

# GUIDANCE NOTE 3 (COMPLEX)

## SELF-ASSESSMENT FOR PROPOSED NEW AND UPGRADED CHP SCHEMES (DESIGN SUBMISSION) – COMPLEX SCHEMES

### INTRODUCTION

#### GN3.1

The purpose of a Design Submission is to provide a description and Self-Assessment of a proposed new CHP Scheme (at final design stages or under construction) or an upgrade of the prime mover of an existing Scheme. This Self-Assessment based on design data and anticipated operating conditions will determine what portion of the Scheme fuel inputs, power outputs and capacity qualify as Good Quality CHP. A Design Submission requires information under the following main headings:

- Scheme identification
- General site information
- Project background, state of development and timescales
- Site energy demands
- Scheme equipment details
- Scheme performance details (design and expected operation)
- Scheme monitoring arrangements (existing or proposed)
- Simple Self-Assessment based on expected annual average and MaxHeat operation (Heat and Power Efficiencies and QI only)
- Threshold Criteria for Good Quality CHP relevant to Scheme size and type
- Calculation of the qualifying power capacity ( $CHP_{QPC}$ ) for Schemes that do not meet the QI Threshold
- For Schemes expected to begin<sup>1</sup> Initial Operation in the current calendar year:
  - Calculation of energy inputs and outputs for the remaining part of the calendar year
  - Threshold criteria for Good Quality for Schemes in initial operation
  - Calculation of the qualifying fuel input,  $CHP_{QFI}$  and qualifying power output,  $CHP_{QPO}$  for annual operation for that year only
  - Exports of electricity and heat
- CHPQA in relation to Renewables Obligation Certificates and Contracts for Difference
- Declaration

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<sup>1</sup> The CHPQA Administrator must be informed in writing when the Initial Period of Operation starts.

The complex submission journey must be used for all Schemes with TPC >2 MW<sub>e</sub> and for Schemes with TPC ≤2 MW<sub>e</sub> if boilers are included, if the fuel is not a single conventional fuel or if the prime mover is not a single reciprocating engine. Otherwise, the simple submission journey may be followed.

## PROCEDURE

### GN3.2

For a completely new Scheme, registration of the User and the Scheme with the CHPQA programme must have been completed (see Guidance Note 1). Following registration, a Design Submission must be completed by the Responsible Person to provide details of the Scheme and to undertake the Self-Assessment. The information provided will be validated by the CHPQA Administrator and forms the basis on which the initial CHPQA Certificate is issued. CHPQA Certification of new Schemes will be used by Government to assess eligibility for available benefits.

Like CHPQA Certificates for existing Schemes, Certificates for Schemes in design, development or construction stages must be renewed annually each January until the Scheme has entered Initial Operation. It is only necessary to provide details of any changes to the design or anticipated operating conditions each year.

An Operational Submission must be made in the first January following the year of commencement of Initial Operation. Initial Operation is considered to have commenced in a year if the scheme operated for at least one month of data in CHP mode in that year.

### GN3.3

**A Design Submission must also be made for any major change to an existing CHP Scheme that involves new increased power generation capacity.** This includes the installation of prime movers or the installation of replacement prime movers to change the power output of the Scheme. In such cases, a new Scheme reference and CHPQA Certificate will be provided and, once the installation has been completed, the existing CHP Scheme will be considered closed. In order to help ensure continuity in CHPQA Certification, the Design Submission should be made prior to any change being made to the existing Scheme. Lesser changes to an existing CHP Scheme, e.g. boundary changes involving the inclusion or exclusion of existing plant or modification of existing plant, or the installation of additional boilers or heat recovery equipment, must be notified through the usual Operational Submission.

### GN3.4

A Design Submission should only be made once a Scheme's details are well established and all main components are identified. It is expected that the details would be finalised prior to making the final Design Submission ahead of entering Initial Operation.

### GN3.5

The Self-Assessment for normal operation shall be based on the expected whole year energy utilisation averaged over the Scheme's annual operating hours. The only exception is that Residential Community Heating Schemes can be Self-Assessed over a seven-month Heating Season, subject to meeting the conditions set out in GN30.

The Self-Assessment for MaxHeat operation shall be based on operation at the heat output that is expected to be exceeded for the hours specified in the CHPQA Standard

and further explained in GN27.4, depending on the use of the CHP heat output.

### **GN3.6**

For CHP Schemes serving Residential Community Heating, performance on a seven-month Heating Season can be used for calculation of QI (refer to GN30), but data covering 12 months are still required for other calculations.

### **GN3.7**

These Guidance Notes provide all the information needed to ensure compliance with the requirements of the CHPQA programme including Self-assessment. Should applicants have any unanswered problems, further assistance may be obtained by contacting The CHPQA Administrator, at [chpqainfo@chpqa.com](mailto:chpqainfo@chpqa.com) or by phoning the CHPQA Helpline on 01235 753004.

## **SITE INFORMATION**

### **Basic Information**

### **GN3.8**

Select the Industrial Sector applicable to your site and provide the basic information on site operating hours and production hours requested. This is where you identify any existing Scheme(s) at the site and provide an explanation of the rationale for the proposed Scheme, its state of development and expected timescales.

- Refer to GN12.1 for guidance on Sector definitions.

It is required that you state the site total annual operating hours, broken down into production and non-production hours. For simplicity, operating hours may be regarded as the time when there is significant demand for heat and power. For example, a site (a) that operates continuously year-round has 8,760 annual operating hours whereas a site (b) that operates 16 hours/day, 6 days/week for 48 weeks/year has 4,608 annual operating hours.

It may be that in the second example (b) there is a demand for heat and/or power for the first two hours of each day before production begins and increased demands during the remaining 14-hour production period. In this case, the annual non-production hours would be 576 hours and annual production hours would be 4,032 hours, the sum of the two being equal to the operating hours.

If there is an existing CHP Scheme on the site, the Administrator must be informed of this fact, including whether the existing scheme has been registered with the CHPQA programme and if so, the Scheme reference number. You must also state clearly whether (a) the proposed Scheme is an upgrade of the existing Scheme (within the same boundary) to increase power generation capacity, (b) the proposed Scheme is a new Scheme within its own boundary, or (c) some other explanation, e.g. the proposed Scheme is a replacement for the existing Scheme.

An explanation of the overall objectives of the proposed Scheme and a brief non-technical description of the Scheme are required. Some of the possible objectives include:

- To better meet the existing site heat demands (e.g. more economically or with greater security of supply)
- To meet increased site heat demands

- To provide part or all of the site power demands (e.g. more economically or with greater security of supply)
- To meet increased site power demands
- To meet the entire site heat and/or power demands and provide surplus heat and/or power for sale to external customers

The general description of the Scheme should include reference to issues such as ownership, operation and maintenance arrangements, normal running hours, anticipated typical operation and uses of the heat and power outputs.

If there is not sufficient space available in the submission for the objectives and general description, please provide the information as a separate numbered attachment and refer to this in the submission.

Finally, an indication is required of the state of development of the proposed Scheme and likely dates for the key milestones of (a) start of construction, (b) start of commissioning and (c) start of Initial Operation. The CHPQA Administrator must be informed when the Initial Period of Operation starts.

- Refer to GN10.17 for guidance on Initial Operation.

## **Site/Consumer Energy Demands**

### **GN3.9**

This part of the self-assessment requires information on the electricity and heat/steam demands at the site and the networks to which the proposed CHP Scheme is to be connected. Note that this information is for the site and not the CHP Scheme itself.

To give an indication of seasonal or other extended variations in demand, provision is made for two sets of figures to represent current site operation. This will usually be sufficient but, if appropriate, additional sets of figures may be included. Typically, distinct differences may exist between winter and summer demands. In this case, the figures entered under Period 1 may be the winter or heating season loads, say October to April inclusive, while the summer loads covering May to September would be entered under Period 2. For some sites, periods representing a different subdivision of the year may be more appropriate. For example, for a sugar refinery, tabulation of data for the “campaign” and “juice run” periods may be appropriate to represent two distinctly different operating modes with different site heat and power loads. In all cases the sum of the operating hours for the two (or more) Periods should equal the total annual operating hours for the site.

The third block of data is required for predicted future annual loads where these differ from the current site loads. This data should be based on total annual operating hours (i.e. not subdivided into a number of Periods).

The self-assessment calls for a statement of base, peak and average demands. The base demand is the lower level of demand on which other fluctuating demands are superimposed. In many cases, there will be a well-defined base demand that is sustained for a substantial proportion of the time. However, in cases where the loads are continuously spiky the base demand may be taken as that which is exceeded for about 90% of the operating hours. Conversely, the peak demand may be taken as the level of demand that is exceeded for only 10% of the operating hours. The average demand is the average demand over the whole of the operating hours in the Period (i.e. total kWh divided by the total hours in the Period).

Steam heat demands should be declared on a CHPQA basis (GN16.3), i.e. the heat content of the steam supplied to the site relative to a datum of water at 10°C and ignoring the heat returned in recovered condensate.

Heat demands that are supplied by circulating hot water or thermal fluid systems should be expressed as the actual heat transferred to the system, i.e.

$$\text{Heat demand} = \text{circulation rate} \times \text{specific heat} \times [\text{flow temp.} - \text{return temp.}] \text{ (kW)}$$
$$= \quad (\text{kg/s}) \quad (\text{kJ/kg.}^\circ\text{C}) \quad (^\circ\text{C})$$

Heat demands of equipment such as kilns, ovens, furnaces or fired process heaters should be included only if they are to be supplied fully or in part by the proposed CHP Scheme. Such heat demands are the sum of the heat taken up by the process plus any fixed or unavoidable losses from the equipment. It will usually be appropriate to determine these heat demands by subtracting the energy lost in the leaving products of combustion (flue gas) from the energy inputs. For direct-fired equipment, the energy input is the energy derived from the fuel consumed or, where the heat is supplied by CHP, it is the energy content of the gas turbine or engine exhaust gases plus any additional energy derived from supplementary or auxiliary firing.

Either in the submission or on a separate numbered attachment show the derivation of the heat demands in kW from the relevant input data:

- Steam: mass flow, specific enthalpy (indicate pressure and temperature)
- Circulating liquid: mass circulation rate, specific heat capacity, flow and return temperatures
- Direct fired: energy input (gross or net calorific value basis), heat loss in flue gases (same basis)

## **DETAILED DESCRIPTION OF PROPOSED SCHEME/ UPGRADE**

### **CHP Scheme Line Diagram**

#### **GN3.10**

The CHP Scheme line diagram should show the CHP Scheme and its fuel input and heat and power output streams.

- Refer to GN11.1 to GN11.11 for guidance on CHP Scheme definition and boundaries.
- Refer to GN12.2 & GN12.3 for guidance on the Scheme line diagram and equipment tag notation.

### **Scheme Equipment Details (Proposed and Existing Equipment)**

#### **GN3.11**

The submission requires details of both proposed and existing main items of CHP equipment. It must include all prime movers and boilers within the CHP Scheme boundary, identified by tag number, and must include maximum capacities in terms of power (referenced to ISO conditions) and/or heat. Where a prime mover drives a mechanical load (e.g. a pump or a compressor), the mechanical power output is to be converted to an equivalent electrical output using a multiplying factor of 1.05.

- Refer to GN12.3 & GN12.6 for guidance on equipment list.
- Refer to GN15 & GN16 for guidance on energy outputs.
- Refer to GN15.4 to GN15.6 & GN22 for guidance on mechanical output.

## **Projected Scheme Performance Details**

### **GN3.12**

If the submission is being used for an upgrade to an existing CHP Scheme, where additions are being made within the existing Scheme boundary, information must be provided for the complete Scheme.

The CHP design and anticipated operating cases summarised in the Table should be supported by the following Attachments:

- Energy flow diagrams (showing energy and mass flows) for each case
- Site and Scheme annual and daily heat profiles)
- Site and Scheme load duration curves for initial operation and long term annual operation

The CHP Scheme energy flow diagrams are copies of the line diagram (Sankey diagrams are not required) marked up to show flow rates, energy inputs, heat outputs and electrical and mechanical power output rates in kW. In line with conventional practice for process flow diagrams, streams should be identified by stream number (rather than instrument tag numbers) at this stage.

CHP Schemes with a heat rejection facility should provide heat output profiles and heat load duration curves for the 'annual operation' cases to give an indication of the amount of heat dumped either directly or indirectly (e.g. via cooling water).

- Refer to GN11 for guidance on CHP Scheme definitions and boundaries.
- Refer to GN12.2 to GN12.4 for guidance on line and energy flow diagrams.
- Refer to GN12.5 for guidance on heat profiles and load duration curves.

The energy and mass flows that cross the Scheme boundary associated with the four cases (below) should be given. Fuel energy inputs should be specified on a gross calorific value basis (note that engine and gas turbine manufacturers almost universally quote performance figures based on net calorific value). CHP power and heat outputs should be expressed in accordance with the relevant Guidance Notes.

- Refer to GN14 for guidance on CHP Scheme energy inputs.
- Refer to GN15 for guidance on CHP Scheme power outputs.
- Refer to GN16 for guidance on CHP Scheme heat outputs.

Where appropriate, a listing of steam and condensate mass flows is required. The four cases for which data should be provided are:

- Process design MCR (maximum continuous rating) case. It is possible that there will be more than one design case. The case giving the greatest overall efficiency should be used.
- Annual operation – initial operation case. Where figures are available as annual outputs in kWh (or MWh) divide these by the Scheme's expected

operating hours to give the average hourly flows. Note that where the Scheme includes auxiliary or back-up boilers, the Scheme operating hours will probably differ from engine or gas turbine operating hours and the average hourly flows will differ from the CHP design values.

- Annual operation – long-term operation case. Where the CHP outputs are expected to develop (or decline) over the operating life of the Scheme, figures based on the developed outputs should be provided. Where no significant changes in outputs are envisaged simply copy Initial Operation data.
- MaxHeat operation. Operation at maximum heat output under long-term Normal Operating Conditions (excluding start-up, transients, etc.)
  - Refer to GN27.4 and GN27.5 for guidance and definition of MaxHeat.

For the MaxHeat case, enter the cumulative number of hours per year (i.e. 1000, 750 or 500) that the Scheme will operate at or in excess of the total heat output tabulated for this case. The minimum required operating hours to qualify as Normal Operating Conditions are set out in GN27.4.

## **Scheme Monitoring Arrangements**

### **GN3.13**

This section requires a list of all installed and proposed metering equipment that will be used to monitor the performance of the CHP Scheme. Where an indirect method is proposed to derive an unmetered input or output, supporting calculations must be included as attachments.

- Refer to GN12.3 for guidance on meter tag notation and GN12.7 - GN12.13 for guidance on monitoring arrangements.
- Refer to GN13 for guidance on CHP Scheme monitoring.
- Refer to GN14, GN15 & GN16 for guidance on input/output metering requirements.
- Refer to GN20, GN21 & GN22 for guidance on indirect monitoring methods.
- Refer to GN17 & GN18 for guidance on determination of monitoring uncertainties.

It is appreciated that instrumentation details are unlikely to be available at the initial design stages of the project. The metering arrangements selected should take account of the requirements for CHPQA and the uncertainty figures stated should be the best assessment of what will be achievable in practice.

## **SCHEME PERFORMANCE FOR CHPQA**

### **GN3.14**

This is a simple Self-Assessment comprising of the determination of the heat efficiency, power efficiency and overall efficiency of the Scheme and its Quality Index based on the expected annual average operation (for initial and ultimate loads) and MaxHeat operation.

## **Projected Annual and MaxHeat Operation**

### **GN3.15**

Where the future site heat or electricity demands are greater than present demands, evidence of when the future loads are likely to come on stream must be provided. Such evidence may be taken from relevant parts of the site business plan, evidence of a contract to provide heat, or letters of intent from adjacent sites to take heat.

The submission then takes the total anticipated annual energy inputs, heat outputs and power outputs and calculates the power efficiency and heat efficiency, where:

- power efficiency, % = 100 x total power outputs/total energy inputs
- heat efficiency, % = 100 x total heat outputs/total energy inputs

Please note that energy input should always be based on a 'gross calorific value' basis.

The Power Efficiency and Heat Efficiencies may be expressed as:

$$\begin{aligned} \text{Power Efficiency, } \eta_p &= \frac{\text{CHPTPO}}{\text{CHPTFI}} = \frac{\text{MW}_{(p)} \times \text{operating hours}}{\text{MW}_{(f)} \times \text{operating hours}} = \frac{\text{MW}_{(p)}}{\text{MW}_{(f)}} \\ \text{Heat Efficiency, } \eta_h &= \frac{\text{CHPQHO}}{\text{CHPTFI}} = \frac{\text{MW}_{(h)} \times \text{operating hours}}{\text{MW}_{(f)} \times \text{operating hours}} = \frac{\text{MW}_{(h)}}{\text{MW}_{(f)}} \end{aligned}$$

Where:

$\text{MW}_{(f)}$  = average hourly fuel inputs, MW

$\text{MW}_{(p)}$  = average hourly power outputs, MW

$\text{MW}_{(h)}$  = average hourly heat outputs, MW

By the same logic, the power and heat efficiencies for cases other than annual operation, such as design cases and MaxHeat operation may be represented in terms of energy flows in MW in the same way:

$$\begin{aligned} \text{Power Efficiency, } \eta_p &= \frac{\text{power outputs}}{\text{fuel inputs}} = \frac{\text{MW}_{(p)}}{\text{MW}_{(f)}} \\ \text{Heat Efficiency, } \eta_h &= \frac{\text{heat outputs}}{\text{fuel inputs}} = \frac{\text{MW}_{(h)}}{\text{MW}_{(f)}} \end{aligned}$$

Note that since actual meter readings are not used for Design Submissions there is no requirement to adjust energy inputs and outputs to account for any excess uncertainty in these values, as is required for operational Schemes.

## EXPORTS OF ELECTRICITY AND HEAT

### Electricity and Heat Customers

#### GN3.16

Where appropriate, details of non-domestic **heat** customers, and the amount of heat to be taken by these customers **is** necessary for CHPQA Certification.

Details of non-domestic **electricity** customers, and the amount of electricity taken by these customers is **not** necessary for CHPQA Certification but can be required by the Secretary of State under the Electricity Act 1989.

- Refer to GN15 for guidance on recording electricity exports.
- Refer to GN16 for guidance on recording heat exports.



## **SECRETARY OF STATE (CHP) EXEMPTION CERTIFICATE APPLICATION**

### **GN3.17**

You will be provided with a Secretary of State (CHP) Exemption Certificate, depending on your response to the question.

## **DECLARATION**

### **GN3.18**

The declaration is a signed statement by the Responsible Person confirming the validity of the information provided, based on the CHPQA Standard. Applicants should note that for resolving queries that arise on the details submitted, arranging an Audit and for ensuring eligibility for benefits, contact will be with the Responsible Person.