## FINAL REPORT OF RUNWAY EXCURSION OF MYANMAR NATIONAL AIRLINES, ATR 72-600 AIRCRAFT (XY-AME) AT YANGON INTERNATIONAL AIRPORT, ON 17<sup>th</sup> NOVEMBER, 2022



# Myanmar Transport Safety Branch Ministry of Transport and Communications Myanmar

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#### **Myanmar Transport Safety Branch (MTSB)**

The Myanmar Transport Safety Branch (MTSB) is one of the division of Minister's office under the Ministry of Transport and Communications. It is an independent investigation authority which is responsible for the investigation of air, marine and rail transport accidents, serious incidents and incidents in Myanmar. Its mission is to promote transport safety through the conduct of independent investigations into air, marine and rail accidents, serious incidents.

For aviation related investigations, the MTSB conducts investigations in accordance with Myanmar Aircraft Act and Myanmar Aircraft Accident and Incident Investigation Rules and Annex-13 to the Convention on International Civil Aviation.

In carrying out the investigations, the MTSB adheres to ICAO's stated objective, which is as follows:

"The sole objective of the investigation of an accident or incident shall be the prevention of accidents and incidents. It is not the purpose of this activity to apportion blame or liability."

Accordingly, it is inappropriate that MTSB reports should be used to assign fault or blame or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

## **GLOSSARY OF ABBREVIATIONS**

AAL	Above aerodrome level
AFL	Actual flight level
AFM	Airplane flight manual
AGL	Above ground level
AIP	Aeronautical information publication
ARFF	Aircraft rescue and fire fighting
ATIS	Automatic terminal information service
CRM	Crew resource management
CVR	Cockpit voice recorder
DA	Decision Altitude
1 DOT	One dot represents $\pm 0.8$ degrees of deviation on the localizer scale and
	$\pm 0.4$ degrees on the glideslope scale
FAF	Final approach fix
FDR	Flight data recorder
GS	Glideslope
GPS	Global positioning system
IAS	Indicated airspeed
IFR	Instrument flight rules
ILS	Instrument landing system
IMC	Instrument meteorological conditions
IP	Instructor pilot
LOC	Localizer
MDA	Minimum descent altitude
MTSB	Myanmar Transport Safety Branch
NDB	Non-directional beacon
PF	Pilot flying
PM	Pilot monitoring
PSI	Pounds per square inch
RNP	Required navigation performance
SOP	Standard operating procedures
Vapp	Final approach speed
VFR	Visual flight rules
VMC	Visual meteorological conditions
VOR	Very high frequency Omni-directional radio range
Vref	Landing reference speed
WOW	Weight-on-wheels

## FINAL REPORT OF RUNWAY EXCURSION OF MYANMAR NATIONAL AIRLINES, ATR 72-600 AIRCRAFT (XY-AME) AT YANGON INTERNATIONAL AIRPORT, ON 17<sup>th</sup> NOVEMBER, 2022

#### **SYNOPSIS**

At 14:13 local time (LT) on 17<sup>th</sup> November 2022, Myanmar National Airlines ATR 72-600 aircraft, registered (XY-AME) performing flight UB-402 from Sittwe to Yangon encountered a runway excursion when the aircraft landed on runway 21 of the Yangon International Airport (VYYY). On board the aircraft were the Pilot-In-Command (PIC), Co-Pilot (Instructor Pilot), 2 cabin crew and 72 passengers. There were no injuries but the aircraft sustained substantial damage due to collision with the runway distance marker board on the right side of runway shoulder. The Myanmar Transport Safety Branch (MTSB) classified the occurrence as a serious incident.

#### **Aircraft Details**

Registered owner and operator	: Myanmar National Airlines
Aircraft type	: ATR 72-600
Nationality	: Myanmar
Registration	: XY-AME
Place of Occurrence	: Yangon International Airport
	(VYYY), N 16°54'42", E 96°07'57"
Date & Time	: 17 <sup>th</sup> November 2022 at 14:13 LT
Type of operation	: Scheduled passenger flight
Phase of operation	: Landing on runway 21
Persons on Board	: Four Air Crew and Seventy-two passengers

#### **1 FACTUAL INFORMATION**

All times used in this report are Myanmar local times. Myanmar local time is six hours and thirty minutes ahead of Coordinated Universal Time (UTC).

#### 1.1 History of the flight

The aircraft flew the two routes on that day. The first route was RGN-MGZ-RGN and it started at 07:00 (LT) and finished at 10:25 (LT). The second route was RGN-AKY-RGN and it started at 11:17 (LT) from Yangon to Sittwe. And then it landed at Sittwe at 12:28 (LT). After that from Sittwe (AKY) on the way back to Yangon International Airport, the plane departed with 72 persons on board at 13:00 (LT). The flight crew comprised a Pilot-In-Command (PIC), a Co-pilot (IP) and two cabin crew. The PIC was a pilot monitoring and the Co-pilot (IP) was a pilot flying on that way. The departure and en-route segments of the flight proceeded normally. The aircraft was making a precision approach with ILS to runway 21 at 14:12 (LT). The Auto Pilot was manually disconnected at 538 feet, 12 seconds later the ILS deviations were no longer available, and the approach was continued visually. They received the weather and aerodrome information from Yangon Control Tower, "Surface wind 030°, 5 to 8 knots, runway 21 clear to land, caution landing runway wet". At that time, there was a light rain at Yangon International Airport. According to the Co-Pilot, the runway was visible when the aircraft descent to decision height. Therefore the pilots continued with the approach and land the aircraft. The approach and landing was carried out in light rain. The runway was wet.

The aircraft landed on the right side of the runway about 37 feet from the runway centerline pointing to the right and about 4400 feet from the runway 21 threshold. And then the aircraft veered slightly to the right and exited the pave runway and continued parallel with the runway about 810 feet on the grass turf and collided with the runway distance maker board No. (6/5) where was installed on the right side of runway shoulder. After that the flight crew managed to steer the aircraft back to the runway centerline about 200 feet before the exit taxiway B3 and continued taxiing and came to a complete stop at parking bay No.13 without any further incident. The ground path of the aircraft was according to the accident site inspection and measurement by MTSB investigators. See figure (1).

All the passengers on board disembarked from the aircraft following normal disembarkation procedures, with the help of the cabin crew. There were no injuries and no fire broke out in this serious incident. In the wake of the incident, the authorities concerned and ARFF team inspected the runway and cleared foreign object debris (FOD) on the runway.



Figure (1) Ground path of the aircraft



Figure (2) Layout of Accident Site

## 1.2 Injuries to Persons

## 1.2.1 Myanmar National Airlines

Injuries	Crew	Passengers	Other	Total
Fatal	0	0	0	0
Serious	0	0	0	0
None	4	72	0	76
Total	4	72	0	76

## 1.3 Damage to Aircraft

(a) Aircraft right fuselage skin (between frame No.20 and 21) was torn as a triangular shape and the rupture of fuselage skin was about 22 inches long, 22 inches wide and 12 inches height. See figure (7)

- (b) Aircraft right fuselage skin near the emergency exit door (between structure No.17,18 and frame No.23 A) was torn about 10 inches. See figure (8)
- (c) Aircraft fuselage skin under the belly was torn about 12 inches horizontally and transversely. See figure (9)
- (d) Aircraft left fuselage skin, frame No.25 and left main landing gear door hinge were damaged. See figure (10) and (11)
- (e) Air-condition pack intake area of the aircraft was torn and damaged. See figure (12)
- (f) Aircraft landing light cover was damaged. See figure (13)



Figure (3) The Wheel Impact Marks on the runway



Figure (4) The Wheel Impact Marks along the right side of runway shoulder



Figure (5) Location of the runway distance marker board No.(6/5)



Figure (6) The Wheel Impact Marks at which the aircraft returned to the runway centerline



Figure (7) Damage to the aircraft right fuselage skin



Figure (8) Damage to the aircraft right fuselage skin near the emergency exit door



Figure (9) Damage to the aircraft fuselage skin on the belly



Figure (10) Damage to the aircraft fuselage skin on the belly



Figure (11) Damage to the left main landing gear door hinge



Figure (12) Damage to the air-condition pack intake area



Figure (13) Damage to the landing light cover

## 1.4 Other Damage

Runway Distance Marker Board No.(6/5) was damaged due to the aircraft impact during the runway excursion.



Figure (14) Damage to the runway distance marker board No.(6/5)

## 1.5 Personnel Information

## **Pilot-In-Command (Myanmar National Airlines)**

Age	: 44 years
Licence	: Airline Transport Pilot Licence
Licence issued date	: 14 August 2015
Total hours	: 6310:35 hrs
On type	: 4087:11 hrs
Medical expire	: 31 January 2023
Line check date	: 15 June 2022
Type rating check date	: 7 October 2018 (PI)
Last 90 days	: 172:49 hrs
Last 30 days	: 56:28 hrs
Last 24 hours	: 3:08 hrs
Rest before duty	: 1 day

#### **Co-Pilot (Myanmar National Airlines)**

Age	: 48 years
Licence	: Airline Transport Pilot Licence
Licence issued date	: 15 April 2011
Total hours	: 15095:17 hrs
On type	: 11895:17 hrs
Medical expire	: 31 October 2023
Line Check date	: 28 July 2022
Type rating check date	: 17 July 2010 (PI)
Last 90 days	: 164:15 hrs
Last 30 days	: 50:05 hrs
Last 24 hours	: 3:08 hrs
Rest before duty	: 1 day

## **1.6** Aircraft information

## Myanmar National Airlines ATR 72 Aircraft

Manufacture	: Avions de Transport Regional
Туре	: ATR 72-212 A
Serial number	: 1338
Date of Manufacture	: 11 July 2016
Total Airframe hours	: 10854:26 hrs /11326 (Cycle)
Certificate of Registration	: XY-AME
C of A issue date	: 11 October 2023
Last Time Check	: 400 FH+ Bridging Checking
Total flying hours	: 10854:26 hrs

#### **1.7** Meteorological Information

The METAR weather reported at Yangon International Airport on 17<sup>th</sup> November 2022 at 14:00 (LT) was wind speed 5 knots from 120 degrees, visibility 6000 meters, broken clouds at 1500 feet, few clouds at 1700 feet, overcast at 10000 feet with light thunderstorm with rain, temperature was 27°C, dew point was 26°C and QNH 1007 hPa.

When landing clearance was issued, the updated weather and aerodrome information that the pilots received from ATC was surface wind 030 degrees, 5 to 8 knots and runway 21 and landing runway was wet.

#### **1.8** Aid to Navigation

Navigation facilities equipped in Yangon International Airport were normal and which are not related to the serious incident.

#### 1.8.1 GPS Signal

GPS data was lost around 10 minutes before landing in Yangon International Airport due to the anti-drone system equipped near the airport.

#### **1.9** Communication

Radio communications between the aircraft and Yangon Air Traffic Control were normal and were not a factor in this incident.

#### 1.10 Aerodrome Information

Yangon International Airport has one main runway 03/21 with a length of 11200 feet at an elevation of 110 feet above mean sea level and is certified for both VFR and IFR flight. Runway strength (PCN) is 56/R/C/X/T and the airport has an Air Traffic Control (ATC) Tower, controlling Class B airspace with radar surveillance facilities.

It is a certificated aerodrome and the associated aerodrome manual has been developed and implemented since 2010. The aerodrome operation hours are 24 hours. The aerodrome category for the firefighting is CAT-9. Runway Distance Marker Board No.(6/5) was damaged due to the aircraft impact during this incident. Except for one aircraft from Myanmar National Airlines had to make a go-around and the aerodrome operations was normal.

#### 1.11 Recorders

The aircraft's Flight Data Recorder (FDR) and Cockpit Voice Recorder (CVR) were removed and read out at Transport Safety Investigation Bureau of Singapore (TSIB).

#### 1.11.1 Flight Data Recorder

The part number of Flight Data Recorder (FDR) is 2100-4245-00 and the serial number is 001074048.

The recording quality of the FDR data was of good quality. The FDR contained 72 hours and 13 minutes and 24 seconds of flight data that included recorded data of the incident flight. The FDR had 749 parameters in the data frame file. Based on the recorded data in the FDR, the following were recorded at that point of autopilot disengagement:

- Radio height was 568 feet.
- Magnetic heading was 214.7 degrees.
- Indicated airspeed (IAS) was 128 knots.
- Vertical speed was -656 feet/minute.
- Flaps were in the 33 degrees position.
- Wind direction and speed was 95.1 degrees and 3 knots respectively.
- Glideslope deviation was 0 dot and Localizer deviation were -0.1 dots.

The following were observed in the subsequent 58 seconds, just prior to touchdown:

- 12 seconds after the Auto Pilot disengagement, the ILS deviations were no longer displayed.
- Wind direction was 94.4 degrees and wind speed was 3 knots during this period.
- IAS was within the range of 125 knots and 128.6 knots.
- Inputs to the control wheel ranged from -17.56 to 22.24 degrees with the degree of rotation from the neutral position increasing as the aircraft was closer to touchdown. The aircraft was oscillating along the longitudinal axis with the recorded roll angle ranging between -4.3 to 6.08 degrees.
- The vertical speed varied between -192 to -832 feet/minute.
- The torque for both engines were reduced at 14:13:27 when the aircraft was at 34.8 feet above ground level (AGL). It was maintained at idle for the next eight seconds until the first Weight-On-Wheels signal was recorded.

At 14:13:35, the first Weight-on-Wheels (WOW) Ground signal for the main gear was recorded, indicating the first instance where the main landing gear made contact with the surface of the runway. At this first instance of touchdown,

the aircraft heading was 219 degrees (pointing towards the right edge of the runway), IAS was 95.8 knots and torque developed by Engine 1 and 2 was 2.4% and 0.4% respectively. The roll angle was 1.7578 degrees (right wing down) and pitch angle was 4.35 degrees (nose up). The highest vertical acceleration recorded shortly after was  $\pm 1.574G$ .

One second later, at 14:13:36, the all gear WOW Ground signal was recorded indicating that the nose gear and both main gears had made contact with the surface of the runway. Almost immediately, there was input to the left rudder pedal reaching the maximum recorded value of 11.1 degrees while the maximum recorded rudder deflection around this period was 26.7 degrees to the left. The application of the left rudder was consistent with the action to de-crab and align the aircraft with the runway centerline (the heading for runway 21 is 214 degrees).

Over the next six seconds, the recorded magnetic heading decreased to 188.6 degrees consistent with the motion of the aircraft pivoting around the yaw axis for the nose to point towards the left edge of the runway (The pilot monitoring reportedly used the nose wheel steering to steer the nose of the aircraft to the left, in addition to the recorded left rudder inputs). At 14:13:42, just prior to the recorded heading reaching 188.6 degrees, the brake pressure for the right inboard and outboard wheels increased to 248 PSI and 769 PSI respectively while the brake pressure on the left inboard and outboard wheels were 46 PSI and 44 PSI respectively. In addition, there was input to the rudder pedal reaching maximum recorded value of -7.9 degrees with the corresponding rudder deflection reaching a maximum of 23.9 degrees to the right.

Between 14:13:43 to 14:13:48, the recorded magnetic heading increased from 188.6 degrees to 219.2 degrees, consistent with nose of aircraft rotating in the opposite direction to point towards the right edge of the runway. While the magnetic heading was passing 208.9 degrees, there was input to the rudder pedal reaching 11.8 degrees and the corresponding maximum rudder deflection was 26.8 degrees to the left.

Between 14:13:48 to 14:13:53, the final sequence of magnetic heading transition was recorded. The magnetic heading decreased from 219.2 degrees to 206.6 degrees, consistent with the aircraft nose rotating left. After this series of left-right-left rotation around the aircraft yaw axis, brake pressure of above 600 PSI was recorded on the brakes of all four wheels. Over the next 18 seconds, slight differential braking was applied (more pressure on the right wheels and less pressure on the left wheels) and by 14:14:14, the aircraft heading was 214.1 degrees, aligned with the runway heading.



Figure (15) Flight Data Recorder

## 1.11.2 Cockpit Voice Recorder (CVR)

The part number of Cockpit Voice Recorder (CVR) is 2100-1020-02 and the serial number is 000442668.

The CVR contained four audio tracks of duration 2 hours and 4 minutes and 14 seconds. The CVR stopped recording at 14:53:43.



Figure (16) Cockpit Voice Recorder

#### 1.12 Wreckage, Site and Impact Information

The coordinates of serious incident site were Latitude N 16°54'42" and Longitude E 96°08'17". When the investigators from Myanmar Transport Safety Branch (MTSB) arrived at the occurrence site, the aircraft was in the hangar of Myanmar National Airlines.

Debris from the aircraft and broken pieces from the runway distance marker board were found at the occurrence site. Measurements and photographs were taken of the occurrence site, ground markings and tracks were inspected and informal interviews were conducted among witnesses.

#### **1.13** Medical and Pathological Information

No one was injured in this occurrence. The pilots underwent a medical and toxicological test after the occurrence. The tests revealed no abnormality.

According to the ECG examination and running tests at the time of license renewal process 1 month ago, the medical assessor allowed the Co-pilot as fit to fly the aircraft only as Co-pilot. Before that he was a pilot.

#### 1.14 Fire

There was no fire before and after the incident.

#### **1.15** Survival Aspects

When the aircraft had skidded to the right side of runway edge and returned to the centerline of the runway, the cabin crew checked outside condition of the aircraft. As soon as the aircraft came to a full stop at the parking bay No.13, the cabin crew checked and confirmed that there was no risk or hazard and let all passengers on board disembark according to the normal procedure.

#### 1.16 Organizational and Management Information

#### **1.16.1** Myanmar National Airlines

Myanmar National Airlines (MNA) headed by Chief Executive Officer (CEO) is the national flag carrier of Myanmar and has the most extensive network in the country and international schedule flight to Singapore, Bangkok, Kunming, Chiangmai and Incheon as well. It had 10 numbers of fleet such as Boeing 737-800 and ATR 72-212-600. Myanmar National Airlines, Engineering and Maintenance Department are doing the Installation, Inspection and Maintenance of their aircraft. They are doing maintenance in conformity with Myanmar Civil Aviation Requirements (MCAR) Part 145 and Part M. It was observed that Brake System, Navigation System, Control Surfaces and Engine of the incident aircraft were operational and in normal conditions. The instructors for the training of Myanmar National Airlines are senior and experienced pilots. The pilots operating the ATR 72-600 aircraft have to undergo proficiency checks every six months.

Myanmar National Airlines has established and maintained a flight data analysis program as part of its safety management program since 2015. The Safety Action Group (SAG) meeting is held once a month and the Safety Review meeting every three months respectively.

#### 1.16.2 Air Traffic Control

Department of Civil Aviation is the air traffic control service provider at Yangon International Airport.

#### 1.16.3 The Operator's Stabilization Criteria

According to the operator's procedures, all flights must be stabilized by 1000 feet above airport elevation in Instrument Meteorological Conditions (IMC) and 500 feet above airport elevation in Visual Meteorological Conditions (VMC).

An approach should be considered stable when all of the following stabilized approach elements are met:

- a) The aircraft is on the correct flight path; Only small changes in heading/pitch are necessary to maintain the correct flight path;
- b) The airspeed is not more than Vref + 20 knots indicated speed and not less than Vref;
- c) The aircraft is in the correct landing configuration; Sink rate between -1100 and -200 fpm; if an approach requires a sink rate greater than 1100 feet/minute a special briefing should be conducted;
- d) Power setting is appropriate for the aircraft configuration and is not below the minimum power for the approach as defined by the aircraft operating manual;

- e) Track is aligned to runway (within 20 degrees or 35 is offset approach);
- f) Airspeed: airspeed minus selected approach speed within -5 to +20 knots (for 5 secs) or Vapp within -5 to +20 knots (for 5 secs) or Vref within -5 to +35 knots (for 5 secs);
- g) Speed brake shall not use below 1000 feet Above Aerodrome Level (AAL);
- h) All briefings and checklists have been conducted;
- Unique approach conditions or abnormal situations necessitating a deviation from the elements of a stable approach require a special briefing;
- j) Specific types of approach are stable if they also fulfill the following:
  - ILS approaches must be flown within one dot of the glide-slope and localizer;
  - Circling approach, wings should be level on final when the airplane reaches 300 feet actual flight level (AFL).

**NOTE:** the ILS stability is not assessed below 200 feet AAL. The condition at 200 feet (stable or unstable) is assumed to continue until landing.

As the airplane crosses the runway threshold it should be:

- a) stabilized on approach airspeed to within + 10 knots until arresting descent rate at flare;
- b) on a stabilized flight path using normal maneuvering;
- c) flight crew shall make the aircraft so as to touchdown within the touchdown zone.

Flight crew shall execute a missed approach or go-around if the aircraft is not stabilized in accordance with stabilization criteria.

## **Deviations during Approach**

Only small deviations are allowed and shall be immediately called out and corrected:

a) Altitude during initial approach:  $\pm 100$  feet;

- b) Lateral guidance on final approach segment: half LOC scale deviation for precision or  $\pm 5^{\circ}$  on radial on non-precision approach;
- c) Vertical path on final approach segment: half GS scale deviation or + 200/-0 feet for non-precision approaches;
- d) Altitude deviation at DA or MDA: 0 feet;
- e) The aircraft speed is Vapp target + 10 knots / 0 knots.

Only small adjustments in pitch and/or heading are allowed to stay on track:

- a) Maximum sink rate is 1000 feet per minute;
- b) Maximum rate of descent adjustments is ±300 feet per minute from target rate;
- c) Bank angles are no more than 15°;
- d) Localizer guidance adjustments are done with heading bug width;
- e) Lateral guidance on final approach segment: half LOC scale deviation for precision or within 2.5 degrees (VOR) / 5 degrees (NDB) - nonprecision approaches;
- f) GS guidance adjustments must be within  $\pm 2^{\circ}$  of pitch change;
- g) Vertical path on final approach segment: half GS scale deviation or + 200/-0 feet for non-precision approaches;
- h) Altitude deviation at DA or MDA: 0 feet;
- i) Speed +10/-0 kt.

Unique approach procedures or abnormal conditions requiring a deviation from the above elements of a stabilized approach require a special briefing.

NOTE: Any approach, which is commenced as an instrument approach, shall be stabilized by 1000 feet above airport elevation even in VMC conditions and shall not follow visual circuit approach parameters.

These conditions should be maintained throughout the rest of the approach for it to be considered a stabilized approach. If the criteria above cannot be established and maintained, a go-around must be initiated.

As the aircraft crosses the runway threshold it should be:

- a) stabilized on target airspeed to within Vapp target + 10 kts / 0 kts until flare;
- b) on a stabilized flight path using normal maneuvering;
- c) positioned to make a normal landing within the touchdown zone.

## 1.16.4 ATR's Stabilization Criteria

According to the procedures of ATR, approaches must be stabilized (and remain stable):

- 1000 feet AAL in IMC conditions
- 500 feet AAL in VMC conditions
- 300 feet AAL following circle-to-land

An approach is considered stabilized when all of the following criteria are met:

- Lateral path (Loc, Radial or RNP path) is tracked
- Landing configuration is established
- Energy management:
  - Vertical path (Glide, Altitude versus Distance or RNP path) is tracked
  - Power setting is consistent with appropriate aircraft weight, Head/Tail wind component and vertical guidance requirements
  - Speed and pitch attitude are relevant to actual conditions
- Briefing and checklists are completed
- Aircraft trimed if Auto Pilot off

## Deviations

Stabilization criteria: Only small deviations are allowed if immediately called out and corrected:

- Lateral guidance on final approach segment: Not more than 1 DOT deviation for all approaches
- Vertical path on final approach segment: Not more than 1 DOT deviation or + or 100 feet for 2D operation
- Altitude deviation at DA or MDA: +50 / -0 feet
- Speed +/- 5knot (+10/-5 knot in single engine)

Stabilization technique: Only small adjustments in pitch and/or heading are allowed to stay on track:

- Maximum sink rate is 1000 feet per minute
- Maximum rate of descent adjustments are ±300 feet per minute from target rate
- Bank angles are no more than 15°
- Localizer guidance adjustments are done within heading bug width
- GS guidance adjustments must be within  $\pm 2^{\circ}$  of pitch change

Regarding the subject mentioned above the stabilization criteria, MNA's stabilization differs from ATR's stabilization criteria and it may induce confusion to the flight crew. The speed references to Vref and the use of speed brakes are not relevant to ATR. The sink rate reference provided in the operator's criteria is less restrictive than the one provided in the deviations during approach numeral (a) and ATR's stabilization criteria.

#### 1.16.5 The Operator's Go-Around Decision-Making

The flight parameter deviation criteria and the minimum stabilization altitude / height at or below which the decision to land or go-around should be made. Pilots should regard the go-around as a normal phase of flight, to be initiated whenever the safety of a landing appears to be compromised. Typically, this occurs for one of these reasons:

- a) Instructed by ATC; ATC may instruct a go-around for a variety of reasons, including insufficient separation, occupied runway or runway incursion;
- b) Abnormal aircraft conditions; an aircraft system malfunction or erroneous indication may make a landing unsafe;
- c) Abnormal approach conditions; speed and altitude, either ATC or pilot related;
- d) Environmental factors; sudden and/or un-forecast changes in environmental conditions like tailwind, wind shear or precipitation; These unexpected events may require a go-around even after the airplane has touched down following a stable approach;

- e) Whenever the stable approach criteria are not met at the required stabilization altitude and maintained thereafter until landing;
- f) Whenever the landing cannot be made within the touchdown zone; in the case of a long flare or 'floated' landing.

#### **1.17 Additional Information**

#### 1.17.1 Testimony of a Pilot-In-Command

The PIC stated that on 17<sup>th</sup> November 2022, he was a pilot monitoring performing the flight UB-402, for Sittwe-Yangon sector.

The flight from Sittwe to Yangon the Co-Pilot was a pilot flying. The aircraft made an ILS approach to runway 21. He received the weather information from ATIS and it was ILS 21, wind 120°/05 knots, visibility 6000 meter, broken 015, few 017, overcast 100, temperature 27°C, dew point 26°C and QNH 1007 hPa.

During landing, there was a slightly rain on the runway. The Co-pilot said that he could see the runway and he was going to land the aircraft because the runway was clearly visible up to decision height. Therefore, they decided to land the aircraft and they continued landing.

After touching down the runway, the aircraft skidded to the right side of runway edge. Therefore he controlled the nose wheel steering and rudder of aircraft to return the aircraft to runway centerline. After that shortly the aircraft had returned to the runway centerline and continued taxi to the parking bay No.13 without further incident.

After stopping the aircraft, he made a walk around check and found the damage to the aircraft fuselage and belly. He reported that no one was injured in this occurrence.

#### 1.17.2 Testimony of a Co-pilot

The Co-pilot stated that he was a pilot flying performing flight UB-402 for Sittwe-Yangon sector and departed Sittwe airport at 13:00. And then the aircraft made an ILS approach to runway 21 at 14:13.

He received the weather information from ATIS at 13:30 and it was wind  $120^{\circ}/5$  knots, visibility 6000 meter, broken 015, overcast 10000 feet, temperature 27°C, dew point 26°C and QNH 1007 hPa.

While landing the aircraft, there was a slightly rain on the runway. He decided to land the aircraft because he had a clear view of the runway up to decision height. Therefore he said that he could see the runway and he was going to land. And then he continued landing.

After touching down the runway, the aircraft skidded to the right side of runway edge, like as a hydroplaning. Therefore the PIC took the control of aircraft to return to the runway centerline and then taxied to the parking. After stopping the aircraft, he contacted the cabin crew to open the main door of the aircraft. And then he made a walk around check and he found the damage to aircraft fuselage and belly. He reported that no one was injured in this occurrence.

#### 1.17.3 Testimony of a Cabin Crew

She stated that she was a cabin crew performing flight UB-402 for Sittwe-Yangon sector and the aircraft was a runway excursion at 14:13 during landing. At that time, a little bit abnormal shaking occurred in the cabin and then the aircraft was returned to the runway.

Therefore, she checked the outside condition and found the aircraft was going to the parking normally. She announced the passengers to keep their seat belts on until the signal light switched off and to remain seated until the aircraft came to a full stop because some passengers were taking off their seat belts at that time. After that she made a standard after landing announcement normally at 14:15.

When the aircraft stopped at parking bay No.13, she let all passengers on board disembark as per the normal procedure.

#### 1.17.4 Testimony of an Air Traffic Controller

He stated that he was a manager of air traffic control on that day. The aircraft contacted to the Approach Control Unit at 13:52. And then the aircraft made an ILS approach and established at 14:11. After that the aircraft contacted to Tower Unit and the tower controller asked him to confirm the runway insight. The pilot replied the affirmative and then tower controller gave him the weather information and landing clearance.

uched down or

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The tower controller noticed that after the aircraft had touched down on the runway at 14:14, the aircraft skidded to the right side of runway edge and then the aircraft returned to the runway. Therefore he asked the pilot what happened to the aircraft. The pilot reported to the tower that the aircraft exited slightly the pave runway and now it was steady. Therefore the tower controller instructed the next incoming landing aircraft (UB-002) to make a go-around. And then the tower controller notified the fire station (ARFF) to inspect the runway.

#### 2 ANALYSIS

#### 2.1 Introduction

The analysis by the investigation team has focused on the following areas:

- a) Recognition of unstabilized approach
- b) Pilot action prior to runway excursion

#### 2.2 Recognition of unstabilized approach

According to the recorded FDR data, it appears that the approach became unstabilized shortly after the autopilot was disengaged. In the 58 seconds where the aircraft was flown by the pilot, the aircraft heading oscillated between 212 degrees to 219 degrees just priority to touchdown. The pilot's inputs to the control wheel that ranged from -17.56 to 22.24 degrees which was increasing in magnitude as the aircraft approached the runway. As the aircraft passed over the threshold of runway 21, it was about 200 feet above ground level (AGL) which was about 146 feet higher than the standard threshold crossing height as specified in the AIP Myanmar.

The operator's procedure mentions that a stabilized approach includes providing only small changes in the heading and pitch axis to maintain the correct flight path. The inputs to the control wheel which were increasing in magnitude as the aircraft approached the runway and higher than normal altitude as the aircraft passed over the runway threshold did not trigger either of the pilots to consider that the approach had become unstabilized and execute a missed approached.

#### 2.3 Pilot actions prior to runway excursion

The attitude of the aircraft at the first instance of touchdown was 1.7578 degrees right wings down and the aircraft heading was 219 degrees, pointing to the right edge of the runway. The aircraft was in this attitude likely due to the unstabilized approach and the momentum of the aircraft could have resulted in the aircraft skidding towards the right edge of the runway, that was reported by the pilots.

The pilot monitoring used nose wheel steering, which should only be used as speeds under about 70 to 80 knots, in an attempt to bring the aircraft back towards the runway centerline. During this period, the pilot flying also provided left rudder input. The combination of nose wheel steering and rudder inputs likely resulted in the aircraft being overcorrected along the yaw axis as seen in the magnetic heading decreasing from 214 degrees to 188.6 degrees over a span of six seconds.

Subsequently, the pilot flying provided asymmetrical braking input where the brake pressure for the right inboard and outboard wheels increased to 248 PSI and 769 PSI respectively while the brake pressure on the left inboard and outboard wheels were 46 PSI and 44 PSI respectively. This would have resulted in the aircraft yawing right, pivoting mainly on the right outboard wheel and contributed to the aircraft tracking towards the right edge of the runway, eventually resulting in the runway excursion.

#### **3** CONCLUSIONS

#### 3.1 Findings

From the evidence available, the following findings are identified .These findings should not be read as apportioning blame or liability to any particular organization or individual:

- (a) Wind direction was 94.4 degrees and wind speed was 3 knots in the subsequent 58 seconds, just prior to touchdown. Therefore there was no turbulence during landing.
- (b) The maximum permissible landing weight of ATR 72-600 is 22350 kg as per the Airplane Flight Manual (AFM). On 17<sup>th</sup> November 2022, the actual landing weight for that sector was 21200 kg. Therefore it was within limit.
- (c) The aircraft engines, control surfaces, navigation system and brake system were normal.
- (d) For the incident flight, at 14:12:37 the autopilot was disengaged at 568 feet above ground level (AGL). At that time, magnetic heading was 214.7 degrees, indicated airspeed (IAS) was 128 knots and vertical speed was -656 feet/minute. The flaps were in the 33 degrees position.
- (e) The approach was unstable as the indicated airspeed (IAS) of the aircraft was within the range of 125 knots and 128.6 knots in the subsequent 58 seconds, just prior to touchdown. Therefore the airspeed was 19 knots higher than the approach speed (Vapp), which corresponded to 109 knots, as specified in the Quick Reference Handbook of ATR 72-600.

- (f) The inputs to the control wheel ranged from -17.56 to 22.24 degrees with the degree of rotation from the neutral position increasing as the aircraft was closer to touchdown. The aircraft was oscillating along the longitudinal axis with the recorded roll angle ranging between -4.3 to 6.08 degrees. And the vertical speed varied between -192 to -832 feet/minute.
- (g) The torque for both engines were reduced at 14:13:27 when the aircraft was at 34.8 feet above ground level (AGL). It was maintained at idle for the next eight seconds until the first Weight-On-Wheels signal was recorded.
- (h) At 14:13:35, the first Weight-On-Wheels (WOW) Ground signal for the main gear was recorded, indicating the first instance where the main landing gear made contact with the surface of the runway. At this first instance of touchdown, the aircraft heading was 219 degrees (pointing towards the right edge of the runway), IAS was 95.8 knots and torque developed by engine 1 and 2 was 2.4% and 0.4% respectively. The roll angle was 1.7578 degrees (right wing down) and pitch angle was 4.35 degrees (nose up). The highest vertical acceleration recorded shortly after was +1.574G.
- (i) Although the altitude of the aircraft must be 54 feet above ground level (AGL) as specified in the AIP Myanmar when passing through the threshold of runway 21, it was between 100 and 200 feet above ground level (AGL) according to the pilot interview. Therefore the aircraft was unstable during landing.
- (j) Pilot-In-Command (PIC) did not make a required call out as per Standard Operating Procedures (SOP) completely.

#### 3.2 Primary Cause

- (a) The final approach airspeed of the aircraft was higher than the airspeed limit specified in the Quick Reference Handbook.
- (b) The aircraft was oscillating along the longitudinal axis and unstable due to changing the control wheel position inputs excessively.

- (c) According to the pilot interview, when passing through the threshold of runway 21, the height of the aircraft was higher than the standard threshold crossing height as specified in the AIP Myanmar.
- (d) At the time of both engines' torque of the aircraft were reduced to idle, the altitude of the aircraft was about 34 feet which is 14 feet higher than the normal altitude 20 feet.
- (e) When the aircraft landed on the runway, the magnetic heading of the aircraft was 219 degrees instead of the normal heading, 214 degrees.
- (f) Despite the unstabilized approach, both flight crew decided to land the aircraft and did not consider to execute a go-around.
- (g) The use of both nose wheel steering and rudder inputs resulted in the initial overcorrection of the aircraft causing it to yaw left.
- (h) The subsequent asymmetrical brake application by the pilot flying resulted in the aircraft yawing right, pivoting around the right outboard wheel and the aircraft tracked towards the right edge of the runway, eventually resulting in the runway excursion.

#### **4** SAFETY RECOMMENDATIONS

To reduce and eliminate of accidents and serious incidents, MTSB recommended the followings:

- **4.1** The operator should ensure that their pilots strictly follow the Standard Operating Procedures and Limitations in order to reduce the accidents during approach and landing, and maintain the aircraft in a stabilized approach all the way to touchdown. If the aircraft is not stabilized, the pilots should strictly follow the go-around procedures without hesitation.
- **4.2** The operator should review its stabilization criteria and amend to be more clear and understanding in accordance with ATR's stabilization criteria.
- **4.3** The pilot should be trained with enhanced training in Crew Resource Management related to the situational awareness, threat and error management, cockpit communications and leadership.
- **4.4** The operator should conduct a tabletop exercise regarding the aircraft go around and should hold the awareness workshop in terms of initiating a go-around immediately

without any hesitation if the aircraft is not stabilized during approach and landing.

#### **5** SAFETY ACTIONS

During the course of investigation and through the discussion with MTSB, the following safety actions have been taken by the aircraft operator and Department of Civil Aviation.

#### 5.1 Actions by the aircraft operator

- **5.1.1** Flight Operations Meeting
- 5.1.2 Stabilized Approach Workshop
- 5.1.3 ATR 72-600 Aircraft System Review and Exam
- 5.1.4 ATR 72-600 CRM Training
- 5.1.5 ATR 72-600 Flight Crew Recurrent Training and Check

#### 5.2 Actions by Department of Civil Aviation

**5.2.1** Regarding the loss of GPS data at Airport, Department of Civil Aviation has reviewed the anti-drone systems equipped near the airport and is coordinating with the relevant authorities to replace them with better anti-drone system.