

Tele 022-22751134

Naval Trials and Acceptance Authority  
c/o Fleet Mail Office  
Mumbai - 400001

NATAA/318/IMAT

26 Dec 22

The Chief of Naval Staff  
[for Cmde (ME)]  
Directorate of Marine Engineering  
IHQ MoD(N)  
New Delhi 110011

The Chief of Naval Staff  
[for Cmde (EE)]  
Directorate of Electrical Engineering  
IHQ MoD(N)  
New Delhi 110011

**INTEGRATED FACTORY ACCEPTANCE TRIAL (IFATs) REPORTS**  
**DIESEL GENERATORS**

1. Refer to NATAA letter NATAA/318/IMAT dated 01 Sep 22 regarding Integrated Machinery Acceptance Trials (IMAT) of DAs/ TAs/ GTG (not addressed to all).
2. NATAA vide letter ibid had requested various trial authorities/units viz ETMA/ ETMU/ ETT/ DTTTs/ GTTTs/ MTUs to undertake performance/ vibration trials of respective alternators/ prime movers iaw IMAT protocol and forward individual trial reports as per the approved format to NATAA and all stakeholders. Thereafter, NATAA would scrutinize and compile all the individual trial reports and render a Comprehensive Integrated Machinery Acceptance Trials (IMAT) reports for DAs/ TAs/ GTGs after major refits (NR/ MR) to all concerned.
3. **Factory Acceptance Trials (FATs) Reports of Diesel Generators.** Gap analysis of the present practice of rendering trial reports post conduct of Factory Acceptance Trials (FATs) of Diesel Generators prior installation on new construction/ in-service platforms has revealed that the status of trials of complete Diesel Generator Set in form of FATs reports, is not available comprehensively to all stakeholders in Professional Directorates (DME/ DEE), Command HQs (CEO/ CLO) and WOTs. This is primarily due to the fact that all stakeholders are always handling only their relevant part of the equipment/ systems and a comprehensive FATs Report of the complete Diesel Generator Set is not compiled/ rendered by any trial unit.

4. In order to overcome this shortcoming, it is planned to formulate an '**Integrated Factory Acceptance Trials (IFATs) Report**' for all new Diesel Generators being inducted for naval platforms under construction/ in service, akin to Comprehensive IMAT report rendered for all Generators (DAs/TAs/GTGs) of ships post major refits. The IFATs report will be compiled by NATAA based on the individual reports forwarded by respective trial units. Generation of Integrated FATs reports of Diesel Generators comprising complete trial/ vibration data of both prime mover and the alternator, would enable the Professional Directorates and concerned trial agencies to have a clear and unambiguous status of the complete DG Set in one document. Further, in order to have standardisation, the format of the IFATs report for DG sets has been kept identical to that promulgated vide NATAA fax NATAA/300/Trial Protocol dated 07 Mar 22 (not addressed to all).

5. Towards implementation of the procedure for rendering integrated FATs reports for Diesel Generators, NATAA has compiled IFAT Report (placed at **Enclosure**) for the 6<sup>th</sup> Diesel Generator Set (Capacity- 01 MW) for P-17A (2<sup>nd</sup> ship) under construction at M/s MDL, Mumbai. The FATs of the DG set were conducted at GRSE (Ranchi) by trial teams from DTTT (Mbi), MTU(Kol) and ETMU (Kol) in Sep 22.

6. In view of the aforesaid, IFATs reports of all Diesel Generators will be compiled by NATAA henceforth based on individual reports of respective trial units (in the promulgated format) and forwarded to all stakeholders for information and record.



(Sandeep Puri)  
Commodore  
Director  
for Director General

Enclosure: - As above

Copy to: -

The Flag Officer Commanding-in-Chief  
[for CSO(Tech)]  
Headquarters, Western Naval Command  
Mumbai 400023

The Commander-in-Chief  
[for CTO (Marine)]  
Headquarters, A & N Command  
Port Blair 744102

The Flag Officer Commanding-in-Chief  
[for CSO(Tech)]  
Headquarters, Eastern Naval Command  
Visakhapatnam 530014

The Flag Officer Commanding-in-Chief  
[for CSO(Tech)]  
Headquarters, Southern Naval Command  
Kochi 682004

Directors/ Os i/C - With a request to forward respective trial reports of DAs post completion of FATs as per the format of Integrated Trials Report promulgated vide NATAA/300/Trial Protocol dated 07 Mar 22.

Internal: - ACOM (IT&S)      ACOM (D&R)      DG NATAA

**Enclosure to NATAA letter  
NATAA/318/IMAT dated 26 Dec 22**

Tele : 022-22752557

Naval Trials and Acceptance Authority  
C/o Fleet Mail Office  
Mumbai 400001

NATAA/318/IFATs

**23 Dec 22**

The Chief of Naval Staff  
{for Capt (ME)/ Capt (EE)}  
Integrated Headquarters  
Ministry of Defence (Navy)  
'C' Wing, Sena Bhawan  
New Delhi -110011

**INTEGRATED FACTORY ACCEPTANCE TRIALS (IFATs) REPORT**  
**6<sup>TH</sup> DA (SECOND SHIPSET) - P17A**

1. Refer to the following (not addressed to all): -
  - (a) MTU (Kol) letter MTU/300/P17A/Y-12652 dated 30 Sep 22.
  - (b) DTTT (Mbi) fax DTTT/415/02 dated 29 Sep 22.
  - (c) ETMU (Kol) fax ETMU/318/SEP dated 21 Sep 22.
2. Factory Acceptance Trials (FATs) of 6<sup>th</sup> DA (Second Shipset) of P17A of capacity 01 MW was conducted at GRSE (Dhruwa), Ranchi iaw approved protocol from 12 to 15 Sep 22. The trials were witnessed by reps from DND, MTU (Kol), ETMU (Kol), QAE (WP/WE) Kol, WOT(Mbi), DN and MDL (Mbi). The individual reports of the trial agencies have been merged and the detailed Integrated FATs (IFATs) report is placed at **Annexure 1**.
3. The details of Diesel Alternator are as follows:-

<b>Ser.</b>	<b>Description</b>	<b>Remarks</b>
(a)	Engine Make	MTU
(b)	Engine Type	12V396TE54
(c)	Engine Rated Speed	1500 RPM
(d)	Engine Serial No.	5584237
(e)	Alternator Make	Elmot Alternators Pvt Ltd
(f)	Alternator Rating	1000 KW
(g)	Alternator Serial no.	20020258

4. **Salient Observations (Prime Mover)**. Salient observations / defects observed during the trials are as follows:-

- (a) The Lub oil report of samples drawn post FATs have been examined and found SAT.

- (b) The pH value after load trials as per the coolant report was found on the lower side (7.3).
- (c) SBN/ ABN reports received from the OEM have been scrutinized by this unit. ABN reports are found to be satisfactory. However, SBN values above 2<sup>nd</sup> stage mounts at 100 % load at few points were found to exceed the specified limit.
- (d) Attenuation across 2<sup>nd</sup> stage mounts have also been calculated and found to be satisfactory. However, attenuation values at few points were found to beyond the specified limit.
- (e) Calibration certificates of equipment used for SBN/ ABN and vibration trials not received and are awaited from OEM.

**5. Salient Observations (Alternator). Nil**

6. The summary of trials is enumerated below: -

Ser	Description	Status
(a)	Overall Status	Sat
(b)	Prime Mover (SDCs, Performance and Instrumentation trials)	Sat
(c)	Alternator (Insulation, SPM, Instrumentation, Speed and Voltage control tests)	Sat
(d)	Vibration	NA
(e)	Attenuation / SV Mounts and Foundation	Sat (with observations)
(f)	Coupling	NA
(g)	Balancing	NA
(h)	Alignment	NA
(j)	Paralleling	NA

7. **Recommendations**. In view of the above, following recommended: -

- (a) Liquidation of defects/ observations mentioned at Para 4 above.
- (b) The shipbuilder may be directed to comply with de-preservation and re-preservation procedure in case of delay in commissioning of the unit.
- (c) The IFATs protocol be amended to undertake all trials iaw Def Stan 08-142, EED-Q-242(R2) and BR 6500.
8. 6<sup>th</sup> DA (Second Shipset) of P17A project may be cleared wrt SDC and load trials.



(RK Pillai)  
Commander  
Jt Director  
for Director General

**Enclosure:-** As above

**Copy to:-**

The Officer-in-Charge  
Diesel Testing and Tuning Team  
c/o Fleet Mail Office,  
Visakhapatnam 530014

The Officer-in-Charge  
Electrical Trials Maintenance Unit  
C/o Navy Office  
Hastings  
Kolkata 700022

The Officer-in-Charge  
Machinery Trials Unit  
C/o Navy Office  
Hastings  
Kolkata 700022

**Annexure 1**  
 (refers to para 2 of Enclosure)

**INTEGRATED FACTORY ACCEPTANCE TRIALS (IFATs) REPORT**  
**6<sup>TH</sup> DA (SECOND SHIPSET) - P17A**

**Section - I (General Information)**

- |                             |  |
|-----------------------------|--|
| 1. Machinery Name, Location | : 6 <sup>th</sup> DA (Second Shipset) - P17A |
| 2. Occasion                 | : FATs                                       |
| 3. Routine Undertaken       | : NA   |
| 4. Presented by             | : GRSE (Ranchi)                              |
| 5. Proposal Reference       | : -----                                      |
| 6. File Reference           | : -----                                      |

**Section - II (Prime Mover)**

- |  |  |
|--|--|
| 1. Trial inspectors                      | : (a) Mayank, ERA 3, DTTT(Mbi)<br>(b) AB Sharma, CHERA, MTU(Kol) |
| 2. Date                                  | : 12 to 15 Sep 22  |
| 3. Equipment used for performance trials | : (a) SPM T-30<br>(b) Temperature Gun                            |
| 4. Make with Eqpt Ser No                 | : MTU, Ser No: 5584237   |
| 5. Rated full load capacity              | : 1000 KW  |
| 6. Running hours since last MOH          | : NA   |
| 7. Last major routines undertaken        | : NA   |
| 8. Restrictions imposed, if any          | : NA   |
| 9. Coupling                              | : NA   |
| 10. Foundation                           | : NA   |
| 11. Ancillary System                     |  |
| (a) Lub Oil System                       | : NA   |
| (b) Fuel System                          | : NA   |
| (c) SW System                            | : NA   |

- (d) Coolant System : NA
- (e) Intake / Exhaust System  
(Including deck filters, support structures and load hangers, if any) : NA
- (f) Crankcase breather : NA
12. Control System including Instrumentation (Omega / Aux Control System/MCS ) : NA
13. Calibration Certificates : NA
14. Onboard Lub Oil Test Kit : NA
15. Balancing Report : NA  
(In case of MOH/Major repair/Rotor defects)
16. Details of trials are as follows:-

(a) **Safety Device Checks**

Ser	Parameters	Limit	Unit	Value	Status
<b>Trips</b>					
1.	Overspeed	1725↑ (Overspeed tested with test Overspeed push button on LOP at 1500 rpm)	RPM	1509	SAT
2.	Low Lub Oil Pressure	3.8↓ (and below) at 1500 rpm	bar	3.8 bar	SAT
3.	High Coolant / Fresh Water Temp	93↑ (and above)	°C	93	SAT
4.	Alternator Bearing Temp at Drive End	100	°C	100	SAT
5.	Alternator Bearing Temp at Non - Drive End	100	°C	100	SAT
6.	Alternator U Phase Winding Temp	140	°C	140	SAT
7.	Alternator V Phase Winding Temp	140	°C	140	SAT
8.	Alternator W Phase Winding Temp	140	°C	140	SAT
9.	Alternator Air Inlet Temp	70	°C	70	SAT
10.	Alternator Air Outlet Temp	95	°C	95	SAT

<u>Alarms</u>					
1.	Cooling / Fresh Water Level	-	-	ops	SAT
2.	Air Flap Closed / Open	-	-	ops	SAT
3.	High Lub Oil Temp	105↑ (and above)	°C	105	SAT
4.	High Coolant/ Fresh Water Temp	87↑ (and above)	°C	87	SAT
5.	Lub Oil Differential Pressure	1.5↑ (and above)	bar	1.5	SAT
6.	Start Air Pressure	16↓ (and below)	bar	16	SAT
7.	Low Coolant/ Fresh Water Pressure	2.0↓ (and below)	bar	1.5	SAT
8.	Water Level Fuel Pre Filter	-	-	ops	SAT
9.	Charge Air Temperature	77↑ (and above)	°C	77	SAT
10.	Low Lub Oil Pressure	4.3↓ (and below) at 1500 rpm	bar	4.3	SAT
11.	Sea Water Pressure	1.2↓ (and below) at 1500 rpm	bar	1.2	SAT
12.	Leakage Fuel	-	-	ops	SAT
13.	Fuel Pressure	2.1↓ (and below) at 1500 rpm	bar	2.1	SAT
14.	Exhaust Gas Temp A Bank	740↑ (and above)	°C	740	SAT
15.	Exhaust Gas Temp B Bank	740↑ (and above)	°C	740	SAT
16.	Leakage Alternator Cooler	-	-	ops	SAT
17.	AVR Fault	-	-	ops	SAT
18.	Voltage Out Of Limit	-	-	ops	SAT
19.	Engine Turning Gear Engaged	-	-	ops	SAT
20.	Exhaust Back Pressure	50 mbar ↑ (and above)	mbar	ops	SAT
21.	U-Phase Winding Temperature	130↑	°C	130	SAT
22.	V-Phase Winding Temperature	130↑	°C	130	SAT
23.	W-Phase Winding Temperature	130↑	°C	130	SAT
24.	DE Bearing Temperature	90↑ and above	°C	90	SAT
25.	NDE Bearing Temperature	90↑ and above	°C	90	SAT
26.	Alternator Air Temperature Inlet/ Cooler Air Outlet Temperature	65↑ and above	°C	65	SAT

27.	Alternator Air Outlet Temp	90↑ and above	°C	90	SAT
28.	Fire Zone 1	-	-	OPS	SAT
29.	Fire Zone 2	-	-	OPS	SAT
30.	Fire Zone 3	-	-	OPS	SAT
31.	Fire Zone 4	-	-	OPS	SAT
32.	Fire Zone 5	-	-	OPS	SAT
33.	Enclosure Door	-	-	OPS	SAT
34.	Acoustic Enclosure Temperature	57↑ and above	°C	57	SAT
35.	Diode Failed	-	-	OPS	SAT
36.	Battery Charger Fuse/Phase Failure	-	-	OPS	SAT
37.	Battery Charger High Temp Overload	-	-	OPS	SAT
Indications		LOP	LCP	Value	Status
1.	Raw / Sea Water Temperature	YES	YES	OPS	SAT
2.	Fuel Rack Position	YES	YES	OPS	SAT
3.	Air Intake Temperature	YES	YES	OPS	SAT
4.	Start Air Solenoid Valve	-	-	OPS	SAT
5.	Sight Glass For Coolant Expansion Tank	-	-	OPS	SAT
6.	Engine Stop	-	-	OPS	SAT
7.	Shut Down Air Flap	-	-	OPS	SAT
8.	Engine Running Hour	YES	YES	OPS	SAT
9.	Anti Condensation Heating	-	-	OPS	SAT
DG Start Interlocks		Operating /Display Location		Unit	Remarks
		LOP	LCP		
1.	Turning Gear Engaged	No Start	No Start	-	-
2.	Air Flap In Closed Condition	No Start	No Start	-	-
3.	LOP In Local Mode	NA	No Start	-	-
4.	LOP In Remote Mode	No Start	NA	-	-
5.	LOP & LCP in Remote	No Start	No Start	-	Start possible from IPMS/APMS
					SAT. Start from IPMS/APMS to be checked during on-board trial

**(b) Performance Trials**

<u>Ser</u>	<u>Parameters</u>	<u>Operating Range @ 100% load</u>	<u>Unit</u>	<u>Load (in %)</u>					
				25	50	75	100	100	110

1.	RPM	$1500 \pm 1\%$	RPM	1513	1509	1505	1501	1501	1499
2.	Load	1000	kw	250	500	750	1000	1000	1100
3.	Lub Oil Pressure	4.5 - 5.5	bar	5.7	5.6	5.6	5.5	5.2	5.5
4.	Cooling Water Temperature (After Cooler)	85	°C	70	72	74	77	77	78
5.	Fuel Rack	-	mm	5.2	7.8	10.4	13.2	13.2	14.3
6.	Fuel Oil Pressure (After Fuel Filter)	2.5 - 4.0	bar	3.3	3.1	3.0	2.9	2.9	2.8
7.	Exhaust Gas Temp 'A' Bank	740 max	°C	402	500	557	633	633	656
8.	Exhaust Gas Temp 'B' Bank	740 max	°C	390	495	554	621	621	647
9.	Lub Oil Temp (After Cooler)	90	°C	72	73	75	75	75	75
10.	Pressure Raw Water	1.3 - 2.2	bar	2.1	2.0	2.0	2.0	2.0	2.0
11.	Pressure Cooling Water	2.0 - 3.5	bar	2.3	2.3	2.3	2.3	2.3	2.3
12.	Air Intake Depression	15	mbar	-2	-3	-4	-8	-8	-7
13.	Exhaust Back Pressure	30	mbar	1	2	3	5	5	5
14.	P-Charge Air After Cooler	2.45	bar	0.3	0.7	1.3	1.8	1.8	2.0
15.	Enclosure Temp	57 max	°C	36	37	38	40	41	41
16.	Starting Air Pressure	20 - 40	bar	28.1	27.6	27.2	26.8	26.7	26.6
17.	Ambient Temp	-	°C	27	27	27	29	29	29
18.	T-Charge Air After Cooler	50 - 70	°C	60	58	56	53	53	51
19.	Fuel - Temp	-	°C	26.6	26.4	26.6	27.5	27.5	27.7
20.	Temp-Intake Air	30 - 45	°C	29	28	27	28	28	28
21.	Gen. Bearing Temp at DE	45 - 85	°C	57	61	65	77	77	74
22.	Gen. Bearing Temp at NDE	35 - 70	°C	40	41	43	49	49	49
23.	Gen. Winding Temp R - Phase	130 max	°C	47	55	67	92	92	86
24.	Gen. Winding Temp Y - Phase	130 max	°C	44	50	60	79	79	75
25.	Gen. Winding Temp B - Phase	130 max	°C	43	49	57	74	74	71
26.	Alternator Inlet Temp	30 - 45	°C	31	32	34	38	37	37

(c) Vibration Trials. NA

17. Attenuation Checks. SBN/ ABN reports received from the OEM have been scrutinized by MTU(Kol). ABN reports are found to be satisfactory. However, SBN values above 2<sup>nd</sup> stage mounts at 100 % load at few points were found to exceed the specified limit and the same are tabulated below.

SBN Limit on 2 <sup>nd</sup> Stage above Mounts
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X Direction
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<b>Mounts Ser No.</b>	<b>Frequency</b>	<b>Obtained value</b>	<b>Limiting Value</b>
A1	25	93.93	90.0
A2	25	91.55	90.0
A3	25	90.8	90.0
A4	2000	98.78	98.0
A5	2000	98.48	98.0
A6	800	96.97	95.0
B1	25	94.61	90.0
B2	25	92.09	90.0
B3	25	92.94	90.0

**Y Direction**

A1	25	95.07	90.0
	400	97.70	95.0
A2	25	95.47	90.0
	1600	103.68	98.0
A3	25	95.18	90.0
	315	98.08	95.0
A4	25	95.60	90.0
	630	97.35	95.0
A5	25	95.62	90.0
A6	25	95.58	90.0
	800	99.28	95.0
B1	25	96.68	90.0
	630	97.57	95.0
	800	99.10	95.0
B2	25	96.68	90.0
B3	25	96.59	90.0
	630	99.27	95.0
B4	25	97.64	90.0
	500	95.31	95.0
B5	25	97.36	90.0
B6	25	97.20	90.0
	500	95.51	95.0
	630	98.95	95.0

**Z Direction**

A3	3150	100.44	98.0
A5	3150	100.24	98.0
A6	5000	99.50	98.0
B2	5000	100.25	98.0

18. The attenuation report for the 2<sup>nd</sup> stage mounts has also been calculated and found to be satisfactory. However, Attenuation values at few points were found to beyond the specified limit and the same are highlighted below.

<b>Mount</b>	<b>Above</b>	<b>Below</b>	<b>Attenuation (70% - 90%)</b>
A1	1.54	0.27	82.47
A2	1.25	0.34	72.80
A3	1.09	0.20	81.65
A4	1.01	0.20	80.19
A5	1.10	0.25	77.27
A6	1.67	0.21	87.43
B1	1.12	0.23	79.46
B2	0.99	0.46	<b>53.54</b>
B3	1.14	0.18	84.21

B4	1.01	0.26	74.25
B5	0.95	0.40	<b>57.89</b>
B6	1.67	0.27	83.83

### Section – III (Alternator)

#### 1. Trial Details

(a)	Presented by*	GRSE (Ranchi)
(b)	Trial date*	12-15 Sep 22
(c)	Occasion of current trial*	IFATS
(d)	Date of last trial carried out on*	-
(e)	Proposal reference*	GRSE Email No. DEP/QA/17A/787 dated 01 Sep 22
(f)	File reference*	
(g)	Reference document for trial	<b>Def Stan 08-142, EED-Q-242(R2) and BR 6500</b>

#### 2. Test Equipment Used\*

#### 3. Equipment Details

<b>Engine</b>		
(a)	Make**	MTU Germany
(b)	Model & serial no.**	12V396TE54 & ESN-5584237
(c)	RPM**	1500

<b>Governor</b>		
(a)	Make**	MTU Germany
(b)	Model & serial no.**	X00E50203923,244534880&244534876
(c)	Type**	Electronic

<b>Alternator</b>		
(a)	Make and rating**	Elmot Alternators Pvt. Ltd.
(b)	Model & serial no.**	20020258
(c)	Rated voltage**	415 V
(d)	Rated frequency**	50 Hz
(e)	Rated KVA/ kW**	1250 KVA/1000 KW
(f)	Rated current**	1739 A
(g)	Bearing number**	DE-NU230 & NDE-NUP 228

<b>AVR</b>		
(a)	Make and type**	BASLER DECS 250/Digital
(b)	Model & serial no.**	LN2SN1N,H02997423,H02983153

<b>Supply Breaker</b>		
(a)	Make**	NA
(b)	Model & serial no.**	NA
(c)	Rated capacity (Amps)**	NA

#### 4. Insulation Resistance (iaw NES 511 (Issue 2) and NES 502 Issue 4)

(a)	Generator hot ( $>1M\Omega$ )*	$>20 M\Omega$
(b)	Generator cold ( $>1M\Omega$ )*	$>20 M\Omega$

(c)	Switchboard ( $>2M\Omega$ )*	NA
(d)	Generator to switchboard cable ( $>20M\Omega$ )*	NA
(e)	Insulation of breaker( $>10M\Omega$ )*	NA

5. **Protection Checks.** Not applicable as per IFAT protocol.

Ser	Protection	Calibration Date*	Calibration Certificate Provided (Yes/No)*	Tripping Value*	Observed Value*	Status (Sat/Unsat)*
<b>Breaker Protection</b>						
(a)	Over voltage	NA	NA	110% of rated voltage	NA	NA
(b)	Under voltage	NA	NA	85% of rated voltage	NA	NA
(c)	Overload	NA	NA	NA	NA	NA
<b>Generator/ Switchboard Protection</b>						
(a)	Over voltage trip	NA	NA	110% of rated voltage	NA	NA
(b)	Under voltage trip	NA	NA	85% of rated voltage	NA	NA
(c)	Reverse power relay	NA	NA	NA	NA	NA
(d)	Diode failure trip	NA	NA	NA	NA	NA
(e)	Winding temp alarm	NA	NA	NA	NA	NA
(f)	Bearing temp alarm	NA	NA	NA	NA	NA

## 6. Instrumentation

Ser	Meter	Ops/ Non Ops*	Calibration Date*	Calibration Certificate Provided (Yes/ No)*	Status (Sat/ Unsat)*
(a)	KW meter	Ops	NA	Yes	Sat
(b)	Voltmeter	Ops	10 Jun 22	Yes	Sat
(c)	Ammeter	Ops	10 Jun 22	Yes	Sat
(d)	Frequency meter	Ops	10 Jun 22	Yes	Sat
(e)	Power factor meter	Ops	10 Jun 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)*	Sat

(e)	Switch/ knobs (Sat/Unsat)*	Sat
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### 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 deg C) (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**	NA
(l)	DTTT trial status (Sat/Unsat)**	NA
(m)	Internal communication (Sat/Unsat)*	NA
(n)	Lighting of compartment (Sat/Unsat)*	NA
(p)	Ventilation of compartment (Sat/Unsat)*	NA
(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)*	NA
(s)	Generator/ Swbd is earthed (Sat/Unsat)*	NA
(t)	Generator supply breaker operates electrically (Sat/Unsat)*	Sat
(u)	Ambient temperature at start**	NA
(v)	Temperature rise after two hours of running at full load**	Sat
(w)	Routine on cooler last carried out on (date)**	Sat
(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) *	Sat

Note: For Para 1 to 8, following to be followed while filling the details mentioned in sub serials:-

- (i)        \*\* - To be checked/filled/measured by ETMA trial member.
- (ii)      \*\* - To be provided by SS.
- (iii)     \*\*\* - To be checked/ provided by Yard.

### 9. Speed Control Test

(a) Steady State Test. Steady state trials with AVR 1 is tabulated below:-

Load (% of Rated Capacity)	Initial Speed (Hz)	Final Speed (Hz)	Governor Droop (At 100% Load Change)	Permissible Limit of Droop/ Steady State	Frequency Modulation (Less Than $\pm 0.25\%$ of Rated Frequency)
0	50.25	50.16	NA	Load range tolerance – 1Hz or 2% of rated value Constant load tolerance - 0.5Hz or 1% of rated value	0.08
25	50.20	50.14			0.05
50	50.04	50.00			0.03
75	49.81	49.70			0.10

Load (% of Rated Capacity)	Initial Speed (Hz)	Final Speed (Hz)	Governor Droop (At 100% Load Change)	Permissible Limit of Droop/ Steady State	Frequency Modulation (Less Than $\pm 0.25\%$ of Rated Frequency)
100	49.79	49.75			0.03
100 - 0 (Governor Droop)	49.79	50.26	0.93%	<ul style="list-style-type: none"> <li>- Between 0.875% to 1% (for Electronic Governors).</li> <li>- Between 3.5% to 4% (for Mechanical Governors).</li> <li>- Upto 3% onboard Teg and Talwar class ships.</li> </ul> <p style="text-align: center;"><u>(No load freq.- full load freq.)*100</u> Nominal freq.</p>	NA

(b) **Steady State Test.** Steady state trials with AVR 2 is tabulated below: -

Load (% of Rated Capacity)	Initial Speed (Hz)	Final Speed (Hz)	Governor Droop (At 100% Load Change)	Permissible Limit of Droop/ Steady State	Frequency Modulation (Less Than $\pm 0.25\%$ of Rated Frequency)
0	50.23	50.26		Load range tolerance - 1Hz or 2% of rated value	0.03
25	50.18	50.20		Constant load tolerance - 0.5Hz or 1% of rated value	0.02
50	50.04	50.07			0.03
75	49.90	49.93			0.03
100	49.76	49.81			0.10
100 - 0 (Governor Droop)	49.78	50.23	0.90 %	<ul style="list-style-type: none"> <li>- Between 0.875% to 1% (for Electronic Governors).</li> <li>- Between 3.5% to 4% (for Mechanical Governors).</li> <li>- Upto 3% onboard Teg and Talwar class ships.</li> </ul> <p style="text-align: center;"><u>(No load freq.-full load freq.)*100</u> Nominal freq.</p>	NA

**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 stabilized after each load change the steady state frequency to be recorded. (Set frequency to rated value when at 50% load)

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

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

(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.

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

(c) Transient Tests. Transient trials with AVR 1 Governor 1 are as follows:-

Load %		Initial Speed (Hz)	Momentary Speed (Hz)	Final Speed (Hz)	% Peak		Time of Recovery to Within $\pm 1\% / 0.2\%$ of Final Value	
Initial	To				Observed	Permissible Limit	Observed	Permissible Limit (Sec)

**For All Alternators (Turbo/ Diesel Including Turbo-Charged Machines)**

0	25	50.25	49.65	50.18	1.19	1.5% of nominal speed and the speed should recover to within 0.2% of final speed	1.40	2 Sec
25	50	50.20	49.55	50.07	1.29		1.74	
50	75	50.04	49.34	49.93	1.39		1.76	
75	100	49.81	49.21	49.68	1.19		1.36	
100	75	49.79	50.46	49.90	1.33		1.60	
75	50	49.93	50.64	50.06	1.41		1.60	
50	25	50.10	50.81	50.18	1.41		1.66	
25	0	50.18	50.85	50.26	1.33		1.68	

**For Machines Installed With Turbo-Charged Diesel Engines**

**Electronic Governor**

0	70	49.96	47.76	49.90	4.39	5%	4.00	5 sec
100	0	49.79	52.21	50.26	4.83	5%	3.20	5 sec

(d) Transient Tests. Transient trials with AVR 2 Governor 1 are as follows: -

Load %		Initial Speed (Hz)	Momentary Speed (Hz)	Final Speed (Hz)	% Peak		Time of Recovery to Within $\pm 1\% / 0.2\%$ of Final Value	
Initial	To				Observed	Permissible Limit	Observed	Permissible Limit (Sec)

**For Machines Installed With Turbo-Charged Diesel Engines**

**Electronic Governor**

0	70	50.28	47.85	49.98	4.85	5%	3.36	5 sec
100	0	49.81	52.30	50.26	4.97	5%	2.80	5 sec

(e) Transient Tests. Transient trials with AVR 2 Governor 2 are as follows: -

Load %		Initial Speed (Hz)	Momentary Speed (Hz)	Final Speed (Hz)	% Peak		Time of Recovery to Within $\pm 1\% / 0.2\%$ of Final Value	
Initial	To				Observed	Permissible Limit	Observed	Permissible Limit (Sec)
<b>For All Alternators (Turbo/ Diesel Including Turbo-Charged Machines)</b>								
0	25	49.90	49.35	50.20	1.10	1.5% of nominal speed and the speed should recover to within 0.2% of final speed	2.00	2 Sec
25	50	49.84	49.18	50.04	1.30		1.66	
50	75	49.46	49.17	49.92	0.58		1.26	
75	100	49.79	49.29	49.79	1.00		1.48	
100	75	49.79	50.39	49.90	1.20		1.70	
75	50	49.93	50.60	50.04	1.34		1.58	
50	25	50.07	50.81	50.18	1.48		1.64	
25	0	50.20	50.82	50.25	1.24		1.44	

<b>For Machines Installed With Turbo-Charged Diesel Engines</b>								
<b>Electronic Governor</b>								
0	70	50.21	47.85	49.95	4.72	5%	2.88	5 sec
100	0	49.78	51.98	50.23	4.40	5%	3.30	5 sec

(f) **Transient Tests.** Transient trials with AVR1 Governor 2 are as follows:-

Load %		Initial Speed (Hz)	Momentary Speed (Hz)	Final Speed (Hz)	% Peak		Time of Recovery to Within $\pm 1\% / 0.2\%$ of Final Value				
Initial	To				Observed	Permissible Limit	Observed	Permissible Limit (Sec)			
<b>For Machines Installed With Turbo-Charged Diesel Engines</b>											
<b>Electronic Governor</b>											
0	70	50.28	47.84	49.93	4.88	5%	3.48	5 sec			
100	0	50.01	52.24	50.23	4.46	5%	3.18	5 sec			

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 =  $\frac{(\text{Initial frequency} - \text{Momentary frequency})}{\text{Nominal frequency}} * 100$

(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.

(g) **Governor Range**. Not applicable as per IFAT protocol

Load %	Measured Frequency (Hz)	Remark
0	NA	Sat / Unsat
100	NA	Sat / Unsat

Note:

(i) Permitted limits for frequencies measured at 0% and 100% loads should not be less than  $\pm 3\%$  (as per Def Stan) and  $\pm 1\%$  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.

(h) **Rate Affected by Governor Motor**. Not applicable as per IFATs protocol.

Load %	Rate (Hz/Sec)		Permissible Limits
	Up	Down	
0	NA	NA	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	NA	NA	

Note:

(i) Permitted limits for frequencies measured at 0% and 100% loads should not be less than  $\pm 3\%$  and  $\pm 1\%$  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**. Steady state test with AVR 1 are as follows:-

Load %	KW	Volts		P.F.	Voltage Modulation (Less Than 2% of Rated Voltage)
		Observed	Permissible Limit		
100	1000	412.30	$\pm 1\%$ (as per Def Stan)	0.8	SAT
75	750	413.14		0.8	SAT
50	500	413.28		0.8	SAT
25	250	414.60		0.8	SAT
0	0	415.10		0.8	SAT

(b) **Steady State Test**. Steady state test with AVR 2 are as follows:-

Load %	KW	Volts		P.F.	Voltage Modulation (Less Than 2% of Rated Voltage)
		Observed	Permissible Limit		
100	1000	414.10	$\pm 1\%$ (as per Def Stan)	0.8	SAT
75	750	414.20		0.8	SAT
50	500	414.60		0.8	SAT
25	250	415.00		0.8	SAT
0	0	415.15		0.8	SAT

Note:

(i) Permitted limits of voltage  $\pm 1\%$  (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.

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

(c) **Transient Test**. Transient trials with AVR 1 Governor 1 are as follows:-

Load %	Initial Voltage (V)	Momentary Voltage (V)	Final Voltage (V)	% Peak	Time of Recovery to Within $\pm 1\%$ of Final Value

Initial	To					Observed	Permissible Limit	Observed (Sec)	Permissible Limit (Sec)
100	75	414.06	430.15	413.44	3.88	7.5	15	0.60	1
75	50	413.75	430.63	413.26	3.59			0.36	
50	25	412.97	430.31	414.60	4.19			0.50	
25	0	413.59	433.59	415.10	4.83			0.40	
0 + M		NA	NA	NA					
25 + M		NA	NA	NA					
50 + M		NA	NA	NA					
75 + M		NA	NA	NA					
85 + M		412.5	365.94	412.34	11.28			0.84	

(d) Transient Test. Transient trials with AVR 2 Governor 1 are as follows:-

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	NA	NA	NA	NA	7.5	NA	1
75	50	NA	NA	NA	NA		NA	
50	25	NA	NA	NA	NA		NA	
25	0	NA	NA	NA	NA		NA	
0 + M		NA	NA	NA	NA		NA	
25 + M		NA	NA	NA				
50 + M		NA	NA	NA				
75 + M		NA	NA	NA				
85 + M		414.22	373.91	414.38	9.83		0.87	

(e) Transient Test. Transient trials with AVR 2 Governor 2 are as follows:-

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	413.44	428.91	413.60	3.73	7.5	0.50	1
75	50	412.97	428.75	414.04	3.80		0.51	
50	25	414.06	430.62	415.24	3.99		0.40	
25	0	415.47	435.63	415.60	4.82		0.42	
0 + M		NA	NA	NA	NA		NA	
25 + M		NA	NA	NA				
50 + M		NA	NA	NA				
75 + M		NA	NA	NA				
85 + M		412.50	366.25	414.38	10.60		0.78	

(f) **Transient Test.** Transient trials with AVR 1 Governor 2 are as follows:-

Load %		Initial Voltage (V)	Momentary Voltage (V)	Final Voltage (V)	% Peak		Time of Recovery to Within $\pm 1\%$ of Final Value	
Initial	To				Observed	Permissible Limit	Observed (Sec)	Permissible Limit (Sec)
100	75	NA	NA	NA	NA	7.5	NA	1
75	50	NA	NA	NA	NA		NA	
50	25	NA	NA	NA	NA		NA	
25	0	NA	NA	NA	NA		NA	
0 + M		NA	NA	NA	NA		NA	
25 + M		NA	NA	NA	NA		NA	
50 + M		NA	NA	NA	NA		NA	
75 + M		NA	NA	NA	NA		NA	
85 + M		412.50	368.75	414.22	11.21		0.90	

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 =  $\frac{(\text{Initial voltage} - \text{Momentary voltage}) * 100}{\text{Nominal voltage}}$

$$\text{Nominal voltage} = (\text{No load voltage} + \text{Full load voltage})$$

(g) **Voltage Balance.** Not applicable as per IFAT protocol

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	NA	NA	NA	V	V
100	NA	NA	NA	V	V

(h) **Voltage Range.** Not applicable as per IFAT protocol

	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		
AVR Control	0	NA	NA	V	NA
	100	NA	NA		NA
Hand Control	0	NA	NA	V	NA
	100	NA	NA		NA

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

(j) **Voltage Waveform Harmonic Content.**

Maximum total harmonic content of waveform at no load (not to exceed 2% of the amplitude of fundamental)	NA
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11. **Paralleling Trials.** Not applicable as per IFAT protocol.