CASESTUDY SERIES

EXTREME WEATHER

Typhoon 21 | Japan | 2018

This case study is part of an extreme weather impact project, in partnership with Swiss RE Corporate Solutions and Marsh & McLennan Companies, which aims to identify and share best practice within the energy sector to enable more agile and adaptive response to extreme weather and natural hazard impacts on energy systems and supplies.

CASE STUDY AT GLANCE

WEATHER EVENT
Typhoon 21 (Jebi) and Typhoon 24 (Trami)

ORGANISATION
Kansai Electric Power and Chubu Electric Power

INDUSTRY SUB-SECTOR
Generation, Transmission Distribution

RESILIENCE COSTS
10.2 billion yen (Kansai)

On September 4, Typhoon 21 (Jebi), the most powerful typhoon to hit Japan in 25 years, tore through the western part of the country with heavy rain and violent winds. Ships and vehicles were tossed about, buildings were damaged, and the area's main international airport was flooded. 11 people died, and dozens were injured. The typhoon unleashed torrential rain and winds in excess of 200km/h on the Japanese cities of Osaka, Kyoto, Kobe, and Nagoya. It caused severe damage to the power infrastructure due to flying galvanized iron roof panels, fallen trees, floods and landslides. Over 2.2 million households suffered outages in Kansai region. Typhoon 24 (Trami), hit on September 30, also caused broad damage in Chubu region. 1.2 million households experienced outages.

Despite the fact that power companies have been strengthening emergency disaster systems to prepare for natural disasters using accumulated experience, the typhoons Jebi and Trami exposed many challenges that need to be overcome, such as issues in disseminating information to the public on the state of outages and prospects for restoration.

This case study explores Kansai and Chubu electric power companies (EPCOs) experience in dealing with the 2018 typhoon crisis.

CONTEXT

ORGANISATIONAL PROFILE: KANSAI EPCO

- Vertically integrated organization providing generation (34,245 MW from thermal, hydro, nuclear and renewable sources), and T&D services to the Kansai District.
- Owns 18,803 km transmission lines, 132,137 km distribution lines, 1596 substations, and 2,823,598 supporting structure units (utility poles, etc).

ORGANISATIONAL PROFILE: CHUBU EPCO

- Vertically integrated organisation providing generation (34,586 MW from thermal, hydro, nuclear and renewable sources), and T&D services to the Chubu District.
- Owns 12,220 km (transmission line), 937 substations, 134,297 km (distribution line), and 2,823,598 supporting structure units (utility poles).

TYPHOON 21 (JEBI)

- A category-3 typhoon, out of 5, on the Saffir-Simpson scale. The typhoon broke the historical records of 10-minute maximum sustained winds at 53 weather stations and the maximum gust at 100 weather stations in Japan. The highest sustained winds and gusts were recorded at the Kansai international airport (167 km/h and 209 km/h respectively).

TYPHOON 24 (TRAMI)

- Same category as Typhoon 21. The highest gust was recorded at Yoron island, Kagoshima. The highest gust were recorded at Yoron Island, Okinawa(204 km/h)

ENERGY IMPACTS

2.2 million households experienced outages in the Kansai region and 1.2 million in Chubu area.

95% of outage was restored in 3 days, but the rest lasted 17 days longest in the limited areas such as mountainous villages (Kansai).Longest power outage duration was 6 days and 12 hours 21 minutes (Chubu).

RESILIENCE: PREVENTION AND IMMEDIATE RESPONSE

Prior to the arrival of Typhoon Jebi, both Kansai and Chubu EPCOs put emergency disaster control systems in place. For Chubu EPCO. They involved:

- halting any planned works to secure personnel and preparing equipment for disaster restoration;
- dispatching personnel from the areas where damage is expected to be minor to the areas where damage is expected to be significant;
- carrying out tree-trimming in cooperation with the local government in the areas most-prone to damage (i.e. where outages occurred due to fallen trees in the past).
- setting up sealing devices to prevent the inundation of substation facilities;
- duplication of power transmission lines and substation facilities;
- selecting the construction sites of transmission towers considering landslides;
- strengthening the resilience of power transmission equipment such as by replacing open wires to cables and constructing auxiliary support wires.

Furthermore, both companies have a very useful tool to forecast typhoon damage. The Risk Assessment and Management system for Power lifeline - Typhoon" (RAMPT) developed by the Japanese Central Research Institute of Electric Power Industry (CRIEPI). RAMPT can estimate the scale and areas of damage to establish the restoration strategy.

STRATEGIC DISASTER RESTORATION SUPPORT TECHNOLOGY FOR ELECTRIC POWER DISTRIBUTION AND SUBSTATION EQUIPMENT

The CRIEPI also developed a disaster restoration support system. It supports utilities of their restoration for damaged distribution and substation equipment, risk assessment and management for disasters. This includes earthquake and typhoon wind-force evaluation systems (RAMPer and RAMPT respectively), damage assessment systems, and emergency restoration process simulators.

Informing the government and customers of the outages immediately was a key step in the response strategies for both companies. However, this was difficult for Kansai EP because the information system failed due to exceeding its capacity. EPCOs made effort to disseminate outage information through their website homepage, social media outlets, and radio, they recovery time estimation was not sufficiently timely or accurate. In addition, landslides and fallen trees damaged roads and prevented repair teams from accessing damaged area.

RESILIENCE: RECOVERY

Following the typhoon 21 event, Kansai EPCO set up a "Typhoon 21 Response Verification Committee" to applying lessons learned through this experience in responding to future disasters. This Committee categorized the issues into three groups:

- Minimize the damage and shorten the recovery time from outage,
- Improve response for customers: disseminating information with more swiftness and accuracy,
- Strengthen collaboration with local governments: sharing information and collaborating on recovery work.

The following aspects are considered necessary for future resilience:

- Equipment recovery system: exploring measures to maximize recovery efficiency by dispatching recovery personnel in advance to places expected to be hit by the storm and discussing methods to grasp the state of the damage quickly;
- Disseminating information to customers: studying methods to swiftly and effectively convey the status of the outages and recovery information;
- Information sharing and cooperation with municipalities: building a system that rapidly gathers and shares information necessary for cooperation.

The two EPCOs shared lessons learned in the committee of the Ministry of Economy, Trade and Industry (METI), the Organization for Crossregional Coordination of Transmission Operators (OCCTO) and Federation of Electric Power Companies (FEPC).

METI established the Electricity Resilience working group (WG) to review the important infrastructures and to discuss challenges and measures for making resilient systems by learning from experiences of recent national disasters, such as Typhoon 21.

BARRIERS

- Poor access to damaged areas (fallen trees and landslides, which caused roadblocks, and in turn prevented repair teams to reach customers to restore supply)
- Failure of the information system, which delayed repair work

> JAPAN'S EPCOs ANTICIPATE INCREASING DAMAGE FROM NATURAL DISASTERS IN THE FUTURE

ENABLERS

- Accumulated know-how for restoration learning from past experiences and countermeasures against typhoons.
- Technical: Distribution Automation System (DAS) with three phase sensors equipped switches
- Support from other power utility companies
- Outage information from smart meters
- Operational: dispatching restoration teams from less damaged areas to severely damaged areas

ANTICIPATION OF FUTURE EVENTS

EPCOs anticipate that damage from natural disasters will increase in the future. For example, in the west of Japan, a ruinous earthquake is excepted occur (80% probability) over the next 30 years. They also understand the need to strengthen resilience to minimize damage, facilitate early recovery and enhance customer and local government response. Therefore, they have been developing policy measures against large-scale earthquakes and tsunamis. At the same time, drills have been conducted to strengthen response capabilities, and CRIEPI has been working with power utilities to improve RAMPT functions. In addition, EPCOs have organized regular meetings to discuss the emergency disaster response in the distribution sector and to enhance the effectiveness of mutual support in case of an emergency. They agreed to work together to:

- Strengthen a wide-area support system with other electric power companies;
- Implement smart meters to obtain rapid outage data and enhance information dissemination by introducing "Outage information system applications" that can notify the public about outages;
- Improve access to real-time information about road traffic incidents to enable field crew vehicles to pass safely;
- Utilize drone technology to assess damage remotely;
- Acquire advanced knowledge of which customers need to be restored preferentially;
- Implement an equipment restoration system that can help to pre-deploy personnel, identify damage promptly, and benefit from process control for restoration works and logistical support;
- Provide swift and accurate information to customers. This requires reinforcement of human resources at call centres, multiple means of information sharing, segmentation of power outage information and expanding reception desks using an Interactive Voice Response (IVR system);
- Information sharing and cooperation with local governments: mutual exchange of internal information regarding disaster management, and prevention of fallen trees in cooperation with local governments (planned logging).

LESSONS LEARNT FOR DYNAMIC RESILIENCE

- Advanced preparation for disaster recovery
  Firm operation of Distribution Automation System; Secure equipment for restoration; Stand-by the indispensable restoration teams
- Communication
  Provide timely information through social media; Develop application software that can provide real time information about outages; Improve company website design for outage notification.