



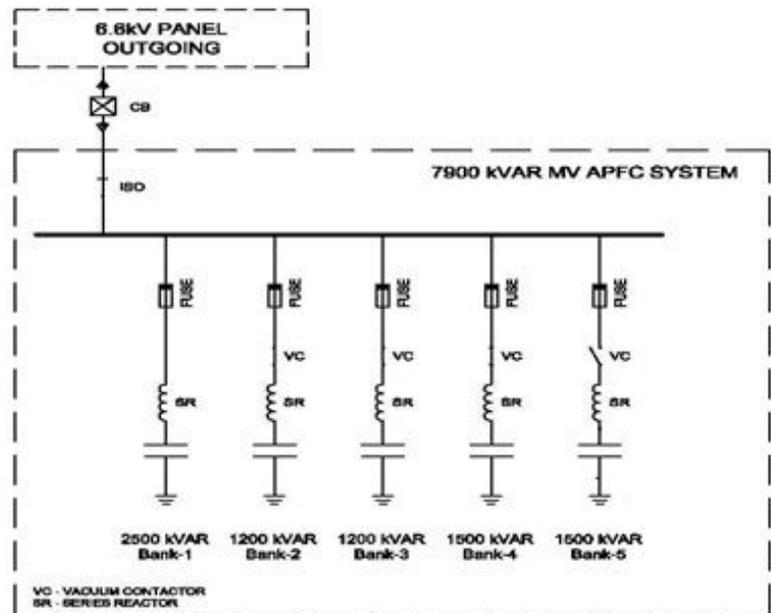
## Case Study – How an Unchecked Capacitor can cause loss of revenue

Loss of Revenue is one of the biggest headaches for all the industries across world. And losses may come from Failure of Equipments, Accidents, Less production, Production at higher costs, N number of things. Everyday we come to know about some new breakdowns happening in industries due to various issues in our Electrical system. And our Motto is one problem must not be repeated in other plants. And sometime few problems help us to provide the best solution to other plants where such problem may arrive. Presenting you all the case now.

### Background

Power Factor, one of the important parameters that grid connected industries continuously measured. As the rise and fall of the same has impact on the penalty or less rebate in electricity bills.

We received an emergency call from a grid connected process industries for tripping of 6.6 kV 1500 KVAR capacitor bank in Earth fault, which resulted into low PF. This 1500 KVAR was a part of 7900 KVAR capacitor bank. To support the costumer, System Protection is always ready on their feet. So, within 24 hours, we sent our expert engineer to check and resolve the issue. Below is the diagram of the cap bank.



### Findings – at Site

Before calling, Maintenance team did the check-up like Visual Inspection, cleaning of capacitor bank and Insulation resistance measurement, but all the checks were found to be ok. They decided to normalise the system by charging complete capacitor bank again. So, they charged the capacitor bank and started closing individual bank one by one. Again, the Bank-5 tripped in E/F.

Now our engineer took over and checked the capacitor bank, following were the findings

Authorised Channel Partners

**SIEMENS**

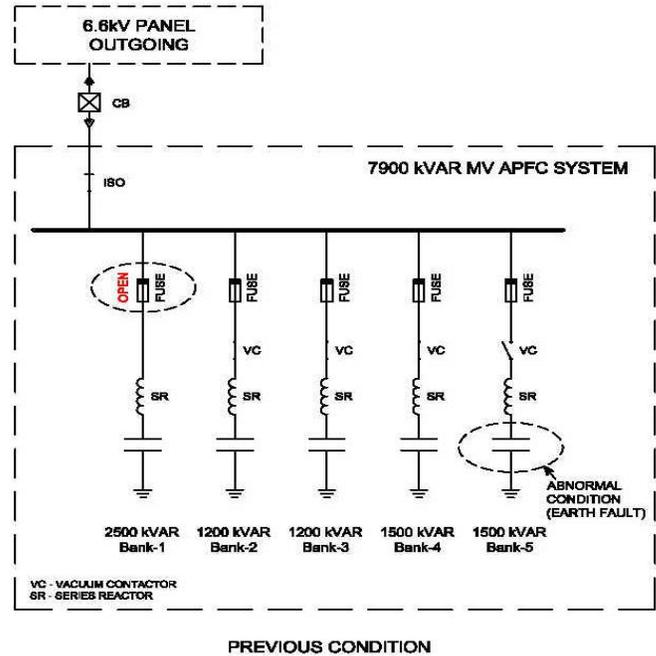
**KYORITSU**  
Quality and reliability in our tradition

**Honeywell**  
SALISBURY

**CLARIANT** FRAKO



1. 2500 KVAR Bank was in isolate condition as the fuse were removed. We inquired about the same and found that this is the condition since commissioning.
2. 1500 KVAR Bank was already out due to E/F tripping, which was to be checked thoroughly.
3. Out of 5 Banks, now 2 banks were in isolate condition, causing Low PF.



### Troubleshooting and Root Cause analysis

Our expert team reached the site and in consultation with process team 6.6 kV outgoing feeder of APFC was made off and isolated. We were given only 2 to 3 hours of time frame (due to operation related issue) by O&M team to diagnose the exact reason of E/F and suggest recommended actions.

We repeated the IR test with our Calibrated instruments of individual capacitor and series reactor after isolating, done through visual check of capacitor, reactor, support insulator, busbar, cleaning, tightness and Capacitance / Reactance measurement by instrument and test set.

After doing above test we got something, which is mentioned in below tabular form.

Capacitance value as measured by Calibrated Multimeter.

Phase	Qn (KVAR)	IN (A)	Un (KV)	Cn (µF)	Capacitance value (µF)
R1	250.0	56.05	4.46	40.02	42.01
R2	250.0	56.05	4.46	40.02	31.0
Y1	250.0	56.05	4.46	40.02	42.3
Y2	250.0	56.05	4.46	40.02	42.3
B1	250.0	56.05	4.46	40.02	41.7
B2	250.0	56.05	4.46	40.02	42.2

We found capacitance value of one the capacitor different. To make sure we checked the same by Voltage source method and below were the readings.

Authorised Channel Partners



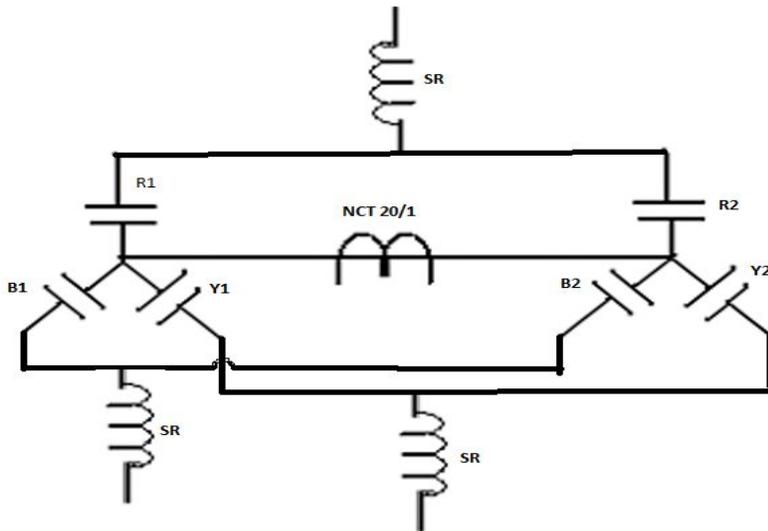


Phase	Capacitor Value @ name plate (μF)	Capacitance value (μF) by Voltage source method
R1	40.02	42.53
R2	<b>40.02</b>	<b>31.62</b>
Y1	40.02	42.62
Y2	40.02	42.55
B1	40.02	42.00
B2	40.02	42.48



**Name Plate of one of the capacitors**

**DOUBLE STAR CONNECTION SCHEME OF CAPACITORS**



- In this scheme capacitors are connected in double star formation with neutrals interconnected through a neutral CT as shown in figure above. In balance condition there is no current flowing through the neutral CT.

- Measured capacitance of R2 capacitor by both the method was around 31.0 μF.

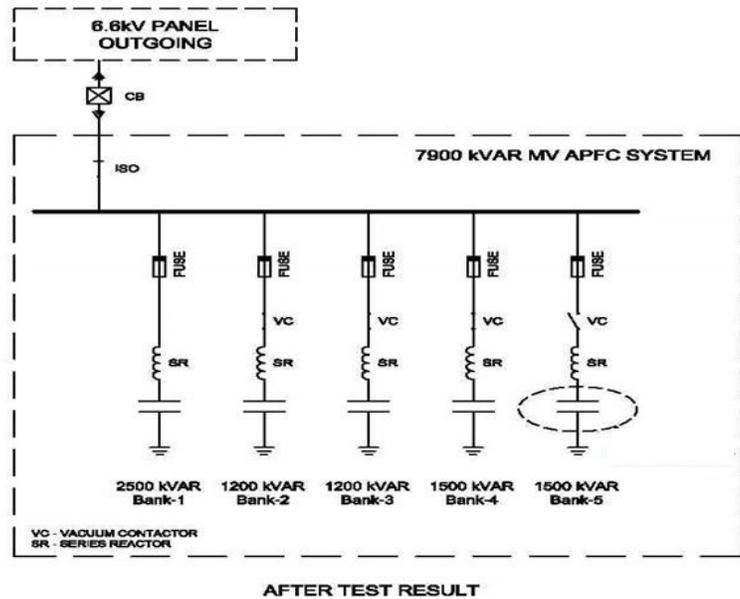
- In the event of R2 capacitor failure or unbalance, it will create unbalance system condition. This was causing flow of current in neutral CT 20/1 which was giving tripping in Earth Fault. So, the recommendation was to replace R2 Capacitor with healthy one for 1500 KVAR cap bank to work healthily.
- The 1500 KVAR E/F root cause was found, but problem of the plant remains in as it is condition i.e. Low PF
- So, we went one step further to check the 2500 KVAR bank with all the routine tests. And to our astonishment that Cap bank was healthy, but why fuse was removed earlier were not known to the current team.
- The reason which we thought could be, that at the time of commissioning, plant must be on NO Load, so during charging this 2500 KVAR capacitor would have come directly in line, which could have been causing leading PF, Hence the fuse must have been removed at that time to avoid Leading PF and its impact.

**Authorised Channel Partners**





- So, we installed the fuse and charge the system successfully and the power factor was maintained.
- And at last, we were delighted to 'WOW' the customer again, who learnt at last, the difference between symptom solving agents and Proper doctors.



### Conclusion – How routine / diagnostic testing of all the electrical equipment can prevent loss of Revenue / Profit.

- In industries, testing is always prioritized as per priority of Equipments, like Relays and / or Release are given High priority in Panels, after that come Circuit breakers and if time, budget, and management permits time come for CT / PT testing, and for other equipment no body ask what to do. So, we normally see that in a panel, CT / PT, Panel Schemes, Power Cables, Capacitor bank, Series reactor, etc are not given priority and are rarely tested.
- We recommend that industry should do testing and maintenance of such untouched electrical Equipments like CT, PT, Cap bank, Power cables, Schemes, etc with latest and advanced testing, so that time to time healthiness of those can also be monitored.

We, as an Electrical asset consultant and service provider always suggest what is best to run your industries smoothly and without hiccups of maloperation and breakdown.

And if you are looking for a dedicated agency that understands the direct link between your assets and your revenue, call/write to us, we will be happy to assist you.

### SYSTEM PROTECTION

E-Mail : [bdm@systemprotection.in](mailto:bdm@systemprotection.in)

Web : [www.systemprotection.in](http://www.systemprotection.in)

Tele : +91-265-2225137

(Servicing & Testing of Circuit Breaker, Relay, CT, PT, Transformer, Other Switchyard Equipment's, Relay Co-ordination Studies, Cable, etc.)