CRAIG BLIZARD, ZOHEIR RABIA – Photovoltaic-diesel (PVD) hybrid solutions represent a key market segment that is discernibly influenced by the reduction in the manufacturing costs of the photovoltaics (PVs). In response to recent PV module price drops and diesel price increases over time, PV diesel hybrid solutions are beginning to gain acceptance around the world as an economically attractive alternative to grid extension and mini-grid systems that operate solely on diesel.
The high cost of and strong reliance on diesel fuel in countries belonging to Sub-Saharan Africa, Latin America and Southeast Asia, as well as their geographic remoteness, insular distribution and topography are key factors that make PVD solutions ideal for customers in these locations.

The ABB PVD solution, which includes the PVD automation and solar inverters, can be setup as an additional source of energy in these locations thereby maximizing fuel savings and reducing running time costs. The current low prices of PV systems are an added bonus that result in a quick return on investment.

The PVD energy solution provides customers with a compelling alternative to the sole use of diesel-powered mini-grids. Worldwide there are tens of gigawatts (GW) worth of power in isolated diesel-based microgrids that would lend themselves to be retrofitted through the integration of renewable energy technologies such as the PVD. This existing diesel mini-grid market represents an enormous economic potential for years to come.

**Microgrids**

Microgrids refer to distributed energy resources and loads that can be operated in a controlled, coordinated way either connected to the main power grid or in “island” mode where they neither draw power from the main grid nor supply power to it. Microgrids are a general classification of small, self-sufficient power networks that serve consumers.

Using the knowledge and benefits of the microgrid plus system, PVD 1.0 has been designed with a focus on cost effectiveness as well as engineering simplicity.
Peak solar penetrations of around 30 – 50 percent are typically achievable, corresponding to net renewable energy and fuel offsets of up to 15 percent during a year.

Power sources such as diesel generators was deemed suitable during mission critical situations such as during energy disruptions. Today however, microgrids that focus on the integration and effective management of renewable energy resources are gaining significance. Their potential as a sensible commercial solution to everyday power needs can be beneficial under many different circumstances.

**ABB microgrid expertise**

ABB is an expert on microgrids, having accumulated more than 25 years of knowledge and experience and having successfully executed more than 30 projects. ABB’s commitment to microgrids has been demonstrated through ongoing research and development, investment and product innovation. This work has been applied to the field of plant automation for conventional and modern power generation technologies, as well as power system technologies such as grid-stabilization and energy storage systems.

**Photovoltaic diesel**

ABB’s microgrid plus product line is a dedicated automation platform designed to manage power generation systems characterized by different combinations of conventional and renewable energy technologies such as diesel, gas, geothermal, hydro, wind, solar and energy storage systems. Microgrids can be effectively managed through the incorporation of the Microgrid Plus product line. The result is the ultimate balance of power quality and security, while ensuring ideal renewable energy utilization.

ABB’s PVD is the newest addition to the microgrid automation product palette. PVD has been created by ABB specifically for the automation of hybrid plant solutions comprising solar PV and fossil fuel generators. Using the knowledge and benefits of the Microgrid Plus system, PVD has been designed with a focus on cost effectiveness as well as engineering simplicity. This design philosophy has resulted in a reduction in the number of components and drastically simplified the project delivery model.

Because minimizing costs is at the forefront of PVD design, the end user can deploy a complete automation solution out of the box. Pre-engineered libraries and minimal site commissioning costs as well as a low component count mean that no specialized skills are required and additional engineering development costs are unnecessary.

In terms of performance, PVD has been designed with medium penetration renewable technologies in mind. Peak solar penetrations of around 30 – 50 percent are typically achievable. This corresponds to net renewable energy and fuel offsets of up to 15 percent during a year, a clear performance benefit.

In addition, the PVD offers a consistent deployment method and setup for control systems ranging from one to 16 genera-
tors and one to 32 inverters in order to accommodate various plant configurations in a simple and effective manner thereby meeting an array of customer needs ➔ 1.

**ABB inverters**

Both string inverters and central inverters can be used in a PVD application and ABB has developed products to manage solar generators. Two types of ABB inverters have been combined with the PVD: the three-phase string inverter (TRIO) for string inverters and inverters of the PVS class for central inverters. Both inverters have been tested and verified on interface maps with PVD.

These inverters have been selected from the full range of products and services that ABB offers for the generation, transmission and distribution of solar energy in both solar panel systems connected to the grid and hybrid systems – operating along the entire solar value chain.

**ABB string inverters**

The TRIO 20.0 and 27.6 are part of the TRIO family of inverters that represent the most efficient solution for both commercial PV applications and large-scale ground-mounted PV plant energy harvesting solutions ➔ 2. These string inverters are ideally suited for small and medium industries, hotels and resorts and warehouses and commercial buildings located in remote areas.

Furthermore, the TRIO’s high dependability, thanks to the natural convection cooling and IP65 environmental protection rating, make it resistant to extreme environmental conditions and therefore ideal for external use.

In addition to proven reliability, high efficiency (up to 98.2 percent) and broad input voltage range, the TRIO inverters are advantageous for the aforementioned locations due to their design configuration flexibility, which allows them to fit in a variety of solar park layouts. TRIO inverters also offer two independent maximum power point trackers (MPPT), which guarantee optimal energy output from two sub-arrays, characterized by different orientations. Furthermore, this inverter solution offers customers rapid installation due to the presence of an easily detachable wiring box.

As of today TRIO inverters with a cumulative power rating of approximately 4 GW have been shipped all over the world, making these inverters a valuable tool to drive energy needs for customers in isolated communities.

**ABB central inverters**

For multi-megawatt plants especially in the mining and heavy industry segment, central inverters are highly rated by both system integrators and end-users who require high performance solar inverters for utility-scale PV power plants and a maximum return on investment over the life cycle of a power plant.

The PVS 800 central inverter consists of proven components and has a long track record of performance excellence for both demanding applications and harsh environments ➔ 3. Equipped with extensive electrical and mechanical protection, the inverters are engineered to provide a long and reliable service life of at least 20 years.

In addition, ABB central inverters provide high total performance based on high efficiency, low auxiliary power consumption, verified reliability and ABB’s experienced worldwide service organization. The inverters are available from 100 kW up to 1,000 kW, and are optimized for use in multi-megawatt PV power plants.

**PVD package solution**

PVD consists of dedicated controllers packaged as a complete kit solution designed to facilitate integration into new and previously developed industrial installations ➔ 4. The controllers have been classified according to two distinct functions, firstly the G (or generator) controller responsible for automation of fossil fuel generators and the P (or PV) controller responsible for managing the PV generation.

For the purposes of site configuration and commissioning duties, a dedicated tool is included as a key component of

Equipped with extensive electrical and mechanical protection, central inverters are engineered to provide a long and reliable service life of at least 20 years.
ABB’s PVD system utilizes MGC690 controllers, which consist of control hardware and software designed to be robust and reliable and meet the stringent requirements of total plant automation.

The MGC690 controller’s industrial grade embedded system architecture allows the PVD solution to execute the entire plant automation logic rapidly, in under 100 ms. The low power consumption coupled with the extended operating temperature range enables the MGC690 to be installed in sealed enclosures without the need for fans, louvers, air filters or other forced cooling equipment. This eliminates maintenance requirements associated with cooling systems and significantly reduces operating costs associated with control system equipment, which is particularly advantageous for microgrid customers.

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ABB’s PVD solution with the PVD controller and choice of string or central solar inverters provides a reliable, efficient and cost-effective alternative to microgrids and grid extensions that operate solely on fossil fuels. The engineered design and flexibility of configuration make these two different power solution products highly suitable for small to mid-size industries, geographically isolated areas or in utility-scale power plants. The MGC690 and the PVD provide consumers with the benefits of rapid, accurate and uninterrupted control of their microgrid systems enabling a stable and reliable power supply. This in combination with the low price of photovoltaics, fuel savings and low running time costs of implementing a PVD solution lead to a quick return on investment and value for customers.