“Case Study of Lightning Arrester Healthiness in Coastal and Non Coastal Areas”

Trend Analysis of 3rd Harmonic Resistive Leakage Current

Names of Authors:
Tirtha S. Vishwakarma,
Nitin Chitte,
Anil S. Khopkar

High Voltage Laboratory
Electrical Research and Development Association (ERDA),Vadodara

Presented By : Tirtha S. Vishwakarma

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TOPICS COVERED

- Importance of Test
- Methodology
- Test Set-up & Requirement
- Test Results
- Interpretation of Test Results
- Conclusion

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IMPORTANCE OF TEST

- To ensure healthiness of lightning arresters and avoid premature failures, it is necessary to monitor health of lightning arresters at regular intervals.

WHY HEALTH MONITORING

- The leakage current is known to increase with time & hence the rate of increase dictates the life i.e. ageing.
- Increase of leakage current leads to increase of ZnO element temperature.
- Increase of element temperature leads to an increases of leakage current.
- Repetition of the above results in thermal runway.
- Thermal runway is essentially a current creep.
- This leads to the failure of the arrester causing…
- Shutdown in the operation, huge monetary loss
- Damage of the nearby equipments.

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IMPORTANCE OF TEST

- The leakage current through the arrester is broadly classified as
- Capacitive Component originated from
  - Permittivity of Zno elements.
  - Stray capacitance
  - grading capacitors
- Resistive Component originated from
  - ZnO elements.
  - Porcelain surface current (pollution)

- Resistive Component is in-phase with voltage cause increase joule heating & hence, the resistive current is the major parameter that needs to be monitored regularly to understand health of arrester.

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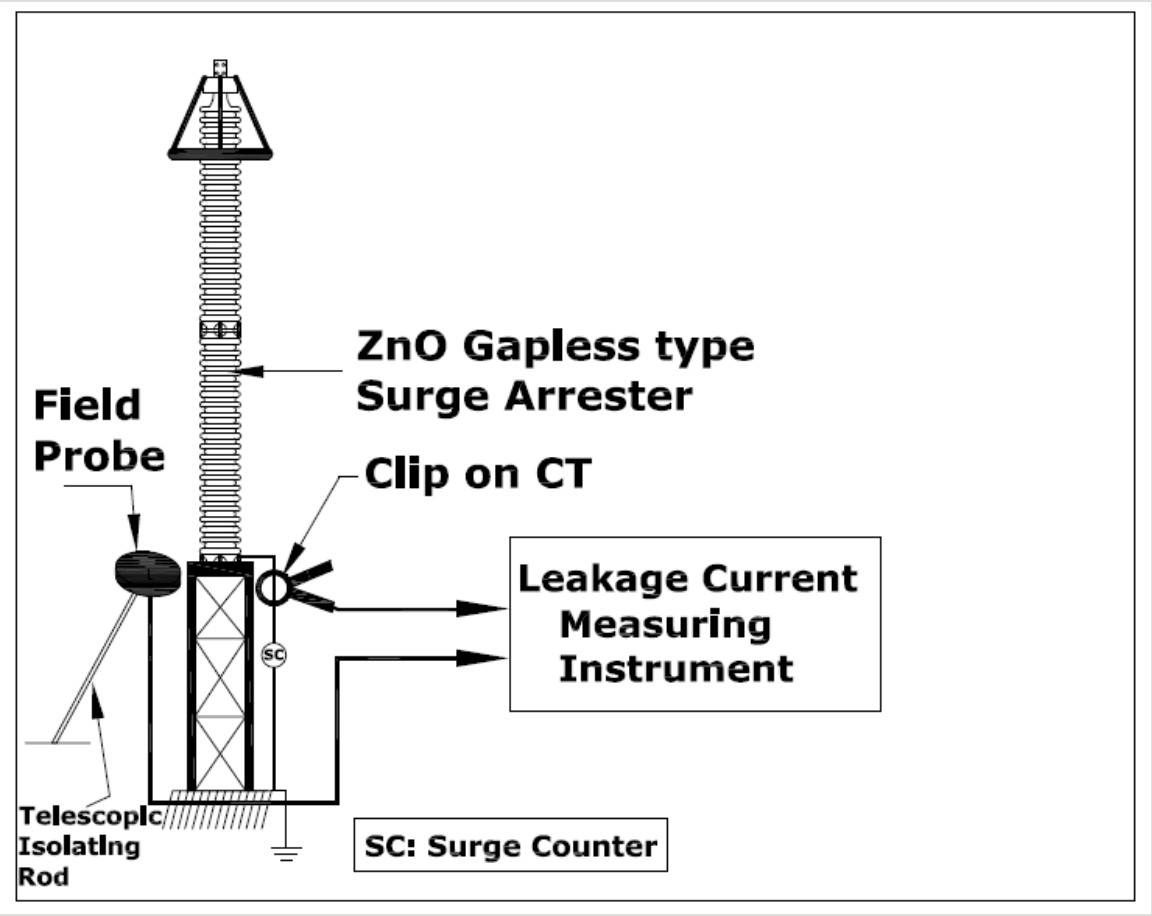
METHODOLOGY

- Two substations were selected for the study.
  - One was located near the sea coast (Coastal area) and
  - One was located in a non-coastal area.
- For each location, two transmission lines and two transformers were selected for the study.
- Measurements were carried out for Total current and third harmonic resistive component of leakage current. Trend of the 3rd harmonic resistive leakage current was monitored.
  - Once in a year for 10 years for the non-coastal area
  - Once in a year for 6 years for coastal area.

METHODOLOGY

- Additionally, measurements were carried out for seasonal variations & different regions (coastal, non-coastal & polluted) for 5 years.
- Details of the measurements carried out are given below:
  - On 220 kV lightning arrester located at coastal area
  - On 220 kV lightning arrester located at non-coastal area
  - On 220 kV lightning arrester but during different weather conditions i.e. in peak summer, after monsoon and peak winter.

TEST SET-UP & REQUIREMENT



REQUIREMENT : Based on the various case studies the maximum allowable limit for THRC of 220 kV system lightning arrester is fixed 500 µAp.

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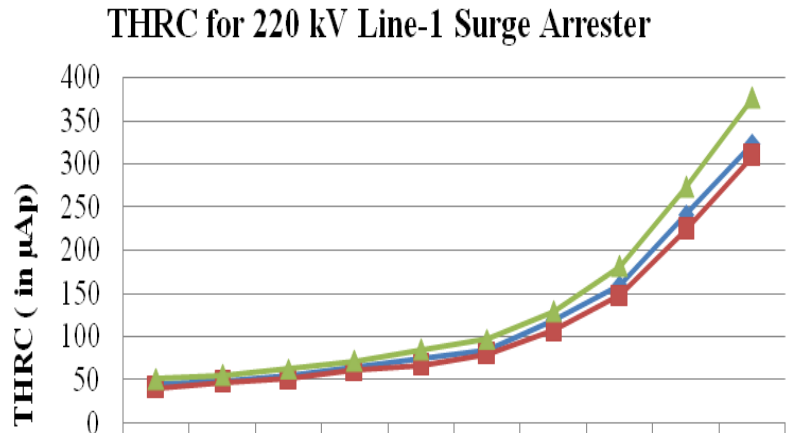
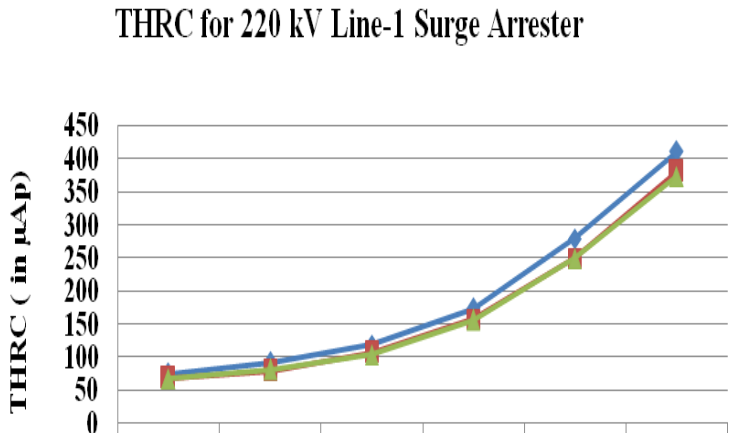
TEST RESULTS

THRC Measurement for Line-1



	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year	9th Year	10th Year
Line-1 (R- Phase)	45	49	55	65	74	85	119	159	241	323
Line-1 (Y- Phase)	41	47	51	61	67	80	107	148	224	309
Line-1 (B- Phase)	51	55	63	72	85	97	129	181	273	376

Non-Coastal Area



	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year
Line-1 (R- Phase)	75	92	119	173	279	411
Line-1 (Y- Phase)	68	79	107	157	249	381
Line-1 (B- Phase)	67	81	104	156	249	374

Coastal Area

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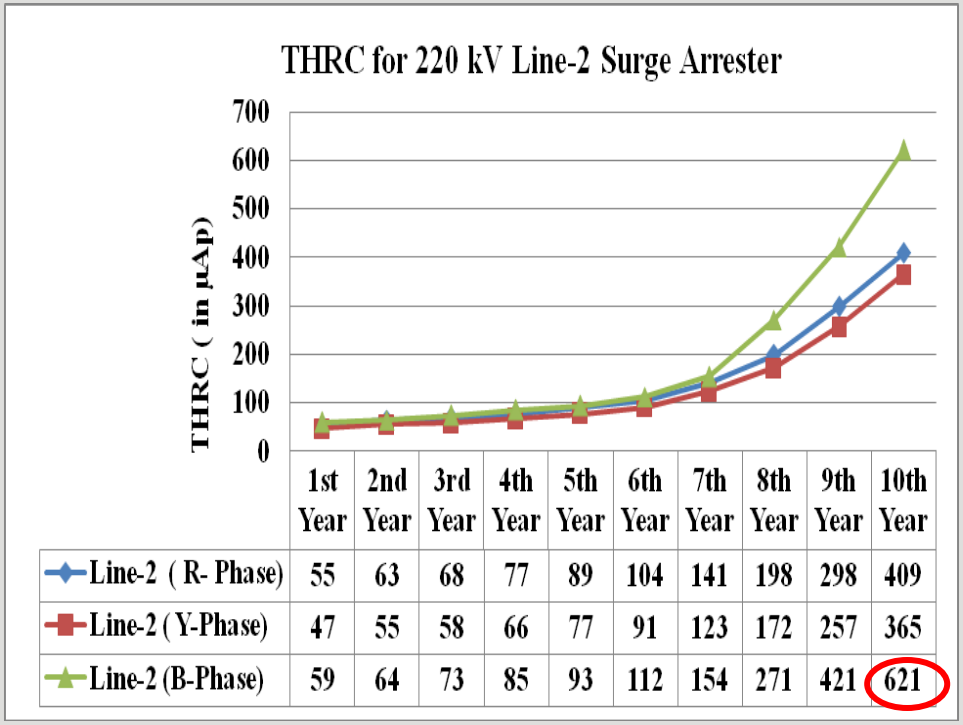
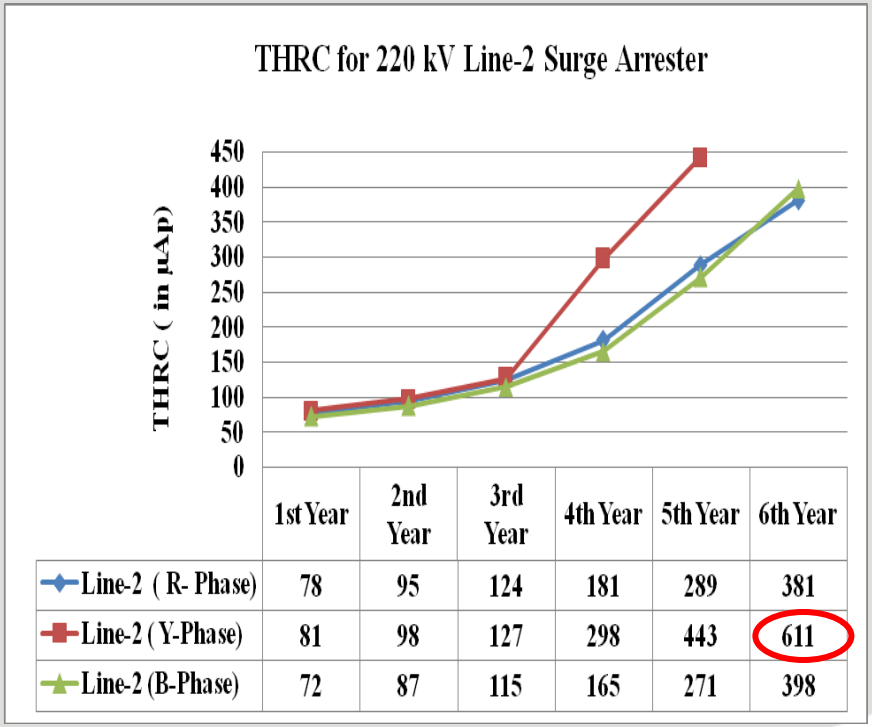
TEST RESULTS

THRC Measurement for Line-2



	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year	9th Year	10th Year
Line-2 (R- Phase)	55	63	68	77	89	104	141	198	298	409
Line-2 (Y-Phase)	47	55	58	66	77	91	123	172	257	365
Line-2 (B-Phase)	59	64	73	85	93	112	154	271	421	621

Non- Coastal Area



	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year
Line-2 (R- Phase)	78	95	124	181	289	381
Line-2 (Y-Phase)	81	98	127	298	443	611
Line-2 (B-Phase)	72	87	115	165	271	398

Coastal Area

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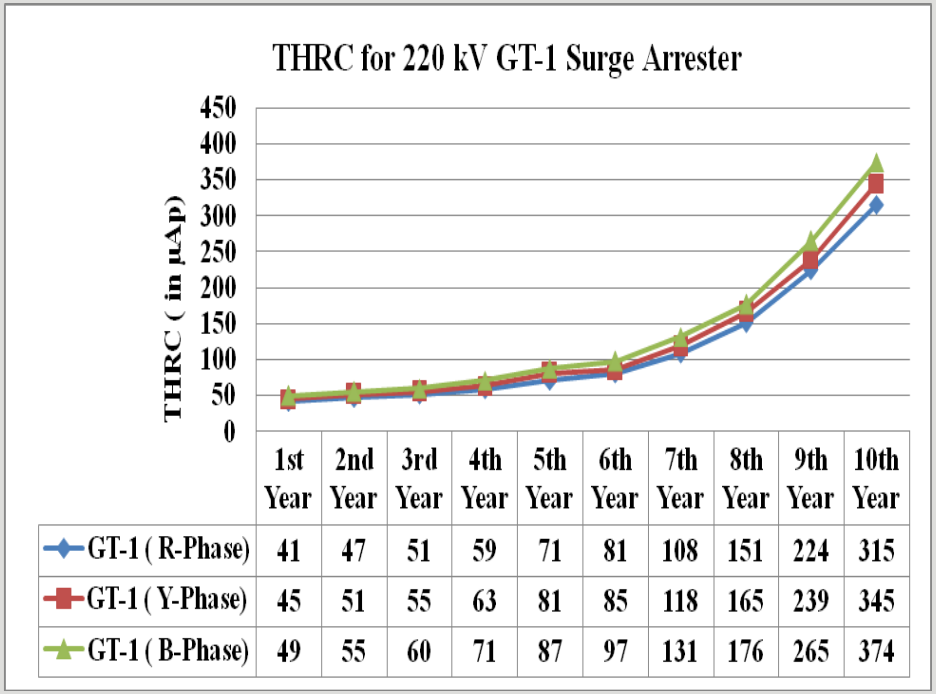
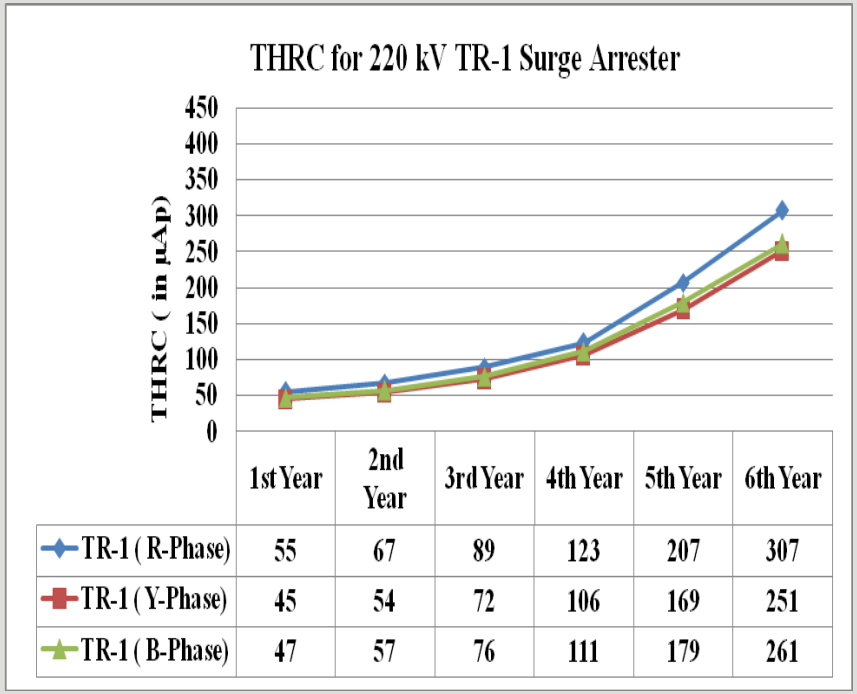
TEST RESULTS

THRC Measurement for GT-1



	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year	9th Year	10th Year
GT-1 (R-Phase)	41	47	51	59	71	81	108	151	224	315
GT-1 (Y-Phase)	45	51	55	63	81	85	118	165	239	345
GT-1 (B-Phase)	49	55	60	71	87	97	131	176	265	374

Non- Coastal Area



	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year
TR-1 (R-Phase)	55	67	89	123	207	307
TR-1 (Y-Phase)	45	54	72	106	169	251
TR-1 (B-Phase)	47	57	76	111	179	261

Coastal Area

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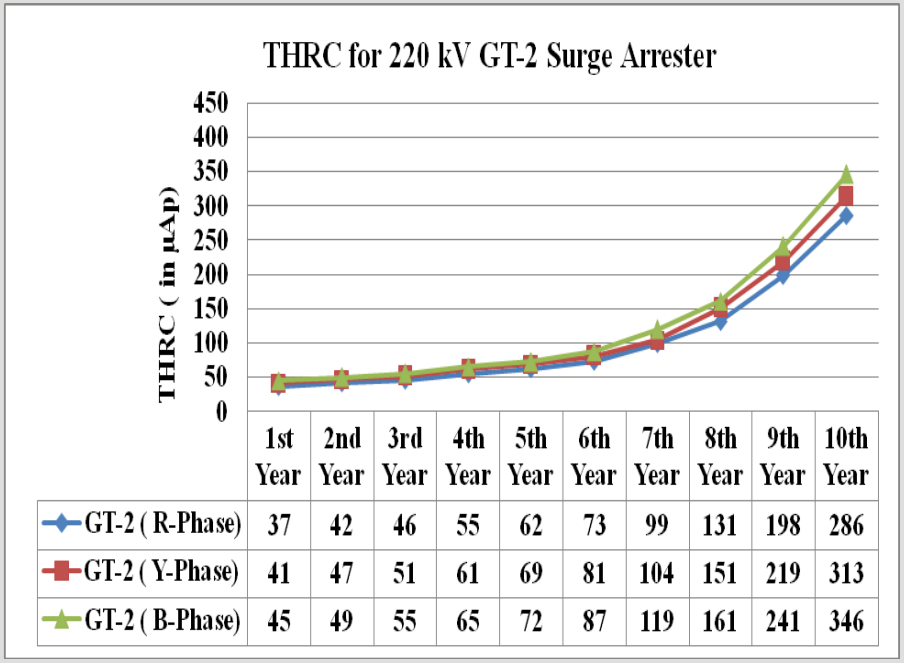
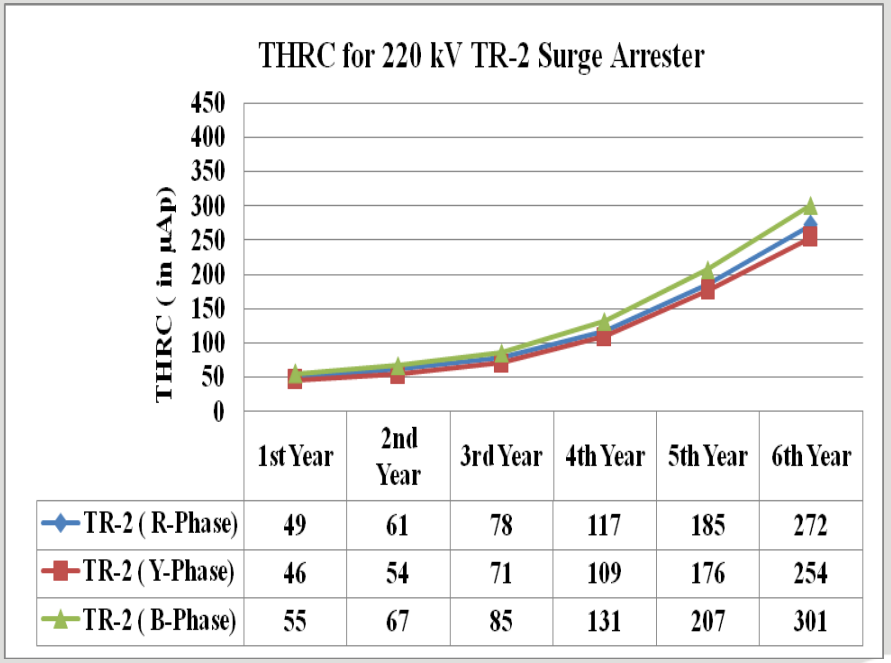
TEST RESULTS

THRC Measurement for GT-2



	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year	9th Year	10th Year
GT-2 (R-Phase)	37	42	46	55	62	73	99	131	198	286
GT-2 (Y-Phase)	41	47	51	61	69	81	104	151	219	313
GT-2 (B-Phase)	45	49	55	65	72	87	119	161	241	346

Non- Coastal Area



	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year
TR-2 (R-Phase)	49	61	78	117	185	272
TR-2 (Y-Phase)	46	54	71	109	176	254
TR-2 (B-Phase)	55	67	85	131	207	301

Coastal Area

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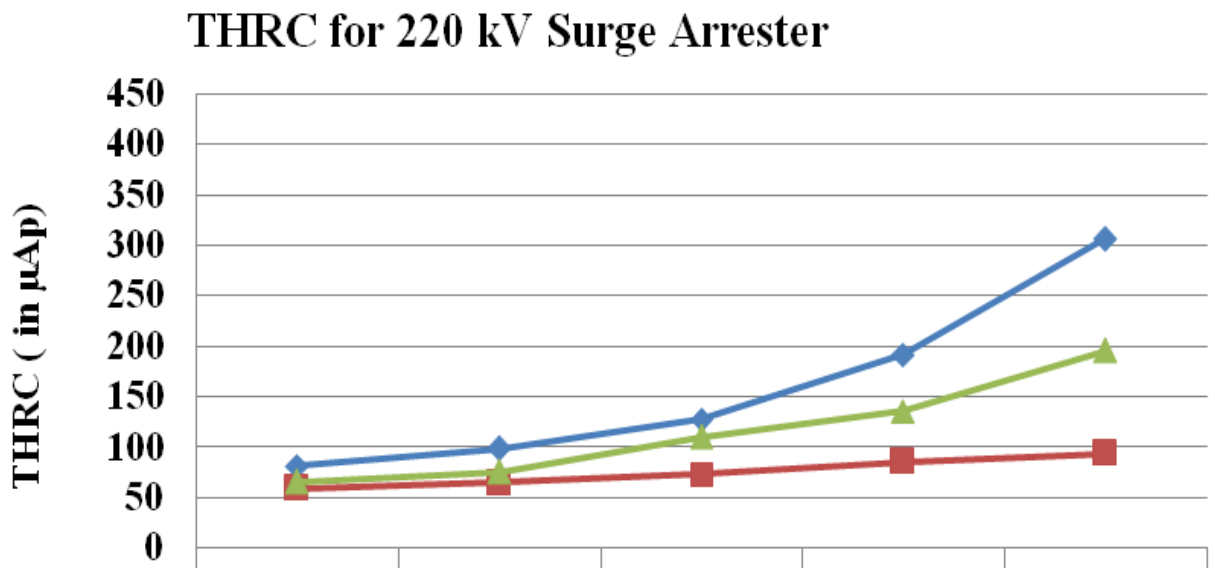
TEST RESULTS

THRC Measurement at different region



	1st Year	2nd Year	3rd Year	4th Year	5th Year
Coastal Area	81	98	127	191	306
Non- Coastal Area	59	64	73	85	93
Polluted Area	65	75	110	135	195

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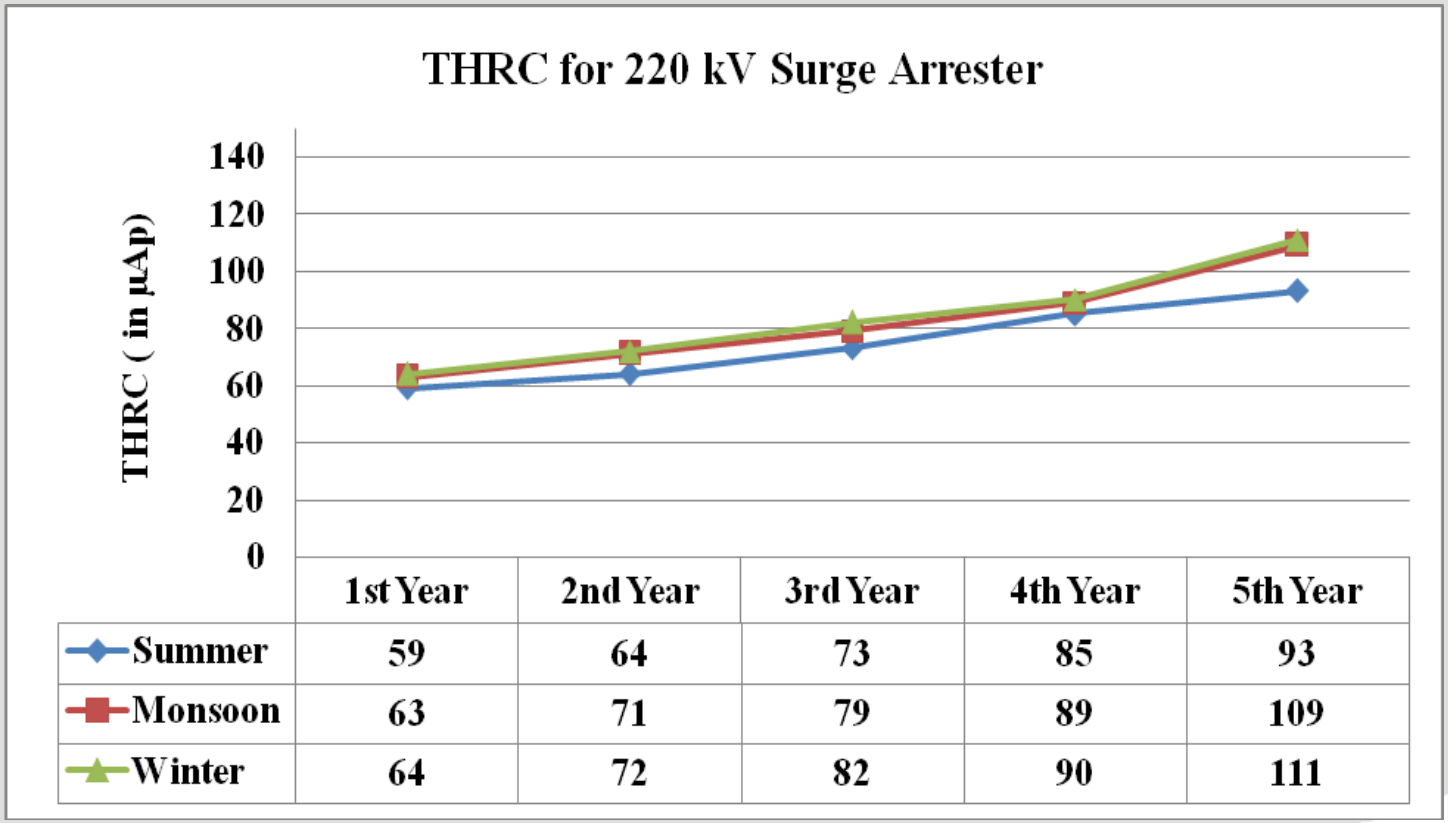
TEST RESULTS

THRC Measurement in Different Weather Conditions



	1st Year	2nd Year	3rd Year	4th Year	5th Year
Summer	59	64	73	85	93
Monsoon	63	71	79	89	109
Winter	64	72	82	90	111

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Interpretation of Test Results

- The rate of rise of THRC is higher for coastal areas in comparison with non-coastal areas.
- The THRC increased by approximately two times for non-costal area within a span of 6 years.
- The THRC increased by 5.5 times to 7.5 times for costal area within a span of 6 years.
- The maximum seasonal variation is higher for THRC from summer to monsoon season as compared to monsoon to winter season.
- The THRC increased by maximum 17% for seasonal variation between summer and monsoon seasons.
- The THRC increased by maximum 3% for seasonal variation between monsoon and winter seasons.

Interpretation of Test Results

- It was recommended to replace the LA in B-phase of Line-2 in non coastal area as THRC value was more than 500 µAp after 10 years.

- It was recommended to replace the LA in Y-phase of Line-2 in coastal area as THRC value was more than 500 µAp after 6 years.

Conclusion

- Measurement of 3rd harmonic of resistive leakage current is an important tool for the online condition monitoring of lightning arresters. Trend analysis shows a higher rate of rise of THRC in coastal area compared to non-coastal areas.

- The frequency of measurement of THRC should be increased in coastal areas.

- Regular cleaning of external surface of lightning arresters helps to reduce the total leakage current flowing through lightning arresters.

- Similar analysis for 400 kV and 765 kV rating lightning arresters can be done.

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Thank You

Contact :

tirtha.vishwakarma@erda.org

nitin.chitte@erda.org

anil.khopkar@erda.org

ERDA Road, G.I.D.C., Makarpura,
Vadodara-390 010, Gujarat, India
Contact No.: +919978940945

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