2G Energy upgrades a gas engine for use as a demand response solution Source: 2G

Emergency Power and Grid Support with Demand Response Solutions

For decades, diesel generators were the classic emergency solution to energy supply bottlenecks. However, as the global energy system is being restructured, other technologies are now coming to the forefront that reliably supply electricity and reduce emissions. An example is a demand response solution based on a natural gas engine design.

The consequences of climate change are made clear to the world's population in many ways: Reports on periods of drought, extreme rainfall, and severe storms are now part of the painful everyday life of many news programs. Even though nature's warnings have now been recognised in many places and have led to a massive expansion of renewable energies, the consequences of climate change are already confronting many energy suppliers, network operators, and consumers with significant challenges. According to evaluations by the US energy supplier Enel, disruptions in the US power grid have almost quadrupled in the last ten years. In addition to the weather events already mentioned, an aging power grid combined with the drastic expansion of data centers across the US creates a mix that repeatedly pushes the entire system to the edge of its performance. Energy suppliers and network operators are alarmed and must develop technical solutions that ensure the energy security of many consumers.

In addition to the classic provision of emergency power capacity, this also includes grid stabilisation to prevent blackouts from occurring in the first place. A technology that makes this possible is the stationary gas engine, which has become established in many parts of the world in recent decades, particularly as part of combined heat and power projects. The biggest difference: While classic gas engines are

designed for a system operating time of several thousand hours per year, "demand response" solutions only require a maximum of a few hundred hours yearly. There is increasing potential for energy suppliers to develop lucrative business models with the help of demand response solutions for larger customers such as hospitals, data centers, and other industries.

With efficient operations, network bottlenecks can be avoided, and consumers can rely on the security of electric supply. However, a crucial building block for establishing such models is primarily the gas engine technology, which needs to be sufficiently upgraded for use as a demand response solution. 2G Energy AG, a globally established manufacturer of combined heat and power systems, has accepted the challenge and is preparing to enter the new segment.

Development work carried out has made progress possible

Frank Grewe (Figure 1), board member and head of development at 2G, smiles a little when he thinks about the current new product development: "I would never have dreamed that we would one day be technologically able to compete with diesel engines with our gas engines. In my early days at 2G and when the biogas industry was ramping up, the motto was usually 'full load', with more than 8,000 operating hours per year to generate as much feed-in tariff as possible. With demand response, we are talking about a fraction of this runtime, but it must then be delivered with absolute reliability as soon as a network bottleneck threatens. First and foremost, this development is the best proof of the know-how combined with the huge innovation potential that our company now has."

The fundamental difference between classic cogeneration and demand response is noticeable: Whereas cogeneration is primarily about converting gas into electricity and heat with the highest possible efficiency, demand response is all about making electricity available at the push of a button – without any heat extraction. But how exactly did the new product come about?

2G was intensively involved in developing mechanical and control solutions for rapid load jumps over a decade ago. With the increasing need to make biogas plants more operationally flexible – especially in Germany – the need for flexible operation of the gas engines installed in those plants had also increased. Corresponding technical adjustments were necessary. Starting with modified ramps, harder materials for the heavily stressed bearing shells, and changing ignition timing, Grewe states: "The challenges at that time are certainly not comparable to today's demand to replace diesel generators, but the development work on those former projects helped us. Ultimately, it´s all about achieving the perfect balance between the materials used, efficient combustion chamber geometry, and coordinated control." Depending on the country and individual regulations, engine ramps of ten seconds must be safely adhered to, which further increases the development challenges and takes them to another level.

Lambda 1 technology ensures low emissions

Shortly after the decision to develop a new product, it was clear that all development steps would be based on the existing Lambda 1 technology used in the low-emission aura series. With its weakly charged turbocharger, this served as the basis for further development. Compared to a lean-burn engine, Lambda 1 technology produces NO_X and CO emissions, which react in the downstream three-way catalytic converter and thus enable particularly low-emission operation. The basis for the demand response product is a new generation of engines with stroke extension and increased power density, which makes the development possible in the first place.

"With demand response, we are talking about a short runtime, but it must then be delivered with absolute reliability as soon as a network bottleneck threatens", says Frank Grewe, board member and head of development at 2G Source: 2G

The first product under development is a 12-cylinder V-engine, which will have 650 kW (ESP) of electrical power in the emergency power variant and 600 kW (LTP) in the grid stabilisation variant. The first tests started in October 2023, and the engine has successfully completed its first 600 hours of operating time. Grewe is extremely satisfied with the experiences of the first few months, stating, "We are fully in line with our expecta-

tions with the development and were able to gain valuable experience in the design of the core components such as turbochargers and cylinder heads – especially given the very hot combustion of the Lambda 1 engine and the associated fatigue limits. We certainly benefit greatly from our intensive development work over the last few years. Without the know-how and the corresponding manpower behind the project, such development steps would certainly not be possible in such a short time".

Balancing quality vs. cost

The biggest challenge in bringing the new series to market is not the technology, Grewe clarifies: "In this case, particular attention is paid to product costs. Since our company was founded, we have always positioned ourselves as a company with high technological and quality standards, which was not necessarily the cheapest in terms of Capex costs. The strong cost-effectiveness of the 2G products was often a consequence of the low Opex costs, which were due to high efficiencies on the one hand and an individually tailored service offering on the other."

Grewe illustrates the extent to which the development of the new product takes place: "In the performance class of the 12-cylinder engine, we average specific investment costs of around €800 per installed electrical kilowatt for a CHP project. For a demand response solution, we are talking about a third of the price." As there is no heat recovery from the engine, the costs are significantly lower. In addition, the structure, including the frame, is only fundamentally reminiscent of a classic CHP system.

However, Grewe makes one thing clear: "The heart of the new product is and remains the engine, which, despite being designed as a demand response solution, must meet the highest quality standards." In addition to its own research and development, the German manufacturer benefits from an expanding supply network and expertise from its suppliers. "We traditionally involve our upstream suppliers closely in our strategic development projects and try to develop a sensitivity for our market and the requirements here too. The current demand response project is certainly a prime example – also given the cost pressure."

Primary focus: US launch in 2025

The idea of developing the product originally arose from colleagues at the 2G subsidiary in the US, where the need for a demand response solution was a direct result of the previously described mix of increasingly extreme weather events and an aging grid infrastructure. As the electrical grid is reaching its limits, there is a need for technologies that can alleviate the constraints with rapid load switching capability. The official product launch is planned for mid-2025 in the US, with various field tests being completed beforehand.

"The situation is extremely comfortable for us as a company, as we have had our own branch in the US for 15 years and our local colleagues have in-depth know-how in the market. The development of the demand response product, therefore, takes place in close coordination between the developers at the headquarters in Germany and their colleagues in the US. The same applies here, without this excellent teamwork, the development of such a project within a very short period of time would not be possible." However, Grewe makes it no secret that the US should only be the beginning: „The growth story of 2G is based on innovation, passion, and the strategic establishment of networks and markets around the world. In many countries, there are many other potential applications and customers for whom this type of solution will be interesting in the future. The US is just the beginning."

The future focus: renewable gases and hydrogen

While switching from diesel engines to gas engine-based solutions already significantly reduces CO_2 emissions, the medium-term goal must be achieving complete climate neutrality. Initially, the majority of the systems installed in the US will be operated with natural gas due to its availability. However, Grewe proudly points to the history of 2G and his company's development successes regarding renewable gases – especially with hydrogen. „Since the company was founded in 1995, we have concentrated on using gases of various qualities in our systems. We are particularly proud to see ourselves as one of the pioneers of the global market when it comes to hydrogen in CHP plants. So, it's only logical that we always keep renewable gases such as biogas and hydrogen in mind when developing the Demand Response series. In the future, the energy world will be decentralised and renewable – this applies to classic power plants as well as to our specialised demand response solutions. This claim should be self-evident."

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