Encl to DSMAQ Note
MQ/3515/XLUUV dt 21 Oct 22

Statement of Case for AIP - Make I Category
Extra Large Unmanned Underwater Vehicle (XLUUV)

1.	**Description of Equipment/ System**
	(a) Extra Large Unmanned Underwater Vehicle (XLUUV) is an autonomous extra-large unmanned underwater vehicle designed to meet the demand for underwater domain awareness and payload delivery. The XLUUV is envisaged for Combat role and would be able to undertake additional roles such as Intelligence, Surveillance and Reconnaissance (ISR), Anti-Submarine Warfare (ASW) and Mine Warfare (MW). Therefore, the XLUUV should be considered as a force multiplier capable of taking on some of the roles of a submarine. The XLUUVs can undertake high risk missions in restricted and shallow waters, long duration missions of up to two months and pre-programmed missions. (b) The '*Integrated Unmanned Roadmap of IN*' envisages that *IN* should adopt a graduated approach for unmanned vehicle development, starting with smaller vehicles and progressing to larger and more complex designs. Further, DND (SDG) is preparing a concept design of XLUUV for Intelligence, Surveillance and Reconnaissance (ISR) role. (c) The extant proposal is for design and development of XLUUV for Combat role through Make I category *iaw* Chapter III of DAP- 20. (d) The XLUUV should be capable of autonomous operations for transit from harbour to open sea, mission planning, diving/ surfacing, adjusting buoyancy, obstacle avoidance, battery monitoring and recharging, operations (ISR, ASW and Mine Warfare) and return transit to harbour. The XLUUV should be capable of gathering/ recording acoustic, visual, electronic and IR data of targets for analysis. The XLUUV is envisaged to be a very versatile platform and can undertake different mission based on Payloads. Therefore XLUUVs are envisaged to have interchangeable/ modular payload section and incorporate a universal interface which would facilitate inclusion of new/ different payloads based on mission requirement. These payloads should be able to operate simultaneously without interference up to the maximum depth. The scope of work for the proposal involves the following:- (i) Design and development of prototype followed by production of XLUUVs. (ii) Training for operator and maintainer crew for operating the XLUUV and its associated Mission Planning and Control System. (iii) Detailed Documentation covering Mission Planning aspects and maintenance of XLUUV and its associated support equipment.

	(iv) Comprehensive Maintenance and Product Support Package including Manufacturers Recommended List of Spares {MRLS Onboard Spares (OBS) and Base & Depot (B&D)}.	
2.	**How is the requirement currently being met.**	
	Presently, there are no XLUUVs in service. Currently these missions are undertaken by submarines and XLUUVs are envisaged to augment the existing submarine force levels to meet the operational tasking.	
3.	**Dual Use Technology**	
	Yes, the XLUUV being a niche technology has potential for exploitation by other stakeholders/ agencies.	
4.	**Quantity Required.**	
	Design and development of one prototype (XLUUV) is planned as per the extant proposal. Post prototype development, it is planned to procure twelve (12) XLUUVs to meet the operational requirement. Prototype (based on acceptance criteria and tests): Design and development of One (01) XLUUV. Bulk: Post successful development of prototype, production of twelve (12) will be progressed with delivery timelines of two (02) XLUUV per year.	
5.	**Estimated Cost**	
	(a) For Development of Prototype	INR 4,21,60,00,000.00
	(b) Unit Cost for Bulk Qty	Details as mentioned below {Para 5(c)}.
	(c) Basis of Estimated Cost	The estimated cost has been derived from RFI response received from M/s tkMS, Germany in May 22, wherein the Firm has indicated a budgetary cost for 12 XLUUVs as 591.6 million € (excluding taxes) equivalent to INR 50,286,000,000.00 (Rupees Five thousand twenty eight crores and sixty lakhs only) @ 1€ = INR 85.00 resulting in a price per XLUUV of 49.3 million € equivalent to INR 4,216,000,000.00 (Rupees Four hundred twenty one crores and sixty lakhs only) @ 1€ = INR 85.00 (On price basis 12/2021).

6.	**Justification to progress the case under Make-I category.**
	(a) Full Operational Capability. The technology for XLUUV is available with only a few Nations and it being a niche and advanced technology no Nation would permit sharing of Full Operational Capability of the XLUUV. (b) Technological Risk. The design and construction of the XLUUVs is being attempted for the first time by the Indian Industry. The vehicles are unique with significant technical challenges in the areas of propulsion, power requirements, autonomous control, sensors etc which will require hand holding by OEMs already involved in the development of such vehicles. The XLUUV also involves a large extent of miniaturization of equipment, sensors and weapons. This is a technological challenge and has technical risks. Therefore, incentivizing the Indian Industry to take on this challenge is paramount. (c) Expertise. The Indian Private Industry especially shipyards have developed a certain level of expertise in submarine design and construction. This expertise, capacity and agility to harness technology is required to be utilised to enable timely completion of the project. (d) Early Developers. The Indian industry could take advantage of being 'Early birds' in the field of development of autonomous XLUUVs and capture a significant global market of XLUUV. This would prove to be economically advantageous to the industry and Nation. Further, the project would serve as a stepping stone for the future unmanned platforms as per the *IN* Integrated Unmanned Roadmap.
7.	**Expected lead time for prototype development.**
	The lead time for prototype development is 36 months based on RFI responses.
8.	**Requirement to indigenise the proposed equipment.**
	Not applicable as there are no XLUUVs in service presently.
9.	**Details of RFI/ Market Survey undertaken with date and responses therein.**
	(a) **RFI**. The AIP of VCNS for undertaking a technology scan in the global market through a RFI for the XLUUVs was accorded on 08 Nov 21. Post APSO approval on 11 Feb 22 and DNI clearance, RFI (Global) for XLUUVs for Indian Navy was issued to the following prospective Vendors on 25 Feb 22:- (i) M/s Boeing, USA. (ii) M/s MSubs Ltd, UK. (iii) M/s JSC ROE, Russia. (iv) M/s Naval Group, France. (v) M/s tkMS, Germany.

	(vi) M/s SAAB, Sweden. (vii) M/s IAI ELTA, Israel. (viii) M/s L & T, Mumbai. (ix) M/s MDL, Mumbai. (x) Hindustan Shipyard Ltd (HSL), Visakhapatnam. (xi) CSL, Kochi. (xii) M/s Tata Advanced Systems Ltd, Mumbai. (xiii) M/s Mahindra Defence Systems Ltd, Mumbai. (xiv) M/s Bharat Forge Ltd, Pune. (b) **RFI Responses**. RFI responses were received from the following Vendors:- (i) M/s MSubs Ltd, UK. (ii) M/s tkMS, Germany. (iii) M/s IAI ELTA, Israel. (iv) M/s L & T, Mumbai. (v) CSL, Kochi. (c) It has emerged from the RFI responses received from Vendors that the production of XLUUVs with envisaged roles is feasible. However, XLUUV being a niche technology the details/ technical parameters have not been shared by the Vendors.
10.	**Details of any collaboration envisaged with foreign partner.**
	NA.
11.	**Confirmation that the indigenisation is not being undertaken through DRDO/ PSU or IA/IAF.** **If indigenisation has been attempted previously then the bottlenecks that the present proposal aims to overcome.**
	The XLUUV is a new induction and hence the indigenization is not applicable to the extant proposal.
12.	**Details of technical specs of the equipment/ system.**
	The details of technical specifications are contained in the PSQRs for XLUUV placed at Appendix 'A' to SoC.
13.	**Details of operational requirements of the equipment/ Role of proposed item in overall operation strategy.**

	The XLUUV is planned for induction into the *IN* to meet the demand of underwater domain awareness and payload delivery. The XLUUV is meant for Combat role and would be able to undertake additional roles such as Intelligence, Surveillance and Reconnaissance (ISR), Anti-Submarine Warfare (ASW) and Mine Warfare (MW).The XLUUVs would be used to augment the existing submarine force levels considering the planned phasing out of conventional submarines over the next fifteen years.
14.	**List and venue of likely trials and environment tests/ type iaw MIL or other standards.**
	(a) Presently there is no existing prototype existing in the Indian market. Hence, the prototype system to be developed would be tested by the *IN iaw* the Trial Methodology (to be proposed by the vendor in consultation with the *IN* based on functional and operational requirements) at the user premises in Mumbai/ Visakhapatnam. The Acceptance Trials will be conducted based on the trial methodology. The vendor is to have the requisite infrastructure for design and development of prototype. The venue for trials will be decided mutually between the vendor and the *IN*. (b) The specifications/ equivalents as per latest version are to be adhered for MIL Grade components in the system *as applicable as per design*. COTS items are to be suitably ruggedised for use in underwater marine environment and IEC Standards or equivalents are to be indicated where MIL standards are not applicable. The detailed list of Standards and Specifications will be intimated to the vendor(s) at a suitable stage.
15.	**Any envisaged export potential of the equipment / system.**
	The XLUUVs are at various stages of development for various world navies. With the advent of technology XLUUVs are being developed to complement submarines in some of their roles. The navies world over are engaging their lead industries in order to harness this technology. Hence, the export potential of the system is likely.
16.	**New/ Critical technology expected to be developed within the country.**
	The XLUUV is a niche technology planned for induction into the *IN* for the first time. The new/ critical technologies to be developed/ customized for the XLUUV includes the following:- (a) Underwater Vehicle with integral sensors (fixed or modular configuration). (b) Command, Control and Communication System for the unmanned vehicle. (c) Control surfaces for launch/ recovery at a pier and/or lifting points for deployment using Vessel of Opportunity (VOO)/ Mother Ship. (d) Stowage and Support Systems – Customised ISO containers for transportation of XLUUV by land using suitable trailers and/or sea using a VOO.

	(e) Vessel Autonomy - Autonomous unmanned operations of the XLUUV. (f) Power Requirements - (i) Identification of suitable batteries and means of battery recharging (as laid down in the Draft PSQRs). (ii) Power distribution network and battery charging needs to be integrated and interfaced with the platform control. (g) Integration of Various Systems – System architecture and interfacing requirements. (h) Payloads – Identification of suitable payloads such as Navigation System, Sonar Suite, Periscope, ESM, Radar, Doppler Velocity Log (DVL), Communication System (including SATCOM) to meet the envisaged roles (as mentioned in draft PSQRs).
17.	**Draft Project Report/ Feasibility Report.**
	The Draft PSQRs for XLUUVs covering various aspects are placed at Appendix 'A'. The inputs pertaining to critical technology and infrastructure available/ required for the Project have been obtained from DRDO and are as follows:- (a) **Critical Technology Required**. The critical technologies related to XLUUV are synonymous with the development of a submarines, although, in this case the subsystem have to be compact, of lesser electrical power consumption and lesser capabilities in general. Moreover, the challenge lies in integrating these subsystems into the framework of autonomy designed for XLUUV. The critical technologies involved include the following:- (i) Propulsion System and Controls. (ii) Main Power Source. (iii) Embedded Systems such as Mission Computer System, secured storage systems and image processing systems. (iv) Navigation and Guidance – A Mission Planning algorithm is required for executing the guidance part, executing the deliberate and reactive path planning. (v) Power Distribution. (vi) Sensors namely Flank Array Sonar (FAS), Towed Array Sonar (TAS), Multi Beam Echo Sounder (MBES), Side Scan Sonar (SSS) and Collision Avoidance Sonar (CAS). (vii) Image Processing Systm (IPS) – provides a suite for AI based perception algorithms.

(viii) Communication Systems – The major technologies/ systems to meet the requirements are –

- Compact and Low Profile Antennas.
- Radome for underwater requirements.
- Spectral/ power efficient baseband communication techniques.
- Miniaturised and efficient RF technologies.
- Compact and efficient Power Amplifiers.

(ix) Data Security.

(x) Launch Computer System – A processor based embedded system to carryout mission planning, monitoring and post mission analysis.

(b) **Infrastructure Required/ Available with DRDO**. The following infrastructure available to support XLUUV development:-

(i) Hydrodynamic Test Facilities.

(ii) CFD Ecosystem.

(iii) Hydrodynamic design capabilities for hull form, propeller and control surfaces.

(iv) Design capabilities for sensors such as communication systems, Sonar Systems (FAS, TAS, Bow Sonar, MBES, CAS) Sub bottom profiler, Radar, ELINT.

(v) Expertise in developing control, guidance and navigation algorithms for unmanned underwater vehicles.

(vi) Expertise in developing embedded systems for unmanned underwater vehicles.

(vii) Expertise in electrical power distribution for fully electric vehicles.

(viii)Simulator models for UUVs.

(ix) Environmental Test Centres (partially available with DRDO)

(x) Expertise in acoustic communication system, acoustic recorder, acoustic transport beacon.

The following infrastructure is further required for the XLUUV development:-

(i) Structural design of XLUUV.

(ii) Integration bay with integration jigs and storage.

(iii) Handling systems and support systems.

(iv) Bench checks for subsystems and individual test panels.

	(v) Simulation hardware. (vi) Propeller- Shaft integration. (vii) CG measurement systems. (viii) Ballast tank for weight-buoyancy balancing and leak checks. (ix) Pressure test facility. (x) Battery charging/ discharging equipment. (xi) Environmental Test Centres (Industry). (c) **Infrastructure Required for Trials**. The details are as follows:- (i) Test ranges. (ii) Transportation and storage systems. (iii) Launch and Recovery systems. (iv) Launch Control Systems including mission planning computer and associated cable interface for pre-setting the vehicle, data analysis consoles, check-out systems. (v) Power supply systems.
18.	**List of probable vendors with justification.**
	The list of probable vendors is as follows:- (a) M/s L&T, Mumbai (b) CSL, Kochi. Both the vendors have responded to the RFI and expressed their interest in participation of the XLUUV project.
19.	**Approval and priority from APSO concerned for case to be fielded under Make I category.**
	APSO approval for the design and development of XLUUV under Make I has been accorded on **21 Oct 22**. Priority for the proposal is Immediate.
20.	**Details of nodal officer who shall execute the project through the Capital Route under MAKE I category from user / nodal Dte.**
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