

**United Cargo Flight 1416**  
GA C250-004 Cyclor, S114US  
Earth-Mars cyclor trajectory  
June 18, 2084



## **United Transportation Safety Board**

**Accident Report**  
**Preliminary transcript, for internal use only**  
**UTSB/SPC-08/24**

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## Abstract

This report contains the transcript of the last 6 minutes recorded by the crew communications and input recorder (CCIR) from the June 18, 2084 accident. The craft disintegrated after losing multiple critical systems to the extreme solar storm. The 2 crew members were killed in the violent depressurization of the utility and crew module. The craft was deemed lost due to the various trajectories of its debris. No recovery missions have been planned.

The GA C250-004 Cyclor consists of three main modules – crew, utility, and cargo. The utility module remains at the craft's center of rotation, while the crew and cargo module are attached to opposite ends of the utility module using interconnect cables. The lengths of these cables vary depending on the mass of the cargo module. The rotation of the craft is controlled so that the crew module would experience 1G (9.8 m/s<sup>2</sup>) of artificial gravity throughout the flight.

Thomas Rivetti (Captain) and Stephen Edwards (Pilot) were performing repairs on a failed drive in array B2, located in the utility module. Edwards remained in the crew module while Rivetti performed an extravehicular activity and entered into the utility module. Both modules were equipped with primary and auxiliary life support systems.

In addition to human error, this transcript reveals the Flight Management System's (FMS) fatal mistakes. The FMS's inability to determine faulty input variables and the crew's inability to override its decisions under emergency recovery mode demands further investigation. Advanced Processor Technologies (R) introduced the emergency recovery mode in 2044 and has not made significant updates since. APT's claims that the system can recover a craft from severe failures without requiring input from the crew is questioned by these events. APT has yet to respond to our inquiries.

## Legend

■	Blue squares indicate verbal communication, either between the crew (labeled as “COMM-internal”) or between the crew and a command center using the Interplanetary Communications System (IPCS) satellite network (labeled as “COMM-external”).
▼	Green triangles indicate terminal inputs and outputs. This is the primary way crew interact with the spacecraft. Commands (starting with “\$”) are entered into the terminal with a keyboard and outputs (responses) are displayed on a monitor. Crew usually carry a laptop with them to serve as a personal endpoint.
●	Red circles indicate alarms. The transcribed text was broadcasted through the craft’s announcement system. These alarms are triggered when the Master Alarm System (MAS) deems an issue requires immediate intervention.
FMS	Flight Management System. This is the central system that monitors and controls the spacecraft developed by APT. It consists of the Central Flight Unit (CFU) and 5 Flight Control Units (FCU) that carry out commands issued by the CFU.
CFU	Central Flight Unit. The “brain” of the spacecraft. The CFU is made up of three identical computers that perform the same calculations. Every result is compared to ensure that no data corruption occurred during processing.
FCU	Flight Control Units. Peripheral computers that control a segment of the spacecraft. FCUs directly command other hardware and interpret inputs from various sensors. Each FCU is also attached to a storage array, which it monitors and maintains. FCUs have redundancy built-in, only 2 of the 5 FCUs need to be functional for the spacecraft to be operational.
DMS	Data Management System. A subsystem of the FMS that controls the storage arrays attached to each FCU.
MAS	Master Alarm System. The most resilient computer onboard any spacecraft. The MAS is built to withstand extreme radiation, heat, and vibrations. It should remain functional even when all other systems fail. It reads inputs from other systems and issues alarms when necessary. It is also responsible for the CCIR.
RCS	Reaction Control System. A subsystem of the FMS that controls the guidance and propulsion system. It makes small adjustments to the spacecraft using thrusters throughout the flight.

COMM-internal  
13:05:32

Thomas R. → Stephen E.

**Steve, how's the CFU doing?**

COMM-internal  
13:05:35

Stephen E. → Thomas R.

**The flight unit - uh - let me check.**

TERMINAL  
13:05:37

Stephen E. → FMS

**\$ fms status**

TERMINAL  
13:05:37

FMS → Stephen E.

**Using default scope: all**

**Connecting to flight control units:**

- FCU #1: **connected**
- FCU #2: **connected**
- FCU #3: **connected**
- FCU #4: **connected**
- FCU #5: **connected**

**Performing system checks:**

- Life support systems: **nominal**
- Structural system: **nominal**
- Guidance system: **nominal**
- Propulsion system: **nominal**
- Payload system: **nominal**
- Power generation system: **nominal**
- Communications system: **nominal**

**Performing array checks:**

- Array A1: **valid** [=== ] 413TB/3200TB
- Array A2: **valid** [=== ] 413TB/3200TB
- Array A3: **valid** [=== ] 413TB/3200TB
- Array B1: **valid** [===== ] 891TB/1000TB
- Array B2: **error** [===== ] 891TB/1000TB

**> Caution: parity drive 2 data does not match rest of array.  
Rebuild array. If failed, replace drive immediately or stop array.**

COMM-internal  
13:05:43

Stephen E. → Thomas R.

**The parity drive in array B2 is still bad even after the rebuild.**

COMM-internal  
13:05:46

Thomas R. → Stephen E.

**Must be a bad drive, or it could be a bad backplane.**

COMM-internal  
13:05:52

Stephen E. → Thomas R.

**Not sure – I mean, it reads data perfectly fine, can't be the backplane.**

COMM-internal  
13:05:57

Thomas R. → Stephen E.

**I'll get command to send us a new drive for the next Mars intercept?**

COMM-internal  
13:06:01

Stephen E. → Thomas R.

**Sure, I'll stop the array for now.**

COMM-internal  
13:06:05

Thomas R. → Stephen E.

**I'll let them know.**

TERMINAL 13:06:08 Stephen E. → DMS  
**\$ dms stop ARRAY\_B2**

TERMINAL 13:06:09 DMS → Stephen E.  
**Stopping array:**  
- Pausing automatic syncing with ARRAY\_B1: **done**  
- Updating storage mapping: **done**  
- Shutting down drives: **done**  
**COMPLETE**

COMM-external 13:06:12 Thomas R. → E-USA-EYW-EN, Stephen E.  
**Key West Command, this is Barcode one four one six, requesting a new - umm -**

COMM-internal 13:06:14 Stephen E. → Thomas R.  
**EHS ProShield five**

COMM-external 13:06:15 Thomas R. → E-USA-EYW-EN, Stephen E.  
**- new a hundred terabyte EHS ProShield five drive to be added to the resupply capsule when we get to Mars. One of ours failed and the array has been taken offline.**

TERMINAL 13:06:22 FMS → Thomas R.  
**Sending transmission:**  
- IPCS satellite network: **connected**  
- Expected one-way delay: **00:48**  
**COMPLETE**

COMM-internal 13:06:24 Thomas R. → Stephen E.  
**Two minutes.**

COMM-internal 13:06:27 Stephen E. → Thomas R.  
**Out of all the call signs they could have chosen, it just had to be 'Barcode.'**

COMM-internal 13:06:31 Thomas R. → Stephen E.  
**Hey, it lets people know we transport cargo.**

COMM-internal 13:06:34 Stephen E. → Thomas R.  
**Yeah sure, but it could have been something cooler. Atlantic has 'Speedbird' and I just love that.**

COMM-internal 13:06:39 Thomas R. → Stephen E.  
**That's actually the old British Airways call sign. It's good -**

COMM-internal 13:06:41 Stephen E. → Thomas R.  
**But I've heard Atlantic doesn't give you a lot of data storage. It's like a hundred terabytes per crew or something. That's barely enough for my family photos, let alone music and everything else.**

COMM-internal 13:06:55 Thomas R. → Stephen E.  
**Yeah - that's pretty bad.**

COMM-internal 13:06:57 ■ Stephen E. → Thomas R.  
**You always load like half of yours with family stuff, you ever go through all of it?**

COMM-internal 13:07:03 ■ Thomas R. → Stephen E.  
**Most of it, yeah. It gets lonely out here.**

COMM-internal 13:07:07 ■ Stephen E. → Thomas R.  
**Can't disagree with you there.**

COMM-internal 13:07:11 ■ Thomas R. → Stephen E.  
**How's Joe doing?**

COMM-internal 13:07:14 ■ Stephen E. → Thomas R.  
**He'll turn four in two and a half weeks. Can't believe that.**

COMM-internal 13:07:18 ■ Thomas R. → Stephen E.  
**Time flies. Last time I saw him he was like what? Two?**

COMM-internal 13:07:23 ■ Stephen E. → Thomas R.  
**Yeah - I really wanted to be there for his birthday. I just want him to have memories of me before he grows up, you know?**

COMM-internal 13:07:30 ■ Thomas R. → Stephen E.  
**I know.**

TERMINAL 13:07:35 ▼ Stephen E. → FCU #4  
**\$ cd /crew/00178/familySutff**

TERMINAL 13:07:35 ▼ FCU #4 → Stephen E.  
**Opening directory in Array B1: done. 0.12 sec**

COMM-internal 13:07:52 ■ Stephen E. → Thomas R.  
**You think they'll ever do solo missions after the legislation changes?**

COMM-internal 13:07:57 ■ Thomas R. → Stephen E.  
**I don't know – they'll need to figure out a way for it to be safe enough.**

COMM-internal 13:08:02 ■ Stephen E. → Thomas R.  
**Maybe we'll get a longer rest window between these transits.**

COMM-internal 13:08:08 ■ Thomas R. → Stephen E.  
**I doubt that. Even if we do, that also means more time on Mars.**

COMM-internal 13:08:12 ■ Stephen E. → Thomas R.  
**Ugh. I hate that pl-**

COMM-external 13:08:13 ■ E-USA-EYW-EN → \*all  
**Barcode one four one six, one hundred terabyte replacement drive will be added to your resupply list. Confirm array is stopped?**

TERMINAL 13:08:20 Stephen E. → FMS  
**\$ fms status arrays**

TERMINAL 13:08:21 FMS → Stephen E.  
**Performing array checks:**  
- Array A1: **valid** [=== ] 413TB/3200TB  
- Array A2: **valid** [=== ] 413TB/3200TB  
- Array A3: **valid** [=== ] 413TB/3200TB  
- Array B1: **valid** [===== ] 891TB/1000TB  
- Array B2: **stopped**

COMM-internal 13:08:23 Stephen E. → Thomas R.  
**B2 is stopped.**

COMM-external 13:08:25 Thomas R. → E-USA-EYW-EN, Stephen E.  
**Affirmative, array is stopped. Barcode one four one six.**

TERMINAL 13:08:27 FMS → Thomas R.  
**Sending transmission:**  
- IPCS satellite network: **connected**  
- Expected one-way delay: **00:48**  
  
**COMPLETE**

COMM-internal 13:08:28 Thomas R. → Stephen E.  
**'Kay, that's done. Handing over to autopilot.**

TERMINAL 13:08:32 Thomas R. → FMS  
**\$ fms enable autopilot**

TERMINAL 13:08:32 FMS → Thomas R.  
**Engaging autopilot:**  
- autopropulsion: **active**  
- autoguidance: **active**  
  
**COMPLETE**

COMM-internal 13:08:36 Stephen E. → Thomas R.  
**You want to come back soon-**

TERMINAL 13:08:37 FMS → Thomas R.  
  
**> Caution: external communication lost**

COMM-internal 13:06:38 Thomas R. → Stephen E.  
**What?**

ALARM 13:08:38 MAS → \*all  
**MASTER ALARM**  
  
**Multiple critical system failures. Aborting all procedures.  
Seek personal life support system immediately.**

TERMINAL  
13:08:38

MAS → \*all

Initiating automatic self-test:

- connecting to flight management system: **error**
- connecting to central flight unit: **error**

Performing system checks:

- Life support systems: **no status**
- Structural system: **no status**
- Guidance system: **no status**
- Propulsion system: **no status**
- Payload system: **no status**
- Power generation system: **no status**
- Communications system: **no status**

Initiating emergency procedures:

- Auxiliary life support system: **error**
- Auxiliary power unit: **error**

> **Warning: auxiliary power until failed to initialize. Aborting all procedures. Emergency batteries will supply power for the next 15 min. Refer to the emergency checklist.**

COMM-internal  
13:08:41

Thomas R. → Stephen E.

**Loss of power. No status on all systems. Confirm PLSS active.**

COMM-internal  
13:08:45

Stephen E. → Thomas R.

**Confirm. Running emergency checklist.**

COMM-external  
13:08:49

Thomas R. → E-USA-EYW-EN, Stephen E.

**Mayday, mayday, mayday. Barcode one four one six with multiple system failures. No life support, loss of power. Mayday, mayday, mayday.**

TERMINAL  
13:08:55

MAS → Thomas R.

> **Caution: flight management system response timeout.**

COMM-internal  
13:08:57

Thomas R. → Stephen E.

**We lost flight management. Manually rebooting.**

TERMINAL  
13:09:06

FMS → \*all

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Advanced Processor Technologies <R> cyclcr Flight Management System

Phinux 23.04.01 LTS ARM\_128  
Improper shutdown detected.  
Low power mode active.  
Booting...

COMM-internal  
13:09:08

Stephen E. → Thomas R.

**Checklist: observer auxiliary power unit automatic startup.**

COMM-internal 13:09:12 ■ Thomas R. → Stephen E.  
**Failed.**

COMM-internal 13:09:16 ■ Stephen E. → Thomas R.  
**Failed. Uh - manually start either APU.**

COMM-internal 13:09:20 ■ Thomas R. → Stephen E.  
**One has no response.**

COMM-internal 13:09:23 ■ Stephen E. → Thomas R.  
**Trying two.**

TERMINAL 13:09:26 ▼ MAS → \*all  
**Power restored.**

Initiating emergency procedures:  
 - Auxiliary life support system: **error**  
 - Auxiliary power unit: **active**  
 - Initiating FMS emergency recovery mode: **done**

TERMINAL 13:09:26 ▼ FMS → \*all  
**Initiating emergency recovery mode.**

> **Note: flight management system acquired full root user privileges.**

COMM-internal 13:09:28 ■ Stephen E. → Thomas R.  
**Two is up.**

COMM-internal 13:09:29 ■ Thomas R. → Stephen E.  
**FMS is in emergency recovery mode.**

COMM-internal 13:09:32 ■ Stephen E. → Thomas R.  
**Okay. Checklist: reboot flight control units. Ensure at least two are operational.**

TERMINAL 13:09:37 ▼ Thomas R. → FMS  
**\$ sudo fcu reboot**

TERMINAL 13:09:37 ▼ FMS → Thomas R.  
**Rebooting flight control units:**  
 - FCU #1: rebooting... **connected**  
 - FCU #2: **no connection**  
 - FCU #3: **no connection**  
 - FCU #4: rebooting... **connected**  
 - FCU #5: rebooting... **connected**

COMM-internal 13:09:38 ■ Thomas R. → Stephen E.  
**One, four, and five are up.**

COMM-internal 13:09:42 ■ Stephen E. → Thomas R.  
**Check primary and secondary oxygen tank integrity.**

TERMINAL 13:09:45 FMS → \*all  
 > **Warning: excessive angular velocity. Initiating automatic spin correction.**  
  
 Engaging reaction control system:  
 - Thruster #1: **engaged**  
 - Thruster #4: **engaged**  
 - Thruster #13: **engaged**  
 - Thruster #16: **engaged**

ALARM 13:09:45 MAS → \*all  
**ROTATION RATE**  
  
**Excessive angular velocity.**  
**Increased artificial gravity.**

COMM-internal 13:09:49 Stephen E. → Thomas R.  
**Rotation? Feels fine to me.**

COMM-internal 13:09:52 Thomas R. → Stephen E.  
**Let me make sure guidance is running correctly.**

TERMINAL 13:09:55 Thomas R. → FMS  
**\$ fms status systems**

TERMINAL 13:09:55 FMS → Thomas R.  
**Performing system checks:**  
 - Life support systems: **down**  
 - Structural system: **nominal**  
 - Guidance system: **nominal**  
 - Propulsion system: **nominal**  
 - Payload system: **limited**  
 - Power generation system: **limited**  
 - Communications system: **nominal**

COMM-internal 13:09:58 Thomas R. → Stephen E.  
**Okay, it's fine. Comms is up too.**

COMM-internal 13:10:03 Stephen E. → Thomas R.  
**Alright. O2 tanks look good. Manually starting auxiliary life support.**

COMM-external 13:10:08 Thomas R. → E-USA-EYW-EN, Stephen E.  
**Mayday, Mayday, Mayday. Barcode one four one six, lost primary life support and primary power.**

TERMINAL 13:10:13 FMS → Thomas R.  
**Sending transmission:**  
 - IPCS satellite network: **no connection**  
  
 > **Caution: IPCS response timeout. Retry connection in 1 min.**

COMM-internal 13:10:15 Thomas R. → Stephen E.  
**Still no connection.**

COMM-internal 13:10:19 ■ Stephen E. → Thomas R.  
**Thomas? The RCS thrusters are still firing.**

COMM-internal 13:10:21 ■ Thomas R. → Stephen E.  
**What?**

TERMINAL 13:10:23 ▼ Stephen E. → FMS  
**\$ fms status crewmod**

TERMINAL 13:10:23 ▼ FMS → Stephen E.  
**Crew module:**  
- Pressure: **101.3 kPa**  
- O2 level: **21%**  
- Rotation: **-7.63 RMP**

COMM-internal 13:10:25 ■ Stephen E. → Thomas R.  
**It thinks the crew module is at negative eight RMP. The gyroscopes must be faulty.**

COMM-internal 13:10:30 ■ Thomas R. → Stephen E.  
**I'm shutting down the thrusters.**

TERMINAL 13:10:32 ▼ Thomas R. → FMS  
**\$ fms stop rcs**

TERMINAL 13:10:32 ▼ FMS → Thomas R.  
**> Warning: failed. Cannot override emergency recovery mode procedures.**

TERMINAL 13:10:34 ▼ Thomas R. → FMS  
**\$ sudo fms stop rcs**

TERMINAL 13:10:34 ▼ FMS → Thomas R.  
**> Warning: failed. Cannot override emergency recovery mode procedures.**

COMM-internal 13:10:35 ■ Thomas R. → Stephen E.  
**Stephen, I can't stop it. Emergency recovery has priority.**

COMM-internal 13:10:39 ■ Stephen E. → Thomas R.  
**Shit. What now? We can't disconnect the gyros.**

COMM-internal 13:10:43 ■ Thomas R. → Stephen E.  
**Shut off the APU, that'll force the RCS into low power mode.**

ALARM 13:10:49 ● MAS → \*all  
**POWER LOSS**  
**Limited power availability. Aborting all procedures. Start APU immediately.**

COMM-internal 13:10:51 ■ Stephen E. → Thomas R.  
**Okay, that worked. But we can't use the RCS to slow it back down.**

COMM-internal 13:10:58 ■ Thomas R. → Stephen E.  
**You're right.**

COMM-internal 13:11:02 ■ Stephen E. → Thomas R.  
**Damn it.**

COMM-internal 13:11:11 ■ Thomas R. → Stephen E.  
**Wait. Steve, I can adjust the cable length between the modules. That'll slow down the rotation.**

COMM-internal 13:11:18 ■ Stephen E. → Thomas R.  
**Conservation of angular momentum.**

COMM-internal 13:11:21 ■ Thomas R. → Stephen E.  
**Exactly. I'll extend them by 30 meters first.**

COMM-internal 13:11:24 ■ Stephen E. → Thomas R.  
**Alright, I'll complete the life support checklist.**

TERMINAL 13:11:27 ▼ Thomas R. → FMS  
**\$ fms struc --extend 30**

TERMINAL 13:11:27 ▼ FMS → Thomas R.  
**Extend interconnect cables by 30 meters? [Y/N]**

TERMINAL 13:11:28 ▼ Thomas R. → FMS  
**Y**

TERMINAL 13:11:28 ▼ FMS → Thomas R.  
**Extending interconnect cables...**  
**> Caution: flight management system in low power mode, unable to balance mass distribution**

ALARM 13:11:29 ● MAS → \*all  
**DEPRESURIZATION**  
**Utility module experiencing violent depressurization. Aborting all procedures. Seek personal life support system immediately. Brace for impact.**

ALARM 13:11:29 ● MAS → \*all  
**STRUCTURAL INTEGRITY**  
**Interconnect cable malfunction. Aborting all procedures. Seek personal life support system immediately. Brace for impact.**

ALARM  
13:11:29



MAS → \*all

**MASTER ALARM**

**Multiple critical system failures. Aborting all procedures.  
Seek personal life support system immediately.**

COMM-internal  
13:11:30



Stephen E. → Thomas R.

**Thomas! What the-**

END OF RECORDING