

CHPQA PROGRAMME

Metering Requirements & Data Quality

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Introduction

- Metering of fuel input and power and useful heat outputs is an essential requirement of CHPQA
- CHPQA auditors usually ask for proof of meter uncertainty, calibration certificates and completed Guidance Note 17 (GN.17) uncertainty sheets
- A brief overview is given here:
 - with references to the main CHPQA Guidance Notes 13 – 19, and
 - some additional discussion on heat outputs

Metering Requirements

- An appropriate level of metering is good practice, in terms of monitoring and improving CHP Scheme performance
- It should be designed, manufactured and installed to an acceptable standard and sound practice as given by British, European (EN) or International (ISO) Standards and Guides
- Associated calibration procedures & timescales should similarly be robust but these very often already form part of the site's existing QA System (e.g. ISO9001).

What should be monitored?



- Fuel Inputs (e.g. natural gas, biogas, biodiesel, coal, etc.)
 - Fuel input should be monitored in basic units (e.g. m^3) and converted to MWh using gross calorific value (GCV)
 - Evidence of GCV should be available and provided during audits
- Generated Power Outputs
- Useful Heat Outputs associated with the CHPQA scheme



Meter Uncertainty

- Metering should be done to a specified standard of accuracy so need to know the % uncertainty (error band) on the metered figures
- According to CHPQA, overall meter uncertainty is affected by (i) the meter uncertainty, (ii) time elapsed since last calibration and (iii) fluctuations in fluid properties
- For many meters, these figures can be readily obtained from data sheets/calibration certificates without requirement for further work

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The effect of 'time elapsed since last calibration'

- If a meter is out of calibration, the % uncertainty applied to quantities metered by this meter will increase
- Details on what this should be are provided in GN.17
- These %s are based on the meter type/component and the time elapsed since calibration or inspection, for example:

Values for additional uncertainty due to time elapsed since last calibration of transmitter		Values for additional uncertainty due to time elapsed since last calibration of primary device	
> 2-3 years	2%	> 5 – 7 years	3%
> 3 – 5 years	4%	> 7 – 10 years	7%
> 5 years	10%	> 10 years	10%

CHPQA Metering Requirements

- In our Guidance (GN13), we provide a table of maximum uncertainties deemed to be “best practice” for the measurement of energy flows of different types
- Meters that comply are deemed to be best practice and no adjustments to their output values are required

CHPQA Metering and Uncertainty Requirements

• Fuel Inputs, kWh	±2.0% of reading	GN14
• Energy <u>inputs</u> as steam or hot water, kWh	As for steam or hot water as appropriate (see below)	
• Heat metering, of hot water, thermal fluid or other liquid heat circulating loops, kWh,	Metering to BS EN 1434-1:2007, metrological Class 3 (typically 4.5% of reading) with concessions for Schemes with TPC <2MWe	GN16
• Heat metering of steam flows, kWh	±2.0% of full scale or ±3.0% of reading	GN16
• Electric power, kWh	Metering to applicable BS and Class dependant on rating.	GN15

Summary

- You must know the uncertainty (error band) on the metered or derived values of all energy inputs and outputs to the CHP Scheme
- These may be based on the meter manufacturers' specs or on accepted standards
- If need to calculate, must take into account all components of the measurement (e.g. sensor, transducer etc.)
- Must determine if compliant with CHPQA's metering requirements.

Run into Problems?

- RPs would normally use their own values, supported by documentation and calculation when determining the overall uncertainty of a metering system.
- However, our guidance provides a *simplified* approach that can be used for determining overall uncertainties where it is difficult to determine actual figures when assessing the overall uncertainties of their various flow meters
- This offers R.P.s default values from tables against each uncertainty element , pick those that apply and, if appropriate, add together to get the **overall uncertainty value**. We have 'uncertainty' worksheets to help with this calculation.

The Uncertainty Worksheet

- Complete for each flow meter that forms part of the self-assessment (except for metering of minor streams)
- This applies whether a direct measure of an energy input or output, or an input to a used calculated value.
- You may choose to use our default values, or use your own values, (or a mixture) when filling up the worksheet
- Where 'claimed' uncertainties, other than the default values are used these must be justified
- **INCLUDE WITH F4 SUBMISSION**

Non-compliance with Metering Requirements



- Uncertainty adjustments must be applied (with the exception of simple schemes <2MWe)
- These factors are incorporated into the efficiency calculations in Self Assessment Form F4 and thus impact on the resultant power efficiency and QI.

What is an 'Uncertainty Adjustment'

- The excess uncertainty is the amount by which the overall uncertainty exceeds the permitted uncertainty for “best practice” .
- This is used to determine the individual adjustment factor for the flow measurement
- Eg: If overall uncertainty is 4.85% and acceptable uncertainty is 3% then excess uncertainty or adjustment factor, is 1.85%
- For minor energy streams (<10% of annual total), default individual adjustment factors for ‘energy’ inputs, ‘power’ outputs and ‘heat’ outputs can be found in the Guidance.

Flow Meter Uncertainty

Flow Meter	Tag Number: M9(FQ)		Metered fluid: MP Steam		
Line conditions	Pressure, bar(gauge)	10	Temperature, °C	200	
Meter type – Primary device (tick appropriate box)	Orifice Plate <input checked="" type="checkbox"/>	Venturi	Averaging pitot	“V-cone”	“Gilflow”
	Vortex shedding	Coriolis	Turbine	Other (please specify)	
Table of Uncertainties	Ref GN	Effective Uncertainty Ue			Ue²
		Default value of Ue, %	Claimed value of Ue, %	Ref to source data attached	
Primary meter uncertainty	17.34	1.0	0.72	O/P data sheet	0.5184
Transmitter and computations	17.35	1.0		1.0	1.0000
Fluctuations in fluid properties	17.36 to 17.44	Table GN17-2: 3.0 Uncompensated SH Steam			9.0000
Time elapsed since last calibration (transmitter to output value)	17.45	Table GN17-3: 2.0 30-months	Use default value		4.0000
Time elapsed since last calibration or inspection of primary flow device	17.46	Table GN17-4: 3.0 6-years	Use default value		9.0000
Sum of all Ue² = U²				Total	23.5184
Overall Uncertainty, Uo = Square root U²					4.85%
Acceptable Uncertainty for “Best Practice”, UBP (GN17.12-GN17.14)					3.00%
Excess Uncertainty, Ux = Uo minus UBP (Ux = 0 if Uo < UBP)					1.85%

1-0.0185
=0.9815
Adjustment
Factor

WORKSHEET FOR HEAT OUTPUTS – UNCERTAINTY ADJUSTMENT FACTOR

Each adjustment factor is weighted in proportion to its annual contribution to the annual scheme heat output.

For minor energy streams (<10% of annual total), not necessary to derive 'uncertainty' but a default individual adjustment factor must be applied.

Meter or Calc. No.	Description of Output (e.g. MP steam to site)	Annual Heat Output (From Form F4, Section 6c) (Absolute values)	Fraction of QHO F	Acceptable Uncertainty for Best Practice UBP	Actual Uncertainty Uo	Excess Uncertainty Ux = Uo - UBP (if $U_o < U_{BP}$, $U_x = 0.00$)	Individual Adjustment Factor Fi = $1 - (U_x/100)$	Weighed Adjustment Factor Fw = $F \times F_i$
		MWh	(4 decimal places)	% (2 decimal places)	% (2 decimal places)	% (2 decimal places)	(4 decimal places)	(4 decimal places)
M8(FQ)	LP steam to site	37,350	0.3260	3.000	7.68	4.68	0.95328	0.3107
M9(FQ)	MP steam to site	77,220	0.6740	3.00	4.85	1.85	0.9815	0.6615
The line below is to be completed only where the concessions offered for minor energy steams is to be used								
	Minor heat outputs			N/A	N/A	N/A	0.9000	
	Total	114,570	1.0000		Overall Adjustment Factor FOH (= sum of Fw Factors)			0.9722

CHP Scheme Efficiency (F4)

$$\eta_{Power} = 100 \times \frac{(CHP_{TPO} \times F_{OI})}{(CHP_{TFI} \times F_{OI})} = \text{_____}\%$$

$$\eta_{Heat} = 100 \times \frac{(CHP_{QHO} \times F_{OH})}{(CHP_{TFI} \times F_{OI})} = \text{_____}\%$$

Non-complying inputs shall be increased by a factor based on the excessive uncertainty.

Non-complying outputs shall be reduced by a factor based on the excessive uncertainty.

Heat Monitoring



CHP Scheme Heat Outputs

- Aim is to determine useful heat supplied to the process
- Excludes heat rejected to environment which therefore is not put to use (heat lost from chimneys or exhaust & heat rejected in equipment such as condensers & radiators)
- Also excludes steam used within the CHP Scheme for de-aeration, condensate heating, make-up/boiler feed water heating.



CHP Scheme Heat Outputs

- Remember that for ‘heat output’ to qualify as ‘useful heat’, it must be demonstrably utilised to displace heat that would otherwise be supplied from other energy sources -i.e. **delivered to satisfy an economically justifiable demand for heat or cooling**
- Where heat is supplied off site, details of non-residential heat customers must be provided.



Remember

- **If you don't have any heat metering and have the facility to dump heat; you can't be certificated by CHPQA**
- Simple RE schemes below 2MWe using circulating hot water are not required to meter heat outputs, if no heat rejection facility is installed (can use H:P ratio and the metered power output to determine heat).