



1
00:00:04,630 --> 00:00:03,110
welcome back to building 220 johnson

2
00:00:06,309 --> 00:00:04,640
space center where we are standing here

3
00:00:08,710 --> 00:00:06,319
in front of the deep space habitat where

4
00:00:10,709 --> 00:00:08,720
the autonomous mission operations test

5
00:00:13,030 --> 00:00:10,719
has been going on this week and we have

6
00:00:14,870 --> 00:00:13,040
um today's commander with us now alvin

7
00:00:17,109 --> 00:00:14,880
drew he's been working inside the deep

8
00:00:20,150 --> 00:00:17,119
space habitat working with some calm

9
00:00:21,830 --> 00:00:20,160
delay issues right yes so tell us how

10
00:00:24,070 --> 00:00:21,840
these tests are going for you they're

11
00:00:25,750 --> 00:00:24,080
going fine we've done two tests so far

12
00:00:27,589 --> 00:00:25,760
one with about a

13
00:00:29,269 --> 00:00:27,599

50-second con delay

14

00:00:31,349 --> 00:00:29,279

which puts about maybe 10 million miles

15

00:00:32,950 --> 00:00:31,359

away from earth this one puts us about

16

00:00:34,389 --> 00:00:32,960

out this one we have about a five minute

17

00:00:37,030 --> 00:00:34,399

convoy which puts us at maybe the

18

00:00:38,389 --> 00:00:37,040

closest point of mars and uh it becomes

19

00:00:39,670 --> 00:00:38,399

significantly harder to work with

20

00:00:41,510 --> 00:00:39,680

mission control

21

00:00:42,950 --> 00:00:41,520

especially when you're used to working

22

00:00:45,750 --> 00:00:42,960

in near real time with them with very

23

00:00:47,750 --> 00:00:45,760

minimal delay to tell them something and

24

00:00:49,510 --> 00:00:47,760

you have to wait 10 minutes for a reply

25

00:00:50,790 --> 00:00:49,520

back from them so how are you testing

26
00:00:53,270 --> 00:00:50,800
that out what kind of things are you

27
00:00:54,869 --> 00:00:53,280
doing with the convolution we're running

28
00:00:56,310 --> 00:00:54,879
just normal operations for a bit where

29
00:00:57,510 --> 00:00:56,320
you do your normal things and there's

30
00:00:58,630 --> 00:00:57,520
certain coordinations where they want

31
00:01:00,150 --> 00:00:58,640
data they want you to read something and

32
00:01:01,990 --> 00:01:00,160
give it back to them and there may be

33
00:01:03,430 --> 00:01:02,000
some some fine tuning they want to give

34
00:01:05,429 --> 00:01:03,440
you you know i really want you to look

35
00:01:07,750 --> 00:01:05,439
at this instead of that and so now you

36
00:01:09,030 --> 00:01:07,760
do a lot more just guessing

37
00:01:10,149 --> 00:01:09,040
okay they might have wanted these other

38
00:01:12,310 --> 00:01:10,159

three things so i'll give them all three

39

00:01:13,750 --> 00:01:12,320

of them rather than have them have this

40

00:01:15,670 --> 00:01:13,760

30 minute exchange while they get that

41

00:01:17,030 --> 00:01:15,680

one piece of information out

42

00:01:19,350 --> 00:01:17,040

where it gets tougher is when things

43

00:01:20,550 --> 00:01:19,360

don't go exactly as planned when pumps

44

00:01:21,830 --> 00:01:20,560

shut off when they're not supposed to

45

00:01:24,070 --> 00:01:21,840

light suddenly cut off when they're not

46

00:01:25,670 --> 00:01:24,080

supposed to and and you've got a set of

47

00:01:26,950 --> 00:01:25,680

procedures which gives you about 80

48

00:01:28,149 --> 00:01:26,960

percent of the way there but if it's

49

00:01:29,670 --> 00:01:28,159

more tricky than that it's more than

50

00:01:31,350 --> 00:01:29,680

like two failures acting against each

51
00:01:32,550 --> 00:01:31,360
other than you really need all the

52
00:01:34,069 --> 00:01:32,560
backgrounds and mission control to

53
00:01:35,990 --> 00:01:34,079
really look at these things tough uh

54
00:01:37,190 --> 00:01:36,000
quick and so they may have you

55
00:01:38,630 --> 00:01:37,200
helping them troubleshoot you know turn

56
00:01:39,830 --> 00:01:38,640
this off and see what happens turn this

57
00:01:41,190 --> 00:01:39,840
back on just like you would if you were

58
00:01:42,950 --> 00:01:41,200
working on any complex piece of

59
00:01:44,469 --> 00:01:42,960
equipment just go out and dupe it out

60
00:01:45,910 --> 00:01:44,479
and that's where it gets to be really

61
00:01:47,990 --> 00:01:45,920
long and drawn out because every one of

62
00:01:49,590 --> 00:01:48,000
those steps now waits at least 10

63
00:01:51,990 --> 00:01:49,600

minutes so you're hearing from mission

64

00:01:53,749 --> 00:01:52,000

control okay turn this off

65

00:01:55,510 --> 00:01:53,759

they say it you hear it five minutes

66

00:01:56,789 --> 00:01:55,520

later you turn it off and let them know

67

00:01:58,389 --> 00:01:56,799

that you turn it off and then it's

68

00:01:59,990 --> 00:01:58,399

another five minutes so ten minutes for

69

00:02:01,270 --> 00:02:00,000

them for them to hear that you've turned

70

00:02:03,350 --> 00:02:01,280

it off right and then be able to tell

71

00:02:05,670 --> 00:02:03,360

you if yes and then be able to tell you

72

00:02:06,950 --> 00:02:05,680

okay that fixed it or more likely no

73

00:02:08,469 --> 00:02:06,960

that didn't fix so now i'm gonna turn

74

00:02:11,830 --> 00:02:08,479

off this and it's the whole thing again

75

00:02:13,350 --> 00:02:11,840

yeah right okay so what happens is you

76

00:02:15,350 --> 00:02:13,360

like me your attention span just isn't

77

00:02:16,710 --> 00:02:15,360

that long so i've wandered off to

78

00:02:18,790 --> 00:02:16,720

something else and they'll call up and

79

00:02:20,390 --> 00:02:18,800

goes well that didn't fix it

80

00:02:21,830 --> 00:02:20,400

didn't fix what

81

00:02:22,710 --> 00:02:21,840

i'm already after reading the comic book

82

00:02:24,150 --> 00:02:22,720

so

83

00:02:27,030 --> 00:02:24,160

refresh me on what you're talking about

84

00:02:28,470 --> 00:02:27,040

yes what's been the hardest thing so far

85

00:02:30,229 --> 00:02:28,480

that has been the hardest part is that

86

00:02:31,910 --> 00:02:30,239

it's that sometimes we're having

87

00:02:33,350 --> 00:02:31,920

different conversations i'll be talking

88

00:02:35,030 --> 00:02:33,360

to them about something that's

89

00:02:36,869 --> 00:02:35,040

that i'm working on right now and i'm

90

00:02:38,790 --> 00:02:36,879

getting your transmission back from them

91

00:02:40,869 --> 00:02:38,800

something that happened 10 minutes ago

92

00:02:41,910 --> 00:02:40,879

and so like we it's easy to step on top

93

00:02:43,589 --> 00:02:41,920

of each other on the radio

94

00:02:45,750 --> 00:02:43,599

communications because you're you don't

95

00:02:46,949 --> 00:02:45,760

have that real-time feedback and so

96

00:02:48,229 --> 00:02:46,959

you'll stop your communication and of

97

00:02:49,350 --> 00:02:48,239

course there on the ground wondering why

98

00:02:50,790 --> 00:02:49,360

you stopped talking to them in

99

00:02:52,550 --> 00:02:50,800

mid-sentence

100

00:02:54,949 --> 00:02:52,560

so those kind of things go on that's

101
00:02:56,550 --> 00:02:54,959
about the toughest part yeah well

102
00:02:58,550 --> 00:02:56,560
you've been in space a couple of shuttle

103
00:03:00,149 --> 00:02:58,560
missions under your belt right so how do

104
00:03:02,229 --> 00:03:00,159
you how does it compare how does how do

105
00:03:04,390 --> 00:03:02,239
you i guess see that it would change

106
00:03:07,110 --> 00:03:04,400
things if you had to deal with that on a

107
00:03:10,309 --> 00:03:07,120
space shuttle mission

108
00:03:12,949 --> 00:03:10,319
it's something as complex as the the

109
00:03:14,550 --> 00:03:12,959
space station build up

110
00:03:17,030 --> 00:03:14,560
you almost had cameras right over your

111
00:03:19,030 --> 00:03:17,040
shoulder you were scrolls right there in

112
00:03:19,990 --> 00:03:19,040
in the modules with you you're talking

113
00:03:21,190 --> 00:03:20,000

with them because there's a lot of

114

00:03:22,869 --> 00:03:21,200

things going on and you really want to

115

00:03:24,309 --> 00:03:22,879

make sure you get them all right uh

116

00:03:25,910 --> 00:03:24,319

somewhere in here with these time blades

117

00:03:27,110 --> 00:03:25,920

you have to have that that zen moment

118

00:03:28,470 --> 00:03:27,120

where you just go

119

00:03:30,070 --> 00:03:28,480

they can't talk to me real time they

120

00:03:32,390 --> 00:03:30,080

have to just go and press ahead with

121

00:03:33,910 --> 00:03:32,400

this and hope it's the right thing and

122

00:03:35,030 --> 00:03:33,920

if it's not too critical or something

123

00:03:36,309 --> 00:03:35,040

that that 10 minutes now they can go

124

00:03:38,470 --> 00:03:36,319

back and correct

125

00:03:39,830 --> 00:03:38,480

but you have to just suddenly just say

126

00:03:41,110 --> 00:03:39,840

mission control has kind of a bigger

127

00:03:42,470 --> 00:03:41,120

picture function okay that we're all

128

00:03:44,710 --> 00:03:42,480

kind of heading down the right path

129

00:03:45,990 --> 00:03:44,720

they're not into the very the the nuts

130

00:03:47,750 --> 00:03:46,000

and bolts the ones and zeros of your

131

00:03:49,509 --> 00:03:47,760

daily operation this can't be because

132

00:03:51,270 --> 00:03:49,519

they're always several minutes behind

133

00:03:52,710 --> 00:03:51,280

you right well you think you know you

134

00:03:53,830 --> 00:03:52,720

wait a few minutes to hear the answer

135

00:03:55,910 --> 00:03:53,840

that doesn't sound like that big deal

136

00:03:57,110 --> 00:03:55,920

but that changes the mission doesn't it

137

00:03:58,869 --> 00:03:57,120

it can if you're going to wait five

138

00:04:00,070 --> 00:03:58,879

minutes for every single answer i just

139

00:04:01,270 --> 00:04:00,080

know i've just got a stack of things

140

00:04:02,470 --> 00:04:01,280

we're going to go do and i'm telling

141

00:04:03,750 --> 00:04:02,480

them i'm doing this now i'm doing that

142

00:04:04,630 --> 00:04:03,760

now doing that now doing that and if you

143

00:04:06,229 --> 00:04:04,640

have a problem with it you know 10

144

00:04:08,229 --> 00:04:06,239

minutes on here okay i wish you you know

145

00:04:10,149 --> 00:04:08,239

put the switch back to a instead of b

146

00:04:11,270 --> 00:04:10,159

but i'm not going to wait for them

147

00:04:12,710 --> 00:04:11,280

unless there's something extremely

148

00:04:13,990 --> 00:04:12,720

critical

149

00:04:15,750 --> 00:04:14,000

for them to come back with an answer

150

00:04:17,270 --> 00:04:15,760

saying yeah it's okay or that's not okay

151

00:04:19,189 --> 00:04:17,280

so it means i've got to have a certain

152

00:04:21,349 --> 00:04:19,199

level more insight into what i'm doing i

153

00:04:23,189 --> 00:04:21,359

just can't blindly throw switches uh

154

00:04:24,310 --> 00:04:23,199

because i just need to know that this

155

00:04:25,830 --> 00:04:24,320

isn't going to hurt something or i have

156

00:04:27,430 --> 00:04:25,840

a better set of confidence because if

157

00:04:29,749 --> 00:04:27,440

i'm waiting again again everything slows

158

00:04:31,510 --> 00:04:29,759

down dramatic dramatically yes well i

159

00:04:32,950 --> 00:04:31,520

guess i mean us kind of getting a good

160

00:04:34,629 --> 00:04:32,960

feel for this is pretty critical to

161

00:04:36,710 --> 00:04:34,639

being able to explore further out in the

162

00:04:38,230 --> 00:04:36,720

future would you say that's true yes now

163

00:04:39,430 --> 00:04:38,240

part of the thing is that the crews are

164

00:04:40,550 --> 00:04:39,440

never going to be as smart as mission

165

00:04:42,469 --> 00:04:40,560

control you know as much as i like to

166

00:04:43,670 --> 00:04:42,479

think i'm the smartest flight controller

167

00:04:45,350 --> 00:04:43,680

i'm not as smart as anyone flight

168

00:04:46,629 --> 00:04:45,360

controller i'm certainly not as smart as

169

00:04:48,469 --> 00:04:46,639

five or six flight controllers and they

170

00:04:49,270 --> 00:04:48,479

outnumber us

171

00:04:50,390 --> 00:04:49,280

you know

172

00:04:52,230 --> 00:04:50,400

they are smarter than this but they

173

00:04:54,230 --> 00:04:52,240

outnumber us as well so we're outclassed

174

00:04:55,350 --> 00:04:54,240

and outnumbered to begin with and so how

175

00:04:57,030 --> 00:04:55,360

do you

176

00:04:58,230 --> 00:04:57,040

reproduce that in really in critical

177

00:04:59,430 --> 00:04:58,240

situations so we haven't done anything

178

00:05:01,430 --> 00:04:59,440

that's really critical yet nothing's

179

00:05:03,350 --> 00:05:01,440

caught firing here with us that kid's

180

00:05:04,070 --> 00:05:03,360

going to in the next run

181

00:05:05,510 --> 00:05:04,080

so

182

00:05:06,870 --> 00:05:05,520

how do you what do you do is can you

183

00:05:09,189 --> 00:05:06,880

have a virtual mission control can use

184

00:05:10,870 --> 00:05:09,199

artificial intelligence can you capture

185

00:05:12,870 --> 00:05:10,880

mission control's philosophy their

186

00:05:14,629 --> 00:05:12,880

culture their flight rules all the

187

00:05:16,870 --> 00:05:14,639

things that a flight director would

188

00:05:17,830 --> 00:05:16,880

decide given all that information that

189

00:05:19,749 --> 00:05:17,840

they're getting from their flight

190

00:05:21,270 --> 00:05:19,759

controllers and their flight rules and

191

00:05:22,390 --> 00:05:21,280

that's what i think the goal of this

192

00:05:24,870 --> 00:05:22,400

particular

193

00:05:25,749 --> 00:05:24,880

exercise is is can we capture that i

194

00:05:27,990 --> 00:05:25,759

mean

195

00:05:29,670 --> 00:05:28,000

autonomous mission operations amo is

196

00:05:30,710 --> 00:05:29,680

trying to do just that and i don't think

197

00:05:32,070 --> 00:05:30,720

we have any ambition that we're going to

198

00:05:33,830 --> 00:05:32,080

get there on the first try or even the

199

00:05:35,189 --> 00:05:33,840

second try but you have to start

200

00:05:37,029 --> 00:05:35,199

somewhere you have to grow this thing

201
00:05:39,430 --> 00:05:37,039
and have mission controllers work with

202
00:05:40,870 --> 00:05:39,440
it make it smarter let it learn and then

203
00:05:43,110 --> 00:05:40,880
it may be something that we all have

204
00:05:45,909 --> 00:05:43,120
confidence in so when we are

205
00:05:47,749 --> 00:05:45,919
5 10 15 light minutes away from earth

206
00:05:50,310 --> 00:05:47,759
and this thing says i'm going to shut

207
00:05:51,590 --> 00:05:50,320
down your backup hydraulic system you go

208
00:05:52,870 --> 00:05:51,600
okay there's probably a good reason for

209
00:05:55,110 --> 00:05:52,880
that because it just wouldn't do that on

210
00:05:56,309 --> 00:05:55,120
its own unless it's playing how uh-huh

211
00:05:58,550 --> 00:05:56,319
well do you feel like you're learning

212
00:06:00,469 --> 00:05:58,560
things and and getting stuff out of this

213
00:06:02,150 --> 00:06:00,479

yes quite a bit it's it's good to work

214

00:06:03,909 --> 00:06:02,160

in terms of deep space i'm used to being

215

00:06:05,830 --> 00:06:03,919

in low-earth orbit and i'm in places

216

00:06:07,029 --> 00:06:05,840

that are not lower anymore and just

217

00:06:08,629 --> 00:06:07,039

thinking very differently it's a very

218

00:06:09,909 --> 00:06:08,639

different mindset to think that you're

219

00:06:11,749 --> 00:06:09,919

just not going to look out the out of

220

00:06:14,150 --> 00:06:11,759

the window and see big blue beach ball

221

00:06:15,590 --> 00:06:14,160

earth right beneath you it just may be

222

00:06:17,029 --> 00:06:15,600

a blue and gold dot out there that's the

223

00:06:19,189 --> 00:06:17,039

earth moon system and trying to pick

224

00:06:20,469 --> 00:06:19,199

that out so it's it's a it makes you

225

00:06:21,749 --> 00:06:20,479

think about that that this is very

226

00:06:23,510 --> 00:06:21,759

different than what we've been doing for

227

00:06:25,189 --> 00:06:23,520

about the last

228

00:06:27,029 --> 00:06:25,199

30 35 years

229

00:06:28,550 --> 00:06:27,039

well i know you've lived in the deep

230

00:06:29,909 --> 00:06:28,560

space habitat a little bit before for

231

00:06:32,150 --> 00:06:29,919

some of the other analog missions right

232

00:06:33,510 --> 00:06:32,160

yes this and the uh the suv the uh the

233

00:06:35,749 --> 00:06:33,520

rovers okay

234

00:06:37,270 --> 00:06:35,759

how you know are we how does it feel to

235

00:06:39,510 --> 00:06:37,280

be part of all this stuff that's going

236

00:06:40,870 --> 00:06:39,520

on to get us ready to go out it's very

237

00:06:42,469 --> 00:06:40,880

cool it feels like i'm living in the

238

00:06:44,469 --> 00:06:42,479

middle of a science fiction novel some

239

00:06:46,870 --> 00:06:44,479

days the the conversations i have at my

240

00:06:48,629 --> 00:06:46,880

desk are sometimes very surreal

241

00:06:50,390 --> 00:06:48,639

oh let's talk about you know logistics

242

00:06:51,670 --> 00:06:50,400

concepts for we're going out on the far

243

00:06:53,670 --> 00:06:51,680

side of the moon like

244

00:06:55,430 --> 00:06:53,680

okay this is today you know we're we're

245

00:06:57,510 --> 00:06:55,440

at most about 400 miles above the earth

246

00:06:59,430 --> 00:06:57,520

and we're talking about going 400 000

247

00:07:01,110 --> 00:06:59,440

miles away from the earth as if there's

248

00:07:02,870 --> 00:07:01,120

something going on right now and we're

249

00:07:04,469 --> 00:07:02,880

having a heated debates about you know

250

00:07:06,390 --> 00:07:04,479

how many ships come up per month and how

251

00:07:08,550 --> 00:07:06,400

many tons we need to bring back and how

252

00:07:10,070 --> 00:07:08,560

much electricity you need uh you know

253

00:07:11,270 --> 00:07:10,080

we're in those gory details if there's

254

00:07:12,629 --> 00:07:11,280

something happening right now like okay

255

00:07:13,830 --> 00:07:12,639

this is not happening right now we're

256

00:07:16,230 --> 00:07:13,840

planning it we're going to get there but

257

00:07:17,350 --> 00:07:16,240

it's just a step back a few times ago

258

00:07:19,589 --> 00:07:17,360

it's kind of disappointing to walk out

259

00:07:21,270 --> 00:07:19,599

of the office and back into reality

260

00:07:22,550 --> 00:07:21,280

but it's a nice office to come to right

261

00:07:23,909 --> 00:07:22,560

yes it is all right well thanks so much