



**BUREAU  
VERITAS**

# Certificate of compliance

**Applicant:** **Huawei Technologies Co., Ltd.**  
Administration Building, Headquarters of Huawei Technologies  
Co., Ltd., Bantian, Longgang District, Shenzhen, 518129  
P.R. China

**Product:** **Grid-tied photovoltaic (PV) inverter**

**Model:** **SUN2000-12KTL  
SUN2000-15KTL  
SUN2000-17KTL  
SUN2000-20KTL  
SUN2000-23KTL  
SUN2000-28KTL**

## Use in accordance with regulations:

Automatic disconnection device with three-phase mains surveillance in accordance with Engineering Recommendation G59/3 for photovoltaic systems with a three-phase parallel coupling via an inverter in the public mains supply. The automatic disconnection device is an integral part of the aforementioned inverter. This serves as a replacement for the disconnection device with isolating function that can access the distribution network provider at any time.

## Applied rules and standards:

### Engineering Recommendation G59/3:2013

Recommendation for the Connection of Generating Plant to the Distribution Systems of licensed Distribution Network Operators.

### DIN V VDE V 0126-1-1:2006-02 (Functional safety)

Automatic disconnection device between a generator and the public low-voltage grid

The SUN2000-12KTL, SUN2000-15KTL, SUN2000-17KTL, SUN2000-20KTL, SUN2000-23KTL and SUN2000-28KTL are rated >16A (1 phase) and ≤ 50kW (3 phase). The default values for "Small Power Stations" on the low-voltage grid were verified.

At the time of issue of this certificate the safety concept of an aforementioned representative product corresponds to the valid safety specifications for the specified use in accordance with regulations.

**Report number:** **12TH0607-G59/3**

**Certificate number:** **U14-0439**

**Date of issue:** **2014-08-14**

## Certification body

Dieter Zitzmann



Deutsche  
Akkreditierungsstelle  
D-ZE-12024-01-01

Certification body of Bureau Veritas Consumer Products Services Germany GmbH  
Accredited according to EN 45011 - ISO / IEC Guide 65

**Appendix 13.1 Type Testing a Generating Unit**

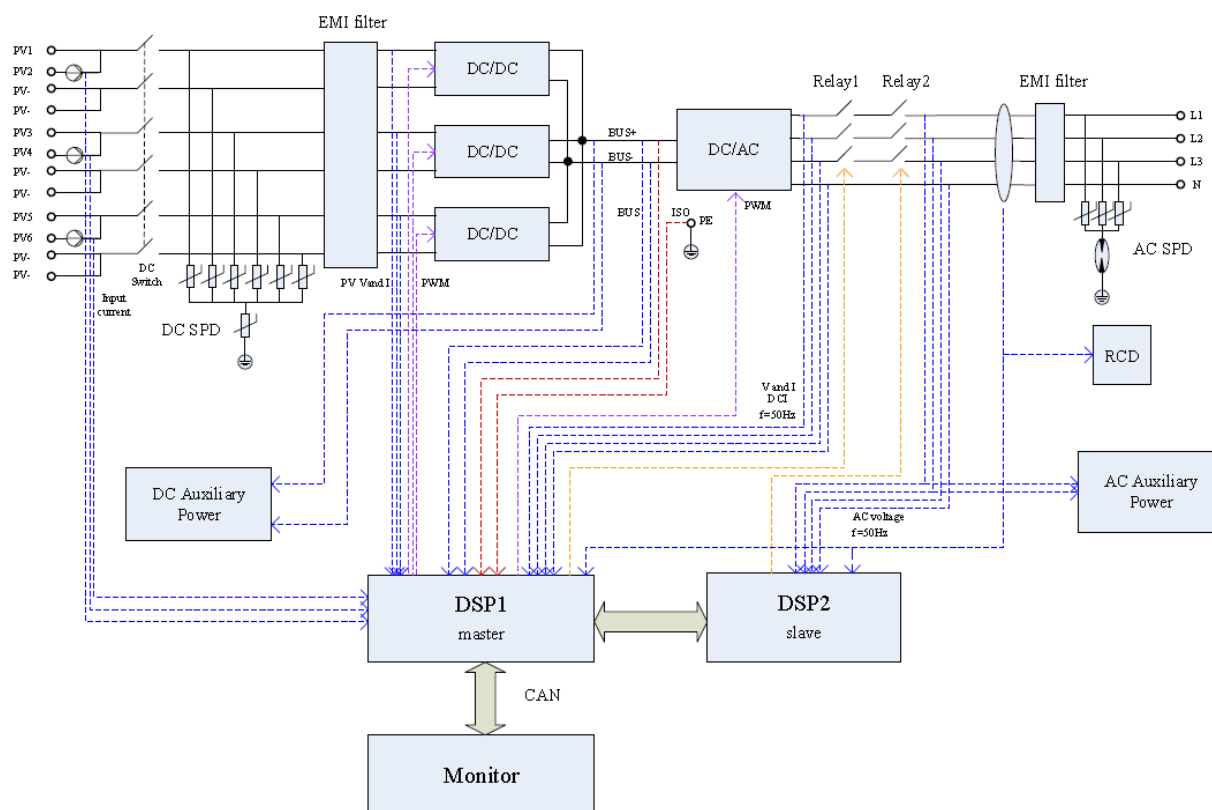
Extract from test report according the Engineering Recommendation G59/3

Nr. 12TH0607

Type Approval and declaration of compliance with the requirements of Engineering Recommendation G59/3.						
Manufacturer / applicant:	Huawei Technologies Co., Ltd. Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 518129 P.R. China					
Generating Unit technology	Grid-tied photovoltaic inverter					
Rated values	SUN2000-12KTL	SUN2000-15KTL	SUN2000-17KTL	SUN2000-20KTL	SUN2000-23KTL	SUN2000-28KTL
Maximum rated capacity	13,2 kW	16,5 kW	18,7 kW	22,0 kW	23,0kW	27,5kW
Rated voltage	400V, 3W+N+PE					480V, 3W+PE
Firmware version	V100R002					
Measurement period:	2014-07-15 to 2014-08-01					

**Description of the structure of the power generation unit (Figure 1):**

The power generation unit is equipped with a PV and line-side EMC filter. The power generation unit has no galvanic isolation between DC input and AC output. Output switch-off is performed with single-fault tolerance based on two series-connected relays in line and neutral. This enables a safe disconnection of the power generation unit from the network in case of error.



**Figure 1 – Schematic structure of the power generation unit**

**Differences between Generating Units:**

The models SUN2000-12KTL, SUN2000-15KTL, SUN2000-17KTL, SUN2000-20KTL and SUN2000-23KTL differ in size of the performance-related components (Sine filter, EMC filter, power semiconductor, machine transformer).  
The model SUN2000-28KTL provides no neutral wire and is rated for a voltage of 480V 3 phase voltage.



## Annex to the G59/3 certificate of compliance No. U14-0150

### Appendix 13.1 Type Testing a Generating Unit

Extract from test report according to the Engineering Recommendation G59/3

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The above stated Generating Units are tested according to the requirements in the Engineering Recommendation G59/3. Any modification that affects the stated tests must be named by the manufacturer/supplier of the product to ensure that the product meets all requirements of the Engineering Recommendation G59/3.

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 12TH0607

Protection. Voltage tests.						
SUN2000-23KTL Phase 1						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	200,1V	2,5s	200,3V	2,728s	204,1V / 3,5s	No trip
U/V stage 2	184V	0,5s	184,0V	0,712s	188V / 2,48s	No trip
					180V / 0,48s	No trip
O/V stage 1	262,2V	1,0s	262,1V	1,208s	258.2V 2,0s	No trip
O/V stage 2	273,7V	0,5s	273,6V	0,714s	269,7V 0,98s	No trip
					277,7V 0,48s	No trip

Protection. Voltage tests.						
SUN2000-23KTL Phase 2						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	200,1V	2,5s	200,4V	2,720s	204,1V / 3,5s	No trip
U/V stage 2	184V	0,5s	184,1V	0,720s	188V / 2,48s	No trip
					180V / 0,48s	No trip
O/V stage 1	262,2V	1,0s	262,1V	1,204s	258.2V 2,0s	No trip
O/V stage 2	273,7V	0,5s	273,7V	0,698s	269,7V 0,98s	No trip
					277,7V 0,48s	No trip

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

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Protection. Voltage tests.						
SUN2000-23KTL Phase 3						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
<b>U/V stage 1</b>	200,1V	2,5s	200,3V	2,722s	204,1V / 3,5s	No trip
<b>U/V stage 2</b>	184V	0,5s	184,1V	0,718s	188V / 2,48s	No trip
					180V / 0,48s	No trip
<b>O/V stage 1</b>	262,2V	1,0s	262,1V	1,220s	258.2V 2,0s	No trip
<b>O/V stage 2</b>	273,7V	0,5s	273,4V	0,704s	269,7V 0,98s	No trip
					277,7V 0,48s	No trip
<p>Note. For Voltage tests the Voltage required to trip is the setting <math>\pm 3,45V</math>. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting <math>\pm 4V</math> and for the relevant times as shown in the table above to ensure that the protection will not trip in error.</p>						

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

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Protection. Voltage tests.						
SUN2000-23KTL Phase 1 (240V grid)						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	208,8V	2,5s	208,8V	2,722s	212,8V / 3,5s	No trip
U/V stage 2	192V	0,5s	192,2V	0,716s	196V / 2,48s	No trip
					188V / 0,48s s	No trip
O/V stage 1	273,6V	1,0s	273,6V	1,222s	269,6V 2,0s	No trip
O/V stage 2	285,6V	0,5s	285,6V	0,732s	281,6V 0,98s	No trip
					289,6V 0,48s	No trip

Protection. Voltage tests.						
SUN2000-23KTL Phase 2 (240V grid)						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	208,8V	2,5s	209,2V	2,728s	212,8V / 3,5s	No trip
U/V stage 2	192V	0,5s	192,2V	0,722s	196V / 2,48s	No trip
					188V / 0,48s s	No trip
O/V stage 1	273,6V	1,0s	273,6V	1,234s	269,6V 2,0s	No trip
O/V stage 2	285,6V	0,5s	285,6V	0,734s	281,6V 0,98s	No trip
					289,6V 0,48s	No trip

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 12TH0607

Protection. Voltage tests.						
SUN2000-23KTL Phase 3 (240V grid)						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
<b>U/V stage 1</b>	208,8V	2,5s	209,0V	2,722s	212,8V / 3,5s	No trip
<b>U/V stage 2</b>	192V	0,5s	192,2V	0,716s	196V / 2,48s	No trip
					188V / 0,48s s	No trip
<b>O/V stage 1</b>	273,6V	1,0s	273,6V	1,226s	269,6V 2,0s	No trip
<b>O/V stage 2</b>	285,6V	0,5s	285,6V	0,726s	281,6V 0,98s	No trip
					289,6V 0,48s	No trip

Note. For Voltage tests the Voltage required to trip is the setting  $\pm 3,45V$ . The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting  $\pm 4V$  and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

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Protection. Voltage tests.						
SUN2000-28KTL Phase 1 to Phase 2						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	417,6V	2,5s	417,8V	2,786s	421,6V / 3,5s	No trip
U/V stage 2	384V	0,5s	384,2V	0,794s	388V / 2,48s	No trip
					380V / 0,48s	No trip
O/V stage 1	528V	1,0s	527,7V	1,286s	524V 2,0s	No trip
O/V stage 2	542,4V	0,5s	541,9V	0,780s	538,4V 0,98s	No trip
					546,4V 0,48s	No trip

Protection. Voltage tests.						
SUN2000-28KTL Phase 2						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	200,1V	2,5s	417,8V	2,768s	421,6V / 3,5s	No trip
U/V stage 2	184V	0,5s	384,2V	0,780s	388V / 2,48s	No trip
					380V / 0,48s	No trip
O/V stage 1	262,2V	1,0s	527,8V	1,286s	524V 2,0s	No trip
O/V stage 2	273,7V	0,5s	542,3V	0,780s	538,4V 0,98s	No trip
					546,4V 0,48s	No trip



**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

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Protection. Voltage tests.						
SUN2000-28KTL Phase 3						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
<b>U/V stage 1</b>	200,1V	2,5s	418,0V	2,780s	421,6V / 3,5s	No trip
<b>U/V stage 2</b>	184V	0,5s	384,0V	0,784s	388V / 2,48s	No trip
					380V / 0,48s	No trip
<b>O/V stage 1</b>	262,2V	1,0s	527,7V	1,272s	524V 2,0s	No trip
<b>O/V stage 2</b>	273,7V	0,5s	542,0V	0,776s	538,4V 0,98s	No trip
					546,4V 0,48s	No trip
<p>Note. For Voltage tests the Voltage required to trip is the setting <math>\pm 3,45V</math>. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting <math>\pm 4V</math> and for the relevant times as shown in the table above to ensure that the protection will not trip in error.</p>						

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

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Protection. Frequency tests.						
SUN2000-23KTL						
Function	Setting		Trip test		No trip test	
	Frequency	Time delay	Frequency	Time delay	Frequency / time	Confirm no trip
U/F stage 1	47,5Hz	20s	47,50Hz	20,20s	47,7Hz / 25s	No trip
U/F stage 2	47Hz	0,5s	47,01Hz	0,724s	47,2Hz / 19,98s	No trip
					46.8Hz / 0,48s	No trip
O/F stage 1	51,5Hz	90s	51,50Hz	90,20s	51,3Hz / 95s	No trip
O/F stage 2	52Hz	0,5s	52,00Hz	0,730s	51,8Hz / 89,98s	No trip
					52,2Hz / 0,48s	No trip
<p>Note. For Frequency Trip tests the Frequency required to trip is the setting <math>\pm 0,1</math>Hz. In order to measure the time delay a larger deviation than the minimum required to operate the projection can be used. The "No-trip tests" need to be carried out at the setting <math>\pm 0,2</math>Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.</p>						

Protection. Frequency tests.						
SUN2000-28KTL						
Function	Setting		Trip test		No trip test	
	Frequency	Time delay	Frequency	Time delay	Frequency / time	Confirm no trip
U/F stage 1	47,5Hz	20s	47,50Hz	20,27s	47,7Hz / 25s	No trip
U/F stage 2	47Hz	0,5s	47,00Hz	0,786s	47,2Hz / 19,98s	No trip
					46.8Hz / 0,48s	No trip
O/F stage 1	51,5Hz	90s	51,49Hz	90,12s	51,3Hz / 95s	No trip
O/F stage 2	52Hz	0,5s	51,99Hz	0,774s	51,8Hz / 89,98s	No trip
					52,2Hz / 0,48s	No trip
<p>Note. For Frequency Trip tests the Frequency required to trip is the setting <math>\pm 0,1</math>Hz. In order to measure the time delay a larger deviation than the minimum required to operate the projection can be used. The "No-trip tests" need to be carried out at the setting <math>\pm 0,2</math>Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.</p>						

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

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<b>Protection. Loss of Mains.</b>						
<b>SUN2000-12KTL</b>						
Note as an alternative, inverters can be tested to BS EN 62116. The following sub set of tests should be recorded in the following table.						
<b>Balancing load on islanded network</b>	33% of -5% Q Test 22	66% of -5% Q Test 12	100% of -5% P Test 5	33% of +5% Q Test 31	66% of +5% Q Test 21	100% of +5% P Test 10
<b>Trip time. Ph1 fuse removed</b>	114ms	61ms	272ms	82ms	86ms	273ms
<b>Trip time. Ph2 fuse removed</b>	114ms	61ms	272ms	82ms	86ms	273ms
<b>Trip time. Ph3 fuse removed</b>	114ms	61ms	272ms	82ms	86ms	273ms
Note for technologies which have a substantial shut down time this can be added to the 0,5 seconds in establishing that the trip occurred in less than 0,5s. Maximum shut down time could therefore be up to 1,0 seconds for these technologies.						
Indicate additional shut down time included in above results. (Integrated interface switch)				Type of switching equipment 1: Relay Omron G8P-1A4P-BG with 20ms Type of switching equipment 2: Relay Omron G8P-1A4P-BG with 20ms		
Note. All relays are direct coupled and open directly by receiving the islanding signal from the controller. Therefore the measured disconnection time on all phase is identical.						

<b>Protection. Loss of Mains.</b>						
<b>SUN2000-17KTL</b>						
Note as an alternative, inverters can be tested to BS EN 62116. The following sub set of tests should be recorded in the following table.						
<b>Balancing load on islanded network</b>	33% of -5% Q Test 22	66% of -5% Q Test 12	100% of -5% P Test 5	33% of +5% Q Test 31	66% of +5% Q Test 21	100% of +5% P Test 10
<b>Trip time. Ph1 fuse removed</b>	112ms	247ms	316ms	158ms	281ms	275ms
<b>Trip time. Ph2 fuse removed</b>	112ms	247ms	316ms	158ms	281ms	275ms
<b>Trip time. Ph3 fuse removed</b>	112ms	247ms	316ms	158ms	281ms	275ms
Note for technologies which have a substantial shut down time this can be added to the 0,5 seconds in establishing that the trip occurred in less than 0,5s. Maximum shut down time could therefore be up to 1,0 seconds for these technologies.						
Indicate additional shut down time included in above results. (Integrated interface switch)				Type of switching equipment 1: Relay Omron G8P-1A4P-BG with 20ms Type of switching equipment 2: Relay Omron G8P-1A4P-BG with 20ms		
Note. All relays are direct coupled and open directly by receiving the islanding signal from the controller. Therefore the measured disconnection time on all phase is identical.						

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

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<b>Protection. Loss of Mains.</b>						
<b>SUN2000-23KTL</b>						
Note as an alternative, inverters can be tested to BS EN 62116. The following sub set of tests should be recorded in the following table.						
<b>Balancing load on islanded network</b>	33% of -5% Q Test 22	66% of -5% Q Test 12	100% of -5% P Test 5	33% of +5% Q Test 31	66% of +5% Q Test 21	100% of +5% P Test 10
<b>Trip time. Ph1 fuse removed</b>	266ms	192ms	186ms	158ms	166ms	201ms
<b>Trip time. Ph2 fuse removed</b>	266ms	192ms	186ms	158ms	166ms	201ms
<b>Trip time. Ph3 fuse removed</b>	266ms	192ms	186ms	158ms	166ms	201ms
Note for technologies which have a substantial shut down time this can be added to the 0,5 seconds in establishing that the trip occurred in less than 0,5s. Maximum shut down time could therefore be up to 1,0 seconds for these technologies.						
Indicate additional shut down time included in above results. (Integrated interface switch)				Type of switching equipment 1: Relay Omron G8P-1A4P-BG with 20ms Type of switching equipment 2: Relay Omron G8P-1A4P-BG with 20ms		
Note. All relays are direct coupled and open directly by receiving the islanding signal from the controller. Therefore the measured disconnection time on all phase is identical.						

<b>Protection. Loss of Mains.</b>						
<b>SUN2000-28KTL</b>						
Note as an alternative, inverters can be tested to BS EN 62116. The following sub set of tests should be recorded in the following table.						
<b>Balancing load on islanded network</b>	33% of -5% Q Test 22	66% of -5% Q Test 12	100% of -5% P Test 5	33% of +5% Q Test 31	66% of +5% Q Test 21	100% of +5% P Test 10
<b>Trip time. Ph1 fuse removed</b>	123ms	167ms	189ms	108ms	146ms	225ms
<b>Trip time. Ph2 fuse removed</b>	123ms	167ms	189ms	108ms	146ms	225ms
<b>Trip time. Ph3 fuse removed</b>	123ms	167ms	189ms	108ms	146ms	225ms
Note for technologies which have a substantial shut down time this can be added to the 0,5 seconds in establishing that the trip occurred in less than 0,5s. Maximum shut down time could therefore be up to 1,0 seconds for these technologies.						
Indicate additional shut down time included in above results. (Integrated interface switch)				Type of switching equipment 1: Relay Omron G8P-1A4P-BG with 20ms Type of switching equipment 2: Relay Omron G8P-1A4P-BG with 20ms		
Note. All relays are direct coupled and open directly by receiving the islanding signal from the controller. Therefore the measured disconnection time on all phase is identical.						

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

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Protection. Re-connection timer.				
SUN2000-23KTL				
Test should prove that the reconnection sequence starts in no less than 20 seconds for restoration of voltage and frequency to within the stage 1 settings of table 10.5.7.1.				
Voltage				
Time delay setting		Measured delay		
20s		72s		
Frequency				
Time delay setting		Measured delay		
20s		72s		
	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.			
	At 266,2V	At 196,1V	At 47,4Hz	At 51,6Hz
<b>Confirmation that the Generating Unit does not re-connect.</b>	No reconnection	No reconnection	No reconnection	No reconnection

Protection. Re-connection timer.				
SUN2000-28KTL				
Test should prove that the reconnection sequence starts in no less than 20 seconds for restoration of voltage and frequency to within the stage 1 settings of table 10.5.7.1.				
Voltage				
Time delay setting		Measured delay		
20s		76s		
Frequency				
Time delay setting		Measured delay		
20s		80s		
	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.			
	At 266,2V	At 196,1V	At 47,4Hz	At 51,6Hz
<b>Confirmation that the Generating Unit does not re-connect.</b>	No reconnection	No reconnection	No reconnection	No reconnection

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

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Protection. Frequency change, Stability test.				
SUN2000-23KTL				
	Start Frequency	Change	End Frequency	Confirm no trip
Positive Vector Shift	49,5Hz	+9 degrees		No trip
Negative Vector Shift	50,5Hz	- 9 degrees		No trip
Positive Frequency drift	49,5Hz	+0,19Hz/sec	51,5Hz	No trip
Negative Frequency drift	50,5Hz	-0,19Hz/sec	47,5Hz	No trip

Protection. Frequency change, Stability test.				
SUN2000-28KTL				
	Start Frequency	Change	End Frequency	Confirm no trip
Positive Vector Shift	49,5Hz	+9 degrees		No trip
Negative Vector Shift	50,5Hz	- 9 degrees		No trip
Positive Frequency drift	49,5Hz	+0,19Hz/sec	51,5Hz	No trip
Negative Frequency drift	50,5Hz	-0,19Hz/sec	47,5Hz	No trip

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

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SUN2000-12KTL						
Phase 1						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 6,002kW		100% of rated output 13,161kW			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in %	Measured Value (MV) in Amps	Measured Value (MV) in %	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,026	0,27	0,043	0,22	8	8
3rd	0,051	0,53	0,062	0,32	21,6	N/A
4th	0,030	0,31	0,040	0,21	4	4
5th	0,080	0,83	0,199	1,04	10,7	10,7
6th	0,013	0,14	0,028	0,15	2,67	2,67
7th	0,086	0,89	0,197	1,03	7,2	7,2
8th	0,012	0,12	0,020	0,10	2	2
9th	0,013	0,13	0,015	0,08	3,8	N/A
10th	0,013	0,13	0,013	0,07	1,6	1,6
11th	0,073	0,76	0,114	0,59	3,1	3,1
12th	0,012	0,12	0,021	0,11	1,33	1,33
13th	0,072	0,75	0,125	0,65	2	2
14th	0,010	0,10	0,019	0,10	N/A	N/A
15th	0,010	0,10	0,012	0,06	N/A	N/A
16th	0,010	0,10	0,010	0,05	N/A	N/A
17th	0,050	0,52	0,082	0,43	N/A	N/A
18th	0,010	0,10	0,011	0,06	N/A	N/A
19th	0,043	0,45	0,081	0,42	N/A	N/A
20th	0,009	0,09	0,009	0,05	N/A	N/A
21th	0,008	0,09	0,007	0,04	N/A	N/A
22th	0,007	0,08	0,007	0,04	N/A	N/A
23th	0,021	0,21	0,055	0,29	N/A	N/A
24th	0,007	0,07	0,006	0,03	N/A	N/A
25th	0,015	0,16	0,045	0,23	N/A	N/A
26th	0,006	0,06	0,006	0,03	N/A	N/A
27th	0,006	0,06	0,005	0,03	N/A	N/A
28th	0,005	0,06	0,005	0,03	N/A	N/A
29th	0,013	0,14	0,031	0,16	N/A	N/A
30th	0,005	0,05	0,005	0,02	N/A	N/A
31th	0,009	0,09	0,025	0,13	N/A	N/A
32th	0,005	0,05	0,004	0,02	N/A	N/A
33th	0,005	0,05	0,004	0,02	N/A	N/A
34th	0,004	0,04	0,004	0,02	N/A	N/A
35th	0,007	0,07	0,019	0,10	N/A	N/A
36th	0,004	0,04	0,004	0,02	N/A	N/A
37th	0,009	0,09	0,015	0,08	N/A	N/A
38th	0,004	0,04	0,004	0,02	N/A	N/A
39th	0,004	0,04	0,004	0,02	N/A	N/A
40th	0,004	0,04	0,003	0,02	N/A	N/A
THD	1,96%		1,94%		23	13
PWHD	3,66%		3,50%		23	22

**Appendix 13.1 Type Testing a Generating Unit**  
**Extract from test report according the Engineering Recommendation G59/3** **Nr. 12TH0607**

Phase 2						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 6,002kW		100% of rated output 13,161kW			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in %	Measured Value (MV) in Amps	Measured Value (MV) in %	Limit inBS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,026	0,28	0,080	0,42	8	8
3rd	0,074	0,77	0,125	0,65	21,6	N/A
4th	0,027	0,28	0,077	0,40	4	4
5th	0,094	0,98	0,260	1,35	10,7	10,7
6th	0,014	0,15	0,055	0,28	2,67	2,67
7th	0,081	0,84	0,235	1,22	7,2	7,2
8th	0,014	0,15	0,036	0,19	2	2
9th	0,015	0,15	0,028	0,15	3,8	N/A
10th	0,013	0,14	0,023	0,12	1,6	1,6
11th	0,077	0,81	0,142	0,74	3,1	3,1
12th	0,012	0,12	0,042	0,22	1,33	1,33
13th	0,065	0,68	0,149	0,78	2	2
14th	0,011	0,11	0,044	0,23	N/A	N/A
15th	0,011	0,12	0,023	0,12	N/A	N/A
16th	0,010	0,11	0,019	0,10	N/A	N/A
17th	0,054	0,56	0,098	0,51	N/A	N/A
18th	0,010	0,11	0,020	0,10	N/A	N/A
19th	0,039	0,41	0,092	0,48	N/A	N/A
20th	0,009	0,10	0,016	0,08	N/A	N/A
21th	0,009	0,09	0,013	0,07	N/A	N/A
22th	0,008	0,08	0,012	0,06	N/A	N/A
23th	0,023	0,24	0,064	0,33	N/A	N/A
24th	0,007	0,07	0,010	0,05	N/A	N/A
25th	0,014	0,15	0,052	0,27	N/A	N/A
26th	0,006	0,06	0,010	0,05	N/A	N/A
27th	0,006	0,06	0,010	0,05	N/A	N/A
28th	0,005	0,05	0,007	0,04	N/A	N/A
29th	0,014	0,14	0,037	0,19	N/A	N/A
30th	0,005	0,05	0,007	0,04	N/A	N/A
31th	0,008	0,08	0,032	0,17	N/A	N/A
32th	0,004	0,05	0,007	0,04	N/A	N/A
33th	0,005	0,05	0,007	0,03	N/A	N/A
34th	0,004	0,04	0,007	0,03	N/A	N/A
35th	0,007	0,08	0,023	0,12	N/A	N/A
36th	0,004	0,04	0,006	0,03	N/A	N/A
37th	0,008	0,08	0,019	0,10	N/A	N/A
38th	0,004	0,04	0,006	0,03	N/A	N/A
39th	0,004	0,04	0,006	0,03	N/A	N/A
40th	0,004	0,04	0,006	0,03	N/A	N/A
THD	2,08%		2,51%		23	13
PWHD	3,73%		4,27%		23	22



**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 12TH0607

Phase 3						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 6,002kW		100% of rated output 13,161kW			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in %	Measured Value (MV) in Amps	Measured Value (MV) in %	Limit inBS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,019	0,20	0,044	0,23	8	8
3rd	0,074	0,77	0,111	0,58	21,6	N/A
4th	0,013	0,14	0,036	0,19	4	4
5th	0,092	0,95	0,248	1,29	10,7	10,7
6th	0,014	0,14	0,030	0,16	2,67	2,67
7th	0,079	0,82	0,190	0,99	7,2	7,2
8th	0,008	0,08	0,021	0,11	2	2
9th	0,010	0,10	0,014	0,07	3,8	N/A
10th	0,010	0,10	0,016	0,08	1,6	1,6
11th	0,079	0,82	0,126	0,66	3,1	3,1
12th	0,010	0,10	0,020	0,10	1,33	1,33
13th	0,067	0,69	0,117	0,61	2	2
14th	0,008	0,08	0,019	0,10	N/A	N/A
15th	0,008	0,08	0,009	0,05	N/A	N/A
16th	0,008	0,08	0,009	0,05	N/A	N/A
17th	0,055	0,57	0,089	0,47	N/A	N/A
18th	0,009	0,09	0,008	0,04	N/A	N/A
19th	0,043	0,44	0,074	0,39	N/A	N/A
20th	0,007	0,07	0,008	0,04	N/A	N/A
21th	0,007	0,07	0,005	0,03	N/A	N/A
22th	0,006	0,06	0,006	0,03	N/A	N/A
23th	0,022	0,23	0,059	0,31	N/A	N/A
24th	0,005	0,05	0,004	0,02	N/A	N/A
25th	0,015	0,16	0,041	0,22	N/A	N/A
26th	0,004	0,05	0,005	0,03	N/A	N/A
27th	0,005	0,05	0,004	0,02	N/A	N/A
28th	0,004	0,04	0,004	0,02	N/A	N/A
29th	0,012	0,13	0,034	0,18	N/A	N/A
30th	0,003	0,03	0,003	0,02	N/A	N/A
31th	0,009	0,09	0,023	0,12	N/A	N/A
32th	0,003	0,03	0,003	0,02	N/A	N/A
33th	0,004	0,04	0,003	0,02	N/A	N/A
34th	0,003	0,03	0,003	0,01	N/A	N/A
35th	0,007	0,07	0,021	0,11	N/A	N/A
36th	0,003	0,03	0,003	0,02	N/A	N/A
37th	0,008	0,09	0,013	0,07	N/A	N/A
38th	0,003	0,03	0,002	0,01	N/A	N/A
39th	0,003	0,03	0,003	0,02	N/A	N/A
40th	0,003	0,03	0,002	0,01	N/A	N/A
THD	2,03%		2,13%		23	13
PWHD	3,67%		3,50%		23	22

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 12TH0607

SUN2000-23KTL						
Phase 1						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 11,530kW		100% of rated output 22,972kW			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in %	Measured Value (MV) in Amps	Measured Value (MV) in %	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,064	0,38	0,147	0,44	8	8
3rd	0,105	0,63	0,168	0,50	21,6	N/A
4th	0,039	0,23	0,072	0,22	4	4
5th	0,099	0,60	0,196	0,59	10,7	10,7
6th	0,012	0,07	0,014	0,04	2,67	2,67
7th	0,085	0,51	0,137	0,41	7,2	7,2
8th	0,012	0,07	0,028	0,08	2	2
9th	0,012	0,07	0,018	0,06	3,8	N/A
10th	0,016	0,09	0,032	0,10	1,6	1,6
11th	0,077	0,46	0,100	0,30	3,1	3,1
12th	0,012	0,07	0,017	0,05	1,33	1,33
13th	0,080	0,48	0,079	0,24	2	2
14th	0,016	0,09	0,028	0,08	N/A	N/A
15th	0,014	0,08	0,026	0,08	N/A	N/A
16th	0,016	0,10	0,029	0,09	N/A	N/A
17th	0,088	0,53	0,113	0,34	N/A	N/A
18th	0,017	0,10	0,023	0,07	N/A	N/A
19th	0,091	0,55	0,116	0,35	N/A	N/A
20th	0,018	0,11	0,026	0,08	N/A	N/A
21th	0,020	0,12	0,032	0,10	N/A	N/A
22th	0,017	0,10	0,026	0,08	N/A	N/A
23th	0,075	0,45	0,092	0,28	N/A	N/A
24th	0,017	0,10	0,019	0,06	N/A	N/A
25th	0,057	0,34	0,074	0,22	N/A	N/A
26th	0,013	0,08	0,017	0,05	N/A	N/A
27th	0,013	0,08	0,017	0,05	N/A	N/A
28th	0,011	0,07	0,014	0,04	N/A	N/A
29th	0,031	0,19	0,051	0,15	N/A	N/A
30th	0,010	0,06	0,011	0,03	N/A	N/A
31th	0,024	0,15	0,045	0,14	N/A	N/A
32th	0,008	0,05	0,011	0,03	N/A	N/A
33th	0,008	0,05	0,010	0,03	N/A	N/A
34th	0,007	0,04	0,008	0,02	N/A	N/A
35th	0,019	0,11	0,037	0,11	N/A	N/A
36th	0,007	0,04	0,009	0,03	N/A	N/A
37th	0,012	0,07	0,031	0,09	N/A	N/A
38th	0,006	0,04	0,008	0,03	N/A	N/A
39th	0,006	0,04	0,007	0,02	N/A	N/A
40th	0,006	0,03	0,006	0,02	N/A	N/A
THD	1,68%		1,30%		23	13
PWHD	4,77%		3,26%		23	22

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 12TH0607

Phase 2						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 11,530kW		100% of rated output 22,972kW			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in %	Measured Value (MV) in Amps	Measured Value (MV) in %	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,073	0,44	0,137	0,41	8	8
3rd	0,152	0,91	0,238	0,72	21,6	N/A
4th	0,036	0,22	0,066	0,20	4	4
5th	0,093	0,56	0,204	0,62	10,7	10,7
6th	0,013	0,08	0,020	0,06	2,67	2,67
7th	0,090	0,54	0,172	0,52	7,2	7,2
8th	0,014	0,08	0,034	0,10	2	2
9th	0,011	0,07	0,027	0,08	3,8	N/A
10th	0,013	0,08	0,029	0,09	1,6	1,6
11th	0,075	0,45	0,095	0,29	3,1	3,1
12th	0,008	0,05	0,019	0,06	1,33	1,33
13th	0,077	0,46	0,084	0,25	2	2
14th	0,013	0,08	0,032	0,10	N/A	N/A
15th	0,012	0,07	0,032	0,10	N/A	N/A
16th	0,011	0,07	0,032	0,10	N/A	N/A
17th	0,088	0,53	0,106	0,32	N/A	N/A
18th	0,011	0,07	0,027	0,08	N/A	N/A
19th	0,084	0,51	0,111	0,34	N/A	N/A
20th	0,013	0,08	0,030	0,09	N/A	N/A
21th	0,014	0,08	0,032	0,10	N/A	N/A
22th	0,012	0,07	0,031	0,09	N/A	N/A
23th	0,075	0,45	0,092	0,28	N/A	N/A
24th	0,012	0,07	0,021	0,06	N/A	N/A
25th	0,051	0,31	0,065	0,20	N/A	N/A
26th	0,009	0,05	0,018	0,05	N/A	N/A
27th	0,009	0,06	0,017	0,05	N/A	N/A
28th	0,007	0,04	0,016	0,05	N/A	N/A
29th	0,032	0,19	0,053	0,16	N/A	N/A
30th	0,007	0,04	0,012	0,04	N/A	N/A
31th	0,023	0,14	0,041	0,12	N/A	N/A
32th	0,006	0,03	0,011	0,03	N/A	N/A
33th	0,006	0,04	0,011	0,03	N/A	N/A
34th	0,005	0,03	0,009	0,03	N/A	N/A
35th	0,019	0,11	0,038	0,11	N/A	N/A
36th	0,005	0,03	0,009	0,03	N/A	N/A
37th	0,010	0,06	0,028	0,08	N/A	N/A
38th	0,005	0,03	0,009	0,03	N/A	N/A
39th	0,005	0,03	0,008	0,02	N/A	N/A
40th	0,004	0,02	0,007	0,02	N/A	N/A
THD	1,77%		1,43%		23	13
PWHD	4,51%		3,19%		23	22

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 12TH0607

Phase 3						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 11,530kW		100% of rated output 22,972kW			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in %	Measured Value (MV) in Amps	Measured Value (MV) in %	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,034	0,21	0,051	0,15	8	8
3rd	0,061	0,37	0,085	0,26	21,6	N/A
4th	0,041	0,25	0,085	0,26	4	4
5th	0,078	0,47	0,121	0,37	10,7	10,7
6th	0,013	0,08	0,018	0,05	2,67	2,67
7th	0,084	0,51	0,128	0,39	7,2	7,2
8th	0,011	0,07	0,025	0,08	2	2
9th	0,017	0,10	0,032	0,10	3,8	N/A
10th	0,014	0,09	0,026	0,08	1,6	1,6
11th	0,078	0,47	0,100	0,30	3,1	3,1
12th	0,011	0,06	0,015	0,04	1,33	1,33
13th	0,075	0,45	0,083	0,25	2	2
14th	0,012	0,07	0,026	0,08	N/A	N/A
15th	0,014	0,08	0,020	0,06	N/A	N/A
16th	0,012	0,07	0,025	0,07	N/A	N/A
17th	0,083	0,50	0,102	0,31	N/A	N/A
18th	0,014	0,09	0,021	0,06	N/A	N/A
19th	0,082	0,49	0,104	0,31	N/A	N/A
20th	0,014	0,09	0,022	0,07	N/A	N/A
21th	0,015	0,09	0,024	0,07	N/A	N/A
22th	0,014	0,08	0,022	0,07	N/A	N/A
23th	0,069	0,41	0,079	0,24	N/A	N/A
24th	0,013	0,08	0,016	0,05	N/A	N/A
25th	0,056	0,34	0,067	0,20	N/A	N/A
26th	0,011	0,07	0,013	0,04	N/A	N/A
27th	0,011	0,07	0,014	0,04	N/A	N/A
28th	0,009	0,06	0,011	0,03	N/A	N/A
29th	0,029	0,18	0,047	0,14	N/A	N/A
30th	0,008	0,05	0,009	0,03	N/A	N/A
31th	0,025	0,15	0,041	0,12	N/A	N/A
32th	0,007	0,04	0,008	0,03	N/A	N/A
33th	0,008	0,05	0,009	0,03	N/A	N/A
34th	0,006	0,04	0,007	0,02	N/A	N/A
35th	0,018	0,11	0,034	0,10	N/A	N/A
36th	0,006	0,04	0,007	0,02	N/A	N/A
37th	0,012	0,07	0,027	0,08	N/A	N/A
38th	0,006	0,03	0,009	0,03	N/A	N/A
39th	0,006	0,03	0,006	0,02	N/A	N/A
40th	0,005	0,03	0,006	0,02	N/A	N/A
THD	1,46%		1,01%		23	13
PWHD	4,43%		2,91%		23	22

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 12TH0607

SUN2000-28KTL						
Phase 1						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 13,968kW		100% of rated output 27,445kW			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in %	Measured Value (MV) in Amps	Measured Value (MV) in %	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,032	0,19	0,098	0,30	8	8
3rd	0,100	0,60	0,174	0,53	21,6	N/A
4th	0,044	0,27	0,174	0,53	4	4
5th	0,042	0,25	0,089	0,27	10,7	10,7
6th	0,017	0,10	0,037	0,11	2,67	2,67
7th	0,032	0,19	0,054	0,16	7,2	7,2
8th	0,024	0,14	0,025	0,08	2	2
9th	0,025	0,15	0,025	0,08	3,8	N/A
10th	0,013	0,08	0,028	0,09	1,6	1,6
11th	0,020	0,12	0,021	0,06	3,1	3,1
12th	0,014	0,08	0,028	0,09	1,33	1,33
13th	0,015	0,09	0,028	0,08	2	2
14th	0,019	0,11	0,066	0,20	N/A	N/A
15th	0,020	0,12	0,027	0,08	N/A	N/A
16th	0,013	0,08	0,048	0,15	N/A	N/A
17th	0,091	0,55	0,142	0,43	N/A	N/A
18th	0,013	0,08	0,024	0,07	N/A	N/A
19th	0,069	0,41	0,087	0,27	N/A	N/A
20th	0,010	0,06	0,014	0,04	N/A	N/A
21th	0,011	0,07	0,016	0,05	N/A	N/A
22th	0,010	0,06	0,014	0,04	N/A	N/A
23th	0,040	0,24	0,066	0,20	N/A	N/A
24th	0,008	0,05	0,014	0,04	N/A	N/A
25th	0,030	0,18	0,048	0,15	N/A	N/A
26th	0,007	0,04	0,011	0,03	N/A	N/A
27th	0,008	0,05	0,010	0,03	N/A	N/A
28th	0,006	0,04	0,008	0,02	N/A	N/A
29th	0,024	0,14	0,043	0,13	N/A	N/A
30th	0,006	0,04	0,010	0,03	N/A	N/A
31th	0,017	0,10	0,034	0,10	N/A	N/A
32th	0,005	0,03	0,007	0,02	N/A	N/A
33th	0,007	0,04	0,007	0,02	N/A	N/A
34th	0,005	0,03	0,007	0,02	N/A	N/A
35th	0,015	0,09	0,029	0,09	N/A	N/A
36th	0,008	0,04	0,010	0,03	N/A	N/A
37th	0,011	0,07	0,024	0,07	N/A	N/A
38th	0,004	0,03	0,006	0,02	N/A	N/A
39th	0,006	0,03	0,006	0,02	N/A	N/A
40th	0,004	0,02	0,006	0,02	N/A	N/A
THD	1,17%		1,13%		23	13
PWHD	3,62%		2,96%		23	22

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 12TH0607

Phase 2						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 13,968kW		100% of rated output 27,445kW			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in %	Measured Value (MV) in Amps	Measured Value (MV) in %	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,221	1,30	0,429	1,29	8	8
3rd	0,048	0,28	0,141	0,42	21,6	N/A
4th	0,032	0,19	0,146	0,44	4	4
5th	0,034	0,20	0,081	0,25	10,7	10,7
6th	0,016	0,10	0,032	0,10	2,67	2,67
7th	0,032	0,19	0,055	0,16	7,2	7,2
8th	0,033	0,19	0,027	0,08	2	2
9th	0,021	0,12	0,037	0,11	3,8	N/A
10th	0,016	0,09	0,027	0,08	1,6	1,6
11th	0,019	0,11	0,021	0,06	3,1	3,1
12th	0,018	0,11	0,032	0,10	1,33	1,33
13th	0,014	0,09	0,023	0,07	2	2
14th	0,030	0,18	0,056	0,17	N/A	N/A
15th	0,026	0,15	0,035	0,11	N/A	N/A
16th	0,018	0,11	0,060	0,18	N/A	N/A
17th	0,092	0,54	0,145	0,44	N/A	N/A
18th	0,016	0,09	0,021	0,06	N/A	N/A
19th	0,078	0,46	0,094	0,28	N/A	N/A
20th	0,020	0,12	0,021	0,06	N/A	N/A
21th	0,016	0,09	0,019	0,06	N/A	N/A
22th	0,014	0,08	0,016	0,05	N/A	N/A
23th	0,040	0,24	0,065	0,19	N/A	N/A
24th	0,012	0,07	0,014	0,04	N/A	N/A
25th	0,034	0,20	0,056	0,17	N/A	N/A
26th	0,012	0,07	0,018	0,05	N/A	N/A
27th	0,010	0,06	0,012	0,04	N/A	N/A
28th	0,009	0,05	0,011	0,03	N/A	N/A
29th	0,024	0,14	0,042	0,13	N/A	N/A
30th	0,009	0,05	0,010	0,03	N/A	N/A
31th	0,019	0,11	0,038	0,11	N/A	N/A
32th	0,009	0,05	0,011	0,03	N/A	N/A
33th	0,008	0,05	0,009	0,03	N/A	N/A
34th	0,007	0,04	0,010	0,03	N/A	N/A
35th	0,015	0,09	0,028	0,08	N/A	N/A
36th	0,008	0,05	0,009	0,03	N/A	N/A
37th	0,012	0,07	0,027	0,08	N/A	N/A
38th	0,007	0,04	0,009	0,03	N/A	N/A
39th	0,006	0,04	0,008	0,02	N/A	N/A
40th	0,006	0,03	0,007	0,02	N/A	N/A
THD	1,69%		1,64%		23	13
PWHD	3,94%		3,08%		23	22

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 12TH0607

Phase 3						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 13,968kW		100% of rated output 27,445kW			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in %	Measured Value (MV) in Amps	Measured Value (MV) in %	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,207	1,24	0,370	1,13	8	8
3rd	0,074	0,44	0,136	0,41	21,6	N/A
4th	0,045	0,27	0,176	0,53	4	4
5th	0,037	0,22	0,074	0,22	10,7	10,7
6th	0,015	0,09	0,021	0,06	2,67	2,67
7th	0,031	0,19	0,054	0,16	7,2	7,2
8th	0,020	0,12	0,036	0,11	2	2
9th	0,025	0,15	0,042	0,13	3,8	N/A
10th	0,017	0,10	0,019	0,06	1,6	1,6
11th	0,020	0,12	0,021	0,06	3,1	3,1
12th	0,016	0,10	0,036	0,11	1,33	1,33
13th	0,014	0,08	0,025	0,07	2	2
14th	0,025	0,15	0,062	0,19	N/A	N/A
15th	0,029	0,17	0,037	0,11	N/A	N/A
16th	0,017	0,10	0,061	0,19	N/A	N/A
17th	0,095	0,57	0,154	0,47	N/A	N/A
18th	0,015	0,09	0,023	0,07	N/A	N/A
19th	0,074	0,44	0,095	0,29	N/A	N/A
20th	0,016	0,10	0,019	0,06	N/A	N/A
21th	0,015	0,09	0,016	0,05	N/A	N/A
22th	0,012	0,07	0,016	0,05	N/A	N/A
23th	0,040	0,24	0,072	0,22	N/A	N/A
24th	0,009	0,05	0,014	0,04	N/A	N/A
25th	0,033	0,20	0,053	0,16	N/A	N/A
26th	0,010	0,06	0,014	0,04	N/A	N/A
27th	0,009	0,05	0,011	0,03	N/A	N/A
28th	0,008	0,05	0,010	0,03	N/A	N/A
29th	0,022	0,13	0,045	0,14	N/A	N/A
30th	0,007	0,04	0,010	0,03	N/A	N/A
31th	0,019	0,11	0,037	0,11	N/A	N/A
32th	0,007	0,04	0,008	0,03	N/A	N/A
33th	0,007	0,04	0,007	0,02	N/A	N/A
34th	0,006	0,03	0,010	0,03	N/A	N/A
35th	0,013	0,08	0,030	0,09	N/A	N/A
36th	0,006	0,03	0,008	0,02	N/A	N/A
37th	0,011	0,07	0,026	0,08	N/A	N/A
38th	0,005	0,03	0,009	0,03	N/A	N/A
39th	0,006	0,03	0,006	0,02	N/A	N/A
40th	0,005	0,03	0,008	0,02	N/A	N/A
THD	1,67%		1,56%		23	13
PWHD	3,87%		3,22%		23	22

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 12TH0607

Power Quality. Power factor.				
SUN2000-12KTL				
	216,2V	230V	253V	Measured at three voltage levels and at full output. Voltage to be maintained within $\pm 1.5\%$ of the stated level during the test.
Measured value	0,999	0,999	0,999	
Limit	>0,95	>0,95	>0,95	

Power Quality. Power factor.				
SUN2000-23KTL				
	216,2V	230V	253V	Measured at three voltage levels and at full output. Voltage to be maintained within $\pm 1.5\%$ of the stated level during the test.
Measured value	0,998	0,999	0,999	
Limit	>0,95	>0,95	>0,95	

Power Quality. Power factor.				
SUN2000-28KTL				
	216,2V	230V	253V	Measured at three voltage levels and at full output. Voltage to be maintained within $\pm 1.5\%$ of the stated level during the test.
Measured value	0,999	0,999	0,999	
Limit	>0,95	>0,95	>0,95	



**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 12TH0607

Power Quality. Voltage fluctuation and Flicker.									
	Phase	Starting			Stopping			Running	
		dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
<b>SUN2000-12KTL</b>									
Measured values at test impedance	L1	0,24	0,10	0,01	0,27	0,05	0,01	0,38	0,26
	L2	0,30	0,09	0,01	0,27	0,02	0,01	0,67	0,44
	L3	0,23	0,06	0,01	0,25	0,05	0,01	0,32	0,22
Normalised to standard impedance	L1	0,24	0,10	0,01	0,27	0,05	0,01	0,38	0,26
	L2	0,30	0,09	0,01	0,27	0,02	0,01	0,67	0,44
	L3	0,23	0,06	0,01	0,25	0,05	0,01	0,32	0,22
Normalised to required maximum impedance	L1	0,24	0,10	0,01	0,27	0,05	0,01	0,38	0,26
	L2	0,30	0,09	0,01	0,27	0,02	0,01	0,67	0,44
	L3	0,23	0,06	0,01	0,25	0,05	0,01	0,32	0,22
<b>SUN2000-23KTL</b>									
Measured values at test impedance	L1	0,01	0,01	0,01	0,01	0,01	0,01	0,10	0,10
	L2	0,01	0,01	0,01	0,40	0,08	0,01	0,09	0,09
	L3	0,01	0,01	0,01	0,01	0,01	0,01	0,09	0,09
Normalised to standard impedance	L1	0,01	0,01	0,01	0,01	0,01	0,01	0,10	0,10
	L2	0,01	0,01	0,01	0,40	0,08	0,01	0,09	0,09
	L3	0,01	0,01	0,01	0,01	0,01	0,01	0,09	0,09
Normalised to required maximum impedance	L1	0,01	0,01	0,01	0,01	0,01	0,01	0,10	0,10
	L2	0,01	0,01	0,01	0,40	0,08	0,01	0,09	0,09
	L3	0,01	0,01	0,01	0,01	0,01	0,01	0,09	0,09
<b>SUN2000-28KTL</b>									
Measured values at test impedance	L1	0,01	0,01	0,01	0,40	0,08	0,01	0,08	0,08
	L2	0,01	0,01	0,01	0,40	0,08	0,01	0,08	0,08
	L3	0,01	0,01	0,01	0,40	0,08	0,01	0,08	0,08
Normalised to standard impedance	L1	0,01	0,01	0,01	0,40	0,08	0,01	0,08	0,08
	L2	0,01	0,01	0,01	0,40	0,08	0,01	0,08	0,08
	L3	0,01	0,01	0,01	0,40	0,08	0,01	0,08	0,08
Normalised to required maximum impedance	L1	0,01	0,01	0,01	0,40	0,08	0,01	0,08	0,08
	L2	0,01	0,01	0,01	0,40	0,08	0,01	0,08	0,08
	L3	0,01	0,01	0,01	0,40	0,08	0,01	0,08	0,08
Test impedance	R	0,24		Ω	XI		0,15	Ω	
Standard impedance	R	0,24* 0,4^		Ω	XI		0,15* 0,25^	Ω	
Maximum Impedance	R	0,24		Ω	XI		0,1	Ω	

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 12TH0607

Power Quality. DC injection.			
SUN2000-12KTL Phase 1			
Test level power	10%	55%	100%
Recorded value	19 mA	25 mA	21 mA
As % of rated AC current	0,11%	0,15%	0,12%
Limit	0,25%	0,25%	0,25%
SUN2000-12KTL Phase 2			
Test level power	10%	55%	100%
Recorded value	9 mA	8 mA	22 mA
As % of rated AC current	0,05%	0,05%	0,12%
Limit	0,25%	0,25%	0,25%
SUN2000-12KTL Phase 3			
Test level power	10%	55%	100%
Recorded value	19 mA	16 mA	22 mA
As % of rated AC current	0,11%	0,09%	0,12%
Limit	0,25%	0,25%	0,25%

Power Quality. DC injection.			
SUN2000-23KTL Phase 1			
Test level power	10%	55%	100%
Recorded value	14mA	-17mA	-43mA
As % of rated AC current	0,042%	0,051%	0,129%
Limit	0,25%	0,25%	0,25%
SUN2000-23KTL Phase 2			
Test level power	10%	55%	100%
Recorded value	-13mA	-17mA	-26mA
As % of rated AC current	0,039%	0,051%	0,078%
Limit	0,25%	0,25%	0,25%
SUN2000-23KTL Phase 3			
Test level power	10%	55%	100%
Recorded value	-12mA	-15mA	-40mA
As % of rated AC current	0,036%	0,045%	0,012%
Limit	0,25%	0,25%	0,25%

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 12TH0607

<b>Power Quality. DC injection.</b>			
<b>SUN2000-28KTL Phase 1</b>			
<b>Test level power</b>	10%	55%	100%
<b>Recorded value</b>	-25mA	-28mA	-28mA
<b>As % of rated AC current</b>	0,062%	0,069%	0,069%
<b>Limit</b>	0,25%	0,25%	0,25%
<b>SUN2000-28KTL Phase 2</b>			
<b>Test level power</b>	10%	55%	100%
<b>Recorded value</b>	17mA	20mA	-12mA
<b>As % of rated AC current</b>	0,042%	0,049%	0,030%
<b>Limit</b>	0,25%	0,25%	0,25%
<b>SUN2000-28KTL Phase 3</b>			
<b>Test level power</b>	10%	55%	100%
<b>Recorded value</b>	23mA	21mA	28mA
<b>As % of rated AC current</b>	0,057%	0,051%	0,069%
<b>Limit</b>	0,25%	0,25%	0,25%

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 12TH0607

Fault level Contribution.					
SUN2000-12KTL Phase 1					
For a directly coupled SSEG			For a Inverter SSEG		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	$I_p$	N/A	20ms	30,6	25,6
Initial Value of aperiodic current	A	N/A	100ms	23,3	19,0
Initial symmetrical short-circuit current*	$I_k$	N/A	250ms	N/A	N/A
Decaying (aperiodic) component of short circuit current*	$i_{DC}$	N/A	500ms	N/A	N/A
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,062	In seconds
SUN2000-12KTL Phase 2					
For a directly coupled SSEG			For a Inverter SSEG		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	$I_p$	N/A	20ms	30,4	24,0
Initial Value of aperiodic current	A	N/A	100ms	23,0	17,4
Initial symmetrical short-circuit current*	$I_k$	N/A	250ms	N/A	N/A
Decaying (aperiodic) component of short circuit current*	$i_{DC}$	N/A	500ms	N/A	N/A
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,051	In seconds
SUN2000-12KTL Phase 3					
For a directly coupled SSEG			For a Inverter SSEG		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	$I_p$	N/A	20ms	29,3	25,3
Initial Value of aperiodic current	A	N/A	100ms	23,0	18,4
Initial symmetrical short-circuit current*	$I_k$	N/A	250ms	N/A	N/A
Decaying (aperiodic) component of short circuit current*	$i_{DC}$	N/A	500ms	N/A	N/A
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,058	In seconds

For rotating machines and linear piston machines the test should produce a 0s – 2s plot of the short circuit current as seen at the Generating Unit terminals.

\* Values for these parameters should be provided where the short circuit duration is sufficiently long to enable interpolation of the plot.

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 12TH0607

Fault level Contribution.					
SUN2000-23KTL Phase 1					
For a directly coupled SSEG			For a Inverter SSEG		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	$I_p$	N/A	20ms	31,0V	37,9A
Initial Value of aperiodic current	A	N/A	100ms	26,0V	29,6A
Initial symmetrical short-circuit current*	$I_k$	N/A	250ms	N/A	N/A
Decaying (aperiodic) component of short circuit current*	$i_{DC}$	N/A	500ms	N/A	N/A
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,061	In seconds
SUN2000-23KTL Phase 2					
For a directly coupled SSEG			For a Inverter SSEG		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	$I_p$	N/A	20ms	27,9V	38,1A
Initial Value of aperiodic current	A	N/A	100ms	25,0V	29,3A
Initial symmetrical short-circuit current*	$I_k$	N/A	250ms	N/A	N/A
Decaying (aperiodic) component of short circuit current*	$i_{DC}$	N/A	500ms	N/A	N/A
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,060	In seconds
SUN2000-23KTL Phase 3					
For a directly coupled SSEG			For a Inverter SSEG		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	$I_p$	N/A	20ms	30,6V	36,8A
Initial Value of aperiodic current	A	N/A	100ms	25,8V	29,4A
Initial symmetrical short-circuit current*	$I_k$	N/A	250ms	N/A	N/A
Decaying (aperiodic) component of short circuit current*	$i_{DC}$	N/A	500ms	N/A	N/A
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,060	In seconds
For rotating machines and linear piston machines the test should produce a 0s – 2s plot of the short circuit current as seen at the Generating Unit terminals.					
* Values for these parameters should be provided where the short circuit duration is sufficiently long to enable interpolation of the plot.					

**Appendix 13.1 Type Testing a Generating Unit**

Extract from test report according the Engineering Recommendation G59/3

Nr. 12TH0607

Fault level Contribution.					
SUN2000-28KTL Phase 1					
For a directly coupled SSEG			For a Inverter SSEG		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	$I_p$	N/A	20ms	35,3V	39,5A
Initial Value of aperiodic current	A	N/A	100ms	27,8V	27,8A
Initial symmetrical short-circuit current*	$I_k$	N/A	250ms	N/A	N/A
Decaying (aperiodic) component of short circuit current*	$i_{DC}$	N/A	500ms	N/A	N/A
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,052	In seconds
SUN2000-28KTL Phase 2					
For a directly coupled SSEG			For a Inverter SSEG		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	$I_p$	N/A	20ms	35,0V	36,2A
Initial Value of aperiodic current	A	N/A	100ms	28,0V	30,2A
Initial symmetrical short-circuit current*	$I_k$	N/A	250ms	N/A	N/A
Decaying (aperiodic) component of short circuit current*	$i_{DC}$	N/A	500ms	N/A	N/A
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,065	In seconds
SUN2000-28KTL Phase 3					
For a directly coupled SSEG			For a Inverter SSEG		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	$I_p$	N/A	20ms	37,6V	41,0A
Initial Value of aperiodic current	A	N/A	100ms	27,8V	28,4A
Initial symmetrical short-circuit current*	$I_k$	N/A	250ms	N/A	N/A
Decaying (aperiodic) component of short circuit current*	$i_{DC}$	N/A	500ms	N/A	N/A
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,050	In seconds
For rotating machines and linear piston machines the test should produce a 0s – 2s plot of the short circuit current as seen at the Generating Unit terminals.					
* Values for these parameters should be provided where the short circuit duration is sufficiently long to enable interpolation of the plot.					



## Annex to the G59/3 certificate of compliance No. U14-0439

### Appendix 13.1 Type Testing a Generating Unit

Extract from test report according the Engineering Recommendation G59/3

Nr. 12TH0607

Self Monitoring – Solid state switching.	N/A
It has been verified that in the event of the solid state switching device failing to disconnect the Generating Unit, the voltage on the output side of the switching device is reduced to a value below 50 volts within 0,5 seconds.	
Note. Unit does not provide solid state switching relays. In case the semiconductor bridge is switched off, then the voltage on the output drops to 0. In this case the relays on the output will also open.	

Additional comments
The model SUN2000-28KTL provides no neutral wire and is rated for a voltage of 480V 3 phase voltage.