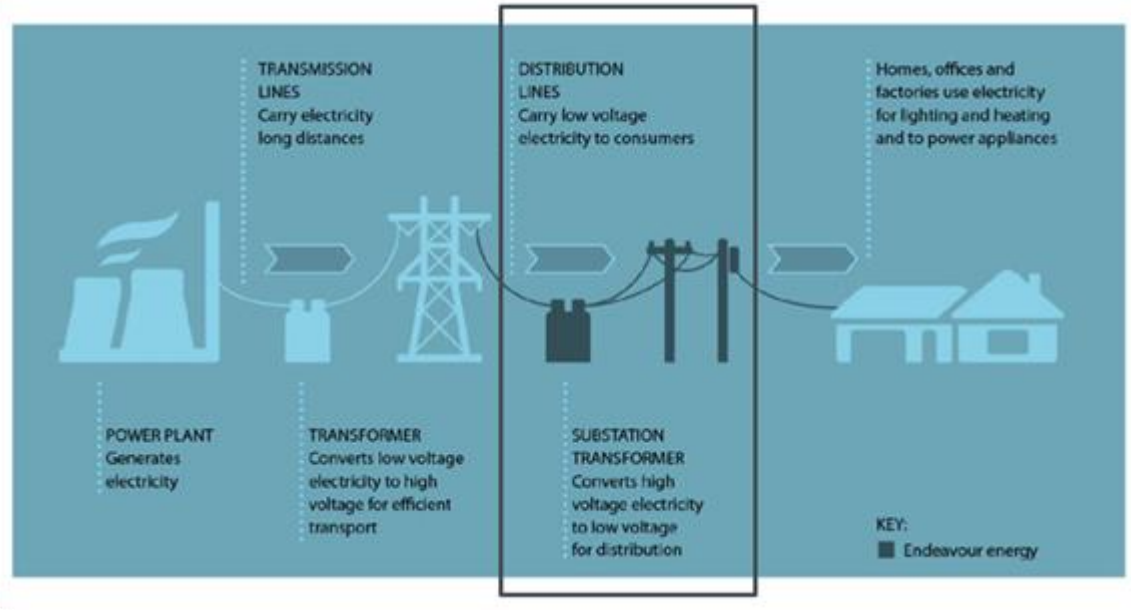
FLOOD RESPONSE AND IMPACTS ON ELECTRICITY DISTRIBUTION NETWORK

ELECTRICITY DISTRIBUTION NETWORK

The following diagram illustrates how the electricity distribution network operates.



Source: Endeavour Energy Distribution Annual Planning Report December 2020

FLOOD RESPONSE

Endeavour Energy's response to flood events is detailed in System Control Branch Procedure NCB 0615 'Flood Response Plan' is based on a substation prioritisation ranking, comprised of flood risk and damage potential, to focus the flood response efforts toward areas and resources in order of highest importance. It includes details of the flood levels giving an indication accessibility prior to floods closing roads, rather than the heights at which electricity mains and substation are inundated.

The substation prioritisation ranking for flood events takes into consideration the voltage of the substation as the higher the voltage, the greater the number of customers taking supply. The three types of substations which are part of Endeavour Energy's network consists of:

- Transmission substations with a primary voltage of 132,000 volts /132 kilovolt (kV) and secondary voltage of 66,000 volts / 66 kV or 33,000 volts / 33 kV, connected directly or indirectly to a TransGrid Bulk Supply Point (BSP) for supplying zone substations.
- Zone substations that transforms sub-transmission voltages (33 kV – 132 kV) to a lower voltage less than or equal to 22,000 volts / 22 kV.
- Distribution substations that transforms distribution voltages (11,000 volts / 11 kV – 22 kV) to a lower voltage less than or equal to 240 / 415 volts.

The flood response is based on electricity supply being maintained as long as practicable consistent with the safety of employees, general public and emergency services personnel. This involves the duty Senior System Operator analysing the situation from flood maps located in the Control Room (Huntingwood) and acting upon information received from the weather bureau about anticipated flood levels to then commence rearranging the network.

The rearranging of the network is done in order to allow for safer, speedier operation and because water conducts electricity, isolation of electrical assets to prevent any electrical accidents. Once isolated during a flood, restoration of supply can only occur once the flood waters have receded and the area has been patrolled clear and flooded installations inspected. Any damage to the electrical assets will be repaired as soon as possible after the flood. The response is aimed at eliminating or reducing the number and duration of customer service interruptions from flooding impacts, particularly to other critical infrastructure / services and life support customers.

Accordingly a flood mitigation strategy that assists in maintaining road access to the critical infrastructure allows for electricity supply to be maintained for a longer period and quicker restoration of supply.

Essentially all the outputs from the Council's flood studies are valuable to Endeavour Energy's operations, from the initial design of the network to the flood response plans. Endeavour Energy has an environmental geographic information system (GIS) but this does not currently have flood information / mapping. The flooding information for environmental assessments is based on enquiries to Council and in some situations the engagement of consultants to prepare specific flood studies for a project / site. Endeavour Energy's System Control Branch refer to the Council's flood studies to assist in the preparation and implementation of their flood response plans.

FLOOD IMPACTS

The electricity distribution network required to service an area / development must be fit for purpose and meet the technical specifications, design, construction and commissioning standards based on Endeavour Energy's risk assessment associated with the implementation and use of the network connection / infrastructure for a flood prone site. Risk control has focused typically on avoiding the threat, but where this is not possible, reducing the negative effect or probability of flood damage to assets by implementing good design and maintenance practices.

Overhead Power Lines

Overhead power lines which can be damaged by flying or floating debris, falling trees and branches, inundation by floodwater and in colder parts of the network, collected ice and snow. The main guide to the construction of overhead power lines is AS/NZS 7000:2016 Australian/New Zealand Standard 'Overhead line design' which has specific as well as general guidance in regard to design of overhead power lines in flood prone land. The following is a summary of the relevant applicable sections within the Standard:

SECTION 2 DESIGN PHILOSOPHIES

Includes requirements for security (minimal structural or component failures) and reliability (appropriate outage rates).

SECTION 3 ELECTRICAL REQUIREMENTS

Deals with minimum clearances of the lines from the ground with the clearances determined having regard to local conditions and requirements such as the existence of waterways, flood plains and snowfields,

SECTION 6 BASIS OF STRUCTURAL DESIGN

Includes environmental considerations and requirements for component strength for the structures ranging from the towers down to the fittings for the attaching the conductors. It also considers 'accidental actions' including flood debris loads. avalanches, etc.

S E C T I O N 7 A C T I O N O N L I N E S

Flood is included as ‘special load’ and shall be considered where appropriate.

S E C T I O N 9 F O U N D A T I O N S

The design principles have regard to extreme windstorm or floodwater events which can cause foundation failure.

The following photographs shows March 2021 flooding across the Hawkesbury Nepean Valley which resulted 17,000 customers without power due to flooding. The Flood Restoration Plan (a copy of which is attached s an annexure) prioritised the return of essential electricity supply to flood affected customers and communities as soon as it is safe to do so when flood waters recede and roads reopen.

Underground Cables

Underground cables are less likely to be damaged from storm events but are still susceptible to flooding and tidal surges. Saltwater, which is a very good conductor and causes electrolysis reactions with the metal conductors and can result in accelerated corrosion to the underground cables and associated infrastructure. With appropriate design electrical cables are commonly run underwater and in other hostile environments and likewise can also take into consideration potential flood events. With underground cables it can take longer to restore power because workers cannot go into flooded areas as quickly and the location of faults can be harder to identify.

The main guide to the construction of underground cables used by Endeavour Energy are its:

- Mains Design Instruction MDI 0028 ‘Underground distribution network design’.
- Mains Construction Instruction MCI 0006 ‘Underground distribution construction standards manual’.

These documents have specific as well as general guidance applicable to the design and construction of underground cables in flood prone land.

Substations

In regard to the flood susceptibility of substations, if located in a flood liable area, generally the critical infrastructure / components are elevated to such an extent that flooding should not disturb their operation ie. reducing the potential for contact between floodwaters and sensitive substation equipment and energised conductors. However, if there is a significant change to flood levels, Endeavour Energy would need to investigate the flood risk and determine what steps can be taken to make the electricity network more resilient eg. alterations to the location of critical components, construction of defences such as walls or drains etc.

Transmission and zone substations have isolating transformers which are used for network rearrangement (for which floods may be a triggering event) and to protect against electric shock. These substations have cable basements that are installed under substation switch rooms and control rooms. This is where the cables entering and leaving the substation are connected to the switchgear with the basements used primarily as 'cable marshalling' areas. Depending on the voltage and function these basements they can have a height of up to 3,100mm from the floor to ceiling (or slab soffit) and may be subject to flood inundation. The basement does not usually contain any significant / critical electrical power equipment. Due to the installation of conduits in perimeter walls of the cable basements, such areas may collect seepage groundwater and are therefore fitted with a pump system. Ideally a cable basement would not be subject to flood inundation but if this occurs, it is not a catastrophic event.

Flooding to Baulkham Hills Transmission Substation basement March 2021.

In the event of the probable maximum flood occurring, it is likely that there would be water damage to protection, automation and control equipment (ie. to substation switch rooms and control rooms) as well as damage to high voltage equipment in the switchyard. The de-energisation of the substation would leave the area served by the substation without power for a significant period of time ie. a catastrophic event.

Distribution substations should not be subject to flood inundation or stormwater runoff ie. the padmount substation cubicles are weatherproof not flood proof and the cable pits whilst designed to be self-draining should not be subject to excessive ingress of water. Section 7 'Substation and switching stations' of Endeavour Energy's Mains Construction Instruction MCI 0006 'Underground distribution construction standards manual' provides the following details of the requirements for flooding and drainage in new distribution substation locations.

7.1.6 Flooding and drainage

Substations are to be located such that the risk of flooding or stormwater damage is minimal.

As a minimum the level at the top of the transformer footing, HV and LV switchgear, shall not be lower than the 1:100 year flood level.

All drains within the substation site area or in the vicinity shall be properly maintained to avoid the possibility of water damage to Endeavour Energy's equipment.

In areas where, as determined by the Network Substation Manager, there is a high water table or a heightened risk of flooding, indoor substations will not be permitted.

All materials used in the construction below the substation (ground level) shall be capable of withstanding prolonged immersion in water without swelling or deterioration.

Figure 51 - Example substation raised above 1:100 flood level

All materials used in the construction below the substation (ground level) shall be capable of withstanding prolonged immersion in water without swelling or deterioration. For this reason underground cables have to be insulated / encased and protected in a number of specially made materials along their entire length and may be buried direct or laid in conduits / ducts. The conduits must use coupled and glued joints and be sealed / capped at their ends against the ingress of water. The challenge during flooding is when a cable comes aboveground and attaches to a transformer, switch etc. the flood waters could enter the conduits. Conversely, if the conduits leak, it could result in the flooding of cable pits and basement-type substations and switchroom. There are also standards relating to cable routes, minimum cover, bedding and backfill ie. if the backfill is not properly compacted subsidence may occur and damage the conduits, which also contribute to protect and harden the network against flood damage resulting from hydrostatic pressure, erosion etc.

Endeavour Energy's restoration plan

We're committed to supplying electricity to customers impacted by the 1-in-50-year floods affecting the Hawkesbury, Nepean and Colo rivers and surrounding areas as soon as it is safe to do so. We will do this by supplying electricity from our network or by generators where our site investigations show network repairs will take some time.

We have the people and resources ready to repair the electricity network as soon as flood waters recede and there is safe access for heavy vehicles to reach worksites. We are in constant contact with other emergency service agencies, including the NSW Police and SES, to coordinate our efforts and to help get our communities back on their feet.

Despite our best intentions, we know parts of our network remain submerged in flood waters and so this will hamper the time it takes to get power back to everyone. Our restoration plan is based on the information we have available today and it remains subject to change based on further damage assessments and weather and safety conditions.

Thanks for your patience and understanding and support of our crews as they carry out this essential work.

Our restoration process

Our restoration process aims to restore power to the largest number of customers as quickly as possible. This involves the distribution powerlines which connect to individual locations such as powerlines in local streets. Repairs are then made to distribution transformers and service wires to homes and businesses.

Local restoration plans

It is important to understand that power supply will be gradually restored along electricity feeders as flood waters recede and repairs can be completed. The first step involves our crews inspecting the flooded areas to assess damage to understand what equipment is needed to make final repairs. Please note the plans below are a guide and are subject to change, based on the rate at which flood waters recede and SES and Police advice.

McGraths Hills and South Windsor. On Friday 26 March, crews will be making repairs and cleaning switchgear and substations that have been inundated with water. It is hoped that the water will subside in these areas on Friday to enable us to complete repairs and restore supply. There may be some premises in these areas that have been underwater that may need further work and an electrical contractor check before supply can be restored.

Freemans Reach and Wilberforce: On Friday 26 March, crews across the river will be undertaking switching and scoping work. It is not expected that we will be able to restore many customers in these areas on Friday as we will need to wait until floodwaters subside before we can get safe access to power assets

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with vehicles. This scoping will ensure that we are planned and ready to go as soon as the water level is low enough for access.

Webbs Creek, Mcdonald and St Albans: On Friday 26 March, we will be sending crews across the river with the help of NSW Police to access and inspect power assets in these areas. We hope to be able to restore supply to some customers in these areas, however there will also be a need for inspections of individual premises by electrical contractors where premises have been impacted by floodwater.
Camden: On Friday 26 March, hopefully restoring power to around 100 customers, subject to flood conditions and inspection of the network as waters fall.

Driftway at Londonderry: On Friday 26 March, we hope to be able to restore supply to some of these customers on the Southern end of the Driftway.

Pitt Town, areas of Richmond Lowlands, Cornwallis, Gronos Point and Ebenezer. Unfortunately, it is not expected that any access will be available into these areas **until at least Sunday** for us to start assessing and planning repairs due to access issues.

Customer assistance package

We want to help customers in flood affected areas with our customer assistance package. We are:

- undertaking free inspections of meter boards to determine if it is safe to reconnect properties
- pausing disconnections and follow up on private powerline defects in flood affected areas.
- providing generators to customers who remain with power where the network is damaged and where we can safely access the site
- ringing all life support customers to do a welfare check
- waiving all application, site establishment and Accredited Service Provider inspection fees, valued between $350 and $600) for customers reconnecting flood damaged properties to the network.
- locating Community Liaison Officers at evacuation centres to answer customer enquiries.

Safety tips for customers

Moving through a flooded area

Treat all power lines as ALIVE and dangerous:

- keep well clear of **ALL POWER LINES** and particularly avoid contact with wires which are hanging low or on the ground, dangling in flood water or tangled in trees.
- do not drive across fallen power lines. If power lines have fallen across or have been become entangled in your vehicle, remain inside your vehicle and call for help. If in danger, open the door and jump well clear keeping your hands off the vehicle and feet together. Once you have jumped free, shuffle your feet slowly along the ground until you are at least 8 metres clear of fallen trees.
- take extra care on roads at night as streetlights might not be working in flood affected areas.
- If you are moving through flooded areas in a boat, **LOOK UP** and ensure there is a **5.5m clearance** between your vessel and overhead electricity lines.

After a flood

A licensed electrician **must** inspect your premises before power can be restored power. You should not:

- use electrical appliances that have been in floodwaters.
- handle any wet electrical equipment.

- replace circuit fuses or restore power to a property which has been flooded until the home has thoroughly dried out and been checked by a licensed electrician.

Frequently asked questions and answers for customers

1. Wiring and water

If your home has been inundated by water, your building's wiring and appliances may be damaged. You must have a licensed electrical contractor check the wiring in your property and complete any necessary work so that it is safe for Endeavour Energy to reconnect power to your home. If you don't do this, water may have created conditions for a short circuit of the home or building's wiring.

2. Avoid damage to appliances

If your home is without power, unplug all your appliances at the power point to avoid the possibility of electrical shock, damaged appliances, or even a fire a when the power is restored.

3. Use generators correctly

Portable generators must only be run outside your home or business - never inside or in a garage and well away from open windows, including any neighbours. This is so exhaust fumes do not enter the home.
Do not connect a generator to your home or business fixed wiring unless you have a change-over switch installed by a licensed electrical contractor. Otherwise, generators can send electricity back down the lines and make Endeavour Energy's network 'live' and extremely dangerous.

4. Stay safe around solar panels and batteries

Solar panels may also have been damaged in the floods or heavy rain. Remember they can also create risks under these conditions. They should be turned off and checked by an electrical contractor. If you have a
water affected battery, please call an electrical contractor and ask for a safety check.

Enquiries

Customers should go to www.endeavourenergy.com.au/outages or call **131 003**

Emergencies

Dial 000

Helpful contacts

- For emergency help in floods and storms, ring your local SES Unit on **132 500**
- For information on personal hardship and distress assistance, call Service NSW on **137 788**
- For flood safety www.ses.nsw.gov.au
- Tips after returning home after flooding ses.nsw.gov.au/floodsafe/prepare-your-home/after-flooding/
- For emergency help ring SES on **132 500**
- Flood safety www.ses.nsw.gov.au
- Weather forecasts and warnings www.bom.gov.au
- Radio updates www.abc.net.au
- Traffic conditions and flood impacts www.emergency.nsw.gov.au
- Government assistance www.service.nsw.gov.au