



1  
00:00:05,030 --> 00:00:02,389  
so by the time we got to apollo 13 this

2  
00:00:06,789 --> 00:00:05,040  
was our third lunar landing mission

3  
00:00:08,310 --> 00:00:06,799  
previous two missions had been pretty

4  
00:00:12,870 --> 00:00:08,320  
sporty and we were hoping this mission

5  
00:00:17,269 --> 00:00:15,030  
crewmembers for jim lovell fred hayes and

6  
00:00:18,950 --> 00:00:17,279  
ken mattingly

7  
00:00:20,390 --> 00:00:18,960  
lovell and hayes were they crew in the

8  
00:00:22,230 --> 00:00:20,400  
lunar mountain they're scheduled to

9  
00:00:24,950 --> 00:00:22,240  
descend a very rugged landing site on

10  
00:00:26,870 --> 00:00:24,960  
the moon that we called fraumero

11  
00:00:28,710 --> 00:00:26,880  
ken mattingly was the command module

12  
00:00:30,070 --> 00:00:28,720  
pilot he'd remain circling the moon in

13  
00:00:31,669 --> 00:00:30,080

the ship

14

00:00:33,270 --> 00:00:31,679

about three days prior to launch we had

15

00:00:35,510 --> 00:00:33,280

been scrubbed from the mission because

16

00:00:37,110 --> 00:00:35,520

he had been exposed to measles

17

00:00:39,990 --> 00:00:37,120

and is replaced by jack swaggart a

18

00:00:42,069 --> 00:00:40,000

member of a backup crew

19

00:00:44,069 --> 00:00:42,079

emissions run in trust

20

00:00:45,910 --> 00:00:44,079

when you turn and a half million pounds

21

00:00:47,990 --> 00:00:45,920

of thrust loose with saturn five that's

22

00:00:50,470 --> 00:00:48,000

commitment there is no change in their

23

00:00:52,150 --> 00:00:50,480

mind no turning back from that decision

24

00:00:54,470 --> 00:00:52,160

and trust allows you to make the

25

00:00:56,790 --> 00:00:54,480

split-second decisions very rapidly seek

26

00:00:58,470 --> 00:00:56,800

out every option that may exist

27

00:01:00,150 --> 00:00:58,480

we lost an engine during the second

28

00:01:01,830 --> 00:01:00,160

stage of powered flight

29

00:01:03,590 --> 00:01:01,840

we looked at the remaining four engines

30

00:01:05,830 --> 00:01:03,600

they were all go we computed the new

31

00:01:07,429 --> 00:01:05,840

engine shutdown times verified we had

32

00:01:08,149 --> 00:01:07,439

enough propellant to get the corrupted

33

00:01:10,070 --> 00:01:08,159

orb

34

00:01:12,390 --> 00:01:10,080

pass this information up to the crew

35

00:01:13,990 --> 00:01:12,400

everything everything kept working

36

00:01:16,230 --> 00:01:14,000

got him up in orbit checked the

37

00:01:18,230 --> 00:01:16,240

spacecraft out and two and a half hours

38

00:01:20,789 --> 00:01:18,240

later we give the crew the go for

39

00:01:22,469 --> 00:01:20,799

translunar injection

40

00:01:24,710 --> 00:01:22,479

so now by the end of the second day this

41

00:01:25,590 --> 00:01:24,720

crew is 200 miles 200 000 miles from

42

00:01:27,510 --> 00:01:25,600

earth

43

00:01:28,630 --> 00:01:27,520

a fifty thousand miles from the surface

44

00:01:29,910 --> 00:01:28,640

of the moon

45

00:01:31,429 --> 00:01:29,920

and we're entering a phase of the

46

00:01:32,950 --> 00:01:31,439

mission we use the term entering the

47

00:01:34,390 --> 00:01:32,960

lunar sphere of influence and this is

48

00:01:36,149 --> 00:01:34,400

the point in the mission where you cross

49

00:01:38,870 --> 00:01:36,159

over from the earth's gravity

50

00:01:40,630 --> 00:01:38,880

to the moon's gravity

51  
00:01:42,230 --> 00:01:40,640  
and for about a short period of time of

52  
00:01:44,469 --> 00:01:42,240  
four hours you have two mission award

53  
00:01:45,830 --> 00:01:44,479  
options one comes around the front side

54  
00:01:47,109 --> 00:01:45,840  
of the moon takes a day and a half to

55  
00:01:48,870 --> 00:01:47,119  
return to earth

56  
00:01:50,950 --> 00:01:48,880  
the other one goes completely around the

57  
00:01:52,310 --> 00:01:50,960  
moon takes between four and five days to

58  
00:01:53,749 --> 00:01:52,320  
get back home

59  
00:01:56,310 --> 00:01:53,759  
it's got to make up your mind quick

60  
00:01:58,230 --> 00:01:56,320  
because time on these options is running

61  
00:01:59,990 --> 00:01:58,240  
out

62  
00:02:01,510 --> 00:02:00,000  
my team was on the console we were just

63  
00:02:03,109 --> 00:02:01,520

finishing our second shift everything

64

00:02:05,190 --> 00:02:03,119

was looking pretty good

65

00:02:06,950 --> 00:02:05,200

during the shift we had had a television

66

00:02:08,630 --> 00:02:06,960

broadcast from the crew

67

00:02:10,469 --> 00:02:08,640

and during the broadcast the crew's

68

00:02:12,710 --> 00:02:10,479

wives and families had been sitting

69

00:02:14,390 --> 00:02:12,720

behind me in the viewing room

70

00:02:15,990 --> 00:02:14,400

when we secured the television link

71

00:02:17,830 --> 00:02:16,000

families went home

72

00:02:19,350 --> 00:02:17,840

and now in my main control room the

73

00:02:21,350 --> 00:02:19,360

noise level was building up because the

74

00:02:23,910 --> 00:02:21,360

next team of controllers had reported in

75

00:02:25,910 --> 00:02:23,920

for shift handore

76

00:02:27,990 --> 00:02:25,920

their flight director was glenn lonnie

77

00:02:29,910 --> 00:02:28,000

he was a leader of the black team

78

00:02:31,589 --> 00:02:29,920

we used colors to identify teams in

79

00:02:34,070 --> 00:02:31,599

those days he was sitting next to me at

80

00:02:36,070 --> 00:02:34,080

the console reading my log

81

00:02:37,670 --> 00:02:36,080

final thing my team had to do is to put

82

00:02:39,589 --> 00:02:37,680

the crew to sleep

83

00:02:41,110 --> 00:02:39,599

we have a five page pea sleep checklist

84

00:02:43,350 --> 00:02:41,120

we go through very carefully to make

85

00:02:45,190 --> 00:02:43,360

sure everything's properly configured

86

00:02:47,110 --> 00:02:45,200

before we give the go for start of the

87

00:02:49,430 --> 00:02:47,120

sleep we got down to the final entry and

88

00:02:52,390 --> 00:02:49,440

the final entry asks a question do we

89

00:02:54,229 --> 00:02:52,400

require a cryo stir

90

00:02:56,869 --> 00:02:54,239

now the fuels on board the spacecraft

91

00:02:59,030 --> 00:02:56,879

are cryogenic oxygen and hydrogen

92

00:03:01,350 --> 00:02:59,040

super dense super cold liquid packed in

93

00:03:03,430 --> 00:03:01,360

vacuum insulated tanks at incredibly low

94

00:03:05,110 --> 00:03:03,440

temperatures of minus 300 minus 400

95

00:03:06,949 --> 00:03:05,120

degrees fahrenheit

96

00:03:09,110 --> 00:03:06,959

cryogenics react with the catalyst in a

97

00:03:10,869 --> 00:03:09,120

fuel cell to produce electricity

98

00:03:12,309 --> 00:03:10,879

and as a byproduct they produce heat and

99

00:03:14,070 --> 00:03:12,319

pure water

100

00:03:15,990 --> 00:03:14,080

so this is the energy heat and water

101

00:03:17,350 --> 00:03:16,000

resource we need to go to the moon

102

00:03:18,550 --> 00:03:17,360

operate in the vicinity of the moon and

103

00:03:20,470 --> 00:03:18,560

then return to earth so they're

104

00:03:21,990 --> 00:03:20,480

enormously important

105

00:03:23,589 --> 00:03:22,000

two days into the mission however i've

106

00:03:25,270 --> 00:03:23,599

used some of these cryogenics and if i

107

00:03:26,949 --> 00:03:25,280

could look inside the tank right now i

108

00:03:28,630 --> 00:03:26,959

would see a two-phase condition part

109

00:03:29,990 --> 00:03:28,640

liquid part gas

110

00:03:31,750 --> 00:03:30,000

and in this condition it's very

111

00:03:33,350 --> 00:03:31,760

difficult to manage the inlet pressures

112

00:03:35,670 --> 00:03:33,360

to the fuel cells because within the

113

00:03:38,309 --> 00:03:35,680

same tank there are different different

114

00:03:40,229 --> 00:03:38,319

areas of very the pressure varies

115

00:03:42,309 --> 00:03:40,239

throughout the tank

116

00:03:43,990 --> 00:03:42,319

so the designers put fans inside the

117

00:03:45,430 --> 00:03:44,000

tank they would turn on to stir this

118

00:03:46,710 --> 00:03:45,440

mixture up and we had a heater that we

119

00:03:48,869 --> 00:03:46,720

used to raise the pressure that's what a

120

00:03:50,390 --> 00:03:48,879

crosstar was all about

121

00:03:52,070 --> 00:03:50,400

jack swigert in the command module

122

00:03:53,429 --> 00:03:52,080

acknowledged our request for this stir

123

00:03:54,949 --> 00:03:53,439

and he looked behind him and coming

124

00:03:56,470 --> 00:03:54,959

through the tunnel from the lunar module

125

00:03:59,030 --> 00:03:56,480

with fred hayes

126

00:04:01,509 --> 00:03:59,040

swigert then threw two switches

127

00:04:03,990 --> 00:04:01,519

nothing happened for 16 seconds

128

00:04:05,589 --> 00:04:04,000

and then inside oxygen tank to a spark

129

00:04:07,670 --> 00:04:05,599

just between the fan and the heater

130

00:04:09,589 --> 00:04:07,680

assembly and the pressure in that tank

131

00:04:11,110 --> 00:04:09,599

risers very rapidly over the next six

132

00:04:12,229 --> 00:04:11,120

seconds until it blows the dome of the

133

00:04:14,070 --> 00:04:12,239

tank off

134

00:04:15,910 --> 00:04:14,080

when the dome came off the insulation

135

00:04:17,830 --> 00:04:15,920

surrounding the tank caught fire and fed

136

00:04:19,990 --> 00:04:17,840

by the oxygen it was oxygen it was like

137

00:04:21,270 --> 00:04:20,000

a blowtorch racing through the bay of

138

00:04:23,030 --> 00:04:21,280

the spacecraft carrying out the

139

00:04:25,270 --> 00:04:23,040

instrumentation and the plumbing and the

140

00:04:26,629 --> 00:04:25,280

electrical system shocking valves closed

141

00:04:27,830 --> 00:04:26,639

until the pressure increased to the

142

00:04:29,350 --> 00:04:27,840

point where it blew the side of the

143

00:04:31,189 --> 00:04:29,360

spacecraft off

144

00:04:33,030 --> 00:04:31,199

when the side came off the spacecraft

145

00:04:35,189 --> 00:04:33,040

the area surrounding it

146

00:04:37,430 --> 00:04:35,199

was enveloped in a cloud of debris from

147

00:04:38,790 --> 00:04:37,440

an explosion and frozen particles of

148

00:04:40,790 --> 00:04:38,800

oxygen

149

00:04:41,749 --> 00:04:40,800

we did not know an explosion had

150

00:04:43,990 --> 00:04:41,759

occurred

151  
00:04:45,510 --> 00:04:44,000  
it's 55 hours 55 minutes and four

152  
00:04:47,110 --> 00:04:45,520  
seconds from launch

153  
00:04:48,790 --> 00:04:47,120  
my voice loops come alive hey flight

154  
00:04:50,629 --> 00:04:48,800  
we've had a computer restart another

155  
00:04:52,870 --> 00:04:50,639  
controller calls off main bus interval

156  
00:04:54,390 --> 00:04:52,880  
third one says antenna switch then down

157  
00:04:55,430 --> 00:04:54,400  
from the spacecraft level calls hey

158  
00:04:57,110 --> 00:04:55,440  
houston

159  
00:04:58,469 --> 00:04:57,120  
we got a problem

160  
00:04:59,909 --> 00:04:58,479  
i already had a bunch of problems

161  
00:05:01,350 --> 00:04:59,919  
reporting i was wondering which one he

162  
00:05:03,270 --> 00:05:01,360  
was talking about

163  
00:05:04,629 --> 00:05:03,280

the controllers at that instant didn't

164

00:05:06,469 --> 00:05:04,639

know what to believe because none of

165

00:05:08,710 --> 00:05:06,479

their data made sense the crew thought

166

00:05:11,430 --> 00:05:08,720

they had been hit by a meteor

167

00:05:13,029 --> 00:05:11,440

and for about 60 seconds the

168

00:05:15,749 --> 00:05:13,039

communications loops are literally

169

00:05:17,590 --> 00:05:15,759

chaotic with all the reports coming in

170

00:05:19,110 --> 00:05:17,600

and then the training kicked in the

171

00:05:20,710 --> 00:05:19,120

controller started working the problem

172

00:05:22,870 --> 00:05:20,720

we started voicing instructions up the

173

00:05:24,230 --> 00:05:22,880

resource some of the lost functions

174

00:05:26,550 --> 00:05:24,240

so by three minutes we're into the

175

00:05:27,830 --> 00:05:26,560

process of recovery but all the problems

176  
00:05:29,430 --> 00:05:27,840  
that remain

177  
00:05:31,029 --> 00:05:29,440  
fall upon a single controller by the

178  
00:05:33,189 --> 00:05:31,039  
name of silaberg

179  
00:05:34,870 --> 00:05:33,199  
and psy has the system's responsibility

180  
00:05:36,950 --> 00:05:34,880  
for those things you need to stay alive

181  
00:05:39,670 --> 00:05:36,960  
in space power oxygen pressure heat

182  
00:05:41,510 --> 00:05:39,680  
water but i can't work with psy because

183  
00:05:43,510 --> 00:05:41,520  
the tumbling motion of the spacecraft is

184  
00:05:45,110 --> 00:05:43,520  
momentarily overcome levels ability to

185  
00:05:47,510 --> 00:05:45,120  
control it now we're driving towards a

186  
00:05:49,029 --> 00:05:47,520  
condition we call gimbal luck

187  
00:05:50,870 --> 00:05:49,039  
if this occurs we're going to tumble our

188  
00:05:52,629 --> 00:05:50,880

gyros we'll lose our ability to point

189

00:05:54,310 --> 00:05:52,639

the spacecraft communicate perform

190

00:05:55,590 --> 00:05:54,320

maneuvers find our way back to earth if

191

00:05:57,110 --> 00:05:55,600

we get in the gimbal lock condition

192

00:05:58,150 --> 00:05:57,120

we're literally going to be lost in

193

00:06:00,790 --> 00:05:58,160

space

194

00:06:02,950 --> 00:06:00,800

until we can go through the complex and

195

00:06:05,029 --> 00:06:02,960

time-consuming process of reordering a

196

00:06:07,029 --> 00:06:05,039

navigation system so we must avoid it at

197

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

all costs and you're becoming

198

00:06:10,230 --> 00:06:08,639

increasingly desperate you're working

199

00:06:12,230 --> 00:06:10,240

the blind and you still have a clue

200

00:06:14,230 --> 00:06:12,240

what's happened

201  
00:06:15,909 --> 00:06:14,240  
plus 20 minutes lovell's looking outside

202  
00:06:17,990 --> 00:06:15,919  
the hatch when he says hey houston i see

203  
00:06:21,270 --> 00:06:18,000  
some kind of a gassy substance

204  
00:06:23,270 --> 00:06:21,280  
i believe we are venting our oxygen

205  
00:06:24,950 --> 00:06:23,280  
all of a sudden the pieces fit together

206  
00:06:26,950 --> 00:06:24,960  
there had been explosion on board the

207  
00:06:28,870 --> 00:06:26,960  
spacecraft with an enormous amount of

208  
00:06:30,790 --> 00:06:28,880  
collateral damage

209  
00:06:32,150 --> 00:06:30,800  
when i debriefed my controllers after

210  
00:06:33,590 --> 00:06:32,160  
the mission they described their feeling

211  
00:06:35,909 --> 00:06:33,600  
at that instant as if they were just

212  
00:06:37,909 --> 00:06:35,919  
tumbling into a void

213  
00:06:39,830 --> 00:06:37,919

i was a fighter pilot fighter pilots and

214

00:06:41,430 --> 00:06:39,840

i they use the term looking into the

215

00:06:43,350 --> 00:06:41,440

eyes of a tiger

216

00:06:45,029 --> 00:06:43,360

and this is the stark and the very

217

00:06:47,590 --> 00:06:45,039

lonely feeling that you get when the

218

00:06:49,270 --> 00:06:47,600

only thought on your mind is survival

219

00:06:51,589 --> 00:06:49,280

and you're trying to find some way out

220

00:06:53,510 --> 00:06:51,599

of the box you're in

221

00:06:55,189 --> 00:06:53,520

i was a flight director and my job to

222

00:06:56,629 --> 00:06:55,199

get going so i call the flight

223

00:06:58,469 --> 00:06:56,639

controllers up and say okay flight

224

00:07:00,070 --> 00:06:58,479

controller settle down

225

00:07:02,309 --> 00:07:00,080

quit your guessing and let's start

226

00:07:04,150 --> 00:07:02,319

working this problem electrical basa is

227

00:07:05,110 --> 00:07:04,160

still good don't do anything to screw it

228

00:07:06,710 --> 00:07:05,120

up

229

00:07:08,390 --> 00:07:06,720

the lunar module is attached we're going

230

00:07:10,870 --> 00:07:08,400

to use that as our lifeboat now get me

231

00:07:14,629 --> 00:07:10,880

some backup people here and get me more

232

00:07:16,550 --> 00:07:14,639

computing and communications resources

233

00:07:18,790 --> 00:07:16,560

plus 30 minutes my boss chris craft

234

00:07:20,629 --> 00:07:18,800

comes in just as we're starting a series

235

00:07:22,230 --> 00:07:20,639

of emergency power downs we're trying to

236

00:07:23,830 --> 00:07:22,240

buy some time

237

00:07:25,510 --> 00:07:23,840

and beiber got comes to me and he says

238

00:07:27,270 --> 00:07:25,520

flight i'd like to shut down fuel cells

239

00:07:28,790 --> 00:07:27,280

one and three

240

00:07:30,309 --> 00:07:28,800

i say sorry we better think about that

241

00:07:33,110 --> 00:07:30,319

and he says no flight i think that's the

242

00:07:34,390 --> 00:07:33,120

only way we're going to stop these leaks

243

00:07:36,230 --> 00:07:34,400

and they say sorry are you ready for

244

00:07:37,430 --> 00:07:36,240

your final option he says yes flight

245

00:07:39,350 --> 00:07:37,440

it's time

246

00:07:41,430 --> 00:07:39,360

i have three fuel cells on board the

247

00:07:43,350 --> 00:07:41,440

spacecraft that use these cryogenics to

248

00:07:45,510 --> 00:07:43,360

produce all the resources we need to fly

249

00:07:49,189 --> 00:07:45,520

but the problem was once they're shut

250

00:07:51,029 --> 00:07:49,199

down they could never be restarted

251

00:07:53,430 --> 00:07:51,039

very reluctantly i agree outside that

252

00:07:55,029 --> 00:07:53,440

it's time to shut down to the fuel cells

253

00:07:55,990 --> 00:07:55,039

we always see instructions up to jim

254

00:07:57,350 --> 00:07:56,000

lovell

255

00:07:58,869 --> 00:07:57,360

and the discussion with jim is very

256

00:08:01,029 --> 00:07:58,879

short very intense

257

00:08:03,430 --> 00:08:01,039

and very reluctantly jim proceeds to

258

00:08:05,510 --> 00:08:03,440

shut down to the fuel cells

259

00:08:07,189 --> 00:08:05,520

this is probably the lowest point in

260

00:08:08,550 --> 00:08:07,199

morale in the entire mission because now

261

00:08:10,390 --> 00:08:08,560

we know there's no more going to the

262

00:08:14,070 --> 00:08:10,400

moon we also know it's going to be tough

263

00:08:15,909 --> 00:08:14,080

maybe impossible to get this crew home

264

00:08:18,469 --> 00:08:15,919

not through decisions yet because you

265

00:08:20,550 --> 00:08:18,479

have to pick the return path

266

00:08:22,309 --> 00:08:20,560

if i jettison the lunar module and use

267

00:08:23,749 --> 00:08:22,319

the bulk of my propellant i can be home

268

00:08:25,830 --> 00:08:23,759

in roughly about a day and a half i'll

269

00:08:27,589 --> 00:08:25,840

come around the front side of the moon

270

00:08:29,670 --> 00:08:27,599

but something some gut feeling and

271

00:08:31,270 --> 00:08:29,680

that's all it is is don't use it that

272

00:08:32,870 --> 00:08:31,280

engine won't work

273

00:08:34,230 --> 00:08:32,880

the other option i'm going to have to go

274

00:08:36,149 --> 00:08:34,240

completely around the moon it's going to

275

00:08:37,029 --> 00:08:36,159

take between four and five days to get

276

00:08:38,709 --> 00:08:37,039

home

277

00:08:40,070 --> 00:08:38,719

but to the best of my knowledge i only

278

00:08:43,269 --> 00:08:40,080

have enough electrical power in the

279

00:08:45,030 --> 00:08:43,279

lunar module for two people for two days

280

00:08:46,389 --> 00:08:45,040

there's nothing more than this gut

281

00:08:48,150 --> 00:08:46,399

feeling

282

00:08:49,509 --> 00:08:48,160

i make the decision

283

00:08:51,110 --> 00:08:49,519

to swing the mission around the moon

284

00:08:53,030 --> 00:08:51,120

call my controllers up and say okay all

285

00:08:55,110 --> 00:08:53,040

flight controllers listen up

286

00:08:58,150 --> 00:08:55,120

be advised that all mission planning

287

00:09:00,949 --> 00:08:58,160

from now on will be around the moon we

288

00:09:02,710 --> 00:09:00,959

will not i repeat we will not execute

289

00:09:04,230 --> 00:09:02,720

a direct abortion

290

00:09:06,310 --> 00:09:04,240

this comes as a shock to many of the

291

00:09:08,630 --> 00:09:06,320

controllers because they believe this is

292

00:09:10,230 --> 00:09:08,640

the wrong decision but they also know it

293

00:09:12,150 --> 00:09:10,240

is decision time

294

00:09:13,430 --> 00:09:12,160

and they are the ones that must execute

295

00:09:14,870 --> 00:09:13,440

it

296

00:09:16,470 --> 00:09:14,880

plus one hour

297

00:09:18,310 --> 00:09:16,480

my team has finally accomplished

298

00:09:20,389 --> 00:09:18,320

handover to glenn lonnie's team and he

299

00:09:22,070 --> 00:09:20,399

is immediately challenged because the

300

00:09:23,670 --> 00:09:22,080

third fuel cell is now failing in

301

00:09:26,230 --> 00:09:23,680

lifetime and that cell is down to less

302

00:09:27,750 --> 00:09:26,240

than 15 minutes so he scrambles the crew

303

00:09:29,350 --> 00:09:27,760

over the lunar module to complete the

304

00:09:31,030 --> 00:09:29,360

power but most importantly has to

305

00:09:32,550 --> 00:09:31,040

transfer the navigation data from the

306

00:09:33,670 --> 00:09:32,560

command module computer which is going

307

00:09:35,110 --> 00:09:33,680

to die

308

00:09:37,269 --> 00:09:35,120

and put it over in the lunar module

309

00:09:39,030 --> 00:09:37,279

computer we didn't have a data bus

310

00:09:41,350 --> 00:09:39,040

transfer capability in those days all