

## Chapter 1 : Boiler Cleaning with Shock Pulse Generators

*Steam Boiler Operations and Maintenance Manual. power switch and all power to the boiler is OFF prior Section III of this boiler manual.*

Flue-gas stack For units over about MW capacity, redundancy of key components is provided by installing duplicates of the forced and induced draft fans, air preheaters, and fly ash collectors. The list of coal power stations has the largest power stations ranging in size from 2,MW to 5,MW. Boiler and steam cycle[ edit ] 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, most commonly utilizing hot exhaust from a gas turbine. 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 do not need boilers because 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 superheater coils. Necessary safety valves are located at suitable points to relieve excessive boiler pressure. The air and flue gas path equipment include: 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. The feed water cycle begins with condensate water being pumped out of the condenser after traveling through the steam turbines. Diagram of boiler feed water deaerator with vertical, domed aeration section and horizontal water storage section. The water is pressurized in two stages, and 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, in the middle of this series of feedwater heaters, and before the second stage of pressurization, the condensate plus the makeup water flows through a deaerator [9] [10] 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. Its walls are made of a web of high pressure steel tubes about 2. Pulverized coal is air-blown into the furnace through burners located at the four corners, or along one wall, or two opposite walls, and it is ignited to rapidly burn, 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. As the water in the boiler circulates it absorbs heat and changes into steam. 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. Plants designed for lignite brown coal are increasingly used in locations as varied as Germany , Victoria , Australia, and North Dakota. Lignite is a much younger form of coal than black coal. It has a lower energy density than black coal and requires a much larger furnace for equivalent heat output. The firing systems also differ from black coal and typically draw hot gas from the furnace-exit level and mix it with the incoming coal in fan-type mills that inject the pulverized coal and hot gas mixture into the boiler. Plants that use gas turbines to heat the water for conversion into steam use boilers known as heat recovery steam generators HRSG. The exhaust heat from the gas turbines is used to make superheated steam that is then used in a conventional water-steam generation cycle, as described in the gas turbine combined-cycle plants section. Boiler furnace and steam drum[ edit ] The water enters the boiler through a section in the convection pass called the economizer. From the economizer it passes to the steam drum and from there it goes through

downcomers to inlet headers at the bottom of the water walls. From these headers the water rises through the water walls of the furnace where some of it is turned into steam and the mixture of water and steam then re-enters the steam drum. In the steam drum, the water is returned to the downcomers and the steam is passed through a series of steam separators and dryers that remove water droplets from the steam. The dry steam then flows into the superheater coils. 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 superheater coils and headers have air vents and drains needed for initial start up. Superheater[ edit ] Fossil fuel power stations often have a superheater section in the steam generating furnace. Here the steam 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 superheaters in an attempt to improve overall plant operating cost. If the condenser can be made cooler, the pressure of the exhaust steam is reduced and efficiency of the cycle increases. Diagram of a typical water-cooled surface condenser. Such condensers use steam ejectors or rotary motor-driven exhausts for continuous removal of air and gases from the steam side to maintain vacuum. For best efficiency, the temperature in the condenser must be kept as low as practical in order to achieve the lowest possible pressure in the condensing steam. Thus leaks of non-condensable air into the closed loop must be prevented. The large decrease in volume that occurs when water vapor condenses to liquid creates the low vacuum that helps pull steam through and increase the efficiency of the turbines. Plants operating in hot climates may have to reduce output if their source of condenser cooling water becomes warmer; unfortunately this usually coincides with periods of high electrical demand for air conditioning. The condenser generally uses either circulating cooling water from a cooling tower to reject waste heat to the atmosphere, or once-through water from a river, lake or ocean. A Marley mechanical induced draft cooling tower The heat absorbed by the circulating cooling water in the condenser tubes must also be removed to maintain the ability of the water to cool as it circulates. The circulation flow rate of the cooling water in a MW unit is about Nevertheless, they may become internally fouled during operation by bacteria or algae in the cooling water or by mineral scaling, all of which inhibit heat transfer and reduce thermodynamic efficiency. Many plants include an automatic cleaning system that circulates sponge rubber balls through the tubes to scrub them clean without the need to take the system off-line. Another form of condensing system is the air-cooled condenser. The process is similar to that of a radiator and fan. Exhaust heat from the low-pressure section of a steam turbine runs through the condensing tubes, the tubes are usually finned and ambient air is pushed through the fins with the help of a large fan. The steam condenses to water to be reused in the water-steam cycle. Air-cooled condensers typically operate at a higher temperature than water-cooled versions. While saving water, the efficiency of the cycle is reduced resulting in more carbon dioxide per megawatt-hour of electricity. Reheater[ edit ] Power station furnaces may have a reheater section containing tubes heated by hot flue gases outside the tubes. Exhaust steam from the high-pressure turbine is passed through these heated tubes to collect more energy before driving the intermediate and then low-pressure turbines. Air path[ edit ] External fans are provided to give sufficient air for combustion. The Primary air fan takes air from the atmosphere and, first warms the air in the air preheater for better economy. Primary air then passes through the coal pulverizers, and carries the coal dust to the burners for injection into the furnace. The Secondary air fan takes air from the atmosphere and, first warms the air in the air preheater for better economy. 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 leakage of combustion products from the boiler casing. Steam turbine generator[ edit ] Main article: Turbo generator Rotor of a modern steam turbine, used in a power station The turbine generator consists of a series of steam turbines interconnected to each other and a generator on a common shaft. There is usually a high-pressure turbine at one end, followed by an intermediate-pressure turbine, and finally one, two, or three 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. 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 six functions of blackout emergency power batteries on site. The other five being emergency lighting , communication , station alarms, generator hydrogen seal system, and turbogenerator lube oil. The hot reheat steam is conducted to the intermediate pressure turbine, where it falls in both temperature and pressure and exits directly to the long-bladed low-pressure turbines and finally exits to the condenser. There is generally no permanent magnet , thus preventing black starts. The rotor spins in a sealed chamber cooled with hydrogen gas, selected because it has the highest known heat transfer coefficient of any gas and for its low viscosity , which reduces windage losses. This system requires special handling during startup, with air in the chamber first displaced by carbon dioxide before filling with hydrogen. This ensures that a highly explosive hydrogen&#x2013;oxygen environment is not created. The desired frequency affects the design of large turbines, since they are highly optimized for one particular speed. The electricity flows to a distribution yard where transformers increase the voltage for transmission to its destination. The steam turbine-driven generators have auxiliary systems enabling them to work satisfactorily and safely. The steam turbine generator, being rotating equipment, generally has a heavy, large-diameter shaft. The shaft therefore requires not only supports but also has to be kept in position while running. To minimize the frictional resistance to the rotation, the shaft has a number of bearings. The bearing shells, in which the shaft rotates, are lined with a low-friction material like Babbitt metal. Oil lubrication is provided to further reduce the friction between shaft and bearing surface and to limit the heat generated. Stack gas path and cleanup[ edit ] See also: Flue-gas emissions from fossil-fuel combustion and Flue-gas desulfurization As the combustion flue gas exits the boiler it is routed through a rotating flat basket of metal mesh which picks up heat and returns it to incoming fresh air as the basket rotates. This is called the air preheater. The gas exiting the boiler is laden with fly ash , which are tiny spherical ash particles. The flue gas contains nitrogen along with combustion products carbon dioxide , sulfur dioxide , and nitrogen oxides. The fly ash is removed by fabric bag filters in baghouses or electrostatic precipitators. Once removed, the fly ash byproduct can sometimes be used in the manufacturing of concrete. This cleaning up of flue gases, however, only occurs in plants that are fitted with the appropriate technology. Still, the majority of coal-fired power stations in the world do not have these facilities.

### Chapter 2 : Power Engineering and Boiler Operator Diploma - curriculum

*HMRLJRZKQQ This BOILER OPERATION MANUAL IN THERMAL POWER PLANT PDF start with Intro, Brief Session up until the Index/Glossary page, read the table of content for additional information, when.*

### Chapter 3 : Thermal power station - Wikipedia

*Power EPC Brochure Power EPC Presentation Power O&M Brochure. In consonance with our mission to provide reliable power at the most competitive lifetime cost per Megawatt, we offer comprehensive operation and maintenance services for power plants, through our own experienced manpower and proprietary processes.*

### Chapter 4 : Boiler operation manual in thermal power plant by katie - Issuu

*Steam Boiler operation and maintenance Training manuals. Boilers OM Manuals of different companies and power plants helps you a lot to understand Erection, Commissioning, installation troubleshooting and operation Shutdown Procedure of Coal gas and oil fired boilers.*

### Chapter 5 : Boiler-Tuning Basics, Part II

*High fire A condition wherein the boiler is operating at maximum combustion performance. when the manufacturing plant in Brantford, OPERATION. operation manual.*

## Chapter 6 : Heating Boiler Operator's Manual: Maintenance, Operation, and Repair

*Keep various steam water qualities by means of continuous blowdown and periodic blowdown of boiler The reheat steam temperature is governed depending on the sway of burner during boiler normal operation the outlet steam temperature of superheater and reheater should be controlled at rated  $\hat{a},f$ . and improve the boiler efficiency*

## Chapter 7 : Operation And Maintenance Of Power Plant

*COMPARISON OF THERMAL POWER PLANT WITH OTHER BASIC PRINCIPLE OF THERMAL POWER PLANT 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.*

## Chapter 8 : Boiler and Mechanical Power Digital Library

*reliable operation, but can be shipped loose for in the field installation by others upon request. The following is an overview of the various boiler water control systems available.*

## Chapter 9 : Boilers O&M Manuals

*Boiler systems are major inancial investments, yet the methods for protecting these invest- ments vary widely. Proper maintenance and operation of boilers systems is important with regard to.*