NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research and Engineering
Vehicle Recorder Division
Washington, D.C. 20594

SPECIALIST'S FACTUAL REPORT OF INVESTIGATION

SOUND SPECTRUM STUDY

ERA14FA300

By
James Cash

NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division

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Sound Spectrum Study

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1. EVENT SUMMARY

Location:	Huntsville, Alabama
Date:	June 18, 2014 1424 CDT
Aircraft:	Israel Aerospace Industries WestWind, Registration N793BG
Operator:	SynFuels Holdings Finance LLC
NTSB Number:	ERA14FA300

On June 18, 2014, about 1424 central daylight time, an Israel Aircraft Industries (IAI) 1124A, N793BG, crashed into a field during takeoff from Huntsville International Airport-Carl T. Jones Field (HSV), Huntsville, Alabama. The FAA authorized Pilot Proficiency Examiner (PPE), airline transport rated pilot, and airline transport pilot rated passenger were fatally injured; the airplane was destroyed by impact and a post-crash fire. The airplane was registered to and operated by SynFuels Holdings Finance LLC, under the provisions of 14 Code of Federal Regulations (CFR) Part 91 pilot proficiency flight. Visual meteorological conditions prevailed at the time and no flight plan was filed for the flight, which was originating at the time of the accident.

A tape cockpit voice recorder (CVR) was sent to the National Transportation Safety Board (NTSB) Vehicle Recorder Division for evaluation. The recovered recording was examined to determine engine performance and thrust reverser deployment during the previous full stop landing and during the accident takeoff.

2. GROUP

A group was not convened.

3. DETAILS OF INVESTIGATION

The good quality 4-track, 30-minute CVR recording was examined to determine if engine performance and thrust reverser deployment could be extracted from the background sounds heard on the recording. A CVR group was convened that prepared a transcript of select portions of the recording. See Group Chairman's Factual Report of Investigation, CVR Transcript.

3.1 CVR Recording

Several segments of the accident recording were examined to document the background sounds. The first segment was during a full stop landing prior to the accident flight. The landing was performed by the accident flight crew and they utilized

aircraft braking and thrust reverser operation to stop the aircraft. The second segment that was examined was the accident takeoff.

Both segments were analyzed using signal processing software that separates and displays the various frequency components of the audio recording. The software also permits the plotting of the frequency components using differential color scales (see plot 1). CVR track 2 and the cockpit area microphone channel (CAM) of the CVR recording were used for the sound analysis study.

3.2 Tape Speed

The tape speed of the original recording was found to be not at the normal design speed of 1 7/8 inches per second (IPS). It was discovered that the tape speed was running slow, at about 94.4% of the normal design speed. A correction of 1.059 was made to all of the frequency and time data recovered from the spectrum charts (Plot-1 and Plot-3).

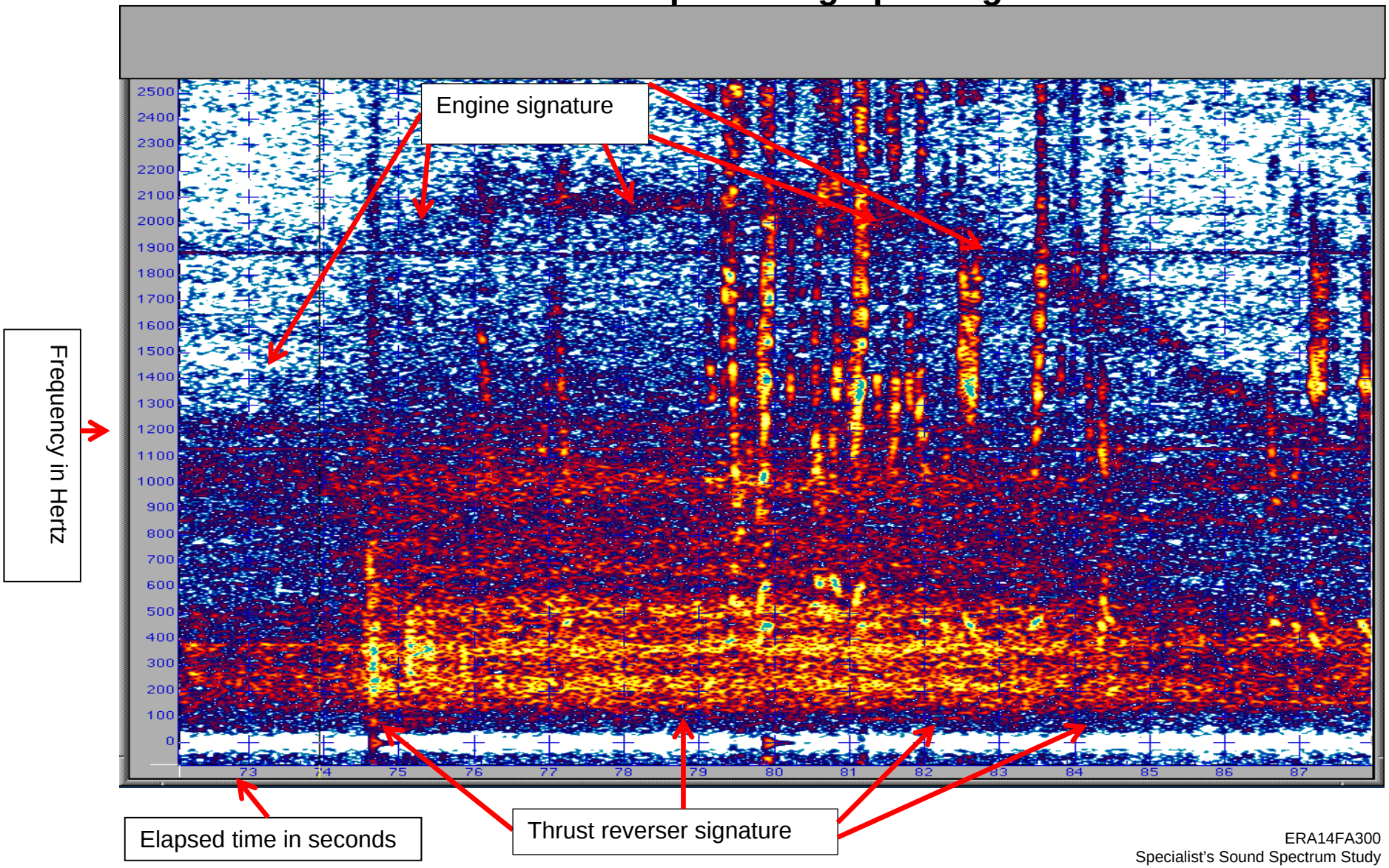
3.3 Previous Landing

The previous landing segment of the CVR recording was examined to determine if a spectrum signature could be developed that corresponded to the thrust reverser use during the landing roll out. The CAM channel of the recording was examined utilizing the signal processing software. A spectrum plot was developed of the landing that depicts the various frequency components of the landing sounds. Plot 1 is a spectrogram plot that depicts elapsed time in seconds along the bottom X axis, frequency in hertz along the vertical or Y axis. Additionally, intensity of the various signals is depicted using a color scale from light blue to dark red. Blue being the lower intensities and red being the more intense signals.

During the landing segment several frequency signatures could be seen. One signature was associated with the rotation speed of the engines. Specifically, the second harmonic of the sound produced by the rotation of the “HP-Spool” or N-2 of the engine. Even though, the aircraft has two engines, only one sound signature was visible. This is attributed to both engines rotating at approximately the same speed. This second harmonic of the N-2 trace was visible from just above idle speed throughout the reverser deployment of about 80% N-2, and back to about the idle setting.

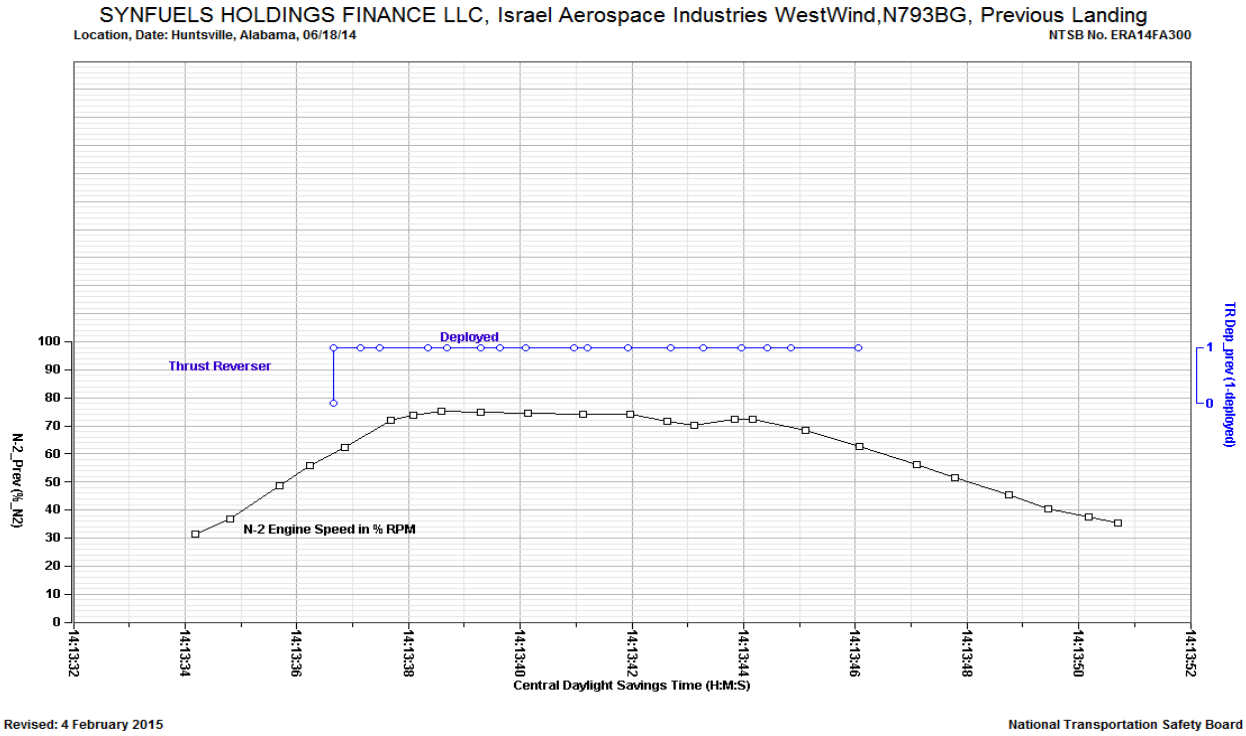
The second signature that was identified was associated with the thrust reverser deployment during the landing roll. The signature appears as the engine is accelerating above approximately 55% N-2 in reverse thrust. The signature is visible until the engine decelerates below about 60% N-2 during the landing roll out.

PLOT- 1
Previous Full Stop Landing Spectrogram



To better illustrate the data recovered from the sound spectrum examination of the landing portion of the recording, Plot-2 was generated. This plot depicts the aircraft's N-2 engine speed and thrust reverser status during the landing rollout.

PLOT-2
Previous Landing Data

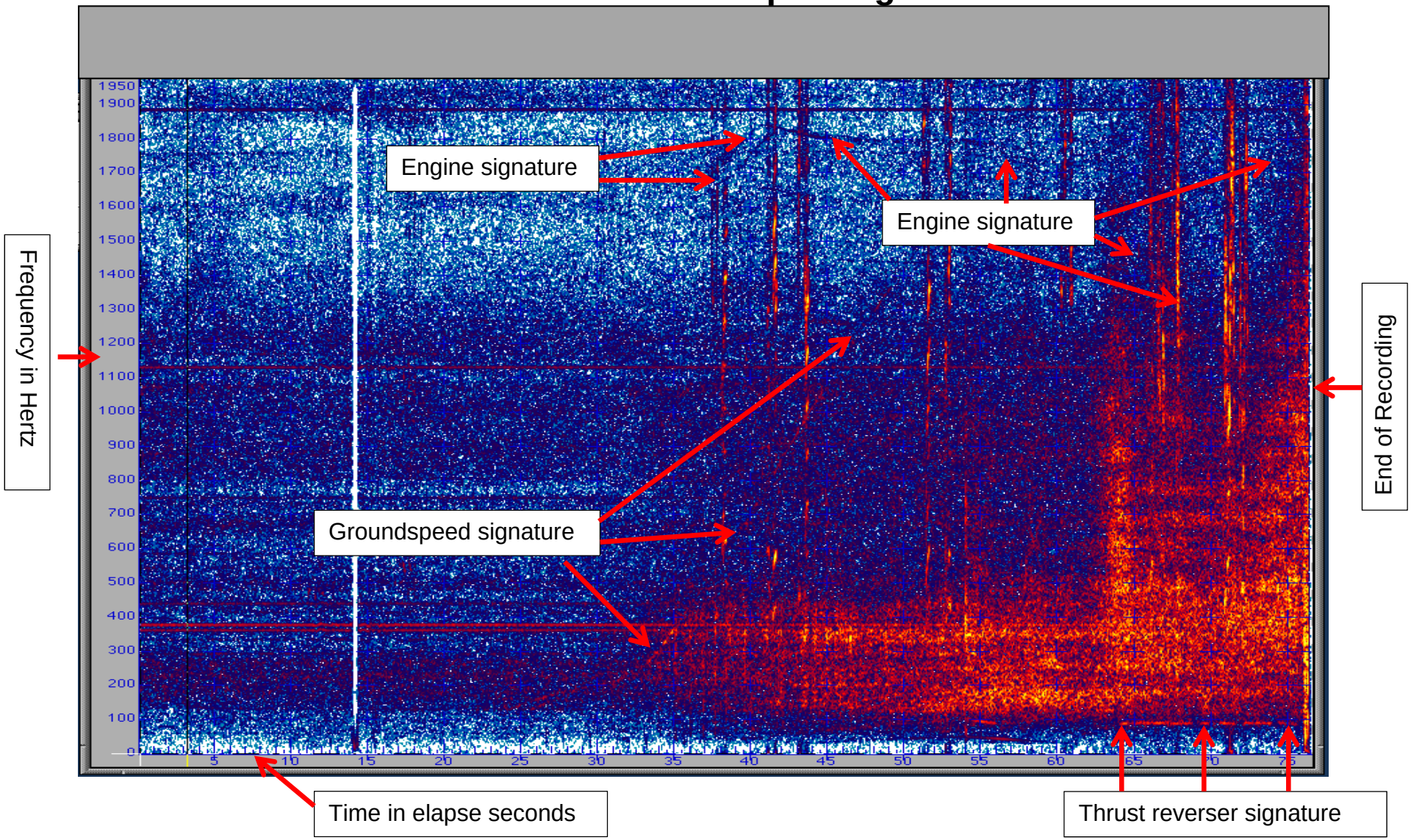


3.4 Accident Takeoff

The second segment of the CVR recording that was examined was the accident takeoff. The same engine and thrust reverser sound signatures that were identified in the previous landing segment were also present in portions of the takeoff recording. In addition to the engine and thrust reverser sound signatures an additional signature associated with the ground speed of the aircraft was identified. This sound was being generated by the aircraft's wheels interacting with the runway grooving during the takeoff roll of the aircraft.

Plot-3 depicts the last 75 seconds of the CAM channel of the CVR recording. As in the previous plot, elapsed time in seconds is depicted along the X or horizontal axis and frequency in Hertz is depicted along the Y or vertical axis. Intensity of the signals is shown by the various colors from blue to red indicating low to higher intensities.

PLOT 3
Accident Takeoff Spectrogram

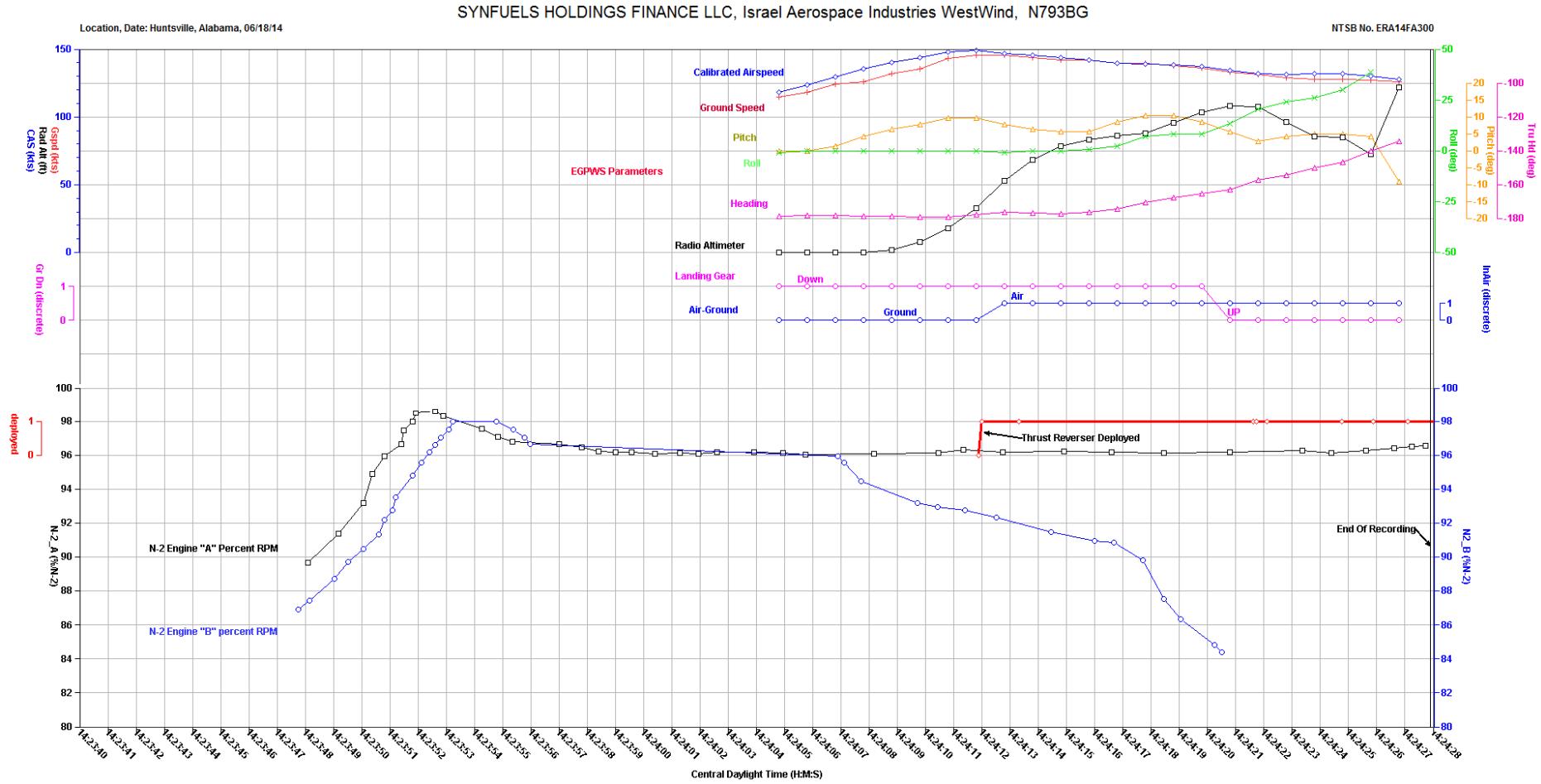


It can be seen on Plot -3 that the beginning of the takeoff appeared normal. During the takeoff roll, two engine sound signatures are identifiable, one from the right engine and the other from the left engine. It should be noted that there is no way to associate which sound trace was being produced by which engine. It can be seen that both engines peek at about 98 to 99% N-2 and then drop down to a stabilized 96% N-2. Additionally the sound trace associated with the aircraft's groundspeed can be seen as a steadily increasing frequency trace consistent an accelerating wheel speed.

To better illustrate the data shown on Plot-3 along with data recovered from the aircraft's Enhanced Ground Proximity Warning system (EGPWS), Plot-4 was generated[1]. Plot 4 depicts the sound spectrum derived data (engine "A" N-2 speed, engine "B" N-2 speed, and thrust reverser deployment signature) along with EGPWS data (radio altimeter, aircraft pitch, roll, groundspeed, calibrated airspeed, heading, landing gear up/down status, and aircraft air-ground status). In addition a second plot, Plot-5, was produces which contained the data found on Plot-4 overlaid with selected CVR background noises and crew comments.

[1] For additional information concerning the EGPWS data see Specialist's Factual Report of Investigation EGPWS

PLOT-4
Accident Takeoff Data

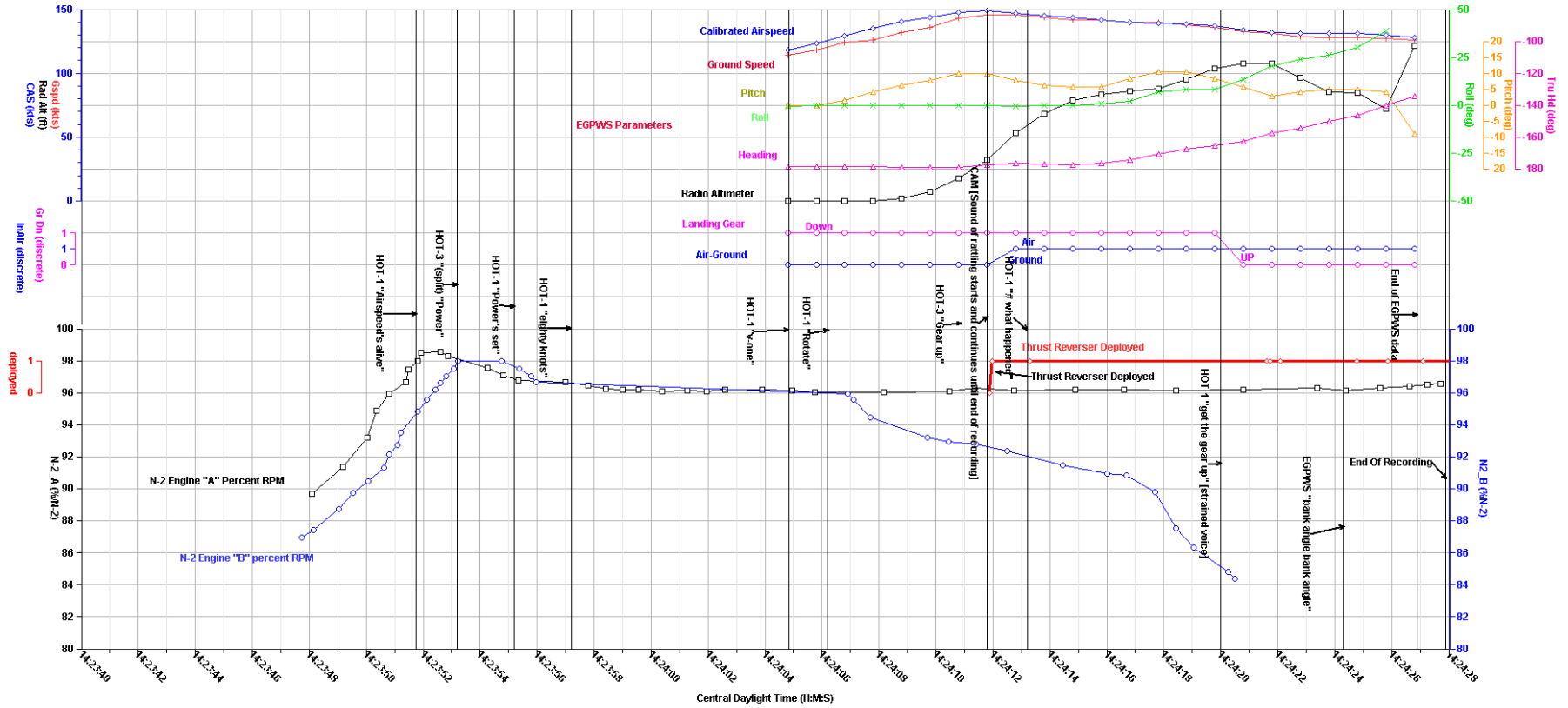


PLOT-5
Accident Takeoff Data with Selected CVR Text

SYNFUELS HOLDINGS FINANCE LLC, Israel Aerospace Industries WestWind, N793BG

Location, Date: Huntsville, Alabama, 06/18/14

NTSB No. ERA14FA300



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It can be seen on Plots 3-5 that as the engines were advanced for takeoff, two engine traces could be seen. After peaking at about 98-99% N-2 RPM both engines settled at about 96% N-2. At about 1424:07 CDT it is observed that one of the two engine traces start to decrease from the steady 96% N-2 speed. This decrease happens just after the “rotate” call from the pilot. The engine continues to decrease in RPM until the trace was no longer visible at about 84% N-2. The other engine trace remains steady at about 96% N-2 until the end of the recording at 1424:28 CDT.

The sound signature that was associated with the thrust reverser deployment during the previous landing (Plot-1 and Plot-2) could again be identified during the accident takeoff. The signature starts at 1424:12 CDT, just after the sound of rattling is heard on the CVR recording. The thrust reverser signature remains visible until the end of the recording at 1424:28 CDT.

James Cash
Electronics Engineer