Lecture 5

Load Flow Studies

- The 60 Hz machine of the frequency converters were modeled as generators and when they operated as motors the generators were deemed to be supplying negative power.

Load Flow Studies

- The various busbars were designated as follows:
  - Garden of Eden 13.8 kV busbar- Slack Bus
  - Demerara Power GOE busbars - PV Bus
  - Sophia Station 13.8 kV busbar - PV bus
  - Versailles Power Station busbar - PV bus

Load Flow Studies

- Transformer taps were set as per system
  - 1.0 for Garden of Eden transformers
  - 0.955 for Sophia transformers.

Load Flow Studies

- Hourly load flow runs were carried out for three of the days from which hourly data had been collected, that is, two weekdays and Saturday.
- Transformer taps were changed to determine the best tap position

Load Flow Studies

- The frequency converters were represented as an 13.8/11 kV autotransformer in combination with a capacitor. Load flow runs were carried out on the combined Demerara 50 and 60 Hz systems for system peak load.

Load Flow Studies

- The frequency converters were removed from the system and the 60Hz system was extended to cater for the present 50 Hz load.

- Load flow runs were carried out for day and night peaks.

Analysis of Results

- The following abbreviations apply:
- DPGOE - Demerara Power station at Garden of Eden
- GPLGOE - GPL's Garden of Eden Station
- LFR - The hourly load flow run

Analysis of Results

- As GPLGOE was the slack busbar comparison was made between its generation during GPL operations and the load flow runs. For the GPL operations GPLGOE generation was higher than that of the LFR by 70% during the off peak periods and up to 120% during evening peaks.

Analysis of Results

- The LFR generation of MVars at Sophia was consistently higher than that of GPL operations. This was as high as 15 MVar at peak load whereas GPL operations generate just around 10 MVars at the same period

Analysis of Results

- MVar generation at GPLGOE and Versailles were quite similar for both GPL operations and the LFR

Analysis of Results

- **Changing of transformer taps**
  - The present tap positions of the GPL transformers proved to be the optimum positions to maintain bus voltages and minimise losses.

Analysis of Results

- **Static Representation of the Frequency Converters**
  - The results achieved from the load flow run for system peak suggest that this model could be acceptable if separate representation is made for the mechanical losses of the frequency converters.

Analysis of Results

- **Total Demerara Load at 60 Hz**
  - The frequency converters would not be required so capacitors would be needed at all locations to provide the MVar injection presently done by the frequency converters
  - Switched capacitors would have to be used as different values would be required for the day and night peaks

Conclusions

- The usefulness of load flow studies in the investigation of the following were demonstrated
  - Optimum system running conditions and load distribution.
  - Optimum system losses.
  - Optimum tap range of transformers.
  - Effect of incorporating new circuits on system loading.

Conclusions

- The data collection and analysis highlighted problems with GPL’s system operations which were confirmed by the load flow study.
- The difference in GPL’s calculated loads and generation show a high level of losses in GPL’s generation and transmission system which require further investigation.
- The Sophia 13.8 kV bus voltages are lower than the other bus voltages and need to be increased for proper system operation.

Conclusions

- The static representation of the frequency converters by a transformer and a variable capacitor is an adequate model for load flow studies. Converter mechanical losses can be added subsequently to the total system losses.

Conclusions

- The availability of load flow studies would be helpful to small utilities as they seek to integrate their power system with different types of generation