GOVERNMENT OF INDIA
MINISTRY OF CIVIL AVIATION
AIRCRAFT ACCIDENT INVESTIGATION BUREAU

FINAL INVESTIGATION REPORT OF SERIOUS INCIDENT TO SPICEJET DASH8 Q400 AIRCRAFT VT-SUM ON 30TH JUNE 2019

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FOREWORD

This document has been prepared based upon the evidences collected during the investigation and opinion obtained from the experts. The investigation has been carried out in accordance with Annex 13 to the convention on International Civil Aviation and under Rule 11 of Aircraft (Investigation of Accidents and Incidents), Rules 2017 of India. The investigation is conducted not to apportion blame or to assess individual or collective responsibility. The sole objective is to draw lessons from this serious incident which may help in preventing such incidents in future.

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FINAL INVESTIGATION REPORT ON SERIOUS INCIDENT (RUNWAY EXCURSION) TO SPICEJET DASH8 Q400 AIRCRAFT VT-SUM WHILE OPERATING FLIGHT SG-3722 ON 30TH JUNE 2019

1.0 FACTUAL INFORMATION

1.1 History of Flight

On 30th June 2019, DASH8 Q400 aircraft VT-SUM was involved in a serious incident of runway excursion while operating flight SG-3722 (Bhopal-Surat). This was the sixth sector for aircraft and fourth sector for the operating crew(of the day). There were 43 passengers and 4 crew members on board.

Aircraft took off from Bhopal and the flight was uneventful till approach into Surat. The METAR of 1400 hrs (UTC) indicated visibility of 5000 m which as per METAR of 1430 hrs (UTC) reduced to 4000 m with thunderstorm and rain. While on approach to RWY 22 at around 1430 hrs., another aircraft which was taking off from same runway reported that the visibility was reducing below 2000 m.

As per the PIC (PF), strong winds from 150 degree direction with CB and lightening was observed. RWY approach lights were visible well before MDA. While on final approach the ATC reported heavy rain fall. At minimums, the PIC confirmed that the runway was in sight and disconnected the auto pilot. According to DFDR the auto pilot was used until 77ft AGL. As per the FCOM, for percision approaches the AP must be disengaged at or above 200 feet AGL.

Flare for landing was carried out at 30 ft. and the aircraft floated for about 15 seconds. The torque was observed to be 25% (normal torque 15%) with speed of Vref+20 knots. The aircraft touchdown was on RWY 22,brakes were applied progressively and MAX reversers were used. However the deceleration was not sufficient and the aircraft overshot the runway.

The aircraft finally stopped in RESA area, approximately 233m from runway end. There was no mud/ sand on RESA. RESA was made from gravels/concrete. No fire or smoke was observed in the cockpit or cabin. The ATC was appraised about the overshoot and requested for emergency services. ATC reported that they could not see the aircraft from tower. There was no injury to any of the

passengers and crew. The passengers deplaned normally. At the time of landing, the ATC did not report of the runway being contaminated or flooded with water due heavy rain. Nor any braking action report was relayed to the pilot. However a video showed runway flooded with water.

Only forward passenger air stair door was used for deplaning. APU provided electric power as well as pneumatic for air conditioning. At the site Wheel and brake condition was checked and was found satisfactory.Aircraft was pushed back to paved surface by using tow truck and tow bar and finally parked on bay. There was no injury or damage to the aircraft.

1.2 Injuries to Persons

INJURIES	CREW	PASSENGERS	OTHERS
FATAL	Nil	Nil	Nil
SERIOUS	Nil	Nil	Nil
~~MINOR~~ / NONE	04	43	Nil

1.3 Damage to Aircraft

Nil

1.4 Other Damage

Nil

1.5 Personnel Information

1.5.1 Pilot Flying

Age	54 years
License	ATPL
Date of Issue	29-Dec-16
Valid up to	28-Dec-21
Date of Class I Med. Exam.	27-Aug-18
Validity	Valid
Date of issue FRTOL License	16258

Endorsements as PIC (on)	DHC 8 402
Total flying experience	3013:07 Hrs.
Total flying experience during last 1 year	978:27 Hrs
Total flying experience during last 6 Months	372:01 Hrs
Total flying experience during last 30 days	35:17 Hrs
Total flying experience during last 07 Days	07:45 Hrs
Total flying experience during last 24 Hours	6:46 Hrs
Rest period before flight	16:40 Hrs

1.5.2 Pilot Monitoring

Age	33 Years
License	CPL
Date of Issue	24-Aug-11
Valid up to	20-Jan-22
Date of Class I Med. Exam.	02-Mar-19
Class I Medical Vaid up to	01-Mar-20
Date of issue FRTOL License	24-Aug-11
FRTO License valid up to	18-Jan-22
Total flying experience	3642:01 Hrs
Total flying experience during last 1 year	337:55 Hrs
Total flying experience during last 6 Months	337:55 Hrs
Total flying experience during last 30 days	88:43 Hrs
Total flying experience during last 07 Days	10:30 Hrs
Total flying experience during last 24 Hours	6:46 Hrs
Rest period before flight	16:40 Hrs

1.6 Aircraft Information

The aircraft bearing MSN 4402 was manufactured in the year 2012 and was registered under category ‘A’ with Certificate of Registration Number 4336. The Certificate of Airworthiness Number 6445 under “Normal category” (subdivision

Passenger / Mail / Goods) was issued by DGCA on 30.06.2012. The specified minimum operating crew is two and the maximum all up weight is 29,257 Kgs. At the time of incident, the Certificate of Airworthiness and Aero Mobile License A010/049/RLO was valid. The aircraft was fitted with two PW150A engines.

There was no snag pending rectification. The aircraft and its engines were maintained as per the Maintenance Programme consisting of calendar period / flying hours or Cycles based maintenance as per maintenance programme approved by DGCA. All concerned Airworthiness Directive, mandatory Service Bulletins, and DGCA Mandatory Modification on this aircraft and engines have been complied with as on date of incident.

1.7 Meteorological Information

The information as per the METARs is as below:

Time UTC HH:MM	Winds degree /knots	Visibility meters	Cloud Base	Temp/DP °C	Tempo
14:00	140/05	5000	SCT 010 BKN 020 OVC 080	27/25	
14:30	060/06	4000	SCT 010 BKN 020 FEW 030 CB OVC 080	27/25	TSRA
14:35	060/06	1200	SCT 010 BKN 020 FEW 030 CB OVC 080	27/25	+TSRA
15:00	150/06	1000	SCT 010 BKN 020 FEW 030 CB OVC 080	27/25	+TSRA

During the period of landing, heavy rain with thunderstorm was reported. No weather warning was declared either by ATC or Meteorological Department. The Fire Control Room In-charge had declared bad weather conditions and weather standby was maintained at Fire Station.

1.8 Aids to Navigation

As per the AIP following Navigational Aids were available and operational.

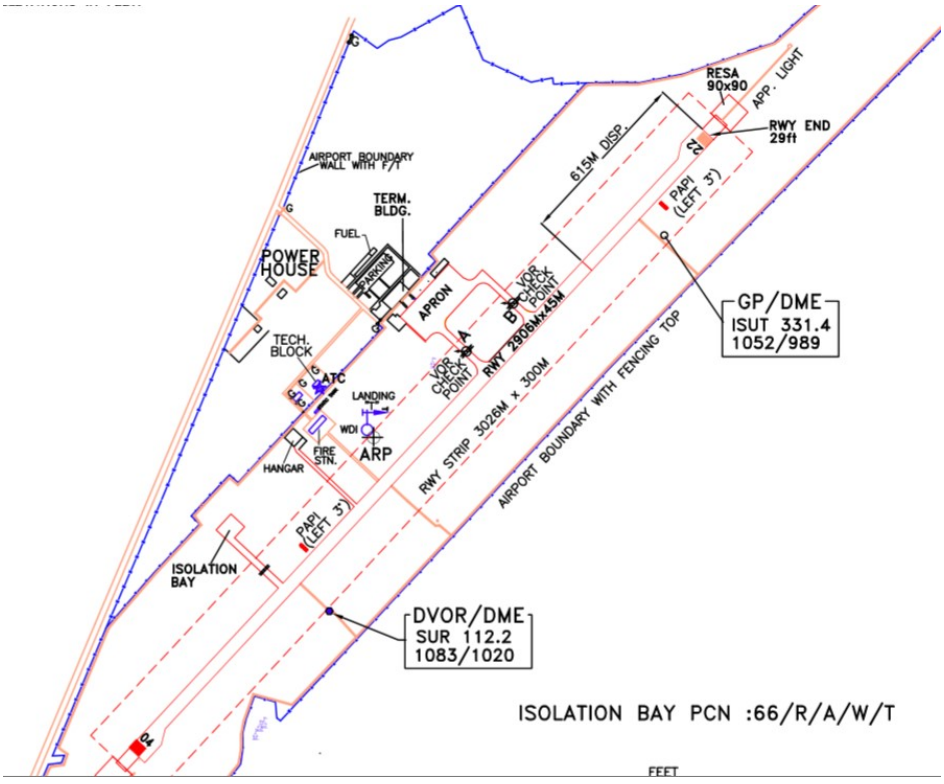
Type of aids, magnetic and type of supported operation for ILS/MLS, basic GNSS, SBAS and GBAS, and for VOR/ILS/MLS station used for technical line-up of the aid	Identification	Frequency(ies), Channel number(s), Service provider, and reference path identifier(s) (RPI), as appropriate	Hours of operation, as appropriate;	Geographical coordinates of the position of the transmitting antenna	Elevation of transmitting antenna of DME/ elevation of GBAS reference point	Service volume radius from the GBAS reference point	Remarks
1	2	3	4	5	6	7	8
LOC 22	ISUT	109.100 MHz	AS ATS	210615.20271N 0724354.70752E	---		
GP 22	ISUT	331.400 MHz	AS ATS	21 0720.35552N 0724505.16688E	---		Glide angle 3 DEG
DME(ILS)	ISUT	CH28X	AS ATS	210720.158N 0724505.205E	43.0FT		Collocated with GP
DVOR	SUR	112.200 MHz	AS ATS	210638.30707N 0724425.21398E	---		
DME	SUR	CH59X	AS ATS	210638.215N 0724425.548E	52.0FT		Collocated with DVOR

1.9 Communication

There was always two way communications between the aircraft and ATC/ Ground.

1.10 Aerodrome Information

Surat airport has got a single runway 04/22 with instrument approaches available for both ends.



The relevant declared distances are as follows:

RWY Designator	TORA (M)	TODA (M)	ASDA (M)	LDA (M)	Remarks Including runway entry or start point where alternative reduced declared distances have been declared.
1	2	3	4	5	6
04	2291	2291	2291	2906	
22	2906	2906	2906	2291	Threshold displaced by 615 M

1.11 Flight Recorders

Both the CVR and DFDR recordings were available for investigation. Following is the relevant information from DFDR:

Time (UTC)	Sequence of Events
14:35:09	LOC engaged, Altitude: 3062 ft(baro), DME1 10.75
14:36:06	Flap 5 selected, Altitude: 2404 ft (baro), DME1 8.25
14:36:18	Landing gear down and locked Altitude: 2416 ft (baro), DME1 7.63
14:36:29	Glideslope engaged Altitude: 2402 ft (baro), DME1 7.13
14:36:54	Flap 15 selected Altitude: 1910 ft AGL, DME1 6.13
14:38:25	At 1001 ft AGL Torque #1: 26, #2: 28.5 ROD: 570 fpm, CAS: 126 kts, DME1 3.125 Wind speed: 18 kts, Wind direction: 225 deg
14:39:07	At 499 ft AGL Torque #1: 6.5, #2: 8 ROD: 900 fpm, CAS: 133.5 kts, DME1 1.75 Wind speed: 12 kts, Wind direction: 233.4 deg
14:39:16	At 395 ft AGL Torque #1: 26, #2: 25.5 ROD: 210 fpm, CAS: 129 kts, DME1 1.375 Wind speed: 11 kts, Wind direction: 241.2 deg
14:39:25	At 299 ft AGL Torque #1: 24.5, #2: 25

	ROD: 390 fpm, CAS: 131 kts, DME1 1 Wind speed: 8 kts, Wind direction: 249.6 deg
14:39:33	At 208 ft AGL Torque #1: 22, #2: 19.5 ROD: 840 fpm, CAS: 134.5 kts, DME1 0.75 Wind speed: 6 kts, Wind direction: 251 deg
14:39:42	At 98 ft AGL Torque #1: 23, #2: 22.5 ROD: 750 fpm, CAS: 133 kts, DME1 0.375 Wind speed: 2 kts, Wind direction: 263.7 deg
14:39:44	Auto pilot disengaged, Altitude: 77 ft AGL
14:39:47	At 52 ft AGL Torque #1: 26.5, #2: 26 ROD: 300 fpm, CAS: 136.5 kts, DME1 0.25 Wind speed: 0 kts, Wind direction: 291.1 deg
14:40:08	Aircraft touch down CAS: 132.5 kts, Torque #1: 2.5, #2: 1, Landing g: 2.98

1.12 Wreckage and impact information

After the aircraft came to final halt, forward passenger air stair door was open and normal passenger deplaning was carried out. APU was running and supplying electric power as well as pneumatic for air conditioning. Wheel and brake condition was found satisfactory. There was no mud/sand on RESA. RESA was made from gravels/concrete. Main landing gear pins were installed and nose gear lock was engaged. Aircraft was pushed back to paved surface and parked on bay #1 from RESA. There was no major damge to the aircraft.

1.13 Medical and Pathological Information

The crew had undergone pre-flight medical at Surat before departure of the first flight of the day. The pre-flight medical test was satisfactory and the breath analyser test was negative.

1.14 Fire

Nil

1.15 Survival Aspects

The incident was survivable.

1.16 Tests and Research

Nil

1.17 Organizational and Management Information

The aircraft was operated by a DGCA approved aircraft operator holding AOP (S-16) in Passenger and Cargo Category which was valid till 16.5.2023. The operator carries out its own maintenance as CAR 145 approved organisation. There is in house training facility for the pilots, cabin crew, airport services and engineering.

During discussions with the Training Manager (TM) (Q400), it was observed that the TM was not conversant with the latest requirements laid down by the company regarding Q400. He was completely dependent on the Training Assistant.

1.17.1 Flight Crew Training

Basic Aircraft Performance

In the current aviation scenario, across all the operators in the country, most of the flight crew undergo their aircraft "Type Rating" course from an ATO during which ATO concentrates on "Type Specific Performance" training only. There is no detailed "Basic Aircraft Performance" training. Flight crew are not tested for knowledge of "Basic Aircraft Performance" at any stage of flying.

1.17.2 Runway Surface Condition Reporting

At all airports in India, runway surface condition is reported mainly by using readings from a runway friction measuring device or an aircraft braking action report. No other parameter such as type and depth of contaminant etc. are taken into account. Even globally, the methods used for such purpose are not standardised. The way this information is compiled and reported to the end-users (flight crews and flight planners) with regard to terminology, format and timeliness is also not standardised.

It is also true that in most of the runway excursions, runway contamination was present and the runway surface condition played a role. Collective root cause analysis of these occurrences has identified lack of standardisation in the way runway surface condition and braking action are assessed, reported and used by the various stake holders. A discrepancy between the reported runway surface condition and the actual one may effect the performance calculations, the use of deceleration devices and the flight crew's ability to maintain directional control.

In view of the above, world over, airlines and pilots are made aware of the risks associated with incorrect or unreliable runway surface condition reporting. States have either made the rules or are in the process of framing the same. In the mean time, States have also taken proactive actions for the purpose of mitigating the associated risks. Airlines are also supposed to take appropriate risk mitigation actions under Safety Management System.

So, the basic requirements are:

- Establish and implement one consistent method of contaminated runway surface condition assessment and reporting by the aerodrome operator for use by aircraft operators. Ensure the relation of this report to aircraft performance as published by aircraft manufacturers.
- Aircraft operators always conduct an in-flight assessment of the landing performance prior to landing. (Apply an appropriate margin to these results).

ICAO. Annex 14, Volume I contains high-level SARPs related to the assessment and reporting of runway surface condition. The Air Navigation Commission, ICAO has approved certain amendments to the first edition of the Procedures for Air Navigation Services – Aerodromes (PANS—Aerodromes) i.e. Doc 9981 with an applicability date of 5th November 2020. The amendment introduces the division of the PANS-Aerodromes Part II. Part I contains high-level matters, including aerodrome certification and Part II (Airport operations management) contains day-to-day operational matters.

Airport operations management part of ICAO Doc 9981 is intended to provide the information needed by the flight crew. When the runway is wholly or partly

contaminated or is wet, the runway condition report should be disseminated as soon as possible. It also provides operational procedures for the operation and management of airports and related airport activities. The requirements contained in that part are applicable to the airport operator and/ or other relevant entities operating on the airport.

The document further requires that the Runway Condition Report (RCR) is used for reporting assessed information. The RCR describes a basic structure applicable for all these climatic variations. The philosophy of the RCR is that the airport operator assesses the runway surface conditions whenever contaminants including water are present on an operational runway. From this assessment, a runway condition code (RWYCC) and a description of the runway surface are reported which can be used by the flight crew for aircraft performance calculations. This format, based on the type, depth and coverage of contaminants, is the best assessment of the runway surface condition by the airport operator. Changes in conditions are to be reported without delay.

The global reporting format for reporting runway surface conditions in a standardized manner will help the flight crew to accurately determine aircraft take-off and landing performance which in turn will result in a global reduction of runway excursion incidents/ accidents. Also, occurrences of disruptions to airport/ air traffic operations and the removal of aircraft disabled at an airport, on a runway will be reduced.

1.17.3 Landing Distance Calculation

The operator has issued a Performance Booklet for DHC-8-402 which contains charts/ tables for

TAKEOFF ANALYSIS
ENROUTE PERFORMANCE &
LANDING PERFORMANCE

and is available to all flight crew on board the aircraft. The booklet was reviewed by investigation team. In this booklet operator has given un-factored landing

distances for various flap configuration both for dry & wet runway conditions. A page from the booklet is as below for ready reference:

UNFACTORED LANDING DISTANCE AND APPROACH CLIMB GRADIENT

SpiceJet DHC-8-402

APPROACH FLAPS 10; LANDING FLAPS 15
(Landing Weight 28,123 KG; Bleeds OFF; ISA + 25; ZERO WIND)

Airport	Rwy	Elevation (ft)	Approach Climb Gradient (%)	Un-factored Landing Distance – Dry (m)	Un-factored Landing Distance – Wet (m)
RAJAHMUNDRY	05	146	4.33	801	921
RAJAHMUNDRY	23	146	4.33	895	1029
SILCHAR	06	338	4.28	819	942
SILCHAR	24	338	4.28	878	1010
SURAT	04	29	4.37	833	958
SURAT	22	29	4.37	845	972
TIRUCHIRAPALLY	09	288	4.3	866	996
TIRUCHIRAPALLY	27	288	4.3	826	950
TIRUPATI	08	350	4.28	863	992
TIRUPATI	26	350	4.28	830	955
THIRUVANANTHAPURAM	14	15	4.37	865	995
THIRUVANANTHAPURAM	32	15	4.37	833	958
TUTICORIN	10	85	4.35	845	972
TUTICORIN	28	85	4.35	834	959
UDAIPUR	08	1684	3.93	886	1019
UDAIPUR	26	1684	3.93	853	981
VARANASI	09	266	4.3	841	967
VARANASI	27	266	4.3	844	971
VIJAYAWADA	08	83	4.35	850	978
VIJAYAWADA	26	83	4.35	831	956
VIZAG	10	10	4.37	842	968
VIZAG	28	10	4.37	834	959
VIZAG	23	10	4.37	833	958

NOTE: An additional 15% margin has been incorporated for calculation of Un-factored Landing Distance for Wet Runway Condition.

WIND CORRECTION

Additional Un-factored Landing Distance due to Tail Wind

5 kt Tail Wind	10 kt Tail Wind	15 kt Tail Wind
75m	145m	NA

Flight crew was required to be aware that the distances are “Un-factored” and calculate the landing distance requirements after appropriately factoring (based on runway condition etc.) the landing distance given in the charts. Company has not defined any policy for calculating landing distances based on runway condition (wet, contaminated etc) for Q400 aircraft.

1.18 Additional information

1.18.1 Command upgrade

A Pilot-In-Command (PIC) is the person who is given authority by law and by the operator to be responsible for the safety of the aircraft that they fly and of that what is contained in that aircraft, from the airfield of departure to the destination airfield.

The method of upgrading flight crew from Co-pilot to PIC is a long process and covers sufficient hours of flying under supervision from the Co-pilot (right) seat. The flying after upgrade can be quite distressing if one does not get an opportunity to participate in decision making when he is flying under supervision as Co-pilot. The PIC supervising these flights of transition pilots are required to further the development and give them sufficient hands on experience.

The PIC has to take a global overview of the whole operation and has to have a greater “Situational Awareness” than the Co-Pilot. NASA defines “Situational Awareness” as “*Awareness of all that is going on, both inside and outside the aircraft*”. This includes having the best interests of the safety at heart. Not just getting the aircraft from A to B. Therefore, a greater understanding of the aircraft in general and how it operates are required.

The second aspect is psychometric analysis of personality. If the behavior of a person is “Authoritarian” while dealing with his subordinates and “Submissive” while dealing with his superiors, it means the PIC changes his style as per situation and is not “Assertive” when the situation demands and this can have its own ramifications. It is to be seen that he uses his authority as PIC but at the same time he is approachable, technically competent and takes responsibility.

Such issues of personality can be trapped with a good psychometric testing, based on which induction and further growth must be planned. Merely having flying experience & appropriate flight crew licence are not the only criteria for being upgraded as PIC. The operator must conduct a full assessment, before one is taken up for PIC simulator training. On successful completion, additional training must be imparted. Individuals coming from Defence Forces must understand the requirements wherein “Safety of Operations” takes precedence over “Mission” at hand. They must be more “Safety Oriented” rather than “Mission Oriented”. This requires a radical shift in their thought process as compared to what they have been used to during their Defence flying.

Investigation team was given to understand that PIC had difficulties during earlier attempts to become PIC.

1.18.2 Monsoon Operations – Requirements

To enhance the operational safety during adverse weather particularly in the monsoon season which is prevalent in India are laid down in Annexure to the CAR Section 8 Series C Part I. As per these procedures, the operator is accountable and has to ensure that pilots are qualified and efficiently trained before undertaking flights into adverse weather. The crew who is roistered to fly during monsoon should have undergone annual adverse weather ground training even if the crew have flown during previous adverse weather. Ground training should invariably cover Aircraft Performance during Take-off and Landing with specific emphasis on wet and contaminated runway conditions, calculation of take-off and landing field lengths and impact of individual failure events.
In addition to the specific requirements, general conditions are also laid down.

The relevant ones are:

- Approach briefing prior to Top of Descent shall include wet/ contaminated Actual Landing Distance calculation.
- Scheduled Operators shall prepare a quick analysis table for use during normal operations for wet/contaminated ALD and 1.15*ALD in view of the

high cockpit workload environment. For aircrafts where the ALD is factored by at least 15% to derive an Operational Landing Distance, this figure may be used.

- ILS approaches are to be preferred to non-precision approaches. In case of non-precision approaches, emphasis must be given on CDFA (Continuous Descent Final Approach).
- Greater emphasis given on stabilized approaches. Go around is encouraged in case the pilot is not comfortable.

Full flap landing and adequate usage of reverse thrust and consideration of extra en-route/ terminal fuel computation shall be adhered to. (Type specific manufacturer's guidance accepted)

1.18.3 Landing Simulation – Crew Perspective

During discussions with the flight crew, PF reported the touchdown point on the runway which was significantly earlier than actual as established through DFDR parameter readout. The PF reported that he could see the touchdown zone prior to landing which was not in consonance with the other aspects of the flight including DFDR readout.

To better understand the crew perspective of the point of touch down, an attempt was made to assess flight crew response in a simulator under similar scenarios. Approaches were flown on simulator in various configurations with the following simulated conditions for runway 22 at Surat (Temperature - 28°C, QNH -1005, Aircraft Gross Weight – 21.0 tons).

The results are indicative that the crew perception of their actual touchdown point on the runway is definitely effected when the visibility is lower than expected (sudden change).

Scenario		Specific Instruction	Result
Winds 220/05 kts.	Flap 15, normal braking & reverse.	None	Normal ILS22 landing was carried out and aircraft stopped comfortably on the runway.
Winds 040/15 kts.	Flap 15, normal braking & reverse.	None	
Winds 040/15 kts.	Flap 15, normal braking & reverse.	Below 500 feet, fly ILS with "One Dot above Glide slope"	
Winds 040/15 kts.	Flap 15, normal braking & reverse.	Below 500 feet, fly ILS with "Two dots above Glide Slope"	
Winds 040/15 kts. Rwy Wet	Flap 15, normal braking & reverse.	Below 500 feet, fly ILS with "Two dots above Glide Slope"	
Winds 040/15 kts. Rwy wet	Flap 15, delayed pilot braking, Braking Poor.	Land after an "extended flare" (aircraft to maintain 50 to 30 feet RA)	Normal ILS22 landing was carried out, aircraft touchdown with 3000 feet of runway remaining and left the runway around 55 knots.
Winds 040/15 kts. Rwy wet & Contaminated	Flap 15 normal braking & reverse,	Land after an "extended flare" (aircraft to maintain 50 to 30 feet RA)	Normal ILS22 landing was carried out, aircraft touchdown with 3000 feet of runway remaining and left the runway around 45 knots.
Winds 040/15 kts.	Flap 15 Runway wet & poor braking	Normal flare & landing	Normal ILS22 landing was carried out and aircraft stopped comfortably on the runway.
Winds 040/15 kts. Rwy wet	Flap 15 with normal braking & reverse,	Poor braking	Touchdown was in touchdown zone and aircraft stopped comfortably on the runway.
Winds 040/15 kts. Rwy wet & poor braking	Flap 35 with normal braking & reverse,	extended flare	Touchdown with 3000 feet of runway remaining and aircraft stopped on the runway.

1.19 Useful or effective investigation Technique

Nil

2.0 ANALYSIS

2.1 General

- Both the operating crew were appropriately licensed and qualified to operate the flight.
- The aircraft had a valid Certificate of Airworthiness and was issued Certificate of Release to Service at the airport of departure. Airworthiness Directive, Service Bulletins, DGCA Mandatory Modifications were complied with. Transit inspections were carried out as per approved transit inspection schedules and all the higher inspection schedules including checks/inspection as per the manufacturer's guidelines specified in Maintenance Programme and approved by the Quality Manager.

2.2 Weather

As per the METARs of 14:00 hrs., 14:30 hrs., 14:35 hrs., & 15:00 hrs. the visibility was continuously reducing. Within 4 to 5 minutes i.e. from 14:30 to 14:35 the visibility had reduced from 4000 m to 1200 m with Thunderstorm and heavy rain. No RVR was available to the flight crew. The aircraft had touched down at 14:40 hrs. ATC had not issued any warning to the flight crew regarding runway being contaminated/ flooded or any braking action report. However post landing a video was made available to the investigation team which indicated runway was contaminated / flooded with water due heavy rain. Though no warning was issued by Airport Meteorological Office but the Airport Fire Station In charge has taken "stand by position" in view of the deteriorating weather.

PF has also mentioned that he was aware of weather all around and at the time of commencing the approach the visibility was 2000 meters with CB overhead. The visibility was continuously reducing as the aircraft was coming close to the airport. By the time the aircraft established itself on the ILS, the visibility further reduced with heavy rain. The flight crew experienced heavy to very heavy rain showers around the flare height.

There was another aircraft (of same operator) enroute to arrive into Surat, however after observing the weather, the flight crew of that flight, diverted to Mumbai. The PF should have taken a clue from the report of departing aircraft flight crew & diversion call by that aircraft to Surat ATC and re-assessed his decision. However during discussions PF continuously maintained that the weather was within "minima". **Does weather reported (visibility) being "within Minima" safe to commence an approach for landing?**

It is not so. Flight crew must assess weather in totality and not only the "minima" (visibility) before commencing an approach. The presence of CB in the near vicinity of the airport, heavy rain showers, possibility of wind shear, sudden wind shift or gust can cause a loss of control situation and in turn resulting into severe hard landing, runway excursion or overrun. Hence weather (visibility) reported being "within minima" is not a blanket clearance to commence an approach. In the subject flight, the PF did not assess the weather conditions in an appropriate manner nor was his decision to continue the approach in deteriorating weather conditions appropriate.

2.3 Monsoon Training

The training program of the operator was reviewed to ascertain if the flight crew go through a proper "Monsoon Training" program. The intent of DGCA CAR which gives details of the "Monsoon Training" appeared to be not followed either in spirit or in practicality. India being a country wherein there is a clear cut "Monsoon Season", this season brings along with it its own set of issues. If these issues are not fully appreciated by the operators Flight Operations Department; implemented by the Training Department & followed by the flight crew, it can have drastic effects. As it is, in last few years, the operator has suffered more than one runway excursion.

2.4 Landing Distance Required (LDR)

Irrespective of the LDR calculations, in the present case, the aircraft has gone beyond the runway because it touched down very late. From the safety point of

view, the LDR calculation procedure was discussed with various flight crew members of the operator and it was confirmed that they do not carry out the calculations of the landing distances taking into account the runway conditions. Though un-factored landing charts are available onboard the aircraft, for calculation of landing distances, it was inferred that neither the training department discusses this aspect with the flight crew nor is it followed by flight crew in flight. The flight crew in general was found susceptible of using lower flaps because of the encouragement to do so for the purpose of fuel saving. There was ambiguity among the flight crew regarding directions from the operator on the use of landing flap, use of braking devices etc. while landing on wet runway.

Landing distance charts provided by the operator indicates that the landing is not permitted with tailwinds greater than 10 kts. DFDR indicates at the time of landing the aircraft was experiencing almost NIL winds.

2.5 Experience on Type – Command upgrade:

Though in this particular case the PIC had adequate experience on type, but review of his training records indicated that he was taken up for PIC training earlier also and he did not qualify to be a PIC due to various issues.

This is not an isolated case. With the rapid growth in aviation industry and massive shortage of pilots, all airlines have to either take pilots with FATA or recruit pilots' from the Defence Forces. As far as the requirement of experience in terms of total hours is concerned, the pilots from the Forces exceed the laid down requirements. These flight crew members after selection by an airline however spend minimum time (as per the Regulations) on the "Right Seat" before being moved to the "Left Seat". Though most of them manage the aircraft handling but other required soft skills like: CRM, multi-crew operations coordination, ATC procedures, reading of Jeppesen Charts, runway markings & signage etc, remains a challenge for many because of the totally opposite environment which exists between the Defence (Mission oriented flying) as compared to civil air transport (Safety oriented flying). Further the Defence

Forces do not follow the ICAO requirements for runway signage & markings, nor do they use Jeppesen charts or other navigation charts used in civil operations. There is no system in place at present to check competency of these pilots in areas like ATC procedures, Runway Marking & Signage, Navigation Charts (Instrument charts like Jepessen etc) by the regulator. It is amply known that these skills cannot be learnt in such a short duration. In today's aviation scenario soft skills play an almost equal role while managing a flight deck as compared to technical knowledge.

Review of the Regulatory requirements in general also revealed that the transition into civil flying environment is not taken care of as one would expect it to be. To adapt & learn, after serving in different environment for 20 + years is not easy and requires lots of unlearning and re-learning. In absence of any laid down requirements or procedures, very few do it in a desired manner. DGCA has not laid down any period/ experience for transition from right seat to left seat for pilots (from Forces) and is left to the discretion of airline, which varies from one airline to the other. During past few years this has been changed by the airlines not on any rational basis but on the basis of "demand & supply".

2.6 Circumstances leading to the incident

Aircraft took off from Bhopal and the flight was uneventful till approach into Surat. At the time of commencement of approach, there was weather all around and the visibility was 2000 meters with CB overhead. The visibility was continuously reducing as the aircraft was coming close to the airport. By the time the aircraft established itself on the ILS, the visibility further reduced with heavy rain. PF had elected to carry out a reduced flap landing in heavy shower in violation of DGCA CAR on All Weather Operations / Adverse weather.

PF continued to use the Auto-Pilot till very late into the approach & went below "Minimum Decent Altitude" with Auto-Pilot 'ON' (Disconnected at 77 feet RA). The flight crew experienced heavy to very heavy rain showers around the flare height there by reducing the visibility further. The PF flared the aircraft high probably to be extra cautious but during the process he partially lost "Situational

Awareness" of the runway distance covered and held on to flare to avoid a firm touchdown. During this period he observed some of the touchdown zone markings on the runway. Thinking that he was at the correct touchdown zone, PF continued with the landing, whereas in reality he had observed the touchdown zone markings of the opposite side of the runway.

During extended flare the aircraft had floated for quite some time. At the time of touchdown the runway was contaminated / Flooded with water due heavy rain which the flight crew were unaware off. On touchdown (after the fire station) the PF selected the maximum reverse pitch on power levers after one second of landing. Despite selection of "maximum reverse pitch on power levers" the aircraft exited the runway at high speed and traversed into RESA.

It is opined that had the PF elected to carry out a comparison of landing distances (while doing approach briefing) between Flap 15 & Flap 35, he would have elected to carry out a "Full Flap" landing and the aircraft would have still stopped on the remaining runway. Though the runway was contaminated due to flooding however there was no evidence of aquaplaning on the runway as observed during investigation.

3.0 CONCLUSIONS

3.1 Findings

3.1.1 General

- Both the operating crew were appropriately licensed and qualified to operate the flight.
- The aircraft had a valid Certificate of Airworthiness and was issued Certificate of Release to Service at the airport of departure.
- Airworthiness Directive, Service Bulletins, DGCA Mandatory Modifications were complied with.
- There was no defect or snag pending at the time of departure and no abnormality was reported by the flight crew during or after the flight.

- The visibility was continuously reducing for some time prior to landing.PF was aware of weather all around and at the time of commencement of approach the visibility was 2000 meters with CB overhead.
- Within 4 to 5 minutes prior to touchdown, the visibility had reduced from 4000 m to 1200 m due to thunderstorm and heavy rain.

In addition to the above findings, root cause analysis of the incident was carried out particularly taking into account the systemic deficiencies in the organization, unsafe supervision, preconditions to the unsafe act and lastly the unsafe act itself.

There were occurrences (incidents and accident) to the aircraft operated by the organization under similar circumstances and more or less due to same in-actions/ errors by the flight crew. The investigation of these occurrences and those to the aircraft operated by other organization have given recommendations to obviate these occurrences in future. It was observed that majority of the safety recommendations were either not implemented in true letter and spirit or the action taken has withered away with passage of time. It also appears that there was resistance to implementation of certain requirements indicating cultural aspect across the industry. One such aspect being low drag approaches and not going around when appropriate to do so.

At the time of accident the organization was not having an active flight watch/ monitoring programme. Once the aircraft departed, no advice or update was sent to the flight crew. The investigation has observed the above aspects in other organizations also.

Though DGCA carries out audits of the organization as per the mandate given in the various regulations. None of the audit reports have pointed out to these serious safety weaknesses in the system. Had these serious safety issues been brought out and acted upon in a proactive manner under SSP/SMS or otherwise, definitely there was an opportunity to arrest the unwanted lapses before these culminated into serious incident/ accident. The findings are as follows:

3.1.2 Organisation

- There were two different operating cultures (safety) existing in the organization (i.e. for Boeing 737 fleet & the Q400 fleet). Q400 was observed to be more of a neglected fleet without any monitoring of its operations.
- There was ambiguity among the flight crew regarding directions from the operator on the use of landing flap, use of braking devices etc. while landing on wet runway.
- There was no laid down procedure for “Transition Training” of flight crew joining from the Forces to ensure that they are conversant with the civil procedures.
- There was no laid down procedure of carrying out “Psychometric Analysis” of the flight crew before joining the airline or upgrade to as a Captain.
- The operator does not have an active “Flight Watch & Flight Monitoring” program.
- “Internal Safety Audit” mechanism for Q400 did not address issues related to safety oversight, fleet management, training etc.

3.1.3 Unsafe Supervision

- The Training Manager (Q400 flight crew) was not conversant with the requirements to manage training activities. The knowledge level of the Q400 “Training Manager” was found to be inadequate to the extent that he was not aware of the training requirements and corresponding training documentation but was to be assisted by training department staff.
- There was no system/ procedure to ensure that post holders/ managers, managing the Q400 Flight Operations have required management skills.
- There was no established system to have proper oversight over Q400 “Operations Control” and there was tacit lack of adequate support to flight crew to make a safe decision whether to continue to destination or divert to the alternate.

- Requisite guidelines and procedures were not available to utilize analyzed flight safety data for enhancing safety and implementing “Evidence Based Training”.

3.1.4 Pre-conditions to the Unsafe Act

- Inadequate knowledge of Basic Aircraft Performance & Mission oriented attitude of the PF rather than being safety oriented.
- Poor exhibition of CRM (Situational Awareness, Decision Making & Communication).
- No RVR was available with the flight crew.

3.1.5 Unsafe Act

- PF not able to assess the deteriorating weather conditions and deciding to continue the approach.
- PF elected to carry out a reduced flap landing.
- Late disconnection of Auto-Pilot (77 feet RA)
- Holding on to the aircraft “Flare” to make smooth touchdown.
- Extraordinarily extended flare & late touchdown.
- Not deciding to Go-Around after realizing that the touchdown was too far and too late.

3.2 Probable Cause of the Incident

The runway excursion occurred because of combination of:

- Due to the late disconnection of Auto-Pilot by PF, he could not adapt to the rapidly deteriorating environmental condition due to heavy rain.
- Reduced visual cues due to heavy rain impacting depth perception and ascertaining of actual touchdown position. PIC did not realise the runway exhausted due to the extended flare.
- Not going around in view of deteriorating weather during approach; prior to landing or after touchdown.
- Late touchdown of the aircraft on the runway.
- Approach with lower flaps & higher approach speed added to the extended flare and higher landing distance.

4.0 RECOMMENDATIONS

4.1 Schedule Airlines having both “Turbo-jet” & “Turbo-prop” fleet must give equal importance to both the fleets. Oversight of the “Turbo-Prop” fleet must be equal to the jet fleet.

4.2 Schedule Airlines must carry out “Operational Risk Assessment” once every 2 years for operation to airports where “Turbo-Prop” aircraft operates and may be included as part of the station safety audit.

4.3 Scheduled Airlines must enhance their Surveillance/ Observation flights during adverse weather period like: Pre-Monsoon, Monsoon & Winter months as per the regulatory requirement.

4.4 DGCA Flight Inspectors should carry out surveillance during above mentioned months in effective manner capturing the inherent and latent safety issues pro-actively. It must be ensured that RVR is available to flight crew at all stations.

4.5 Scheduled Airlines as recommended earlier must ensure that before a candidate joins as flight crew, he/she must be subjected to psychometric testing. The final analysis of such reports must be carried out by suitably qualified individuals and the salient observations be available with the training department to address the specific requirements for the individual.

4.6 Scheduled Airlines must ensure that before any individual is upgraded from Co-Pilot to Captain or a Captain to a Trainer, he/she is subjected to “Suitability Psychometric Evaluation” for the role.

4.7 All Operators must include a course on “Basic Aircraft Performance” before any “Type Rating Course” simulator training for Co-Pilot and while upgrading from Co-Pilot to Captain.

4.8 DGCA should ensure that all flight crew who are currently flying for Scheduled & Non-Schedule operators must undergo “Basic Aircraft Performance” training in stipulated time period.

4.9 DGCA must have “Relevant Record” from Defence Forces of flight crew who have not flown transport aircraft in their Defence Career and apply for a civil pilot’s licence, which may be kept confidential. The same be shared with AAIB in case the flight crew is involved in any serious incident or accident.

4.10 Ex-Armed Force personnel who have not flown transport aircraft in their Defence Career must occupy the right seat for at least 1000 hours for better adjustment into the civil operations, prior to upgrade to left seat.

4.11 Till the time ICAO Doc 9981 becomes applicable and DGCA issues regulation in that regard, the operators should ensure that:

- Before commencing an approach to land, the commander shall be satisfied that, according to the information available to him/her, the weather at the aerodrome and the condition of the runway intended to be used should not prevent a safe approach, landing or missed approach, having regard to the performance information contained in the operations manual.
- Within their Safety Management System (SMS) operators should consider and be aware of the runway surface condition reporting methodology at the aerodromes to which they operate. Special consideration should be given to those aerodromes that are critical in terms of runway length, challenging weather conditions and reliability for runway surface conditions assessment and reporting.
- Airport operator must start reporting runway "Braking Action Report" during adverse conditions (wet & flooded conditions)
- All scheduled operators Flight Crew Training Programme must include:
  - Description of runway surface condition reporting methods;
  - Types of runway contamination and its effects;
  - Aircraft take-off and landing performance on wet and contaminated runways.
  - Calculation of landing distances during wet & contaminated runway conditions.
  - Applicable cross wind limits for their aircraft fleet depending on the "Braking Action/ Estimated Runway Surface Friction"& width of the runway.

(Capt. Dhruv Rebbapragada)
Investigator

(R. S. Passi)
Investigator In Charge

New Delhi
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