Variable Speed Gensets

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Topics Discussed in the Presentation

- What is a Variable Speed Genset?
- Comparison of Variable Speed Genset and a Fixed Speed Genset.
- What are the advantages of a Variable Speed Genset?
- How does a CVT based Variable Speed Genset work?
- What are the target markets for the Variable Speed Gensets?
What is a Variable Speed Genset?

A variable speed genset is an engine driven electrical power generating system that uses technology to control engine speed to provide performance enhancement, fuel savings, reduced emissions and noise reduction while providing power to the load at a specified voltage and frequency.
Variable Speed Gensets

• There are two types of Variable Speed Gensets
  – Those based on power electronics
  – Those based on a Continuously Variable Transmission

• Both designs share a common heritage with the traditional fixed speed genset that you are familiar with.

• There are several major differences however between the fixed speed genset and the variable speed genset designs.
Variable Speed Gensets

- *Power Electronics* based designs use an engine driven alternator along with IGBTs, inductors, capacitors and a control scheme to create voltage and current waveforms comparable to that generated by a fixed speed synchronous genset.

- The *CVT or Continuously Variable Transmission* based design employs a mechanical solution that uses a standard synchronous alternator and a variable speed engine.
Power Electronics Based Variable Speed Genset Components

- Variable Speed Engine
- Synchronous Alternator
- Control System
- Power Electronics Package
  - maintains constant voltage and frequency output during most load conditions.
  - may also provide
    - fault protection
    - protective relays
    - industry standard power quality
Power Electronics Based Variable Speed Genset
Power Electronics Based Variable Speed Genset

- Advantages of Power Electronics Based Gensets over fixed speed units:
  - Average fuel savings of 20-50%
  - Reduced emissions as fuel is burned more cleanly
  - Reduced noise and vibrations (>6dB)
  - Decreased engine wear - time to overhaul can be doubled
  - Optimum engine sizing: engine can be sized according to average load requirement, with peak loads supplied from electrical energy storage unit
Mechanical Variable Speed Genset Components

• Variable Speed Engine
• Synchronous Alternator
• Control System
• Toroidal Traction Continuously Variable Transmission
What is a Toroidal Traction Continuously Variable Transmission?

- It is a mechanical device that transmits torque between curved traction discs using actuated rollers and a highly engineered traction fluid. This allows the output speed to be varied through an infinite number of ratios between throughout its operating range.
  - High Efficiency (92% +)
  - High Torque and Power Capacity
  - Simple, Robust, Reliable
  - Simple Control
  - Rapid Ratio Changes
    - 0.3 seconds for 5:1 range
    - Uses a simple 30W DC motor for actuation
Mechanical Continuously Variable Transmission (CVT)
Mechanical Variable Speed Genset
Advantages of a Mechanical Variable Speed Genset Over a Fixed Speed Genset

- Fuel savings of 10% to 50% with averages of 10% to 30% depending on load factor
- Reduced emissions
- More power available for a given engine
- Smaller displacement engine technology running at higher speed with greater efficiency can now be used
- Engine temperature stays warm even at low electrical loads
- Decreased engine wear - time to overhaul can be doubled
Advantages of a Mechanical Variable Speed Genset

• Lower noise
• Can withstand 300% and greater inrush current
• Greater motor starting capacity
• System can be balanced to combine fuel economy and ISO8528 G1, G2 or G3 steady state and transient power quality.
• Traditional engine and alternator can be easily combined with a CVT using an SAE standard mechanical coupling.
# ROI with a 50kW Variable Speed Genset

<table>
<thead>
<tr>
<th>Average Load</th>
<th>Yearly Fuel Savings</th>
<th>ROI</th>
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<tbody>
<tr>
<td>30%</td>
<td>$ 15,000</td>
<td>5 months</td>
</tr>
<tr>
<td>40%</td>
<td>$ 13,600</td>
<td>6 months</td>
</tr>
<tr>
<td>50%</td>
<td>$ 11,500</td>
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<tr>
<td>60%</td>
<td>$ 8,800</td>
<td>10 months</td>
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<tr>
<td>70%</td>
<td>$ 5,900</td>
<td>15 months</td>
</tr>
</tbody>
</table>

* Based on fuel price of $3.80 (USD) per Gallon
Target Markets

- Prime Power
  - Remote Location
  - Telecom
  - Mining, Oil and Gas
- Peak Shaving
- Rental and Construction
- Marine Genset
- Military
- Propane and Natural Gas Standby Gensets
Thank You!

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