NAME : JARUDATE VORASEE
COUNTRY : THAILAND
REGISTRATION NUMBER : 6911

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Question 2.6:

Artificial intelligence is currently providing insights to assist operations staff in their decision-making. How can artificial intelligence be harnessed to provide further support such as recommending courses of action for operational decision-makers?

The high penetration of variable renewable energy (VRE) resources into power networks brings technical and economic challenges in terms of operation, stability and reliability. As VRE power plants multiply and represent a major contribution to the power system, it is increasingly become important to manage their variability and fluctuation. Additionally, the intermittent nature of VRE causes operational planning to be more complex and requires power system to be more flexible. Under such circumstances, accurate VRE power forecasting is becoming increasingly important for system operators to optimize unit commitment and regulate power quality of the power networks.

The deployment of artificial intelligence (AI) tools in energy sector has become highly relevant. Driven by a wealth of accumulated data, an increase in computational power and improvement in algorithms. Artificial neural network is one of the learning algorithms in AI that teach machine to process data and can improve performance over time in a way that inspired by the human brain. Artificial neural networks have become the mainstream of research territory to forecast power generation from VRE resources. This is because artificial neural network is able to learn and model relationships between input and output data that are nonlinear and complex, i.e. meteorological data and output power. Artificial neural network requires large amount of high-quality and relevant data for training through the process of learning based on historical data. The result of learning is mathematical model, which is then used for prediction.

The high integration of VRE resources requires additional operating reserve to guard against the uncertainty of VRE power generation which imposes higher operating costs on power system. AI has the ability to learn complex power systems and support fast decision-making process, leading to increased grid flexibility and integration of VRE. AI empowers system operators to make better decision and optimize the utilization of VRE by enhancing future situational awareness about the availability of these energy sources. During the high penetration of VRE, Energy Storage System (ESS) is used to store excess energy and supplied when demand is high. AI optimizes dispatch decision when is the best time to charge and discharge ESS. Furthermore, an improvement in accuracy in prediction model would lead to relatively high penetration of VRE into electricity market or reduced curtailment. The capabilities of AI enable improved VRE forecasting and help in ensuring that the grid stays balanced, smoothing the path for transition to VRE-based power generation. The potential of AI is able to improve operational planning, increase dispatch efficiency and, as a result, minimize the amount of operating reserve capacity required in the system.

AI is not a magic formula, and nor an ultimate solution to facilitating VRE integration. But given the urgency, scale, and complexity of the power system, it is imperative to leverage AI for a more resilient energy system. AI will help accelerate the energy transition while ensuring security, economy, and sustainability.