Paris Session 2022

The blackout event in Thai power system: stability assessment, investigation, and prevention

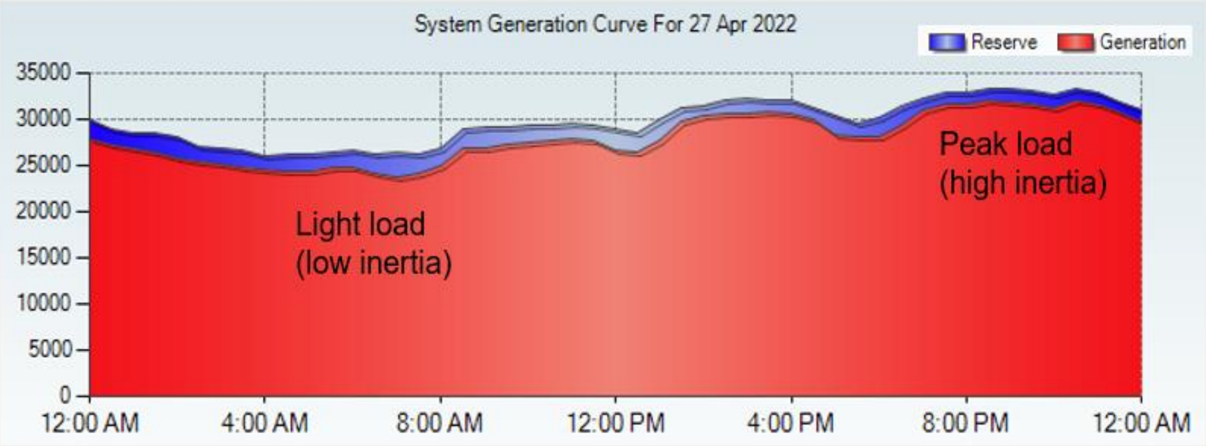
C4 PS3 Q15

What system studies, success criteria, coordination and considerations shall be accounted for when designing special protection schemes or other critical system level protection for managing system stability as the power system and generation mix are changing rapidly?

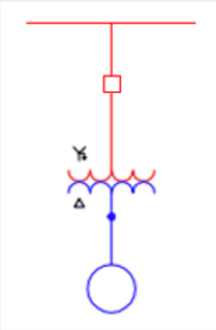
MR. ATSAWIN NUNTHACHAI, THAILAND

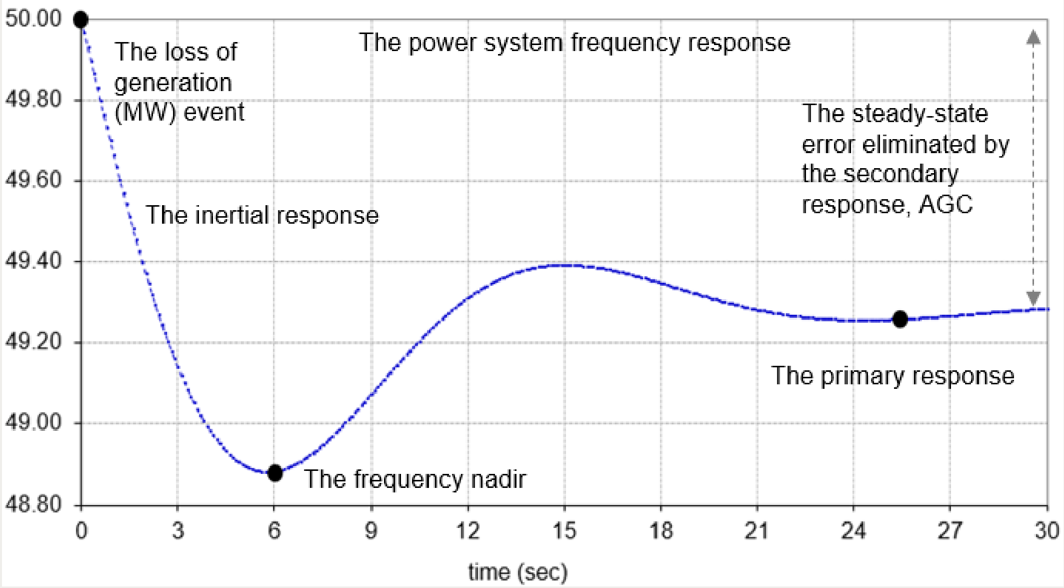
- *The success criterion for the operation protection and control of power system frequency*
  - The N – 1 criterion for the maximum unit (MW) of the power plant tripped must be considered
  - The light load condition must be considered
  - The power system frequency is not less than 49.0 Hz
  - The case of the system frequency < 49.0 Hz the stability frequency is protected by the frequency relay

The power system generation curve of Thailand (MW)

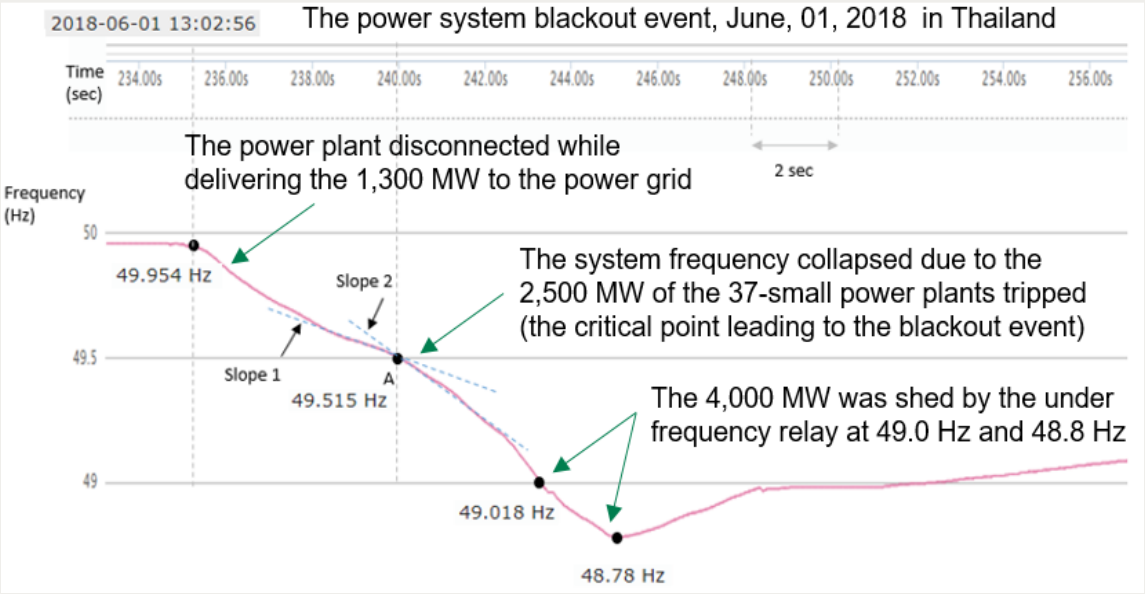


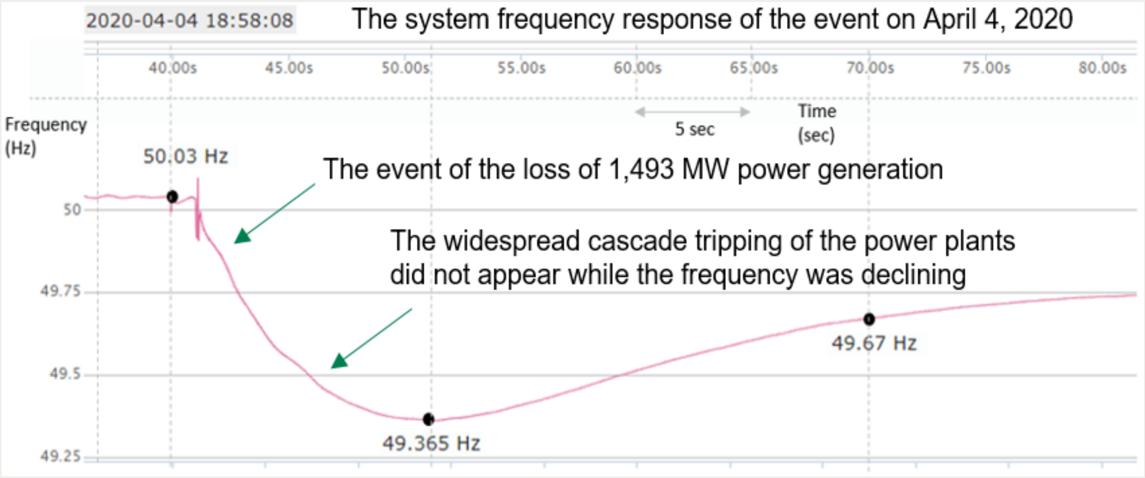
The N - 1 maximum unit (MW) tripped





- *The success criterion for the operation protection and control of power system frequency (continued)*
  - The system frequency response must be assessed and followed up when the event occurred
- *The lesson learned*
  - The widespread cascade tripping of the small power plants while the system frequency reached the 49.5 Hz
- *The follow up*
  - After the frequency relay setting of the power plants have been corrected, 48.0 Hz

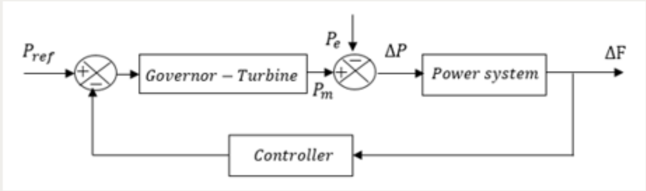




•*The impact of the generation mix and the power system changing rapidly on the system frequency response*

– To reduce the concern, the Electricity Generating Authority of Thailand, EGAT has assessed and followed up the system frequency response and the model when the event occurred

System Frequency Response, SFR model *



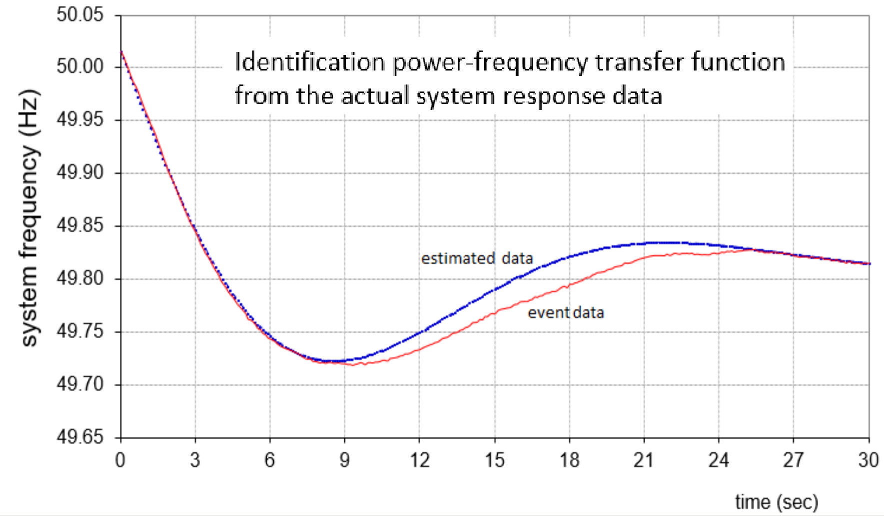
$$\frac{\Delta F(s)}{\Delta P(s)} = \frac{\omega_n^2 T_R}{\beta} \frac{s + \frac{1}{T_R}}{s^2 + 2\zeta\omega_n s + \omega_n^2}$$

$$\lim_{s \to 0} s\Delta F(s) = \frac{1}{\beta}\Delta P$$

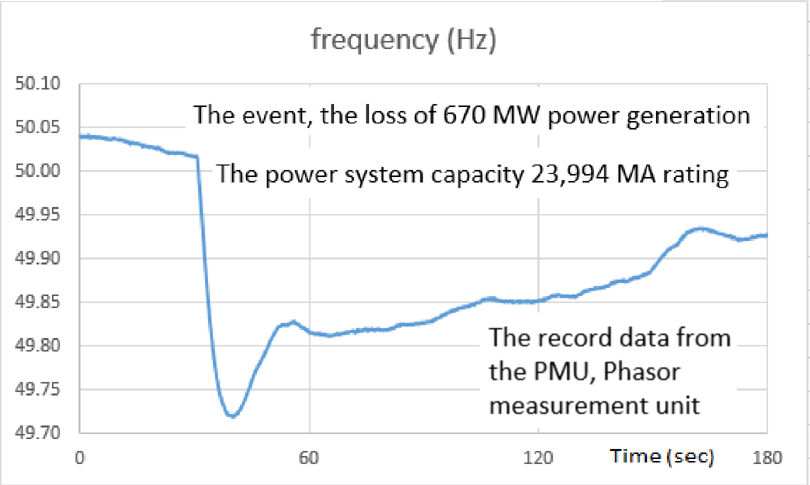
$$\Delta f(t) = \mathcal{L}^{-1}\left(\frac{\Delta P}{s}\frac{\omega_n^2 T_R}{\beta}\frac{s + \frac{1}{T_R}}{(s + \zeta\omega_n)^2 + (\omega_n\sqrt{1-\zeta^2})^2}\right)$$

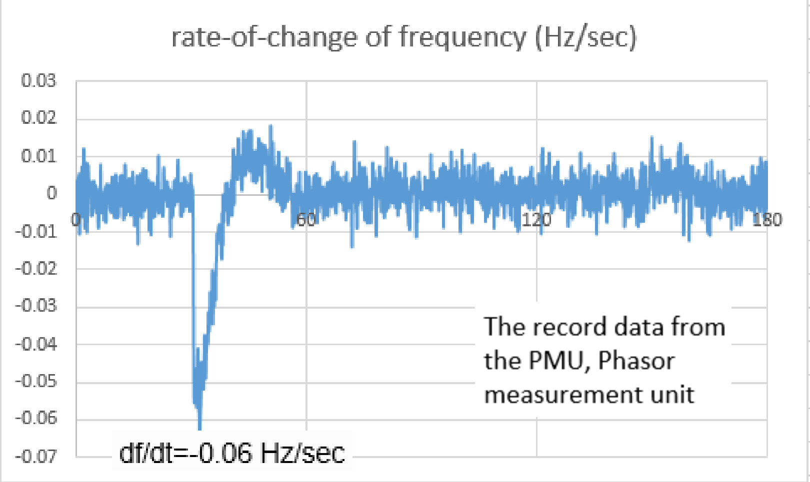
$$2\sum_{i=1}^{n_g} H_i = \frac{f_0}{\frac{df}{dt}\big|_{t=0}}\Delta P \qquad \zeta = \frac{H\omega_n}{\beta} \qquad \omega_n^2 = \frac{\beta}{2HT_R}$$

Power system parameters	Estimated data
T_R, Effective time constant of all regulatory mechanisms	4.6 sec
β, Stiffness of power system	336 MW/0.1 Hz
H, Power system inertia	11.35 sec



The dynamic performance of power system frequency





*** BIBLIOGRAPHY**

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