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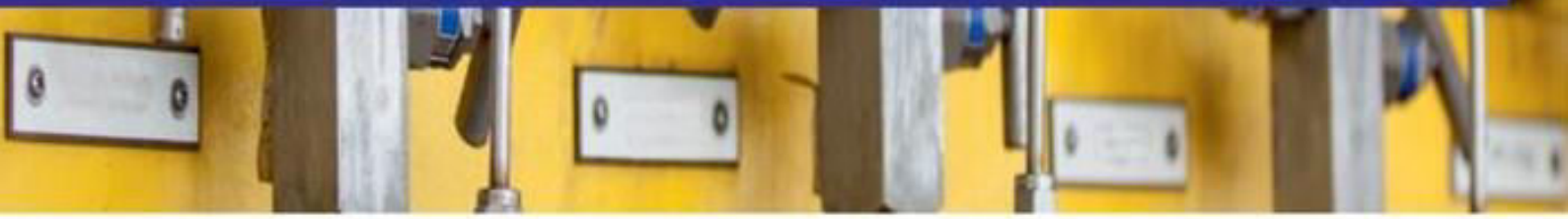

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Enhanced LV Panel Switchgear Design by Selecting ACB as a Function of Temperature

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ABSTRACT: Low voltage switchgear power system is used to distribute supply to loads .Development is enormous, best switchgear power systems are available from the suppliers .In the site where it is installed overheating is happening that is temperature crossing the limits because of this effect electrical components will damage, shutdown of the switchgear for maintenance or repairs leading to the power cut. This will have a impact on loads where needed 100% reliability of supply examples are factories, airports, hospitals etc. This paper discusses an enhanced low voltage switchgear power system design by selecting air circuit breakers as a function of temperature. Previously circuit breakers considered based on load ratings. Now the temperature effect is considered in my paper leading to breaker selection not only on load but also temperature factor. This minimizes the downtime, increase reliability and life and helps the designers and maintenance directors.

KEYWORDS: Derating Factors, Air circuit breaker, Switchgear.

I. INTRODUCTION

In the past 100 years, switchgear is always improved in workmanship and design .Air circuit breakers and moulded case circuit breakers failure occurs due to the overheating and leading to fire hazard .There are many other factors responsible like bolts loose connection ,contacts damaged etc.But in this paper considering the derating factors because of temperature effect. [1].

II. OVER HEATING FACTORS

2.1 CONNECTIONS/TERMINALS

Main ACB terminals when connected to cu busbars If they are not correct torque .It will lead to the hotspot

Fig1: connection/terminals

Fig2 .Damaged due to overheating cluster

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Cluster spring having reduced spring lead to the hot spot and leading to fire and power interruption to loads [2]

Fig3 :Poor ventilation

FIG 4.Switchboard

The switch board has circuit breakers installed as per the view.

III. PROPOSED METHODOLOGY

De-rating Requirement for switchgear

The maximum allowable temperature at the terminals of ACB or MCCBS is 120C.The current rating of ACB normally operated well at 40oc. But at higher temperatures it is derated in some areas where it is installed. Iam considering the maximum temperature 70C for selection of the circuit breakers to be used in switchboard. In Hot countries like india ambient temperature is very high .

Circuit breakers Dimensions installed in switchboards.

Table1

2300x800x900 (HxLxD)	E1-E2-E3
2300x1400x1500(HxLxD)	E4-E6

3.1 Observation I: E1 type circuit breaker

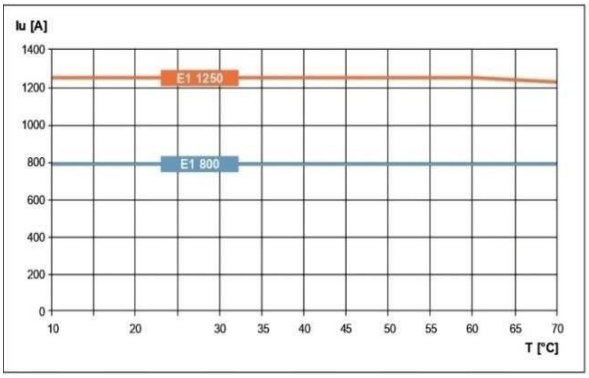

Fig5. Current vs Temperature Characteristics

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Table :2 E1 800 E1 1250

Temperature[c]	%	[A]	%	[A]
40	100	800	100	1250
70	100	800	98	1230

E1 800A CB caries full rated current at 70C whereas E1 1250 CB caries only 98% ie 1230A instead of 1250 ie derated from the nominal capacity

3.2 Obervation II: E2 type circuit breaker

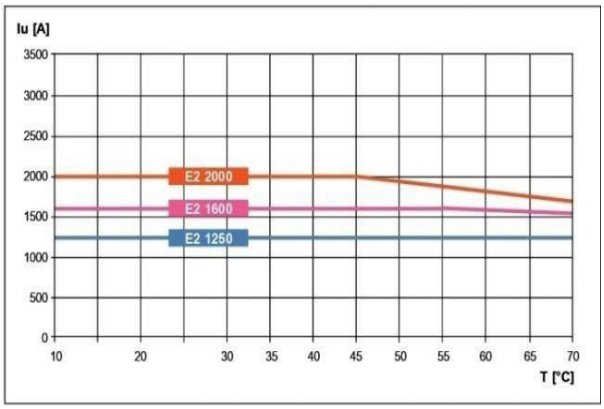

FIG6. Current vs Temperature Characteristics

Table 3: E2 -1250 E2-1600 E2-2000

Temp(° c)	%	[A]	%	[A]	%	[A]
40	100	1250	100	1600	100	2000
70	100	1250	94	1510	85	1705

E2 1250A CB caries full rated current at 70oc where as E2 1600 and E2 2000 is derated from their nominal capacity.

3.3. observation III: E3 type circuit breaker

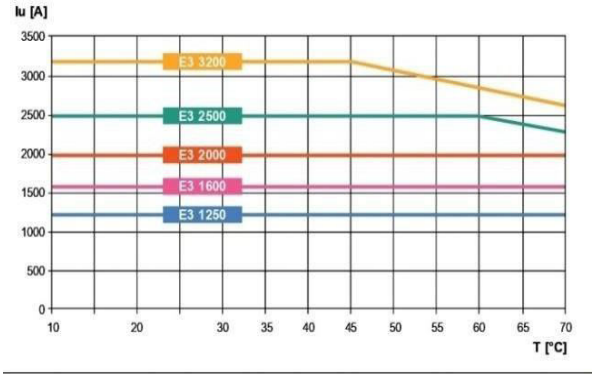

Fig7. current vs temperature characteristics

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Table 4: E31250 E31600 E3-2000

Temp(°c)	%	[A]	%	[A]	%	[A]
40	100	1250	100	1600	100	2000
70	100	1250	100	1600	100	2000

Table 5: E3 -2500 E3-3200

Temp(°c)	%	[A]	%	[A]
40	100	2500	100	3200
70	94	2350	82	2630

At 70c E3 1250,E3 1600,E3 2000 carries full rated current but E3 2500 ,E3 3200 is derated from the nominal capacity

IV. THREE-PHASE VOLTAGE SOURCE INVERTER (VSI) WITH SVPWM

4.1 Observation IV: E4 Type circuit breaker

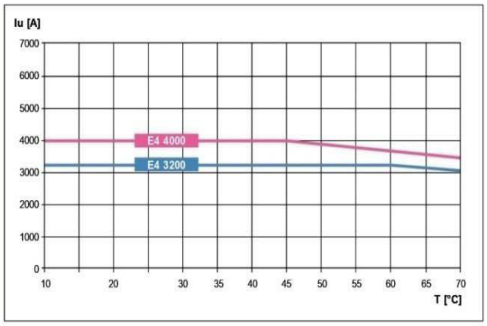

Fig 8. current vs temperature characteristics

Table 6: E4 3200 E4 4000

Temp(°c)	%	[A]	%	[A]
40	100	3200	100	4000
70	95	3040		

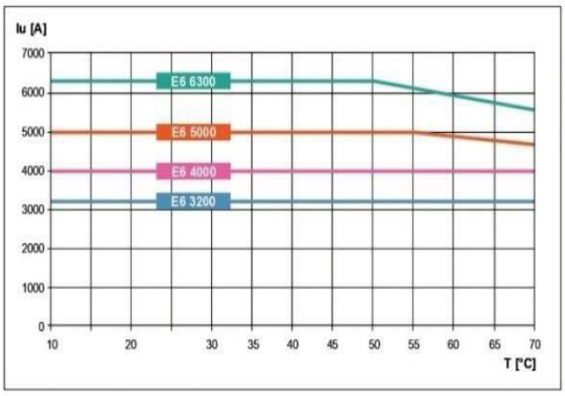

Fig. 9 current vs temperature characteristics

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Table 7: E6-3200 E6-4000

Temp(°c)	%	[A]	%	[A]
40	100	3200	100	4000
70	100	3200	100	4000

Table 8: E6-5000 E6-6300

Temp(°c)	%	[A]	%	[A]
40	100	5000	100	6300
70	94	4720	92	5600

At 70C, E6-3200,E6-4000 caries full rated current but E6-5000,E6-6300 is derated from their nominal capacity.

V. SELECTION OF CB FOR A PARTICULAR APPLICATION

Suppose need 1600A circuit breaker so it is available in E2 and E3 type CBS. But at 70oc temperature E2-1600,carries only 94% ie 1510.where as E3-1600 caries full 100% So when C2 CB installed in switch board temperature derating occurs leading to overheating .Whereas E3 CB installed in switchgear it carries the full current without overheating which is desirable and enhanced the switchgear power system performance **.**

VI. ECONOMIC ANALYSIS

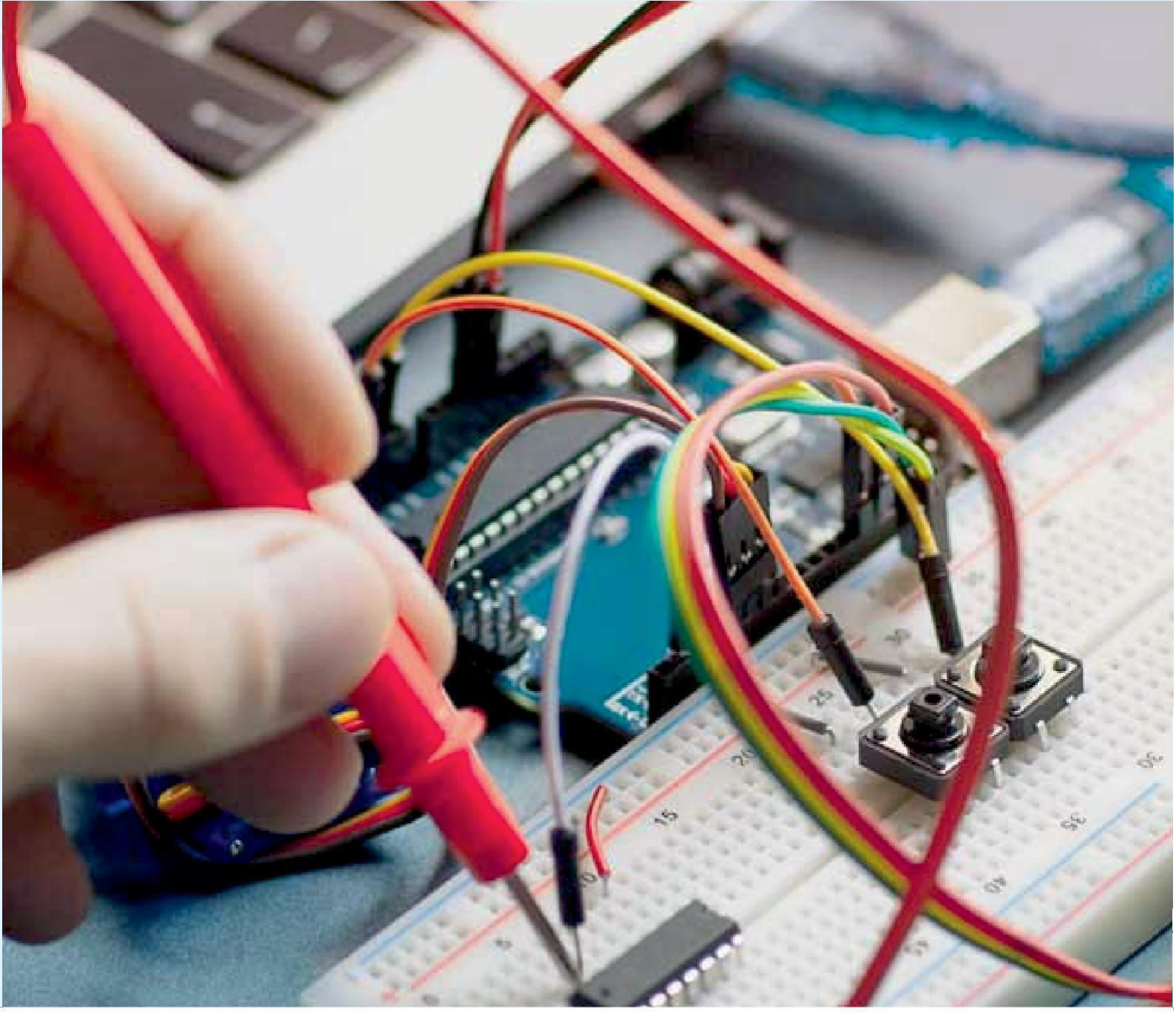
E2 -1600 A -1,10,000 rs E3-1600A – 1,30,000 rs
By comparing the prices only little variation is there but in bulk order this may effect the over all cost of the project but to improve the quality the modification has to be done

VII.CONCLUSION

Switchgear power system overheating problem is tackled by considering the temperature deration while selecting the air circuit breaker, leading to the enhancement of the switchgear power system design quality ,life ,reliability is improved This technique increase the project cost but the benefits are compensation.

REFERENCES

[1].ABB switchgear
[2].Temperature rise test and analysis of high current switchgear in distribution system, Haotian Xia ; Yonggang GuanZhanqing Yu ; Suxiong Cai ; Xiaorui Wang ; Zhaowei Peng ; Shisen Gao 3. The Journal of Engineering
[3] H. Xia, Y. Guan, Z. Yu, S. Cai, and X. Wang, “Temperature rise test and analysis of high current switchgear in distribution system,” The Journal of Engineering, 2019.DOI: 10.1049/joe.2018.8371
[4] J. Wang et al., “Research on temperature rise of high current switchgear in distribution system,” *The Journal of Engineering*, 2019.DOI: 10.1049/joe.2018.8769
[5] M. Bedkowski, J. Smolka, Z. Bulinski, and A. Ryfa, “Simulation of cooling enhancement in industrial low-voltage switchgear using validated coupled CFD-EMAG model,” International Journal of Thermal Sciences, vol. 111, pp. 437–449, 2017.DOI: 10.1016/j.ijthermalsci.2016.09.025
[6] P. B. R. Alves et al., “A Hybrid Thermal and Machine Learning Approach for Predicting Temperature Rise in Low-Voltage Switchgear,” IEEE Access, 2026.DOI: 10.1109/ACCESS.2026.3675360
[7] S. Spinsante, G. Iadarola, G. Mazzocchi, and C. Romagnoli, “Temperature Rise in MV Switchgears: the Role of Loose Busbar Joints,” IMEKO TC-4 Symposium, 2022.



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