CLAYTON ENHANCES EFFICIENCY AT MEDWAY POWER STATION

Mitsui Babcock Energy Services Limited have announced the completion of a project which has increased efficiency and flexibility at one of the UK's most advanced combined cycle power stations.

The improvements have been brought about at the Medway Power Station on the Isle of Grain in Kent by the installation of a new Steam Generator, which provides an auxiliary supply of superheated steam to the plant.

The 688 MW Power Station was built in 1995 and operates with two GE Frame 9FA gas turbines and one GE reheat, condensing steam turbine. The waste heat in the exhaust from both gas turbines is utilised to produce steam in heat recovery steam generators (HRSG's) which is used to power the single steam turbine. The station is one of the first of its kind in England and generates enough electricity to supply an area the combined size of Southampton and Portsmouth.

The driving force behind the project was the commitment of Medway Power Limited to 'flexible operations' which involves the plant being shut down and re-started, as required, in response to electricity demand and prices. A new Clayton steam generator was installed as part of a package of measures to meet this commitment and it allows the station to be brought on-line and achieve base load significantly sooner after a shutdown than was previously possible. The time saving is achieved because the new steam supply can be made available to seal the glands on the steam turbine long before steam from the HRSG's is available. This seal permits the vital vacuum conditions to be established on the steam condenser and reduces the time to synchronization of the gas and steam turbines, allowing the gas turbines to achieve best possible emissions in a shorter time

The new steam supply is provided by the Clayton Steam Generator, which is capable of producing 7700 kg/hr of superheated steam at a pressure of 17 barg. Norman Bell who is a Plant Leader at the Medway Power Station said *"To ensure the success of this project we needed a boiler which could start up and quickly produce steam of high quality and at the right terminal conditions from cold, basically at the flick of a switch. We also investigated taking the traditional approach of using duty and standby wet back type boilers and keeping one of them warm all the time so that it would be ready for operation when we needed steam. However, because of the flexibility we required as well as the space & budget restraints combined with efficiency and emissions considerations, the Clayton Steam Generator proved to be ideal for our purpose".*

The Clayton Steam Generator

The high efficiency and quick start-up demanded by this application are inherent in the design of the Clayton Steam Generator which operates on the principle of forced circulation of water through a single tube. This water tube is of a specially designed coil construction and has been developed to maximise heat transfer and minimise energy loss.

In the upper part of the coil, the tube is wound into flat reels which are arranged in layers. Water entering the steam generator is directed to the topmost layer from where it spirals downwards through each level to the lower part of the boiler. In this lower section, the tube forms a cylindrical shield around the combustion chamber. Heat loss is reduced to a minimum since the combustion chamber is enclosed by the water wall at the sides - and the coil layers above.

One of the main advantages of this design is that the steam generator

The Boilerhouse

contains only a small volume of water and is therefore safe and can be started up very quickly from a cold condition.

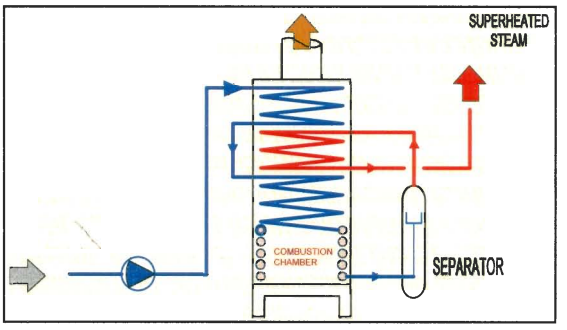
Because the installation was an extension to a fully operational plant, Mitsui Babcock had to work within a number of constraints during the project.

The building, which houses the steam generator, had to be located in a strategic position and be designed to fit-in with its surroundings. To do this it was necessary to move some existing plant to make way for a new, custom designed, building, and as a result of the limited space available, the internal floor area was restricted to only 7 metres by 5 metres.

The steam generator can be operated with limited monitoring from the main control room which is the nerve centre of the entire plant. Once the start sequence has been initiated, the generator automatically runs through a series of safety checks before steam is produced. Boiler feedwater is forced through the coil by variable speed, positive displacement, diaphragm, 'packless' type pumps which are designed by Clayton to ensure stability of flow over a wide

The Clayton Pumps

range of varying pressure conditions. As the water passes through the steam generator it picks up heat, and steam is produced at the outlet from where the flow is directed to a



Superheated Steam Production in a Clayton Steam Generator

pressurised separator vessel. The required superheat is then obtained by feeding this dry steam back to the steam generator where it passes through an integral superheat coil before entering the main steam system leading to the sealing glands of the steam turbine.

As part of the new system a feedwater deaerator for the steam generator had to be mounted at a high level in a separate part of the plant and the steam, condensate, blowdowns, and fuel lines had to be laid around the site. Paul Terry, who was the Mitsui Babcock Project Manager for the job said, *"The complete design, installation and commissioning procedure had to be planned to the last detail and this ensured that we were able to complete the work without imposing any downtime whatsoever on the station. The successful outcome of this project is a credit to all concerned."*

One of the major considerations was the need to minimise the pollution effect on the environment. For this reason the Clayton Steam Generator was fitted with a special low NOx gas burner. This burner ensures that combustion of the gas and air mixture takes place in such a way that pollution is reduced to a minimum and, because the burner is of Clayton design and manufacture, it can be matched to suit the individual steam generator. Although the predicted NOx level was specified at less than 60 mg/Nm^3, levels of below 25 mg/Nm^3 are being achieved in practice.

Before the new auxiliary steam system was installed, the power station had to vent the main steam supply to atmosphere for a longer period to allow the pressure to come up to the desired level for gland sealing. By reducing this vent of steam to atmosphere the new system not only saves energy, water, and water treatment chemicals but also enables the gas turbines to achieve best possible emissions in a shorter time and production of electricity up to base load to begin sooner.

An added bonus of using a steam generator for this application is that steam can be made available to preserve the vacuum in the turbine during an emergency trip condition, or overnight if required, thus allowing a more speedy return to service. The installation has allowed for future developments such as utilisation of the steam output from the generator being used for sparging the HRSG's and pre-warming other systems and equipment.

AES Medway Operations are continually looking for improvements that use the best available technology. Norman Bell commented, *"This project epitomised our AES culture and values with the selection of the coil steam generator being a move away from tradition but totally in keeping with modern CCGT plant construction philosophy".*

Clayton

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