1
00:00:20,560 --> 00:00:31,750
so

2
00:00:37,910 --> 00:00:34,470
good morning from orbital atk's test

3
00:00:41,190 --> 00:00:37,920
complex at promontory utah today a team

4
00:00:42,549 --> 00:00:41,200
of nasa and orbital atk engineers are

5
00:00:45,270 --> 00:00:42,559
getting ready for the first

6
00:00:47,590 --> 00:00:45,280
qualification test of the five-segment

7
00:00:50,709 --> 00:00:47,600
booster that will power nasa's space

8
00:00:52,630 --> 00:00:50,719
launch system and orion spacecraft on

9
00:00:59,430 --> 00:00:52,640
future missions to deep space

10
00:01:03,990 --> 00:01:01,270
i'm nasa public affairs officer

11
00:01:07,350 --> 00:01:04,000
stephanie shearholds and i'm here today

12
00:01:08,789 --> 00:01:07,360
outside the orbital atk test engineering

13
00:01:11,109 --> 00:01:08,799

support center

14
00:01:13,590 --> 00:01:11,119
today's test is a major milestone for

15
00:01:15,910 --> 00:01:13,600
the agency and the space launch system

16
00:01:17,030 --> 00:01:15,920
program as we continue on our journey to

17
00:01:20,789 --> 00:01:17,040
mars

18
00:01:22,710 --> 00:01:20,799
this two-minute test will generate 3.6

19
00:01:26,550 --> 00:01:22,720
million pounds of thrust

20
00:01:30,149 --> 00:01:26,560
the test is set for 9 38 a.m mountain

21
00:01:31,990 --> 00:01:30,159
time 11 30 a.m eastern and the countdown

22
00:01:34,630 --> 00:01:32,000
is progressing normally

23
00:01:36,789 --> 00:01:34,640
we'll have full coverage of today's test

24
00:01:39,350 --> 00:01:36,799
for the next hour as we progress through

25
00:01:41,749 --> 00:01:39,360
the countdown the test and reaction

26
00:01:44,310 --> 00:01:41,759
afterward from managers

27
00:01:48,550 --> 00:01:44,320
you can follow along on social media

28
00:01:49,749 --> 00:01:48,560
with at nasa and at nasa underscore sls

29
00:01:53,990 --> 00:01:49,759
on twitter

30
00:01:57,190 --> 00:01:54,000
nasa sls on facebook and the hashtag sls

31
00:01:59,670 --> 00:01:57,200
fired up and journey to mars

32
00:02:02,389 --> 00:01:59,680
sls will be the most powerful rocket

33
00:02:04,950 --> 00:02:02,399
ever built and will send astronauts and

34
00:02:07,590 --> 00:02:04,960
the orion spacecraft far into the solar

35
00:02:09,830 --> 00:02:07,600
system it will also have the ability to

36
00:02:12,630 --> 00:02:09,840
send other payloads like scientific

37
00:02:14,229 --> 00:02:12,640
robotic spacecraft to places we've never

38
00:02:15,910 --> 00:02:14,239

explored before

39
00:02:18,470 --> 00:02:15,920
while engineers have been preparing for

40
00:02:21,430 --> 00:02:18,480
this booster test and making progress in

41
00:02:24,150 --> 00:02:21,440
all areas of sls development nasa's

42
00:02:26,470 --> 00:02:24,160
other exploration systems programs also

43
00:02:29,350 --> 00:02:26,480
have been making progress of their own

44
00:02:31,510 --> 00:02:29,360
in december nasa's orion spacecraft

45
00:02:33,830 --> 00:02:31,520
successfully flew in space for the first

46
00:02:36,190 --> 00:02:33,840
time and returned home after traveling

47
00:02:39,430 --> 00:02:36,200
to an altitude of about

48
00:02:41,270 --> 00:02:39,440
3604 miles farther than a spacecraft

49
00:02:43,110 --> 00:02:41,280
designed for humans has been in more

50
00:02:45,509 --> 00:02:43,120
than 40 years

51
00:02:47,509 --> 00:02:45,519
at kennedy space center in florida where

52
00:02:49,910 --> 00:02:47,519
sls and orion will begin their deep

53
00:02:52,229 --> 00:02:49,920
space journeys the ground systems

54
00:02:54,150 --> 00:02:52,239
development and operations team is

55
00:02:57,110 --> 00:02:54,160
transforming it into a multi-user

56
00:02:59,910 --> 00:02:57,120
spaceport they just completed testing of

57
00:03:02,710 --> 00:02:59,920
new traction roller bearings on crawler

58
00:03:05,589 --> 00:03:02,720
transporter 2 which is being upgraded to

59
00:03:08,229 --> 00:03:05,599
support up to 18 million pounds to

60
00:03:10,229 --> 00:03:08,239
transport the orion and sls to the

61
00:03:11,910 --> 00:03:10,239
launch pad

62
00:03:14,630 --> 00:03:11,920
several years worth of work and

63
00:03:16,550 --> 00:03:14,640

preparation have led up to today's to

64
00:03:18,710 --> 00:03:16,560
today's booster test

65
00:03:20,869 --> 00:03:18,720
to learn more about the booster

66
00:03:23,509 --> 00:03:20,879
we'll go to bill hubshere one of our

67
00:03:25,509 --> 00:03:23,519
media specialist support staff from

68
00:03:28,309 --> 00:03:25,519
nasa's marshall space flight center in

69
00:03:30,229 --> 00:03:28,319
huntsville alabama where this sls

70
00:03:31,830 --> 00:03:30,239
program is managed

71
00:03:33,589 --> 00:03:31,840
good morning stephanie i'm outside of

72
00:03:35,990 --> 00:03:33,599
the viewing area about a mile and a half

73
00:03:37,910 --> 00:03:36,000
from the test stand as well as a few

74
00:03:39,670 --> 00:03:37,920
hundred folks are out here viewing it

75
00:03:41,509 --> 00:03:39,680
with me uh waiting for the smoke and

76
00:03:43,270 --> 00:03:41,519
fire to usher in the next chapter in

77
00:03:45,990 --> 00:03:43,280
developing this amazing vehicle and i'm

78
00:03:48,630 --> 00:03:46,000
joined by bruce tiller he is now nasa's

79
00:03:49,910 --> 00:03:48,640
deputy sls booster program manager bruce

80
00:03:51,750 --> 00:03:49,920
thanks very much for taking the time

81
00:03:53,190 --> 00:03:51,760
with us today uh first of all tell us a

82
00:03:54,630 --> 00:03:53,200
little bit more about this particular

83
00:03:57,190 --> 00:03:54,640
booster how long have you and your team

84
00:04:00,149 --> 00:03:57,200
been been designing this for sls many

85
00:04:02,470 --> 00:04:00,159
years bill we actually have fired three

86
00:04:04,390 --> 00:04:02,480
development motors already so so we got

87
00:04:05,990 --> 00:04:04,400
a lot of experience with this design you

88
00:04:07,589 --> 00:04:06,000

could almost say we've been working on

89
00:04:10,149 --> 00:04:07,599
this thing since the shuttle program

90
00:04:12,149 --> 00:04:10,159
because many of the pieces that uh that

91
00:04:13,830 --> 00:04:12,159
are on this booster actually flew on

92
00:04:15,429 --> 00:04:13,840
shuttle in fact someone told me the

93
00:04:18,789 --> 00:04:15,439
other day that the aft skirt that's on

94
00:04:20,949 --> 00:04:18,799
this motor was actually on sts-1 wow so

95
00:04:23,350 --> 00:04:20,959
so so we've we've taken advantage of

96
00:04:25,590 --> 00:04:23,360
what we had during the shuttle days and

97
00:04:27,030 --> 00:04:25,600
we've added to it and improved it to get

98
00:04:29,189 --> 00:04:27,040
some more performance that the new

99
00:04:31,270 --> 00:04:29,199
vehicle needs and

100
00:04:32,870 --> 00:04:31,280
and so it's been quite a while so we're

101
00:04:34,469 --> 00:04:32,880
we're getting to that qualification

102
00:04:36,390 --> 00:04:34,479
phase and this is exciting because now

103
00:04:37,909 --> 00:04:36,400
this is for score so we've done some

104
00:04:42,070 --> 00:04:37,919
development and now we're really going

105
00:04:43,990 --> 00:04:42,080
to gonna uh qualify our design uh

106
00:04:45,590 --> 00:04:44,000
for the vehicle and get the performance

107
00:04:46,870 --> 00:04:45,600
they're looking for well for the folks

108
00:04:49,110 --> 00:04:46,880
at home as well as a little bit of

109
00:04:51,030 --> 00:04:49,120
clarification for my myself a lot of

110
00:04:52,790 --> 00:04:51,040
people will sometimes call this a solid

111
00:04:54,310 --> 00:04:52,800
rocket motor versus a solid rocket

112
00:04:55,830 --> 00:04:54,320
booster can you tell us the difference

113
00:04:58,310 --> 00:04:55,840

between the two terms they're not quite

114
00:05:00,790 --> 00:04:58,320
interchangeable you're right and i can

115
00:05:02,310 --> 00:05:00,800
so the motor is what we're testing today

116
00:05:05,030 --> 00:05:02,320
but there are parts of the booster on a

117
00:05:07,350 --> 00:05:05,040
motor test as well the booster includes

118
00:05:08,950 --> 00:05:07,360
both the the top and the bottom so to

119
00:05:11,110 --> 00:05:08,960
speak the motor is the part in the

120
00:05:13,110 --> 00:05:11,120
middle that actually produces the thrust

121
00:05:15,670 --> 00:05:13,120
it contains all the propellant and it's

122
00:05:17,510 --> 00:05:15,680
the pressure vessel that actually

123
00:05:19,590 --> 00:05:17,520
expels the gas it gives you the thrust

124
00:05:22,070 --> 00:05:19,600
and it goes out the nozzle the booster

125
00:05:24,070 --> 00:05:22,080
includes all that and more it includes

126
00:05:26,790 --> 00:05:24,080
the nose cap and the and the avionics

127
00:05:28,469 --> 00:05:26,800
and the forged skirt um the af skirt and

128
00:05:29,990 --> 00:05:28,479
the thrust vector control system is part

129
00:05:32,469 --> 00:05:30,000
of the booster as well and of course

130
00:05:34,790 --> 00:05:32,479
then you add the parts that attach you

131
00:05:37,510 --> 00:05:34,800
to the main vehicle so so the booster is

132
00:05:39,350 --> 00:05:37,520
everything that goes on the sls vehicle

133
00:05:40,629 --> 00:05:39,360
the motor is the

134
00:05:42,710 --> 00:05:40,639
i guess the

135
00:05:44,629 --> 00:05:42,720
thrust producing part in the middle

136
00:05:46,390 --> 00:05:44,639
so what does the sls team expect to get

137
00:05:48,310 --> 00:05:46,400
out of this test well you know we're

138
00:05:50,390 --> 00:05:48,320

really looking to gain that confidence

139
00:05:53,350 --> 00:05:50,400
that our development test

140
00:05:56,310 --> 00:05:53,360
gave us the data we expected to get so

141
00:05:57,990 --> 00:05:56,320
um uh we got a lot of data 500 sensors

142
00:06:00,230 --> 00:05:58,000
at least we're gonna we're gonna we're

143
00:06:02,790 --> 00:06:00,240
gonna review all of that and confirm

144
00:06:04,469 --> 00:06:02,800
that uh the booster does as we expect so

145
00:06:05,909 --> 00:06:04,479
um teams ready i think we're pretty

146
00:06:07,270 --> 00:06:05,919
excited and we're looking forward to a

147
00:06:09,430 --> 00:06:07,280
good test today

148
00:06:11,510 --> 00:06:09,440
thanks very much bruce tiller nasa's

149
00:06:13,029 --> 00:06:11,520
deputy program booster program manager

150
00:06:14,550 --> 00:06:13,039
for the sls of the marshall space flight

151
00:06:16,070 --> 00:06:14,560
center so while we proceed with the

152
00:06:23,749 --> 00:06:16,080
countdown let's learn a little bit more

153
00:06:29,110 --> 00:06:26,390
this project has been a real fun effort

154
00:06:31,350 --> 00:06:29,120
in trying to take a a heritage booster

155
00:06:33,270 --> 00:06:31,360
that had many many years of reliability

156
00:06:35,590 --> 00:06:33,280
and great performance and evolve it into

157
00:06:37,270 --> 00:06:35,600
something bigger and better when we

158
00:06:39,590 --> 00:06:37,280
first undertook this design and

159
00:06:41,590 --> 00:06:39,600
qualification for the new booster part

160
00:06:42,790 --> 00:06:41,600
of the mission was to make the

161
00:06:44,150 --> 00:06:42,800
booster

162
00:06:46,150 --> 00:06:44,160
more affordable

163
00:06:48,150 --> 00:06:46,160

and and more modern and of course it had

164
00:06:50,309 --> 00:06:48,160
to be completely redesigned for a new

165
00:06:52,550 --> 00:06:50,319
mission it's a larger booster and the

166
00:06:53,909 --> 00:06:52,560
mission profile is sufficiently

167
00:06:55,830 --> 00:06:53,919
different to where pretty much

168
00:06:57,909 --> 00:06:55,840
everything on the inside of the booster

169
00:07:00,309 --> 00:06:57,919
is different there's well over a

170
00:07:02,150 --> 00:07:00,319
thousand individual processes working

171
00:07:04,390 --> 00:07:02,160
with our customer we were able to

172
00:07:06,309 --> 00:07:04,400
identify several hundred areas of

173
00:07:08,950 --> 00:07:06,319
improvement we've got totally new

174
00:07:10,950 --> 00:07:08,960
avionics on this vehicle versus what we

175
00:07:12,950 --> 00:07:10,960
had on shuttle it's state of the art

176
00:07:15,749 --> 00:07:12,960
we've taken that avionics and and

177
00:07:17,909 --> 00:07:15,759
actually uh tested in development units

178
00:07:20,150 --> 00:07:17,919
in a full flight configuration and are

179
00:07:22,469 --> 00:07:20,160
about to enter some qualification

180
00:07:24,710 --> 00:07:22,479
testing with that system but in this

181
00:07:26,710 --> 00:07:24,720
particular test we will actually control

182
00:07:28,790 --> 00:07:26,720
the thrust vector control system with

183
00:07:31,430 --> 00:07:28,800
the flight avionics the old shuttle

184
00:07:33,589 --> 00:07:31,440
program utilized a rubber insulation

185
00:07:36,710 --> 00:07:33,599
between the case segment and the

186
00:07:39,589 --> 00:07:36,720
propellant that contained asbestos and

187
00:07:41,749 --> 00:07:39,599
so we selected a fiber called pbi which

188
00:07:42,950 --> 00:07:41,759

is used widely in the fire protection

189
00:07:45,110 --> 00:07:42,960
industry

190
00:07:46,629 --> 00:07:45,120
developed a new rubber formulation and

191
00:07:48,469 --> 00:07:46,639
ended up with a rubber that is actually

192
00:07:50,550 --> 00:07:48,479
higher performing than the previous

193
00:07:53,110 --> 00:07:50,560
material which allowed us to remove a

194
00:07:54,550 --> 00:07:53,120
fair amount of insulation and replace it

195
00:07:57,189 --> 00:07:54,560
with fuel and get a little bit more

196
00:07:58,550 --> 00:07:57,199
performance out of it so not only is it

197
00:08:00,390 --> 00:07:58,560
environmentally friendly

198
00:08:02,550 --> 00:08:00,400
it's a higher performing material and a

199
00:08:04,309 --> 00:08:02,560
higher performing rocket structurally

200
00:08:06,629 --> 00:08:04,319
we've had to make some changes the aft

201
00:08:08,469 --> 00:08:06,639
attach point of this booster in order to

202
00:08:10,469 --> 00:08:08,479
accommodate the the structural

203
00:08:13,350 --> 00:08:10,479
configuration of the sls vehicle has

204
00:08:15,909 --> 00:08:13,360
been moved several feet aft and actually

205
00:08:17,670 --> 00:08:15,919
this qm1 test will be the first test in

206
00:08:20,390 --> 00:08:17,680
a static configuration that we've done

207
00:08:22,710 --> 00:08:20,400
with that actual sls attach point in

208
00:08:24,550 --> 00:08:22,720
place we had to design a new core and a

209
00:08:26,230 --> 00:08:24,560
new propellant grain inside the fuel

210
00:08:28,390 --> 00:08:26,240
that's inside the rocket part of that

211
00:08:31,510 --> 00:08:28,400
required is to design and manufacture

212
00:08:33,909 --> 00:08:31,520
all new tooling that forms the inside of

213
00:08:35,670 --> 00:08:33,919

the motor we had to redesign our nozzle

214
00:08:37,269 --> 00:08:35,680
because we have a different performance

215
00:08:39,589 --> 00:08:37,279
different things going on inside the

216
00:08:42,469 --> 00:08:39,599
motor and so large portion of the nozzle

217
00:08:44,870 --> 00:08:42,479
was redesigned also we've had a major

218
00:08:46,630 --> 00:08:44,880
major effort over the last two years to

219
00:08:48,949 --> 00:08:46,640
try and improve the affordability of

220
00:08:50,470 --> 00:08:48,959
this vehicle because the intent here was

221
00:08:52,470 --> 00:08:50,480
not only to have a

222
00:08:54,310 --> 00:08:52,480
higher performing vehicle but to have

223
00:08:56,070 --> 00:08:54,320
one that actually costs less and we

224
00:08:58,790 --> 00:08:56,080
believe we've achieved that and this

225
00:09:05,110 --> 00:08:58,800
test of qm1 will will be evidence of

226
00:09:09,110 --> 00:09:07,190
as we've just heard this five-segment

227
00:09:11,670 --> 00:09:09,120
booster is improved in design and

228
00:09:13,829 --> 00:09:11,680
performance but it is built using cases

229
00:09:17,190 --> 00:09:13,839
that have flown in space before

230
00:09:19,350 --> 00:09:17,200
in fact the aft skirt on today's booster

231
00:09:22,389 --> 00:09:19,360
flew on the first space shuttle mission

232
00:09:24,550 --> 00:09:22,399
with bob crippen and john young and also

233
00:09:26,310 --> 00:09:24,560
on the seventh space shuttle mission

234
00:09:28,389 --> 00:09:26,320
launching america's first female

235
00:09:30,389 --> 00:09:28,399
astronaut sally ride

236
00:09:33,430 --> 00:09:30,399
and now these pieces that have powered

237
00:09:36,070 --> 00:09:33,440
such significant human space flights are

238
00:09:38,230 --> 00:09:36,080

playing a critical role in advancing our

239
00:09:39,430 --> 00:09:38,240
journey deeper into space and eventually

240
00:09:41,750 --> 00:09:39,440
to mars

241
00:09:44,949 --> 00:09:41,760
when qualified and completed two

242
00:09:48,389 --> 00:09:44,959
five-segment boosters and four rs-25

243
00:09:50,710 --> 00:09:48,399
engines will power sls to space

244
00:09:53,269 --> 00:09:50,720
for the last several hours teams have

245
00:09:55,590 --> 00:09:53,279
been working to secure the test area and

246
00:09:57,990 --> 00:09:55,600
prepare for the final countdown

247
00:10:00,150 --> 00:09:58,000
a little later we'll listen in to the

248
00:10:02,230 --> 00:10:00,160
last several minutes as the test

249
00:10:03,590 --> 00:10:02,240
conductor and team make final

250
00:10:06,630 --> 00:10:03,600
preparations

251
00:10:07,910 --> 00:10:06,640
but first let's hear more from bill and

252
00:10:09,509 --> 00:10:07,920
learn a little bit more about the

253
00:10:10,790 --> 00:10:09,519
boosters

254
00:10:12,870 --> 00:10:10,800
thanks very much again stephanie we're

255
00:10:14,310 --> 00:10:12,880
about 15 minutes away from this booster

256
00:10:16,710 --> 00:10:14,320
test of course outside of the the

257
00:10:18,230 --> 00:10:16,720
five-minute planned hold and i am joined

258
00:10:20,870 --> 00:10:18,240
by the chief engineer for booster

259
00:10:23,110 --> 00:10:20,880
integration at orbital atk alicia

260
00:10:24,710 --> 00:10:23,120
carrillo now alicia first of all tell

261
00:10:26,310 --> 00:10:24,720
everyone what booster integration means

262
00:10:28,550 --> 00:10:26,320
what does that entail so booster

263
00:10:29,829 --> 00:10:28,560

integration is essentially the process

264
00:10:31,350 --> 00:10:29,839
of bringing together all of the

265
00:10:33,590 --> 00:10:31,360
components and making sure they're all

266
00:10:35,110 --> 00:10:33,600
assembled checked out and ready to go

267
00:10:36,550 --> 00:10:35,120
and of those many what are the main

268
00:10:38,310 --> 00:10:36,560
components of the booster though we've

269
00:10:39,750 --> 00:10:38,320
we've heard about the after motor of

270
00:10:41,190 --> 00:10:39,760
course right so we're essentially going

271
00:10:43,350 --> 00:10:41,200
from the nose cap down through the

272
00:10:45,750 --> 00:10:43,360
forward skirt into the motor elements

273
00:10:47,829 --> 00:10:45,760
aft skirt and then the exit cone

274
00:10:49,590 --> 00:10:47,839
so we're actually conditioning the motor

275
00:10:51,190 --> 00:10:49,600
today and outside for us anyway it's a

276
00:10:52,790 --> 00:10:51,200
little bit overcast a little bit chilly

277
00:10:55,190 --> 00:10:52,800
not too bad though but the motor is

278
00:10:57,030 --> 00:10:55,200
under almost tropical conditions it is

279
00:10:59,030 --> 00:10:57,040
now this motor has to be qualified from

280
00:11:01,030 --> 00:10:59,040
uh 40 degrees fahrenheit up to 90

281
00:11:03,509 --> 00:11:01,040
degrees fahrenheit this is our hot motor

282
00:11:04,790 --> 00:11:03,519
test so it's just over 90 degrees and

283
00:11:07,190 --> 00:11:04,800
you know you might think that you know

284
00:11:08,389 --> 00:11:07,200
90 degrees doesn't sound hot but keep in

285
00:11:09,670 --> 00:11:08,399
mind there's a million and a half pounds

286
00:11:11,509 --> 00:11:09,680
of propellant up there that we had to

287
00:11:13,030 --> 00:11:11,519
get up to an average temperature of 90

288
00:11:14,550 --> 00:11:13,040

degrees and this is the kind of

289
00:11:15,910 --> 00:11:14,560
temperatures that it could experience as

290
00:11:17,509 --> 00:11:15,920
it launches from florida right

291
00:11:18,949 --> 00:11:17,519
essentially you know long-term exposure

292
00:11:20,870 --> 00:11:18,959
in florida of course that's not

293
00:11:22,710 --> 00:11:20,880
including the many many

294
00:11:24,069 --> 00:11:22,720
degrees higher than it will be when it

295
00:11:25,829 --> 00:11:24,079
actually launches at the business end of

296
00:11:27,829 --> 00:11:25,839
the nozzle right quite a bit warmer on

297
00:11:29,269 --> 00:11:27,839
the inside and coming out the exit plane

298
00:11:30,870 --> 00:11:29,279
well i imagine that you and your team

299
00:11:32,230 --> 00:11:30,880
have been working very long very hard on

300
00:11:34,230 --> 00:11:32,240
this what goes into the months of

301
00:11:35,590 --> 00:11:34,240
preparation for this test you have a lot

302
00:11:37,590 --> 00:11:35,600
you know going on to the physical

303
00:11:39,430 --> 00:11:37,600
assembly and integration a lot of

304
00:11:40,949 --> 00:11:39,440
instrumentation going on a lot of

305
00:11:42,310 --> 00:11:40,959
checkout you know a lot of data systems

306
00:11:44,310 --> 00:11:42,320
just making sure that everything is is

307
00:11:46,310 --> 00:11:44,320
really queued up and ready to go

308
00:11:48,470 --> 00:11:46,320
so a lot of folks at the home uh may or

309
00:11:50,230 --> 00:11:48,480
hell may not know that you

310
00:11:52,389 --> 00:11:50,240
were actually the former test chief

311
00:11:54,310 --> 00:11:52,399
engineer out here at orbital tk so you

312
00:11:56,150 --> 00:11:54,320
had a lot of experience on this test

313
00:11:57,829 --> 00:11:56,160

stand uh can you tell us about let's see

314
00:12:00,230 --> 00:11:57,839
some of the safety that that you and

315
00:12:01,829 --> 00:12:00,240
your team would take would take into

316
00:12:03,350 --> 00:12:01,839
consideration before you have a test

317
00:12:05,509 --> 00:12:03,360
like this so you know obviously there's

318
00:12:07,030 --> 00:12:05,519
been quite a bit of safety elements

319
00:12:09,670 --> 00:12:07,040
going on so far you know they cleared

320
00:12:11,670 --> 00:12:09,680
the bay lots of gates and lights and

321
00:12:13,590 --> 00:12:11,680
clearing everything going on right now

322
00:12:15,350 --> 00:12:13,600
the closest people are in the control

323
00:12:17,350 --> 00:12:15,360
bunker which is actually underground and

324
00:12:19,750 --> 00:12:17,360
then we're here at the closest that

325
00:12:21,190 --> 00:12:19,760
people are allowed to be above ground

326
00:12:22,550 --> 00:12:21,200
those that are allowed to view it from

327
00:12:24,389 --> 00:12:22,560
here of course

328
00:12:26,150 --> 00:12:24,399
now we mentioned that the team has been

329
00:12:28,230 --> 00:12:26,160
here since three o'clock this morning

330
00:12:29,829 --> 00:12:28,240
when they first rolled back the building

331
00:12:31,350 --> 00:12:29,839
because the booster itself is actually

332
00:12:33,430 --> 00:12:31,360
tied down right it's so it can't go

333
00:12:35,269 --> 00:12:33,440
anywhere right the booster is not going

334
00:12:36,949 --> 00:12:35,279
anywhere it's you know it's into the

335
00:12:39,350 --> 00:12:36,959
thrust block which is going to react the

336
00:12:40,790 --> 00:12:39,360
3.6 million pounds of thrust it's tied

337
00:12:42,710 --> 00:12:40,800
down in several locations through the

338
00:12:44,310 --> 00:12:42,720

test stand it's got a restraint system

339
00:12:47,190 --> 00:12:44,320
and the crew has just been busy making

340
00:12:48,629 --> 00:12:47,200
sure that everything is is all tidied up

341
00:12:49,990 --> 00:12:48,639
yeah and i know they've been there but

342
00:12:51,509 --> 00:12:50,000
uh what are some of the other things

343
00:12:53,590 --> 00:12:51,519
they've been doing to prepare the site

344
00:12:55,190 --> 00:12:53,600
for for this test so you know i mean

345
00:12:56,949 --> 00:12:55,200
obviously smoke and fire coming out the

346
00:12:58,949 --> 00:12:56,959
back end we've got some concrete blocks

347
00:13:00,550 --> 00:12:58,959
on and lots of sand on the back end we

348
00:13:02,389 --> 00:13:00,560
want to protect that concrete as much as

349
00:13:04,310 --> 00:13:02,399
possible so we don't basically sand

350
00:13:05,829 --> 00:13:04,320
blast the whole aft end of the bay

351
00:13:07,350 --> 00:13:05,839
and also hit the side of that mountain

352
00:13:09,430 --> 00:13:07,360
right there now we want to mention that

353
00:13:11,190 --> 00:13:09,440
we've also got quite a few uh of our

354
00:13:13,590 --> 00:13:11,200
nasa social media enthusiasts here with

355
00:13:16,389 --> 00:13:13,600
us today have been using the hashtag uh

356
00:13:17,829 --> 00:13:16,399
sls fired up and hashtag journey to mars

357
00:13:19,030 --> 00:13:17,839
so you've taken some time to speak with

358
00:13:20,069 --> 00:13:19,040
fact you spoke with them this morning

359
00:13:21,590 --> 00:13:20,079
what were some of the questions they

360
00:13:23,670 --> 00:13:21,600
were asking you you know they're really

361
00:13:25,030 --> 00:13:23,680
interested in you know the procedures

362
00:13:26,790 --> 00:13:25,040
and the buy-off and what this

363
00:13:28,470 --> 00:13:26,800

qualification motor means to the overall

364
00:13:30,710 --> 00:13:28,480
verification you know they're also

365
00:13:32,310 --> 00:13:30,720
pretty interested in you know a female

366
00:13:34,710 --> 00:13:32,320
presence in engineering and in the

367
00:13:36,629 --> 00:13:34,720
aerospace industry fantastic alicia

368
00:13:38,710 --> 00:13:36,639
carrillo the booster integration with

369
00:13:40,310 --> 00:13:38,720
orbital atk thanks so much for taking

370
00:13:41,590 --> 00:13:40,320
the time to talk with us today so when

371
00:13:43,350 --> 00:13:41,600
it comes to of course igniting this

372
00:13:44,710 --> 00:13:43,360
booster it's a bit more complicated than

373
00:13:46,550 --> 00:13:44,720
just lighting a match and running for

374
00:13:47,590 --> 00:13:46,560
the cover uh

375
00:13:49,590 --> 00:13:47,600
we'll learn a little bit more about what

376
00:13:51,590 --> 00:13:49,600
it takes to light this proverbial candle

377
00:13:53,030 --> 00:13:51,600
with gordy russell the orbital atk

378
00:13:58,389 --> 00:13:53,040
manager at the marshall space flight

379
00:14:02,550 --> 00:14:00,230
so we are getting ready to stack fire

380
00:14:03,910 --> 00:14:02,560
the qm1 static test motor it's full

381
00:14:05,430 --> 00:14:03,920
rocket booster it's made of five

382
00:14:07,670 --> 00:14:05,440
segments pieced together and that's

383
00:14:09,189 --> 00:14:07,680
important as we've added another length

384
00:14:10,870 --> 00:14:09,199
of a segment into this booster to make

385
00:14:12,470 --> 00:14:10,880
it bigger and better a lot of planning

386
00:14:14,550 --> 00:14:12,480
and work is done ahead of time as we

387
00:14:16,949 --> 00:14:14,560
design these rocket boosters to get the

388
00:14:18,949 --> 00:14:16,959

propellant geometry just right we know

389
00:14:21,509 --> 00:14:18,959
at any given time during the burn of

390
00:14:23,509 --> 00:14:21,519
that motor what the what the thrust is

391
00:14:25,829 --> 00:14:23,519
and what the profile of the pressure is

392
00:14:29,030 --> 00:14:25,839
inside that motor so with the new thrust

393
00:14:30,949 --> 00:14:29,040
profile for the sls boosters we've added

394
00:14:32,949 --> 00:14:30,959
an extra fin and change some of the

395
00:14:34,629 --> 00:14:32,959
geometry of our propellant surfaces so

396
00:14:36,629 --> 00:14:34,639
we can burn more propellant at the

397
00:14:38,949 --> 00:14:36,639
beginning of the test or beginning of

398
00:14:41,110 --> 00:14:38,959
rocket firing to get a solid rocket

399
00:14:43,269 --> 00:14:41,120
booster burn we have an igniter at the

400
00:14:45,590 --> 00:14:43,279
front end that that it's like a small

401
00:14:47,509 --> 00:14:45,600
rock in itself and it shoots a flame 150

402
00:14:49,110 --> 00:14:47,519
feet down this entire rocket booster and

403
00:14:51,189 --> 00:14:49,120
ignites all the surface of the

404
00:14:53,509 --> 00:14:51,199
propellant all at once once you ignite a

405
00:14:55,110 --> 00:14:53,519
solid rocket booster it can't stop it

406
00:14:57,110 --> 00:14:55,120
you don't flip a switch to turn it on

407
00:14:59,350 --> 00:14:57,120
off at the same time you can't turn a

408
00:15:01,110 --> 00:14:59,360
knob to increase your thrust or decrease

409
00:15:03,670 --> 00:15:01,120
your thrust that's why it's important to

410
00:15:05,670 --> 00:15:03,680
design this beforehand so we can get the

411
00:15:07,910 --> 00:15:05,680
amount of thrust we need at each point

412
00:15:09,990 --> 00:15:07,920
during this two-minute burn to reach the

413
00:15:11,750 --> 00:15:10,000

maximum thrust at the given time points

414
00:15:13,990 --> 00:15:11,760
that we need at the beginning of the

415
00:15:15,350 --> 00:15:14,000
burn is when we have the most thrust

416
00:15:17,269 --> 00:15:15,360
about three and a half million pounds of

417
00:15:19,590 --> 00:15:17,279
thrust that we maintain for about 25

418
00:15:21,430 --> 00:15:19,600
seconds it takes just over two minutes

419
00:15:23,189 --> 00:15:21,440
of rocket firing for the propellant to

420
00:15:24,870 --> 00:15:23,199
completely burn out and the propellant

421
00:15:26,550 --> 00:15:24,880
is burning really fast it's got a

422
00:15:28,629 --> 00:15:26,560
certain rate that it's burning but it's

423
00:15:30,790 --> 00:15:28,639
burning from inside out so as every

424
00:15:32,790 --> 00:15:30,800
second goes by it's like one layer of

425
00:15:34,470 --> 00:15:32,800
that propellant essentially being peeled

426
00:15:37,509 --> 00:15:34,480
away and shot out the end of that rocket

427
00:15:40,310 --> 00:15:37,519
motor and as this propellant burns and

428
00:15:41,910 --> 00:15:40,320
and begins to to create this mass that

429
00:15:43,990 --> 00:15:41,920
we are projecting out of this rocket we

430
00:15:45,590 --> 00:15:44,000
are creating the thrust that we need to

431
00:15:50,870 --> 00:15:45,600
carry humans and astronaut and more

432
00:15:55,749 --> 00:15:53,829
we are at about 10 minutes t minus 40 10

433
00:15:58,069 --> 00:15:55,759
minutes and 40 seconds away from the

434
00:15:59,670 --> 00:15:58,079
actual test as you see the folks are

435
00:16:02,870 --> 00:15:59,680
gathering are here in the in the viewing

436
00:16:05,030 --> 00:16:02,880
area and the anticipation is palpable

437
00:16:06,790 --> 00:16:05,040
one might say as you take a closer look

438
00:16:08,310 --> 00:16:06,800

there at the motor up there in the test

439
00:16:09,910 --> 00:16:08,320
tester the booster the entire full

440
00:16:11,590 --> 00:16:09,920
booster i should say tied down in the

441
00:16:13,350 --> 00:16:11,600
test complex area i'm joined now by

442
00:16:15,350 --> 00:16:13,360
someone who has ridden a vehicle with

443
00:16:17,509 --> 00:16:15,360
two boosters similar to the design of

444
00:16:19,189 --> 00:16:17,519
today's test motor uh charlie precourt

445
00:16:21,269 --> 00:16:19,199
veteran astronaut one time chief of the

446
00:16:22,870 --> 00:16:21,279
astronaut corps and now vice president

447
00:16:25,030 --> 00:16:22,880
and general uh general manager of the

448
00:16:26,870 --> 00:16:25,040
propulsion systems with orbital atk sir

449
00:16:28,069 --> 00:16:26,880
thanks very much for coming to join us

450
00:16:29,350 --> 00:16:28,079
today first of all you've got to be

451
00:16:31,350 --> 00:16:29,360
proud of your team making it to this

452
00:16:33,509 --> 00:16:31,360
milestone immensely proud this is a

453
00:16:34,629 --> 00:16:33,519
culmination of a lot of work a lot of

454
00:16:36,629 --> 00:16:34,639
people

455
00:16:38,949 --> 00:16:36,639
working very closely with our nasa

456
00:16:40,949 --> 00:16:38,959
customer and the leadership at the nasa

457
00:16:42,470 --> 00:16:40,959
team it's been a great effort and we're

458
00:16:43,430 --> 00:16:42,480
really excited about what this booster

459
00:16:45,829 --> 00:16:43,440
can do

460
00:16:47,110 --> 00:16:45,839
so what will us here at the viewing area

461
00:16:48,949 --> 00:16:47,120
and of course the folks at home see

462
00:16:51,189 --> 00:16:48,959
today well we're going to ignite the

463
00:16:53,829 --> 00:16:51,199

booster and run it through a full series

464
00:16:56,069 --> 00:16:53,839
of tests that will verify the design

465
00:16:57,350 --> 00:16:56,079
that we put together here in particular

466
00:17:00,389 --> 00:16:57,360
folks will be able to see the nozzle

467
00:17:02,069 --> 00:17:00,399
fluctuating as we vector the thrust for

468
00:17:04,309 --> 00:17:02,079
the steerage that would be needed on a

469
00:17:05,669 --> 00:17:04,319
normal mission asset to orbit so well

470
00:17:07,510 --> 00:17:05,679
let's talk a little bit about that uh

471
00:17:09,189 --> 00:17:07,520
the steering mechanisms it's just

472
00:17:10,949 --> 00:17:09,199
basically a couple of very small motors

473
00:17:13,829 --> 00:17:10,959
attached to the side right well the

474
00:17:16,230 --> 00:17:13,839
inside the aft skirt we call it the near

475
00:17:18,309 --> 00:17:16,240
the nozzle underneath the structure

476
00:17:21,350 --> 00:17:18,319
there are two hydraulic actuators that

477
00:17:23,189 --> 00:17:21,360
move the nozzle left right and up down

478
00:17:25,669 --> 00:17:23,199
as we look at it on the stand up there

479
00:17:27,429 --> 00:17:25,679
today and they can swing about five

480
00:17:29,510 --> 00:17:27,439
degrees in either direction and that

481
00:17:31,750 --> 00:17:29,520
allows us to move that three and a half

482
00:17:33,510 --> 00:17:31,760
million pounds of thrust just enough to

483
00:17:34,470 --> 00:17:33,520
steer the whole vehicle

484
00:17:35,669 --> 00:17:34,480
three and a half million pounds of

485
00:17:37,510 --> 00:17:35,679
thrust that's a lot and that's only for

486
00:17:39,669 --> 00:17:37,520
one booster that's right that's right

487
00:17:41,190 --> 00:17:39,679
one booster and multiply that by two so

488
00:17:42,630 --> 00:17:41,200

you've had a little bit of experience on

489
00:17:44,710 --> 00:17:42,640
riding these what can you tell us about

490
00:17:46,390 --> 00:17:44,720
that compared to this one well there's

491
00:17:48,950 --> 00:17:46,400
an immense amount of energy that we're

492
00:17:51,350 --> 00:17:48,960
controlling here and i always describe

493
00:17:53,029 --> 00:17:51,360
it as if you take a chair at the dinner

494
00:17:55,110 --> 00:17:53,039
table and lay it over on the floor on

495
00:17:56,950 --> 00:17:55,120
its back and you're laying on the floor

496
00:17:58,470 --> 00:17:56,960
looking up and imagine a giant hand

497
00:18:00,470 --> 00:17:58,480
reaching in under that chair and

498
00:18:02,310 --> 00:18:00,480
lurching you towards the ceiling

499
00:18:04,150 --> 00:18:02,320
and then the push continues for eight

500
00:18:05,909 --> 00:18:04,160
and a half minutes that same thrust in

501
00:18:08,150 --> 00:18:05,919
the back all the way to orbit

502
00:18:10,070 --> 00:18:08,160
the key for a booster is to provide that

503
00:18:12,470 --> 00:18:10,080
thrust to be able to fly the vertical

504
00:18:14,630 --> 00:18:12,480
portion of the trajectory lift all that

505
00:18:16,710 --> 00:18:14,640
weight to get us out of the atmosphere

506
00:18:18,150 --> 00:18:16,720
and turn the corner on our way to orbit

507
00:18:19,510 --> 00:18:18,160
i think some of the things that folks

508
00:18:21,510 --> 00:18:19,520
are going to experience here anyway is

509
00:18:22,789 --> 00:18:21,520
you of course felt that all the way up

510
00:18:24,230 --> 00:18:22,799
where and we're going to feel like for a

511
00:18:25,669 --> 00:18:24,240
good two minutes here whereas at launch

512
00:18:27,350 --> 00:18:25,679
for the folks watching on the ground

513
00:18:29,110 --> 00:18:27,360

it's really only for a few seconds

514
00:18:30,950 --> 00:18:29,120
that's right and at the launch site

515
00:18:32,789 --> 00:18:30,960
you'll feel the vibration

516
00:18:34,789 --> 00:18:32,799
waving towards you

517
00:18:36,950 --> 00:18:34,799
but once that wave is passed the vehicle

518
00:18:38,310 --> 00:18:36,960
is out of sight and you don't feel that

519
00:18:40,390 --> 00:18:38,320
anymore you're going to feel it

520
00:18:41,350 --> 00:18:40,400
continuously here this morning feel it

521
00:18:42,789 --> 00:18:41,360
we'll definitely hear it because i

522
00:18:44,230 --> 00:18:42,799
understand that with overcast skies it

523
00:18:45,830 --> 00:18:44,240
directs all the acoustics keeps it

524
00:18:47,270 --> 00:18:45,840
pretty close to the ground that's that's

525
00:18:48,549 --> 00:18:47,280
likely

526
00:18:49,990 --> 00:18:48,559
charlie precor thanks very much for

527
00:18:52,390 --> 00:18:50,000
taking the time to see it let's hear a

528
00:18:54,470 --> 00:18:52,400
little bit more about qm1 and the sls

529
00:18:56,310 --> 00:18:54,480
from one of charlie's uh compatriots and

530
00:18:58,630 --> 00:18:56,320
fellow astronauts and a colleague here

531
00:19:00,470 --> 00:18:58,640
at orbital aquitai kent rominger and

532
00:19:09,990 --> 00:19:00,480
from the sls program

533
00:19:16,950 --> 00:19:13,830
this upcoming test the qm1 motor firing

534
00:19:19,909 --> 00:19:16,960
is going to be a really big deal for us

535
00:19:21,669 --> 00:19:19,919
these motors have 25 percent more energy

536
00:19:23,590 --> 00:19:21,679
than the motors we use to get the

537
00:19:25,350 --> 00:19:23,600
shuttle off the ground

538
00:19:26,710 --> 00:19:25,360

during the space shuttle days as a space

539
00:19:28,630 --> 00:19:26,720
shuttle astronaut i flew the space

540
00:19:30,390 --> 00:19:28,640
shuttle five times every one of those

541
00:19:32,230 --> 00:19:30,400
was on the redesigned

542
00:19:34,150 --> 00:19:32,240
rocket motor that proved itself to be

543
00:19:36,070 --> 00:19:34,160
the most reliable rocket motor in the

544
00:19:38,070 --> 00:19:36,080
world so this motor we're looking at

545
00:19:40,310 --> 00:19:38,080
here is called the qualification motor

546
00:19:41,909 --> 00:19:40,320
number one and it's actually the fourth

547
00:19:43,510 --> 00:19:41,919
motor in a series we had three

548
00:19:44,950 --> 00:19:43,520
development motors and on the

549
00:19:46,710 --> 00:19:44,960
development motors they really are

550
00:19:49,830 --> 00:19:46,720
development where you start out

551
00:19:51,750 --> 00:19:49,840
conservatively you do a test fine you

552
00:19:53,510 --> 00:19:51,760
see how all the insulators worked how

553
00:19:55,830 --> 00:19:53,520
much thrust what was the performance of

554
00:19:59,190 --> 00:19:55,840
the motor really and then you start

555
00:20:01,590 --> 00:19:59,200
optimizing so qm1 is the first of two

556
00:20:03,909 --> 00:20:01,600
tests that will be used to qualify the

557
00:20:05,430 --> 00:20:03,919
motors for flight we're actually already

558
00:20:07,590 --> 00:20:05,440
building the pieces of the second

559
00:20:09,590 --> 00:20:07,600
qualification motor flight this is a

560
00:20:11,669 --> 00:20:09,600
really exciting time for all of us here

561
00:20:13,110 --> 00:20:11,679
coming off of orion's first flight test

562
00:20:15,070 --> 00:20:13,120
in december

563
00:20:17,510 --> 00:20:15,080

less than a month later we had the new

564
00:20:19,669 --> 00:20:17,520
rs25 engines which are the liquid

565
00:20:21,750 --> 00:20:19,679
engines that will power the rocket

566
00:20:23,669 --> 00:20:21,760
have been tested at stennis with a brand

567
00:20:26,870 --> 00:20:23,679
new state-of-the-art controller the

568
00:20:29,750 --> 00:20:26,880
pieces of the rocket itself the core

569
00:20:31,750 --> 00:20:29,760
almost 30 feet in diameter are all

570
00:20:32,630 --> 00:20:31,760
being manufactured at michoud as we

571
00:20:34,950 --> 00:20:32,640
speak

572
00:20:37,669 --> 00:20:34,960
there's a company called conrad down in

573
00:20:39,830 --> 00:20:37,679
south louisiana they took our pegasus

574
00:20:41,350 --> 00:20:39,840
barge which is the barge we used to move

575
00:20:43,510 --> 00:20:41,360
the external tank around during the

576
00:20:46,310 --> 00:20:43,520
space shuttle days they had to cut it in

577
00:20:48,230 --> 00:20:46,320
half and add 65 feet and stiffen it up

578
00:20:50,310 --> 00:20:48,240
to be able to handle the massive core

579
00:20:52,630 --> 00:20:50,320
that will come out of michoud near new

580
00:20:54,390 --> 00:20:52,640
orleans to be shipped down to ksc and

581
00:20:56,310 --> 00:20:54,400
then in a few months we'll actually

582
00:20:58,470 --> 00:20:56,320
complete the critical design review of

583
00:21:00,950 --> 00:20:58,480
the space launch system this is where we

584
00:21:02,549 --> 00:21:00,960
actually say we are now done designing

585
00:21:04,710 --> 00:21:02,559
and it's time to start putting all this

586
00:21:06,710 --> 00:21:04,720
hardware together and running it through

587
00:21:08,310 --> 00:21:06,720
its test and verifying that it actually

588
00:21:11,110 --> 00:21:08,320

meets the requirements we're going to

589
00:21:12,470 --> 00:21:11,120
fly the sls system in 2018 and between

590
00:21:14,390 --> 00:21:12,480
now and then we're going to fire this

591
00:21:16,870 --> 00:21:14,400
motor less than a year from now we'll

592
00:21:18,310 --> 00:21:16,880
fire the second qualification motor and

593
00:21:20,310 --> 00:21:18,320
then we'll start assembling that space

594
00:21:23,110 --> 00:21:20,320
launch system rocket in florida launch

595
00:21:24,950 --> 00:21:23,120
in 2018 and the second flight of that

596
00:21:26,950 --> 00:21:24,960
rocket motor will take astronauts

597
00:21:29,110 --> 00:21:26,960
further into space than we've ever been

598
00:21:31,430 --> 00:21:29,120
from there we're now into the proving

599
00:21:34,390 --> 00:21:31,440
ground where we test the ability to be

600
00:21:36,950 --> 00:21:34,400
distant from earth by days and weeks and

601
00:21:38,950 --> 00:21:36,960
getting ready for the long-term exposure

602
00:21:41,029 --> 00:21:38,960
to deep space that gets us ready for a

603
00:21:42,789 --> 00:21:41,039
mars mission in the future so they say

604
00:21:44,710 --> 00:21:42,799
the journey of a thousand miles begins

605
00:21:46,549 --> 00:21:44,720
with the first step in this case our

606
00:21:48,470 --> 00:21:46,559
journey is millions of miles away to

607
00:21:49,510 --> 00:21:48,480
mars and we're starting to take these

608
00:21:51,350 --> 00:21:49,520
steps

609
00:21:52,950 --> 00:21:51,360
the next step is going to be this qm

610
00:21:58,470 --> 00:21:52,960
motor firing and we're really getting

611
00:22:01,590 --> 00:22:00,230
we're about eight minutes away from

612
00:22:04,149 --> 00:22:01,600
today's

613
00:22:06,149 --> 00:22:04,159

booster test which is scheduled for 9 30

614
00:22:08,870 --> 00:22:06,159
a.m mountain time everything is

615
00:22:10,830 --> 00:22:08,880
progressing normally in the countdown

616
00:22:13,029 --> 00:22:10,840
we'll listen in now to some of the

617
00:22:15,190 --> 00:22:13,039
countdown and you'll primarily hear the

618
00:22:17,669 --> 00:22:15,200
voices of the test conductor richard

619
00:22:19,510 --> 00:22:17,679
rupp and the test control coordinator

620
00:22:22,149 --> 00:22:19,520
howard healey

621
00:22:24,549 --> 00:22:22,159
this test is sometimes called a hot test

622
00:22:26,470 --> 00:22:24,559
because orbital atk has spent the last

623
00:22:28,710 --> 00:22:26,480
month getting all parts of the booster

624
00:22:30,710 --> 00:22:28,720
inside and out heated to a temperature

625
00:22:33,110 --> 00:22:30,720
of 90 degrees fahrenheit

626
00:22:34,630 --> 00:22:33,120
combined with a second test next year at

627
00:22:36,870 --> 00:22:34,640
40 degrees

628
00:22:39,430 --> 00:22:36,880
teams will get a full range of data to

629
00:22:41,190 --> 00:22:39,440
feed into analytical models that inform

630
00:22:42,470 --> 00:22:41,200
how the booster performs at any

631
00:22:45,110 --> 00:22:42,480
temperature

632
00:22:47,350 --> 00:22:45,120
more than 530 instruments are recording

633
00:22:49,510 --> 00:22:47,360
data during this test

634
00:22:51,750 --> 00:22:49,520
in this test the real heat will be

635
00:22:53,510 --> 00:22:51,760
inside the motor chamber where the gas

636
00:22:56,149 --> 00:22:53,520
temperature reaches

637
00:23:32,710 --> 00:22:56,159
600 degrees fahrenheit hot enough to

638
00:23:32,720 --> 00:23:40,310

t-minus seven minutes

639
00:23:44,070 --> 00:23:42,470
verifying that the test range is clear

640
00:23:46,310 --> 00:23:44,080
of all personnel

641
00:23:48,710 --> 00:23:46,320
soon he will authorize the arming crew

642
00:23:51,590 --> 00:23:48,720
to surrender the fire control key to the

643
00:23:53,750 --> 00:23:51,600
test conductor the arming crew is also

644
00:23:55,909 --> 00:23:53,760
verifying that the emergency diesel

645
00:23:58,149 --> 00:23:55,919
generator is online

646
00:24:00,630 --> 00:23:58,159
the diesel generator acts as a backup

647
00:24:03,029 --> 00:24:00,640
power source in the unlikely event that

648
00:24:32,789 --> 00:24:03,039
the test area suffers a power failure

649
00:24:37,590 --> 00:24:35,510
t minus six minutes

650
00:24:39,750 --> 00:24:37,600
central support systems operator this is

651
00:24:40,870 --> 00:24:39,760
the test conductor turn on the water

652
00:24:45,110 --> 00:24:40,880
boost pump

653
00:24:47,510 --> 00:24:45,120
system have just been turned on

654
00:24:50,070 --> 00:24:47,520
these pumps provide the necessary water

655
00:24:52,070 --> 00:24:50,080
pressure to feed about 1 million gallons

656
00:24:53,990 --> 00:24:52,080
of water through a series of nozzles

657
00:24:55,830 --> 00:24:54,000
underneath the motor chamber

658
00:24:58,230 --> 00:24:55,840
it's essentially a bank of sprinkler

659
00:25:01,350 --> 00:24:58,240
heads that spray water up onto the

660
00:25:03,750 --> 00:25:01,360
chamber after the test to cool the case

661
00:25:06,149 --> 00:25:03,760
the water deluge lasts a minimum of 20

662
00:25:12,630 --> 00:25:06,159
minutes for the forward segments and at

663
00:25:17,110 --> 00:25:15,269

roger high speed operator monitor rock

664
00:25:19,110 --> 00:25:17,120
and tilt gas generator temperatures on

665
00:25:32,630 --> 00:25:19,120
the genesis system and verify they are

666
00:25:37,909 --> 00:25:35,830
t minus five minutes

667
00:25:40,310 --> 00:25:37,919
the test conductor is surrendering the

668
00:25:41,590 --> 00:25:40,320
fire control key to the test control

669
00:25:43,510 --> 00:25:41,600
coordinator

670
00:25:45,190 --> 00:25:43,520
the key will be turned to the on

671
00:25:47,669 --> 00:25:45,200
position

672
00:25:50,470 --> 00:25:47,679
at t minus 70 seconds when the final

673
00:25:51,909 --> 00:25:50,480
decision to commit the motor is made

674
00:25:53,590 --> 00:25:51,919
in just a moment

675
00:25:56,470 --> 00:25:53,600
the test conductor will pull all

676
00:25:58,789 --> 00:25:56,480
stations for a go for the test each

677
00:26:00,310 --> 00:25:58,799
station will report go before we proceed

678
00:26:01,990 --> 00:26:00,320
for ignition

679
00:26:04,470 --> 00:26:02,000
among the stations you'll hear make a

680
00:26:32,789 --> 00:26:04,480
call are the support systems various

681
00:26:32,799 --> 00:26:37,430
t minus four minutes

682
00:26:40,950 --> 00:26:39,669
this is the test conductor report system

683
00:26:43,190 --> 00:26:40,960
status

684
00:26:44,470 --> 00:26:43,200
the support systems are go for static

685
00:26:46,630 --> 00:26:44,480
test

686
00:26:48,310 --> 00:26:46,640
low speed data systems are go high speed

687
00:26:50,870 --> 00:26:48,320
data systems are go

688
00:26:53,350 --> 00:26:50,880

ultrasonic data system is go avionics

689
00:26:56,950 --> 00:26:53,360
solicit systems go redline monitor

690
00:26:59,269 --> 00:26:56,960
system is go bus monitor system is go

691
00:27:00,470 --> 00:26:59,279
motor temperatures are go for static

692
00:27:07,909 --> 00:27:00,480
test

693
00:27:10,950 --> 00:27:07,919
and with that all stations are go for

694
00:27:32,710 --> 00:27:10,960
today's static test of the sls booster

695
00:27:32,720 --> 00:27:37,590
t minus three minutes

696
00:27:42,230 --> 00:27:39,750
at the viewing area all eyes are on the

697
00:28:07,909 --> 00:27:42,240
countdown now less than three minutes

698
00:28:18,389 --> 00:28:10,710
t minus 145 seconds

699
00:28:32,630 --> 00:28:19,669
all high speed data systems are

700
00:28:42,389 --> 00:28:35,029
t minus two minutes

701
00:28:47,350 --> 00:28:44,710
all low speed data systems are recording

702
00:28:49,430 --> 00:28:47,360
roger bus monitor operators select stop

703
00:28:51,990 --> 00:28:49,440
all followed by startall to begin a new

704
00:28:54,149 --> 00:28:52,000
recording file bus monitor is recording

705
00:29:02,710 --> 00:28:54,159
a new file roger

706
00:29:02,720 --> 00:29:12,789
t minus 90 seconds

707
00:29:17,190 --> 00:29:14,870
t minus 80 seconds

708
00:29:22,870 --> 00:29:17,200
test control coordinator standby to

709
00:29:27,029 --> 00:29:24,950
t minus 70 seconds

710
00:29:33,110 --> 00:29:27,039
commit the motor

711
00:29:42,630 --> 00:29:35,590
t-minus 60 seconds

712
00:29:42,640 --> 00:29:52,470
t minus 50 seconds

713
00:29:52,480 --> 00:29:56,549

t minus 40 seconds

714
00:29:56,559 --> 00:30:03,029
bad flush is on

715
00:30:03,039 --> 00:30:08,630
t minus 30 seconds

716
00:30:08,640 --> 00:30:13,510
minus 25

717
00:30:13,520 --> 00:30:18,149
minus 20

718
00:30:18,159 --> 00:30:22,630
minus 15.

719
00:30:25,269 --> 00:30:24,230
t minus 10

720
00:30:26,149 --> 00:30:25,279
9

721
00:30:27,190 --> 00:30:26,159
8

722
00:30:28,149 --> 00:30:27,200
7

723
00:30:29,190 --> 00:30:28,159
6

724
00:30:30,149 --> 00:30:29,200
5

725
00:30:31,190 --> 00:30:30,159
4

726
00:30:32,230 --> 00:30:31,200
3

727
00:30:33,110 --> 00:30:32,240
2

728
00:30:34,789 --> 00:30:33,120
1

729
00:30:37,350 --> 00:30:34,799
fire

730
00:31:02,710 --> 00:30:37,360
we have ignition of nasa's space launch

731
00:31:02,720 --> 00:31:12,789
plus 30.

732
00:31:12,799 --> 00:31:23,190
plus 40.

733
00:31:23,200 --> 00:31:32,870
plus 50.

734
00:31:32,880 --> 00:31:43,509
t plus 60 seconds

735
00:31:43,519 --> 00:31:54,310
plus 70.

736
00:31:58,830 --> 00:31:56,389
central support systems operator enabled

737
00:32:03,669 --> 00:31:58,840
the dilution co2 and quench tool

738
00:32:26,710 --> 00:32:07,269

plus 90 over the two liter enable valve

739
00:32:45,990 --> 00:32:41,110
activated

740
00:32:47,750 --> 00:32:46,000
activate quench tool command forward and

741
00:33:18,149 --> 00:32:47,760
half co2

742
00:33:25,110 --> 00:33:21,350
t plus 165 seconds high speed data

743
00:33:27,350 --> 00:33:25,120
operator stop recording

744
00:33:28,630 --> 00:33:27,360
the full two minute test has concluded

745
00:33:32,950 --> 00:33:28,640
high speed recording now the carbon

746
00:33:34,389 --> 00:33:32,960
dioxide quench arm pumps 31 tons of co2

747
00:33:36,630 --> 00:33:34,399
into the booster

748
00:33:39,350 --> 00:33:36,640
the carbon dioxide quenches any burning

749
00:33:41,190 --> 00:33:39,360
of the insulation without damaging it to

750
00:33:42,310 --> 00:33:41,200
preserve the state it was in during the

751
00:33:44,230 --> 00:33:42,320
test

752
00:33:47,750 --> 00:33:44,240
this allows the team to get the best

753
00:33:49,350 --> 00:33:47,760
data about how it will perform in flight

754
00:33:51,669 --> 00:33:49,360
there's quite a bit of action remaining

755
00:33:53,430 --> 00:33:51,679
for the teams here as they ensure the

756
00:33:56,070 --> 00:33:53,440
test area is safe

757
00:33:58,230 --> 00:33:56,080
and the data are recorded

758
00:33:59,909 --> 00:33:58,240
following motor burnout the chamber will

759
00:34:02,710 --> 00:33:59,919
be sprayed with 2

760
00:34:04,470 --> 00:34:02,720
300 gallons of water per minute on the

761
00:34:05,990 --> 00:34:04,480
underside of the case to help cool it

762
00:34:08,069 --> 00:34:06,000
down

763
00:34:10,389 --> 00:34:08,079

this will cool the chamber from 1000

764
00:34:11,829 --> 00:34:10,399
degrees fahrenheit to 300 degrees

765
00:34:13,750 --> 00:34:11,839
fahrenheit

766
00:34:15,669 --> 00:34:13,760
avionics engineer verified that the

767
00:34:23,109 --> 00:34:15,679
solidistic has finished saving the log

768
00:34:27,750 --> 00:34:25,109
redline monitor operator transfer the

769
00:34:30,389 --> 00:34:27,760
log file to the local computer roger and

770
00:34:32,829 --> 00:34:30,399
work roger bus monitor operator transfer

771
00:34:48,230 --> 00:34:32,839
the data files to the local computer in

772
00:35:08,310 --> 00:34:49,829
monitor files have been transferred to

773
00:35:12,470 --> 00:35:10,310
let's go back out to bill where he's

774
00:35:15,030 --> 00:35:12,480
standing by for first reactions from

775
00:35:16,550 --> 00:35:15,040
those who were outside watching the test

776
00:35:18,470 --> 00:35:16,560
thanks very much stephanie yeah two

777
00:35:20,310 --> 00:35:18,480
minutes of excitement and exhilaration

778
00:35:22,069 --> 00:35:20,320
followed by jubilation from the crowd as

779
00:35:24,870 --> 00:35:22,079
well as some of the gentlemen who helped

780
00:35:27,109 --> 00:35:24,880
make this happen i'm joined by alex

781
00:35:28,390 --> 00:35:27,119
priscos he's the sls booster manager at

782
00:35:31,270 --> 00:35:28,400
the marshall space flight center of

783
00:35:33,270 --> 00:35:31,280
course rejoined by orbital atks charlie

784
00:35:35,190 --> 00:35:33,280
precor charlie let me quickly start with

785
00:35:36,470 --> 00:35:35,200
you everything seemed to go well and uh

786
00:35:38,630 --> 00:35:36,480
how do you think it looked it looked

787
00:35:41,190 --> 00:35:38,640
really clean we're very excited it's

788
00:35:43,109 --> 00:35:41,200

great result you could feel the the

789
00:35:45,349 --> 00:35:43,119
pressure coming off the motor you could

790
00:35:46,710 --> 00:35:45,359
see the plume and watch the vectoring it

791
00:35:48,390 --> 00:35:46,720
all looked great we'll be looking for

792
00:35:49,990 --> 00:35:48,400
the quick lick data but

793
00:35:51,430 --> 00:35:50,000
really nice result i think what was

794
00:35:52,470 --> 00:35:51,440
exciting and i haven't been to one of

795
00:35:54,230 --> 00:35:52,480
these in a couple of years so it was

796
00:35:55,990 --> 00:35:54,240
really exciting to see is is you've got

797
00:35:57,270 --> 00:35:56,000
that initial pause when the when

798
00:35:58,950 --> 00:35:57,280
everything loads you see all the smoke

799
00:36:00,550 --> 00:35:58,960
in the fire and then suddenly that sound

800
00:36:02,470 --> 00:36:00,560
wave hits you great little science

801
00:36:04,069 --> 00:36:02,480
demonstration for the speed of light the

802
00:36:05,670 --> 00:36:04,079
speed of sound you know a little delay

803
00:36:07,349 --> 00:36:05,680
and then the noise hits you really

804
00:36:09,430 --> 00:36:07,359
pretty neat i know that you and your

805
00:36:10,870 --> 00:36:09,440
crew are far from finished what what

806
00:36:12,630 --> 00:36:10,880
immediately is your crew doing up there

807
00:36:13,990 --> 00:36:12,640
right now so we're making sure all the

808
00:36:15,910 --> 00:36:14,000
systems are shut down you know we've had

809
00:36:19,109 --> 00:36:15,920
hydraulic power units running and so

810
00:36:20,550 --> 00:36:19,119
forth all that post fire stuff begins

811
00:36:22,630 --> 00:36:20,560
we've got quenching going on there's a

812
00:36:25,030 --> 00:36:22,640
lot of water systems up there cooling

813
00:36:26,950 --> 00:36:25,040

the belly of the booster because a lot

814
00:36:28,870 --> 00:36:26,960
of the residual

815
00:36:31,109 --> 00:36:28,880
materials in there that are so hot that

816
00:36:32,950 --> 00:36:31,119
plume was 5000 degrees

817
00:36:36,230 --> 00:36:32,960
a lot of that hot stuff is laying in the

818
00:36:38,710 --> 00:36:36,240
belly of the booster so we got cooling

819
00:36:41,349 --> 00:36:38,720
water jets cooling off the belly of the

820
00:36:42,470 --> 00:36:41,359
booster so that it doesn't get too hot

821
00:36:43,750 --> 00:36:42,480
and then

822
00:36:45,030 --> 00:36:43,760
over time

823
00:36:46,790 --> 00:36:45,040
we'll be able to go up and take a look

824
00:36:48,790 --> 00:36:46,800
and the dissection will begin and all

825
00:36:50,870 --> 00:36:48,800
the data will start to flow and we'll be

826
00:36:52,630 --> 00:36:50,880
looking for qualifications and if i'm

827
00:36:54,790 --> 00:36:52,640
not mistaken a lot of that hardware can

828
00:36:57,990 --> 00:36:54,800
be reused right absolutely all of this

829
00:37:00,069 --> 00:36:58,000
stuff will get recycled and used in

830
00:37:01,430 --> 00:37:00,079
either another test or maybe in flight

831
00:37:03,670 --> 00:37:01,440
all right thanks very much charlie let

832
00:37:05,190 --> 00:37:03,680
me turn now to alex priscos once again

833
00:37:06,710 --> 00:37:05,200
with the sls program out of the marshall

834
00:37:09,109 --> 00:37:06,720
space flight center you look like a

835
00:37:11,910 --> 00:37:09,119
happy man i am very happy this morning

836
00:37:14,550 --> 00:37:11,920
great test uh just just a fantastic

837
00:37:16,470 --> 00:37:14,560
result uh you used a stopwatch we

838
00:37:17,750 --> 00:37:16,480

haven't seen the real preliminary data

839
00:37:19,030 --> 00:37:17,760
but we get a little bit with just a

840
00:37:21,750 --> 00:37:19,040
watch and this thing was about as

841
00:37:23,990 --> 00:37:21,760
perfect and nominal as we it could be we

842
00:37:26,550 --> 00:37:24,000
were looking for two-minute firing time

843
00:37:29,430 --> 00:37:26,560
and and that's what we got so

844
00:37:31,109 --> 00:37:29,440
it's great i'd like to thank uh orbital

845
00:37:32,710 --> 00:37:31,119
atk and the nasa team for all they've

846
00:37:35,109 --> 00:37:32,720
done to get us here it's been just a

847
00:37:36,470 --> 00:37:35,119
fantastic effort on everybody's part

848
00:37:37,990 --> 00:37:36,480
so let me ask you i know you've got a

849
00:37:39,589 --> 00:37:38,000
lot of your team here as well as you met

850
00:37:42,390 --> 00:37:39,599
some of the folks from orbital atk as

851
00:37:43,510 --> 00:37:42,400
well as some of our nasa social media uh

852
00:37:44,870 --> 00:37:43,520
visitors

853
00:37:46,230 --> 00:37:44,880
what has been some of the reaction from

854
00:37:47,990 --> 00:37:46,240
some of them about being here and then

855
00:37:49,990 --> 00:37:48,000
seeing something like that i saw lots of

856
00:37:51,829 --> 00:37:50,000
handshaking on your way up here you know

857
00:37:53,829 --> 00:37:51,839
the enthusiasm

858
00:37:55,990 --> 00:37:53,839
uh that you're getting a test like this

859
00:37:57,589 --> 00:37:56,000
is just incredible it shows what what

860
00:37:59,510 --> 00:37:57,599
these kind of tests mean to everybody

861
00:38:00,470 --> 00:37:59,520
that that literally spend years and

862
00:38:02,550 --> 00:38:00,480
years and

863
00:38:05,829 --> 00:38:02,560

hours and hours and hours every every

864
00:38:08,870 --> 00:38:05,839
week working on it is as well as those

865
00:38:10,630 --> 00:38:08,880
uh that just show an extreme amount of

866
00:38:12,790 --> 00:38:10,640
interest and to watch the momentum and

867
00:38:15,030 --> 00:38:12,800
the interest build in this program has

868
00:38:17,750 --> 00:38:15,040
absolutely been fantastic and it has

869
00:38:19,829 --> 00:38:17,760
really really built uh consistently the

870
00:38:22,230 --> 00:38:19,839
last uh several months

871
00:38:23,510 --> 00:38:22,240
so what's next for the booster team in

872
00:38:27,270 --> 00:38:23,520
the short term

873
00:38:29,349 --> 00:38:27,280
this data we we will look at it on

874
00:38:31,430 --> 00:38:29,359
several levels we'll get our first free

875
00:38:33,910 --> 00:38:31,440
look at the data in in probably about an

876
00:38:35,589 --> 00:38:33,920
hour but we'll continue to dissect and

877
00:38:36,950 --> 00:38:35,599
go deeper and deeper into data for

878
00:38:38,790 --> 00:38:36,960
several months

879
00:38:40,630 --> 00:38:38,800
meanwhile we will be preparing uh

880
00:38:42,470 --> 00:38:40,640
qualification motor number two which is

881
00:38:44,950 --> 00:38:42,480
our second call test which will be a

882
00:38:46,470 --> 00:38:44,960
cold test to understand the performance

883
00:38:48,310 --> 00:38:46,480
in a cold condition

884
00:38:49,990 --> 00:38:48,320
and that will probably happen early next

885
00:38:51,109 --> 00:38:50,000
year so what are some of the finer

886
00:38:52,390 --> 00:38:51,119
points of the data that you're going to

887
00:38:55,109 --> 00:38:52,400
be looking for

888
00:38:57,349 --> 00:38:55,119

uh pressure time curve which really

889
00:38:59,750 --> 00:38:57,359
gives us a sense of power and when it

890
00:39:02,390 --> 00:38:59,760
happens and how much we'll be looking at

891
00:39:04,630 --> 00:39:02,400
the erosion of the insulator which tells

892
00:39:06,710 --> 00:39:04,640
us how much margin we have thermally in

893
00:39:09,510 --> 00:39:06,720
in the system and we'll be looking at

894
00:39:11,589 --> 00:39:09,520
nozzle erosion uh those are just three

895
00:39:14,069 --> 00:39:11,599
there are several hundred parameters but

896
00:39:15,990 --> 00:39:14,079
those are the three that we'll

897
00:39:16,870 --> 00:39:16,000
be looking at very very hard and very

898
00:39:18,390 --> 00:39:16,880
quickly

899
00:39:20,390 --> 00:39:18,400
all right excellent well thanks once

900
00:39:22,550 --> 00:39:20,400
again very much to the both of you uh

901
00:39:23,910 --> 00:39:22,560
congratulations on a successful test and

902
00:39:25,430 --> 00:39:23,920
and i know a lot of us i speak for many

903
00:39:26,790 --> 00:39:25,440
of us out here we're just glad we could

904
00:39:29,190 --> 00:39:26,800
have been here to be a part of it uh

905
00:39:31,990 --> 00:39:29,200
once again charlie precourt with orbital

906
00:39:33,910 --> 00:39:32,000
atk alex priscos from the sls booster

907
00:39:35,910 --> 00:39:33,920
program so gentlemen uh we're going to

908
00:39:37,670 --> 00:39:35,920
take before we head back inside first to

909
00:39:39,190 --> 00:39:37,680
stephanie for a few last words let's

910
00:39:42,790 --> 00:39:39,200
take a look at some of the replays of

911
00:39:45,349 --> 00:39:42,800
the test we just saw

912
00:40:01,510 --> 00:39:45,359
we have ignition of nasa's space launch

913
00:40:01,520 --> 00:40:10,710

yes

914
00:40:10,720 --> 00:40:20,710
plus 30.

915
00:40:20,720 --> 00:40:31,190
plus 40.

916
00:40:31,200 --> 00:40:40,870
plus 50.

917
00:40:40,880 --> 00:41:05,109
t plus 60 seconds

918
00:41:11,670 --> 00:41:07,910
co2 and quench tool controls

919
00:41:11,680 --> 00:41:15,270
plus

920
00:41:15,280 --> 00:41:21,030
simulator enabled

921
00:41:21,040 --> 00:46:12,470
plus 100.

922
00:46:31,510 --> 00:46:15,030
we have ignition of nasa's space launch

923
00:46:31,520 --> 00:47:00,870
morning

924
00:47:00,880 --> 00:47:11,430
plus 50.

925
00:47:11,440 --> 00:47:31,990
seconds

926
00:47:34,990 --> 00:47:34,069
sample support systems operator enabled

927
00:47:50,710 --> 00:47:35,000
the

928
00:47:50,720 --> 00:52:15,910
plus 100.

929
00:52:43,829 --> 00:52:18,470
we have ignition of nasa's space launch

930
00:52:43,839 --> 00:53:04,309
plus 30.

931
00:53:04,319 --> 00:53:14,549
plus 50.

932
00:53:14,559 --> 00:53:39,670
60 seconds

933
00:53:39,680 --> 00:53:54,470
controls

934
00:53:54,480 --> 00:55:14,069
100

935
00:55:18,950 --> 00:55:16,069
today's successful test of the space

936
00:55:21,190 --> 00:55:18,960
launch system five segment booster is a

937
00:55:23,589 --> 00:55:21,200
major milestone on our journey back into

938
00:55:25,670 --> 00:55:23,599

deep space and on to mars

939
00:55:27,990 --> 00:55:25,680
but today's a busy day for other parts

940
00:55:30,390 --> 00:55:28,000
of nasa as well

941
00:55:32,470 --> 00:55:30,400
we have the earth science mission and

942
00:55:35,109 --> 00:55:32,480
the international state space station

943
00:55:38,470 --> 00:55:35,119
program have major events happening

944
00:55:40,950 --> 00:55:38,480
today at 11 a.m mountain time 1 pm

945
00:55:43,270 --> 00:55:40,960
eastern join us for the science briefing

946
00:55:46,309 --> 00:55:43,280
for nasa's magnetospheric multi-scale

947
00:55:49,829 --> 00:55:46,319
mission which launches thursday at 10 44

948
00:55:52,549 --> 00:55:49,839
pm eastern today at 1 pm mountain time 3

949
00:55:54,630 --> 00:55:52,559
pm eastern nasa tv will air live

950
00:55:56,870 --> 00:55:54,640
coverage of the undocking of three

951
00:55:59,910 --> 00:55:56,880
international space station expedition

952
00:56:02,069 --> 00:55:59,920
42 crew members including nasa astronaut

953
00:56:06,470 --> 00:56:02,079
barry wilmore as they begin their

954
00:56:08,230 --> 00:56:06,480
journey home after 167 days in space

955
00:56:11,270 --> 00:56:08,240
thank you for joining us for today's

956
00:56:14,150 --> 00:56:11,280
live coverage of the sls booster test

957
00:56:17,030 --> 00:56:14,160
from orbital atk's test complex at

958
00:56:19,030 --> 00:56:17,040
promenatory utah i've been your host

959
00:56:21,990 --> 00:56:19,040
stephanie shareholtz we'll conclude

960
00:56:24,630 --> 00:56:22,000
today's broadcast with a note that you

961
00:56:29,109 --> 00:56:24,640
can follow us and keep up to date on all

962
00:56:36,470 --> 00:56:32,309
gov www.nasa.gov sls and follow us on

963
00:56:40,069 --> 00:56:36,480

facebook slash nasa sls and at twitter

964
00:56:42,470 --> 00:56:40,079
at nasa underscore sls and on instagram

965
00:56:45,109 --> 00:56:42,480
at explorenasa

966
00:56:47,190 --> 00:56:45,119
for all the latest news on nasa as we

967
00:56:49,670 --> 00:56:47,200
reach for new heights to reveal the