HUBBELL® OHIO BRASS®
POWER SYSTEMS

IEEE DESIGN TEST REPORT
Report No. TD 01 060 E00
Type PVR HD Riser Pole Distribution Class Surge Arrester

This report records the results of the design tests made on Type PVR Riser Pole Distribution Class surge arresters in accordance with IEEE Standard C62.11-2012 "IEEE Standard for Metal Oxide Surge Arresters for AC Power Circuits (> 1kV)".

Type tests performed on PVR Riser Pole Distribution arresters demonstrate full compliance with the relevant clauses of the referenced standard and apply to all Hubbell PVR Riser Pole Distribution arresters of this design manufactured and assembled at the following ISO 9001:2008 certified Hubbell locations:

Hubbell Power Systems
1850 Richland Avenue, East
Aiken, South Carolina
29801

Hubbell Electric (Wuhu) Company, Ltd.
Exports Processing Zone, No 68
North Jiuhua Road, Wuhu City
Anhui Province, PR China

The above locations manufacture, assemble, and test utilizing manufacturing, quality, and calibration procedures developed from Hubbell Engineering Department Specifications. Engineering Department Specifications are controlled by Arrester Business Unit design engineering in the USA.

Dennis W. Lenk

Dennis W. Lenk
Principal Engineer

Fayaz Khatri

Fayaz Khatri
Design Engineering Supervisor

Separate reports provide details of the tests, according to the following table:

Report No.	Description	Clause	Issue Date
TD 01 060 E01	Insulation Withstand	8.1	6/21/2016
TD 01 060 E02	Discharge Voltage	8.2	6/21/2016
TD 01 060 E03	Disc Accelerated Aging	8.5	6/21/2016
TD 01 060 E04	Polymer Accelerated Aging	8.6	6/21/2016
TD 01 060 E05	Salt Fog Accelerated Aging	8.7	6/21/2016
TD 01 060 E06	Verification of Thermally Prorated Section	7.2.2	6/21/2016
TD 01 060 E07	Arrester Seal Integrity Test	8.9	6/21/2016
TD 01 060 E08	Partial Discharge	8.11	6/21/2016
TD 01 060-E09	High Current, Short Duration	8.12	6/21/2016
TD 01 060 E10	Low Current, Long Duration	8.13	6/21/2016
TD 01 060-E11	Duty Cycle	8.16	6/21/2016
TD 01 060 E12	Temporary Overvoltage	8.17	6/21/2016
TD 01 060 E13	Short Circuit for Polymer-Housed Arrester	8.18	6/21/2016
TD 01 060 E14	Arrester Disconnector Tests	8.21	6/21/2016
TD 01 060 E15	Maximum Design Cantilever Load-Static	8.22	6/21/2016

IEC TYPE TEST REPORT
Report No. TD 01 060 E01
Type PVR Riser Pole
IEEE HD Distribution Class Arrester

Insulation Withstand Test on Arrester Housing

This report records the results of this type test made on the Type PVR Riser Pole IEEE Heavy Duty Distribution Class arrester design rated 3 thru 36 kV in accordance in accordance with IEEE C62.11-2012 Standard "IEEE Standard for Metal-Oxide Surge Arresters for AC Power Circuits (>1kV)."

Dennis W. Lenk
Principal Engineer

Fayaz Khatri
Design Engineering Supervisor

Date: 6/21/2016

Type PVR Riser Pole Heavy Duty Distribution Class Arrester
Insulation Withstand Clause 8.1

Introduction: The following table lists the strike distance and height for the PDV100 Optima arrester mounted on the insulating support bracket. The table also summarizes the 10 second wet 60 Hz and impulse withstand requirements for each arrester rating.

Table 1

Catalog #	Ur kV rms	Uc kV rms	Arrester Strike w/Brkt mm	Arr Total Ht W/Brkt mm	8/20 20 kA IR kVc	Reqd BIL WS kVc	Actual Imp WS Arr w/Brkt kVc	Reqd 10 second wet power frequency WS kVc	Actual 10 second wet WS Arr w/Brkt kVc
221603	3	2.55	92	175	10.4	14.8	50	6.7	20
221605	6	5.1	173	236	21	29.8	105	13.4	40
221608	9	7.65	173	236	28.1	39.9	105	20.2	40
221609	10	8.4	173	236	31	44.0	105	22.1	40
221610	12	10.2	173	236	37.3	53.0	105	26.9	40
221613	15	12.7	264	312	46.5	66.0	150	33.5	60
221615	18	15.3	264	312	56.1	79.7	150	40.3	60
221617	21	17	264	312	63.8	90.6	150	44.8	60
221620	24	19.5	305	371	74.4	105.6	165	51.4	70
221622	27	22	475	533	82.6	117.3	270	58.0	105
221624	30	24.4	475	533	92.9	131.9	270	64.3	105
221629	36	29	475	533	110	156.2	270	76.4	105

Per Section 8.1.2.1c), the insulating bracket exceeded the required 10 second wet withstand requirements per Table 2.

Table 2

Bracket Assy Part #	Arrester MCOV	Bracket size	Required 10 second wet withstand kVrms	Actual 10 second wet withstand kVrms
273206	2.55-10.2	Small	15.3	30
274334	12.7-17	Medium	25.5	35
273207	19.5-29	Large	43.5	45

Conclusion: In all cases, the actual withstand values shown for each arrester rating exceed the minimum values specified in the Standard.

IEEE Type Test Report
Report No. TD 01 060 E02
Type PVR Riser Pole
IEEE HD Distribution Class Arrester

Residual Voltage Test

This report records the results of this type test made on Type PVR arresters in accordance with IEEE C62.11-2012 Standard "IEEE Standard for Metal-Oxide Surge Arresters for AC Power Circuits (>1kV)."

Dennis W. Lenk

Dennis W. Lenk
Principal Engineer

Fayaz Khatri

Fayaz Khatri
Design Engineering Supervisor

Date:6/21/2016

RESIDUAL VOLTAGE TESTS

Sample Preparation

Residual voltage tests were performed on three 40mm x 40 mm MOV discs.

Test Procedure

The following tests were performed on each sample. Each sample was allowed to cool to ambient temperature between discharges.

1. Steep Current Impulse Residual Voltage Test: 1/2 µs, 10 kA;
2. Lightning Impulse Residual Voltage Test: 8/20 µs, 1.5, 3, 5, 10, 20 kA;
3. Switching Impulse Residual Voltage Test: 30-100/60-200 µs and 500 A.

Test Results

Each of the three test samples was subjected to a 10 kA, 1/2 µs steep current impulse with and without an aluminum disc with the same geometry of the MOV disc. The difference in the residual voltages is the inductive drop across the MOV disc. Figures 1a and 1b show the oscillograms of the measured FOW residual voltage discharges of Sample 3 without and with an aluminum spacer, respectively.

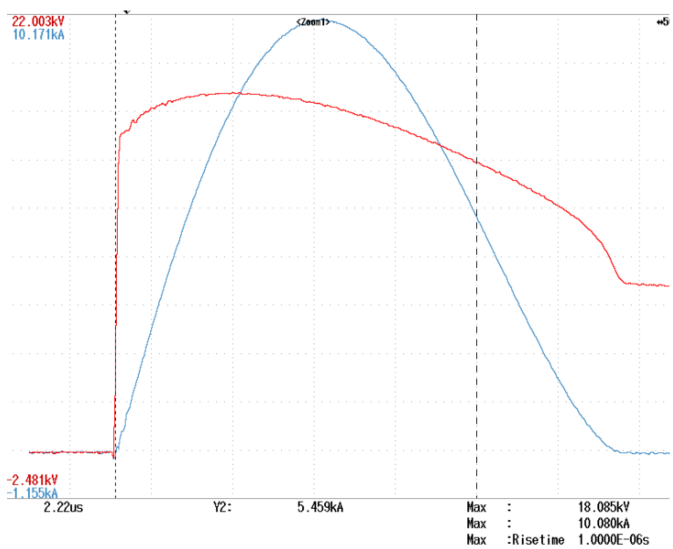


Figure 1a: Sample 3, 10.080 kA, 18.085 kV w/o Aluminum spacer.

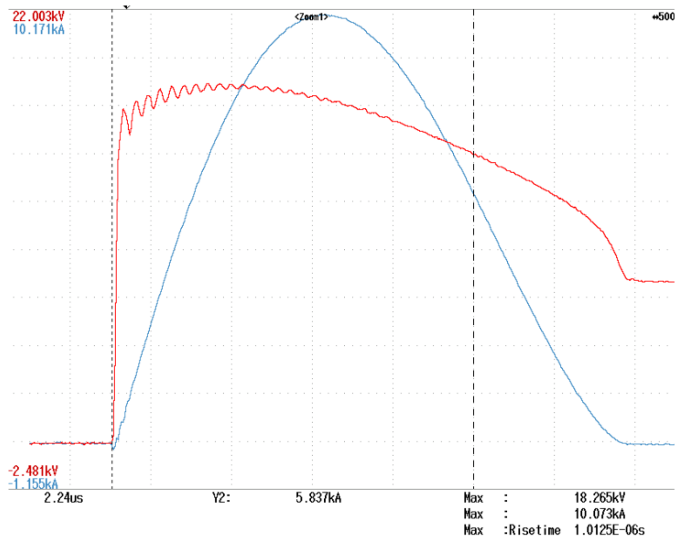


Figure 1b: Sample 3, 10.073 kA, 18.265 kV with Aluminum spacer.

Each sample was then subjected to 1.5, 3, 5, 10 and 20 kA lightning surge impulses. Figure 2 shows the oscillogram of the 10kA 8/20 discharge of Sample 3.

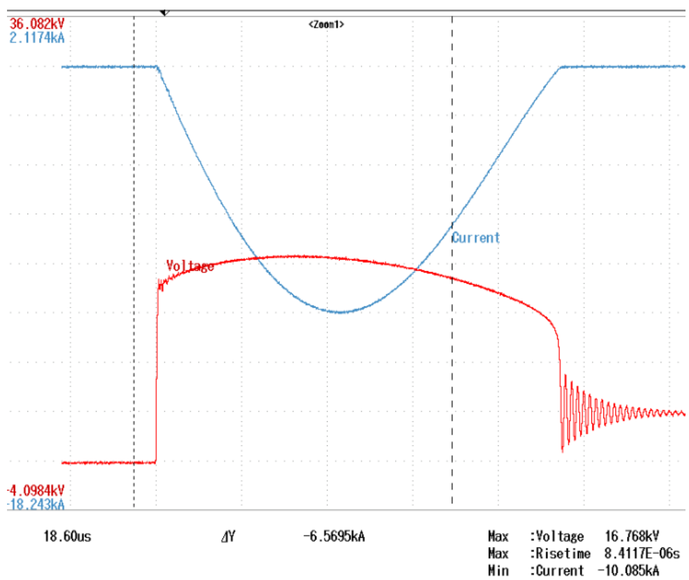


Figure 2: Sample 3, 10.085 kA, 16.768 kV.

Each sample was then subjected to 500 A switching surge impulses. Figure 3 shows the oscillogram of the switching surge discharge of Sample 3.

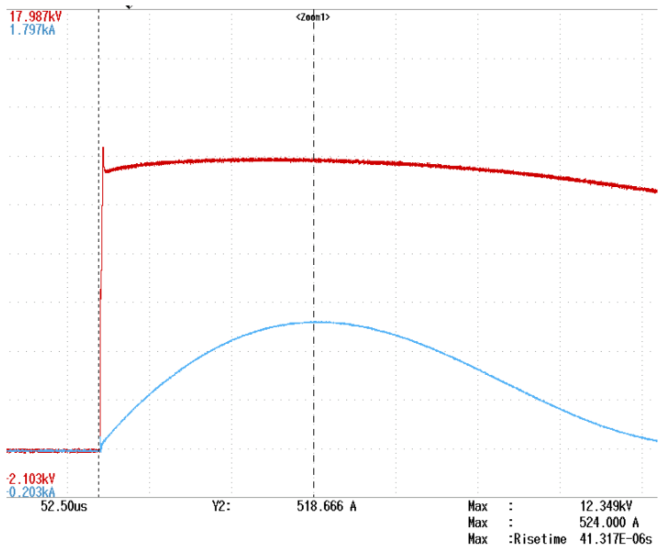


Figure 3: Sample 3, 524 A, 12.349 kV.

Table 1 shows the 10kA IRs of the steep front wave measured with and without the aluminum disc.

Table 1: Measurement of Inductive effect on MOV discs

Sample No.	I (kA)	IR (KVpk) with Al disc	IR (KVpk) w/o Al disc	L(di/dt) effect (kV)	Voltage drop across MOV disc w/o inductive effect (kV)
1	10	18.330	18.150	.180	17.970
2		18.183	18.036	.147	17.889
3		18.265	18.085	.180	17.905

Table 2 summarizes the design factors used to extrapolate the 1.5 through 20 kA 8/20 residual voltage, the 500 amp switching surge residual voltage, and MOV disc .5 microsecond FOW residual voltage. The highest factor for each wave shape is shown bolded and is multiplied by the 10 kA residual voltage of each rating to develop the family of residual voltage values. Table 3 summarizes the residual voltage values measured and claimed for each arrester rating.

Table 2: Residual Voltage Test.

Impulse Current (kA)	**Wave Shape (µs)**	**Discharge Voltage (kVpk)**			**Discharge Voltage Ratio (IR/10kV 8/20 IR)**		
		Sample 1	**Sample 2**	**Sample 3**	**Sample1**	**Sample2**	**Sample3**
0.5	45/99	12.201	11.826	12.349	0.726	0.708	**0.736**
1.5	8/20	14.166	14.287	13.964	0.843	**0.855**	0.833
3	8/20	14.946	14.866	14.946	0.890	0.889	**0.891**
5	8/20	15.579	15.471	15.552	**0.928**	0.926	0.927
10	8/20	**16.795**	**16.715**	**16.768**	1	1	1
20	8/20	18.563	18.429	18.536	1.105	1.103	**1.105**
40	8/20	21.456	21.376	21.456	1.278	1.279	**1.280**
10	1/2 (w/o inductive effect)	17.970	17.889	17.905	**1.070**	1.070	1.068

Table 3: Summary of Arrester Discharge Voltages

		IR Multipliers	0.736	0.855	0.891	0.928	1	1.105	1.28	1.07	10		
		Waveshape	45/100	8/20	8/20	8/20	8/20	8/20	8/20	Disc 0.5 usec	Unit Ht	10 kA Induct Drop	Total FOW
MCOV	**Rating**	**I (kA)**	**0.5**	**1.5**	**3**	**5**	**10**	**20**	**40**	**10**	m.	kV	**10**
2.55	3	Measured IR	6.6	7.7	8.0	8.3	8.96	9.9	11.5	9.6	0.079	0.79	10.4
		Catalog IR	6.7	7.8	8.1	8.4	9.1	10.1	11.6	9.7	0.079	0.79	10.5
5.1	6	Measured IR	13.4	15.5	16.2	16.8	18.14	20.0	23.2	19.4	0.140	1.40	20.8
		Catalog IR	13.5	15.6	16.3	17.0	18.3	20.2	23.4	19.6	0.140	1.40	21.0
7.65	9	Measured IR	18.0	20.9	21.8	22.7	24.48	27.1	31.3	26.2	0.140	1.40	27.6
		Catalog IR	18.0	20.9	21.8	22.7	24.5	27.1	31.4	26.2	0.140	1.40	27.6
8.4	10	Measured IR	19.8	23.0	23.9	24.9	26.9	29.7	34.4	28.7	0.140	1.40	30.1
		Catalog IR	19.9	23.1	24.1	25.1	27.0	29.8	34.6	28.9	0.140	1.40	30.3
10.2	12	Measured IR	23.8	27.6	28.8	30.0	32.3	35.7	41.3	34.6	0.140	1.40	36.0
		Catalog IR	23.9	27.8	29.0	30.2	32.5	35.9	41.6	34.8	0.140	1.40	36.2
12.7	15	Measured IR	29.8	34.6	36.1	37.6	40.48	44.7	51.8	43.3	0.216	2.16	45.5
		Catalog IR	29.8	34.6	36.1	37.6	40.5	44.8	51.8	43.3	0.216	2.16	45.5
15.3	18	Measured IR	35.9	41.6	43.4	45.2	48.7	53.8	62.3	52.1	0.216	2.16	54.3
		Catalog IR	36.0	41.8	43.6	45.4	48.9	54.0	62.6	52.3	0.216	2.16	54.5
17	21	Measured IR	40.7	47.3	49.3	51.3	55.3	61.1	70.8	59.2	0.216	2.16	61.3
		Catalog IR	40.9	47.5	49.5	51.6	55.6	61.4	71.2	59.5	0.216	2.16	61.7
19.5	24	Measured IR	47.5	55.2	57.6	59.9	64.6	71.4	82.7	69.1	0.277	2.77	71.9
		Catalog IR	47.8	55.5	57.8	60.2	64.9	71.7	83.1	69.4	0.277	2.77	72.2
22	27	Measured IR	52.7	61.2	63.8	66.4	71.6	79.1	91.6	76.6	0.436	4.36	81.0
		Catalog IR	53.0	61.6	64.2	66.8	72.0	79.6	92.2	77.0	0.436	4.36	81.4
24.4	30	Measured IR	59.4	69.0	72.0	74.9	80.8	89.2	103.4	86.4	0.436	4.36	90.8
		Catalog IR	59.6	69.3	72.2	75.2	81.0	89.5	103.7	86.7	0.436	4.36	91.0
29	36	Measured IR	70.4	81.8	85.3	88.8	95.7	105.7	122.5	102.4	0.436	4.36	106.7
		Catalog IR	70.7	82.2	85.6	89.2	96.1	106.2	123.0	102.8	0.436	4.36	107.2

Test Summary

Table 1 summarizes the result of FOW discharge testing performed, per the standard, with and without an aluminum spacer. The MOV disc FOW residual voltage is combined with the inductive drop (associated with the arrester height) to develop each rated arrester’s total FOW residual voltage.

Table 2 summarizes residual voltage measurements for the three test samples across the range of specified wave shapes and current values. The residual voltage of each MOV disc is measured as a routine test with a discharge current of 10 kA, 8/20 μs. The MOV discs of each arrester are accumulated within 10 kA residual voltage ranges as specified for each arrester rating. To verify the catalog maximum residual voltage levels, a discharge voltage ratio was established at each current level based on the 10 kA residual voltage of each test sample, as shown in Table 2. This ratio was multiplied by the maximum 10-kA residual voltage accumulation specified for each rating. As summarized on Table 3, the residual voltage calculated based on the prorated test samples were less than the maximum declared catalog levels.

TYPE TEST REPORT No. TD 01 060 E03

Disc Accelerated Aging
PVR Riser Pole HD Distribution Arrester

CERTIFICATION

This is to certify that the disc accelerated aging design tests have been successfully performed on Ohio Brass Type PVR Heavy Duty Riser Pole Distribution Class Surge arresters.

Dennis W. Lenk

Dennis W. Lenk
Principal Engineer

Fayaz Khatri

Fayaz Khatri
Design Engineering Supervisor

Date: 6/21/2016

DESIGN TEST REPORT
PVR Riser Pole HD Distribution Class Surge Arrester

TITLE: Accelerated aging procedure

TEST PROCEDURE: Tests were performed to measure MOV disc aging characteristics. Measured watts values are used to develop elevated voltage ratios k_c and k_r for use in proration of duty cycle and discharge current withstand test samples.

TEST SAMPLES: Six arrester prorated sections were prepared. Three sections consisted of (1) 40 mm diameter x 21mm long MOV disk , spring, end terminals, barrier film and fiberglass/epoxy wrap using standard module construction. Three additional sections consisted of (1) 40 mm diameter x 42mm long MOV disk , spring, end terminals, barrier film and fiberglass/epoxy wrap using standard module construction

TEST PROCEDURE: Tests were performed per section 8.5 of IEEE Standard C62.11-2012. Samples were placed inside a 115 °C ±2 °C. oven and energized at Uct, a voltage level greater than MCOV, for 1,000 hours.

TEST RESULTS: Watts loss for each sample was measured at Uct two hours after energization and at the completion of the 1000 hour test duration. The table below summarizes test results. Watts loss was periodically monitored at Uct during the 1000 hour test duration to identify the minimum watts loss value recorded during the test.

Accelerated aging test data

Sample No. -length	Watts Loss at 2 Hr @Uc P_{start} (w)	Watts Loss minimum @Uc P_{min} (w)	Watts Loss at 1000 Hr @Ur P_{end} (w)	Reqd ratio None Measured P_{end} / P_{min}	Reqd ratio <1 Measured P_{end} / P_{start}
1-40x21	**0.90**	**0.54**	**.054**	**1**	**0.60**
2-40x21	**0.78**	**0.49**	**0.49**	**1**	**0.62**
3-40x21	**1.09**	**0.80**	**0.80**	**1**	**0.73**
4-40x42	**0.86**	**0.42**	**0.42**	**1**	**0.49**
5-40x42	**0.87**	**0.43**	**0.43**	**1**	**0.49**
6-40x42	**0.93**	**0.65**	**0.65**	**1**	**0.70**

CONCLUSION: Over the 1000 hour test duration, each test sample demonstrated decreasing watts loss at Uct, successfully completing the disc accelerated aging test.

TYPE TEST REPORT
Report No. TD 01 060 E04
Polymer Accelerated Aging
PVR Riser Pole Arrester

CERTIFICATION

This is to certify that the polymer accelerated aging design tests have been successfully performed on Ohio Brass Type PVR Riser Pole Heavy Duty Distribution Class surge arresters.

Dennis W. Lenk

Dennis W. Lenk
Principal Engineer

Date: 6/21/2016

DESIGN TEST REPORT
PVR Riser Pole Distribution Class Surge Arrester
Accelerated Aging Tests of External Polymeric Insulating Systems for Distribution Arresters.

Introduction: These tests were performed per clause 8.6 of IEEE Standard C62.11-2012. Accelerated aging tests by exposure to light were performed per clause 8.6.1 test method 8.6.1.2.c. Tests on polymer housing and insulating bracket material using the fluorescent UV technique described in ASTM G53-1996. Test duration was 1000 hours on three samples of each material. Accelerated aging tests by exposure to electrical stress were performed per clause 8.6.2.

Samples: Accelerated aging tests by exposure to electrical stress were performed per clause 8.6.2. Three PVR 10.2 kV MCOV and three PVR 17 kV MCOV arresters were tested. These represent the highest MCOV stress based on leakage distance and arcing distance. Tests were performed by attaching arresters to a vertical Ferris wheel. As the wheel rotates, each arrester is sequentially dipped into a 400 ohm-centimeter water bath. Each arrester is allowed to drip off excessive contaminant and is then energized at MCOV to force the arrester housing into a dry band arcing condition. The test is performed until each arrester has reached 1000 hours of energized test time. Prior to and after the 1000 hour test, each arrester is subjected to a 10 kA 8/20 discharge to confirm its electrical integrity.

The final portion of the test procedure consists of subjecting each arrester insulating bracket to 20 hours on voltage with the insulating bracket energized at MCOV. At the completion of the above tests, the arresters are examined to ensure there is no evidence of surface tracking.

Conclusion: Both polymer housing and insulating bracket materials passed the test requirements of clause 8.6.1.3, as there were no cracks greater than the allowed depth of 0.1 mm. The arresters also passed the requirements of clause 8.6.2.4, as the arrester discharge voltage changed by less than 1 % as a result of the 1000 hour Ferris wheel test. There was no evidence of external flashovers, punctures, or internal breakdowns during the described tests. There was no evidence of surface tracking on the PVR arrester housings after the 1000 hour on-voltage test or on the insulating bracket after the 20 hour on-voltage test.

IEC Type Test Report
Report No. TD 01 060 E05
Type PVR Riser Pole
IEEE HD Distribution Class Arrester

1000 Hour Salt Fog Test

This report records the results of this type test made on Type PVR arresters in accordance with IEEE C62.11-2012 Standard “IEEE Standard for Metal-Oxide Surge Arresters for AC Power Circuits (>1kV).”

Dennis W. Lenk
Principal Engineer

Fayaz Khatri
Design Engineering Supervisor

Date:6/21/2016

Design Test Report
PVR Riser Pole Distribution Class Surge Arrester
1000 Hour Salt Fog Test

TITLE: 1000 Hour Salt Fog Exposure Test

TEST OBJECTIVE: Perform 1000 hour salt fog exposure test per section 8.7 of C62.11 – 2012 Standard.

TEST SAMPLE: Two 29 kV MCOV arresters were tested. Arrester #1 was tested with its insulating support bracket attached to the base end of the arrester. Arrester #2 was tested without the insulating support bracket.

TEST PROCEDURE: The arresters were mounted vertically inside the salt fog chamber. Prior to and after the 1000 hour test, the reference voltage and partial discharge of the sample were measured. The 1000 hour test was performed with a spray having an NaCl salt content of 10 kg/m^3 per the procedure specified in section 8.7.3 of the standard

TEST RESULTS: The test arrester passed the 1000 hour salt exposure. The physical condition of the polymer housings showed no signs of surface tracking or surface erosion. There was no evidence of housing or shed punctures. The following table summarizes the results of the electrical testing.

Sample #	Reference Voltage kVc Before Salt Fog	Reference Voltage kVc After Salt Fog	Reference Voltage % Change	Partial Discharge After Salt Fog PC
1	38.8	39.0	+0.5	<1
2	39.2	40.0	+2.0	<1

Photograph #1 shows the salt-contaminated surfaces of the one of the two arresters after completion of the 1000 hour duration salt fog test. There was no evidence of surface tracking, erosion, or shed punctures on either of the two test samples.

Photograph #1

CONCLUSION: The physical condition of the test arrester and the electrical testing confirmed that the PVR Optima arrester successfully passed the 1000 hour salt fog exposure test.

IEEE Type Test Report
Report No. TD 01 060 E06
Type PVR Riser Pole
IEEE HD Distribution Class Arrester

Verification of Thermally Prorated Section

This report records the results of this type test made on Type PVR arresters in accordance with IEEE C62.11-2012 Standard "IEEE Standard for Metal-Oxide Surge Arresters for AC Power Circuits (>1kV)."

Dennis W. Lenk
Principal Engineer

Fayaz Khatri
Design Engineering Supervisor

Date: 6/21/2016

DESIGN TEST REPORT
PVR Heavy Duty Riser Pole Distribution Class Surge Arrester

TITLE: Verification of thermally prorated arrester section:

INTRODUCTION: Tests were performed as required by clause 7.2.2.3 of IEEE C62.11-2012 Standard, to compare the cooling characteristics of the prorated test sections used for type tests with those of a full-size arrester unit.

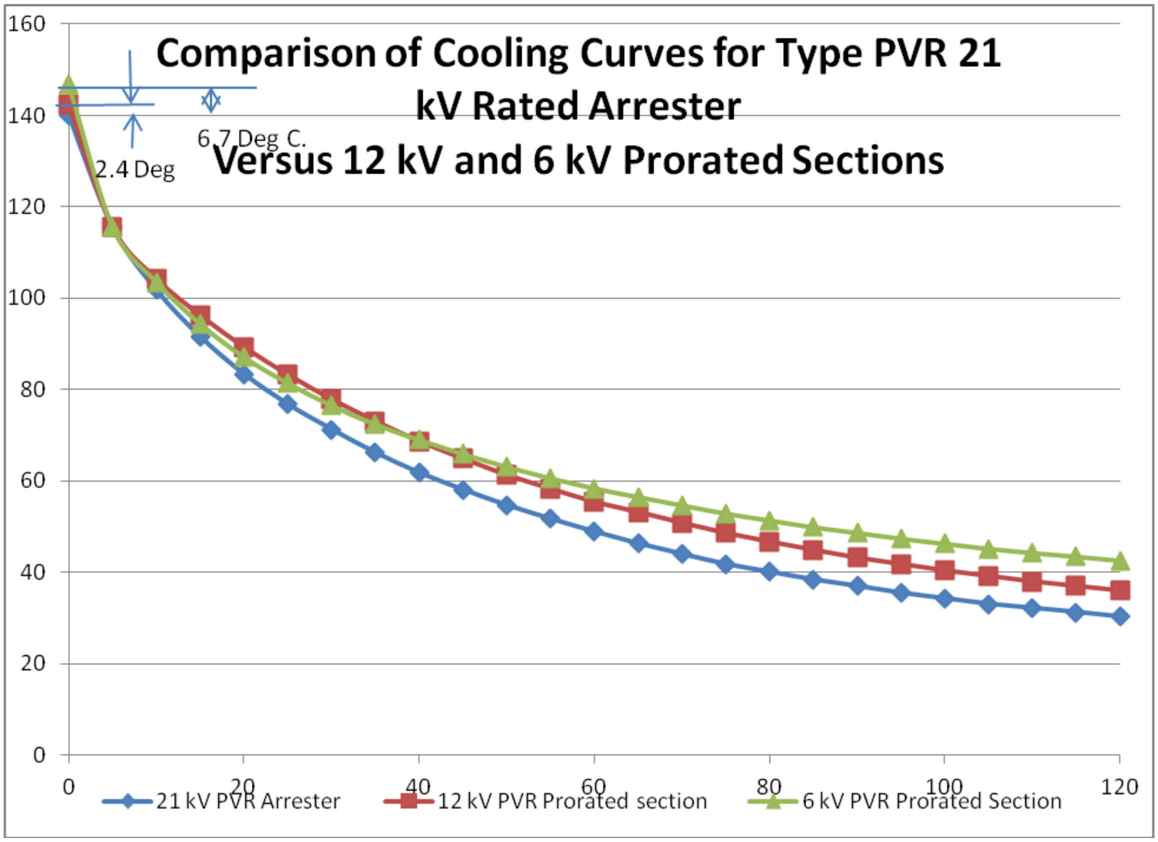
PURPOSE: The purpose of this test is to verify that the thermal cooling curve for the Type PVR prorated sections, when internally heated, will cool slower than that of a full size 21 kV rated arrester unit.

PROCEDURE: A full size single unit 21 kV rated Type PVR arrester and a 12 kV and a 6 kV prorated section were heated up by applying a temporary overvoltage to the test samples. Per clause 7.2.2.3, all samples (the arrester and the prorated sections) were energized in approximately 10 minutes to a starting temperature of 140 ºC, at which time the voltage was removed. The full size arrester and the two prorated sections were instrumented with (1) fiber-optic sensors located in the middle of the MOV disc stack. During the cooling portion of the test, the temperatures of the arrester and the test sections were monitored at 5 minute intervals to develop the cooling curve for each sample.

SUMMARY: As allowed in clause 7.2.2.3.5, the cooling curves for both the 12 kV and 6 kV prorated sections were adjusted higher to assure that, at no time during the 120 minute cooling period, do the section cooling curves drop below that of the full size arrester. The adjusted temperature shown for each rated section was added to the durability tests requiring a 60 degree C. preheat.

The cooling curve (Figure 1 below) confirms that the cooling rate of the 12 kV and 6 kV prorated sections is slower than that of the full size 21 kV Rated Type PVR arrester unit, confirming the thermal equivalency of the prorated sections to the full size arrester.

Figure 1



Comparison of Cooling Curves for Type PVR 21 kV Rated Arrester
Versus 12 kV and 6 kV Prorated Sections
6.7 Deg C.
2.4 Deg
160
140
120
100
80
60
40
20
0
0
20
40
60
80
100
120
21 kV PVR Arrester
12 kV PVR Prorated section
6 kV PVR Prorated Section

TYPE TEST REPORT
Report No. TD 01 060 E07

Seal Integrity Test
PVR Riser Pole Arrester

CERTIFICATION

This is to certify that the seal integrity design tests have been successfully performed on Ohio Brass Type PVR Riser Pole Heavy Duty Distribution Class Surge arresters.

Dennis W. Lenk
Principal Engineer

Date:6/21/2016

DESIGN TEST REPORT
PVR Riser Pole Distribution Class Surge Arrester
Seal Integrity Design test

TEST SAMPLES: Tests were performed per section 8.9 of IEEE Standard C62.11-2012 on four 12 kV and four 18 kV rated arresters.

TEST PROCEDURE: The seal integrity test consisted of the following steps:

a) Initial Electric Test: Watts loss and IIV were measured while each arrester was energized at rated voltage.
b) Terminal Torquing: A ¼" diameter hard lead was inserted between the wire clamp and arrester end stud on one side only. The clamping nut was torqued to 22 ft-lb.
c) Thermal Conditioning: Each arrester was placed in a 70°C ± 3° C environment for 14 days, after which the arresters were stabilized at ambient room temperature and watts was measured.
d) Seal Pumping: The arresters were heated to 60°C ± 3°C for one hour, then placed into a 4°C ± 3°C water bath for two hours, after which the samples were returned to the 60°C oven. Each arrester was subjected to ten repetitions of this cycle. The transfer time between media was 1-2 minutes.
e) Final Electrical Test: Step (a) was repeated.
f) Final Inspection: The arresters were disassembled to verify no moisture penetration was evident.

TEST RESULTS: As indicated in the following table, all arresters demonstrated adequate sealing with no evidence of internal moisture or change in watts loss or IIV.

Sample Number	Applied Voltage (kV rms)	Initial Watts Loss	Final Watts Loss	Initial Partial Discharge (coulombs)	Final Partial Discharge (coulombs)
1	18	1	1	<1	<1
2	18	1	1.1	<1	<1
3	18	1	0.9	<1	<1
4	18	1.1	1.2	<1	<1
5	12	0.8	0.7	<1	<1
6	12	0.8	0.8	<1	<1
7	12	0.8	0.8	<1	<1
8	12	0.7	0.7	<1	<1

CONCLUSION: The arrester watts loss increase was less than 10%, below the allowed 50% level. Internal partial discharge was unchanged after completion of the seal integrity test. In addition, disassembly revealed no evidence of internal moisture inside the test arresters. Therefore, the PVR Riser Pole arrester successfully passed the seal integrity design test.

IEC TYPE TEST REPORT
Report No. TD 01 060 E08
Type PVR Riser Pole
IEEE HD Distribution Class Arrester

Partial Discharge Test

This report records the results of this type test made on the Type PVR Riser Pole IEEE Heavy Duty Distribution Class arrester design rated 3 thru 36 kV in accordance in accordance with IEEE C62.11-2012 Standard “IEEE Standard for Metal-Oxide Surge Arresters for AC Power Circuits (>1kV).”

Dennis W. Lenk
Principal Engineer

Date: 6/21/2016

Fayaz Khatri
Design Engineering Supervisor

Partial Discharge test

TEST PROCEDURE AND SAMPLE: Partial discharge testing was performed per section 8.11 of IEEE Standard C62.11-2012. The test was performed on a 36 kV rated, 29.0 kV MCOV PVR Riser Pole arrester.

TEST RESULTS: The measured partial discharge at 1.05 times MCOV was 0 pc.

CONCLUSION: The 36 kV rated PVR Riser Pole arrester passed test requirements as measured partial discharge was well below the allowed 10 pc test limit. As there was no extra shielding on the top end of the arrester, the RIV test was not performed.

IEEE Type Test Report
Report No. TD 01 060 E09
Type PVR Riser Pole
IEEE HD Distribution Class Arrester

High Current, Short Duration Test

This report records the results of this type test made on Type PVR arresters in accordance with IEEE C62.11-2012 Standard "IEEE Standard for Metal-Oxide Surge Arresters for AC Power Circuits (>1kV)."

Dennis W. Lenk

Dennis W.Lenk
Principal Engineer

Fayaz Khatri

Fayaz Khatri
Design Engineering Supervisor

Date: 6/21/2016

PVR Riser Pole Heavy Duty Distribution Class Surge Arrester

TITLE: High Current, Short Duration Discharge Withstand Tests:

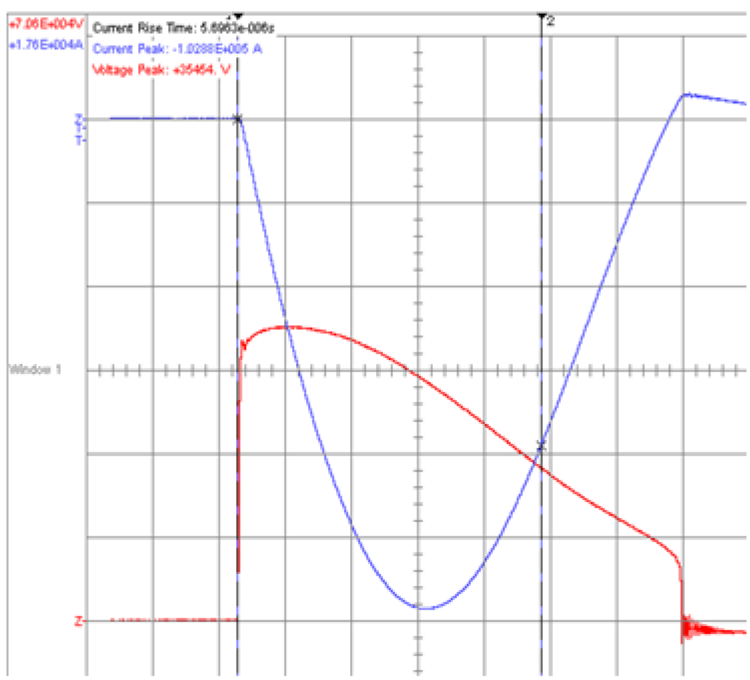
OBJECTIVE: High current, short duration discharge withstand tests were performed per section 8.12 of IEEE Standard C62.11-2012. Tests were performed per Heavy Duty Distribution Class arrester requirements.

TEST SAMPLE: As required by the standard, prorated samples contained the minimum MOV mass per specified for the design. MCOV voltage was also prorated per unit Vref to reflect the lowest margin case of the standard voltage ratings offered in this design.

TEST PROCEDURE: Test samples were subjected to two 100 kA, 4/10 µs discharges. Sufficient time was allowed between discharges for the sample to cool to ambient temperature 22 °C. Within 100 milliseconds after the second high current discharge, samples were energized at the prorated MCOV recovery voltage. Watts loss was monitored over a 30 minute period demonstrating thermal stability. Residual voltage at 10 kA measured prior to and following the 100 kA discharge and thermal recovery tests verified characteristics remained within acceptable limits.

TEST RESULTS: The following Figure 1 for sample #2 is typical for the three samples tested.

Figure 1: Sample #2, Shot 1, 102.8 kA, 35.46 kV 5.2/12.4



Within 100 milliseconds after the 2nd high current shot, the test arrester was energized at recovery voltage for 30minutes and the sample watts loss was monitored to assure the sample was not thermally unstable. Figures 2 and 3 show the arrester grading current immediately after the 2nd high current discharge and 30 minutes later, respectively.

FIGURE 2: THERMAL RECOVERY FOR SAMPLE #1

Time = 0

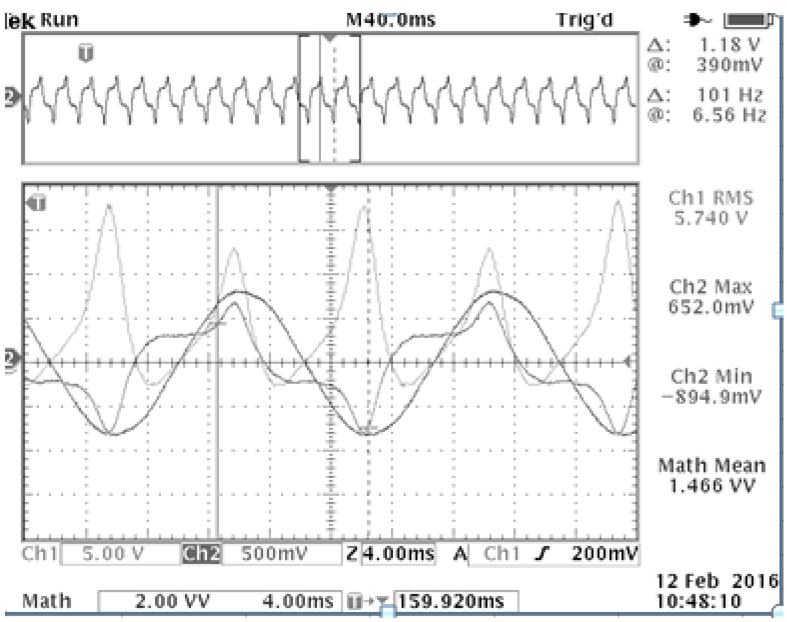


FIGURE 3: THERMAL RECOVERY FOR SAMPLE #1

Time = 30 minutes

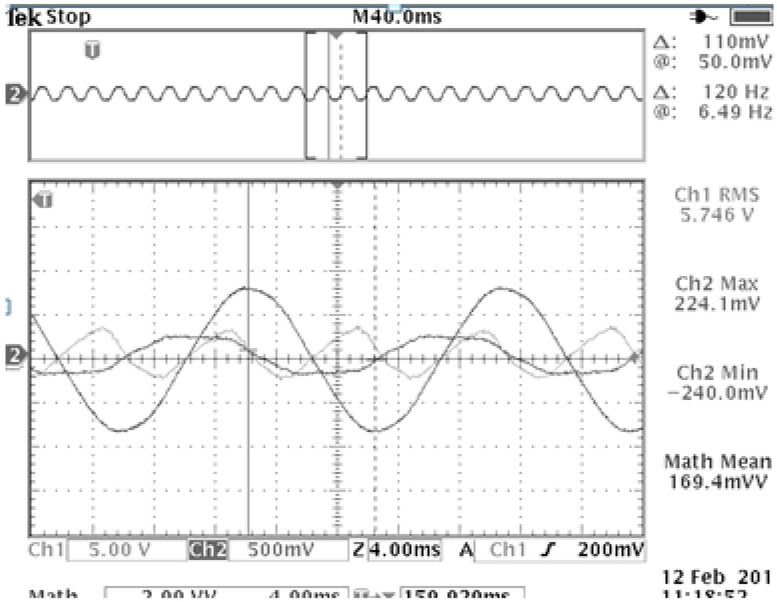


Table 1 summarizes the results of this test for all three samples.

Table 1:High Current Short Duration
Discharge Withstand Test Summary

	Sample #1	Sample #2	Sample#3
Shot 1 (kA)	104.4	102.8	102.1
Shot 2 (kA)	104.4	102.6	110.9
Recovery Watts@ Time (minutes)			
0	9.49	6.02	8.38
2	1.73	1.64	2.08
5	1.31	1.32	1.44
10	1.02	1.01	1.15
20	0.77	0.78	0.91
30	0.66	0.70	0.79
10 kA IR Before	16.126	15.965	15.697
10 kA IR After	16.313	16.259	16.072
10 kA IR % Change	+1.2%	+1.8%	+2.4%

CONCLUSIONS: All prorated test samples successfully completed the high current test and demonstrated thermal stability during the recovery test. Disassembly revealed no evidence of physical damage to the test samples, confirming the PVR Riser Pole arrester successfully passed the Heavy Duty Distribution Class arrester high current, short duration requirement.

IEEE Type Test Report
Report No. TD 01 060 E10
Type PVR Riser Pole
IEEE HD Distribution Class Arrester

Low Current, Long Duration Test

This report records the results of this type test made on Type PVR arresters in accordance with IEEE C62.11-2012 Standard "IEEE Standard for Metal-Oxide Surge Arresters for AC Power Circuits (>1kV)."

Dennis W. Lenk
Principal Engineer

Date: 6/21/2016

Fayaz Khatri
Design Engineering Supervisor

PVR Heavy Duty Distribution Class Surge Arrester
Low Current, Long Duration Discharge Withstand Tests

Introduction: The low current, long duration discharge withstand test was performed per clause 8.13 IEEE Standard C62.11-2012. Tests were performed per Heavy Duty distribution arrester requirements using 6 kV rated test samples.

Test Samples: Per section 8.21.2.1, a ground lead disconnector (GLD) was connected in series with each of the three LCLD 6 kV rated test samples.

Procedure: Per section 8.13.3, each test sample was subjected to six sets of three nominal 2000 μs duration discharges greater than 250 amps. Sufficient time was allowed between sets of discharges for the section to cool to room ambient temperature. Per section 8.13.4, the 10 kA residual voltage of each MOV disc section was measured prior to and after the (18) shot LCLD test.

Results: Table 1 summarizes the results of the 18 shot test performed on the three test samples.

Table 1

	Sample #1			Sample #2			Sample #3		
Shot No.	Amps	Coul	KJ/Shot	Amps	Coul	KJ/Shot	Amps	Coul	KJ/Shot
1	269	0.67	8.26	270	0.67	8.24	275	0.69	8.4
2	270	0.67	8.32	276	0.68	8.47	272	0.68	8.4
3	275	0.68	8.56	275	0.69	8.57	273	0.68	8.47
4	271	0.68	8.31	278	0.69	8.47	266	0.67	8.12
5	272	0.68	8.43	274	0.68	8.49	268	0.67	8.24
6	274	0.69	8.59	271	0.68	8.45	266	0.66	8.26
7	271	0.68	8.32	278	0.69	8.48	275	0.69	8.45
8	273	0.68	8.49	276	0.69	8.53	278	0.69	8.58
9	274	0.68	8.59	278	0.69	8.69	276	0.69	8.6
10	271	0.68	8.35	278	0.69	8.49	275	0.69	8.42
11	278	0.69	8.63	278	0.69	8.6	278	0.69	8.58
12	272	0.65	8.16	279	0.7	8.71	275	0.68	8.57
13	271	0.68	8.36	273	0.68	8.36	275	0.69	8.42
14	269	0.67	8.36	277	0.69	8.54	278	0.69	8.58
15	278	0.69	8.68	274	0.69	8.59	275	0.68	8.57
16	275	0.69	8.49	275	0.69	8.42	273	0.68	8.35
17	273	0.68	8.47	275	0.69	8.51	279	0.69	8.63
18	274	0.68	8.6	276	0.69	8.63	280	0.7	8.71

Figures 1 and 2, respectively show oscillograms of the 3rd and 18th shots performed on sample #1. These oscillograms are typical for all three test samples.

Figure #1

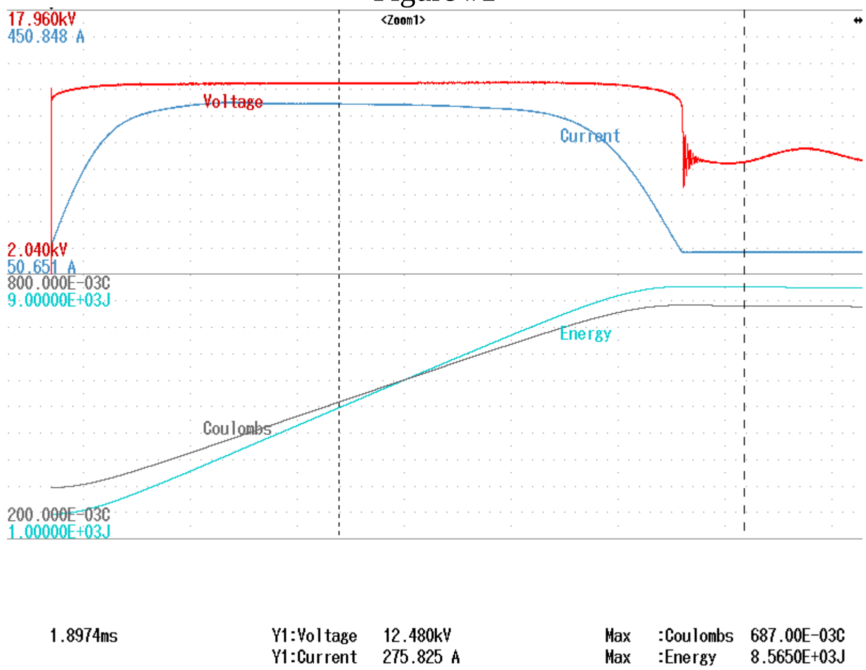
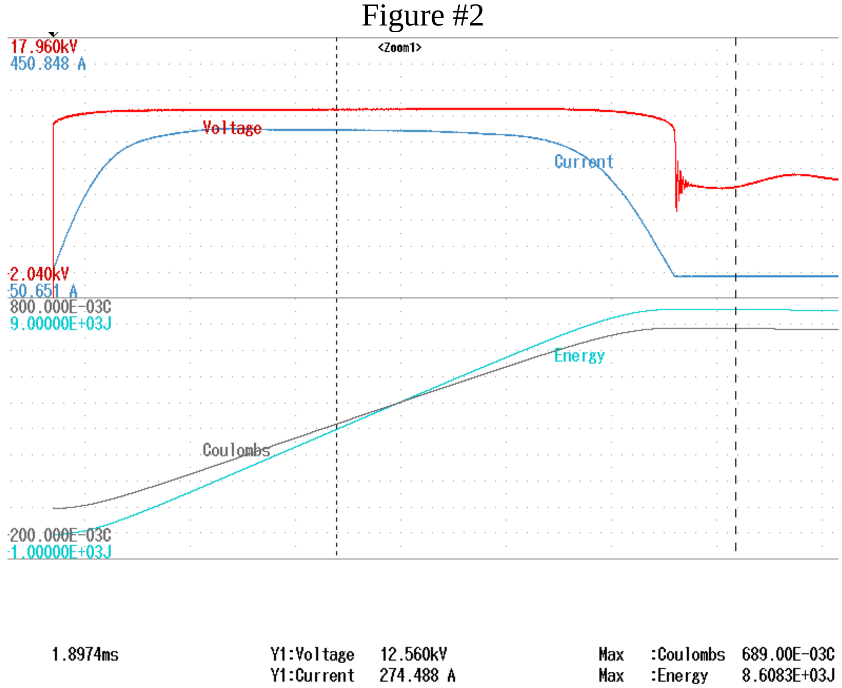


Figure #2



Residual voltage at 10 kA was measured prior to and following the 18-shot 250 A discharge tests. Table 2 summarizes the results of the 10 kA discharge voltage testing.

Table 2

Sample #	10 kA IR-kVc (Before)	10 kA IR-kVc (After)	10 kA IR % Change
1	16.675	16.661	-0.08%
2	16.675	16.635	-0.24%
3	16.608	16.688	+0.48%

Conclusion: The prorated test samples successfully completed the 18-shot low current, long duration test. The sample discharge voltage was less than 0.5%, well below the 10% change allowed in Section 8.13.4 of IEEE C62.11-2012 Standard. Disassembly revealed no evidence of physical damage to the test samples. The ground lead disconnectors did not detonate during the 18 shot test series. The PVR arrester successfully met the LCLD requirements of the Heavy Duty Distribution Class arrester.

IEEE Type Test Report
Report No. TD 01 060 E11
Type PVR Riser Pole
IEEE HD Distribution Class Arrester

Duty Cycle Test

This report records the results of this type test made on Type PVR arresters in accordance with IEEE C62.11-2012 Standard "IEEE Standard for Metal-Oxide Surge Arresters for AC Power Circuits (>1kV)."

Dennis W. Lenk
Principal Engineer

Fayaz Khatri
Design Engineering Supervisor

Date: 6/21/2016

PVR Heavy Duty Distribution Class Riser Pole Surge Arrester

TITLE: Duty Cycle Test:

TEST OBJECTIVE: Section 8.16.3 of IEEE C62.11-2012 standard specifies that the 20-shot rated voltage portion be performed with 10 kA 8/20 lightning impulses and the 2-shot recovery portion of the Duty Cycle test on Heavy Duty Distribution Class arresters be performed with 40 kA 8/20 lightning impulses.

TEST SAMPLE: As required by clause 8.16.1, prorated samples contained the minimum MOV mass per specified for the design. MCOV and rated voltages were also prorated per unit Vref to reflect the lowest margin case of the standard voltage ratings offered in this design. The test data shows the results of tesing performed on three test sections.

TEST PROCEDURE: Each prorated test section was energized at its rated voltage and subjected to twenty 10 kA, 8/20 discharges spaced at 1 minute increments. Following the twentieth impulse, the test section was placed in an oven at 63 ˚C. After reaching 63 ˚C, the sample was subjected to two 40 kA, 8/20 discharges. Within 5 minutes after the second high current discharge, the sample was energized at the prorated recovery voltage. Watts loss was monitored over a 30 minute period demonstrating thermal stability.

TEST RESULTS: The following data summarizes the results of the duty cycle test. Figure 1 shows the 20th shot performed on Sample #1 during the rated voltage portion of the duty cycle test.

Figure 1
Sample #1 20th Shot @ Rated Voltage

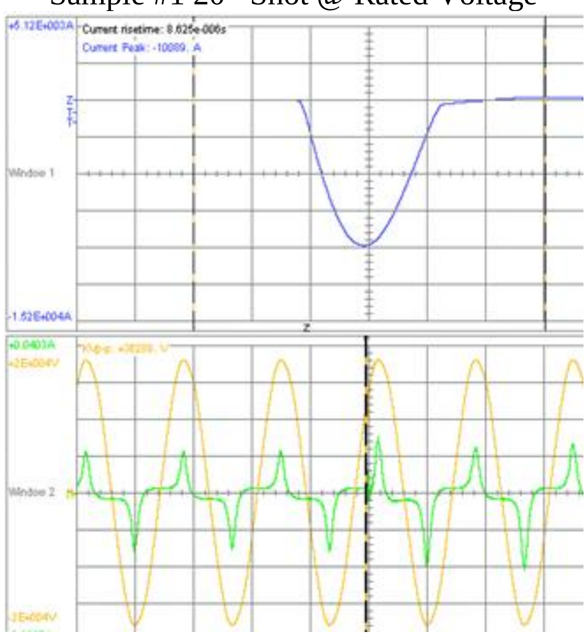
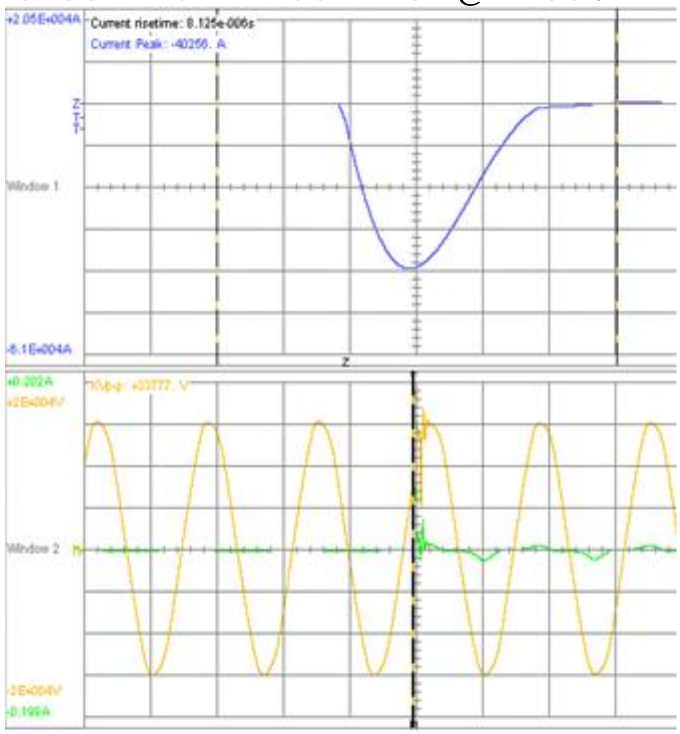


Figure #2 shows the oscillogram for the 2nd 40 kA impulse applied to Sample #1 during the recovery portion of the duty cycle test.

FIGURE 2
SAMPLE #1 SECOND 40 KA DISCHARGE @ RECOVERY VOLTAGE



Figures 3 and 4 show the grading current through Sample #1 at time zero and 30 minutes, demonstrating thermal recovery has occurred.

Figure 3 Recovery @ Time = 0+

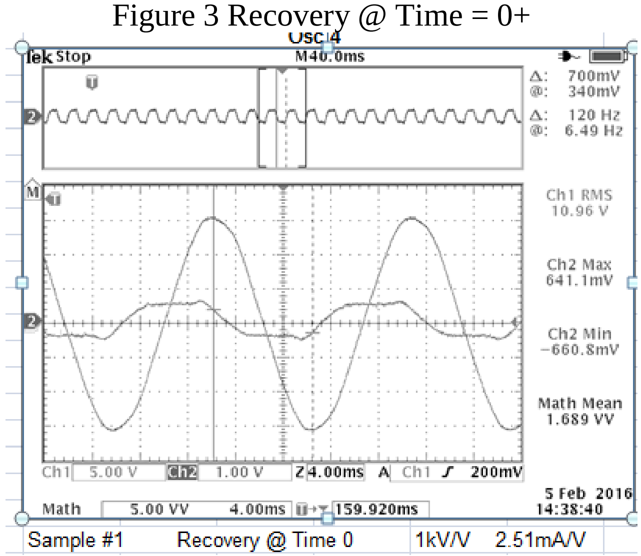


Figure 4 Recovery @ Time = 30 Minutes

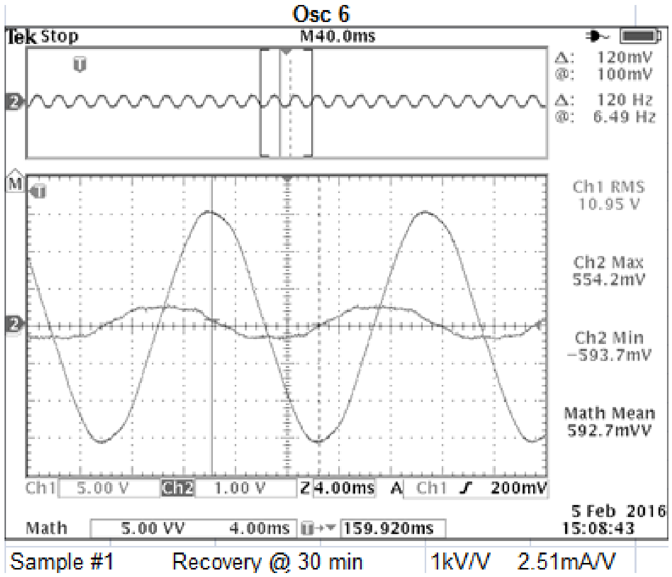


Table 1 summarizes the results of 20 shot 10 kA surge duty testing at rated voltage performed on the three test sections.

Table 1

Duty Cycle Shot Number	Sample #1 8/20 Impulse Current kAc	Sample #2 8/20 Impulse Current kAc	Sample #3 8/20 Impulse Current kAc
1	10.3	10.3	10.4
2	10.2	10.1	10.1
3	10.1	10.1	10.0
4	10.1	10.1	10.2
5	10.0	10.1	10.1
6	10.1	10.0	10.1
7	10.1	10.0	10.0
8	10.0	10.1	10.1
9	10.0	10.1	10.2.
10	10.0	10.1	10.1
11	10.0	10.1	10.1
12	10.0	10.2	10.1
13	10.0	10.1	10.0
14	10.0	10.1	10.0
15	10.0	10.1	10.0
16	10.1	10.0	10.2
17	10.0	10.1	10.2
18	10.1	10.1	10.0
19	10.1	10.2	10.2
20	10.1	10.2	10.2

After successful completion of the 20 shot rated voltage portion of the duty cycle test, the samples are preheated in an oven to 64 +/- 3 Deg C. and then subjected to (2) 40 kA 8/20 discharges spaced 1 minute apart. Table 2 shows the results of the 2-shot duty and the subsequent recovery portion of the test.

Table 2

40 kA Surge Duty	Sample #1-kA	Sample #2 kA	Sample #3 kA
Shot 21	41.8	42.2	41.9
Shot 22	40.3	40.9	40.7
Recovery Time	Sample #1 Watts	Sample #2 watts	Sample #3 Watts
0	4.24	3.72	3.97
2	3.43	.70	3.13
5	2.95	.65	2.64
10	2.51	.50	2.18
20	1.83	.35	1.66
30	1.47	.05	1.36

Prior to and after the duty cycle test, the sample 10 kA 8/20 discharge voltage is measured. Table 3 summarizes this test data.

Table 3

Sample No.	10 kA IR Before kVc	10 kA IR After kVc	% Change in 10 kA IR
1	31.66	32.12	+1.4%
2	31.61	31.98	+1.2%
3	31.66	32.04	+1.2%

CONCLUSION: The prorated test sample successfully completed Duty Cycle testing and demonstrated thermal stability during the recovery test. The 10 kA discharge voltage increased 1.2 to 1.4%, less than the allowed 10% limit specified in Section 8.16.4 of C62.11-2012 Standard. Disassembly revealed no evidence of physical damage to the test sample. The PVR Riser Pole arrester successfully met the Duty Cycle requirements of the Heavy Duty Distribution Class arrester.

IEEE Type Test Report
Report No. TD 01 060 E12
Type PVR Riser Pole
IEEE HD Distribution Class Arrester

Temporary Overvoltage Test

This report records the results of this type test made on Type PVR arresters in accordance with IEEE C62.11-2012 Standard "IEEE Standard for Metal-Oxide Surge Arresters for AC Power Circuits (>1kV)."

Dennis W. Lenk
Principal Engineer

Fayaz Khatri
Design Engineering Supervisor

Date: 6/21/2016

PVR Riser Pole Distribution Class Surge Arrester
Temporary Over-Voltage Tests (TOV) Performed on Arrester Section
Without Insulating Bracket:

Introduction; Temporary over-voltage tests were performed per clause 8.17 of IEEE Standard C62.11-2012. Tests were performed per Heavy Duty distribution arrester requirements using four prorated test sections.

Test Sections: Nominally 6 and 12 kV rated prorated sections were used to facilitate testing. The short time data points were generated using 6 kV rated sections while the longer time data points used 12 kV rated sections. As both sizes of arresters were thermally equivalent to the highest rated PVR arrester, the results of these tests cover ratings 3 - 36 kV with corresponding MCOV levels of 2.55 - 29.0 kV.

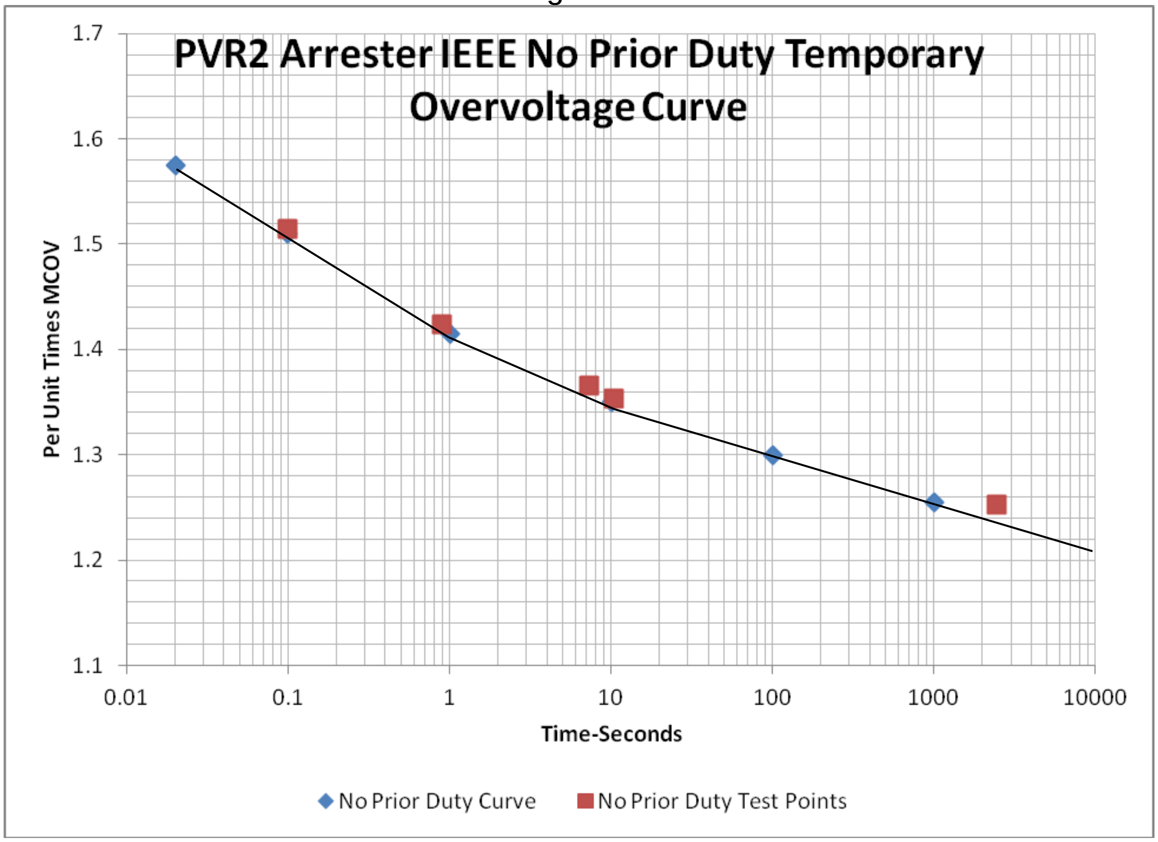
Results: Per clause 8.17.3, each prorated sample was tested within four of the six designated time ranges a - f, spanning over-voltage durations of .01 - 10,000 seconds. The tests were performed demonstrating TOV capability of the design under "no prior duty" conditions. For each TOV voltage setting, the test circuit applied voltage to the sample (preheated to 67^{o}C) for a time duration sufficient to exceed that claimed on the "no prior duty" curve. TOV voltage was superimposed over recovery voltage such that when TOV was removed, there was no delay prior to application of recovery voltage. Recovery voltage was applied for 30 minutes to demonstrate thermal stability. As required by Section 8.17.3, Table 1 summarizes the Type PVR No Prior Duty TOV data points for the arrester assembled without the ground lead disconnecting (GLD) bracket.

Table 1

Time-Seconds	TOV Per Unit Times MCOV
0.02	1.575
0.1	1.510
1	1.415
10	1.350
100	1.300
1000	1.255

Figure 1 summarizes the results of the TOV testing performed on the prorated sections without the ground lead disconnecting (GLD) bracket.

Figure 1



Per Section 8.17.4, the 10 kA discharge voltage for each test section was measured prior to and after TOV testing. Table 2 summarizes the results of that testing.

Table 2

Data Range	Time Seconds	Section Size	10 kA Discharge Voltage -kVc		
			Before TOV	After TOV	% Change
a	0.1	6 kV	16.072	16.548	2.90%
b	0.9	6 kV	15.992	16.467	2.97%
c	7.27	12 kV	31.983	32.799	2.55%
d	10.5	12 kV	31.983	32.53	1.71%
f	2460	12 kV	31.983	32.719	2.30%

Conclusion: Tests were successfully completed on four prorated samples in four specified time ranges. Each sample demonstrated thermal stability after TOV exposure. Residual voltage at 10 kA measured prior to and after the TOV test series changed much less than the allowed 10%. There was no evidence of physical damage to the test sections, validating the PVR arrester TOV capability claim.

IEEE Type Test Report
Report No. TD 01 060 E13
Type PVR Riser Pole
IEEE HD Distribution Class Arrester

Short Circuit Test

This report records the results of this type test made on Type PVR arresters in accordance with IEEE C62.11-2012 Standard "IEEE Standard for Metal-Oxide Surge Arresters for AC Power Circuits (>1kV)."

Dennis W. Lenk
Principal Engineer

Fayaz Khatri
Design Engineering Supervisor

Date: 6/21/2016

PVR Riser Pole Distribution Class Surge Arrester
Short-Circuit Test

OBJECTIVE: Short circuit tests were performed on the Type PVR Riser Pole Distribution Class arrester per section 8.18 of IEEE Standard C62.11-2005. Tests were performed per Table 14 of the referenced standard.

TEST SAMPLE: Fault current tests were performed on the longest mechanical section, as required in Section 8.18.1 of the standard. As required in Section 8.18.1, two test samples for the high current test were assembled with a fuse wire oriented axially between the mov disc stack and the fiberglass-epoxy wrap. These samples were subjected to the full offset current test. In addition, six samples represented standard production arresters. These samples were failed using the specified 2-source failure mode procedure.

TEST RESULTS: The following table summarizes the results these tests which validated the claimed maximum 20 kA_{rms} symmetrical, 12 cycle fault current withstand capability of this design, with an applied ratio of 1.55 between total asymmetrical to symmetrical rms currents. This corresponds to a 2.6 ratio, in the first half loop of fault current, between the crest asymmetrical to rms symmetrical current, i.e., full offset. In addition to testing at the claimed maximum capability, tests were also performed, using the 2-source procedure, at half the claimed capability and at 600 amps as specified in Table 14 of the standard.

All tests were performed at full voltage. Therefore, the prospective fault current, as measured during the bolted fault test on the generator, is the claimable fault current capability of the design.

Calibration Test 21.85 kA Symmetrical RMS 34.74 kA Asymmetrical RMS

Sample #	Failure Mode	Minimum Test Duration-seconds	Condition of Module/Polymer Housing After Test
1	Fuse Wire	.2	Module Intact/Housing Separated
2	Fuse Wire	.2	Module Intact/Hsg Torn but in Place
3	2-Source	.2	Module Intact/Hsg Torn but in Place
4	2-Source	.2	Module Intact/Hsg Torn but in Place

Calibration Test 10.1 kA Symmetrical RMS No Asymmetrical Requirement

Sample #	Failure Mode	Minimum Test Duration-seconds	Condition of Module/Polymer Housing After Test
5	2-Source	.2	Module Intact/Hsg Torn but in Place
6	2-Source	.2	Module Intact/Hsg Separated

Calibration Test 600 Amp Symmetrical RMS No Asymmetrical Requirement

Sample #	Failure Mode	Minimum Test Duration-seconds	Condition of Module/Polymer Housing After Test
7	2-Source	1.0	Module Intact/Hsg Torn but in Place
8	2-Source	1.0	Module Intact/Hsg Torn but in Place

Conclusion: The eight test arresters assembled with the longest mechanical unit met the test evaluation criteria as specified in Section 8.18.3 of IEEE C62.11-2005 Standard. In all tests, the arrester module remained intact on the insulating support bracket after the completion of each test. The flexible polymer housing wall section split, as intended, on all samples to allow venting of internal arcing gases to the outside of the arrester. In all cases, flames associated with the fault current test extinguished immediately after completion of the test, well within the allowed 2 minute duration. These tests have demonstrated the capability of the PVR arrester design to discharge a maximum claimable 20 kA_{rms} symmetrical fault current using the test procedure defined in Section 8.18 of IEEE C62.11-2005 Standard.

IEC TYPE TEST REPORT
Report No. TD 01 060 E14
Type PVR Riser Pole
IEEE HD Distribution Class Arrester

Insulating Bracket Disconnector Test

This report records the results of this type test made on the Type PVR Riser Pole IEEE Heavy Duty Distribution Class arrester design rated 3 thru 36 kV in accordance in accordance with IEEE C62.11-2012 Standard "IEEE Standard for Metal-Oxide Surge Arresters for AC Power Circuits (>1kV)."

Dennis W. Lenk

Dennis W. Lenk
Principal Engineer

Fayaz Khatri

Fayaz Khatri
Design Engineering Supervisor

Date: 6/21/2016

PVR Heavy Duty Distribution Riser Pole Surge Arrester
Insulating Bracket Disconnector Tests

OBJECTIVE: Tests were performed per clause 8.21 of IEEE Standard C62.11-2012.

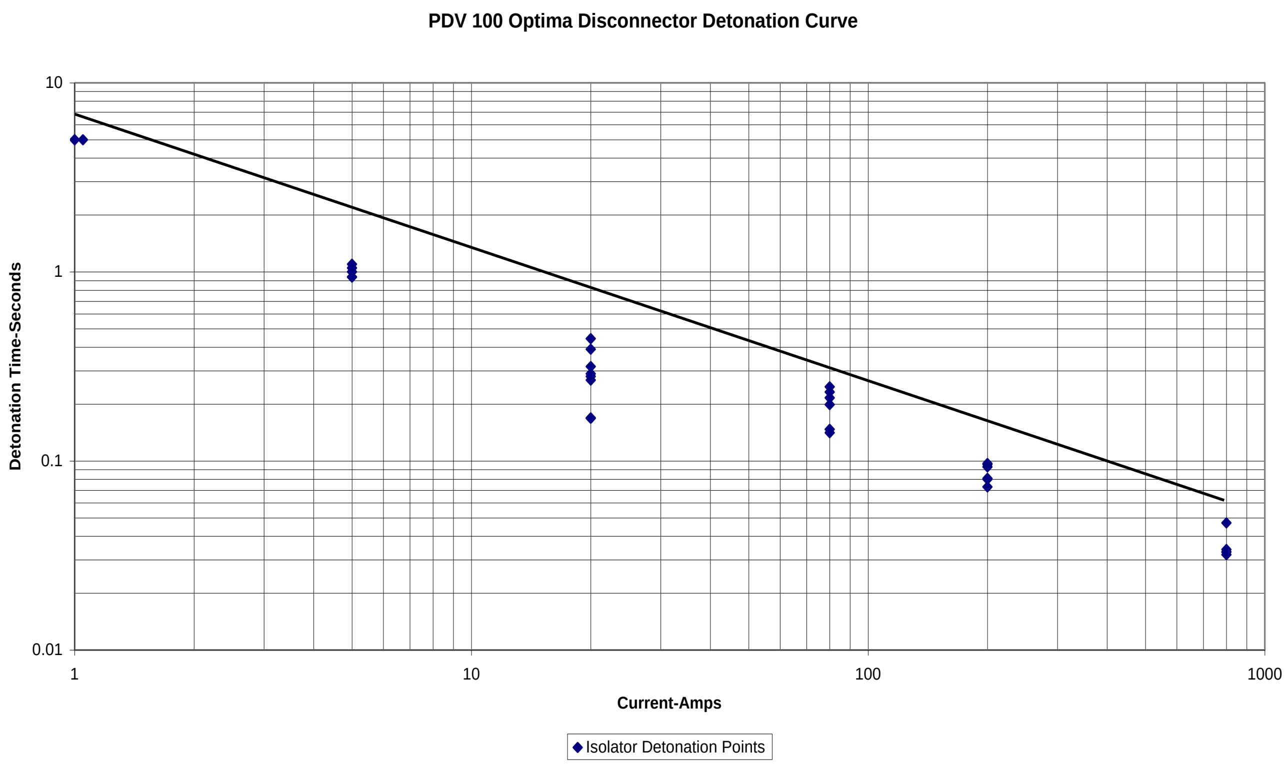
TEST PROCEDURES: High current short duration, low current long duration discharge, and duty cycle tests were successfully performed on thermally prorated test sections having the disconnector assembly connected in series.

Disconnector detonation testing was performed on five bracket/isolator assemblies each at 20, 80, 200, and 800 A_{rms}. In addition, detonation testing was also performed at 1 and 5 A_{rms}.

TEST RESULTS: Disconnectors did not operate when subjected to high current short duration, low current long duration discharge duty tests, and duty cycle tests.

In all cases, disconnectors separated during detonation tests at each of the required current levels.

CONCLUSION: The disconnector passed all requirements of clause 8.21. The following figure shows the detonation curve for the PVR Riser Pole disconnector.



IEEE Type Test Report
Report No. TD 01 060 E15
Type PVR Riser pole
IEEE HD Distribution Class Arrester

Maximum Design Cantilever and Moisture Ingress Test

CERTIFICATION

This is to certify that the maximum design cantilever (MDCL) and moisture ingress test has been successfully performed on the Ohio Brass Type PVR Riser Pole HD Distribution Class surge arrester.

Dennis W. Lenk

Dennis W. Lenk
Principal Engineer

Fayaz Khatri

Fayaz Khatri
Design Engineering Supervisor

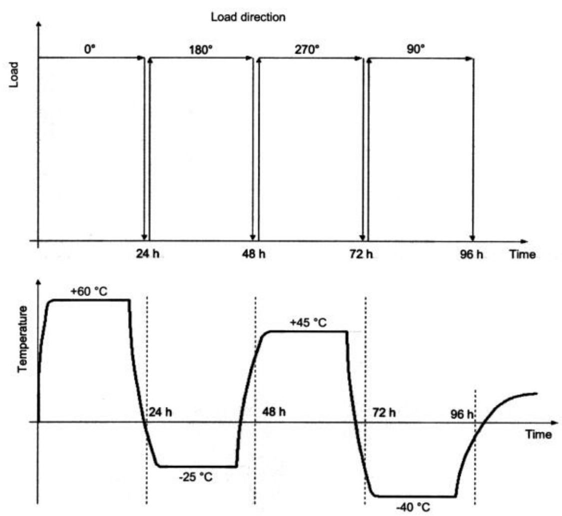
Date: 6/21/2016

DESIGN TEST REPORT
PVR Riser Pole HD Distribution Class Surge Arrester

TITLE: Maximum design cantilever (MDCL) and moisture ingress test:

TEST SAMPLES: The maximum design cantilever and moisture ingress test was performed on a PVR 17 kV MCOV arrester consisting of the longest mechanical unit. Tests were performed on this 8.5" long arrester to validate the claimed 1200 inch-pound continuous cantilever rating.

TEST PROCEDURE: The test was performed per section 8.22 of C62.11-2012 Standard. The test arrester was subjected to PD, watts loss, and discharge voltage tests prior to the bending moment and boiling water immersion test. The mechanical portion of the test consisted of first applying a 20 ft-lb torque to the arrester end terminals for 30 second duration. The test arrester was then placed inside a thermal cycling oven and mechanically loaded to its 1200 in-lb continuous cantilever rating. The load application and test temperature is shown on the attached figure.



TEST RESULTS: After completion of the thermal cycling under load test, the test arrester was mechanically loaded in four directions and the top end deflection under load and the residual deflection under no load were recorded. Table 1 summarizes the results of this mechanical loading procedure.

Table 1

	0^o Load	90^o Load	180^o Load	270^o Load
Deflection @load (in)	.875	1.00	1.125	1.125
Residual Deflection (in)	.125	.375	.125	.563

At the completion of the mechanical loading test, the water immersion portion of the bending moment test was performed per para. 8.22.3.3.b) and consists of placing the mechanically stressed arrester into 80 degree C. salt water bath for 168 hours, after which the arrester is cooled to room temperature and electrical tests are repeated. See Table 2 below for results.

Table 2

Sample No.	Initial Watts @ MCOV	Final Watts @ MCOV	Initial PD @ 1.05 times MCOV (pC)	Final PD @ 1.05 times MCOV (pC	Initial 10 kA Residual Voltage kVc	Final 10 kA Residual Voltage kVc
1	.532	.546	0	0	50.85	50.16

CONCLUSION: Per Section 8.22.4, the partial discharge levels were unchanged and the watts loss changed 2.6%, less than the allowed 20% increase. The 10 kA IR changed 1.3%, less than the allowed 10%. Visual examination revealed no evidence of mechanical damage or moisture ingress inside the arrester as a result of the test procedure. The above tests have validated the 1200 inch-pound continuous cantilever rating of the base mounted PVR Riser Pole HD Distribution arrester.