Paris Session 2022

cigre
For power system expertise

Characterisation of Grid-forming Converters

Study Committee C4

Power System Technical Performance

PS 3 – Question 20:

What are the key design and control parameters of the battery and associated inverter to optimise the collective provision of system services such as frequency control, inertia, and system strength in a power system planning horizon?

Stephen Sproul, Australia

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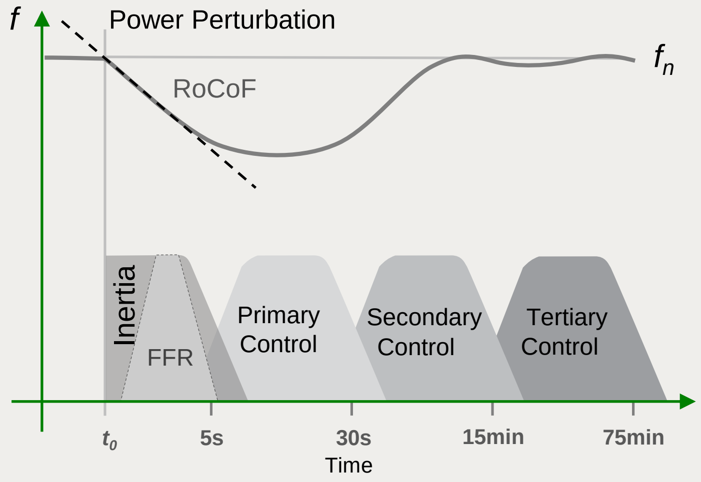
Grid-forming converters and services

- Grid-forming control
  - Droop, virtual oscillator and VG/VSM need to be compared
- Inertia
  - Only GFM - real power service (converter MVA = battery MW)
- System strength
  - Only GFM - reactive power service (converter MVA > battery MW)



GFL = Grid-following
GFM = Grid-forming
VG = Virtual Generator
VSM = Virtual Synchronous Machine
RoCoF = Rate of change of frequency
FFR = Fast frequency response

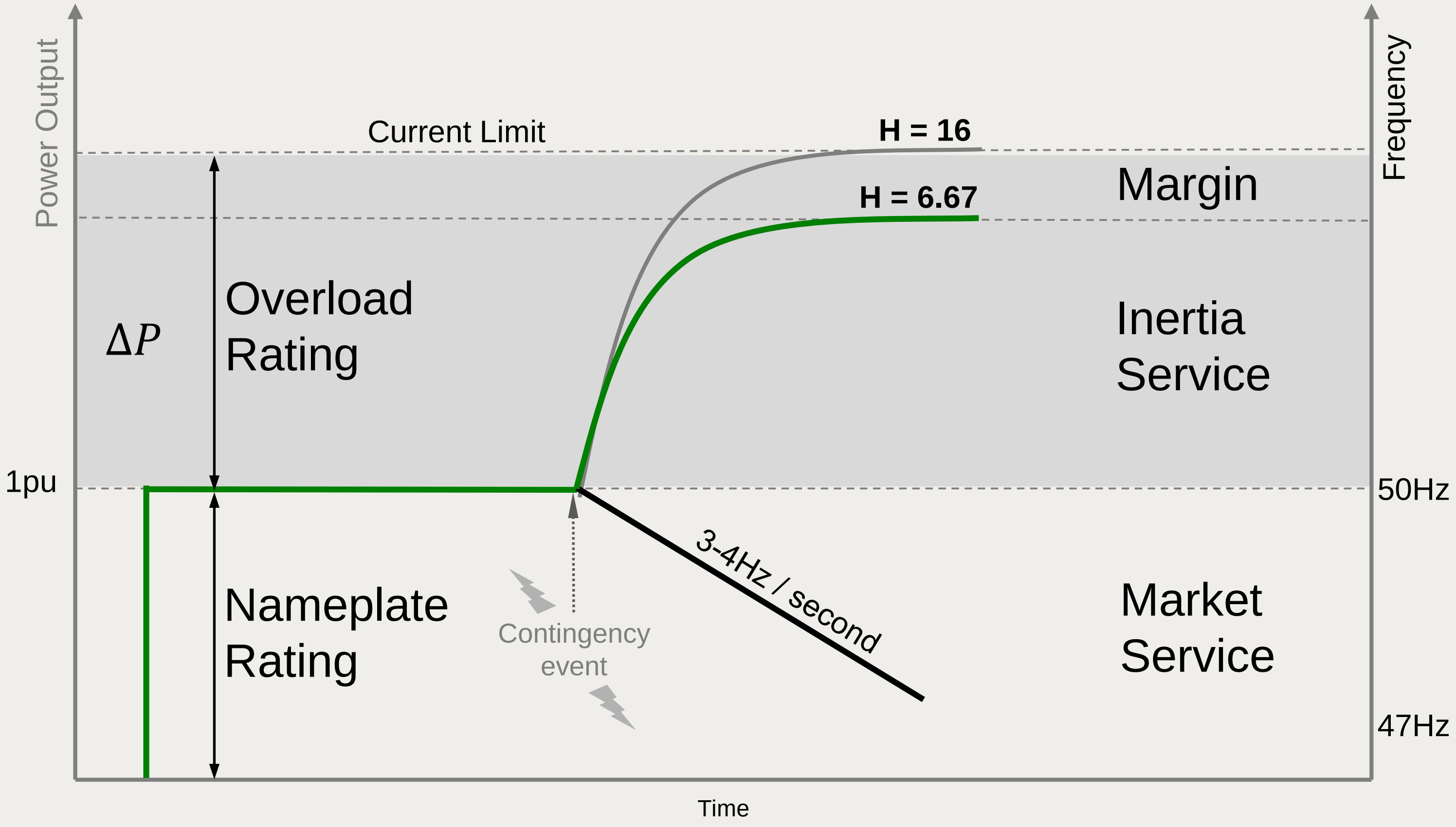
Grid-forming converters: Overload vs switching modes

- During a contingency a grid-forming converter needs to current limit at a point
- How is this managed:
  - Switch mode (Switch to Grid-following/current source mode)
  - Oversize (Install additional converters)
  - Utilise overload (Utilise a specific class of high-power converters)
- Broad spectrum of capabilities needs better understood and defined, with updated, fit for purpose interconnection rules.

GFM = Grid-forming
IBR = Inverter-based resource
IC = Interconnection
VSM = Virtual Synchronous Machine

Overload to enable multiple services - Inertia example

- Dalrymple BESS Example
  - Interconnection Rule RoCoF requirements
  - 4Hz/sec for 0.25 seconds
  - 3Hz/sec for 1 second



$$H = \frac{\Delta P}{2RoCof} \times f_0$$

ΔP = Size of Contingency (MW lost)
$RoCoF$ = Rate of change of frequency
f_0 = Frequency at the time of disturbance (Hz)

RoCoF = Rate of change of frequency