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NASA making progress on EVA-35 water leak incident

March 15, 2016 by Chris Bergin



NASA teams are continuing to evaluate the root cause of the water leak that resulted in the termination of EVA-35. Suspicion is currently falling on an element of the sublimator in the EMU 3011 suit, which may have become contaminated during storage aboard the International Space Station (ISS). This suit will be returned to Earth at the conclusion of the next SpaceX Dragon mission.

Water Leak:

US EVA-35 successfully replaced a failed electrical component, called the Sequential Shunt Unit (SSU), in order to restore the station to its full power generation capacity.



The spacewalk was the first ever to be conducted by a British astronaut, Tim Peake. However, due to water entering "EV1" Tim Kopra's helmet – a potentially life-threatening incident – the EVA was terminated early for safety reasons.

Due to well-practised procedures, both spacewalkers safely made it back into the Quest Airlock around two hours earlier than scheduled.

Tim Kopra's suit (EMU 3011) was immediately investigated via the collection of suit samples during the

post-EVA procedures.

Some of these samples were returned for analysis on the ground onboard the Soyuz that recently returned former ISS commander Scott Kelly.



The crew had already pressurized the EMU during testing and an unmanned leak screening was performed for a duration of six hours. The screening was successfully completed with no leaks detected.

However, a week after the EVA, as the crew configured EMU suits 3008 and 3011 for the regular task of loop scrubbing. A leak was observed at the Liquid Cooling and Ventilation Garment (LCVG) to water processing jumper connector, at the time potentially pointing to a root cause.

"Photographs of the leak were taken and the area dried. (However,) an attempt to recreate the leak during iodination was unsuccessful," noted L2 ISS notes.



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Troubleshooting also looked into the Fan/Pump/Separator – which was the cause of the EVA-23 anomaly where four times as much water entered Luca Parmitano’s helmet in what was a far more serious incident.

However, for Kopra’s EMU, this device was deemed to be performing nominally during troubleshooting. The tests also indicated that other parts of the EVA system were not leaking.

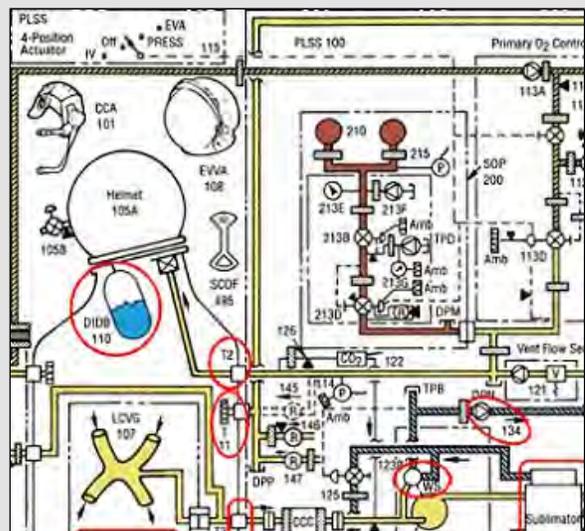
While an intermittent failure which could have occurred – and then

cleared – during EVA 35, the investigation continued to look at all elements of the suit for a “smoking gun”. This effort continued via regular Anomaly Resolution Team (ART) meetings at the Johnson Space Center (JSC).

In order to utilize the vast resource of EMU experience at NASA, a Problem Resolution Team (PRT) was established, allowing for weekly meetings that included reps from all stakeholders, while splinter meetings were scheduled as required for in-depth technical topics and for the results to be briefed to the PRT.

Fault tree closures and status briefing were then elevated to the Space Station Program Control Board (SSPCB).

“The investigation is tasked with the review of ground and on-orbit EMU performance data for trending. Data for all suits will be reviewed again in an effort to identify any early indicators of degraded performance and the provision of fault tree analysis,” noted recent status.



The latest theory, as presented by NASA management – including Bill Gerstenmaier and the director of the ISS at NASA HQ, Sam Scimemi, during the recent NASA Advisory Council (NAC) meeting – noted suspicion is falling on “sublimator carry-over”, where excess water from the sublimator overwhelms the pick-up tubes – known as “slurper tubes” – that are supposed to return water back to the cooling loop.

“It could be a function of how the EVA was done. The crew was very warm to begin with and then they went into a rest period,” noted Mr. Gerstenmaier. “(Then) the body wants to then dump heat and that puts stress on the sublimator – and that’s when the water

started turning up. So we’re pretty sure it’s water carry-over.”

It was also noted that contamination of the hydrophilic coating in the sublimator plumbing – in turn reducing its effectiveness – is a possible contributing factor, and this may have arisen from the way the EMUs are stored in the Leonardo Permanent Multipurpose Module (PMM).

The storage of some “hygiene products” in the module may be a possible source of contaminating chemicals.

The impact of such chemicals on the hydrophilic coating is already



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known, which is why there are strict rules on astronauts using items such as after-shave and lotions.

“(I supposed) you’ve got to balance (the risk) out with spending a year on orbit for a year without deodorant,” joked on NAC member on the audio of the presentation (L2).



The investigation will be aided by the return of EMU 3011 to Earth in May on board [SpaceX’s CRS-8 Dragon](#) when she unberths from her upcoming mission to the ISS.

“I think we need to get this suit back to understand what’s going on,” as Mr. Gerstenmaier noted during the NAC presentation.

NASA’s associate administrator for the Human Exploration and Operations Directorate also noted that the hands-on inspection will play into

the mitigation of future issues, which, as noted, is currently focusing on how the suits are [stored in the PMM on Station between EVAs](#), along with potential design changes.



It’s not the first time since Dragon has come to the aid of an EMU anomaly investigation, with the spacecraft also involved with a [suit relay surrounding Luca Parmitano’s faulty suit](#).

Dragon’s have the ability to host a special EMU rack inside the pressurized section of the capsule for the transfer of space suits to and from the orbital outpost.

Ultimately, the aim is to conclude the EMU 3011 investigation by July.

However, in the event of an unplanned/contingency EVA being called, the Station has EMU’s 3003, 3008 and 3010 deemed to be ready for use.

“We’re not in any hurry, but if we absolutely had to do an EVA, we can go do a contingency EVA,” added Mr. Gerstenmaier. “If we need to do a nominal EVA, we’ll get this issue cleared by then.”

(Images: via NASA and L2 Sections).

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