SIMPLE GUIDE TO CHPQA MONITORING

Abstract

This is a simple guide to CHPQA monitoring, addressing what needs to be monitored, how this is done and the accepted monitoring arrangements.

CHPQA Administrator

chpqainfo@chpqa.com

1. Introduction

The ‘Simple Guide To’ series is designed to assist Responsible Persons (RPs) in understanding various aspects of the CHPQA process. The content here is a simplified and condensed form of that found in the detailed Guidance Notes 13-16 which are outlined below and can be accessed online with the following hyperlinks. References are made to these and other guidance notes in the form “**GNXX.X**” which refer to paragraphs within the detailed guidance notes. In any cases of doubt, please refer to the detailed guidance notes as they are comprehensive and shall always take precedence.

Detailed Guidance Notes:

GN13 – CHP Scheme Monitoring Information

GN14 – CHP Scheme Energy Inputs Information

GN15 – CHP Scheme Power Outputs Information

GN16 – CHP Scheme Heat Outputs Information

CHPQA Guidance Notes:

https://www.gov.uk/guidance/chpqa-guidance-notes

To be able to report performance data to the CHPQA programme, Schemes must have an appropriate monitoring arrangement in place to determine a Scheme’s energy inputs and outputs. The benefits available to a CHP Scheme is dependent on its performance, accurate monitoring of a Scheme’s performance is therefore essential in ensuring that the correct fiscal benefits are received.

The RP is required to maintain records of monthly and annual energy inputs and outputs and retain the records for a minimum of six years. Records of heat and power metering and equipment calibration should also be maintained by the RP.

2. What data is required to be monitored by CHPQA?

For CHPQA to assess a Scheme's performance, there are three key performance values that need to be monitored:

Total Fuel Input (CHP_{TFI})

The CHP Total Fuel Input (CHP_{TFI}) is the annual fuel input to a CHP Scheme (in MWh) and is used in the calculation of the power and heat efficiencies (η_{Power} and η_{Heat}). The fuel inputs must always be based on the Gross Calorific Value (GCV) of the fuel (also referred to as Higher Heating Value or HHV).

Total Power Output (CHP_{TPO})

The CHP Total Power Output (CHP_{TPO}) is the annual gross electrical or mechanical energy output of a CHP Scheme (in MWh) and is used in the calculation of the power efficiency (η_{Power}).

Qualifying Heat Output (CHP_{QHO})

The CHP Qualifying Heat Output (CHP_{QHO}) is the annual amount of useful heat supplied from a CHP Scheme (in MWh) and is used in the calculation of heat efficiency (η_{Heat}).

3. How should it be monitored?

The monitoring of a CHP Scheme is typically achieved by the installation of fuel, heat and power meters. In some circumstances, CHP energy inputs and outputs cannot be metered directly and must be indirectly determined via calculation. The accepted monitoring methods are described in the sections below:

3.1. Fuel monitoring

Conventional Fuels - These are typically a fossil fuel such as natural gas, oil, or coal. Natural gas should be monitored using a utility or billing meter; the meter will record the volume of gas consumed, the energy equivalent should then be derived using the calorific value stated on a supplier's gas bill. For oil products, the volume of oil burned in the CHP Scheme will need to be recorded either with a volume flow meter or evidenced by fuel purchase documentation along with records of oil inventories (opening and closing stock). Just as for natural gas, the fuel supplier's declared calorific value is the accepted true calorific value for commercial fuel oils.

Alternative Fuels - These are typically a sustainable or renewable fuel such as biofuels, wood fuels, or industry by-products. Many alternative fuels are solid (such as wood fuels and municipal waste) and so cannot be easily metered directly. Accepted methods of monitoring solid fuels include: using a weighbridge to record the weight of incoming fuel deliveries and using visual indicators on the amount of fuel remaining in a fuel store. The calorific value of an alternative fuel may not be readily available from a fuel supplier and so a method of estimation or laboratory analysis of its calorific value may need to be conducted. The method of determining an alternative fuel's calorific value will need to be agreed with CHPQA. See GN14 and GN29 for more information on the determination of alternative fuel calorific value.

See GN13 and GN14 for further detailed information on fuel monitoring requirements.

3.1. Power monitoring

The power outputs of a CHP Scheme are monitored using electricity meters. Electricity meters operate by continuously measuring the instantaneous voltage (volts) and current (amps) to determine energy generated (in kWh or MWh).

3.1.1. Power meters

For metering electricity, clearly labelled commercial/industrial three-phase electricity meters of billing quality should be used. It is important that the watt-hour meters, current and voltage transformers should be appropriately sized with accuracies suitable for the type and size of Scheme in question. More on this can be found in the accompanying ***Simple Guide to CHPQA Uncertainty***. Also, see GN13 and GN15 for further detailed information on power metering requirements such as accepted metering classifications and calibration requirements.

3.2. Heat monitoring

The monitoring of a CHP Scheme's heat output is typically achieved by the metering of the working fluid (usually hot water or steam). It is imperative that the monitoring arrangement can distinguish between 'Useful heat' to be included as part of CHP_{QHO} and exclude heat without any beneficial use, such as heat supplied to a hotwell or rejected to the environment. See the accompanying ***Simple Guide to Eligibility*** for more information on what is considered 'Useful heat'. In some circumstances, it may not be necessary to meter heat outputs – these are detailed in section 4 below.

3.2.1. Heat meters

Selecting an appropriate heat meter depends on the working fluid (water or steam), the operating ranges for flow rate, pressure and temperature, pipe diameter, whether the meter is battery or mains-powered, and whether the flowmeter is installed in the flow or return pipe. A heat or steam meter comprises three key components: a flow meter (flow sensor), pressure and/or temperature sensors and an integrator (calculator) with display.

Flow meter (flow sensor)

A flow meter measures the flow rate of the water or steam. It is usually installed within a return pipe.

Working Fluid Condition sensors

A matched pair of temperature sensors measure the temperature in hot water flow and return pipes. In a steam main, the sensors measure pressure and temperature.

Integrator (calculator)

This is the brain of the heat meter. It takes the flow rate and conditions provided by the other components to calculate and display the mass flow or the amount of heat generated (usually provided in kWh or MWh).

If measuring steam, the energy output should be calculated to a datum point of 10°C. See **GN13** and **GN16** for further detailed information on heat metering requirements such as accepted metering classifications and calibration requirements.

3.3. Calculated energy inputs & outputs

For some Schemes it may be acceptable to indirectly calculate the energy inputs and outputs instead of metering them directly. Such an example could be where high-pressure steam to a back-pressure steam turbine is metered, but the exhaust steam that is supplied to the site across the Scheme boundary is not metered nor is its condition (pressure and temperature) monitored. Where a calculated energy input or output is to be used in the reporting of a Scheme's performance, the calculation methodology must be agreed with CHPQA Administrator. The uncertainty of a calculated energy input or output must be determined using the methodology set out in GN18.

The following situations are not considered to be "calculated" energy inputs and outputs and would instead be considered "metered":

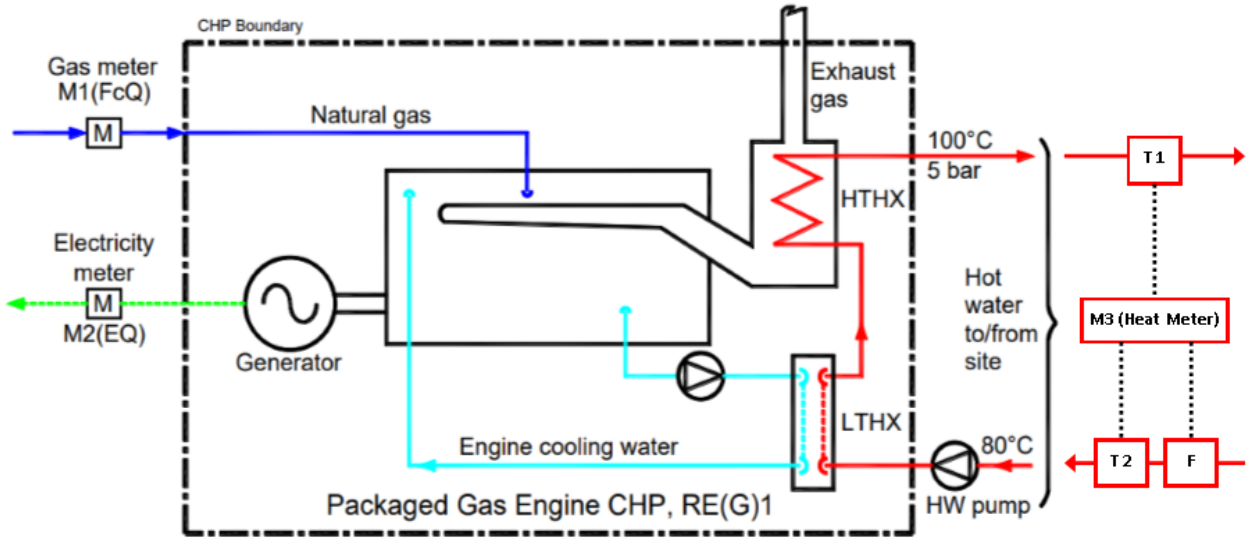
- data processing, such as conversion of units, which may include the application of factors such as specific enthalpy or calorific values.
- the summation of the reported values for several meters.
- the deduction of a metered or calculated steam flow that is used within the Scheme boundary (e.g. steam to hot well or deaerator, or gas turbine steam injection)

4. What are the accepted monitoring arrangements?

The CHPQA Programme has four accepted monitoring arrangements for Schemes falling under certain criteria. These are: Reciprocating Engine (RE) based schemes below 500kW$_e$ with no Heat Rejection Facility (HRF), RE based schemes below 2MW$_e$ with no HRF, schemes below 2MW$_e$ with a HRF and schemes over 2MW$_e$. These have been detailed in the table and diagrams below:

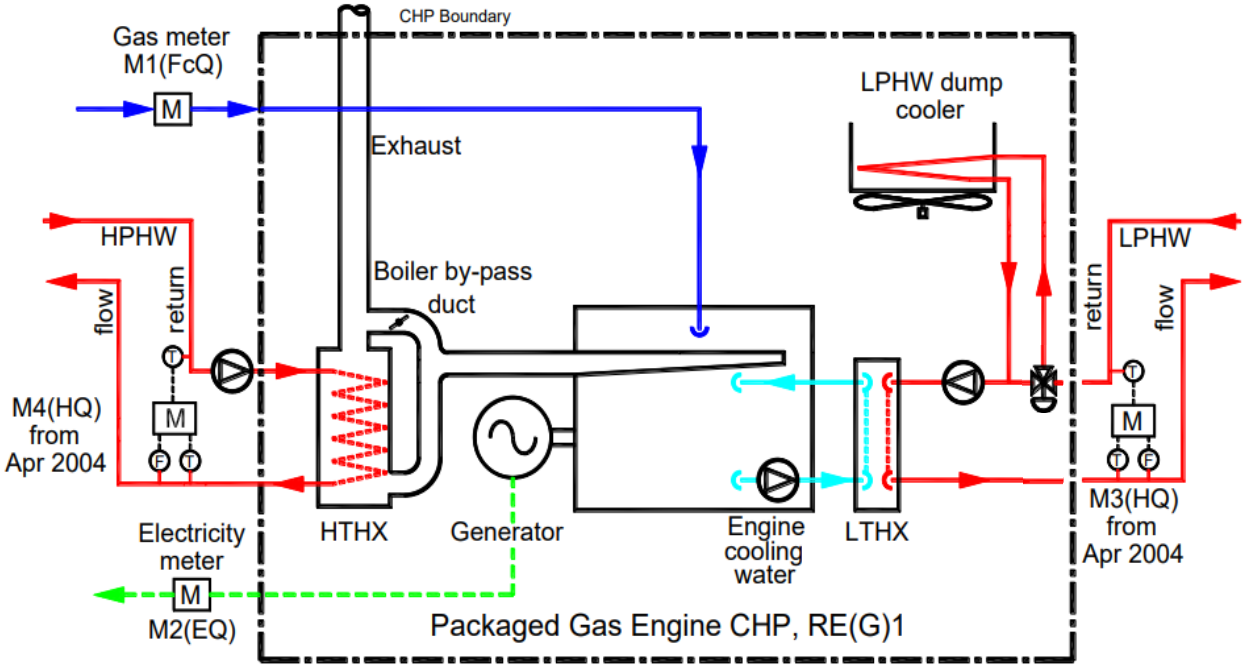
Energy input/output	**Reciprocating Engine (RE), no Heat Rejection Facility (HRF), <500kWe and <2MWe**	**<2MWe & with HRF**	**>2MWe**
CHP_{TFI}	If a single RE CHP <500kWe on the CHPQA Unit List, with no HRF, then fuel input can be estimated using the design power efficiency and the metered power output. Otherwise, claimed fuel input must be metered.	Fuel input to the CHP plant must be monitored (and monitored separately to any other non-CHP user of the same fuel supply).	
CHP_{TPO}	Power output must be metered.		
CHP_{QHO}	If a single RE CHP under 500kWe with no HRF then heat output can be estimated using the design heat to power ratio and the metered power output. Otherwise, claimed 'useful heat' must be metered.	Claimed 'useful heat' must be metered. Rejected heat must NOT be included with 'useful heat'.	Claimed 'useful heat' must be metered. Rejected heat must NOT be included with 'useful heat'. Exported heat to customers must be monitored and legitimately used. Evidence of how exported heat has been used must be provided.

4.1. No HRF, < 500kWe and < 2MWe

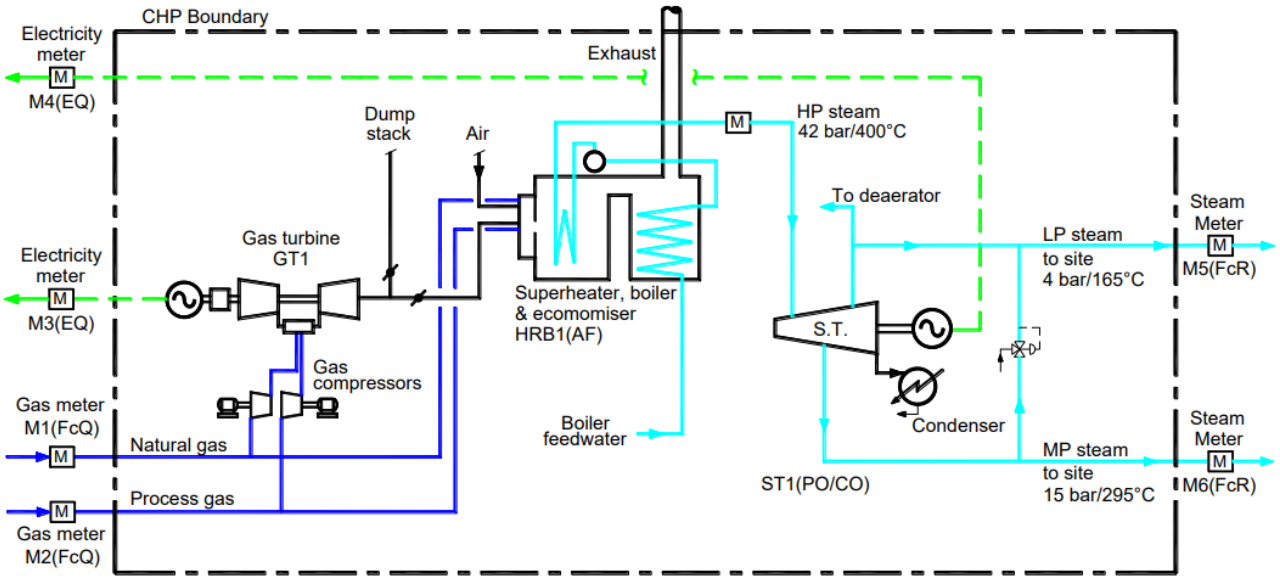


NOTE: Heat meter M3 is not needed when the RE is <500kWe capacity. Heat output can be determined by multiplying the power output (from M2) by the design heat to power ratio of the engine. Similarly, if the RE is <500kWe, the fuel can be determined by multiplying the power output (from M2) by the design power efficiency the engine (if the engine is on the CHPQA Unit List).

4.2. < 2MWe & With HRF



4.3. > 2MW$_e$



4.4. What evidence of the monitoring arrangement do I need to submit to CHPQA?

When making an application to CHPQA it is necessary to detail a Scheme's monitoring arrangement via a Scheme Line Diagram (SLD) and by providing monitoring details in forms F3 or F2 (dependant on whether it is a new or existing Scheme). A Scheme's monitoring arrangements will also be subject to inspection as part of the CHPQA audit.

4.4.1. Scheme Line Diagram (SLD)

It is necessary to submit a Scheme Line Diagram (SLD) to CHPQA showing the CHP Scheme and its relationship to the site. It should detail the Scheme's monitoring arrangements, the main plant items that lie within the CHP Scheme boundary, their interconnections, any piping and cables carrying fuel and energy inputs, as well as power and heat outputs (steam, hot water, or exhaust gas, as applicable). Examples of accepted SLDs are shown in sections 4.1-4.3, generic SLDs can be downloaded here.

The key points to be aware of when constructing this diagram are:

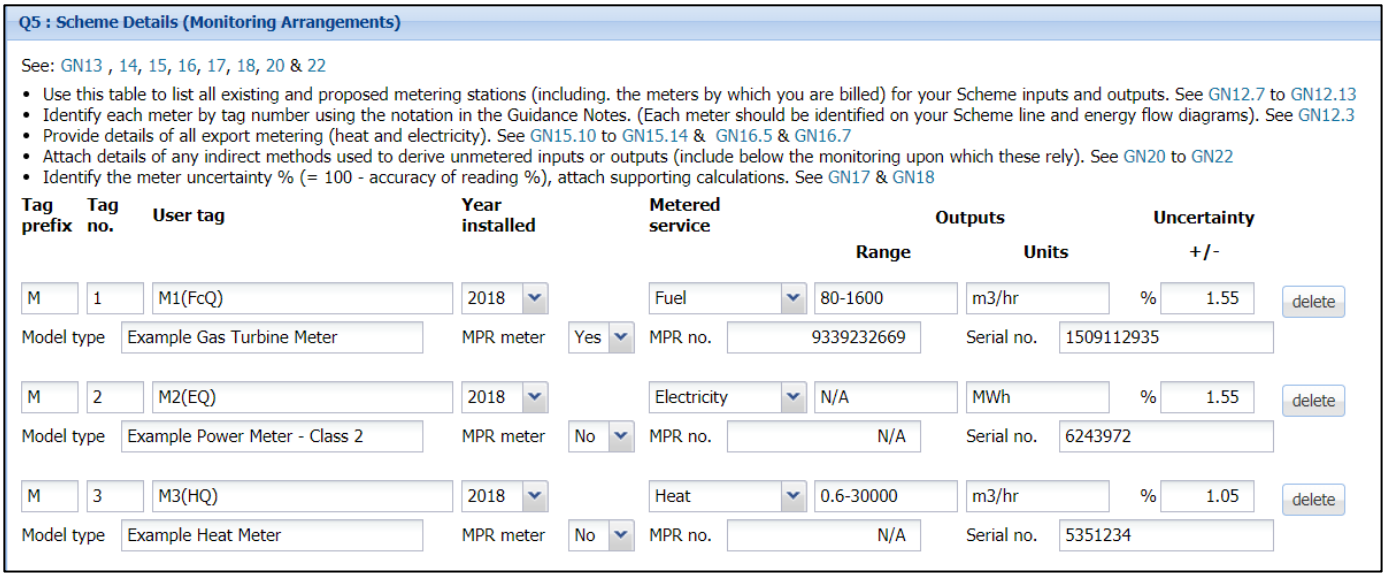
- highlighting the location of all meters.
- highlighting the CHP Scheme boundary.
- showing whether there is a Heat Rejection Facility (HRF) and how the location(s) of the heat meter(s) account for this.

4.4.2. Meter Details

Details of the metering arrangement must be provided to CHPQA on either the F2 or F3 forms (depending on whether it is a proposed or existing Scheme). The following details are requested in form F2:

- Make and model
- Year of installation
- MPR number (if mains gas meter)
- Capacity/range of the meter
- Serial number
- Design uncertainty

An example of a completed monitoring arrangement section of an F2 form is shown below:



Q5 : Scheme Details (Monitoring Arrangements)

See: GN13 , 14, 15, 16, 17, 18, 20 & 22

- Use this table to list all existing and proposed metering stations (including. the meters by which you are billed) for your Scheme inputs and outputs. See GN12.7 to GN12.13
- Identify each meter by tag number using the notation in the Guidance Notes. (Each meter should be identified on your Scheme line and energy flow diagrams). See GN12.3
- Provide details of all export metering (heat and electricity). See GN15.10 to GN15.14 & GN16.5 & GN16.7
- Attach details of any indirect methods used to derive unmetered inputs or outputs (include below the monitoring upon which these rely). See GN20 to GN22
- Identify the meter uncertainty % (= 100 - accuracy of reading %), attach supporting calculations. See GN17 & GN18

Tag prefix	Tag no.	User tag	Year installed		Metered service	Outputs Range	Outputs Units	Uncertainty +/-	
M	1	M1(FcQ)	2018		Fuel	80-1600	m3/hr	% 1.55	delete
Model type	Example Gas Turbine Meter	MPR meter	Yes	MPR no.	9339232669	Serial no.	1509112935		
M	2	M2(EQ)	2018		Electricity	N/A	MWh	% 1.55	delete
Model type	Example Power Meter - Class 2	MPR meter	No	MPR no.	N/A	Serial no.	6243972		
M	3	M3(HQ)	2018		Heat	0.6-30000	m3/hr	% 1.05	delete
Model type	Example Heat Meter	MPR meter	No	MPR no.	N/A	Serial no.	5351234		

5. Further Information

5.1. Further guidance

See the accompanying series of ‘Simple Guide to’ guides and the detailed guidance notes here: https://www.gov.uk/guidance/chpqa-guidance-notes

5.2. Contact Us

In the first instance, all queries on CHPQA should be directed to the CHPQA helpline, or emailed to the Administration team using the details below:

CHPQA Helpline:

- Tel: 01235 753004
- E-mail: chpqainfo@chpqa.com
- Website: https://www.gov.uk/combined-heat-power-quality-assurance-programme