
INGENUITY
NASA
JPL

1
00:00:11,410 --> 00:00:17,590
[Music]

2
00:00:17,600 --> 00:00:33,350
t-minus one minute

3
00:01:01,029 --> 00:00:43,380
[Music]

4
00:01:01,039 --> 00:01:06,710
we are go for launch

5
00:01:14,469 --> 00:01:10,550
t-minus 10 9 8

6
00:01:18,070 --> 00:01:14,479
7 six five four

7
00:01:28,860 --> 00:01:18,080
three two one

8
00:01:28,870 --> 00:01:38,830
[Music]

9
00:01:54,060 --> 00:01:40,840
so

10
00:01:54,070 --> 00:02:05,590
[Music]

11
00:02:09,510 --> 00:02:08,790
welcome back to the nasa virtual social

12
00:02:12,869 --> 00:02:09,520
for mars

13
00:02:15,190 --> 00:02:12,879

2020 i am your host wayne sachser and

14
00:02:16,229 --> 00:02:15,200
on this episode the final one we are

15
00:02:19,030 --> 00:02:16,239
going to be talking

16
00:02:20,790 --> 00:02:19,040
about nuclear batteries joining me is my

17
00:02:21,190 --> 00:02:20,800
co-host allison allison how you doing

18
00:02:22,790 --> 00:02:21,200
today

19
00:02:24,470 --> 00:02:22,800
i'm doing great wayne and i'm so happy

20
00:02:25,589 --> 00:02:24,480
to be your co-host today and for

21
00:02:27,190 --> 00:02:25,599
everyone who is joining us

22
00:02:28,550 --> 00:02:27,200
live i've been monitoring your questions

23
00:02:29,670 --> 00:02:28,560
for the earlier shows i think you guys

24
00:02:31,830 --> 00:02:29,680
are going to be really excited about the

25
00:02:34,229 --> 00:02:31,840
guests we have with us today so please

26
00:02:35,670 --> 00:02:34,239
drop your questions in the comment box

27
00:02:37,030 --> 00:02:35,680
hashtag

28
00:02:40,470 --> 00:02:37,040
mars and we'll see if we get most of

29
00:02:44,550 --> 00:02:42,869
yeah as alison said we have a great we

30
00:02:46,470 --> 00:02:44,560
have a great show prepared for you

31
00:02:48,630 --> 00:02:46,480
like i said talking about nuclear

32
00:02:49,670 --> 00:02:48,640
batteries we have a guest joining us we

33
00:02:52,070 --> 00:02:49,680
will introduce him

34
00:02:53,509 --> 00:02:52,080
after this video and we want to show you

35
00:02:56,070 --> 00:02:53,519
what does it mean to persevere

36
00:02:58,710 --> 00:02:56,080
how did this rover get its name we as a

37
00:03:01,110 --> 00:02:58,720
species and as a company at nasa

38
00:03:02,630 --> 00:03:01,120

we want to know what it means so please

39
00:03:05,750 --> 00:03:02,640
take a look at this video

40
00:03:11,220 --> 00:03:05,760
and we will come right back we

41
00:03:11,230 --> 00:03:16,830
[Music]

42
00:03:16,840 --> 00:03:20,470
believers

43
00:03:26,020 --> 00:03:23,589
to overcome the many challenges this is

44
00:03:27,670 --> 00:03:26,030
what brings out the best in us

45
00:03:30,789 --> 00:03:27,680
[Music]

46
00:03:32,630 --> 00:03:30,799
our path has led to success and to

47
00:03:35,030 --> 00:03:32,640
bitter losses we come together

48
00:03:35,910 --> 00:03:35,040
today to mourn the loss of seven brave

49
00:03:39,990 --> 00:03:35,920
americans

50
00:03:44,550 --> 00:03:40,000
yet even when faced with tragedy

51
00:03:47,990 --> 00:03:44,560
and setbacks we persevere

52
00:03:51,030 --> 00:03:48,000
we keep striving we

53
00:03:54,229 --> 00:03:51,040
keep believing from space

54
00:03:54,949 --> 00:03:54,239
we see our planet as a whole we see the

55
00:04:01,990 --> 00:03:54,959
challenges

56
00:04:05,509 --> 00:04:02,000
together we will not give

57
00:04:07,830 --> 00:04:05,519
up we challenge convention we refuse to

58
00:04:10,949 --> 00:04:07,840
accept the status quo

59
00:04:14,470 --> 00:04:10,959
the time at hand is hard but

60
00:04:15,350 --> 00:04:14,480
we will persevere we can still draw hope

61
00:04:19,030 --> 00:04:15,360
from the moon

62
00:04:22,710 --> 00:04:19,040
and the stars from space

63
00:04:28,150 --> 00:04:22,720

from exploration there is a new day

64
00:04:31,749 --> 00:04:28,160
beyond the challenges we face now

65
00:04:33,990 --> 00:04:31,759
spirit opportunity if you think about it

66
00:04:40,950 --> 00:04:34,000
all of these names of past mars rovers

67
00:04:43,190 --> 00:04:40,960
are qualities we possess as humans

68
00:04:44,550 --> 00:04:43,200
are to be the stars of us as a race

69
00:04:53,230 --> 00:04:44,560
[Applause]

70
00:04:58,800 --> 00:04:55,110
[Music]

71
00:05:01,830 --> 00:04:58,810
are a perseverance of explorers

72
00:05:04,870 --> 00:05:01,840
[Music]

73
00:05:07,050 --> 00:05:04,880
we will meet many obstacles on our way

74
00:05:08,390 --> 00:05:07,060
to mars

75
00:05:11,749 --> 00:05:08,400
[Music]

76
00:05:15,830 --> 00:05:11,759
but as humans will

77
00:05:15,840 --> 00:05:27,590
we will always persevere

78
00:05:31,510 --> 00:05:29,670
as you saw there the name perseverance

79
00:05:34,150 --> 00:05:31,520
definitely has meaning to us

80
00:05:34,550 --> 00:05:34,160
and speaking of names it's not just

81
00:05:37,270 --> 00:05:34,560
called

82
00:05:38,469 --> 00:05:37,280
a nuclear battery it's a multi-mission

83
00:05:40,870 --> 00:05:38,479
radio isotope

84
00:05:42,230 --> 00:05:40,880
thermoelectric generator and here to

85
00:05:44,469 --> 00:05:42,240
talk to us about it

86
00:05:45,909 --> 00:05:44,479
is greg hula greg how you doing today

87
00:05:47,430 --> 00:05:45,919
i'm doing well wayne thank you

88
00:05:48,950 --> 00:05:47,440

you're welcome can you tell us a little

89
00:05:52,629 --> 00:05:48,960
bit about what it is

90
00:05:54,870 --> 00:05:52,639
on what the mmr is what your role with

91
00:05:57,909 --> 00:05:54,880
it is and kind of what it is you do

92
00:06:00,390 --> 00:05:57,919
yeah so the mmrpg as wayne mentioned

93
00:06:02,390 --> 00:06:00,400
is a nuclear battery it's essentially a

94
00:06:04,309 --> 00:06:02,400
system that converts heat

95
00:06:05,990 --> 00:06:04,319
from the natural decay of radioisotope

96
00:06:08,469 --> 00:06:06,000
fuel into electrical

97
00:06:10,469 --> 00:06:08,479
power and that's power that will provide

98
00:06:13,029 --> 00:06:10,479
electrical power for the rover

99
00:06:14,070 --> 00:06:13,039
on the surface of mars our role at the

100
00:06:17,670 --> 00:06:14,080
inl

101
00:06:18,870 --> 00:06:17,680
for the mars 2020 mission includes the

102
00:06:20,550 --> 00:06:18,880
assembly

103
00:06:21,990 --> 00:06:20,560
and the testing and the delivery of the

104
00:06:25,670 --> 00:06:22,000
power system

105
00:06:27,670 --> 00:06:25,680
for the rover you said inl that's the

106
00:06:28,790 --> 00:06:27,680
can you tell us what what that is and

107
00:06:32,390 --> 00:06:28,800
what your role there is

108
00:06:34,309 --> 00:06:32,400
yeah i can ida ida inl stands for idaho

109
00:06:36,230 --> 00:06:34,319
national laboratory

110
00:06:38,150 --> 00:06:36,240
we are part of the department of

111
00:06:41,270 --> 00:06:38,160
energy's complex

112
00:06:43,029 --> 00:06:41,280
and our role in the at the inl in the

113
00:06:44,710 --> 00:06:43,039

space nuclear power division which is

114
00:06:48,070 --> 00:06:44,720
the group i work in

115
00:06:52,070 --> 00:06:48,080
my role in that division is a nuclear

116
00:06:55,350 --> 00:06:52,080
safety and we look at

117
00:06:57,830 --> 00:06:55,360
the safety of the rtg power system

118
00:06:58,950 --> 00:06:57,840
in context of facility operations

119
00:07:01,510 --> 00:06:58,960
transportation

120
00:07:02,550 --> 00:07:01,520
and most recently in some launch safety

121
00:07:05,270 --> 00:07:02,560
context

122
00:07:06,629 --> 00:07:05,280
wow so i i spent some time researching

123
00:07:08,629 --> 00:07:06,639
this and i could ask you

124
00:07:10,150 --> 00:07:08,639
tons of questions but this is this is

125
00:07:10,790 --> 00:07:10,160
all about our viewers so we're gonna

126
00:07:12,710 --> 00:07:10,800
jump

127
00:07:14,070 --> 00:07:12,720
right to allison do we have any

128
00:07:15,510 --> 00:07:14,080
questions coming in from social

129
00:07:17,430 --> 00:07:15,520
yeah our viewers are definitely excited

130
00:07:18,469 --> 00:07:17,440
to learn about this first

131
00:07:19,830 --> 00:07:18,479
can we talk about a little bit the

132
00:07:20,790 --> 00:07:19,840
difference between switching from the

133
00:07:24,309 --> 00:07:20,800
solar panels

134
00:07:26,390 --> 00:07:24,319
to this nuclear battery and what the

135
00:07:28,830 --> 00:07:26,400
pros of it are yeah there's a couple of

136
00:07:30,070 --> 00:07:28,840
benefits of using a system such as an

137
00:07:35,430 --> 00:07:30,080
rtg

138
00:07:37,270 --> 00:07:35,440

say dust that might accumulate on a

139
00:07:39,510 --> 00:07:37,280
solar panel and

140
00:07:41,430 --> 00:07:39,520
reduce the efficiency of the panel the

141
00:07:44,869 --> 00:07:41,440
rtg is a completely sealed

142
00:07:47,350 --> 00:07:44,879
system so you don't have impacts of dust

143
00:07:48,869 --> 00:07:47,360
or other planetary environments that may

144
00:07:51,189 --> 00:07:48,879
degrade

145
00:07:52,869 --> 00:07:51,199
adversely affect the system the other

146
00:07:54,070 --> 00:07:52,879
benefit is that the nuclear battery

147
00:07:57,830 --> 00:07:54,080
provides

148
00:07:59,189 --> 00:07:57,840
power 24 hours a day over the course of

149
00:08:02,869 --> 00:07:59,199
many many years

150
00:08:06,869 --> 00:08:04,790
have adverse effect from you know sun

151
00:08:09,909 --> 00:08:06,879
not shining etcetera

152
00:08:13,270 --> 00:08:09,919
evenings days nights days nights

153
00:08:16,150 --> 00:08:13,280
so it's a very reliable source of power

154
00:08:17,830 --> 00:08:16,160
and it's actually got design life of

155
00:08:20,950 --> 00:08:17,840
about 17 years

156
00:08:23,830 --> 00:08:20,960
and we expect that that source of power

157
00:08:26,950 --> 00:08:23,840
the rtg to provide power

158
00:08:27,990 --> 00:08:26,960
for as long as the mission and the rover

159
00:08:29,270 --> 00:08:28,000
need it

160
00:08:30,550 --> 00:08:29,280
yeah that's really cool i was i was

161
00:08:32,149 --> 00:08:30,560
talking to my brother last night and

162
00:08:33,829 --> 00:08:32,159
that was his first question is

163
00:08:35,509 --> 00:08:33,839

well if we're not using solar panels

164
00:08:36,550 --> 00:08:35,519
then you know how long is this battery

165
00:08:37,990 --> 00:08:36,560
going to last so to hear it's going to

166
00:08:39,909 --> 00:08:38,000
go 17 years like

167
00:08:41,190 --> 00:08:39,919
that's a pretty long life cycle for you

168
00:08:42,790 --> 00:08:41,200
know something that's being sent to

169
00:08:45,990 --> 00:08:42,800
another planetary body

170
00:08:47,509 --> 00:08:46,000
it is and these um these rtgs have been

171
00:08:49,430 --> 00:08:47,519
used by nasa

172
00:08:50,870 --> 00:08:49,440
provided by the department of energy for

173
00:08:54,070 --> 00:08:50,880
over 50 years

174
00:08:56,150 --> 00:08:54,080
going back to the late 60s early 70s

175
00:08:59,190 --> 00:08:56,160
they've been reliably used as sources of

176
00:09:00,870 --> 00:08:59,200
power not only for deep space missions

177
00:09:02,710 --> 00:09:00,880
but also for missions such as the

178
00:09:05,190 --> 00:09:02,720
planetary surface on mars

179
00:09:06,630 --> 00:09:05,200
yeah wow alison do we have another

180
00:09:08,870 --> 00:09:06,640
question coming in from social

181
00:09:10,790 --> 00:09:08,880
yes we do so our viewers want to know is

182
00:09:12,949 --> 00:09:10,800
this the only power source on the

183
00:09:15,990 --> 00:09:12,959
perseverance rover

184
00:09:19,750 --> 00:09:16,000
this is this is not it

185
00:09:20,710 --> 00:09:19,760
this rtg provides power to lithium-ion

186
00:09:26,389 --> 00:09:20,720
batteries

187
00:09:27,990 --> 00:09:26,399
up the power provided by the rtg

188
00:09:30,389 --> 00:09:28,000

and meet peak demands of the

189
00:09:31,750 --> 00:09:30,399
perseverance rover's instruments and

190
00:09:34,070 --> 00:09:31,760
scientific

191
00:09:34,790 --> 00:09:34,080
packages it is the only nuclear power

192
00:09:38,389 --> 00:09:34,800
system

193
00:09:38,790 --> 00:09:38,399
on the rover though awesome and then

194
00:09:42,230 --> 00:09:38,800
what's

195
00:09:45,190 --> 00:09:42,240
next for the mm-rtg well the mm-rtg

196
00:09:46,150 --> 00:09:45,200
was successfully integrated to the rover

197
00:09:48,150 --> 00:09:46,160
last week

198
00:09:51,030 --> 00:09:48,160
remain integrated in the sense of

199
00:09:53,430 --> 00:09:51,040
attached electrically and mechanically

200
00:09:54,550 --> 00:09:53,440
and with the perseverance rover we

201
00:09:57,509 --> 00:09:54,560
launched

202
00:09:58,389 --> 00:09:57,519
successfully tomorrow and once on the

203
00:10:01,829 --> 00:09:58,399
surface of

204
00:10:05,350 --> 00:10:01,839
mars the rtg will provide power

205
00:10:07,509 --> 00:10:05,360
to the rover for many years

206
00:10:09,030 --> 00:10:07,519
and so i i actually have this question

207
00:10:10,790 --> 00:10:09,040
we get this a lot

208
00:10:12,389 --> 00:10:10,800
can you talk a little bit when you hear

209
00:10:13,509 --> 00:10:12,399
nuclear battery i think that makes

210
00:10:15,430 --> 00:10:13,519
people a little nervous

211
00:10:17,350 --> 00:10:15,440
sure so can you talk about kind of what

212
00:10:18,630 --> 00:10:17,360
it means for it to be a nuclear battery

213
00:10:21,190 --> 00:10:18,640

and some of the safety that's been

214
00:10:23,670 --> 00:10:21,200
implemented yeah it can

215
00:10:24,550 --> 00:10:23,680
we have a kind of a half size replica of

216
00:10:27,750 --> 00:10:24,560
the rtg

217
00:10:28,630 --> 00:10:27,760
the multi-mission rtg and as i mentioned

218
00:10:32,230 --> 00:10:28,640
it's a

219
00:10:34,470 --> 00:10:32,240
system that converts the heat from the

220
00:10:37,269 --> 00:10:34,480
natural decay of radioactive material

221
00:10:38,870 --> 00:10:37,279
to electrical power and it's essentially

222
00:10:41,030 --> 00:10:38,880
consists of two parts

223
00:10:42,069 --> 00:10:41,040
at the center of the unit as shown in

224
00:10:44,949 --> 00:10:42,079
the orange

225
00:10:46,870 --> 00:10:44,959
blocks that's the heat source and the

226
00:10:51,110 --> 00:10:46,880
heat source consists of about

227
00:10:52,949 --> 00:10:51,120
10.6 pounds of plutonium dioxide fuel

228
00:10:54,230 --> 00:10:52,959
and the main isotope in that fuel that

229
00:10:58,230 --> 00:10:54,240
produces heat

230
00:11:02,150 --> 00:10:58,240
is plutonium-238 that heat source

231
00:11:04,790 --> 00:11:02,160
is surrounded by 768 thermocouples

232
00:11:07,190 --> 00:11:04,800
the thermal converter part of the system

233
00:11:09,509 --> 00:11:07,200
and those thermocouples are collected

234
00:11:11,030 --> 00:11:09,519
um they're they're assembled into an

235
00:11:14,150 --> 00:11:11,040
electrical circuit

236
00:11:16,310 --> 00:11:14,160
that convert the 2000 watts of heat into

237
00:11:17,110 --> 00:11:16,320
approximately 110 watts of electrical

238
00:11:20,310 --> 00:11:17,120

power

239
00:11:23,430 --> 00:11:20,320
for the rover and

240
00:11:25,190 --> 00:11:23,440
the the ability to use a system like

241
00:11:26,790 --> 00:11:25,200
this a nuclear power system such as an

242
00:11:30,069 --> 00:11:26,800
rtg

243
00:11:32,470 --> 00:11:30,079
is largely possible because of the

244
00:11:33,829 --> 00:11:32,480
very high degree of safety that goes

245
00:11:37,269 --> 00:11:33,839
into the heat source

246
00:11:39,350 --> 00:11:37,279
and by heat source i mean

247
00:11:40,310 --> 00:11:39,360
the blocks they're called general

248
00:11:43,269 --> 00:11:40,320
purpose heat source

249
00:11:45,030 --> 00:11:43,279
modules and it's about four inch by four

250
00:11:47,190 --> 00:11:45,040
inch by two inch block

251
00:11:50,069 --> 00:11:47,200
and these are the heat sources that

252
00:11:52,389 --> 00:11:50,079
contain the plutonium oxide fuel

253
00:11:55,110 --> 00:11:52,399
and the general purpose heat source is

254
00:11:57,269 --> 00:11:55,120
composed of several layers

255
00:11:58,550 --> 00:11:57,279
and i'm talking i'm going to talk or

256
00:11:59,990 --> 00:11:58,560
describe it

257
00:12:01,990 --> 00:12:00,000
from the inside out and if you think

258
00:12:03,590 --> 00:12:02,000
about an onion if you were to peel the

259
00:12:04,470 --> 00:12:03,600
layers of an onion back till you got to

260
00:12:08,230 --> 00:12:04,480
the inside

261
00:12:11,590 --> 00:12:08,240
purpose heat source

262
00:12:14,470 --> 00:12:11,600
and at the inside um is

263
00:12:15,910 --> 00:12:14,480

the fuel i've got a kind of a model of a

264
00:12:18,710 --> 00:12:15,920
fuel pellet here

265
00:12:20,470 --> 00:12:18,720
and the red reflects the heat generated

266
00:12:22,870 --> 00:12:20,480
by the plutonium-238

267
00:12:25,190 --> 00:12:22,880
this pellet is about one inch tall and

268
00:12:28,629 --> 00:12:25,200
about one inch in diameter

269
00:12:29,750 --> 00:12:28,639
that fuel is a ceramic form of plutonium

270
00:12:32,389 --> 00:12:29,760
dioxide

271
00:12:34,310 --> 00:12:32,399
and the benefit of ceramic is that under

272
00:12:36,870 --> 00:12:34,320
impact accident environments

273
00:12:38,629 --> 00:12:36,880
it will tend to fracture or break into

274
00:12:39,190 --> 00:12:38,639
pieces and particles that are largely

275
00:12:41,910 --> 00:12:39,200
too

276
00:12:43,829 --> 00:12:41,920
large to be carried away by wind the

277
00:12:46,949 --> 00:12:43,839
containment of that fuel pellet

278
00:12:48,550 --> 00:12:46,959
is provided by an alloy of iridium

279
00:12:52,230 --> 00:12:48,560
called dope 26

280
00:12:54,150 --> 00:12:52,240
and that it's basically a metal casing

281
00:12:57,350 --> 00:12:54,160
that encapsulates the plutonium oxide

282
00:13:01,190 --> 00:12:57,360
pellet and provides for the containment

283
00:13:02,389 --> 00:13:01,200
of the fuel surrounding that fuel clad

284
00:13:06,310 --> 00:13:02,399
are three

285
00:13:07,430 --> 00:13:06,320
very special layers of carbon carbon

286
00:13:08,949 --> 00:13:07,440
material

287
00:13:12,150 --> 00:13:08,959
the first one is called a graphite

288
00:13:13,990 --> 00:13:12,160

impact shell and it's a cylindrical

289
00:13:15,190 --> 00:13:14,000
component it's about two and a half

290
00:13:18,150 --> 00:13:15,200
inches long and it holds

291
00:13:20,310 --> 00:13:18,160
two of the fuel clads fuel clouds would

292
00:13:23,190 --> 00:13:20,320
sit inside of the graphite impact shell

293
00:13:25,110 --> 00:13:23,200
this graphite impact shell provides

294
00:13:27,350 --> 00:13:25,120
protection under very

295
00:13:29,350 --> 00:13:27,360
energetic impact scenarios are these to

296
00:13:30,949 --> 00:13:29,360
scale these are the scale

297
00:13:32,790 --> 00:13:30,959
and we have a half scale model here

298
00:13:34,230 --> 00:13:32,800
that's correct these are two scales yes

299
00:13:36,790 --> 00:13:34,240
the components that i've got for the

300
00:13:38,949 --> 00:13:36,800
gphs module are to scale cool

301
00:13:39,910 --> 00:13:38,959
and then surrounding the graphite impact

302
00:13:42,150 --> 00:13:39,920
shell

303
00:13:43,750 --> 00:13:42,160
is a carbon-based component that

304
00:13:46,870 --> 00:13:43,760
basically serves

305
00:13:49,350 --> 00:13:46,880
as a thermal insulator so under the

306
00:13:51,269 --> 00:13:49,360
very high temperature environments

307
00:13:53,430 --> 00:13:51,279
associated with like

308
00:13:54,470 --> 00:13:53,440
atmospheric reentry that thermal

309
00:13:57,590 --> 00:13:54,480
insulator

310
00:14:01,430 --> 00:13:57,600
serves to protect the fuel clad from

311
00:14:04,870 --> 00:14:02,629
so atmospheric reentry like what you're

312
00:14:06,470 --> 00:14:04,880
saying is in the event of a

313
00:14:07,990 --> 00:14:06,480

the extremely unlikely event of a

314
00:14:11,590 --> 00:14:08,000
contingency that

315
00:14:12,550 --> 00:14:11,600
this will actually protect the plutonium

316
00:14:15,110 --> 00:14:12,560
what you said

317
00:14:16,629 --> 00:14:15,120
on reentry so this can survive a

318
00:14:18,310 --> 00:14:16,639
re-entry all on its own

319
00:14:20,310 --> 00:14:18,320
it is designed to survive re-entry

320
00:14:22,069 --> 00:14:20,320
that's correct okay the outermost

321
00:14:25,189 --> 00:14:22,079
protective layer which is

322
00:14:28,069 --> 00:14:25,199
um the most substantial part

323
00:14:29,509 --> 00:14:28,079
of the gphs module is what we call the

324
00:14:33,750 --> 00:14:29,519
aeroshell

325
00:14:34,550 --> 00:14:33,760
accommodate two of the graphite impact

326
00:14:36,949 --> 00:14:34,560
shells

327
00:14:39,189 --> 00:14:36,959
such that there's four fuel clads in

328
00:14:42,230 --> 00:14:39,199
each gphs module

329
00:14:44,470 --> 00:14:42,240
this this aerial shell is made

330
00:14:46,230 --> 00:14:44,480
of the same material similar material

331
00:14:49,350 --> 00:14:46,240
that's on the nose cone of a missile

332
00:14:51,910 --> 00:14:49,360
so it's very very rugged very durable

333
00:14:52,949 --> 00:14:51,920
and very provides a very high level of

334
00:14:54,790 --> 00:14:52,959
protection

335
00:14:56,310 --> 00:14:54,800
under impact as well as thermal

336
00:14:58,230 --> 00:14:56,320
environments

337
00:15:01,269 --> 00:14:58,240
the components when assembled into the

338
00:15:02,790 --> 00:15:01,279

aeroshell is what we call the gphs

339
00:15:04,949 --> 00:15:02,800
or the general purpose heat source

340
00:15:05,750 --> 00:15:04,959
module and there's eight of these

341
00:15:08,389 --> 00:15:05,760
modules

342
00:15:10,230 --> 00:15:08,399
that are stacked in the center of the

343
00:15:13,350 --> 00:15:10,240
multi-mission rtg

344
00:15:16,389 --> 00:15:13,360
and produce about 2 000 watts of heat

345
00:15:16,870 --> 00:15:16,399
from the plutonium 238 decay wow and so

346
00:15:20,389 --> 00:15:16,880
we were

347
00:15:23,030 --> 00:15:20,399
behind the scenes and i was told

348
00:15:23,590 --> 00:15:23,040
that you know this is actually very very

349
00:15:25,430 --> 00:15:23,600
safe

350
00:15:27,750 --> 00:15:25,440
it's alpha raised and the only thing

351
00:15:30,470 --> 00:15:27,760
that you need to not do is eat it

352
00:15:32,230 --> 00:15:30,480
and that you would be fine right yeah

353
00:15:33,829 --> 00:15:32,240
you know actually wayne that

354
00:15:35,269 --> 00:15:33,839
what we don't want to do is have any of

355
00:15:38,949 --> 00:15:35,279
it released

356
00:15:40,790 --> 00:15:38,959
and eating it is one one way where it

357
00:15:42,550 --> 00:15:40,800
could get in the body the other is

358
00:15:44,550 --> 00:15:42,560
through inhalation

359
00:15:46,230 --> 00:15:44,560
so the general purpose heat source

360
00:15:48,389 --> 00:15:46,240
module is designed

361
00:15:50,470 --> 00:15:48,399
to provide a very high degree of

362
00:15:54,069 --> 00:15:50,480
protection

363
00:15:57,269 --> 00:15:54,079

for the fuel inside it is possible

364
00:15:59,430 --> 00:15:57,279
under some very um very energetic

365
00:16:01,990 --> 00:15:59,440
accident environments there can be some

366
00:16:04,389 --> 00:16:02,000
small quantities of plutonium released

367
00:16:05,990 --> 00:16:04,399
and the the concern with that as you

368
00:16:07,030 --> 00:16:06,000
mentioned is the potential for health

369
00:16:09,030 --> 00:16:07,040
risk

370
00:16:10,790 --> 00:16:09,040
from those kinds of releases but that's

371
00:16:12,150 --> 00:16:10,800
why we have we have these systems we

372
00:16:14,310 --> 00:16:12,160
have backup systems and

373
00:16:15,749 --> 00:16:14,320
and safety is one of our core values

374
00:16:17,590 --> 00:16:15,759
here absolutely

375
00:16:19,189 --> 00:16:17,600
yeah absolutely and we do have one last

376
00:16:22,069 --> 00:16:19,199
question from social

377
00:16:22,389 --> 00:16:22,079
why was the mm rtg attached at the very

378
00:16:24,069 --> 00:16:22,399
end

379
00:16:26,790 --> 00:16:24,079
just before the rocket was about to roll

380
00:16:29,829 --> 00:16:26,800
out so

381
00:16:31,189 --> 00:16:29,839
the one of the reasons for that has to

382
00:16:33,749 --> 00:16:31,199
do with the fact that

383
00:16:36,150 --> 00:16:33,759
not only does the plutonium emit alpha

384
00:16:39,189 --> 00:16:36,160
radiation but it also emits some

385
00:16:40,389 --> 00:16:39,199
gamma and neutron radiation which isn't

386
00:16:42,150 --> 00:16:40,399
easily blocked

387
00:16:43,990 --> 00:16:42,160
by the components so that can be a

388
00:16:46,470 --> 00:16:44,000

health hazard to workers

389
00:16:47,269 --> 00:16:46,480
a radiation hazard it's not very big

390
00:16:50,069 --> 00:16:47,279
poses no

391
00:16:52,310 --> 00:16:50,079
health risk to the public but by by

392
00:16:55,030 --> 00:16:52,320
holding off on the integration

393
00:16:56,069 --> 00:16:55,040
of the rtg to the end or very close to

394
00:16:58,310 --> 00:16:56,079
launch

395
00:16:59,350 --> 00:16:58,320
there's less people working around the

396
00:17:01,590 --> 00:16:59,360
rtg

397
00:17:02,949 --> 00:17:01,600
and exposed to that kind of radiation

398
00:17:06,309 --> 00:17:02,959
and then also i believe

399
00:17:11,510 --> 00:17:07,170
serves to

400
00:17:15,350 --> 00:17:14,150
not introduce a thermal hazard early in

401
00:17:18,949 --> 00:17:15,360
the spacecraft

402
00:17:19,829 --> 00:17:18,959
assembly so you're basically holding off

403
00:17:22,069 --> 00:17:19,839
on that

404
00:17:23,510 --> 00:17:22,079
the heat that's generated or put off by

405
00:17:24,789 --> 00:17:23,520
the 238

406
00:17:27,350 --> 00:17:24,799
you don't have that thermal hazard

407
00:17:29,430 --> 00:17:27,360
present as well that makes sense

408
00:17:31,350 --> 00:17:29,440
so i gotta say after hearing you talk

409
00:17:33,190 --> 00:17:31,360
about this i

410
00:17:34,789 --> 00:17:33,200
you know when you're you hear you're oh

411
00:17:37,110 --> 00:17:34,799
we're launching uh

412
00:17:38,710 --> 00:17:37,120
a nuclear battery on on the perseverance

413
00:17:40,549 --> 00:17:38,720

river and sending it to mars like

414
00:17:42,630 --> 00:17:40,559
you do kind of feel a little uneasy but

415
00:17:44,710 --> 00:17:42,640
hearing all the safety precautions that

416
00:17:46,950 --> 00:17:44,720
you know inl and the department of

417
00:17:49,590 --> 00:17:46,960
energy have gone through to make this

418
00:17:51,350 --> 00:17:49,600
so safe i feel safer so thank you for

419
00:17:53,990 --> 00:17:51,360
talking to us absolutely

420
00:17:55,750 --> 00:17:54,000
so you know i can add too i you know i i

421
00:17:56,390 --> 00:17:55,760
feel very safe around it we work around

422
00:17:59,270 --> 00:17:56,400
this

423
00:17:59,990 --> 00:17:59,280
regularly at the idaho national lab

424
00:18:03,110 --> 00:18:00,000
we've worked around

425
00:18:04,710 --> 00:18:03,120
it down here with nasa and jpl and in

426
00:18:06,630 --> 00:18:04,720
addition to the safety and the very

427
00:18:08,390 --> 00:18:06,640
rugged compact

428
00:18:09,990 --> 00:18:08,400
safety features and protective layers

429
00:18:12,630 --> 00:18:10,000
that the module provides

430
00:18:14,150 --> 00:18:12,640
as well as the layers in the rtg you

431
00:18:17,029 --> 00:18:14,160
know nasa's done a a

432
00:18:17,510 --> 00:18:17,039
remarkable job of contingency planning

433
00:18:19,350 --> 00:18:17,520
and

434
00:18:21,029 --> 00:18:19,360
you'd have to talk to them to nasa to

435
00:18:23,350 --> 00:18:21,039
get more details on that

436
00:18:24,070 --> 00:18:23,360
but uh that you know full-on contingency

437
00:18:27,430 --> 00:18:24,080
plan

438
00:18:29,669 --> 00:18:27,440

in the event of an anomaly okay

439
00:18:31,029 --> 00:18:29,679
great so allison you said that was it

440
00:18:32,870 --> 00:18:31,039
for a social question yep that was what

441
00:18:35,029 --> 00:18:32,880
we have for social well then i will ask

442
00:18:36,230 --> 00:18:35,039
my last question and that's uh greg

443
00:18:36,789 --> 00:18:36,240
where are you going to be for launch

444
00:18:38,870 --> 00:18:36,799
tomorrow

445
00:18:41,029 --> 00:18:38,880
i will be in the joint information

446
00:18:42,310 --> 00:18:41,039
center which is part of the radiological

447
00:18:44,870 --> 00:18:42,320
control center

448
00:18:45,669 --> 00:18:44,880
i'll be serving as the mmrtg point of

449
00:18:47,909 --> 00:18:45,679
contact

450
00:18:49,510 --> 00:18:47,919
during the launch how exciting i'm

451
00:18:52,470 --> 00:18:49,520
excited we're going to be out here

452
00:18:53,669 --> 00:18:52,480
for those of you who cannot be out here

453
00:18:54,950 --> 00:18:53,679
can't join us you're not here in

454
00:18:57,669 --> 00:18:54,960
titusville

455
00:18:58,310 --> 00:18:57,679
or the the space coast region please

456
00:19:02,390 --> 00:18:58,320
join us

457
00:19:05,430 --> 00:19:02,400
online at www.nasa.gov

458
00:19:07,909 --> 00:19:05,440
live we would be remiss

459
00:19:09,830 --> 00:19:07,919
not to thank everybody all of our

460
00:19:11,110 --> 00:19:09,840
viewers for exploring with us for going

461
00:19:13,830 --> 00:19:11,120
through this process

462
00:19:15,909 --> 00:19:13,840
i want to thank stephanie and madison

463
00:19:17,750 --> 00:19:15,919

coming in on set with me

464
00:19:19,830 --> 00:19:17,760
they were amazing hosts we've had a lot

465
00:19:21,669 --> 00:19:19,840
of people working behind the scenes on

466
00:19:25,110 --> 00:19:21,679
this as well we have bethany

467
00:19:26,630 --> 00:19:25,120
doing production back there i think

468
00:19:26,950 --> 00:19:26,640
that's that's all we have we're going to

469
00:19:30,870 --> 00:19:26,960
wrap

470
00:19:32,549 --> 00:19:30,880
up for the the mars 2020 nasa social

471
00:19:34,470 --> 00:19:32,559
and allison i think you have one last

472
00:19:36,070 --> 00:19:34,480
thing to say of course i do

473
00:19:37,990 --> 00:19:36,080
so we're very excited for the launch

474
00:19:40,310 --> 00:19:38,000
tomorrow go ahead and show your love

475
00:19:41,190 --> 00:19:40,320
by dropping a cheer in the comments go