

Voltage sag test

- Summary of inverter tested

Table 3: Summary of inverter behaviors due to short duration voltage sag

	2005 inverters			2015 inverters		
	Inv.	Brand	Total	Inv.	Brand	Total
N°of inv. riding through	1/14	A/E	2	1,6,7/3,13,19/5/17 22/23	A/C/E/G J/K	9
N°of inv. disconnecting	8/15/18,21	A/F/I	4	11/20	F/H	2
N°of inv. curtailing ($P > 0$)	-	-	-	2/16	B/D	2
N°of inv. curtailing ($P = 0$)	-	-	-	4, 10, 12	D	3
N°of inv. with other behavior	6,24/9	A/B	3	-	-	-
Total N°of inv. tested	9			16		

- Installed power not riding through the voltage sag (just refer to the “this milestone” row)

Table 4: Cumulative power of inverters tested not riding-through the short duration voltage sag test. The percentage figure is obtained by dividing the power reported in the table by the total DER power in a state or the NEM (considering DER of power up to 10 kW)

	NSW	VIC	QLD	SA	WA	TAS	NT	NEM
MW - prev. Milestone	24	37	43	16	15	2	1	138
%	2	3	2	2.0	2	2	2	2
MW - this Milestone	105	91	116	46	32	6	3	398
%	7	7	6	6	3	6	5	6

- Estimated installed power not riding through the voltage sag, assuming the distribution of inverters installed in the field is the same as the one of the inverter tested in the lab (just refer to the “this milestone” row)

Table 5: Power loss due to disconnection or curtailment caused by fast voltage sag, under the hypothesis that all inverters in the NEM behaves like the inverters tested so far

	NSW	VIC	QLD	SA	WA	TAS	NT	NEM
MW - prev. Milestone	361	527	292	278	303	29	9	1549
%	24	41	14	35	32	26	16	23
MW - this Milestone	620	513	472	244	268	33	13	2095
%	41	40	23	31	29	30	25	31

Phase angle jump test

- Summary of inverter tested

2005 inverters

Table 6: Phase-angle-jump tests for 2005 inverters

Inv.	Brand	15°	30°	45°	90 °
1	A	✓	✓	✓	✓
6	A	✓	✓	✓	✓
8	A	✓	✓	✓	X
9	B	✓	✓	X	X
14	E	✓	✓	✓	X
15	G	✓	X	X	X
18	I	✓	✓	✓	✓

2015 inverters

Table 7: Phase-angle-jump tests for 2015 inverters

Inv.	Brand	15°	30°	45°	90°
1	A	✓	X	-	-
2	B	✓	curtail	X	X
3, 13	C	✓	✓	✓	✓
4	D	P=0	curtail	P=0	P=0
5	E	✓	✓	✓	✓
6	A	✓	X	X	X
7	A	✓	curtail	P=0	P=0
10	D	P=0	P=0	P=0	P=0
11	F	X	X	-	-
12	D	P=0	P=0	P=0	P=0
13	C	✓	✓	✓	✓
16	D	✓	✓	✓	curtail
17	G	✓	✓	✓	✓
19	A	✓	✓	curtail	P=0
20	H	✓	✓	X	X
21	I	✓	✓	✓	✓
22	J	✓	✓	✓	✓
23	K	✓	curtail	curtail	curtail
24	A	✓	✓	✓	✓

- Installed power not riding through the phase angle jump tests (just refer to the “this milestone” rows)

Table 8: Cumulative power of inverters not riding-through phase-angle-jump tests (note: the percentage figure is a ratio between the cumulative power in MW and the total DER power of inverters up to 10 kW installed in a state or in the NEM)

Not riding through PAJ		NSW	VIC	QLD	SA	WA	TAS	NT	NEM
15°	MW - prev. Miles	5	13	11	3	4	1 5	0	36
	%	0.3	1.0	0.5	0.4	0.4	0.9	0	0.5
15°	MW - this Miles	7	13	12	5	5	1	0	42
	%	0.4	1.0	0.6	0.6	0.5	0.9	0	0.6
30°	MW - prev. Miles	20	32	34	11	11	2	1	113
	%	1	3	2	1	1	2	2	2
30°	MW - this Miles	40	59	39	14	37	2	1	192
	%	2.7	4.6	1.9	1.7	3.9	1.8	1.6	2.8
45°	MW - prev. Miles	34	39	54	22	17	3	4	173
	%	2	3	3	3	2	2	8	3
45°	MW - this Miles	97	99	116	44	55	6	6	423
	%	7	8	6	6	6	5	11	6
90°	MW - prev. Miles	43	50	145	28	23	6	5	299
	%	3	4	7	4	2	6	9	4
90°	MW - this Miles	114	117	259	54	62	10	6	623
	%	8	9	12	7	7	9	12	9

- Estimated installed power not riding through the phase angle jump tests, assuming the distribution of inverters installed in the filed is the same as the one of the inverter tested in the lab (just refer to the “this milestone” row)

Table 9: Extrapolated power vulnerable to phase-angle jump disturbances, under the assumption that the distribution of inverters in the NEM is identical to the distribution of inverters bench-tested

Not riding through PAJ		NSW	VIC	QLD	SA	WA	TAS	NT	NEM
15°	MW - prev. Miles	71	188	73	54	78	12	0	410
	%	5	15	3	7	8	11	0	6
15°	MW - this Miles	40	76	47	24	42	5	0	222
	%	3	6	2	3	4	4	0	3
30°	MW - prev. Miles	307	462	235	195	236	22	8	1266
	%	20	36	11	25	25	20	15	19
30°	MW - this Miles	239	335	159	72	310	10	5	1010
	%	20	36	11	25	25	20	15	19
45°	MW - pre. Miles	515	558	368	371	360	30	42	1947
	%	34	43	18	47	38	27	78	29
45°	MW - this Miles.	577	561	470	233	463	30	31	2224
	%	39	44	22	29	49	27	58	33
90°	MW - prev. Miles	639	722	990	483	470	73	43	3366
	%	43	56	47	61	50	65	80	50
90°	MW - this Miles	673	663	1054	287	523	54	33	3276
	%	45	52	50	36	56	49	61	48

RoCoF test

- Summary

Table 10: Summary of inverter behaviors caused by RoCoF stimuli

	2005 inverters			2015 inverters		
	Inv.	Brand	Total	Inv.	Brand	Total
N ^o of inv. disconnecting @ 10 Hz/s	-	-	-	4	D	1
N ^o of inv. disconnecting @ 1, 4, 10 Hz/s	14	E	1	5	E	1
N ^o of inv. riding through @ 1, 4, 10 Hz/s	all others		8	all others		14
Total N ^o of inv. tested			5			16

- Installed power not riding through 1 Hz/s RoCoF (just refer to the “this milestone” rows)

Table 11: Cumulative power of inverters not riding-through RoCoF. The percentage figure is a ratio between the power reported in the table and the total DER power in a state or the NEM, for DER up to 10 kW

Not riding through 1 Hz/s RoCoF		NSW	VIC	QLD	SA	WA	TAS	NT	NEM
Inv. 5 & Inv. 14	MW - prev. Miles	22	21	165	12	9	5	0	234
	%	1	2	8	2	1	5	1	3

- Estimated installed power not riding through the 1 Hz/s RoCoF test, assuming the distribution of inverters installed in the field is the same as the one of the inverter tested in the lab (just refer to the “this milestone” row)

Table 12: Power loss due to disconnection caused by RoCoF, under the hypothesis that all inverters in the NEM behaves like the inverters tested so far

Not riding through 1 Hz/s RoCoF		NSW	VIC	QLD	SA	WA	TAS	NT	NEM
Inv. 5 & Inv. 14	MW - prev. Miles	323	301	1129	207	178	61	4	2629
	%	22	23	54	26	19	55	7	39
Inv. 5 & Inv. 14	MW - this Miles	128	119	672	64	72	27	2	1232
	%	9	9	32	8	8	24	4	18

Other tables of interest

Cumulative power from rooftop PV systems < 10 kW and installed power from the inverter tested in the lab

Table 1: Cumulative power in GW of PV systems with size up to 10 kW installed to date in Australia [13]

	NSW	VIC	QLD	SA	WA	TAS	NT	NEM
GW	1.5	1.29	2.1	0.79	0.94	0.11	0.05	6.78

Table 2: Power from the inverter tested so far, obtained by multiplying the number of units installed by the power rating of each unit

	NSW	VIC	QLD	SA	WA	TAS	NT	NEM
MW	253	227	516	149	112	21	10	1288

We have tested 1.288 GW out of 6.78 GW installed (note that the power installed figure is increasing month by month and updated in the APVI website)