
JPL
Electro-Optics
Cryogenics
Division
Lockheed

1
00:00:00,010 --> 00:00:04,050
[Tech sounds]

2
00:00:08,100 --> 00:00:12,110
[Music]

3
00:00:12,130 --> 00:00:16,140
>>BEN: We are developing the technology to be able to go to

4
00:00:16,160 --> 00:00:20,150
a satellite, and have a robot refuel it. The ability

5
00:00:20,170 --> 00:00:24,230
to refuel, repair, and relocate

6
00:00:24,250 --> 00:00:28,260
satellites in orbit can be applied to

7
00:00:28,280 --> 00:00:32,350
scientific missions that are looking out at stars; it can be

8
00:00:32,370 --> 00:00:36,390
applied to weather satellites that save thousands of lives a year and

9
00:00:36,410 --> 00:00:40,400
billions of dollars in predicting storms; to communication;

10
00:00:40,420 --> 00:00:44,410
search and rescue; to the International Space Station, helping astronauts

11
00:00:44,430 --> 00:00:48,540
explore our solar system. >>MARION: Those satellites, their

12
00:00:48,560 --> 00:00:52,600
life is limited by the amount of fuel they have. So if we can

13
00:00:52,620 --> 00:00:56,630

bring fuel to them, we can have their lives extended.

14
00:01:08,830 --> 00:01:00,640
[Music]

15
00:01:08,850 --> 00:01:12,890
>>MATT: So this test is the technology development test, and what we're doing here is

16
00:01:12,910 --> 00:01:16,940
proving and maturing technologies required for satellite servicing.

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00:01:16,960 --> 00:01:20,970
>>ALEX: So there are several things new and unique about this test itself. The first

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00:01:20,990 --> 00:01:24,990
was that I was controlling the robot remotely from Greenbelt, Maryland while the robot was

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00:01:25,010 --> 00:01:29,090
located down at Kennedy Space Center. The second was this was the first time

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00:01:29,110 --> 00:01:33,180
we were actually transferring a hazardous fluid. The Robotic Refueling Mission

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00:01:33,200 --> 00:01:37,230
on the Space Station transferred ethanol, which isn't a hazardous fluid and it's

22
00:01:37,250 --> 00:01:41,270
not actually a component of satellite fuel. >>BEN: On the International

23
00:01:41,290 --> 00:01:45,300
Space Station, we wanted to be sure to be safe around the astronauts.

24
00:01:45,320 --> 00:01:49,440
>>MATT: Here, what we're doing now is using actual spacecraft propellant.

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00:01:49,460 --> 00:01:53,510
>>BRIAN: It's a very dangerous fluid, very deadly fluid. That's why

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00:01:53,530 --> 00:01:57,550
we'll be in personal protective equipment, these full-assembly

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00:01:57,570 --> 00:02:01,590
SCAPE suits, and that protects the people in the suit from any sort of

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00:02:01,610 --> 00:02:05,610
exposure. ...

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00:02:05,630 --> 00:02:09,740
>>ALEX: So on the day of the test, I used the tool on the robot to attach to a satellite

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00:02:09,760 --> 00:02:13,850
fill drain valve, where we then transferred fluid through the tool

31
00:02:13,870 --> 00:02:17,950
and into the satellite valve, simulating a refueling task.

32
00:02:17,970 --> 00:02:21,990
>>MATT: So as a tool designer, during the test, we need to make sure the tool is operating as we expect.

33
00:02:22,010 --> 00:02:26,030
So we sit right next to the robot operators, as they're driving the robot,

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00:02:26,050 --> 00:02:30,050
we're looking at video, we're looking at telemetry, making sure that the tool is behaving

35
00:02:30,070 --> 00:02:34,170
as expected. >>ALEX: Operating the robotic arm remotely feels,

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00:02:34,190 --> 00:02:38,240
it actually kinda feels a lot like a video game, because I'll have two joy-sticks in front of me that I'll be using

37
00:02:38,260 --> 00:02:42,290
to control the robot. And while it's moving very slowly, I'm looking at tool cameras in front of

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00:02:42,310 --> 00:02:46,330

me, that show the end of the robot itself.

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00:02:46,350 --> 00:02:50,350
>>MARION: Kennedy was commissioned to design and build the propellant transfer

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00:02:50,370 --> 00:02:54,480
assembly, because they have such expertise in propellants.

41
00:02:54,500 --> 00:02:58,570
We, here at Goddard, have expertise in robotics. >>BRIAN: We have a great

42
00:02:58,590 --> 00:03:02,630
relationship with Goddard and a great team here at KSC and up at Goddard

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00:03:02,650 --> 00:03:06,670
working on the development of these new technologies.

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00:03:06,690 --> 00:03:10,700
[Cheering] >>BEN: The testing went nominal,

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00:03:10,720 --> 00:03:14,710
we couldn't be more pleased. But that doesn't mean we're done, not by a long shot.

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00:03:14,730 --> 00:03:18,820
>>MATT: We're going to take the lessons learned from here, integrate them into new

47
00:03:18,840 --> 00:03:22,890
technologies, and do a complete end-to-end refueling test.

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00:03:22,910 --> 00:03:26,920
>>BEN: I feel just great, so satisfied

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00:03:26,940 --> 00:03:30,940
knowing that the capabilities that we are helping to develop

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00:03:30,960 --> 00:03:35,050
are going to be able to be applied to so many meaningful

51
00:03:35,070 --> 00:03:39,170
missions that NASA works on.

52
00:03:39,190 --> 00:03:43,260
[Beep beep... beep beep...]