Westinghouse Electric Corporation
Distribution Apparatus Division
Bloomington, Indiana 47401

December, 1975
New Information and Supersedes P.D. 38-136, pages 1-2, dated November 1974 and P.D. 38-126, pages 1-2 dated December 1973
E, D, C/1981/PL

Indoor-Outdoor
Altitude 0-10,000 feet
3-468 KV

Station Arrester Type CPL Controlled Protective Level

CPL Station Arresters

CPL arresters assure lower discharge voltages and lower impulse and switching surge sparkover voltages which permit selection of transformers with multi-step reduced BIL's saving users thousands of dollars.

The performance characteristics of the CPL arrester are demonstrated by tests conducted in accordance with ANSI C62.1.

Table I – Electrical Protective Characteristics

Arrester Rating KV Rms Maximum Valve-Off or Maximum Reseal Rating ①	Maximum Circuit Voltage Phase-to-Phase KV Rms		Maximum Front-of-Wave Impulse Sparkover	Maximum 100% Impulse Sparkover 1.2 x 50 Wave	Maximum Switching Surge Sparkover	Minimum 60 Hz Sparkover	Maximum Discharge Voltage with Discharge Current, 8 x 20 Wave					
	Ungrounded Neutral 100% Arrester ②	Effectively Grounded Neutral 80% Arrester ②	KV Crest ③	KV Crest ④	KV Crest ⑤⑥	KV Rms ⑦	1.5 KA KV Crest	3 KA	5 KA	10 KA	20 KA	40 KA
3	3	3.75	10	10	10	4.5	4.7	5.3	6	6.7	7.7	8.9
4.5	4.5	5.63	16	15	14	6.8	7	8	8.9	10.1	11.5	13.3
6	6	7.5	19	18	18	9	9.3	10.6	11.9	13.4	15.3	17.7
7.5	7.5	9.38	24	22	24	11.3	11.6	13.3	14.8	16.7	19.1	22.1
9	9	11.25	28.5	25	28	13.5	13.9	16	17.8	20.1	22.9	26.5
12	12	15	36	32	35	18	18.5	21.3	23.7	26.7	30.1	35.3
15	15	18.75	45	40	43	22.5	23.1	26.6	29.6	33.4	38.2	44.1
18	18	22.5	52	47	51	27	27.7	31.9	35.5	40.1	45.8	52.9
21	21	26.25	63	56	59	31.5	32.3	37.2	41.4	46.8	53.4	61.7
24	24	30	71	62	65	36	36.9	42.5	47.3	53.4	61	70.5
27	27	33.75	80	72	73	40.5	41.5	47.8	53.3	60.2	68.7	79.3
30	30	37.5	89	80	81	45	46.1	53.1	59.2	66.9	76.3	88.1
36	36	45	107	96	95	54	55.3	63.7	71	80.1	91.5	105.7
39	39	48.75	115	104	101	58.5	60	69	76.9	86.8	99.1	114.5
45	45	56.25	134	119	116	67.5	69.2	79.6	88.7	100.2	114.4	132.1
48	48	60	143	128	124	72	73.8	84.9	94.7	106.8	122	140.9
60	60	75	170	144	136	81	102	110	118	132	150	168
72	72	90	204	173	163	97	122	132	141	159	180	202
90	90	112.5	255	216	203	122	153	166	176	199	225	252
96	96	120	272	231	218	130	163	177	188	212	240	269
108	108	135	305	260	245	146	183	199	212	238	270	303
120	120	150	339	289	272	162	204	221	235	265	300	336
132	132	165	373	317	299	178	224	243	259	291	330	370
144	144	180	407	346	326	194	244	265	282	318	360	404
168	168	210	475	404	381	227	285	309	329	371	420	471
180	180	225	509	430	400	243	305	331	353	397	450	505
192	192	240	543	460	426	259	326	353	376	424	480	538
204	204	255	577	490	453	276	346	375	400	450	510	572
216	216	270	611	519	479	292	367	397	424	476	545	605
228	228	285	640	547	506	308	387	419	446	503	570	639
240	240	300	679	577	533	324	407	441	470	530	605	673
258	258	322.5	693	620	573	348	438	474	505	569	650	723
264	264	330	709	635	586	356	448	485	517	582	665	740
276	276	345	742	664	612	373	468	507	540	609	690	773
288	288	360	774	692	640	389	489	529	564	635	725	807
300	300	375	806	721	666	405	509	551	588	662	755	841
312	312	390	838	750	693	421	530	574	611	688	780	874
396	396	495	1064	950	868	535	672	726	734	871	990	1109
420	420	525	1128	1005	921	567	713	770	826	924	1050	1176
444	444	555	1193	1055	973	600	753	814	873	977	1110	1243
468	468	585	1257	1110	1026	632	794	858	921	1030	1170	1310

Notes

① Maximum permissible continuous power frequency voltage across the arrester, line to ground, at which the arrester will perform its duty cycle, 50 or 60 Hz. Reference: For selection of arrester rating: ANSI C62.2 "Guide for Application".

② Grounded and ungrounded neutral systems are defined by EEI Pub. No. R-6 (NEMA Pub. No. 117) Appendix B and ASA Standards C841; "Preferred Voltage Rating."
For reference the same information is included in NEMA Pub. No. LA1.

③ These values based on requirements of ANSI C62.1 which require maximum rate of rise be 1200 kv/μs.

④ Highest 1.2 x 50 Wave Impulse Voltage that apparatus insulation is subjected to, since this voltage consistently produces arrester sparkover. (ANSI C62.1).

⑤ The switching surge discharge voltage will not exceed the maximum switching surge sparkover, for transmission line discharge requirements in accordance with Table III page 2.

⑥ Values to be used for 10 microsecond to sparkover in protecting a-c rotating machinery.

⑦ Power-frequency sparkover voltage shall be not less than 1.35 times rated voltage – for station class arresters rated 60 KV and above. (ANSI C62.1)

Arrester Insulation Withstand Test Voltages ANSI C62.1

The assembled insulating members of the CPL arrester or single unit will withstand impulse and power-frequency voltages between line and ground terminals in accordance with Table II.

Table II – Station Arresters

Voltage Rating of Arrester KV; rms	Impulse Test 1.2 x 50 Microsecond Full Wave KV Crest① (BIL)	Alternating-Current 60-Hz Test Voltage KV, Rms 1-Minute Dry	10-Second Wet
3	60	21	20
4.5	75	27	24
6	75	27	24
7.5	95	35	30
9	95	35	30
12	110	50	45
15	110	50	45
18	150	70	60
21	150	70	60
24	150	70	60
27	200	95	80
30	200	95	80
36	200	95	80
39	250	120	100
45	250	120	100
48	250	120	100
60	350	175	145
72	350	175	145
90	450	225	190
96	450	225	190
108	550	280	230
120	550	280	230
132	650	335	275
144	650	335	275
168	750	385	315
180	825	465	385
192	900	465	385
204	1050	545	445
216	1050	545	445
228	1050	545	445
240	1050	545	445
258	1175	625	520
264	1300	680	565
276	1300	680	565
288	1300	680	565
300	1300	680	565
312	1300	680	565
396	1980	1020	840
420	2100	1090	890
444	2220	1150	940
468	2350	1210	990

① The values given apply for either positive or negative waves.

Cantilever strength:

The lateral force, such as line lead pull, that may be applied to the top of the arrester is determined by dividing the cantilever strength by the height of the arrester.

Arrester Rating (KV)	Cantilever Strength Inch-Pounds	Foot-Pounds
3-48	70,000	5,800
60-312	200,000	17,000
396-468	300,000	25,000

CPL arresters will withstand winds in excess or 120 mph and a 0.5 g earthquake shock.

Further Information

38-140 P WE A
38-141 D WE A
38-142 F WE A

Thermal Protective Characteristics

CPL arresters have high thermal discharge capabilities that exceed modern system requirements.

Table III tabulates transmission line discharge parameters and values.

Transmission line discharge tests, with 20 unit tests per arrester or prorated section, were made as specified by the industry standard, ANSI C62.1.

Table III – Transmission Line Discharge Performance

Nominal System Line-to-Line Voltage KV rms	Arrester Rating KV	Line Length Miles	Line Surge Impedance ohms	Per Unit Charge Voltage maximum line to ground crest
500 KV	396	250	300	2.5
	420	250	300	2.57
	444	250	300	2.64
	468	250	300	2.72
345	258	200	350	2.8
	264	200	350	2.9
	276	200	350	3.0
	288	200	350	3.1
	300	200	350	3.2
	312	200	350	3.3
230	180	250	400	>3.0
	192	250	400	>3.0
161	144	250	400	>3.0
	168	250	400	>3.0
138	120	250	400	>3.0
	132	250	400	>3.0
	144	250	400	>3.0
115	120	300	450	>3.0
	96	300	450	>3.0

Pressure Relief Protective Characteristics②

The fundamental technique of pressure relief is a Westinghouse "first" that was developed and patented in 1949. The "safe fault current" pressure relief ratings of CPL arresters meet and exceed ANSI C62.1 as shown in Table IV:

Table IV - High Current Test

Arrester Rating (KV)	ANSI C62.1 Standard – Class 1	CPL Rating
3-15	65000 Amperes RMS Sym.	66000 Amperes RMS Sym.
21-48③	40000 Amperes RMS Sym.	44000 Amperes RMS Sym.
60-192	40000 Amperes RMS Sym.	63000 Amperes RMS Sym.
240-294④	25000 Amperes RMS Sym.	63000 Amperes RMS Sym.
300-312	Not Given	63000 Amperes RMS Sym.
396-468	Not Given	63000 Amperes RMS Sym.

Low Current Test

Arrester Rating (KV)	ANSI C62.1 Standard	CPL Rating
3-48	400-600 Amperes RMS Sym.	465 Amperes RMS Sym.
60-294	400-600 Amperes RMS Sym.	530 Amperes RMS Sym.
294-468	Not Given	530 Amperes RMS Sym.

CPL arresters 3-312KV have exhaust ports providing directional venting of the gasses in the unlikely event of an arrester failure.
Directing the ionized gases is extremely important to prevent loss of adjacent apparatus from flashover.

② Pressure relief ratings for porcelain top arresters are not standardized. Above ratings apply to metal top arresters only.
③ 18 kv arrester included with these ratings.
④ Includes 204, 216, and 228 Kv ratings

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