
NASA
Jet Propulsion Laboratory

1
00:00:08,710 --> 00:00:06,470
welcome to nasa's jet propulsion

2
00:00:11,350 --> 00:00:08,720
laboratory in pasadena california i'm

3
00:00:13,509 --> 00:00:11,360
veronica mcgregor we are holding our

4
00:00:16,070 --> 00:00:13,519
final news conference for this week a

5
00:00:17,910 --> 00:00:16,080
week that has seen us have a tremendous

6
00:00:20,390 --> 00:00:17,920
success in landing on mars in the

7
00:00:21,269 --> 00:00:20,400
beginning of the exploration of a new

8
00:00:22,550 --> 00:00:21,279
world

9
00:00:24,630 --> 00:00:22,560
we're going to hear in a little while

10
00:00:26,550 --> 00:00:24,640
from ben city senior software engineer

11
00:00:28,230 --> 00:00:26,560
here at jpl who's going to give us a

12
00:00:30,230 --> 00:00:28,240
preview of what's coming up in the next

13
00:00:31,669 --> 00:00:30,240

few days for the rover but first we're

14
00:00:33,110 --> 00:00:31,679
going to hear from the entry descent and

15
00:00:34,870 --> 00:00:33,120
landing team

16
00:00:36,470 --> 00:00:34,880
they have been pouring over the data

17
00:00:38,869 --> 00:00:36,480
since sunday night and they have some

18
00:00:42,069 --> 00:00:38,879
new details to give us and to begin with

19
00:00:44,709 --> 00:00:42,079
i want to start by introducing the entry

20
00:00:47,430 --> 00:00:44,719
descent and landing phase lead adam

21
00:00:56,470 --> 00:00:47,440
steltzner and his deputy miguel san

22
00:00:59,990 --> 00:00:58,950
thank you veronica

23
00:01:02,150 --> 00:01:00,000
um

24
00:01:04,469 --> 00:01:02,160
we have a talented panel here for you

25
00:01:06,789 --> 00:01:04,479
today and and miguel really and i really

26
00:01:08,149 --> 00:01:06,799
wanted to be the ones to introduce

27
00:01:10,550 --> 00:01:08,159
them to you

28
00:01:13,190 --> 00:01:10,560
uh leading off the rotation from the jet

29
00:01:17,109 --> 00:01:13,200
propulsion laboratory the operations

30
00:01:19,429 --> 00:01:17,119
lead for entry descent landing alan chen

31
00:01:20,789 --> 00:01:19,439
to his left from the johnson space

32
00:01:22,950 --> 00:01:20,799
flight center

33
00:01:24,710 --> 00:01:22,960
in charge of guidance that guided entry

34
00:01:26,469 --> 00:01:24,720
that got us to the

35
00:01:28,950 --> 00:01:26,479
spot on mars

36
00:01:31,350 --> 00:01:28,960
gavin mendec

37
00:01:33,830 --> 00:01:31,360
to his left

38
00:01:36,789 --> 00:01:33,840

again from the jet propulsion laboratory

39
00:01:38,310 --> 00:01:36,799
in the segment owner for parachute

40
00:01:41,670 --> 00:01:38,320
descent

41
00:01:45,350 --> 00:01:41,680
devon kipp followed by

42
00:01:47,830 --> 00:01:45,360
also from the jet propulsion laboratory

43
00:01:49,109 --> 00:01:47,840
in charge of powered flight sort of an

44
00:01:51,510 --> 00:01:49,119
important thing

45
00:01:53,350 --> 00:01:51,520
steve cell

46
00:01:54,870 --> 00:01:53,360
beside him

47
00:01:57,270 --> 00:01:54,880
looking much better than

48
00:02:00,550 --> 00:01:57,280
steve

49
00:02:03,590 --> 00:02:00,560
from the langley research center

50
00:02:04,709 --> 00:02:03,600
trajectory specialist

51
00:02:05,830 --> 00:02:04,719
jody

52
00:02:09,510 --> 00:02:05,840
davis

53
00:02:12,070 --> 00:02:09,520
and last but not least the uh senior

54
00:02:13,190 --> 00:02:12,080
software engineer and flight software

55
00:02:15,270 --> 00:02:13,200
coggi

56
00:02:17,670 --> 00:02:15,280
and my personal idol

57
00:02:21,990 --> 00:02:17,680
ben zichi

58
00:02:25,830 --> 00:02:22,000
now this team here up on the uh on the

59
00:02:29,270 --> 00:02:25,840
stage represents the tip of the iceberg

60
00:02:31,830 --> 00:02:29,280
of a very very talented set of folks

61
00:02:35,350 --> 00:02:31,840
that worked together to make

62
00:02:37,030 --> 00:02:35,360
this day possible and to have a rover on

63
00:02:39,670 --> 00:02:37,040

the surface and some of the rest of the

64
00:02:41,750 --> 00:02:39,680
team are sitting here uh

65
00:02:44,229 --> 00:02:41,760
representing some of the rest of that

66
00:02:47,270 --> 00:02:44,239
iceberg in some

67
00:02:49,190 --> 00:02:47,280
small measure because it's a big iceberg

68
00:02:50,949 --> 00:02:49,200
and i would personally like to give take

69
00:03:02,869 --> 00:02:50,959
this moment to give them a little round

70
00:03:05,830 --> 00:03:04,470
and so now on

71
00:03:07,830 --> 00:03:05,840
to the briefing

72
00:03:09,990 --> 00:03:07,840
gentlemen

73
00:03:12,390 --> 00:03:10,000
um obviously we had a great day uh on

74
00:03:13,990 --> 00:03:12,400
mars on sunday um we just want to set up

75
00:03:15,270 --> 00:03:14,000
the the things you're going to hear from

76
00:03:18,070 --> 00:03:15,280
the rest of our team and what we know

77
00:03:20,149 --> 00:03:18,080
about edl i'll start with uh how we got

78
00:03:22,070 --> 00:03:20,159
there and what the conditions were like

79
00:03:23,670 --> 00:03:22,080
when we got to mars and and where

80
00:03:25,030 --> 00:03:23,680
exactly were and what the atmosphere was

81
00:03:26,550 --> 00:03:25,040
like

82
00:03:28,229 --> 00:03:26,560
we obviously had an incredibly clean

83
00:03:30,390 --> 00:03:28,239
ride from the cruise team we traveled

84
00:03:33,270 --> 00:03:30,400
over 350 million miles on the way to

85
00:03:35,110 --> 00:03:33,280
mars and we missed our entry target by

86
00:03:36,710 --> 00:03:35,120
only about one mile

87
00:03:39,509 --> 00:03:36,720
so a pretty impressive ride by the

88
00:03:41,589 --> 00:03:39,519

cruise team and our thanks to them

89
00:03:43,670 --> 00:03:41,599
over a week out we made a prediction of

90
00:03:46,149 --> 00:03:43,680
where where curiosity would be at the

91
00:03:48,949 --> 00:03:46,159
entry point and gave that to curiosity

92
00:03:50,949 --> 00:03:48,959
um that was we were about uh 1.25

93
00:03:52,630 --> 00:03:50,959
million miles from mars at the time we

94
00:03:55,190 --> 00:03:52,640
turned off to turned out to be off by

95
00:03:56,789 --> 00:03:55,200
only 800 800 feet

96
00:03:58,710 --> 00:03:56,799
so curiosity had a very good idea where

97
00:04:00,390 --> 00:03:58,720
she was at the top of the atmosphere and

98
00:04:01,670 --> 00:04:00,400
that's something that uh that gavin over

99
00:04:03,429 --> 00:04:01,680
here with our entry guidance took

100
00:04:04,229 --> 00:04:03,439
advantage of

101
00:04:06,470 --> 00:04:04,239
um

102
00:04:08,470 --> 00:04:06,480
if you bring up my first figure uh

103
00:04:09,830 --> 00:04:08,480
excuse me the atmosphere

104
00:04:11,990 --> 00:04:09,840
figure if you would

105
00:04:14,550 --> 00:04:12,000
um you'll see that the

106
00:04:16,469 --> 00:04:14,560
atmosphere was very much as we expected

107
00:04:18,789 --> 00:04:16,479
can we switch figures to the atmosphere

108
00:04:19,670 --> 00:04:18,799
figure

109
00:04:21,270 --> 00:04:19,680
thank you

110
00:04:23,270 --> 00:04:21,280
um i don't think we've had a weather

111
00:04:25,189 --> 00:04:23,280
report since the day before we landed

112
00:04:27,670 --> 00:04:25,199
but this is the weather as we knew it on

113
00:04:29,030 --> 00:04:27,680

the day we did land on august 5th

114
00:04:31,110 --> 00:04:29,040
it looks very similar to the days you

115
00:04:33,670 --> 00:04:31,120
saw before uh you know we have clear

116
00:04:36,230 --> 00:04:33,680
skies some water rise clouds nice clear

117
00:04:38,310 --> 00:04:36,240
and cold day just like we liked it just

118
00:04:40,150 --> 00:04:38,320
just like we thought we would see so

119
00:04:41,510 --> 00:04:40,160
there was very few dust events they are

120
00:04:43,270 --> 00:04:41,520
beginning to pick up in the season but

121
00:04:44,870 --> 00:04:43,280
still far away from the crater

122
00:04:47,030 --> 00:04:44,880
we got there before any dust could get

123
00:04:49,510 --> 00:04:47,040
there so that contributed to us having a

124
00:04:51,590 --> 00:04:49,520
very good day

125
00:04:53,510 --> 00:04:51,600
in general edl performance was as

126
00:04:55,350 --> 00:04:53,520
expected with very few exceptions people

127
00:04:58,230 --> 00:04:55,360
will walk through that in some detail

128
00:04:59,990 --> 00:04:58,240
here but we only know that because our

129
00:05:01,430 --> 00:05:00,000
edl communications was so good on the

130
00:05:03,510 --> 00:05:01,440
night of landing everything that you're

131
00:05:05,110 --> 00:05:03,520
going to hear today is based on uh is

132
00:05:06,550 --> 00:05:05,120
primarily based on data that we received

133
00:05:08,150 --> 00:05:06,560
that night

134
00:05:10,710 --> 00:05:08,160
from either from all our different

135
00:05:13,590 --> 00:05:10,720
sources

136
00:05:14,950 --> 00:05:13,600
so we had edl communications from

137
00:05:16,310 --> 00:05:14,960
all three orbiters that were listening

138
00:05:17,590 --> 00:05:16,320

from mars odyssey from mars

139
00:05:18,629 --> 00:05:17,600
reconnaissance orbiter and from mars

140
00:05:20,550 --> 00:05:18,639
express

141
00:05:22,950 --> 00:05:20,560
we also had information sent direct to

142
00:05:25,990 --> 00:05:22,960
earth via the tones that were heard both

143
00:05:27,590 --> 00:05:26,000
at uh canberra and at isa's new norsha

144
00:05:29,670 --> 00:05:27,600
station so both nasa and esa were

145
00:05:31,270 --> 00:05:29,680
listening uh we even listened to some of

146
00:05:33,430 --> 00:05:31,280
the information that was being sent to

147
00:05:35,510 --> 00:05:33,440
the relay orbiters from earth from radio

148
00:05:39,189 --> 00:05:35,520
observatory here on earth so we got all

149
00:05:40,150 --> 00:05:39,199
the data we expected to see

150
00:05:41,590 --> 00:05:40,160
you know there's one more source of

151
00:05:43,590 --> 00:05:41,600
course that will help us do a really

152
00:05:46,150 --> 00:05:43,600
detailed edl reconstruction and that's

153
00:05:48,629 --> 00:05:46,160
the recorded data that's on curiosity

154
00:05:50,710 --> 00:05:48,639
still right now waiting to be sent back

155
00:05:53,029 --> 00:05:50,720
that's should be in total about 100

156
00:05:54,469 --> 00:05:53,039
megabytes worth of data that'll help us

157
00:05:56,150 --> 00:05:54,479
learn everything

158
00:05:57,510 --> 00:05:56,160
that's on the order of 60 iphone

159
00:05:59,029 --> 00:05:57,520
pictures but

160
00:06:01,270 --> 00:05:59,039
that'll help us figure out what was

161
00:06:02,550 --> 00:06:01,280
going on in detail right now all we're

162
00:06:04,710 --> 00:06:02,560
really working from is what we got back

163
00:06:06,710 --> 00:06:04,720

that night which is about one megabyte

164
00:06:07,670 --> 00:06:06,720
or less than less than most iphone

165
00:06:09,110 --> 00:06:07,680
pictures

166
00:06:11,189 --> 00:06:09,120
but it still lets us know a lot about

167
00:06:12,950 --> 00:06:11,199
what was going on

168
00:06:15,909 --> 00:06:12,960
direct to earth we received

169
00:06:17,430 --> 00:06:15,919
we received 67 heartbeat tones and 26

170
00:06:18,710 --> 00:06:17,440
informational tones the fact that there

171
00:06:20,550 --> 00:06:18,720
were so many heartbeat tones tells us

172
00:06:22,070 --> 00:06:20,560
everything was going well the spacecraft

173
00:06:24,710 --> 00:06:22,080
didn't really have any errors to report

174
00:06:25,909 --> 00:06:24,720
and things were going very normally

175
00:06:28,070 --> 00:06:25,919
the last tone we received was heat

176
00:06:29,909 --> 00:06:28,080
shields operation this was completely as

177
00:06:31,590 --> 00:06:29,919
expected we lost signal almost exactly

178
00:06:32,790 --> 00:06:31,600
five minutes after entry

179
00:06:35,670 --> 00:06:32,800
which was within seconds of our

180
00:06:39,029 --> 00:06:35,680
prediction so things went pretty much as

181
00:06:40,950 --> 00:06:39,039
expected for uh for direct earth tones

182
00:06:42,790 --> 00:06:40,960
from mro we actually got more data than

183
00:06:44,629 --> 00:06:42,800
we expected we had coverage for about 19

184
00:06:46,309 --> 00:06:44,639
minutes we actually locked up about

185
00:06:47,670 --> 00:06:46,319
eight minutes before entry about five

186
00:06:49,110 --> 00:06:47,680
minutes early compared to our

187
00:06:50,629 --> 00:06:49,120
predictions

188
00:06:51,749 --> 00:06:50,639

and had coverage through landing plus

189
00:06:53,510 --> 00:06:51,759
six minutes

190
00:06:56,469 --> 00:06:53,520
um as we you know were concerned about

191
00:06:58,550 --> 00:06:56,479
we had a plasma blackout for about uh 43

192
00:07:00,070 --> 00:06:58,560
seconds but the flight software the way

193
00:07:01,749 --> 00:07:00,080
we designed the dl communications we

194
00:07:02,870 --> 00:07:01,759
were prepared for a blackout of 75

195
00:07:04,550 --> 00:07:02,880
seconds

196
00:07:06,710 --> 00:07:04,560
so that actually worked out as well too

197
00:07:08,150 --> 00:07:06,720
and we have data interleaved in there to

198
00:07:09,990 --> 00:07:08,160
tell us what was going on during the

199
00:07:11,749 --> 00:07:10,000
blackout we send some data after the

200
00:07:14,550 --> 00:07:11,759
blackout to tell us what might what was

201
00:07:15,909 --> 00:07:14,560
going on during the blackout

202
00:07:18,390 --> 00:07:15,919
odyssey had coverage for about 12

203
00:07:20,629 --> 00:07:18,400
minutes uh started about two minutes and

204
00:07:22,550 --> 00:07:20,639
19 seconds after entry that was about 20

205
00:07:24,230 --> 00:07:22,560
seconds later than we expected but still

206
00:07:26,870 --> 00:07:24,240
well within our predictions

207
00:07:29,350 --> 00:07:26,880
um you know the total data from uh from

208
00:07:32,070 --> 00:07:29,360
mars odyssey end and mro was about one

209
00:07:33,510 --> 00:07:32,080
megabyte of unique data

210
00:07:34,790 --> 00:07:33,520
so right now we're just uh working with

211
00:07:36,870 --> 00:07:34,800
the subset of the data that's been

212
00:07:38,230 --> 00:07:36,880
relayed soon we'll have in a couple

213
00:07:39,909 --> 00:07:38,240

weeks we'll have all the data coming

214
00:07:42,150 --> 00:07:39,919
back from the rover to tell us exactly

215
00:07:43,909 --> 00:07:42,160
what went on and uh we'll be able to

216
00:07:45,430 --> 00:07:43,919
reconstruct our folder trajectory and

217
00:07:46,870 --> 00:07:45,440
learn anything we can about this edl

218
00:07:48,790 --> 00:07:46,880
system that we might want to push

219
00:07:50,469 --> 00:07:48,800
forward

220
00:07:52,469 --> 00:07:50,479
we have some data that shows the actual

221
00:07:53,749 --> 00:07:52,479
event timing there was some confusion

222
00:07:55,270 --> 00:07:53,759
but i think we've got that all sorted

223
00:07:56,230 --> 00:07:55,280
out now on when the actual events

224
00:07:57,510 --> 00:07:56,240
occurred

225
00:08:00,150 --> 00:07:57,520
so if you look at the figure that we're

226
00:08:02,469 --> 00:08:00,160
showing here we have both uh the actual

227
00:08:05,029 --> 00:08:02,479
time that occurred on mars and the time

228
00:08:07,430 --> 00:08:05,039
uh that we heard about it here on earth

229
00:08:09,270 --> 00:08:07,440
uh for some major events here that folks

230
00:08:10,790 --> 00:08:09,280
will talk about

231
00:08:12,390 --> 00:08:10,800
so as we step through entry ascend

232
00:08:13,510 --> 00:08:12,400
landing that's kind of how this panel is

233
00:08:14,790 --> 00:08:13,520
laid out

234
00:08:16,390 --> 00:08:14,800
to the side here

235
00:08:18,550 --> 00:08:16,400
we'll first start with gavin talking

236
00:08:20,150 --> 00:08:18,560
about the entry guidance and how well we

237
00:08:22,309 --> 00:08:20,160
did there okay

238
00:08:24,150 --> 00:08:22,319

thank you alan so the the entry phase

239
00:08:27,270 --> 00:08:24,160
you know we enter the atmosphere about

240
00:08:29,589 --> 00:08:27,280
24 times the speed of sound mach 24

241
00:08:31,749 --> 00:08:29,599
and we plunged deep in the atmosphere

242
00:08:33,430 --> 00:08:31,759
and then using uh the techniques that

243
00:08:35,589 --> 00:08:33,440
curiosity had compared to previously

244
00:08:37,029 --> 00:08:35,599
recent landers flew parallel to the

245
00:08:38,949 --> 00:08:37,039
ground and i'm going to talk a little

246
00:08:41,029 --> 00:08:38,959
bit more in detail about that

247
00:08:42,550 --> 00:08:41,039
and we flew entry all the way down to

248
00:08:44,389 --> 00:08:42,560
just under mach 2.

249
00:08:45,829 --> 00:08:44,399
uh lasted about three and a half minutes

250
00:08:47,829 --> 00:08:45,839
very close to the expected time the

251
00:08:49,670 --> 00:08:47,839
duration we were we were thinking we'd

252
00:08:51,670 --> 00:08:49,680
see we pulled a little bit over 11 earth

253
00:08:53,750 --> 00:08:51,680
gs so if you were a human riding on

254
00:08:54,470 --> 00:08:53,760
board it'd be a little bit of a rough

255
00:08:55,829 --> 00:08:54,480
ride

256
00:08:57,190 --> 00:08:55,839
but fortunately curiosity is made of

257
00:09:00,150 --> 00:08:57,200
some pretty sturdy stuff and she handled

258
00:09:03,910 --> 00:09:02,630
so i want to provide some context for uh

259
00:09:05,430 --> 00:09:03,920
how this mission did compared to

260
00:09:07,509 --> 00:09:05,440
previous missions so if we could go to

261
00:09:09,990 --> 00:09:07,519
the the landing lips graphic what we're

262
00:09:11,509 --> 00:09:10,000
looking at here is a topography map of

263
00:09:13,190 --> 00:09:11,519

gale crater you can see mount sharp

264
00:09:14,949 --> 00:09:13,200
right there in the middle of the crater

265
00:09:17,269 --> 00:09:14,959
you can see our curiosity ellipse the

266
00:09:20,150 --> 00:09:17,279
smallest lips right there on the just

267
00:09:21,750 --> 00:09:20,160
north of the slopes of mount sharp

268
00:09:24,150 --> 00:09:21,760
but let's back up a little bit i mean in

269
00:09:25,509 --> 00:09:24,160
the 1970s we had the two viking landers

270
00:09:26,710 --> 00:09:25,519
they landed in different parts of mars

271
00:09:28,550 --> 00:09:26,720
not here

272
00:09:30,230 --> 00:09:28,560
but we got their landing ellipses and

273
00:09:32,150 --> 00:09:30,240
certainly of where they would land

274
00:09:33,829 --> 00:09:32,160
um sort of provided here for scale and

275
00:09:35,110 --> 00:09:33,839
you can see it's a very large area i

276
00:09:36,710 --> 00:09:35,120
mean part that was due to the atmosphere

277
00:09:38,389 --> 00:09:36,720
uncertainties was the first time we

278
00:09:40,470 --> 00:09:38,399
landed on mars we knew very little about

279
00:09:42,310 --> 00:09:40,480
what the atmosphere would really do

280
00:09:44,389 --> 00:09:42,320
and the landers did quite well they both

281
00:09:45,829 --> 00:09:44,399
landed successfully then it was uh

282
00:09:47,030 --> 00:09:45,839
unfortunately several decades before we

283
00:09:49,350 --> 00:09:47,040
returned to mars with the lander and

284
00:09:51,350 --> 00:09:49,360
then pathfinder the river that could

285
00:09:53,350 --> 00:09:51,360
landed

286
00:09:54,870 --> 00:09:53,360
with a smaller ellipse but it didn't use

287
00:09:57,590 --> 00:09:54,880
a lift and entry came in more like a

288
00:09:59,030 --> 00:09:57,600

cannonball spinning cannonball

289
00:10:00,790 --> 00:09:59,040
but over the years with spirit and

290
00:10:02,710 --> 00:10:00,800
opportunity in phoenix we're able to

291
00:10:04,710 --> 00:10:02,720
reduce those landing areas even better

292
00:10:07,030 --> 00:10:04,720
and a lot of that's due to the hard work

293
00:10:08,790 --> 00:10:07,040
of our interplanetary navigation team to

294
00:10:11,030 --> 00:10:08,800
further pinpoint the entry point in the

295
00:10:12,949 --> 00:10:11,040
atmosphere so what was then dominating a

296
00:10:14,230 --> 00:10:12,959
lot of the dispersion was what the

297
00:10:15,430 --> 00:10:14,240
atmosphere did and how the vehicle

298
00:10:17,030 --> 00:10:15,440
actually flew

299
00:10:19,030 --> 00:10:17,040
and so what curiosity did here is we

300
00:10:21,190 --> 00:10:19,040
basically built on top of all those

301
00:10:22,870 --> 00:10:21,200
improvements to make that even even

302
00:10:24,150 --> 00:10:22,880
better

303
00:10:26,790 --> 00:10:24,160
so the

304
00:10:28,069 --> 00:10:26,800
the way we fly our entry i think adam's

305
00:10:30,710 --> 00:10:28,079
mentioned over the last few days the

306
00:10:32,310 --> 00:10:30,720
tungsten ballast basically six segments

307
00:10:34,310 --> 00:10:32,320
right here and what they do is they

308
00:10:36,870 --> 00:10:34,320
basically trim the vehicle so when we're

309
00:10:39,910 --> 00:10:36,880
hypersonic speed we we have a little bit

310
00:10:42,230 --> 00:10:39,920
of lift basically we we glide slightly

311
00:10:43,670 --> 00:10:42,240
in the direction that we're leaning and

312
00:10:44,550 --> 00:10:43,680
very slowly but when you're going mach

313
00:10:46,230 --> 00:10:44,560

314
00:10:47,350 --> 00:10:46,240
that's more than enough speed for for

315
00:10:52,230 --> 00:10:47,360
what we need

316
00:10:54,870 --> 00:10:53,590
i guess before i get into that let me

317
00:10:56,150 --> 00:10:54,880
just explain

318
00:10:57,509 --> 00:10:56,160
we marked the star right there on our

319
00:10:58,870 --> 00:10:57,519
landing ellipse

320
00:11:00,389 --> 00:10:58,880
it's it's a little bit close to center

321
00:11:02,630 --> 00:11:00,399
it's about one and a half miles

322
00:11:04,069 --> 00:11:02,640
downrange and i want to explain what we

323
00:11:05,990 --> 00:11:04,079
know today why we weren't right in the

324
00:11:07,910 --> 00:11:06,000
middle like we wanted to be but hey

325
00:11:10,470 --> 00:11:07,920
we're still happy where we landed

326
00:11:11,910 --> 00:11:10,480
the one half miles comes to the way we

327
00:11:13,670 --> 00:11:11,920
flew so

328
00:11:15,110 --> 00:11:13,680
when we enter the atmosphere

329
00:11:16,150 --> 00:11:15,120
we've got this trim angle attack as i

330
00:11:18,150 --> 00:11:16,160
mentioned

331
00:11:19,509 --> 00:11:18,160
uh so imagine my hand is the heat shield

332
00:11:22,470 --> 00:11:19,519
right here and so we're flying in this

333
00:11:23,750 --> 00:11:22,480
direction so as we're you know leaning

334
00:11:25,590 --> 00:11:23,760
we'll basically turn the direction that

335
00:11:27,350 --> 00:11:25,600
we're leaning very slowly

336
00:11:28,550 --> 00:11:27,360
and what that

337
00:11:30,310 --> 00:11:28,560
what we're doing during that period is

338
00:11:31,990 --> 00:11:30,320

we're looking how far away to the target

339
00:11:33,990 --> 00:11:32,000
we're going to fly past it are we going

340
00:11:35,350 --> 00:11:34,000
to fly short of it

341
00:11:37,590 --> 00:11:35,360
we respond to that if we think we're

342
00:11:38,870 --> 00:11:37,600
going to fly past it oh i need to get a

343
00:11:40,710 --> 00:11:38,880
little bit deeper in the atmosphere so i

344
00:11:43,670 --> 00:11:40,720
don't fly past it so a little bit more

345
00:11:45,350 --> 00:11:43,680
lift down but while i'm doing that i'm

346
00:11:46,630 --> 00:11:45,360
also turning a little bit to the side

347
00:11:47,910 --> 00:11:46,640
but i still want to go back to the

348
00:11:50,230 --> 00:11:47,920
target and so we have what we call these

349
00:11:51,190 --> 00:11:50,240
bank reversals which basically rotate us

350
00:11:52,790 --> 00:11:51,200
over

351
00:11:54,150 --> 00:11:52,800
and during curiosity's entry we had

352
00:11:55,910 --> 00:11:54,160
three bank reversals the number that we

353
00:11:57,190 --> 00:11:55,920
expected but what's interesting about

354
00:12:00,069 --> 00:11:57,200
curiosity is that that third bank

355
00:12:01,670 --> 00:12:00,079
reversal uh was right at the end of

356
00:12:03,430 --> 00:12:01,680
range control where we're controlling

357
00:12:05,190 --> 00:12:03,440
our distance from so we had our third

358
00:12:07,430 --> 00:12:05,200
reversal

359
00:12:09,110 --> 00:12:07,440
and then we had it for a few seconds but

360
00:12:10,710 --> 00:12:09,120
during that period of time we climbed a

361
00:12:11,910 --> 00:12:10,720
little bit in the atmosphere

362
00:12:13,110 --> 00:12:11,920
we didn't have a lot of time after the

363
00:12:14,790 --> 00:12:13,120

reversal before we said you know we're

364
00:12:16,069 --> 00:12:14,800
done with range control now we're going

365
00:12:17,269 --> 00:12:16,079
to start aiming towards the target and

366
00:12:19,190 --> 00:12:17,279
so at the end of range control we

367
00:12:20,710 --> 00:12:19,200
already had close to a mile of air

368
00:12:22,629 --> 00:12:20,720
already which is you know well within

369
00:12:24,310 --> 00:12:22,639
the dispersions that's basically some of

370
00:12:26,310 --> 00:12:24,320
the setup that we're seeing to explain

371
00:12:28,389 --> 00:12:26,320
part of our missed distance why it was

372
00:12:29,430 --> 00:12:28,399
closer to two mile and a half there's

373
00:12:31,190 --> 00:12:29,440
some other things that could have

374
00:12:32,389 --> 00:12:31,200
contributed to that we're sensitive to

375
00:12:34,230 --> 00:12:32,399
tailwinds as we've seen our computer

376
00:12:36,230 --> 00:12:34,240
simulations and over the next several

377
00:12:37,990 --> 00:12:36,240
weeks and months we'll be looking at

378
00:12:39,430 --> 00:12:38,000
that to see how much the tailwinds did

379
00:12:46,550 --> 00:12:39,440
as well

380
00:12:51,509 --> 00:12:48,069
i would be remiss if i didn't mention

381
00:12:56,150 --> 00:12:53,430
as adam mentioned i'm from johnson space

382
00:12:59,030 --> 00:12:56,160
center uh we've done guided entry there

383
00:13:00,389 --> 00:12:59,040
since the 60s gemini apollo shuttle uh

384
00:13:02,629 --> 00:13:00,399
it's very important coming back from the

385
00:13:03,910 --> 00:13:02,639
moon that you you land the crew and the

386
00:13:05,509 --> 00:13:03,920
payload

387
00:13:06,389 --> 00:13:05,519
down and get to them as quickly as you

388
00:13:07,750 --> 00:13:06,399

can

389
00:13:09,750 --> 00:13:07,760
and so

390
00:13:11,750 --> 00:13:09,760
when msl started actually over 10 years

391
00:13:12,949 --> 00:13:11,760
ago we were uh

392
00:13:14,550 --> 00:13:12,959
we were trying to improve the line of

393
00:13:16,150 --> 00:13:14,560
ellipse and and guidance seemed like the

394
00:13:18,629 --> 00:13:16,160
right thing to do and i'm glad to say it

395
00:13:20,389 --> 00:13:18,639
worked really well

396
00:13:21,670 --> 00:13:20,399
the the the

397
00:13:22,870 --> 00:13:21,680
predictions errors we're seeing during

398
00:13:24,389 --> 00:13:22,880
guidance they looked very close to what

399
00:13:25,590 --> 00:13:24,399
we were expecting um i've been trying to

400
00:13:27,110 --> 00:13:25,600
find something interesting to talk about

401
00:13:28,230 --> 00:13:27,120
besides our slight miss distance and

402
00:13:29,590 --> 00:13:28,240
unfortunately we haven't found anything

403
00:13:31,829 --> 00:13:29,600
yet

404
00:13:33,030 --> 00:13:31,839
so um but that really goes i think a lot

405
00:13:34,710 --> 00:13:33,040
of credit to the aerodynamics team at

406
00:13:36,629 --> 00:13:34,720
langley the atmosphere teams here at

407
00:13:38,069 --> 00:13:36,639
some of these universities and jpl they

408
00:13:39,910 --> 00:13:38,079
think they did a great job

409
00:13:42,470 --> 00:13:39,920
uh helping us characterize how we're

410
00:13:43,590 --> 00:13:42,480
gonna fly and it looked like um we did

411
00:13:45,430 --> 00:13:43,600
well

412
00:13:47,350 --> 00:13:45,440
so uh at the end of the entry guidance

413
00:13:50,790 --> 00:13:47,360

phase uh we're you know approaching the

414
00:13:52,069 --> 00:13:50,800
target ellipse we then do a rotation

415
00:13:54,389 --> 00:13:52,079
because we want to get rid of this entry

416
00:13:56,150 --> 00:13:54,399
ballast right before pair should deploy

417
00:13:58,069 --> 00:13:56,160
and uh with that i'll hand it over to

418
00:13:59,189 --> 00:13:58,079
devin kipp to talk about that thanks

419
00:14:00,870 --> 00:13:59,199
kevin

420
00:14:03,829 --> 00:14:00,880
uh so what i'm going to share with

421
00:14:05,189 --> 00:14:03,839
everybody today is a a brief sampling of

422
00:14:07,350 --> 00:14:05,199
of what we already know about the

423
00:14:09,430 --> 00:14:07,360
parachute descent segment and how well

424
00:14:11,269 --> 00:14:09,440
this piece of hardware performed on the

425
00:14:13,670 --> 00:14:11,279
way down

426
00:14:15,030 --> 00:14:13,680
we only have some cursory ideas of how

427
00:14:17,269 --> 00:14:15,040
well it performed until we get a

428
00:14:19,110 --> 00:14:17,279
detailed trajectory reconstruction and

429
00:14:21,670 --> 00:14:19,120
atmospheric construction

430
00:14:23,750 --> 00:14:21,680
we can only infer things

431
00:14:26,389 --> 00:14:23,760
but this is an incredibly important

432
00:14:28,069 --> 00:14:26,399
piece of data to get because we don't

433
00:14:31,030 --> 00:14:28,079
have a lot of experience flying

434
00:14:33,910 --> 00:14:31,040
parachutes in the martian atmosphere

435
00:14:35,350 --> 00:14:33,920
we've done it six times before now seven

436
00:14:37,430 --> 00:14:35,360
and we've only done it at earth a few

437
00:14:39,590 --> 00:14:37,440
times as well so when you've only done

438
00:14:41,590 --> 00:14:39,600

something 10 times or so

439
00:14:44,870 --> 00:14:41,600
the 11th time is a lot of extra data and

440
00:14:47,590 --> 00:14:44,880
it's it's really exciting to to see that

441
00:14:49,910 --> 00:14:47,600
just as a flight test of a parachute

442
00:14:51,430 --> 00:14:49,920
so let's bring up the first image

443
00:14:54,310 --> 00:14:51,440
everybody's seen this

444
00:14:55,829 --> 00:14:54,320
uh as of about 3 a.m monday morning this

445
00:14:58,949 --> 00:14:55,839
was the most beautiful picture i had

446
00:15:00,470 --> 00:14:58,959
ever seen in my life and you can tell a

447
00:15:01,670 --> 00:15:00,480
whole lot about how the parachute

448
00:15:02,949 --> 00:15:01,680
performed just by looking at this

449
00:15:05,269 --> 00:15:02,959
parachute

450
00:15:06,870 --> 00:15:05,279
you can see that it's got its inflated

451
00:15:08,550 --> 00:15:06,880
shape perfectly

452
00:15:10,470 --> 00:15:08,560
you can see the dark area at the top of

453
00:15:12,150 --> 00:15:10,480
the parachute which is the vent that

454
00:15:13,350 --> 00:15:12,160
lets some air escape through the top of

455
00:15:14,870 --> 00:15:13,360
the parachute

456
00:15:17,030 --> 00:15:14,880
the shape here is exactly what we

457
00:15:19,189 --> 00:15:17,040
expected to see and you don't see any

458
00:15:21,750 --> 00:15:19,199
any apparent damage there's there's no

459
00:15:24,710 --> 00:15:21,760
holes visible there's no tearing visible

460
00:15:26,790 --> 00:15:24,720
and this picture was taken well into the

461
00:15:29,189 --> 00:15:26,800
parachute descent segment probably 40 to

462
00:15:30,389 --> 00:15:29,199
50 seconds after parachute deployment

463
00:15:32,470 --> 00:15:30,399

and

464
00:15:34,629 --> 00:15:32,480
we see a perfectly functioning parachute

465
00:15:36,790 --> 00:15:34,639
that looks exactly like we thought so

466
00:15:38,629 --> 00:15:36,800
that's great news

467
00:15:41,030 --> 00:15:38,639
more than that we can get some

468
00:15:43,590 --> 00:15:41,040
information by looking at the event

469
00:15:45,670 --> 00:15:43,600
times when did things happen compared to

470
00:15:49,030 --> 00:15:45,680
when we expected things to happen

471
00:15:51,590 --> 00:15:49,040
the parachute deployed about 259 seconds

472
00:15:55,670 --> 00:15:51,600
after entry compared to our predict of

473
00:15:57,030 --> 00:15:55,680
between 241 and 263 seconds so we're

474
00:15:58,550 --> 00:15:57,040
right in that sweet spot where we

475
00:16:00,629 --> 00:15:58,560
thought we would be

476
00:16:02,629 --> 00:16:00,639
perhaps a little bit later than the

477
00:16:04,230 --> 00:16:02,639
center which is consistent with having

478
00:16:06,629 --> 00:16:04,240
maybe a little less drag than we

479
00:16:08,949 --> 00:16:06,639
expected during the entry phase but from

480
00:16:10,710 --> 00:16:08,959
this we can conclude that the parachute

481
00:16:12,629 --> 00:16:10,720
opened in the conditions we thought it

482
00:16:15,030 --> 00:16:12,639
would open and that we had tested it to

483
00:16:17,189 --> 00:16:15,040
open it so the right mach number regime

484
00:16:19,110 --> 00:16:17,199
the right dynamic pressure regime and

485
00:16:22,069 --> 00:16:19,120
therefore the right loading on the

486
00:16:24,150 --> 00:16:22,079
parachute during the inflation event the

487
00:16:25,910 --> 00:16:24,160
second event time we can look at is when

488
00:16:28,150 --> 00:16:25,920

did the heat shield deploy

489
00:16:30,710 --> 00:16:28,160
the heat shield deploys based on a

490
00:16:32,310 --> 00:16:30,720
sensed velocity so after you you open

491
00:16:35,749 --> 00:16:32,320
this parachute you very quickly

492
00:16:39,030 --> 00:16:35,759
decelerate from mach 1.7 or so

493
00:16:41,509 --> 00:16:39,040
subsonically down to about mach 0.7

494
00:16:43,590 --> 00:16:41,519
and that took 20 seconds for the

495
00:16:46,150 --> 00:16:43,600
parachute to slow you down that much

496
00:16:48,629 --> 00:16:46,160
compared to our predict of between 16

497
00:16:50,870 --> 00:16:48,639
and 26 seconds so again right in the

498
00:16:52,949 --> 00:16:50,880
sweet spot of what we predicted and that

499
00:16:54,870 --> 00:16:52,959
tells us that the supersonic drag of

500
00:16:57,350 --> 00:16:54,880
this parachute was again

501
00:16:59,030 --> 00:16:57,360
very nominal what we expected to see it

502
00:17:01,030 --> 00:16:59,040
performed beautifully

503
00:17:03,030 --> 00:17:01,040
and then the third time point you can

504
00:17:06,069 --> 00:17:03,040
look at is is when backshell separation

505
00:17:08,789 --> 00:17:06,079
happened and that was about 95 seconds

506
00:17:10,789 --> 00:17:08,799
after heat shield separation again right

507
00:17:13,429 --> 00:17:10,799
in line with what we expected

508
00:17:16,549 --> 00:17:13,439
here we had a very large dispersion on

509
00:17:17,750 --> 00:17:16,559
what we expected anywhere from 60 to 150

510
00:17:19,990 --> 00:17:17,760
seconds that we could have been

511
00:17:22,390 --> 00:17:20,000
descending slowly on that parachute

512
00:17:24,390 --> 00:17:22,400
that's mostly due to not knowing what

513
00:17:27,110 --> 00:17:24,400

altitude precisely the parachute was

514
00:17:28,870 --> 00:17:27,120
going to deploy at and also not knowing

515
00:17:30,789 --> 00:17:28,880
so well the subsonic drag that the

516
00:17:31,990 --> 00:17:30,799
parachute was going to provide

517
00:17:34,310 --> 00:17:32,000
so the fact that we're right in the

518
00:17:36,549 --> 00:17:34,320
middle of that time window suggests not

519
00:17:38,310 --> 00:17:36,559
only the parachute behaved perfectly

520
00:17:40,310 --> 00:17:38,320
but also that the parachute deploy

521
00:17:42,230 --> 00:17:40,320
altitude was fairly nominal and almost

522
00:17:44,070 --> 00:17:42,240
precisely what we expected

523
00:17:45,430 --> 00:17:44,080
again all of these are implications we

524
00:17:47,669 --> 00:17:45,440
don't know these things for sure but

525
00:17:51,110 --> 00:17:47,679
based on the limited data we have

526
00:17:54,310 --> 00:17:52,470
the second

527
00:17:55,350 --> 00:17:54,320
thing i want to discuss with you is what

528
00:17:58,150 --> 00:17:55,360
we call

529
00:18:00,390 --> 00:17:58,160
wrist mode it's the behavior of the

530
00:18:02,630 --> 00:18:00,400
capsule underneath the parachute

531
00:18:03,909 --> 00:18:02,640
as the capsule is suspended down below

532
00:18:05,350 --> 00:18:03,919
the parachute

533
00:18:06,630 --> 00:18:05,360
it's not going to be perfectly still

534
00:18:08,549 --> 00:18:06,640
it's going to wobble some and that's

535
00:18:11,990 --> 00:18:08,559
what we call the wrist mode as the the

536
00:18:13,750 --> 00:18:12,000
capsule oscillates under the parachute

537
00:18:15,430 --> 00:18:13,760
there's some dynamics going on that we

538
00:18:16,710 --> 00:18:15,440

want to keep very slight you don't you

539
00:18:17,830 --> 00:18:16,720
don't want the capsule going all over

540
00:18:20,549 --> 00:18:17,840
the place

541
00:18:22,950 --> 00:18:20,559
for a variety of reasons one is the

542
00:18:25,350 --> 00:18:22,960
separation events are designed to have

543
00:18:27,270 --> 00:18:25,360
fairly benign motions when you separate

544
00:18:29,029 --> 00:18:27,280
that heat shield for it to separate

545
00:18:30,630 --> 00:18:29,039
cleanly and not re-contact you don't

546
00:18:33,830 --> 00:18:30,640
want the capsule dancing all over the

547
00:18:35,029 --> 00:18:33,840
place same thing at backshell separation

548
00:18:36,630 --> 00:18:35,039
the other thing though is we have these

549
00:18:38,150 --> 00:18:36,640
radar beams that are trying to measure

550
00:18:40,549 --> 00:18:38,160
their altitude and velocity of the

551
00:18:41,990 --> 00:18:40,559
spacecraft relative to the ground and if

552
00:18:44,070 --> 00:18:42,000
the capsule is dancing all over the

553
00:18:45,669 --> 00:18:44,080
place uh those radar beams might be

554
00:18:47,430 --> 00:18:45,679
looking far far away from the landing

555
00:18:49,190 --> 00:18:47,440
location and measuring the altitude of

556
00:18:50,549 --> 00:18:49,200
some terrain feature that

557
00:18:52,630 --> 00:18:50,559
that's far away that we don't really

558
00:18:54,230 --> 00:18:52,640
care about uh so if you can bring up the

559
00:18:56,390 --> 00:18:54,240
movie

560
00:18:58,549 --> 00:18:56,400
uh this is the the thumbnail version of

561
00:19:00,150 --> 00:18:58,559
the marty movie and you see the camera

562
00:19:02,070 --> 00:19:00,160
dancing around a little bit and this is

563
00:19:04,150 --> 00:19:02,080

this is good evidence of of some wrist

564
00:19:07,029 --> 00:19:04,160
mode happening as the camera field of

565
00:19:08,870 --> 00:19:07,039
view is changing uh what we know both

566
00:19:10,950 --> 00:19:08,880
from the the real-time data products

567
00:19:13,190 --> 00:19:10,960
from our inertial measurement unit and

568
00:19:15,669 --> 00:19:13,200
from this image is that the wrist mode

569
00:19:18,390 --> 00:19:15,679
we saw was very benign and consistent

570
00:19:19,909 --> 00:19:18,400
with what we would have expected

571
00:19:22,710 --> 00:19:19,919
wrist mode is something that that caused

572
00:19:25,110 --> 00:19:22,720
some concern for us on msl because

573
00:19:26,150 --> 00:19:25,120
during the mars exploration rover

574
00:19:28,470 --> 00:19:26,160
entries

575
00:19:30,549 --> 00:19:28,480
uh we got surprised a little bit and we

576
00:19:31,830 --> 00:19:30,559
saw some risk mode behavior

577
00:19:33,190 --> 00:19:31,840
for mer

578
00:19:35,510 --> 00:19:33,200
that was a little bit higher than we

579
00:19:37,669 --> 00:19:35,520
expected and we couldn't really explain

580
00:19:40,630 --> 00:19:37,679
at the time that the physics that went

581
00:19:42,310 --> 00:19:40,640
into that so one of the major focuses

582
00:19:44,789 --> 00:19:42,320
for the mars science laboratory was to

583
00:19:46,230 --> 00:19:44,799
figure out how to model this better how

584
00:19:48,710 --> 00:19:46,240
to better understand the physics of

585
00:19:50,950 --> 00:19:48,720
wrist mode and the fact that the

586
00:19:52,549 --> 00:19:50,960
observed wrist mode aligns very well

587
00:19:54,150 --> 00:19:52,559
with our predicts

588
00:19:56,710 --> 00:19:54,160

gives us some confidence that we may

589
00:19:58,150 --> 00:19:56,720
have have conquered that problem

590
00:20:01,270 --> 00:19:58,160
one interesting thing you'll see in this

591
00:20:03,669 --> 00:20:01,280
video is is the ground is is spinning

592
00:20:06,230 --> 00:20:03,679
and that's consistent with the capsule

593
00:20:08,870 --> 00:20:06,240
rotating underneath the parachute at

594
00:20:10,789 --> 00:20:08,880
between one and two degrees per second

595
00:20:11,669 --> 00:20:10,799
during the 90 seconds we're descending

596
00:20:13,830 --> 00:20:11,679
here

597
00:20:16,150 --> 00:20:13,840
we almost do a complete revolution

598
00:20:17,909 --> 00:20:16,160
underneath the parachute and again

599
00:20:19,830 --> 00:20:17,919
that's consistent with our predicts we

600
00:20:22,230 --> 00:20:19,840
thought maybe up to three degrees per

601
00:20:24,630 --> 00:20:22,240
second of rotation and we're down at one

602
00:20:25,990 --> 00:20:24,640
degree per second

603
00:20:27,909 --> 00:20:26,000
so

604
00:20:29,270 --> 00:20:27,919
not a lot of exciting things happen

605
00:20:31,430 --> 00:20:29,280
because everything was right down the

606
00:20:34,230 --> 00:20:31,440
pipe of what we expected

607
00:20:35,750 --> 00:20:34,240
but that's how we want it

608
00:20:37,430 --> 00:20:35,760
one other thing i want to point out if

609
00:20:39,029 --> 00:20:37,440
you can bring up the third image and

610
00:20:42,070 --> 00:20:39,039
this is just sort of

611
00:20:44,710 --> 00:20:42,080
nice because it's it's it's verification

612
00:20:47,430 --> 00:20:44,720
of an edl requirement we have countless

613
00:20:50,789 --> 00:20:47,440

edl requirements that we have to verify

614
00:20:53,190 --> 00:20:50,799
and this image fortuitously is almost

615
00:20:54,470 --> 00:20:53,200
exactly three seconds after heat shield

616
00:20:57,590 --> 00:20:54,480
separation

617
00:21:00,630 --> 00:20:57,600
and the heat sealed is about 15 meters

618
00:21:02,549 --> 00:21:00,640
away from the back shell and this is an

619
00:21:05,029 --> 00:21:02,559
important number because until the heat

620
00:21:07,590 --> 00:21:05,039
shield is 15 meters away we're a little

621
00:21:09,430 --> 00:21:07,600
bit nervous about the radar because it's

622
00:21:11,110 --> 00:21:09,440
possible that more than one radar beam

623
00:21:13,430 --> 00:21:11,120
can actually see the heat shield during

624
00:21:15,510 --> 00:21:13,440
those first 15 meters of motion

625
00:21:17,270 --> 00:21:15,520
and if they do they'll get a measurement

626
00:21:19,990 --> 00:21:17,280
of a very close altitude that will be

627
00:21:21,110 --> 00:21:20,000
rejected it won't cause any hazards but

628
00:21:22,789 --> 00:21:21,120
we want we want to get the heat shield

629
00:21:23,590 --> 00:21:22,799
more than 15 meters away as quick as we

630
00:21:25,830 --> 00:21:23,600
can

631
00:21:27,110 --> 00:21:25,840
and our requirement was 15 meters in

632
00:21:29,029 --> 00:21:27,120
five seconds

633
00:21:31,190 --> 00:21:29,039
and this picture tells us we got 15

634
00:21:33,430 --> 00:21:31,200
meters in three seconds

635
00:21:36,710 --> 00:21:33,440
so that's one verification that we can

636
00:21:38,950 --> 00:21:36,720
check we met that requirement

637
00:21:40,549 --> 00:21:38,960
so with that i'll let steve talk about

638
00:21:41,669 --> 00:21:40,559

power descent

639
00:21:43,590 --> 00:21:41,679
thanks devin

640
00:21:45,830 --> 00:21:43,600
so just really quickly i want to go

641
00:21:48,789 --> 00:21:45,840
through what power what happens during

642
00:21:51,190 --> 00:21:48,799
uh power descent and uh we start off by

643
00:21:53,430 --> 00:21:51,200
we're on the back shell the rover and

644
00:21:55,830 --> 00:21:53,440
the descent stage are inside the the

645
00:21:58,710 --> 00:21:55,840
back shell we get about 1.6 kilometers

646
00:22:00,390 --> 00:21:58,720
or one mile altitude we drop and free

647
00:22:02,549 --> 00:22:00,400
fall out of the back shelf for one

648
00:22:05,510 --> 00:22:02,559
second and then we light the engines

649
00:22:07,110 --> 00:22:05,520
and divert to the side so we don't run

650
00:22:09,510 --> 00:22:07,120
into the parachute that's still coming

651
00:22:11,830 --> 00:22:09,520
down behind us vertical flight all the

652
00:22:13,190 --> 00:22:11,840
way to the ground

653
00:22:14,870 --> 00:22:13,200
so i want to

654
00:22:17,110 --> 00:22:14,880
bring up basically the rest of the video

655
00:22:20,230 --> 00:22:17,120
that devin first started if we can go

656
00:22:22,230 --> 00:22:20,240
ahead and start that this is uh 3.88

657
00:22:24,549 --> 00:22:22,240
frames a second you can see we're

658
00:22:26,470 --> 00:22:24,559
starting out here with some wrist mode

659
00:22:27,990 --> 00:22:26,480
dynamics that devin talked about you

660
00:22:29,990 --> 00:22:28,000
back and forth and then you'll see it

661
00:22:32,230 --> 00:22:30,000
get really still

662
00:22:34,310 --> 00:22:32,240
right here

663
00:22:36,630 --> 00:22:34,320

the descent engines have started here

664
00:22:38,310 --> 00:22:36,640
and we are now under powered flight the

665
00:22:40,549 --> 00:22:38,320
first thing that happens is we divert to

666
00:22:43,909 --> 00:22:40,559
the side so you can see the ground

667
00:22:45,909 --> 00:22:43,919
moving that's the camera being swung

668
00:22:47,830 --> 00:22:45,919
about 20 degrees off vertical as we're

669
00:22:49,510 --> 00:22:47,840
moving to the side to avoid the back

670
00:22:51,029 --> 00:22:49,520
shell then the camera starts to

671
00:22:53,590 --> 00:22:51,039
straighten up again

672
00:22:55,590 --> 00:22:53,600
and it will basically snap to straight

673
00:22:57,190 --> 00:22:55,600
vertical

674
00:22:58,549 --> 00:22:57,200
we go through the rest of

675
00:23:01,270 --> 00:22:58,559
power descent you'll start to see the

676
00:23:03,270 --> 00:23:01,280
plumes impacting the ground

677
00:23:05,669 --> 00:23:03,280
and in a second you'll see the the wheel

678
00:23:08,230 --> 00:23:05,679
drop into place as we start sky crane

679
00:23:09,430 --> 00:23:08,240
and lower the mobility

680
00:23:11,510 --> 00:23:09,440
and then of course the camera goes

681
00:23:15,909 --> 00:23:11,520
pretty dark as we get

682
00:23:19,190 --> 00:23:16,870
and so

683
00:23:21,270 --> 00:23:19,200
as devin pointed out from the

684
00:23:23,590 --> 00:23:21,280
from all of the the data we've received

685
00:23:25,270 --> 00:23:23,600
so far we kind of

686
00:23:27,990 --> 00:23:25,280
we flew this right down the middle it's

687
00:23:29,510 --> 00:23:28,000
it's absolutely incredible to have

688
00:23:31,830 --> 00:23:29,520

worked on a plan

689
00:23:33,909 --> 00:23:31,840
for so many years and then just see

690
00:23:36,230 --> 00:23:33,919
everything happen exactly according to

691
00:23:38,630 --> 00:23:36,240
plan and as we were watching this in the

692
00:23:40,870 --> 00:23:38,640
in the in the war room on on landing

693
00:23:43,669 --> 00:23:40,880
night it was like all these contingency

694
00:23:46,310 --> 00:23:43,679
plans that we had made leading up to edl

695
00:23:48,070 --> 00:23:46,320
about what to do if we lose calm here or

696
00:23:49,350 --> 00:23:48,080
or lose calm there or if we don't know

697
00:23:51,270 --> 00:23:49,360
where the rover is when it lands down

698
00:23:53,190 --> 00:23:51,280
all of those were just shedding

699
00:23:55,590 --> 00:23:53,200
off it was like weights being lifted off

700
00:23:57,990 --> 00:23:55,600
our shoulders as as as we were able to

701
00:23:58,710 --> 00:23:58,000
watch all all of the data come in and

702
00:24:02,070 --> 00:23:58,720
and

703
00:24:06,470 --> 00:24:02,080
according to plan

704
00:24:08,149 --> 00:24:06,480
so uh uh as you can see uh

705
00:24:09,750 --> 00:24:08,159
when we hit the ground there the next

706
00:24:11,909 --> 00:24:09,760
thing that happens is the flyaway

707
00:24:13,830 --> 00:24:11,919
maneuver and we were actually

708
00:24:16,549 --> 00:24:13,840
uh extremely lucky but it was sort of a

709
00:24:19,110 --> 00:24:16,559
planned uh planned event uh if you go to

710
00:24:21,909 --> 00:24:19,120
the to the next image

711
00:24:22,789 --> 00:24:21,919
we were lucky enough to catch to take a

712
00:24:24,390 --> 00:24:22,799
rear

713
00:24:26,630 --> 00:24:24,400

oh can you go

714
00:24:28,070 --> 00:24:26,640
one more i'm sorry i might have

715
00:24:29,269 --> 00:24:28,080
yeah there

716
00:24:31,110 --> 00:24:29,279
uh if

717
00:24:33,269 --> 00:24:31,120
you look in the left image

718
00:24:35,510 --> 00:24:33,279
we believe we've caught what is the

719
00:24:38,070 --> 00:24:35,520
descent stage impact

720
00:24:40,549 --> 00:24:38,080
on the on the martian surface now this

721
00:24:42,230 --> 00:24:40,559
photo was taken about 40 seconds after

722
00:24:43,990 --> 00:24:42,240
touchdown

723
00:24:46,950 --> 00:24:44,000
the predicted time of flight of the

724
00:24:48,390 --> 00:24:46,960
descent stage is about 20 seconds so

725
00:24:50,070 --> 00:24:48,400
the descent stage would have already

726
00:24:51,669 --> 00:24:50,080
impacted by the time this picture was

727
00:24:52,950 --> 00:24:51,679
taken but

728
00:24:57,510 --> 00:24:52,960
the

729
00:24:59,350 --> 00:24:57,520
that

730
00:25:02,149 --> 00:24:59,360
the same image from the same camera

731
00:25:04,630 --> 00:25:02,159
taken 45 minutes later that that

732
00:25:06,630 --> 00:25:04,640
artifact is not there anymore and we do

733
00:25:08,789 --> 00:25:06,640
know that the artifact is real because

734
00:25:10,470 --> 00:25:08,799
it appears in multiple hazcam pictures

735
00:25:13,669 --> 00:25:10,480
from the rear of the rover

736
00:25:15,350 --> 00:25:13,679
so uh that's about 600 meters away from

737
00:25:17,590 --> 00:25:15,360
the rear of the rover and that is the

738
00:25:19,350 --> 00:25:17,600

direction that the descent stage

739
00:25:21,029 --> 00:25:19,360
should have flown away and so we're

740
00:25:22,710 --> 00:25:21,039
fairly certain that that is the impact

741
00:25:24,310 --> 00:25:22,720
plume so basically

742
00:25:26,070 --> 00:25:24,320
when the descent stage hits the ground

743
00:25:27,830 --> 00:25:26,080
it's going about 100 miles an hour and

744
00:25:28,710 --> 00:25:27,840
we expected it to kick up quite a lot of

745
00:25:31,510 --> 00:25:28,720
dust

746
00:25:34,310 --> 00:25:31,520
we actually selected the rear haz cam to

747
00:25:36,230 --> 00:25:34,320
be the first image uh taken actually the

748
00:25:38,390 --> 00:25:36,240
the timing of the haz cam pictures both

749
00:25:40,710 --> 00:25:38,400
front and rear were timed so that we

750
00:25:42,710 --> 00:25:40,720
would possibly catch any kind of uh

751
00:25:44,310 --> 00:25:42,720
cloud like this and and the fact that

752
00:25:46,789 --> 00:25:44,320
the descent stage flew

753
00:25:48,710 --> 00:25:46,799
directly after the rover was an amazing

754
00:25:51,830 --> 00:25:48,720
coincidence that we were able to to

755
00:25:56,710 --> 00:25:53,190
and

756
00:25:58,549 --> 00:25:56,720
so you also saw in the uh in the video

757
00:26:00,390 --> 00:25:58,559
that we were as we're touching down we

758
00:26:03,269 --> 00:26:00,400
started kicking up dust and if we can go

759
00:26:04,710 --> 00:26:03,279
to the the image before um i want to

760
00:26:06,149 --> 00:26:04,720
show you something that i personally

761
00:26:08,470 --> 00:26:06,159
find just

762
00:26:09,830 --> 00:26:08,480
so incredibly moving is that

763
00:26:12,230 --> 00:26:09,840

you're looking off the left side of the

764
00:26:14,630 --> 00:26:12,240
rover if i have the model here

765
00:26:17,190 --> 00:26:14,640
you can see basically the camera it's a

766
00:26:19,269 --> 00:26:17,200
shot from the the nav cams up on top of

767
00:26:21,590 --> 00:26:19,279
the mast here it's looking that way down

768
00:26:23,430 --> 00:26:21,600
to the off the left side of the rover

769
00:26:25,590 --> 00:26:23,440
and you can see two

770
00:26:28,230 --> 00:26:25,600
divots in the ground

771
00:26:29,990 --> 00:26:28,240
over there and you know we blasted those

772
00:26:33,029 --> 00:26:30,000
with our rocket engines so

773
00:26:34,630 --> 00:26:33,039
that makes me extremely happy

774
00:26:36,710 --> 00:26:34,640
now of course

775
00:26:39,029 --> 00:26:36,720
as you might expect landing on mars is a

776
00:26:41,590 --> 00:26:39,039
very very dirty event uh i mean we're

777
00:26:44,470 --> 00:26:41,600
basically off-roading for the next two

778
00:26:46,230 --> 00:26:44,480
years so we expected uh some debris and

779
00:26:48,710 --> 00:26:46,240
dirt and dust to get on things of course

780
00:26:50,630 --> 00:26:48,720
if you take your suv out and you

781
00:26:53,269 --> 00:26:50,640
actually use it off-road you expect it

782
00:26:55,190 --> 00:26:53,279
to get a little bit dirty and so uh we

783
00:26:56,549 --> 00:26:55,200
of course wanted to start off day one

784
00:26:58,470 --> 00:26:56,559
with a little bit of

785
00:26:59,990 --> 00:26:58,480
dirt on the side so you know you never

786
00:27:01,669 --> 00:27:00,000
like having those brand new sneakers

787
00:27:03,190 --> 00:27:01,679
that are nice and shiny

788
00:27:05,830 --> 00:27:03,200

so you can see on the top deck of the

789
00:27:07,510 --> 00:27:05,840
rover there uh there is a little bit of

790
00:27:10,070 --> 00:27:07,520
uh debris that we kicked up with the

791
00:27:11,430 --> 00:27:10,080
rocket engines uh as expected and so

792
00:27:14,230 --> 00:27:11,440
again this is

793
00:27:18,470 --> 00:27:14,240
more evidence of you know we we did that

794
00:27:24,310 --> 00:27:20,950
and so uh with that i'll turn it over to

795
00:27:27,110 --> 00:27:24,320
jody walk us through uh our predicted

796
00:27:28,390 --> 00:27:27,120
versus actual trajectory performance

797
00:27:31,110 --> 00:27:28,400
thanks steve

798
00:27:34,950 --> 00:27:31,120
uh so i'll be talking about two things

799
00:27:37,669 --> 00:27:34,960
um first we'll go through a google mars

800
00:27:39,990 --> 00:27:37,679
animation which is we use google mars

801
00:27:42,630 --> 00:27:40,000
and it actually has our latest predicted

802
00:27:45,350 --> 00:27:42,640
trajectory this is prior to landing

803
00:27:48,070 --> 00:27:45,360
and then we'll go through after landing

804
00:27:50,870 --> 00:27:48,080
and how we used our simulations and what

805
00:27:52,950 --> 00:27:50,880
we got from curiosity at touchdown to

806
00:27:55,269 --> 00:27:52,960
determine where we thought we landed and

807
00:27:56,470 --> 00:27:55,279
how that actually compared to where we

808
00:27:59,350 --> 00:27:56,480
really landed

809
00:28:01,029 --> 00:27:59,360
so if i could have the the video

810
00:28:02,389 --> 00:28:01,039
this is google mars and it's going to

811
00:28:04,710 --> 00:28:02,399
take us through and remember this is

812
00:28:05,990 --> 00:28:04,720
real simulation data here uh we're going

813
00:28:08,149 --> 00:28:06,000

through the bank reversals the first

814
00:28:10,950 --> 00:28:08,159
bank reversal second and third and this

815
00:28:12,630 --> 00:28:10,960
is only half of of the angle

816
00:28:16,470 --> 00:28:12,640
of the bank reversal

817
00:28:18,950 --> 00:28:16,480
this is going four times real time and

818
00:28:21,590 --> 00:28:18,960
we actually use google mars to analyze

819
00:28:23,590 --> 00:28:21,600
the trajectory to see it in 3d space

820
00:28:26,230 --> 00:28:23,600
instead of just you know numbers on

821
00:28:29,669 --> 00:28:26,240
white paper or matlab files

822
00:28:32,149 --> 00:28:29,679
and so this is taking us through uh

823
00:28:34,230 --> 00:28:32,159
the entry balance mass jettison and what

824
00:28:36,149 --> 00:28:34,240
we'll do is we'll pitch over

825
00:28:38,230 --> 00:28:36,159
and we'll look at the landing site

826
00:28:39,590 --> 00:28:38,240
and we'll actually see a couple pans of

827
00:28:43,430 --> 00:28:39,600
the landing site

828
00:28:45,990 --> 00:28:43,440
now this this trajectory is is what we

829
00:28:47,909 --> 00:28:46,000
assumed uh is the nominal trajectory

830
00:28:51,190 --> 00:28:47,919
that was based off of the latest and

831
00:28:53,190 --> 00:28:51,200
greatest nav uh navigation that we got

832
00:28:56,149 --> 00:28:53,200
right prior to landing

833
00:28:57,669 --> 00:28:56,159
so this just takes a glimpse over gale

834
00:29:00,230 --> 00:28:57,679
crater

835
00:29:02,310 --> 00:29:00,240
parachute deploy

836
00:29:05,269 --> 00:29:02,320
this is the configuration that we were

837
00:29:08,870 --> 00:29:05,279
at and parachute deploy happened about

838
00:29:10,149 --> 00:29:08,880

10 15 just five seconds after 10 15 mars

839
00:29:11,350 --> 00:29:10,159
time

840
00:29:13,350 --> 00:29:11,360
pacific

841
00:29:14,710 --> 00:29:13,360
so here we have heat shield separation

842
00:29:16,230 --> 00:29:14,720
heat shield separation happened 20

843
00:29:19,909 --> 00:29:16,240
seconds after

844
00:29:23,750 --> 00:29:19,919
lock up

845
00:29:25,750 --> 00:29:23,760
about a kilometer and a half higher than

846
00:29:27,669 --> 00:29:25,760
what we expected and that's not a bad

847
00:29:28,789 --> 00:29:27,679
thing that's that's a good thing

848
00:29:32,070 --> 00:29:28,799
and

849
00:29:33,909 --> 00:29:32,080
77 seconds after that we have back shell

850
00:29:36,310 --> 00:29:33,919
separation

851
00:29:37,750 --> 00:29:36,320
time happened as expected things are

852
00:29:39,990 --> 00:29:37,760
looking nominal

853
00:29:40,950 --> 00:29:40,000
and here we kind of pan down to to the

854
00:29:43,110 --> 00:29:40,960
rover

855
00:29:44,389 --> 00:29:43,120
touchdown happened 55 seconds after

856
00:29:46,389 --> 00:29:44,399
backshell set

857
00:29:48,149 --> 00:29:46,399
all as we expected

858
00:29:49,510 --> 00:29:48,159
i wanted to point out here that the flag

859
00:29:51,669 --> 00:29:49,520
the american flag that's sitting under

860
00:29:53,990 --> 00:29:51,679
the rover give a shout out to google

861
00:29:55,350 --> 00:29:54,000
mars they actually put our landing

862
00:29:57,269 --> 00:29:55,360
location

863
00:29:59,110 --> 00:29:57,279

in google mars already so that was that

864
00:30:00,149 --> 00:29:59,120
was kind of neat so this is the types of

865
00:30:02,789 --> 00:30:00,159
things that we were looking at right

866
00:30:04,389 --> 00:30:02,799
before right before entry

867
00:30:06,149 --> 00:30:04,399
to see how things were looking and how

868
00:30:09,269 --> 00:30:06,159
they were going to compare after entry

869
00:30:11,990 --> 00:30:09,279
after touchdown um so if we could move

870
00:30:14,310 --> 00:30:12,000
to the next figure

871
00:30:16,710 --> 00:30:14,320
so now this is this is after landing we

872
00:30:18,149 --> 00:30:16,720
want to know where is this rover or

873
00:30:20,070 --> 00:30:18,159
where is an estimate of where we think

874
00:30:22,710 --> 00:30:20,080
it is so so the folks that are actually

875
00:30:25,269 --> 00:30:22,720
going to find this using highrise from

876
00:30:27,110 --> 00:30:25,279
mro will have a good idea

877
00:30:29,110 --> 00:30:27,120
so right after landing we get

878
00:30:31,029 --> 00:30:29,120
information from curiosity

879
00:30:33,110 --> 00:30:31,039
some touchdown information

880
00:30:35,430 --> 00:30:33,120
and we take that information

881
00:30:37,750 --> 00:30:35,440
and we account for our known errors such

882
00:30:39,669 --> 00:30:37,760
as navigation errors and we come up with

883
00:30:41,990 --> 00:30:39,679
a best estimate and that's the green

884
00:30:44,310 --> 00:30:42,000
diamond in the middle

885
00:30:46,789 --> 00:30:44,320
in the uh blue ellipse there

886
00:30:48,870 --> 00:30:46,799
so this was actually shown right after

887
00:30:50,230 --> 00:30:48,880
landing this was our prediction latest

888
00:30:51,190 --> 00:30:50,240

and greatest that we had immediately

889
00:30:53,510 --> 00:30:51,200
after

890
00:30:55,510 --> 00:30:53,520
some of you may have already seen this

891
00:30:57,750 --> 00:30:55,520
and this kind of sets up the next figure

892
00:30:59,029 --> 00:30:57,760
that i have if you could go to the next

893
00:31:02,710 --> 00:30:59,039
graphic

894
00:31:05,110 --> 00:31:02,720
so here we have the landing target that

895
00:31:09,190 --> 00:31:05,120
same light blue ellipse

896
00:31:11,430 --> 00:31:09,200
and like gavin said the landing target

897
00:31:14,070 --> 00:31:11,440
we missed it by about a mile and a half

898
00:31:15,510 --> 00:31:14,080
it's actually off the graphic there to

899
00:31:18,710 --> 00:31:15,520
the left

900
00:31:21,110 --> 00:31:18,720
and the green diamond is where we

901
00:31:23,029 --> 00:31:21,120
thought we landed right afterwards and

902
00:31:25,510 --> 00:31:23,039
that's the estimate that we gave

903
00:31:26,710 --> 00:31:25,520
to the localization folks to try to find

904
00:31:28,630 --> 00:31:26,720
the rover

905
00:31:30,710 --> 00:31:28,640
now we thought it would be within a

906
00:31:33,990 --> 00:31:30,720
kilometer of that

907
00:31:37,190 --> 00:31:34,000
the red x is where we actually landed

908
00:31:41,029 --> 00:31:37,200
so our estimation and where we actually

909
00:31:43,590 --> 00:31:41,039
landed was only two 200 meters apart

910
00:31:46,470 --> 00:31:43,600
well within that one kilometer green

911
00:31:49,750 --> 00:31:46,480
green air uh circle

912
00:31:52,230 --> 00:31:49,760
so we were very happy about that

913
00:31:54,470 --> 00:31:52,240

now to kind of shift gears and if you

914
00:31:56,389 --> 00:31:54,480
look over to the right you'll see the

915
00:31:57,990 --> 00:31:56,399
tungsten ballast masses the entry

916
00:32:01,110 --> 00:31:58,000
balance masses

917
00:32:03,190 --> 00:32:01,120
and our predictions now this is actually

918
00:32:04,149 --> 00:32:03,200
before landing where we thought these

919
00:32:07,110 --> 00:32:04,159
six

920
00:32:10,710 --> 00:32:07,120
heavy balls of tungsten would land um

921
00:32:12,870 --> 00:32:10,720
are within that dark blue ellipse

922
00:32:15,669 --> 00:32:12,880
and actually if you look

923
00:32:18,310 --> 00:32:15,679
where we expected those to land there's

924
00:32:20,789 --> 00:32:18,320
blue circles six blue circles and they

925
00:32:24,470 --> 00:32:20,799
actually show the same trends that have

926
00:32:25,509 --> 00:32:24,480
been shown um uh from the ctx stem um

927
00:32:27,110 --> 00:32:25,519
from

928
00:32:28,630 --> 00:32:27,120
uh that was shown i believe a couple

929
00:32:31,350 --> 00:32:28,640
days ago with the actual landing

930
00:32:34,630 --> 00:32:31,360
location of those balance masses and

931
00:32:37,190 --> 00:32:34,640
that's the overlay figure that you see

932
00:32:39,029 --> 00:32:37,200
and so you can see that those locations

933
00:32:40,950 --> 00:32:39,039
are well within

934
00:32:42,470 --> 00:32:40,960
the aero ellipse that's drawn around

935
00:32:43,269 --> 00:32:42,480
those balance masses

936
00:32:45,269 --> 00:32:43,279
so

937
00:32:46,789 --> 00:32:45,279
those actually impacted where we

938
00:32:48,389 --> 00:32:46,799

expected

939
00:32:50,070 --> 00:32:48,399
so that's kind of just to give you a

940
00:32:51,509 --> 00:32:50,080
flavor of what's to come and this is

941
00:32:53,110 --> 00:32:51,519
based off like al and everyone has

942
00:32:54,470 --> 00:32:53,120
mentioned off of minimal data that we

943
00:32:57,750 --> 00:32:54,480
have so far

944
00:32:59,269 --> 00:32:57,760
so stay tuned this is a huge effort and

945
00:33:01,029 --> 00:32:59,279
it's going to be exciting when we get

946
00:33:02,549 --> 00:33:01,039
the rest of the data back to really be

947
00:33:04,950 --> 00:33:02,559
able to tell the story of of what

948
00:33:07,509 --> 00:33:04,960
happened during edl

949
00:33:09,190 --> 00:33:07,519
so with that i pass it off to ben

950
00:33:11,990 --> 00:33:09,200
thank you

951
00:33:13,990 --> 00:33:12,000
all right so as jody just talked about

952
00:33:16,070 --> 00:33:14,000
uh all the hardware that we jettisoned

953
00:33:17,669 --> 00:33:16,080
as we went through the edl maneuver and

954
00:33:19,190 --> 00:33:17,679
we uh successfully landed on mars last

955
00:33:20,470 --> 00:33:19,200
sunday i'm going to talk about what

956
00:33:23,110 --> 00:33:20,480
we're going to do next on the surface

957
00:33:25,590 --> 00:33:23,120
which is to jettison the edl software

958
00:33:26,870 --> 00:33:25,600
and to now move on to our surface

959
00:33:29,110 --> 00:33:26,880
version of software so if you can pull

960
00:33:29,909 --> 00:33:29,120
up the first chart

961
00:33:35,669 --> 00:33:29,919
so

962
00:33:37,750 --> 00:33:35,679
controls all the onboard functions in

963
00:33:39,750 --> 00:33:37,760

the rover the software is responsible

964
00:33:41,190 --> 00:33:39,760
for everything all the autonomous

965
00:33:43,029 --> 00:33:41,200
functions that happened during cruise

966
00:33:45,110 --> 00:33:43,039
and the software ran this edl sequence

967
00:33:46,950 --> 00:33:45,120
that this wonderful team designed uh

968
00:33:48,389 --> 00:33:46,960
last sunday and the software is also

969
00:33:50,149 --> 00:33:48,399
what we've been using to do the

970
00:33:52,710 --> 00:33:50,159
characterization phase up until now on

971
00:33:54,630 --> 00:33:52,720
up until software on the surface of mars

972
00:33:56,630 --> 00:33:54,640
if you think about it what's what's hard

973
00:33:57,509 --> 00:33:56,640
about this uh if you think about my my

974
00:34:02,950 --> 00:33:57,519
phone

975
00:34:05,509 --> 00:34:02,960
times as fast as the processor that's on

976
00:34:08,629 --> 00:34:05,519
curiosity and it has 16 times as much

977
00:34:09,990 --> 00:34:08,639
storage as curiosity has and my phone

978
00:34:11,829 --> 00:34:10,000
doesn't have to land anything on mars

979
00:34:15,109 --> 00:34:11,839
all my phone has to do is follow bob's

980
00:34:22,069 --> 00:34:18,069
so

981
00:34:23,990 --> 00:34:22,079
this is that my phone wouldn't wouldn't

982
00:34:25,750 --> 00:34:24,000
survive the journey to mars so we have

983
00:34:27,669 --> 00:34:25,760
to build computers that are robust

984
00:34:29,829 --> 00:34:27,679
enough to survive the harsh interstellar

985
00:34:30,790 --> 00:34:29,839
space the hardest interplanetary space

986
00:34:31,909 --> 00:34:30,800
and

987
00:34:33,349 --> 00:34:31,919
when we do that there are certain

988
00:34:34,869 --> 00:34:33,359

limitations that we have and so some of

989
00:34:36,149 --> 00:34:34,879
those limitations include the size of

990
00:34:37,589 --> 00:34:36,159
the flight software image that we have

991
00:34:39,829 --> 00:34:37,599
and that that forces us every now and

992
00:34:41,430 --> 00:34:39,839
then to update the flight software to

993
00:34:42,470 --> 00:34:41,440
add new capabilities so if you go to the

994
00:34:44,310 --> 00:34:42,480
next chart

995
00:34:45,909 --> 00:34:44,320
uh when we launched back in november we

996
00:34:48,069 --> 00:34:45,919
included four major applications in the

997
00:34:49,430 --> 00:34:48,079
software that was really where we had

998
00:34:51,829 --> 00:34:49,440
the launch cruise application which

999
00:34:53,829 --> 00:34:51,839
compute controlled uh the the the

1000
00:34:55,669 --> 00:34:53,839
function the rover during cruise we had

1001
00:34:57,430 --> 00:34:55,679
our edl application our first version of

1002
00:34:59,670 --> 00:34:57,440
our edl application a first version of

1003
00:35:01,510 --> 00:34:59,680
sort of the core surface flight software

1004
00:35:03,349 --> 00:35:01,520
and we also had a fourth application

1005
00:35:05,510 --> 00:35:03,359
which was designed in from the start

1006
00:35:07,670 --> 00:35:05,520
which was the capability for us to

1007
00:35:09,910 --> 00:35:07,680
update the software while we were in

1008
00:35:11,589 --> 00:35:09,920
route to mars so unlike the hardware

1009
00:35:12,630 --> 00:35:11,599
which once we launch it it's gone it's

1010
00:35:14,470 --> 00:35:12,640
on its way to mars and there's nothing

1011
00:35:15,990 --> 00:35:14,480
we can do to get it back the software we

1012
00:35:17,829 --> 00:35:16,000
can radiate those bits to mars and have

1013
00:35:19,430 --> 00:35:17,839

them catch up with the rover on its way

1014
00:35:21,750 --> 00:35:19,440
there and actually update the software

1015
00:35:24,710 --> 00:35:21,760
in cruise so if you go to the next line

1016
00:35:27,030 --> 00:35:24,720
this software update capability uh we've

1017
00:35:29,510 --> 00:35:27,040
now exercised it already once in in

1018
00:35:32,069 --> 00:35:29,520
cruise we used it when back at the first

1019
00:35:33,750 --> 00:35:32,079
week of june to update the edl software

1020
00:35:35,589 --> 00:35:33,760
so to go from those four applications we

1021
00:35:37,349 --> 00:35:35,599
had in the launch cruise software and

1022
00:35:38,870 --> 00:35:37,359
actually update to what was our final

1023
00:35:40,390 --> 00:35:38,880
version of the edl software so if you

1024
00:35:42,950 --> 00:35:40,400
skip to the next turn

1025
00:35:44,790 --> 00:35:42,960
i and this really was edl v2o is what i

1026
00:35:45,910 --> 00:35:44,800
call 2.0 of the edl software and we

1027
00:35:47,750 --> 00:35:45,920
added a number of robustness

1028
00:35:49,349 --> 00:35:47,760
improvements in the edl software and we

1029
00:35:51,829 --> 00:35:49,359
really exercised this software update

1030
00:35:54,550 --> 00:35:51,839
capability now we also rev the surface

1031
00:35:56,069 --> 00:35:54,560
software somewhat we added v 1.1 of the

1032
00:35:57,510 --> 00:35:56,079
surface software but what we couldn't do

1033
00:35:59,589 --> 00:35:57,520
is we couldn't put all of the surface

1034
00:36:01,349 --> 00:35:59,599
software in to the flight software image

1035
00:36:02,630 --> 00:36:01,359
that we uploaded in cruz back in the

1036
00:36:04,150 --> 00:36:02,640
first week of june

1037
00:36:06,470 --> 00:36:04,160
because there just wasn't enough space

1038
00:36:08,069 --> 00:36:06,480

for it there just wasn't enough we have

1039
00:36:09,589 --> 00:36:08,079
a limitation on the size of that flight

1040
00:36:10,790 --> 00:36:09,599
software image and well the surface

1041
00:36:12,390 --> 00:36:10,800
mission is pretty complicated and

1042
00:36:14,069 --> 00:36:12,400
requires a lot of smarts and those

1043
00:36:15,430 --> 00:36:14,079
smarts exceeded the size of the the

1044
00:36:17,430 --> 00:36:15,440
image that we could have

1045
00:36:18,550 --> 00:36:17,440
so what we did was that if you go to the

1046
00:36:21,670 --> 00:36:18,560
next chart

1047
00:36:23,510 --> 00:36:21,680
uh we uploaded in cruz the r10 version

1048
00:36:24,630 --> 00:36:23,520
of flight software but we just left it

1049
00:36:26,310 --> 00:36:24,640
on the rover and we didn't actually

1050
00:36:27,670 --> 00:36:26,320
install it and what the r10 version of

1051
00:36:30,310 --> 00:36:27,680
the flight software gives us is it gives

1052
00:36:31,670 --> 00:36:30,320
us this not just the basic surface

1053
00:36:33,829 --> 00:36:31,680
capabilities

1054
00:36:36,310 --> 00:36:33,839
but also adds in the ability for us to

1055
00:36:38,310 --> 00:36:36,320
use the sampling system on the rover and

1056
00:36:40,230 --> 00:36:38,320
for us to drive with the rover and so

1057
00:36:42,710 --> 00:36:40,240
those are our real two new apps that are

1058
00:36:44,230 --> 00:36:42,720
coming in r10 and the cool features that

1059
00:36:46,550 --> 00:36:44,240
we have in the r10 flight software and

1060
00:36:48,550 --> 00:36:46,560
why we want to spend these next few saws

1061
00:36:51,270 --> 00:36:48,560
on mars updating to the r10 flight

1062
00:36:53,109 --> 00:36:51,280
software so if you go to the next turn

1063
00:36:54,710 --> 00:36:53,119

so first one the sampling system right

1064
00:36:56,310 --> 00:36:54,720
now we have the capability in just our

1065
00:36:57,349 --> 00:36:56,320
basic surface software to check out all

1066
00:36:59,270 --> 00:36:57,359
the health of the instruments but we

1067
00:37:00,870 --> 00:36:59,280
don't really have the capability to go

1068
00:37:02,470 --> 00:37:00,880
and make the full use of all this great

1069
00:37:03,910 --> 00:37:02,480
hardware that we shipped with us to mars

1070
00:37:06,870 --> 00:37:03,920
and so our 10 software gives us the

1071
00:37:08,870 --> 00:37:06,880
capability to use the robotic arm fully

1072
00:37:11,589 --> 00:37:08,880
to use the drill to use the dust removal

1073
00:37:13,670 --> 00:37:11,599
tool to use the whole sampling chain and

1074
00:37:15,510 --> 00:37:13,680
to ingest those samples into sam and

1075
00:37:16,550 --> 00:37:15,520
analyze them with chemin and so all this

1076
00:37:19,349 --> 00:37:16,560
exciting stuff that you're going to see

1077
00:37:21,190 --> 00:37:19,359
this mission do over the next few

1078
00:37:22,630 --> 00:37:21,200
months and and years on mars you're

1079
00:37:24,390 --> 00:37:22,640
going to see that that comes from the

1080
00:37:25,670 --> 00:37:24,400
capabilities that are in this r10

1081
00:37:27,910 --> 00:37:25,680
software

1082
00:37:29,190 --> 00:37:27,920
and so there's one other application go

1083
00:37:31,430 --> 00:37:29,200
to the next chart

1084
00:37:34,230 --> 00:37:31,440
well curiosity is a martian mega rover

1085
00:37:36,870 --> 00:37:34,240
curiosity was was born to drive and so

1086
00:37:38,310 --> 00:37:36,880
the r10 software includes the capability

1087
00:37:40,150 --> 00:37:38,320
for curiosity to really get out and

1088
00:37:42,230 --> 00:37:40,160

stretch your wheels and the surface of

1089
00:37:44,310 --> 00:37:42,240
mars so this is the the r10 software

1090
00:37:45,910 --> 00:37:44,320
gives us the autonomous driving

1091
00:37:47,510 --> 00:37:45,920
capabilities the ability for the rover

1092
00:37:49,670 --> 00:37:47,520
to drive both in

1093
00:37:51,109 --> 00:37:49,680
using onboard images to detect hazards

1094
00:37:52,870 --> 00:37:51,119
that are around the rover and to drive

1095
00:37:54,230 --> 00:37:52,880
safely across the surface of mars and

1096
00:37:57,109 --> 00:37:54,240
this is really what we'll use when we

1097
00:37:58,950 --> 00:37:57,119
set out on our first drive here on mars

1098
00:38:02,230 --> 00:37:58,960
and so if you go to the next slide

1099
00:38:03,109 --> 00:38:02,240
so we really say r10 unlike r9 r9 was

1100
00:38:04,950 --> 00:38:03,119
the version of software that was

1101
00:38:06,790 --> 00:38:04,960
optimized for edl and allowed our edl

1102
00:38:09,030 --> 00:38:06,800
friends to get us down sourcely to save

1103
00:38:11,190 --> 00:38:09,040
us some surfs of mars but r10 is

1104
00:38:12,950 --> 00:38:11,200
optimized for surface and so it has a

1105
00:38:14,230 --> 00:38:12,960
lot of great stuff that the science team

1106
00:38:16,150 --> 00:38:14,240
wants that the surface team wants in

1107
00:38:17,270 --> 00:38:16,160
order to enable this fantastic mission

1108
00:38:19,030 --> 00:38:17,280
and so that's why we're willing to spend

1109
00:38:21,030 --> 00:38:19,040
some time here doing doing the install

1110
00:38:22,230 --> 00:38:21,040
and if you go to the next chart

1111
00:38:23,829 --> 00:38:22,240
so

1112
00:38:25,430 --> 00:38:23,839
where we are right now is that we just

1113
00:38:27,510 --> 00:38:25,440

completed our software activities and

1114
00:38:28,390 --> 00:38:27,520
our software activities were to prepare

1115
00:38:30,550 --> 00:38:28,400
for

1116
00:38:32,310 --> 00:38:30,560
the installation of this of the flight

1117
00:38:33,750 --> 00:38:32,320
software and so everything is good we've

1118
00:38:36,069 --> 00:38:33,760
gotten a go for mission management to

1119
00:38:38,069 --> 00:38:36,079
proceed forward with this four day

1120
00:38:39,829 --> 00:38:38,079
installation process of installing the

1121
00:38:41,990 --> 00:38:39,839
flight software on board the rover now

1122
00:38:44,069 --> 00:38:42,000
we have two computers so it takes a

1123
00:38:46,230 --> 00:38:44,079
little bit longer for us to do the full

1124
00:38:48,230 --> 00:38:46,240
install because we want to do it very

1125
00:38:49,829 --> 00:38:48,240
safely do it step by step and take take

1126
00:38:51,910 --> 00:38:49,839
our time doing the the software update

1127
00:38:53,910 --> 00:38:51,920
so what you see is that on solve five

1128
00:38:55,670 --> 00:38:53,920
what we'll do is we'll do a toe dip into

1129
00:38:58,550 --> 00:38:55,680
the r10 flight software so just on our

1130
00:39:00,310 --> 00:38:58,560
prime computer we'll do a boot into the

1131
00:39:01,990 --> 00:39:00,320
r10 flight software but don't install it

1132
00:39:03,510 --> 00:39:02,000
fully just to check it out and we'll

1133
00:39:05,510 --> 00:39:03,520
come back out we'll look at all the data

1134
00:39:06,630 --> 00:39:05,520
that we got down from the rover to make

1135
00:39:08,950 --> 00:39:06,640
sure that the r10 software is

1136
00:39:10,630 --> 00:39:08,960
functioning nominally and then if

1137
00:39:12,470 --> 00:39:10,640
everything looks good on sol 6 we'll

1138
00:39:13,990 --> 00:39:12,480

commit to r10 and so we'll actually do

1139
00:39:15,910 --> 00:39:14,000
the full install on the prime computer

1140
00:39:17,109 --> 00:39:15,920
of the r10 flight software

1141
00:39:18,470 --> 00:39:17,119
and once we have that and everything's

1142
00:39:20,710 --> 00:39:18,480
working well on the prime computer with

1143
00:39:22,310 --> 00:39:20,720
the r10 flight software we'll move on to

1144
00:39:24,390 --> 00:39:22,320
doing the same thing except now on our

1145
00:39:26,950 --> 00:39:24,400
backup computer where on saw seven we'll

1146
00:39:29,270 --> 00:39:26,960
do another toe dip into the the r10

1147
00:39:31,750 --> 00:39:29,280
flight software on the backup computer

1148
00:39:33,430 --> 00:39:31,760
and on sol 8 we'll do a full commit of

1149
00:39:35,270 --> 00:39:33,440
r10 onto the backup computer at which

1150
00:39:37,109 --> 00:39:35,280
point we will have all the r10 flight

1151
00:39:39,270 --> 00:39:37,119
software installed and ready to go

1152
00:39:42,150 --> 00:39:39,280
with r10

1153
00:39:43,430 --> 00:39:42,160
so that's all i have

1154
00:39:45,109 --> 00:39:43,440
thank you we're going to begin with

1155
00:39:46,870 --> 00:39:45,119
questions here in the auditorium and

1156
00:39:48,870 --> 00:39:46,880
then we will go to the phone lines and

1157
00:39:50,470 --> 00:39:48,880
so let me get a microphone to you we'll

1158
00:39:52,870 --> 00:39:50,480
start here in the very front and give us

1159
00:39:54,870 --> 00:39:52,880
your name and affiliation thanks hi joe

1160
00:39:57,349 --> 00:39:54,880
palka from npr

1161
00:39:59,430 --> 00:39:57,359
two questions um

1162
00:40:01,430 --> 00:39:59,440
one is when you talked about uh

1163
00:40:02,870 --> 00:40:01,440

capturing the ground with the radar were

1164
00:40:05,190 --> 00:40:02,880
you capturing

1165
00:40:08,069 --> 00:40:05,200
a wide swath of mars or was there or was

1166
00:40:09,910 --> 00:40:08,079
the radar able to differentiate between

1167
00:40:11,589 --> 00:40:09,920
a bumpy place and a smooth place or

1168
00:40:12,790 --> 00:40:11,599
something like that and the second

1169
00:40:14,069 --> 00:40:12,800
question is

1170
00:40:16,069 --> 00:40:14,079
if you were gonna

1171
00:40:17,910 --> 00:40:16,079
run this mission again today

1172
00:40:20,550 --> 00:40:17,920
or let's say three months from now when

1173
00:40:22,870 --> 00:40:20,560
you've got all the data down would you

1174
00:40:25,589 --> 00:40:22,880
make that ellipse smaller or are you at

1175
00:40:27,510 --> 00:40:25,599
the limits of what this system

1176
00:40:29,030 --> 00:40:27,520
can actually do

1177
00:40:30,790 --> 00:40:29,040
all right i think i can take the first

1178
00:40:33,750 --> 00:40:30,800
part and maybe i can take the second

1179
00:40:37,430 --> 00:40:33,760
part uh so the the radar

1180
00:40:39,270 --> 00:40:37,440
is is fixed to the the descent stage

1181
00:40:41,829 --> 00:40:39,280
it's at the mercy of

1182
00:40:43,829 --> 00:40:41,839
where the wrist mode chooses to point it

1183
00:40:45,109 --> 00:40:43,839
in terms of what ground it's going to be

1184
00:40:47,670 --> 00:40:45,119
measuring

1185
00:40:50,390 --> 00:40:47,680
and it it doesn't do any discrimination

1186
00:40:52,870 --> 00:40:50,400
if we have a very wild wrist mode and

1187
00:40:54,470 --> 00:40:52,880
the radar ends up looking at mount sharp

1188
00:40:55,990 --> 00:40:54,480

and measuring the top of mount sharp

1189
00:40:57,510 --> 00:40:56,000
which it couldn't actually do but

1190
00:40:58,950 --> 00:40:57,520
hypothetically

1191
00:41:01,109 --> 00:40:58,960
it would be measuring the vehicle's

1192
00:41:03,829 --> 00:41:01,119
altitude relative to that point

1193
00:41:06,309 --> 00:41:03,839
and so one of the reasons we picked the

1194
00:41:08,790 --> 00:41:06,319
landing ellipse we did was that we knew

1195
00:41:11,109 --> 00:41:08,800
the altitude across the entire landing

1196
00:41:13,030 --> 00:41:11,119
ellipse didn't vary that much and no

1197
00:41:15,270 --> 00:41:13,040
matter what terrain feature the radar

1198
00:41:16,870 --> 00:41:15,280
was pointed at the altitude measured

1199
00:41:19,030 --> 00:41:16,880
relative to that terrain feature would

1200
00:41:20,870 --> 00:41:19,040
be close enough that we would still

1201
00:41:23,190 --> 00:41:20,880
separate from the back shell

1202
00:41:24,790 --> 00:41:23,200
at the right point

1203
00:41:27,030 --> 00:41:24,800
around the moment of back shell

1204
00:41:29,030 --> 00:41:27,040
separation the radar is certainly

1205
00:41:31,190 --> 00:41:29,040
looking within about a kilometer of the

1206
00:41:33,349 --> 00:41:31,200
ultimate landing site and so our

1207
00:41:35,109 --> 00:41:33,359
criteria is we want the altitude of the

1208
00:41:37,829 --> 00:41:35,119
ground to vary no more than about a

1209
00:41:41,190 --> 00:41:37,839
hundred meters within a kilometer range

1210
00:41:44,950 --> 00:41:43,430
and then for the the second question

1211
00:41:45,910 --> 00:41:44,960
can we get the lip size smaller next

1212
00:41:47,030 --> 00:41:45,920
time

1213
00:41:49,430 --> 00:41:47,040

there were some ideas that we came up

1214
00:41:50,870 --> 00:41:49,440
with over the design of this vehicle

1215
00:41:52,870 --> 00:41:50,880
private depends on where you're landing

1216
00:41:54,069 --> 00:41:52,880
if it's a higher elevation site then we

1217
00:41:55,750 --> 00:41:54,079
may need a little bit more lift to make

1218
00:41:56,870 --> 00:41:55,760
sure we can land our heavy rover a

1219
00:41:58,390 --> 00:41:56,880
little bit higher and that can that

1220
00:41:59,829 --> 00:41:58,400
folds in the ellipse size a little bit

1221
00:42:01,430 --> 00:41:59,839
but we do have a few ideas that can

1222
00:42:02,710 --> 00:42:01,440
probably shave a couple miles off of it

1223
00:42:04,870 --> 00:42:02,720
we did really well this time we have to

1224
00:42:05,750 --> 00:42:04,880
look at the data and see

1225
00:42:08,150 --> 00:42:05,760
you know

1226
00:42:10,470 --> 00:42:08,160
are our uh the way we imagine it work

1227
00:42:11,829 --> 00:42:10,480
are we correct but uh i'm confident we

1228
00:42:14,069 --> 00:42:11,839
can continue to do at least as good as

1229
00:42:16,710 --> 00:42:14,079
curiosity and better

1230
00:42:19,190 --> 00:42:16,720
in the future the big winners for uh

1231
00:42:21,349 --> 00:42:19,200
ellipse size error tend to be atmosphere

1232
00:42:23,510 --> 00:42:21,359
so i have a hand in that and uh

1233
00:42:25,030 --> 00:42:23,520
and the aerodynamics so what we learned

1234
00:42:26,390 --> 00:42:25,040
from the reconstruction that we do over

1235
00:42:27,910 --> 00:42:26,400
the next few months should help us take

1236
00:42:32,309 --> 00:42:27,920
a look at that and see if we can if we

1237
00:42:34,309 --> 00:42:33,270
okay we're going to take one more

1238
00:42:35,589 --> 00:42:34,319

question here in the room and then we'll

1239
00:42:36,630 --> 00:42:35,599
go to the phone line right over on this

1240
00:42:40,710 --> 00:42:36,640
side

1241
00:42:45,109 --> 00:42:42,470
thank you it's uh craig kavault with

1242
00:42:49,589 --> 00:42:45,119
aerospace america

1243
00:42:55,190 --> 00:42:53,190
was the altitude accordion capability

1244
00:42:56,630 --> 00:42:55,200
did it play a role here or was

1245
00:42:59,109 --> 00:42:56,640
everything so

1246
00:43:01,910 --> 00:42:59,119
tight that it just didn't

1247
00:43:03,750 --> 00:43:01,920
didn't matter so the altitude accordion

1248
00:43:06,950 --> 00:43:03,760
the accordion that we had allocated was

1249
00:43:08,630 --> 00:43:06,960
100 meters so we allowed for our

1250
00:43:11,349 --> 00:43:08,640
estimate of where the ground was to be

1251
00:43:13,750 --> 00:43:11,359
wrong by up to 100 meters from the data

1252
00:43:16,230 --> 00:43:13,760
we've gotten so far it was wrong by

1253
00:43:19,270 --> 00:43:16,240
three meters so

1254
00:43:21,750 --> 00:43:19,280
we overachieved in that area as well

1255
00:43:23,670 --> 00:43:21,760
so it everything again it was it was

1256
00:43:26,069 --> 00:43:23,680
right down the middle

1257
00:43:28,069 --> 00:43:26,079
okay the second question since edl has

1258
00:43:29,910 --> 00:43:28,079
been achieved i guess to the whole edl

1259
00:43:31,829 --> 00:43:29,920
team

1260
00:43:35,510 --> 00:43:31,839
a show of hands maybe on how many people

1261
00:43:35,520 --> 00:43:38,710
serious question

1262
00:43:38,720 --> 00:43:42,309
really

1263
00:43:42,319 --> 00:43:45,109

sure

1264
00:43:48,150 --> 00:43:46,550
i don't think we've we've started to

1265
00:43:50,470 --> 00:43:48,160
think about that yet yes we're still

1266
00:43:51,750 --> 00:43:50,480
relishing exactly success and actually a

1267
00:43:54,870 --> 00:43:51,760
lot of us are going to be involved in

1268
00:43:56,470 --> 00:43:54,880
the reconstruction as well but i think

1269
00:43:58,390 --> 00:43:56,480
you know we're thinking about future

1270
00:44:01,829 --> 00:43:58,400
projects and what to be what we're going

1271
00:44:03,829 --> 00:44:01,839
to be working on definitely

1272
00:44:05,589 --> 00:44:03,839
okay thank you

1273
00:44:07,910 --> 00:44:05,599
we're going to go to the phone line next

1274
00:44:09,270 --> 00:44:07,920
julia sizzler with canadian broadcasting

1275
00:44:11,990 --> 00:44:09,280
go ahead

1276
00:44:13,670 --> 00:44:12,000
hi uh this is julia sisler with uh cbc

1277
00:44:15,109 --> 00:44:13,680
in yellowknife

1278
00:44:17,589 --> 00:44:15,119
and yeah i just have a couple of

1279
00:44:19,990 --> 00:44:17,599
questions about the naming process

1280
00:44:25,910 --> 00:44:20,000
um so how did you decide to call the

1281
00:44:28,069 --> 00:44:26,710
yeah

1282
00:44:29,990 --> 00:44:28,079
that's i think that's a team you will

1283
00:44:31,510 --> 00:44:30,000
have to ask the question you'll have to

1284
00:44:33,030 --> 00:44:31,520
ask the surface team

1285
00:44:35,109 --> 00:44:33,040
i think john grotzinger is certainly

1286
00:44:37,670 --> 00:44:35,119
willing to talk about that at length

1287
00:44:39,349 --> 00:44:37,680
okay the basic idea was that

1288
00:44:40,630 --> 00:44:39,359

there are old rocks on mars and there

1289
00:44:42,630 --> 00:44:40,640
are some of the oldest rocks in the

1290
00:44:47,430 --> 00:44:42,640
world by yellowknife was there more to

1291
00:44:50,630 --> 00:44:49,430
i would like to know too

1292
00:44:52,069 --> 00:44:50,640
unfortunately you're just talking to the

1293
00:44:56,470 --> 00:44:52,079
delivery guys here

1294
00:45:01,750 --> 00:44:59,349
maybe you can tell me um just if it's

1295
00:45:02,790 --> 00:45:01,760
normal practice to name landing sites

1296
00:45:08,150 --> 00:45:02,800
after

1297
00:45:11,510 --> 00:45:09,829
i think the naming convention was done

1298
00:45:12,710 --> 00:45:11,520
by the science team and i'm looking

1299
00:45:14,150 --> 00:45:12,720
around here in the room to see if we

1300
00:45:16,550 --> 00:45:14,160
have a science team member and i don't

1301
00:45:17,430 --> 00:45:16,560
see one but maybe we oh wait i do see

1302
00:45:18,790 --> 00:45:17,440
one

1303
00:45:20,710 --> 00:45:18,800
but let me see if she's prepared to

1304
00:45:23,109 --> 00:45:20,720
answer the question

1305
00:45:24,790 --> 00:45:23,119
and uh joy crisp the deputy project

1306
00:45:27,349 --> 00:45:24,800
scientist is here in the room and let us

1307
00:45:28,870 --> 00:45:27,359
get her a microphone perfect thank you

1308
00:45:30,870 --> 00:45:28,880
great here we go

1309
00:45:32,950 --> 00:45:30,880
i don't fully know that

1310
00:45:34,870 --> 00:45:32,960
the you know what's behind the name but

1311
00:45:37,750 --> 00:45:34,880
i can make one correction which is it's

1312
00:45:39,670 --> 00:45:37,760
a quadrangle name so i think you heard

1313
00:45:41,910 --> 00:45:39,680

in previous press conferences that the

1314
00:45:43,910 --> 00:45:41,920
whole ellipse was divided up into these

1315
00:45:47,510 --> 00:45:43,920
quadrangles that are about a mile by a

1316
00:45:49,990 --> 00:45:47,520
mile in size and then each one of those

1317
00:45:53,270 --> 00:45:50,000
uh was mapped by a team member

1318
00:45:56,069 --> 00:45:53,280
and we got in ready right before landing

1319
00:45:57,430 --> 00:45:56,079
with geologically significant names that

1320
00:46:00,870 --> 00:45:57,440
related to

1321
00:46:02,950 --> 00:46:00,880
things like ancient geology terrains on

1322
00:46:06,470 --> 00:46:02,960
the earth that tie into our theme of

1323
00:46:08,710 --> 00:46:06,480
science so yellowknife is this one but i

1324
00:46:10,950 --> 00:46:08,720
i can't answer all the questions you

1325
00:46:12,309 --> 00:46:10,960
know that you've asked but i did want to

1326
00:46:15,109 --> 00:46:12,319
set that straight it's the name of the

1327
00:46:17,190 --> 00:46:15,119
quadrangle that we landed in

1328
00:46:18,710 --> 00:46:17,200
okay are all the other quadrangles named

1329
00:46:21,030 --> 00:46:18,720
also

1330
00:46:23,430 --> 00:46:21,040
they will be we're getting those lined

1331
00:46:26,950 --> 00:46:23,440
up okay but it is the quadrangle that

1332
00:46:29,109 --> 00:46:26,960
the curiosity landed in yes okay um do

1333
00:46:31,349 --> 00:46:29,119
you know if it's if it's

1334
00:46:33,589 --> 00:46:31,359
normal practice to name these things i

1335
00:46:35,750 --> 00:46:33,599
guess or is this unique to this project

1336
00:46:38,870 --> 00:46:35,760
well what is unique to this project was

1337
00:46:40,870 --> 00:46:38,880
that the dividing up of the ellipse into

1338
00:46:42,630 --> 00:46:40,880

quadrangles and mapping ahead of time

1339
00:46:45,750 --> 00:46:42,640
and that was really driven by the

1340
00:46:47,990 --> 00:46:45,760
wonderful orbital data sets that we had

1341
00:46:50,390 --> 00:46:48,000
we wanted to get ready by doing this

1342
00:46:52,710 --> 00:46:50,400
mapping so that we could more quickly do

1343
00:46:56,150 --> 00:46:52,720
strategic planning of where to send the

1344
00:46:57,990 --> 00:46:56,160
rover and and understand where we landed

1345
00:46:59,670 --> 00:46:58,000
could you just speak about the sort of

1346
00:47:02,069 --> 00:46:59,680
similarity between

1347
00:47:04,950 --> 00:47:02,079
the rock and surface on mars compared to

1348
00:47:06,309 --> 00:47:04,960
what's here near yellowknife

1349
00:47:07,270 --> 00:47:06,319
not yet

1350
00:47:09,270 --> 00:47:07,280
okay

1351
00:47:11,349 --> 00:47:09,280
but am i correct to say that the basis

1352
00:47:13,589 --> 00:47:11,359
between picking the name yellowknife was

1353
00:47:17,510 --> 00:47:13,599
the age of the rock right they're on the

1354
00:47:19,510 --> 00:47:17,520
order of 2.7 billion years old uh so we

1355
00:47:21,670 --> 00:47:19,520
went to mars to really get out the

1356
00:47:24,630 --> 00:47:21,680
ancient geology because that's where we

1357
00:47:28,470 --> 00:47:24,640
think there might be evidence for past

1358
00:47:30,230 --> 00:47:28,480
environments similar to on earth so it's

1359
00:47:31,829 --> 00:47:30,240
it's connected in that way simply

1360
00:47:34,550 --> 00:47:31,839
ancient rocks that might preserve

1361
00:47:37,349 --> 00:47:34,560
evidence of past environments favorable

1362
00:47:40,710 --> 00:47:39,190
one life question um

1363
00:47:42,870 --> 00:47:40,720

would anyone in yellowknife have been

1364
00:47:45,510 --> 00:47:42,880
consulted before this or or is this just

1365
00:47:48,150 --> 00:47:45,520
purely based on geological similarities

1366
00:47:50,150 --> 00:47:48,160
not that i know of but uh again i'm not

1367
00:47:52,309 --> 00:47:50,160
i wasn't totally plugged into the the

1368
00:47:53,829 --> 00:47:52,319
naming and how it was done right so

1369
00:47:55,030 --> 00:47:53,839
we'll we'll uh if you'd like to call our

1370
00:47:56,710 --> 00:47:55,040
newsroom we'll put you on the phone with

1371
00:47:58,230 --> 00:47:56,720
the person who came up with the name and

1372
00:48:00,309 --> 00:47:58,240
uh we can probably answer a lot more of

1373
00:48:01,670 --> 00:48:00,319
your questions that way and we're going

1374
00:48:02,950 --> 00:48:01,680
to take a couple more questions here in

1375
00:48:04,790 --> 00:48:02,960
the room and then we'll go back to the

1376
00:48:05,990 --> 00:48:04,800
phone lines i know you were next and

1377
00:48:07,030 --> 00:48:06,000
we'll get the microphone up here to the

1378
00:48:10,390 --> 00:48:07,040
front of the room and then we'll go to

1379
00:48:15,430 --> 00:48:12,470
uh hi there jonathan was bbc news couple

1380
00:48:17,430 --> 00:48:15,440
of quick ones did mars express see

1381
00:48:18,550 --> 00:48:17,440
uh all the way down to the ground i know

1382
00:48:20,630 --> 00:48:18,560
that

1383
00:48:22,950 --> 00:48:20,640
people in europe were were thinking they

1384
00:48:24,309 --> 00:48:22,960
may miss the uh the actual landing yeah

1385
00:48:26,390 --> 00:48:24,319
to my knowledge they did not get to the

1386
00:48:29,510 --> 00:48:26,400
ground uh this was per our predict uh we

1387
00:48:30,710 --> 00:48:29,520
expected them to to lose coverage of us

1388
00:48:31,910 --> 00:48:30,720

about a minute before landing and that

1389
00:48:33,589 --> 00:48:31,920
was about right

1390
00:48:36,390 --> 00:48:33,599
okay and the other the second one has

1391
00:48:39,030 --> 00:48:36,400
anybody sort of studied the debris field

1392
00:48:40,309 --> 00:48:39,040
uh from the descent stage impact to

1393
00:48:41,750 --> 00:48:40,319
consider what

1394
00:48:44,390 --> 00:48:41,760
how it broke apart what happened what

1395
00:48:46,710 --> 00:48:44,400
sort of impact it had uh we we have

1396
00:48:48,710 --> 00:48:46,720
another imaging opportunity coming up

1397
00:48:50,549 --> 00:48:48,720
six days after landing where we're going

1398
00:48:52,630 --> 00:48:50,559
to take another high-rise image of the

1399
00:48:55,190 --> 00:48:52,640
lander and also of the the descent stage

1400
00:48:57,109 --> 00:48:55,200
debris field that will be a nader image

1401
00:48:58,630 --> 00:48:57,119
so it'll be better resolution cleaner

1402
00:48:59,910 --> 00:48:58,640
image and we might be able to see more

1403
00:49:03,349 --> 00:48:59,920
detail

1404
00:49:05,270 --> 00:49:03,359
we have currently because it was taken

1405
00:49:06,870 --> 00:49:05,280
at such an oblique angle

1406
00:49:08,230 --> 00:49:06,880
in order to see a lot of detail there so

1407
00:49:11,910 --> 00:49:08,240
we're really waiting for that for the

1408
00:49:16,470 --> 00:49:13,910
okay we'll go next uh here on the room

1409
00:49:19,430 --> 00:49:16,480
yeah hi uh this is for ben um

1410
00:49:20,630 --> 00:49:19,440
and as as someone who is perhaps not as

1411
00:49:28,390 --> 00:49:20,640
uh

1412
00:49:31,349 --> 00:49:28,400
could one go over again

1413
00:49:33,430 --> 00:49:31,359

what the the capabilities were relative

1414
00:49:35,270 --> 00:49:33,440
to a cell phone and two if you could

1415
00:49:36,870 --> 00:49:35,280
just maybe walk us through a little bit

1416
00:49:40,230 --> 00:49:36,880
as to how you could do that i mean how

1417
00:49:41,430 --> 00:49:40,240
you can have so much capability on mars

1418
00:49:45,430 --> 00:49:41,440
based on

1419
00:49:46,630 --> 00:49:45,440
uh on software that is

1420
00:49:48,230 --> 00:49:46,640
less than what you're going to have in a

1421
00:49:50,790 --> 00:49:48,240
cell phone

1422
00:49:52,390 --> 00:49:50,800
yeah so the the rover has a uh a

1423
00:49:53,990 --> 00:49:52,400
radiation hardened processor in it

1424
00:49:56,710 --> 00:49:54,000
actually has two of them in its two

1425
00:49:59,910 --> 00:49:56,720
redundant compute elements uh the the

1426
00:50:01,510 --> 00:49:59,920
processor runs at 133 megahertz so if

1427
00:50:02,950 --> 00:50:01,520
you think about your phone having a one

1428
00:50:04,870 --> 00:50:02,960
gigahertz processor in it and your

1429
00:50:06,790 --> 00:50:04,880
desktop now having a two gigahertz or

1430
00:50:09,589 --> 00:50:06,800
two and a half gigahertz processor in it

1431
00:50:12,230 --> 00:50:09,599
uh the the processing power in our rover

1432
00:50:14,630 --> 00:50:12,240
is much less but we do have two full

1433
00:50:16,230 --> 00:50:14,640
computers in the rover so we have both a

1434
00:50:19,030 --> 00:50:16,240
prime and a redundant backup that's

1435
00:50:20,069 --> 00:50:19,040
there um and they have onboard flash

1436
00:50:22,710 --> 00:50:20,079
storage in them so when i talked about

1437
00:50:24,549 --> 00:50:22,720
the storage of the the of my phone my

1438
00:50:26,309 --> 00:50:24,559

phone has 64 gigabytes of storage the

1439
00:50:29,270 --> 00:50:26,319
rover has four gigabytes of storage in

1440
00:50:30,950 --> 00:50:29,280
it um but what we're able to do is that

1441
00:50:32,950 --> 00:50:30,960
since we're designing this custom

1442
00:50:34,390 --> 00:50:32,960
software for it we're able to optimize

1443
00:50:36,549 --> 00:50:34,400
that software for the particular

1444
00:50:38,950 --> 00:50:36,559
application that we want to do and so

1445
00:50:40,549 --> 00:50:38,960
when we were writing the edl software we

1446
00:50:41,910 --> 00:50:40,559
knew of the limitations of our processor

1447
00:50:43,670 --> 00:50:41,920
and we were able to

1448
00:50:45,829 --> 00:50:43,680
focus it just for what we needed to do

1449
00:50:46,950 --> 00:50:45,839
to get done with the edl to make edl

1450
00:50:49,030 --> 00:50:46,960
successful

1451
00:50:51,030 --> 00:50:49,040
and when you have a team that's a you

1452
00:50:52,630 --> 00:50:51,040
know really a world-class talented

1453
00:50:55,030 --> 00:50:52,640
software team and you give them a

1454
00:50:56,470 --> 00:50:55,040
challenge like make edl work on this

1455
00:50:58,150 --> 00:50:56,480
processor they're going to find a way to

1456
00:50:59,910 --> 00:50:58,160
do it and so it's really the ultimate

1457
00:51:01,910 --> 00:50:59,920
reason about how we're able to do it is

1458
00:51:03,270 --> 00:51:01,920
that we have a lot of very very talented

1459
00:51:05,109 --> 00:51:03,280
software engineers a really talented

1460
00:51:06,950 --> 00:51:05,119
software engineering team that when

1461
00:51:08,309 --> 00:51:06,960
they're given a challenge they solved it

1462
00:51:10,950 --> 00:51:08,319
and they were able to get it to work on

1463
00:51:12,150 --> 00:51:10,960

the on a on a slower processor

1464
00:51:13,990 --> 00:51:12,160
and then so one of the reasons why we

1465
00:51:14,950 --> 00:51:14,000
wait for the the r10 flight software is

1466
00:51:16,710 --> 00:51:14,960
that now we can have a version of

1467
00:51:18,950 --> 00:51:16,720
software that is optimized for the

1468
00:51:20,710 --> 00:51:18,960
surface and so we can have we can write

1469
00:51:22,230 --> 00:51:20,720
that custom software that now can just

1470
00:51:23,349 --> 00:51:22,240
focus on the surface part of the mission

1471
00:51:24,630 --> 00:51:23,359
and doesn't need to worry about some of

1472
00:51:26,390 --> 00:51:24,640
the control loops and some of the

1473
00:51:27,589 --> 00:51:26,400
additional processing overhead that

1474
00:51:30,309 --> 00:51:27,599
loads down the system when you're

1475
00:51:31,910 --> 00:51:30,319
running edl and so by going to r10 we're

1476
00:51:34,150 --> 00:51:31,920
actually freeing up some of our

1477
00:51:35,750 --> 00:51:34,160
processor utilization so we actually get

1478
00:51:37,270 --> 00:51:35,760
a lower utilization it's like closing a

1479
00:51:39,030 --> 00:51:37,280
few applications on your computer and

1480
00:51:41,589 --> 00:51:39,040
wow the whole thing runs faster and now

1481
00:51:44,309 --> 00:51:41,599
i can drive so that's what we want to do

1482
00:51:45,990 --> 00:51:44,319
and processing doesn't change at all

1483
00:51:48,390 --> 00:51:46,000
even though

1484
00:51:49,829 --> 00:51:48,400
you're going to need more

1485
00:51:51,270 --> 00:51:49,839
it's going to be doing a lot more things

1486
00:51:53,030 --> 00:51:51,280
now on the surface

1487
00:51:55,190 --> 00:51:53,040
right well the the core processor speed

1488
00:51:57,430 --> 00:51:55,200

doesn't change but we we are running a

1489
00:51:59,030 --> 00:51:57,440
lot less stuff and that's that's how we

1490
00:52:01,190 --> 00:51:59,040
we gain back some of that margin to be

1491
00:52:02,309 --> 00:52:01,200
able to uh to run the great surface

1492
00:52:05,829 --> 00:52:02,319
science applications that are going to

1493
00:52:09,589 --> 00:52:07,990
yes and and shout out from the front row

1494
00:52:11,990 --> 00:52:09,599
yes the processor is much faster than

1495
00:52:12,950 --> 00:52:12,000
the murder processor that we have

1496
00:52:14,630 --> 00:52:12,960
all right next i'm going to go to the

1497
00:52:16,390 --> 00:52:14,640
phone line we have irene claus from

1498
00:52:18,390 --> 00:52:16,400
reuters go ahead

1499
00:52:20,390 --> 00:52:18,400
um thanks very much i i have two

1500
00:52:22,150 --> 00:52:20,400
questions the first is um

1501
00:52:24,069 --> 00:52:22,160
following up i think it was the first

1502
00:52:27,030 --> 00:52:24,079
question about the um

1503
00:52:30,549 --> 00:52:27,040
homing in this uh landing target even

1504
00:52:32,549 --> 00:52:30,559
more because this sky crew system is

1505
00:52:34,950 --> 00:52:32,559
kind of being touted as a

1506
00:52:37,430 --> 00:52:34,960
i think the phrase was a workhorse for

1507
00:52:39,510 --> 00:52:37,440
the future i was just wondering if the

1508
00:52:40,790 --> 00:52:39,520
precision that you were able to get with

1509
00:52:43,750 --> 00:52:40,800
curiosity

1510
00:52:46,390 --> 00:52:43,760
is indeed going to make the cut for

1511
00:52:47,910 --> 00:52:46,400
you know future missions including like

1512
00:52:49,510 --> 00:52:47,920
supplies or

1513
00:52:51,270 --> 00:52:49,520

some of these other kind of farther off

1514
00:52:52,549 --> 00:52:51,280
things that have been talked about and

1515
00:52:54,309 --> 00:52:52,559
if you could maybe just flesh out a

1516
00:52:57,510 --> 00:52:54,319
little bit more by what you said about

1517
00:53:00,470 --> 00:52:57,520
being able to tweak that by a few miles

1518
00:53:02,549 --> 00:53:00,480
what what exactly would that entail sure

1519
00:53:03,990 --> 00:53:02,559
so i mean one of the important things

1520
00:53:05,589 --> 00:53:04,000
that curiosity does is demonstrate that

1521
00:53:07,670 --> 00:53:05,599
guided entry as we've seen here on earth

1522
00:53:09,030 --> 00:53:07,680
works on mars and that's an incredible

1523
00:53:11,670 --> 00:53:09,040
tool for the future missions to take

1524
00:53:18,470 --> 00:53:13,270
the

1525
00:53:20,870 --> 00:53:18,480
future um are we looking to land at a

1526
00:53:22,790 --> 00:53:20,880
particular target to to land near a base

1527
00:53:24,150 --> 00:53:22,800
or a sample that we want to bring back

1528
00:53:25,430 --> 00:53:24,160
um there

1529
00:53:28,069 --> 00:53:25,440
it really depends on the mission but i

1530
00:53:29,510 --> 00:53:28,079
think there are a few things that

1531
00:53:31,030 --> 00:53:29,520
we've already imagined and i think we'll

1532
00:53:32,470 --> 00:53:31,040
come up with some other ideas after we

1533
00:53:34,069 --> 00:53:32,480
look at the data to figure out how much

1534
00:53:36,150 --> 00:53:34,079
more we can can

1535
00:53:37,589 --> 00:53:36,160
finesse that ellipse and

1536
00:53:38,950 --> 00:53:37,599
and make it better yeah i think it's

1537
00:53:41,109 --> 00:53:38,960
safe to say that we're already looking

1538
00:53:43,190 --> 00:53:41,119

at it yeah

1539
00:53:47,030 --> 00:53:43,200
um thanks and then my other question i

1540
00:53:49,109 --> 00:53:47,040
think i saw a uh jpl blog post that uh

1541
00:53:51,349 --> 00:53:49,119
rob manning won the

1542
00:53:53,910 --> 00:53:51,359
the the bingo game of where it was gonna

1543
00:53:56,309 --> 00:53:53,920
land and uh just was curious if there

1544
00:54:00,309 --> 00:53:56,319
was any uh any anything more than

1545
00:54:01,190 --> 00:54:00,319
accolades with that with that gas

1546
00:54:05,430 --> 00:54:01,200
uh

1547
00:54:07,750 --> 00:54:05,440
bingo games

1548
00:54:09,910 --> 00:54:07,760
uh among different groups of people uh

1549
00:54:12,230 --> 00:54:09,920
the biggest one was a giant poster about

1550
00:54:14,790 --> 00:54:12,240
10 feet long that was printed out and

1551
00:54:16,630 --> 00:54:14,800
rob manning indeed was the closest

1552
00:54:18,630 --> 00:54:16,640
rob manning was also one of what we call

1553
00:54:20,790 --> 00:54:18,640
our grumlins who operated some of the

1554
00:54:27,030 --> 00:54:20,800
readiness testing so we believe he may

1555
00:54:30,390 --> 00:54:28,549
okay we're coming

1556
00:54:32,150 --> 00:54:30,400
back in the room and john johnson go

1557
00:54:34,390 --> 00:54:32,160
ahead

1558
00:54:36,790 --> 00:54:34,400
i just wanted a little more information

1559
00:54:38,950 --> 00:54:36,800
if any of you have it about that already

1560
00:54:40,710 --> 00:54:38,960
iconic photograph of the

1561
00:54:41,829 --> 00:54:40,720
parachute descending in the with the

1562
00:54:44,309 --> 00:54:41,839
rover

1563
00:54:46,870 --> 00:54:44,319

below it um is can you

1564
00:54:49,510 --> 00:54:46,880
this this picture had to be programmed

1565
00:54:51,990 --> 00:54:49,520
far in advance is that right to be taken

1566
00:54:53,670 --> 00:54:52,000
yeah that's right we had to give the uh

1567
00:54:55,349 --> 00:54:53,680
in fact we provided the first timing

1568
00:54:57,030 --> 00:54:55,359
that we wanted this parachute picture to

1569
00:54:59,670 --> 00:54:57,040
be taken uh

1570
00:55:01,750 --> 00:54:59,680
way uh back in april uh it was

1571
00:55:03,990 --> 00:55:01,760
originally it's targeted for about six

1572
00:55:05,750 --> 00:55:04,000
minutes after entry uh the goal was to

1573
00:55:07,510 --> 00:55:05,760
make sure that you know remember things

1574
00:55:09,750 --> 00:55:07,520
are focused on in case things don't go

1575
00:55:11,510 --> 00:55:09,760
well not if things do go well

1576
00:55:13,109 --> 00:55:11,520
but the idea was to get a picture to

1577
00:55:15,270 --> 00:55:13,119
make sure that we saw an inflated

1578
00:55:17,750 --> 00:55:15,280
parachute or not an inflated parachute

1579
00:55:19,670 --> 00:55:17,760
to see if there was any damage or not

1580
00:55:20,950 --> 00:55:19,680
so the goal was to take it long enough

1581
00:55:23,270 --> 00:55:20,960
into entry to make sure the parachute

1582
00:55:29,510 --> 00:55:23,280
was inflated but not so late that it had

1583
00:55:32,470 --> 00:55:31,030
it's it's certainly very difficult it

1584
00:55:34,069 --> 00:55:32,480
was certainly a little bit more

1585
00:55:36,069 --> 00:55:34,079
uncertain this time than it was for

1586
00:55:38,150 --> 00:55:36,079
phoenix per se because

1587
00:55:41,510 --> 00:55:38,160
mro is coming which took the picture the

1588
00:55:43,270 --> 00:55:41,520

high-rise the high-rise camera is on mro

1589
00:55:45,589 --> 00:55:43,280
that's right and it's coming overhead

1590
00:55:47,750 --> 00:55:45,599
almost directly overhead so we had to be

1591
00:55:49,990 --> 00:55:47,760
in the middle roughly five and a half

1592
00:55:52,230 --> 00:55:50,000
six kilometers of the uh with it of the

1593
00:55:53,430 --> 00:55:52,240
landing target to uh to make sure we

1594
00:55:55,430 --> 00:55:53,440
were in the picture

1595
00:55:56,630 --> 00:55:55,440
uh guided entry helped with that a lot

1596
00:55:58,950 --> 00:55:56,640
obviously we wouldn't be there without

1597
00:56:00,470 --> 00:55:58,960
guided entry uh so it's a

1598
00:56:02,069 --> 00:56:00,480
it's a also this picture is also a

1599
00:56:03,829 --> 00:56:02,079
confirmation of the precision with which

1600
00:56:06,230 --> 00:56:03,839
we landed

1601
00:56:09,109 --> 00:56:06,240
just some stats on on that photograph it

1602
00:56:12,470 --> 00:56:09,119
was uh it's about uh

1603
00:56:15,829 --> 00:56:12,480
one second or so before mle priming so

1604
00:56:17,750 --> 00:56:15,839
we're at an altitude here of about 3000

1605
00:56:19,270 --> 00:56:17,760
meters just a little bit uh right around

1606
00:56:21,910 --> 00:56:19,280
3000 meters

1607
00:56:23,990 --> 00:56:21,920
and uh descending probably about

1608
00:56:24,950 --> 00:56:24,000
uh about 80 meters per second at this

1609
00:56:26,549 --> 00:56:24,960
point

1610
00:56:29,589 --> 00:56:26,559
and i'll add one more thing clearly we

1611
00:56:34,950 --> 00:56:32,630
pre pre-landing day uh we guessed we had

1612
00:56:37,589 --> 00:56:34,960
about a 50 50 chance of actually getting

1613
00:56:38,870 --> 00:56:37,599

this picture uh just based on the fact

1614
00:56:40,630 --> 00:56:38,880
that the field of view of the high-rise

1615
00:56:44,950 --> 00:56:40,640
camera doesn't cover the entire landing

1616
00:56:46,069 --> 00:56:44,960
ellipse so it was about 50 50.

1617
00:56:46,950 --> 00:56:46,079
okay we're going to take one more here

1618
00:56:50,230 --> 00:56:46,960
in the room and then we'll go to the

1619
00:56:51,430 --> 00:56:50,240
phone lines go ahead yeah i i

1620
00:56:52,950 --> 00:56:51,440
i just want to double check when does

1621
00:56:55,190 --> 00:56:52,960
this the installation of the software

1622
00:56:57,190 --> 00:56:55,200
upgrade begin on earth time would that

1623
00:56:58,309 --> 00:56:57,200
be like tomorrow or

1624
00:56:59,349 --> 00:56:58,319
and like how long and it's supposed to

1625
00:57:01,109 --> 00:56:59,359
go for four days you know when it's

1626
00:57:03,430 --> 00:57:01,119
supposed to end earth time approximately

1627
00:57:05,349 --> 00:57:03,440
right so it's it's it goes through saw

1628
00:57:07,270 --> 00:57:05,359
eight so it starts on five so it starts

1629
00:57:09,030 --> 00:57:07,280
today and starts later today earth time

1630
00:57:10,870 --> 00:57:09,040
right and it goes through saw eight so

1631
00:57:11,829 --> 00:57:10,880
four days from today

1632
00:57:13,589 --> 00:57:11,839
okay and then the other thing is that

1633
00:57:16,069 --> 00:57:13,599
what can can you guys just we're quickly

1634
00:57:18,309 --> 00:57:16,079
kind of more in a succinct more uh

1635
00:57:21,190 --> 00:57:18,319
consumer friendly way explain like the

1636
00:57:23,670 --> 00:57:21,200
what you think were the factors in in in

1637
00:57:24,549 --> 00:57:23,680
the there being a 1.5

1638
00:57:27,270 --> 00:57:24,559

mile

1639
00:57:30,309 --> 00:57:27,280
deviation from the you know your your

1640
00:57:32,390 --> 00:57:30,319
ideal landing sure spot well i mean it

1641
00:57:33,670 --> 00:57:32,400
was all ideal right it was inside

1642
00:57:35,670 --> 00:57:33,680
inside the ellipse

1643
00:57:38,630 --> 00:57:35,680
but the uh so we're still looking at the

1644
00:57:40,390 --> 00:57:38,640
data but as i tried to explain before

1645
00:57:43,589 --> 00:57:40,400
we had a bank reversal

1646
00:57:45,030 --> 00:57:43,599
uh pretty late and that basically lofts

1647
00:57:46,150 --> 00:57:45,040
us a little bit basically stretches us a

1648
00:57:47,510 --> 00:57:46,160
little bit out and we didn't have time

1649
00:57:49,270 --> 00:57:47,520
to correct for that

1650
00:57:50,950 --> 00:57:49,280
before we started aligning it to fly

1651
00:57:52,950 --> 00:57:50,960
right towards the center of the

1652
00:57:55,510 --> 00:57:52,960
along the center line of the ellipse

1653
00:57:57,270 --> 00:57:55,520
so we think that's part of it um

1654
00:57:59,190 --> 00:57:57,280
as al's mentioned before we're also

1655
00:58:01,190 --> 00:57:59,200
sensitive in terms of where we land the

1656
00:58:02,950 --> 00:58:01,200
ellipse due to headwind or tail when

1657
00:58:03,829 --> 00:58:02,960
compared to what we were expecting and

1658
00:58:05,030 --> 00:58:03,839
so that's only one of the things we

1659
00:58:06,789 --> 00:58:05,040
tried to reconstruct is what were the

1660
00:58:09,030 --> 00:58:06,799
winds doing the day we landed

1661
00:58:10,230 --> 00:58:09,040
and how did that shift where we where we

1662
00:58:11,670 --> 00:58:10,240
landed you thought it might have been a

1663
00:58:13,030 --> 00:58:11,680

tailwind in this case

1664
00:58:14,870 --> 00:58:13,040
it would suggest that but we'll have to

1665
00:58:16,390 --> 00:58:14,880
look at it

1666
00:58:17,750 --> 00:58:16,400
thank you

1667
00:58:18,950 --> 00:58:17,760
all right we're going to the phone line

1668
00:58:21,430 --> 00:58:18,960
leonard david

1669
00:58:23,589 --> 00:58:21,440
with aerospace america go ahead yeah hi

1670
00:58:25,109 --> 00:58:23,599
leonard david here um

1671
00:58:26,870 --> 00:58:25,119
you've kind of already touched on some

1672
00:58:28,470 --> 00:58:26,880
of this but i hate to drag you back

1673
00:58:30,549 --> 00:58:28,480
there but uh

1674
00:58:32,870 --> 00:58:30,559
if you were an astrobiologist on this

1675
00:58:35,190 --> 00:58:32,880
mission you probably would be a little

1676
00:58:38,789 --> 00:58:35,200
concerned about the kick-up of

1677
00:58:41,270 --> 00:58:38,799
of material off mars and scattering on

1678
00:58:43,430 --> 00:58:41,280
top of the rover

1679
00:58:45,829 --> 00:58:43,440
is there anything that could be done

1680
00:58:47,109 --> 00:58:45,839
with longer tethers or less powerful

1681
00:58:49,430 --> 00:58:47,119
engines or

1682
00:58:51,750 --> 00:58:49,440
anything like that that

1683
00:58:53,670 --> 00:58:51,760
would fit into a new

1684
00:58:55,109 --> 00:58:53,680
design of a sky crane particularly if

1685
00:58:56,470 --> 00:58:55,119
we're really going to be using that

1686
00:58:58,789 --> 00:58:56,480
particular

1687
00:59:02,309 --> 00:58:58,799
device in the future

1688
00:59:04,549 --> 00:59:02,319

sure certainly one way that you could

1689
00:59:06,390 --> 00:59:04,559
one way that you could help mitigate uh

1690
00:59:08,230 --> 00:59:06,400
doing this is actually using a longer

1691
00:59:09,190 --> 00:59:08,240
tether but

1692
00:59:14,470 --> 00:59:09,200
we

1693
00:59:16,470 --> 00:59:14,480
development of uh during development of

1694
00:59:18,789 --> 00:59:16,480
curiosity and

1695
00:59:21,190 --> 00:59:18,799
we tried to keep the

1696
00:59:23,589 --> 00:59:21,200
strike the balance between keeping the

1697
00:59:25,510 --> 00:59:23,599
bridles short and short enough to be

1698
00:59:27,190 --> 00:59:25,520
manageable and

1699
00:59:29,589 --> 00:59:27,200
reducing the amount of debris that we

1700
00:59:32,789 --> 00:59:29,599
would kick up and all along we consulted

1701
00:59:34,870 --> 00:59:32,799
with the instruments and the the people

1702
00:59:37,589 --> 00:59:34,880
who were the cognizant engineers on the

1703
00:59:39,829 --> 00:59:37,599
rover top deck to make sure that they

1704
00:59:42,150 --> 00:59:39,839
were in the loop about uh knowing that

1705
00:59:44,390 --> 00:59:42,160
debris could be up there and and to what

1706
00:59:46,230 --> 00:59:44,400
extent it could be there and so

1707
00:59:48,230 --> 00:59:46,240
everything that that we've seen in the

1708
00:59:50,069 --> 00:59:48,240
pictures and the data that we've got

1709
00:59:51,990 --> 00:59:50,079
during landing it's all

1710
00:59:55,030 --> 00:59:52,000
all as expected

1711
00:59:57,109 --> 00:59:55,040
okay thanks very much

1712
00:59:59,589 --> 00:59:57,119
okay we've got another call on the phone

1713
01:00:01,510 --> 00:59:59,599

line it's mike wahl from space.com go

1714
01:00:03,510 --> 01:00:01,520
ahead

1715
01:00:04,950 --> 01:00:03,520
yeah like i've got two questions for for

1716
01:00:06,549 --> 01:00:04,960
ben first of all could you just actually

1717
01:00:07,589 --> 01:00:06,559
confirm that the

1718
01:00:09,030 --> 01:00:07,599
the

1719
01:00:10,789 --> 01:00:09,040
actual surface software that you're

1720
01:00:13,030 --> 01:00:10,799
going to switch over to that that was

1721
01:00:14,309 --> 01:00:13,040
being to the rover during cruise right i

1722
01:00:16,789 --> 01:00:14,319
just want to make sure that i understand

1723
01:00:18,230 --> 01:00:16,799
that correctly and it wasn't set

1724
01:00:20,390 --> 01:00:18,240
an extent from work for the last few

1725
01:00:22,950 --> 01:00:20,400
days and also i mean is there any

1726
01:00:24,630 --> 01:00:22,960
science that that the rover can be doing

1727
01:00:26,150 --> 01:00:24,640
during during the installation or is it

1728
01:00:29,670 --> 01:00:26,160
going to be pretty pretty quiet on the

1729
01:00:31,750 --> 01:00:29,680
science front for the next few days

1730
01:00:34,150 --> 01:00:31,760
so on the first question uh yeah we we

1731
01:00:36,630 --> 01:00:34,160
uploaded this software during cruise

1732
01:00:38,230 --> 01:00:36,640
and had it stored on the the file system

1733
01:00:40,870 --> 01:00:38,240
ready to be installed once we got down

1734
01:00:42,630 --> 01:00:40,880
to the surface on surface of mars

1735
01:00:43,990 --> 01:00:42,640
we do have just for background we do

1736
01:00:45,589 --> 01:00:44,000
have the capability to upload software

1737
01:00:47,510 --> 01:00:45,599
while we're on the surface and we do

1738
01:00:49,670 --> 01:00:47,520

actually plan to continue to update the

1739
01:00:51,750 --> 01:00:49,680
software as we go through the mission so

1740
01:00:53,030 --> 01:00:51,760
this isn't it didn't necessarily need to

1741
01:00:54,230 --> 01:00:53,040
be uploaded in cruise but we had an

1742
01:00:55,829 --> 01:00:54,240
opportunity to do that and the software

1743
01:00:57,349 --> 01:00:55,839
is ready to go so we chose the app we

1744
01:00:58,549 --> 01:00:57,359
chose that as the opportunity to upload

1745
01:01:00,950 --> 01:00:58,559
the software

1746
01:01:02,470 --> 01:01:00,960
um as far as science goes over the next

1747
01:01:04,549 --> 01:01:02,480
few solves this is primarily an

1748
01:01:07,109 --> 01:01:04,559
engineering activity um

1749
01:01:08,870 --> 01:01:07,119
so we are we are mostly focusing on just

1750
01:01:10,710 --> 01:01:08,880
getting done the engineering of doing

1751
01:01:13,510 --> 01:01:10,720
the installation and standing down on

1752
01:01:15,829 --> 01:01:13,520
science for the next four songs

1753
01:01:17,829 --> 01:01:15,839
thank you

1754
01:01:18,630 --> 01:01:17,839
okay we're going now here in front go

1755
01:01:20,710 --> 01:01:18,640
ahead

1756
01:01:22,870 --> 01:01:20,720
hi there sally rail with planetary

1757
01:01:25,430 --> 01:01:22,880
society

1758
01:01:28,470 --> 01:01:25,440
were there any surprises

1759
01:01:30,789 --> 01:01:28,480
in edl at all or would it be safe to say

1760
01:01:35,190 --> 01:01:30,799
that the biggest surprise was that it

1761
01:01:38,870 --> 01:01:36,630
there were a couple surprises i think

1762
01:01:40,549 --> 01:01:38,880
that we're going to look into

1763
01:01:42,630 --> 01:01:40,559

you know we landed with

1764
01:01:43,910 --> 01:01:42,640
more fuel than i think we expected a

1765
01:01:45,910 --> 01:01:43,920
little bit more fuel than we think you

1766
01:01:47,109 --> 01:01:45,920
expected not a bad situation to be in

1767
01:01:48,870 --> 01:01:47,119
necessarily

1768
01:01:50,470 --> 01:01:48,880
but it's something we we definitely want

1769
01:01:53,270 --> 01:01:50,480
to take a look at

1770
01:01:55,589 --> 01:01:53,280
there were also a couple of uh of tone

1771
01:01:57,349 --> 01:01:55,599
indications uh sent direct to earth uh

1772
01:01:59,510 --> 01:01:57,359
that uh also

1773
01:02:01,430 --> 01:01:59,520
you know seem unlikely so we wanna take

1774
01:02:04,069 --> 01:02:01,440
a look take a look at that as well uh to

1775
01:02:05,670 --> 01:02:04,079
see if anything is real there too uh you

1776
01:02:07,589 --> 01:02:05,680
know again we're working with one

1777
01:02:09,270 --> 01:02:07,599
megabyte of the 60 megabytes or 100

1778
01:02:11,270 --> 01:02:09,280
megabytes excuse me that we eventually

1779
01:02:13,430 --> 01:02:11,280
hope to get so i think the best thing

1780
01:02:14,950 --> 01:02:13,440
for us to do now is kind of wait and see

1781
01:02:16,710 --> 01:02:14,960
get that full data set and go through

1782
01:02:19,270 --> 01:02:16,720
that in detail that'll answer all our

1783
01:02:21,670 --> 01:02:19,280
questions okay and a personal question

1784
01:02:25,190 --> 01:02:21,680
for you alan you have been through

1785
01:02:26,789 --> 01:02:25,200
landing before with mer you announced um

1786
01:02:29,270 --> 01:02:26,799
the curiosity landy and i'm just

1787
01:02:32,309 --> 01:02:29,280
wondering how does that fit in your

1788
01:02:33,750 --> 01:02:32,319

repertoire of life moments

1789
01:02:37,190 --> 01:02:33,760
certainly way up there this has been an

1790
01:02:40,470 --> 01:02:38,630
thank you thank you

1791
01:02:41,990 --> 01:02:40,480
all right lee right with irish

1792
01:02:43,750 --> 01:02:42,000
television i just wanted to follow up on

1793
01:02:47,430 --> 01:02:43,760
leonard david's question

1794
01:02:49,109 --> 01:02:47,440
um about the descent stage

1795
01:02:51,349 --> 01:02:49,119
looking to the future since this seems

1796
01:02:52,230 --> 01:02:51,359
to be a game changer potentially

1797
01:02:54,309 --> 01:02:52,240
um

1798
01:02:55,750 --> 01:02:54,319
are there obvious uh

1799
01:02:57,829 --> 01:02:55,760
ways that you would do it differently

1800
01:02:58,950 --> 01:02:57,839
now for instance it would seem that it

1801
01:03:01,270 --> 01:02:58,960
was

1802
01:03:04,230 --> 01:03:01,280
dare i say over engineered for safety

1803
01:03:06,549 --> 01:03:04,240
reasons you used viking legacy jets and

1804
01:03:07,910 --> 01:03:06,559
so on uh are there

1805
01:03:10,150 --> 01:03:07,920
obvious things that you would do

1806
01:03:11,990 --> 01:03:10,160
differently straight away and do you

1807
01:03:14,630 --> 01:03:12,000
envisage that that this would be a much

1808
01:03:15,589 --> 01:03:14,640
lighter and meaner vehicle uh next time

1809
01:03:17,029 --> 01:03:15,599
around

1810
01:03:19,109 --> 01:03:17,039
well

1811
01:03:21,349 --> 01:03:19,119
there are minor things that we would

1812
01:03:23,750 --> 01:03:21,359
probably change if we had to do it again

1813
01:03:25,029 --> 01:03:23,760

but you know one of the one of the best

1814
01:03:26,390 --> 01:03:25,039
ways to do

1815
01:03:28,470 --> 01:03:26,400
lower cost

1816
01:03:29,670 --> 01:03:28,480
more reliable missions is to stick with

1817
01:03:30,870 --> 01:03:29,680
what works

1818
01:03:32,549 --> 01:03:30,880
and

1819
01:03:34,710 --> 01:03:32,559
you know i wouldn't say that the system

1820
01:03:37,510 --> 01:03:34,720
was was over designed at all i mean it

1821
01:03:39,910 --> 01:03:37,520
was designed to allow the scientists to

1822
01:03:41,670 --> 01:03:39,920
choose where they wanted to explore on

1823
01:03:44,710 --> 01:03:41,680
mars they happened to

1824
01:03:47,829 --> 01:03:44,720
pick a place that had a nice flat

1825
01:03:50,069 --> 01:03:47,839
landing pad right next to it and so

1826
01:03:52,390 --> 01:03:50,079
as an edl team we kind of got lucky

1827
01:03:55,190 --> 01:03:52,400
because the the science store they

1828
01:03:56,549 --> 01:03:55,200
wanted to go to had a parking lot and so

1829
01:04:01,109 --> 01:03:56,559
we were

1830
01:04:03,270 --> 01:04:01,119
of that and uh had we landed on you know

1831
01:04:04,870 --> 01:04:03,280
we had we used the sky crane to its full

1832
01:04:07,029 --> 01:04:04,880
extent we would have been able to handle

1833
01:04:08,950 --> 01:04:07,039
uh much more rugged terrain much larger

1834
01:04:10,950 --> 01:04:08,960
rocks things like that so i wouldn't say

1835
01:04:12,470 --> 01:04:10,960
it's over designed and and things that

1836
01:04:15,349 --> 01:04:12,480
we would change in the future

1837
01:04:17,910 --> 01:04:15,359
uh you know just very minor very minor

1838
01:04:20,950 --> 01:04:19,430

okay we have a call on the line ken

1839
01:04:21,990 --> 01:04:20,960
kramer with space flight magazine go

1840
01:04:24,150 --> 01:04:22,000
ahead

1841
01:04:27,029 --> 01:04:24,160
hi thank you well congratulations first

1842
01:04:27,829 --> 01:04:27,039
on on a great success uh my question is

1843
01:04:29,910 --> 01:04:27,839
um

1844
01:04:32,230 --> 01:04:29,920
would you be able to apply any of these

1845
01:04:34,470 --> 01:04:32,240
guided entry techniques to the airbag

1846
01:04:36,710 --> 01:04:34,480
system if you had to go back to that to

1847
01:04:39,430 --> 01:04:36,720
make that a little bit you know far more

1848
01:04:41,670 --> 01:04:39,440
precise actually thank you

1849
01:04:42,710 --> 01:04:41,680
i believe we could but it would require

1850
01:04:45,349 --> 01:04:42,720
um

1851
01:04:47,190 --> 01:04:45,359
using rcs jets just like curiosity did

1852
01:04:48,470 --> 01:04:47,200
to basically control the uh the

1853
01:04:50,390 --> 01:04:48,480
orientation

1854
01:04:52,870 --> 01:04:50,400
during the hypersonic flight

1855
01:04:55,430 --> 01:04:52,880
um i don't think the mer rovers had that

1856
01:04:58,549 --> 01:04:55,440
capability so it would it would be a

1857
01:05:01,589 --> 01:04:59,750
thanks

1858
01:05:07,990 --> 01:05:01,599
okay any more questions here in the room

1859
01:05:12,230 --> 01:05:10,230
uh jonathan amos bbc again is there any

1860
01:05:14,470 --> 01:05:12,240
heat shield data

1861
01:05:16,789 --> 01:05:14,480
uh there is a medley data which is this

1862
01:05:18,710 --> 01:05:16,799
the mars edl instrumentation data uh

1863
01:05:20,789 --> 01:05:18,720

that instrumented the heat shield uh to

1864
01:05:22,470 --> 01:05:20,799
tell us about what was going on uh we

1865
01:05:23,990 --> 01:05:22,480
are just getting that data back now uh

1866
01:05:26,470 --> 01:05:24,000
some of that was sent in real time but

1867
01:05:28,309 --> 01:05:26,480
the the the recorded data parts of that

1868
01:05:29,990 --> 01:05:28,319
now are actually have gotten down and

1869
01:05:31,109 --> 01:05:30,000
we're beginning to look at that

1870
01:05:32,710 --> 01:05:31,119
i think it's safe to say we have the

1871
01:05:34,309 --> 01:05:32,720
data i think it's also safe to say that

1872
01:05:35,190 --> 01:05:34,319
we haven't looked through it in detail

1873
01:05:37,029 --> 01:05:35,200
yet

1874
01:05:39,430 --> 01:05:37,039
we do know that we we triggered several

1875
01:05:41,029 --> 01:05:39,440
tones during uh during edl that told us

1876
01:05:43,109 --> 01:05:41,039
that things were going pretty much as

1877
01:05:45,190 --> 01:05:43,119
expected that we did see heating on the

1878
01:05:47,190 --> 01:05:45,200
spacecraft but we don't have enough yet

1879
01:05:48,870 --> 01:05:47,200
to go through in detail about how well

1880
01:05:51,109 --> 01:05:48,880
the heat shield performed do you have a

1881
01:05:53,190 --> 01:05:51,119
peak temperature we don't right now i

1882
01:05:55,670 --> 01:05:53,200
think we need to look at uh exactly how

1883
01:05:57,190 --> 01:05:55,680
deep uh which thermocouples uh

1884
01:05:58,630 --> 01:05:57,200
we got measurements from and and what

1885
01:06:00,150 --> 01:05:58,640
those measurements were

1886
01:06:01,750 --> 01:06:00,160
the medley team is i'm sure already

1887
01:06:03,910 --> 01:06:01,760
beginning to look at information but we

1888
01:06:05,589 --> 01:06:03,920

need to correlate that as well against

1889
01:06:08,870 --> 01:06:05,599
the spacecraft trajectory data which

1890
01:06:12,870 --> 01:06:08,880
we're also waiting to get back down

1891
01:06:16,309 --> 01:06:14,470
mark kaufman again with washington post

1892
01:06:17,349 --> 01:06:16,319
in national geographic steve you had

1893
01:06:18,630 --> 01:06:17,359
said that

1894
01:06:22,470 --> 01:06:18,640
reusing

1895
01:06:24,470 --> 01:06:22,480
technology is the best way to cut cost

1896
01:06:25,829 --> 01:06:24,480
just in terms of a ballpark figure if

1897
01:06:27,589 --> 01:06:25,839
you were to do

1898
01:06:31,190 --> 01:06:27,599
something like this again i mean are we

1899
01:06:36,470 --> 01:06:33,750
i'm not falling into that trap but

1900
01:06:38,150 --> 01:06:36,480
uh you know i you know we would have to

1901
01:06:40,549 --> 01:06:38,160
we'd have to look at the numbers to see

1902
01:06:44,630 --> 01:06:40,559
exactly you know what what a rebuild of

1903
01:06:49,270 --> 01:06:45,670
okay

1904
01:06:51,430 --> 01:06:49,280
grotzinger in the room and he wants to

1905
01:06:54,470 --> 01:06:51,440
talk a little bit more about the naming

1906
01:06:56,309 --> 01:06:54,480
of that quadrangle so john go ahead

1907
01:06:57,990 --> 01:06:56,319
um i just want to make sure that

1908
01:06:59,670 --> 01:06:58,000
everybody's on the same page and i'm

1909
01:07:01,349 --> 01:06:59,680
happy to answer questions afterwards not

1910
01:07:02,470 --> 01:07:01,359
to detract from the great work these

1911
01:07:04,870 --> 01:07:02,480
guys have done

1912
01:07:06,950 --> 01:07:04,880
uh to point number one is this is not

1913
01:07:08,950 --> 01:07:06,960

the name of the landing site yellowknife

1914
01:07:10,630 --> 01:07:08,960
is the name of the quadrangle

1915
01:07:12,230 --> 01:07:10,640
and the reason that the science team

1916
01:07:15,190 --> 01:07:12,240
came up with that as an option is

1917
01:07:17,190 --> 01:07:15,200
because in north america if you ask what

1918
01:07:19,190 --> 01:07:17,200
is the port of call that you leave from

1919
01:07:21,349 --> 01:07:19,200
to go on the great missions of

1920
01:07:23,829 --> 01:07:21,359
geological mapping to the oldest rocks

1921
01:07:25,510 --> 01:07:23,839
in north america it's yellowknife you

1922
01:07:27,029 --> 01:07:25,520
can drive there you can fly there you

1923
01:07:29,109 --> 01:07:27,039
can't take a train there

1924
01:07:31,829 --> 01:07:29,119
and uh and from there you have to get in

1925
01:07:33,190 --> 01:07:31,839
a bush plane uh store some gear and go

1926
01:07:35,349 --> 01:07:33,200
off for several months at a time and

1927
01:07:36,710 --> 01:07:35,359
usually get picked up later on having

1928
01:07:38,710 --> 01:07:36,720
maps some old rocks so we thought it

1929
01:07:39,910 --> 01:07:38,720
would be kind of neat because our sort

1930
01:07:41,910 --> 01:07:39,920
of

1931
01:07:43,750 --> 01:07:41,920
mapping procedure

1932
01:07:46,549 --> 01:07:43,760
will involve moving between these

1933
01:07:48,309 --> 01:07:46,559
different quadrangles and it's sort of a

1934
01:07:51,510 --> 01:07:48,319
great tradition that was started here on

1935
01:07:53,430 --> 01:07:51,520
earth and we're trying to do it on mars

1936
01:07:54,950 --> 01:07:53,440
great thank you okay we have a question

1937
01:08:01,029 --> 01:07:54,960
at the very back

1938
01:08:04,950 --> 01:08:03,430

totten with kpcc um you know i was

1939
01:08:06,630 --> 01:08:04,960
wondering just i mean this landing

1940
01:08:08,150 --> 01:08:06,640
happened in the middle of the olympics

1941
01:08:09,670 --> 01:08:08,160
and i you know i think we all expected

1942
01:08:11,190 --> 01:08:09,680
to be a big deal but it is really caught

1943
01:08:12,470 --> 01:08:11,200
on i can't seem to turn on facebook or

1944
01:08:14,390 --> 01:08:12,480
twitter without

1945
01:08:16,789 --> 01:08:14,400
someone still talking about it or new

1946
01:08:19,510 --> 01:08:16,799
memes popping up animations you know

1947
01:08:21,189 --> 01:08:19,520
cats all over the rover now

1948
01:08:23,430 --> 01:08:21,199
i want to know a little bit if the sort

1949
01:08:25,269 --> 01:08:23,440
of total love and embrace that the

1950
01:08:27,030 --> 01:08:25,279
public seems to be giving it surprises

1951
01:08:28,390 --> 01:08:27,040
you a bit because you were just focused

1952
01:08:29,349 --> 01:08:28,400
on the science and kind of what what are

1953
01:08:30,550 --> 01:08:29,359
some of the more interesting things

1954
01:08:32,709 --> 01:08:30,560
you've seen

1955
01:08:34,149 --> 01:08:32,719
in the public sphere about this landing

1956
01:08:35,990 --> 01:08:34,159
and about curiosity have you gotten any

1957
01:08:37,110 --> 01:08:36,000
cool fan mail or any cool reactions from

1958
01:08:39,910 --> 01:08:37,120
people have you seen something that just

1959
01:08:42,149 --> 01:08:39,920
like totally tickled you

1960
01:08:43,590 --> 01:08:42,159
well i can i can say a few words about

1961
01:08:45,910 --> 01:08:43,600
that and i'll let everybody else on the

1962
01:08:48,709 --> 01:08:45,920
team chime in too but uh i i've actually

1963
01:08:50,950 --> 01:08:48,719

been overwhelmed by the the amount of uh

1964
01:08:52,390 --> 01:08:50,960
just the social media interaction i i

1965
01:08:55,510 --> 01:08:52,400
get questions on

1966
01:08:58,070 --> 01:08:55,520
on twitter and email and facebook and

1967
01:08:59,910 --> 01:08:58,080
it it's great to be able to to be

1968
01:09:01,590 --> 01:08:59,920
completely in touch with the public on

1969
01:09:02,709 --> 01:09:01,600
this i feel like it gives them an

1970
01:09:04,789 --> 01:09:02,719
opportunity to feel like they're

1971
01:09:07,110 --> 01:09:04,799
connected to this mission and after all

1972
01:09:08,950 --> 01:09:07,120
they paid for it so they should be

1973
01:09:11,990 --> 01:09:08,960
and uh

1974
01:09:13,349 --> 01:09:12,000
it was kind of hard to follow all of the

1975
01:09:15,030 --> 01:09:13,359
all of this

1976
01:09:16,229 --> 01:09:15,040
outside activities that were going on

1977
01:09:18,149 --> 01:09:16,239
when you're in the control room and

1978
01:09:20,630 --> 01:09:18,159
focused on making making sure we land

1979
01:09:22,630 --> 01:09:20,640
safely but uh but i've still it's it's

1980
01:09:24,390 --> 01:09:22,640
going to take me weeks to to get through

1981
01:09:28,470 --> 01:09:24,400
all of the

1982
01:09:29,749 --> 01:09:28,480
the twitter comments and and all the

1983
01:09:32,309 --> 01:09:29,759
other articles that have been online

1984
01:09:33,669 --> 01:09:32,319
it's just been amazing for me

1985
01:09:36,950 --> 01:09:33,679
i think i think it's great i think it

1986
01:09:39,430 --> 01:09:36,960
actually shows that that america the

1987
01:09:41,349 --> 01:09:39,440
world is interested in math and science

1988
01:09:44,390 --> 01:09:41,359

really when you break it down to that

1989
01:09:46,470 --> 01:09:44,400
so i i think it's uh it's it's great i

1990
01:09:49,829 --> 01:09:46,480
hope the communication and the social

1991
01:09:51,349 --> 01:09:49,839
media it keeps keeps rolling along um

1992
01:09:53,910 --> 01:09:51,359
especially now that we're in surface

1993
01:09:56,149 --> 01:09:53,920
operations things are also

1994
01:09:57,430 --> 01:09:56,159
just as exciting as edl

1995
01:09:58,550 --> 01:09:57,440
did you ever expect when you started

1996
01:10:02,149 --> 01:09:58,560
this mission though that you guys would

1997
01:10:03,750 --> 01:10:02,159
end up being such rock stars

1998
01:10:05,910 --> 01:10:03,760
i got recognized in the pizza parlor on

1999
01:10:08,470 --> 01:10:05,920
my day

2000
01:10:10,390 --> 01:10:08,480
that was a little weird for me

2001
01:10:12,470 --> 01:10:10,400
you know sometimes you worry that uh you

2002
01:10:13,750 --> 01:10:12,480
know that that as a as a people we're

2003
01:10:15,669 --> 01:10:13,760
not that interested in doing this

2004
01:10:16,550 --> 01:10:15,679
anymore but it's it's great to see that

2005
01:10:17,990 --> 01:10:16,560
we are

2006
01:10:22,790 --> 01:10:18,000
that

2007
01:10:25,910 --> 01:10:24,149
for me the

2008
01:10:28,229 --> 01:10:25,920
you know the the media attention the

2009
01:10:30,630 --> 01:10:28,239
social media has been overwhelming but

2010
01:10:32,550 --> 01:10:30,640
the the biggest surprise

2011
01:10:33,510 --> 01:10:32,560
to me having gone through this now is

2012
01:10:37,910 --> 01:10:33,520
the

2013
01:10:39,110 --> 01:10:37,920

associated with a successful landing and

2014
01:10:41,030 --> 01:10:39,120
the

2015
01:10:43,510 --> 01:10:41,040
how much that's amplified by having such

2016
01:10:45,030 --> 01:10:43,520
an awesome group of co-workers

2017
01:10:46,149 --> 01:10:45,040
uh you know there's thousands of people

2018
01:10:47,990 --> 01:10:46,159
that have put this together and

2019
01:10:50,630 --> 01:10:48,000
everybody's worked tirelessly with

2020
01:10:52,790 --> 01:10:50,640
tremendous dedication uh everybody here

2021
01:10:54,870 --> 01:10:52,800
is fantastic to work with and it just

2022
01:10:56,630 --> 01:10:54,880
makes it all the sweeter to to share the

2023
01:11:00,550 --> 01:10:56,640
triumph with such a fantastic group of

2024
01:11:03,750 --> 01:11:02,149
all right do we have any more questions

2025
01:11:07,990 --> 01:11:03,760
here in the room we've got one up here

2026
01:11:08,000 --> 01:11:10,790
okay

2027
01:11:14,310 --> 01:11:12,790
thanks craig cavall with aerospace

2028
01:11:17,669 --> 01:11:14,320
america again

2029
01:11:20,070 --> 01:11:17,679
uh how important was the two-year delay

2030
01:11:23,990 --> 01:11:20,080
to the ultimate success

2031
01:11:28,709 --> 01:11:25,910
i think it was critical um you know the

2032
01:11:31,270 --> 01:11:28,719
we we weren't ready uh in 2009 i think

2033
01:11:32,790 --> 01:11:31,280
uh you know of you know as a as a

2034
01:11:34,790 --> 01:11:32,800
mission we were not ready as a project

2035
01:11:36,229 --> 01:11:34,800
we were not ready you know it's it's

2036
01:11:37,910 --> 01:11:36,239
easy to point fingers but i mean we're

2037
01:11:39,430 --> 01:11:37,920
all in this together and you know having

2038
01:11:40,870 --> 01:11:39,440

that extra time certainly gave us the

2039
01:11:42,229 --> 01:11:40,880
opportunity to make sure that everything

2040
01:11:47,270 --> 01:11:42,239
was going to work right

2041
01:11:51,430 --> 01:11:49,669
okay i believe that is it no more

2042
01:11:53,270 --> 01:11:51,440
questions for today but i do want to

2043
01:11:55,350 --> 01:11:53,280
tell everyone that this is our final

2044
01:11:57,110 --> 01:11:55,360
news conference for this week but be

2045
01:11:59,430 --> 01:11:57,120
sure to follow us online we'll have

2046
01:12:01,510 --> 01:11:59,440
updates posted for our next news

2047
01:12:03,510 --> 01:12:01,520
telecons and of course all of our new

2048
01:12:09,030 --> 01:12:03,520
images and videos all of that

2049
01:12:13,990 --> 01:12:11,510
msl or at the jpl homepage at

2050
01:12:15,350 --> 01:12:14,000
jpl.nasa.gov

2051
01:12:17,669 --> 01:12:15,360
and we will have more news on the

2052
01:12:19,350 --> 01:12:17,679
mission next week so be sure to check

2053
01:12:21,270 --> 01:12:19,360
there and follow the mission we have a

2054
01:12:38,470 --> 01:12:21,280
long way to go thank you so much for