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A different approach in system restoration with special consideration of Islanding schemes

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ABSTRACT

The restoration process of the bulk-power transmission system following a partial or a total blackout, has two main issues during a restoration, these are voltage control and frequency control. Special attention is therefore given to the behavior of network parameters, control equipments as they affect the voltage and frequency regulation during the restoration process. During restoration due to wide fluctuations in the frequency and voltage it becomes very difficult to maintain the integrity in the system. Inability to control the frequency may lead to unsuccessful restoration. Repeated collapse of the system Islands due to tripping of generators due to either over frequency or under frequency causes delay in getting normalcy. This paper considers aspects of computer application in restoration and Islanding in the context of Maharashtra State power system. During conditions of blackout, the process of Islanding can satisfy the power requirements for a particular area, thus assisting the grid operator as well as helping in reducing the time required for the complex restoration processes. The main obstacle in the process of restoration or Islanding is the number of switchgears located at various locations with different configurations.

1. Introduction

Large interconnected power systems may be seriously affected by severe occurrences that could lead to a cascade of automatic actions. These types of events may be the source of an uncontrolled network splitting with harmful effects on power quality to end-users. In highly stressed operating conditions, a cascade outage may eventually conduct to a partial or complete blackout. The power systems operated by the utilities in developing countries suffer from a large gap between demand and generation, inadequate transmission capacity, and non-uniform location of the load centres and generating stations. In most of the cases, occurrences of faults in such systems end up with the worst consequence, which is complete blackout. Uninterrupted power supply is essential for the national productivity and social structure, and hence the system must be made flawless at any cost. After the occurrence of severe system disturbances, the system may split into parts, which may or may not survive depending on the load-generation balance. The part system containing the generation sources and certain loads, which are planned to be separated from the main grid during system disturbance at preconceived points through either under frequency and/or directional power relays, is called 'Islands'. During restoration due to wide fluctuations in the frequency, it becomes very difficult to maintain the load-generation balance. Inability to control the frequency may lead to unsuccessful restoration. Repeated collapse of the system Islands due to tripping of generators due to either over frequency or under frequency causes delay in getting normalcy. The restorative procedure is the operation of the power system equipments but with portions of the load not being served and/or with loss of system integrity [1]. In the present Islanding and restoration systems, concentration is only on the Islands and not on the restoration procedure, that is, posts Islanding conditions. The grid requires power pool for restoration and the power pool can be any Islanded system, separated from the main grid at predetermined points.

2. Maharashtra state power system

The western region of Indian Power Grid consists of Maharashtra state power system, with the highest installed generating capacity of around 15,000 MW (as on 31/03/2005), along with Gujrat, Madhya Pradesh, Chattisgad, and Goa. Some private players also play a power game in hands with State Electricity Generation Company. The wide electrical power grid also supports the system. Fig. 1 indicates the 400 kV power system network in Maharashtra state with major transmission lines. The major hydroelectric power station, Koyna, situated in western Maharashtra has a total installed capacity of 1960 MW. Power generation of Dabhol Power Corporation (DPC) of 728 MW is not available since 29th May

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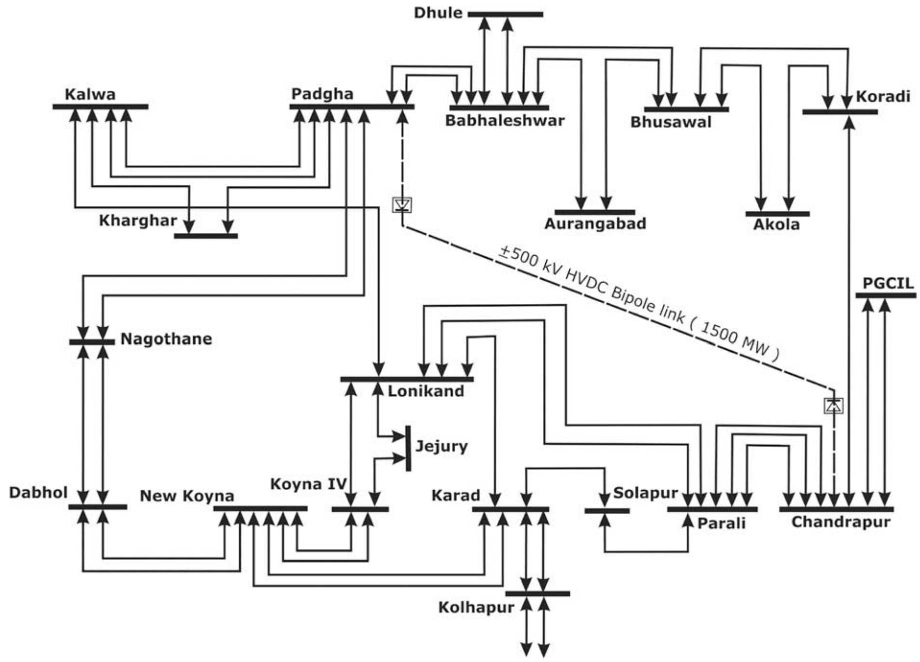

Fig. 1. Maharashtra State power system network.

2001. The major generating stations are located in eastern Maharashtra, i.e. at Koradi (1080 MW), Chandrapur (2340 MW), Khaparkheda (840 MW) and Bhusawal (478 MW). The load centres are mainly around Mumbai and Pune regions situated in western Maharashtra. The distance between generating station and major load centres is of the order of 800–900 circuit kilometres. For evacuating power from eastern Maharashtra to western Maharashtra there are ±500 kV HVDC bipolar line, five 400 kV lines and associated 220/132 kV networks in the state. The western part of the state excluding the small area near Mumbai is monitored from SLDC (State Load Dispatch Centre) at Kalwa. The eastern part comprising Vidarbh, Khandesh and Marathwada region is monitored by ALDC (Area Load Dispatch Centre) at Ambazari near Nagpur. Both the Load Dispatch Centres are equipped with a R-30 computer system. This system provides the Supervisory Control and Data Acquisition System (SCADA) functions. SLDC at Kalwa and ALDC at Ambazari are equipped with time synchronization using G.P.S. signals. The major power generating stations in the state are directly connected with the other parts of the state with 400 kV transmission line, which is an added advantage for the above system. But the power system is divided into two regions: one with a higher generating capacity but less load consumers that is, the eastern

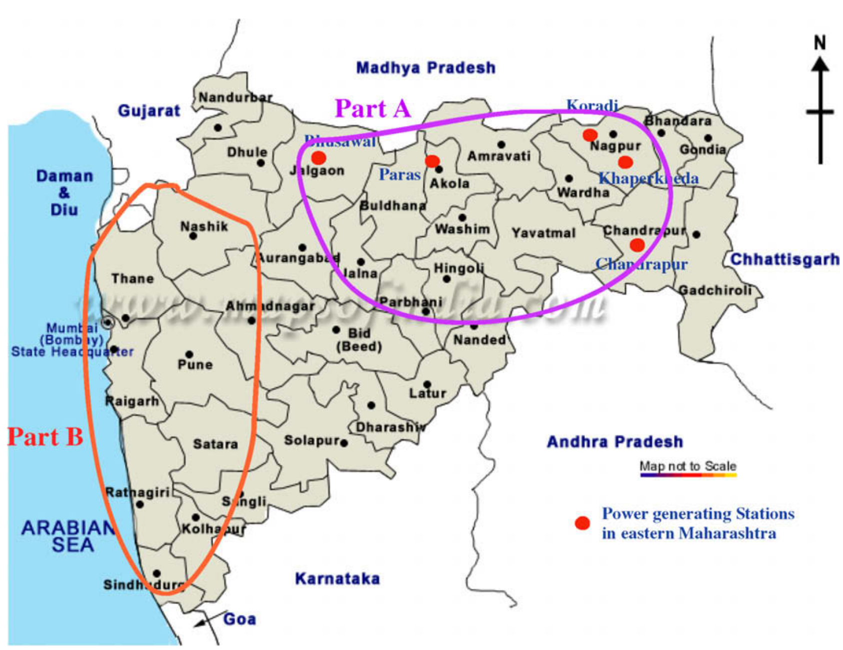

Fig. 2. Maharashtra State power system splitting.