Measures to Improve Power Quality in Distribution System

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BACKGROUND

A good power quality allows equipment to run satisfactory and efficiently without unwanted economic loss and reduction of life expectancy. The voltage sag, voltage swell and harmonics are the most common power quality problems consumers faced. The reasons why PQ has increased concern are as follows:

- **Problem Complexity:** The widespread use of electronic equipment which is the nonlinear loads in distribution system comes up with new disturbance and harmonics issues and changes the power system nature.
- **Immunity decline:** Meanwhile, the electronic devices such as digital control and power electronic converters (which has increased significantly) are highly sensitive to the disturbance.
- **Technology improvement:** However the best solution to power quality is use the some custom power devices based on power electronics technology.

It is interesting that the major causes and the major victims as well as the solution are all come from the world of power electronics.

CUSTOMER POWER DEVICE

- **DVR (dynamic voltage restorer):**
- **Series compensator** to mitigate the power quality problems in terminal voltage.
- **DSTATCOM (distribution static compensators):**
- **Shunt compensators** to solve the current-based power quality problems in distribution system.
- **UPQC(Unified Power Quality Compensators):**
  - A combination of shunt and series compensators for mitigating multiple PQ problems.

MANAGEMENT

- **Multiple Power Quality Supply System (MPQSS):** develop technology and systems to meet different levels of consumer PQ needs using new energy and DERs.

**DIFFERENT PQ LEVEL** → **DIFFERENT CUSTOMER**

There will be gradation in price, the configuration of the system are in figure above.

- Other power quality management strategies are as follows:
  - Improve Power Quality Management Systems
  - Strengthen Power Grid Construction Planning
  - Strengthen the Operation and Management
  - Strengthen the Cause of Contaminated Power Quality Control Efforts

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FUTURE TREND

- **Monitor**
  - Monitoring is a primarily needed process to solve power quality problems and classification these problems. With the development of big data and AI, we can build a web-based measurement system with smart sensors. Besides, PQ disturbances are usually not single and involve a combination of two or more single types. In the future of monitoring system we could monitor PQ parameters from multi measuring points in real-time and perform the real time analyses of signals. In terms of software, easy-to-use software enables customer collect and PQ data at their own measurement points.
- **Renewable power**
  - The output of renewable energy generations is unsteady with fluctuation. Power system frequency stability relies on the balance between the active power output of the generators and the active power consumption in the loads. Therefore, it is essential to mitigate the renewable energy power fluctuation. For mitigating fluctuations, superconducting magnetic energy storage (SMES) can reduce fluctuations of renewable energy sources in power network. What's more, with increase of renewable energy sources, there will be a significant number of inverters in the power system. The use of active filters or the development of inverters, which will not generate significant interference, can solve the problem caused by inverters. However technical methods are expensive now, meanwhile there is currently no appropriate legislation relating to the power of renewable energy sources connected to the medium voltage grid. Both aspects need improve in the near future.

CONCLUSION

This research summarizes the reasons of the increasing importance of power quality. The impact and the immunity of electronic devices make the problem complicated. With the development of electronic equipment, various power quality enhancement devices are present in distribution system, the customer power devices such as DSTATCOM, DVR and UPQC has been reviewed. Meanwhile develop technology and systems to meet different levels of consumer PQ can be one of the best management strategies in the future. The expansion of distribution generation and a large-scale of renewable energy generation have the potential to change the power quality issue. In the future, there will be more and more power electronic devices interfacing the grid and distributed sources. We also need more advanced monitoring system by use of AI and big data technology. However, the establishment of more rules and limitation is urgent and significant.

BIBLIOGRAPHY