

## **A. Preamble**

OFB has undertaken a project of development of 155 mm- 39/45 cal Gun System with limited scooting abilities. The main systems of the gun are hydraulically operated which is powered by a prime mover mounted on the gun and complete system is controlled electrically. The basic features of the gun are propulsion, laying, loading of ammunition, firing and deployment of the gun as well as tandem driving by a towed vehicle.

## **B. Scope of work**

The scope of work of this RFP includes: development, manufacturing, supply and proving of Power Plant with reference to Part No 1155261. The PDF copies of (a) technical description (Annexure-A), (b) the complete parts catalogue (Annexure-B) and (c) Bill Of Material (BOM) (Annexure-C) of the existing power plant are included in the tender document to be used as a reference. Drawings supplied by the OEM, of existing Power plant are available with the Gun Carriage Factory, Jabalpur. On successful development and trials, orders for substantial number of Gun System are inline.

The weight of the complete Gun is 12.7 tonnes. The engine aggregate should be ergonomically and adequately accommodated in the available enclosed space and mounted on the existing mounting points with suitable bearers and buffers to with stand acceleration of 5g in all directions. The vendor should keep the space constraints in mind while offering the engine aggregates. The weight distribution inside the engine housing and CG of the complete power plant has to be the same as of existing Power plant in order to comply with operational requirements of the Gun system.

The power plant will drive two hydraulic axial piston pumps which in turn will supply the high pressure fluid to the hydraulic motors for driving the wheels, as well as for operating the loading and laying equipment of the gun. The power plant will also generate electric power, through an alternator, required for the operation of the electric & electronic devices in the gun and charging two 12V/80 AH cold start batteries in series. The air compressor, which is also included in scope of work, is to be mounted on the engine body. The compressor supplies compressed air for operating the wheel brakes.

The deliverable items should comprise of all the Assys/Subassys/components as per the complete parts catalogue and the BOM. The vendor has to cater for obsolescence with respect to assys / sub assys of existing Power Plant without degrading the functional requirement of the Gun System. A list of deliverables vis a vis existing complete parts catalogue will be provided by the vendor.

The vendors may contact the Project team of Gun Carriage Factory for further information, if any, required to submit their bid. The vendor can also make a visit to the GCF, with prior appointment, for getting exposure to the systems that are available with GCF Jabalpur, before submitting their bid.

**C. Technical parameters of the engine used in the existing Power Plant:**

S. No	Description	Engine specification
1	Make	Daimler-Benz
2	Model	OM 616 D 98
3	Type	4 cylinder in line, indirect injection, water cooled
4	Engine weight when fitted with equipment	190 kg
5	Power	50 kW @ 4400 RPM
6	Torque	135 N-m @ 2000-2400 RPM
7	Bore stroke (mm)	90.9 x 92.4
8	Compression ratio	21:1
9	Displacement (cc)	2399
10	Firing Order	1-3-4-2
11	Oil sump capacity	6.5 ltrs
12	FIP	In line FIP with 24 V stop solenoid
13	Fuel	Diesel
14	Rated RPM	4400
15	Electrical system	24 V
16	Starter	24 V

Technical parameters of the engine aggregate and associated system and accessories intended to be procured:

S.No.	Description	Engine specifications
1	Make	As per proposal of the vendor with dimensions and configuration suitable for fitting within the available space as per drawings of the power plant housing.
2	Model	
3	Type	Indirect/Direct injection, water cooled
4	Emission Compliance	BSIII CEV /BSIII
5	Engine dry weight when fitted with equipment	275 ± 10 kg less than 300 kg
6	Overall Height (Engine)	Within 767 to 770mm
7	Overall Width (Engine)	Within 630 mm
8	Overall Length (Engine)	Within 700 mm
9	Power	Minimum 80Hp @ 2200 to 4400 rpm as per applicable SAE Std. To be read in conjunction with regulated RPM of Pump system para E(v)
10	Torque(Max)	To produce torque input of value twice the torque input for Sauer Danfoss/Sauer4 Getriebe series 20 axial piston pump
11	Bore stroke (mm)	As per proposed model complete data sheet performance curves, installation drawings to be included in the bid with drawing no and revision no of the drawing(s) of the OEM of
12	Compression ratio	
13	Displacement (cc)	

14	Firing Order	the engine duly marked.
15	Oil sump capacity	
16	Fuel Injection System	(a) Mechanical: Rotary or inline type with 24 V stop solenoid. (b) Electronic injection: (i) Electronic control unit and its enclosure should be EMI/EMC compliant as per MIL Std and sustain 5g acceleration in all directions. (ii) All connectors to be of MIL Grade and enclosures complying IP 55 to 65 respectively and sustain 5g acceleration in all directions.
17	Fuel	Diesel
18	Rated RPM	2200-4400
19	Electrical System	24 V
20	Starter motor	24 V
21	Air intake system	For NA engine: Inlet manifold should be located on the same side of the exhaust. For TC: The turbocharger inlet should be on the right side of the engine when viewed from the fly wheel end.
22	Exhaust system	Exhaust silencer should be of length not more than 640 mm to be accommodated in the recess for the same in the Power Plant Housing (refer drawing) and tail pipe end should end towards the left right edge of the engine housing when viewed from the front.
23	Cold Start	Unaided: Upto -10°C Aided: Upto -20°C
24	Altitude capacity	Not more than 25% drop in power @ 4500 m above MSL (mean seal level)
25	Total Power Plant Wt.	To be kept within 1100 kg (Approx) +2%

**D. The Engine should be equipped with (as per technical spec. 0 806 983 Annexure 'D'):**

- 1) Air suction system
- 2) Injection pump with RSF regulator
- 3) Exhaust system
- 4) Lube Oil filter
- 5) Fuel filter
- 6) Fly wheel, clutch and clutch plates
- 7) Water pump with belt pulley wheel
- 8) Crank shaft belt pulley wheel
- 9) Thermostat housing
- 10) 24 Volt electrical system including start motor, glow plug, temp. gauge, oil pressure gauge

**E. Engine Requirements (as per technical spec. 0 806 983):**

Engine Requirements (DIN 70020 & API Service CD, CC) or higher specifications meeting military application requirement norms. Same is to be specified by vendor.

(i) General

1. The engine with equipment shall be so dimensioned as to withstand the acceleration of 5 g in all directions.
2. The engine shall be capable of a great number of starts including idling and lengthy stationery running and lengthy periods of non-use.
3. The engine shall withstand and fulfill the functional performance requirements when run containing a coolant consisting of 50% water and 50% glycol, alternatively water containing an anti rust additive.
4. The engine shall be marked with a number which is unique to each engine (engine number).

(ii) Fuel and oils: The engine fuel shall be diesel fuel.

(iii) Engine with equipment

1. Inclination angle: The engine shall be capable of running continually while inclined at a traverse angle of 30<sup>0</sup>, and 23<sup>0</sup> longitudinally, and a combination of these angles. It shall be of capable of running for short periods (5 minutes) inclined at an angle of 45<sup>0</sup> transversely and longitudinally (longitudinal= parallel with the crankshaft). When warm the engine shall be capable of being restarted at these angles.
2. Cold start: It shall be possible to start the engine without extra equipment (engine heater or similar) when the ambient air, coolant, oil, fuel, and battery acid all have a temperature of -20<sup>0</sup> C, the batteries being of cold start type. There shall be two 12 Volt batteries connected in series and having a capacity of 80 Ah, and they are expected to be half charged (75% of full charge).

It is expected at this stage the engine is not particularly inclined.

(iv) Environmental resistance

1. Performance in accordance with point (vii) below shall be fulfilled at ambient air temperatures ranging from -20<sup>0</sup> C to +50<sup>0</sup> C, high altitude (more than 10,000 feet above sea level) and a relative humidity from 20-100 %, where upon adjustments shall be made to allow for climatic conditions which deviate from those stated in DIN 70020.
2. The engine shall be capable of idling for at least 24 hours at an ambient air temperature of maximum +50<sup>0</sup> C and a coolant temperature in the radiator of maximum +100<sup>0</sup> C and thereafter fulfill requirements stated in this technical specification.

(v) RPM regulation: The engine shall be equipped with an electronic microprocessor based engine speed control system having a compact structure containing both the control unit and actuator unit in a single housing. The unit should be programmable inline (when installed on engine) in field condition with PC/Laptop based service tool. The following engine speed regulations are to be set:

- (a) **Model 1:** on an input from selector switch (tandem mode) run at the rated rpm at rated power to drive the pump input shaft 3850 rpm.
- (b) **Model 2:** On an input from selector switch (Firing Mode) run at a speed determined by the gear ratio of the Splitter G/Box to drive the axial piston pumps at 2767 rpm.
- (c) **Model 3:** Continuously regulated rpm from rated minimum **idle rpm** to maximum engine rpm on the input from a potentiometer of 5kΩ with linear resistance tolerance of 5% and stroke 11.17 mm.

In this context the engine functions and performance shall fulfill the requirements stated in point (vii) below.

(vi) Tightness: No leakage of oil, fuel and coolant is permitted from fixed seals. Lubricating oil consumption shall be a maximum of 1.5 g/kWh

(vii) Performance: When testing well warmed engines, excluding fan, in a normal workshop environment at a temperature of +20 C at the input filter and in general in accordance with that stated in principal document (2 026 875 Annexure 'E') the effect at max rpm shall be at least 60 kW± 5% (to cater for production tolerance).

#### **F. Special Terms and Conditions:**

1. The vendor should quote for the complete Power Plant; offer quoted for part items/ assemblies will be considered as incomplete and will be rejected summarily.
2. The vendor should manufacture/develop items as per the technical document provided by the GCF. For any deficiency in drawing provided by the GCF or if any data/Drawing is inadequate, the vendor has to take up the work of design/ preparation of drawing. For filling the gaps, vendor's representative may visit GCF to study the Power Plant available with GCF. GCF will provide all necessary support for the study of the system.
3. The detailed drawing of the engine housing is provided in the TE documents (Annex-'G') to enable the vendor to assess the space constraints.
4. QA Plan: the vendor has to submit his QA plan, incorporating the points complying with the standards and specifications mentioned in the tender document.
5. Test benches, gauges, fixtures and measuring instruments that are necessary for the development of the system at vendor's premises, have to be arranged by the vendor at no extra cost.

6. Training: the vendor should provide necessary training to GCF personnel for maintenance of the power plant.
7. Drawings and technical specification annexed with this document are not complete but indicative in nature for the assessment for the commercial aspect of the tender. Production/maintenance drawings will be supplied to successful vendor at the time of placement of the supply order.
8. Non-disclosure agreement: All the production drawings and technical details supplied by GCF to the vendor at this stage, and on later stages, as well as the drawings and technical details developed by the vendor during the process of realization of the system will be the property of the GCF. Transferring or sharing of the drawings and technical details to any one else is strictly prohibited. The drawings and technical details are to be returned back to GCF on the completion of the supply order.
9. Sustainability - The vendor should provide service support including spares for at least 20 years.
10. EMI EMC – The complete power plant should be compliant to Mil standard 461E.
11. Emission Norms - Should be as per norms prevalent in the country at the time of delivery (at least BS-III CEV/ BS-III).
12. Test Equipment- Test Equipment should be specified which are required for checking health of engine and its sub systems.
13. MTBF & MTTR – The firm must provide MTBF & MTTR for all modules.
14. The firm has to be associated till completion of successful trials of the weapon system.
15. The firm has to prepare complete technical documents, design documents, operating procedure, repair manual, list of SMTs & STEs, CES proposed to be issued with Power Plant, drawing and 3D models of the system developed and same is to be submitted to OFB/GCF in hard and soft copy as per Indent requirement.

**G. Acceptance criteria:**

1. At the vendor's premises: The complete engine along with its accessories will be proven by the vendor at the GCF premises, against all the technical and functional performance parameters as specified in this Tender Enquiry. The vendor should submit the parameters in his bid, which should be meeting the minimum requirements of this specification. The necessary load conditions to be simulated by the vendor at vendor premises for proving the engine.

Being a development project, the rep of GCF will be associated during the testing of these sub-systems. However, in case of foreign supplier, COC, Certificate of conformity from OEM will be required to be submitted. The vendor should submit the detailed

performance parameters of each of the sub-systems in his technical bid, which will become the criterion of acceptance after the bid is accepted. Bids without these details will be treated as incomplete and will be summarily rejected.

2. Functional and fitment trial at GCF: the complete power plant will be fitted on the gun available with GCF and its performance will be evaluated as per the specification 0 806 983.
3. Final acceptance/user trials: the final acceptance of the power plant will be after successful completion of the proof firing of the gun and the user trials. The vendor's rep will be associated until this stage, to ensure trouble free functioning of the power plant during this entire cycle of proving the gun. Tentative Trial methodology to be followed is enclosed as Annexure-'F'
4. For bought out items, the vendor will submit the test report/inspection reports of the OEM.

**H. compliance sheet (to be submitted along with the technical bid)**

CLAUSE NO.	DESCRIPTION	COMPLIANCE (YES/NO)	REMARKS
A.	Preamble		
B.	Scope of Work		
C.	Technical parameters of the engine used in the existing Power Plant	Specification being offered by the vendor	
C.1	Make		
C.2	Model		
C.3	Type		
C.4	Engine weight when fitted with equipment		
C.5	Power		
C.6	Torque		
C.7	Bore stroke (mm)		
C.8	Compression ratio		
C.9	Displacement (cc)		
C.10	Firing Order		
C.11	Oil sump capacity		
C.12	FIP		
C.13	Fuel		
C.14	Rated RPM		
C.15	Electrical system		
C.16	Starter		
D.	The Engine should be equipped with (as per technical spec. 0 806 983):	COMPLIANCE (YES/NO)	
D.1	Air suction system		
D.2	Injection pump with RSF regulator		
D.3	Exhaust system		
D.4	Lube Oil filter		
D.5	Fuel filter		

D.6	Fly wheel, clutch and clutch plates		
D.7	Water pump with belt pulley wheel		
D.8	Crank shaft belt pulley wheel		
D.9	Thermostat housing		
D.10	24 Volt electrical system including start motor, glow plug, temp. gauge, oil pressure gauge		
E. Engine Requirements (as per technical spec. 0 806 983):		COMPLIANCE (YES/NO)	
E. (i)	General		
E. (ii)	Fuel and oils		
E. (iii) Engine with equipment			
E. (iii). 1	Inclination angle		
E. (iii). 2	Cold start		
E. (iv) Environmental resistance			
E. (iv). 1	Performance		
E. (iv). 2	Idling		
E. (v)	RPM regulation		
E. (vi)	Tightness		
E. (vii)	Performance		
F. Special Terms and Conditions			
F.1	Quoted for complete power plant		
F.2	Technical documents		
F.3	Space constraints as per existing Drawing of Engine Housing		
F.4	QA Plan		
F.5	Arrangement of Test benches, gauges, fixtures and measuring instruments by the vendor		
F.6	Training		
F.7	Supply of drgs and doc.		
F.8	Non-disclosure agreement		
F.9	Sustainability		
F.10	EMI EMC Compliance		
F.11	Emission Norms		
F.12	Test Equipment		
F.13	MTBR & MTTR		
F.14	Association during trials		
F.15	Tech documents etc		
G. Acceptance criteria			
G.1	On engine test stand, at vendor's premises		
G.2	Functional and fitment trial at GCF		
G.3	Final acceptance after user trials		
G.4	Inspection reports of OEM		

**NOTE:**

(i) The vendor has to mention specific reasons in the remarks column for non compliance of any of the above clauses.