# FINAL INVESTIGATION REPORT ON ENGINE FIRE SERIOUS INCIDENT TO M/S NACIL(A), B747-400 AIRCRAFT,VT-ESM AT MUMBAI AIRPORT ON 4th Sep'2009

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|---|---|---|
| 1. | **Aircraft** | Type & model :B747-400<br>Engines :Prat&Whitny,PW4056<br>Nationality :Indian<br>Registration :VT–ESM |
| 2. | **Owner/ Operator** | : M/s. NACIL (A),New Delhi |
| 3. (a) | **Pilot-in-Command**<br>**First Officer**<br>other crew | : ALTP Holder<br>: ALTP Holder<br>: cabin crew 14 |
| (b) | Extent of injuries | : nil |
| 5. (a) | Number of **Passengers** | : 213 |
| (b) | **Extent of injuries** | : minor :21 |
| 6. | **Place of incident** | : Mumbai Airport |
| 7. | **Date & Time of incident** | : 4th Sept'2009,0530 UTC |
| 8. | **Type of Serious Incident** | : **Engine on fire** |

**(ALL TIMINGS IN THE REPORT ARE IN UTC)**

## S Y N O P S I S

On 4/9/2009 M/s NACIL (A) B747-400 aircraft, VT-ESM, was operating flight AI-829 from Mumbai to Riyadh under the command of Captain bearing ALTP license with First Officer , ALTP license. There were 213 passengers and 16 crew members onboard. While taxing for takeoff for Runway 27 and holding on A3 taxi track the ATC-SMC controller informed the aircraft that there was a heavy fuel leak from the left side of the aircraft and instructed to switch off the engines immediately as the fire had developed by that time. The crew carried out the emergency shut down for all the engines and discharged fire bottle for NO 2 and NO 1 engine. The Cabin crew in-charge ordered the evacuation command from the RH side. All passengers and crew evacuated the aircraft safely through slide chutes. The fire services reached the aircraft within no time and put off the fire. There was minor injury to some of the passengers. Aircraft received fire damage on port side.

## 1. FACTUAL INFORMATION:

### 1.1 History of the flight

On 4/9/2009 AI-829 was scheduled to operate flight from Mumbai to Riyadh. Originally it was scheduled to operate at 2030UTC(3.9.2009) ie., 0200 IST of 4.9.2009. However aircraft returned back to bay due technical fault. After snag rectification it was taxied out but the snag reappeared and the aircraft again returned back to bay around 0030UTC. Passengers were deplaned and Departure was revised to 0415 UTC. Then aircraft VT-ESM was offered to operate AI-829 and cabin crew boarded VT-ESM at about 0340 UTC. Prior to the flight from Mumbai both the commander and the First officer obtained a briefing and proceeded for the flight. There were 213 passengers and 16 cabin crew members onboard. The APU was under MEL and therefore engine #4 was started at bay#63 prior to pushback. After some ATC delay the push back commenced at around 0519 UTC. The tow bar failed after the aircraft had moved just 8-10 feet. After arranging a new tow bar the push back was completed facing east and rest of the 3 engines were started in the sequence of 3, 2, 1. The aircraft started taxing at around 0524 UTC and turned to taxi way G. While taxing on G, one of the company aircrafts operated AI864 which was docked on Bay 95, saw the gushing of fuel around LH side engine of VT-ESM and immediately informed to dispatch on the company channel about the fuel leak. The Captain of this aircraft could not contact VT-ESM since he was on the ground frequency and VT-ESM had already changed over to tower frequency. The dispatch called AI-829 on company channel to inform about the fuel leak; however the VHF 3 (company channel)was kept in the off position by the operating crew since it creates a lot of disturbance during briefing and taxi/takeoff clearances. This was in non-conformance with the company operating procedures. While the aircraft was taxing on G, the engineer who was allocated on the other company aircraft also saw the fuel leak from No 1 engine of the aircraft and took off his ramp jacket and started signaling to the aircraft. The Cabin crew in-charge (CCIC) did see the person signaling but could not figure out the reason and hence ignored the same. The follow me jeep in the vicinity noticed the fuel leak and

informed ATC immediately to switch off the engine. The follow me jeep could only tell the registration to the ATC . As the aircraft turned on to taxiway A3, ATC gave a call for VT-ESM twice. However there was no reply from the aircraft. Then the ATC called IC-629 confirming their registration as ESM which they said negative. Finally ATC(SMC controller) called out AI-829 to check registration ESM, which was confirmed by the crew. Then ATC informed that as per the follow me jeep3 there was a heavy fuel leak from the left engine of the aircraft and gave instructions to switch off the engines immediately.

The commander announced for Cabin Crew In-charge (CCIC) in the cockpit and started the emergency checklist. By the time, the engine no:1 already caught fire and started moving towards NO 2 engine. The CCIC saw the fire while getting up from her located position and immediately gave evacuation commands on the PA (evacuation from the right). The passengers by now had also noticed fire from the cabin windows and rushed towards the door. The crew managed the passengers and deployed the RH side escape slides. All the passengers and the crew evacuated the aircraft safely. After ensuring nobody was left behind inside the aircraft CCIC evacuated the aircraft. Since the cockpit is on the upper deck, both the pilots evacuated from the upper deck and did not come down to the lower deck during evacuation. They also came out before evacuation was completed.

In the process of emergency evacuation there was minor injury to 21 passengers of the aircraft and were given first aid and then shifted to AI hospital. By the time the fire vehicles had reached the aircraft and sprayed foam to put off the fire. Two of the fire men climbed the escape slide from the RH side and went onboard the aircraft to check for any passengers left behind during the evacuation. They in fact opened the LH side doors as there was fume and smell inside and hence the LH side slides were deployed by the fire men after the evacuation was carried out by the cabin crew. The incident took place at about 0530 UTC under day light condition and there was drizzling. Aircraft was damaged on LH side due to fire.(sketch of the location of incident attached as appendix-1)

**1.2 Injuries to persons:**

| INJURIES | CREW | PASSENGERS | OTHERS |
|---|---|---|---|
| FATAL | Nil | Nil | Nil |
| SERIOUS | Nil | Nil | NIL |
| MINOR/None | NIL | 21 | Nil |

**1.3 Damage to aircraft:**

The aircraft sustained damage mainly to NO 1 engine and pylon, LH wing leading edge area, LH wing trailing edge area due to fire.

**1.4 Other damage:** Nil.

**1.5 Personnel information:**

**1.5.1 Pilot – in – Command:**

Age : 58yrs (15/6/1951)
Licence : ALTP Holder
Date of Issue : 16.04.85
Valid up to : 28.12.09
Category : Aeroplane
Class : Multi Engine- land
Endorsements as PIC : B747-400, 747-200/300, & A310.
Date of Med. Exam : 29.06.09
Med. Exam valid upto : 28.12.09
FRTO Licence No. : 2155
Date of issue : 30.1.76
Valid up to : 4.01.12
Total flying experience : 12838:20hrs
Experience on type : 4821hrs
Experience as PIC on type : 4648:35hrs
Last flown B747-400 : 27.8.09
Total flying experience during last 90 days : 94:20hrs

Total flying experience during last 30 days : 49:40hrs
Total flying experience during last 07 Days : Nil
Total flying experience during last 24 Hours : Nil

**1.5.2 First Officer:**

| | | |
|---|---|---|
| Age | : | 63yrs (20.05.46) |
| Licence | : | ALTP Holder |
| Date of Issue | : | 29.09.88 |
| Valid up to | : | 24.01.10 |
| Category | : | Aeroplane |
| Class | : | Multi Engine- land |
| Endorsements as PIC | : | B747-400, 747-200/300, &A310 |
| Date of Med. Exam | : | 19.06.09 |
| Med. Exam valid upto | : | 18.12.09 |
| FRTO Licence No. | : | 3466 |
| Date of issue | : | 19/10/1987 |
| Valid up to | : | 28/07/2012 |
| Total flying experience | : | 12593 hours |
| Experience on type | : | 4520 hrs |
| Experience as PIC on type | : | 4207 hrs |
| Last flown B747-400 | : | 24.08.09 |

Total flying experience during last 90 days : 102:10hrs
Total flying experience during last 30 days : 33:50hrs
Total flying experience during last 07 Days : Nil
Total flying experience during last 24 Hours: Nil

He is working with the airlines on contract basis.

**1.6 Aircraft Information:**

The aircraft was manufactured by M/s Boeing Airplane Company, Seattle USA in the year 1993. It is Indian registered aircraft having sl.no MSN 27078. C of R is valid till 23.05.2015.It is powered with four Pratt & Whitney PW4056 model engines, rated 56000 pounds of thrust. There are ten doors in main deck and two upper deck doors in the aircraft for the passengers. The main deck plug type doors are hinged on forward side vertically. It

swings out outboard and forward when opened. Two upper deck doors are hinged horizontally and swing open upwards. The aircraft has total fuel capacity of approximately 161 tons and can fly for 12 hours. The last C of A renewal of the aircraft was done on 07/09/07 and was valid till 09/09/09. The aircraft was registered under Normal category “A”.

Scrutiny of the Airframe and Engine log books of the aircraft has revealed that on the day of incident, the aircraft had done 59225: 31 airframe hours since new and 7099: 14 hours since the renewal of last Certificate of Airworthiness (C of A).

Engine #1 had logged 37971: 05 hours since new and C Check was due at 41903: 17 hours.

Engine #2 had logged 44636: 21 hours since new and C Check was due at 46449: 26 hours.

Engine #3 had logged 40305: 01 hours since new and 22081: 58 hours since last overhaul and C Check was due at 44237: 13 hours.

Engine #4 had logged 39695: 25 hours since new and 1340: 09 hours since last overhaul and C Check was due at 45855: 16 hours

Scrutiny of the aircraft records further revealed that all the mandatory modifications on the aircraft were found to be complied with during the renewal of Certificate of Airworthiness on 07/09/07.

Further the last ‘D’ Check was carried out on the aircraft on 27/06/05. During this check following work carried out on the aircraft in the affected area:-

1. Engine fuel feed system engine 1 strut fuel tube drain line installation as per SB 747-28-2193R1.

2. Replacement of strut fuel feed line coupling ‘O’ rings as per MPD task card.

Last ‘C’ check was carried out on the aircraft on 11/09/08 and during this check to facilitate spring beam replacement; No. 1 strut was removed and re-installed including removal and installation of fuel line and coupling on front spar and drain lines.

Last ‘4A’ Check was carried out on the aircraft on 25/04/09 and no specific work was carried out on the affected area.

On 01/05/09, during the ground check at Frankfurt some fuel drops were found on engine #1, some fuel drops. Engine motoring performed with cowl’s open. Found all normal. At base on 04/05/09, during detailed inspection/rectification no evidence for fuel leak and oil leak was noticed and subsequently the aircraft was released for flight. There after there was no snag report for fuel leakage on the aircraft till the aircraft was involved in the incident.

Last ‘2A’ Check was carried out on the aircraft on 08/08/09 and no specific work was carried out on the affected area.

Scrutiny of the aircraft technical log book revealed that the aircraft was holding valid Flight Release Certificate which was issued on 25/04/09 after carrying out all inspection schedules.

**1.7 Meteorological information:**

As per the MET information at time 0510 UTC for Mumbai airport, Weather was Hazy. Runway in use 27,, winds 290/03knots, visibility 1700mtrs, 1800MFB, QNH 1006, QFE 1005, RVR for runway 27 1700mtrs, temp 27,DP 26,Trend No SIG. However at the time of taxiing it was reported raining/drizzling.

Weather was not a contributory factor to the incident.

**1.8** Aids **to navigation:** NA

**1.9 Communications:**

There was always a 2 way communication between the aircraft and the ATC.
However the company channel of the aircraft VHF3 was kept off in the aircraft due to which flight dispatch could not pass on the fuel leak information to the aircraft VT-ESM when it was reported by the other company aircraft to dispatch. The above action of the pilots are in nonconformance with company policy.

**ATC tape transcript** of conversation between Mumbai tower(SMC frequency) and the aircraft was made and its extract is produced below:

The SMC controller (senior manager-ATC) at tower gave taxi instruction to AI 829 at 052527 UTC to taxi via 'G' hold short of A3.Later it was asked to follow Indian airlines aircraft A320 . As the aircraft turned on to A3 at 052803 utc, the follow me jeep-3 in the vicinity called SMC at least thrice but no information was passed. On 4$^{th}$ attempt follow me jeep 3 could inform ATC-SMC at 052819 utc "aircraft ESM on A3 having fuel leakage on LH engine and to advise aircraft to check" . At the same time AIC 864 was trying to contact ESM to convey the fuel leakage , but could not contact. After about 21 secs SMC wanted to confirm position of ESM for which immediately follow me replied "A3 near G, aircraft ESM". Then the ATC called IC-657 for confirming their registration as ESM which they said negative and after about 30secs then finally ATC called out AI-829 to confirm registration ESM, which was confirmed by the crew. The ATC informed the ESM that as per the follow me jeep there was a heavy fuel leak from the left engine of the aircraft and gave instructions to switch off the engines immediately. Crew started shutting down the engines. The crew by then noticed the fire from #1 engine and carried out the emergency shutdown. Last conversation by SMC with ESM was at 052929 UTC. There after the ATC had no communication with the aircraft.

Sufficient time was lost in confirming the aircraft registration. Once the follow me jeep reported ESM with fuel leakage, SMC controller should have called the aircraft by registration instead of flight no.

**Communication is not a contributory factor to the incident.**

**1.10 Aerodrome information:**

Mumbai airport has got 2 cross runways with the orientation 09/27 and 14/32. At the time of incident the runway 09/27 was in use. The aircraft was parked on Bay#63. The aircraft pushed back facing east and thereafter taxied via 'G' to A3. The fuel leak

was detected on A3 and the aircraft stopped at that position which is parallel to runway 09/27. Emergency evacuation was carried out on taxi way A3.

**1.11 Flight recorders**:

**1.11.1 Cockpit Voice recorder (CVR)**:

CVR recording revealed that during initial pushback the tow bar sheared off and then another tow bar was connected to push back the aircraft. Thereafter all four engines were started and nothing unusual was noticed by the cockpit crew. During taxi out the first officer mentioned that the engineer had already left as it was raining at that time. When the aircraft turned to A3 there was call from the ATC twice enquiring about the registration VT-ESM however there was no reply from the cockpit crew.. Then the ATC called IC-629 to confirm their registration as ESM which they said negative. Then finally ATC called out AI-829 asking for registration ESM, which was confirmed by the crew. The ATC informed that as per the follow me jeep there was a heavy fuel leak from the left engine of the aircraft and gave instructions to switch off the engines immediately. The crew by then noticed the fire from #1 engine and carried out the emergency shutdown. Thereafter the ATC called the flight number to which the cockpit crew replied that it was their aircraft. Then the ATC intimated that the follow me jeep had noticed fuel leak from the left side #1 engine and ATC asked the aircraft to stop and switch off the engines. The pilot asked for the emergency checklist; however the first officer asked captain to switch off the engines first. The commander gave a call on the PA for the IFS to cockpit and then pulled the engine fire handle to stop the engines immediately. There after the CVR recording stopped.

**1.11.2 Digital flight data recorder (DFDR)**:

DFDR read-out revealed that during push back and startup, as APU was under MEL first #4 engine was started then #3, #2 and final #1 engine was started. During startup and initial taxi there is no significant difference in fuel flow in all engines however the fuel flow for #1 engine is slightly high. Till the time the

engines are shut down there is no significant change in the parameters as compared to normal parameters.

**1.12 Wreckage and impact information:**

The incident happened during taxing. There was no disintegration of any part during the incident. All the damages incurred on the aircraft were consequential of the fire due to fuel leak from the #1 engine strut. The fire affected #1engine and pylon area . it did spread towards #2 engine from inboard side damaging the LH wing bottom.

**1.13 Medical and pathological Information:**

Both the cockpit crew had undergone preflight medical examination prior to the flight and were not under the influence of any intoxicating drugs or alcohol. The records were found to be in order.

**1.14 Fire:**

There was fire on the #1 engine and adjacent area due to heavy fuel leak on the hot engine. It was reported by the follow me jeep 3 that engine caught fire after about 45 secs after the engines were switched off.

As per the substation officer who was on duty on 04.09.09 at the time of incident was in charge of Crash Fire Tender TATRA-II at main fire station stated that at around 0529 UTC he heard a fire bell, an announcement from PA system that heavy leak from aircraft VT-ESM taxing on taxiway ‘G’ towards A3. He immediately moved crash fire tender along with 2 of his accomplices and proceeded towards the aircraft on A3. On reaching the incident site, they saw flames coming out from # 1 engine on port side. As the crew got ready with personal protection suit to handle the situation, one of the fire man who was the aviation fire fighter was directed to position, monitor towards the port side and started fire fighting using foam through monitor targeting port side to bring down the intensity of fire. Meanwhile Crash Fire Tender Panther-II had also joined

in fire fighting. At 0531 UTC, CFT panther I also reported at site as standby.

The Aircraft sustained damage on port side due fire. The #1 engine inlet cowl bottom and RH side outer surface was burnt. The RH fan cowl outer surface was burnt completely. The LH thrust reverser cowl outer surface burnt completely. The RH core cowl burnt and small area missing. The nacelle/strut external composite panel was damaged and burnt. The strut aft LH fairing door was cracked and damaged. The No 2 nacelle/strut composite material panel above and aft of exhaust sleeve was burnt and damaged. LH aft fairing door and the sail board panel outboard side damaged. Fixed leading edge panel bottom surface outboard of No 1 strut damaged/burnt. Leading edge fixed panel between No 1 & No 2 engine /strut has bottom surface damaged/burnt. Leading edge flap assembly no 6 to 10 burnt /damaged. LH outboard aileron inboard bottom surface damaged/burnt. LH wing outboard flap assembly bottom surface damaged/ burnt. LH fixed fairing and moveable fairing on flap track No 1, 2 and 3 damaged/ burnt. LH inboard aileron bottom surface damaged/burnt. Rear spar access panel between flap track 2 & 3 burnt/damaged.

**1.15 Survival aspects:**

The incident was survivable. However 21 passengers got minor injuries while evacuating through escape slide chutes on RH side.

After having noticed fuel leakage of aircraft on A3 taxiway near ‘G’ from fire watch tower at about 0529 utc, fire station immediately sent Panther II (CFT) to that location. On seeing the fire from the aircraft all the fire vehicle were asked by fire station to proceed to A3. At about 0530 utc Tatra II and Panther II attacked the fire while nearing the aircraft through monitor by using foam. At about 0531 UTC fire was brought under control and at the same time first chute slide was deployed from starboard side by the cabin crew. Fire crew were helping them while passengers were sliding ,to avoid injury. At about 0532 utc fire was completely extinguished and further continuous cooling of engine was done through side lines of Panther II. All fire vehicles returned back to fire station except Panther-I and

informed ATC for maintaining CAT9. At about 0533 utc all escape slide chutes of STBD side were deployed and all passengers were safely moved to the safe place. They were also taken to main fire station for head count. Later at about 0540 utc 2 fire crew went to the aircraft using the slide chute for search and rescue operation inside the aircraft. At that time they observed fumes and uneven smell from fuselage. To ventilate the area fire crew opened the port side no.3 door after ensuring the fire was completely extinguished. Around 0542 utc 21 passengers who got minor injuries were sent to casualty centre for medical treatment. AI doctor also reported at Main fire station at about 0630utc and then to casualty centre. Later 0715 utc from MI room 4 passengers were shifted to AI hospital by AI doctors. All the uninjured passengers were taken to security hold area 4 and 5. At 0945 Panther-I also returned back to the main fire station after the aircraft was safely removed to AI Hangar. Search and rescue was declared over.

During the rescue process emergency services crew of airport assisted the passengers to evacuate the aircraft at the base of slide chute. The evacuated passengers were asked to move away from the aircraft towards the downward direction on A3 and also informed to remain away from the active runway. The passengers evacuated were shifted to main fire station with the help of AI coach, ambulance and safety jeep along with crew members. 3 CFTs, 2 ambulances, 1 operational jeep were used for fire fighting and search and rescue process. The incident site was suitably cordoned by CISF and airport safety department personnel.

**1.16 Tests and research:**

Aircraft suffered fire damage to the #1 pylon and to the left hand wing. Fuel tube coupling which was safety wired, was found loose and safety wire had pulled through the coupling safety wire hole. This caused the fuel leakage.

In order to establish the root cause of the above failure adjacent to the hole and to make suitable recommendation to eliminate such failures in future, the affected fuel tube coupling and the safety wire removed from the affected airplane

were sent to M/S Boeing for lab examination. It was reported to be observed after the fire, the safety wire was found intact but no longer attached to the coupling. The small ligament of material at the wire tie hole in the coupling body was fractured and deformed sufficiently to allow the tie wire to detach. After completion of the examination, **M/S Boeing (BR&T) has made the following findings:**

1. The#3 wire tie hole(out of 4 holes) in the coupling body was breached sufficiently to allow the release of the 304 CRES tie wire.ie., the failure of the hole was a result of ductile overload. Exact cause is not known. But installation, maintenance or environmental variables that may have affected the failure can not be excluded.
2. The fracture surface morphology at the #3 wire tie hole was consistent with rubbing and wear of the surface by contact with the stainless steel tie wire
3. Whether #3 wire tie hole was breached before or during the fire could not be determined with certainty.
4. The coupling body alloy composition, microstructure and hardness were consistent with the drawing requirements for 2024-T851 aluminum alloy.
5. The tie wire alloy composition was consistent with 304CRES.As the wire loop associated with the #3 hole on the coupling, was not fractured or worn through, no further analysis on it were deemed necessary.
6. No other anomalous conditions were identified as contributing to the fracture observed.

It was also found during closer Lab examination of the coupling body that #3 and#4 holes had dark colored, viscous contaminant around the holes. The contaminant was sampled by Boeing research and technology (BR&T) analytical chemical group and it was found to consist of a mixture of environmental minerals/moisture and an adhesive. The adhesive appears to be an aluminum silicate filled poly-isoprene. This material is readily apparent in another hole labeled #4. There were also small amounts of wear or corrosion products of a CRES material. The report of a de ionized water extraction of the dark deposits contained sodium, chlorine and potassium with traces of Sulphur. There appears to

be more aluminum wear/corrosion product present in the samples from #3 hole and inside of safety wire loop. Ester oil was detected in the safety wire loop deposits. The end loop of the tie wire that breached the side material of coupler housing had flat sides. The tie wire had 10 twists per inch.

Based on the above findings, M/s Boeing concluded “The breach of the tie wire (locking wire) through the coupling body could not be contributed to any single event. The fracture surface morphology was consistent with extensive rubbing and wear of the fracture surfaces by extended contact with the stainless steel tie wire. Whether a fracture occurred before the significant rubbing and wear of the surfaces could not be determined. **The wear at a second tie wire, through-hole location suggests that the coupling had likely experienced some maintenance at some time during its intensive life.** It can not be determined when or why this may have occurred. **The integrity of the maintenance practices during any possible removal or reinstallation could not be determined”**

Since the above findings did not give definitive cause of the failure M/s Boeing has been asked to give certain clarification. It has been clarified by M/s Boeing through e.mail that:

- A definitive conclusion determining what caused the safety wire to pull through the safety wire hole could not be reached based on the laboratory analysis of the failed parts. However, there are certain causes that can be ruled out. For instance, the analysis has verified the coupling material and heat treated condition to be per the engineering drawing. The analysis has also verified that the location of the safety wire holes were also per specification.

- M/S Boeing is aware of similar damage to a fuel coupling, and it was determined that **the coupling was not tightened to the proper specification, causing the coupling to rotate (undergo tightening and loosening cycles), which eventually caused the coupling material to fracture.** M/S Boeing could not determine with certainty that what occurred in the

subject event, but were of the above opinion the most likely scenario.

- **M/S Boeing recommended maintenance/inspection personnel of the importance of correctly tightening all similar fittings to the proper torque. An additional aspect to consider would be to ensure replacement of fuel system components when wear (such as the material displacement found on an adjacent safety wire hole) is found.**

- **As an interim action, M/S Boeing advised Air India to consider a once around the fleet visual inspection of the coupling to verify that the installation is per AMM specification. It also advised that if any tightening of coupling is required, o-ring (gasket) replacement may be necessary. At the same time, a visual inspection to determine serviceable condition of the safety wiring holes could be conducted.**

- Due to the infrequency of similar occurrence in the fleet, M/S Boeing does not believe that additional fleet wide inspection on the fuel supply components are warranted at this time. However, they will continue to monitor in-service experiences for similar reports of loose or damaged coupling.

- M/S Boeing was of the opinion that presently no change to the fuel coupling material is currently being considered as a result of the subject incident. In-service experience has shown that when the coupling is properly tightened and safety wire (or other retention device, as provided) properly installed, the assembly provides an acceptable sealing function.

**M/s Boeing reiterated the importance of proper torqueing of fuel system components and the replacement of worn out components.**

**From the above it is felt that the coupling was not tightened to the proper specification, causing the coupling to rotate**

**(undergo tightening and loosening cycles), which eventually caused the coupling material to ductile fracture.**

### 1.17 Organizational and management information:

**NIL**

### 1.18 Additional information:

#### 1.18.1 Work done at Newark

Scrutiny of the aircraft records revealed that while landing at Newark on 16.11.08 under strong crosswind conditions #1 engine cowl got damaged at 6 O'clock location since it touched the ground during landing roll. The aircraft was grounded at Newark for one week for detailed inspection and rectification. However, the involved fuel strut line was not disturbed and no work was carried out in that area. During rectification #1 engine nose cowl was replaced and inspection as per AMM carried out. Engine ground run up was carried out and all parameters were found satisfactory. Thereafter the aircraft flew and there was no report of fuel leak from any of the four engines until may 2009.

#### 1.18.2 Statements, collection of evidences and investigation:

To facilitate the investigation statements/clarification of cockpit crew, cabin crew, engineering crew, search and rescue personnel, fire crew, ATC personnel and other eyewitnesses etc., had been recorded. The above statements are corroborated with ATC tape read-out, flight recorders, Air India test and exercise report at various stages and Boeing lab reports. Volume of photographs had been taken for covering the ground evidences and aircraft damages. Air India provided all the technical assistance during the investigation.

The inputs provided by the various agencies like Air India, various Airport agencies and Boeing investigation group have been taken into consideration and is carefully studied with various other evidences of the inputs. All their valid views

and comments/clarifications are also taken while finalizing the investigation report.

**1.19 Useful or effective investigation techniques:**

**1.19.1 Detection of source of fuel leakage:**

After the fire incident ensuring all safety precautions aircraft was shifted to Air India hangar side for further inspection. On 5.9.2009:

- On inspection total fuel left was found to be 46.9t
- in order to locate the source of fuel leak on the left side, #1 pylon upper gap panel and the left hand pylon access panels were opened to gain the access to #1 engine fuel feed line .
- Fan cowl, core cowl and thrust reverser cowl were opened and all areas were inspected for evidence of fuel leak. Nil leak was noticed.
- Since there was no traces of fuel leak on the strut and the engine, to detect the source of fuel leak the fuel feed system of #1 engine was pressurized by first deactivating the engine ignition, engine start system and then switching on #1 fuel tank boost pump by powering the aircraft with ground power. **As soon as the aircraft was powered, within no time heavy fuel was gushing out from the #1 engine strut drain.**
- Since there was no leak from the couplings on the visible area of the strut, access panel on the RH side of the strut was opened to gain access to the fuel feed line coupling on the fire wall(horizontal bulkhead of the pylon)
- Fuel leak was noticed on this coupling assembly as found dislodged and its lock wire adrift due opened out upper locking hole
- During inspection of the fuel strut line immediately after the incident it was observed that the wire lock hole on the coupling body had opened out and the wire lock had dislodged from its position. All four threads were open and the coupling was dislodged from its position.

**(Refer photographs)**

**1.19.2 Simulating situation of fuel leak:**

Later the affected fuel feed tube assembly along with coupling was removed from the aircraft and tested in shop as an assembly for leakage under different coupling nut engagement conditions. The test could not simulate the exact configuration of assembly in the aircraft and hence the leak could not be ascertained. To establish the situation under which fuel leakage could take place the fuel feed assembly was reinstalled on the aircraft and normalized as per AMM. The coupling was also installed without the wire lock. The booster pump was put on. Exercise was carried out under different coupling nut engagement conditions. One thread was opened and it was observed that there was no leak. Then 2nd thread was opened, no leak was observed. When the nut was loosened for 2 and quarter threads fuel seepage started. When more than two and a half thread was opened, Heavy fuel was gushing out through strut drain.

**From the above exercise it is established that leak did not take place at single event. There might be fuel leak for several cycles during which coupling was unlocking after the safety wire to pull through the failed safety wire hole under ductile failure. The symptoms of leakage could have been observed either during departure or arrival, had the ground AMEs attending the aircraft made meticulous inspections/checks. Finally when the nut was completely dislodged fuel gushing took place and leading to the incident.**

**2. A N A L Y S I S:**

**2.1 Serviceability of the aircraft:**

The aircraft was manufactured by M/S Boeing Airplane Company, Seattle USA in the year 1993 and has been in service for about 17 years. Scrutiny of the aircraft records further revealed that all the mandatory modifications on the aircraft were found to be

complied with during the renewal of Certificate of Airworthiness on 07/09/07. The aircraft is registered in the name of INV 747-320 Leasing Company on 25.11.08. It has then been leased to INVESTEC International Ltd which is further leased to M/S National Aviation Company Of India Ltd. (NACIL- A) which is the operator of the aircraft. The last aircraft weighing was carried out on 06.09.08 and is valid for 5 years. Scrutiny of the aircraft technical log book revealed that the aircraft was holding valid Flight Release Certificate which was issued on 25/04/09 after carrying out all inspection schedules.

Further investigation revealed that on the day of incident, the aircraft had done 59225: 31 airframe hours since new and 7099: 14 hours since the renewal of last Certificate of Airworthiness (C of A). Scrutiny of the Airframe and Engine log books of the aircraft has revealed that engine #1 had logged 37971: 05 hours since new and ‘C’ Check was due at 41903: 17 hours. Engine #2 had logged 44636: 21 hours since new and ‘C’ Check was due at 46449: 26 hours. Engine #3 had logged 40305: 01 hours since new and 22081: 58 hours since last overhaul and ‘C’ Check was due at 44237: 13 hours. Engine #4 had logged 39695: 25 hours since new and 1340: 09 hours since last overhaul and ‘C’ Check was due at 45855: 16 hours.

The last ‘D’ Check was carried out on the aircraft on 27/06/05, during this check the affected area was disturbed since strut fuel feed line coupling ‘O’ rings was replaced as per MPD task card. Also Engine fuel feed system engine 1 strut fuel tube drain line was installed as per service bulletin.

Last ‘C’ check was carried out on the aircraft on 11/09/08 and during this check to facilitate spring beam replacement; the affected area was disturbed since No. 1 strut removal and re-installation required strut fuel feed line / couplings on front spar and drain lines to be removed. Last ‘4A’ Check was carried out on the aircraft on 25/04/09 and no specific work was carried out on the affected area.

**There could be possibility that during the above mentioned “D’ check or “C” check the coupling was not tightened to the proper specification and procedure, causing the coupling to rotate (undergo tightening and loosening cycles) for the last several**

**cycles, which eventually caused the coupling material to fracture on the tie wire hole.**

Scrutinizing the aircraft defect logbook, it was observed that on 01/05/09 that during the ground check at Frankfurt on engine #1 some fuel drops were observed. As per rectification engine motoring was performed with cowl's open, found all normal and the aircraft was released for flight. At base station Mumbai on 04/05/09, detailed inspection/rectification was carried out and no evidence of fuel leak and oil leak was noticed. Subsequently the aircraft was released for flight. There after there was no snag report for fuel leakage reported on the air craft till the aircraft was involved in the incident. Last '2A' Check was carried out on the aircraft on 08/08/09 and no specific work was carried out on the affected area.

Post fire incident during inspection it was observed that the fuel leak was from the No. 1 strut fuel feed line wherein the fuel coupling was completely dislodged and the safety wire(locking wire) was also dislodged from the locking hole(wire tie hole). **As inspection of this fuel line is not covered under Daily inspection and also not in any of the major schedules other than check 'D', the same was not inspected by the engineering department for a period of 4 years. After the locking wire got dislodged from the locking hole failure, with the operation of the aircraft and the vibration induced during landings and takeoffs the fuel coupling started loosening and over the period completely dislodged from its position which resulted into heavy fuel leak and subsequently # 1 engine fire. However, when the locking wire got dislodged from its position cannot be ascertained since the area is only inspected normally during check 'D'.**

After the incident the quality control department of Air India had carried out one time inspection on the entire 747-400 fleet and was found satisfactory. The inspection task of strut fuel feed line/ couplings has been introduced on all 747-400 aircrafts on a permanent basis during every check 'C'/18 months interval.

**From the above, it is opined that the coupling was not tightened to the proper specification and procedure during the recent "D' check or "C" check, wherein coupling body was disturbed, causing the coupling to rotate (undergo tightening and loosening cycles) for the last several cycles, which eventually caused the coupling material to fracture on the tie wire hole.**

**Serviceability/maintenance of the aircraft is hence a factor to the incident.**

**2.2 Weather:**

The incident occurred during the monsoon time. As per METAR of 0510 UTC, weather was reported Hazy , the visibility was around 1700mtrs and NO sig. But at the time of incident it was raining. The crew obtained the latest weather from ATIS information "B" 04:37UTC and the weather reported was, runway in use 27, surface wet, transition level 55, winds 280/04knots, visibility 1600mtrs, 1800MFB, QNH 1006, QFE 1005, RVR for runway 27 1600mtrs, temp 27. The Engineer on the head set had started all the four engines and the #1 engine was started at the end. The fuel leak would have started once the booster pump for number #1 engine was put on. Since it was raining and the final clearance was from the right side by the engineer, he failed to notice fuel leak from No1 engine since from his position No 1 engine was not visible.

Weather is not a contributory factor.

**2.3 Pilot handling of the aircraft:**

Prior to the flight from Mumbai both the commander and the F/O obtained a briefing and a walk around inspection was carried out by the F/O, thereafter both the crew proceeded to the aircraft for the flight. During cockpit preparation the crew had switched off the company frequency channel as the crew got distracted with the company transmissions while doing their start up and ATC communications. Also the emergency frequency volume was kept low during the engine start up procedures. Check list and procedures were carried out by the crew and thereafter engine #4 was started on the bay itself prior to pushback as the APU was

under MEL. First officer was handling R/T and the commander was on control. The push back commenced at around 0519 UTC and the tow bar failed after the aircraft moved just 8-10 feet. The aircraft started taxing at around 0524 UTC and turned to taxi way G. While taxing on G, one of the company aircrafts operated AI864 which was docked on Bay 95, saw the fuel leak from the aircraft VT-ESM and immediately informed on the company channel to dispatch about the fuel leak. The Capt of this aircraft did not call out to VT-ESM since he was on the ground frequency and VT-ESM had already changed over to tower frequency. The dispatch called AI-829 on company channel to inform about the fuel leak however, the VHF 3 was kept in the off position. ATC called IC-629 to confirm their registration as ESM which they said negative and then finally ATC called out AI-829 to confirm registration ESM, which was confirmed by the crew. The ATC informed that as per the follow me jeep 3 there was a heavy fuel leak from the left engine of the aircraft and gave instructions to switch off the engines immediately. The commander announced on PA for CCIC in the cockpit and started the emergency shutdown checklist. By the time, the fire had already started moving towards # 2 engine. The CCIC saw the fire while getting up from her located position and immediately gave evacuation commands on the PA (evacuation from the right). **There was no evacuation command given by the commander**. Since the crew had deployed the RH side escape slides and the evacuation had commenced, the commander along with the F/O evacuated the aircraft from the upper deck without ensuring that all the passengers had evacuated and prior to the completion of evacuation. They also did not come down to lower deck to ensure all the persons were evacuated. Pilots also failed to notice any symptoms of fuel leak on the engine/strut area on LH side during walk around inspection.

**From the above it is clear that the crew were in non-conformance with the company operating procedures regarding switching off the company channel and also evacuating the aircraft before the passengers and cabin crew. They also failed to notice any symptoms of fuel leak on the engine/strut area on LH side during walk around inspection.**

**2.4 Role of AIRCRFT MAINTENANCE ENGINEER (AME) in the incident:**

On 4/9/2009 B747-400 aircraft was engaged in flight from Mumbai to Riyadh. Since the APU was under MEL, engine #4 was started at bay. After completion of the push back rest of the 3 engines were started in the sequence of 3, 2, 1. At this time it was raining and the visibility was around 1700mtrs. **The departure Engineer** on the head set had started all the four engines and the #1 was started at the end. The fuel leak would have started once the booster pump for number #1 engine was put on. Since it was raining and the final clearance was from the right side by the engineer, he failed to notice fuel leak from No1 engine since from his position No 1 engine was not visible. Normally final clearance to the departure will be from LH side. **Further before the aircraft started taxiing the AME had already left the bay.** It was reported by the departure AME that he carried out base transit check of airframe and pre-departure check on the aircraft. **But he failed to notice any fuel leak from engine / strut area.**

**From the above it is opined that probably departure AME failed to notice any fuel leak from engine / strut area during his relevant inspection. He had not given clearance from the left side which is a usual practice. He left the bay prior to aircraft taxiing out from the bay. Hence he failed to adhere the standard maintenance practices and at lapse of meticulous inspection.**

**2.5. Role of cabin crew:**

Cabin crew in-charge(CCIC) stated that AI-829 was scheduled to operate originally at 2030UTC(3.9.2009) ie., 0200 IST of 4.9.2009. She boarded the aircraft at 1940UTC. However aircraft returned back to bay due technical fault. After snag rectification it was taxied out and the snag reappeared and again came back to the bay around 0030UTC. Passengers were deplaned and Departure was revised to 0415 UTC. There was a change of aircraft and crew boarded VT-ESM at about 0340 UTC. She reported that her another cabin crew seated next to her showed CCIC during taxing 2 persons were signaling to the aircraft and fire was noticed. Till this time there was no command from the cockpit. The fire was seen on left side near

engine 1 area. **She said there is no time for cabin preparation for evacuation and passengers started running towards the door. No megaphone was used. Emergency evacuations were mostly given in Hindi for right side evacuation.** All the right side doors (5doors ie R1,R2,R4,R5 and U/D right door except R3) was opened and slide chutes were fully deployed. All passengers and crew were evacuated though slide chutes only standard commands and SOP for evacuation were followed. **There was no cabin crew down the slide to assist the passengers on ground. She was the second last person to come out. She saw already the cockpit crew were down. She also confirmed that no cabin crew on LH location (lower deck/upper deck) had informed the fuel leak or fire broke-out till the ground staff signaling to the aircraft on LH side fuel leak and fire on engine #1 . Even though aircraft caught fire on A3 which is closer to the active runway, no specific caution was issued to passengers while evacuation either by the cockpit crew or cabin crew. It was observed by the airport staff that passengers were running towards the active runway. Emergency escape path light was not illuminated for guiding the passengers.** The above information of CCIC were also ascertained by the other cabin crew members.

**From the above it is felt emergency situation could have been more professionally handled by the cabin crew as well cockpit crew. This could have avoided minor injuries to 21 passengers.**

**2.6 ATC role:**

Statement and clarification of the SMC controller(Senior Manager-ATC) revealed that SMC controller was doing dual duty of SMC as well tower supervisor at the time of incident. He is also the instructor and was imparting training on SMC position from 0405 UTC to 0515 UTC. He reported traffic volume was heavy but could not justify his dual role with a such heavy volume of traffic. However he was performing this dual job as per duty roster. There is no such provision existing at Mumbai airport for temporarily handing over tower supervisor duty to another person during heavy traffic. For his position A3 was partially blocked by main fire station, watch tower and one overhead tank. Hence causing limitation of visual coverage of movement of aircraft. However he was not aware of any safety assessment for

the limitation of visual coverage. At the time of incident he reported visibility was 1700M and RVR 1700M with drizzling. Even though visual limitation is there he did not take any assistant or used the binocular for ascertaining the aircraft movements. There is no SMR(surface movement Radar) at Mumbai. During emergency A precious time of 58 secs was lost in confirming the ESM location as he was working with call sign-flight number but not with aircraft registration. **Departure /arrival register was also not maintained for aircraft registration even though it is required to be maintained as per the format. Similarly flight progress strip also does not mention aircraft registration but only flight number.**

**There is no simulator training provision available at Mumbai ATS for handling emergency situation of the aircraft to tower/SMC position.**

The SMC controller at tower gave taxi instruction to AI 829 at 0525 UTC to taxi via 'G' hold short of A3.Later it was asked to follow Indian airlines aircraft A320 . As the aircraft turned on to A3, the follow me jeep-3 in the vicinity noticed the fuel leak and informed ATC immediately to inform the aircraft to switch off the engine. However, the jeep could only tell the registration to the ATC and not the flight number Then the ATC called IC-657 confirming their registration as ESM which they said negative and then finally ATC called out AI-829 is your registration ESM, which was confirmed by the crew. The ATC informed that as per the follow me jeep there was a heavy fuel leak from the left engine of the aircraft and gave instructions to switch off the engines immediately. The crew by then noticed the fire from #1 engine and carried out the emergency shutdown. There after the ATC had no communication with the aircraft.

**From the above it is apparent that Sufficient time was lost in locating and confirming the aircraft registration. Once the follow me jeep reported ESM with fuel leakage, SMC controller should have called the aircraft by registration instead of flight number Emergency situational awareness was missing in the SMC controller's action. ATC(SMC) could not provide prompt and effective assistance to the flight crew immediately after receiving the fuel leakage information from follow me jeep.**

**2.7. Circumstances Leading to the Engine Fire:**

Aircraft VT-ESM was chocked off from bay 63 at 0455UTC. As APU was unserviceable and under MEL, engine #4 was started at bay prior to pushback. The push back commenced at around 0519 UTC and the tow bar failed after the aircraft moved just 8-10 feet. After arranging a new tow bar the push back was completed facing east and rest of the 3 engines were started in the sequence of 3, 2, 1. The aircraft started taxing at around 0524 UTC and turned to taxi way G. While taxing on G, one of the company aircraft operated AI864 which was docked on Bay 95, saw the gushing of fuel around LH side engine of VT-ESM and immediately informed to dispatch on the company channel about the fuel leak. The Captain of this aircraft could not contact VT-ESM since he was on the ground frequency and VT-ESM had already changed over to tower frequency. The dispatch called AI-829 on company channel to inform about the fuel leak; however the VHF 3 (company channel)was kept in the off position. The attempt made by AI-864 and Air India dispatch to contact the pilot on 131.9 M Hz frequency was unsuccessful. While the aircraft was taxing on G, the engineer who was on bay #95 also saw the fuel leak from No 1 engine strut of the aircraft and took off his ramp jacket and started signaling to the aircraft. The Cabin crew in-charge (CCIC) did see the person signaling but could not figure out the reason and hence ignored the same.

The follow me jeep in the vicinity also noticed the fuel leak and informed ATC(SMC) immediately to switch off the engine. The follow me jeep could only tell the registration to the ATC . ATC called IC-657 for confirming their registration as ESM which they said negative. Finally ATC(SMC controller) called out AI-829 to check registration ESM, which was confirmed by the crew. In this process precious time of about 50 secs was lost. Then ATC informed that as per the follow me jeep3 there was a heavy fuel leak from the left engine of the aircraft and gave instructions to switch off the engines immediately. The commander announced for CCIC in the cockpit and started the emergency checklist. Subsequent to engine shutdown engine no:1 caught fire and started moving towards NO 2 engine. Aircraft stopped on A3 taxiway. Airport fire services arrived immediately

as the incident location was close to main fire station and fire was put off. All passengers and crew were evacuated using escape slides on RH side of the aircraft. The incident took place at about 0530 UTC under day light condition and there was drizzling.

**From the foregoing exhaustive inspection and analysis carried out on the aircraft and fuel coupling body unit it is confirmed that the safety wire had pulled through the safety wire hole of the coupling body which had failed under ductile load. This led to the Fuel tube coupling adjacent to firewall in #1 engine strut to adrift and found loose. This caused heavy fuel leakage and leaked fuel fallen on the hot engine leading to the fire on engine and adjacent areas.**

## 3. CONCLUSIONS:

### 3.1 Findings:

a) Aircraft had a valid C of A and valid Flight Release Certificate (CRS) on the day of incident.

b) As per the cockpit compliment the commander was below the age of 60. The F/O who was also the type rated commander, aged above 60 yrs and on contract to the company

c) Both pilots were appropriately licensed and qualified to undertake the flight. They were also medically fit and given adequate rest prior to operating the flight.

d) Commander had total flying experience of 12838 hrs of which 4821 hrs were on type. First officer had total flying experience of 12593 hrs out of which 4520 hrs on type.

d) Pilots were not under the influence of alcohol.

e) At the time of engine push back and start it was raining/drizzling. But Weather is not a contributory factor to the incident

f) The departure AME failed to notice the symptoms of fuel leak on LH side during base transit check of airframe and pre-departure check on the aircraft and during # 1 engine start. The engineer after giving start to all the engines left the bay and did not give the final clearance since it was raining.

g) The pilot, during the cockpit preparation had kept VHF 3 in the off position. The above action was in non-conformance with the company operation Procedures. Because of this dispatch did not contact the aircraft.

**h)** After having received the fuel leak information from follow me jeep3, sufficient **time was lost by SMC in locating and confirming the aircraft registration. Once the follow me jeep reported ESM with fuel leakage, SMC controller should have called the aircraft by registration instead of flight number Emergency situational awareness was not there with the SMC controller's action. ATC(SMC) could not provide prompt and effective assistance to the flight crew immediately after receiving the fuel leakage information from follow me jeep.**

i) Flight strip as well departure/arrival register has no Information of aircraft registration

j) The cockpit crew initiated emergency engine shut down procedures and called CCIC to the cockpit. However as required no evacuation command was given immediately by the commander after ATC told about the emergency.

k) Neither cockpit crew or cabin crew promptly acted on the hand signal received from the ground staff

l) The commander and first officer came out of the aircraft prior to the completion of evacuation and did not ensure before evacuating the aircraft that all the passenger and crew had evacuated the aircraft.

m) After the evacuation was initiated, there was no cabin crew at the bottom of the slide to assist the passengers and also to direct them to move away from the aircraft and stay away from the active run way 27. Few of the passengers were injured during evacuation. Some of the passengers were running towards the active runway who were stopped and guided by the airport emergency services.

n) Airport fire services and search and rescue team had been deployed on time to ensure the evacuated passengers shifted to the safe place and proper first aid was given to injured passengers.

o) There was no serious injury to any of the occupants. 21 passengers received minor injuries.

p) Post fire incident during inspection it was observed that the fuel leak was from the No. 1 strut fuel feed line wherein the fuel coupling was completely dislodged and **safety wire had pulled through the safety wire hole. This caused heavy fuel leakage and leaked fuel had fallen on the hot engine leading to the fire on engine and adjacent areas.**

q) Inspection of this fuel line is not covered under Daily inspection and also not in any of the major schedules other than check 'D', the same was not inspected by the engineering department for a period of 4 years.

r) After the locking wire got dislodged from the locking hole, with the operation of the aircraft and the vibration induced during landings and takeoffs the fuel coupling started unscrewing, and, over the period completely dislodged from its position which resulted into heavy fuel leak and subsequently #1engine fire. **Serviceability/ maintenance of the aircraft is hence a factor to the incident.**

s) **Fuel Leak did not take place at single event. There might be fuel leak for several cycles during which coupling was unlocking after the safety wire to pull through the failed safety wire hole under ductile failure.** This is also confirmed by extensive rubbing and wear of the fracture surfaces by extended contact with the stainless steel tie wire.

t) **The coupling was most probably not tightened to the proper specification and procedure during the latest "D' check or "C" check wherein coupling body was disturbed, causing the coupling to rotate (undergo tightening and loosening cycles) for the last several cycles, which eventually caused the coupling material to fracture on the tie wire hole.** Installation, maintenance or environmental variables that may have affected the failure can not be excluded.

## 3.2. C A U S E (S)

Complete dislodging of No. 1 strut fuel feed line coupling due to dislodging of tie wire from the failed tie wire hole is the cause for heavy fuel leak and leaked fuel falling on hot #1 engine resulted into fire.

**Contributory factors:**

1. **Not tightening the coupling to the proper specification and procedure** during maintenance resulting into ductile failure of coupling material is the main contributory causative factor.
2. Installation , maintenance or environmental variables.
3. Failure of departure AME in adhering to the standard procedures and his perfunctory function.
4. Lapses/failure of the pilots during walk around inspection
5. Non-conformance by the pilots- company operating procedures

6. Failure of ATC-SMC personnel for prompt and effective handling emergency situation.

7. Lack of situational awareness and crew coordination.

## 4. S A F E T Y R E C O M E N D A T I O N S:

(a) Appropriate corrective action as deemed fit should be taken on the involved captain, first officer, all Cabin crew and the Departure AME for their deficient performance and lapses.

(b) Appropriate corrective action as deemed fit should be taken on the SMC controller for his tardy and ineffective handling of the emergency situation.

(c) Air India shall Review maintenance program, its schedules and maintenance practices for more stringent, effective and frequent inspection and identification of fuel leak from the aircraft.

(d) The incident may be brought to the knowledge of all concerned.

(e) AAI shall introduce, monitor proper training procedure to all ATC personnel for handling emergency situation.

(f) AAI shall review the Existing System of documenting Departure/arrival register and flight progress strip for inclusion of information of aircraft registration.

(g) Installation of SMR at Mumbai airport shall be done immediately by concerned airport agencies.

Date: 16.07.2010 (C.P.M.P.RAJU)
Place: Mumbai Enquiry officer VT-ESM