

Mission to MARS

Rising again to the red planet



JPL and the Space Age

1
00:00:05,990 --> 00:00:04,550
the mars polar lander and mars climate

2
00:00:07,909 --> 00:00:06,000
orbiter missions failed

3
00:00:09,589 --> 00:00:07,919
we had to get back in the saddle we had

4
00:00:11,190 --> 00:00:09,599
to get something landed on the surface

5
00:00:12,950 --> 00:00:11,200
of mars

6
00:00:14,870 --> 00:00:12,960
i thought it was honestly it's like a

7
00:00:15,589 --> 00:00:14,880
crazy idea given the amount of time that

8
00:00:17,590 --> 00:00:15,599
we have

9
00:00:19,109 --> 00:00:17,600
the probability of failure was

10
00:00:21,029 --> 00:00:19,119
unacceptable

11
00:00:24,470 --> 00:00:21,039
engineers don't like designing when

12
00:00:28,630 --> 00:00:25,990
they fooled me into taking this job

13
00:00:31,109 --> 00:00:28,640

saying that oh won't be that hard

14

00:00:32,709 --> 00:00:31,119

it's a reflex pathfinder you have all

15

00:00:34,950 --> 00:00:32,719

the pieces there

16

00:00:37,110 --> 00:00:34,960

we knew it would be a challenge but i

17

00:00:39,590 --> 00:00:37,120

don't think we adequately assessed

18

00:00:41,350 --> 00:00:39,600

how difficult it would be i think in the

19

00:00:41,990 --> 00:00:41,360

back of your mind you're always prepared

20

00:00:44,310 --> 00:00:42,000

for

21

00:00:45,910 --> 00:00:44,320

anything to happen but this wasn't one

22

00:00:49,670 --> 00:00:45,920

of the places that we thought

23

00:00:51,510 --> 00:00:49,680

something would go wrong come on man

24

00:00:56,830 --> 00:00:51,520

you don't put a system like this on a

25

00:01:00,310 --> 00:00:58,709

moment trouble is

26

00:01:02,310 --> 00:01:00,320

it's great on paper but until you put it

27

00:01:04,950 --> 00:01:02,320

out there and test it you really don't

28

00:01:06,870 --> 00:01:04,960

know what you have

29

00:01:08,870 --> 00:01:06,880

you know i tell my people that in terms

30

00:01:10,390 --> 00:01:08,880

of my top ten list of worries

31

00:01:11,910 --> 00:01:10,400

the first three are schedule schedule

32

00:01:13,510 --> 00:01:11,920

and schedule and there's nothing in

33

00:01:14,870 --> 00:01:13,520

fourth place

34

00:01:16,550 --> 00:01:14,880

i came to the realization that the

35

00:01:19,190 --> 00:01:16,560

heritage wasn't in the blueprints the

36

00:01:20,870 --> 00:01:19,200

heritage was the people

37

00:01:22,870 --> 00:01:20,880

our next pass through this if it doesn't

38

00:01:25,109 --> 00:01:22,880

come together it's an all-go-home thing

39

00:01:29,030 --> 00:01:25,119

it's an

40

00:01:41,650 --> 00:01:29,040

sixth green over five four three

41

00:01:48,149 --> 00:01:41,660

two one

42

00:02:04,469 --> 00:01:50,870

the end of 1999 the mars polar lander

43

00:02:08,150 --> 00:02:07,109

jpl was responsible for these missions

44

00:02:10,949 --> 00:02:08,160

and that changed

45

00:02:11,670 --> 00:02:10,959

everything there was a loss of

46

00:02:13,030 --> 00:02:11,680

confidence

47

00:02:15,270 --> 00:02:13,040

what had to be done is we had to get

48

00:02:22,309 --> 00:02:15,280

back in the saddle we had to get

49

00:02:27,270 --> 00:02:22,319

something landed on the surface of mars

50

00:02:27,280 --> 00:02:41,670

we have to go back to something we know

51
00:02:45,190 --> 00:02:43,190
and what we knew is we knew the

52
00:02:47,670 --> 00:02:45,200
pathfinder lander and because of that

53
00:02:49,030 --> 00:02:47,680
confidence we can do it in a short time

54
00:03:08,080 --> 00:02:49,040
we got to take the pathfinder laner and

55
00:03:12,390 --> 00:03:09,990
[Applause]

56
00:03:14,470 --> 00:03:12,400
here we go six pulses for equalization f

57
00:03:21,509 --> 00:03:14,480
minus 18 db

58
00:03:26,470 --> 00:03:24,550
we knew at the time we had a three year

59
00:03:27,990 --> 00:03:26,480
project to go to launch that's just very

60
00:03:29,030 --> 00:03:28,000
very tight for a mission of this kind of

61
00:03:31,589 --> 00:03:29,040
complexity

62
00:03:32,710 --> 00:03:31,599
and we've been fighting that challenge

63
00:03:34,710 --> 00:03:32,720

since the beginning

64

00:03:36,550 --> 00:03:34,720

you worry about am i got the right plan

65

00:03:42,390 --> 00:03:36,560

do i really have it figured out

66

00:03:45,509 --> 00:03:44,630

i'll briefly go over launch crews and

67

00:03:47,830 --> 00:03:45,519

edl

68

00:03:49,589 --> 00:03:47,840

and just give you an idea of how the

69

00:03:50,470 --> 00:03:49,599

downlink process works during those

70

00:03:52,710 --> 00:03:50,480

phases

71

00:03:54,470 --> 00:03:52,720

i'll spend a lot more time on surface

72

00:03:55,670 --> 00:03:54,480

specifically the tactical downlink

73

00:03:57,350 --> 00:03:55,680

process

74

00:03:59,670 --> 00:03:57,360

i'll also talk a little bit about a

75

00:04:01,350 --> 00:03:59,680

couple key additional requirements for

76

00:04:01,750 --> 00:04:01,360

red river goes to start getting into

77

00:04:03,589 --> 00:04:01,760

this

78

00:04:04,630 --> 00:04:03,599

cycle of things changing just a little

79

00:04:06,149 --> 00:04:04,640

bit here and just a little bit there and

80

00:04:07,750 --> 00:04:06,159

all of a sudden the mass got heavier and

81

00:04:10,550 --> 00:04:07,760

so other things had to change

82

00:04:11,990 --> 00:04:10,560

your design heritage the blueprint i use

83

00:04:13,589 --> 00:04:12,000

the phrase phrase that i will never use

84

00:04:17,430 --> 00:04:13,599

again because no one will believe me

85

00:04:20,710 --> 00:04:19,030

i said we will take the mars pathfinder

86

00:04:22,230 --> 00:04:20,720

lander and build to print

87

00:04:24,070 --> 00:04:22,240

we will take the blueprints and we will

88

00:04:25,430 --> 00:04:24,080

send it to the machine shop build these

89

00:04:29,350 --> 00:04:25,440

same things again and that will be the

90

00:04:30,390 --> 00:04:29,360

shell that we landed

91

00:04:32,870 --> 00:04:30,400

and then we just have to design this

92

00:04:34,790 --> 00:04:32,880

rover that fits inside

93

00:04:37,110 --> 00:04:34,800

that build to print concept is the one

94

00:04:39,110 --> 00:04:37,120

thing that was completely wrong

95

00:04:44,310 --> 00:04:39,120

the message here is if you see something

96

00:04:47,430 --> 00:04:45,670

i came to the realization that the

97

00:04:49,430 --> 00:04:47,440

heritage wasn't in the blueprints

98

00:04:50,870 --> 00:04:49,440

the heritage was in the people and the

99

00:04:52,390 --> 00:04:50,880

people who designed this thing before

100

00:04:53,990 --> 00:04:52,400

they've gone through this design work

101
00:04:56,629 --> 00:04:54,000
they've experienced all the difficulties

102
00:04:59,990 --> 00:04:56,639
they know how to solve it

103
00:05:15,670 --> 00:05:00,000
and then we have a final tcm

104
00:05:34,950 --> 00:05:23,640
[Music]

105
00:05:41,189 --> 00:05:37,110
they tell us these only weigh 40 pounds

106
00:05:49,270 --> 00:05:43,189
we are building airbag systems to

107
00:05:52,870 --> 00:05:51,029
well we have a deadline to meet for

108
00:05:55,029 --> 00:05:52,880
testing so we have to work a lot of

109
00:05:59,830 --> 00:05:55,039
hours and work hard and get it

110
00:06:02,070 --> 00:05:59,840
done on time and make it work good too

111
00:06:05,590 --> 00:06:02,080
a lot of it is sewing through these

112
00:06:08,629 --> 00:06:08,230
it's very difficult the stuff we coat it

113
00:06:10,870 --> 00:06:08,639

with

114

00:06:12,070 --> 00:06:10,880

makes it hard to go through we've had to

115

00:06:14,790 --> 00:06:12,080

get special needles

116

00:06:15,909 --> 00:06:14,800

special machines and it takes a lot of

117

00:06:18,830 --> 00:06:15,919

strength to

118

00:06:20,629 --> 00:06:18,840

press it out with your fingers and sew

119

00:06:23,990 --> 00:06:20,639

it

120

00:06:26,230 --> 00:06:24,000

i've worked gloves and now and i've

121

00:06:29,909 --> 00:06:26,240

worked these

122

00:06:31,990 --> 00:06:29,919

it's like peas and carrots you know

123

00:06:33,430 --> 00:06:32,000

gloves are more delicate more

124

00:06:37,350 --> 00:06:33,440

complicated

125

00:06:39,510 --> 00:06:37,360

mentally smaller

126

00:06:44,469 --> 00:06:39,520

this is physically challenging because

127

00:06:48,070 --> 00:06:46,230

we have a lot of questions because then

128

00:06:50,309 --> 00:06:48,080

the whole time you're building it

129

00:06:51,749 --> 00:06:50,319

you're wondering is this going to be

130

00:06:54,550 --> 00:06:51,759

right is it going to be okay

131

00:06:55,510 --> 00:06:54,560

is it going to work you can't imagine

132

00:06:57,430 --> 00:06:55,520

the

133

00:06:59,350 --> 00:06:57,440

joy we were jumping up and down when

134

00:07:00,830 --> 00:06:59,360

pathfinder landed it was successful

135

00:07:02,469 --> 00:07:00,840

and that's what we want to bring into

136

00:07:03,909 --> 00:07:02,479

this

137

00:07:05,670 --> 00:07:03,919

how would you feel if you knew that

138

00:07:06,710 --> 00:07:05,680

something you had actually worked on and

139

00:07:10,309 --> 00:07:06,720

touched every day

140

00:07:12,070 --> 00:07:10,319

was on mars our names are on mars

141

00:07:12,309 --> 00:07:12,080

because we got to sign the lander panel

142

00:07:14,309 --> 00:07:12,319

of

143

00:07:37,660 --> 00:07:14,319

pathfinder and believe me we'll have our

144

00:07:56,830 --> 00:07:48,250

[Music]

145

00:07:56,840 --> 00:08:04,710

hello

146

00:08:09,589 --> 00:08:08,070

it's been hit a lot i mean seriously no

147

00:08:10,950 --> 00:08:09,599

no no these things lose a little of

148

00:08:12,710 --> 00:08:10,960

their edge

149

00:08:13,909 --> 00:08:12,720

look it's got the same texture down

150

00:08:15,110 --> 00:08:13,919

underneath where it's never been tested

151

00:08:16,790 --> 00:08:15,120

this is the rocket was causing all the

152

00:08:19,670 --> 00:08:16,800

problems in the last test

153

00:08:21,189 --> 00:08:19,680

so we were right up to the hairy edge

154

00:08:21,830 --> 00:08:21,199

we're supposed to just be checking the

155

00:08:23,110 --> 00:08:21,840

box

156

00:08:25,029 --> 00:08:23,120

we were waiting to see if we had a

157

00:08:26,950 --> 00:08:25,039

working airbag system it was pretty

158

00:08:28,629 --> 00:08:26,960

scary replica

159

00:08:30,309 --> 00:08:28,639

it's a mate you never would have guessed

160

00:08:32,630 --> 00:08:30,319

that this rocket caused so much trouble

161

00:08:34,070 --> 00:08:32,640

no it's not

162

00:08:36,070 --> 00:08:34,080

they fooled me into taking this job

163

00:08:38,149 --> 00:08:36,080

saying that oh won't be that hard

164

00:08:40,870 --> 00:08:38,159

it's a re-flight of mars pathfinder you

165

00:08:43,110 --> 00:08:40,880

have all the pieces there

166

00:08:44,070 --> 00:08:43,120

put it together again it'll work and

167

00:08:46,230 --> 00:08:44,080

every single

168

00:08:47,670 --> 00:08:46,240

last darn piece on that entry descent

169

00:08:49,430 --> 00:08:47,680

landing system had to be redesigned

170

00:08:52,550 --> 00:08:49,440

sometimes almost from scratch

171

00:08:55,750 --> 00:08:52,560

so we're using the reference drop

172

00:08:57,350 --> 00:08:55,760

for this first draw mer as being this

173

00:09:12,560 --> 00:08:57,360

heritage this build to print

174

00:09:12,570 --> 00:09:20,829

[Music]

175

00:09:20,839 --> 00:09:24,240

so

176

00:09:40,470 --> 00:09:32,920

[Music]

177

00:09:44,230 --> 00:09:40,480

i own the overall system responsibility

178

00:09:47,350 --> 00:09:44,240

but effectively i was more of a busybody

179

00:09:49,670 --> 00:09:47,360

getting in adam cessna's way rather than

180

00:09:50,470 --> 00:09:49,680

driving the system i wanted to see

181

00:09:52,310 --> 00:09:50,480

firsthand

182

00:09:54,630 --> 00:09:52,320

to understand the challenges and

183

00:09:57,030 --> 00:09:54,640

sometimes you can't really understand it

184

00:09:58,310 --> 00:09:57,040

unless you're there on site and seeing

185

00:10:00,470 --> 00:09:58,320

all the debates

186

00:10:02,310 --> 00:10:00,480

that bring out those subtle nuances of

187

00:10:05,509 --> 00:10:02,320

the design that you do not hear any

188

00:10:06,870 --> 00:10:05,519

other way we thought we understood

189

00:10:08,949 --> 00:10:06,880

how the airbag system was going to

190

00:10:10,550 --> 00:10:08,959

behave we knew it was marginal and

191

00:10:14,630 --> 00:10:10,560

nobody was expecting it to be

192

00:10:16,630 --> 00:10:14,640

a robust but the initial design

193

00:10:21,030 --> 00:10:16,640

failed and got damaged in ways we were

194

00:10:21,040 --> 00:10:51,990

45 seconds

195

00:10:55,269 --> 00:10:54,310

today we tested at 16 meters per second

196

00:10:57,670 --> 00:10:55,279

and it worked

197

00:10:59,190 --> 00:10:57,680

i would say that you know on one hand we

198

00:11:01,110 --> 00:10:59,200

have good reason to be excited

199

00:11:02,550 --> 00:11:01,120

but on the other hand it was expected to

200

00:11:05,829 --> 00:11:02,560

work at 16 meters per second

201
00:11:08,870 --> 00:11:05,839
we didn't expect this one to fail

202
00:11:26,069 --> 00:11:08,880
wow yeah

203
00:11:31,509 --> 00:11:29,269
look at it wrinkling up catching

204
00:11:32,870 --> 00:11:31,519
that is awesome you can even see a piece

205
00:11:35,590 --> 00:11:32,880
of it looks like

206
00:11:39,269 --> 00:11:35,600
we have some clear damages the

207
00:11:42,790 --> 00:11:40,790
back up a little bit you can actually

208
00:11:45,269 --> 00:11:42,800
see an abrasion layer

209
00:11:47,269 --> 00:11:45,279
lift it off and just sit in there that

210
00:12:04,949 --> 00:11:47,279
piece of abrasion layer is just

211
00:12:09,110 --> 00:12:06,470
what we've got here is what we're

212
00:12:10,150 --> 00:12:09,120
calling classic airbag damage where the

213
00:12:12,470 --> 00:12:10,160

outermost layers

214

00:12:13,910 --> 00:12:12,480

are there as sacrificial elements to

215

00:12:15,509 --> 00:12:13,920

protect the bladder layer

216

00:12:16,949 --> 00:12:15,519

it's a lot like a bulletproof vest it

217

00:12:19,110 --> 00:12:16,959

gets torn up and you

218

00:12:20,949 --> 00:12:19,120

tear the outside part of the the outer

219

00:12:22,710 --> 00:12:20,959

layers of the vest and

220

00:12:53,750 --> 00:12:22,720

you protect the user on the inside in

221

00:12:58,069 --> 00:12:56,629

this tool's formal name is the rock

222

00:13:00,870 --> 00:12:58,079

abrasion tool

223

00:13:02,389 --> 00:13:00,880

and in nasa you have to have your name

224

00:13:05,829 --> 00:13:02,399

shortened to an acronym

225

00:13:09,030 --> 00:13:05,839

so naturally that makes us the creators

226

00:13:12,629 --> 00:13:11,269

i can't tell you how many suggestions i

227

00:13:15,430 --> 00:13:12,639

get almost daily

228

00:13:15,910 --> 00:13:15,440

for logos it's a bit of a joke around

229

00:13:18,150 --> 00:13:15,920

here

230

00:13:32,949 --> 00:13:18,160

uh and in the space science community

231

00:13:39,430 --> 00:13:35,990

one of the biggest issues facing us is

232

00:13:42,470 --> 00:13:39,440

the dusker to prevent the dust

233

00:13:44,790 --> 00:13:42,480

from coming out perhaps billowing up

234

00:13:46,389 --> 00:13:44,800

and damaging the other instruments

235

00:13:48,550 --> 00:13:46,399

however it's a very

236

00:13:49,590 --> 00:13:48,560

slow-moving drill and only sends up

237

00:13:54,230 --> 00:13:49,600

small wisps of

238

00:13:58,710 --> 00:13:56,550

we don't like the skirt it's almost as

239

00:14:00,389 --> 00:13:58,720

like you're saying okay we want to eject

240

00:14:01,350 --> 00:14:00,399

the dust for digging this hole so we can

241

00:14:03,670 --> 00:14:01,360

look in

242

00:14:04,470 --> 00:14:03,680

but we're building a cover right around

243

00:14:28,829 --> 00:14:04,480

the hole

244

00:14:28,839 --> 00:14:33,100

um

245

00:14:33,110 --> 00:14:39,269

[Music]

246

00:14:41,590 --> 00:14:40,389

you know what i recommend though we go

247

00:14:43,509 --> 00:14:41,600

through the report first and then we

248

00:14:46,389 --> 00:14:43,519

just usually won

249

00:14:49,910 --> 00:14:46,399

sure and then we do what what's who asks

250

00:14:53,670 --> 00:14:52,949

there was a discussion that perhaps got

251
00:14:57,269 --> 00:14:53,680
a little

252
00:15:00,389 --> 00:14:57,279
persnickety because the pi

253
00:15:03,590 --> 00:15:00,399
on the telecon said no

254
00:15:07,189 --> 00:15:03,600
we have to keep the skirt in place

255
00:15:07,910 --> 00:15:07,199
and perform yet a whole another round of

256
00:15:09,350 --> 00:15:07,920
tests

257
00:15:11,110 --> 00:15:09,360
but i haven't heard anything do you

258
00:15:13,189 --> 00:15:11,120
think they were going to do that well i

259
00:15:14,150 --> 00:15:13,199
actually i question why why bother doing

260
00:15:16,710 --> 00:15:14,160
that we don't

261
00:15:17,910 --> 00:15:16,720
know what the skirt does at these

262
00:15:19,350 --> 00:15:17,920
different angles we don't know what

263
00:15:20,150 --> 00:15:19,360

happens without insert at these

264

00:15:21,750 --> 00:15:20,160

different angles

265

00:15:24,069 --> 00:15:21,760

this whole thing has been sufficiently

266

00:15:25,910 --> 00:15:24,079

counter-intuitive to me from the get-go

267

00:15:27,509 --> 00:15:25,920

then i'd rather see that's what's going

268

00:15:29,189 --> 00:15:27,519

to happen now wait a minute

269

00:15:30,949 --> 00:15:29,199

trying to sell the van trying to tell

270

00:15:33,189 --> 00:15:30,959

the idea of getting rid of the skirt

271

00:15:34,710 --> 00:15:33,199

is going to be a lot easier if you can

272

00:15:37,110 --> 00:15:34,720

show the tape you know

273

00:15:39,189 --> 00:15:37,120

this thing creates a the skirt actually

274

00:15:41,110 --> 00:15:39,199

hurts things quite a bit

275

00:15:42,470 --> 00:15:41,120

where does the dust go how fast what

276

00:15:44,310 --> 00:15:42,480

velocity does it fly off

277

00:15:45,910 --> 00:15:44,320

at which direction is it going to go etc

278

00:15:46,310 --> 00:15:45,920

i mean is there does it fly off in a

279

00:15:48,710 --> 00:15:46,320

sheet

280

00:15:49,670 --> 00:15:48,720

a cone well that may agree we're going

281

00:15:51,509 --> 00:15:49,680

to test

282

00:15:53,030 --> 00:15:51,519

completely thoroughly i was just

283

00:15:54,629 --> 00:15:53,040

questioning continual testing with the

284

00:15:55,189 --> 00:15:54,639

skirt that's all i just didn't quite

285

00:15:57,350 --> 00:15:55,199

understand

286

00:15:59,189 --> 00:15:57,360

why that should be so extensive we'll do

287

00:16:03,749 --> 00:15:59,199

it handle discussion

288

00:16:04,790 --> 00:16:03,759

okay from their perspective i understand

289

00:16:12,629 --> 00:16:04,800

you know their instruments they're

290

00:16:16,069 --> 00:16:15,269

however engineers don't like designing

291

00:16:28,710 --> 00:16:16,079

when there are

292

00:16:28,720 --> 00:16:42,510

a couple of uh

293

00:16:49,189 --> 00:16:47,030

[Music]

294

00:16:50,870 --> 00:16:49,199

that's the baseline and everything that

295

00:16:52,949 --> 00:16:50,880

these guys talked about

296

00:16:55,110 --> 00:16:52,959

is consistent with that budget there's a

297

00:16:56,710 --> 00:16:55,120

list of threats

298

00:16:58,150 --> 00:16:56,720

that these guys have come to me with and

299

00:17:01,670 --> 00:16:58,160

they've said okay

300

00:17:04,710 --> 00:17:01,680

i may i the more structure may be late

301
00:17:06,470 --> 00:17:04,720
the pma contracted ball may increase

302
00:17:07,909 --> 00:17:06,480
uh the flight software workforce may

303
00:17:09,750 --> 00:17:07,919
stretch to the right

304
00:17:11,510 --> 00:17:09,760
the et cetera et cetera et cetera and

305
00:17:13,029 --> 00:17:11,520
i've added all those threats up they're

306
00:17:15,110 --> 00:17:13,039
in the category of everything we can

307
00:17:16,549 --> 00:17:15,120
think of that can go wrong

308
00:17:17,990 --> 00:17:16,559
although froze would argue that we've

309
00:17:19,189 --> 00:17:18,000
made that claim before and we haven't

310
00:17:21,909 --> 00:17:19,199
thought of everything

311
00:17:22,870 --> 00:17:21,919
i submit that based on the data i gave

312
00:17:25,429 --> 00:17:22,880
you this week

313
00:17:28,470 --> 00:17:25,439

you can't draw that conclusion what is

314

00:17:30,789 --> 00:17:28,480

the internal processes in division 35

315

00:17:31,590 --> 00:17:30,799

to make sure that these promise dates

316

00:17:33,510 --> 00:17:31,600

are going to be met

317

00:17:35,430 --> 00:17:33,520

we are holding the subsystems fee to the

318

00:17:38,390 --> 00:17:35,440

fire as much as we can

319

00:17:39,830 --> 00:17:38,400

what part of this gives you guess where

320

00:17:41,669 --> 00:17:39,840

are you concerned

321

00:17:43,830 --> 00:17:41,679

problem presentation presents to the

322

00:17:46,310 --> 00:17:43,840

board they can't

323

00:17:47,350 --> 00:17:46,320

make a judgment if they were to make a

324

00:17:51,909 --> 00:17:47,360

judgment they'd say

325

00:17:54,549 --> 00:17:51,919

you're in in very very serious trouble

326

00:17:56,549 --> 00:17:54,559

we're not done with this review yet okay

327

00:17:58,310 --> 00:17:56,559

i mean we understand that problem

328

00:17:59,909 --> 00:17:58,320

and if you want us to impress the story

329

00:18:02,549 --> 00:17:59,919

into one hour we can do

330

00:18:03,190 --> 00:18:02,559

it that's not going to work here i mean

331

00:18:05,270 --> 00:18:03,200

clearly

332

00:18:06,230 --> 00:18:05,280

he does not shift his knee date to the

333

00:18:08,310 --> 00:18:06,240

delivery date

334

00:18:10,310 --> 00:18:08,320

just as a matter of principle every time

335

00:18:11,909 --> 00:18:10,320

it happens we go through a very long

336

00:18:15,350 --> 00:18:11,919

process of trying to push back on the

337

00:18:17,350 --> 00:18:15,360

subsystems the procedures have got to be

338

00:18:19,669 --> 00:18:17,360

more self-contained john's right we've

339

00:18:21,830 --> 00:18:19,679

got to clean it up mechanisms

340

00:18:22,950 --> 00:18:21,840

at acs for example we are hardware and

341

00:18:26,070 --> 00:18:22,960

software constrained

342

00:18:26,870 --> 00:18:26,080

big time and so there are probably some

343

00:18:28,230 --> 00:18:26,880

things we can do

344

00:18:29,830 --> 00:18:28,240

you know there's always some something

345

00:18:30,950 --> 00:18:29,840

you can do but a lot of it tends to be

346

00:18:36,150 --> 00:18:30,960

non-critical path

347

00:18:40,630 --> 00:18:39,510

we have to go there's some wow lousy

348

00:18:46,630 --> 00:18:40,640

sucks

349

00:18:50,470 --> 00:18:48,310

we've had that objective right from the

350

00:18:52,310 --> 00:18:50,480

start right but if we go out

351
00:18:54,710 --> 00:18:52,320
into the middle of the listing we've

352
00:18:58,150 --> 00:18:54,720
lost that the main objective the main

353
00:19:01,190 --> 00:18:59,190
for those of you haven't been in this

354
00:19:03,110 --> 00:19:01,200
process before that ray knows well you

355
00:19:05,270 --> 00:19:03,120
don't put a system like this on a major

356
00:19:07,029 --> 00:19:05,280
spacecraft like this at the last moment

357
00:19:08,470 --> 00:19:07,039
this is there's this tension that exists

358
00:19:12,870 --> 00:19:08,480
between the engineering team

359
00:19:15,990 --> 00:19:12,880
and the scientists the engineers want

360
00:19:17,669 --> 00:19:16,000
success in order to assure success they

361
00:19:20,470 --> 00:19:17,679
have to be very conservative people

362
00:19:22,150 --> 00:19:20,480
yeah the landing system is very fragile

363
00:19:22,950 --> 00:19:22,160

in the presence of sustained winds that

364

00:19:25,510 --> 00:19:22,960

if

365

00:19:27,510 --> 00:19:25,520

sustained winds go above a certain level

366

00:19:30,150 --> 00:19:27,520

that the landing system the airbags

367

00:19:31,750 --> 00:19:30,160

cannot do the job and so that's another

368

00:19:32,630 --> 00:19:31,760

point that says that even if you don't

369

00:19:34,470 --> 00:19:32,640

believe the models

370

00:19:36,630 --> 00:19:34,480

you better be wary of what they're

371

00:19:39,110 --> 00:19:36,640

saying and that and that actually

372

00:19:41,270 --> 00:19:39,120

changes the site selection criteria

373

00:19:44,070 --> 00:19:41,280

that's the bottom line that's right

374

00:19:45,350 --> 00:19:44,080

you're seeing a much greater concern

375

00:19:48,310 --> 00:19:45,360

over wins than

376

00:19:50,950 --> 00:19:48,320

we even considered going in but the way

377

00:19:52,390 --> 00:19:50,960

we started this was you have to certify

378

00:19:55,430 --> 00:19:52,400

the site is safe

379

00:19:59,990 --> 00:19:58,310

so i don't think that the project will

380

00:20:01,350 --> 00:20:00,000

not recommend that we land in an unsafe

381

00:20:03,190 --> 00:20:01,360

site

382

00:20:16,470 --> 00:20:03,200

you know regardless of the science

383

00:20:20,070 --> 00:20:17,990

you could probably imagine two partially

384

00:20:21,830 --> 00:20:20,080

ordered sets one from the scientific

385

00:20:23,590 --> 00:20:21,840

point of view these are all great these

386

00:20:23,909 --> 00:20:23,600

are in between and these are not the

387

00:20:25,909 --> 00:20:23,919

good

388

00:20:27,430 --> 00:20:25,919

and the same thing from engineering and

389

00:20:28,310 --> 00:20:27,440

you can imagine lining those two up side

390

00:20:30,630 --> 00:20:28,320

by side

391

00:20:32,230 --> 00:20:30,640

and then trying to decide whether or not

392

00:20:33,909 --> 00:20:32,240

to exist to the site that was not

393

00:20:34,310 --> 00:20:33,919

unacceptable from either point of view

394

00:20:36,789 --> 00:20:34,320

right

395

00:20:39,590 --> 00:20:36,799

and this was done during pathfinder and

396

00:20:42,070 --> 00:20:39,600

the gentry was there in the very end

397

00:20:42,870 --> 00:20:42,080

myrrh is more complex because there were

398

00:20:45,190 --> 00:20:42,880

so many more

399

00:20:45,909 --> 00:20:45,200

data sets that you could throw at the

400

00:20:48,149 --> 00:20:45,919

problem

401
00:20:50,230 --> 00:20:48,159
we have two orbiters that are going

402
00:20:52,710 --> 00:20:50,240
around mars that we can direct to take

403
00:20:54,630 --> 00:20:52,720
pictures at target locations

404
00:20:57,190 --> 00:20:54,640
so now it's much more involved you're

405
00:20:58,950 --> 00:20:57,200
actually acquiring the information

406
00:21:00,710 --> 00:20:58,960
while you're in the decision-making

407
00:21:02,630 --> 00:21:00,720
process while you're building the

408
00:21:04,950 --> 00:21:02,640
spacecraft while you're worried about

409
00:21:06,950 --> 00:21:04,960
what the spacecraft can actually do

410
00:21:08,230 --> 00:21:06,960
and what sort of site it can and can't

411
00:21:11,669 --> 00:21:08,240
land at

412
00:21:14,390 --> 00:21:11,679
excuse me i i in terms of

413
00:21:15,510 --> 00:21:14,400

distant views and relief clearly there's

414

00:21:18,390 --> 00:21:15,520

an issue here but

415

00:21:20,630 --> 00:21:18,400

what that hematite looks deposit looks

416

00:21:21,750 --> 00:21:20,640

like on a centimeter to 10 centimeter to

417

00:21:23,590 --> 00:21:21,760

meter scale

418

00:21:25,669 --> 00:21:23,600

nobody in this room knows it could be

419

00:21:29,990 --> 00:21:25,679

wild it could be weird

420

00:21:31,270 --> 00:21:30,000

it could be very very strange-looking

421

00:21:33,669 --> 00:21:31,280

and let me just follow that up

422

00:21:35,270 --> 00:21:33,679

pathfinder was just as dull and boring

423

00:21:36,950 --> 00:21:35,280

from an orbital point of view and we

424

00:21:38,870 --> 00:21:36,960

landed there were some hills there that

425

00:21:40,549 --> 00:21:38,880

people got pretty excited about

426
00:21:42,789 --> 00:21:40,559
uncertainty on this category matt might

427
00:21:46,630 --> 00:21:42,799
rival the uncertainty on the winds

428
00:21:51,430 --> 00:21:46,640
how could that be scientists trying to

429
00:21:56,230 --> 00:21:53,430
i i think you can explain this one to

430
00:22:00,070 --> 00:21:58,230
oh man if i explain pathfinders in

431
00:22:01,029 --> 00:22:00,080
public i can explain hematite to the

432
00:22:09,750 --> 00:22:01,039
public

433
00:22:13,270 --> 00:22:11,990
we have a landing site where that

434
00:22:16,710 --> 00:22:13,280
category is not

435
00:22:19,669 --> 00:22:16,720
green i think we have a real problem yes

436
00:22:20,390 --> 00:22:19,679
so but remember the dynamic range is

437
00:22:22,950 --> 00:22:20,400
going to get open

438
00:22:24,630 --> 00:22:22,960

there may be some that have reds here

439

00:22:26,470 --> 00:22:24,640

the question i'm having is what is the

440

00:22:28,470 --> 00:22:26,480

meaning of that road and what is the

441

00:22:30,149 --> 00:22:28,480

meaning of good diversity

442

00:22:31,430 --> 00:22:30,159

because you can have so much diversity

443

00:22:33,029 --> 00:22:31,440

that you don't know what the hell you're

444

00:22:36,390 --> 00:22:33,039

doing

445

00:22:43,270 --> 00:22:36,400

let's go on let's leave it and see if it

446

00:22:43,280 --> 00:23:02,549

who thought this up

447

00:23:08,070 --> 00:23:05,190

arthur can you find one more person we

448

00:23:10,789 --> 00:23:08,080

need another person for this game

449

00:23:12,149 --> 00:23:10,799

they lost one so the beginning of june

450

00:23:15,750 --> 00:23:12,159

of 2002

451
00:23:17,990 --> 00:23:15,760
the year before launch picnic we are 51

452
00:23:19,830 --> 00:23:18,000
weeks from launch

453
00:23:21,270 --> 00:23:19,840
last week the team went out and had a

454
00:23:26,710 --> 00:23:21,280
good lunch time and played a little

455
00:23:32,549 --> 00:23:28,950
the schedule is the big concern on this

456
00:23:36,470 --> 00:23:34,470
you know i tell my people that in terms

457
00:23:38,070 --> 00:23:36,480
of my top 10 list of worries

458
00:23:39,510 --> 00:23:38,080
the first three are scheduled schedule

459
00:23:42,630 --> 00:23:39,520
and schedule and there's nothing in

460
00:23:45,750 --> 00:23:43,990
that's just very very tight for a

461
00:23:47,110 --> 00:23:45,760
mission of this kind of complexity and

462
00:23:50,630 --> 00:23:47,120
we've been fighting that

463
00:23:52,789 --> 00:23:50,640

challenge basically since the beginning

464

00:23:54,070 --> 00:23:52,799

so the pressure now is on getting the

465

00:23:55,590 --> 00:23:54,080

flight equipment together

466

00:23:57,750 --> 00:23:55,600

through the assembly test and launch

467

00:23:58,710 --> 00:23:57,760

operations phase in order to get ready

468

00:24:05,590 --> 00:23:58,720

to go to florida

469

00:24:07,990 --> 00:24:05,600

in march of 2003

470

00:24:09,830 --> 00:24:08,000

the schedule situation has forced us to

471

00:24:11,590 --> 00:24:09,840

expend money at a greater rate than we

472

00:24:13,269 --> 00:24:11,600

expected so we've had to go back to nasa

473

00:24:13,990 --> 00:24:13,279

headquarters and ask for an infusions of

474

00:24:15,590 --> 00:24:14,000

funds

475

00:24:17,269 --> 00:24:15,600

they've been extremely supportive of our

476
00:24:18,630 --> 00:24:17,279
requests and we've gotten everything

477
00:24:20,310 --> 00:24:18,640
we've asked for

478
00:24:21,990 --> 00:24:20,320
[Music]

479
00:24:24,070 --> 00:24:22,000
but in going through that process you

480
00:24:25,750 --> 00:24:24,080
worry about have i got the right plan do

481
00:24:28,630 --> 00:24:25,760
i really have it figured out

482
00:24:30,630 --> 00:24:28,640
are we on track can we stay on track my

483
00:24:31,510 --> 00:24:30,640
job is to make sure that the rest of the

484
00:24:33,830 --> 00:24:31,520
team

485
00:24:34,549 --> 00:24:33,840
a very high caliber very motivated group

486
00:24:38,310 --> 00:24:34,559
of people

487
00:24:40,390 --> 00:24:38,320
can get their job done so my job is to

488
00:24:44,830 --> 00:24:40,400

get the stuff that gets in their way out

489

00:24:44,840 --> 00:24:53,470

running

490

00:24:53,480 --> 00:25:12,830

[Music]

491

00:25:20,230 --> 00:25:14,230

so

492

00:25:20,240 --> 00:25:30,870

what's your opinion if we uh

493

00:25:36,710 --> 00:25:33,750

i think since this is the zero degree um

494

00:25:38,789 --> 00:25:36,720

it's probably worth doing

495

00:25:40,230 --> 00:25:38,799

so i i've got your concurrence that it

496

00:25:43,510 --> 00:25:40,240

will count as a test

497

00:25:47,350 --> 00:25:44,950

are you questioning whether you're going

498

00:25:49,590 --> 00:25:47,360

to get air data boom data

499

00:25:51,669 --> 00:25:49,600

uh the pilot indicates that we have a

500

00:25:53,590 --> 00:25:51,679

very high probability in these gusty

501
00:25:54,789 --> 00:25:53,600
conditions that we will smash the air

502
00:26:19,590 --> 00:25:54,799
downfall

503
00:26:33,350 --> 00:26:22,830
i'm i'm really amazed at the amount of

504
00:26:33,360 --> 00:26:44,630
look at it

505
00:26:53,830 --> 00:26:47,909
look at that that

506
00:26:57,190 --> 00:26:53,840
is that's blended

507
00:26:57,200 --> 00:27:27,190
awesome oh that's fantastic

508
00:27:30,710 --> 00:27:28,710
well here's here's the thing too if

509
00:27:32,470 --> 00:27:30,720
let's say let's say this one hits

510
00:27:33,990 --> 00:27:32,480
and it's a good test we quickly found

511
00:27:38,870 --> 00:27:34,000
out that we weren't testing them the way

512
00:27:42,789 --> 00:27:40,310
i think in the back of your mind you're

513
00:27:45,110 --> 00:27:42,799

always prepared for anything to happen

514

00:27:55,750 --> 00:27:45,120

but this wasn't one of the places that

515

00:28:02,389 --> 00:27:59,029

we went back in mid-june

516

00:28:15,110 --> 00:28:02,399

and had the very dramatic

517

00:28:28,830 --> 00:28:18,710

count and failures five

518

00:28:28,840 --> 00:28:39,430

one

519

00:28:39,440 --> 00:28:54,950

it was it was slightly devastating

520

00:29:01,190 --> 00:28:59,830

significant severe shoot damage

521

00:29:03,029 --> 00:29:01,200

well the political spin on this is

522

00:29:05,110 --> 00:29:03,039

pretty easy because this chute

523

00:29:06,630 --> 00:29:05,120

did not have any of the reinforcements

524

00:29:09,669 --> 00:29:06,640

that we put in to stop

525

00:29:10,630 --> 00:29:09,679

just these very kinds of failures these

526

00:29:13,110 --> 00:29:10,640

kinds of failures

527

00:29:13,750 --> 00:29:13,120

are not surprising and that's why we

528

00:29:15,990 --> 00:29:13,760

chose to use

529

00:29:18,789 --> 00:29:16,000

you got to remember these soft good

530

00:29:21,590 --> 00:29:18,799

systems like parachutes or air bags

531

00:29:23,510 --> 00:29:21,600

they are not readily amenable to

532

00:29:25,430 --> 00:29:23,520

analysis

533

00:29:26,789 --> 00:29:25,440

the inflation of a parachute is actually

534

00:29:30,230 --> 00:29:26,799

a chaotic event

535

00:29:31,830 --> 00:29:30,240

it's a non-linear dynamic event highly

536

00:29:33,430 --> 00:29:31,840

driven by the initial conditions of the

537

00:29:36,070 --> 00:29:33,440

inflation in that regard

538

00:29:37,350 --> 00:29:36,080

i i'm not surprised or disheartened at

539

00:29:39,909 --> 00:29:37,360

all by this

540

00:30:06,830 --> 00:29:39,919

i need to get the right spin on this so

541

00:30:06,840 --> 00:30:11,190

oh

542

00:30:18,950 --> 00:30:16,149

that was of a nature that just makes you

543

00:30:21,110 --> 00:30:18,960

you're taken aback it even takes a day

544

00:30:27,909 --> 00:30:21,120

or two to absorb the magnitude of what

545

00:30:31,430 --> 00:30:29,750

that was rough first of all you have to

546

00:30:32,630 --> 00:30:31,440

figure out why you have a failure

547

00:30:34,789 --> 00:30:32,640

you have to figure out what your

548

00:30:35,830 --> 00:30:34,799

possible fixes are and you don't have

549

00:30:37,990 --> 00:30:35,840

the schedule to

550

00:30:42,230 --> 00:30:38,000

investigate this in a more methodical

551
00:30:49,510 --> 00:30:45,909
so we have to change our thinking

552
00:30:51,590 --> 00:30:49,520
on most likely the love and

553
00:30:52,630 --> 00:30:51,600
it didn't look like there was a it

554
00:30:54,710 --> 00:30:52,640
looked like there was a

555
00:30:56,070 --> 00:30:54,720
several different types of failure there

556
00:30:57,750 --> 00:30:56,080
at least to me uh

557
00:30:58,710 --> 00:30:57,760
to me it looked like it was yeah but

558
00:30:59,590 --> 00:30:58,720
again i'm looking through a little

559
00:31:05,190 --> 00:30:59,600
camera screen

560
00:31:16,789 --> 00:31:05,200
well even i mean it just you know

561
00:31:23,509 --> 00:31:20,070
coming to you dennis this cone's for you

562
00:31:24,870 --> 00:31:23,519
it's coming to you the fact that uh the

563
00:31:27,350 --> 00:31:24,880

parachute exploded

564

00:31:29,110 --> 00:31:27,360

not a good thing well yeah i'd rather

565

00:31:32,070 --> 00:31:29,120

have it happen here than

566

00:31:33,350 --> 00:31:32,080

mars yeah that's right unfortunately

567

00:31:35,110 --> 00:31:33,360

strictly speaking

568

00:31:36,549 --> 00:31:35,120

that shoot that just exploded was the

569

00:31:39,430 --> 00:31:36,559

shoot that we were planning on taking to

570

00:31:43,909 --> 00:31:42,389

complete structural failures repeated

571

00:31:45,110 --> 00:31:43,919

complete structural failures of the

572

00:31:49,190 --> 00:31:45,120

parachute

573

00:31:53,269 --> 00:31:49,200

and that was extremely distressful

574

00:31:54,710 --> 00:31:53,279

i mean that is a sense of panic

575

00:32:05,509 --> 00:31:54,720

like oh my god what are you gonna do

576

00:32:09,590 --> 00:32:08,070

the chute failed in the correct loads

577

00:32:11,190 --> 00:32:09,600

that tells us that we have a parachute

578

00:32:14,470 --> 00:32:11,200

that's not

579

00:32:15,750 --> 00:32:14,480

up to the job we need it to do because

580

00:32:18,389 --> 00:32:15,760

we have packed

581

00:32:20,310 --> 00:32:18,399

as much parachute as we can into the

582

00:32:22,310 --> 00:32:20,320

volume that's available to us

583

00:32:23,909 --> 00:32:22,320

our only recourse in making the

584

00:32:25,990 --> 00:32:23,919

parachute stronger

585

00:32:27,590 --> 00:32:26,000

is to change the configuration and

586

00:32:29,590 --> 00:32:27,600

reduce the band

587

00:32:31,190 --> 00:32:29,600

length the way you make it stronger is

588

00:32:34,389 --> 00:32:31,200

you put maybe other webbing

589

00:32:36,950 --> 00:32:34,399

or reinforcements or thicker fabric

590

00:32:38,149 --> 00:32:36,960

the net result is that you need more

591

00:32:41,669 --> 00:32:38,159

volume to pack that

592

00:32:44,710 --> 00:32:41,679

fabric in we don't have any more volume

593

00:32:47,750 --> 00:32:44,720

it's going to require people to be

594

00:32:51,750 --> 00:32:47,760

brave especially managers

595

00:32:53,990 --> 00:32:51,760

to be brave because the certainty

596

00:32:54,950 --> 00:32:54,000

that we have the job done is going to

597

00:32:56,149 --> 00:32:54,960

come very late

598

00:32:58,549 --> 00:32:56,159

and that's going to make everybody

599

00:33:00,549 --> 00:32:58,559

nervous our next pass through this if it

600

00:33:04,890 --> 00:33:00,559

doesn't come together

601
00:33:10,360 --> 00:33:08,830

[Music]

602
00:33:15,350 --> 00:33:10,370
over

603
00:33:17,269 --> 00:33:15,360
[Music]

604
00:33:18,710 --> 00:33:17,279
about a month ago we began assembly test

605
00:33:20,710 --> 00:33:18,720
and launch operations

606
00:33:23,190 --> 00:33:20,720
when the first part of the flight units

607
00:33:24,950 --> 00:33:23,200
are or in our case engineering models

608
00:33:26,630 --> 00:33:24,960
are beginning to be integrated in the

609
00:33:27,830 --> 00:33:26,640
assembly facility where the spacecraft

610
00:33:29,830 --> 00:33:27,840
goes together

611
00:33:31,350 --> 00:33:29,840
that's a big deal because it indicates

612
00:33:33,350 --> 00:33:31,360
that you're now

613
00:33:34,789 --> 00:33:33,360

have completed enough fabrication that

614

00:33:36,950 --> 00:33:34,799

you can begin the test phase

615

00:33:40,070 --> 00:33:36,960

and begin to understand what it is we

616

00:33:42,389 --> 00:33:40,080

really have designed and built

617

00:33:43,669 --> 00:33:42,399

and where did we build it a certain way

618

00:33:45,669 --> 00:33:43,679

and it behaves in a way that's

619

00:33:47,430 --> 00:33:45,679

unexpected and to fix those problems so

620

00:33:49,830 --> 00:33:47,440

that at the end of that test period

621

00:33:51,029 --> 00:33:49,840

we know exactly what the article will do

622

00:33:52,950 --> 00:33:51,039

so we can send it to mars with

623

00:33:55,430 --> 00:33:52,960

confidence

624

00:33:57,110 --> 00:33:55,440

we are doing two shifts per day we

625

00:33:59,909 --> 00:33:57,120

started that from the very beginning

626
00:34:02,070 --> 00:33:59,919
we knew it would be a a challenge but i

627
00:34:04,789 --> 00:34:02,080
don't think we adequately assessed

628
00:34:06,250 --> 00:34:04,799
how difficult it would be i think that's

629
00:34:08,550 --> 00:34:06,260
been the biggest surprise

630
00:34:10,950 --> 00:34:08,560
[Music]

631
00:34:13,190 --> 00:34:10,960
the trouble is it's great on paper but

632
00:34:16,389 --> 00:34:13,200
until you put it out there and test it

633
00:34:19,109 --> 00:34:16,399
you really don't know what you have

634
00:34:20,230 --> 00:34:19,119
so our electronics are failing at our

635
00:34:22,310 --> 00:34:20,240
vibration tests

636
00:34:23,589 --> 00:34:22,320
sometimes we find it's a real problem in

637
00:34:42,570 --> 00:34:23,599
other cases we realize there's nothing

638
00:34:42,580 --> 00:34:58,710

[Music]

639

00:34:58,720 --> 00:35:09,349

clear this off

640

00:35:13,589 --> 00:35:12,950

there's two camps of assembling and

641

00:35:16,870 --> 00:35:13,599

testing

642

00:35:19,430 --> 00:35:16,880

the rovers and the spacecraft as a whole

643

00:35:19,910 --> 00:35:19,440

the assembly test and launch operations

644

00:35:21,589 --> 00:35:19,920

team

645

00:35:23,030 --> 00:35:21,599

is assembling the flight hardware the

646

00:35:24,630 --> 00:35:23,040

stuff that's actually going to go to

647

00:35:27,349 --> 00:35:24,640

mars

648

00:35:28,630 --> 00:35:27,359

our area the integration and test area

649

00:35:31,270 --> 00:35:28,640

has our own lab

650

00:35:32,630 --> 00:35:31,280

which is a clean room and a sandbox

651
00:35:35,670 --> 00:35:32,640
where we have rovers that we

652
00:35:37,829 --> 00:35:35,680
test in the dirt so we receive

653
00:35:39,990 --> 00:35:37,839
one set of electronics the brains of the

654
00:35:42,790 --> 00:35:40,000
spacecraft

655
00:35:44,790 --> 00:35:42,800
then we plug in to each connector and

656
00:35:45,990 --> 00:35:44,800
make sure that each connector works and

657
00:35:48,390 --> 00:35:46,000
we start

658
00:35:49,270 --> 00:35:48,400
slowly building up a spacecraft on a

659
00:35:51,109 --> 00:35:49,280
tabletop

660
00:35:52,630 --> 00:35:51,119
configuration where then the flight

661
00:35:54,710 --> 00:35:52,640
software team can

662
00:35:56,310 --> 00:35:54,720
come in and develop the the software

663
00:35:57,430 --> 00:35:56,320

that they need to operate each of the

664

00:36:00,150 --> 00:35:57,440

devices

665

00:36:01,829 --> 00:36:00,160

and then the as part of the test team we

666

00:36:02,710 --> 00:36:01,839

start doing higher level functional

667

00:36:04,069 --> 00:36:02,720

tests

668

00:36:05,910 --> 00:36:04,079

the other one would verify that we

669

00:36:09,910 --> 00:36:05,920

didn't have a short

670

00:36:12,150 --> 00:36:09,920

chat i like to think my job was kind of

671

00:36:15,349 --> 00:36:12,160

like working in the garage

672

00:36:17,510 --> 00:36:15,359

it was a lot of hands-on knowing how the

673

00:36:19,270 --> 00:36:17,520

vehicle operated or how the vehicle was

674

00:36:20,710 --> 00:36:19,280

put together

675

00:36:22,870 --> 00:36:20,720

you're trying to balance all these

676
00:36:24,550 --> 00:36:22,880
different groups people want to use the

677
00:36:25,190 --> 00:36:24,560
arm people want to use the mast and

678
00:36:26,390 --> 00:36:25,200
image

679
00:36:29,190 --> 00:36:26,400
people want to use both of those

680
00:36:32,310 --> 00:36:29,200
together at the same time we're

681
00:36:35,349 --> 00:36:32,320
testing in our lab they're putting these

682
00:36:37,349 --> 00:36:35,359
the real pieces together

683
00:36:39,430 --> 00:36:37,359
it was a lot i mean it was a lot of time

684
00:36:41,430 --> 00:36:39,440
it was three shifts around the clock

685
00:36:43,190 --> 00:36:41,440
every weekend and there was always

686
00:36:43,750 --> 00:36:43,200
somebody in the lab just because things

687
00:36:45,910 --> 00:36:43,760
weren't

688
00:36:47,349 --> 00:36:45,920

ready yet for us to start testing and

689

00:37:06,829 --> 00:36:47,359

your job is just to make sure that

690

00:37:06,839 --> 00:37:20,870

is

691

00:37:20,880 --> 00:37:35,940

i look at my tie please

692

00:37:35,950 --> 00:37:51,870

[Applause]

693

00:37:56,790 --> 00:37:54,790

[Laughter]

694

00:37:57,829 --> 00:37:56,800

if you get a gust of wind the system

695

00:37:59,990 --> 00:37:57,839

starts to oscillate

696

00:38:02,390 --> 00:38:00,000

and when you fire your retro rockets you

697

00:38:04,230 --> 00:38:02,400

might impart an horizontal velocity so

698

00:38:06,630 --> 00:38:04,240

you might touch down with a very gentle

699

00:38:09,670 --> 00:38:06,640

vertical velocity but you might be going

700

00:38:11,829 --> 00:38:09,680

30 meters per second horizontally

701
00:38:13,349 --> 00:38:11,839
when we do statistical analysis of that

702
00:38:15,030 --> 00:38:13,359
problem for me it came out that the

703
00:38:17,910 --> 00:38:15,040
probability of failure

704
00:38:37,270 --> 00:38:17,920
was unacceptable so we need to come up

705
00:38:40,230 --> 00:38:38,630
if you put a camera and you take two

706
00:38:42,390 --> 00:38:40,240
pictures and then you can look at the

707
00:38:43,990 --> 00:38:42,400
displacement

708
00:38:45,829 --> 00:38:44,000
in the two pictures how much you moved

709
00:38:47,270 --> 00:38:45,839
and you divided by the amount of time

710
00:38:47,910 --> 00:38:47,280
between the two images you can figure

711
00:38:50,230 --> 00:38:47,920
out how much

712
00:38:51,190 --> 00:38:50,240
what's your velocity you know the loss

713
00:38:54,310 --> 00:38:51,200

of fixes

714

00:39:07,240 --> 00:38:54,320

you know where were good to us hey this

715

00:39:07,250 --> 00:39:15,109

[Music]

716

00:39:19,349 --> 00:39:18,310

we are doing what is our most recent and

717

00:39:23,270 --> 00:39:19,359

possibly our last

718

00:39:23,990 --> 00:39:23,280

actually test taking the fido rover out

719

00:39:26,829 --> 00:39:24,000

to some

720

00:39:28,710 --> 00:39:26,839

mysterious field site we do not know

721

00:39:31,270 --> 00:39:28,720

where

722

00:39:32,790 --> 00:39:31,280

and it's a fantastic site it's an

723

00:39:34,950 --> 00:39:32,800

absolutely wonderful landing site

724

00:39:36,150 --> 00:39:34,960

it's got terrific geology and best of

725

00:39:37,670 --> 00:39:36,160

all there aren't any bushes

726

00:39:39,349 --> 00:39:37,680

because this rover doesn't like bushes

727

00:39:40,630 --> 00:39:39,359

it's good with dirt it's good with rocks

728

00:39:42,069 --> 00:39:40,640

it's terrible with bushes because it's

729

00:39:42,790 --> 00:39:42,079

designed for mars where there aren't any

730

00:39:44,150 --> 00:39:42,800

bushes

731

00:39:45,750 --> 00:39:44,160

or where at least it would be a real

732

00:39:47,589 --> 00:39:45,760

discover if we found one we're going to

733

00:39:49,589 --> 00:39:47,599

come up with more than you can possibly

734

00:39:52,150 --> 00:39:49,599

execute on a drive saw

735

00:39:53,670 --> 00:39:52,160

okay what will happen is if we get in

736

00:39:55,750 --> 00:39:53,680

there and we find out on the basis of

737

00:39:57,670 --> 00:39:55,760

uhf data that we can do remote sensing

738

00:39:58,310 --> 00:39:57,680

but we can't do idd then i'll try to get

739

00:40:00,950 --> 00:39:58,320

the full set

740

00:40:02,150 --> 00:40:00,960

point of this test is to train the

741

00:40:05,910 --> 00:40:02,160

science team

742

00:40:09,510 --> 00:40:05,920

and how to do field geology with a robot

743

00:40:11,990 --> 00:40:09,520

that is somewhere else and

744

00:40:13,030 --> 00:40:12,000

using it to simulate the kind of science

745

00:40:14,390 --> 00:40:13,040

that we're going to do

746

00:40:20,630 --> 00:40:14,400

on the martian surface with the mer

747

00:40:25,190 --> 00:40:23,109

i don't know where we are in terms of

748

00:40:26,309 --> 00:40:25,200

latitude and longitude and what state of

749

00:40:27,109 --> 00:40:26,319

the united states we're in but that

750

00:40:29,430 --> 00:40:27,119

doesn't matter

751

00:40:30,230 --> 00:40:29,440

what we do know now is we know where we

752

00:40:33,349 --> 00:40:30,240

are in

753

00:40:36,230 --> 00:40:33,359

some synthetic orbital images we've got

754

00:40:38,150 --> 00:40:36,240

images taken from overhead that simulate

755

00:40:38,950 --> 00:40:38,160

the kind of data that we'll have from

756

00:40:41,589 --> 00:40:38,960

ours

757

00:40:42,630 --> 00:40:41,599

the sowg meeting will begin in here

758

00:40:45,270 --> 00:40:42,640

promptly

759

00:40:47,190 --> 00:40:45,280

at 8 15. so at 8 15 i want everybody in

760

00:40:48,230 --> 00:40:47,200

their seats in this room quiet ready to

761

00:40:50,309 --> 00:40:48,240

go

762

00:40:51,750 --> 00:40:50,319

which rock we choose will be influenced

763

00:40:53,270 --> 00:40:51,760

not just by the geology

764

00:40:55,349 --> 00:40:53,280

but also by where we're going to go

765

00:40:57,109 --> 00:40:55,359

after that that's not something comes

766

00:40:59,190 --> 00:40:57,119

naturally to a field geologist

767

00:41:01,270 --> 00:40:59,200

we got to stay real focused on the task

768

00:41:01,829 --> 00:41:01,280

at hand which is doing the best job that

769

00:41:04,390 --> 00:41:01,839

we can

770

00:41:07,670 --> 00:41:04,400

for 10 days of really simulating the

771

00:41:09,990 --> 00:41:07,680

science that we're going to do on mars

772

00:41:10,790 --> 00:41:10,000

geology yeah yeah i know you guys love

773

00:41:12,150 --> 00:41:10,800

the pancake

774

00:41:13,349 --> 00:41:12,160

excuse me could i have attention for a

775

00:41:14,470 --> 00:41:13,359

moment yeah i know you guys love the

776

00:41:15,670 --> 00:41:14,480

hand cam panorama

777

00:41:17,430 --> 00:41:15,680

don't forget one thing you've really got

778

00:41:18,950 --> 00:41:17,440

to focus on is what the next style is

779

00:41:19,990 --> 00:41:18,960

going to be so be looking at the current

780

00:41:21,510 --> 00:41:20,000

location

781

00:41:23,190 --> 00:41:21,520

front has cam so you know what's in your

782

00:41:25,910 --> 00:41:23,200

work life okay all right

783

00:41:27,990 --> 00:41:25,920

good uh we have a western green floor i

784

00:41:30,470 --> 00:41:28,000

probably want to get this thing here

785

00:41:32,230 --> 00:41:30,480

say hey folks anybody's got questions

786

00:41:34,550 --> 00:41:32,240

issues on how to do naming

787

00:42:08,390 --> 00:41:34,560

of things roxanna wales here is our

788

00:42:13,750 --> 00:42:11,990

but so 17 18 19 three days of testing

789

00:42:17,990 --> 00:42:13,760

if we really knock them out like the two

790

00:42:22,630 --> 00:42:21,030

maybe make wasty right

791

00:42:25,510 --> 00:42:22,640

okay i mean that's just the only concern

792

00:42:27,109 --> 00:42:25,520

is that okay so the other scenario is

793

00:42:30,150 --> 00:42:27,119

then you start asking what is it even

794

00:42:33,670 --> 00:42:30,160

getting one or two of them

795

00:42:36,870 --> 00:42:33,680

it is it's worth look if 1.6

796

00:42:40,150 --> 00:42:36,880

fails that's huge and we have

797

00:42:46,390 --> 00:42:40,160

three mortars okay

798

00:42:51,510 --> 00:42:48,550

lay the parachute out like this and

799

00:42:54,710 --> 00:42:51,520

we're simply going to be relying on

800

00:42:57,349 --> 00:42:54,720

the friction with the floor

801
00:42:59,990 --> 00:42:57,359
to keep it from sucking the lines into

802
00:43:01,589 --> 00:43:00,000
the death zone

803
00:43:03,829 --> 00:43:01,599
the way i'd like is to make it to full

804
00:43:05,430 --> 00:43:03,839
inflation at center of the

805
00:43:07,030 --> 00:43:05,440
thing you just gotta but you gotta just

806
00:43:08,710 --> 00:43:07,040
you can't hit the top of the wall

807
00:43:10,829 --> 00:43:08,720
so you gotta stay safely off the top of

808
00:43:34,980 --> 00:43:10,839
the wall and that's it you go that high

809
00:43:38,470 --> 00:43:35,460
[Music]

810
00:43:45,589 --> 00:43:38,480
[Applause]

811
00:43:54,069 --> 00:43:49,829
come on come on what is that

812
00:43:59,990 --> 00:43:54,079
what is that what

813
00:44:13,030 --> 00:44:01,349

i don't know what it is what do you

814

00:44:18,950 --> 00:44:17,750

we are uh mobilizing or scrambling all

815

00:44:22,309 --> 00:44:18,960

forces

816

00:44:25,589 --> 00:44:22,319

to have a discussion at 12 p.m

817

00:44:30,470 --> 00:44:25,599

pacific on this subject

818

00:44:34,150 --> 00:44:30,480

what am i breaking up

819

00:44:37,990 --> 00:44:34,160

at any rate um yeah but

820

00:44:41,670 --> 00:44:38,000

it is a um it may be a function

821

00:44:57,030 --> 00:44:41,680

of the geometric porosity

822

00:45:01,670 --> 00:44:59,990

richard it's uh robin and tracin and

823

00:45:07,910 --> 00:45:01,680

adam and wayne is talking to

824

00:45:11,670 --> 00:45:09,670

this is not anything that was seen

825

00:45:16,230 --> 00:45:11,680

during pathfinder

826

00:45:18,150 --> 00:45:16,240

or thus far during mer's development

827

00:45:19,430 --> 00:45:18,160

just as a general policy clamp down on

828

00:45:21,910 --> 00:45:19,440

the information until

829

00:45:22,870 --> 00:45:21,920

until robin and i have had a chance to

830

00:45:33,030 --> 00:45:22,880

release

831

00:45:35,589 --> 00:45:33,040

the emails you receive yeah okay

832

00:45:36,309 --> 00:45:35,599

that's how information about this drop

833

00:45:39,270 --> 00:45:36,319

goes out

834

00:45:39,910 --> 00:45:39,280

first because i found with the airbag

835

00:45:41,910 --> 00:45:39,920

drops

836

00:45:43,670 --> 00:45:41,920

that if you make a telephone call

837

00:45:45,270 --> 00:45:43,680

somebody tells somebody else and they

838

00:45:46,230 --> 00:45:45,280

play the telephone game and by the time

839

00:45:47,829 --> 00:45:46,240

it makes it to

840

00:45:49,430 --> 00:45:47,839

up the food chain all the good words

841

00:45:50,630 --> 00:45:49,440

have been lost and only the bad words

842

00:45:52,950 --> 00:45:50,640

have remained

843

00:45:53,910 --> 00:45:52,960

but this allows you to inform your

844

00:45:55,829 --> 00:45:53,920

management before

845

00:45:57,430 --> 00:45:55,839

it gets through the grapevine yeah

846

00:46:07,270 --> 00:45:57,440

wouldn't you like to tell pete before

847

00:46:11,750 --> 00:46:10,390

that's right okay okay because number

848

00:46:37,190 --> 00:46:11,760

one i'd like to come up i mean i think

849

00:46:45,510 --> 00:46:43,190

two one fire

850

00:46:47,030 --> 00:46:45,520

there it goes look at that beautiful

851
00:46:54,790 --> 00:46:47,040
beautiful

852
00:46:54,800 --> 00:46:59,670
big that is awesome

853
00:47:03,910 --> 00:47:02,069
that was perfect that's center of the

854
00:47:05,109 --> 00:47:03,920
thing everything everything awesome

855
00:47:07,910 --> 00:47:05,119
awesome awesome

856
00:47:08,390 --> 00:47:07,920
oh that's so good yeah this is totally

857
00:47:12,069 --> 00:47:08,400
cool

858
00:47:29,829 --> 00:47:12,079
great huh we are so stoked

859
00:47:36,829 --> 00:47:33,430
ten nine eight

860
00:47:40,470 --> 00:47:36,839
seven six

861
00:47:52,950 --> 00:47:40,480
five four three

862
00:48:15,910 --> 00:47:52,960
two one pull five

863
00:48:28,549 --> 00:48:19,829

can we pull the transition through no

864

00:48:32,710 --> 00:48:30,230

as soon as the transition got to the

865

00:48:34,630 --> 00:48:32,720

first roller this broke

866

00:48:36,230 --> 00:48:34,640

probably a spiking load due to the fact

867

00:48:37,190 --> 00:48:36,240

of trying to push all that extra around

868

00:48:42,549 --> 00:48:37,200

that color

869

00:48:42,559 --> 00:48:47,589

i hope they do

870

00:48:54,309 --> 00:48:51,270

hey babe how are you

871

00:48:56,549 --> 00:48:54,319

oh really oh no

872

00:48:58,230 --> 00:48:56,559

things are going couldn't be going any

873

00:49:01,190 --> 00:48:58,240

worse

874

00:49:03,109 --> 00:49:01,200

yeah oh no no not that's not clear we're

875

00:49:04,790 --> 00:49:03,119

going to decide the next uh

876

00:49:07,430 --> 00:49:04,800

next half hour here what we're going to

877

00:49:13,030 --> 00:49:07,440

do and i'll call you when i find out

878

00:49:17,750 --> 00:49:16,069

oh oh my little transition joint why

879

00:49:21,510 --> 00:49:17,760

couldn't you have gone a little further

880

00:49:21,520 --> 00:49:25,510

well i made it

881

00:49:33,270 --> 00:49:31,109

transition joy made it

882

00:49:34,549 --> 00:49:33,280

that was 104. we got to get this thing

883

00:49:35,750 --> 00:49:34,559

fixed because this

884

00:49:37,829 --> 00:49:35,760

we don't have a mission without this

885

00:49:38,630 --> 00:49:37,839

device yeah please we we just got to

886

00:49:40,870 --> 00:49:38,640

test some more

887

00:49:41,829 --> 00:49:40,880

you put this on a cd for me and let me

888

00:50:01,430 --> 00:49:41,839

take it home

889

00:50:01,440 --> 00:50:26,420

okay yeah let's do that

890

00:50:26,430 --> 00:50:37,640

[Applause]

891

00:52:19,760 --> 00:50:46,630

[Music]

892

00:52:20,520 --> 00:52:19,770

take a little trip to me

893

00:52:22,650 --> 00:52:20,530

[Applause]

894

00:52:24,480 --> 00:52:22,660

[Music]

895

00:52:38,630 --> 00:52:24,490

[Applause]

896

00:52:38,640 --> 00:52:50,230

let's start moving them out guys okay

897

00:52:50,240 --> 00:52:58,829

[Applause]

898

00:52:58,839 --> 00:53:02,050

wow

899

00:53:05,740 --> 00:53:02,410

[Music]

900

00:53:08,630 --> 00:53:05,750

[Applause]

901
00:53:14,069 --> 00:53:08,640

[Music]

902
00:53:17,190 --> 00:53:14,079

just can't wait to get on the road again

903
00:53:19,109 --> 00:53:17,200

making music with my friends and i can't

904
00:53:21,430 --> 00:53:19,119

wait to get on the road again

905
00:53:28,069 --> 00:53:21,440

oh guys you're on the camera on the road

906
00:53:31,750 --> 00:53:28,079

again top of that pathfinder

907
00:53:44,630 --> 00:53:31,760

seeing things that i may never see again

908
00:53:44,640 --> 00:53:48,309

my last convoy

909
00:53:55,270 --> 00:53:49,589

well we're coming to an end we've been

910
00:53:57,270 --> 00:53:55,280

about 2 425 miles we got another 150

911
00:53:59,109 --> 00:53:57,280

miles or so to go and

912
00:54:00,870 --> 00:53:59,119

we'll be finishing up this particular

913
00:54:05,190 --> 00:54:00,880

wide load convoy

914

00:54:07,589 --> 00:54:05,200

which will be my last convoy over the

915

00:54:09,430 --> 00:54:07,599

41 years i've worked at jpl but it's

916

00:54:11,750 --> 00:54:09,440

been a

917

00:54:13,270 --> 00:54:11,760

quite an experience this is my 19th

918

00:54:15,109 --> 00:54:13,280

mission that i've worked on

919

00:54:16,309 --> 00:54:15,119

of course the role i also used to play

920

00:54:18,470 --> 00:54:16,319

most of the time

921

00:54:20,150 --> 00:54:18,480

was the spacecraft test engineer where i

922

00:54:21,750 --> 00:54:20,160

was actually out on the floor

923

00:54:23,030 --> 00:54:21,760

doing the electrical integration putting

924

00:54:24,069 --> 00:54:23,040

things together and then somehow or

925

00:54:25,990 --> 00:54:24,079

another i

926
00:54:28,549 --> 00:54:26,000
started picking up doing the logistics

927
00:54:31,910 --> 00:54:28,559
part as far as the transportation

928
00:54:33,190 --> 00:54:31,920
my first trip down here not convoy the

929
00:54:38,870 --> 00:54:33,200
project was

930
00:54:40,309 --> 00:54:38,880
ranger six that was of 1962.

931
00:54:43,910 --> 00:54:40,319
things are a lot different down here

932
00:54:50,829 --> 00:54:47,270
it's been a real experience

933
00:54:53,190 --> 00:54:50,839
quite a ride couldn't want it ain't

934
00:54:56,549 --> 00:54:53,200
better

935
00:54:57,990 --> 00:54:56,559
now it's been documented so i don't have

936
00:54:58,950 --> 00:54:58,000
to tell it over and over again i can

937
00:55:03,750 --> 00:54:58,960
show them the video

938
00:55:26,069 --> 00:55:05,190

how about if we pull all the trucks up

939

00:55:26,079 --> 00:55:41,400

rolling here we go

940

00:55:48,240 --> 00:55:46,829

[Music]

941

00:56:05,830 --> 00:55:48,250

oh

942

00:56:24,230 --> 00:56:15,190

[Music]

943

00:56:30,870 --> 00:56:24,240

t minus 10 9 8 7

944

00:56:33,670 --> 00:56:30,880

6 green board

945

00:56:36,150 --> 00:56:33,680

and liftoff of the delta ii rocket

946

00:56:39,750 --> 00:56:36,160

carrying the spirit from earth to planet

947

00:56:56,470 --> 00:56:43,850

load relief is responding

948

00:56:56,480 --> 00:57:03,370

for this

949

00:57:12,900 --> 00:57:10,390

[Music]

950

00:57:15,890 --> 00:57:12,910

nice clean signature there

951
00:58:32,670 --> 00:57:15,900
[Applause]

952
00:58:48,829 --> 00:58:34,829
[Music]

953
00:58:48,839 --> 00:58:54,280
so