INTEGRATED HEADQUARTERS OF MINISTRY OF DEFENCE(NAVY)
DIRECTORATE OF ARMAMENT PRODUCTION AND INDIGENISATION

INVITATION FOR EXPRESSION OF INTEREST(EOI)

INDIGENOUS DEVELOPMENT OF 'UNIVERSAL PROXIMITY AND DA FUZE FOR 76/62 GUN AMMUNITION (WITH ELECTRONICS ADAPTABLE TO 76MM TO 127MM AMMUNITION)'

Reference : **Defence Procurement Procedure 2016(DPP 16)**

Appendices:

Appendix 'A' : Indigenous Content aspect.

Appendix 'B' : IPR of Government.

Appendix 'C' : Association of Persons Agreement.

Appendix 'D' : Technical Capability Assessment Criteria.

Appendix 'E' : Information Performa

Appendix 'F' : Certificate

Appendix 'G' : Specification of Universal Fuze

Introduction

1. Indian Navy has been focusing on developing indigenous platforms, equipment and systems/sub-systems/components towards achieving enhanced self-reliance. This Expression of Interest (EoI) invites responses from eligible Indian Companies for indigenous development of 'Universal Proximity and DA fuze for 76/62 Gun Ammunition (with electronics adaptable to 76mm to 127mm ammunition)' here and after referred as Universal Fuze for Indian Navy. The present proposal for development of Universal Fuze under Make-II category is termed as 'Project Universal Fuze'. **Project Universal Fuze is designed to provide certain operational capabilities to the Navy.** The Ministry of Defence (MoD), Govt of India, shall own Project Universal Fuze. The information regarding the project will be shared strictly on 'Need to Know' basis. This prototype (Qty 130) development of Universal Fuze has been approved as 'Make-II' category project. Subsequent procurement will be under the '**Buy (Indian-IDDM)**' category. The project is reserved for MSMEs as stipulated in Para 7 of Chapter III-A of DPP 2016. In case no MSME responds, then the proposal of other firms will be considered for evaluation.

Objective

2. The objective of this EoI is to seek responses from eligible Indian industries and to shortlist potential companies. Responses to EoI will be evaluated as per the assessment criteria given in the EoI. Project shall be progressed ahead even if only one EoI respondent is found meeting eligibility criteria.

Layout

3. The EoI has been covered under the following parts:-

(a)	Part I	:	General Information
(b)	Part II	:	Technical Requirements
(c)	Part III	:	Critical Technology Areas
(d)	Part IV	:	Guidelines for formation of Association of Persons (AOP) i.e. consortium
(e)	Part V	:	Eligibility Criteria
(f)	Part VI	:	Assessment Parameters
(g)	Part VII	:	Evaluation Criteria of Assessment Parameters
(h)	Part VIII	:	Documents to be submitted by EOI Respondents
(j)	Part IX	:	Queries and Clarifications
(k)	Part X	:	Miscellaneous

PART I: GENERAL INFORMATION

4. The project, i.e. indigenous development of **'Universal Proximity and DA fuze for 76/62 Gun Ammunition (with electronics adaptable to 76mm to 127mm ammunition)'** has been approved under the 'Make-II' category for the prototype development (Qty 130) and for subsequent procurement under the 'Buy(Indian-IDDM)' category as per DPP 2016. Details of the stages involved in the development process are enumerated in Chapter III-A of DPP 2016. The progress of the project will be monitored by the Project Facilitation Team(PFT) of Indian Navy/MoD constituted for this purpose. PFT will act as interface between India Navy and Industry during the design and development stage of the project. ***No reimbursement of development cost is permissible under Make-II scheme***.

5. **Eligibility to Respond to an EoI as Individual Entity or as Consortium**. The EoI can be responded to, at the option of an EoI recipient, by any of the following entities:-

(a) Individual EoI Recipient; or

(b) **Association of Persons(AoP)** i.e., Consortium of Indian Companies consisting of two or more than two EoI recipients undertaking joint and several liability and an EoI Recipient designated as the lead member through a '***Association of Persons(AoP)Agreement***'. All EoI Recipients as the members of the AoP will sign the contract with MoD. This Agreement will be applicable for the entire project including but not limited to Production Phase and Lifecycle/Technology Refresh Contract placed by MoD, if any.

6. **Indigenous Content**. The product indigenously designed, developed and manufactured should have minimum of 60% Indigenous Content(IC) on cost basis of the total contract value; Or products having 60% IC on cost basis of the total contract value, which may not have been designed and developed indigenously. Apart from overall IC as detailed above, the same percentage of IC will also be required in (a) Basic Cost of Equipment; (b) Cost of Manufacturers' Recommended List of Spares(MRLS); and (c) Cost of Special Maintenance Tools(SMT) and Special Test Equipment(STE), taken together at all stages, including FET stage. For IC on cost basis, vendor should ensure compliance as detailed in **Appendix 'A'**.

7. **Intellectual Property Rights(IPRs)**. Intellectual Property Rights of Government in "Make" projects are placed at **Appendix 'B'**. Development Agency/Agencies(DA/DAs) shall retain title or ownership and all other rights in intellectual property generated during the development of project. However, the Government shall have March-in rights under which the Government can require the contractor to grant, or may itself grant license for, inter alia, the following reasons:-

(a) Where health and safety requirements so require the Government to act in public interest;

(b) For National Security Reasons;

(c) To meet requirements for public use not reasonably satisfied by the contractor;

(d) For failure of the contractor to substantially manufacture the products embodying the subject invention in India; or

(e) For failure of the contractor to comply with any of the requirements laid down under these guidelines.

8. **Foreign Collaboration**. If the DA(s) collaborate(s) with a foreign firm as a technology provider in a certain technology area for the project, the nature of such collaboration and the technology areas being transferred must be clearly stated in the response. The contribution of the Indian industry in acquiring, developing and indigenising including design critical technologies shall be one of the key criteria in assessment of various proposals.

9. No component or any sub system of Universal Fuze shall be subjected to any type of inspection or audit by any Foreign Govt or Agency without prior approval of MoD, Govt of India.

10. A trusted supply chain that will include the engineering support requirements would be established for all components of Universal Fuze. All documents related to the Universal Fuze project are liable to be audited by Indian Govt or its nominated agency.

11. Detailed information about blacklisting of the company/consortium partners and foreign technology partner by any Govt Agency in India/ any other country would be provided as part of the response. Companies currently blacklisted by any Indian Govt Agency are ineligible for participation. Any such information not disclosed but revealed at a later stage would render the Company/Consortium ineligible for further participation.

12. **Time frames and critical activities**. The important time frames and critical activities for the project Universal Fuze are as follows:-

Sr. No	Activity	Time in weeks from submission of EoI (T_0)
(a)	EoI Response Submission	T_0
(b)	EoI Response Evaluation	5
(c)	Issue of Project Sanction Order	2
(d)	Design & Development of prototype	72-96
(e)	Conversion of Preliminary Specifications to Specifications/ Solicitation of Commercial offer	4
(f)	User Trials & Staff Evaluation	8-26

13. **Milestones of the Project**.

(a) **Evaluation of EoI Responses**. EoI responses will be evaluated in accordance with assessment parameters and evaluation criteria given in Part VI & VII of the EoI. All the shortlisted companies will be called Development

Agencies(DAs). The project is presently reserved for MSME, however if no MSME responds, the responses from other industries will be evaluated. Project shall be progressed ahead even if only one EoI respondent is found meeting the eligibility criteria.

(b) **Project Sanction Order**. PFT will issue Project Sanction Order for the development of prototype with **Nil** financial implication for Indian Navy/MoD. In case of only single vendor having offered the developed prototype ready for user trials within timelines stipulated in the Project Sanction Order, not more than two time extensions will be accorded and thereafter the case is to be progressed as resultant Single Vendor Case(SVC).

(c) **Design and Development of Prototype**. PFT will act as the primary interface between the Indian Navy and the industry during the design and development stage under Make-II subcategory projects and facilitate the following:-

(i) Finalisation of trial methodology.

(ii) Provision of requisite professional inputs/documentation (if feasible/available with IN) to industry.

(iii) Providing clarifications related to functional or operational aspects of the store under development, as may be sought by the DAs from time to time, during the design and development of prototype.

(d) **Finalisation of Specification**. PFT will facilitate the finalisation of preliminary specification to final specification prior to commencement of user trials. The specification of the store would therefore be a part of the trial directives, and only the essential parameters as detailed in the specification will be tested.

(e) **Solicitation of Commercial offers**. A commercial Request for Proposal(RFP) for 'Buy(Indian-IDDM)' phase will be issued to all DAs for submission of their commercial offer prior to commencement of User trials. A User Trial Readiness Review (UTRR) will be conducted at all the firms premises which are ready with the prototype, by the Project Facilitation Team in order to establish completion of development of prototypes along with test certificates in lines of mandated specifications. This would include all destructive/ non destructive checks by the NABL/QA agencies on the prototype.

(f) **User Trials**. User trials would be carried out by Indian Navy/PFT to validate the performance of the store against the parameters/specifications approved after the development of prototype. Indian Navy will formulate the trial

directives and constitute the Trial Team. The trial directive will specify the fundamental points that need to be addressed for validating the 'essential' parameters. The validation of the support system and maintainability trials, integral to and complementing the trial programme of the defence equipment/upgrades/product/system should be held simultaneously, wherever feasible. A total number of 130 prototypes are envisaged for prototype development including user trials. Documents regarding no of prototypes used for certain development may be produced to the UTRR team. The user trials is envisaged to be undertaken at PXE, Balasore and will be informed prior trials. Safe to use certificate should be forwarded by the development agencies.

(g) **Staff Evaluation**. Based on the User trials, the Indian Navy would carry out a Staff Evaluation, which gives the compliance of the demonstrated performance of the store vis-à-vis the specification. On the acceptance of Staff Evaluation report, the specification shall form the basis for the 'Buy(Indian-IDDM)' category of acquisition. If the prototypes of only a single firm/individual clears the trials, the project will be progressed as resultant single vendor.

(h) **Award of Contract**. Commercial offers of only those DAs/vendors will be opened whose store has been short-listed consequent to Staff Evaluation and the L1 bidder would be determined based on the provisions of the Commercial RFP and awarded the contract for manufacture.

14. Once the prototype is successfully validated, Five Thousand (5000) such Universal Fuzes shall be procured by MoD, Govt of India under Buy(Indian-IDDM) category. Delivery of the Universal Fuze shall be in a phased manner.

15. Other successful DAs that have developed the prototype successfully but have not qualified as L1, would be issued a certificate by DDP indicating that product/system has been successfully trial evaluated.

16. **Multiple Technological Solutions**. Not Applicable.

PART II: TECHNICAL REQUIREMENTS

17. **Scope of the Project**. The scope of Project Universal Fuze includes:-

(a) Indigenous development of an effective and reliable proximity and DA fuze with electronics compatible to 76mm-127mm ammunition. The fuze is to be designed for use in operation against Sea Skimming missiles as well as in anti aircraft role against aerial targets. The fuze should operatie in two mode viz. Proximity and Direct action.

(b) **Major Components of the Store**. Major components of the proposed fuze which are required to be developed include:-

(i) Universal Electronics compatible for requirements of 76-127mm ammunition.

(ii) Fuze hardware.

(iii) Explosive Chain, Safety and Arming device, Activation sensor.

(iv) Sea Clutter rejection circuit.

(iv) Packaging as per specification.

18. **Essential Parameters**. The detailed specification of the Universal Fuze is placed at Annexure I. The essential parameters are summarised below:-

(a) **Limiting Dimensions**. The fuze should have the following parameters:-

(i)	Length	:	203.40mm(max)
(ii)	Outer Diameter	:	62.0mm
(iii)	Weight and CG	:	The overall weight and CG as that of existing 76/62 Fuze is to be maintained.
(iv)	Arming Data		
	(aa) Spin	:	Non-Arming: 1000 rpm Arming: 3000 rpm
	(bb) Inertial Pin	:	Non- Arming: 500g(min) Arming : 800g (min)
(v)	Muzzle Safety Distance	:	80m(min)

(b) **Functionality**. The fuze shall be designed to operate in any of the two modes viz Proximity and Direct Action on sensing the target:-

(i) **Proximity Mode**. The fuze shall function on proximity against fast moving high performance aerial targets and sea skimming missiles where the characteristics of the target are within the following envelope:-

(aa) Speed of the Target : up to 1.5Mach

(ab) Minimum Attack Height : > 5m above the peak of waves.

(ac) Minimum Target Dia. : 0.3m

(ad) Height of Function : 0.5m to 30m above the target.

(ae) Range of Functioning : 500m from muzzle to Max. Gun range.

(af) Self-Destruction : 27± 2 Sec

(ii) **Direct Action Mode**. The DA function shall always serve as a backup in case of proximity failure.

(aa) Range of Functioning : 100m from Muzzle to Max. Gun range

(ab) Conditions for Functioning : Between impact and 3m behind, if it hits a 2 mm steel or Aluminum plate, at a minimum distance of 100m from the muzzle, with an incidence angle of between 20° and 90°.

(c) **Main Components of Fuze**. The main components of the fuze could be broadly classified as:-

(i) **RF Head Antenna**. Fuze would comprise of RF antenna working on FMCW principle with characteristics of beam pattern such that the sensitivity at the front is zero and maximum at 30-50° wrt fore and aft axis. This is required to ensure the initiation in direct impact mode on collision course to the target and initiation in proximity mode only for other condition.

(ii) **RF Head**. It should comprise of electronics to generate the radiated signal and process the reflected echo to arrive at an optimum distance for detonation to warhead. The signal processor continuously is required to process the incoming target signal with respect to vibration and clutter to improve upon the Signal to Noise Ratio(SNR). Besides this the electronics should cater for Point Detonation(PD), Electronic Safety(460ms), Self-Destruction(SD).

(iii) **Point Detonation Activation Sensor**. It should comprise of Direct Action pin located in the center of RF head assembly. Upon

impact it should deform and cause an electrical switch to open, initiating the firing pulse to the electrical detonator.

(iv) **RF Shield and Nose Cone**. The electronics should be encased in RF shielded nose cone and encapsulated using polyurethane foam.

(v) **Battery Module with Firing Circuit**. A reserve type battery should be brought into action with setback and spin forces. Upon firing, the ampules must cut/break releasing the electrolyte into the cell stack generating a steady voltage. The desirable parameters of battery are as mentioned in the specification.

(vi) **Firing Circuit**. It should be an integral part of the battery module mounted on a PCB comprising of a voltage regulation circuit with stablised supply of 23 V and a firing circuit to generate the firing pulse for detonator either upon proximity, impact or after lapse of 27 ± 2 Sec.

(vii) **Sea Clutter Rejection Circuit**. The fuze is to be provided with a sea clutter rejection circuit to disregard the sea clutter in the proximity mode.

(viii) **Switching Circuit**. Feature for switching between different modes of operation (proximity and impact) is to be provided by way of paralyzing/inhibition circuit compatible with the existing weapon system.

(ix) **Fuze Body**. The fuze body is to be made of steel with plastic insulator and brass contact rings. The assembly is to be crimped together along with RF head assembly and the battery module and potted with epoxy resin.

(x) **Safety and Detonating Mechanism(SAD)**. SAD is the mechanical safety device which would ensure safety against inadvertent initiation during handling, transportation and storage. The firing pulse would be transmitted to the booster pellet only on satisfactory sensing of launch and alignment of explosive train.

(xi) **Activation of Initiating Chain**. The initiating chain comprising of initiating composition, intermediary/booster(CE Pellet) would be inline only on satisfactory sensing of launch by the SAD.

(xii) **Electronics**. The electronics of the fuze is to be compatible with 76-127mm ammunition.

(d) **Safety**. In-built safety should be incorporated in the mechanically/ logic of the electronic circuit to prevent arming of the Universal Fuze during storage, transportation, loading, ramming events. The Universal Fuze design should cater for physical barriers as well misalignment of the explosive chain. The built in safety features of fuze are to adhere to MIL STD 1316E.

(e) **Electromagnetic Environment**. Fuzes in their normal life cycle configurations, shall not inadvertently arm or function during or after exposure to electromagnetic radiation(EMR), electrostatic discharge(ESD), electromagnetic pulse(EMP) electromagnetic interference(EMI), lightening effects(LE) or power supply transients(PST). The fuzes shall not exhibit unsafe operation during and after exposure to the above environments. In the development phase, Certificate of Conformance from NABL/ QA agency is to be obtained for the above requirements and handed over during the UTRR at firms permises.

(f) **Life**. Shelf life of the Universal Fuze, governed by the explosive components, ***should not be less than 10 years***.

(g) **Environmental Conditions**. The fuzes would be stored in depots in their original packaging protected from humidity and with appropriate ventilation, until the moment they are ready to be used. The fuzes shall withstand the following combination of conditions without any adverse effects:-

(i) Storage Conditions : 23 ± 5 °C with humidity 20-60 %.

(ii) Operating Conditions: - 20°C to +55°C with humidity of 95%.

(h) **Design and Construction**. All binding drawings including dimensional drawings, schematics, weight and CG calculation, electronic/electrical drawings are to be provided. The material used shall comply with the specification mentioned in the drawing and shall be accepted/tested according to the specification. The workmanship should be meeting the requisite MIL standards.

(j) **Software Validation**. The updated version of software should be subjected to independent validation and verification. The following to be ensured:-

(i) For fuzing systems containing embedded microprocessor, controller or other computing device, the analysis shall include determination of the contribution of the software to the enabling of a safety feature. The software is to be tested and validated through DRDO(ARDE) or empaneled/authorised agencies to Level-II as per coding standard 'MISRA-C:2012'(for C language) or Embedded System Development Coding Reference Guide(ESCR) (for embedded systems).

(ii) Where the software is shown to directly control or remove one or more safety features, a detailed analysis and testing of the applicable software shall be performed to assure that no design weaknesses, credible software failures or credible hardware failures propagating through the software can result in compromise of the safety features.

(k) **Maintainability**. The fuze in its original packing and stored under specified conditions, shall not require any maintenance during the entire shelf life.

(l) **Interchangeability**. The fuze should be interchangeable between rounds.

(m) **Reliability**. The fuze should have 90% reliability at 90% confidence level. Certificate for the same is to be produced.

(n) **Qualification Tests(QTs), Electronic Stress Screening (ESS), En-Tests and Acceceptance Tests(ATs)**. The QTs and ATs of prototype fuzes should be carried out in accordance with the methodology outlined below:-

(i) **Qualification Tests (75=5+50+20)**. The qualification tests of fuze will be carried out as per the schedule given below:-

Card Level Screening of PCB (05 Nos).		
Ser	**Test**	**Details**
(i)	High Temp. Storage Test (Test No 22, JSS 50101)	Temp 65±3°C for 16 hrs with RH≤50%
(ii)	Thermal Shock Test ((Test No 20, JSS 50101)	(i) +55±3°C for 30min (ii) -20±3°C for 30min (iii) Transfer time 2min (iv) Duration 30 min. (v) No of cycles: 10
(iii)	Burn-in Test	(i) PCB shall be placed in a chamber at temp +55°C with tolerance of 5°C. (ii) PCB shall be maintained at this temp. Continuously for 48 hrs in power ON condition. (iii) PCBs shall be checked immediately after removing from the chamber.

(ii) **Electronic Stress Screening (ESS).** ESS to be undertaken on all the Fuzes as per the following:-

Ser	**Test**	**Specification**	**Remarks**
1.	Random Vibration	(i) 20-80 Hz, +3db/octave 6grms (ii) 80 -350 Hz, 0.04g²/Hz (iii) 350 -2000 Hz -3 db /octave 6.06 grms (iv) Duration 5min/axis in all the three axes	1. Module under test to be powered and monitored during random vibration and at the temperature extremes.
2.	Temperature Cycling	(i) -30°C to +70 °C T/min = 10 °C, dwell = 60 min (ii) No. of Cycles = 6	

Ser	Test	Specification	Remarks
3.	Random Vibration	(i) 20-80 Hz, +3 db /octave 6 grms (ii) 80 -350 Hz, 0.04 g^2/Hz; (iii) 350 -2000 Hz -3 db /octave 6.06 grms (iii) Duration 5min/axis in all the three axes	2. Functional testing to be done after EN tests

(iii) **En Tests on Assembled Fuze(50)**. Post satisfactory card level screening, 50 fuzes are to be integrated and subjected to the following tests:-

Ser	Environmental Tests	Qty	Acceptance Criteria
(i)	High Temperature (Test 1P of JSG 0102) (+55°C for 48h)	5	SAT Static Firing
(ii)	Low Temperature (As per Ch 3-04 of Def Std 00-35, Part 3/3) (-10°C for 16 hrs)	5	
(iii)	Impact Safety Drop (Test 21U of JSG 0102) (Drop from height of 12m)	5	Should not function/ detonate
(iv)	Impact Vertical (Test 14P) as per JSG 0102 (Drop from 1.5m)	5	
(iv)	Jolt Test (MIL 331 C Test A1)	5	
(v)	Combined Temperature Humidity Cycle followed by Vibration **Temp-Humidity Cycle**. (As per 507.4 of MIL-STD-810F(05 cycles) **Vibration**. As per Test 20P of JSG 0102	5	SAT Static Firing
(vi)	Salt Mist (Test 10U of JSG 0102)	5	SAT
(vii)	Sealing (Test 13U(c) of JSG 0102)	5	SAT
(viii)	ISAT A (Test 4P of JSG 0102)	5	SAT Static Firing
(ix)	Acceleration (Test 22U JSG 0102)	5	Should not detonate
	Total	**50**	

(iv) **Electro Mechanical (EM) Environmental Tests(20).**

Ser	Details of Tests	Qty	Acceptance Criteria
(i)	EMI/EMC Tests: (MIL-STD-461G) CS101: Power Leads 30 Hz to 150 kHz CS114 : Bulk cable injection, 10 kHz to 200 MHz CS116: Damped sinusoidal transients, cables and power leads, 10 kHz to 100 MHz RS103: Radiated emissions, antenna spurious and harmonic outputs, 10 kHz to 40 GHz	5	SAT Functional Tests
(ii)	EMP as per MIL-STD 461G or DOD-STD-2169	5	
(iii)	ESD as per MIL-STD 331	5	
(iv)	HERO as per MIL STD 464A	5	
	Total	20	

(v) **Acceptance Testing of Fuze (60)**. The lots shall comprise of 5000 nos. The following acceptance tests are to be undertaken on each lot as per MIL-STD-105E, General Inspection Level II, Sampling Plan for Normal Inspection:-

Ser	Type of Tests	Quantity	Description
(a)	Visual and dimensional Inspection	100%	All the fuzes used for dynamic testing shall be inspected both visually and with X Rays.
(b)	**Dynamic Tests**		
	Fuzes shall be assembled to 76mm rounds HE/ Flash Rounds and conditioned at 21±3 °C for a minimum of 8 hrs.		
	(i) Muzzle Safety (Flash Filled)	10	A 6mm Aluminum plate shall be used as a target and shall be placed 60 m from muzzle. The fuze should not function before, on or up to 5m after the target.
	(ii) Impact (Flash Filled) in paralyzed mode	10	A 2 mm steel plate shall be used for the target and shall be placed at 100 m from the muzzle. Fuzes shall be tested at incidence angles of 20° and 90° respectively. The fuze shall detonate on or within 3m from the target plate.
	(iii) Surface Proximity (HE)	10	Fire rounds at an elevation giving impact angles of 30° and 50°. Fuze should detonate between 0.5m and 30m above the surface.

Ser	Type of Tests	Quantity	Description
	(iv) Self Destruct	10	Fire all rounds at an elevation giving a flight time of more than 35 seconds. All fuzes should detonate at 27 ± 2 Sec.
(c)	Conditioning : 8 @ +50± 3°,4 @ +21± 3°, 8 @ -20± 3°		
	Proximity Destruct (with Flash Filled)	20	A target shall be mounted 5 m above sea level at a distance between 700m and 2000m from the gun. The fuze should function in the prescribed zone.

(p) **Testing**. All the above, lab testing by the DA is to be undertaken by a NABL accredited lab/ Govt lab. DA is to forward draft test protocols of all tests for approval to ensure validation of essential parameters of specification. The DA would be required to provide Quality Assurance Plan(QAP), if necessary. DGNAI or his designated QA agency reserves the right to modify the QAP, if necessary. The Universal fuzes supplied by vendor would be accepted subject to inspection clearance by DGNAI or his representative. The DA would be required to provide all test facilities at his premises or premises of sub-vendor for acceptance inspection by DGNAI and also train their team.

(q) **Battery Type Approval**. As a part of the type approval tests, characterization of battery including discharge tests is to be undertaken and all related tests certificates are to be submitted to IHQ MOD(N)/DGNAI. A primary battery of reserve type is to be used for enhanced safety and longer shelf life.

(r) **Standards for Testing/ Qualification of Fuze**. The following standards are applicable for design, qualification and evaluation of the fuze:-

(i) **MIL-STD-331D**. Fuze and Fuze Components: Environmental and Performance Tests.

(ii) **MIL-STD-461G**. Requirements for control of Electromagnetic Interference: Characteristics of subsystems and equipment (EMI/EMC).

(iii) **DOD-STD-2169**. High Altitude Elecro Magnetic Pulse(HEMP)

(iv) **MIL-STD-1316E**. Design Criteria: Fuze Design Safety

(v) **MIL-HDBK-344A**. ESS for Electronic Equipment

(vi) **MIL-STD 464A**. Electromagnetic Environment Effects

(vii) **JSG 0102**. Environmental Test of Armament Store.

(viii) **JSS 55555 and JSS 50101**. En Tests of Electronic Equipment.

(ix) **MIL-STD-105E**. Sampling procedures and tables for inspection by attributes.

(s) **Documentation**. The documentation to be provided must include Technical Description, Maintenance and Operational Manual any other document felt necessary. All requisite documentation are to be forwarded prior offering the prototype for User Trials Readiness Review.

(t) **Explosive License**. The DA must have valid Explosive licence issued by the Government of India.

(u) **Certification**. Sub component certification to MIL std, CE/CS, JSS/JSG etc is considered acceptable with corresponding test certificates.

(v) **Packing and Marking**. The body of the fuze are to be marked with product reference number, lot number, manufacturer's code and last two digits of the year. The fuzes are to be packed in a metal airtight box. Each box should house 8 fuzes. Desiccant bag to absorb moisture and dampeners to hold the fuzes in place and reduce the vibrations are to be used. The following markings are to be made on the box:-

(i) No of Fuzes.

(ii) Type of Ammunition.

(iii) Serial Lot Number, Manufacturer Code and Year of Manufacture.

(iv) Explosive Hazard Classification.

(v) Package Number, Gross/Net Weight and Volume.

PART III: CRITICAL TECHNOLOGY AREAS

19. The capability assessment of the DAs will largely depend on their ability to design and develop critical sub-components like RF Head Antenna, Point Detonation Activation Sensor, Electronic Circuit, Safety and Arming Device, Sea Clutter Rejection Circuit, Explosive chain and the Hardware. It is imperative that the project attains complete independence in providing Indian Navy with a fuze with high reliability, safety and assured shelf life of 10 years. **The contribution of the Indian industry in acquiring and developing technologies in critical areas, if any, shall be a key criterion in assessment of the proposal**.

20. The assessment of critical technologies for the Project Universal Fuze offered by the DA(s)/Consortium must be supported with all Rights and Licenses(IPR) as mentioned at **Appendix 'B'**.

PART IV: GUIDELINES FOR FORMATION OF ASSOCIATION OF PERSONS(AOP) OR CONSORTIUM

21. Where an AoP/Group of EoI recipients("Consortium") comes together to implement the project in accordance with the mechanisms outlined under Para 5(b) above, there must exist, at the time of responding to EoI, an '***Association of Persons(AoP) Agreement***' to form an AoP i.e. Consortium to execute and implement the complete 'Make' project.

22. Where the EoI Respondent is an AoP/Consortium, it shall, while responding to the EoI, comply with the following additional requirements:-

(a) Number of members in a Consortium shall not exceed 05(five).

(b) The EoI Response should contain requisite information for each member of the AoP/Consortium.

(c) Members of the AoP/Consortium shall nominate one member as the Lead Member(the 'Lead Member').

(d) The EoI Response should include a description of the roles and responsibilities of individual members, particularly with reference to production arrangements in India and R&D activities for which IPRs will vest with MoD as per **Appendix 'B'**.

(e) An individual EoI respondent cannot at the same time be member of an AoP/Consortium responding to the EoI. Further, a member of a particular responding AoP/Consortium cannot be member of any other Consortium responding to the EoI.

(f) Members of the AoP/Consortium shall enter into a legally binding Agreement, substantially in the form specified at **Appendix 'C'** for the purpose of responding to the EoI. The Agreement to be submitted along with the EoI Response, shall, *inter alia:*

(i) Form the basis for the AoP members to enter into a contract and perform all the obligations of the DA in terms of the contract, in case a development contract to undertake the 'Make' Project is awarded to the Consortium;

(ii) Clearly outline the proposed roles and responsibilities, if any, of each member;

(iii) Include a statement to the effect that members of the AoP/Consortium shall be liable jointly and severally for all obligations of the DA in relation to the 'Make' Project as required under these Guidelines.

Change in Membership of a Consortium

23. Change in the composition of an AoP/Consortium will not be permitted after the submission of EoI responses until the award of a Development Contract for Prototype Development.

24. Where the EoI Respondent is an AoP/Consortium, change in the composition of a Consortium AoP may be permitted by the Authority after the award of a development contract only where:-

(a) The Lead Member continues to be the Lead Member of the AoP/Consortium and shall not be changed under any circumstances;

(b) The non-lead substitute member(s) shall continue to meet eligibility criteria for membership of an AoP/ Consortium;

(c) The new Member(s) expressly adopt(s) the EoI Response and the Development Contract already made on behalf of the AoP/Consortium as if it/they were a party to it originally and is/are not a Member of any other Consortium short-listed for the 'Make' Project, while undertaking the joint and several or joint liabilities(as applicable) of the member it/they are replacing.

25. Any change in the composition of an AoP/Consortium shall require prior approval of MoD/ DDP.

26. The approval to such changes shall be at the sole discretion of MoD/ DDP and must be approved by them in writing for the approval to take effect.

27. The modified AoP/Consortium/Partners shall submit a revised 'Association of Persons Agreement'.

Miscellaneous Provisions

28. Any violation of any of the guidelines by any company shall render it liable to initiation of proceedings for suspension and/or banning of business dealings as per the Guidelines for Putting on Hold, Suspension, Debarment and any other penal action on the Entities dealing with the Ministry of Defence, as promulgated by Government from time to time, will be applicable on procurement process and bidders.

PART V: ELIGIBILITY CRITERIA

29. **Reservation for MSMEs**. The Project Universal Fuze is earmarked for MSMEs. In case no MSME expresses interest, MoD may open the project for other participants in accordance with Para 7 of chapter III-A of DPP 2016.

30. Indian entity satisfying all of the following criteria shall be considered as eligible 'Indian Vendor' for issue of EoI by PFT:-

(a) Public limited company, private limited company, partnership firms, limited liability partnership, one Person Company, sole proprietorship

registered as per applicable Indian laws. In addition, such entity shall also possess or be in the process of acquiring a license as per DIPP's licensing policy.

(b) The entity has to be owned and controlled by resident Indian citizens; entity with excess of 49% foreign investment will not be eligible to take part in 'Make' category of acquisition.

31. Start-ups recognised by the DIPP are eligible for the project. Start-ups registered under the following categories and industry domains are eligible:-

(a) Categories.

(i) Engineering

(ii) Manufacturing

(iii) Research

(iv) Government

(b) Industry Domains.

(i) Aeronautics/Aerospace & Defence

(ii) Technology Hardware

32. This EoI is being published on MoD/DDP website inviting Companies to participate in the 'Make-II' project and also issued to the potential vendors who have indicated willingness during the Feasibility Study to participate in the development of Electronic Fuze.

33. **Vendors are required to be compliant to Chapter III-A of DPP 2016 published in www.makeinindia.gov.in**

PART VI: ASSESSMENT PARAMETERS

34. The assessment of the EoI responses would be based on the Evaluation Criteria, which are elaborated in the succeeding paragraph.

35. **Technical Capability Criteria**. The Project Universal Fuze is a store which will require sound knowledge of hardware technology, explosive characteristics and

qualification methodologies. The DA(s) should have a good understanding of Project Management, required for the development of Universal Fuze. The contribution of the DA in acquiring and developing technologies in critical areas shall be an important criterion in assessment of the proposal. The respondents to this EoI(including start-ups) are required to furnish information about their technical capabilities as per **Appendix 'D'**.

PART VII: EVALUATION CRITERIA OF ASSESSMENT PARAMETERS

36. **Evaluation Criteria for All Entities Other Than 'Start-Ups'**. The responses to this EoI will be evaluated based on the assessment parameters given at **Appendix 'D'** to identify Companies/Consortia with proven Commercial, R&D, Indigenisation and Technical strengths and capabilities. The weightage for each of the criteria and sub-criteria at **Appendix 'D'** would be finalised by the Project Facilitation Team.

37. **MoD, Govt of India reserves the right to modify these criteria at any time before the responses are opened for evaluation**. MoD, Govt of India also reserves the right to disqualify a respondent/consortium if he/they fail to comply with specific criteria at any stage of the evaluation process by the PFT. **No amendment/ change in response to EoI will be accepted under any circumstances once the EoI response is submitted**.

Note 1. **Details regarding proposed expenditure/establishment of facilities/lab etc. are liable to be included in the contract in case the Company/ Consortium gets shortlisted for development of Universal Fuze.**

Note 2. **Company/Consortium giving False/Misleading information will be barred from participation in the project Universal Fuze.**

PART VIII: DOCUMENTS TO BE SUBMITTED BY EoI RESPONDENTS

38. Following documents are required to be submitted by EoI respondents:-

(a) Annexure I of Appendix 'A'.

(b) Appendix 'C', if applicable

(c) Appendix 'D' (Technical Criteria).

(d) Information Performa as per Appendix 'E'.

(e) Certificate as per Appendix 'F'.

(f) Documents in proof of Evaluation Criteria(i.e. Technical capability)

(g) MSME certificate, if claiming to be MSME. Start-ups are to submit their certificate in specified domain registered with DPITT.

39. The EoI respondents shall submit three(03) copies of response to EoI, clearly marking one copy as 'Original Copy' and the remaining two as 'Copy No 2 & 3'. The respondents are also required to submit a soft copy of the response to EoI in a CD/ DVD. In the event of any discrepancy between the content in copies of documents submitted, the contents in the 'Original Copy' shall govern/prevail. Each page of the response will bear the signatures of the authorised signatory of the Company/Lead Member in a Consortium.

40. **Guidelines for Submitting EoI Responses**.

(a) The responses should be submitted strictly as per the formats given in respective appendices. Should a Vendor/Consortium need to mention any other information, a separate column may be added as the last column only.

(b) All response appendices should be submitted in a single file/folder. Supporting documents/additional reference should be submitted in a separate folder with proper reference mentioned against each parameters/sub parameters/sub sub parameters in respective appendices.

(a) Any supporting document/evidence without any reference to specific parameter of criteria will not form part of the assessment.

41. The envelopes shall be addresses as under:-

Chairman, PFT
Project Universal Fuze
Directorate of Armament Production & Indigenisation
IHQ MoD (Navy)
West Block-V(FF), Wing-5
RK Puram, New Delhi 110 066
Email : dapi.ihq@navy.gov.in Ph: 011-26712719

42. The response to this EoI must be submitted by 1530 hrs on 28 Sep 20 at the address mentioned above.

43. A Company/Consortium can submit only one response to this EoI. If a Company submits more than one response, then all responses of the Company will be rejected and the Company/Consortium, to which the Company belongs, would not be assessed further.

44. MoD, Govt of India at its discretion can extend this deadline for the submission of responses to EoI and the same shall be notified in writing.

PART IX: QUERIES AND CLARIFICATIONS

45. Following aspects will govern the procedure for queries and clarifications:-

(a) **Companies/Consortium may submit written queries/clarification/ amplifications on specific issues by 30 Aug 20**. Consolidation and examination of the queries received will be carried out by the PFT and clarification will be given to all the industries during the pre-response meeting.

(b) **Pre-Response Meeting**. A pre-response meeting is scheduled on 02 Sep 20 at 1430 hrs at Directorate of Armament Production & Indigenisation, West Block-V(FF), Wing-5, RK Puram, New Delhi 110 066 to clarify the issues/queries raised to facilitate submission of response.

(c) If deemed necessary, a written reply may be given to all respondents after the meeting.

PART X: MISCELLANEOUS

46. This EoI is being invited with ***no financial commitment*** on part of the Govt. of India/ MoD. Govt of India reserves the right to withdraw or change or vary any part thereof at any stage. MoD, Govt of India also reserves the right to disqualify any company should it be so necessary at any stage on grounds of national security.

47. Respondent/consortium would be disqualified if they make false, incorrect, or misleading claims in their response to this EoI. A certificate as per the format at **Appendix 'F'** would be furnished as part of the response, including respective consortium partners, where applicable.

Note. The above guidelines are to be read in conjunction with the guidelines under Chapter III-A of DPP 2016.

(M Phani Sushanth)
Lieutenant Commander
Secretary, PFT
Project Universal Fuze
for Chairman
17 Aug 20

Enclosure:- Appendices 'A' to 'G'

Distribution: - Shortlisted vendors & hosted on MoD/DDP website

A

SPECIFICATION FOR UNIVERSAL PROXIMITY AND DA FUZE FOR 76/62 GUN AMMUNITION (WITH ELECTRONICS ADAPTABLE TO 76 MM TO 127 MM AMMUNITION)

1. **Introduction**. The specification enumerates requirements of Universal Proximity and DA Fuze (with electronics adaptable to 76 mm to 127 mm ammunition) performance, design, testing, manufacture and acceptance with Direct Impact functions for 76/62 Gun Ammunition.

2. **Design Features of the Fuze**. The fuze is to be designed for use in operation against sea skimming missiles as well as in an anti-aircraft role against aerial targets. The fuze is required to operate in two modes viz. Proximity and Direct Action. It should also be effective against surface targets or shore bombardment. The fuze is required to operate in the Ultra High Frequency (UHF) range. The antenna is to be optimised for maximum sensitivity in the required burst area when engaging small targets. Novel frequency modulation techniques are to be employed to enable the fuze to engage missiles skimming the sea surface heights of only a few meters, by reducing the unwanted sea clutter signal in conjunction with an optimised clutter rejection circuit.

3. **Universal Electronics**. The electronics of the fuze should be 'universal' which can be adapted to the specific requirements of 76 to 127 mm ammunition.

4. **Salient Features of the Gun/Ammunition**. The salient features of the 76/62 gun and ammunition are as follows:-

Gun

(a)	Calibre/Length	:	76 mm / 4710 mm
(b)	Range	:	Max 15900 m (Extended: 20000m)
(c)	Rate of Fire	:	120 rpm
(d)	Muzzle Velocity	:	905 m/s (Residual: 307m/s)
(e)	Spin	:	24100 rpm
(f)	Recoil Max	:	230 mm
(g)	Force	:	10000 kgf
(h)	Elevation	:	85 ° (Max), -15 °(Min)

(a) Mass : 930 ± 15 gms

(b) Ballistic Levels

(i) Velocity : 905 m/s

(ii) Max Spin Rate : 25000 g

(iii) Max Axial Acceleration : 30000 g (Setback)

(iv) Max Radial Acceleration : 811000 rad/s^2

(c) Arming Data

(i) Spin : Non-Arming : 1000 rpm; Arming : 3000 rpm

(ii) Inertial Pin : Non- Arming : 500g(min) ; Arming : 800g (min)

(d) Muzzle Safety Distance : 80m (min)

(e) Dimensions :

(i) Length : 203 mm (max)

(ii) OD : 62.0 mm

The dimensional sketch of the fuze is placed at **Appendix 'A'**.

5. **Modes of Operation**. The fuze shall be designed to operate in any of the two modes viz Proximity and Direct Action on sensing the target:-

(a) **Proximity Mode**. The fuze shall function on proximity against fast moving high performance aerial targets and sea skimming missiles where the characteristics of the target are within the following envelope:-

(i) Speed of the Target : up to 1.5 Mach

(ii) Minimum Attack Height : > 5m above the peak of waves.

(iii) Minimum Target Dia. : 0.3m

(iv) Height of Function

(aa) Surface Targets : 0.5 m to 30 m above the target.
(ab) Aerial Targets : 5 m around the target.

(v) Range of Functioning : 500m from muzzle to Max. Gun range.

(vi) Self-Destruction : 27± 2 Sec

(b) **Direct Action(DA) Mode**. DA function shall always serve as a backup in case of proximity failure. The following are the functional parameters:-

(i) Range of Functioning : 100m from Muzzle to Max. Gun range.

(ii) Conditions for Functioning : Between impact and 3m behind, if it hits a 2 mm steel or Aluminum plate, at a minimum distance of 100m from the muzzle, with an incidence angle of between 20° and 90°.

6. **Environmental Conditions**. The fuzes would be stored in depots in their original packaging protected from humidity and with appropriate ventilation, until the moment they are ready to be used. The fuzes shall withstand the following combination of conditions without any adverse effects:-

(a) Storage Conditions : 23± 5 °C with humidity 20-60 %

(b) Operating Conditions: - 20°C to +55°C with humidity of 95%

7. **Design and Construction**. The material used shall comply with the specification mentioned in the drawing and shall be accepted/tested according to the specifications. The workmanship should be meeting the requisite standards.

8. **Main Components of Fuze**. The main components of the fuze could be broadly classified as:-

(a) **RF Head Antenna**. Fuze would comprise of RF antenna working on FMCW principle with characteristics of beam pattern such that the sensitivity at the front is zero and maximum at 30-50° wrt fore and aft axis. This is required to ensure the initiation in direct impact mode on collision course to the target and initiation in proximity mode only for other condition.

(b) **RF Head**. It should comprise of electronics to generate the radiated signal and process the reflected echo to arrive at an optimum distance for detonation to warhead. The signal processor continuously is required to process the incoming target signal with respect to vibration and clutter to improve upon the Signal to Noise Ratio(SNR). Besides this the electronics should cater for Point Detonation(PD), Electronic Safety(460ms), Self-Destruction(SD) are to be embedded into the circuit.

(c) **Point Detonation Activation Sensor**. It should comprise of Direct Action pin located in the center of RF head assembly. Upon impact it should deform and

cause an electrical switch to open, initiating the firing pulse to the electrical detonator.

(d) **RF Shield and Nose Cone**. The electronics should be encased in RF shield and plastic nose cone and encapsulated using polyurethane foam.

(e) **Battery Module with Firing Circuit**. A reserve type battery should be brought into action with setback and spin forces. Upon firing, the ampules must cut/break releasing the electrolyte into the cell stack generating a steady voltage.

(i) Operating Parameters:

(aa) Setback : 1200g-28000g

(ab) Spin : 2700 – 28000 rpm

(ac) Temperature : -46 °C to 63°C

(ii) Insulation Resistance: 200MΩ measured between 200 V DC

(iii) Shelf Life : 15 Years

(iv) Activation Time : 100- 450ms at 18-25V over the operating temperature range

(v) Load resistance : 1000Ω discharge for 150 Sec.

(vi) Safety Feature : Encapsulated in a plastic mould using polyurethane foam and epoxy resin. As a safety feature, the battery must initiate only after the round has crossed the safety distance after firing.

(f) **Firing Circuit**. It should be an integral part of the battery module mounted on a PCB comprising of a voltage regulation circuit and a firing circuit to generate the firing pulse for detonator either upon proximity, impact or after lapse of 27 ± 2 Sec.

(g) **Fuze Body**. The fuze body is to be made of steel with plastic insulator and brass contact rings fitted. The assembly is to be crimped together along with RF head assembly and the battery module and potted with epoxy resin.

(h) **Safety and Detonating Mechanism(SAD)**. SAD is the mechanical safety device which would ensure safety against inadvertent initiation during handling, transportation and storage. The firing pulse would be transmitted to the booster pellet only on satisfactory sensing of launch and alignment of explosive train.

(j) **Activation of Initiating Chain**. The initiating chain comprising of initiating composition, intermediary/booster(CE Pellet) would be inline only on satisfactory sensing of launch by the SAD.

9. **Electromagnetic Environment**. Fuzes in their normal life cycle configurations, shall not inadvertently arm or function during or after exposure to: electromagnetic radiation(EMR), electrostatic discharge(ESD), electromagnetic pulse(EMP) electromagnetic interference(EMI), lightening effects(LE) or power supply transients(PST). The fuzes shall not exhibit unsafe operation during and after exposure to the above environments.

10. **Safety**. The fuze should be safe during storage, handling, transportation as well as during loading/ramming/firing events. Towards this the following safety mechanisms are to be incorporated:-

(a) **Mechanical Safety**. A mechanical Safety and Arming Device (SAD) is required to be housed inside the fuze with out-of-line explosives to ensure safety during launch subject to sensing of actual environment (setback, spin and arming distance).

(b) **Electronic Safety**. Proximity functioning of the fuze shall be inhibited for a minimum of 350ms after battery arming.

The Built in Safety Features of Fuze enumerated in MIL STD 1316E are placed at **Appendix 'B'**.

11. **Type of HE Filling of Shell**. Conventional HE.

12. **Overall Weight and CG**. The overall weight and CG as that of existing 76/62 Fuze is to be maintained.

13. **Software Validation**. The updated version of software should be subjected to independent validation and verification. The following to be ensured:-

(a) For fuzing systems containing embedded microprocessor, controller or other computing device, the analysis shall include determination of the contribution of the software to the enabling of a safety feature. The software is to be tested and validated through DRDO(ARDE) or empaneled/authorized agencies to Level-II as per coding standard 'MISRA-C:2012' (for C Language) or Embedded System Development Coding Reference Guide (for embedded systems).

(b) Where the software is shown to directly control or remove one or more safety features, a detailed analysis and testing of the applicable software shall be performed to assure that no design weaknesses, credible software failures or

credible hardware failures propagating through the software can result in compromise of the safety features.

14. **Battery Type Approval**. As a part of the type approval tests, characterization of battery including discharge tests is to be undertaken and all related tests certificates are to be submitted to IHQ MOD(N)/DGNAI. A primary battery of reserve type is to be used for enhanced safety and longer shelf life.

15. **Explosive Type Approval**. The explosives viz igniter/ detonator/ CE Pellet should be subjected to EMI/EMC, qualification and functional tests (including No Fire Current/ All Fire Current) aimed at establishing the safety, reliability and functional aspects of the fuze. The fuze should be subjected to chain trial with HE composition to establish the initiation of warhead.

16. **Reliability**. The fuze should have 90% reliability at 90% confidence level.

17. **Shelf Life**. When stored under specified conditions, the fuze shall have a shelf life of 10 years without degradation in performance.

18. **Maintainability**. The fuze in its original packing and stored under specified conditions, shall not require any maintenance during the entire shelf life.

19. **Transportability**. The fuze in its original packing should withstand vibration, shocks and bumps encountered during transportation by road, rail, or sea.

20. **Interchangeability**. The fuze should be interchangeable between rounds.

21. **Standards for Testing/ Qualification of Fuze**. The following standards are applicable for design, qualification and evaluation of the fuze:-

(a) **MIL-STD-331D**. Fuze and Fuze Components: Environmental and Performance Tests.

(b) **MIL-STD-461G**. Requirements for control of Electromagnetic Interference: Characteristics of subsystems and equipment (EMI/EMC)

(c) **DOD-STD-2169**. High Altitude Elecro Magnetic Pulse(HEMP)

(c) **MIL-STD-1316E**. Design Criteria: Fuze Design Safety

(d) **MIL-HDBK-344A**. ESS for Electronic Equipment

(e) **MIL-STD 464A**. Electromagnetic Environment Effects

(f) **JSG 0102**. Environmental Test of Armament Store.

(g) **JSS 55555 and JSS 50101**. En Tests of Electronic Equipment.

(h) **MIL-STD-105E**. Sampling procedures and tables for inspection by attributes.

22. **Qualification Tests (75=5+50+20)**. The qualification tests of fuze will be carried out as per the schedule given below:-

(a) **Card Level Screening of PCB (05 Nos)**.

Ser	Test	Details
(i)	High Temp. Storage Test (Test No 22, JSS 50101)	Temp 65±3°C for 16 hrs with RH≤50%
(ii)	Thermal Shock Test ((Test No 20, JSS 50101)	(i) +55±3°C for 30min (ii) -20±3°C for 30min (iii) Transfer time 2min (iv) Duration 30 min. (v) No of cycles: 10
(iii)	Burn-in Test	(i) PCB shall be placed in a chamber at temp +55°C with tolerance of 5°C. (ii) PCB shall be maintained at this temp. Continuously for 48 hrs in power ON condition. (iii) PCBs shall be checked immediately after removing from the chamber.

(b) **Electronic Stress Screening (ESS)**. ESS to be undertaken on all the Fuzes as per the following:-

Ser	Test	Specification	Remarks
1.	Random Vibration	(i) 20-80 Hz, +3db/octave 6grms (ii) 80 -350 Hz, 0.04g²/Hz (iii) 350 -2000 Hz -3 db /octave 6.06 grms (iv) Duration 5min/axis in all the three axes	1. Module under test to be powered and monitored during random vibration and at the temperature extremes. 2. Functional testing to be done after EN tests
2.	Temperature Cycling	(i) -30°C to +70 °C T/min = 10 °C, dwell = 60 min (ii) No. of Cycles = 6	
3.	Random Vibration	(i) 20-80 Hz, +3 db /octave 6 grms	

		(ii) 80 -350 Hz, 0.04 g^2/Hz; (iii) 350 -2000 Hz -3 db /octave 6.06 grms (iii) Duration 5min/axis in all the three axes	

(c) **En Tests on Assembled Fuze(50)**. Post satisfactory card level screening, 50 fuzes are to be integrated and subjected to the following tests:-

Ser	Environmental Tests	Qty	Acceptance Criteria
(i)	High Temperature (Test 1P of JSG 0102) (+55°C for 48h)	5	SAT Static Firing
(ii)	Low Temperature (As per Ch 3-04 of Def Std 00-35, Part 3/3) (-10°C for 16 hrs)	5	
(iii)	Impact Safety Drop (Test 21U of JSG 0102) (Drop from height of 12m)	5	Should not function/ detonate
(iv)	Impact Vertical (Test 14P) as per JSG 0102 (Drop from 1.5m)	5	
(iv)	Jolt Test (MIL 331 C Test A1)	5	
(v)	Combined Temperature Humidity Cycle followed by Vibration **Temp-Humidity Cycle**. (As per 507.4 of MIL-STD-810F(05 cycles) **Vibration**. As per Test 20P of JSG 0102	5	SAT Static Firing
(vi)	Salt Mist (Test 10U of JSG 0102)	5	SAT
(vii)	Sealing (Test 13U(c) of JSG 0102)	5	SAT
(viii)	ISAT A (Test 4P of JSG 0102)	5	SAT Static Firing
(ix)	Acceleration (Test 22U JSG 0102)	5	Should not detonate
	Total	**50**	

(d) **Electro Mechanical (EM) Environmental Tests(20).**

Ser	Details of Tests	Qty	Acceptance Criteria

(i)	EMI/EMC Tests: (MIL-STD-461G) CS101: Power Leads 30 Hz to 150 kHz CS114 : Bulk cable injection, 10 kHz to 200 MHz CS 116: Damped sinusoidal transients, cables and power leads, 10 kHz to 100 MHz RS 103: Radiated emissions, antenna spurious and harmonic outputs, 10 kHz to 40 GHz	5	SAT Functional Tests
(ii)	EMP as per MIL-STD 461G or DOD-STD-2169	5	
(iii)	ESD as per MIL-STD 331	5	
(iv)	HERO as per MIL STD 464A	5	
	Total	20	

23. **Acceptance Testing of Fuze (60)**. The lots shall comprise of 5000 nos. The following acceptance tests are to be undertaken on each lot as per MIL-STD-105E, General Inspection Level II, Sampling Plan for Normal Inspection:-

Ser	Type of Tests	Quantity	Description
(a)	Visual and dimensional Inspection	100%	All the fuzes used for dynamic testing shall be inspected both visually and with X Rays.
(b)	**Dynamic Tests**		
	Fuzes shall be assembled to 76mm rounds HE/ Flash Rounds and conditioned at 21±3 °C for a minimum of 8 hrs.		
	(i) Muzzle Safety (Flash Filled)	10	A 6mm Aluminum plate shall be used as a target and shall be placed 60 m from muzzle. The fuze should not function before, on or up to 5m after the target.
	(ii) Impact (Flash Filled)	10	A 2 mm steel plate shall be used for the target and shall be placed at 100 m from the muzzle. Fuzes shall be tested at incidence angles of 20° and 90° respectively. The fuze shall detonate on or within 3m from the target plate.
	(iii) Surface Proximity (HE)	10	Fire rounds at an elevation giving impact angles of 30° and 50°. Fuze should detonate between 0.5m and 30m above the surface.

	(iv) Self Destruct	10	Fire all rounds at an elevation giving a flight time of more than 35 seconds. All fuzes should detonate at 27 ± 2 Sec.
(c)	Conditioning : 8 @ +50± 3°,4 @ +21± 3°, 8 @ -20± 3°		
	Proximity Destruct (with Flash Filled)	20	A target shall be mounted 5 m above sea level at a distance between 700m and 2000m from the gun. The fuze should function in the prescribed zone as shown in Appendix C.

24. **Packing and Marking**. The body of the fuze are to be marked with product reference number, lot number, manufacturers code and last two digits of the year. The fuzes are to be packed in a metal airtight box. Each box should house 8 fuzes. Desiccant bag to absorb moisture and dampeners to hold the fuzes in place and reduce the vibrations are to be used. The following markings are to be made on the box:-

(a) No of Fuzes

(b) Type of Ammunition

(c) Serial Lot Number, Manufacturer Code and Year of Manufacture

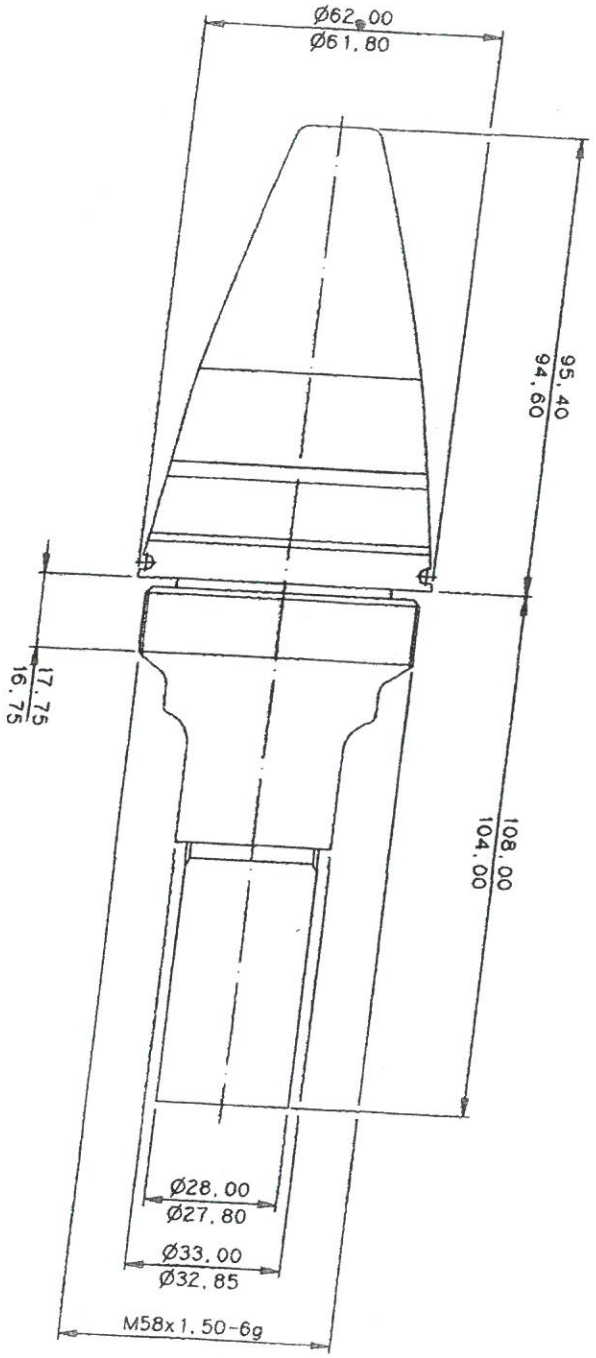
(d) Explosive Hazard Classification

(e) Package Number, Gross/Net Weight and Volume

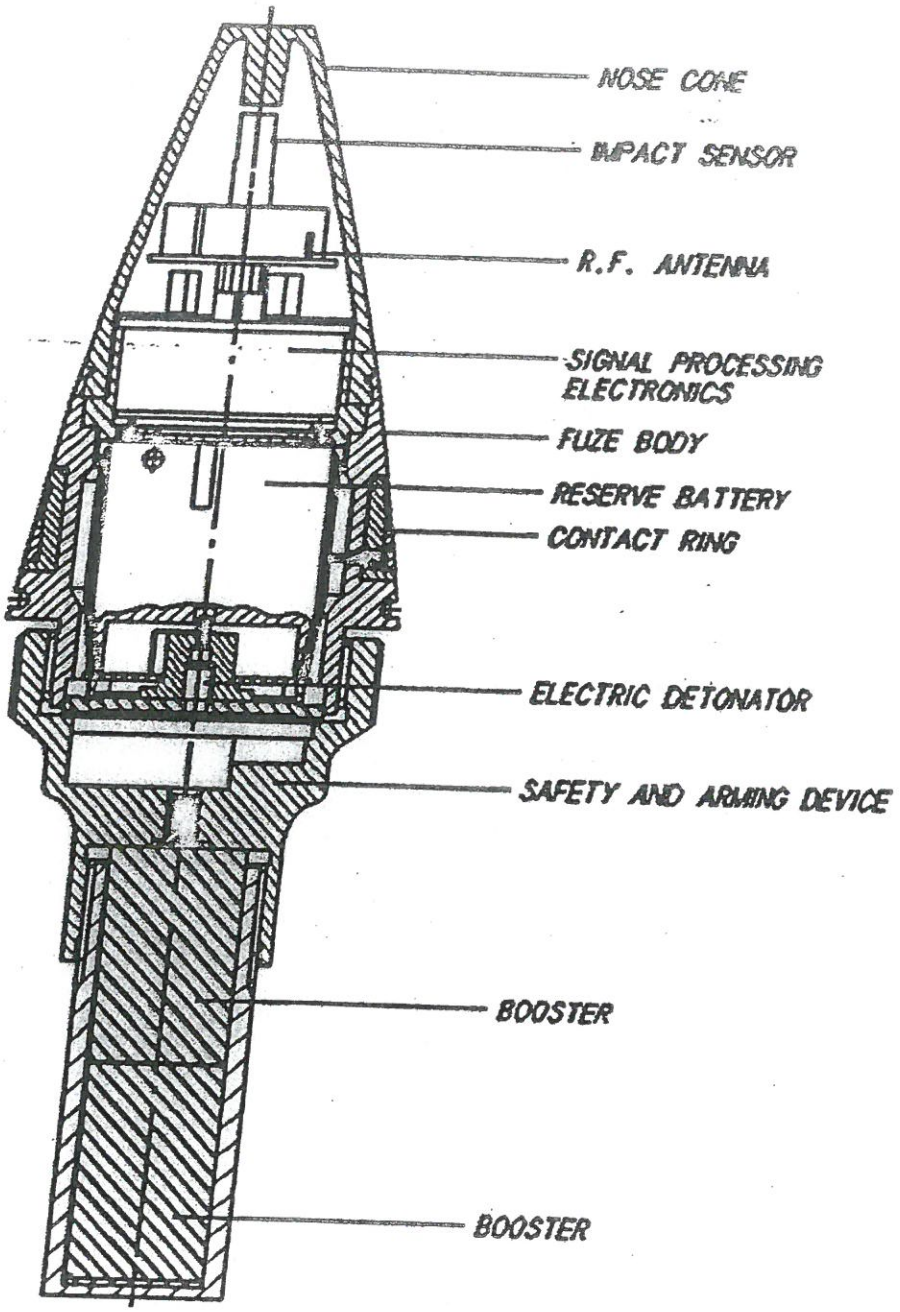
Appendix 'A'
(Refers to Para 3(f))

SKETCH OF PROXIMITY AND DIRECT ACTION FUZE 76/62 (FOR REFERENCE)

(a) **Sketch 1: Dimensional Features**



(b) **Sketch 2**: Configuration Diagram



Appendix'B'
(Refers to Para 14)

BUILT IN SAFETY FEATURES: MIL STD 1316E

1. The design of the safety features shall be robust enough to permit exposure of the fuze system to the environments and handling stresses anticipated in its life cycle with no deterioration or degradation of the fuze safety system. The fuze should have built in safety features as per MIL-STD-1316F: '**Safety Criteria for Fuze Design**' and are to include the following:-

(a) **Functional Isolation**. The control and operation of safety features are to be functionally isolated from other processes within the munition system.

(b) **Fuze Safety System**. Fuze shall comprise at least two independent safety features each of which shall prevent unintentional arming of the fuze and unintentional detonation of the ammunition due to the fuzes.

(c) **Safety Redundancy**. Forces enabling a minimum of two safety features shall be derived from different environments (such as set-back, spin, rocket ignition command etc).

(d) **Electronic Safety**. Electronic circuits should have 'g' switches, accelerometers and sensors to sense the environment (acceleration/ retardation and spin) to ascertain the launch.

(e) **Arming Delay**. Safety feature of the fuze shall provide an arming delay and shall assure safe separation distance in all operating conditions before the arming of the explosive.

(f) **Manual Arming**. The assembled fuze shall not be capable of being manually armed.

(g) **Mechanical Safety**. Safety and Actuating Mechanism (SAM) should have at least one interrupter (barrier, shutter, rotor or slider). The effectiveness of the interrupter shall be tested as per MIL-STD- 331C.

(h) **Safe or Armed Condition**. A positive means of determining safe and armed condition to be provisioned (visual observation) so as to ensure safe condition before assembly of fuze.

(j) **Safety System Failure Rate**. The safety system failure rate of a fuze shall be calculated by performing a safety analysis and shall be verified to the extent practicable.

(k) **Electronic Logic Functions**. Any electronic logic related to safety functions performed by the fuze shall be embedded as firmware or hardware. Firmware devices shall not be erasable or alterable by credible environments which the fuze would otherwise survive.

(l) **Stored Energy**. Stored energy shall not be employed for enabling or arming. Environmentally derived energy, after initiation of the launch cycle, can be practically obtained.

(m) **Compatibility of Fuze Elements**. All fuze materials shall be chosen to be compatible so that under all life-cycle conditions none of the following shall occur in an unarmed fuze:-

(i) Premature Arming

(ii) Dangerous Ejection of Material

(iii) Deflagration or detonation of lead or booster

(iv) An increase in the sensitivity of explosive train components, beyond the level appropriate for service use.

(v) Compromise of safety or sterlisation features

(vi) Production of unacceptable levels of toxic or other hazardous materials.

(n) Inbuilt safety logic should prevent premature functioning during storage, transportation and onboard ships.