

# Investigations on Testing and Installation of LT Panel: A Review

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## Abstract:

A low-tension panel is an electrical distribution board that receives power from a generator or transformer and distributes the same to various electrical and electronics devices and distribution boards such panels are used in industries, domestics' applications.LT Panel will play a critical role in the continuity of the electrical supply for the load appliances like fans, motors, etc. In this panel different types of switchgear equipment are used such as Bus Coupler, Air Circuit Breaker (ACB), Miniature Circuit Breaker (MCB), Relays, Switches, and Fuses. The paper majorly deals with the Reliability Analysis and the different types of tests being conducted on a 440V, 800LT panel and testing of all parts and its protective devices.

*Keywords* —:LT Panel, Air circuit breaker, Relays, Switches

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## I. INTRODUCTION

LT Panel play a critical role in the continuity of the electrical supply for the load appliances like fans, motors, etc. In this panel different types of switchgear equipment are used such as Bus Coupler, Air Circuit Breaker (ACB), Miniature Circuit Breaker (MCB), Relays, Switches, and Fuses. There are different types of circuit breakers used to extinguish arc Like Air circuit breaker (ACB), Oil circuit breaker (OCB), Sulphur hexafluoride circuit breaker (SF6), Vacuum circuit breaker (VCB), etc. But for low voltage applications Air circuit breaker (ACB) is used a low-voltage circuit breaker is suited for circuits rated at 600 volts or lower. One of the most commonly used low-voltage air circuit breakers is the Air circuit breaker. The major failures such as overvoltages, under-voltage,

overload, and overcurrents will lead to reducing the performance of the panel. The electrical panel test in any system is made to ensure that the panel construction, connection, and performance is correct from the operational, reliability, and safety viewpoint; hence, to ensure the continuity of electrical operation tests are carried out in the factory, with many different inspections, quality, and panel test procedures. Also when testing circuit breakers, it is important to check the condition of the circuit breaker contacts and circuit breaker operating mechanism to assure that the circuit breaker is opening and closing as designed.

## II.CONSTRUCTION

Electrical Panels are primarily designed to distribute and control the power for various mechanical implements. These panels are unit products of smart quality raw materials following

industrial quality standards. Electrical control panels are widely used in the industrial and commercial sector for various applications and utilities, including commercial buildings, hospitals, telecommunications, research laboratories, and others. There are primarily two types of electrical panels available in the market – High Tension (HT) and Low Tension (LT) panels, each one is designed for a specific arrangement and includes devices to operate specific equipment. Air circuit breaker (ACB) is used a low-voltage circuit breaker is suited for circuits rated at 600 volts or lower. One of the most commonly used low-voltage air circuit breakers is the Air circuit breaker. Because ACB are simpler and lighter in construction. It is a trouble-free CB though has a shorter history, it has been in use longer than its intended life span of say 20 years. For low voltages system. The Air circuit breaker is fast in operation so ideal for fault clearing. It is suitable for repeated operation and almost maintenance-free. When oil circuit breaker, during arcing, oil decomposes and becomes polluted by carbon particles, which reduces its dielectric strength. Hence, it requires periodic maintenance and replacement but for ACB it's easy to maintain.

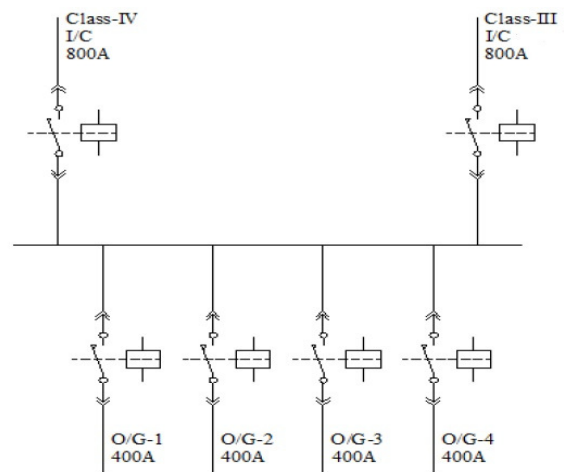
**II. SINGLE LINE DIAGRAM OF LT PANEL**

Now for this LT panel, the SLD is shown below is include the Incoming line (nominal voltage and amount – capacity and value) Main circuit breaker, main fuse, cut-outs, switch, and busbar connection, Feeder circuit breaker Fused switches relays (function, use, and type) In this as shown in fig 2. there are two incomers (incoming power source)

Fig 1. LT Panel



Fig 2 Single line diagram of LT panel



and Four outgoing feeders. Incomers are rated for 800A each and feeders are the rating at 400A each and in the panel six circuit breaker are used two 800A rated for incomers and the other four are rated 400A.

#### **IV. MAIN COMPONENTS**

##### **A. Internal Bus bars**

The bus bars are insulated and made of high quality and high conductivity, high strength aluminum. The interconnection between bus bars and various components shall be high conductivity aluminum. The bus bars have uniform cross-section throughout the length and The interconnections are insulated with heat shrinkable PVC sleeve color-coded red, yellow, blue, and black is to identify the three phases and neutral of the LT panel.

##### **B. Air Circuit Breaker**

Air circuit breakers are one of the main components of the switchboard. It is employed for the protection of electrical equipment with a tripping coil connected to a relay designed to open the breaker automatically under abnormal conditions, such as over current, overload, overloads, etc. Air Circuit Breaker provides the short circuit, overload, earth fault protection of LT panel. The Air circuit breaker consists of fixed contact, moving contact and an arc shield mounted in an arc chamber. The outer insulating body is made with glass and has a highly insulated plastic capacity. The movable member is connected to the bellows.

##### **C. Current Transformers**

Current transformers, along with voltage or potential transformers, are instrument transformers. Instrument transformers scale the large values of voltage or current to small, standardized values that are easy to handle for measuring instruments and protective relays. The instrument transformers isolate measurement or protection circuits from the high voltage of the primary system. A current transformer provides a secondary current that is accurately proportional to the current flowing in its primary. The current transformer presents a negligible load to the primary circuit.

##### **D. Protective Relay**

"Protective relay is a device that detects the faults and initiates the operation of the circuit breaker to isolate the defective element from the rest of the system." High-performance protective relaying comes into its own when it's a question of minimizing power system operating costs. The uncomplicated operation, convenient commissioning tools, and flexible communication are all important elements when service and maintenance costs have to be reduced. IDMT relay is an inverse definite minimum time relay. It is one in which Time of operation is inversely proportional to the magnitude of fault current near pickup value and becomes substantially constant slightly above the pickup value of the Relay.

#### **V. Tests on LT Panel**

##### **A. Physical verification of the Panel**

Before the electric test of the panel to ensure proper testing condition panel have to go through the physical verification and mechanical test of the component like a circuit breaker, busbar, incomer section, and outgoing section. In this test, we ensure the physical visual inspection of the panel, Mechanical checks if there is any loose door or screw. If there is any insulation failure in the bus bar. Bus bar joints are connected properly with the incomer cables. And tripping circuit is connected properly like a relay, current transformer, and circuit breaker connection.

##### **B. Electrical Tests on Panel**

###### **1. Insulation Resistance Test**

To test for insulation resistance, an instrument known as a megger is used. A megger instrument applies a known DC voltage to a given wire for a

given period to test the resistance within the insulation on that particular wire or winding. Voltage must be employed as the resistance checked with an ohmmeter may differ when there is no report of potential differences. It should also be noted that if you apply a voltage that is too high for that insulation to withstand, then you could potentially damage the insulation so there is a procedure to conduct the test. When performing insulation testing, it is recommended that auxiliary equipment, such as potential transformers and lightning arresters, be removed from the stationary switchgear. Insulation resistance tests are made with the circuit breaker in an open and closed position, whereas the insulation test for the switchgear bus is made with one phase to ground at a time, with the other two phases grounded.

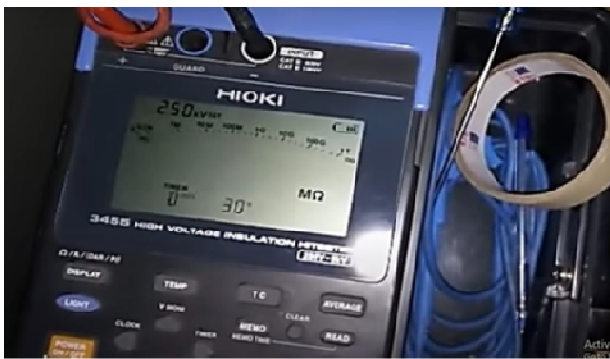


Fig 3 Test Set up

	R	Y	B	N
E	0.5	0.5	0.5	0.5
N	0.5	0.5	0.5	~
B	0.5	0.5	~	~
Y	0.5	~	~	~

Table1 Test Results

**2.HV Test**

A dielectric withstands test is an electrical test performed on a component or product to determine

the effectiveness of its insulation. The test is a means to qualify a device's ability to operate safely during rated electrical conditions. Voltage withstand testing is done with a high voltage source and voltage and current meters. A single instrument called an "HV Tester" is often used to perform this test. It applies the necessary voltages to a device and monitors leakage current. The current can trip a fault indicator. The tester has output overload protection. The test duration must be under the safety standard being used. The test time for most standards, including products covered under IEC 60950, is 1 minute.

- ◆ High voltage tests on power and control wiring 2.5 kV for one minute on the power circuit and 2 kV for one minute on control
- ◆ Circuit with all meters and instrument transformers in the circuit.
- ◆ Ensure that proper earthing is provided to H.V. Test set, fulfilling the interlocking required to make the set "ON".
- ◆ Increase the H.V. voltage smoothly up to 2.5KV for the 60s and start the timer for count down

**3.Air Circuit Breaker Test**

- ◆ The air circuit breaker operated within the voltage level 1 kV. Mainly for heavy fault current on low voltages (low voltage level above 1 kV) ABCs with an appropriate arc control device, are a good choices. These breakers normally have two pairs of contacts.
- ◆ The main pair of contacts carry the current at normal load and these contacts are made of copper. The additional pair is the arcing contact and is made of carbon. When the circuit breaker is being opened, the main contacts open first, and during the opening of main

contacts the arcing contacts are still in touch with each other. When a fault occurs on the electrical power system, fast and reliable protection means everything. If a circuit breaker fails to clear the fault at that critical moment, the resulting damage can be disastrous in terms of both personnel injury and equipment damage.

- ◆ Even though circuit breakers can be very reliable, they tend to gather dirt, moisture, and contaminants while in service. Breakers used in hostile environments can be exposed to various corrosive contaminants, which damage not only the insulation system but also metal components, including the main contacts inside air circuit breakers.

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## VI CONCLUSION

In this research paper, a brief overview of construction, working, Testing, and objective of equipment's installed in a Panel and the process of installing the panel to the sites explained different types of switchgear equipment is used such as Bus Coupler, Air Circuit Breaker (ACB), Miniature Circuit Breaker (MCB), Relays, Switches and Fuses, Instrument transformer. All the tests are performed on 440V, 800/400A, 3 Phase LT Panel, and on its types of equipment. The respective test, which defines the condition of the LT Panel, Also the tests are carried out at the site and they gave satisfactory results.