CASE STUDY SERIES

# EXTREME WEATHER

## Cyclone Mekunu | Oman | May 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. The case study has been reported by the World Energy Council FEL Taskforce: Yana Popkostova [project lead]; Nora Nezamuddin, Anna Seremet

## CASE STUDY AT GLANCE

**WEATHER EVENT**
Tropical Cyclone

**ORGANISATION**
Oman Authority for Electricity Regulation

**INDUSTRY SUB-SECTOR**
Regulator

**RESILIENCE RESPONSE**
Regulatory changes, coordination and improved communication and human resources

**RESILIENCE COSTS**
Mudslides and Flash Flooding

**RESILIENCE BENEFITS**
Improved prevention and mitigation strategies

The Mekunu cyclone was equivalent to a category 3 hurricane on the Saffir Simpson scale with wind speeds of 170 km/h and gusting of up to 200 km/h. Around 328 mm of rainfall occurred within 36hrs in Salalah, compared to an annual average of about 130mm. Another city - Dhalqut - received 540 mm of rain. Mudslides and flash floods occurred with damages to roads and infrastructure, and 3 casualties reported. Disruption to electricity supply was minimal and where it did occur, the recovery process was prompt [98% of electricity supply restored within 8 days]. Cyclones striking the Arabian Peninsula are rare but not uncommon. An earlier Super Cyclone - Gonu hit Oman in 2007, with a death toll of 12 people and severe economic and structural damages. Cyclones usually impact the eastern provinces, while Mekuno made landfall in the southern province of Dhofar.

The regular warnings from Oman meteorology services, the early mobilisation of special government disaster management cells and the National Multi-Hazard early warning centre meant that the cyclone impacts were reduced to temporary inconvenience rather than a systemic disruption of the energy system. Special regulatory mandates and the harmonisation of technical standards after lessons from earlier cyclones, combined by equipment inspections and upgraded new urban grid infrastructure bolstered the resilience of the system.

Additionally, significant efforts were put into coordinating a regular media messages and disseminating safety information to customers, as well as evacuating exposed areas ahead of landfall, and creating temporary shelters with sufficient supplies of clean water, cooling and medical facilities. This meant residents were prepared and resilient, and minimised any panic during the storm.

This case study explores the context of the power outages and the critical role of adequate preparedness in addressing dynamic system resilience.

## CONTEXT

### ORGANISATIONAL PROFILE: OMAN AUTHORITY OF ELECTRICITY REGULATION (AER)

- Established by Art.19 of the Law for the Regulation and Privatisation of the Electricity and Related Water Sector in 2004; responsible for regulating the electricity sector and some aspects of the water sector.
- AER has a legal personality and financial and administrative autonomy. It reports directly to the Council of Ministers.
- Its mission is to protect the interests of electricity customers, electricity sectoral companies and the Government.

### CYCLONE MEKUNU, MAY 2018

A category 3 cyclone stuck the cities of Salalah and Dhalqut. This resulted in flash floods and mudslides which significantly damaged infrastructure.

### ENERGY IMPACTS

- Overhead lines were affected; underground lines flooded.
- Power supply was interrupted.
- Coastal areas were flooded, plants felled

Underground lines are susceptible to flooding. Overhead lines are exposed and susceptible to the influence of weather and the external environment. Disruption of infrastructure and fog in the area resulted in difficult access and mobile generators had to be transported by boats to remote coastal areas with the army's assistance. The primary uses of electricity in Oman are water treatment, distribution and cooling, the first being more essential to provide the civilian population as well as industrial users with water. It should be noted that a tropical cyclone post landfall, electricity consumption temporally decreases due to lower temperatures, however only for 3 to 4 days typically after which temperatures are recover.

## CYCLONE MEKUNU IMPACT

Mekunu was the strongest storm to strike Oman's Dhofar Governorate since 1959 and the fourth cyclone in 12 years to hit Oman. It developed out of low pressure in the North Indian Ocean on 21st May and gradually intensified until striking Oman on 25th May 2018 at its peak intensity with sustained winds of 175km/h and heavy rainfall. The storm rapidly weakened after landfall, dissipating on May 27th. Mudslides and flooding were considerate, but with few fatalities (3 according to police reports and 7 by newspaper coverage) in Oman. Near Salalah, the resulting storm surge caused flooding, especially in coastal areas and low-laying areas, blocking roads. Rainfall rather than wind was the more destructive. Damaged housed, cars, boats and other property resulted in 1,123 insurance claims, totalling US$404 million. The damages to infrastructure were reported to reach US$1.5 billion. The rains collected in area dams and created lakes in Rub' al Khali, (the Empty Quarter). The storm damaged underground lines causing service interruptions. Recovery was impeded to a certain extent by blocked infrastructure and the fog in the area. Additionally, cyclones usually hit different parts of the country, hence operational preparedness on the ground was not optimal. Nevertheless, outages were not systemic due to the distribution network being mostly underground in the main cities and towns. The Oman State Council Bureau noted that national unity during the storm helped mitigate its impacts. Preventive measures and regulatory frameworks put in place after earlier cyclones ensured system resilience and bolstered cooperation between military, police, information agencies and citizens.

**Times of Oman, May 27, 2018 | December 31, 2018 | Both retrieved August 31, 2019**
Relief Web, May 31, 2018 | Retrieved August 31, 2019

## RESILIENCE: PREVENTION AND IMMEDIATE RESPONSE

After 2007 when Cyclone Gonu caused considerable damages, Oman AER has focused on planning and managing the potential impacts of super cyclones on the electricity and water system. This included mandating a special regulatory framework for utilities, and harmonising technical standards on risk preparedness operations across the country. As a part of this framework, Oman AER instigated a Mutual Aid Scheme (Agreement). This agreement would require emergency services and utilities to lend support to affected areas and companies across jurisdictional boundaries. Utilities were also required to prepare Business Continuity Plans as well as regular flood-risk assessments (a regulatory requirement). These measures ensured the resilience of the network and helped to mitigate the effects of Cyclone Mekunu (2018). The focus of Oman AER's regulatory framework is to minimise the potential impacts of cyclones on the customer. Some examples of initiatives the framework uses are:

- A very early warning system and preparation of contingency plans that were quickly activated ahead of the cyclone's landfall.
- Prohibition of installation of lines close to flood basins, despite the alternative routing cost increase. The requirement of the water-proof ceiling of cable water points.
- The early launch of coordination mechanisms between the meteorology services, the National Emergency Committee, the Civil Defence National committee and on the ground operations. This was a crucial prevention step that minimised the systemic interruptions.
- Dispatch suitable emergency response teams including deploying teams travelling from other districts to facilitate recovery efforts (Mutual Aid Scheme).
- Prepare in advance and stockpile heavy machinery and repair equipment necessary to ensure speedy recovery; position it in predetermined strategic locations.
- Establish shelters equipped with temporary generators and sufficient fuel and water for a few days.
- A flood risk assessment is required for all new investments.

In addition, Oman AER was extreme vigilant in coordinating the emergency response and the media messaging & safety information provided to residents. Critical measures implemented ahead of the cyclone landfall included:

- Encourage alertness among residents in the affected region using coherent media narrative and regular dissemination of safety information and shelter locations details. Regular safety videos were disseminated after the first cyclone to avoid future fatalities.
- Ensure that a medium-term solution is available for any power or water asset damaged by the weather conditions dispatching generators and ensuring sufficient quantities of fuel and water.
- As a part of the Mutual Aid Agreement, ensure that response and recovery processes can rely on all assets across the country. The agreement also ensures all utility staff are familiar with the current specifications and are equipped and ready to be deployed across the country in emergencies. Using identical mechanisms and specifications to respond and mitigate the adverse impacts of such events across the country meant that holistically the system is better prepared.
- Ensure that communication channels will not be disrupted between emergency response teams and the industry; satellite phones were acquired in advance.
- During previous cyclones, there was competition amongst utilities to access repair equipment and machinery necessary to restore operations and repair overhead lines. For future cyclones, the Emergency Committee ensured that there was sufficient equipment for all affected assets, thus avoiding competition and speeding up the recovery process. Helicopters were used to facilitate the dispatching of mobile generators to remote help or inaccessible areas. The army was engaged to speed recovery.

## EMERGENCY PROTOCOL

Ahead of the Cyclone, the Oman Meteorology Services provided regular updates and emergency response cells were activated within the Government, but also across the industry and utilities. A contingency mechanism was put into operation and regular media messages were circulated to residents. Risk-assessments and data analysis on cyclone trajectory identified locations that would be the hardest hit and repair equipment and machinery was transported ahead of landfall. Furthermore, communications amongst all stakeholders was ensured via satellite phones to maintain coordination efforts and strategic response.

The government has a National Emergency Committee, Civil Defence Committee and National Multi-Hazard Early Response Centre that collaborate with each other and coordinate with industry to manage crisis situations. Utilities are required by law to ensure business continuity and have own emergency response teams. Harmonised standards ensured interoperability and maximise human resources on the ground once the cyclone struck. Shelters were prepared ahead of time and exposed areas evacuated. The army was mobilised to aid recovery.

## TIMELY RECOVERY

After the cyclone passed, a comprehensive review on the effectiveness of the response and prevention actions was undertaken and identified the following success factors:

1. Establish an interface amongst all key stakeholders to ensure coordination of efforts and dispatching of repair crews to outage locations.
2. Stockpile repair equipment to predetermined strategic locations ahead of time.
3. Develop coordinated media messages and safety videos aiming at enhancing customer understanding of the timeline and preparedness ahead of landfall.
4. Integrate risk-assessments and dedicated flood-assessments within utilities investment and upgrade strategies to enhance resilience, supply reliability and reduce outage time.
5. Harmonise technical standards and emergency response mechanisms across the sector to better manage national crisis situations. This includes setting up a structure that will familiarise utility permanent and contractor personnel on standards and procedures.
6. Establish a contingency planning to enhance the stability and reliability of the power and water supply while ensuring the safety of the public and contributing to swift and no-panic response and recovery.
7. Work with the utilities to ensure long-term resilience of the system and solutions to eliminate black-outs and weak links in the network via targeted investment and regular personnel training.

### BARRIERS

Accessibility of rural areas and development of rural infrastructure

Poor access to hit locations (flooding and heavy winds which caused roadblocks, and in turn prevented repair teams to restore supply)

Previous cyclones hit other locations within Oman, so while on national level preparedness was advanced, at certain regional/local levels preparation was challenging

### ENABLERS

Existence of clear-set coordination amongst key stakeholders

Mandated risk-assessments

Temperature drop reduced demand.

Effective mechanisms for communications amongst emergency response teams but also with the public.

> ***Experience showed that you cannot stand against the force of nature but there are ways to minimise its impact. Proactively, a combination of employment of risk assessment techniques for better infrastructure location and improved specification helped make the electricity networks much more resilient during the event. On disaster recovery, and as the electricity sector and the country as a whole gained more experience in dealing with extreme weather events it became evident that early preparation, clear prioritisation, closer coordination, and better communication are key to better management of recovery efforts.***
>
> **- IBRAHIM AL HARTHI, AER-**

## LESSONS LEARNT FOR DYNAMIC RESILIENCE

- **PREPARATION** | Preparation is key. The regulator must ensure that all companies have sufficient resources to cope with extreme risk.
- **ANTICIPATION |** Safe, efficient and economic measures to ensure system resilience are mandated to all utilities with a potential punishment if gaps are being detected. This increases the holistic resilience of the system. The Regulator has set specific safety requirements for rooftop solar installations to improve system resilience in in a low-carbon economy.
- **COORDINATION** | Sharing knowledge from past experiences and having a process of managing extreme weather situations is key.
- **COMMUNICATIONS** | Communications and security are central – looking ahead further emphasis need to be placed upon effectively disseminating early warning, information and safety tips to the residents to avoid fatalities but also facilitate the work of the repair teams.
- Transitioning to Distributed Renewable Energy Generation will improve the resilience of the system.
- Equipment specifications have been updated to ensure resilience to future weather hazards. The practice has to be maintained.