CEEAMA™
Consulting Electrical Engineers Association of Maharashtra

CEEAMA LiveWire

E-NEWSLETTER

Published by Consulting Electrical Engineers Association of Maharashtra

Topic for June 2025

GIS SUBSTATIONS

Dive into this month's edition! Inside: thought-provoking articles and a must-read incident report.

Electrical Consultants Newsletter
Volume No. 4 Issue #51
June 2025

CEEAMA Governing Council
Directors

Mr. Chidambar Joshi
Hon. President

Mr. Ulhas Vajre
Hon. Secretary

Mr. Anil Bhandari
Hon. Treasurer

Directors

Mr. Narendra Duvedi

Mr. Mohan Kelkar

Mr. Ulhas Vajre

Mr. Krishna S. Chandavar

Mr. Veejhay Limaaye

Mr. Subhash L. Bahulekar
Chief Editor - CEEAMA LIVEWIRE

From the Editors Desk,

Yet again, as we try to forget the cowardly terrorist attack on unarmed common tourists in Pahalgam, this month will be remembered for the ghastly Aeroplane crash in Ahmedabad killing 241 passengers on board and 33 medical staff on the ground inside the Medical college. Even though in the past 15 years of its operation there was no reported incidence, this Boeing Dreamliner definitely was on the radar of many people for its poor maintenance…or was it some kinda sabotage considering that there was Gujarat's ex-CM Mr. Vijaybhai Rupani on the same flight. Whatever it maybe, such incidents again and again highlight life's fragile side and how important it is to remain in close bonding with our near and dear ones, always!

I remember to have investigated a case of death inside a factory manufacturing 400kV SF6 Circuit breaker way back in 2009. It was unbelievable to come to terms of life when a person with 30 years' shop floor experience dies in a freak accident of the insulator blast some 20m above his head and small splinter piercing his head for a on-the-spot death! Read more about the same in this issue of LiveWire.

I am sure the plane-crash investigation will also pin-point to the lack of maintenance and how safety adherence is of prime importance, similar to my investigation report concluding on the above factory accident.

Here I would like to express my sincere gratitude towards our veterans in the field of safety like our own Mr. Ulhas Vajre sir. His expertise of many decades has immensely benefitted many industries and avoided many fatal incidences.

\We are also proud of our past president, Mr. Narendra Duvedi who was chosen as a moderator at the 3rd Edition of MEP consultants meet organised by IEEMA in Cochin (Kochi) between 12th & 14th June 2025.

As human progresses many folds in the modern age technology, power requirement has increased multiple times. This poses challenge to manage the same as power in GWs at any single location is no more a rare scenario. That is where GIS substations play important role! Read more about it in some of the articles below.

Wish you yet another month of safety and happiness!

Subhash L. Bahulekar
Chief Editor – CEEAMA

From the President's desk:

Dear Friends,

While the world reels with the present geo-political scenario, this month the LiveWire edition focusses on the SF_6 (sulphur hexafluoride) technology. SF_6 is a potent greenhouse gas, with a Global Warming Potential (GWP) ~23,500 times greater than CO_2 over a 100-year period. It stays in the atmosphere for approximately 3,200 years, contributing significantly to climate change if leaked. SF_6 can leak over time due to Poor sealing or aging gaskets, improper handling during maintenance or Micro-cracks in enclosures. Even small leaks are environmentally harmful and lead to pressure drops, compromising the circuit breaker's performance. When SF_6 breaks down during arc interruption, it forms toxic and corrosive byproducts like sulphur tetrafluoride (SF_4), sulphuryl fluoride (SO_2F_2), and hydrogen fluoride (HF) which can pose health risks to personnel during maintenance or in the event of an internal fault. Hence the SF_6 circuit breaker switchgear floor requires proper ventilation, gas detection, and personal protective equipment (PPE) during servicing.

The cost of SF_6 Circuit Breaker is high as compared to Vacuum Circuit Breaker due to complex sealing systems and pressure monitoring as well as additional safety and handling equipment required. The operators require training for gas filling as well as evacuation, leak detection and gas quality monitoring. Inadequate handling of SF_6 Circuit Breaker can result in leaks or contamination, affecting both safety and reliability. You may be aware of the fact that special care is needed to reclaim and recycle SF_6 and dispose of contaminated equipment and that improper disposal risks environmental release and regulatory penalties.

Depending on the voltage level and application (AIS, GIS, outdoor breaker, etc.), the best choice to replace SF_6 Circuit Breaker may be as follows:

a. MV systems: Vacuum + air/solid insulation is the most mature.

b. HV systems: Fluoroketone and g^3-based systems (Green Gas for Grid) are becoming the go-to alternatives.

c. Environmentally stringent regions (like the EU): Active phase-out of SF_6, pushing rapid adoption of alternatives.

Friends, electrical consultants need to keep abreast of the latest standards as well as take opportunity to comment on the standards to improve them from time to time. Our Secretary Mr. Ulhas Vajre has provided some pointers in his note, which you can take advantage of.

Do write to us about your experiences, feedback, or suggestions. Do send your emails to admin@ceeama.org.

Friends, CEEAMA is changing. The website will be revamped and some additional features will be planned. Please feel free to write to admin@ceeama.org regarding your suggestions and ideas for the revamp. We will discuss and implement your ideas after the Governing Council consensus.

International Yoga Day falls on 21st June. Do take an opportunity to participate in Yoga exercises Or start following Yoga on this day for freshers. Have a healthy June and beyond.

Mr. Chidambar Joshi
Hon. President
CEEAMA

From the Secretary's desk:

Dear Friends,

The first quarter of financial Year 2025-26 has seen many revisions of Acts, Codes and Rules, including National Building Code of India 2025, National Lighting Code of India 2025, The Ammonium Nitrate (Amendment) Rules 2025, The Gas Cylinder (Amendment) Rules 2025, The Boilers Act 2025, The Disaster Management (Amendment) Act 2025, The Environment (Protection) Second Amendment Rules 2025, The Environment (Construction and Demolition) Waste Management Rules 2025, etc.

Many Industries and establishments have celebrated World Environment Day (WED), held annually on 5th June, which was established by the United Nations General Assembly (UNGA) in 1972, is a pioneering moment for collective environment action to save nature.

This year United Nations Environment Programme (UNEP) hosted program with the theme on Ending Plastic Pollution. The theme underscores the pressing issue of plastic waste and strengthen commitment towards sustainable production, consumption and environmental conservation.

The Consulting Electrical Engineers fraternity shall promote not only electrical safety but sustainability and environment protection also and work in that direction.

Sincerely Yours

Mr. Ulhas Vajre

Hon. Secretary

CEEAMA

GIS Substation

INTRODUCTION ABOUT GIS SUBSTATION

A gas-insulated substation (GIS) is a high-voltage substation where the main conducting structures are enclosed within a sealed environment, using sulfur hexafluoride (SF6) gas as the insulating medium.
The main feature of a GIS device is the use of SF6 gas, an inert gas with exceptional insulation properties as well as chemical & thermal stability.

WORKING PRINCIPAL OF THE GIS SUBSTATION

Switchgear utilizing SF6 gas safeguards the electrical power supply and distribution by interrupting the current flow in an electrical circuit when needed.
Under normal conditions, the breaker contacts remain closed. However, when a failure occurs in the electrical system, these contacts separate, causing an arc to form between them.
The displacement of the mobile contacts is synchronized with a valve that permits the entry of high-pressure SF6 into the chamber where the arc is occurring.
The properties of SF6 gas enable the absorption of free electrons in the arc's path, forming ions that do not carry an electrical charge due to their increased mass. This significantly enhances the gas dielectric strength, leading to the arc's extinction.
Additionally, SF6 gas rapidly recombines as the arc is extinguished, resulting in a decrease in pressure.
Due to these properties, SF6 gas insulating is much more effective than air insulating, about three times compared to Air which makes these substations ideal for medium and high-voltage power systems.

FUNCTION OF GIS SUBSTATION

The primary function of a GIS substation is to switch, isolate, transform, measure, and distribute electrical energy within power systems.

TYPES OF GIS SUBSTATION

Indoor type GIS substation
Outdoor type GIS substation
Hybrid type GIS substation

COMPONENTS / EQUIPMENT OF GIS SUBSTATION:

CIRCUIT BREAKERS:

Devices that are designed to interrupt the flow of current in an electrical circuit during a fault use either a vacuum or SF6 gas as the interrupting medium, depending on the voltage level and application.

DISCONNECTORS/ISOLATORS:

Devices that are designed to isolate a segment of the circuit from rest of the system for maintenance or testing purposes which also utilize SF6 gas as the insulation medium. These devices can be operated either manually or remotely.

BUS BARS:
Conductors that link various components of the circuit, such as generators, transformers, feeders, and more. They use SF6 as the insulation medium and arranged in a three-phase system.

TRANSFORMERS:

Devices that can alter the voltage level of an electrical circuit. They use SF6 gas as the insulating medium. These devices can be either power transformers or instrument transformers i.e., current transformers or potential transformers.

EARTH SWITCHES:

Devices designed to connect a part of the circuit to the earth for safety or grounding purposes. They utilize SF6 gas as the insulation medium. These devices can be operated either manually or remotely.

SURGE ARRESTERS:
Devices which can safeguard the circuit from overvoltage induced by lightning strikes or switching operations. They utilize SF6 gas as the insulation medium and can be either metal oxide varistors (MOVs) or spark gaps.
All these devices are enclosed in a metal housing filled with SF6 gas at a specific pressure. The enclosure is divided into several compartments, each separated by gas-tight barriers. These compartments are interconnected by gas pipes and valves, facilitating gas flow and pressure control.

ADVANTAGES OF GIS SUBSTATION:

- These units are ideal for urban or industrial areas with limited space and high levels of pollution.
- Due to their compact structure, these devices can integrate seamlessly without compromising the aesthetics of the switchyard.
- GIS offers high reliability as it is protected from environmental damage (floods, rains, storms) and is less sensitive to earthquakes.
- This type of switchgear has various configurations that can be applied to different types of bus bars.
- There is no risk of oil leakage or explosion due to ignition.
- Installation is straightforward and modular.
- Units operate quietly.
- Lower operating costs.
- Some models use their metal casing to counteract external electromagnetic interference.

APPLICATION OF GIS SUBSTATION:

Due to their small, compact, and armored structure, GIS substations are the preferred choice for installations in areas with limited space and/or high levels of pollution, dust, chemicals, salt layers, and other factors that might cause flashovers in other types of substations.

Among its applications we have:

- Industrial townships
- Hydro stations
- Underground substations
- High polluted areas
- City building extensions.
- Offshore platforms

- Roofs
- Railways
- Power transmission
- As renewable power generation units toward the electric system
- Large towns with little space
- Valleys
- Mountain regions
- Industrial complexes
- High-voltage transmission systems

GAS INSULATED SWITCHGEAR vs. AIR INSULATED SWITCHGEAR

GIS offers multiple advantages over the conventional air-insulated switchgear (AIS), including:

- **Space saving:** GIS can reduce the footprint of a substation by up to 90% compared to AIS. This is because GIS can be installed in single or multi-story buildings, or even underground, whereas AIS requires a large accessible area for installation and maintenance.
- **Safety:** GIS can significantly enhance the safety of personnel and equipment by eliminating exposure to live parts and arc flash hazards. Additionally, GIS reduces the risk of fire, explosion, or environmental contamination, as it contains SF6 gas within a sealed enclosure that prevents leakage.
- **Reliability:** GIS can enhance the reliability of the power supply due to its fewer moving parts and joints, which are less prone to wear and failure. Additionally, GIS boasts a longer service life compared to AIS, as it is less affected by environmental factors such as humidity, dust, corrosion, and pollution.
- **Maintenance:** GIS can reduce maintenance costs and downtime, as it requires less frequent inspection and testing compared to AIS. Additionally, GIS is equipped with self-diagnostic features that can detect faults and alert operators before they become critical.

COMPARISON BETWEEN AIS & GIS SUBSTATION

Sr. no.	Description	AIS substation	GIS substation
1	Design standards:	IEC (IEC 62271-1, IEC 62271-100, IEC 62271-200, etc.)	
2	Bus bar insulation:	Air media	SF6 media
3	Switching:	Oil, Air, Vacuum or SF6	Vacuum or SF6
4	Execution type (switching):	Fixed or design-based	Fixed
5	Size:	Fairly larger (tens of square meters)	10-30% less than AIS
6	Sensitivity to external elements:	Moderate	Excellent
7	Maintenance requirements:	Moderate	Minimal
8	Cable necessities:	Variable	Specific
9	Monitoring of gas pressure:	Only for switching devices that include SF6 gas	Switching devices and bus bars

HOWEVER, GIS ALSO HAS SOME DISADVANTAGES COMPARED TO AIS, SUCH AS:

- **Cost:** GIS is more expensive than AIS in terms of initial investment and operation. This is because GIS requires more sophisticated technology and materials, as well as higher quality standards and testing procedures.

- **Complexity:** GIS is more complex than AIS in terms of design and installation due to the need for greater coordination and integration among various components and systems, including gas management, protection, control, and communication.
- **Availability:** GIS may have lower availability than AIS in certain situations, particularly when a fault occurs within a compartment that impacts multiple components. This is because GIS may necessitate more time and effort to isolate and repair the fault compared to AIS.

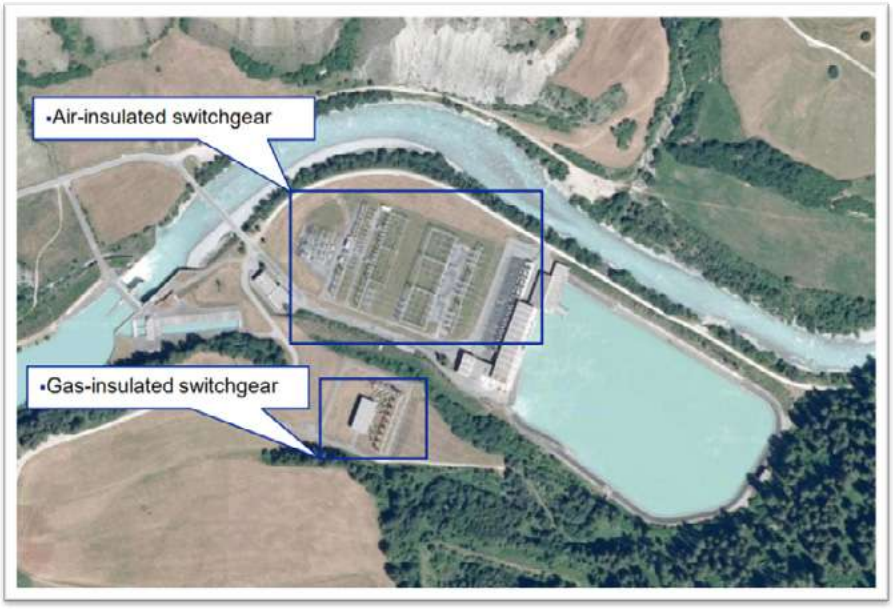
SOME GLIMPSE OF GIS SUBSTATION:

INDOOR TYPE GIS SUBSTATION:

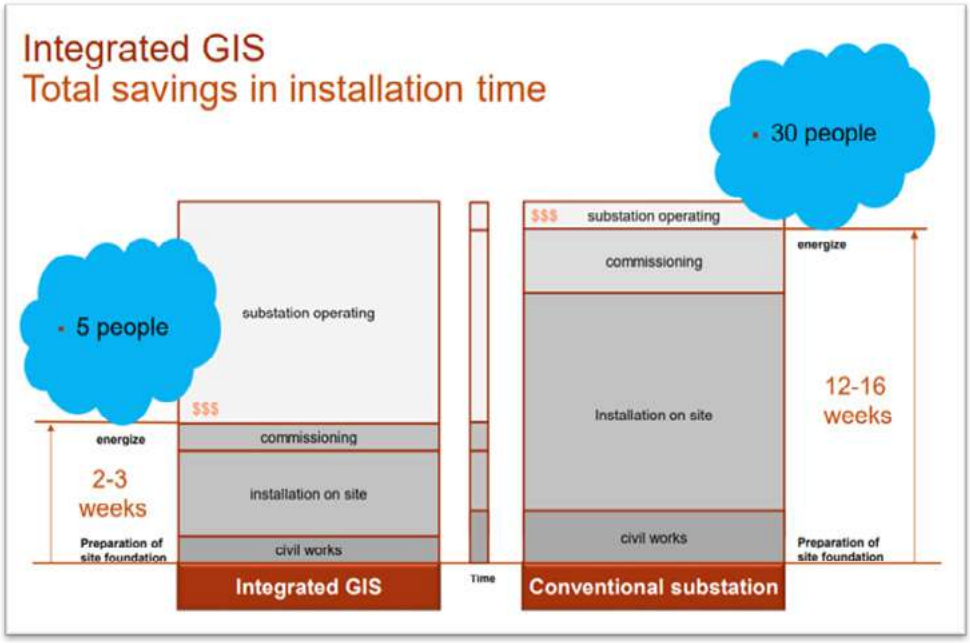
OUTDOOR TYPE GIS SUBSTATION :

HYBRID GIS SUBSTATION :

SPACE COMPARATIVE BETWEEN AIS & GIS SUBSTATION:



SPACE SAVING:



Contributed By

Rajan Rajeshbhai Rathod
Sr. Electrical Engineer (Chemical Depart.)
L&T Technology Services

Incident Investigation Report

420kV SF_6 Gas Circuit Breaker Interrupting Unit

FATAL ACCIDENT

Location: EHV SF6 GAS CIRCUIT BREAKER ASSEMBLY PLANT
Date of incidence: 11th December 2012 – 3.40pm (approx.)
Date of intimation: 12th December 2012
Date of investigation: 13th to 15th December 2012

DISCLAIMER:

This report is the product of investigation conducted by Mr. Subhash L. Bahulekar at XYZ works. The report is based on physical evidence at site, the interview with relevant stakeholders and the documentary evidence presented. The recommendations are based on the best practices in the industry, national and international standards and applicable rules and legislations of the country. We do not hold responsibility for the results arising out of the implementation of the recommendations.

1.0 EXECUTIVE SUMMARY

M/s. XYZ's 420kV SF_6 Gas Circuit Breaker's Interrupting Unit's porcelain housing ripped off at their works on 11th Dec. 2012. There was one fatal casualty due to a piece of porcelain hitting the deceased's head in the said incident. Accident Investigation of the said incident upon their request was taken on 13th Dec. 2012 and was concluded on 15th Dec. 2012.

The sequence of events that happened during the incident is discussed in detail in this document. Probable reason for blast and the extent of damage also is discussed. Some photographs of incident scenes are attached in the report.

Different measures that are to be taken to avoid recurrence of such incidents are given at the last section of this document. Other measures required to improve safety also is provided.

2.0 INTRODUCTION (Not produced here for secrecy reasons)

3.0 OBJECTIVES OF THE STUDY

- To carry out detailed investigation in order to find out the root cause of the incident.
- To suggest remedial measures to avoid recurrence of such incidents in future.

4.0 PEOPLE INTERVIEWED (Not produced here for secrecy reasons)

5.0 FACILITY DESCRIPTION

M/s. XYZ manufactures Extra High Voltage (EHV), GIS, Outdoor Type, Circuit Breakers. These CBs come with PIR – Pre-Insertion Resistor and/or GC – Grading capacitor as option; depending upon the customer and site requirement.

Most of the parts of the investigated 420kV CBs are outsourced. The major part of the CB is the Porcelain insulator (bushing with Aluminium flanges on either side) which is outsourced from MIL, Ahmedabad. The insulator has been jointly developed by XYZ since 1985. No failures have been reported in the last 20-25 years, although there were few cases initially like sagging, etc.

Other parts from various vendors include Housing (Control mechanism enclosure), Air-tank, cylinder & nozzle support, holding latch, coils, piston rod, spacer, joint cage, piston, joint casting, O ring, nozzle, upper rod end, upper tank, puffer cylinder, control valve body, etc.

Prior to the assembly of the CB, the porcelain insulator is subjected to Hydraulic pressure test since it is eventually filled with SF_6 gas at 7.2kg/cm^2 (for 400kV). Other parts are verified for their respective vendor reports/certificates. After the assembly, the internal tests are carried out prior to FAT with customer.

6.0 THE INCIDENT

M/s. ABC has regular orders with XYZ for various projects. One such order was for 420kV, SF_6 Outdoor type Circuit Breaker. This is also called as "Ravan" by the shop-floor staff.

As part of final inspection, prior to dispatch, ABC's inspector attended factory inspection, and testing on 10th & 11th December 2012. During the testing, XYZ personnel were present on the shop floor to help carry out the required tests. The testing in-charge person was monitoring the tests from the control room upstairs.

Breakers under testing were located on test-pad for R, Y, & B phases. Accident happened on R-phase CB.

Routine tests such as ON/OFF switching with rated control voltage, timings, contact resistance test, Physical verification, BOM verification, etc. were carried out on 10th Dec. 2012.

XYZ personnel started the HV tests (630kV) on 11th Dec. 2012 at 3.00pm and found some abnormality (flashover with abnormal sound but couldn't see where). The test was abandoned when second time too the results were negative (meter stopped at 400kV & suddenly jumped to 800kV) forcing the team to stop manually. The time limit for such tests was also over! In order to investigate the reasons for the flashover, the team stepped down. It was found that the neighbouring 145kV CB was without gas & that the HV testing (bare) conductor was very close to this CB. Production team was accordingly advised to fill gas (was not filled later too). (This carelessness must be avoided in the future).

Later, the shop staff (as mentioned above) proceeded to carry out gas leakage test which was successful. The next step of testing the CB switching (for verification of control wiring) proved fatal as the left-side porcelain housing of the interrupting unit gave way with a blast. A large and pointed piece of the porcelain hit XYZ personnel who got fatally injured in head and fell down on drainage cover where pool of blood can be seen. His spectacles, blood mark on porcelain, tools, etc. could be seen at the spot of the incident.

The other 4 staff (as mentioned above) too got injured with minor cuts, internal injury, etc. Most of the people around ran off being scared by the blast. Later they came forward to lift the injured people.

7.0 EXTENT OF DAMAGE - SITE OBSERVATIONS

All of the personnel injured were moved out in 5 minutes through ambulance to a hospital where the XYZ personnel was pronounced dead.

At the factory, the whole area of testing was found with splinters shattered across. Few CB poles around were also found to be damaged with these splinters.

Neighbouring area's glass partition was also shattered with a piece of the porcelain flying through. One of the high-bay lighting fitting was damaged. The roof of the factory was also found to be broken at 2 places where the splinters might have ripped through.

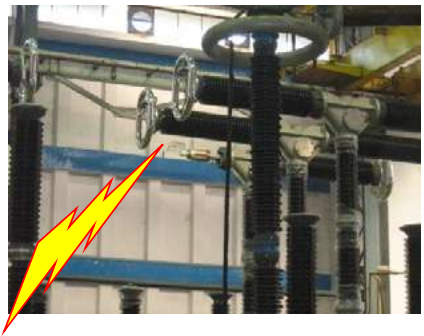
The gas leakage detection machine was also damaged.

Further damage analysis could not be done since the area was cordoned off with prevention for checking of operation of the equipment around till the factory inspector gives clearance.

Some photographs showing the affected area are as below.

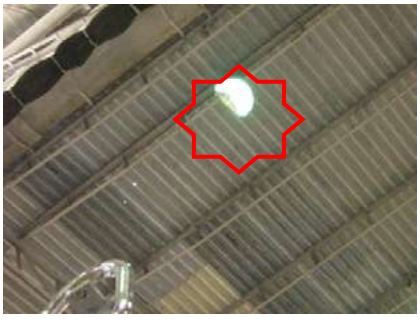
Management reported to have faced extensive wrath of workers (approx. 250). The news was spread in local newspapers, & TV channels. Later, PCB (Pollution Control Board) too came to know and had reached factory for investigation. Management had earlier informed to the factory inspector and had lodged police complaint as well.

Pictures showing extent of damage: Circuit Breaker – Interrupter Porcelain



Pictures showing extent of damage: Blood marks of the deceased

Pictures showing extent of damage: spread of splinters, glass wall ripped through, High-bay fitting damaged



8.0 EXTENT OF INVESTIGATION

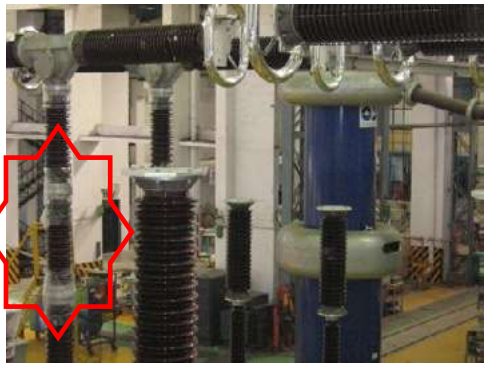
The investigator probed the site, the product, operating procedures, testing procedures, and interviewed several personnel in-charge, managers and workers of various areas.

Product

A fully assembled 420kV SF_6 CB comprises of the bottom panel assembly also called as housing contains all the mechanism to operate the CB. On top of this housing sits support assembly in 3 sections. On top of this, there is horizontal assembly of interrupting unit (tank connected by 2 porcelain housings on either side) where the main switching occurs. The arc quenching and insulation is achieved with the use of pressurised SF_6 gas (7.2kg/cm^2). Incoming & outgoing terminals are on either side of the interrupting unit.

The assembly of these various parts is carried out in the same section where the FAT is also performed. This needs to be improved upon.

The gas leakage test is done by using polythene bags covered over the joints of the vertical support assembly. Unfortunately, the upper horizontal interrupting unit gas leakage can be tested only after dismantling due to space/operational constraints.



The major part of the CB is the porcelain. The investigator probed the various stages, starting from the arrival of the material at the store, hydraulic (water) tests, assembly with various parts, etc. Porcelain testing was understood in more details since that forms an important thread in the investigation.

The photograph shows the various stages of storage, transport, testing, and assembly.

Porcelain moved out from open storage yard

Unpacking of porcelain from wooden crate

Porcelain ready for Hydraulic test

Hydraulic testing facility

Hydraulic test procedure chart

Gasket crack detection procedure

Interrupter fixed & moving parts assembly

Interrupter tank

Assembly of closing/tripping mechanism

Porcelain assembly shop

Assembly of various other parts was also carefully observed & understood. Design aspect was understood by reviewing various drawings and manuals such as:- a) Catalogue of SF_6 Gas CB & disconnectors, b) Instructions, Installation & Maintenance manual, c) GA – Interrupter insulator, Pole unit assembly, CB assembly, etc., d) Specification of porcelain insulator, e) BOM.

Test reports were verified such as a) Fault & Rework record for GCB (format S3/FT-02), Routine test reports as per IEC 62271-100, IEC 60694 & S3-PIS-1., b) vendor test certificates for various parts such as Porcelain insulator, cylinder & nozzle support, holding latch, coils, piston rod, spacer, joint cage, piston, joint casting, O ring, nozzle, upper rod end, upper tank, puffer cylinder, control valve body, etc. These were found to be in order.

HV Test room was also viewed where the meters were found calibrated by ERDA appropriately.

The internal tests were carried out on 8th Dec. 2012.

It was identified that the testing is generally carried out between 2 shifts to avoid managing too many people on the shop-floor. The time between 2 shifts e.g. 3.00 to 3.30pm has less nos. of people.

Photographs taken by various staff after the incident were viewed.

Interviews of various personnel were taken (see list under clause 4.0).

9.0 PROBABLE CAUSES OF ACCIDENT

The probable cause of the accident could not be established clearly. However, some of the reasons that could have lead to the accident are enlisted here below:-

- Failure of HV tests (twice)
- Deterioration of the insulating properties of SF_6 after HV test.
- Over injection of HV (almost 800kV) due to improper indication at the testing room and break-down in the SF_6 gas.
- Over-straining of Porcelain insulator probably due to excess voltage and reduction of insulating property of SF_6.
- Unchecked cracks in the porcelain, probably due to testing at time by casual labour who did not attend fully.

10.0 MEASURES TO PREVENT RECURRENCE

- ENSURE REGULAR ACCURATE TESTING & INSPECTION

Majority of the people interviewed (esp. the shop floor workers & engineers) showed concern for the casual way the porcelain is tested. The testing, esp. at night times (the porcelain of the accident was also tested for hydraulic pressure at night) is carried out by casual labourer without the attention of any supervisor. During day-time too, the supervisor is reportedly not to be seen. This makes it very easy for the workers to try short-cuts and avoid 100% & stringent checks. Apparently in earlier days, slight sag or any inferior quality in the insulator during test was rejected; which is not the case nowadays (in last 1.5 years). The competence of the store manager (also acts as supervisor) needs to be verified for such activities. Optionally, the testing responsibility can be put under QA dept.

Some even pointed out procurement of inferior materials (e.g. from China, etc.). This, however, could not be verified or established.

Porcelain insulators must be now subjected to more stringent tests with diligence. Pressure tests to be increased (pressure & duration). Sample checking of Porcelain with SF_6 gas itself can be done after the hydraulic tests (Design or R&D departments to comment on this).

Similarly, other components too must be subject to tests before put up for assembly. QA dept. to look into the same.

- ABANDON TESTS IF ABNORMAL SITUATION ARISE

Tests must be abandoned if the testing personnel observe any abnormal situation, results, sound, visuals, etc. Failure of HV test twice in the said incident was supposed to be taken seriously. The SF_6 gas inside the porcelain which burst, should have been checked for its deterioration prior to proceeding for next tests. Meggar tests before and after HV tests shall be conducted for identifying rupturing of insulation.

QAP to be reviewed internally and criteria for continuation of next test must be mentioned.

- IMPLEMENTATION OF PPE 100%

PPE must be made mandatory for each one entering the area under test or assembly. Safety manager must ensure that enough encouragement, disciplinary action, incentives, etc. shall be provided. All the injured people (except 1) were not wearing Helmets during the incident. One was not even wearing safety shoes (& hence got hurt in foot)! Managers assigning jobs to the workers must be made responsible for ensuring their PPE.

Helmet shall be tested & certified for all types of accidents in the factory. Impact intensity due to gas pressure, weight of the porcelain, sharpness, etc. shall be taken into consideration.

- BARRICADE AREA & PROVIDE DAMAGE CONTAINING MEASURES

Any equipment under test which pose potential hazard must be cordoned off during tests. E.g. Porcelain can be provided with some net to contain the splintering. HV equipment can be cordoned to avoid any accidental touch. In the said incident, gas was removed from the CB of Y & B phases only. However, the neighbouring CBs which might have been damaged directly or indirectly also should have been analysed and gas evacuation, etc. must be carried out.

- REGULAR MAINTENANCE OF TESTING SYSTEM

Regular calibration of the testing equipment may not be sufficient. The entire circuitry, gas filling hose, earthing, etc. shall be maintained regularly to ensure there is not interfacing problems between job under test and the measuring equipment.

11.0 OTHER SAFETY MEASURES REQUIRED AT SITE

- EMERGENCY EXISTS AND UNOBSTRUCTED ACCESS TO SAME

There must be provision of emergency exit doors at appropriate locations which shall be visible either directly or through EXIT signage. During the incident, most of the assembly staff working there (almost 25 of them) found it difficult to run off fast, immediately and far off due to obstruction of the various jobs under progress with their doors open. Surprisingly, the investigator found that assembly was carried out even in passage way! Gas Pipe laid on floor forms certain obstruction too for escape.

It was also found that the Testing room upstairs too do not have emergency exit. The 400kV CB should not be tested very close to this room either!

Pictures showing congested assembly / testing area / obstruction in escape route, etc.

- FIRE FIGHTING

Presently Fire extinguishers are used. Fire Hydrant work is in progress (completion expected by March 2013). This needs to be expedited for taking care of any unforeseen accident.

- REMOTE TESTING

Testing area must be isolated from any other operation; whether assembly, storage, packing, etc.

All tests shall be carried out from remote as much as possible. The procedures and test jig must be modified accordingly.

Apparently, this was practiced in the past. Such practices were abandoned for speeding up the work, and also to avoid obstruction of various cables laid on the shop-floor.

- SHIFTING OF HAZARDOUS MATERIAL TO SAFE LOCATION

Care can be taken on regular basis to avoid keeping of any hazardous, pointed, sharp material on ground or on the path of escape.

- REPORTING PROCEDURE AND RESPONSIBILITY CHARTS

As soon as any incidence occurs, there should be an authority person to take charge of the accident area. Nobody can move in or out of that area without the permission of that person. Neither should any material be moved without his permission.

It was of utmost importance that the nearby CB affected directly or indirectly be made safe by removing the gas from it.

- AVOID TOO MANY HUMAN INTERVENTION

Most of the shifting, assembly, testing, packaging, storage, dispatch can be organised with less manpower and more automated logistics tools & tackles such as continuous hoists, remote testing, etc. It was found that to move an assembled porcelain unit, 2-3 hoists need to be changed & thus manual intervention is inevitable. This can also damage the job.

- THOROUGH INVESTIGATION EVEN AFTER MINOR ACCIDENT

Many employees cited examples of the past and how the management did not implement the suggested improvements. There was an accident of porcelain blasting a couple of times in the past (recent one, 6 months ago), although no fatal injuries. But there were no major improvements adopted except for cordoning off of the area with access detection. The improvement in earthing system claimed needs to be assessed.

- SAFETY DRILLS

Workers reported that there is no training nor mock drills for preparedness of such incidence. This was verified with Safety manager who denied such allegations. (Details on such training records need to be ascertained).

- NEW SYSTEM / TECHNOLOGY

HR & Safety department must be intimated by the management of any new machine, technology, system or methodology implemented in the factory. In turn, Safety department must formulate all safety norms to be followed. HR shall assist Safety dept. for its effective implementation. They can also suggest management any opinion for better human safety.

- LESSONS LEARNT

Implementing improvements from the lessons learnt from the past must be effective and without any delay.

There was also an incident 3 months ago (approx.) where voltage was reaching CB during HV test but was not getting indicated on the meter. Hence, again it was important to get the whole system checked and maintained regularly.

Turn-table arrangement for HV test

Net/cage provided for HV test room

Similarly, there was a good suggestion to keep HV test separately on a turn-table which can be lifted after the test and assembled for operation test. However, this too is yet to be implemented. There are limit switches provided at the entrance of each cordoned off area to trip testing if there is tress-passing. Alarm lights are provided with siren having 2 tunes – 1 for preparation & 2nd during actual operation). Similarly, steel mesh was added on the windows. (This is appreciable).

- DESIGN IMPROVEMENT

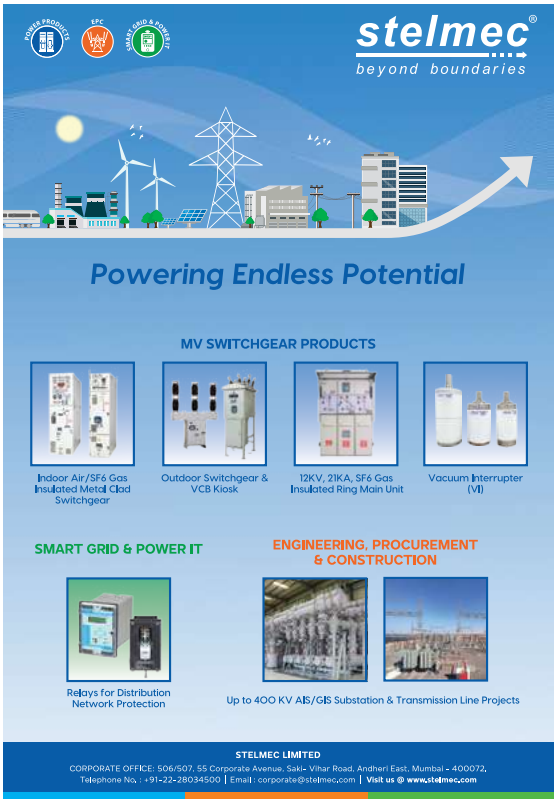
Design shatter-proof porcelain insulators (similar to the windshield in car) as suggested by the design head. Also suggested by him was to provide fail-safe testing to ensure the HV test can't start without filling of neighbouring CB with gas. Possibility of providing FRP tube cover is also looked into.

- CLIENT FEEDBACK

Site installation & post-installation health/mishaps can be reported on regular basis to form a statistics of all installation, failure incidences, reasons, action taken, etc.

- OCCUPATIONAL SAFETY AND HEALTH AUDIT

An extensive session with safety manager revealed some of the improvements that can be implemented in view of Health & Safety requirements at work place. This can be put in place by engaging an auditor for regulating and implementing HSE.



Additional Safety Requirements for Gas Insulated Substation as per CEA Safety Regulations 2023

Additional safety requirements for gas insulated substation – In addition to the Regulations mandated under the various regulations, following regulations shall also be applicable to gas insulated substation (GIS):

A. General safety requirements. –

(1) A separate emergency source of illumination with automatic initiation shall be provided in every room or compartment of gas insulated substation.

(2) Cable cover protection unit shall be provided between flanges of gas insulated substation and cable termination unit.

(3) Gas insulated substation installation of 220 kV and above voltage shall be provided with Partial discharge monitoring system.

(4) SF6 gas leakage rate from any single compartment of gas insulated substation to atmosphere and between compartments shall not exceed as stipulated in the relevant standards.

B. Earthing requirements. –

(1) Enclosure of gas insulated substation bay shall be earthed for high Frequency transient voltage as per original equipment manufacturer recommendations, apart from the regular earthing.

(2) Earthing of gas insulated substation installation shall be as per relevant standards.

(3) Travelling wave energy generated inside the gas insulated substation due to switching operations shall be diverted to the earth by providing effective earthing from bushing shroud to the earth.

Contributed by

Ulhas Vajre

PRABHA
ENTERPRISES

DIGITAL MARKETING
IT & SOFTWARE
CONTENT CREATION

grow your Digital Presence with us!!

Software Development
Business Process Automation / Re-engineering
Windows Application Development
Microsoft Technology Asp.Net, Win Forms, MS Access.
Website design & development
Android App development
Digital media marketing

People Networking
Marketing
Business Development
Team Building and management

Graphic designing
Brand designing
Visual and spatial consultancy
Print media content creation
Digital content creation
Photography and Videography Services

Contact Us:
+91 9765150066
prabhaenterprises09@gmail.com

www.prabhaenterprises.com

WINNERS OF QUIZ
APRIL 2025

JIDNESH ASHOK GANGURDE

RADHIKA VAZE

MAHESH GHARAT

DINESH REDEKAR

Congratulations

QUIZ JUNE 2025

1. Minimum bending radius for LV armoured cable inside a tray:
   A. 8-12 x cable diameter
   B. 100mm
   C. 750mm
   D. 3-5 x cable diameter

2. Structured cabling is a standardized approach to designing and building:
   A. Under-ground power lines
   B. Telecommunications infrastructure
   C. Wireless technology
   D. iMCC Marshalling cabinet

3. Which electrical products brand recently changed its name to LK (Lauritz Knudsen)?
   A. Schneider Electrical
   B. Panasonic Automation
   C. L&T Electrical & Automation
   D. Anchor Electrics

4. Electrical faults include:
   A. Short Circuits
   B. Earth faults
   C. Inter-turn faults
   D. All of the above

5. Electrical abnormal conditions include:
   A. Over excitation
   B. Out of step operation
   C. Over load, over-voltage
   D. All of the above

6. Luminous flux:
   A. Lumen (lm)
   B. Candela (Cd)
   C. Lux (lx)
   D. All of the above

7. The national Building Code of India, NPC, was published in __ and revised in ___:
   A. 1970 & 2004
   B. 1970 & 2016
   C. 1947 & 2005
   D. 1947 & 1983

8. Types of Transmission Lines
   A. Short, Medium, Long
   B. Efficient, inefficient and dormant
   C. Steel, Copper, Aluminum
   D. All of the above

9. Typically, Zone 0, Zone 1, & Zone 2 are:
   A. Electrical relay protection categories
   B. Illumination isolux areas
   C. Hazardous Area Classification in an explosive environment
   D. None of the above

10. Core saturation causes
    A. Drastic reduction in magnetizing impedance
    B. Heavy inrush current
    C. Both A & B
    D. Drastic reduction in magnetizing current

Rules for the QUIZ:

- The Quiz will be open for 10 days from the date of EMAIL.
- Each correct answer received on DAY 1 will get 100 points
- Next days the points will reduce as 90 – 80 – 70 and on 10th day points will be ZERO even if the
- answer is correct.
- All participants will receive E certificate signed by CEEAMA President with the points earned
- mentioned on the same.

Please use following google form link to participate in the QUIZ.

https://forms.gle/T6JYqz2QzW5cu5JF7

"Thank you all for the overwhelming response to the E-NEWS in general and E-Quiz in particular. MCQ based quiz is always tricky and surprisingly can take us aback when we realise our conceptions (misconceptions) about the subject / system / product.

The aim of the feature was to create inquisitiveness in your mind and help you check your technical quotient

quickly. The response will also help us to present articles and webinars on subjects which are important, but which

lack enough awareness / knowledge in general.

It can open a pandora box for our discussions and arguments and probable solutions. Engineering evolves with conception. It gets fuelled with community discussions and capitalist actions. All stakeholders start realising the need to take a closer look and help improve standards as we have seen in the past century. Surely it makes the world a better place.

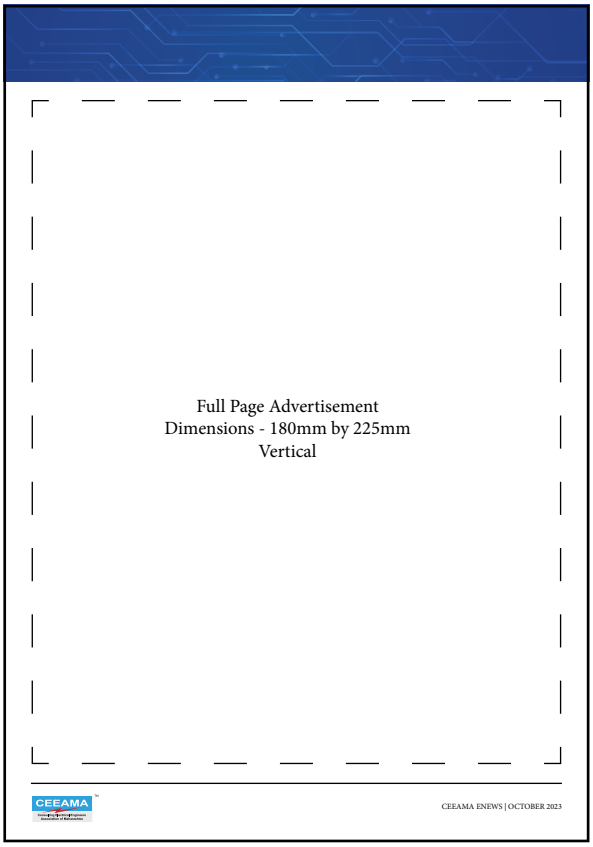
Wish you all a better luck this time.

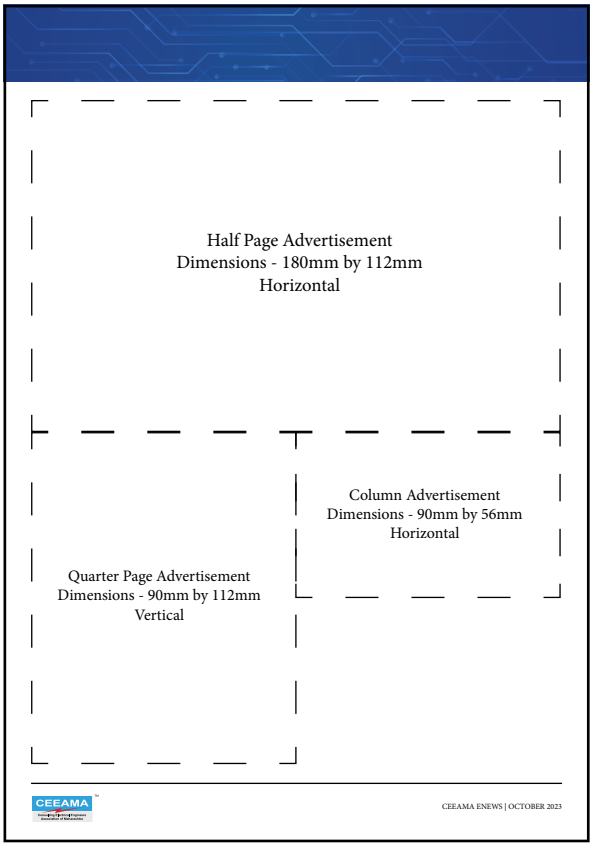
Do spread the word.

May 2025 Quiz Answers

1. A. Indian Green Building Council
2. C. Heat Capacity
3. D. All of the above
4. B. Carbon dioxide
5. D. All of the above
6. C. Temperature
7. B. Stator resistance
8. A. L.F. x D.F.
9. D. None of the above
10. A. 40 lm/m2

ADVERTISEMENT RATES





Above given layouts are only for understanding the advertisement sizes. Actual positions of ads may vary as per space available in the issues.
Below given rates are for advertisement size and number of issues published monthly.

E-Newsletter Ad	3 months	6 months	9 months	12 months
Full Page Ad	INR 1000/-	INR 2000/-	INR 2700/-	INR 3300/-
Half Page Ad	INR 800/-	INR 1600/-	INR 2200/-	INR 2800/-
Quarter Page Ad	INR 600/-	INR 1200/-	INR 1600/-	INR 2100/-
Column Ad	INR 400/-	INR 800/-	INR 1000/-	INR 1400/-
Website Ad	INR 1000/-	INR 2000/-	INR 2700/-	INR 3300/-

GST @18% will be additional on all the above rates.

Please send the E-Newsletter Advertisement in PDF or JPG format ONLY.
Please send the Website Advertisement in JPG or PNG format ONLY.

CEEAMA™

Consulting Electrical Engineers Association of Maharashtra

CEEAMA *LiveWire*

E-NEWSLETTER

Published by Consulting Electrical Engineers Association of Maharashtra

Electrical Consultants Newsletter
Volume No. 4 Issue #51
JUNE 2025

A-103. Sanpada Railway Station Building, 1st floorSanpada East, Navi Mumbai – 400705
Email: admin@ceeama.org