

GUIDANCE NOTE 13

CHP SCHEME MONITORING

GN13.1

Before the relevant Sections of these Guidance Notes are considered, the following terms should be read and understood.

- **CHP Total Fuel Input (CHP_{TFI})** is the total registered annual fuel input to a CHP Scheme (MWh), based on GCV. This includes any fuel used for pilot burners or other 'parasitic' uses and fuels of all types whether Conventional or Alternative.
- **CHP Total Power Output (CHP_{TPo})** is the total annual power generation from a CHP Scheme (MWe), as measured at the generator terminals, plus the electrical equivalent of any qualifying mechanical power supplied by the Scheme.
- **CHP Qualifying Heat Output (CHP_{QHo})** is the registered amount of useful heat supplied annually from a CHP Scheme (MWhth). It is the heat output that is demonstrably utilised to displace heat that would otherwise be supplied from other sources.
- **Quality Index (QI)** QI is calculated using the above three sets of annual data.
- **CHP Qualifying Fuel Input (CHP_{QFI})** is the registered annual fuel input to a CHP Scheme qualifying as input to Good Quality CHP (MWh), based on GCV.
- **CHP Qualifying Power Output (CHP_{QPo})** is the registered annual power generation from a CHP Scheme (MWe) that either fully or partially qualifies as Good Quality CHP.
- **CHP Qualifying Power Capacity (CHP_{QPC})** is the registered power generation capacity of a CHP Scheme (MWe) that qualifies as Good Quality CHP.
 - Refer to GN25 for further guidance on CHP_{QFI} .
 - Refer to GN26 for further guidance on CHP_{QPo} .
 - Refer to GN27 for further guidance on CHP_{QPC} .

All monitored data should be unique to the CHP Scheme boundary, i.e. monitored separately from other site uses such as boilers, etc.

RECIPROCATING ENGINE (RE) BASED SCHEMES ≤ 2 MWe WITH NO HEAT REJECTION FACILITY:

GN13.2

Reciprocating Engine (RE) based Schemes ≤ 2 MWe with no heat rejection facility will be certified as Good Quality if, each year, evidence is provided of:

- **Total Fuel Input (CHP_{TFI})** CHP fuels, including back-up fuels, must be monitored separately from other uses i.e. where a common fuel source

supplies both CHP plant and non-CHP plant, separate metering of the fuel to the CHP plant boundary is required

- **Total Power Output (CHP_{TPO})** Electrical output must be metered, and Power Efficiency must be $\geq 20\%$ otherwise qualifying fuel inputs will be calculated using the CHP_{QFI} methodology. Basic checks can be performed on CHP_{TFI} , CHP_{TPO} and on load factor
- **Qualifying Heat Output (CHP_{QHO})** Qualifying heat output must be metered. However, there are arrangements for single RE based CHP Schemes of ≤ 500 kWe with no heat rejection facility, where the heat output may be estimated for the 12 months Self-Assessment period (where metered values are not available) by multiplying the design heat- to-power ratio from the CHPQA Unit list by the Total Power Output. When heat demand falls, such CHP Schemes must regulate their output and finally shut down, otherwise serious engine failure will occur. In these circumstances, in the absence of a heat rejection facility, no heat can be supplied beyond the site demand.

Calculation of QI will be required using the above three sets of data.

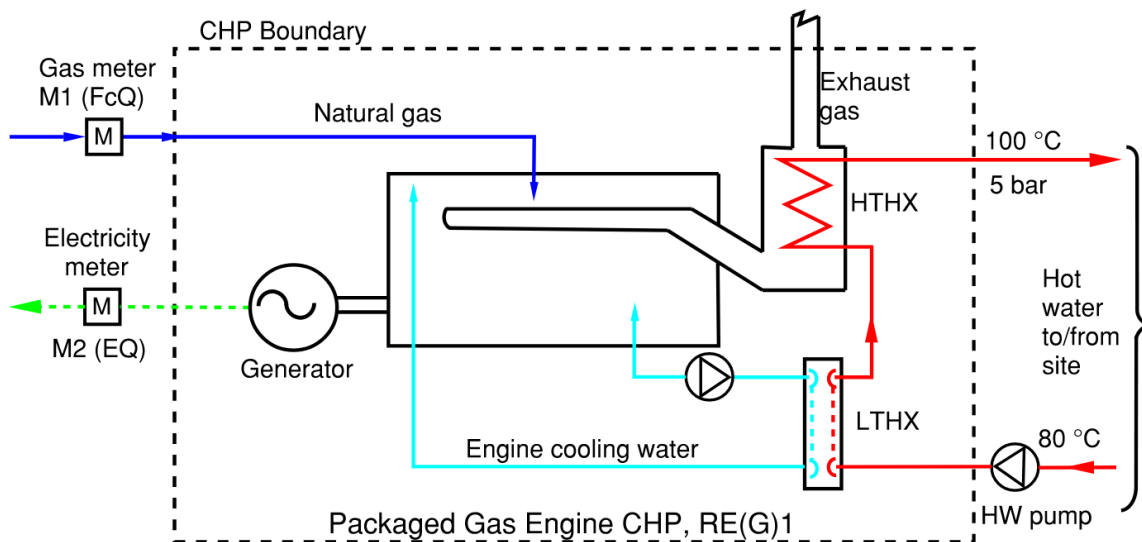


Fig GN13-1 Small-scale CHP Scheme with no Heat Rejection Facility

SCHEMES ≤ 2 MWe WITH HEAT REJECTION FACILITY:

GN13.3

Schemes ≤ 2 MWe with a heat rejection facility will be certified as Good Quality on the basis of evidence of the following:

- **Total Fuel Input (CHP_{TFI})** CHP fuels, including back-up fuels, must be monitored separately from other uses i.e. where a common fuel source supplies both CHP plant and non-CHP plant, separate metering of the fuel to the CHP plant is required. Some CHP Schemes in this range include back-up fuels such as oil, fed from a common tank also supplying oil-fired boilers.
- **Total Power Output (CHP_{TPO})** Electrical output must be metered, and Power Efficiency must be $\geq 20\%$ otherwise qualifying fuel inputs will be calculated using the CHP_{QFI} methodology. Basic checks can be performed on CHP_{TFI} ,

CHP_{TPO} and on load factor

- **Qualifying Heat Output (CHP_{QHO})** Claimed 'Useful heat' must be monitored in accordance with CHPQA **GN13.10** requirements. Refer to **GN16** for guidance on metering requirements.

Calculation of QI will be required using the above three sets of data

Calculation of CHP_{QPO} & CHP_{QPC} is required if the QI Threshold is not achieved.

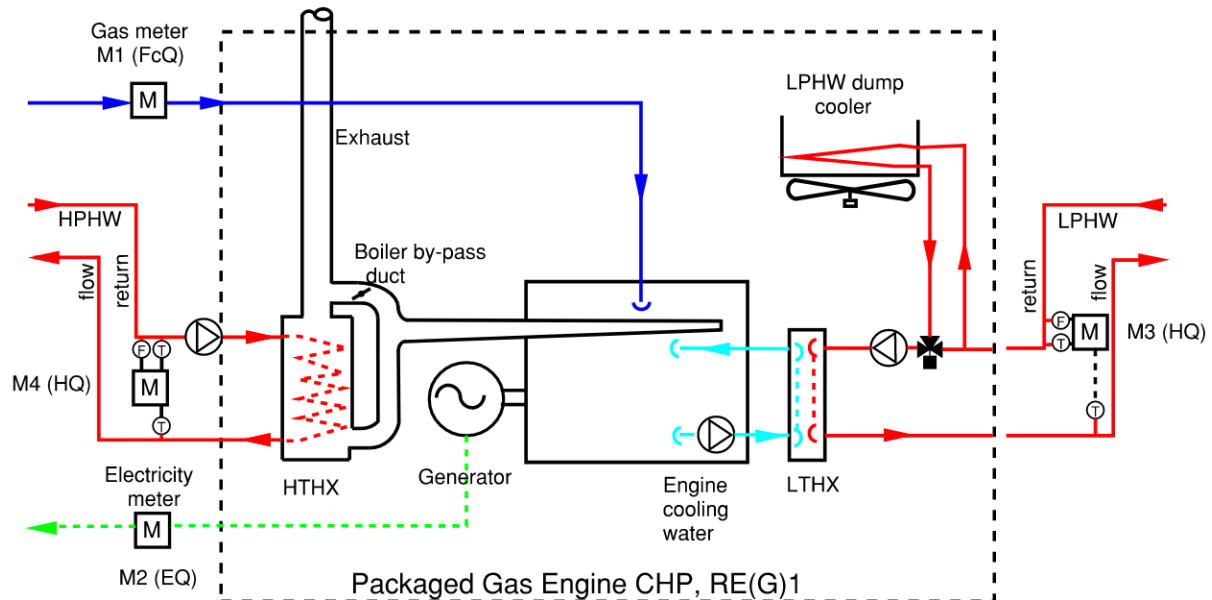


Fig GN13-2 Small-Scale Scheme with Heat Rejection Facility

SCHEMES > 2 MWe:

GN13.4

CHP Schemes having a rated power capacity (TPC) > 2 MWe are required to monitor all inputs and outputs to the specified standard of accuracy.

- **Total Fuel Input (CHP_{TFI})** CHP fuels, including back up fuels, must be monitored separately from other uses i.e. where a common fuel source supplies both CHP plant and non-CHP plant, separate metering of the fuel to the CHP plant is required
- **Total Power Output (CHP_{TPO})** Electrical output must be metered. Mechanical power outputs may be determined by indirect means and converted to an equivalent electrical output for including in the total power outputs
- **Qualifying Heat Output (CHP_{QHO})** Useful heat outputs must be monitored separately from other heat sources supplying the process. All exported heat must be monitored to declared customers who must legitimately use the heat. Evidence of usage of exported heat/steam must be provided.

Calculation of QI will be required using the above three sets of data

Calculation of CHP_{QPO} & CHP_{QPC} is only required if the QI Threshold is not achieved

GN13.5

It is recognised that where a heat output is not sold, e.g. heat is supplied to site, it is sometimes not monitored. In such cases, a monitoring system will need to be installed for CHPQA purposes, the details of which must be included in a Scheme's submission. Estimates of heat utilisation are not acceptable and should not be included in CHP_{QHO} until an appropriate monitoring system is installed.

GN13.6

Some CHP inputs and outputs cannot be metered directly. Examples include fuels of variable calorific value, the use of exhaust gases for drying, and mechanical outputs from prime movers or subsidiary steam turbine drives.

- Refer to GN20 for guidance on indirect determination of energy inputs.
- Refer to GN21 & 22 for guidance on indirect determination of outputs.

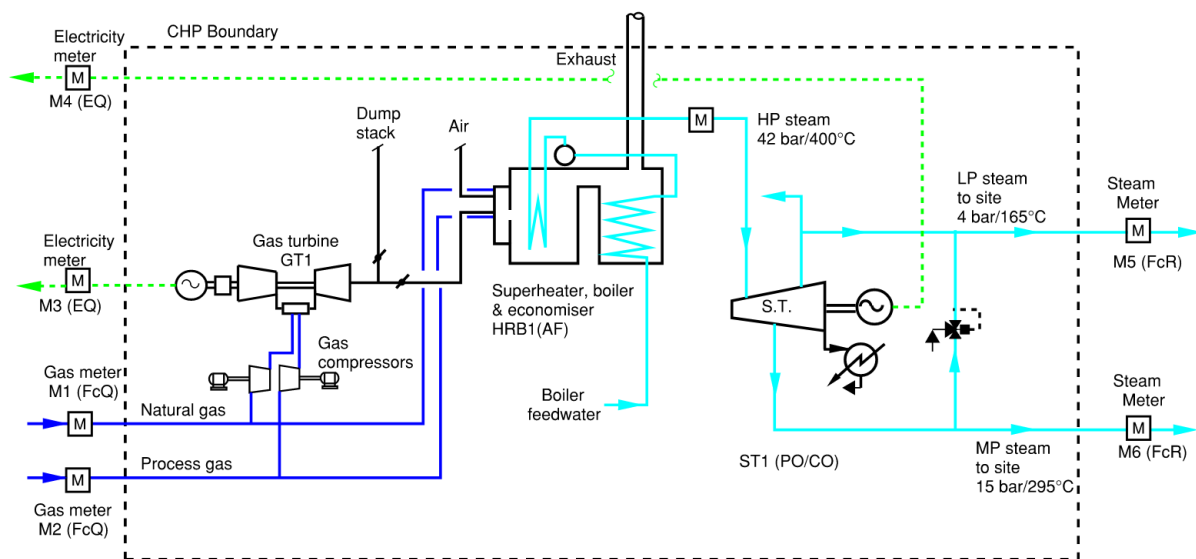


Fig GN13-3 Large-Scale Combined Cycle Gas Turbine (CCGT) CHP Scheme

METERING REQUIREMENTS

GN13.7

An appropriate level of metering is nothing more than good practice, in terms of monitoring and improving CHP Scheme performance. The outline requirements for monitoring each scheme type are in GN13.2 - 13.6 above. More detailed information on metering is provided below.

GN13.8

The metering installation should be designed, manufactured and installed to an acceptable standard and sound practice as given by British, European (EN), or International (ISO) Standards or Guides.

Where commercial transactions or tax arrangements are based on metered or measured quantities (e.g. custody transfer of fuel), such metering (the meter from which you are billed) or measurement will normally be regarded as sufficient for CHPQA purposes providing appropriate independent validation procedures are in place.

For all other metering arrangements (other than above), read the following requirements:

- Validation procedures for the monitoring system should be in place either by direct calibration or by validating each of the components within the measurement system
- Periodic calibration should be carried out by the manufacturer or by United Kingdom Accreditation Service (UKAS) accredited organisations working within the scope of National Accreditation of Measurement and Sampling (NAMAS) procedures. Auditable evidence should be kept of the calibrations conducted (e.g. calibration certificates with the serial number of the meter tested, name of testing body etc.)
- To ensure that monitoring system uncertainties are maintained within the meter's specification, a calibration schedule that has been submitted to and approved by CHPQA must be implemented. Guidance on the frequency and method of calibrating the primary metering element(s) and secondary components such as transmitters and computations is provided in GN13.14 to GN13.19. Failure to meet these requirements will incur the imposition of excess uncertainties as set out in GN17. A dispensation option is available for minor streams as set out in GN13.20 and GN13.21
- Meters should be tamper-proof
- Where heat supplies are not sold, monitoring arrangements may not exist (for example, where an organisation owns the CHP Scheme and the site). In such cases, CHPQA requires the installation of effective monitoring systems

Evidence of the integrity of monitoring arrangements will be inspected as part of a CHPQA Site Audit. Such issues may form part of a site's existing quality assurance system (such as ISO 9001).

UNCERTAINTY AND BIAS

GN13.9

The uncertainty (error band) associated with the metered or derived values of all energy inputs and outputs must be determined. Uncertainties may be based on the meter manufacturer's specifications, or on accepted standards.

Calculation of the uncertainty must consider all components of the measurement (e.g. the sensor(s) or measuring element(s), transducer, transmitter, and integrator, recorder or computations). Note that additional uncertainties are applied to account for excessive time elapsed since calibration as set out in GN17. In addition, all metered or derived energy inputs and outputs must be checked to detect bias (errors) in the recorded values. All calculations of uncertainty and checks for bias must be fully documented.

- Refer to GN17 for guidance on Uncertainty in Metered Inputs and Outputs.
- Refer to GN18 for guidance on Uncertainty in Calculated Energy Inputs and Outputs.
- Refer to GN23 for guidance on Correction of Bias in Inputs and Outputs.

GN13.10

To be deemed best practice, the maximum uncertainties (including where applicable any additional uncertainties associated with time elapsed since calibration or variations in fluid properties) associated with the measurement of energy flows of different types are as follows:

Fuel Inputs, kWh	$\pm 2.0\%$ of reading
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 1434-1:2022, metrological Class 3 (typically 4.5% of reading) or better, with concessions for Schemes with TPC ≤ 2 MWe), see GN16.15 – 16.16.
Metering of steam flows and derivation of energy content, kWh	$\pm 2.0\%$ of full scale $\pm 3.0\%$ of reading
Electric power, kWh	Metering to applicable BS and metrological Class dependent on rating, see GN15.6
Indirect measurement or calculation of energy input or output, kWh	$\pm 2.0\%$ of value, except for heat outputs from Schemes with TPC ≤ 2 MWe where $\pm 5.0\%$ of value applies.

GN13.11

Meters that comply with the requirements of paragraph GN13.10 in terms of accuracy (uncertainty) shall be deemed best practice and no adjustment of their output values is required to take account of uncertainties when calculating scheme efficiencies etc.

GN13.12

Where the uncertainty, including any additional uncertainty due to time elapsed since calibration, associated with a metered value or indirect measurement of an input or output exceeds the uncertainty level that is deemed to be best practice for that type of variable, an adjustment is required for the purposes of determining the value of the QI. The procedure for making such adjustments for excessive uncertainty is given in GN19.

- Refer to GN19 for guidance on Adjustment of Energy Inputs and Outputs for Excessive Uncertainty.

CALCULATED VALUES OF ENERGY INPUTS OR OUTPUTS

GN13.13

The definition of a “calculated value” is given in GN18. The following data processing that may be required for self-assessment are not calculated values within the context of GN18:

- Most raw data will be subjected to conversion of units to permit reporting of energy values in MWh. This may involve the application of specific enthalpy values or calorific values. These conversions are not calculations within the context of GN18.
- The summation of a number of separate meters that meter the same type of energy input or output is not a calculation. Each meter is to be reported separately, and individual uncertainties must be treated as set out in GN19 (uncertainties of meters in parallel must not be combined using a root-sum-of-squares method). In the few cases where there are a number of meters measuring a similar stream (e.g. steam flows to a large number of small steam turbine drives), it is permissible to report these separately in an attachment, with the sum of each month's values within the submission, however the uncertainty to apply to the summed value is the weighted mean uncertainty and not the combined “root-sum-of-squares” uncertainty. The use of meter uncertainties under CHPQA is not a statistical exercise in probabilities but simply a means to encourage best practice in metering.

CALIBRATION AND VALIDATION OF METERS

GN13.14

All meters that are used for self-assessment that are not independently calibrated by others (such as gas or electricity supply companies as part of their statutory obligations or by heat or power customers as part of a commercial arrangement) should be regularly calibrated or validated in accordance with a calibration schedule that has been submitted to and approved by CHPQA. Guidance on what is likely to constitute an acceptable calibration schedule is given in GN13.15 - GN13.19. Note that additional uncertainties are imposed for excessive time elapsed since calibration, as set out in GN17. There is an optional dispensation from calibration available for “minor” metered flows, which is set out in GN13.20 - GN13.21.

GN13.15

Acceptable calibration schedules for fluid flow meters are:

(a) Meters with fixed in-pipe primary flow elements including: orifice plates, flow nozzles, venturis, V-cone, vortex shedding meter bluff bodies, pitots and annubars:

- Visual inspections and dimensional check against the specification/data sheet every 5 years.
- Elements exhibiting distortion, ovality, erosion to be replaced. See also GN13.19. Alternatively, wet calibration off-site or on-site calibration using independent metering that is traceable to a calibration standard is acceptable.
- Calibration of secondary components such as transducers, transmitters and computations every 2 years.

(b) Meters with moving in-pipe primary flow elements including: turbine meters and Gilflow meters:

- 5-yearly wet calibration off-site or on-site calibration using independent metering that is traceable to a calibration standard is acceptable.
- Calibration of secondary components such as transducers, transmitters and computations every 2 years.

(c) Meters without any in-pipe components including ultra-sonic, mag-flow and coriolis meters:

- 5-yearly wet calibration off-site or on-site calibration using independent metering that is traceable to a calibration standard is acceptable.
- Calibration of secondary components such as transducers, transmitters and computations every 2 years.

(d) For packaged heat meters see GN13.17.

(e) For meters not covered by the above, a proposed schedule must be provided for approval by CHPQA.

If it is to be claimed that calibrations are valid beyond the periods set out above such claims must be submitted to CHPQA for approval supported by a statement from the meter manufacturer appertaining to the meters that are installed stating the calibration/verification period and the longevity of the existing certificates.

GN13.16

An acceptable calibration schedule for solid fuel meters including weighbridges, belt weighers and grab load cells, is calibration traceable to a calibration standard not less than once every 2 years.

GN13.17

For heat meters that are supplied as a package comprising a flow meter, a pair of temperature sensors and a calculator ("complete instrument" as defined in BS EN 1434-1:2022) recalibration or replacement is required in accordance with the manufacturer's specification. New or replacement units must be supplied with a calibration certificate with a stated expiry date. Alternatively, 5-yearly wet calibration off-site or on-site calibration using independent metering that is traceable to a calibration standard is acceptable.

Calibration of secondary components such as transducers, transmitters and computations should occur every 2 years. If it is to be claimed that calibrations are valid beyond the 2 and/or 5-year periods such claims must be submitted to CHPQA for approval supported by a statement from the meter manufacturer appertaining to the meters that are installed stating the calibration/verification period and the longevity of the existing certificates.

For heat meters that are supplied as separate sub-assemblies comprising of flow meter, temperature sensor pair and the calculator ("combined instrument" as defined in BS EN 1434-1:2022) GN13.15 applies.

GN13.18

Electricity meters on individual power outputs require calibration and accuracy checks carried out on a schedule as set out in the Balancing and Settlement Code (BSC),

Code of Practice 4: The Calibration, Testing and Commissioning Requirements of Metering Equipment for Settlement Purposes (Elexon, Issue 6, Version 18 or later). In accordance with Appendix A, this requires calibrations to be carried out at 5-, 10- or 15-year intervals depending on the capacity and metering system installed.

GN13.19

In some situations, particularly in old industrial boiler/power houses, the removal of meters for inspection may present particular problems, possibly due to inaccessibility, asbestos or the inability to isolate the meter. Where there are a number of such meters, that meter the same fluid at similar line conditions CHPQA may grant a partial dispensation under the following circumstances: If any one of these meters can be inspected and shown to be within specification after more than 5 years in service, CHPQA may grant dispensation from the need to inspect others within the group of meters for a further 5 years (i.e. the sample is deemed to be representative of the whole group) without incurring any additional uncertainty. In general, “within specification” means dimensionally correct, sharp edged (orifice plates), free from ovality, buckling, erosion, corrosion, and blockage or obstruction of pressure tapings. The requirement for the calibration of secondary components such as transducers, transmitters and computations remain unaffected by this dispensation.

MINOR ENERGY STREAMS

GN13.20

It is recognised that for streams that cumulatively make only a small contribution to energy inputs or outputs it may be uneconomical to implement a regular calibration schedule. For this reason, a concession is available for “minor” streams, defined as streams that cumulatively constitute no more than 5% of the annual total energy input, power output or heat output of the scheme. For example, if there are two streams each representing 3% of the energy inputs, then only one of these can be treated as a minor stream since the sum of the two exceeds the 5% limit.

GN13.21

For minor streams, a calibration schedule is not obligatory, nor is it necessary to include these meters in the calculation of uncertainties as set out in GN17. This also applies to meters that are used to derive the values of calculated minor streams.

For calculated minor streams, it is not necessary to derive the uncertainty associated with the calculation as set out in GN18, provided the calculation can be shown to be based on sound principles and reliable data.

However, where the above concession for minor streams is adopted a default individual adjustment factor (F_i) must be applied to minor streams in calculating the value of the overall uncertainty adjustment factors as set out in the worksheets in GN19 as follows:

- Individual adjustment factor 1.1000 for minor energy inputs
- Individual adjustment factor 0.9500 for minor power outputs
- Individual adjustment factor 0.9000 for minor heat outputs