Service Investigation

Accident / Incident Report

P&WC 8114 (11-98)

Pratt & Whitney Canada
A United Technologies Company

Report No.: 19-122

JRM Air LLC
Textron Aviation 680A, N8JR
Elizabethton, Tennessee
August 15th 2019
PW306D1
Left Hand Engine S/N CN0015
Right Hand Engine S/N CN0016

[redacted]

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Service Investigation Department

[redacted]

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	U.S.	P-ECCN NSR	P-USML NSR
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		LOCAL REGULATION	
	CANADA	EIPA (ECL)	DPA (CG)
		NSR	NSR

Table of Contents

I ANALYSIS

1.0 ACCIDENT SYNOPSIS

On August 15th 2019, a Textron Aviation Inc. 680A, Aircraft Reg. No. N8JR, overran the runway after landing at the Elizabethton Municipal Airport, in Elizabethton, Tennessee. The pilots were not injured. One passenger received minor injuries and two passengers were not injured. The aircraft was destroyed.

2.0 SUMMARY OF FINDINGS

The visual and borescope examinations of the left and right engines did not reveal any evidence of any pre-impact mechanical anomalies that would have precluded normal engine operation.

The EDU's from each engine were interrogated. Communication was established with the left hand engine EDU. It was not possible to establish communication with the right hand EDU. Records contained in the left EDU indicated that the left engine and the engine control system performed according to design intent. Based on the data in the left EDU recordings and the right engine behavior was consistent with the left engine. Traces from the No. 1 engine EDU indicated that the power lever was moved to idle after landing and when the aircraft touched down on the runway the weight on wheels (WOW) signal transitioned to on ground. At this time the power lever was moved to the reverse region to initiate the thrust reverser (T/R) deployment. The aircraft bounced three times, resulting the WOW signal changing to in air and back to on ground. The T/R switch feedback indicated that the reverser was stowed until the third bounce. After the third bounce the power lever was moved to forward idle, and feedback from the T/R switches indicated that the T/R was unlatched. Following the T/R unlatch, the WOW signal from landing gear changed to in air and stayed in that state for approximately 10 seconds. The power lever was moved to the maximum forward position and the engine accelerated to approximately 75% N2. 1.4 seconds later the EEC received the T/R deployed status, 0.5 seconds later the EEC enunciated a T/R deployed in-flight (TA) fault. When the TA fault was declared, the EEC commanded the engine to idle as per design. The fuel flow rate was limited by the deceleration control loop and the fuel flow was reduced to keep the engine at flight idle.

3.0 CONCLUSIONS

The left hand EDU data indicates that the engine control system was functioning as per design according to aircraft input signals during the landing and the subsequent runway excursion. The right hand engine behavior was consistent with the left hand engine.

There were no pre-impact mechanical anomalies evident that would have precluded normal operation of the engines.

II FACTUAL INFORMATION

1.0 INVESTIGATION PARTICIPANTS

The powerplant investigations were performed on November 6th and 7th 2019 at Atlanta Air Recovery and Storage Facilities, in Griffin, Georgia. The following individuals participated in the investigation as representatives of their respective organisations:

Ralph Hicks	National Transportation Safety Board Senior Air Safety Investigator
Jeff Davis	Pratt & Whitney Canada Investigator

2.0 LEFT HAND ENGINE HISTORY

PW306-D1 S/N CN0015

Hours Since New: 1148.2 per CesCom 10-Aircraft Status Report, dated 26-Jul-2019

Cycles Since New: 770 per CesCom 10-Aircraft Status Report, dated 26-Jul-2019

3.0 LEFT HAND ENGINE EXAMINATION

All positional references are in relation to view from aft looking forward. Upstream and downstream references are in relation to gas path flow from the compressor inlet to exhaust.

3.1 **External Condition:** The aircraft was partially burned and the wings were separated from the fuselage (Ref. Photos No. 1 & 2). The engines were viewed at the storage facility separated from the aircraft (Ref. Photo No. 1). The left hand engine was orientated in upright position, resting on the heat distressed aircraft cowling (Ref. Photos No. 3 & 4). The engine was moved to the inverted position to access the bottom of the aircraft cowling. The external engine components and the bypass ducts were coated in soot and exhibited evidence of being heat distressed from exposure to the post impact fire (Ref. Photo No. 6). The engine data plate showed that the engine serial number was PCE-CN0015 (Ref. Photo No. 7).

Photo No. 1

Photo No. 2

Photo No. 3

Photo No. 4

Photo No. 5

Photo No. 6

3.1.1 External Cases

Intermediate Case: The visible exterior regions of the case were covered in soot and the paint was discoloured (Ref. Photo No. 7, red arrow).

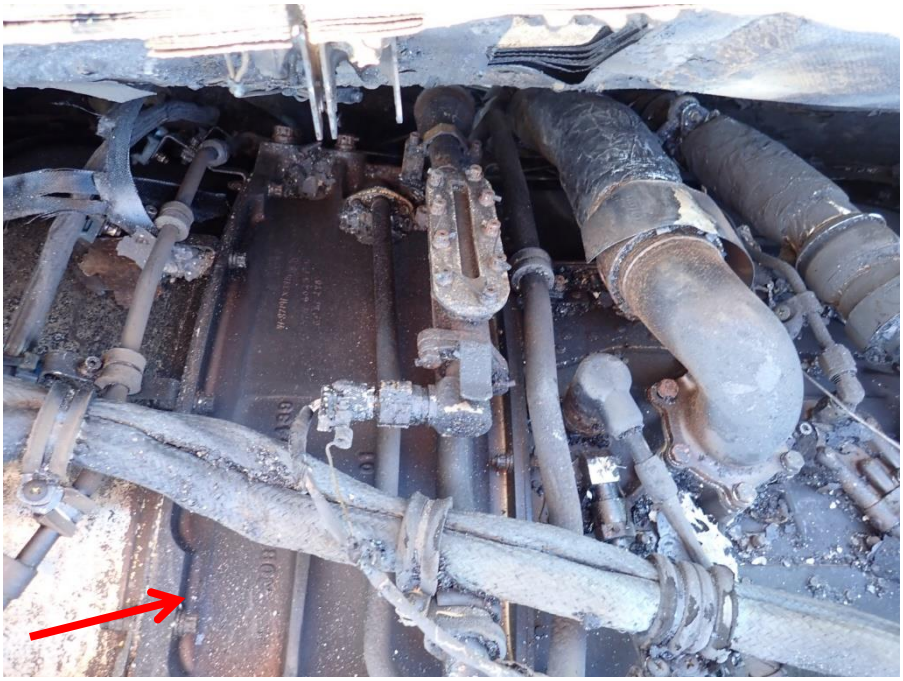


Photo No. 7

Fan Case: The shroud region of the case was thermally damaged from exposure to the post impact fire (Ref. Photo No. 8, red arrow). The visible regions of the case exterior were partially coated in soot.

Photo No. 8

Exhaust Duct: Soot and ash attached to the visible portion of the exterior of the case at numerous locations (Ref. Photo No. 9).

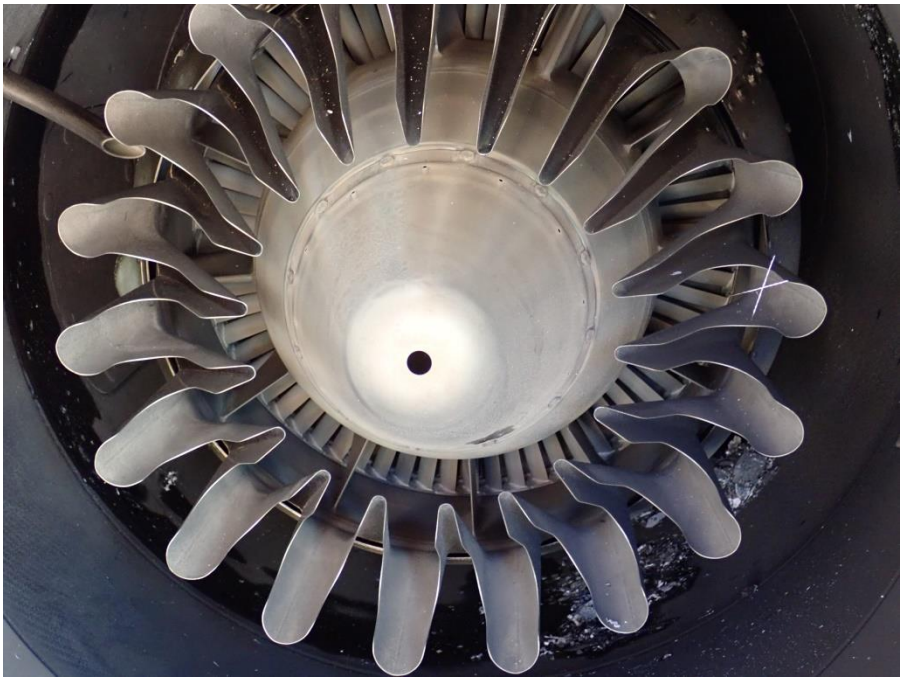


Photo No. 9

Outer and Inner Bypass Ducts: The visible sections of the outer and inner ducts were discoloured and stained with soot from exposure the post impact fire (Ref. Photo No. 10).

Photo No. 10

Gas Generator Case: The case was not accessed for the purpose of this investigation.

Accessory Gearbox: The gearbox was coated with soot and the paint was discoloured (Ref. Photo No. 11, red arrow). The externally mounted accessories were attached to their respective mounting pad on the gearbox.

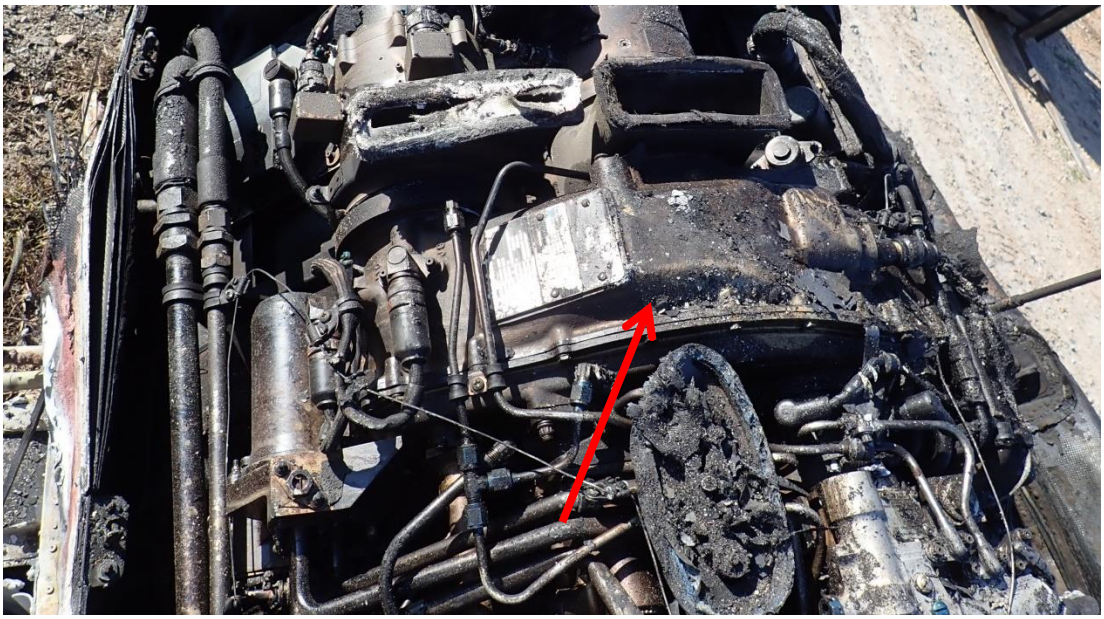


Photo No. 11

3.1.2 **Fuel Shut Off Valve Cable/Linkage:** The tripper lever was not extended above the valve housing, showing that the valve was not tripped (Ref. Photo No. 12). This indicates that the fuel flow through the valve was not interrupted. The valve housing was discoloured and ash/debris from post impact fire was adhered to the exterior of the housing. The visible section of the cable was unremarkable. The cable was not removed for the purpose of this investigation.

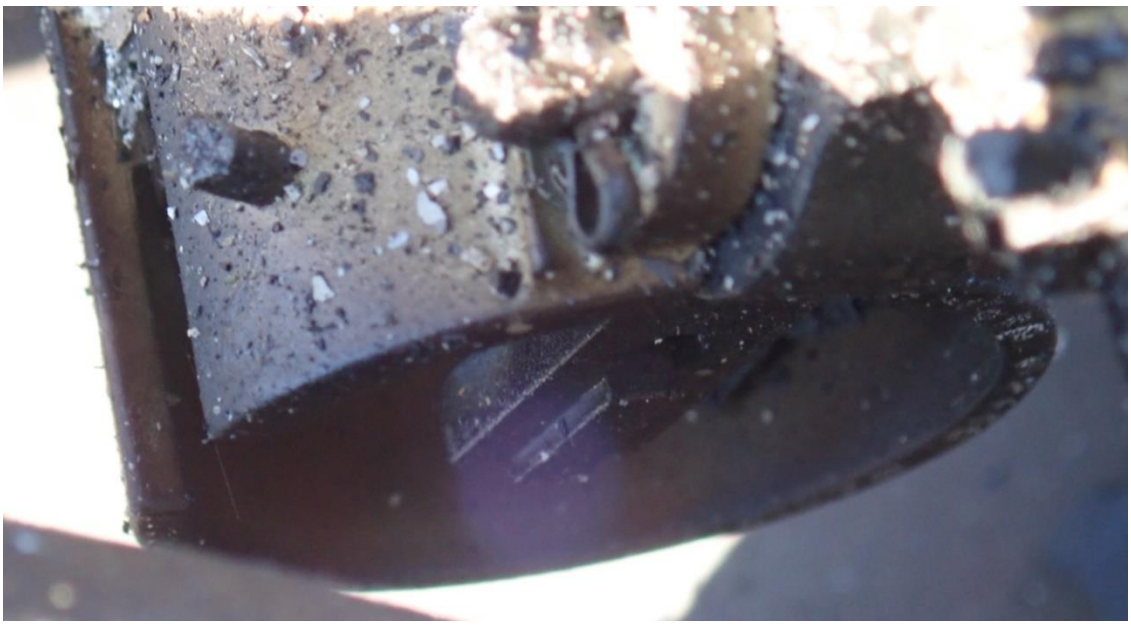


Photo No. 12

3.1.3 Pneumatic Lines

Compressor Discharge Air (P3) Transducer Tube: The line was in place and secure (Ref. Photo No. 13, red arrow).

P3 Pressure Transducer: The transducer was secure on its respective mounting pad on the bypass duct (Ref. Photo No. 13, blue arrow).

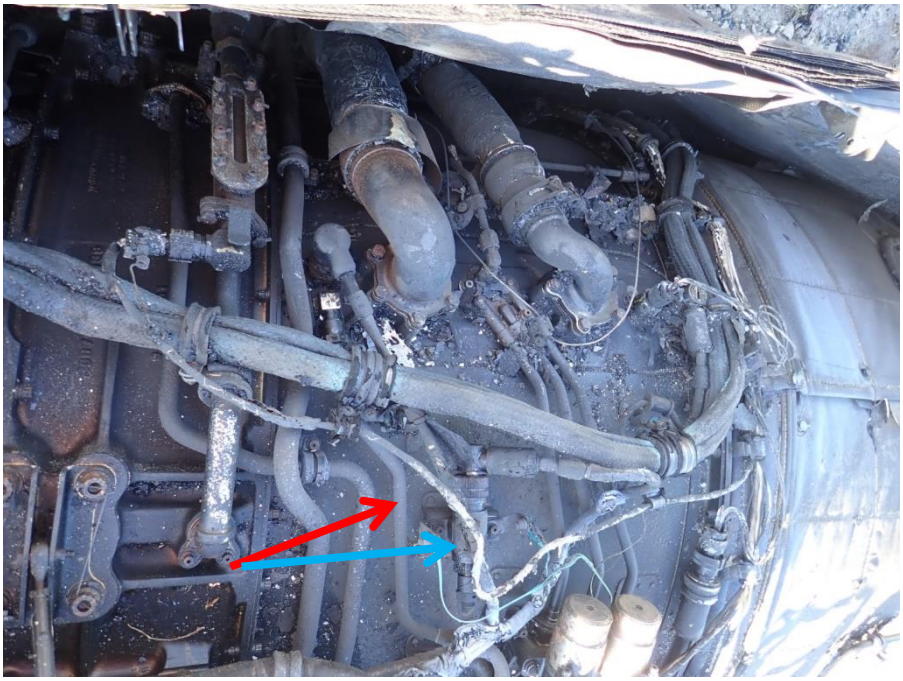


Photo No. 13

P1 Pressure Sensing Tube: The tube was not accessed for the purpose of this investigation.

P1/T1 Sensors: The ends of the sensors located in the gas path were in place and coated with soot. The sensors were not accessed or removed for the purpose of this investigation.

3.1.4 Chip Detectors and Filters

Accessory Gearbox Chip Detector: No metallic debris was adhered to magnetic poles of the chip detector (Ref. Photo No. 14).

Photo No. 14

Oil Filter: The oil filter cover was distorted from impact damage (Ref. Photo No. 15, red arrow). The damage to the cover prevented removal of the filter element (Ref. Photo No. 16). The filter was stained with soot from the post impact fire but the visible regions of the element did not display contamination that was related to engine operation (Ref. Photo No. 16).

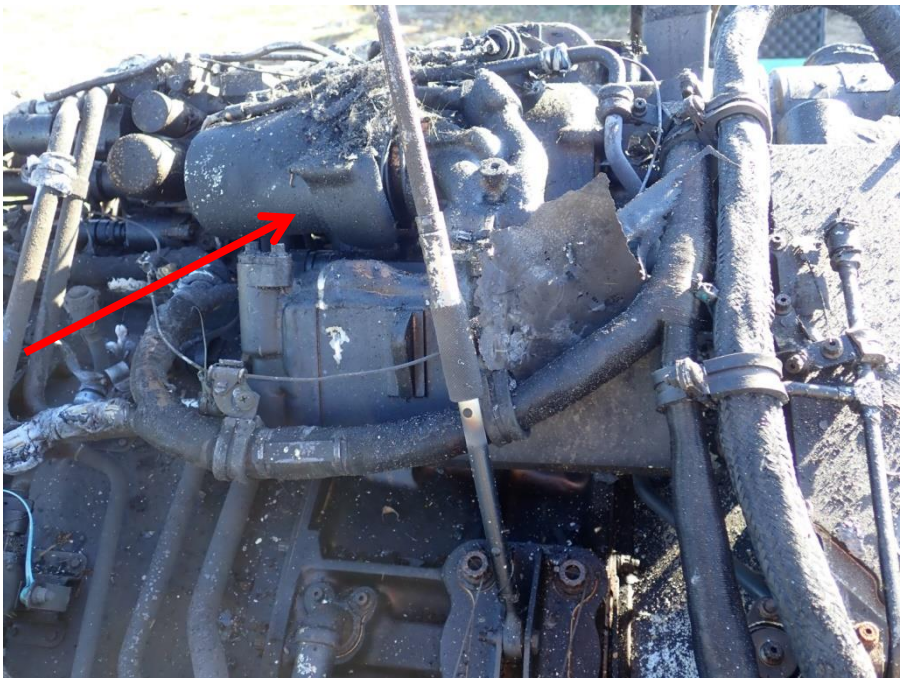


Photo No. 15

Photo No. 16

Fuel Filter: No visible contamination was evident in the fuel filter (Ref. Photo No. 17). The residual fuel in the filter cover had a pungent fuel smell and it contained some dark coloured particulate (Ref. Photo No. 18).

Photo No. 17

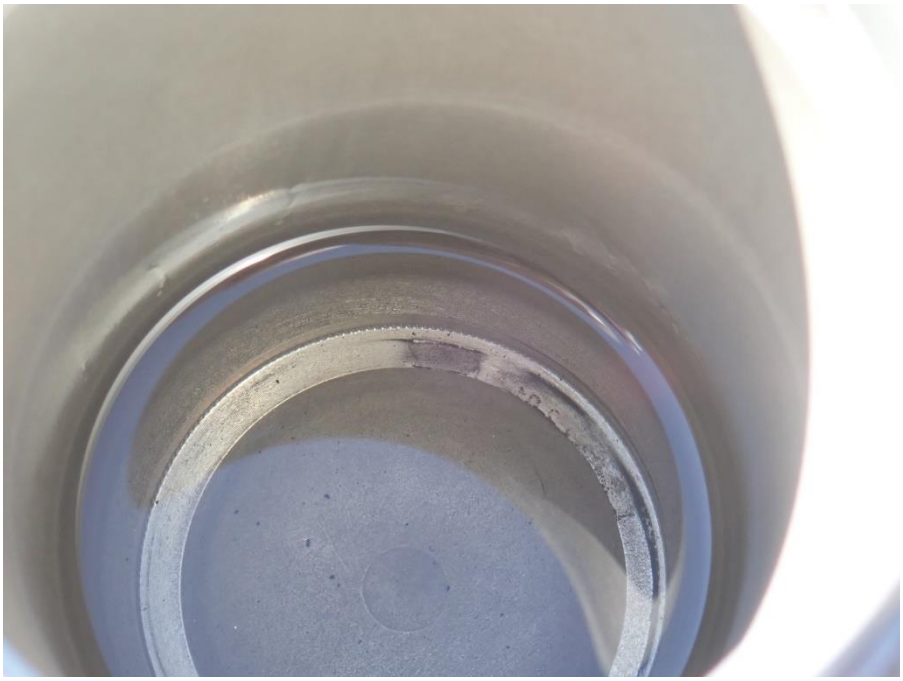


Photo No. 18

3.2 **Inspection Observations:** The engine was not disassembled for the purpose of this investigation. The visible external components were visually inspected and a borescope inspection was conducted on the accessible gas path components.

3.2.1 **Low-Pressure (LP) Compressor Section**

LP Fan Case and Shroud: The abradable shroud was deteriorated from exposure to the post impact fire (Ref. Photo No. 8, red arrow). The visible portions of the external section of the case were partially coated in soot. The case was not removed for the purpose of this investigation.

LP Compressor Fan: The fan blades were discoloured with soot from the post impact fire (Ref. Photos No. 19 & 20). The fan was not capable of manual rotation. The fan was not removed for the purpose of this investigation. The nose cone was discoloured and stained.

Photo No. 19

Photo No. 20

Fan Exit Stator: The stator was viewed through/between the fan blades. Some of the stator airfoils exhibited impact damage, and the airfoils were stained (Ref. Photo No. 21, red arrow). The stator was not removed for the purpose of this investigation.

Compressor Inlet Stator: The stator was viewed through/between the fan blades. The stator airfoils were stained (Ref. Photo No. 21, blue arrow). The stator was not removed for the purpose of this investigation.

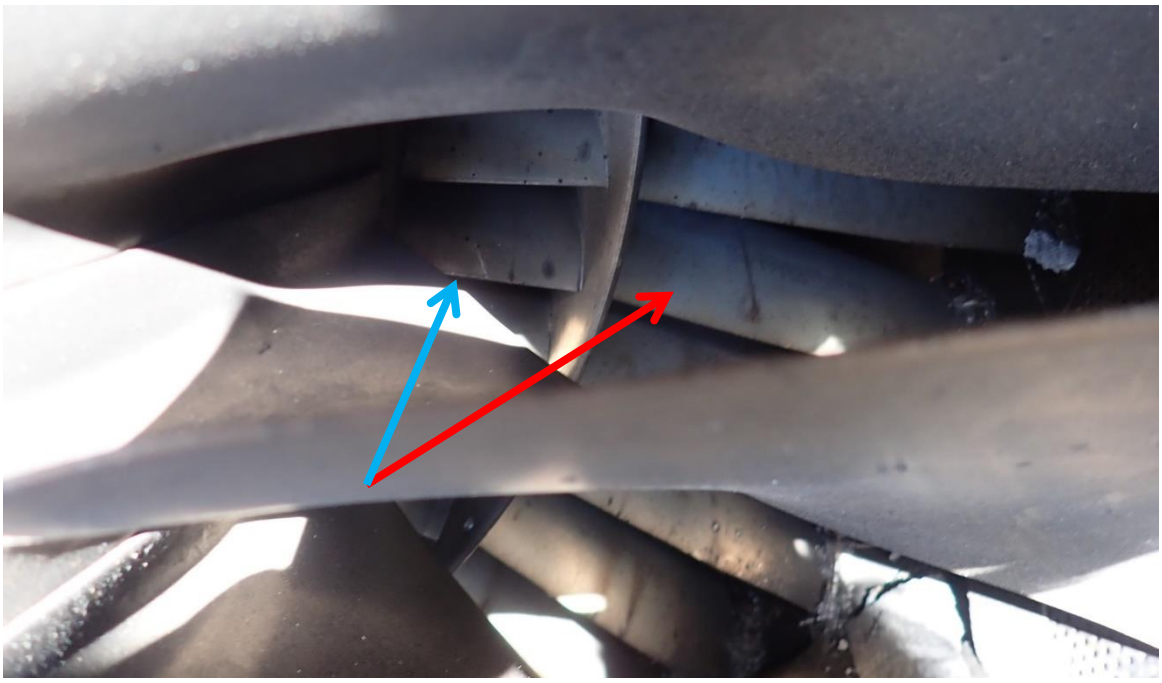


Photo No. 21

3.2.2 **High-Pressure (HP) Compressor Section:** The accessory gearbox breather gear was manually rotated and the gear rotated freely. Mechanical continuity was confirmed between the gearbox and the HP compressor. A borescope was utilized to inspect the accessible compressor components.

Compressor 1st, 2nd, 3rd, and 4th Stage Blades: A borescope inspection of the 1st, trailing edge of the 3rd stage, and the leading edge of the 4th stage compressor blades was conducted and no visible damage was evident (Ref. Photos No. 22, red arrow). The 2nd stage blades were not accessible with the borescope.

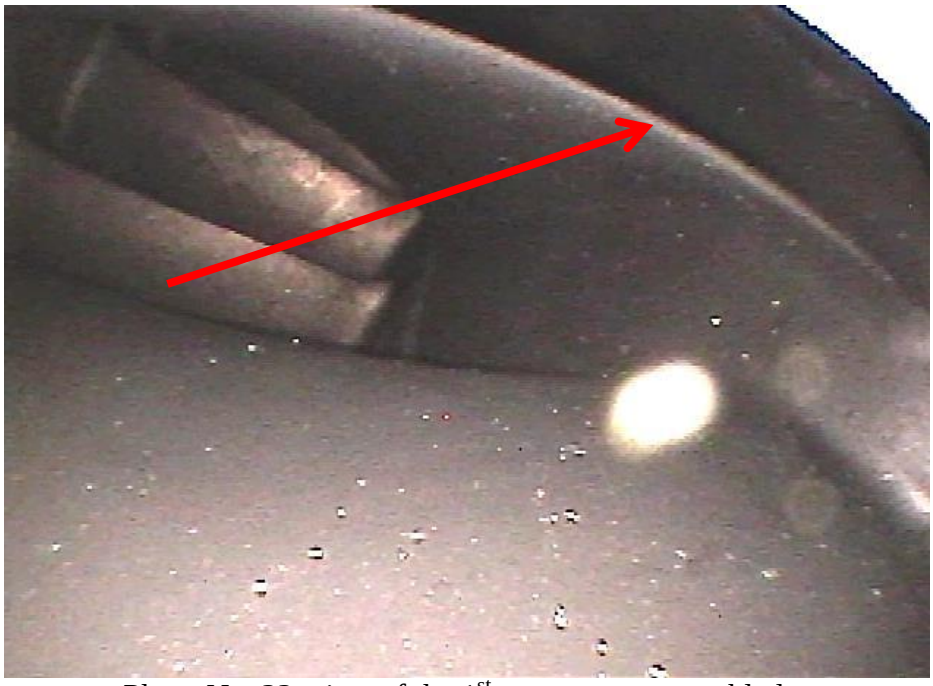


Photo No. 22, view of the 1st stage compressor blades

Inlet and 1st Stage Variable Guide Vanes and 1st Stage Shroud: No damage was evident on the visible inlet and 1st stage vanes. No visible rubbing was evident on the shroud.

Compressor 2nd, 3rd, and 4th Stage Stators and Shrouds: The 3rd and 4th stage stators did not display any damage. No visible rubbing was evident on the 3rd and 4th stage shroud. The 2nd stage stator and shroud were not accessible with the borescope.

No. 2 Bearing: The bearing was not accessed but the compressor rotation indicates that the bearing rotated freely.

No. 3 Bearing: The bearing was not accessed but the compressor rotation indicates that the bearing rotated freely.

3.2.3 Turbine Section

1st Stage High Pressure Turbine Guide Vane Ring: No visible damage was evident on the visible vane airfoils.

1st Stage High Pressure Turbine Shroud: The shroud segments exhibited a localized rubbed region from contact with the 1st stage turbine blade tips (Ref. Photo No. 23, red arrow).

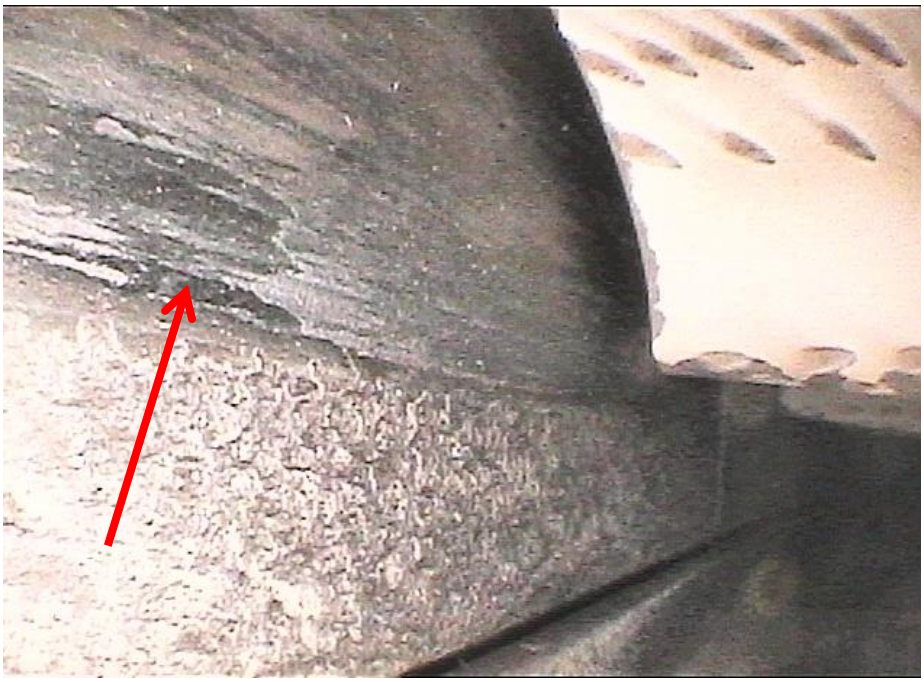


Photo No. 23

1st Stage High Pressure Turbine: The leading edge of the blade airfoils and blade platforms exhibited some erosion of their protective coating (Ref. Photo No. 24, red arrow).

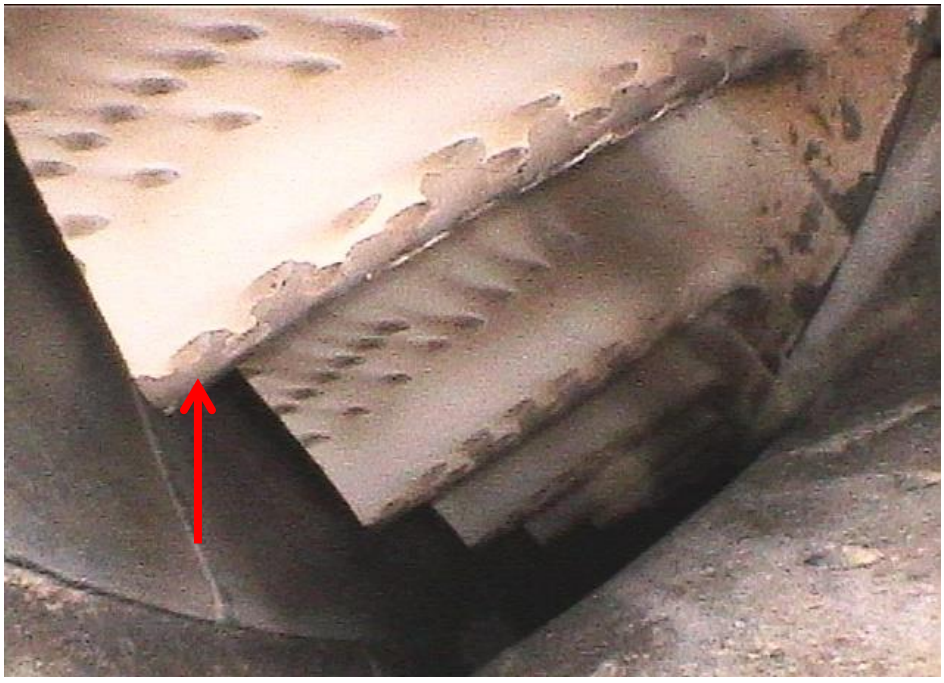


Photo No. 24

2nd Stage High Pressure Turbine Guide Vane Ring: No visible damage was evident on the vane airfoils.

2nd Stage High Pressure Turbine Shroud: The shroud segments exhibited a localized rubbed region from contact with the 2nd stage turbine blade tips.

2nd Stage High Pressure Turbine: The turbine blades did not exhibit any visible damage except some tip discolouration (Ref. Photo No. 25).

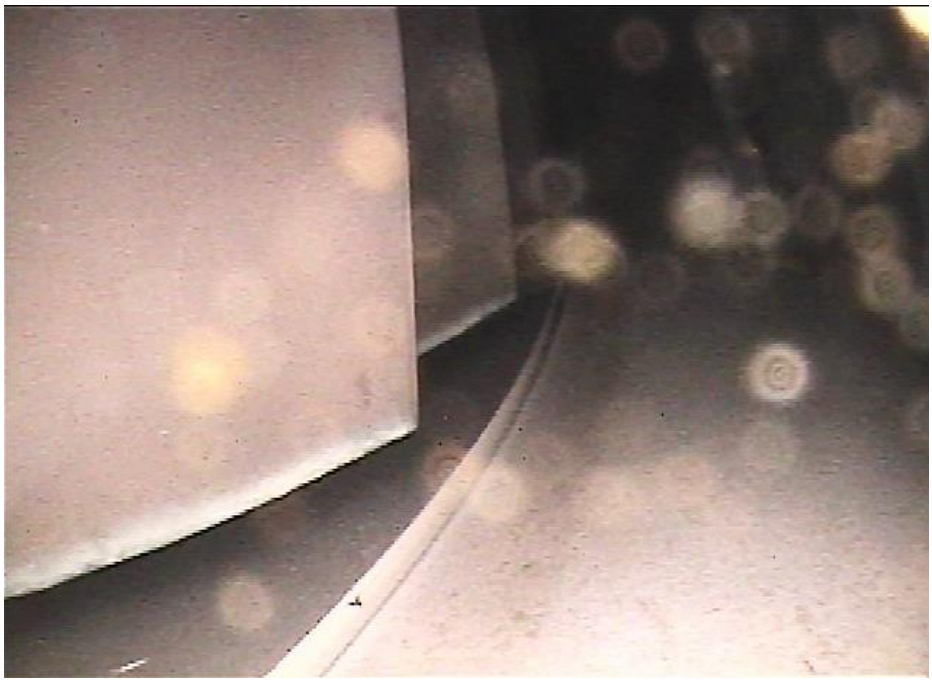


Photo No. 25

ITT Probes, Busbar and Terminal Box: The visible probes were unremarkable. One of the busbars was fractured adjacent to thermocouple mounting flange (Ref. Photo No. 26). The box was secured in place on its respective mounting position (Ref. Photo No. 26).

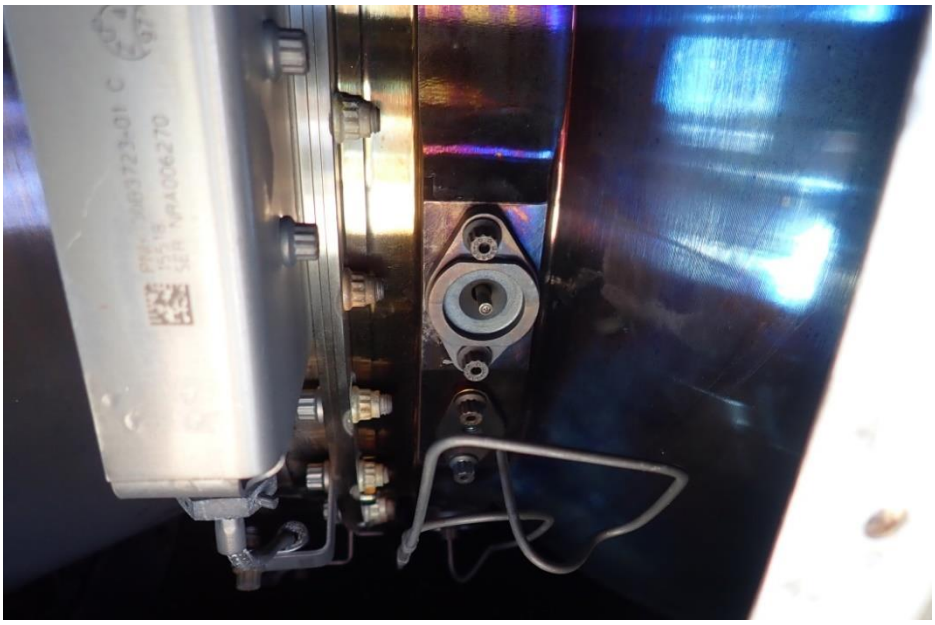


Photo No. 26

3rd Stage Low Pressure Turbine Guide Vane Ring: No visible damage was evident on the vane airfoils.

3rd Stage Low Pressure Turbine: No visible damage was evident on the blades (Ref. Photo No. 27).

Photo No. 27

5th Stage Low Pressure Turbine Guide Vane Ring: No visible damage was evident on the vane airfoils.

5th Stage Low pressure Turbine: No visible damage was evident on the blades (Ref. Photo No. 28).

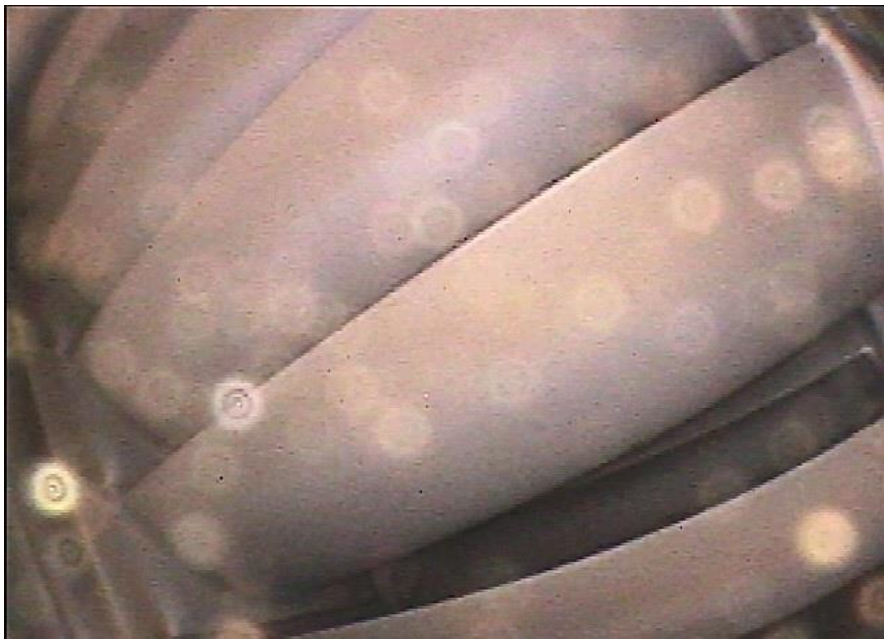


Photo No. 28

3.2.4 **Accessory Gearbox**: The gearbox was not disassembled for the purpose of this investigation but the gear-train was manually rotated and the components rotated freely.

3.3 Controls and Accessories Evaluation

3.3.1 Ignition System

Exciter Boxes: The boxes were in place. The exterior of both boxes were thermally damaged from exposure to the post impact fire (Ref. Photo No. 29).

Photo No. 29

Ignition Leads: The leads were in place but exhibited corrosion and thermal damage in the regions that were exposed to the post impact fire.

Ignition Plugs: The plugs were removed and the tips were eroded adjacent to the central conductor (Ref. Photo No. 30). The erosion is consistent with operational use.

Photo No. 30 (Textron supplied Photo)

3.3.2 Fuel System

Fuel Heater: The heater exhibited some impact damage, the mounting bosses were fractured and the exterior housing was coated in soot (Ref. Photo No. 31, red arrow).

Photo No. 31

Hydromechanical Fuel Control Unit: The control was in place, the housing was fractured, and the exterior housing was partially coated in soot (Ref. Photo No. 32, red arrow shows the fractured area).

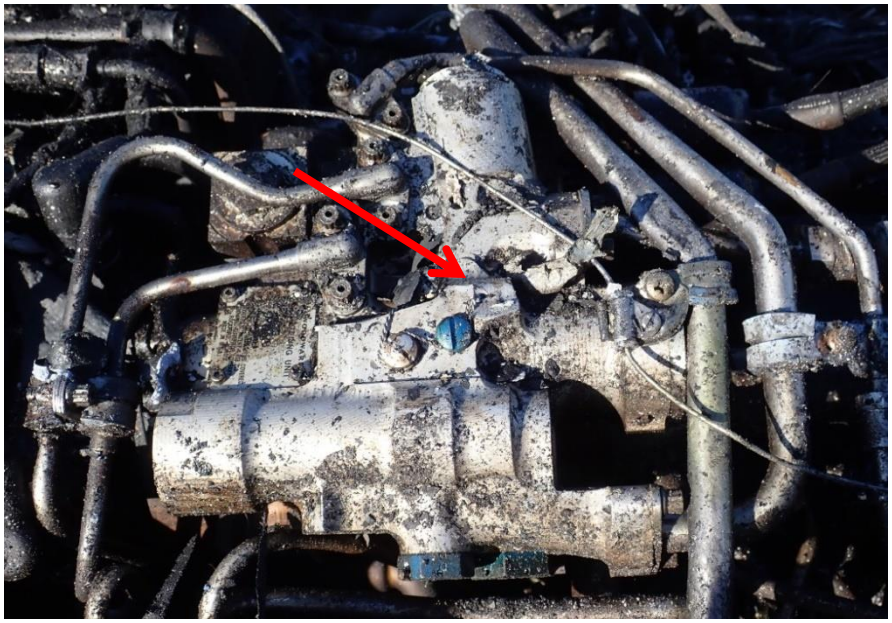


Photo No. 32

Fuel Waste Ejector: The ejector was in place, coated in soot, and exhibited some thermal distress from exposure to the post impact fire (Ref. Photo No. 33).

Photo No. 33

Start and Dump Valve: The valve was in place and the exterior was discoloured from exposure to heat and soot from the post impact fire (Ref. Photo No. 34).

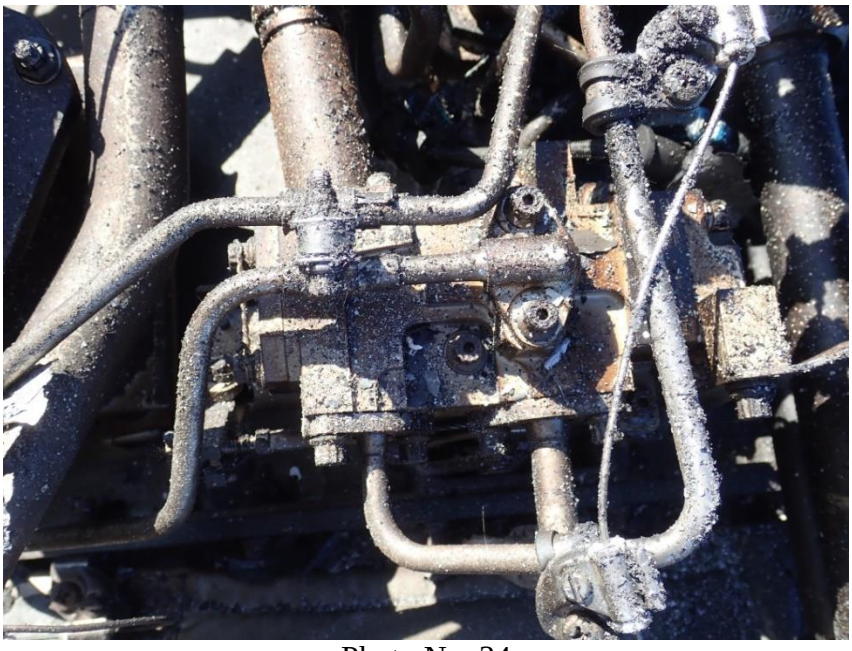


Photo No. 34

3.3.3 **Air System:**

Compressor Bleed Valve Solenoid: The solenoid was in place and coated with soot (Ref. Photo No. 35).

Photo No. 35

3.3.4 **Electrical System**

Engine Electronic Control (EEC): The control was secured in place on its respective mounting pad (Ref. Photo No. 36, red arrow). The exterior housing was burnt and discoloured from exposure to the post impact fire.

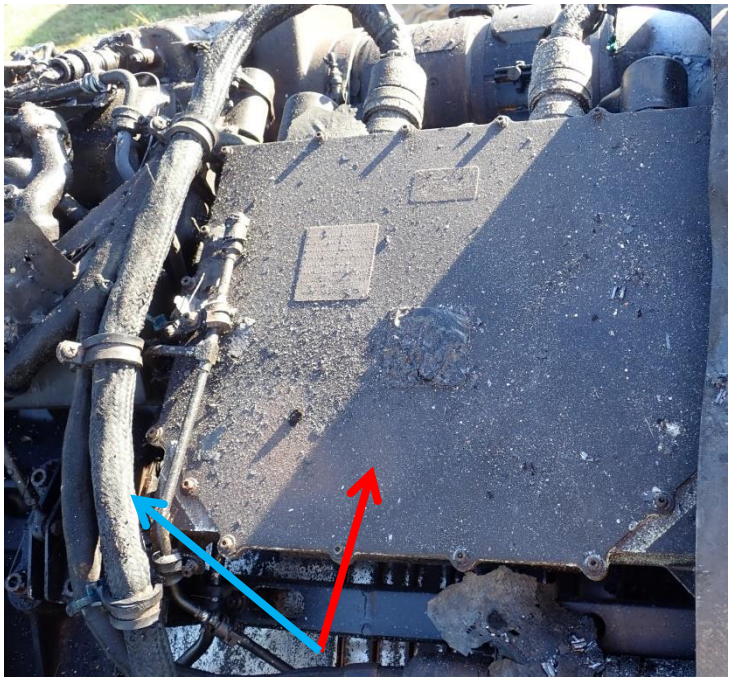


Photo No. 36

Outer Electrical Wiring Harness: The harness was in place and all of the visible connections were attached to their respective components (Ref. Photo No. 36, blue arrow). The outer protective sheath was discoloured.

Engine Diagnostic Unit (EDU): The unit was discoloured and partially coated in soot (Ref. Photo No. 37). The EDU was forwarded to P&WC's Accessory Investigations for data recovery.

Photo No. 37

4.0 RIGHT HAND ENGINE HISTORY

PW306-D1 S/N CN0016

Hours Since New: 1148.2 per CesCom 10-Aircraft Status Report, dated 26-Jul-2019

Cycles Since New: 770 per CesCom 10-Aircraft Status Report, dated 26-Jul-2019

5.0 RIGHT HAND ENGINE EXAMINATION

All positional references are in relation to view from aft looking forward. Upstream and downstream references are in relation to gas path flow from the compressor inlet to exhaust.

5.1 **External Condition:** The right hand engine was lying on its right hand side of the heat distressed airframe cowling (Ref. Photos No. 38 & 39). The engine was moved to the inverted position to access the bottom of the aircraft cowling. The external engine components and the bypass ducts were coated in soot and exhibited heat distress from exposure to the post flight fire (Ref. Photo No. 40). The engine data plate showed the engine serial number was PCE-CN0016 (Ref. Photo No. 41).

Photo No. 38

Photo No. 39

Photo No. 40

Photo No. 41

5.1.1 External Cases

Intermediate Case: The visible exterior regions of the case were covered in soot and the paint was discoloured (Ref. Photo No. 42, red arrow).

Photo No. 42

Fan Case: The shroud region of the case was thermally damaged from exposure to the post impact fire (Ref. Photo No. 43, red arrow). The visible regions of the case exterior were coated in soot.

Photo 43

Exhaust Duct: Soot and ash were attached to the visible portion of the exterior of the case at numerous locations (Ref. Photo No. 44).

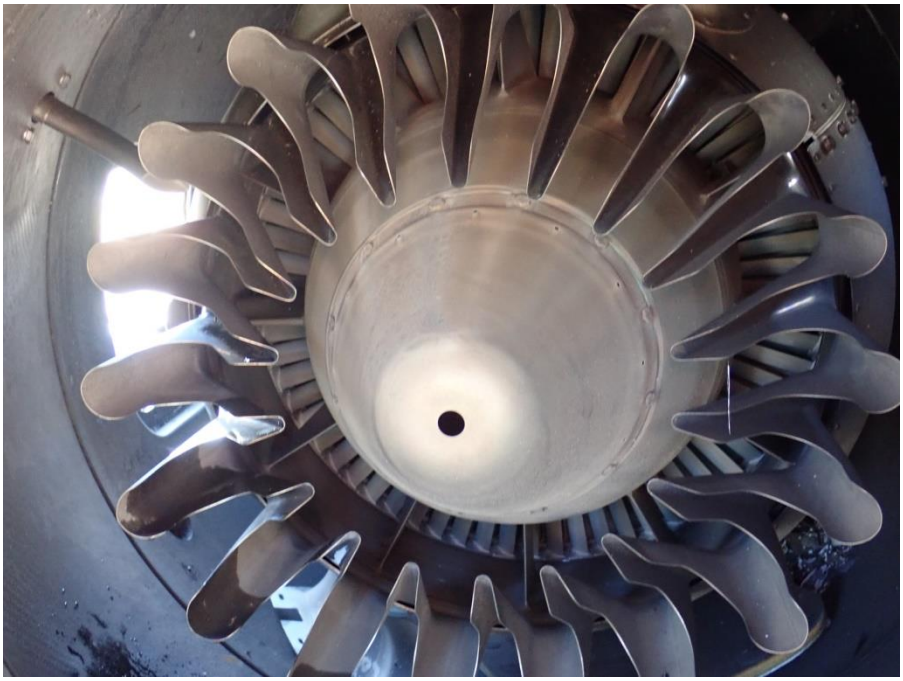


Photo No. 44

Outer and Inner Bypass Ducts: The visible sections of the lower section outer duct was discoloured and stained with soot from exposure the post impact fire (Ref. Photo No. 45). The upper section of the outer bypass duct and the visible portions of the inner bypass ducts were thermally distressed and partially burned from the post impact fire (Ref. Photo No. 45, red arrow).

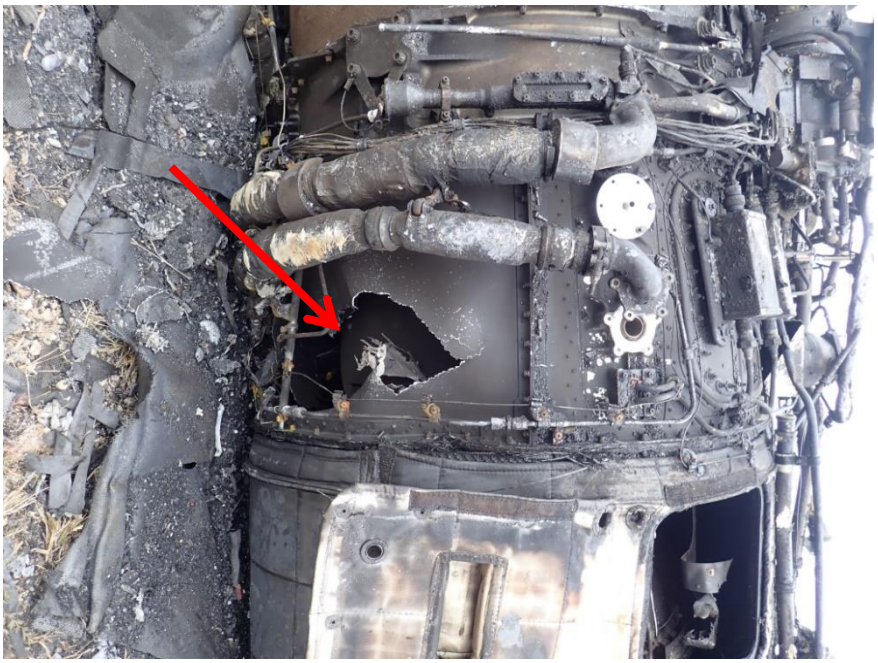


Photo No. 45

Gas Generator Case: The case was not accessed for the purpose of this investigation.

Accessory Gearbox: The gearbox was coated with soot and the paint was discoloured (Ref. Photo No. 46, red arrow). The externally mounted accessories were attached to their respective mounting pad on the gearbox.

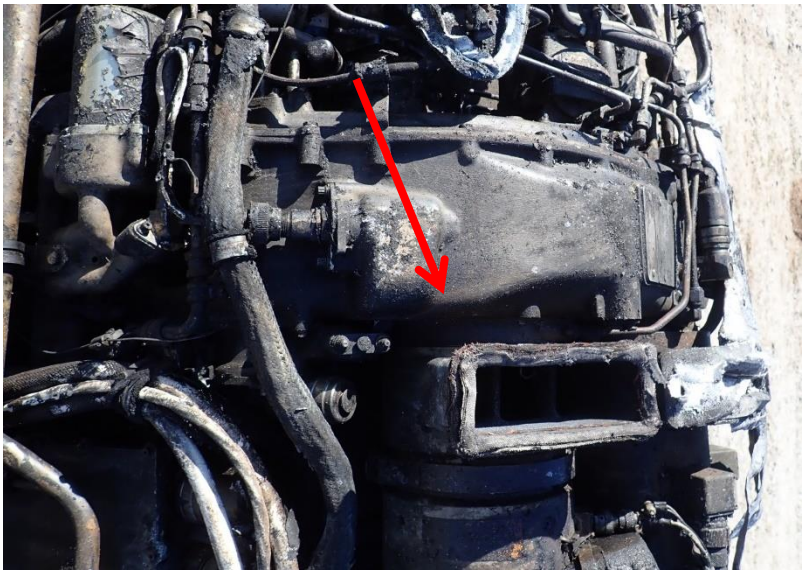


Photo No. 46

5.1.2 **Fuel Shut Off Valve Cable/Linkage:** The tripper lever was not extended above the valve housing, showing that the valve was not tripped (Ref. Photo No. 47). This indicates that the fuel flow through the valve was not interrupted. The valve housing was discoloured and ash/debris from post impact fire was adhered to the exterior of the housing. The visible section of the cable was unremarkable. The cable was not removed for the purpose of this investigation.

Photo No. 47

5.1.3 **Pneumatic Lines**

Compressor Discharge Air (P3) Transducer Tube: The line was in place and secure (Ref. Photo No. 48, red arrow).

P3 Pressure Transducer: The transducer was secure on its respective mounting pad on the bypass duct (Ref. Photo No. 48, blue arrow).

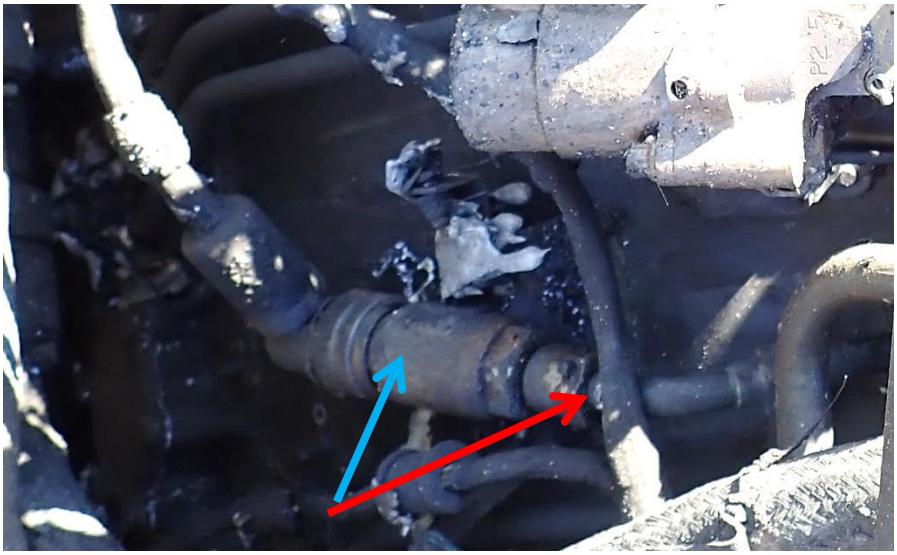


Photo No. 48

P1 Pressure Sensing Tube: The visible section of the tube was coated with soot (Ref. Photo No. 49, red arrow).

P1/T1 Sensors: The mounting pads for the sensors were burned away. The sensors were discoloured and coated with soot (Ref. Photo No. 49, blue arrows).

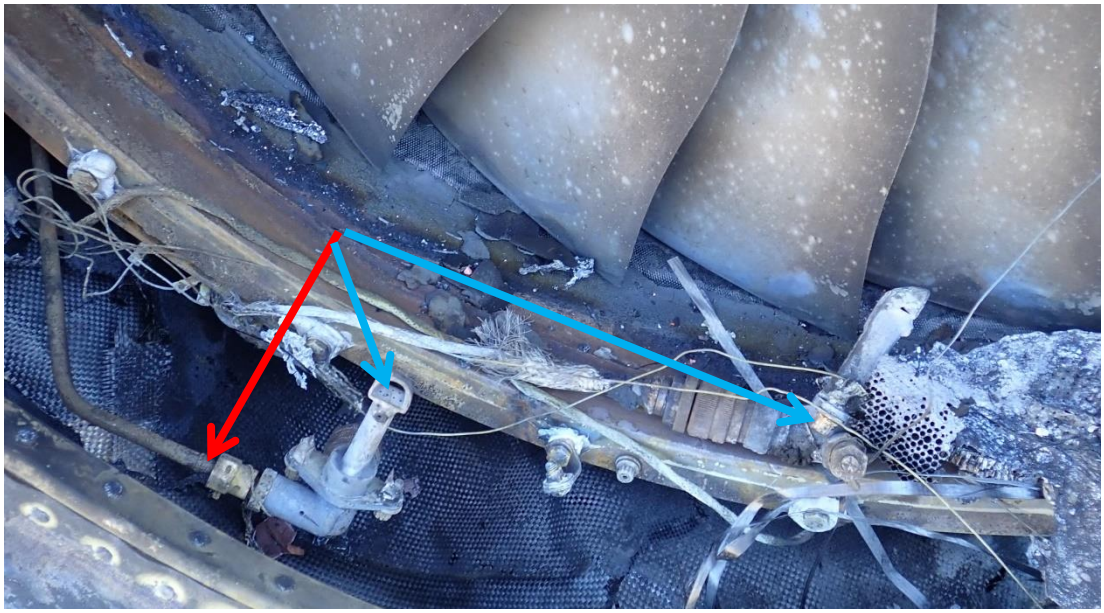


Photo No. 49

5.1.4 Chip Detectors and Filters

Accessory Gearbox Chip Detector: Some small particulate was adhered to magnetic poles of the chip detector (Ref. Photo No. 50).

Photo No. 50

Oil Filter: No visible contamination was evident in the filter (Ref. Photo No. 51).

Photo No. 51

Fuel Filter: The fuel filter cover was penetrated from impact damage (Ref. Photo No. 52, red arrow). No visible contamination was evident in the filter (Ref. Photo No. 53).

Photo No. 52

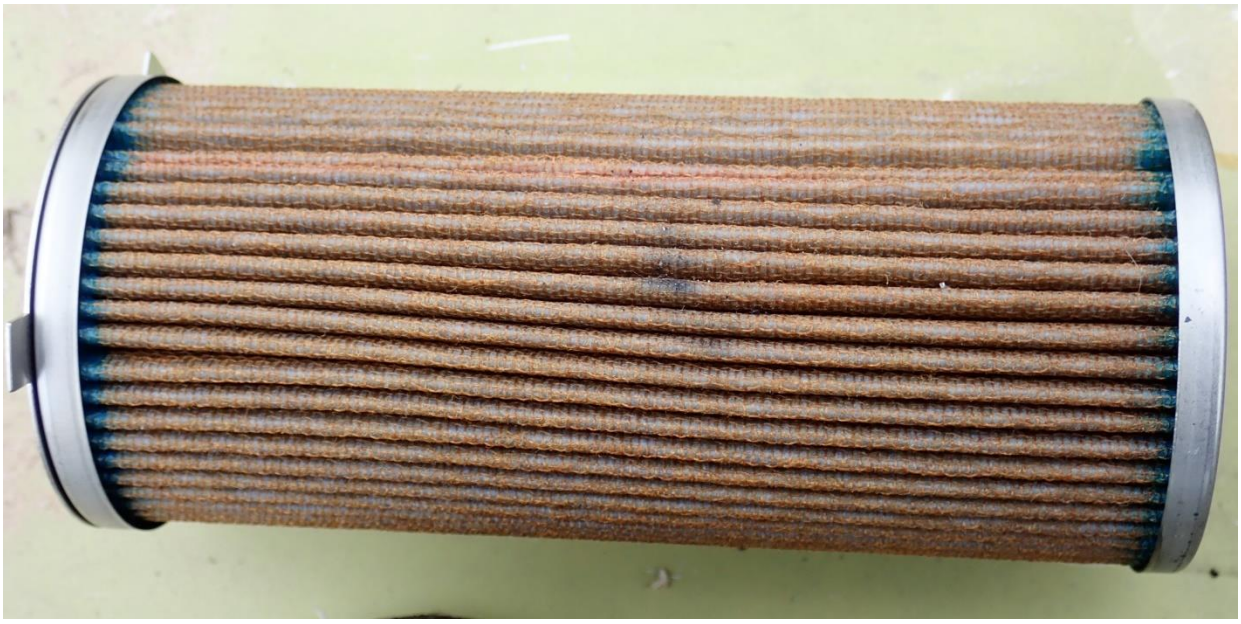


Photo No. 53

5.2 **Inspection Observations:** The engine was not disassembled for the purpose of this investigation. The visible external components were visually inspected and a borescope inspection was conducted on the accessible gas path components.

5.2.1 **Low-Pressure (LP) Compressor Section**

LP Fan Case and Shroud: The abradable shroud was deteriorated from exposure to the post impact fire (Ref. Photo No. 54, red arrow). The visible portions of the external section of the case were coated in soot. The case was not removed for the purpose of this investigation.

Photo No. 54

LP Compressor Fan: The fan blades were discoloured with soot from the post impact fire (Ref. Photos No. 55 & 56). The fan was not capable of manual rotation. The fan was not removed for the purpose of this investigation. The nose cone was missing material and melted from the post impact fire (Ref. Photo No. 55, red arrow).

Photo No. 55 (NTSB supplied Photo)

Photo No. 56

Fan Exit Stator: The stator was viewed through/between the fan blades. Most of the stator airfoils were burned/missing from the post impact fire. The stator was not removed for the purpose of this investigation.

Compressor Inlet Stator: The stator was viewed through/between the fan blades. The stator airfoils were stained (Ref. Photo No. 57, blue arrow). The stator was not removed for the purpose of this investigation.

Photo No. 57

5.2.2 **High Pressure Compressor Section:** The accessory gearbox breather gear was manually rotated and some abnormal resistance was evident. Mechanical continuity was confirmed between the gearbox and the HP compressor. An audible noise was evident during the HP compressor rotation. A borescope was utilized to inspect the accessible compressor components.

Compressor 1st, 2nd, 3rd, and 4th Stage Blades: A borescope inspection of the 1st, trailing edge of the 3rd stage, and the leading edge of the 4th stage compressor blades was conducted and no visible damage was evident (Ref. Photos No. 58). The 1st stage blades were coated in soot. Some staining was evident on the 3rd and 4th stage blades. The 2nd stage blades were not accessible with the borescope.

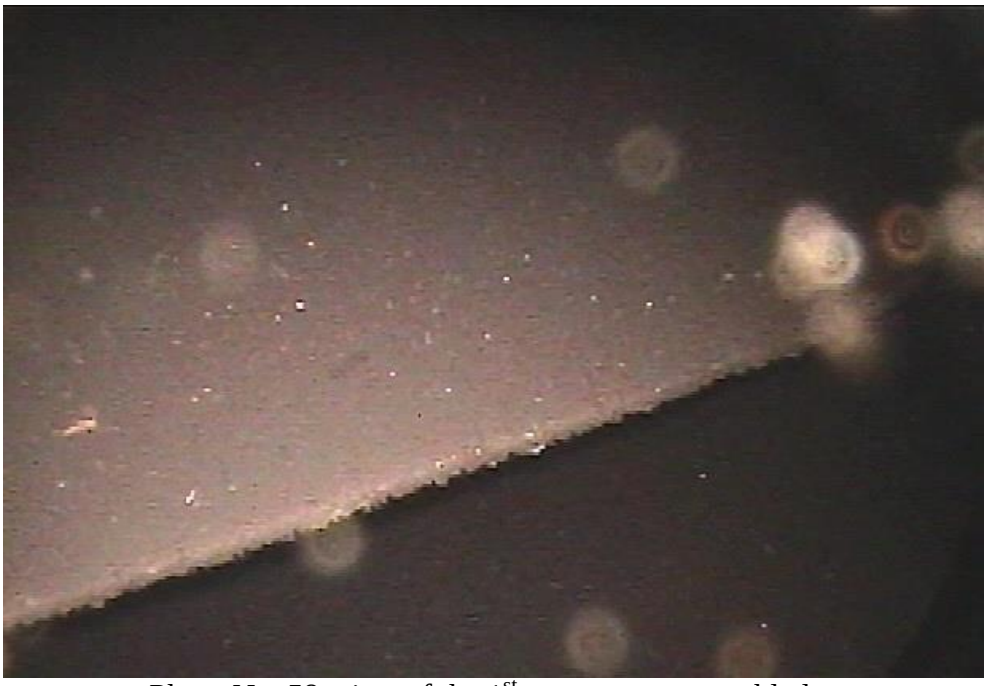


Photo No. 58, view of the 1st stage compressor blades

Inlet and 1st Stage Variable Guide Vanes and 1st Stage Shroud: No damage was evident on the visible inlet and 1st stage vanes. The vane airfoils were coated with soot. No visible rubbing was evident on the shroud.

Compressor 2nd, 3rd, and 4th Stage Stators and Shrouds: The 3rd and 4th stage stators did not display any damage. No visible rubbing was evident on the 3rd and 4th stage shroud. The 2nd stage stator and shroud were not accessible with the borescope.

No. 2 Bearing: The bearing was not accessed but the compressor rotation indicates that the bearing rotated freely.

No. 3 Bearing: The bearing was not accessed but the compressor rotation indicates that the bearing rotated freely.

5.2.3 Turbine Section

1st Stage High Pressure Turbine Guide Vane Ring: No visible damage was evident on the visible vane airfoils.

1st Stage High Pressure Turbine Shroud: The shroud segments exhibited a localized rubbed region from contact with the 1st stage turbine blade tips (Ref. Photo No. 59, red arrow).

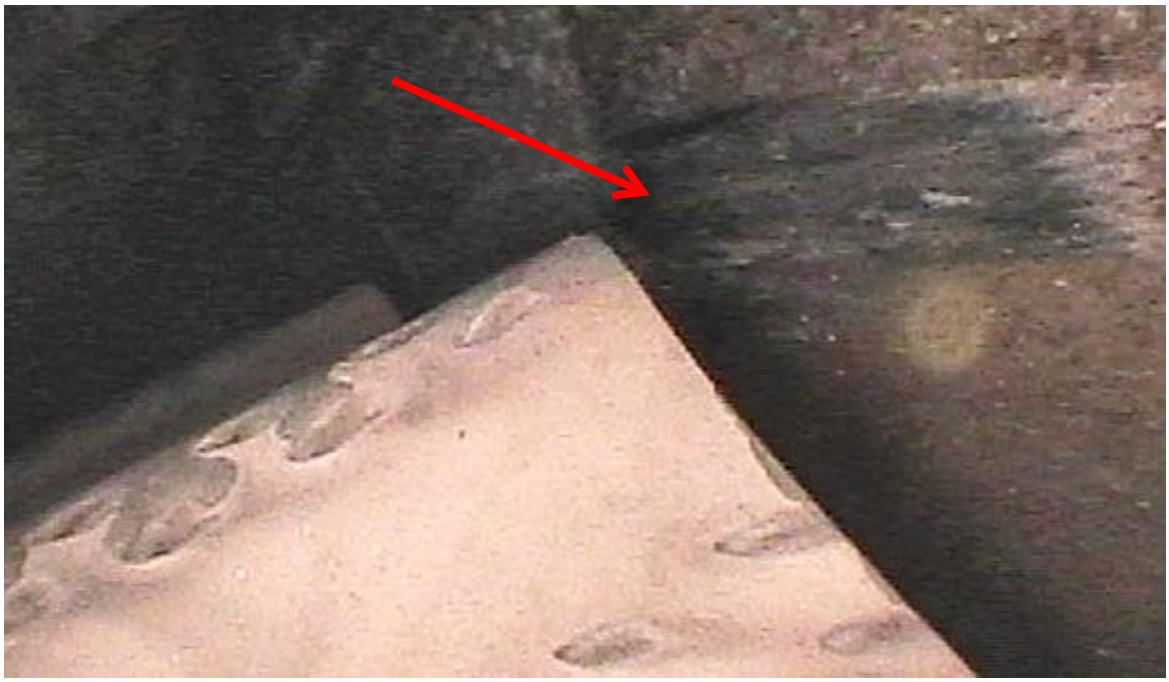


Photo No. 59

1st Stage High Pressure Turbine: The leading edge of the blade airfoils and blade platforms exhibited some erosion of their protective coating (Ref. Photo No. 60, red arrow).

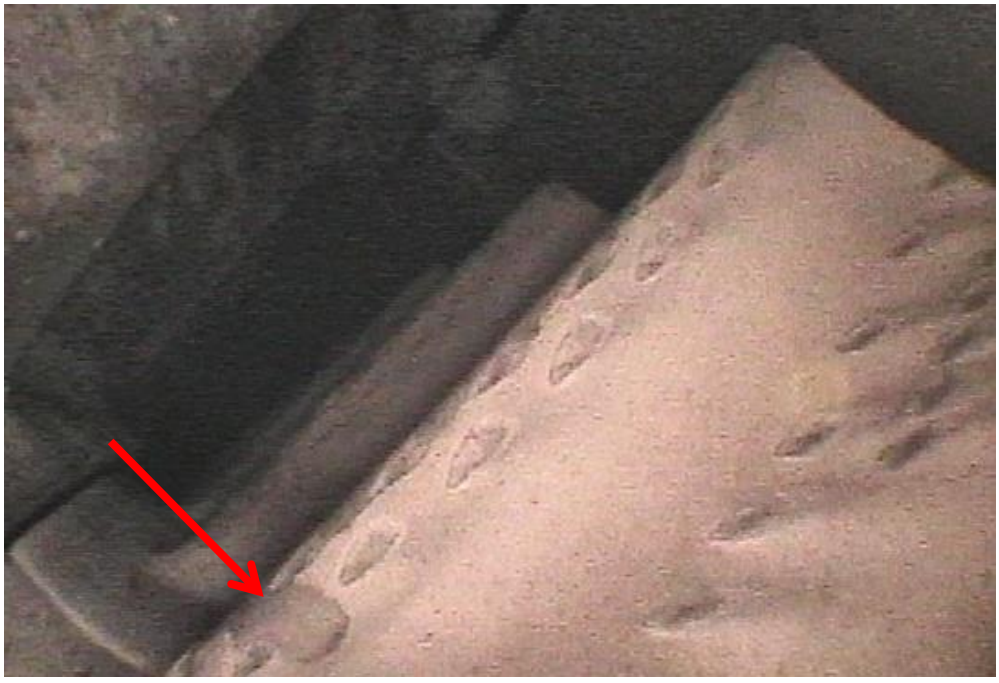


Photo No. 60

2nd Stage High Pressure Turbine Guide Vane Ring: No visible damage was evident on the vane airfoils.

2nd Stage High Pressure Turbine Shroud: The shroud segments exhibited a localized rubbed region from contact with the 2nd stage turbine blade tips.

2nd Stage High Pressure Turbine: The turbine blades did not exhibit any visible damage except some tip deformation from the rubbing with the shroud segments (Ref. Photo No. 61).

Photo No. 61

ITT Probes, Busbar and Terminal Box: The visible probes were unremarkable. The visible portions of the busbars were unremarkable except for thermal discoloration (Ref. Photo No. 62, red arrow). The box was secured in place on its respective mounting position and was thermally discoloured (Ref. Photo No. 62, blue arrow).

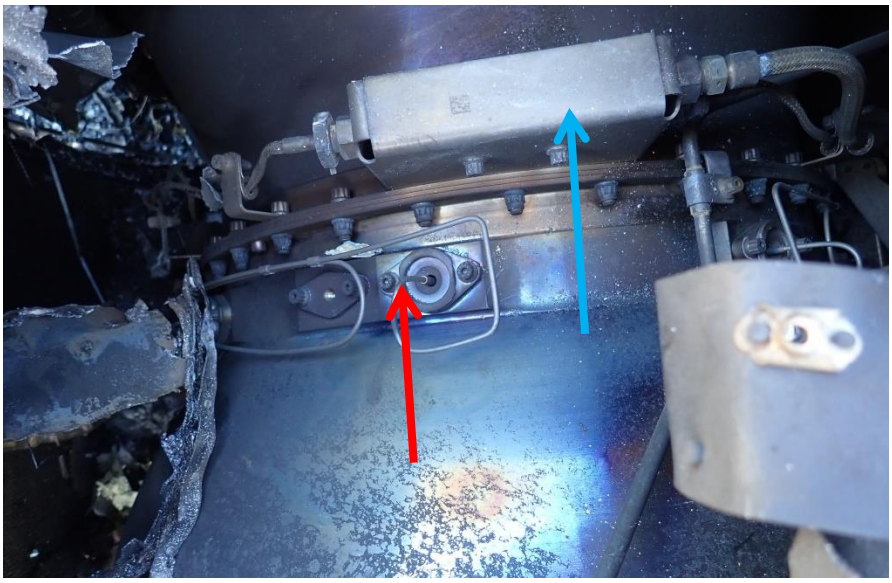


Photo No. 62

3rd Stage Low Pressure Turbine Guide Vane Ring: No visible damage was evident on the vane airfoils.

3rd Stage Low Pressure Turbine: No visible damage was evident on the blades (Ref. Photo No. 63).

Photo No. 63

5th Stage Low Pressure Turbine Guide Vane Ring: No visible damage was evident on the vane airfoils.

5th Stage Low Pressure Turbine: No visible damage was evident on the blades (Ref. Photo No. 64).

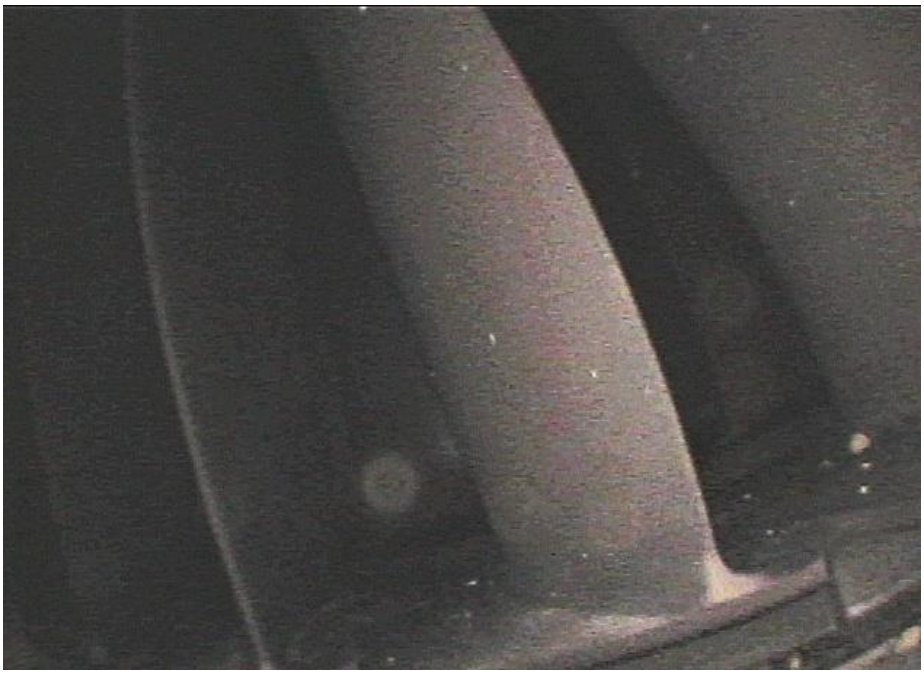


Photo No. 64

5.2.4 **Accessory Gearbox**: The gearbox was not disassembled for the purpose of this investigation but the gear-train was manually rotated and the components rotated freely.

5.3 Controls and Accessories Evaluation

5.3.1 Ignition System

Exciter Boxes: The boxes were in place. The exterior of both boxes were thermally damaged from exposure to the post impact fire (Ref. Photo No. 65).

Photo No. 65

Ignition Leads: The leads were in place but exhibited corrosion and thermal damage in the regions that were exposed to the post impact fire.

Ignition Plugs: The plugs were removed and the tips were eroded adjacent to the central conductor (Ref. Photo No. 66). The erosion is consistent with operational use.

Photo No. 66

5.3.2 **Fuel System**

Fuel Heater: The heater was coated in soot (Ref. Photo No. 67, red arrow).

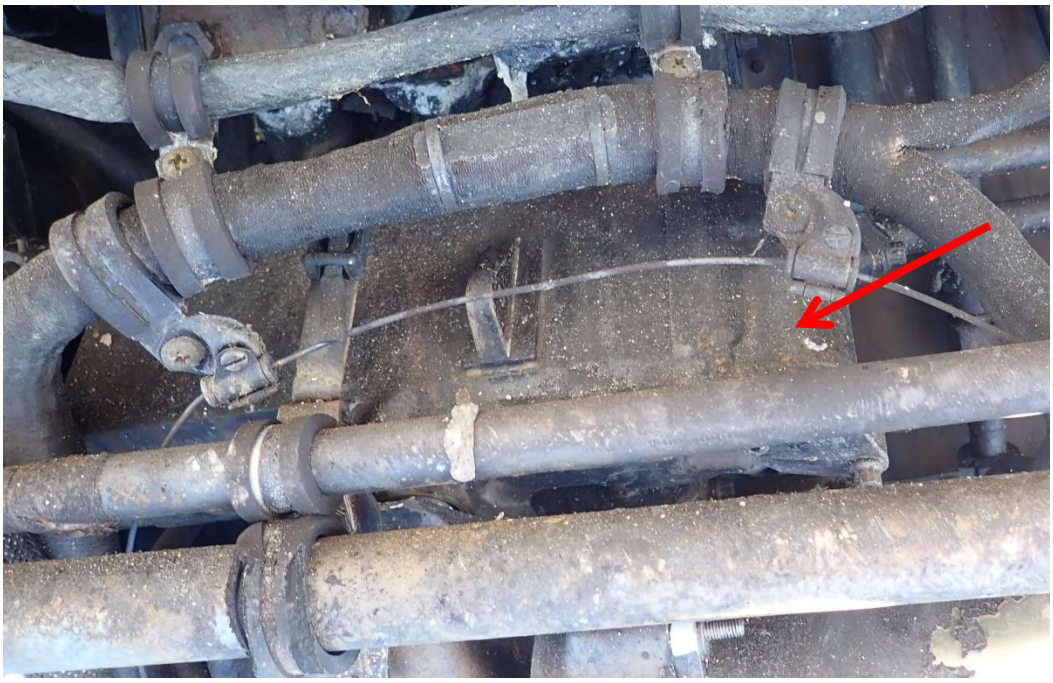


Photo No. 67

Hydromechanical Fuel Control Unit: The control was in place and the exterior housing was partially coated in soot (Ref. Photo No. 68, red arrow).

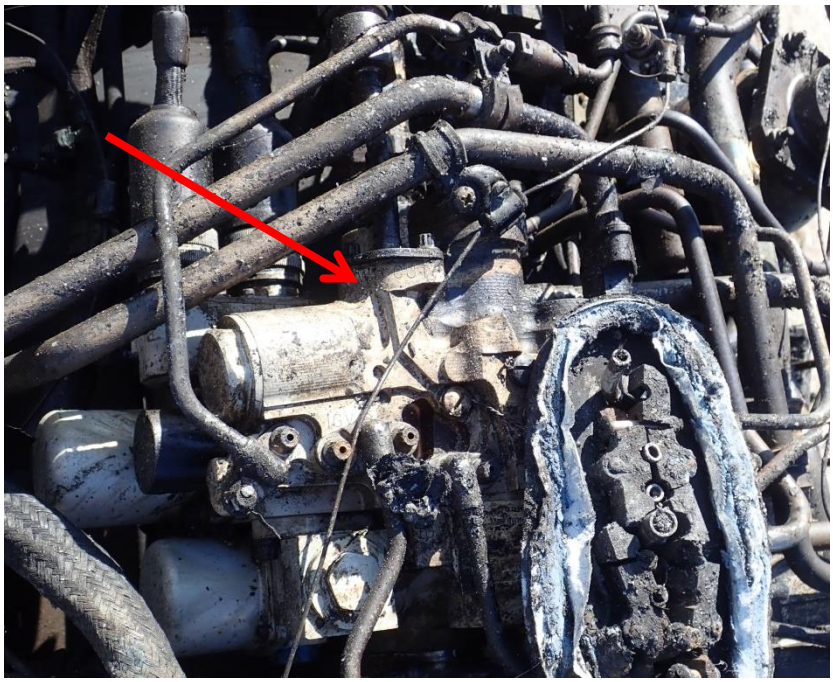


Photo No. 68

Fuel Waste Ejector: The ejector was in place and exhibited thermal distress from exposure to the post impact fire (Ref. Photo No. 69, red arrow).

Photo No. 69

Start and Dump Valve: The valve was in place and the exterior was discoloured from exposure to heat from the post impact fire (Ref. Photo No. 70, red arrow).

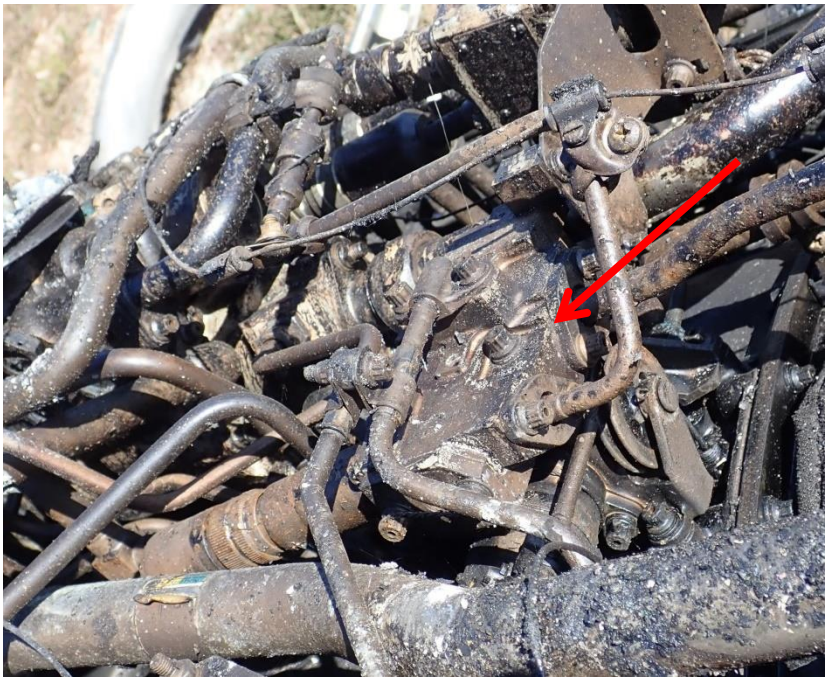


Photo No. 70

5.3.3 **Air System:**

Compressor Bleed Valve Solenoid: The solenoid was in place and coated with soot (Ref. Photo No. 71).

Photo No. 71

5.3.4 Electrical System

Engine Electronic Control (EEC): The control was secured in place on its respective mounting pad (Ref. Photo No. 72, red arrow). The exterior housing was burnt and discoloured from exposure to the post impact fire.

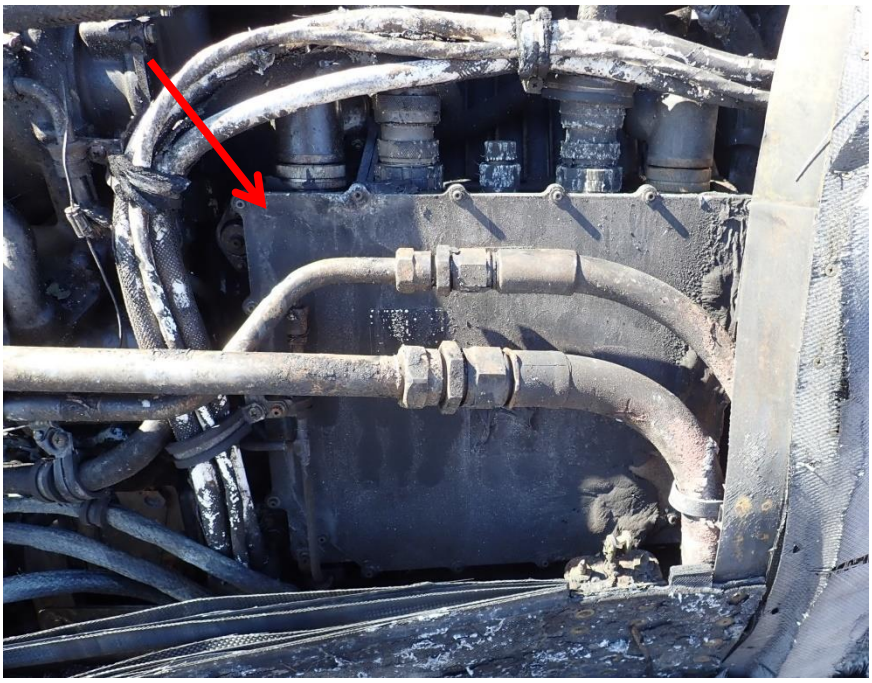


Photo No. 72

Outer Electrical Wiring Harness: The harness was in place and all of the visible connections were attached to their respective components (Ref. Photo No. 73, blue arrow). The outer protective sheath was discoloured.

Engine Diagnostic Unit (EDU): The unit was discoloured and partially coated in soot (Ref. Photo No. 73). The EDU was forwarded to P&WC's Accessory Investigations for data recovery.

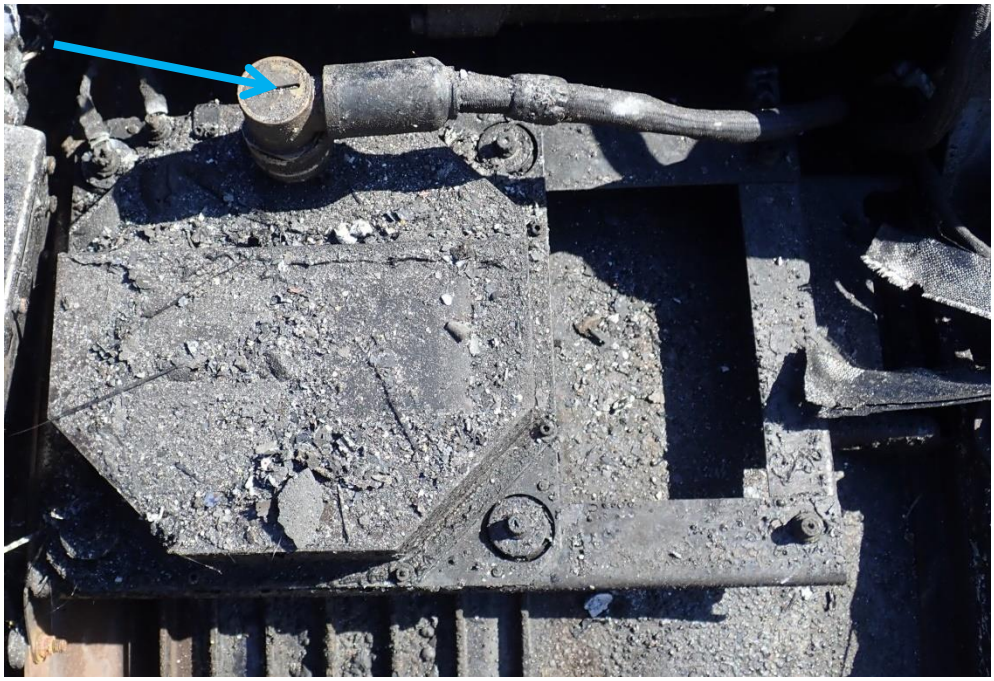


Photo No. 73

6.0 EDU Investigations:

The EDU investigation was performed on January 6th 2020, at P&WC Facilities in Mississauga, Ontario. The following individuals participated in the investigation as representatives of their respective organisations:

Peter Rowntree	Transportation Safety Board (TSB)
Dave Barnard	P&WC
Janusz Fiedler	P&WC
Ezzat Meshkin Fam	P&WC
Dave Tonks	P&WC
Richard Xu	P&WC
Terry Yuen	P&WC

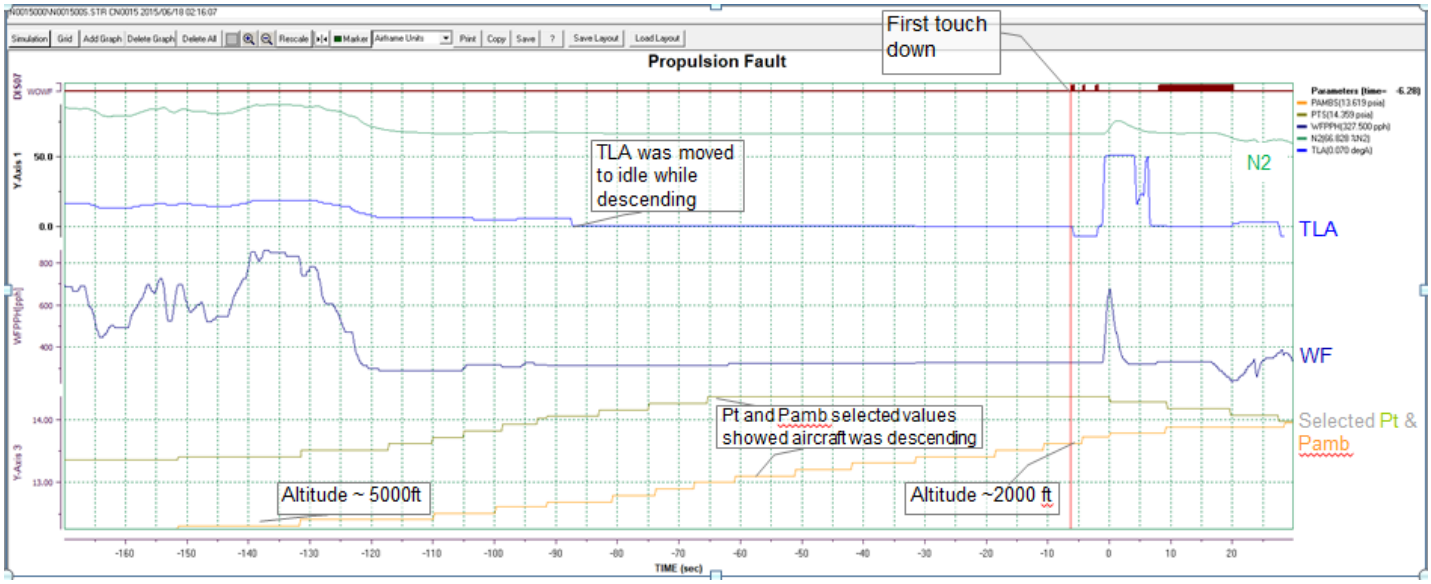
The exterior of the left hand engine EDU was blackened due to exposure to the post impact fire. All of the external labels were blackened and partially illegible. The anti-vibration mounts were present but were affected by heat exposure. All of the pins were present and straight in the electrical connector.

Data was retrieved from the engine CN0015 EDU's memory. The data time-stamp did not reflect the date and time of the occurrence. The date-time stamps are usually provided from the airframe, but had not been uploaded into the EDU. Based on the description of the events in the memory the event was recorded at 2015/06/18.

The sequence of the EDU recordings for the event shows multiple incidents being detected by the EEC as follows:

- TC fault (T/R Unlatched In-Flight) on both channels.
- TA Fault (T/R Deployed In-Flight) on both channels, About 22 seconds later a SA fault (WOW discrete check) was detected on both channels.
- Flameout event and the ARINC bus failures for the oil pressure and oil pressure respectively.
- There is also a manual recording at the end of the EDU logs, however, the recording appears to have been corrupted data due to the power interruption during the event.

The EDU has trace data from -163.72 seconds before the first touchdown to 36.28 seconds after. Following the TLA movements to idle at -87.07 seconds, the EEC commanded the engine to idle setting schedule as expected (Ref. Graph No. 1).

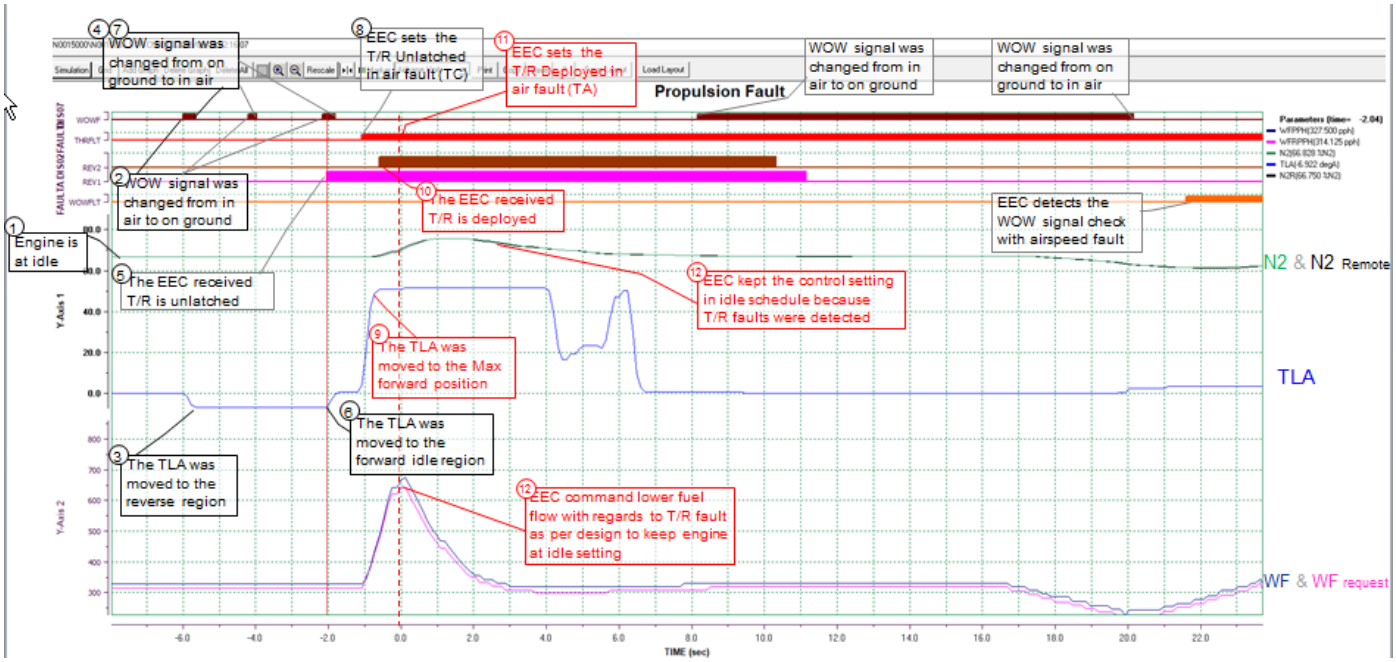


Graph No. 1

The focus of the next slide is from -6.28 seconds (first touchdown) to 30 seconds after. The following slide demonstrates the sequence of commands sent and feedback received by the EEC corresponding to the numbers on the Graph No. 2:

1. The engine was at the idle setting
2. The WOW signal transitioned to “on-ground” state, indicating that the main landing gears and nose gear had all touched down.
3. TLA was moved to the reverse idle region.
4. The aircraft bounced three times, resulting in the WOW signal changing to “in-air” and back to “on-ground”.
5. The T/R unlatched switch (Rev 1) feedback indicated that the reverser was stowed until the third bounce.
6. On the third bounce, the TLA moved from reverse idle to forward idle, at this time, The T/R unlatch feedback indicates that the T/R was unlatched (deploying).
7. Following the T/R unlatch, the WOW signal changed to “in-air” and stayed in the “in-air” state for approximately ten seconds.
8. One second after the T/R unlatched, the EEC annunciated a T/R Unlatched In Flight fault (TC) as per design.
9. The TLA was moved to maximum forward position, and the engine accelerated to approximately 75% N2.

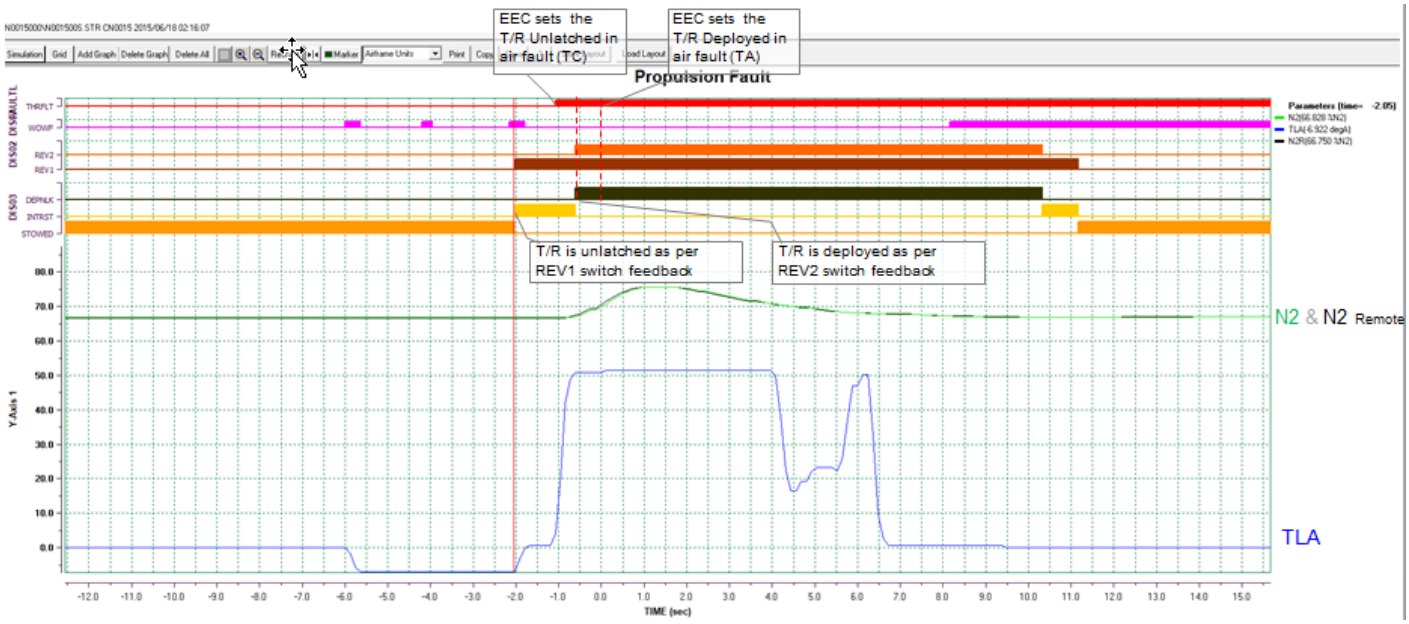
10. 1.4 seconds after the T/R unlatched, the EEC received the T/R deployed status (Rev 2 = True). The EEC recognizes the T/R status to be "Deployed and Locked"
11. 0.5 seconds later, the EEC annunciated a T/R Deployed In-Flight fault (TA) as per design.
12. When the TA fault was declared, the EEC commanded the engine to idle as per design and fuel flow was reduced to keep the engine at flight idle.



Graph No. 2

The following Graph No. 3 shows the EEC processed parameters for the T/R status:

- When the Rev1 switch feedback was received, the EEC recognizes the T/R to be "Unlatched".
- When the Rev 2 switch feedback was received, the EEC recognizes the T/R status to be "Deployed and Locked".



Graph No. 3

The exterior of the right hand engine EDU was blackened due to exposure to the post impact fire. All of the external labels were blackened and illegible. The anti-vibration mounts were present but were affected by heat exposure. All of the pins were present and straight in the electrical connector.

No Data was recovered from the right engine EDU due to post impact fire damage.

Based on the remote engine N1 and N2 parameters in the left engine EDU recording, the right engine behaviour was consistent with the left hand engine.