Chapter-1
Introduction about the Topic

Welfare includes anything that is done for the comfort and improvement of employees and is provided over and above the wages. Welfare helps in keeping the morale and motivation of the employees high so as to retain the employees for longer duration. The welfare measures need not be in monetary terms only but in any kind/forms. Employee welfare includes monitoring of working conditions, creation of industrial harmony through infrastructure for health, industrial relations and insurance against disease, accident and unemployment for the workers and their families. Labor welfare entails all those activities of employer, which are directed towards providing the employees with certain facilities and services in addition to wages or salaries.

**Employee welfare defines as “efforts to make life worth living for workmen”**. These efforts have their origin either in some statute formed by the state or in some local custom or in collective agreement or in the employer’s own initiative. It includes:

- To give expression to philanthropic and paternalistic feelings.
- To win over employee’s loyalty and increase their morale.
- To combat trade unionism and socialist ideas.
- To build up stable labour force, to reduce labour turnover and absenteeism.
- To develop efficiency and productivity among workers.
- To save oneself from heavy taxes on surplus profits.
- To earn goodwill and enhance public image.
- To reduce the threat of further government intervention.
- To make recruitment more effective (because these benefits add to job appeal).

**Features: - The basic features of Employees Welfare are as follows:**

1. Employees welfare includes various facilities, services and amenities provided to for improving their health, efficiency, economic betterment and social status.
2. Welfare measures are in addition to regular wages and other economic benefits available to workers due to legal provisions and collective bargaining.

3. Employees welfare schemes are flexible and ever-changing. New welfare measures are added to the existing ones from time to time.

4. Welfare measures may be introduced by the employers, government, employees or by any social or charitable agency.

5. The purpose of employee’s welfare is to bring about the development of the whole personality of the workers to make a better workforce. The very logic behind providing welfare schemes is to create efficient, healthy, loyal and satisfied labor force for the organization. The purpose of providing such facilities is to make their work life better and also to raise their standard of living.

**Benefits:-**

**The important benefits of welfare measures can be summarized as follows:**

1. They provide better physical and mental health to workers and thus promote a healthy work environment. Facilities like housing schemes, medical benefits, and education and recreation facilities for workers’ families help in raising their standards of living. This makes workers to pay more attention towards work and thus increases their productivity.

2. Employers get stable labor force by providing welfare facilities. Workers take active interest in their jobs and work with a feeling of involvement and participation.

3. Employee welfare measures increase the productivity of organization and promote healthy industrial relations thereby maintaining industrial peace. The social evils prevalent among the labors such as substance abuse, etc are reduced to a greater extent by the welfare policies.

4. Organizations provide welfare facilities to their employees to keep their motivation levels high. The employee welfare schemes can be classified into two categories viz. statutory and non-statutory welfare schemes. The statutory schemes are those schemes that are compulsory to provide by an organization as compliance to the laws governing
employee health and safety. These include provisions provided in industrial acts like Factories Act 1948, Dock Workers Act (safety, health and welfare) 1986, Mines Act 1962. The non statutory schemes differ from organization to organization and from industry to industry.

**Employees Welfare Schemes:-**

**Statutory Welfare Schemes: - It includes:-**

1. **Drinking Water:** At all the working places safe hygienic drinking water should be provided.

2. **Facilities for sitting:** In every organization, especially factories, suitable seating arrangements are to be provided.

3. **First aid appliances:** First aid appliances are to be provided and should be readily assessable so that in case of any minor accident initial medication can be provided to the needed employee.

4. **Latrines and Urinals:** A sufficient number of latrines and urinals are to be provided in the office and factory premises and are also to be maintained in a neat and clean condition.

5. **Canteen facilities:** Cafeteria or canteens are to be provided by the employer so as to provide hygienic and nutritious food to the employees.

6. **Spittoons:** In every work place, such as ware houses, store places, in the dock area and office premises spittoons are to be provided in convenient places and same are to be maintained in a hygienic condition.

7. **Lighting:** Proper and sufficient lights are to be provided for employees so that they can work safely during the night shifts.
8. Washing places: Adequate washing places such as bathrooms, wash basins with tap and tap on the stand pipe are provided in the port area in the vicinity of the work places.

9. Changing rooms: Adequate changing rooms are to be provided for workers to change their cloth in the factory area and office premises. Adequate lockers are also provided to the workers to keep their clothes and belongings.

10. Rest rooms: Adequate numbers of restrooms are provided to the workers with provisions of water supply, wash basins, toilets, bathrooms, etc.

Non Statutory Schemes: - It includes: -

1. Personal Health Care (Regular medical check-ups): Some of the companies provide the facility for extensive health check-up.

2. Flexi-time: The main objective of the flextime policy is to provide opportunity to employees to work with flexible working schedules. Flexible work schedules are initiated by employees and approved by management to meet business commitments while supporting employee personal life needs.

3. Employee Assistance Programs: Various assistant programs are arranged like external counseling service so that employees or members of their immediate family can get counseling on various matters.

4. Harassment Policy: To protect an employee from harassments of any kind, guidelines are provided for proper action and also for protecting the aggrieved employee.

5. Maternity & Adoption Leave – Employees can avail maternity or adoption leaves. Paternity leave policies have also been introduced by various companies.

6. Medi-claim Insurance Scheme: This insurance scheme provides adequate insurance coverage of employees for expenses related to hospitalization due to illness, disease or
or pregnancy.

7. **Employee Referral Scheme**: In several companies employee referral scheme is implemented to encourage employees to refer friends and relatives for employment in the organization.

**Principles of Employee Welfare Service:**

Following are generally given as the principles to be followed in setting up an employee welfare service:

1. The service should satisfy real needs of the workers. This means that the manager must first determine what the employee’s real needs are with the active participation of workers.

2. The service should such as can be handled by cafeteria approach. Due to the difference in Sex, age, marital status, number of children, type of job and the income level of employees there are large differences in their choice of a particular benefit. This is known as the cafeteria approach. Such an approach individualizes the benefit system though it may be difficult to operate and administer.

3. The employer should not assume a benevolent posture.

4. The cost of the service should be calculated and its financing established on a sound basis.

5. There should be periodical assessment or evaluation of the service and necessary timely on the basis of feedback.
Types of Employee Welfare Services:-

1. Safety Services:-
Prevention of accidents is an objective which requires an explanation. The costs of accidents are enormous in suffering to the injured, in reduction or loss of earnings, in disabilities and incapacities which afflict those involved and in compensation, insurance and legal costs, in lost time, filling in reports and attending to enquiries, and in spoilage of materials, equipment and tools to management. Accidents are the consequence of two basic factors: technical and human. Technical factors include all engineering deficiencies, related to plant, tools material and general work environment. Thus, for example, improper lighting, inadequate ventilation, poor machine guarding and careless housekeeping are some hazards which may cause accidents. Human factors include all unsafe acts on the part of employees. An unsafe act is usually the result of carelessness. Young and new employees, because of their difficulty in adjusting to the work situation and to life in general, also have many more accidents than do old and nature workers. Some persons believe wrongly in the theory that certain individuals are accident prone, that is, they have some personality trait as opposed to some characteristic of the environment which predisposes them to have more accidents than others in work condition where the risk of hazards is equal to all.

Components of a Safety Service:-

There are many components of a safety service like:-

(a) Appointment of safety officer:-
In big organizations, the appointment of a safety officer to head the safety department is a must. In small organizations, the personnel manager may look after the functions of this department. The head of the safety department, who is usually a staff man, is granted power to inspect the plant for unsafe condition, to promote sound safety practices to make safety rules, and to report violations to the plant manager.

(b) Support by line management:- The head of the safety department, whether enjoying a staff or a functional position, by himself, cannot make a plan safe. His appointment lulls line management into assuming that all its safety problems have been solved.
(c) **Elimination of hazards**:–

Although complete elimination of all hazards is virtually impossibility but following steps can be taken to help reduce them:

1. **Job safety analysis**:–
   All job procedures and practices should be analysed by an expert to discover hazards. He should then suggest changes in their motion patterns, sequence and the like.

2. **Placement**:–
   A poorly placed employee is more apt to incur injury than a properly placed employee. Employees should be placed on jobs only after carefully estimating and considering the job requirements with those which the individual apparently possesses.

3. **Personal protective equipment**:–
   Endless variety of personal safety equipment is available nowadays which can be used to prevent injury.

4. **Safeguarding machinery**:–
   Guards must be securely fixed to all power driven machinery.

5. **Materials handling**:–
   Though often ignored, the careless handling of heavy and inflammable materials is an important source of several injuries and fire.

6. **Hand tools**:–
   Minor injuries often result from improperly using a good tool or using a poorly designed tool. Therefore, close supervision and instruction should be given to the employees on the proper tool to use the proper use of the tool.

7. **Safety training, education and publicity**:– Safety training is concerned with developing safety skills, whereas safety education is concerned with increasing contest
programmes, safety campaigns, suggestion awards, and various audiovisual aids can be considered as different forms of employee education.

8. Safety inspection:-
An inspection by a trained individual or a committee to detect evidence of possible safety hazards (such as poor lighting, slippery floors, unguarded machines, faulty electrical installations, poor work methods and disregard of safety rules) is a very effective device to promote safety.

2. Counseling Services:-
An employee very often comes across problems which have emotional content. For example, he may be nearing retirement and feeling insecure or he may be getting promotion and feeling hesitant to shoulder increased responsibility or he may be worried due to some family problem. It includes:-

Employee Welfare in India:-
There are following Principles of State Policy in our Constitution expresses the need for employee welfare thus:

1. The State shall strive to promote the welfare of the people by securing and protecting as effectively as it may a social order in which justice, social, economic and political, shall inform all the institutions of the national life.

2. The State shall, in particular, direct its policy towards securing.

3. That the citizens, men and women equally, have the right to an adequate means of livelihood.

4. That the ownership and control of the material resources are so distributed as to sub serve the common good.
Reasons for the Employees welfare activities in India:-

1) Increase in efficiency of employees: - It increases in efficiency of employees to work. These facilities helps in developing feeling of dedication among them. Due to the increase in efficiency the production and the productivity of the enterprise increase considerably.

2) Establishment of organizational peace: - It helps in establishing sound relations between employers and employees. When the employees of the organization feels that they are getting all the possible facilities and the employers are very carrying to them, then such good feeling increases enthusiasm among employees which will establish peace in the organization.

3) Helpful in reducing the Absenteeism and labour turnover: - The rate of absenteeism and labour turnover is much higher in India as compared to that of developed countries of the world. Provision of employee welfare activities helps in reducing this because the employees feels themselves well settled at one place.

Motivation of Employees

Motivation is a process that starts with a physiological or psychological deficiency or need that activates a behavior or drive that is aimed at a goal or incentive. Thus, the process involves needs, which set drives in motion to accomplish a goal (anything that alleviates a need and reduces a drive).

Motivation is the key to performance improvement

There is an old saying you can take a horse to the water but you cannot force it to drink; it will drink only if it's thirsty - so with people. They will do what they want to do or otherwise motivated to do. Whether it is to excel on the workshop floor or in the 'ivory tower' they must be motivated or driven to it, either by themselves or through external stimulus. Are they born with the self-motivation or drive? Yes and no. If no, they can be
motivated, for motivation is a skill which can and must be learnt. This is essential for any business to survive and succeed.

Performance is considered to be a function of ability and motivation, thus:

- **Job performance =f(ability)(motivation)**

Ability in turn depends on education, experience and training and its improvement is a slow and long process. On the other hand motivation can be improved quickly. There are many options and an uninitiated manager may not even know where to start. As a guideline, there are broadly seven strategies for motivation.

- Positive reinforcement / high expectations
- Effective discipline and punishment
- Treating people fairly
- Satisfying employees needs
- Setting work related goals
- Restructuring jobs
- Base rewards on job performance

These are the basic strategies, though the mix in the final 'recipe' will vary from workplace situation to situation. Essentially, there is a gap between an individuals actual state and some desired state and the manager tries to reduce this gap. Motivation is, in effect, a means to reduce and manipulate this gap. It is inducing others in a specific way towards goals specifically stated by the motivator. Naturally, these goals as also the motivation system must conform to the corporate policy of the organization. The motivational system must be tailored to the situation and to the organization.
**Industry Profile**

**Introduction:**

A thermal power station is a power plant in which the prime mover is steam driven. Water is heated, turns into steam and spins a steam turbine which drives an electrical generator. After it passes through the turbine, the steam is condensed in a condenser and recycled to where it was heated; this is known as a Rankine cycle. The greatest variation in the design of thermal power stations is due to the different fuel sources. Some prefer to use the term energy center because such facilities convert forms of heat energy into electricity. Some thermal power plants also deliver heat energy for industrial purposes, for district heating, or for desalination of water as well as delivering electrical power. A large part of human CO₂ emissions comes from fossil fueled thermal power plants; efforts to reduce these outputs are various and widespread. Almost all coal, nuclear, geothermal, solar thermal electric, and waste incineration plants, as well as many natural gas power plants are thermal.

Natural gas is frequently combusted in gas turbines as well as boilers. The waste heat from a gas turbine can be used to raise steam, in a combined cycle plant that improves overall efficiency. Power plants burning coal, fuel oil, or natural gas are often called fossil-fuel power plants. Some biomass-fueled thermal power plants have appeared also. Non-nuclear thermal power plants, particularly fossil-fueled plants, which do not use co-generation, are sometimes referred to as conventional power plants. Commercial electric utility power stations are usually constructed on a large scale and designed for continuous operation. Electric power plants typically use three-phase electrical generators to produce alternating current (AC) electric power at a frequency of 50 Hz or 60 Hz. Large companies or institutions may have their own power plants to supply heating or electricity to their facilities, especially if steam is created anyway for other purposes. Steam-driven power plants have been used in various large ships, but are now usually used in large naval ships. Shipboard power plants usually directly couple the turbine to the ship's propellers through gearboxes. Power plants in such ships also provide steam to smaller turbines driving electric generators to supply electricity. Shipboard steam power plants can be either fossil fuel or nuclear. Nuclear marine propulsion is, with few exceptions, used only in naval vessels.
There have been perhaps about a dozen turbo-electric ships in which a steam-driven turbine drives an electric generator which powers an electric motor for propulsion. Combined heat and power (CH&P) plants, often called co-generation plants, produce both electric power and heat for process heat, space heating, or process heat. Steam and hot water lose energy when piped over substantial distance, so carrying heat energy by steam or hot water is often only worthwhile within a local area, such as a ship, industrial plant, or district heating of nearby buildings. Haryana has a number of coal-based power plants that have ensured energy supply across the state. These Haryana power plants are well-linked by roads and rail routes. The Haryana government has always given high priority to its power sector. Constant power supply is the key to its continuous economic growth. However, power generation needs good supply of coal. The Haryana power department has been facing coal shortage for a long time. To solve this, the Central Government has allocated a coal block in Madhya Pradesh to Haryana. The Haryana Government is planning to use this coal for the power plants it aims to set up in the coming years. The Haryana Power Generation Corporation Ltd (HPGCL) is aiming to generate about 2000 MW additional power supply in the upcoming years. This is expected to solve the minor energy crises faced by the state. The coal block for Haryana and additional power generation is supposed to make the state energy surplus by 2012.

**Thermal power plants in Haryana**

Some of the important Haryana Thermal Power Plants are:

**Rajiv Gandhi Thermal Power Project (RGTPP)**
Address:
Khedar, Hissar, Haryana, India.

**Deen Bandhu Chhotu Ram Thermal Power Station**
Address:
Yamuna Nagar, Haryana, India

**Panipat Thermal Power Station 1**
Address:
Assan, Panipat, Haryana, India.

Panipat Thermal Power Station 2
Address:
Assan, Panipat, Haryana, India.

**Upcoming Haryana thermal plants**

Haryana has achieved 100% electrification. But the number of industries and electrical equipments is growing at a rapid rate. Hence, the state is presently facing a high demand for power. The Haryana government is aiming at the expansion of its power sector. It is planning to set up some more power plants in the coming years.

**Some of the upcoming thermal plants in Haryana are:**

Haryana Power Generation Corporation Ltd
Address: Yamunanagar, Haryana, India.

Haryana Aban Power Corporation Ltd
Address: Ballabgarh, Faridabad, India.

**History:**

Reciprocating steam engines have been used for mechanical power sources since the 18th Century, with notable improvements being made by James Watt. The very first commercial central electrical generating stations in the Pearl Street Station, New York and the Holborn Viaduct power station, London, in 1882, also used reciprocating steam engines. The development of the steam turbine allowed larger and more efficient central generating stations to be built. By 1892 it was considered as an alternative to reciprocating engines. Turbines offered higher speeds, more compact machinery, and stable speed regulation allowing for parallel synchronous operation of generators on a common bus. Turbines entirely replaced reciprocating engines in large central stations after about 1905. The largest reciprocating engine-generator sets ever built were completed in 1901 for the Manhattan Elevated Railway. Each of seventeen units weighed
about 500 tons and was rated 6000 kilowatts; a contemporary turbine-set of similar rating would have weighed about 20% as much.

**Efficiency:**

The energy efficiency of a conventional thermal power station, considered as salable energy as a percent of the heating value of the fuel consumed, is typically 33% to 48%. This efficiency is limited as all heat engines are governed by the laws of thermodynamics. The rest of the energy must leave the plant in the form of heat. This waste heat can go through a condenser and be disposed of with cooling water or in cooling towers. If the waste heat is instead utilized for district heating, it is called co-generation. An important class of thermal power station is associated with desalination facilities; these are typically found in desert countries with large supplies of natural gas and in these plants, freshwater production and electricity are equally important co-products.

**Cost of electricity:**

Relative cost of electricity generated by different sources. The direct cost of electric energy produced by a thermal power station is the result of cost of fuel, capital cost for the plant, operator labor, maintenance, and such factors as ash handling and disposal. Indirect, social or environmental costs such as the economic value of environmental impacts, or environmental and health effects of the complete fuel cycle and plant decommissioning, are not usually assigned to generation costs for thermal stations in utility practice, but may form part of an environmental impact assessment.
Typical diagram of a coal-fired thermal power station

**Table 1.1**

1. Cooling tower
2. Cooling water pump
3. Transmission line (3-phase)
4. Step-up transformer (3-phase)
5. Electrical generator (3-phase)
6. Low pressure steam turbine
7. Condensate pump
8. Surface condenser
9. Electrical generator (3-phase)
10. Steam Control valve
11. High pressure steam turbine
12. Deaerator
13. Feedwater heater
14. Coal conveyor
15. Coal hopper
16. Coal pulverizer
17. Boiler steam drum
18. Surface condenser
19. Superheater
20. Forced draught (draft) fan
21. Reheater
22. Combustion air intake
23. Economiser
24. Air preheater
25. Precipitator
26. Induced draught (draft)
Boiler and steam cycle:-

In fossil-fueled power plants, steam generator refers to a furnace that burns the fossil fuel to boil water to generate steam. In the nuclear plant field, steam generator refers to a specific type of large heat exchanger used in a pressurized water reactor (PWR) to thermally connect the primary (reactor plant) and secondary (steam plant) systems, which generates steam. In a nuclear reactor called a boiling water reactor (BWR), water is boiled to generate steam directly in the reactor itself and there are no units called steam generators. In some industrial settings, there can also be steam-producing heat exchangers called heat recovery steam generators (HRSG) which utilize heat from some industrial process. The steam generating boiler has to produce steam at the high purity, pressure and temperature required for the steam turbine that drives the electrical generator. Geothermal plants need no boiler since they use naturally occurring steam sources. Heat exchangers may be used where the geothermal steam is very corrosive or contains excessive suspended solids. A fossil fuel steam generator includes an economizer, a steam drum, and the furnace with its steam generating tubes and super heater coils. Necessary safety valves are located at suitable points to avoid excessive boiler pressure. The air and flue gas path equipment include: forced draft (FD) fan, Air Preheater (AP), boiler furnace, induced draft (ID) fan, fly ash collectors (electrostatic precipitator or baghouse) and the flue gas stack.

Feed water heating and deaeration:-

The feed water used in the steam boiler is a means of transferring heat energy from the burning fuel to the mechanical energy of the spinning steam turbine. The total feed water consists of recirculated condensate water and purified makeup water. Because the metallic materials it contacts are subject to corrosion at high temperatures and pressures, the makeup water is highly purified before use. A system of water softeners and ion
exchange demineralizers produces water so pure that it coincidentally becomes an electrical insulator, with conductivity in the range of 0.3–1.0 micro siemens per centimeter. The makeup water in a 500 MWe plant amounts to perhaps 20 US gallons per minute (1.25 L/s) to offset the small losses from steam leaks in the system. The feed water cycle begins with condensate water being pumped out of the condenser after traveling through the steam turbines. The condensate flow rate at full load in a 500 MW plant is about 6,000 US gallons per minute (400 L/s).

Fig 1.2

Diagram of boiler feed water deaerator (with vertical, domed aeration section and horizontal water storage section. The water flows through a series of six or seven intermediate feed water heaters, heated up at each point with steam extracted from an appropriate duct on the turbines and gaining temperature at each stage. Typically, the condensate plus the makeup water then flows through a deaerator that removes dissolved air from the water, further purifying and reducing its corrosiveness. The water may be dosed following this point with hydrazine, a chemical that removes the remaining oxygen in the water to below 5 parts per billion (ppb). It is also dosed with pH control agents such as ammonia or morpholine to keep the residual acidity low and thus non-corrosive.
**Boiler operation:-**

The boiler is a rectangular furnace about 50 feet (15 m) on a side and 130 feet (40 m) tall. Its walls are made of a web of high pressure steel tubes about 2.3 inches (58 mm) in diameter. Pulverized coal is air-blown into the furnace from fuel nozzles at the four corners and it rapidly burns, forming a large fireball at the center. The thermal radiation of the fireball heats the water that circulates through the boiler tubes near the boiler perimeter. The water circulation rate in the boiler is three to four times the throughput and is typically driven by pumps. As the water in the boiler circulates it absorbs heat and changes into steam at 700 °F (371 °C) and 3,200 psi (Template: Convert/MP). It is separated from the water inside a drum at the top of the furnace. The saturated steam is introduced into superheat pendant tubes that hang in the hottest part of the combustion gases as they exit the furnace. Here the steam is superheated to 1,000 °F (500 °C) to prepare it for the turbine.

**Boiler furnace and steam drum:-**

Once water inside the boiler or steam generator, the process of adding the latent heat of vaporization or enthalpy is underway. The boiler transfers energy to the water by the chemical reaction of burning some type of fuel. The water enters the boiler through section in the convection pass called the economizer. From the economizer it passes to the steam drum. Once the water enters the steam drum it goes down to the lower inlet water wall headers. From the inlet headers the water rises through the water walls and is eventually turned into steam due to the heat being generated by the burners located on the front and rear water walls (typically). As the water is turned into steam/vapor in the water walls, the steam/vapor once again enters the steam drum. The steam/vapor is passed through a series of steam and water separators and then dryers inside the steam drum. The steam separators and dryers remove water droplets from the steam and the cycle through the water walls is repeated. This process is known as natural circulation.

The boiler furnace auxiliary equipment includes coal feed nozzles and igniter guns, soot blowers, water lancing and observation ports (in the furnace walls) for observation of the
furnace interior. Furnace explosions due to any accumulation of combustible gases after a trip-out are avoided by flushing out such gases from the combustion zone before igniting the coal.

The steam drum (as well as the super heater coils and headers) have air vents and drains needed for initial start up. The steam drum has internal devices that removes moisture from the wet steam entering the drum from the steam generating tubes. The dry steam then flows into the super heater coils.

**Super heater:-**

Fossil fuel power plants can have a super heater and/or re-heater section in the steam generating furnace. In a fossil fuel plant, after the steam is conditioned by the drying equipment inside the steam drum, it is piped from the upper drum area into tubes inside an area of the furnace known as the super heater, which has an elaborate set up of tubing where the steam vapor picks up more energy from hot flue gases outside the tubing and its temperature is now superheated above the saturation temperature. The superheated steam is then piped through the main steam lines to the valves before the high pressure turbine.

Nuclear-powered steam plants do not have such sections but produce steam at essentially saturated conditions. Experimental nuclear plants were equipped with fossil-fired super heaters in an attempt to improve overall plant operating cost.

**Steam condensing:-**

The condenser condenses the steam from the exhaust of the turbine into liquid to allow it to be pumped. If the condenser can be made cooler, the pressure of the exhaust steam is reduced and efficiency of the cycle increases.

**Re heater:-**

Power plant furnaces may have a re heater section containing tubes heated by hot flue gases outside the tubes. Exhaust steam from the high pressure turbine is rerouted to go
inside the reheater tubes to pickup more energy to go drive intermediate or lower pressure turbines.

**Air path:-**

External fans are provided to give sufficient air for combustion. The forced draft fan takes air from the atmosphere and, first warming it in the air preheater for better combustion, injects it via the air nozzles on the furnace wall.

The induced draft fan assists the FD fan by drawing out combustible gases from the furnace, maintaining a slightly negative pressure in the furnace to avoid backfiring through any opening.

**Steam turbine generator:-**

**Fig 1.3**

The turbine generator consists of a series of steam turbines interconnected to each other and a generator on a common shaft. There is a high pressure turbine at one end, followed by an intermediate pressure turbine, two low pressure turbines, and the generator. As steam moves through the system and loses pressure and thermal energy it expands in volume, requiring increasing diameter and longer blades at each succeeding stage to extract the remaining energy. The entire rotating mass may be over 200 metric tons and
100 feet (30 m) long. It is so heavy that it must be kept turning slowly even when shut down (at 3 rpm) so that the shaft will not bow even slightly and become unbalanced. This is so important that it is one of only five functions of blackout emergency power batteries on site. Other functions are emergency lighting, communication, station alarms and turbo generator lube oil.

**Fly ash collection:-**

Fly ash is captured and removed from the flue gas by electrostatic precipitators or fabric bag filters (or sometimes both) located at the outlet of the furnace and before the induced draft fan. The fly ash is periodically removed from the collection hoppers below the precipitators or bag filters. Generally, the fly ash is pneumatically transported to storage silos for subsequent transport by trucks or railroad cars.

**Bottom ash collection and disposal:-**

At the bottom of the furnace, there is a hopper for collection of bottom ash. This hopper is always filled with water to quench the ash and clinkers falling down from the furnace. Some arrangement is included to crush the clinkers and for conveying the crushed clinkers and bottom ash to a storage site.

**Fuel preparation system:-**

In coal-fired power stations, the raw feed coal from the coal storage area is first crushed into small pieces and then conveyed to the coal feed hoppers at the boilers. The coal is next pulverized into a very fine powder. The pulverizes may be ball mills, rotating drum grinders, or other types of grinders.

Some power stations burn fuel oil rather than coal. The oil must kept warm in the fuel oil storage tanks to prevent the oil from congealing and becoming unpumpable. The oil is usually heated to about 100 °C before being pumped through the furnace fuel oil spray nozzles.
Boilers in some power stations use processed natural gas as their main fuel. Other power stations may use processed natural gas as auxiliary fuel in the event that their main fuel supply (coal or oil) is interrupted. In such cases, separate gas burners are provided on the boiler furnaces.

**Oil system:**

An auxiliary oil system pump is used to supply oil at the start-up of the steam turbine generator. It supplies the hydraulic oil system required for steam turbine's main inlet steam stop valve, the governing control valves, the bearing and seal oil systems, the relevant hydraulic relays and other mechanisms.

At a preset speed of the turbine during start-ups, a pump driven by the turbine main shaft takes over the functions of the auxiliary system.

**Generator cooling:**

While small generators may be cooled by air drawn through filters at the inlet, larger units generally require special cooling arrangements. Hydrogen gas cooling, in an oil-sealed casing, is used because it has the highest known heat transfer coefficient of any gas and for its low viscosity which reduces wind age losses. This system requires special handling during start-up, with air in the generator enclosure first displaced by carbon dioxide before filling with hydrogen. This ensures that the highly flammable hydrogen does not mix with oxygen in the air.

The hydrogen pressure inside the casing is maintained slightly higher than atmospheric pressure to avoid outside air ingress. The hydrogen must be sealed against outward leakage where the shaft emerges from the casing. Mechanical seals around the shaft are installed with a very small annular gap to avoid rubbing between the shaft and the seals. Seal oil is used to prevent the hydrogen gas leakage to atmosphere.

The generator also uses water cooling. Since the generator coils are at a potential of about 22 kV and water is conductive, an insulating barrier such as Teflon is used to
interconnect the water line and the generator high voltage windings. Demineralized water of low conductivity is used.

**Generator high voltage system:**

The generator voltage for modern utility-connected generators ranges from 11 kV in smaller units to 22 kV in larger units. The generator high voltage leads are normally large aluminum channels because of their high current as compared to the cables used in smaller machines. They are enclosed in well-grounded aluminum bus ducts and are supported on suitable insulators. The generator high voltage leads are connected to step-up transformers for connecting to a high voltage electrical substation (of the order of 115 kV to 520 kV) for further transmission by the local power grid.

**Monitoring and alarm system:**

Most of the power plant operational controls are automatic. However, at times, manual intervention may be required. Thus, the plant is provided with monitors and alarm systems that alert the plant operators when certain operating parameters are seriously deviating from their normal range.

**Transport of coal fuel to site and to storage:**

Most thermal stations use coal as the main fuel. Raw coal is transported from coal mines to a power station site by trucks, barges, bulk cargo ships or railway cars. Generally, when shipped by railways, the coal cars are sent as a full train of cars. The coal received at site may be of different sizes. The railway cars are unloaded at site by rotary dumpers or side tilt dumpers to tip over onto conveyor belts below. The coal is generally conveyed to crushers which crush the coal to about ¾ inch (6 mm) size. The crushed coal is then sent by belt conveyors to a storage pile. Normally, the crushed coal is compacted by bulldozers, as compacting of highly volatile coal avoids spontaneous ignition. The crushed coal is conveyed from the storage pile to silos or hoppers at the boilers by another belt conveyor system.
Mission
To empower Haryana’s growth on all fronts by maximizing generation from existing plants and by planning and implementing new projects.

Vision
"To become a modern world class integrated power generation company, committed to powering Haryana’s growth on all fronts by maximizing generation from existing plants and by planning and implementing new generation projects"

Green Power
Generating efficient eco-friendly power for people of Haryana.

Policy:-
Quality, Environment, Health & Safety
We are committed to generate sufficient, uninterrupted environment friendly Power for millions of consumers of the State of Haryana with optimum efficiency under safe working conditions.

To achieve this goal, we shall:

- Set & achieve regular targets of plant efficiency.
- Comply with all applicable legal and other requirements related to Quality, Environment and Occupational Health & Safety (OH&S) issues.
- Prevent pollution & accidents due to our various plant operations.
- Make continuous improvements in the effectiveness of Quality, Environment and OH&S management systems.
- Reduce the environmental impacts from various emissions & discharges from plant operations, by optimum utilization of resources.
- Improve the Health & safety of our employees & associates while performing various tasks related to generation of power

**Objectives:-**

**Quality:**

- To provide cost effective, uninterrupted quality power at optimum efficiency.
- To make Haryana a power surplus State by maximizing generation from existing plants and by planning and implementing new generation projects.
- To explore all possible alternate sources of power generation.

**Environment, Health & Safety:**

- To minimize the impact of fly ash on the environment.
- To Develop “Green Belt” in the plants and surrounding areas.
- To monitor stack emission, ambient air quality, noise level, effluents etc.
- To minimize damage to men, material and machinery.
Summary:-

Panipat Thermal Power Station (PTPS) has a total installed generation capacity of 1367.8 MW comprising of four Units of 110 MW each (unit 1 uprated to 117.8 MW during R&M), two Units of 210 MW each and two Units of 250 MW each. As all the balance of plant facilities viz. Coal Handling Plant, Ash Handling Plant, Cooling towers, C.W. System are separate for 4x110 MW Unit 1 to 4 and are completely independent from Units 5 to 8. Keeping this in view and in order to improve the performance of the Plant and to have a better control, a need was felt to bifurcate PTPS into two Thermal Power Station i.e. PTPS-1, comprising of 4x110MW Units 1 to 4 and PTPS-2 comprising of 210MW /250MW Units 5 to 8. In this regard the Board of Directors in its 54th meeting held on 29.03.07, approved the proposal of bifurcation of Panipat Thermal Power Station, Panipat into two Thermal Power Stations i.e. PTPS-1, comprising of 4x110MW Units I to IV and PTPS-2 comprising of 210MW / 250MW Units V to VIII. The matter was subsequently taken up with Central Electricity Authority (CEA), New Delhi for according approval of Government of India (Ministry of Power) regarding bifurcation of PTPS. CEA, New Delhi vide letter dated 16.10.07 have conveyed their acceptance to HPGCL proposal of bifurcation of Panipat Thermal Power Station into two Thermal Power Stations namely PTPS-1 and PTPS-2.

Salient Aspects of PTPS-1

In order to improve the performance of all the 4X110 MW Units of PTPS-1, which are quite old and of obsolete technology, the Renovation & Modernization of these units has been started with the following objectives:

- To extend the life of the Units by 15 to 20 years
- To restore original rated capacity of the units.
- To improve Plant availability/load factor.
- To enhance operational efficiency and safety
- To remove ash pollution and to meet up environmental standards.
The R&M of Unit-1 & 2 has already been done by M/s BHEL which are now running at full capacity. The process of R&M of the Units 3 & 4 is under consideration and shall be carried out shortly. With the completion of R&M, these old Units are expected to generate maximum cost effective electricity for the State of Haryana.

Table 1.2

<table>
<thead>
<tr>
<th>Year</th>
<th>Generation (MU)</th>
<th>Plant Load Factor (%)</th>
<th>All India (110 MW Group)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003-04</td>
<td>2800.2</td>
<td>72.45</td>
<td>53.6</td>
</tr>
<tr>
<td>2004-05</td>
<td>2377.6</td>
<td>61.69</td>
<td>42.9</td>
</tr>
<tr>
<td>2005-06</td>
<td>2226.8</td>
<td>57.77</td>
<td>52.8</td>
</tr>
<tr>
<td>2006-07</td>
<td>2566.6</td>
<td>66.59</td>
<td>55.8</td>
</tr>
<tr>
<td>2007-08</td>
<td>2296.3</td>
<td>59.41</td>
<td>55.4</td>
</tr>
</tbody>
</table>

Performance of PTPS-1

![Figure 1.5](All India Average and PTPS-1 Load Factor Over Time)

Figure 1.5
Salient Aspects of PTPS-2

Panipat Thermal Power Station-2 (PTPS-2) has a total installed generation capacity of 920 MW comprising of two Units of 210 MW each and two Units of 250 MW each.

Table 1.3

<table>
<thead>
<tr>
<th>Year</th>
<th>PTPS-2 Generation (MU)</th>
<th>Plant Load Factor (%)</th>
<th>PTPS-2 (Unit 5&amp;6)</th>
<th>All India (210 Group)</th>
<th>PTPS-2 (Unit 7&amp;8)</th>
<th>All India (250 Group)</th>
<th>MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003-04</td>
<td>3149.1</td>
<td>85.59</td>
<td>79.4</td>
<td>-</td>
<td>86.5</td>
<td>90.2</td>
<td></td>
</tr>
<tr>
<td>2004-05</td>
<td>3379.0</td>
<td>80.14</td>
<td>79.8</td>
<td>-</td>
<td>90.2</td>
<td>87.7</td>
<td></td>
</tr>
<tr>
<td>2005-06</td>
<td>5908.9</td>
<td>85.75</td>
<td>79.2</td>
<td>63.57</td>
<td>87.7</td>
<td>93.7</td>
<td></td>
</tr>
<tr>
<td>2006-07</td>
<td>7341.5</td>
<td>91.48</td>
<td>82.4</td>
<td>90.78</td>
<td>93.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007-08</td>
<td>7564.9</td>
<td>94.71</td>
<td>83.0</td>
<td>92.70</td>
<td>88.8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig. 1.6
Under Implementation

3X500 MW Indira Gandhi Super Thermal Power Project (IGSTPP), Jhajjar

This Coal based Super Thermal Power Project is being set up at Jhajjar. The Project is being executed by NTPC from concept to commissioning and subsequent Operation & Maintenance in Joint Venture with Government of Delhi and Government of Haryana. The MOU in this regard was signed between NTPC, Government of National Capital Territory (NCT), Delhi and Government of Haryana on 24.08.2006. The best efforts Commissioning Schedule of three Units under this Project is 35, 38 & 41 months. The Joint Venture Agreement for execution of this Project was signed on 14.12.2006 and the Joint Venture Company i.e. Aravali Power Company Pvt. Ltd. for execution of this Project, was found on 21.12.2006.

Table 1.4

<table>
<thead>
<tr>
<th>Installed Capacity</th>
<th>3 X 500 MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Jhajjar</td>
</tr>
<tr>
<td>Total estimated cost</td>
<td>Rs 7892.42 crore</td>
</tr>
<tr>
<td>Coal linkage</td>
<td>Coal linkage of 6.94 Million Tonne Per Annum allocated from Mahanadi Coalfields Ltd. by Ministry of Coal, Govt. of India.</td>
</tr>
<tr>
<td>Haryana’s Share</td>
<td>750 MW</td>
</tr>
<tr>
<td>Equity contribution</td>
<td>NTPC-50%, Haryana-25%, Delhi-25%</td>
</tr>
<tr>
<td>Date of LOI of Boiler &amp;Turbine</td>
<td>06.07.07 &amp; 14.07.07 respectively.</td>
</tr>
<tr>
<td>Power Availability</td>
<td>Generation from this project shall start during 2010 and after commissioning of this project 180 Lac Units of electricity per day would be available for the State</td>
</tr>
<tr>
<td>Commissioning Schedule</td>
<td>500 MW Unit-I commissioned on 1.11.2010</td>
</tr>
<tr>
<td></td>
<td>500 MW Unit-II July, 2011</td>
</tr>
<tr>
<td></td>
<td>500 MW Unit-III Jan. 2012</td>
</tr>
</tbody>
</table>
1320 MW Mahatma Gandhi Thermal Power Project in Jhajjar Case-II

- Tariff based competitive bids were invited for setting up a 1320 mw coal based project at jhajjar.
- 11 bidders qualified.
- LOI issued to M/s CLP Power India Pvt. Ltd. on 23.07.08.
- Coal linkage for the project - 5.21 mtpa received from CCL
- Water availability of 50 cusecs allowed by Haryana irrigation deptt. from Jawahar Lal Nehru Canal.
- PPA signed by UHBVNL & DHBVNL on 07.08.08.
- Power likely to be available from Dec., 2011.

Procurement of upto 2000 MW on long term basis through tariff based competitive bidding- Case I

- Arrangements finalized for procurement of 2113 MW Power through tariff based competitive bidding under Case-I.
- PPA already signed with M/s Adani for 1424 MW and M/s PTC for 300 MW.

Future Projects

- 1500 MW Gas based Project at Faridabad.
- 660 MW capacity additional super critical Thermal Unit at Yamuna Nagar as an extension of 2x300 MW DCRTPP, Yamuna Nagar.
- 2800 MW (4x700 MW) Nuclear Power Plant in Distt. Fatehabad near Village Gorakhpur – Site stands identified by Nuclear Power Corporation of India. Govt. of India has approved the setting of this Nuclear Power Project in Haryana during October 2009
- Coal block at Mara-to-Mahan in MP with estimated coal reserves of 956 Million Tonnes allocated jointly to HPGCL and Delhi Govt. Required steps being taken for development of coal block.
Operational Performance:-

(a) Installed Capacity:-

At present, HPGCL has a total generating capacity of 3480.5 MW consisting of the following Thermal & Hydel Stations:

Table 1.5

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of Power Station</th>
<th>Capacity (MW) &amp; Date of Commissioning</th>
<th>Unit No.</th>
<th>COD</th>
</tr>
</thead>
<tbody>
<tr>
<td>ii.</td>
<td>Panipat Thermal Power Station, Panipat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage-I</td>
<td>117.8 MW Unit-1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>110 MW Unit-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage-II</td>
<td>110 MW Unit-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>110 MW Unit-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage-III</td>
<td>210 MW Unit-5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage-IV</td>
<td>210 MW Unit-6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage-V</td>
<td>250 MW Unit-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stage-VI</td>
<td>250 MW Unit-8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iii.</td>
<td>Deen Bandhu Chhotu Ram Thermal Power Project, Yamuna Nagar</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>300 MW Unit -1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>300 MW Unit -2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iv.</td>
<td>Rajiv Gandhi Thermal Power Project, Khedar, Hisar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>600 MW Unit -1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>600 MW Unit -2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>v.</td>
<td>Indra Gandhi Super Thermal Power Project, Jhajjar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>500 MW Unit-1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Haryana’s share = 250 MW)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>vi.</td>
<td>WYC Hydro Electric Station, Yamuna Nagar</td>
<td></td>
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<td></td>
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<tr>
<td>-------------------------------------</td>
<td>----------</td>
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<td>----------</td>
</tr>
<tr>
<td><strong>PTPS-1 (Units I-IV)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generation (MU)</td>
<td>2377.65</td>
<td>2226.76</td>
<td>2566.62</td>
<td>2296.32</td>
</tr>
<tr>
<td>Target (MU)</td>
<td>2520</td>
<td>2504</td>
<td>2310</td>
<td>2515</td>
</tr>
<tr>
<td>PLF (%)</td>
<td>61.69</td>
<td>57.77</td>
<td>66.59</td>
<td>59.41</td>
</tr>
<tr>
<td>Aux. Consumption (%)</td>
<td>12.13</td>
<td>11.75</td>
<td>11.59</td>
<td>12.13</td>
</tr>
<tr>
<td>Coal Consumption (gm/kwh)</td>
<td>858</td>
<td>843</td>
<td>842</td>
<td>876</td>
</tr>
<tr>
<td>Oil Consumption (ml/kwh)</td>
<td>5.43</td>
<td>5.26</td>
<td>2.92</td>
<td>2.93</td>
</tr>
<tr>
<td>Station Heat Rate (Kcal/kwh)</td>
<td>3567</td>
<td>3665</td>
<td>3341</td>
<td>3470</td>
</tr>
<tr>
<td><strong>PTPS-2 (Units V-VIII)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generation (MU)</td>
<td>3378.95</td>
<td>5908.94</td>
<td>7341.51</td>
<td>7564.94</td>
</tr>
</tbody>
</table>

(b) Generation Statistics:-

Table 1.6

PERFORMANCE AT A GLANCE OF THERMAL AND HYDEL POWER STATIONS OF HPGCL SINCE 2004-05 to 2009-10

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PTPS-2 (Units V-VIII)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generation (MU)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PANIPAT THERMAL POWER STATION, PANIPAT (1367.8 MW)</td>
<td>FARIDABAD THERMAL POWER STATION (165 MW)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>--------------------------------------------------</td>
<td>---------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Generation (MU)</strong></td>
<td>5756.60  8135.70  9908.13  9861.26  9588.42  10206.827</td>
<td>867.884  787.305  616.359  713.814  501.193  383.769</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Target (MU)</strong></td>
<td>6440  8952  9090  9606  9847  9649</td>
<td>900  850  861  750  725  407</td>
<td></td>
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<tr>
<td><strong>PLF (%)</strong></td>
<td>91.14  68.53  83.17  82.55  80.48  85.19</td>
<td>60.04  54.47  42.64  49.25  42.61  55.70</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Coal Consumption (gm/kwh)</strong></td>
<td>694  665  649  652  658  672</td>
<td>934  1014  1076  1166  1082  1167</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Oil Consumption (ml/kwh)</strong></td>
<td>2.82  2.92  0.86  0.59  0.80  1.05</td>
<td>4.45  5.56  9.27  8.86  9.62  6.01</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td><strong>Station Heat Rate (Kcal/kwh)</strong></td>
<td>2858  2703  2620  2571  2574  2561</td>
<td>4186  4195  4325  4801  4518  4604</td>
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<tr>
<td><strong>Gross Calorific Value (Kcal/kg)</strong></td>
<td>4091  4109  3995  3934  3900  3801</td>
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<td></td>
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<tr>
<td></td>
<td>4432</td>
<td>4083</td>
<td>3932</td>
<td>4042</td>
<td>4086</td>
<td>3894</td>
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<tr>
<td>Gross Calorific Value (Kcal/kg)</td>
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<tr>
<td><strong>DCRPP, YAMUNANAGAR (600 MW)</strong></td>
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<tr>
<td>Generation (MU)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3146.97</td>
<td>4275.912</td>
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<tr>
<td>Target (MU)</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>4204</td>
<td>4536</td>
</tr>
<tr>
<td>Plant Load Factor (%)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>69.05</td>
<td>81.35</td>
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<tr>
<td>Aux. Consumption (%)</td>
<td>-</td>
<td>-</td>
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<td>-</td>
<td>9.33</td>
<td>9.29</td>
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<tr>
<td>Coal Consumption (gm/kwh)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>667</td>
<td>641</td>
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<td>Oil Consumption (ml/kwh)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>6.32</td>
<td>1.70</td>
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<tr>
<td>Station Heat Rate (Kcal/kwh)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2450</td>
<td>2387</td>
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<tr>
<td>Gross Calorific Value (Kcal/kg)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3670</td>
<td>3725</td>
</tr>
<tr>
<td><strong>HPGCL THERMAL (1367.8 MW + 110 MW + 600 MW =2077.8 MW)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Generation (MU)</td>
<td>6624.48</td>
<td>8923.00</td>
<td>10524.49</td>
<td>10575.1</td>
<td>13236.58</td>
<td>14866.508</td>
</tr>
<tr>
<td>Target (MU)</td>
<td>7340</td>
<td>9802</td>
<td>9951</td>
<td>10356</td>
<td>14776</td>
<td>15438</td>
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<tr>
<td>Plant Load Factor (%)</td>
<td>69.46</td>
<td>67.00</td>
<td>78.78</td>
<td>78.94</td>
<td>75.01</td>
<td>82.93</td>
</tr>
<tr>
<td>Aux. Consumption (%)</td>
<td>11.04</td>
<td>10.08</td>
<td>9.80</td>
<td>9.93</td>
<td>9.66</td>
<td>9.77</td>
</tr>
<tr>
<td>Coal Consumption (gm/kwh)</td>
<td>784</td>
<td>741</td>
<td>721</td>
<td>735</td>
<td>712</td>
<td>706</td>
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<tr>
<td>Oil Consumption (ml/kwh)</td>
<td>3.97</td>
<td>3.74</td>
<td>1.85</td>
<td>1.66</td>
<td>2.87</td>
<td>1.61</td>
</tr>
<tr>
<td>Station Heat Rate (Kcal/kwh)</td>
<td>3287</td>
<td>3074</td>
<td>2894</td>
<td>2916</td>
<td>2762</td>
<td>2684</td>
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<tr>
<td><strong>WYC HYDEL (62.4 MW)</strong></td>
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<tr>
<td>Generation (MU)</td>
<td>290.480</td>
<td>258.325</td>
<td>255.720</td>
<td>270.310</td>
<td>282.389</td>
<td>235.419</td>
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<tr>
<td>Target (MU)</td>
<td>312</td>
<td>310</td>
<td>310</td>
<td>275</td>
<td>275</td>
<td>275</td>
</tr>
<tr>
<td><strong>HPGCL (Thermal+Hydel = 2140.2 MW)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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