Permanent Magnet Generators for On Board Vehicle Power

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A Finmeccanica Company

Distribution Statement A
Approved for public release; distribution is unlimited.
Benefits of Permanent Magnet (PM) Machines

- Flexible topologies
- Robust
- High power density
- Efficiency across speed range

**Radial**

**Cup**

**Axial (SRS)**

**Axial (RSR)**

**Simple & Compact Permanent Magnet Motor**

- ½ Back Iron

**Graphs:**
- Efficiency (%)
- Speed
- High Speed
- Synchronous with gear
- Low Speed PM
- High Speed PM
- Efficiency across speed range

**Rotor**
- (many Poles)
- Can drive both ends
- Short end turns

**Stator (thin)**
Relevant DRS PTI OBVP PM Experience

Motor Model Series Designators:
PA = Permanent Magnet Axial Field
PR = Permanent Magnet Radial Field
PC = Permanent Magnet Cup Motor

PA44
- 450hp @ 2860 RPM (825 ft-lb)
- 1475 ft-lb at stall
- 25.5” D x 8.8” L
- 395 lbs

PA57
- 1000hp @ 3600 RPM (1450 ft-lb)
- 2000 ft-lb at stall
- 31” D x 10.5” L
- 780 lbs

PR40
- 33kW @ 1800 RPM (130 ft-lb)
- 21.2” D x 4.7” L
- 113 lbs

PC36
- 240hp @ 4600 RPM (275 ft-lb)
- 500 ft-lb at stall
- 18” D x 7.2” L
- 139 lbs

PC45
- 115+kW @ 1700 RPM (480 ft-lb)
- 60kW constant
- 19.3” D x 10.1” L
- 241 lbs
DRS Approach to OBVP – Driveline Integration

Advantages:
- No effect on driveline overall length
- One unit… similar to replacing a transmission
- Rear crankshaft power draw
- Suitable for starter functionality
- High torque, low speed

System-level view, solid teaming, and tight integration (mechanical and electrical) critical to solution development
PR40 Permanent Magnet Generator

Radial PMG:
- Works within available space outboard of the torque converter (GTP 4L80 transmission)
- Rotor assembly replaces the flywheel
- Starting ring gear incorporated into motor rotor
- 33kW @ 1800 RPM (130 ft-lb)
- 10kW on-the-move
- 21.2” D x 4.7” L, 113 lbs
- 400 VDC system output (controller setting)
- 95C coolant
• 1 Development Vehicle, 1 Bid Sample Vehicle, 1 Pre-production Deliverable, 15 units on order by USMC and in production. 1 full system SIL (test cell test bed) used for continued development and refinement of hardware, software, and expanded kit.

• 2 vehicles passed mobile electric power test sequence at proving ground. 1 vehicle passed basic proving ground driving sequence (5,000 miles). Pre-production at or going to APG for completion of OBVP power and vehicle checks.

• DRS establishing capability for continued low rate builds. Continuing work on kit cost reduction and capability envelope expansion.
PC45 Permanent Magnet Generator

Cup PMG:
- Most suitable for space made available by removal of the mechanical PTO (ATI 3200 MSG transmission)
- Evolution of PR40 integration… true TIG (Transmission Integral Generator)
- 60kW constant
- 19.3” D x 10.1” L, 241 lbs
- 600 VDC system output (controller setting)
- 80°C coolant
PC45 Status

- One unit in System Integration Lab (full system test cell)
- One unit in test mule durability runs (driveline plus containerized power kit and loads)
- One unit for TARDEC SIL
- On-going LUT/LRIP preparations
Conclusions

• Permanent magnet generators offer many advantages for OBVP

• DRS Technologies has breadth and depth of relevant PMG experience

• Several benefits with transmission integral solutions