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Grid-Forming Study

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Grid-Forming Study

- Purpose of the assessment
 - To follow up on the CSI study by focusing on spring and low inertia conditions to investigate how recent changes in technology affect the Western Interconnection.
- Top two reliability questions
 - How do grid-forming (GFM) inverters respond during a major loss of generation?
 - What percentage of total generation is needed from GFM and grid-following (GFL) inverters to keep frequency in the Western Interconnection from hitting the 59.5 Hz UFLS threshold?
 - Determine the amount of headroom that is needed to prevent the Western Interconnection from hitting the 59.5 Hz threshold (interconnection wide).



Cases Used

Scenario	Assumptions
2020 LS11_3AM (3AM)	High Wind generation,
	 Light Spring Load (~72GW)
	• Inertia (397,840 MW*s)
24 LSP2S (1PM)	• High IBR
	• Medium load (~90GW)
	• Inertia (163,744 MW*s)



What Dynamic Models were Replaced?

- Synchronous generators replaced with either GFL or GFM
 - 582 generating units (36,570 MW)
 - Excludes nuclear and geothermal units
- Split the 36,570 MW into four groups
 - Each group has between 9,105 and 9,164 MW
- Replaced all 36,570 MW with a nonresponsive GFL to frequency event



Input Data

- GFL used the generic data that General Electric (GE) supplies in its Positive Sequence Load Flow (PSLF) manual
 - Started with the GFL used in the CSI study
 - Modified the following parameters to disable the voltage control due to the collector system not being present in the case
 - REPC_A parameters that were changed, Kp, ki, tp, tlag, and puflag
- GFM used generic data provided by Pacific Northwest National Laboratory (PNNL)



Approach

• Simulated a standard disturbance for the double Palo Verde outage

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 MW response from hydro, IBR FR (frequency response activated), IBR, and gas turbine



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CSI Study with GFM

3 AM GFL and GFM Frequency Response



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1PM Case with Nonresponsive GFL



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1 PM Case with GFM



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1PM Case with CSI GFL



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Voltages



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Next Steps

- Working on imbalance scenarios
- Compile results and write report





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