POWER • DATA • CONTROL

POWER BOSS

Turn drilling rigs into hybrid drlling rigs.

NABORS

CleanDesign
Power Systems, Inc.

POWER BOSS

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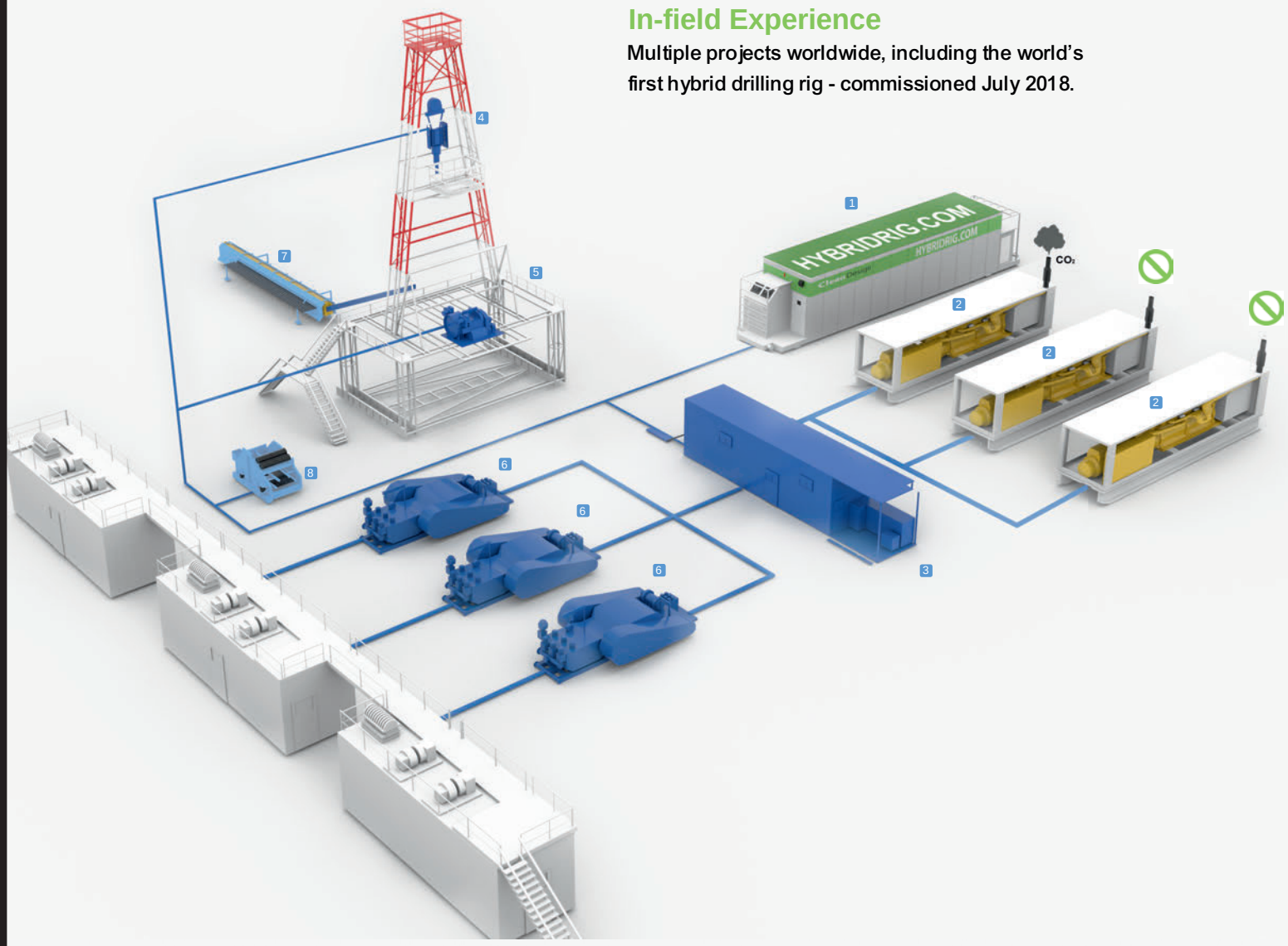
In-field Experience

Multiple projects worldwide, including the world's first hybrid drilling rig - commissioned July 2018.



1	PowerBoss with Lithium-Ion Batteries & the hybrid Energy Management System (hEMS)	5	Drawworks
2	Gensets	6	Mud Pumps
3	Variable Frequency Drive (VFD) House	7	Pipe Handing Equipment
4	Top Drive	8	Additional Hydraulic Components (e.g. Shaker)

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HYBRID DRILLING RIGS

Today's oil and gas industry is seeking to lower carbon intensity and lower costs. PowerBoss helps oil and gas customer to address this emissions challenge while improving performance.

The hEMS (hybrid energy management system) uses battery energy storage and engine automation to reduce the number of gensets operating and increase the fuel efficiency of the rig. The key to achieving fuel savings is automatically turning gensets on and off.

Tight integration of the batteries and the drilling rig's controls is designed for no reduction in drawworks speed, elimination of power limits, and increased overall drilling speed.

hEMS artificial intelligence (AI) monitors power generation to meet power demand. Batteries provide the buffer of energy to optimize the number of gensets operating and ultimately the fuel efficiency and emissions of the rig.

Data 24/7

24/7 data is available for customers to manage power generation, review fuel consumption, and confirm emissions savings. Monthly reports allow for easy communication of results throughout your organization. 1s by 1s data files are provided to audit cost savings, and verify achievement of environmental, social, & governance (ESG) goals such as reducing CO_2.

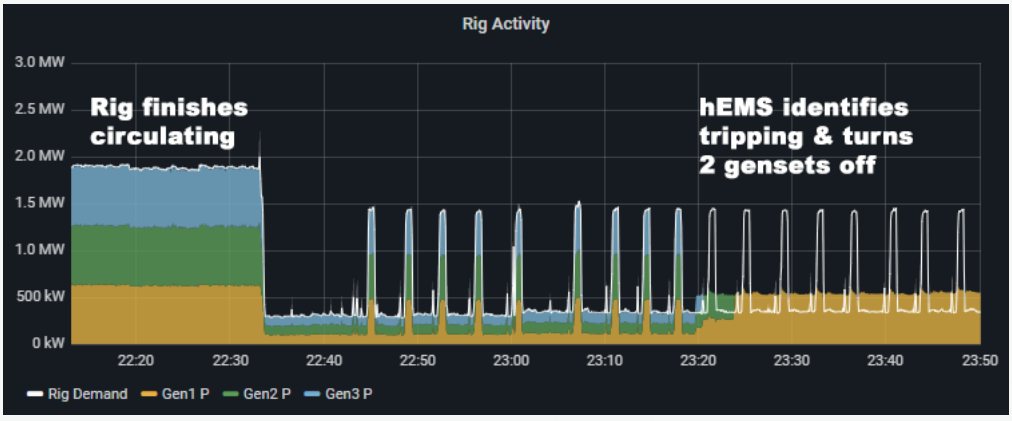
"There are many claims made by companies about
power quality & the business cases for batteries. Here's what matters..."

Patrick Wagner, VP of Busines Development

Full Engine Automation

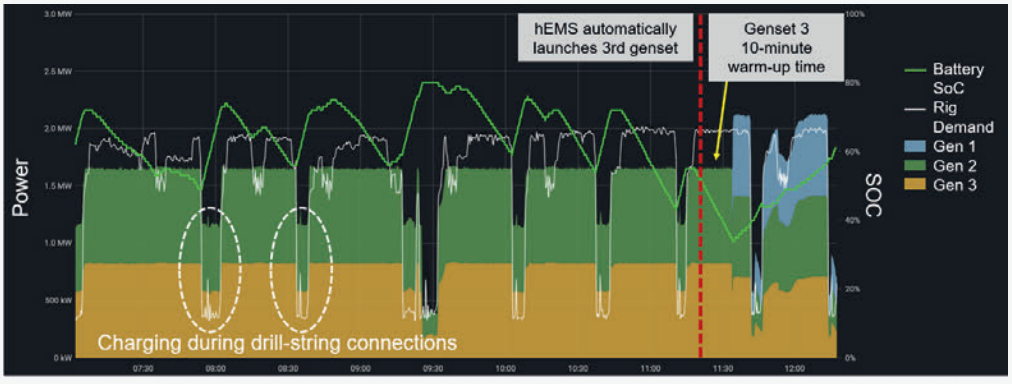
The hybrid energy management system (hEMS) monitors the drilling rig's power demand and optimizes the number of gensets running.

For example, the system turns off gensets to save fuel and emissions during tripping. Batteries instantly provide the additional power required.



Full Engine Automation

Batteries allow fewer generators to be operated. Additional generators are automatically launched by the hEMS when needed, and the battery provides the power required during the gensets warmup period.



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SAFETY FEATURES

Equipment Specifications	1.5 MVA DC Connected	1.1 MVA DC Connected	750 kVA DC Connected
hEMS Output Voltage (Nominal)	810-850 VDC	810-850 VDC	810-850 VDC
DC-DC Converter Output	4@375 kW	3@375 kW	2@375 kW
Energy Storage Capacity	497 kWh	373 kWh	249 kWh
Peak Battery Power (6C)	3 MW	2.2 MW	1.5 MW
Max Continuous Charge/Discharge Rate (3C/3C)	1.5 MW	1.1 MW	750 kW
Standard HVAC (Ambient Temp.)	-20°C to 40°C	-20°C to 40°C	-20°C to 40°C
Ruggedized HVAC (Ambient Temp.)	-45°C to 55°C	-45°C to 55°C	-45°C to 55°C

Monitoring & Safety Specifications	
Genset Operational Data Monitoring, Alerts, & Protection	Plug-and-Play Ready
Localized Data	Driller's Cabin & Other HMIs
Online Data Room	Yes - 24/7 Cloud Access
Data Auditing	Monthly Report & Logged Data
Marine Grade Batteries	DNVGL-CG-0339 Certificate Available or Equivalent
Thermal Runaway Protection	Passive; Cell-level; DNV-GL Pt.6 Ch.2, NMA 2016 Circular
Short Circuit Protection	Battery Side & Output Side
Emergency Stop Circuit	Hard-Wired
Disconnect Switchgear Rating	Full Load
Shock & Vibration Dampening	MIL-STD-810G Category 4

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Power Systems, Inc.

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