Standard & Optional Items, Certifications and RFQ
Standard & Optional Items, Certifications and RFQ

- Standard Items
- Optional Items
- Hazardous Certifications
- Marine Certifications
- API-546
- Request for Quote
Standard Items

- Voltage regulator (exception: oil drilling)
  - Kato K65, K125
  - Basler SSR63, SSR125
  - Basler DECS-100, DECS-200
  - Basler DECS-250

- Permanent magnet generator (PMG) (exception: oil drilling) – Powers voltage regulators
Advantages of a PMG

• Provides an economical and simple means of reliable, responsive and stable input power to the voltage regulator.

• Supplies continuous power to the exciter through the voltage regulator to maintain up to 300% short-circuit current from the generator during a fault condition.

• Provides full exciter power, regardless of generator voltage, for motor starting and is a separate voltage source for use external to the generator set, such as a tachometer and relay options.

• Reduces the effects of both conducted and radiated electromagnetic interference (EMI). With an EMI filter, the PMG and a KATO™ voltage regulator will meet the emissions requirements of Mil-Std. 461C, Part 9, Class C2.

• Enhances manual voltage control regulation as the PMG provides a more stable power source to the manual control.
# Types of Excitation

<table>
<thead>
<tr>
<th></th>
<th>Self excited</th>
<th>AREP</th>
<th>PMG</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Motor starting</strong></td>
<td>Standard</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td><strong>Short-circuit capability</strong></td>
<td>None</td>
<td>300% @ 60 Hz</td>
<td>300% @ 60 Hz</td>
</tr>
<tr>
<td><strong>Susceptibility to non-linear loads</strong></td>
<td>Maximum</td>
<td>Minimum</td>
<td>Minimum</td>
</tr>
<tr>
<td><strong>Number of components</strong></td>
<td>Minimum</td>
<td>Minimum</td>
<td>Maximum</td>
</tr>
<tr>
<td><strong>Retrofitability</strong></td>
<td>N/A</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Generator length</strong></td>
<td>Minimum</td>
<td>Minimum</td>
<td>Maximum</td>
</tr>
<tr>
<td><strong>Price</strong></td>
<td>$$</td>
<td>$$</td>
<td>$$$</td>
</tr>
<tr>
<td><strong>Stator design</strong></td>
<td>Standard</td>
<td>Special</td>
<td>Standard with PM attachment</td>
</tr>
<tr>
<td><strong>Voltage build up</strong></td>
<td>Residual magnetism</td>
<td>Residual magnetism and permanent magnet inserts on some frames</td>
<td>Positive from permanent magnets</td>
</tr>
</tbody>
</table>
Standard Items (cont.)

- Space heaters
  - In generator frame
  - Commercial version
  - Maintain the temperature of the stator housing slightly above ambient air temperature to prevent condensation on generator windings.
  - Require a separate power source
    - Need to be de-energized during generator operation
    - Variety of configurations depending on application
Standard Items (cont.)

• Main stator RTDs
  – Used to measure internal hot spot temperatures of a machine’s winding
  – Placed in between coils
  – Two per phase
  – 100-ohm platinum
  – May be required by specification or application
Standard Items (cont.)

- Generator enclosure
  - Open drip proof (IP-23)
- Terminal box (main and auxiliary boxes)
  - Steel (IP-43) side with bottom entry
  - Standoff terminals for customer connections
Standard Items (cont.)

• Two-bearing configuration
  – Regreasable anti-friction for small machines
  – Grease lubricated split roller for medium machines
  – Oil lubricated split sleeve for large machines
Standard Items (cont.)

- Form-wound main stator (armature) coils
## Form-Wound vs. Random-Wound

<table>
<thead>
<tr>
<th>Form-Wound Coils</th>
<th>Random-Wound Coils</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire is rectangular or square with Dacron glass cover or mica turn tape over 200º C heavy film. The wire is more costly and inventory costs are increased because many different sized wires are used.</td>
<td>Round wire with 200º C heavy film is used. Fewer sizes need to be kept on hand, and the wire is more economically priced.</td>
</tr>
<tr>
<td>Individual turns are systematically arranged throughout the coil.</td>
<td>Turns have a random location; wires from a turn can touch any other turn.</td>
</tr>
<tr>
<td>Coils have insulation tapes</td>
<td>Coils are not taped.</td>
</tr>
<tr>
<td>The slots have uniform copper fill. Individual wires are tightly held in the slot.</td>
<td>Wire fit in slots is not uniform.</td>
</tr>
<tr>
<td>Coil-to-coil connections are usually required.</td>
<td>Only phase connections are required.</td>
</tr>
<tr>
<td>End windings are shaped to form a basket with large openings between the coils to promote cooling and reduce coil contamination.</td>
<td>End of windings are completely covered. Excessive resin can build up and seal all openings. Moisture and contaminate can accumulate.</td>
</tr>
</tbody>
</table>
# Form-Wound vs. Random-Wound

<table>
<thead>
<tr>
<th>Form-Wound Coils</th>
<th>Random-Wound Coils</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is uniform resin buildup in VPI and uniform temperature distribution.</td>
<td>Resin builds up unevenly based upon the looseness of the wires in the slots. Design is more sensitive to localized hot spots due to internal voids.</td>
</tr>
<tr>
<td>There is uniform turn-to-turn voltage stress</td>
<td>Turn-to-turn voltage can be as high as (#1 of turns - 1) × volts/turn.</td>
</tr>
<tr>
<td>There is minimum potential for wire damage during assembly or disassembly.</td>
<td>There is a higher potential of wire damage during assembly or disassembly.</td>
</tr>
</tbody>
</table>
FW vs RW Application Guide

- **Clean environment**
  - Standby: Random wound
  - Continuous: Form wound

- **Harsh environment**
  - Standby: Random wound
  - Continuous: Form wound

- **Low non-linear load**
  - Lower power rating

- **High non-linear load**
  - Higher power rating

**Applicable/recommended:**
- Choice exists. Use caution and review all factors
- Review all factors to avoid premature failure
FW vs. RW Application Guide

- Type of generator set rating
  - Standby load applications, which have limited running time, may not require form-wound generators, especially with optional space heaters.
  - Prime and continuous applications, especially when running at high load factors, should have form-wound generators.

- Power rating
  - Smaller generator sets at lower power ratings (under 800 kW) may use random-wound generators if no other adverse conditions exist. (Form-wound generators may not be offered and available for the low power ratings.)
  - With high-power generator sets (above 2 MW) and critical power installations, consider form-wound generators.
  - Applications in the middle of the rating range (800 to 2250 kW) merit careful consideration.
FW vs. RW Application Guide

• Installation environment
  – When installed in the corrosive, coastal (salt-laden), dusty or any other adverse environment without the protection of air filters, protective enclosures or a filtered building, generators with form-wound coils should be used. Additionally, the optional coastal insulation winding protection may be applicable.

• Type of load
  – High SCR and non-linear loads may cause winding end turn vibration, which results in insulation cracking that makes the generators more susceptible to moisture failures. Form-wound generators are inherently more robust and suitable for these applications.
Standard & Optional Items, Certifications and RFQ

- Standard Items
- Optional Items
- Hazardous Certifications
- Marine Certifications
- API-546
- Request for Quote
Optional Items

- Dual-redundant voltage regulator system
  - Near bumpless transfer from auto-manual voltage control
  - Applications: Generally offshore in the petroleum industry
Optional Items (cont.)

- Vibration proximity probes & proximitors for sleeve bearings

Petroleum, larger apps.
Optional Items (cont.)

- Velocity probes for ball and split roller bearings
Optional Items (cont.)

- Sleeve bearing oil coolers.
Optional Items (cont.)

- Stator RTDs increased to three or four maximum per phase
- Bearing RTDs - Up to two per bearing
- Both are 100-ohm platinum but also available in the following:
  - 10-ohm copper
  - 120-ohm nickel
  - Thermocouples (less than 5000 V)

Petroleum, larger apps.
Optional Items (cont.)

- Low surface temp. space heater (generator frame)
- Low surface temp. space heater (main terminal box)
Optional Items (cont.)

- Space heater thermostat
- Redundant series connected rotating rectifiers

Any critical application
Optional Items (cont.)

- Current transformers (CTs) installed in the main and/or neutral terminal boxes
Optional Items (cont.)

- Voltage clamping module for CTs mounted in main or neutral box on hazardous applications in Hazardous Zone II areas.
Optional Items (cont.)

- IP54 exciter rectifier assembly for hazardous applications

Hazardous Zone II areas
Optional Items (cont.)

- TEAAC / CACA enclosure
  - 304 stainless tubes
  - 316 stainless tube
- TEFC enclosure

Offshore petroleum where exposure to corrosive atmosphere is likely. Water is not readily available to be used for TEWAC / CACW.
Optional Items (cont.)

- Weather protected II enclosure

Land-based gas and steam turbine applications
Optional Items (cont.)

- Air filters for inlet and/or outlet
  - A differential pressure safety switch is included. If the filter becomes clogged, the switch actuates.
    - alarm
    - indicator lights
    - shutdown circuitry
  - Removable for easy cleaning

Dusty or dirty areas
Optional Items (cont.)

• Separate main and neutral terminal boxes
  – Mount on opposite sides
  – May be specified when differential and neutral CTs are required
  – Provide more space for mounting other current transformers and components

• Terminal box enclosures available from IP43 thru IP65.

Dusty, dirty and wet areas
Optional Items (cont.)

- TEWAC / CACW
  enclosure radiator available in two types:
  - Single tube
  - Double tube

Note: Standard is 90/10 CuNi tubes. Other materials available upon request
Optional Items (cont.)

- Sealed insulation system (water immersion for API)
- Severe environment epoxy paint system

Petroleum, larger apps.
Optional Items (cont.)

- Stainless steel terminal boxes (304 or 316)

Offshore petroleum and marine
Optional Items (cont.)

- Lightning arrestors and surge capacitors

All applications that could be exposed to direct lightning strikes or susceptible to voltage surges.
Rotor Monitoring

• Measures insulation resistance on a stationary or operational generator.
• Measures generator rotor voltage.
• Transmits diode fault signal.
• Ultra-low power design (powered from stationary inductive loop).
• Wireless digital data transmission to stationary receiver.
• Field-programmable for additional features / upgrades.

Larger generators typically powered by gas or steam turbines. Also specified on some diesel or natural gas applications.
Optional Items (cont.)

- 316-CE marking (European conformity): Declaration that the product complies with the essential requirements of the relevant European health, safety and environmental protection legislation

- CSA label for non-hazardous areas
Standard & Optional Items, Certifications and RFQ

- Standard Items
- Optional Items
- Hazardous Certifications
- Marine Certifications
- API-546
- Request for Quote
Hazardous Certifications

- Canadian Standards Association (CSA) Certified for Class 1, Division 2 or Class 1, Zone 2. T3 Temperature.
- BASEEFA Certified for EEx nA II T3 (ATEX or IECEx) requirements
Hazardous Certifications (cont.)

• Minimum requirements for hazardous duty (Class 1, Div 2):
  – Non sparking
  – Low temperature space heater (200°C maximum surface temperature)
  – CSA certified
  – Heat test is performed on 1st of design
Hazardous Certifications (cont.)

• Additional requirements for Class 1, Zone 2:
  – IP54 terminal boxes
  – Voltage clamping device - Used if CTs are mounted in the terminal box
Hazardous Certifications (cont.)

- Additional requirements for ATEX or IECEx EEx nA II T3
  - Final vacuum test
  - Totally enclosed - on generator and terminal boxes
  - Open drip proof (IP23) - vacuum test on each terminal box
  - Design requirements must meet IEC EN60079-15. Special clearances, creepage, enclosures, air gaps, terminals, rotor cage, bearing and shaft seals, ventilation, auxiliary devices, and markings
  - All components used must be approved and certified by an approved agency. Kato uses BASEEFA for this certification.
Hazardous Certifications (cont.)

- Additional requirements for ATEX or IECEx EEx p II T3:
  - Purging system and fresh air intake to ensure a combustible gas-free environment
  - Over pressure test
  - Enclosure purge test
Hazardous Certifications (cont.)

- EEx p II T3 video
Standard & Optional Items, Certifications and RFQ

- Standard Items
- Optional Items
- Hazardous Certifications
- Marine Certifications
- API-546
- Request for Quote
Marine Certifications

- American Bureau of Shipping (ABS)
- Det Norske Veritas (DNV)
- Bureau Veritas (BV)
- British Lloyds
- Russian Maritime
Marine Certifications (cont.)

• Minimum features for typical certification:
  – Space heater
  – PMG
  – Stator RTDs
  – Specific shaft material

• Minimum additional tests for certification:
  – Overspeed test
  – Overload test
  – Steady state short-circuit test
  – Heat test on 1st of design
Standard & Optional Items, Certifications and RFQ

- Standard Items
- Optional Items
- Hazardous Certifications
- Marine Certifications
- API-546
- Request for Quote
API-546


• This standard is used globally by the petroleum industry to do the following:
  – improve performance and reliability
  – facilitate communication between users and suppliers
  – enhance quality
  – increase safety
  – encourage rational and fair regulations
API-546 (cont.)

- Available on most Kato Engineering generator frames
  - Premium design and construction
  - Sealed insulation system with form coils
  - Special lamination steel
  - Special precision balancing
  - Special shaft, coil, and stator tests
  - 120°C maximum total insulation temperature 80°C rise/40°C ambient or 70°C rise/50°C ambient
  - Special data sheets are filled in by specifying engineer that can include additional construction features and special tests
  - IP23 thru IP56 can be specified
Standard & Optional Items, Certifications and RFQ

- Standard Items
- Optional Items
- Hazardous Certifications
- Marine Certifications
- API-546
- Request for Quote
Request for Quote

- The generator manufacturer is the expert on interpreting detailed specifications.

- If the bid package can be sent electronically, please include the complete package in your Email.

- Other sections of the specification may include information relevant to the generator design and construction.
Request for Quote (cont.)

• Supply the following info:
  – Country of destination
  – User name
  – Project name and application
  – Complete specification
  – Number of units
  – Generator delivery date
Request for Quote (cont.)

• Supply the following info:
  – kW, voltage, frequency, speed, power factor
  – Enclosure type
  – Temperature rise
  – Options required
  – Driver model
  – Does it parallel with another generator? Give details.
  – Is there motor starting involved? Give details.
  – Is it for a marine or offshore application? Indicate pitch & roll expected.