
# AVIATION ACCIDENT INVESTIGATION REPORT

## REPORT OF SMOKE IN THE COCKPIT

## JETBLUE AIRWAYS

## FLIGHT JBU 876

## EMBRAER ERJ 190 - 100 IGW

## UNITED STATES REGISTRATION N267JB

## NORMAN MANLEY INTERNATIONAL AIRPORT
## KINGSTON, JAMAICA

## 31 MARCH 2014

## REPORT NUMBER JA-2014-01

**Investigation conducted by the Jamaica Civil Aviation Authority.**

**Accredited Representative: The National Transportation Safety Board of the United States of America (NTSB).**

**The State of Manufacture of the aircraft, Brazil, elected not to appoint an Accredited Representative.**

**In accordance with Annex 13 to the *Convention on International Civil Aviation,* it is not the purpose of aircraft accident investigation to apportion blame or liability. The sole objective of the investigation and the Final Report is the prevention of accidents and incidents.**

# Factual Information

## 1.1 History of the flight

**JetBlue 876 History of the Flight**

JetBlue 876 (JB876) was an Embraer ERJ 190 on a scheduled service from Norman Manley International Airport, Kingston (MKJP) to Fort Lauderdale. At about 17:39 local time, the captain called for the clearance to Fort Lauderdale and the crew received the automatic terminal information service (ATIS). After engine start and taxi, the flight departed MKJP at 18:43[1] (Sunset was at approx. 18:20) with ninety eight (98) passengers, four (4) crew members and 14,000 pounds of fuel.

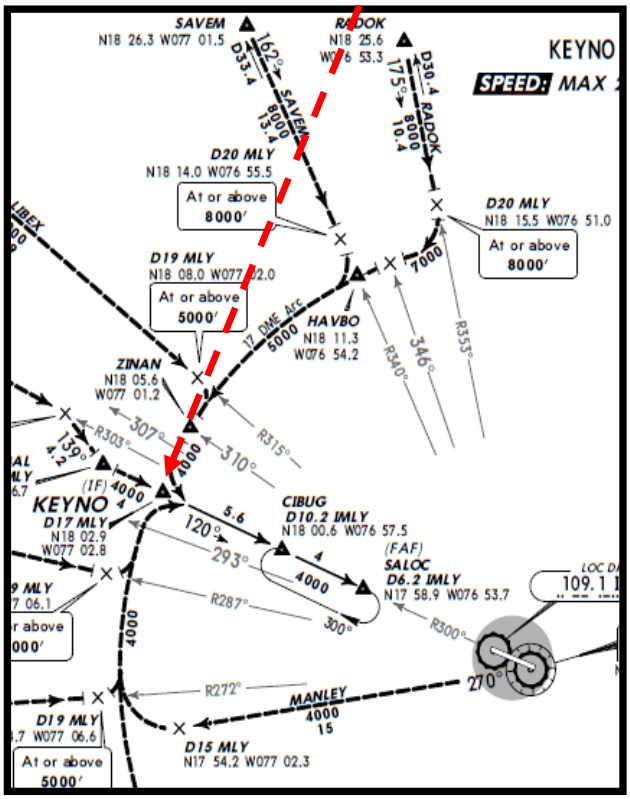



**Figure 1 – Kingston**

The captain was the pilot flying and the first officer the non-flying pilot.

The aircraft was cleared to flight level three four zero (FL340) proceeding north towards the boundary with Havana and was about to contact Havana Control when the smell of smoke was detected by the cockpit crew and after some discussion the decision was made to return to MKJP.

At approximately 18:53 JB876 declared an emergency to air traffic control (ATC), Kingston Centre Radar (KIN RADAR).

KIN RADAR advised JB876 to stop his climb at flight level two three zero (FL230) and cleared JB876 to turn left, when ready, and proceed direct to KEYNO (south towards Kingston).

The captain elected to hand over pilot flying duties to the first officer in order to give his attention to the overall management of the situation. Both pilots put on their oxygen masks, and begun the descent and preparations to return to MKJP, including

[1] All times in this report are local time (EST)

reprograming the flight management system (FMS), beginning the quick reference handbook (QRH) 'Cockpit /Cabin Smoke /Fumes' procedure as well as completing the normal procedures and checks.

Meanwhile ATC informed the Aircraft Rescue Fire Fighting services (ARFF), referred to by Norman Manley International Airports Limited (NMIAL) as Airport Protection Services (APS), that JB876 had declared an emergency and would be returning to MKJP, due to smoke in the cockpit. A 'Full Emergency' was immediately declared with APS. NMIAL Operations was notified thereafter.

The crew continued their descent and approach to MKJP, prepared for landing, and made the decision to evacuate the aircraft on the runway.

At approximately 18:55 local time, KIN RADAR instructed JB876 to switch to VHF frequency 120.6 MHz and to continue with MANLEY APPROACH.

The crew, both cockpit and cabin, were busy preparing for the unscheduled landing, continuing to discuss the presence of smoke in the aircraft and confirming the decision to carry out an evacuation of the aircraft. They continued their communication with MANLEY APPROACH, receiving the hand-off to MANLEY TOWER at 19:03 local.

The captain called the tower at 19:04 local, reporting on a 10 mile final for Runway12 MKJP and received landing clearance. The tower advised him that emergency equipment was standing by. The captain and crew continued to discuss and brief on the pending 'emergency landing' while flying the approach into MKJP.

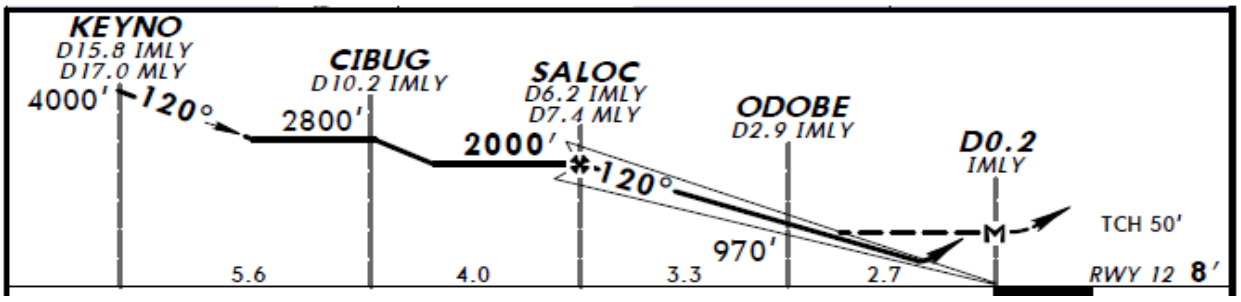



**Figure 2B— approach into MKJP**

An overweight, but otherwise normal, landing was accomplished at 19:08 and an emergency evacuation was carried out on the runway at approximately 5,300ft from the threshold of runway 12 at 19:09.

All persons successfully evacuated the aircraft.

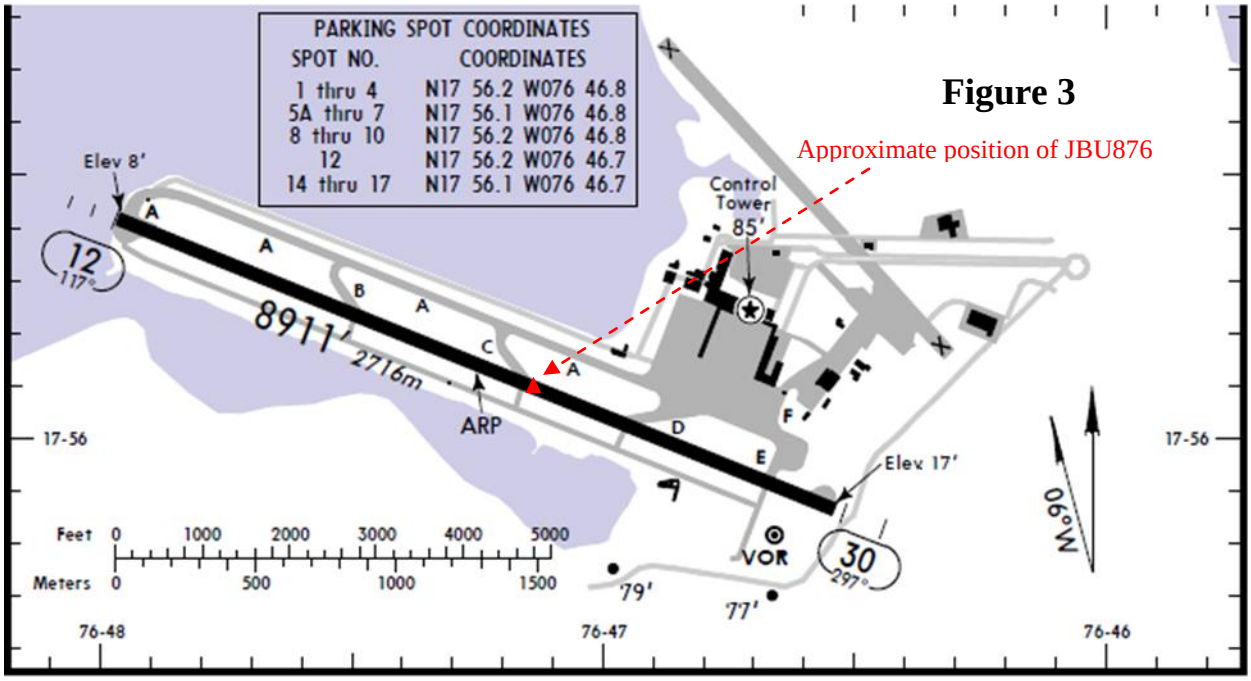



**Figure 3**

## 1.2 Injuries to Persons

**Table 1. Injury Chart.**

| Injuries | Flight Crew | Flight Attendants | Passengers | Other | Total |
|---|---|---|---|---|---|
| Fatal | - | - | - | - | - |
| Serious | - | - | 1 | - | 1 |
| Minor/None | 2 | 2 | 97 | - | 101 |
| Total | 2 | 2 | 98 | - | 102 |

Note: ICAO Annex 13 defines a serious injury as an injury which is sustained by a person in an accident and which: (a) requires hospitalization for more than 48 hours, commencing within seven days from the date the injury was received; or (b) results in a fracture of any bone (except simple fractures of fingers, toes or nose); or (c) involves lacerations which cause severe haemorrhage, nerve, muscle or tendon damage; or (d) involves injury to any internal organ; or (e) involves second or third degree burns, or any burns affecting more than 5 per cent of the body surface; or (f) involves verified exposure to infectious substances or injurious radiation.

Six (6) passengers received injuries, of which one (1) had a serious injury. The two (2) flight attendants were able to perform their emergency duties effectively.

## 1.3 Damage to aircraft

There was no damage either to the fuselage, exterior or interior of the aircraft.

## 1.4 Other Damage

There was no damage sustained to any buildings, vehicles, navigation facilities, aerodrome structures and installations, neither was there any damage to the environment.

## 1.5 Personnel Information

**Flight Crew**
The captain of the flight had approximately 10,000 hours of flight time and the first officer had approximately 6,000 hours of flight time. The licences and medical certificates of both members of the flight crew were valid at the time of the event. Both pilots were qualified on the aircraft and their recurrent training was up to date.

**Cabin Crew**
**Table 2.** Cabin Crew Information

| Flight Attendant Position # | Location of Jumpseat | Years/Months as Flight Attendant with JetBlue | Last Annual Recurrent Training[2] |
|---|---|---|---|
| 1 | 1L | 8 years 11 months | July 2013 |
| 2 | 2L | 11 months | N/A |

There were two flight attendants occupying the first two positions on this aircraft. They were assigned to flight attendant stations 1L and 2L, in accordance with the Federal Aviation Administration (FAA) regulatory requirements and company operating procedures.

Section 391(3) of Title 14 Code of Federal Regulations (CFR), Part 121, states "*For airplanes having a seating capacity of more than 50 but less than 101 passengers – two flight attendants*". The flight attendants comprising the minimum crew must be qualified on the type of equipment being operated. The FAA minimum crew for this Embraer ERJ-190 (100 seat aircraft configuration) is two. The occurrence flight attendants were certified and qualified for their assigned duties on this aircraft.

**Air Traffic Services**
All Air Traffic Control Officers (ATCOs) that provided Air Traffic Control Services to the flight crew of JB876 were in possession of valid Air Traffic Control (ATC) licences and medical certificates and were properly rated to provide ATC in their respective Air Traffic Services (ATS) units in accordance with the licencing requirements of the Jamaica Civil Aviation Regulations (CARs) 2012. The training records for the ATCOs

[2] Annual Recurrent Training includes Evacuation Drills

who were on duty did not have any record of recurrent training in normal and emergency procedures as required by CARs.

**NMIA Airport Protection Service Personnel**
Documentation provided by NMIAL indicated that the eight (8) APS/ARFF persons that participated in the emergency response had undergone some training. However, there is no evidence that the training had been conducted as a part of a formalized training programme. The APS/ARFF training records that were reviewed did not indicate that the APS/ARFF personnel had received familiarization training on the Embraer 190 aircraft.

**NMIA Operations Personnel**
Documentation provided by NMIAL indicated that the ten (10) Operations persons who participated in the full emergency had undergone some training. However, there is no evidence that the training had been conducted as a part of a formalized training programme.

## 1.6 Aircraft information

The Embraer ERJ 190 IGW low-wing twin-engine jet aircraft is made by Embraer S.A. of Brazil. It was assigned manufacturer Serial Number 19000065 and was manufactured February 15, 2007. It went into service on February 27, 2007 with registration N267JB. The registered owner was Wells Fargo Bank Northwest NA Trustee and the aircraft was being operated by JetBlue Airways at the time of the accident. All certificates were valid at the time of the accident. Since entry into service, the aircraft had accumulated 20,266:02 flight hours (FH) and 12,180 cycles.

The aircraft was fitted with two General Electric engines of model type CF34-10E6. The left engine bore serial number 994159 and had accumulated 19,030:27 hours and 11,563 cycles since new. The time since last shop visit was 1,554:53 hours and 968 cycles. The right engine bore serial number 994388 and had accumulated 18,144:01 hours and 10,798 cycles since new. The time since last shop visit was 2,954:59 hours and 1,903 cycles.

The aircraft was being maintained using the JetBlue Airways Aircraft Maintenance Program at revision E32-002, dated July 01, 2013 and approved by the FAA effective July 05, 2013.

All applicable Airworthiness Directives were in compliance. Life-limited components for the engines, landing gears and aircraft systems were all showing to be in compliance with their replacement schedule.

The type of fuel used in the aircraft was JET A-1; this was the type of fuel approved for this aircraft. The amount of fuel on the aircraft at departure was 14,000 pounds; this was determined by the fuel gauges and computation.

The Air Cycle Machine (ACM), which would emerge as a significant item in this event, was manufactured by Hamilton Sundstrand. The model number of the unit was EC70A, with OEM Part Number: 1000700-5, and OEM Serial Number: 2006070251. The total time since new of the ACM was 16,487.58 hours and the total cycles since new was 9,952.00 cycles.

At the time of the event there were no open defects recorded in the technical log book aboard the aircraft.

| | |
|---|---|
| The maximum certificated take-off weight of the aircraft is: | 114,199 lbs. |
| The maximum certificated landing weight is: | 97,003 lbs. |
| The actual take-off weight of the aircraft for the flight was: | 100,474 lbs. |
| The actual landing weight was: | 97,650 lbs. |
| The calculated Center of Gravity for take-off was: | 16.4% |
| The Zero Fuel Weight Center of Gravity was: | 19.3% |

Prior to the flight, an aircraft load sheet was filled out that included the fuel uplift as well as cargo and baggage. The weight and balance of the aircraft were within the prescribed limits.

**Air Conditioning System**

The air conditioning system supplies airflow to the cockpit and passenger cabin for ventilation and pressurization. It also controls the temperature and humidity of the air. Air Management System (AMS) controller cards provide the electronic control for this system. There are eight cards installed in the Secondary Distribution Assembly (SPDA) two are located at the middle electronic compartment and all cards are Line Replaceable Modules (LRM). The architecture of the AMS controller consists of two independent control channels which are identical to each other and consists of four cards each. Only one channel is in control at a time and there is automatic transfer of control thirty seconds after each landing. In operation, if the active channel fails, the control of the system is automatically transferred to the other channel, with no interruption of AMS system functions.

The cooling system receives hot bleed air from the Auxiliary Power Unit (APU) or engines and supplies conditioned air to the distribution system. There are two identical cooling packs (left and right) and they are located in the Environmental Control System (ECS) pack bay in the forward fairing of the aircraft. Each air cooling pack consists of a dual heat exchanger, air cycle machine, condenser/reheater, water collector, valves and

temperature sensors. Apart from supplying conditioned air to the cabin distribution system, the pack also performs the following secondary functions:

- Internal cooling pack overtemperature protection, along with compressor outlet temperature monitoring.
- Removal of water from the compressor outlet air flow which contains internal condensing cycle with water collection system.
- Integral air-cooling pack vibration isolation.

The AMS controller utilizes temperature sensors installed in five pack locations for control and conditioning monitoring of pack inlet, pack outlet, condenser inlet, compressor outlet, and compressor inlet temperatures.

- The condenser inlet temperature is continuously monitored by the AMS controller using electronic feedback from the condenser inlet temperature sensor. The condenser inlet temperature is controlled by adding warm compressor outlet air to the condenser inlet airflow. Under most pack operating condition, this temperature is controlled to one degree Celsius to prevent water from freezing in the condenser. In certain low humidity conditions the condenser inlet may be controlled to ten degrees Celsius.
- The pack outlet temperatures are continuously monitored by the AMS controller using electronic feedback from the pack outlet temperature sensor. The pack outlet temperature is controlled by adding hot pack inlet air to the pack outlet airflow.

The temperature control system for the aircraft provides independent closed loop temperature control for the cockpit and one or two separate passenger cabin zones.

**Aircraft Interior**

The Embraer ERJ 190-100 series aircraft is a single aisle passenger transport aircraft.

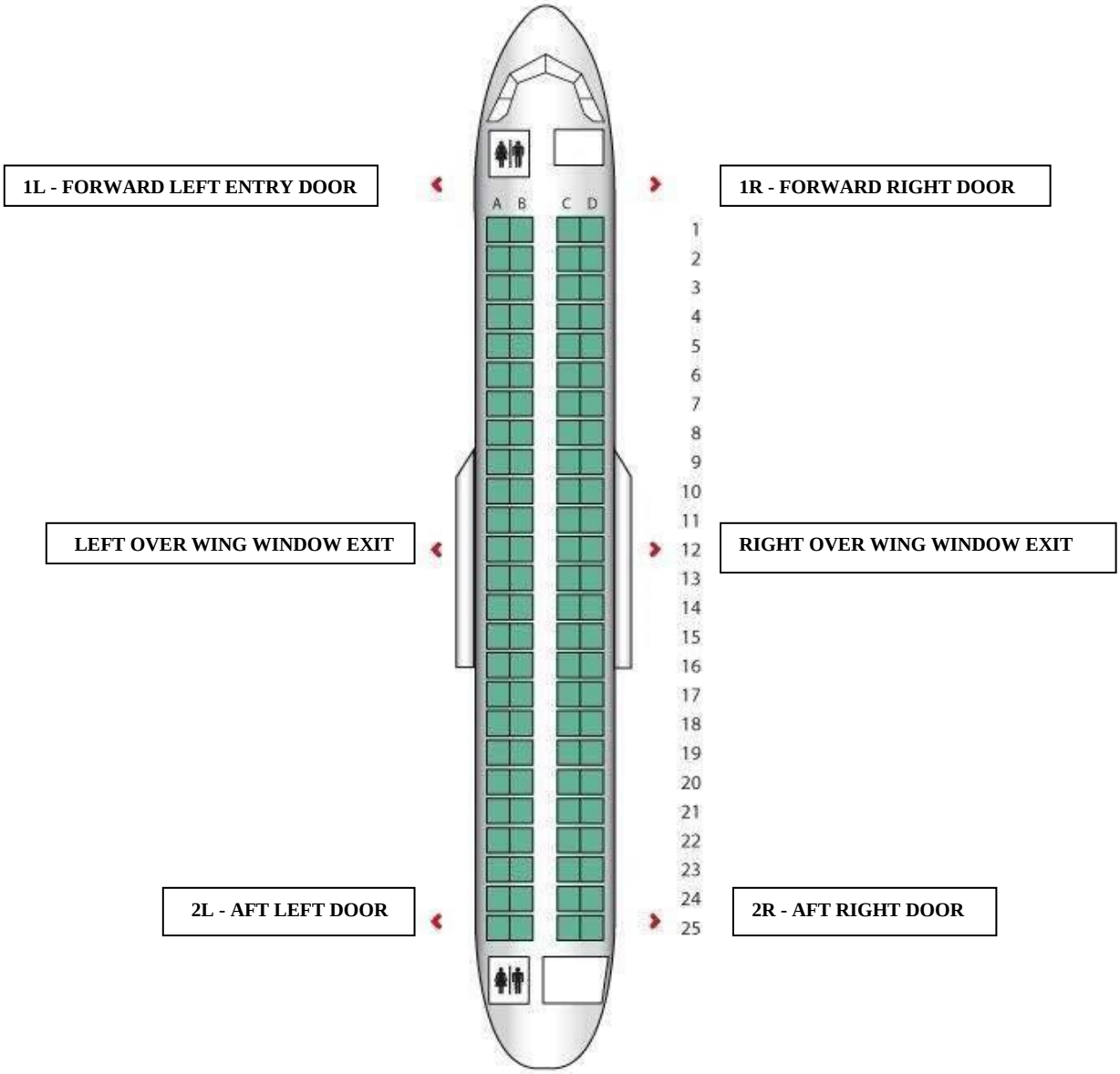
The flight deck accommodates two pilots, plus one observer seat.

The aircraft passenger cabin was configured to accommodate 100 passenger seats. Passenger seats are in a two-seat configuration on either side of the aisle with designated letters AB on the left and CD on the right. There are 25 rows starting at row 1 and ending at row 25. (see Figure 4)

The aircraft has four cabin doors: two on the left side (1L and 2L) and two on the right side (1R and 2R), and two over wing window emergency exits at Row 12. The cabin doors are used as entrance and exit doors for the passengers and the crew. The two over wing window exits are for emergency use only.

The aircraft cabin was equipped with three cabin crew stations at 1L, 2L and 2R. The cabin crew stations are each equipped with a single flight attendant jump seat. From a seated position, cabin crews could reach certain emergency equipment.

**Figure 4. Embraer 190-100 Aircraft Cabin and Exits**



**Aircraft Seats and Restraint Systems** - The passenger and flight attendant seats were certified to Title 14 CFR Part 25, Section 25.785 (described as 9.0g horizontally). Passenger seats were equipped with a lap belt. The flight attendant seats were equipped with shoulder harness and seat belt restraint system.

**Emergency Exits** - There were four doors and two over wing emergency window exits, all of which were available for use.

**Exit Doors** - The four cabin doors at 1L, 1R, 2L and 2R are Type 1 floor level emergency exits. The cabin doors are designed to be opened from the inside and the outside.

Section 25.807(a)(1) of Title 14 CFR, Part 25 defines a Type 1 emergency exit as "a floor level exit with a rectangular opening of not less than 24 inches wide by 48 inches high, with corner radii not greater than one-third the width of the exit".

**Over Wing Window Exits** - There are two over wing window exits, one on the left hand side and one on the right hand side of the aircraft. The over wing window exits are located adjacent to seats 12AB and 12CD. Each window weighs approximately 38 lbs. The over wing window exits are not equipped with escape slides because when the flaps are fully lowered, the wings are low enough to the ground that passengers can evacuate safely.

**Evacuation Escape Slides** - The aircraft was equipped with Type 1 inflatable single-lane escape slides at each cabin door. These slides are to facilitate rapid occupant egress in the event of an emergency. Each slide on the accident aircraft is packed in a valise and stows inside a compartment on the lower inboard face of each aircraft exit door. The slides are manufactured by Goodrich Corporation. The deployment and inflation of the escape slides are automatically initiated when the door is opened in the armed mode. In the event that inflation does not start automatically, each slide is equipped with a red manual inflation handle. The slides are equipped with escape slide lights which remain on for a minimum of 10 minutes, even after the slide is disconnected from the aircraft. The escape slide takes approximately six seconds to be fully inflated.

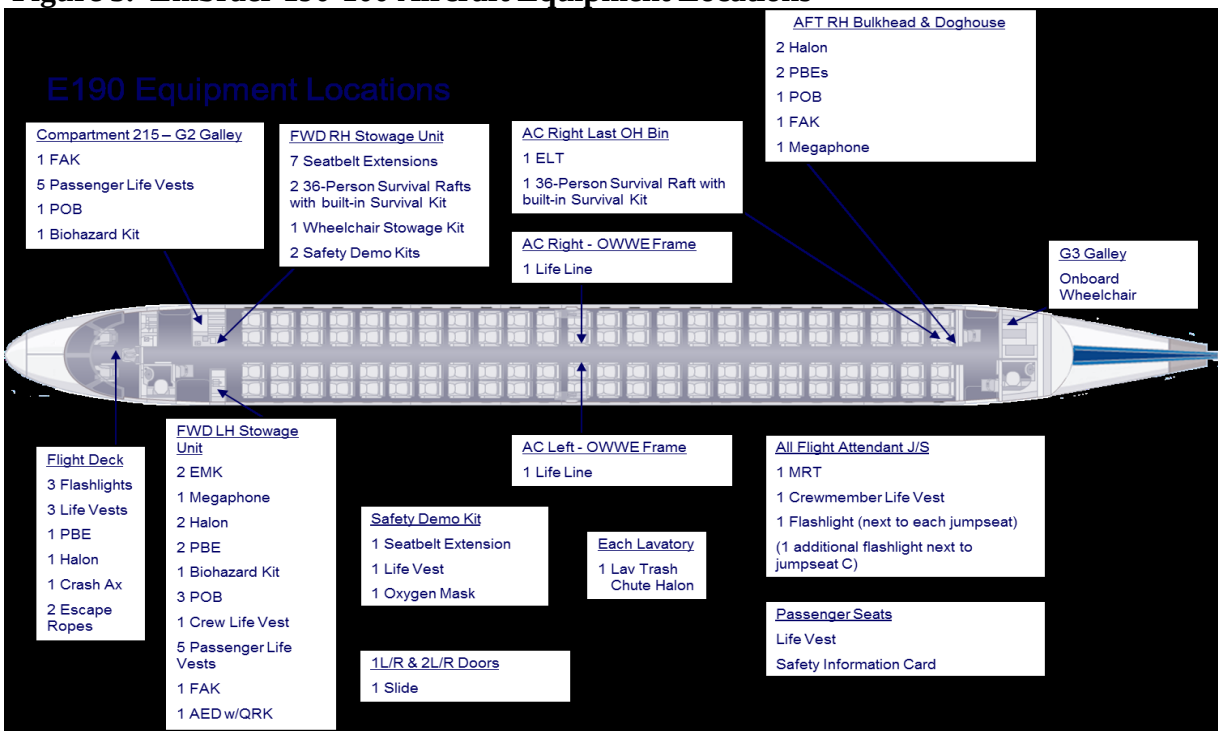
**Cabin Emergency Lighting** - The aircraft is equipped with an emergency lighting system that can be manually controlled from the forward attendant panel at 1L and the aft attendant panel at 2L. They are designed to come on automatically when there is a loss of aircraft electrical power.

There is also an emergency escape path lighting consisting of photo luminescent lighting strips that are installed along the passenger cabin floor to provide means of identifying the emergency escape path when the aircraft is in darkness or in dense smoke conditions. There are double red dots on the strips indicating the end of each exit path.

**Public Address System** - There are three handsets that are located by each flight attendant Jumpseat at 1L, 2L and 2R. These enable communication between crewmembers and for making public announcements to passengers.

Emergency Equipment - The cabin was equipped with portable emergency equipment in accordance with the applicable regulatory requirements. A description of this equipment and its location throughout the aircraft can be found in the diagram below (Figure 5).

**Figure 5. Embraer 190-100 Aircraft Equipment Locations**



## 1.7 Meteorological information

The Meteorological Aerodrome Report (METAR) issued at 00:00 Universal Coordinated Time (UTC) by the Meteorological Watch Office (MWO) located at the NMIA, reported Visual Meteorological Conditions (VMC) at the NMIA at the time of the accident. The METAR read as follows:

> *"MET REPORT MKJP 010000Z WIND 35004 KT VIS 10KM CLDS FEW 1800 FT CB AIR TEMP/ DEW PT 26/24 QNH 1014HPA, HAZE CB WSW ="*

The METAR indicated that the wind at the NMIA was from the North North-West, 350 degrees true, at four (4) knots. The prevailing visibility at station was 10 kilometers. Few clouds (Cumulonimbus) were observed at 1,800 Feet above ground level (AGL). Air temperature was 26 degrees Celsius (˚C) and the Dew Point was 24˚C. The Atmospheric Pressure was 1014 Hectopascals (HPA). Haze with embedded Cumulonimbus cloud was observed in the West South West (WSW) quadrant of the observation area.

The aircraft landed in the hours of darkness (at night), approximately 47 minutes after sunset and 25 minutes after civil twilight.

The flight crew was aware of the prevailing meteorological conditions at the time of the accident.

## 1.8 Aids to Navigation

There was no reported unserviceability regarding any of the aids to navigation at MKJP.

## 1.9 Communications

JBU 876 on returning to MKJP communicated with:

- Kingston Center
- Manley Approach (Radar)
- Manley Tower

There was no reported unserviceability with any of the aeronautical mobile or aeronautical fixed service communications systems.

The captain first made contact with the flight attendant at 1L to find out if she had smelt smoke in the cabin. The flight attendants informed the passengers of the landing and put on the pre-recorded tape in preparation for the emergency landing.

## 1.10 Aerodrome information

The accident occurred at the Norman Manley International Airport. The NMIA is served by one runway constructed of asphalt on a cement stabilized base.

| | |
|---|---|
| NMIA: | ICAO– MKJP; IATA– KIN. |
| Airport elevation: | 3.05 meters (10 feet) |
| Airport Reference Point: | N17 56.1 W076 47.3 |
| Runway 12/30: | 2716 meters (8911 feet) long, and 46 meters (151 feet) wide. |

The NMIA was designated as a Code 4E airport in accordance with the criteria outlined in ICAO Annex 14, Volume 1.


The runway environment was equipped with runway end and runway threshold lights and runway edge lights. Runway 12 was also equipped with Precision Approach Path Indicator (PAPI) lighting system which was set at a three (3) degree angle.

A complete simple instrument approach landing system served Runway 12, the runway used by JBU 876.

Aerodrome Air Traffic Control was provided from an aerodrome control tower located in a tower cab set upon the terminal building and was operated by the Jamaica Civil Aviation Authority (JCAA) Air Navigation Services. Approach control for MKJP was also provided by the JCAA but from an approach control office which was located at the JCAA headquarters.

At the time of the accident, the NMIAL emergency response services featured Three (3) airport fire tenders and an airport ambulance. NMIAL was also in possession of a rescue boat; however it was not operational at the time of this event.

## 1.11 Flight Recorders

Combination Cockpit Voice Recorder/Digital Flight Data Recorder (CVR/DFDR)**.**

| | |
|---|---|
| Recorder Manufacturer/Model: | **Honeywell 6025** |
| Recorder Serial Number: | **DVDR-00419** |

The Honeywell 6025 was a combination solid-state CVR/DFDR that recorded 2 hours of high quality 4-channel digital cockpit audio and a minimum of 25 hours of digital flight data.
The CVR/DFDR was removed from the aircraft shortly after the accident, and hand-carried to the facilities of the NTSB Vehicle Recorder Division's Audio Laboratory in Washington DC for analysis. The recorder was received by the NTSB in good condition.

**Cockpit Voice Recorder - General**
A Cockpit Voice Recorder (CVR) Group was convened on 08 April 2014, with members from the JCAA, NTSB, FAA and JetBlue.
The four channels of audio information were extracted from the recorder without any difficulty, and were all of excellent quality.
The four channels consisted of Captain, First Officer, Observer and Cockpit Area Microphone.
With the assistance of the NTSB staff, a transcript of the CVR was produced, upon which all members of the CVR Group agreed

**Cockpit Voice Recorder – Content**
The CVR transcript was examined to determine the actions of the crew during the emergency.
The actions of the crew were compared to the JetBlue EMB-190 Standard Operating Procedures (SOPs). It was determined that the flight crew's actions during the emergency conformed closely to the requirements of the SOPs.
The transcript of the cockpit voice recorder is not essential to the analysis and understanding of this event and as such, is not included in this report.

**Digital Flight Data Recorder – General**
A Digital Flight Data Recorder (DFDR) Group was convened on 08 April 2014, with members from the JCAA, NTSB and JetBlue.
The data was extracted normally using the NTSB's DFDR readout equipment. Only the event flight was downloaded for analysis.

**Digital Flight Data Recorder – Content**
The event flight, from take-off to landing, was 25 minutes and 36 seconds in duration, and the DFDR data ended 43 seconds after touchdown.
The DFDR analysis indicated that the DFDR started recording at approximately time 18:35:00 Local Time and ceased to record at approximately time 19:10:00 Local Time, less than one minute after the aircraft landed. The recording started after the #1 engine was started, and ceased just after touchdown when power was removed.
The DFDR analysis indicated that the aircraft reached a maximum of approximately 24,000 feet, then descended and returned to the airport for landing.
The DFDR indicated that the handling of the aircraft was within normal parameters.

## 1.12 Wreckage and impact information

Apart from being overweight, the landing was normal, so there was no wreckage or impact information.

## 1.13 Medical and Pathological Information

Given the nature of this accident, it was determined that it was not necessary to conduct blood and alcohol tests of the flight crew.

The Aircraft Incident/ Accident Report received from NMIA Airports Limited stated that their Emergency Management Team (EMT) assessed one female passenger as having suffered a broken left ankle and one male passenger with suspected back injuries, and both were transported to the Kingston Public Hospital. The investigation team was advised that the female passenger was admitted while the male passenger was examined and released. Numerous requests were made to the female passenger regarding the nature of her injuries by the investigation team; however the passenger was unwilling to divulge any information regarding her injuries. Furthermore, the investigation team requested an injury report from the hospital and was informed that the information could not be divulged without the consent of the patient; this consent has not been forthcoming.

# 1.14 Fire

There was no evidence of fire in flight or after landing

# 1.15 Survival Aspects

**Landing**
The landing was normal on the runway.

**The Evacuation**

The crew gave commands for the passengers to evacuate the aircraft. The passengers used the slides at doors 1L, 1R and 2L for evacuation. There were fire trucks surrounding the aircraft which provided flood lighting to the aircraft. The passengers were gathered on the grassy field adjacent to the runway.

Passenger Behaviour

The flight attendant positioned at 1L reported that the evacuation was orderly and no one attempted to disembark with hand luggage.

However, the flight attendant positioned at 2L reported after opening the 2L door she was unable to control the evacuation in an orderly manner, this caused her to abandon any attempt to open and use the 2R door. She also reported that some passengers attempted to take their baggage with them.

**Emergency Exits**

There were four Type 1 floor level emergency exit doors each equipped with a Type 1 inflatable single-lane escape slide at 1L, 1R, 2L and 2R. The slides are equipped with escape slide lights which remain on for a minimum of 10 minutes, even after the slide is disconnected. There are two over wing window exits, one on the left hand side and one on the right hand side of the aircraft. The aircraft is not fitted with over wing window exit evacuation slides.

Exits 1L, 2L and 1R were used for evacuation, 2R was not opened, both over-wing exits were opened but not used.

**Forward Left Door (1L)**

The 1L door was open and the slide fully deployed and used for passenger evacuation. The slide was illuminated with the escape slide lights.


**Forward Right Door (1R)**

The 1R door was open and the slide fully deployed and used for passenger evacuation. The slide was illuminated with the escape slide lights.


**Aft Left Door (2L)**
The 2L door was open and the slide fully deployed and used for passenger evacuation. The slide was illuminated with the escape slide lights.

**Aft Right Door (2R)**
This door remained closed and was not used during the passenger evacuation. The flight attendant assigned to position number 2, at the rear of the aircraft, stated that it was not safely possible for her to open 2R, as there were too many people coming at her and if she let go of the 'assist handle' she would have been pushed out of the aircraft.


**Over Wing Window Exits (OWWE)**
The two over wing window exits were opened during the passenger evacuation.

**Flight Deck**
The flight deck remained intact. There was no evidence of damage to the flight deck door, seats, floor, sidewalls, windows, windscreen or instrument panels.

**Forward Flight Attendant Seating and Forward Galley Area**
There was no evidence of damage to the forward flight attendant jump seat and forward galley area.

**Main Cabin**
There was no evidence of damage to the main cabin.

**Aft Flight Attendant Seating and Aft Galley Area**
There was no evidence of damage to the aft flight attendant jump seats and aft galley area.

**Emergency Equipment**
All of the emergency equipment contained in the cabin was found to be correctly secured. A halon extinguisher was removed from its stowage location in the flight deck and was found on the galley counter in the forward galley area.

**Emergency Lights**

From a review of responses to passenger questionnaires, the following information was obtained:

1. Cabin Lights – 6 passengers responded that they did not notice any cabin lights and two passengers responded that they noticed that cabin light were on.s it could not be ascertained if the interior emergency lights came on during the evacuation.
2. Exit Lights – 5 passengers responded that they did not notice any exit lights and six passengers noticed that exit lights were on.

Based on the low level of responses received and answers given by passengers it could not be determined whether or not they were illuminated

The investigators observed that all the lights on the emergency slides that were deployed were illuminated.

**Injuries**

The passengers were assessed by NMIAL's EMT and it was determined that two passengers who were injured should be sent to the hospital.

## 1.16 Tests and Research

A review of defects raised on this aircraft over the last twelve months showed no particular unusual trend, with the exception of defects noted for the left air condition system. This system was investigated further and revealed deficiencies as shown in Table 3 below. The first reported discrepancy was less than two months after the aircraft's entry into service. It is also important to note that there had been five previous reports of smoke

either in the cabin or cockpit, which resulted in the replacement of the Left Air Cycle Machine.

**TABLE 3**

| **Date** | **Event / Reason** |
|---|---|
| Feb 27, 2007 | ***Aircraft entry into service*** |
| Apr 23, 2007 | Left ACM replaced due ***Smoke in Cabin*** |
| May 08, 2007 | Left ACM replaced due making grinding noise |
| Sep 07, 2008 | Left ACM replaced due ACM seized |
| Sep 16, 2008 | Left ACM replaced due pack failed |
| Jan 07, 2009 | Left ACM replaced due pack frozen |
| Mar 08, 2010 | Left ACM replaced due ***Smoke in Cabin*** |
| Nov 01, 2011 | Left ACM replaced due ***Smoke in Cabin*** |
| Mar 19, 2012 | Left ACM replaced due ***Smoke in Cockpit*** |
| Jan 01, 2013 | Left ACM replaced due ACM failed |
| Feb 09, 2013 | Left ACM replaced due ACM failed |
| Mar 03, 2013 | Left ACM replaced due ***Smoke in Cockpit*** |
| Mar 04, 2014 | Left ACM replaced due burning smell |
| Mar 31, 2014 | Left ACM replaced due ***Smoke in Cockpit*** (current event) |

Following the in-flight turn-back, the aircraft was thoroughly examined on the ground. At initial entry of the aircraft a distinct burning smell was detected. On inspection, there was no evidence of soot at or around the air outlets in the cockpit or cabin.

After it was determined that it was safe to apply power to the aircraft, both air condition packs were operated, individually at first and then together. These tests were done about thirty six hours after the aircraft had landed and the burning smell no longer existed in the cockpit or cabin. Pneumatics from the APU was used to operate the packs at full cold. There was a noticeable heavy mist in the cabin and cockpit when the left pack was in operation. The mist was far less with the right pack operating. In addition, drops of water could be felt coming from the air outlets when the left pack was in operation. No burning smell or smoke was observed.

**Aircraft cabin**

**Aircraft cockpit**

The engines were run at approximately cruise power and the same process was repeated in the operation of the packs. The heavy mist was not present when using the engines to supply pneumatics. The pack flow was slightly less as the air pressure was less than that supplied by the APU. No burning smell or smoke was observed during the operation of the packs using engine pneumatics.

Prior to the engines being shut down, the APU was restarted and the packs then switched back to the APU supplying pneumatics. Shortly afterwards, a loud grinding noise emanated from the left ACM and a faint burning smell was also observed, however there was no smoke seen.

The left pack was deferred in accordance with the Minimum Equipment List (MEL) and the aircraft later dispatched on a ferry flight to a repair station in Tennessee, USA, for further investigation on the left pack system.

At Embraer Aircraft Maintenance Services, Inc., this being a FAA Repair Station (1MBR176B) in Tennessee, where further investigations were carried out, the left ACM was replaced for failure. The heat exchanger failed the operational health check and was also replaced. Table 4 below indicates the items which were replaced. Four additional items were replaced as a precaution and not because they had failed.

**TABLE 4**

| Item | Part Number | Serial Number | Reason for Replacement |
|---|---|---|---|
| Air Cycle Machine | 1000700-5 | 2006070251 | Failed |
| Heat Exchanger | 1002832-1 | 777 | Failed Operational Check |
| Low Limit Valve | 1001250-2 | 2007100091 | Precaution |
| Condenser/Reheater | 1001657-1 | 0480 | Precaution |
| Water Collector | 1003520-1 | 2006110632 | Precaution |
| Add Heat Valve | 820966-3 | 0398 | Precaution |

The shop report for all six items removed indicated that all items, with the exception of the air cycle machine, exhibited signs of normal service wear. The air cycle machine had complete bearing failure, wear/ erosion damage, metal to metal contact/ rub of rotating parts and overheating damage.

During the troubleshooting and rectification of this defect on the left pack, it was discovered that two sensors had their harnesses cross-connected. The harnesses are for the Pack Outlet Temperature Sensor and the Condenser Inlet Temperature Sensor. The operator informed the Investigator that there was no specific maintenance record of work being done on either sensor, so it was not possible to identify how and when the cross connection occurred.

A fleet campaign was accomplished by the operator of its Embraer 190 aircraft to check if there was any other aircraft which had a cross connection of the sensors. This showed that there was no other aircraft found in the fleet with this finding.

## 1.17 Organizational and Management Information

NMIA Airports Limited (NMIAL) was the operator of the publicly owned NMIA. NMIAL was incorporated in 2003 and was a wholly-owned subsidiary of the Airports Authority of Jamaica (AAJ). The AAJ was established under the Airports Authority Act in 1974.

At the time of the event, NMIA was not certified, as required under the Civil Aviation Regulations 2012.

JetBlue Airways Corporation is headquartered in the Long Island City, NY, and holds an Air Operators Certificate issued by the Federal Aviation Administration (FAA) as well as a Foreign Air Operators Certificate issued by the Jamaica Civil Aviation Authority (JCAA).

## 1.18 Other Information

NMIA Airports Limited submitted a post-accident report on May 16, 2014 which indicated that the response of all emergency response parties was adequate and was in accordance with their procedures.

The Aerodromes & Air Navigation Services Group Report for this accident provided evidence of the following:

1. NMIAL was not certified by the JCAA
2. There were significant deficiencies in the training of the air traffic controllers and NMIAL operations personnel.
3. The NMIAL emergency response plan was not properly developed, had not been fully implemented and had not been approved by the JCAA.
4. There was significant deficiencies in the training of air traffic control personnel

# ANALYSIS

## 2.1 Aircraft systems

The cross connection of the Pack Outlet Temperature Sensor and the Condenser Inlet Temperature Sensor may have resulted in the Air Management System (AMS) controlling the condenser to run hotter than normal. This would explain the excessive moisture as the condenser functionality would be affected. The excessive moisture may have caused ice to form on the Air Cycle Machine (ACM) turbine causing vibrations due to imbalance and eventual premature failure of the ACM. The metal to metal contact of the rotating parts accompanied by the overheat condition may have given off a burning smell in the air leaving this ACM. This burning smell coupled with the heavy mist/ moisture was probably what caused the flight crew to conclude that there was smoke in the cockpit, with the possibility of there being a fire.

### 2.2 Air Traffic Control

Although there were some inconsistencies and deficiencies of ATC's operations, they did not contribute to the cause of the accident.

## 2.3 NMIAL

Although there were some inconsistencies and deficiencies found in aspects of the operations of NMIAL, these did not adversely affect the emergency response for this event.

## 2.4 JET BLUE AIRWAYS

The fact that the 2R door and its slide were not used in the evacuation is significant, as this increased the time for the evacuation and might have resulted in serious injuries or fatalities if the aircraft had been on fire. The two rear doors, 2L and 2R, were part of the resources available for evacuation; however 2R was not used, indicating that there was an issue with the management of these resources.
The flight attendant manning the aft doors reported that she was unable to open the 2R door because she was trapped by the flow of passengers evacuating through 2L, and would have been swept out of the 2L door had she released her grip on the handle. The flight attendant training for the JetBlue ERJ 190 aircraft should accommodate this eventuality, and train the flight attendants to ensure that both 2L and 2R doors of the EMB190 aircraft are opened before the evacuation commences.

The fact that that the left air cycle machine was replaced twelve times within a seven year period along with five reports of smoke being observed in the cabin or cockpit prior to this event should have warranted further investigation and analysis of this problem.

**CONCLUSION**

# 3. Conclusions

### 3.1 Findings

1. The flight crew were licensed and qualified for the flight in accordance with existing regulations.

2. The flight attendants were trained and qualified in accordance with existing regulations.

3. The 2R door remained closed and was not used during the passenger evacuation. The flight attendant assigned to position number 2, at the rear of the aircraft, stated that it was not safely possible for her to open 2R, as there were too many people coming at her and if she let go of the ‘assist handle’ she would have been pushed out of the aircraft.

4. The maintenance records indicated that the aircraft was equipped and maintained in accordance with existing regulations and approved procedures.

5. The mass and center of gravity of the aircraft were within the prescribed limits; however the aircraft landed over the maximum certificated landing weight by 647 lbs.

6. There were seven previous instances where the left air cycle machine (ACM) was replaced due to smoke or burning smell on this aircraft since entry into service.

7. The connectors for the left pack outlet sensor and the condenser inlet temperature sensor were found to be cross connected.

8. A thorough examination of the aircraft on the ground revealed no evidence of soot at or around the air outlets in the cockpit or cabin.

9. Operational tests conducted on the ground of the air-condition system using the engines and the APU did not duplicate what was reported by the flight crew.

10. The left Air Cycle Machine was removed from the aircraft and sent for teardown inspection at the component manufacturer and the inspection confirmed that the unit had failed.

11. The training records for the Air Traffic Control Officers (ATCOs) who were on duty did not show that recurrent training in normal and emergency procedures had been conducted in accordance with Civil Aviation Regulations.

12. The ATCOs at the NMIA Aerodrome Control Tower were using a document containing emergency procedures in response to aviation emergencies which had been withdrawn since 2006. The Aerodrome Control Tower did not have current emergency response documentation.

13. The Air Traffic Service did not have a current copy of the NMIAL Emergency Response Plan.

14. There was no Aerodrome Grid Map displayed in the tower cab, as required by Civil Aviation Regulations.

15. The Norman Manley International Airports Limited did not possess an Aerodrome Operator's Certificated at the time of the accident.

16. The NMIAL Emergency Response Plan was not approved by the Jamaica Civil Aviation Authority.

17. There was no evidence that the NMIAL ARFF personnel training had been conducted as a part of a formalized training programme.

18. There was no evidence that the NMIAL Operations personnel training had been conducted as a part of a formalized training programme.

19. There was no evidence of consistent meetings of the Aerodrome Emergency Committee, which was required to be established under Civil Aviation Regulations.

20. The National Disaster Action Plan for Jamaica-Part 3 - Appendix 5 to Annex A - transport accident or incident (sea) – did not include the Jamaica Defence Force (JDF) as a primary, secondary or support agency for an accident or incident at sea.

21. The National Disaster Action Plan for Jamaica was not structured to give a clear demarcation of "on" and "off" airport boundaries and did not define jurisdictions in the event of an off-airport accident which would inform how response procedures for each agency would be designated.

# SAFETY RECOMMENDATIONS

## 4. Safety Recommendations

### 4.1 **Safety Actions Taken**

**TABLE 5**

| Item | Part Number | Serial Number | Reason for Replacement |
|---|---|---|---|
| Air Cycle Machine | 1000700-5 | 2006070251 | Failed |
| Heat Exchanger | 1002832-1 | 777 | Failed Operational Check |
| Low Limit Valve | 1001250-2 | 2007100091 | Precaution |
| Condenser/Reheater | 1001657-1 | 0480 | Precaution |
| Water Collector | 1003520-1 | 2006110632 | Precaution |
| Add Heat Valve | 820966-3 | 0398 | Precaution |

1. The aircraft components listed in table 5 above were replaced at Embraer Aircraft Maintenance Services, Inc. (EAMS) Facility in Nashville, Tennessee.

2. The connectors for the left pack outlet temperature sensor and the condenser inlet temperature sensor, which were found to be cross connected, were restored to their normal configuration.

3. The aircraft manufacturer, Embraer issued an Embraer Technical Disposition, ETD2014-190-030521, dated April 15, 2014 under the subject ERJ 190 – ATA 21-20 – Condenser Inlet/ Pack Temp Sensor Inspection – Permanent Repair, see Appendix A to this report.

4. The aircraft manufacturer, Embraer issued an optional Service Bulletin, SB No. 190-21-0051(original), dated December 18, 2014. The SB is entitled Air Conditioning – Improvement of Harness Routing to Avoid Inverted Connection between Connectors P0655 and P0979, see Appendix B to this report.

5. A Fleet Campaign Inspection document was raised by JetBlue's Engineering Department to inspect the sensor installation to ensure cross-connections does not exist in the remainder of JetBlue's fleet, see Appendix C to this report.

6. The Quick Access Recorder (QAR) fitted to the aircraft was modified to record approximately 18 additional Air Management System (AMS) parameters for health monitoring and aid future trouble shooting of the pack systems. The remainder of the fleet will be modified to record these additional parameters as they flow through scheduled maintenance visits.

## 4.2 **Safety Actions Required**

### Aircraft Manufacturer – Embraer

1. That Embraer Service Bulletin No 190-21-0051 is made mandatory for all applicable aircraft.

2. That the aircraft manufacturer modify the wiring harness connectors of the air conditioning pack outlet temperature sensor and the condenser inlet temperature sensor in such a manner that would ensure fool proof installation.

### Aircraft Operator – JetBlue Airways

1. That the flight attendant training for the JetBlue ERJ 190 aircraft should recognize that, when there is one flight attendant at the 2L and 2R doors, it may be possible that the flight attendant has difficulty in ensuring both doors are opened, and train the flight attendants to ensure that both 2L and 2R doors are opened before an emergency evacuation commences.

2. That JetBlue Airways improves their analysis of recurring defects.

### Aerodrome – NMIA

1. Pursue the goal of meeting the JCAA requirement of aerodrome certification.

2. Develop detailed training lesson plans for required training subjects of initial and recurrent training.

3. Enhance existing training procedures used for aircraft familiarization to include acquisition of current training aids for each commercial service aircraft currently using MKJP.

4. NMIA Airports Limited should, as a matter of priority, establish the Aerodrome Emergency Committee required by the Civil Aviation Regulations.

5. NMIA Airports Limited, through the Aerodrome Emergency Committee, should formalize coordination and establish responsibilities during emergency response

situations with industry and national stakeholders through memoranda of understanding.

6. NMIA Airports Limited and the Air Traffic Services should, along with industry and national stakeholders, coordinate the development of emergency response procedures for the Norman Manley International Airport.

7. NMIA Airports Limited should establish and effectively implement a Safety Management System as soon as possible.

**JCAA – ATS**

1. That the Jamaica Civil Aviation Authority should ensure that all Air Traffic Control Personnel undergo recurrent training in accordance with the requirements of the Civil Aviation Regulations.

2. That the Jamaica Civil Aviation Authority should procure a current copy of the NMIAL Emergency Response Plan and an Aerodrome Grid Map for display in the tower cab.

**Office of Disaster Preparedness Emergency Management (OPPEM)**

1. That the National Disaster Action Plan for Jamaica-Part 3 - Appendix 5 to Annex A - transport accident or incident (sea) – be amended to include the JDF as a primary, secondary or support agency for an accident or incident at sea.

2. That the National Disaster Plan be structured to give a clear demarcation of "on" and "off" airport boundaries, thereby defining jurisdictions in the event of an off-airport accident which would inform how response procedures for each agency would be designated.