



GE Power Conversion | ALL ENERGY CONFERENCE | MAY 2022

# Pioneering Flywheel Technology for Grid Stability

## Simon Mulley

© 2022 General Electric Company. GE Proprietary Information - This document contains General Electric Company (GE) proprietary information.

\*Trademark of General Electric Company

It is the property of GE and shall not be used, disclosed to others or reproduced without the express written consent of GE, including, but without limitation, in the creation, manufacture, development, or derivation of any repairs, modifications, spare parts, or configuration changes or to obtain government or regulatory approval to do so, if consent is given for reproduction in whole or in part, this notice and the notice set forth on each page of this document shall appear in any such reproduction in whole or in part. The information contained in this document may also be controlled by the US export control laws. Unauthorized export or re-export is prohibited. This presentation and the information herein are provided for information purposes only and are subject to change without notice. NO REPRESENTATION OR WARRANTY IS MADE OR IMPLIED AS TO ITS COMPLETENESS, ACCURACY, OR FITNESS FOR ANY PARTICULAR PURPOSE. All relative statements are with respect to GE technology unless otherwise noted.

# Pioneering Flywheel Technology for Grid Stability



- Transmission System Operators have to **protect against possible blackouts** caused by generators dropping off the grid.
- Historically grid stability has been provided by large synchronous generators (Coal, Nuclear, Gas) which can respond to changes in grid frequency.
- The **increasing use of non-synchronous generation**, such as Wind and Solar energy, is reducing the amount of synchronous generation on the grid.
- The **lack of synchronous inertia** becomes a larger problem when power demand is low but renewable energy production is high – for example windy and sunny weekends or windy nights.
- This can lead to the grid operator constraining renewable generation to **aiming to ensure grid stability** or running coal or gas power plants in reserve just in case there is a fault.



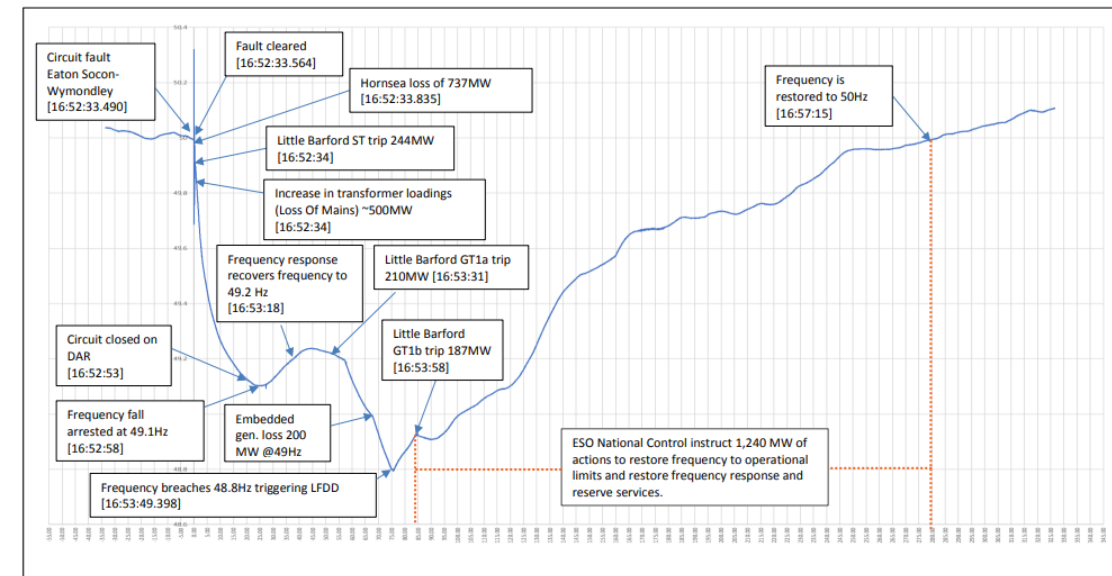
There were several occurrences during 2020 where there was enough zero carbon generation to supply our electricity demands.

Due to a lack of grid stability/inertia on the system, National Grid ESO (NGESO) were forced to shut some renewable generation off and add CCGT and biomass to the system.

# National Grid Stability Pathfinder – Phase 1



- Pathfinder Phase 1 was looking for the most cost-effective way to increase inertia (stored energy) across Great Britain.
- Inertia in the rotating machines connected to the grid helps counter the change of frequency
- This helps preventing blackouts
- Pathfinder Phase 1 was launched in July 2019 with contracts awarded in January 2020



Graph from National Grid ESO Technical report on the events of 9 August 2019

# Rotating Stabilisers for Grid Stability

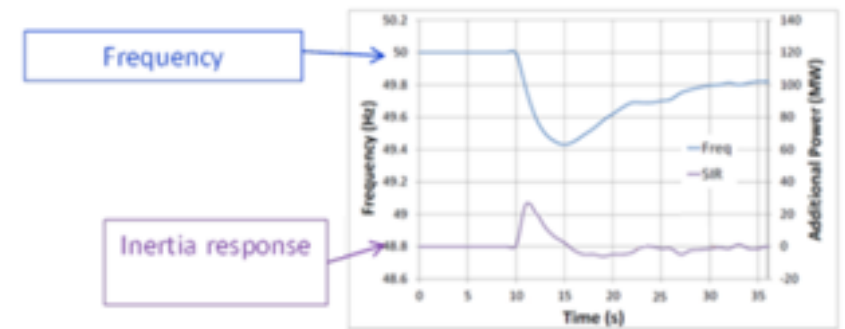
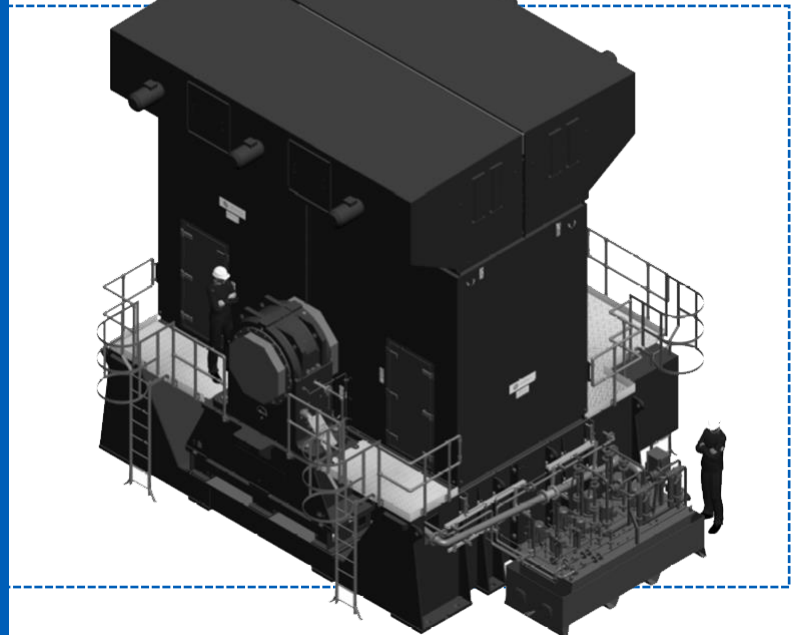


## Pathfinder Phase 1

- Statkraft was awarded a contract by National Grid at Keith in Scotland using two of GE's Rotating Stabilisers.

## Rotating Stabiliser

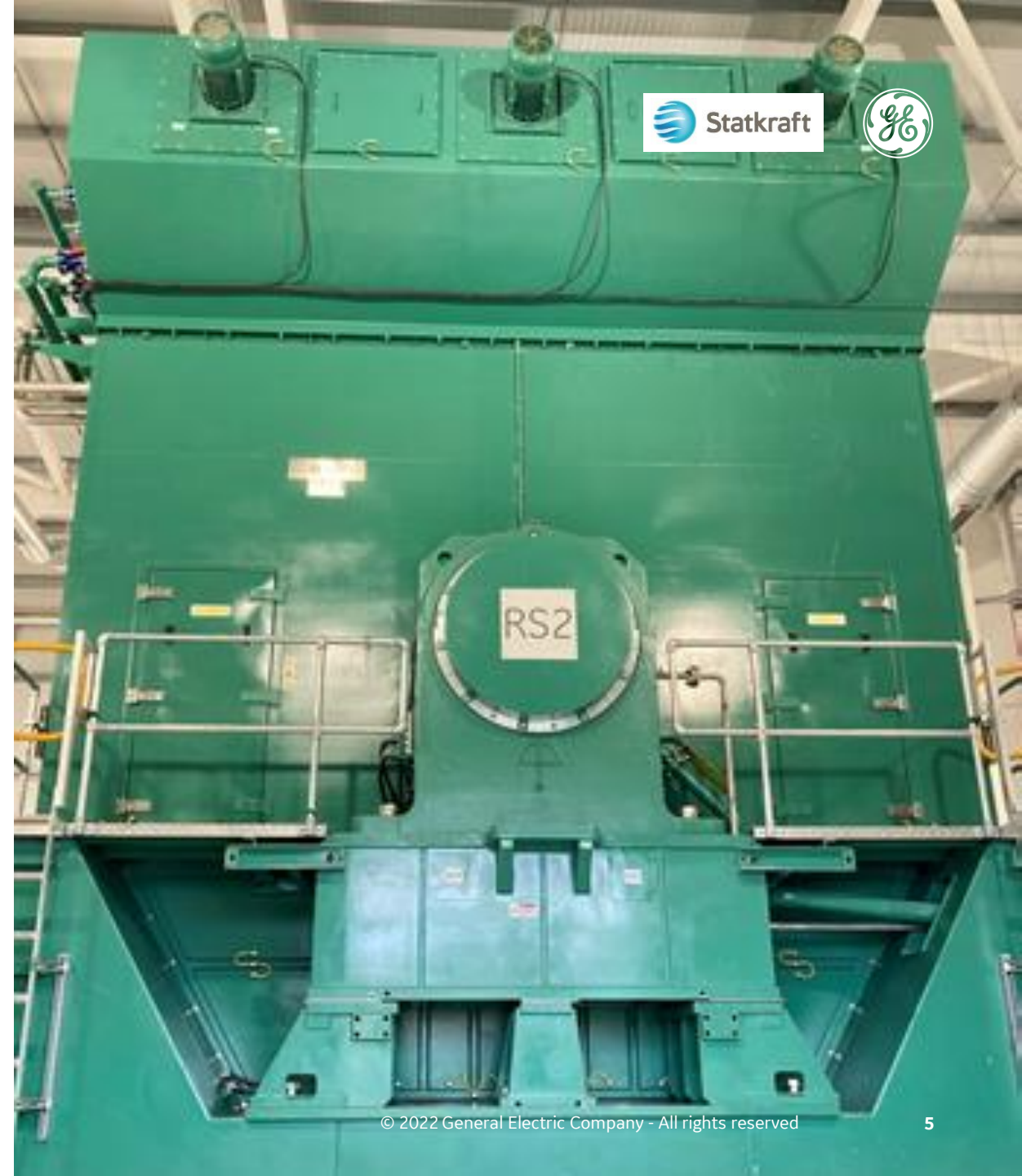
- High-inertia salient pole synchronous condenser
- No external fly-wheel
- It can generate and absorb KVAR with no power generation
- Based upon hydro power generator design so mature technology
- Low numbers of parts giving high reliability and low maintenance
- Built at Rugby



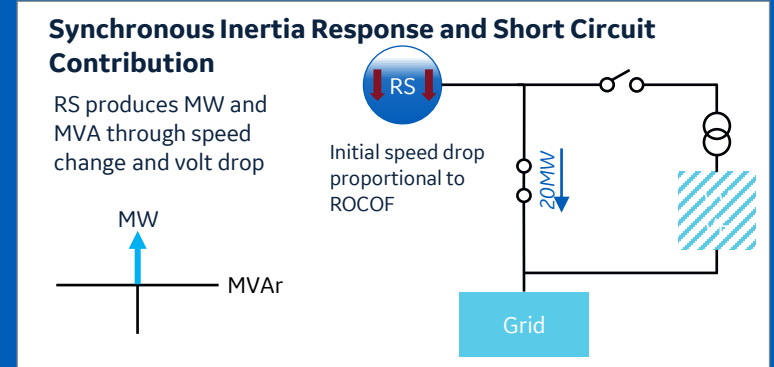
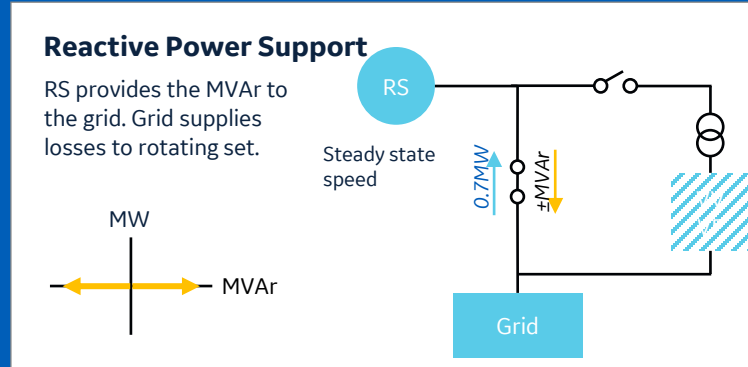
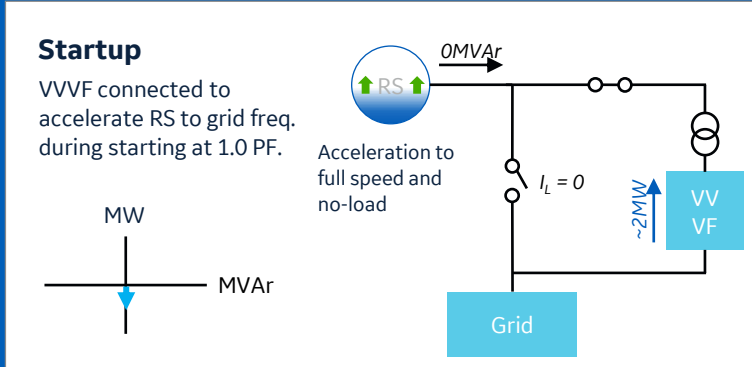
# Rotating Stabiliser – Key Data

## Horizontally mounted synchronous machine Built in Rugby, UK

- Reactive Power ..... 65 MVar
- Stored Energy ..... 450 MW.s
- Short circuit contribution ..... 590 MVA
- Voltage ..... 13.8 kV
- Rotor weight ..... 196 T
- Length ..... 4.7 m
- Width ..... 6.8 m
- Height ..... 6.5 m
- Cooling ..... CACW



# Rotating Stabilisers for Grid Stability



# Keith Greener Grid Park



- Keith, Moray
- Semi-industrial location on town outskirts
- Next to SSE 132kV sub-station
- £25M project
- Operational December 2021



# Key project contributions



The Rotating Stabiliser is helping address the UK grid issues of

- grid stability and security of supply,
- increasing the amount of renewable energy that can be utilised on the grid
- lowering the cost of energy.

## UK Supply Chain

- Shaft from Sheffield Forgemaster
- Rotating Stabiliser from GE Power Conversion Rugby
- More than £1.6m was spent in the Keith area during construction
- Statkraft funding community initiatives to deliver local net zero projects

## Global Opportunities

- One Rotating Stabiliser installed on wind farm in South Australia
- Other opportunities with fast growth of Renewables. Specific opportunities in Spain, Ireland, Australia, Saudi Arabia





**Statkraft**

# Q&A

