

Cascading and complex network failures

■ Dr John Bates, Australian Institute for Disaster Resilience

The extreme weather event that affected South Australia from 28 September to 5 October 2016 provided an opportunity to explore the impacts of the events themselves and more importantly, how the consequences of damage and disruption caused by the force of the storms (a combination of thunderstorms, destructive winds, large hailstones and heavy rain) impacted on the South Australian community. AIDR's Cascading and Complex Network Failures Forum explored the South Australian extreme weather event on 7 April 2017 through a range of guest speakers and panel sessions.

In the lead up to the extreme weather event in South Australia:

- there had already been multiple extreme weather events; the most recent in mid-September 2016 with widespread flooding in metropolitan areas
- the water catchments were saturated
- recovery activities were still underway from previous events
- emergency services and support agency staff and volunteers were fatigued.

The Independent Review of the Extreme Weather Event¹ concluded that:

- individuals, businesses and governments experienced difficulties with access to food, medications, fuel, credit card payments, cash, fuel, telecommunications, essential home and business appliances and water
- business continuity plans across government, business and some emergency services proved in some instances to be inadequate
- emergency plans to manage shortages of electricity, fuel and gas had not contemplated such a widespread impact from a loss of supply to the electricity grid.

At the Forum, Leanne Adams from South Australia State Emergency Service discussed some of the unanticipated consequences arising from the storms and power failure and lessons that can be learned to minimise future impact.

- IVF embryos were lost when parts of the Flinders Medical Centre lost power due to a failure of the main generator.

- Critical infrastructure systems, including communications towers and NBN phone and data connections, failed either because back-up power supplies failed or because there was no back-up power supply.
- Perishable food was lost in supermarkets, food outlets and homes.
- Public transport backup plans relied on an accessible electricity supply to run lighting and ventilation systems to manage fumes from diesel powered trains and safety at night. Available backup generators were either not available or ultimately failed.
- To preserve mobile telephony, data services were progressively switched off.
- Fuel was available but not readily accessible to either the public or emergency service organisations (ESO) and where fuel was accessible (typically where fuel providers had their own generators) customers needed cash (not credit card or EFTPOS) to make purchases.
- People who were unprepared panic-bought food and other supplies, quickly depleting available stocks.
- Triple Zero services were not available in some areas.
- Paging services used by ESOs for communication were switched off to conserve power.

Alongside all of this, there was significant physical damage across South Australia to roads, bridges, electricity infrastructure, residential and commercial buildings, coastal erosion and agricultural areas.

Beck Dawson, Chief Resilience Officer at Resilient Sydney, described cascading failure as invisible. All too often the flow-on failures from a single event are not well thought through and are either not considered or are thought to be so rare that it is better to focus on something that is more likely to occur. Resilience, she rightly said, is a team sport – no one can do it by themselves.

One topic that was explored by presenters and participants during the forum was the depth of the cascading effects of network failures linked to the availability of liquid fuel and food security. In our modern society, food distribution is managed from local distribution centres and relies heavily on road transport, which in turn is dependent on available and accessible fuel supplies. The events in South Australia demonstrated the vulnerabilities of fuel supplies in the event of loss of power arising from any event that

¹ Independent Review of the Extreme Weather Event, South Australia, 28 September-5 October 2016.

affects the electricity grid; from equipment failure through extreme weather events to criminal activities. Beyond that, however, is the absolute reliance on imported, liquefied fuels to meet demands. A series of reports commissioned by the NRMA and published in 2014² conclude that Australia imports more than 90 per cent of its liquid fuel needs. Those reports bring together information from a variety of sources to provide a snapshot of food distribution logistics:

- In the face of a significant liquid fuel crisis, and where this is the only shock affecting a community, the estimated stock available from point-of-sale outlets for essential items based on normal purchasing patterns is limited. For example, medical supplies (three days), petrol stations (three days) and chilled and frozen food (seven days).
- In September 2016, the Office of the Chief Economist reported³ that the average holding of diesel oil within Australia was sufficient to cover demand for 17-20 days, and automotive gasoline for 23-27 days.
- The closure of refineries and reduction in onshore stocks of liquid fuels within Australia makes us more susceptible to global shocks and the decisions of oil-producing countries.

While it is important to understand the cascading effects of complex network failures, it is ultimately the impacts that these events have on individuals, communities, businesses and governments that is of fundamental importance.

There is no easy way to solve these complex challenges and we know that individuals, communities, businesses and governments will respond differently, depending on their experiences, their expectations and the context in which an emergency or disaster strikes them.

At a macro level, governments and private providers of critical infrastructure and essential services need to work harder on business continuity planning. They need to pay particular attention to a reliance on other critical systems and services and how the continuity of their business plays a critical role in the continuity of communities and other businesses and services.

In preparation for the next unexpected sequence of natural disasters, criminal acts and global shocks (and the one after that) individually and collectively we need to better imagine what is possible and how we can mitigate against, or adapt to, that reality. It is not a simple task and we will not always get it right. However, when we understand the complexity and we all own the risks that are relevant to us, we will be better able to minimise the impacts of these inevitable events.

² www.mynrma.com.au/about/australias-liquid-fuel-security.htm

³ https://industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/aps/2016/Australian_Petroleum_Statistics_242_September2016.pdf

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