

HYBRID POWER PLANTS

ELECTRICITY FROM DIESEL AND SUNLIGHT

MTU Onsite Energy gensets are ideally suited to take advantage of the combined power of diesel generators and photo-voltaic solar arrays, for maximum economic benefit and maximum power supply reliability.



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The trend towards alternative and sustainable energy sources has led in recent years to the widespread use of photo-voltaic solar farms. Solar energy is eco-friendly and literally inexhaustible but is not continuously and predictably available. Darkness and weather conditions can lead to fluctuations in the energy supply. One answer to this problem is provided by diesel generator sets that produce energy reliably around the clock. Working together with project partners, MTU Onsite Energy offers its clients bespoke solutions that combine the advantages of photo-voltaic solar arrays and diesel power plants to create a reliable and sustainable system.

DIESEL GENERATORS: PERMANENTLY AVAILABLE ENERGY

Diesel gensets are available 24/7, 365 days a year if needed and reliably generate electricity for an enormous variety of applications, such as emergency power supply backup in hospitals or computer centres, to cover demand peaks in power grids or as small-scale power plants providing a permanent supply independent of the mains grid. The latter example is a dependable and practical method of ensuring the supply of energy in regions without comprehensive grid coverage. It is a type of power generation that has proven itself many times over. MTU has already supplied several thousand such power generation modules. Many of them have been in use for decades.

Diesel gensets supplied by MTU Onsite Energy are particularly fuel-efficient, low-maintenance and comply with the strictest emission stand-

ards. What is more, they are distinguished by outstanding load-uptake characteristics and low-load capabilities above the average for the sector. And diesel gensets in general still offer more potential for improvement in terms of operating costs and environmental credentials.

PHOTO-VOLTAIC SOLAR FARMS: RENEWABLE ENERGY WITH LIMITED AVAILABILITY

Solar farms are in widespread use today. The trend away from fossil fuels such as coal and gas towards alternative and renewable energy sources has continued over recent years and gained significantly in importance. With falling production costs and continual improvements in terms of efficiency and durability, photo-voltaic (PV) arrays play a significant role in electricity generation from renewable sources. However, power generation from PV solar farms

also harbours risks and faces energy suppliers and grid operators with new challenges. Solar energy is eco-friendly but is not continuously and predictably available. At night when the sun is not shining, PV panels do not supply any electricity. Fluctuations and other limitations affecting the output of a PV array can be caused by effects such as the sudden appearance of clouds or rain and thunderstorms. Although predicting the weather is possible, it is not always exact – and that creates problems with the forward planning of solar energy availability.

An important precondition for using electricity produced from solar energy is the existence of a stable power grid. PV arrays cannot form a power grid on their own, which is why they can only be efficiently operated in combination with an existing grid or battery storage systems. Since solar farms produce direct current, the electrical energy generated must first be converted into alternating current by means of a power

inverter before it can be fed into an existing AC power grid. The alternative would be to store the generated direct current in batteries. From there the stored energy could be drawn off at a later date when required, again converted by a power inverter, and fed into the grid. However, the capacity of battery storage systems is limited by virtue of their size and acquisition cost.

PRINCIPLE OF HYBRID POWER PLANTS

One possible answer to those challenges, and a relatively new trend in energy generation, is the idea of diesel/PV hybrid plants. In the context of power generation, we refer to a hybrid system as one where two or more energy sources are combined, such as diesel and solar energy in this case. A combination with wind energy and battery storage systems

is also conceivable but requires even more complex control and regulation systems. Power generation using diesel gensets is predictable, controllable and reliable. What is more, diesel gensets using synchronous AC generators can form a stable power grid that is permanently available. However, their operating costs are relatively high, primarily because of the consumption of fuel, which does not arise with PV systems.

ADVANTAGES OF THE HYBRID SOLUTION

In view of those aspects, the combination of the two technologies would appear to make sense. The hybrid concept combines the respective advantages of energy generation by diesel generators and PV solar arrays and reduces the disadvantages of both concepts, thereby creating added value for





the customer. That added value consists, firstly of the continuous availability of the energy and a stable power grid as provided by the use of a diesel generator, and secondly, of the fuel saving. When solar energy is available, the diesel genset can be taken off line and the PV array can take over the majority of the load. To balance out the electricity demand at any particular time, on the one hand, and the available energy, on the other, in the best possible way, an intelligent overall control system is required. That system measures the amount of electricity actually required and regulates the feed-in of the available solar power.

The diesel gensets run continuously. That is necessary in order to create the power grid. However, the control system reduces the diesel genset out-

put as much as possible so as to cover as much of the demand as possible from the PV system. Only the electricity demand over and above the solar output has to be provided by the diesel gensets. Thus, maximum supply security at minimum fuel consumption is ensured. The resulting low fuel consumption reduces the environmental impact and saves the operator expenditure on fuel.

CUSTOMER BENEFITS OF MTU ONSITE ENERGY GENSETS IN HYBRID POWER PLANTS

A hybrid power plant should always be designed so that the installed diesel gensets do not run at below the defined minimum load. A figure

widely applied in the industry for the minimum load is 30%. That means that a diesel genset should not be operated at less than 30% of its rated output. Otherwise it would be operating in low-load mode. That damages the unit in the long term, as the diesel engine does not reach its optimum operating temperature and so optimum combustion cannot take place. In the worst-case scenario, that can even result in total failure of the genset. But if gensets have to be run at 30% minimum load, the maximum PV share is 70% of the load. From an economical viewpoint, however, higher PV shares would be desirable. The higher the PV share is within a hybrid plant, the greater is the potential saving due to lower fuel consumption.

This is where one of the most important advantages of the MTU Onsite Energy solution comes into play. The MTU Onsite Energy Series 1600 and 2000 diesel gensets have better-than-average low-load capabilities for the sector. Gensets in those series can be operated at between 0 and 20% of their rated output for up to 12 hours. The precondition for such low-load operation is that immediately afterwards they are run at an output of at least 60% for a

minimum of one hour so as to avoid the problem of oil transfer. That can cause oiling up of the engine due to the operating temperature being too low. The particular low-load capability of these engines allows the customer to draw as much as 100% of the required energy from the solar array at certain periods, thereby achieving the maximum fuel saving.

In general, MTU Onsite Energy diesel gensets are distinguished by their better-than-average fuel economy across the entire power curve. Even if the genset is operated at high loads for long periods in order to safeguard the power supply, the fuel consumption is lower than the average for the industry.

In addition, MTU Onsite Energy gensets have outstanding load-uptake characteristics. If, for example, the solar farm output should collapse due to heavy cloud formation, the diesel genset has to take up the load and supply the electrical equipment with power within a matter of seconds. MTU Onsite Energy gensets demonstrate above-average capabilities in that regard too and their characteristics make them particularly well suited to hybrid plant applications.

SUMMARY

Hybrid power plants that combine the advantages of diesel generators and photo-voltaic solar arrays are a reliable and efficient answer to the challenges of using renewable energies in regions without power grid access. Natural and renewable energy sources are not always constantly and predictably available. In such cases, diesel gensets can quickly and economically ensure power supply availability.

MTU Onsite Energy gensets are ideally suited to such tasks. With their especially good low-load capabilities, their economical fuel consumption and their outstanding load-uptake characteristics, they offer customers maximum economic benefit combined with maximum power supply reliability.

MTU Onsite Energy

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MTU Onsite Energy is a brand of Rolls-Royce Power Systems. It provides diesel and gas-based power system solutions: from mission-critical to standby power to continuous power, heating and cooling. MTU Onsite Energy power systems are based on diesel engines with up to 3,250 kilowatts (kWe) power output and gas engines up to 2,530 kW.

