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Swiss Transportation Safety investigation Board STSB

Aviation Division

Final Report No. 2236
by the Swiss Transportation
Safety Investigation Board (STSB)

concerning the serious incident involving the Hawker Beechcraft Beechjet 400A aircraft, registration N400AJ, converted to Nextant 400XT,

on 12 June 2012

at Zurich Airport

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Ursachen

Der schwere Vorfall ist darauf zurückzuführen, dass ein unerkannt gebliebener Bedienungsfehler der Besatzung in der Startvorbereitung zu einem weitreichenden Ausfall der elektrischen Stromversorgung führte, was eine Notlandung zur Folge hatte.

Zum schweren Vorfall beigetragen haben:

- Eine zu wenig aufmerksame und systematische Arbeitsweise der Besatzung.
- Mangelhafte Arbeitsunterlagen der Besatzung.
- Ein unzureichendes *difference training* der Besatzung.

General information on this report

This report contains the Swiss Transportation Safety Investigation Board's (STSB) conclusions on the circumstances and causes of the accident which is the subject of the investigation.

In accordance with Article 3.1 of the 10th edition, applicable from 18 November 2010, of Annex 13 to the Convention on International Civil Aviation of 7 December 1944 and Article 24 of the Federal Air Navigation Act, the sole purpose of the investigation of an aircraft accident or serious incident is to prevent accidents or serious incidents. The legal assessment of accident/incident causes and circumstances is expressly no concern of the investigation. It is therefore not the purpose of this investigation to determine blame or clarify questions of liability.

If this report is used for purposes other than accident/incident prevention, due consideration shall be given to this circumstance.

The definitive version of this report is the original in the German language.

All information, unless otherwise indicated, relates to the time of the serious incident.

All times in this report, unless otherwise indicated, are stated in local time (LT). At the time of the serious incident, Central European Summer Time (CEST) applied as local time in Switzerland. The relation between LT, CEST and coordinated universal time (UTC) is:
LT = CET = UTC + 2 hours.

Events that relate to a point in time are specified to the exact second. Events that cover a period of time are specified to the exact minute.

Contents

Final Report

Synopsis

Owner	AptarGroup Inc., 475 West Terra Cotta Avenue, Crystal Lake, USA
Operator	German Technologies GmbH, 475 West Terra Cotta Avenue, Crystal Lake, USA
Manufacturer	Hawker Beechcraft Corporation, USA
Aircraft type	Beechjet 400A, converted to Nextant 400XT in accordance with supplemental type certificates (STCs)
Country of registration	United States of America
Registration	N400AJ
Location	Zurich Airport
Date and time	12 June 2012, 17:01

Investigation

The serious incident occurred on 12 June 2012. It began at 17:01 and ended at 17:23. The investigation was opened on the same day at 18:30 by the former Swiss Accident Investigation Board (SAIB).

The SAIB informed the American National Transportation Safety Board (NTSB) of the serious incident. The NTSB in turn appointed an accredited representative on 20 June 2012.

The present final report is published by the Swiss Transportation Safety Investigation Board (STSB).

Summary

The business jet Hawker Beechcraft Beechjet 400A, registration N400AJ, was converted with supplemental type certificates (STCs) to a type 400XT and privately operated by a company.

On 12 June 2012 the crew planned to conduct a flight with passengers from Zurich to Paris. During take-off preparations an unrecognised system operating error by the crew occurred, which resulted in both generators remaining off-line. As a result an extensive electrical power supply failure occurred shortly after take-off. The crew of N400AJ decided to return to Zurich Airport. As a result of the loss of electrical power other systems ceased to be available. After the emergency extension of the landing gear, N400AJ landed just before the half-way point of runway 14 and decelerated over a distance of approximately 800 m up to taxiway H1. The main wheel thermal fuse plugs vented air after a few minutes after landing due to the overheating. The left and the right braking systems exhibited clear signs of overheating.

After landing, the commander noted that after resetting, both generators once again provided power to the electrical system and the avionics system then functioned normally.

The aircraft was slightly damaged. The occupants were not injured. There was no other damage.

Causes

The serious incident is attributable to the fact that an unrecognised system operating error by the crew during take-off preparations led to a widespread electrical power supply failure, which resulted in an emergency landing.

The following factors contributed to the serious incident:

- The crew's method of working was not sufficiently attentive or systematic.
- The crew's operating documents were inadequate.
- The difference training for the crew was insufficient.

Safety recommendations

In the context of the investigation, no safety recommendation was issued.

1 Factual information

1.1 Pre-flight history and history of the flight

1.1.1 General

The recordings of the radar data and the conversations in the cockpit, as well as the radiotelephony transcripts and the statements of the crew were used for the following description of the pre-flight history and history of the flight. For the entire flight the commander was pilot flying (PF) and the co-pilot was pilot not flying (PNF).

Within the organisation of flight operations, the commander was designated as pilot in command (PIC) and the co-pilot as second in command (SIC). These designations have been adopted in this report.

The flight was conducted under instrument flight rules. The flight was a private flight as part of a corporate flight operation.

1.1.2 Pre-flight history

The business jet Hawker Beechcraft Beechjet 400A, registration N400AJ was equipped with a new engine type and a new avionics system by Nextant Aerospace in accordance with supplemental type certificates (STCs). After the modification time of approximately six months, and having completed difference training, the crew ferried the aircraft from the USA to their base in Donaueschingen, Germany on 13 May 2012.

After the serious incident, the crew stated that they felt comfortable in the converted aircraft during normal operations. In the first 24 hours after taking delivery of the aircraft the following technical errors occurred:

The PIC's flight management system 1 (FMS 1) occasionally failed and had to be reset and restarted using the circuit breaker (CB*).* The bleed air source right fail warning light illuminated several times. After the ferry flight of the modified aircraft to Germany, the crew twice requested the technical investigation of the events by the maintenance organisation in Augsburg.

On 11 June 2012, the day before the serious incident, the crew flew N400AJ without notable incident from Augsburg to Paris in order to then transport 6 passengers to Zurich.

After switching off the engines in Zurich, the crew left the avionics system on for approximately 10 minutes on battery power, as the aircraft was not equipped with an auxiliary power unit (APU) and no external power was used. This meant that the charge of the aircraft battery was accordingly reduced. The crew then conducted the final tasks and drove home.

On 12 June 2012 the crew prepared for the planned flight with 7 passengers from Zurich to Paris. The flight plan was filed for 16:45. After the crew arrived at the airport, the SIC went to the aircraft and prepared it in accordance with the checklist. She also prepared the cabin and placed the flight documentation in the cockpit. The battery was switched on for approximately 20 seconds to check the fuel content on the multifunctional display (MFD). There were 2905 lb of fuel on board. The SIC immediately switched off the automatically activated cabin light in order to minimize battery draining.

A little later, before the passengers arrived, the SIC performed the pre-flight check with checklists up to the point of switching on the battery. The SIC used both the 400A checklist from CAE SimuFlite that she was familiar with and the new Nextant

BE-400XT single card check list. According to the statement of the crew, the reason for this was that the process of merging the old and new checklists had not yet been completed and they were used to working with the CAE SimuFlite checklist.

1.1.3 History of the flight

After the PIC arrived with the passengers at N400AJ, they boarded the aircraft and the doors were closed. The take-off slot had previously been allotted for 17:00.

The crew requested clearance to start the engines on the COM 1[1] radio. This was issued approximately 5 minutes later. At 16:48 the battery was turned on for engine start. During the engine start phase, the crew worked with the Nextant BE-400XT single card checklist. Due to a typing error when entering the security code for the engine start there was an unavoidable further delay because of the required system restart. After the left engine start, the PIC and SIC together monitored the generator load display. When the charge current was below 150 Amps, the second engine was started. The SIC then entered the flight plan into the FMS to calculate the safe speeds according to the masses entered. Fearing that he would miss the take-off slot, the PIC already requested taxi clearance, even though the SIC had not yet completed the checklist after starting the engines.

The SIC again referred to the CAE SimuFlite checklist and independently performed several checks that she had not yet performed in order to conserve the battery before starting the engines. One of these was the master test, in which various systems were tested for GO or NO GO by means of a rotary switch on the overhead panel. Turning this switch from the "OFF" position to either of the first positions causes both generators to go off-line (cf. Section 1.6.4), which is correspondingly indicated. This went unnoticed by the crew.

The SIC then began to use the electronic checklist, which was displayed on the right-hand MFD. The checklist item "*DC amperes and voltage"* was mentioned, however, the crew did not check the corresponding displays.

While the PIC steered the aircraft the short distance along the taxiway from the apron to the holding point for runway 28, the SIC worked through the electronic checklist. At the checklist item "*Annunciators"* the crew did not notice any warning lights. While the PIC was lining up N400AJ on runway 28, the SIC asked the PIC if the amber light STBY PWR ON was normal. The PIC responded that he had seen it like that before.

After receiving take-off clearance, N400AJ took-off at 17:01 on runway 28 and followed the standard instrument departure route VEBIT 5W. After the SIC had changed the radio frequency to Zurich Departure, N400AJ was in clouds at 3500 ft QNH, turning left to fly towards waypoint BREGO. The landing gear and flaps had been retracted. At this moment the SIC was unable to click the electronic checklist on the control yoke switch. Shortly thereafter, she saw the red-framed warning message on the FMS 2 display screen. This meant that FMS 2 had failed. The PIC, who was flying the aircraft manually, then tried to reset the associated circuit breaker. Shortly thereafter, FMS 1 also failed.

At 17:03 the crew of N400AJ received clearance to climb to flight level (FL) 120 and to fly directly to waypoint VEBIT. After a short consultation with the PIC, the SIC asked air traffic control (ATC) for radar assistance as follows: *"(…) due to FMS failure, we need vectoring."* The PIC then flew on the assigned heading (HDG) of 250°. Controlling the aircraft required his full attention, as he had not noticed that

[1] COM 1 can be operated without an activated battery. See Section 1.6.3.8 (hot battery bus).

he had mistrimmed the aircraft about the longitudinal axis when resetting the circuit breakers.

At 17:05, air traffic control advised that the altitude information of N400AJ on the radar screen was no longer visible. At this stage, both the primary flight display (PFD) and the MFD failed on the SIC's side in the cockpit. Shortly afterwards the PIC's PFD and MFD also failed. The SIC no longer had radio contact on her side and the intercom was no longer working. ATC was barely audible for the PIC. He could confirm the revised altitude clearance to FL 100.

At 17:06 the PIC responded to air traffic control's question regarding the current altitude of N400AJ as follows: *"…Altitude, ah, but we lost almost everything."* Air traffic control then demanded an immediate climb to the minimum safe altitude of 6000 ft QNH. At this moment, N400AJ was already above this altitude and climbing.

The PIC then switched the battery to the emergency operation (EMER) position. This fed the remaining battery charge to the emergency bus, which supplied the most important electrical systems. He also manually switched his PFD to the MFD display screen on the right of the PFD. The summary page on this screen then provided the primary flight display, the engine data and the essential navigation data. This screen was also powered by an uninterruptible power supply (UPS). The pitch trim worked in emergency trim, but it was no longer possible to trim the roll axis.

At 17:08, N400AJ was at FL 100. The PIC requested radar vectors back to runway 14 in Zurich. Approximately one minute later, N400AJ received clearance to descend to 6000 ft QNH. At this stage of the descent, the SIC realised that the PIC had decided to return to Zurich. The SIC had stopped talking to the PIC, because during the climb the PIC had signalled that he almost could not hear air traffic control anymore. The SIC then independently began with landing preparations. The destination aerodrome elevation was re-entered for the cabin pressure system, the approach speed was determined for the current aircraft mass, and the instrument landing system (ILS) data for runway 14 including the approach charts were looked up on a tablet computer. According to the crew, the intercom was still not working.

The aircraft crossed the extended runway 14 centreline at an altitude of 4000 ft QNH and received a new heading from approach control to intercept the runway 14 localizer. Shortly afterwards, the crew noticed that the flaps could not be extended anymore. It was also no longer possible to extend the landing gear normally. The PIC requested the alternate gear extension checklist. However, the SIC could not find this checklist in due time. In order to gain time, the PIC requested permission from air traffic control to perform a 360° turn during the approach. Shortly before this, N400AJ had exited the clouds and the crew was able to see runway 14.

After completing the 360° turn, the landing gear was extended and the PIC attempted to reduce the approach speed to the required speed for an approach with retracted flaps. The aircraft was now in the final approach phase, slightly over the nominal glide slope. The thrust levers were in the idle position. The PIC was not able to reduce the approach speed as intended. The crew discussed briefly the possibility of normal braking not being available after landing. The SIC then removed the safety wire on the emergency brakes.

The PIC decided to keep the aircraft in the air as long as possible before landing to further reduce the touch down speed. N400AJ touched down just before the half-way point of the runway at 17:22. The PIC decelerated the aircraft and vacated the runway at the first possible taxiway H1, a highspeed taxiway.

Approximately 100 m short of taxiway Z, N400AJ had to hold for approximately 10 minutes due to other traffic. During this time, the PIC was considering the possible cause of the events and discovered that the battery voltage was very low. The two generator charge indicators, which are located next to the battery voltage display, did not indicate any charging current.

With the engines running, the PIC operated the generator reset switch on the overhead panel and observed that the left and right generator charge displays were once again in the normal range. The 4 screens once again showed the appropriate display. A little later, when the PIC attempted to continue taxying, the crew felt that something was wrong with the main landing gear tyres and suspected one or more failed tyres. At the same time, the fire brigade signalled that N400AJ must not continue taxying. The PIC stopped the aircraft and informed the relevant control centre that N400AJ would have to turn shut down its engines at this point.

The passengers vacated the aircraft normally via the airstairs and were taken into the airport building, while the crew remained with the aircraft. No one was injured.

1.1.4 Location of the serious incident

Location	Zurich Airport (LSZH)
Date and time	12 June 2012, 17:01
Lighting conditions	Daylight

1.2 Injuries to persons

1.2.1 Injured persons

Injuries	Crew	Passengers	Total number of occupants	Others
Fatal	0	0	0	0
Serious	0	0	0	0
Minor	0	0	0	0
None	2	7	9	Not applicable
Total	2	7	9	0

1.3 Damage to aircraft

The aircraft suffered minor damage.

1.4 Other damage

There was no other damage.

1.5 Personnel information

1.5.1 Flight crew

1.5.1.1 Pilot in Command

1.5.1.1.1 General

Person	German citizen, born 1952
Licence	Airline transport pilot certificate, issued by the Federal Aviation Administration (FAA) on 13 January 2009
Ratings	Type ratings BE-400 and MU-300
Last proficiency check	Recurrent training on 2 September 2011 at CAE SimuFlite in Dallas/USA

Based on available information, the PIC started duty well-rested and in good health. There are no indications that fatigue was a factor at the time of the serious incident.

1.5.1.1.2 Flying experience

Total	11,165 hours
on type BE-400	3,424 hours
on the type involved in the incident	34 hours
during the last 90 days	34 hours
of which on the type involved in the incident	34 hours

1.5.1.2 Second in Command

1.5.1.2.1 General

Person	German citizen, born 1967
Licence	Commercial pilot certificate, issued by the FAA on 4 September 2010
Ratings	Type ratings BE-400 and MU-300
Last proficiency check	Recurrent training on 2 September 2011 at CAE SimuFlite in Dallas/USA

Based on available information, the SIC started duty well-rested and in good health. There are no indications that fatigue was a factor at the time of the serious incident.

1.5.1.2.2 Flying experience

Total	1240 hours
on type BE-400	754 hours
on the type involved in the incident	30 hours
during the last 90 days	30 hours
of which on the type involved in the incident	30 hours

1.5.2 Crew experience and training

1.5.2.1 Training information provided by Nextant Aerospace

Nextant Aerospace provided the following information regarding the process and content of training on the aircraft:

Training on type Nextant 400XT included 4 hours of interactive computer based training with aided instructions for both pilots. The training areas covered were those as listed in the *"Acceptable Operator Difference Requirements (ODR)"* as published in the "*FAA Flight Standardization Board Report Revision 1"* for type BE-400. Both pilots passed the theory test.

The PIC received 4.1 hours of practical instruction in an aircraft with the same modification status as N400AJ. The training involved practical application of the acquired knowledge including cockpit procedures and application of the checklist. A flight with multiple instrument approaches, as well as take-offs and landings was completed.

In addition to the above flying hours, the PIC received 1.4 hours of instruction during the customer acceptance flight of his company’s aircraft, which included two precision approaches. The SIC was an observing passenger.

The SIC received 2.2 hours of practical instruction on her company’s aircraft. Multiple approaches, take-offs and landings were performed. The PIC was an observing passenger.

1.5.2.2 Training information provided by the crew

The crew of N400AJ provided the following information regarding the process and content of training and their experience on the aircraft:

The aircraft downtime of approximately 5 months (from 2 December 2011 until customer delivery after the modification on 7 May 2012), led to a decrease in the general training level of the crew.

This was less noticeable in the case of the PIC than of the SIC because of his large number of total hours on the aircraft type. Prior to the conversion of the aircraft, the SIC had usually flown as PIC under supervision.

As prior to the delivery of N400AJ no appropriate flight simulator was available that represented the Nextant 400XT modification, difference training was performed at Nextant. This training focused primarily on the most important new features of the avionics and engines. It was not adapted to the long interruption to the training of the PIC and SIC. The theoretical instruction on the differences was provided through computer-based training, while practical instruction on the new Proline 21 avionics system was performed using a procedure training device. During flying training, the checklists were executed silently by the instructor, while the PIC and SIC focused on the operation of the aircraft. From the perspective of the crew, neither they nor the training staff recognised that both the PIC and the SIC were not sufficiently addressing the new cockpit layout and slightly modified checklist with sufficient intensity. According to the statement of the crew, the SIC who prior to the conversion had primarily flown as PIC under supervision in the left seat, would have required intense procedure training in an aircraft on the ground.

Even after taking delivery of N400AJ, in the case of the abnormalities that occurred on an irregular basis in the cockpit, the crew was often unsure whether the issue was due to differences between the Proline 4 and Proline 21 avionics systems or a technical failure. The crew stated that for various reasons, the aircraft was not available to them for any extended period of time either at the manufacturer or at their own site in order to familiarise themselves with the new cockpit.

1.6 Aircraft information

1.6.1 General information

Registration	N400AJ
Aircraft type	Beechjet 400A, converted to Nextant 400XT in accordance with supplemental type certificates (STCs)
Characteristics	Twin-jet executive aircraft, constructed as a cantilever low-wing aircraft of full metal construction with T-tail and retractable landing gear in nosewheel configuration
Manufacturer	Hawker Beechcraft Corporation, USA
Year of manufacture	1997
Serial number	RK-137
Owner	AptarGroup Inc., 475 West Terra Cotta Avenue, Crystal Lake, USA
Operator	German Technologies GmbH, 475 West Terra Cotta Avenue, Crystal Lake, USA
Engines	Williams International FJ44-3AP
Operating hours	Airframe: 3491 hours Engines: 29 hours
Number of landings	2566
Max. permitted masses	Max. permitted take-off mass 16,300 lb Max. permitted landing mass 15,700 lb
Mass and centre of gravity	The mass of the aircraft at the time of departure was 15,100 lb. Both the mass and centre of gravity were within the permitted limits according to the aircraft flight manual (AFM).
Maintenance	A maintenance organisation in Augsburg maintained the aircraft.
Technical limitations	The following entries were listed in the hold item list (HIL): *"pitch sync at yoke left"* and *"xpdr ident button left not functioning"*
Fuel	According to the statement of the crew, the wing tanks were full and there were 55 lb of fuel in the fuselage tank when the engines were started. There were therefore 2905 lb of fuel on board.
Certificate of Aircraft Registration	Issued by the FAA on 13 July 2011, valid till 31 July 2014.

Airworthiness certificate	Issued by the FAA on 29 March 1997, valid as long as the aircraft is maintained in accordance with regulations or till deletion from the aircraft registry.
Scope of Utilisation	Non-commercial corporate operation
Category	IFR Category I
Modifications	The following modifications were signed-off on 7 May 2012: STC SA659CH-T: Rockwell Collins Pro-Line 21 (EFIS) avionics system with Rockwell Collins FMS-6100 STC ST02371LA: Williams FJ44-3AP engines STC 03960AT: In-flight entertainment system

1.6.2 Modifications and conversions

1.6.2.1 General

The original version of N400AJ was equipped with two Pratt & Whitney Canada JT15D-5 engines and a Collins Proline 4 avionics system.

Nextant Aerospace LLC, based in Ohio, USA modified this aircraft with Williams International FJ44-3AP engines. These engines were each equipped with a full authority digital engine control (FADEC). Furthermore, the Proline 4 avionics system was replaced by a Proline 21 avionics system with FMS-6100. These changes were carried out using various STCs. The new model designation after implementation of these STCs was Nextant 400XT. N400AJ was the tenth aircraft being converted under these STCs.

1.6.2.2 Annunciator system

In the original version of the aircraft (model 400A) the annunciators of the master warning/caution system (MWCS) were mounted in two vertical rows between the main display screens (see Annex 3). The top six displays were red warnings. Below these were 20 amber caution displays. Two annunciations could be displayed in each field. The two displays for off-line or failed generators were situated in the centre of the amber displays, which corresponded approximately to the horizontal centre line of the screens. This was the arrangement with which the crew was familiar on the basis of their experience.

Because of the size of the new screens, there was no room for the MWCS displays on the instrument panel. As part of the modification to the 400XT an annunciator panel was therefore mounted below the overhead panel.

The annunciators were arranged in 4 groups of 15. All red annunciators are located in the left group, closest to the central field of vision of the pilot in the left seat. The amber annunciators for deactivated or failed systems are to the right of these. In the middle of these three groups are the annunciators for the operating status of the two generators (see Annexes 4 and 5).

1.6.2.3 Electrical system

In principle, the electrical system remained unchanged.

In addition to the two existing PS 835 uninterruptible power supplies (UPS) a third such system was installed. A UPS is a small emergency battery that is kept charged during normal operation. The power supply is routed to the connected systems via the UPS. In the event of loss of power to an electrical bus, the connected systems are automatically operated for a certain amount of time by the energy stored in the UPS.

Some electrical consumers were also connected to different buses.

1.6.3 Description of the electrical system

The primary components of the type 400XT electrical system (see Annex 2) are a main ship battery and two generators, each driven by an engine. The generated electrical power is distributed through a system of buses to the consumer systems. These buses are designated as follows and are described as follows by Nextant Aerospace:

- start bus
- battery charge bus
- left and right main bus
- left and right load bus
- left and right radio bus
- left and right overhead bus
- left and right non-essential bus
- hot battery bus
- emergency bus
- standby bus
- aux battery bus

1.6.3.1 Start bus

"*The start bus is fed by the main ship battery and optionally by an external ground power unit (GPU).* […] *Selecting an engine for start and pressing the corresponding start button connects the start bus to the generator and places the corresponding GCU into start mode. Each generator will be placed in generate mode once all of the following conditions are met:*

1. *Start cycle has successfully completed,*
2. *Engine start selector toggle switch moved to neutral or to the opposing engine position,*
3. *Generator reset switch is moved momentarily to RESET, then to NORM.*
4. *Generator master switch is in NORM."*

1.6.3.2 Battery charge bus

"This bus is fed by the left and right main buses which in turn receive power from the corresponding generator. The battery charge bus feeds the start bus and ultimately the main ship battery for the purpose of battery charging unless the battery master switch is in the EMER position. Placing the main ship battery into EMER position isolates the battery from all other systems except those fed by the emergency and hot battery buses"

1.6.3.3 Main buses

"Each main bus is fed by its corresponding generator and feeds the battery charge bus and corresponding on-side load bus through a series of remote circuit breakers (RCCB). The RCCBs are controlled in the cockpit by low current control CBs and can be remotely reset. Certain aft aircraft systems and high current systems are fed directly off the main buses. The main bus to load bus electrical wires are protected by a ground fault circuit which open the RCCBs if a fault is detected."

1.6.3.4 Load buses

"The load buses are the main power connection from the battery/generator/GPU to the various electrical systems. Each bus is connected to the other via a load bus tie RCCB to allow each power source to supply power to systems located on either load bus. The load tie breaker can be opened by the crew in the event it is necessary to isolate one load bus from the other. The design of the load buses took into consideration the need to power alternate corresponding systems in the event of a failure in one of the load buses. As such the LH load bus typically powers the #1 systems and RH the #2 systems. In the case of systems that lack redundancy, these systems were assigned to the load bus with the most available capacity."

1.6.3.5 Radio buses

"These buses are powered from their corresponding load bus through a circuit breaker in the cockpit. Generally the LH radio bus powers the #1 radios and in like manner the RH Radio Bus the #2 radios. Differences between the 400A and 400XT variants are principally the differences in Proline 21 vs. Proline 4 avionics systems.

1.6.3.6 Overhead buses

"These buses power systems that are controlled from the cockpit overhead panel. The systems on these buses were, for the most part, unchanged."

1.6.3.7 Non-essential buses

"The non-essential buses service the cabin entertainment system appliances as well as certain systems that were deemed excess of those necessary to operate the aircraft safely."

1.6.3.8 Hot battery bus

"This bus powers ground comm, battery volt meter, and cabin entry and aft entry lights. These systems are fed directly from the main ship battery and are live constantly unless an individual system CB is tripped."

1.6.3.9 Emergency bus

"The emergency bus powers electrical systems that are deemed critical to the safe operation of the aircraft. The bus is fed from either load bus in normal operation. Placing the battery switch in the EMER position opens the contactors between the battery and GPU to the start bus and therefore the load buses. At the same time a contactor is closed between the main ship battery and the emergency bus. This powers the emergency bus systems directly from the battery thus isolating any failure in load and main buses. This limits the useful operating time of the emergency bus systems to the capacity of the main ship battery. Unless the crew powers down unneeded systems immediately after selecting the EMER position on the battery master, useful operating time can be as little as 15 minutes."

Some extremely critical systems are dual powered, once from the emergency bus and a second time from the aux or standby bus (e.g. AHRS #1). This affords additional operating time as the standby and aux buses are powered by independent uninterruptable power supplies (PS835)."

It should be noted that even if the emergency bus is isolated by switching the battery switch to the EMER position, it cannot provide electrical power to the connected systems if the main ship battery is depleted.

1.6.3.10 Aux battery bus

"This bus is powered by both load buses through two independent PS835 uninterruptable power supplies. This bus is capable of operating for more than 50 minutes after the load buses cease to provide power. The aux battery bus powers the MFD 1, AHRS 1 and ADC 1, and various controls and displays necessary to operate the MFD including PFD reversionary mode (PFD/MFD combined in overlay format). The aux battery bus also powers the DCUs in order to provide secondary engine parameters to the MFD."

1.6.3.11 Standby Bus

"This bus is similar to the aux battery bus in that it provides power to essential devices. Specifically the standby bus powers the standby analog instruments, COM1 and RTU1. The standby bus is designed to provide standby power for a minimum of 30 minutes after the failure of the load and emergency buses. Unlike the aux battery bus, the standby bus must be enabled by the crew by placing the standby power switch into the ARM position. Failure to do so disables this bus."

The standby bus is fed via the emergency bus using a PS 835 uninterruptible power supply (UPS).

1.6.4 Master test rotary switch

On the overhead panel is the master test switch and the corresponding GO and NO GO indicator lights. This rotary switch has the following positions:

- OFF
- R GEN GND FAIL
- FLAP ASYM
- L FIRE DET
- R FIRE DET
- L STALL
- STBY POWER
- R STALL
- L GEN GND FAIL

Figure 1: Master test switch

This switch is used to test eight essential systems. This is achieved by simulating system failures. A successful test is confirmed with the GO indicator light.

By turning the switch to the R GEN GND FAIL or L GEN GND FAIL position after starting the engine and with activated generators, a successful test is indicated as follows:

- The green GO indicator light illuminates to indicate that the test has been successfully completed.
- The corresponding generator goes offline.

- The corresponding amber GEN OFF caution on the MWCS illuminates.
- The amber master caution light flashes until it is cancelled by pressing the indicator. However, the GEN OFF caution on the MWCS remains until the corresponding generator is reactivated using the reset function.

1.6.5 System behaviour in the case of deactivated generators

When both generators are offline, the main ship battery powers the electrical system or the uninterruptible power supplies (UPS) until they are depleted.

In ideal conditions, the battery capacity is approximately as follows:

Main ship battery:	< 30 minutes
Auxiliary bus UPS:	50 minutes
Standby bus UPS:	30 minutes from the time of the interruption of the supply from the emergency bus

The manufacturer's procedures fundamentally require that in such a case the main ship battery switch be switched from the ON position to the EMER position to shed the battery load.

The uninterruptible power supplies (UPS) for the auxiliary bus and the standby bus activate upon a corresponding voltage drop in the main ship battery.

The systems still available on these buses are:

- Left attitude heading reference system (AHRS)
- Left air data computer (ADC)
- Left MFD, displays information including the primary engine data
- COM 1
- A file server unit (FSU), on which the electronic charts are stored
- Secondary engine displays
- All emergency instruments

The navigation receiver (NAV 1) is only available as long as there is sufficient main ship battery voltage.

The following major systems are no longer available after the main ship battery is depleted:

- Flaps
- Normal landing gear operation
- Anti-skid system
- Airbrakes
- Electric trim
- Ice protection system for horizontal stabilizer and windscreen

1.6.6 Emergency procedures according to the Nextant 400XT check list supplement

The following relevant procedures can be found in the Nextant 400XTaircraft flight manual (AFM):

"Section 3 Emergency Procedures

ELECTRICAL SYSTEMS

LOSS OF BOTH GENERATORS (L AND R GEN OFF ANNUNCIATORS ILLUMINATED)

1. GEN FLD and START/GEN Circuit Breakers (AFT MAIN PANEL).....CHECK

2. Generator Reset (L and R) ………………..………………...…...RESET/NORM

(…)

If Neither Generator Comes On:

4. Battery …………………………………………………………………......EMER

5. Master Generator Switches ……………………………………...……...EMER

6. Pitch Trim ………………………………………………………...……...EMER

7. Land ……………………………………………NEAREST SUITABLE AIRPORT

(…)"

1.7 Meteorological information

1.7.1 General meteorological situation

Western and Central Europe were situated below a longwave trough. This contained an area of low pressure with multiple centres, stretching from Scandinavia to the Adriatic Sea.

1.7.2 Weather at the time of the accident

The sky was overcast. The main cloud base was at 3000 ft AAE[2]. 1/8 - 2/8 stratus clouds were also observed at 900 ft AAE. At ground level, there was moderate rain and a weak south-westerly wind. The wind direction varied between south-easterly and south-westerly.

Weather/cloud	1/8 - 2/8 ST 900 ft AAE 8/8 SC at 3000 ft AAE
Visibility	6 km
Wind	200 degrees at 5 kt, variable between 150 and 230 degrees
Temperature/dew point	13 °C / 12 °C
Atmospheric pressure QNH	1007 hPa
Hazards	None
Trend	Within the next 2 hours, visibility will periodically, but for less than an hour in total, reduce to 5000 metres.

1.7.3 Astronomical information

Position of the sun	Azimuth: 260°	Elevation: 41°
Lighting conditions	Daylight	

[2] AAE: above aerodrome elevation.

1.8 Aids to navigation

1.8.1 Information regarding aids to navigation and landing

The instrument landing systems of runways 14 and 16 were fully operational at the time of the serious incident.

1.9 Communications

Radio communication between the pilot and the ground control unit was characterised by occasionally marginal intelligibility due to the on-board system failures. The crew declared neither an emergency nor an urgency message. However, the crew informed air traffic control of the loss of essential displays in the cockpit.

1.10 Aerodrome information

1.10.1 Runway equipment

The Zurich Airport runways have the following dimensions:

Runway	Dimensions	Elevation of runway thresholds
16/34	3700 x 60 m	1390/1388 ft AMSL[3]
14/32	3300 x 60 m	1402/1402 ft AMSL
10/28	2500 x 60 m	1391/1416 ft AMSL

1.10.2 Rescue and fire-fighting services

The airport's fire brigade was on permanent standby duty during flight operations and was deployed during the incident.

1.11 Flight recorders

1.11.1 Flight data recorder

Not required, not fitted.

1.11.2 Cockpit voice recorder

It was possible to analyse the cockpit voice recorder (CVR).

1.11.3 Engine control recording

It was possible to read out the full authority digital engine control (FADEC).

The following fault was recorded with time stamp 15:07:40 UTC:

"Fault name: T2_HEATER_FAULT: NE

Heater Reported OFF w/bleed; Below Minimum Limit (Open Circuit Detection)"

The following fault was recorded with time stamp 15:09:36 UTC:

"Fault name: POWER_SETTING_FAULT: ND*”*

The following fault was recorded with time stamp 15:14:05 UTC:

"Fault name: AIRCRAFT_POWER_FAULT: ND

28 V airframe power signal below minimum limit"

[3] AMSL: above mean sea level.

1.11.4 Maintenance data computer

In the context of the investigation the memory of the maintenance data computer (MDC) was read out. On 12 June 2012 at 15:01 UTC, 8 fault messages were generated, which can be explained by the course of the power failure event.

The entries for the period of 14 days prior to the serious incident showed no recordings relevant to the event.

1.12 Wreckage and impact information

The main wheel thermal fuses vented air after a few minutes after landing due to overheating. The left and the right braking systems exhibited clear signs of overheating.

Figure 2: Left braking system

Figure 3: Right braking system

1.13 Medical and pathological information

There are no indications of the pilots suffering health problems during the flight.

1.14 Fire

Fire did not break out.

1.15 Survival aspects

Not applicable

1.16 Tests and research

Not applicable

1.17 Organisational and management information

1.17.1 Private corporate operation

The aircraft N400AJ was privately operated according to the FAR[4]/CFR[5] Part 91 requirements by a corporation.

Private corporate operation means the carriage of persons and goods in the interests of the business and not on behalf of any third party.

[4] FAR – Federal Aviation Regulations

[5] CFR – Code of Federal Regulations

1.18 Additional information

1.18.1 Aircraft operating documents

1.18.1.1 General

Nextant Aerospace provided the owner and operator with comprehensive documentation after the conversion of the aircraft. In addition to the existing and largely still applicable AFM and Pilot Operating Handbook (POH), supplements were also published. These supplementary documents contained new information on topics affected by the conversion. They are used in parallel to the existing documents. It is the responsibility of the crew to use the new information from the supplements when necessary and to ignore the corresponding superseded information in the original documents.

In addition to the AFM and POH, which are relatively voluminous and therefore cumbersome for use in the cockpit, Nextant Aerospace has created a significantly abbreviated version (single card checklist). This checklist is based on the NXT1 checklist supplement created by Nextant. According to statements of the crew, this abbreviated checklist was used during the training flights at CAE SimuFlite.

At the time of the serious incident, the crew had information from the following documents regarding the operation of the aircraft:

- Airplane Flight Manual (AFM) for Beechjet model 400A (Hawker 400XP)
  Hawker Beechcraft, 23 June 2011.
- Airplane Flight Manual Supplement for Hawker Beechcraft 400A with Williams engines, Collins Proline 21 Cockpit
  Nextant Aerospace, NXT1-AFMS, First Edition 15 September 2011.

  The following comment can be found in this document:

  "The operating procedures that are outlined in this section are to be used in conjunction with the original Beechjet 400A AFM. Procedures outlined within this section are only the procedures that have been affected by this installation. Disregard Tests and procedures outlined in the original AFM for EFC[6] and Thrust Reversers as these systems have been removed. Refer to original Beechjet 400A AFM for procedures not listed."
- Airplane Flight Manual Supplement for Hawker Beechcraft 400A Collins Proline 21 with FMS-6100 and Williams FJ44-3AP Engines
  Nextant Aerospace, First Edition, 2 September 2011.

  This document primarily contains information about systems that were changed during modification. It contains only a few checklists, which are not of relevance to the serious incident.
- Checklist Supplement for Nextant 400XT
  Nextant Aerospace, First Edition 21 December 2011.

  The following comment can be found in the "Preflight Inspection" section of this document:

  " 9. Airplane Flight Manual (AFM) / Pilot’s Operating Manual (POM) ON BOARD
  10. AFM Supplement for Collins Proline 21 ON BOARD
  11. AFM Supplement for Williams Int. FJ44-3AP & Collins Proline 21 w/ EIS ON BOARD"
- Single Card Checklist for Nextant BE-400XT
  FJ44-3AP Rev 2 and Rev 6 of 19 December 2011.

[6] EFC – electronic fuel control.

- Pilot Checklist for Beechjet/Hawker 400XP, model 400A
  Raytheon Aircraft Company (with FlightSafety International logo).
- Operating Handbook for Beechjet 400A
  Published by CAE SimuFlite, with the comment "*Developed for Training Purposes Aug 06*".

  This document contains checklists and tables.
- The electronic checklist that can be displayed on the multifunction display. This corresponded to the single card checklist for Nextant BE-400XT in terms of content. The pilot can click through the displayed list using a push button on the cursor control panel (CCP) or the checklist line advance switch.

The crew worked with the Beechjet 400A operating handbook by CAE SimuFlite, the Nextant BE-400XT single card checklist and the electronic checklist on the MFD.

1.18.1.2 Checklists used by the crew

According to the statements of the crew they had carried out the type rating on the Beechjet 400A and the annual recurrent training at CAE SimuFlite in Dallas/USA. The corresponding operating handbook by CAE SimuFlite was always used. Due to the intensive training they were familiar with these lists and also used them for the operation of their 400A aircraft. According to the statements of the crew, after the aircraft had been converted they had made it their habit to use three checklists to prepare for take-off. For the "BEFORE STARTING ENGINES" section they continued to use the CAE SimuFlite checklist. For the engine start they used the Nextant single card checklist and then the electronic checklist on the MFD. However, this was only intended as a temporary solution until it was possible to consolidate the detailed Nextant checklist in a handy format.

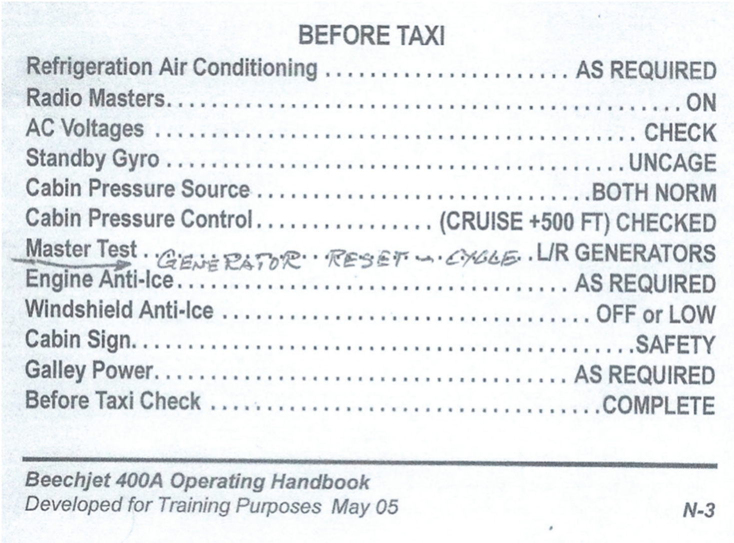
According to the statements of the crew, the CAE SimuFlite checklists corresponded to the original checklist of the aircraft manufacturer. Apart for a few minor differences, they differ in the master test step in the "BEFORE STARTING ENGINES" section, as follows:

Hawker Beechcraft Model 400A AFM and Nextant Aerospace, NXT1-AFMS	CAE Simuflite operating handbook
Master Test .... TEST NOTE *(...)* *It is permissible to recheck the STBY PWR during the TAXI procedures if the No-Go light illuminates during the initial standby power check. It will be necessary to reset a generator if the master test switch is rotated out of the OFF position subsequent to engine starting.*	*Master Test (All Except Generators)* ..... TEST

This checklist item is not mentioned in the Nextant BE-400XT single card checklist.

The checklists agree in that the position of the generator reset switches should be checked before starting the first engine. When the first engine is started with the battery, a check is conducted to ensure that the current from the respective generator is less than 150 A before the second engine is started. If both engines are running, a check is conducted to ensure the generator reset switches are in the "NORM" position.

The checklists differ in the "BEFORE TAXI" section, which follows immediately after starting the engine. The "Master Test L/R GENERATORS" checklist item, which was not explicitly carried out in the CAE SimuFlite checklist prior to starting the engine, is now noted here.



BEFORE TAXI

Refrigeration Air Conditioning .... AS REQUIRED
Radio Masters... ON
AC Voltages .... CHECK
Standby Gyro .... UNCAGE
Cabin Pressure Source .... BOTH NORM
Cabin Pressure Control................ (CRUISE +500 FT) CHECKED
Master Test . GENERATOR · RESET → CYCLE . L/R GENERATORS
Engine Anti-Ice.................................. AS REQUIRED
Windshield Anti-Ice .... OFF or LOW
Cabin Sign.. SAFETY
Galley Power.................................... AS REQUIRED
Before Taxi Check .... COMPLETE

Beechjet 400A Operating Handbook
Developed for Training Purposes May 05 *N-3*

Figure 4: Excerpt from the CAE SimuFlite checklist with the "Master Test L/R GENERATOR" checklist item and the handwritten notes of the crew.

This checklist item is not included in the Hawker Beechcraft Model 400A AFM or the Nextant Aerospace NXT1-AFMS checklists in this section.

This checklist item is represented as follows in the Nextant BE-400XT single card checklist:

"Master Test (L/R Generators)........................*Checked"*

The following checklist item is immediately below:

"DC Amps & Voltages....................................*Checked"*

Prior to take-off, in the "BEFORE TAKEOFF" section, the checklists contain an instruction that the annunciators are checked.

1.18.2 Calculation of landing distance

The mass of the aircraft at the time of landing was 14,500 lb.

A recalculation of the required landing distances based on information provided by the manufacturer, taking into account the requirements of FAR/CFR Part 91 (factored landing distance 125%) gave the following values:

On a dry runway, without an anti-skid system and a flap setting of 0° the calculated landing distance was 5320 ft (1620 m).

On a wet runway, as in the present case, the calculated landing distance increased to approximately 6120 ft (1860 m).

The available landing distance on runway 14 is 3150 m from the threshold of runway.

The distance from the half-way point of runway 14 to taxiway H1 is approximately 800 m.

The distance from taxiway H1 to the end of the runway is approximately 800 m.

2 Analysis

2.1 Technical aspects

There are no indications of any pre-existing technical defects which might have caused or influenced the serious incident.

The crew stated that they had ensured the charging current of the relevant generator was below 150 A before starting the second engine. It can therefore be assumed that at least one generator was supplying power to the on-board power supply. There is no evidence that the second generator was not functioning and supplying the electrical system with power after the second engine was started. After landing, the PIC noted that after resetting, both generators once again provided power to the electrical system and the avionics was once again operating.

2.2 Human and operational aspects

2.2.1 Flight plan and flight preparations

The N400AJ flight planned for 12 June 2012 was comprehensively prepared by the crew. No problems were expected with regards to either the passengers to be transported or the weather conditions at the take-off and destination locations. The crew was aware that before running the engines there could be a minor reduction in the aircraft battery capacity due to slightly longer use on the previous day after turning off the engines. The SIC took this into account when preparing the cockpit.

2.2.2 Application of the checklist item master test

The crew used various superseded and current checklists during flight operations. The reason given was that the SIC in particular did not feel sufficiently confident with the new checklists. Whether and in what respects they differ was not sufficiently taken into account. It was striking that the Nextant Aerospace NXT1 AFMS checklist and the abbreviated Nextant BE 400XT single card checklist were not coordinated and complete in terms of structure and content. This situation led to risks and contributed to an unstructured approach.

As the SIC had not worked through all the checklist items before the engine was started, she did this independently after the engines were started, while the PIC was busy taxiing the aircraft. The SIC conducted these checklist items out of the intended sequence. However, this approach presupposed a sufficient awareness of the status of the systems before and in particular after starting the engines.

As the SIC was working through the master test sequence, the two generators were put offline by the test signal. This went unnoticed by the crew. Neither of the caution lights for the two deactivated generators L GEN OFF and R GEN OFF were noticed, while the corresponding MASTER CAUTION light was turned off without being addressed. The fact that these lights had been rearranged made this more likely to occur (cf. Annexes 3, 4 and 5).

The note in the Nextant Aerospace NXT1-AFMS is as follows: *"It will be necessary to reset a generator if the master test switch is rotated out of the OFF position subsequent to engine starting".*

Because the generators were not reset, the SIC clearly operated the master test rotary switch with insufficient system knowledge or without sufficient awareness.

It is worth noting that the master test remained unchanged both technically and in relation to operation after the conversion of N400AJ to a Nextant 400XT.

2.2.3 Crew cooperation

The crew knew each other well. There was no evidence of negative factors in the cooperation. There was a clear difference in experience between the PIC and the SIC. Cross monitoring was inadequate.

The crew's work methodology and structure degraded during irregularities in flight operations. Examples of this are:

- The request for taxi clearance by the PIC before the necessary preparations had been completed.
- The unaddressed turning off of the MASTER CAUTION light.
- Insufficient checking of the annunciators on the master warning/caution system (MWCS) before take-off.
- Insufficient analysis when the STBY PWR ON amber warning light was illuminated.

After the onset of the first system failures shortly after take-off the error-proneness of the work structure of the crew was revealed in the biased perception and the failure to analyse the fault. The PIC attributed these initial system failures to technical shortcomings that were known from previous flights, and missed the opportunity to perform an immediate and systematic analysis. There was no structured approach to identify and remedy the cause of the failure.

The experienced PIC in the role of pilot flying may have initially been busy, but the SIC, who had somewhat more capacity as pilot not flying, was clearly unable to compensate for this degradation of working structure at this critical juncture.

It was not possible to distribute the workload between the crew members sufficiently during the course of the electrical power loss. A further example of this was the PIC's request for the emergency gear extension checklist during the final approach, which the SIC was only able to find after a certain period of time and with the help of the PIC, who remained calm.

2.2.4 History of the flight

It is understandable that the crew wanted to land again as quickly as possible as a result of the events.

The PIC retained his role as pilot flying. This resulted in a significant workload due to the aircraft's restricted trimming capability, the communication with air traffic control and preparation for a landing without flaps. He also assisted the SIC in the emergency extension of the landing gear. The result was an approach above the nominal glide slope with excessive speed. Instead of a controlled touchdown in the normal landing zone, the PIC decided to reduce the excessive speed of the aircraft in the air. The touchdown therefore only took place shortly before the half-way point of the runway. The aircraft was decelerated over a distance of approximately 800 m up to taxiway H1. This resulted in an exceedance of the maximum permissible operating temperature of the brakes. The remaining distance from H1 to the end of the runway was approximately 800 m.

2.2.5 Crew training

Training on the converted aircraft, particularly in reference with its new avionics system, was not sufficiently comprehensive. The content of the difference training must include knowledge of the prescribed documents and checklists, as well as proper application of them. The fact that no procedure trainer was available to train the crew and that no emphasis was placed on working through the checklist correctly puts the quality of the training in question.

Evidently neither the crew nor the training personnel placed sufficient emphasis on the application of the new operational documentation for the modified cockpit during the practical part of the difference training. Working with the current checklists was not practised sufficiently. The 5-month interruption of training was insufficiently considered in relation to the required procedure training.

The significant changes to the position of the annunciators in the field of vision of the crew were also insufficiently addressed.

3 Conclusions

3.1 Findings

3.1.1 Technical aspects

- The aircraft was certified for IFR category I.
- Both the mass and centre of gravity of the aircraft were within the permitted limits according to the AFM.
- There are no indications of any pre-existing technical defects which would have caused or influenced the serious incident.
- N400AJ was equipped with a new engine type and new avionics by Nextant Aerospace in accordance with supplemental type certificates (STCs).
- The location of the annunciators in the field of vision of the crew has been changed with the modification of the aircraft.
- The master test remained unchanged both technically and in relation to operation after the conversion of N400AJ to the Nextant 400XT.
- Turning the rotary switch from the OFF position to either of the first positions in order to work through the various test sequences separates both generators from the electrical system.
- When both generators are offline, the entire electrical system is powered by the main ship battery or the uninterruptible power supplies (UPSs) until they are completely depleted.

3.1.2 Crew

- The crew held the necessary licences for the flight.
- There are no indications of the crew suffering health problems during the flight.
- The crew were trained for the modified aircraft by means of a difference training.

3.1.3 Operational aspects

- The crew used various superseded and current checklists during flight operations.
- The day before, the crew had left the avionics system and the battery switched on for approximately 10 minutes.
- The Nextant Aerospace NXT1-AFMS checklist stipulates that the master test be performed before starting the engines.
- The SIC completed checklist items, including the master test, independently after the engines were started, as she had not yet performed this step before engine start.
- In this phase, the PIC was already busy taxiing the aircraft.
- While the SIC was working through the master test, the two generators were separated from the electrical system by the test signal. This went unnoticed by the crew.
- As N400AJ entered the clouds, FMS 2 failed. This was followed by other system failures due to the draining batteries.
- At 17:06 the PIC answered air traffic control's question regarding the current altitude of N400AJ as follows: *"…Altitude, ah, but we lost almost everything*."

- The PIC then switched the battery to the emergency operation (EMER) position.
- The pitch trim worked in emergency trim, but it was no longer possible to trim the roll axis.
- The crew decided to land in Zurich as quickly as possible.
- The approach to runway 14 was above the nominal glide path with excessive speed.
- N400AJ touched down just before the half-way point of the runway at 17:22.
- The aircraft was decelerated over a distance of approximately 800 m up to taxiway H1.
- This resulted in exceeding the maximum permissible operating temperature of the brakes.
- A distance of approximately 800 m from taxiway H1 to the end of the runway was still available.
- The main wheel fuse plugs vented air after a few minutes after landing due to the overheating. The left and the right braking systems exhibited clear signs of overheating.
- After landing, the PIC noted that after resetting both generators they provided power to the electrical system once again and the avionics system then functioned normally.
- No one was injured.

3.1.4 General conditions

- The sky was overcast. The main cloud base was at 3000 ft AGL. 1/8 - 2/8 stratus clouds were also observed at 900 ft AGL.
- No appropriate simulator or procedure trainer was available for the Nextant 400XT type training.
- During the Nextant 400XT type training, insufficient emphasis was placed on the use of the new operating documents in the modified cockpit.

3.2 Causes

The serious incident is attributable to the fact that an unrecognised system operating error by the crew during take-off preparations led to a widespread electrical power supply failure, which resulted in an emergency landing.

The following factors contributed to the serious incident:

- The crew's method of working was not sufficiently attentive or systematic.
- The crew's operating documents were inadequate.
- The difference training for the crew was insufficient.

4 Safety recommendations, safety advices and measures taken since the serious incident

4.1 Safety recommendations

None

4.2 Safety advices

None

4.3 Measures taken since the accident

None

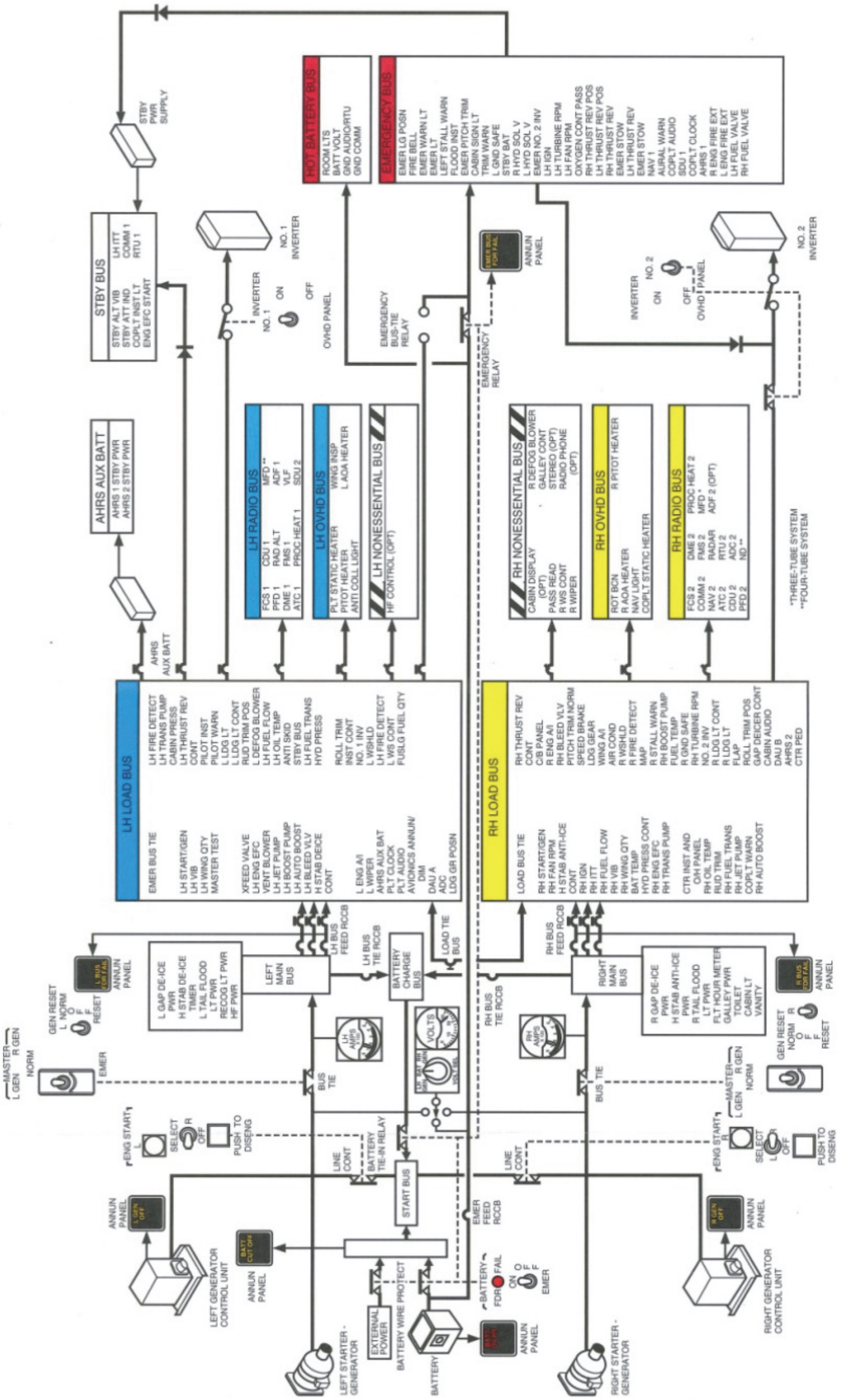
Payerne, 1 September 2015 Investigation Bureau STSB

This final report was approved by the Board of the Swiss Transportation Safety Investigation Board STSB (Art. 10 lit. h of the Ordinance on the Safety Investigation of Transportation Incidents of 17 December 2014).

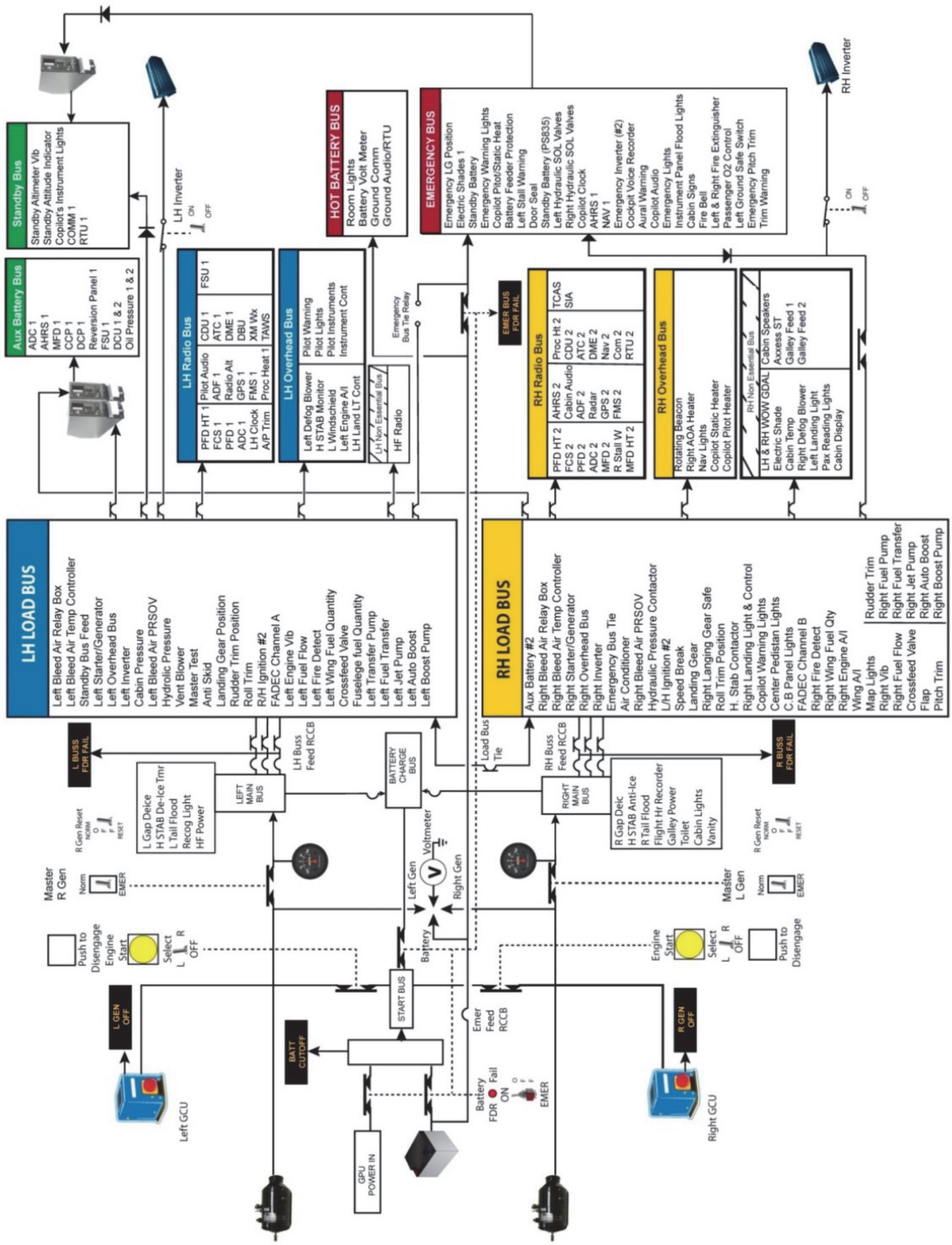
Berne, 20 August 2015

Annexes

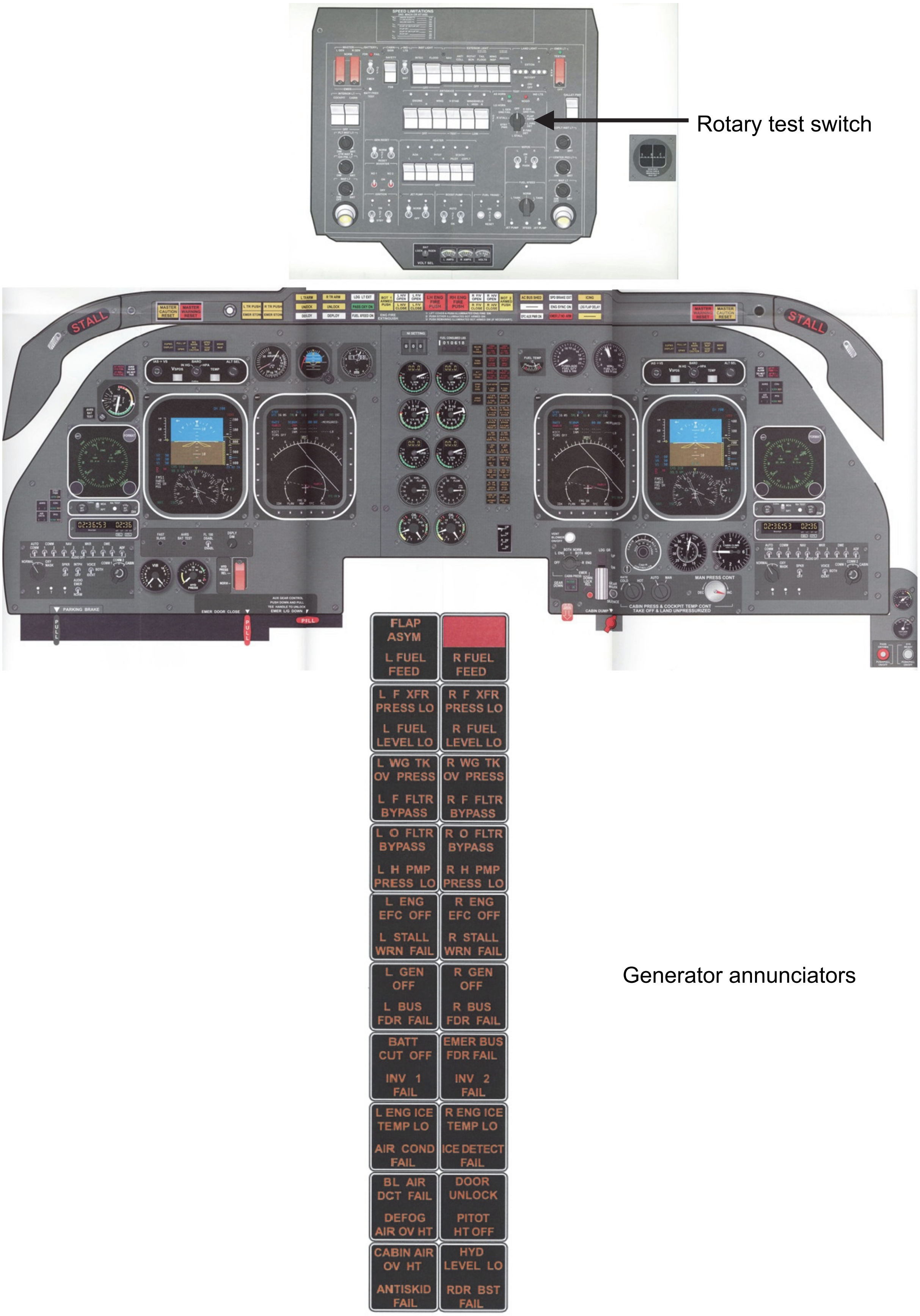
Annex 1: Original layout of the electrical system (Type 400A)



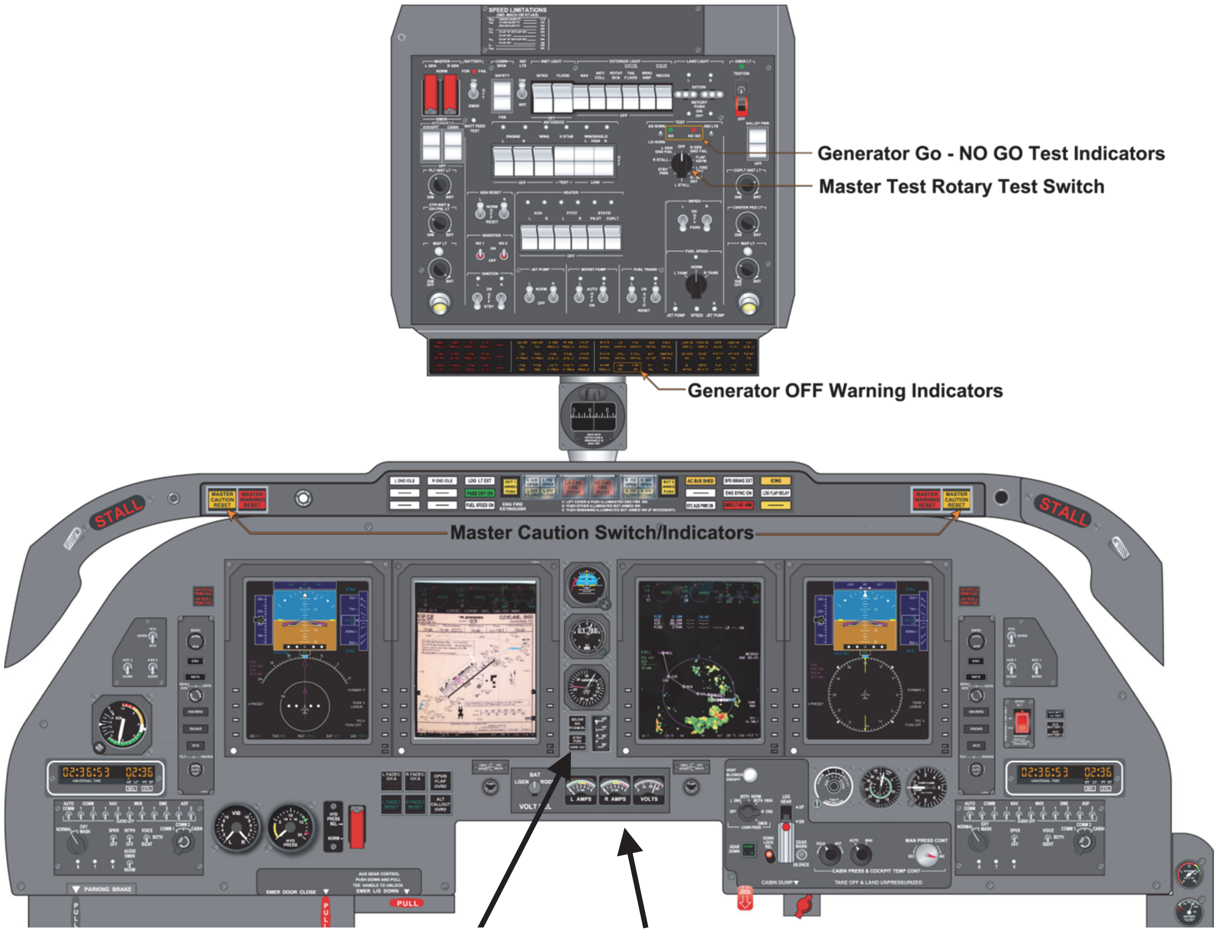
Annex 2: Modified layout of the electrical system (Type 400XT)



Annex 3: Original layout of the cockpit displays and controls (Type 400A)



Annex 4: Modified layout of the cockpit displays and controls (Type 400XT)



STBY PWR lights: green "*arm*", orange "*on*". Electrical displays (power and voltage)

Annex 5: Master Caution/Master Warning (MCMW) Panel on Type 400XT

During the modification to type 400XT the Master Caution/Master Warning (MCMW) was moved from the instrument panel (see Annex 3) to the bottom of the overhead panel (see Annex 4 above).