

REQUESTED CHARTS & INFO

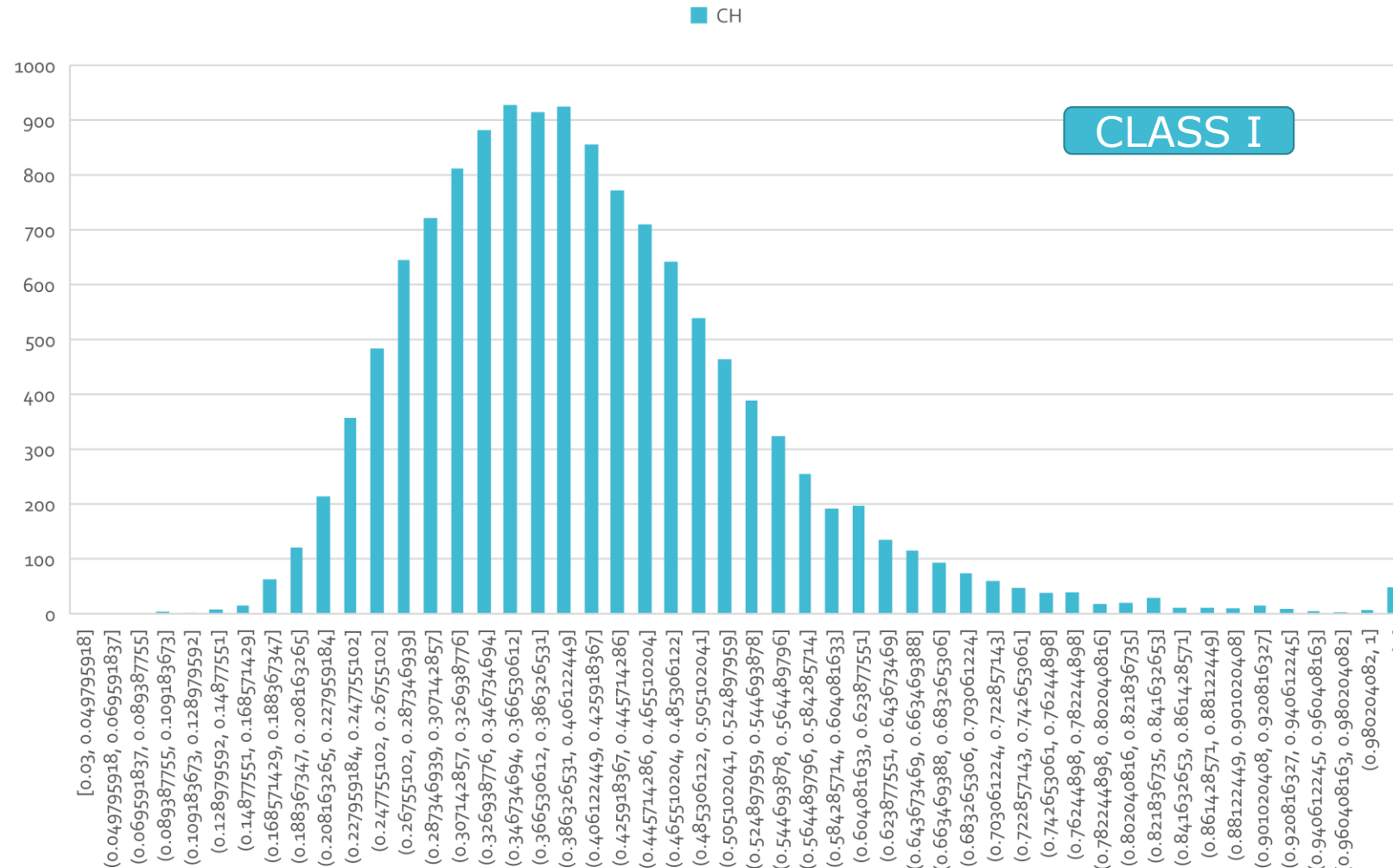
PF @ 20°C (17°C-23°C) for units 1MVA and below
PF @ 20°C (17°C-23°C) for units between 1 – 100 MVA
PF for units 100MVA and above

PF for units 10kV and below
PF for units between 10kV - 230kV
PF for units 230kV and above

**DATA
SET**

148k+ Transformers
Multiple Manufacturers

PF @ 20C Transformers ≤ 1MVA



	CH	CHL	CL
Peak PF:	1.780	1.900	1.480
Lowest PF:	0.030	0.040	0.030
Average PF:	0.413	0.490	0.289
Std Deviation:	0.134	0.149	0.093

Total Sample: 148,470 Transformers
Transformers ≤ 1MVA: 22,531 (Class I)
Average kVA: 359

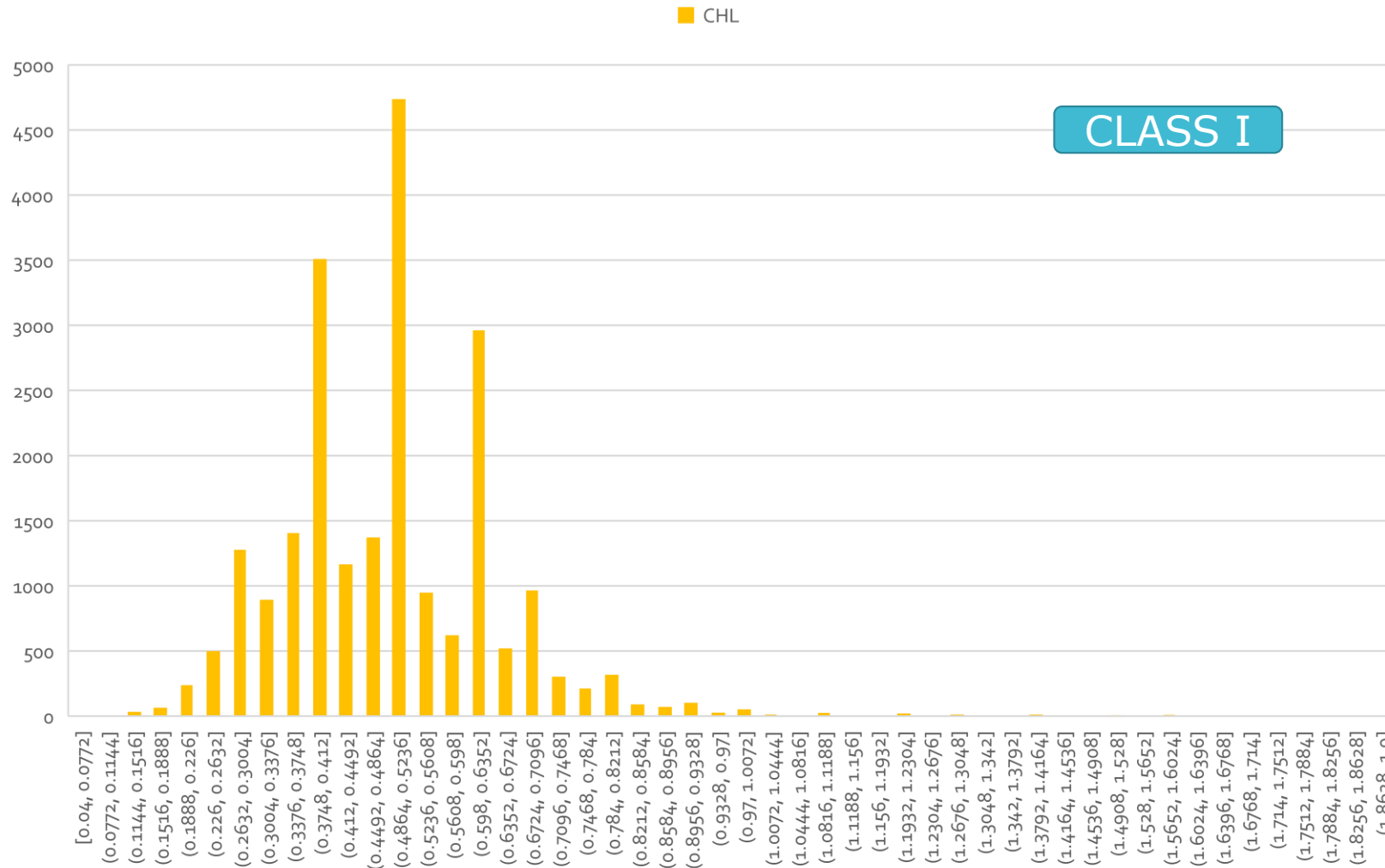
Insulation_Temp_deg.C: 17°C-23°C

Draft-Preliminary Analysis

Confidential to IEEE SA and WG C57.12.00, C5712.90. Labeled by Ernesto Vega Janica (Sr.Mgr. IEEE SA)

Rev. 03.09.2020

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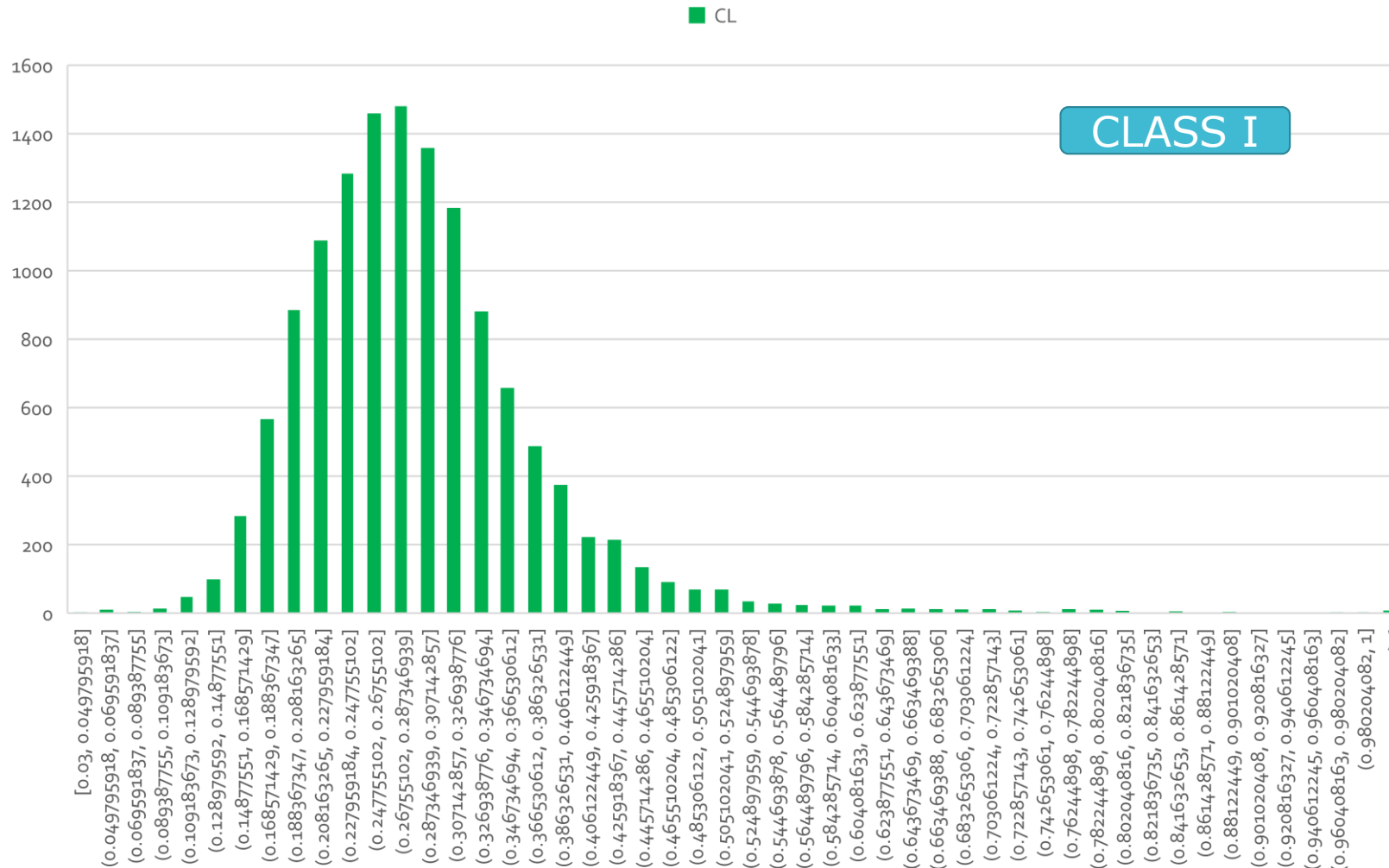
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INSULATION RESISTANCE (MΩ after 1min test)

CAUTION: Very Limited Data Provided

	(HV+LV)- GND	HV- (LV&GND)	LV- (HV&GND)	HV- (LV+TV+GND)	LV- (HV+TV+GND)	TV- (HV+LV+GND)	(HV+LV+TV) -GND
Peak IR:	99302	191000	190000	0	0	0	0
Lowest IR:	445	1520	418	0	0	0	0
Average IR:	16760	100720	84880	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Standard Deviation:	9081	47783	41968	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

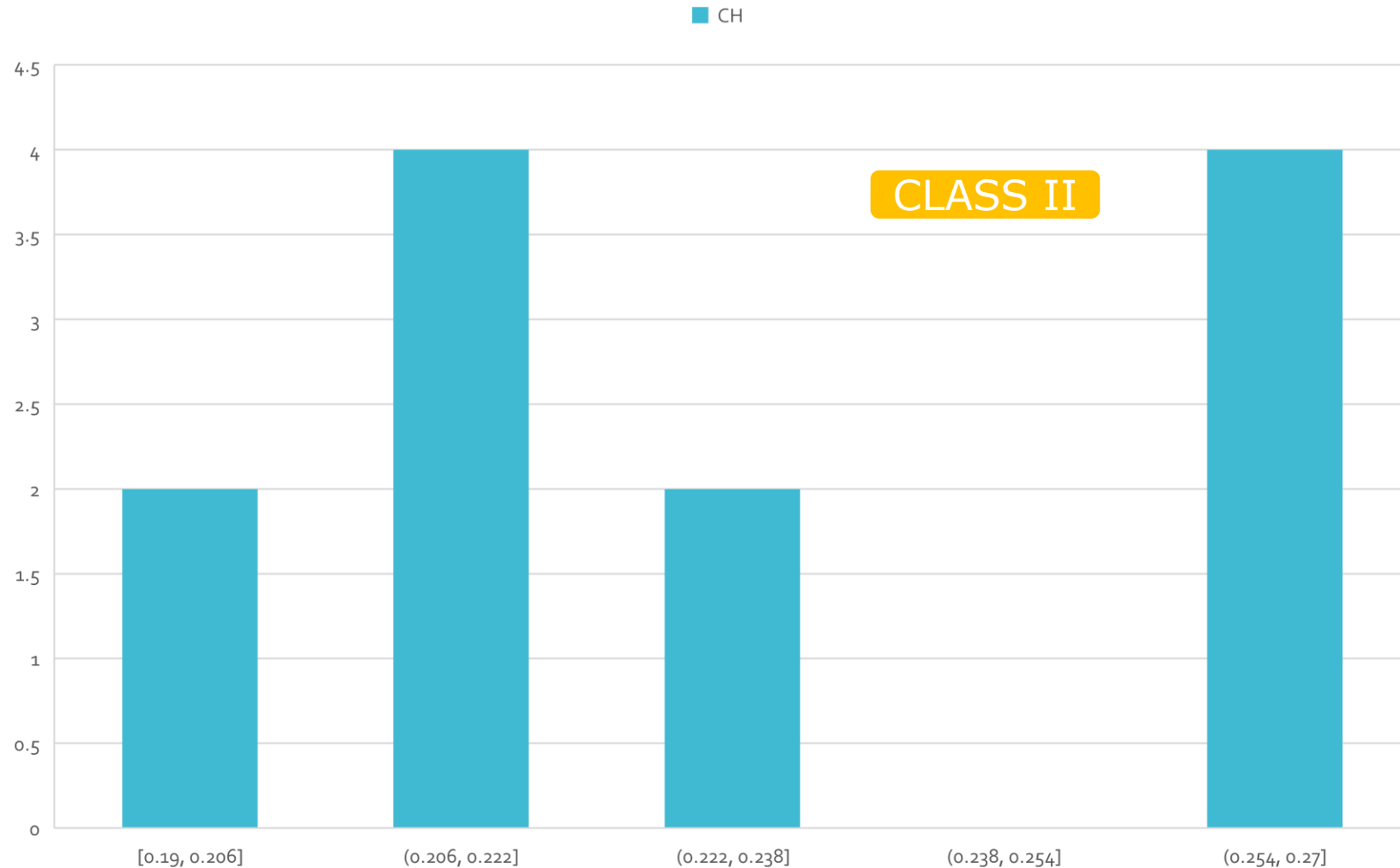
CAUTION: NO DATA PROVIDED

CLASS I

Total Sample: 148,470 Transformers
Transformers ≤ 1MVA: 22,531 (Class I)
Average kVA: 359

Insulation_Temp_deg.C: 17°C-23°C

PF @ 20C Transformers ≤ 1MVA

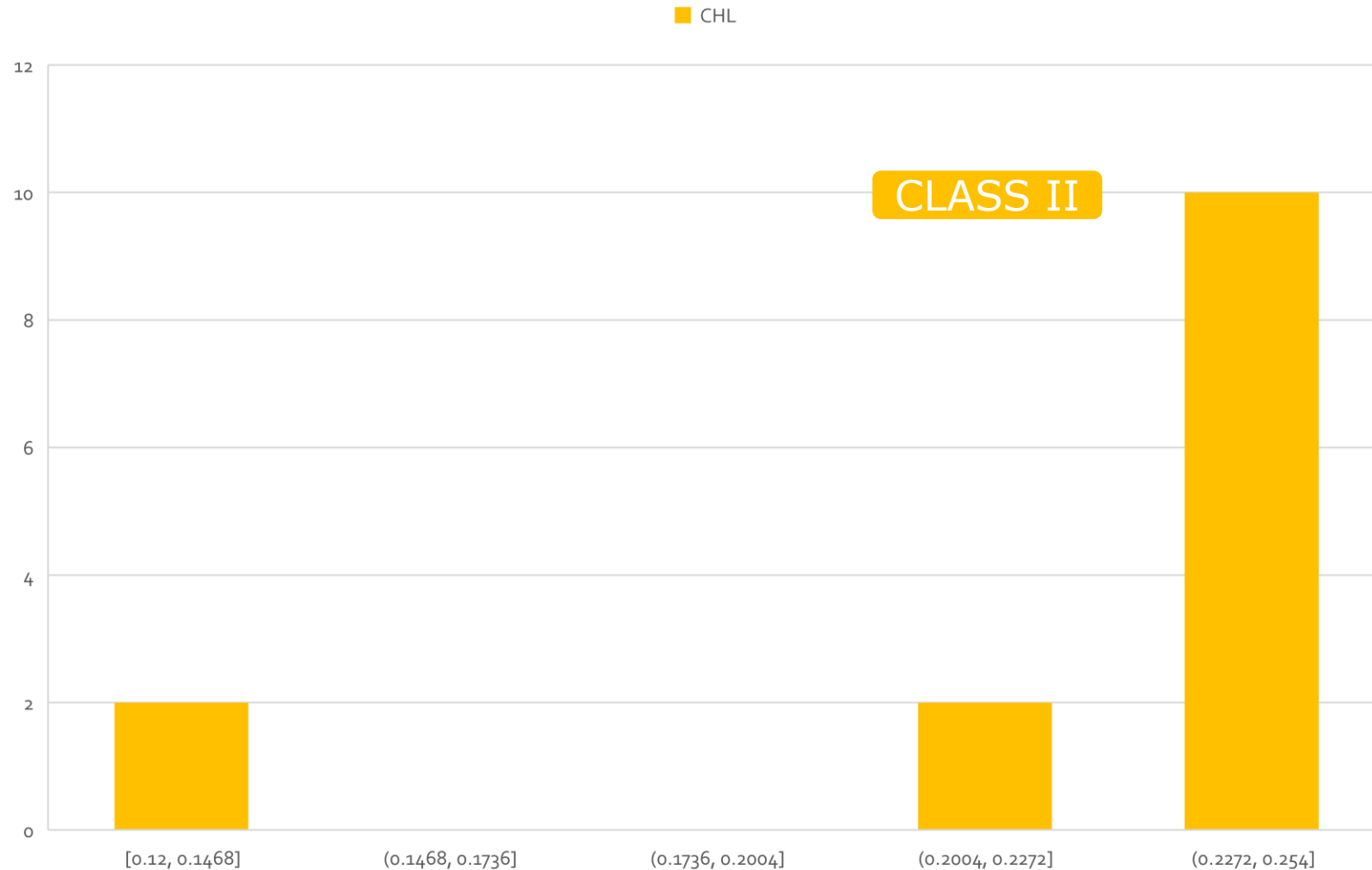


	CH	CHL	CL
Peak PF:	0.270	0.254	0.290
Lowest PF:	0.190	0.120	0.180
Average PF:	0.231	0.225	0.258
Std Deviation:	0.030	0.046	0.042

Total Sample: 148,470 Transformers
Transformers ≤ 1MVA: 14 (Class II)
Average kVA: 359

Insulation_Temp_deg.C: 17°C-23°C

PF @ 20C Transformers ≤ 1MVA

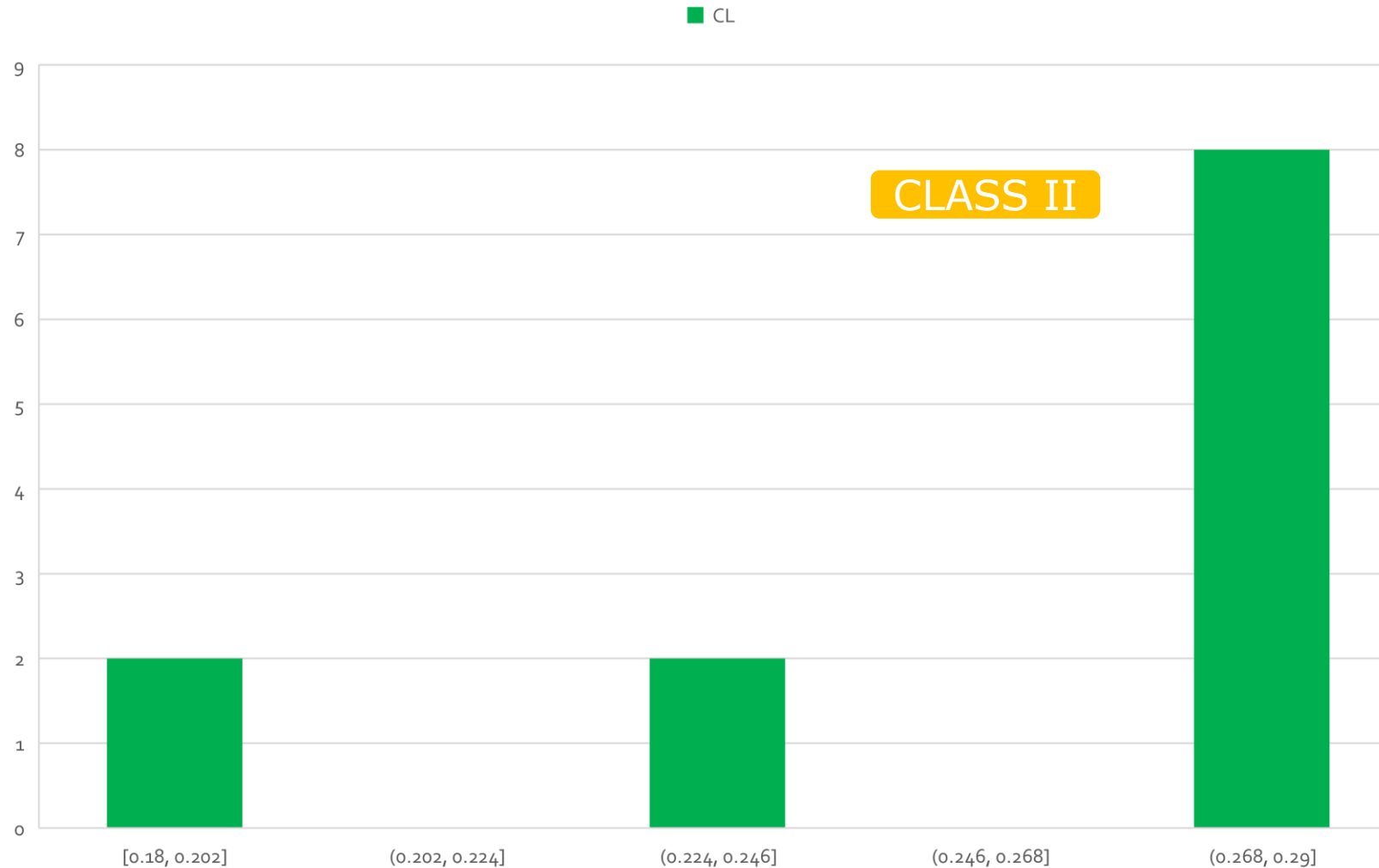



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Lowest PF:	0.190	0.120	0.180
Average PF:	0.231	0.225	0.258
Std Deviation:	0.030	0.046	0.042

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PF @ 20C Transformers ≤ 1MVA




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Average kVA: 359

Insulation_Temp_deg.C: 17°C-23°C

INSULATION RESISTANCE (MΩ after 1min test)

CAUTION: Very Limited Data Provided

	(HV+LV)- GND	HV- (LV&GND)	LV- (HV&GND)
Peak IR:	8210	9650	7110
Lowest IR:	3250	1890	2800
Average IR:	5388	6134	5064
Standard Deviation:	2283	2670	1767

HV- (LV+TV+GND)	LV- (HV+TV+GND)	TV- (HV+LV+GND)	(HV+LV+TV) -GND
3020	1480	2230	1970
3020	1480	2090	1970
3020	1480	2160	1970
CAUTION: VERY LIMITED DATA PROVIDED			
0	0	81	0

CLASS II

Total Sample: 148,470 Transformers
Transformers ≤ 1MVA: 14 (Class II)
Average kVA: 359

Insulation_Temp_deg.C: 17°C-23°C

Draft-Preliminary Analysis

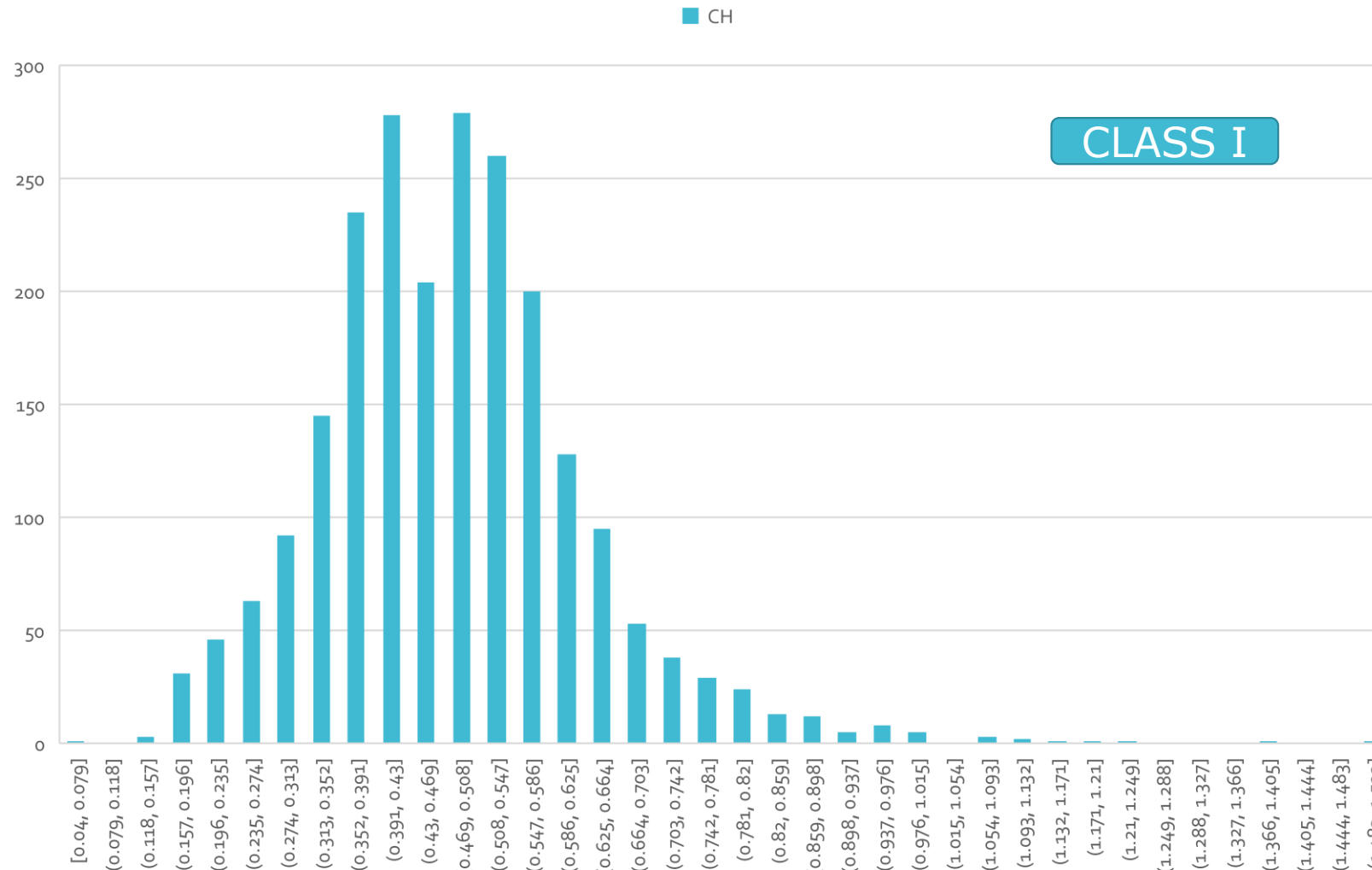
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IEEE Std C57.12.00-2015 Section 5.10

- Therefore, power transformers are separated into two different classes as follows:
 - a) **Class I** power transformers are any that are not categorized as Class II, described in item b).
 - b) **Class II** power transformers shall include power transformers with high-voltage windings rated for 115 kV nominal system voltage and above, and also power transformers with high-voltage windings rated 69 kV through 115 kV nominal system voltage, having a top nameplate rating of at least 15 000 kVA for three-phase transformers or 10 000 kVA for single-phase transformers.

PF @ 20C Transformers 1-100MVA



	CH	CHL	CL
Peak PF:	1.490	1.380	1.230
Lowest PF:	0.040	0.070	0.020
Average PF:	0.479	0.549	0.342
Std Deviation:	0.146	0.190	0.168

Total Sample: 148,470 Transformers
 Transformers 1-100MVA: 2,268 (Class I)
 Average kVA: 3,253

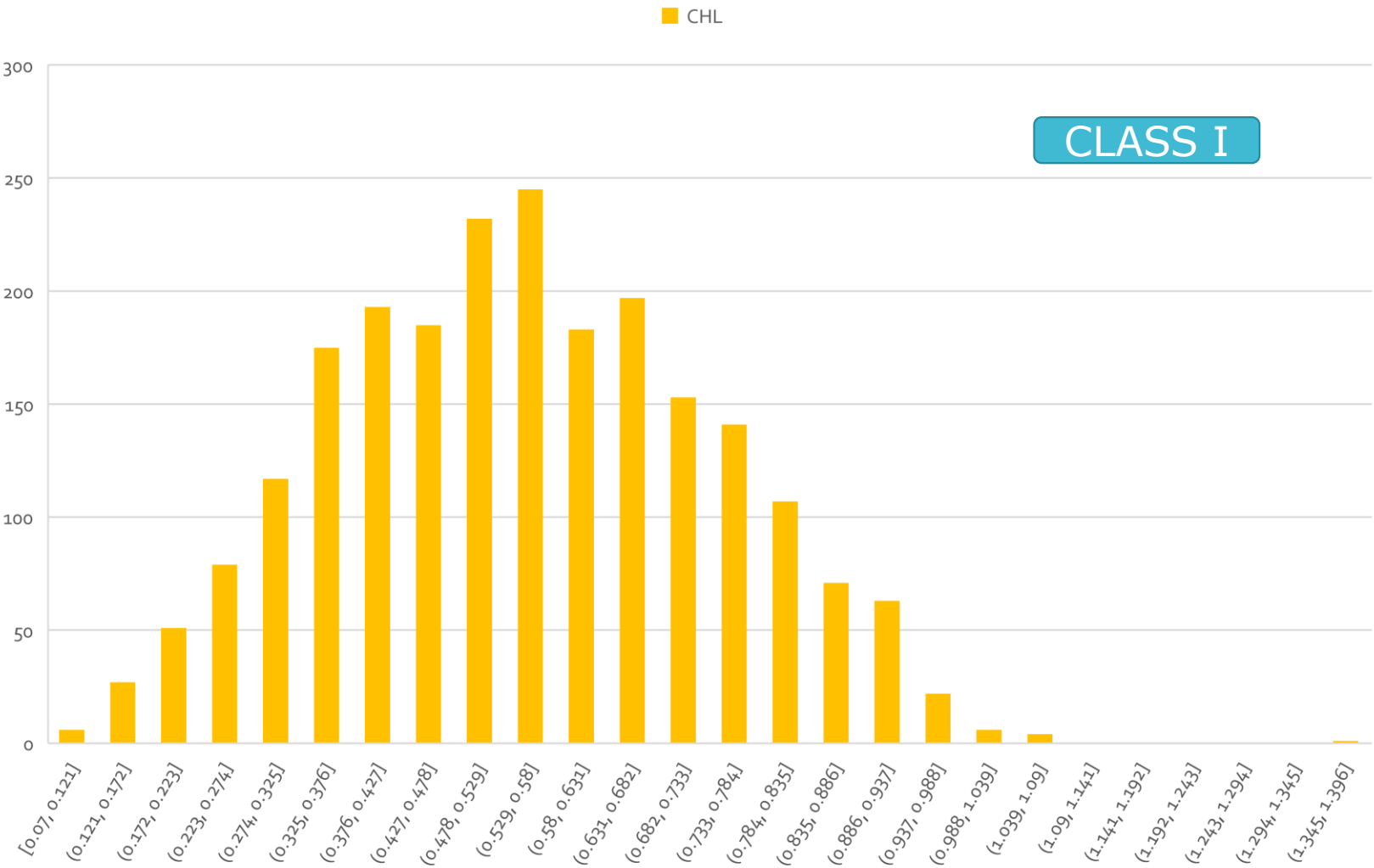
Insulation_Temp_deg.C: 17°C-23°C

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PF @ 20C Transformers 1-100MVA

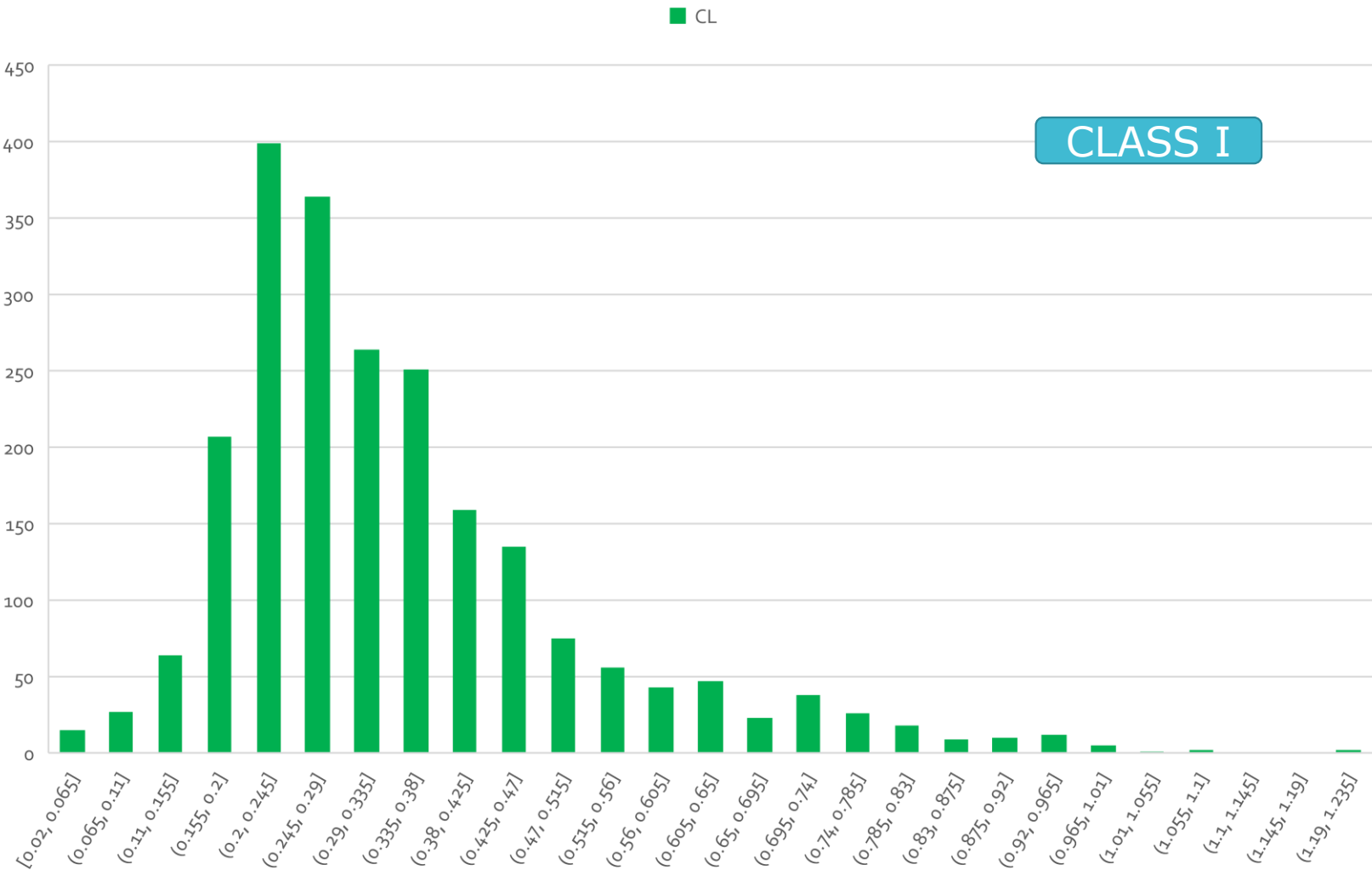


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Average kVA: 3,253

Insulation_Temp_deg.C: 17°C-23°C

INSULATION RESISTANCE (MΩ after 1min test)

CAUTION: Very Limited Data Provided

	(HV+LV)- GND	HV- (LV&GND)	LV- (HV&GND)	HV- (LV+TV+GND)	LV- (HV+TV+GND)	TV- (HV+LV+GND)	(HV+LV+TV) -GND
Peak IR:	124000	112000	99000	21400	0	0	0
Lowest IR:	2490	25	9	3300	0	0	0
Average IR:	14034	14147	11376	9333	#DIV/0!	#DIV/0!	#DIV/0!
Standard Deviation:	23963	22496	17875	10450	#DIV/0!	#DIV/0!	#DIV/0!

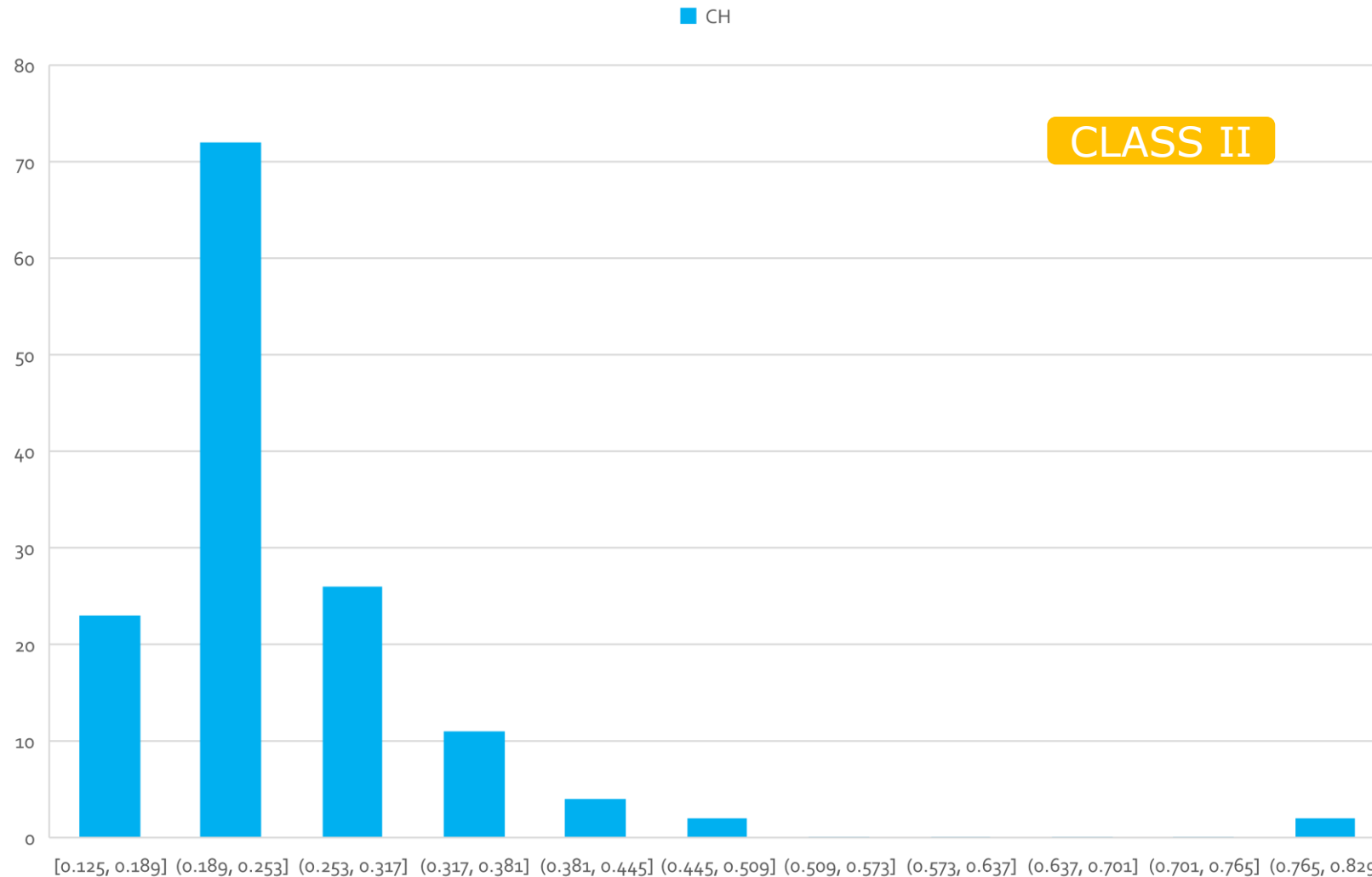
CAUTION: NO DATA PROVIDED

CLASS I

Total Sample: 148,470 Transformers
Transformers 1-100MVA: 2,268 (Class I)
Average kVA: 3,253

Insulation_Temp_deg.C: 17°C-23°C

PF @ 20C Transformers 1-100MVA

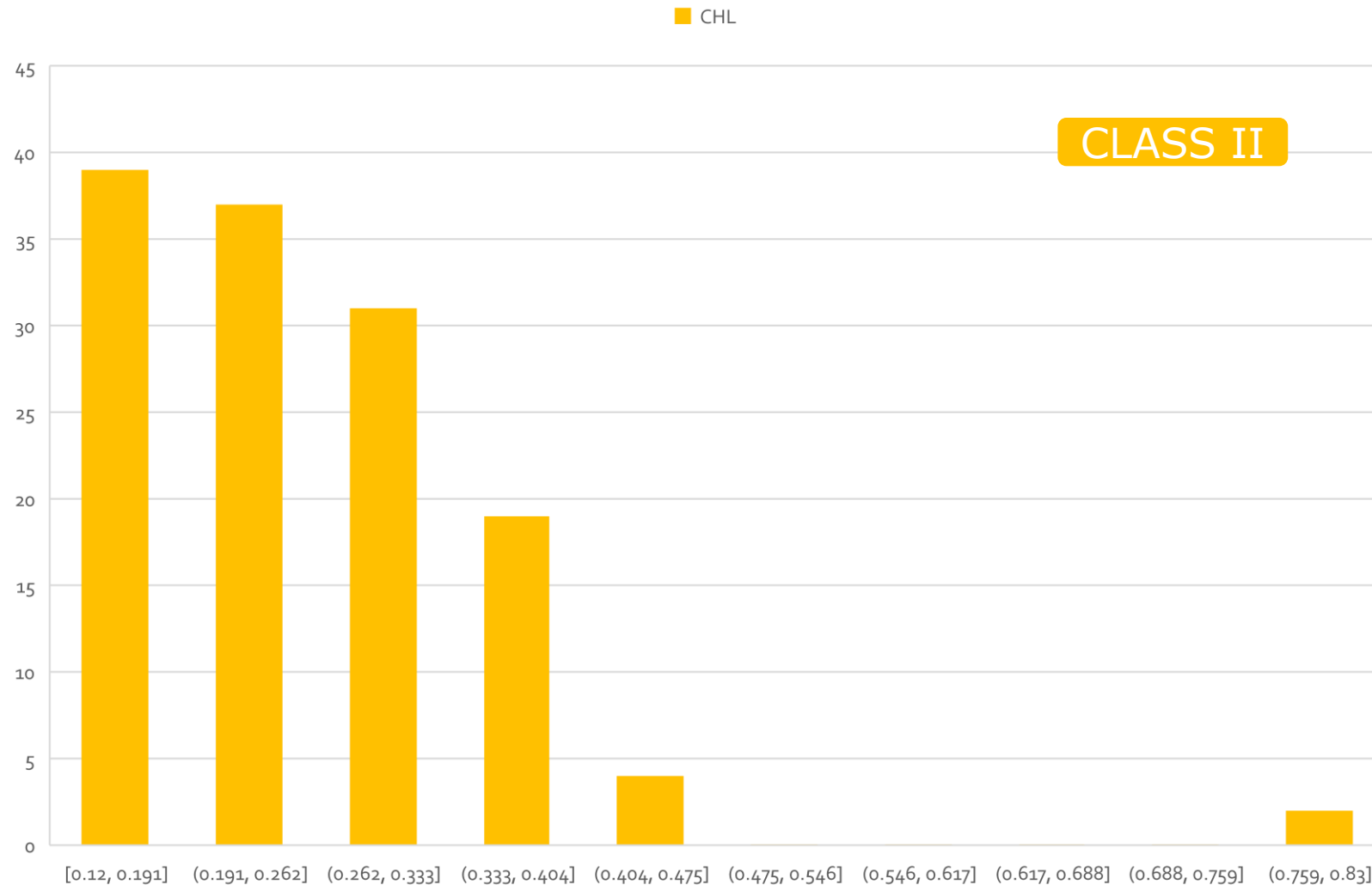


	CH	CHL	CL
Peak PF:	0.770	0.780	0.720
Lowest PF:	0.125	0.120	0.130
Average PF:	0.247	0.258	0.288
Std Deviation:	0.095	0.104	0.105

Total Sample: 148,470 Transformers
Transformers 1-100MVA: 140 (Class II)
Average kVA: 74,717

Insulation_Temp_deg.C: 17°C-23°C

PF @ 20C Transformers 1-100MVA

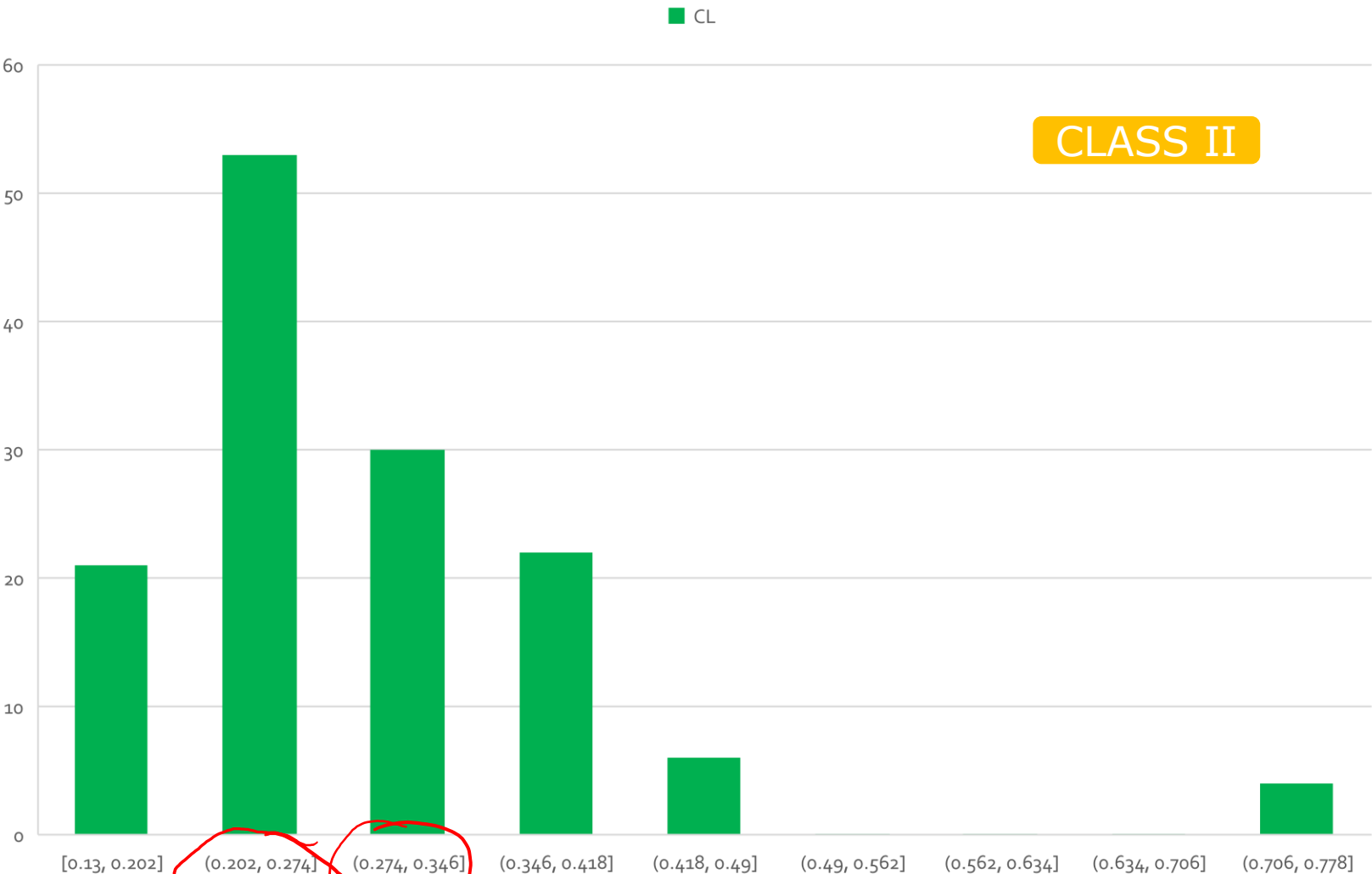



	CH	CHL	CL
Peak PF:	0.770	0.780	0.720
Lowest PF:	0.125	0.120	0.130
Average PF:	0.247	0.258	0.288
Std Deviation:	0.095	0.104	0.105

Total Sample: 148,470 Transformers
 Transformers 1-100MVA: 140 (Class II)
 Average kVA: 74,717

Insulation_Temp_deg.C: 17°C-23°C

PF @ 20C Transformers 1-100MVA



	CH	CHL	CL
Peak PF:	0.770	0.780	0.720
Lowest PF:	0.125	0.120	0.130
Average PF:	0.247	0.258	0.288
Std Deviation:	0.095	0.104	0.105

Total Sample: 148,470 Transformers
Transformers 1-100MVA: 140 (Class II)
Average kVA: 74,717

Insulation_Temp_deg.C: 17°C-23°C

INSULATION RESISTANCE (MΩ after 1min test)

CAUTION: Very Limited Data Provided

	(HV+LV)- GND	HV- (LV&GND)	LV- (HV&GND)	HV- (LV+TV+GND)	LV- (HV+TV+GND)	TV- (HV+LV+GND)	(HV+LV+TV) -GND
Peak IR:	4620	16500	12500	7440	5940	5940	3960
Lowest IR:	525	11	15	1740	2784	70	2784
Average IR:	2394	6035	2717	4768	3551	3257	3397
Standard Deviation:	1750	5264	2928	1925	1155	1491	489

CLASS II

Total Sample: 148,470 Transformers
Transformers 1-100MVA: 140 (Class II)
Average kVA: 74,717

Insulation_Temp_deg.C: 17°C-23°C

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Rev. 03.09.2020

PF @ 20C Transformers >100MVA

CLASS I

NO DATA AVAILABLE

CH CHL CL

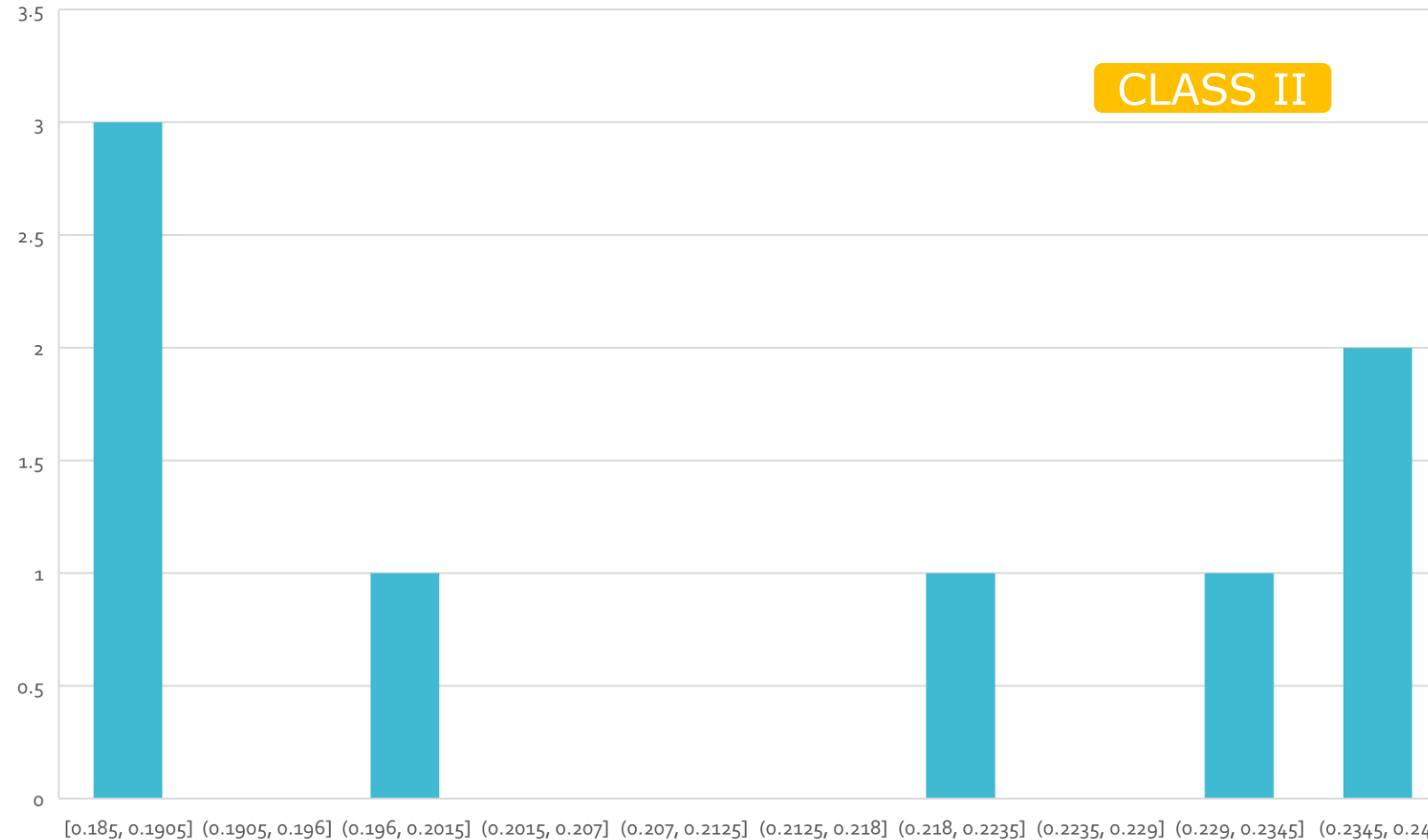
Peak PF:
Lowest PF:
Average PF:
Std Deviation:

Total Sample: 148,470 Transformers
Transformers >100MVA: 0 (Class I)
Average kVA: 247,375

Insulation_Temp_deg.C: 17°C-23°C

PF @ 20C Transformers >100MVA

■ CH



CLASS II

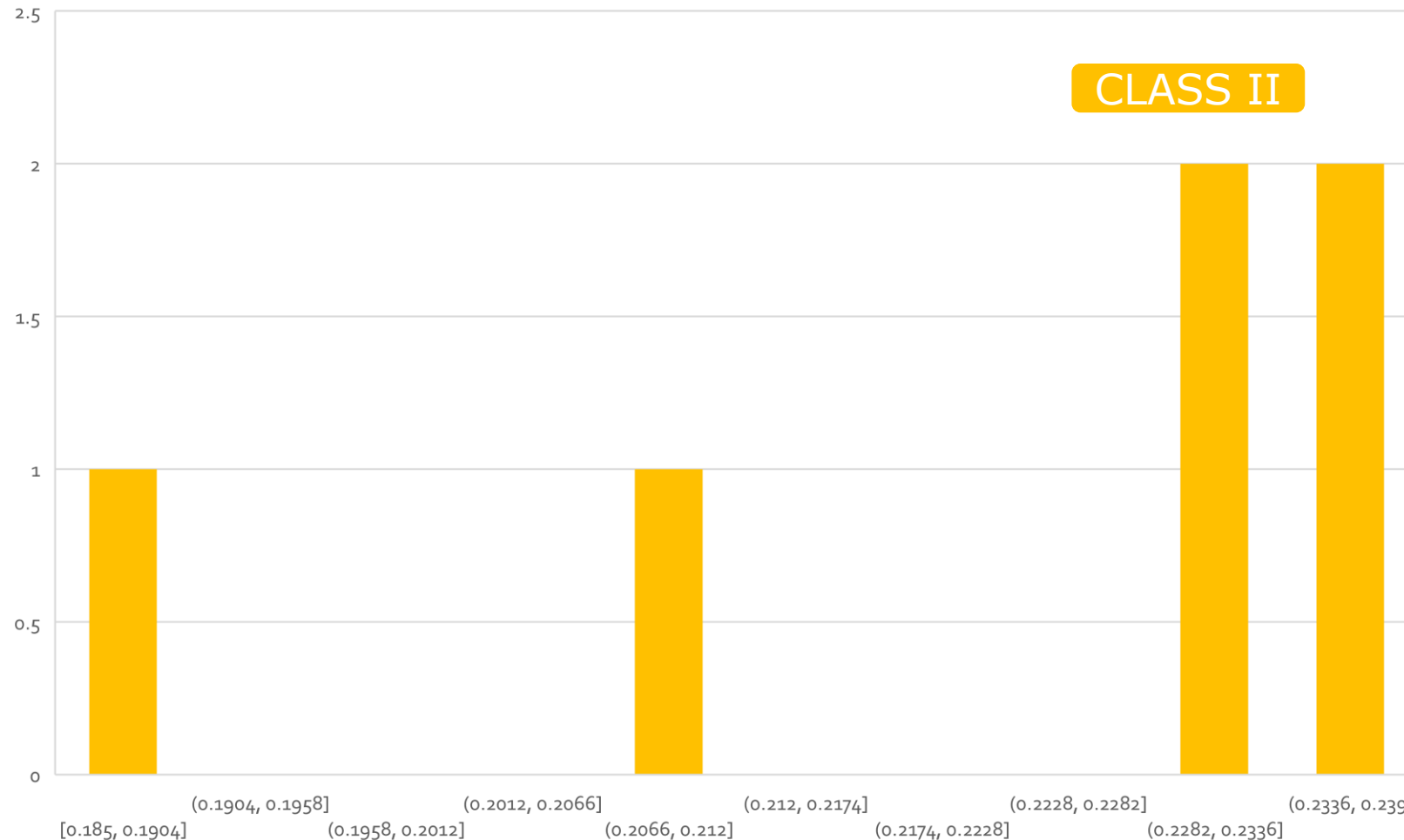
	CH	CHL	CL
Peak PF:	0.240	0.239	0.237
Lowest PF:	0.185	0.185	0.210
Average PF:	0.212	0.222	0.226
Std Deviation:	0.023	0.021	0.014

Total Sample: 148,470 Transformers
Transformers >100MVA: 8 (Class II)
Average kVA: 247,375

Insulation_Temp_deg.C: 17°C-23°C

PF @ 20C Transformers >100MVA

■ CHL

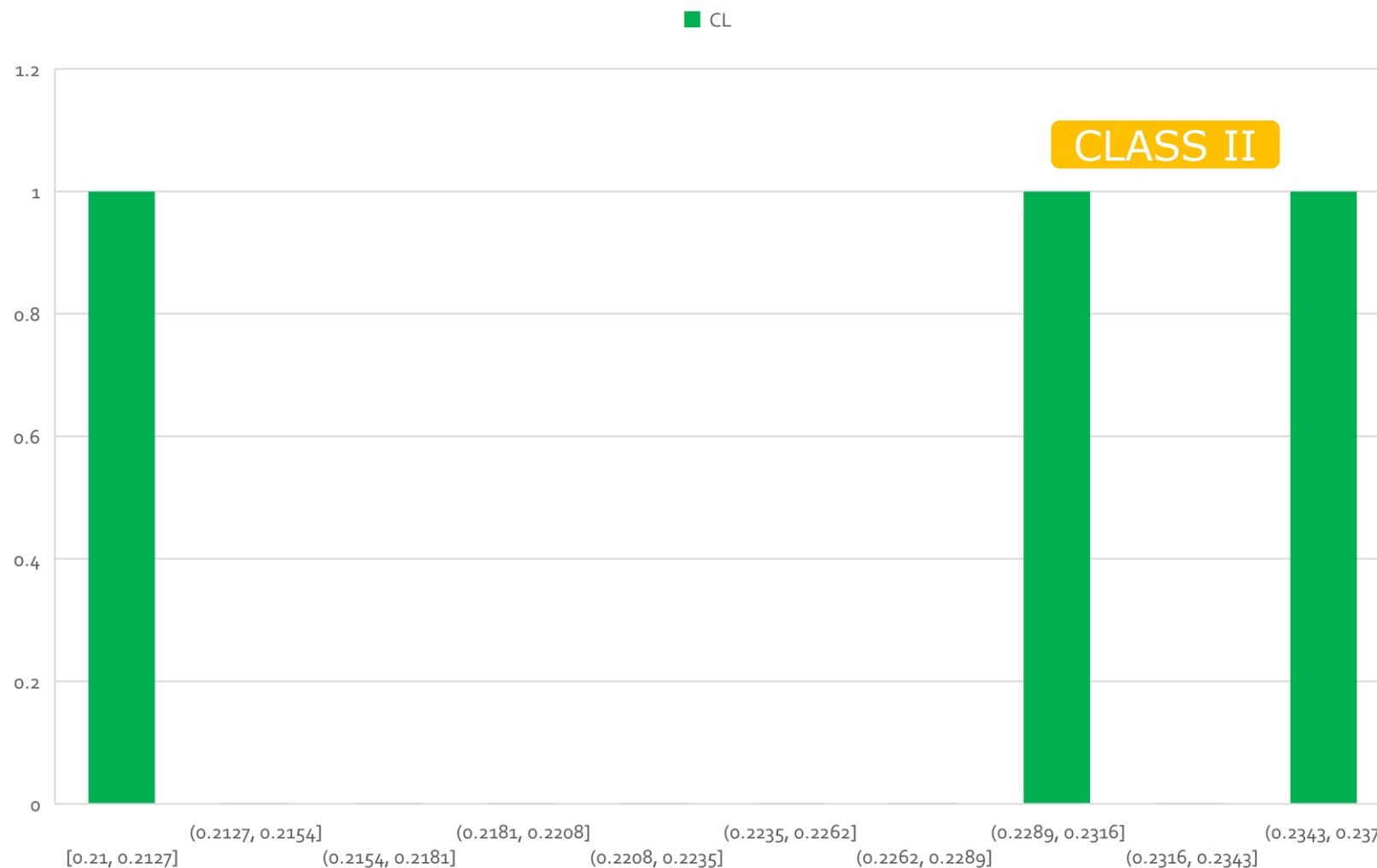


	CH	CHL	CL
Peak PF:	0.240	0.239	0.237
Lowest PF:	0.185	0.185	0.210
Average PF:	0.212	0.222	0.226
Std Deviation:	0.023	0.021	0.014

Total Sample: 148,470 Transformers
Transformers >100MVA: 8 (Class II)
Average kVA: 247,375

Insulation_Temp_deg.C: 17°C-23°C

PF @ 20C Transformers >100MVA



	CH	CHL	CL
Peak PF:	0.240	0.239	0.237
Lowest PF:	0.185	0.185	0.210
Average PF:	0.212	0.222	0.226
Std Deviation:	0.023	0.021	0.014

Total Sample: 148,470 Transformers
Transformers >100MVA: 8 (Class II)
Average kVA: 247,375

Insulation_Temp_deg.C: 17°C-23°C

INSULATION RESISTANCE (MΩ after 1min test)

CAUTION: Very Limited Data Provided

	(HV+LV)- GND	HV- (LV&GND)	LV- (HV&GND)	HV- (LV+TV+GND)	LV- (HV+TV+GND)	TV- (HV+LV+GND)	(HV+LV+TV) -GND
Peak IR:	0	83	110	0	0	2350	0
Lowest IR:	0	25	32	0	0	51	0
Average IR:	#DIV/0!	42	63	#DIV/0!	#DIV/0!	1207	#DIV/0!
Standard Deviation:	#DIV/0!	27	33	CAUTION: NO DATA PROVIDED			
	#DIV/0!			#DIV/0!	#DIV/0!	1319	#DIV/0!

CLASS II

Total Sample: 148,470 Transformers
Transformers >100MVA: 8 (Class II)
Average kVA: 247,375

Insulation_Temp_deg.C: 17°C-23°C

REQUESTED CHARTS & INFO

PF @ 20°C (17°C-23°C) for units 1MVA and below
PF @ 20°C (17°C-23°C) for units between 1 – 100 MVA
PF for units 100MVA and above

PF for units 10kV and below
PF for units between 10kV - 230kV
PF for units 230kV and above

**DATA
SET**

148k+ Transformers
Multiple Manufacturers

IR @ 20C Transformers ≤ 10KV

CAUTION: Very Limited Data Provided

	(HV+LV)- GND	HV- (LV&GND)	LV- (HV&GND)
Peak IR:	99302	64400	53060
Lowest IR:	445	2320	2970
Average IR:	17756	17310	15772
Standard Deviation:	9552	26477	21089

HV- (LV+TV+GND)	LV- (HV+TV+GND)	TV- (HV+LV+GND)	(HV+LV+TV) -GND
0	0	0	0
0	0	0	0
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
CAUTION: NO DATA PROVIDED			
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

	CH	CHL	CL
Peak PF:	1.490	1.900	1.390
Lowest PF:	0.080	0.060	0.020
Average PF:	0.406	0.479	0.293
Std Deviation:	0.137	0.128	0.104

Total Sample: 148,470 Transformers
Transformers ≤10KV: 7,660
Average kVA: 328

Insulation_Temp_deg.C: 17°C-23°C

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IR @ 20C Transformers 10KV-230KV

CAUTION: Very Limited Data Provided

	(HV+LV)- GND	HV- (LV&GND)	LV- (HV&GND)	HV- (LV+TV+GND)	LV- (HV+TV+GND)	TV- (HV+LV+GND)	(HV+LV+TV) -GND
Peak IR:	124000	191000	190000	21400	5940	5940	3960
Lowest IR:	525	11	9	1740	2784	70	2784
Average IR:	15211	44142	36519	5681	3551	3120	3397
Standard Deviation:	8398	54343	46830	4700	1155	1427	489

	CH	CHL	CL
Peak PF:	1.780	1.900	1.480
Lowest PF:	0.030	0.040	0.020
Average PF:	0.423	0.500	0.297
Std Deviation:	0.139	0.165	0.110

Total Sample: 148,470 Transformers
Transformers 10KV-230KV: 17,287
Average kVA: 1,354

Insulation_Temp_deg.C: 17°C-23°C

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IR @ 20C Transformers ≥ 230KV

CAUTION: Very Limited Data Provided

	(HV+LV)- GND	HV- (LV&GND)	LV- (HV&GND)
Peak IR:	4230	6240	4200
Lowest IR:	3450	1890	2800
Average IR:	3840	4065	3500
Standard Deviation:	450	2511	808

HV- (LV+TV+GND)	LV- (HV+TV+GND)	TV- (HV+LV+GND)	(HV+LV+TV) -GND
3020	1480	2090	1970
3020	1480	2090	1970
3020	1480	2090	1970
CAUTION: VERY LIMITED DATA PROVIDED			
0	0	0	0

	CH	CHL	CL
Peak PF:	0.267	0.250	0.290
Lowest PF:	0.190	0.240	0.278
Average PF:	0.226	0.246	0.283
Std Deviation:	0.035	0.005	0.006

Total Sample: 148,470 Transformers
Transformers ≥ 230KV: 6
Average kVA: 109
Insulation_Temp_deg.C: 17°C-23°C