Hawaiian Electric GFM Requirements

ESIG Grid-Forming Workshop

Tuesday, June 7, 2022

Denver, Colorado

Presented by Andrew L. Isaacs

ELECTRANIX
SPECIALISTS IN POWER SYSTEM STUDIES

Acknowledgements and Disclaimer

- This presentation is based on a lot of study work. The study team consisted of :Lukas Unruh, Anuradha Kariyawasam, Suren Dadallage, Andrew Isaacs from Electranix, as well as engineers from Hawaiian Electric – Interconnection Services, Transmission Planning, System Operations, and other supporting divisions. NREL and equipment OEMs have also been helpful!!

- This presentation represents my personal views and is not necessarily a reflection of the views of Hawaiian Electric Company.

Industry Reprimand!!

- Hawai'i has a number of fragile, islanded systems. By 2023 they may be seeing near 90% renewable penetrations with very high DER penetrations. They have accordingly been leading the world in modelling and procuring GFM battery technology.
- They will be trying out GFM technology for the first time and gaining real world experience with the hardware, relying on it to maintain grid frequency and prevent blackouts.
- Since the technology is already for sale, at very little marginal cost, why is all of North America willing to wait, watch and see what happens in Hawai'i? You will need it eventually, so **procure GFM BESS *now*, and test it yourselves in your strong systems!!**

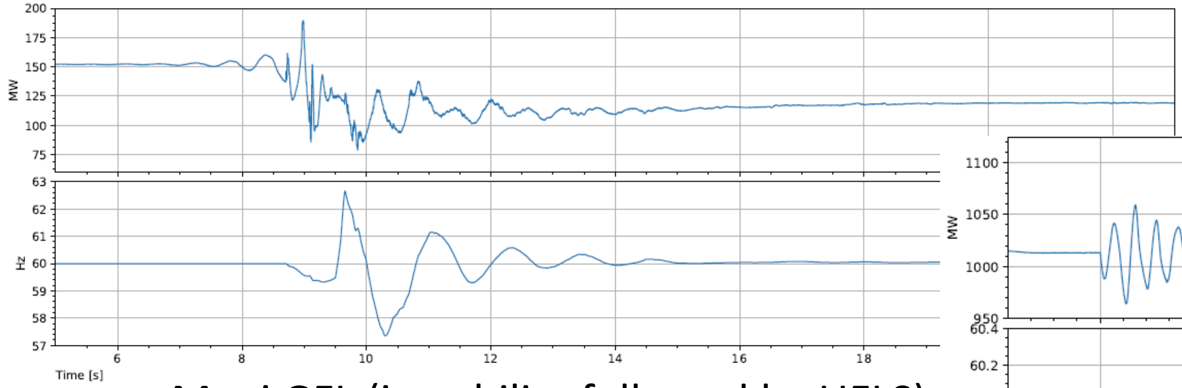
Drivers for Hawaiian Electric requirements

Hawaiian Islands are currently dependent on fossil fuel based generation. It not only emits carbon dioxide, but it is very expensive!! They have aggressive plans to retire this generation, but…

1. IBR penetration levels nearing 100% by 2023 (N-0) mean very little conventional inertia.
2. 50-70% DER penetration expected. This type of resource is difficult to control, and is not specified to meet bulk connected resource standards for grid support.
3. Concerns about low fault current and protection mis-operation.

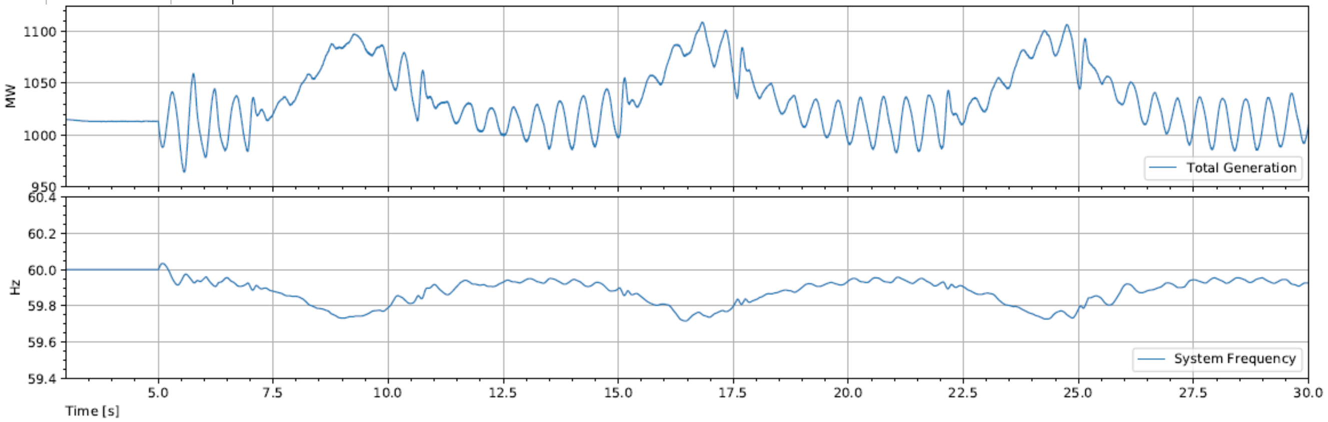
Drivers for Hawaiian Electric GFM Requirement

- IBR penetration levels nearing 100% by 2023 (N-0), little conventional inertia.
- The 2023 scenarios examined for Oahu and Maui were **not stable** in steady state (no fault) when Stage 2 IRS battery projects were operated in Grid-Following mode. These projected scenarios with very little conventional generation in service are not viable as proposed.



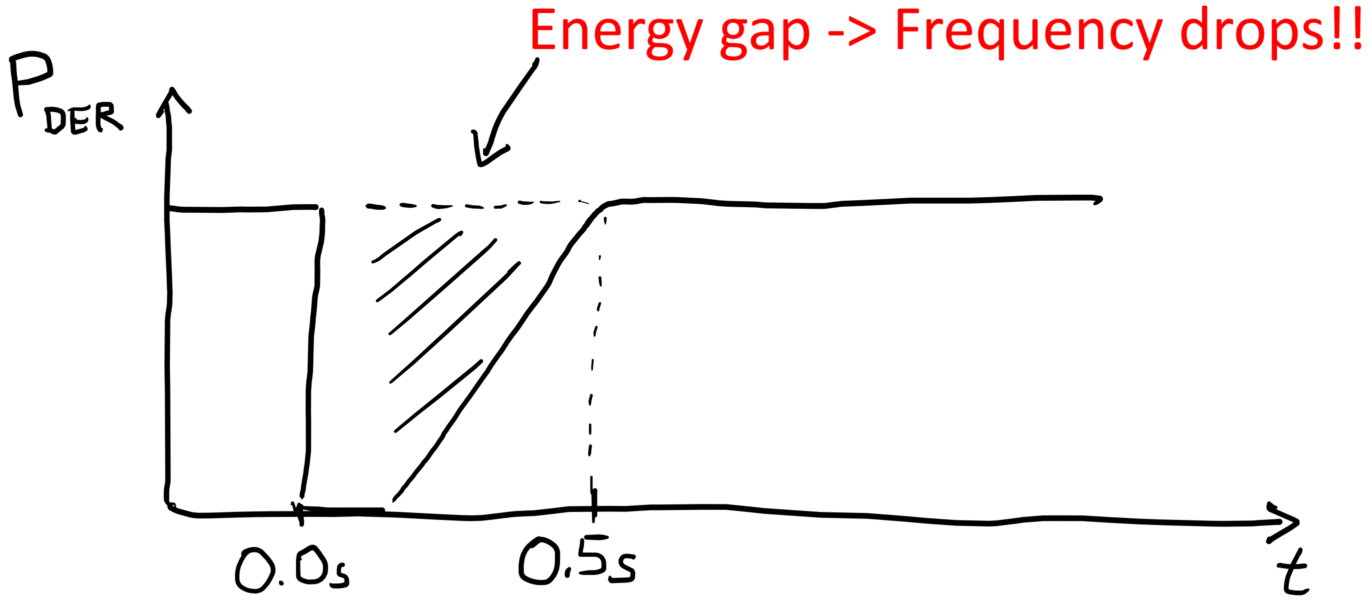
Maui GFL (instability followed by UFLS)

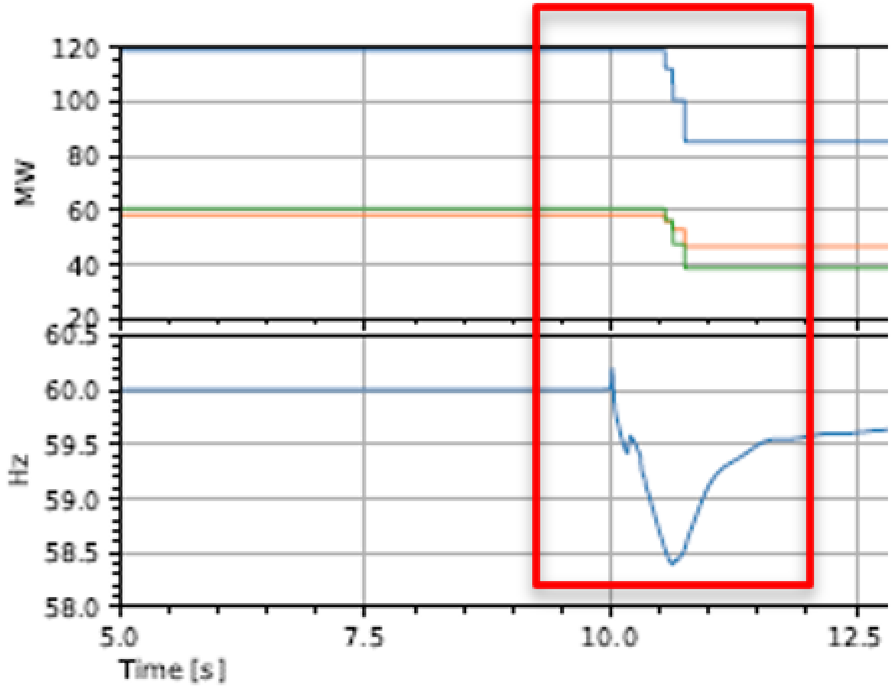
Oahu GFL (instability)



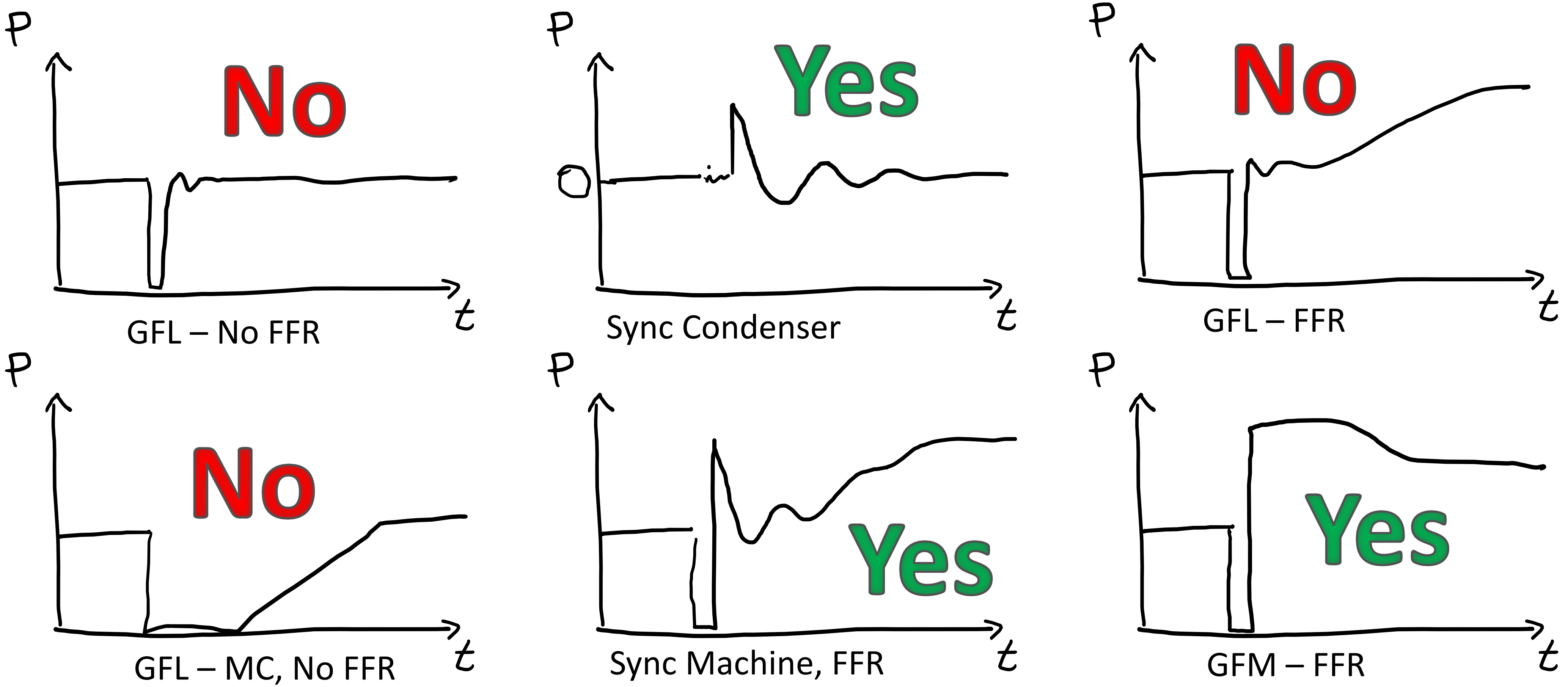
Drivers for Hawaiian Electric GFM requirements

- 50-70% DER penetration, with approximately 0.5 pu UV block threshold, short MC, and recovery ramp rate of 2.2 pu/s.

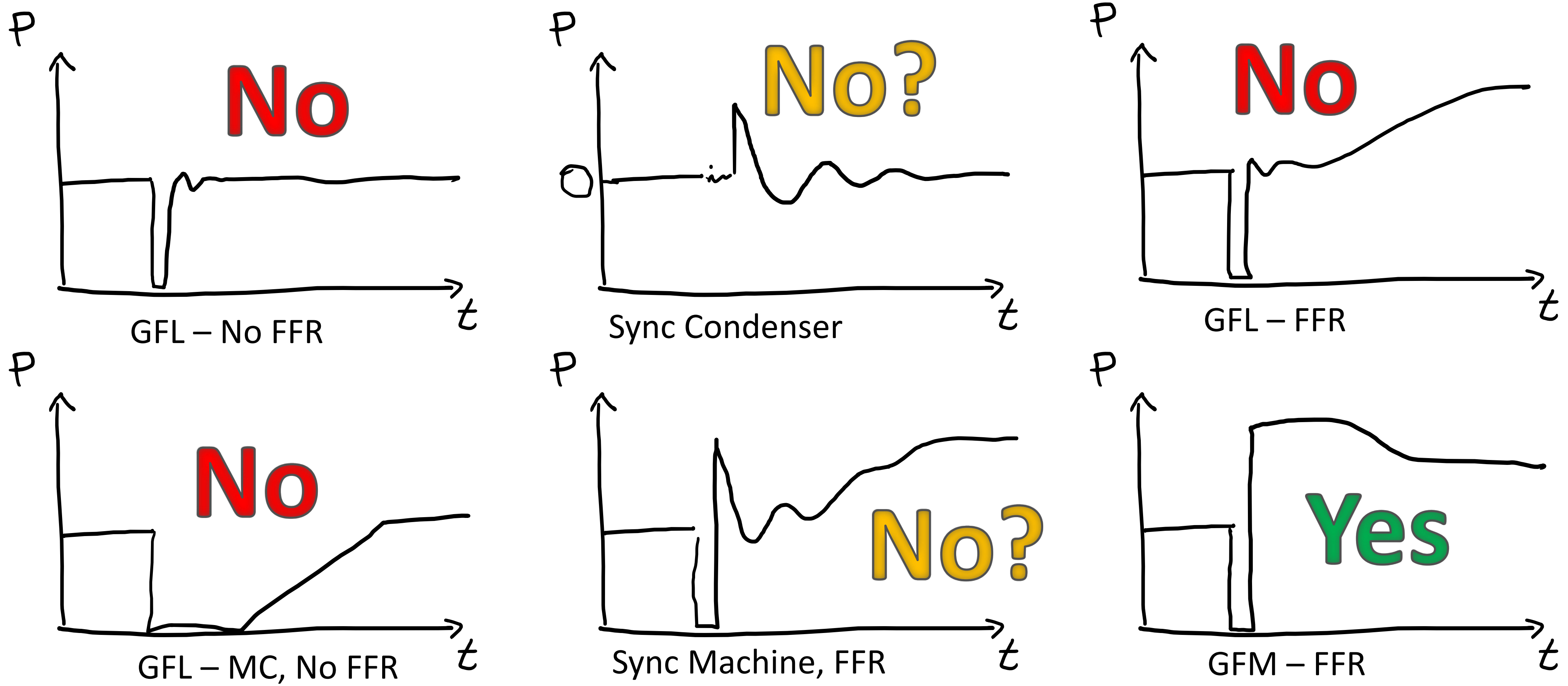




What behaviour do we want to mitigate low inertia/weak grid instability?



What behaviour do we want to mitigate energy gap from DER blocking?



How do you ask for this?

- Tell the developers what the models should be capable of!
- Basic functional testing, including:
  - Basic grid support functions
  - Loss of “last synchronous gen”
  - Playing nice with others
  - Frequency response

HAWAIIAN ELECTRIC GENERATION FACILITY TECHNICAL MODEL REQUIREMENTS AND REVIEW PROCESS

August 23, 2021

Table of Contents

How can you confirm it works for you?

Stay tuned for the presentation tomorrow!!

Links:

Modeling requirements:

- https://www.hawaiianelectric.com/documents/clean_energy_hawaii/selling_power_to_the_utility/competitive_bidding/20210901_cbre_rfp/20210825_redline_lanai_appxb_att3.pdf

GFM study from 2020:

- https://dms.puc.hawaii.gov/dms/DocumentViewer?pid=A1001001A21F14B62327F00172

Questions?

Andrew L. Isaacs
Power Systems Engineer, VP
Electranix Corporation
ai@electranix.com
1-204-953-1833
Winnipeg, MB, Canada