Clean Cycle II J-Series
Technical Specification

Product description
GE’s Clean Cycle® II heat-to-power generator is a compact, modular system that converts waste heat – from an array of heat sources – into power. The conversion process requires no additional fuel, produces no additional emissions, and delivers base-load power that may be used on-site or sold to the grid.

GE’s Clean Cycle II J-Series is specifically designed for reciprocating engine applications that use heat from the engine jacket water. The jacket water heat acts as a pre-heater for the Clean Cycle working fluid, and provides thermal energy – in addition to the exhaust heat from the engine – to ensure increased output from a given engine.

How it works
GE’s Clean Cycle II generates electricity in a process called the Organic Rankine Cycle (ORC). The process is similar to the steam cycle, except that the ORC uses a working fluid (in place of water) with a lower boiling point, enabling access to a greater range of heat sources.

![Diagram showing the process]

1. Thermal energy is brought to the Clean Cycle II system’s heat exchangers through a pressurized hot water loop from the engine exhaust, and a separate loop from the engine jacket water.
2. The working fluid in the Clean Cycle II system is pumped through its heat exchangers and changes state from a liquid to high pressure vapor.
3. The high pressure vapor enters the Integrated Power Module (IPM) and expands across a turbine generator, causing it to spin and generate power.
4. A condenser cools the vapor back to liquid form and is pumped back to the heat source.

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Performance data

GE's Clean Cycle II heat-to-power generator automatically generates the maximum power possible based on the heat transferred to the ORC and the condensing temperature. The temperature of the thermal energy delivered to the Clean Cycle II heat-to-power generator can vary by source; the chart below assumes it is 155°C (311°F).

**System parameters**

- Maximum gross output from generator: 140±5% kW
- Maximum grid output from power electronics: 115±5% kW
- Working fluid evaporation temperature: 155°C, 311°C

**Scope of supply**

Core components delivered

- The Clean Cycle II skid (see back page for details): Standard
- Skid mounted condenser: Optional
- R245fa working fluid: Optional

Engineering services

- Heat source heat exchanger: Spec and/or supply
- High pressure hot water system: Spec and/or supply
- Custom condenser and system design: Spec and/or supply
- Overall system design: Optional
- Commissioning: Optional

**Electrical output**

- Frequency: Hz 60 50
- Voltage: V 680 400
- Power factor: - 1.0 1.0
- Load current (full gross): A 168 202
- Peak starting current: A 53 64

**System design**

- Gross electrical output: 50 - 140 kW
- Working fluid: R245fa (benign, non-ozone depleting)
- Power electronics: Built in inverter – matches AC grid power
- Electrical output: 50 or 60Hz AC 3-phase power
- Dimensions: 384.0 x 121.9 x 217.4 cm (151.2 x 48.0 x 85.6 in)
- Weight (not filled): 3,548kg (7,822 lbs)
Connection information

**Electrical connections**

Electrical power to grid from SEB: 3/0 3-conductor with ground

Internet connection: Ethernet CAT-5 cable from customer internet

Heat valve output to BOP: Output from Clean Cycle II PLC 4-20 mA signal to control customer heat source

Temperature input from BOP: Input from Customer 4-20 mA representing heat source supply temperature

**Other connections**

Instrument air, Control valve actuators: 100 PSIG (7BAR) clean/dry instrument air capable of 5 cfm

**Piping connections**

<table>
<thead>
<tr>
<th>Connection</th>
<th>CE</th>
<th>Non-CE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main heat source supply (HSS)</td>
<td>DIN 80 PN40</td>
<td>3&quot; - 300#</td>
</tr>
<tr>
<td>Main heat source return (HSR)</td>
<td>DIN 80 PN40</td>
<td>3&quot; - 300#</td>
</tr>
<tr>
<td>Jacket water supply (JWS)</td>
<td>DN 80 PN40</td>
<td>3&quot; - 300#</td>
</tr>
<tr>
<td>Jacket water supply (JWR)</td>
<td>DN 80 PN40</td>
<td>3&quot; - 300#</td>
</tr>
<tr>
<td>Indirect condenser water supply (CWS)</td>
<td>DIN100 PN40</td>
<td>4&quot; - 300#</td>
</tr>
<tr>
<td>Indirect condenser water return (CWR)</td>
<td>DIN100 PN40</td>
<td>4&quot; - 300#</td>
</tr>
<tr>
<td>Direct refrigerant to condenser (RTC)</td>
<td>DIN 100 PN40</td>
<td>DIN100 PN40</td>
</tr>
<tr>
<td>Direct refrigerant from condenser (RFC)</td>
<td>DIN 100 PN40</td>
<td>DIN100 PN40</td>
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</tbody>
</table>

* Connections for direct condenser not shown/defined in illustration

** Plant piping from Clean Cycle II unit to condenser to be 15 cm or 6 in
**Integrated Power Module (IPM)**
A high speed turbine expander integrated with a permanent magnet generator into one hermetically sealed unit. Contains only one moving part, no gearbox, no lubrication, no oils.

**Single Electronics Box (SEB)**
Contains the core electrical components in one easily accessible enclosure.

<table>
<thead>
<tr>
<th>Power Electronics Module (PEM)</th>
<th>Converts high frequency electrical energy into 50Hz/60Hz useable power for the utility grid.</th>
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<tbody>
<tr>
<td>Magnetic Bearing Controller (MBC)</td>
<td>Controls the magnetic bearings to ensure that the turbine generator floats in the precisely calibrated location as it spins. In the event of a power loss, an internal UPS will power the magnetic bearings until the IPM reaches zero RPM's.</td>
</tr>
<tr>
<td>Programmable Logic Controller (PLC)</td>
<td>Provides start, run and stop controls as well as complete safety and system supervisory functions such as over-speed control, high-temperature and high-pressure limit control, fault coding, emergency shutdown, and data logging.</td>
</tr>
<tr>
<td>Power distribution components &amp; controller</td>
<td>Provides up to 120A of current for balance of plant (BOP) equipment. The SEB is also designed with a 5KVA transformer to convert from 480/400VAC to single phase 240/120VAC voltage that will power individual items inside of the container.</td>
</tr>
<tr>
<td>Human Machine Interface (HMI)</td>
<td>A touch panel on the SEB that handles control functions (on-site and remote) as well as data logging.</td>
</tr>
</tbody>
</table>

**Receiver and working fluid**
Where the working fluid, R245fa, is stored. R245fa is a benign, non-flammable, non ozone-depleting working fluid with a lower boiling point than water.

**Heat exchanger – Jacket Water / Pre-Evaporater**
A brazed plate heat exchanger which is dual-function. One side of the heat exchanger introduces pumped hot Engine Jacket Water heat into the working fluid, warming it to efficiently begin the evaporation process. The second side serves as a Pre-Evaporator adding more sensible heat (no phase change) into the working fluid before it enters the Main Evaporator.

**Heat exchanger – Evaporator**
A brazed plate heat exchanger where the working fluid changes phase from liquid to vapor and the vapor is superheated before entering the IPM.

**Heat exchanger – Condenser (optional)**
A brazed plate heat exchanger where working fluid leaving the expander is cooled from a vapor to a liquid.

**System pump**
A multiple stage liquid pump designed for low inlet pressure and high flow rates, driven by a 15 HP motor.

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For more information
email us: info.heatmaprecovery@ge.com
or visit: www.geheatrecovery.com

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Distributed Power

GE Imagination at work

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