



Worldwide Patent Pending

Variable Frequency Generator as a power supply for an ESP

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What is a VFG?

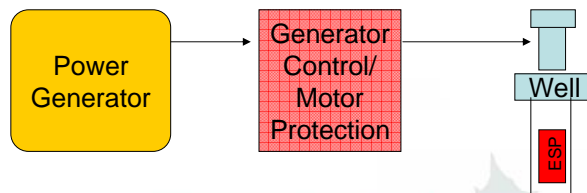
VARIABLE FREQUENCY GENERATOR (VFG)

- Power Generator that Varies Frequency and Voltage output
- Operates 30-70 Hz, 400-5000 Volts
- For use with ESP's & other Variable Torque Loads requiring variable speed
- Eliminates Variable Speed Drive and Transformer
- Designed & Patented by Foundation Enterprises LTD
- Manufactured by: Canadian Advanced Inc. in conjunction with Finning Calgary



How the VFG Works!

- Reduced Speed Start
- Reduced Voltage Start
- Control Module controls:
 - Voltage, Current & Hz (RPM)
 - Engine (Diesel/Natural Gas)/Fuel/Governor
 - Motor Protection
 - SCADA/Communication



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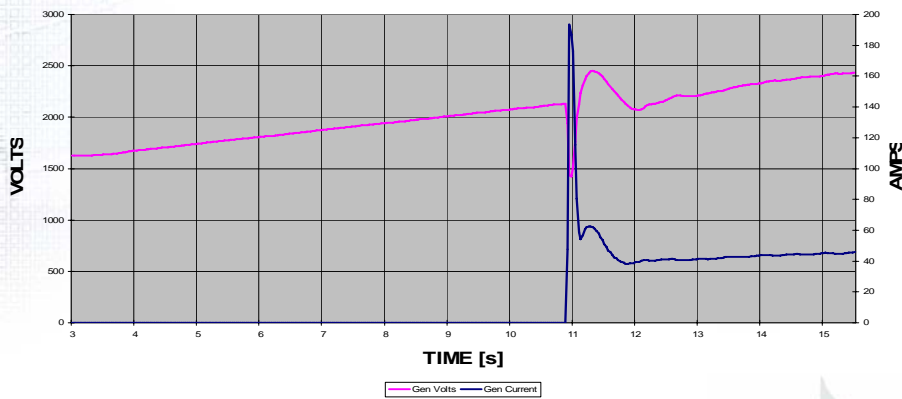
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Start-up Traces (40 Hz ESP start)

3508 CAT; 12000 BPD pump and 644HP/3480V/117A motor

Ramp Start

Nominal full load Volt 3480V@60Hz
Nominal full load Amps 90A@60Hz
2sec for system stabilizations
inrush current 2.4 x full load current



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Advantages of the VFG

- Lower Capital & Maintenance Cost
- More Efficient System, less Diesel fuel
- Smaller Engines required to Drive Large ESP's
- No Harmonics, spikes or mirroring
- Increase Production
- Easy to Use – Fully Integrated System - Touch Screen
- Improved Run Times
- Volt/Current Optimization
- Hard Starting Advancements
- Recoverable Asset (Compared to High Line)
- Smaller Foot Print- Offshore Applications

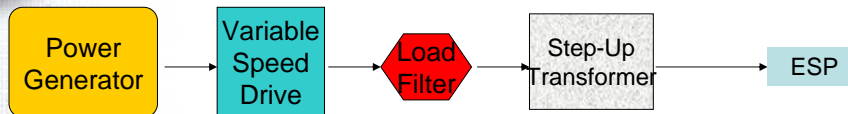


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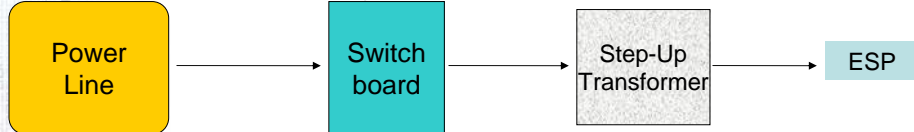


VFG System Comparison

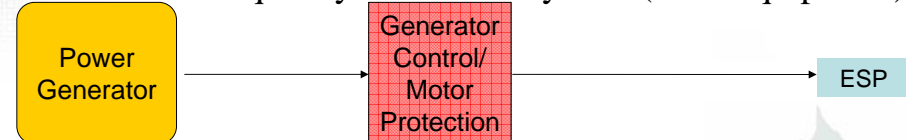
Typical Variable Speed Drive System



Typical Switchboard System



NEW Variable Frequency Generator System (Less Equipment)



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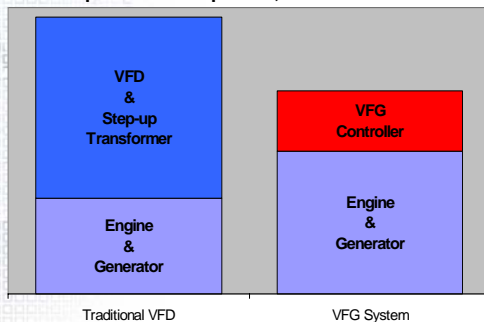
Lower Capital/Maintenance Cost

- Engine Matched to Full Load of ESP
- Low frequency Soft Start-up
 - No Need to Oversize Engine
 - VFG = 2.5 X Nameplate Current
 - Switchboard = 6-8 X Nameplate Current
- Eliminates VFD & Transformer Capital Cost
- Eliminates VFD Maintenance Cost

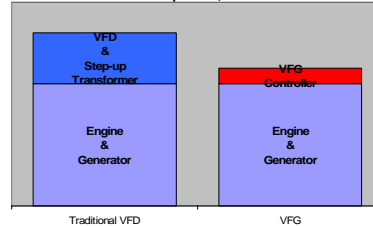


Capital & Operating Cost

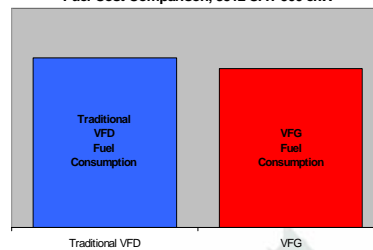
Capital Cost Comparison, 3512 CAT 900 kW



Maintenance Cost Comparison, 3512 CAT 900 kW



Fuel Cost Comparison, 3512 CAT 900 kW



Note: charts are for illustrative purposes only. Actual comparisons vary by application.



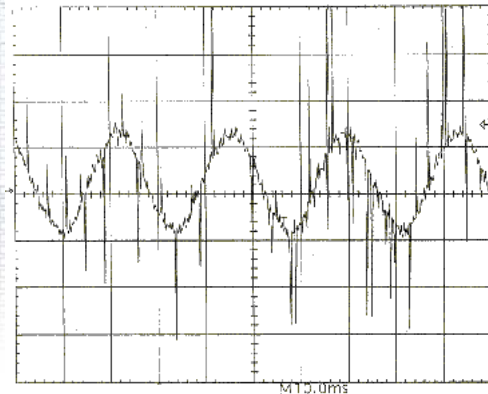


Advantages of the VFG

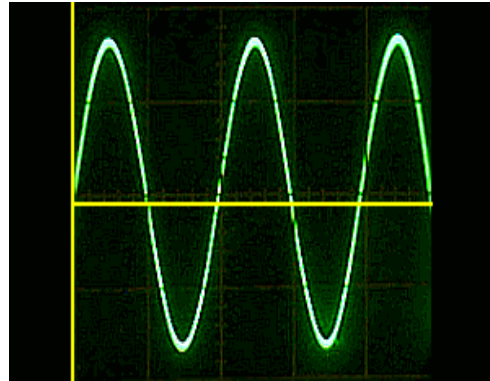
VFD (Variable Frequency Drive or Variable Speed Drive) Output

Vs

VFG Generator Output (Ideal Sine Wave)



VFD or VSD



VFG



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Improved Run Times

- Soft Starts Reduce Shaft Stress
- Cable Runs Cooler – Longer Life
- Motor Runs Cooler – Longer Life
- No Voltage Spikes – Ideal Sine Wave W/O Any Filter

RESULTS: Longer ESP Electric System Life



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Increased Production-Example

- Improve Efficiency by 5-10% – Less Heat!
- VFG eliminates Heat and Turns to Oil Production
- Example for Maximum of 3508 CAT Diesel Generator, 562 Series CKC12000, 650 hp ESP

Traditional VFD & Transformer

Maximum Frequency = 58 Hz

Gross Fluid = 11,600 bbl/day

Net Oil (90%WCT) = 1160 bbl/day

VFG System

Maximum Frequency = 63 Hz

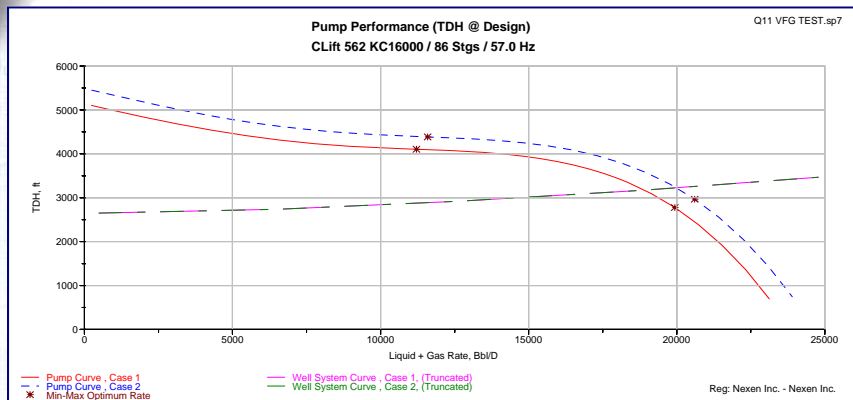
Gross Fluid = 12,400 bbl/day

Net Oil (90%WCT) = 1240 bbl/day

- **INCREASE of 80 bbl/day OIL or \$4800 per Day**
- **THAT'S \$1.752M PER YEAR @ \$60/bbl!**
- **APPROXIMATELY 2 MONTHS FOR RETURN OF INITIAL INVESTMENT**



VFG Production Gain Example



Qataban 11 Production gain example. (Actual)

On a VSD at 114 Amps and 57.0 Hz, 18,250 bfpd **RED SOLID LINE**

On a VFG at 114 Amps and 59.0 Hz, 19,550 bfpd **BLUE DASHED LINE**

VFG measured benefit of an extra 1,300 bfpd for a 7.1% increase.





Entire Unit Prepared for Shipment



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Typical VFG System - Heijah 49



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WHEN TO USE THE VFG?

- **Every time a Generator is Used on ESP**
- **Temporary or Permanent Installation**
- **Portable Well Testing**
- **Areas of Power Quality Problems**
- **Weak or Insufficient Supply Power**
- **Other Applications – PCP, Beam Pump, Ships, Fans, etc.**



QUESTIONS?

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