

ENGINEERING DOCUMENT NUMBER 4865

INVESTIGATION REPORT

World Atlantic Airlines MD80 Forward Slide Deployment Failure
Public Docket

Slide Evacuation System D29982-121
Serial number 1091

Revision A

Distribution: NTSB (Pocholo Cruz)

This document was created to support an NTSB investigation and may be released as part of the public docket.

Revision Control Sheet

REV.	DATE	DESCRIPTION	APPROVAL
A	8 May 2019	Initial Issue	PLA



LIST OF EFFECTIVE PAGES

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1.0 SCOPE

This document is a summary of the investigation of an evacuation slide that failed to deploy following an incident involving a World Atlantic Airlines MD-83 on 20 April 2018 in Alexandria, Louisiana. The evacuation slide system for the left hand forward passenger door did not deploy during the evacuation of the aircraft. The aircraft had lost its right hand main landing gear during rollout after landing.

2.0 APPLICABLE INFORMATION/DOCUMENTS

2.1 Evacuation System Identification

MD-80 Forward Passenger Evacuation Slide p/n D29982-121,
Serial number 1091, Date of Manufacture September 1988

2.2 Air Cruisers Documentation/References

Air Cruisers Component Maintenance Manuals (CMM) 25-60-48
and 25-65-11

Incident logged as IN-0320 in the Safran Aerosystems
(formerly Zodiac Aero Evacuation Systems) Incident Database

2.3 Other Documentation and References

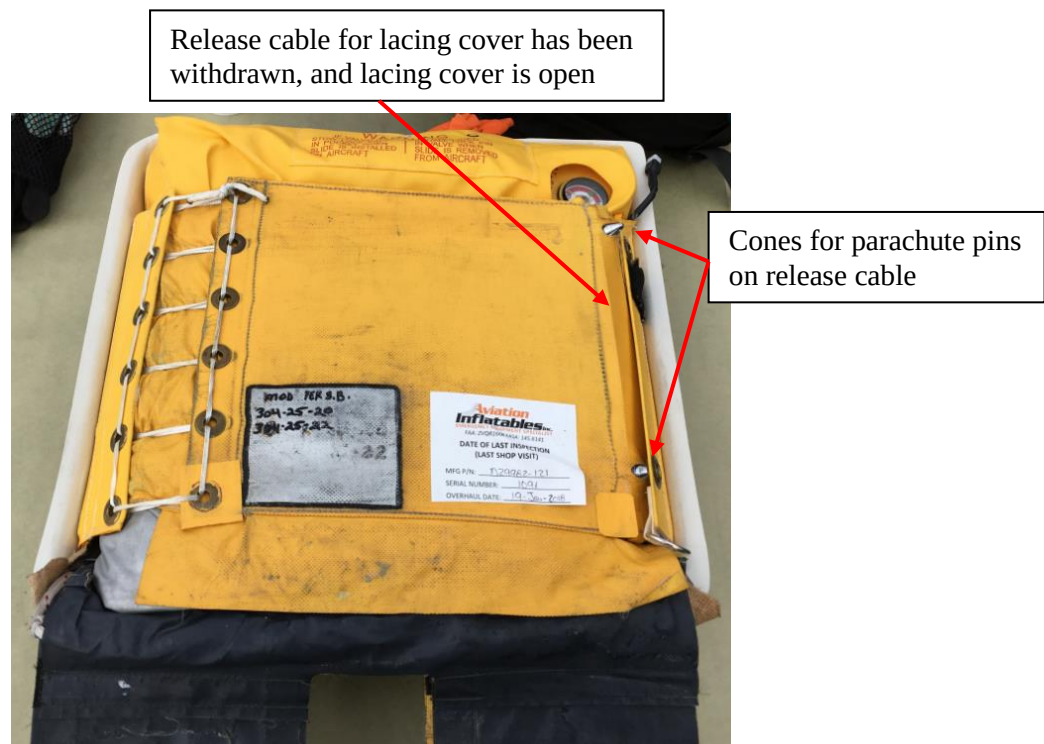
Photos provided by NTSB, included herein

NTSB Survival Factors Group Slide Teardown Report,
NTSB #DCA18FA144, dated 3 May 2018

NTSB Survival Factors Group Inflation Valve Teardown Report,
NTSB #DCA18FA144, dated 8 August 2018

3.1 Incident Description

After the event, the National Transportation Safety Board (NTSB) provided a photo of the forward door slide that failed to inflate, shown in Figure 1 below.



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This photo shows that the release cable for the lacing cover had been pulled away. The release cable for the lacing cover has two parachute pins that are inserted through metal cones on the lacing cover to secure the lacing cover together. These parachute pins had been withdrawn from these cones, so the lacing cover was open to release the slide for inflation. However, the slide did not inflate as expected, and the slide remained within the confines of the lacing cover.

The NTSB provided a photo of the pressure gage on the reservoir and valve assembly after the event, which is shown in Figure 2. The gage indicated that the inflation gas reservoir was empty.

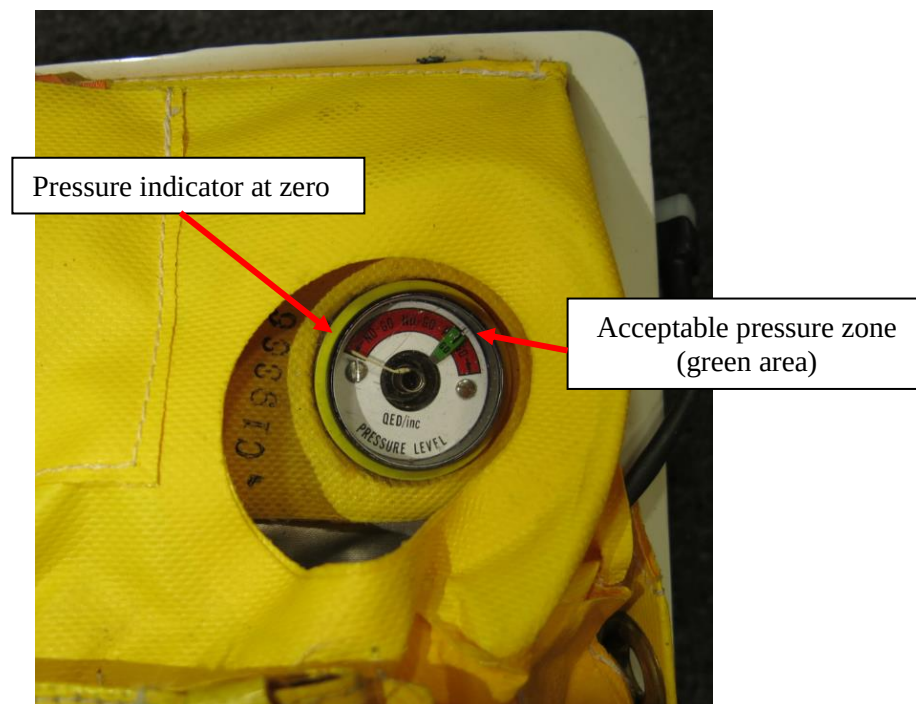


Figure 2
Zero Gas Pressure

The NTSB also provided a photo of the indicator pin on the inflation valve assembly, which is visible on the rear of the packboard. This pin, shown in Figure 3, is in the



position that indicates that the valve is in the fully open position. This is the expected position following a slide deployment, after the inflation valve has been opened to release the inflation gas in the reservoir.

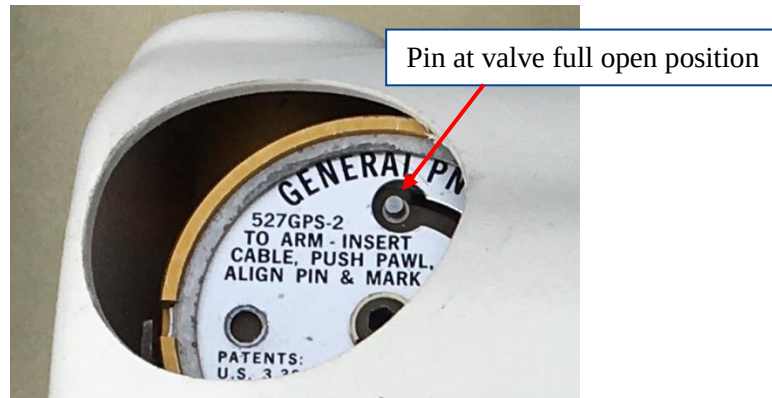


Figure 3
Indicator Pin Showing Inflation Valve is Full Open

The slide system was sent to the Belmar facility of Safran Aerosystems (formerly dba Zodiac Aero Evacuation Systems) for inspection and evaluation.

3.2 System Inspection

The evacuation slide system was inspected by members of the NTSB Survival Factors Group on 3 May 2018.

The slide system, shown in Figure 4, was in the same condition as shown in the photo provided by the NTSB after the event (reference Figure 1). The release cable for the lacing cover had been pulled free of the slide system, which released the parachute pins that secure the lacing cover in place over the packed slide assembly. The parachute cones on the lacing cover had disengaged from the grommets on the adjacent lacing cover flap, and the lacing cover was free to open. The lacing cover was in good condition with no findings.



Figure 4
Slide System Prior to Inspection

The slide was in its folded and packed condition within the packboard tray as shown in Figure 5. There was no evidence of inflation of the folded slide assembly.



Figure 5
Slide Still in Packed Condition



No defects or damage was found on the inflation valve or the gas reservoir. The inflation cable had been withdrawn from the inflation valve. The inflation cable was located in the shipping box separate from the evacuation system, and it was in good condition. The cable was identified as part number 62957-103, which is the correct part number per the CMM.

The inflation hose was connected between the reservoir and valve assembly (RVA) and the slide assembly. The part number on the inflation hose, P/N C17734-105, was verified to be correct per the Component Maintenance Manual (CMM). The hose had been hydrotested in January 2018, and it appeared to be in good condition.

The pressure gage on the Reservoir and Valve Assembly (RVA) indicated that the reservoir had zero pressure. The filler valve on the inflation valve was opened, and there was no release of gas, which confirmed that the gas reservoir was empty. The indicator pin on the inflation valve was confirmed to be in the 'valve open' position, as shown in Figure 6.

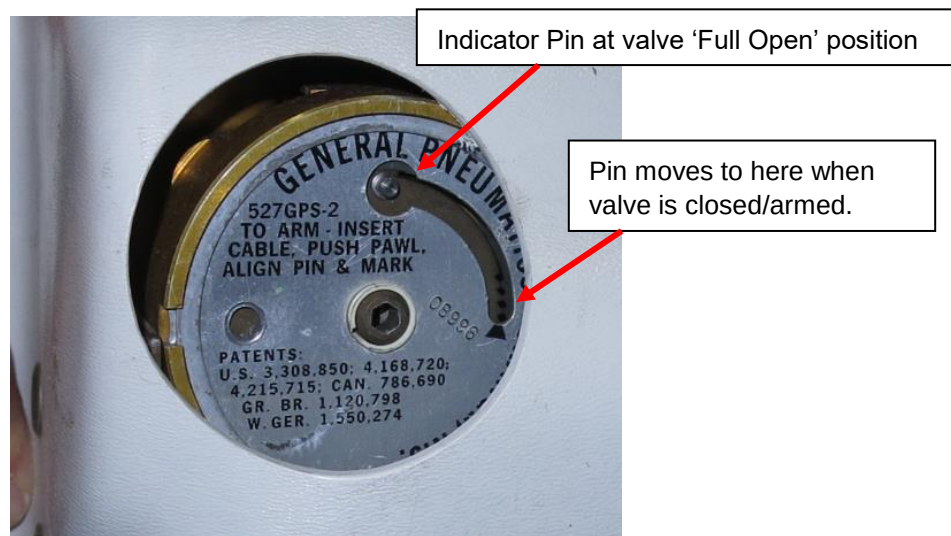


Figure 6
Valve Position Indicator Pin



The girt on the slide assembly was inspected with no unexpected findings, other than wear consistent with its age.

A fitting was attached to the discharge port of the inflation valve, and the Reservoir and Valve Assembly was charged to approximately 200 psig. All threaded connections between the components of the RVA were inspected for leakage using leak detection fluid, with no findings.

The inflation valve was closed and armed with the inflation cable. The RVA was then charged with carbon dioxide and nitrogen gases per CMM requirements. Using a small pool of leak detection fluid, a small leak was detected in the outlet port of the inflation valve as shown in Figure 7.

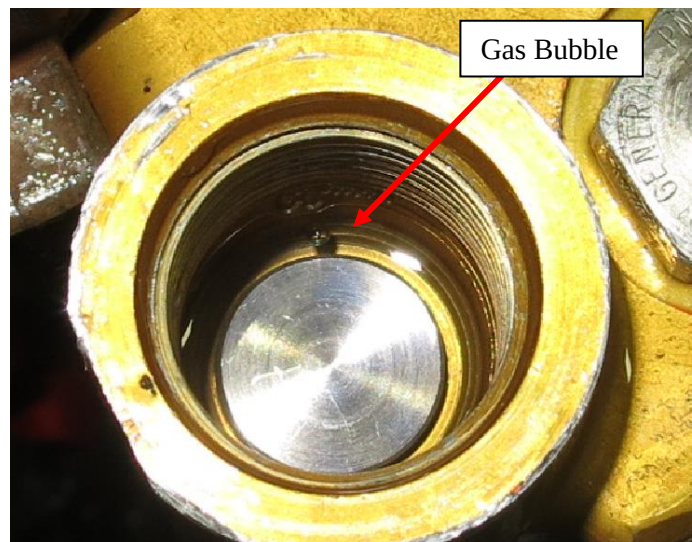


Figure 7
Leak at Inflation Valve Outlet Port

The charged RVA was then installed on the packboard, and the inflation hose was connected to the inflation valve. The slide was unfolded and a floor run inflation test was performed. The slide inflated successfully as shown in Figure 8, with no issues



noted. The pull force to initiate inflation was measured to be 11.5 lbs., which is within the CMM specification of 15 lbs. max.



Figure 8
Successful Floor Run

Following the floor run, the inflation valve was removed from the reservoir and installed on a Pressure Chuck for testing purposes. The valve was then pressurized to a point within the green “GO” Band on the pressure gage and a photograph was taken of the gage indicator position. This photo is shown on the left hand side of Figure 9. After 4 hours 24 minutes, the pressure gage showed visible evidence of a pressure loss as shown by the photo on the right hand side of Figure 9.

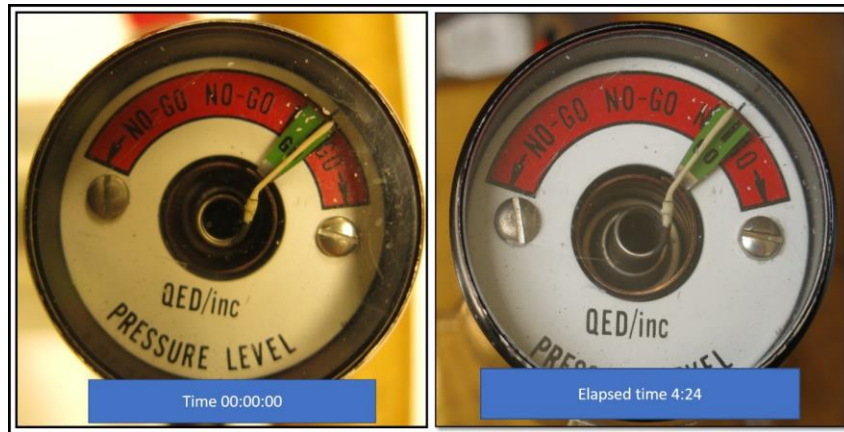
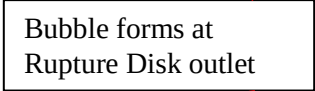


Figure 9
Pressure Loss after 4 hours 24 minutes

The valve test assembly was submerged in an alcohol bath to confirm the origin of the gas leakage. This test revealed a periodic release of a gas bubble emanating from the Rupture Disk Assembly, as shown in Figure 10. No other locations of gas leakage were noted during this dunk test, including the valve outlet previously identified in Figure 7.



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The valve test assembly was removed from the alcohol bath, and the inflation valve was removed and installed onto the reservoir. The reassembled Reservoir and Valve assembly was charged with 0.55 lbs. of carbon dioxide and 0.82 lbs. of nitrogen in accordance with the requirements of the inflation CMM for a total gas weight of 1.37 lbs. The total weight of the charged RVA assembly was 7.04 lbs. as recorded on 4 May 2018. Without the inflation gases, the weight of the RVA is approximately 5.67 lbs.

The RVA was then checked periodically over several months to determine a leak rate. Table 1 lists the recorded values of the total weight of the RVA at various dates, with the net loss calculated between each date.

TABLE 1
Calculated Leak Rate

Date	Total Weight (lbs.)	Net Loss (lbs.)	Net Number of Days	Calculated Net Loss/Day (lbs./day)
4 May	7.04	-	-	-
1 June	6.710	0.33	28	0.0118
19 July	6.285	0.425	48	0.0089
8 August	6.125	0.16	20	0.0080
TOTAL		0.915	96	.0095

Table 1 shows an expected decline in leak rate as the pressure decreases in the RVA.

After 96 days, the total system weight was 6.125 lbs. Subtracting the RVA tare weight of 5.67 lbs. from this weight, approximately 0.455 lbs. of inflation gas remain in the RVA. Using a net loss of 0.0080 lbs. per day from the last net loss calculation in the Table, it would take at least 56 days to empty the RVA of these remaining



inflation gases. Therefore, a rough approximation of the time it would take to empty this RVA due to the Rupture Disk leak when fully charged is 152 days (96 days + at least 56 days) or approximately 5 months from the charge date. This roughly correlates with the time between last slide system maintenance (19 January 2018) and the date of the incident (20 April 2018) which is approximately 3 months.

3.3 Inflation Valve Inspection

On 8 August 2018, members of the NTSB Survival Factors Group inspected the valve assembly. After recording the total weight as noted previously, the inspection team concentrated on the identified leak path through the Rupture Disk Assembly. This device has an internal disk that is designed to rupture if the internal gas pressure reaches a pre-determined high-pressure value, to prevent catastrophic rupture of the reservoir. Once the disk ruptures, the gas in the reservoir can vent to the atmosphere through ports on two sides of the device.

The leak through the Rupture Disk Assembly was verified by sealing one of the outlet vents with a finger and then filling the other outlet vent with leak detection fluid. The bubbles of leak detection fluid from the outlet vent confirmed that the leak through the Rupture Disk was still active, as shown in Figure 11.



Figure 11
Rupture Disk Outlet Leaking

After discharging the inflation gases in the reservoir, the Rupture Disk Assembly was removed from the inflation valve body. The Rupture Disk Assembly had no obvious signs of damage or corrosion on the exterior surfaces as shown in Figure 12. The Rupture Disk Assembly was identified as “GPC 826GPS07-1 4500 psi”, which is the correct part number and limiting pressure value.



Figure 12
Rupture Disk Assembly

An exploded view of the Rupture Disk Assembly is shown in Figure 13. The interior rupture disk is seated against the body of the Assembly by a compression bushing, which is secured in place by a threaded plug. The rupture disk is securely held against the compression bushing by a matching V-shaped edge around both components. This V-shaped edge maintains the pressure seal and limits movement of the rupture disk within the Assembly.

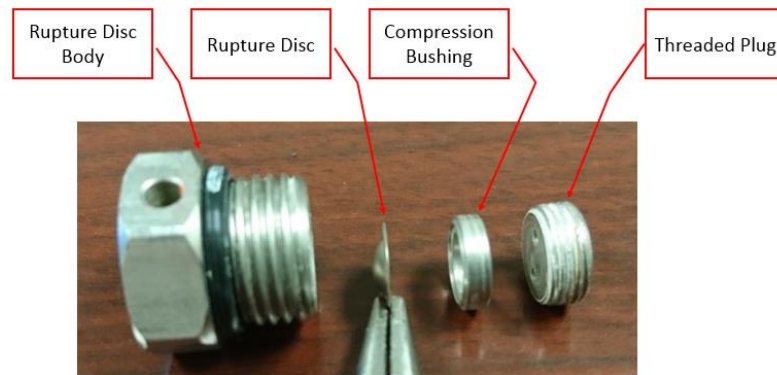


Figure 13
Exploded View of the Rupture Disk Assembly

The threaded plug was carefully loosened and removed to gain access to the interior of the Assembly. The plug was adequately secured in place and appeared to be undamaged upon removal.

Once the threaded plug was removed, the rupture disk was visible and intact as shown in Figure 14. There was no evidence of cracks or other defects. The debris shown in the photo is consistent with previously applied thread sealant.



Figure 14
Internal Rupture Disk Intact

The compression bushing and the rupture disk were carefully removed for further inspection. No evidence of damage or corrosion was found around the edges of the rupture disk or on the compression bushing.

Inspection of the interior rim inside the body of the rupture disk assembly found three small areas of surface corrosion, shown in Figure 15. These areas are located on the sealing surface where the rupture disk makes contact with the assembly body.

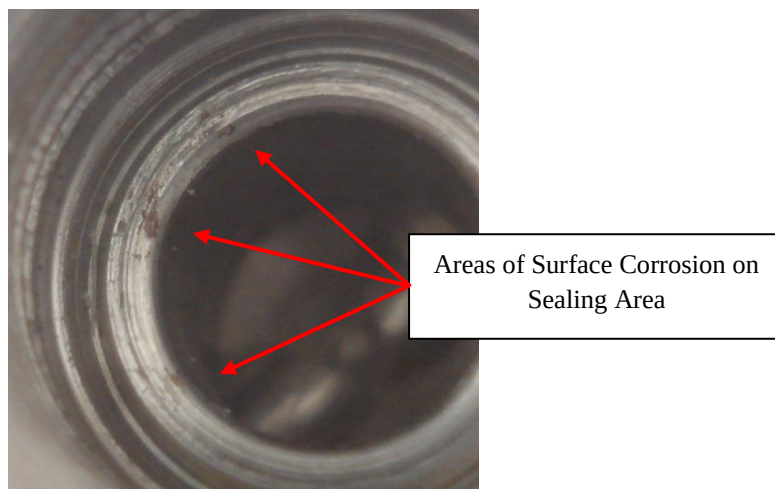


Figure 15
Minor Surface Corrosion

3.4 Maintenance History

The slide was last maintained and released on 19 January 2018. The slide was installed on the aircraft on 25 January 2018.

3.5 Similar Incidents

Slow leakage of inflation gas from charged RVA has been known to occur. Each inflation valve has several ports (for the pressure gage, rupture disk, etc.) that are sealed using o-rings, and a set of seals that isolate the flow ball that controls flow into the valve outlet. Damaged seals, dirt, or other debris which could have been



introduced during the assembly/overhaul process are known factors that can lead to a long term, slow leak. The Component Maintenance Manual includes a set of standard test procedures for use during RVA maintenance to identify potential leaks. The RVA also includes a pressure gage for use during periodic field checks of the evacuation slide system during service.

4.0 ANALYSIS & DISCUSSION

4.1 Deployment Analysis

This evacuation system was found with the release cable withdrawn from the lacing cover, which opened the lacing cover to allow the slide to deploy. The inflation cable was found withdrawn from the inflation valve, and the inflation valve was in its full open position, which should have released the inflation gases for inflation of the slide assembly. However, the slide remained in its fully packed condition, and there is no evidence that indicates that any inflation gas reached the slide assembly when the slide deployment was initiated.

The successful floor run indicates that both the slide assembly and the inflation system were capable of a successful deployment.

The likely root cause is that the gas reservoir was empty when the incident occurred, which is supported by the leak found through the Rupture Disk Assembly.

4.2 Risk Assessment

The inflation valve was found with a slow leak that would have bled off all of the inflation gas in the Reservoir and Valve Assembly over a period of several months. Regular monitoring of the pressure gage on this evacuation slide system should have detected that the gas pressure had decreased to an unacceptable level prior to the incident.



4.3 Risk Mitigation

All Air Cruiser Component Maintenance Manuals (CMMs) for evacuation slide systems recommend periodic in-service inspections at intervals to be determined by the operator. During these inspections, the pressure gages are to be checked for acceptable pressure to ensure that the gas reservoir in these systems is sufficient for emergency use.

This check can be performed by mechanics, line personnel, or flight crew members. The pressure gages on evacuation slide systems typically use simple Green/Red GO/NO GO indicators for simplicity.

5.0 CONCLUSION

This unsuccessful deployment is the result of an empty inflation gas reservoir. The slide assembly was found in a fully packed condition with no evidence of gas flow into the assembly, even though the inflation valve was fully open, and the lacing cover was open. A floor run of the system was successful, indicating that the slide assembly and inflation system were capable of a successful slide deployment during the incident.

A slow leak was found in the Rupture Disk Assembly on the inflation valve. This leak was at a rate that would have emptied the gas reservoir over a period of several months.