

# INDIGENISATION OF AIR-LAUNCHED WEAPONS?

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The air armaments can be classified into two categories i.e. the externally mounted stores like aircraft gun ammunition, unguided rockets, bombs, Precision Guided Munitions (PGM), air-launched missiles, etc, and the armament stores fitted inside the aircraft like the store release carts, escape aid explosives and various power cartridges. The design and development of air armament stores is a complex and time consuming activity. It needs close coordination with the user, production agency, airworthiness approval agency and flight testing agency. Indigenisation of low technology weapons like bombs and cartridges either through reverse engineering or through new development could be achieved by our Research and Development (R&D) agencies to some extent. However, till date, the Defence Research and Development Organisation (DRDO) could not develop high-tech weapons like air-launched missiles and PGMs. Even in the case of low-tech weapons like unguided rockets and fuzes for aerial bombs, the Indian R&D failed to develop credible air armaments. Most of the air armaments are imported even if these are low-tech weapon systems.

India is emerging as a major economic power in the world. In most of the technology intensive industrial sectors, we are surging forward at a brisk pace. We have the largest pool of technical personnel. India was able

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to launch lunar missions and launch various satellites. Despite all these credentials, why does India still depend on the import of air armaments? What ails our air armament industry? It is necessary to delve into the reasons for the inability to design, develop and produce air armaments in India. We need to introspect and alleviate the problem areas in order to achieve self-reliance.

## **AIM**

The aim of this paper is to analyse why India is unable to design, develop and produce air armaments for all three Services. The idea is not to find faults with the system but to identify the deficiencies in the user, R&D, producer and Ministry of Defence (MoD), with an aim to improve the respective establishments in the area of indigenisation. An attempt has also been made, especially for the Indian Air Force (IAF), to suggest remedial measures for overcoming this problem.

## **HISTORY**

The requirement of air armaments depends on the type of military aircraft in use. Initially, a majority of the air armament stores was imported. During the British rule, the technology to manufacture the bombs which were released by the earlier bomber aircraft was provided to Indian agencies. This technology was provided by the Ministry of Supply, Royal Aircraft Establishment, London. Some of the documents were designed in the 1930s. In the early 1950s, certain stores viz. aircraft gun ammunition and bombs were produced by the Ordnance Factories Board (OFB) using these original technology documents. At that time, there were no separate agencies responsible for design, airworthiness certification and quality assurance. Subsequently, upon formation of the Directorate of Technical Development and Production (Air) [DTD&P (Air)], a large number of low-tech weapon systems viz. bombs, escape aid cartridges and gun ammunition

were developed through reverse engineering, and drawings and specifications were formulated. Even now, the **IAF is using the 1,000 lb bombs whose specifications were issued in 1952.** At that time, the designer, quality assurance agencies and user were together as DTD&P (Air). Therefore, the coordination was good and a large number of projects were successfully accomplished through reverse engineering. Subsequently, the task of indigenisation was assigned to individual DRDO labs. Initially the development activities of the Armament Research and Development Establishment (ARDE) and High Energy Material Research Laboratory (HEMRL) (then Engineer Research and Development Laboratory—ERDL) were well coordinated and the products were successfully developed in the prescribed time-frames. However, the progress of development activities became rather slow in the subsequent years.

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The Air Staff Requirements (ASR) for new generation bombs like the 250/450 kg HSLD and the fuzes for these bombs, were issued in the late 1970s. However, the bulk production could commence only from early 2000 onwards. The delay in bulk production was primarily due to the delay in formulation of documentation and initial production problems. **Since the designer was not responsible for bulk production, this time lag from design to bulk production was very high compared to international standards.**

Till the late 1990s, indigenisation of air armaments was tasked to the DRDO only. Due to inordinate delays in development and DRDO's reluctance to take up reverse engineering projects, the IAF had tasked OFB to indigenise certain low-tech weapons like the Russian origin bombs and rockets. However, except for one bomb i.e. the 100-120 kg natural fragmentation bomb, none of the air armament stores could be produced by OFB till date. The success story for designing the 100-120 kg bomb is mainly due to the involvement of the Directorate General Aeronautical Quality Assurance (DGAQA) and employment of retired IAF officer, Air Cmde K.V. Rao, as a consultant for OFB for one year.

The development of air-launched missiles and laser-guided bomb kits has been in progress for the last two decades. The progress is very slow and the IAF continues to depend on imports.

### **PRESENT SCENARIO**

The design and development of air-launched weapons are different from those of ground-launched weapons. The design safety and airworthiness are of paramount importance. The designer, airworthiness certification agency, quality assurance agency and flight testing agency are to work in a cohesive manner for expeditious completion of development projects. Each agency has an important role to play in the indigenisation of air armaments. Once the product is developed, the transfer of technology would take place to the bulk production agency. At present, there are two sources for supply of air armament stores i.e. OFB and ARDE. The bulk production of a majority of the stores is through OFB whereas certain stores viz. power cartridges, release cartridges, etc. are supplied in limited numbers by ARDE. Therefore, depending on the type of weapon system, the indents are placed by the Services. Bharat Dynamic Ltd (BDL) is trying to refurbish/provide life extension of Russian origin air-launched missiles. However, a proper system has not yet been formulated.

### **INDIGENISATION OF AIR ARMAMENTS**

The indigenisation projects may be classified broadly into two categories. i.e. the Services-sponsored projects and technology demonstration projects. In the case of Services-sponsored projects, the Staff Requirements are defined and the design agency is to submit the feasibility report and after acceptance of the feasibility report, the R&D work commences. In the case of technology development projects, the R&D work commences as a technology demonstration and once a certain degree of success is achieved, the Services are briefed for its acceptance as a Services-sponsored project.

In the IAF, the externally mounted stores are required by the Operational Branch and the power cartridges are indigenised by the Maintenance Branch. In both cases, indigenisation is not the primary duty—it is an additional duty.

Therefore, adequate time is not devoted by the IAF for indigenisation activities. A scrutiny of the technical specifications of indigenous air armaments has revealed that IAF officers (Technical Armament Branch) had worked on these products during the development stage and all specifications were formulated by them. A sizeable number of armaments were designed by the IAF officers during the DTD&P (Air) times.

Amongst the air armaments, indigenous production is very limited. Only low technology weapons are being produced in bulk. The list is given below:

- 1000 lb bomb of different makes – production based on British documents.
- 250 kg HSLD bomb – designed in 2000 by ARDE.
- 450 kg HSLD bomb – designed in 2000 by ARDE.
- 100-120 kg bomb – designed 2002 by OFB.
- 68 mm rocket – designed in the late 1980s by ARDE.
- 30 mm ADEN ammunition – through Transfer of Technology (ToT) by OFB.
- 30 mm GSH – through Transfer of Technology (ToT) by OFB.
- 23 mm GSH – through ToT by OFB.
- Various power cartridges and escape aid explosive cartridges.

The fuzes for the aviation bombs were developed by ARDE. However, their usage has been discontinued as incidents of air burst occurred due to certain design deficiencies. The ARDE was initially reluctant to accept that there were deficiencies in design. However, by the time ARDE accepted the need to design the fuzes in the fail safe mode, the IAF had stopped using these fuzes and adapted a Russian origin fuze as the common fuze for all bombs. Regarding the live ammunition for aircraft guns, OFB is unable to make this due to difficulties in quality assurance problems for fuzes. Therefore, the live ammunition is being imported and the practice ammunition is being made in India.

In the case of the 68 mm rocket, a large number of amendments are pending for ratification by the ARDE. Since the rocket group of ARDE

had been wound up a long time back, there is no response from ARDE despite being the designer. OFB is continuing to produce the rockets with deviations, as the product with the changed specifications is performing without any problems.

At present, the following air armaments are under indigenisation:

**OFB (tasked in November 1999)**

- 57 mm rocket – first flight trials done in September 2007. Still pending.
- 80 mm rocket – development stage.
- 240mm rocket S-24B – development stage.

**DRDO**

- 100-120 kg pre-fragmented bomb – under pilot lot production.
- 250 kg pre-fragmented bomb – under development.
- 500 kg pre-fragmented bomb – under feasibility study.
- 500 kg M-62 Russian origin bomb – under feasibility study.
- Laser guided kit – under development for 20 years.
- Anti-tank missile – under development.
- Air-to-air active radar-guided missile – under development.
- IN/GPS guidance kit with range enhancement – under development.

**DEFICIENCIES OF AGENCIES INVOLVED IN INDIGENISATION**

The primary agencies involved in indigenisation are the user, R&D organisation, flight testing agency, airworthiness certification and production units. Since all these establishments are under the MoD, the MoD policies play a major role in their approach for indigenisation. It is, therefore, necessary to identify the areas which affect the process of indigenisation. The details are given in the subsequent paragraphs.

***System Deficiencies at User Level***

- (a) Domain knowledge on air armaments is very limited in the IAF and Indian Army. Some of the Requests For Induction (RFIs) from the Army are classic examples of lack of core competence. Earlier, the IAF had the Technical Armament Branch which had expertise on air armaments. Now, very few

experts on armaments are available. Every AE(M) officer would like to work on aircraft instead of armaments as the recognition of an officer's effort on aircraft is clearly visible and better appreciated by the commanders. Armament activities are least visible. Very few commanders give importance to the armaments in the field units. The flying task is given paramount importance compared any other activity in the field units. Since the working environment is not conducive to develop core competence in armaments, the number of officers who have the capability to lead the armament indigenisation projects is limited.

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- (b) Air Headquarters (HQ), especially the Operation (Op) Branch, has not given importance to air armaments. A majority of the armament functions like procurement, War Wastage Reserve/Armoured Assault Tank (WWR/AAT) scaling, allotments, utilisation policies, trials and indigenisation of main stores are looked after by the Op Branch. The highest ranking officer to look after this is a Group Captain. In fact, in the chain of command, till the year 2008, there were two officers between the Director Weapons and the Vice Chief of the Air Force. Now, it has been increased to three officers. The greater the number of officers in the chain of command, the more will be the hurdles. Whereas, maintenance of these stores at the Maintenance Branch is looked after by an officer of Air Vice Marshal rank. Moreover, the total number of officers in the Directorate of Weapons (Op Branch) is so low, that they are barely sufficient for day-to-day fire-fighting, and there is no time for policy matters. Compared to the Naval Armament Inspectorate, the total number of officers working in the area of air armaments in the entire Air HQ is very limited despite the fact that the IAF has more variants and numbers of armament stores.

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- (c) Longer tenures could have helped the officers to build up expertise. But due to typical tenure-based posting across the board, the officers working in the armament field are unable to gain core competence.
- (d) Indigenisation is not the primary responsibility of the officers in the present system of work. The officers' primary responsibility is the operational utilisation and its maintenance. A separate officer is to be posted to both the branches for dedicated work on indigenisation.
- (e) When the Services Qualitative Requirements (SQRs) are formulated, the Services seek the best features available on similar systems in the global market. When the primary version of a new generation system cannot be indigenised, the advanced systems cannot be designed and developed by our R&D. Therefore, the SQRs must be given as Mark-1, Mark-2, and so on, for any weapon system. Initially, the basic version to be developed is the Mark-1 and the advancements could be in the other versions.
- (f) The Services often provide the SQRs of the main weapon system. The associated equipment required to utilise the main system is not defined. It is often presumed that the designer would know the requirement. Due to this, development of associated accessories gets delayed which, in turn, delays induction of the equipment into the Services.
- (g) Due to the very nature of tenure-based postings, the person defining the SQRs may not have the requisite knowledge of the entire weapon system. Therefore, errors at project definition could occur.
- (h) Project management at the user end needs expertise and continuity. The project manager needs to interact with the R&D teams and testing agency. In case the officers are posted to the R&D team, they could manage the project efficiently.
- (j) Since the technology is changing rapidly, the Services keep changing the specifications to keep pace with the technology. This leads to delay



in project completion. It is important to fix the project definition. Any amendment to specifications could be considered as an upgrade of the first project. Generally, this is not in practice.

- (k) The user feedback is not given to the design agency routinely unless defects occur. Feedback helps in improving the design of the weapon system.

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*System Deficiencies at DRDO*

- (a) Due to lack of knowledge of the overall requirements of any weapon system, parallel R&D of the main system and its associated equipment does not take place. All R&D activities are concentrated on the main item only. Only when the main item is successful, does the R&D team consider indigenisation of the associated items.
- (b) The gestation period is very long at the design and development stage as well as ToT for bulk production. There is no accountability for lapses in time-frames. In a majority of cases, the project team gives unrealistic time-frames and never meets the deadlines.
- (c) Without adequate ground trials, the project team seeks flight trials. The cost of the flight trials is not included in the project cost. One flight trial of air armament stores costs approximately Rs. 1.5 crore. In the case of the proximity fuze development, the project was shelved after the conduct of 11 flight trials, wherein the fuze functioned inadvertently in the last two flight trials.
- (d) Once the prototype is developed successfully, the project team declares successful completion of R&D and does not complete the associated documentation on time. At times, after successful flight trials, it takes 10 years for an item to be produced in bulk due to lack of documentation and non-availability of associated equipment.
- (e) The designer is not responsible for bulk production. Therefore, the designer does not spend adequate time in preparing the production

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technology documents. Preparation of documents for the process schedule and the Quality Assurance (QA) requirements must be the responsibility of the designer. When any product is produced under ToT from abroad, all production documents are properly made by the designer and one representation of the designer ensures production as per the standards. No such methods are followed in India. The DRDO needs to study the ToT documentation of any air armament product ex-abroad and prepare the documentation accordingly. In fact, two groups

from the same lab prepare different standards of documents for ToT. There is no standard template. When one such checklist was prepared by DGAQA, the DRDO justified why they should not make efforts to make such a comprehensive template.

- (f) During the development phase, the hardware is manufactured under the direct supervision of the scientists of DRDO. Since they are the designers, the production process control cannot be accomplished under their supervision. When the same product is to be manufactured in bulk by the OFB or trade sources, the educational qualification and understanding of the quality and specification requirements of the product is limited as the technicians are uneducated. Therefore, it is necessary to stipulate step-by-step procedures in the production process documentation by the designer. This is not done by the DRDO.
- (g) Once the product is in regular production, the designer closes the project, whereas the production agency faces difficulties in bulk production and certain amendments would be required to the drawings and specifications. Also, there would be a need to introduce additional QA measures based on the feedback from the producer and user. Hence, there is a need for constant upgradation of the product by the designer in terms of quality and performance. Generally, this is lacking from the designer.

- (h) After finalisation of the design, the drawings and specifications are issued as 'provisional' documents. Based on the production problems and feedback from the user, the product specifications and drawings are to be changed. However, the latter part does not take place. It is pertinent to note that the **specifications issued in 1952 for the 1,000 lb bomb are still 'provisional'. Till date, almost all the specifications issued for air armament stores are still 'provisional'.** The designer has never made efforts to issue final specifications and drawings.
- (j) The DRDO is reluctant to accept positive criticism about the performance and quality of the design. The deficiencies in design are never accepted. The user always compares the product with a similar item from abroad. If the performance is not up to the expectations, it would be better to classify the item as Mark-1 and try to design a better product as the Mark-2 version. This system is not followed.
- (k) Aircraft availability for flight trial becomes critical if the aircraft serviceability is low and the commitments of the Services are high. In case the R&D team conducts extensive ground trials and has a high degree of confidence in their ground tests, the air armament weapon systems could be cleared with a minimum number of flight trials.

#### *System Deficiencies at OFB*

- (a) OFB is a production organisation. R&D is not their core competency. The primary effort of any ordnance factory is to chase targets and increase production turnover. The man-hours spent by the workforce on R&D, which affect production, are not acceptable to the management. Therefore, R&D takes a back seat. Even if they are able to produce any item through reverse engineering, they are not able to complete the process of tests and documentation required for the qualification and airworthiness certification of air armament stores.
- (b) Most of the products produced by OFB are meant for the ground forces. The entire staff of OFB i.e. officers and technicians are, therefore, used to the quality norms of the ground forces which are a little relaxed, when compared to those of the air armaments. Since the Quality Assurance/

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Quality Control (QA/QC) requirements and proof testing of air armaments is much more stringent, OFB finds it difficult to produce items of the correct specification. Since the volume of orders for air armament stores is low compared to that of the ground forces, OFB is reluctant to take up the air armament task.

(c) The old industrial employees of OFB are not educated. Most of the old technicians are 8<sup>th</sup> class qualified. Therefore, adherence to process schedules and process control is very difficult, and without

this, quality products cannot be made. There is no practice of following a checklist by the technicians/ supervisors. It is based on memory and practice. Therefore, the possibility of non-adherence to the correct process cannot be ruled out.

(d) The industrial employees of OFB (below the Gp B officers) are entitled for financial incentives based on the number of items produced and overtime work. Since R&D is considered non-productive activity, the workforce does not come forward actively for such work. They need to be forced to work on R&D project. OFB also uses its best employees in production rather than R&D work. Therefore, R&D activities are non-starters.

(e) The technical involvement of middle level management is very low. They act as managers rather than as technical officers. Dependence on junior level managers, who do not possess the requisite knowledge of the armament systems, is of no use. Except for a few individuals, as a system, OFB cannot implement a fool-proof process of manufacture so as to provide a quality product. Generally, the factories are supposed to formulate a process schedule and follow it meticulously. Instead, they tend to follow whatever system in vogue which may not meet the process schedule and the gauge schedule. It is only when the QA agency objects about the production for non-adherence, that the system is followed. This attitude needs to be changed for improvement in quality.

- (f) Because of strict quality norms, the number of gauges used in air armament systems is more compared to the items used for the ground forces. In case any component of the armament store is to be outsourced, the outsourced firm is to manufacture all the gauges to produce the item. Since there is no guarantee that the firm would again be in the L-1 category the next year, the firm either delays the production or seeks enhancement of cost. If the ordnance factories are given permission to indent the next five years' requirement in a phased manner from the trade sources, this problem could be alleviated.
- (g) The machines, jigs and fixtures are to be periodically calibrated. In practice, it is done mostly only on paper. Only the gauges are calibrated periodically but the jigs and fixtures are checked only when the quality is affected.
- (h) There is no accountability for rejected items in a semi-finished condition. All higher officials seek the cost of the items produced. No one sees the cost of items rejected at each stage of manufacture. Since rejections at this stage are not monitored by the MoD, OFB adds the cost of the rejected material to the final finished product. In the case of the 450 kg HSLD bomb, the rejection at the casing stage is almost 75 per cent. This aspect is not reflected anywhere in the system audit. If an audit is conducted on the total raw material procured and the end product weight, the loss to the state could be assessed. Since the rejections are not monitored, it has become a practice to manufacture armament stores with minor deviations. Since such deviations are not acceptable to the air armament stores, indigenous stores cannot be made as per the expectations.
- (j) Whenever ToT takes place, OFB does not sign any contract with the ToT firm for regular updates in product specifications as well as the proof specification. It may be noted that the ADEN gun ammunition is manufactured under ToT. The fuze 933 of this gun ammunition's

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testing is carried out as per the **proof specification of 1946**. All the designers and manufacturers need to update the technology and obtain the latest acceptance rejection criteria and the testing methodology. This is never looked into by OFB.

(k) The process schedules and process control documents are not available at the shop floor when any product is made. These are kept separately. Therefore, the process audit cannot be accomplished properly.

(l) The promotion policies of OFB do not encourage professional competence. The management is concerned about the target quantity rather than the quality and adherence to process

schedules. Unlike the armed forces where filtration is ensured at every rank, above Lieutenant Colonel/Wing Commander, this is not practised in the Ordnance Factories (OFs.)

(m) The OFB is not able to produce quality propellants for gun ammunition and rockets. Most of the propellants produced are with certain deviations. Clearance for using these propellants is given only after proof testing with the hardware. Since the propellants are in the boarder case at the time of manufacture, their performance might deteriorate during storage.

(n) A majority of the OFs are working on vintage technology in explosive filling and handling. Loss of human lives is not taken seriously. They are considered expendable as risks are involved in the handling of explosives. The entire process of handling of explosives needs to be brought at par with the European countries.

#### ***System Deficiencies at MoD***

- The MoD depends heavily on the DRDO. The industry is considered a 'trader' rather than a 'partner'. The existing process does not permit funding of any defence project to the private industry. Without the participation

of the major players of the private industry, the new generation weapon systems cannot be indigenised. Design and development of air armament stores is a complicated process, considering the requirements of flight safety. Only an integrated approach would be a viable option. Dependence on DRDO alone would delay the process. The industry, which has the requisite technology for manufacturing the hardware, needs to be taken as a 'partner' rather than a 'vendor'. The industry would come forward only when there is an assurance that its investment would get proper returns in developing the product. Therefore, the MoD needs to debate this issue and give suitable instructions to the Integrated Defence Staff (IDS) and DRDO. On many occasions, the industry involved in the development of the equipment does not get the contract when it is produced in bulk. Therefore, after a couple of experiences, they do not come forward for development activity.

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- The IDS had issued certain convening orders to the IAF for development of products of air armament stores. These would remain a paper exercise unless a separate expert team is formed for dedicated work on the project. When the IDS projects are received by the IAF, the concerned officials consider these as additional tasks. They tend to concentrate on the primary task. Therefore, a separate team needs to look into the IDS projects for indigenisation of air armament stores. Some of the project definitions are unrealistic to achieve. We cannot start running directly without learning how to walk. However, the projects defined are very ambitious. A realistic assessment is to be made to redefine/prioritise the projects.
- At present, the user does not sign any contract with OFB. Targets are decided and OFB issues the price list. Since there is no competition, the prices of indigenous air armament stores are very high compared to the imported stores, especially for bombs and rockets. The cost of a majority

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of the indigenous bombs is double compared to the imported bombs. Moreover, OFB does not supply all the items of the bomb in one go. The warheads are supplied separately and the tail units are supplied separately. Also the items are not supplied on time. To improve, the efficiency of OFB, contracts may be signed with OFB by the user (as was done for Hindustan Aeronautics Limited – HAL) for time-bound supply and cost negotiations, comparing with the cost of items abroad.

- At present, the industry is not permitted to do the explosive filling. Therefore, the user has to place the indents on either OFB or ARDE or BDL for any armament products. To make it more competitive, the government needs to permit the industry to compete with OFB and BDL. The explosive filling may be retained with any government agency, if necessary.
- Every department tries to protect and defend its own system. The MoD may not get the correct picture of the problems of indigenous development. It would be better to have **an independent body working directly under the MoD, to link all the other departments (DRDO, user, OFB, DGAQA and CEMILLAC) for expeditious completion of the indigenisation task.** The team needs to assess the feasibility of realisation of the project within the given time-frame. Experts from each department/Service may be pooled to carry out this activity. The tenure of the task force team should be a minimum of five years, considering the gestation period of development projects.

## ANALYSIS

It emerges from the above that the failure of indigenisation of air armaments is primarily due to lack of coordination and focus. Each department/Service has its own agenda in which indigenisation does not figure as a primary task. Since OFB is a production agency, the indigenisation projects should not be assigned to them. They may be involved by the respective R&D agency from



the beginning of development for expeditious bulk production. India has the largest pool of technical manpower. But we are import dependent mainly due to the non-involvement of industry as a partner and lack of thrust in every department. Giving the authority and accountability to a dedicated team, it will be possible to indigenise the low-tech weapons. Also, the existing weapons could be improved. For the development of high-tech weapons, we need to take industry and foreign companies as partners and make a beginning. Since we are considered one of the largest armed forces, we need to establish a credible weapon industry. So far, the focus has been only on the weapon delivery platform, not on the weapon itself. We feel satisfied that we are able to indigenise the fighter aircraft, but we need to remember that it would be carrying mostly imported weapons. Therefore, the deficiencies mentioned above need to be examined by an independent body and necessary policy changes are to be initiated in each organisation for achieving self-reliance.

**Certain posts should be created exclusively for indigenisation of air armament stores. The posts could be at Air HQ as well as at DRDO, MoD, IDS, etc.**

## RECOMMENDATIONS

The following are recommended:

### IAF

- (a) The IAF is a fighting force. All flying efforts are meant for ensuring the delivery of weapons. But the weapons and people handling the weapons are given least importance. The IAF needs to create an environment to enhance core competence in air armament activities. The P-Branch needs to deliberate on the system to be incorporated for enhancing the core competence in the field of air armaments. It should indicate the training, career profile and promotional avenues.
- (b) Certain posts should be created exclusively for indigenisation of air armament stores. The posts could be at Air HQ as well as at DRDO, MoD, IDS, etc. The primary responsibility of the officers is indigenisation

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of air armament stores and improvement of the existing products. In fact, the IAF has not been sparing officers for the projects of air armaments.

(c) The tenures of the project managers must be five years instead of two / three years.

(d) The Op Branch may deliberate on the requirement to create a post of ACAS Weapons (Ops), who would come directly under the DG Ops (Air). The ACAS (Ops) could also take the responsibility of the operational utilisation role of

equipment common to multiple fleets of Air Defence (AD) and Ground Aircraft (GA) role aircraft. Also, this directorate would be responsible for procurement of associated equipment of the main stores viz training weapons, belting machines, proof equipment, tools, manuals, mandatory spares, etc. At present, the weapon is procured by the Op Branch and role equipment and Tool Testers Ground Equipment (TTGE) are procured by the Maintenance Branch based on the inputs of the respective fleet's Op Directorate. In case the AVM rank post cannot be created, there could be at least an Air Cmde (PD Wpns), who could directly come under DG Ops (Air). This would ensure expeditious decisions on all aspects related to air armaments for the AD as well as GA roles.

- (e) Increase the number of officers posted to DASE and D Weapons in the Maintenance and Op Branches respectively.
- (f) Create better testing facilities at 28 ED for life extensions and defect investigations of imported and indigenous stores.
- (g) Indigenisation projects must not be given to OFB. All projects are to be given either to DRDO or the industry (if the government permits it to participate).
- (h) While formulating the SQRs, the Services need to indicate the associated equipment required for testing, storage and transportation. Since SQRs for associated equipment cannot be defined clearly, these must be mentioned in the project directive.

- (j) When new products are to be developed, formulations of SQRs must be realistic and provide scope for improved versions as Mark-I, Mark-II, so on.

**India needs effective air-launched weapons of its own. Except for limited unguided weapons, India is not able to design modern guided weapons.**

The remedial actions to be taken at DRDO, OFB and MoD have not been specified. Based on the deficiencies mentioned for each organisation, the respective organisation needs to introspect frankly. If need be, the MoD may form a committee of experts and find an amicable solution. Firstly, there must be will and resolve to give greater impetus to indigenisation. Then only, some tangible solutions would emerge.

## CONCLUSION

Considering the internal and external security scenario, India needs effective air-launched weapons of its own. Except for limited unguided weapons, India is not able to design modern guided weapons. The private industry has the technology to produce modern non-armament related equipment. If this is tapped and translated from generic technology into air armaments, we will be able to produce world class products. However, indigenisation of air armaments is a long drawn process. Unless the government introspects and takes certain radical measures, the blame game of DRDO vs. the user will continue and we will be depending on imports for another two/three decades. The deficiencies mentioned in each system need to be analysed and corrective measures undertaken. When we can send a satellite to space, we can also make a missile to hit a target. Only the resolve and implementation system is lacking.