



F.3 Requirements for the Test Report for Power Generation Systems

Extract from test report for unit certificate "Determination of electrical properties"						No. JJJJ-nnnn (consecutive number) _____					
Type of system: Microturbine Generator/Inverter						Manufacturer's data					
System manufacturer: Capstone Turbine Corporation						Type of system (CHP, PV-WT, etc.):					
Street, number: 21211 Nordhoff St.						Micorturbine Generator/Inverter					
City, State/Province: Chatsworth, CA						Active power (nominal power at reference conditions)				65 kW	
Zip/Postal code: 91311						Rated voltage:				230 V	
Measuring period						from:2013-02-28			to:2013-03-06		
Active power						P _E max			65 kW		
Reactive power reference											
Active power P/P _n [%]	10	20	30	40	50	60	70	80	90	100	
Maximum possible cos φ _{underexcited}	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	
Maximum possible cos φ _{overexcited}	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	
Compliance of required displacement factor cos φ											
Default in system control	0,900 _{ov}	0,920 _{ov}	0,930 _{ov}	0,960 _{ov}	0,980 _{ov}	1,000	0,980 _{un}	0,960 _{un}	0,940 _{un}	0,920 _{un}	0,900 _{un}
Measured value at PGU terminals	0.92	0.93	0.94	0.97	0.99	1	0.97	0.95	0.93	0.91	0.89
Reactive power transfer function – Standard-cos φ (P)-characteristic											
Active power P/P _n [%]	10	20	30	40	50	60	70	80	90	100	
cos φ	1	1	1	1	1	0.98	0.96	0.95	0.93	0.9	
Conform to Standard-cos φ (P)-characteristic											
Switching actions											
Making operation without default (of primary energy carrier)						k _i Worst		0.025			
Case at switch over of generator sections						k _i		0.135			
Making operation at reference conditions (of primary energy carrier)						k _i		0.025			
Breaking operation at nominal power						k _i Worst-		1			
Case value of all switching operations						k _{imax}		1			
Flicker		Angle of network impedance ψ		30°	50°	70°	85°				
		Coefficient of system flicker c _{ψ}		28.5	-	-	-				
Harmonics: PF 1.0											
Active power P/P _n [%]	0	10	20	30	40	50	60	70	80	90	100
Harmonic number	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]
2	0.21	0.05	0.07	0.01	0.16	0.26	0.1	0.18	0.03	0.19	0.01
3	3.3	3.22	3.14	2.99	2.67	2.64	2.68	2.35	2.48	2.33	2.26
4	0.05	0.14	0.13	0.11	0.1	0.14	0.1	0.12	0.07	0.11	0.07
5	0.38	0.5	0.51	0.51	0.48	0.4	0.55	0.47	0.61	0.47	0.63



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Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Harmonic number	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]
6	0.03	0.01	0	0.01	0.04	0.05	0.02	0.04	0.01	0.05	0.01
7	0.87	0.99	1.06	0.97	0.64	0.46	0.88	0.64	0.09	0.58	0.91
8	0.05	0.02	0.07	0.08	0.07	0.06	0.07	0.07	0.05	0.06	0.03
9	0.32	0.42	0.47	0.37	0.18	0.11	0.25	0.14	0.23	0.1	0.18
10	0.04	0.05	0.02	0.05	0.06	0.03	0.07	0.04	0.05	0.04	0.04
11	0.09	0.16	0.26	0.19	0.08	0.04	0.17	0.09	0.21	0.07	0.22
12	0.01	0	0	0.01	0.02	0.03	0.01	0.02	0	0.02	0.01
13	0.05	0.08	0.16	0.1	0.01	0.02	0.06	0.03	0.09	0.03	0.09
14	0.01	0.02	0.06	0.01	0.01	0.03	0.04	0.02	0.04	0.02	0.04
15	0.02	0.03	0.06	0.03	0.01	0.01	0.02	0.02	0.04	0.02	0.03
16	0.02	0.01	0.07	0.01	0.01	0.03	0.03	0.02	0.03	0.02	0.03
17	0.02	0.04	0.11	0.04	0.01	0.03	0.03	0.02	0.05	0.02	0.06
18	0.01	0	0.01	0	0.01	0.02	0.01	0.01	0	0.01	0
19	0	0	0	0	0.01	0	0	0	0	0	0.04
20	0.01	0.01	0.03	0.02	0.01	0.02	0.01	0.02	0.02	0.02	0.02
21	0.01	0	0.01	0	0.01	0.01	0.01	0.01	0	0.01	0.01
22	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
23	0.01	0.03	0.15	0.03	0.01	0.01	0	0.01	0.02	0.01	0.01
24	0.01	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
25	0.01	0.02	18	0.03	0.01	0.01	0	0.01	0.02	0.01	0.01
26	0.01	0.01	0.06	0	0.01	0.01	0	0.01	0.01	0.01	0.01
27	0.01	0.03	19	0.03	0.01	0.01	0.01	0.01	0.04	0.01	0.04
28	0.01	0.01	0.05	0	0.01	0.01	0	0.01	0	0.01	0.01
29	0.01	0.01	0.09	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
30	0.01	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
31	0.01	0	0.06	0	0.01	0.01	0	0.01	0.01	0.01	0.01
32	0.01	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0.01
33	0.01	0	0.04	0.01	0.01	0.01	0	0.01	0	0.01	0
34	0.01	0	0.03	0	0.01	0.01	0	0.01	0	0.01	0
35	0	0	0.05	0	0.01	0.01	0	0.01	0	0.01	0
36	0.01	0	0	0	0.01	0.01	0	0.01	0	0.01	0
37	0	0	0.04	0	0.01	0.01	0	0.01	0	0.01	0

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Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Harmonic number	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]
38	0.01	0	0.02	0	0.01	0.01	0	0.01	0	0.01	0
39	0	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
40	0	0	0.03	0	0.01	0.01	0	0.01	0	0.01	0
Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency [Hz]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]
75	0.26	0.04	0.03	0.04	0.34	0.39	0.16	0.29	0.01	0.33	0.02
125	0.11	0.02	0	0.03	0.14	0.17	0.06	0.14	0.01	0.15	0.02
175	0.04	0.03	0.02	0.01	0.06	0.08	0.025	0.05	0.02	0.06	0.01
225	0.03	0.02	0.01	0.01	0.05	0.07	0.02	0.04	0	0.05	0.03
275	0.03	0.02	0.01	0.02	0.06	0.05	0.02	0.05	0.02	0.06	0.01
325	0.03	0.03	0.01	0.03	0.05	0.05	0.02	0.04	0.01	0.04	0
375	0.03	0.01	0	0.01	0.03	0.05	0.01	0.04	0	0.04	0
425	0.02	0.02	0.01	0.02	0.03	0.05	0	0.03	0.01	0.03	0.02
475	0.02	0.01	0	0.01	0.02	0.03	0.01	0.03	0.01	0.03	0
525	0.02	0.01	0	0.01	0.03	0.03	0.01	0.02	0	0.02	0
575	0.01	0.01	0.01	0.01	0.02	0.03	0.01	0.02	0	0.02	0
625	0.01	0.01	0	0.01	0.02	0.03	0.01	0.02	0	0.02	0
675	0.01	0	0	0	0.02	0.03	0.01	0.02	0	0.02	0
725	0.01	0.01	0	0	0.02	0.02	0.01	0.01	0	0.02	0
775	0.01	0	0.01	0	0.02	0.02	0.01	0.02	0	0.02	0
825	0.01	0	0	0.01	0.02	0.02	0.01	0.02	0	0.01	0
875	0.01	0	0.01	0	0.01	0.02	0.01	0.01	0	0.01	0
925	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0	0.01	0
975	0.01	0	0	0	0.01	0.02	0	0.01	0	0.01	0
1025	0.01	0	0.01	0	0.01	0.02	0.01	0.01	0	0.01	0
1075	0.01	0	0	0	0.01	0.01	0	0.01	0	0.01	0
1125	0.01	0	0	0	0.01	0.01	0.01	0.01	0	0.01	0
1175	0.01	0	0	0	0.01	0.01	0	0.01	0	0.01	0
1225	0.01	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
1275	0.01	0	0	0	0.01	0.01	0	0.01	0	0.01	0
1325	0.01	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
1375	0.01	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
1425	0.01	0	0	0	0.01	0.01	0	0.01	0	0.01	0

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Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency [Hz]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]
1475	0.01	0	0	0	0.01	0.01	0	0.01	0	0.01	0
1525	0	0	0.02	0	0.01	0.01	0	0.01	0	0.01	0
1575	0.01	0	0	0	0.01	0.01	0	0.01	0	0.01	0
1625	0	0	0.02	0	0.01	0.01	0	0.01	0	0.01	0
1675	0.01	0	0	0	0.01	0.01	0	0.01	0	0.01	0
1725	0.01	0	0	0	0.01	0.01	0	0.01	0	0.01	0
1775	0.01	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
1825	0.01	0	1	0	0.01	0.01	0	0.01	0	0.01	0
1875	0	0	0	0	0.01	0.01	0	0.01	0	0.01	0
1925	0.01	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
1975	0	0	0	0	0.01	0.01	0	0.01	0	0.01	0
Higher Frequencies											
Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency [Hz]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]
2,1	0	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
2,3	0	0	0.01	0	0	0	0	0.01	0	0.01	0
2,5	0	0	0.03	0	0	0	0	0	0	0.01	0
2,7	0	0	0.01	0	0	0	0	0	0	0	0
2,9	0	0	0.02	0	0	0	0	0	0	0	0
3,1	0	0	0.02	0	0	0	0	0	0	0	0
3,3	0	0	0.01	0	0	0	0	0	0	0	0
3,5	0	0	0.01	0	0	0	0	0	0	0	0
3,7	0	0	0.01	0	0	0	0	0	0	0	0
3,9	0	0	0	0	0	0	0	0	0	0	0
4,1	0	0	0	0	0	0	0	0	0	0	0
4,3	0	0	0.01	0	0	0	0	0	0	0	0
4,5	0	0	0	0	0	0	0	0	0	0	0
4,7	0	0	0.01	0	0	0	0	0	0	0	0
4,9	0	0	0	0	0	0	0	0	0	0	0
5,1	0	0	0	0	0	0	0	0	0	0	0
5,3	0	0	0.01	0	0	0	0	0	0	0	0
5,5	0	0	0.01	0	0	0	0	0	0	0	0
5,7	0	0	0	0	0	0	0	0	0	0	0

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Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency [Hz]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]
5,9	0	0	0	0	0	0	0	0	0	0	0
6,1	0	0	0	0	0	0	0	0	0	0	0
6,3	0	0	0	0	0	0	0	0	0	0	0
6,5	0	0	0.01	0	0	0	0	0	0	0	0
6,7	0	0	0	0	0	0	0	0	0	0	0
6,9	0	0	0	0	0	0	0	0	0	0	0
7,1	0	0	0	0	0	0	0	0	0	0	0
7,3	0	0	0	0	0	0	0	0	0	0	0
7,5	0	0	0	0	0	0	0	0	0	0	0
7,7	0	0	0	0	0	0	0	0	0	0	0
7,9	0	0	0	0	0	0	0	0	0	0	0
8,1	0	0	0	0	0	0	0	0	0	0	0
8,3	0	0	0	0	0	0	0	0	0	0	0
8,5	0	0	0	0	0	0	0	0	0	0	0
8,7	0	0	0	0	0	0	0	0	0	0	0
8,9	0	0	0	0	0	0	0	0	0	0	0



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Extract from test report for unit certificate "Determination of electrical properties"						No. JJJJ-nnnn (consecutive number) _____					
Type of system: Microturbine Generator/Inverter						Manufacturer's data					
System manufacturer: Capstone Turbine Corporation						Type of system (CHP, PV-WT, etc.):					
Street, number: 21211 Nordhoff St.						Micorturbine Generator/Inverter					
City, State/Province: Chatsworth, CA						Active power (nominal power at reference conditions)				65 kW	
Zip/Postal code: 91311						Rated voltage:				230 V	
Measuring period						from:2013-02-28			to:2013-03-06		
Active power						P _E max			65 kW		
Reactive power reference											
Active power P/P _n [%]	10	20	30	40	50	60	70	80	90	100	
Maximum possible cos φ _{underexcited}	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	
Maximum possible cos φ _{overexcited}	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	
Compliance of required displacement factor cos φ											
Default in system control	0,900 _{ov}	0,920 _{ov}	0,930 _{ov}	0,960 _{ov}	0,980 _{ov}	1,000	0,980 _{un}	0,960 _{un}	0,940 _{un}	0,920 _{un}	0,900 _{un}
Measured value at PGU terminals	0.92	0.93	0.94	0.97	0.99	1	0.97	0.95	0.93	0.91	0.89
Reactive power transfer function – Standard-cos φ (P)-characteristic											
Active power P/P _n [%]	10	20	30	40	50	60	70	80	90	100	
cos φ	1	1	1	1	1	0.98	0.96	0.95	0.93	0.9	
Conform to Standard-cos φ (P)-characteristic											
Switching actions											
Making operation without default (of primary energy carrier)						k _i Worst		0.025			
Case at switch over of generator sections						k _i		0.135			
Making operation at reference conditions (of primary energy carrier)						k _i		0.025			
Breaking operation at nominal power						k _i Worst-		1			
Case value of all switching operations						k _{imax}		1			
Flicker		Angle of network impedance ψ		30°	50°	70°	85°				
		Coefficient of system flicker c _{ψ}		28.5	—	—	—				
Harmonics: PF 0.9 lead											
Active power P/P _n [%]	0	10	20	30	40	50	60	70	80	90	100
Harmonic number	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]
2	0.21	0.06	0.02	0.04	0.14	0.24	0.07	0.15	0.03	0.16	0.06
3	3.3	3.18	3.03	2.89	2.59	2.46	2.49	2.23	2.24	2.1	2.02
4	0.05	0.09	0.06	0.04	0.03	0.08	0.04	0.07	0.01	0.07	0.02
5	0.38	0.47	0.53	0.52	0.52	0.39	0.53	0.46	0.59	0.45	0.58

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Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Harmonic number	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]
6	0.03	0	0.01	0.01	0.04	0.05	0.03	0.05	0.02	0.04	0.02
7	0.87	1.06	1.11	1.02	0.81	0.47	0.96	0.7	1.03	0.71	1.03
8	0.05	0.05	0.09	0.06	0.02	0.05	0.01	0.03	0.02	0.03	0.03
9	0.32	0.41	0.46	0.33	0.21	0.1	0.22	0.12	0.2	0.08	0.15
10	0.04	0.06	0.05	0.04	0.04	0.04	0.03	0.04	0.02	0.03	0.02
11	0.09	0.2	0.22	0.14	0.102	0.04	0.17	0.09	0.23	0.08	0.23
12	0.01	0	0	0	0.02	0.03	0.01	0.02	0	0.02	0
13	0.05	0.08	0.14	0.07	0.02	0	0.07	0.03	0.09	0.03	0.1
14	0.01	0.02	0.02	0.04	0.02	0.03	0.03	0.02	0.02	0.02	0.01
15	0.02	0.03	0.07	0.03	0	0.01	0.02	0.02	0.04	0.01	0.03
16	0.02	0.02	0.05	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01
17	0.02	0.05	0.14	0.04	0.02	0.03	0.04	0.02	0.06	0.02	0.07
18	0.01	0	0.01	0	0.01	0.02	0.01	0.01	0	0.01	0
19	0	0	0	0	0	0	0	0	0	0	0
20	0.01	0.01	0.03	0.01	0.01	0.01	0	0.01	0.01	0.01	0.01
21	0.01	0.01	0.04	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
22	0.01	0	0.07	0	0.01	0.02	0.01	0.01	0.01	0.01	0.01
23	0.01	0.03	0.18	0.02	0.01	0.01	0.01	0.01	0.02	0.01	0.01
24	0.01	0	0.01	0	0.01	0.01	0.01	0.01	0	0.01	0
25	0.01	0.02	0.19	0.02	0	0.01	0	0.01	0.01	0.01	0
26	0.01	0	0.01	0	0.01	0.01	0.01	0.01	0.01	0.01	0.01
27	0.01	0.02	0.16	0.02	0.01	0.01	0.01	0.01	0.04	0.01	0.03
28	0.01	0.01	0.04	0	0.01	0.01	0	0.01	0	0.01	0
29	0.01	0.01	0.07	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0
30	0.01	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
31	0.01	0	0.03	0	0.01	0.01	0	0.01	0.01	0.01	0
32	0.01	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
33	0.01	0.01	0.07	0	0.01	0.01	0	0.01	0.01	0.01	0.01
34	0.01	0	0.05	0.01	0.01	0.01	0	0.01	0	0.01	0
35	0	0	0.04	0	0.01	0.01	0	0.01	0	0.01	0
36	0.01	0	0	0	0.01	0.01	0	0.01	0	0.01	0
37	0	0	0.02	0	0	0.01	0	0.01		0.01	0

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Requirements for the Test Report for Power Generation Systems

Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Harmonic number	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]
38	0.01	0	0.01	0	0	0.01	0	0.01	0	0.01	0
39	0	0	0.01	0	0	0.01	0	0.01	0	0.01	0
40	0	0	0.05	0	0	0.01	0	0.01	0	0.01	0
Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency [Hz]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]
75	0.26	0.04	0.03	0.07	0.22	0.39	0.17	0.34	0.08	0.34	0.07
125	0.11	0.02	0.02	0.03	0.11	0.18	0.07	0.15	0.03	0.13	0.02
175	0.04	0	0	0.02	0.05	0.08	0.03	0.07	0.03	0.07	0
225	0.03	0.01	0.01	0.01	0.05	0.07	0.03	0.04	0.03	0.05	0.03
275	0.03	0.01	0.01	0.01	0.04	0.05	0.03	0.05	0.03	0.05	0.01
325	0.03	0.02	0.01	0.02	0.04	0.05	0.02	0.04	0	0.05	0.02
375	0.03	0	0.01	0	0.02	0.05	0.01	0.03	0.01	0.03	0.01
425	0.02	0.01	0.02	0.01	0.02	0.04	0.01	0.03	0.01	0.03	0.01
475	0.02	0.01	0.02	0.01	0.02	0.03	0.02	0.03	0	0.03	0.01
525	0.02	0	0	0.01	0.02	0.03	0.01	0.02	0.01	0.03	0
575	0.01	0	0.01	0.01	0.02	0.03	0.01	0.02	0	0.02	0
625	0.01	0.01	0.01	0	0.01	0.03	0.01	0.02	0	0.02	0
675	0.01	0	0	0.01	0.01	0.02	0.01	0.02	0	0.02	0
725	0.01	0	0.01	0	0.01	0.02	0.01	0.02	0	0.02	0
775	0.01	0	0.02	0	0.01	0.02	0.01	0.02	0	0.02	0
825	0.01	0	0	0	0.01	0.02	0.01	0.01	0	0.02	0.01
875	0.01	0	0	0.01	0.01	0.02	0.01	0.01	0	0.01	0
925	0.01	0	0.01	0	0.01	0.02	0.01	0.01	0	0.01	0
975	0.01	0	0	0	0.01	0.02	0.01	0.01	0	0.01	0
1025	0.01	0	0.01	0	0.01	0.02	0.01	0.01	0	0.01	0
1075	0.01	0	0.02	0	0.01	0.02	0.01	0.01	0	0.01	0
1125	0.01	0	0	0	0.01	0.01	0	0.01	0	0.01	0
1175	0.01	0	0.01	0	0.01	0.02	0	0.01	0	0.01	0
1225	0.01	0	0	0	0.01	0.01	0.01	0.01	0	0.01	0
1275	0.01	0	0	0	0.01	0.01	0	0.01	0	0.01	0
1325	0.01	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
1375	0.01	0	0.02	0	0.01	0.01	0	0.01	0	0.01	0
1425	0.01	0	0	0	0.01	0.01	0	0.01	0	0.01	0

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Requirements for the Test Report for Power Generation Systems

Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency [Hz]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]
1475	0.01	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
1525	0	0	0.02	0	0.01	0.01	0	0.01	0	0.01	0
1575	0.01	0	0	0	0.01	0.01	0	0.01	0	0.01	0
1625	0	0	0.02	0	0.01	0.01	0.01	0.01	0	0.01	0
1675	0.01	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
1725	0.01	0	0	0	0.01	0.01	0	0.01	0	0.01	0
1775	0.01	0	0.01	0	0	0.01	0	0.01	0	0.01	0
1825	0.01	0	0	0	0.01	0.01	0	0.01	0	0.01	0
1875	0	0	0	0	0.01	0.01	0	0.01	0	0.01	0
1925	0.01	0	0.01	0	0	0.01	0	0.01	0	0.01	0
1975	0	0	0.02	0	0.01	0.01	0	0.01	0	0.01	0
Higher Frequencies											
Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency [Hz]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]
2,1	0	0	0	0	0	0.01	0	0.01	0	0.01	0
2,3	0	0	0.02	0	0	0.01	0	0.01	0	0.01	0
2,5	0	0	0.02	0	0	0.01	0	0.01	0	0.01	0
2,7	0	0	0.02	0	0	0.01	0	0	0	0	0
2,9	0	0	0.01	0	0	0.01	0	0	0	0	0
3,1	0	0	0.03	0	0	0.01	0	0	0	0	0
3,3	0	0	0	0	0	0	0	0	0	0	0
3,5	0	0	0.02	0	0	0	0	0	0	0	0
3,7	0	0	0.01	0	0	0	0	0	0	0	0
3,9	0	0	0.01	0	0	0	0	0	0	0	0
4,1	0	0	0.01	0	0	0	0	0	0	0	0
4,3	0	0	0.01	0	0	0	0	0	0	0	0
4,5	0	0	0	0	0	0	0	0	0	0	0
4,7	0	0	0.01	0	0	0	0	0	0	0	0
4,9	0	0	0.01	0	0	0	0	0	0	0	0
5,1	0	0	0	0	0	0	0	0	0	0	0
5,3	0	0	0	0	0	0	0	0	0	0	0
5,5	0	0	0.01	0	0	0	0	0	0	0	0
5,7	0	0	0	0	0	0	0	0	0	0	0

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Requirements for the Test Report for Power Generation Systems

Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency [Hz]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]
5,9	0	0	0	0	0	0	0	0	0	0	0
6,1	0	0	0	0	0	0	0	0	0	0	0
6,3	0	0	0	0	0	0	0	0	0	0	0
6,5	0	0	0	0	0	0	0	0	0	0	0
6,7	0	0	0	0	0	0	0	0	0	0	0
6,9	0	0	0	0	0	0	0	0	0	0	0
7,1	0	0	0	0	0	0	0	0	0	0	0
7,3	0	0	0	0	0	0	0	0	0	0	0
7,5	0	0	0	0	0	0	0	0	0	0	0
7,7	0	0	0	0	0	0	0	0	0	0	0
7,9	0	0	0	0	0	0	0	0	0	0	0
8,1	0	0	0	0	0	0	0	0	0	0	0
8,3	0	0	0	0	0	0	0	0	0	0	0
8,5	0	0	0	0	0	0	0	0	0	0	0
8,7	0	0	0	0	0	0	0	0	0	0	0
8,9	0	0	0	0	0	0	0	0	0	0	0



F.3 Requirements for the Test Report for Power Generation Systems

Extract from test report for unit certificate "Determination of electrical properties"						No. JJJJ-nnnn (consecutive number) _____					
Type of system: Microturbine Generator/Inverter						Manufacturer's data					
System manufacturer: Capstone Turbine Corporation						Type of system (CHP, PV-WT, etc.):					
Street, number: 21211 Nordhoff St.						Microturbine Generator/Inverter					
City, State/Province: Chatsworth, CA						Active power (nominal power at reference conditions)				65 kW	
Zip/Postal code: 91311						Rated voltage:				230 V	
Measuring period						from:2013-02-28			to:2013-03-06		
Active power						P _{Emax}			65 kW		
Reactive power reference											
Active power P/P _n [%]	10	20	30	40	50	60	70	80	90	100	
Maximum possible cos $\varphi_{\text{underexcited}}$	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	
Maximum possible cos $\varphi_{\text{overexcited}}$	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	
Compliance of required displacement factor cos φ											
Default in system control	0,900 _{ov}	0,920 _{ov}	0,930 _{ov}	0,960 _{ov}	0,980 _{ov}	1,000	0,980 _{un}	0,960 _{un}	0,940 _{un}	0,920 _{un}	0,900 _{un}
Measured value at PGU terminals	0.92	0.93	0.94	0.97	0.99	1	0.97	0.95	0.93	0.91	0.89
Reactive power transfer function – Standard-cos φ (P)-characteristic											
Active power P/P _n [%]	10	20	30	40	50	60	70	80	90	100	
cos φ	1	1	1	1	1	0.98	0.96	0.95	0.93	0.9	
Conform to Standard-cos φ (P)-characteristic											
Switching actions											
Making operation without default (of primary energy carrier)						k _i Worst		0.025			
Case at switch over of generator sections						k _i		0.135			
Making operation at reference conditions (of primary energy carrier)						k _i		0.025			
Breaking operation at nominal power						k _i Worst-		1			
Case value of all switching operations						k _{imax}		1			
Flicker		Angle of network impedance ψ		30°	50°	70°	85°				
		Coefficient of system flicker c _{ψ}		28.5	-	-	-				
Harmonics: PF 0.9 lag											
Active power P/P _n [%]	0	10	20	30	40	50	60	70	80	90	100
Harmonic number	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]
2	0.21	0.06	0.01	0.01	0.2	0.21	0.07	0.18	0.03	0.2	0.03
3	3.3	3.26	3.22	3.14	2.78	2.85	2.92	2.71	2.74	2.56	2.56
4	0.05	0.09	0.08	0.04	0.09	0.08	0.03	0.07	0.02	0.08	0.01
5	0.38	0.54	0.56	0.55	0.48	0.43	0.57	0.48	0.63	0.49	0.69



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Requirements for the Test Report for Power Generation Systems

Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Harmonic number	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]
6	0.03	0.02	0	0	0.05	0.05	0.02	0.05	0.01	0.05	0.01
7	0.87	1	1.06	0.96	0.58	0.5	0.83	0.5	0.8	0.45	0.74
8	0.05	0.08	0.06	0.05	0.03	0.03	0.02	0.03	0.02	0.03	0.02
9	0.32	0.43	0.49	0.39	0.15	0.15	0.28	0.13	0.25	0.1	0.2
10	0.04	0.03	0.05	0.04	0.03	0.02	0.02	0.02	0.02	0.03	0.02
11	0.09	0.14	0.2	0.15	0.04	0.05	0.15	0.06	0.17	0.06	0.19
12	0.01	0.01	0	0	0.02	0.02	0	0.02	0	0.02	0
13	0.05	0.08	0.14	0.07	0.01	0.02	0.06	0.02	0.07	0.02	0.08
14	0.01	0.01	0.04	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02
15	0.02	0.02	0.05	0.03	0.02	0.02	0.03	0.02	0.04	0.02	0.04
16	0.02	0.01	0.02	0.02	0.02	0.03	0.02	0.02	0.01	0.02	0.01
17	0.01	0.05	0.09	0.04	0.02	0.02	0.04	0.02	0.05	0.03	0.05
18	0	0.01	0.01	0	0.01	0	0.01	0.01	0	0.02	0
19	0.01	0	0	0	0	0.01	0	0	0	0	0
20	0.01	0.01	0.09	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
21	0.01	0	0.01	0	0.01	0.01	0.01	0.01	0.01	0.01	0
22	0.01	0.01	0.04	0.01	0.01	0.01	0	0.01	0	0.01	0.01
23	0.01	0.03	0.15	0.03	0.01	0.01	0.02	0.01	0.03	0.01	0.02
24	0.01	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
25	0.01	0.03	0.16	0.03	0.01	0.01	0.01	0.01	0.03	0.01	0.02
26	0.01	0.01	0.04	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
27	0.01	0.03	0.22	0.03	0.01	0.01	0.01	0.01	0.03	0.01	0.04
28	0.01	0	0.02	0	0.01	0.01	0.01	0.01	0	0.01	0
29	0.01	0.01	0.07	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
30	0.01	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
31	0.01	0.01	0.04	0.01	0.01	0.01	0.01	0.01	0	0.01	0.01
32	0.01	0	0.02	0.01	0.01	0.01	0	0.01	0	0.01	0.01
33	0.01	0	0.03	0	0.01	0.01	0	0.01	0	0.01	0.01
34	0.01	0	0.02	0	0.01	0.01	0	0.01	0	0.01	0
35	0	0	0.05	0.01	0.01	0.01	0	0.01	0	0.01	0
36	0.01	0	0	0	0.01	0.01	0	0.01	0	0.01	0
37	0	0	0.04	0	0.01	0.01	0	0.01	0	0.01	0



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Requirements for the Test Report for Power Generation Systems

Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Harmonic number	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]
38	0.01	0	0.03	0.03	0.01	0.01	0	0.01	0	0.01	0
39	0	0	0.01	0.01	0.01	0.01	0	0.01	0	0.01	0
40	0	0	0.02	0.02	0.01	0.01	0	0.01	0	0.01	0
Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency [Hz]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]
75	0.26	0.06	0.03	0.04	0.36	0.4	0.1	0.32	0.03	0.36	0.02
125	0.11	0.01	0.01	0.02	0.15	0.17	0.05	0.16	0.02	0.16	0.01
175	0.04	0.02	0.01	0.01	0.06	0.07	0.02	0.07	0.01	0.08	0.03
225	0.03	0.02	0	0.01	0.06	0.06	0.02	0.06	0.01	0.06	0.02
275	0.03	0.03	0.01	0.01	0.05	0.05	0.02	0.05	0.01	0.05	0.02
325	0.03	0.01	0.02	0.01	0.03	0.04	0.02	0.05	0.02	0.04	0.02
375	0.03	0.01	0.01	0.01	0.03	0.05	0.01	0.05	0	0.04	0.01
425	0.02	0.01	0.01	0.01	0.03	0.04	0.01	0.04	0.01	0.04	0.01
475	0.02	0.01	0.01	0	0.02	0.03	0.01	0.03	0	0.03	0.01
525	0.02	0.01	0	0	0.02	0.03	0.01	0.03	0	0.03	0
575	0.01	0	0.02	0	0.02	0.02	0.01	0.02	0.01	0.03	0.01
625	0.01	0.01	0.01	0	0.02	0.02	0.01	0.02	0	0.02	0
675	0.01	0	0	0	0.02	0.02	0.01	0.02	0	0.02	0
725	0.01	0.01	0.01	0	0.02	0.02	0	0.02	0	0.02	0
775	0.01	0	0	0.01	0.02	0.02	0.01	0.02	0	0.02	0
825	0.01	0	0.01	0	0.02	0.02	0.01	0.02	0	0.02	0
875	0.01	0.01	0.01	0	0.01	0.02	0	0.02	0	0.02	0
925	0.01	0	0.01	0	0.01	0.02	0.01	0.01	0	0.02	0
975	0.01	0	0	0	0.01	0.01	0	0.01	0	0.01	0
1025	0.01	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
1075	0.01	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
1125	0.01	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
1175	0.01	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
1225	0.01	0	0	0	0.01	0.01	0	0.01	0	0.01	0
1275	0.01	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
1325	0.01	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
1375	0.01	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
1425	0.01	0	0	0	0.01		0.01	0.01	0	0.01	0

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Requirements for the Test Report for Power Generation Systems

Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency [Hz]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]
1475	0.01	0	0	0	0.01	0.01	0	0.01	0	0.01	0
1525	0	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
1575	0.01	0	0	0	0.01	0.01	0	0.01	0	0.01	0
1625	0	0	0.02	0	0.01	0.01	0	0.01	0	0.01	0
1675	0.01	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
1725	0.01	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
1775	0.01	0	0.02	0	0.01	0.01	0	0.01	0	0.01	0
1825	0.01	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
1875	0	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
1925	0.01	0	0	0	0.01	0.01	0	0.01	0	0.01	0
1975	0	0	0.01	0	0.01	0.01	0	0.01	0	0.01	0
Higher Frequencies											
Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency [Hz]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]
2,1	0	0	0	0	0.01	0.01	0	0.01	0	0.01	0
2,3	0	0	0.02	0	0.01	0.01	0	0.01	0	0.01	0
2,5	0	0	0.02	0	0.01	0.01	0	0.01	0	0.01	0
2,7	0	0	0	0	0	0.01	0	0	0	0	0
2,9	0	0	0.01	0	0	0	0	0	0	0	0
3,1	0	0	0.03	0	0	0	0	0	0	0	0
3,3	0	0	0	0	0	0	0	0	0	0	0
3,5	0	0	0.02	0	0	0	0	0	0	0	0
3,7	0	0	0.02	0	0	0	0	0	0	0	0
3,9	0	0	0	0	0	0	0	0	0	0	0
4,1	0	0	0.01	0	0	0	0	0	0	0	0
4,3	0	0	0.02	0	0	0	0	0	0	0	0
4,5	0	0	0	0	0	0	0	0	0	0	0
4,7	0	0	0.01	0	0	0	0	0	0	0	0
4,9	0	0	0.01	0	0	0	0	0	0	0	0
5,1	0	0	0.01	0	0	0	0	0	0	0	0
5,3	0	0	0.01	0	0	0	0	0	0	0	0
5,5	0	0	0.01	0	0	0	0	0	0	0	0
5,7	0	0	0.01	0	0	0	0	0	0	0	0

F.3

Requirements for the Test Report for Power Generation Systems

Active power P/P_n [%]	0	10	20	30	40	50	60	70	80	90	100
Frequency [Hz]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]	1[%]
5,9	0	0	0.01	0	0	0	0	0	0	0	0
6,1	0	0	0.01	0	0	0	0	0	0	0	0
6,3	0	0	0.01	0	0	0	0	0	0	0	0
6,5	0	0	0	0	0	0	0	0	0	0	0
6,7	0	0	0	0	0	0	0	0	0	0	0
6,9	0	0	0.01	0	0	0	0	0	0	0	0
7,1	0	0	0	0	0	0	0	0	0	0	0
7,3	0	0	0	0	0	0	0	0	0	0	0
7,5	0	0	0	0	0	0	0	0	0	0	0
7,7	0	0	0	0	0	0	0	0	0	0	0
7,9	0	0	0	0	0	0	0	0	0	0	0
8,1	0	0	0	0	0	0	0	0	0	0	0
8,3	0	0	0	0	0	0	0	0	0	0	0
8,5	0	0	0	0	0	0	0	0	0	0	0
8,7	0	0	0	0	0	0	0	0	0	0	0
8,9	0	0	0	0	0	0	0	0	0	0	0