

Protect your operations and unlock hidden value with your backup generator

Your guide to best practice generator
testing and maintenance

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Introduction: the power of backup generators

Continuity of power is vital for almost every business, whether it's a food processor or cold store trying to maintain produce at the right temperature, a data centre working to keep banking applications available to customers, or a water corporation, ensuring clean supply of water.

In all these cases, loss of power would come at a significant cost. That's why many Singaporean businesses choose to install a backup generator onsite so that operations can continue as usual, even if a power outage does occur.

However, backup generators are infrequently (if ever) used and, in our experience, don't always respond reliably when needed in an emergency.

All sorts of different issues can cause backup generator failures, like system design flaws, inadequate maintenance and old equipment failure, which can often happen unexpectedly. The best way to detect and mitigate these problems is to test the generators regularly under your site's load, while still having the safety net of grid power behind you.

It's essential Singaporean businesses have backup systems in place to protect their operations. In recent years, we've experienced a few blackouts, most notably the September 2018 blackout. This occurred when two power-generating units tripped, resulting in insufficient supply to meet demand.

Protection devices in the power system automatically disconnected electricity to around 150,000 consumers to rebalance the system.

Singapore's Energy Market Authority (EMA) explained in a media release: The stability of the power system requires the electricity supply to constantly meet electricity demand. When a power-generating unit trips, the other units in operation will increase their electricity supply automatically.

Before the blackout, one of Singapore's major power-generating units tripped while ramping up additional supply. Subsequently, two additional power-generating units tripped, which resulted in insufficient electricity supply to meet demand.

Events like this reinforce the importance of having backup systems. If you have invested in a backup generator, here's the good news: if you offer your generator as a paid resource to support the electricity grid, it will be tested on a regular basis, and your business will reap the financial rewards.

This is called power flexibility, and it creates a triple bottom line benefit for your business:

1. Your backup power systems will be more reliable
2. You'll get a new revenue stream for your business
3. You'll play a significant role in supporting Singapore's electricity grid

This guide focuses on why a regular maintenance and testing program is so important for long generator life, and how power flexibility can improve your readiness for energy emergencies.

Best practice for generator testing

Both engine manufacturers and generator service companies produce updated guidelines detailing best practice generator maintenance. We've summarised some of their recommendations below, which we believe are indicative of industry consensus, and invite you to investigate with your generator supplier.

Caterpillar

A leading provider of backup generators and industrial engines

Caterpillar states¹ that a good maintenance and testing program is key to a long generator life. They recommend testing at least once per month, with an operational load check where the generator runs on at least 50% of the site's load for one to two hours.

Power & Drive Solutions

Specialists in the design, construction and installation of engine-based control systems

Managing Director Luke Thomson says:

"At a minimum, generators should be run every month on the site's load at no less than 50% capacity for one hour. Ideally, it should be done more frequently and as close to the maximum generator capacity as possible, as full-load testing is the best way to identify a potential failure or malfunction during a real emergency. Overall, regular testing means businesses can optimise their generator's performance and significantly improve its life expectancy. Plus, any unforeseen issues will arise in a controlled testing environment and not when the generator is called on during an emergency."

Cummins

A global corporation that designs, manufactures, and distributes engines, filtration, and power generation products.

In their generator manuals, Cummins specifies the importance of regularly testing generators² "Exercising the generator set re-lubricates the engine and removes oxides from the electrical contacts. The result is better starting, more reliable operation and longer engine life."



¹ Caterpillar, Generator Set Operator & Maintenance Instruction Manual, 2014

² Cummins Operator Manual, 2017

What is power flexibility?

Power flexibility gives businesses the ability to strategically adjust when they use power from the electricity grid. Not only does this support the grid in times of need, power flexibility helps to reduce the cost of energy for businesses and consumers.

As intermittent renewable energy sources make up a greater portion of our energy supply, power flexibility is becoming increasingly valuable to maintain grid frequency at 50 Hz and keep the lights on in Singapore.

Most businesses with backup generators can deliver power flexibility. Globally, we look to work with businesses that can give us more than 400kVA of power from their generator. These are across many different sectors, from cold storage facilities, manufacturing and industrial to water agencies, data centres and commercial buildings.

We pay businesses to make their backup generator available to support the grid when needed. This happens to maintain the grid's frequency when there is a temporary imbalance in supply and demand.

Businesses can control when and how much their generator is used, but we typically find 20-25 hours each year is the most that's required. When a backup generator is used to deliver power flexibility, we call this a 'dispatch event'.

Businesses receive an availability payment to say thanks for being on standby.

Together, these payments can amount to up to 13% of a business's total electricity spend, resulting in a significant new revenue source.



The benefits of power flexibility

Businesses can use power flexibility to perform real-world stress tests to check how reliable their generators are, while still having the safety net of the grid to fall back on in case there are any issues.

This can add significant operational value to your business:

You get early warning when the grid becomes unstable

Since dispatch events almost always happen when the grid is under stress, your business will be one of the first to know about these situations.

You can prepare your staff

By participating in regular dispatch events, your staff will be better prepared to act. You can use these events as an opportunity to identify potential weaknesses in your training and operational checklists, which can then be addressed and updated.

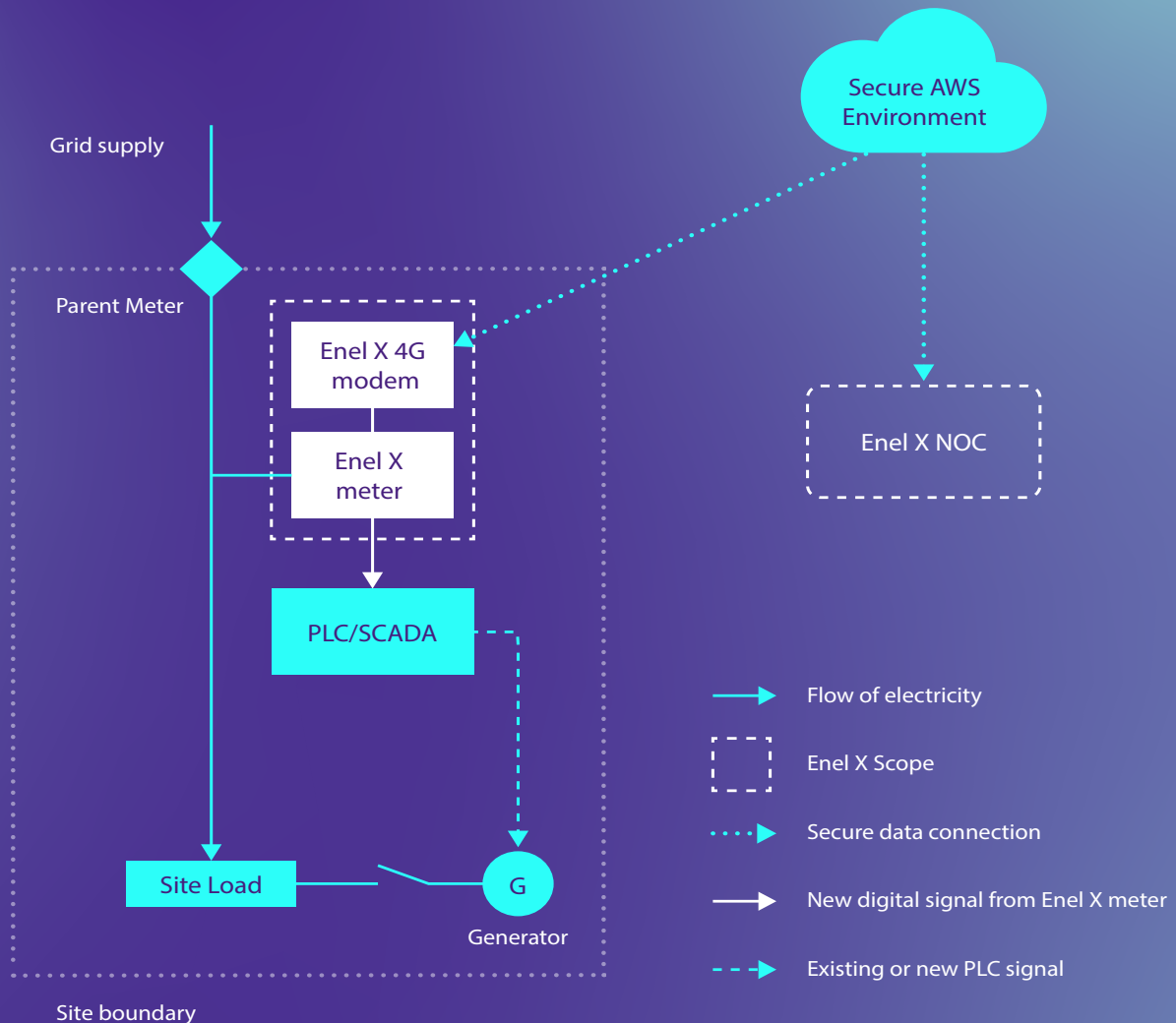
You get a new revenue stream

You can counter rising energy costs with a new revenue stream, where you earn payments from using your backup generator in the energy market.



How it works in practice

This diagram shows the Enel X technical solution, and how we use it to communicate with backup generators in the field.



1

We install a meter to measure grid consumption. This data is transmitted to our Network Operations Centre (NOC) via a secure and private connection. This 4G network connection is robustly protected at every level.

2

The meter has a control output that when activated sends a signal to transfers power to and from the generator during dispatch events. This output can be wired to take action using new or existing sequences. When this signal is sent, SMS and email notifications are automatically sent to pre-identified site contacts.

Case study: AT&T

Telecommunications company AT&T is a great example of an organisation that's experienced the benefits of power flexibility.

We spoke to Frank Howd, former manager of maintenance, who, during his time at AT&T, was responsible for 425 generators. He also oversaw AT&T's participation in power flexibility programs for over a decade.

He said: *"For me, it all came down to reliability, and that's why power flexibility caught my interest. Overall, the events were the best possible real world-testing scenario we could have designed."*

During every event, we had the grid behind us in case our equipment or processes failed, so we had a big safety net that allowed us to test under realistic conditions with full load, something we had not previously been able to do.

If I had to guess, I would say 25 generator problems happened over the years during power flexibility events, but there was never a single service interruption or loss".

Frank gave us three examples of specific problems that were identified during power flexibility dispatch events, and subsequently resolved. They demonstrate that small, unexpected things can lead to failures, which drives home the importance of regular testing under significant load.

Event 1

Issue

Faulty weather hoods caused radiator exhaust to recirculate, which remained undetected until summer testing.

Resolution

AT&T engineers designed winter-summer modes for the weather hoods, which meant they could discharge radiator exhaust vertically in the summer and horizontally in winter.

Event 2

Issue

The fuel pumping system failed due to inherent design flaws, leading to generator failure.

Resolution

AT&T engineers designed a dual-source duty/standby feed from two fuel distribution centres, with a switch to alternate between sources. The control problems on both failed engines were fixed upon the technician's arrival.

Event 3

Issue

Engine failure during transfer back from generator to grid power.

Resolution

The electrician correctly wired two new warranty motors, and replaced the overloaded heater elements with the proper size. Over the last two years of use, the unit has been subject to annual four-hour runs and power failures lasting days to weeks, with no further problems.

Case study: Cold Storage

Oxford Cold Storage operates the largest temperature controlled warehouse in Australia.

In 2018, Oxford Cold Storage's cost of electricity rose by 130% to \$6.4 million. By participating in Enel X demand response programs, the company reduced its electricity bill by around 10%.

Enel X installed frequency control meters on its main refrigeration plant room switchboards, so it support the grid's frequency when a deviation occurs.

When a signal is received from the energy market operator, the refrigeration control software system reacts within one second to lower the electricity demand by 440kW to 3,100kW. After an event, the refrigeration plant automatically restarts.

These events react to the electricity grid system frequency variations and are unplanned. Oxford Cold Storage is notified via text message and email when an event occurs and when it is terminated.

"Participating in power flexibility services requires refrigeration plant engineers to monitor the shut down and restart procedures, but the financial rewards are substantial."

"It allows us to support the grid, and the payments go directly to the bottom line."

Enel X works with more than 350 cold storage sites globally to deliver critical grid services.



About us

As part of Enel, one of the world's 100 largest companies, we harness transformative technologies to create simple, intuitive solutions for people, cities and businesses.

We provide a services platform that gets your business maximum value from flexibility, both today and into the future.

1500+ MW

of flexibility under management across Asia Pacific

6000+ MW

under management across more than 15,000 clients

550+ MW

of backup generators enrolled into flexibility programs globally

Unmatched market access

which means you get the most value from flexibility

24-7

trading operations and a software platform that constantly adapts to changes in the market

Corporate strength

and financial backing to fund any necessary upgrades to get you started

Speak to our team

If you have any questions about your generator or enrolling in our power flexibility programs, please get in touch.

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