FINAL REPORT
AIRCRAFT SERIOUS INCIDENT

M-00511/AIG-05

TF-FIH
Boeing 757-200 PCF
Keflavik Airport (BIKF)
January 30th, 2011

1. Factual Information

Location and time	
Location:	Keflavik Airport, at stand 20 on cargo apron
Date:	January 30th, 2011
Time[1]:	10:12:56

Aircraft	
Type:	Boeing 757-200 PCF
Registration:	TF-FIH
Year of manufacture:	1990, cargo converted 2006
Serial number:	24739
CoA[2]:	Valid
Engines:	Two Rolls-Royce RB211-535E turbofans

Other information	
Persons	
on board:	• One maintenance technician
on ground:	• Three loading crew members
Injuries:	None
Damage to aircraft:	Main cargo door and supporting structure severely damaged
Short description:	In gusty wind conditions the main cargo door was damaged and fell uncontrolled down to its closed position
Weather:	Wind 282°/35, gusting 42 knots
Type of flight:	Cargo flight

[1] All times in the report are UTC and where applicable local times are shown in ( )

[2] Certificate of Airworthiness

1.1 History of the flight

At 10:01:10[3] on January 30th 2011, aircraft TF-FIH arrived at Stand 20 on the cargo apron at Keflavik Airport (BIKF) after a flight from New York (KJFK). The aircraft was parked with the nose heading in a direction[4] of 290°. An air stair was positioned at door 1L, located on the forward left side of the aircraft. At the same time a cargo Hi-loader proceeded towards the aircraft's main cargo door on its left side. See Figure 1 for details.

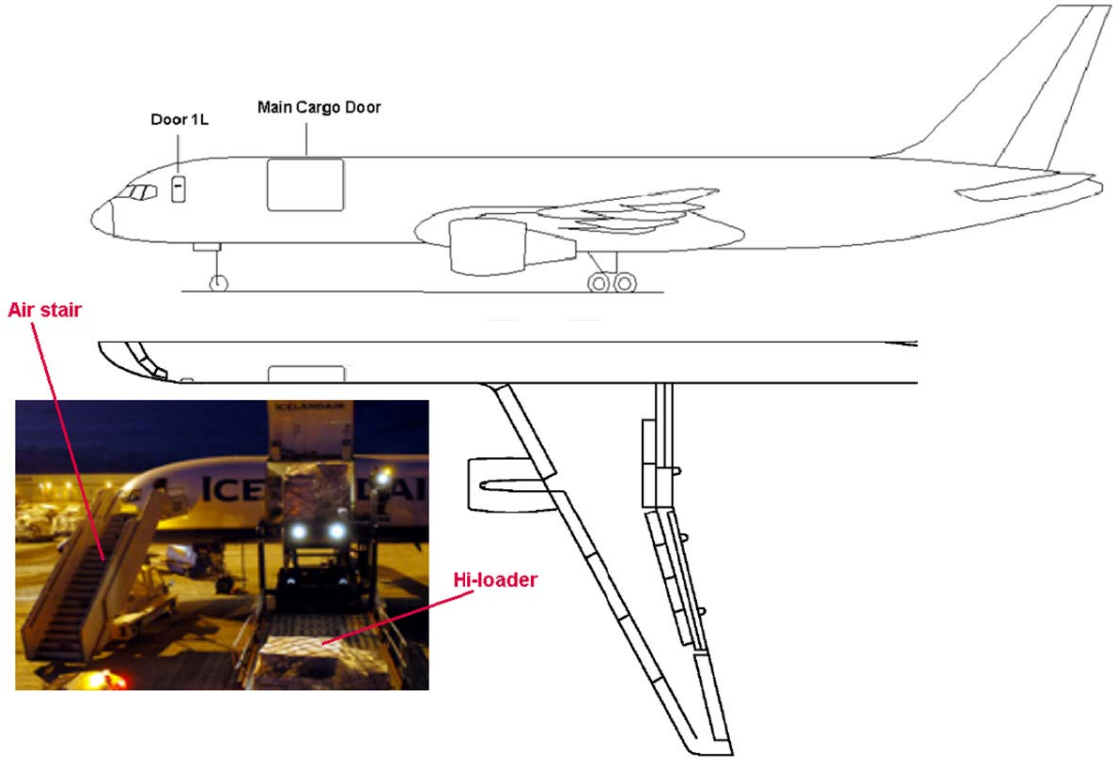

Figure 1 - Layout of Door 1L and Main Cargo Door

The cargo Hi-loader stopped 4-5 meters from the main cargo door, per normal procedures, as it must wait for the door to be opened before it can be positioned at the cargo door.

[3] The times in section 1.1 are based on the airport surveillance video, as shown in Figure 2

[4] Magnetic (all directions in the report are magnetic unless otherwise stated)

According to the commander, when landing at RWY 29, ATC[5] had reported to the flight crew that the wind was 270/35 gusting 41 knots. The commander determined this to be within operating limits of the main cargo door and at 10:02:07 he proceeded to open it. The commander monitored the door during opening, as he was concerned about the wind conditions. Once the door was in its full open position, the door seemed steady to him. Surveillance video from the airport showed the main cargo door to sway a little back and forth initially after it was fully opened and then to remain still.

When the main cargo door was reaching its fully open position and the crew of the Hi-loader proceeded towards the aircraft main cargo door, the Hi-loader's engine stopped. This had happened before on other occasions and the crew of the Hi-loader started joggling its sensors in order to restart it.

While the Hi-loader was inoperative, at 10:06:40, a maintenance technician walked up the air stairs and entered the flight deck via door 1L. The commander and the maintenance technician discussed the wind direction and speed as well as how close the wind was to the maximum operating limit of the main cargo door. The maintenance technician was concerned about the wind direction relative to the aircraft. According to the commander's information, the ATC reported wind direction was 20° into the door[6].

According to Precision Conversions operations manual for the main cargo door[7], the maximum operating limit for the main cargo door is 45 knots of actual or anticipated wind. No restriction is set on how the aircraft should be positioned with regards to wind direction when operating the main cargo door.

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[5] Air Traffic Control

[6] Aircraft heading 290° - Wind direction 270° = 20°

[7] Precision Conversions B757-200PCF Operations Manual PC-0118-02, Revision 05/30/2009, page 1.50.8

The commander and the maintenance technician concluded that the wind was below the set limit. The commander handed control of the aircraft over to the maintenance technician and had left the scene when the incident occurred.

The airport surveillance video shows the main cargo door on TF-FIH starting to sway back and forth in the fully open position at 10:11:10. Figure 2 gives a snap shot of this, as the main cargo door sways past its top position.

Figure 2 – Stand 20 as seen on airport surveillance video

At 10:11:40 the main cargo door's swaying increased considerably. Simultaneously the team leader of the loading crew heard 3-4 loud bangs. Initially he believed the bangs to be from the Hi-loader, but then realized they were coming from the aircraft. He noticed that the main cargo door was open past its fully open position and seemed to be resting on top of the fuselage. The loading crew team leader also noticed that the covers of the door hydraulic jacks were no longer in place and were hanging from the door interior. At 10:12:19 the loading crew team leader was seen running up the air stair to door 1L on the aircraft. The team leader notified the maintenance technician,

located in the flight deck of the aircraft, that something was wrong with the main cargo door and that it must be shut.

The airport surveillance video shows, the team leader and the maintenance technician walking to the aft end of the air stair deck at 10:12:29. The maintenance technician re-entered the flight deck and started closing the main cargo door at 10:12:53.

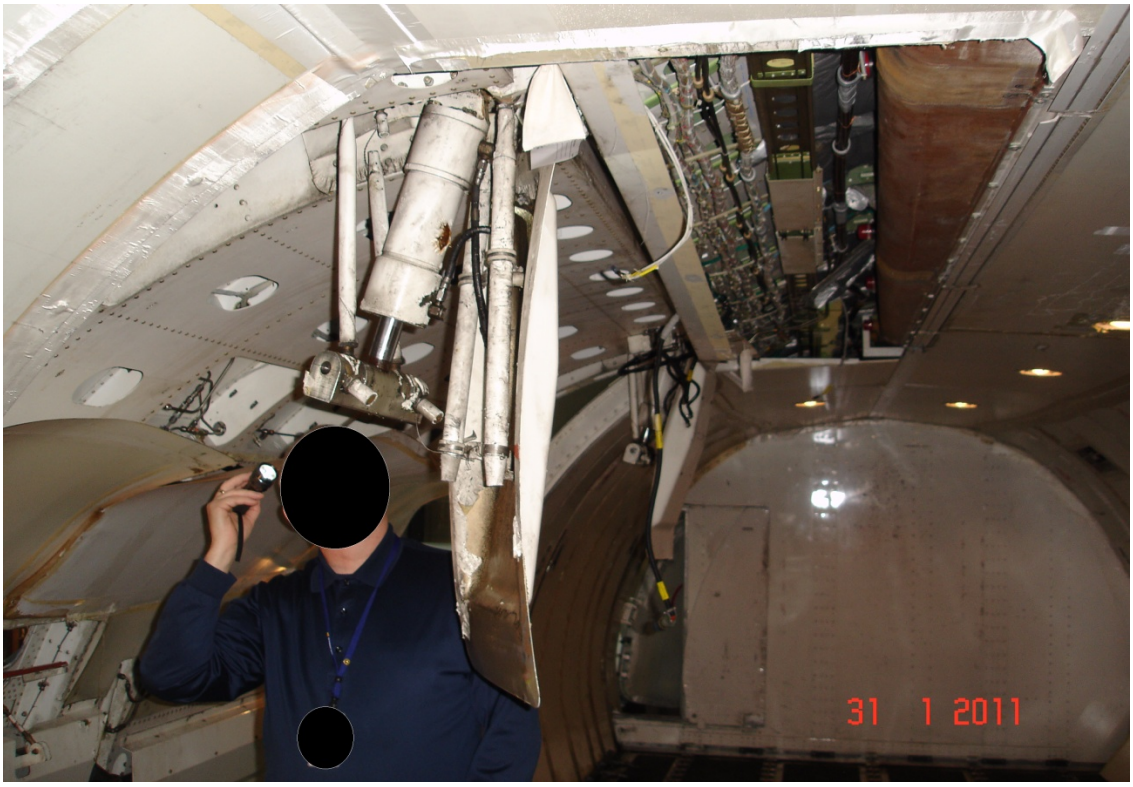
At 10:12:56, as the main deck cargo door moved past its vertical top position, it fell uncontrolled down to its closed position.

1.2 Injuries to persons

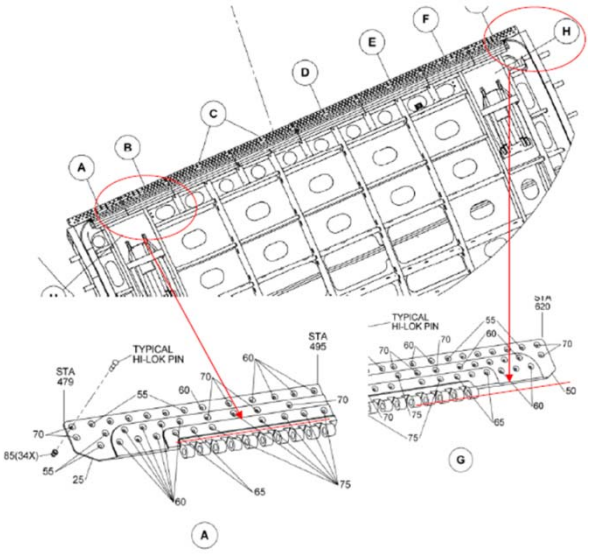
No one was injured.

1.3 Damage to aircraft

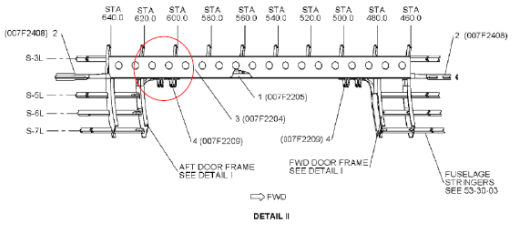
The door hinges at the top of the main cargo door had gouge markings along their total length and pulled fasteners were found in many locations. All four rods in the upper forward and aft position of the main cargo door were sheared off. Supporting assemblies for the rods were torn out. The forward and aft hydraulic actuators were pulled out of position and partially sheared off. The upper sill inner skin was buckled. The upper sill beam assembly was buckled and cracked in several places. The next two pages contain pictures showing the damage (marked as Figure 3).

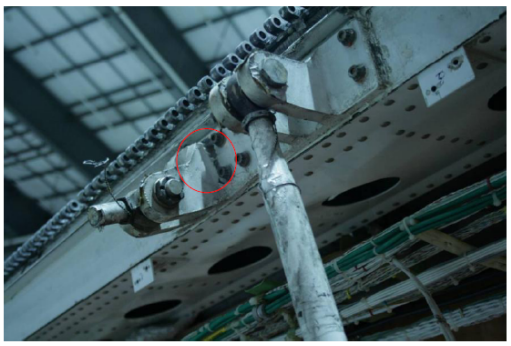


Door hinge damage

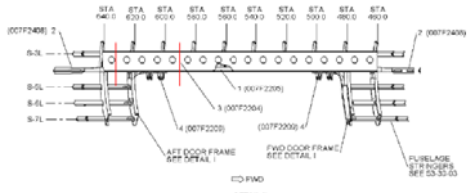


AFT support assembly hinge torn

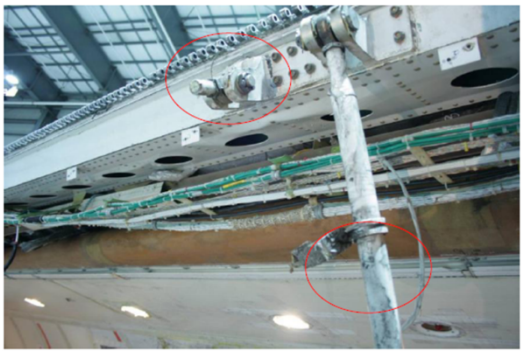




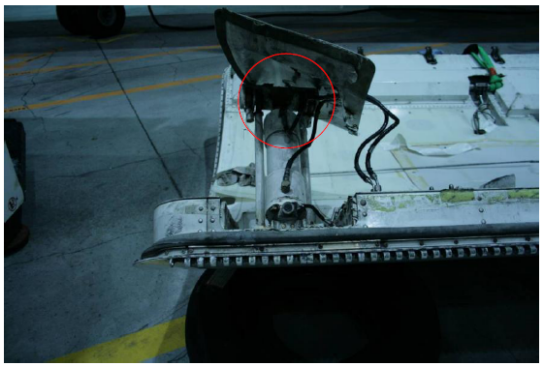
Skin buckled between red lines shown approx STA 590 – 630



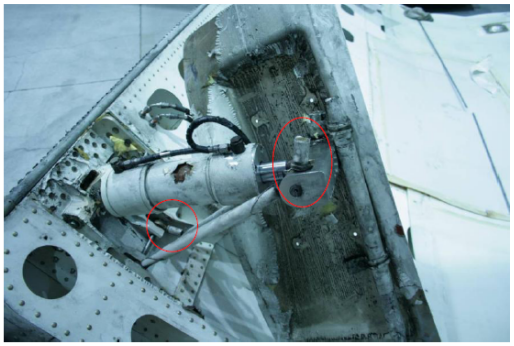
Rod Assembly Damage



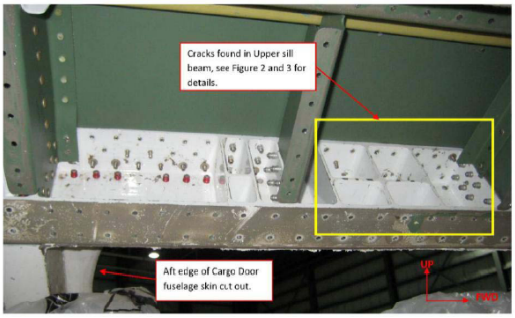
FWD hydraulic actuator and FWD rod assembly



AFT Hydraulic actuator and AFT rod assemblies.



Upper sill beam cracks



Upper sill beam cracks

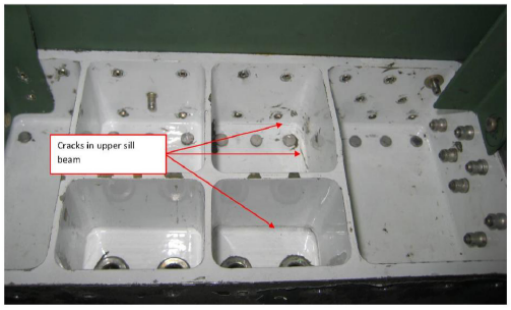


Figure 3 – Main cargo door and door structure damage

1.4 Other damage

No corrosion or any other underlying damage, that could have reduced the strength of the main cargo door and its structure, were found.

1.5 Personnel information

Commander	
Age and sex:	49 year old, male
License:	ATPL
Ratings:	B757/767, DC3, SEL
Medical certificate:	First class, valid
Flight experience:	Total hours: 11,628.55 Total hours on this type:: 4785.00 Last 90 days on this type: 56.00 Last 24 hours on this type: 7.35

Maintenance technician	
Age and sex:	51 year old, male
License:	EASA Part 66, category B1
Ratings:	B757-200/300 & B767-300

Loading crew team leader	
Age and sex:	62 year old, male
Loading experience:	29 years

1.6 Aircraft Information

TF-FIH is a Boeing 757-200 aircraft manufactured in 1990 for the operator under FAA Type Certificate A2NM. In November 2006, TF-FIH was converted to cargo freighter

aircraft by Precision Conversions LLC in accordance with FAA[8] Supplemental Type Certificate (STC) #ST01529SE and EASA[9] STC #EASA.IM.A.S.01423.

1.7 Meteorological Information

The 10:00 METAR reported the wind to be from a direction of 250° (true) at 27 knots with gusting up to 37 knots:

```
METAR BIKF 301000Z 25027G37KT 9999 VCSH FEW024CB BKN042 04/00
Q0984
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The 08:00 TAF valid at the time of the incident had forecast 25 knots with gusting up to 40 knots from a direction of 240° (true):

```
FTIL31 BICC 300800
TAF BIKF 300802Z 3009/3109 24025G40KT 9999 SHRA BKN025
         BECMG 3009/3011 SHRASN BKN015
         TEMPO 3011/3103 2500 SHSN BKN010
         BECMG 3103/3106 12010KT NSW BKN030
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Note:

The magnetic variation at BIKF is 18° west.

[8] Federal Aviation Administration

[9] European Aviation Safety Agency

2. Analysis and Conclusion

Figure 4 shows the location of stand 20 on the cargo apron at Keflavik Airport in relation to the nearest buildings and wind monitoring stations.

Figure 4 – Location of Stand 20 and the nearest wind monitoring stations

2.1 Flight Operations

The actual wind data was collected from the two closest wind monitoring stations at the airport, i.e. at RWY11 and at RWY20. Figure 6 to Figure 9 in the Appendix show the wind direction and the wind strength when the incident occurred. Special attention should be given to the highest (gust) values at the time of the incident, which were as follows:

- RWY11 monitoring: Gust 42 knots from a direction of 282°
- RWY20 monitoring: Gust 40 knots from a direction of 280°

Therefore, at the time of this serious incident the maximum gust at the closest airport wind monitoring stations was 42 knots from a direction of 282°. This is 3 knots below the (actual or anticipated) maximum operating wind limit, set by the Precision Conversions B757-200PCF Operations Manual, for the main cargo door.

Cargo stand 20 at Keflavik International Airport is located close to several large buildings and hangars, as seen in Figure 5. At the cargo stand the local wind conditions are likely to vary slightly from those measured at the RWY11 and RWY20 monitoring stations, due to local wind channeling effects between buildings.

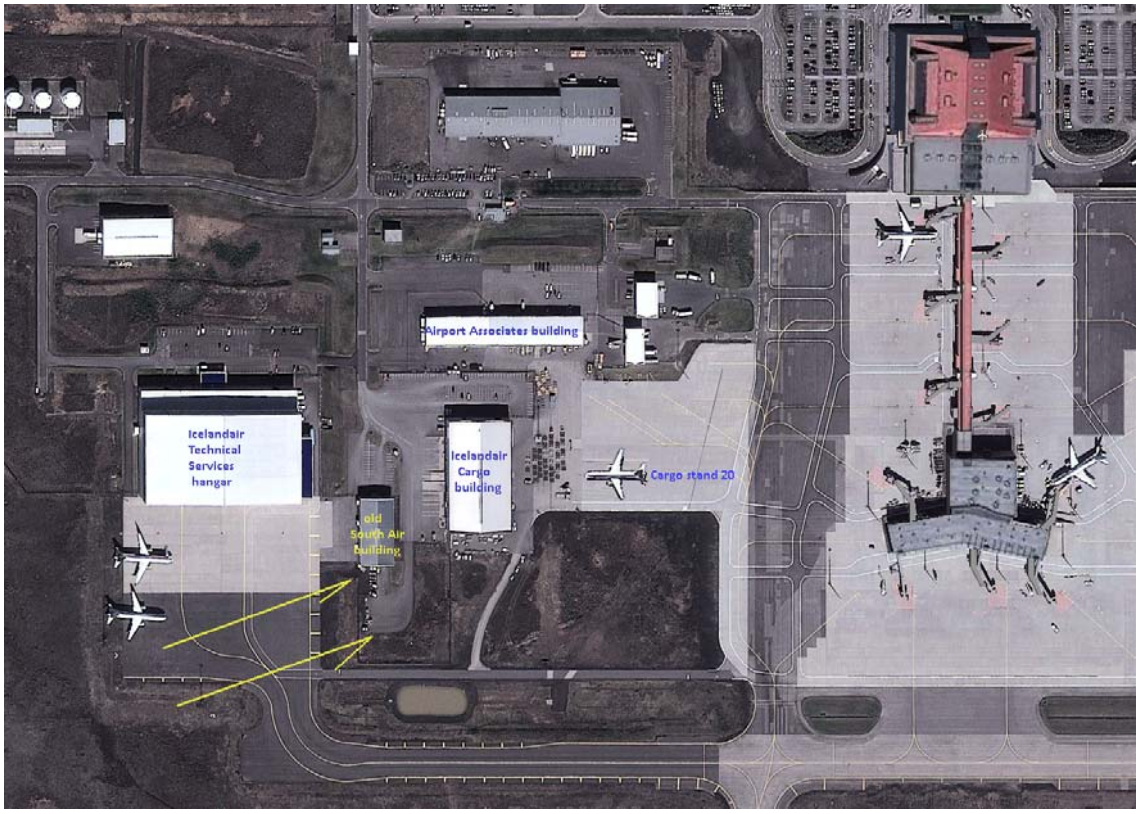

Figure 5 : Cargo stand 20 and surrounding area (yellow arrows indicate wind direction)

2.2 Aircraft

The cargo conversion was designed and certified to comply with FAA FAR[10] and EASA CS[11] regulations, which falls under subchapter 25 for transport category aircrafts.
In case of both the FAA and EASA, Subpart C – Structure of regulation 25.301(a) states:

[10] Federal Aviation Regulation

[11] Compliance Specifications

„Strength requirements are specified in terms of limit loads (the maximum loads to be expected in service) and ultimate loads (limit loads multiplied by prescribed factors of safety). Unless otherwise provided, prescribed loads are limit loads.“

In case of the FAA and EASA, Subpart C – Structure of regulation 25.303 also states:

„Unless otherwise specified, a factor of safety of 1.5 must be applied to the prescribed limit load which are considered external loads on the structure. When a loading condition is prescribed in terms of ultimate loads, a factor of safety need not be applied unless otherwise specified.“

Therefore in case of the door structure, there must be a safety factor of 1.5 between the maximum limit load allowed, and its ultimate failure load:

$$\frac{F_{ultimate\ load}}{F_{limit\ load}} = 1.5$$

The relationship between the wind and the door structure loading can be determined by the drag loading formula on the door in its open position:

$$Door\ drag\ loading = \frac{1}{2}\ C_D \rho V^2 S$$

From this it is apparent that the relationship between the load generated on the door (drag) and the wind (V) is:

$$Load\ \propto V^2$$

This can be simplified to:

$$V\ \propto \sqrt{Load}$$

The relationship between the ultimate load wind and the limit load wind can therefore be determined by:

$$\frac{V_{ultimate\ wind}}{V_{limit\ wind}} = \sqrt{1.5}$$

The maximum operating limit for the main cargo door is 45 knots. This represents the limit load wind. The ultimate load wind can then be determined by:

$$V_{ultimate\ wind} = (45\ knots)\sqrt{1.5}\ \approx 55\ knots$$

The ITSB believes that the door failed due to ultimate loading being exceeded at wind speed lower than 55 knots.

2.3 Actions already taken as a result of this incident

After this serious incident, the operator recognized that there was a problem with this 45 knots maximum wind limit when operating the main cargo door at the cargo ramp at Keflavik Airport. The flight operator therefore inserted the following into its Flight Crew Operation Manual[12]:

> *"Experience has shown that wind read-out on main cargo ramp at Icelandair hub in KEF can be different from KEF airport read-out. Upon arrival to KEF, if wind velocity is more than 35 knots consult Maintenance Control (MC) and/or Central Load Control (CLC) on whether the door should be opened or not and in which direction the aircraft should be parked."*

[12] FCOM, Chapter 4.2.4.2 - Main Cargo Door Operation

The flight operator set this limit to allow a 10 knot buffer to the manufacturer's limit in high winds. The flight operator also installed in cooperation with Isavia[13] a wind monitoring station at the cargo ramp, to measure the actual wind where the cargo aircraft are parked. The procedures for the operator's maintenance control and/or central load control are as follows:

- If the highest gusting official airport wind is more than 45 knots, the main cargo door cannot be opened.

- If the local wind at the cargo ramp is more than 40 knots, the main cargo door cannot be opened.

[13] The operator of Keflavik Airport (BIKF)

2.4 Findings

- The main cargo door maximum operation limits set by the door manufacturer is 45 knots.
- According to the 08:00 TAF at BIKF, the wind was forecast 240/25 gusting 40 knots[14].
- According to the 10:00 METAR at BIKF, the wind was 250/27 gusting 37 knots[13].
- According to the commander when TF-FIH was landing, ATC reported the wind 270/35 gusting 41 knots.
- According to the actual wind data collected from two closest wind monitoring stations at the airport at RWY11 and at RWY20, at the time of the incident the maximum gust was 282°/42 knots.
- The cargo door support structure failed when the door was operated in 42 knot measured airport wind.
- Based on 45 knots wind limit load, calculations show that the door should endure up to 55 knots wind before reaching its ultimate failure condition.
- The main cargo door support structural design does not meet the requirements set forth in FAA and EASA, Subpart C – Structure of regulation 25.301(a) and 25.303.

2.5 Causes

- The cargo door support structural design does not meet the requirements set forth in FAA and EASA, Subpart C – Structure of regulation 25.301(a) and 25.303.

[14] True wind

3. Safety recommendations

The Icelandic Transportation Safety Board (ITSB) recommends:

Precision Conversions:

- Review the structural design of the main cargo door with respect to the 45 knots maximum wind operation loading and make the necessary design changes in order to meet the requirements of FAA FAR and EASA CS, subchapters 25.301(a) and 25.303.

EASA:

- Require the STC holder of EASA STC #EASA.IM.A.S.01423 to review the structural design of the main cargo door with respect to the 45 knots maximum wind operation loading and make the necessary design changes in order to meet the requirements of EASA CS, subchapters 25.301(a) and 25.303.

FAA:

- Require the STC holder of FAA STC #ST01529SE to review the structural design of the main cargo door with respect to the 45 knots maximum wind operation loading and make the necessary design changes in order to meet the requirements of FAA FAR subchapters 25.301(a) and 25.303.

Reykjavik, April 10, 2014

Icelandic Transportation Safety Board

4. Appendix

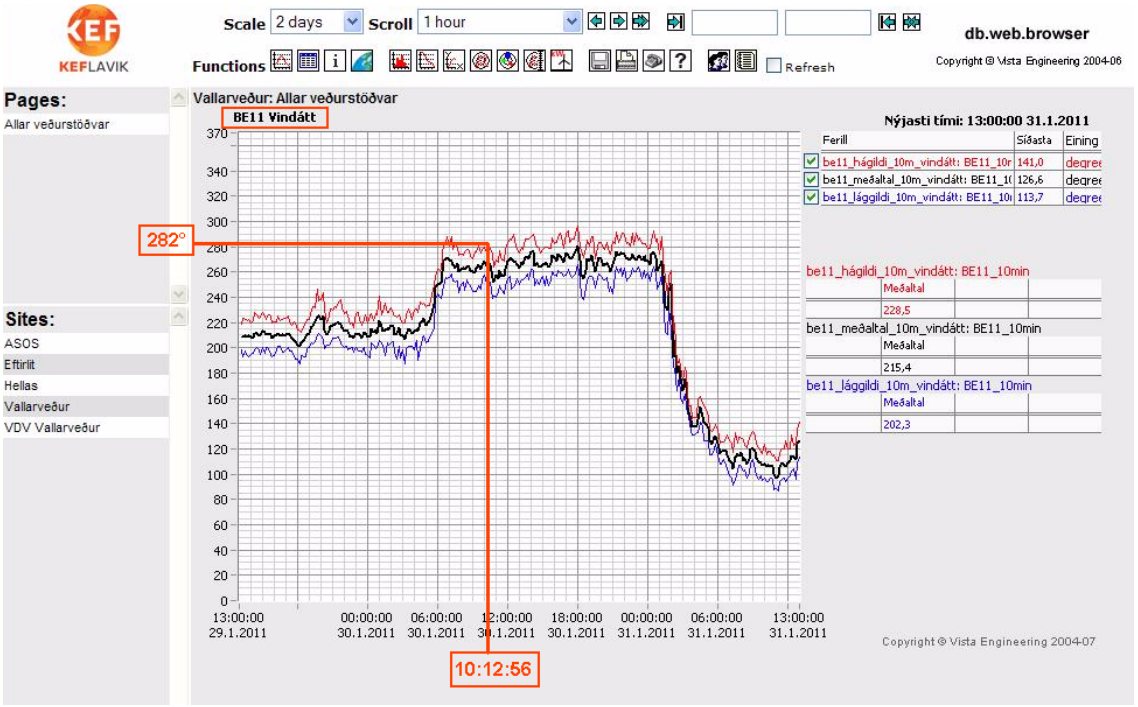

Figure 6 – Wind direction at the RWA 11 monitoring station

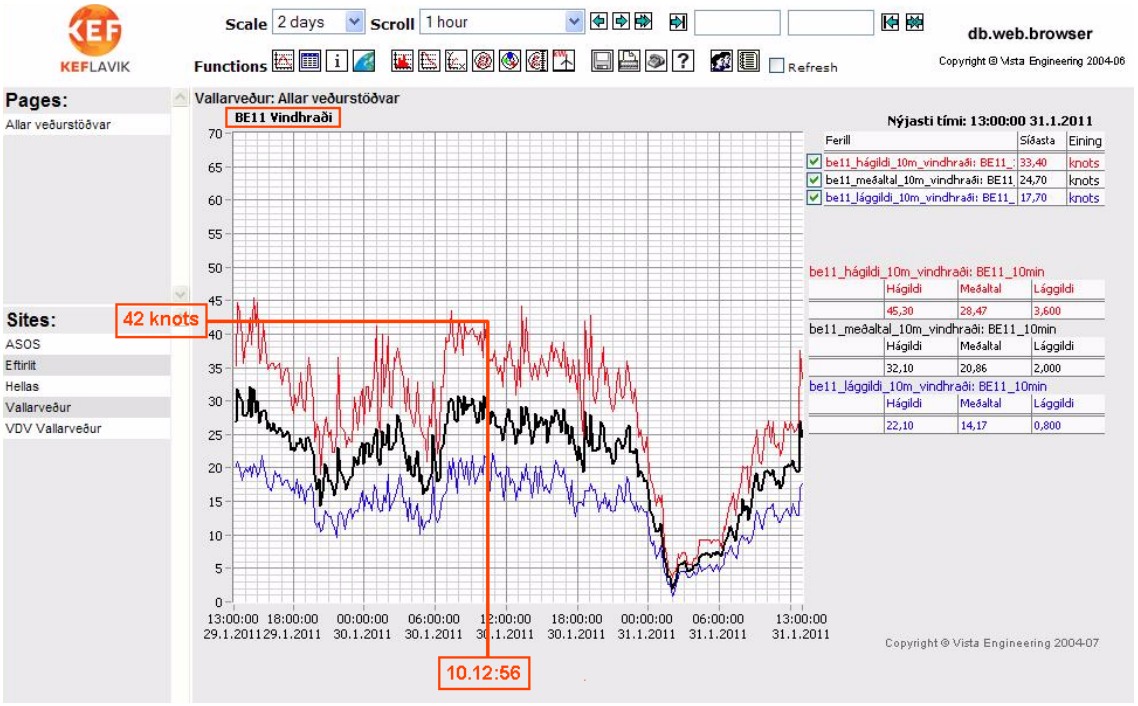

Figure 7 - Wind strength at the RWA 11 monitoring station

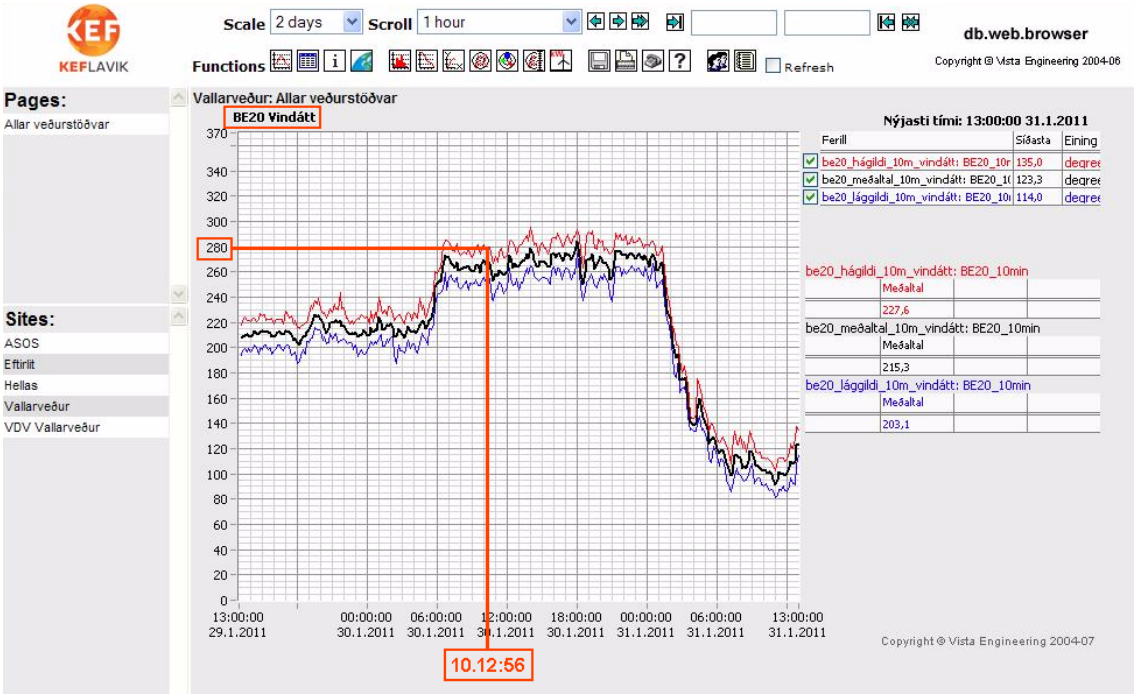

Figure 8 – Wind direction at the RWA 20 monitoring station

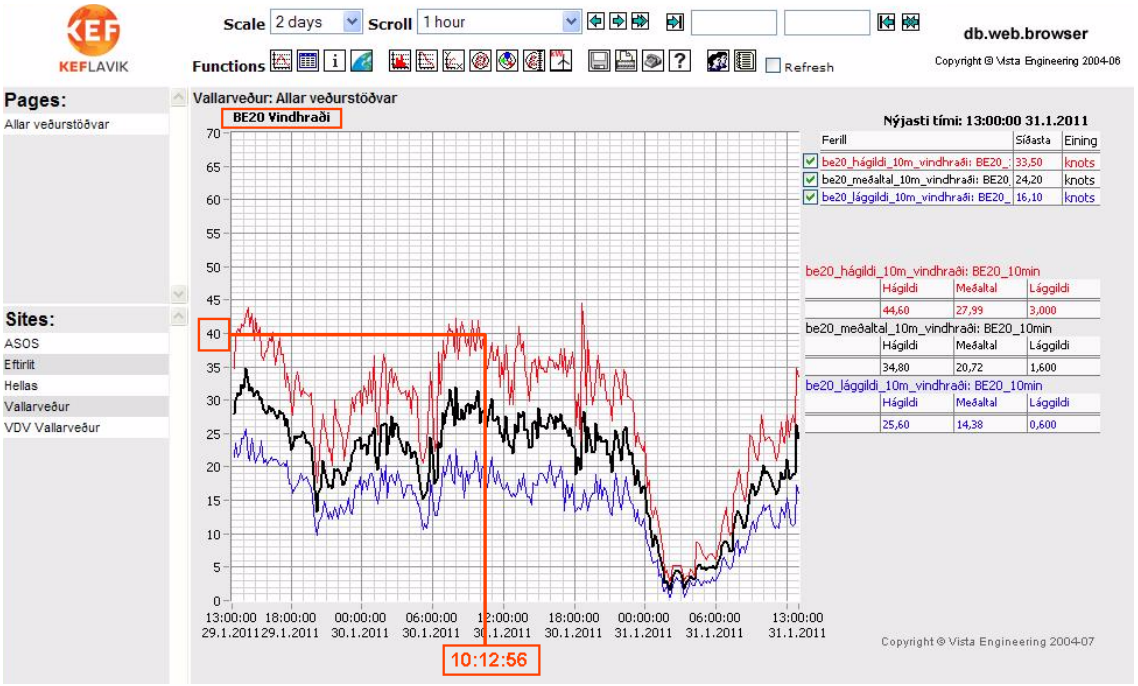

Figure 9 - Wind strength at the RWA 20 monitoring station