

**Annexure -I**

**(Refers to in Para No.1.11.2)**

List of Action Taken Notes not received as on 30 September 2014

<b>Sl. No.</b>	<b>Report Nos. and Year</b>	<b>Para No.</b>	<b>Pertains to</b>	<b>Brief Subject</b>
1.	No.10 of 2013	Entire Report	MOD (Air Force)	Acquisition of helicopters for VVIP
2.	PA 31 of 2013	Entire Report	MOD (Navy)	Planning and Management of refit of Indian Naval Ships

**ANNEXURE-II**

**(Referred to in Para No. 3.8.7.2.1)**

- (i) **Mi-17 Helicopter** crashed (November 2010) near station 'A' and all the 12 passengers (2 Pilots, one Army Officer and 09 PBOR) suffered fatal injuries. The accident occurred due to breaking of a blade in flight. Defence Metallurgical Research Lab in its report stated that main rotor experienced a flat fracture indicative of an impact overload in air. In the absence of Flight Data Recorder and Cockpit Voice Recorder, the exact cause of the breaking of blade remained inconclusive.
- (ii) **MiG-27 aircraft** met with an accident (July 2010) at Station 'B' due to material failure of blade caused due to fatigue resulted from failure of Engine. The blade got detached and caused collateral damage to the Low Pressure Turbine Rotor (LPTR) assembly leading to reduced efficiency of the LPTR. A small dent on the leading edge near the root of blade initiated the fatigue crack and resulted in failure of blade. CoI found that the dent could have occurred due to mishandling/transportation during manufacture/ assembly or due to Foreign Object Damage (FOD) during exploitation. However, CoI failed to ascertain the exact cause of the dent.
- (iii) **MiG-27 aircraft** met with an accident (September 2010) at Station 'C' due to failure of compressor disc owing to fatigue fracture, resulting in dislodgement of nose bullet and fairing got ingested. CoI could not conclusively establish the nose bullet factor as primary reason due to lack of material evidence.
- (iv) **MiG-21 aircraft** met with an accident (February 2011) at Station 'D' due to flame out of engine caused due to shearing off of the teeth of the Main Spiral Bevel Pinion in the Accessories Gear Box leading to loss of drive to the accessory gear box. CoI assessed that Shearing – off of the teeth of the spiral bevel pinion was due to tooth bending fatigue. However the exact cause of tooth bending fatigue could not be conclusively established by CoI.

- (v) **MiG-21 BiS aircraft** met with an accident (September 2011) near Ganoor due to Engine surge but CoI failed to deduce the reasons for 'Engine Surge'.
- (vi) **Kiran MK-II** met with an accident (January 2012) at AFS Tambaram due to engine flame out. The accident is classified as un-resolved.

**ANNEXURE-III**  
**(Referred to in Para No.3.8.7.2.2)**  
**Causes of Human Error (HE)**

<b>Sl. No.</b>	<b>Name of aircraft</b>	<b>Exact Cause of Human Error</b>
1.	MiG-21	Due to situational overload
2.	MiG-21	Error of Skill, Inexperience and inaccurate appreciation of approach
3.	Kiran MK-I	Due to delayed take over and improper transfer of controls
4.	Hawk	Delayed flare out while landing the air craft
5.	MiG-21	Incorrect actions by the pilot starting with incorrect approach management
6.	MiG-21	Delayed emergency action by the pilot
7.	Kiran	Incorrect procedure followed by Flight Commander . The pilot posture during the ejection was incorrect
8.	MiG-21	Error of skill, inexperience of the pilot
9.	MiG-21	Type-I disorientation
10.	SU-30 MK-I	Incorrect maintenance practice followed by technicians during servicing
11.	Kiran MK-I	Not holding the correct touchdown attitude by pilot
12.	Jaguar	Disorientation of the pilot
13.	Chetak	Incorrect decision of the pilot to continue flight in adverse weather in clear violation of laid down SOPs
14.	ALH	Mishandling of controls at Low Height by the Pilot
15.	MI-17	Due to error of judgment ,procedural and decision making errors
16.	MiG-29	Incorrect retraction by the pilot before the aircraft had lifted off the RW
17.	Jaguar JS-201	Disorientation of the pilot
18.	Chetak Z1417	Lack of situational awareness
19.	MI-26 Z-3076	Incorrect carrying of load.

ANNEXURE-IV

(Referred to in Para No.3.8.7.5.3 refers)

Sl. No.	Aircraft No. and Type	Date of accident	Name of unit	Cause of Accident	Remedial measure yet to be implemented	Agency responsible for implementation
	MiG-21 T-96 C-1545	01.03.11	37SQN 5 FBSU	Cat I HE(A)	<p>1. The issue regarding equipping the crash crew with modern firefighting equipment was being actively pursued. The case for scaling of FR clothing was also under process.</p> <p>Ops branch was to issue necessary instruction to all MOFT Units on the followings:</p> <p>2. All important aspects regarding necessity of checks and procedures, knowledge of systems, meticulous reporting of weaknesses must be reiterated.</p> <p>3. Circuit flying/rejoin procedures and various kinds of circuits must be emphasized in the units. The units must utilise GPS as a debrief aid to specifically debrief the circuit flown by the trainees.</p> <p>4. The publications must be devoid of any ambiguity regarding flying techniques of briefings.</p> <p>5. The demonstration of flying with Auto Pilot Mode 'On' needs to be given more emphasis in the MOFT units, especially during pre-solo dual checks.</p> <p>6. DGMS (Air) was to issue necessary instructions for reinforcing the methodology for evacuation of injured aircrew.</p>	<p>IAF (D Ops)</p> <p>IAF (D Ops)</p> <p>IAF DGMS (Air)</p>

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					7. Fresh instructions for reiterating procedures laid down in the Chapter 3 of IAP 4305 were to be issued.	IAF DGMS (Air)
	MiG-27 ML TS-572	24.07.10 6/10-11	22SQn 16 WG	Cat I (TD)	1. Ops Branch: - The DG (I&S) branch was to actively and expeditiously pursue the issue of light weight integrated Helmets (LWH). The new indigenous helmet was to be commissioned as early as possible, preferably within the next six months.  Maintenance Branch:- The following remedial measures need to be actioned by the maintenance branch  2. Lack of Data on failed blades. 3. PSP/CSP contents 4. SARBE 8.	IAF DG (I&S)+ Local agency  IAF  IAF  IAF OEM
	MiG-27 ML TS-579	24.09.10	18SQN 5 WG	Cat I (TD)	1. The fitment of SSFDR on MiG-27 (UPG) is to be completed at the earliest by HAL. 2. A study is to be carried out by Maintenance branch to check the feasibility of fitting SSFDR in all remaining (non-upgraded) MiG - 27 ML aircraft.	(HAL) DEng A4/A6 (T)  (HAL KWD)
	MiG-21 CU 2818	04.02.11 17/10-11	TACDE 40 WG	Cat I (TD)	As the pilot's crash helmet flew off during the ejection, DQAS at Air HQ (RKP) was to initiate a case for modification of the flying helmets on a fast track basis. DG(I&S) is also to hasten testing and certification of indigenous common MiG-series helmets in liaison with DEBEL and CEMILAC.	IAF+ Local agency DG (I&S) and DAS
	Hawk MK 132 'A' 3628	30.5.11 2/11-12	406 AFS	Cat I (HE)	Training Dte:- The following remedial measures are to be instituted by Trg Dte:- 1. Issue instruction to introduce the 'Mechanics of PIOs' as part of ground training syllabus. It should be included in the 'Application of Aerodynamics to Practical	IAF D Trg

					Problems of flying' chapter of the aerodynamics précis issued by FIS. The same should to be covered during relevant stages of flying training. 2. Issue amendments to the operator's manual to elaborate the fact, that while carrying out flare out, the pilot must concentrate on visual cues for flare out rather than rely on HUD inputs viz to raise the-'VV' to the inertial horizon-	IAF D Trg
	Mig-21 BISON CU-2089	08.8.11 6/11-12	23 SQN 35 WG	Cat III HE (A)+TD(A)	HAL along with RCMA and DDGAQA has been approached vide Air HQ/81756/8/CU-2089/EA2(T) dt. 30 April 12 to conduct an endurance test on the brake cable along with Bowden and also study the feasibility of providing speed indication replication on HUD along with the MFD.	HAL Eng A2(T)
	Kiran MK-I U-679	22.8.11 7/11-12	AFS Hakim- pet	Cat I HE (A)	1. A separate chapter on all procedures/profiles (Rejoin procedure) is to be added in the SOP for Kiran ac by Dte of Trg 2. Dte of Projects was to be look in to the feasibility of pilots carrying a Dictaphone connected to the helmet in ac where CVR is not fitted.	IAF D Trg  IAF D Prog
	MiG-29 KB 703	18.10.11 11/11-12	47 SQN 8 WG	Cat I (F) HE(A)	1. Procurement process of Fire Retardant Aircrew Survival Jacket (FR ASJ) for carrying SARBE-8 PLB by Ftr/Tr aircrew has been initiated.	HAL/OEM D Store
	SU-30 MK-I SB-142	13.12.11 14/11-12	20 SQN 2 WG	Cat I HE(S)	1. Maintenance Branch was to issue directions to CSDO to propose a methodology of referring to task cards while carrying out the activity. In addition Maint Branch is to study the Rectification Log Card concept and feasibility of its implementations.	IAF D Eng A1

					<p>2. Maintenance Branch was to approach OEM to provide detailed FBW publications of Su-30MKI aircraft, which include system logic signal path and Fault Analysis Tree (FAT).</p> <p>3. Maintenance Branch is to approach National Aerospace Laboratory (NAL) to conduct capsule course for AE officers on FBW control law at 9 TETTRA School. In the interim period 10 TETTRA School could conduct this module for AE officers detailed for Su-MKI training.</p> <p>4. MOD 30044 is being implemented for relocation for Crash Survivable Memory Unit (CSMU) on Su-30MKI fleet by HAL Nasik.</p> <p>DCAS Branch: The following remedial Measures have been/need to be instituted by DCAS Branch:-</p> <p>5. SDI and ADA have been tasked to design Mathematical model for FBW of Su-30MKI vide Air HQ/S. 96256/1/Proj (Su-30)BM-1412 dt. 10 Apr 12</p> <p>6. Design deficiencies observed in Su-30MKI FBW system are to be addressed as part of Super-30 project.</p> <p>7. FBW study group has been constituted vide ACAS (Proj) Task Directive no. 13 of 2012 dt. 11 July 12.</p> <p>8. HAL has been tasked to study the feasibility of mapping FBW data on FDR of Su-30MKI.</p>	<p>OEM D Eng A1</p> <p>IAF/NAL D Eng A1</p> <p>HAL D Eng A1</p> <p>IAF/SDI/ADA (DCAS Br)</p> <p>OEM (DCAS Br)</p> <p>IAF/OEM</p> <p>HAL (DCAS Br)</p>
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					9. HAL to be approached to provide a detachable connector between memory module on PCB and flexible cord inside the metal cylinder of CSMU as part of development of SSFDR.	HAL (DCAS Br)
	MiG-21 BIS ac CU-2189	06.09.11 8/11-12	3 SQN 8 WG	Cat I (TD)	Maintenance branch to explore feasibility of integrating anti surge system 'SPP 25' to all modes of operation in MiG-21 Bison aircraft.	OEM D Eng A2 (T)
	Kiran MK-II U 2462	31.01.12 16/11-12	AFS Tambaram	Cat I (TD)	Personnel Branch:- The following measures needs to be instituted by personnel branch: 1. Importance of correct ejection procedure needs to be reiterated to all Aircrews in FTEs, periodically.  2. Instructions for all pilots to carryout periodic ejection drills to be issued by Air HQrs Dte of Trg to all FTEs.	IAF D Trg  IAF D Trg
	Mirage2000 KT-210	05.03.12	40 WG	Cat I (TD)	1. Case for procurement of GPS enabled Aircrew wrist watches be processed expeditiously and the watches be issued to pilots at the earliest to aid search and rescue. 2. Maintenance branch is to ensure that Mod 500-2 modification on the AB fuel pumps of the Mirages fleet is accomplished at the earliest.	IAF D OPAG  IAF D Eng Mirage
	Jaguar Twin Seater JT 061	11.06.12 2/12-13	27 SQN 15 WG	Cat III HE(A)	Maintenance Branch is to ensure the following  1. An IAF team comprising reps from DASI Ops and maintenance has undertaken an audit of Jaguar bases, HAL, ADL OH Div. and HAL engine Div. to ascertain reasons for debris in fuel	HAL/ADA D Eng J

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					<p>cooled Hydraulic oil cooler, LP Filter and their possible sources. The recommendation of the study reports are to be implemented.</p> <p>2. An audit team has been constituted at HAL, ADL with reps from IAF, RCMA and CRI of both HAL Div. as well as HAL Engine Div. to ascertain assembly and production related issues, if any, and to ascertain sources of debris found in the engine fuel system besides suggesting preventive measures. The preventive measures as suggested by the team are to be implemented.</p>	<p>HAL D Eng J</p>
	Z-3026 MI-17	19/11/10 1206 hrs 14/10-11	19 Wg	Cat I (F)	<p>1. DCAS branch to give due priority to procurement of automatic portable ELTs for helicopter fleet.</p> <p>Maintenance Br to:-</p> <p>2. Pursue with the OEM replacement of existing FDR and CVR with two solid state combinations FDR/CVR (one in front and one at rear). In case not feasible, to take up relocation of FDR to avoid damage destruction due post-crash aircraft fire.</p> <p>3. Follow up on in flight monitoring of spar failure warning and NDT on MRBs with OEM.</p> <p>Ops Branch to:-</p> <p>4. To provision AFTR/suitable recording and storage devices to record the R/T with the aircraft at regularly manned ALGs.</p>	<p>IAF/HAL/ OEM</p> <p>OEM</p> <p>OEM</p> <p>IAF</p>

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	Z-3076 MI-26	14/12/10 0929 hrs  15/10-11	126 23 23 Wg	CAT-I/HE/ HE(A)	<p>1. Air HQ (VB) Dte of Eng (H) to expedite development of the Flight Data Recorder Milking System used by 126 HF to ensure better consistency and utilisation.</p> <p>2. 126 HF to procure load cells to accurately determine the CG of load.</p>	<p>IAF/OEM D Eng (H)</p> <p>IAF 126 HF</p>
	Z-2904 & Z-3089 MI-17	30/8/12 1205 hrs 5/12-13	40 Wg	Cat I HE/HE (A)	<p>1. Ops branch had to Initiate a case for provisioning of satellite phones for helicopter units.</p> <p>Maintenance Branch</p> <p>2. Provide solid state FDR/CVR and area mikes on Mi-17 helicopters</p> <p>3. Cohesiveness of maintenance team earmarked for servicing of helicopters attached to TACDE for composite courses by tasking a single command to provide maintenance support.</p> <p>DG(I&amp;S)Branch</p> <p>4. To take up psychological study of aircrew involved in Cat I accidents so as to suggest changes to psychological profiling template used at selection boards.</p>	<p>IAF</p> <p>IAF</p> <p>IAF</p> <p>IAF</p>