Final Investigation Report on Incident of EGPWS Warning to M/s Indigo Airbus A-320 aircraft VT-IGK on 27.02.2016 while operating flight No. 6E-237 (Ahmedabad-Jaipur) on 27.02.2016

O/o Director Air Safety(NR),
Safdarjung Airport, New Delhi-03

Foreword

This document has been prepared based upon the evidences collected during the investigation, opinion obtained from the experts etc. The investigation has been carried out in accordance with Annex. 13 to the Convention on International Civil Aviation and under the Rule 13(1) of Aircraft (Investigation of Accidents and Incidents) Rules 2012. The investigation is conducted not to apportion blame or to assess individual or collective responsibility. The sole objective is to draw lessons from this incident which may help to prevent such future accidents or incidents.

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a) Type/ Model	:	Airbus A 320–232
Nationality	:	Indian
Registration	:	VT-IGK
b) Owner	:	M/s Klaatu Aircraft Leasing (Ireland) Limited
c) Operator	:	M/s InterGlobe Aviation Ltd.
d) Pilot-in-Command	:	ATPL Holder
Extent of injury	:	Nil
f) Date of Incident	:	27.02.2016
g) Place of Incident	:	Jaipur Latitude: 26° 49' 40.44" E Longitude: 75° 51' 6" N
h) Last Point of Departure	:	Ahmedabad
i) Point of Intended Landing	:	Jaipur
j) Type of Operation	:	Scheduled Flight
k) Phase of Operation	:	Final Approach
l) Type of Incident	:	CFIT (marginally avoided)

(All timings in the report are in IST unless otherwise specified)

SYNOPSIS

M/s Indigo A320 aircraft VT-IGK operating Flight 6E-237(Ahmadabad-Jaipur) was involved in EGPWS "TOO LOW TERRAIN" warning when aircraft was on finals during visual approach at runway 27 at Jaipur (VIJP). The crew carried out a "Go Around" and landed safely on subsequent ILS approach on R/W 27. There was no damage to aircraft and no injury was reported.

DGCA instituted investigation under Rule 13(1) of the Aircraft (Investigation of Accidents and Incidents) Rules 2012.

The Incident occurred as the PIC misidentified a portion of a road parallel to the runway 27 at Jaipur, as the "Runway" and his failure to carryout "Go Around" despite the First officer (PF) saying, more than once, that he did not have runway in sight.

1. FACTUAL INFORMATION

1.1 History of the Flight

On 27th February 2016, M/s Indigo A-320 aircraft VT-IGK was operating flight 6E-237 from Ahmedabad to Jaipur. The scheduled time of departure from Ahmedabad was 1610 hrs. IST and the scheduled time of arrival at Jaipur was 17:10 hrs. The flight departed at 16:00 hrs IST.

Prior to the flight, flight crew operated 01 sector (Chennai-Ahmedabad). 6E- 236 came in contact with Jaipur approach at 16:32 hrs IST. The aircraft was being flown by First Officer (F/O) on Ahmadabad-Jaipur sector. He was cleared by M/s Indigo for assisted flying. Pilot in Command (PIC) also had clearance from M/s Indigo for imparting assisted flying. Jaipur approach advised Indigo "expect ILS localizer approach R/W 27 and gave it clearance to "JJP" via "BUBNU" waypoint, radial 240 JJP. The clearance was copied by the crew. The subsequent descent clearance to F110 was copied by the crew. PIC briefed and planned for ILS approach via overhead.

At around 35 DME (between 16:43:26 hrs IST and 16:43:34 hrs IST) the Jaipur approach advised Indigo aircraft that the visibility was 5000 meters and gave them the option of Visual Approach. Crew accepted to carry out a visual approach. Accordingly ATC gave them further descent clearance to transition level FL 60 QNH 1018 Hpa. Aircraft was given further descent clearance to 3600ft and they reported field in sight. Approach cleared them for visual approach R/W 27 with instructions to report left base R/W 27 and they were changed over to tower. (Between 16:50:14 and 16:50:36 hrs. IST).

Aircraft joined left hand downwind Runway 27 at 2700 feet AMSL with AP2 engaged, Flaps 1 and speed selected as 180 knots. It flew outbound for 60 seconds and started turning for base. Right before turning for base, Config-2, Landing gear was selected down, Auto Pilot was disconnected and speed was managed on FCU. Aircraft joined the base leg at around 4 NM from threshold and started descending. In the base leg turn, both of them started looking for the runway. On the base roll out the PIC said "Runway in sight" and told the First Officer to descend. At 2600 feet, Config-3 was selected. Aircraft continued descend in the base leg. Max. Rate of Descent of 1000 feet/min was maintained for approx. 30 seconds. While turning for finals, approx. 4.4 NM from threshold, aircraft was at 1000 feet RA and indicated air speed (IAS) was 140 knots (Vapp =140 knots), Config-3 and Gear down. During final rollout the Co-Pilot still did not have the runway in sight and the visibility deteriorated due to sun in the eyes.

First Officer sighted the runway at 500 ft and what Captain was assuming to be runway was a straight road, and realized that the PIC was asking him to descend with reference to this road only. The aircraft was at 3 NM from threshold and 480 feet RA with ROD continuously decreasing. Aircraft took

approx. 39 seconds to descend from 400 feet RA to 200 feet RA. By this time they both realized that they were too low and should carry out a "Go Around". They reduced the rate of descent. FDR data indicates that at approx. 1.7 NM from threshold, aircraft was at 250 feet RA and aircraft leveled off for approx. 10 seconds. At that time the EGPWS warning "Too Low Terrain" was triggered and the aircraft was at approx. 1.27 NM from threshold and at 200 feet RA. Subsequently an immediate "Go Around" was carried out. TOGA Thrust was selected and "Go Around" executed at 189 feet RA. First Officer was Pilot Flying for "Go Around" also.

Subsequently an ILS approach for the Runway 27 was carried out and aircraft landed safely.

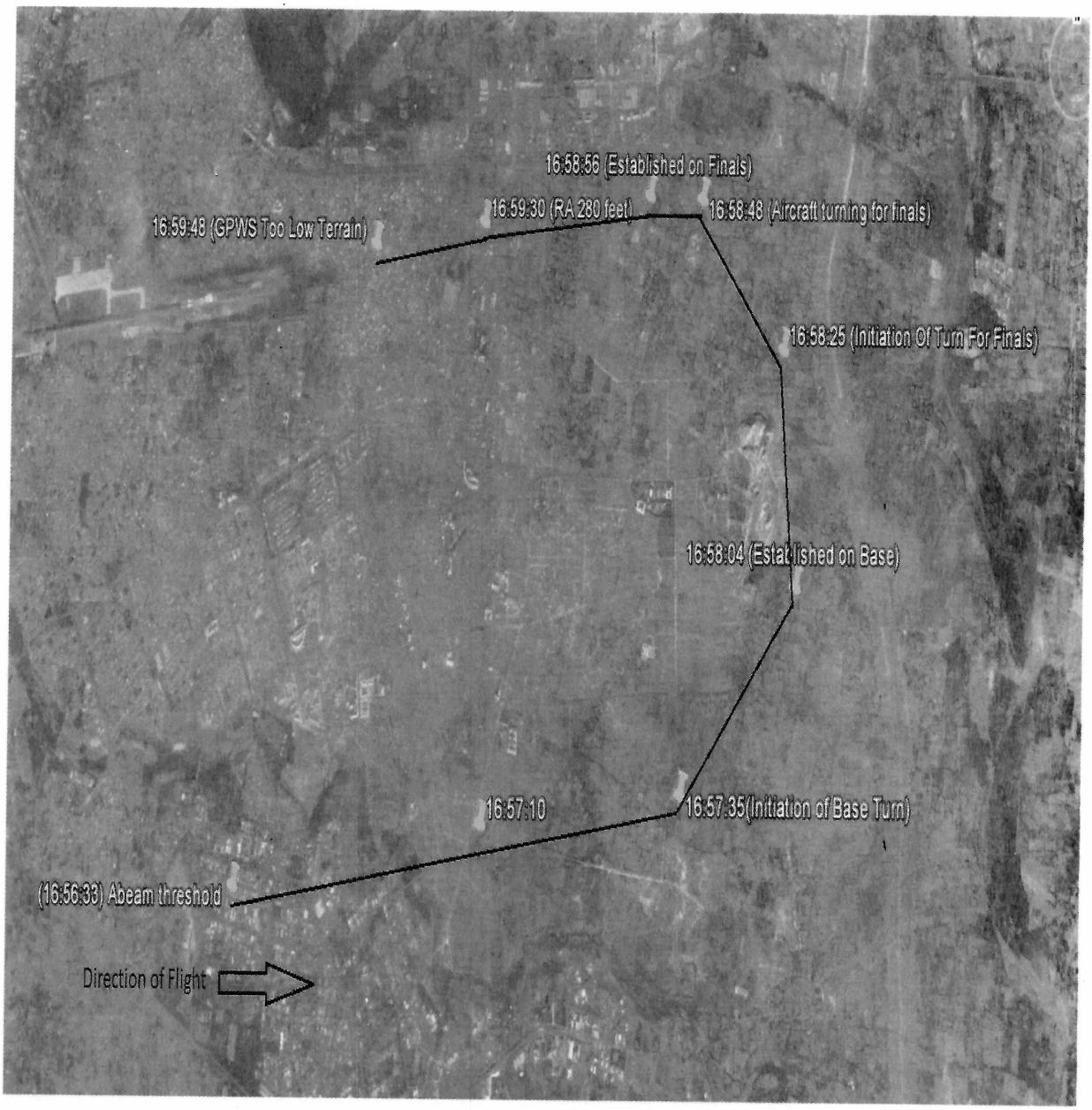


Fig.1: Progress of Flight: from abeam Threshold R/W 27 to the point EGPWS warning was triggered.

1.2 **Injuries to Persons:**

Injuries	Crew	Passengers	Others
Fatal	Nil	Nil	Nil
Serious	Nil	Nil	Nil
Minor	Nil	Nil	
None	6	167	

1.3 **Damage to Aircraft**

Nil

1.4 **Other Damage**

Nil

1.5 **Personnel information**

1.5.1 **Pilot-in-Command**

He was a pilot with the defense forces and joined Indigo Airlines on 1st September 2010. He underwent his endorsement training on Airbus 320 type of aircraft after joining M/s Indigo Airlines. He had flown the incident flight to Jaipur after a long gap of approx. 2 years and was not aware of any road to the south of the R/W.

1.5.1.1 **License Details (As on date of incident)**:

License type	:	ATPL
ATPL Valid up to	:	20-06-2016
Date of Initial Issue	:	21-06-2010
Date of Birth	:	17-03-1966
Medical Valid up to	:	23-05-2016
FRTOL (Issue date)	:	10-06-2008
Date of last IR Check	:	13-12-2015
Date of last Route Check	:	04-04-2015
PPC	:	13-12-2015

1.5.1.2 **Aircraft Ratings**:

As PIC	:	Cessna 172R, Piper Seneca PA34, Airbus A320
Date of Endorsement on A320 Aircraft	:	08-07-2011
Last technical Refresher	:	18-10-2015

1.5.1.3 **Flying Experience**

Total flying experience	:	6791:49 hrs.
Total flying hours on A320 aircraft	:	3941:39 hrs
As Captain on A320 aircraft	:	870:00 hrs.
Flying hours in last 12 months	:	973:08 hrs
Flying hours in last 30 days	:	79:36 hrs.
Flying hours in last 7 days	:	19:04 hrs.
Flying during last 24 hrs.	:	9:28 hrs.

1.5.2 **First Officer (As on date of incident):**

First Officer underwent initial endorsement training for Airbus A-320 aircraft at a training academy in CAE Madrid as per DGCA approved type training course. He was cleared to fly as First Officer on 26.09.2011.

1.5.2.1 **License Details**:

License type		CPL
Valid up to	:	22-04-2018
Date of Initial Issue	:	23-04-2013
Date of Birth	:	28-11-1988
Medical Valid up to	:	10-02-2017
FRTOL No, valid till	:	23-04-2018
Date of last IR Check	:	21-12-2015
Date of last Route Check	:	02-09-2015

1.5.2.2 **Aircraft Ratings**:

As PIC	:	Cessna 172, Piper Seneca PA34
As Co-pilot	:	Airbus A-320
Last technical Refresher	:	04-06-2015
PPC	:	21-12-2015

1.5.2.3 **Flying Experience**

Total flying Experience	:	1577 hrs.
Total on Airbus A320	:	1317 hrs.
Flying hours in last 12 months	:	890:18 hrs.
Flying hours in last 30 days	:	82:10 hrs.
Flying hours in last 7 days	:	22:34 hrs.
Flying during last 24 hrs.	:	9:28 hrs.

1.6 Aircraft Information

1.6.1

Manufacturer	Airbus Industries, Toulouse, France
Type	A320-232
Constructor's S.NO.	3457
Year of Manufacture	22-Feb-2010
Certificate of Airworthiness	4216
Airworthiness Review Certificate	DDG/NR/ARC/2015/046
Category	Normal
Sub Division	Passenger/Mail/Goods
Certificate of Registration	4069/1
Owner	M/s Klaatu Aircraft Leasing (Ireland) Limited, 8 Fitzwilliam Place, Dublin 2, Ireland.
Operator	M/s InterGlobe Aviation Limited
Minimum Crew Required	Two
Maximum All Up Weight Authorised	73500 kgs
Last Major Inspection	19-Jan- 16 (C Check – 7500 hrs / 5000 cycles / 24 months inspection)
Air frame Hrs. Since New	20944.05 hrs.

1.6.2 **Scrutiny of record**

No defect was reported by the crew and observed by engineering on arrival, no maintenance was carried out on arrival at Jaipur.

1.6.3 **Weight and Balance**

There were total of 163 + 4 infant's passengers, departure fuel: 5900kgs (block fuel), T/O W 62515 kgs % MACTOW: 27.46%.

1.7 **Meteorological Information:**
Jaipur METAR 27 FEB 2016:

Time	Weather report
10:30Z (16:00 IST)	260/05KT, 5000 HZ, Temp 30° C, DP 04° Q1018 NOSIG
11:00Z (16:30 IST)	160/03KT, 5000 HZ, Temp 30° C, DP 04° Q1018 NOSIG
11:30 Z (17:00 IST)	250/05KT, 5000 HZ ,Temp 30 ° C DP 03° Q1018 NOSIG
12:00 Z (17:30 IST)	VRB/03KT,5000 HZ, Temp 29 °C DP 04° Q1018 NOSIG

Sunset Time: - 18:26 Hrs. Elevation 26 degree above Horizon.

The weather was clear and visibility was 5000 m in Haze, well above the minimum for a visual approach.

However the time of approach was approx. one hour before sunset, on a dead westerly heading.

1.8 **Aids to Navigation:**

No defect was reported with the NAV aids at Jaipur
R/W 27 is equipped with ILS for approaches.

1.9 **Communications** :
Aircraft was maintaining two way communication with the ATC.

1.9.1 Relevant portion of communication with Jaipur Approach at frequency 125.25 MHz From time 16:30 IST (1100UTC) TO 17:30 IST (1200 UTC)

Time (IN UTC) HHMMSS	From	To	TAPE TRANSCRIPT
110033-110117	IGO 237	APP	JAIPUR IGO 237
	APP	IGO 237	IGO 237 JAIPUR
	IGO 237	APP	IGO 237 GOOD AFTERNOON VACATE FL310 WITH DELHI CONTROL SQUAWK 6315 ESTIMATING JJP 1127
	APP	IGO 237	EXPECT ILS ZULU APPROACH R/W27 CLEAR TO JJP VIA BUBNU 240 RADIAL JJP

	IGO 237	APP	ROGER EXPECT ILS ZULU APP R/W 27 FOR JJP AND REQUESTING OVERHEAD PROCEDURE IGO237
	APP	IGO 237	ROGER
111231-111336	IGO 237	APP	JAIPUR IGO237 RELEASED BY DELHI WE DESCENDING PASSING 223 FOR 150
	APP	IGO 237	IGO237 DESCEND TO FL110
	IGO 237	APP	DESCENT TO F110 IGO 237
111326-111334	APP	IGO237	IGO 237 VISIBILITY 5000 M ADVISEABLE TO ACCEPT VISUAL APP R/W27
111335-111403	IGO 237	APP	ROGER SIR WE ACCEPT VISUAL APPROACH R/W27
	APP	IGO237	IGO237 EXPECT VISUAL APPROACH R/W27 DESCEND TO FL60 TRANSITION LEVEL QNH 1018 HPa REPORT 25 M
	IGO237	APP	DESCEND TO FL60 TRANSITION LEVEL FL55 1018 COPIED
	APP	IGO237	TRANSITION LEVEL FL60 DESCEND TO FL60
	IGO237	APP	DESCEND TO FL60 COPIED IGO237
111609-11658	IGO237	APP	IGO237 25DME
	APP	IGO237	IGO237 DESCEND TO 5000FT ON QNH 1018 HPa TLFL60 REPORT R/W IN SIGHT

	IGO 237	APP	DESCENT TO 5000 FT QNH 1018 TL55 CALL U R/W IN SIGHT IGO237
112014-112036	IGO 237	APP	DESCEND TO 3600 FT ON QNH1018
	IGO237	APP	IGO237 MAY WE DESCEND TO CIRCUIT ALTITUDE, FIELD INSIGHT
	APP	IGO237	CONFIRM R/W INSIGHT
	IGO237	APP	AFFIRM SIR IGO237
	APP	IGO237	IGO237 CLEARED VISUAL APPROACH R/W27 DESCEND AS PER PROCEDURE. REPORT RIGHT BASE R/W 27 AND CORRECTION REPORT LEFT BASE R/W 27 AND EXPECT FREQUENCY CHANGE OVER TO TOWER
	IGO237	APP	CALL YOU LEFT BASE R/W27WE ARE IN DOWNING
112141-112148	APP	IGO237	IGO237 CONTACT TOWER 124.3 GOOD DAY
	IGO237	APP	TWR 124.3 GOOD DAY SIR

1.9.2 **Communication with Tower at frequency 124.3 MHZ**

TIME (IN UTC) HHMMSS	FROM	TO	TAPE TRANSCRIPT
112152	IGO237	TOWER	TOWER IGO234 WE ARE ON LEFT BASE R/W27
	TOWER	IGO237	IGO237 REPORT FINAL R/W27
	IGO237	TOWER	FINAL R/W 27
112429	TOWER	IGO237	IGO 237 JAIPUR INSIGHT R/W27 CLEAR TO LAND WIND 250 DEG 05 KTS

	IGO 237	TOWER	CLEAR TO LAND IGO 237 ROGER
112504	IGO 237	TOWER	IGO 237 GOING AROUND
112525			IGO237 JAIPUR CLIMB STRAIGHT AHEAD 3600 FEET JOIN JJP HOLD AS PUBLISHED CONTACT APPROACH 125.25
112534			CLEARANCE IGO237
			CLIMB TO 3600 FT CONTACT APPROACH 125.25
			CONTACT... SAY AGAIN FREQUENCY
			125.25
			125.25 ROGER GOOD DAY

1.10 Aerodrome Information:

1.10.1 Jaipur airport is owned and fully controlled by Airports Authority of India. The co-ordinates of the aerodrome reference point are 26°49'27" N & 07°54'81"E. The elevation of the ARP is 1263 feet. The airfield has a single runway 09/27 which is 2797 meters long and 45 meters wide. The magnetic bearing of the runway are 085°/265° which are same as geographical bearings. The elevation of runway 09 threshold is 1263 feet and that of runway 09 is 1250 feet. The declared distances of TORA, TODA, ASDA and LDA for both runway 09 and 27 are 2797 meters. There are no obstructions in the approach and take off areas. The runway is marked with runway threshold, touchdown, centerline and runway side line markings.

Jaipur airport meets the ICAO category VII requirements in respect of fire and rescue services. As per the AIP India, meteorological information is provided on 24 hours basis and provides TAF.

1.10.2 There is a city road 200ft wide running parallel to the runway 27 towards its left. The road is at approximately 380 meters away from center line of runway 27. The road is not straight and has traffic lights. There is a road divider running through the center of the road along its length.

1.10.3 There is no defined circuit pattern & Circuit altitude at Jaipur however MSA is 3600 feet.

Fig. 2 Position of Airport Road with respect to R/W

1.11 **Flight Recorders**:

1.11.1 **Cockpit Voice Recorder:**

The CVR was not removed as the incident was reported as Go around due to triggering of GPWS warning.

1.11.2 **Digital Flight Data Recorder:**

- Aircraft joined left hand downwind at 2700 feet AMSL with AP2 engaged, Flaps 1 and speed selected as 180 knots.
- Aircraft flew outbound for 60 seconds and started turning for base. Right before turning for base, Config-2, Landing gear down selected, AP disconnected and Speed Managed. Aircraft joined the base leg at around 4 NM from threshold and started descending. During the base leg turn the maximum bank angle recorded was 29.2 degree.
- At 2600 feet, Config-3 was selected. Aircraft descended throughout the Base leg. Max. ROD 1000 feet/min maintained for approx. 30 seconds.
- While turning for finals, approx. 4.4 NM from threshold, aircraft was at 1000 feet RA, speed 140 knots (Vapp =140 knots), Config-3 and Gear down.
- At 3 NM from threshold, aircraft was at 480 feet RA with ROD continuously decreasing.
- Aircraft took approx. 39 seconds to descend from 400 feet RA to 200 feet RA.
- At approx. 1.7 NM from threshold, aircraft was at 250 feet RA and aircraft leveled off for approx. 10 seconds.
- At approx. 1.27 NM from threshold, aircraft was at 200 feet RA when EGPWS "Too Low Terrain" Warning was triggered.
- Subsequently, TOGA Thrust was selected and Go-around executed at 189 feet RA. RHS was PF and for the approach and Go-around

1.12 **Wreckage and Impact Information.**

N/A

1.13 **Medical and Pathological Information:**

Flight crew were subjected to PFME (BA Test) at Chennai and the test result was negative.

1.14 **Fire:**

There was no fire.

1.15 **Survival Aspects:**

The incident was survivable.

1.16 **Tests and Research:**

Nil

1.17 Organizational and Management Information:

M/s Indigo is a scheduled airline with a fleet of 171 Airbus A-320 aircrafts and 10 ATR 72-600 aircrafts, operating flights on domestic and international sectors. The company is in operation for last 07 years. The Company is headed by CEO assisted by a leadership team of professional of various departments.

1.17.1 Procedure for Visual Approach:

M/s Indigo Flight crew techniques Manual for A320 aircraft for the visual approach prescribes the following procedures

VISUAL APPROACH

Applicable to: ALL

Ident.: PR-NP-SOP-190-GUI-G-00019397.0002001 / 20 MAR 17

INITIAL APPROACH

The flight crew must keep in mind that the pattern is flown visually. However, the cross track error on ND is a good cue of the aircraft lateral position versus the runway centerline. This indication can be obtained when performing a DIR TO radial inbound on the last available waypoint, positionned on the extended runway centerline.

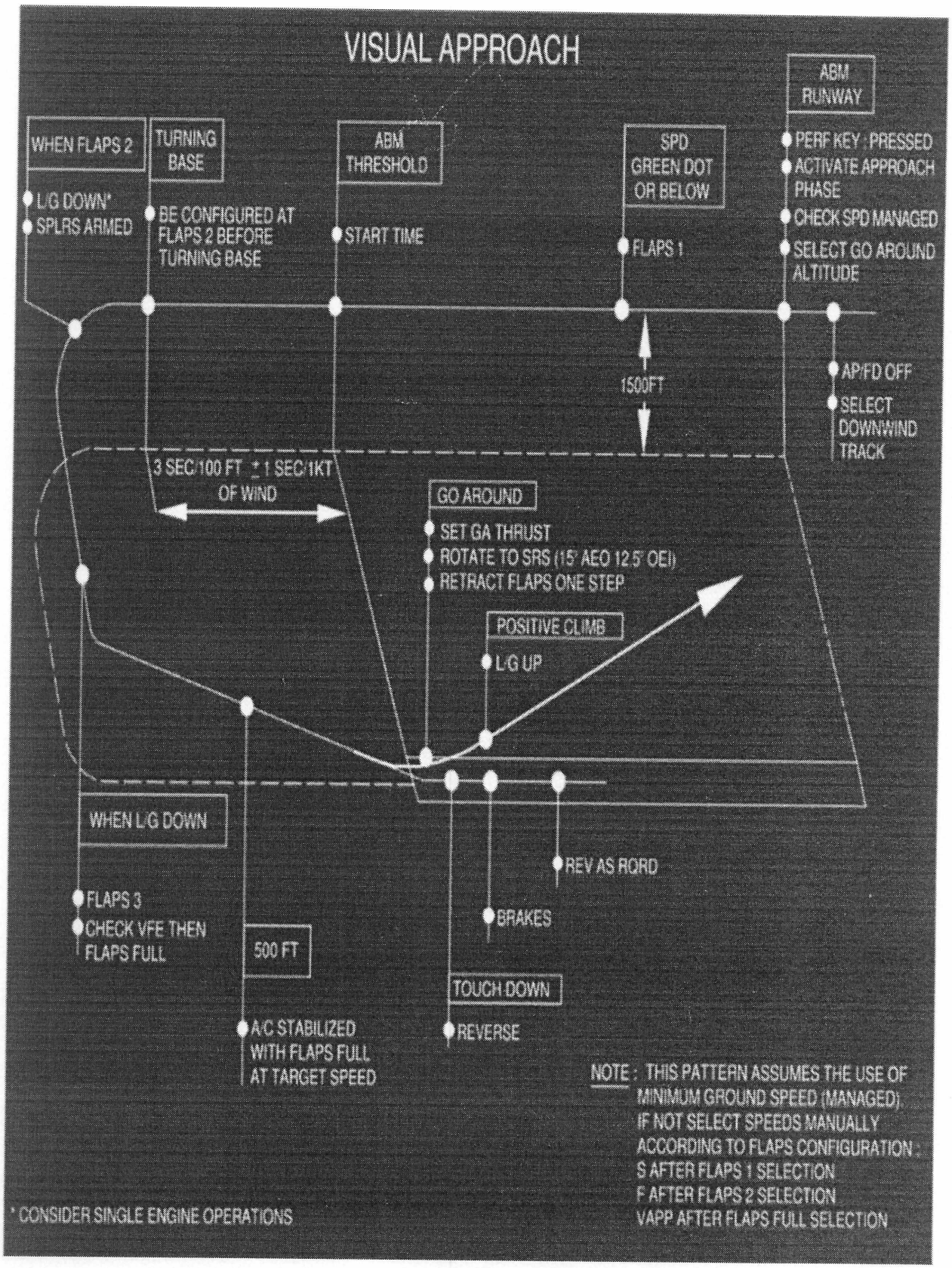
The flight crew will aim to get the following configuration at beginning of the downwind leg:

- Both AP and FDs will be selected off
- BIRD ON
- A/THR confirmed active in speed mode, i.e. SPEED on the FMA
- Managed speed will be used to enable the "GS mini" function
- The downwind track will be selected on the FCU to assist in downwind tracking
- The downwind track altitude will be set on FCU.

Ident.: PR-NP-SOP-190-GUI-G-00019398.0001001 / 20 MAR 17

INTERMEDIATE / FINAL APPROACH

Assuming a 1 500 ft AAL circuit, the base turn should be commenced 45 s after passing abeam the downwind threshold (3 s/100 ft +/- 1 s/1 kt of head/downwind).
The final turn onto the runway centreline will be commenced with 20 ° angle of bank. Initially the rate of descent should be 400 ft/min, increasing to 700 ft/min when established on the correct descent path
The pilot will aim to be configured for landing at VAPP by 500 ft AAL, at the latest. If not stabilised, a go-around must be carried out.


VISUAL APPROACH
WHEN FLAPS 2
L/G DOWN*
SPLRS ARMED
TURNING BASE
BE CONFIGURED AT FLAPS 2 BEFORE TURNING BASE
ABM THRESHOLD
START TIME
SPD GREEN DOT OR BELOW
FLAPS 1
ABM RUNWAY
PERF KEY : PRESSED
ACTIVATE APPROACH PHASE
CHECK SPD MANAGED
SELECT GO AROUND ALTITUDE
1500FT
AP/FD OFF
SELECT DOWNWIND TRACK
3 SEC/100 FT ± 1 SEC/1KT OF WIND
GO AROUND
SET GA THRUST
ROTATE TO SRS (15° AEO 12.5° OEI)
RETRACT FLAPS ONE STEP
POSITIVE CLIMB
L/G UP
WHEN L/G DOWN
FLAPS 3
CHECK VFE THEN FLAPS FULL
500 FT
A/C STABILIZED WITH FLAPS FULL AT TARGET SPEED
TOUCH DOWN
REVERSE
REV AS RQRD
BRAKES
NOTE : THIS PATTERN ASSUMES THE USE OF MINIMUM GROUND SPEED (MANAGED).
IF NOT SELECT SPEEDS MANUALLY ACCORDING TO FLAPS CONFIGURATION :
S AFTER FLAPS 1 SELECTION
F AFTER FLAPS 2 SELECTION
VAPP AFTER FLAPS FULL SELECTION
* CONSIDER SINGLE ENGINE OPERATIONS

1.17.2 **Indigo Instructions for the Visual approach and use of instruments during approach**

Following is the extract of instruction contained in the Operations Manual Part A of M/s Indigo for the Visual approach and use of instruments:

c) **Line Flying:**

- Auto Pilot engagement is recommended soon after minimum engagement altitude for all flights during take-off. Auto Pilot when used, should be within AFM/ FCOM limitations, in both, normal and failure cases.
- FDs shall not be selected OFF in order to practice 'No FDs Take-Off'. MEL Dispatch with no FDs is permitted.
- Autopilot may be selected off below 10,000 ft. For approaches; Selection of Autopilot Off is to be accomplished during low work load conditions and preferably well before intercepting LOC/ Final Approach track.
- Auto Thrust and FDs must stay ON (Automation Level not to reduce below Level 2 as defined in table above).
- Standard visual Circuit patterns and radar vectored visual circuit could be practiced under the following conditions:
    - Traffic density/ ATC permission
    - Visibility minima as laid down by SOP (not below that for a NPA for that runway or 3200m, whichever is higher)
    - Cloud ceiling not below MSA and no significant cloud at or below standard circuit height of 1500ft AAL.
    - Pilot familiar with the airfield.
    - As per SOP, Auto Pilot and FDs would be switched OFF and FPV (Bird) selected ON
    - Wind limitation as per SOP.
    - Flight crew are advised to back up the visual approach with ILS approach indications, if available, for that runway. This is to ensure that aircraft is aligned to the active runway and correct profile is being flown.
    - A thorough briefing must be carried out on planned execution, including how and where the visual circuit pattern is planned to be intercepted.

d) **Training Flights**

- Auto Pilot engagement is recommended soon after minimum engagement altitude for all flights during take-off. Auto Pilot when used, should be within AFM/ FCOM limitations, in both, normal and failure cases.

1.17.3 **Crew Training Procedure on CRM**

M/s Indigo has developed a detailed in-house CRM training programme which is contained in the Operations Manual Part-'D'. The training programme also includes joint CRM. The relevant extract from the OM-'D' is appended below

1.9.5.1 CRM training

This training will be conducted by Company Authorised approved CRM facilitators.

Duration of CRM Training:

For Initial	06 hrs × 2 Days = 12 hrs
For Recurrent	03 hrs × 1 Day = 03 hrs

Note: Initial CRM course will be imparted to all newly inducted Cockpit Crew by at least one CRM Facilitator in accordance with Table 1

All crew shall thereafter undergo regular recurrent training annually.

Duration of Recurrent CRM may be reviewed from time to time.

Joint (combined) CRM with flight and cabin crew shall be conducted not later than 2 years from the initial CRM course.

1.9.5.2 Introduction to the CRM training modules

The modular CRM training programme will cover all major elements of CRM training and will be covered over a period not exceeding three years.

a) Human error and reliability, error chain, error prevention and detection;
b) Company safety culture, SOPs, organizational factors;
c) Stress, Stress management, fatigue and vigilance;
d) Information acquisition and processing, situation awareness, workload management;
e) Decision Making;
f) Communication and coordination inside and outside the cockpit;
g) Leadership and team behaviour, synergy;
h) Automation and philosophy of the use of automation (if relevant to the type);
i) Specific type-related differences;
j) Case based studies;
k) Additional areas which warrant extra attention, as identified by the accident prevention and flight safety programme.

1.9.5.3 Elements of the CRM

The following table indicates elements of CRM to be included in each type of training.

Table 1

<table>
<tr><th>Core Elements</th><th>Initial CRM Course

(duration 2 days)</th><th>Operator's conversion course when changing Type</th><th>Operator's conversion course when changing operator</th><th>Command course</th><th>Recurrent training</th></tr>
<tr><td>Human error and reliability, error chain, error prevention and detection, human performance and limitations</td><td rowspan="6">In depth</td><td>In depth</td><td>Overview</td><td>Overview</td><td rowspan="6">Overview</td></tr>
<tr><td>Company safety culture, SOPs, organizational factors</td><td rowspan="2">Not required</td><td>In depth</td><td rowspan="5">In depth</td></tr>
<tr><td>Stress, stress management, fatigue & vigilance</td><td rowspan="3">Not required</td></tr>
<tr><td>Information acquisition and processing situation awareness, workload management</td><td rowspan="3">Overview</td></tr>
<tr><td>Decision making</td></tr>
<tr><td>Communication and co- ordination inside and outside the cockpit</td><td>Overview</td></tr>
</table>

Leadership and team behavior synergy					
Automation, philosophy of the use of automation (if relevant to the type)	As required	In depth	In depth	As required	As required
Specific type- related differences			Not required		
Case based studies	In depth	In depth	In depth	In depth	As appropriate

Note: All Joint CRM training will be conducted by at least one Pilot CRM Facilitators along with Non Pilot CRM Facilitator. Non Pilot CRM Facilitator utilised to conduct Joint CRM will be nominated by the Chief CRM coordinator/Chief Pilot Training

Indigo Training modules have been designed on the basis of the DGCA prescribed syllabus. A specific modular CRM training program ensures that all major topics of CRM training are covered over a period not exceeding three years.

1.17.4 Pilot Training and qualification

The Indigo Operations Manual-Part 'D' contains the training requirements for qualification of the operating crew. The relevant extract is appended below:

1.10 PILOT TRAINING QUALIFICATION (SIMULATOR AND LINE TRAINING)

a) Pilot Training and evaluations shall include:
   I) Pilot Monitoring/Pilot Flying and other flight crew division of duties (Task Sharing)
   II) Positive Transfer of aircraft control
   III) Consistent Check List philosophy
   IV) Emphasis on a prioritization of Tasks (Fly, Navigate, communicate)
   V) Proper use of all levels of Automation

   B) The Pilot flight crew members shall complete an evaluation that includes a demonstration of knowledge of the operations and such evaluation shall include a demonstration of knowledge of:

   i) Approaches authorized by the authority

   ii)Ceiling and visibility requirements for take-off, approach and landing

   iii) Allowance of inoperative ground components

iv) Wind limitations (Cross winds, Tail winds, if applicable head wind)

1.10.1 Simulator training

As the normal line operations environment does not offer 'training' avenues for non-normal operations, flight Crew will undergo training which will include demonstration of competence in normal and non-normal procedures and procedures to include as a minimum, rejected take-off, emergency evacuation, engine failure, windshear avoidance and recovery from predictive and actual wind shear, terrain awareness (CFIT) procedures and manoeuvres and /or those procedures and manoeuvres specified by the Company/Authority.

1.17.5. **Route and Aerodrome Qualification**

Para 9.4.3.3 – 9.4.3.6 of DGCA CAR Section 8 Series O Part II states that

"A pilot-in-command shall have made an actual approach into each aerodrome of landing on the route, accompanied by a pilot who is qualified for the aerodrome, as a member of the flight crew or as an observer on the flight deck, unless:

a) the approach to the aerodrome is not over difficult terrain and the instrument approach procedures and aids available are similar to those with which the pilot is familiar, and a margin approved by DGCA is added to the normal operating minima, or there is reasonable certainty that approach and landing can be made in visual meteorological conditions; or
b) the descent from the initial approach altitude can be made by day in visual meteorological conditions; or
c) the operator qualifies the pilot-in-command to land at the aerodrome concerned by means of an adequate pictorial presentation; or
d) the aerodrome concerned is adjacent to another aerodrome at which the pilot-in-command is currently qualified to land."

9.4.3.5 An operator shall not continue to utilize a pilot as a pilot-in-command on a route or within an area specified by the operator and approved by DGCA unless, within the preceding 12 months, that pilot has made at least one trip as a pilot member of the flight crew, or as a check pilot, or as an observer in the flight crew compartment:
a) within that specified area; and
b) if appropriate, on any route where procedures associated with that route or with any aerodromes intended to be used for take-off or landing require the application of special skills or knowledge.

9.4.3.6 In the event that more than 12 months elapse in which a pilot-in-command has not made such a trip on a route in close proximity and over similar terrain, within such a specified area, route or aerodrome, and has not practised such procedures in a training device which is adequate for this purpose, prior to again

serving as a pilot-in-command within that area or on that route, that pilot must requalify in accordance with 9.4.3.2 and 9.4.3.3.

1.17.6 M/s Indigo Procedure for Route and Aerodrome Qualification:

Operations Manual-Part 'D' of M/s Indigo prescribes the procedure for route and aerodrome qualification. Relevant extract is appended below:

1.26 ROUTE/ ROLE COMPETENCE QUALIFICATION

a) Route and Aerodrome Competence

The pilot must ensure, prior to being assigned as PIC on a route or as pilot to whom the flight may be delegated by the PIC, that he/ she has obtained adequate knowledge of the route to be flown and of the aerodromes (including alternates) facilities and procedures to be used.

b) Route Competence

i) Training

Route competence training includes knowledge of:

- Terrain and minimum safe altitudes
- Seasonal meteorological conditions
- Meteorological, communications and air traffic facilities, services and procedures
- Search and rescue procedures
- Navigational facilities associated with the route along which the flight is to take place
- Depending upon the complexity of the route the following methods of familiarization will be used:
- Less complex routes: self-briefing with documentation, or programmed instructions.
- More complex routes: Routes in the vicinity of high terrain, using metric system for altitude reporting, not using English as the

official language for communication are considered as more complex routes. In addition to the self-instruction, in-flight familiarization under supervision or familiarization in an approved simulator using a database appropriate to route concerned.

ii) **Requirements**

For route competence, the PIC must have knowledge of:

- Terrain and minimum safe altitudes;
- Seasonal meteorological conditions;
- Meteorological, communication and air traffic facilities, services and procedures.
- Search and rescue procedures; and
- Navigational facilities associated with the route along which the flight is to take place.
- Loss of radio communication procedures

The following method of familiarization will be used:

For less complex routes:

Familiarization by self-briefing with route documentation.

In flight familiarisation as observer & co-pilot, or pilot under supervision.

For more complex routes: specific route competence is required.

c) **Aerodrome Competence**

i) **Training**

Aerodrome competence training includes knowledge of:

- Obstacles, general topography, lighting approach aids, minimum safety altitudes.
- Arrival, departure, holding and instrument approach procedures, as well as any procedure applicable to flight path over heavily populated areas.

- Loss of radio communication procedures for the particular aerodrome.
- Depending upon the complexity, aerodrome are classified in categories from A to C. Category A is given to the least demanding aerodrome; Category B and C are applied to more demanding aerodromes.
- Where applicable; noise abatement procedure may be practiced.

ii) **Requirements**

For Aerodrome competence the PIC must have knowledge of and must brief himself on the parameters indicated below:

- Aerodrome layout
- Radio Aids
- Standard Instrument Arrival and Departure procedures
- Local weather and Company minima
- Emergency and Safety Services
- Obstacle and minimum safe altitudes

1.17.7 **Discontinued Appraoch /Go round procedure**

M/s Indigo opearations manual Part B in Chapter 02 Inter area state that The responsibility for thrust levers and the decision of 'Go Around' shall be the sole and complete responsibility of the Pilot inCommand. When required, the PIC shall clearly announce. 'I have controls'and take over controls without compromising flight path/Safety. The other pilot will acknowledge by announcing 'you have controls' and continue to fly the aircraft till a positive input is made by the PIC.

1.18 **Additional Information**:

A. Stabilized Approach: A stabilized approach is critical to pilots and flight crew for maintaining situational awareness of the external environment. This means pilots and flight crew are able to receive, process and utilize situational information to a greater affect. However, an unstable approach requires increased concentration on the performance of the airplane, by both the pilot flying (PF) and pilot monitoring (PM), to the detriment of processing other equally important situational information.

B. Following an incident involving a commercial airliner on July 7, 2017 at San Francisco, FAA has issued a safety Alert for the operators on the subject "Incorrect

Airport Surface Approaches and Landings". In the incident a commercial airline aircraft conducting a visual approach at night overflew other aircrafts positioned on a taxiway and awaiting takeoff clearance. This airliner was cleared to land on runway 28R at the San Francisco International Airport yet flew the approach while lined up on Taxiway "C", which is adjacent and to the right of runway 28R. Runway 28L was closed and unlit, except for a lighted "X" identifying the runway closure. Taxiway "C" had four airliners in line to take-off on runway 28R. The inbound flight crew queried the air traffic control tower (ATC) via radio asking about traffic on the runway. The response from ATC was "confirmed cleared to land" and that the runway was clear. The flight crew continued their approach and associated misalignment without further questioning of ATC. A crewmember on one of the waiting airliners broadcast that the approaching jet was "on the taxiway." The inbound flight crew initiated a go-around while flying directly over the taxiway and waiting airplanes.
This event highlights the importance of employing best practices for successful approaches and landings to the correct airport and runway and recommends following best practices:

Technology: Utilize published approaches such as Very High Frequency Omni Directional Radio Range (VOR), Localizer (LOC), Instrument Landing System (ILS), Area Navigation (RNAV), etc. Conducting an approach in visual conditions increases the potential for confusing visual clues such as airport lighting configuration, surrounding lights, or areas that look similar to the airport. Therefore, use of the most precise available approach or Flight Management System (FMS) RNAV navigational aids will serve to support pilot and flight crew decisions.

C. Cockpit/Crew Resource Management (CRM): Effective CRM is imperative because it leverages the skills of all crew-members. In a two-person (or more) flight deck, there is always a PF and a PM. If something does not look correct the observing crewmember bears the responsibility for communicating what they see. The key behind successful CRM is being receptive, informative, proactive, and persistent. CRM also delineates job functions and the expectation of support.

D. Utilization of Available Resources: Effective CRM also establishes the use of all available resources including but not limited to:

- A briefing of the airfield diagram;
- A review of airport lighting including any approach lights systems (ALS);
- A review and discussion of Notices to Airmen (NOTAMS);
- Performance of the approach and landing checklists according to approved procedures;
- Use of approach navigational aids under both IMC and VMC conditions;
- Monitoring of the Automatic Terminal Information Service (ATIS) for information and changes to field conditions;
- Listening closely to all radio transmissions for pertinent information; and, Identification and verification of visual glide path information such as a Visual Approach Slope Indicator (VASI) or Precision Approach Path Indicator (PAPI) not

only for glide path indications but also their location relative to the runway of intended landing.

E. Be Ready to Go-Around: The potential for a go-around/missed approach is briefed during every approach briefing. However, PFs/PMs need to be aware of the variety of reasons that a go-around may be necessary so they are ready to use it, and, if necessary, use it early, particularly during a time of confusion. The old aviator's adage, "when in doubt, go-around" still applies.

1.19 **Useful or Effective Investigation Techniques:**

N/A

2. ANALYSIS

2.1 Visual Approach:

The Crew had elected the ILS approach for ILS 27, however decided to carry out a visual approach after an option was given to them by the Approach control at Jaipur.

2.1.1 **Deviation from AOM/FCTM visual approach Procedure:**
The AOM/FCTM(Flight Crew Techniques Manual) for the visual approach inter alia prescribes that assuming a 1500 ft AAL circuit, the base turn should be commenced 45s after passing the downwind threshold (3s/100 ft +/-1 of head/downwind).

The final turn onto the runway centerline will be commenced with 20° angle of bank, initially the rate of descent should be 400 ft/min, increasing to 700 ft/min when established on the correct descent path.

As per the procedure the crew was required to time out the out bound leg or the downwind leg, as a function of the prevailing airspeed and wind component. As per the flight data analysis aircraft flew outbound for 60 seconds joined the base leg at around 4 NM from threshold and started descending. During the base leg turn the maximum bank angle recorded was 29.2 degree. The aircraft went further away from the threshold R/W 27 in the downwind leg then prescribed by the procedure. Also the rate of descent and rate of turn maintained was high.

Thus the crew did not adhere to the Visual Approach procedure prescribed in AOM/FCTM and extended the downwind leg.

2.1.2 **Use of NAV Aids**:
Although the visibility was above minimum they overlooked the fact that they would land into the sun which would affect their ability to sight the runway and other visual landing aids. They disconnected the autopilot and continued the approach without ILS as a back-up making a visual approach in difficult visual conditions.

Company policy regarding standard visual circuit and RADAR vectored visual circuits during line flying inter alia prescribe following conditions:

- As per SOP, Auto Pilot and FDs would be switched OFF and FPV (Bird) selected ON.
- Flight crew are advised to back up the visual approach with ILS approach indications, if available for that runway. This is to ensure that the aircraft is aligned to the active runway and the correct profile is being flown.

ILS as back up in visual approach. ILS localizer approach was available. They were cleared by ATC for left base visual circuit approach.

The F/O continued to fly from RHS on a visual on left hand visual circuit. He was entirely dependent upon the PIC for calling out runway threshold on the downwind leg.

The PIC mistook a wide road parallel to runway 27 on its left side as the runway and instructed the First Officer to continue with the descent.

Crew did not adhere to the company policy regarding visual approach. Use of ILS as a back-up while making a visual approach in difficult visual conditions would have helped them to correctly align with the runway 27.

2.2 **Crew Resource Management**

Effective CRM leverages the skills of all crew-members. In a two-person (or more) flight deck, there is always a PF and a PM. If something does not look correct the observing crewmember bears the responsibility for communicating what they see. The key behind successful CRM is being receptive, informative, proactive, and persistent. CRM also delineates job functions and the expectation of support.

The F/O did not have runway in sight while turning into base leg or when initially aligning to the R/W. However, the PIC told him to continue the descent. While turning into finals, initially F/O still did not have R/W in sight and neither of the crew considered go around nor the F/O decide on handing over the control to the captain. The result was that an aircraft was low on profile on the finals. The First Officer reduced the Vertical speed.

Both the pilots realized that they were low on approach and decided to Go-Around. The EGPWS triggered at the same time. The Go- around was initiated at about 200 Ft RA. As per M/s Indigo procedure, the Go Around was to be initiated by the PIC. Considering the fact that the PIC had lost the situational awareness. The action of first officer is appropriate for the safety of operations.

There was lack of assertiveness on the part of the first officer, when he did not have runway in sight and he continued the descent and did not consider handing over the controls. Also the PIC did not consider the input from the First officer in other words he was not receptive.

M/s Indigo has detailed CRM training programme in place. However it is imperative that its effectiveness is tested during the simulator assessment, line audit etc. for continuous improvement.

2.3 **Route and Aerodrome Qualification:**

2.3.1 **Impact on Situational Awareness**:
The PIC operated this flight after a gap of approximately two years. He was not aware of the changes in the ground references/visual clues. A visual approach is an approach when either part or all of an instrument approach procedure is not completed and the approach is executed with visual reference to the terrain. Visual features used for approach path guidance include features in the airfield environment (especially runways) runway visual approach aids e.g. runway lights, PAPI and general landmarks.

He mistook a road running parallel to R/W 27 on its left side as the R/W 27. His lack of situational awareness was further accentuated by not making use of the ILS and PAPI.

Thus lack of familiarity coupled with the other factors affected the situational awareness of the PIC.

2.3.2 **Exception in the Regulation**
Para 9.4.3.3 of DGCA CAR Section 8 Series O Part II requires PIC to have made approach into each aerodrome of landing on the route accompanied by a pilot who is qualified for the aerodrome, as a member of the flight crew or as an observer on the flight deck. There is exception in these regulations which inter alia states as follows:

a) the approach to the aerodrome is not over difficult terrain and the instrument approach procedures and aids available are similar to those with which the pilot is familiar, and a margin approved by DGCA is added to the normal operating minima, or there is reasonable certainty that approach and landing can be made in visual meteorological conditions; or
b) the descent from the initial approach altitude can be made by day in visual meteorological conditions; or

Similarly Para 9.4.3.5 of the CAR prescribes procedure for the route qualification.

Jaipur airport is covered under the exception of sub para (a) and (b). The crew was roistered to operate to Jaipur after a gap of approximately two years. Due to lack of familiarity coupled with the Hazy conditions, The PIC mistook a wide road parallel to runway 27 on its left side as the runway.

3. Conclusions

3.1 Findings

3.1.1 The crew had planned for ILS approach via overhead JJP & carried out briefing as per SOP. However, on suggestion of ATC the flight crew elected to carry out a Visual approach to R/W 27 despite the fact that they would be landing into the setting sun.

3.1.2 The crew was stabilized in terms of speed, height and configuration and positioned themselves correctly on R/W 27 left hand downwind.

3.1.3 The First Officer was the pilot flying from the RH seat.

3.1.4 Crew commenced the base leg turn after 60 seconds. They did not adhere to the Visual Approach procedure prescribed in AOM/FCTM and extended the downwind leg. The PIC identified a wide road parallel to runway 27 as the Runway and commenced the descent.

3.1.5 The First Officer did not have runway in sight. However, PIC prompted him to descend since he thought he had runway in sight.

3.1.6 On finals, the First Officer again called runway not in sight and levelled off. At this stage the captain shifted his scan forward and picked up the runway, by this time they were too low on profile and simultaneously EGPWS "Too Low Terrain" warning triggered. A "Go Around" was carried out and subsequently the aircraft landed on R/W 27 after carrying out an ILS approach.

3.1.7 The aircraft was consistently and significantly below glide path on finals. The PIC was not aware of this since his reference was the road, slightly left and short of actual R/W threshold. The First officer did not have runway in sight and therefore reduced the Vertical Speed..

3.1.8 The PIC did not "Take-over", or initiated a "Go-around" when the Pilot Flying (First Officer) asserted that he did not have R/W in sight.

3.1.9 First Officer (PF) did not hand over control or called for a Go Around but continued to descend on instructions of the PIC.

3.1.10 There was lack of assertiveness on the part of the first officer, when he did not have runway in sight and he continued the descent and did not consider handing over the controls. Also the PIC did not consider the input from the First officer in other words he was not receptive.

3.1.11 Lack of familiarity with airfield environment/surrounding Terrain coupled with the other factors effected the situational awareness of the PIC.

3.1.12 Crew did not use ILS as a back-up making a visual approach in difficult visual conditions as per company policy.

3.2 **Cause :**

The Incident occurred due to PIC misidentifying a portion of a road parallel to and short of the runway, as the "Runway" and his failure to Go Around despite the First officer (PF) saying, more than once, that he did not have runway in sight.

Contributory Factors:

a) The Crew decision to carry out a visual approach to R/W 27, knowing that the setting sun would impair their visibility.
b) Failure of crew to use ILS as a back-up while doing the visual approach, especially with the sun into their eyes.
c) Both the crew were operating to Jaipur after a long gap
d) Lack of assertiveness on part of First Officer even when he did not have runway in sight and non-receptive PIC.

4. Recommendations:

4.1 This incident may be circulated to all the service providers for the guidance of their crew.

(Maneesh Kumar)
Director Air Safety
Inquiry Officer-VT-IGK
8/01/2019.

Appendix "A"

GLOSSARY OF ABBREVIATIONS USED IN THIS REPORT

AMSL	:	Above Mean Sea Level
APP	:	Approach
ATC	:	Air Traffic Control
ATCO	:	Air Traffic Control Officer
ATPL	:	Air Transport Pilot License
AP	:	Auto Pilot
CAR	:	Civil Aviation Requirements
CB	:	Cumulonimbus Clouds
CPL	:	Commercial Pilot License
CVR	:	Cockpit Voice Recorder
DME	:	Distance Measuring Equipment
DP	:	Dew Point
EGPWS	:	Enhanced Ground Proximity Warning System
ETA	:	Estimated Time of Arrival
ETD	:	Estimated Time of Departure
FCTM	:	Flight Crew Techniques Manual
FCU	:	Flight Control Unit
FDR	:	Flight Data Recorder
HZ	:	Haze
ILS	:	Instrument Landing System
IAS	:	Indicated Air Speed
IFR	:	Instrument Flight Rules
IMC	:	Instrument Metrological Conditions
IST	:	Indian Standard Time

JJP	:	Jaipur VOR
KT	:	Knot
NAV	:	Navigation
NM	:	Nautical Mile
NOSIG	:	No Significant
% MACTOW	:	Location of aircraft C.G as percentage of Mean Aerodynamic Chord at Take-off weight
PIC	:	Pilot-in-Command
PF	:	Pilot Flying
PM	:	Pilot Monitoring
QNH	:	Pressure Setting to Indicate Elevation
QNF	:	Local Altimeter Setting
RA	:	Radio Altitude
ROD	:	Rate of Descent
R/W	:	Runway
TOGA	:	Take off / Go Around
TSN	:	Time Since New
TWR	:	Air traffic Control Tower
TSO	:	Time Since Overhaul
VRB	:	Variable
VFR	:	Visual Flight Rules
VMC	:	Visual Meteorological Conditions
Vapp	:	Approach Speed
VOR	:	Very High Frequency Omni Range