

## Project: Barugh

### Introduction

Lindenberg Anlagen GmbH ("LiAG") is located in Overath, Germany and has been producing generating units for nearly 70 years. The Company works with major manufacturers such as MWM, John Deere, Perkins and Kawasaki. LiAG is the preferred technology supplier to Energy Circle plc ("ECP").

ECP is developing a pipeline of distributed generation plants in the UK. Each project will comprise gas fired generating units housed in containers that are manufactured and tested in the LiAG factory in Overath. Projects may also comprise of engine units and energy storage systems also housed in sound attenuated containers.

### Site specific parameters

Site name	Barugh
Project description	The project on the Barugh site will house 20 containers to suit the 20MVA grid connection.
Export capacity	20MW
Number of engines	<p>Each site comprises of a number of containers commensurate with the DNO grid connection capacity based on 1,000kW per container. The project on the Barugh site will house 20 containers to suit the 20MVA grid connection.</p> <p>Each container will house one Perkins 4016-61 TRS2 gas engine connected to a Leroy Somers Alternator. A Bowman Electric Turbo Generator will be installed in the exhaust of the engine to recover waste heat from the hot gases. The Container will house all electrical equipment such as control systems and generator switch gear. A fan type cooling system is located on the roof of the container adjacent to the exhaust silencer.</p>
Required Noise Levels and Engineering Solution	<p>An Environmental Noise Impact Assessment has been carried out to establish the prevailing background noise levels expected at the nearest noise sensitive premises to the site.</p> <p>This established typical weekday daytime background noise levels of 48 dB LA90, 15min and 43dB LA90, 15min at measurement positions 1 and 2. The typical weekend measurements were 44 dB LA90, 15min and 37 dB LA90, 15min. These measurements formed the benchmark for determining acceptable noise levels when the</p>

	<p>FlexGen facility is operational.</p> <p>The noise impact assessment concluded that, without mitigation, the predicted noise at the receptors (including a third receptor, a proposed new housing development) would exceed the existing background noise levels at the receptors during weekdays and weekends. As a result, it is necessary to implement appropriate mitigation.</p> <p>The identified noise sources associated with the FlexGen facilities are:</p> <ul style="list-style-type: none"> <li>• The generator enclosures including the air outlet louvre;</li> <li>• The air inlet penthouse louvre;</li> <li>• The fan cooler at the container top, and</li> <li>• The engine exhaust.</li> </ul> <p>The noise model determined the maximum permissible noise level emissions associated with the generator, as follows:</p> <table border="1" data-bbox="513 1164 1370 1485"> <thead> <tr> <th>Identified Noise Source</th> <th>Recommended Permissible Noise Level Emissions</th> </tr> </thead> <tbody> <tr> <td>Generator Enclosure (including Air Inlet Penthouse Louvre)</td> <td>60 dB <math>L_{Aeq, T}</math> at 1m</td> </tr> <tr> <td>Air Inlet Penthouse Louvre</td> <td>60 dB <math>L_{Aeq, T}</math> at 1m</td> </tr> <tr> <td>Engine Exhaust</td> <td>65 dB <math>L_{Aeq, T}</math> at 1m</td> </tr> <tr> <td>Fan cooler</td> <td>80 dB <math>L_{Aeq, T}</math> at 1m</td> </tr> </tbody> </table> <p>These levels can be achieved by implementing the following engineering solutions:</p> <p><b><u>Technical Specification</u></b></p> <p style="padding-left: 40px;">In order to achieve permissible noise levels, it is necessary to factor in a series of mitigation measures. These are as follows:</p> <p style="padding-left: 40px;">Increase the thickness of sound damping materials inside container walls from 80mm to 100mm per wall.</p>	Identified Noise Source	Recommended Permissible Noise Level Emissions	Generator Enclosure (including Air Inlet Penthouse Louvre)	60 dB $L_{Aeq, T}$ at 1m	Air Inlet Penthouse Louvre	60 dB $L_{Aeq, T}$ at 1m	Engine Exhaust	65 dB $L_{Aeq, T}$ at 1m	Fan cooler	80 dB $L_{Aeq, T}$ at 1m
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Container side wall panels steel plates and front/back wall steel plates thickness will be increased from 1.5mm standard to 4mm.


Optionally, it is possible to use a recirculating attenuator instead of sound baffles for the air inlet and outlet.

The table cooler will be calculated with bigger fan diameter and less rpm per fan to decrease sound level of the cooler on the roof top.

For additional sound mitigation, concrete panels for every container and sound protection walls can be installed as LIAG have previously installed (see pictures below).



Concrete housings will be installed for every container with air inlet and outlet openings. Containers will be equipped with doors at every sidewall and removable front- and backwalls.

	 <p>Additional sound protection walls can be erected around the complete plant.</p> <p>The Environmental Noise Impact Assessment confirms that, with the proposed noise mitigation in place, the predicted noise from the FlexGen facility will not exceed the existing background noise levels at the identified noise receptors.</p>
<p>Monitoring and Compliance</p>	<p>The Site Operator is committed to the levels of mitigation required.</p> <p>Planning conditions can be imposed to ensure that the maximum permissible noise rating levels are achieved. The Applicant and operating company confirm this is standard practice.</p> <p>Detailed acoustic compliance monitoring will be conducted upon the commissioning of the plant and at appropriate operational intervals. This can also be subject of a planning condition.</p>

**Contractual Guarantees**

LiAG will enter into agreements that contain performance specifications that have to be met, these include noise emissions. LiAG will agree the design specification to suit the local planning requirements based on best available techniques and financial viability of each project.

Based on the information provided by our client we can confirm that we can meet the planning authorities noise emission limits.