NETAJI SUBHAS UNIVERSITY OF TECHNOLOGY

Department of ELECTRICAL ENGINEERING.

INDUSTRIAL TRAINING REPORT

# AN OVERVIEW OF THE COMBINED CYCLE GAS POWER PLANT

(NTPC FARIDABAD)

***Submitted by:***

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**To**

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# ABOUT THE COMPANY

## Corporate Vision:

"To be the world's leading power company, energizing India's growth."

Its core values include **Integrity, Innovation, Excellence, Customer Focus, and Sustainability**, which form the foundation of its operations and long-term strategic goals.

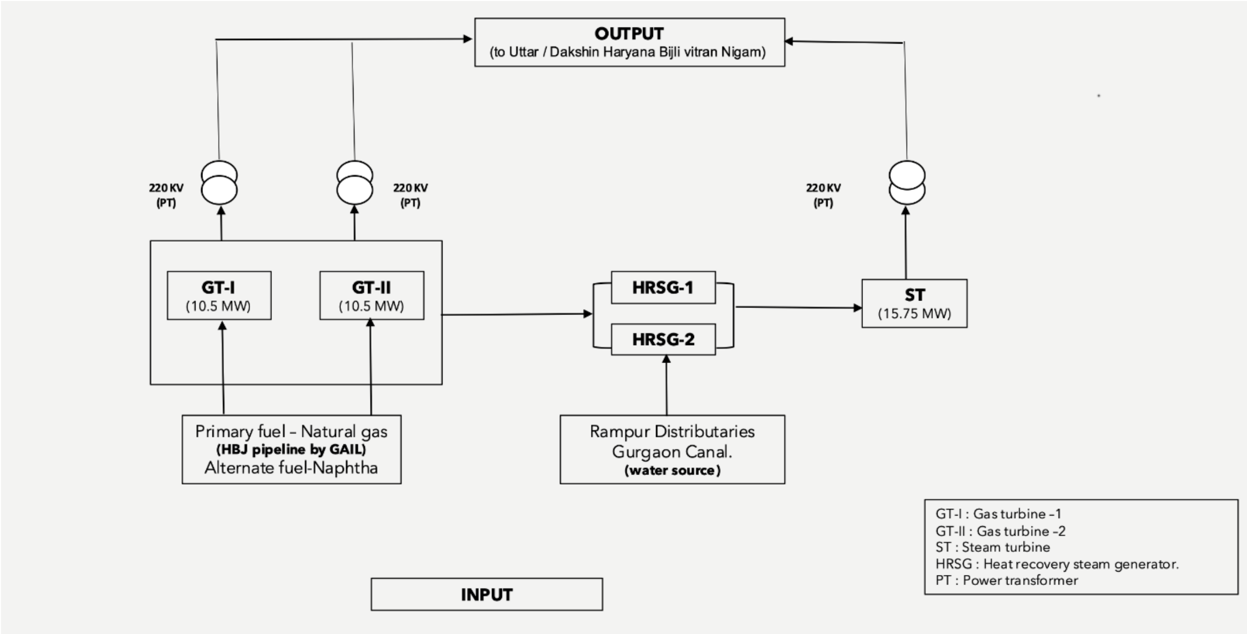
NTPC Limited, incorporated in 1975 as a wholly owned enterprise of the Government of India, is India's largest thermal power generating company. The Government currently holds approximately **51.10%** of its equity, with the remaining shares held by foreign institutional investors, mutual funds, insurance companies, domestic banks, and the public. Within a span of 31 years, NTPC has emerged as a truly national power company, with power generating facilities in all the major regions of the country. NTPC's core business is the engineering, construction, and operation of power generating plants. It also provides consultancy in the areas of project management, engineering, and power plant operations.

As of June 2025, NTPC's total installed capacity stands at approximately 81,368 MW, including joint ventures and subsidiaries. In FY 2024–25, it added 3,972 MW of new capacity. The company achieved a record generation of 400 billion units by March 1, 2025-12 days (about 1 week 10 days) ahead of the previous year.

# INTRODUCTION TO NTPC FARIDABAD


The **NTPC Faridabad** Gas Power Plant was approved on 25th July 1997 and completed in September 1999, with a total project cost of ₹1163 crore. Located near Mujedi and Neemka villages in Faridabad, Haryana, the plant became fully operational in 2000 with an installed capacity of 432 MW. It is a Combined Cycle Gas Power Plant (CCGPP) comprising two gas turbines of 138 MW each and one steam turbine of 156 MW. The primary fuel used is natural gas, with naphtha and high-speed diesel (HSD) as alternate fuels in case of shortage. The electricity generated is exclusively supplied to the state of Haryana under a state agreement.

The plant operates on base load but can also handle peak and load-following demands. Natural gas is supplied through GAIL's HBJ pipeline, with an average requirement of 2 million cubic meters per day. HSD is provided by Indian Oil Corporation (IOCL) during emergencies, and water is sourced from the Agra Canal. The gas turbines are supplied by SIEMENS, using the V94.2 model. The combined cycle operation increases efficiency by utilizing the exhaust heat from gas turbines to produce steam, which powers the steam turbine, thus enhancing overall performance.

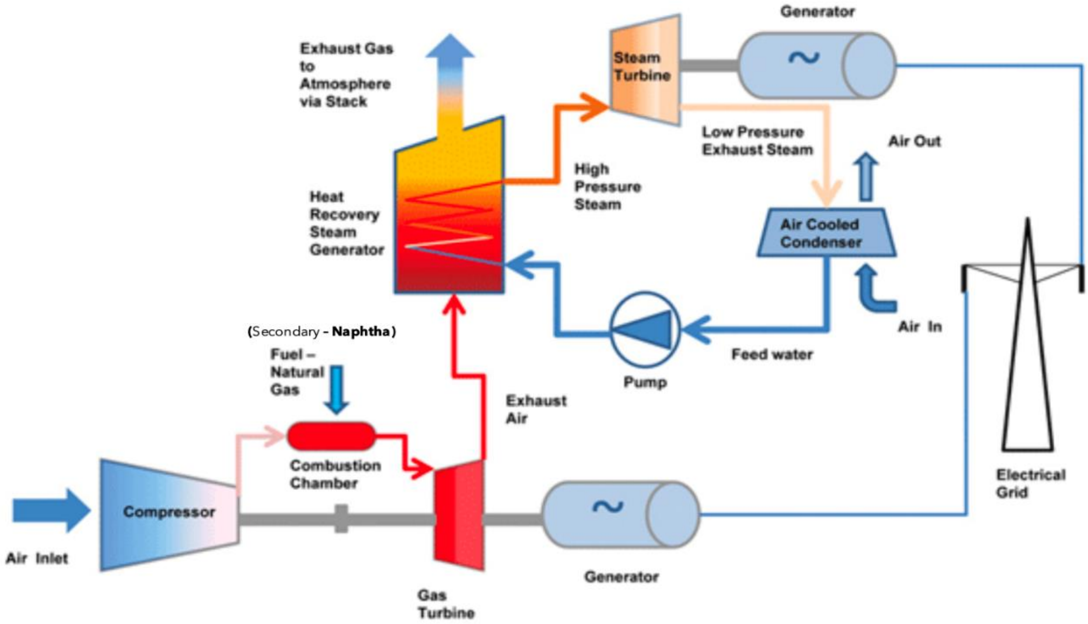



**(PLANT LAYOUT)**

# Features:

| | |
|---|---|
| 1. Project | Faridabad Gas Power Project |
| 2. Plant Configuration (432MW Capacity) | Gas turbine I – 138 MW<br>Gas turbine II – 138 MW<br>Steam turbine – 156 MW |
| 3. Fuel | Natural gas |
| 4. Alternate Fuel | Naphtha / HSD |
| 5. Fuel source | HBJ pipeline (through GAIL) |
| 6. Naphtha storage | 2 tanks of 8000Kl capacity each |
| 7. Water source | Rampur Distributary source |
| 8. Power Evacuation | 2*220 KV Double circuit lines each to 220KV sub-station at Samaypur(Ballabgarh) and HVPN sub-station at Palla (Faridabad). |

# WORKING OF COMBINED CYCLE GAS POWER PLANT.

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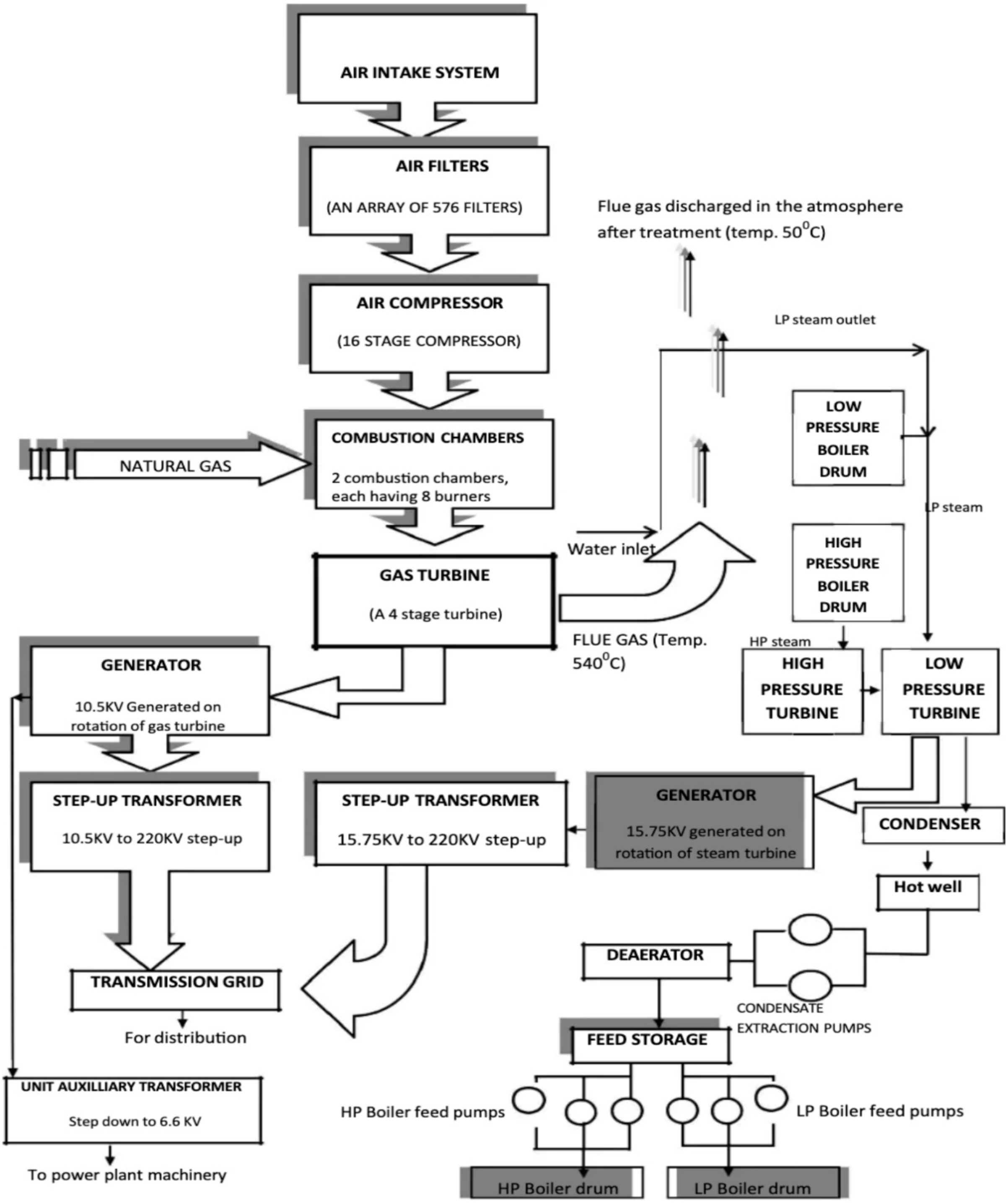
It operates on both the Brayton cycle (gas turbine cycle) and the Rankine cycle (steam turbine cycle) to improve overall efficiency.

In a **combined cycle power plant**, fuel is burned in gas turbines to generate high-pressure, high-temperature flue gases that rotate turbine shafts connected to generators, producing electricity. The hot flue gases then pass through a Waste Heat Recovery Steam Generator (WHRSG), where their heat is used to produce both high-pressure and low-pressure steam. This steam is supplied to high-pressure and low-pressure steam turbines, which are also connected to generators. The rotation of these turbines leads to further electricity generation. The use of both gas and steam cycles increases the overall thermal efficiency of the plant.

# FARIDABAD COMBINED CYCLE POWER GENERATION




The above figure is of combined cycle process at NTPC Faridabad.

# CONVERSION FROM GAS TO ELECTRICITY

The basic principle of the Combined Cycle is simple: burning gas in a gas turbine (GT) produces not only power - which can be converted to electric power by a coupled generator but also extremely hot exhaust gases. Routing these gases through a water-cooled heat exchanger produces steam, which can be turned into electric power with a coupled steam turbine and generator.

This set-up of Gas Turbine, waste-heat boiler, steam turbine and generators are called a combined cycle. This type of power plant is being installed in increasing numbers round the world where there is access to substantial quantities of natural gas. This type of power plant produces high power outputs at high efficiencies and with low emissions. It is also possible to use the steam from the boiler for heating purposes so such power plants can operate to deliver electricity alone.

The electricity produced here is supplied to the distribution grids as well as used to operate the plant. In case of total power failure, the plant is operated using a Black Star Diesel Generator set. The exciter of the turbine as well as other machinery is coupled to both the BSDG as well as main power supply. In case of power failure, the power source is automatically switched to BSDG supply. Efficiencies are very wide ranging depending on the lay-out and size of the installation. Developments needed for this type of energy conversion is only for the gas turbine. Both waste heat boilers and steam turbines are in common use and well-developed, without specific needs for further improvement.

# MECHANISM AND ITS COMPONENT'S FUNCTION:

- **AIR INTAKE SYSTEM**

The air intake system in a gas power plant plays a critical role in supplying the necessary air for combustion in the gas turbines. The primary function of the air intake system is to provide clean, filtered air to ensure efficient and reliable operation of the gas turbines.

**1. Air Filters:** The air intake system typically incorporates air filters to remove impurities, such as dust, debris, and particulate matter, from the incoming air. These filters help protect the gas turbines from potential damage and maintain their performance.
**2. Inlet Ducts:** The air intake system includes inlet ducts that guide the filtered air from the atmosphere into the gas turbines. These ducts are designed to

minimize pressure losses and maintain a smooth and controlled airflow.

**3. Silencers:** Gas turbines can generate significant noise during operation. To mitigate noise pollution, silencers or sound attenuators are often installed in the air intake system. These devices help reduce noise levels and maintain compliance with environmental regulations.

- **AIR COMPRESSOR**

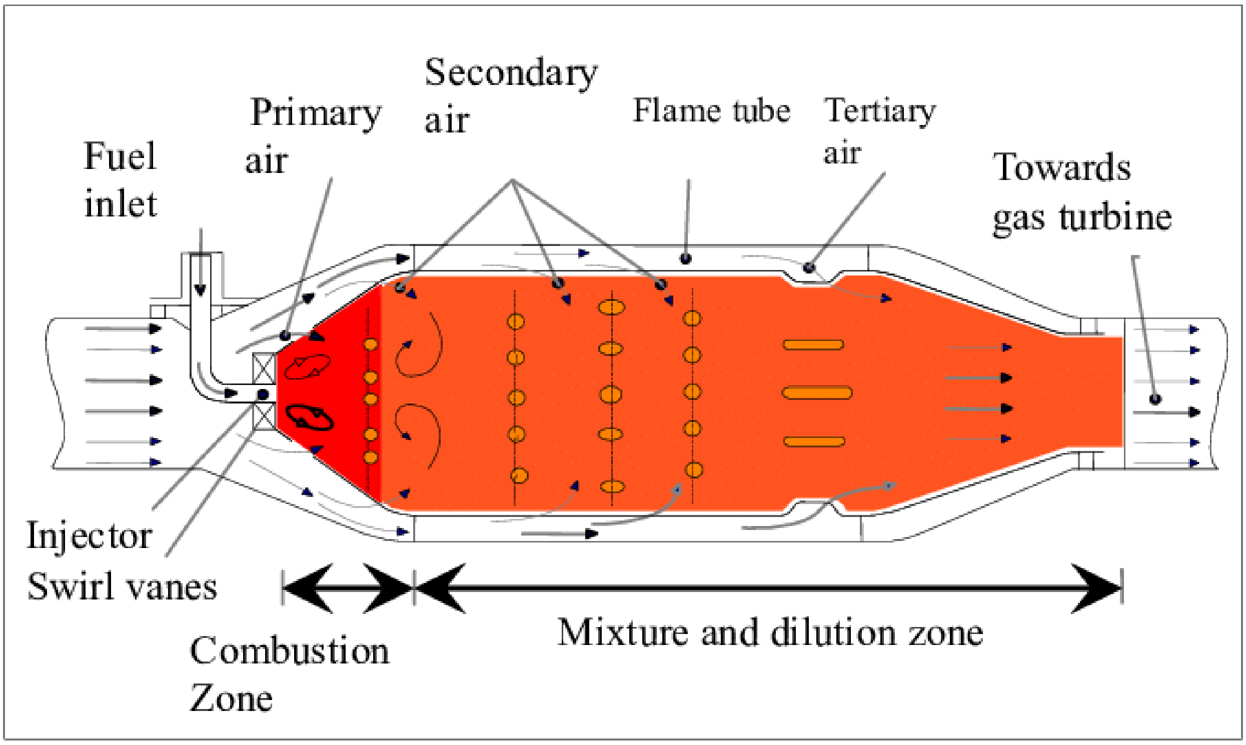
The filtered air is then passed through the compressor section, where the compression of air takes place in 16 stages. This multi-stage compression increases the temperature of the air. To compensate for the heat loss and to prevent temperature shock in the next stage, heat addition is carried out in the subsequent combustion phase. The image below shows a sectional view of an air compressor used in this process.

- **COMBUSTION CHAMBER**

The combustion chambers, also known as combustors or combustion chambers, are critical components where the fuel and air are mixed and burned to produce high-temperature gases. These hot gases then drive the gas turbine to generate mechanical power or electricity.

Here is an overview of the combustion chambers in a gas power plant:

**1. Function**: The primary function of the combustion chambers is to facilitate the controlled combustion of fuel. The combustion process occurs at elevated temperatures and pressures, converting the chemical energy of the fuel into thermal energy in the form of hot gases.




**2. Fuel Injection**: The fuel, typically natural gas, is injected into the combustion chamber along with a controlled amount of air. The fuel and air mixture must be properly proportioned to ensure efficient and stable combustion. Advanced combustion systems may utilize multiple fuel injectors arranged strategically within the combustion chamber for improved performance.

**3. Ignition:** To initiate the combustion process, an ignition source, such as a spark plug or pilot flame, is used. The ignition source ignites the fuel and air mixture, initiating the combustion reaction.

**4. Combustion Process:** Once the fuel and air mixture ignite, a self-sustaining combustion process takes place. The fuel undergoes rapid oxidation, releasing heat energy. The hot gases produced by combustion expand and exit the combustion chamber at high velocity.

**5. Combustion Control:** Combustion chambers are designed to maintain stable and efficient combustion conditions. Control mechanisms, such as fuel and air flow control systems, are employed to regulate the combustion process and optimize performance, ensuring proper fuel-to-air ratios and minimizing emissions.

**6. Emissions Control:** Combustion chambers in gas power plants are designed to minimize emissions of pollutants, such as nitrogen oxides and carbon monoxide. Various techniques, including lean burn combustion, water or steam injection, and exhaust gas recirculation, can be employed to reduce emissions.

**7. Combustion Chamber Design:** Combustion chambers are engineered to withstand elevated temperatures, pressures, and thermal stresses. They are typically constructed using high-temperature-resistant materials and incorporate cooling features to protect the chamber structure.

- ## GAS TURBINE

A gas turbine is a type of continuous flow internal combustion engine that converts the energy from a fuel into mechanical work through a process called the Brayton cycle. Atmospheric air flows through a compressor, increasing its pressure, then fuel is sprayed into the air and ignited, generating a high-temperature flow. This hot, pressurized gas then enters a turbine, producing shaft work output that drives the compressor and can be used to power various applications such as aircraft propulsion, electricity generation, or mechanical systems.

The Gas Turbine used at NTPC-Faridabad is **V94.2** is manufactured by **SIEMENS.**

It is worth noting that gas turbines can operate on various fuels, including natural gas, diesel, and some liquid fuels. Natural gas is a popular choice due to its lower emissions and availability.


**(NTPC Faridabad GT Hall-2).**

During the start-up of generator, it acts as motor. The **generator is given supply and compressor start working.** The function of the compressor is to provide air at the high pressure to combustion chamber, once air is supplied to the combustion fuel is ignited.

Due to the burning of the fuel flue gases are released at high pressure and temperature and thermal expansion of the gases rotates the turbine blades that are connected to the shaft back supply to the generator is then stopped. Fuel supply is slowly increased till the optimum speed **3000 rpm** at 50 Hz is attained. Fuel supply is kept constant. The fuel gases after rotating the turbine can be directed to the HRSG.

The rotation of gas turbine leads to the rotation of the rotor part of the generator which is connected to the same shafts a s that of the turbine.

- **GENERATOR**

In a gas power plant, the generator is a crucial component that converts the mechanical energy produced by the gas turbine into electrical energy through electromagnetic induction. It consists of a rotor (rotating part) connected to the turbine and a stator (stationary part) with windings. As the rotor spins, it creates a changing magnetic field that induces current in the stator windings. This electricity is then transmitted to transformers and integrated into the power grid or used locally. The generator installed at the plant has an output **capacity of 137.76 MW** and operates at a voltage **rating of 10.5 kV.** The generator's output must be synchronized with the grid's frequency and voltage to ensure stable power delivery. Generators are designed for high efficiency and reliability, and multiple generators may be used for redundancy and load sharing. Auxiliary generators may also power internal plant systems.

- **Excitation System**

**1. Static Excitation System:**

The generators in Stage-1 (Units U-1 and U-2) are equipped with a static excitation system. This system utilizes a slip ring and carbon brush arrangement. It comprises a step-down transformer, a converter, and an Automatic Voltage Regulator (AVR) to maintain voltage stability and control.

**2. Brushless Excitation System:**

The generators in Stage-2 (Units U-3, U-4, and U-5) are equipped with a brushless excitation system. This type of system includes two exciters: a main exciter and a pilot exciter. The brushless configuration eliminates the need for slip rings and brushes, offering improved reliability and reduced maintenance requirements.

- **TRANSFORMER**

Transformers are static electrical devices used to transfer energy between two or more circuits through the principle of electromagnetic induction. Operating based on mutual induction between primary and secondary windings, these transformers are designed to function at high voltages are known for their continuous operation with high efficiency. Their primary function is to step up or step-down alternating current voltage levels, which is essential for efficient power transmission across long distances. By adjusting voltage levels, transformers help minimize energy losses in transmission lines. Due to their crucial role in bulk power transfer, they are commonly installed at generation stations and substations. These transformers are typically large and expensive reflecting their importance in the electrical power system.

**<u>STEP UP TRANSFORMER</u>** The electricity is generated at 10.5KV. But this voltage is very less for the purpose of transmission over a long distance and hence the step-up transformer is used to step up the voltage from 10.5KV to 220KV.

## UNIT AUXILIARY TRANSFORMER

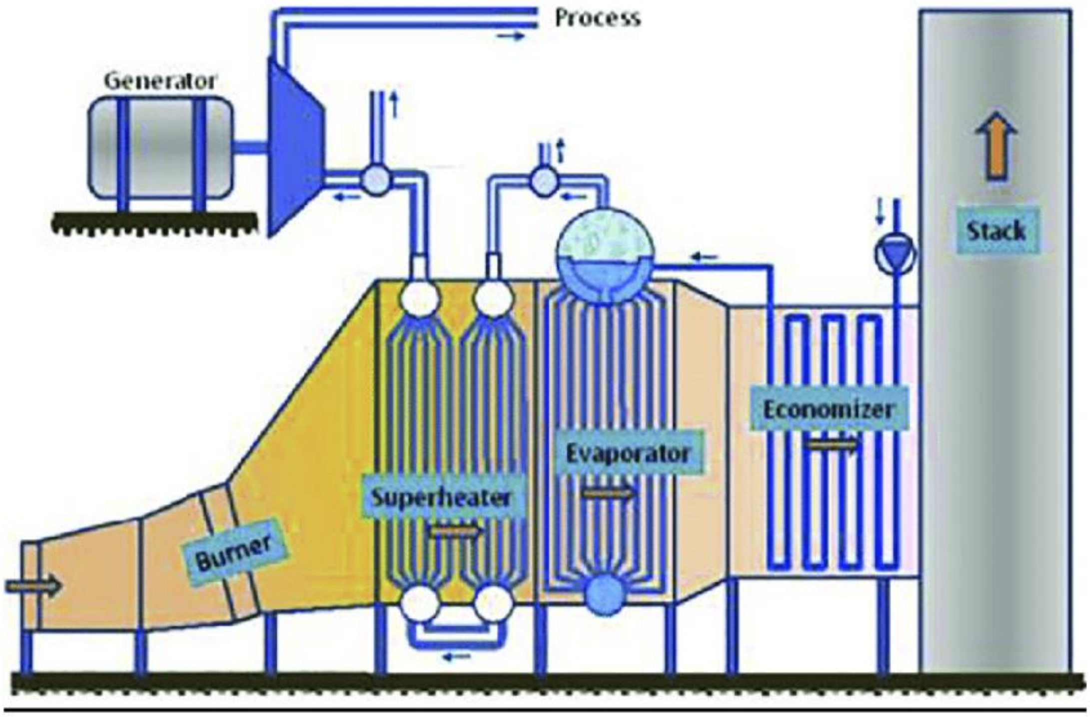
To running the machinery of the plant and exciting the generator, the power obtained from the gas turbine is utilized. Since the machinery is operated at 6.6KV, the voltage is first stepped down from 10.5KV to 6.6KV using the unit auxiliary transformer and then supplied within the plant.

**COMPONENTS OF TRANSFORMER**

The **magnetic core** of a transformer provides a low-reluctance path for magnetic flux, enabling efficient energy transfer between the **primary** and **secondary windings**. Made of laminated steel sheets, the core minimizes **eddy current** and **hysteresis losses**. The primary winding receives input AC voltage and creates an alternating magnetic field, which the secondary winding intercepts to induce the required output voltage. Both windings are well insulated to handle high electrical stress and ensure safe operation. The **transformer tank** houses the core and windings, filled with insulating oil for cooling and electrical insulation. The **conservator** accommodates oil expansion, while the **breather**, containing silica gel, prevents moisture contamination. The **Buchholz relay**, a gas-actuated protection device, detects internal faults in oil-immersed transformers. The **tap changer**, either **on-load (OLTC)** or **off-load**, adjusts the voltage ratio to match load demands or grid conditions. These components collectively ensure efficient, safe, and reliable transformer performance.

- ## HEAT RECOVERY STEAM GENERATOR (HRSG)

The heat recovery unit is a natural circulation system that uses turbine exhaust gases to produce steam without extra firing. It has finned surfaces for better heat transfer. A feed control system between the economizer and drain helps avoid steaming and allows efficient operation. A preheater is added to warm the condensate in the low-temperature area. This unit produces both high-pressure (H.P.) and low-pressure (L.P.) steam to improve overall plant efficiency.




**PARTS OF HRSG:**

**Preheater**, located at the end of the WHRSG, helps lower the temperature of flue gases and improves the thermal efficiency of the plant. It consists of spiral-finned tubes welded to top and bottom headers and is arranged in multiple rows per module.

**Economizer section** has three types. The **low-pressure (L.P.) economizer** heats feedwater for L.P. steam generation. It uses spiral-finned, fully drainable tubes. The **high-pressure (H.P.) economizer** works similarly but for H.P. steam, using the same tube design and layout.

**Evaporator section** includes both L.P. and H.P. evaporators. The **L.P. evaporator** is connected to the L.P. steam drum and uses spiral-finned tubes. The **H.P. evaporator**, placed closer to the turbine exhaust, connects to the H.P. steam drum and uses the same type of tubes for generating H.P. steam.

**Superheaters** raise the temperature of steam above saturation. The **L.P. superheater** is the fourth heat transfer surface in the gas flow direction, made of finned tubes with two rows per module. It uses a single gas flow on the tube side and is fully drainable. The **H.P. superheaters (1 & 2)** are the first in the gas path and consist of multi-pass flow on the steam side with single-pass gas flow.

At the top of the HRSG, there are two **Steam drums.** The **L.P. drum** stores L.P. steam from the L.P. evaporator and is smaller in size. It includes a blow-off cork at the top to prevent excessive pressure buildup. The **H.P. drum** stores steam from the H.P. section and has a blow cork for safety purposes.

**<u>WORKING:</u>**

The boiler feed pumps supply water to the HP and LP economizers, where its temperature is raised close to saturation. From the economizers, water flows through a feed control system into the steam drums. It then travels via downpipes to the evaporator’s bottom header, where it is partially converted into steam. This steam-water mixture moves through riser pipes back to the drum, where centrifugal separators separate the steam from water. The separated water is recirculated, while the steam passes to the superheater. To regulate steam temperature, a spray-type desuperheater is installed between HP Superheater 1 and 2. Finally, the superheated steam is directed to the steam turbine through feed pipes.

- **<u>STEAM TURBINE</u>**

A steam turbine is an external combustion engine that converts thermal energy from high-pressure steam into mechanical work by rotating turbine blades. The steam, produced in a boiler, expands through the turbine to generate shaft power, which is used for electricity generation, mechanical drives, or propulsion. After expansion, the steam is condensed and returned to the boiler, completing the Rankine cycle.

The plant is equipped with a single steam turbine generating unit rated at **156 MW**, operating at **3000 rpm** and **50 Hz**. It is a condensing-type turbine without any steam extraction for feedwater heating. The turbine consists of two cylinders: a high-pressure and low-pressure**.** It is fitted with two main stop and control valves and two L.P. stop and control valves for regulation and protection. The H.P. and L.P. sections have individual rotors, which are rigidly coupled to each other and to the generator, enabling synchronized and efficient power generation.

**<u>WORKING</u>**

High-pressure steam is directed to the HP section of the steam turbine through stop and control valves, where it expands and performs work. After expansion, it exits as low-pressure steam. Additional LP steam from the Heat Recovery Steam Generator (HRSG) is also fed into the double-flow LP turbine, where it undergoes further expansion. The combined action of both HP and LP turbine rotors drives the generator rotor, producing electricity. The exhaust steam from the LP turbine then passes into the condenser, where it is condensed back into water and returned to the HRSG for reuse, completing the cycle.

## STEAM TURBINE GENERATOR


As the thrust is created on the steam turbine blades, the rotor section of the generator to which the turbine is connected, is rotated due to the rotation of the turbine shaft. This generates power of 156 MW, and a voltage of 15.75 kV is generated which is then stepped up at the next stage and sent for transmission.

- **STEP UP TRANSFORMER**

The electricity is generated at 15.75KV. But this voltage is very less for the purpose of transmission over a long distance and hence the step-up transformer is used to step up the voltage from 15.75`KV to 220KV.

- ## CONDENSER

A condenser is a crucial component in various power plants, including gas power plants, steam power plants, and refrigeration systems. Its primary function is to convert steam or gas back into a liquid state by removing heat from the working fluid. In power plants,

A condenser in a power plant serves the vital function of converting exhaust steam from the turbine back into liquid, thereby improving overall efficiency and enabling reuse of the working fluid. It operates by transferring heat from the steam to a cooling medium—typically water—through a large surface area in either shell-and-tube or plate-type designs. This cooling medium absorbs the steam's heat, causing condensation, and is then discharged for cooling, often via a cooling tower. Condensers are usually maintained under vacuum to enhance heat transfer, and the resulting condensate is collected and pumped back to the boiler or HRSG.

**This process minimizes energy loss and plays a crucial role in sustaining the thermal cycle in combined cycle and other power plants.**

# ELECTRICAL OPERATIONS & SYSTEMS

- **SWITCHYARD**

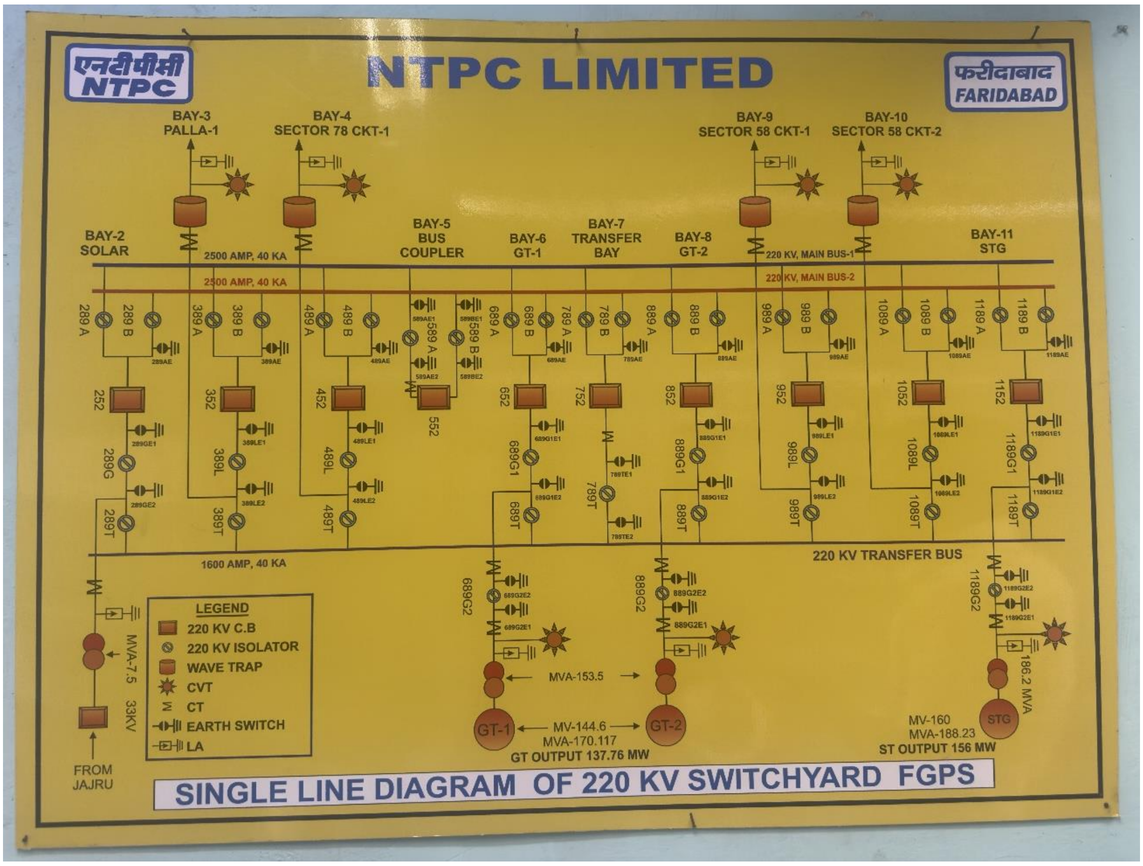
A switchyard, also known as a substation or switching station, is critical component of an electrical power system that plays a crucial role in the transmission and distribution of electricity. It **serves as a hub for connecting power generators, transformers, transmission lines, and distribution lines**, allowing for the efficient and controlled transfer of electrical energy across different voltage levels. Switchyards are typically found in both utility-scale power systems and industrial facilities.

**Switchyard Equipment's:**

| | |
|---|---|
| 1. Power transformer | 2. Current Transformer |
| 3. Circuit Breakers | 4. Capacitive Voltage Transformer |
| 5. Isolators | 6. Lightning Arresters |
| 7. Busbars | 8. Wave Traps |

# SINGLE LINE DIAGRAM - SWITCHYARD

## 220KV FGPP SLD:




## Power Generation Sources

- Gas Turbine Units:
    - GT-1: Installed capacity of 137.76 MW
    - GT-2: Installed capacity of 137.76 MW
- Steam Turbine Generator (STG):
    - Installed capacity of 156 MW
- Additional Input:
    - Power input received from the 33 kV **Jajru Solar Plant (5MW)** line.

**BAY WISE DISTRIBUTION:**

| | |
|---|---|
| 1. Bay-2 | Solar Input |
| 2. Bay-3 & Bay-4 | Feeders to Palla-1 & Sector 78 (Ckt-1) |
| 3. Bay-5 | Bus coupler |
| 4. Bay-6 | GT-I Output Connection |
| 5. Bay-7 | Transfer bay |
| 6. Bay-8 | GT-II Output Connection |
| 7. Bay-9 & Bay-10 | Feeders to Sector 58 (Ckt-1) and (Ckt-2) |
| 8. Bay-11 | STG Output Connection |

## KEY FUNCTION OF SWITCHYARD:

**1. Voltage Conversion**

Switchyards facilitate the conversion of electricity between different voltage levels. Electricity generated at high voltages in power plants is stepped down to lower voltages suitable for distribution to consumers.

**2. Interconnection**

Switchyards provide the means to interconnect multiple power sources, such as generators, and enable the transfer of power from one source to another or from one transmission line to another.

**3. Control and Protection**

Switchyards include protective devices, such as circuit breakers and relays, to ensure the safety of equipment and personnel. These devices automatically disconnect faulty equipment or sections of the grid to prevent damage and ensure system reliability.

### 4. Metering and Monitoring

Metering equipment in switchyards measures the flow of electricity and provides data for billing purposes, system monitoring, and operational control.

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## KEY ELECTRICAL EQUIPMENT IN THE SWITCHYARD:

- **LIGHTNING ARRESTER**
  Lightning arresters are installed to protect electrical equipment from overvoltage and surges caused by lightning strikes on transmission lines. Typically positioned near the equipment to be safeguarded, they provide a low-resistance path for surge currents to safely dissipate into the ground, preventing damage to components such as transformers and reactors. It is **the initial switchyard device installed in a power plant,** serving as the primary protection against voltage surges.
  The arrester features a round metal cap on top, known as the corona ring, which helps minimize corona losses. Additionally, a meter is provided to indicate surface leakage and the internal grading current of the arrester.

- Green - arrester is healthy
- Red - arrester is defective

In case of red, we first de-energize the arrester and then do the operation.

- **CURRENT TRANSFORMER**

Current Transformer (CT) is a crucial instrument in the field of electrical engineering that is used to measure the current flowing in an electric circuit. It is an essential component in power systems for various purposes, including protection, metering, and control. CTs are commonly used in conjunction with other equipment in switchyards, substations, and power distribution systems.

These are used for stepping down AC current from higher value to lower value for measurement, protection and control. Here $N_2$ gas is used to prevent oil from moisture.

- **ISOLATOR**

  Isolator, also known as a disconnect switch or isolation switch, is an electrical device used to safely de-energize and isolate a specific part of an electrical system from the power source. It ensures that maintenance, repair, or operational tasks can be performed without the risk of electric shock or system interference. Isolators are widely used in power distribution systems, substations, and industrial facilities to enhance safety and operational control.

  The primary function of an isolator is to physically disconnect a circuit or equipment from the power source. This disconnection ensures that there is no flow of current between the isolated portion and the rest of the electrical system. Isolators are used to create a visible gap in the electrical circuit, providing a clear indication that a particular section is de-energized and safe to work on.

The Standard code for Isolator is 89.

**<u>Operating Sequence for Circuit Opening and Closing</u>:**

- Opening: Open circuit breaker → Open isolator → Close earthing switch (if present)

- Closing: Ensure circuit breaker is open → Close isolator → Open earthing switch → Close circuit breaker.

An isolator typically consists of one or more sets of parallel blades, which can be opened or closed manually or using a motorized mechanism. When the isolator is in the closed position; the blades provide a continuous electrical. path, allowing current to flow. In the open position, the blades create an air gap, interrupting the flow of current.

- **CIRCUIT BREAKER**

The code for a circuit breaker is **52**. It is crucial electrical switching device used to control and protect electrical circuits from overcurrent, short circuits, and other faults. Acting as an automatic switch, a circuit breaker can interrupt or isolate the flow of electrical current when necessary, ensuring the safety and reliability of the electrical system.

The primary function of a circuit breaker is to interrupt the flow of electrical current when abnormal conditions such as overloads or short circuits occur. This action protects electrical equipment, prevents potential damage, and ensures the safety of personnel by minimizing the risk of electrical fires and other related hazards.

**<u>A circuit breaker consists of several key components:</u>**

**Contacts**: The circuit breaker has contacts that can open and close. When closed, these contacts allow current to flow through the circuit. When an abnormal condition is detected, the contacts are opened to interrupt the current.

**Operating Mechanism**: The circuit breaker can be operated manually or automatically. Manual operation involves physically moving a lever or handle to open or close the contacts. Automatic operation relies on protective relays that detect abnormal conditions and send signals to trip the circuit breaker.

**Arc Quenching**: When the contacts open, an arc is generated due to the interruption of current. The circuit breaker is designed to extinguish this arc to prevent damage to the contacts and ensure safe operation. Arc quenching mechanisms include using materials like air, oil, vacuum, or gas (such as sulfur hexafluoride) to quickly cool and extinguish the arc.

Two types of circuit breakers are installed at the NTPC Faridabad switchyard:

- **SF6 Circuit Breaker** – Manufactured by **ALSTOM**
- **Gas Circuit Breaker** – Manufactured by **CGL**

## Key Differences Between Circuit Breakers and Isolators

Isolators should not be confused with circuit breakers. While both can interrupt the flow of current, **isolators are primarily used for isolation and physical separation**, typically during maintenance or shutdown procedures. In contrast, **circuit breakers are designed to interrupt current under both normal and fault conditions**, such as overloads or short circuits. Circuit breakers are more advanced devices capable of handling **high fault currents** and are often equipped with **protective functions**, making them essential for system safety and operational control.

- **CAPACITIVE VOLTAGE TRANSFORMER**

The carrier current equipment can be connected through the capacitor of the Capacitive Voltage Transformer (CVT), eliminating the need for a separate coupling capacitor. A reactor is connected in series with the burden and is tuned to a value that causes it to resonate with the combined capacitance of the two capacitors at the supply frequency, thereby minimizing error. CVTs are installed at the end of each transmission line and on buses for effective voltage measurement and signal transmission.

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The main points of difference between a CVT and a potential transformer (PT) is that in a PT full line voltage is impressed upon the transformer while in CVT line voltage after standard reduction is applied to the transformer.

<u>Mainly used for three purposes:</u>

- Metering
- Protection
- PLCC

- **BUSBAR**

  There is total three buses. Two main buses (bus 1 and bus 2) and one transfer bus. Busbars are conductors that connect various circuits within the switchyard. They ensure reliable power distribution and easy connection between equipment. Their design allows flexibility in power flow.

- **PLCC – POWER LINE CARRIER COMMUNICATION**

  In addition to power supply transfer, transmission line is also used for communication purpose. This is done by PLCC system. Here line conductors itself are used as channel for carrying information between two ends of line. The PLCC system is used to trap the frequency higher than 50 Hz through high inductance and low resistance along with a coupling capacitor.

  The main components of PLCC are :

  1. Wave trap
  2. CVT
  3. PLCC cabinet

- **WAVE TRAP**

  Wave traps block high-frequency carrier communication signals on power lines. They allow normal power frequency to pass through without interference. This ensures clear communication for system monitoring and control.

It is used in PLCC system to trap frequency higher than 50 Hz. It is lightly inductive having very less resistance. It is attached at each end of transmission line. It is of cylindrical shape mounted on top of the transmission line.

# CONCLUSION

On completion of my vocational training at NTPC Faridabad, I have come to know about how the very necessity of our lives nowadays i.e. how electricity is generated and what all processes are needed to generate and run the plant on a 24*7 basis. NTPC Faridabad is one of the plants in India to be highest Load factor for the maximum duration of time and that to operating of the NTPC as compared to the rest of country is the highest with 95% the highest since its inception. The training gave me an opportunity to clear my concepts from practical point of view with the availability of machinery of diverse ratings.

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