In this chapter, to discuss the electric power emergency management platform, we begin with a brief introduction about its background information and the overall structure. Correspondingly, the fundamental principles of the decision support system are also discussed. We use the improved OPA algorithm to design catastrophe evolution models in this chapter since it converges fast and is applicable to large-scale systems. Then the decision support system is constructed for the disaster assessment and disaster prevention evaluation. As case studies, we evaluate the operational risk of the Northeast Power Grid of China under several simulated disasters. The analysis of the affected areas are carried out, based on which disaster prevention plans are made. A power grid disaster forecasting and early-warning model based on AC power flow is also included in this chapter.

Human society has made great achievements in science and technology but is still at risk, sometimes even vulnerable, when facing large-scale emergencies like natural disasters. Therefore, many countries have established public emergency management systems to respond to various disasters due to human or natural causes to reduce casualties and property losses as much as possible. The electric power emergency management system, which copes with power grid large-scale blackouts, is one of the most indispensable and critical components in such public emergency management systems.

The construction of the electric power emergency management platform not only deals with complex modern power systems, but also has to consider factors such as weather conditions, geographical features, transportation limits, available human resources and so on. Hence, without exaggeration, it is an extremely challenging task. On the other hand, we have established different blackout models in the previous chapters and consequently we have been able to describe the dynamic behaviors of large-scale power grids on the fast and slow two different time scales. This has enabled us to analyze quantitatively the probability for potential accidents and their possible scales, which in turn has provided us with powerful decision-making support for the establishment of the eclectic power emergency management platform, especially for the analysis of power grid evolution mechanism and the forecast and early warning for catastrophes.
14.1 Brief Introduction on Electric Power Emergency Management Platform

With the interconnection of regional power grids and the parallel operation of large-capacity generation units, a high-voltage, long-distance and trans-regional transmission pattern has taken shape in China. However, in the mean time, China’s power grid construction has been lagging behind its load growth, especially in large- and medium-scale cities because of the difficulty in choosing construction sites, strong resistance during land acquisition and the high cost for removal, resettlement and compensation. As a result, China’s power grid structure is still relatively weak and not capable enough to handle all the transmission and distribution demands. In addition, those load centers of large- and medium-scale cities in China are in general in short of dynamic reactive power supports and thus have an uneven reactive power resource distribution. Due to the above reasons, the power system stability problem is becoming increasingly prominent and even considered to be a threat to the secure and stable operation of large-scale power grids. In recent years, catastrophic blackouts and large generation unit accidents have taken place in China and elsewhere\[^{1-5}\], which indicates that there is still a long way to go to develop the power system safety and control theory to keep up with the increasing scale and complexity of modern power systems. One can safely say that the risk for disastrous events in the Chinese power grids as well as other main power grids in the world cannot be ignored.

Besides faults within a power system, accidents have also been induced by external destructions for China’s power grids. Electric power facilities are often damaged or stolen, and unapproved buildings that pose threat against the power grid safety can often be seen in cities. According to incomplete statistics from the Chinese State Grid Corporation, there are altogether 22 major transmission faults in 2006 (41 faults in 2005) that are caused by building construction projects, car accidents damaging electric poles, theft, deforestation and other external destructions, which accounts for 50% of the power transmission accidents (43.2% in 2005) and 15% of all the accidents. External forces are in fact a serious threat to power grid safety. What needs to be pointed out in particular is that in the past few years, China’s power grids have suffered from typhoons, tornadoes, mudslides, icing and other natural disasters for several times. For example, the 9·26 large-scale blackout in Hainan Province in 2005\[^{1}\] and the icing accident in China Southern Power Grid in the spring of 2008\[^{2}\] are both sudden catastrophic incidents in power systems.

Large-scale power grid blackouts have taken place around the world. Some happened in international metropolises in developed countries, and some in cities