TCS Quantum Challenge 2023

Challenge 2 – Optimising Power Distribution Network

Technical - Frequently Asked Questions (FAQ)

Version 1.1

1. What are the deliverables for each phase (Phase 1 and Phase 2) of the Challenge?

Phase 1:
During this phase the participating teams will be expected to submit and present their proposed approach to solving one or more of the Challenge Statements, along with some results of preliminary experimentation using the approach. The submissions and presentations will be evaluated by a jury panel, and the most promising proposals for each Challenge Statement will be shortlisted for participation in Phase 2.
Note: In phase 1, code is not required, however participants are welcome to include the same.

Phase 2:
During this phase the teams shortlisted at the end of Phase 1 will be expected to implement their solution using quantum hardware/simulators provided and then submit & present their results, learnings and proposed future work. The submissions and presentations will be evaluated by a jury panel, and the best solution to each Challenge Statement, as adjudged by the jury will be declared as the winner.

2. What do Scenario 1 and Scenario 2 imply of the challenge?

Scenario 1 is Level 1 complexity which is comparatively simpler, and Scenario 2 is Level2 complexity which is more complex.
It is expected that participants would first attempt to solve the Scenario 1 sub-challenge and then having solved the scenario 1 problem, move on to solving the scenario 2 sub-challenge.

For Scenario 2, participants can assume any disruptive scenario.
For Example, one of the possible scenarios can be that Line 2 experiences a disruption. The remaining network stays operational but certain lines are now operating beyond their designated safety Maximum Voltage Amplitude (MVA) rating. The task is to find the corrective topology within 5 timesteps.

3. There are multiple formats of the dataset, which dataset needs to be downloaded?

These are the formats used by power systems datasets and are available in formats to be used by simulators.
PowerWorld Simulator and PowerWorld DS makes use of (*.pwb, *.pwd, *.tsb, *.aux), Siemens PTI PSS/E makes use of (*.raw, *.dyr), and GE PSLF (*.epc, *.dyd) respectively.
Participants can refer to the *.raw format of the dataset for formulation their model.

For the benefit of the participants, the actual dataset has been provided in the Addendum section of the Challenge Document.

4. There are other types of network reconfiguration scenarios which are not mentioned in the challenge document. Can they be used in our model?

Yes. We have given three network reconfiguration scenarios - line switching, bus splitting and changing generation dispatch options. Participants have the flexibility to come up with a model for other types as well. The goal is to be able to model the scenario using Mixed Integer Linear Program, where Quantum computing will be effective.

5. How does the load vary for different cases? What is the expected range of load variation?

Assuming the first question is related to the second scenario of the challenge statement, the participants can expect unforeseen test situations primarily including forced line disconnection (not available for connection for the subsequent time steps) or load variation up to 30%. In either of the scenarios, the goal would be to drive the grid to normalcy (no line overflows) in five time-steps as indicated in the addendum.

6. What is the difference between line switching and bus switching, are they being used for the same conditions?

Line switching refers to turning on/off a particular line, i.e., forcibly disconnecting a line if it is already connected. Bus switching refers to a switching action that enables altering the busbar a line is connected to, thereby changing the network topology.

7. Please explain the following two constraints in detail

(1) Bus splitting constraint

(2) Limiting number of open lines constraint

Bus splitting constraint refers to the three bus splitting scenarios described in Figure 2 of the challenge statement.
Ideally, one would not leave a lot of power lines open, i.e., not change the network topology too much. A solution with a lower number of open lines is preferred.

8. What is the MVA rating of the transmission lines other than the ones mentioned?

The exact MVA ratings for all transmission lines are included in the dataset provided in the challenge statement. The expectation from the participants is to arrive at a generic solution where we can plug in different network settings and extract suitable reconfiguration actions.