



# **LBNL Study: Frequency Control Requirements for Reliable Interconnection Frequency Response**

---

Eddy Lim

Electrical Engineer  
Office of Electric Reliability

June 2018

06/06/2018

888



# Disclaimer

*This report was prepared by Lawrence Berkeley National Laboratory for the Office of Electric Reliability. This report does not necessarily reflect the views of the Commission.*



# Objective

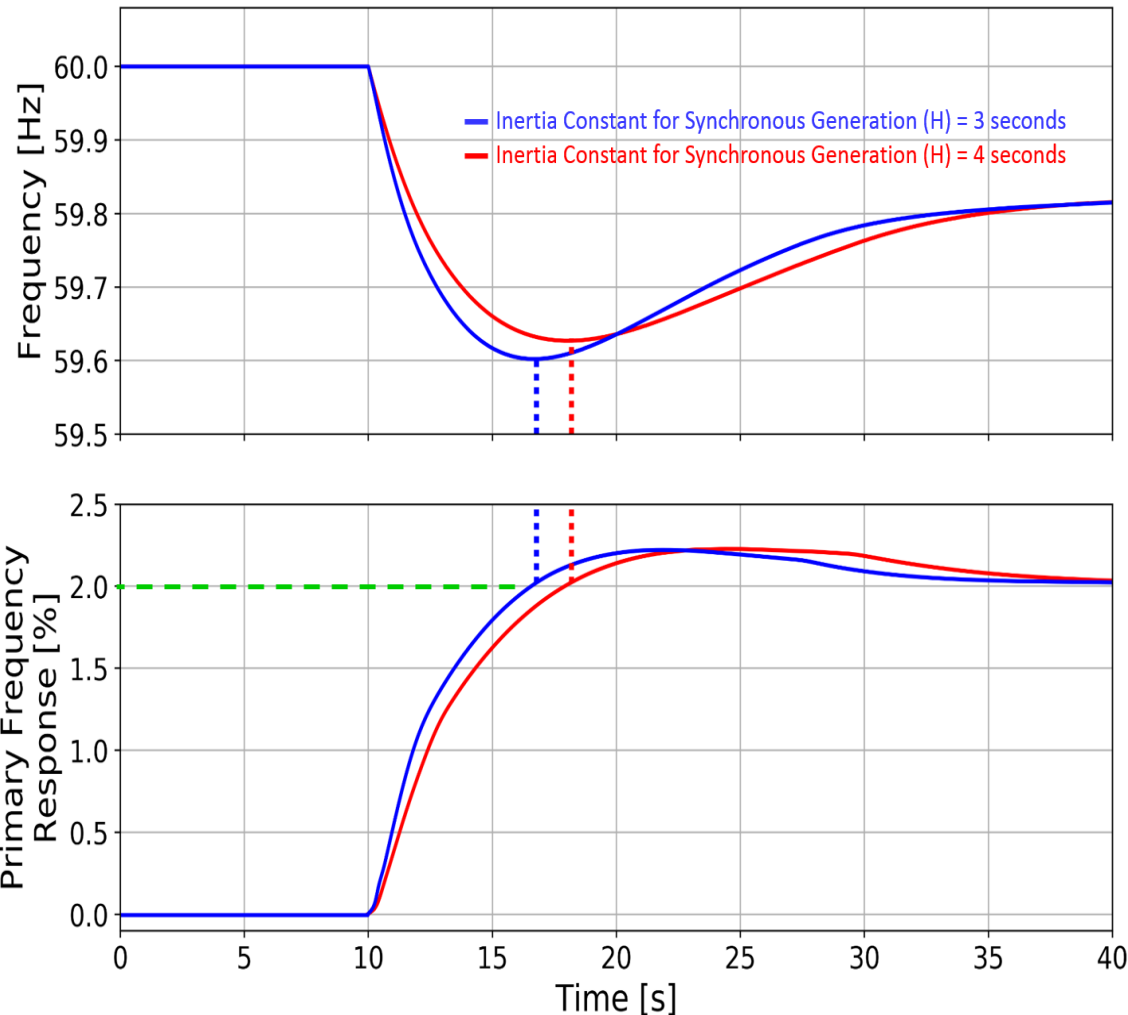
- To assess and identify the key parameters of frequency control in response to a sudden loss of generation or load on the bulk power system.
  - Head Room, speed of response, sustained response, inertia, dead band, load response, frequency bias of plant controllers, size of the interconnection, size of the generation loss
  - Rate of change of frequency, nadir and settling frequency



# Physical Requirements for Arresting Frequency

Frequency is arrested when the amount of primary frequency response delivered equals the amount of generation lost

Reserves held to provide primary frequency control must exceed the expected loss of generation

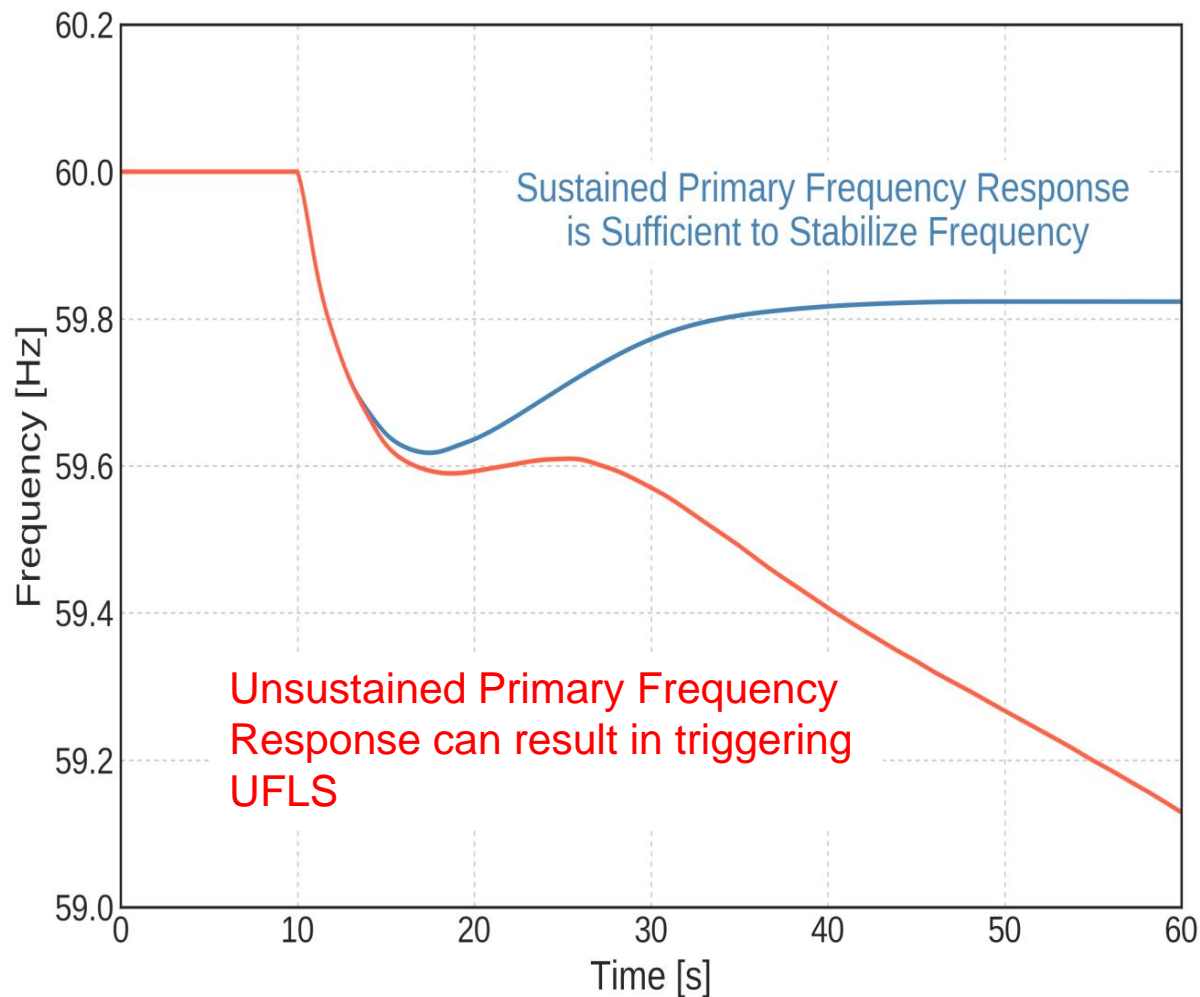




# The Importance of Sustained Primary Frequency Response

Failure to sustain sufficient primary frequency response will trigger UFLS

Primary frequency response must be sustained until secondary frequency response can replace it





# Key Study Findings

Rapidly deployed and then sustained primary control action in response to the sudden loss of generation is a fundamental reliability requirement.

This requirement is met by the action of turbine governors and, in some cases, by fast demand response.

*Generation interconnection policies* should determine:

- The extent to which the fleet is equipped to provide primary frequency response

*Generation dispatch policies* should determine:

- The required amount of primary frequency response
  - ...which depends on the size of the generation loss event the interconnection is designed to withstand
- The required rate of delivery of primary frequency response
  - ...which depends on the inertia of the interconnection



# Study Recommendations

- Focused attention needed on the collection, maintenance, and validation of operating data and study models
- International practices should be reviewed as options for U.S. grid operators to consider for adoption/adaptation
- All generators should have the capability to provide sustained primary frequency response
- Ensuring plant load controls don't withdraw frequency response
- The contributions of non-traditional resources for primary frequency control should be studied and incorporated, as appropriate, into future operations
- The changing composition of loads should be studied and addressed



# LBNL Study: Frequency Control Requirements for Reliable Interconnection Frequency Response

LBNL-2001103

Frequency Control Requirements for  
Reliable Interconnection Frequency Response

Authors:

Joseph H. Eto,<sup>1</sup> John Undrill,<sup>2</sup> Claran Roberts,<sup>1</sup> Peter Mackin,<sup>3</sup> and Jeffrey Ellis<sup>3</sup>

<sup>1</sup>Lawrence Berkeley National Laboratory

<sup>2</sup>John Undrill, LLC

<sup>3</sup>Utility Systems Efficiencies, Inc.

Energy Analysis and Environmental Impacts Division  
Lawrence Berkeley National Laboratory

February 2018



This work was supported by the Federal Energy Regulatory Commission, Office of Electric Reliability, under interagency Agreement #FERC-16-1-0105, and in accordance with the terms of Lawrence Berkeley National Laboratory' Contract No. DE-AC02-05CH11231 with the U.S. Department of Energy.

<https://www.ferc.gov/industries/electric/indus-act/reliability.asp>

Contact: Eddy Lim

FERC - Office of Electric Reliability

Division of Engineering Planning and  
Operations

202.502.6713

Eddy.Lim@ferc.gov