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INTEGRATED FULL POWER TRIALS OF SHIPS - PRE/ POST REFITS

1. **Introduction.** Full Power Trial (FPT) Protocols for Gas Turbine, Diesel Engine and Steam Turbine propelled ships formulated by NATAA have been approved and published as **DME Specification 513**, vide IHQ MoD(N)/DME letter EG/5602/TRN dated 22 Apr 21, not addressed to all. Further, uniform shaft trending regimes for different class of ships have also been promulgated as Appendix 'B' to DME Specification 513.

Significance of Full Power Trials

2. Main Propulsion Plant (MPP) performance evaluation trials/ FPTs are undertaken by trial units as part of periodic health assessment checks and during Pre/ Post refit trials. These trials are significant in evaluating the operational readiness of the platform. The performance evaluation is undertaken by exploiting the MPP at *authorised full power* on specific laid down occasions. *Authorised full power* is defined as the power achieved when any authorised limitation is reached. The authorised limitation for operation of Main Propulsion for ships and submarines is specified in Technical Manuals/ Acceptance/ Trials Report issued and NOs, as amended from time to time by the IHQ MoD(Navy). Authorised full power is not to be exceeded, except in cases of emergency.

3. All operational ships are required to carry out FPT as per the occasions listed in Article 0332 of INBR 3000. The FPTs are to be undertaken only for the necessary time duration to ensure that the systems are working satisfactorily and to obtain a set of readings of performance parameters for comparison with those recorded during previous performance trials. The duration of trials for each type of propulsion/ class of ship has been elucidated in DME Specifications 513. The records of performance parameters of the machinery and systems are to be maintained onboard. Major observations are to be intimated to Operational/ Administrative Authority. During FPT, health of the MPP and its auxiliaries is assessed by a combination of performance monitoring by parametric trending, health monitoring by vibration analysis and lub oil analysis. It is, therefore, prudent that **FPT is planned and executed as per DME Specification 513** to avoid repeated trials and subjecting the ship and its machinery to extreme stresses and strains.

4. **Factors Affecting MPP Performance during FPT.** The performance of MPP during FPT across different types of propulsion aggregates and class of ships depends on several factors. Whilst a major factor for sub-optimal performance of MPP during FPT is observed to be *increased displacement of platform*, the following factors may also contribute to the sub-optimal performance of MPP: -

(a) Underwater hull and propeller fouling affecting the ship's overall hydrodynamic performance. Each of these factors may contribute to almost 10% of extra energy demand.

(b) Change in trim impacting the ship's energy demand and affecting propulsion plant performance.

(c) Shifting of Propeller Curve due to change in propeller characteristics affected by propeller/ hull conditions, displacement, etc.

(d) Sub-optimal performance of MPP auxiliary machinery and systems.

(e) Improper Engine Room Ventilation due to defective flaps, poor state of ventilation trunkings/ bilge coolers. Sub-optimal performance of motors of exhaust and supply blowers.

(f) Steam leakages, Main Condenser vacuum, Boiler casing integrity and performance of steam auxiliaries for Steam ships.

(g) High air inlet temperature and low mass flow rates due to choked filters and intake restrictions for Diesel ships.

(h) Throttle Control/ Combinator lever issues, high exhaust gas temperatures, improper fuel equipment calibration and leakages in fuel system for Gas Turbine ships.

(j) Sea state and wind conditions wherein the wave height/ swell also impedes the performance of the MPP.

5. **Condition of Ship during FPT.** During FPT, all ships including Tankers are to be at/ near CST displacement conditions. In addition, all harbour checks are to be completed as per DME Spec 513 and underwater hull and propellers be cleaned if the ship has been berthed alongside for prolonged duration (more than 1 to 1.5 month) especially during long refits (NCD 1483 refers).

6. **Holistic Approach for Conduct of FPT.** Individual trial agencies viz GTTTs, DTTTs and CBIU/ MTUs are presently involved in undertaking FPT of respective class of ships during PRTs/ PSTs and periodic EHM trials. The shafting trials pan-Navy are undertaken by MTUs/ CTT(Pbr) across all class of ships. Further, the trials of various

pumps and motors associated with the MPP are undertaken by MTUs/ CTT(Pbr) and ETMA/ ETMU/ ETT respectively. Since individual trial agencies progress with respective trials, the issues pertaining to the complete propulsion system as a whole are not being evaluated/ resolved presently. Further, mitigation actions, in case full power is not achieved, also remain ineffective. ***There is, therefore, a need to conduct Integrated FPT (akin to IMAT) by respective trial units during PRT/ Post Refit Trials or other occasions, as required, followed by rendition of a Comprehensive Full Power Trials report.***

7. **Conduct of Full Power Trials.** In line with NATAA policy on conduct of IMAT, the FPT of ships during Pre/ Post refit trials will be carried out as '***Integrated Trials***' with immediate effect. The FPT will be steered by the '***Lead Trials Unit***' who shall be supported by the '***Assisting Trial Units***' in each Command/ Station. This would ensure proper monitoring, evaluation and mitigation actions on the issues pertaining to the sub-optimal performance of the MPP observed during the trials. The responsibility matrix for the trials is as shown below: -

<u>Ser</u>	<u>Propulsion</u>	<u>Lead Trial Unit</u>	<u>Assisting Trial Units</u>
(a)	Gas Turbines (COGAG)	GTTT (for GT and RG and its associated Control system)	(i) MTU (for shafting including torsionmeter, PBs, stern tube, shaft brake, shaft lock etc.) (ii) HITU (for Machinery Spaces Ventilation System) (iii) ETMA/ ETMU/ ETT (for motors/ electrical components of MPP auxiliaries, ventilation supply/ exhaust blower motors, etc.)
(b)	Diesel Engines	DTTT (for Main DEs and its associated Control system)	(i) MTU (for RG and shafting including torsionmeter, PBs, stern tube, shaft brake, shaft lock etc.) (ii) HITU (for Machinery Spaces Ventilation System) (iii) ETMA/ ETMU/ ETT (for motors/ electrical components of MPP auxiliaries, ventilation supply/ exhaust blower motors, etc.)

(c)	Steam Engines	MTU (for Main Engines, Shafting and all components of shafting and Control system)	(i) CBIU (for Boilers) (ii) HITU (for Machinery Spaces Ventilation System) (iii) MSETT (for Steam, LO System integrity checks, other system checks etc) (iv) ETMA/ ETMU/ ETT (for motors/ electrical components of MPP auxiliaries, ventilation supply/ exhaust blower motors, etc.)
(d)	CODOG	GTTT (for GT and RG and its associated Control system) DTTT (for Main DEs and its associated Control system)	(i) MTU (for shafting including torsionmeter, PBs, stern tube, shaft brake, shaft lock etc.) (ii) HITU (for Machinery Spaces Ventilation System) (iii) ETMA/ ETMU/ ETT (for motors/ electrical components of MPP auxiliaries, ventilation supply/ exhaust blower motors, etc.)

8. **Role and Responsibility of Lead and Assisting Trial Units.** The role and responsibilities of various units towards conduct of FPT are elaborated below: -

(a) **Lead Trial Unit.** Lead trial unit will function as the nodal point of contact for ship staff, Yard, Ops Authority, Admin Authority and IHQ MoD(N) for the conduct of FPT. The responsibility lies with the Lead trial unit to co-ordinate with the Assisting trial units for the conduct of FPT. A single Integrated FPT report is to be generated by the Lead trial unit in conjunction with the reports received from the Assisting trial units as per the guidelines laid down in DME Specification 513, clearly bringing out the mitigative actions, in case full power/ speed is not achieved by the ship.

(b) **Assisting Trial Units.** The Assisting trial units are to support the Lead trial unit in assessing the overall performance of the MPP aggregate as part of FPT. The Assisting trial units are to undertake their part of ship trials during the FPT and render suitable reports to the Lead trial unit towards making the Integrated FPT report.

9. In view of the above, following is requested to be undertaken for all ships presently undergoing NR/ MR and those scheduled to enter into NR/ MR hereafter: -

(a) FPT be undertaken by Trial units as part of PRT to benchmark the performance of MPP prior commencement of refit and as part of Post Refit Trials

to assess the performance of MPP on completion of all maintenance routines/ liquidation of defects.

(b) The trial units (Lead and Assisting Trial Units) undertaking Full Power Trials follow the protocols laid down in the DME Specification 513 and render reports accordingly.

(c) Lead trial unit to clearly bring out mitigation actions in case of sub-optimal performance of MPP and its auxiliaries, to ensure necessary corrective measures.

(d) During MPP shafting trials, the readings be recorded/ trended as per the revised trending SRPMs promulgated (Appendix 'B' of DME Specification 513 refers).

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