CHAPTER II: PERFORMANCE AUDIT ON CONSTRUCTION OF INDIGENOUS AIRCRAFT CARRIER

2.1 Executive Summary

Background

India's aircraft carrier construction programme is driven by certain imperatives of Naval Plans critical to the development of our maritime capabilities, which, *inter alia,* provide for ready combat availability of two aircraft carriers for East and West coast at any given time. Project approval for construction of the Indigenous Aircraft Carrier had been accorded by the Cabinet Committee on Security in May 1999, with revisions in October 2002 and July 2014.

Audit Approach

Audit examination consisted of scrutiny of documents/records at various Directorates at Integrated Headquarters of Ministry of Defence (Navy) and its field formations *viz.* Warship Overseeing Team, Kochi, Headquarters Naval Aviation, Goa as well as at Cochin Shipyard Limited, Kochi, the selected shipyard.

Key Findings

(i) Planning and Design

The selected shipyard had no previous experience of warship construction and DCN[1] recommendations to augment capabilities of the yard were partially implemented. Project approval (October 2002) was obtained before promulgating Preliminary Staff Requirements for a ship of 37,500 tons. Delays in completion of Aviation Facilities Complex and Propulsion System Integration designs affected project timelines. The Indian Navy envisioned adoption of the Integrated Hull Outfit and Painting (IHOP) approach to reduce the build period and increase productivity. However, adoption of concurrent design approach compromised the IHOP method. The Build Strategy has not

[1] DCN - Direction Des Constructions Et Armis Navales, French Naval Design and Shipbuilding Authority engaged for concept design.

been finalised and continues to be revised with progress in project activities/timelines, preventing the benefits of a credible and comprehensive build strategy from accruing to the project. The General Arrangement[2] has undergone more than 4,000 changes and thus, the design of the ship is yet to be finalised.

(Para 2.3)

(ii) Carrier Construction

The Indian Navy and the shipyard did not carry out a review within six months from the date of conclusion of Phase-II contract (December 2014). There is continuing disagreement over project timelines between the Indian Navy and Cochin Shipyard Limited, with realistic dates for delivery yet to be worked out. Non-availability of steel delayed commencement of hull fabrication whereas late receipts of critical equipment like Diesel Alternators and Gear Boxes delayed launching of the ship. Continuing changes to HVAC[3] design and delays in delivery of Aviation Facilities Complex equipment affected the construction schedule.

Delayed constitution of the Empowered Apex Committee deprived monitoring of the project at the apex level. The Steering Committee remained dysfunctional (October 2007-August 2013) for almost the entire duration of the Phase-I contract (May 2007). Shortfall in meetings of the Project Management Board and other project monitoring mechanisms, ranged from 60 *per cent* to 91 *per cent*. Neither the Ministry nor the shipyard could assess the physical state of construction of the ship as the Ministry failed to incorporate essential formats for progress reporting in the contracts.

(Para 2.4)

(iii) MiG29K/KUB Aircraft

The MiG29K, which is a carrier borne multi role aircraft and the mainstay of integral fleet air defence**,** is riddled with problems relating to airframe, RD MK-33 engine and fly-by-wire[4] system. Aircraft were being technically

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[2] General Arrangement – the basic document upon which the ship is designed and constructed.

[3] HVAC – Heating, Ventilation and Air-conditioning

[4] Fly-by-wire (FBW) is a system that replaces the conventional manual flight controls of an aircraft with an electronic interface and allows automatic signals sent by the aircraft computers to perform functions without the pilot's input, as in systems that automatically stabilise the aircraft.

accepted despite having discrepancies/anomalies. Serviceability of MiG29K was low, ranging from 15.93 *per cent* to 37.63 *per cent* and that of MiG29KUB ranging from 21.30 *per cent* to 47.14 *per cent*. The augmentation of infrastructure at Visakhapatnam is still at the Detailed Project Report stage even six years after approval (December 2009). The Full Mission Simulator was assessed to be unsuitable for Carrier Qualification (CQ) simulator training for pilots, as the visuals did not support the profile. The service life of the aircraft is 6000 hours or 25 years (whichever is earlier) and with issues facing the MiG29K/KUB, the operational life of the aircraft already delivered would be reduced. Further, the deliveries of the aircraft under the Option Clause scheduled between 2012 and 2016 are much ahead of the delivery schedule of the Indigenous Aircraft Carrier in 2023, as projected by Cochin Shipyard Limited.

(Para 2.5)

(iv) Financial Management

The Ministry failed to negotiate/quantify sub-contracting work and its cost with reference to the Phase-I contract thereby leading to undue advantage to the shipyard. There was incorrect estimation of man-hour per ton to be utilised for fabrication and outfitting in the Phase-I contract which led to undue benefit to the shipyard to the tune of ₹476.15 crore. Large unspent balances in the project account and unilateral withdrawal of funds by the shipyard were indicators of weak financial management.

(Para 2.6)

Recommendations

- ✓ The Ministry should ensure progress reporting as per essential formats stipulated by the Naval Engineering Standard 33, to enable assessment of the actual state of physical construction and monitoring **;**
- ✓ The Ministry should augment efforts to build infrastructure for MiG29K/KUB at Visakhapatnam, which is the home port for the IAC **;**

✓ The Ministry should synchronise delivery of the Option clause aircraft with the realistic delivery date of the IAC, to fully exploit the service life of the aircraft.

2.2 Introduction

An aircraft carrier is a warship designed to support and operate aircraft, engaged in attacks on targets afloat or ashore and to undertake sustained operations in support of other forces. An aircraft carrier is central to the operational requirements and fleet doctrine[5] of the Indian Navy and is the only means of ensuring air defence[6] of sea. The Indian Navy commissioned its first aircraft carrier, INS Vikrant[7] in March 1961.

The Indian Navy Perspective Plan (1985-2000) envisaged a requirement of three aircraft carriers, with two to be operational (East and West coast) and one in refit at any time. This requirement was also reiterated in the Maritime Capability Perspective Plan (2012-27). Meanwhile, the Indian Navy commissioned its second aircraft carrier, INS Viraat[8] in May 1987.

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[5] Fleet Doctrine - Naval Doctrine stipulating control of the sea

[6] Air defence – measures designed to nullify or reduce the effectiveness of hostile actions by aircraft, missiles or other airborne objects

[7] INS Vikrant – aircraft carrier (ex HMS Hercules) acquired from the UK in January 1957 and commissioned in March 1961 as the INS Vikrant with a displacement of 19500 tons

[8] INS Viraat - an aircraft carrier with a displacement of 28,700 tons, commissioned in 1959 as the British Navy's HMS Hermes and transferred to India in 1987

The Indian Navy formulated (September 1985) Staff Requirements[9] (SRs) for a ship of approximately 35,000 tons. Subsequently, a contract was concluded (December 1988) by the Indian Navy with DCN[10], France for the concept design of the Sea Control Ship[11]. The concept design received in March 1990, based on the operational requirements of the Navy, concluded that a ship of around 37,500 tons was required. However, as seen from the Ministry's proposal (October 2002) to the Cabinet Committee on Security (CCS), the resource crunch of the early 1990s forced the Indian Navy to prune down (1992-93) the SRs and limit the size of the carrier to 19,500 tons. Subsequently, the length of the Flight Deck of the envisaged carrier was increased (1995) by about 15 meters and the tonnage to around 24,000 tons.

The Ministry informed (May 1999) the CCS that INS Vikrant had been decommissioned (January 1997) and INS Viraat was due for major repairs and refit[12] and proposed the construction of an indigenously designed Air Defence Ship (ADS)[13] at an estimated cost of ₹1,725.24 crore, with delivery in 8-10 years, without mentioning the tonnage of the ship. Subsequently, the Ministry informed (October 2002) the CCS that in view of the changed operational scenario, revision to the proposal was necessary. Further, considering the strategic importance and role of the aircraft carrier envisaged for the 21st century and studies carried out by the Indian Navy concluded that an aircraft carrier of around 37,000 tons was required. Accordingly, the Ministry proposed (October 2002) to the CCS, a revision in cost of design/construction of the ADS from ₹1,725.24 crore to ₹3,261 crore[14], with delivery in December 2010 (*i.e.*, eight years). Thereafter,

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[9] Staff Requirement – a staff statement in broad terms of function, main features and performance

[10] DCN - Direction Des Constructions Et Armes Navales

[11] Sea Control Ship - aircraft carrier capable of destroying enemy naval forces, suppressing enemy sea commerce, protecting vital sea lanes, and establishing local military superiority in vital sea areas

[12] Repairs and refit – Refit of INS Viraat was done in July 1999

[13] Air Defence Ship – Name of the IAC in the Ministry's proposals of May 1999 and October 2002

[14] ₹3261 crore - the approved cost was further enhanced to ₹3912.77 crore to cater to additional infrastructure at Cochin Shipyard Limited and fund requirement for ship construction activities. As of March 2014, the total funds released to the project were ₹3717.93 crore

the Ministry again proposed (March 2014) to the Cabinet Committee on Security (CCS) a revision in cost of the aircraft carrier to ₹19,341 crore along with revision in its delivery schedule from December 2010 to December 2018, which was approved (July 2014) by the CCS. As of 30 June 2015, against the total sanction (July 2014) of ₹19,341 crore for the Indigenous Aircraft Carrier (IAC), the expenditure incurred is ₹5,035.13 crore. However, the overall physical progress was not assessable as discussed in Para 2.4.5.5

Even as the IAC continues to be constructed in Cochin Shipyard Limited and the fact that INS Viraat is expected to be decommissioned in 2016-17, the Indian Navy's operational readiness and maritime capability will be affected due to the availability of only one aircraft carrier, INS Vikramaditya[15] till delivery of the IAC.

2.2.1 Requirements of the IAC

As per the Preliminary Staff Requirements (August 2004), the maximum speed of the ship would be 28 knots while the cruising speed[16] would

[15] INS Vikramaditya- erstwhile Admiral Gorshkov commissioned in the Indian Navy in November 2013.

[16] Cruising speed – speed at which the vessel travels in most fuel efficient manner along with other fleet ships

be 18 knots. The ship would have a 45 days logistics endurance and a range[17] of 7,500 Nautical Miles (NM) at 18 knots. The propulsion package would consist of twin shaft arrangement with each shaft line having two Gas Turbines, a combining Gear Box and associated auxiliaries. The main machinery/auxiliaries would comprise of Diesel Alternators, AC plants, Reverse Osmosis Plants, Air Compressors, etc. The ship would be designed to have a complement of 160 officers and 1400 sailors.


Navy Personnel onboard an Aircraft Carrier

2.2.2 Choice of Aircraft

The Ministry's proposal (October 2002) to the Cabinet Committee on Security (CCS) brought out that 30 aircraft of various types (twelve MiG29K, eight Advanced Light Helicopters, two Kamov-31 and eight Sea Harrier/Light Combat Aircraft (Navy) were envisaged to operate from the IAC. The MiG29K was cleared (February 2003) by the Defence Procurement Board (DPB) for INS Vikramaditya and by the Defence Acquisition Council (DAC)[18] for ADS (*i.e.*, IAC) in September 2008. As per the Ministry's proposal (November 2009) for Option Clause[19] aircraft, the MiG29K is a carrier

[17] Range – the distance a ship can travel which is determined by fuel capacity

[18] DAC is headed by the Raksha Mantri

[19] Option clause - exercised by the Ministry of Defence for acquisition of 29 MiG29K/KUB aircraft in March 2010, which included 12 MiG29K and 01 MiG29KUB for the IAC. The Main Contract for acquisition of 16 MiG29K/KUB aircraft was concluded in January 2004

borne multi role aircraft and would be the mainstay of integral fleet air defence.

2.2.3 Organisational structure for project implementation

Naval shipbuilding comprises various activities as enumerated in Annexure-I. Numerous directorates/entities are involved in the construction and monitoring of the IAC as well as the MiG29K/KUB aircraft. The details are discussed in Annexure-II.

2.2.4 Reasons for Review and Review Objectives

As per the Ministry's proposal (October 2002), trials/delivery of the Indigenous Aircraft Carrier (IAC) was to be completed in 2010, however, as of August 2013, only launching[20] has been completed. Further, keeping in view the critical significance of IAC to the maritime capability and operational readiness of the Indian Navy as well as the fact that indigenous design and construction of the ship had been acknowledged by the Indian Navy as its most prestigious project, audit reviewed the project to ascertain whether :

- The project was being implemented with effective control and monitoring as per the Cabinet Committee on Security (CCS) approvals/contractual provisions and timelines **(Para 2.3.2, 2.3.4.1, 2.3.5, 2.3.6, 2.4.1, 2.4.2, 2.4.3, 2.4.4 and 2.4.5)**
- Acquisition of MiG29K and creation of requisite infrastructure for its exploitation and maintenance was planned and implemented properly in a timely and cost effective manner **(Para 2.5.1, 2.5.2, 2.5.3, 2.5.4, 2.5.5, 2.5.6 and 2.5.7)**

[20] Launching – stage of physical construction when the ship is lowered into water for the first time on completion of the ship's outer hull , major internal hull and part of machinery work, including lowering of major equipment/machineries. Ship construction involves the stages : (i) production (ii) keel laying (iii) launching (iv) outfitting (v) basin trials (vi) contractor sea trials (vii) final machinery trials

- ❖ Effective financial systems were in place and functional to ensure timely and cost effective implementation of the project **(Para 2.6.1, 2.6.2 and 2.6.3)**

2.2.5 Review Criteria

- Cabinet Committee on Security (CCS) approvals (May 1999, October 2002 and July 2014)
- Audit Report of M/s DCN France (1989-90)
- Work Orders (January 2004, November 2005), Phase-I[21] contract (May 2007) and Phase-II[22] contract (December 2014)
- Naval Book of Reference (BR) 1921, Naval Engineering Standards (NES) 33 (May 1981) and Controller of Warship Production and Acquisition (CWP&A) Memo (1998)
- MiG29K/KUB - CCS approval of December 2009 and Option Clause Contract (March 2010) of the Main Contract (January 2004)

2.2.6 Scope and methodology of audit

Review covered the period from 1999-2000 up to September 2015, with regard to construction of the Indigenous Aircraft Carrier. As regards the MiG29K/KUB, the period of audit scrutiny pertained to the period from 2009-2010 to 2014-2015.

Audit examination was carried out between June 2014 and December 2014 and again from June 2015 to September 2015 and consisted of scrutiny of documents/records of the Directorate of Naval Design and other Directorates[23] of Integrated Headquarters of Ministry of Defence (Navy),

[21] Phase-I contract – concluded in May 2007 with scope of work for hull structure construction of 15,000T and outfit of 2,500 T and procurement of materials, equipment blasting and painting, etc.

[22] Phase-II contract – concluded in December 2014 with scope of work for building and floating out the completed hull of the vessel totaling approx 21500 tons of steel weight, blasting and system painting of the hull and outfit, outfitting of accommodation spaces and modular accommodation

[23] Directorates- Directorate of Naval Plans, Directorate of Staff Requirements, Directorate of Electrical Engineering, Directorate of Marine Engineering, Directorate of Weapon Equipment, Directorate of Aircraft Acquisition, Directorate of Aviation Projects Management, Directorate of Naval Air Staff, Directorate of Aircraft Systems and Engineering

Headquarters Naval Aviation, Goa, the Warship Overseeing Team, Kochi and Cochin Shipyard Limited, Kochi.

The draft report was issued to the Ministry of Defence in February 2015 requesting for a written response within six weeks. Pending response, a revised draft report was issued to the Ministry in October 2015. Exit Conference was held (November 2015) with the Ministry of Defence. The reply of the Ministry is awaited (April 2016).

2.2.7 Acknowledgement

We acknowledge the support extended by Integrated Headquarters of Ministry of Defence (Navy), Warship Overseeing Team, Kochi and Cochin Shipyard Limited, Kochi in furnishing the requisite documents, information and replies to the audit queries raised during the course of the Performance Audit.

2.3 Planning and Design

2.3.1 Readiness of the selected shipyard

The Ministry's proposal (May 1999) to the Cabinet Committee on Security (CCS) brought out that a technical audit of the shipyard *viz.* Cochin Shipyard Limited (CSL) was carried out by DCN, France in 1989-90.

The DCN Report (1989) while confirming the capabilities of CSL, mentioned the following issues:

- CSL had never built warships and was not used to the complexity of their designs, hull and systems.
- The shipyard's organisation was mostly vertical without enough functional links between various departments. CSL had no real project management central organisation and was working with many separated departments.
- To adapt Cochin Shipyard Limited (CSL) to produce an aircraft carrier, the DCN Report prescribed basic proposals with respect to augmentation of shipyard's infrastructure, organisation and human resources, which included creation of a Shipyard Project Management Team and a liaison team.

Audit sought clarification on the extent and promptness of action taken by CSL on the basic proposals. CSL replied (May 2015) that the Report of the DCN was not traceable at their end and in the absence of the Report, they had no comments to offer.

Audit scrutiny of records showed that Indian Navy in July 2011 held that the Project Management Team of the shipyard was weak and needed to be replaced with a stronger team. The Indian Navy also contemplated appointment of a dedicated project leader at Director level with an integrated team of Naval officers and yard personnel to bring the project on track. Audit scrutiny further showed that in the revised proposal (March 2014) to the Cabinet Committee on Security, the Ministry brought out that one of the reasons for revision in delivery date was the slow progress of this maiden venture of CSL in warship construction.

The fact thus remains that since CSL was constructing an aircraft carrier for the first time, it was incumbent upon them to fully implement the DCN proposals so as to execute the project within approved timelines.

2.3.2 Preliminary Staff Requirements

Preliminary Staff Requirements (PSRs) indicate the role of the ship, its dimensions, specifications of its hull, major machinery, weapons, sensors, accommodation and manpower, endurance and fuel capacity etc.

PSRs are crucial as they lay down the benchmarks for the platform to be procured, based on which the platform is evaluated and its suitability determined for induction into the service.

Audit scrutiny revealed that:

- The concept design received from DCN in March 1990, based on the operational requirements of the Indian Navy, concluded that a ship of around 37,500 tons was required. However, for various reasons, the Navy considered different tonnage for the ship and accordingly promulgated PSRs which were not in sync with a ship of 37,500 tons. This apart, while submitting (May 1999) the proposal to the CCS, the Ministry did not indicate any tonnage of the ship, as discussed in Para 2.1. Subsequently, in its revised proposal (October 2002) to the CCS, the Ministry indicated that an aircraft carrier of around 37,000 tons was required, without firming up the requisite PSRs. PSRs for the ship of 37,500 tons were promulgated in August 2004 only.
- CCS approved the Ministry's proposal (October 2002) that the ship would be manned by 100 officers and 1350 sailors. However, subsequent to the CCS approval (October 2002), the complement of manpower for accommodation purposes was discussed (January – August 2003) in Assistant Controller of Carrier Projects (ACCP) Review meetings and the complement of manpower at 160 officers and 1400 sailors was finalised in August 2003, which was promulgated in the PSRs of August 2004.

- Even though the Preliminary Staff Requirements (PSRs) of August 2004 stipulated an increased complement of 160 officers and 1400 sailors, the Ministry in its revised (March 2014) proposal to the CCS continued to indicate the earlier approved (October 2002) complement of 100 officers and 1350 sailors, without disclosing the complement stipulated in the PSRs of August 2004.

Directorate of Naval Design (DND) accepted (November 2014) that PSRs for the ship of 37,500 tons were issued in August 2004, but added that the PSRs were processed keeping in mind that the production schedule of the ship was not affected in any way.

Despite the fact that the requirement of the Indian Navy for a ship of 37,500 tons had been identified in 1990, the different PSRs being promulgated were not firmed up in keeping with the identified operational requirement. PSRs for a ship of 37,500 tons were promulgated only in August 2004, nearly 14 years later. Besides, the Ministry did not also mention any tonnage requirement while seeking approval (May 1999) of the Cabinet Committee on Security (CCS). Further, manpower requirements promulgated in the PSRs of August 2004 were not intimated by the Ministry in its revised proposal (March 2014) to the CCS, as mentioned above.

2.3.3 General Arrangement

The General Arrangement (GA) is a document based on which the ship is designed and constructed. The GA drawings principally represent– volumes, spaces, compartments, bulkheads[24], hull forms, decks and main equipment. Examination of records of Cochin Shipyard Limited (CSL) and the Indian Navy revealed the following:

- There were more than 4270 changes to the GA document by the Indian Navy and due to design changes, more than 1150 modifications in hull structure had been done by the shipyard. Frequent modifications to the hull structure was one of the main reasons for a delay of approximately two years in hull fabrication. Cochin Shipyard Limited (CSL) claimed that the continuing changes had not permitted the yard to complete the design of the ship and was one of the major reasons for delay in design completion. While the

[24] Bulkheads – a wall within the hull of a ship which enhances structural rigidity of the vessel, splits functional areas into rooms and creates watertight compartments to contain water in the case of hull breach

Indian Navy contended that 1193 changes were proposed by Cochin Shipyard Limited (CSL), the latter observed that modifications to General Arrangement (GA) document raised by them had been done to resolve/correct issues arising out of incorrect design in GA document prepared by the Indian Navy.

- Any modification to the GA document of Indigenous Aircraft Carrier (IAC) had a consequential effect on the detailed design and construction schedule of the carrier. As hull construction was complete and further changes had larger implications, CSL requested (May 2015) the Indian Navy to restrict any more changes in order to allow the yard to proceed unhindered with building the carrier. CSL also considered it very important that the arrangements be frozen before realistic target dates for completion of the ship could be defined.

It is evident that frequent changes in GA document by the Indian Navy have had an adverse impact on the progress of the project.

2.3.4 Work Order

The Ministry decided (August 2003) that a contract could be entered into with CSL only after the design was frozen and the cost elements became clear. The Ministry, therefore, placed (January 2004) on CSL a Work Order for 'Design Development and Pre-Production Activities', to enable the design activities to proceed unhindered along with ordering of long lead items and steel. Later, an amendment to the Work Order was issued (November 2005), primarily to cater to shipbuilding charges, material procurement, payment of advances, infrastructure for IAC and validity of the Work Order till 16 April 2006 or up till the signing of the shipbuilding contract.

2.3.4.1 Contracts for External Design Inputs

The Cabinet Committee on Security (CCS) approved the Ministry's proposal (October 2002) for engaging suitable external agencies to undertake certain design modules and provide necessary consultancy inputs/design inputs of Aviation Facilities Complex (AFC), weapon/sensor systems and spaces.

Audit scrutiny of records relating to external design inputs revealed the following:

2.3.4.1 (a) Aviation Facilities Complex Design

Aviation Facilities Complex (AFC)[25] houses aviation armament, stationary and mobile systems, devices and aggregates for ship borne aircraft technical support and maintenance. AFC design is one of the most critical activity for design of the AFC spaces comprising composite layout of more than 300 compartments and specifications of equipment. AFC design was scheduled to be carried out between September 2002 and December 2004, however, the contract for undertaking AFC design was concluded between CSL and ROE, Russia only in April 2006 at a cost of ₹75 crore. The design was completed in January 2009, against scheduled completion by December 2004.

Audit analysed the reasons for delayed conclusion of contract and found that:

- The preliminary Price Negotiation Committee (PNC) held in January 2003 remained inconclusive as the Indian side found the cost provided by the Russian side to be insufficient as the cost did not indicate item-wise breakdown of man-hours. The Russian side expressed their inability to furnish these details as the Indian side had provided them with initial data which included only several sketches of General Arrangement[26].
- The subsequent PNC held in December 2003 also remained inconclusive as the Russian side could not substantiate the cost, which was eventually substantiated only in March 2005.
- There were changes (March 2005) to scope of work and the draft contract incorporating changes was made available by the Indian Navy to CSL only in August 2005 and the PNC was held and the contract concluded in April 2006.

The delay had an adverse effect on the project as discussed below :

- ✓ Delay in conclusion of the Aviation Facilities Complex (AFC) design contract was one of the reasons for shift in the ship's delivery date from December 2010 to December 2014.

[25] AFC - items, systems and technical devices required for using the aircraft onboard the ship

[26] GA- It is a document based on which the ship is designed and constructed

- ✓ AFC equipment were to be ordered by December 2006, however it was only after completion of AFC technical design[27] in January 2009 that the procurement action for AFC equipment could be initiated (April 2009).
- ✓ Change in specifications of Diesel Alternators (DAs) from 2 MW to 3 MW **-** The load chart initially developed in 2000 for Indigenous Aircraft Carrier was based on inputs from INS Viraat and did not take into account majority of the equipment forming the AFC proposed for IAC. Subsequent to progress of AFC design, the load of AFC equipment increased to 8.7 times the initial planned load. To cater to the increased load and space constraints, specifications of the Diesel Alternators were changed (November 2007) and retendering was resorted to, delaying procurement, as discussed in Para 2.4.4.2 (a) (i). Even as the specifications of DAs were intrinsically linked with the load of AFC equipment, the tenders for 2MW DAs were floated (November 2006) without firming up the AFC design inputs.
- ✓ As the AFC design was still being finalised during 2007 and 2008, there were changes to the GA document, resulting in relocation of compartments. Consequently, as seen from the Minutes of CPRM[28], there was loss of 4,440 design man days.

Directorate of Naval Design (DND) stated (November 2015) that the delays were unavoidable since design and construction of the Indigenous Aircraft Carrier (IAC) was being undertaken for the first time.

The reply of the DND is not acceptable as the Indian side failed to provide the complete GA document and did not work in close coordination with the Russian counterparts to finalise the contract within scheduled timelines. In spite of the fact that design and construction of the ship was being undertaken for the first time, the Ministry while seeking approval (October 2002) for construction of the ship had

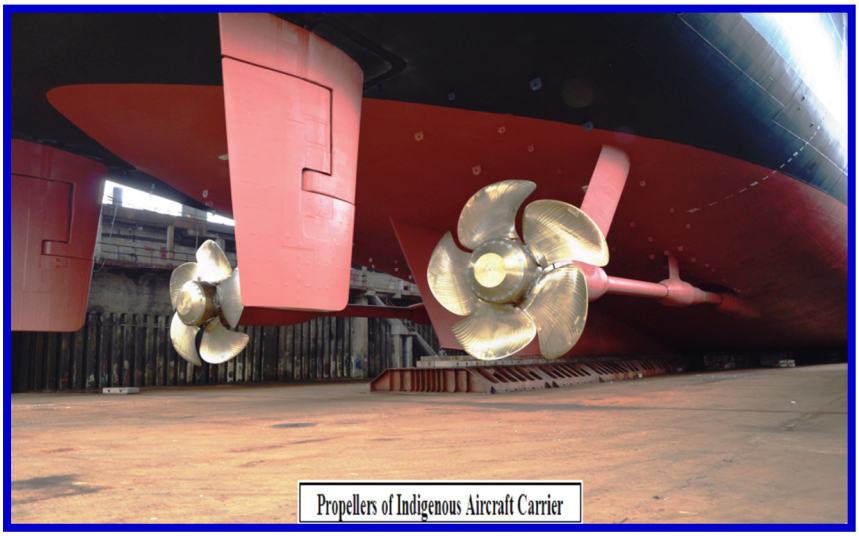
[27] Technical design – design documents containing final technical decisions, data, drawings, technical assignments and procurement specifications developed by the Russians as per the contract

[28] CPRM – Controller of Warship Production and Acquisition Progress Review Meeting

scheduled the delivery in December 2010, which proved to be highly optimistic.

2.3.4.1 (b) Propulsion Systems Integration

As per the Ministry's proposal (October 2002) to the Cabinet Committee on Security (CCS), Propulsion Systems[29] Integration (PSI) design was scheduled to be carried out between June 2002 and March 2006, however, the contract for PSI was concluded only in May 2004.



Audit analysed the reasons for delay and found continued lack of clarity on the work package as discussed below :

The preliminary work package was prepared (July 2001) by the Directorate of Naval Design (DND), on which technical proposals of firms were obtained, leading to recasting of work package. Subsequently, draft contract and draft work package document were forwarded (September 2002) by Directorate of Naval Design (DND) for comments of firms prior to issue of tenders in January 2003. However, even after issue of tenders by Cochin Shipyard Limited (CSL), there was difference in methodology of various firms for Propulsion System Integration. This again necessitated rationalisation of the work package and its recasting to arrive at a technically common platform. This was indicative of lack of clarity on the work package at the time of

[29] Propulsion system - consists of two propulsion plants each comprising two Gas Turbines per shaft, each plant comprising (i)two Gas Turbine, one Gearbox, shaftlines, Thrust block, Plummer blocks, CPP hydraulic system and associated systems, Controllable pitch propeller (CPP), Gas Turbine intakes/uptakes and associated auxiliary equipment and systems.

issue of tender, which was issued after several discussions with the firms, leading to delay in conclusion of the PSI contract.

Ultimately, the PSI design was completed by October 2009 only, *i.e.*, 3 ½ years after the scheduled completion by March 2006. Delay in conclusion of the PSI contract was one of the reasons for revision in delivery date of the carrier.

2.3.5 Integrated Hull Outfit and Painting

As per the VCNS[30] Memo (March 2000), Integrated Hull Outfit and Painting (IHOP) method of construction reduces the build period and enhances the productivity. It involves extensive outfitting of hull blocks in the shop floor before taking them to the building dock for integration. This method of construction to be followed by Cochin Shipyard Limited (CSL) required that the equipment fit and design to be largely frozen before the production commences, as it allows only very limited telescoping of design and production. Directorate of Naval Design observed (September 2002) that Indigenous Aircraft Carrier (IAC) was to be the first Indian naval vessel to be built under IHOP.

However, the Indian Navy considered (May 2004) it desirable to commence at least hull fabrication as soon as the structural design was completed without waiting for the outfit design, which was at variance to the concept of IHOP. Audit scrutiny revealed that the concurrent design progress along with ship construction had affected the progress of the project and took more efforts and resource allocation from the yard than was originally envisaged, as discussed in Para 2.3.3, 2.4.4.2 (a) (ii), 2.4.4.2 (b) and 2.4.4.2 (d).

In response to audit query about extent of implementation of IHOP in ship construction, Directorate of Naval Design (DND) replied (December 2014) that the concept of IHOP was intended to be adopted for the Indigenous Aircraft Carrier (IAC) to allow integrated outfitting and painting of structural blocks so that there was an increase in productivity and reduction in build period. However, the design finalisation of various systems/equipment was not possible and the concept was implemented partially, to the extent possible during the Phase-I construction.

It is evident that while the Indian Navy's vision to utilize the IHOP method of construction did not fructify in the IAC project due to non-

[30] VCNS – Vice Chief of Naval Staff

finalisation of design and equipment fit before taking up hull construction. Further, the Navy itself took the decision to commence hull construction without waiting for the outfit design. Resultantly, the benefits to be derived in the form of a shorter build period could not be achieved.

2.3.6 Build Strategy

Build Strategy is a document which contains comprehensive plan/schedule of the yard covering all important activities of design, phases of construction, yard's procurement schedule for machineries and equipment, availability of yard resources like manpower/shop floor etc. The Naval Shipbuilding Procedure stipulates approval of the Build Strategy prior to seeking approval of the competent authority.

The Build Strategy was a deliverable of the Detailed Engineering and Documentation Contract (DEDC) concluded (May 2004) by CSL with Fincantieri, Italy.

Audit observed (July 2014) that: -

- Scrutiny of records (July 2005) of the Warship Overseeing Team revealed that Fincantieri had requested the productivity norms of CSL which the shipyard did not provide on the plea that they did not have norms relating to warship production and that CSL had an apprehension that Fincantieri might propose a Build Strategy which they would find difficult to emulate.
- Based on the document submitted by M/s Fincantieri, Cochin Shipyard Limited (CSL) prepared (November 2005) a Build Strategy which did not cover productivity norms and commitment of infrastructure, manpower, equipment etc.
- A revised Build Strategy was forwarded (February 2008) by CSL to Integrated Headquarters, Ministry of Defence (Navy) {IHQ MoD (N)}, being a deliverable of the Phase-I contract (May 2007). However, with revision in project timelines, the Empowered Apex Committee (EAC) had directed (June 2012) CSL to revise the Build Strategy, accordingly.

- The Phase-II contract (December 2014) stipulated that the Builder shall prepare a PERT showing the major milestones of the work along with a Build Strategy and progress the work accordingly.

In response to audit query (July 2014) about when the Build Strategy was finalised, the Indian Navy replied (February 2015) that the Build Strategy of November 2005 was being referred to different phases of shipbuilding.

The reply of the Indian Navy is not tenable because the Build Strategy of November 2005 was an incomplete document as it did not cover productivity norms and commitment of infrastructure, manpower, equipment etc. Frequent revisions to the Build Strategy contradicted the Naval Shipbuilding Procedure which stipulates approval of the Build Strategy prior to seeking approval of the competent authority.

2.3.7 Design Feedback Reports

Design audit of new construction ships is to be effected through the system of Design Feedback Reports (DFRs). The aim of undertaking a design audit is to methodically examine and review suggested design changes that would enhance the operational effectiveness of the ship. The reports are required to be raised by the Indian Navy to cover different phases of ship's lifecycle *viz*, design phase (up to launching), construction and induction (from ship's launch to guarantee period) and operational period. While forwarding the DFR to Directorate of Staff Requirement, the concerned Production Directorate is to evaluate and endorse on the DFR, the feasibility of implementing the proposals in ongoing project/delivered ships through the Builder along with cost and time penalties where applicable.

Audit scrutiny revealed that the carrier was launched in August 2013, however, no DFRs had been generated. Directorate of Naval Design (DND) accepted (May 2014) that DFRs had not been generated so far, however it stated that the initial design evolution of IAC had been in close interaction / discussions with the Professional Directorates and stake holders.

Though, DFRs are required to be raised and processed for completing the feedback-action loop to derive the benefit of inputs in ship design, the core purpose and aim of design audit, the benefits to be derived

through DFRs on the carrier were not available to the Indian Navy during the present project of IAC.

2.4 Carrier Construction

2.4.1 Introduction

The Ministry concluded (May 2007) Phase-I contract with Cochin Shipyard Limited, Kochi for construction of Air Defence Ship (later on rechristened as Indigenous Aircraft Carrier). The contract covered fixed price element for hull fabrication/erection of 15,000 tons and outfitting of 2,500 tons, with cost plus element consisting of purchase of equipment and machinery required for launching of the ship by October 2010. Thereafter, the Ministry concluded (December 2014) Phase-II contract for hull fabrication/erection of 6500 tons and outfitting of 5700 tons in fixed price scope of work, with activities up to DG sets harbour trials and setting to work of GT support systems, to be achieved by December 2016. The Ministry's proposal (March 2014) to the Cabinet Committee on Security (CCS) brought out that Phase-III would include outfitting of 1200 tons and balance work (which includes starting of Gas Turbines, Sea trials, etc) up to delivery targeted by December 2018.

Construction on IAC in progress

2.4.2 Construction Timelines

The Ministry's proposal (October 2002) to the Cabinet Committee on Security (CCS) envisaged the construction of the ship between January 2004 and December 2010 without mentioning Phase-wise construction.

Audit scrutiny of records showed the following:

- The Ministry sought (December 2006) the approval of Raksha Mantri (RM) to conclude the Phase-I contract activities up to launching scheduled in October 2010 and rest of the activities up to delivery of the Indigenous Aircraft Carrier in Phase-II. However, in August 2010, Cochin Shipyard Limited (CSL) proposed further splitting of the activities after Phase-I, into Phase-II and III, which was deliberated and accepted (August 2010) by the 5th Empowered Apex Committee (EAC). The EAC decided that CSL was to submit offer for scope of work and yard effort cost for Phase-II as well as rough estimate for balance work till delivery.
- The Phase-I contract (May 2007) stipulated that the contract for the subsequent phase should be signed at least six months prior to completion of hull fabrication and outfitting under Phase-I contract. The launching of the carrier took place in August 2013, the final stage of Phase-I construction. However, there was undue delay in conclusion of Phase-II contract, which was concluded only in December 2014, *i.e.*, sixteen months after conclusion of Phase-I construction. There was no contractual criteria for monitoring the progress in absence of Phase-II contract for the intervening period of 16 months.
- Cochin Shipyard Limited (CSL) submitted (November 2011) a PERT chart which indicated the targeted delivery of the carrier as 2018. The Navy pointed out (May 2012) that the scope of work submitted by CSL for Phase-II planned for completion by 2016 left out a large number of critical shipbuilding activities[31] which cannot be completed in the remaining two years. Yet, the Ministry went ahead

[31] Critical shipbuilding activities - commissioning and trials of Aviation Facilities Complex systems, Basin Trials, Sea Trials etc

with seeking (March 2014) approval of the CCS for targeted delivery of the ship in December 2018.

- The project review was required to be carried out within six months of conclusion of the Phase-II contract *i.e.*, by June 2015. However, no project review had been undertaken as of June 2015. This is despite the fact that completion of project review was essential for CSL to continue work on the project, as per the Preamble of the Phase-II contract (December 2014).

Even as the construction of the ship was being executed in Phases, however, due to the impasse or continuing disagreement over scope of work and timelines between the Indian Navy and CSL up to June 2015, realistic dates for delivery were yet to be worked out with certainty, as discussed in Para 2.4.3. This shows that the Navy and CSL had to work in sync for ensuring delivery of the ship as per approved timelines.

2.4.3 Timelines for Final Delivery

Naval Engineering Standard (NES) 33 informs that as the shipbuilder manages and controls the entire shipbuilding process, he is the only authority able to report with complete knowledge as to his achievements, intentions and management activities.

Cochin Shipyard Limited (CSL) submitted (September 2014) a PERT chart to the Indian Navy which indicated shift in project timelines to 2023, however as seen from the records of the Indian Navy and CSL, an impasse persisted between CSL and the Indian Navy over the review of timelines even after conclusion (December 2014) of the Phase-II contract. In spite of acknowledging (May 2012) itself that Phase-II work planned for completion by 2016 left out a large number of critical shipbuilding activities which cannot be completed in the remaining two years as discussed in Para 2.4.2, the Indian Navy informed (June 2015) CSL that the delivery of the Indigenous Aircraft Carrier in December 2018, as approved (July 2014) by the Cabinet Committee on Security (CCS), should be the basis for planning / execution and project timelines be revised accordingly. This was not acceptable to CSL, which informed (June 2015) the Indian Navy that unless realistic dates were targeted, they would be

unable to plan or execute contracts with various suppliers and turnkey works including accommodation.

Audit scrutiny (September 2015) of CSL's records indicated shift in timelines as tabulated below:

Sl No.	Activity	As per PERT[32] chart of 22 November 2011	As per PERT chart of 02 September 2014*	Shift in Timelines (months)
1	Hull Structure Design	October 2012	December 2017	62
2	Ship System Drawing	January 2015	December 2018	48
3	Electrical Design Activity	July 2016	June 2020	47
4	HVAC Activity	December 2015	December 2019	48
5	AFC Equipment Procurement and Installation	August 2017	September 2021	49
6	Completion of Design & Fitting Plans for Compartments other than Accommodation	April 2014	June 2019	62

**These timelines proposed by CSL are yet to be approved by the Indian Navy*

Further scrutiny of CSL's records showed the following major reasons for shift in timelines of activities as discussed below:

- ✓ The timeline for hull structure design was revised from October 2012 to December 2017 as the completed hull structure required revisions for incorporation of Russian Aviation Facilities Complex (AFC) equipment/ systems modifications, as discussed in **Para 2.3.3**.
- ✓ Production drawings for ship system piping above 4th deck can be issued only after getting details of AFC Power Supply System (PSS), Heating, Ventilation and Air Conditioning (HVAC) system, Russian equipment and inputs from the Indian Navy. Completion of detailed design and issue of production drawings were expected to be completed by Q4 2018, as discussed in **Para 2.4.4.2 (c).**
- ✓ Electrical design activities were delayed by more than four years due to delay in finalisation of inputs from Russian AFC systems/equipment, modification of HVAC system and other equipment inputs such as oxygen system, nitrogen plant, etc. The inputs which are required for completion of electrical design are

[32] PERT – Programme Evaluation and Review Technique

expected to be available by 2016, as discussed in **Para 2.4.4.2 (a) (i) and 2.4.4.2 (c).**

- ✓ Working design documentation from Russian side needed for completion of Heating, Ventilation and Air Conditioning (HVAC) system is expected by September 2018 only with installation and setting to work by December 2019, as discussed in **Para 2.4.4.2 (a) (ii)**
- ✓ Contract and detailed design for certain Russian Aviation Facilities Complex (AFC) equipment had not been finalised and their completion date was the third quarter of 2021, as discussed in **Para 2.4.4.2 (c)**
- ✓ Completion of compartments other than accommodation areas were delayed by more than five years due to non-finalisation of inputs from AFC Russian equipment/systems, modification in HVAC system and other delayed inputs.

It is evident from the PERT chart (September 2014) of CSL that while the delivery of the carrier with completion of all activities is likely to be achieved only by 2023, the Ministry and the Indian Navy continue to hold the timelines of final delivery of the ship as December 2018.

2.4.4 Revision in Project Timelines

The Ministry's revised proposal (March 2014) to the Cabinet Committee on Security (CCS) indicated overall shift in project timelines, *vis-à-vis* the approval of October 2002, as tabulated below:

Sl No.	Area/Segment	Scheduled as per CCS 2002	Actually achieved	Shift in actual time lines (in months)
1	Aviation Facilities Complex (AFC) Design	December 2004	January 2009	48
2	Propulsion System Integration (PSI) Design	January 2006	October 2009	45
3	Commencement of Ordering Long Lead Items	January 2002	January 2004	24
4	Commencement of Production (due to non-availability of steel)	January 2004	November 2006	34
5	AFC Equipment Ordering	December 2006	February 2013	74
6*	Receipt of Gear Box	August 2009	February 2013	42
7*	Receipt of Diesel Alternators	October 2009	December 2012	46
8*	Phase-I Launch	October 2010	August 2013	34
9	Trials/Delivery	December 2010	December 2018	96

* The timelines for receipt of Gear Boxes, Diesel Alternators and Launching were taken by the Ministry from the Phase-I contract (May 2007)

Aerial View of dock with IAC under construction

The effect of conclusion of the AFC design contract and PSI contract in April 2006 and May 2004 respectively on the project have been discussed in Para 2.3.4.1 (a) and 2.3.4.1 (b). Audit analysis of other major delays which have affected the progress of the project are discussed below :

2.4.4.1 Procurement of steel

As per the Ministry's proposal (October 2002) to the CCS, ordering of steel was to commence in March 2003, however, order was eventually placed in December 2004. Non-availability of steel was one of the major reasons which affected the progress of ship construction. Audit analysis showed:

- Supply of steel from M/s Rosoboronexport (ROE), Russia did not materialise as Cochin Shipyard Limited (CSL) could not accept the Corporate Guarantee offered by ROE against the requirement of Bank Guarantee stipulated in the Reserve Bank of India (RBI) circular (December 2003). Consequently, the Indian Navy decided (February 2004) to use indigenous steel which was the equivalent of Russian steel.
- Despite the fact that Steel Authority of India Limited (SAIL) informed (May 2004) the Indian Navy that they could supply only steel plates, the Indian Navy intimated (July 2004) Cochin Shipyard Limited (CSL) that SAIL had confirmed their ability to supply all steel plates and sections (bulb bars) required. Accordingly, CSL placed (December 2004) a Purchase Order on SAIL for supply of steel plates and bulb bars.

Moulding of Steel for hull construction

- The supply of bulb bars from SAIL remained unsatisfactory, warranting their procurement from an alternate source, Rosoboronexport (India) Limited, Mumbai.
- Lack of timely availability of bulb-bars from SAIL severely affected production[33] which commenced in November 2006 [against the schedule of January 2004 as per the approval (October 2002) of the Cabinet Committee on Security] and postponed launching from March 2009 to October 2010.

2.4.4.2 Delivery of Equipment

2.4.4.2 (a) Major equipment

Phase-I contract (May 2007) prescribed the list of 49 major machinery/ equipment to be shipped onboard the Indigenous Aircraft Carrier. Audit scrutiny revealed that delivery delays ranged from three months to 49 months in respect of 49 equipment, against scheduled delivery dates in Purchase Orders (POs), as given in Annexure-III. Audit analysed major reasons for delayed delivery which are tabulated below:

[33] Production – commencement of fabrication of blocks for construction of the ship

No of equipments	Major reasons for delay in delivery
33	Failure of the vendors to adhere to supply schedule
06	Non-adherence to inspection schedule by Quality Assurance Establishment
03	Excess time taken by the foreign collaborator in obtaining authorisation for export from their government.
07	➢ Two Diesel Alternators (DA) were damaged in road accident leading to rescheduling of delivery dates by the firm, ➢ Gear Box components had repeatedly failed, ➢ Delay in finalisation of scope of work of Heating, Ventilation and Air Conditioning System (HVAC) by the Navy ➢ Approval of drawings (Oily Water Separator), ➢ Non-availability of test cell (Gas Turbine), ➢ Incorrect inspection procedures(Steering Gear), ➢ Non-availability of naval team for Factory Acceptance Trials (Sewage Treatment Plant).

Audit analysis of major equipment delays which had affected ship construction are discussed below:

(i) Diesel Alternators and Gear Boxes

A Diesel Alternator (DA) is a generator which in combination with diesel engine generates electric energy for the ship, whereas, a Gear Box is a complex arrangement controlling turbines and powering a large propeller shaft. Both are pre-requisite for launching of the ship.

Audit observed (July/October 2014) that:

Diesel Alternator

- As per the Phase-I contract (May 2007), Purchase Order (PO) for eight DAs was to be placed by August 2007 with delivery by October 2009. Tenders were floated (November 2006) for procurement of 2MW DAs, however, subsequent to progress of Aviation Facilities Complex (AFC) design with the Russian side, there was change (November 2007) in specifications of DAs from 2 MW to 3 MW, as discussed in Para 2.3.4.1 (a). As a result, tenders were re-issued and PO was placed only in September 2008 on Wartsila India (₹155.70 crore), 13 months after scheduled placement of PO. The Diesel Alternators (DAs) were to be delivered in four batches between July 2010 and April 2011.
- The delay in placement of PO got compounded with transit damage (March 2010), resulting in the first batch of two DAs being actually delivered in December 2012. Meanwhile, the remaining six DAs were delivered between September 2011 and July 2012, entailing a delay of nearly three years against scheduled delivery under Phase-I contract.

Gear Box

As per the Phase-I contract (May 2007), purchase order (PO) for Gear Boxes was to be placed by January 2007 with delivery by August 2009. The PO for design, manufacture and supply of two [Port (P) and Starboard (S)] Gear Boxes was placed (January 2007) by Cochin Shipyard Limited (CSL) on Elecon at a cost of ₹38.70 crore, with delivery within 24 months. As per the work sharing between Elecon and Renk[34], all main pinions, gears and shafts except bull gear of Gear Boxes were to be manufactured by Elecon, while manufacturing of bull gear, final assembly and acceptance trials would be undertaken at Renk.

Audit scrutiny (October 2014) of the Indian Navy's and CSL's records showed that :

- The Quality Assurance Establishment (QAE) observed (January 2009) that during impact testing (October 2008) and re-testing (November 2008) of disc wheels, test pieces failed due to low impact value[35],

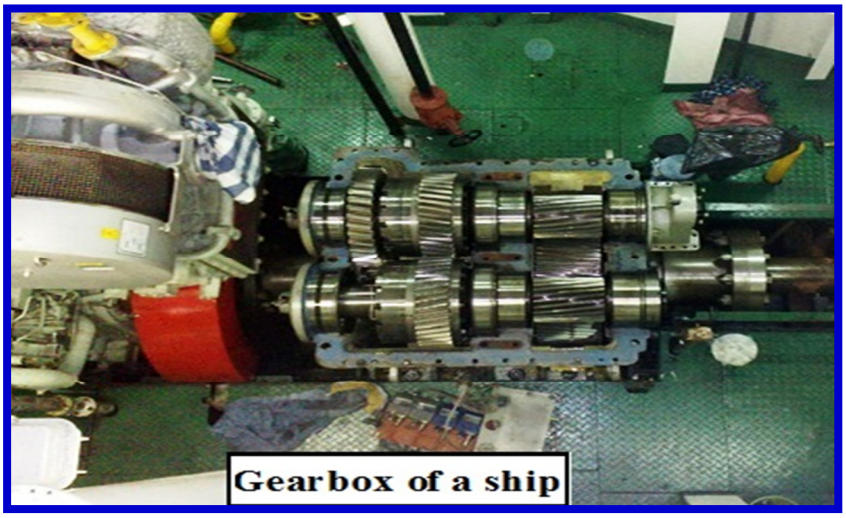
[34] Renk – Original Equipment Manufacturer / Foreign Collaborator of Elecon for the Gear Boxes

[35] Low impact value – the OEM indicated that low impact value could be due to high tensile strength or grain growth. Further testing ruled out grain growth.

indicating issues in quality. Low impact value was due to high tensile strength which in the opinion of the OEM, could be tolerated. However, QAE observed (January 2009) that the specification approved by the Directorate of Quality Assurance (Warship Projects) did not have any clause for acceptance of material with low impact value having high tensile strength.

- Nearly one year after, the Directorate of Marine Engineering observed (December 2009) that the manufacturing of Gear Box components had repeatedly reported defects [36] due to production/quality problems at Elecon.

- A joint meeting was held (February 2010) wherein non-conformities pertaining to rotating components (input shafts) and static components (casing) were discussed. It was decided that if the Gear Box components were found recoverable by Renk (foreign collaborator), they would be shifted to Renk for final machining/corrective operations. The firm committed to deliver the two Gear Boxes in October and November 2010 respectively, which was shifted (September 2010) by the firm to April 2011 and May 2011.



[36] Defects - including (i) delayed cracking on discs (ii) broken/damaged tooth of a gear pinion (iii) runouts beyond permissible limits on both input shafts of the Port GB (iv) bore dimensions, centre to centre distance and parallality beyond permissible limits on Port GB casing

The Gear Boxes were finally delivered by February 2013, a delay of four years. Consequently, instead of launching, a technical float-out (an unplanned/unscheduled activity) of the ship was carried out in December 2011 without DAs/Gear Boxes. The ship was re-docked in February 2013 for installation of DAs/ Gear Boxes and launched finally in August 2013, entailing a delay of 34 months from scheduled launching in October 2010.

(ii) Heating, Ventilation and Air Conditioning System

Heating, Ventilation and Air Conditioning (HVAC) system is a vital system which impacts the overall ship thermal management system and manages supply, exhaust and recirculation of air in every ship compartment.

The Indian Navy provided the Single Line Diagram[37] (SLD) (September 2008) to Cochin Shipyard Limited (CSL) to proceed with modeling in Tribon[38]. CSL placed Purchase order (PO)[39] (May 2010) on Johnson Controls Limited (JCL) for detailed design, fabrication and supply of HVAC system onboard IAC at a cost of ₹97.42 crore, with delivery to be completed by March 2012.

Audit scrutiny of Indian Navy's, CSL's and JCLs records showed that:

- Placement (May 2010) of the Purchase Order (PO) by CSL was prior to finalisation of the HVAC design
- JCL submitted (April 2010) a design validation report for the HVAC system to Indian Navy for approval, in which the firm had brought out design errors and inadequate calculations carried out by Indian Navy. Hence, JCL recommended essentially required modifications, which were accepted by Indian Navy.
- In September 2010, Indian Navy requested additional changes to HVAC design including change in compartment temperatures, manning policy and heat loads etc. Accordingly, JCL submitted the revised Single Line Diagram (SLD) for HVAC in June 2011 which was approved by the Indian Navy in October 2011. The new SLD was entirely different

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[37] Single Line Diagram - is the blueprint for electric system

[38] Tribon – Tribon is a comprehensive 3D shipbuilding software that supports the complete the shipbuilding process material and document control and even product lifecycle after the ship is delivered. The software is being used by public sector shipyards, besides other privately owned shipyards in India

[39] Purchase order - for detailed design, fabrication, supply, installation and commissioning of HVAC

from the Navy's earlier (September 2008) approved SLD, thereby CSL had to undertake complete modification of HVAC. This resulted in variation in the quantity of equipment from original purchase order as well as certain technical requirements/ additional scope which were addressed through an amendment (March 2013).

- During a meeting (December 2012) for Aviation Facilities Complex (AFC) equipment, Russian delegation stated that room air requirements and duct layout inside AFC spaces would be provided by them. Accordingly, HVAC design in AFC compartments had to be modified, which resulted in technical requirements/additional scope, which was addressed by separate Work Order (March 2014).
- Russian side intimated (April 2014) that heat loads in AFC Power Supply System (PSS) compartments were on higher side than those specified initially and hence needed to be recalculated. The heat load changes in AFC PSS required a complete rework of AFC redesign work already completed by JCL. Even after meetings (July 2014 and December 2014) to discuss additional modification on HVAC and finalise redesign inputs, it was seen that Indian Navy has been forwarding further modification requests to JCL even in April 2015.

It was observed that CSL highlighted that changes to HVAC design impacted the design of 800 out of a total of 2,300 ship's compartments, which was likely to have a cascading impact on the design completed in the compartments. Consequently, CSL projected in the PERT chart (September 2014) revised timelines of December 2019 for installation and setting to work of the HVAC system, against targeted delivery of the ship in December 2018.

2.4.4.2 (b) Integrated Platform Management System

Integrated Platform Management System (IPMS) is a distributed control and monitoring system (with 13000 inputs/outputs) of the ship's machinery related to propulsion, power generation & distribution, and auxiliary machinery.

As per the Phase-I contract (May 2007), Statement of Technical Requirement (SOTR) was to be finalised by the Indian Navy by August 2007, with placement of order by CSL in June 2008 and delivery by June 2010. Purchase Order (PO) was placed (October 2010) by CSL on Bharat Heavy Electricals Limited for supply of IPMS and Onboard Spares

and Special Tools, at a total order value of ₹41.56 crore, with the scheduled date of delivery as October 2012.

Audit observed that:

- The Indian Navy finalised the Statement of Technical Requirement for IPMS in September 2008 against August 2007 as scheduled in the Phase-I contract.
- The issue of data sharing was not dealt prior to issue of tenders and was taken up by the Navy only during technical negotiations (July 2009), which caused a delay of nearly eight months in deciding technical suitability.
- Due to additional requirements projected by the Indian Navy, scope of work had been altered and two amendments were issued (June 2014 and December 2014) for change in deliverables, affecting delivery of the system.
- There were disagreements between Bharat Heavy Electricals Limited (BHEL) and Cochin Shipyard Limited (CSL) over issues relating to finalization of input/output list, documents pending with BHEL for submission to the Indian Navy/CSL, collection of interface data from various OEMs and Software Requirement Review.

Changes to the scope effected by the Indian Navy after placement of PO coupled with disagreement over issues affecting delivery of the system was affecting the cardinal dates of the ship as of June 2015.

2.4.4.2 (c) Aviation Facilities Complex equipment

Aviation Facilities Complex (AFC)[40] design was to be completed by December 2004 which was actually completed in January 2009, as discussed in Para 2.3.4.1 (a). Therefore, procurement action for 32 AFC equipment[41] could be initiated only in April 2009 as against the scheduled timeline of December 2006.

Audit scrutiny of records of Indian Navy and CSL showed that:

[40] AFC – items, systems and technical devices required for using the aircraft onboard the ship

[41] 32 AFC equipment – 35 AFC equipment were there as of May 2009, which are now 32 equipment as of November 2015

- Out of 14 non-Russian origin equipment, nine were ordered between May 2010 and October 2015, indicating that even 8 years after scheduled timelines, remaining equipment were yet to be ordered. Of these, seven equipment have been received between September 2012 and May 2015, while two equipment are expected to be delivered in May 2016/June 2016.
- 17 Russian origin Aviation Facilities Complex (AFC) equipment have been ordered between January 2012 and November 2015, after conclusion (June 2011) of a General Contract[42] between CSL and Rosoboronexport. This indicated that procurement commenced nearly 5 years after scheduled timeline of December 2006. Of these, six have been received between December 2014 and June 2015. Out of the remaining 11 equipment, four equipment *i.e.*, arresting gear, hydraulic stations, restraining gear, Navigation Complex Ilmen-71, for which deliveries were scheduled between July 2013 and October 2014, were not delivered as of November 2015. The deliveries for the remaining seven out of 11 equipment were expected between December 2015 and March 2019 (beyond ship's targeted delivery of December 2018).
- The protocol (August 2015) of the 26th meeting of Indo Russian Inter Governmental Commission–Military Technical Cooperation (IRIGC-MTC) highlighted that delay in delivery of the arresting gear and restraining gear was seriously impacting the construction schedule of the IAC.

In response to audit query, Directorate of Naval Design (DND) admitted (November 2015) that delay in delivery of ordered AFC equipment and delay in concluding contracts for balance AFC equipment had affected the progress of construction of Indigenous Aircraft Carrier (IAC). DND also replied that lack of design information on some of the ordered

[42] General Contract – an umbrella contract for placing orders on ROE under separate supplementary agreements which are concluded for manufacture and delivery of AFC equipment. Signed (June 2011) between CSL and Rosoboronexport (ROE) on turnkey basis, it stipulated that the supplier would render technical assistance in the form of documentation, installation, trials and performance of the AFC equipment within 66 months from the date on which the contract comes into effect. The general contract had come into effect from 01 August 2012

Russian equipment and unordered AFC equipment was precluding the completion of modelling of compartments above 4th deck and thereby delay in outfitting of these compartments.

2.4.4.2 (d) Combat Management System

Combat Management System (CMS) for IAC is a software/hardware integration project, designed to handle various battle scenarios.

As per the agreed schedule (July 2008) between Indian Navy and CSL, CMS was to be ordered by November 2009 and delivered by December 2011.

Audit scrutiny (September 2015) of records revealed that:

- Statement of Technical Requirement was forwarded (January 2010) by Indian Navy to CSL for initiating tendering and procurement action in January 2010, as against the scheduled date of November 2009 for ordering the equipment.
- The Indian Navy did not firm up the scope of work prior to initiating tender action and post tender opening (September 2010), more than 13 months were taken in finalising the issues in technical negotiations (November 2011).
- During and post TNC, it was seen that Indian Navy had proposed new technical requirements and changes to scope of work like (i) requirement of a design consultant for development of application software (ii) CASE[43] tools for development with 05 year support and upgrades to be provided by the OEM with warranty. Purchase Order (PO) was eventually placed by Cochin Shipyard Limited (CSL) on Tata Power Co Ltd (TPCL) in July 2012 .
- Post issue of purchase order (PO), TPCL raised (October 2012) certain issues about the ambiguity in the Purchase Order Technical Specification (POTS) enclosed with the PO. A meeting was held (October 2012) between Indian Navy and TPCL to convey the Navy's stand on the issues raised by TPCL, indicating lack of clarity in the scope of work even 04 months after placement of PO.
- Changes in requirement by the Indian Navy had extended the timeline for design and development stages. The Indian Navy

[43] CASE – Computer Aided Software Engineering

initiated more than 300 design change requests leading to rework. There were change requests which had not yet been discussed and approved (May 2015).

Consequently, as seen from the records of CSL, delay in delivery would have serious impact on the work content of the yard and IAC project timelines due to late arrival of equipment and transshipping majority of large size consoles (to be installed onboard as per Phase-II contract) in lower deck areas.

2.4.4.2 (e) Fire Fighting System for Machinery compartments

The fire fighting system for machinery compartments is designed to fight major fires in the engine room and Diesel Alternator (DA) room. It is essential for setting to work[44] and trials of equipment in the engine room and Diesel Alternator (DA) room.

Audit observed (September 2015) that changes to technical requirements/ specifications of the fire fighting system and lack of decisive and timely action while tendering by IN/CSL led to repeated re-tendering (April 2011, October 2012, September 2013 and August 2014). As per the PERT chart appended to the Phase-II contract (December 2014), DA trials are scheduled between December 2015 and December 2016.

However, CSL had informed (June 2015) the Ministry of Shipping that the design of the system had not been finalised and the delay would lead to rework on the outfitting front in the engine rooms, where the yard had already gone ahead and completed issue of all drawings. Audit observed that the purchase order had not been placed till September 2015.

2.4.5 Project Management and Overseeing

The Ministry's proposal (May 1999) to the Cabinet Committee on Security (CCS) considered it necessary to have a two tier Project Management Board (PMB) under an Empowered Apex Committee[45] (EAC)

[44] Setting to Work – operation of equipment independently on completion of installation onboard and to conduct checks on the necessary parameters.

[45] Empowered Apex Committee - Ministry of Defence constituted the EAC in April 2005 with Defence Secretary (Chairman), Vice Chief of Naval Staff (Alternate Chairman) and Secretary (Defence/Finance), Special Secretary (Acq), Addl Secretary (I), Joint Secretary (Shipping), Chief of Material, Controller of Warship Production & Acquisition, Assistant Chief of Naval Staff (Policy &Plans), Director General Naval Designs, Principal Director Naval Design and Assistant Controller Carriers Projects as members

and an Air Defence Ship (ADS) Project Group headed by a Rear Admiral with a view to minimize time and cost overruns. The revised proposal (October 2002) of the Ministry further provided for the Steering Committee[46] as part of the two-tiered PMB and brought out that a Warship Overseeing Team (WOT) would also be set up to supervise and oversee the construction of the ship at Kochi.

Besides the above mechanisms, the Ministry had constituted the Assistant Controller Carrier Projects (ACCP) in May 2000 and the Integrated Project Management Committee (IPMT) in March 2006. The first CPRM for review of the project took place in May 2003.

Audit findings on the setting up and functioning of these project management and monitoring mechanisms is discussed in subsequent paragraphs:

2.4.5.1 Delayed constitution of the Empowered Apex Committee

Audit observed (July 2014) that the Empowered Apex Committee (EAC) was constituted only in April 2005, nearly six years after the project was approved (May 1999) by the Cabinet Committee on Security (CCS). Directorate of Naval Design (DND) admitted (July 2014) that the project was being monitored by the Steering Committee.

Audit, however, observed that the impasse over procurement of steel arose in December 2003 and EAC was not constituted by then, preventing the project from receiving its guidance then.

2.4.5.2 Role and Functions of the Monitoring Mechanisms

(A) Empowered Apex Committee

- Authorised to exercise full powers of the Government for project execution, review physical and financial progress and take corrective measures.
- Looks into all issues entailing time and cost overruns referred to it by the Steering Committee on the IAC project.

[46] Steering Committee - Ministry of Defence constituted the SC in June 2004 with Additional Secretary (Chairman), Principal Director Naval Plans (Member-Secretary) and Jt Secretary & Acquisition Manager (Maritime & Systems), Addl Financial Adviser in charge of Naval Acquisition and Jt Secretary (IWT) (in charge of CSL), Director (Operations), Assistant Controller Carrier Project, Principal Director Naval Design as members

(B) Steering Committee

- Monitoring the progress of work in each contract and ensuring completion of stipulated activity at each stage
- Referring all issues which entailed time/cost overruns to the Apex Committee.

(C) Integrated Project Management Team

- Examining and expediting all aspects of design, construction of the ship
- Regularly reviewing the progress against measurable targets

2.4.5.3 Shortfall in frequency of meetings

Audit observed (July 2014)

- Shortfall in frequency of meetings of the various project monitoring committees. The details from first meeting till June 2014, are tabulated below:

Mechanism	First meeting	Total number of meetings to be held since first meeting	Actual number of meetings held till June 2014	Shortfall (*per centage)*
EAC	August 2005	20	8	60
Steering Committee	February 2001	54	8	85
CPRM	May 2003	45	18	60
IPMT	May 2006	198	18	91

- During the entire duration (May 2007-August 2013) of execution of the Phase-I contract (May 2007), only one meeting of the Steering Committee was held (September 2007), indicating that the Committee was dysfunctional for the above mentioned duration. The next meeting after September 2007 took place only in May 2015. The absence of meetings during this period precluded any reference to the Empowered Apex Committee about issues which entailed time/cost overruns.
- Further, there was no meeting of the Steering Committee between July 2001 and May 2004 when the bottleneck over procurement of steel from Rosoboronexport arose (December 2003). The project was therefore, devoid of its guidance on this issue.

- There were no meetings of IPMT between December 2010 and June 2014, preventing examining/expediting all aspects of design, construction of the ship.

Directorate of Naval Design (DND) accepted (August 2014) that there was shortfall in meetings of project monitoring committees.

2.4.5.4 Effectiveness of CWP&A Progress Review Meeting

CWP&A Memo 01/98[47] (February 1998) stipulates that for every delay, the shipyard is to render a report to WOT, which in turn, will put up a detailed report[48] to IHQ MoD (N) whose findings should be ratified during the ensuing CWP&A Progress Review Meeting (CPRM) and the minutes of CPRM are to conclusively attribute delays along with the revised cardinal dates and cost overruns.

It was noticed in audit that only six notices of delay (with respect to equipment) were served (September 2007) by the shipyard and none thereafter. There were no reports rendered by WOT(K) as per the prescribed format of the Memo. Resultantly, CPRMs were not sufficiently apprised of delays, so revised cardinal dates and cost overruns could not be realistically determined. DND accepted (September 2014) that delays were discussed in CPRMs in the form of issues and action addressees only.

It is evident that the mechanism to capture time and cost overruns had not been scrupulously followed, depriving the project of the course of action to mitigate the effect of delay as well as preventing an assessment of the implications of delay on the sanctioned cost and time of the Project.

2.4.5.5 Monitoring of physical progress

Naval Engineering Standard (NES) 33 (May 1981) prescribes a form of reporting procedure throughout the period of building a ship, condensing any ship progress into a coherent series of documents which together allow a quick and accurate assessment of overall progress. There are 11

[47] CWP&A Memo – Procedure for Reporting and Attributing Causes for Delays in Shipbuilding

[48] Detailed report – covered aspects like (i) recommended course of action to mitigate the effect of delay (ii)implications of delay on the sanctioned cost and time of the Project (iii)revised PERT chart consequent to the delay

essential reporting subjects/groups. Formats have been prescribed for six[49] groups which include one group (Group C) for reporting on activity-wise percentage progress of work at the ship and in the shop.

Audit observed (September 2015) that the Ministry failed to incorporate tables containing the following aspects (from six essential formats for progress reporting by the shipyard) in the contracts.

- Milestones programmed but not achieved till date of report, with reasons for failure and revised date (ii) milestones at risk during next three months, with reasons for doubt and revised date
- Number of drawings programmed for completion at report date and number of drawings issued to production, with breakup of drawings between Ship, Mechanical and Electrical drawing offices etc
- Progress of work at ship and in shop showing activity-wise percentage programmed and actually completed
- Break-up of utilisation of manpower between planning office, hull drawing office, mechanical drawing office, electrical drawing office, quality assurance etc., with cumulative hours charged to ship at the date of the report.

Resultantly neither the Ministry nor CSL could assess the physical progress of construction as the reported progress of construction did not convey the true picture of the state of construction, the rate of construction and the required rate of construction to meet the targeted delivery of the ship in December 2018.

2.5 MiG29K/KUB Aircraft

2.5.1 Procurement of aircraft

MiG29K is the mainstay of the Indian Navy's fleet air defence, being the choice of aircraft for both the aircraft carriers, viz. INS Vikramaditya and

[49] Six reporting groups –Group A (Progress against Cardinal Date Programme), Group B (Drawings-Issue of drawings to production), Group C (Progress of Design/Development), Group D (Utilisation of Labour), Group E (Equipment procurement-Shipbuilder Supplies item), and Group F (Equipment Procurement-Ministry's Supplies Items)
Remaining five groups – Group G (Quality Documentation), Group H (Alterations and Changes) Group J (Weight and Stability Control), Group K (Type Testing), and Group L (Support Management)

Indigenous Aircraft Carrier (christened as INS Vikrant) as well as two naval air stations on the East and West coast.

The MiG29K of the Indian Navy is a new generation aircraft and has a newly designed airframe with latest technology, incorporating high strength composites in its construction making the structure significantly more resilient than its predecessors *i.e.*, MiG29, as indicated in the Cabinet Committee on Security approval of December 2009. The aircraft has fly-by-wire[50] technology and its RD 33 MK engines are a definitive advancement over the MiG29.


MiG 29 K Aircraft landing on deck of Aircraft Carrier

The Ministry concluded (January 2004) a contract with the Russian Aircraft Corporation (RAC) MiG for acquisition of 16 MiG 29K/KUB aircraft[51] and associated equipment at a cost of USD 740.35 million (₹3,568.49 crore), which included 13 aircraft for Admiral Gorshkov (*i.e.*, INS Vikramaditya). Thereafter, the Ministry had concluded (March 2010) an Option Clause contract for acquisition of 29 MiG 29K/KUB aircraft (which included 12 MiG29K and one MiG 29KUB for the Indigenous Aircraft Carrier (IAC) at a cost of USD 1466.44 million (₹6,840.94 crore), estimating that the IAC would be delivered by 2014. The deliveries of the Option clause aircraft scheduled between 2012 and 2016 are much ahead of the delivery schedule of the IAC in 2023, as projected by Cochin Shipyard Limited.

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[50] Fly-by-wire (FBW) is a system that replaces the conventional manual flight controls of an aircraft with an electronic interface and allows automatic signals sent by the aircraft computers to perform functions without the pilot's input, as in systems that automatically stabilise the aircraft

[51] 16 MiG 29K/KUB aircraft– includes 12 MiG 29K, 01 MiG 29KUB for INS Vikramaditya and none for IAC

Audit scrutiny of documents relevant to the MiG 29K/KUB aircraft revealed the following issues:

2.5.2 Quality of the MiG29K/KUB

As per the Cabinet Committee on Security approval of December 2009 for acquisition of 29 MiG29K/KUB aircraft under Option clause of the Main Contract (January 2004), the carrier compatibility of MiG29K aircraft would be tested/evaluated [52] on the Russian carrier Kuznetsov in Russia followed by certification trials from ex-Gorshkov once she is ready.

As per Clause 1.3 of the Main contract (January 2004) and Option clause contract (March 2010), aircraft shall mean MiG29K and KUB aircraft which are capable to be used from Project 11430 (INS Vikramaditya). All 16 aircraft of the Main contract were delivered between December 2009 and October 2012. The first deck landing of the MiG29K/KUB on the decks of Admiral Gorshkov was undertaken at Russia in July 2012.

Since the capability of the Main contract aircraft could not be tested/proved from the decks of INS Vikramaditya prior to exercising the Option clause, the quality of the airframe, engines as well as fly-by-wire of the MiG 29K/KUB remained un-assessable prior to exercising the Option clause.

2.5.2.1 RD-33 MK Engine

The service life of RD-33MK engine fitted on MiG29K/KUB is 10 years/4000 hours with an overhaul life of 1000 hours.

The Navy had placed on RAC MiG a total order for 113 engines along with 45 aircraft (90 installed on aircraft[53] and 23 spare engines) under Main and option clause contract. The Indian Navy accepted 21 aircraft up to September 2014.

[52] Tested/evaluated – RAC MiG had successfully completed carrier demonstration trials from the Russian carrier Kuznetsov on 29 September 2009

[53] MiG29K/KUB-consisting of two engines

Audit observed (December 2014) that as of September 2014, a total of 65 engines (42 with 21 aircraft and 23 spare) had been accepted. However, since induction in February 2010, 40 engines (representing 62 *per cent* of 65 engines) had been withdrawn from service/rejected due to design related defects/deficiencies. The issue had serious flight safety implications, since in-flight engine defects had led to ten cases of single engine landings.

Audit further observed from the protocol (September 2014) of the 16th IRIGC-MTC[54] that RAC MiG had forwarded a list of 17 modifications which they had scheduled to complete on all engines held in India by November 2014. However, as of September 2015, it was seen that four modifications (out of 17) had been implemented by RAC MiG on all engines and balance 13 modifications would be implemented as and when engines were sent to OEM at Russia for overhaul/repair.

In response to audit query about status of repairs on engines withdrawn, the Indian Navy replied (November 2015) that repairs of defective engines were being taken up with RAC MiG based on warranty/non-warranty basis, adding that repair of non-warranty engines were being progressed under IHQ MoD (N) indents.

[54] IRIGC-MTC : Indo Russian Inter-Governmental Commission – Military Technical Cooperation

The fact remains that up to August 2015, the number of engines withdrawn from service/rejected was 46, indicating that even as the RD-33 MK engine was considered an advancement over the engine of the MiG29, its reliability remains questionable.

2.5.2.2 Failure of airframe parts during deck operations

Major defects arose during first (July 2012) and subsequent deck trials of the MiG 29K/KUB on Admiral Gorshkov as reported (July 2013) by Headquarters Western Naval Command, Mumbai to Directorate of Naval Air Staff. The Russian Aircraft Corporation (RAC) certified (May 2014) that aircraft performance of MiG29K/KUB aircraft under tested conditions of INS Vikramaditya operations mainly conformed to the assigned specifications, however added that weaknesses were revealed during flight tests, which were to be eliminated. Directorate of Air Support Equipment informed (June 2014) RAC MiG that numerous defects[55] pertaining to failure of airframe parts had occurred during deck operations despite modifications.

Responding to audit query (August 2014), Navy stated (September 2014) that the defects on the aircraft were being monitored and RAC MiG was being apprised of the criticality to initiate suitable remedial measures.

Audit, however observed from the protocol of the 18th Indo Russian Inter Governmental Commission – Military Technical Cooperation (IRIGC-MTC) (August 2015) that defects had occurred despite numerous design improvements and modifications and regular occurrence of these defects on sortie to sortie basis was having an adverse impact on Indian Navy pilots training and capability of aircraft for undertaking prolonged deployments.

2.5.2.3 Fly-by-wire system

Audit observed (December 2014) from the Agenda points of 6th Reliability and Maintainability Programme Plan (RMPP) for MIG29K/KUB aircraft that the reliability[56] of the fly by wire was very poor, ranging from 3.5 *per cent* to

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[55] Defects - Defect of shearing of side bolt of engine mounting, failures of INCOM mounting tray, failure of Radar scanner mountings had been observed

[56] Reliability – calculated in terms of percentage of Mean Time Between Defects (MTBD) actual as against MTBD by OEM. MTBD is the arithmetic mean flying hours between defects, calculated by dividing the fleet flying hours in a given operation period by the number of defects observed in the same operating period

7.5 *per cent* between 01 July 2012 and 30 June 2014 and measures were to be taken by RAC MiG to improve reliability of the system.

2.5.3 Delay in build-up of aircraft

As per Clause 16 of the Option Clause contract (March 2010), post delivery of aircraft, the Russian Warranty Team (RWT) has to assemble/build up[57] the aircraft and offer to the Navy for technical acceptance.

Audit scrutiny revealed:

- The service life of the aircraft is 6000 hrs or 25 calendar years whichever is earlier, as seen from the Option clause contract (March 2010).
- Out of 19 aircraft delivered up to November 2015, 12 had been built up, with time taken for build up ranging from two months to fifteen months.
- The contract did not stipulate any timeframe for completion of build up/assembly. Therefore, the delays in build up would reduce the service life**,** thereby impacting the operational life of the aircraft.

2.5.4 Technical Acceptance of the aircraft

As per the Option Clause contract (March 2010), in case the customer's representatives have any observations during the aircraft technical acceptance, these shall be eliminated by the supplier's representative before the Technical Acceptance Report (TAR) is signed. As of November 2015, ten aircraft had been technically accepted.

Audit observed discrepancies/anomalies on the first MiG29K/KUB of the Main Contract technically accepted in February 2010, continued to persist on six aircraft acquired under the Option clause as discussed below :

- The Acceptance Protocols (December 2013 – March 2015) of aircraft showed discrepancies/anomalies with respect to Log cards, passport and defects during pre-flight acceptance of aircraft.
- The Russian side agreed (December 2013 – March 2015) that technical acceptance had not been undertaken in the full scope of

[57] Build up – Assembly of aircraft after delivery

the aircraft capabilities and the technical acceptance checks as per Clause 16.6 of the contract

- The Russians were paid the final 20 *per cent* towards the cost of aircraft even as the Navy signed the TAR prior to liquidation of limitations

Directorate of Aviation Projects Management (DAPM) at IHQ MoD (N) admitted (December 2014) that various defects/discrepancies/ observations were found during the technical acceptance of the individual aircraft, however stated that they were forwarded to Russian Warranty Team for liquidation.

2.5.5 Low serviceability of aircraft

'Serviceability'[58] implies that the aircraft is technically available and is not undergoing a scheduled repair or overhaul at any level.
Audit observed from the Serviceability Status Reports (SSR) of MiG29 K/KUB aircraft at Goa, that the serviceability of aircraft was low, as tabulated below :

Year	MiG29K *(per cent)**	MiG 29KUB *(per cent)**
2009-10	35	30.83
2010-11	28.73	44.93
2011-12	15.93	37.88
2012-13	32.97	45.66
2013-14	30.49	21.3
2014-15	37.63	47.14

**serviceability is calculated assuming 30 days in a month.*

From the above, it is clear that the serviceability of MiG29K was unsatisfactory, ranging from 15.93 *per cent* to 37.63 *per cent.* However, the serviceability of the MiG 29KUB, i.e., trainer aircraft was comparatively better, ranging from 21.30 *per cent* to 47.14 *per cent*.

2.5.6 Infrastructure for the MiG29K/KUB

The Cabinet Committee on Security (CCS) approved (December 2009) creation of infrastructure at Visakhapatnam for operating MiG 29K/KUB

[58] *Per cent* serviceability - As per Indian Naval Air Publication, *percentage* serviceability is equal to [(the number of days aircraft serviceable x 100)/No of days in the month].

aircraft procured as complement of IAC, to be based on the East Coast at an indicative cost of ₹218.30 crore. As per the Option Clause contract (March 2010) 29 aircraft were to be delivered between March 2012 and November 2016. Ten aircraft, totally approximately costing ₹1,680 crore had been technically accepted by the Indian Navy between December 2013 and November 2015.


MiG 29 K Aircraft landing on deck of Aircraft Carrier

Audit, however, noticed that the Go-ahead sanction for preparation of Detailed Project Report (DPR) for infrastructure was accorded in August 2014 only and the expected date of submission of DPR is February 2016, six years after in-principle approval (November 2009).

2.5.7 Sub-optimal utilisation of Full Mission Simulator

The Full Mission Simulator (FMS) costing ₹183.16 crore, is a major training aid of the MiG29K and is designed for the ground training of a pilot. The MiG29K Simulator facility had been commissioned at INS Hansa, Goa in May 2013. The MiG29K training squadron has been earmarked at Goa, the squadron however had not been fully operationalised as of September 2015.

Audit scrutiny (August 2014) of records showed that:

- The simulator remained unserviceable (July 2014) due to defects in three out of nine visual channels and was being used for training for basic flying profile akin to a procedure trainer.

- As per the protocol of the 16th Indo-Russian Inter Governmental Commission – Military Technical Cooperation (IRIGSC-MTC) (September 2014), un-serviceability of the simulator had prevented its optimum utilization for training of IN pilots.

In reply to an audit query, Directorate of Aviation Projects Management (DAPM) admitted (December 2014) that the simulator was assessed to be unsuitable for Carrier Qualification (CQ) simulator training for pilots, as the visuals did not support the profile which required high accuracy and fidelity. As of 31st July 2015, the OEM was still in the process of software corrections as required to make the simulator as realistic as aircraft.

2.6 Financial Management

2.6.1 Financial implications (Fixed Cost scope of work)

The Ministry concluded the Phase-I (May 2007) and Phase-II (December 2014) contracts with Cochin Shipyard Limited (CSL) on Fixed Price[59] and Cost Plus[60] basis. The Fixed Price scope of work under Phase-I included building and launching the hull of 15,000 tons, outfitting of 2,500 tons and detailed engineering design/drawings whereas Phase-II[61] provided for 6,500 tons of hull fabrication/erection and 5,700 tons of outfitting.

[59] Fixed Price – building and launching the hull of approx 15,000 tons steel weight and outfitting consisting of approx 2500 tons and detailed engineering design/drawings
[60] Cost Plus – mainly purchasing of equipment and machinery
[61] Phase-II contract comprised fixed price scope of work and outfitting

2.6.1.1 Sub-contracting by the shipyard

Phase-I contract permitted the shipyard to sub-contract any portion of the steel/outfit work except bow and stern, within the contracted cost of ₹1,040 crore.

Audit scrutiny revealed that the Ministry failed to negotiate/quantify the sub-contracted work/cost, benefitting CSL to the extent of 40 *per cent* as evident in CSL's admission (January 2013) to the Contract Negotiation Committee of Phase-II contract.

In response to an audit query the Indian Navy stated (August 2014) that Cochin Shipyard Limited (CSL) was not contractually bound to furnish details, whereas CSL stated (May 2015) that no separate account was maintained for this purpose.

The fact remains that the Ministry failed to negotiate/quantify sub-contracting work and its cost under the Phase-I contract, thereby, resulting in undue advantage to the shipyard.

2.6.1.2 Manpower and salary hike at CSL

As per Contract Negotiation Committee (CNC) held between July and October 2006 for the Phase-I contract, CSL had considered increase of their direct workers from the then existing strength of 1156 to 1760, *i.e.*, an increase by 52 *per cent*, to ensure launching on or before 31st October 2010. While determining labour-hour rates, CSL had considered 52 *per cent* hike in salary of direct labour, as well as proportionate increase in Labour Overheads consisting of salary of officers, supervisors and indirect workers. CNC finally agreed for 35 *per cent* increase and negotiated the fixed price cost of the Phase-I contract to ₹1,040 crore.

Audit noticed from the Annual Reports of CSL that even the aggregate of direct and indirect workers at CSL never reached 1760 between 2007-08 to 2013-14, as evident from the bar chart given in Annexure-IV. Thus, the yard derived undue benefit owing to no increase in manpower.

2.6.1.3 Incorrect estimation of man-hours

The Phase-I contract (May 2007) covered 15,000 tons of hull fabrication/ erection and 2,500 tons of outfitting under fixed price scope of work.

Audit observed from the Contract Negotiation Committee (CNC) (February 2013) for Phase-II contract that CSL consumed 8.58 lakh man days 'in-house labour' (68.64 lakh man-hours) to achieve 12,894 tons of fabrication/erection and 1,310 tons of outfitting under Phase-I contract (May 2007) by the end of March 2012. With this input, audit calculated (October 2014) that, as of March 2012, the shipyard effort was to the tune of ₹358.53 crore only with reference to man-hour rates accepted whereas the yard received ₹834.68 crore (worked out proportionately for the *ibid* quantity of work) under Phase-I contract. Due to overestimation of per ton man-hours to be utilised for fabrication and outfitting on one hand and actual consumption of lesser man hours in comparison on the other under Phase-I contract, led to inflated reimbursement to Cochin Shipyard Limited (CSL), which according to audit estimation works out to ₹476.15 crore, as tabulated in Annexure -V.

In response to audit query(October 2014), Directorate of Naval Design (DND) stated (February 2015) that the payments made to CSL were in accordance with the milestones as agreed by the CNC and as mentioned in the contract.

The reply is evasive because the Contract Negotiation Committee for the Phase-I contract had negotiated the fixed cost to ₹1,040 crore, while incorrectly estimating the man-hours.

2.6.2 Fund Releases and Flexi Account

The Work Orders (January 2004 and November 2005) stipulated that the shipyard would submit forecast of funds required to Integrated Headquarters Ministry of Defence (Navy) [IHQ MoD(N)] and advances would be paid for incurring expenses, which would be kept in a separate account and any interest earned on such advances shall be credited to the project with effect from 1 April 2005.

CSL opened (August 2006) a Flexi Account[62] with the Union Bank of India, to receive funds released by the Owner (Navy) against projections by the Builder on quarterly basis for the financial year.

Audit observed that:

(a) Huge amounts ranging from ₹186 crore to ₹602 crore, were lying unutilised in the Flexi Account at close of the financial years ending 2006-07 to 2012-13, as given in Annexure-VI. WOT(K) accepted (September 2014) that amounts were not utilised by CSL as projected, citing delays in fund outgo on account of equipment delivery as well as stage payments.

(b) CSL withdrew unilaterally a total of ₹51.75 crore on three occasions between March 2009 and March 2014, which were later adjusted/deposited back.

Therefore, the Flexi Account was being operated with weak financial controls and there was a need to bring robustness in the operation of the flexi account.

2.6.3 Financial implications (Cost Plus scope of work)

The Phase-I contract (May 2007) and Phase-II contract (December 2014) included Cost Plus activities in their scope of work**,** which mainly comprised purchase of equipment and machinery.

Audit scrutiny revealed the following:

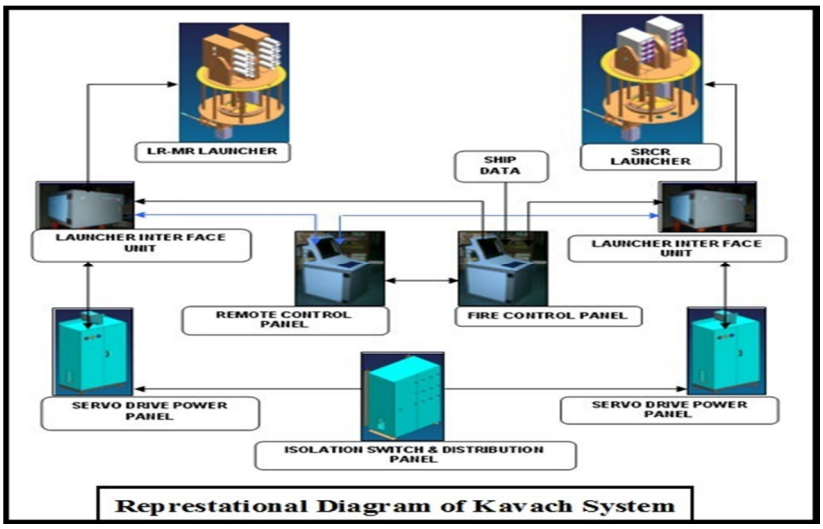
2.6.3.1 Procurement of KAVACH MOD-II

Based on the nomination of the Indian Navy, Cochin Shipyard Limited (CSL) floated a tender enquiry to MTPF[63] in March 2011 for procurement of Kavach MOD-II (Anti-missile Chaff System). The technical evaluation of the bid, received in June 2011 with validity up to 31 August 2013, was carried out in

[62] Flexi Account - a special kind of account offered by banks, which is a combination of demand deposit and a fixed deposit. The depositor is able to enjoy both the liquidity of savings and current accounts as well as the high returns of fixed deposits.

[63] Machine Tools Prototype Factory, Ambernath under Ordannce Factory Board.

October 2012 and the Indian Navy technically accepted the offer in June 2013. Subsequently, the PNC was held in August 2013 wherein MTPF put forward additional commercial conditions. However, Integrated Financial Advisor (Navy) did not approve of placement of order on these conditions and asked the Indian Navy to obtain waiver from the Ministry.



Meanwhile, Cochin Shipyard Limited (CSL) sought six extensions for validity of the bid, the last extension being up to 28 Feb 2014. The requisite waiver from the Ministry was received in January 2014. CSL asked MPTF to extend the validity up to 30 April 2014, which was not agreed to by MTPF. Finally, the purchase order was placed by CSL at a cost of ₹24.57 crore against the negotiated quote of ₹21.91 crore, resulting in avoidable expenditure of ₹2.66 crore.

2.7 Conclusion

Even though the operational requirement for a ship of 37,500 tons was identified in 1990, the Preliminary Staff Requirements for the Indigenous Aircraft Carrier of 37,500 tons were not promulgated before obtaining approval (October 2002) of the Cabinet Committee on Security. The Build Strategy has undergone numerous revisions, preventing the project from reaping the benefits of a finalised Build Strategy. The Indian Navy envisioned

adoption of the Integrated Hull Outfit and Painting (IHOP) approach to reduce the build period and increase productivity. However, adoption of concurrent design approach compromised the IHOP method. There were delays in conclusion of the contract for the Aviation Facilities Complex design and Propulsion Systems Integration, which had a cascading effect on the project timelines.

The Phase-II contract was to be concluded six months prior to completion (August 2013) of the Phase-I contract, however, there was undue delay in conclusion of the Phase-II contract (December 2014). As a result, there was no contractual monitoring of the project during the intervening period of 16 months. The shipyard projected that delivery schedule of the aircraft carrier would be in 2023, against December 2018 as per approval of the Cabinet Committee on Security. The Indian Navy and the shipyard were not operating in sync, which was reflected in lack of agreement on project timelines as well as lack of review of project timelines, for arriving at realistic delivery date. Commencement of production had been delayed due to non-availability of requisite steel. Launching of the ship under Phase-I contract could not be achieved as per schedule due to non-availability of major equipment. The Ministry did not incorporate stipulated progress reporting formats in the contracts. Thus, an objective assessment of the actual state of physical construction was not possible.

Effective project management is imperative to project success, yet there was shortfall in the frequency of meetings of the project management committees. Failure to negotiate/quantify the sub-contracting work and its cost led to undue advantage to the shipyard. Further, incorrect estimation of man-hours resulted into inflated reimbursement to the yard.

MiG29K, the chosen aircraft for the Indigenous Aircraft Carrier continues to face operational deficiencies due to defects in engines, airframe and fly-by-wire. Carrier compatibility of the aircraft during deck operations is yet to be fully proved and multiple modifications are being carried out to liquidate defects. Further, the aircraft continues to suffer from low serviceability. As a result of issues facing the MiG29K/KUB and the delayed delivery of the IAC, the service life of the aircraft would be reduced, thereby affecting the

operational life of the aircraft already delivered. The delivery of the Option clause aircraft scheduled between 2012 and 2016, is much ahead of the delivery schedule of the IAC, in 2023 as projected by Cochin Shipyard Limited.

In sum, while the Indian Navy envisions ready combat availability of two aircraft carriers at any given time, with INS Vikramaditya in service and INS Viraat likely to be decommissioned in 2016-17, continuous shifting of timelines of delivery of the Indigenous Aircraft Carrier will adversely impact naval capabilities.