
DEEP
SPACE
HABITAT
HYGIEN
CAUTION

1
00:00:06,150 --> 00:00:04,309
hi welcome to building 220 at the

2
00:00:07,909 --> 00:00:06,160
johnson space center where we're here in

3
00:00:09,750 --> 00:00:07,919
front of the deep space habitat where

4
00:00:11,350 --> 00:00:09,760
we've got a new analog mission going on

5
00:00:13,669 --> 00:00:11,360
this week the autonomous mission

6
00:00:15,430 --> 00:00:13,679
operations test we're here talking with

7
00:00:17,670 --> 00:00:15,440
jeremy frank who is the principal

8
00:00:20,230 --> 00:00:17,680
investigator for the test actually here

9
00:00:21,670 --> 00:00:20,240
from ames research center in california

10
00:00:24,470 --> 00:00:21,680
so can you tell us a little bit about

11
00:00:25,189 --> 00:00:24,480
what autonomous mission operations means

12
00:00:27,589 --> 00:00:25,199
so

13
00:00:30,550 --> 00:00:27,599

autonomous mission operations is a

14
00:00:32,870 --> 00:00:30,560
project designed to figure out for deep

15
00:00:34,709 --> 00:00:32,880
space missions where the crew is going

16
00:00:36,389 --> 00:00:34,719
to be very very far away from the

17
00:00:38,389 --> 00:00:36,399
control center

18
00:00:40,069 --> 00:00:38,399
there will be a large time delay between

19
00:00:42,549 --> 00:00:40,079
the crew and the vehicle

20
00:00:44,150 --> 00:00:42,559
for example at mars

21
00:00:45,910 --> 00:00:44,160
the amount of time that it takes for a

22
00:00:47,990 --> 00:00:45,920
communication to get sent from the

23
00:00:48,910 --> 00:00:48,000
spacecraft back to earth could be as

24
00:00:51,670 --> 00:00:48,920
much as

25
00:00:55,670 --> 00:00:51,680
24 minutes one way

26
00:00:57,350 --> 00:00:55,680
24 minutes 24 minutes wow so

27
00:00:59,349 --> 00:00:57,360
we've never operated a space mission

28
00:01:01,430 --> 00:00:59,359
with people on board a spacecraft at a

29
00:01:03,830 --> 00:01:01,440
distance like that before

30
00:01:05,189 --> 00:01:03,840
so everybody understands that you can't

31
00:01:06,469 --> 00:01:05,199
operate a mission the same way that you

32
00:01:09,109 --> 00:01:06,479
do today

33
00:01:10,870 --> 00:01:09,119
but we don't exactly know why not so the

34
00:01:13,510 --> 00:01:10,880
autonomous mission operations project's

35
00:01:15,429 --> 00:01:13,520
purpose is to start to understand how it

36
00:01:17,910 --> 00:01:15,439
would be like to operate a spacecraft

37
00:01:19,109 --> 00:01:17,920
very far away from earth so explain it a

38
00:01:20,550 --> 00:01:19,119

little bit what you mean you say we

39
00:01:22,469 --> 00:01:20,560
don't we know we can't do it like we've

40
00:01:24,469 --> 00:01:22,479
been doing it but we're not sure why not

41
00:01:26,390 --> 00:01:24,479
why can't you just kind of on paper say

42
00:01:28,550 --> 00:01:26,400
okay here's how we're going to do it why

43
00:01:29,429 --> 00:01:28,560
is why do you need an analog test to do

44
00:01:30,149 --> 00:01:29,439
that

45
00:01:31,590 --> 00:01:30,159
so

46
00:01:33,510 --> 00:01:31,600
let's pick two things that mission

47
00:01:35,910 --> 00:01:33,520
operations does today that might be done

48
00:01:37,910 --> 00:01:35,920
very differently in the future so one of

49
00:01:40,390 --> 00:01:37,920
them is planning so

50
00:01:42,069 --> 00:01:40,400
planning means things like figuring out

51
00:01:44,550 --> 00:01:42,079
what the crew is going to do on any

52
00:01:46,149 --> 00:01:44,560
particular day it might mean deciding

53
00:01:48,630 --> 00:01:46,159
when a spacecraft is actually going to

54
00:01:50,469 --> 00:01:48,640
perform a maneuver it might mean

55
00:01:51,830 --> 00:01:50,479
operating a piece of equipment which

56
00:01:53,590 --> 00:01:51,840
means that you need to configure the

57
00:01:54,630 --> 00:01:53,600
power systems differently

58
00:01:56,469 --> 00:01:54,640
so

59
00:01:58,630 --> 00:01:56,479
planning might actually be done

60
00:02:01,109 --> 00:01:58,640
similarly today because typically you

61
00:02:02,550 --> 00:02:01,119
get a plan for an entire day or perhaps

62
00:02:05,749 --> 00:02:02,560
an entire week

63
00:02:07,990 --> 00:02:05,759

so the process of generating a plan

64
00:02:10,229 --> 00:02:08,000
sending that plan to the crew getting

65
00:02:12,470 --> 00:02:10,239
the crew up to speed on that plan

66
00:02:15,510 --> 00:02:12,480
that's not something that looks very

67
00:02:18,070 --> 00:02:15,520
different whether your spacecraft is

68
00:02:19,510 --> 00:02:18,080
at the moon or at mars

69
00:02:21,110 --> 00:02:19,520
but other things that the ground does

70
00:02:22,630 --> 00:02:21,120
quite a lot today is actually send

71
00:02:23,670 --> 00:02:22,640
commands to individual pieces of

72
00:02:26,150 --> 00:02:23,680
equipment

73
00:02:27,589 --> 00:02:26,160
so if you rely on commanding a piece of

74
00:02:29,510 --> 00:02:27,599
equipment and getting insight into

75
00:02:31,350 --> 00:02:29,520
whether that commander worked worked or

76
00:02:32,949 --> 00:02:31,360
didn't work very quickly

77
00:02:34,830 --> 00:02:32,959
that sort of thing probably can't be

78
00:02:37,990 --> 00:02:34,840
done very effectively all the way to

79
00:02:40,229 --> 00:02:38,000
mars the jet propulsion lab for example

80
00:02:41,910 --> 00:02:40,239
operates the rovers and spacecraft

81
00:02:43,110 --> 00:02:41,920
around mars by sending them a whole

82
00:02:44,550 --> 00:02:43,120
day's plan

83
00:02:46,229 --> 00:02:44,560
and letting it run

84
00:02:47,910 --> 00:02:46,239
we can't do that with individual pieces

85
00:02:48,869 --> 00:02:47,920
of equipment on board spacecraft where

86
00:02:50,949 --> 00:02:48,879
you need

87
00:02:52,309 --> 00:02:50,959
insight into what happened immediately

88
00:02:53,910 --> 00:02:52,319

so two very different facets of

89
00:02:56,869 --> 00:02:53,920
operations which might be very very

90
00:02:57,750 --> 00:02:56,879
different at different time delays okay

91
00:02:59,430 --> 00:02:57,760
so

92
00:03:01,270 --> 00:02:59,440
then you test that here on the ground

93
00:03:03,270 --> 00:03:01,280
before we're even

94
00:03:05,350 --> 00:03:03,280
anywhere close to getting ready to

95
00:03:07,990 --> 00:03:05,360
actually go why is that

96
00:03:10,229 --> 00:03:08,000
so part of the reason for that is that

97
00:03:12,149 --> 00:03:10,239
tests that are done with very very

98
00:03:14,149 --> 00:03:12,159
simple-minded simulations

99
00:03:16,070 --> 00:03:14,159
aren't going to have the complexity of a

100
00:03:17,589 --> 00:03:16,080
real spacecraft they're not even going

101
00:03:18,949 --> 00:03:17,599
to have the complexity of a real flight

102
00:03:21,190 --> 00:03:18,959
control team

103
00:03:22,949 --> 00:03:21,200
so doing it with a

104
00:03:25,750 --> 00:03:22,959
pretend spacecraft like the deep space

105
00:03:28,149 --> 00:03:25,760
habitat here is a really good way

106
00:03:29,589 --> 00:03:28,159
of experimenting with something that

107
00:03:31,830 --> 00:03:29,599
approaches the complexity of a real

108
00:03:33,990 --> 00:03:31,840
spacecraft and

109
00:03:35,830 --> 00:03:34,000
even this is not as complex as we really

110
00:03:37,350 --> 00:03:35,840
need to be testing with before we get to

111
00:03:39,750 --> 00:03:37,360
the point where we know how to build and

112
00:03:41,509 --> 00:03:39,760
operate an honest-to-god space mission

113
00:03:43,750 --> 00:03:41,519

so this is just kind of a first step

114
00:03:45,509 --> 00:03:43,760
this is a first step exactly so what

115
00:03:47,750 --> 00:03:45,519
what how are the tests actually working

116
00:03:50,550 --> 00:03:47,760
what does this first step look like so

117
00:03:52,630 --> 00:03:50,560
the way the first step works is we have

118
00:03:54,470 --> 00:03:52,640
a crew of four people who are inside our

119
00:03:56,070 --> 00:03:54,480
deep space habitat

120
00:03:57,750 --> 00:03:56,080
we then have a flight control team that

121
00:03:58,869 --> 00:03:57,760
consists of eight actual flight

122
00:04:02,229 --> 00:03:58,879
controllers

123
00:04:03,990 --> 00:04:02,239
responsible for one facet of mission

124
00:04:06,309 --> 00:04:04,000
operations so you'd have a flight

125
00:04:08,550 --> 00:04:06,319
director and a capsule communicator or

126
00:04:10,390 --> 00:04:08,560
capcom the same way that you would today

127
00:04:11,990 --> 00:04:10,400
in addition to that you would have a

128
00:04:13,990 --> 00:04:12,000
couple of people managing different

129
00:04:15,830 --> 00:04:14,000
systems you'd have a person responsible

130
00:04:18,150 --> 00:04:15,840
for building the crew's plan

131
00:04:20,310 --> 00:04:18,160
and what we then do is we simulate about

132
00:04:23,830 --> 00:04:20,320
two hours of activity

133
00:04:25,270 --> 00:04:23,840
a little bit like what you would see on

134
00:04:26,310 --> 00:04:25,280
for example the international space

135
00:04:28,469 --> 00:04:26,320
station

136
00:04:29,830 --> 00:04:28,479
what we then do is we run a repeated set

137
00:04:31,749 --> 00:04:29,840
of tests

138
00:04:33,670 --> 00:04:31,759

in each test we vary the amount of time

139
00:04:34,870 --> 00:04:33,680
between the flight control room and the

140
00:04:37,990 --> 00:04:34,880
spacecraft

141
00:04:39,990 --> 00:04:38,000
we also vary what happens

142
00:04:42,070 --> 00:04:40,000
during the mission sometimes nothing

143
00:04:43,830 --> 00:04:42,080
will happen everything will go normally

144
00:04:45,830 --> 00:04:43,840
there won't be any problems the crew

145
00:04:47,030 --> 00:04:45,840
will basically execute their day and

146
00:04:49,430 --> 00:04:47,040
you're finished

147
00:04:52,230 --> 00:04:49,440
sometimes we'll simulate a failure

148
00:04:54,310 --> 00:04:52,240
we will for example say that part of the

149
00:04:57,189 --> 00:04:54,320
power system decides not to function

150
00:04:58,950 --> 00:04:57,199
properly anymore or for example that if

151
00:05:00,550 --> 00:04:58,960
water transfer activity between two

152
00:05:01,909 --> 00:05:00,560
water tanks doesn't go the way it's

153
00:05:03,350 --> 00:05:01,919
expected to go

154
00:05:04,710 --> 00:05:03,360
and then the crew will have to decide

155
00:05:05,990 --> 00:05:04,720
how to handle that

156
00:05:07,749 --> 00:05:06,000
the flight control team will have to

157
00:05:08,550 --> 00:05:07,759
decide how to handle that

158
00:05:10,790 --> 00:05:08,560
or

159
00:05:13,029 --> 00:05:10,800
last and not least we may have a medical

160
00:05:14,629 --> 00:05:13,039
emergency and so you can imagine how

161
00:05:16,070 --> 00:05:14,639
interesting a medical emergency can be

162
00:05:17,350 --> 00:05:16,080
if you're very very far away from the

163
00:05:18,310 --> 00:05:17,360

nearest doctor

164
00:05:20,710 --> 00:05:18,320
so

165
00:05:22,230 --> 00:05:20,720
all of those things combined will

166
00:05:24,550 --> 00:05:22,240
basically tell us something about how

167
00:05:26,710 --> 00:05:24,560
emissions would run if we ran them the

168
00:05:28,310 --> 00:05:26,720
way that they were run today at these

169
00:05:30,390 --> 00:05:28,320
different time delays

170
00:05:31,830 --> 00:05:30,400
so that's the first phase of what it is

171
00:05:33,350 --> 00:05:31,840
that we're going to do that's what we're

172
00:05:35,350 --> 00:05:33,360
doing this week and that's what's

173
00:05:37,990 --> 00:05:35,360
happening this week right

174
00:05:39,830 --> 00:05:38,000
and then now in june we've got another

175
00:05:41,430 --> 00:05:39,840
week of testing plans and that'll be a

176
00:05:43,350 --> 00:05:41,440
little bit different that's exactly

177
00:05:45,189 --> 00:05:43,360
right so the difference between the

178
00:05:48,469 --> 00:05:45,199
tests that we run in may and the test

179
00:05:50,150 --> 00:05:48,479
that we run in june is this time in june

180
00:05:51,749 --> 00:05:50,160
we'll give the crews a little bit more

181
00:05:54,710 --> 00:05:51,759
authority a little bit more

182
00:05:57,029 --> 00:05:54,720
responsibility than they usually have

183
00:05:58,469 --> 00:05:57,039
and what we want to do is give them and

184
00:06:00,950 --> 00:05:58,479
the flight control team some different

185
00:06:02,870 --> 00:06:00,960
tools so for example

186
00:06:04,790 --> 00:06:02,880
today the crews don't usually plan and

187
00:06:06,710 --> 00:06:04,800
schedule their own day they're given a

188
00:06:08,710 --> 00:06:06,720

plan that they execute but they don't

189
00:06:10,070 --> 00:06:08,720
actually manipulate that plan

190
00:06:11,510 --> 00:06:10,080
so what if they had a tool that helped

191
00:06:12,870 --> 00:06:11,520
them figure out how to actually build

192
00:06:14,790 --> 00:06:12,880
their plan

193
00:06:17,029 --> 00:06:14,800
so that if things don't go well they can

194
00:06:19,029 --> 00:06:17,039
decide how to reschedule or replan their

195
00:06:20,629 --> 00:06:19,039
own activities okay so that's one

196
00:06:22,390 --> 00:06:20,639
example of the kinds of tools that we

197
00:06:24,790 --> 00:06:22,400
intend to give crew in order to help

198
00:06:26,629 --> 00:06:24,800
them do this job differently all right

199
00:06:29,350 --> 00:06:26,639
but what we will do is run exactly the

200
00:06:31,189 --> 00:06:29,360
same set of tests only with these tools

201
00:06:32,309 --> 00:06:31,199
okay in order to see whether it makes

202
00:06:34,629 --> 00:06:32,319
things better

203
00:06:36,070 --> 00:06:34,639
or worse okay and so for doing this

204
00:06:38,150 --> 00:06:36,080
you've got a crew

205
00:06:40,070 --> 00:06:38,160
like you said a couple hours at a time

206
00:06:41,830 --> 00:06:40,080
working in the deep space habitat as

207
00:06:44,550 --> 00:06:41,840
though they were in space that's right

208
00:06:46,629 --> 00:06:44,560
tell me about your crew who is that so

209
00:06:49,029 --> 00:06:46,639
we have four different crews

210
00:06:50,950 --> 00:06:49,039
each crew is led by an astronaut

211
00:06:52,309 --> 00:06:50,960
and the other three members of the crew

212
00:06:54,070 --> 00:06:52,319
are mission operations directorate

213
00:06:55,909 --> 00:06:54,080

flight controllers

214
00:06:58,710 --> 00:06:55,919
so part of the reason that we did that

215
00:07:01,189 --> 00:06:58,720
is to make sure that each crew got the

216
00:07:03,270 --> 00:07:01,199
widest range of experience possible so

217
00:07:06,150 --> 00:07:03,280
each crew will experience one of the

218
00:07:07,909 --> 00:07:06,160
time delays each of the time delays and

219
00:07:09,909 --> 00:07:07,919
in addition each crew will experience

220
00:07:12,390 --> 00:07:09,919
one of the situate each of the

221
00:07:14,629 --> 00:07:12,400
situations the normal situation a

222
00:07:17,270 --> 00:07:14,639
systems failure situation and a medical

223
00:07:19,029 --> 00:07:17,280
situation okay and so that gives you

224
00:07:20,629 --> 00:07:19,039
kind of a range of data to start looking

225
00:07:21,589 --> 00:07:20,639
at and then planning how we would

226
00:07:23,350 --> 00:07:21,599
actually