Using portable battery systems to commission transformers

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Executive summary

- Power System CAPEX projects can take advantage of portable generation to commission electrical equipment before a grid connection is available
- Commissioning such equipment involves energising transformers which traditionally require large generator systems to provide inrush currents
- Zenobē have used commissioning experience and portable power expertise to develop an alternative solution using a mobile BESS[1] (Powerskid) to execute a controlled ramp up of the voltage and limit the inrush currents, reducing generator size requirements by up to 30x
- Further savings are made by using the Powerskids to handle load step changes during commissioning to improve generator operating efficiency
- Case Study
  - 300MW BESS project with 102 pairs of MV Tx being commissioned ahead of grid connection
  - For the 12-week Hot Commissioning process taking place over summer, Zenobē Portable Power have provided 2 x Powerskids, 2 x 300kVA generators and associated equipment and services to enable a full energisation and ongoing commissioning program as a hybrid system
  - Zenobe Portable Power worked closely with project team before and during the project to develop and adapt operation strategy throughout, ensuring it meets commissioning requirements at each stage while optimising fuel usage
  - Hot Commissioning savings are on track to beat expectations of 25 – 30% of c.£1m expected cost from a traditional generator solution
  - **Total cost for portable power solution to the example project will be between 25% to 30% lower than benchmark solution (c.£1m expected cost from a traditional generator solution) including fuel savings of 257,000 litres and 678 tCO2**

[1] *BESS: Battery Energy Storage System*

Case Study: Kilmarnock South 300MW/600MWh BESS

Problem	Traditional Solution	Portable Power Solution	Benefits of PP Solution
Transformer Energisation • Energising transformers at nominal voltage results in a significant inrush current, **requiring a large power supply to enable it** • Kilmarnock South has over 100 MV Transformer pairs that need to be energised during hot commissioning	Generator Size • Each pair of Transformers on Kilmarnock would be commissioned one at a time at nominal voltage without a grid available. • **For a 2MVA skid, 3.5MVA of generator capacity is required to manage the active and reactive power demands of the inrush current**	Voltage Ramp Up • Instead of energising at nominal voltage, a Powerskid inverter executes a controlled ramps up the nominal voltage on the LV side of the Tx, **inrush current is reduced by a factor of 30x and a much small generator is needed to supply the ongoing energy requirements** • After the first pairs of site inverters are commissioned, they can be used to support the inrush current from the energisation of the remaining skids on site which happens at nominal voltage	• Reduction of generator and additional equipment hire and transport costs -> **Savings c.50% on hire costs** • Fuel consumption reduction due to correct generator sizing and running at optimum loading -> **Fuel savings c.50%, 257,000ltrs and 678tCO2** • Total reduction in costs for commissioning Medium Voltage Power Skids on Kilmarnock in base case -> **c.25%-30% of temporary power for commissioning costs**
Inverter Commissioning Step Changes • After initial energisation, commissioning required **step changes of the order of 100kW** • The steps prevented the generators working in a load on demand system, as they would trip before the system could respond and support	Fixed Export Generators • **Generators were run in fixed export mode with a load bank**, so the step changes did not cause tripping • This resulted in **large amounts of fuel being burned and dissipated in the load bank**	Batteries Supporting Generators • Using **mobile batteries mean that they can respond easily to step changes in the load**, protecting the generators and mitigating the risk of tripping • Generators are still used to provide the energy but only run to supply energy used for commissioning rather than into a load bank	

Solution comparison - equipment

Generator-only solution

+ Consists of 3.75MVA of generator capacity to manage Tx energisation. A diagram of the proposed solution is in Fig 1, which had weekly hire costs of £15k+
+ Generators were expected run in non-efficient strategy to ensure they could handle the variability in load throughout the commissioning process

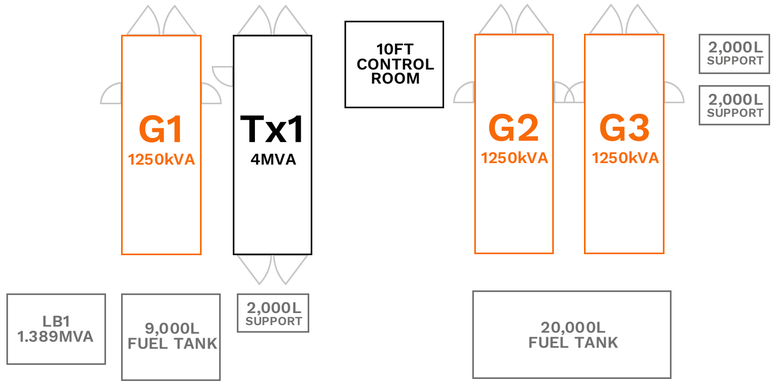

Fig 1: Gen Only Solution proposed by generator supplier made up of 3.75MVA Generators, 1.4MVA load bank and corresponding fuel and control equipment

Hybrid Solution

+ Using Powerskids to reduce the inrush current during energisation reduces the required generator capacity by a factor of six to 600kVA. New solution is illustrated in Fig 2.
+ The Powerskid inverters will handle the load variability during commissioning and enable the generators to only run when needed in their most efficient manner
+ Generator capacity could be reduced even further but has been maintained at current level to provide redundancy
+ Battery operating strategy will be adjusted through commissioning project to ensure performance and maximise fuel savings

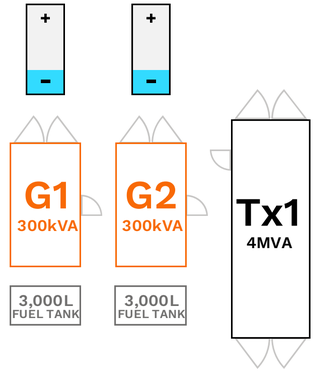

Fig 2: Hybrid Solution developed by Zenobē Portable Power with NI Construction team, made up of 600kVA of generators with 2 x 100kW/150kWh Powerskids

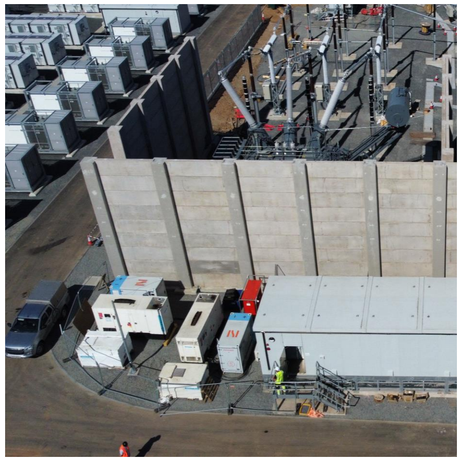

Fig 3: Real Hybrid Solution in operation on site

Technical Description

- The magnetisation process is managed by using the PowerSkid to execute a controlled ramp of both the current and voltage of the connected transformers.

- The voltage steps were automated at 5% increments and were only incremented if the current draw remained below a current limit threshold. Test results illustrating the approach are shown in Figure 4 below.

- This controlled ramp capability and overall microgrid management techniques are utilised throughout the commissioning process as requirements from the hybrid portable power supply vary

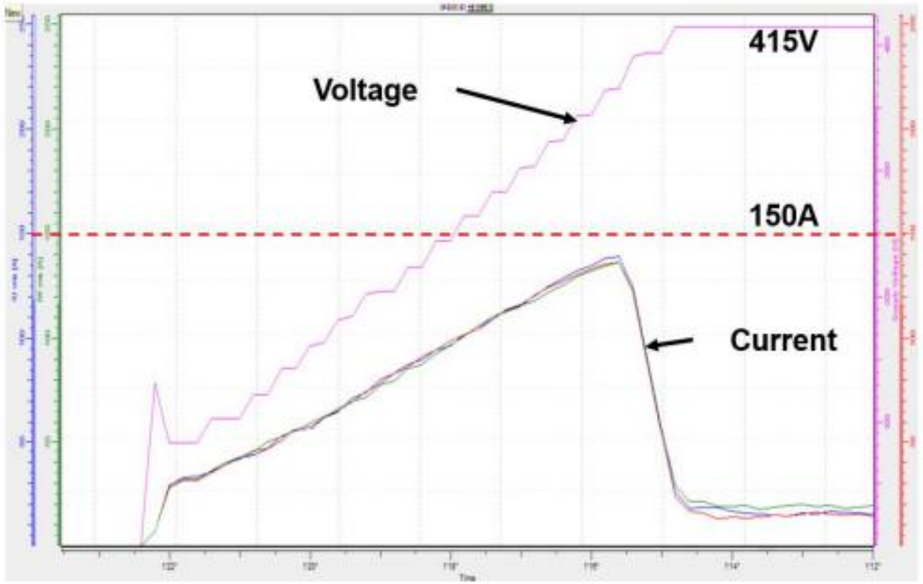

Fig 4: Plot showing voltage and current during ramped magnetisation process

Commission smarter with battery storage. Reach out to learn more.

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