Australian Institute for Disaster Resilience

Australian Institute for Disaster Resilience Submission

Senate Select Committee into Resilience of Electricity Infrastructure in a Warming World

February 2017

The Australian Institute for Disaster Resilience

The Australian Institute for Disaster Resilience (AIDR) is a not-for-profit organisation formed through a partnership between AFAC, the Australian Red Cross, the Bushfire & Natural Hazards Cooperative Research Centre and the Commonwealth Attorney-General's Department.

AIDR supports the national disaster resilience agenda by providing a vehicle for national debate and thought leadership in support of implementation of the National Strategy for Disaster Resilience (NSDR, 2011).

Core to AIDR's role in the implementation of the NSDR is the development, promotion and utilisation of Australia's Disaster Resilience Body of Knowledge to inform what we do and to challenge and improve how we think, providing a foundation for excellence in decision-making.

As a national organisation, AIDR plays an important role working between levels of government and public and private organisations that are active in preparation for, planning, response and recovery from disasters.

Fundamental Principles of Disaster Resilience

For Australia to make significant improvements to our national resilience to disasters, there are some fundamental principles that will need to be embraced:

1) Sustained behavioural change is essential at all levels of our society; allowing us to use the knowledge that we have, and which we will continue to generate, to build within our society the ability for individuals and organisations to remain aware of their circumstances and to use this knowledge and skills to manage through crises and hazards that may at times be beyond anything they have experienced before.
2) Short-term goals are important, but we must set medium and long-term goals that recognise the need to empower individuals, groups and communities at all levels through timely and accurate information, education, planning and public debate.
3) Consistency of information and messaging (preparation, fact-sheets, alerts, warnings, advice) across the country that recognises and understands the constant movement of people within our country, including tourists.
4) Understanding that the systems that we have developed to support and protect our lives and lifestyles are significantly interconnected and that changes in any one of them may have unintended consequences on one or more seemingly unrelated systems.
5) Trust and trusted partnerships are fundamental requirements for sustainable resilience.
6) Actions to build resilience occur at all levels, from individuals to the peak of Australian Government. Our initiatives and actions must acknowledge these linkages and actively work to ensure that these essential linkages are not ignored.

Australian Institute for Disaster Resilience ABN 52 060 049 327
370 Albert Street, East Melbourne, VIC 3002
+61 3 9419 2388 enquiries@aidr.org.au www.aidr.org.au

Conceptualising a Connected, Robust and Resilient Electricity System

The published terms of reference for the Committee focus on two core elements:

(a) the role of storage technologies and localised, distributed generation to provide Australia's electricity networks with the resilience to withstand the increasing severity and frequency of extreme weather events driven by global warming; and
(b) recommend measures that should be taken by federal, state and local governments to hasten the rollout of such technologies.

With this guidance, our view is that to be effective in achieving its goal, a connected, robust and resilient electricity system must:

1) Efficiently provide the necessary power for the safe and effective functioning of communities, businesses and governments; understanding that at times, and without appropriate access to, or use of, appropriate storage systems, there is an excess of generated power that is lost from the system;
2) Be well planned, and linked at multiple levels to ensure that if locally generated and stored electrical power is available from an appropriate source, the infrastructure connecting it to the user base will continue to be available;
   a) Local generation or storage technologies will not remove the need to build and maintain distribution services that are able to both:
      i) withstand substantial threats from natural or human induced hazards; and
      ii) be integrated into a distribution network with multiple layers of redundancy that will allow electricity to be efficiently and remotely re-routed through one or more alternate mechanisms throughout the network
3) Support the development of accessible electricity storage systems that are an integrated element of the supply system and which provide:
   a) A top-up source of electricity during peak energy demand;
   b) Temporary power to supplement demand during routine generation facility and distribution infrastructure replacement and maintenance; and
   c) A source of localised electricity during significant un-planned power outages, including (but not limited to) damage caused by natural hazards.
4) Not create a 'power-class' divide within the country where significant electricity storage is retained within individual homes and businesses and not made available to others in the community who may have limited funds to invest in these technologies at an individual level.

Even if this is achieved, electricity users too have a responsibility, and need to understand that even with the best of planning, short-term power outages will occur across a network and where a constant supply of electricity is required, individuals need to be responsible for meeting their own short-term needs.

Challenges to Electricity and other Infrastructure by Natural and Other Hazards

In broad terms, electricity infrastructure is no different to any other infrastructure in its exposure to disruption and damage resulting directly and indirectly from natural hazards and from hazards caused by human intervention (both malicious and unintentional).

We must continue to assume that events will occur that have the capability of disrupting essential infrastructure, including electricity supplies. Whilst research, planning, management and engineering solutions in combination are likely to strengthen the security and robustness of the electricity supply, in the face of a full force of nature event or malicious human intervention, significant prolonged and potentially geographically dispersed interruptions to electricity supply (generation, distribution and control systems) will occur.

During major storm events, for example, electricity supply, distribution infrastructure and control systems are all exposed to damage directly from the event itself, from flying debris, from associated floods and from land / soil subsidence.

For local generation and electricity storage to remain relevant and deliver a substantially more resilient electricity supply in this context, the robustness of the generation and storage and the means of connecting the electricity to consumers are critical.

Any integrated dispersed electricity generation and storage solution must take into account:

1) The robustness of the local generation and/or storage to deliver electricity on demand and to remain unaffected by the hazard event;
2) How, and how quickly, the storage capacity can be re-charged after its initial supply is exhausted. Essentially, this is the robustness of the local generation capability and the connections to that capability;
3) The robustness of the localised distribution system – ensuring electricity can continue to be delivered to where it is needed;
4) Integration and connectedness of the broader distribution systems; allowing access to supplies that are dispersed across a 'local supply region', to ensure that where available, generation and storage capacity does not sit idle through lack of connectivity.

Storage and Generation Options

AIDR does not have a view on the benefits of any one generation or storage capability over any other. For any situation, guidance and principles that guide the selection process need to be well defined and communicated.

National Electricity Infrastructure Resilience

The resilience of the national electricity infrastructure is influenced by the elements that are combined to bring electricity to the places it is needed at the times at which it is required. At a high level, the elements are:

1) Generation capacity (in all its forms)
2) Distribution networks
3) Connections and fail-safe mechanisms

If there are good electricity storage facilities, the capacity of the generation resource to quickly come back to restore power generation following a significant event is critical – storage capacity without a means of re-charging will provide a benefit but will not deliver a truly resilient electricity supply.

The connections and fail-safe mechanisms that underpin the national electricity network and the evidence and modelling behind the parameters that allow them to function and those which may cause them to behave abnormally or to disconnect will become more influential in the ongoing robustness of the electricity supply and distribution network as the number of individual 'sources' of electricity increase as significant storage capabilities become available.

Equity across the socioeconomic spectrum

In promoting the implementation and use of storage technologies, consideration must be given to the social equity of the resulting solution. A sense of community is important in building and maintaining resilience – and this will be challenged during a time of crisis if there is a divide created by any differences in the availability (or lack of availability) of electricity amongst the members of a community.

Potential Impacts of Localised Generation and Storage Capabilities on the Safety of Emergency Responders

Current challenges are being experienced by emergency services personnel (paid and volunteer) from the rollout of photovoltaic panels on residential and business premises. Residual current in these devices remains a safety issue and the addition of electricity storage capacity to those devices will require standards to be developed, implemented and actively enforced to ensure that emergency personnel (and private contractors) responding to damage in premises, frequently in fire or storm conditions, are not inadvertently exposed to life-threatening risks from unsafe electrical installations.

Ownership of Risks and Their Management

Using risk identification and management as a means of minimising system failures is a well understood process and in emergency management, guidance is provided through the National Emergency Risk Assessment Guidelines (NERAG, Australian Disaster Resilience Handbook 10).

AIDR's observation is that, whilst risks are often identified, there can be a substantial exposure that arises when identified risks are not effectively 'owned'. This lack of ownership of risks is observed in individuals and in corporations and causes no ill-effects until the event identified in the risk actually occurs.

A lack of risk ownership (avoiding responsibility) has the potential to become a major weakness in complex multi-layered outsourcing arrangements. In this scenario, solutions are at risk of being delivered to a price rather than to a quality standard that includes safety margins that are sufficient to deliver resilient outcomes in the face of a serious hazard impact.

Development of Resilience Statements

AIDR has developed and is beginning to explore the concept of Resilience Statements for developers of major infrastructure, businesses and residential developments. These Resilience Statements, whilst not mandatory would provide an opportunity for developers, owners and operators to explain the communities in which they are located, in plain language, how their asset(s), systems, processes and behaviours will contribute to the resilience of the communities in which they are built. For example, for a building complex a Resilience Statement might describe:

1) How a building's design, quality of workmanship and choice of equipment, fittings and fixtures contribute to the longevity of the building and access and egress routes for employees and visitors?
2) What features or services of the building can be made available to support the local community in times of need (for example shelter, electricity generation or storage, underground carparks that are designed to be used as flood abatement reservoirs)?
3) How, and how well, is the building and its operation designed to become a net contributor to resilience of the community in which it is located, rather than being a net user of restricted local resources in a time of crisis?
4) How will the building owner / operator manage a significant and extended 'lock-in' or evacuation of its occupants if there is need, without compromising similar actions of the community in which they are located?
5) How the developer, owner or operator will behave (in promoting and practicing resilience) for the benefit of the community.
6) Where toxic or other dangerous materials are used or located at the building, how will they be contained to protect the community and what can the community do to support this containment?

This concept could easily be applied to promote a resilience focus on the design, build and operation of both centralised and distributed electricity generation and storage facilities.

Summary

We must plan to be resilient to major natural hazard events and those caused by human intervention. Electricity storage and localised generation are two important elements of the complex puzzle that is resilience. To have a significant impact on a resilient electricity supply system, electricity storage and local generation will need to be coupled with:

1) Practical, considered and connected regulations, guidelines and compliance systems that recognise and understand the roles, contributions and limitations of each of the elements in a connected electricity supply system.
2) Where financial incentives are provided to individuals, businesses, installers, manufacturers and others, that those incentives are based on resilience-focused incentives, which might include:
    a) Whether the contribution to a 'network' is actually enough to make a difference. For example:
        i) electricity from batteries in a single home would most likely add very little to a neighbourhood power supply, whilst a neighbourhood of houses all with battery storage could make a difference.

        ii) Where the contribution of a single residence from local storage is negligible, benefits could instead simply flow through reduced electricity usage, with up-side benefits through an ability to withstand short-medium term grid supply interruptions.
    b) The duration for which power can be supplied and the proportion (or size) of the local community that will be supported by that supply;
    c) The ability to re-generate power in linked storage facilities to deliver uninterrupted power
    d) Regular evidence of testing the system under some form of stress in preparation for rapid activation in times of emergency
3) Some significant focus on the resilience of distribution systems to ensure robust connections between distributed generation, storage and users.
4) Greater research, development, modelling and exercising (testing under stress) of the control and fail-safe mechanisms that glue an electricity system together
5) Strong governance of the approval and installation processes to ensure the safety of installers, those who occupy the property and emergency responders to avoid situations where the technologies (and there are potentially many variations) may create new electrical safety risks through faults or improper use and installation.
6) Assurance processes that business arrangements (including outsourcing) for the delivery of electricity services ensure that reasonably imaginable risks are identified, owned and actively managed to a (national) minimum performance expectation or standard.
7) An opportunity for providers to develop Resilience Statements for each of their facilities that will demonstrate to the communities that they intend to support, how their systems will function to deliver that resilience outcome and the benefits / performance standards that the community should expect to receive in routine and crisis situations.

If there are any matters in this submission that you would like to discuss, please do not hesitate to contact AIDR's Director, Dr John Bates on .