

GM/00592 Greatham Replacement Boilers

Environmental Permit Variation - Commissioning Plan

Background

The existing Greatham boilers are approximately 88MW gross thermal input (80MW net) with a nameplate steam capacity of 98 tonnes per hour and will have non-compliant NO_x emissions at the end of June 2020. The Industrial Emissions Directive (IED) limit for existing Large Combustion Plant (defined as >50MW gross thermal input) after that date is <100 mg/Nm³. The current emissions are in the region of 200-250 mg/Nm³ with a consent limit of 400 mg/Nm³.

The Project

Four new steam boilers will be sited on the land previously occupied by the Black End which stopped operation in 2002 and was subsequently demolished in 2006. The new plant will have a gross thermal input of 90MW (81.6MW net), NO_x emissions of <60 mg/Nm³ and CO emissions of <15 mg/Nm³ to comply with the BAT conclusions.

Up to 108 tonnes per hour steam will be raised at 24barg and 255-273°C (there is no material change to the operating conditions). Each boiler is to be fitted with a 'steam raiser' that will route up to 10 tph steam to atmosphere through a silenced vent to allow a minimum temperature of 255°C to be achieved before steam is permitted to enter the main. This is a Greatham process constraint being imposed on the project design to prevent production interruption due to the presence of poor quality steam in the main and addresses an existing issue.

A new 40m high shared stack will be sited centrally to the east of the boilers and will be fitted with a Continuous Emissions Monitoring System (CEMS) and manual sampling points.

The existing boiler plant and stack will be demolished after the new boilers are commissioned and is expected to take place in 2021

Timing

The new boilers are expected to be delivered to Site in July 2019, with civils preparations already in place and the remaining construction activities completed early in Q1 2020. This allows commissioning to proceed and be completed before the June 30th 2020 deadline

Commissioning

There are limits to the availability of boiler feed water (BFW) and natural gas for commissioning if the Site is operating at full production capability. Total BFW is limited to approximately 110tph made up from 100tph softened water and up to 10tph condensate return. The Site maximum steam demand is approximately 94tph.

Natural gas is limited to 122.6MW (Site Hourly Quantity, SHQ) contractually and the Site consumption sometimes exceeds 100MW. Therefore, it is unrealistic to expect to be able to operate more than one new boiler at maximum fire (100% MCR) to atmospheric vent during commissioning. Each boiler will take two weeks to commission. Activity is expected to be on day working basis ie 8-10 hour days, 5 or 6 days per week over a 2 month period.

A temporary, silenced atmospheric vent, is to be installed on the steam main close to the new boiler plant to effect single or multi boiler proving and sized to allow 27tph steam to vent to atmosphere. Each boiler will be proven in turn followed by two boilers operating together at part load (13.5tph each) and perhaps three boilers at low load (9tph each). The boiler combustion gases will be routed to the new shared stack, at all times during commissioning. During this time the new boilers will remain isolated from the existing steam main and the Site will continue to operate from the existing supplies (Existing boilers and COCOS WHBs). This commissioning activity will require closely coordinating between the Site and Project teams.

The boiler/burner design utilizes flue gas recycle (FGR) to limit O₂ content in the combustion air and therefore flame temperature in order to limit the formation of NO_x. The FGR range available on the chosen design is 0-30% of total combustion air and this will assist in the burner tuning to achieve optimum operating conditions and minimum emissions.

Commissioning of the boilers will be carried out with the assistance and leadership of both Cochran and Dunphy, the boiler and burner manufacturers respectively. The CEMS manufacturer will also be present to commission the flue gas monitoring equipment.

Effect on the environment

Prior to the new steam main being made live to the Greatham process, the maximum steam emitted from the commissioning activity will be 27tph. This will then determine the upper limit of the combustion gases and therefore NO_x and CO emitted in addition to the existing boiler plant.

The NO_x limit of 60 mg/Nm³ and CO limit of 15 mg/Nm³ is guaranteed by the boiler vendor. The actual emission is expected to be lower, but for the purposes of this exercise the daily average value of 85 mg/Nm³ will be used.

Due to the limit of BFW (110tph) to the Site and the need to route 27tph to the commissioning activity, no more than 83tph can be allowed for Site production which is a shortfall on the maximum demand rate of 94tph. This can be adequately managed.

During commissioning, the new boilers (one equivalent) are assumed to emit at half rate for half of the time and full rate for half of the time. Commissioning operation time is assumed to be 10 hours per day for 6 days per week for 8 weeks, although steam generation will not take place for the whole time.

	NO _x concentration (mg/Nm ³)	Steam demand (tph)	Existing normal emission factor	Existing maximum Emission factor	Additional maximum emission factor
Current operation					
Maximum steam demand		94			
Maximum NO _x emitted (current consent limit)	400			37600 (94*400)	
Normal NO _x emitted (current actual)	250		23500 (94*250)		
Commissioning period					
Maximum boiler feed water available to new and old plants during commissioning		110			
Max additional steam raised during commissioning		27 (vented to atmosphere)			
Max additional NO _x emitted during commissioning	85				2341 (27*1.02*85)
Max steam demand from existing boilers during commissioning	250	83 (110-27)	20750 (83*250)		

Assumptions:

- 1) New boiler combustion gas volumetric flowrate is 2% larger than existing boilers (new boilers 90MW gross thermal input (81.6MW net) versus existing boilers 88MW gross thermal input (80MW net))
- 2) For comparison purposes, a numerical value of NO_x emission factor is calculated by multiplying the steam generated by the NO_x emitted. This is inflated by 2% for the new boilers
- 3) Maximum BFW available is 110tph. Using 27tph for commissioning (all vented to atmosphere) leaves 83tph that can be used for Site production purposes and this is a manageable situation.
- 4) Current actual NO_x emission is within the range 200-250 mg/Nm³. A value of 250 has been used for this comparison.
- 5) The maximum additional NO_x emitted during commissioning is assumed to be equivalent to the daily average value of 85 mg/Nm³

Therefore, in terms of maximum hourly impact, the commissioning activity (Additional maximum emission factor) plus the Existing normal emission

factor during commissioning from the existing boilers is less than the emission at full site demand i.e. $(20750+2341) < 23500$ and much less than maximum allowable (37,600)

It should be noted that the new boiler emission of $60 \text{ mg/Nm}^3 \text{ NO}_x$ is approximately a quarter of the current emission and 15% of the current consent.

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