IOSR Journal of Engineering (IOSR JEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
PP 29-32

Modernization of Power Generation and Distribution System

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Abstract: *Last two decade has seen lot of changes in power generation and distribution sector. The use of PLC and SCADA plays instrumental role in performing load flow analysis.Today the power plants are constructed with modern techniques. This paper discuss about the modern approaches used in power sector and gives the idea about the switchyard ,oil circuit breaker ,air blast circuit breaker, vacuum circuit breaker etc. It also discusses how the boiler works and briefly describes the components of boiler. This technical paper gives the brief idea of the NTPC vindhyanchal, some of the data of the turbo generator of vindhyanchal is also given in this paper. There is a brief discussion on the transformer and switchgear which are used in modern power plants.*

I. Introduction

NTPC Limited is India's largest power generating company having total installed capacity of 4760 MW from 27 power generating stations established in different parts of India. It is a Central Public Sector Undertaking which is governed by the Power Ministry of Government of India. NTPC has been established in year 1975 with intent to meet out the power requirements in the country.

The status of "Maharatna" has been accredited to NTPC by Government of India.The main area of activity of NTPC is to generate and distribute electrical power in India through various distribution companies of state governments and State Electricity Boards. Owing to its expansion and diversification plan NTPC has started venturing into oil and gas exploration as well as coal mining.

II. Switchyard

Switchyard is considered as the HEART of the Power Plant. Switchyard plays a very important role as a buffer between the generation and transmission [1]. It is a junction, which carries the generated power to its destination. Switchyard is basically a yard or an open area where many different kinds of equipment's are installed (isolator, circuit breaker etc.) for receiving and then transmission of electrical power.

There are different types of circuit available in the Switch yard. they are as follows-

1) Oil circuit breaker
2) Air blast circuit breaker
3) SulphurHexa-fluoride (SF6) circuit breaker
4) Vacuum circuit breaker

1)Oil Circuit Breaker

In oil circuit breaker, to extinguish the fire oil is used [2]. Whenever the fixed contact is moving from the running contact the arc is produced which is not good for the circuit. That's why whenever arc is struck the oil surrounds it and after that this arc come in contact with oil to produce hydrogen gas which helps in quenching the fire

2)Air Blast Circuit Breaker

In air blast circuit breaker it uses air as a medium which is used for quenching the arc. They also works in a similar way they remove the arcing products from the arcing region thus it helps in extinguishing the arc Sulphur Hexafluoride Circuit Breaker

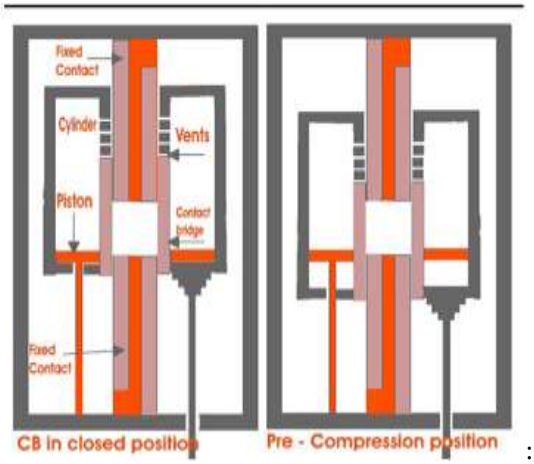

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Fig.1 Circuit Breaker

3)The SulphurHexafluoride Circuit Breaker

It works similar to the air blast circuit breaker the difference is only that the medium is different here we used SF6.medium .this medium is more heavier than air .whenever the circuit is broken under high electrical stress a high arc is produced but sf6 reconstitute itself very quickly .its dielectric strength is twice .

4)Vacuum Circuit Breaker

Vacuum circuit breaker is the safest type of circuit breaker in which there is no medium used .That's why whenever the circuit is break no arc is produced or we can say that it is free from fire or the electric arc .

III. Boiler

Boiler is a device which is used to generating steam ,and from that steam we used in power processing.. Boiler is designed to transmit heat from an external combustion sources contained within the boiler itself.
Boilers may be classified on the basis of the following characteristics:
a) Use: The quality of boiler is varying according to their nature,which type of work is performed by it. Mainly customarily Boilers are called stationary or mobile.
b)Pressure: for the safety purpose, the boilers are given boilers codes during the time of construction of boilers,these codes are given according to the boilers characteristics.
c) Materials: Material must be selected according to the boiler code material specification.
d) Size: The size have been standardize by the rating core and this rating is based upon heating surfaces.. The same is verified by performance tests.
e) Tube Contents: The fire tube and water tube boilers are two another general steel boilers. In addition with the shell type of boiler.
f) Firing: The boiler might be fired or unfired pressure vessel.
g) Heat Source: The heat produced from either by the combustion of fuel or the hot gases which is produced from the chemical reaction or the utilization of nuclear energy.

1)Boiler Accessories
i)Boiler furnace: The boiler furnaces is that place where the fuel is burned and from that the combustion product pass into the boiler proper actually it provided a chamber where the reaction is isolated and also confined the reaction must be a controlled force .it provided a support for the firing equipment.

ii)Economizer:-the economizer is used to heat the boiler feed water before it is goes into the steel drum it heat this water by recovered the heat from the fuel gases .it passes below the rear horizontal super heater.

iii)Burners: For corner fired C.E type boilers there are 24 pulverized coal burners are available.

IV. Turbo Generator

Parameters	Standard Value
Rated Voltage	15.75 kV
Rated Power	247000 kVA
Stator Current	9067A
Rotor Current	2640 A
Frequency	50.05 Hz
Connection	YY (DOUBLE -STAR)
Rotor Voltage	313 V
Power Factor	0.85 LAG
Rated H2 Pressure	4KgF/cm2
Maximum Torque at	
Short Circuit	8 TIMES
Operational Duty	S1
Class of Insulation	B

This type of Turbo generator is a Synchronous Alternator basically [3]. The stator houses, the armature windings, the rotor houses, the field windings. The slip rings provided DCvoltage to the fieldwindings. When the rotor rotated about its axis then the lines of magnetic flux cut through the stator windings. Due to this it induced an e.m.f in the stator windings.
The rotor speed is 3000 rpm by the turbines [1]

V. Transformer

The transformer used in the power station to convert the low voltage(LV) to high voltagee (HV) or high voltage(HV) to low voltage (LV).

Different types of Transformer in a power station are as follows:
a)Generator transformer: The isolated bus duct is attached to the generator transformer, this bus duct is coming from the power turbo generator .this transformer helps in step up the generating voltage of the excite tor it converts the 15.75KV to 400KV [5].This type oftransformer is cooled by oil natural air forced.
b) Unit Auxiliary Transformer (UAT):The Unit Auxiliary Transformer connecting medium which connect the generator to the generator transformer .it takes the input from the main bus duct.it helps in working of the larger devices such as boiler heavy motors etc.
c) Station Transformer: the station transformer helps the auxiliaries in the initial starts by giving the power to it. Actually this transformer helps in the startup of the unit.it have the capacity of 60%of the load at full generating capacity
d) ICT (Inter Connecting Transformer): It attached 400KV substation to 132 KV substations.
e) CPT (Construction Power Transformer): this transformer helps in the construction as it gives the voltage of 220V For the purpose of constructing.

VI. Motor

3-Phase induction motor produces a magnetic field in rotor and stators .the speed of rotor is directly proportional to the main frequency and it is inversely proportional to no. of pair of every coil of the stator occupy one stator slot and it have single layer winding [7] . There are many types of stator winding available [5] 2 common types are
a) Single Layer winding : In this winding the stator contains each winding in different stator slots .
b) Double Layer winding : In this winding the two separate coil contains a single slot .

There are various types and sizes of motors used in the power stations. These are used for various purposes as prime movers. Apart from the simple motor used in different areas, these HT motors used in the various heavy duty equipment's [7]. These are FD, ID, PA fans, boiler feed pumps, CW pumps, etc [3]. These motors have certain special features like cooling, auto starting, inter locks and control. These are generally squirrel cage motors. The rotor never rotates at the synchronous speed. Off load, the induction motor has poor efficiency and power factor. On load we get an efficiency of 85% and 0.8 power factor [6].

Synchronous Motor: [7]These are motors which always run at synchronous speed and speed of rotation depends upon the pair of poles. Synchronous motors do not start on their own they need an external exciting system which gives it an initial rotation. Generally an induction motor is used for this purpose. As the load increases, load angle increases and power drawn from the supply increases. With an excessive load, the rotor

pulls out of synchronism. When operating at synchronous speed the power factor can be changed by varying the degree of excitation.

VII. Switchgear

The apparatus used for Switching, Controlling and Protecting the Electrical Circuits and equipment is referred to as "Switchgear" [9].Generally switchgear is referred to as an assembly of all the necessary equipment pertaining to handling and operation of electrical power [10]. It comprises of various switching devices, relays and system protection equipment in a logical manner [9]. It also may comprise devices and systems for control, metering and power regulation.

VIII. Conclusion

This paper gives a brief idea about modern power system unit. The power generation and transmission sector in India is modernized now and this paper gives an detail technical specification about these sections Vindhyanchal NTPC is one among the most modernized technology which is being used in NTPC throughout India.

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