

## **F Summary of power system incidents that caused unserved energy**

In Section 2.3.5 we presented a breakdown of the load shedding events that originated in the generation and transmission sectors since 2005. In particular, we concluded that of all the load shedding due to supply interruptions in the generation and transmission sectors of the supply chain approximately:

- 50% was due to weather related security events (such as heat waves, lightning, storm damage);
- 38% was due to non-weather related security events (such as equipment failure); and
- 12% was due to reliability events (generally due to heat waves).

This analysis was based on the attached list of all significant power system events since 2005, that was provided by AEMO, and included the following information:

- the date;
- the affected region or regions;
- an estimate of the USE, if practicable, in each affected region;
- the source for the event (i.e. in the transmission or generation system);
- whether the event was a security or reliability event; and
- whether the event was related to extreme weather.

AEMO advised that in most cases the estimate of unserved energy is a rough calculation based on the MW lost multiplied by the hours the load was interrupted, however, where possible the incident reports were used to refine these values.

Date	Region	Description of Event	Amount of load shed	Security or Reliability Event?	Related to extreme weather?	Unserved Energy (MWh)	
						Load Shed Start Time	Load Restoration Start Time
14 March 2005	SA	A fault on the Playford-Davenport line led to offloading of the Northern power station, which then triggered the loss of the VIC-SA Interconnector and shedding of 700 MW load in SA due to under frequency load shedding.	660 MW	Security	No	06:39	07:06 to 08:25
						Duration: 106 minutes	
						Unserved Energy = $660 \times (27/60) + 660 \times 0.5 \times (79/60)$ = 732 MWh	
25 June 2005	TAS	Trip of a Gordon unit caused under frequency load shedding of Comalco (90MW) and Ziniflex (84MW)	174 MW	Security	No	14:46	Comalco restored - 15:19 Ziniflex restored - 15:30
						Unserved Energy = $90 \times (0.55) + 84 \times (0.73)$ = 111 MWh	
25 November 2005	TAS	A Lightning strike resulted in the simultaneous loss of 2 220kV lines (Sheffield - Georgetown #1 and #2). This	267 MW	Security	No	23:43	00:00
						Duration: 17 minutes	

Date	Region	Description of Event	Amount of load shed	Security or Reliability Event?	Related to extreme weather?	Unserviced Energy (MWh)	
						Load Shed Start Time	Load Restoration Start Time
		loss then resulted in the loss of two further lines (Sheffield - Farrell, Sheffield-Palmerston) and three generating units (Fisher, Bastyan, Woolnorth). Tasmanian system was split and 267 MW of load shed.				Unserved Energy $= 267 \text{ MW} \times (17/60) \text{ hr}$ $= 76 \text{ MWh}$	
23 May 2006	TAS	Between 7.55 am and 8.00 am some Tasmanian Generators (Butlers Gorge, Gordon, Bastyan, and Wayatina) tripped out of service resulting in under frequency load shedding of 240 MW.	240 MW	Security	No	07:59	08:53
						Duration: 54 minutes	
						Unserved Energy $= 240 \text{ MW} \times (54/60) \text{ hr}$ $= 216 \text{ MWh}$	
3 August 2006	QLD	At 11:11 hrs the No.1 110kV Bus at H023 Upper Kedron Substation tripped due to a 3 phase high voltage fault. The circuit breakers at the Upper Kedron end of all connected high voltage 110kV lines were opened. The voltage dip as a result of the fault caused the reduction of 200MW of load in South East Queensland	200 MW	Security	No	11:11	11:26
						Duration = 0.25 hrs	
						Unserved Energy $= 200 \text{ MW} \times (0.25) \text{ hr}$ $= 50 \text{ MWh}$	

Date	Region	Description of Event	Amount of load shed	Security or Reliability Event?	Related to extreme weather?	Unserved Energy (MWh)	
						Load Shed Start Time	Load Restoration Start Time
17 August 2006	NSW	At 06:14 hr, an isolator flashover at Sydney West Substation in New South Wales caused a 330 kV bus-bar to trip. The fault on the isolator caused a voltage depression that reduced the load around Sydney West and the bus-bar trip led to the disconnection of a 330 kV line from Sydney West to Vineyard and a 330 kV static var compensator (SVC) and off-loading of two 330/132 kV transformers at Sydney West Substation.	200 MW	Security	No	06:14	06:25
						Duration: 11 minutes	
						Unserved Energy $= 200 \text{ MW} \times (11/60) \text{ hr}$ $= 36.6 \text{ MWh}$	
23 October 2006	VIC	At 1147 hrs, the No 1 and No 2 220 kV Busbars at Terang Terminal Station in the Victorian Region tripped. This caused the loss of all supplies to the distribution network supplied from this terminal station for about four and half	90 MW	Security	No	11:47	16:16
						Duration = 4.48 hrs	

Date	Region	Description of Event	Amount of load shed	Security or Reliability Event?	Related to extreme weather?	Unserviced Energy (MWh)	
						Load Shed Start Time	Load Restoration Start Time
		hours. The load interrupted was approximately 90 MW.				Unserviced Energy = 90 MW*(4.48)hrs = 403.2 MWh	
10 December 2006	TAS	At 12:33 hrs, Basslink tripped while transferring power from Tasmania to the mainland. As a result loads in Tasmania tripped at Comalco and Temco. Generation was also tripped at Poatina units 2 and 5.	204 MW	Security	No	12:33	12:55
						Duration: 22 minutes	
						Unserviced Energy = 204 MW*(22/60)hrs =75 MWh	
16 Jan 2007	VIC and SA	Bushfires caused separation between VIC and Snowy and subsequently VIC and SA; approx. 2490 MW of load reduced in Victoria and 100MW in SA mainly due to transient effects of the disturbances	2490 MW in VIC and 100MW in SA	Security	Yes	15:02	15:49
						Duration: 193 minutes	
						Unserviced Energy = 7300 MWh (from system incident report)	
23 February 2007	TAS	Simultaneous loss of two 110kV lines (Meadowbank - New Norfolk, Tarraleah - New	205 MW	Security	No	19:43	19:53
						Duration: 10 minutes	

Date	Region	Description of Event	Amount of load shed	Security or Reliability Event?	Related to extreme weather?	Unserviced Energy (MWh)	
						Load Shed Start Time	Load Restoration Start Time
		Norfolk) due to lightning in Tasmania caused reduction of 205MW of load.				Unserviced Energy = 205 MW*(10/60)hrs = 34 MWh	
16 March 2007	SA	Loss of 132kV Busbar at Playford. This resulted in a loss of 125MW of generation and about 1 MW of customer load	1 MW	Security	No	01:56	03:22
						Duration: 1.43 hrs	
						Unserviced Energy = 1 MW*(1.43)hrs = 1.4 MWh	
21 July 2007	QLD	Loss of a 275kV line (Ross-Chalumbin), a 275kV bus at and an SVC at Ross substation due to a high voltage fault near the bus. Event resulted in loss of 140MW of load due to a low voltage network transient caused by the fault.	140 MW	Security	No	22:57	00:27
						Duration: 1.5 hrs	
						Unserviced Energy = 140 MW*(1.5)hrs = 210 MWh	
2 September 2007	VIC	Anglesea - Point Henry 220kV line tripped followed by the loss of Anglesea Power Station thus interrupting supply to Point Henry 1 and 3 potlines.	214 MW	Security	No	22:14	23:26
						Duration: 1.2 hrs	
						Unserviced Energy = 214 MW*(1.2)hrs = 257 MWh	

Date	Region	Description of Event	Amount of load shed	Security or Reliability Event?	Related to extreme weather?	Unserviced Energy (MWh)	
						Load Shed Start Time	Load Restoration Start Time
14 November 2007	TAS	Trip of both Sheffield 110kV buses during commissioning tests resulting in loss of generation and load. Approx. 77MW of customer load was lost.	77 MW	Security	No	13:36	13:51
						Duration: 15 minutes	
						Unserviced Energy = 77 MW*(15/60)hrs = 19 MWh	
20 December 2007	TAS	Loss of a Sheffield-Burnie 220kV line and a Sheffield-Burnie 110kV line due to severe lightning caused a transient depression in system voltage in Tasmania.	191.3 MW load reduction (no disconnection) due to the event, 126 MW load lost due to customer participation in FCSPS	Security	No	04:13	04:24
						Duration = 11 minutes	
						Unserviced Energy = 191.3 MW*(11/60)hrs = 35 MWh	
30 December 2007	QLD	A fault on a Country Energy 66kV line caused the transformers at Terranora to trip out of service thus	64 MW	Security	No	12:10	15:12
						Duration: 3.03 hrs	

Date	Region	Description of Event	Amount of load shed	Security or Reliability Event?	Related to extreme weather?	Unserviced Energy (MWh)	
						Load Shed Start Time	Load Restoration Start Time
		interrupting auxiliary supplies to Directlink. Event resulted in loss of Directlink and 64 MW of load.				Unserviced Energy = 64 MW*(3.03)hrs = 194 MWh	
6 January 2008	QLD	Current Transformer failure at Palmwoods resulted in tripping of No.2 transformer and No.1 and 2 132 kV bus sections. Event resulted in a loss of approx. 110MW of load.	110 MW	Security	No	07:08	08:12
						Duration: 1.06 hrs	
						Unserviced Energy = 110 MW*(1.06)hrs = 117 MWh	
11 May 2008	QLD	Trip of Woree 1 and 2 132kV Busbars, resulting in loss of supply to Cairns, Innisfail and Edmonton. Approx. 96 MW of load was lost.	96 MW	Security	No	07:18	07:58
						Duration:0.67 hrs	
						Unserviced Energy = 96 MW*(0.67)hrs = 64 MWh	
18 August 2008	NSW	Control problem with Directlink resulted in trip of 3 Lismore 132kV feeders subsequently interrupting 149MW of customer load	149 MW	Security	No	19:58	20:21
						Duration: 0.38 hrs	
						Unserviced Energy = 149 MW*(0.38)hrs = 57 MWh	



Date	Region	Description of Event	Amount of load shed	Security or Reliability Event?	Related to extreme weather?	Unserviced Energy (MWh)	
						Load Shed Start Time	Load Restoration Start Time
27 November 2008	QLD	Multiple Contingency event involving the loss of 2 132kV lines (Townsville - Cardwell and Ingham South - Cardwell) resulting in interruption of supply to Cardwell. Approx. 4MW of load interrupted.	4MW	Security	No	12:59	13:26
						Duration: 0.45 hrs	
						Unserviced Energy = 4 MW*(0.45)hrs = 1.8 MWh	
8 December 2008	QLD	Unplanned Outage of both Woree-Chalumbin 275kV lines due to high voltage faults caused by severe lightning resulted in loss of 238 MW of supply in far north Queensland	238 MW	Security	No	16:13	16:33
						Duration: 0.33 hrs	
						Unserviced Energy = 238 MW*(0.33)hrs = 79.3 MWh	
29 December 2008	NSW	Newcastle-Eraring 330kV line tripped due to lightning activity during a thunderstorm, resulting in a voltage and frequency depression. This caused No.1 potline of Hydro Aluminium to trip interrupting 102MW of potline load.	102 MW	Security	Yes	13:05	13:19
						Duration: 0.23 hrs	
						Unserviced Energy = 102 MW*(0.23)hrs = 23.5 MWh	
22 January	QLD	North Queensland system	786 MW	Security	No	17:31	17:56

Date	Region	Description of Event	Amount of load shed	Security or Reliability Event?	Related to extreme weather?	Unserviced Energy (MWh)	
						Load Shed Start Time	Load Restoration Start Time
2009		collapsed to a black system due to loss of Strathmore-Ross and Clare-Townsville 275kV lines resulting in 786 MW of load being interrupted.				Duration: 0.42 hrs	
						Unserviced Energy = 786 MW*(0.42)hrs = 330 MWh	
29 January 2009	VIC & SA	LOR3 in Victoria between 12:40 hrs to 15:20 hrs Victoria region. Approximately 280 MW of load shed in Victoria.	280 MW in VIC, 140 MW in SA	Reliability	Yes	VIC	
						12:40	15:20
						Duration: 2.67 hrs	
		Unserviced Energy = 807 MWh (as per incident report)					
		SA					
		13:50				15:22	
		Duration: 1.53 hrs					
Unserviced Energy = 160 MWh (as per incident report)							
30 January 2009	VIC & SA	LOR3 in Victoria between 12:25 hrs to 16:15 hrs. Approx 340MW load shed in Vic region.	340 MW in VIC, 90 MW in SA	Reliability	Yes	VIC	
						12:25	16:15
		Duration: 3.83 hrs					
		Unserviced Energy = 1071 MWh (as per incident report)					
		SA					
LOR3 in SA between 12:52 hrs to 15:35 hrs. Approx 90 MW load shed in SA region.							

Date	Region	Description of Event	Amount of load shed	Security or Reliability Event?	Related to extreme weather?	Unserved Energy (MWh)	
						Load Shed Start Time	Load Restoration Start Time
						12:52	15:35
						Duration: 2.72 hrs	
						Unserved Energy = 263 MWh (as per incident report)	
30 January 2009	VIC	Sydenham - South Morang # 2 500kV line tripped with the South Morang - Keilor line already out of service, requiring 1200 MW of load to be shed west of Keilor	1200 MW	Security	No	17:01	20:00
						Duration: 2.98 hrs	
						Unserved Energy = 2783 MWh (as per incident report)	
8 February 2009	VIC	NSW and VIC power systems separated following a further transmission line fault in Victoria in addition to the six transmission lines that were already out of service from the previous day due to bushfire related line faults. A total of 198MW of load was shed over the whole day.	Up to 198 MW during several periods of shedding	Security	Yes	00:22	04:22
						Duration: 4 hrs	
						Unserved Energy = 143 MWh (calculated from incident report)	
8 February 2009	VIC	Further load shedding of 50MW to maintain flow on Ballarat-Bendigo line.	Up to 198 MW during several periods of shedding	Security	No	11:16	12:25
						Duration: 1.15 hrs	
						Unserved Energy = 109 MWh (calculated from incident report)	

Date	Region	Description of Event	Amount of load shed	Security or Reliability Event?	Related to extreme weather?	Unserviced Energy (MWh)	
						Load Shed Start Time	Load Restoration Start Time
8 March 2009	QLD	Multiple unplanned outages of Woree-Chalumbin 275kV lines resulted in a load loss of 178 MW.	178 MW	Security	No	20:30	20:55
						Duration: 0.42 hrs	
						Unserviced Energy = 178 MW*(0.42)hrs = 75 MWh	
3 April 2009	VIC	Unplanned outage of both Dederang-Wodonga and Jindera-Wodonga 330kV lines blacked out Wodonga substation interrupting 50MW of load supplied from Wodonga substation.	50 MW	Security	No	15:51	16:03
						Duration: 0.2 hrs	
						Unserviced Energy = 50 MW*(0.2)hrs = 10 MWh	
9 June 2009	SA	Unplanned Transformer and Bus outage due to heavy hailstorms at Snuggery caused disconnection of 2 of 3 33kV feeders supplying industrial load in the area. Industrial load reduced by 6 MW.	Load reduction of 6 MW.	Security	Yes	08:13	10:26
						Duration: 2.22hrs	
						Unserviced Energy = 6 MW*(2.22)hrs = 13 MWh	

Date	Region	Description of Event	Amount of load shed	Security or Reliability Event?	Related to extreme weather?	Unserviced Energy (MWh)	
						Load Shed Start Time	Load Restoration Start Time
2 July 2009	NSW	Multiple generator disconnection from the power system (All units at Bayswater, Mt.Piper Unit 2, Gladstone Unit 5, Tarong Unit 4) resulted in 1131 MW of load being interrupted due to under frequency load shedding.	1131 MW	Security	No	Loads were disconnected for varying amounts of time mostly between 10:47-11:50  Unserved Energy = $100*0.6 + 83*0.8+287*0.53 +97*1+60*0.183 +30*0.183 +150*0.32+324*0.23$  = 515 MWh	
23 July 2009	QLD	A 33kV fault at Cooroy resulted in tripping of 2 132kV lines and consequent loss of transformers at Gympie. A total of 92 MW of load in the Sunshine Coast area was interrupted as a result.	92 MW	Security	No	14:32	15:14
						Duration: 0.7hr	
						Unserved Energy = $92 \text{ MW}*(0.7)\text{hrs}$ = 64 MWh	
8 October 2009	VIC	An unplanned outage of the #1 220kV bus at Keilor, with a prior outage of #3 220kV Bus resulted in tripping a transformer. Subsequent overload and trip of another transformer resulted in loss of 242 MW of load.	242 MW	Security	No	15:00	16:17
						Duration: 1.28 hrs	
						Unserved Energy = $242 \text{ MW}*(1.28)\text{hrs}$ = 310 MWh	

Date	Region	Description of Event	Amount of load shed	Security or Reliability Event?	Related to extreme weather?	Unserviced Energy (MWh)	
						Load Shed Start Time	Load Restoration Start Time
13 October 2009	QLD	Townsville South 132kV Busbar tripped resulting in a reduction of load of approximately 100MW supplied from the Townsville South substation.	100 MW	Security	No	13:05	16:49
						Duration: 3.73 hrs	
						Unserviced Energy = 100 MW*(3.73)hrs = 373 MWh	
21 November 2009	QLD	An unplanned outage of a 132kV busbar at Alan Sheriff substation caused a load interruption of 9 MW for 54 seconds.	9 MW	Security	No	USE = 9MW * 0.015 = 0.1 MWh	
28 November 2009	NSW	Multiple Contingency Event involving loss of Newcastle to Tomago 330kV Transmission Line, Energy Australia 132kV feeders 960, 961 and 96Z due to bushfires in the vicinity. Approx 800MW of customer load and Alcan potlines 1(105MW) and 2(107MW) lost.	1078 MW P/L (Tomago + Kurri) + 243 MW customer	Security	Yes	Customer load lost - 15:52	Customer load restored 16:14
						Potline load lost - 15:54 to 16:27	Potline load restored - 16:20 to 18:20
						USE = 1706 MWh (calculated from incident report)	
25 January 2010	QLD	A contingency involving the loss of a transformer at Edmonton and 2 132kV lines	13MW	Security	No	03:45	06:55
						Duration = 3.2 hrs	

Date	Region	Description of Event	Amount of load shed	Security or Reliability Event?	Related to extreme weather?	Unserviced Energy (MWh)	
						Load Shed Start Time	Load Restoration Start Time
		(Woree – Edmonton and Innisfail- Edmonton) resulted in a loss of load of 13MW at Edmonton.				Unserviced Energy = 13 MW*(3.2)hrs = 42 MWh	
14 February 2010	QLD	Loss of both Lilyvale-Claremont and Claremont – Barcaldine132kV transmission lines caused a 6MW loss of load at Barcaldine and 19 MW at Claremont.	25MW	Security	No	17:40	18:13
						Duration: 0.55 hrs	
						Unserviced Energy = 25 MW*(0.55)hrs = 14 MWh	
16 February 2010	QLD	Unplanned outage of both South Pine to Palmwoods, 110kV lines resulted in interrupting approx. 120MW of load at Caboolture.	120MW	Security	No	14:14	14:34
						Duration: 0.33 hrs	
						Unserviced Energy = 120 MW*(0.33)hrs = 40 MWh	
16 February 2010	QLD	Loss of both Cardwell-Townsville and Cardwell-Ingham South 132kV lines resulted in tripping approx. 6MW of load at Cardwell and Ingham East.	6MW	Security	No	17:35	17:53
						Duration: 0.3 hrs	
						Unserviced Energy = 6 MW*(0.3)hrs = 2 MWh	
17 February 2010	QLD	Loss of both Cardwell-Townsville and Cardwell-	8MW	Security	No	20:32	20:56
						Duration: 0.4 hrs	

Date	Region	Description of Event	Amount of load shed	Security or Reliability Event?	Related to extreme weather?	Unserved Energy (MWh)	
						Load Shed Start Time	Load Restoration Start Time
		Ingham South 132kV lines resulted in tripping approx. 8MW of load at Cardwell and Ingham East.				Unserved Energy = 8 MW*(0.4)hrs = 3 MWh	