Question 2.10:

Manual or automatic load-shedding has often been a last resort mechanism to maintain power system security under extreme operating conditions. With increasing penetration of distributed energy resources and power electronic interfaced resources what mechanisms can assist maintaining power system security under extreme low demand and/or low inertia conditions?

Background

South Africa is currently experiencing severe generation shortages due to ageing of its predominant coal fleet. Operating reserve provision is mostly deficient throughout the day. The country's integrated resource plan indicates a significant penetration of renewables energy and a subsequent decommissioning of synchronous generators by 2030. South Africa is part of the Southern African Power Pool.

Mechanisms to maintain power system security under extreme low demand/ inertia

Power system security will be maintained through planning and operational based interventions.

1. Planning interventions

(i) Ensure long term integrated energy plan is flexible as far as possible

- Frequency control on the current system is suboptimal due to inflexible generation resources. The long term generation mix must include flexible generation resources to ensure there is sufficient ramping and ancillary services provision to enhance grid reliability.

(ii) Ensuring that contracted primary, secondary and tertiary reserves meets minimum reliability requirements for compliance with South African Grid Code

- All contracted resources must comply with Grid Code requirements to ensure ancillary services reserve requirements are not compromised for different operating conditions.

(iii) Increase utilisation of demand response for frequency control

- The future grid must include increased use of demand side based resources to offer different types of reserves. This will increase grid flexibility and enhance system reliability.

(iv) Contracting reserves from non-conventional/ inverter based sources e.g. BESS, Wind

- The future system will include a higher share of inverter based resources. Contracting reserves from these resources will be key to counter the impact of losing synchronous sources and higher rates of change of frequency (RoCoF).

(v) Increased participation in newly formed balancing market will enable South Africa to access cheaper hydro-based balancing power from Northern SAPP countries

- Southern African Power Pool introduced a balancing market from April 2022. Increased participation in this market will provide opportunities to reduce the use of expensive reserve resources in Southern Africa.

2. Operational based interventions

(i) Optimisation of automatic under-frequency scheme settings at pumped storage and gas generators for different modes of operation i.e. Pump mode or Synchronous Condensor Operation (SCO) mode

- Frequency control has been challenging owing to severe generation constraints which have resulted in implementation of load shedding. It has thus become imperative to review the optimality of settings for automatic schemes at pumped storage and gas turbine generators.

(ii) Strict enforcement of compliance to Grid Code for mandatory frequency response e.g. when frequency > 50.50Hz all online generators shall reduce generation

- To ensure frequency remains within the continuous operating range even during major disturbances, generators are required to reduce generation to keep frequency below 50.50Hz

(iii) Optimally tuning of SAPP protection devises to ensure that inter-area oscillatory mode of 0.3Hz gets sufficiently damped if triggered

- The Eskom network is weakly interconnected to Northern SAPP countries via a single 400kV line. Whenever significant changes in load or generation occur, an inter-area oscillatory mode is triggered. Thus, it's critical for key protection devices (power system stabilisers and static var compensator) to be optimally tuned to damp the 0.3Hz oscillatory mode.

(iv) Real-time monitoring of damping to ensure a secure interconnected power system

- The use of WAMS is key to monitor actual damping on the IPS in real time. Whenever low damping is observed, action should be taken to ensure key protection devises are in service to improve damping.