
HOUSTON
WE HAVE A
PODCAST
NASA
FLIGHT
FLIGHT DIRECTOR
EPISODE 209
ARTEMIS FLIGHT DIRECTORS

1
00:00:27,349 --> 00:00:19,320
[Music]

2
00:00:29,109 --> 00:00:27,359
everyone thanks for joining us for an

3
00:00:30,470 --> 00:00:29,119
on-camera version of houston we have a

4
00:00:32,630 --> 00:00:30,480
podcast we're going to be talking with

5
00:00:34,790 --> 00:00:32,640
flight directors rick legroad and judd

6
00:00:36,870 --> 00:00:34,800
freeling today about what it's like in

7
00:00:38,709 --> 00:00:36,880
mission control for an artemis mission

8
00:00:40,630 --> 00:00:38,719
specifically for artemis one gentlemen

9
00:00:42,310 --> 00:00:40,640
thanks for coming today

10
00:00:44,869 --> 00:00:42,320
cool awesome let's uh let's get right

11
00:00:46,229 --> 00:00:44,879
into it i wanted to talk uh mainly about

12
00:00:48,470 --> 00:00:46,239
the artemis mission we're going to dive

13
00:00:50,470 --> 00:00:48,480

into the operations inside mission

14
00:00:52,069 --> 00:00:50,480
control but first i want to understand a

15
00:00:54,150 --> 00:00:52,079
little bit more about you your history

16
00:00:55,189 --> 00:00:54,160
and what got you into this position rick

17
00:00:57,189 --> 00:00:55,199
we'll start with you i know you have a

18
00:00:58,869 --> 00:00:57,199
lot of experience with shuttle

19
00:01:01,750 --> 00:00:58,879
and some other stuff as well

20
00:01:03,189 --> 00:01:01,760
yeah well i started uh actually this end

21
00:01:05,189 --> 00:01:03,199
of this month

22
00:01:06,950 --> 00:01:05,199
uh it'll be 36 years i've been working

23
00:01:08,870 --> 00:01:06,960
mission control i started as a shuttle

24
00:01:10,789 --> 00:01:08,880
flight direct flight controller in the

25
00:01:12,469 --> 00:01:10,799
instrumentation and communications

26
00:01:14,710 --> 00:01:12,479
officer position uh we have that same

27
00:01:15,510 --> 00:01:14,720
position in the artemis program now cool

28
00:01:17,270 --> 00:01:15,520
um

29
00:01:19,749 --> 00:01:17,280
and it was basically a

30
00:01:22,310 --> 00:01:19,759
com guy so responsible for the all the

31
00:01:25,030 --> 00:01:22,320
communications with the shuttle it's the

32
00:01:28,550 --> 00:01:25,040
audio the telemetry the commands and

33
00:01:31,030 --> 00:01:28,560
video so i did that for 13 years i was a

34
00:01:32,390 --> 00:01:31,040
contractor and then

35
00:01:33,429 --> 00:01:32,400
i was just at the right spot at the

36
00:01:38,550 --> 00:01:33,439
right

37
00:01:40,950 --> 00:01:38,560
and they um they opened up selections to

38
00:01:43,429 --> 00:01:40,960

flight directors to contractors so i

39
00:01:45,190 --> 00:01:43,439
applied and i was selected as the first

40
00:01:46,469 --> 00:01:45,200
contractor flight director

41
00:01:48,069 --> 00:01:46,479
uh when i when i joined the office then

42
00:01:51,350 --> 00:01:48,079
i became a civil servant

43
00:01:54,630 --> 00:01:51,360
and when my class had um had four in it

44
00:01:57,109 --> 00:01:54,640
and two of us went iss two of us went uh

45
00:01:59,510 --> 00:01:57,119
two of them went um shuttle so i started

46
00:02:01,510 --> 00:01:59,520
off on the iss side okay and i did uh

47
00:02:04,069 --> 00:02:01,520
the about the first half of the assembly

48
00:02:05,910 --> 00:02:04,079
sequence as a as a iss flight director

49
00:02:07,109 --> 00:02:05,920
and then i then i transferred over and

50
00:02:10,150 --> 00:02:07,119
was certified as a shuttle flight

51
00:02:11,750 --> 00:02:10,160
director and uh did the last uh half of

52
00:02:13,430 --> 00:02:11,760
the of the assembly sequence on the

53
00:02:15,270 --> 00:02:13,440
shuttle side and and because i was

54
00:02:16,470 --> 00:02:15,280
considered one of the more veteran uh

55
00:02:17,990 --> 00:02:16,480
flight directors in the office i was

56
00:02:19,190 --> 00:02:18,000
able to uh i worked the last three

57
00:02:21,910 --> 00:02:19,200
shuttle flights

58
00:02:23,830 --> 00:02:21,920
very cool very cool from the shuttle end

59
00:02:26,070 --> 00:02:23,840
right okay very cool so how does that

60
00:02:28,150 --> 00:02:26,080
how does that time um you look back on

61
00:02:29,670 --> 00:02:28,160
it now working with international space

62
00:02:31,110 --> 00:02:29,680
station look

63
00:02:33,190 --> 00:02:31,120

working with shuttle what are some of

64
00:02:35,110 --> 00:02:33,200
the things yeah it was it was great i

65
00:02:38,390 --> 00:02:35,120
mean just becoming a flight director is

66
00:02:40,869 --> 00:02:38,400
an amazing experience to start with um

67
00:02:43,350 --> 00:02:40,879
but uh and then going iss and i started

68
00:02:44,949 --> 00:02:43,360
in in 98 so it was just before we

69
00:02:47,270 --> 00:02:44,959
started the assembly sequence for the

70
00:02:48,309 --> 00:02:47,280
international space station and i was

71
00:02:50,869 --> 00:02:48,319
fortunate

72
00:02:53,030 --> 00:02:50,879
when we launched the expedition one crew

73
00:02:56,630 --> 00:02:53,040
um i was actually the flight director

74
00:02:59,910 --> 00:02:56,640
resident in in moscow in in the the

75
00:03:01,990 --> 00:02:59,920
control center in in moscow so uh that

76
00:03:04,149 --> 00:03:02,000
just it was it was a so it was a

77
00:03:06,309 --> 00:03:04,159
completely different culture

78
00:03:08,550 --> 00:03:06,319
but it was really enlightening to see

79
00:03:10,470 --> 00:03:08,560
how the how um

80
00:03:11,990 --> 00:03:10,480
how the uh the russian flight control

81
00:03:14,309 --> 00:03:12,000
team operates it's you know we're very

82
00:03:16,309 --> 00:03:14,319
similar and and you know it's it's a

83
00:03:18,550 --> 00:03:16,319
technical job and

84
00:03:20,149 --> 00:03:18,560
communications or paramount so uh in

85
00:03:22,790 --> 00:03:20,159
that regard they uh they are very

86
00:03:24,390 --> 00:03:22,800
similar to what we do uh and uh but the

87
00:03:25,830 --> 00:03:24,400
culture was is very different than

88
00:03:27,990 --> 00:03:25,840

anything i experienced before so i

89
00:03:29,990 --> 00:03:28,000
really really enjoyed that part of it uh

90
00:03:31,509 --> 00:03:30,000
so but that's a big part of especially

91
00:03:33,110 --> 00:03:31,519
being an international space station

92
00:03:35,190 --> 00:03:33,120
flight controller right is you're not

93
00:03:37,190 --> 00:03:35,200
it's not just a it's not a one mission

94
00:03:38,550 --> 00:03:37,200
control kind of thing it's a it's called

95
00:03:39,910 --> 00:03:38,560
an international space station for a

96
00:03:41,190 --> 00:03:39,920
reason right

97
00:03:42,070 --> 00:03:41,200
yeah it's a challenge right there's

98
00:03:44,229 --> 00:03:42,080
challenges that come with it there's

99
00:03:45,190 --> 00:03:44,239
pros and cons like everything right yeah

100
00:03:46,630 --> 00:03:45,200
um

101
00:03:48,630 --> 00:03:46,640
uh they bring a lot to the table they

102
00:03:50,550 --> 00:03:48,640
had a lot of experience uh in space

103
00:03:53,350 --> 00:03:50,560
station stations right with their their

104
00:03:54,710 --> 00:03:53,360
mirror space station um and uh their

105
00:03:56,550 --> 00:03:54,720
experience really uh they brought a lot

106
00:03:58,869 --> 00:03:56,560
to the table um and we do things

107
00:04:00,390 --> 00:03:58,879
differently but uh we it was just great

108
00:04:02,070 --> 00:04:00,400
to have each other to lean on so it was

109
00:04:04,550 --> 00:04:02,080
it was really good experience at what

110
00:04:05,990 --> 00:04:04,560
point did they call on you to say hey

111
00:04:08,470 --> 00:04:06,000
rick we'd like you we'd like you to

112
00:04:10,470 --> 00:04:08,480
start working on artemis now uh that was

113
00:04:12,869 --> 00:04:10,480

pretty good too so it was towards the

114
00:04:16,150 --> 00:04:12,879
end of the it was so it was probably

115
00:04:19,189 --> 00:04:16,160
2008 uh so it was actually constellation

116
00:04:21,670 --> 00:04:19,199
then wow yeah so ares and el ryan was

117
00:04:23,510 --> 00:04:21,680
still there um but uh we had an

118
00:04:26,230 --> 00:04:23,520
individual in our office that was prime

119
00:04:27,590 --> 00:04:26,240
and and uh he was he was he'd been a

120
00:04:29,270 --> 00:04:27,600
flight director for a while so they

121
00:04:30,950 --> 00:04:29,280
wanted to give someone else offload he

122
00:04:32,390 --> 00:04:30,960
was it was getting really busy so they

123
00:04:35,270 --> 00:04:32,400
wanted to offload some of his work and

124
00:04:37,430 --> 00:04:35,280
they asked me to to to help him out so i

125
00:04:39,350 --> 00:04:37,440
started doing that and then he left the

126
00:04:40,390 --> 00:04:39,360
office so i became prime and then it was

127
00:04:42,070 --> 00:04:40,400
shortly after that that the

128
00:04:43,510 --> 00:04:42,080
constellation was canceled but orion

129
00:04:45,110 --> 00:04:43,520
survived and then they came the artemis

130
00:04:47,110 --> 00:04:45,120
program and so i kind of i've been

131
00:04:49,590 --> 00:04:47,120
involved ever since uh and it's yeah

132
00:04:52,310 --> 00:04:49,600
it's with different forms of what is a

133
00:04:54,629 --> 00:04:52,320
moon mission or exploration oh yeah yeah

134
00:04:55,909 --> 00:04:54,639
so i've seen it all very cool yeah it's

135
00:04:58,070 --> 00:04:55,919
been really neat awesome well we're

136
00:04:59,670 --> 00:04:58,080
gonna get into uh a lot of uh you know

137
00:05:01,590 --> 00:04:59,680
what goes behind that what you have been

138
00:05:03,189 --> 00:05:01,600

planning since 2008 when it comes to a

139
00:05:05,029 --> 00:05:03,199
moon mission we'll get into that john i

140
00:05:07,830 --> 00:05:05,039
want to learn about your experience uh

141
00:05:10,950 --> 00:05:07,840
um that led you to this uh this artemis

142
00:05:11,830 --> 00:05:10,960
role sure uh so i

143
00:05:12,950 --> 00:05:11,840
have

144
00:05:15,350 --> 00:05:12,960
started

145
00:05:16,870 --> 00:05:15,360
actually a year before rick got selected

146
00:05:18,790 --> 00:05:16,880
as a flight director

147
00:05:21,510 --> 00:05:18,800
so as a flight controller i was a flight

148
00:05:23,029 --> 00:05:21,520
controller when i started uh i started

149
00:05:25,029 --> 00:05:23,039
in the international space station so i

150
00:05:27,430 --> 00:05:25,039
was a flight controller i did

151
00:05:28,790 --> 00:05:27,440
the command and data handling

152
00:05:29,909 --> 00:05:28,800
portions you know all the onboard

153
00:05:31,350 --> 00:05:29,919
computers

154
00:06:05,990 --> 00:05:31,360
i

155
00:06:06,710 --> 00:06:06,000
the the computers on the shuttle network

156
00:06:09,749 --> 00:06:06,720
so

157
00:06:12,150 --> 00:06:09,759
uh i got to be um an asian entry flight

158
00:06:13,110 --> 00:06:12,160
controller for for shuttle and the dps

159
00:06:14,550 --> 00:06:13,120
officer

160
00:06:17,350 --> 00:06:14,560
uh so i did that

161
00:06:18,469 --> 00:06:17,360
a few years even got to work the last

162
00:06:21,749 --> 00:06:18,479
missions

163
00:06:23,909 --> 00:06:21,759

as shuttle was retiring um and uh and

164
00:06:25,990 --> 00:06:23,919
after uh the shuttle retired is when i

165
00:06:26,870 --> 00:06:26,000
got selected to be a flight director uh

166
00:06:28,790 --> 00:06:26,880
so

167
00:06:31,270 --> 00:06:28,800
that was 2011

168
00:06:33,110 --> 00:06:31,280
and i've been a flight director for uh

169
00:06:35,189 --> 00:06:33,120
space station ever since

170
00:06:36,710 --> 00:06:35,199
very cool now what how do you compare

171
00:06:38,550 --> 00:06:36,720
those two rules for those that might not

172
00:06:40,230 --> 00:06:38,560
be familiar is you were a fight

173
00:06:42,790 --> 00:06:40,240
controller for a long time now you

174
00:06:45,350 --> 00:06:42,800
become a flight director so what are the

175
00:06:47,189 --> 00:06:45,360
responsibilities that you assume yeah

176
00:06:48,790 --> 00:06:47,199
you know the um

177
00:06:51,350 --> 00:06:48,800
when you're a flight controller really

178
00:06:53,589 --> 00:06:51,360
what you're you're focused specifically

179
00:06:56,550 --> 00:06:53,599
on the system that you're um you're

180
00:06:57,909 --> 00:06:56,560
controlling right uh so for instance uh

181
00:06:59,749 --> 00:06:57,919
you know when i was in charge of the

182
00:07:02,390 --> 00:06:59,759
computers and so i had a real detailed

183
00:07:06,309 --> 00:07:02,400
knowledge of all the computer systems

184
00:07:09,430 --> 00:07:06,319
uh and and and and how

185
00:07:12,150 --> 00:07:09,440
failures might manifest you know how

186
00:07:14,710 --> 00:07:12,160
uh you know what how they kind of kind

187
00:07:16,469 --> 00:07:14,720
of how they fit in with with the other

188
00:07:17,510 --> 00:07:16,479

systems

189
00:07:20,950 --> 00:07:17,520
but

190
00:07:22,870 --> 00:07:20,960
as a flight director you're really

191
00:07:25,589 --> 00:07:22,880
looking at all of the systems and how

192
00:07:28,309 --> 00:07:25,599
they integrate together and

193
00:07:31,270 --> 00:07:28,319
you're really more on track with how you

194
00:07:34,070 --> 00:07:31,280
can use those systems to perform your

195
00:07:35,350 --> 00:07:34,080
mission right and how how you can

196
00:07:39,189 --> 00:07:35,360
bring the team together what are the

197
00:07:40,950 --> 00:07:39,199
mission objectives uh and and and know

198
00:07:42,950 --> 00:07:40,960
know a little about a little bit about a

199
00:07:45,029 --> 00:07:42,960
lot

200
00:07:46,710 --> 00:07:45,039
um now you have to do it for artemis so

201
00:07:48,469 --> 00:07:46,720
when did you get the call that says hey

202
00:07:50,390 --> 00:07:48,479
we want you to move away from from

203
00:07:52,150 --> 00:07:50,400
station and start doing more moon

204
00:07:54,390 --> 00:07:52,160
missions yeah so

205
00:07:56,230 --> 00:07:54,400
so i had completed a stint as a

206
00:07:57,430 --> 00:07:56,240
increment lead flight director for the

207
00:07:58,790 --> 00:07:57,440
station

208
00:08:00,390 --> 00:07:58,800
um

209
00:08:02,070 --> 00:08:00,400
and was

210
00:08:04,070 --> 00:08:02,080
starting to to get other lead

211
00:08:06,950 --> 00:08:04,080
assignments so i had a couple of you

212
00:08:08,869 --> 00:08:06,960
know spacewalks that i led and and cargo

213
00:08:09,909 --> 00:08:08,879

missions cargo vehicle missions that i

214
00:08:11,350 --> 00:08:09,919
led and

215
00:08:13,830 --> 00:08:11,360
and uh

216
00:08:15,909 --> 00:08:13,840
they were looking for well we we have an

217
00:08:18,230 --> 00:08:15,919
area where you know we need we need you

218
00:08:19,909 --> 00:08:18,240
to provide some help to uh our ass and

219
00:08:22,790 --> 00:08:19,919
entry flight director at the time tony

220
00:08:25,909 --> 00:08:22,800
soccer uh and uh and so i became his

221
00:08:28,390 --> 00:08:25,919
backup uh and and uh started to learn

222
00:08:30,150 --> 00:08:28,400
from him you know kind of what is this

223
00:08:31,670 --> 00:08:30,160
artemis one mission all about you know

224
00:08:33,670 --> 00:08:31,680
and and that was really in the

225
00:08:36,870 --> 00:08:33,680
development phase when when we were

226
00:08:38,709 --> 00:08:36,880
really uh trying to to to psych out all

227
00:08:39,990 --> 00:08:38,719
the mission rules all the how are we

228
00:08:41,909 --> 00:08:40,000
gonna to

229
00:08:44,470 --> 00:08:41,919
you know put this whole thing together

230
00:08:46,710 --> 00:08:44,480
what are the limitations of the rockets

231
00:08:48,870 --> 00:08:46,720
and what's the limitation of the capsule

232
00:08:50,630 --> 00:08:48,880
those kinds of things um

233
00:08:54,310 --> 00:08:50,640
not too long after that i think it was

234
00:08:57,110 --> 00:08:54,320
maybe a year or so after after i was uh

235
00:08:59,990 --> 00:08:57,120
you know tony's back up he retired

236
00:09:01,910 --> 00:09:00,000
and uh and so then i was uh a little bit

237
00:09:04,230 --> 00:09:01,920
out of a field promotion

238
00:09:06,630 --> 00:09:04,240

filled in perfect right um

239
00:09:08,389 --> 00:09:06,640
it sound like you you mentioned lead you

240
00:09:10,470 --> 00:09:08,399
were lead increment lead for for

241
00:09:11,670 --> 00:09:10,480
spacewalks for cargo missions sounds

242
00:09:13,110 --> 00:09:11,680
like that's a little bit different as a

243
00:09:14,470 --> 00:09:13,120
flight director you're the lead in the

244
00:09:16,310 --> 00:09:14,480
room but now it sounds like there's a

245
00:09:19,670 --> 00:09:16,320
little bit more that goes to being a

246
00:09:21,110 --> 00:09:19,680
lead for a certain part of what is this

247
00:09:23,269 --> 00:09:21,120
international space station missions

248
00:09:25,350 --> 00:09:23,279
what goes into being a lead yeah so so

249
00:09:27,990 --> 00:09:25,360
just like rick is the lead for artemis

250
00:09:30,389 --> 00:09:28,000
one uh you know we we have leads for

251
00:09:32,550 --> 00:09:30,399
various dynamic missions in in the space

252
00:09:34,710 --> 00:09:32,560
station as well right so so things that

253
00:09:36,630 --> 00:09:34,720
take a little bit more planning and a

254
00:09:39,509 --> 00:09:36,640
little bit more coordination than just

255
00:09:42,630 --> 00:09:39,519
your average uh day-to-day life on the

256
00:09:43,990 --> 00:09:42,640
station right so uh so we assign leads

257
00:09:45,990 --> 00:09:44,000
to those a little bit more dynamic

258
00:09:49,110 --> 00:09:46,000
phases so spacewalks is a really good

259
00:09:51,430 --> 00:09:49,120
example there's a lot of intricate uh

260
00:09:53,030 --> 00:09:51,440
planning and detailed you know

261
00:09:54,710 --> 00:09:53,040
coordination among the different team

262
00:09:56,790 --> 00:09:54,720
members that that you really need

263
00:09:59,110 --> 00:09:56,800

somebody to to kind of

264
00:10:01,829 --> 00:09:59,120
uh you know haunt you and and and and

265
00:10:04,230 --> 00:10:01,839
help pull together and and lead and so

266
00:10:05,829 --> 00:10:04,240
that's what we assign that so cargo

267
00:10:08,150 --> 00:10:05,839
missions is another great example you

268
00:10:10,150 --> 00:10:08,160
know there's multiple different teams uh

269
00:10:13,030 --> 00:10:10,160
from multiple centers uh you know that

270
00:10:14,389 --> 00:10:13,040
we need to make sure that we're all um

271
00:10:16,230 --> 00:10:14,399
you know

272
00:10:18,710 --> 00:10:16,240
looking at the same sheet of music

273
00:10:20,630 --> 00:10:18,720
essentially so so rick from your lead

274
00:10:23,269 --> 00:10:20,640
position of artemis what

275
00:10:25,269 --> 00:10:23,279
responsibilities aside from sitting in

276
00:10:27,269 --> 00:10:25,279
mission control and actually being the

277
00:10:29,110 --> 00:10:27,279
flight director for you know whatever

278
00:10:30,630 --> 00:10:29,120
your shift is what are the lead

279
00:10:31,750 --> 00:10:30,640
responsibilities that you're helping out

280
00:10:32,949 --> 00:10:31,760
with yeah

281
00:10:35,990 --> 00:10:32,959
i think um

282
00:10:38,230 --> 00:10:36,000
and this goes for any lead uh any lead

283
00:10:42,069 --> 00:10:38,240
role whether it be for an increment an

284
00:10:44,710 --> 00:10:42,079
iss or a cargo mission or artemis is the

285
00:10:46,230 --> 00:10:44,720
lead is is really ultimately responsible

286
00:10:47,829 --> 00:10:46,240
for

287
00:10:49,990 --> 00:10:47,839
building the mission and then executing

288
00:10:52,710 --> 00:10:50,000

it and that's that's you interface with

289
00:10:53,910 --> 00:10:52,720
the programs with the esd the

290
00:10:55,350 --> 00:10:53,920
exploration system division of

291
00:10:57,910 --> 00:10:55,360
headquarters

292
00:10:59,670 --> 00:10:57,920
they provide us the mission objectives

293
00:11:01,590 --> 00:10:59,680
the mission priorities that they want us

294
00:11:04,150 --> 00:11:01,600
to go and accomplish and then we take

295
00:11:06,069 --> 00:11:04,160
those we build a plan

296
00:11:08,790 --> 00:11:06,079
then we train to that plan and then we

297
00:11:12,150 --> 00:11:08,800
go and execute that plan so uh and it's

298
00:11:13,750 --> 00:11:12,160
a constant back and forth uh so the lead

299
00:11:15,990 --> 00:11:13,760
is the point person really that's

300
00:11:18,150 --> 00:11:16,000
interfacing with the up and out and then

301
00:11:20,150 --> 00:11:18,160
uh conveys it down and then and works

302
00:11:21,910 --> 00:11:20,160
with the various piece parts uh to build

303
00:11:24,790 --> 00:11:21,920
that plan and then go and train it and

304
00:11:26,389 --> 00:11:24,800
then execute it so essentially it sounds

305
00:11:28,630 --> 00:11:26,399
like it's like a high level plan first

306
00:11:30,310 --> 00:11:28,640
like the goal is we want to put you know

307
00:11:31,829 --> 00:11:30,320
human boots on the moon that's that's

308
00:11:33,269 --> 00:11:31,839
what we want to do and you're saying

309
00:11:35,110 --> 00:11:33,279
here's how we get there from an

310
00:11:36,310 --> 00:11:35,120
operational perspective here's what we

311
00:11:38,470 --> 00:11:36,320
need to accomplish here's what we need

312
00:11:40,069 --> 00:11:38,480
to verify to get to that goal yeah they

313
00:11:41,670 --> 00:11:40,079

rely on us to actually put together the

314
00:11:43,670 --> 00:11:41,680
mission to achieve their their their

315
00:11:45,750 --> 00:11:43,680
mission objectives that's it okay now

316
00:11:47,110 --> 00:11:45,760
let's dive into mission control so what

317
00:11:48,790 --> 00:11:47,120
do you do so there's a lot of different

318
00:11:50,310 --> 00:11:48,800
pieces to this this is specifically

319
00:11:51,910 --> 00:11:50,320
about when it comes to an artemis

320
00:11:54,470 --> 00:11:51,920
mission what are you doing in mission

321
00:11:56,150 --> 00:11:54,480
control so so the grander picture judd

322
00:11:58,150 --> 00:11:56,160
i'll go to you the grander picture when

323
00:12:00,310 --> 00:11:58,160
it comes to an artemis mission what is

324
00:12:02,550 --> 00:12:00,320
the responsibility what is the purpose

325
00:12:04,470 --> 00:12:02,560
of mission control

326
00:12:07,990 --> 00:12:04,480
essentially to

327
00:12:09,750 --> 00:12:08,000
be responsible for all of the execution

328
00:12:10,389 --> 00:12:09,760
of that mission that particular mission

329
00:12:13,110 --> 00:12:10,399
so

330
00:12:16,150 --> 00:12:13,120
whether that be uh you know uplinking

331
00:12:17,990 --> 00:12:16,160
plans to do burns whether that be

332
00:12:19,750 --> 00:12:18,000
uh you know coordinating all the

333
00:12:20,949 --> 00:12:19,760
communication requirements things like

334
00:12:25,750 --> 00:12:20,959
that

335
00:12:28,629 --> 00:12:25,760
does is it controls the vehicle uh and

336
00:12:30,550 --> 00:12:28,639
so so we we do that a number of

337
00:12:31,670 --> 00:12:30,560
different ways we we we talked about a

338
00:12:32,949 --> 00:12:31,680

little bit you know being a flight

339
00:12:35,430 --> 00:12:32,959
controller versus flight director you

340
00:12:38,069 --> 00:12:35,440
know uh we divide

341
00:12:40,629 --> 00:12:38,079
the vehicle up into different systems

342
00:12:42,389 --> 00:12:40,639
and so each one of those systems

343
00:12:44,389 --> 00:12:42,399
we represent with a flight controller

344
00:12:46,230 --> 00:12:44,399
right so one of those systems could be

345
00:12:47,829 --> 00:12:46,240
the the computer systems one of them

346
00:12:49,990 --> 00:12:47,839
could be the communication systems one

347
00:12:51,670 --> 00:12:50,000
of them could be the navigation systems

348
00:12:53,590 --> 00:12:51,680
one of them eventually will be the

349
00:12:56,470 --> 00:12:53,600
environmental systems when we when we

350
00:12:59,190 --> 00:12:56,480
put humans on on on artemis

351
00:13:02,150 --> 00:12:59,200
thermal systems and so so we look to to

352
00:13:04,069 --> 00:13:02,160
each one of those flight controllers to

353
00:13:07,269 --> 00:13:04,079
advise us on hey what's going on with

354
00:13:09,509 --> 00:13:07,279
that system you know how best can we um

355
00:13:11,990 --> 00:13:09,519
uh you know complete our mission

356
00:13:14,069 --> 00:13:12,000
objectives based on conditions that we

357
00:13:15,350 --> 00:13:14,079
we encountered got it

358
00:13:16,230 --> 00:13:15,360
now rick

359
00:13:17,750 --> 00:13:16,240
this

360
00:13:18,550 --> 00:13:17,760
taking on everything that judge just

361
00:13:21,190 --> 00:13:18,560
said

362
00:13:22,550 --> 00:13:21,200
for artemis one what is that mission

363
00:13:24,949 --> 00:13:22,560

that you guys are controlling what is

364
00:13:26,949 --> 00:13:24,959
artemis one yeah so the biggest thing

365
00:13:28,710 --> 00:13:26,959
with artemis one our primary objectives

366
00:13:31,110 --> 00:13:28,720
really is to

367
00:13:33,430 --> 00:13:31,120
test the vehicle validate its capability

368
00:13:35,590 --> 00:13:33,440
before we put the astronauts on it on

369
00:13:37,030 --> 00:13:35,600
artemis ii so we have

370
00:13:39,030 --> 00:13:37,040
we're building and we're still doing it

371
00:13:42,710 --> 00:13:39,040
right now uh we're building the timeline

372
00:13:45,670 --> 00:13:42,720
that's um going to include uh just

373
00:13:47,590 --> 00:13:45,680
operating the systems to to understand

374
00:13:50,230 --> 00:13:47,600
how they're going to perform in in the

375
00:13:52,629 --> 00:13:50,240
cis lunar environment or during acid and

376
00:13:55,030 --> 00:13:52,639
entry for judd's team um

377
00:13:56,949 --> 00:13:55,040
you know they've done testing uh so we

378
00:13:58,470 --> 00:13:56,959
have a feel for how the system is going

379
00:13:59,990 --> 00:13:58,480
to operate testing it plumb rook where

380
00:14:01,350 --> 00:14:00,000
they do a thermal vacuum they bring it

381
00:14:02,389 --> 00:14:01,360
all the way down to vacuum they heat it

382
00:14:04,310 --> 00:14:02,399
they cool it

383
00:14:05,829 --> 00:14:04,320
and so we see how the systems responded

384
00:14:07,590 --> 00:14:05,839
in the test but it's a different

385
00:14:08,870 --> 00:14:07,600
environment when you get when you leave

386
00:14:12,710 --> 00:14:08,880
low earth orbit you're heading to the

387
00:14:15,030 --> 00:14:12,720
moon so we're building a a timeline a

388
00:14:16,870 --> 00:14:15,040

mission plan flight plan that's gonna

389
00:14:18,550 --> 00:14:16,880
just gonna just test all the various

390
00:14:20,949 --> 00:14:18,560
systems and each of the disciplines that

391
00:14:23,110 --> 00:14:20,959
judge spoke of they are responsible for

392
00:14:25,910 --> 00:14:23,120
their their discip their uh their

393
00:14:27,590 --> 00:14:25,920
systems and operating it and doing these

394
00:14:30,790 --> 00:14:27,600
deep we call them detailed flight test

395
00:14:32,230 --> 00:14:30,800
objectives or flight test objectives um

396
00:14:33,509 --> 00:14:32,240
operating the system to see how it's

397
00:14:36,710 --> 00:14:33,519
going to operate how it's going to

398
00:14:38,710 --> 00:14:36,720
function and um and and and just we're

399
00:14:40,710 --> 00:14:38,720
following the timeline now a big piece

400
00:14:43,110 --> 00:14:40,720
about the mission control also is when

401
00:14:45,110 --> 00:14:43,120
things don't go as planned for whatever

402
00:14:46,150 --> 00:14:45,120
reason we run into something we didn't

403
00:14:48,550 --> 00:14:46,160
expect

404
00:14:50,069 --> 00:14:48,560
then we have to replan we re-timeline we

405
00:14:51,590 --> 00:14:50,079
may move hey that didn't turn out the

406
00:14:53,350 --> 00:14:51,600
way we planned it but we understand or

407
00:14:55,829 --> 00:14:53,360
we got to look at the data we understand

408
00:14:57,829 --> 00:14:55,839
so let's try it again and so the team

409
00:15:00,150 --> 00:14:57,839
has to rebuild the plan that we spent

410
00:15:02,389 --> 00:15:00,160
months building and now we gotta replant

411
00:15:05,269 --> 00:15:02,399
it so uh there's there's execution

412
00:15:06,150 --> 00:15:05,279
shifts there's replant shifts and so uh

413
00:15:09,030 --> 00:15:06,160

it just

414
00:15:10,949 --> 00:15:09,040
continues 2407 we're just working on

415
00:15:12,710 --> 00:15:10,959
executing the mission and and then

416
00:15:14,629 --> 00:15:12,720
updating the flight plan to

417
00:15:17,110 --> 00:15:14,639
as necessary to get all those mission

418
00:15:19,189 --> 00:15:17,120
objectives accomplished that's it so um

419
00:15:21,110 --> 00:15:19,199
when it comes to jud like all those

420
00:15:22,790 --> 00:15:21,120
things that are coming in what like that

421
00:15:24,470 --> 00:15:22,800
are that are monitoring really let's

422
00:15:26,069 --> 00:15:24,480
just let's just say like the avionics

423
00:15:27,750 --> 00:15:26,079
position all the data's coming in and

424
00:15:29,030 --> 00:15:27,760
they say oh this is not what it's

425
00:15:31,269 --> 00:15:29,040
supposed to be because i know what it's

426
00:15:33,670 --> 00:15:31,279
supposed to be at this so this is where

427
00:15:34,870 --> 00:15:33,680
those replans this is where those those

428
00:15:37,110 --> 00:15:34,880
different

429
00:15:38,230 --> 00:15:37,120
operations come in that says you know

430
00:15:41,670 --> 00:15:38,240
this is how we're going to deal with

431
00:15:44,150 --> 00:15:41,680
this scenario yeah so so in in your

432
00:15:45,990 --> 00:15:44,160
example avionics person says hey i've

433
00:15:48,069 --> 00:15:46,000
got a computer that's throwing me a

434
00:15:50,949 --> 00:15:48,079
piece of information that it's not right

435
00:15:52,870 --> 00:15:50,959
or or you know forbid that that the

436
00:15:54,870 --> 00:15:52,880
computer one of the computers has failed

437
00:15:56,310 --> 00:15:54,880
you know completely

438
00:15:58,150 --> 00:15:56,320

yeah so they'll say hey these are the

439
00:15:59,829 --> 00:15:58,160
things that we can do with it you know

440
00:16:02,310 --> 00:15:59,839
to try to troubleshoot

441
00:16:04,629 --> 00:16:02,320
um you know these these are the the

442
00:16:06,550 --> 00:16:04,639
capabilities that we have lost these are

443
00:16:08,470 --> 00:16:06,560
the capabilities that we still have

444
00:16:10,150 --> 00:16:08,480
uh and and so

445
00:16:11,189 --> 00:16:10,160
then you put that together with well

446
00:16:13,590 --> 00:16:11,199
what are the

447
00:16:15,990 --> 00:16:13,600
the the the forward objectives that we

448
00:16:17,990 --> 00:16:16,000
have for the vehicle you know coming up

449
00:16:19,749 --> 00:16:18,000
you know are they still compatible are

450
00:16:22,069 --> 00:16:19,759
we going to have to move those down you

451
00:16:23,670 --> 00:16:22,079
know down the line a little bit further

452
00:16:25,189 --> 00:16:23,680
until we you know completely

453
00:16:27,990 --> 00:16:25,199
troubleshoot what the problem is that

454
00:16:28,790 --> 00:16:28,000
you had in this particular system

455
00:16:30,550 --> 00:16:28,800
so

456
00:16:32,389 --> 00:16:30,560
when it comes in the room the flight

457
00:16:33,910 --> 00:16:32,399
director it sounds like is the person

458
00:16:37,030 --> 00:16:33,920
that's really absorbing all the

459
00:16:38,629 --> 00:16:37,040
information from that avionics guy from

460
00:16:40,230 --> 00:16:38,639
you know wherever ground control make

461
00:16:42,310 --> 00:16:40,240
sure all the satellites are working make

462
00:16:44,230 --> 00:16:42,320
sure you got the the systems in mission

463
00:16:46,150 --> 00:16:44,240

control you're the one absorbing all of

464
00:16:48,389 --> 00:16:46,160
that information give us a lay of the

465
00:16:49,590 --> 00:16:48,399
land so it sounds like it sounds like if

466
00:16:51,509 --> 00:16:49,600
i were to look at a picture of mission

467
00:16:53,110 --> 00:16:51,519
control you guys have rows of different

468
00:16:55,350 --> 00:16:53,120
flight controllers you're in the back

469
00:16:57,749 --> 00:16:55,360
you're listening to all this information

470
00:16:59,189 --> 00:16:57,759
you're looking at a lot of data you know

471
00:17:00,949 --> 00:16:59,199
what's what's sort of the lay of the

472
00:17:02,470 --> 00:17:00,959
land when it comes to um you know

473
00:17:03,910 --> 00:17:02,480
mission control is it just the one room

474
00:17:05,350 --> 00:17:03,920
of people what's what's happening in

475
00:17:06,870 --> 00:17:05,360
there

476
00:17:08,789 --> 00:17:06,880
yeah so so

477
00:17:11,189 --> 00:17:08,799
you know for each one of those systems

478
00:17:13,590 --> 00:17:11,199
so systems flight controllers that that

479
00:17:15,990 --> 00:17:13,600
represent a system on the vehicle uh

480
00:17:18,309 --> 00:17:16,000
they they have multiple support you know

481
00:17:20,949 --> 00:17:18,319
people that they can call upon sometimes

482
00:17:22,949 --> 00:17:20,959
they'll they'll usually have a back room

483
00:17:26,549 --> 00:17:22,959
you know another person that's really in

484
00:17:28,870 --> 00:17:26,559
the down and in you know detailed part

485
00:17:30,310 --> 00:17:28,880
of of the system whereas

486
00:17:31,430 --> 00:17:30,320
the flight controller out in the front

487
00:17:32,549 --> 00:17:31,440
room

488
00:17:34,070 --> 00:17:32,559

they're more

489
00:17:35,510 --> 00:17:34,080
they absolutely have that knowledge but

490
00:17:37,830 --> 00:17:35,520
they're also looking to kind of

491
00:17:39,350 --> 00:17:37,840
integrate and try to try to understand

492
00:17:40,470 --> 00:17:39,360
how they're going to impact the other

493
00:17:42,310 --> 00:17:40,480
systems

494
00:17:43,750 --> 00:17:42,320
in addition to the backroom support that

495
00:17:45,990 --> 00:17:43,760
they have

496
00:17:49,029 --> 00:17:46,000
you you have mission evaluation you have

497
00:17:50,710 --> 00:17:49,039
engineers that have worked on uh the the

498
00:17:53,350 --> 00:17:50,720
vehicle have built in many cases built

499
00:17:56,070 --> 00:17:53,360
the vehicle uh and so you can reach back

500
00:17:57,510 --> 00:17:56,080
and and draw upon their experience uh to

501
00:17:59,510 --> 00:17:57,520
try and troubleshoot something that

502
00:18:01,669 --> 00:17:59,520
maybe you haven't seen before or try to

503
00:18:03,590 --> 00:18:01,679
understand if you know

504
00:18:05,510 --> 00:18:03,600
did we expect this or

505
00:18:06,549 --> 00:18:05,520
was was this a feature of the of the

506
00:18:08,310 --> 00:18:06,559
vehicle

507
00:18:09,909 --> 00:18:08,320
so you have the flight controllers they

508
00:18:12,150 --> 00:18:09,919
have their own support networks you got

509
00:18:13,990 --> 00:18:12,160
some engineering support and if i'm if

510
00:18:16,789 --> 00:18:14,000
i'm understanding this correctly all of

511
00:18:18,870 --> 00:18:16,799
that feeds up to the flight director

512
00:18:20,789 --> 00:18:18,880
right now the flight director

513
00:18:22,950 --> 00:18:20,799

do they have the ultimate authority over

514
00:18:24,710 --> 00:18:22,960
the mission absolutely you know if

515
00:18:26,310 --> 00:18:24,720
everything goes as planned

516
00:18:28,870 --> 00:18:26,320
we don't have to really our job's very

517
00:18:31,110 --> 00:18:28,880
easy we just let the the team execute

518
00:18:32,549 --> 00:18:31,120
the timeline and get the data and and

519
00:18:34,789 --> 00:18:32,559
it's a great mission

520
00:18:36,390 --> 00:18:34,799
but that's that's not very likely so

521
00:18:38,549 --> 00:18:36,400
when things don't go as planned then

522
00:18:40,870 --> 00:18:38,559
they look to the flight director to um

523
00:18:42,470 --> 00:18:40,880
to to weigh the options you know we

524
00:18:44,710 --> 00:18:42,480
understand the priorities that have been

525
00:18:48,230 --> 00:18:44,720
given to us from even the

526
00:18:50,789 --> 00:18:48,240
the programs or esd and then we uh we

527
00:18:52,549 --> 00:18:50,799
weigh the options based on inputs from

528
00:18:55,110 --> 00:18:52,559
the flight control team

529
00:18:58,390 --> 00:18:55,120
their mipsers the engineering team

530
00:18:59,750 --> 00:18:58,400
uh program provides comments and and we

531
00:19:01,510 --> 00:18:59,760
ultimately have the responsibility to

532
00:19:03,190 --> 00:19:01,520
make a decision as to how to proceed

533
00:19:04,230 --> 00:19:03,200
from here what is our what's our next

534
00:19:05,990 --> 00:19:04,240
step

535
00:19:07,190 --> 00:19:06,000
okay so they so there and it's kind of

536
00:19:09,350 --> 00:19:07,200
like their advisors the flight

537
00:19:11,669 --> 00:19:09,360
controllers are sort of advisors to you

538
00:19:13,669 --> 00:19:11,679

and you say hey hey judd this is this is

539
00:19:14,789 --> 00:19:13,679
happening what should we do um and

540
00:19:16,390 --> 00:19:14,799
you're the one that has to make that

541
00:19:18,470 --> 00:19:16,400
ultimate decision and that's the culture

542
00:19:20,390 --> 00:19:18,480
the culture is a very hierarchical it's

543
00:19:22,310 --> 00:19:20,400
very leadership if you say that's what

544
00:19:25,350 --> 00:19:22,320
we're doing that's what we're doing

545
00:19:26,870 --> 00:19:25,360
yep yeah okay i mean uh over the years

546
00:19:28,549 --> 00:19:26,880
you know and and the culture you

547
00:19:30,950 --> 00:19:28,559
mentioned

548
00:19:33,590 --> 00:19:30,960
we've developed an incredible

549
00:19:35,350 --> 00:19:33,600
relationship across the it's a family so

550
00:19:36,950 --> 00:19:35,360
there's a trust factor that has been

551
00:19:38,390 --> 00:19:36,960
developed over the

552
00:19:41,669 --> 00:19:38,400
several years that we've been working

553
00:19:44,070 --> 00:19:41,679
together on this mission you know uh

554
00:19:46,470 --> 00:19:44,080
it's a team effort to build the timeline

555
00:19:47,990 --> 00:19:46,480
and and then we go and train it and

556
00:19:49,750 --> 00:19:48,000
we've been through all these scenarios

557
00:19:52,470 --> 00:19:49,760
the training team is throwing at us all

558
00:19:53,669 --> 00:19:52,480
these failures and and and you learned

559
00:19:56,150 --> 00:19:53,679
how each other

560
00:19:58,230 --> 00:19:56,160
each other works and so uh it's just

561
00:19:59,350 --> 00:19:58,240
amazing how how it becomes a cohesive

562
00:20:01,510 --> 00:19:59,360
team and how

563
00:20:03,190 --> 00:20:01,520

it becomes easy i mean the hard part is

564
00:20:05,190 --> 00:20:03,200
you know when when you get two things

565
00:20:06,149 --> 00:20:05,200
that are just equal how do you decide

566
00:20:07,830 --> 00:20:06,159
which way you want to go and that's

567
00:20:09,750 --> 00:20:07,840
where the flight directors you know come

568
00:20:12,230 --> 00:20:09,760
in and you know through experience

569
00:20:13,029 --> 00:20:12,240
through you know gut feeling sometimes

570
00:20:14,870 --> 00:20:13,039
you know

571
00:20:16,789 --> 00:20:14,880
and through discussion amongst the team

572
00:20:18,789 --> 00:20:16,799
here we we talk amongst ourselves and

573
00:20:21,430 --> 00:20:18,799
try to figure out way the options and

574
00:20:23,350 --> 00:20:21,440
and uh but it's it's it's really the

575
00:20:25,190 --> 00:20:23,360
team effort that that really helps us

576
00:20:27,510 --> 00:20:25,200
drive the you know drive the decisions

577
00:20:29,350 --> 00:20:27,520
that trust factor seems super important

578
00:20:30,870 --> 00:20:29,360
too because you have to rely these are

579
00:20:32,470 --> 00:20:30,880
your advisors they're they're making

580
00:20:34,549 --> 00:20:32,480
recommendations to you you're the one

581
00:20:35,909 --> 00:20:34,559
that has to say this is what that is and

582
00:20:37,430 --> 00:20:35,919
then they have to go execute it but it

583
00:20:39,590 --> 00:20:37,440
has to go back to that training that you

584
00:20:41,909 --> 00:20:39,600
said so there's there's this training so

585
00:20:43,430 --> 00:20:41,919
judd what are you guys doing to train to

586
00:20:45,909 --> 00:20:43,440
prepare all the different team members

587
00:20:48,789 --> 00:20:45,919
so that you can in when the moment comes

588
00:20:50,549 --> 00:20:48,799

trust them yeah so i mean back to the

589
00:20:52,310 --> 00:20:50,559
back to the first point though too you

590
00:20:54,630 --> 00:20:52,320
know it's not not as if

591
00:20:57,350 --> 00:20:54,640
all situations are like that where where

592
00:20:59,430 --> 00:20:57,360
we you know we always have to you know

593
00:21:01,750 --> 00:20:59,440
kind of figure out what to do we try to

594
00:21:03,909 --> 00:21:01,760
write a lot of those things down before

595
00:21:05,750 --> 00:21:03,919
the mission right we try to write down

596
00:21:08,390 --> 00:21:05,760
you know what are the scenarios we think

597
00:21:10,070 --> 00:21:08,400
of let's let's say we we lose this one

598
00:21:11,990 --> 00:21:10,080
piece of equipment can we continue on

599
00:21:13,830 --> 00:21:12,000
the mission and we write those down in

600
00:21:16,549 --> 00:21:13,840
what are called flight rules and those

601
00:21:19,350 --> 00:21:16,559
flight rules are pretty much a contract

602
00:21:21,350 --> 00:21:19,360
with the the enterprise the programs

603
00:21:23,510 --> 00:21:21,360
that say hey

604
00:21:26,149 --> 00:21:23,520
for for these types of scenarios we've

605
00:21:29,350 --> 00:21:26,159
kind of pre-thought those out beforehand

606
00:21:31,590 --> 00:21:29,360
and and so we all agree this is the the

607
00:21:33,750 --> 00:21:31,600
avenue we're going to take right

608
00:21:35,830 --> 00:21:33,760
it's when we're outside of those kind of

609
00:21:37,430 --> 00:21:35,840
pre-thought out things is when you know

610
00:21:40,149 --> 00:21:37,440
what what rick's talking about a little

611
00:21:41,830 --> 00:21:40,159
bit there is is that we you know we we

612
00:21:43,190 --> 00:21:41,840
talk about options we talk about you

613
00:21:45,669 --> 00:21:43,200

know is there something that's in line

614
00:21:46,549 --> 00:21:45,679
with the philosophy of our mission rules

615
00:21:49,029 --> 00:21:46,559
and so

616
00:21:51,110 --> 00:21:49,039
to your point on on training what we do

617
00:21:53,029 --> 00:21:51,120
is in training is we we present the

618
00:21:55,029 --> 00:21:53,039
flight controllers and the team with

619
00:21:57,590 --> 00:21:55,039
scenarios that are maybe

620
00:22:00,950 --> 00:21:57,600
right on the edge of you know they're

621
00:22:02,710 --> 00:22:00,960
not exactly uh what the the flight rules

622
00:22:04,549 --> 00:22:02,720
would say we would do they're kind of in

623
00:22:06,950 --> 00:22:04,559
a little bit of a gray area and so they

624
00:22:10,070 --> 00:22:06,960
push the boundaries right so that helps

625
00:22:13,110 --> 00:22:10,080
uh you know our controllers

626
00:22:14,950 --> 00:22:13,120
be more of a methodical thinkers and and

627
00:22:16,630 --> 00:22:14,960
and and talk about you know what's the

628
00:22:18,390 --> 00:22:16,640
methodology you know

629
00:22:19,990 --> 00:22:18,400
we have a rule we have a mission rule

630
00:22:20,710 --> 00:22:20,000
that says we're going to do this x but i

631
00:22:23,110 --> 00:22:20,720
mean

632
00:22:24,710 --> 00:22:23,120
what happens if it's not exactly that

633
00:22:27,990 --> 00:22:24,720
you know that

634
00:22:29,909 --> 00:22:28,000
exact you know way of of uh that that

635
00:22:31,830 --> 00:22:29,919
the failure presents itself you know

636
00:22:33,270 --> 00:22:31,840
what's really the intent and that's

637
00:22:35,270 --> 00:22:33,280
that's that's really what we're trying

638
00:22:37,590 --> 00:22:35,280

to teach when we do these simulations

639
00:22:39,270 --> 00:22:37,600
right is is how do you not only

640
00:22:40,870 --> 00:22:39,280
communicate really effectively with not

641
00:22:42,950 --> 00:22:40,880
only your flight director the the rest

642
00:22:44,950 --> 00:22:42,960
of the team but also how do you convey

643
00:22:47,430 --> 00:22:44,960
the intent of what

644
00:22:49,669 --> 00:22:47,440
previous mission rules have told you

645
00:22:53,270 --> 00:22:49,679
you you should you should be after how

646
00:22:56,390 --> 00:22:53,280
do you how do you um convey that in a

647
00:22:58,390 --> 00:22:56,400
precise concise uh methodical matching

648
00:22:59,750 --> 00:22:58,400
matter so it's not only understanding

649
00:23:01,750 --> 00:22:59,760
the vehicle and understanding the

650
00:23:04,310 --> 00:23:01,760
operations and you don't you know it

651
00:23:06,710 --> 00:23:04,320
goes to your point it goes beyond

652
00:23:08,310 --> 00:23:06,720
understanding just you know what happens

653
00:23:09,830 --> 00:23:08,320
in a normal scenario you have these

654
00:23:11,430 --> 00:23:09,840
rules that are helping to guide your

655
00:23:12,950 --> 00:23:11,440
decisions and make the recommendations

656
00:23:13,909 --> 00:23:12,960
all thought out ahead of time that's

657
00:23:15,750 --> 00:23:13,919
awesome

658
00:23:18,549 --> 00:23:15,760
but really what the training does is it

659
00:23:20,789 --> 00:23:18,559
helps you to think about that flight

660
00:23:22,549 --> 00:23:20,799
rule what is how should i interpret that

661
00:23:24,149 --> 00:23:22,559
because it's not exactly within those

662
00:23:25,110 --> 00:23:24,159
parameters so how can i interpret that

663
00:23:26,710 --> 00:23:25,120

how can i

664
00:23:28,630 --> 00:23:26,720
make recommendations

665
00:23:31,190 --> 00:23:28,640
but it sounds like communication is a

666
00:23:33,590 --> 00:23:31,200
huge piece of it too

667
00:23:37,029 --> 00:23:33,600
not only being able to digest the

668
00:23:39,029 --> 00:23:37,039
information but to calmly and correctly

669
00:23:40,710 --> 00:23:39,039
assess and deliver that information to

670
00:23:42,789 --> 00:23:40,720
you the flight director yeah when we

671
00:23:44,870 --> 00:23:42,799
evaluate a

672
00:23:47,510 --> 00:23:44,880
flight controller to be certified to

673
00:23:49,510 --> 00:23:47,520
operate their console for whatever

674
00:23:50,710 --> 00:23:49,520
specific phase of the mission

675
00:23:51,990 --> 00:23:50,720
that is

676
00:23:56,310 --> 00:23:52,000
the first

677
00:23:59,190 --> 00:23:56,320
communication skills because without

678
00:24:01,110 --> 00:23:59,200
that then they're they they can't work

679
00:24:02,710 --> 00:24:01,120
as a team they can't they could be the

680
00:24:05,909 --> 00:24:02,720
smartest person in the room smartest

681
00:24:08,470 --> 00:24:05,919
person on the on on on of that system

682
00:24:09,909 --> 00:24:08,480
and if they can't articulate that to

683
00:24:11,750 --> 00:24:09,919
the flight director to other team

684
00:24:13,510 --> 00:24:11,760
members their own team members

685
00:24:15,830 --> 00:24:13,520
then it just

686
00:24:18,630 --> 00:24:15,840
it won't work it just won't work so that

687
00:24:20,549 --> 00:24:18,640
communications is paramount that is huge

688
00:24:21,830 --> 00:24:20,559

okay let's get into the artemis mission

689
00:24:23,510 --> 00:24:21,840
so

690
00:24:25,029 --> 00:24:23,520
we're going around the room we're

691
00:24:26,549 --> 00:24:25,039
looking at all the different roles that

692
00:24:29,269 --> 00:24:26,559
have to contribute

693
00:24:31,269 --> 00:24:29,279
advice to you the flight director judd

694
00:24:33,190 --> 00:24:31,279
what are those what are those rules what

695
00:24:34,630 --> 00:24:33,200
are the in the room with you what what

696
00:24:36,870 --> 00:24:34,640
are the different uh flight control

697
00:24:38,470 --> 00:24:36,880
positions yeah so we start off uh in the

698
00:24:40,470 --> 00:24:38,480
ascent phase and we have a little bit

699
00:24:41,830 --> 00:24:40,480
more uh flight controllers in the asset

700
00:24:42,950 --> 00:24:41,840
phase than we do that's right it's not

701
00:24:44,149 --> 00:24:42,960
just in the room

702
00:24:45,590 --> 00:24:44,159
because we have a whole different other

703
00:24:46,549 --> 00:24:45,600
vehicle right we have actually two other

704
00:24:49,190 --> 00:24:46,559
vehicles

705
00:24:52,149 --> 00:24:49,200
with us so we've got a booster um that

706
00:24:54,950 --> 00:24:52,159
that that takes us up and and uh not

707
00:24:56,470 --> 00:24:54,960
only the sls core stage uh space

708
00:24:59,430 --> 00:24:56,480
launches some core stage but we also

709
00:25:01,510 --> 00:24:59,440
have a second stage which is the uh

710
00:25:04,630 --> 00:25:01,520
interim uh control propulsion module

711
00:25:06,549 --> 00:25:04,640
icps uh and so i have i have a flight

712
00:25:08,310 --> 00:25:06,559
controller that represents the booster

713
00:25:10,870 --> 00:25:08,320

right you know and really it's the

714
00:25:12,230 --> 00:25:10,880
booster it's that first and second stage

715
00:25:14,870 --> 00:25:12,240
so there's a booster flight controller

716
00:25:17,510 --> 00:25:14,880
and he he knows all about all of the you

717
00:25:18,870 --> 00:25:17,520
know the the cryogenics the valves the

718
00:25:20,390 --> 00:25:18,880
you know engine performance that's

719
00:25:22,710 --> 00:25:20,400
supposed to happen with the all of the

720
00:25:24,950 --> 00:25:22,720
engines uh but then i also have a

721
00:25:27,350 --> 00:25:24,960
control position who's really in charge

722
00:25:29,990 --> 00:25:27,360
of understanding how does that rocket

723
00:25:31,909 --> 00:25:30,000
not only the core stage and the icps how

724
00:25:35,190 --> 00:25:31,919
is that supposed to be controlled you

725
00:25:36,950 --> 00:25:35,200
know what are the the uh

726
00:25:39,669 --> 00:25:36,960
you know guidance navigation control

727
00:25:42,070 --> 00:25:39,679
inputs and outputs uh for the for the

728
00:25:44,870 --> 00:25:42,080
rockets uh both both the first stage and

729
00:25:47,029 --> 00:25:44,880
second stage uh so in addition to that

730
00:25:48,470 --> 00:25:47,039
i've got um you know

731
00:25:50,789 --> 00:25:48,480
folks that are responsible for looking

732
00:25:52,789 --> 00:25:50,799
at the capsule so the orion capsule you

733
00:25:54,470 --> 00:25:52,799
know making sure that that the systems

734
00:25:56,710 --> 00:25:54,480
are good on on the orion caps because

735
00:25:58,789 --> 00:25:56,720
eventually the rocket's going to drop

736
00:26:00,710 --> 00:25:58,799
orion off you know in

737
00:26:03,350 --> 00:26:00,720
in translunar orbit and we want to make

738
00:26:05,110 --> 00:26:03,360

sure that that that the the capsule is

739
00:26:06,630 --> 00:26:05,120
still still looking good as far as we

740
00:26:09,350 --> 00:26:06,640
can tell

741
00:26:11,669 --> 00:26:09,360
when it goes heads towards the moon

742
00:26:14,149 --> 00:26:11,679
so as part of the capsule

743
00:26:17,110 --> 00:26:14,159
systems we have uh you know a guidance

744
00:26:19,110 --> 00:26:17,120
navigation control officer a gnc

745
00:26:20,870 --> 00:26:19,120
looking to make sure you know where

746
00:26:22,870 --> 00:26:20,880
you're at and you know how to get to

747
00:26:24,390 --> 00:26:22,880
where you want to go

748
00:26:26,230 --> 00:26:24,400
we've got a a

749
00:26:28,310 --> 00:26:26,240
flight uh

750
00:26:30,630 --> 00:26:28,320
trajectory officer you know a fido

751
00:26:33,029 --> 00:26:30,640
flight dynamics officer uh and and

752
00:26:34,950 --> 00:26:33,039
they're really uh in charge of well

753
00:26:36,149 --> 00:26:34,960
where is that place that you need to go

754
00:26:37,909 --> 00:26:36,159
right you know

755
00:26:39,750 --> 00:26:37,919
how how do we get there you know what's

756
00:26:42,070 --> 00:26:39,760
the what's the correct burn trajectory

757
00:26:45,110 --> 00:26:42,080
where do we need to burn at what what uh

758
00:26:47,350 --> 00:26:45,120
what speed um and then then we've also

759
00:26:49,590 --> 00:26:47,360
got um you know for the other systems

760
00:26:51,350 --> 00:26:49,600
part we've got an electrical officer who

761
00:26:54,149 --> 00:26:51,360
is not only electrical officer but also

762
00:26:56,470 --> 00:26:54,159
is in charge of the mechanics part of of

763
00:26:59,029 --> 00:26:56,480

the orion vehicle as well so it's a kind

764
00:27:00,710 --> 00:26:59,039
of a dual role of uh you know eps

765
00:27:03,029 --> 00:27:00,720
electrical power systems and mechanical

766
00:27:05,430 --> 00:27:03,039
we call them an mpo

767
00:27:07,269 --> 00:27:05,440
it's mechanical and power officer

768
00:27:10,070 --> 00:27:07,279
right so so they're advising us on all

769
00:27:11,909 --> 00:27:10,080
the the solar ray uh inputs from the

770
00:27:14,710 --> 00:27:11,919
service module that's connected the

771
00:27:16,710 --> 00:27:14,720
orion space capsule uh they're advising

772
00:27:19,430 --> 00:27:16,720
us on the mechanical system so the

773
00:27:21,590 --> 00:27:19,440
pyrotechnics that have to be fired in

774
00:27:24,950 --> 00:27:21,600
order to to make things move

775
00:27:27,510 --> 00:27:24,960
uh in in all all manners uh we also have

776
00:27:29,990 --> 00:27:27,520
uh an environmental systems operator

777
00:27:32,230 --> 00:27:30,000
even though we don't have a full

778
00:27:33,190 --> 00:27:32,240
life support system on orion for artemis

779
00:27:35,990 --> 00:27:33,200
one

780
00:27:37,830 --> 00:27:36,000
we do have thermal control and and and

781
00:27:39,430 --> 00:27:37,840
we've got you know we got somebody that

782
00:27:41,590 --> 00:27:39,440
needs to look after all the thermal

783
00:27:43,830 --> 00:27:41,600
control aspects of that and so that's

784
00:27:46,389 --> 00:27:43,840
the ecom you know environmental control

785
00:27:50,710 --> 00:27:48,870
obviously we've got a ground control um

786
00:27:53,430 --> 00:27:50,720
you know person that's kind of in in

787
00:27:56,230 --> 00:27:53,440
charge of all of the uh the the ground

788
00:27:59,750 --> 00:27:56,240

stations uh communicating you know when

789
00:28:01,750 --> 00:27:59,760
we when we need to uh uh

790
00:28:03,669 --> 00:28:01,760
get all the ground stations you know at

791
00:28:05,190 --> 00:28:03,679
the right times uh we've got a

792
00:28:08,789 --> 00:28:05,200
communication officer

793
00:28:11,430 --> 00:28:08,799
inco which was what rick was formerly a

794
00:28:12,870 --> 00:28:11,440
controller for back in the shuttle days

795
00:28:14,389 --> 00:28:12,880
so they're in charge of all of the

796
00:28:16,870 --> 00:28:14,399
communications

797
00:28:19,430 --> 00:28:16,880
and we've got a cdh officer a command

798
00:28:21,750 --> 00:28:19,440
and data handling officer uh who's in

799
00:28:23,590 --> 00:28:21,760
charge of the the uh the avionics or the

800
00:28:25,990 --> 00:28:23,600
computers on board

801
00:28:27,190 --> 00:28:26,000
so ricky this makes me think about you

802
00:28:28,630 --> 00:28:27,200
were talking about people and the

803
00:28:30,149 --> 00:28:28,640
communication skills and everything

804
00:28:31,669 --> 00:28:30,159
because one thing that's going through

805
00:28:33,669 --> 00:28:31,679
my head is you have all these different

806
00:28:35,029 --> 00:28:33,679
they sound very technical you know

807
00:28:36,149 --> 00:28:35,039
you're getting the flight dynamics

808
00:28:37,669 --> 00:28:36,159
you're thinking about trajectories

809
00:28:39,669 --> 00:28:37,679
guidance navigation control all these

810
00:28:41,510 --> 00:28:39,679
different systems of orion and the

811
00:28:43,269 --> 00:28:41,520
boosters

812
00:28:45,350 --> 00:28:43,279
there's got to be a reason why you can't

813
00:28:47,190 --> 00:28:45,360

just let data do the work and then it

814
00:28:48,789 --> 00:28:47,200
just gets fed to you and then you can

815
00:28:50,710 --> 00:28:48,799
make decisions why do you have to have

816
00:28:52,630 --> 00:28:50,720
all these different people

817
00:28:54,389 --> 00:28:52,640
well so we have a good idea through

818
00:28:55,350 --> 00:28:54,399
testing on how the systems are going to

819
00:28:56,470 --> 00:28:55,360
operate

820
00:28:57,909 --> 00:28:56,480
but

821
00:29:03,430 --> 00:28:57,919
they're not going to operate exactly how

822
00:29:05,430 --> 00:29:03,440
they tested here on 1g on on earth so uh

823
00:29:07,669 --> 00:29:05,440
the team is there to

824
00:29:09,350 --> 00:29:07,679
monitor and then control the system to

825
00:29:11,029 --> 00:29:09,360
make sure it's operating the way it's

826
00:29:13,029 --> 00:29:11,039
designed to and the way we need it to in

827
00:29:15,669 --> 00:29:13,039
order to execute the mission and achieve

828
00:29:18,070 --> 00:29:15,679
the objectives um

829
00:29:19,990 --> 00:29:18,080
you know if things go perfectly there's

830
00:29:22,230 --> 00:29:20,000
an onboard sequencer that in a lot of

831
00:29:24,149 --> 00:29:22,240
ways will will um

832
00:29:26,310 --> 00:29:24,159
you know change the configuration of the

833
00:29:28,549 --> 00:29:26,320
system as we go through the timeline but

834
00:29:29,909 --> 00:29:28,559
uh there's is very manuals also there's

835
00:29:31,510 --> 00:29:29,919
a lot of interaction that the team has

836
00:29:34,389 --> 00:29:31,520
to do they have to be building commands

837
00:29:35,190 --> 00:29:34,399
continuously um to configure the vehicle

838
00:29:36,789 --> 00:29:35,200

their

839
00:29:39,110 --> 00:29:36,799
system both

840
00:29:40,549 --> 00:29:39,120
pre-burn in order to execute the burn

841
00:29:42,230 --> 00:29:40,559
and then post burn get back into the

842
00:29:43,029 --> 00:29:42,240
coast configuration

843
00:29:45,029 --> 00:29:43,039
um

844
00:29:47,110 --> 00:29:45,039
and and so there's a lot of uh care and

845
00:29:49,510 --> 00:29:47,120
feeding that the team has to has to do

846
00:29:51,029 --> 00:29:49,520
um and that's one of the i don't want to

847
00:29:52,389 --> 00:29:51,039
say it was a challenge but one of the

848
00:29:53,990 --> 00:29:52,399
the differences that

849
00:29:56,310 --> 00:29:54,000
in working with the lockheed martin the

850
00:29:58,149 --> 00:29:56,320
prime contractor for orion is is their

851
00:30:00,789 --> 00:29:58,159
their expertise uh most of their

852
00:30:02,389 --> 00:30:00,799
experience spaces has been the um

853
00:30:04,630 --> 00:30:02,399
uh the uncrewed

854
00:30:06,870 --> 00:30:04,640
deep space probes which were totally

855
00:30:08,789 --> 00:30:06,880
automated right um so when you put

856
00:30:10,470 --> 00:30:08,799
humans on board there's a whole new

857
00:30:11,750 --> 00:30:10,480
aspect and so we've had to work with

858
00:30:14,070 --> 00:30:11,760
each other and learn how each other's

859
00:30:15,990 --> 00:30:14,080
work uh you know how to get along and

860
00:30:17,750 --> 00:30:16,000
and because there's dramatic differences

861
00:30:19,590 --> 00:30:17,760
in the way we operate so uh the flight

862
00:30:22,230 --> 00:30:19,600
control team and mission control are

863
00:30:23,909 --> 00:30:22,240

really uh responsible for making sure

864
00:30:26,149 --> 00:30:23,919
that the system operates the way it's

865
00:30:27,590 --> 00:30:26,159
supposed to so there's that it goes

866
00:30:29,110 --> 00:30:27,600
beyond the data that's just being

867
00:30:30,549 --> 00:30:29,120
delivered it goes into the it sounds

868
00:30:33,669 --> 00:30:30,559
like it's like the interpretation of

869
00:30:35,909 --> 00:30:33,679
that data each each system is wildly

870
00:30:37,110 --> 00:30:35,919
intricate in its own way and you said

871
00:30:38,310 --> 00:30:37,120
each of them have different support

872
00:30:40,789 --> 00:30:38,320
networks too that are thinking about

873
00:30:43,190 --> 00:30:40,799
even more intricate details and so you

874
00:30:44,310 --> 00:30:43,200
just need those levels of understanding

875
00:30:46,630 --> 00:30:44,320
to

876
00:30:48,070 --> 00:30:46,640
have that information be so ultimately

877
00:30:51,110 --> 00:30:48,080
when it's delivered to you the flight

878
00:30:53,510 --> 00:30:51,120
director it is delivered by a human that

879
00:30:54,950 --> 00:30:53,520
a human has digested digested of all the

880
00:30:56,950 --> 00:30:54,960
information thought about it they've

881
00:30:58,789 --> 00:30:56,960
studied they've they've put in the work

882
00:31:01,029 --> 00:30:58,799
and now they they're the ones making the

883
00:31:04,070 --> 00:31:01,039
recommendation to you you need that

884
00:31:06,070 --> 00:31:04,080
person absolutely yeah yeah i mean it's

885
00:31:07,509 --> 00:31:06,080
you know it's it's true in in most

886
00:31:09,029 --> 00:31:07,519
systems you know

887
00:31:10,950 --> 00:31:09,039
when you cross boundaries whether it's

888
00:31:13,669 --> 00:31:10,960

you know it's an interface boundary yeah

889
00:31:16,789 --> 00:31:13,679
whether it's with with hardware or with

890
00:31:18,149 --> 00:31:16,799
people you know the the greatest chance

891
00:31:20,149 --> 00:31:18,159
of you losing either drop in

892
00:31:22,789 --> 00:31:20,159
communication or to get communication

893
00:31:24,470 --> 00:31:22,799
garbled is those boundaries between two

894
00:31:27,269 --> 00:31:24,480
different systems or two different teams

895
00:31:28,789 --> 00:31:27,279
right and so so that's that part is

896
00:31:31,110 --> 00:31:28,799
really what we need a human in the loop

897
00:31:32,470 --> 00:31:31,120
to help us out with the like interpret

898
00:31:34,389 --> 00:31:32,480
you know what is

899
00:31:35,750 --> 00:31:34,399
what is the you know the correct

900
00:31:38,389 --> 00:31:35,760
communication that needs to happen

901
00:31:40,310 --> 00:31:38,399
between these two things yeah

902
00:31:41,830 --> 00:31:40,320
a good example um

903
00:31:43,909 --> 00:31:41,840
there's gonna be phases throughout the

904
00:31:45,350 --> 00:31:43,919
mission where uh whenever we do a major

905
00:31:48,149 --> 00:31:45,360
burn we have to position the solar

906
00:31:49,110 --> 00:31:48,159
arrays into a position that will support

907
00:31:51,110 --> 00:31:49,120
um

908
00:31:53,669 --> 00:31:51,120
the loading from the actual burning of

909
00:31:55,590 --> 00:31:53,679
the engine and then also uh thermal from

910
00:31:56,630 --> 00:31:55,600
the thrusters that are fired we want to

911
00:31:58,789 --> 00:31:56,640
protect them

912
00:32:00,389 --> 00:31:58,799
um and when we when we go to these

913
00:32:01,990 --> 00:32:00,399

positions

914
00:32:03,830 --> 00:32:02,000
we're no longer generating power or

915
00:32:05,750 --> 00:32:03,840
severely reduced power generation so we

916
00:32:07,509 --> 00:32:05,760
have batteries on orion that that will

917
00:32:09,350 --> 00:32:07,519
then pull provide the systems the

918
00:32:11,029 --> 00:32:09,360
battery but depending on how long we're

919
00:32:12,789 --> 00:32:11,039
out of attitude and where those

920
00:32:16,070 --> 00:32:12,799
batteries are with respect to state of

921
00:32:17,830 --> 00:32:16,080
charge um we may not be able to handle

922
00:32:19,430 --> 00:32:17,840
uh the next worst failure of losing a

923
00:32:21,750 --> 00:32:19,440
battery so we

924
00:32:24,870 --> 00:32:21,760
we may have to do what would be called

925
00:32:28,230 --> 00:32:24,880
power downs or cross ties and this these

926
00:32:30,149 --> 00:32:28,240
flight controllers the mpo officer um

927
00:32:32,070 --> 00:32:30,159
mechanical and power officer who's gonna

928
00:32:34,149 --> 00:32:32,080
have to come to us with recommendations

929
00:32:35,990 --> 00:32:34,159
on on what should we do in order to

930
00:32:37,669 --> 00:32:36,000
configure the vehicle to ensure that we

931
00:32:39,590 --> 00:32:37,679
can successfully make it through this

932
00:32:40,870 --> 00:32:39,600
burn and achieve achieve ultimately

933
00:32:43,269 --> 00:32:40,880
achieve the objective because because

934
00:32:45,190 --> 00:32:43,279
it's not just about that next thing that

935
00:32:47,509 --> 00:32:45,200
person is thinking about the step after

936
00:32:48,950 --> 00:32:47,519
that and making sure okay what if i make

937
00:32:51,110 --> 00:32:48,960
this decision how is that going to

938
00:32:52,310 --> 00:32:51,120

impact it downstream yeah we're really

939
00:32:54,470 --> 00:32:52,320
good about always thinking about the

940
00:32:55,669 --> 00:32:54,480
next worst failure and putting ourselves

941
00:32:57,029 --> 00:32:55,679
in a configuration that we'll be able to

942
00:32:59,669 --> 00:32:57,039
support that

943
00:33:01,269 --> 00:32:59,679
so um rick earlier on you mentioned you

944
00:33:02,149 --> 00:33:01,279
know what what is what is the purpose

945
00:33:03,990 --> 00:33:02,159
you know what are we trying to

946
00:33:06,310 --> 00:33:04,000
accomplish for for artemis one and you

947
00:33:08,789 --> 00:33:06,320
said we have you know we've designed a

948
00:33:10,950 --> 00:33:08,799
mission profile for artemis one that is

949
00:33:12,230 --> 00:33:10,960
going to help us to meet some objectives

950
00:33:14,549 --> 00:33:12,240
so tell us a little bit about that

951
00:33:16,549 --> 00:33:14,559
profile what is what is the uh the

952
00:33:17,509 --> 00:33:16,559
booster orion what is everything going

953
00:33:19,750 --> 00:33:17,519
to do

954
00:33:22,710 --> 00:33:19,760
to meet the objectives that you want to

955
00:33:24,789 --> 00:33:22,720
meet for this mission yeah well so it's

956
00:33:26,549 --> 00:33:24,799
two pieces um let me start with so we've

957
00:33:28,310 --> 00:33:26,559
done a lot of testing there's a lot of

958
00:33:30,710 --> 00:33:28,320
analysis on how the systems are gonna

959
00:33:32,950 --> 00:33:30,720
operate what what what thermally what's

960
00:33:35,029 --> 00:33:32,960
their boundaries you know so the

961
00:33:36,789 --> 00:33:35,039
the engineering team have done a lot of

962
00:33:39,110 --> 00:33:36,799
analysis so they they have a pretty good

963
00:33:42,230 --> 00:33:39,120

understanding but the uh without real

964
00:33:43,990 --> 00:33:42,240
data there's um a lot of margin in those

965
00:33:46,470 --> 00:33:44,000
analysis and and

966
00:33:47,830 --> 00:33:46,480
the analysis really uh they put

967
00:33:50,310 --> 00:33:47,840
constraints on how we operate the

968
00:33:52,789 --> 00:33:50,320
vehicle so most of the time

969
00:33:53,750 --> 00:33:52,799
as we're coasting to the to the moon

970
00:33:55,269 --> 00:33:53,760
um

971
00:33:58,070 --> 00:33:55,279
we're tailed to sun so we're putting the

972
00:34:00,230 --> 00:33:58,080
rear end of orion towards the sun and

973
00:34:01,990 --> 00:34:00,240
the solar rays are out parallel and

974
00:34:03,509 --> 00:34:02,000
they're direct sunlight onto the under

975
00:34:05,110 --> 00:34:03,519
the arrays generate as much power as we

976
00:34:08,230 --> 00:34:05,120
can um

977
00:34:09,750 --> 00:34:08,240
and if we were to leave that attitude

978
00:34:11,669 --> 00:34:09,760
rules right now the announce show we can

979
00:34:13,349 --> 00:34:11,679
leave it for three hours at a time and

980
00:34:15,909 --> 00:34:13,359
then when we come back we have to be in

981
00:34:17,349 --> 00:34:15,919
attitude for 10 hours to recover

982
00:34:19,349 --> 00:34:17,359
those are pretty significant strength

983
00:34:21,589 --> 00:34:19,359
constraints on if we wanted to do some

984
00:34:23,669 --> 00:34:21,599
some other mission objective

985
00:34:25,510 --> 00:34:23,679
this mission the data we're going to go

986
00:34:27,430 --> 00:34:25,520
out of attitude for periods of time

987
00:34:29,349 --> 00:34:27,440
we're going to see how the the the

988
00:34:30,869 --> 00:34:29,359

systems respond we're going to come back

989
00:34:33,030 --> 00:34:30,879
an attitude we're going to see how long

990
00:34:35,669 --> 00:34:33,040
it recovers so after our mission all

991
00:34:38,069 --> 00:34:35,679
that data is going to be used to update

992
00:34:39,909 --> 00:34:38,079
the engineer models so the next time we

993
00:34:41,109 --> 00:34:39,919
fly this vehicle with the astronauts on

994
00:34:42,950 --> 00:34:41,119
board

995
00:34:44,869 --> 00:34:42,960
we're going to we're going to um

996
00:34:46,389 --> 00:34:44,879
there'll be less conservativism in it so

997
00:34:48,310 --> 00:34:46,399
it'll make it easier for us to be able

998
00:34:49,669 --> 00:34:48,320
to operate that vehicle so that's that's

999
00:34:51,829 --> 00:34:49,679
that's kind of the big picture part of

1000
00:34:53,430 --> 00:34:51,839
it yeah the other piece so ascent

1001
00:34:55,430 --> 00:34:53,440
obviously testing the rocket to make

1002
00:34:58,470 --> 00:34:55,440
sure it can it can insert the vehicle

1003
00:35:01,030 --> 00:34:58,480
and orion into the right spot um

1004
00:35:04,470 --> 00:35:01,040
and and and it's it every mission has a

1005
00:35:06,069 --> 00:35:04,480
different profile so um

1006
00:35:07,990 --> 00:35:06,079
they're testing the the performance of

1007
00:35:09,670 --> 00:35:08,000
the of the rocket itself and the solid

1008
00:35:11,589 --> 00:35:09,680
rocket boosters and then the same thing

1009
00:35:12,870 --> 00:35:11,599
with the upper stage you know how is it

1010
00:35:14,550 --> 00:35:12,880
it's going to be completely used

1011
00:35:15,990 --> 00:35:14,560
completely different on armish and

1012
00:35:17,670 --> 00:35:16,000
artemis one we're it's going to do the

1013
00:35:19,510 --> 00:35:17,680

translunar injection and send us on the

1014
00:35:21,349 --> 00:35:19,520
way to the moon but it's not going to do

1015
00:35:23,109 --> 00:35:21,359
that for artemis ii it's going to put

1016
00:35:26,150 --> 00:35:23,119
them in a high lunar orbit where they

1017
00:35:27,750 --> 00:35:26,160
can test the systems out for 24 to 36

1018
00:35:29,430 --> 00:35:27,760
hours i think before they actually

1019
00:35:31,030 --> 00:35:29,440
commit to the moon and it'll be the

1020
00:35:33,190 --> 00:35:31,040
service module that will actually do the

1021
00:35:35,750 --> 00:35:33,200
last burn tli burn to get get orion

1022
00:35:37,910 --> 00:35:35,760
going to the moon so we're testing the

1023
00:35:39,190 --> 00:35:37,920
systems to to prove that they're capable

1024
00:35:41,750 --> 00:35:39,200
of doing what we need them to do when we

1025
00:35:44,710 --> 00:35:41,760
put when astronauts on there and then

1026
00:35:46,790 --> 00:35:44,720
orion itself uh you know when we go to

1027
00:35:48,470 --> 00:35:46,800
the moon we're going to be using all the

1028
00:35:50,069 --> 00:35:48,480
big engines the ohms engine which is the

1029
00:35:52,470 --> 00:35:50,079
ones at the back end that was actually a

1030
00:35:54,790 --> 00:35:52,480
heritage shuttle engine that we used uh

1031
00:35:56,310 --> 00:35:54,800
on shuttle that have been used on orion

1032
00:35:58,230 --> 00:35:56,320
and then it has these auxiliary

1033
00:36:00,470 --> 00:35:58,240
thrusters we're going to those are our

1034
00:36:03,109 --> 00:36:00,480
main means of doing large translational

1035
00:36:04,550 --> 00:36:03,119
burns or big burns essentially um so we

1036
00:36:08,950 --> 00:36:04,560
need to test those the capability of

1037
00:36:10,069 --> 00:36:08,960
those of those systems and then um

1038
00:36:12,790 --> 00:36:10,079

and then

1039
00:36:14,310 --> 00:36:12,800
on the way back one of the um before we

1040
00:36:16,790 --> 00:36:14,320
get back there's a there's a lot of

1041
00:36:18,870 --> 00:36:16,800
pieces that uh that need to need to

1042
00:36:21,589 --> 00:36:18,880
operate we have an optical nav system

1043
00:36:23,829 --> 00:36:21,599
that is used to update the the uh the

1044
00:36:26,550 --> 00:36:23,839
onboard nav state in the event that we

1045
00:36:28,630 --> 00:36:26,560
lost com permanent loss of com the

1046
00:36:31,030 --> 00:36:28,640
optical nav system actually could use be

1047
00:36:33,030 --> 00:36:31,040
used to update the update the onboard

1048
00:36:35,190 --> 00:36:33,040
state vector so that we could bring

1049
00:36:37,750 --> 00:36:35,200
orion back successfully

1050
00:36:39,829 --> 00:36:37,760
there's star trackers there's um

1051
00:36:41,510 --> 00:36:39,839
all the thermal control system we're

1052
00:36:43,109 --> 00:36:41,520
going to be ringing out that system

1053
00:36:44,710 --> 00:36:43,119
testing that where's the edges of the

1054
00:36:46,710 --> 00:36:44,720
box you know really getting that

1055
00:36:48,790 --> 00:36:46,720
engineering data so we can update our

1056
00:36:50,950 --> 00:36:48,800
models and and and really understand how

1057
00:36:52,710 --> 00:36:50,960
it works and then one of the one of the

1058
00:36:54,550 --> 00:36:52,720
major pieces of the mission one of the

1059
00:36:55,430 --> 00:36:54,560
major objectives is to test the heat

1060
00:36:57,670 --> 00:36:55,440
shield

1061
00:37:00,150 --> 00:36:57,680
uh coming back at lunar velocities to

1062
00:37:03,030 --> 00:37:00,160
make sure that it uh will support uh

1063
00:37:04,950 --> 00:37:03,040

keeping orion intact and then so the the

1064
00:37:07,910 --> 00:37:04,960
astronauts could safely splash down the

1065
00:37:10,790 --> 00:37:07,920
coast of california perfect so you are

1066
00:37:12,069 --> 00:37:10,800
this is definitely a mission to really

1067
00:37:14,550 --> 00:37:12,079
you said put it through the ringer to

1068
00:37:16,550 --> 00:37:14,560
really ring out test push the limits of

1069
00:37:18,550 --> 00:37:16,560
this of these vehicles you really want

1070
00:37:20,150 --> 00:37:18,560
to understand because you just it sounds

1071
00:37:21,670 --> 00:37:20,160
like you can't really do it on earth it

1072
00:37:23,349 --> 00:37:21,680
sounds like this is something you have

1073
00:37:25,190 --> 00:37:23,359
to test in space all these different the

1074
00:37:26,790 --> 00:37:25,200
thrusters you know you can put it in a

1075
00:37:28,550 --> 00:37:26,800
sim as many times as you want but when

1076
00:37:30,870 --> 00:37:28,560
you actually put it in space what's it

1077
00:37:32,790 --> 00:37:30,880
going to do turning the solar away is a

1078
00:37:34,710 --> 00:37:32,800
rays away from the sun not something you

1079
00:37:36,710 --> 00:37:34,720
want to do you know with humans on board

1080
00:37:38,470 --> 00:37:36,720
but let's test it out let's see if those

1081
00:37:40,150 --> 00:37:38,480
limits are what we expect you can only

1082
00:37:41,670 --> 00:37:40,160
you can only test it in space that's

1083
00:37:43,430 --> 00:37:41,680
really what it comes down to and you can

1084
00:37:45,670 --> 00:37:43,440
only test it as an integrated vehicle

1085
00:37:46,870 --> 00:37:45,680
you know so one of the first things that

1086
00:37:49,190 --> 00:37:46,880
that they're going to test is going to

1087
00:37:51,109 --> 00:37:49,200
do a modal test you know to to kind of

1088
00:37:52,630 --> 00:37:51,119

vibrate the whole thing and see how

1089
00:37:54,550 --> 00:37:52,640
everything shakes and make sure it

1090
00:37:57,270 --> 00:37:54,560
doesn't shake itself to death right yeah

1091
00:37:59,750 --> 00:37:57,280
you know and so so you can only do that

1092
00:38:01,829 --> 00:37:59,760
um you know when you're in space uh with

1093
00:38:03,270 --> 00:38:01,839
the whole vehicle right without putting

1094
00:38:05,030 --> 00:38:03,280
crew in danger

1095
00:38:06,470 --> 00:38:05,040
test it now before you put the crew on

1096
00:38:08,630 --> 00:38:06,480
board right you know and it's it's

1097
00:38:11,109 --> 00:38:08,640
incremental steps too right i mean you

1098
00:38:12,550 --> 00:38:11,119
test this you you kind of get the data

1099
00:38:14,870 --> 00:38:12,560
that you need to anchor all your

1100
00:38:17,030 --> 00:38:14,880
engineering models you know because

1101
00:38:18,790 --> 00:38:17,040
their best guesses right now and in the

1102
00:38:21,030 --> 00:38:18,800
and that's why rick was talking earlier

1103
00:38:22,630 --> 00:38:21,040
about how how heavily constrained some

1104
00:38:23,910 --> 00:38:22,640
of these things are

1105
00:38:25,430 --> 00:38:23,920
it's because

1106
00:38:26,550 --> 00:38:25,440
from the engineering point of view you

1107
00:38:27,829 --> 00:38:26,560
just don't

1108
00:38:30,310 --> 00:38:27,839
know how

1109
00:38:32,230 --> 00:38:30,320
how much of fidelity you have on the on

1110
00:38:34,710 --> 00:38:32,240
the models right and so the way you

1111
00:38:37,109 --> 00:38:34,720
anchor though is you get test data

1112
00:38:39,430 --> 00:38:37,119
and and and then you know all the way to

1113
00:38:41,190 --> 00:38:39,440

the end where you know you're making

1114
00:38:43,349 --> 00:38:41,200
sure that that whole capsule can come

1115
00:38:47,109 --> 00:38:43,359
back you know do a mission come back

1116
00:38:48,790 --> 00:38:47,119
safely you know and and and be intact uh

1117
00:38:50,870 --> 00:38:48,800
so that you have high confidence that

1118
00:38:52,870 --> 00:38:50,880
when you put humans and astronauts on

1119
00:38:55,030 --> 00:38:52,880
board you know that that they'll come

1120
00:38:58,470 --> 00:38:55,040
back you know safely

1121
00:39:00,630 --> 00:38:58,480
you mentioned earlier on rick that um

1122
00:39:02,150 --> 00:39:00,640
it's it's a long day the the launch day

1123
00:39:03,589 --> 00:39:02,160
is a long day so we're gonna let's jump

1124
00:39:05,829 --> 00:39:03,599
there let's jump to launch day for

1125
00:39:07,030 --> 00:39:05,839
artemis one judd you're on first right

1126
00:39:09,030 --> 00:39:07,040
so what are some of the first things

1127
00:39:10,310 --> 00:39:09,040
that you're looking at on launch day for

1128
00:39:11,030 --> 00:39:10,320
artemis one

1129
00:39:13,990 --> 00:39:11,040
so

1130
00:39:16,550 --> 00:39:14,000
you know we start off the day obviously

1131
00:39:19,589 --> 00:39:16,560
you know the the launch team at kennedy

1132
00:39:21,750 --> 00:39:19,599
space center has has prepped the vehicle

1133
00:39:23,190 --> 00:39:21,760
uh they've they've put it together it's

1134
00:39:25,190 --> 00:39:23,200
taken them months and months and months

1135
00:39:28,470 --> 00:39:25,200
to put the vehicle together

1136
00:39:30,310 --> 00:39:28,480
they've loaded up all the fuel on board

1137
00:39:32,310 --> 00:39:30,320
they've started to

1138
00:39:34,230 --> 00:39:32,320

turn on all the systems so every all of

1139
00:39:35,750 --> 00:39:34,240
the all the lights come on all of the

1140
00:39:37,750 --> 00:39:35,760
computers come on

1141
00:39:39,190 --> 00:39:37,760
we start to get data they start to get

1142
00:39:41,349 --> 00:39:39,200
data

1143
00:39:43,190 --> 00:39:41,359
once they're ready and we they've met

1144
00:39:44,950 --> 00:39:43,200
all of their constraints they'll launch

1145
00:39:46,630 --> 00:39:44,960
the vehicle and then hand it immediately

1146
00:39:48,710 --> 00:39:46,640
over to my team

1147
00:39:50,470 --> 00:39:48,720
and of course we'll be you know

1148
00:39:52,870 --> 00:39:50,480
following along with them lockstep but

1149
00:39:54,790 --> 00:39:52,880
we're more of advisors um you know when

1150
00:39:56,870 --> 00:39:54,800
we're still on the ground we're we're

1151
00:39:58,870 --> 00:39:56,880
saying this is how you know if you had

1152
00:40:01,510 --> 00:39:58,880
this failure here this is how it would

1153
00:40:03,349 --> 00:40:01,520
affect the the mission going forward uh

1154
00:40:05,990 --> 00:40:03,359
you know but we're not really the prime

1155
00:40:07,990 --> 00:40:06,000
folks that that are gonna uh safe things

1156
00:40:10,230 --> 00:40:08,000
or you know troubleshoot or things like

1157
00:40:12,390 --> 00:40:10,240
that uh but as soon as the the the

1158
00:40:15,510 --> 00:40:12,400
rocket's lit then uh that my team's in

1159
00:40:17,589 --> 00:40:15,520
control uh we're we're making sure that

1160
00:40:18,790 --> 00:40:17,599
uh you know from the get-go that we're

1161
00:40:20,630 --> 00:40:18,800
doing the right thing that we're

1162
00:40:24,790 --> 00:40:20,640
supposed to do we we start that roll

1163
00:40:27,430 --> 00:40:24,800

maneuver out uh and and keep on uh going

1164
00:40:29,589 --> 00:40:27,440
towards uh you know our our max dynamic

1165
00:40:31,910 --> 00:40:29,599
pressure throttle bucket um you know

1166
00:40:32,710 --> 00:40:31,920
once that's complete that we're you know

1167
00:40:36,150 --> 00:40:32,720
uh

1168
00:40:37,670 --> 00:40:36,160
boosters you know they do their job

1169
00:40:39,430 --> 00:40:37,680
after about two minutes

1170
00:40:42,150 --> 00:40:39,440
and then we continue on with just the

1171
00:40:44,309 --> 00:40:42,160
core stage uh engines

1172
00:40:46,550 --> 00:40:44,319
and uh we'll follow that all the way up

1173
00:40:47,990 --> 00:40:46,560
to miko main engine cutoff of those four

1174
00:40:49,750 --> 00:40:48,000
major engines

1175
00:40:53,190 --> 00:40:49,760
and then the uh

1176
00:40:56,550 --> 00:40:53,200
the icps plus the orion service module

1177
00:40:58,630 --> 00:40:56,560
and orion capsule uh they will they will

1178
00:41:01,430 --> 00:40:58,640
uh separate from the core stage core

1179
00:41:04,790 --> 00:41:01,440
stage will fall back uh to earth in the

1180
00:41:07,430 --> 00:41:04,800
in in the ocean and icps and and above

1181
00:41:10,870 --> 00:41:07,440
will continue on and the icps then goes

1182
00:41:12,870 --> 00:41:10,880
and uh does a series of burns and and

1183
00:41:15,349 --> 00:41:12,880
and before it does its first burn which

1184
00:41:17,589 --> 00:41:15,359
it's perigee rays maneuver so perigee is

1185
00:41:18,550 --> 00:41:17,599
the the closest approach to the to the

1186
00:41:19,510 --> 00:41:18,560
earth

1187
00:41:23,910 --> 00:41:19,520
um

1188
00:41:26,390 --> 00:41:23,920

does the burn to raise that that

1189
00:41:29,190 --> 00:41:26,400
altitude at perigee uh

1190
00:41:29,990 --> 00:41:29,200
we go ahead and deploy the solar rays so

1191
00:41:31,990 --> 00:41:30,000
so

1192
00:41:34,309 --> 00:41:32,000
up until that point uh the orion

1193
00:41:35,990 --> 00:41:34,319
spacecraft is is on batteries this this

1194
00:41:39,910 --> 00:41:36,000
whole time through through the mission

1195
00:41:42,309 --> 00:41:39,920
so at about 16 ish or 17 minutes or so

1196
00:41:43,990 --> 00:41:42,319
we start to deploy the solar arrays and

1197
00:41:46,309 --> 00:41:44,000
uh make sure that they deploy first of

1198
00:41:48,230 --> 00:41:46,319
all and then that we can get them in in

1199
00:41:51,270 --> 00:41:48,240
the proper uh you know as rick was

1200
00:41:54,309 --> 00:41:51,280
alluding to the proper angles uh and and

1201
00:41:55,990 --> 00:41:54,319
sweep uh in order to do that first uh

1202
00:41:58,870 --> 00:41:56,000
perigee raised maneuver burn that's

1203
00:42:01,430 --> 00:41:58,880
going to be done by the icps icps is

1204
00:42:03,030 --> 00:42:01,440
this the interim control proposal module

1205
00:42:04,790 --> 00:42:03,040
so it's the second stage second stage

1206
00:42:07,109 --> 00:42:04,800
okay

1207
00:42:09,030 --> 00:42:07,119
uh and so that second stage

1208
00:42:11,910 --> 00:42:09,040
burns prm

1209
00:42:12,950 --> 00:42:11,920
and we go through another series of uh

1210
00:42:15,670 --> 00:42:12,960
you know

1211
00:42:18,069 --> 00:42:15,680
icps takes us through a bunch of uh kind

1212
00:42:20,309 --> 00:42:18,079
of roll maneuvers just kind of to make

1213
00:42:23,270 --> 00:42:20,319

sure that the thermal uh heating on all

1214
00:42:26,790 --> 00:42:23,280
sides of the whole vehicle is is

1215
00:42:27,589 --> 00:42:26,800
heated and cooled uh equivalent

1216
00:42:30,950 --> 00:42:27,599
we

1217
00:42:32,870 --> 00:42:30,960
use our ammonia

1218
00:42:34,630 --> 00:42:32,880
boiler systems on the on the orion

1219
00:42:36,790 --> 00:42:34,640
spacecraft at that point

1220
00:42:39,829 --> 00:42:36,800
to start cooling the interior so we've

1221
00:42:42,470 --> 00:42:39,839
got a heat exchanger that exchanges

1222
00:42:45,829 --> 00:42:42,480
ammonia on the outside with the the

1223
00:42:47,990 --> 00:42:45,839
coolant loop which is a just a glycol uh

1224
00:42:51,589 --> 00:42:48,000
type uh

1225
00:42:53,109 --> 00:42:51,599
coolant on the inside uh and

1226
00:42:54,790 --> 00:42:53,119
we make sure that we reject all the heat

1227
00:42:57,670 --> 00:42:54,800
that all the avionics and all of the

1228
00:43:00,150 --> 00:42:57,680
interior part of the orion is is and we

1229
00:43:02,069 --> 00:43:00,160
make sure that that's working okay and

1230
00:43:03,190 --> 00:43:02,079
uh and then eventually about an hour and

1231
00:43:05,190 --> 00:43:03,200
a half or so

1232
00:43:07,829 --> 00:43:05,200
into the mission we do uh the trans

1233
00:43:10,550 --> 00:43:07,839
lunar injection burn with icps that

1234
00:43:12,950 --> 00:43:10,560
second stage and uh hopefully that takes

1235
00:43:14,870 --> 00:43:12,960
us on our on our trajectory to the moon

1236
00:43:16,550 --> 00:43:14,880
there you go right you have to activate

1237
00:43:18,470 --> 00:43:16,560
the spacecraft check everything out make

1238
00:43:20,230 --> 00:43:18,480

sure it is good to go before you get to

1239
00:43:22,390 --> 00:43:20,240
that point at what point are you taking

1240
00:43:23,910 --> 00:43:22,400
over rick right after orion separates

1241
00:43:26,390 --> 00:43:23,920
after the the

1242
00:43:28,230 --> 00:43:26,400
upper stage does performs uh translunar

1243
00:43:29,589 --> 00:43:28,240
injection okay and then orion pops off

1244
00:43:31,349 --> 00:43:29,599
and does it step that's we're going to

1245
00:43:33,270 --> 00:43:31,359
do a quick hand over right then

1246
00:43:35,190 --> 00:43:33,280
because right after that uh judd

1247
00:43:37,030 --> 00:43:35,200
mentioned the modal survey that's one of

1248
00:43:38,950 --> 00:43:37,040
the first things we have to do um and

1249
00:43:41,190 --> 00:43:38,960
it's just a series of rcs reaction

1250
00:43:42,950 --> 00:43:41,200
controlled thruster firings and we have

1251
00:43:45,510 --> 00:43:42,960
accelerometers and they're doing video

1252
00:43:46,470 --> 00:43:45,520
watching how the how the solar rays are

1253
00:43:47,510 --> 00:43:46,480
going to flap

1254
00:43:50,550 --> 00:43:47,520
i don't know if you ever seen it but

1255
00:43:52,710 --> 00:43:50,560
there's some old video of a of a bridge

1256
00:43:54,069 --> 00:43:52,720
i think it was in california that the

1257
00:43:55,829 --> 00:43:54,079
winds came by and it hit a resonant

1258
00:43:57,589 --> 00:43:55,839
frequency and it basically

1259
00:43:59,190 --> 00:43:57,599
destroyed itself was it the bridge that

1260
00:44:00,870 --> 00:43:59,200
was sort of doing the sine wave kind of

1261
00:44:02,390 --> 00:44:00,880
maneuvering yes it has caused it to hit

1262
00:44:04,230 --> 00:44:02,400
a resonant frequency that caused it to

1263
00:44:06,069 --> 00:44:04,240

basically self-destruct

1264
00:44:07,190 --> 00:44:06,079
we're testing the on-board system to

1265
00:44:10,550 --> 00:44:07,200
make sure

1266
00:44:12,550 --> 00:44:10,560
the gains and the on the control systems

1267
00:44:14,309 --> 00:44:12,560
are set such that that doesn't happen

1268
00:44:16,309 --> 00:44:14,319
got it so we're going to do that quick

1269
00:44:18,630 --> 00:44:16,319
test until we do that test we're limited

1270
00:44:20,470 --> 00:44:18,640
on on how long of burns we can do our um

1271
00:44:22,390 --> 00:44:20,480
they can only be our ohms burn the big

1272
00:44:23,990 --> 00:44:22,400
engine they would ultimately

1273
00:44:26,630 --> 00:44:24,000
get us to go into the distant retrograde

1274
00:44:27,990 --> 00:44:26,640
orbit uh 30 seconds and that's not near

1275
00:44:30,230 --> 00:44:28,000
long enough to do anything on our

1276
00:44:33,030 --> 00:44:30,240
mission so um we got us we got to get a

1277
00:44:35,030 --> 00:44:33,040
good uh modal survey and then also on my

1278
00:44:36,790 --> 00:44:35,040
shift we will do the first

1279
00:44:38,630 --> 00:44:36,800
um they're called outbound trajectory

1280
00:44:40,390 --> 00:44:38,640
correction they're correction burns

1281
00:44:41,430 --> 00:44:40,400
they're small burns but the very first

1282
00:44:42,870 --> 00:44:41,440
one we're actually going to go we're

1283
00:44:44,790 --> 00:44:42,880
going to it's going to be the ohms

1284
00:44:46,870 --> 00:44:44,800
checkout um

1285
00:44:48,950 --> 00:44:46,880
burn so we're going to burn that ohm's

1286
00:44:50,630 --> 00:44:48,960
engine for 30 seconds to make sure it's

1287
00:44:51,990 --> 00:44:50,640
good to go for because the first time we

1288
00:44:54,470 --> 00:44:52,000

use it actually is for the outbound

1289
00:44:55,910 --> 00:44:54,480
power flyby and and that's sending us up

1290
00:44:57,109 --> 00:44:55,920
to the distant retrograde orbit and you

1291
00:44:59,190 --> 00:44:57,119
want to make sure it works well so it's

1292
00:45:01,990 --> 00:44:59,200
going to test it there got it so those

1293
00:45:04,309 --> 00:45:02,000
are the primary things on flight day one

1294
00:45:06,630 --> 00:45:04,319
and then after that we do a uh we're

1295
00:45:08,550 --> 00:45:06,640
it's just a series of a couple days as

1296
00:45:10,710 --> 00:45:08,560
we coast up to

1297
00:45:12,870 --> 00:45:10,720
up to the outbound trajectory flyby we

1298
00:45:15,190 --> 00:45:12,880
have a couple trajectory trajectory

1299
00:45:17,030 --> 00:45:15,200
correction maneuvers um

1300
00:45:18,630 --> 00:45:17,040
we want to make sure we when we go by

1301
00:45:21,349 --> 00:45:18,640
the moon which by the way it's going to

1302
00:45:23,510 --> 00:45:21,359
be around 60 miles off the surface of

1303
00:45:26,390 --> 00:45:23,520
the moon close crazy so we got to make

1304
00:45:28,150 --> 00:45:26,400
sure we don't get too close right um

1305
00:45:29,670 --> 00:45:28,160
and then that's what those those

1306
00:45:31,510 --> 00:45:29,680
trajectory correction maneuvers are

1307
00:45:33,670 --> 00:45:31,520
really important uh targeting that

1308
00:45:36,309 --> 00:45:33,680
outbound power flyby and then um we'll

1309
00:45:38,710 --> 00:45:36,319
burn that guy and that'll take us up to

1310
00:45:40,230 --> 00:45:38,720
uh the distant retrograde uh orbit where

1311
00:45:42,230 --> 00:45:40,240
we're doing insertion

1312
00:45:44,790 --> 00:45:42,240
and depending on if we launch in in

1313
00:45:47,030 --> 00:45:44,800

november it's it's uh around 14 days i

1314
00:45:50,069 --> 00:45:47,040
think we're up in the in that orbit it's

1315
00:45:52,309 --> 00:45:50,079
either a half a lap or a lap and a half

1316
00:45:54,230 --> 00:45:52,319
so got it and that's all it depends on

1317
00:45:56,710 --> 00:45:54,240
what time of the year we launch and

1318
00:45:58,630 --> 00:45:56,720
that's all to set up for lighting it at

1319
00:46:00,870 --> 00:45:58,640
splashdown for judd's and the recovery

1320
00:46:03,670 --> 00:46:00,880
team we want it to be lit so that the

1321
00:46:05,750 --> 00:46:03,680
recovery forces can watch the watch the

1322
00:46:07,670 --> 00:46:05,760
capsule come down watch shoots deploy

1323
00:46:09,750 --> 00:46:07,680
just see how it uh how it functions and

1324
00:46:12,589 --> 00:46:09,760
then recover all the piece parts lit

1325
00:46:14,390 --> 00:46:12,599
meaning the sun is shining in the sky

1326
00:46:16,309 --> 00:46:14,400
yeah san diego right off the coast of

1327
00:46:18,390 --> 00:46:16,319
san diego there it is so and that burn

1328
00:46:20,230 --> 00:46:18,400
happens at the moon

1329
00:46:22,470 --> 00:46:20,240
it does pretty much yeah like it's like

1330
00:46:24,390 --> 00:46:22,480
what six or seven days before yeah

1331
00:46:26,870 --> 00:46:24,400
splash down so it starts when we

1332
00:46:29,030 --> 00:46:26,880
actually depart it's drd district

1333
00:46:30,870 --> 00:46:29,040
retrograde departure burn which starts

1334
00:46:33,829 --> 00:46:30,880
heading us back to the moon

1335
00:46:35,109 --> 00:46:33,839
and then ultimately uh you know where

1336
00:46:37,270 --> 00:46:35,119
the the shuttle used to have that

1337
00:46:39,190 --> 00:46:37,280
deorbit burn our dr burns is actually

1338
00:46:41,270 --> 00:46:39,200

happening as we go by the moon

1339
00:46:43,270 --> 00:46:41,280
and john's gonna take that shift so it's

1340
00:46:45,190 --> 00:46:43,280
uh it targets the um but when we leave

1341
00:46:46,550 --> 00:46:45,200
the dro which actually sets up for when

1342
00:46:48,950 --> 00:46:46,560
we're going to actually do that that

1343
00:46:50,630 --> 00:46:48,960
return powered flyby so before we we

1344
00:46:52,470 --> 00:46:50,640
head back to earth and talk about some

1345
00:46:55,030 --> 00:46:52,480
of the things there what are some of the

1346
00:46:57,270 --> 00:46:55,040
checkouts that are happening in this in

1347
00:46:59,829 --> 00:46:57,280
the lunar vicinity

1348
00:47:01,910 --> 00:46:59,839
uh you know actually around the around

1349
00:47:02,790 --> 00:47:01,920
the moon there's we're it's very similar

1350
00:47:04,550 --> 00:47:02,800
to the things we're doing on the way

1351
00:47:07,750 --> 00:47:04,560
there and on the way back the optical

1352
00:47:10,710 --> 00:47:07,760
nav system checkout systems um where we

1353
00:47:12,630 --> 00:47:10,720
have a series of payloads uh like the

1354
00:47:14,790 --> 00:47:12,640
it's called um

1355
00:47:17,030 --> 00:47:14,800
callisto callisto it's a it's a

1356
00:47:19,190 --> 00:47:17,040
interactive where there's a there's oh

1357
00:47:20,710 --> 00:47:19,200
cool yeah it's we're gonna have um

1358
00:47:22,470 --> 00:47:20,720
people come into the control center in a

1359
00:47:25,109 --> 00:47:22,480
special room where they actually will be

1360
00:47:26,790 --> 00:47:25,119
able to talk to a a um

1361
00:47:44,470 --> 00:47:26,800
a

1362
00:47:46,870 --> 00:47:44,480
uh one of the big things when we're in

1363
00:47:49,270 --> 00:47:46,880

in the dro is to look look for that um

1364
00:47:50,829 --> 00:47:49,280
that first moon rise that shot earth

1365
00:47:52,950 --> 00:47:50,839
rise earth

1366
00:47:55,270 --> 00:47:52,960
yeah that's a big one yeah so that that

1367
00:47:57,270 --> 00:47:55,280
is a big one so uh and again it's all

1368
00:47:59,190 --> 00:47:57,280
testing the systems we're doing uh

1369
00:48:01,750 --> 00:47:59,200
different mode operations for the

1370
00:48:03,990 --> 00:48:01,760
systems like the radiators we go to a

1371
00:48:05,589 --> 00:48:04,000
flow control versus speed control which

1372
00:48:07,030 --> 00:48:05,599
is just a different mode of operating it

1373
00:48:09,349 --> 00:48:07,040
just to see how it's gonna how it's

1374
00:48:11,510 --> 00:48:09,359
gonna operate very cool yeah so when we

1375
00:48:12,710 --> 00:48:11,520
get to recovery judd what are some of

1376
00:48:14,630 --> 00:48:12,720
the key things that you're gonna be

1377
00:48:16,309 --> 00:48:14,640
looking for we already we have spoilers

1378
00:48:17,349 --> 00:48:16,319
with the heat shield there's a couple of

1379
00:48:18,870 --> 00:48:17,359
other things that you're gonna be

1380
00:48:21,270 --> 00:48:18,880
looking for what are those key things

1381
00:48:23,190 --> 00:48:21,280
yeah so so once we're way back at the

1382
00:48:24,630 --> 00:48:23,200
moon and we do the the burn to get us

1383
00:48:27,589 --> 00:48:24,640
out you know we're looking for a very

1384
00:48:29,910 --> 00:48:27,599
tight corridor uh to for uh entry

1385
00:48:32,309 --> 00:48:29,920
interface you know um you know it all

1386
00:48:34,150 --> 00:48:32,319
has to do with the geometry and and and

1387
00:48:36,470 --> 00:48:34,160
the speed and everything you know if

1388
00:48:39,270 --> 00:48:36,480

you're you know too shallow you bore

1389
00:48:41,349 --> 00:48:39,280
into the earth too much and you burn up

1390
00:48:44,390 --> 00:48:41,359
the heat shield too much if you're too

1391
00:48:46,790 --> 00:48:44,400
uh if you're if you're too

1392
00:48:48,950 --> 00:48:46,800
too shallow no sorry too shallow then

1393
00:48:51,430 --> 00:48:48,960
you'll skip off if you you go bore in

1394
00:48:53,349 --> 00:48:51,440
too too hard then you you know you you

1395
00:48:55,270 --> 00:48:53,359
have too much heating on the on the

1396
00:48:57,109 --> 00:48:55,280
throne goldilocks

1397
00:48:59,430 --> 00:48:57,119
trying to get right at the right part

1398
00:49:01,510 --> 00:48:59,440
we're also trying to do an objective

1399
00:49:04,390 --> 00:49:01,520
where we get to a point where we do

1400
00:49:06,390 --> 00:49:04,400
what's called a skip entry we we do a we

1401
00:49:07,829 --> 00:49:06,400
we intentionally get at an angle where

1402
00:49:09,589 --> 00:49:07,839
we skip a little bit

1403
00:49:11,750 --> 00:49:09,599
and then come right back in and that's

1404
00:49:14,390 --> 00:49:11,760
in order so we get like a double heating

1405
00:49:16,390 --> 00:49:14,400
profile so that we test the the heat

1406
00:49:18,710 --> 00:49:16,400
shield to make sure um

1407
00:49:21,750 --> 00:49:18,720
if we ever want to do that you know on

1408
00:49:25,270 --> 00:49:21,760
future uh crude flights that we have

1409
00:49:28,069 --> 00:49:25,280
that capability to have a double thermal

1410
00:49:29,990 --> 00:49:28,079
you know uh heat shield objective so

1411
00:49:32,790 --> 00:49:30,000
that it gives us more flexibility in

1412
00:49:34,870 --> 00:49:32,800
future missions to to to have a

1413
00:49:36,470 --> 00:49:34,880

different ei or quarter or ei

1414
00:49:38,630 --> 00:49:36,480
constraints or entry interface

1415
00:49:40,710 --> 00:49:38,640
constraints okay and you're doing that

1416
00:49:42,390 --> 00:49:40,720
purposely for artemis

1417
00:49:44,790 --> 00:49:42,400
just to test it and then you won't do a

1418
00:49:47,670 --> 00:49:44,800
skip entry unless but now you know you

1419
00:49:49,510 --> 00:49:47,680
know we can yeah so maybe if that you

1420
00:49:52,309 --> 00:49:49,520
know if the mission dictates it in the

1421
00:49:53,670 --> 00:49:52,319
future yes we know we know that uh that

1422
00:49:55,190 --> 00:49:53,680
the heat shield can take it and that's

1423
00:49:56,950 --> 00:49:55,200
exactly what we're looking for right

1424
00:49:59,030 --> 00:49:56,960
we're looking to see how does the heat

1425
00:50:01,589 --> 00:49:59,040
shield perform so that we know for

1426
00:50:03,030 --> 00:50:01,599
future missions uh you know how do we

1427
00:50:03,829 --> 00:50:03,040
how do we

1428
00:50:06,150 --> 00:50:03,839
uh

1429
00:50:08,390 --> 00:50:06,160
modify or or create those missions such

1430
00:50:11,670 --> 00:50:08,400
that you know we take full advantage of

1431
00:50:12,630 --> 00:50:11,680
the capability of the of the vehicle uh

1432
00:50:15,190 --> 00:50:12,640
so when

1433
00:50:18,390 --> 00:50:15,200
once we hit entry interface um you know

1434
00:50:19,829 --> 00:50:18,400
we're we're we're pretty much um along

1435
00:50:21,990 --> 00:50:19,839
for the ride it's really quick from

1436
00:50:24,150 --> 00:50:22,000
there it's about 20 minutes

1437
00:50:25,990 --> 00:50:24,160
until we splash down from from entry

1438
00:50:27,750 --> 00:50:26,000

interface obviously we're looking to

1439
00:50:30,790 --> 00:50:27,760
make sure that all of the systems come

1440
00:50:32,549 --> 00:50:30,800
online uh you know we have a barrel

1441
00:50:34,630 --> 00:50:32,559
altimeters that tell us you know what

1442
00:50:37,109 --> 00:50:34,640
the what the altitude is because you

1443
00:50:38,710 --> 00:50:37,119
need to deploy your your your drogue

1444
00:50:41,030 --> 00:50:38,720
shoots and your main shoots at certain

1445
00:50:42,549 --> 00:50:41,040
altitudes and that's heavily reliant on

1446
00:50:44,150 --> 00:50:42,559
what altitude what pressure that the

1447
00:50:45,510 --> 00:50:44,160
atmosphere is at that determines the

1448
00:50:47,670 --> 00:50:45,520
altitude

1449
00:50:49,589 --> 00:50:47,680
and we have uh gps receivers that come

1450
00:50:51,270 --> 00:50:49,599
on that also tell us that not only tells

1451
00:50:53,349 --> 00:50:51,280
us altitude in addition to what the

1452
00:50:55,589 --> 00:50:53,359
barrel altimeters tell us but also tell

1453
00:50:57,910 --> 00:50:55,599
us where we're at and so kind of how how

1454
00:50:59,109 --> 00:50:57,920
do we steer how do we steer ourselves uh

1455
00:51:02,150 --> 00:50:59,119
into the wind

1456
00:51:03,190 --> 00:51:02,160
as we're coming in right and and and so

1457
00:51:04,470 --> 00:51:03,200
so uh

1458
00:51:07,430 --> 00:51:04,480
we're making sure that all of those

1459
00:51:09,829 --> 00:51:07,440
systems come online properly and and are

1460
00:51:12,470 --> 00:51:09,839
able to you know meet the demands of the

1461
00:51:14,790 --> 00:51:12,480
the the splashdown

1462
00:51:17,270 --> 00:51:14,800
that is uh quite a mission there's a lot

1463
00:51:19,750 --> 00:51:17,280

to that um when you're looking at it and

1464
00:51:21,670 --> 00:51:19,760
looking at what there's left to do to to

1465
00:51:23,510 --> 00:51:21,680
build up to this moment what do you guys

1466
00:51:25,990 --> 00:51:23,520
still have to work on from now the time

1467
00:51:27,510 --> 00:51:26,000
that we're recording this to to when we

1468
00:51:29,349 --> 00:51:27,520
actually are ready to go on the launch

1469
00:51:30,390 --> 00:51:29,359
pad for artemis one what's their left to

1470
00:51:33,030 --> 00:51:30,400
do

1471
00:51:34,710 --> 00:51:33,040
probably the most the significant thing

1472
00:51:36,309 --> 00:51:34,720
is to train the team and certify the

1473
00:51:37,910 --> 00:51:36,319
team to be ready to execute the mission

1474
00:51:40,390 --> 00:51:37,920
okay um

1475
00:51:42,470 --> 00:51:40,400
as we as we do that though we're

1476
00:51:43,910 --> 00:51:42,480
we're refining our rules jed talked

1477
00:51:45,829 --> 00:51:43,920
about the flight rules our contract with

1478
00:51:46,630 --> 00:51:45,839
the programs and the enterprise

1479
00:51:48,470 --> 00:51:46,640
um

1480
00:51:50,230 --> 00:51:48,480
we're learning we're learning as as they

1481
00:51:52,309 --> 00:51:50,240
test the vehicle when they're uh they're

1482
00:51:54,390 --> 00:51:52,319
assembling it out at ksc

1483
00:51:56,470 --> 00:51:54,400
then we're and they're they're testing

1484
00:51:58,069 --> 00:51:56,480
it we're learning idiosyncrasies of it

1485
00:52:00,390 --> 00:51:58,079
that may affect our rules on the way

1486
00:52:01,270 --> 00:52:00,400
we're going to operate it so um

1487
00:52:02,790 --> 00:52:01,280
we'll be

1488
00:52:05,109 --> 00:52:02,800

we're training

1489
00:52:07,109 --> 00:52:05,119
certifying the team and we're making

1490
00:52:09,270 --> 00:52:07,119
sure our products are are ready to go

1491
00:52:10,870 --> 00:52:09,280
those are the primary objectives

1492
00:52:11,750 --> 00:52:10,880
yeah and i would say in addition to that

1493
00:52:13,670 --> 00:52:11,760
so

1494
00:52:15,750 --> 00:52:13,680
up to this point um

1495
00:52:17,190 --> 00:52:15,760
the individual teams have trained

1496
00:52:18,950 --> 00:52:17,200
together really well like so for

1497
00:52:21,030 --> 00:52:18,960
instance the flight control team in

1498
00:52:23,270 --> 00:52:21,040
houston we've done a lot of simulations

1499
00:52:25,430 --> 00:52:23,280
and rick talked about those uh together

1500
00:52:27,750 --> 00:52:25,440
just as a houston team

1501
00:52:29,510 --> 00:52:27,760
down at ksc the launch

1502
00:52:31,670 --> 00:52:29,520
you know the launch team has done a lot

1503
00:52:34,870 --> 00:52:31,680
of training events for just that launch

1504
00:52:36,630 --> 00:52:34,880
team you know the the the mission

1505
00:52:38,470 --> 00:52:36,640
evaluation the engineering guys they've

1506
00:52:40,390 --> 00:52:38,480
they've trained individually so what

1507
00:52:42,870 --> 00:52:40,400
we're really focusing on now is making

1508
00:52:45,109 --> 00:52:42,880
sure all of those teams come together

1509
00:52:47,270 --> 00:52:45,119
and function as a cohesive unit right

1510
00:52:49,030 --> 00:52:47,280
you know the the recovery team so they

1511
00:52:51,589 --> 00:52:49,040
know that we're we're all on the same

1512
00:52:54,230 --> 00:52:51,599
page the launch you know team we know so

1513
00:52:56,390 --> 00:52:54,240

so it so it basically becomes

1514
00:52:58,870 --> 00:52:56,400
you know a seamless end-to-end mission

1515
00:53:01,109 --> 00:52:58,880
that starts you know with the folks at

1516
00:53:03,589 --> 00:53:01,119
uh you know at kennedy space center you

1517
00:53:05,270 --> 00:53:03,599
know transitions over to us at johnson

1518
00:53:08,150 --> 00:53:05,280
and then back you know at that

1519
00:53:10,470 --> 00:53:08,160
splashdown in san diego uh to to the

1520
00:53:12,230 --> 00:53:10,480
folks at kennedy and and with the help

1521
00:53:13,270 --> 00:53:12,240
of our our navy friends it all works

1522
00:53:16,230 --> 00:53:13,280
together

1523
00:53:18,069 --> 00:53:16,240
we refer to those as as joint integrated

1524
00:53:19,430 --> 00:53:18,079
simulations and we're also taking

1525
00:53:21,030 --> 00:53:19,440
advantage of a lot of the already the

1526
00:53:22,870 --> 00:53:21,040
things they are already planned down at

1527
00:53:25,829 --> 00:53:22,880
ksc like uh when they do a what just

1528
00:53:27,270 --> 00:53:25,839
rehearsal or a pre-launch sim judd and

1529
00:53:28,630 --> 00:53:27,280
his team will be on console just to

1530
00:53:30,549 --> 00:53:28,640
start continue to build these

1531
00:53:33,270 --> 00:53:30,559
relationships you know in the flight

1532
00:53:35,030 --> 00:53:33,280
environment so it really is very

1533
00:53:37,430 --> 00:53:35,040
important to a successful it's all

1534
00:53:39,349 --> 00:53:37,440
coming up real soon and uh

1535
00:53:41,910 --> 00:53:39,359
sounds like you guys have a lot that you

1536
00:53:43,670 --> 00:53:41,920
need to focus on a lot to do but when it

1537
00:53:45,190 --> 00:53:43,680
comes down to it we're doing a mission

1538
00:53:46,390 --> 00:53:45,200

to the moon around the moon we're going

1539
00:53:47,750 --> 00:53:46,400
to see earthrise we're going to see a

1540
00:53:48,950 --> 00:53:47,760
lot of cool stuff when you look at it

1541
00:53:50,390 --> 00:53:48,960
rick what are you looking forward to

1542
00:53:53,109 --> 00:53:50,400
most

1543
00:53:55,270 --> 00:53:53,119
wow it's it's that's a good question um

1544
00:53:56,790 --> 00:53:55,280
just the whole experience of leaving low

1545
00:53:59,030 --> 00:53:56,800
earth orbit i've been doing this as i

1546
00:54:00,870 --> 00:53:59,040
said 36 years uh

1547
00:54:03,349 --> 00:54:00,880
and you know all of it's been low earth

1548
00:54:05,750 --> 00:54:03,359
orbit until now and uh

1549
00:54:07,430 --> 00:54:05,760
i was mentioning judd that i'm every bit

1550
00:54:08,950 --> 00:54:07,440
as excited about this mission as i was

1551
00:54:10,549 --> 00:54:08,960
the first day i walked in the doors

1552
00:54:11,910 --> 00:54:10,559
coming out of college you know walking

1553
00:54:13,990 --> 00:54:11,920
in the mission control for the first

1554
00:54:15,349 --> 00:54:14,000
time uh it's you know there's a lot of

1555
00:54:17,990 --> 00:54:15,359
responsibilities so i'm gonna be really

1556
00:54:20,870 --> 00:54:18,000
really nervous but yeah um

1557
00:54:22,630 --> 00:54:20,880
but just uh the team is amazing uh that

1558
00:54:25,670 --> 00:54:22,640
we've got so much support from across

1559
00:54:27,829 --> 00:54:25,680
the the globe really uh it's gonna be so

1560
00:54:29,750 --> 00:54:27,839
exciting i just uh yeah it's gonna be

1561
00:54:30,790 --> 00:54:29,760
hard to contain myself very cool judd

1562
00:54:32,630 --> 00:54:30,800
what about you

1563
00:54:35,190 --> 00:54:32,640

i'm really looking forward to splashdown

1564
00:54:37,109 --> 00:54:35,200
right off san diego and it's and it's

1565
00:54:39,190 --> 00:54:37,119
not so much you know that it's the end

1566
00:54:42,150 --> 00:54:39,200
of a mission it's the beginning of a

1567
00:54:44,789 --> 00:54:42,160
campaign right you know it's in is the

1568
00:54:47,270 --> 00:54:44,799
beginning of a campaign of uh you know

1569
00:54:50,069 --> 00:54:47,280
re-engaging that you know pushing the

1570
00:54:52,069 --> 00:54:50,079
boundaries of human exploration to go to

1571
00:54:53,670 --> 00:54:52,079
the to the moon and beyond to mars

1572
00:54:54,950 --> 00:54:53,680
beautiful and we'll end it right there

1573
00:54:56,230 --> 00:54:54,960
gentlemen thank you both so much for

1574
00:54:58,069 --> 00:54:56,240
coming on houston we have a podcast what

1575
00:55:19,430 --> 00:54:58,079
a cool discussion our pleasure thank you