Enclosure to CTT (PBR) letter

CTT/300/04/05 dated 03 Jan 23

INTEGRATED TRIALS REPORT - PDA

Section – I (General Information)

1.	Machinery Name, Location	: PDA
2.	Occasion	: NR-22
3.	Routine Undertaken	: 24K
4.	Presented by	: Ship staff NSRY(Pbr) / CTT(Pbr)
5.	Service Log Updated	: Held
6.	Compartment Temperature	: 29 deg C
7.	SW Temperature	: 25 deg C
8.	Proposal Reference	: Nil
9.	File Reference	: CTT/300/04/05/TECH

Section – II (Prime Mover)

1.	Trial inspectors	: (a) Amit Kumar, ERA 3 (b) P S Tomar, LME
2.	Date, Time	: 11 Oct 22 (1400 - 1900Hrs)
3.	Equipment used for performance trials	:(a) SPM T-30 (b) Temperature Gun (c) Nagman Temp. & Pr. Calibrator
4.	Make with Eqpt Ser No	: Cummins INDIA LTD, 25208750
5.	Rated full load capacity	: 350 kW
6.	Running hours since last MOH	: 805.00
7.	Last major routines undertaken	: NR-22
8.	Restrictions imposed, if any	: Nil
9.	Coupling	: Sat
10.	Foundation	: Sat

11. Auxiliary System

(a) Lub Oil System : Sat.

(b) Fuel System : Sat.

(c) SW System : Sat.

(d) Coolant System : Sat.

(e) Intake / Exhaust System : Sat.

(f) Crankcase breather : Sat.

12. Control System including Instrumentation : Sat.

13. Calibration Certificates : Sat.

14. Onboard lub oil test kit : Available

15. Balancing Report (In case of MOH/Major repair/ Crank Shaft Defects) : Nil

16. **Details of trials are as follows: -**

(a) **<u>Safety Device Checks</u>.**

Ser	Description	Unit	Design Value	Port DA	Remarks
(i)	Low LO Pr. alarm	Kg/cm^2	1.8	1.8	Sat
(ii)	Low LO Pr. trip	Kg/cm^2	0.8	0.8	
(iii)	High F/W temp. alarm(LB/RB)	°C	91±2	91/91	
(iv)	High F/W temp. trip(LB/RB)	°C	97±2	97/97	
(v)	High lub oil temp. alarm	°C	121±4	122	
(vi)	High lub oil temp. trip	°C	129±4	128	
(vii)	Over speed trip	RPM	1650	1650	
(viii)	High Exhaust Temp Alarm(LB/RB)	°C	570	570/570	

(b) **<u>Performance Trials</u>**.

Ser.	Parameter readings	Unit	Port DA
(i)	Max. sustained Load	kW	350
(ii)	RPM	RPM	1500

Ser.	Parameter readings	Unit	Port DA
(iii)	L.O. Pressure	Kg/cm²	3.8
(iv)	S.W. Pressure	Kg/cm²	1.2
(v)	L.O. Temp.	°C	92
(vi)	F.W. Temp(LB/RB)	°C	84/83
(vii)	Exhaust Temp(LB/RB)	°C	510/ 520

(c) **Vibration trials.** Vibration trials of the DA were undertaken at load 210kW (60% of rated load) and 350 kW (100% of rated load).

Ser.	Measuring Points	At 60% (210 KW) load			Remarks (Limit 16 mm/sec)
		H	V	A	
(i)	Engine free end	3.5	4.9	1.8	Sat
(ii)	Engine drive end	8.7	4.7	4.4	Sat
(iii)	Alternator drive end	14.5	4.3	6.1	Sat
(iv)	Alternator free end	10.5	14.1	5.6	Sat

Ser.	Measuring Points	At 100% (350 KW) load			Remarks (Limit 16 mm/sec)
		H	V	A	
(i)	Engine free end	7.6	5.4	2.3	Sat
(ii)	Engine drive end	9.7	6.7	4.9	Sat
(iii)	Alternator drive end	15.5	3.8	8.9	Sat
(iv)	Alternator free end	12.6	15.8	7.2	Sat

17. **Attenuation Checks.** Physical condition- Sat. DA attenuation checks were carried out on the 10 SV mounts and found SAT.

Position	Vibration readings of SV mounts at 60 % Load									
	1	2	3	4	5	6	7	8	9	10
Top	8.8	5.3	4.1	13.4	13.3	7.3	9.9	5.7	4.4	8.9
Bottom	2.5	3.0	1.0	1.6	1.3	1.7	1.0	1.0	1.0	2.0
Attenuation %	71	**43**	75	88	90	76	89	82	77	77

(Above 70%)										
Remarks	Sat	**Unsat**	Sat							

Position	**Vibration readings of SV mounts at 100 % Load**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Top	10.1	6.1	8.5	17.1	13.7	8.8	10.1	9.2	7.6	14.9
Bottom	1.9	1.7	1.9	1.1	0.8	1.6	0.9	1.1	1.1	3.4
Attenuation % (Above 70%)	81	72	77	93	94	81	91	88	85	77
Remarks	Sat									

18. **SPM Reading**.

Ser.	**Description**	**0 % Load dbm/dbc**	**100 % Load dbm/dbc**
(i)	Alternator driven end	10/1	6/-5
(ii)	Alternator free end	3/-8	19/-9

Section – III PDA (Alternator)

1. **Trial Details.**

(a)	Presented by*	NR22
(b)	Trial date*	11 Oct 22
(c)	Occasion of current trial*	24K Routine
(d)	Date of last trial carried out on*	-
(e)	Proposal reference*	Refer to ANCO (Tech) chapter 5 {Art 0508(a)} regarding Post Refit Trials
(f)	File reference*	CTT/300/04/05/TECH
(g)	Reference document for trial	Refer to ANCO (Tech) chapter 5 {Art 0508(a)} regarding Post Refit Trials

2. **Test Equipment Used.*** Power Quality Analyzer 435II

3. **Equipment Details.**

Engine		
(a)	Make**	Cummins India Ltd
(b)	Model & serial no.**	VTA 1710 MG.
(c)	RPM**	1500

Governor		
(a)	Make**	Woodward
(b)	Model & serial no.**	2066657
(c)	Type**	Electronic Digital Governor

Alternator		
(a)	Make and rating**	Kirloskar
(b)	Model & serial no.**	-
(c)	Rated voltage**	415 KW
(d)	Rated frequency**	50Hz
(e)	Rated kVA/ kW**	350Kw
(f)	Rated current**	600 Amps
(g)	Bearing number**	-

AVR		
(a)	Make and type**	Kirloskar.
(b)	Model & serial no.**	2066657

Supply Breaker		
(a)	Make**	L & T
(b)	Model & serial no.**	LV525827
(c)	Rated capacity (Amps)**	800 Amps

4. **Insulation Resistance (i.a.w. NES 511(Issue 2) and NES 502 Issue 4).**

(a)	Generator hot (>1MΩ)*	04 MΩ
(b)	Generator cold (>1MΩ)*	06 MΩ
(c)	Switchboard (>2MΩ)*	08 MΩ
(d)	Generator to switchboard cable (>20MΩ)*	80 MΩ

(e)	Insulation of breaker (>10MΩ)*	20 MΩ

5. **Protective Devices**.

(a) Over Voltage Trip : Sat
(b) Reverse Power Relay : Not calibrated
(c) Under Voltage Relay : Sat

6. **Instrumentation.**

Ser	Meter	Ops/ Non Ops*	Calibration Date*	Calibration Certificate Provided (Yes/ No)*	Status (Sat/ Unsat)*
(a)	kW meter	Ops	17 Aug 22	Yes	Sat
(b)	Voltmeter	Ops	12 Apr 22	Yes	Sat
(c)	Ammeter	Ops	08 Jun 22	Yes	Sat
(d)	Frequency meter	Ops	08 Jun 22	Yes	Sat
(e)	Power factor meter	Ops	17 Aug 22	Yes	Sat

7. **DA Control Panel Checks.**

(a)	Condition of cables (Sat/ Unsat)*	Sat
(b)	Cleanliness (Sat/ Unsat)*	Sat
(c)	Instrumentation (Date of calibration and certificate available - Yes/ No)*	Sat
(d)	Indication lamps (Sat/ Unsat)*	-
(e)	Switch/ knobs (Sat/ Unsat)*	Sat

8. **Miscellaneous Checks.**

(a)	Main stator resistance checks***	Sat
(b)	Main rotor resistance checks***	Sat
(c)	Exciter stator resistance checks***	Sat
(d)	Exciter rotor resistance checks***	Sat
(e)	SPM of bearing (Sat/ Unsat)*	Sat
(f)	Temp of bearing after trial (<93 degC) (Sat/ Unsat)*	Sat
(g)	Lubricant used**	Sat
(h)	Greasing instruction on DA (Avl/ NA)*	Sat
(j)	Anti-condensation heater (Ops/ Non ops)*	Sat
(k)	Date of RRA replacement**	-
(l)	CTT trial status (Sat/ Unsat)**	Sat
(m)	Internal communication (Sat/ Unsat)*	Sat
(n)	Lighting of compartment (Sat/ Unsat)*	**Unsat**
(p)	Ventilation of compartment (Sat/ Unsat)*	Sat
(q)	Generator terminal box and top cover nuts and bolts cover are secured (Sat/ Unsat)*	Sat
(r)	Loose cables / wires of various Instrumentation secured (Sat/ Unsat)*	Sat
(s)	Generator/ Swbd is earthed (Sat/ Unsat)*	Sat

(t)	Generator supply breaker operates electrically (Sat/ Unsat)*	Sat
(u)	Ambient temperature at start**	Sat
(v)	Temperature rise after two hours of running at full load**	Sat
(w)	Routine on cooler last carried out on (date)**	Jun 22
(x)	Temperature of cooler inlet pipe line*	Sat
(y)	Temperature of cooler outlet pipe line*	Sat
(z)	Check condition of zinc plugs (Sat/ Unsat)**	Sat
(aa)	Stator winding temperature (where applicable) *	NA

9. **Speed Control Test.**

(a) **Steady State Test.**

(b) **Load%**	**Initial Speed (Hz)**	**Final Speed (Hz)**	**Governor droop(at 100 % load)**	**Permitted limits**
50	--	Set frequency at 50 Hz	$\frac{(NI-N2)x100}{N}$	Between 0.875% to 1% (for electronic governor)
0-25	50.32	50.09	NA	
25-50	50.09	50.00		
50-75	50.00	49.88		
75-100	49.88	49.83		
100-0	**49.83**	**50.30**	**0.93**	

Note:

(i) The load to be gradually reduced in quarter load steps from full load to no load and increased in the same manner up to full load. When the speed has stabilised after each load change the steady state frequency to be recorded. (set frequency to rated value when at 50% load)

(ii) Governor Droop - $\frac{\text{(No load frequency - Full load frequency)}}{\text{Nominal frequency}} *100$

$$\text{Nominal frequency} - \frac{\text{(No load frequency + Full load frequency)}}{2}$$

(iii) Frequency Modulation. Frequency Modulation is the periodic variation in frequency. The periodicity of Frequency modulation should be considered to be longer than 1 cycle time at nominal frequency and less than 10 seconds.

$$\text{Frequency Modulation(Percent)} = 100 \times \frac{(Fmax - Fmin)}{(2 \times Fnominal)}$$

(b) **Transient Tests.**

Load %		Initial Speed (Hz)	Momentary Speed (Hz)	Final Speed (Hz)	% Peak		Time of Recovery to Within ± 1 %/ 0.2% of Final Value	
Initial	To				Observed	Permissible Limit	Observed	Permissible Limit (Sec)
For All Alternators (Turbo/ Diesel Including Turbo-Charged Machines)								
0	25	50.31	49.94	50.09	0.74	1.5 %	2	2 sec
25	50	50.09	49.86	50.00	0.46		2	
50	75	50.00	49.81	49.88	0.38		2	
75	100	49.88	49.74	49.83	0.28		2	
100	75	49.83	50.01	49.92	0.36		2	
75	50	49.92	50.07	50.00	0.30		2	
50	25	50.00	50.20	50.12	0.40		2	
25	0	50.12	50.47	50.32	0.70		2	
For Machines Installed With Turbo - Charged Diesel Engines								
Mechanical Governor								
0	70	-	-	-	-	10%	-	No limit
100	0	-	-	-	-	10%	-	No limit
Electronic Governor								
0	70	50.32	49.16	49.92	2.32	5 %	0.36	5
100	0	49.82	50.98	50.32	2.32	5 %	0.55	5

Note:

(i) The maximum speed variations resulting from sudden increase of 25% load stops when the generator is loaded at zero, 25, 50 and 75 % of rated full load and similar sudden decrease back to zero load should be recorded.

(ii) Formula for % peak – $\frac{\text{(Initial frequency – Momentary frequency)}}{\text{Nominal frequency}} * 100$

(iii) '****' Mechanical Governor – 2.5% of nominal speed and the speed should recover to within 1% of final speed within 2 secs and Electronic Governor – 1.5% of nominal speed and the speed should recover to within 0.2% of final speed within 2 secs. WJFACs – 3% of nominal speed. Non weapon platforms as per IHQ MoD(N)/ DEE letter EE/03/9700 dated 11 Jun 19 – 3.5% of nominal speed.

(iv) Permissible limit for 0-70% regime is decided iaw IHQ/MoD(N)/ DEE letter EE/03/9700 letter dated 24 Jun 15.

(v) In case of Water based load tank transient loading to be done from 0-25% and 25-0%, 0-70% and 100-0% for Turbo-charged engines and 0-100% and 100-0% for all machines other than turbo-charged engines.

(c) **Governor Range**.

Load %	Achieved frequency	Permitted	Remarks
0	50.31	49.50 – 50.50	Sat
100	49.83		Sat

Note:

(i) Permitted limits for frequencies measured at 0% and 100% loads should not be less than ± 3% (as per Def Stan) and ± 1% of Nominal for mechanical governors and electronic governors respectively.

(ii) This test is undertaken by varying the frequency using the frequency control knob/ lever provided for the alternator on the switchboards.

(d) **Rate Affected by Governor Motor.**

Load %	Rate (Hz/ Sec)		Permissible Limits
	Up	Down	
0	0.05	0.06	Between 0.2 to 0.4 Hz/Sec for mechanical governors and 0.05 Hz to 0.07 Hz/ Sec for electronic governors. For APMS ships, limits as specified in SOTRs/ GRAQs of new construction ships and Technical manuals of ships in commission.
100	0.05	0.06	

Note:

(i) Permitted limits for frequencies measured at 0% and 100% loads should not be less than ± 3% and ± 1% of Nominal for mechanical governors and electronic governors respectively.

(ii) This test is undertaken by holding the lever for frequency change in Up position or Down position for durations sufficient to record the graphs.

10. **Voltage Control Test.**

(a) **Steady State Test**.

Load%	KW	Voltage(V)		Amps	PF
		Observed	Permitted		
0	0	414.4	± 4.15	0	-
25	92	414.0		145	0.8
50	180	414.3		288	0.8
75	258	414.9		437	0.8
100	346	415.7		583	0.8

Note:

(i) Permitted limits of voltage ± 1% (as per def stan) of rated voltage or as per technical manuals for commissioned ships.

(ii) The load to be gradually reduced in say quarter load steps from full load to no load and when the voltage has stabilised after each load change the steady state voltage to be recorded. (Set voltage to Nominal value at 50% load).

(iii) **Voltage Modulation.** Voltage Modulation is the periodic voltage variation of single line to line user voltage. The periodicity of voltage modulation should be considered to be longer than 1 cycle time at nominal frequency and less than 10 seconds. Voltage used in the below mentioned equation is RMS voltage.

$$\text{Voltage Modulation (Percent)} = 100 \times \frac{(V_{max} - V_{min})}{(2 \times V_{nominal})}$$

(b) **Transient Test.**

Load %		Initial Voltage (V)	Momentary Voltage (V)	Final Voltage (V)	% Peak		Time of Recovery to Within ±1% of Final Value	
Initial	To				Observed	Permissible Limit	Observed (Sec)	Permissible Limit (Sec)
100	75	415.8	426.1	414.9	2.5	7.5	1	1
75	50	415.9	423.4	414.5	2.0		1	
50	25	414.5	422.5	414.2	1.9		1	
25	0	414.2	422.8	414.3	2.0		1	
0 + M		414.4	387.0	414.2	6.5	15	1	
25 + M		414.1	387.1	414.1	6.5		1	
50 + M		414.6	387.0	414.6	6.6		1	
75 + M		414.9	380.8	414.9	8.4		1	
85 + M		415.2	375.1	415.3	9.6		1	

Note:

(i) M-Load equals application of an additional load equal to 50% rated kVA at zero to 0.4 PF lagging. Towards this starting of an induction motor could be undertaken if M-Load is not available. The motor chosen should be such that its kVA calculated based on its starting current and voltage input is equal to 50% of rated kVA of the alternator. The motor should have Direct-on-Line (DOL) starter.

(ii) Formula for % peak – $\frac{(\text{Initial voltage} - \text{Momentary voltage})}{\text{Nominal voltage}} * 100$

$$\text{Nominal voltage} - \frac{(\text{No load voltage} + \text{Full load voltage})}{2}$$

(c) **Voltage Balance.**

Load %	Line Voltages			Difference (Between Max & Min of Three Values)	Permissible Limit (1% of the Average of Three Line Voltages)
	R-Y	Y-B	B-R		
0	415.8	416.2	416.7	0.9 V	4.15V
100	415.7	415.9	416.3	0.6 V	4.15V

(d) **Voltage Range.**

	Load %	Voltage Measured on Switchboard (Volts)		Permissible Limit (5% of Rated Voltage)	Status (Sat/ Unsat)
		At Lowest Limit of Trimmer	At Highest Limit of Trimmer		
A.V.R. Control	0	395	435	394.25V - 435.75V	Sat
	100	395	435		Sat
Hand Control	0	-	-		-
	100	-	-		-

Note: This test is undertaken by varying the voltage trimmer (Hand/ Auto as applicable) from lowest limit to the highest limit.

11. **Paralleling Trial**. Sat.

INTEGRATED TRIALS REPORT - SDA

Section – I (General Information)

1.	Machinery Name, Location	: SDA
2.	Occasion	: NR-22
3.	Routine Undertaken	: 6K
4.	Presented by	: Ship staff /NSRY (Pbr)/CTT(Pbr)
5.	Service Log Updated	: Held
6.	Compartment Temperature	: 31 deg C
7.	SW Temperature	: 26 deg C
8.	Proposal Reference	: Nil
9.	File Reference	: CTT/300/04/05/TECH

Section – II (Prime Mover)

1.	Trial inspectors	: (a) Sarv Jeet Singh,ERA 3 (b) P S Tomar, LME
2.	Date, Time	: 18 Aug 22 (1000 - 1830 hrs)
3.	Equipment used for performance trials	: (a) SPM T-30 (b) Temperature Gun
4.	Make with Eqpt Ser No	: Cummins INDIA LTD, 4622975
5.	Rated full load capacity	: 350 kW
6.	Running hours since last MOH	: 19881.50
7.	Last major routines undertaken	: NR-22
8.	Restrictions imposed, if any	: Nil
9.	Coupling	: Sat.
10.	Foundation	: Sat.
11.	Auxiliary System	
	(a) Lub Oil System	: Sat.

(b) Fuel System : Sat.

(c) SW System : Sat.

(d) Coolant System : Sat.

(e) Intake / Exhaust System : Sat.

(f) Crankcase breather : Sat.

12. Control System including Instrumentation : Sat.

13. Calibration Certificates : Sat.

14. Onboard lub oil test kit : Availabe

15. Balancing Report (In case of MOH/Major repair/ Crank Shaft Defects) : Nil

16. Details of trials are as follows:-

(a) **Safety Device Checks**.

Ser	Description	Unit	Design Value	STBD DA	Remarks
(a)	Low LO Pr. alarm	Kg/cm^2	1.8	1.8	Sat
(b)	Low LO Pr. trip	Kg/cm^2	0.8	0.8	
(c)	High F/W temp. alarm(LB/RB)	°C	91±2	92/91	
(d)	High F/W temp. trip(LB/RB)	°C	97±2	97/97	
(e)	High lub oil temp. alarm	°C	121±4	122	
(f)	High lub oil temp. trip	°C	129±4	128	
(g)	Over speed trip	RPM	1650	1650	
(h)	High Exhaust Temp Alarm(LB/RB)	°C	570	565/561	

(b) **Performance Trials**.

Ser.	Parameter readings	Unit	STBD DA
(a)	Max. sustained Load	kW	350
(b)	RPM	RPM	1500
(c)	L.O. Pressure	Kg/cm^2	3.6

Ser.	Parameter readings	Unit	STBD DA
(d)	S.W. Pressure	Kg/cm²	1.1
(e)	L.O. Temp.	°C	101
(f)	F.W. Temp(LB/RB)	°C	90/88
(g)	Exhaust Temp(LB/RB)	°C	540/ 550

(c) **Vibration trials**. Vibration trials of the DA were undertaken at load 21kW (60% of rated load) and 35 kW (100% of rated load). Over all vibration readings of DA at monitoring points found within permissible limit and Sat. The details of trials are as follows:-

Ser.	Measuring Points	At 60% (210 KW) load			Remarks (Limit 16 mm/sec)
		H	V	A	
(i)	Engine free end	6.1	3.6	3.9	Sat
(ii)	Engine drive end	12.7	4.1	6.3	Sat
(iii)	Alternator drive end	4.6	4.2	8.6	Sat
(iv)	Alternator free end	9.3	4.2	8.9	Sat

Ser.	Measuring Points	At 100% (350 KW) load			Remarks (Limit 16 mm/sec)
		H	V	A	
(i)	Engine free end	5.6	3.5	2.6	Sat
(ii)	Engine drive end	11.3	5.3	3.9	Sat
(iii)	Alternator drive end	9.9	4.8	7.0	Sat
(iv)	Alternator free end	10.4	4.7	4.4	Sat

17. **Attenuation Checks**. Physical condition - Sat. DA attenuation checks were carried out on the 10 SV mounts and found SAT.

Position	Vibration readings of SV mounts at 60 % Load									
	1	2	3	4	5	6	7	8	9	10
Top	5.8	14.5	4.7	5.4	4.5	12.5	3.5	7.0	6.1	16.4
Bottom	1.4	0.8	1.1	1.2	1.3	1.4	2.9	1.5	1.3	3.1

Attenuation % (Above 70%)	75	94	76	77	71	89	**17**	78	78	81
Remarks	Sat						**UNSAT**	Sat		

Position	**Vibration readings of SV mounts at 100 % Load**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Top	6.9	10.4	27.7	13.0	16.0	14.8	3.8	7.5	9.5	23.5
Bottom	2.8	2.6	1.2	1.3	2.0	4.4	3.3	1.8	1.7	4.6
Attenuation % (Above 70%)	**59**	75	95	90	87	70	**13**	76	82	80
Remarks	**UNSAT**	Sat					**UNSAT**	Sat		

18. **SPM Reading**.

Ser.	**Description**	**0 % Load dbm/dbc**	**100 % Load dbm/dbc**
(iii)	Alternator driven end	14/4	16/3
(iv)	Alternator free end	2/-9	-2/-9

Section – III SDA (Alternator)

1. **Trial Details**.

(a)	Presented by*	SS/ NSRY(Pbr)
(b)	Trial date*	12 SEP 22
(c)	Occasion of current trial*	NR-22
(d)	Date of last trial carried out on*	-
(e)	Proposal reference*	ANCO (Tech) Art 0810 (f)
(f)	File reference*	CTT/300/04/05
(g)	Reference document for trial	ANCO (Tech) Art 0810 (f)

2. **Test Equipment Used**.* Power Quality Analyzer Fluke 435

3. **Equipment Details**.

Engine		
(a)	Make**	Cummins India Ltd
(b)	Model & serial no.**	VTA 1710 MG
(c)	RPM**	1500

Governor		
(a)	Make**	-
(b)	Model & serial no.**	-
(c)	Type**	Electrical

Alternator		
(a)	Make and rating**	Cummins
(b)	Model & serial no.**	-
(c)	Rated voltage**	415V
(d)	Rated frequency**	50Hz
(e)	Rated kVA/ kW**	350Kw
(f)	Rated current**	600 Amps

AVR		
(a)	Make and type**	Cummins
(b)	Model & serial no.**	-

Supply Breaker		
(a)	Make**	-
(b)	Model & serial no.**	-
(c)	Rated capacity (Amps)**	-

4. **Insulation Resistance (i.a.w. NES 511(Issue 2) and NES 502 Issue 4)**.

(a)	Generator hot (>1MΩ)*	07 MΩ
(b)	Generator cold (>1MΩ)*	05 MΩ
(c)	Switchboard (>2MΩ)*	12 MΩ
(d)	Generator to switchboard cable (>20MΩ)*	42 MΩ
(e)	Insulation of breaker (>10MΩ)*	21 MΩ

5. **Protective Devices**.

(a) Over Voltage Trip : Sat
(b) Reverse Power Relay : Not calibrated
(c) Under Voltage Relay : Sat

6. **Instrumentation.**

Ser	Meter	Ops/ Non Ops*	Calibration Date*	Calibration Certificate Provided (Yes/ No)*	Status (Sat/ Unsat)*
(f)	kW meter	Ops	17 Aug 22	Yes	Sat
(g)	Voltmeter	Ops	12 Apr 22	Yes	Sat
(h)	Ammeter	Ops	16 Apr 22	Yes	Sat
(i)	Frequency meter	Ops	26 Jul 22	Yes	Sat
(j)	Power factor meter	Ops	17 Aug 22	Yes	Sat

7. **DA Control Panel Checks**.

(a)	Condition of cables (Sat/ Unsat)*	Sat
(b)	Cleanliness (Sat/ Unsat)*	Sat
(c)	Instrumentation (Date of calibration and certificate available - Yes/ No)*	Sat
(d)	Indication lamps (Sat/ Unsat)*	-
(e)	Switch/ knobs (Sat/ Unsat)*	Sat

8. **Miscellaneous Checks**.

(a)	Main stator resistance checks***	Sat
(b)	Main rotor resistance checks***	Sat
(c)	Exciter stator resistance checks***	Sat
(d)	Exciter rotor resistance checks***	Sat
(e)	SPM of bearing (Sat/ Unsat)*	Sat
(f)	Temp of bearing after trial (<93 degC) (Sat/ Unsat)*	Sat
(g)	Lubricant used**	Sat
(h)	Greasing instruction on DA (Avl/ NA)*	Sat
(i)	Anti-condensation heater (Ops/ Non ops)*	Sat
(j)	Date of RRA replacement**	-
(k)	DTTT trial status (Sat/ Unsat)**	Sat
(l)	Internal communication (Sat/ Unsat)*	Sat
(m)	Lighting of compartment (Sat/ Unsat)*	**Unsat**

(n)	Ventilation of compartment (Sat/ Unsat)*	Sat
(o)	Generator terminal box and top cover nuts and bolts cover are secured (Sat/ Unsat)*	Sat
(p)	Loose cables / wires of various Instrumentation secured (Sat/ Unsat)*	Sat
(q)	Generator/ Swbd is earthed (Sat/ Unsat)*	Sat
(r)	Generator supply breaker operates electrically (Sat/ Unsat)*	Sat
(s)	Ambient temperature at start**	Sat
(t)	Temperature rise after two hours of running at full load**	Sat
(u)	Routine on cooler last carried out on (date)**	-
(v)	Temperature of cooler inlet pipe line*	Sat
(w)	Temperature of cooler outlet pipe line*	Sat
(x)	Check condition of zinc plugs (Sat/ Unsat)**	Sat
(y)	Stator winding temperature (where applicable) *	-

9. **Speed Control Test**.

(a) **Steady State Tests**. (Set frequency at 50 Hz at 50 % Load)

Load%	**Initial Speed (Hz)**	**Final Speed (Hz)**	**Governor droop(at 100 % load)**	**Permitted limits**
50	--	Set frequency at 50 Hz	$\frac{(NI-N2)x100}{N}$	Between 0.875% to 1% (for electronic governor)
0-25	50.36	50.15	NA	
25-50	50.15	50.00		
50-75	50.00	49.88		
75-100	49.88	49.81		
100-0	**49.81**	**50.36**	**1.0**	

Note:

(i) The load to be gradually reduced in quarter load steps from full load to no load and increased in the same manner up to full load. When the speed has stabilised after each load change the steady state frequency to be recorded. (set frequency to rated value when at 50% load)

(ii) Governor Droop - $\frac{\text{(No load frequency - Full load frequency)}}{\text{Nominal frequency}} *100$

$$\text{Nominal frequency} - \frac{\text{(No load frequency + Full load frequency)}}{2}$$

(iii) Frequency Modulation. Frequency Modulation is the periodic variation in frequency. The periodicity of Frequency modulation should be considered to be longer than 1 cycle time at nominal frequency and less than 10 seconds.

$$\text{Frequency Modulation(Percent)} = 100 \times \frac{(Fmax - Fmin)}{(2 \times Fnominal)}$$

(b) **Transient Tests**.

Load %		Initial Speed (Hz)	Momentary speed (Hz)	Final Speed (Hz)	% Peak = Initial-momentary / Nominal		Time of recovery (in sec)	
Initial	To				Observed	Permitted	Observed	Permitted
0	25	50.36	49.69	50.15	1.34	1.5 (L)	2	2
25	50	50.15	49.94	50.02	0.42		2	
50	75	50.02	49.81	49.88	0.42		2	
75	100	49.88	49.70	49.88	0.36		2	
100	75	49.88	50.02	49.93	0.40		2	
75	50	49.93	50.11	50.05	0.36		2	
50	25	50.05	50.27	50.19	0.44		2	
25	0	50.19	50.81	50.37	1.24		2	

For Machine Charged With Turbo Charged Engine.

Load %		Initial Speed (Hz)	Momentary speed (Hz)	Final Speed (Hz)	% Peak = Initial - Final / Nominal		Remarks
Initial	To				Observed	Permitted	
0	70	50.38	48.46	49.95	3.84	5 %	Sat
100	0	49.82	51.88	50.38	4.12	5 %	Sat

Note:

(vi) The maximum speed variations resulting from sudden increase of 25% load stops when the generator is loaded at zero, 25, 50 and 75 % of rated full load and similar sudden decrease back to zero load should be recorded.

(vii) Formula for % peak – $\frac{\text{(Initial frequency – Momentary frequency)}}{\text{Nominal frequency}} * 100$

(viii) '****' Mechanical Governor – 2.5% of nominal speed and the speed should recover to within 1% of final speed within 2 secs and Electronic Governor – 1.5% of nominal speed and the speed should recover to within 0.2% of final speed within 2 secs. WJFACs – 3% of nominal speed. Non weapon platforms as per IHQ MoD(N)/ DEE letter EE/03/9700 dated 11 Jun 19 – 3.5% of nominal speed.

(ix) Permissible limit for 0-70% regime is decided iaw IHQ/MoD(N)/ DEE letter EE/03/9700 letter dated 24 Jun 15.

(x) In case of Water based load tank transient loading to be done from 0-25% and 25-0%, 0-70% and 100-0% for Turbo-charged engines and 0-100% and 100-0% for all machines other than turbo-charged engines.

(c) **Governor Range**.

Load %	Achieved frequency	Permitted	Remarks
0	50.36	49.50 – 50.50	Sat
100	49.81		Sat

Note:

(i) Permitted limits for frequencies measured at 0% and 100% loads should not be less than ± 3% (as per Def Stan) and ± 1% of Nominal for mechanical governors and electronic governors respectively.

(ii) This test is undertaken by varying the frequency using the frequency control knob/ lever provided for the alternator on the switchboards.

(d) **Rate Affected by Governor Motor**.

Load %	Rate Hz/s		Permitted	Remarks
	Up	Down	Between 0.05 to 0.07 Hz per sec for Electronic Governors	
0	0.06	0.05		Sat
100	0.07	0.06		Sat

Note:

(i) Permitted limits for frequencies measured at 0% and 100% loads should not be less than ± 3% and ± 1% of Nominal for mechanical governors and electronic governors respectively.

(ii) This test is undertaken by holding the lever for frequency change in Up position or Down position for durations sufficient to record the graphs.

10. **Voltage Control Test**.

(e) **Steady State Test**.

Load%	KW	Voltage(V)		Amps	PF
		Observed	Permitted		
0	0	418.0	± 4.15	0	-
25	87	417.9		145	0.8
50	175	415.4		289	0.8
75	262	415.3		434	0.8
100	350	415.5		581	0.8

Note:

(i) Permitted limits of voltage ± 1% (as per def stan) of rated voltage or as per technical manuals for commissioned ships.

(ii) The load to be gradually reduced in say quarter load steps from full load to no load and when the voltage has stabilised after each load change the steady state voltage to be recorded. (Set voltage to Nominal value at 50% load).

(iii) Voltage Modulation. Voltage Modulation is the periodic voltage variation of single line to line user voltage. The periodicity of voltage modulation should be considered to be longer than 1 cycle time at nominal frequency and less than 10 seconds. Voltage used in the below mentioned equation is RMS voltage.

$$\text{Voltage Modulation(Percent)} = 100 \times \frac{(V_{max} - V_{min})}{(2 \times V_{nominal})}$$

(f) **Transient Test**.

Load %		Initial Voltage	Momentary Voltage	Final Voltage	% Peak Initial-momentary Nominal		Time of recovery (in sec)	
Initial	To				Observed	Permitted	Observed	Permitted
100	75	415.6	418.9	415.5	0.07	7.5	1	1
75	50	415.5	419.6	415.5	0.98		1	
50	25	415.5	418.4	415.4	0.69		1	
25	0	415.4	416.3	415.5	0.21		1	
0+M		415.5	381.2	415.4	8.20	15	1	
25+M		415.4	384.6	415.3	7.40		1	
50+M		415.5	383.7	415.4	7.60		1	
75+M		415.2	389.0	415.4	6.30		1	
85+M		415.3	388.5	415.3	6.40		1	

Note:

(i) M-Load equals application of an additional load equal to 50% rated kVA at zero to 0.4 PF lagging. Towards this starting of an induction motor could be undertaken if M-Load is not available. The motor chosen should be such that its kVA calculated based on its starting current and voltage input is equal to 50% of rated kVA of the alternator. The motor should have Direct-on-Line (DOL) starter.

(ii) Formula for % peak – $\frac{(\text{Initial voltage} - \text{Momentary voltage})}{\text{Nominal voltage}} * 100$

$$\text{Nominal voltage} - \frac{(\text{No load voltage} + \text{Full load voltage})}{2}$$

(g) **Voltage Balance**.

Load %	Line Voltage			Difference (Between Max and Min of three values)	Permitted limits (1% of Avg of three line voltage)
	R-Y	Y-B	B-R		
0	416.5	417.7	417.8	1.3 V	4.17 V
100	414.7	416.5	415.9	1.8 V	

(h) **Voltage Range**.

	Load %	At lowest limit of trimmer	At highest limit of trimmer	Remarks
AVR trimmer	0	-		SAT
	100			
Hand regulator	0	395	435	
	100	395	435	

Note: This test is undertaken by varying the voltage trimmer (Hand/ Auto as applicable) from lowest limit to the highest limit.

11. **Paralleling Trial**. Sat

INTEGRATED TRIALS REPORT - CDA

Section – I (General Information)

1.	Machinery Name, Location	: CDA
2.	Occasion	: NR-22
3.	Routine Undertaken	: 24K
4.	Presented by	: Ship staff /NSRY (Pbr)/CTT(Pbr)
5.	Service Log Updated	: Held
6.	Compartment Temperature	: 31 deg C
7.	SW Temperature	: 26 deg C
8.	Proposal Reference	: Nil
9.	File Reference	: CTT/300/04/05/TECH

Section – II (Prime Mover)

1.	Trial inspectors	: (a) Sonu Yadav, ERA 3 (b) Aman Kunar, LME
2.	Date, Time	: 04 Dec 22 (1100 - 1530Hrs)
3.	Equipment used for performance trials	: (a) SPM T-30 (b) Temperature Gun (c) Nagman LP Calibrator (d) Nagman Temp. Calibrator (e) Frequency Generator
4.	Make with Eqpt Ser No	: Cummins INDIA LTD, 25208748
5.	Rated full load capacity	: 350 kW
6.	Running hours since last MOH	: 176.10
7.	Last major routines undertaken	: NR-22
8.	Restrictions imposed, if any	: Nil

9. Coupling : Sat.

10. Foundation : Sat.

11. Auxiliary System

(a) Lub Oil System : Sat.

(b) Fuel System : Sat.

(c) SW System : Sat.

(d) Coolant System : Sat.

(e) Intake / Exhaust System : Sat.

(f) Crankcase breather : Sat.

12. Control System including Instrumentation : Sat.

13. Calibration Certificates : Sat.

14. Onboard lub oil test kit : Availabe

15. Balancing Report (In case of MOH/Major repair/ Crank Shaft Defects) : Nil

16. **Details of trials are as follows: -**

(a) **<u>Safety device checks</u>**.

Ser	Description	Unit	Design Value	centre DA	Remarks
(a)	Low LO Pr. alarm	Kg/cm^2	1.8	1.8	Sat
(b)	Low LO Pr. trip	Kg/cm^2	0.8	0.8	
(c)	High F/W temp. alarm(LB/RB)	°C	91±2	90/90	
(d)	High F/W temp. trip(LB/RB)	°C	97±2	95/95	
(e)	High lub oil temp. alarm	°C	121±4	120	
(f)	High lub oil temp. trip	°C	129±4	125	
(g)	Over speed trip	RPM	1650	1650	
(h)	High Exhaust Temp Alarm(LB/RB)	°C	570	570/570	

(b) **Performance Trials**.

Ser.	Parameter readings	Unit	STBD DA
(a)	Max. sustained Load	kW	350
(b)	RPM	RPM	1500
(c)	L.O. Pressure	Kg/cm²	4.3
(d)	S.W. Pressure	Kg/cm²	1.6
(e)	L.O. Temp.	°C	100
(f)	F.W. Temp(LB/RB)	°C	84/82
(g)	Exhaust Temp(LB/RB)	°C	535/ 550

(c) **Vibration trials**.

Ser.	Measuring Points	At 60% (210 KW) load			Remarks (Limit 16 mm/sec)
		V	A	H	
(a)	Engine free end	3.2	1.8	2.1	Sat
(b)	Engine drive end	4.2	2.1	4.3	
(c)	Alternator drive end	5.3	3.3	5.2	
(d)	Alternator free end	2.6	3.4	5.6	

Ser.	Measuring Points	At 100% (350 KW) load			Remarks (Limit 16 mm/sec)
		V	A	H	
(a)	Engine free end	4.0	2.7	2.5	Sat
(b)	Engine drive end	5.5	2.8	6.1	
(c)	Alternator drive end	4.4	4.9	5.9	
(d)	Alternator free end	4.7	5.7	6.4	

(d) **Attenuation Checks**. DA attenuation checks were carried out at 60 % and 100% of rated load.

Position	Vibration readings of SV mounts at 60 % Load									
	1	2	3	4	5	6	7	8	9	10
Top	8.4	7.0	3.7	2.9	5.7	10.4	6.9	3.9	5.1	11.5

Bottom	0.8	1.0	0.6	1.3	1.8	2.3	0.8	0.5	0.9	1.4
Attenuation % (Above 70%)	90	85	83	**55**	**68**	77	88	87	82	87
Remarks	Sat			**Unsat**		Sat				

Position	**Vibration readings of SV mounts at 100 % Load**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Top	10.5	12.3	5.4	4.4	10.3	18.9	10.2	6.3	9.6	18.6
Bottom	1.7	1.6	0.6	1.3	3.1	4.5	1.3	0.5	1.5	2.2
Attenuation % (Above 70%)	83	86	88	**70**	**70**	76	87	92	84	88
Remarks	Sat									

(e) **SPM Reading**.

Ser.	**Description**	**0 % Load dbm/dbc**	**100 % Load dbm/dbc**
(i)	Alternator driven end	6/-9	8/0
(ii)	Alternator free end	1/-7	7/-9

Section – III CDA (Alternator)

1. **Trial Details**.

(a)	Presented by*	SS/ NSRY(Pbr)
(b)	Trial date*	04 Dec 22
(c)	Occasion of current trial*	NR-22
(d)	Date of last trial carried out on*	-
(e)	Proposal reference*	ANCO (Tech) Art 0810 (f)
(f)	File reference*	CTT/300/04/05
(g)	Reference document for trial	ANCO (Tech) Art 0810 (f)

2. **Test Equipment Used**.* Power Quality Analyzer Fluke 435

3. **Equipment Details**.

Engine		
(a)	Make**	Cummins India Ltd
(b)	Model & serial no.**	25208748
(c)	RPM**	1500

Governor		
(a)	Make**	Woodward
(b)	Model & serial no.**	18124279
(c)	Type**	Electrical

Alternator		
(a)	Make and rating**	Kirloskar
(b)	Model & serial no.**	-
(c)	Rated voltage**	415V
(d)	Rated frequency**	50Hz
(e)	Rated kVA/ kW**	350Kw
(f)	Rated current**	600 Amps

AVR		
(a)	Make and type**	Kirloskar
(b)	Model & serial no.**	IVER-2N

Supply Breaker		
(a)	Make**	L & T
(b)	Model & serial no.**	ACB/HV858994
(c)	Rated capacity (Amps)**	800 Amps

4. **Insulation Resistance (i.a.w. NES 511(Issue 2) and NES 502 Issue 4)**.

(a)	Generator hot (>1MΩ)*	09 MΩ
(b)	Generator cold (>1MΩ)*	05 MΩ
(c)	Switchboard (>2MΩ)*	23 MΩ
(d)	Generator to switchboard cable (>20MΩ)*	49 MΩ
(e)	Insulation of breaker (>10MΩ)*	23 MΩ

5. **Protective Devices**.

(a) Over Voltage Trip : Sat
(b) Reverse Power Relay : Not calibrated
(c) Under Voltage Relay : Sat

6. **Instrumentation**.

Ser	Meter	Ops/ Non Ops*	Calibration Date*	Calibration Certificate Provided (Yes/ No)*	Status (Sat/ Unsat)*
(a)	kW meter	Ops	10 Jun 22	Yes	Sat
(b)	Voltmeter	Ops	13 Jun 22	Yes	Sat
(c)	Ammeter	Ops	12 Apr 22	Yes	Sat
(d)	Frequency meter	Ops	08 Jun 22	Yes	Sat
(e)	Power factor meter	Ops	16 Mar 22	Yes	Sat

7. **DA Control Panel Checks**.

(a)	Condition of cables (Sat/ Unsat)*	Sat
(b)	Cleanliness (Sat/ Unsat)*	Sat
(c)	Instrumentation (Date of calibration and certificate available - Yes/ No)*	Sat
(d)	Indication lamps (Sat/ Unsat)*	-
(e)	Switch/ knobs (Sat/ Unsat)*	Sat

8. **Miscellaneous Checks**.

(a)	Main stator resistance checks***	Sat
(b)	Main rotor resistance checks***	Sat
(c)	Exciter stator resistance checks***	Sat
(d)	Exciter rotor resistance checks***	Sat
(e)	SPM of bearing (Sat/ Unsat)*	Sat
(f)	Temp of bearing after trial (<93 degC) (Sat/ Unsat)*	Sat
(g)	Lubricant used**	Sat
(h)	Greasing instruction on DA (Avl/ NA)*	Sat
(o)	Anti-condensation heater (Ops/ Non ops)*	Sat
(p)	Date of RRA replacement**	-
(q)	DTTT trial status (Sat/ Unsat)**	Sat
(r)	Internal communication (Sat/ Unsat)*	Sat
(s)	Lighting of compartment (Sat/ Unsat)*	**Unsat**
(p)	Ventilation of compartment (Sat/ Unsat)*	Sat
(q)	Generator terminal box and top cover nuts and bolts	Sat

	cover are secured (Sat/ Unsat)*	
(r)	Loose cables / wires of various Instrumentation secured (Sat/ Unsat)*	Sat
(s)	Generator/ Swbd is earthed (Sat/ Unsat)*	Sat
(t)	Generator supply breaker operates electrically (Sat/ Unsat)*	Sat
(u)	Ambient temperature at start**	Sat
(v)	Temperature rise after two hours of running at full load**	Sat
(w)	Routine on cooler last carried out on (date)**	-
(x)	Temperature of cooler inlet pipe line*	Sat
(y)	Temperature of cooler outlet pipe line*	Sat
(z)	Check condition of zinc plugs (Sat/ Unsat)**	Sat
(aa)	Stator winding temperature (where applicable) *	-

9. **Speed Control Test**.

(a) **Steady State Tests**. (Set frequency at 50 Hz at 50 % Load)

Load%	**Initial Speed (Hz)**	**Final Speed (Hz)**	**Governor droop(at 100 % load)**	**Permitted limits**
50	--	Set frequency at 50 Hz	$\frac{(NI-N2)x100}{N}$	Between 0.875% to 1% (for electronic governor)
0-25	50.03	49.75	NA	
25-50	49.75	50.00		
50-75	50.00	49.92		
75-100	49.92	49.85		
100-0	**49.85**	**50.38**	**1.0**	

Note:

(i) The load to be gradually reduced in quarter load steps from full load to no load and increased in the same manner up to full load. When the speed has stabilised after each load change the steady state frequency to be recorded. (set frequency to rated value when at 50% load)

(ii) Governor Droop - $\frac{\text{(No load frequency - Full load frequency)}}{\text{Nominal frequency}} *100$

$$\text{Nominal frequency} - \frac{\text{(No load frequency + Full load frequency)}}{2}$$

(iii) Frequency Modulation. Frequency Modulation is the periodic variation in frequency. The periodicity of Frequency modulation should be considered to be longer than 1 cycle time at nominal frequency and less than 10 seconds.

$$\text{Frequency Modulation(Percent)} = 100 \times \frac{(Fmax - Fmin)}{(1 \times Fnominal)}$$

(b) **Transient Tests**.

Load %		Initial Speed (Hz)	Momentary speed (Hz)	Final Speed (Hz)	% Peak = Initial-momentary / Nominal		Time of recovery (in sec)	
Initial	To				Observed	Permitted	Observed	Permitted
0	25	50.38	50.00	49.75	0.76	1.5 (L)	2	2
25	50	49.75	49.94	50.00	0.38		2	
50	75	50.00	49.86	49.92	0.28		2	
75	100	49.92	49.78	49.85	0.34		2	
100	75	49.85	50.01	49.94	0.32		2	
75	50	49.94	50.11	50.05	0.34		2	
50	25	50.05	50.21	50.15	0.32		2	
25	0	50.15	50.51	50.39	0.72		2	

For Machine Charged With Turbo Charged Engine.

Load %		Initial Speed (Hz)	Momentary speed (Hz)	Final Speed (Hz)	% Peak = Initial - Final / Nominal		Remarks
Initial	To				Observed	Permitted	
0	70	50.38	49.22	49.95	2.32	5 %	Sat
100	0	49.85	51.02	50.38	2.34	5 %	Sat

Note:

(xi) The maximum speed variations resulting from sudden increase of 25% load stops when the generator is loaded at zero, 25, 50 and 75 % of rated full load and similar sudden decrease back to zero load should be recorded.

(xii) Formula for % peak – $\frac{\text{(Initial frequency – Momentary frequency)}}{\text{Nominal frequency}} * 100$

(xiii) '****' Mechanical Governor – 2.5% of nominal speed and the speed should recover to within 1% of final speed within 2 secs and Electronic Governor – 1.5% of nominal speed and the speed should recover to within 0.2% of final speed within 2 secs. WJFACs – 3% of nominal speed. Non weapon platforms as per IHQ MoD(N)/ DEE letter EE/03/9700 dated 11 Jun 19 – 3.5% of nominal speed.

(xiv) Permissible limit for 0-70% regime is decided iaw IHQ/MoD(N)/ DEE letter EE/03/9700 letter dated 24 Jun 15.

(xv) In case of Water based load tank transient loading to be done from 0-25% and 25-0%, 0-70% and 100-0% for Turbo-charged engines and 0-100% and 100-0% for all machines other than turbo-charged engines.

(c) **Governor Range.**

Load %	Achieved frequency	Permitted	Remarks
0	50.38	49.50 – 50.50	Sat
100	49.85		Sat

Note:

(i) Permitted limits for frequencies measured at 0% and 100% loads should not be less than ± 3% (as per Def Stan) and ± 1% of Nominal for mechanical governors and electronic governors respectively.

(ii) This test is undertaken by varying the frequency using the frequency control knob/ lever provided for the alternator on the switchboards.

(d) **Rate Affected by Governor Motor.**

Load %	Rate Hz/s		Permitted	Remarks
	Up	Down	Between 0.05 to 0.07 Hz per sec for Electronic Governors	
0	0.05	0.06		Sat
100	0.05	0.06		Sat

Note:

(i) Permitted limits for frequencies measured at 0% and 100% loads should not be less than ± 3% and ± 1% of Nominal for mechanical governors and electronic governors respectively.

(ii) This test is undertaken by holding the lever for frequency change in Up position or Down position for durations sufficient to record the graphs.

10. **Voltage Control Test**.

(e) **Steady State Test**.

Load%	KW	Voltage(V)		Amps	PF
		Observed	Permitted		
0	0	416.6	± 4.15	0	-
25	91	416.1		157	0.8
50	183	415.4		306	0.8
75	260	415.9		445	0.8
100	347	416.8		598	0.8

Note:

(i) Permitted limits of voltage ± 1% (as per def stan) of rated voltage or as per technical manuals for commissioned ships.

(ii) The load to be gradually reduced in say quarter load steps from full load to no load and when the voltage has stabilised after each load change the steady state voltage to be recorded. (Set voltage to Nominal value at 50% load).

(iii) Voltage Modulation. Voltage Modulation is the periodic voltage variation of single line to line user voltage. The periodicity of voltage modulation should be considered to be longer than 1 cycle time at nominal frequency and less than 10 seconds. Voltage used in the below mentioned equation is RMS voltage.

$$\text{Voltage Modulation(Percent)} = 100 \times \frac{(V_{max} - V_{min})}{(2 \times V_{nominal})}$$

(f) **Transient Test**.

Load %		Initial Voltage	Momentary Voltage	Final Voltage	% Peak Initial-momentary Nominal		Time of recovery (in sec)	
Initial	To				Observed	Permitted	Observed	Permitted
100	75	416.6	428.4	415.7	2.84	7.5	1	1
75	50	415.7	427.4	415.4	2.81		1	
50	25	415.5	427.0	415.1	2.77		1	
25	0	415.1	424.0	414.9	2.14		1	
0+M		415.1	380.6	414.9	8.31	15	1	
25+M		415.2	377.6	414.9	9.06		1	
50+M		415.6	387.8	415.3	6.69		1	
75+M		415.8	375.5	413.8	9.71		1	
85+M		414.2	377.7	413.3	8.79		1	

Note:

(i) M-Load equals application of an additional load equal to 50% rated kVA at zero to 0.4 PF lagging. Towards this starting of an induction motor could be undertaken if M-Load is not available. The motor chosen should be such that its kVA calculated based on its starting current and voltage input is equal to 50% of rated kVA of the alternator. The motor should have Direct-on-Line (DOL) starter.

(ii) Formula for % peak – $\frac{(\text{Initial voltage} - \text{Momentary voltage})}{\text{Nominal voltage}} * 100$

$$\text{Nominal voltage} - \frac{(\text{No load voltage} + \text{Full load voltage})}{2}$$

(g) **Voltage Balance.**

Load %	Line Voltage			Difference (Between Max and Min of three values)	Permitted limits (1% of Avg of three line voltage)
	R-Y	Y-B	B-R		
0	416.4	415.9	415.8	0.6 V	4.17 V
100	417.1	418.2	418.3	1.1V	

(h) **Voltage Range**.

	Load %	At lowest limit of trimmer	At highest limit of trimmer	Remarks
AVR trimmer	0	-		SAT
	100			
Hand regulator	0	395	435	
	100	395	435	

Note: This test is undertaken by varying the voltage trimmer (Hand/ Auto as applicable) from lowest limit to the highest limit.

11. **Paralleling Trial**. Sat.

INTEGRATED TRIALS REPORT - ADA

Section – I (General Information)

1.	Machinery Name, Location	: ADA
2.	Occasion	: NR-22
3.	Routine Undertaken	: 6K
4.	Presented by	: Ship staff /NSRY (Pbr)/CTT(Pbr)
5.	Service Log Updated	: Held
6.	Compartment Temperature	: 31 deg C
7.	SW Temperature	: 26 deg C
8.	Proposal Reference	: Nil
9.	File Reference	: CTT/300/04/05/TECH

Section – II (Prime Mover)

1.	Trial inspectors	: (a) Vipin Kumar,ERA 3 (b) P S Tomar, LME
2.	Date and Time	: 24 Aug 22 (1400 - 1900Hrs)
3.	Equipment used for SDCs (b) Nagman LP Calibrator (c) Nagman Temp. Calibrator (d) Frequency Generator	
4.	Equipment used for Performance trials (a) SPM T-30 (b) Temperature gun	
5.	Make with Eqpt Ser No	: Cummins INDIA LTD, 25208749
6.	Rated full load capacity	: 350 kW
7.	Running hours since last MOH	: 13255.50
8.	Last major routines undertaken	: NR-22

9. Restrictions imposed, if any : Nil

10. Coupling : Sat.

11. Foundation : Sat.

12. Auxiliary System :

(a) Lub Oil System : Sat.

(b) Fuel System : Sat.

(c) SW System : Sat.

(d) Coolant System : Sat.

(e) Intake / Exhaust System : Sat.

(f) Crankcase breather : Sat.

13. Control System including Instrumentation : Sat.

14. Calibration Certificates : Sat.

15. Onboard lub oil test kit : Available

16. Balancing Report (In case of MOH/Major repair/ Crank Shaft Defects) : Nil

17. **Details of trials are as follows:-**

(a) **Safety device checks**.

Ser	Description	Unit	Design Value	Aft DA	Remarks
(i)	Low LO Pr. alarm	Kg/cm^2	1.8	1.8	Sat
(j)	Low LO Pr. trip	Kg/cm^2	0.8	0.8	
(k)	High F/W temp. alarm(LB/RB)	°C	91±2	91/92	
(l)	High F/W temp. trip(LB/RB)	°C	97±2	97/97	
(m)	High lub oil temp. alarm	°C	121±4	121	
(n)	High lub oil temp. trip	°C	129±4	126	
(o)	Over speed trip	RPM	1650	1650	
(p)	High Exhaust Temp Alarm(LB/RB)	°C	570	565/566	

(b) **Performance Trials**.

Ser.	Parameter readings	Unit	Aft DA
(a)	Max. sustained Load	kW	350
(b)	RPM	RPM	1500
(c)	L.O. Pressure	Kg/cm²	3.6
(d)	S.W. Pressure	Kg/cm²	0.8
(e)	L.O. Temp.	°C	100
(f)	F.W. Temp(LB/RB)	°C	85/83
(g)	Exhaust Temp(LB/RB)	°C	510/ 540

(c) **Vibration trials**.

Ser.	Measuring Points	At 60% (210 KW) load			Remarks (Limit 16 mm/sec)
		H	V	A	
(v)	Engine free end	4.6	3.5	2.8	Sat
(vi)	Engine drive end	4.2	6.3	2.8	Sat
(vii)	Alternator drive end	2.8	7.5	7.7	Sat
(viii)	Alternator free end	7.6	2.4	6.0	Sat

Ser.	Measuring Points	At 100% (350 KW) load			Remarks (Limit 16 mm/sec)
		H	V	A	
(v)	Engine free end	4.4	3.2	2.0	Sat
(vi)	Engine drive end	6.0	6.2	2.2	Sat
(vii)	Alternator drive end	8.4	3.8	7.6	Sat
(viii)	Alternator free end	7.2	3.4	6.8	Sat

(d) **Attenuation Checks**. DA attenuation checks were carried out at 60 % of rated load. and maximum load sustained by the DA.

Position	Vibration readings of SV mounts at 60 % Load									
	1	2	3	4	5	6	7	8	9	10

Top	6.5	5.7	5.8	3.4	3.6	2.6	5.1	8.9	6.2	4.8
Bottom	0.6	0.7	0.4	0.3	0.3	1.5	0.4	1.0	0.5	4.0
Attenuation % (Above 70%)	90	87	93	91	91	**42**	92	88	91	**16**
Remarks	Sat					**Unsat**	Sat			**Unsat**

Position	**Vibration readings of SV mounts at 100 % Load**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Top	5.7	7.3	7.3	3.2	4.3	4.1	8.4	11.8	11.7	6.3
Bottom	4.7	0.5	0.3	0.3	1.4	1.9	0.9	0.3	0.8	5.9
Attenuation % (Above 70%)	**17**	93	95	90	**67**	**53**	89	97	93	**06**
Remarks	**Unsat**	Sat			**Unsat**		Sat			**Unsat**

(e) **SPM Reading**.

Ser.	**Description**	**0 % Load dbm/dbc**	**100 % Load dbm/dbc**
(iii)	Alternator driven end	17/6	18/7
(iv)	Alternator free end	2/7	9/7

Section – III AFT DA (Alternator)

1. **Trial Details**.

(a)	Presented by*	SS/ NSRY(Pbr)/CTT(Pbr)
(b)	Trial date*	10 Sep 22
(c)	Occasion of current trial*	NR-22
(d)	Date of last trial carried out on*	-
(e)	Proposal reference*	ANCO (Tech) Art 0810 (f)
(f)	File reference*	CTT/300/04/05
(g)	Reference document for trial	ANCO (Tech) Art 0810 (f)

2. **Test Equipment Used**.* Power Quality Analyzer Fluke 435

3. **Equipment Details**.

Engine		
(a)	Make**	Cummins India Ltd
(b)	Model & serial no.**	25208749
(c)	RPM**	1500

Governor		
(a)	Make**	Woodward
(b)	Model & serial no.**	19234930
(c)	Type**	Electrical

Alternator		
(a)	Make and rating**	Kirloskar
(b)	Model & serial no.**	8930775-09
(c)	Rated voltage**	415V
(d)	Rated frequency**	50Hz
(e)	Rated kVA/ kW**	350Kw
(f)	Rated current**	600 Amps

AVR		
(a)	Make and type**	Kirloskar
(b)	Model & serial no.**	-

Supply Breaker		
(a)	Make**	L & T
(b)	Model & serial no.**	CT423280
(c)	Rated capacity (Amps)**	800 Amps

4. **Insulation Resistance (i.a.w. NES 511(Issue 2) and NES 502 Issue 4)**.

(a)	Generator hot (>1MΩ)*	04 MΩ
(b)	Generator cold (>1MΩ)*	03 MΩ
(c)	Switchboard (>2MΩ)*	21 MΩ
(d)	Generator to switchboard cable (>20MΩ)*	39 MΩ
(e)	Insulation of breaker (>10MΩ)*	18 MΩ

5. **Protective Devices**.

(a) Over Voltage Trip : Sat
(b) Reverse Power Relay : Not calibrated
(c) Under Voltage Relay : Sat

6. **Instrumentation**.

Ser	Meter	Ops/ Non Ops*	Calibration Date*	Calibration Certificate Provided (Yes/ No)*	Status (Sat/ Unsat)*
(f)	kW meter	Ops	17 Aug 22	Yes	Sat
(g)	Voltmeter	Ops	12 Apr 22	Yes	Sat
(h)	Ammeter	Ops	12 Apr 22	Yes	Sat
(i)	Frequency meter	Ops	16 Mar 22	Yes	Sat
(j)	Power factor meter	Ops	17 Aug 22	Yes	Sat

7. **DA Control Panel Checks**.

(a)	Condition of cables (Sat/ Unsat)*	Sat
(b)	Cleanliness (Sat/ Unsat)*	Sat
(c)	Instrumentation (Date of calibration and certificate available - Yes/ No)*	Sat
(d)	Indication lamps (Sat/ Unsat)*	-
(e)	Switch/ knobs (Sat/ Unsat)*	Sat

8. **Miscellaneous Checks**.

(a)	Main stator resistance checks***	Sat
(b)	Main rotor resistance checks***	Sat
(c)	Exciter stator resistance checks***	Sat
(d)	Exciter rotor resistance checks***	Sat
(e)	SPM of bearing (Sat/ Unsat)*	Sat
(f)	Temp of bearing after trial (<93 degC) (Sat/ Unsat)*	Sat
(g)	Lubricant used**	Sat
(h)	Greasing instruction on DA (Avl/ NA)*	Sat
(i)	Anti-condensation heater (Ops/ Non ops)*	Sat
(j)	Date of RRA replacement**	-
(k)	DTTT trial status (Sat/ Unsat)**	Sat
(l)	Internal communication (Sat/ Unsat)*	Sat

(m)	Lighting of compartment (Sat/ Unsat)*	**Unsat**
(n)	Ventilation of compartment (Sat/ Unsat)*	Sat
(o)	Generator terminal box and top cover nuts and bolts cover are secured (Sat/ Unsat)*	Sat
(p)	Loose cables / wires of various Instrumentation secured (Sat/ Unsat)*	Sat
(q)	Generator/ Swbd is earthed (Sat/ Unsat)*	Sat
(r)	Generator supply breaker operates electrically (Sat/ Unsat)*	Sat
(s)	Ambient temperature at start**	Sat
(t)	Temperature rise after two hours of running at full load**	Sat
(u)	Routine on cooler last carried out on (date)**	-
(v)	Temperature of cooler inlet pipe line*	Sat
(w)	Temperature of cooler outlet pipe line*	Sat
(x)	Check condition of zinc plugs (Sat/ Unsat)**	Sat
(y)	Stator winding temperature (where applicable) *	-

9. **Speed Control Test**.

(a) **Steady State Tests**. (Set frequency at 50 Hz at 50 % Load)

Load%	**Initial Speed (Hz)**	**Final Speed (Hz)**	**Governor droop(at 100 % load)**	**Permitted limits**
50	--	Set frequency at 50 Hz	$\frac{(NI-N2)x100}{N}$	Between 0.875% to 1% (for electronic governor)
0-25	50.056	50.826	NA	
25-50	50.826	49.729		
50-75	49.729	49.619		
75-100	49.619	49.584		
100-0	**49.584**	**50.056**	**0.947**	

Note:

(i) The load to be gradually reduced in quarter load steps from full load to no load and increased in the same manner up to full load. When the speed has stabilised after each load change the steady state frequency to be recorded. (set frequency to rated value when at 50% load)

(ii) Governor Droop - $\frac{\text{(No load frequency - Full load frequency)}}{\text{Nominal frequency}} *100$

$$\text{Nominal frequency} - \frac{\text{(No load frequency + Full load frequency)}}{2}$$

(iii) Frequency Modulation. Frequency Modulation is the periodic variation in frequency. The periodicity of Frequency modulation should be considered to be longer than 1 cycle time at nominal frequency and less than 10 seconds.

$$\text{Frequency Modulation(Percent)} = 100 \times \frac{(Fmax - Fmin)}{(2 \times Fnominal)}$$

(e) **Transient Tests**.

Load %		Initial Speed (Hz)	Momentary speed (Hz)	Final Speed (Hz)	% Peak = Initial-momentary / Nominal		Time of recovery (in sec)	
Initial	To				Observed	Permitted	Observed	Permitted
0	25	50.06	49.65	49.84	0.74	1.5 (L)	2	2
25	50	49.84	49.66	49.74	0.46		2	
50	75	49.74	49.59	49.65	0.38		2	
75	100	49.65	49.52	49.58	0.28		2	
100	75	49.58	49.72	49.66	0.36		2	
75	50	49.66	49.82	49.76	0.30		2	
50	25	49.76	49.94	49.85	0.40		2	
25	0	49.85	50.54	50.06	0.70		2	

For Machine Charged With Turbo Charged Engine.

Load %		Initial Speed (Hz)	Momentary speed (Hz)	Final Speed (Hz)	% Peak = Initial - Final / Nominal		Remarks
Initial	To				Observed	Permitted	
0	70	50.09	49.22	49.68	1.74	5 %	Sat
100	0	49.58	51.97	50.06	4.78	5 %	Sat

Note:

(xvi) The maximum speed variations resulting from sudden increase of 25% load stops when the generator is loaded at zero, 25, 50 and 75 % of rated full load and similar sudden decrease back to zero load should be recorded.

(xvii) Formula for % peak – $\frac{\text{(Initial frequency – Momentary frequency)}}{\text{Nominal frequency}} * 100$

(xviii) '****' Mechanical Governor – 2.5% of nominal speed and the speed should recover to within 1% of final speed within 2 secs and Electronic Governor – 1.5% of nominal speed and the speed should recover to within 0.2% of final speed within 2 secs. WJFACs – 3% of nominal speed. Non weapon platforms as per IHQ MoD(N)/ DEE letter EE/03/9700 dated 11 Jun 19 – 3.5% of nominal speed.

(xix) Permissible limit for 0-70% regime is decided iaw IHQ/MoD(N)/ DEE letter EE/03/9700 letter dated 24 Jun 15.

(xx) In case of Water based load tank transient loading to be done from 0-25% and 25-0%, 0-70% and 100-0% for Turbo-charged engines and 0-100% and 100-0% for all machines other than turbo-charged engines.

(f) **Governor Range**.

Load %	Achieved frequency	Permitted	Remarks
0	50.056	49.50 – 50.50	Sat
100	49.50 – 50.50		Sat

Note:

(i) Permitted limits for frequencies measured at 0% and 100% loads should not be less than ± 3% (as per Def Stan) and ± 1% of Nominal for mechanical governors and electronic governors respectively.

(ii) This test is undertaken by varying the frequency using the frequency control knob/ lever provided for the alternator on the switchboards.

(g) **Rate Affected by Governor Motor**.

Load %	Rate Hz/s		Permitted	Remarks
	Up	Down	Between 0.05 to 0.07 Hz per sec for Electronic Governors	
0	0.06	0.05		Sat
100	0.07	0.06		Sat

Note:

(i) Permitted limits for frequencies measured at 0% and 100% loads should not be less than ± 3% and ± 1% of Nominal for mechanical governors and electronic governors respectively.

(ii) This test is undertaken by holding the lever for frequency change in Up position or Down position for durations sufficient to record the graphs.

10. **Voltage Control Test**.

(a) **Steady State Test**.

Load%	KW	Voltage(V)		Amps	PF
		Observed	Permitted		
0	0	416.4	± 4.15	0	-
25	87	415.8		145	0.8
50	175	415.0		288	0.8
75	260	414.7		437	0.8
100	350	415.1		583	0.8

Note:

(i) Permitted limits of voltage ± 1% (as per def stan) of rated voltage or as per technical manuals for commissioned ships.

(ii) The load to be gradually reduced in say quarter load steps from full load to no load and when the voltage has stabilised after each load change the steady state voltage to be recorded. (Set voltage to Nominal value at 50% load).

(iii) Voltage Modulation. Voltage Modulation is the periodic voltage variation of single line to line user voltage. The periodicity of voltage modulation should be considered to be longer than 1 cycle time at nominal frequency and less than 10 seconds. Voltage used in the below mentioned equation is RMS voltage.

$$\text{Voltage Modulation(Percent)} = 100 \times \frac{(V_{max} - V_{min})}{(2 \times V_{nominal})}$$

(b) **Transient Test**.

Load %		Initial Voltage	Momentary Voltage	Final Voltage	% Peak Initial-momentary Nominal		Time of recovery (in sec)	
Initial	To				Observed	Permitted	Observed	Permitted
100	75	415.9	423.1	415.2	1.7	7.5	1	1
75	50	415.2	421.4	416.0	1.4		1	
50	25	416.0	428.1	415.8	1.4		1	
25	0	415.8	424.6	415.3	2.1		1	
0+M		415.8	399.0	415.7	4.0		1	
25+M		415.7	408.2	415.4	1.8		1	
50+M		415.2	401.1	415.2	3.4		1	
75+M		415.1	401.1	415.4	3.3		1	
85+M		415.6	402.5	414.8	3.1		1	

Note:

(i) M-Load equals application of an additional load equal to 50% rated kVA at zero to 0.4 PF lagging. Towards this starting of an induction motor could be undertaken if M-Load is not available. The motor chosen should be such that its kVA calculated based on its starting current and voltage input is equal to 50% of rated kVA of the alternator. The motor should have Direct-on-Line (DOL) starter.

(ii) Formula for % peak – $\frac{(\text{Initial voltage} - \text{Momentary voltage})}{\text{Nominal voltage}} * 100$

$$\text{Nominal voltage} - \frac{(\text{No load voltage} + \text{Full load voltage})}{2}$$

(c) **Voltage Balance**.

Load %	Line Voltage			Difference (Between Max and Min of three values)	Permitted limits (1% of Avg of three line voltage)
	R-Y	Y-B	B-R		
0	416.5	417.4	415.4	2.0 V	4.17 V
100	414.5	416.2	416.8	2.3 V	

(d) **Voltage Range**.

	Load %	At lowest limit of trimmer	At highest limit of trimmer	Remarks
AVR trimmer	0	-		SAT
	100			
Hand regulator	0	395	435	
	100	395	435	

Note: This test is undertaken by varying the voltage trimmer (Hand/ Auto as applicable) from lowest limit to the highest limit.

11. **Paralleling Trial**. Sat.