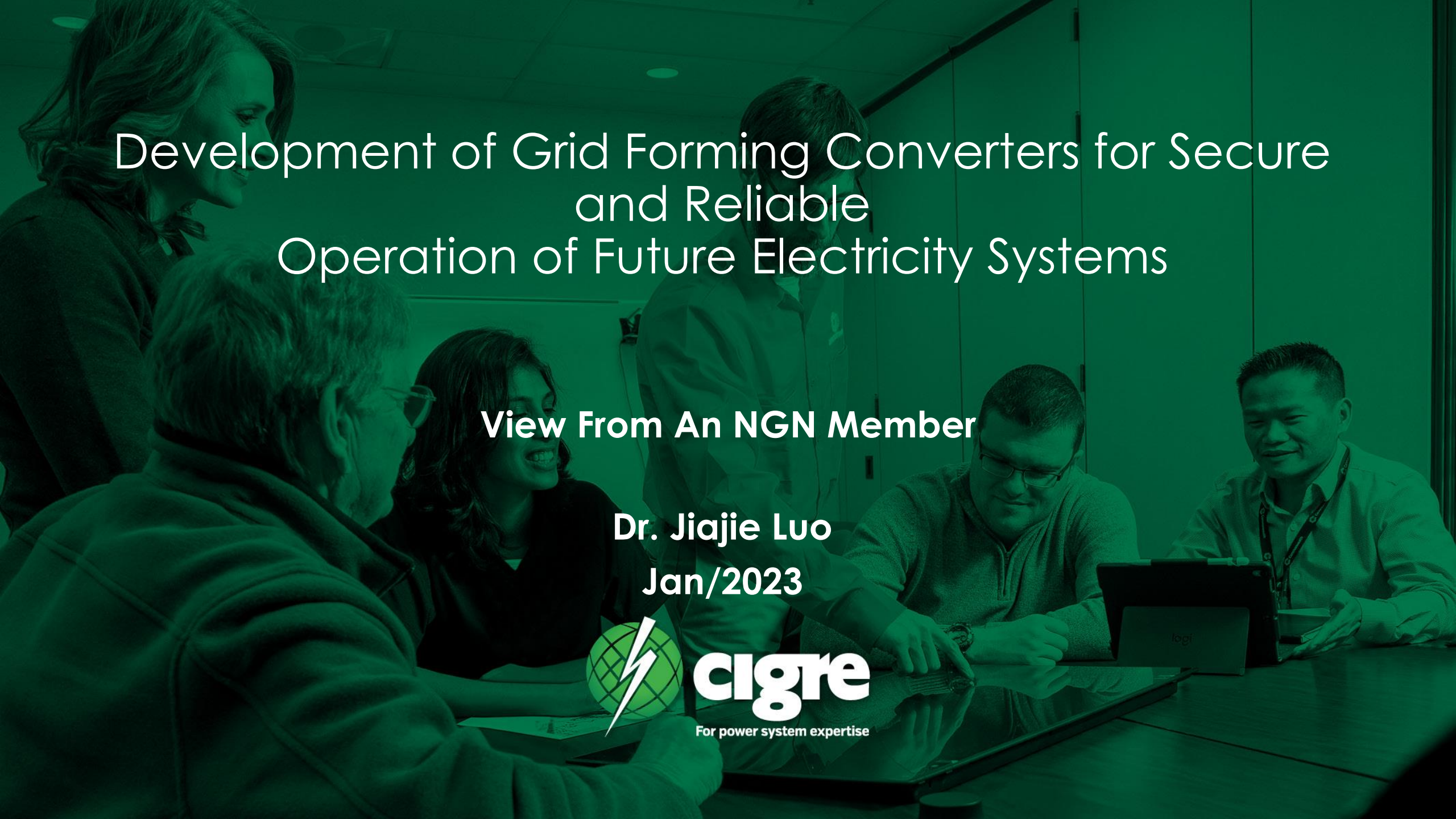

Development of Grid Forming Converters for Secure and Reliable Operation of Future Electricity Systems

View From An NGN Member

Dr. Jiajie Luo

Jan/2023

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About Me

- Software and Control Engineer, Siemens Gamesa. Since Mar 2019
  - Research, develop and maintain the converter control algorithm and software for wind turbines
- PhD University of Birmingham, 2016 - 2019
  - Modelling and control of multi-level converter for offshore wind farm applications
- CIGRE Next Generation Network (NGN)
  - Secretary and Treasurer, 2021 –2022
  - Vice Chair, since Nov 2022
- CIGRE Technical Committee (TC)
  - Secretary, since Oct 2022

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Benefits Of Participating In Working Group

1. Address key issues and challenges of cutting-edge technologies
2. Learn from more experienced experts within CIGRE
3. Broaden social network with enthusiastic individuals from different background
4. Enhance skills
   - Writing skill – technical brochure, Electra report
   - Communication skill
   - Etc.

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How To Get Involved

- Be a CIGRE member (NGN, individual or collective)
- CIGRE Website working group opportunities

  https://cigre.org.uk/news-2/working-group-opportunities/
- Subscribe CIGRE mailing list

  New Working Group Members Required
- Monthly newsletter/ Technical Committee Annual Report

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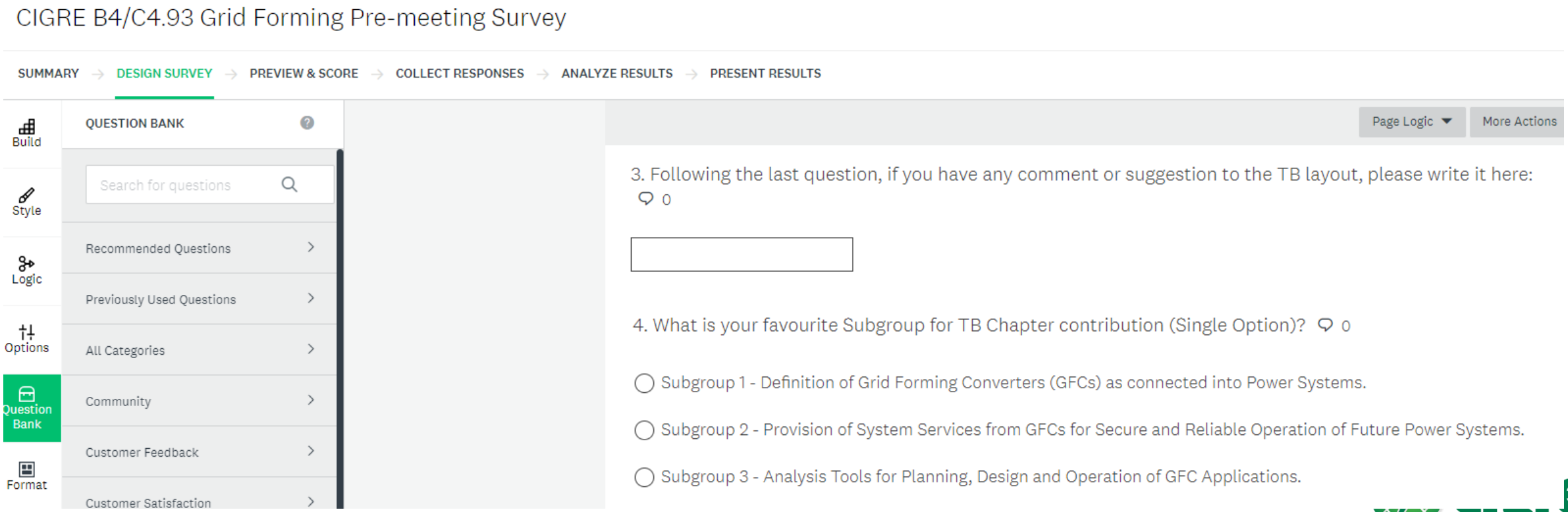
My Responsibilities As An NGN Member

1. Survey (meeting options, sub-group selections etc.)
2. Arrange meetings, meeting minutes
3. Data management platform, e.g. KMS



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Challenges

1. Time difference among members across the globe
   - Arrange two sessions for big group meetings when necessary
   - Make use of tools: survey, recording..
   - Shorten meeting length
   - Physical meetings (occasional)
2. IT issues
   - Accessibility of KMS, Google drive etc.

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A Site Test Experience On Grid Forming From Siemens Gamesa

- First UK converter-connected wind farm to operate in grid-forming
- 23-turbine, 69 MW farm, GF for 6 weeks in 2019
- Direct-drive full-converter PMSG (D3)

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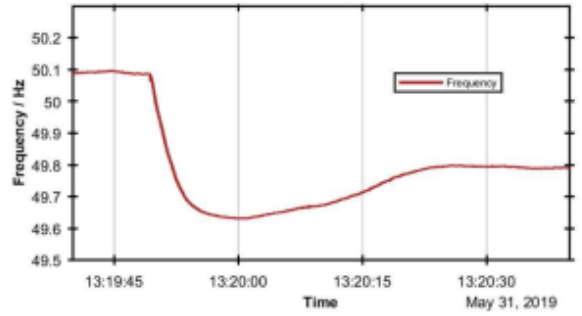
Continue1 – SGRE Grid Forming

1. Event 1
   - IFA (Interconnexion France-Angleterre) tripped, 31 May 2019
   - Infeed loss of ~1 GW, ROCOF peaked at ~ −0.11 Hz/s, frequency drop of nearly 0.5 Hz
   - Turbine setting H = 4s
   - Prediction is ~1.2 MW, which matches measurement

$$\Delta P \approx -\frac{2 \times H \times S_{\text{Rating}}}{f_0} \times \frac{\mathrm{d}f}{\mathrm{d}t}.$$



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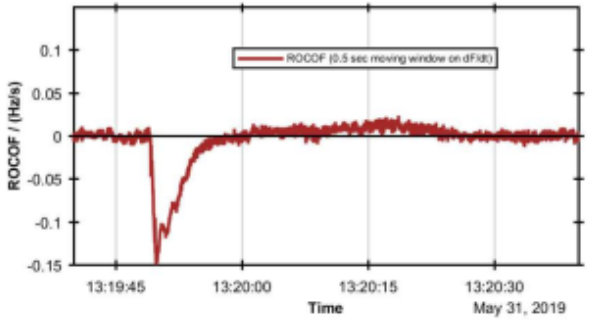

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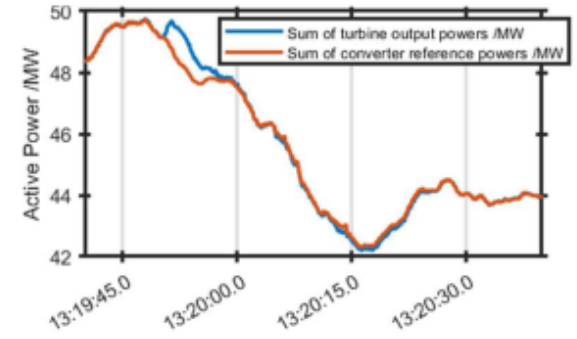

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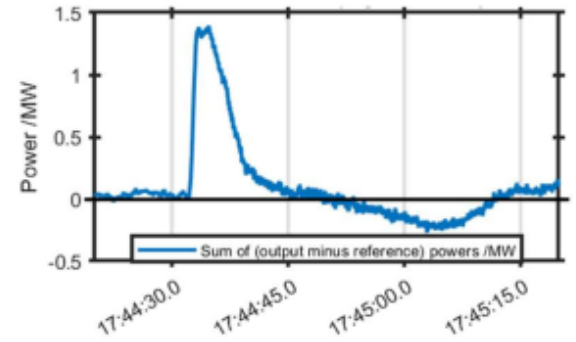
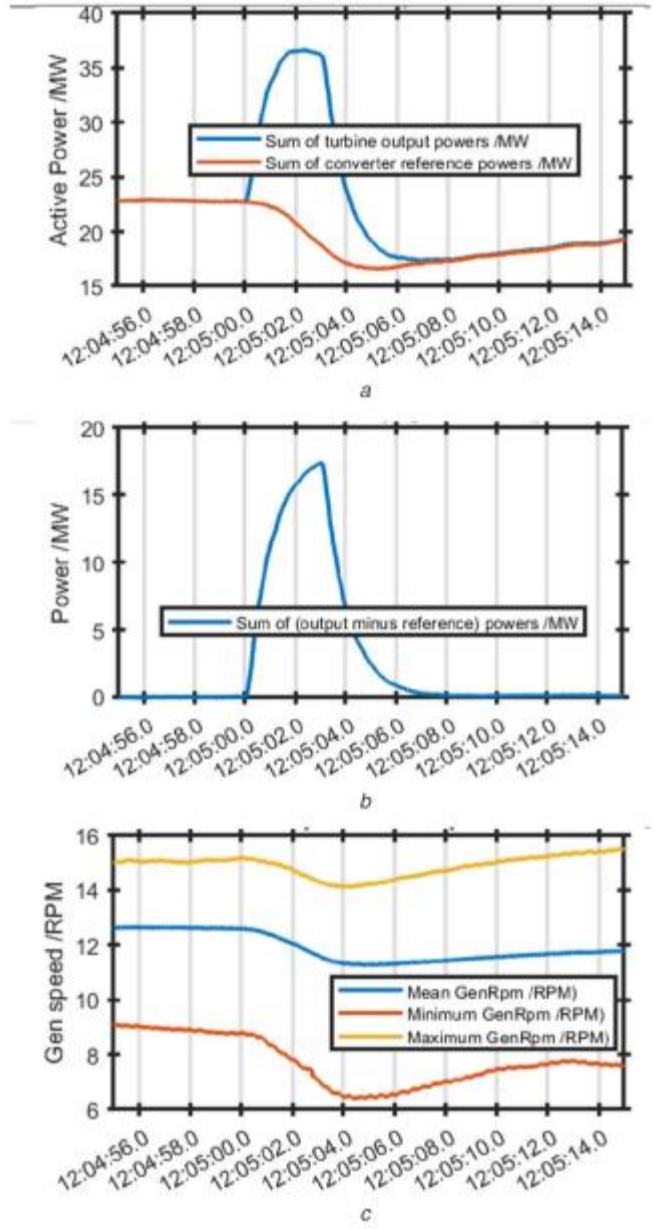


Continue2 – SGRE Grid Forming

1. Event 2
   - Synthetic event, − 1 Hz/s, 3 Hz drop. farm H = 8 s
   - Reductions in rotor speed are significant
   - Limits on WTG, without additional energy storage or pre-event curtailment
   - Possibilities: Various H real-time; Energy storage etc.



Thank you!

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- Ref paper: https://ietresearch.onlinelibrary.wiley.com/doi/full/10.1049/iet-rpg.2020.0638

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