



الهيئة العامة للطيران المدني
GENERAL CIVIL AVIATION AUTHORITY

Air Accident Investigation Sector

Incident

- Final Report -

AAIS Case # AIFN/0006/2014

Aircraft Tail-Tipping

Operator: European Air Transport / DHL Aviation

Type: Airbus A300B4-622R

Registration: D-AEAH

Location: Bay 205, Abu Dhabi International Airport

State of Occurrence: United Arab Emirates

Date of Occurrence: 1 April 2014

Incident Brief

GCAA AAI Report No.:	AIFN/0006/2014
Operator:	European Air Transport – DHL Aviation
Aircraft Type and Registration:	Airbus A300B4-622R, D-AEAH
MSN	0783
No. and Type of Engines:	Two, Pratt & Whitney PW4158-3A, Turbofan Engines
Date and Time (UTC):	01 April 2014, 1348 UTC
Location:	Parking Bay 205 at Abu Dhabi International Airport
Type of Flight:	Cargo
Persons Onboard:	None
Injuries:	None

Investigation Objective

This Investigation considers the aspects related to the unloading of Airbus A300B4-622R, D-AEAH and the consequent tail tipping of the aircraft.

This Investigation is performed pursuant to the UAE Federal Act No 20 of 1991, promulgating the Civil Aviation Law, Chapter VII, Aircraft Accidents, Article 48. The Investigation is in compliance with the UAE Civil Aviation Regulations, Part VI, Chapter 3, in conformity with *Annex 13 to the Convention on International Civil Aviation* and in adherence to the *Air Accidents and Incidents Investigation Manual*.

The sole objective of this Investigation is to prevent aircraft accidents and incidents. It is not the purpose of this activity to apportion blame or liability.

Investigation Process

The occurrence involved an Airbus A300B4-622R Cargo Aircraft, registration D-AEAH, and was notified to the General Civil Aviation Authority (GCAA) Duty Investigator (DI) by phone call to the Hotline Number +971 50 641 4667.

After the Initial/On-Site Investigation phase, the occurrence was classified as an 'Incident'.

An Investigation Team was formed in line with the ICAO Annex 13 obligations of the United Arab Emirates (UAE) being the State of Occurrence.

The scope of this Investigation is limited to the events leading up to the occurrence; no in-depth analyses of non-contributing factors were undertaken.

Notes:

- 1 Whenever the following words are mentioned in this Report with the first letter Capitalized, it shall mean:
 - (Aircraft) - the aircraft involved in this Incident.
 - (Investigation) - the investigation into this Incident
 - (Incident) - this investigated incident
 - (Report) - this Incident Summary Report
- 2 Unless otherwise mentioned, all times in this Report are Coordinated Universal Time (UTC), (UAE Local Time minus 4).
- 3 Photos used in the text of this Report are taken from different sources and are adjusted from the original for the sole purpose to improve clarity of the Report. Modifications to images used in this Report are limited to cropping, magnification, file compression, or enhancement of color, brightness, contrast or insertion of text boxes, arrows or lines.

Abbreviations and Definitions

AAIS	Air Accident Investigation Sector
AOC	Air Operator Certificate
CG	Center of Gravity
CLS	Cargo Loading System
CoA	Certificate of Airworthiness
CoR	Certificate of Registration
CSN	Cycles Since New
CSO	Cycles Since Overhaul
DHL	Originally standing for (D)alsey, (H)illblom and (L)ynn
DI	Duty Investigator
DOW	Dry Operating Weight
EAS	Etihad Airport Services
EDP	Electronic Data Processing
FAK	Fly Away Kit
FWD	Forward
GAPS	Global Aviation Procedures & Standards
GD or Gen Dec	General Declaration
GCAA	General Civil Aviation Authority of the United Arab Emirates
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
Kg	Kilogram
Kts	Knot(s) (airspeed/wind speed unit)
KPI	Key Performance Indicator
Lbs	Pound(s) (mass unit)
LBA	Luftfahrt-Bundesamt
LH	Left hand
LT	Local Time
LW	Landing Weight
MAC	Mean Aerodynamic Chord
Mb	Millibar (pressure unit)
MDL	Main Deck Loader
MHL	Medical Hi-Loader



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MLW	Maximum Landing Weight
MSN	Manufacturer Serial Number
MTOW	Maximum Take Off Weight
MZFW	Maximum Zero Fuel Weight
No.	Number
NOSIG	No Significant Weather
NSC	No Significant Cloud
OAT	Outside Air Temperature
PDU	Power Drive Unit
PLD	Payload
RH	Right Hand
Q/QNH	Barometric pressure adjusted to sea level
SABLE	System Automated Balance Loading Equipment
SOP	Standard Operating Procedures
TSN	Time Since New
TSO	Time Since Overhaul
TOW	Take-off Weight
TW	Taxi Weight
UAE	The United Arab Emirates
ULD	Unit Load Device
UTC	Coordinated Universal Time
ZFW	Zero Fuel Weight

Synopsis

On 1 April 2014, at approximately 1711 local time, an Airbus A300B4-622R Cargo Aircraft, registration D-AEAH, operating flight number DHX520, arrived at Abu Dhabi International Airport from Lahore. The Aircraft parked at parking bay 205.

The Aircraft was loaded with a total of thirty cargo containers and pallets, of which ten containers and pallets were scheduled to be unloaded at Abu Dhabi. At 1348, while unloading the final pallet bound for Abu Dhabi, the Aircraft tipped onto its tail.

The unloading activity involved a loadmaster and two different ramp teams. The loadmaster left the Aircraft before the unloading process was completed, and there was a work shift change of the ramp teams during the unloading activity.

The Investigation, conducted by the Air Accident Investigation Sector (AAIS) of the General Civil Aviation Authority (GCAA), determined that the causes of the Aircraft tail tipping were:

- The Aircraft CG position exceeded the Aft CG position limit of the Aircraft stability on wheels;
- The unloading process was not conducted as per the Operator's standard operating procedures; and
- The aftwards movement of the unlocked ULDs on the main-deck, while the nose was pitching up slowly, caused the CG to move aftwards, beyond the Aft CG position limit of the Aircraft stability on wheels.

The Investigation identifies the following contributing factors to the incident:

- The inadequate briefing, instruction and supervision provided by the loadmaster to the ramp team;
- The failure to inspect the physical lock positions of the repositioned ULDs;
- The improper work shift change of the ramp teams;
- The lack of clear definition of the individual responsibilities for the tasks in loading and unloading the aircraft in the agreements between the organizations involved;
- The lack of specific loading and unloading training on the Aircraft type provided to the loadmaster;
- The loadmaster had not been made aware of his responsibilities, as per DHL procedures; and
- The loadplan did not reflect a change of unloading destination of some containers.

A total of ten (10) safety recommendations are included in this report, which are addressed to the operator, handling companies, and airport ground handling services.

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1. Factual Information

1.1 History of the Flight

On 1 April 2014, at approximately 1711 local time (LT), an Airbus A300B4-622R Cargo Aircraft, registration D-AEAH, operating flight number DHX520, arrived from Lahore International Airport (OPLA)¹ and positioned at parking bay/stand 205 at Abu Dhabi International Airport (OMAA)².

The Aircraft was loaded with a total of thirty cargo containers and pallets, of which ten containers and pallets were scheduled to be unloaded at Abu Dhabi. At 1348, while unloading the last pallet, the Aircraft tipped onto its tail, as shown in Figure 1.



Figure 1. Aircraft Tail-Tipping

After the Aircraft was chocked and the engines were shutdown, various items of ground equipment were positioned at the Aircraft to unload the cargo. At 1315, after the main-deck cargo door was opened, the loadmaster met the ramp agent and handed over the required documents, which included the loadplan for the flight from Lahore to Abu Dhabi, and details of the cargo to be unloaded at Abu Dhabi.

¹ OPLA is the ICAO's 4 letter airport code for Lahore International Airport

² OMAA is the ICAO's 4 letter airport code for Abu Dhabi International Airport

The loadplan was reviewed by the loadmaster and the ramp agent. The loadmaster discussed about the cargo/ULDs³ to be unloaded and the transit pallets for Bahrain⁴, as detailed in the loadplan. The ramp agent enquired as to the contents of the bulk hold, and was told by the loadmaster that the Fly Away Kit (FAK) was in the bulk hold. The loadmaster stated “do not touch it”⁵.

The cargo to be unloaded at Abu Dhabi consisted of six ULDs on the upper main-deck and four pallets in the forward cargo hold (forward lower-deck compartment), whereas all ULDs in the aft cargo hold (aft lower-deck compartment) were transit ULDs (Figure 2).

The loadmaster instructed the ramp team⁶ to start unloading the ULDs from the main-deck compartment. He also directed the team to reposition some ULDs from aft to forward, after the Abu Dhabi ULDs on the main-deck had been unloaded, but he did not clearly specify which ULDs should be repositioned nor their final positions. Then, the instruction was to continue unloading the ULDs from the forward cargo hold.

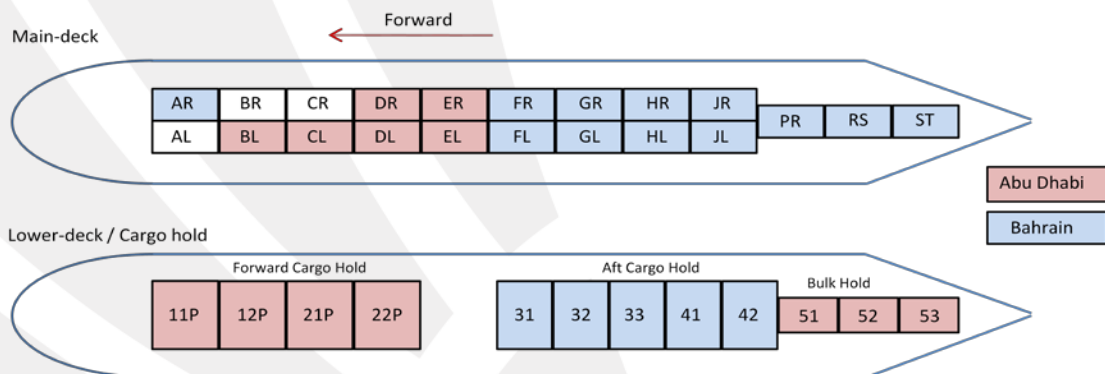


Figure 2. ULDs for Abu Dhabi (Red) and Bahrain (Blue)

At approximately 1320, unloading commenced. Four ULDs in positions BL through EL (Figure 3) on the main-deck were unloaded first.

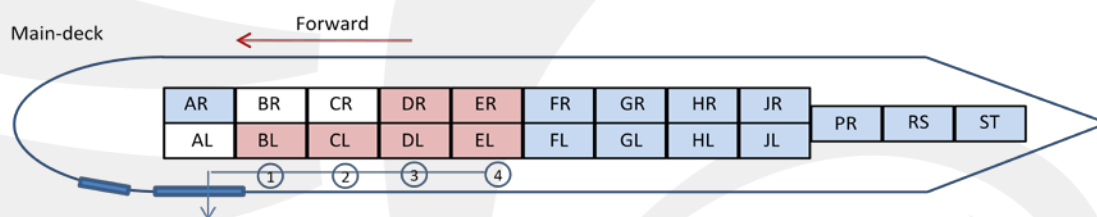


Figure 3. ULDs in positions BL through EL were moved and unloaded

³ ULD stands for Unit Load Device and is a pallet or container used to load baggage, freight and mail on wide-body aircraft and specific narrow-body aircraft

⁴ Pallets for Bahrain: the next flight of the Aircraft was from Abu Dhabi to Bahrain

⁵ “do not touch” meant do not unload

⁶ Ramp Team consists of a Ramp Agent and 2 Loaders

Then, the ULD in position AR was moved to position BL, and at about the same time, the ULD in position FL was unlocked and moved to position CL as shown in Figure 4. This was the last occasion that the loadmaster observed the unloading as he left the Aircraft at this time along with the flight crew.

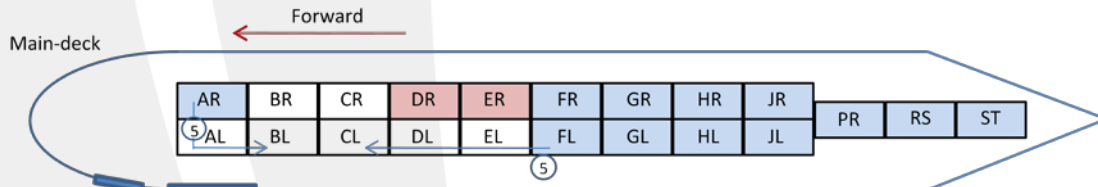


Figure 4. ULD in position AR moved to position BL and ULD in position FL moved to position CL

Thereafter, the two ULDs in positions DR and ER were unloaded, and at about the same time, the ULDs in positions GL and HL were unlocked and moved forward to positions DL and EL respectively, as shown in Figure 5. The ramp agent stepped onto the main deck loader (MDL) and went down to the ramp with these last two unloaded ULDs from the main-deck.

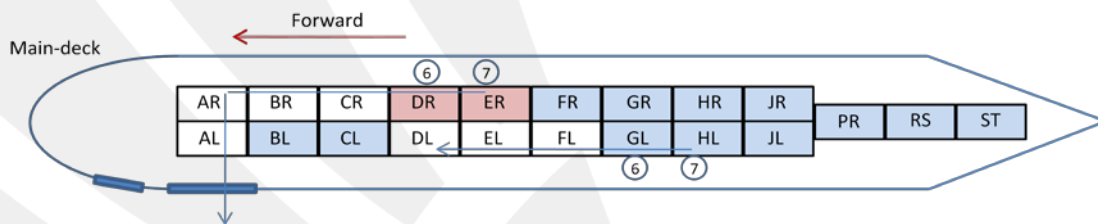


Figure 5. ULDs in positions DR and ER unloaded, and ULDs in positions GL and HL moved to positions DL and EL respectively

After unloading two ULDs from positions DR and ER, four ULDs in positions BL through EL were moved one position forward to positions AL through DL respectively based on the statement from the loaders, as shown in Figure 6.

It is possible that the four pallets in positions BL through EL were not repositioned forward one space to positions AL through DL, as described above. This is based on the information received from the airport services handling company as stated by the loaders during their interview. This statement contradicts with the statement received during the Investigation interview with the loaders, where they stated the four pallets in positions BL through EL were moved forward one space to positions AL through DL. For the purpose of the Investigation, the loaders statement made during the investigation interview is used.

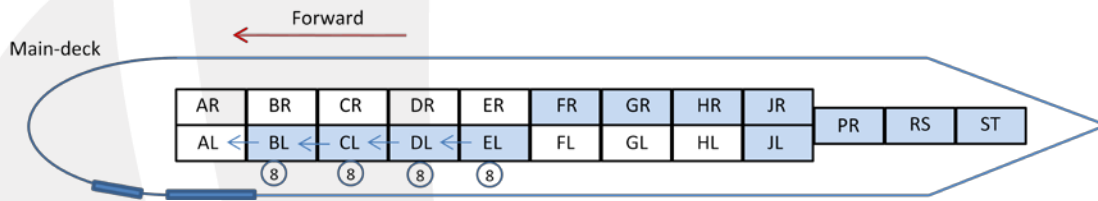


Figure 6. ULDs in positions BL through EL shifted forward one position

After unloading all six ULDs from the main-deck, the unloading of the four ULDs from the forward cargo hold commenced.

At 1330, the high loader operator at the forward cargo hold commenced unloading the two ULDs from positions 11P and 12P (Figure 7). The two loaders descended from the upper main-deck after moving four ULDs from positions BL through EL forward one position to positions AL through DL. The loaders then went to the forward cargo hold high loader to push the ULDs from the high holder onto the dollies.

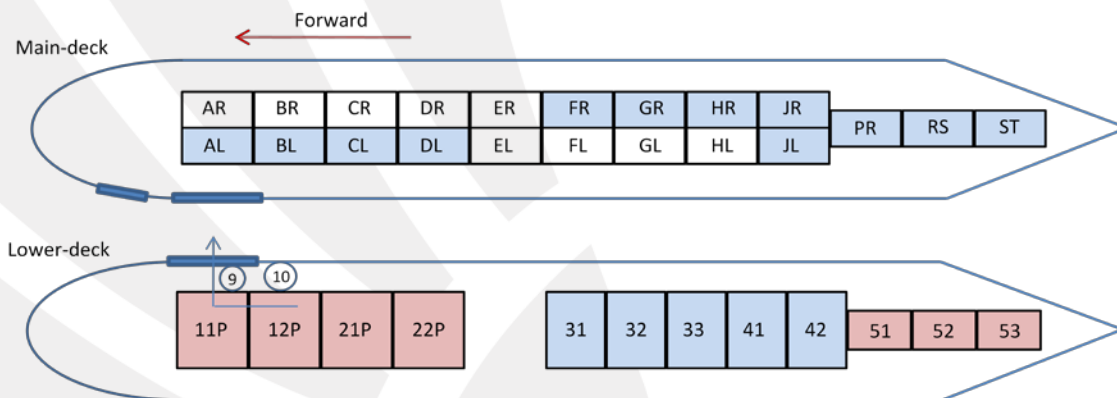


Figure 7. Unloading ULDs on 11P and 12P

At 1338, there was a work shift change of the unloading team. According to the working shift schedule, the work shift change should have occurred at 1330. The handover between the ramp agents was brief, and did not include a physical examination of the unloading progress. After the handover, the ramp agent of the handing over (first) team left his duty. However, the two loaders in his team continued working on the pallets in the forward cargo hold.

At 1344, two loaders from the replacement (second) team arrived at the Aircraft and joined, and assisted the two loaders of the first team in unloading the forward cargo hold.

At about 1348, the taking over (second team) ramp agent returned to the Aircraft⁷. He found two pallets (originally from positions 11P and 12P) had already been unloaded and he documented the unit numbers while standing at the rear of the high loader.

⁷ After the briefed handover between the ramp agents, the second ramp agent drove the first ramp agent to their office in order to catch his transportation home.

The pallets which were in positions 21P and 22P, were being moved forward to positions 11P and 12P respectively (Figure 8) just before the second team ramp agent arrived at the Aircraft. The third pallet was being unloaded through the forward cargo hold door at about the time he arrived.

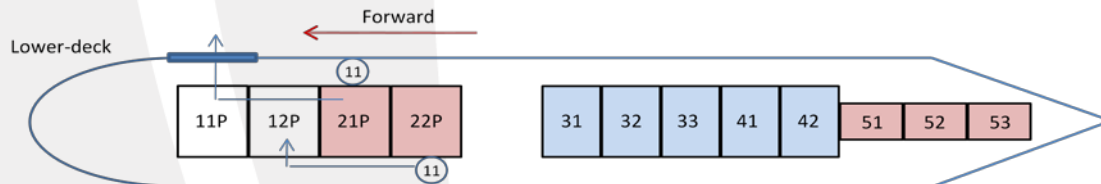


Figure 8. Moving pallets on 21P and 22P to position 11P and 12P

While the ramp agent was noting the unit number of the unloaded third pallet from the forward cargo hold, the 4th pallet in position 12P was being moved through position 11P, and being unloaded from the hold onto the high loader by the high loader operator (Figure 9).

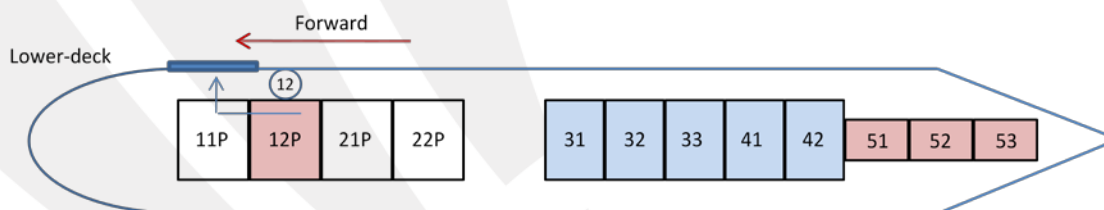


Figure 9. Unloading pallet in position 12P

While unloading the final pallet through position 11P, the Aircraft started to pitch up slowly. The high loader operator stated that he had problems in pulling the pallet out of the hold due to a cargo system fault. While the Aircraft nose was continuing to rise, and the fourth pallet was still moving out of the hold, the pallet's cargo net became trapped on the lock mechanism of the forward cargo hold door, as shown in Figures 10 and 11. Consequently, as the Aircraft's nose rose, the pallet was lifted up, due to the pallet netting being snagged, until the Aircraft tail touched the ramp surface. However, the pallet was sustained by the high loader after the Aircraft had tipped onto its tail.

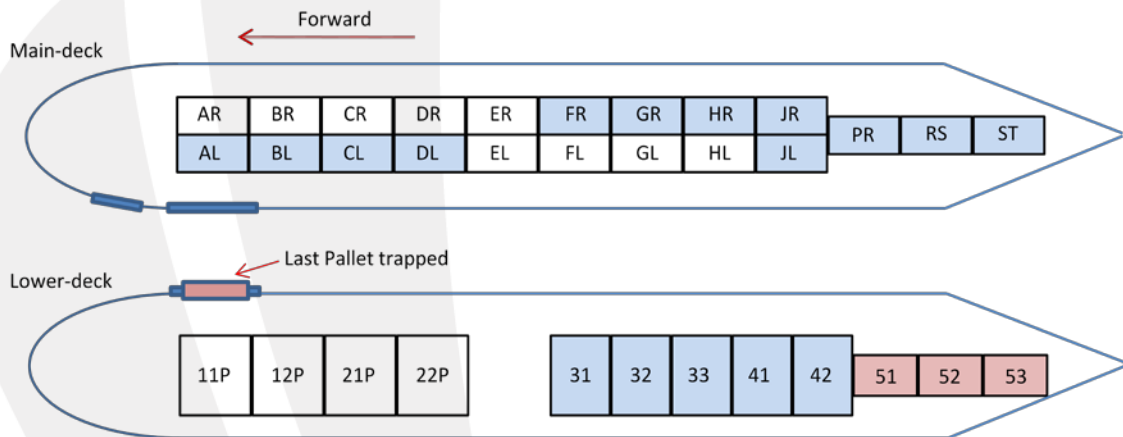


Figure 10. During unloading of the final pallet, the pallet net became snagged on the forward cargo hold door lock mechanism.



Figure 11. Net of the unloaded final pallet snagged on the lock mechanism of forward cargo hold door.

Shortly after the Aircraft tipped onto its tail, the ramp agent alerted the Duty Officer and the Emergency Response Plan was activated.

1.2 Injuries to Persons

There were no injuries as a result of this incident.

Injuries to persons						
Injuries	Flight Crew	Cabin Crew	Other Crew Onboard	Passengers	Total Onboard	Others
Fatal	0	0	0	0	0	0
Serious	0	0	0	0	0	0
Minor	0	0	0	0	0	0
None	0	0	0	0	0	9
TOTAL	0	0	0	0	0	9

1.3 Damage to Aircraft

The Aircraft sustained substantial damage. The damage included:

- For Frames 64, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78:
 - o Deformation/cracks/damage of some stringers, stiffeners, brackets, frame segments, shear ties (clips), strut, strap, beam, butt-strap, skin panels, frame assembly, tail bumper internal reinforcement
 - o Bent cross beam
 - o Scratch marks
 - o Cracked frames
 - o Sheared rivets
- Frames 68-79:
 - o Stringers deformed together with skin panels
- Frames 85-86
 - o Strap deformed
- Frames 70-72:
 - o Edge damage
- Frames 72-73:
 - o Corner damage (cracked attachment areas)
- Frames 73-76:
 - o Corner damage (cracked on each attachment areas)
- Frames 72-78:
 - o Scratch marks

More details of the damage to the Aircraft are listed in Appendix 3.

1.4 Other Damage

The ramp surface of parking bay 205 sustained localized light breakup and groves on the area where the Aircraft tail rested.

The conveyer belt (belt loader) was damaged as it contacted the bulk hold door when the tail tipping occurred.

1.5 Personnel Information

The on-duty personnel involved in this occurrence were: the loadmaster; two ramp teams each of them comprised a ramp agent and two loaders/porters; and two ground equipment operators, one for the main-deck and one for the cargo hold.

Loadmaster

The Loadmaster had been employed since 15 January 2014 by a third party handling company, and he was assigned to the Operator's base at Bahrain. The Loadmaster had approximately 15 years' experience and had been trained as a loadmaster on several aircraft types, including the A300-600 aircraft type.

The loadmaster commenced his duty with the Operator since 15 January 2014. However he was provided with the DHL Global Aviation Procedures & Standards Manual including procedures for the Airbus A300-622R on 25 March 2014 (i.e. 7 days before the incident). The loadmaster did not receive specific loading and unloading training for this aircraft type, nor the DHL Operation Manuals related to the duties and responsibilities of the loadmaster from the Operator.

The loadmaster had experienced complications following previous flights in passing through immigration on a single General Declaration (GD or Gen Dec)⁸, when he was not in the company of the rest of the crew. On this occasion, he was required to join them on the bus to the terminal in order that they clear immigration together. He left the Aircraft along with the crew, before unloading had been completed. The loadmaster verbally briefed the first ramp agent before leaving the Aircraft.

Ramp Team

Two Ramp Teams were involved in the unloading of the Aircraft. Each Team comprised a ramp agent and two loaders.

Based on the EAS Procedures Manual, the Ramp Agent is responsible for supervising the team involved in loading and unloading of the aircraft, which includes:

- Supervising the build-up/breakdown of aircraft ULDs ensuring baggage/cargo/mail are processed in accordance with load planning.
- Supervising the recording and dispatch of baggage/cargo/mail to respective flights.

⁸ General Declaration is a custom entry/exit documents for flight, cabin crew and other crew of the flight

- Performing loading/unloading functions on aircraft.
- Adhering to safe practices in ramp activities.

The first ramp agent had completed a 5-day basic ramp handling training course in January 2009, and ULD Handling training on 2 October 2010. His last ramp handling refresher training was on 12 August 2013.

The second ramp agent had completed a 5-days basic ramp handling training course in November 2008, and refresher training on 11 November 2010. His last ramp handling refresher training was on 14 August 2013.

Awareness training on airside safety & security; quality, health & safety, environment; airport emergency plan; and human factors, had also been completed by both ramp agents within the last year. All of the training noted is required for ramp agents as per the *Etihad Ground Services – Ground (EAS-Ground) training programme*.

Three of the four loaders involved had been trained in awareness of airside safety and security; quality, health and safety, environment; the airport emergency plan; and human factors. One loader had not received this awareness training. This training is required for loaders as per the *EAS-Ground Training Programme*.

Ground Support Equipment (GSE) Operator

Two ground equipment operators were involved in unloading the Aircraft. Both ground equipment operators had valid Main Deck Loader (MDL) and Medical Hi-Loader (MHL) licenses. They had also received training in awareness of airside safety & security; quality, health & safety, environment; airport emergency plan; and human factors. The licenses and training are required for ground equipment operators as per *EAS-Ground GSE Operations Training Manual* and the *EAS-Ground Training Programme*.

1.6 Aircraft Information

1.6.1 General

General Aircraft information	
Make and Model:	Airbus A300B4-622R
Manufacturer Serial Number (MSN):	0783
Manufacturing Year	6 June 1998
State of Registry:	Germany
Registration:	D-AEAH
Time Since New (TSN):	27,740 Hours

Cycles Since New (CSN): 29,960 Cycles

Certificate of Airworthiness (CoA)

Issuing Authority: Luftfahrt-Bundesamt (LBA: Federal Office of Civil Aviation), Federal Republic of Germany

Issuance date: 25 March 2014

Valid until: 31 March 2016

Certificate of Registration (CoR)

Issuing Authority: LBA

Issue Date: 11 January 2013

Maximum Take Off Weight (MTOW): 171,700 Kg

Maximum Landing Weight (MLW): 140,000 Kg

Engines: Two High-bypass Turbofan, Pratt & Whitney, PW4158-3A

No 1 Engine

MSN: P724847CN

TSN: 33,469:01 Hours

CSN: 27,817 Cycles

Time Since Overhaul (TSO): 3,165:59 Hours

Cycles Since Overhaul (CSO): 2,427 Cycles

No 2 Engine

MSN: P724851CN

TSN: 33,853:55 Hours

CSN: 26,160 Cycles

TSO: 3,577:42 Hours

CSO: 2,785 Cycles

The cargo compartments of the Aircraft are comprised of (Figure 12):

- main-deck cargo compartment
- Forward Cargo Hold
- Aft Cargo Hold
- Bulk Hold

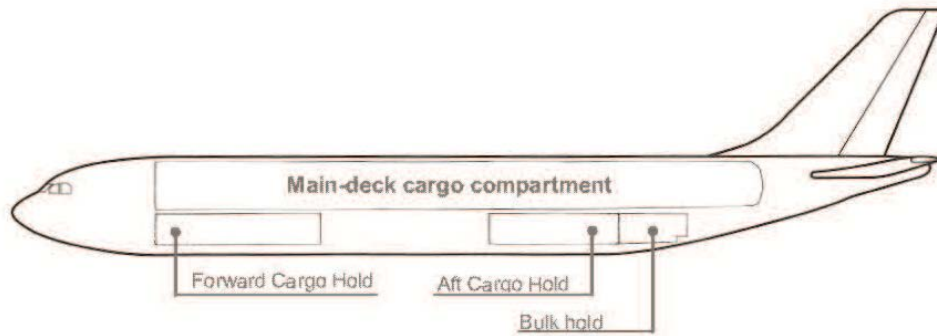
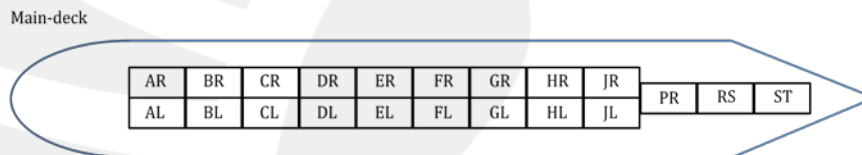


Figure 12. Cargo compartments

The main-deck cargo compartment is provided with an integrated single row and side-by-side rows semi-automatic cargo loading system, which accommodates eighteen (125” x 88”) ULDs in side-by-side configuration, and three (125” x 88”) ULDs in a single row. This is known as the standard DHL configuration.

The main-deck cargo compartment of the Aircraft was configured to carry containers and pallets. Each ULD position and its maximum allowable weight, is shown in Figure 13. For this configuration, the allowed ULDs are AAJ, AAK, AAP, AAZ, AAA, AAC, AAY, AAX, RAP or PAG to contour. The codes are IATA⁹ ULD Codes.



ULD Position and Max Weight (Kg) – Twin Track 125” x 88”												
Position	A L/R	B L/R	C L/R	D L/R	E L/R	F L/R	G L/R	H L/R	J L/R	PR	RS	ST
Max Gross Weight (Kg)*	2000	2358	2537		4321		3181	2400	2090		2826	2429

* The maximum gross weight per ULD in Kg includes the tare weight of the ULD's. Including nets and/or igloo shells

⁹ IATA is the trade association for the world's airlines and supports airline activity and helps formulate industry policy and standards.

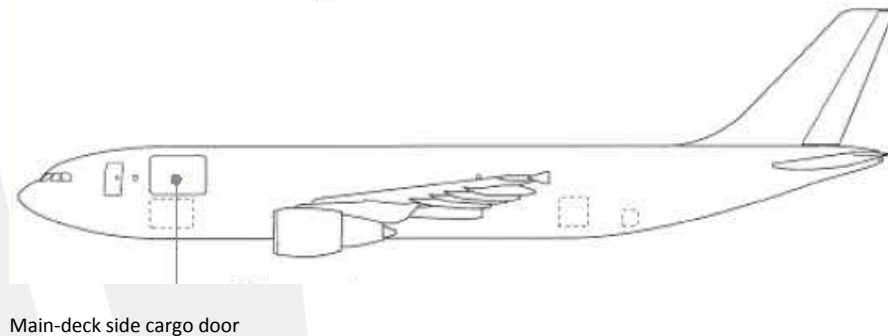


Figure 13. Upper main-deck compartment

The forward cargo hold (forward lower-deck) is provided with a semi-automatic loading system and is designed to carry four (125" x 88") containers and pallets in a single row. It is prohibited to carry bulk freight in this cargo hold. The forward cargo hold of this Aircraft was configured to carry pallets. The forward cargo hold is divided into two zones: zone 1 contains the positions 11P and 12P, whereas zone 2 contains positions 21P and 22P. The ULD position and maximum weight is given in Figure 14. This cargo hold has a maximum cumulative load capacity of 18,507kg. For this configuration, the allowed ULDs are AAF, AAJ, AAK, AAN, AAZ, RAP or PAG to contour.

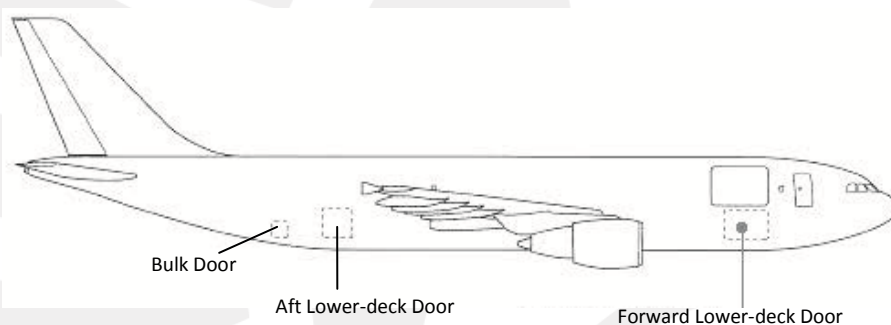
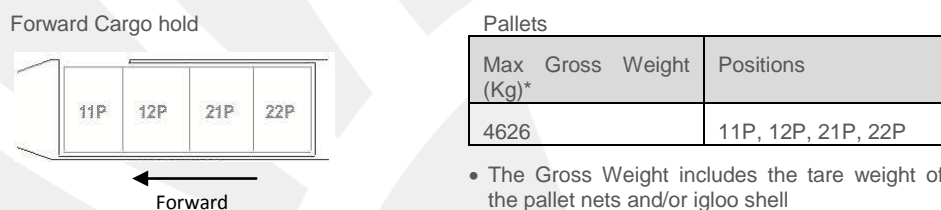
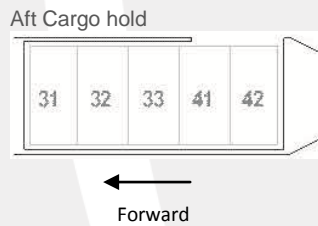


Figure 14. Forward cargo compartment/hold

The aft cargo hold is provided with a semi-automatic loading system and is designed to carry five (125" x 60.4") containers and pallets in a single row. It is prohibited to carry bulk freight in this cargo hold. The aft cargo hold of this Aircraft is configured to carry containers and pallets. The aft cargo hold is divided into two zones: zone 3 contains positions 31, 32 and 33, whereas zone 4 contains positions 41 and 42. The ULD position and maximum weight is given in Figure 15. This cargo hold has a maximum cumulative load capacity of 12,837 Kg. For this configuration, the allowed ULDs are ALF, ALP or PLA/PLW to contour.



Containers and Pallets

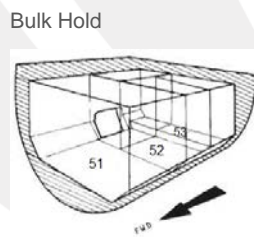
Max Gross Weight (Kg)*	Positions
3174	31, 32, 33, 41, 42

* For containers: the Gross Weight includes the tare weight of the containers

For pallets: the Gross Weight includes the tare weight of the pallet nets and/or igloo shell

Figure 15. Aft cargo compartment/hold

The bulk cargo hold is provided for bulk freight loading of loose loads, baggage or freight not contained in a ULD. The bulk cargo compartment has only one zone, called zone 5, which contains positions 51, 52 and 53. The bulk freight position and maximum weight is given in Figure 16.



Containers and Pallets

Max Weight (Kg)	Position
1840	51
656	52
274	53

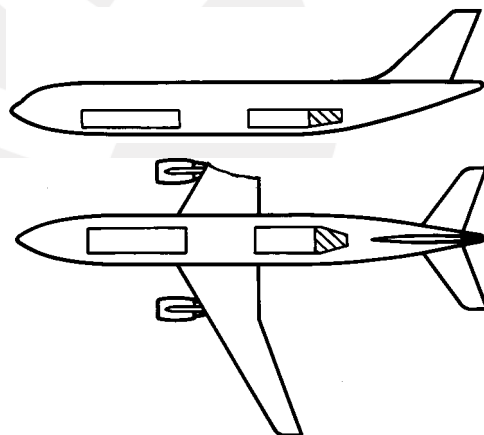


Figure 16. Bulk cargo compartment/hold

1.6.2 Maintenance Records

The Aircraft Defect Records for the last six months prior to the Incident did not reveal significant defects related to the cargo compartment.

Only one defect related to the loading/unloading mechanism in the cargo compartment was reported on 23 February 2014: "2 of aft cargo container latches very

stiff to operate“. The entered corrective action was replacing the container latches as per AMM 25-52-00 Rev. 59. The post-maintenance operational check was satisfactory.

No ('Nil') defects were reported in the Incident flight Technical logbook (Page No. 8019479).

1.6.3 Fuel

The remaining total fuel on arrival at OMAA was approximately 19,600lbs, distributed as follows:

- LH Outboard Tank: 8,200 lbs
- RH Outboard Tank: 8,190 lbs
- LH Inboard Tank: 1,610 lbs
- LH Inboard Tank: 1,600 lbs
- Tail Tank: empty

1.7 Meteorological Information

Table below shows the METAR/actual weather for Abu Dhabi International Airport on 1 April 2014, over the period from 1300 to 1400 UTC.

METAR OMAA 011300Z 33013KT 8000 NSC 28/19 Q1008 A2978 NOSIG

METAR OMAA 011400Z 33014KT 7000 NSC 26/21 Q1008 A2979 NOSIG

The above mentioned METAR description is as following:

METAR ¹⁰		
	1300 UTC	1400 UTC
Wind	330°/13kts	330°/14kts
Visibility	8,000m	7,000m
Clouds	No Significant Cloud	No Significant Cloud
OAT	28°C	26°C
Dew Point	19°C	21°C
Pressure (Altimeter)	1008mb (29.78 inches Hg)	1008mb (29.79 inches Hg)
Condition	No Significant Weather	No Significant Weather

¹⁰ METAR is a format for reporting weather information (Aviation Routine Weather Report)

The prevailing meteorological conditions were not a factor in the occurrence.

1.8 Aids to Navigation

Ground-based navigation aids, onboard navigation aids, and aerodrome visual ground aids and their serviceability were not a factor in this Incident.

1.9 Communications

Ground-based communication aids and onboard communication aids were not a factor in this Incident.

1.10 Aerodrome Information

Abu Dhabi International Airport, ICAO code OMAA, coordinates 242559N 0543904E, is located 30.6 kilometers east of Abu Dhabi, the UAE. The elevation is 88 ft.

The airport has two asphalt runways: 13R/31L and 13L/31R, both with lengths of 4,100 meters.

The Incident occurred on parking bay 205.

1.11 Flight Recorders

The flight recorders were not offloaded, nor were required for this Investigation.

1.12 Wreckage and Impact Information

After the Aircraft's recovery, minor scars were engraved on the ground surface area where the Aircraft's tail rested.

1.13 Medical and Pathological Information

No medical or pathological investigations were conducted as a result of this occurrence, nor were they required.

1.14 Fire

There was no evidence of pre-or post-impact fire.

1.15 Survival Aspects

The airport fire brigade and emergency services arrived shortly after the Emergency Response was activated. Only a part of the aircraft recovery practice was required.

After the Aircraft's recovery, an inspection was carried out of the upper main-deck and it was found that the four ULDs on the left hand side (positions AL through DL), which had been repositioned, did not have the locks in the up position, and the bases of the third and fourth units (originally from positions CL and DL), were in an overlapping condition, which ended in positions GL and HL respectively, after the Aircraft had tipped onto its tail.

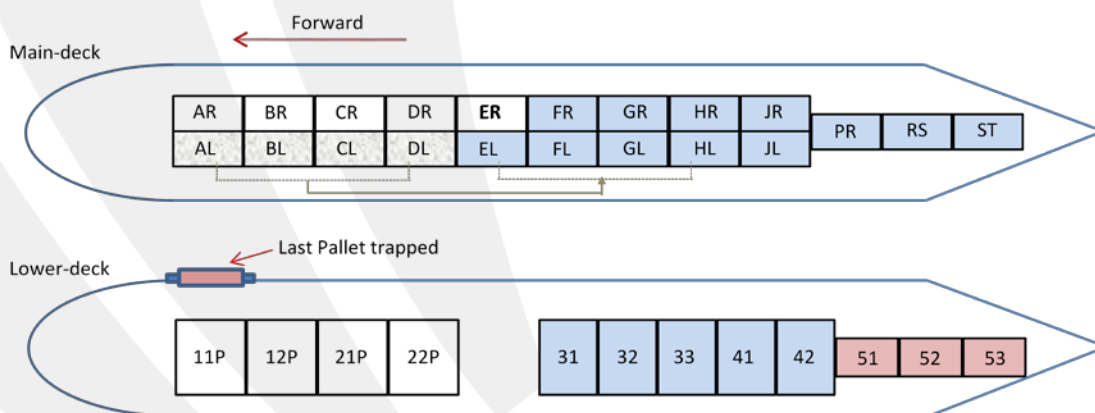


Figure 17. ULDs Configuration after Aircraft's Recovery

All of the remaining ULDs on the main-deck were secured with locks forward and aft engaged.

All ULDs and FAKs in the aft cargo hold and bulk cargo were secured with locks up and/or nets in place.

All holds were inspected and no internal damage was found.

1.16 Tests and Research

Based on the interviews of the personnel involved in the unloading of the Aircraft, DHL performed an evaluation/simulation of the ULD movement using SABLE¹¹ to determine the Aircraft longitudinal center of gravity (CG) at the moment of the tail tipping. SABLE fuel distribution is based on the weight and balance manual for the Aircraft. The SABLE system is described in paragraph 1.18.1 of this Report.

The results of the SABLE simulation are described in Appendix 4, while the following table shows the summary of the simulation.

¹¹ System Automated Balance Loading Equipment (SABLE) is the computerized system in use at DHL stations, which produces loading/unloading information.

Figure	Unloading Description	Weight (kg)	CG (%MAC)	Max Aft CG (%MAC)	Diff (%MAC)	Remarks
A4-1	Before unloading	137,862	32.01	35.0	2.99	Within CG envelope
A4-2	After unloading 4 ULDs in position BL to EL on main-deck	129,852	37.33	33.98	-3.35	beyond max permissible aft CG
A4-3	After unloading 6 ULDs and moving ULDs to positions BL to EL on main-deck	125,296	33.24	33.22	-0.02	At about max permissible aft CG
A4-4	After moving 4 ULDs from BL through EL to positions AL through DL	125,296	30.27	33.22	2.95	Within CG envelope
A4-5	After 1 st pallet unloaded in fwd cargo hold	123,734	32.9	32.96	0.06	Within CG envelope
A4-6	After 2 nd pallet unloaded in fwd cargo hold	122,180	35.15	32.7	-2.45	beyond max permissible aft CG
A4-7	After moving pallets in positions 21P & 22P to positions 11P and 12P respectively	122,180	33.26	32.7	-0.56	beyond max permissible aft CG
A4-8	After 3 rd pallet unloaded in fwd cargo hold	120,552	36.11	32.42	-3.69	beyond max permissible aft CG
A4-9	After 4 th /last pallet unloaded in fwd cargo hold	118,944	38.54	32.16	-6.38	beyond max permissible aft CG
A4-10	After unlocked 4 ULDs in positions AL through DL moved/slipped to positions EL through HL	118,944	51.05	32.16	-18.89	beyond max permissible aft CG
A4-11	If the unloading starts from aft cargo hold	133,176	28.2	34.53	6.33	Within CG envelope

1.17 Organisational and Management Information

1.17.1 Organizations

DHL Aviation is a division of DHL Express (owned by Deutsche Post DHL) responsible for providing air transport capacity. It is not a single airline but refers to several airlines owned, co-owned or chartered by DHL Express.

One of the airlines is European Air Transport Leipzig GmbH which commenced operations on 25 March 2014 as per the Air Operator Certificate (AOC). The AOC was issued by the Federal Office of Civil Aviation of Germany (LBA) and it authorized the airline to conduct cargo commercial air transportation to the European region (EUR), African Indian ocean (AFI), North Atlantic region (NAT), Caribbean region (CAR), South American region (SAM), and the Middle East/Asia region (MID/ASIA).

The Aircraft was operating under a wet lease agreement between DHL Aviation EEMEA B.S.C (c) as the Lessee, and European Air Transport as the Lessor. The DHL Aviation EEMEA B.S.C (c) is DHL's air network operations across the Middle East and Africa, based in Manama, Kingdom of Bahrain.

Wings 24 Limited is a handling company which provides aviation support services to the Aircraft's operator, European Air Transport Leipzig GmbH. In this Incident, the loadmaster was an employee of Wings 24 Limited and outsourced to the Aircraft Operator.

Etihad Airport Services (EAS) is the Etihad Airways holding company which provides airport services, ground handling and cargo operations at Abu Dhabi International Airport. EAS-Ground is one of the divisions under EAS, which provides a comprehensive range of ground handling services of all types of passenger and cargo requirements to aircraft operators operating to or from Abu Dhabi International Airport.

Agreements

The aircraft wet lease agreement between European Air Transport Leipzig GmbH and DHL Aviation EEMEA B.S.C (c) was dated on 19 January 2014. In this contract, European Air Transport Leipzig GmbH was referred to as the "Carrier", and DHL Aviation EEMEA B.S.C (c) as the "Customer".

The contract between European Air Transport Leipzig GmbH and Wings 24 Limited was based on IATA Standard Ground Handling Agreement version 2008 Annex A – Ground Handling Services. A simplified procedure of the scope of works, which was described in Annex B of the contract, was made with an effective date on 1 November 2013. In this contract, European Air Transport Leipzig GmbH was referred to as "the Carrier", and DHL Aviation EEMEA B.S.C (c) as "the new handling company" replaced the original handling company, Air Dispatch GmbH, based on their contract on 1 November 2011.

The agreement between European Air Transport Leipzig GmbH and Wings 24 Limited, did not clearly define the loadmaster's duties and responsibilities. Also, the DHL Operations Manual was not provided by the Operator to the handling company that had hired the loadmaster.

The contract between DHL EEMEA B.S.C (c) and Etihad Airport Services was based on IATA Standard Ground Handling Agreement Annex A – Ground Handling Services. A

simplified procedure was described in Annex B of the contract with an effective date on 15 January 2014. In this contract, DHL Aviation EEMEA B.S.C (c) was referred to as “the Carrier”, and Etihad Airport Services – Ground LLC as “the handling company”.

The responsibility for the ground stability of the aircraft during loading and unloading was not defined clearly in the agreement between DHL EEMEA B.S.C (c) and Etihad Airport Services.

1.17.2 General Unloading Procedures for All Aircraft Types

According to the *DHL Global Aviation Procedures & Standards (GAPS) Manual – Part C Aircraft Ground Handling, Chapter 1 Paragraph 105.5.2 – Un-loading of Aircraft*, the unloading procedures are as described below:

“105.5 UN-LOADING OF AIRCRAFT

2. Un-loading procedures

Refer to GAPS C203 or C204 for specific un-loading procedures applicable to the different aircraft types operated by or on behalf of DHL.

Before unloading commences the tail-post (tail-stand) or nose tether for those aircraft types which are equipped with or configured for, its use must be installed and sill-guard lowered or fitted.

On certain aircraft it is necessary to step/stage un-load, whereby a ULD is held in a foremost position or in the doorway until the previous ULD is in the final position and subsequent ULD is available to be un-loaded to replace the ULD now held in the doorway.

This ensures that there is always a pallet held in a forward position to act as a counter-balance when the aft positions are being un-loaded.

Follow the applicable un-loading sequence for the aircraft type being handled.

Team leaders should ensure a sufficient number of staff members are available on the main deck to move the containers.

As ULDs and loose loads are un-loaded, ensure they are distributed, or made available for distribution, to their intended next check-point.

In the event of wind speeds at or above 25 kts during unloading, particular care must be taken to ensure that empty ULDs are not blown off HiLo or dollies. It is recommended that empty ULDs be ballasted before un-load. The recommended minimum ballast weight is a weight equal to the tare weight of the ULD.

Upon completion of un-load, all compartments shall be checked that all loads for a given station have been un-loaded. Any load found on the aircraft that cannot be accounted for on the inbound load-sheet must be reported using the Ramp incident Reporting (RIR) system. For unsuspected loads which are not on the load-sheet, but not on the LDM, raise a Ramp Trouble Report (RTR) as per GAPS E306.4.

During un-loading, all ULD Tags must be checked for conformity with the off-load plan.

*Upon completion of offloading the cargo compartment **must** be checked for damage or evidence of shipment leakage. Particular attention should be paid to*

the cargo loading system, including missing or damaged restraint, and cargo hold lining damage.”

1.17.3 Loading and Unloading Standard Operating Procedures (SOP)

According to the *DHL Global Aviation Procedures & Standards Manual – Part C Aircraft Type Information, Chapter 2 Paragraph 203.7.17*, the loading and un-loading SOP to prevent the aircraft tipping onto its tail is as described below:

“203.7.17 LOADING & UN-LOADING

1. Cargo Loading System (CLS)

The aircraft is equipped with Lower-deck PDUs, controlled by a joystick located in the doorway of the FWD and AFT holds, and may be used for both lateral and longitudinal movement of ULDs.

Only suitably trained staff may use the CLS.

WARNING

RISK OF TAIL-TIPPING

Observe the following rules to prevent tail-tipping

2. Un-Loading

Step 1: Un-load the aft Lower-deck

Step 2: Un-load the Main-deck in the following sequence, and **respect standard step un-loading method:**

- First, un-load positions AL/AR and BL/BR
- Second, un-load positions CR thru JR
- Third, un-load positions CL thru JL
- Fourth, un-load positions PR thru ST

Step 3: Un-load the forward Lower-deck

3. Loading

Step 1: Load the forward Lower-deck

Step 2: Load the Main-deck in the following sequence, **and respect standard step loading method:**

- First, load position ST thru PR (see note below)
- Second, load ULDs for final positions HL and JL in temporary positions DL and EL
- Third, load positions JR thru CR
- Fourth, move HL and JL into final positions
- Fifth, load positions GL thru CL
- Sixth, load positions BR, BL, AR and AL

Step 3: Load the aft Lower-deck

Note: Temporarily place positions PR, RS and ST forward of F to provide counter-ballast. Keep them in temporarily position while Second step is being completed.

4. Loading Notes

a. Tail-tank Effect on Ground Stability

This aircraft is fitted with a tail-tank in the horizontal stabilizer. Any fuel remaining in the tail-tank will have a considerable aft moment effect.

WARNING

Un-loading and loading with fuel remaining in the tail-tank must be done with extreme caution, and strict adherence to the standard un-loading and loading procedures.

b. Ballasting during windy conditions

In **wind speeds exceeding 55 knots**, and when left unattended, the aircraft shall be ballasted according to these guide-lines:

- **Two (2) ballast ULDs each weighing 2000 kg (4400) lbs) must be loaded in AL and AR**
- **"Ballast Loaded"* placards must be placed clearly, one (1) at foot of the crew stairs and one (1) on the centre pedestal in the flight deck**

* See GAPS C111 Section 3 for specimen

c. TMP Procedures

Parallel dolly train un-load, as per TMP procedures, is allowed for this aircraft type."

1.17.4 Loadmaster

According to the *DHL Operations Manual Part A, Paragraph 1.5.2*, the duties and responsibilities of the Loadmaster are as described below:

"1.5.2 The Loadmaster

The loadmaster reports to the Manager Ground Operations and Fuel. During a flight assignment he is responsible to the Commander to assist in the safe and efficient conduct of the flight. The loadmaster is responsible to:

- Monitor and control all aspects of aircraft loading, handling, Ground Operations processes and to act as a first point of contact for the flight crews to coordinate with all providers.
- Ensure all aspects of the loading sequence are followed and to reduce potential for aircraft damage and delays

- *Closely cooperate in the support of ground personnel and handling related procedures and instructions in the Operations Manuals*
- *Ensure that all legal requirements and the provisions of the airline relating to ground operations are strictly observed*
- *Report any incidents, inconsistencies and other reportable events to allow for follow up and rectification from Operator side*

In cases required, to:

- *Perform a courier area, cargo deck and bellies security check*
- *Perform a careful check of the main cargo deck condition and report any damage resulting from the carriage of the cargo, for inscription in the aircraft technical log.*
- *Establish the load plan, supervise the loading and offloading of cargo and complete the load sheet.*
- *Assist in developing and maintaining an emergency response organizational structure and the related emergency response procedures in order to appropriately respond to an aircraft accident.*
- *Act in the most appropriate manner to prevent acts of unlawful interference and, if such an act has occurred, to minimize its consequences.”*

1.18 Additional Information

1.18.1 Computerized Loadsheets

According to the Operator's (*DHL – European Air Transport*) A300-600 *Operations Manual Part B, Paragraph 6.4.1*, Electronic Data Processing (EDP) is a means of producing a Loadsheets using a computer system.

The System Automated Balance Loading Equipment (SABLE) is a computerized system used at DHL stations.

The purposes of using SABLE are:

1. Producing information faster than a manual load-sheet.
2. Providing Loading information for the loading team
3. Not trimming the aircraft unless all loading regulations and CG parameters are met.
4. Not allowing the aircraft to be loaded so as to exceed maximum weights limitations.
5. Reducing human error

SABLE utilizes the Dry Operating Weight (DOW) and the moment for each A300-600 in the EAT fleet. It uses the station numbers (arms) and % of MAC formulas. It also uses conversion formulas for computing fuel load CG and stabilizer trim settings, all derived from source documents on file.

SABLE automatically checks that the following limits are not exceeded:

- The MTOW limit
- The maximum taxi weight limit.
- The maximum cargo compartment and accumulative weight limits.
- The maximum zero fuel weight (MZFW)
- The MLW

- The CG (expressed by % of MAC) for the actual zero fuel weight (ZFW), taxi weight, take-off weight (TOW) and landing weight (LW).

In addition to producing a load-sheet, SABLE will produce the associated Loadplan.

1.18.2 Limitation of Aircraft Stability on Wheels

According to the *Airbus A300-600 Weight and Balance Manual Supplement, Chapter 3, Paragraph 10.6*, the limitation of aircraft ground stability on wheels is as described in the table below.

06. Aircraft stability on wheels

CAUTION 1 : IF THE TIPPING CONDITIONS ARE NOT CHECKED DURING LOADING OR UNLOADING BY APPROPRIATE METHODS, SUITABLE MEANS HAVE TO BE PROVIDED TO AVOID TIPPING OF THE AIRCRAFT (e.g. use of the safety stay at the rear of the fuselage, sequential loading, tie-down of the aircraft or use of ballast pallets in the forward cargo compartment).

CAUTION 2 : LOADING CONFIGURATIONS WITH WING TANKS EMPTY AND FUEL LOAD IN TRIM TANK MIGHT BE CRITICAL FOR STATIC GROUND STABILITY.

Aircraft tip up is a function of CG and aircraft attitude.

In practice the tip up CG position is approximately 50% RC (H-arm = 31.652 m (1246 in)).

To avoid tipping of the aircraft a tail stanchion shall be connected to the auxiliary stabilizing point, the aircraft shall be tied-down or ballast pallets shall be loaded in the forward cargo hold.

2. Analysis

2.1 Aircraft Unloading and SABLE Simulation

The *SOP* contains three steps for unloading the Aircraft: first unload the aft cargo hold; second unload the upper main-deck in the following sequence, positions AL/AR and BL/BR, positions CR through JR, positions CL through JL, and then positions PR through ST respectively; and lastly, unload the forward cargo hold.

All of the ULDs in positions 31 through 33, and positions 41 and 42 in the aft cargo hold, were transit ULDs to be unloaded at Bahrain as mentioned in the loadplan (Appendix 1). Although these ULDs were planned for Bahrain, they had to be temporarily unloaded before commencing to unload the ULDs bound for Abu Dhabi. This *SOP* step was skipped due to, most probably, an attempt to speed up the unloading of the Aircraft.

After unloading the first ULD, located in position 11P of the forward cargo hold, the Aircraft CG position was close to the maximum permissible aft limit. Unloading of the three ULDs in positions 12P, 21P and 22P, caused the CG position to move beyond the maximum permissible aft limit, and consequently, the Aircraft, started to pitch up.

Based on the SABLE simulation, as illustrated in Figure A4-9, after unloading the last pallet in the forward cargo hold, the Aircraft CG position reached 38.54% MAC and the maximum permissible aft CG position was 32.16% MAC. The difference between the actual CG position and the maximum permissible aft CG position was 6.38% MAC. Because the locks of the four ULDs in positions AL through DL on the main-deck were not engaged, as the Aircraft's nose started to rise, the four ULDs moved aftwards, causing an excessive aftwards movement of the Aircraft CG position. Consequently, the Aircraft continued to pitch up until its tail rested on the ramp surface. When the four unlocked pallets slid to positions EL through HL, the CG position was at 51.05% MAC, and this was about 1% of MAC beyond the limit of the Aircraft's ground stability on wheels. Most probably, the tail tipping started just before the moving pallets stopped in positions EL through HL, but after passing positions DL through GL, when the CG was at about 50% MAC.

During the removal of the final ULD from the forward cargo hold, the loader operator stated that he had difficulty pulling the ULD out of the hold. The Investigation believes that this problem was due to the fact that the aircraft had pitched up to a position, which prevented the semi-automatic loading system from functioning properly, due to sideways forces generated by the ULD on the loading system mechanism.

Based on the simulation of the unloading of the final pallet as illustrated in Figure A4-9, the four unlocked ULDs in positions AL through DL started to move when the CG moved to approximately 38.54% MAC. Referring to the simulations illustrated in Figure A4-1 and A4-11, if the unloading was commenced with the ULDs in the aft cargo hold first, as per *SOP*, and thereafter unloading continued with the same unloading sequence as occurred during the Incident, the CG should have been at approximately 34.73% MAC after the unloading of the final pallet in the forward cargo hold. In this case, the Aircraft pitch with this CG position should not have caused the four unlocked ULDs to move aftwards, and no tail tipping would have occurred.

Alternatively, for unloading using the same unloading sequence as occurred during the Incident, but with the four ULDs in positions AL through DL, in the locked condition, the 38.54% MAC of CG position would not have led to tail tipping.

2.2 Unloading Documentation and Briefing

As mentioned in the loadplan (Appendix 1 and 2), the Fly Away Kit (FAK) loaded in positions 51 through 53 in the bulk hold, was intended to be unloaded at Abu Dhabi. However, the load master told the ramp agent not to unload the cargo in the bulk hold after a belt loader had been positioned accordingly. The Investigation believes that the loadplan was either not prepared properly, or it was not revised to reflect the change of the unloading destination to Bahrain.

In addition, an inadequate briefing was given by the loadmaster during the handover of the required documents. It was after positioning the belt loader that the loadmaster told the ramp agent not to unload the cargo in the bulk hold.

2.3 Loadmaster

The loadmaster was only present at the Aircraft for part of the unloading process in Abu Dhabi. Consequently, he did not supervise the unloading of the ten ULDs for which he was responsible, as laid down in the *DHL Operations Manual Part A, Paragraph 1.5.2*.

At the beginning of unloading, the loadmaster was present at the Aircraft, and his instruction to the ramp team was to unload the six ULDs on the main-deck, and then continue with the four ULDs in the forward cargo hold. No instructions were provided to the ramp team to temporarily offload the ULDs from the aft cargo hold, in order to prevent tail tipping.

Before the loadmaster left the Aircraft, while unloading of the main-deck was ongoing, he directed the team to reposition some ULDs from aft to forward positions. However, he did not clearly specify which ULDs should be repositioned nor their final positions.

The loadmaster was in a hurry to leave the Aircraft as he was required to accompany the other crewmembers in case of any delay at immigration.

Although the loadmaster had 15 years operational experience, and had been trained as a loadmaster on several aircraft types, including the A300-600, the Investigation believes that the loadmaster had not been made fully aware of his responsibilities, as described in DHL procedures, since he had not been provided with the DHL Operations Manual and the loadmaster role was not defined in the GAPS Manual.

The loadmaster's supervision during the unloading process was not as per the Operator/DHL *Operations Manual Part A, Paragraph 1.5.2*, and the Investigation believes that this contributed to the use of an improper unloading technique that led to the Incident.

According to the loadmaster's statement, starting to unload the six ULDs on the main-deck, then moving transit ULDs on the main-deck to positions AL through DL (Figure 7) and locking them before unloading the four pallets in the forward cargo hold, would not cause the Aircraft to tip onto its tail. This unloading sequence had also been previously practiced by him without incident.

2.4 Ramp Teams

Two ramp teams were involved in unloading the ten Abu Dhabi ULDs. The first ramp team was involved from the time that the loadmaster reviewed the loadplan at about 1315, until the handover to the second ramp team at about 1338. The first ramp team was involved in unloading the Aircraft for about 23 minutes.

When the last two ULDs on the main-deck were unloaded, the first ramp agent descended to the ramp using the main deck loader. At about the same time, the two loaders on the main-deck started to move the 4 pallets in positions BL through EL forward one space to positions AL through DL. Thereafter, they exited the main-deck and descended to the high loader positioned at the forward cargo hold door, to assist in unloading of the ULDs onto dollies.

The Investigation believes that after the four ULDs had been repositioned, the two loaders were not certain whether these ULDs should be locked, as the ramp agent was not present on the main-deck, and no clear instruction to lock these ULDs after moving them to positions AL through DL had been given.

According to the working shift schedule, the work shift change should have taken place at 1330. However, the work handover between the ramp agents occurred at 1338 which was 8 minutes later than scheduled. The first ramp agent needed to catch his transportation home, and for this, the second ramp agent was requested to transport him to the bus assembly point at their office. Consequently, the handover brief was conducted verbally and hastily, without any physical description of the unloading progress. In addition to that, the two loaders of the first unloading team continued to work after their duty period had finished. The Investigation could not find any procedures of the handover process.

After dropping off the first ramp agent, the second ramp agent arrived at the Aircraft about 10 minutes after the handover. During this 10-minutes gap, the unloading process was ongoing without proper attendance and supervision by the second ramp agent. Once the second ramp agent arrived at the Aircraft bay, he started to document the numbers of the two unloaded pallets. The Investigation believes that, most probably during this gap, the second ramp agent did not have a clear perception of the progress of the unloading. The inadequate instructions provided by the second ramp agent added further complications. Unloading the last two pallets from the forward cargo hold was the final step in the unloading process that led to the excessive aftwards movement of the Aircraft's CG which caused the tail tipping.

The shift change procedure during loading or unloading should be examined to ensure that no steps in the unloading process are skipped under any circumstances, or at least to reduce the risk by having one ramp team for the complete loading and/or unloading activity.

Basic weight and balance was one of the subjects of the basic handling training for the ramp agent, however, none of the ramp agents were aware of and practiced their basic knowledge of aircraft weight and balance during the unloading, although it was not the responsibility of the ramp agent for the unloading sequence as per EAS Procedures Manual.

2.5 Training

Although the loadmaster had been provided with the *DHL Global Aviation Procedures and Standards Manual*, (7 days before the Incident) which contains information on the Aircraft type, he was not provided with any specific loading/unloading training for the Aircraft type by the Operator. The Investigation believes that proper loading/unloading training for a specific aircraft type would have enhanced the capabilities of the loadmaster to perform his duty safely and efficiently.

2.6 Agreements

The agreement between European Air Transport Leipzig GmbH and Wings 24 Limited, did not categorically define the loadmaster's duties and responsibilities. The Aircraft was operating under a wet lease agreement between DHL Aviation EEMEA B.S.C (c) as the Lessee, and European Air Transport as the Lessor, and the fact that neither Wings 24 Limited, as the handling company that hired the loadmaster, nor the loadmaster had been provided with the related DHL Operations Manual by the Operator.

Therefore, the Investigation believes that the procedures contained in the DHL GAPS and DHL Operations Manuals were not effectively implemented by either the lessee and the lessor of the Aircraft.

The agreement between DHL EEMEA B.S.C (c) and Etihad Airport Services, did not describe clearly the responsibility for the ground stability of the aircraft during loading and unloading. The Investigation believes that there was confusion as to which party is responsible for this aircraft stability during the unloading process.

Therefore, the Investigation believes that in general the agreements between the organizations involved, did not define clearly the individual responsibilities for the tasks involved in the loading and unloading of the aircraft.

2.7 Wind and Ground Slope Effect

The wind direction was prevailing from 330 degrees with a speed of 14 knots. The Aircraft was parked on parking bay 205 after landing at Abu Dhabi International Airport. On parking, the Aircraft nose was pointing in the direction of 218 degrees. This means that the Aircraft had a tailwind component of approximately 5.2 knots. The tail wind component, probably, was a factor in preventing the tail tipping before the unloading of the final ULD for Abu Dhabi.

If there was a headwind and/or an upwards sloping of the ramp where the Aircraft parked, it is most likely that the tail tipping would have occurred before the unloading of the final ULD, since there was condition within the unloading sequence where the CG position was approaching the tail tipping Incident's CG position (38.54% MAC).

3. Conclusions

3.1 General

From the evidence available, the following findings, causes and contributing factors were determined with respect to this Incident. These shall not be read as apportioning blame or liability to any particular organisation or individual.

To serve the objective of this Investigation, the following sections are included in the conclusions heading:

- **Findings-** are statements of all significant conditions, events or circumstances in this Incident. The findings are significant steps in this Incident sequence but they are not always causal or indicate deficiencies.
- **Causes-** are actions, omissions, events, conditions, or a combination thereof, which led to this Incident.
- **Contributing factors-** are actions, omissions, events, conditions, or a combination thereof, which, if eliminated, avoided or absent, would have reduced the probability of the accident or incident occurring, or mitigated the severity of the consequences of the accident or incident. The identification of contributing factors does not imply the assignment of fault or the determination of administrative, civil or criminal liability.

3.2 Findings

- 3.2.1 The Aircraft was certified, equipped and maintained in accordance with the existing requirements of the Federal Office of Civil Aviation (Luftfahrt-Bundesamt), Federal Republic of Germany.
- 3.2.2 The Aircraft was airworthy on arrival at Abu Dhabi.
- 3.2.3 Examination of the maintenance records did not reveal any evidence of pre-existing Aircraft structural or mechanical anomalies related to the loading or unloading system that could have contributed to the Incident.
- 3.2.4 The loadmaster was not provided with specific loading/unloading training for this Aircraft type since he commenced working for the Operator.
- 3.2.5 The personnel of both ramp teams, except one loader, were provided with training for performing their tasks and responsibilities as per EAS Training Programme.
- 3.2.6 Both ground equipment operators held valid licenses to operate the loading/unloading equipment and were trained to perform their tasks as per EAS-Ground requirements.
- 3.2.7 The loadplan for the flight from Lahore to Abu Dhabi did not reflect the change in unloading the freight in the bulk compartment.
- 3.2.8 A comprehensive briefing during the handover of the required documents to the ramp agent was not provided by the loadmaster.
- 3.2.9 The loadmaster's instruction to start unloading the ULDs from the main deck was not in accordance with the Operator's SOP.

- 3.2.10 There was no instruction from the loadmaster to unload the ULDs in the aft cargo hold.
- 3.2.11 The loadmaster did not perform his responsibilities as per the Operator Operations Manual Part A, when he left the Aircraft before the unloading activity was completed.
- 3.2.12 Two ramp teams had worked on the unloading.
- 3.2.13 The first ramp agent left the main-deck compartment before the unloading activity was completed. Consequently, physically inspection of the ULDs and other was not performed after completing unloading activity on the main-deck compartment.
- 3.2.14 No clear instruction was given by the ramp agent to the loaders to lock certain ULDs after they had been repositioned from aft to forward positions in order to balance the Aircraft.
- 3.2.15 No handover process procedures of the work shift change between ramp teams were found.
- 3.2.16 The work shift change between the two ramp teams occurred later than the scheduled time and the work handover briefing was improperly carried out.
- 3.2.17 After the handover, the second (taking over) ramp agent arrived late at the Aircraft while the unloading was ongoing.
- 3.2.18 The second ramp agent provided no instruction to the loaders to continue the unloading activity after handover.
- 3.2.19 None of the ramp agents were aware of and practiced their basic knowledge of Aircraft weight and balance during the unloading, although it is not the responsibility of the ramp agent for the unloading sequence as per EAS Procedures Manual.
- 3.2.20 The net of the last unloaded pallet became snagged on the lock mechanism of the forward cargo hold door.
- 3.2.21 There were no injuries as a result of this Incident.
- 3.2.22 There was substantial damage to the Aircraft caused by the Incident.
- 3.2.23 Light scar marks were found engraved on the ground surface area where the Aircraft tail rested.
- 3.2.24 Damage to the conveyer belt (belt loader) was found due to the fact that it contacted the bulk hold door when the Incident occurred.
- 3.2.25 From the inspection after the Aircraft recovery, the four ULDs in positions AL through DL to balance the Aircraft were not locked into position, and the base of the third and fourth units (originally from positions CL and DL) were in an overlapping condition, which ended in positions GL and HL respectively. The other ULDs and FAKs were secured and their nets were in place.
- 3.2.26 The loadmaster had not been made aware of his responsibilities, as per DHL procedures, since he had not been provided with a copy of the DHL Operations Manual, and his role was not defined in the GAPS Manual which had been provided to him.

- 3.2.27 The handling company that had hired the loadmaster was not provided with the DHL Operations Manual by the Operator.
- 3.2.28 The procedures contained in the DHL GAPS and DHL Operations Manual were not effectively implemented by either the Lessee and the Lessor of the Aircraft.
- 3.2.29 There was confusion as to which of the parties was responsible for the unloading sequence. This also applied to ensuring the ground stability of the Aircraft, during the unloading process.
- 3.2.30 The agreements between the organizations involved, did not define clearly the individual responsibilities for the tasks involved in loading and unloading the aircraft.

3.3 Causes

The Air Accident Investigation Sector determines that the causes of the Aircraft tail tipping were:

- 3.3.1 The Aircraft CG position exceeded the Aft CG position limit of the Aircraft stability on wheels.
- 3.3.2 The unloading process was not conducted as per the Operator's standard operating procedures.
- 3.3.3 The aftwards movement of the unlocked ULDs on the main-deck, while the nose was pitching up slowly, caused the CG to move aftwards, beyond the Aft CG position limit of the Aircraft stability on wheels.

3.4 Contributing Factors to the Incident

The Investigation identifies the following contributing factors to the Incident:

- 3.4.1 The inadequate briefing provided by the loadmaster before the unloading process commenced. In addition, his instructions to the ramp agent were improper before he left the Aircraft.
- 3.4.2 The early departure of the loadmaster during unloading resulted in a lack of supervision of the unloading process, especially ensuring all aspects of the unloading sequence were followed as per DHL Operation Manual. In addition, none of the ramp agents were aware of or practiced their basic knowledge of Aircraft weight and balance during the unloading.
- 3.4.3 The inspection of physical lock positions of the repositioned ULDs was not performed by the ramp agent after completing the unloading activity on the main-deck compartment.
- 3.4.4 The work shift change handover between the ramp teams was improper and no procedures for this were available.
- 3.4.5 The unloading activity continued during the work shift change handover.
- 3.4.6 After the work shift change, the second (replacement) ramp agent arrived at the Aircraft late and no instruction for further unloading was given to the loaders.

- 3.4.7 The agreements between the organizations involved, did not define clearly the individual responsibilities for the tasks involved in loading and unloading the aircraft.
- 3.4.8 The lack of specific loading and unloading training on the Aircraft type provided to the loadmaster.
- 3.4.9 The loadmaster had not been made aware of his responsibilities, as per DHL procedures, since he had not been provided the DHL Operations Manual, and his role was not defined in the GAPS Manual which had been provided to him.
- 3.4.10 The loadplan did not reflect the change of unloading destination for the Fly Away Kit (FAK).

4. Safety Recommendations

4.1 General

Safety actions have been taken after the Incident which is described in paragraph 4.2.

The safety recommendations are proposed according to paragraph 6.8 of *Annex 13 to the Convention on International Civil Aviation*¹², and are based on the conclusions listed in heading 3 of this Report. The GCAA expects that all safety issues identified by the Investigation are addressed by the receiving States and organizations.

4.2 Safety Actions Taken

DHL Aviation

A Safety Bulletin was issued by DHL Aviation following the Incident to DHL Express and to all handling agents, including Etihad Airport Services, aiming to:

- Remind all stations of the importance of adhering to the step (stage) loading / un-loading procedure as in GAPS C203 and C204.
- Remind all stations that the step loading / un-loading procedure is in place to ensure that the aircraft's centre of gravity remains within acceptable limits whilst the aircraft is being loaded or un-loaded.
- Ensure that the step loading / un-loading procedure is followed at all times. If transit material is involved, it must be included in the scope of the step loading / un-loading procedure and must be loaded / un-loaded accordingly.
- Ensure that the locks must be raised at the front and aft of the ULD group when being moved into their temporary position during the step loading / un-loading procedure. This shall ensure that if the aircraft becomes unstable, the ULDs will not exacerbate the situation by rolling towards the front or the tail of the aircraft.

Etihad Airport Services – Ground

A Safety Alert regarding “Safe Cargo Aircraft Handling” with immediate effect was issued by EAS-Ground following the Incident aiming to ensure:

- The correct unloading sequence and movement of ULDs inside the aircraft;
- The ramp agent to instruct the team in the correct unloading sequence of the compartments;
- The ramp agent to actively and physically supervise the whole aircraft loading and unloading process;

¹² Paragraph 6.8 of *Annex 13 to the Convention on International Civil Aviation* states: 'At any stage of the investigation of an accident or incident, the accident or incident investigation authority of the State conducting the investigation shall recommend in a dated transmittal correspondence to the appropriate authorities, including those in other States, any preventive action that it considers necessary to be taken promptly to enhance aviation safety'.

- Loading or unloading must be stopped if the ramp agent needs to leave the aircraft;
- If any transit ULDs are required to be moved, these ULDs must be locked in position (lock in the UP position) – forward and aft.

A Work Instruction regarding Ramp Agents Duties and Responsibilities was also issued to reinforce ramp agent's duties and responsibilities for ensuring the safe completion of aircraft unloading and loading.

4.3 Safety Recommendations

The Air Accident Investigation Sector recommends that:

4.3.1 European Air Transport Leipzig GmbH / DHL Aviation / DHL Express / DHL Aviation EEMEA B.S.C (c) to:

SR 31/2014

Ensure the effectiveness of the loading and unloading procedures by the Lessee and the Lessor of the Aircraft.

SR 32/2014

Enhance the training requirements for loadmasters to ensure that specific loading and unloading training for each aircraft type is provided before performing their tasks on type.

SR 33/2014

Enhance the policy/guideline of the loadmaster's duties and responsibilities and ensure their implementation as provided for in the DHL Operations Manual Part A, and/or enhance the agreements with the airport services handling company and the other related handling companies regarding the individual responsibilities for the tasks including the ground stability of the aircraft in the loading and unloading process.

SR 34/2014

Enhance its existing procedures for changing cargo loading and unloading instructions, with particular consideration to transit loads.

4.3.2 Etihad Airport Services – Ground to:

SR 35/2014

Establish procedures, and/or a new policy or enhance its existing policy for ramp work shift change during loading and unloading.

SR 36/2014

Although a “Safety Alert – Safe Cargo Aircraft Handling” and “Work Instruction – Ramp Agent Duties and Responsibilities” were issued by EAS – Ground; establish new procedures or enhance the existing procedures for aircraft loading and unloading for the ramp teams.

SR 37/2014

Although the unloading sequence is not the responsibility of the ramp agent; ensure that ramp agents practice their basic weight and balance knowledge and skills to maintain safety awareness in aircraft loading and unloading.

SR 38/2014

Enhance the training requirement and guidelines for ramp teams to ensure that the required training is provided before performing their tasks.

SR 39/2014

Enhance the agreement with aircraft Operators regarding the individual responsibilities for the tasks, including the ground stability of the aircraft in the loading and unloading process.

4.3.3 Wings 24 Limited to:

SR 40/2014

Establish procedures or enhance the existing policy of the required training, and manual(s) to be provided, to the loadmasters prior to commencing their tasks.



AVIATION A306EAT LOADPLAN LOADPLAN PRINTOUT NR: 1
OM: LHE TO: AUH FLIGHT: DHX520 A/C REG: DAEAH SCHED. DATE: 01/04/2014 10:15

UPPERDECK

CAPTAIN: Lentzsch Uwe | ABZ 1ST OFFICER: Jensen Soeren | ABZ

	AL	AR	AR: AAX3627DHL 1896 kg to BAH BAHHUBUSP(MPS)NCYORGOAI
<i>TR. ex AR</i>	BL	BR	
<i>BL: PAG5079DHL 1704 kg to AUH AUHGTWACS(BSA)COYORGLHE</i>	CL	CR	
<i>CL: PAG3456DHL 1762 kg to AUH AUHGTWACS(BSA)CNYORGLHE</i>	DL	DR	DR: PAG2523DHL 2359 kg to AUH AUHGTWACS(BSA)CNYORGLHE
<i>DL: PAG2495DHL 2116 kg to AUH AUHGTWACS(BSA)COYORGLHE</i>	EL	ER	ER: PAG5137DHL 2237 kg to AUH AUHGTWACS(BSA)COYORGLHE
<i>EL: PAG3766DHL 2476 kg to AUH AUHGTWACS(BSA)COYORGLHE</i>	FL	FR	FR: PAG9492DHL 2150 kg to BAH BAHHUBCOYACSORGLHE
<i>FL: PAG3403DHL 1895 kg to BAH BAHHUBCOYACSORGLHE</i>	GL	GR	GR: PAG5256DHL 2450 kg to BAH BAHHUBCNYACSORGLHE
<i>GL: PAG1677DHL 1735 kg to BAH BAHHUBCOYACSORGLHE</i>	HL	HR	HR: AAX3566DHL 1977 kg to BAH EWRGTWUSPNCYORGOAI
<i>HL: PAG2620DHL 2150 kg to BAH BAHHUBCOYACSORGLHE</i>	JL	JR	JR: PAG3748DHL 1449 kg to BAH EWRGTWUSPNCYORGOAI(AAC)
<i>JL: AAX3235DHL 2011 kg to BAH EWRGTWUSPNCYORGOAI</i>		PR	
<i>PR: AAA5750DHL 1802 kg to BAH EWRGTWUSPNCYORGOAI</i>		RS	
<i>RS: PAG5401DHL 1397 kg to BAH EWRGTWUSPNCYORGOAI(AAC)</i>		ST	
<i>ST: PAG2917DHL 1061 kg to BAH EWRGTWUSPNCYORGMZR(AAC)</i>			

Mohamed Mansoori (BAH)
PREPARED BY
LOADPLAN PROD. AT: 08:40
TAILTIP:

SIGNATURE SIGNIFIES:
ALL LOCKS UP / BELLY NETS FITTED
SIGNATURE
PRINT NAME



الهيئة العامة للطيران المدني
GENERAL CIVIL AVIATION AUTHORITY

FLIGHT: A306EAT LOADPLAN
LOADPLAN PRINTOUT NR: 1
FROM: LHE TO: AUH FLIGHT: DHX520 A/C REG: DAEA
SCHED. DATE: 01/04/2014 10:1

LOWERDECK

11P: PAG5866DHL 1573 kg to AUH AUHGTWACS(BSA)COYORGLHE	11P
12P: PAG4869DHL 1562 kg to AUH AUHGTWACS(BSA)NCYORGLHE	12P
21P: PAG4597DHL 1638 kg to AUH AUHGTWACS(BSA)CNYORGLHE	21P
22P: PAG4561DHL 1626 kg to AUH AUHGTWACS(BSA)CNYORGLHE	22P

on the aircraft

31: ALP0513DHL 1464 kg to BAH BAHHUBWPXCNYORGOAI	31
32: ALP0237DHL 1074 kg to BAH BAHHUBWPXCNYORGOAI	32
33: ALP7005DHL 258 kg to BAH BAHHUBUSP(LCM)NCYORGOAI	33
41: ALP0314DHL 323 kg to BAH BAHHUBMIP(ACA)CNYORGOAI	41
42: ALP0437DHL 1125 kg to BAH BAHHUBCOYACSORGLHE	42
51: 51@DHX519 180 kg to AUH FAK	51
52: 52@DHX519 140 kg to AUH FAK	52
53: 53@DHX519 80 kg to AUH FAK	53

Red Mansoori (BAH)
RED BY
LAN PROD. AT: 08:40

SIGNATURE SIGNIFIES:
ALL LOCKS UP / BELLY NETS FITTED

SIGNATURE PRINT NAME

Appendix 2. ULDs Weights

Weights recorded in AUH are shown in **BLUE**, with differences shown in **RED**.

CPM

DHX520/01.DAEAH.LHE-AUH

-AL/N

-AR/AAX3627DHL/1896/BAH/C.TR

VOID

-BL/PAG5079DHL/1704/AUH/C.

1686kg -18kg

-BR/N

VOID

-CL/PAG3456DHL/1762/AUH/C.

1756kg -6kg

-CR/N

VOID

-DL/PAG2495DHL/2116/AUH/C.

2104kg -12kg

-DR/PAG2523DHL/2359/AUH/C.

2334kg -25kg

-EL/PAG3766DHL/2476/AUH/C.

2464kg -12kg

-ER/PAG5137DHL/2237/AUH/C.

2222kg -15kg

-FL/PAG3483DHL/1895/BAH/C.

1894kg -1kg

-FR/PAG9492DHL/2150/BAH/C.

2159kg +9kg

-GL/PAG1677DHL/1735/BAH/C.

1738kg +3kg

-GR/PAG5256DHL/2450/BAH/C.

2450kg NIL

-HL/PAG2620DHL/2150/BAH/C.

2145kg -5kg

-HR/AAX3566DHL/1977/BAH/C.TR

1985kg +8kg

-JL/AAX3235DHL/2011/BAH/C.TR

2020kg +9kg

-JR/PAG3748DHL/1449/BAH/C.TR

1448kg -1kg

-PR/AAA5750DHL/1802/BAH/C.TR

1814kg +12kg

-RS/PAG5401DHL/1397/BAH/C.TR

1410kg +13kg

.ST/PAG2917DHL/1061/BAH/C.TR

1065kg +4kg

-11P/PAG5866DHL/1573/AUH/C.

1562kg -11kg

-12P/PAG4869DHL/1562/AUH/C.

1554kg -8kg

-21P/PAG4597DHL/1638/AUH/C.

1628kg -10kg

-22P/PAG4561DHL/1626/AUH/C.

1608kg -18kg

-31/ALP0513DHL/1464/BAH/C.TR

1464kg +11kg

-32/ALP0237DHL/1074/BAH/C.TR

1091kg +17kg

-33/ALP7005DHL/0258/BAH/C.TR

267kg +9kg



United Arab Emirates



الهيئة العامة للطيران المدني
GENERAL CIVIL AVIATION AUTHORITY

-41/ALP0314DHL/0323/BAH/C.TR

333kg

+10kg

-42/ALP0437DHL/1125/BAH/C.

1131kg

+6kg

-51/0180/BAH/C FAK.TR

Fly Away Kit

-52/0140/BAH/C FAK.TR

Fly Away Kit

-53/0080/BAH/C FAK.TR

Fly Away Kit

-BULK/NIL/BAH/C.

VOID

Appendix 3. Damage of the Aircraft

DAR No	Location	Description of the damage & Dimensions	A300-600 SRM Ref.	Affected P/N and/or FIN	
53.0020.01	FR.64, STGR 56L	Angle . Angle deformed/damaged.	53-17-13 Fig. 6/Item 555	A53974534234	
53.0020.02	FR69, STRG 51R-54L	Frame segment. Frame segment deformed at multiple locations. The longest deformed frame outer flange of 520mm in length is located between 54R-54L.	53-17-13 Fig. 7/Item 20	A53974504208	
	FR69, STRG 54R-55L	Shear tie. Multiple shear tie (clip) deformation/damage.	53-17-13 Fig. 7/Item 255 53-17-13 Fig. 7/Item 260 53-17-13 Fig. 7/Item 265 53-17-13 Fig. 7/Item 270	F53486034217 (2 EA) A53974539208 A53974539206 F53486034216	
	FR69, STGR 57	Profile. Deformed/Damage profile (stiffener).	53-17-15 Fig. 11/Item 215	A53974438216	
	FR69, BETWEEN STGR 54L-55L	Bracket. Sheared rivet on control cable bracket.	NONE	A2797045320000 (P/N as labeled)	
	FR70, STRG 48R-48L	Frame segment. Frame segment deformed at multiple locations. The longest deformed frame of 910mm in length is located between 54R-53L. (NOTE: The max.	53-17-13 Fig. 7/Item 25	A53974504206	
53.0020.03	FR70, STRG 54R-53L	Shear Tie. Multiple shear tie (clip) deformation/damage.	53-17-13 Fig. 7/Item 300 53-17-13 Fig. 7/Item 305 53-17-13 Fig. 7/Item 310 53-17-13 Fig. 7/Item 315 53-17-13 Fig. 7/Item 320 53-17-13 Fig. 7/Item 660 53-17-13 Fig. 7/Item 665	A5397450210 A5397450205 (2EA) A5397450208 A5397450206 A5397450204 A5397450202 A5397450228	
	FR70, STRG 52L-53L	Profile. Deformed profile (stiffener) at lower portion.	53-17-15 Fig. 11/Item 290	A53974438220	
	FR70, STRG 53R-54R	Strut. Deformed strut (stiffener) at lower portion.	53-17-15 Fig. 11/Item 300	A53974128326	
	53.0020.04	FR71, STRG 51R-55L	Frame segment. Frame segment deformed and crack at multiple locations. The deformed frame length of 280mm between STGR 48R-51R and between STGR 48L-51L. The longest frame cracked is 125mm in length between STGR 56R-57. (NOTE: The max. deflection is 10mm at STGR 50L.)	53-17-13 Fig. 7/Item 30	A53974504204
		FR71, STRG 48R-49L	Shear tie. Multiple shear tie (clip) deformation/damage.	53-17-13 Fig. 7/Item 325 53-17-13 Fig. 7/Item 330 53-17-13 Fig. 7/Item 355 53-17-13 Fig. 7/Item 360 53-17-13 Fig. 7/Item 795 53-17-13 Fig. 7/Item 797	A53974541218 A53974541214 A53974541206 A53974541204 A53974541222 (2 EA) A53974541224
	53.0020.05	FR72, STRG 43R-46R	Frame segment. Frame segment deformed and cracked from splicing at STGR 46R to 43R. The deformed segment is about 280 mm from frame splice and with crack of 20mm in length at STGR 44R. (NOTE: The max. deflection is 5mm at STGR 45R.)	53-17-13 Fig. 5/Item 35 (Original SRM) 53-17-13 Fig. 5/Item 35 (Supplement SRM)	A53973116216 R539H0143238
		FR72, STRG 46R-45L	Frame segment. Frame segment deformed and cracked at multiple locations. The longest frame crack goes completely through the frame cross-section between STGR 57 - 56L. (NOTE: The max. deflection is 6mm at STRINGERS 50R and 48L.)	53-17-13 Fig. 7/Item 35	A53974504202
FR72, STRG 44R-46L		Shear tie. Multiple shear tie (clip) deformation/damage.	53-17-13 Fig. 5/Item 585	A53973116208	
			53-17-13 Fig. 5/Item 590	A53973116210	
			53-17-13 Fig. 5/Item 595	A53973116212	
			53-17-13 Fig. 5/Item 600	A53973185276	
			53-17-13 Fig. 7/Item 370	A53974542242	
			53-17-13 Fig. 7/Item 375	A53974542240	
			53-17-13 Fig. 7/Item 380	A53974542238	
			53-17-13 Fig. 7/Item 420	A53974542224	
	53-17-13 Fig. 7/Item 425		A53974542222		
	53-17-13 Fig. 7/Item 735		A53974542204		
53-17-13 Fig. 7/Item 740	A53974542206				
53-17-13 Fig. 7/Item 745	A53974542208				
53-17-13 Fig. 7/Item 770	A53974542218				
53-17-13 Fig. 7/Item 775	A53974542220				
FR72, STRG 44R-47R	Strap. Deformed/Damaged Strap.	53-17-13 Fig. 5/Item 610	A539745081212		
FR72, STRG 53L-55L	Beam. Deformed/Damaged Lateral Beam.	53-17-15 Fig. 11/Item 330	A53974322236		
FR72, STRG 53L-55L	Strut. Detached strut (stiffener.)	53-17-15 Fig. 11/Item 345	A53974128332		
53.0030.01	FR72, STGR 56R-54L	Butt-strap. The circumferential joint butt-strap was found bulging/deformed upward. A total length of 360mm of affected strap between STGR 56R-54L, and deepest bulging of 4mm located between STGR 56L-57. (See also damage details on Figure F53.0040.1 at FR72 skin damage locations as reference.)	53-17-12 Fig. 4/Item 205	A53974552000	

DAR No	Location	Description of the damage & Dimensions	A300-600 SRM Ref.	Affected P/N and/or FIN
53-0040.1	FR 68-79, 41L-37R	Skin Panels (5 total) deformed/torn LxWxD = 5830x2740x44 [mm]. Refer to picture for exact location and dimensions. Note: Maximum depth of skin deformation is given at each frame for each skin panel with additional reference maximum depths between FR76-78 (Tail Bumper area).	53-17-12 Fig. 4 item 1A	A53974525202
			53-17-12 Fig. 4 item 5	A53974526200
			53-18-12 Fig. 1 item 370A	A53980664212
			53-18-12 Fig. 1 item 465A	A53980853202
			53-18-12 Fig. 1 item 560E	A53980666214
53-0050.1	FR 73, STRG 44R-48R	Frame Segment deformed/cracked (approx 250 mm length) & deflection (4 mm displacement)	Supplement 53-18-13 Fig. 1 item 10	R539M1018200/201
			Supplement 53-18-13 Fig. 1 (sheet 2) item XX	Item pn to be reconfirmed.
	FR 73, STRG 45R-46R	Shear Tie deformed. Note: PN to be clarified. Shear tie physically looks modified but not shown in supplement.	Supplement 53-18-13 Fig. 1 item 10	R539M1018200/201
	FR 73, STRG 54L-56R	Frame Segment deformed/cracked (approx 300 mm length) & deflection (3 mm displacement)	Supplement 53-18-13 Fig. 1 item 10	R539M1018200/201
	FR 73, STRG 54L-54R	Shear Ties (6 total) deformed. Note: PN to be clarified. Shear tie between STRG 45-46 physically looks modified but not shown in supplement.	53-18-13 Fig. 5 item 385A	A53980856221
			53-18-13 Fig. 5 item 385A	A53980856221
			53-18-13 Fig. 5 item 380A	A53980856224
			53-18-13 Fig. 5 item 390A	A53980856222
53-18-13 Fig. 5 item 440A			A53980856220	
FR 73, STRG 44L-47L	Frame Segment deformed/cracked (approx 250 mm length) & deflection (3 mm displacement)	Supplement 53-18-13 Fig. 1 item 10	R539M1018200/201	
		Supplement 53-18-13 Fig. 1 (sheet 2) item XX	Item pn to be reconfirmed.	
53-0050.2	FR 74, STRG 44R-48R	Frame Segment deformed/cracked (approx 230 mm length) & deflection (15 mm displacement)	Supplement 53-18-13 Fig. 1 item 90	R539M1018202/203
			Supplement 53-18-13 Fig. 1 (sheet 2) item XX	Item pn to be reconfirmed.
	FR 74, STRG 45R-46R	Shear Tie deformed. Note: PN to be clarified. Shear tie physically looks modified but not shown in supplement.	Supplement 53-18-13 Fig. 1 item 90	R539M1018202/203
	FR 74, STRG 53L-56R	Frame Segment deformed/cracked (approx 340 mm length) & deflection (6 mm displacement)	Supplement 53-18-13 Fig. 1 item 90	R539M1018202/203
	FR 74, STRG 47L-52L	Frame Segment deformed/cracked (approx 310 mm length) & deflection (4 mm displacement)	Supplement 53-18-13 Fig. 1 item 90	R539M1018202/203
	FR 74, STRG 49L-56R	Shear Ties (9 total) deformed.	53-18-13 Fig. 5 item 345A	A53980857217
			53-18-13 Fig. 5 item 355A	A53980857220
53-18-13 Fig. 5 item 350A			A53980857218	
53-18-13 Fig. 5 item 350A			A53980857218	
53-18-13 Fig. 5 item 445A			A53980857216	
53-18-13 Fig. 5 item 340A			A53980857214	
53-18-13 Fig. 5 item 335A			A53980857212	
Note: Maximum deformation on skin at FR 74 is 9.00 mm @ STRG 57.				
53-0050.3	FR 75, STRG 43R-50R	Frame Segment deformed/cracked (approx 500 mm length) & deflection (15 mm displacement)	Supplement 53-18-13 Fig. 1 item 110	R539M1018204/205
			Supplement 53-18-13 Fig. 1 item 110	R539M1018204/205
	FR 75, STRG 49L-54R	Frame Segment deformed/cracked (approx 770 mm length) & deflection (10 mm displacement)	Supplement 53-18-13 Fig. 1 item 110	R539M1018204/205
	FR 75, STRG 44R-50L	Shear Ties (20 total) deformed.	53-18-13 Fig. 5 item 50A	A53980858205
			53-18-13 Fig. 5 item 55A	A53980858207
			53-18-13 Fig. 5 item 55A	A53980858207
			53-18-13 Fig. 5 item 50A	A53980858205
			53-18-13 Fig. 5 item 55A	A53980858207
			53-18-13 Fig. 5 item 395A	A53980858209
53-18-13 Fig. 5 item 400A			A53980858211	
53-18-13 Fig. 5 item 405A			A53980858213	
53-18-13 Fig. 5 item 410A			A53980858215	
53-18-13 Fig. 5 item 415A			A53980858217	
FR 75, STRG 35L-37R	Frame Segment deformed/cracked (approx 100 mm length) & deflection (5 mm displacement)	Supplement 53-18-13 Fig. 1 item 110	R539M1018204/205	
		Supplement 53-18-13 Fig. 1 (sheet 2) item XX	Item pn to be reconfirmed.	
		Supplement 53-18-13 Fig. 1 item 110	R539M1018204/205	
		Supplement 53-18-13 Fig. 1 (sheet 2) item XX	Item pn to be reconfirmed.	
		Supplement 53-18-13 Fig. 1 item 110	R539M1018204/205	
		Supplement 53-18-13 Fig. 1 (sheet 2) item XX	Item pn to be reconfirmed.	
		Supplement 53-18-13 Fig. 1 item 110	R539M1018204/205	
		Supplement 53-18-13 Fig. 1 (sheet 2) item XX	Item pn to be reconfirmed.	
		Supplement 53-18-13 Fig. 1 item 110	R539M1018204/205	
		Supplement 53-18-13 Fig. 1 (sheet 2) item XX	Item pn to be reconfirmed.	
Note: Maximum deformation on skin at FR 75 is 8.00 mm @ STRG 50R.				
53-0050.4	FR 76, STRG 38R-40R	Frame Segment deformed/cracked (approx 170 mm length) & deflection (2 mm displacement)	53-18-13 Fig. 6 item 15A	A53980867201
			53-18-13 Fig. 6 item 10A	A53980362206
	FR 76, STRG 43R-51R	Frame Segment deformed/cracked (approx 640 mm length)	53-18-13 Fig. 6 item 15A	A53980867200
	FR 76, STRG 36L-39L	Frame Segment deformed/cracked (approx 170 mm length) & deflection (2 mm displacement)	53-18-13 Fig. 6 item 15A	A53980867200
Supplement 53-18-13 Fig. 1 (sheet 2) item XX				
FR 76, STRG 35L-38R	Shear Ties (41 total) deformed.	53-18-13 Fig. 6	as per figure	
		Supplement 53-18-13 Fig. 1 (sheet 2) item XX	as per figure	
Note: Maximum deformation on skin at FR 76 is 13.00 mm @ STRG 54R.				

DAR No	Location	Description of the damage & Dimensions	A300-600 SRM Ref.	Affected P/N and/or FIN
53-0050.5	FR 77, STRG 37L-37R	Frame Assy severe damaged. Tail bumper attachments to Fr 76 and Fr 77 also damaged. Tail bumper 'sink' into frame bay 76-77. Refer to pictures for extend of damage.	53-18-13 Fig. 6 Supplement 53-18-13 Fig. 1	as per figure as per figure
	FR 76-77, STRG 56L-	Tail Bumper Internal Reinforcement deformed.	53-18-18 Fig. 6	as per figure
	Note: Maximum deformation on skin/fuselage at FR 77 is 15.00 mm @ STRG 57. Maximum gap at torn skin 44.00 mm (from frame assy).			
53-0050.6	FR 78, STRG 50R-52R	Frame Segment deformed (approx 180 mm length).	53-18-13 Fig. 7 item 5A	A53980869200
	FR 78, STRG 48R-56R	Shear Ties (7 total) deformed.	53-18-13 Fig. 7 item 130A	A53980861207
			53-18-13 Fig. 7 item 135A	A53980861209
			53-18-13 Fig. 7 item 140B	A53980861211
			53-18-13 Fig. 7 item 270A	A53980861226
		Supplement 53-18-13 Fig. 1 item 180	R539M1016270	
		Supplement 53-18-13 Fig. 1 item 255	R539M1016216	
		Supplement 53-18-13 Fig. 1 item 275	R539M1016218	
	FR 78, STRG 38L-41R	Frame Segment deformed (approx 200 mm length).	53-18-13 Fig. 7 item 5A	A53980869200
Note: Maximum deformation on skin at FR 78 is 5.00 mm @ STRG 57.				
53-0060.1	FR 68 -79, STRG 37L-37R	Stringers deformed together with skin panels. Dimensions for deformation from original profile difficult to be determined except severe damaged areas (at Fr 76 and Fr 77) where stringers has cracks/breaks.	53-18-14 Fig. 6, 7 and 8	as per figure
Note: Refer to skin damage DAR 53-0040.1 for deformation basic dimensions.				
53.0170.01	FR.85-86, STGR 34R	Strap . Strap deformed/damaged approx. 508mm in length.	53-19-18 Fig. 4/Item 105	F53571544204

DAR No	LOCATION	DAMAGE/DIMENSION/Remark	SRM REFERENCE	P/N and/or FIN of the affected part	PART
53.0010.01 (See the photos DAR. NO:)	FR 67, STR 39R-40R	Scratch mark;. The scratch marks removed by smooth blend IAW SRM 51-73-00 Para. 4; HFEC Performed IAW NTM 51-10-08 Part 6. Result: NIL CRACK.	SRM 53-17-12 FIG.2 ITEM 40	A53973277210	SKIN PANEL SURROUND RH BULK CARGO CUT
	FR 67/68, STR 36R-37R	Scratch marks; The scratch marks removed by smooth blend IAW SRM 51-73-00 Para. 4; HFEC Performed IAW NTM 51-10-08 Part 6. Result: NIL CRACK.	SRM 53-17-12 FIG.2 ITEM 40		
	FR 68/69 STR 35R-36R	Scratch marks; The scratch marks removed by smooth blend IAW SRM 51-73-00 Para. 4.HFEC Performed IAW NTM 51-10-08 Part 6. Result: NIL CRACK. UTG performed to measure remaining thickness and original thickness IAW NTM 51-10-04 Part 4.	SRM 53-17-12 FIG.2 ITEM 40		SKIN PANEL SURROUND CARGO CUT
	FR 67/68, STR 29R-30R	Scratch marks; The scratch marks removed by smooth blend IAW SRM 51-73-00 Para. 4; HFEC Performed IAW NTM 51-10-08 Part 6. Result: NIL CRACK; UTG performed to measure remaining thickness and original thickness IAW NTM 51-10-04 Part 4.	SRM 53-17-12 FIG.2 ITEM 1	A53978152200	EXTERNAL F SKIN PANEL
53.0070.01 (See the photos DAR. NO: 53.0070.01 and 53.0120.01)	FR77	Cross beam bent started from bet. -Y1137 and -Y1580.5 to -Y450, followed by 60 mm depth of deflection to aft side direction at -Y1137. This bent caused a cracked length of 280 mm between -Y794.3 and -Y1580.	SRM SUP. 53-18-15 FIG.1 ITEM 25	R532H147700200C	CROSS BEA
		Cracked	SRM SUP. 53-18-15 FIG.2 ITEM 65	A53275439201	FITTING at -
		Cracked	SRM SUP. 53-18-15 FIG.2 ITEM 70	A53278191205	FITTING at -
		Pulled	SRM SUP. 53-18-15 FIG.2 ITEM 65	A53275439201	FITTING at -
		Bent on the center	SRM SUP. 53-18-15 FIG.2 ITEM 235	A5327463723600	SUPPORT
	Bent on the center	SRM SUP. 53-18-15 FIG.2 ITEM 240	A5327463723800	SUPPORT	
53.0090.01	FR 72	Deformed 160 mm width	SRM 53-17-15 FIG.11 ITEM 330	A53974343200	FLOOR STRU BEAM
		Shared rivet at STGR 55LH FR 72	SRM 53-17-15 FIG.11 ITEM 345	A53974128334	FLOOR STRU STRUT
	FR 73	Deformed	SRM 53-18-18 FIG.7 ITEM 30	A53980855220	FLOOR STRU SUPPORT
		Deformed	SRM 53-18-18 FIG.7 ITEM 45	A53980008260	FLOOR STRU BRACKET
	FR 74	Deformed	SRM 53-18-18 FIG.7 ITEM 50	A53980855202	FLOOR STRU PROFILE
	FR 75	Deformed	SRM 53-18-18 FIG.7 ITEM 110	A53980797202	FLOOR STRU PROFILE
FR 76	Shared rivet at FR 76	SRM 53-18-18 FIG.7 ITEM 115	A53980855202	FLOOR STRU PROFILE	
53.0100.01 (See the photos DAR. NO: 53.0100.01)	FR 70 - 72	Edge damage (cracked)	IPC 53-10-77 FIG.1 ITEM 10	A5397434600400	PANEL - CAT
	FR 72 - 73	Corner Damages (Cracked attachment areas)	IPC 53-10-77 FIG.1 ITEM 30	A5398065800800	PANEL - CAT
	FR 73 - 76	Corner Damages (Cracked on each attachment areas)	IPC 53-10-77 FIG.1 ITEM 40	A5398065600600	PLATFORM - MAINTENAN
53.0120.01 (See the photos DAR. NO: 53.0070.01 and 53.0120.01)	FR 76	Bent at lower attachment at -Y1137.1	IPC 53-10-47, FIG. 3B SH 1. BUT IPC P/N ARE NOT THE SAME WITH ACTUAL	A5327500003800T	STRUT SUPPORT
		Bent at lower attachment at -Y1137.1		A5327500003600T	
		Bent at lower attachment at Y1137.1		A5327500003600T	
		Bent at lower attachment at Y1137.1		A5327500003800T	
	FR 77	Broken through at -Y1137.1	IPC 53-10-47, FIG. 3B SH 1. BUT IPC P/N ARE NOT THE SAME WITH ACTUAL	A5327422802600E	STRUT SUPPORT
		Bent at Floor beam attachment at -Y1137.1		F5347849701600F	
		Broken through at Y1137.1		A5327422802600E	
	Bent at Floor beam attachment at Y1137.1		F5347849701600F		
53.13.0020.01 (See the photos DAR. NO: 53.13.0020.01)	FR 27 - FR 28, STR20L/21L	Scratch marks; The scratch marks removed by smooth blend IAW SRM 51-73-00 Para. 4.HFEC Performed IAW NTM 51-10-08 Part 6. Result: NIL CRACK. UTG performed to measure remaining thickness and original thickness IAW NTM 51-10-04 Part 4.	SRM 53-13-12 FIG. 5 ITEM 375	A53771103202	SKIN PANEL SURROUND CARGO CUT
53.13.0030.01 (See photos DAR. NO: 53.13.0030.01)	FR 20A- FR 25A, STR 41R - 43R	GVI Performed to the skin panel section 13 RHS, Resut : NIL FINDINGS on skin panel, and areas surround RH FWD Cargo cut out. But on Dents and protrude dent (Bulging)found on RH FWD Cargo Cover Plates lower edge -due to impact.	IPC 53-13-83 FIG. 1 ITEM 120	A5247007000000	PLATE - COV
			IPC 53-13-83 FIG. 1 ITEM 140	A5247007020400	PLATE - COV
25.0040.01 (See photos DAR. NO:25.0040.01)	FR 63 - FR 70	GVI Performed to the lower deck bulk cargo compartment. Result: FINDINGS on Floor panels (dents). Please note that these findings are normal findings due to operational, not caused by the incident. Hence please see photos that shown Sample of typical damages due to operational.	IPC 53-10-35 FIG. 2 SH 1 ITEM 80	161 AF	FLOOR PANE
			IPC 53-10-35 FIG. 2 SH 1 ITEM 100	161 CF	FLOOR PANE
			IPC 53-10-35 FIG. 3 SH 1 ITEM 10	161 GF	FLOOR PANE

APPENDIX 4 SABLE Simulation

Figure A4-1 illustrates the SABLE weight and longitudinal balance (CG) simulation for the Aircraft' weight and CG position before unloading. The weight is 137,862 kg and the longitudinal CG position is at 32.01% Mean Aerodynamic Chord (MAC), whereas the maximum permissible aft CG position is at 35.0% MAC.

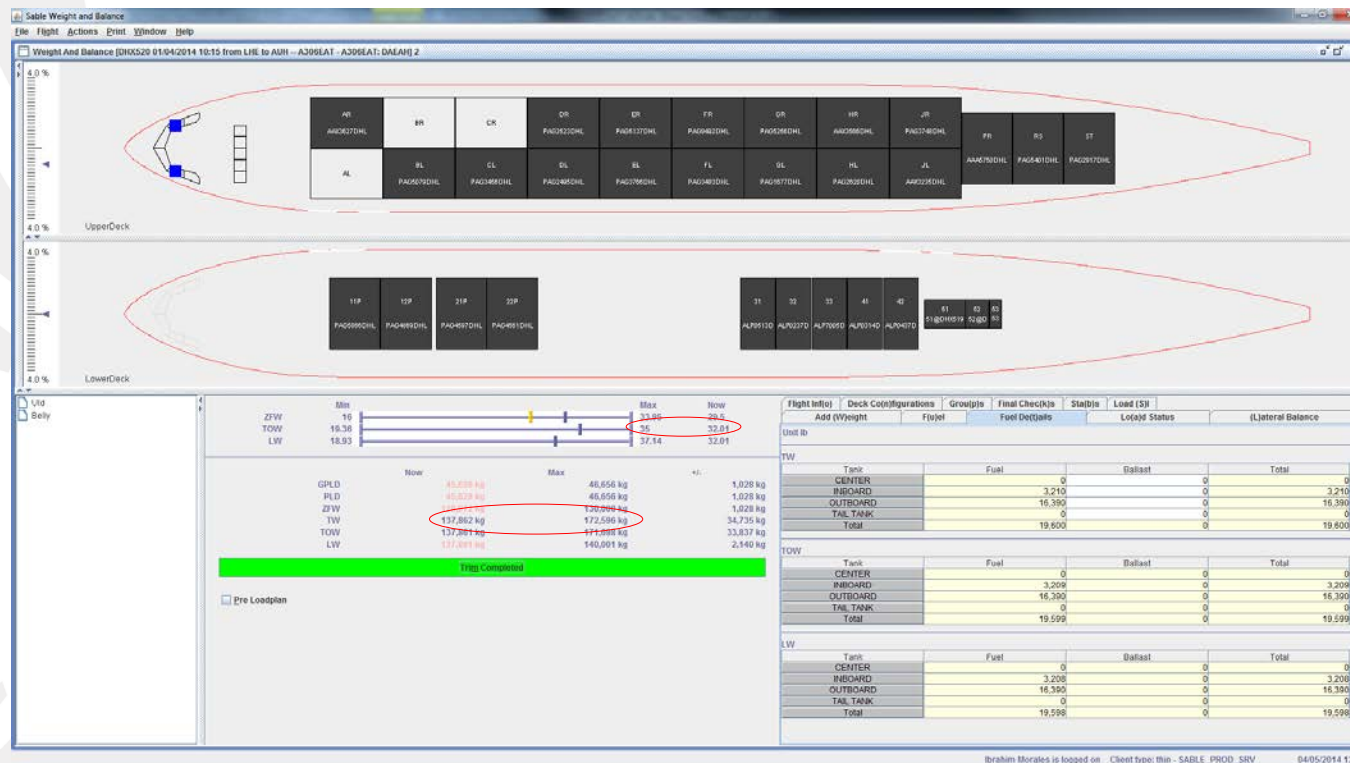


Figure A4-1. Simulated weight and balance of the Aircraft before unloading

The simulation in Figure A4-2 illustrates the Aircraft weight and CG position after unloading the four ULDs in positions BL through EL on the main-deck. The weight is 129,852 kg and the longitudinal CG position is at 37.33% MAC, whereas the maximum permissible aft CG position is at 33.98% MAC.

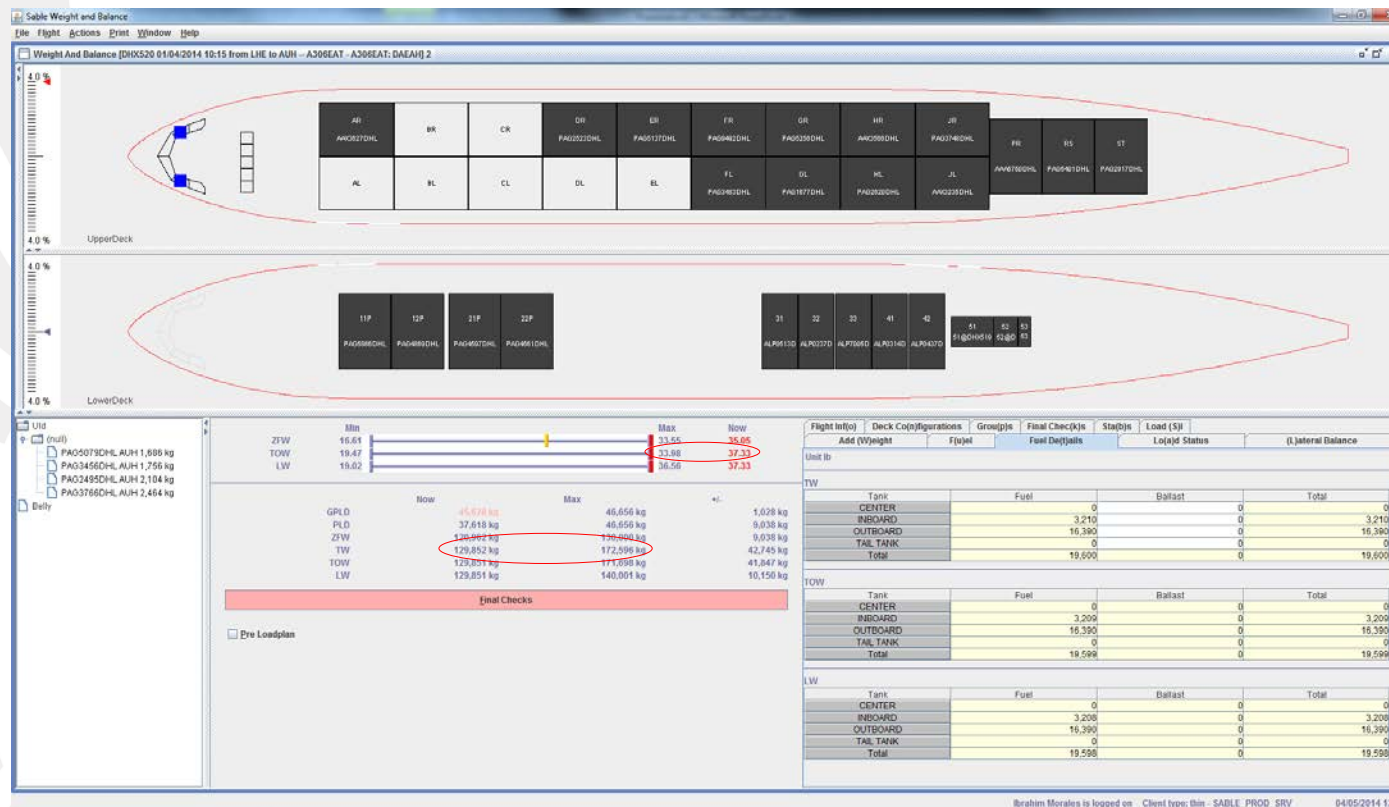


Figure A4-2. Simulated weight and balance of the Aircraft after unloading ULDs in positions BL through EL

The simulation in Figure A4-4 illustrates the Aircraft weight and CG position after unloading the six ULDs on the main-deck intended for Abu Dhabi and four ULDs are moved from positions BL through EL to positions AL through DL, respectively. The weight is 125,296 kg and the longitudinal CG position is at 30.27% MAC, whereas the maximum permissible aft CG position is at 33.22% MAC.

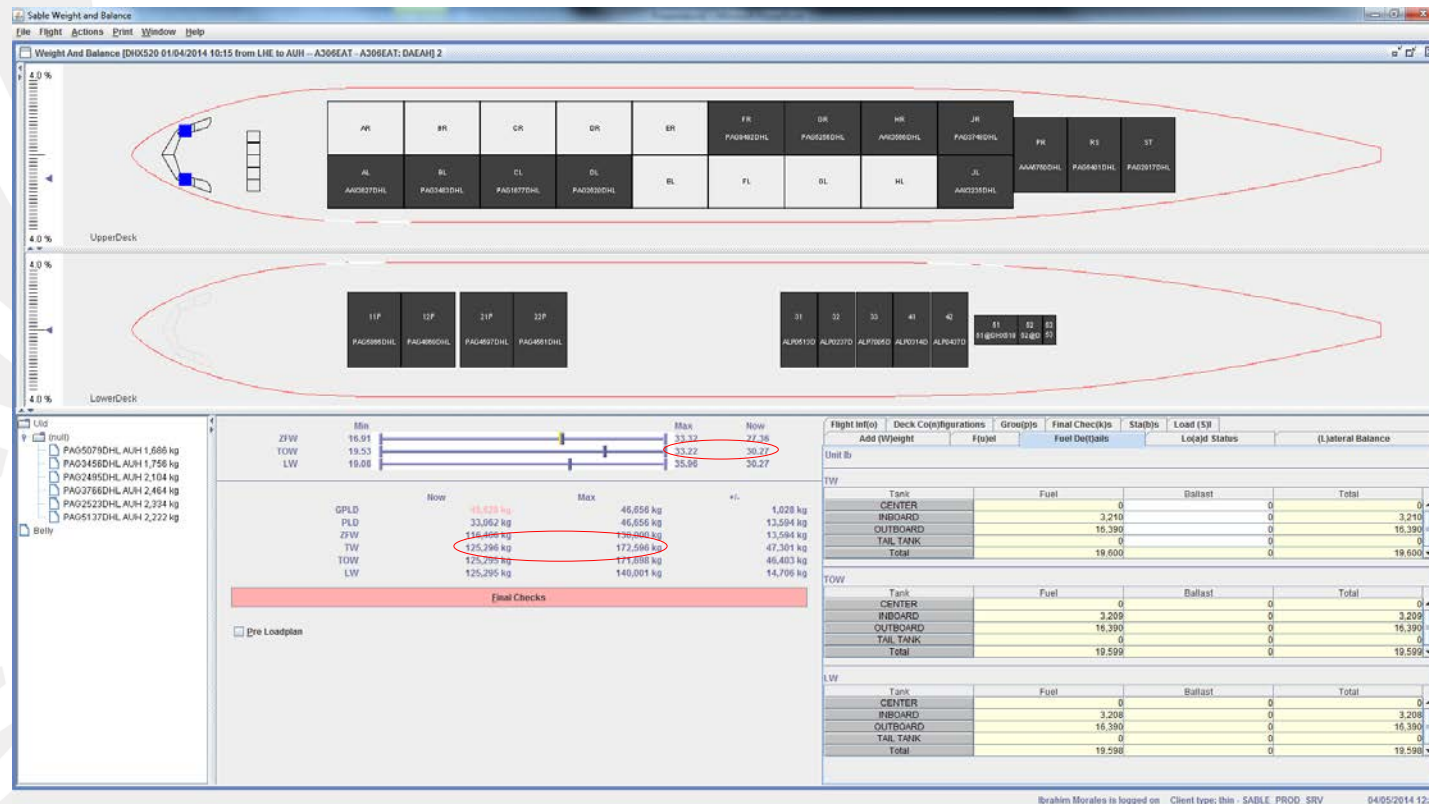


Figure A4-4. Simulated weight and balance of the Aircraft after unloading six ULDs on the main-deck and placing four ULDs in positions AL through DL

Figure A4-5 illustrates simulation of the Aircraft weight and CG position after the ULD in position 11P is unloaded. The weight is 123,734 kg and the longitudinal CG position is at 32.9% MAC, whereas the maximum permissible aft CG position is at 32.96% MAC.

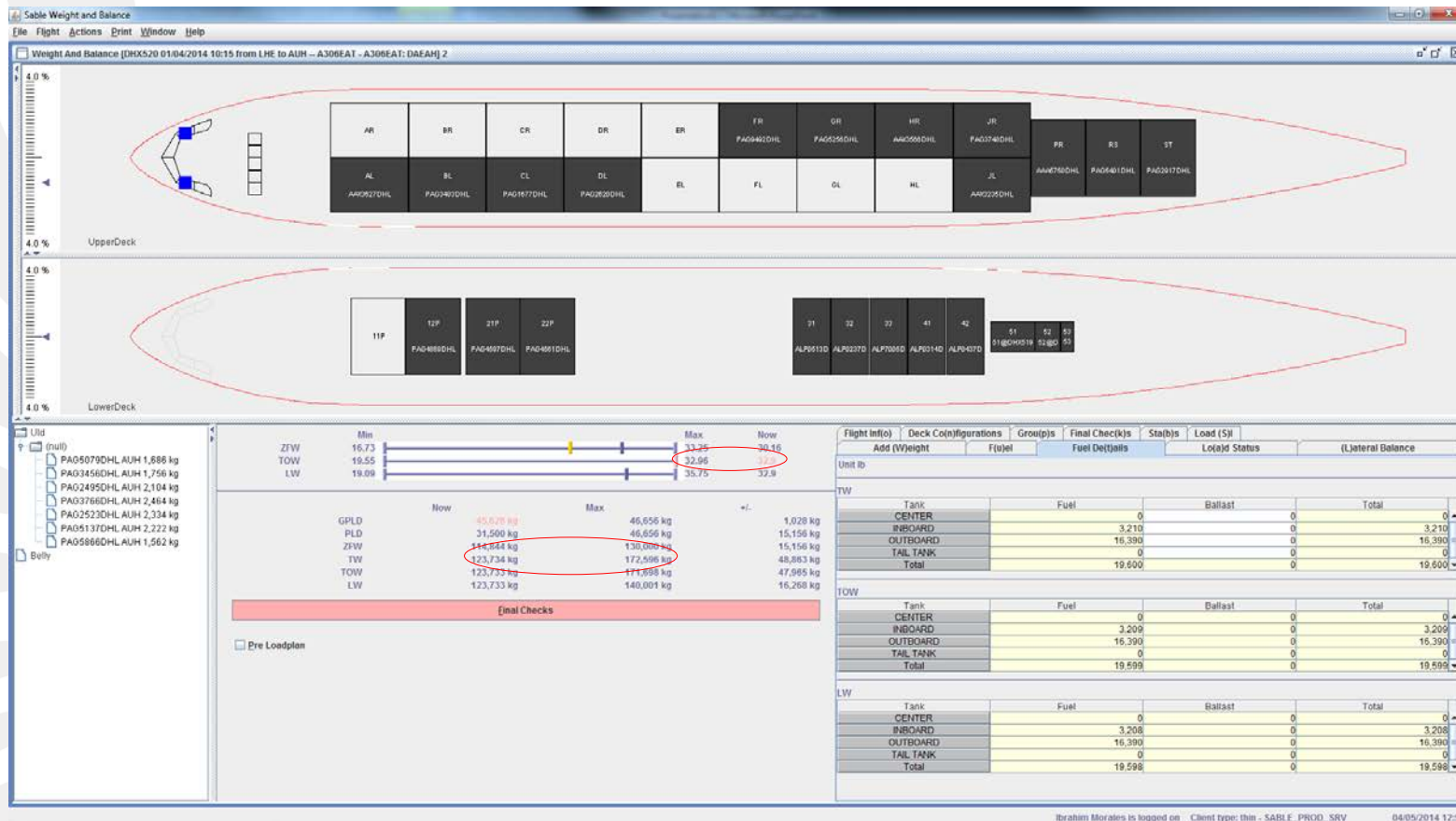


Figure A4-5. Simulated weight and balance of the Aircraft after unloading the 1st ULD in position 11P

Figure A4-6 illustrates simulation of the Aircraft weight and CG position after ULD in position 12P is unloaded. The weight is 122,180 kg and the longitudinal CG position is at 35.15% MAC, whereas the maximum permissible aft CG position is at 32.7% MAC.

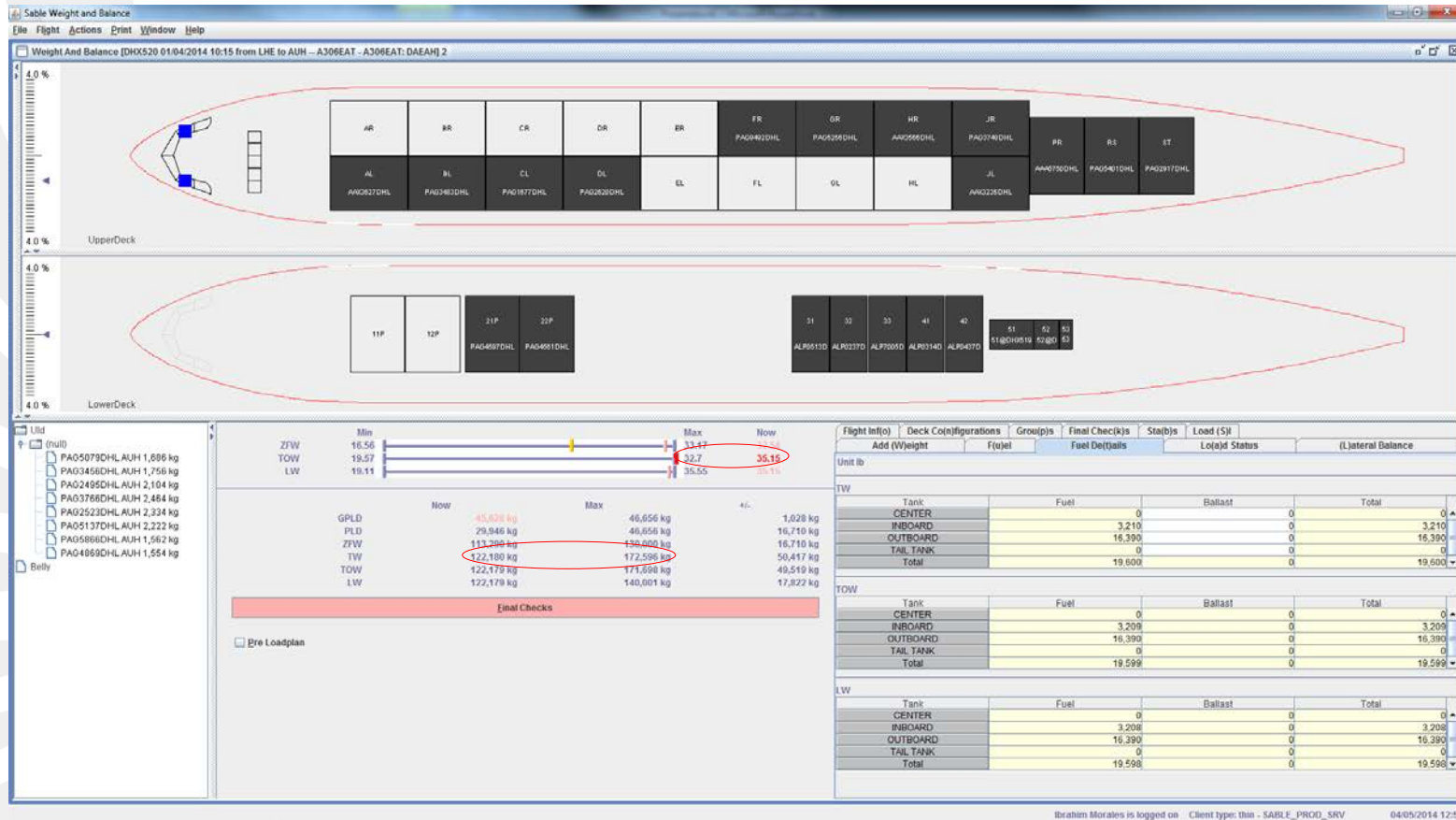


Figure A4-6. Simulated weight and balance of the Aircraft after unloading ULD in position 12P

Figure A4-7 illustrates simulation of the Aircraft weight and CG position after ULDs in positions 21P and 22P are moved to positions 11P and 12P respectively. The weight is 122,180 kg and the longitudinal CG position is at 33.26% MAC, whereas the maximum permissible aft CG position is at 32.7% MAC.

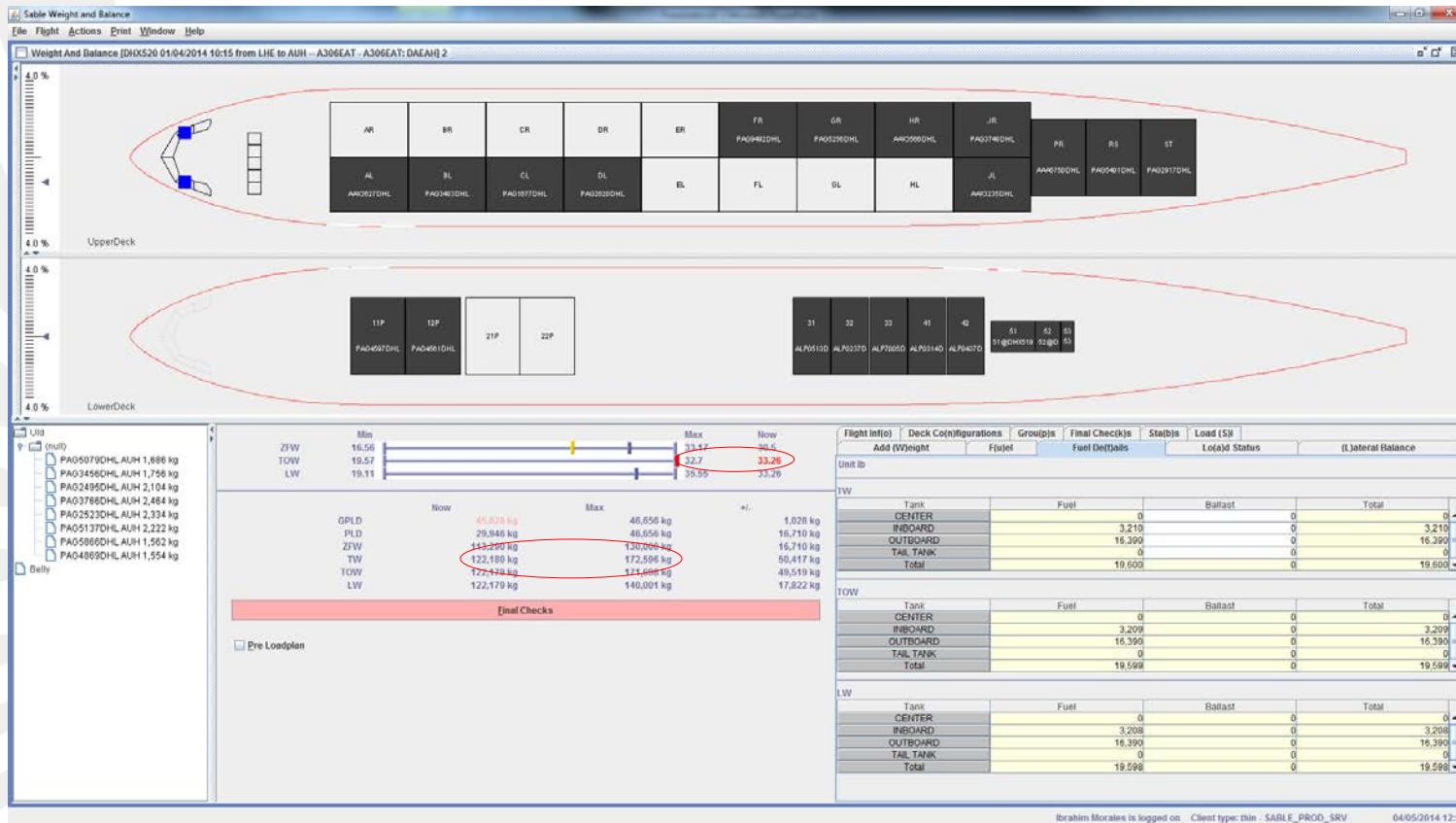


Figure A4-7. Simulated weight and balance of the Aircraft after moving ULDs in positions 21P and 22P to positions 11P and 12P

Figure A4-8 illustrates simulation of the Aircraft weight and CG position after the ULD in position 11P is unloaded. The weight is 120,552 kg and the longitudinal CG position is at 36.11% MAC, whereas the maximum permissible CG position is at 32.42% MAC.

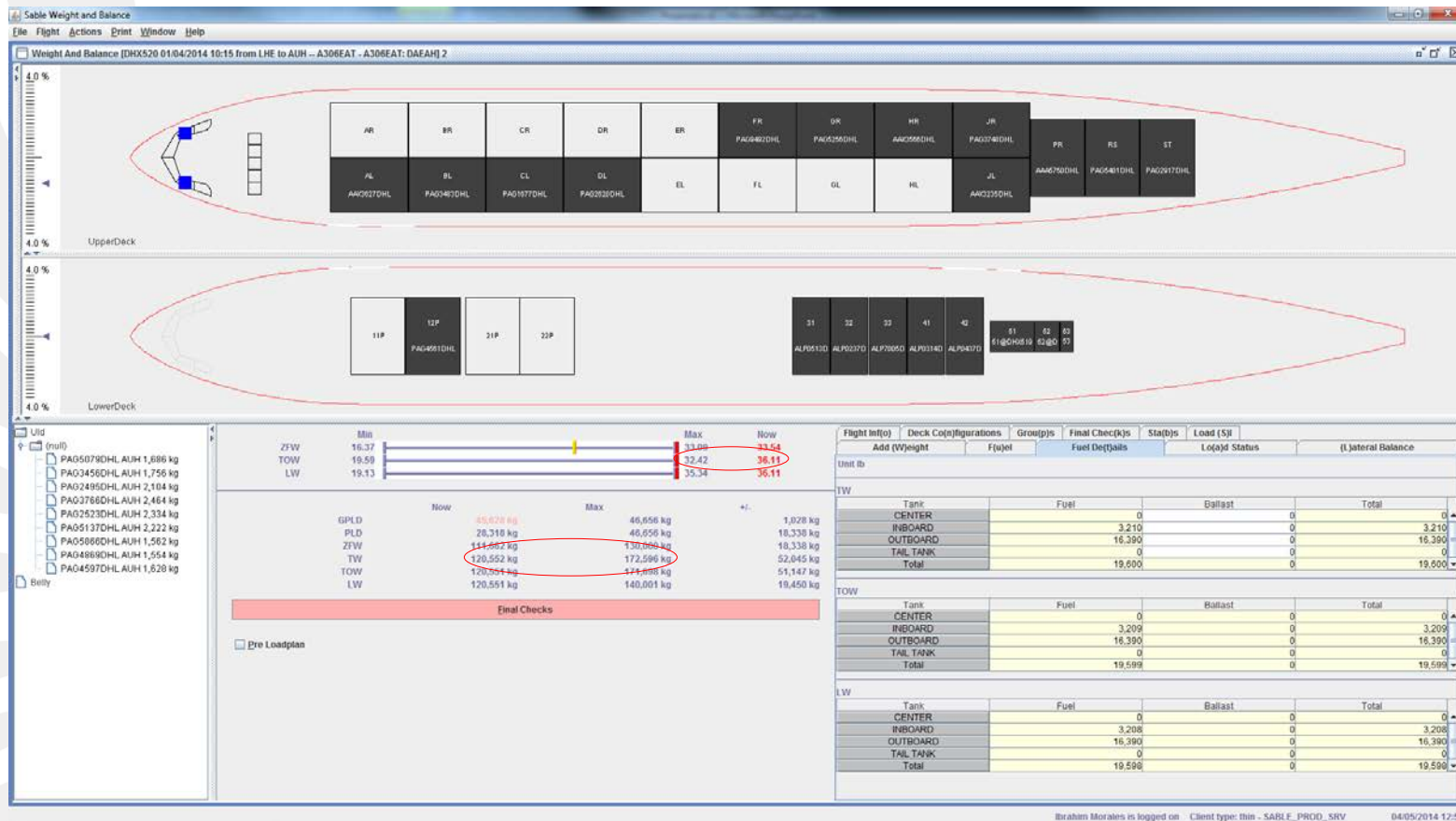


Figure A4-8. Simulated weight and balance of the Aircraft after unloading the ULD in position 11P

Figure A4-9 illustrates simulation of the Aircraft weight and CG position after the ULD in position 12P is unloaded. The weight is 118,944 kg and the longitudinal CG position is at 38.54% MAC, whereas the maximum permissible CG position is at 32.16% MAC. The weight and longitudinal CG of Figure A4-9 is representative of the actual condition as given in Figure 10.

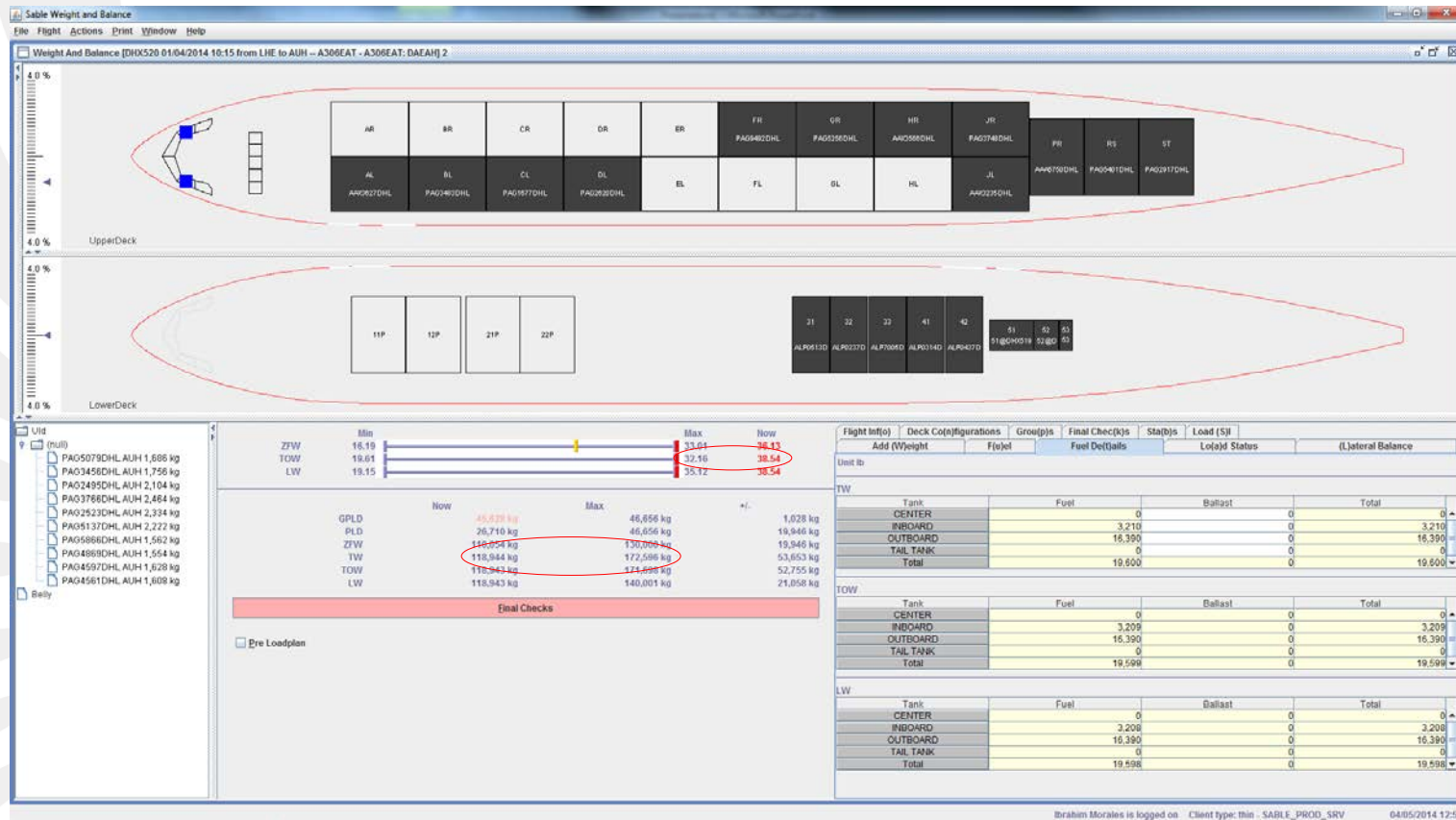


Figure A4-9. Simulated weight and balance of the Aircraft after unloading the ULD in position 12P

Figure A4-10 illustrates simulation of the Aircraft weight and CG position after the unlocked four ULDs in positions AL through DL moved/slipped to positions EL through HL. The weight is 118,944 kg and the longitudinal CG position is at 51.05% MAC, whereas the maximum permissible CG position is at 32.16% MAC. This means that slipping backwards each space of the four ULDs, the CG shifts aft about 3.12% MAC.

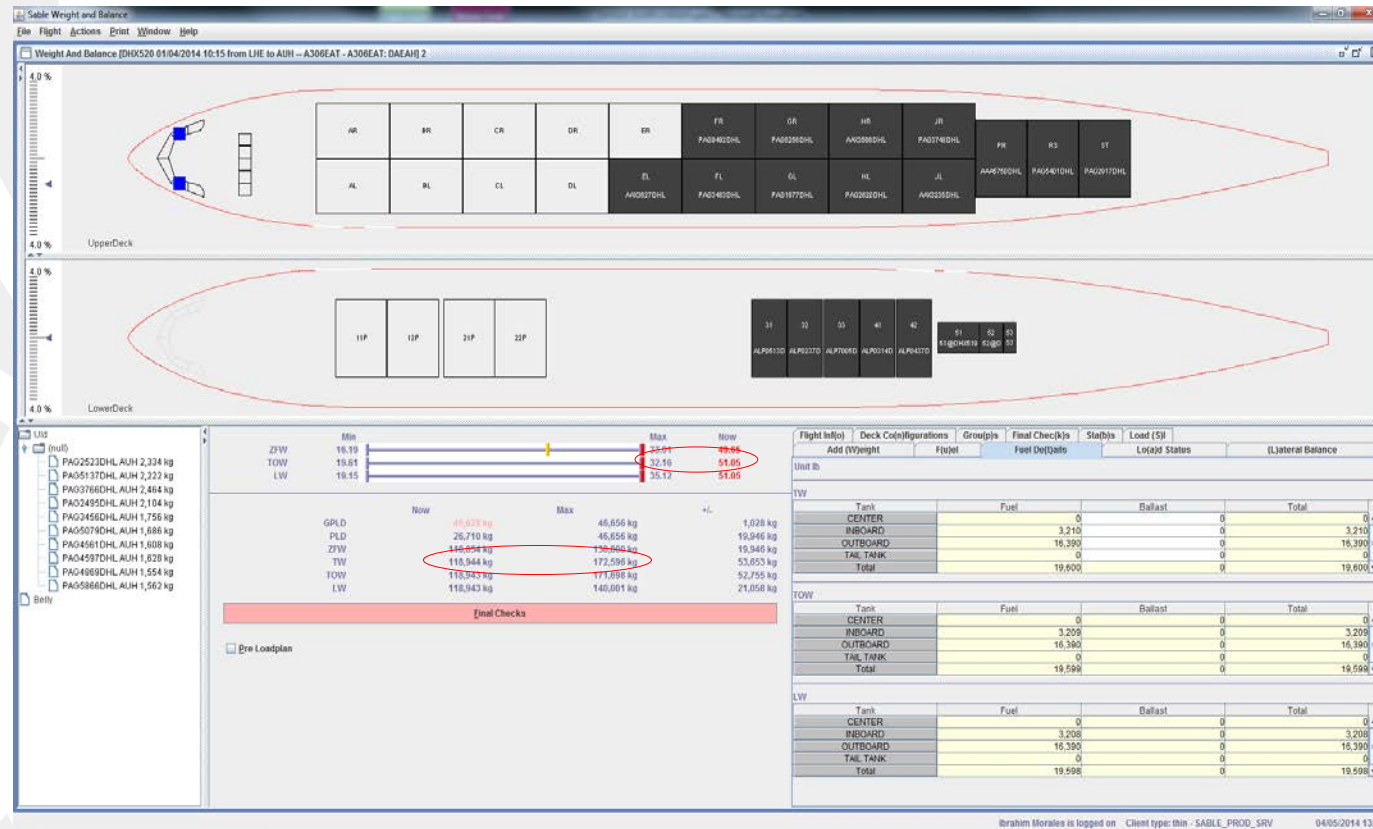


Figure A4-10. Simulated weight and balance of the Aircraft after 4 ULDs in positions AL through DL moved/slipped to positions EL through HL

The simulation in Figure A4-11 illustrates the Aircraft weight and CG position if the unloading steps are commenced by unloading the aft cargo hold first, in accordance with the SOP. The weight is 133,176 kg and the longitudinal CG position is at 28.2% MAC, whereas the maximum permissible CG position is at 34.53% MAC.

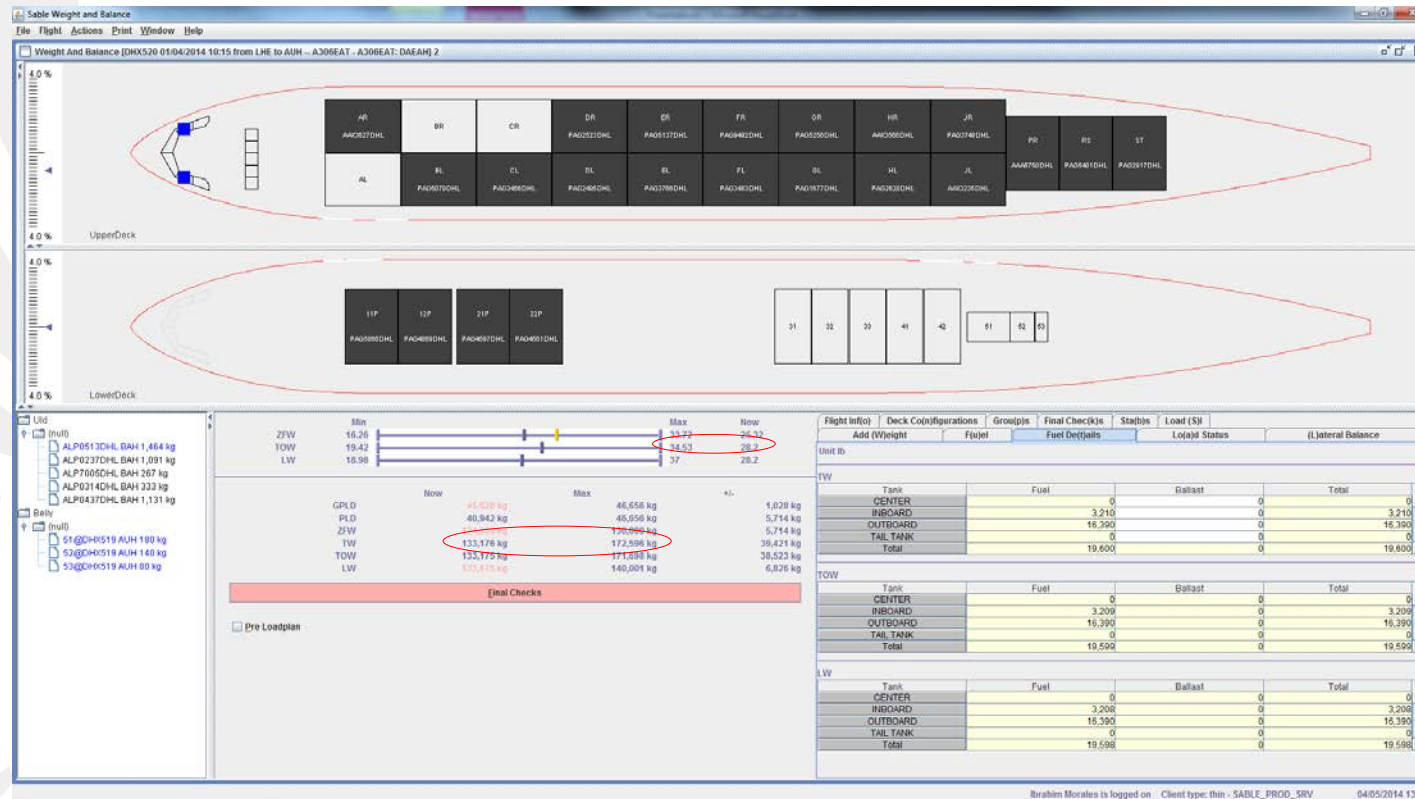


Figure A4-11. Simulated weight and balance of the Aircraft when unloading starts from the aft lower-deck