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## Big Punch, Small Package

Mobile generator set delivers power outputs up to 1 MW

Clear Energy Systems (CES) has introduced the Genesis 1000, a compact and lightweight 1 MW power generation system. Developed specifically for gaseous fuels, its unique air-cooled radial engine delivers electrical efficiency and emissions compliance at low operating costs. With advanced monitoring and controls, and optional mobility package, the Genesis 1000 sets a new standard in mobile and distributed power generation, the company said.

“At the time of our product development, the market was generally full of diesel gen-sets, which tended to be heavy, large in size and expensive both to buy and operate,” said Anthony Carmen, president and CEO of Clear Energy Systems. “Our purpose was to create a generating system that was lighter, smaller, more efficient and more cost effective than what everyone was currently using.”

The Genesis 1000 is a fully operational, self-contained generator set ready for most environments and applications. With an optional mobility package, it can be towed behind a pickup truck or airlifted by helicopter, making it a suitable choice in military

and disaster relief situations. The Genesis delivers power outputs of 1 MW in standby duty, 900 kW in prime power, and 750 kW in continuous operation. It can be used on a stand-alone basis or ganged with other units in parallel to fulfill high-energy, base-load applications, the company said.

“We see this product as ideal for a rental fleet, as a partner with electrical facilities, prime power facilities, data centers, military bases, manufacturing plants, oil & gas producers — particularly for our distributor in Canada — and on almost any other application you can think of,” Carmen said. “With our focus on emissions, we think we are a perfect fit as a hybrid with renewable energy. They need a backup source, a peak saving source, and we provide that as well.”

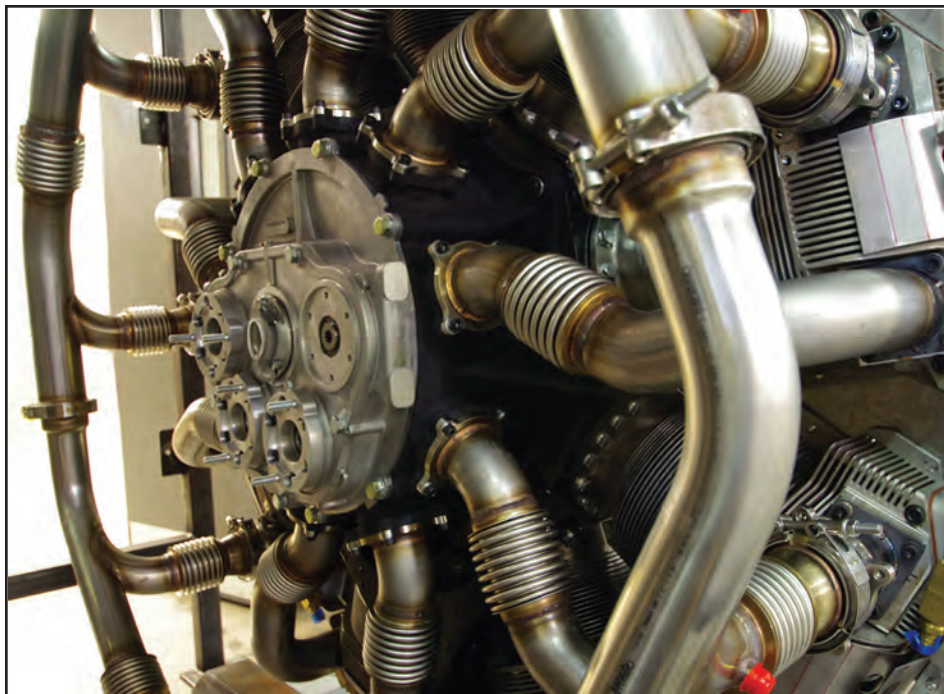
The Genesis 1000 is designed to run on natural gas supplied either through pipeline infrastructure or delivered in tanks as liquid natural gas (LNG) or compressed natural gas (CNG). However, the intake, combustion and control systems are also fuel agile, enabling the use of biogas, landfill gas, flare gas and LP gas. Multiple calibra-

tion curves permit field switching of fuel types, and custom calibrations accommodate site-specific fuels.

The Genesis unit measurements vary depending upon configuration: the open skid unit measures 4.3 m long x 1.9 m wide x 2.3 m high and weighs 6078 kg; the enclosed skid measures 4.5 m long x 2.3 m wide x 2.4 m high and weighs 6781 kg; and the enclosed mobile unit measures 4.5 m long x 2.6 m wide x 2.9 m high and weighs 7121 kg.

The power generation system combines components developed by Clear Energy Systems and its suppliers. At its heart is CES’ engineering of the ARC-930TA power plant: a radially configured, nine-cylinder, air-cooled and turbocharged reciprocating piston engine inspired by the well-known aircraft platform, the company said.

Radial engine geometry permits a lighter block, a smaller, simpler and more mechanically efficient crankshaft, fewer parts and bearings, reduced contact surfaces and a lower coefficient of friction. In the ARC-930TA, all rods act upon a single crank journal. The low master and link rod angles yield superior transmission of cylinder pressure to the crankshaft, the company said. “The crankshaft is very short and sturdy compared to its long inline counterparts,” Carmen said. “As a result,



CES's new power plant is engineered for durability and long service life in heavy-duty, mission-critical applications.

it does not suffer from significant torsional distortion or excessive friction.”

With a bore of 156 mm, a stroke of 175 mm, and a displacement of 30 L, the engine is capable of producing 1155 kW at a constant 2300 r/min. The company said its 930 power plant delivers high-load capacity, extended maintenance intervals and long service life while retaining all the advantages inherent in its radial design: high kW-to-weight ratio, compact size, low internal friction and high operating efficiency.

CES said that maintenance and overhaul costs will be less for the Genesis 1000 than for comparable products because of simplified fuel and intake systems, advanced filtration, reduced friction surfaces, fewer components, and use of synthetic oil. The ARC930TA meets extended durability requirements and its radial configuration facilitates access to major engine components. Each individual cylinder may be overhauled independently without removing or disassembling the engine, significantly reducing overhaul time and cost.

Another key component of the Genesis 1000 is the Marelli 400 MB4 three-phase, four-pole, continuous duty, class H insulated, auxiliary wound, IP 23, synchronous generator provided by Italy-based Marelli

Motori. Coupling the engine and generator, CES engineered a new transfer case that delivers rotational power to the generator shaft at the optimal speed for 50 Hz (1500 r/min) or 60 Hz (1800 r/min) power frequencies without having to vary from the optimal engine r/min of 2300.

Engine conditions are monitored by the company's privately developed electronic control module. “We determined early on that we were not going to go with an off-the-shelf monitoring system,” Carmen said. “Working with experts overseas, we decided that we had to develop our own control system with unique features that will help reduce maintenance costs and frequency.”

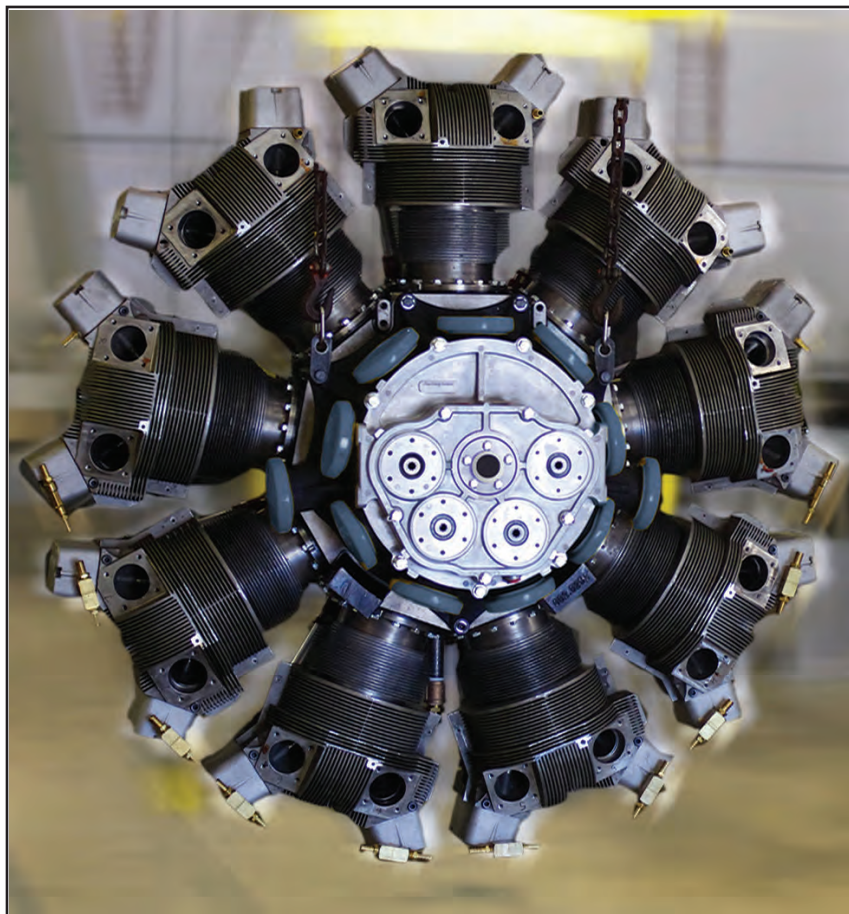
The result of that effort is the micro-processor-based Universal Digital Control (UDC) that integrates monitoring, diagnostics and control of both engine and alternator in a single system employing CAN bus technology. The UDC measures a host of engine performance functions: intake manifold, gas, air filter, and cylinder head temperatures; camshaft, crankcase, ignition coil, knock sensors and dual O<sub>2</sub> sensors; hydraulic fluid temperature, fluid low level and pressure; and oil level switch, oil metal chip sensor, oil pressure sensor, and oil reservoir and output temperatures.

Developed in collaboration with Sysmop Technologies, the UDC is also capable of integrated spark timing control, turbocharger control, speed governing, cylinder knock control, and a time-stamped, full diagnostics reporting system. It has complete engine data display capability, and gen-set and engine monitoring and protection including emergency stop, fail to start shutdown, permissive start/fuel presence shutdown, and engine vitals monitoring. Complete logs for operational data, including start attempts, starts, running hours and kW hours are also included.

The UDC allows parallel operation with up to 30 other Genesis units and with utility service, providing paralleling data, functions and protection, as well as frequency synchronization and voltage matching.

Operator-friendly instrumentation is displayed onboard through a 38 cm color touch screen monitor, or on remote computer via Ethernet connection and proprietary CES software. The system is designed for EMC compliance and constructed to meet the most rugged duty cycles for gen-sets, the company said.

A 100 Amp alternator for battery charging and controller system



**The ARC930TA power plant is a radially configured, nine-cylinder, air-cooled and turbocharged reciprocating engine.**

power, a 24 V starting motor and lead acid batteries are part of the charging and start system. A cold weather package enables start-up and operation in extreme cold weather conditions to  $-40^{\circ}\text{C}$ . This package includes a 10 Amp battery charger, battery heater, hydraulic fluid heater, oil line and reservoir heaters and insulation, cold weather oil formation, and dual starter motors. An intermittent auto start-up feature replaces heaters in off-grid conditions. The emergency start package meets Type 10 standards for emergency start demands and includes an NFPA-approved battery charger, certified battery and an oil reservoir heater.

CES said that all components are supplied by well known industrial manufacturers: ignition components by Bosch, Delphi, Stonebridge, Motor Tech, Comap and Denso; turbochargers from Borg Warner; hydrau-

lic components by Parker Hannifin; cooling fan from American Fan; exhaust system from Katcon; bearings from SKF and Federal Mogul; air filtration from Donaldson Air Filtration; and enclosure from Di-Metrics.

The Genesis 1000 has been engineered for reduced emissions of greenhouse gases and other air pollutants and is equipped to meet or exceed all current and scheduled EPA, California Air Resources Board (CARB) and EU emissions requirements. This includes EPA regulations governing both mobile and stationary large spark ignition engines.

“As time went by, the emissions side of the picture became even more important,” said Carmen. “The advanced design of the ARC930TA, coupled with the low carbon structure of natural gas and alternative fuels, makes the Genesis 1000 an environmentally friendly power source — emitting

fewer and more easily controlled emissions than other diesel engines.”

Attention was also paid to sound emissions, especially important for hospitals and other environments where extremely quiet operation is demanded. A protective weather enclosure with sound attenuation to 75 dB(A) is standard equipment. With optional packages, critical and super critical levels can be achieved.

Domestically, CES will market the Genesis 1000 from its headquarters in Tempe, Arizona, U.S.A., while globally, master distribution partnerships are in development. Two such partnerships have been concluded to date. The first is with SARN Power LLC, a subsidiary of SARN Energy, based in Washington, DC, U.S.A., and Prague, Czech Republic. SARN will market and service CES power generation products throughout Central and Eastern Europe and the Commonwealth of Independent States (CIS).

“We’re excited to add Clear Energy Systems’ advanced power generation products to our portfolio,” said Stephen Richards, chairman of SARN Energy. “There is a strong demand for distributed power generation and innovative technology platforms.”

A second master distribution partnership has been finalized for the Canadian market with Toronto-based GasGen Canada, Ltd.

“We see strong opportunities for CES’ innovative technology in various energy applications including peak shaving, demand response, on-site power rental and remote operations,” said Greg Reid, president of GasGen Canada. “These units are indispensable for oil and gas exploration and resource development, especially in remote areas.”

Steve Bray, president of Power Plus, a California, U.S.A.-based energy solutions company and early advocate of Genesis power technology, summarized the attractiveness of the new product, “The combination of small size and weight, fully enclosed trailer mobility, and massive generating power means that this technology will transform how energy managers plan for or deploy distributed generation assets.”