

Factory Acceptance Test Report

Customer	<i>The Generator Company - Royal Hallamshire Hospital</i>
Subsidiary	<i>PRAMAC UK</i>
Date	21-22-23/11/2023
Tested Gensets	<p>Gensets code SF332TMAC07</p> <p>Model GSW3360M</p> <p>Serial numbers HEI0010071 - HEI0010072 - HEI0010073</p> <p>Customer identification:</p> <p>TGC diesel driven alternators, model type TGC-P2500</p> <p>Model TGC-P2500</p>
Witnesses	<p>Andrew Litherland</p> <p>Rob Heeley</p> <p>Anibal Dickson</p> <p>Karl Atkin</p> <p>Aneal Clayton</p> <p>Martin Mottershead</p>
Total Pages	24

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1) GSW3360M (TGC-P2500) – SF332TMAC07 – GENSET RATING

Input data

Engine 20V4000G63LF Prime Gross Power with Overload – Application 3B MTU = 2590 kWm

Engine 20V4000G63LF Prime Gross Power with Overload – Application 3B MTU +10% = 2849 kWm

Medium voltage alternator efficiency @ 100% = 96,95%

NO radiator

Alternator LEROY SOMER model LSA54.2 ZL14 power 125/40 = 4000 kVA

Alternator LEROY SOMER model LSA54.2 ZL14 power 125/40 +10% = 4400 kVA

Genset rating

Generator was rated as capable of developing:

Genset PRP rating = 2000 kW_e → at power factor 0,8 → 2500 kVA

Overload capability: 10% 1 hour in 12:

Genset PRP rating +10% = 2200 kW_e → at power factor 0,8 → 2750 kVA

3 phases, 4 wires, 11,000V, 50 Hz at a rotational speed of 1500 revs/min

2) GSW3360M (TGC-P2500) – SF332TMAC07 – GENERAL INFORMATION

HEI0010071

Engine

Brand: MTU
Model: 20V4000G63LF – Application 3B
Serial Number: 5495000208

Alternator

Brand: LEROY SOMER
Model: LSA54.2 ZL14
Serial Number: 790692 003

HEI0010072

Engine

Brand: MTU
Model: 20V4000G63LF – Application 3B
Serial Number: 5495000207

Alternator

Brand: LEROY SOMER
Model: LSA54.2 ZL14
Serial Number: 790692 001

HEI0010073

Engine

Brand: MTU
Model: 20V4000G63LF – Application 3B
Serial Number: 5495000209

Alternator

Brand: LEROY SOMER
Model: LSA54.2 ZL14
Serial Number: 790692 002

3) TEST PROCEDURE – VISUAL INSPECTION

- 1) Dimensional inspection
- 2) Check of the scope of supply

4) TEST PROCEDURE – TEST ON LOAD

Reactive load bank @ 0.8 power factor

Load test procedure

- 1) Single Step at 1500 kVA
- 2) 4 hours at 2500 kVA
- 3) 1 hour at 2750 kVA

Note: the genset doesn't include radiator, so we use our external electrical radiator

5) TEST PROCEDURE – ALARMS TEST

- ⇒ High coling water temperature
- ⇒ Low oil pressure
- ⇒ Emergency stop
- ⇒ Over frequency
- ⇒ Over Voltage
- ⇒ Under frequency
- ⇒ Under Voltage

Tests will be done trough simulation and not as real condition

6) TEST PROCEDURE – GRAPHS

Performance table according to ISO 8528-5:

Table 4 — Performance class operating limit values

Parameter	Symbol	Unit	Operating limit values			
			Performance class			
			G1	G2	G3	G4
Frequency droop	δf_{st}	%	≤ -8	≤ -5	$\leq -3^r$	AMC ^a
Steady-state frequency band	β_f	%	$\leq \pm 2,5$	$\leq \pm 1,5^b$	$\leq \pm 0,5$	AMC
Related range of downward frequency setting	$\delta f_{s,do}$	%	$> (2,5 + \delta f_{st})$			AMC
Related range of upward frequency setting	$\delta f_{s,up}$	%	$> +2,5^c$			AMC
Rate of change of frequency setting	v_f	%/s	0,2 to 1			AMC
Transient frequency difference from initial frequency	100 % sudden power decrease ^p	δf_d	$\leq +18$	$\leq +12$	$\leq +10$	AMC
	sudden power increase ^{d,e,q}		$\leq -(15 + \delta f_{st})^d$	$\leq -(10 + \delta f_{st})^d$	$\leq -(7 + \delta f_{st})^d$	
Transient frequency deviation from rated frequency	100 % sudden power decrease ^p	δf_{dyn}	$\leq +18$	$\leq +12$	$\leq +10$	AMC
	sudden power increase ^{d,e,q}		$\leq -15^d$	$\leq -10^d$	$\leq -7^d$	
Frequency recovery time	$t_{f,lin}$	s	$\leq +10^f$	$\leq +5^f$	$\leq +3^f$	AMC
	$t_{f,de}$		$\leq +10^d$	$\leq +5^d$	$\leq +3^d$	
Related frequency tolerance band	α_f	%	3,5	2	2	AMC
Steady-state voltage deviation	δU_{st}	%	$\leq +5$	$\leq +2,5$	$\leq +1$	AMC
Voltage unbalance	$\delta U_{2,0}$	%	1 ⁱ	1 ⁱ	1 ⁱ	1 ⁱ
Related range of voltage setting	δU_s	%	$\leq \pm 5$			AMC
Rate of change of voltage setting	v_U	% s ⁻¹	0,2 to 1			AMC
Parameter	Symbol	Unit	Operating limit values			
			Performance class			
			G1	G2	G3	G4
Transient voltage deviation	100 % sudden power decrease	δU_{dyn}^+	$\leq +35$	$\leq +25$	$\leq +20$	AMC
	sudden power increase ^{d,e}		$\leq -25^d$	$\leq -20^d$	$\leq -15^d$	
Voltage recovery time (see Figure 5)	$t_{U,lin}$	s	$\leq +10$	$\leq +6$	$\leq +4$	AMC
	$t_{U,de}$		$\leq +10^d$	$\leq +6^d$	$\leq +4^d$	
Voltage modulation ^{k,l} (see Figure 8)	$\hat{U}_{mod,s}$	%	AMC	0,3 ^{m,n}	0,3 ⁿ	AMC
Active power sharing ^o	between 80 % and 100 % of the nominal rating	ΔP	—	$\leq +5$	$\leq +5$	AMC
	between 20 % and 80 % of the nominal rating		—	$\leq +10$	$\leq +10$	AMC
Reactive power sharing	between 20 % and 100 % of the nominal rating	ΔQ	—	$\leq +10$	$\leq +10$	AMC

5Hz

3,5Hz

1Hz

1Hz

110V

250V

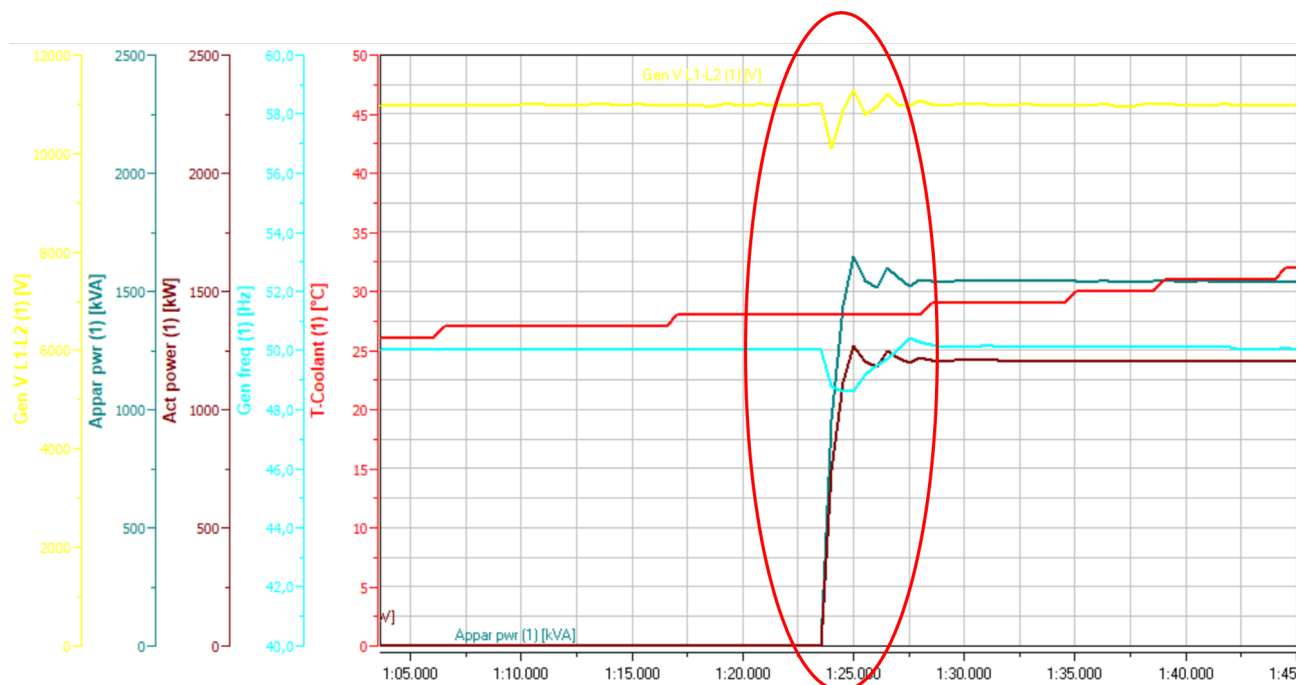
1650V

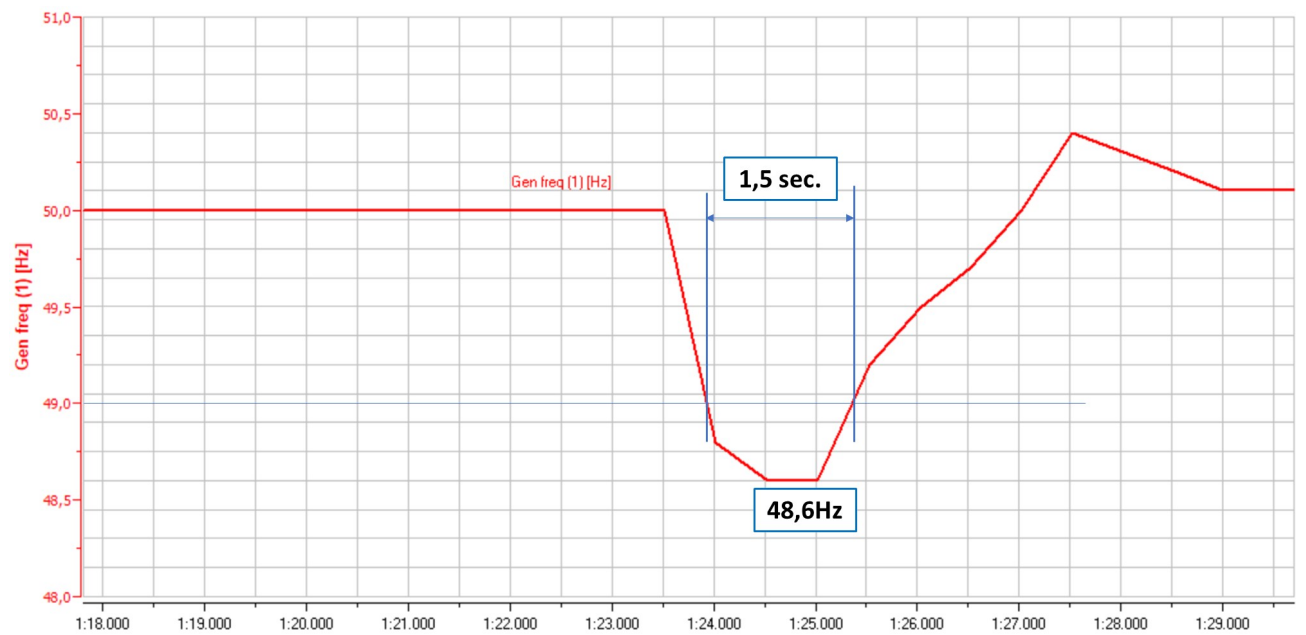
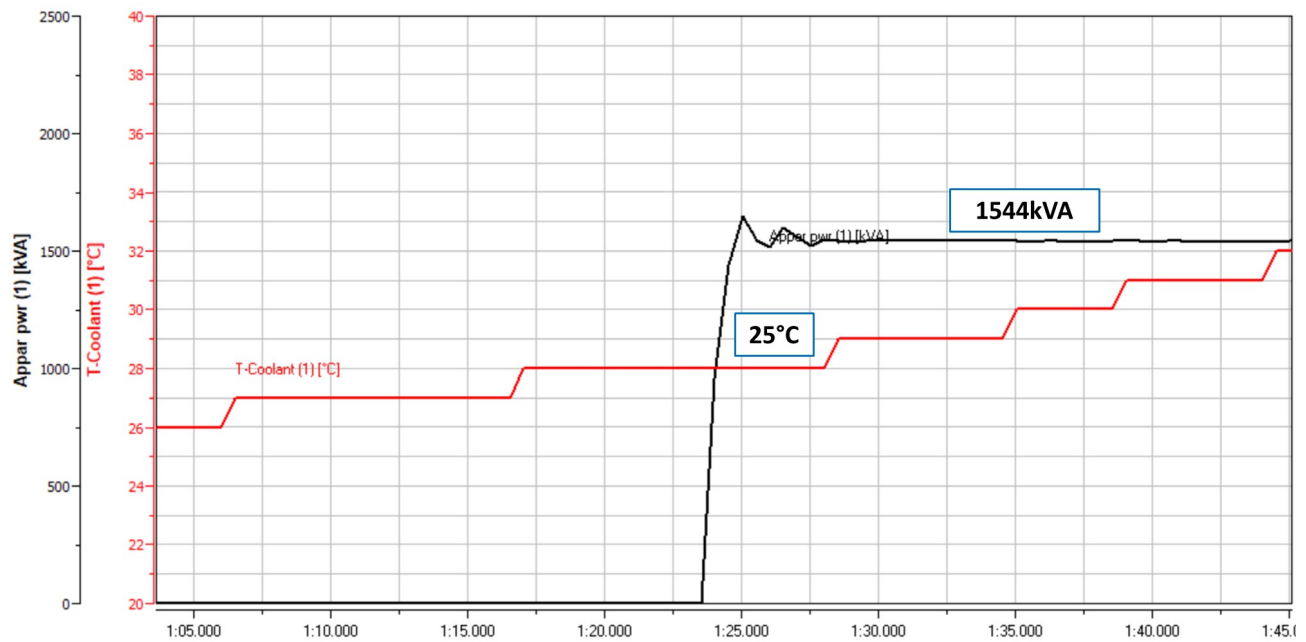
2200V

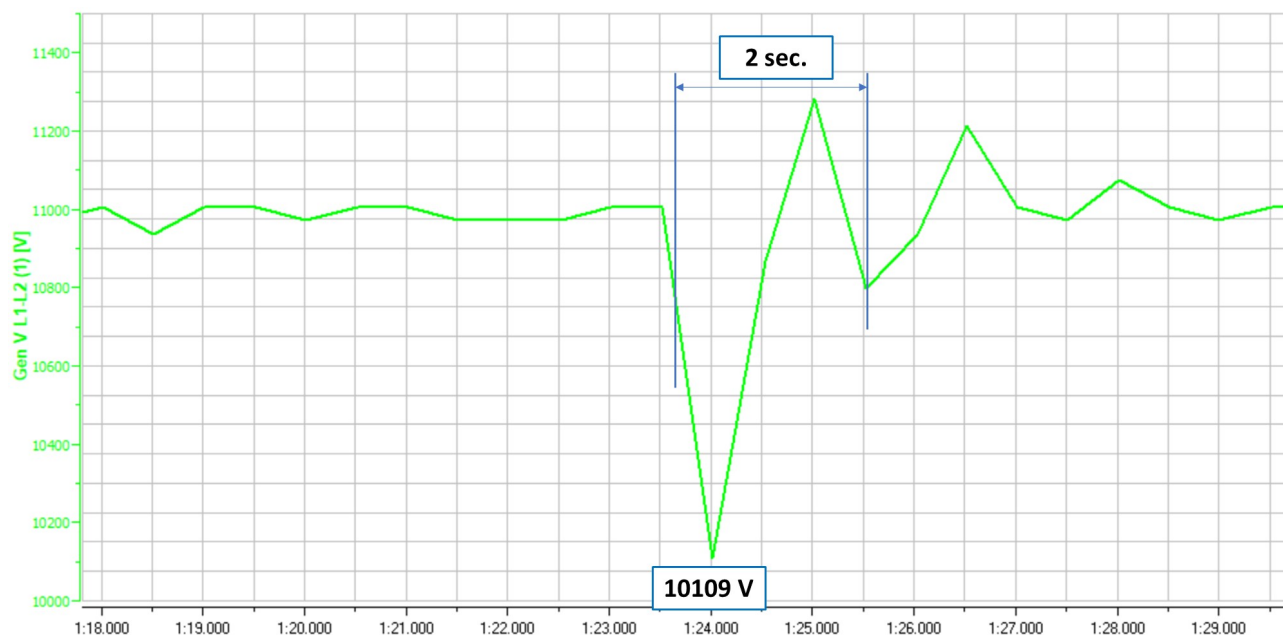
According to ISO 8528-5 the recovery time, after a transient for a sudden power increase/decrease, are evaluated considering:

- Voltage: the time within voltage remain outside of 2 x Steady-state voltage band.
- Frequency: the time within frequency remain outside of 2% of rated frequency

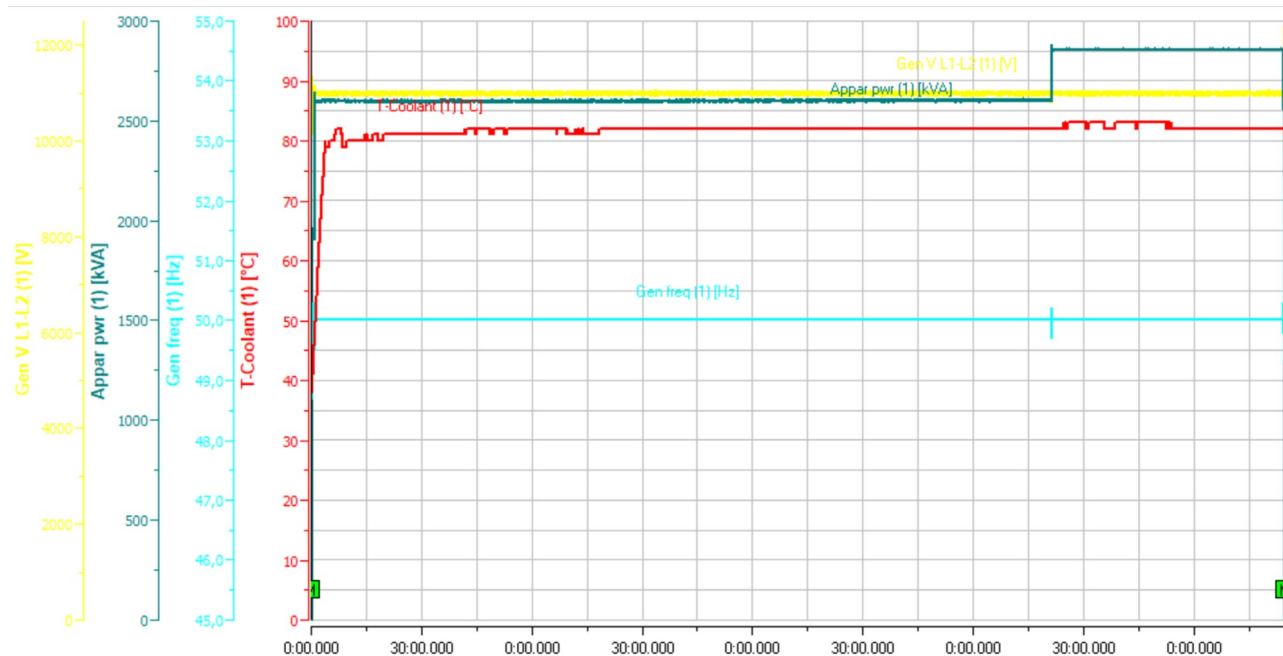
HEI0010071



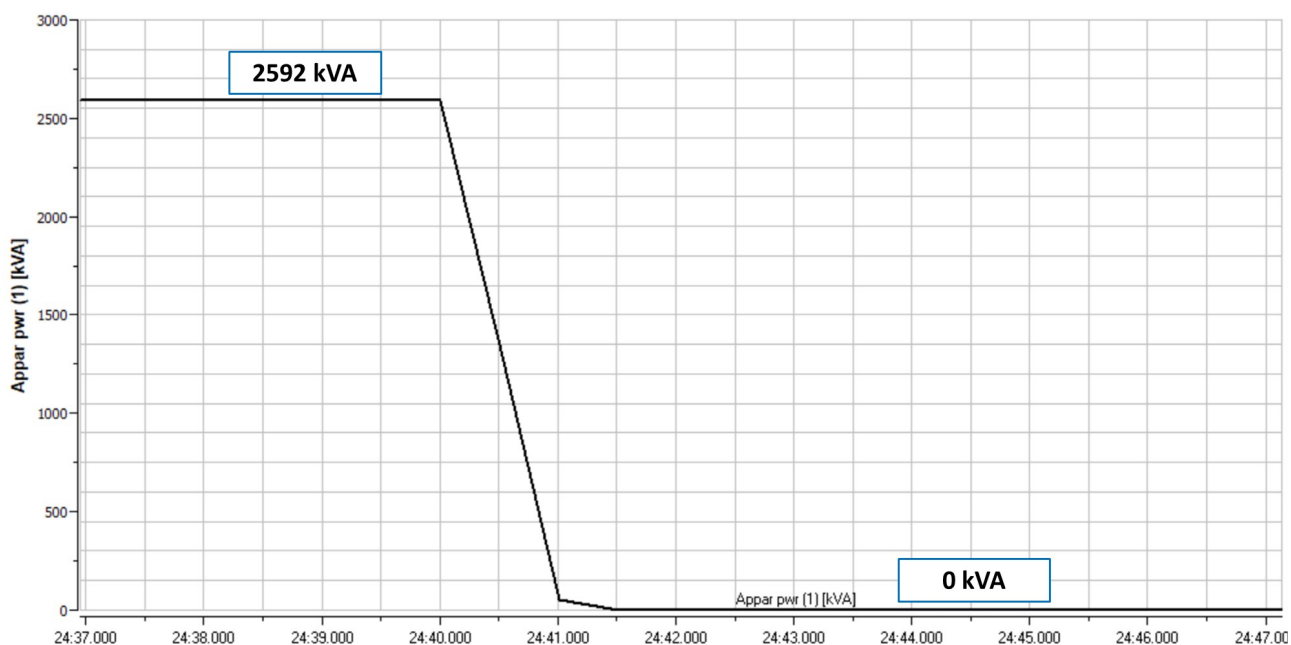
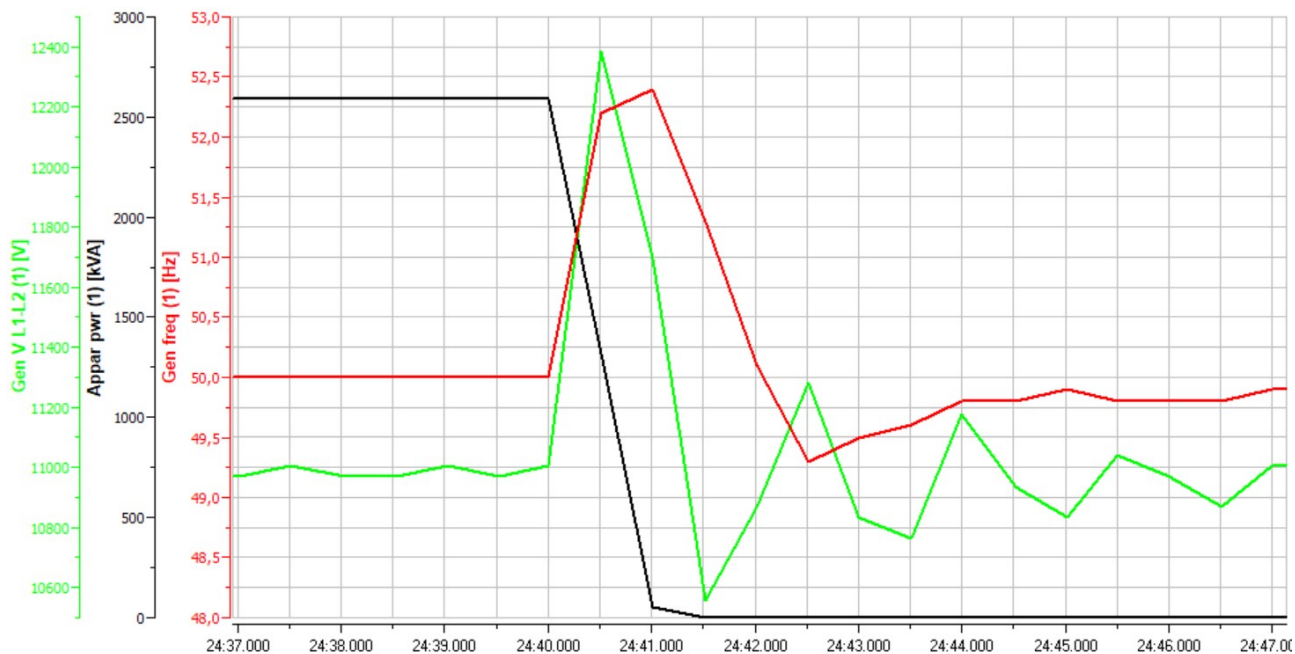


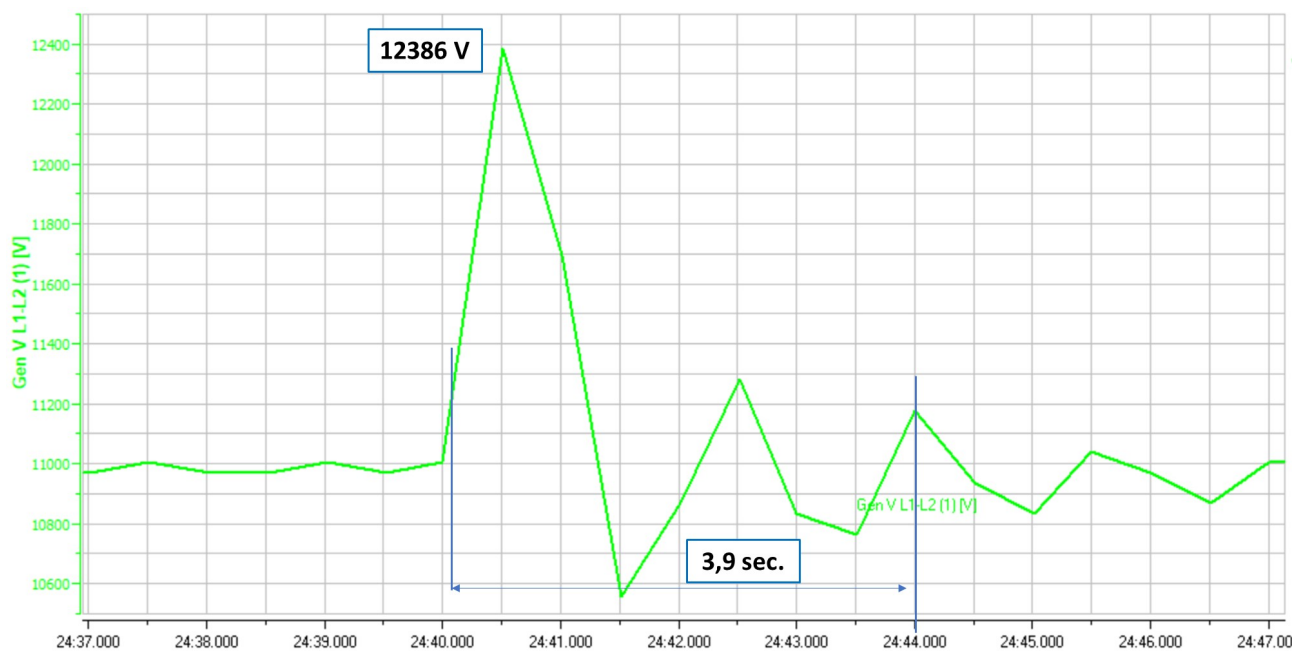
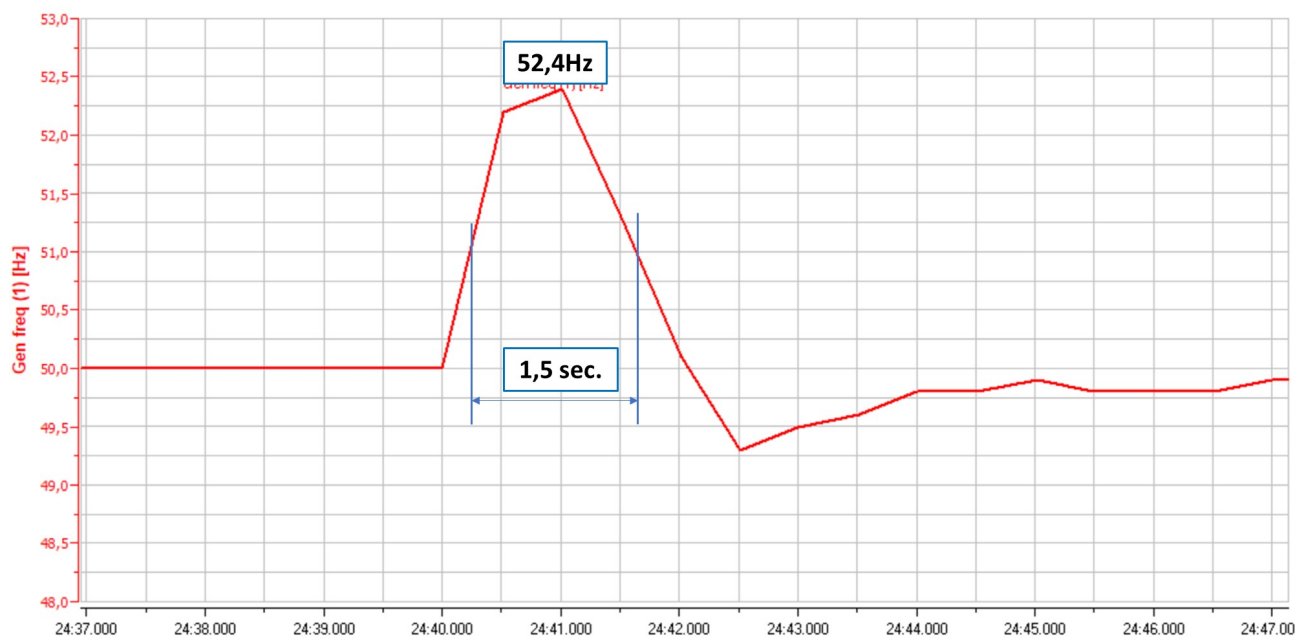


Long running (3hours 2500kVA + 1 hour 2750kVA):



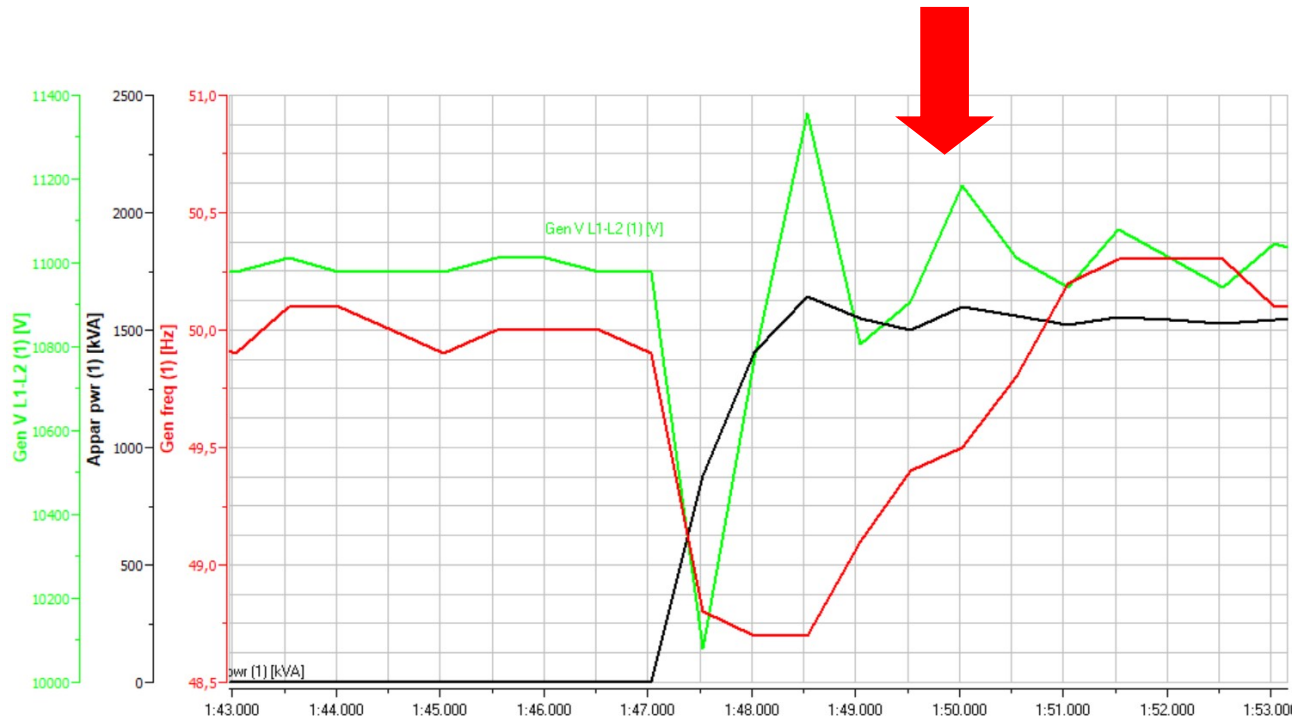
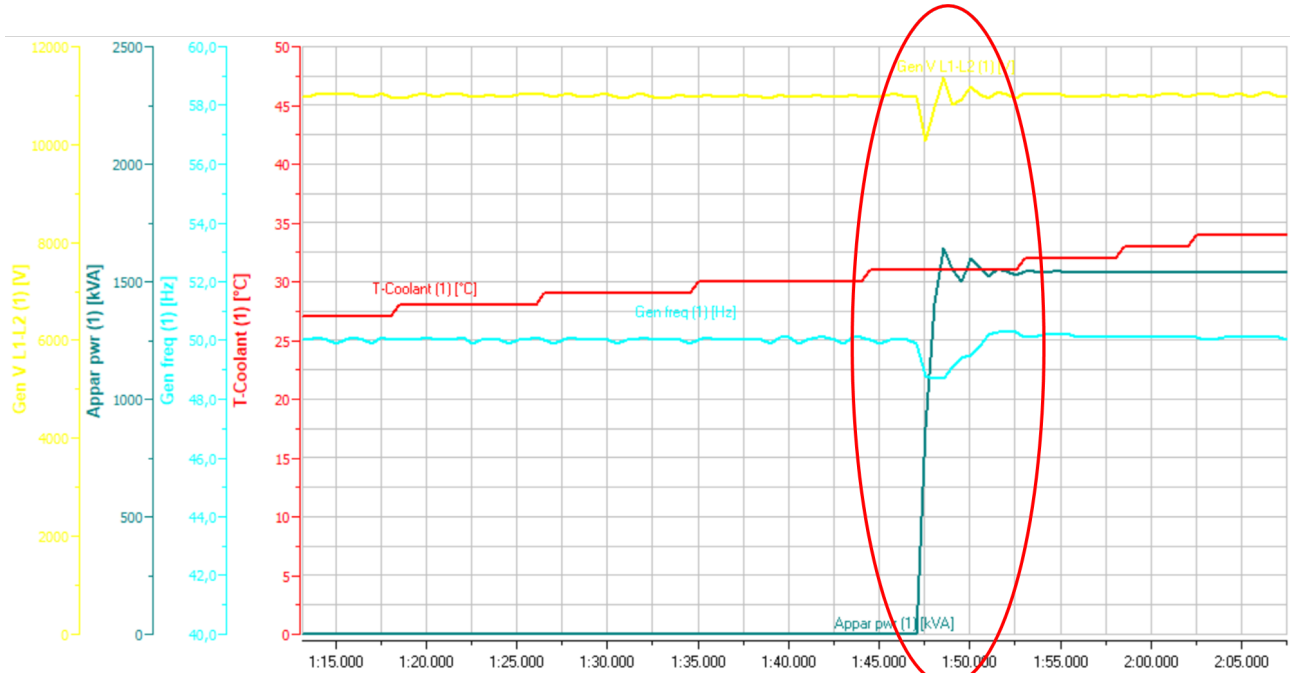
sudden power decrease (2500kVA to 0):

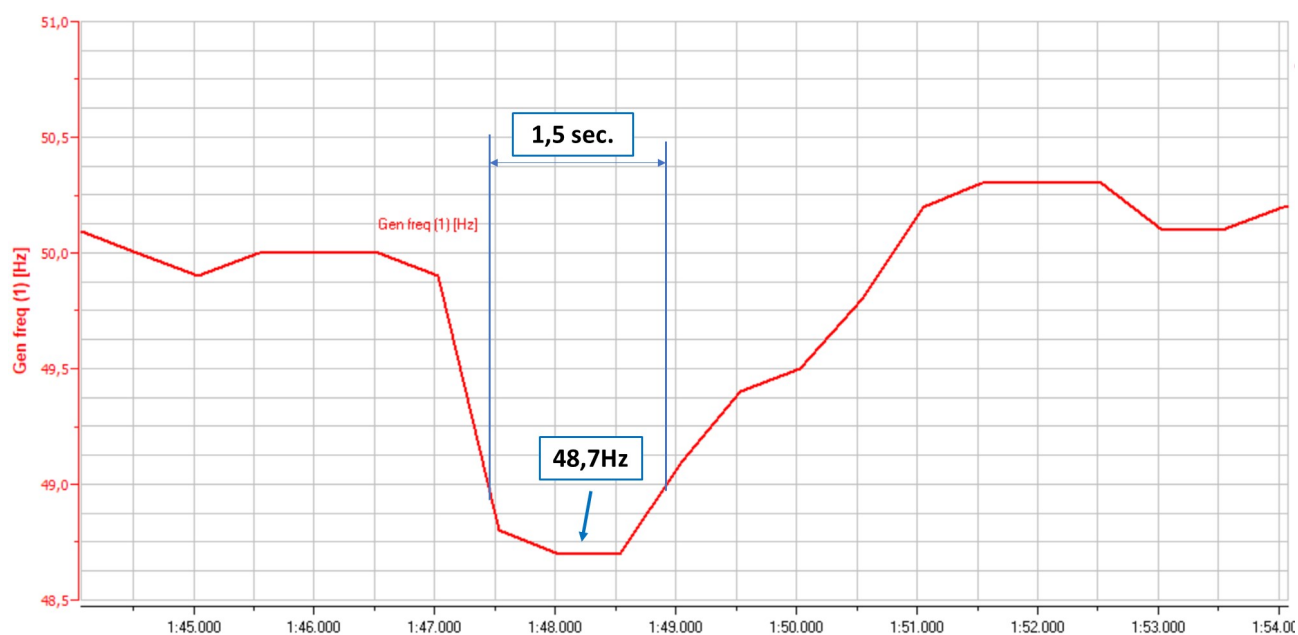
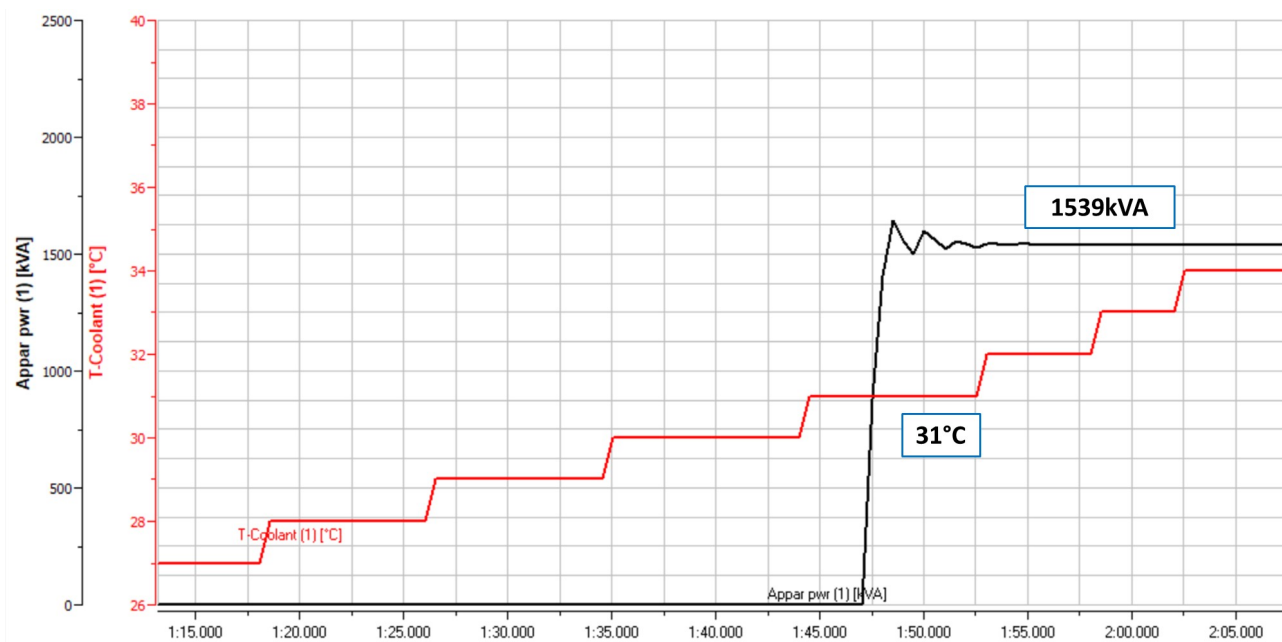


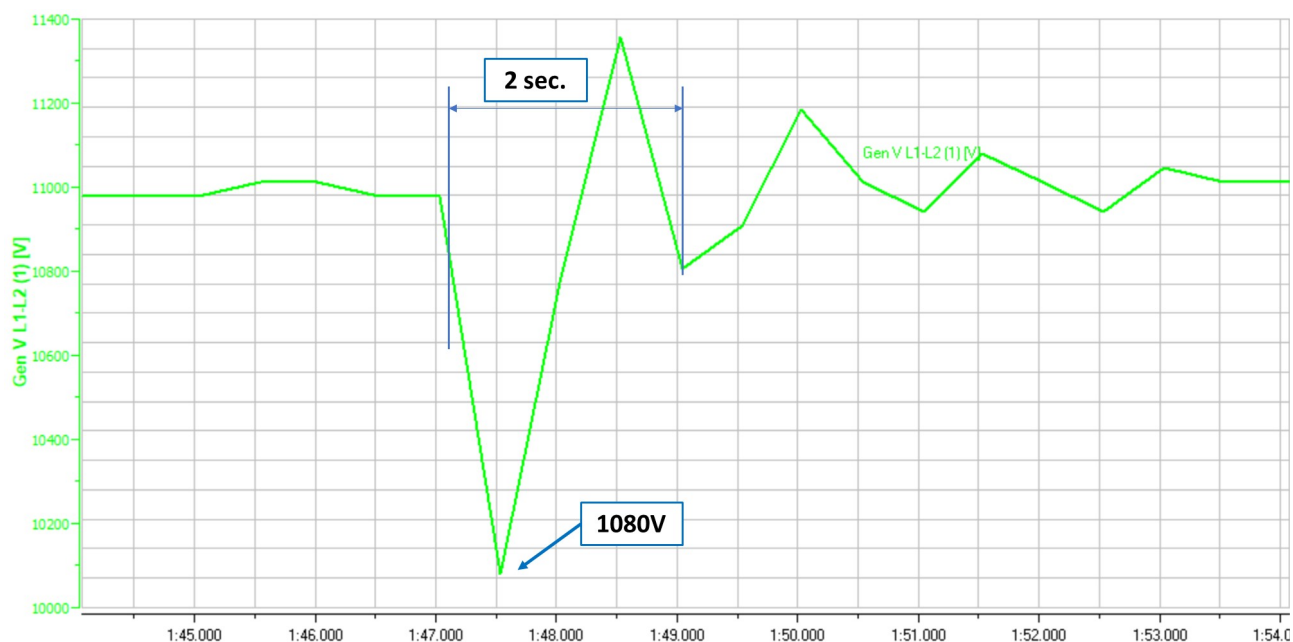


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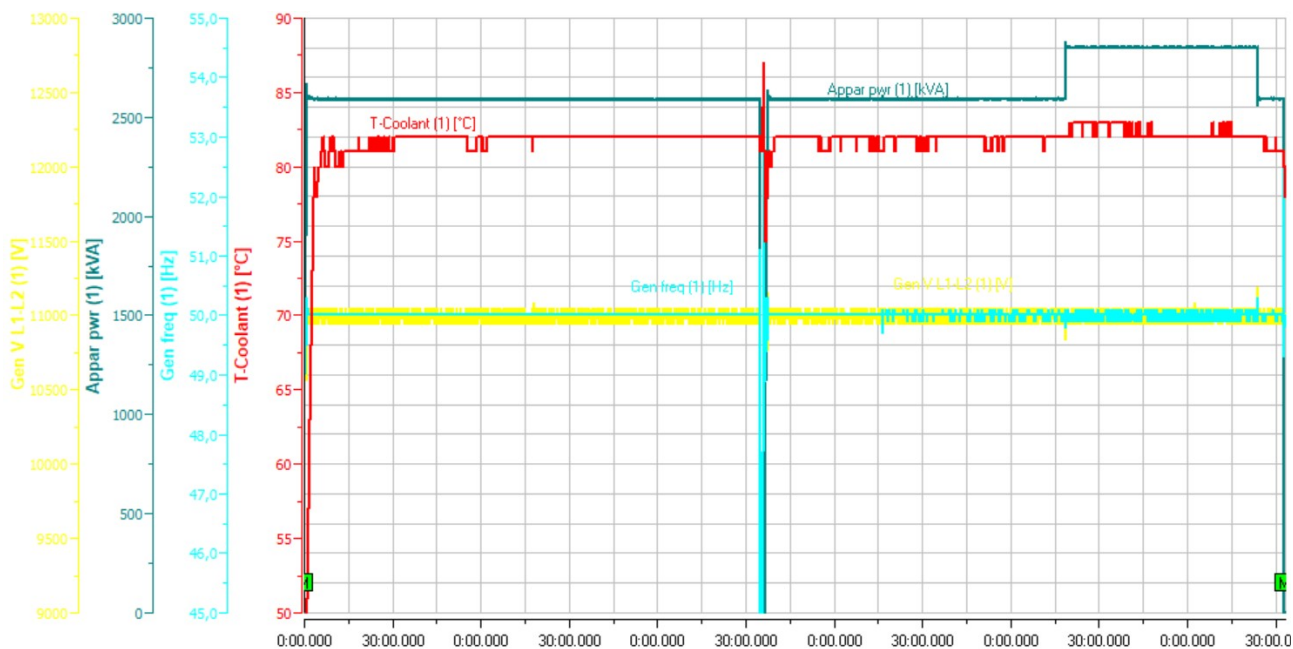
Step Load at 1500kVA:



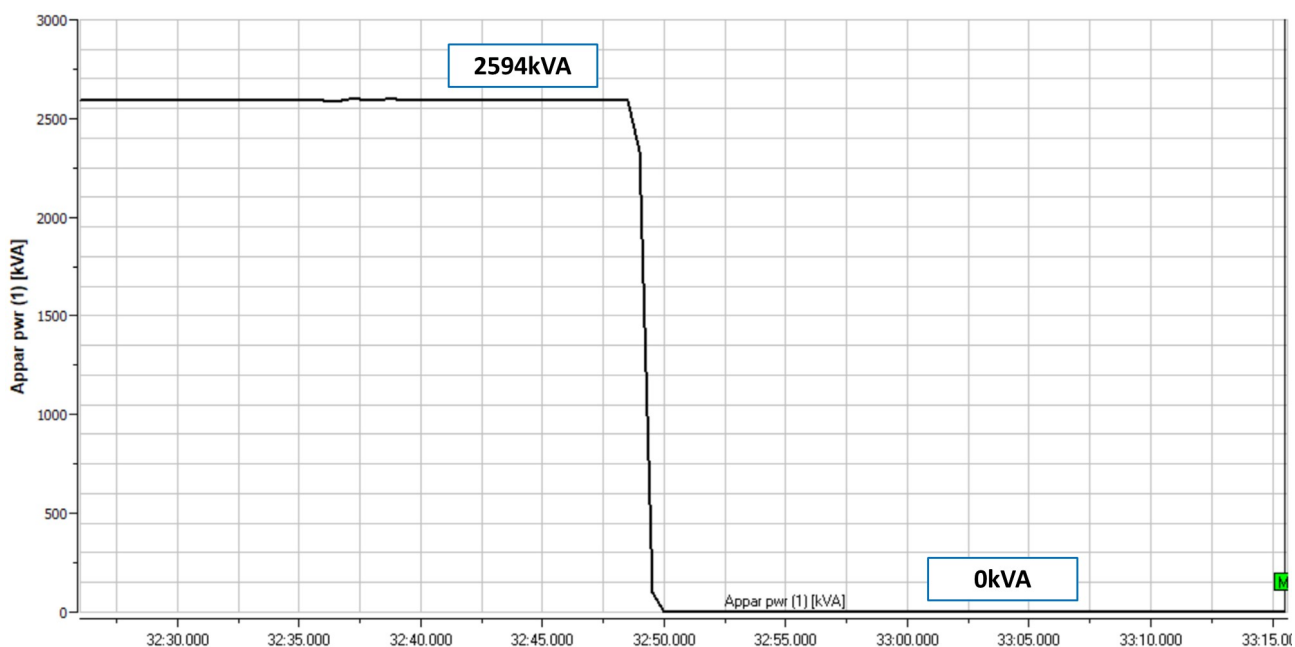
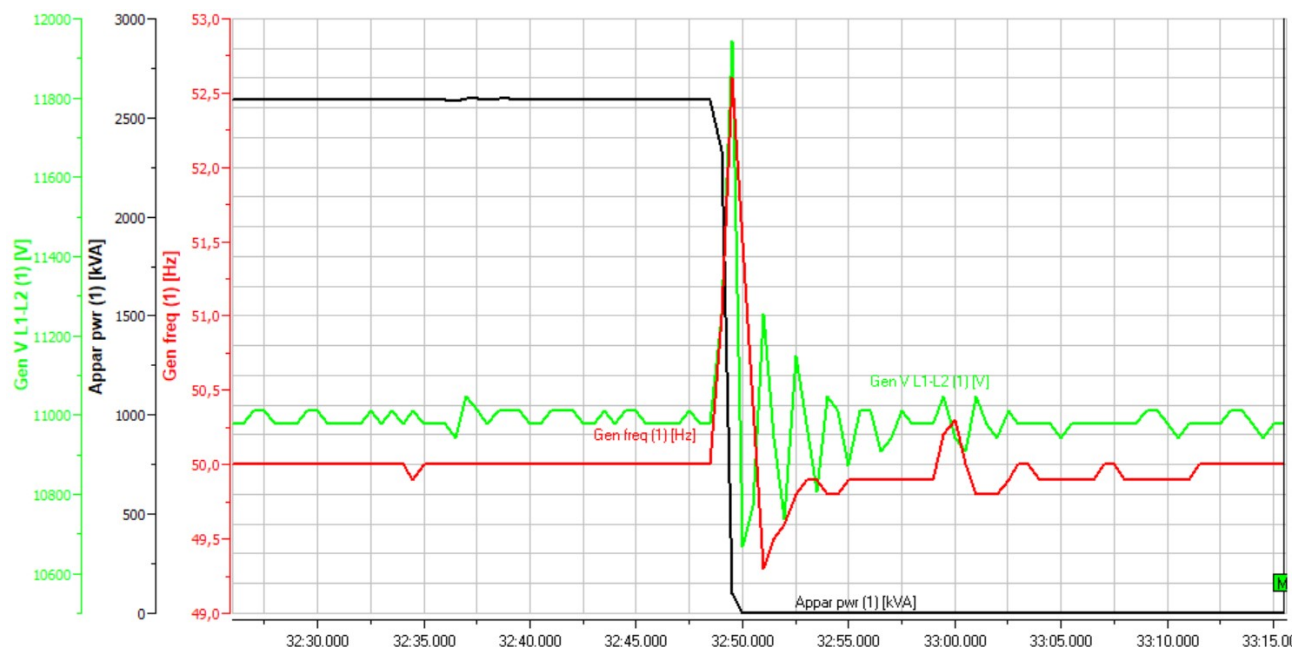


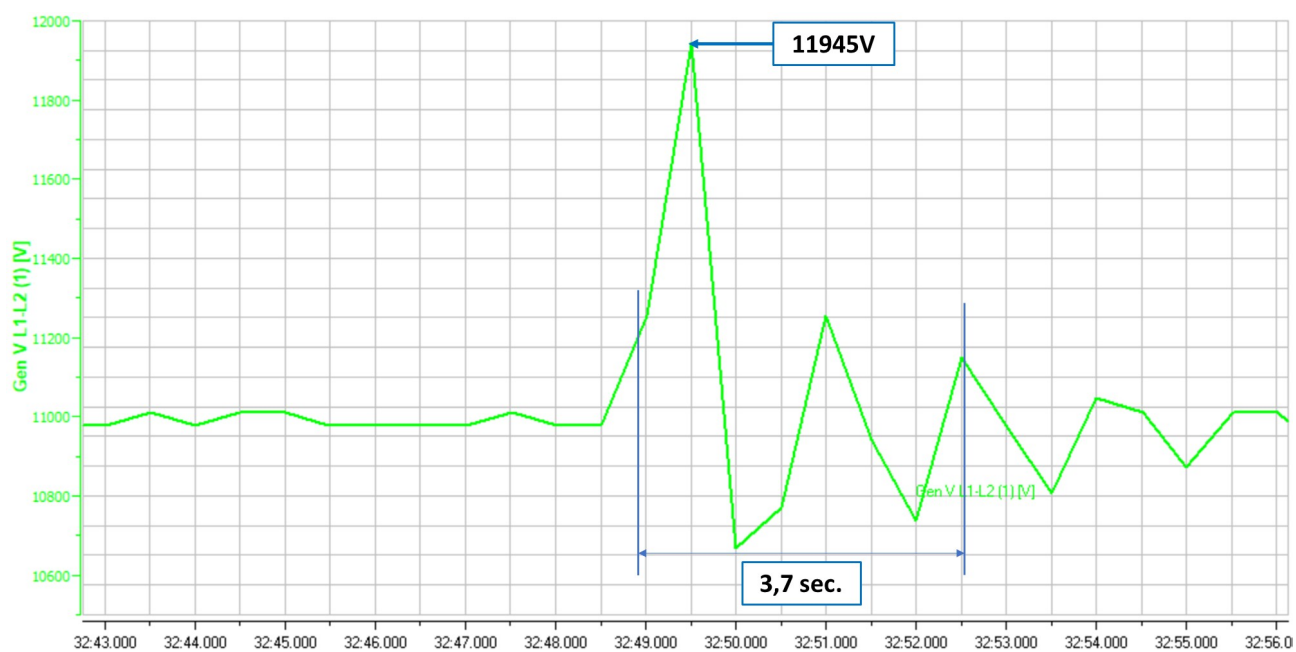
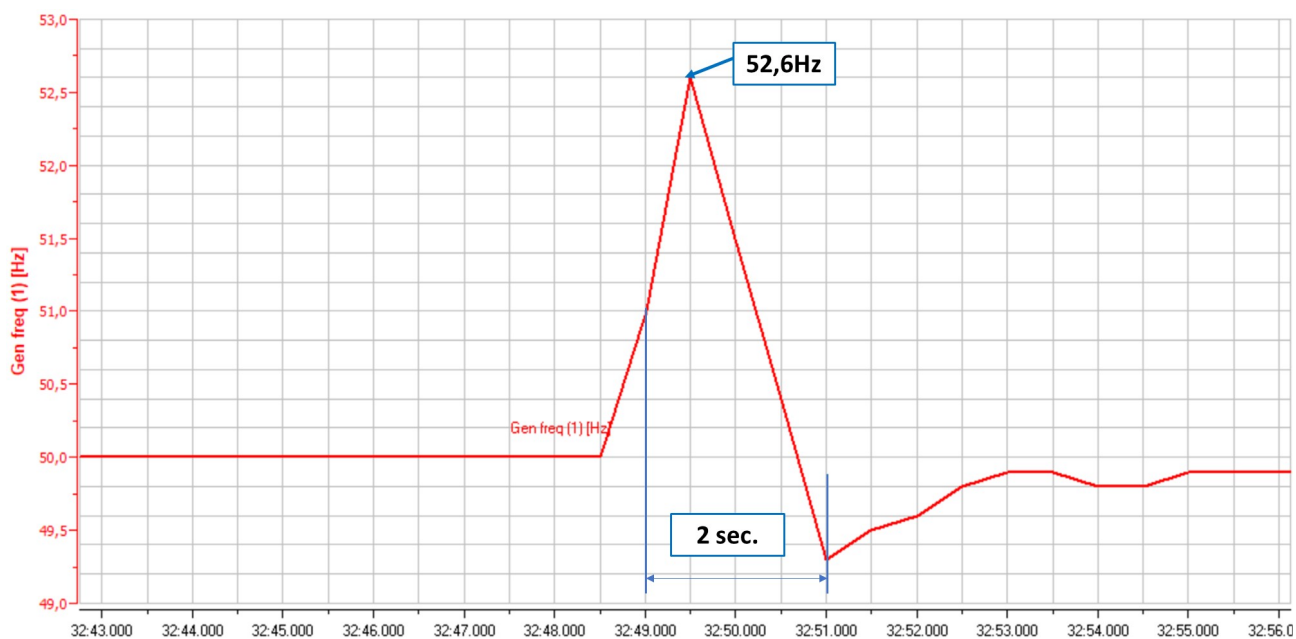


Long running (4hours 2500kVA + 1 hour 2750kVA):



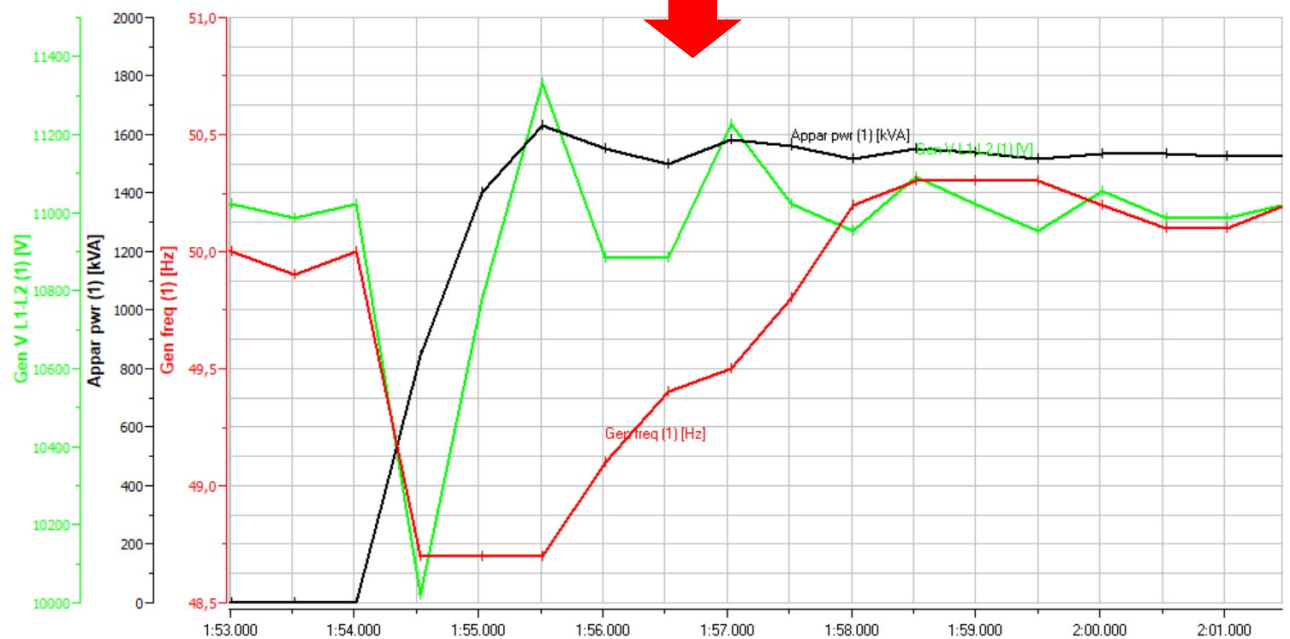
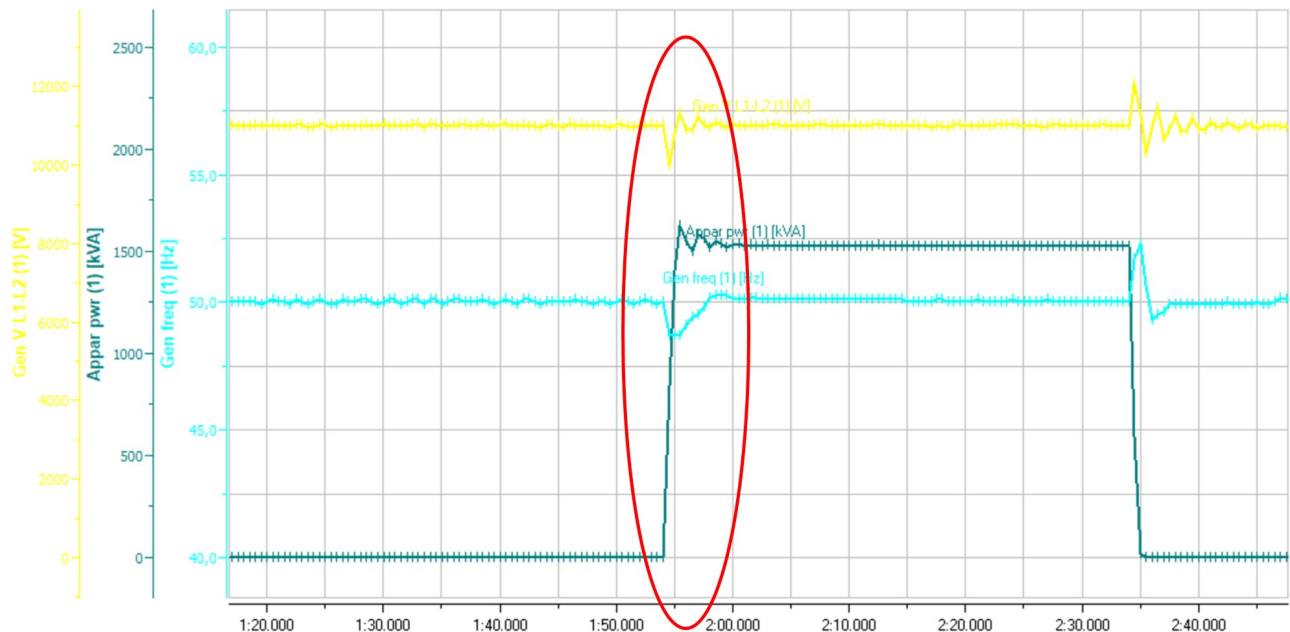
sudden power decrease (2500kVA to 0):

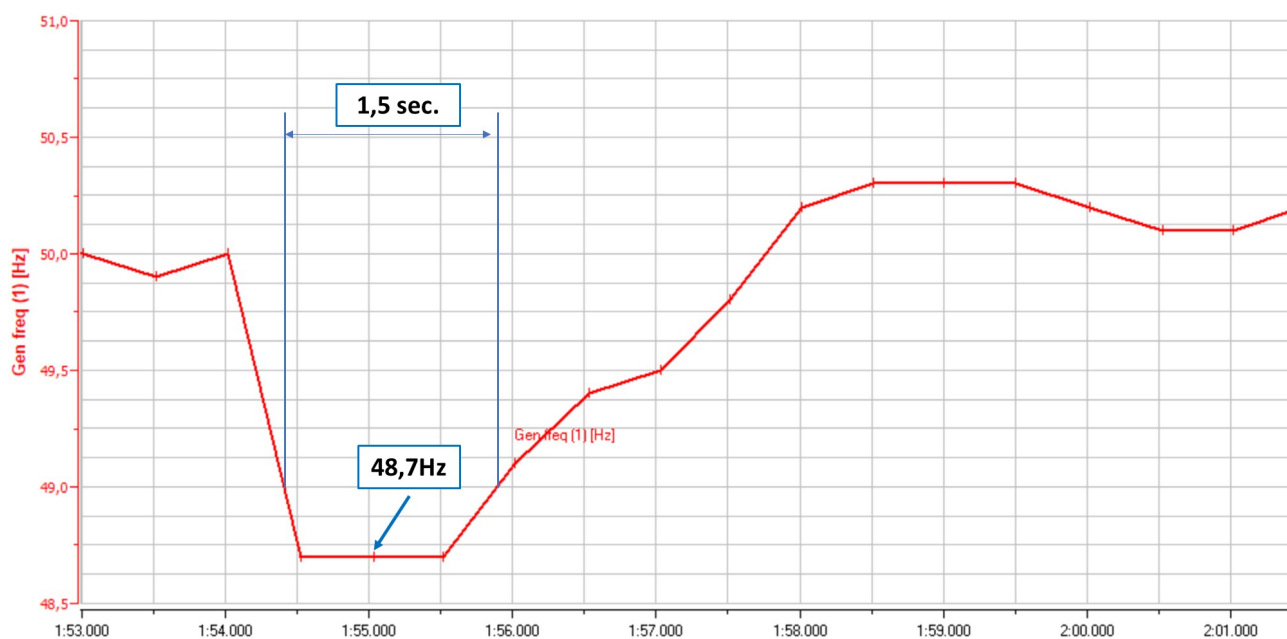
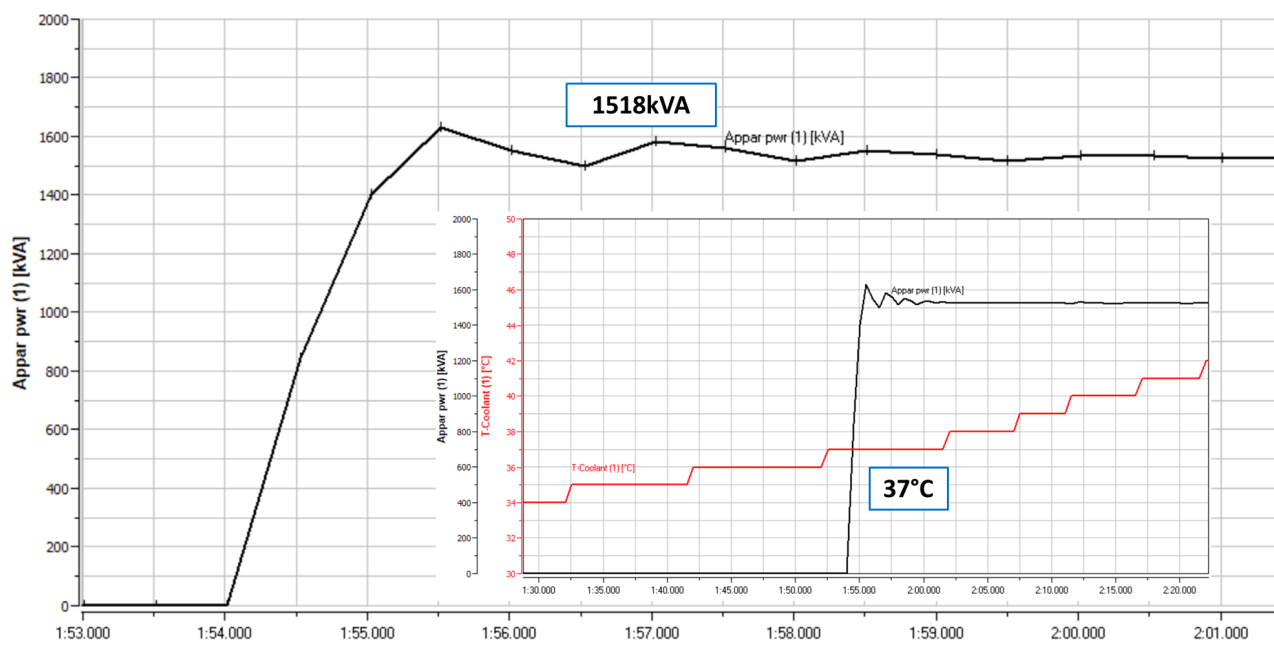


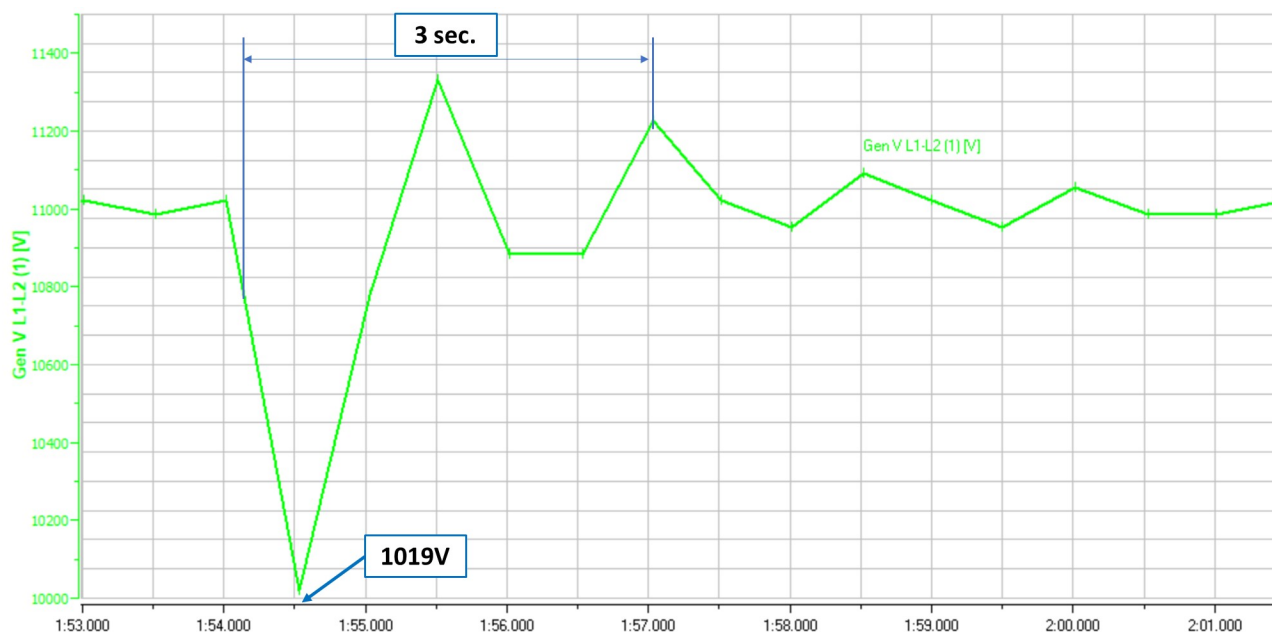


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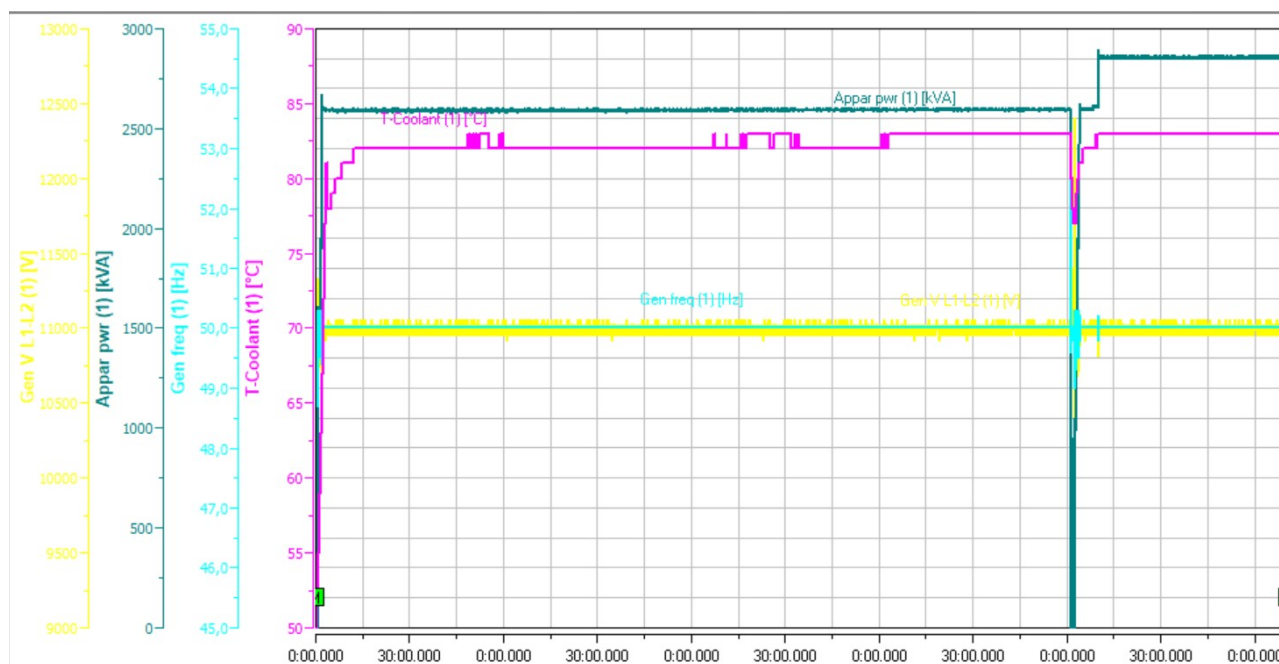
Step Load at 1500kVA:



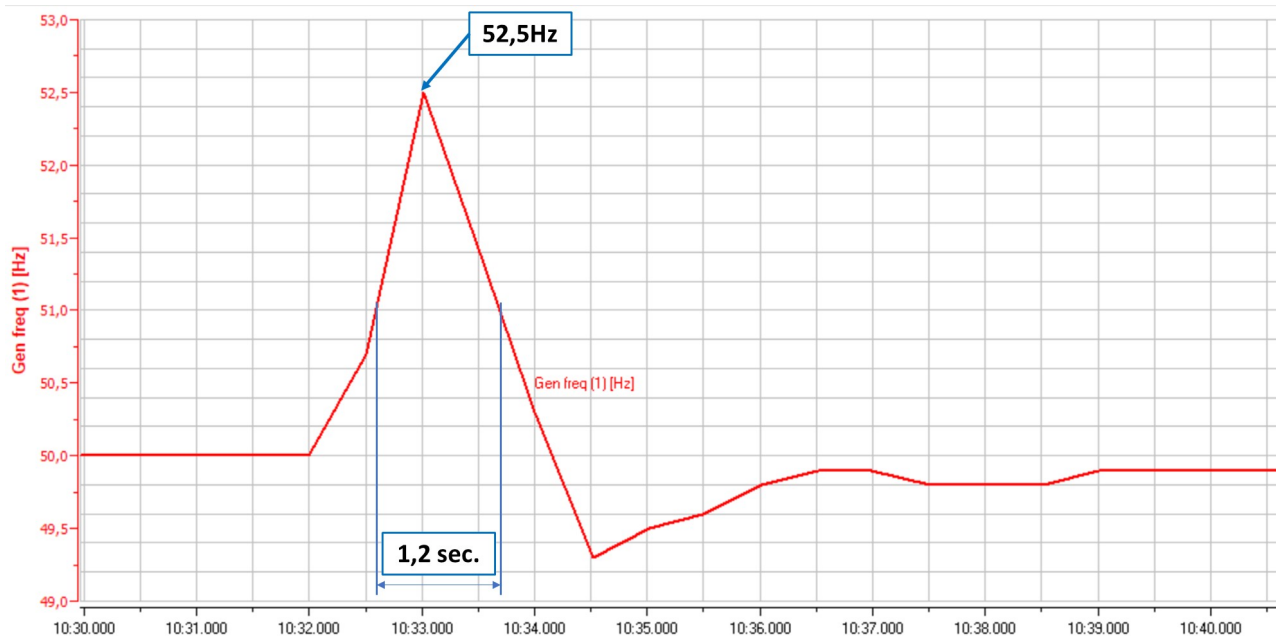
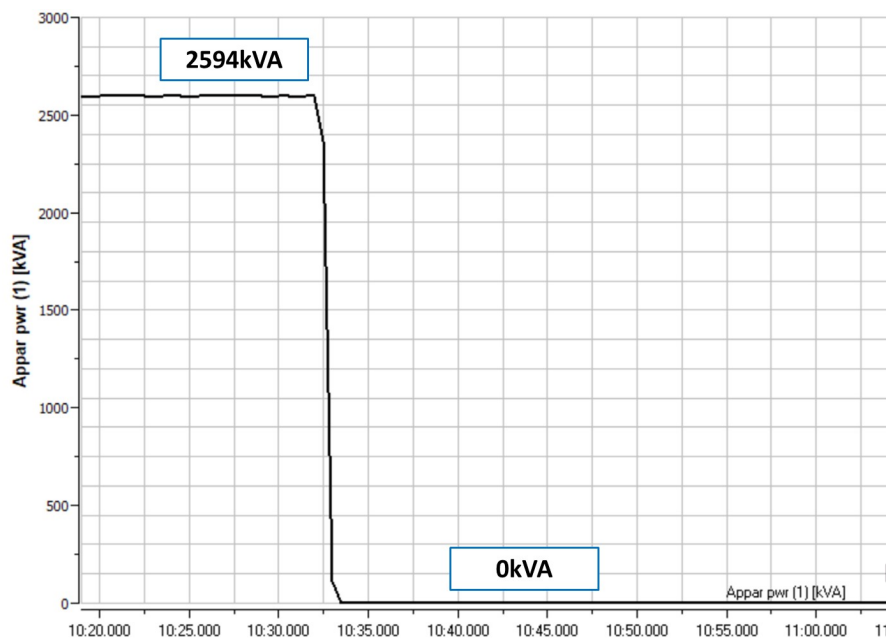


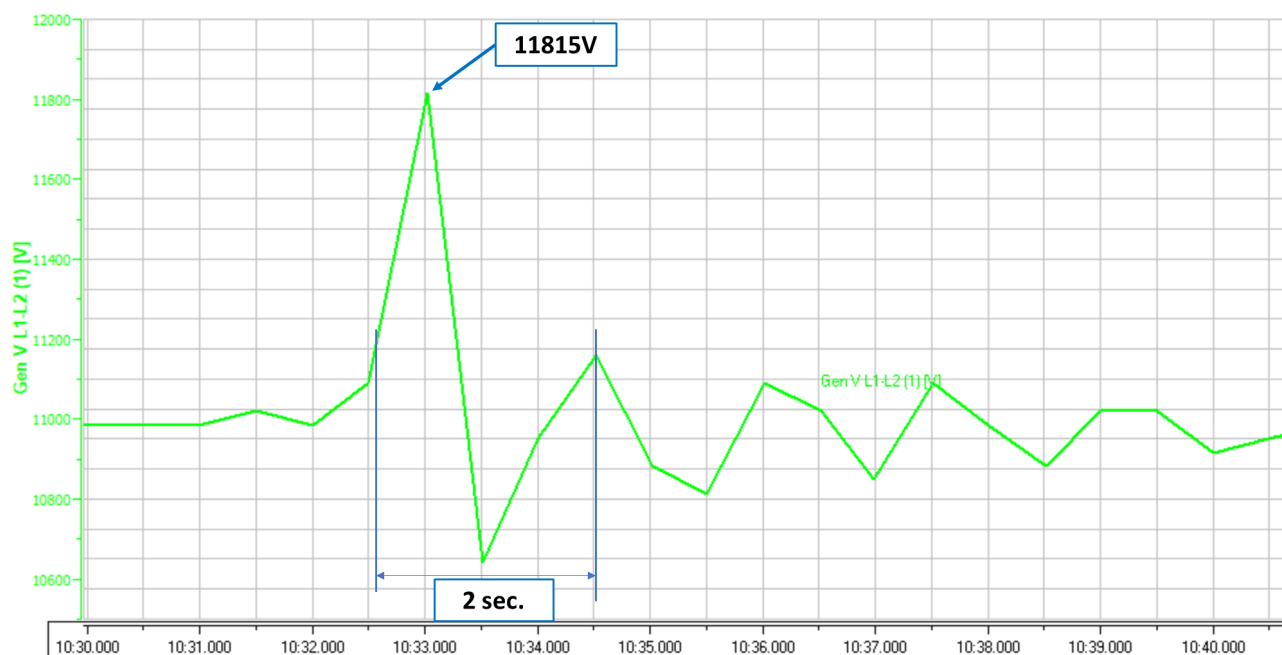


Long running (4hours 2500kVA + 1 hour 2750kVA):



sudden power decrease (2500kVA to 0):





7) COMMENTS

This plant is satisfactory to the requirements of the contract/order subject to the qualifications listed below:		
Item	Description/Comment	Resolved Y/N
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

8) ATTENDEES & SIGNATURES

Company	Name	Date	Signatures
Andrew Litherland	TGC UK	23/11/2023	
Rob Heeley	Heeley Consultancy Ltd	23/11/2023	
Anibal Dickson	Nifes	23/11/2023	
Karl Atkin	Sheffield Teaching Hospitals	23/11/2023	
Aneal Clayton	PRAMAC UK	23/11/2023	
Martin Mottershead	PRAMAC UK	23/11/2023	
Andrea Genovesi	PR industrial	23/11/2023	