
NASA
Laboratory Footage
MFT is demonstrating how a robot would release, capture,
and remove the 'tertiary cap' from a satellite fill/drain valve.

1
00:00:02,240 --> 00:00:07,560
You're getting a look now at the station's
robotic arm using the Dextre multi dexterous

2
00:00:07,560 --> 00:00:13,010
manipulator as it works to change out
some of the tools and get ready to move

3
00:00:13,010 --> 00:00:15,340
through the operations for today.

4
00:00:15,340 --> 00:00:20,670
And joining me on console right now we
have our, one of our robotics operators

5
00:00:20,670 --> 00:00:24,990
from the Goddard Space Flight Center who's been
involved hand in hand with the controllers here

6
00:00:24,990 --> 00:00:28,710
in Mission Control Houston as they move
through to do some of these checkout.

7
00:00:28,710 --> 00:00:33,350
So his name is Alex Janas, and Alex, thank
you very much for joining me here today.

8
00:00:33,350 --> 00:00:34,330
Thanks for having me here.

9
00:00:34,330 --> 00:00:39,900
So why don't you tell us a little bit about
what you do up at Goddard and how you got there.

10
00:00:39,900 --> 00:00:40,870
A pleasure.

11
00:00:40,870 --> 00:00:44,340
So, at Goddard I'm one of the robot operators,

12
00:00:44,340 --> 00:00:47,270
for the satellite servicing
capabilities project.

13
00:00:47,270 --> 00:00:54,620
The project as a whole is working on using
robotics to practice servicing satellites

14
00:00:54,620 --> 00:00:58,910
as we've ramped down a lot
of manned spaceflight work.

15
00:00:58,910 --> 00:01:02,490
My job there, I work on the robotic test bed.

16
00:01:02,490 --> 00:01:04,560
Obviously here we're doing flight robotics.

17
00:01:04,560 --> 00:01:08,080
There we're testing everything on the
ground before we can send it up to orbit,

18
00:01:08,080 --> 00:01:12,050
So what I've done there is,
we design tools to interface

19
00:01:12,050 --> 00:01:15,820
with non-corporative satellite
interfaces, that being the satellites

20
00:01:15,820 --> 00:01:19,340
in orbit right now aren't
designed on to be interfaced

21
00:01:19,340 --> 00:01:22,140
with robotics It's a very
non-friendly interface.

22

00:01:22,140 --> 00:01:25,140
There's lots of wires and valves and covers.

23
00:01:25,140 --> 00:01:29,540
So we work with the tool designer tubes to
design the tools, and my job is to throw them

24
00:01:29,540 --> 00:01:34,510
on our robots which are actually industrial
robots but we've used custom software

25
00:01:34,510 --> 00:01:41,110
to mimic flight robots, And we take them and
we test out the tools, and we provide feedback,

26
00:01:41,110 --> 00:01:45,470
and the ideas to have the best
possible when we send it up in flight.

27
00:01:45,470 --> 00:01:46,830
Okay, very cool.

28
00:01:46,830 --> 00:01:49,730
And as we've been talking about
a little bit through this hour,

29
00:01:49,730 --> 00:01:53,680
they are working on the Robotic Refueling
Mission, which is a payload flown

30
00:01:53,680 --> 00:01:56,260
up last July in the final shuttle mission.

31
00:01:56,260 --> 00:01:58,170
So we actually have an animation
that's going to go

32
00:01:58,170 --> 00:02:00,950
over some more general points of that payload.

33
00:02:00,950 --> 00:02:03,040
And why don't we talk a little
bit about that now.

34
00:02:03,040 --> 00:02:06,530
Sure thing.

35
00:02:06,530 --> 00:02:12,850
So what you're looking at here is the SPDM,
special purpose dexterous manipulator,

36
00:02:12,850 --> 00:02:17,400
and its excessing that big box there,
is RRM, the Robotic Refueling Mission.

37
00:02:17,400 --> 00:02:24,480
It's on one of the ELC carriers, and
there's four different tools on RRM itself.

38
00:02:24,480 --> 00:02:28,060
RRM is kind of a self- contained test bed here.

39
00:02:28,060 --> 00:02:34,120
We have four tools that we can pull out and we
use those tools to interface with about half

40
00:02:34,120 --> 00:02:38,210
of the interfaces, our custom-designed
interfaces that have tools and adapters,

41
00:02:38,210 --> 00:02:43,620
like here you see the multifunction tool pulling
out an adapter that removes tertiary caps,

42
00:02:43,620 --> 00:02:48,370
And once it pulls out this adapter it'll
access what's called fill/drain valve,

43
00:02:48,370 --> 00:02:51,640

and these valves are very
common on satellite interfaces.

44
00:02:51,640 --> 00:02:55,410
And these are the interfaces you
have to have to remove these caps

45
00:02:55,410 --> 00:02:58,810
and ties before it's actually
accessed the refueling port

46
00:02:58,810 --> 00:03:02,530
where you can transfer fluid
to refill satellites.

47
00:03:02,530 --> 00:03:08,690
So here it's removed the tertiary cap, it's now
stowing the cap in a tertiary cap receptacle.

48
00:03:08,690 --> 00:03:14,660
Basically there's a process, these fill/drain
valves, the way they're capped off and secured

49
00:03:14,660 --> 00:03:18,550
on a satellite is they're meant to never
be accessed again right before launch.

50
00:03:18,550 --> 00:03:23,630
So the refueling port itself
will be torqued closed and then

51
00:03:23,630 --> 00:03:27,290
after that we'll put two
different caps on top of that valve

52
00:03:27,290 --> 00:03:30,290
and then those caps themselves
will be wired shut as well.

53
00:03:30,290 --> 00:03:32,070

So it's really a not friendly interface.

54
00:03:32,070 --> 00:03:33,920
It's non-corporative.

55
00:03:33,920 --> 00:03:37,680
And here we're pulling out the
EVR nozzle tool, or the ENT,

56
00:03:37,680 --> 00:03:40,910
and this is actually the
fluid transfer tool itself.

57
00:03:40,910 --> 00:03:43,330
You'll see there's a hose attached to it.

58
00:03:43,330 --> 00:03:48,330
The tool goes ahead and it connects to the
refueling valve, and once that threads on,

59
00:03:48,330 --> 00:03:54,090
it releases the valve, to open it up and we
transfer fluid through the payload itself.

60
00:03:54,090 --> 00:03:58,400
And the RRM payload itself does
have fluid transfer capability,

61
00:03:58,400 --> 00:04:04,210
so were actually practicing transferring fluid
out of RRM through the tool and back into RRM.

62
00:04:05,880 --> 00:04:12,440
Okay, so like you mentioned, this is all being
done in order to eventually service satellites

63
00:04:12,440 --> 00:04:15,320
that were built and made to never be serviced.

64

00:04:15,320 --> 00:04:18,280
So what are some of the activities
it's going to be doing to kind

65
00:04:18,280 --> 00:04:21,610
of mimic tackling those challenges?

66
00:04:22,880 --> 00:04:26,240
So that's a very good question.

67
00:04:26,240 --> 00:04:31,790
You know, the challenges being
the, these interfaces don't have,

68
00:04:31,790 --> 00:04:38,100
with robotics you're very used to using optical
cues and large lead ins to access something.

69
00:04:38,100 --> 00:04:42,820
You know, with a human hand you're typically
used to being compliant in yourself,

70
00:04:42,820 --> 00:04:45,790
you know its very easy to feel
around and feel how something fits.

71
00:04:45,790 --> 00:04:50,700
With a robot that's very difficult because the
robot can't really sense the way human can.

72
00:04:50,700 --> 00:04:56,450
So the real challenge is making sure we design
the tools correctly to access these interfaces

73
00:04:56,450 --> 00:04:58,740
because we have no control how
the interface was designed.

74
00:04:58,740 --> 00:05:01,350
It's already up there, you

know, on hundreds of satellites

75
00:05:01,350 --> 00:05:05,040
and the satellite designers don't want
to change anything to accommodate us

76
00:05:05,040 --> 00:05:07,340
because we haven't proved we
can service a satellite yet.

77
00:05:07,340 --> 00:05:11,560
So RRM is here trying to build
experience and we're trying to say,

78
00:05:11,560 --> 00:05:13,500
"Look we can do it on these interfaces.

79
00:05:13,500 --> 00:05:17,900
These are just like interfaces on
satellites that are already up in orbit."

80
00:05:17,900 --> 00:05:22,660
So it's kind of test bed to prove
we have this kind of experience.

81
00:05:22,660 --> 00:05:27,070
So really just kind of the first step
in assuring you can convince others

82
00:05:27,070 --> 00:05:29,560
that such a process is even
going to be possible.

83
00:05:29,560 --> 00:05:30,380
Precisely.

84
00:05:30,380 --> 00:05:33,450
Okay, well walk us through a little
bit of the activities going on today.

85
00:05:33,450 --> 00:05:35,040
I know they're checking out some of the tools.

86
00:05:35,040 --> 00:05:38,670
What are the exact specifications
to what they're doing today?

87
00:05:38,670 --> 00:05:43,940
Sure. This is a very exciting day because this
is the first day that we actually access three

88
00:05:43,940 --> 00:05:46,120
of our tools and power on the tool cameras.

89
00:05:46,120 --> 00:05:52,430
So the three different tools today that
we're checking out are the wire cutting tool,

90
00:05:52,430 --> 00:05:55,100
the safety cap tool and the multifunction tool.

91
00:05:55,100 --> 00:06:01,090
And what we're going to do initially is SPDM
will go up and grasp the three tools harmonics,

92
00:06:01,090 --> 00:06:02,610
power them on, make sure the tool cameras work.

93
00:06:02,610 --> 00:06:03,770
We'll pull them out of the bay.

94
00:06:03,770 --> 00:06:07,900
We'll do a visual inspection
of them, and then we'll...

95
00:06:07,900 --> 00:06:10,570
excuse me...and then we'll actually access...

96

00:06:10,570 --> 00:06:14,270
we'll use the torque to command the tools
and make sure all the tools modes work.

97
00:06:14,270 --> 00:06:18,800
And once we've checked out the tools we'll
proceed to use the multifunction tool

98
00:06:18,800 --> 00:06:23,930
to release basically we have launch locks on
some of the adapters and we need to go ahead

99
00:06:23,930 --> 00:06:28,720
and we need to release those launch locks
so we're prepared to pull the adapters out.

100
00:06:28,720 --> 00:06:33,940
And then after that we're going to use the wire
cutter tool where we have a gas fittings panel

101
00:06:33,940 --> 00:06:37,510
which is representative of, you
know, different satellite interfaces.

102
00:06:37,510 --> 00:06:39,060
Not also satellites just need refueling.

103
00:06:39,060 --> 00:06:41,830
Some of them need gas coolant filled.

104
00:06:41,830 --> 00:06:45,310
And we have wires on some of those caps
there that we use the wire cutter to tool

105
00:06:45,310 --> 00:06:49,100
to cut the wire between two different
T-valves and then there's a cap

106
00:06:49,100 --> 00:06:51,030
on there we need to cut a wire on.

107
00:06:51,030 --> 00:06:55,730
Okay. And so like you said, today's exciting,
but it's just kind of a checkout day.

108
00:06:55,730 --> 00:06:57,010
What about the next two days?

109
00:06:57,010 --> 00:06:57,590
Is that going to be...

110
00:06:57,590 --> 00:07:02,010
you going to be cutting wires, actually
transferring any fluid over the next few days,

111
00:07:02,010 --> 00:07:03,550
or what are the activities going to involve?

112
00:07:03,550 --> 00:07:05,680
No, we won't be transferring
fluid unfortunately.

113
00:07:05,680 --> 00:07:08,150
That's a bit down the road, but you're correct.

114
00:07:08,150 --> 00:07:09,250
We will be cutting wires.

115
00:07:09,250 --> 00:07:13,110
We don't have a full set schedule
for each of the next days.

116
00:07:13,110 --> 00:07:15,950
The idea is to press, see how
much we can get done every day.

117
00:07:15,950 --> 00:07:18,280
Ideally we'd like to get ahead.

118
00:07:18,280 --> 00:07:22,510
Today will be mostly just the
free space checkout of the tools

119
00:07:22,510 --> 00:07:25,840
and then tomorrow we'll probably be releasing
those launch locks I was talking about,

120
00:07:25,840 --> 00:07:27,960
and then the final day will be cutting wires.

121
00:07:27,960 --> 00:07:29,750
Okay. All right, very cool.

122
00:07:29,750 --> 00:07:33,340
We're going to be following along with
everything, and again this is all being done

123
00:07:33,340 --> 00:07:37,650
by controllers here in Houston and
back at Goddard, so it's all people

124
00:07:37,650 --> 00:07:42,670
down the ground controlling this robot 220
miles up the air, so very exciting stuff.

125
00:07:42,670 --> 00:07:45,960
Well Alex, we want to thank you very
much for being here with me today.

126
00:07:45,960 --> 00:07:48,620
Really appreciate the information,
and we'll be following along.

127
00:07:48,620 --> 00:07:51,090
Thank you so much for your time, and
if there's one more thing I can throw

128
00:07:51,090 --> 00:07:53,190

in is it's not just controllers
here, but we're also working

129
00:07:53,190 --> 00:07:54,910
with the Canadian Space Agency and MDA.

130
00:07:54,910 --> 00:07:57,490
So we have controllers up in
Canada helping us as well.

131
00:07:57,490 --> 00:08:03,340
Okay, because Canada's heavily involved in all
the robotic arms, pretty much producing them,

132
00:08:03,340 --> 00:08:06,360
all the ones that are onboard the station.

133
00:08:06,360 --> 00:08:06,720
All right.

134
00:08:06,720 --> 00:08:07,360
Very cool.