Episode 13: When Rockets Need Rescue

August 2019

@NASAKennedy
#NASARocketRanch

New episodes every month!

1
00:00:00,299 --> 00:00:03,100
One good test is worth a thousand expert opinions.

2
00:00:03,100 --> 00:00:09,070
You could say we got 1000 expert opinions
on the Orion Launch Abort System on July 2.

3
00:00:09,070 --> 00:00:14,470
Next on the Rocket Ranch.

4
00:00:14,470 --> 00:00:22,970
[intro music]

5
00:00:22,970 --> 00:00:27,689
We are combing through the second, incredibly
successful test of the Orion Launch Abort

6
00:00:27,689 --> 00:00:32,579
System that happened last month and we had
a chance to sit down with Carlos Garcia, the

7
00:00:32,579 --> 00:00:34,530
lead for that launch abort system.

8
00:00:34,530 --> 00:00:40,140
But first, we caught up a bit of a test flight
expert, Jon Cowart, to learn more about test

9
00:00:40,140 --> 00:00:41,140
flights in general.

10
00:00:41,140 --> 00:00:44,270
Alright, so, I am now in the booth with Jon
Cowart.

11
00:00:44,270 --> 00:00:45,940
Jon, thanks for joining me.

12

00:00:45,940 --> 00:00:46,940
Glad to be here.

13
00:00:46,940 --> 00:00:47,940
This is fun.

14
00:00:47,940 --> 00:00:51,609
So, if you could, tell me just really briefly,
what is it that you do here in the commercial

15
00:00:51,609 --> 00:00:52,769
crew program for NASA?

16
00:00:52,769 --> 00:00:56,499
In the commercial crew, I work in the mission
management and integration office.

17
00:00:56,499 --> 00:01:01,629
We are charged with basically each mission
has a mission manager, and that mission manager's

18
00:01:01,629 --> 00:01:06,610
responsible for all aspects of getting that
flight ready to go fly, working with the ISS,

19
00:01:06,610 --> 00:01:10,850
working with whatever partner we have for
that flight, and all of the things that we

20
00:01:10,850 --> 00:01:12,780
within NASA have to do to get ready for that.

21
00:01:12,780 --> 00:01:17,050
So, I used to be a mission manager, and then
I got made deputy manager of the entire office,

22
00:01:17,050 --> 00:01:20,360
which means I help all the managers do all
the tasks that they've got to do across all

23
00:01:20,360 --> 00:01:21,750
the flights and all the providers.

24
00:01:21,750 --> 00:01:22,750
Cool.

25
00:01:22,750 --> 00:01:25,850
So, I think, actually, the first time I ever
heard you speak...

26
00:01:25,850 --> 00:01:26,850
Yeah.

27
00:01:26,850 --> 00:01:30,640
...you were doing a debrief after the Ares
I-X flight.

28
00:01:30,640 --> 00:01:34,170
And we'll never forget that, 'cause you had
some humorous things to say about that.

29
00:01:34,170 --> 00:01:35,170
[Laughs]

30
00:01:35,170 --> 00:01:38,760
Which I mention only to say that you have
some good experience with test flights.

31
00:01:38,760 --> 00:01:39,760
Yes.

32
00:01:39,760 --> 00:01:42,360
So, the Ares I-X, for those that don't know,
2009, I believe?

33
00:01:42,360 --> 00:01:43,560
That was it.

34

00:01:43,560 --> 00:01:48,960
We launched the Ares I-X, which was a test
flight, and then 2015 we had the pad abort

35
00:01:48,960 --> 00:01:50,620
test for SpaceX?

36
00:01:50,620 --> 00:01:51,620
That was pad abort.

37
00:01:51,620 --> 00:01:52,620
Right.

38
00:01:52,620 --> 00:01:53,620
Exactly.

39
00:01:53,620 --> 00:01:54,620
And you were involved with both of those.

40
00:01:54,620 --> 00:01:55,620
Yes.

41
00:01:55,620 --> 00:01:58,030
So, tell me a little bit about your experience
and involvement and kind of just launch tests

42
00:01:58,030 --> 00:01:59,470
in general.

43
00:01:59,470 --> 00:02:03,940
There's a famous quote by Wernher von Braun
that kind of outlines exactly what flight

44
00:02:03,940 --> 00:02:04,940
tests are about.

45
00:02:04,940 --> 00:02:10,110
And it's something along the lines of "one
good test is worth a thousand expert opinions."

46
00:02:10,110 --> 00:02:13,260
Within NASA, what we try to do is we try to
design it as best we can.

47
00:02:13,260 --> 00:02:20,560
You have an idea what you need, you go design
it, and then you go do a little bit of testing.

48
00:02:20,560 --> 00:02:23,280
That philosophy pays huge dividends.

49
00:02:23,280 --> 00:02:27,210
You can think you've designed it great all
day long until you go test.

50
00:02:27,210 --> 00:02:31,510
And so whenever we do these flight tests,
we learn so very much.

51
00:02:31,510 --> 00:02:35,590
And what people have a hard time believing
is that when you go do a test and something

52
00:02:35,590 --> 00:02:41,330
goes what y'all would think is awfully wrong,
that's actually good for us, that we found

53
00:02:41,330 --> 00:02:45,730
it in a flight test or some kind of a test
rather than with people onboard or when the

54
00:02:45,730 --> 00:02:47,210
mission is critical.

55
00:02:47,210 --> 00:02:51,030
So while it looks bad -- and we never go into
a test thinking we're going to fail.

56

00:02:51,030 --> 00:02:56,810
Obviously, you go in not just optimistic,
but pretty darn sure things are gonna be successful.

57
00:02:56,810 --> 00:03:00,310
When you find out that you didn't, you learn
more from your mistakes than you ever learn

58
00:03:00,310 --> 00:03:02,150
from your successes.

59
00:03:02,150 --> 00:03:06,490
And so when you go into a test like that,
what's the -- how do you build that?

60
00:03:06,490 --> 00:03:09,030
And obviously, being a mission manager, you
have some experience with this.

61
00:03:09,030 --> 00:03:10,030
Yeah.

62
00:03:10,030 --> 00:03:12,400
Kind of how do you kind of construct, like,
what do we want to accomplish with a test?

63
00:03:12,400 --> 00:03:17,040
So, anytime you have a flight test, you have
a set of flight-test objectives in which you

64
00:03:17,040 --> 00:03:21,819
go through and you clearly outline, "Okay,
when I get to this point in the countdown,

65
00:03:21,819 --> 00:03:23,069
I want to do this.

66
00:03:23,069 --> 00:03:25,640
When I get to this point in the flight, I
want to do these things."

67
00:03:25,640 --> 00:03:27,110
And you talk about them very clearly.

68
00:03:27,110 --> 00:03:29,850
For example, I'll just make one up.

69
00:03:29,850 --> 00:03:36,130
If I'm in flight and I want my environmental
control system to keep the cabin between 65

70
00:03:36,130 --> 00:03:38,300
degrees and 80 degrees, I'm going to test
that.

71
00:03:38,300 --> 00:03:42,340
I'm going to put it at different ways toward
the sun and see how the system responds and

72
00:03:42,340 --> 00:03:45,910
if it keeps the temperature within the bounds
of where we think it should be.

73
00:03:45,910 --> 00:03:49,600
If it doesn't, we go, "Okay, well, there's
something going on that we didn't account

74
00:03:49,600 --> 00:03:50,600
for."

75
00:03:50,600 --> 00:03:51,660
And if you do, you go, "Alright.

76
00:03:51,660 --> 00:03:53,280
We did a good design.

77
00:03:53,280 --> 00:03:54,280
Fantastic."

78
00:03:54,280 --> 00:03:59,660
So, temperature inside the capsule obviously
is important, but that seems, like, trivial

79
00:03:59,660 --> 00:04:00,660
in a way.

80
00:04:00,660 --> 00:04:03,370
Is that a trivial thing to kind of analyze
with a spacecraft?

81
00:04:03,370 --> 00:04:08,020
No, because in the environment of space, one
thing I tell people all the time is if you

82
00:04:08,020 --> 00:04:12,570
are out walking in space, even in Earth orbit,
and you hold your hand up, the side of your

83
00:04:12,570 --> 00:04:16,410
hand that is facing the sun is very quickly
going to get to 250 degrees.

84
00:04:16,410 --> 00:04:20,559
The side of your hand that is not facing the
sun, that's in shadow, will very quickly get

85
00:04:20,559 --> 00:04:21,889
to -150 degrees.

86
00:04:21,889 --> 00:04:23,439
That feels uncomfortable, I'm assuming.

87
00:04:23,439 --> 00:04:24,439
[Laughs]

88
00:04:24,439 --> 00:04:25,710
That would be very uncomfortable.

89
00:04:25,710 --> 00:04:28,449
So, just controlling temperature is not a
simple thing.

90
00:04:28,449 --> 00:04:30,069
You insulate it as best you can.

91
00:04:30,069 --> 00:04:33,080
You put reflectors on the outside, some kind
of material that reflects the sun.

92
00:04:33,080 --> 00:04:36,449
But, then, when you're in the shadow of the
Earth, well, now you got to find heat from

93
00:04:36,449 --> 00:04:38,580
somewhere to keep the cabin warm.

94
00:04:38,580 --> 00:04:43,550
So you may think that's a trivial example,
and maybe it would seem that way to someone

95
00:04:43,550 --> 00:04:47,021
who's worried about the pressures and temperatures
and thrust of a rocket engine, which is a

96
00:04:47,021 --> 00:04:48,659
very dynamic event.

97
00:04:48,659 --> 00:04:49,659
Sure.

98
00:04:49,659 --> 00:04:50,659
But it's equally important to the crew.

99
00:04:50,659 --> 00:04:52,050
I can assure you of that.

100

00:04:52,050 --> 00:04:57,229
So, can you give me some perspective on the number of things that you might test on a

101
00:04:57,229 --> 00:04:58,229
flight?

102
00:04:58,229 --> 00:05:01,169
And obviously, I know it's gonna change pretty heavily from what you're testing.

103
00:05:01,169 --> 00:05:02,169
Right.

104
00:05:02,169 --> 00:05:04,699
But, again, in my mind, if I were building requirements, like, temperature inside the

105
00:05:04,699 --> 00:05:06,469
capsule is not one that comes to mind quickly.

106
00:05:06,469 --> 00:05:07,469
Okay.

107
00:05:07,469 --> 00:05:10,349
And that raises the question of, like, how many things am I not thinking about?

108
00:05:10,349 --> 00:05:12,860
[Laughs] Thousands and thousands of things.

109
00:05:12,860 --> 00:05:17,319
You've got to look at your guidance, your navigation, your ability to control the thrust

110
00:05:17,319 --> 00:05:18,589
in every one of your thrusters.

111
00:05:18,589 --> 00:05:21,879

Depending on which vehicle you're flying,
you've got different numbers of thrusters.

112
00:05:21,879 --> 00:05:26,800
Are you going to bother to test some kind
of optical alignment system?

113
00:05:26,800 --> 00:05:28,719
How well did that perform if you do?

114
00:05:28,719 --> 00:05:33,539
You've got to worry about the thermals on
the outside, thermals on the inside.

115
00:05:33,539 --> 00:05:34,539
You structure.

116
00:05:34,539 --> 00:05:36,930
You look at did the vehicle flex the way I
thought it would?

117
00:05:36,930 --> 00:05:37,999
Now comes re-entry time.

118
00:05:37,999 --> 00:05:39,449
I've got a heat shield on the bottom.

119
00:05:39,449 --> 00:05:40,449
Will that perform?

120
00:05:40,449 --> 00:05:41,830
How much of that is going to erode away?

121
00:05:41,830 --> 00:05:43,249
Will any of it erode away?

122
00:05:43,249 --> 00:05:46,159
What's the aerodynamics of the vehicle as
I fly up through the atmosphere and then coming

123
00:05:46,159 --> 00:05:47,210
back through the atmosphere?

124
00:05:47,210 --> 00:05:48,419
Like I said.

125
00:05:48,419 --> 00:05:51,669
So each one of those things I just mentioned
right there breaks down into hundreds of other

126
00:05:51,669 --> 00:05:55,180
little things if you test very specifically
in various locations.

127
00:05:55,180 --> 00:05:59,240
For example, with the structure, you don't
just put a strain gauge at one point.

128
00:05:59,240 --> 00:06:03,389
You put it all over the vehicle in various
places to find out how the vehicle flexes.

129
00:06:03,389 --> 00:06:08,610
You're checking pressures and temperatures
and thermal stuff all over.

130
00:06:08,610 --> 00:06:14,309
And so based on kind of that just real brief
explanation, it almost starts feeling like

131
00:06:14,309 --> 00:06:17,940
you would treat a test flight like its entire
own complete mission.

132
00:06:17,940 --> 00:06:20,219
Is that a fair way to kind of assess that?

133
00:06:20,219 --> 00:06:21,219

Yes.

134
00:06:21,219 --> 00:06:25,460
In many ways, it might be more important,
because you're trying to set the table for

135
00:06:25,460 --> 00:06:27,240
a nominal mission.

136
00:06:27,240 --> 00:06:31,339
During a flight test, you might not -- you're
not gonna try to operate out of what we call

137
00:06:31,339 --> 00:06:32,339
certification.

138
00:06:32,339 --> 00:06:37,410
If you've got a box that's designed to operate
between let's say 50 and 100 degrees, you're

139
00:06:37,410 --> 00:06:42,129
not going to do anything to verify that it
operates between 30 and 150.

140
00:06:42,129 --> 00:06:46,250
But you don't mind testing as you get near
the edges of its performance envelope.

141
00:06:46,250 --> 00:06:50,119
And by the way, one of the things I forgot
to mention previously, so, we're talking about

142
00:06:50,119 --> 00:06:52,969
hardware things, but there's also software
things.

143
00:06:52,969 --> 00:06:53,969
Yeah.

144

00:06:53,969 --> 00:06:54,969
You're gonna test the software.

145
00:06:54,969 --> 00:06:57,399
And then there's also the people aspect of
it.

146
00:06:57,399 --> 00:06:59,300
Did I plan on all the things that the astronauts
could do?

147
00:06:59,300 --> 00:07:02,479
Oh, what about the folks on the ground, the
mission controllers and the flight controllers

148
00:07:02,479 --> 00:07:04,589
and the launch controllers, those people?

149
00:07:04,589 --> 00:07:06,009
They have to be trained.

150
00:07:06,009 --> 00:07:09,009
They're certified as well as the vehicle and
the software.

151
00:07:09,009 --> 00:07:10,779
All these things have to be tested in a flight
test.

152
00:07:10,779 --> 00:07:15,649
And I know when I've done flight tests before,
the first time, you get all the people on

153
00:07:15,649 --> 00:07:19,550
the loop talking about a test, they're saying
that's like, "Hey, Joe, did you see that?"

154
00:07:19,550 --> 00:07:21,990
Well, that's not very professional, and it
doesn't communicate very well.

155
00:07:21,990 --> 00:07:22,990
[Laughs]

156
00:07:22,990 --> 00:07:27,529
You've got to learn to say, you know, things
like, "Pad leader, step 23, did you get 75?"

157
00:07:27,529 --> 00:07:30,039
You've got to be very specific.

158
00:07:30,039 --> 00:07:34,520
And then your responses and your callback
-- those can be very important to you if something

159
00:07:34,520 --> 00:07:38,089
bad were to go wrong, and then you've got
to go back and play the tapes and figure out,

160
00:07:38,089 --> 00:07:40,529
"Okay, what was everybody thinking?

161
00:07:40,529 --> 00:07:42,389
What was going on at that particular time?”

162
00:07:42,389 --> 00:07:46,039
And the voice loops and the data you're getting
on your screens are all just as important

163
00:07:46,039 --> 00:07:48,069
as what's going on on the vehicle.

164
00:07:48,069 --> 00:07:52,409
And so, as a manager of a mission, planning
a mission -- you just kind of alluded to this

165
00:07:52,409 --> 00:07:56,770
-- you have to have a procedure and kind of
a guideline for how to do everything.

166
00:07:56,770 --> 00:08:01,649
So, what kind of time is involved in just
writing a procedure and making sure that your

167
00:08:01,649 --> 00:08:04,679
procedure makes sense?

168
00:08:04,679 --> 00:08:09,119
Of course, you know, we're all engineers,
and we know the more planning you do up front,

169
00:08:09,119 --> 00:08:12,109
the better you will do when you actually get
to the event.

170
00:08:12,109 --> 00:08:13,929
And this plays out into everything else.

171
00:08:13,929 --> 00:08:15,370
I think -- what was it?

172
00:08:15,370 --> 00:08:18,649
-- Muhammad Ali said, "Everybody's got a plan
until they get punched in the mouth."

173
00:08:18,649 --> 00:08:19,649
[Laughs]

174
00:08:19,649 --> 00:08:23,179
Well, in particular, when things go bad, you
want to have some kind of a plan.

175
00:08:23,179 --> 00:08:28,179
And in that sense, he's probably correct in
that, "Okay, now things have gone really south.

176
00:08:28,179 --> 00:08:31,869
I didn't plan on things going this particular

direction, perhaps, but because I've done

177
00:08:31,869 --> 00:08:37,169
the thinking that planned for similar contingencies,
I have a better idea of what to expect."

178
00:08:37,169 --> 00:08:42,919
So these procedures that we -- even on a nominal
mission, literally for every hour you spend

179
00:08:42,919 --> 00:08:48,790
in orbit, you put thousands of hours into
planning what to do during that time.

180
00:08:48,790 --> 00:08:53,670
We're very, very thorough, and you have to
be, because space is very unforgiving of inattention

181
00:08:53,670 --> 00:08:54,670
to detail.

182
00:08:54,670 --> 00:08:59,750
So, you mentioned this idea of space being
unforgiving.

183
00:08:59,750 --> 00:09:02,060
Does that kind of impact the way we do testing?

184
00:09:02,060 --> 00:09:06,639
'Cause I know that some testing obviously
involves atmosphere and flight through atmosphere

185
00:09:06,639 --> 00:09:08,069
or returning into atmosphere.

186
00:09:08,069 --> 00:09:09,069
Right.

187
00:09:09,069 --> 00:09:10,850

And some of it's in space.

188
00:09:10,850 --> 00:09:17,440
So...I struggle with the question, 'cause
it's just like how do you do that?

189
00:09:17,440 --> 00:09:18,440
Yeah.

190
00:09:18,440 --> 00:09:21,400
Like, I don't want to lose the reality of,
like, "This is rocket science, and it's really

191
00:09:21,400 --> 00:09:22,400
difficult."

192
00:09:22,400 --> 00:09:23,400
Right.

193
00:09:23,400 --> 00:09:24,760
Which has become almost kind of a trite statement.

194
00:09:24,760 --> 00:09:28,250
But it's not to us, because we know how difficult
it is.

195
00:09:28,250 --> 00:09:31,769
And like you're suggesting, we've got to look
at all of these things.

196
00:09:31,769 --> 00:09:34,230
And so it is a mountain of work to get over.

197
00:09:34,230 --> 00:09:39,279
I alluded to it before, where if a box is
designed to operate let's say between 50 and

198
00:09:39,279 --> 00:09:44,130
100 degrees, when we certify that box for

use in spaceflight, and in particular human

199
00:09:44,130 --> 00:09:48,470
spaceflight, I will certify that it can operate
between 30 and 150.

200
00:09:48,470 --> 00:09:53,100
When I qualify that box, I will test it between
30 and 150.

201
00:09:53,100 --> 00:09:57,209
And from then on, my flight plan should always
keep it between 50 and 100.

202
00:09:57,209 --> 00:10:00,740
These are all just examples so people can
easily understand.

203
00:10:00,740 --> 00:10:02,779
So, that's how you certify something.

204
00:10:02,779 --> 00:10:08,480
You qualify to a greater number so that you
can have some error in what you're doing,

205
00:10:08,480 --> 00:10:11,889
and then you try to operate within normal
bounds.

206
00:10:11,889 --> 00:10:15,209
That way, if you occasionally deviate outside
of that, you know, hey, the box will still

207
00:10:15,209 --> 00:10:18,019
work, whatever it's got to go do.

208
00:10:18,019 --> 00:10:24,790
So, space is tough because, like I said, it's
unforgiving, and so we have to think very

209
00:10:24,790 --> 00:10:26,949
carefully about everything, the way we design it.

210
00:10:26,949 --> 00:10:30,100
Even when we're designing something, we go through something called a PDR, a preliminary

211
00:10:30,100 --> 00:10:31,100
design review.

212
00:10:31,100 --> 00:10:32,100
That's where you're about 10% of the way into the design.

213
00:10:32,100 --> 00:10:34,459
You say, "Okay, I kind of think this is where I'm heading.

214
00:10:34,459 --> 00:10:35,899
Everybody sit down and look at this.

215
00:10:35,899 --> 00:10:36,899
What do you think?

216
00:10:36,899 --> 00:10:38,449
Are we designing in the right direction?"

217
00:10:38,449 --> 00:10:39,529
You design a lot more.

218
00:10:39,529 --> 00:10:43,209
You get to about what you would call the 90% of what we call a critical design review.

219
00:10:43,209 --> 00:10:46,940
At this point, you might have actually made some test hardware and tested a couple things

220
00:10:46,940 --> 00:10:48,620
you weren't sure were gonna operate.

221
00:10:48,620 --> 00:10:52,819
But at CDR, you're essentially saying, "Okay,
once we leave this meeting, we're gonna go

222
00:10:52,819 --> 00:10:57,290
build this box that I have designed that's
90%.

223
00:10:57,290 --> 00:11:01,310
And there's maybe like 10% left there, but
we're gonna go start building this for flight,

224
00:11:01,310 --> 00:11:06,810
and we're gonna go build a test model first
and go test it, and, then, once we've gotten

225
00:11:06,810 --> 00:11:09,509
to CDR and we've built a test model, we'll
go test it.

226
00:11:09,509 --> 00:11:13,259
If it works out fine, that's the box we're
gonna go build, and that's the box we're gonna

227
00:11:13,259 --> 00:11:15,600
go fly.

228
00:11:15,600 --> 00:11:23,600
And as we kind of look at the history of NASA,
with test flights ranging for about 60 years

229
00:11:23,600 --> 00:11:24,600
now...

230
00:11:24,600 --> 00:11:25,600
Right.

231
00:11:25,600 --> 00:11:28,460
...do we find a lot of these things like CDR
and PDR you mentioned.

232
00:11:28,460 --> 00:11:29,460
Right.

233
00:11:29,460 --> 00:11:31,100
Are those legacy products?

234
00:11:31,100 --> 00:11:35,790
Do we have a guidance of how to do test flights
well, or are we kind of trying to reinvent

235
00:11:35,790 --> 00:11:37,640
it a little bit every time?

236
00:11:37,640 --> 00:11:39,220
So, we're trying to be smart.

237
00:11:39,220 --> 00:11:44,519
It is the 21st Century, and what we did in
the '50s and '60s might need a little updating.

238
00:11:44,519 --> 00:11:50,009
The kind of the process with the CDR and the
PDR, we continue to do that sort of thing,

239
00:11:50,009 --> 00:11:55,569
but with the modern tools we have available
and the computers that can do -- I mean, you

240
00:11:55,569 --> 00:12:00,750
know, the whole -- we went to the moon practically
with slide rules.

241
00:12:00,750 --> 00:12:02,160
[Laughs] Literally.

242
00:12:02,160 --> 00:12:03,160
[Laughs]

243
00:12:03,160 --> 00:12:04,160
Yeah.

244
00:12:04,160 --> 00:12:05,160
So we're way beyond that now.

245
00:12:05,160 --> 00:12:09,649
So we're trying to be smart, and I would say
particularly in the commercial crew program.

246
00:12:09,649 --> 00:12:13,889
Boeing and SpaceX are both trying to drag
us in some ways into the 21st Century and

247
00:12:13,889 --> 00:12:15,920
use more modern tools.

248
00:12:15,920 --> 00:12:22,360
But we still do and mentally, we still follow
that PDR and CDR process.

249
00:12:22,360 --> 00:12:30,060
SpaceX in particular seems to prefer to do
less design work up front and go build something

250
00:12:30,060 --> 00:12:34,230
real quick, because, like I said, one good
test is worth a thousand analyses.

251
00:12:34,230 --> 00:12:35,230
Right.

252
00:12:35,230 --> 00:12:38,930
They tend to be more of a design, test, design,
test, design, test, whereas traditionally,

253
00:12:38,930 --> 00:12:43,339
NASA has been kind of a design, design, design, design, design, test -- one big test.

254
00:12:43,339 --> 00:12:45,370
We put all our eggs in one big basket.

255
00:12:45,370 --> 00:12:47,100
They've got a slightly different philosophy.

256
00:12:47,100 --> 00:12:51,000
And that's closer to what our Russian colleagues do, what their philosophy is.

257
00:12:51,000 --> 00:12:55,980
So, there's more than one way to go skin this cat, and we're trying to find the smartest

258
00:12:55,980 --> 00:12:57,319
way at all times.

259
00:12:57,319 --> 00:12:58,319
Yeah.

260
00:12:58,319 --> 00:13:02,319
So, obviously, NASA, we are on a path to the moon, hopefully here 2024.

261
00:13:02,319 --> 00:13:03,319
Wow.

262
00:13:03,319 --> 00:13:04,319
So, yes.

263
00:13:04,319 --> 00:13:05,319
Yeah.

264

00:13:05,319 --> 00:13:07,550
And we have a lot of test flights coming up,
preparing for that, getting ready and on our

265
00:13:07,550 --> 00:13:08,550
way.

266
00:13:08,550 --> 00:13:09,550
Right.

267
00:13:09,550 --> 00:13:10,550
So, Jon, appreciate your expertise.

268
00:13:10,550 --> 00:13:11,550
Thanks for coming.

269
00:13:11,550 --> 00:13:12,550
My pleasure.

270
00:13:12,550 --> 00:13:15,399
I think people should hear this and know that
this is a tough business, but we love doing

271
00:13:15,399 --> 00:13:17,519
it.

272
00:13:17,519 --> 00:13:20,399
That path to the moon leads through the Orion
spacecraft.

273
00:13:20,399 --> 00:13:22,949
Here’s Carlos Garcia with more.

274
00:13:22,949 --> 00:13:28,070
So, the title is fairly self-explanatory,
I think -- launch abort system.

275
00:13:28,070 --> 00:13:30,790
This is a system that we use to abort a launch.

276
00:13:30,790 --> 00:13:32,529
Is that a fair way to describe it?

277
00:13:32,529 --> 00:13:34,820
Yes, that's correct.

278
00:13:34,820 --> 00:13:40,269
In addition to abort a launch, we also have
ascent abort.

279
00:13:40,269 --> 00:13:48,170
So, not to get terribly specific yet, but
we have the capability to provide ascent abort

280
00:13:48,170 --> 00:13:54,759
roughly, you know, of course after launch,
up until about 2 1/2 minutes after the solid

281
00:13:54,759 --> 00:13:57,550
rocket boosters separate from the launch vehicle.

282
00:13:57,550 --> 00:14:00,639
Can you just give me a quick rundown kind
of of the process from start to finish of

283
00:14:00,639 --> 00:14:05,290
what is involved in utilizing the launch abort
system.

284
00:14:05,290 --> 00:14:12,170
So, imagine the crew ingresses via the crew
module and the crew access arm is retracted.

285
00:14:12,170 --> 00:14:18,860
So, at that point, the launch abort system
is armed, and if there is an anomaly detected

286
00:14:18,860 --> 00:14:25,139

on the pad, the launch control center will
obviously be concerned about the crew and

287
00:14:25,139 --> 00:14:29,520
initiate a pad abort with the launch control
system.

288
00:14:29,520 --> 00:14:36,680
Their boat motor will fire and propel the
crew module away from any harm, and the bulk

289
00:14:36,680 --> 00:14:39,870
of that thrust occurs within three seconds.

290
00:14:39,870 --> 00:14:42,959
It burns to an additional two more seconds.

291
00:14:42,959 --> 00:14:47,389
At the same time, the attitude control motor
reorients the crew module to allow for the

292
00:14:47,389 --> 00:14:52,579
jettison of the launch abort system, which
will allow the crew module to deploy its parachutes

293
00:14:52,579 --> 00:14:54,990
and land safely in the ocean.

294
00:14:54,990 --> 00:15:03,640
At that time, the rescue crew will be on its
way to arrive and safely egress the crew from

295
00:15:03,640 --> 00:15:05,629
the crew module.

296
00:15:05,629 --> 00:15:08,649
Where are we talking about landing taking
place?

297

00:15:08,649 --> 00:15:13,820
And can you kind of compare and contrast if we do the pad abort versus an ascent abort?

298
00:15:13,820 --> 00:15:16,370
I'm assuming we're going into the Atlantic Ocean regardless.

299
00:15:16,370 --> 00:15:17,370
Yes.

300
00:15:17,370 --> 00:15:22,010
We'll be going in the Atlantic Ocean during most of the abort phase.

301
00:15:22,010 --> 00:15:27,540
Again, I don't have the specific details on how many nautical miles out, you know, in

302
00:15:27,540 --> 00:15:28,540
that trajectory.

303
00:15:28,540 --> 00:15:30,649
But yes, we'll be in the Atlantic Ocean.

304
00:15:30,649 --> 00:15:34,959
And obviously, depending on when in flight you would abort, you're gonna be in a different

305
00:15:34,959 --> 00:15:35,959
spot anyway.

306
00:15:35,959 --> 00:15:36,959
That's correct.

307
00:15:36,959 --> 00:15:39,040
Let's, again, assume we kind of had a bad day.

308

00:15:39,040 --> 00:15:42,079
We ended up with astronauts in the ocean,
in a capsule.

309
00:15:42,079 --> 00:15:43,079
Mm-hmm.

310
00:15:43,079 --> 00:15:44,079
They're alive.

311
00:15:44,079 --> 00:15:46,329
How do we get them out of the water, and how
fast can we do that?

312
00:15:46,329 --> 00:15:48,059
Let's see.

313
00:15:48,059 --> 00:15:54,639
So, we've been working very closely with our
partners here at Patrick Air Force Base and

314
00:15:54,639 --> 00:15:57,209
those recovery assets.

315
00:15:57,209 --> 00:16:00,459
You know, we've been training various times.

316
00:16:00,459 --> 00:16:05,780
They have -- and I don't recall all the details
of the simulators that were used, but they

317
00:16:05,780 --> 00:16:09,310
have to know exactly where the crew module
is.

318
00:16:09,310 --> 00:16:10,660
We have lat long, of course.

319
00:16:10,660 --> 00:16:13,249

We have a locator beacon and so forth.

320
00:16:13,249 --> 00:16:19,720
So we have pre-deployed assets through the whole path of that flight trajectory.

321
00:16:19,720 --> 00:16:24,300
And I know -- I forget the actual time limit, but I believe they have to be there within,

322
00:16:24,300 --> 00:16:25,890
you know, several hours.

323
00:16:25,890 --> 00:16:26,890
Okay.

324
00:16:26,890 --> 00:16:29,519
So it's not an instantaneous kind of thing, but they'll be there pretty quick...

325
00:16:29,519 --> 00:16:30,519
That's correct.

326
00:16:30,519 --> 00:16:32,010
: ...to kind of get to the crew and get them safe?

327
00:16:32,010 --> 00:16:34,899
And they obviously train for all this, as well, about how to deal with that if they

328
00:16:34,899 --> 00:16:35,949
end up in the water...

329
00:16:35,949 --> 00:16:36,949
Oh, yes.

330
00:16:36,949 --> 00:16:37,949
...what to do, how to be safe, those kinds

of things?

331
00:16:37,949 --> 00:16:38,949
Yes.

332
00:16:38,949 --> 00:16:42,250
I mean, we have to put handholds in certain
areas on the crew module so the flight and

333
00:16:42,250 --> 00:16:46,700
rescue crew can actually get there, you know,
and help open up the hatch and get our astronauts

334
00:16:46,700 --> 00:16:47,700
out.

335
00:16:47,700 --> 00:16:51,560
So, once they get there -- so it's a couple
hours later, a few hours later, they get to

336
00:16:51,560 --> 00:16:57,740
the capsule -- are the astronauts trained
to be outside the capsule as soon as possible?

337
00:16:57,740 --> 00:16:59,460
Are they supposed to wait inside the capsule?

338
00:16:59,460 --> 00:17:00,460
What's kind of that process at that point?

339
00:17:00,460 --> 00:17:04,440
They're supposed to wait inside the capsule,
right, until help arrives, yes?

340
00:17:04,440 --> 00:17:05,440
Okay.

341
00:17:05,440 --> 00:17:08,080
And then the crews that come in, obviously,

are trained on how to get in, pull them out...

342
00:17:08,080 --> 00:17:09,080
That's correct.

343
00:17:09,080 --> 00:17:10,080
...and to safety?

344
00:17:10,080 --> 00:17:11,080
Great.

345
00:17:11,080 --> 00:17:16,220
So, there's part of me that thinks that this
sounds like a really fun ride -- a high-speed

346
00:17:16,220 --> 00:17:17,470
ride.

347
00:17:17,470 --> 00:17:18,720
[Laughs]

348
00:17:18,720 --> 00:17:23,210
You chuckle, and so your response kind of
makes me think that maybe this isn't, like,

349
00:17:23,210 --> 00:17:26,940
your typical amusement-park thrill ride.

350
00:17:26,940 --> 00:17:28,400
Probably times 10.

351
00:17:28,400 --> 00:17:30,670
[Laughs] Which is a good thing or a bad
thing?

352
00:17:30,670 --> 00:17:33,240
'Cause I feel like at some point, it gets
dangerous.

353
00:17:33,240 --> 00:17:35,260
I'm guessing we're not in that range yet.

354
00:17:35,260 --> 00:17:36,260
No, it's not dangerous.

355
00:17:36,260 --> 00:17:40,660
That's why we have our amazing astronauts
that can sustain these kind of loads.

356
00:17:40,660 --> 00:17:47,780
And the abort motor essentially can produce
up to 11 G's of force, you know, on the body,

357
00:17:47,780 --> 00:17:48,780
which is not insignificant.

358
00:17:48,780 --> 00:17:52,490
So, but they do have pressurized suits, of
course, yes.

359
00:17:52,490 --> 00:17:53,490
Okay.

360
00:17:53,490 --> 00:17:55,220
So it's a pretty wild ride.

361
00:17:55,220 --> 00:17:56,220
Yes.

362
00:17:56,220 --> 00:18:00,120
But obviously, the goal here being a rough
ride, maybe, but you live.

363
00:18:00,120 --> 00:18:01,790
Correct, correct.

364
00:18:01,790 --> 00:18:05,050

Is the launch abort system for Orion particularly sophisticated?

365
00:18:05,050 --> 00:18:09,780
Obviously, we know that we're building it now, so it is current in technology.

366
00:18:09,780 --> 00:18:14,920
But is there something that sets it apart from commercial launch abort systems or past

367
00:18:14,920 --> 00:18:15,920
launch abort systems?

368
00:18:15,920 --> 00:18:19,680
Well, the systems are essentially a heritage technology.

369
00:18:19,680 --> 00:18:23,010
Solid rocket motors have been around for some time.

370
00:18:23,010 --> 00:18:29,030
We do have advanced avionics, you know, with the computers, of course, in addition to -- we

371
00:18:29,030 --> 00:18:33,060
have composite materials on the fairing -- what we call the O-Jives.

372
00:18:33,060 --> 00:18:38,820
And that essentially, you know, makes the shroud of the launch abort system as light

373
00:18:38,820 --> 00:18:39,830
as possible.

374
00:18:39,830 --> 00:18:40,920
What's an O-Jive?

375
00:18:40,920 --> 00:18:45,860
That's what we call the actual fairing that
goes around the crew module for the launch

376
00:18:45,860 --> 00:18:46,860
abort system.

377
00:18:46,860 --> 00:18:50,870
Is there a story behind that, or is that just
a shortening of its name?

378
00:18:50,870 --> 00:18:52,900
I've never questioned it.

379
00:18:52,900 --> 00:18:53,900
Sorry.

380
00:18:53,900 --> 00:18:57,260
[Laughs] And that, my friend, is indicative
of some NASA things.

381
00:18:57,260 --> 00:18:59,690
We don't necessarily question.

382
00:18:59,690 --> 00:19:02,760
We just kind of use them and know what they
mean.

383
00:19:02,760 --> 00:19:03,760
[Laughs]

384
00:19:03,760 --> 00:19:04,760
And what's a shroud?

385
00:19:04,760 --> 00:19:15,170
A shroud, essentially, is the protective area
of the crew module to protect the crew and

386

00:19:15,170 --> 00:19:19,540
the actual crew module from aerodynamic loads.

387
00:19:19,540 --> 00:19:24,710
For people that are on the ground, and maybe
if this unfortunately were to happen someday,

388
00:19:24,710 --> 00:19:25,960
what's a spectator gonna see?

389
00:19:25,960 --> 00:19:27,840
What's this visually like?

390
00:19:27,840 --> 00:19:32,520
So, obviously, with all the cameras, you know,
prior to launch, the spectators would definitely

391
00:19:32,520 --> 00:19:33,610
see a pad abort.

392
00:19:33,610 --> 00:19:39,580
They may not notice some anomaly on the pad,
but, you know, they'll just like, "Wow.

393
00:19:39,580 --> 00:19:40,580
What happened?”

394
00:19:40,580 --> 00:19:46,740
You can see the actual, you know, crew module
with the launch abort system take off, and

395
00:19:46,740 --> 00:19:50,920
as I mentioned before, you know, the abort
motor will propel it over the ocean and then

396
00:19:50,920 --> 00:19:54,620
jettison, and then the crew module would deploy
its parachutes and land, you know, in the

397

00:19:54,620 --> 00:19:59,340
ocean to be recovered from our flight and
rescue team at Patrick.

398
00:19:59,340 --> 00:20:04,660
So, something that you noticed, but not necessarily
the same kind of visual impact as a launch?

399
00:20:04,660 --> 00:20:05,660
Of course.

400
00:20:05,660 --> 00:20:11,210
Now, obviously, you know, if it's a pad abort,
we would definitely be able to see, you know,

401
00:20:11,210 --> 00:20:12,540
all the details about that.

402
00:20:12,540 --> 00:20:18,500
If it occurs during ascent, as we talked,
for an ascent abort, that altitude can be

403
00:20:18,500 --> 00:20:20,440
greater than 24,000 feet.

404
00:20:20,440 --> 00:20:26,270
So, you know, from the layman's eye, you won't
necessarily see an ascent abort, you know,

405
00:20:26,270 --> 00:20:28,030
obviously, very clearly.

406
00:20:28,030 --> 00:20:30,520
Just 'cause it's so high and it's traveling
downrange so far?

407
00:20:30,520 --> 00:20:31,520
That's correct.

408

00:20:31,520 --> 00:20:32,520
Gotcha.

409
00:20:32,520 --> 00:20:33,520
Cool.

410
00:20:33,520 --> 00:20:35,020
So, what's the likelihood of needing to use
this?

411
00:20:35,020 --> 00:20:39,010
Obviously, like, it's super important because
we're dealing with safety of humans, and so

412
00:20:39,010 --> 00:20:42,320
we want it, but what's the likelihood that
we will ever use this system?

413
00:20:42,320 --> 00:20:43,320
It's highly unlikely.

414
00:20:43,320 --> 00:20:45,680
You know, and I don't have numbers I can share
with you.

415
00:20:45,680 --> 00:20:48,890
I'm sure we do have some, but I just don't
have those in front of me.

416
00:20:48,890 --> 00:20:51,880
It's extremely unlikely.

417
00:20:51,880 --> 00:20:57,940
I do recall from the Russian rocket, they
did have to use their pad abort system sometime,

418
00:20:57,940 --> 00:21:00,380
but I think it only was used once.

419

00:21:00,380 --> 00:21:01,580
But it did save the crew.

420
00:21:01,580 --> 00:21:02,580
Awesome.

421
00:21:02,580 --> 00:21:06,670
So, you know, again, it's something you definitely never want to use, but if you need it, it's

422
00:21:06,670 --> 00:21:08,920
there.

423
00:21:08,920 --> 00:21:13,210
Believe it or not, shortly after we interviewed Carlos, a Russian Soyuz launch headed to the

424
00:21:13,210 --> 00:21:19,650
Space Station was aborted successfully, pulling the capsule and two crew members to safety.

425
00:21:19,650 --> 00:21:24,560
And how does the call, so to speak, take place to use this?

426
00:21:24,560 --> 00:21:27,710
You mentioned a minute ago about a team kind of deciding that.

427
00:21:27,710 --> 00:21:28,710
Mm-hmm.

428
00:21:28,710 --> 00:21:31,380
Is this a human decision, or are there computers involved here to help make this decision?

429
00:21:31,380 --> 00:21:33,240
Carlos Garcia: Well, there's three instances.

430

00:21:33,240 --> 00:21:41,960
You know, of course, the Orion has abort software
in that, you know, monitors its situation

431
00:21:41,960 --> 00:21:45,300
awareness, as well as the launch vehicle.

432
00:21:45,300 --> 00:21:52,050
So, in most cases, because this has to occur
extremely fast, Orion itself will initiate

433
00:21:52,050 --> 00:21:53,320
an abort if needed.

434
00:21:53,320 --> 00:22:00,540
If we're in flight, then Mission Control and
Houston will initiate abort, or, during launch,

435
00:22:00,540 --> 00:22:05,900
the launch control system can initiate an
abort, as well as if, for some reason, the

436
00:22:05,900 --> 00:22:08,920
crew needs to do it, they have that ability,
as well.

437
00:22:08,920 --> 00:22:09,920
Okay.

438
00:22:09,920 --> 00:22:11,710
So, just piquing my curiosity there.

439
00:22:11,710 --> 00:22:15,110
So, obviously, if Orion, the software is essentially
making that choice.

440
00:22:15,110 --> 00:22:16,380
Then it's an automatic thing.

441

00:22:16,380 --> 00:22:17,380
Mm-hmm.

442
00:22:17,380 --> 00:22:18,380
Correct.

443
00:22:18,380 --> 00:22:20,780
Is there a button that somebody has to push
that does this?

444
00:22:20,780 --> 00:22:22,490
Is it a physical button, or what is it?

445
00:22:22,490 --> 00:22:26,230
Well, normally, it's a fire and arm, so it's
more than just one button.

446
00:22:26,230 --> 00:22:27,230
Okay.

447
00:22:27,230 --> 00:22:28,710
[Laughs] So not just like an "ah-choo,"
like, "Whoops."

448
00:22:28,710 --> 00:22:29,710
Yes.

449
00:22:29,710 --> 00:22:30,710
[Laughs]

450
00:22:30,710 --> 00:22:31,710
But you got to do a couple things.

451
00:22:31,710 --> 00:22:32,710
Right.

452
00:22:32,710 --> 00:22:33,710
Yes.

453
00:22:33,710 --> 00:22:34,710
But it is a physical toggle of some nature
that you have to --

454
00:22:34,710 --> 00:22:35,930
If it's a manual input, yes.

455
00:22:35,930 --> 00:22:36,930
Okay.

456
00:22:36,930 --> 00:22:37,930
Alright, cool.

457
00:22:37,930 --> 00:22:39,590
Let me just mention this.

458
00:22:39,590 --> 00:22:47,400
So, we kind of touched on it, but the launch
abort system, you know, can be automatically

459
00:22:47,400 --> 00:22:53,980
initiated by the Orion software -- we talked
about that -- or initiated manually through

460
00:22:53,980 --> 00:22:55,900
several different paths.

461
00:22:55,900 --> 00:23:03,140
And that's either through the crew or the
launch control center or mission control center.

462
00:23:03,140 --> 00:23:10,230
Again, during flight, so, the Orion monitors
its health and status during the whole time.

463
00:23:10,230 --> 00:23:17,660
It also has input from the launch vehicle,
and it's looking for several abort conditions

464
00:23:17,660 --> 00:23:18,800
from the launch vehicle.

465
00:23:18,800 --> 00:23:22,990
And obviously, if some of those conditions
are met, it's gonna receive a command to go

466
00:23:22,990 --> 00:23:25,620
ahead and initiate an abort.

467
00:23:25,620 --> 00:23:27,380
And what's the window to be able to use this?

468
00:23:27,380 --> 00:23:32,610
'Cause you talked about having the crew onboard
and having armed the system.

469
00:23:32,610 --> 00:23:35,580
So how much window are we talking about?

470
00:23:35,580 --> 00:23:40,630
Because, not knowing how the processing will
go for SLS, I know that for shuttle, we had

471
00:23:40,630 --> 00:23:43,980
hours where we had a crew onboard, and we
weren't flying yet.

472
00:23:43,980 --> 00:23:47,290
So are we looking at a similar timeline where
that could be a possibility?

473
00:23:47,290 --> 00:23:49,100
It's a possibility, but nominally.

474
00:23:49,100 --> 00:23:52,370
You know, we don't want to have the crew in
there any longer than we have to.

475
00:23:52,370 --> 00:23:58,220
So, you know, you imagine the crew getting
in the actual Orion crew module, you know,

476
00:23:58,220 --> 00:24:02,590
they have to walk through the access arm,
get situated, get strapped in.

477
00:24:02,590 --> 00:24:11,520
Once that is, you know, essentially behind
us, we move the crew access arm, this launch

478
00:24:11,520 --> 00:24:18,660
abort system is then armed, and anytime after,
you know, the crew access arm has actually

479
00:24:18,660 --> 00:24:25,230
been retracted and the crew is inside the
crew module, they have the capability for

480
00:24:25,230 --> 00:24:27,010
a pad abort.

481
00:24:27,010 --> 00:24:30,900
And that can be, you know, five minutes before
a launch, or if there is a delay, you know,

482
00:24:30,900 --> 00:24:33,550
that can be, you know, hours per weather or
what have you.

483
00:24:33,550 --> 00:24:34,550
Sure.

484
00:24:34,550 --> 00:24:40,520
And, again, so, we have pad abort of course
on the pad, and then ascent abort up to about

485
00:24:40,520 --> 00:24:46,450

2 1/2 minutes in-flight, just after solid
rocket booster separation from the launch

486
00:24:46,450 --> 00:24:47,450
vehicle.

487
00:24:47,450 --> 00:24:48,450
Gotcha.

488
00:24:48,450 --> 00:24:49,800
After 2 1/2 minutes, what's kind of the situation
at that point?

489
00:24:49,800 --> 00:24:51,460
Are we at a point where we're much safer or
--

490
00:24:51,460 --> 00:24:52,460
Well, yes.

491
00:24:52,460 --> 00:24:58,950
We're much safer, because if we -- well, you
know, the roughest ride structurally is with

492
00:24:58,950 --> 00:25:02,010
the solid rocket boosters on the launch vehicle.

493
00:25:02,010 --> 00:25:07,860
Once we have those separated, yes, the ride
is much smoother, but then we have to jettison

494
00:25:07,860 --> 00:25:10,830
the launch abort system because it's no longer
needed.

495
00:25:10,830 --> 00:25:14,330
But there are other abort modes for Orion
if needed.

496

00:25:14,330 --> 00:25:20,140
But essentially, that's just, you know, the
Orion capsule separating and then either landing

497
00:25:20,140 --> 00:25:25,230
in the ocean or whatever abort to orbit or
those other abort modes that are needed.

498
00:25:25,230 --> 00:25:26,230
Gotcha.

499
00:25:26,230 --> 00:25:28,660
So there's other systems in place beyond that
2 1/2-minute timeline?

500
00:25:28,660 --> 00:25:29,660
That's correct.

501
00:25:29,660 --> 00:25:30,660
Cool.

502
00:25:30,660 --> 00:25:33,840
So, the Orion monitors its health and status
during the whole time.

503
00:25:33,840 --> 00:25:41,270
It also has input from the launch vehicle,
and it's looking for several abort conditions

504
00:25:41,270 --> 00:25:42,410
from the launch vehicle.

505
00:25:42,410 --> 00:25:46,600
And obviously, if some of those conditions
are met, it's gonna receive a command to go

506
00:25:46,600 --> 00:25:48,880
ahead and initiate an abort.

507

00:25:48,880 --> 00:25:50,950
Can you give me a few examples?

508
00:25:50,950 --> 00:25:52,820
Like, what kinds of things?

509
00:25:52,820 --> 00:25:55,720
Obviously, that's probably a long list, but
what are some of the things that would trigger

510
00:25:55,720 --> 00:25:56,720
that?

511
00:25:56,720 --> 00:26:02,590
If for some reason the trajectory is off its
nominal path, right?

512
00:26:02,590 --> 00:26:06,410
Therefore, you know, hey, we have unsafe condition.

513
00:26:06,410 --> 00:26:07,410
Sure.

514
00:26:07,410 --> 00:26:12,850
You know, we're reaching some aerodynamic
loads that exceed what the vehicle have been

515
00:26:12,850 --> 00:26:18,070
designed for, and therefore it would initiate
an automatic abort.

516
00:26:18,070 --> 00:26:22,230
And on the ground, what kinds of things would
the system be looking for, as well?

517
00:26:22,230 --> 00:26:26,910
Those would be mostly launch-pad conditions.

518
00:26:26,910 --> 00:26:31,390

You know, if for some reason there's a fire on the pad or anomaly with a launch vehicle

519
00:26:31,390 --> 00:26:35,930
during loading, a leak in the fire with the launch vehicle, then yeah, then the launch

520
00:26:35,930 --> 00:26:38,310
control system would initiate an abort -- a pad abort.

521
00:26:38,310 --> 00:26:42,740
So, Carlos, you're working on a system that is designed to save people's lives in the

522
00:26:42,740 --> 00:26:44,360
event of an emergency.

523
00:26:44,360 --> 00:26:49,100
I'm guessing there's some sort of really great feeling that comes along with that.

524
00:26:49,100 --> 00:26:50,460
Do you kind of process that day-to-day?

525
00:26:50,460 --> 00:26:52,650
Yes and no.

526
00:26:52,650 --> 00:26:55,410
I mean, not necessarily.

527
00:26:55,410 --> 00:27:00,450
The bulk of our time is essentially trying to build, you know, the launch abort system,

528
00:27:00,450 --> 00:27:03,140
you know, in a timely manner to support our schedules.

529

00:27:03,140 --> 00:27:07,380
But in the back of our minds, we do know how important this particular piece of hardware

530
00:27:07,380 --> 00:27:08,380
is.

531
00:27:08,380 --> 00:27:12,570
There's a great team, you know, in Houston, as well as the Langley Research Center, that

532
00:27:12,570 --> 00:27:15,250
have been working on this for some time.

533
00:27:15,250 --> 00:27:21,030
We have proven this with our pad abort test back in -- I believe it was 2010.

534
00:27:21,030 --> 00:27:27,610
So, you know, we try not to, you know, worry about everything that can go wrong, but ensure

535
00:27:27,610 --> 00:27:30,400
ourselves, you know, when days go right.

536
00:27:30,400 --> 00:27:36,840
The launch abort system is essentially, you know, insurance for the Orion capsule, but,

537
00:27:36,840 --> 00:27:39,280
more importantly, the crew.

538
00:27:39,280 --> 00:27:45,810
As all things, we hope never to have to use our launch abort system, but in the event

539
00:27:45,810 --> 00:27:51,580
that we do have, unfortunately, a bad day, either on the pad or during ascent, we are

540
00:27:51,580 --> 00:27:56,720
very confident that our launch abort system
will safely remove the crew from harm and

541
00:27:56,720 --> 00:27:59,250
we can recover them and rescue them safely.

542
00:27:59,250 --> 00:28:03,190
Alright, so, Carlos, I appreciate you being
here today.

543
00:28:03,190 --> 00:28:07,300
Big thank you to you and your entire team
for the work you're doing and for making spaceflight

544
00:28:07,300 --> 00:28:09,660
that much safer for the future.

545
00:28:09,660 --> 00:28:10,660
You're very welcome.

546
00:28:10,660 --> 00:28:14,140
Thanks for having me.

547
00:28:14,140 --> 00:28:19,160
The completion of the three and half minute
Ascent Abort 2 test saw the Orion mockup travel

548
00:28:19,160 --> 00:28:24,500
6 miles in altitude before the abort motor
successfully pulled the capsule away from

549
00:28:24,500 --> 00:28:26,440
the modified peacekeeper.

550
00:28:26,440 --> 00:28:31,230
Definitively proving that we can outrun a
speeding rocket.

551
00:28:31,230 --> 00:28:37,050
Every test and every day that goes by we take
another small step towards the moon and Mars.

552
00:28:37,050 --> 00:28:40,300
I'm Joshua Santora, and that's our show.

553
00:28:40,300 --> 00:28:42,380
Thanks for stoppin' by the rocket ranch.

554
00:28:42,380 --> 00:28:46,460
And special thanks to our guests Jon Cowart
and Carlos Garcia.

555
00:28:46,460 --> 00:28:52,320
To learn more about Orion visit nasa.gov/orion
And to learn more about everything going on

556
00:28:52,320 --> 00:28:55,280
at the Kennedy Space Center, go to nasa.gov/kennedy.

557
00:28:55,280 --> 00:29:00,600
Check out NASA's other podcasts to learn
more about what's happening at all of our

558
00:29:00,600 --> 00:29:02,420
centers at nasa.gov/podcasts.

559
00:29:02,420 --> 00:29:09,840
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560
00:29:09,840 --> 00:29:14,040
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