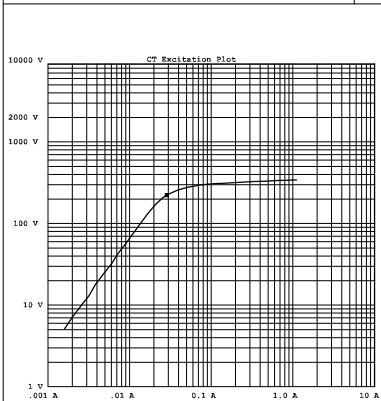
TEST # 1: X3-X4

TEST NOTES:

KNEE TYPE: IEEE 30 Deg

FREQUENCY: 60 Hz

IEEE 30	IEEE 45	IEC 10/50	NP-RATIO: 2000/5.0	Ex V[Volts]: 155.400	Phase Angle:0.06°
Vkp[Volts]: 223.16	Vkp[Volts]: 179.12	Vkp[Volts]: 258.64	M-RATIO: 399.944	Ex I[Amps]: 0.019	In Phase
Ikp[Amps]: 0.0288	Ikp[Amps]: 0.0216	Ikp[Amps]: 0.0394	% ERROR: 0.0141	Winding Res: 659.96 milliohms	



CT DATA POINTS

POINT	CUR(A)	VTG(V)	Z(OHM)	POINT	CUR(A)	VTG(V)	Z(OHM)	POINT	CUR(A)	VTG(V)	Z(OHM)
1	0.0016	5.16	3225.00	14	0.0254	206.76	8140.16	27	0.8668	339.52	391.69
2	0.0020	7.12	3560.00	15	0.0310	233.16	7521.29	28	1.1214	343.32	306.15
3	0.0026	10.08	3876.92	16	0.0390	257.64	6606.15				
4	0.0032	13.04	4075.00	17	0.0514	278.56	5419.46				
5	0.0038	17.64	4642.11	18	0.0632	290.00	4588.61				
6	0.0048	24.12	5025.00	19	0.0724	296.52	4095.58				
7	0.0060	31.84	5306.67	20	0.1032	306.88	2973.64				
8	0.0072	42.72	5933.33	21	0.1240	311.24	2510.00				
9	0.0090	56.72	6302.22	22	0.1320	311.76	2361.82				
10	0.0112	76.84	6860.71	23	0.2424	322.64	1331.02				
11	0.0136	100.12	7361.76	24	0.3372	327.00	969.75				
12	0.0168	132.48	7885.71	25	0.4722	331.36	701.74				
13	0.0206	169.48	8227.18	26	0.6394	335.72	525.05				

RCF(10%)=N/A, RCF(100%)=N/A

Class B-0.1 Metering N/A Bmag=0.10, Br=0.09, Bi=0.04, Btot=0.878, Vsec(10%)=0.439, Vsec(100%)=4.391

Interpolated 100% Point not found. Point#1=not found, Point#2=found

Interpolated 10% Point not found. Point#1=not found, Point#2=found

RCF(10%)=N/A, RCF(100%)=N/A

Class B-0.2 Metering N/A Bmag=0.20, Br=0.18, Bi=0.09, Btot=0.971, Vsec(10%)=0.486, Vsec(100%)=4.855

Interpolated 100% Point not found. Point#1=not found, Point#2=found

Interpolated 10% Point not found. Point#1=not found, Point#2=found

RCF(10%)=N/A, RCF(100%)=1.000

Class B-0.5 Metering N/A Bmag=0.50, Br=0.45, Bi=0.22, Btot=1.256, Vsec(10%)=0.628, Vsec(100%)=6.281

Interpolated 100% vsec 6.281 (VtgPt1 5.16 VtgPt2 7.12) (Ipt1 0.0016 Ipt2 0.0020) I 0.0018 (PhsPt1 0.00 PhsPt2 0.00 Phs 0.00)

Interpolated 10% Point not found. Point#1=not found, Point#2=found

RCF(10%)=N/A, RCF(100%)=1.000

Class B-0.9 Metering N/A Bmag=1.00, Br=0.90, Bi=0.44, Btot=1.743, Vsec(10%)=0.871, Vsec(100%)=8.713

Interpolated 100% vsec 8.713 (VtgPt1 7.12 VtgPt2 10.08) (Ipt1 0.0020 Ipt2 0.0026) I 0.0023 (PhsPt1 0.00 PhsPt2 0.00 Phs 0.00)

Interpolated 10% Point not found. Point#1=not found, Point#2=found

RCF(10%)=N/A, RCF(100%)=1.000

Class B-1.8 Metering N/A Bmag=2.00, Br=1.80, Bi=0.87, Btot=2.730, Vsec(10%)=1.365, Vsec(100%)=13.650

Interpolated 100% vsec 13.650 (VtgPt1 13.04 VtgPt2 17.64) (Ipt1 0.0032 Ipt2 0.0038) I 0.0033 (PhsPt1 0.00 PhsPt2 0.00 Phs 0.00)

Interpolated 10% Point not found. Point#1=not found, Point#2=found

RCF(10%)=N/A, RCF(100%)=N/A

Class B-0.1 Metering N/A Bmag=0.10, Br=0.09, Bi=0.04, Btot=0.878, Vsec(10%)=0.439, Vsec(100%)=4.391

Interpolated 100% Point not found. Point#1=not found, Point#2=found

Interpolated 10% Point not found. Point#1=not found, Point#2=found

RCF(10%)=N/A, RCF(100%)=N/A



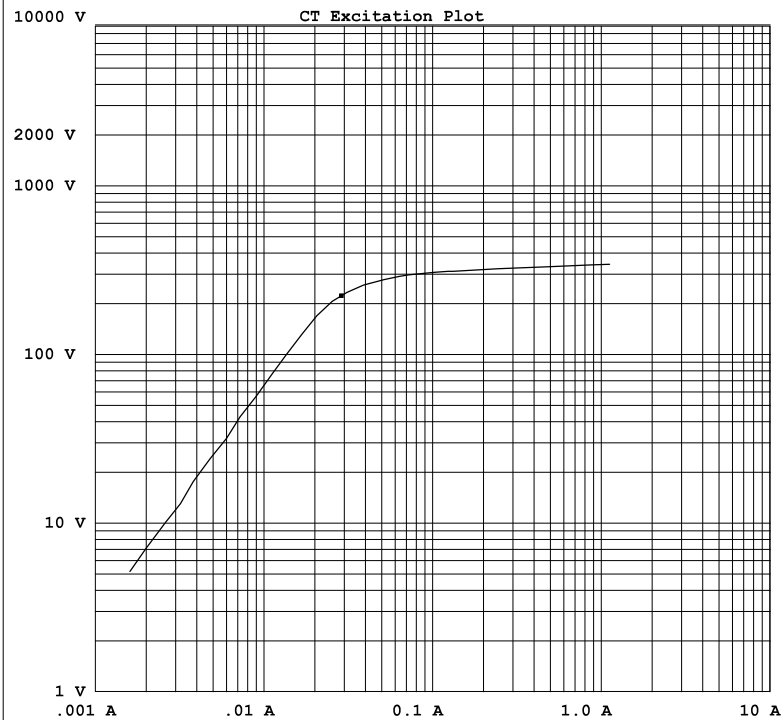
FILENAME: Grassy Creek C Phase.plan
DATE: 07/28/20 08:54:08
COMPANY: TC Energy
STATION: Grassy Creek
CIRCUIT: Metering Cabinet C P

MFR: GE
MODEL: JCM-4
SN: 7561114
OPERATOR: BH
COMMENTS:

SUMMARY REPORT
KNEE TYPE: IEEE 30 Deg
FREQUENCY: 60 Hz

Test	Tap	IEEE30 (V/I)	IEEE45 (V/I)	IEC 10/50 (V/I)	NP-Ratio	M-Ratio	% Error	Phase Angle	Winding Res
8	X3-X4	223.16/0.0288	179.12/0.0216	258.64/0.0394	2000/5.0	399.944	0.014 %	0.06° [In Ø]	659.96 m-ohms

Test Notepad



Summary Metering Class CT Report

Test terminals: X3-X4

Accuracy Class: N/A B-0.1
RCF(10%)=N/A, RCF(100%)=N/A

Accuracy Class: N/A B-0.2
RCF(10%)=N/A, RCF(100%)=N/A

Accuracy Class: N/A B-0.5
RCF(10%)=N/A, RCF(100%)=1.000

Accuracy Class: N/A B-0.9
RCF(10%)=N/A, RCF(100%)=1.000

Accuracy Class: N/A B-1.8
RCF(10%)=N/A, RCF(100%)=1.000



FILENAME: Grassy Creek C Phase.plan
DATE: 07/28/20 08:54:08
COMPANY: TC Energy
STATION: Grassy Creek
CIRCUIT: Metering Cabinet C P

MFR: GE
MODEL: JCM-4
SN: 7561114
OPERATOR: BH
COMMENTS:

TEST PLAN
TEST NOTES:
KNEE TYPE: IEEE 30 Deg
FREQUENCY: 60 Hz

	Nameplate Ratio	Ratio Test	Excitation Test	Winding Res Test	Excitation Voltage (V)	Excitation Current (A)	Note
X3-X4	2000/5.0	[X]	[X]	[X]	300.00	1.00	Megger Test (Insulation Resistance) - > 2.2 GOhm
Burden Test	[]						
Insulation Test	[]						

- Insulation test completed with Megger
- Burden test results found in "Test Sheets" section of report

Test Sheets – Inspection & Test Plan



3 PHASE, DRY TYPE TRANSFORMERS ELECTRICAL TESTING



CUSTOMER TC Energy PAGE 1 OF 1
USER TC Energy JOB # 20-T262-1082
ADDRESS _____ TESTED BY BH/TS
PLANT Grassy Creek DD / MM / YYYY
PLANT AREA Grassy Creek DATE 29/07/2020
EQUIPMENT ID A PHASE CT TEMP. 25 °C HUMIDITY 75 %

NAMEPLATE DATA

MANUFACTURER _____ GE SERIAL NO. 7561117

WINDING TEMPERATURE _____ °C

DISSIPATION TCF _____

TRANSFORMER CAPACITANCE & DISSIPATION FACTOR TESTS

TEST #	MEASUREMENT	TEST MODE	CAPACITANCE (pF)	% DISSIPATION FACTOR	
1	$C_{HG} + C_{HL}$	GST GND	516	0.754	
2	C_{HG}	GST	437	0.604	
3	C_{HL}	UST	79	1	
4	CHECK (TEST 1 MINUS 2)	-	79	-	-
5	$C_{LG} + C_{HL}$	GST GND	591	0.72	
6	C_{LG}	GST	512	0.52	
7	C_{LH}	UST	79	1	
8	CHECK (TEST 5 MINUS 6)	-	79	-	-

COMMENTS:

DEFICIENCIES:

TEST EQUIPMENT USED RF 27



3 PHASE, DRY TYPE TRANSFORMERS ELECTRICAL TESTING



CUSTOMER TC Energy
USER TC Energy
ADDRESS _____
PLANT Grassy Creek
PLANT AREA Grassy Creek
EQUIPMENT ID B PHASE CT

PAGE 1 OF 1
JOB # 20-T262-1082
TESTED BY BH/TS
DATE 29/07/2020
TEMP. 25 °C HUMIDITY 75 %

NAMEPLATE DATA

MANUFACTURER _____ GE SERIAL NO. 7561113

WINDING TEMPERATURE _____ °C

DISSIPATION TCF _____

TRANSFORMER CAPACITANCE & DISSIPATION FACTOR TESTS

TEST #	MEASUREMENT	TEST MODE	CAPACITANCE (pF)	% DISSIPATION FACTOR	
1	$C_{HG} + C_{HL}$	GST GND	487	0.92	
2	C_{HG}	GST	401	0.82	
3	C_{HL}	UST	84	1.15	
4	CHECK (TEST 1 MINUS 2)	-	83	-	-
5	$C_{LG} + C_{HL}$	GST GND	592	1.02	
6	C_{LG}	GST	907	1.04	
7	C_{LH}	UST	84	1.15	
8	CHECK (TEST 5 MINUS 6)	-	85	-	-

COMMENTS:

DEFICIENCIES:

TEST EQUIPMENT USED RF 27



3 PHASE, DRY TYPE TRANSFORMERS ELECTRICAL TESTING



CUSTOMER TC Energy PAGE 1 OF 1
USER TC Energy JOB # 20-T262-1082
ADDRESS _____ TESTED BY BH/TS
PLANT Grassy Creek DD / MM / YYYY
PLANT AREA Grassy Creek DATE 29/07/2020
EQUIPMENT ID C PHASE CT TEMP. 25 °C HUMIDITY 75 %

NAMEPLATE DATA

MANUFACTURER _____ GE SERIAL NO. 7561114

WINDING TEMPERATURE _____ °C

DISSIPATION TCF _____

TRANSFORMER CAPACITANCE & DISSIPATION FACTOR TESTS

TEST #	MEASUREMENT	TEST MODE	CAPACITANCE (pF)	% DISSIPATION FACTOR	
1	$C_{HG} + C_{HL}$	GST GND	434	0.84	
2	C_{HG}	GST	358	0.742	
3	C_{HL}	UST	77	0.78	
4	CHECK (TEST 1 MINUS 2)	-	76	-	-
5	$C_{LG} + C_{HL}$	GST GND	594	0.81	
6	C_{LG}	GST	517	0.73	
7	C_{LH}	UST	77	0.78	
8	CHECK (TEST 5 MINUS 6)	-	77	-	-

COMMENTS:

DEFICIENCIES:

TEST EQUIPMENT USED RF 27



GENERAL TEST FORM



CUSTOMER TC Energy
USER TC Energy
ADDRESS _____
PLANT Grassy Creek
PLANT AREA Grassy Creek
EQUIPMENT ID METERING CABINET CT BURDEN TESTING

PAGE 1 OF 1
JOB # 20-T262-1082
TESTED BY BH/TS
DATE 29/07/2020
TEMP. 25 °C HUMIDITY 75 %

CT BURDEN TEST:

A PHASE (1A INJECTED ON CT SECONDARY):

X1- 23.8mv
LINE SIDE OF FORK TERMINAL- 14.1mv
LOAD SIDE OF FORK TERMINAL- 13.8mv
LINE SIDE OF METER 1- 11.4mv
LOAD SIDE OF METER 1- 11.2mv
LINE SIDE OF METER 2- 5mv
LOAD SIDE OF METER 2- 4.8mv
LINE SIDE OF NEUTRAL FORK TERMINAL- 3.2mv
LOAD SIDE OF NEUTRAL FORK TERMINAL- 2.1mv
X2- 39.6mv

B PHASE (1A INJECTED ON CT SECONDARY):

X1- 26.3mv
LINE SIDE OF FORK TERMINAL- 14.6mv
LOAD SIDE OF FORK TERMINAL- 14.4mv
LINE SIDE OF METER 1- 11.8mv
LOAD SIDE OF METER 1- 11.6mv
LINE SIDE OF METER 2- 5.4mv
LOAD SIDE OF METER 2- 5.1mv
LINE SIDE OF NEUTRAL FORK TERMINAL- 3.2mv
LOAD SIDE OF NEUTRAL FORK TERMINAL- 2.1mv
X2- 39.6mv

C PHASE (1A INJECTED ON CT SECONDARY):

X1- 29.3mv
LINE SIDE OF FORK TERMINAL- 14.5mv
LOAD SIDE OF FORK TERMINAL- 14.3mv
LINE SIDE OF METER 1- 12.2mv
LOAD SIDE OF METER 1- 12mv
LINE SIDE OF METER 2- 5.5mv
LOAD SIDE OF METER 2- 5.3mv
LINE SIDE OF NEUTRAL FORK TERMINAL- 3.2mv
LOAD SIDE OF NEUTRAL FORK TERMINAL- 2.1mv
X2- 39.6mv

COMMENTS:

DEFICIENCIES:

TEST EQUIPMENT USED RF73



VOLTAGE TRANSFORMERS VISUAL & MECHANICAL INSPECTION



CUSTOMER TC Energy
USER TC Energy
ADDRESS _____
PLANT Grassy Creek
PLANT AREA Grassy Creek
EQUIPMENT ID METERING CABINET

PAGE 1 OF 2
JOB # 20-T262-1082
TESTED BY BH/TS
DATE 29/07/2020
TEMP. 25 °C HUMIDITY 75 %

NAMEPLATE DATA

MANUFACTURER ABB CATALOG NO. AE-1407 TYPE VIZ-75 NAMEPLATE RATIO 4200 : 120
PRIMARY VOLTAGE 4,200 SECONDARY VOLTAGE 120 KVA 1.5 CLASS 8.7kV
ADDITIONAL _____
PRIMARY FUSE: MANUFACTURER EATON TYPE 15CLPT SIZE 0.5A
SECONDARY FUSE: MANUFACTURER N/A TYPE _____ SIZE _____

DESCRIPTION	INSPECTED	N/A	COMMENTS
* VT DATA COMPARES WITH DRAWINGS & SPECIFICATIONS	☒	☐	GOOD, VERIFIED
PHYSICAL & MECHANICAL CONDITION	☒	☐	GOOD CONDITION
CORRECT CONNECTION WITH SYSTEM REQUIREMENTS	☒	☐	GOOD, VERIFIED
* CLEARANCES BETWEEN PRIMARY & SECONDARY CIRCUIT WIRING	☒	☐	GOOD
CLEANLINESS	☒	☐	FOUND CLEAN
GROUNDING & SHORTING CONNECTIONS	☒	☐	GOOD, GROUNDING VERIFIED
WITHDRAWAL MECHANISM & GROUNDING OPERATION	☒	☐	GOOD, ME
CORRECT FUSE SIZES	☒	☐	GOOD, SEE DEFICIENCIES
LUBRICATION	☒	☐	GOOD, PT STABS LUBED
POTENTIAL CIRCUITS ARE GROUNDED WITH ONLY ONE GROUNDING POINT	☒	☐	GOOD, VERIFIED

* ACCEPTANCE TESTING ONLY

ELECTRICAL CONNECTIONS VERIFIED BY: ☐ CONNECTION TIGHTNESS ☐ THERMOGRAPHIC SURVEY ☒ MEASURED RESISTANCE

COMMENTS:

DEFICIENCIES: B PHASE LINE SIDE FUSE WAS FOUND BLOWN

TEST EQUIPMENT USED _____



VOLTAGE TRANSFORMERS ELECTRICAL TESTS



CUSTOMER TC Energy PAGE 2 OF 2
USER TC Energy JOB # 20-T262-1082
ADDRESS _____ TESTED BY BH/TS
PLANT Grassy Creek DD / MM / YYYY
PLANT AREA Grassy Creek DATE 29/07/2020
EQUIPMENT ID METERING CABINET TEMP. 25 °C HUMIDITY 75 %

NAMEPLATE DATA

MANUFACTURER _____ ABB

VT CONNECTION: ☐ 1 PHASE ☒ 3 PHASE PRIMARY: ☒ WYE ☐ DELTA ☐ OPEN DELTA SECONDARY: ☒ WYE ☐ DELTA ☐ OPEN DELTA

EQUIP. TEMPERATURE 20 °C Indicates Temperature Corrected Reading to 20°C INSULATION TCF 1

VT IDENTIFICATION _____ A PHASE

SERIAL NUMBER 11316712

URNS RATIO TEST

TAP POSITION	PRIMARY VOLTAGE	SECONDARY VOLTAGE	CALCULATED RATIO	MEASURED RATIO
-	4,200	120	35	34.987

NSULATION TESTS

PRIMARY - SECONDARY	PRIMARY - GROUND	SECONDARY - GROUND
5 KV	5 KV	0.5 KV
325,600 MEG OHMS	298,500 MEG OHMS	550 MEG OHMS
325,600 MEG OHMS	298,500 MEG OHMS	550 MEG OHMS

POLARITY ☒

VT IDENTIFICATION _____ B PHASE

SERIAL NUMBER 11316716

URNS RATIO TEST

TAP POSITION	PRIMARY VOLTAGE	SECONDARY VOLTAGE	CALCULATED RATIO	MEASURED RATIO
-	4,200	120	35	34.986

NSULATION TESTS

PRIMARY - SECONDARY	PRIMARY - GROUND	SECONDARY - GROUND
5 KV	5 KV	0.5 KV
412,900 MEG OHMS	523,200 MEG OHMS	550 MEG OHMS
412,900 MEG OHMS	523,200 MEG OHMS	550 MEG OHMS

POLARITY ☒

VT IDENTIFICATION _____ C PHASE

SERIAL NUMBER 11316713

URNS RATIO TEST

TAP POSITION	PRIMARY VOLTAGE	SECONDARY VOLTAGE	CALCULATED RATIO	MEASURED RATIO
-	4,200	120	35	34.984

NSULATION TESTS

PRIMARY - SECONDARY	PRIMARY - GROUND	SECONDARY - GROUND
5 KV	5 KV	0.5 KV
542,300 MEG OHMS	429,300 MEG OHMS	550 MEG OHMS
542,300 MEG OHMS	429,300 MEG OHMS	550 MEG OHMS

POLARITY ☒

COMMENTS:

DEFICIENCIES:

TEST EQUIPMENT USED RF27, RF69



GENERAL TEST FORM



CUSTOMER TC Energy
USER TC Energy
ADDRESS _____
PLANT Grassy Creek
PLANT AREA Grassy Creek
EQUIPMENT ID METERING CABINET PT BURDEN TESTING

PAGE 1 OF 1
JOB # 20-T262-1082
TESTED BY BH/TS
DATE 29/07/2020
TEMP. 25 °C HUMIDITY 75 %

PT BURDEN TEST:

A PHASE:

X1-LINE SIDE OF FORK TERMINAL: 0.2 OHMS
LINE SIDE OF FORK TERMINAL-LOAD SIDE OF FORK TERMINAL: 0.2 OHMS
LOAD SIDE OF FORK TERMINAL-LINE SIDE OF METER 1: 0.2 OHMS
LOAD SIDE OF FORK TERMINAL-LINE SIDE OF METER 2: 0.2 OHMS

B PHASE:

X2-LINE SIDE OF FORK TERMINAL: 0.2 OHMS
LINE SIDE OF FORK TERMINAL-LOAD SIDE OF FORK TERMINAL: 0.2 OHMS
LOAD SIDE OF FORK TERMINAL-LINE SIDE OF METER 1: 0.2 OHMS
LOAD SIDE OF FORK TERMINAL-LINE SIDE OF METER 2: 0.2 OHMS

C PHASE:

X3-LINE SIDE OF FORK TERMINAL: 0.2 OHMS
LINE SIDE OF FORK TERMINAL-LOAD SIDE OF FORK TERMINAL: 0.2 OHMS
LOAD SIDE OF FORK TERMINAL-LINE SIDE OF METER 1: 0.2 OHMS
LOAD SIDE OF FORK TERMINAL-LINE SIDE OF METER 2: 0.2 OHMS

NEUTRAL:

LOAD SIDE OF METER 1-LINE SIDE OF NEUTRAL FORK TERMINAL: 0.2 OHMS
LOAD SIDE OF METER 2-LINE SIDE OF NEUTRAL FORK TERMINAL: 0.2 OHMS
LINE SIDE OF NEUTRAL FORK TERMINAL-LOAD SIDE OF NEUTRAL FORK TERMINAL: 0.2 OHMS
LOAD SIDE OF NEUTRAL FORK TERMINAL-X0: 0.2 OHMS

COMMENTS:

DEFICIENCIES:

TEST EQUIPMENT USED



SWITCHGEAR AND SWITCHBOARD ASSEMBLIES VISUAL & MECHANICAL INSPECTION



CUSTOMER TC Energy PAGE 1 OF 2
USER TC Energy JOB # 20-T262-1082
ADDRESS _____ TESTED BY BH/TS
PLANT Grassy Creek DD / MM / YYYY
PLANT AREA Grassy Creek DATE 28/07/2020
EQUIPMENT ID METERING CABINET TEMP. 25 °C HUMIDITY 75 %

NAMEPLATE DATA

MANUFACTURER MEC RATED AMPS 3000A TYPE NL
SERIAL NO. 12477-01 RATED VOLTS 6900V WITHSTAND RATING (kA) NL
CATALOG NO. 25472-101-3PS-3M00-W0001 ADDITIONAL NAMEPLATE _____

DESCRIPTION	INSPECTED	N/A	COMMENTS
* SWITCHGEAR DATA COMPARES WITH DRAWINGS & SPECIFICATIONS	☒	☐	GOOD, VERIFIED
PHYSICAL & MECHANICAL CONDITION	☒	☐	GOOD CONDITION
ANCHORAGE & ALIGNMENT	☒	☐	GOOD
GROUNDING	☒	☐	GOOD, GROUNDING VERIFIED
REQUIRED CLEARANCES	☒	☐	GOOD
CLEANLINESS	☒	☐	FOUND CLEAN
FUSE & BREAKER SIZE CORRESPOND W/ DRAWINGS	☒	☐	GOOD, VERIFIED
CT'S & PT'S CORRESPOND W/ DRAWINGS	☒	☐	GOOD, VERIFIED
OPERATION & SEQUENCE OF INTERLOCKS	☒	☐	GOOD, KIRK KEYS OPERATE PROPERLY
LUBRICATION	☒	☐	GOOD, PT STABS LUBED
INSULATORS	☒	☐	GOOD
BARRIER & SHUTTER INSTALLATION / OPERATION	☒	☐	GOOD
ACTIVE COMPONENTS & INDICATING DEVICES	☐	☒	NO METERS INSTALLED
FILTERS AND VENTS	☒	☐	GOOD, DOOR SEALS IN TACT
INSTRUMENT TRANSFORMERS	☒	☐	GOOD
CONTROL POWER TRANSFORMERS	☒	☐	GOOD
HEATERS	☒	☐	GOOD, TESTED
PHASING (DOUBLE-ENDED OR DUAL SOURCE S/G)	☒	☐	GOOD

* ACCEPTANCE TESTING ONLY

ELECTRICAL CONNECTIONS VERIFIED BY: ☐ CONNECTION TIGHTNESS ☐ THERMOGRAPHIC SURVEY ☒ MEASURED RESISTANCE

COMMENTS:

DEFICIENCIES:

TEST EQUIPMENT USED _____



SWITCHGEAR AND SWITCHBOARD ASSEMBLIES ELECTRICAL TESTING



CUSTOMER TC Energy PAGE 2 OF 2
USER TC Energy JOB # 20-T262-1082
ADDRESS _____ TESTED BY BH/TS
PLANT Grassy Creek DD / MM / YYYY
PLANT AREA Grassy Creek DATE 28/07/2020
EQUIPMENT ID METERING CABINET TEMP. 25 °C HUMIDITY 75 %

NAMEPLATE DATA

MANUFACTURER _____ MEC SERIAL NO. 12477-01

EQUIP. TEMPERATURE 20 °C Indicates Temperature Corrected Reading to 20°C

BOLTED CONNECTION RESISTANCE

☒ MICRO-OHMS ☐ MILLI-OHMS

RESISTANCE TCF 1

FROM	TO	PHASE A	PHASE B	PHASE C	NEUTRAL	GROUND
OUTGOING CONNECTION	TOP OF BUS BRAID	12	13	15		
		12	13	15		
OUTGOING CONNECTION	BOTTOM OF BUS BRAID	22	20	19		
		22	20	19		
OUTGOING CONNECTION	LINE SIDE CT	35	29	25		
		35	29	25		
OUTGOING CONNECTION	LOAD SIDE CT	46	41	35		
		46	41	35		
OUTGOING CONNECTION	BOLTED CONNECTION	63	54	43		
		63	54	43		
OUTGOING CONNECTION	BACK OF INCOMING CONNECTION	69	57	45		
		69	57	45		
OUTGOING CONNECTION	INCOMING CONNECTION	87	74	65		
		87	74	65		
OUTGOING CONNECTION CELL	INCOMING CONNECTION CELL					211
						211

OVERPOTENTIAL TESTS

☐ MEG-OHMS ☒ MICRO-AMPS

INSULATION TCF 1

BUS SECTION TESTED	KV	TIME (min)	A-GND	B-GND	C-GND	N-GND
ALL BUS	21	1	4.07	4.76	4.83	
			4.07	4.76	4.83	

COMMENTS:

DEFICIENCIES:

TEST EQUIPMENT USED RF7, RF54



Deficiency Summary

Job #:20-T262-1082



PAGE _____

Customer TC Energy

USER TC Energy

-- _____

PLANT: Grassy Creek

Page : _____

PLANT AREA: Grassy Creek

Test Date and Time: 7/29/2020

Equipment: PT - VOLTAGE XFMR - INSPECT

B PHASE LINE SIDE FUSE WAS FOUND BLOWN



Blown fuse was replaced

Test Equipment - Calibration Certificates



Certificate of Calibration

The CAT Rental Store
Wirtanen Division
10235 - 180 Street Edmonton, AB T5L 3B2
PHONE: (780) 434-8421
www.catrents.ca



For Instrument : Raytech TR-MarkIII

Description : Transformer Turns Ratiometer

Serial Number : 341139

Asset Number : RF 22

Customer: Shermco - Regina

1033 Kearns Cres.

Regina, SK

S4P 3B2

The CAT Rental Store certifies that the above listed instrument meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the National Research Council of Canada (NRC) or the National Institute of Standards and Technology (NIST), or to NIST accepted intrinsic standards of measurement, or derived by the ratio type of self-calibration techniques.

This report may not be reproduced, except in full, unless permission for the publication of an approved abstract is obtained in writing from the calibration organization issuing this report.

Quality Management system registered to ISO 9001: 2015

CALIBRATION INFORMATION

Cal Date: 2 Aug 2019

Temperature 20.0°C

Condition as Received/Returned: IN TOLERANCE
(Pass)

Next Cal Due: 2 Aug 2020

Humidity 40 %

Remarks:

Cal Procedure Raytech TR-Mark III Transformer Turns Ratiometer

Revision 1.0

STANDARDS USED FOR CALIBRATION

Asset Number

88990

Description

Megger 550555 Calibrator

Cal Date

11 Feb 2019

Due Date

11 Feb 2020



Signed:

Edwin Zhang - Technician

SERIAL NUMBER: 341139

ASSET NUMBER: RF 22

Report of Calibration

The CAT Rental Store
Wirtanen Division
10235 - 180 Street Edmonton, AB T5L 3B2
PHONE: (780) 434-8421
www.catrents.ca

UNIT UNDER TEST:	Raytech TR-MarkIII Transformer Turns Ratiometer	TEST RESULT:	PASS
SERIAL NUMBER:	341139	PERFORMED ON:	02 August 2019
ASSET NUMBER:	RF 22	DATA TYPE:	FOUND-LEFT
PROCEDURE NAME:	Raytech TR-Mark III Transformer Turns Ratiometer	TEMPERATURE:	20.00 °C
PROCEDURE REV.:	1.0	HUMIDITY:	40 %
CALIBRATED BY:	Edwin Zhang		
P.O. NUMBER:			
CUSTOMER:	Shermco - Regina 1033 Kearns Cres. Regina, SK S4P 3B2		

The CAT Rental Store certifies that the above listed instrument meets or exceeds all specifications as stated in the referenced procedure unless otherwise noted. It has been calibrated using measurement standards traceable to the National Institute of Standards and Technology (NIST), or to NIST accepted intrinsic standards of measurement, or derived by the ratio type of self-calibration techniques.

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Note: Any Test Uncertainty Ratio (TUR) that is less than four to one will appear under the "TUR" heading on the data record. If the TUR meets or exceeds four to one, the field is left blank.

REMARKS:

Standards Used

<u>Asset #</u>	<u>Description</u>	<u>Cal Date</u>	<u>Due Date</u>
88990	Megger 550555 Calibrator	2/11/2019	2/11/2020

Test Results

<u>Test Description</u>	<u>True Value</u>	<u>Test Result</u>	<u>Lower limit</u>	<u>Upper limit</u>	<u>Units</u>	<u>TUR</u>
10V	1.0000	1.0000	0.9983	1.0017	Ratio	Pass
	2.0000	2.0008	1.9968	2.0032	Ratio	Pass
	5.0000	5.0020	4.9923	5.0077	Ratio	Pass
	10.000	10.007	9.983	10.017	Ratio	Pass
	20.000	20.018	19.968	20.032	Ratio	Pass
	50.000	50.040	49.923	50.077	Ratio	Pass
	100.00	100.07	99.83	100.17	Ratio	Pass
	200.00	200.06	199.68	200.32	Ratio	Pass
	500.00	500.20	499.23	500.77	Ratio	Pass
	1000.0	1000.1	998.3	1001.7	Ratio	Pass
	2000.0	1998.7	1996.8	2003.2	Ratio	Pass
40V	1.0000	0.9999	0.9993	1.0007	Ratio	Pass
	2.0000	2.0008	1.9987	2.0013	Ratio	Pass

Test Results

<u>Test Description</u>	<u>True Value</u>	<u>Test Result</u>	<u>Lower limit</u>	<u>Upper limit</u>	<u>Units</u>	<u>TUR</u>
	5.0000	5.0025	4.9969	5.0031	Ratio	Pass
	10.000	10.004	9.993	10.007	Ratio	Pass
	20.000	20.008	19.987	20.013	Ratio	Pass
	50.000	50.030	49.969	50.031	Ratio	Pass
	100.00	100.05	99.93	100.07	Ratio	Pass
	200.00	200.12	199.87	200.13	Ratio	Pass
	500.00	500.25	499.69	500.31	Ratio	Pass
	1000.0	1000.4	999.3	1000.7	Ratio	Pass
	2000.0	2000.8	1998.7	2001.3	Ratio	Pass

Phase

1.5	1.67
-1.5	-1.46

***** End of Certificate *****

Technician



Edwin Zhang - Technician



Certificate of Calibration

The CAT Rental Store
Wirtanen Division
10235 - 180 Street Edmonton, AB T5L 3B2
PHONE: (780) 434-8421
www.catrents.ca



For Instrument : MULTI-AMP CB100

Customer: Shermco - Regina

Description : C&DF BRIDGE

1033 Kearns Cres.

Serial Number : 41030502

Regina, SK

Asset Number : RF 27

S4P 3B2

The CAT Rental Store certifies that the above listed instrument meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the National Research Council of Canada (NRC) or the National Institute of Standards and Technology (NIST), or to NIST accepted intrinsic standards of measurement, or derived by the ratio type of self-calibration techniques.

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Quality Management system registered to ISO 9001: 2015

CALIBRATION INFORMATION

Cal Date: 9 Jun 2020

Temperature 20.2°C

Condition as Received/Returned: IN TOLERANCE

Next Cal Due: 9 Jun 2021

Humidity 41 %

(Pass)

Remarks:

Cal Procedure CB100

Revision 1.0

STANDARDS USED FOR CALIBRATION

Asset Number	Description	Cal Date	Due Date
IW3240	GenRad 1433 Decade Box	24 Jun 2019	24 Jun 2020
STDCAP 1	GENERAL RADIO 1401-D STANDARD AIR CAPACITOR	05 Jul 2019	05 Jul 2020
WECO CAPI	IET 1423 Precision Capacitance Decade	21 Feb 2020	21 Feb 2021



Signed:

Justin Smith - Technician

SERIAL NUMBER: 41030502

ASSET NUMBER: RF 27

Report of Calibration

The CAT Rental Store
Wirtanen Division
10235 - 180 Street Edmonton, AB T5L 3B2
PHONE: (780) 434-8421
www.catrents.ca

UNIT UNDER TEST:	MULTI-AMP CB100 C&DF BRIDGE	TEST RESULT:	PASS
SERIAL NUMBER:	41030502	PERFORMED ON:	09 June 2020
ASSET NUMBER:	RF 27	DATA TYPE:	FOUND-LEFT
PROCEDURE NAME:	CB100	TEMPERATURE:	20.20 °C
PROCEDURE REV.:	1.0	HUMIDITY:	41 %
CALIBRATED BY:	Justin Smith		
P.O. NUMBER:			
CUSTOMER:	Shermco - Regina 1033 Kearns Cres. Regina, SK S4P 3B2		

The CAT Rental Store certifies that the above listed instrument meets or exceeds all specifications as stated in the referenced procedure unless otherwise noted. It has been calibrated using measurement standards traceable to the National Institute of Standards and Technology (NIST), or to NIST accepted intrinsic standards of measurement, or derived by the ratio type of self-calibration techniques.

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Note: Any Test Uncertainty Ratio (TUR) that is less than four to one will appear under the "TUR" heading on the data record. If the TUR meets or exceeds four to one, the field is left blank.

REMARKS:

Standards Used

Asset #	Description	Cal Date	Due Date
IW3240	GenRad 1433 Decade Box	6/24/2019	6/24/2020
STDCAP 1	GENERAL RADIO 1401-D STANDARD AIR CAPACITOR	7/5/2019	7/5/2020
WECO CAP1	IET 1423 Precision Capacitance Decade	2/21/2020	2/21/2021

Test Results

Test Description	True Value	Test Result	Lower limit	Upper limit	Units	TUR
Capacitance Reading						
1000.0pF UST						
100pF mult	1000	998.7	993.0	1007.0	pF	Pass
200pF mult	1000	1000.4	993.0	1007.0	pF	Pass
500pF mult	1000	1005.0	993.0	1007.0	pF	Pass
0.001uF mult	1000	1001.3	993.0	1007.0	pF	Pass
100.0pF UST						
20pF mult	100.00	100.28	95.75	104.25	pF	Pass
50pF mult	100.00	101.20	95.75	104.25	pF	Pass
100pF mult	100.00	101.90	95.75	104.25	pF	Pass
DF Reading						
0-1% range UST 10kohm	0.63	0.659	0.600	0.660	%	Pass
0-10% range UST 50kohm	3.15	3.22	2.85	3.45	%	Pass

Test Results

<u>Test Description</u>	<u>True Value</u>	<u>Test Result</u>	<u>Lower limit</u>	<u>Upper limit</u>	<u>Units</u>	<u>TUR</u>
0-10% range UST 100kohm	6.3	6.40	6.00	6.60	%	Pass
0-20% range UST 200kohm	12.5	12.86	12.00	13.00	%	Pass
20-30% range UST 400k	25.00	25.58	23.50	26.50	%	Pass

***** End of Certificate *****

Technician



Justin Smith - Technician

Shermco
RF 73



OMICRON electronics Corp USA
60 Hickory Drive
02451 Waltham MA
1-800 OMICRON
info.usa@omicron.at
www.omicronenergy.com



Certificate of Calibration and Conformance

Conformance

OMICRON electronics Corp USA certifies that the product detailed below (CMC 356, FC578K) has been tested and calibrated using adequate test equipment and appropriate test procedures as specified by OMICRON electronics GmbH.
All necessary repairs were executed following repair instructions defined by OMICRON electronics GmbH using only original components.

We confirm that the product complies with all relevant specifications published in the original manual. It passed all executed tests successfully.

More detailed test data can be found on the enclosed documents.

Traceability Information

All accuracy relevant Test Equipment is traceable to national standards (ÖKD, DKD, NATA, NIST, NPL, PTB, BNM etc.). Some measurements are traceable to natural physical constants, consensus standards or ratio type measurements. Supporting documentation relative to traceability is available for review by appointment. This report shall not be reproduced, except in full, without prior written approval of the calibration facility.

Device Type	CMC 356
Serial Number	FC578K
Options	ELT1
Calibration Date	2019-12-27

Model	Manufacturer	Type	SerialNo	TraceNo	Calibrated Due
3458A	Agilent	DMM	MY45047610	12-054	2020-04-03
CNT-90	Pendulum	Counter	133754	10-135	2020-07-11
175H1	Testo	Climate	40384549	18-060	2021-05-24
1282-0.1	Burster	Shunt	372472	12-043	2020-09-06
1282-0.01	Burster	Shunt	376779	12-044	2020-09-09
OPM200	OMICRON	Phase Meter	12-004	12-004	2020-04-11
FCS Box	OMICRON	FCS Adapter		12-049	2020-04-11

Date of Issue
2019-12-27

Test Engineer

Carlos Carela

Carlos Carela

Calibration Report

General Information

Calibration Date: 2019-12-27
Object: CMC 356
Serial Number: FC578K
Options: ELT1
Manufacturer: OMICRON

Order No:
Customer: Shermco Industries Canada Inc.

Calibration Company: O M I C R O N electronics Corp USA
60 Hickory Drive
02451 Waltham MA
Test Engineer: Carlos Carela

Overall Result / Conformity

Specified Assessments: 418
Passed: 418
Failed: 0
Not Assessed: 0
Adjustment Recommended: 0

Procedure

Name: CMC356 Calibration
Field Calibration Software: 3.63
Calibration Script: 3.41
Comment:

Ambient Conditions

Temperature:	22.8 °C (73.0 °F)	23.0±3.0 °C (73.4±5.4 °F)
Rel. Humidity:	33.7 % RH	45.0±25.0 % RH

Calibration Reference Equipment

Model	Manufacturer	Type	SerialNo	TraceNo	Calibrated Due
3458A	Agilent	DMM	MY45047610	12-054	2020-04-03
CNT-90	Pendulum	Counter	133754	10-135	2020-07-11
175H1	Testo	Climate	40384549	18-060	2021-05-24
1282-0.1	Burster	Shunt	372472	12-043	2020-09-06
1282-0.01	Burster	Shunt	376779	12-044	2020-09-09
OPM200	OMICRON	Phase Meter	12-004	12-004	2020-04-11
FCS Box	OMICRON	FCS Adapter		12-049	2020-04-11

Test Results – Overview

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6.3	Phase Angle (relative to VA1)	32
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Test Results – Detail

1 Voltage Output

1.1 Amplitude Accuracy

VA1, Range I (0...150V)

Nominal in V	Frequency in Hz	Actual in V	Error in mV	±Spec in mV	of Spec in %	Verdict
-150.0	0.0	-150.0097	-9.7	250.0	-3.9	pass
-30.0	0.0	-30.0189	-18.9	154.0	-12.3	pass
30.0	0.0	29.9902	-9.8	154.0	-6.4	pass
150.0	0.0	150.0089	8.9	250.0	3.6	pass
30.0	55.0	30.0024	2.4	54.0	4.5	pass
150.0	55.0	150.0012	1.2	150.0	0.8	pass

VA1, Range II (0...300V)

Nominal in V	Frequency in Hz	Actual in V	Error in mV	±Spec in mV	of Spec in %	Verdict
-300.0	0.0	-300.0297	-29.7	400.0	-7.4	pass
-30.0	0.0	-30.0214	-21.4	184.0	-11.6	pass
30.0	0.0	29.9704	-29.6	184.0	-16.1	pass
300.0	0.0	300.0079	7.9	400.0	2.0	pass
30.0	55.0	30.0018	1.8	84.0	2.2	pass
300.0	55.0	300.0021	2.1	300.0	0.7	pass

VA2, Range I (0...150V)

Nominal in V	Frequency in Hz	Actual in V	Error in mV	±Spec in mV	of Spec in %	Verdict
-150.0	0.0	-150.0290	-29.0	250.0	-11.6	pass
-30.0	0.0	-30.0208	-20.8	154.0	-13.5	pass
30.0	0.0	29.9863	-13.7	154.0	-8.9	pass
150.0	0.0	150.0024	2.4	250.0	0.9	pass
30.0	55.0	30.0038	3.8	54.0	7.1	pass
150.0	55.0	150.0000	0.0	150.0	0.0	pass

VA2, Range II (0...300V)

Nominal in V	Frequency in Hz	Actual in V	Error in mV	±Spec in mV	of Spec in %	Verdict
-300.0	0.0	-300.0308	-30.8	400.0	-7.7	pass
-30.0	0.0	-30.0318	-31.8	184.0	-17.3	pass
30.0	0.0	29.9765	-23.5	184.0	-12.8	pass
300.0	0.0	300.0138	13.8	400.0	3.5	pass
30.0	55.0	30.0036	3.6	84.0	4.3	pass
300.0	55.0	299.9990	-1.0	300.0	-0.3	pass

VA3, Range I (0...150V)

Nominal in V	Frequency in Hz	Actual in V	Error in mV	±Spec in mV	of Spec in %	Verdict
-150.0	0.0	-150.0031	-3.1	250.0	-1.2	pass
-30.0	0.0	-30.0076	-7.6	154.0	-4.9	pass
30.0	0.0	30.0025	2.5	154.0	1.6	pass
150.0	0.0	150.0064	6.4	250.0	2.6	pass
30.0	55.0	30.0028	2.8	54.0	5.2	pass
150.0	55.0	149.9979	-2.1	150.0	-1.4	pass

VA3, Range II (0...300V)

Nominal in V	Frequency in Hz	Actual in V	Error in mV	±Spec in mV	of Spec in %	Verdict
-300.0	0.0	-300.0164	-16.4	400.0	-4.1	pass
-30.0	0.0	-30.0101	-10.1	184.0	-5.5	pass
30.0	0.0	29.9958	-4.2	184.0	-2.3	pass
300.0	0.0	300.0022	2.2	400.0	0.6	pass
30.0	55.0	30.0026	2.6	84.0	3.1	pass
300.0	55.0	299.9958	-4.2	300.0	-1.4	pass

VA4, Range I (0...150V)

Nominal in V	Frequency in Hz	Actual in V	Error in mV	±Spec in mV	of Spec in %	Verdict
-150.0	0.0	-150.0111	-11.1	250.0	-4.5	pass
-30.0	0.0	-30.0096	-9.6	154.0	-6.2	pass
30.0	0.0	29.9973	-2.7	154.0	-1.8	pass
150.0	0.0	150.0029	2.9	250.0	1.2	pass
30.0	55.0	30.0030	3.0	54.0	5.5	pass
150.0	55.0	149.9998	-0.2	150.0	-0.1	pass

VA4, Range II (0...300V)

Nominal in V	Frequency in Hz	Actual in V	Error in mV	±Spec in mV	of Spec in %	Verdict
-300.0	0.0	-300.0147	-14.7	400.0	-3.7	pass
-30.0	0.0	-30.0091	-9.1	184.0	-5.0	pass
30.0	0.0	29.9954	-4.6	184.0	-2.5	pass
300.0	0.0	300.0113	11.3	400.0	2.8	pass
30.0	55.0	30.0023	2.3	84.0	2.8	pass
300.0	55.0	299.9988	-1.2	300.0	-0.4	pass

1.2 Harmonic Distortion (THD+N)
VA1, Range I (0...150V)

Amplitude in V	Frequency in Hz	Nominal THD+N in %	Actual THD+N in %	±Spec in %	of Spec in %	Verdict
150.0	55.0	0.0000	0.0053	0.0500	10.6	pass

VA1, Range II (0...300V)

Amplitude in V	Frequency in Hz	Nominal THD+N in %	Actual THD+N in %	±Spec in %	of Spec in %	Verdict
300.0	55.0	0.0000	0.0042	0.0500	8.4	pass

VA2, Range I (0...150V)

Amplitude in V	Frequency in Hz	Nominal THD+N in %	Actual THD+N in %	±Spec in %	of Spec in %	Verdict
150.0	55.0	0.0000	0.0053	0.0500	10.6	pass

VA2, Range II (0...300V)

Amplitude in V	Frequency in Hz	Nominal THD+N in %	Actual THD+N in %	±Spec in %	of Spec in %	Verdict
300.0	55.0	0.0000	0.0042	0.0500	8.4	pass

VA3, Range I (0...150V)

Amplitude in V	Frequency in Hz	Nominal THD+N in %	Actual THD+N in %	±Spec in %	of Spec in %	Verdict
150.0	55.0	0.0000	0.0045	0.0500	9.1	pass

VA3, Range II (0...300V)

Amplitude	Frequency	Nominal	Actual	±Spec	of Spec	Verdict
in V	in Hz	THD+N in %	THD+N in %	in %	in %	
300.0	55.0	0.0000	0.0034	0.0500	6.7	pass

VA4, Range I (0...150V)

Amplitude	Frequency	Nominal	Actual	±Spec	of Spec	Verdict
in V	in Hz	THD+N in %	THD+N in %	in %	in %	
150.0	55.0	0.0000	0.0046	0.0500	9.3	pass

VA4, Range II (0...300V)

Amplitude	Frequency	Nominal	Actual	±Spec	of Spec	Verdict
in V	in Hz	THD+N in %	THD+N in %	in %	in %	
300.0	55.0	0.0000	0.0034	0.0500	6.9	pass

1.3 Phase Angle (relative to VA1)
VA2, Range I (0...150V)

Amplitude	Frequency	Nominal	Actual	Error	±Spec	of Spec	Verdict
in V	in Hz	in °	in °	in °	in °	in %	
100.0	55.57	0.000	-0.001	-0.001	0.100	-0.7	pass

VA2, Range II (0...300V)

Amplitude	Frequency	Nominal	Actual	Error	±Spec	of Spec	Verdict
in V	in Hz	in °	in °	in °	in °	in %	
100.0	55.57	0.000	-0.001	-0.001	0.100	-1.0	pass

VA3, Range I (0...150V)

Amplitude	Frequency	Nominal	Actual	Error	±Spec	of Spec	Verdict
in V	in Hz	in °	in °	in °	in °	in %	
100.0	55.57	0.000	0.000	0.000	0.100	-0.4	pass

VA3, Range II (0...300V)

Amplitude	Frequency	Nominal	Actual	Error	±Spec	of Spec	Verdict
in V	in Hz	in °	in °	in °	in °	in %	
100.0	55.57	0.000	-0.001	-0.001	0.100	-0.8	pass

VA4, Range I (0...150V)

Amplitude in V	Frequency in Hz	Nominal in °	Actual in °	Error in °	±Spec in °	of Spec in %	Verdict
100.0	55.57	0.000	-0.001	-0.001	0.100	-0.7	pass

VA4, Range II (0...300V)

Amplitude in V	Frequency in Hz	Nominal in °	Actual in °	Error in °	±Spec in °	of Spec in %	Verdict
100.0	55.57	0.000	-0.001	-0.001	0.100	-1.0	pass

2 Current Output

2.1 Amplitude Accuracy, Group A

IA1 (Range 0..32A)

Used shunt for currents up to 12.5 A: Burster 1282-0.1

Used shunt for higher currents: Burster 1282-0.01

Nominal in A	Frequency in Hz	Actual in A	Error in mA	±Spec in mA	of Spec in %	Verdict
-20.0	0.0	-20.0049	-4.9	56.0	-8.8	pass
-3.2	0.0	-3.2013	-1.3	30.8	-4.3	pass
3.2	0.0	3.2005	0.5	30.8	1.7	pass
20.0	0.0	20.0072	7.2	56.0	12.8	pass
3.2	55.0	3.2014	1.4	20.8	6.6	pass
20.0	55.0	20.0180	18.0	46.0	39.2	pass

IA2 (Range 0..32A)

Used shunt for currents up to 12.5 A: Burster 1282-0.1

Used shunt for higher currents: Burster 1282-0.01

Nominal in A	Frequency in Hz	Actual in A	Error in mA	±Spec in mA	of Spec in %	Verdict
-20.0	0.0	-20.0059	-5.9	56.0	-10.5	pass
-3.2	0.0	-3.2008	-0.8	30.8	-2.7	pass
3.2	0.0	3.2014	1.4	30.8	4.4	pass
20.0	0.0	20.0065	6.5	56.0	11.6	pass
3.2	55.0	3.2015	1.5	20.8	7.0	pass
20.0	55.0	20.0186	18.6	46.0	40.4	pass

IA3 (Range 0..32A)

Used shunt for currents up to 12.5 A: Burster 1282-0.1

Used shunt for higher currents: Burster 1282-0.01

Nominal	Frequency	Actual	Error	±Spec	of Spec	Verdict
in A	in Hz	in A	in mA	in mA	in %	
-20.0	0.0	-20.0041	-4.1	56.0	-7.3	pass
-3.2	0.0	-3.2028	-2.8	30.8	-9.0	pass
3.2	0.0	3.2002	0.2	30.8	0.5	pass
20.0	0.0	20.0051	5.1	56.0	9.1	pass
3.2	55.0	3.2014	1.4	20.8	6.7	pass
20.0	55.0	20.0177	17.7	46.0	38.5	pass

2.2 Amplitude Accuracy, Group B

IB1 (Range 0..32A)

Used shunt for currents up to 12.5 A: Burster 1282-0.1

Used shunt for higher currents: Burster 1282-0.01

Nominal	Frequency	Actual	Error	±Spec	of Spec	Verdict
in A	in Hz	in A	in mA	in mA	in %	
-20.0	0.0	-20.0016	-1.6	56.0	-2.9	pass
-3.2	0.0	-3.2013	-1.3	30.8	-4.3	pass
3.2	0.0	3.1993	-0.7	30.8	-2.4	pass
20.0	0.0	20.0025	2.5	56.0	4.4	pass
3.2	55.0	3.2008	0.8	20.8	4.0	pass
20.0	55.0	20.0136	13.6	46.0	29.5	pass

IB2 (Range 0..32A)

Used shunt for currents up to 12.5 A: Burster 1282-0.1

Used shunt for higher currents: Burster 1282-0.01

Nominal	Frequency	Actual	Error	±Spec	of Spec	Verdict
in A	in Hz	in A	in mA	in mA	in %	
-20.0	0.0	-20.0047	-4.7	56.0	-8.4	pass
-3.2	0.0	-3.2027	-2.7	30.8	-8.9	pass
3.2	0.0	3.1996	-0.4	30.8	-1.3	pass
20.0	0.0	20.0040	4.0	56.0	7.2	pass
3.2	55.0	3.2012	1.2	20.8	6.0	pass
20.0	55.0	20.0172	17.2	46.0	37.4	pass

IB3 (Range 0..32A)

Used shunt for currents up to 12.5 A: Burster 1282-0.1

Used shunt for higher currents: Burster 1282-0.01

Nominal	Frequency	Actual	Error	±Spec	of Spec	Verdict
in A	in Hz	in A	in mA	in mA	in %	
-20.0	0.0	-20.0012	-1.2	56.0	-2.1	pass
-3.2	0.0	-3.2011	-1.1	30.8	-3.4	pass
3.2	0.0	3.1987	-1.3	30.8	-4.1	pass
20.0	0.0	20.0049	4.9	56.0	8.8	pass
3.2	55.0	3.2010	1.0	20.8	4.8	pass
20.0	55.0	20.0155	15.5	46.0	33.7	pass

2.3 Harmonic Distortion (THD+N), Group A

IA1 (Range 0..32A)

Used shunt: Burster 1282-0.01

Amplitude	Frequency	Nominal	Actual	±Spec	of Spec	Verdict
in A	in Hz	THD+N in %	THD+N in %	in %	in %	
20.0	55.0	0.000	0.012	0.150	7.8	pass

IA2 (Range 0..32A)

Used shunt: Burster 1282-0.01

Amplitude	Frequency	Nominal	Actual	±Spec	of Spec	Verdict
in A	in Hz	THD+N in %	THD+N in %	in %	in %	
20.0	55.0	0.000	0.011	0.150	7.6	pass

IA3 (Range 0..32A)

Used shunt: Burster 1282-0.01

Amplitude	Frequency	Nominal	Actual	±Spec	of Spec	Verdict
in A	in Hz	THD+N in %	THD+N in %	in %	in %	
20.0	55.0	0.000	0.011	0.150	7.4	pass

2.4 Harmonic Distortion (THD+N), Group B

IB1 (Range 0..32A)

Used shunt: Burster 1282-0.01

Amplitude in A	Frequency in Hz	Nominal THD+N in %	Actual THD+N in %	±Spec in %	of Spec in %	Verdict
20.0	55.0	0.000	0.012	0.150	8.3	pass

IB2 (Range 0..32A)

Used shunt: Burster 1282-0.01

Amplitude in A	Frequency in Hz	Nominal THD+N in %	Actual THD+N in %	±Spec in %	of Spec in %	Verdict
20.0	55.0	0.000	0.012	0.150	7.9	pass

IB3 (Range 0..32A)

Used shunt: Burster 1282-0.01

Amplitude in A	Frequency in Hz	Nominal THD+N in %	Actual THD+N in %	±Spec in %	of Spec in %	Verdict
20.0	55.0	0.000	0.011	0.150	7.1	pass

2.5 Phase Angle (relative to VA1), Group A

IA1 (Range 0...32A)

Amplitude in A	Frequency in Hz	Nominal in °	Actual in °	Error in °	±Spec in °	of Spec in %	Verdict
1.0	55.57	0.000	0.012	0.012	0.200	6.1	pass
10.0	55.57	0.000	0.011	0.011	0.200	5.7	pass

IA2 (Range 0...32A)

Amplitude in A	Frequency in Hz	Nominal in °	Actual in °	Error in °	±Spec in °	of Spec in %	Verdict
1.0	55.57	0.000	0.013	0.013	0.200	6.4	pass
10.0	55.57	0.000	0.012	0.012	0.200	6.0	pass

IA3 (Range 0...32A)

Amplitude in A	Frequency in Hz	Nominal in °	Actual in °	Error in °	±Spec in °	of Spec in %	Verdict
1.0	55.57	0.000	0.017	0.017	0.200	8.4	pass
10.0	55.57	0.000	0.014	0.014	0.200	7.2	pass

2.6 Phase Angle (relative to VA1), Group B
IB1 (Range 0...32A)

Amplitude in A	Frequency in Hz	Nominal in °	Actual in °	Error in °	±Spec in °	of Spec in %	Verdict
1.0	55.57	0.000	0.013	0.013	0.200	6.5	pass
10.0	55.57	0.000	0.012	0.012	0.200	6.1	pass

IB2 (Range 0...32A)

Amplitude in A	Frequency in Hz	Nominal in °	Actual in °	Error in °	±Spec in °	of Spec in %	Verdict
1.0	55.57	0.000	0.012	0.012	0.200	5.8	pass
10.0	55.57	0.000	0.011	0.011	0.200	5.7	pass

IB3 (Range 0...32A)

Amplitude in A	Frequency in Hz	Nominal in °	Actual in °	Error in °	±Spec in °	of Spec in %	Verdict
1.0	55.57	0.000	0.015	0.015	0.200	7.3	pass
10.0	55.57	0.000	0.013	0.013	0.200	6.7	pass

3 Analog DC Input (UDC, IDC)

Voltage Accuracy UDC

Nominal in V	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
-7.0	-7.00107	-7.00035	0.72	2.00	36.0	pass
7.0	7.00130	7.00040	-0.90	2.00	-45.1	pass

3.1 Current Accuracy IDC

Range 1 mA

Nominal in mA	Actual in μ A	Measured in μ A	Error in nA	±Spec in nA	of Spec in %	Verdict
-1	-992.524	-992.420	104	200	51.9	pass
1	994.619	994.520	-99	200	-49.6	pass

Range 20 mA

Nominal in mA	Actual in mA	Measured in mA	Error in μ A	±Spec in μ A	of Spec in %	Verdict
-20	-19.90182	-19.90050	1.32	4.00	33.0	pass
20	19.90500	19.90350	-1.50	4.00	-37.4	pass

4 Binary / Analog Input

4.1 Threshold Binary Input

4.1.1 Potential Free

Binary Input 1

Nominal State	Actual State	Verdict
open	open	pass
close	close	pass
open	open	pass

Binary Input 2

Nominal State	Actual State	Verdict
open	open	pass
close	close	pass
open	open	pass

Binary Input 3

Nominal State	Actual State	Verdict
open	open	pass
close	close	pass
open	open	pass

Binary Input 4

Nominal State	Actual State	Verdict
open	open	pass
close	close	pass
open	open	pass

Binary Input 5

Nominal State	Actual State	Verdict
open	open	pass
close	close	pass
open	open	pass



Binary Input 6

Nominal State	Actual State	Verdict
open	open	pass
close	close	pass
open	open	pass

Binary Input 7

Nominal State	Actual State	Verdict
open	open	pass
close	close	pass
open	open	pass

Binary Input 8

Nominal State	Actual State	Verdict
open	open	pass
close	close	pass
open	open	pass

Binary Input 9

Nominal State	Actual State	Verdict
open	open	pass
close	close	pass
open	open	pass

Binary Input 10

Nominal State	Actual State	Verdict
open	open	pass
close	close	pass
open	open	pass

4.1.2 Potential Sensitive

Binary Input 1

Nominal in V	Threshold in V	Range in V	Error in V	±Spec in V	of Spec in %	Verdict
90.0	88.18	100.0	-1.82	4.00	-45.5	pass

Nominal in V	Hysteresis in V	Range in V	min Spec in mV	max Spec in V	Verdict
90.0	4.00	100.0	280	10.50	pass

Binary Input 2

Nominal in V	Threshold in V	Range in V	Error in V	±Spec in V	of Spec in %	Verdict
90.0	88.18	100.0	-1.82	4.00	-45.5	pass

Nominal in V	Hysteresis in V	Range in V	min Spec in mV	max Spec in V	Verdict
90.0	4.40	100.0	280	10.50	pass

Binary Input 3

Nominal in V	Threshold in V	Range in V	Error in V	±Spec in V	of Spec in %	Verdict
90.0	87.78	100.0	-2.22	4.00	-55.5	pass

Nominal in V	Hysteresis in V	Range in V	min Spec in mV	max Spec in V	Verdict
90.0	4.00	100.0	280	10.50	pass

Binary Input 4

Nominal in V	Threshold in V	Range in V	Error in V	±Spec in V	of Spec in %	Verdict
90.0	87.78	100.0	-2.22	4.00	-55.5	pass

Nominal in V	Hysteresis in V	Range in V	min Spec in mV	max Spec in V	Verdict
90.0	4.40	100.0	280	10.50	pass

Binary Input 5

Nominal in V	Threshold in V	Range in V	Error in V	±Spec in V	of Spec in %	Verdict
90.0	88.58	100.0	-1.42	4.00	-35.5	pass

Nominal in V	Hysteresis in V	Range in V	min Spec in mV	max Spec in V	Verdict
90.0	4.00	100.0	280	10.50	pass

Binary Input 6

Nominal in V	Threshold in V	Range in V	Error in V	±Spec in V	of Spec in %	Verdict
90.0	87.78	100.0	-2.22	4.00	-55.5	pass

Nominal in V	Hysteresis in V	Range in V	min Spec in mV	max Spec in V	Verdict
90.0	4.00	100.0	280	10.50	pass

Binary Input 7

Nominal in V	Threshold in V	Range in V	Error in V	±Spec in V	of Spec in %	Verdict
90.0	88.18	100.0	-1.82	4.00	-45.5	pass

Nominal in V	Hysteresis in V	Range in V	min Spec in mV	max Spec in V	Verdict
90.0	3.60	100.0	280	10.50	pass

Binary Input 8

Nominal in V	Threshold in V	Range in V	Error in V	±Spec in V	of Spec in %	Verdict
90.0	87.38	100.0	-2.62	4.00	-65.5	pass

Nominal in V	Hysteresis in V	Range in V	min Spec in mV	max Spec in V	Verdict
90.0	4.00	100.0	280	10.50	pass

Binary Input 9

Nominal in V	Threshold in V	Range in V	Error in V	±Spec in V	of Spec in %	Verdict
90.0	88.98	100.0	-1.02	4.00	-25.5	pass

Nominal in V	Hysteresis in V	Range in V	min Spec in mV	max Spec in V	Verdict
90.0	3.60	100.0	280	10.50	pass

Binary Input 10

Nominal in V	Threshold in V	Range in V	Error in V	±Spec in V	of Spec in %	Verdict
90.0	87.78	100.0	-2.22	4.00	-55.5	pass

Nominal in V	Hysteresis in V	Range in V	min Spec in mV	max Spec in V	Verdict
90.0	4.00	100.0	280	10.50	pass

4.2 Voltage Accuracy Analog Input

Sampling Rate= 28.44 kHz

4.2.1 Analog Input 1

Range 0.1 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in μ V	±Spec in μ V	of Spec in %	Verdict
0.01	0.0	0.009920	0.009898	-23	450	-5.0	pass
0.10	0.0	0.100021	0.100054	33	450	7.4	pass
0.01	55.0	0.010005	0.009970	-34	300	-11.4	pass
0.10	55.0	0.100013	0.100042	29	300	9.6	pass

Range 1 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
0.1	0.0	0.10002	0.09985	-0.17	4.00	-4.3	pass
1.0	0.0	1.00016	1.00037	0.21	4.00	5.2	pass
0.1	55.0	0.10001	0.09969	-0.33	1.50	-21.7	pass
1.0	55.0	1.00013	1.00031	0.18	1.50	11.7	pass



Range 10 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
1.0	0.0	1.0002	0.9994	-0.7	40.0	-1.8	pass
10.0	0.0	9.9914	9.9922	0.8	40.0	1.9	pass
1.0	55.0	1.0001	0.9967	-3.5	15.0	-23.1	pass
10.0	55.0	10.0016	10.0020	0.3	15.0	2.1	pass

Range 100 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
10.0	0.0	9.991	9.969	-22	400	-5.6	pass
100.0	0.0	99.997	100.000	3	400	0.7	pass
10.0	55.0	10.002	9.966	-35	150	-23.6	pass
100.0	55.0	100.006	100.006	0	150	-0.3	pass

Range 600 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in V	±Spec in V	of Spec in %	Verdict
60.0	0.0	59.998	59.857	-0.141	2.400	-5.9	pass
300.0	0.0	300.009	299.984	-0.024	2.400	-1.0	pass
60.0	55.0	60.004	59.661	-0.342	0.900	-38.0	pass
300.0	55.0	300.004	299.859	-0.145	0.900	-16.1	pass

4.2.2 Analog Input 2

Range 0.1 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in μ V	±Spec in μ V	of Spec in %	Verdict
0.01	0.0	0.009920	0.009783	-138	450	-30.6	pass
0.10	0.0	0.100021	0.099918	-102	450	-22.7	pass
0.01	55.0	0.010005	0.009970	-34	300	-11.4	pass
0.10	55.0	0.100013	0.100035	21	300	7.1	pass

Range 1 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
0.1	0.0	0.10002	0.10020	0.17	4.00	4.4	pass
1.0	0.0	1.00016	1.00070	0.54	4.00	13.6	pass
0.1	55.0	0.10001	0.09969	-0.32	1.50	-21.5	pass

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
1.0	55.0	1.00013	1.00037	0.24	1.50	15.8	pass

Range 10 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
1.0	0.0	1.0002	1.0031	2.9	40.0	7.3	pass
10.0	0.0	9.9914	9.9971	5.6	40.0	14.1	pass
1.0	55.0	1.0001	0.9967	-3.5	15.0	-23.0	pass
10.0	55.0	10.0016	10.0020	0.3	15.0	2.1	pass

Range 100 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
10.0	0.0	9.991	9.996	5	400	1.2	pass
100.0	0.0	99.997	100.023	26	400	6.6	pass
10.0	55.0	10.002	9.967	-35	150	-23.2	pass
100.0	55.0	100.006	100.010	3	150	2.3	pass

Range 600 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in V	±Spec in V	of Spec in %	Verdict
60.0	0.0	59.998	60.121	0.123	2.400	5.1	pass
300.0	0.0	300.009	300.297	0.288	2.400	12.0	pass
60.0	55.0	60.004	59.684	-0.320	0.900	-35.6	pass
300.0	55.0	300.004	299.875	-0.129	0.900	-14.4	pass

4.2.3 Analog Input 3

Range 0.1 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in μ V	±Spec in μ V	of Spec in %	Verdict
0.01	0.0	0.009920	0.009795	-126	450	-27.9	pass
0.10	0.0	0.100021	0.099966	-55	450	-12.1	pass
0.01	55.0	0.010005	0.009971	-33	300	-11.1	pass
0.10	55.0	0.100013	0.100048	35	300	11.6	pass

Range 1 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
0.1	0.0	0.10002	0.10000	-0.03	4.00	-0.6	pass
1.0	0.0	1.00016	1.00061	0.45	4.00	11.3	pass
0.1	55.0	0.10001	0.09970	-0.31	1.50	-20.8	pass
1.0	55.0	1.00013	1.00046	0.33	1.50	21.9	pass

Range 10 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
1.0	0.0	1.0002	0.9985	-1.7	40.0	-4.2	pass
10.0	0.0	9.9914	9.9968	5.4	40.0	13.5	pass
1.0	55.0	1.0001	0.9968	-3.3	15.0	-22.3	pass
10.0	55.0	10.0016	10.0034	1.8	15.0	11.9	pass

Range 100 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
10.0	0.0	9.991	9.993	1	400	0.3	pass
100.0	0.0	99.997	100.025	28	400	7.1	pass
10.0	55.0	10.002	9.968	-33	150	-22.3	pass
100.0	55.0	100.006	100.022	15	150	10.1	pass

Range 600 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in V	±Spec in V	of Spec in %	Verdict
60.0	0.0	59.998	59.975	-0.023	2.400	-1.0	pass
300.0	0.0	300.009	300.172	0.163	2.400	6.8	pass
60.0	55.0	60.004	59.652	-0.351	0.900	-39.0	pass
300.0	55.0	300.004	299.875	-0.129	0.900	-14.4	pass

4.2.4 Analog Input 4

Range 0.1 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in μ V	$\pm$ Spec in μ V	of Spec in %	Verdict
0.01	0.0	0.009920	0.009910	-10	450	-2.3	pass
0.10	0.0	0.100021	0.100004	-16	450	-3.7	pass
0.01	55.0	0.010005	0.009966	-38	300	-12.8	pass
0.10	55.0	0.100013	0.099987	-26	300	-8.8	pass

Range 1 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	$\pm$ Spec in mV	of Spec in %	Verdict
0.1	0.0	0.10002	0.10011	0.08	4.00	2.1	pass
1.0	0.0	1.00016	1.00018	0.03	4.00	0.6	pass
0.1	55.0	0.10001	0.09964	-0.37	1.50	-24.7	pass
1.0	55.0	1.00013	0.99995	-0.17	1.50	-11.7	pass

Range 10 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	$\pm$ Spec in mV	of Spec in %	Verdict
1.0	0.0	1.0002	1.0016	1.5	40.0	3.6	pass
10.0	0.0	9.9914	9.9919	0.5	40.0	1.3	pass
1.0	55.0	1.0001	0.9962	-3.9	15.0	-26.0	pass
10.0	55.0	10.0016	9.9983	-3.3	15.0	-22.3	pass

Range 100 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	$\pm$ Spec in mV	of Spec in %	Verdict
10.0	0.0	9.991	9.997	6	400	1.4	pass
100.0	0.0	99.997	99.996	-1	400	-0.2	pass
10.0	55.0	10.002	9.963	-39	150	-26.0	pass
100.0	55.0	100.006	99.967	-40	150	-26.4	pass

Range 600 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in V	$\pm$ Spec in V	of Spec in %	Verdict
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Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in V	±Spec in V	of Spec in %	Verdict
60.0	0.0	59.998	59.986	-0.012	2.400	-0.5	pass
300.0	0.0	300.009	300.156	0.148	2.400	6.1	pass
60.0	55.0	60.004	59.682	-0.322	0.900	-35.8	pass
300.0	55.0	300.004	299.781	-0.223	0.900	-24.8	pass

4.2.5 Analog Input 5

Range 0.1 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in μ V	±Spec in μ V	of Spec in %	Verdict
0.01	0.0	0.009920	0.009788	-132	450	-29.4	pass
0.10	0.0	0.100021	0.099949	-72	450	-15.9	pass
0.01	55.0	0.010005	0.009971	-33	300	-11.1	pass
0.10	55.0	0.100013	0.100037	23	300	7.7	pass

Range 1 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
0.1	0.0	0.10002	0.10030	0.28	4.00	6.9	pass
1.0	0.0	1.00016	1.00104	0.88	4.00	22.0	pass
0.1	55.0	0.10001	0.09969	-0.32	1.50	-21.6	pass
1.0	55.0	1.00013	1.00031	0.18	1.50	11.7	pass

Range 10 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
1.0	0.0	1.0002	1.0002	0.1	40.0	0.1	pass
10.0	0.0	9.9914	9.9966	5.2	40.0	12.9	pass
1.0	55.0	1.0001	0.9967	-3.4	15.0	-22.6	pass
10.0	55.0	10.0016	10.0027	1.1	15.0	7.0	pass

Range 100 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
10.0	0.0	9.991	10.007	16	400	3.9	pass
100.0	0.0	99.997	100.018	21	400	5.1	pass
10.0	55.0	10.002	9.968	-34	150	-22.7	pass
100.0	55.0	100.006	100.010	3	150	2.3	pass

Range 600 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in V	±Spec in V	of Spec in %	Verdict
60.0	0.0	59.998	60.111	0.113	2.400	4.7	pass
300.0	0.0	300.009	300.250	0.241	2.400	10.1	pass
60.0	55.0	60.004	59.653	-0.350	0.900	-38.9	pass
300.0	55.0	300.004	299.844	-0.160	0.900	-17.8	pass

4.2.6

Analog Input 6

Range 0.1 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in μ V	±Spec in μ V	of Spec in %	Verdict
0.01	0.0	0.009920	0.009890	-30	450	-6.7	pass
0.10	0.0	0.100021	0.100031	10	450	2.3	pass
0.01	55.0	0.010005	0.009969	-35	300	-11.7	pass
0.10	55.0	0.100013	0.100031	17	300	5.8	pass

Range 1 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
0.1	0.0	0.10002	0.10026	0.24	4.00	6.0	pass
1.0	0.0	1.00016	1.00061	0.45	4.00	11.3	pass
0.1	55.0	0.10001	0.09968	-0.33	1.50	-22.2	pass
1.0	55.0	1.00013	1.00031	0.18	1.50	11.7	pass

Range 10 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
1.0	0.0	1.0002	1.0032	3.0	40.0	7.6	pass
10.0	0.0	9.9914	9.9978	6.4	40.0	15.9	pass
1.0	55.0	1.0001	0.9966	-3.5	15.0	-23.2	pass
10.0	55.0	10.0016	10.0012	-0.4	15.0	-2.8	pass

Range 100 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
10.0	0.0	9.991	9.994	2	400	0.6	pass
100.0	0.0	99.997	100.010	13	400	3.2	pass
10.0	55.0	10.002	9.966	-36	150	-23.9	pass



Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
100.0	55.0	100.006	100.002	-4	150	-2.9	pass

Range 600 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in V	±Spec in V	of Spec in %	Verdict
60.0	0.0	59.998	60.103	0.104	2.400	4.4	pass
300.0	0.0	300.009	300.398	0.390	2.400	16.2	pass
60.0	55.0	60.004	59.682	-0.322	0.900	-35.8	pass
300.0	55.0	300.004	299.859	-0.145	0.900	-16.1	pass

4.2.7 Analog Input 7

Range 0.1 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in μ V	±Spec in μ V	of Spec in %	Verdict
0.01	0.0	0.009920	0.009860	-61	450	-13.5	pass
0.10	0.0	0.100021	0.100002	-18	450	-4.1	pass
0.01	55.0	0.010005	0.009969	-35	300	-11.8	pass
0.10	55.0	0.100013	0.100021	8	300	2.7	pass

Range 1 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
0.1	0.0	0.10002	0.10026	0.24	4.00	6.0	pass
1.0	0.0	1.00016	1.00055	0.39	4.00	9.8	pass
0.1	55.0	0.10001	0.09968	-0.34	1.50	-22.4	pass
1.0	55.0	1.00013	1.00015	0.02	1.50	1.6	pass

Range 10 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
1.0	0.0	1.0002	0.9993	-0.9	40.0	-2.3	pass
10.0	0.0	9.9914	9.9959	4.4	40.0	11.1	pass
1.0	55.0	1.0001	0.9966	-3.6	15.0	-23.7	pass
10.0	55.0	10.0016	10.0007	-0.9	15.0	-6.1	pass



Range 100 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
10.0	0.0	9.991	9.997	5	400	1.3	pass
100.0	0.0	99.997	100.006	9	400	2.2	pass
10.0	55.0	10.002	9.966	-36	150	-23.7	pass
100.0	55.0	100.006	99.992	-14	150	-9.4	pass

Range 600 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in V	±Spec in V	of Spec in %	Verdict
60.0	0.0	59.998	60.313	0.314	2.400	13.1	pass
300.0	0.0	300.009	300.289	0.280	2.400	11.7	pass
60.0	55.0	60.004	59.640	-0.364	0.900	-40.4	pass
300.0	55.0	300.004	299.813	-0.192	0.900	-21.3	pass

4.2.8 Analog Input 8

Range 0.1 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in μ V	±Spec in μ V	of Spec in %	Verdict
0.01	0.0	0.009920	0.009816	-104	450	-23.2	pass
0.10	0.0	0.100021	0.099913	-108	450	-24.0	pass
0.01	55.0	0.010005	0.009965	-40	300	-13.3	pass
0.10	55.0	0.100013	0.099979	-34	300	-11.3	pass

Range 1 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
0.1	0.0	0.10002	0.09981	-0.21	4.00	-5.3	pass
1.0	0.0	1.00016	1.00003	-0.13	4.00	-3.2	pass
0.1	55.0	0.10001	0.09963	-0.38	1.50	-25.5	pass
1.0	55.0	1.00013	0.99985	-0.28	1.50	-18.8	pass

Range 10 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
1.0	0.0	1.0002	0.9987	-1.5	40.0	-3.7	pass
10.0	0.0	9.9914	9.9900	-1.4	40.0	-3.6	pass
1.0	55.0	1.0001	0.9961	-4.0	15.0	-26.9	pass

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
10.0	55.0	10.0016	9.9968	-4.8	15.0	-32.1	pass

Range 100 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
10.0	0.0	9.991	9.985	-7	400	-1.7	pass
100.0	0.0	99.997	99.992	-5	400	-1.2	pass
10.0	55.0	10.002	9.961	-41	150	-27.3	pass
100.0	55.0	100.006	99.951	-55	150	-36.8	pass

Range 600 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in V	±Spec in V	of Spec in %	Verdict
60.0	0.0	59.998	59.939	-0.059	2.400	-2.4	pass
300.0	0.0	300.009	300.063	0.054	2.400	2.2	pass
60.0	55.0	60.004	59.659	-0.344	0.900	-38.3	pass
300.0	55.0	300.004	299.734	-0.270	0.900	-30.0	pass

4.2.9 Analog Input 9

Range 0.1 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in μ V	±Spec in μ V	of Spec in %	Verdict
0.01	0.0	0.009920	0.009865	-55	450	-12.2	pass
0.10	0.0	0.100021	0.100008	-13	450	-2.8	pass
0.01	55.0	0.010005	0.009971	-34	300	-11.2	pass
0.10	55.0	0.100013	0.100023	10	300	3.3	pass

Range 1 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
0.1	0.0	0.10002	0.10003	0.00	4.00	0.1	pass
1.0	0.0	1.00016	1.00040	0.24	4.00	6.0	pass
0.1	55.0	0.10001	0.09970	-0.31	1.50	-20.7	pass
1.0	55.0	1.00013	1.00031	0.18	1.50	11.7	pass

Range 10 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
1.0	0.0	1.0002	1.0006	0.4	40.0	1.1	pass
10.0	0.0	9.9914	9.9978	6.4	40.0	15.9	pass
1.0	55.0	1.0001	0.9968	-3.3	15.0	-22.3	pass
10.0	55.0	10.0016	10.0020	0.3	15.0	2.1	pass

Range 100 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
10.0	0.0	9.991	9.986	-5	400	-1.3	pass
100.0	0.0	99.997	100.010	13	400	3.2	pass
10.0	55.0	10.002	9.969	-33	150	-22.1	pass
100.0	55.0	100.006	100.014	7	150	4.9	pass

Range 600 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in V	±Spec in V	of Spec in %	Verdict
60.0	0.0	59.998	60.035	0.037	2.400	1.5	pass
300.0	0.0	300.009	300.133	0.124	2.400	5.2	pass
60.0	55.0	60.004	59.661	-0.342	0.900	-38.0	pass
300.0	55.0	300.004	299.852	-0.153	0.900	-17.0	pass

4.2.10 Analog Input 10

Range 0.1 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in µV	±Spec in µV	of Spec in %	Verdict
0.01	0.0	0.009920	0.009817	-103	450	-23.0	pass
0.10	0.0	0.100021	0.099964	-57	450	-12.6	pass
0.01	55.0	0.010005	0.009971	-33	300	-11.0	pass
0.10	55.0	0.100013	0.100046	33	300	10.9	pass

Range 1 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
0.1	0.0	0.10002	0.09999	-0.03	4.00	-0.8	pass
1.0	0.0	1.00016	1.00070	0.54	4.00	13.6	pass
0.1	55.0	0.10001	0.09969	-0.32	1.50	-21.6	pass



Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
1.0	55.0	1.00013	1.00034	0.21	1.50	13.8	pass

Range 10 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
1.0	0.0	1.0002	1.0019	1.7	40.0	4.3	pass
10.0	0.0	9.9914	9.9988	7.3	40.0	18.4	pass
1.0	55.0	1.0001	0.9967	-3.4	15.0	-22.6	pass
10.0	55.0	10.0016	10.0029	1.3	15.0	8.6	pass

Range 100 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in mV	±Spec in mV	of Spec in %	Verdict
10.0	0.0	9.991	10.015	24	400	6.0	pass
100.0	0.0	99.997	100.057	60	400	14.9	pass
10.0	55.0	10.002	9.968	-34	150	-22.4	pass
100.0	55.0	100.006	100.022	15	150	10.1	pass

Range 600 V

Nominal in V	Frequency in Hz	Actual in V	Measured in V	Error in V	±Spec in V	of Spec in %	Verdict
60.0	0.0	59.998	60.337	0.339	2.400	14.1	pass
300.0	0.0	300.009	300.523	0.515	2.400	21.4	pass
60.0	55.0	60.004	59.692	-0.311	0.900	-34.6	pass
300.0	55.0	300.004	299.906	-0.098	0.900	-10.9	pass

5 Frequency Test

Frequency Test LLOut 1

Amplitude	Nominal	Actual	Error	±Spec	of Spec	Verdict
in V	in Hz	in Hz	in Hz	in Hz	in %	
5.0	500.00000	499.999741	-0.000259	0.000750	-34.5	pass

6 Low Level Output 1-6

6.1 Amplitude Accuracy

LL out 1

Nominal	Frequency	Actual	Error	±Spec	of Spec	Verdict
in V	in Hz	in V	in mV	in mV	in %	
-7.0	0.0	-7.00108	-1.08	6.45	-16.7	pass
7.0	0.0	7.00131	1.31	6.45	20.4	pass
7.0	55.0	7.00124	1.24	4.95	25.0	pass

LL out 2

Nominal	Frequency	Actual	Error	±Spec	of Spec	Verdict
in V	in Hz	in V	in mV	in mV	in %	
-7.0	0.0	-7.00074	-0.74	6.45	-11.5	pass
7.0	0.0	7.00145	1.45	6.45	22.4	pass
7.0	55.0	7.00105	1.05	4.95	21.2	pass

LL out 3

Nominal	Frequency	Actual	Error	±Spec	of Spec	Verdict
in V	in Hz	in V	in mV	in mV	in %	
-7.0	0.0	-7.00089	-0.89	6.45	-13.8	pass
7.0	0.0	7.00139	1.39	6.45	21.6	pass
7.0	55.0	7.00129	1.29	4.95	26.1	pass

LL out 4

Nominal	Frequency	Actual	Error	±Spec	of Spec	Verdict
in V	in Hz	in V	in mV	in mV	in %	
-7.0	0.0	-7.00051	-0.51	6.45	-7.8	pass
7.0	0.0	7.00144	1.44	6.45	22.3	pass
7.0	55.0	7.00098	0.98	4.95	19.7	pass



LL out 5

Nominal in V	Frequency in Hz	Actual in V	Error in mV	±Spec in mV	of Spec in %	Verdict
-7.0	0.0	-7.00080	-0.80	6.45	-12.4	pass
7.0	0.0	7.00113	1.13	6.45	17.4	pass
7.0	55.0	7.00106	1.06	4.95	21.5	pass

LL out 6

Nominal in V	Frequency in Hz	Actual in V	Error in mV	±Spec in mV	of Spec in %	Verdict
-7.0	0.0	-7.00066	-0.66	6.45	-10.3	pass
7.0	0.0	7.00165	1.65	6.45	25.5	pass
7.0	55.0	7.00117	1.17	4.95	23.6	pass

6.2 Harmonic Distortion (THD+N)

LL out 1

Amplitude in V	Frequency in Hz	Nominal THD+N in %	Actual THD+N in %	±Spec in %	of Spec in %	Verdict
7.0	55.0	0.0000	0.0029	0.0500	5.7	pass

LL out 2

Amplitude in V	Frequency in Hz	Nominal THD+N in %	Actual THD+N in %	±Spec in %	of Spec in %	Verdict
7.0	55.0	0.0000	0.0028	0.0500	5.6	pass

LL out 3

Amplitude in V	Frequency in Hz	Nominal THD+N in %	Actual THD+N in %	±Spec in %	of Spec in %	Verdict
7.0	55.0	0.0000	0.0032	0.0500	6.3	pass

LL out 4

Amplitude in V	Frequency in Hz	Nominal THD+N in %	Actual THD+N in %	±Spec in %	of Spec in %	Verdict
7.0	55.0	0.0000	0.0028	0.0500	5.6	pass

LL out 5

Amplitude in V	Frequency in Hz	Nominal THD+N in %	Actual THD+N in %	±Spec in %	of Spec in %	Verdict
7.0	55.0	0.0000	0.0028	0.0500	5.6	pass

LL out 6

Amplitude in V	Frequency in Hz	Nominal THD+N in %	Actual THD+N in %	±Spec in %	of Spec in %	Verdict
7.0	55.0	0.0000	0.0028	0.0500	5.6	pass

6.3 Phase Angle (relative to VA1)

LL out 1

Amplitude in V	Frequency in Hz	Nominal in °	Actual in °	Error in °	±Spec in °	of Spec in %	Verdict
5.0	55.57	0.000	-0.002	-0.002	0.100	-1.5	pass

LL out 2

Amplitude in V	Frequency in Hz	Nominal in °	Actual in °	Error in °	±Spec in °	of Spec in %	Verdict
5.0	55.57	0.000	-0.002	-0.002	0.100	-2.3	pass

LL out 3

Amplitude in V	Frequency in Hz	Nominal in °	Actual in °	Error in °	±Spec in °	of Spec in %	Verdict
5.0	55.57	0.000	-0.001	-0.001	0.100	-1.3	pass

LL out 4

Amplitude in V	Frequency in Hz	Nominal in °	Actual in °	Error in °	±Spec in °	of Spec in %	Verdict
5.0	55.57	0.000	-0.002	-0.002	0.100	-2.0	pass

LL out 5

Amplitude in V	Frequency in Hz	Nominal in °	Actual in °	Error in °	±Spec in °	of Spec in %	Verdict
5.0	55.57	0.000	-0.001	-0.001	0.100	-1.3	pass

LL out 6

Amplitude in V	Frequency in Hz	Nominal in °	Actual in °	Error in °	±Spec in °	of Spec in %	Verdict
5.0	55.57	0.000	-0.001	-0.001	0.100	-1.4	pass

7

Binary Output

Binary Output 1

Nominal State	Actual State	Verdict
open	open	pass
close	close	pass
open	open	pass

Binary Output 2

Nominal State	Actual State	Verdict
open	open	pass
close	close	pass
open	open	pass

Binary Output 3

Nominal State	Actual State	Verdict
open	open	pass
close	close	pass
open	open	pass

Binary Output 4

Nominal State	Actual State	Verdict
open	open	pass
close	close	pass
open	open	pass

8 AUX DC

Amplitude Accuracy

Nominal in V	Actual in V	Error in V	±Spec in V	of Spec in %	Verdict
66.0	66.28	0.28	3.30	8.4	pass
132.0	133.45	1.45	6.60	21.9	pass
264.0	267.60	3.60	13.20	27.3	pass

Appendix

Nomenclature

DUT:	Device Under Test
Actual:	Value measured by reference equipment
Nominal:	Nominal value output by the DUT or source
Measured:	Value measured by the device under test
Error:	Difference between the actual and nominal/measured value
	DUT output: Error = Actual – Nominal
	DUT input: Error = Measured – Actual
Spec:	Specification, i.e. allowed deviation
Of Spec:	Deviation from the specification in percent
	Of Spec = Error / Spec * 100
Amplitude:	Voltage or current amplitude (not assessed)
Frequency:	Nominal output frequency
Hysteresis:	Hysteresis = Upper Threshold – Lower Threshold
Threshold:	Value measured by reference equipment (upper threshold)
Range:	Range setting for DUT measurement
Verdict:	Evaluation of a measurement result
	n/a not assessed
	pass calibration / measurement result OK
	pass * calibration / measurement result OK but an adjustment at OMICRON is recommended
	fail return the unit to OMICRON for adjustment and calibration



Certificate of Calibration

Wirtanen Electric
a Finning Company
10235 - 180 Street Edmonton, AB T5S 1C1
PHONE: (780) 434-8421
www.catrents.ca



For Instrument	: Phenix 6CP50/10-3	Customer:	Shermco - Regina
Description	: 50kV Dielectric Test Set		1033 Kearns Cres.
Serial Number	: 19-3277		Regina, SK
Asset Number	: RF 54		S4P 3B2

Wirtanen Electric certifies that the above listed instrument meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the National Research Council of Canada (NRC) or the National Institute of Standards and Technology (NIST), or to NIST accepted intrinsic standards of measurement, or derived by the ratio type of self-calibration techniques.

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Quality Management system registered to ISO 9001: 2015

CALIBRATION INFORMATION

Cal Date:	8 Jul 2020	Temperature	20.7°C	Condition as Received/Returned:	IN TOLERANCE
Next Cal Due:	8 Jul 2021	Humidity	55 %		(Pass)
Remarks:					
Cal Procedure	Phenix 6CP50/10-3 50kVAC Dielectric Test Set	Revision	1.0		

STANDARDS USED FOR CALIBRATION

<u>Asset Number</u>	<u>Description</u>	<u>Cal Date</u>	<u>Due Date</u>
68383	North Star VD-180B 180kV High Voltage Probe	11 May 2020	11 May 2021
IW5447	Fluke 89IV Multimeter	11 Oct 2019	11 Oct 2020



Signed: _____

Justin Smith - Technician



Certificate of Calibration

Wirtanen Electric
a Finning Company
10235 - 180 Street Edmonton, AB T5S 1C1
PHONE: (780) 434-8421
www.catrents.ca



For Instrument	: AEMC 5050	Customer:	Shermco - Regina
Description	: MEGOHMMETER		1033 Kearns Cres.
Serial Number	: 236285HHDV		Regina, SK
Asset Number	: RF 69		S4P 3B2

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CALIBRATION INFORMATION

Cal Date:	8 Jul 2020	Temperature	20.0°C	Condition as Received/Returned:	IN TOLERANCE
Next Cal Due:	8 Jul 2021	Humidity	40 %		(Pass)
Remarks:					
Cal Procedure	AEMC 5050 Megohmmeter	Revision	1.0		

STANDARDS USED FOR CALIBRATION

<u>Asset Number</u>	<u>Description</u>	<u>Cal Date</u>	<u>Due Date</u>
31922	Fluke 5520A Calibrator	21 May 2020	21 May 2021
IW5210	Fluke 80K-40 HV Probe	05 Dec 2019	05 Dec 2020
IW5447	Fluke 89IV Multimeter	11 Oct 2019	11 Oct 2020
IW5702	WECO 1M-100G Resistance Box	30 Aug 2019	30 Aug 2020



Signed: _____

Chad Coene - Technician

SERIAL NUMBER: 236285HHDV

ASSET NUMBER: RF 69



Certificate of Calibration

The CAT Rental Store
Wirtanen Division
10235 - 180 Street Edmonton, AB T5L 3B2
PHONE: (780) 434-8421
www.catrents.ca



For Instrument : AEMC 6240
Description : MICRO-OHMMETER
Serial Number : 189368ELDV
Asset Number : RF 7

Customer: Shermco - Regina
1033 Kearns Cres.
Regina, SK
S4P 3B2

The CAT Rental Store certifies that the above listed instrument meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the National Research Council of Canada (NRC) or the National Institute of Standards and Technology (NIST), or to NIST accepted intrinsic standards of measurement, or derived by the ratio type of self-calibration techniques.

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Quality Management system registered to ISO 9001: 2015

CALIBRATION INFORMATION

Cal Date: 24 Feb 2020 Temperature 19.2°C Condition as Received/Returned: IN TOLERANCE
Next Cal Due: 24 Feb 2021 Humidity 35 % (Pass)
Remarks:
Cal Procedure AEMC 6240 Micro-ohmmeter Revision 1.0

STANDARDS USED FOR CALIBRATION

Asset Number	Description	Cal Date	Due Date
101294	Burster 1282-0.001 1 mOhm Standard Resistor	03 May 2019	03 May 2020
101295	Burster 1282-0.01 10 mOhm Standard Resistor	03 May 2019	03 May 2020
101296	Burster 1282-0.1 100 mOhm Standard Resistor	03 May 2019	03 May 2020
IW3240	GenRad 1433 Decade Box	24 Jun 2019	24 Jun 2020
IW5447	Fluke 89IV Multimeter	11 Oct 2019	11 Oct 2020
SR2	YEW 2792 1 ohm Resistor	19 Feb 2020	19 Feb 2021



Signed: _____

Chad Coene - Technician

SERIAL NUMBER: 189368ELDV ASSET NUMBER: RF 7

Report of Calibration

The CAT Rental Store
Wirtanen Division
10235 - 180 Street Edmonton, AB T5L 3B2
PHONE: (780) 434-8421
www.catrents.ca

UNIT UNDER TEST:	AEMC 6240 MICRO-OHMMETER	TEST RESULT:	PASS
SERIAL NUMBER:	189368ELDV	PERFORMED ON:	24 February 2020
ASSET NUMBER:	RF 7	DATA TYPE:	FOUND-LEFT
PROCEDURE NAME:	AEMC 6240 Micro-ohmmeter	TEMPERATURE:	19.22 °C
PROCEDURE REV.:	1.0	HUMIDITY:	35 %
CALIBRATED BY:	Chad Coene		
P.O. NUMBER:			
CUSTOMER:	Shermco - Regina 1033 Kearns Cres. Regina, SK S4P 3B2		

The CAT Rental Store certifies that the above listed instrument meets or exceeds all specifications as stated in the referenced procedure unless otherwise noted. It has been calibrated using measurement standards traceable to the National Institute of Standards and Technology (NIST), or to NIST accepted intrinsic standards of measurement, or derived by the ratio type of self-calibration techniques.

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Note: Any Test Uncertainty Ratio (TUR) that is less than four to one will appear under the "TUR" heading on the data record. If the TUR meets or exceeds four to one, the field is left blank.

REMARKS:

Standards Used

<u>Asset #</u>	<u>Description</u>	<u>Cal Date</u>	<u>Due Date</u>
101294	Burster 1282-0.001 1 mOhm Standard Resistor	5/3/2019	5/3/2020
101295	Burster 1282-0.01 10 mOhm Standard Resistor	5/3/2019	5/3/2020
101296	Burster 1282-0.1 100 mOhm Standard Resistor	5/3/2019	5/3/2020
IW3240	GenRad 1433 Decade Box	6/24/2019	6/24/2020
IW5447	Fluke 89IV Multimeter	10/11/2019	10/11/2020
SR2	YEW 2792 1 ohm Resistor	2/19/2020	2/19/2021

Test Results

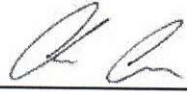
<u>Test Description</u>	<u>True Value</u>	<u>Test Result</u>	<u>Lower limit</u>	<u>Upper limit</u>	<u>Units</u>	<u>TUR</u>
10A - 4000 µOhm						
	1000.0000	1001.0000	995.5000	1004.5000	µΩ	Pass
1A - 40 mOhm						
	1.0000	1.0100	0.9775	1.0225	mΩ	Pass
	10.0000	10.0100	9.9550	10.0450	mΩ	Pass
1A - 400 mOhm						
	10.0000	10.0000	9.7750	10.2250	mΩ	Pass
	100.0000	100.1000	99.5500	100.4500	mΩ	Pass
100mA - 4000 mOhm						
	100.0000	100.0000	97.7500	102.2500	mΩ	Pass

Test Results

<u>Test Description</u>	<u>True Value</u>	<u>Test Result</u>	<u>Lower limit</u>	<u>Upper limit</u>	<u>Units</u>	<u>TUR</u>
10mA - 40 Ohm	1000.0000	1003.0000	995.5000	1004.5000	mΩ	Pass
	5.0000	5.0100	4.9675	5.0325	Ω	Pass
	35.0000	35.0100	34.8925	35.1075	Ω	Pass
10mA - 400 Ohm						
	50.0000	50.0000	49.6750	50.3250	Ω	Pass
	390.0000	389.9000	388.8250	391.1750	Ω	Pass
Current Output						
10A - 4000 μOhm	10.00	10.16	9.00	11.00	ADC	Pass
1A - 40 mOhm	1.00	1.01	0.90	1.10	ADC	Pass
1A - 400 mOhm	1.00	1.01	0.90	1.10	ADC	Pass
100mA - 4000mOhm	100.00	99.95	90.00	110.00	mADC	Pass
10mA - 40 Ohm	10.00	10.15	9.00	11.00	mADC	Pass
10mA - 400Ohm	10.00	10.16	9.00	11.00	mADC	Pass

***** End of Certificate *****

Technician


Chad Coene - Technician

Document Title: Grassy Creek Pump Station MV Metering Cabinet CSA Certificate Package

Document Number: 25472-101-V2A-EMM0-W0018

Revision Number: 0

PO Number: 4500249594

Material Requisition Number: 08 IE

Applicable Tag#: 128-GRSSY-B0-JIT-01



Shermco Industries
1033 Kearns Cres.
Regina, SK
Canada, S4K 0A2
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Supplier Rev.	Rev Date DD-MMM-YYYY	Reason for Issue	Supplier Name
0	13-Aug-2020	First Issue	Shermco Industries

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Toronto :
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Tel: 905-678-7820 Fax: 905-678-7131

Montreal :
1829, 32e Avenue, Lachine QC H8T 3J1
Tel: 514-631-3100 Fax: 514-631-1133

SPECIAL ELECTRICAL EQUIPMENT INSPECTION INSPECTION SPECIALE D'EQUIPEMENT ELECTRIQUE

Submitter / Réquérant: Shermco Industries		Page: 1 of / De 12	Report No. / No. Rapport: 2020-BH-106
Client # / # De Client:		Equipment Description / Description de l'équipement:	
Address / Adresse: 1033 KEARNS CR. PO box 995		Control panel	
M.D.Y / M.J.A: 07/28/2020	City / Ville: Regina	MARKING / MARQUAGE	
Province: Sask	Postal / Code Postal: S4p 3b2	Model / Modèle: 20-T262R-475	
Tel / Tél.: 306-949-8131	Email / Courriel: gcross@shermco.com	Mfr. / Fab.: Shermco Industries	Amps: 3000
EQUIPMENT IS AVAILABLE FOR INSPECTION AT (If different than above) L'EQUIPEMENT EST DISPONIBLE POUR INSPECTION AU (Si adresse differente)		Volts: 6.9KV	Hz: 60
		Watts:	Phase: 3
Location / Emplacement:		Connection: ☒ Permanent ☐ Cord/Cordon	
Address / Adresse:		Plugtype / Type de fiche:	
City / Ville:	Province:	HAS EQUIPMENT BEEN LISTED BY ANOTHER TESTING AGENCY? L'EQUIPEMENT EST-IL DEJA CERTIFIE PAR UN AUTRE ORGANISME?	
Postal / Code Postal:	Tel:	Yes/Oui ☐ No / Non ☒	
		ETL	UL
FILE NO./NO DE DOSSIER:			

CONSTRUCTION	P/C	F/N	N/A	CONSTRUCTION	P/C	F/N	N/A
1. Enclosure/Boitier	☒			7. Overload/protection de surcharge			☒
2. Openings/Ouverture	☒			8. Overcurrent/protection de surintensité	☒		
3. Components/Composants	☒			9. Bonding grounding/Mise à la masse, terre	☒		
4. Comp mounting/Montage de comp.	☒			10. Supply cord/Cordon d'alimentation	☒		
5. Internal wiring/Filage interne	☒			11. Marking/Marquage	☒		
6. Clearance/Espacement	☒						

Sample Size/ Grandeur d'échantillon:	1
Batch Size/ Nombre d'échantillon:	1

P/C – Passed/Conforme F/N – Failed/Non conforme N/A – Non applicable/Non applicable

WERE ADDITIONAL RELATED STANDARDS USED IN THIS EVALUATION? YES ☐ / NO ☒ STANDARD(S) USED: **C22.2 NO.-31-18**
DES NORMES RELATIVES ADDITIONNELLES ONT-ELLES ETES UTILISEES? OUI ☐ / NON ☒ NORMES(S) UTILISEE(S):

#	SERIAL # / # DE SERIE	LABEL / ETIQUETTE	#	SERIAL # / # DE SERIE	LABEL / ETIQUETTE
1	12477-01	C-2007701	6		
2			7		
3			8		
4			9		
5			10		

Alterations Required / Modifications requises Yes/Oui ☐ No/Non ☒ Alterations Completed/ Non-conformités corrigées Yes/Oui ☐ No/Non ☐

1		
2		
3		
4		
5		
6		
7		
8	GST #: 845407378	

LABEL NUMBERS ISSUED:
NUMEROS D'ETIQUETTES EMISES: FROM / DE: C-2007701 TO / A:

I/WE AGREE TO ABIDE BY THE CONDITIONS AND LIMITATIONS OF THE INTERTEK TESTING SERVICES ELECTRICAL EQUIPMENT INSPECTION SERVICE AGREEMENT AND TO PAY ALL COSTS IN CONNECTION WITH THE EXAMINATION, TESTING AND LABELLING OF THE ABOVE EQUIPMENT.
J'NOUS ACCEPTONS DE NOUS CONFORMER AUX CONDITIONS ET LIMITATIONS DE L'ACCORD DE SERVICE D'INSPECTION D'EQUIPEMENT ET A PAYER TOUS LES FRAIS SE RATTACHANT AUX EVALUATIONS, ESSAIS ET MARQUAGE DE L'EQUIPEMENT MENTIONNE CI-DESSUS.

DEREK MUCHA
Print Name / Lettres moulées
[Signature]
Submitter's Signature/Signature du réquérant
07/28/2020
M/D/Y – M/J/A (READ PAGE 3 BEFORE SIGNING – LIRE PAGE 3 AVANT DE SIGNER)

Brad Helgason
Print name / Lettres moulées
[Signature]
Inspector's Signature/Signature de l'inspecteur

Labels/Etiquettes	1	@ 10	\$ 10.00
Labels/Etiquettes		@	\$ 0.00
Name plate/Plaque signalitique		@	\$ 0.00
Inspection Hrs/ Hres	2.5	@ 195	\$ 487.50
Travel Hrs / Hres de transport		@	\$ 0.00
KM		@	\$ 0.00
Expenses/Dépenses		@	\$ 0.00
PAYMENT METHOD MODE DE PAIEMENT		Subtotal Sous Total	\$ 497.50
Credit card/carte de crédit		GST/TPS 5%	\$ 24.88
AUTH # / # AUT		QST/TVQ 0%	\$ 0.00
CHEQUE #		HST/TVH 0%	\$ 0.00
P.O. #	000955	TOTAL	\$ 522.38

SPECIAL ELECTRICAL EQUIPMENT INSPECTION INSPECTION SPECIALE D'EQUIPEMENT ELECTRIQUE

Submitter / Réquérant: Shermco Industries

Page:2 of / De 12

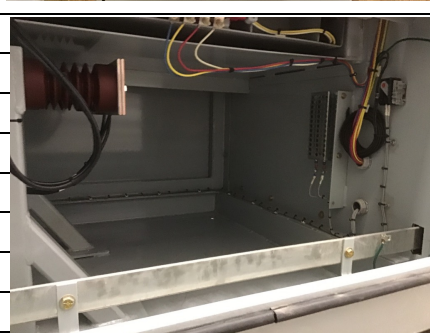
Report No./ No. Rapport: 2020-BH-106

Critical Components / Composantes Critiques

Certified/Certifié

Yes/Oui

No/Non



TESTING

P/C

F/N

N/A

1. Dielectric Strength / Rigidite Dielectrique

✓

Voltage / Voltage 21K V ☒ AC ☐ DC

Duration / Temps 60 Sec

2. Strain Relief / Arret de Traction

✓

Value / Valeur

3. Leakage Current / Courant de Fuite

✓

Value / Valeur

4. Flame Test / Test de Flammabilité

✓

5. Other / Autre

✓

Equipment Inspection Service Agreement / Entente de service d'inspection d'équipement

I/We request Intertek to perform evaluation and testing of equipment to:

Je/Nous demande(ons) à ce que Intertek effectue des essais et évaluation d'équipement selon les normes:

CSA Special Publication, SPE-1000-13, model-code for the Field Evaluation of Electrical Equipment.

CSA publication spéciale, SPE-1000-13, code de référence pour l'évaluation à pied d'oeuvre d'équipement électrique

This Model Code does not apply to the re-evaluation of equipment that has been rejected due to the results of a previous evaluation conducted by a certification organization through any other existing certification service.

We understand that the Special Inspection Service will not be considered as having been completed until payment in full has been received by Intertek. Intertek reserves the right to remove labels from any equipment related to a delinquent account.

We affirm that all cost incurred by Intertek to perform this service shall be borne by the submitter and that the test to be performed to evaluate the products have been disclosed and do not make Intertek or the authority liable in any way for non-performance or malfunction of the products during or subsequent to the tests.

We understand that this Special Inspection Service is not a substitute for Intertek Certification but rather a service offered by Intertek on behalf of participating Provinces and Territories in response to extenuating circumstances. We therefore understand that the final acceptance of our equipment is at the discretion of the local government electrical inspection authority having jurisdiction. We also understand that Intertek in no way implies that this evaluation will satisfy the requirements of other inspection authorities, especially the gas inspection authority, building inspection authority, Workers' Compensation Board etc.

We understand that the Special Inspection Service does not make provision for the documenting of the construction of our product, hence each and every future batch must be completely re-evaluated. We realize that if we wish to take advantage of the similarity of construction of future shipments we must apply for Intertek Certification.

We agree to indemnify and hold harmless Intertek, its members, directors, officers and employees against any and all liability and costs if any of the products of the accepted batch subsequently prove hazardous and by reason, or in consequence of, any acts or omissions of the clients, in respect of the right granted herein to us the Special Inspection Label in connection with the above product, whether authorized or unauthorized.

We understand that it is our responsibility to ensure that the Intertek inspector has examined all units as requested and will verify that the list of serial numbers examined is complete before the Intertek inspector leaves our premises.

We understand that if the Intertek label is damaged or deteriorates, it may void the approval. We understand that Intertek does not in any way guarantee the durability or adhesion properties of the Intertek label.

We agree that any liability attached to the Special Inspection Service to be borne by Intertek is limited to the fee charged.

We agree to inform Intertek if we become aware of any situation where a product/service/system bearing an inspection label could lead to a potential hazard, and to investigate and take appropriate corrective action in accordance with CAN-P-1527, if required.

In accordance with CAN-P-1608, the Standards Council of Canada is the final level in disputes between Intertek and the client regarding conformance with accreditation criteria. Both parties shall abide by all SCC decisions pertaining to accreditation criteria.

Ce code de référence ne s'applique pas à la réévaluation d'équipement qui a été rejeté dû aux résultats d'une évaluation précédente effectuée par un organisme de certification ou par tout autre service de certification.

Nous comprenons que le service d'inspection spéciale ne sera considéré comme étant complété que si un paiement complet a été reçu par Intertek. Intertek se réserve le droit de retirer les étiquettes sur tout équipement se rattachant à un compte délinquant.

Nous déclarons que les coûts encourus par Intertek pour assurer ce service sont à la charge du requérant et que les essais à exécuter pour évaluer les produits ont été rapportés et ne tiennent de quelque façon que ce soit Intertek ou les autorités responsables de la non-performance ou du mal fonctionnement des produits pendant et/ou après les essais.

Nous comprenons que le service d'inspection spéciale n'est pas un substitut au programme de certification d'intertek mais plutôt un service offert par Intertek au nom des provinces et territoires participants en réponse à des circonstances atténuantes. Nous comprenons de ce fait que l'acceptation finale de notre équipement est à la discrétion des autorités ayant juridiction. Nous comprenons aussi qu'en aucun cas Intertek ne prétend que cette évaluation répondra aux exigences d'autres services d'inspection, particulièrement le service d'inspection du gaz, d'inspection en bâtiments, de la CSST etc...

Nous comprenons que le service d'inspection spéciale ne pourvoit pas à la documentation de la construction de votre produit, par conséquent chaque lot futur devra être complètement réévalué. Nous réalisons que si nous souhaitons tirer profit de la similitude de la construction des expéditions futurs nous devons souscrire au programme de certification d'Intertek.

Nous nous engageons à indemniser et à dégager Intertek, ses membres, directeurs, officiers et employés contre toute responsabilité, toute perte ou tout dommage résultant de réclamations, de requêtes, de coûts (incluant les frais juridiques), ou de jugements si le ou les produits(s) devenait (aient) dangereux découlant d'actes de négligence ou intentionnels de la part du client ou d'un tiers relativement au produit auquel est apposé l'étiquette d'inspection spéciale, qu'ils soient autorisés ou non.

Nous comprenons qu'il est de notre responsabilité de s'assurer que l'inspecteur d'intertek ait examiné toutes les unités tel que demandé et vérifié que la liste des numéros de série est complète avant que celui-ci ne quitte les lieux.

Nous comprenons que s'il advenait qu'une étiquette soit détériorée ou endommagée cela pourrait invalider la reconnaissance de l'évaluation de notre produit. Nous comprenons qu'Intertek ne garantit pas la longévité ou les propriétés d'adhérence des étiquettes.

Nous reconnaissons que la responsabilité se rattachant au service de l'inspection spéciale à être effectuée par Intertek se limite aux facturés.

Nous consentons à informer Intertek si nous apercevons une situation là où un produit/service/système ayant une étiquette d'inspection peut conduire à un hazard potentiel, et d'examiner et prendre l'action corrective appropriée conformément à CAN-P-1527 si requis.

Conformément à la CAN-P-1608, le Conseil Canadien des Normes est le niveau supérieur et final dans les litiges entre Intertek et le client en ce qui concerne la conformité aux critères d'accréditation. Les deux parties doivent respecter toutes les décisions du Conseil concernant les critères d'accréditation.

Document Title: Quality Certificate (ISO9001 Equivalent)

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Supplier Rev.	Rev Date DD-MMM-YYYY	Reason for Issue	Supplier Name
0	29-Jun-2020	First Issue	Shermco Industries



Shermco industries
One Line. One Company.

Quality Manual

2016 Edition

Revision 0



shermco.com

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Supplier Rev.	Rev Date DD-MMM-YYYY	Reason for Issue	Supplier Name
0	29-Jun-2020	First Issue	Shermco Industries
1	16-Jul-2020	Datasheet line items were cross referenced with physical cabinet components.	Shermco Industries
2	6-Aug-2020	Kirk Key interlock diagram & general maintenance practices added.	Shermco Industries
3	27-Aug-2020	Added Manufacture infor to datasheet	Shermco Industries

General Maintenance Information

Buses:

- When de-energized & locked out, look for cracked insulation along the buses. Any damaged insulation needs to be replaced.
- Ensure the buses are clean. Recommended cleaner is a dry cloth or denatured alcohol. Do not use cleaners that leave behind residue.
- Ensure all insulators are clean. Recommended cleaner is a dry cloth or denatured alcohol. Do not use cleaners that leave behind residue.

Bushings:

- Inspect each bushing for cracks & damage. If cracks or damage exist, the bushing will have to be replaced.
- When de-energized & locked out, clean the bushing. Recommended cleaner is a dry cloth or denatured alcohol. Do not use cleaners that leave behind residue. Apply collinite wax after cleaning is complete.

Instrument Transformer Drawer:

- When de-energized & locked out, inspect the drawer. There should not be very much resistance when pulling out or pushing back in. If there is, lubrication of the slides the drawer sits in will need to be applied.
- Ensure no debris exists inside the drawer. Inspect the condition of the PT & CT wiring.

Potential Transformer:

- Refer to ANSI/NETA MTS (Section 7.10.2 - Instrument Transformers, Current Transformers) for Maintenance Testing procedures.
- Do not work on any components while energized.

Current Transformer:

- Refer to ANSI/NETA MTS (Section 7.10.1 – Instrument Transformers, Voltage Transformers) for Maintenance Testing procedures.
- Do not work on any components while energized.

Isolated Neutral Bus:

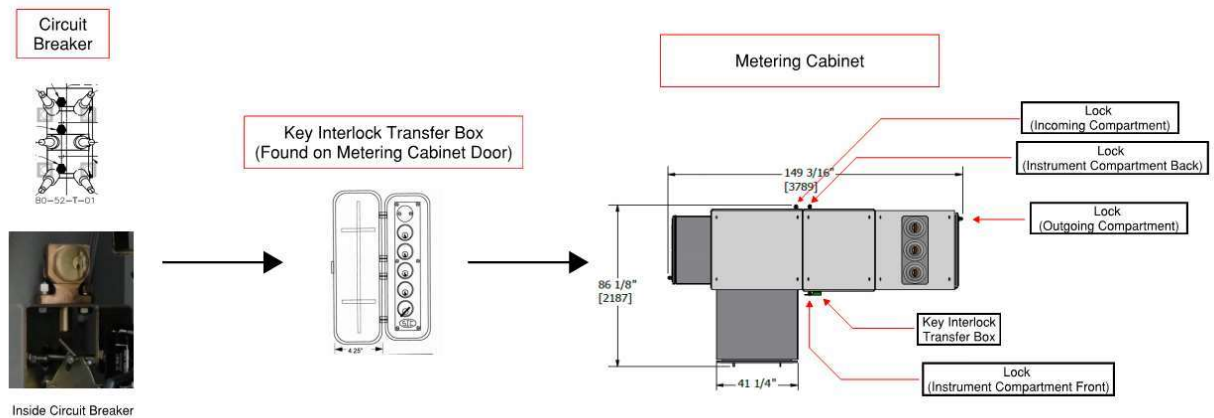
- Remove cable connections and clean with a dry rag. Apply contact lubricant to cable connections if applicable.
- Do not work on any components while energized.

Kirk Key Operation Procedure

INTERLOCK KEY SCHEME:

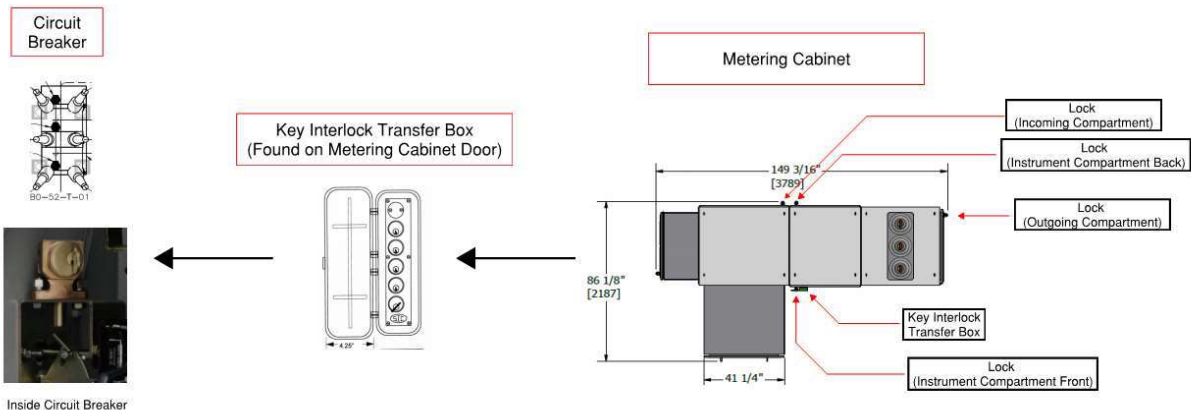
INITIAL CONDITION:

HVCB IS CLOSED WITH KEY "A" CAPTIVE IN ITS RESPECTIVE KEY INTERLOCK. METERING CABINET COMPARTMENTS ARE LOCKED CLOSED WITH NO KEYS PRESENT IN THEIR RESPECTIVE KEY INTERLOCKS. THE 5-KEY TRANSFER INTERLOCK HAS FOUR "B" KEYS CAPTIVE IN ITS SECONDARY CYLINDER POSITIONS.



TO HAVE ACCESS TO METERING CABINET COMPARTMENTS:

1. OPEN HVCB
2. TURN KEY "A" ON LO INTERLOCK ON HVCB TO LOCK OPEN. KEY "A" IS NOW FREE.
3. INSERT KEY "A" IN THE 5-KEY TRANSFER INTERLOCK AND TURN. KEYS "B" ARE NOW FREE.
4. USE THE "B" KEYS TO UNLOCK THE METERING COMPARTMENT DOORS.



REVERSE SEQUENCE TO RESTORE SERVICE.

MV METERING CABINET DATA SHEET

SHT 1 OF 4

CLIENT TRANSCANADA KEYSTONE PIPELINE LIMITED PARTNERSHIP
 PROJECT KEYSTONE XL OIL PIPELINE
 EQ. SPEC. 25472-101-3PS-EM00-W0001

TAG NO. NOTE 2
 SERVICE MEDIUM VOLTAGE METERING CABINET
 SITE VARIOUS CANADIAN PUMPING STATIONS

MANUFACTURER NOTE 1 Magna Electric Corporation (MEC)
 SERIAL NO. NOTE 1 12475-01 (Fox Valley), 12476-01 (Piapot), 12477-01 (Grassy Creek)

MODEL NOTE 1 Not Applicable
 NO. REQUIRED 3

DESCRIPTION	SPECIFIED	VENDOR	Rev
ENVIRONMENTAL CONDITIONS:			
ELEVATION (m):	LESS THAN 1000m	✓	
OUTDOOR AMBIENT TEMPERATURE MIN/MAX (°C)	-40C TO +40C	✓	
AREA CLASSIFICATION	UNCLASSIFIED		
ENVIRONMENT	WIND BLOWN DUST AND DEBRIS, RAIN, SNOW	✓	
HUMIDITY	95% (MAX)	✓	
SEISMIC DATA	PER 25472-100-3PS-S000-W0002 CLIMATIC DATA DOCUMENT		
POWER SUPPLY (6.9KV CLASS):			
LINE TO LINE VOLTAGE (kV)	6.9	✓	
LINE TO GROUND VOLTAGE (kV)	4.0	✓	
LINE TO LINE MAXIMUM CONTINUOUS VOLTAGE (kV)	7.6	✓	
BIL (kV)	110	✓	
PHASES	3	✓	
GROUNDING	RESISTANCE (NGR), 25A, 10 SEC	✓	
FREQUENCY (HZ)	60	✓	
SHORT CIRCUIT AVAILABLE			
SLG (A)	25	✓	
3 PHASE (MVA)	500	✓	
INCOMING SUPPLY CONDUCTOR	15kV, MC-HL, SHIELDED, SINGLE CONDUCTOR CABLE (4C x 750 MCM PER PH.)	✓	
GENERAL REQUIREMENTS			
VOLTAGE RATING (V)	6900	✓	
FREQUENCY (Hz)	60	✓	
PHASES	3	✓	
ENCLOSURES	OUTDOOR RATED METAL ENCLOSED	✓	
EQUIPMENT TAGGING	(NOTE 2) (Site Specific)	✓	
WEIGHT (TOTAL)	(NOTE 1) Approx. 5000 lbs	✓	
OVERALL DIMENSIONS (W x D x H)	(NOTE 1) 12.5' L x 7.5' W x 11.5' H	✓	
PROVISION FOR FUTURE EXPANSION	NOT REQ'D		
SURGE ARRESTOR	NOT REQ'D		
TERMINAL BLOCKS	MIN. 20% SPARE TERMINALS		
GENERAL STRUCTURE REQUIREMENTS			
CONSTRUCTION			
TYPE	NEMA 4	✓	
PROVISION FOR INFRARED SCANNING	NOT REQ'D		
BACK TO BACK MOUNTING	NOT REQ'D		
SIDE BY SIDE MOUNTING	NOT REQ'D		
FINISH - EXTERIOR	ANSI 61 GREY	✓	
FINISH - INTERIOR	ANSI 61 GREY	✓	
MAIN POWER BUS			
BRACING	40kA MIN. (SYMMETRICAL)	✓	
MATERIAL	SILVER PLATED CU.	✓	
INSULATION	REQ'D	✓	
BUS SUPPORT	REQ'D	✓	
MINIMUM CONTINUOUS CURRENT RATING	3000A	✓	

NOTES:

1. Vendor to fill in data.
2. MV Metering Cabinet tags per separate tagging list, see Sheet 4 of 4.

 WorleyParsons resources & energy	JOB NO. 08E4490 DATASHEET NO. 25472-101-ESD-EM00-W0001	REV	DATE	ISSUED FOR	BY	CHKD	APPD
		0D	JAN 19, 2012	IFQ	NL	FM	EJ
		0C	OCT 05, 2011	IFR	RS	FM	RL
		0B	SEPT 15, 2011	IFR	RS	FM	RL
		0A	AUG 22, 2011	IDR	RS	CP	RL

MV METERING CABINET DATA SHEET

SHT 2 OF 4

CLIENT TRANSCANADA KEYSTONE PIPELINE LIMITED PARTNERSHIP
 PROJECT KEYSTONE XL OIL PIPELINE
 EQ SPEC 25472-101-3PS-EM00-W0001

TAG NO. _____
 SERVICE _____
 SITE _____

NOTE 2 _____
 MEDIUM VOLTAGE METERING CABINET
 VARIOUS CANADIAN PUMPING STATIONS

MANUFACTURER NOTE 1 Magna Electric Corporation (MEC)
 SERIAL NO. NOTE 1 12475-01 (Fox Valley), 12476-01 (Piapot), 12477-01 (Grassy Creek)

MODEL _____
 NO. REQUIRED 3

DESCRIPTION	SPECIFIED	VENDOR	Rev
STRUCTURE REQUIREMENTS (CONT'D)			
GROUND BUS			
MINIMUM CONTINUOUS CURRENT RATING	600A	✓	
MATERIAL	SILVER PLATED CU.	✓	
GROUNDING STUDS C/W COVERS	REQ'D	✓	
SPACE HEATER			
SPACE HEATER VOLTAGE	120V, 1-PH	✓	
SPACE HEATER THERMOSTAT	REQ'D	✓	
SPACE HEATER POWER	120VAC EXTERNAL - NORMAL	✓	
INCOMING TERMINATION COMPARTMENT			
SIDE MOUNTED BUSHINGS WITH TERMINAL BOX	REQ'D	✓	
MANUFACTURER	(NOTE 1) Lapp Insulators	✓	
TYPE	PORCELAIN	✓	
VOLTAGE RATING (V)	15000	✓	
CURRENT RATING (A)	4000	✓	
INSULATION	PORCELAIN	✓	
BIL (KV)	110	✓	
CREEPAGE	HIGH STRENGTH WITH CREEPAGE ≥ 35 mm/kV L-Gnd.	✓	
EXTERIOR TERMINATION	SUITABLE TO CONNECT 15kV, MC-HL, SHIELDED, SINGLE CONDUCTOR CABLE (4 NOS. x 750 MCM PER PH.)	✓	
DIMENSIONS (W X D X H)	(NOTE 1)	✓	
BACK ACCESS	REQ'D	✓	
INSTRUMENT TRANSFORMERS COMPARTMENT			
INSTRUMENT TRANSFORMERS - METERING	3 PT'S, 3 CT'S (SUPPLIED BY UTILITY)	✓	
PHASE CT ACCURACY CLASS AND BURDEN	TBD		
PHASE CT RATIO	3000:5	✓	
VT ACCURACY CLASS	TBD		
VT BIL RATING	75kV	✓	
DIMENSIONS (W X D X H)	(NOTE 1)	✓	
FRONT / REAR / ACCESS	REQ'D	✓	
OUTGOING TERMINATION COMPARTMENT			
OUTDOOR ROOF MOUNTED BUSHINGS	REQ'D	✓	
MANUFACTURER	(NOTE 1) Lapp Insulators	✓	
TYPE	PORCELAIN	✓	
VOLTAGE RATING (V)	15000	✓	
CURRENT RATING (A)	4000	✓	
INSULATION	PORCELAIN	✓	
BIL (KV)	110	✓	
CREEPAGE	HIGH STRENGTH WITH CREEPAGE ≥ 35 mm/kV L-Gnd.	✓	
EXTERIOR TERMINATION	SUITABLE TO CONNECT 15kV, MC-HL, SHIELDED, SINGLE CONDUCTOR CABLE (4 NOS. x 750 MCM PER PH.)	✓	
DIMENSIONS (W X D X H)	(NOTE 1)	✓	
SIDE ACCESS	REQ'D	✓	

NOTES:

1. Vendor to fill in data.
2. MV Metering Cabinet tags per separate tagging list, see Sheet 4 of 4.

 WorleyParsons resources & energy	JOB NO <u>08E4490</u> DATASHEET NO <u>25472-101-ESD-EM00-W0001</u>	REV	DATE	ISSUED FOR	BY	CHKD	APPD
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		0A	AUG 22, 2011	IDR	RS	CP	RL

SHT 3 OF 4

TAG NO.	NOTE 2
SERVICE	MEDIUM VOLTAGE METERING CABINET
SITE	VARIOUS CANADIAN PUMPING STATIONS

MODEL	NOTE 1
NO. REQUIRED	3

[illegible]

1. Vendor to fill in data.
2. MV Metering Cabinet tags per separate tagging list, see Sheet 4 of 4.



REV	DATE	ISSUED FOR	BY	CHKD	APPD
0D	JAN 19, 2012	IFQ	NL	FM	EJ
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0B	SEPT 15, 2011	IFR	RS	FM	RL
0A	AUG 22, 2011	IDR	RS	CP	RL

MV METERING CABINET DATA SHEET

SHT 4 OF 4

CLIENT	TRANSCANADA KEYSTONE PIPELINE LIMITED PARTNERSHIP	TAG NO.	NOTE 2
PROJECT	KEYSTONE XL OIL PIPELINE	SERVICE	MEDIUM VOLTAGE METERING CABINET
EQ. SPEC.	25472-101-3PS-EM00-W0001	SITE	VARIOUS CANADIAN PUMPING STATIONS

MANUFACTURER	NOTE 1 Magna Electric Corporation (MEC)	MODEL	NOTE 1 Not Applicable
SERIAL NO.	NOTE 1 12475-01 (Fox Valley), 12476-01 (Piapot), 12477-01 (Grassy Creek)	NO. REQUIRED	3

METERING CABINET TAGGING DATA

PUMPING STATION	PROVINCE	TAG NO.
FOX VALLEY PS-6	SASKATCHEWAN	126-FXVLY-B0-JIT-01
PIAPOT PS-7	SASKATCHEWAN	127-PIAPT-B0-JIT-01
GRASSY CREEK PS-8	SASKATCHEWAN	128-GRSSY-B0-JIT-01

NOTES:

1. Vendor to fill in data.
2. MV Metering Cabinet tags per separate tagging list, see Sheet 4 of 4.

 WorleyParsons resources & energy	JOB NO. 08E4490 DATASHEET NO. 25472-101-ESD-EM00-W0001	REV	DATE	ISSUED FOR	BY	CHKD.	APPD.
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TRANSCANADA PIPELINES LIMITED

Medium Voltage Metering Cabinet Specification

Bechtel Document No.: 25472-101-3PS-EM00-W0001

Keystone Pipeline – Phases 3 & 4
Keystone XL Oil Pipeline

Project No.: 08E4490

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TRANSCANADA PIPELINES LIMITED MEDIUM VOLTAGE METERING CABINET SPECIFICATION

Disclaimer

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MEDIUM VOLTAGE METERING CABINET SPECIFICATION							
REV	DESCRIPTION	ORIGINATOR	REVIEWER	APPROVAL	DATE (DD-MON-YYYY)	CLIENT APPROVAL	DATE (DD-MON-YYYY)
0D	Issued for Quote	N. Landry	F. Medina	E. Joson	19-01-2012		
0C	Issued for Review	R. Sanoja	F. Medina	R. Lehmann	05-10-2011		
0B	Issued for Review	R. Sanoja	F. Medina	R. Lehmann	15-09-2011		
0A	Issued for IDR	R. Sanoja	M. Jensen	R. Lehmann	22-07-2011		



**TRANSCANADA PIPELINES LIMITED
MEDIUM VOLTAGE METERING CABINET
SPECIFICATION**

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**TRANSCANADA PIPELINES LIMITED
MEDIUM VOLTAGE METERING CABINET
SPECIFICATION**

1. SCOPE

This specification describes the technical requirements for the design, manufacture, testing and delivery of medium voltage metal enclosed metering cabinet. The metering cabinet will be installed outdoor (padmount) at various pump station electrical substations in Canada.

The cabinet shall be supplied fully assembled, tested and ready for field connection.

Unless specific exceptions are noted in the Vendor's proposal, it shall be understood that the proposal is based on equipment that complies strictly with the requirements of this specification.



**TRANSCANADA PIPELINES LIMITED
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2. APPLICATION

The intent is to provide specifications for the supply of a medium voltage metering cabinet that shall be suitable for utility revenue metering for a period of 30 years.

The metering cabinet will be connected to the low voltage side (6.9kV L-L) of the electrical substation power transformer.

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3. GENERAL REQUIREMENTS**3.1 Operating Conditions**

The metering cabinet will be located outdoor and be padmounted. The metering cabinet shall be designed to operate continuously at rated load within the operating conditions specified in the datasheet.

3.2 Codes and Standards**3.2.1 General Standards**

The metering cabinet supplied under this specification shall be designed, fabricated and tested in accordance with the latest revision of applicable standards of the following bodies:

STANDARD	DESCRIPTION
CSA	Canadian Standards Association
NEMA	National Electrical Manufacturers Association
IEEE	The Institute of Electrical and Electronics Engineers
ANSI	American National Standards Institute
UL	Underwriters Laboratories
ISO	International Organization for Standardization
NETA	International Electrical Testing Association
Others	Local regulatory bodies having jurisdiction over such apparatus

**TRANSCANADA PIPELINES LIMITED
MEDIUM VOLTAGE METERING CABINET
SPECIFICATION****3.2.2 Specific Standards**

The latest revisions of the following standards specifically apply to the medium voltage metering cabinet supplied under this specification:

STANDARD	CODE	DESCRIPTION
CSA	C22.1	Canadian Electrical Code, Part 1: Safety Standard for Electrical Installations
	C22.2, No 14	Industrial Control Equipment
	C60044-1	Instrument Transformers – Part 1: Current Transformers
	C60044-2	Instrument Transformers – Part 2: Inductive Voltage Transformers
	Z299.4	Quality Assurance Program – Category 4
NEMA	ICS 1	Industrial Control and Systems General Requirements
	ICS 6	Industrial Control and Systems Enclosures
ANSI/IEEE	C57.13	Instrument Transformers
UL	508A	UL Standard for Safety Industrial Control Panels - First Edition; Reprint with revisions through and including February 4, 2010
ISO	9000 Series	Quality System Standards
SaskPower		Electric Service Requirements Section 4 - Requirements for Consumer-Owned Substations Greater than 5 kV

3.3 Certification

The metering cabinet shall bear CSA certification label. Alternatively, the metering cabinet shall have any authorized NRTL member organization certification label, certifying it for installation in Canada as applicable. Certification shall ensure the metering cabinet complies with applicable Canadian standards for its manufacturing and installation requirements.

Warning labels as required by the applicable codes shall be attached to the equipment.



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3.4 Data Sheets

The attached Data Sheet summarizes the equipment to be supplied and shall be read in conjunction with this specification.

The Vendor shall complete the data sheets and return them to Purchaser. Data and information provided by Vendor in the data sheets will be considered contractually binding, as it will be used in the overall system design.

The Vendor shall submit a complete Bill of Material (B.O.M.) detailing catalogue number, ratings, quantity, and supplier with reference to the data sheet.

If inconsistencies exist between the contents of this specification and the data sheets the Vendor shall contact the Owner's Engineer for clarification.

The Vendor shall not make any substitutions without written approval of the Purchaser. Any such approval, however, will not relieve the Vendor of his responsibility for the adequacy and performance of the equipment.

3.5 Definitions

Owner: TransCanada Pipelines Limited.

Utility: Saskatchewan Power Corporation (SaskPower)

Purchaser: Shall mean any person, firm or corporation that issues a purchase order to provide and/or perform services applicable to this specification, or their designated representative.

Vendor: Shall mean the person(s) or company(ies) selling to the purchaser the product as specified in this specification.

3.6 Power System

The metering cabinet will be energized from a voltage source with a neutral grounding resistor as specified in the data sheets.

Bus components shall be braced to withstand a symmetrical short circuit current as stated in the data sheets.



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3.6.1 Auxiliary Control Power

A 120 V AC external supply (normal power) will be utilized for the metering cabinet space heater and receptacle power.

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SPECIFICATION**

4. METERING CABINET DESIGN**4.1 Enclosure**

The metering cabinet shall consist of a pad mounted, metal enclosed, compartmentalized enclosure with NEMA 4 (Outdoor) gasketed construction that will house all components including current transformers, voltage transformers, metering equipment and associated devices.

The structure shall be front, back and side accessible, free standing with necessary provisions for handling. The roof shall be cross-kinked or gabled and sloped front to back (front being highest elevation) to allow for shedding of water. Provide a sunshield on the roof of the enclosure to alleviate heat caused by direct sunlight on the top of the enclosure. The base of the enclosure shall be equipped with structural steel channel. The structure shall be complete with lifting plates or lifting eyes as necessary to facilitate off loading and placement.

The enclosure shall be continuous welded, 11-gauge steel construction. Doors shall be equipped with stainless steel hinges, hinge pins, and 2-point latching stainless steel weatherproof handles. The handles shall be pad-lockable. Drip shields shall be provided over each access door.

The termination and meter compartments shall have adequate phase barriers and grounding means. Where working space or electrical clearances is insufficient to safely install grounds, a ground switch shall be provided.

Thermostatically controlled heaters shall be provided for condensation control. Each compartment heater shall be provided to maintain ambient temperature of minimum 5°C / 41°F in the cabinet.

Each door of the enclosure shall be equipped with appropriate warning signs.

4.2 Power and Ground Bus

All power and ground bus' shall be tin or silver plated, solid, hard-drawn high conductivity copper. All bus supports shall be of non-hygroscopic, flame retardant, track resistant material. The Vendor shall provide removable insulation boots with a di-electric strength equal to the bus insulation at all bus bolted joints.

The power bus shall be insulated and rated as per data sheets.

The metering cabinet shall have a copper ground bus extending throughout its length. The ground bus shall be a minimum 6 mm x 50 mm. The ground bus shall have an extension with holes at each end

**TRANSCANADA PIPELINES LIMITED
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suitable for mounting #4/0 AWG copper ground lugs. External enclosure ground pad (NEMA 2-hole) shall be provided at both ends to connect to ground grid.

4.3 Incoming and Outgoing Termination Compartments

Three outdoor epoxy bushings shall be supplied with NEMA 6-hole pads at the outdoor end, and with NEMA 4-hole pads at the interior end. The rating and location of the bushings shall be as specified in the data sheet.

The outgoing termination compartment height shall be as specified in the datasheet, single line diagram and layout in order to facilitate the connection to Customer's raceway system. The termination compartments access door location shall be as specified in the datasheet. Kirk Key interlock, or approved equivalent, shall be implemented to prevent access to power section while energized.

Connections of the power bus bar to entrance bushings shall be of the flexible type.

Side mounted bushings shall be enclosed in a compartment closed by a bolt on cover and allowing for cable connections with room for stress cones. The compartment shall have ground or stud for attaching cable heads grounding tapes and a bottom removable cover with a gland plate for vertical access of cables from below.

4.4 Instrument Transformers Compartment

The instrument transformers compartment will enclose the instrument transformers, and shall be of sufficient size to enable maintenance and replacement of the transformers. In addition to the electrical clearances specified in the applicable CSA standard, provide for a minimum physical separation of 50mm to be maintained between instrument transformers and the surrounding enclosure to ensure adequate working clearances.

The instrument transformer's compartment shall be padlockable and sealable by the Utility Company.

Instrument transformers shall be supplied by the Utility, and shall be installed and wired by the Vendor.

The compartment shall be equipped with a draw out type or swing out type carriage with disconnect provisions for de-energizing and grounding the primary of each voltage transformer upon withdrawal.

Voltage transformers shall be fused on the primary (i.e. two (2) fuses per transformer). Test blocks shall be provided for all voltage transformer secondary leads.

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Each secondary connection of all current transformers (i.e. two (2) wires per transformer) shall be wired to easily accessible shorting block. The polarity of each shall be identified on the wires with heat shrink markers.

Instrument transformer ratios and metering accuracy, shall be as shown on the single line drawings and data sheets.

4.5 Meter Compartment

The meter compartment will enclose the revenue meter equipment. It shall be equipped with a hinged door, with provisions for sealing by the Utility, and with backing plate. The revenue meter equipment shall be supplied and installed by the Utility.

The meter compartment shall conform to the following dimensions: minimum 850mm height, minimum 914mm width, and 457mm depth.

A 120V AC duplex receptacle and a 13-jaw combination meter socket, with sufficient space for a 10-pole test switch shall be installed in the meter compartment by the Manufacturer. Metering compartment shall have provisions for secondary backup meter.

The wiring between the meter compartment and the instrument transformer compartment shall be supplied and installed by the Vendor.

Each meter shall have separate window for onsite meter reading. (i.e. 2 windows for 2 meters)

4.6 Control Wiring

Control wiring shall be type SIS, stranded, tinned copper, single conductor, with 600 V flame resistant, 90°C insulation. Control wiring shall be neatly formed and secured in place. Wiring at locations where the wires are subjected to flexing, shall be extra flexible and neatly bundled in a flexible guard to prevent spread and damage.

All control wiring in the cubicles between devices and also between devices and terminal blocks, shall be clearly numbered and identified at both ends of the wire with machine lettered wire tag to last over the life of the equipment.

Wires shall be adequately rated for the application and sized for the currents to be carried. For general control service, #14 AWG shall be used. For all current transformers circuits #10 AWG wires and for all voltage transformers circuits #12 AWG wires shall be used.



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Wiring devices shall be CSA rated to suit location of site and be located in the low voltage compartment of the cell.



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5. NAMEPLATES

Engraved lamacoid nameplates, white faces with black core, shall be provided for each device and for each compartment in accordance with the single line diagrams.

A nameplate shall be supplied for each switch, fuse or device. Nameplates shall be attached with reusable plastic rivets.

Each instrument transformer shall be provided with a permanent identification nameplate giving the manufacturer's name, rated voltage, frequency, kilovar and amperes, number of phases, and the volume of liquid identified as flammable, if applicable.

The lettering shall be 3/16 inch high.



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6. FINISHING

Manufacturer's standard for outdoor equipment painting shall be applicable.

The underside of roof panels shall be finished with anti-condensation insulation.

Finish colors shall be:

- Exterior: ANSI 61 grey.
- Interior: ANSI 61 grey.



**TRANSCANADA PIPELINES LIMITED
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7. INSPECTION AND TESTING

All equipment covered by this specification shall, on completion of assembly, wiring and adjustments be completely inspected, quality assured and tested. All apparatus shall be tested for correct operation under simulated service conditions in accordance with the current edition of NETA ATS (Acceptance Testing Specifications) to ensure the accuracy and correct functioning of the schemes. Factory performed testing shall in no way relieve the Vendor of the responsibility for proper operation of the equipment upon installation at the site.

The following tests shall be performed on the equipment:

- Continuity and point-to-point checks,
- Polarity tests, where applicable.
- Verify alignment of all drawout devices and assembly connection points
- High-potential tests of all wiring and bus-work

Purchaser reserves the right to inspect the equipment at any reasonable time in the manufacturing plant.



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8. PACKING, SHIPPING & STORAGE

The Vendor is responsible for packing the equipment to minimize damage during shipment.

Metering Cabinet shall be crated with new construction grade lumber. Prior to crating, steps shall be taken to secure any lightly fastened items such as covers. Each unit shipped shall be wrapped and sealed in polyethylene sheet.

Items which are likely to sustain damage if shipped in place shall be removed and properly packed to prevent shipping damage. One copy of the individual packing list shall be placed inside of each closed package, and one copy of the packing list shall be attached to the outside of each piece in a weatherproof packet.

Metering Cabinet shall be provided with spaces beneath the crating suitable for the purpose of forklift truck handling or be equipped with lifting eyebolts for crane lifting. Panels with eyebolts for lifting shall be shipped in trucks with top access.

The Vendor shall provide instructions for on site storage and handling.



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9. VENDOR DRAWINGS AND DOCUMENTATION

Vendor drawings and documentation requirements shall be as per Vendor Data Requirements of the Purchaser's Material Requisition (MR).



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**TRANSCANADA PIPELINES LIMITED
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APPENDIX A: METERING CABINET DATA SHEETS



**TRANSCANADA PIPELINES LIMITED
MEDIUM VOLTAGE METERING CABINET
SPECIFICATION**

**APPENDIX B: MV METERING CABINET SINGLE LINE
DIAGRAM AND LAYOUT**

Item	Drawing Number	Description	Date	Rev.
1	1399-06-06-SK-001	MV METERING CABINET SINGLE LINE DIAGRAM AND LAYOUT	2012-01-19	0C

Document Title: Packing, Shipping, and Handling Procedure

Document Number: 25472-101-V2A-EMM0-W0021

Revision Number: 0

PO Number: 4500249594

Material Requisition Number: 06, 07, 08 XB

Applicable Tag#: 126-FXVLY-B0-JIT-01, 127-PIAPT-B0-JIT-01, 128-Grssy-B0-JIT-01



Shermco Industries
1033 Kearns Cres.
Regina, SK
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(306) 949-8131

Supplier Rev.	Rev Date DD-MMM-YYYY	Reason for Issue	Supplier Name
0	13-July-2020	First Issue with Referbishment Update	Shermco Industries

Shipping & Handling of MV Metering Cabinets

At Shermco's Regina SK Facility:

- Cabinets are to be lifted and moved with a forklift/lift-truck.
- Cabinets are to be set on dunnage while being stored and worked on.
- Cabinets do not have lifting lugs.

Ready to move out of Shermco's Regina SK Facility:

- Cabinets are to be lifted and moved with a forklift/lift-truck.
- Cabinets will be transported to site by truck & trailer.
- Before cabinets are moved onto the truck, cabinet doors should be locked & wrapped to avoid accidental opening during transport.
- Before cabinets are moved onto the truck, additional protection measures will be provided to the bushings (covers, wrapping, padding, ect).
- When cabinets are placed onto the truck trailer via forklift/lift-truck, each cabinet shall be rigged and secured safely to the truck trailer.

Arrive at TC-Energy Site:

- When truck & trailer arrives at site, cabinets will be offloaded via forklift/lift-truck.
- Cabinets will be placed on dunnage until installation team is ready to install the cabinets.