Response to Ofgem "minded to" consultation on

Connection of Small-Scale Generation – revisions to Distribution code to replace Engineering Recommendation G83/1-1 with G83/2

Overview

- **The proposed replacement of ER G83/1 with ER G83/2 will have a major detrimental impact on Stirling engine non-inverter connected micro combined heat and power (mCHP).**

- **Microgen Engine Corporation (MEC) and BDR Thermea (Baxi) have invested significantly to manufacture and develop their Stirling Engine mCHP product commercialised as Baxi Ecogen. The Baxi Ecogen cannot comply with the frequency ranges proposed in G83/2 therefore if the proposed regulation is implemented the product would be withdrawn from the market.**

- **The Baxi Ecogen has been designed to comply with legislation and regulation and can operate at 50 Hz ±0.5 Hz which complies with G83/1. The proposed ER G83/2 requires a frequency range of 47 Hz to 52 Hz which products like MEC, which are synchronised generators, cannot achieve.**

- **The UK is a global mCHP leader with an array of products being developed domestically and the UK industry foresees significant deployment by 2020. The Baxi Ecogen is the current market leader but will only account for a fraction of future installations and will have no significant impact on the grid. Its withdrawal now would damage investor confidence for all mCHP.**

- **Stirling engine mCHP was not represented on the Working Group which developed G83/2 and therefore the huge impact of such a change on synchronised generators has inadvertently been missed.**

- **A similar regulation[1] which has been introduced in Germany includes an exemption for Stirling Engine microCHP, establishing an important precedent.**

- **An exemption for Stirling engine mCHP would sustain investment in the development of the Baxi Ecogen in the UK and Europe and would serve as a vote of confidence for the development of mCHP in the UK.**

[1] VDE-AR-N-4105:2011-08 Technical minimum requirements for the connection to and parallel operation with low-voltage distribution network. This document can be obtained via the VDE website.

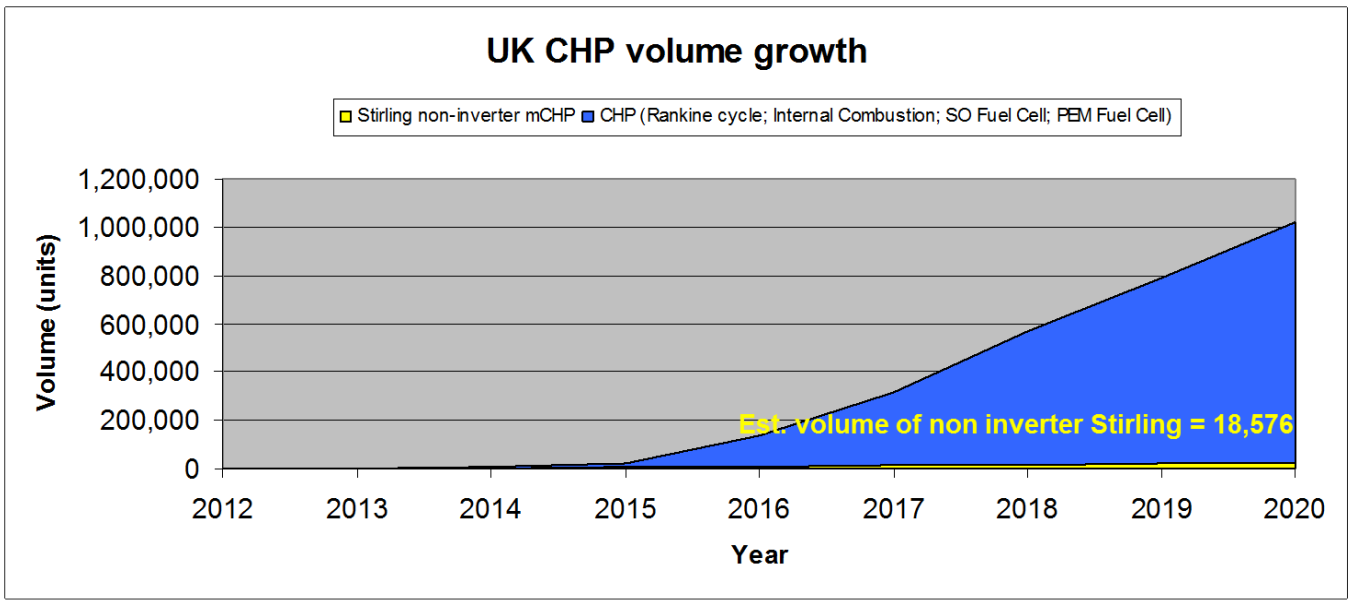
1. The potential of mCHP in the UK and the role of the Baxi Ecogen

BDR Thermea, known as Baxi in the UK, is Europe's leading supplier of mCHP solutions, with a total of over 30,000 units installed across Europe. BDR Thermea has over 20 years of experience in mCHP and we now offer solutions based on a range of technologies including Stirling, internal combustion engines and fuel cell.

The UK market leading mCHP is the Baxi Ecogen, which was awarded the Queen's Award for Enterprise in Innovation earlier this year. Manufactured in Preston, the Baxi Ecogen is a small scale combined heat and power unit that can be installed in homes instead of conventional boilers, saving an average of £300 on fuel bills per unit annually. It is the first commercially available UK mCHP product and the first Microgeneration Certification Scheme (MCS) approved mCHP. Microgen Engine Corporation (MEC) based in Peterborough test, develop and manufacture the Stirling engine generator used in the Baxi Ecogen.

MEC has spent 15 years and many millions of pounds developing its Stirling Engine and mCHP technology which is now being now being manufactured and is commercially available in the UK and Europe as the Baxi Ecogen Unit. In addition, BDR Thermea has invested over £10m in product development, manufacturing tooling and market collateral to promote the product. Thus far the Baxi Ecogen is responsible for the vast majority of MCS registered mCHP installations in the UK.

This Stirling Engine product is laying the foundations for the domestic mCHP industry and is instrumental in kick-starting the domestic mCHP market but will only be a small proportion of the projected uptake. A wide array of companies are currently developing and manufacturing diverse mCHP products rendering the UK the most important mCHP hub in Europe. Most of these products will be commercialised beyond 2014. A group of UK mCHP developers and manufacturers recently published a report setting an objective for the uptake of 1 million mCHP units in the UK by 2020. According to the report, 1 million mCHP units would generate about 20GWh of electricity on a typical winter day - the UK imported on average 19.17GWh of electricity per day during 2011 - and enable the annual saving of up to 2.1 million tonnes of CO_2. It is expected that only 18,576 of these 1 million mCHP units will be using Stirling Engine non-inverter technology. The graph below depicts how expected mCHP uptake would be divided between Stirling non-inverter mCHP and other mCHP technologies.



Figures are based on;

- Market growth in line with the industry/technology ambition for 1 million installed units by 2020.
- Introduction of new inverter-led technologies, such as fuel cells which will account for the majority of market share by 2020
- Stirling engine technology is vital in kick-starting awareness and growth of this emerging energy solution

2. The development of G83/2 and its impact on Stirling Engine mCHP investment

If Engineering Recommendation G83/1 is replaced with G83/2 Stirling engine mCHP technology will not comply with the specified frequency ranges proposed.

The Baxi Ecogen complies with current regulation in UK and Europe. However, the proposed G83/2 requires a frequency range of 47 Hz to 52 Hz which synchronised generators cannot achieve. The frequency range for the MEC single cylinder Linear Free piston Stirling Engine is limited by the tuned mass/spring relationships. In particular, the piston mass and the gas spring and the displacer mass/spring. Since this is a resonant system the frequency of operation is restricted to a maximum of 1Hz. Operation at grid frequencies outside of 50+/-0.5Hz would move the piston and displacer frequencies far away from their resonant frequencies and result in unreliable behaviour including piston crashing or overstroke, loss of power and less efficient operation.

System frequency is a continuously changing variable that is determined and controlled by the second-by-second (real time) balance between system demand and total generation. If demand is greater than generation, the frequency falls while if generation is greater than demand, the frequency rises.

National Grid has a licence obligation to control frequency within the limits specified in the 'Electricity Supply Regulations', i.e. 50.00Hz save in abnormal or exceptional circumstances. National Grid must therefore ensure that sufficient generation and / or demand is held in automatic readiness to manage all credible circumstances that might result in frequency variations.

A key feature of G83/2 will be to impose a requirement on generators to provide frequency response free of charge - a service currently paid for commercially by National Grid. However, it will impose costs on manufacturers of Stirling Engine mCHP which will result in the product no longer being viable either economically or environmentally. It seems quite unreasonable for the costs of frequency control, currently a licence duty on National Grid which it meets by paying commercially for relevant services from generators, to be transferred onto manufacturers of consumer goods by requiring them, at considerable cost, to provide this service free of charge.

Engine redesign would take many years as a bespoke inverter would need to be developed to enable the Baxi Ecogen to comply with G83/2. Off the shelf Inverters do not provide frequency, load control or voltage control for the generator. This additional control is needed with a linear generator which was designed to operate using grid voltages and grid frequency to control amplitudes and generator speed. Without this amplitudes would go too high and mechanical limits would be reached leading to damage.

When operating on grids problems can only occur if operating outside of statutory limits which, was previously not allowed in grid regulations like G83/1 and control systems were built around this requirement. A bespoke inverter solution would be required to minimise the impact where possible to the technology. In addition extra equipment has to be packaged, a mCHP unit only has a certain size and there is limited space to fit this additional hardware inside the unit; this may then require extra units to be installed outside of the current package space, limiting its installation opportunities.

Fitting a bespoke inverter would enable the unit to comply with G83/2 but add significant cost to the product which is already more expensive than a boiler. It would also significantly reduce the efficiency of the product, therefore eliminating much of the carbon savings it brings and making the product neither economically nor environmentally viable.

If G83/2 is introduced unaltered with no exemption for Stirling engine mCHP, the Baxi Ecogen will need to be withdrawn from the UK and European market and its legacy, together with many jobs, will be lost. In addition the deployment of mCHP in the UK will be compromised and with it the opportunity to generate low carbon investment, export opportunities, distributed energy jobs and cost-efficient emissions reductions.

3. The need to review G83/2 and enable Stirling Engine mCHP uptake

The Stirling engine is laying the foundations for the domestic mCHP market but will only be a small proportion of mCHP future deployment. If the forecast of the mCHP industry is met, non-inverter grid connected Stirling engine mCHP will account for only 1.86% of the volume of UK installed CHP. These will be around 1kWe and account for less than 20 MW in 2020.

Since other mCHP technologies do comply with the frequency ranges proposed by G83/2 allowing an exemption for this particular technology would have no significant impact on the grid or detract from its objectives. G83/2 in its current form however, would have a huge impact on MEC and BDR Thermea and the deployment of mCHP. Since the Baxi Ecogen is the first commercially available mCHP in the UK, its withdrawal from the market would seriously damage investor confidence and therefore the prospects of the mCHP industry as a whole.

BDR Thermea and MEC appreciate that the purpose of EREC G83/2 is to simplify and standardise technical requirements for connection and to maintain the integrity of the system. However, we firmly believe that imposing the frequency range of 47 Hz to 52 Hz requirement on Stirling engine mCHP is neither necessary nor helpful in achieving this aim.

MCHP technologies have thus far been supported by the UK Government as demonstrated by the recent increase in the Feed in Tariff for mCHP and the receipt of the Queen's Award for Enterprise in Innovation by the Baxi Ecogen. However, the proposed G83/2 does not take into account the different mCHP technologies and characteristics, and in particular Stirling engine non-inverter technology. We believe an exemption should be allowed for this technology.

4. High Voltage Concerns

The proposed changes to voltage and frequency ranges and the introduction of two stage thresholds used in G59/2 for larger generators, pose some important questions. The introduction of a requirement to operate at 230V +14% and now +19% have been proposed as the statutory upper voltage (230+10%), plus an additional 4% of the nominal voltage and then an additional 5% (230V+19%) for up to 1 second. This means the mCHP unit will have to operate as a generator inside a customer's home far outside of statutory voltages. This would increase household voltages to extremely high levels. This higher voltage may lead to premature failure or shutdown of sensitive electronic and electrical devices. The Stirling engine mCHP is designed to operate at up to 264V.

There seems to be no safety information or studies presented on this voltage issue. Ofgem's consultant's state in their report, "there is no clear statement in the Report to the Authority that all new Health and Safety requirements have been considered." For G83/2 where microCHP units are embedded in domestic dwellings it seems that the over voltage stage two threshold may be unwarranted and too high.

5. The way forward

As the first commercially available mCHP in the UK, the Baxi Ecogen is laying the foundations upon which other mCHP companies and technologies hope to build. Withdrawing this product from the market would seriously damage not just BDR Thermea and MEC but the whole industry and seriously jeopardise industry certainty and emissions reductions objectives.

A similar regulation[1] which has been introduced in Germany includes an exemption for Stirling Engine microCHP. We urge you allow a similar exemption in the UK.