ORMAT REGS

EVALUATING A RECOVERED ENERGY GENERATION PROJECT

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2ND ANNUAL WASTE HEAT TO POWER WORKSHOP
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 ORMAT TECHNOLOGIES, INC.

- Vertically integrated alternative energy company
  - 40 Years of success
  - NYSE (ORA) listed
- Primarily engaged in geothermal and recovered energy project business
  - 800 MW of installed capacity worldwide
- Proprietary ORMAT technology
  - Binary organic Rankine cycle
- Flexible business model in the energy industry
  - Develop, design, build, own, operate
  - Turnkey
  - Equipment sales
  - Finance
ORMAT REGS

What is it?
- Recovered Energy Generation System
- Binary organic Rankine cycle
  - Closed
  - Use of organic motive fluid
  - Rankine cycle is the heart of the power plant
- Environmentally friendly
  - No discharges to the atmosphere
  - No water required
  - Offsets fossil fuel generated power

How is it deployed?
- Up to 10 MW modules
- Gas turbine exhaust
- Any industrial application with waste heat
- Competes more than favorably with steam turbine technology
- Energy cost competitive ($/kWh) in today’s marketplace
REGS – Process Flow

ORMAT Recovered Energy Generation System
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Enterprise – “Neptune”
Gas Processing Station
Key Factors in Evaluating an Opportunity

- Customer motivation
  - Energy costs are rising
  - Offset purchased energy (electric or fuel)
  - Need competitive edge
  - Need reliable energy due to grid failure (large ups)

- Application
  - Large quantity of hot gases “wasted” to atmosphere
    - The sweet spot
  - Runtime
  - Site and flow characteristics

- The questions
  - How much energy can be recovered?
  - How much does it cost vs. saving/making $?
  - Is this a feasible project?
Available Real Estate

- REGS is a compact application
  - ½ acre or less needed
- Close to heat source
  - “Inside the fence”
Permitting

- REGS is environmentally friendly
- No new emission source
  - No fuel is combusted
  - No water supply or waste water disposal
  - Only construction permits and local approvals required
  - Organic fluid storage on site
Operation

- No “upstream” process impact
- Designed and built for unattended operations
- Simple start up and shut down
- Operator “buy in”
  - Operator friendly
  - Single switch operation – off or generate
  - Minimal system maintenance considerations
Typical Project

- Technical data
  - Rolls Royce RB211
  - Exhaust Temp at 910° Fahrenheit
  - Exhaust mass flow at 331 tons per hour
  - Sea level
  - 60°F ambient
  - Air cooling
Typical Project

- 5 MW of net power output using turbine exhaust
- Approximately 39.4 million kWh/year
- Budgetary capex $9 million
- $0.0015/kWh O&M
- Average west coast industrial rate of $0.062/kWh
- Saving of approximately $2,384,000 per year or a payback of around 3.5 years
Conclusions

- REGS economically attractive – even if energy costs stabilize
- REGS energy cost is almost flat over the project life
- REGS offers environmental attributes
- It can be used to offset RPS requirements in several stats
- Market is responding
Thank you

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