Paris Session 2022

Key Take Aways SC C2
Power System Operation and Control

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Outline

- Relevant topics for the Netherlands
- Large disturbance workshop
- Poster sessions impression
- Draft preferential subjects 2024

C2 paper contributions from the Netherlands

- Synchrophasor-based Applications to Enhance Electrical System Performance in the Netherlands
- Potential and challenges of AI-powered decision support for short-term system operations
- State Estimation in Medium Voltage Distribution Networks using Pseudo-Measurements
- Transition to a new regional coordination framework

Relevant topics for the Netherlands (1)

- AI to AI multi-stage collaboration based on coordination of calculation results.
- Is there a limit on allowable tools per control room operator due to cognitive/sensor limits of the operator?
- Topology optimization to manage extreme power system conditions.
- Interaction between different controls aiming at stability enhancement: holistic approaches for powers system stability analysis and coordinated control design are necessary.

Relevant topics for the Netherlands (2)

- The impact of climate change and extreme weather conditions on the power system and security of supply and lessons learned from extreme events.
- Power system resilience: the ability to withstand and mitigate the extent, severity and duration of system degradation following an extreme event: e.g. tough weather conditions and cyber security.
- System Integrity Protection Schemes (SIPS), designed to add an additional layer of defense against large disturbances.
- Grid-forming blackstart Battery Energy Storage Systems (BESS).

Large disturbance workshop (SC C2)

- European System Split, July 24, 2021
  Augustin Diaz (REE, Spain), Laurent Lamy (RTE, France),
  Walter Sattinger (Swissgrid, Switzerland)

- Tokyo Blackout, March 16, 2022
  Toshiro Kataoka (Tepco, Japan)

- Coping with the system cascade separation, March 2020
  Igor Aronovich (NOGA, Israel)

European System Split, July 24, 2021

Conclusions:

- Large disturbance led to a system split
- Combination of automatic and manual measures: Defence Plan and fast coordination among TSOs to mitigate the event
- Full resynchronisation 33 minutes after the separation
- Expert panel to identify lessons learned and possible improvements
- Final report published on 25th March 2022

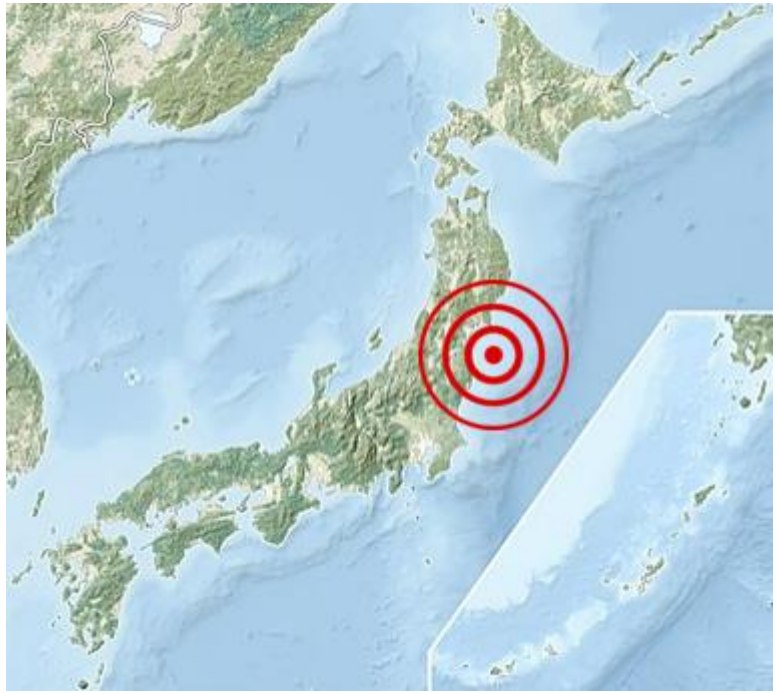
Derived recommendations:

- Reduce volume of non-conform generation tripping
- Communication chain in case of external conditions impacting system operation
- Investigate the opportunity to supplement important transit corridors with SPS functionality (in combination with automatic overload protection)
- Enhance monitoring of Low Frequency Demand Disconnection operation
- Review synchrocheck setting for corridor lines

Tokyo blackout, March 16, 2022

Conclusions:

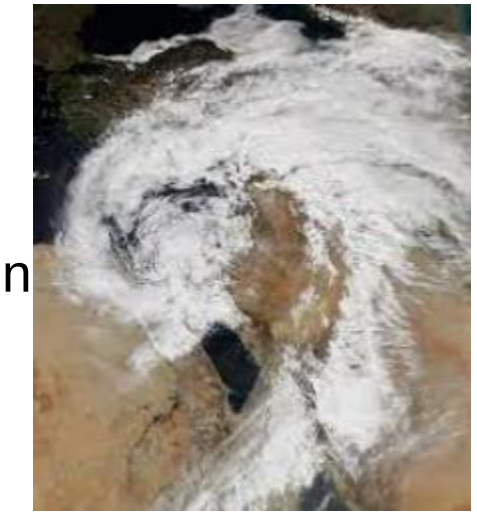
- Despite a large number of power outages, a stable supply was maintained through Under Frequency Load Shedding and collaborative frequency adjustment
- Power supply-demand conditions for the East Japan area will be extremely tight due to unseasonable cold temperature
- With power saving contributions from the customers, uncontrollable outage due to supply shortage was avoided



Recommendations:

- Realize a standard collaborative operation in the East Japan area
- Introduce capacity requirements during off-peak season
- Earlier dissemination of supply and demand information

Coping with the system cascade separation March, 2022



Conclusions:

- Extreme weather conditions (Dragon storm: winds and gusts up to 100 km/h, flooding rains, sandstorm and hail) led to a system separation twice on 400 kV level within 10 hours.
- The control room's and field crew staff have operated as expected in extreme weather conditions.
- All system protections operated properly as expected.
- The system is designed to cope with n-1, n-2 disturbances. During the system separations it stood at n-5.
- System simulations shows that in demand of 13 GW and n-5 contingency the system survived successfully, where only 150 MW manual load shedding and redispatch are required.

Coping with the system cascade separation March, 2022

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Large disturbance workshop (SC C5)

- Resilience test of Indian power system during extremely severe cyclone ‘Tuaktae’
  Vivek Pandei (POSOCO), May 14 – 22, 2021

- Generation an voltage disturbance during very high demand
  Ramu Naidoo (TRANSPOWER – New Zealand), August 9, 2021

- *Widespread impact of cyclone and restoration through long term off-grid supply*
  Jacinda Papps (ALINTA ENERGY - Australia) - was announced, but not presented

- Interim note on suspension of the Australian National Electricity Market
  Greg Thorpe (Convenor AU C5), 10 days in June 2022

Resilience test of Indian power system during extremely severe cyclone ‘Tuaktae’ (May 14 – 22, 2021)

Key success factors

- Early warning
- Geo-mapping transmission assets
- Reinforcements skilled personal
- Adequacy pump dewatering substation
- Large synchr. Interconnection resilience
- Backup communication system
- System visibility
- Seamless flow of information

Lessons learned

- Helped in operational planning and coordination
- Required for impact assessment and restoration coordination
- Challenges in HR mobilisation due to pandemic (another HILF)
- Needed dewatering after cyclone induced rain
- Successful management of sequential and extended demand crash
- Helped a lot during disruption of data during the cyclone impact
- Availability of WAMS enabled and facilitated quick response
- Platforms created for exchange of information between administration, nodal agency and utilities helped in effective crisis management

Generation and voltage disturbance during very high demand – New Zealand, August 9, 2021

Some observations (I)

- An independent review by PBA was commissioned by Transpower
- The review found the root cause of the Grid Emergency situation was a shortage of generation to supply the evening peak demand due to the combined effect of:
  - Planned generation capacity outages and unplanned outages closer to the time of the grid emergency
  - The unexpected loss of wind generation
  - The lack of market pricing signals to provide sufficient commercial incentive to start-up less flexible generation in time to help support the evening peak demand
- The Grid Emergency ended after approx. 4 hours

Some observations (II)

The PBA review recommended that consideration be given to:

- Inflexible plant operation in the electricity spot market
- Use of controllable load before disconnecting customers
- Managing uncertainty of intermittent generators
- Review of the demand allocation process
- Control centre staffing and training
- Industry-wide preparedness for rare scarcity events

Interim note on suspension of the Australian National Electricity Market (10 days in June 2022)

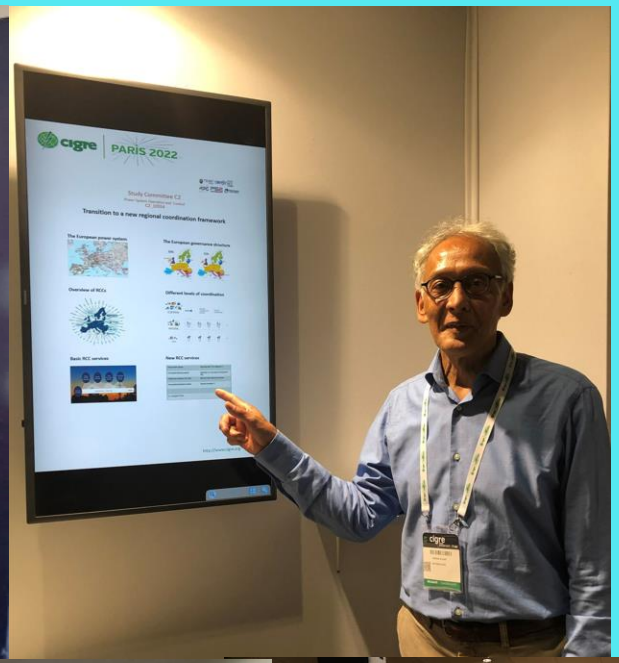
- Extensive forces outages of coal generators
- Wet weather limiting coal supply to some generators, creating energy constrained generation sources
- High coal prices
- High gas prices that were also capped to $40/GJ
- Administered Price Cap triggered – compensation claims possible
  (Cumulative Price Threshold reached: rolling 7-day accumulated sum of real time spot price)
- Multiple intervention directions for dispatch by AEMO – compensation claims possible

- AEMO stated that it was impractical to issue intervention directions fast enough to ensure adequate supply and were losing control of reliability. A perfect storm of events.

→ SUSPEND to protect security of operation (first market-wide suspension in 23 years)

- (A more detailed presentation will be prepared when reviews are complete)

Poster sessions: good discussions and atmosphere



Draft preferential subjects 2024

PS 1 – Create Resilience to climate changes / extreme weather conditions

- Weather forecasting applied to operation planning studies & real time decision support
- Lessons learned from consequences of extreme weather conditions on system operation Performance assessment

PS 2 – Changes on System Operation and Control Considering the Energy Transition

- Blackouts and system restoration in power systems with a high share of inverter-based resources
- Energy Imbalance considering RES (Power System Adequacy Assessment considering RES)
- Power System Operation Strategies & Operation Planning Studies considering a high share of RES


Thank you for your attention!
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