Battery Energy Storage Systems (BESS)

Honeywell

In today's evolving energy landscape, industrial facilities are increasingly seeking solutions to optimize their power generation and reduce their environmental impact.

Pairing gas turbine generators with Battery Energy Storage Systems (BESS) offers a compelling pathway to achieve these goals. BESS provides a valuable complement to gas turbines, enhancing their operational flexibility, improving fuel efficiency, and reducing emissions. By strategically integrating BESS, industrial facilities can optimize their energy consumption, respond more effectively to load fluctuations, and contribute to a more sustainable energy future.

Industry Challenges

Oil & Gas, Petrochemicals, Mining/ Minerals/Metals industries have similar operational requirements related to business continuity, i.e. intense cost and environmental pressures while maintaining high power availability.

Mitigate Risks to Critical Loads

Reduce Greenhouse gas (GHG) Emissions

Reduce Operating Expenses

Suboptimal operation and the need for load response in milliseconds can make cold starts of gas turbines or diesel generators problematic.

Redundant Turbines or Generators

- Redundant gas turbines increase fuel costs and GHG emissions
- Generators may operate well below capacity - Inefficient
- Cold turbines take too long to start up
- Faster wear on engines / additional maintenance

Cost of Additional Generation

- Fuel can account for up to 4/5 total operational costs
- One trip in 5 years = 1 additional turbine operational cost
- End users need to focus on optimizing operations, not just concerns about availability

Many facilities around the world operate in a similar way.

Reducing Spinning Reserve and Maintenance for Industrial Sites with Battery Energy Storage

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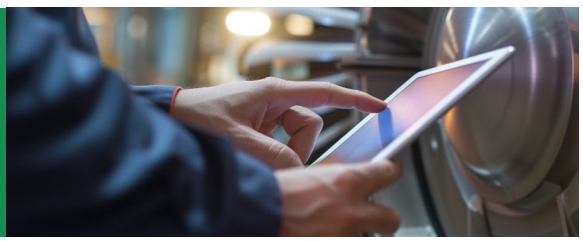


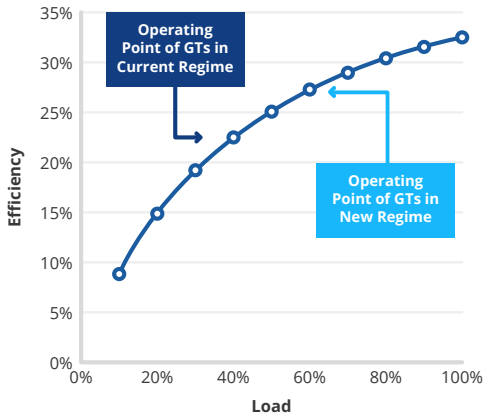
WILEY

The Business Case

How does the business case stack up for shutting down one gas turbine and using battery storage instead?

The graph shows that Gas Turbines have higher efficiency at higher load. By operating 2 x GTs at 60% capacity (higher efficiency of 27.5%) compared to 3 x GTs at 40% capacity (lower efficiency of 22.5%), the overall gas consumption reduces by 17% to cater the same load.

Load vs Fuel Efficiency



Honeywell Ionic™ Analytics and Services

Route to Market

Trading Analytics
Contract Engagement with ISO/grid operators
Dispatch data and setpoints

- Fuel Generator
- Grid
- Solar Panels
- Wind Turbines

Honeywell Ionic™ Control and Energy Management

- Grid
- Building Load
- Plant Load
- Green H2
- Industrial Heat

Honeywell BESS Offering

Battery Block	Inverters	Controls, Energy Management, and Integration	Energy Services	
Battery Block options • Honeywell Ionic • Multiple vendors • More being evaluated and added	**PCS options** • Multiple vendors	**Microgrid/SCADA/PPC Controllers** • Best-in-class **cybersecurity** • Best-in-class **systems integration** and **project execution** • **3 decades of complex project execution** capability • Honeywell's renowned **SCADA** and **microgrid controls** • **BESS unit controllers** • **Power plant controller** • **Energy optimization solutions**	**Traditional Services** • Remote operation centers • SCADA Updates • Onsite Maintenance • Cybersecurity • Battery analytics and warranty tracking	**Advanced Services** • Trading Analytics software • VPP • Digital Twin Solutions • Asset Monitoring/ Capacity Management

Asset Vendor Agnostic

- Multiple communication protocols
- Pre-engineered and tested system architecture
- Renowned Honeywell cybersecurity

Honeywell Supplies Complete System

- Power Study & Pay Back Analysis
- BESS with Energy Management System (EMS)
- Life Cycle Program

Practical Business Case

Study for Petronas in 2023

Redundant Gas Turbines

- Providing extra energy capacity to protect against electrical trips

System Characteristics:

- 4 gas turbines
- 3 normally running
- 15 MW normal load
- 1 in cold standby mode
- 12.5 MW rating
- Each GT runs at 5 MW (40% capacity)

Operation Overview

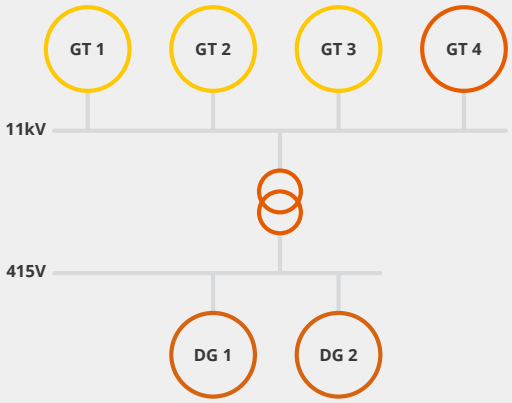
The site uses four gas turbines: three run at 40% load (sharing 5 MW), and one on cold standby, prioritizing reliability over efficiency. The setup ensures continuity but reveals efficiency improvement potential through optimization of GT loading.

Solution

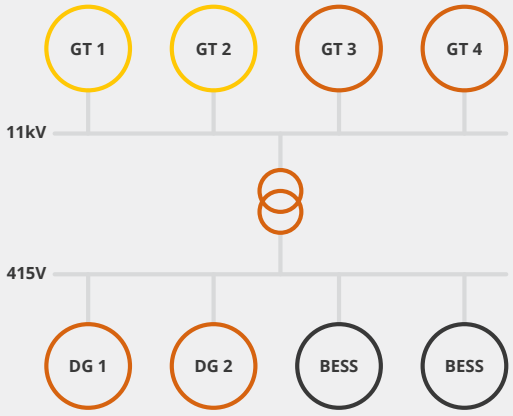
Solution Objectives: Battery energy storage to reduce redundant spinning reserve

- Maintain Power Availability and Reliability
- Reduce Greenhouse Gas (GHG) Emissions
- Reduce Operating and Maintenance Expenses

Operating Regime Before Optimization



Solution Diagram



KEY: Running GTs | Standby GTs and diesel generators (DGs) | Battery Energy Storage System

Two GTs running at **60% load** (up from 40%)

Two GTs in **cold standby** (one can be removed)

Instant back-up provided by **BESS**

BESS capacity **2 x 4.39 MW/ 4.15 MWh**

1 hour sufficient to start GT from cold standby

Proposed Operational Regime

- Install 2 x Battery Energy Storage System (BESS) on each of the 11 kV bus to provide redundancy.
- A grid-forming BESS with a 4.39 MW inverter and 4.6 MWh battery (approx. one hour of support) was chosen. This is enough to start GT from cold standby.
- Two GTs run at 60% capacity each. One GT remains in cold standby providing redundancy and/ or for maintenance periods. Fourth GT can remain as second cold standby or can be removed.
- BESS has sub-second response that seamlessly takes over in case any of the operating GTs trips or has a capacity constraint. BESS has a dedicated ECS to incorporate the new control regime.

Theoretical Case Study | 1st Place Prize Winner

(Continued from page 3)

Based on Live Data from Honeywell's Project Portfolio

Petronas Race2Decarbonize Hackathon Competition

Competition to support Net Zero Carbon Emission by 2050 and reduce Malaysia upstream operations emissions to 49.5 $MtCo_2e$ by 2024

Location

Kuala Lumpur, Malaysia

Petronas has been the custodian of Malaysia's petroleum resources since 1974

Challenges

- Cost of blackouts expensive
- Gas turbines operating much below capacity
- Gas turbines take too long to take on additional load

Customer Needs

- Maintain power availability / reliability
- Reduce greenhouse gas (GHG) emissions with clean and cost-effective backup power
- Reduce fuel gas consumption
- Reduce operating and maintenance expenses via reduced running hours and maintenance cycle extension

Honeywell Solutions

Solutions

- Running gas turbines reduced from three to two units
- BESS seamlessly takes over in case of trips
- Spinning reserve displaced by non-spinning reserve in BESS

Successful plan to reduce GHG emissions, fuel consumption, operating and maintenance expenses

Success Factors

- Fuel gas saving by shutting down one gas turbine allows operation of remaining two at higher load and efficiency point
- Total running time reduced by 33%
- Gas turbine maintenance period can be extended by 33%
- Reducing gas burned directly reduces GHG emissions

Projected Benefits

- GHG abated by **22,317 MT/ year (17%)**
- Solution pays for itself in **<18 months**
  - **64%** contribution from Fuel Gas
  - **36%** from maintenance reduction

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