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# Thinking about Various Risks for Electricity Supply Security

Ken Koyama, PhD
Chief Economist, Managing Director
The Institute of Energy Economics, Japan

On September 8 at the Tobata campus of the Kyushu Institute of Technology, the Institute of Electrical Engineers of Japan held a general meeting of its Society B, including a panel discussion on risks involving the electricity system. I had an opportunity to take part in the discussion as a panelist. Based on interesting arguments and issues given at the discussion, I here would like to think about various risks for electricity supply security.

First, problems at the international energy market positioned in the upstream of the energy supply chain have traditionally become risks for electricity supply security. These risks are potentially important as far as Japan depends on power generation fuel supply from the international energy market. Supply from some regions may be disrupted for some reasons. For the international market works, however, it is difficult to assume any case where fuel supply would be totally stopped. As indicated by the past experiences, however, supply disruptions or a tightening supply-demand balance can cause substantial increases in fuel prices that could affect electricity supply security.

Specific cases of this kind include two oil crises in the1970s. In the latest case of this kind, fuel price spikes (and needs for additional fuel imports to make up for the suspension of nuclear power generation as discussed later) triggered substantial electricity price hikes accompanied by various economic problems in nearly four years from 2011 when crude oil prices remained above $100 per barrel. Responses to such overseas risks may include reducing dependence on imports, diversifying energy and import sources, and enhancing oil reserves and other emergency response capabilities.

Second, supply interruption or destabilization in the electricity supply chain poses direct risks and threats to electricity supply security as a matter of course. Risks of this kind are various and diverse, including those caused by natural disasters, artificial or non-artificial facility or infrastructure accidents, structural market problems, institutional designs and others. Given that electricity is a special good for which demand must be met by supply at any instance, these risks have potential to immediately trigger major problems with electricity supply security, particularly in terms of physical supply availability.

As a case where a natural disaster was combined with an accident to cause a major problem with electricity supply security, the Great East Japan Earthquake and Tsunami triggered the accident at the Fukushima Daiichi Nuclear Power Station. The disaster and accident caused massive losses in nuclear and other power generation capacity. Particularly, electricity supply shortages became a grave matter of concern in eastern Japan. The situation is still vivid in our memory.

Just after the disaster, rolling blackouts were implemented temporarily. Later, electricity consumption cuts and the full operation of substitute electricity sources (fossil fuel power plants) were required. These measures successfully prevented any large-scale blackouts. However, Japan had to procure massive fuel for fossil power generation. Price hikes in the international fuel market were coupled with the massive additional fuel procurement to boost fuel costs for power generation and electricity costs. Based on experiences with the oil crises, Japan has traditionally focused on responses to overseas risks. However, the events in 2011 indicated that any accident in key domestic electricity supply facilities and infrastructure could cause a grave situation.

As a risk that could affect the electricity supply chain, cyberattacks have recently attracted attention. As the computerization of our economic society has made progress, electricity plays even greater roles in the society. At a time when the computerization of the electricity supply system has accelerated, it may be natural for cyberattacks to attract attention as a risk for electricity supply security. In December 2015, a cyberattack by hackers triggered a large-scale blackout affecting more than 200,000 people in Ukraine. In response to growing concern on cyberattacks, the Group of Seven industrial countries and others are tackling an important challenge to enhance initiatives regarding the cyber attack issue and energy supply security. Surely, cyberattacks will become a key issue when we think about future electricity supply security.

Market structure and institutional design problems have also attracted attention as risks that could affect electricity supply security while being characteristically different from the abovementioned risks. One such problem derives from the expansion of power generation with supply intermittency including solar photovoltaics and wind power generation facilities. If intermittent electricity supply expand their share in total power generation, how to maintain electricity supply security in response to a sharp rise or decline in supply from such intermittent sources will become a problem. If it is difficult to adjust electricity supply even by taking full advantage of buffers in the existing system, power suppliers will have to enhance electricity grids, expand electricity storage functions or adjust renewable energy power generation. Even if these measures are taken to adjust supply and demand to secure stability in physical supply-demand balance, we will have to pay attention to relevant costs increase.

Electricity market deregulation may put market players under pressure to rationalize and streamline their business operations. In a competitive market, uncertainties may grow about whether future demand could be secured. Under such situation, decisions to invest in electricity facilities and infrastructure with long lead-time and high upfront investment are not easy to make. When wholesale electricity prices decline in a deregulated market, negative effects may emerge on facility development and maintenance. To address the problem, the introduction of a capacity mechanism to secure sufficient supply capacity has been realized or considered. Countries in the world are still exploring measures to secure stable electricity supply.

At the panel discussion in which I participated, I got an opportunity to discuss risks from various angles. The stable supply of electricity as an indispensable good for maintaining economic and civic livelihood will remain important in the future. We will have to analyze various risks for electricity supply security and consider responses to such risks while watching other important challenges such as safety, carbon emission cuts and liberalization.

Contact: report@tky.ieej.or.jp
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