Gas Insulated Substation

Courtesy: ABB, newABB.com

Courtesy: GE gegridsolutions

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Gas insulated substation-GIS

- What is it?

A gas insulated substation (GIS) is a HIGH VOLTAGE SUBSTATION in which the major structures are contained in a sealed environment with sulfur hexafluoride gas as the insulating medium.

OR

Gas-insulated high-voltage switchgear (GIS) is a compact metal encapsulated switchgear consisting of high-voltage components such as circuit-breakers and disconnectors, which can be safely operated in confined spaces.

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SF6 properties

- Heavy, chemically inert, non toxic
- No poisonous effect on the human body but decomposition products are poisonous.
- Color less and odor less
- It is gaseous at normal room temperature and pressure
- Density is about 6.6g/l at 20oC (5 times denser than air)
- Critical temperature is at 45.6oC and can be liquefied by compression
- Very good insulant with high dielectric strength
- SF6 gas is electronegative (tends to attract the free electrons and has the arc quenching property). Because of this main reason SF6 gas is used for arc quenching and insulation medium in circuit breakers.
- Decomposition occurs on the exposure to the electric arc. (Disassociation products will be SF2 and SF4 lower order fluorides)

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Applications of GIS-72.5 - 1200 kV

- Power transmission
- Integration of renewable power generation units to the grid
- Railways

The places where GISs are preferred:

1. Large towns where space available is limited
2. Industrial complexes where uninterruption of power is necessarily
3. Mountain regions and valleys
4. Underground substations
5. Off-shore (On sea or lake) substations
6. HVDC transmission system terminal substations

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GIS: Advantages

- It occupies very less space (1/10th) compared to ordinary substations. Hence these Gas Insulated Substations (GIS) are most preferred where area for substation is small (e.g. Cities).
- Most reliable compared to Air Insulated Substations as the number of outages are less
- Maintenance free
- Very flexible switchgear designs and problem-free extension
- Economic efficiency
- High reliability
- Long service life
- Low life cycle and maintenance costs
- Safe operation even under extreme environmental conditions

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GIS: Disadvantages

- Cost is higher compared to Ordinary Conventional Substations
- Care should be taken that no dust particles enter into the live compartments which results in flash overs
- When fault occurs internally, diagnosis of the fault and rectifying this takes very long time (outage time is high)
- SF6 gas pressure must be monitored in each compartment, reduction in the pressure of the SF6 gas in any module results in flash overs and faults

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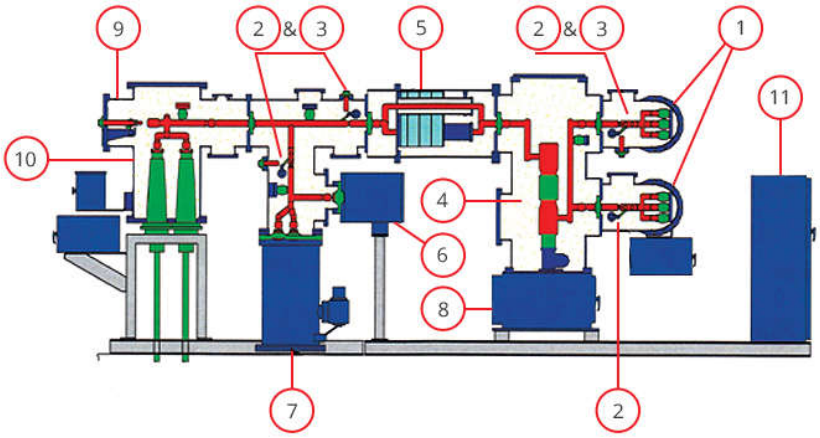
Components of GIS



1 Main Bus
2 Disconnector
3 Earthing Switch
4 Circuit Breaker
5 Current Transformer
6 Voltage Transformer
7 Lightning Arrestor
8 Operating Cubicle
9 Fault Making ES
10 Cable Head Box
11 Local Control Panel

Courtesy: Kanohar, Taiwan

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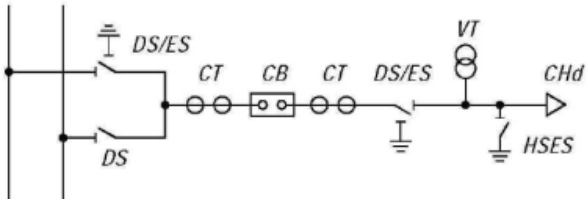

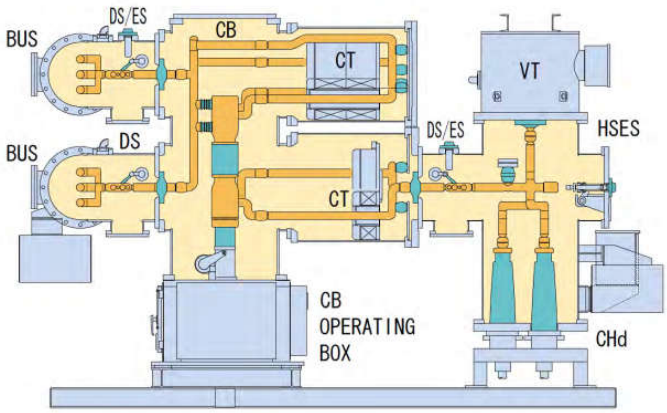

Courtesy: Hitachi, 72 kV, GIS

CB : CIRCUIT BREAKER
DS : DISCONNECTING SWITCH
ES : EARTHING SWITCH
HSES : HIGH SPEED EARTHING SWITCH

CT : CURRENT TRANSFORMER
VT : VOLTAGE TRANSFORMER
CHd : CABLE SEALING END
BUS : BUS BAR

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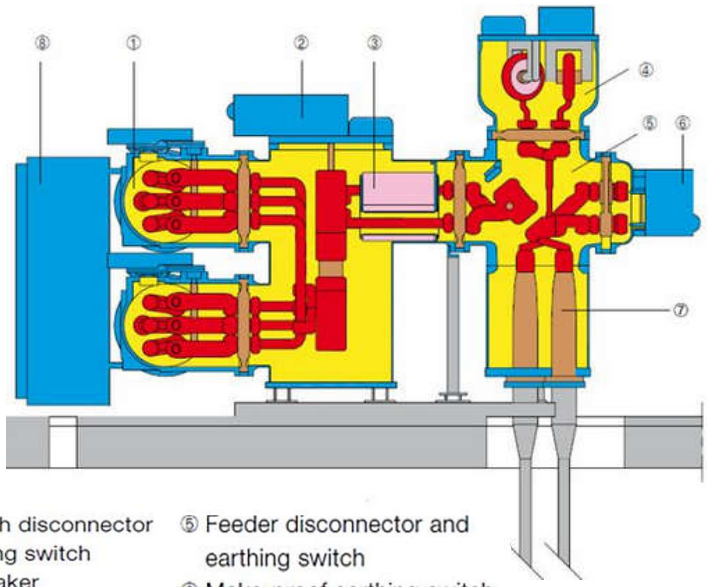
Courtesy: ABB, GIS,
ELK-04, 145 kV, 3150 A, 40 kA



- Active parts under high voltage
- Enclosure
- SF_6-Gas
- Insulation material
- Mechanical parts, structures
- Low voltage parts

① Busbar with disconnector and earthing switch
② Circuit breaker
③ Current transformer
④ Voltage transformer
⑤ Feeder disconnector and earthing switch
⑥ Make-proof earthing switch
⑦ Cable end unit
⑧ Local control cabinet

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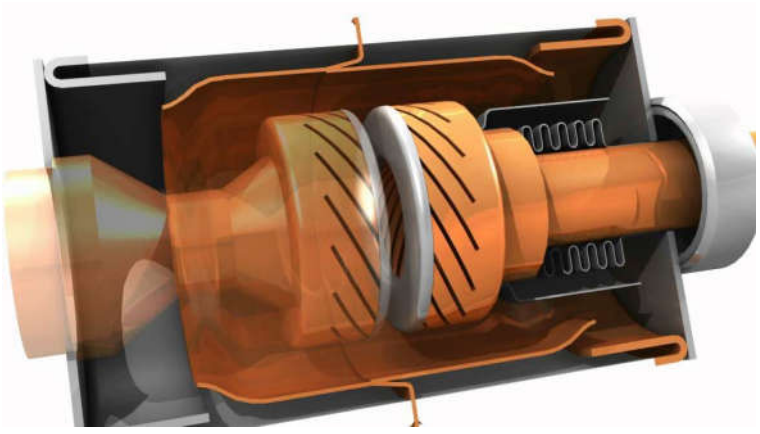
Circuit breaker contacts: GIS



Courtesy: Siemens, GIS technology

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Auxiliary equipment: GIS

- HVAC
  - Heating
  - Ventilation & over-pressure
  - Air-conditioning
- LV distribution board
- UPS
- Small power and lighting
- Fire fighting equipment (fixed or portable)
- Fire detectors
- Pressure relief system





Courtesy: ABB Group

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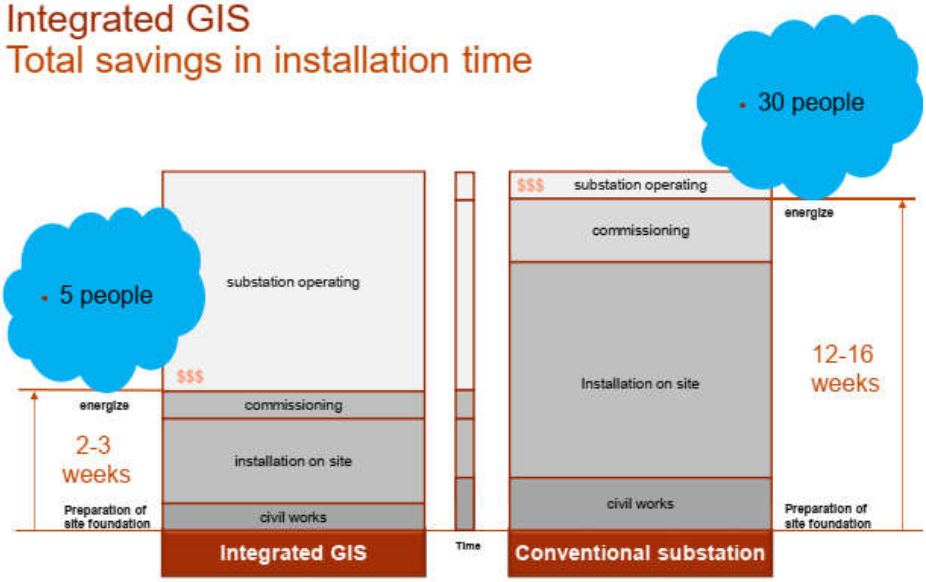
Installation Comparison

Integrated GIS
Total savings in installation time



Courtesy: ABB Group

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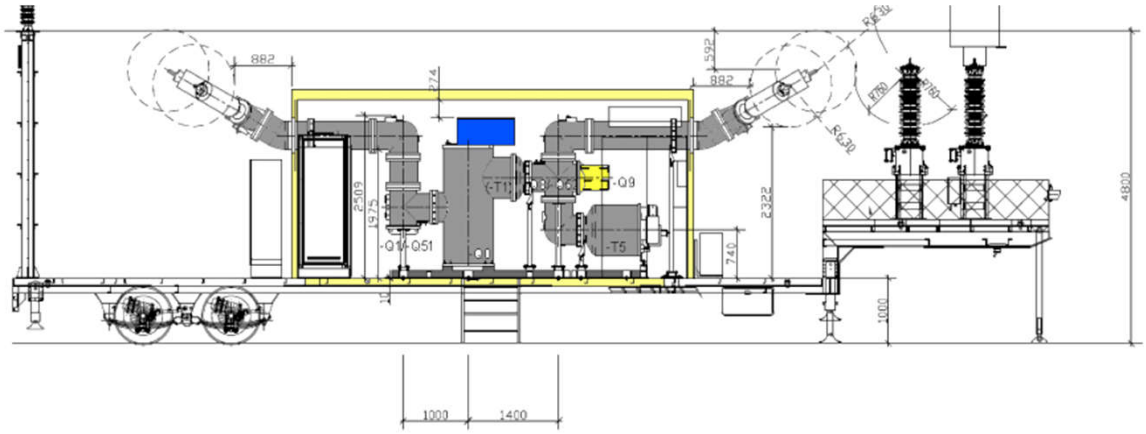
Mobile GIS



Courtesy: Cabines Mobiles, 72.5kV, Sonelgaz, Algeria, ABB Group, October 14, 2016

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