
NASA
Asteroid Initiative
Opportunities Forum
#askNASA
NASA
NASA
Asteroid
Initiative
Opportunities
Forum

1
00:00:06,230 --> 00:00:04,950
hi i'm trim perado public affairs

2
00:00:07,670 --> 00:00:06,240
officer at nasa headquarters in

3
00:00:10,230 --> 00:00:07,680
washington and welcome to nasa's

4
00:00:11,430 --> 00:00:10,240
asteroid initiative opportunities forum

5
00:00:12,870 --> 00:00:11,440
we have a number of exciting

6
00:00:14,070 --> 00:00:12,880
presentations and discussions planned

7
00:00:15,829 --> 00:00:14,080
for you today about the asteroid

8
00:00:17,269 --> 00:00:15,839
initiative for those maybe unfamiliar

9
00:00:18,870 --> 00:00:17,279
with it or those of you watching from

10
00:00:20,630 --> 00:00:18,880
home learning about the asteroid

11
00:00:22,470 --> 00:00:20,640
initiative it comprises a number of

12
00:00:23,750 --> 00:00:22,480
different components it's an asteroid

13
00:00:25,590 --> 00:00:23,760

grand challenge to develop new

14
00:00:27,269 --> 00:00:25,600
partnerships and collaborations to

15
00:00:29,429 --> 00:00:27,279
accelerate nasa's existing planetary

16
00:00:30,870 --> 00:00:29,439
defense work it's an asteroid redirect

17
00:00:32,310 --> 00:00:30,880
mission to capture and redirect an

18
00:00:34,630 --> 00:00:32,320
asteroid and a crude mission to help

19
00:00:36,709 --> 00:00:34,640
send astronauts to visit it and collect

20
00:00:38,549 --> 00:00:36,719
samples you'll hear an update on all the

21
00:00:39,990 --> 00:00:38,559
planning for all these activities

22
00:00:42,830 --> 00:00:40,000
more today and throughout the day we'll

23
00:00:44,709 --> 00:00:42,840
post presentations online at

24
00:00:46,709 --> 00:00:44,719
www.nasa.gov

25
00:00:48,150 --> 00:00:46,719
asteroid forum you can find out more

26
00:00:49,430 --> 00:00:48,160
information generally about the asteroid

27
00:00:51,029 --> 00:00:49,440
initiative through that link or at

28
00:00:52,790 --> 00:00:51,039
nasa.gov

29
00:00:53,990 --> 00:00:52,800
asteroid initiative

30
00:00:56,630 --> 00:00:54,000
we'll have a few opportunities for you

31
00:00:58,150 --> 00:00:56,640
to ask questions of our panelists today

32
00:01:00,709 --> 00:00:58,160
you can start sending those questions in

33
00:01:02,869 --> 00:01:00,719
via twitter using the hashtag ask nasa

34
00:01:04,229 --> 00:01:02,879
we'll get to as many as we can to get us

35
00:01:05,750 --> 00:01:04,239
started though i'd like to show a short

36
00:01:07,590 --> 00:01:05,760
video just highlighting some of the

37
00:01:09,270 --> 00:01:07,600
mission concepts and activities that

38
00:01:19,350 --> 00:01:09,280

you'll be hearing more about today if we

39
00:01:19,360 --> 00:02:12,550
so

40
00:02:17,030 --> 00:02:14,869
okay and now for opening remarks it's my

41
00:02:21,990 --> 00:02:17,040
pleasure to introduce nasa administrator

42
00:02:27,190 --> 00:02:24,630
wow you guys are quiet

43
00:02:29,030 --> 00:02:27,200
uh you know you can relax

44
00:02:31,830 --> 00:02:29,040
uh if you don't

45
00:02:33,670 --> 00:02:31,840
you may as well not get too serious here

46
00:02:35,430 --> 00:02:33,680
i want to thank you trent for in for the

47
00:02:38,550 --> 00:02:35,440
introduction and thanks to everybody

48
00:02:40,229 --> 00:02:38,560
who's come to join us today uh for this

49
00:02:41,990 --> 00:02:40,239
important progress update on nasa's

50
00:02:43,830 --> 00:02:42,000
asteroid initiative and i know we have

51
00:02:46,949 --> 00:02:43,840
people who are looking uh

52
00:02:49,350 --> 00:02:46,959
on nasa tv probably people online as i

53
00:02:51,509 --> 00:02:49,360
see rebecca down there just busily

54
00:02:52,790 --> 00:02:51,519
looking at tweets and twits and all that

55
00:02:54,949 --> 00:02:52,800
other stuff so

56
00:02:56,710 --> 00:02:54,959
let me thank uh some people first i want

57
00:02:58,070 --> 00:02:56,720
to thank michelle gates who's right down

58
00:03:01,110 --> 00:02:58,080
here in front i want to thank chris

59
00:03:03,030 --> 00:03:01,120
moore jason kessler and the whole team

60
00:03:05,990 --> 00:03:03,040
for leading this effort and special

61
00:03:09,110 --> 00:03:06,000
appreciation uh for today goes to erin

62
00:03:12,149 --> 00:03:09,120
mahoney and sarah becker ramsey

63
00:03:13,430 --> 00:03:12,159

becky ramsey for organizing today's

64
00:03:15,110 --> 00:03:13,440
forum

65
00:03:17,110 --> 00:03:15,120
one of the things that that we've

66
00:03:19,430 --> 00:03:17,120
learned after 50 years of space

67
00:03:21,430 --> 00:03:19,440
exploration is that our solar system is

68
00:03:22,710 --> 00:03:21,440
too big for any one of us to get our

69
00:03:24,949 --> 00:03:22,720
hands around

70
00:03:27,589 --> 00:03:24,959
that's why nasa has always sought and

71
00:03:30,070 --> 00:03:27,599
welcomed input from scientists educators

72
00:03:32,550 --> 00:03:30,080
corporations students and citizens from

73
00:03:33,990 --> 00:03:32,560
all walks of life and you've always

74
00:03:35,670 --> 00:03:34,000
answered the call

75
00:03:37,750 --> 00:03:35,680
none of our great accomplishments from

76
00:03:39,509 --> 00:03:37,760
landing a man on the moon to assembling

77
00:03:42,309 --> 00:03:39,519
the iss in space

78
00:03:44,630 --> 00:03:42,319
to landing curiosity rover on mars would

79
00:03:46,869 --> 00:03:44,640
have been possible without the ingenuity

80
00:03:48,789 --> 00:03:46,879
and support of the american people

81
00:03:50,550 --> 00:03:48,799
i'm especially pleased that we have

82
00:03:52,309 --> 00:03:50,560
representatives from the next generation

83
00:03:55,110 --> 00:03:52,319
of scientists and explorers with us

84
00:03:56,710 --> 00:03:55,120
today sitting right down here

85
00:03:59,509 --> 00:03:56,720
i'm talking about the dillard drive

86
00:04:00,949 --> 00:03:59,519
middle school asteroid search team

87
00:04:03,670 --> 00:04:00,959
i want to thank you all for being here

88
00:04:05,270 --> 00:04:03,680

if you all have not met these young men

89
00:04:07,670 --> 00:04:05,280
and women right down here and their

90
00:04:09,190 --> 00:04:07,680
teacher who looks younger would you all

91
00:04:10,949 --> 00:04:09,200
stand up for a second

92
00:04:18,069 --> 00:04:10,959
and just kind of wheel around so people

93
00:04:21,749 --> 00:04:20,310
they didn't come just to have fun

94
00:04:24,150 --> 00:04:21,759
i hope they're going to have some fun

95
00:04:25,909 --> 00:04:24,160
while they're here they are here because

96
00:04:27,350 --> 00:04:25,919
they think their ideas are better than a

97
00:04:29,430 --> 00:04:27,360
lot of you sitting in the audience and

98
00:04:30,950 --> 00:04:29,440
they are serious about it and you ought

99
00:04:32,550 --> 00:04:30,960
to talk to them you will see them when

100
00:04:35,030 --> 00:04:32,560
they give their presentation later on

101
00:04:36,550 --> 00:04:35,040
today uh they've done a lot of work and

102
00:04:37,830 --> 00:04:36,560
and they're really proud and i think

103
00:04:39,590 --> 00:04:37,840
their parents

104
00:04:41,510 --> 00:04:39,600
are the parents back up in here you all

105
00:04:44,070 --> 00:04:41,520
stand up because you know parents don't

106
00:04:46,710 --> 00:04:44,080
get don't get recognized enough and

107
00:04:50,310 --> 00:04:46,720
there's one uh right on the end is a

108
00:04:51,990 --> 00:04:50,320
grandad so he and i had a special uh

109
00:04:53,110 --> 00:04:52,000
affinity this morning because i was

110
00:04:55,350 --> 00:04:53,120
telling him about my three

111
00:04:58,950 --> 00:04:55,360
granddaughters um but that's really

112
00:05:00,950 --> 00:04:58,960
special let let me um

113
00:05:02,469 --> 00:05:00,960

before i go ahead i need to make sure

114
00:05:04,550 --> 00:05:02,479
everybody understands something we

115
00:05:07,189 --> 00:05:04,560
really make a big deal out of this

116
00:05:10,310 --> 00:05:07,199
initiative but you should all understand

117
00:05:12,070 --> 00:05:10,320
this is a tiny tiny piece of getting

118
00:05:13,830 --> 00:05:12,080
humans to mars

119
00:05:16,629 --> 00:05:13,840
i don't want anybody to lose focus on

120
00:05:18,550 --> 00:05:16,639
that the the ultimate goal of this

121
00:05:21,110 --> 00:05:18,560
agency right now when it comes to human

122
00:05:23,830 --> 00:05:21,120
space flight is to put humans on mars

123
00:05:25,990 --> 00:05:23,840
and that's hard that is really hard so

124
00:05:28,070 --> 00:05:26,000
we need a proving ground to develop some

125
00:05:30,950 --> 00:05:28,080
of the technologies and everything else

126
00:05:33,670 --> 00:05:30,960
and and the concept with which we have

127
00:05:35,110 --> 00:05:33,680
arrived is is the asteroid initiative

128
00:05:37,590 --> 00:05:35,120
and we are going to talk about it in

129
00:05:38,390 --> 00:05:37,600
some detail but but i don't want you are

130
00:05:39,909 --> 00:05:38,400
all

131
00:05:41,029 --> 00:05:39,919
asteroid people

132
00:05:43,430 --> 00:05:41,039
um

133
00:05:45,990 --> 00:05:43,440
you're very important the ultimate thing

134
00:05:48,629 --> 00:05:46,000
though is to put boots on the ground on

135
00:05:50,469 --> 00:05:48,639
mars and that's not just a do a touch

136
00:05:52,710 --> 00:05:50,479
and go i mean it's to live there one of

137
00:05:54,790 --> 00:05:52,720
these days and i i always have to when i

138
00:05:56,870 --> 00:05:54,800

look at the audience

139
00:06:00,150 --> 00:05:56,880
i always recognize that many of you are

140
00:06:01,590 --> 00:06:00,160
my generation we're not going to do this

141
00:06:03,510 --> 00:06:01,600
okay

142
00:06:05,510 --> 00:06:03,520
so some of you will scoff

143
00:06:07,189 --> 00:06:05,520
some of you are going yay i'm glad we're

144
00:06:10,390 --> 00:06:07,199
finally doing this because we've been

145
00:06:12,230 --> 00:06:10,400
talking about it for 100 years or more

146
00:06:14,230 --> 00:06:12,240
uh not very many of us are going to do

147
00:06:16,710 --> 00:06:14,240
it i told these young i told the kids

148
00:06:18,469 --> 00:06:16,720
down here this morning it's up to them

149
00:06:20,469 --> 00:06:18,479
to be quite honest so that's why i was

150
00:06:22,870 --> 00:06:20,479
really really really glad

151
00:06:25,510 --> 00:06:22,880
to see that we had a group of seventh

152
00:06:26,870 --> 00:06:25,520
graders who are engaged in this they're

153
00:06:29,350 --> 00:06:26,880
the ones that are going to do it it's

154
00:06:30,710 --> 00:06:29,360
not any it is let me tell you as i look

155
00:06:33,510 --> 00:06:30,720
back there and see all my friends up in

156
00:06:34,550 --> 00:06:33,520
this middle section you guys are toast

157
00:06:37,189 --> 00:06:34,560
you know

158
00:06:38,870 --> 00:06:37,199
you are not gonna do this you're setting

159
00:06:42,629 --> 00:06:38,880
the ground and they're the ones that are

160
00:06:43,830 --> 00:06:42,639
gonna do it so just just uh you know

161
00:06:44,790 --> 00:06:43,840
get over it

162
00:06:46,870 --> 00:06:44,800
uh

163
00:06:49,990 --> 00:06:46,880

as some of you may already know nasa's

164
00:06:51,590 --> 00:06:50,000
asteroid initiative is comprised of an

165
00:06:54,070 --> 00:06:51,600
asteroid grand challenge and a

166
00:06:55,430 --> 00:06:54,080
three-segment strategy to identify and

167
00:06:57,990 --> 00:06:55,440
interact with earth-threatening

168
00:06:59,350 --> 00:06:58,000
asteroids the grand challenge seeks to

169
00:07:01,990 --> 00:06:59,360
develop new partnerships and

170
00:07:04,309 --> 00:07:02,000
collaborations to accelerate nasa's

171
00:07:06,950 --> 00:07:04,319
existing planetary defense work

172
00:07:09,189 --> 00:07:06,960
the three-segment strategy includes as a

173
00:07:11,670 --> 00:07:09,199
first segment our ongoing effort to

174
00:07:14,070 --> 00:07:11,680
identify and characterize as many of the

175
00:07:16,150 --> 00:07:14,080
earth threatening asteroids as feasible

176
00:07:18,629 --> 00:07:16,160
the second segment a robotic mission to

177
00:07:21,110 --> 00:07:18,639
redirect an asteroid into a stable orbit

178
00:07:23,270 --> 00:07:21,120
around the moon and the third segment a

179
00:07:26,469 --> 00:07:23,280
crude visit to that asteroid by

180
00:07:28,150 --> 00:07:26,479
astronauts via sls and orion during

181
00:07:29,589 --> 00:07:28,160
which samples can be collected for

182
00:07:30,870 --> 00:07:29,599
return to earth

183
00:07:32,629 --> 00:07:30,880
you'll hear more about these

184
00:07:35,589 --> 00:07:32,639
complementary parts of the asteroid

185
00:07:38,469 --> 00:07:35,599
initiative from our panel of experts

186
00:07:40,870 --> 00:07:38,479
but today's forum is not only about us

187
00:07:42,230 --> 00:07:40,880
talking to you about where we are and

188
00:07:44,390 --> 00:07:42,240

where we're going

189
00:07:46,309 --> 00:07:44,400
uh with our asteroid initiative it's

190
00:07:47,110 --> 00:07:46,319
most importantly about

191
00:07:51,749 --> 00:07:47,120
you

192
00:07:54,230 --> 00:07:51,759
this exciting and important adventure

193
00:07:56,070 --> 00:07:54,240
last year we issued a call for ideas on

194
00:07:58,710 --> 00:07:56,080
the asteroid redirect mission and the

195
00:08:02,550 --> 00:07:58,720
asteroid grand challenge we received

196
00:08:05,589 --> 00:08:02,560
more than 400 responses 96 of which were

197
00:08:06,950 --> 00:08:05,599
explored in depth at a two-part workshop

198
00:08:08,390 --> 00:08:06,960
in houston

199
00:08:09,909 --> 00:08:08,400
i'm trying to remember it became

200
00:08:11,510 --> 00:08:09,919
two-part because

201
00:08:13,589 --> 00:08:11,520
we didn't have a hurricane but we had

202
00:08:15,270 --> 00:08:13,599
something down there oh

203
00:08:18,309 --> 00:08:15,280
that's right

204
00:08:19,270 --> 00:08:18,319
congress shut the government down

205
00:08:22,230 --> 00:08:19,280
uh

206
00:08:24,629 --> 00:08:22,240
in that small in that same spirit last

207
00:08:27,749 --> 00:08:24,639
friday we released a broad agency

208
00:08:30,309 --> 00:08:27,759
announcement or baa seeking proposals on

209
00:08:33,110 --> 00:08:30,319
an asteroid redirect mission concepts

210
00:08:35,269 --> 00:08:33,120
development the baa seeks input and

211
00:08:38,230 --> 00:08:35,279
ideas to include asteroid capture

212
00:08:40,550 --> 00:08:38,240
systems rendezvous sensors adapting

213
00:08:43,430 --> 00:08:40,560

commercial spacecraft for the asteroid

214
00:08:45,190 --> 00:08:43,440
redirect mission and feasibility studies

215
00:08:47,670 --> 00:08:45,200
of potential future partnership

216
00:08:49,269 --> 00:08:47,680
opportunities for secondary payloads and

217
00:08:51,350 --> 00:08:49,279
the crude mission

218
00:08:53,110 --> 00:08:51,360
we are also aligning our agency

219
00:08:55,990 --> 00:08:53,120
infrastructure to better manage this

220
00:08:58,310 --> 00:08:56,000
effort just this week associate

221
00:09:00,550 --> 00:08:58,320
administrator robert lightfoot announced

222
00:09:03,190 --> 00:09:00,560
the consolidation of two asteroid

223
00:09:05,829 --> 00:09:03,200
mission concept teams into one and

224
00:09:08,310 --> 00:09:05,839
assigned specific project duties to the

225
00:09:10,230 --> 00:09:08,320
various nasa centers across the country

226
00:09:11,670 --> 00:09:10,240
to get us to the next mission definition

227
00:09:13,829 --> 00:09:11,680
milestone

228
00:09:15,750 --> 00:09:13,839
robert may tell you more about that when

229
00:09:16,790 --> 00:09:15,760
he wraps up today's forum with a

230
00:09:21,030 --> 00:09:16,800
discussion

231
00:09:23,670 --> 00:09:21,040
but before we get into the meet of

232
00:09:25,750 --> 00:09:23,680
today's forum let me take a moment to

233
00:09:27,670 --> 00:09:25,760
tell you how all this fits into nasa's

234
00:09:29,110 --> 00:09:27,680
grand vision for a new era of space

235
00:09:31,269 --> 00:09:29,120
exploration

236
00:09:33,590 --> 00:09:31,279
our asteroid initiative is part of a

237
00:09:35,350 --> 00:09:33,600
stepping stone approach focused on

238
00:09:38,870 --> 00:09:35,360

meeting the president's bold challenge

239
00:09:41,110 --> 00:09:38,880
of sending humans to mars in the 2030s

240
00:09:43,190 --> 00:09:41,120
the grand challenge that dovetails with

241
00:09:44,870 --> 00:09:43,200
the identification and characterization

242
00:09:47,590 --> 00:09:44,880
segment of the strategy

243
00:09:50,790 --> 00:09:47,600
includes enhanced near-earth observation

244
00:09:53,590 --> 00:09:50,800
detection and characterization

245
00:09:56,150 --> 00:09:53,600
which will extend our understanding of

246
00:09:57,910 --> 00:09:56,160
neo threats while providing additional

247
00:10:00,070 --> 00:09:57,920
opportunities for investigation of

248
00:10:02,710 --> 00:10:00,080
asteroids and demonstrations of

249
00:10:04,470 --> 00:10:02,720
technologies and capabilities

250
00:10:06,070 --> 00:10:04,480
the robotic mission to redirect an

251
00:10:08,070 --> 00:10:06,080
asteroid will help us develop

252
00:10:09,190 --> 00:10:08,080
technologies including solar electric

253
00:10:11,990 --> 00:10:09,200
propulsion

254
00:10:13,910 --> 00:10:12,000
needed for future deep space missions

255
00:10:15,829 --> 00:10:13,920
the third element the crude mission to

256
00:10:17,670 --> 00:10:15,839
an asteroid will allow us to practice

257
00:10:18,389 --> 00:10:17,680
orbital maneuvering away from low earth

258
00:10:20,710 --> 00:10:18,399
orbit

259
00:10:23,350 --> 00:10:20,720
environment it will also develop

260
00:10:25,829 --> 00:10:23,360
procedures for proximity operations and

261
00:10:27,910 --> 00:10:25,839
extra vehicular activity from the orion

262
00:10:30,790 --> 00:10:27,920
crew module that will be necessary for

263
00:10:33,430 --> 00:10:30,800

human mission to mars our ultimate goal

264
00:10:35,590 --> 00:10:33,440
in our global exploration roadmap

265
00:10:37,750 --> 00:10:35,600
during this astronaut visit we will

266
00:10:40,870 --> 00:10:37,760
collect samples for return to earth and

267
00:10:41,750 --> 00:10:40,880
practice procedures that might be used

268
00:10:44,389 --> 00:10:41,760
might

269
00:10:45,430 --> 00:10:44,399
i say be used in future commercial

270
00:10:46,790 --> 00:10:45,440
mining

271
00:10:49,269 --> 00:10:46,800
you should also know that the

272
00:10:51,509 --> 00:10:49,279
international space station iss

273
00:10:53,430 --> 00:10:51,519
is a critical part of our stepping stone

274
00:10:55,110 --> 00:10:53,440
approach to the exploration of deep

275
00:10:56,790 --> 00:10:55,120
space and mars

276
00:10:58,949 --> 00:10:56,800
the administration's commitment to

277
00:11:00,710 --> 00:10:58,959
extend the life of the iss until at

278
00:11:02,710 --> 00:11:00,720
least 2024

279
00:11:05,190 --> 00:11:02,720
guarantees will have this unique

280
00:11:07,110 --> 00:11:05,200
orbiting opportunity outpost for at

281
00:11:09,190 --> 00:11:07,120
least another decade

282
00:11:11,030 --> 00:11:09,200
this means an expanded market for

283
00:11:13,030 --> 00:11:11,040
commercial space companies

284
00:11:14,949 --> 00:11:13,040
it will also allow time for more

285
00:11:17,670 --> 00:11:14,959
groundbreaking research and science

286
00:11:19,430 --> 00:11:17,680
discovery in microgravity and additional

287
00:11:21,829 --> 00:11:19,440
opportunities to live

288
00:11:23,910 --> 00:11:21,839

work and learn in space over longer and

289
00:11:26,069 --> 00:11:23,920
longer periods of time

290
00:11:29,190 --> 00:11:26,079
as we continue to perform research

291
00:11:30,949 --> 00:11:29,200
aboard the iss we're also making strides

292
00:11:33,670 --> 00:11:30,959
in transitioning cargo and crew

293
00:11:35,990 --> 00:11:33,680
transportation to the station

294
00:11:38,230 --> 00:11:36,000
to commercial space companies ending our

295
00:11:41,030 --> 00:11:38,240
dependence on russian and return

296
00:11:43,990 --> 00:11:41,040
and return launches to american soil

297
00:11:46,150 --> 00:11:44,000
already two companies spacex and orbital

298
00:11:47,750 --> 00:11:46,160
sciences are making regular cargo

299
00:11:48,790 --> 00:11:47,760
deliveries to the international space

300
00:11:50,150 --> 00:11:48,800
station

301
00:11:51,509 --> 00:11:50,160
last year

302
00:11:56,069 --> 00:11:51,519
will

303
00:11:57,750 --> 00:11:56,079
commercial cargo resupply and award

304
00:12:00,230 --> 00:11:57,760
contracts to american aerospace

305
00:12:01,590 --> 00:12:00,240
companies to send our astronauts to low

306
00:12:03,910 --> 00:12:01,600
earth orbit

307
00:12:05,190 --> 00:12:03,920
most important is that this will end our

308
00:12:08,550 --> 00:12:05,200
reliance on russia for the

309
00:12:12,230 --> 00:12:08,560
transportation of our crews to the iss

310
00:12:14,150 --> 00:12:12,240
if congress fully funds our 2015 request

311
00:12:16,629 --> 00:12:14,160
we believe we can maintain critical

312
00:12:19,110 --> 00:12:16,639
competition and stay on track to launch

313
00:12:22,069 --> 00:12:19,120

astronauts to the iss from american

314
00:12:24,389 --> 00:12:22,079
spaceports by the end of 2017.

315
00:12:26,710 --> 00:12:24,399
all of this is freeing nasa to focus on

316
00:12:29,030 --> 00:12:26,720
deep space exploration through the

317
00:12:31,269 --> 00:12:29,040
development of the space launch system

318
00:12:33,590 --> 00:12:31,279
and orion crew vehicle which will take

319
00:12:35,910 --> 00:12:33,600
our astronauts farther into space than

320
00:12:37,990 --> 00:12:35,920
anyone has ever gone before

321
00:12:40,230 --> 00:12:38,000
the asteroid redirect mission will use

322
00:12:42,710 --> 00:12:40,240
slst and orion to test our new

323
00:12:45,829 --> 00:12:42,720
capabilities in the proving ground of

324
00:12:47,750 --> 00:12:45,839
cis lunar space before sending a human

325
00:12:49,829 --> 00:12:47,760
mission to the red planet and for all of

326
00:12:51,990 --> 00:12:49,839
you purists in the audience because i

327
00:12:55,350 --> 00:12:52,000
know there are some i know you know it's

328
00:12:57,590 --> 00:12:55,360
sis luna and trans lunar but

329
00:12:59,750 --> 00:12:57,600
don't be picky

330
00:13:02,310 --> 00:12:59,760
later this year

331
00:13:05,990 --> 00:13:02,320
we will see exploration flight test 1

332
00:13:07,269 --> 00:13:06,000
eft 1 of orion atop a delta iv heavy

333
00:13:08,710 --> 00:13:07,279
launch vehicle

334
00:13:11,430 --> 00:13:08,720
nasa is pressing forward with

335
00:13:15,190 --> 00:13:11,440
development of sls and orion preparing

336
00:13:16,710 --> 00:13:15,200
for a first uncrewed mission to in fy

337
00:13:19,269 --> 00:13:16,720
2018

338
00:13:21,269 --> 00:13:19,279

finally as we speak

339
00:13:23,750 --> 00:13:21,279
astronauts aboard the iss are learning

340
00:13:26,230 --> 00:13:23,760
the fundamental lessons necessary to

341
00:13:27,509 --> 00:13:26,240
safely execute extended missions deeper

342
00:13:29,590 --> 00:13:27,519
into space

343
00:13:31,509 --> 00:13:29,600
today we're very fortunate to have one

344
00:13:33,910 --> 00:13:31,519
of those astronauts with us

345
00:13:35,750 --> 00:13:33,920
astronaut dr karen nyberg was selected

346
00:13:39,269 --> 00:13:35,760
for the astronaut program in july of

347
00:13:40,870 --> 00:13:39,279
2000 after serving in various capacities

348
00:13:43,269 --> 00:13:40,880
as an engineer at the johnson space

349
00:13:45,990 --> 00:13:43,279
center and i just learned yesterday uh

350
00:13:47,430 --> 00:13:46,000
karen started as a were you a co-op

351
00:13:50,069 --> 00:13:47,440
a co-op

352
00:13:51,430 --> 00:13:50,079
at uh at jsc so

353
00:13:53,829 --> 00:13:51,440
there's hope

354
00:13:55,190 --> 00:13:53,839
as i told you all this morning okay

355
00:13:57,430 --> 00:13:55,200
pick her brain

356
00:14:01,189 --> 00:13:57,440
she made her first of two missions to

357
00:14:03,189 --> 00:14:01,199
space as a mission specialist on sts-124

358
00:14:06,710 --> 00:14:03,199
aboard the space shuttle discovery until

359
00:14:08,949 --> 00:14:06,720
in june of 2008 from may 28 to november

360
00:14:10,470 --> 00:14:08,959
10 2013

361
00:14:13,910 --> 00:14:10,480
she served as flight engineer for

362
00:14:16,870 --> 00:14:13,920
expedition 3637 aboard the iss

363
00:14:19,750 --> 00:14:16,880

karen has accumulated more than 180 days

364
00:14:21,110 --> 00:14:19,760
in space during these two missions she

365
00:14:22,790 --> 00:14:21,120
holds a bachelor of science in

366
00:14:25,269 --> 00:14:22,800
mechanical engineering from the

367
00:14:27,750 --> 00:14:25,279
university of north dakota and masters

368
00:14:29,030 --> 00:14:27,760
and doctoral philosophies in mass in

369
00:14:31,350 --> 00:14:29,040
mechanical engineering from the

370
00:14:33,269 --> 00:14:31,360
university of texas at austin ladies and

371
00:14:42,710 --> 00:14:33,279
gentlemen it's my pleasure to present to

372
00:14:47,990 --> 00:14:45,590
thank you good afternoon everyone i'm

373
00:14:49,110 --> 00:14:48,000
glad to be able to be here today

374
00:14:51,269 --> 00:14:49,120
um

375
00:14:53,829 --> 00:14:51,279
last year i was extremely

376
00:14:55,910 --> 00:14:53,839
privileged to live and work for almost

377
00:14:56,870 --> 00:14:55,920
six months on the international space

378
00:14:58,710 --> 00:14:56,880
station

379
00:15:01,110 --> 00:14:58,720
and i can tell you firsthand it is an

380
00:15:02,949 --> 00:15:01,120
incredible facility we spent

381
00:15:03,990 --> 00:15:02,959
every day working on some sort of

382
00:15:08,310 --> 00:15:04,000
research

383
00:15:10,310 --> 00:15:08,320
of the international space station

384
00:15:11,910 --> 00:15:10,320
we're doing research up there

385
00:15:13,430 --> 00:15:11,920
finding things out that we just can't in

386
00:15:16,069 --> 00:15:13,440
the gravity of earth

387
00:15:18,629 --> 00:15:16,079
and a lot of that can benefit

388
00:15:19,590 --> 00:15:18,639

life on earth for us but a lot of it is

389
00:15:20,949 --> 00:15:19,600
for

390
00:15:23,910 --> 00:15:20,959
extending

391
00:15:25,430 --> 00:15:23,920
our reach into the solar system

392
00:15:27,030 --> 00:15:25,440
and

393
00:15:29,030 --> 00:15:27,040
the space station is not only being used

394
00:15:31,750 --> 00:15:29,040
for science right now just as a matter

395
00:15:33,750 --> 00:15:31,760
of its existence it's being used as a

396
00:15:35,829 --> 00:15:33,760
technology testbed

397
00:15:37,910 --> 00:15:35,839
we're looking at life support systems

398
00:15:39,509 --> 00:15:37,920
power systems and those sort of things

399
00:15:42,150 --> 00:15:39,519
that we're going to need

400
00:15:43,590 --> 00:15:42,160
when we send the human our human race

401
00:15:45,430 --> 00:15:43,600
further away

402
00:15:46,870 --> 00:15:45,440
and low earth orbits a great place to do

403
00:15:49,990 --> 00:15:46,880
that because we have cargo vehicles

404
00:15:52,389 --> 00:15:50,000
coming up that can send spares we have

405
00:15:54,150 --> 00:15:52,399
an access to get home immediately if we

406
00:15:55,990 --> 00:15:54,160
need to but once we go further away

407
00:15:58,310 --> 00:15:56,000
we're not going to have that so we need

408
00:16:00,230 --> 00:15:58,320
this test bed

409
00:16:01,829 --> 00:16:00,240
to to study these things and make sure

410
00:16:04,230 --> 00:16:01,839
that we're doing it right before we

411
00:16:06,470 --> 00:16:04,240
actually go

412
00:16:08,550 --> 00:16:06,480
i'm pretty excited to hear about

413
00:16:11,350 --> 00:16:08,560

possibly expanding extending the life of

414
00:16:12,949 --> 00:16:11,360
the space station until 2024. i mean

415
00:16:14,629 --> 00:16:12,959
as astronauts we're really excited about

416
00:16:16,550 --> 00:16:14,639
that for one that means we get more

417
00:16:18,550 --> 00:16:16,560
trips into space

418
00:16:21,269 --> 00:16:18,560
for another it's just a great

419
00:16:23,350 --> 00:16:21,279
opportunity to continue learning more

420
00:16:25,110 --> 00:16:23,360
while we have that amazing facility

421
00:16:26,310 --> 00:16:25,120
there to do that

422
00:16:27,990 --> 00:16:26,320
around the nation right now we're

423
00:16:30,069 --> 00:16:28,000
actually working on getting the

424
00:16:31,990 --> 00:16:30,079
commercial sector involved and during

425
00:16:33,990 --> 00:16:32,000
our mission we were pretty fortunate we

426
00:16:35,590 --> 00:16:34,000
had the first demonstration mission of

427
00:16:36,550 --> 00:16:35,600
the orbital sciences cargo vehicle

428
00:16:39,110 --> 00:16:36,560
cygnus

429
00:16:41,670 --> 00:16:39,120
and uh my colleague luca parmitano from

430
00:16:44,790 --> 00:16:41,680
esa captured that with the robotic arm

431
00:16:46,710 --> 00:16:44,800
and we brought it on board and

432
00:16:49,189 --> 00:16:46,720
pretty amazing to see that and we have a

433
00:16:50,949 --> 00:16:49,199
spacex launch coming up within the week

434
00:16:52,470 --> 00:16:50,959
so we're seeing the commercial sector

435
00:16:54,069 --> 00:16:52,480
get involved and that's going to

436
00:16:55,749 --> 00:16:54,079
continue

437
00:16:58,389 --> 00:16:55,759
again as astronauts we're pretty excited

438
00:17:00,710 --> 00:16:58,399

about the potential of again

439
00:17:03,110 --> 00:17:00,720
launching humans from american soil

440
00:17:04,789 --> 00:17:03,120
so we're very excited about everything

441
00:17:06,630 --> 00:17:04,799
that's going on and the work that's

442
00:17:08,549 --> 00:17:06,640
being done around the nation and i know

443
00:17:10,630 --> 00:17:08,559
everybody here at nasa is extremely

444
00:17:13,029 --> 00:17:10,640
excited to

445
00:17:15,510 --> 00:17:13,039
hear your ideas on how we can go forward

446
00:17:18,630 --> 00:17:15,520
with the asteroid initiative with the

447
00:17:19,829 --> 00:17:18,640
ultimate goal of taking us the world

448
00:17:22,069 --> 00:17:19,839
population

449
00:17:29,830 --> 00:17:22,079
further further into the solar system

450
00:17:33,750 --> 00:17:31,669
like to ask our first panel to go ahead

451
00:17:35,029 --> 00:17:33,760
and start to get situated

452
00:17:37,430 --> 00:17:35,039
um again you can find out more

453
00:17:38,870 --> 00:17:37,440
information about uh what with the nasa

454
00:17:40,230 --> 00:17:38,880
administrator charlie bolden talked

455
00:17:42,789 --> 00:17:40,240
about in the asteroid initiative at

456
00:17:44,070 --> 00:17:42,799
www.nasa.gov

457
00:17:45,430 --> 00:17:44,080
asteroid initiative and really

458
00:17:48,870 --> 00:17:45,440
appreciate the reminder from astronaut

459
00:17:51,510 --> 00:17:48,880
karen nyberg that you know we have

460
00:17:53,270 --> 00:17:51,520
an orbital laboratory um unlike any

461
00:17:55,350 --> 00:17:53,280
other where research is happening that

462
00:17:56,470 --> 00:17:55,360
can't be done on earth 260 miles above

463
00:17:58,230 --> 00:17:56,480

our heads right now and you can find out

464
00:18:01,590 --> 00:17:58,240
more information about that research at

465
00:18:04,789 --> 00:18:01,600
nasa.gov station uh our first panel is

466
00:18:06,950 --> 00:18:04,799
uh here to tell us uh more about the

467
00:18:09,350 --> 00:18:06,960
asteroid redirect mission and i'd like

468
00:18:10,950 --> 00:18:09,360
to introduce our uh panel's moderator

469
00:18:13,029 --> 00:18:10,960
michelle gates who is senior technical

470
00:18:17,909 --> 00:18:13,039
advisor the human exploration operations

471
00:18:22,390 --> 00:18:20,150
thanks trent

472
00:18:24,789 --> 00:18:22,400
good afternoon it's an honor to be here

473
00:18:28,390 --> 00:18:24,799
with you all to share some updates on

474
00:18:30,230 --> 00:18:28,400
our internal mission concept work

475
00:18:31,990 --> 00:18:30,240
it's good to see you all since the last

476
00:18:33,669 --> 00:18:32,000
time we got together with the community

477
00:18:35,669 --> 00:18:33,679
back in november

478
00:18:37,669 --> 00:18:35,679
and the last time in this room actually

479
00:18:39,590 --> 00:18:37,679
in june of last year

480
00:18:42,870 --> 00:18:39,600
i'd like to just briefly introduced our

481
00:18:44,630 --> 00:18:42,880
esteemed colleagues on the panel today

482
00:18:46,549 --> 00:18:44,640
the first one to speak will be lynley

483
00:18:49,029 --> 00:18:46,559
johnson who has been leading our

484
00:18:51,350 --> 00:18:49,039
asteroid observation activity

485
00:18:53,830 --> 00:18:51,360
brian muirhead has been leading the

486
00:18:56,630 --> 00:18:53,840
development of a robotic mission concept

487
00:18:58,230 --> 00:18:56,640
to redirect a small nia to a stable

488
00:18:59,750 --> 00:18:58,240

lunar orbit

489
00:19:01,190 --> 00:18:59,760
dan masnick

490
00:19:03,909 --> 00:19:01,200
has been leading the development of

491
00:19:05,350 --> 00:19:03,919
another concept involving a larger nia

492
00:19:07,029 --> 00:19:05,360
to the same

493
00:19:09,350 --> 00:19:07,039
stable lunar orbit

494
00:19:11,350 --> 00:19:09,360
actually a boulder from the neo

495
00:19:13,750 --> 00:19:11,360
jim ryder has been leading our robotic

496
00:19:15,990 --> 00:19:13,760
concept integration team

497
00:19:19,029 --> 00:19:16,000
and steve stitch has been leading the

498
00:19:20,710 --> 00:19:19,039
crude mission concept and jason crusade

499
00:19:22,390 --> 00:19:20,720
on the end will share with us how this

500
00:19:23,590 --> 00:19:22,400
all fits into the broader human

501
00:19:25,430 --> 00:19:23,600
spaceflight

502
00:19:34,630 --> 00:19:25,440
framework

503
00:19:38,390 --> 00:19:36,390
thank you i just wanted to kick off the

504
00:19:40,230 --> 00:19:38,400
panel today with a reminder

505
00:19:42,310 --> 00:19:40,240
of the preliminary mission objectives

506
00:19:45,029 --> 00:19:42,320
that we shared back in the november idea

507
00:19:47,430 --> 00:19:45,039
synthesis meeting this is the set of

508
00:19:48,390 --> 00:19:47,440
overall mission objectives against which

509
00:19:52,630 --> 00:19:48,400
the

510
00:19:54,470 --> 00:19:52,640
comparative analysis that you'll see jim

511
00:19:56,150 --> 00:19:54,480
present

512
00:19:58,150 --> 00:19:56,160
you might remember there's a set of

513
00:20:01,029 --> 00:19:58,160

primary objectives involving human

514
00:20:03,830 --> 00:20:01,039
exploration technology demonstration and

515
00:20:05,350 --> 00:20:03,840
neo observation and then we had a set of

516
00:20:09,350 --> 00:20:05,360
secondary

517
00:20:11,510 --> 00:20:09,360
objectives as well next slide

518
00:20:12,950 --> 00:20:11,520
our internal studies

519
00:20:15,350 --> 00:20:12,960
that will share the results with you

520
00:20:17,590 --> 00:20:15,360
today included the reference robotic

521
00:20:18,630 --> 00:20:17,600
mission that brian muirhead will be

522
00:20:21,029 --> 00:20:18,640
sharing

523
00:20:22,789 --> 00:20:21,039
another concept involving a larger nia

524
00:20:23,990 --> 00:20:22,799
that dan masnick will be speaking with

525
00:20:25,990 --> 00:20:24,000
you about

526
00:20:27,110 --> 00:20:26,000
steve stitch we'll talk about the crude

527
00:20:28,789 --> 00:20:27,120
mission

528
00:20:30,310 --> 00:20:28,799
uh and then the robotic concept

529
00:20:32,789 --> 00:20:30,320
integration team's comparative

530
00:20:34,630 --> 00:20:32,799
assessment

531
00:20:37,029 --> 00:20:34,640
next slide

532
00:20:38,310 --> 00:20:37,039
as a result of the work that we'll share

533
00:20:39,909 --> 00:20:38,320
with you today

534
00:20:41,750 --> 00:20:39,919
we have consolidated the mission

535
00:20:43,270 --> 00:20:41,760
objectives into the set that you see on

536
00:20:44,549 --> 00:20:43,280
the screen now

537
00:20:46,549 --> 00:20:44,559
you'll be able to find this on the

538
00:20:48,789 --> 00:20:46,559

internet and on the asteroid initiative

539
00:20:51,110 --> 00:20:48,799
website as well but you'll see that we

540
00:20:53,110 --> 00:20:51,120
have included basic planetary defense

541
00:20:54,390 --> 00:20:53,120
demonstration techniques

542
00:20:56,950 --> 00:20:54,400
in the

543
00:20:59,909 --> 00:20:56,960
overall single set of mission objectives

544
00:21:01,190 --> 00:20:59,919
as well as targets of opportunity to

545
00:21:04,710 --> 00:21:01,200
benefit both

546
00:21:07,430 --> 00:21:04,720
scientific and partnership interests

547
00:21:09,430 --> 00:21:07,440
and that's all reflected in the

548
00:21:10,789 --> 00:21:09,440
baa that chris chris will talk about in

549
00:21:12,870 --> 00:21:10,799
the next panel

550
00:21:14,630 --> 00:21:12,880
next slide

551
00:21:16,390 --> 00:21:14,640
just a brief summary

552
00:21:18,149 --> 00:21:16,400
of all the work we've done since we got

553
00:21:20,470 --> 00:21:18,159
together last you'll see

554
00:21:21,430 --> 00:21:20,480
on here the kickoff of the integration

555
00:21:25,270 --> 00:21:21,440
team

556
00:21:26,630 --> 00:21:25,280
that same time frame

557
00:21:28,549 --> 00:21:26,640
we have been working with through

558
00:21:31,190 --> 00:21:28,559
tasking requests some members of the

559
00:21:33,270 --> 00:21:31,200
internet of the external community such

560
00:21:35,510 --> 00:21:33,280
as the aspag and the captain

561
00:21:38,149 --> 00:21:35,520
on special studies

562
00:21:39,830 --> 00:21:38,159
continued spitzer observations

563
00:21:42,070 --> 00:21:39,840

you'll see some work

564
00:21:44,070 --> 00:21:42,080
internally in our technology development

565
00:21:46,470 --> 00:21:44,080
activity that's to be completed this

566
00:21:48,390 --> 00:21:46,480
late spring and summer

567
00:21:50,950 --> 00:21:48,400
evolving into

568
00:21:53,190 --> 00:21:50,960
the input from the baas

569
00:21:57,590 --> 00:21:53,200
and our mission concept review

570
00:22:01,510 --> 00:21:59,830
so uh lindley if you'd like to kick

571
00:22:05,750 --> 00:22:01,520
every if you'd like to get started that

572
00:22:09,430 --> 00:22:07,990
i'm just going to give you a brief uh

573
00:22:11,750 --> 00:22:09,440
status on where we are with the

574
00:22:14,710 --> 00:22:11,760
observation uh segment observation

575
00:22:16,549 --> 00:22:14,720
campaign for finding uh candidates uh

576
00:22:18,390 --> 00:22:16,559
for the armed mission if i could have

577
00:22:19,350 --> 00:22:18,400
the next slide

578
00:22:22,549 --> 00:22:19,360
in

579
00:22:24,549 --> 00:22:22,559
2013 uh this is the

580
00:22:26,390 --> 00:22:24,559
year that we've reached some milestones

581
00:22:28,230 --> 00:22:26,400
with nasa's near earth object

582
00:22:30,230 --> 00:22:28,240
observation program

583
00:22:33,110 --> 00:22:30,240
first of all we

584
00:22:34,549 --> 00:22:33,120
exceeded having found 10 000 near-earth

585
00:22:36,950 --> 00:22:34,559
objects

586
00:22:38,950 --> 00:22:36,960
those are asteroids that are in orbits

587
00:22:41,830 --> 00:22:38,960
that can approach earth

588
00:22:44,630 --> 00:22:41,840

earth's orbit and we also

589
00:22:47,430 --> 00:22:44,640
found more than one thousand neos in a

590
00:22:48,870 --> 00:22:47,440
single year so our capabilities are

591
00:22:50,070 --> 00:22:48,880
really

592
00:22:52,630 --> 00:22:50,080
improving

593
00:22:54,789 --> 00:22:52,640
and accelerating in this area

594
00:22:58,549 --> 00:22:54,799
here you see a breakdown of the

595
00:22:59,350 --> 00:22:58,559
various search teams and uh how much of

596
00:23:03,270 --> 00:22:59,360
that

597
00:23:04,310 --> 00:23:03,280
our leading search team is catalina sky

598
00:23:07,110 --> 00:23:04,320
survey

599
00:23:09,669 --> 00:23:07,120
now these uh search teams uh the

600
00:23:12,630 --> 00:23:09,679
capabilities that uh looking at

601
00:23:14,390 --> 00:23:12,640
they're able to search a thousand

602
00:23:16,310 --> 00:23:14,400
square degrees of sky

603
00:23:18,549 --> 00:23:16,320
down to very dim

604
00:23:21,430 --> 00:23:18,559
sized objects for the techno geeks here

605
00:23:22,870 --> 00:23:21,440
down to about 21st magnitude

606
00:23:24,950 --> 00:23:22,880
so those are the kind of capabilities

607
00:23:27,990 --> 00:23:24,960
that we need in the search is being able

608
00:23:31,510 --> 00:23:28,000
to search a broad area of the sky uh

609
00:23:33,110 --> 00:23:31,520
very uh deeply or dimly

610
00:23:35,270 --> 00:23:33,120
some of our other teams are kind of in

611
00:23:37,510 --> 00:23:35,280
period transition here because we are

612
00:23:38,630 --> 00:23:37,520
enhancing their capabilities uh linear

613
00:23:40,310 --> 00:23:38,640

is converting over to the space

614
00:23:42,149 --> 00:23:40,320
surveillance telescope

615
00:23:44,950 --> 00:23:42,159
uh space watch although it's no longer

616
00:23:47,190 --> 00:23:44,960
doing search as does follow-up force

617
00:23:49,430 --> 00:23:47,200
actually finds uh several objects while

618
00:23:52,630 --> 00:23:49,440
it's doing that and then we reactivated

619
00:23:55,750 --> 00:23:52,640
the y spacecraft uh dedicated to ineo

620
00:23:59,029 --> 00:23:55,760
search uh re uh named it uh neowise and

621
00:24:01,110 --> 00:23:59,039
it just started work uh in december

622
00:24:02,870 --> 00:24:01,120
uh of those thousand objects we found in

623
00:24:05,029 --> 00:24:02,880
last year eleven of them are greater

624
00:24:05,909 --> 00:24:05,039
than a kilometer in size

625
00:24:07,909 --> 00:24:05,919
but

626
00:24:09,510 --> 00:24:07,919
this is rate is down quite a bit from

627
00:24:11,510 --> 00:24:09,520
what it has been in previous years which

628
00:24:13,909 --> 00:24:11,520
indicates that uh we're getting a good

629
00:24:16,470 --> 00:24:13,919
handle on that population and our models

630
00:24:19,830 --> 00:24:16,480
show that we found about 97 percent

631
00:24:22,390 --> 00:24:19,840
one kilometer and larger neos now

632
00:24:24,230 --> 00:24:22,400
73 of those objects uh that we found are

633
00:24:26,070 --> 00:24:24,240
in orbits uh that are potentially

634
00:24:27,830 --> 00:24:26,080
hazardous to earth

635
00:24:29,750 --> 00:24:27,840
they come close enough to earth's orbit

636
00:24:33,029 --> 00:24:29,760
that we should monitor them

637
00:24:35,590 --> 00:24:33,039
uh 36 are in orbits uh subset of those

638
00:24:37,590 --> 00:24:35,600

73 they're in orbits that are reachable

639
00:24:38,950 --> 00:24:37,600
by spacecraft uh

640
00:24:42,070 --> 00:24:38,960
using the

641
00:24:43,830 --> 00:24:42,080
uh threshold their round trip uh delta v

642
00:24:47,190 --> 00:24:43,840
change in velocity of less than eight

643
00:24:49,350 --> 00:24:47,200
kilometers per second so those are a

644
00:24:52,230 --> 00:24:49,360
list of candidates that we

645
00:24:54,070 --> 00:24:52,240
then look at as candidates for

646
00:24:56,470 --> 00:24:54,080
the armed mission

647
00:24:58,630 --> 00:24:56,480
but only 20

648
00:24:59,510 --> 00:24:58,640
of those 20

649
00:25:01,350 --> 00:24:59,520
are

650
00:25:02,710 --> 00:25:01,360
available in the next 10 years which is

651
00:25:03,590 --> 00:25:02,720
the time frame we're looking at for this

652
00:25:06,870 --> 00:25:03,600
mission

653
00:25:08,230 --> 00:25:06,880
of that 28 are estimated to be small

654
00:25:10,630 --> 00:25:08,240
enough

655
00:25:11,430 --> 00:25:10,640
to talk about for the reference mission

656
00:25:13,110 --> 00:25:11,440
but

657
00:25:14,710 --> 00:25:13,120
we need to be able to characterize those

658
00:25:16,070 --> 00:25:14,720
and really understand what the sizes are

659
00:25:18,230 --> 00:25:16,080
and what the masses are and it's a bit

660
00:25:19,750 --> 00:25:18,240
of a challenge to do from from

661
00:25:22,230 --> 00:25:19,760
ground-based

662
00:25:23,830 --> 00:25:22,240
systems because the access to them is is

663
00:25:27,029 --> 00:25:23,840

somewhat limited

664
00:25:28,950 --> 00:25:27,039
also of that 29

665
00:25:31,029 --> 00:25:28,960
might make good candidates for the

666
00:25:33,110 --> 00:25:31,039
alternate mission and boulder retrieval

667
00:25:34,070 --> 00:25:33,120
but we've only been able to characterize

668
00:25:35,590 --> 00:25:34,080
uh

669
00:25:36,950 --> 00:25:35,600
only be able to characterize two of

670
00:25:38,870 --> 00:25:36,960
those uh

671
00:25:41,110 --> 00:25:38,880
in the future in time for the mission

672
00:25:43,590 --> 00:25:41,120
with our ground-based assets

673
00:25:46,789 --> 00:25:43,600
uh next slide

674
00:25:49,110 --> 00:25:46,799
uh so uh in looking at uh one of the

675
00:25:51,430 --> 00:25:49,120
challenges uh for the observation

676
00:25:53,029 --> 00:25:51,440
segment it is characterization uh we are

677
00:25:54,470 --> 00:25:53,039
doing some improvements and enhancements

678
00:25:56,070 --> 00:25:54,480
of that capability

679
00:25:57,990 --> 00:25:56,080
uh these are the capabilities we largely

680
00:25:59,430 --> 00:25:58,000
used to do that if the object is

681
00:26:01,350 --> 00:25:59,440
accessible

682
00:26:03,269 --> 00:26:01,360
through our planetary radar

683
00:26:04,950 --> 00:26:03,279
uh we certainly want to use that that's

684
00:26:07,430 --> 00:26:04,960
the next best thing to having a flyby

685
00:26:10,950 --> 00:26:07,440
spacecraft is being able to do

686
00:26:13,190 --> 00:26:10,960
radar imaging of the objects we also use

687
00:26:14,710 --> 00:26:13,200
our infrared telescope facility

688
00:26:16,789 --> 00:26:14,720

out in hawaii

689
00:26:18,549 --> 00:26:16,799
we have both those

690
00:26:20,549 --> 00:26:18,559
all three of those facilities two radars

691
00:26:23,269 --> 00:26:20,559
and the infrared on rapid response when

692
00:26:25,350 --> 00:26:23,279
we discover object we quickly pass that

693
00:26:26,870 --> 00:26:25,360
data to these facilities so that they

694
00:26:28,549 --> 00:26:26,880
can take the kind of observations that

695
00:26:30,470 --> 00:26:28,559
we need

696
00:26:32,950 --> 00:26:30,480
for doing the characterization so we're

697
00:26:35,029 --> 00:26:32,960
increasing the call up rapid response

698
00:26:36,070 --> 00:26:35,039
for those capabilities

699
00:26:38,230 --> 00:26:36,080
and then

700
00:26:40,789 --> 00:26:38,240
where it has the opportunity we also use

701
00:26:43,669 --> 00:26:40,799
the switcher taste space telescope to

702
00:26:45,430 --> 00:26:43,679
determine size and mass of these objects

703
00:26:46,630 --> 00:26:45,440
based on the thermal

704
00:26:49,430 --> 00:26:46,640
signature

705
00:26:50,390 --> 00:26:49,440
and as michelle mentioned in our list

706
00:26:52,470 --> 00:26:50,400
we've

707
00:26:54,470 --> 00:26:52,480
been using the spitcher space telescope

708
00:26:55,909 --> 00:26:54,480
to take a look at one object that is of

709
00:26:57,830 --> 00:26:55,919
interest

710
00:27:00,070 --> 00:26:57,840
2011 md

711
00:27:01,510 --> 00:27:00,080
we have those observations uh being

712
00:27:03,750 --> 00:27:01,520
analyzed now and we should have some

713
00:27:09,669 --> 00:27:03,760

information here in the next month about

714
00:27:14,549 --> 00:27:13,350
the observation segment in our work here

715
00:27:17,510 --> 00:27:14,559
is

716
00:27:19,029 --> 00:27:17,520
not part of the broad area

717
00:27:20,870 --> 00:27:19,039
opportunity

718
00:27:23,269 --> 00:27:20,880
that we're talking about mostly here and

719
00:27:25,029 --> 00:27:23,279
that's because of the next slide

720
00:27:27,990 --> 00:27:25,039
we have a

721
00:27:30,950 --> 00:27:28,000
solicitation opportunity for proposals

722
00:27:33,350 --> 00:27:30,960
on a yearly basis as part of

723
00:27:35,350 --> 00:27:33,360
nasa's research opportunities in space

724
00:27:37,029 --> 00:27:35,360
and earth sciences the near-earth object

725
00:27:40,230 --> 00:27:37,039
observation program

726
00:27:41,990 --> 00:27:40,240
solicits ideas

727
00:27:44,950 --> 00:27:42,000
for work

728
00:27:48,149 --> 00:27:44,960
in the neo program every year

729
00:27:50,310 --> 00:27:48,159
this year that omnibus solicitation was

730
00:27:52,230 --> 00:27:50,320
released in february 18th uh it's a

731
00:27:54,950 --> 00:27:52,240
component of our overall solar system

732
00:27:56,789 --> 00:27:54,960
observations program and you can see all

733
00:27:58,389 --> 00:27:56,799
the information about the solicitation

734
00:28:01,669 --> 00:27:58,399
at that website

735
00:28:03,350 --> 00:28:01,679
uh the step one notices are due

736
00:28:05,830 --> 00:28:03,360
in just a couple of weeks

737
00:28:06,950 --> 00:28:05,840
and notices of a tent proposals are due

738
00:28:08,630 --> 00:28:06,960

in june

739
00:28:09,990 --> 00:28:08,640
and then they'll be re peer reviewed

740
00:28:12,870 --> 00:28:10,000
later in the

741
00:28:15,510 --> 00:28:12,880
summer and we'll announce new awards

742
00:28:17,590 --> 00:28:15,520
to the program when the 2015 budget

743
00:28:19,990 --> 00:28:17,600
becomes available

744
00:28:22,549 --> 00:28:20,000
and thank you

745
00:28:23,990 --> 00:28:22,559
thanks lindley brian

746
00:28:25,430 --> 00:28:24,000
i'm going to give you a very quick

747
00:28:26,870 --> 00:28:25,440
overview of the

748
00:28:28,789 --> 00:28:26,880
what we call the reference mission this

749
00:28:30,789 --> 00:28:28,799
is a body of work that nasa has been

750
00:28:33,430 --> 00:28:30,799
doing cross-agency for a little over a

751
00:28:35,190 --> 00:28:33,440
year now next chart please

752
00:28:36,950 --> 00:28:35,200
so with respect to meeting the primary

753
00:28:38,710 --> 00:28:36,960
objectives the reference mission has

754
00:28:40,310 --> 00:28:38,720
been focusing on an architecture a

755
00:28:42,549 --> 00:28:40,320
mission design and a flight system that

756
00:28:44,149 --> 00:28:42,559
can deliver the following things a high

757
00:28:45,750 --> 00:28:44,159
performance solar electric propulsion

758
00:28:48,149 --> 00:28:45,760
system much larger than anything that's

759
00:28:49,590 --> 00:28:48,159
been flown in space up to this time

760
00:28:51,750 --> 00:28:49,600
uh something that would be applicable

761
00:28:55,110 --> 00:28:51,760
and expandable to human exploration

762
00:28:56,630 --> 00:28:55,120
beyond leo with a number of applications

763
00:28:59,190 --> 00:28:56,640

the capability to rendezvous with

764
00:29:01,590 --> 00:28:59,200
characterize operate and operate in

765
00:29:03,750 --> 00:29:01,600
close proximity to an asteroid a

766
00:29:07,269 --> 00:29:03,760
near-earth asteroid the capability to

767
00:29:08,950 --> 00:29:07,279
capture to control this asteroid and of

768
00:29:11,430 --> 00:29:08,960
a size of the order of 10 meters and

769
00:29:13,830 --> 00:29:11,440
potentially as much as a thousand tons

770
00:29:15,590 --> 00:29:13,840
tons not kilograms the capability to

771
00:29:17,909 --> 00:29:15,600
accommodate a wide range of alternate

772
00:29:19,350 --> 00:29:17,919
missions daniel talked about that more

773
00:29:21,909 --> 00:29:19,360
including other mission concepts

774
00:29:24,070 --> 00:29:21,919
including emissions maybe even to phobos

775
00:29:26,389 --> 00:29:24,080
in addition to capturing them we also

776
00:29:28,630 --> 00:29:26,399
need to control and return this asteroid

777
00:29:29,750 --> 00:29:28,640
to a stable orbit that is crew

778
00:29:31,750 --> 00:29:29,760
accessible

779
00:29:33,669 --> 00:29:31,760
and we've chosen a near-earth

780
00:29:35,430 --> 00:29:33,679
lunar distant retrograde orbit to do

781
00:29:36,950 --> 00:29:35,440
that and all of this needs to be done in

782
00:29:38,549 --> 00:29:36,960
the context of what we call lean

783
00:29:40,310 --> 00:29:38,559
development which we're working to a

784
00:29:43,750 --> 00:29:40,320
cost driven paradigm with acceptable

785
00:29:45,350 --> 00:29:43,760
cost risk and technical risk next chart

786
00:29:47,430 --> 00:29:45,360
with respect to the secondary objectives

787
00:29:48,630 --> 00:29:47,440
again the architecture is addresses all

788
00:29:50,549 --> 00:29:48,640

of these

789
00:29:52,149 --> 00:29:50,559
we've found that the solar electric

790
00:29:53,510 --> 00:29:52,159
propulsion system is capable of

791
00:29:55,669 --> 00:29:53,520
delivering

792
00:29:58,710 --> 00:29:55,679
solutions for what we call ion beam

793
00:30:00,630 --> 00:29:58,720
deflection or gravity tractor which can

794
00:30:03,110 --> 00:30:00,640
be part of a precise

795
00:30:06,149 --> 00:30:03,120
remaneuvering

796
00:30:08,470 --> 00:30:06,159
trajectory correction shall we say of a

797
00:30:10,549 --> 00:30:08,480
hazardous asteroid from a science point

798
00:30:12,389 --> 00:30:10,559
of view visiting or bringing back a

799
00:30:14,230 --> 00:30:12,399
whole small asteroid represents an

800
00:30:15,990 --> 00:30:14,240
opportunity to understand the structure

801
00:30:17,750 --> 00:30:16,000
and bulk properties of an asteroid

802
00:30:19,269 --> 00:30:17,760
something that's never been done before

803
00:30:21,190 --> 00:30:19,279
we also don't know what kind of neo we

804
00:30:22,389 --> 00:30:21,200
will actually get for sure and so

805
00:30:23,750 --> 00:30:22,399
there'll be some great science

806
00:30:25,510 --> 00:30:23,760
opportunities just associated with the

807
00:30:26,710 --> 00:30:25,520
type of asteroid we retrieve

808
00:30:31,110 --> 00:30:26,720
from a commercial

809
00:30:32,630 --> 00:30:31,120
solar echo propulsion system has great a

810
00:30:34,389 --> 00:30:32,640
great number of opportunities both at

811
00:30:36,389 --> 00:30:34,399
the component level maybe at the system

812
00:30:38,310 --> 00:30:36,399
level and there's another unique

813
00:30:41,590 --> 00:30:38,320

application of the using the ion

814
00:30:43,909 --> 00:30:41,600
thrusters for potentially changing the

815
00:30:45,750 --> 00:30:43,919
orbit of orbital debris and and helping

816
00:30:47,510 --> 00:30:45,760
mitigate that challenge

817
00:30:48,870 --> 00:30:47,520
we can also demonstrate fundamentally we

818
00:30:51,590 --> 00:30:48,880
will demonstrate the ability to bring

819
00:30:53,590 --> 00:30:51,600
back to a crew accessible location 100

820
00:30:54,870 --> 00:30:53,600
potentially hundreds of tons of material

821
00:30:57,510 --> 00:30:54,880
much more than we're actually able to

822
00:30:59,110 --> 00:30:57,520
launch and finally we'll make available

823
00:31:01,590 --> 00:30:59,120
on our spacecraft if the opportunity

824
00:31:03,269 --> 00:31:01,600
presents itself uh assets that

825
00:31:05,110 --> 00:31:03,279
partners commercial or international

826
00:31:06,310 --> 00:31:05,120
could take advantage of next chart

827
00:31:08,149 --> 00:31:06,320
please

828
00:31:10,710 --> 00:31:08,159
this is the basic mission overview very

829
00:31:12,950 --> 00:31:10,720
quickly we can launch on any of four

830
00:31:15,190 --> 00:31:12,960
launch vehicles from the atlas falcon

831
00:31:16,630 --> 00:31:15,200
delta iv or sls

832
00:31:19,909 --> 00:31:16,640
depending on which one we either go

833
00:31:21,350 --> 00:31:19,919
direct or we do a spiral out

834
00:31:22,549 --> 00:31:21,360
then we fly to the asteroid we

835
00:31:23,990 --> 00:31:22,559
rendezvous with the asteroid i'll

836
00:31:26,310 --> 00:31:24,000
describe that a little bit more we

837
00:31:30,630 --> 00:31:26,320
capture it and then we maneuver it back

838
00:31:33,029 --> 00:31:30,640

to uh we adjust its trajectory slightly

839
00:31:35,430 --> 00:31:33,039
in order to align it for a

840
00:31:37,669 --> 00:31:35,440
lunar orbit a lunar gravity assist and

841
00:31:39,029 --> 00:31:37,679
then we sling it into a district

842
00:31:41,110 --> 00:31:39,039
retrograde orbit

843
00:31:45,029 --> 00:31:41,120
next chart all of that is on the order

844
00:31:46,470 --> 00:31:45,039
of a five-year cycle and again the

845
00:31:48,389 --> 00:31:46,480
it's important to recognize that what

846
00:31:50,630 --> 00:31:48,399
we're doing is just slightly adjusting

847
00:31:52,789 --> 00:31:50,640
the natural trajectory or orbit i should

848
00:31:54,549 --> 00:31:52,799
say of the body in order to align it

849
00:31:55,990 --> 00:31:54,559
with the moon and allow us to do that

850
00:31:57,909 --> 00:31:56,000
gravity assist

851
00:32:00,710 --> 00:31:57,919
here's a set of five asteroids that

852
00:32:04,149 --> 00:32:00,720
lindley's team has has found for us

853
00:32:06,310 --> 00:32:04,159
first one is what we call 2009 bd we've

854
00:32:08,630 --> 00:32:06,320
determined this is a valid target this

855
00:32:11,110 --> 00:32:08,640
is one that we can bring back we can put

856
00:32:13,190 --> 00:32:11,120
into orbit with our existing system it's

857
00:32:15,430 --> 00:32:13,200
a slow rotator and it can be brought

858
00:32:18,789 --> 00:32:15,440
back in the time frame in the uh late

859
00:32:21,430 --> 00:32:18,799
2023 or early 2024. only mentioned 2011

860
00:32:23,350 --> 00:32:21,440
md which may be a potential uh target

861
00:32:26,230 --> 00:32:23,360
both of which have been evaluated by

862
00:32:28,710 --> 00:32:26,240
spitzer and uh we're awaiting the uh the

863
00:32:30,149 --> 00:32:28,720

final results on 2011 md

864
00:32:32,870 --> 00:32:30,159
there's other asteroids in the future

865
00:32:36,149 --> 00:32:32,880
and we're expecting the neo program to

866
00:32:37,750 --> 00:32:36,159
find many more targets for us and we're

867
00:32:38,710 --> 00:32:37,760
constantly we're looking on a daily

868
00:32:40,389 --> 00:32:38,720
basis

869
00:32:42,710 --> 00:32:40,399
next chart

870
00:32:44,870 --> 00:32:42,720
this is this shows how the launch date

871
00:32:45,830 --> 00:32:44,880
changes as a function of the mass of the

872
00:32:48,470 --> 00:32:45,840
target

873
00:32:51,669 --> 00:32:48,480
so in this case we drew a line for 2009

874
00:32:55,509 --> 00:32:51,679
bd at about 145 tons and you can see

875
00:32:57,509 --> 00:32:55,519
that we can launch in june of 2019 on

876
00:33:00,389 --> 00:32:57,519
any of these four launch vehicles and

877
00:33:01,830 --> 00:33:00,399
out as late as december of 2020 with our

878
00:33:03,909 --> 00:33:01,840
higher performance heavy lift launch

879
00:33:05,990 --> 00:33:03,919
vehicle so it gives us some flexibility

880
00:33:08,310 --> 00:33:06,000
on the on the launch window

881
00:33:10,630 --> 00:33:08,320
next chart

882
00:33:12,310 --> 00:33:10,640
uh just very quickly from an uh

883
00:33:14,710 --> 00:33:12,320
planetary defense demonstration point of

884
00:33:17,509 --> 00:33:14,720
view there's a couple of techniques that

885
00:33:19,269 --> 00:33:17,519
we can use ion beam or gravity tractor

886
00:33:21,430 --> 00:33:19,279
we've focused on uh what the

887
00:33:25,110 --> 00:33:21,440
capabilities of that can present in

888
00:33:27,750 --> 00:33:25,120

terms of changing the velocity of the

889
00:33:29,669 --> 00:33:27,760
of a small asteroid and it turns out we

890
00:33:31,269 --> 00:33:29,679
can very we can make quite a substantial

891
00:33:33,269 --> 00:33:31,279
change in the order of a millimeter per

892
00:33:35,269 --> 00:33:33,279
second very quickly uh with this

893
00:33:36,870 --> 00:33:35,279
technique for a small body and dan will

894
00:33:40,149 --> 00:33:36,880
talk more about what that means for a

895
00:33:41,590 --> 00:33:40,159
much larger body next chart

896
00:33:44,149 --> 00:33:41,600
with respect to the spacecraft what we

897
00:33:46,549 --> 00:33:44,159
call the asteroid redirect vehicle we've

898
00:33:49,590 --> 00:33:46,559
in order to develop a system that we

899
00:33:51,669 --> 00:33:49,600
think is very cost very can be

900
00:33:53,669 --> 00:33:51,679
implemented in a lean fashion it meets

901
00:33:55,590 --> 00:33:53,679
our cost constraint we've

902
00:33:57,590 --> 00:33:55,600
chosen a modular design where we have a

903
00:33:59,590 --> 00:33:57,600
capture system a mission module set

904
00:34:01,590 --> 00:33:59,600
module and all sitting on top of a

905
00:34:03,269 --> 00:34:01,600
launch vehicle adapter

906
00:34:05,830 --> 00:34:03,279
and each of these can be developed in

907
00:34:08,310 --> 00:34:05,840
parallel and the integration of which is

908
00:34:10,470 --> 00:34:08,320
we believe is relatively straightforward

909
00:34:12,230 --> 00:34:10,480
with the interfaces that we've designed

910
00:34:13,430 --> 00:34:12,240
so the capture system is a unique system

911
00:34:15,190 --> 00:34:13,440
and i'll describe that the mission

912
00:34:18,869 --> 00:34:15,200
module is very high heritage it's built

913
00:34:20,230 --> 00:34:18,879

on on the smap msl experience and the

914
00:34:22,629 --> 00:34:20,240
set module

915
00:34:24,310 --> 00:34:22,639
uses the stmd technologies associated

916
00:34:26,869 --> 00:34:24,320
with high power solar electric

917
00:34:28,470 --> 00:34:26,879
propulsion and hall thrusters

918
00:34:29,990 --> 00:34:28,480
next chart

919
00:34:32,829 --> 00:34:30,000
this just shows the configurations of

920
00:34:34,470 --> 00:34:32,839
the vehicles in the deployed state next

921
00:34:36,149 --> 00:34:34,480
chart

922
00:34:38,869 --> 00:34:36,159
now very quickly you know why did we end

923
00:34:40,550 --> 00:34:38,879
up with a bag uh the thinking here is

924
00:34:42,950 --> 00:34:40,560
that asteroids large asteroids are

925
00:34:44,629 --> 00:34:42,960
rubble piles we believe therefore it's

926
00:34:46,629 --> 00:34:44,639
highly likely that a small asteroid will

927
00:34:48,790 --> 00:34:46,639
also be a rubble pile so we've chosen

928
00:34:51,909 --> 00:34:48,800
this approach which is accommodates a

929
00:34:53,990 --> 00:34:51,919
potential variety of sizes and strengths

930
00:34:56,470 --> 00:34:54,000
associated with these bodies and the bag

931
00:34:58,470 --> 00:34:56,480
basically will protect us in the vehicle

932
00:34:59,910 --> 00:34:58,480
and the crew from something that may not

933
00:35:02,470 --> 00:34:59,920
be as strong as

934
00:35:04,069 --> 00:35:02,480
we anticipated well we've also adopted a

935
00:35:05,910 --> 00:35:04,079
strategy where we're looking primarily

936
00:35:08,230 --> 00:35:05,920
at slow rotators we had looked at fast

937
00:35:10,230 --> 00:35:08,240
rotators uh that represents a more

938
00:35:12,950 --> 00:35:10,240

complex problem but in the interest of

939
00:35:15,430 --> 00:35:12,960
of cost control and simplicity we've

940
00:35:17,589 --> 00:35:15,440
chosen to eliminate maybe 25 percent of

941
00:35:19,910 --> 00:35:17,599
the potential targets but so far our two

942
00:35:21,349 --> 00:35:19,920
primary targets are slow rotators next

943
00:35:23,670 --> 00:35:21,359
chart

944
00:35:25,349 --> 00:35:23,680
this is the basic uh sequence of events

945
00:35:28,150 --> 00:35:25,359
associated with rendezvous and proximity

946
00:35:30,950 --> 00:35:28,160
operations we use our

947
00:35:34,470 --> 00:35:30,960
narrow angle camera to do the rendezvous

948
00:35:36,950 --> 00:35:34,480
uh the final using optical techniques uh

949
00:35:40,630 --> 00:35:36,960
then we characterize with that then as

950
00:35:42,790 --> 00:35:40,640
we approach we start using our 3d lidar

951
00:35:44,390 --> 00:35:42,800
which helps us characterize the shape

952
00:35:46,790 --> 00:35:44,400
the size the rotation

953
00:35:48,470 --> 00:35:46,800
and then we initiate what we call the

954
00:35:51,109 --> 00:35:48,480
precapture activity where we deploy our

955
00:35:53,670 --> 00:35:51,119
airbag we do our approach all of this

956
00:35:56,230 --> 00:35:53,680
now under closed loop control associ

957
00:35:58,390 --> 00:35:56,240
with the the lidar system we then

958
00:36:00,230 --> 00:35:58,400
envelop the asteroid and in fact we

959
00:36:01,829 --> 00:36:00,240
think of it as docking we actually will

960
00:36:03,750 --> 00:36:01,839
fly the spacecraft to the surface of the

961
00:36:05,910 --> 00:36:03,760
asteroid and dock it and at that point

962
00:36:07,910 --> 00:36:05,920
we close the bag and we now have the bag

963
00:36:09,670 --> 00:36:07,920

in the spacecraft integrated and then we

964
00:36:12,150 --> 00:36:09,680
do our final characterization of what

965
00:36:14,150 --> 00:36:12,160
the mass properties are we spin down the

966
00:36:15,829 --> 00:36:14,160
asteroid and now we're ready to begin

967
00:36:17,829 --> 00:36:15,839
the flight back to earth

968
00:36:21,030 --> 00:36:17,839
or back to the moon back to cisco in

969
00:36:24,230 --> 00:36:21,040
space shall i say next chart

970
00:36:26,230 --> 00:36:24,240
the um all of this the

971
00:36:28,630 --> 00:36:26,240
sensing is critical to the

972
00:36:30,630 --> 00:36:28,640
implementation of the strategy uh we've

973
00:36:32,870 --> 00:36:30,640
adopted a strategy where we're using

974
00:36:35,190 --> 00:36:32,880
kind of the minimum sensor suite uh that

975
00:36:36,310 --> 00:36:35,200
is the simplest sweet uh simplest set of

976
00:36:38,710 --> 00:36:36,320
instruments we think they can do

977
00:36:40,230 --> 00:36:38,720
accomplish this job so we've baselined a

978
00:36:42,390 --> 00:36:40,240
narrow angle camera two narrow angle

979
00:36:44,790 --> 00:36:42,400
cameras that again do the rendezvous and

980
00:36:46,550 --> 00:36:44,800
initial characterization a 3d scanning

981
00:36:47,670 --> 00:36:46,560
lidar with a relatively large field of

982
00:36:49,190 --> 00:36:47,680
view because we're going to be

983
00:36:51,430 --> 00:36:49,200
approaching this asteroid and

984
00:36:53,190 --> 00:36:51,440
controlling with that device and then we

985
00:36:55,750 --> 00:36:53,200
have some wide angle cameras

986
00:36:57,829 --> 00:36:55,760
that provide engineering information and

987
00:36:59,670 --> 00:36:57,839
public outreach information uh we've

988
00:37:01,109 --> 00:36:59,680

also included a near infrared

989
00:37:03,670 --> 00:37:01,119
spectrometer which will help give us

990
00:37:05,670 --> 00:37:03,680
composition of the asteroid all of those

991
00:37:08,150 --> 00:37:05,680
are integrated into the assembly as you

992
00:37:11,030 --> 00:37:08,160
see in the figure on top of the is part

993
00:37:13,510 --> 00:37:11,040
of the capture system and um is part of

994
00:37:15,829 --> 00:37:13,520
the overall system so overall uh we've

995
00:37:17,670 --> 00:37:15,839
got a fundamental concept we think meets

996
00:37:20,069 --> 00:37:17,680
the primary and secondary objectives

997
00:37:21,910 --> 00:37:20,079
that nasa has set for us and uh does

998
00:37:23,349 --> 00:37:21,920
that within the cost constraint

999
00:37:26,550 --> 00:37:23,359
that we've been working to

1000
00:37:31,190 --> 00:37:29,829
thanks brian okay thanks michelle um my

1001
00:37:33,430 --> 00:37:31,200
name is dan masnick i'm from nasa

1002
00:37:34,630 --> 00:37:33,440
langley again and um i just first of all

1003
00:37:35,430 --> 00:37:34,640
want to say i've had the honor over the

1004
00:37:36,390 --> 00:37:35,440
past

1005
00:37:40,069 --> 00:37:36,400
six months

1006
00:37:42,470 --> 00:37:40,079
to uh to lead a very capable team um and

1007
00:37:44,150 --> 00:37:42,480
looking at this this mission concept um

1008
00:37:46,470 --> 00:37:44,160
close collaboration with goddard as well

1009
00:37:47,829 --> 00:37:46,480
as the other nasa centers and some

1010
00:37:49,030 --> 00:37:47,839
academic uh

1011
00:37:51,510 --> 00:37:49,040
universities

1012
00:37:54,710 --> 00:37:51,520
so the next chart please

1013
00:37:56,310 --> 00:37:54,720

so in a in a nutshell um you know the

1014
00:37:58,710 --> 00:37:56,320
this this option what we call the

1015
00:38:00,550 --> 00:37:58,720
robotic boulder capture option

1016
00:38:02,790 --> 00:38:00,560
um takes a different tack on the

1017
00:38:06,069 --> 00:38:02,800
asteroid redirect mission and says let's

1018
00:38:08,150 --> 00:38:06,079
go out to a large near-earth asteroid um

1019
00:38:10,150 --> 00:38:08,160
and demonstrate planetary defense

1020
00:38:12,390 --> 00:38:10,160
technique or techniques at that asteroid

1021
00:38:14,710 --> 00:38:12,400
on a relevant size object

1022
00:38:16,550 --> 00:38:14,720
from a from an impact hazard and then

1023
00:38:19,190 --> 00:38:16,560
return a boulder from the surface of

1024
00:38:21,109 --> 00:38:19,200
that object of that asteroid back to cis

1025
00:38:23,190 --> 00:38:21,119
lunar space

1026
00:38:25,190 --> 00:38:23,200
and as part of that mission mature some

1027
00:38:27,109 --> 00:38:25,200
of the key technologies and operations

1028
00:38:29,349 --> 00:38:27,119
um that are required for future space

1029
00:38:32,230 --> 00:38:29,359
operations including uh missions in a

1030
00:38:34,870 --> 00:38:32,240
human class human mars class um mission

1031
00:38:37,829 --> 00:38:34,880
environment for example missions to

1032
00:38:39,030 --> 00:38:37,839
phobos and demos the moons of mars

1033
00:38:40,470 --> 00:38:39,040
so the next

1034
00:38:43,510 --> 00:38:40,480
if we can queue up the video i'm going

1035
00:38:48,390 --> 00:38:46,150
introducing a video here that will show

1036
00:38:50,310 --> 00:38:48,400
the basic portions of the mission we

1037
00:38:55,510 --> 00:38:50,320
could have the video please

1038
00:38:59,349 --> 00:38:57,349

the lights are down

1039
00:39:01,750 --> 00:38:59,359
so again the asteroid redirect vehicle

1040
00:39:02,950 --> 00:39:01,760
which is in large largely the same

1041
00:39:04,390 --> 00:39:02,960
in terms of the sep and the mission

1042
00:39:06,230 --> 00:39:04,400
module we visit a large near earth

1043
00:39:07,030 --> 00:39:06,240
asteroid

1044
00:39:09,349 --> 00:39:07,040
and

1045
00:39:10,470 --> 00:39:09,359
we can deploy the uh the capture system

1046
00:39:11,670 --> 00:39:10,480
and i'll talk a little bit more about

1047
00:39:12,470 --> 00:39:11,680
the different options that we've looked

1048
00:39:16,069 --> 00:39:12,480
at

1049
00:39:19,190 --> 00:39:16,079
arrival and exercise the robotic

1050
00:39:22,390 --> 00:39:19,200
capability we then survey the asteroid

1051
00:39:24,150 --> 00:39:22,400
with a series of one kilometer flybys

1052
00:39:27,030 --> 00:39:24,160
and then we begin boulder collection

1053
00:39:29,270 --> 00:39:27,040
operations uh and that includes a set of

1054
00:39:30,950 --> 00:39:29,280
dry runs to make sure the systems the

1055
00:39:32,230 --> 00:39:30,960
terrain relative navigation is working

1056
00:39:35,030 --> 00:39:32,240
properly

1057
00:39:36,230 --> 00:39:35,040
and then we descend to the surface

1058
00:39:37,430 --> 00:39:36,240
and

1059
00:39:39,670 --> 00:39:37,440
you're again you have to remember we're

1060
00:39:41,270 --> 00:39:39,680
in a microgravity environment so as the

1061
00:39:43,030 --> 00:39:41,280
spacecraft comes the surface this

1062
00:39:46,630 --> 00:39:43,040
actually depiction right now that you're

1063
00:39:47,670 --> 00:39:46,640

seeing is in real time around a 2 to 300

1064
00:39:49,910 --> 00:39:47,680
meter

1065
00:39:52,710 --> 00:39:49,920
large asteroid

1066
00:39:54,310 --> 00:39:52,720
we then contact the surface

1067
00:39:55,910 --> 00:39:54,320
and

1068
00:39:58,069 --> 00:39:55,920
attenuate the loads with what we call

1069
00:40:00,390 --> 00:39:58,079
the capture arms they're akin to landing

1070
00:40:02,150 --> 00:40:00,400
legs but in essence like brian said it's

1071
00:40:03,910 --> 00:40:02,160
more like docking

1072
00:40:06,069 --> 00:40:03,920
um and that was also depicted in real

1073
00:40:08,310 --> 00:40:06,079
time the boulder collection process

1074
00:40:10,950 --> 00:40:08,320
takes approximately 30 minutes

1075
00:40:13,030 --> 00:40:10,960
and and that's obviously sped up

1076
00:40:15,670 --> 00:40:13,040
so this in this scene you see the ascent

1077
00:40:17,430 --> 00:40:15,680
with a three meter boulder

1078
00:40:19,670 --> 00:40:17,440
and again uh this is depicted in real

1079
00:40:21,109 --> 00:40:19,680
time everything happens very slowly

1080
00:40:22,710 --> 00:40:21,119
there are uh

1081
00:40:24,390 --> 00:40:22,720
the accelerations are

1082
00:40:25,910 --> 00:40:24,400
uh the environment the microgravity

1083
00:40:27,750 --> 00:40:25,920
environment is

1084
00:40:29,670 --> 00:40:27,760
uh is very low

1085
00:40:31,270 --> 00:40:29,680
about 10 micro g's on an asteroid like

1086
00:40:35,270 --> 00:40:31,280
itakawa

1087
00:40:40,069 --> 00:40:36,950
is complete and then what happens is we

1088
00:40:41,589 --> 00:40:40,079

transition into a planetary defense

1089
00:40:43,510 --> 00:40:41,599
demonstration mode

1090
00:40:46,470 --> 00:40:43,520
and in this case we focused on an

1091
00:40:48,310 --> 00:40:46,480
enhanced gravity tractor concept where

1092
00:40:50,470 --> 00:40:48,320
we used the mass of the boulder to

1093
00:40:52,310 --> 00:40:50,480
augment the spacecraft which we think

1094
00:40:53,750 --> 00:40:52,320
has a lot of applicability to a to a

1095
00:40:55,990 --> 00:40:53,760
real mission

1096
00:40:57,430 --> 00:40:56,000
and then we enter into a halo orbit that

1097
00:40:58,550 --> 00:40:57,440
maintains a safe distance from the

1098
00:41:01,910 --> 00:40:58,560
asteroid

1099
00:41:04,069 --> 00:41:01,920
and we can we can um demonstrate a

1100
00:41:06,710 --> 00:41:04,079
deflection in about 60 days of

1101
00:41:08,390 --> 00:41:06,720
interaction or as much as 180 days

1102
00:41:09,670 --> 00:41:08,400
waiting for the proper alignment for

1103
00:41:12,390 --> 00:41:09,680
doing the um

1104
00:41:14,710 --> 00:41:12,400
the trajectory analysis

1105
00:41:15,990 --> 00:41:14,720
after that the asteroid redirect vehicle

1106
00:41:18,150 --> 00:41:16,000
and the boulder returned to the stable

1107
00:41:20,470 --> 00:41:18,160
lunar orbit

1108
00:41:22,470 --> 00:41:20,480
where similar to the uh the small

1109
00:41:24,630 --> 00:41:22,480
asteroid capture option

1110
00:41:25,990 --> 00:41:24,640
um the crew can can visit it for

1111
00:41:28,069 --> 00:41:26,000
sampling now

1112
00:41:30,390 --> 00:41:28,079
we're we're going after a coherent

1113
00:41:31,510 --> 00:41:30,400

boulder so as brian talked about we

1114
00:41:34,470 --> 00:41:31,520
don't have the

1115
00:41:36,069 --> 00:41:34,480
the need to encapsulate it we've got

1116
00:41:37,349 --> 00:41:36,079
multiple boulder attempts we've got up

1117
00:41:38,470 --> 00:41:37,359
to five attempts at three different

1118
00:41:40,630 --> 00:41:38,480
sites

1119
00:41:42,790 --> 00:41:40,640
and release capability

1120
00:41:44,550 --> 00:41:42,800
and what we did is we looked at a series

1121
00:41:46,870 --> 00:41:44,560
of different proximity operations and

1122
00:41:48,870 --> 00:41:46,880
capture systems

1123
00:41:50,630 --> 00:41:48,880
including a a three degree of freedom

1124
00:41:52,710 --> 00:41:50,640
space frame which is what you saw there

1125
00:41:54,630 --> 00:41:52,720
in the animation but we've also looked

1126
00:41:57,190 --> 00:41:54,640
at seven degree of freedom of robotic

1127
00:41:58,470 --> 00:41:57,200
arms with uh with grippers and in

1128
00:42:01,270 --> 00:41:58,480
particular we've been looking at the jpl

1129
00:42:02,550 --> 00:42:01,280
microspine um concept for actually uh

1130
00:42:04,470 --> 00:42:02,560
gripping onto the boulder and i'll show

1131
00:42:06,390 --> 00:42:04,480
that in a second and then we also have a

1132
00:42:08,309 --> 00:42:06,400
hybrid option that uses the seven dot

1133
00:42:10,950 --> 00:42:08,319
arms for the actual boulder collection

1134
00:42:12,790 --> 00:42:10,960
but uses the space frame uh contact arms

1135
00:42:15,670 --> 00:42:12,800
for attenuating the loads and and being

1136
00:42:18,470 --> 00:42:15,680
able to provide a mechanical push off

1137
00:42:22,390 --> 00:42:20,470
so as brian mentioned it's a modular

1138
00:42:24,150 --> 00:42:22,400

approach to the the asteroid redirect

1139
00:42:26,470 --> 00:42:24,160
robotic mission

1140
00:42:27,430 --> 00:42:26,480
because we have a lot more operations at

1141
00:42:30,870 --> 00:42:27,440
the

1142
00:42:32,309 --> 00:42:30,880
we're adopting a kind of a payload

1143
00:42:34,150 --> 00:42:32,319
module approach that would bring all the

1144
00:42:36,390 --> 00:42:34,160
sensors and the robotic

1145
00:42:37,589 --> 00:42:36,400
systems together they can be integrated

1146
00:42:39,190 --> 00:42:37,599
and functionally test and then

1147
00:42:40,470 --> 00:42:39,200
integrated with the the mission module

1148
00:42:42,950 --> 00:42:40,480
and the sep

1149
00:42:44,870 --> 00:42:42,960
what this also allows us to do is have a

1150
00:42:46,710 --> 00:42:44,880
sep mission module bus that can be used

1151
00:42:49,109 --> 00:42:46,720
for a multitude of future missions

1152
00:42:51,349 --> 00:42:49,119
there's a lot of extensibility

1153
00:42:54,470 --> 00:42:51,359
aspects that are that are enabled there

1154
00:42:57,510 --> 00:42:56,069
this has a little more details of the

1155
00:42:59,190 --> 00:42:57,520
the hybrid option

1156
00:43:01,030 --> 00:42:59,200
and you can see in the bottom right is

1157
00:43:03,030 --> 00:43:01,040
is a demonstration of the microscop

1158
00:43:04,150 --> 00:43:03,040
microspine

1159
00:43:05,430 --> 00:43:04,160
grippers

1160
00:43:07,349 --> 00:43:05,440
to actually

1161
00:43:09,670 --> 00:43:07,359
reach out and pick up a boulder in a

1162
00:43:11,990 --> 00:43:09,680
test facility

1163
00:43:13,670 --> 00:43:12,000

and you can see that operation going on

1164
00:43:14,470 --> 00:43:13,680
from different angles

1165
00:43:16,630 --> 00:43:14,480
um

1166
00:43:18,790 --> 00:43:16,640
and and what it enables to do is it's a

1167
00:43:21,510 --> 00:43:18,800
series of very small spines that can can

1168
00:43:23,910 --> 00:43:21,520
grab any coherent surface uh whether

1169
00:43:26,309 --> 00:43:23,920
it's curved or flat

1170
00:43:28,630 --> 00:43:26,319
and then we can also use the the contact

1171
00:43:29,670 --> 00:43:28,640
arms as as a containment system for the

1172
00:43:31,750 --> 00:43:29,680
boulder

1173
00:43:34,390 --> 00:43:31,760
and then use the robotic manipulators if

1174
00:43:35,750 --> 00:43:34,400
we want to do further testing or uh

1175
00:43:38,390 --> 00:43:35,760
taking pictures of the boulder on the

1176
00:43:40,069 --> 00:43:38,400
way back to facilitate crude operations

1177
00:43:41,750 --> 00:43:40,079
so we think that this hybrid capture

1178
00:43:44,470 --> 00:43:41,760
system optimizes the functionality for

1179
00:43:46,630 --> 00:43:44,480
the mission and it has again a multitude

1180
00:43:49,349 --> 00:43:46,640
of extensibility aspects from satellite

1181
00:43:50,870 --> 00:43:49,359
servicing to um interaction with phobos

1182
00:43:54,470 --> 00:43:50,880
demos if we if we go to the martian

1183
00:43:56,470 --> 00:43:54,480
moons on a path to the mars surface

1184
00:43:57,670 --> 00:43:56,480
and so there's a lot of options there

1185
00:44:00,230 --> 00:43:57,680
that are enabled

1186
00:44:02,550 --> 00:44:00,240
next please

1187
00:44:05,670 --> 00:44:02,560
so just a quick note about boulder mass

1188
00:44:08,710 --> 00:44:05,680

and size and density um asteroids are a

1189
00:44:11,750 --> 00:44:08,720
variety of different uh compositions

1190
00:44:14,150 --> 00:44:11,760
from metallic to stoney to carbonaceous

1191
00:44:16,470 --> 00:44:14,160
we would and the mass of that is shown

1192
00:44:18,390 --> 00:44:16,480
on the left there between 1 and 50 tons

1193
00:44:21,030 --> 00:44:18,400
but you can see how that parlays into a

1194
00:44:23,589 --> 00:44:21,040
size a much lower density carbonaceous

1195
00:44:24,950 --> 00:44:23,599
brings back a larger boulder

1196
00:44:26,710 --> 00:44:24,960
in comparison you can see how that

1197
00:44:28,470 --> 00:44:26,720
compares to

1198
00:44:30,790 --> 00:44:28,480
the iss over a football field at the

1199
00:44:33,109 --> 00:44:30,800
bottom and the parent body is a 100

1200
00:44:34,150 --> 00:44:33,119
meter asteroid which is about a million

1201
00:44:36,390 --> 00:44:34,160
tons

1202
00:44:38,150 --> 00:44:36,400
of far too much to contemplate returning

1203
00:44:40,309 --> 00:44:38,160
the entire thing but it gives you an

1204
00:44:42,309 --> 00:44:40,319
idea of the different scales

1205
00:44:44,550 --> 00:44:42,319
and again the observed size we think is

1206
00:44:46,470 --> 00:44:44,560
the key characteristic uh of the object

1207
00:44:47,670 --> 00:44:46,480
return that the public sees so from a

1208
00:44:49,270 --> 00:44:47,680
mass standpoint we're not we're not

1209
00:44:51,670 --> 00:44:49,280
going to get out there and weigh it

1210
00:44:53,589 --> 00:44:51,680
but the size of the amount of material

1211
00:44:55,430 --> 00:44:53,599
can be can be substantial even for this

1212
00:44:58,309 --> 00:44:55,440
boulder collection

1213
00:44:59,430 --> 00:44:58,319

option next please

1214
00:45:01,349 --> 00:44:59,440
to give you an idea of some of the

1215
00:45:05,670 --> 00:45:01,359
target

1216
00:45:07,589 --> 00:45:05,680
talking about we have four that we have

1217
00:45:09,829 --> 00:45:07,599
well characterized either

1218
00:45:11,829 --> 00:45:09,839
with existing uh previous precursor

1219
00:45:14,790 --> 00:45:11,839
mission which is itacala

1220
00:45:16,790 --> 00:45:14,800
bennu in 1999 ju3 will both have robotic

1221
00:45:18,790 --> 00:45:16,800
missions that provide that could provide

1222
00:45:21,190 --> 00:45:18,800
precursors before we launch

1223
00:45:23,750 --> 00:45:21,200
and then 2008 ev5 which actually has the

1224
00:45:26,630 --> 00:45:23,760
most mass return um is well

1225
00:45:29,430 --> 00:45:26,640
characterized with radar the um itakawa

1226
00:45:31,190 --> 00:45:29,440
is a stony asteroid and bennu uh ju3 and

1227
00:45:33,430 --> 00:45:31,200
eb5 are all carbonaceous and in

1228
00:45:34,790 --> 00:45:33,440
particular volatile rich and water-rich

1229
00:45:36,390 --> 00:45:34,800
carbonaceous objects which is an

1230
00:45:38,230 --> 00:45:36,400
important characteristic

1231
00:45:39,829 --> 00:45:38,240
in terms of the benefits for science and

1232
00:45:41,750 --> 00:45:39,839
resources

1233
00:45:43,190 --> 00:45:41,760
um and and the other thing to say is

1234
00:45:44,950 --> 00:45:43,200
when we go to one of these large

1235
00:45:47,030 --> 00:45:44,960
asteroids we have the ability to choose

1236
00:45:49,510 --> 00:45:47,040
the boulder that we want to return so

1237
00:45:50,470 --> 00:45:49,520
based on programmatic constraints return

1238
00:45:52,470 --> 00:45:50,480

dates

1239
00:45:54,470 --> 00:45:52,480
there are potentially a multitude of

1240
00:45:56,710 --> 00:45:54,480
boulders that we can choose from

1241
00:45:58,630 --> 00:45:56,720
next please

1242
00:46:01,910 --> 00:45:58,640
so sensor selection

1243
00:46:05,030 --> 00:46:01,920
basically we have a a sensor suite that

1244
00:46:06,630 --> 00:46:05,040
enables redundancy and the ability to

1245
00:46:08,309 --> 00:46:06,640
characterize thousands of boulders

1246
00:46:10,630 --> 00:46:08,319
potentially on the surface of the object

1247
00:46:11,990 --> 00:46:10,640
it also has a lot of public engagement

1248
00:46:13,270 --> 00:46:12,000
and science

1249
00:46:15,430 --> 00:46:13,280
capabilities

1250
00:46:16,870 --> 00:46:15,440
and then we we do not have ground ruled

1251
00:46:18,470 --> 00:46:16,880
in a penetrating ground penetrating

1252
00:46:20,470 --> 00:46:18,480
radar system but that would be an ideal

1253
00:46:22,550 --> 00:46:20,480
mission of opportunity to help gain more

1254
00:46:24,710 --> 00:46:22,560
understanding of the subsurface and uh

1255
00:46:25,589 --> 00:46:24,720
the the asteroid we're visiting in

1256
00:46:28,390 --> 00:46:25,599
general

1257
00:46:30,950 --> 00:46:28,400
next please

1258
00:46:32,870 --> 00:46:30,960
planetary defense demonstration um going

1259
00:46:35,030 --> 00:46:32,880
to a large near earth asteroid allows us

1260
00:46:37,510 --> 00:46:35,040
to be able to do a kinetic impact or as

1261
00:46:39,349 --> 00:46:37,520
well as these other slow push techniques

1262
00:46:41,270 --> 00:46:39,359
our focus was again on this enhanced

1263
00:46:42,470 --> 00:46:41,280

gravity tractor

1264
00:46:43,510 --> 00:46:42,480
but these other mission these other

1265
00:46:45,670 --> 00:46:43,520
types of planetary defense

1266
00:46:47,750 --> 00:46:45,680
demonstrations could be uh

1267
00:46:50,069 --> 00:46:47,760
performed as well

1268
00:46:52,150 --> 00:46:50,079
and so finally

1269
00:46:53,670 --> 00:46:52,160
next slide please

1270
00:46:54,870 --> 00:46:53,680
so just in some closing remarks and i

1271
00:46:56,630 --> 00:46:54,880
haven't had a whole lot of time to

1272
00:46:57,829 --> 00:46:56,640
introduce this there are some backup

1273
00:46:59,510 --> 00:46:57,839
materials that are going to be published

1274
00:47:01,510 --> 00:46:59,520
on the on the website that folks can

1275
00:47:03,589 --> 00:47:01,520
look through with more details but this

1276
00:47:05,910 --> 00:47:03,599
the boulder caption option it do

1277
00:47:07,109 --> 00:47:05,920
addresses a the needs of a broad set of

1278
00:47:10,230 --> 00:47:07,119
stakeholders

1279
00:47:12,470 --> 00:47:10,240
um from mars forward exploration science

1280
00:47:14,790 --> 00:47:12,480
uh resources commercial international

1281
00:47:17,109 --> 00:47:14,800
opportunities and of course a planetary

1282
00:47:19,910 --> 00:47:17,119
defense on a hazardous size nia

1283
00:47:21,589 --> 00:47:19,920
so with that thank you

1284
00:47:23,349 --> 00:47:21,599
thanks dan

1285
00:47:24,950 --> 00:47:23,359
hi my name is jim ryder i'm going to

1286
00:47:26,630 --> 00:47:24,960
talk about some of the integration

1287
00:47:28,710 --> 00:47:26,640
activities that we've had

1288
00:47:31,190 --> 00:47:28,720

for the robotic concepts next chart

1289
00:47:36,230 --> 00:47:33,430
uh so the the integration team was

1290
00:47:38,150 --> 00:47:36,240
formed we had a kickoff in october the

1291
00:47:40,150 --> 00:47:38,160
idea that purpose was to assess the

1292
00:47:42,069 --> 00:47:40,160
robotic concepts and provide

1293
00:47:43,349 --> 00:47:42,079
provide a recommended recommended path

1294
00:47:45,589 --> 00:47:43,359
forward

1295
00:47:47,750 --> 00:47:45,599
incorporating the results from the rfi

1296
00:47:49,190 --> 00:47:47,760
responses last fall

1297
00:47:50,790 --> 00:47:49,200
the membership of this was kind of a

1298
00:47:52,790 --> 00:47:50,800
twofold membership

1299
00:47:55,190 --> 00:47:52,800
we had the representatives from each of

1300
00:47:56,870 --> 00:47:55,200
these teams i was the chair uh but we

1301
00:47:58,390 --> 00:47:56,880
also brought in additional members from

1302
00:48:00,390 --> 00:47:58,400
across the agency to make sure we had a

1303
00:48:01,829 --> 00:48:00,400
broad perspective you know within within

1304
00:48:03,510 --> 00:48:01,839
nasa before

1305
00:48:05,910 --> 00:48:03,520
uh conducting this so it was kind of a

1306
00:48:08,710 --> 00:48:05,920
twofold of where an integration activity

1307
00:48:10,710 --> 00:48:08,720
but also an evaluation activity

1308
00:48:13,190 --> 00:48:10,720
so to help us with that we ended up

1309
00:48:15,109 --> 00:48:13,200
using six special study advisory teams

1310
00:48:16,550 --> 00:48:15,119
i'll talk about each of those um in

1311
00:48:18,790 --> 00:48:16,560
another chart

1312
00:48:22,150 --> 00:48:18,800
and we gave a status in december and our

1313
00:48:24,230 --> 00:48:22,160

result provided our findings in february

1314
00:48:25,670 --> 00:48:24,240
and a lot of those fed into the

1315
00:48:28,069 --> 00:48:25,680
discussions of what we want to do with

1316
00:48:29,829 --> 00:48:28,079
this ba and how we go forward

1317
00:48:32,470 --> 00:48:29,839
next chart please

1318
00:48:33,750 --> 00:48:32,480
uh so michelle showed the preliminary

1319
00:48:35,589 --> 00:48:33,760
objectives that we were given from

1320
00:48:37,270 --> 00:48:35,599
mission objectives we were given we

1321
00:48:39,510 --> 00:48:37,280
converted those into figures of merit as

1322
00:48:41,750 --> 00:48:39,520
shown on this chart so we talked in

1323
00:48:43,349 --> 00:48:41,760
terms of cost schedule

1324
00:48:45,270 --> 00:48:43,359
meeting the primary objectives meeting

1325
00:48:47,190 --> 00:48:45,280
the secondary objectives safety and

1326
00:48:49,270 --> 00:48:47,200
mission success and sustainability and

1327
00:48:50,710 --> 00:48:49,280
within those who broke those down uh for

1328
00:48:53,349 --> 00:48:50,720
each of the primary objectives of course

1329
00:48:55,349 --> 00:48:53,359
as as we've said the the the prime the

1330
00:48:56,950 --> 00:48:55,359
most primary objectives is support for

1331
00:48:59,109 --> 00:48:56,960
human exploration how does it fit into

1332
00:49:01,589 --> 00:48:59,119
our long-term strategy and with that the

1333
00:49:04,230 --> 00:49:01,599
technology demonstrations of those items

1334
00:49:05,990 --> 00:49:04,240
that that will allow us to to

1335
00:49:08,230 --> 00:49:06,000
explore deep space

1336
00:49:09,910 --> 00:49:08,240
and then um enhancing our observation

1337
00:49:11,829 --> 00:49:09,920
campaign from secondaries as we've

1338
00:49:13,750 --> 00:49:11,839

talked the planetary defense

1339
00:49:15,349 --> 00:49:13,760
science commercial and resource use and

1340
00:49:17,910 --> 00:49:15,359
partnership opportunities how does each

1341
00:49:20,710 --> 00:49:17,920
of these concepts uh

1342
00:49:22,549 --> 00:49:20,720
compare in in meeting these objectives

1343
00:49:24,470 --> 00:49:22,559
from safety and mission of success while

1344
00:49:26,790 --> 00:49:24,480
it's a robotic mission when we come back

1345
00:49:28,549 --> 00:49:26,800
to cis lunar space and meet with the

1346
00:49:31,270 --> 00:49:28,559
crude mission the the designs that we

1347
00:49:33,109 --> 00:49:31,280
have can affect crew safety and

1348
00:49:35,109 --> 00:49:33,119
we need to evaluate the mission success

1349
00:49:37,349 --> 00:49:35,119
and technical risks and finally from a

1350
00:49:38,790 --> 00:49:37,359
sustainability standpoint we looked at

1351
00:49:40,150 --> 00:49:38,800
stakeholder interest and mission

1352
00:49:42,309 --> 00:49:40,160
extensibility

1353
00:49:44,549 --> 00:49:42,319
next chart please

1354
00:49:46,470 --> 00:49:44,559
just as a high level comparison as as

1355
00:49:48,710 --> 00:49:46,480
both brian and and

1356
00:49:51,109 --> 00:49:48,720
and dan talked from

1357
00:49:53,030 --> 00:49:51,119
uh a mission arc from a spacecraft

1358
00:49:54,870 --> 00:49:53,040
architecture standpoint the set module

1359
00:49:56,470 --> 00:49:54,880
is very modular and the set module

1360
00:49:58,150 --> 00:49:56,480
itself should be nearly identical

1361
00:49:59,829 --> 00:49:58,160
depending on the mission which is really

1362
00:50:02,069 --> 00:49:59,839
the intent of what we're trying to do

1363
00:50:04,230 --> 00:50:02,079

the uh what we call the mission module

1364
00:50:06,549 --> 00:50:04,240
um can be largely the same it can be the

1365
00:50:08,950 --> 00:50:06,559
same architecture we believe and and can

1366
00:50:10,710 --> 00:50:08,960
kind of create a a spacecraft bus with a

1367
00:50:13,349 --> 00:50:10,720
payload interface

1368
00:50:15,349 --> 00:50:13,359
is is and so the goal for us has been

1369
00:50:17,430 --> 00:50:15,359
can we make it look so that it is that

1370
00:50:18,870 --> 00:50:17,440
bus so it's a multi-use vehicle as we

1371
00:50:21,349 --> 00:50:18,880
evolve it

1372
00:50:23,829 --> 00:50:21,359
um and so that the primary distinction

1373
00:50:25,829 --> 00:50:23,839
between the options naturally the the up

1374
00:50:28,390 --> 00:50:25,839
the proximity operations and how we

1375
00:50:30,470 --> 00:50:28,400
operate near the asteroid but also but

1376
00:50:31,750 --> 00:50:30,480
then it becomes a capture system and so

1377
00:50:33,510 --> 00:50:31,760
many of the risks

1378
00:50:35,270 --> 00:50:33,520
and development are the same and and we

1379
00:50:36,150 --> 00:50:35,280
can proceed in parallel

1380
00:50:39,109 --> 00:50:36,160
as we

1381
00:50:41,510 --> 00:50:39,119
evaluate our concepts next chart please

1382
00:50:44,470 --> 00:50:41,520
um just at a very high level on size

1383
00:50:46,790 --> 00:50:44,480
comparisons um we look at the comparing

1384
00:50:48,230 --> 00:50:46,800
the the points of departure and and you

1385
00:50:49,990 --> 00:50:48,240
can kind of look at it from how big the

1386
00:50:51,430 --> 00:50:50,000
spacecraft is relative to the person

1387
00:50:52,870 --> 00:50:51,440
relative to

1388
00:50:55,589 --> 00:50:52,880

varying size

1389
00:50:57,030 --> 00:50:55,599
boulders or asteroids

1390
00:50:59,109 --> 00:50:57,040
and on the

1391
00:51:02,710 --> 00:50:59,119
what we can receive uh retrieved from an

1392
00:51:04,950 --> 00:51:02,720
itakawa point of departure for um

1393
00:51:07,349 --> 00:51:04,960
for the um boulder

1394
00:51:09,430 --> 00:51:07,359
uh concept a boulder capture concept is

1395
00:51:12,150 --> 00:51:09,440
on the order of two three meters

1396
00:51:14,710 --> 00:51:12,160
um 2009 bd ends up being a little bit

1397
00:51:16,630 --> 00:51:14,720
smaller asteroid in the range of of act

1398
00:51:19,510 --> 00:51:16,640
of asteroids that we might capture on a

1399
00:51:21,430 --> 00:51:19,520
redirect so it's probably four meters or

1400
00:51:23,190 --> 00:51:21,440
around there or less

1401
00:51:25,349 --> 00:51:23,200
and so but it but it led us to a

1402
00:51:27,190 --> 00:51:25,359
discussion of well how big is big enough

1403
00:51:28,950 --> 00:51:27,200
and and we really felt like about two

1404
00:51:30,549 --> 00:51:28,960
meters from a variety of standpoints

1405
00:51:32,950 --> 00:51:30,559
about two meters and above is something

1406
00:51:34,549 --> 00:51:32,960
we can that's viable for our missions

1407
00:51:36,230 --> 00:51:34,559
next start please

1408
00:51:37,990 --> 00:51:36,240
we also tried to understand the trade

1409
00:51:39,910 --> 00:51:38,000
space that we had and characterize it in

1410
00:51:41,589 --> 00:51:39,920
terms of our swim lanes of what what's

1411
00:51:44,470 --> 00:51:41,599
the mission we're trying to accomplish

1412
00:51:46,790 --> 00:51:44,480
the technology capture system design

1413
00:51:48,309 --> 00:51:46,800

uh what type of planetary defense demo

1414
00:51:50,630 --> 00:51:48,319
might we have and whether we have

1415
00:51:53,510 --> 00:51:50,640
payloads for science and commercial use

1416
00:51:55,030 --> 00:51:53,520
we show on there in the red and the blue

1417
00:51:56,710 --> 00:51:55,040
the points of departure for which we

1418
00:51:59,030 --> 00:51:56,720
evaluated but we also tried to show the

1419
00:52:01,670 --> 00:51:59,040
trade space and and look at where from

1420
00:52:03,109 --> 00:52:01,680
the rfi responses that we received so at

1421
00:52:04,710 --> 00:52:03,119
a high level

1422
00:52:05,829 --> 00:52:04,720
the other two options from a mission

1423
00:52:07,190 --> 00:52:05,839
standpoint that we're not talking about

1424
00:52:08,950 --> 00:52:07,200
is you could actually visit both we

1425
00:52:10,309 --> 00:52:08,960
there is a way that you could visit a

1426
00:52:11,750 --> 00:52:10,319
large and a small

1427
00:52:13,910 --> 00:52:11,760
but it's not really one that meets our

1428
00:52:15,670 --> 00:52:13,920
primary objectives very well so that one

1429
00:52:18,549 --> 00:52:15,680
we really didn't look at we looked for a

1430
00:52:20,150 --> 00:52:18,559
while at a mars moon option for this it

1431
00:52:21,910 --> 00:52:20,160
has attractive features and we'll talk a

1432
00:52:23,990 --> 00:52:21,920
bit more about how that fits in but not

1433
00:52:25,349 --> 00:52:24,000
for our first mission is where we got to

1434
00:52:26,790 --> 00:52:25,359
from a technology standpoint we're

1435
00:52:28,230 --> 00:52:26,800
pushing technology that's part of our

1436
00:52:30,870 --> 00:52:28,240
primary objectives for how it meets

1437
00:52:32,790 --> 00:52:30,880
exploration but you could

1438
00:52:34,630 --> 00:52:32,800

craft this uh to back away from those

1439
00:52:36,150 --> 00:52:34,640
technology demonstrations for purposes

1440
00:52:37,750 --> 00:52:36,160
of our study we didn't look at that but

1441
00:52:39,270 --> 00:52:37,760
you'll see as part of this baa we're

1442
00:52:40,150 --> 00:52:39,280
kind of investigating it a little bit

1443
00:52:42,549 --> 00:52:40,160
more

1444
00:52:45,430 --> 00:52:42,559
uh the capture system can any and we got

1445
00:52:47,990 --> 00:52:45,440
a lot of these responses last time

1446
00:52:49,990 --> 00:52:48,000
anywhere from an inflatable bag to um

1447
00:52:52,390 --> 00:52:50,000
deployable booms the manipulator types

1448
00:52:55,510 --> 00:52:52,400
options and and even dual spacecraft so

1449
00:52:58,630 --> 00:52:55,520
you can see where we focused um and

1450
00:53:00,150 --> 00:52:58,640
our activities and in our follow-on call

1451
00:53:02,230 --> 00:53:00,160
we want to focus a little bit more to

1452
00:53:04,390 --> 00:53:02,240
help fill in our trade space

1453
00:53:08,630 --> 00:53:04,400
planetary defense demo you could have no

1454
00:53:10,470 --> 00:53:08,640
demo um both our concepts are

1455
00:53:12,069 --> 00:53:10,480
we're referencing or put including in

1456
00:53:12,950 --> 00:53:12,079
our points of departure slow push type

1457
00:53:14,549 --> 00:53:12,960
system

1458
00:53:16,950 --> 00:53:14,559
and kinetic impactors are ones that are

1459
00:53:19,270 --> 00:53:16,960
options that are out there

1460
00:53:21,190 --> 00:53:19,280
from a science and commercial payload we

1461
00:53:23,270 --> 00:53:21,200
started with no dedicated science or

1462
00:53:24,630 --> 00:53:23,280
payload but as part of this call what

1463
00:53:25,990 --> 00:53:24,640

we're looking for is whether there's

1464
00:53:27,990 --> 00:53:26,000
targets of opportunity that we can

1465
00:53:30,309 --> 00:53:28,000
pursue and as brian talked about is

1466
00:53:32,309 --> 00:53:30,319
we're creating spaces in the vehicles to

1467
00:53:34,230 --> 00:53:32,319
potentially and and in the in the launch

1468
00:53:35,670 --> 00:53:34,240
vehicle to potentially uh take advantage

1469
00:53:37,109 --> 00:53:35,680
of that and we're looking forward to the

1470
00:53:38,309 --> 00:53:37,119
feedback to see how well that fits into

1471
00:53:39,750 --> 00:53:38,319
our plans

1472
00:53:40,950 --> 00:53:39,760
next chart please

1473
00:53:42,710 --> 00:53:40,960
um

1474
00:53:43,990 --> 00:53:42,720
we've looked through mission profile

1475
00:53:45,990 --> 00:53:44,000
comparison for both the points of

1476
00:53:48,230 --> 00:53:46,000
departure and other asteroids and just

1477
00:53:50,309 --> 00:53:48,240
to make sure that we tally up that we

1478
00:53:51,910 --> 00:53:50,319
understand the basically how long this

1479
00:53:54,470 --> 00:53:51,920
would take it does it fit within our

1480
00:53:56,950 --> 00:53:54,480
capacity for the vehicle and and there's

1481
00:53:59,030 --> 00:53:56,960
puts and takes this is uh the the small

1482
00:54:00,870 --> 00:53:59,040
asteroid of 2009 bd because it's a

1483
00:54:03,670 --> 00:54:00,880
little bit smaller than it tends to get

1484
00:54:05,990 --> 00:54:03,680
back sooner it takes a little bit less

1485
00:54:08,470 --> 00:54:06,000
xenon than than it would require for for

1486
00:54:09,349 --> 00:54:08,480
another asteroid uh larger one and from

1487
00:54:10,549 --> 00:54:09,359
the

1488
00:54:12,549 --> 00:54:10,559

it tends to be a little bit harder for

1489
00:54:14,790 --> 00:54:12,559
us to reach um when you look at the

1490
00:54:16,069 --> 00:54:14,800
planetary defense demo when you're doing

1491
00:54:18,069 --> 00:54:16,079
doing that on a small one you can

1492
00:54:20,790 --> 00:54:18,079
demonstrate uh on a small one very

1493
00:54:23,109 --> 00:54:20,800
quickly in a matter of hours whereas on

1494
00:54:24,870 --> 00:54:23,119
a larger one it can be if you want to

1495
00:54:26,950 --> 00:54:24,880
demonstrate all the way to not just

1496
00:54:29,589 --> 00:54:26,960
techniques but showing some measurable

1497
00:54:31,910 --> 00:54:29,599
um effect then it takes a long time um

1498
00:54:33,349 --> 00:54:31,920
so and it these all depend but but

1499
00:54:36,150 --> 00:54:33,359
basically we've looked at a series of

1500
00:54:38,549 --> 00:54:36,160
cases and they all fit within this basic

1501
00:54:41,190 --> 00:54:38,559
spacecraft that we've uh that we've

1502
00:54:42,710 --> 00:54:41,200
specified next chart

1503
00:54:45,430 --> 00:54:42,720
uh from the special study teams as i

1504
00:54:46,950 --> 00:54:45,440
said we had six teams um i'll just very

1505
00:54:48,549 --> 00:54:46,960
quickly go through what they we've

1506
00:54:50,470 --> 00:54:48,559
learned from them there's an automated

1507
00:54:51,829 --> 00:54:50,480
rendezvous and docking commonality team

1508
00:54:53,910 --> 00:54:51,839
heather hinkle led that it was a

1509
00:54:55,349 --> 00:54:53,920
multi-center nasa team and she's going

1510
00:54:57,589 --> 00:54:55,359
to talk a bit more about those results

1511
00:55:00,230 --> 00:54:57,599
because we fed them into this rf this

1512
00:55:02,069 --> 00:55:00,240
this baa and they've identified with

1513
00:55:04,549 --> 00:55:02,079

through that we identified a viable

1514
00:55:05,990 --> 00:55:04,559
common arnd sensor suite that we think

1515
00:55:07,430 --> 00:55:06,000
is applicable to both concepts and the

1516
00:55:09,589 --> 00:55:07,440
crude mission

1517
00:55:11,829 --> 00:55:09,599
uh there is a curation and planning team

1518
00:55:13,829 --> 00:55:11,839
for extraterrestrial materials captain

1519
00:55:15,829 --> 00:55:13,839
it's joint university and nasa team

1520
00:55:18,230 --> 00:55:15,839
where they gave provided us 11 findings

1521
00:55:19,750 --> 00:55:18,240
relative to guiding our eva objectives

1522
00:55:21,349 --> 00:55:19,760
for the crude mission which also

1523
00:55:23,670 --> 00:55:21,359
supported our assessment of robotic

1524
00:55:24,870 --> 00:55:23,680
concepts uh we had

1525
00:55:26,470 --> 00:55:24,880
because

1526
00:55:27,829 --> 00:55:26,480
it was the proximity operations and the

1527
00:55:29,589 --> 00:55:27,839
capture system was the primary

1528
00:55:31,589 --> 00:55:29,599
distinction in terms of technical risks

1529
00:55:33,670 --> 00:55:31,599
of these we formed a peer review team

1530
00:55:35,190 --> 00:55:33,680
for that within nasa and and they

1531
00:55:37,750 --> 00:55:35,200
provided overall technical and schedule

1532
00:55:40,230 --> 00:55:37,760
risk assessments for the concepts we had

1533
00:55:42,069 --> 00:55:40,240
a small team that that assessed did a

1534
00:55:43,990 --> 00:55:42,079
sanity check on the cost basis of

1535
00:55:45,910 --> 00:55:44,000
estimate and provide for each concept

1536
00:55:47,109 --> 00:55:45,920
and provided their findings

1537
00:55:48,309 --> 00:55:47,119
we

1538
00:55:50,630 --> 00:55:48,319

reached out to the small buddies

1539
00:55:52,789 --> 00:55:50,640
assessment group formed a special action

1540
00:55:54,069 --> 00:55:52,799
team and they provided us information on

1541
00:55:56,309 --> 00:55:54,079
the physical nature of the small

1542
00:55:58,230 --> 00:55:56,319
asteroids and boulders as both dan and

1543
00:55:59,349 --> 00:55:58,240
brian talked about a key part of

1544
00:56:00,470 --> 00:55:59,359
formulating this mission is

1545
00:56:02,390 --> 00:56:00,480
understanding those physical

1546
00:56:03,910 --> 00:56:02,400
characteristics and we have forward work

1547
00:56:05,990 --> 00:56:03,920
with them uh to provide science

1548
00:56:06,870 --> 00:56:06,000
considerations as we move to the next

1549
00:56:08,789 --> 00:56:06,880
phase

1550
00:56:10,630 --> 00:56:08,799
and we enlisted some planetary defense

1551
00:56:12,230 --> 00:56:10,640
experts and they which provided

1552
00:56:14,230 --> 00:56:12,240
perspectives related to the potential

1553
00:56:15,589 --> 00:56:14,240
for armed planetary defense techniques

1554
00:56:17,510 --> 00:56:15,599
demonstrations

1555
00:56:20,390 --> 00:56:17,520
next chart please

1556
00:56:22,630 --> 00:56:20,400
we folded that into a risk assessment we

1557
00:56:25,270 --> 00:56:22,640
that we developed in the last few months

1558
00:56:27,510 --> 00:56:25,280
104 risks we captured 19 of them we

1559
00:56:29,750 --> 00:56:27,520
focused down to 19 key ones we to help

1560
00:56:31,829 --> 00:56:29,760
contrast the missions

1561
00:56:33,430 --> 00:56:31,839
we assessed the risks before and after

1562
00:56:35,750 --> 00:56:33,440
mitigation and

1563
00:56:37,910 --> 00:56:35,760

and um showed highlighted some of the

1564
00:56:40,309 --> 00:56:37,920
key risks for both small asteroid and

1565
00:56:43,190 --> 00:56:40,319
robotic boulder capture missions as well

1566
00:56:44,630 --> 00:56:43,200
as key common risks we use these

1567
00:56:47,589 --> 00:56:44,640
first to identify that we didn't have

1568
00:56:49,670 --> 00:56:47,599
show stoppers and then also to say

1569
00:56:51,990 --> 00:56:49,680
to focus on what should be the next step

1570
00:56:53,670 --> 00:56:52,000
next phase for our activities

1571
00:56:56,230 --> 00:56:53,680
next chart

1572
00:56:57,750 --> 00:56:56,240
we looked at distinctions between the on

1573
00:57:01,030 --> 00:56:57,760
the secondary objectives and planetary

1574
00:57:02,549 --> 00:57:01,040
defense science extensibility i um we'll

1575
00:57:04,950 --> 00:57:02,559
provide this for

1576
00:57:06,630 --> 00:57:04,960
for you for for

1577
00:57:08,150 --> 00:57:06,640
look at but it's a it's a contrast as

1578
00:57:10,630 --> 00:57:08,160
we've talked about um

1579
00:57:12,549 --> 00:57:10,640
basically a small one you can you can

1580
00:57:14,390 --> 00:57:12,559
show demonstration techniques uh much

1581
00:57:17,190 --> 00:57:14,400
more quickly for planetary defense but

1582
00:57:19,270 --> 00:57:17,200
for it's more relevant on a larger one

1583
00:57:21,349 --> 00:57:19,280
um next chart please

1584
00:57:23,349 --> 00:57:21,359
and then uh we summarize those into key

1585
00:57:25,270 --> 00:57:23,359
distinguishing characteristics uh

1586
00:57:28,390 --> 00:57:25,280
discuss those with our agency leadership

1587
00:57:30,309 --> 00:57:28,400
and age in in february and and concluded

1588
00:57:32,789 --> 00:57:30,319

that for us what we would like to do is

1589
00:57:34,230 --> 00:57:32,799
is take the next step um work on the

1590
00:57:36,630 --> 00:57:34,240
risk mitigation activities over the next

1591
00:57:38,789 --> 00:57:36,640
several months obtain inputs from

1592
00:57:40,710 --> 00:57:38,799
industry through this baa process

1593
00:57:43,349 --> 00:57:40,720
and then go through another round as

1594
00:57:44,870 --> 00:57:43,359
we're getting closer to an mcr and use

1595
00:57:47,670 --> 00:57:44,880
use the input from the community to help

1596
00:57:49,349 --> 00:57:47,680
us on the down select and next chart and

1597
00:57:51,589 --> 00:57:49,359
then finally what we did is we went back

1598
00:57:53,430 --> 00:57:51,599
through the um the findings from the

1599
00:57:55,670 --> 00:57:53,440
workshop and made sure that we

1600
00:57:57,190 --> 00:57:55,680
incorporated those into our plans

1601
00:57:58,630 --> 00:57:57,200
and looked at those and evaluated you

1602
00:58:00,150 --> 00:57:58,640
know and so the check marks say that

1603
00:58:01,670 --> 00:58:00,160
we've gone through those and evaluated

1604
00:58:03,430 --> 00:58:01,680
which ones are those we'd incorporate

1605
00:58:05,430 --> 00:58:03,440
into gain some additional feedback on

1606
00:58:07,430 --> 00:58:05,440
this baa which is highlighted in green

1607
00:58:08,710 --> 00:58:07,440
on this chart and the next chart

1608
00:58:09,990 --> 00:58:08,720
and so with that we were ready to move

1609
00:58:11,910 --> 00:58:10,000
forward and we're looking forward to

1610
00:58:13,190 --> 00:58:11,920
this through this next phase of getting

1611
00:58:16,710 --> 00:58:13,200
the input back from our community

1612
00:58:20,710 --> 00:58:19,109
thanks steve

1613
00:58:24,069 --> 00:58:20,720

first of all it's great great to be here

1614
00:58:25,589 --> 00:58:24,079
this afternoon uh four months after our

1615
00:58:27,430 --> 00:58:25,599
synthesis workshop down in houston at

1616
00:58:29,589 --> 00:58:27,440
the lunar planetary institute

1617
00:58:31,589 --> 00:58:29,599
um i've been working on the crude

1618
00:58:33,190 --> 00:58:31,599
mission segment for over a year now with

1619
00:58:34,230 --> 00:58:33,200
the multi-center team

1620
00:58:35,750 --> 00:58:34,240
uh

1621
00:58:37,910 --> 00:58:35,760
of course we're leading it out of jsc

1622
00:58:40,309 --> 00:58:37,920
and i've really had the

1623
00:58:41,750 --> 00:58:40,319
an honorable to lead that whole team we

1624
00:58:43,270 --> 00:58:41,760
have representatives from the job

1625
00:58:44,950 --> 00:58:43,280
propulsion lab

1626
00:58:47,109 --> 00:58:44,960
marshall space flight center glenn

1627
00:58:48,950 --> 00:58:47,119
research center kennedy space search

1628
00:58:50,470 --> 00:58:48,960
kennedy space center

1629
00:58:52,309 --> 00:58:50,480
goddard space center and langley so

1630
00:58:54,309 --> 00:58:52,319
we've kind of got a team all across

1631
00:58:56,710 --> 00:58:54,319
crawl across the agency

1632
00:58:57,510 --> 00:58:56,720
let's go to the next slide please

1633
00:59:01,510 --> 00:58:57,520
so

1634
00:59:03,430 --> 00:59:01,520
robotic missions that

1635
00:59:04,870 --> 00:59:03,440
both dan and and brian moorhead have

1636
00:59:07,030 --> 00:59:04,880
talked about

1637
00:59:08,630 --> 00:59:07,040
i think the culmination of those

1638
00:59:11,670 --> 00:59:08,640

missions will be

1639
00:59:13,990 --> 00:59:11,680
in the 2024 time frame when we send

1640
00:59:15,270 --> 00:59:14,000
our astronauts beyond low earth orbit

1641
00:59:17,990 --> 00:59:15,280
once again

1642
00:59:19,670 --> 00:59:18,000
in the orion vehicle to

1643
00:59:21,030 --> 00:59:19,680
obtain samples

1644
00:59:23,349 --> 00:59:21,040
from the asteroid whether it be the

1645
00:59:25,510 --> 00:59:23,359
boulder or the larger asteroid

1646
00:59:27,349 --> 00:59:25,520
by doing two space walks in in this

1647
00:59:29,510 --> 00:59:27,359
distant retrograde orbit

1648
00:59:31,190 --> 00:59:29,520
will have gone further in space 71 000

1649
00:59:33,510 --> 00:59:31,200
kilometers from the moon than ever

1650
00:59:35,349 --> 00:59:33,520
before and if you think about our space

1651
00:59:36,950 --> 00:59:35,359
walking experience

1652
00:59:38,950 --> 00:59:36,960
on a planetary surface or really beyond

1653
00:59:40,549 --> 00:59:38,960
low earth orbit we really just have a

1654
00:59:42,950 --> 00:59:40,559
handful of spacewalks so if you think

1655
00:59:44,549 --> 00:59:42,960
about how this feeds forward to mars

1656
00:59:46,390 --> 00:59:44,559
we'll really be pushing the boundaries

1657
00:59:47,990 --> 00:59:46,400
and expanding that capability

1658
00:59:49,510 --> 00:59:48,000
in this region of the proving ground as

1659
00:59:51,030 --> 00:59:49,520
charlie said earlier and jason will talk

1660
00:59:52,950 --> 00:59:51,040
a little bit about the cis lunar space

1661
00:59:54,789 --> 00:59:52,960
region so we see this as kind of the

1662
00:59:56,230 --> 00:59:54,799
first of a series of missions we'll fly

1663
00:59:58,230 --> 00:59:56,240

in system of space

1664
01:00:00,950 --> 00:59:58,240
but this will be a very bold mission

1665
01:00:02,870 --> 01:00:00,960
using orion as both the transport

1666
01:00:04,150 --> 01:00:02,880
vehicle to get the crew out to system

1667
01:00:07,030 --> 01:00:04,160
inner space

1668
01:00:09,109 --> 01:00:07,040
um also as the living quarters and also

1669
01:00:10,630 --> 01:00:09,119
as an airlock all in one so when i look

1670
01:00:12,470 --> 01:00:10,640
back at my flight director days from

1671
01:00:14,309 --> 01:00:12,480
shuttle this is a pretty bold mission

1672
01:00:17,990 --> 01:00:14,319
that we're talking about executing next

1673
01:00:21,430 --> 01:00:18,870
so

1674
01:00:23,270 --> 01:00:21,440
areas

1675
01:00:25,750 --> 01:00:23,280
since

1676
01:00:27,270 --> 01:00:25,760
what we talked about back in november

1677
01:00:28,630 --> 01:00:27,280
really i'm going to talk about how this

1678
01:00:29,589 --> 01:00:28,640
mission builds capabilities for the

1679
01:00:31,190 --> 01:00:29,599
future

1680
01:00:33,829 --> 01:00:31,200
i'm going to share a little bit about

1681
01:00:35,190 --> 01:00:33,839
the updates as to as to what we've done

1682
01:00:37,030 --> 01:00:35,200
since then and the areas we've focused

1683
01:00:38,309 --> 01:00:37,040
on and then we're going to kind of hand

1684
01:00:40,390 --> 01:00:38,319
it over to jason let him talk about the

1685
01:00:42,150 --> 01:00:40,400
future of exploration but if you look at

1686
01:00:43,589 --> 01:00:42,160
kind of what we're building here on on

1687
01:00:45,270 --> 01:00:43,599
the asteroid redirect mission the crude

1688
01:00:46,390 --> 01:00:45,280

segment we really are building the

1689
01:00:47,910 --> 01:00:46,400
building blocks we're taking the

1690
01:00:49,430 --> 01:00:47,920
capabilities we're working on today

1691
01:00:51,910 --> 01:00:49,440
within the agency

1692
01:00:54,309 --> 01:00:51,920
uh things like the orion vehicle docking

1693
01:00:56,630 --> 01:00:54,319
systems the eva systems we're putting

1694
01:00:58,789 --> 01:00:56,640
those together in a mission in a way

1695
01:01:00,549 --> 01:00:58,799
that provides a compelling location for

1696
01:01:02,710 --> 01:01:00,559
an earlier rhyme mission but also builds

1697
01:01:04,150 --> 01:01:02,720
forward to mars if you kind of start at

1698
01:01:05,670 --> 01:01:04,160
the bottom you see the orion vehicle

1699
01:01:07,510 --> 01:01:05,680
that's going to be the core a

1700
01:01:09,990 --> 01:01:07,520
transportation leg for all deep space

1701
01:01:11,750 --> 01:01:10,000
missions so we see this as a very early

1702
01:01:13,270 --> 01:01:11,760
test flight if you think about

1703
01:01:15,190 --> 01:01:13,280
missions to mars that take a long time

1704
01:01:17,510 --> 01:01:15,200
this is an area that we're nine or ten

1705
01:01:18,789 --> 01:01:17,520
days from the earth if you think about

1706
01:01:21,109 --> 01:01:18,799
docking systems we're going to need

1707
01:01:23,349 --> 01:01:21,119
docking systems as we evolve to missions

1708
01:01:25,190 --> 01:01:23,359
to mars and any other locations so

1709
01:01:26,870 --> 01:01:25,200
that's a fundamental building block and

1710
01:01:29,349 --> 01:01:26,880
then if you think about space walking in

1711
01:01:31,430 --> 01:01:29,359
eva we're building the system today

1712
01:01:33,030 --> 01:01:31,440
starting in advanced exploration systems

1713
01:01:35,190 --> 01:01:33,040

the primary life support systems in the

1714
01:01:37,430 --> 01:01:35,200
suits that then feed forward to mars so

1715
01:01:39,589 --> 01:01:37,440
that's a very important part of the

1716
01:01:40,630 --> 01:01:39,599
mission and then i'll talk a little bit

1717
01:01:42,309 --> 01:01:40,640
at the end about solar electric

1718
01:01:43,510 --> 01:01:42,319
propulsion which is a very fundamental

1719
01:01:46,150 --> 01:01:43,520
building block

1720
01:01:48,230 --> 01:01:46,160
for deploying cargo to mars someday or

1721
01:01:50,549 --> 01:01:48,240
deploying lander systems and things like

1722
01:01:52,150 --> 01:01:50,559
that so we kind of see what we're doing

1723
01:01:53,990 --> 01:01:52,160
with the mission is we're taking things

1724
01:01:55,349 --> 01:01:54,000
that we're working on already today

1725
01:01:56,870 --> 01:01:55,359
hardware that's already in development

1726
01:01:58,789 --> 01:01:56,880
we put them together in this mission and

1727
01:02:00,630 --> 01:01:58,799
then that feeds forward to mars

1728
01:02:02,710 --> 01:02:00,640
next chart

1729
01:02:05,750 --> 01:02:02,720
so what i'll talk about is the different

1730
01:02:07,349 --> 01:02:05,760
segments of the mission and the

1731
01:02:09,670 --> 01:02:07,359
advances that we've made since back in

1732
01:02:11,589 --> 01:02:09,680
november uh the first is in the the

1733
01:02:13,750 --> 01:02:11,599
rendezvous introductory area we've

1734
01:02:15,829 --> 01:02:13,760
really done uh three things one we've

1735
01:02:17,270 --> 01:02:15,839
come up with a common what we think is a

1736
01:02:19,430 --> 01:02:17,280
common approach to rhonda moon docking

1737
01:02:21,190 --> 01:02:19,440
that we can share between what's used on

1738
01:02:23,030 --> 01:02:21,200

orion and then what we'll use on the

1739
01:02:25,430 --> 01:02:23,040
robotic spacecraft and heather will talk

1740
01:02:27,910 --> 01:02:25,440
more about that as it relates to the baa

1741
01:02:29,510 --> 01:02:27,920
in the second panel so

1742
01:02:31,030 --> 01:02:29,520
what we're looking at there is a way to

1743
01:02:32,870 --> 01:02:31,040
save cost and sort of

1744
01:02:34,950 --> 01:02:32,880
feed forward to rendezvous sensor system

1745
01:02:35,990 --> 01:02:34,960
that can be used multiple times in deep

1746
01:02:38,150 --> 01:02:36,000
space

1747
01:02:39,190 --> 01:02:38,160
on the right you see this uh trajectory

1748
01:02:40,630 --> 01:02:39,200
slide

1749
01:02:42,390 --> 01:02:40,640
we've been spending a lot of time trying

1750
01:02:44,470 --> 01:02:42,400
to understand how we'll go ron to move

1751
01:02:45,910 --> 01:02:44,480
and approach the spacecraft the robotic

1752
01:02:47,030 --> 01:02:45,920
spacecraft and system in space with

1753
01:02:48,309 --> 01:02:47,040
orion

1754
01:02:50,150 --> 01:02:48,319
we've been looking at how we would

1755
01:02:52,390 --> 01:02:50,160
execute the transition from the

1756
01:02:54,470 --> 01:02:52,400
insertion into this retrograde orbit and

1757
01:02:56,230 --> 01:02:54,480
then how we would move our orion in

1758
01:02:57,910 --> 01:02:56,240
close to the spacecraft

1759
01:02:59,589 --> 01:02:57,920
we're understanding this region of space

1760
01:03:01,829 --> 01:02:59,599
which we've never really executed

1761
01:03:03,910 --> 01:03:01,839
rendezvous and proxops in and so

1762
01:03:06,870 --> 01:03:03,920
we're learning that it's a pretty simple

1763
01:03:08,150 --> 01:03:06,880

region to work in the maneuvers are very

1764
01:03:09,030 --> 01:03:08,160
straightforward and you get what's

1765
01:03:11,589 --> 01:03:09,040
called

1766
01:03:13,109 --> 01:03:11,599
linear motion as opposed to in low earth

1767
01:03:15,829 --> 01:03:13,119
orbit or low lunar orbit where you have

1768
01:03:17,829 --> 01:03:15,839
uh some gravity effects so the primary

1769
01:03:19,109 --> 01:03:17,839
body and so we think we can kind of set

1770
01:03:20,470 --> 01:03:19,119
the rendezvous approach up to where

1771
01:03:22,390 --> 01:03:20,480
we'll have the sun at the cruise back

1772
01:03:23,109 --> 01:03:22,400
and we can fly on in and we'll have lots

1773
01:03:24,870 --> 01:03:23,119
of

1774
01:03:26,710 --> 01:03:24,880
uh opportunities to rendezvous there and

1775
01:03:28,630 --> 01:03:26,720
so we're working on the details of that

1776
01:03:30,390 --> 01:03:28,640
at the bottom you can see the storm dto

1777
01:03:31,589 --> 01:03:30,400
which just represents one of the sensor

1778
01:03:33,349 --> 01:03:31,599
technologies

1779
01:03:35,430 --> 01:03:33,359
which we've flown on shuttle and we see

1780
01:03:37,589 --> 01:03:35,440
that kind of technology as feeding

1781
01:03:39,670 --> 01:03:37,599
forward to uh to the

1782
01:03:41,190 --> 01:03:39,680
deep deep space missions and then also

1783
01:03:42,950 --> 01:03:41,200
the trajectory techniques at the bottom

1784
01:03:45,029 --> 01:03:42,960
i've talked about this in a lot of

1785
01:03:46,950 --> 01:03:45,039
detail at various forums but

1786
01:03:49,270 --> 01:03:46,960
again we see this as a learning ground

1787
01:03:51,109 --> 01:03:49,280
for those future missions to mars we

1788
01:03:53,029 --> 01:03:51,119

have a swing by the moon both on the

1789
01:03:55,510 --> 01:03:53,039
outbound phase and

1790
01:03:57,750 --> 01:03:55,520
on the inbound phase texaco to lunar

1791
01:03:59,270 --> 01:03:57,760
gravity assisted about 100 kilometers

1792
01:04:01,190 --> 01:03:59,280
and then understanding how to work and

1793
01:04:03,109 --> 01:04:01,200
operate in cis-lunar space the

1794
01:04:04,710 --> 01:04:03,119
navigation techniques all these

1795
01:04:06,630 --> 01:04:04,720
trajectory techniques really do feed

1796
01:04:08,150 --> 01:04:06,640
forward to mars and so we're doing it in

1797
01:04:09,270 --> 01:04:08,160
the region space where we can come back

1798
01:04:11,109 --> 01:04:09,280
in the

1799
01:04:12,470 --> 01:04:11,119
nine to 11 day region which is a little

1800
01:04:13,750 --> 01:04:12,480
further than we do today on space

1801
01:04:15,349 --> 01:04:13,760
station

1802
01:04:17,109 --> 01:04:15,359
next slide

1803
01:04:19,430 --> 01:04:17,119
so in terms of docking systems we are

1804
01:04:21,270 --> 01:04:19,440
again are leveraging uh capabilities

1805
01:04:23,270 --> 01:04:21,280
we're building within heo

1806
01:04:25,910 --> 01:04:23,280
the space station program is building a

1807
01:04:28,150 --> 01:04:25,920
docking capability for commercial crew

1808
01:04:29,349 --> 01:04:28,160
so we're leveraging that system they're

1809
01:04:31,029 --> 01:04:29,359
building what's called a block one

1810
01:04:33,349 --> 01:04:31,039
system it's going to go in two locations

1811
01:04:36,069 --> 01:04:33,359
on space station on the forward-facing

1812
01:04:36,870 --> 01:04:36,079
port and on the upward or zenith port

1813
01:04:40,710 --> 01:04:36,880

on

1814
01:04:42,150 --> 01:04:40,720
and so we're going to evolve that

1815
01:04:43,670 --> 01:04:42,160
capability and we've already started to

1816
01:04:46,549 --> 01:04:43,680
work on that this year with the space

1817
01:04:48,870 --> 01:04:46,559
station program and fy14 we've initiated

1818
01:04:51,589 --> 01:04:48,880
the study to take that block one and

1819
01:04:54,549 --> 01:04:51,599
look at upgrading that for deep space in

1820
01:04:56,069 --> 01:04:54,559
terms of voltages and avionics uh how we

1821
01:04:58,630 --> 01:04:56,079
would handle the deep space environment

1822
01:05:00,549 --> 01:04:58,640
the uh the environment in the cis lunar

1823
01:05:02,390 --> 01:05:00,559
space in this distant retrograde orbit

1824
01:05:04,549 --> 01:05:02,400
is very much colder than the leo

1825
01:05:06,710 --> 01:05:04,559
environment how we reduce the mass

1826
01:05:08,630 --> 01:05:06,720
obviously the mass penalties for going

1827
01:05:10,950 --> 01:05:08,640
into distance retrograde orbit and

1828
01:05:12,630 --> 01:05:10,960
beyond are much harsher than in the leo

1829
01:05:14,549 --> 01:05:12,640
environment and then is there a way we

1830
01:05:15,990 --> 01:05:14,559
can go work on this system and package

1831
01:05:16,870 --> 01:05:16,000
it even better so we've started that

1832
01:05:18,870 --> 01:05:16,880
work

1833
01:05:21,109 --> 01:05:18,880
and this is a unique in this mission how

1834
01:05:23,430 --> 01:05:21,119
we're leveraging investments made by one

1835
01:05:24,630 --> 01:05:23,440
program in another program so here

1836
01:05:26,789 --> 01:05:24,640
you're talking about space station

1837
01:05:30,309 --> 01:05:26,799
working with orion and then also our

1838
01:05:31,829 --> 01:05:30,319

asteroid redirect mission next slide

1839
01:05:33,670 --> 01:05:31,839
so we've spent a lot of time working on

1840
01:05:36,309 --> 01:05:33,680
the primary life support system this is

1841
01:05:39,670 --> 01:05:36,319
a project that jason has in advanced

1842
01:05:41,109 --> 01:05:39,680
exploration systems so we uh we are into

1843
01:05:43,270 --> 01:05:41,119
variable auction regulator testing at

1844
01:05:46,470 --> 01:05:43,280
white sands we've built a plus a

1845
01:05:48,630 --> 01:05:46,480
prototype 2.0 in fy13 we're into testing

1846
01:05:50,630 --> 01:05:48,640
of that in the lab at jsc

1847
01:05:52,390 --> 01:05:50,640
that work involves integrated metabolic

1848
01:05:53,589 --> 01:05:52,400
testing uh functional testing you can

1849
01:05:55,589 --> 01:05:53,599
see the mannequin

1850
01:05:57,029 --> 01:05:55,599
over to the right where we can put a

1851
01:05:59,349 --> 01:05:57,039
bunch of sensors in and understand the

1852
01:06:00,710 --> 01:05:59,359
airflow and the co2 scrubbing capability

1853
01:06:02,309 --> 01:06:00,720
of this plus

1854
01:06:04,549 --> 01:06:02,319
the primary life support system is a big

1855
01:06:06,870 --> 01:06:04,559
upgrade the plus we fly today on space

1856
01:06:09,430 --> 01:06:06,880
station is 40 year old technology and so

1857
01:06:11,029 --> 01:06:09,440
we see this as a infusion path to have a

1858
01:06:11,990 --> 01:06:11,039
new life support system that we could

1859
01:06:13,190 --> 01:06:12,000
fly

1860
01:06:14,710 --> 01:06:13,200
perhaps

1861
01:06:16,950 --> 01:06:14,720
on any kind of exploration mission even

1862
01:06:18,390 --> 01:06:16,960
feeding forward to mars and then also on

1863
01:06:20,950 --> 01:06:18,400

the asteroid redirect mission

1864
01:06:22,470 --> 01:06:20,960
and it would be agnostic of the suit

1865
01:06:24,630 --> 01:06:22,480
whether it be this planetary suit that

1866
01:06:27,750 --> 01:06:24,640
we show in the lower right or the

1867
01:06:29,190 --> 01:06:27,760
mitophytus suit or other kinds of suits

1868
01:06:31,510 --> 01:06:29,200
next slide

1869
01:06:33,109 --> 01:06:31,520
we've also spent a lot of time working

1870
01:06:33,990 --> 01:06:33,119
out the details of how we'll execute the

1871
01:06:36,150 --> 01:06:34,000
two

1872
01:06:38,069 --> 01:06:36,160
evas in the neutral buoyancy lab in

1873
01:06:39,670 --> 01:06:38,079
february we had a

1874
01:06:41,109 --> 01:06:39,680
pretty significant test

1875
01:06:42,950 --> 01:06:41,119
first time we've had two crew members in

1876
01:06:44,549 --> 01:06:42,960
the neutral buoyancy lab with the

1877
01:06:46,630 --> 01:06:44,559
modified aces suit you can see the

1878
01:06:49,589 --> 01:06:46,640
pictures on the slide

1879
01:06:51,829 --> 01:06:49,599
uh we have uh purchased some new suits

1880
01:06:53,829 --> 01:06:51,839
which have some enhancements to try to

1881
01:06:55,190 --> 01:06:53,839
enhance mobility we've changed the bias

1882
01:06:56,870 --> 01:06:55,200
position in the arms and we've added

1883
01:06:58,230 --> 01:06:56,880
some some bearings in the arms to

1884
01:07:00,470 --> 01:06:58,240
provide a little bit more mobility and

1885
01:07:02,390 --> 01:07:00,480
we've also added emu boots to the suit

1886
01:07:03,589 --> 01:07:02,400
and the capability to actually ingress a

1887
01:07:05,109 --> 01:07:03,599
portable foot restraint which is

1888
01:07:07,349 --> 01:07:05,119

necessary for the mission

1889
01:07:09,589 --> 01:07:07,359
and so we did a series of uh of two

1890
01:07:11,510 --> 01:07:09,599
tests in february with the two

1891
01:07:13,589 --> 01:07:11,520
experienced crew members at dan burbank

1892
01:07:15,510 --> 01:07:13,599
and rex wallheim both have flown on

1893
01:07:17,109 --> 01:07:15,520
station and on shuttle and so we're

1894
01:07:19,990 --> 01:07:17,119
working through that capability we'll go

1895
01:07:20,950 --> 01:07:20,000
into a series of tests uh in april next

1896
01:07:22,870 --> 01:07:20,960
month

1897
01:07:24,789 --> 01:07:22,880
and start to work on the second part of

1898
01:07:27,109 --> 01:07:24,799
the mission the test in february really

1899
01:07:28,230 --> 01:07:27,119
focused on the first part of the

1900
01:07:31,109 --> 01:07:28,240
walk

1901
01:07:32,630 --> 01:07:31,119
egressing orion setting up the work site

1902
01:07:34,309 --> 01:07:32,640
setting up the translation pole now

1903
01:07:35,910 --> 01:07:34,319
we'll work on a lot more of the

1904
01:07:37,270 --> 01:07:35,920
techniques to actually

1905
01:07:39,510 --> 01:07:37,280
interact with the bag and cut through

1906
01:07:42,230 --> 01:07:39,520
the bag in april

1907
01:07:43,829 --> 01:07:42,240
and then finally we have a next slide

1908
01:07:45,270 --> 01:07:43,839
please

1909
01:07:47,990 --> 01:07:45,280
so we're uh

1910
01:07:50,630 --> 01:07:48,000
we're looking at uh ways to take the

1911
01:07:52,870 --> 01:07:50,640
spacecraft that that you've heard about

1912
01:07:54,870 --> 01:07:52,880
and evolve that for a mars capability a

1913
01:07:57,430 --> 01:07:54,880

lot of the mars studies today show that

1914
01:08:00,470 --> 01:07:57,440
you have one monolithic sub system of a

1915
01:08:02,150 --> 01:08:00,480
megawatt taking hardware out to mars

1916
01:08:03,910 --> 01:08:02,160
what we're looking at is on the lower

1917
01:08:07,029 --> 01:08:03,920
right where you break that spacecraft up

1918
01:08:09,029 --> 01:08:07,039
into maybe 100 to 250 kilowatt type

1919
01:08:11,270 --> 01:08:09,039
spacecraft and you pre-position

1920
01:08:13,750 --> 01:08:11,280
hardware at mars and and so

1921
01:08:15,109 --> 01:08:13,760
what that does is it enables uh a

1922
01:08:17,110 --> 01:08:15,119
different class of missions you don't

1923
01:08:19,110 --> 01:08:17,120
have to wait for one big monolithic

1924
01:08:21,349 --> 01:08:19,120
spacecraft you can kind of pre-position

1925
01:08:22,630 --> 01:08:21,359
elements uh as you go

1926
01:08:24,550 --> 01:08:22,640
and the next slide shorter shows a

1927
01:08:25,510 --> 01:08:24,560
notional phobos mission that we would

1928
01:08:27,749 --> 01:08:25,520
use

1929
01:08:30,950 --> 01:08:27,759
as a building block from arm we would

1930
01:08:34,390 --> 01:08:30,960
pre-position a phobos habitat and return

1931
01:08:36,229 --> 01:08:34,400
propellant in the mars orbit system

1932
01:08:38,309 --> 01:08:36,239
and that sort of enables a phobos or

1933
01:08:39,669 --> 01:08:38,319
demos landing mission we would fly the

1934
01:08:41,430 --> 01:08:39,679
crew on a traditional trajectory that

1935
01:08:43,269 --> 01:08:41,440
would take seven or nine months we can

1936
01:08:44,550 --> 01:08:43,279
use sep to take three or four years to

1937
01:08:46,630 --> 01:08:44,560
pre-position

1938
01:08:49,110 --> 01:08:46,640

uh these assets out at mars and then use

1939
01:08:50,870 --> 01:08:49,120
those to return the crew then we'd spend

1940
01:08:52,950 --> 01:08:50,880
16 months in the mars system and then we

1941
01:08:54,309 --> 01:08:52,960
could potentially execute a

1942
01:08:55,749 --> 01:08:54,319
phobos type

1943
01:08:57,189 --> 01:08:55,759
mission with the habitat so this is

1944
01:08:58,149 --> 01:08:57,199
something we're looking at but we sort

1945
01:09:00,229 --> 01:08:58,159
of see

1946
01:09:02,309 --> 01:09:00,239
the asteroid redirect vehicle feeding

1947
01:09:04,630 --> 01:09:02,319
very much forward into this kind of

1948
01:09:07,030 --> 01:09:04,640
sequence for a phobos mission

1949
01:09:08,709 --> 01:09:07,040
and then finally our last slide

1950
01:09:10,470 --> 01:09:08,719
so this is the way we see the

1951
01:09:12,229 --> 01:09:10,480
capabilities feeding forward so today on

1952
01:09:14,070 --> 01:09:12,239
station we have deep space habitat

1953
01:09:15,430 --> 01:09:14,080
capability we're testing high

1954
01:09:16,630 --> 01:09:15,440
reliability life support which we need

1955
01:09:18,709 --> 01:09:16,640
for mars

1956
01:09:20,070 --> 01:09:18,719
uh then with the asteroid redirect we

1957
01:09:21,990 --> 01:09:20,080
add a lot of additional exploration

1958
01:09:23,349 --> 01:09:22,000
capabilities we add orion

1959
01:09:25,269 --> 01:09:23,359
we have the experience with deep space

1960
01:09:27,910 --> 01:09:25,279
navigation and docking and guidance and

1961
01:09:28,630 --> 01:09:27,920
control we add exploration eva and then

1962
01:09:29,749 --> 01:09:28,640
we

1963
01:09:32,070 --> 01:09:29,759

add the solar elect propulsion

1964
01:09:34,070 --> 01:09:32,080
capability and you can see that builds a

1965
01:09:36,070 --> 01:09:34,080
set of capabilities needed for the

1966
01:09:38,229 --> 01:09:36,080
ultimate goal which is on the upper

1967
01:09:40,070 --> 01:09:38,239
right a mars short surface day or a long

1968
01:09:42,870 --> 01:09:40,080
surface stay and then later on we

1969
01:09:44,950 --> 01:09:42,880
developed the final capabilities isru

1970
01:09:46,070 --> 01:09:44,960
and power surface systems the surface

1971
01:09:48,630 --> 01:09:46,080
habitat

1972
01:09:49,990 --> 01:09:48,640
and edl capabilities to enable the mars

1973
01:09:52,070 --> 01:09:50,000
landing as charlie talked about in his

1974
01:09:53,829 --> 01:09:52,080
opening remarks so we see the asteroid

1975
01:09:55,430 --> 01:09:53,839
mission as a pretty key component of

1976
01:09:57,270 --> 01:09:55,440
going from where we're at today on

1977
01:09:58,790 --> 01:09:57,280
station which is very complementary to

1978
01:10:00,630 --> 01:09:58,800
the mission building these next

1979
01:10:02,149 --> 01:10:00,640
capabilities and then moving forward in

1980
01:10:03,669 --> 01:10:02,159
exploration

1981
01:10:04,950 --> 01:10:03,679
thanks steve

1982
01:10:08,229 --> 01:10:04,960
jason

1983
01:10:10,229 --> 01:10:08,239
back up a little bit and give you a

1984
01:10:11,590 --> 01:10:10,239
little bigger picture of how what you've

1985
01:10:13,669 --> 01:10:11,600
heard today kind of fits into our

1986
01:10:16,229 --> 01:10:13,679
overall human spaceflight architecture

1987
01:10:18,630 --> 01:10:16,239
so we go to the first chart

1988
01:10:20,390 --> 01:10:18,640

what you're seeing here is a pictation a

1989
01:10:22,550 --> 01:10:20,400
picture of um

1990
01:10:23,590 --> 01:10:22,560
how we move from today's capabilities as

1991
01:10:25,510 --> 01:10:23,600
we're kind of working on the

1992
01:10:27,430 --> 01:10:25,520
fundamentals it's iss and mastering

1993
01:10:29,189 --> 01:10:27,440
those fundamentals

1994
01:10:30,709 --> 01:10:29,199
you see other capabilities are

1995
01:10:32,950 --> 01:10:30,719
advancement of commercial cargo and

1996
01:10:35,270 --> 01:10:32,960
crude or low earth orbit

1997
01:10:37,189 --> 01:10:35,280
and over time now you're seeing how that

1998
01:10:40,070 --> 01:10:37,199
we move from this earth-reliant phase

1999
01:10:41,750 --> 01:10:40,080
which has relatively short durations in

2000
01:10:43,669 --> 01:10:41,760
order to get back to

2001
01:10:46,070 --> 01:10:43,679
earth moving to this proving ground

2002
01:10:48,790 --> 01:10:46,080
phase as steve described that the 9 to

2003
01:10:50,709 --> 01:10:48,800
11 day phase allows us to start testing

2004
01:10:52,950 --> 01:10:50,719
our human space flight systems and

2005
01:10:54,790 --> 01:10:52,960
capabilities in this proving ground on a

2006
01:10:57,030 --> 01:10:54,800
pathway to move out to

2007
01:10:58,630 --> 01:10:57,040
mars to the what we're kind of we

2008
01:11:00,470 --> 01:10:58,640
characterize here is more this earth

2009
01:11:02,470 --> 01:11:00,480
independent phase and you think about

2010
01:11:05,030 --> 01:11:02,480
the this in time duration of it takes

2011
01:11:06,310 --> 01:11:05,040
for the crew to get home um and so it's

2012
01:11:07,750 --> 01:11:06,320
really critical in this proving ground

2013
01:11:09,430 --> 01:11:07,760

phase that we work on the these

2014
01:11:11,590 --> 01:11:09,440
capabilities so i'm going to walk

2015
01:11:12,870 --> 01:11:11,600
through um this at a high level and give

2016
01:11:15,030 --> 01:11:12,880
you some more details on that so the

2017
01:11:17,350 --> 01:11:15,040
next slide

2018
01:11:18,950 --> 01:11:17,360
so this is a chart that many have seen

2019
01:11:21,510 --> 01:11:18,960
over the years that we've used it's our

2020
01:11:23,189 --> 01:11:21,520
capability driven framework um i won't

2021
01:11:27,030 --> 01:11:23,199
spend a lot of time explaining it but at

2022
01:11:29,350 --> 01:11:27,040
the bit at the basis of this slide shows

2023
01:11:31,189 --> 01:11:29,360
as capabilities of ants new missions or

2024
01:11:33,030 --> 01:11:31,199
mission classes open up

2025
01:11:35,669 --> 01:11:33,040
so what we're working on here with the

2026
01:11:37,910 --> 01:11:35,679
asteroid mission is advancing critical

2027
01:11:40,709 --> 01:11:37,920
uh stepping stones of those capabilities

2028
01:11:42,950 --> 01:11:40,719
to start working on in space propulsion

2029
01:11:44,630 --> 01:11:42,960
the sls and orion capabilities the eva

2030
01:11:46,229 --> 01:11:44,640
capabilities and we're actually being

2031
01:11:48,950 --> 01:11:46,239
able to extend our duration of human

2032
01:11:50,950 --> 01:11:48,960
spaceflight into deep space and we're

2033
01:11:53,510 --> 01:11:50,960
kind of walking up the stepping stones

2034
01:11:55,030 --> 01:11:53,520
on our way to the ability to have humans

2035
01:11:56,709 --> 01:11:55,040
into the solar system and onto the

2036
01:11:58,870 --> 01:11:56,719
surface of mars

2037
01:12:00,630 --> 01:11:58,880
on the next page

2038
01:12:02,310 --> 01:12:00,640

one of the things that always talk about

2039
01:12:03,750 --> 01:12:02,320
technical capabilities

2040
01:12:05,189 --> 01:12:03,760
but there's other some guiding

2041
01:12:06,709 --> 01:12:05,199
principles that we have to consider at

2042
01:12:08,149 --> 01:12:06,719
the same time

2043
01:12:10,229 --> 01:12:08,159
it's not just building the right

2044
01:12:12,790 --> 01:12:10,239
technical capabilities but we have to be

2045
01:12:14,870 --> 01:12:12,800
bounded by some realistic expectations

2046
01:12:17,110 --> 01:12:14,880
or principles within human space flight

2047
01:12:18,390 --> 01:12:17,120
um you'll see them listed here

2048
01:12:20,070 --> 01:12:18,400
obviously we're working within our

2049
01:12:22,310 --> 01:12:20,080
budget with our modest increases that we

2050
01:12:24,870 --> 01:12:22,320
have today we're looking at how do we

2051
01:12:26,550 --> 01:12:24,880
apply high technology readiness level

2052
01:12:29,270 --> 01:12:26,560
solutions while still maintaining a

2053
01:12:31,510 --> 01:12:29,280
portfolio of investments for the future

2054
01:12:33,270 --> 01:12:31,520
that we need as well here you saw us

2055
01:12:34,870 --> 01:12:33,280
tying together relatively high

2056
01:12:37,030 --> 01:12:34,880
technology readiness level technologies

2057
01:12:39,189 --> 01:12:37,040
into a mission application that's

2058
01:12:41,750 --> 01:12:39,199
pretty compelling for us to to start

2059
01:12:42,950 --> 01:12:41,760
buying down some more risk towards mars

2060
01:12:45,510 --> 01:12:42,960
we want this

2061
01:12:47,030 --> 01:12:45,520
near-term mission opportunities a

2062
01:12:49,590 --> 01:12:47,040
constant cadence

2063
01:12:51,590 --> 01:12:49,600

we can't just plan to build for 15 years

2064
01:12:52,790 --> 01:12:51,600
of systems and go launch it one day we

2065
01:12:54,950 --> 01:12:52,800
need to be able to figure out how do we

2066
01:12:57,430 --> 01:12:54,960
buy down that risk over time but through

2067
01:12:59,510 --> 01:12:57,440
incremental reasonable steps and have

2068
01:13:00,229 --> 01:12:59,520
that near-term mission cadence to do

2069
01:13:01,910 --> 01:13:00,239
that

2070
01:13:03,990 --> 01:13:01,920
we need to do this not alone we need to

2071
01:13:05,270 --> 01:13:04,000
work with our u.s commercial business

2072
01:13:07,750 --> 01:13:05,280
and expand the lessons that we've

2073
01:13:09,430 --> 01:13:07,760
learned with commercial cargo and crew

2074
01:13:11,110 --> 01:13:09,440
and our overall logistics chain that

2075
01:13:12,310 --> 01:13:11,120
we've had experience with there but how

2076
01:13:14,310 --> 01:13:12,320
do we expand that

2077
01:13:16,790 --> 01:13:14,320
even further markets

2078
01:13:18,550 --> 01:13:16,800
we need to stop throwing away hardware

2079
01:13:20,870 --> 01:13:18,560
is really the point of number five how

2080
01:13:22,870 --> 01:13:20,880
do you how do you do multi-use evolvable

2081
01:13:25,430 --> 01:13:22,880
space infrastructure how do you use

2082
01:13:28,070 --> 01:13:25,440
evolvable capabilities um let's not

2083
01:13:29,430 --> 01:13:28,080
build the same sensor for uh sensor

2084
01:13:31,590 --> 01:13:29,440
capability on multiple vehicles let's

2085
01:13:34,149 --> 01:13:31,600
build one integrated sensor capability

2086
01:13:36,149 --> 01:13:34,159
and use it across let's build one

2087
01:13:37,910 --> 01:13:36,159
set of elements and evolve that element

2088
01:13:39,270 --> 01:13:37,920

over time to the capabilities that we

2089
01:13:41,030 --> 01:13:39,280
need today

2090
01:13:42,709 --> 01:13:41,040
and going back to our the last principle

2091
01:13:44,550 --> 01:13:42,719
here we have a strong partnership

2092
01:13:46,229 --> 01:13:44,560
relationship with all of our iss

2093
01:13:47,910 --> 01:13:46,239
partners and through our global

2094
01:13:49,990 --> 01:13:47,920
exploration rav map the rest of the

2095
01:13:51,830 --> 01:13:50,000
space commute global space community and

2096
01:13:53,830 --> 01:13:51,840
we are then will be leveraging them and

2097
01:13:55,350 --> 01:13:53,840
working with them as true partners as we

2098
01:13:57,669 --> 01:13:55,360
go forward with this

2099
01:14:00,310 --> 01:13:57,679
so next slide

2100
01:14:01,990 --> 01:14:00,320
so is a simple simple way to take a look

2101
01:14:04,149 --> 01:14:02,000
at as we move from this earth throughout

2102
01:14:06,390 --> 01:14:04,159
phase there are sequences of missions

2103
01:14:08,870 --> 01:14:06,400
where arm as charlie described is one of

2104
01:14:10,870 --> 01:14:08,880
those key linchpins but there's it is is

2105
01:14:11,990 --> 01:14:10,880
not everything there are multiple things

2106
01:14:14,149 --> 01:14:12,000
that we need to do in this proving

2107
01:14:16,470 --> 01:14:14,159
ground on our way towards being earth

2108
01:14:20,070 --> 01:14:16,480
independent and ready for mars

2109
01:14:22,790 --> 01:14:21,189
i'm going to give you a little bit of an

2110
01:14:24,950 --> 01:14:22,800
overview here this is our global

2111
01:14:26,709 --> 01:14:24,960
exploration roadmap this is not a nasa

2112
01:14:28,630 --> 01:14:26,719
slide this is a slide actually developed

2113
01:14:31,030 --> 01:14:28,640

by the global community of space

2114
01:14:32,870 --> 01:14:31,040
agencies and what we're looking at here

2115
01:14:34,390 --> 01:14:32,880
is the starting with the principles of

2116
01:14:35,430 --> 01:14:34,400
today our strong international

2117
01:14:39,430 --> 01:14:35,440
partnership

2118
01:14:41,510 --> 01:14:39,440
the life of station to allow us to

2119
01:14:42,790 --> 01:14:41,520
maximize the utilization of station both

2120
01:14:46,790 --> 01:14:42,800
for

2121
01:14:48,709 --> 01:14:46,800
utilization but also our risk reduction

2122
01:14:50,950 --> 01:14:48,719
for exploration leveraging that

2123
01:14:53,990 --> 01:14:50,960
capability starting to think about and

2124
01:14:55,669 --> 01:14:54,000
as we are here today how do robotics

2125
01:14:56,950 --> 01:14:55,679
missions and human space flight missions

2126
01:15:00,070 --> 01:14:56,960
work together

2127
01:15:02,790 --> 01:15:00,080
not just at nasa but in the global sense

2128
01:15:04,709 --> 01:15:02,800
you saw some of our key measurements

2129
01:15:06,709 --> 01:15:04,719
before on which asteroids and which

2130
01:15:08,550 --> 01:15:06,719
boulders you want to go contact it

2131
01:15:10,550 --> 01:15:08,560
wasn't just nasa emissions to these

2132
01:15:12,149 --> 01:15:10,560
asteroids we are coupling the global

2133
01:15:14,550 --> 01:15:12,159
community into these measurements on how

2134
01:15:16,630 --> 01:15:14,560
do we work uh scientific missions along

2135
01:15:18,310 --> 01:15:16,640
with human space flight

2136
01:15:20,310 --> 01:15:18,320
these are kind of our core principles

2137
01:15:22,870 --> 01:15:20,320
then leading into sending humans beyond

2138
01:15:24,950 --> 01:15:22,880

low earth orbit and and working in this

2139
01:15:28,550 --> 01:15:24,960
proving ground on our way to mars

2140
01:15:31,590 --> 01:15:29,350
so

2141
01:15:33,910 --> 01:15:31,600
people ask a lot of times okay what

2142
01:15:35,350 --> 01:15:33,920
what pathways are out there for us i

2143
01:15:37,350 --> 01:15:35,360
mean today we're mastering those

2144
01:15:38,870 --> 01:15:37,360
fundamentals with station we're building

2145
01:15:41,110 --> 01:15:38,880
we're building that high reliable life

2146
01:15:44,390 --> 01:15:41,120
support system lowering mass of those

2147
01:15:46,310 --> 01:15:44,400
systems we're obviously bringing sls and

2148
01:15:47,270 --> 01:15:46,320
orion as our deep space transportation

2149
01:15:48,709 --> 01:15:47,280
leg

2150
01:15:50,790 --> 01:15:48,719
online

2151
01:15:53,110 --> 01:15:50,800
for advancing that we have a high eva

2152
01:15:54,470 --> 01:15:53,120
rate when we did assembly a station we

2153
01:15:55,510 --> 01:15:54,480
really need to figure out what is the

2154
01:15:57,350 --> 01:15:55,520
eva

2155
01:15:59,350 --> 01:15:57,360
dynamics as we go into exploration as

2156
01:16:01,350 --> 01:15:59,360
steve

2157
01:16:02,790 --> 01:16:01,360
talked about autonomous rendezvous and

2158
01:16:04,790 --> 01:16:02,800
docking

2159
01:16:06,870 --> 01:16:04,800
we're still going to have large-scale

2160
01:16:08,550 --> 01:16:06,880
docking in these deep orbits that we

2161
01:16:10,790 --> 01:16:08,560
need to be able to do how do we advance

2162
01:16:12,390 --> 01:16:10,800
that into common docking systems so

2163
01:16:13,830 --> 01:16:12,400

we're building on this high

2164
01:16:15,510 --> 01:16:13,840
kind of fundamental heritage that we

2165
01:16:17,110 --> 01:16:15,520
have and now we're starting to push

2166
01:16:19,189 --> 01:16:17,120
those boundaries from an operational

2167
01:16:21,750 --> 01:16:19,199
perspective getting into the deep space

2168
01:16:22,950 --> 01:16:21,760
operations trajectories uh the radiation

2169
01:16:26,070 --> 01:16:22,960
environment the environments that our

2170
01:16:28,070 --> 01:16:26,080
crews will work in um how do you do true

2171
01:16:30,630 --> 01:16:28,080
robotic and human mission vehicle

2172
01:16:32,310 --> 01:16:30,640
interactions and those complicated

2173
01:16:35,030 --> 01:16:32,320
maneuvers that these spacecraft will

2174
01:16:36,630 --> 01:16:35,040
have to do to work together while still

2175
01:16:40,470 --> 01:16:36,640
working on that advanced in-space

2176
01:16:42,950 --> 01:16:40,480
propulsion and large object maneuvering

2177
01:16:44,550 --> 01:16:42,960
even even going further on our object

2178
01:16:46,070 --> 01:16:44,560
maneuvering if you look at maneuvering

2179
01:16:48,390 --> 01:16:46,080
pieces of an asteroid or an asteroid

2180
01:16:50,310 --> 01:16:48,400
itself that stack size the masses that

2181
01:16:52,630 --> 01:16:50,320
you saw there are similar to the masses

2182
01:16:54,709 --> 01:16:52,640
that we'll have to manipulate in as on

2183
01:16:56,149 --> 01:16:54,719
our pathway to sending humans to mars so

2184
01:16:57,669 --> 01:16:56,159
this will give us critical risk

2185
01:17:00,550 --> 01:16:57,679
reduction there

2186
01:17:02,550 --> 01:17:00,560
and then this opens up pathways through

2187
01:17:04,070 --> 01:17:02,560
mars through mars moons

2188
01:17:06,950 --> 01:17:04,080

working with our international partners

2189
01:17:08,229 --> 01:17:06,960
in sicily inner space as they proceed to

2190
01:17:10,070 --> 01:17:08,239
international or

2191
01:17:11,110 --> 01:17:10,080
potentially even commercial options for

2192
01:17:12,709 --> 01:17:11,120
the moon

2193
01:17:14,070 --> 01:17:12,719
working together so these are the

2194
01:17:16,070 --> 01:17:14,080
critical elements that we're building on

2195
01:17:18,149 --> 01:17:16,080
today to open up all these pathways as

2196
01:17:20,149 --> 01:17:18,159
we go into the future

2197
01:17:21,750 --> 01:17:20,159
next slide

2198
01:17:24,070 --> 01:17:21,760
so a little more specifics about what

2199
01:17:25,910 --> 01:17:24,080
we're here for today talking about this

2200
01:17:27,350 --> 01:17:25,920
builds upon steve's chart that you saw a

2201
01:17:29,830 --> 01:17:27,360
little bit earlier you have the core

2202
01:17:31,910 --> 01:17:29,840
building blocks of what the arm mission

2203
01:17:34,070 --> 01:17:31,920
brings to the table there's a notional

2204
01:17:36,229 --> 01:17:34,080
piece in the middle

2205
01:17:39,350 --> 01:17:36,239
through the baa um we are actually

2206
01:17:41,350 --> 01:17:39,360
asking for specific commercial

2207
01:17:42,630 --> 01:17:41,360
and partnership opportunities how we

2208
01:17:44,470 --> 01:17:42,640
expand

2209
01:17:47,350 --> 01:17:44,480
the relevance and extensibility of these

2210
01:17:49,750 --> 01:17:47,360
systems to look at things like in-situ

2211
01:17:52,070 --> 01:17:49,760
resource utilization additional asteroid

2212
01:17:53,669 --> 01:17:52,080
sample collection this lunar mars

2213
01:17:54,950 --> 01:17:53,679

mission scenarios how do we how do we

2214
01:17:57,189 --> 01:17:54,960
enable this through these fundamental

2215
01:17:58,790 --> 01:17:57,199
capabilities we have the yellow box

2216
01:18:00,630 --> 01:17:58,800
there is specifically

2217
01:18:02,390 --> 01:18:00,640
the area where we're actually actively

2218
01:18:03,990 --> 01:18:02,400
working with the the baa call that you

2219
01:18:05,669 --> 01:18:04,000
hear about from chris here in a little

2220
01:18:07,510 --> 01:18:05,679
bit um

2221
01:18:09,590 --> 01:18:07,520
but what are the missions that look like

2222
01:18:11,590 --> 01:18:09,600
next after the initial human interaction

2223
01:18:12,950 --> 01:18:11,600
with the asteroid what are those what

2224
01:18:15,189 --> 01:18:12,960
should be the next capabilities that

2225
01:18:18,390 --> 01:18:15,199
we're advancing and extensibility of

2226
01:18:20,550 --> 01:18:18,400
those so next slide

2227
01:18:22,149 --> 01:18:20,560
this this enables that multiple pathway

2228
01:18:23,830 --> 01:18:22,159
future

2229
01:18:25,750 --> 01:18:23,840
from everything from this asteroid

2230
01:18:27,830 --> 01:18:25,760
exploitation missions is it just one or

2231
01:18:29,350 --> 01:18:27,840
is it multiple is it working with our

2232
01:18:31,750 --> 01:18:29,360
international partners in the lunar

2233
01:18:33,110 --> 01:18:31,760
vicinity to enable and work with their

2234
01:18:35,110 --> 01:18:33,120
missions and contribute to their

2235
01:18:37,669 --> 01:18:35,120
missions that they run in that area to

2236
01:18:39,189 --> 01:18:37,679
building the fundamental stack

2237
01:18:40,709 --> 01:18:39,199
of vehicle capabilities that we are

2238
01:18:42,149 --> 01:18:40,719

going to take to mars

2239
01:18:43,669 --> 01:18:42,159
you see what we're looking at here is

2240
01:18:45,830 --> 01:18:43,679
fundamental capabilities that build upon

2241
01:18:47,910 --> 01:18:45,840
each other they're modular incense

2242
01:18:50,070 --> 01:18:47,920
they're evolutionary as common building

2243
01:18:51,590 --> 01:18:50,080
blocks and we're not reinventing what we

2244
01:18:52,790 --> 01:18:51,600
need every time we're actually building

2245
01:18:55,030 --> 01:18:52,800
upon

2246
01:18:56,630 --> 01:18:55,040
our paths and and contributions that

2247
01:18:58,550 --> 01:18:56,640
we've made both domestically and with

2248
01:19:00,790 --> 01:18:58,560
our international partners in order to

2249
01:19:02,709 --> 01:19:00,800
enable um the really this capability

2250
01:19:04,390 --> 01:19:02,719
driven framework all the way to what

2251
01:19:06,870 --> 01:19:04,400
charlie gave us as the charge earlier

2252
01:19:09,189 --> 01:19:06,880
today with uh humans

2253
01:19:11,750 --> 01:19:09,199
and boots on the ground at mars as our

2254
01:19:13,830 --> 01:19:11,760
uh near-term destination so with that

2255
01:19:16,470 --> 01:19:13,840
i'll turn it back over

2256
01:19:18,390 --> 01:19:16,480
thank you all thank you

2257
01:19:19,910 --> 01:19:18,400
i think we have a

2258
01:19:21,270 --> 01:19:19,920
little bit less than five minutes for

2259
01:19:22,709 --> 01:19:21,280
questions if

2260
01:19:24,550 --> 01:19:22,719
anyone would like to have some

2261
01:19:29,430 --> 01:19:24,560
microphones in the audience

2262
01:19:34,470 --> 01:19:32,149
we'll bring them to you

2263
01:19:37,189 --> 01:19:34,480

hi there

2264
01:19:40,310 --> 01:19:37,199
hi my name is rick dewitt

2265
01:19:41,270 --> 01:19:40,320
and um this question is for dan

2266
01:19:42,790 --> 01:19:41,280
um

2267
01:19:45,510 --> 01:19:42,800
my question is really about small

2268
01:19:48,229 --> 01:19:45,520
particles uh in the future

2269
01:19:51,270 --> 01:19:48,239
uh when we eventually learn how to use

2270
01:19:54,310 --> 01:19:51,280
asteroid mass to fuel

2271
01:19:57,030 --> 01:19:54,320
an electric mass driver rocket

2272
01:19:59,510 --> 01:19:57,040
we'll be able to use every asteroid like

2273
01:20:01,270 --> 01:19:59,520
a gas station we will be able to hop

2274
01:20:02,950 --> 01:20:01,280
from one to the next to the next to mine

2275
01:20:05,430 --> 01:20:02,960
them

2276
01:20:08,470 --> 01:20:05,440
so mass drivers

2277
01:20:09,910 --> 01:20:08,480
prefer to use really small particles

2278
01:20:11,030 --> 01:20:09,920
because boulders are really hard to

2279
01:20:12,310 --> 01:20:11,040
accelerate

2280
01:20:15,510 --> 01:20:12,320
right so

2281
01:20:16,390 --> 01:20:15,520
the alternative approach

2282
01:20:18,470 --> 01:20:16,400
is

2283
01:20:19,910 --> 01:20:18,480
doesn't have the containment bag

2284
01:20:21,830 --> 01:20:19,920
right so

2285
01:20:23,910 --> 01:20:21,840
uh those little tiny particles will

2286
01:20:25,510 --> 01:20:23,920
probably slough off and might not be

2287
01:20:27,270 --> 01:20:25,520
even available

2288
01:20:29,030 --> 01:20:27,280

to pick up once we get to the moon with

2289
01:20:31,990 --> 01:20:29,040
the the humans

2290
01:20:34,310 --> 01:20:32,000
um so i noticed that you had the

2291
01:20:36,870 --> 01:20:34,320
contingency sample collectors i think

2292
01:20:38,470 --> 01:20:36,880
those are extremely important

2293
01:20:40,790 --> 01:20:38,480
and

2294
01:20:44,229 --> 01:20:42,630
i noticed here i

2295
01:20:46,070 --> 01:20:44,239
am revising my question a little bit

2296
01:20:48,790 --> 01:20:46,080
from what it was earlier i was going to

2297
01:20:50,950 --> 01:20:48,800
complain about the hover mode concept

2298
01:20:52,950 --> 01:20:50,960
but you invented this hybrid mode

2299
01:20:53,990 --> 01:20:52,960
concept

2300
01:20:55,510 --> 01:20:54,000
so

2301
01:20:58,149 --> 01:20:55,520
that pretty much

2302
01:21:00,310 --> 01:20:58,159
helps me out a lot if you can just

2303
01:21:02,229 --> 01:21:00,320
sample those small particles make that a

2304
01:21:04,950 --> 01:21:02,239
secondary mission objective

2305
01:21:08,229 --> 01:21:04,960
we can use that information

2306
01:21:09,830 --> 01:21:08,239
to enable the isru later thank you

2307
01:21:11,910 --> 01:21:09,840
absolutely just comment is that's one of

2308
01:21:13,669 --> 01:21:11,920
the the nice aspects of interacting with

2309
01:21:16,229 --> 01:21:13,679
the surface is you get a lot of

2310
01:21:18,390 --> 01:21:16,239
information that that extends planetary

2311
01:21:20,229 --> 01:21:18,400
defense resource et cetera those

2312
01:21:22,630 --> 01:21:20,239
contingency samples are really kind of a

2313
01:21:26,390 --> 01:21:22,640

regular sampling and a pristine sample

2314
01:21:26,400 --> 01:21:32,310
next question i believe right here

2315
01:21:36,630 --> 01:21:34,229
marshall you buying sierra

2316
01:21:39,030 --> 01:21:36,640
i have sort of the inverse question

2317
01:21:40,790 --> 01:21:39,040
what is your plan if and this is to dan

2318
01:21:42,470 --> 01:21:40,800
i guess what is your plan if none of the

2319
01:21:43,669 --> 01:21:42,480
rocks are coherent

2320
01:21:44,870 --> 01:21:43,679
because i think that's actually quite

2321
01:21:46,470 --> 01:21:44,880
likely that you'll find they're held

2322
01:21:48,310 --> 01:21:46,480
together by van der waals horses or

2323
01:21:49,910 --> 01:21:48,320
something they may look like a boulder

2324
01:21:52,470 --> 01:21:49,920
but you pick them up and they just fall

2325
01:21:53,750 --> 01:21:52,480
pieces yeah so um

2326
01:21:58,390 --> 01:21:53,760
actually

2327
01:22:01,510 --> 01:21:58,400
in the in the effect that these boulders

2328
01:22:03,189 --> 01:22:01,520
um the the uh uh

2329
01:22:05,590 --> 01:22:03,199
the process by which these bold these

2330
01:22:07,270 --> 01:22:05,600
asteroids are created their collisions

2331
01:22:10,870 --> 01:22:07,280
and their re-accretion at a very low

2332
01:22:13,189 --> 01:22:10,880
velocity um if these were simply uh

2333
01:22:15,669 --> 01:22:13,199
non-coherent boulders first of all we

2334
01:22:18,070 --> 01:22:15,679
wouldn't have meteorites um we would we

2335
01:22:21,110 --> 01:22:18,080
would not see coherent meteorites on the

2336
01:22:24,390 --> 01:22:21,120
earth and second they would slough into

2337
01:22:25,750 --> 01:22:24,400
a non-coherent form um due to the forces

2338
01:22:28,229 --> 01:22:25,760

on on an asteroid because of that

2339
01:22:29,750 --> 01:22:28,239
collisional process so we can't

2340
01:22:31,750 --> 01:22:29,760
guarantee that you know this the

2341
01:22:33,430 --> 01:22:31,760
compressive strength is

2342
01:22:34,390 --> 01:22:33,440
it can vary so we're looking at that

2343
01:22:35,750 --> 01:22:34,400
right now what is the minimum

2344
01:22:37,990 --> 01:22:35,760
compressive strength that we can

2345
01:22:39,910 --> 01:22:38,000
tolerate but we also have multiple

2346
01:22:41,030 --> 01:22:39,920
boulder capture attempts

2347
01:22:43,110 --> 01:22:41,040
um

2348
01:22:44,790 --> 01:22:43,120
again we think that the

2349
01:22:47,030 --> 01:22:44,800
the ability for the boulders to main

2350
01:22:49,350 --> 01:22:47,040
maintain their integrity uh is a key

2351
01:22:51,270 --> 01:22:49,360
aspect of picking a boulder if you go to

2352
01:22:52,390 --> 01:22:51,280
the beach and you grab a grab a handful

2353
01:22:53,510 --> 01:22:52,400
of sand and it falls through your

2354
01:22:55,669 --> 01:22:53,520
fingertips yeah you're not going to

2355
01:22:57,910 --> 01:22:55,679
bring back um

2356
01:22:59,669 --> 01:22:57,920
material but we think that based on the

2357
01:23:02,070 --> 01:22:59,679
scientific knowledge that we have to

2358
01:23:03,350 --> 01:23:02,080
date that coherent boulders

2359
01:23:04,550 --> 01:23:03,360
exist

2360
01:23:05,669 --> 01:23:04,560
if i could add real quick that's

2361
01:23:07,669 --> 01:23:05,679
actually one of the questions we're

2362
01:23:10,709 --> 01:23:07,679
having the small bodies assessment group

2363
01:23:12,870 --> 01:23:10,719

uh look at uh as what's

2364
01:23:15,510 --> 01:23:12,880
what's the characteristic of boulders on

2365
01:23:18,390 --> 01:23:15,520
these larger asteroids and as dan says

2366
01:23:19,590 --> 01:23:18,400
initial look at it because we

2367
01:23:22,470 --> 01:23:19,600
have these

2368
01:23:24,470 --> 01:23:22,480
very uh dense coherent mirror rights on

2369
01:23:27,110 --> 01:23:24,480
the ground that obviously exist out

2370
01:23:29,110 --> 01:23:27,120
there it's a question of being able to

2371
01:23:31,030 --> 01:23:29,120
uh look around and and find the right

2372
01:23:33,430 --> 01:23:31,040
one to bring back

2373
01:23:37,030 --> 01:23:33,440
and that's fed into our risk mitigation

2374
01:23:42,310 --> 01:23:39,590
yes martin elvis uh dan and jim i think

2375
01:23:45,030 --> 01:23:42,320
i'm addressing your sensor suite has a

2376
01:23:46,870 --> 01:23:45,040
pretty small uh apertures so i must you

2377
01:23:48,870 --> 01:23:46,880
must be assuming a pretty good orbit

2378
01:23:51,110 --> 01:23:48,880
determination before you set off you're

2379
01:23:52,870 --> 01:23:51,120
not trying to find the asteroid on route

2380
01:23:54,470 --> 01:23:52,880
and correct the course i wondered how

2381
01:23:55,590 --> 01:23:54,480
good that accuracy was that you're

2382
01:23:56,950 --> 01:23:55,600
assuming

2383
01:23:58,470 --> 01:23:56,960
i think this question actually goes to

2384
01:24:01,110 --> 01:23:58,480
lenley yeah

2385
01:24:02,550 --> 01:24:01,120
sure well the uh

2386
01:24:04,709 --> 01:24:02,560
highest uh

2387
01:24:06,790 --> 01:24:04,719
uh viable candidates uh that we have on

2388
01:24:09,350 --> 01:24:06,800

our list are those asteroids which we

2389
01:24:11,590 --> 01:24:09,360
have very good orbits for in fact uh

2390
01:24:13,669 --> 01:24:11,600
our orbits are good enough that uh we

2391
01:24:15,590 --> 01:24:13,679
believe that to well i

2392
01:24:17,110 --> 01:24:15,600
believe we've demonstrated that when

2393
01:24:19,030 --> 01:24:17,120
they come back two or three years later

2394
01:24:21,350 --> 01:24:19,040
they're within a degree or two of where

2395
01:24:22,790 --> 01:24:21,360
we expected them in the sky

2396
01:24:23,750 --> 01:24:22,800
so we're looking at

2397
01:24:27,830 --> 01:24:23,760
that

2398
01:24:30,310 --> 01:24:27,840
you know we categorize the orbit how

2399
01:24:35,189 --> 01:24:30,320
good we know the orbit uh confidence in

2400
01:24:38,950 --> 01:24:37,030
and we believe with the sensors we have

2401
01:24:41,430 --> 01:24:38,960
we can ident we can find the asteroid

2402
01:24:42,709 --> 01:24:41,440
even 50 000 kilometers away and and then

2403
01:24:44,709 --> 01:24:42,719
rendezvous with it

2404
01:24:46,470 --> 01:24:44,719
yeah and for the and for the

2405
01:24:48,229 --> 01:24:46,480
for visiting a large asteroid we

2406
01:24:50,550 --> 01:24:48,239
potentially have or we have robotic

2407
01:24:52,470 --> 01:24:50,560
precursor um and we we know the orbit

2408
01:24:54,070 --> 01:24:52,480
very very well

2409
01:24:58,790 --> 01:24:54,080
to basically over the condition of zero

2410
01:25:02,950 --> 01:25:00,470
one question from twitter

2411
01:25:04,709 --> 01:25:02,960
well we actually have um

2412
01:25:06,070 --> 01:25:04,719
the same question from twitter coming in

2413
01:25:07,830 --> 01:25:06,080

a couple of times and i thought i'd ask

2414
01:25:10,470 --> 01:25:07,840
our panel to address it

2415
01:25:11,750 --> 01:25:10,480
that is um we're talking about asteroids

2416
01:25:14,790 --> 01:25:11,760
a lot right now

2417
01:25:19,830 --> 01:25:14,800
are we in any danger

2418
01:25:25,830 --> 01:25:24,070
there is no object uh in our category

2419
01:25:28,390 --> 01:25:25,840
catalog right now

2420
01:25:30,229 --> 01:25:28,400
that is a danger of impacting the earth

2421
01:25:33,189 --> 01:25:30,239
in the next hundred years

2422
01:25:35,350 --> 01:25:33,199
we have a few uh that we are monitoring

2423
01:25:37,350 --> 01:25:35,360
because they are in orbits uh that do

2424
01:25:38,950 --> 01:25:37,360
come very close to earth's orbit and uh

2425
01:25:40,390 --> 01:25:38,960
and so we want to continue to take

2426
01:25:42,229 --> 01:25:40,400
observations

2427
01:25:44,629 --> 01:25:42,239
of them and

2428
01:25:46,390 --> 01:25:44,639
be able to understand their orbit but

2429
01:25:48,229 --> 01:25:46,400
there's a lot out there that we still

2430
01:25:50,149 --> 01:25:48,239
need to find and that's

2431
01:25:52,629 --> 01:25:50,159
why the continuation of the new earth

2432
01:25:56,149 --> 01:25:52,639
object program

2433
01:25:58,149 --> 01:25:56,159
goes on uh so that we can can find uh

2434
01:26:00,870 --> 01:25:58,159
all the potentially hazardous objects uh

2435
01:26:02,550 --> 01:26:00,880
down to uh a few tens of meters in size

2436
01:26:03,350 --> 01:26:02,560
and there are literally thousands out

2437
01:26:05,590 --> 01:26:03,360
there

2438
01:26:07,590 --> 01:26:05,600

uh that we still need to find and and

2439
01:26:09,430 --> 01:26:07,600
track and follow up and

2440
01:26:10,790 --> 01:26:09,440
actually our students over here are

2441
01:26:12,470 --> 01:26:10,800
helping us with

2442
01:26:15,110 --> 01:26:12,480
with that part of it and getting

2443
01:26:19,270 --> 01:26:15,120
follow-up observations on those objects

2444
01:26:19,280 --> 01:26:35,430
thank you all

2445
01:26:39,830 --> 01:26:37,830
okay thank you michelle and panel we'll

2446
01:26:42,149 --> 01:26:39,840
have our next panel uh start to come up

2447
01:26:44,390 --> 01:26:42,159
and take their seats uh so just reminder

2448
01:26:46,870 --> 01:26:44,400
we saw a lot of presentations there a

2449
01:26:48,709 --> 01:26:46,880
lot of detailed charts our goal is after

2450
01:26:51,189 --> 01:26:48,719
each panel uh to the extent uh the

2451
01:26:53,350 --> 01:26:51,199
electrons allow it to happen fast to go

2452
01:26:56,229 --> 01:26:53,360
ahead and put those up on nasa.gov

2453
01:26:57,590 --> 01:26:56,239
asteroid forum so be sure to check there

2454
01:26:59,669 --> 01:26:57,600
periodically if you'd like to refer back

2455
01:27:02,149 --> 01:26:59,679
to any of the charts you see here today

2456
01:27:03,669 --> 01:27:02,159
nasa.gov asteroid forum and just

2457
01:27:05,270 --> 01:27:03,679
reminder you can you can keep your

2458
01:27:07,110 --> 01:27:05,280
questions coming on twitter using the

2459
01:27:08,149 --> 01:27:07,120
hashtag ask nas and we'll get to as many

2460
01:27:10,470 --> 01:27:08,159
as we can

2461
01:27:11,830 --> 01:27:10,480
uh for now i am going to introduce our

2462
01:27:12,950 --> 01:27:11,840
next panel moderator that you're going

2463
01:27:14,709 --> 01:27:12,960

to hear a little bit more about the

2464
01:27:17,270 --> 01:27:14,719
broad agency announcement

2465
01:27:20,790 --> 01:27:17,280
that we issued uh from from nasa last

2466
01:27:22,550 --> 01:27:20,800
friday you can find that baa at nasa.gov

2467
01:27:23,830 --> 01:27:22,560
asteroid initiative and a link to it we

2468
01:27:25,270 --> 01:27:23,840
put out a press release on that as well

2469
01:27:26,950 --> 01:27:25,280
with some good descriptive information

2470
01:27:28,550 --> 01:27:26,960
on it but here to talk a little bit more

2471
01:27:30,310 --> 01:27:28,560
about it is our next moderator chris

2472
01:27:32,709 --> 01:27:30,320
moore who is the deputy director of

2473
01:27:34,149 --> 01:27:32,719
advanced exploration systems division

2474
01:27:42,950 --> 01:27:34,159
human exploration operations mission

2475
01:27:47,270 --> 01:27:45,189
good afternoon in this panel we're going

2476
01:27:48,550 --> 01:27:47,280
to give you some general information

2477
01:27:51,350 --> 01:27:48,560
about the

2478
01:27:52,709 --> 01:27:51,360
baa and try to answer any questions you

2479
01:27:56,070 --> 01:27:52,719
may have

2480
01:27:59,110 --> 01:27:56,080
let me start by making introductions

2481
01:28:02,709 --> 01:27:59,120
we have jason reboyne he's going to

2482
01:28:05,430 --> 01:28:02,719
cover the asteroid capture systems

2483
01:28:07,830 --> 01:28:05,440
heather hinkle will discuss the

2484
01:28:10,790 --> 01:28:07,840
rendezvous sensors

2485
01:28:13,030 --> 01:28:10,800
mike barrett will talk about adapting

2486
01:28:15,270 --> 01:28:13,040
commercial spacecraft for the asteroid

2487
01:28:18,550 --> 01:28:15,280
redirect mission

2488
01:28:21,430 --> 01:28:18,560

andy petro will talk about partnership

2489
01:28:22,470 --> 01:28:21,440
opportunities for secondary payloads

2490
01:28:25,350 --> 01:28:22,480
and

2491
01:28:27,669 --> 01:28:25,360
mark mcdonald will talk about

2492
01:28:29,350 --> 01:28:27,679
partnership opportunities for the crude

2493
01:28:32,070 --> 01:28:29,360
mission

2494
01:28:33,750 --> 01:28:32,080
so i'll give you some general

2495
01:28:35,189 --> 01:28:33,760
information about

2496
01:28:36,390 --> 01:28:35,199
the baa

2497
01:28:38,709 --> 01:28:36,400
and

2498
01:28:39,590 --> 01:28:38,719
then we'll go to our panel to talk about

2499
01:28:41,510 --> 01:28:39,600
the

2500
01:28:43,669 --> 01:28:41,520
five technical areas

2501
01:28:45,430 --> 01:28:43,679
and then we had some submitted questions

2502
01:28:46,390 --> 01:28:45,440
and i'll go through those at the end and

2503
01:28:48,470 --> 01:28:46,400
then we'll

2504
01:28:50,629 --> 01:28:48,480
open it up to the floor for additional

2505
01:28:54,550 --> 01:28:50,639
questions

2506
01:28:58,229 --> 01:28:56,709
these are the objectives of the broad

2507
01:29:00,149 --> 01:28:58,239
agency announcement

2508
01:29:03,030 --> 01:29:00,159
the first is to

2509
01:29:04,709 --> 01:29:03,040
build upon the over 400 ideas we

2510
01:29:06,070 --> 01:29:04,719
received from our request for

2511
01:29:09,510 --> 01:29:06,080
information

2512
01:29:11,430 --> 01:29:09,520
and that we synthesized in our workshops

2513
01:29:14,229 --> 01:29:11,440

last fall

2514
01:29:16,390 --> 01:29:14,239
we really like to engage the external

2515
01:29:17,270 --> 01:29:16,400
community and asteroid initiatives so

2516
01:29:20,470 --> 01:29:17,280
we're

2517
01:29:22,950 --> 01:29:20,480
doing that by involving you in

2518
01:29:25,669 --> 01:29:22,960
system studies and technology

2519
01:29:26,709 --> 01:29:25,679
development activities and in potential

2520
01:29:29,430 --> 01:29:26,719
partnership

2521
01:29:34,790 --> 01:29:31,830
and we're trying to provide

2522
01:29:36,790 --> 01:29:34,800
alternative system concepts

2523
01:29:39,030 --> 01:29:36,800
that would feed into the

2524
01:29:41,189 --> 01:29:39,040
asteroid redirect mission

2525
01:29:43,669 --> 01:29:41,199
mission concept review

2526
01:29:44,629 --> 01:29:43,679
which we plan to hold

2527
01:29:47,669 --> 01:29:44,639
later

2528
01:29:50,310 --> 01:29:47,679
this year early next year

2529
01:29:52,390 --> 01:29:50,320
okay next please

2530
01:29:55,430 --> 01:29:52,400
okay there are five

2531
01:29:56,629 --> 01:29:55,440
main topic areas for the broad agency

2532
01:30:00,070 --> 01:29:56,639
announcement

2533
01:30:02,229 --> 01:30:00,080
asteroid capture systems are looking for

2534
01:30:05,830 --> 01:30:02,239
deployable structures and autonomous

2535
01:30:08,629 --> 01:30:05,840
robotic manipulators

2536
01:30:09,990 --> 01:30:08,639
sensors that can be used on both the

2537
01:30:13,510 --> 01:30:10,000
s-rig

2538
01:30:16,390 --> 01:30:13,520

redirect vehicle and orion

2539
01:30:17,910 --> 01:30:16,400
trying to adapt commercial spacecraft

2540
01:30:20,709 --> 01:30:17,920
development

2541
01:30:23,910 --> 01:30:20,719
capabilities for the asteroid redirect

2542
01:30:26,709 --> 01:30:23,920
mission spacecraft

2543
01:30:27,830 --> 01:30:26,719
we'd like to do feasibility studies of

2544
01:30:29,669 --> 01:30:27,840
potential

2545
01:30:31,110 --> 01:30:29,679
partnerships

2546
01:30:32,390 --> 01:30:31,120
for secondary payloads that could be

2547
01:30:34,790 --> 01:30:32,400
launched either

2548
01:30:37,350 --> 01:30:34,800
on asteroid redirect mission are on the

2549
01:30:39,830 --> 01:30:37,360
space launch system

2550
01:30:42,709 --> 01:30:39,840
and studies of potential partnership

2551
01:30:44,790 --> 01:30:42,719
opportunities for the crude mission

2552
01:30:46,830 --> 01:30:44,800
these include advancing science

2553
01:30:49,990 --> 01:30:46,840
institute resource

2554
01:30:52,870 --> 01:30:50,000
utilization and

2555
01:30:55,430 --> 01:30:52,880
enabling commercial activities

2556
01:30:59,189 --> 01:30:55,440
and enhancing u.s exploration

2557
01:31:00,830 --> 01:30:59,199
capabilities in cisco inner space

2558
01:31:04,550 --> 01:31:00,840
next

2559
01:31:06,790 --> 01:31:04,560
please this is a summary of the

2560
01:31:09,669 --> 01:31:06,800
available funding and

2561
01:31:12,070 --> 01:31:09,679
anticipated number of awards

2562
01:31:13,270 --> 01:31:12,080
there's approximately six million

2563
01:31:14,629 --> 01:31:13,280

dollars

2564
01:31:17,189 --> 01:31:14,639
total

2565
01:31:19,350 --> 01:31:17,199
that could be awarded to this ba depends

2566
01:31:20,470 --> 01:31:19,360
on the quality of the proposals we

2567
01:31:22,229 --> 01:31:20,480
receive

2568
01:31:23,430 --> 01:31:22,239
and we intend to

2569
01:31:26,149 --> 01:31:23,440
award

2570
01:31:29,030 --> 01:31:26,159
four to six

2571
01:31:32,629 --> 01:31:29,040
contracts in each of the five areas

2572
01:31:34,470 --> 01:31:32,639
the individual award amounts are

2573
01:31:35,750 --> 01:31:34,480
ranging from five hundred thousand

2574
01:31:37,830 --> 01:31:35,760
dollars

2575
01:31:40,390 --> 01:31:37,840
for

2576
01:31:42,470 --> 01:31:40,400
the capture systems to fifty thousand

2577
01:31:44,229 --> 01:31:42,480
dollars for some of the

2578
01:31:46,870 --> 01:31:44,239
initial feasibility studies for

2579
01:31:51,110 --> 01:31:46,880
potential partnerships

2580
01:31:56,950 --> 01:31:53,910
so to help us plan our evaluation

2581
01:31:59,990 --> 01:31:56,960
process we strongly encourage proposers

2582
01:32:02,870 --> 01:32:00,000
to submit a notice of intent

2583
01:32:04,790 --> 01:32:02,880
it's not required you can still submit a

2584
01:32:06,790 --> 01:32:04,800
proposal later if you

2585
01:32:08,709 --> 01:32:06,800
decide to do that

2586
01:32:10,390 --> 01:32:08,719
but it helps us to organize our

2587
01:32:12,629 --> 01:32:10,400
evaluation panels

2588
01:32:15,669 --> 01:32:12,639

so in addition to your contact

2589
01:32:18,629 --> 01:32:15,679
information it's really important if you

2590
01:32:20,629 --> 01:32:18,639
could identify which of the five areas

2591
01:32:22,790 --> 01:32:20,639
you're going to propose in you may not

2592
01:32:23,990 --> 01:32:22,800
know that at this time that's okay but

2593
01:32:27,350 --> 01:32:24,000
if you do

2594
01:32:28,870 --> 01:32:27,360
please let us know because that helps us

2595
01:32:31,510 --> 01:32:28,880
a lot to

2596
01:32:34,470 --> 01:32:31,520
organize things and you can send that

2597
01:32:39,030 --> 01:32:34,480
notice of intent to me at the

2598
01:32:39,040 --> 01:32:42,070
next slide please

2599
01:32:46,790 --> 01:32:44,229
so we're trying to minimize the work

2600
01:32:48,550 --> 01:32:46,800
load on both you as proposers and on us

2601
01:32:50,950 --> 01:32:48,560
as evaluators so we're trying to keep

2602
01:32:54,390 --> 01:32:50,960
the proposals fairly short

2603
01:32:57,430 --> 01:32:54,400
no more than 20 pages and there are

2604
01:32:59,030 --> 01:32:57,440
specific page limits listed in the

2605
01:33:00,550 --> 01:32:59,040
baa for each

2606
01:33:02,390 --> 01:33:00,560
section and you can see a list of the

2607
01:33:03,669 --> 01:33:02,400
eight

2608
01:33:05,270 --> 01:33:03,679
sections there and the types of

2609
01:33:07,990 --> 01:33:05,280
information

2610
01:33:10,310 --> 01:33:08,000
we are requesting for each one are

2611
01:33:12,709 --> 01:33:10,320
described in the baa

2612
01:33:16,550 --> 01:33:12,719
and we'd like you to email

2613
01:33:19,350 --> 01:33:16,560

your proposal in pdf format

2614
01:33:21,350 --> 01:33:19,360
to the email address that's listed there

2615
01:33:25,110 --> 01:33:21,360
in the baa

2616
01:33:29,430 --> 01:33:27,590
these are our criteria for evaluating

2617
01:33:31,110 --> 01:33:29,440
proposals

2618
01:33:34,229 --> 01:33:31,120
we are looking at

2619
01:33:37,030 --> 01:33:34,239
relevance how relevant is the proposal

2620
01:33:39,189 --> 01:33:37,040
to the objectives described in the

2621
01:33:41,830 --> 01:33:39,199
announcement and to

2622
01:33:45,990 --> 01:33:41,840
the specific

2623
01:33:50,629 --> 01:33:48,149
technical merit we're going to evaluate

2624
01:33:52,790 --> 01:33:50,639
the quality depth and thoroughness of

2625
01:33:54,950 --> 01:33:52,800
the technical approach in addition to

2626
01:33:56,310 --> 01:33:54,960
the capabilities of the organization to

2627
01:33:59,430 --> 01:33:56,320
perform the work

2628
01:34:02,470 --> 01:33:59,440
and the experience of key personnel

2629
01:34:05,030 --> 01:34:02,480
and then the final criterion is cost how

2630
01:34:08,709 --> 01:34:05,040
reasonable is your cost proposal for the

2631
01:34:10,950 --> 01:34:08,719
amount of work that's being performed

2632
01:34:13,669 --> 01:34:10,960
next please

2633
01:34:14,870 --> 01:34:13,679
these are some key dates for the baa

2634
01:34:16,870 --> 01:34:14,880
process

2635
01:34:20,870 --> 01:34:16,880
we did issue

2636
01:34:23,669 --> 01:34:20,880
the baa last friday march 21st

2637
01:34:27,590 --> 01:34:23,679
and we'd like to receive the notices of

2638
01:34:29,910 --> 01:34:27,600

intent by next friday april 4th

2639
01:34:31,990 --> 01:34:29,920
we're giving you 45 days to write your

2640
01:34:35,189 --> 01:34:32,000
proposals

2641
01:34:37,669 --> 01:34:35,199
so they're due on may 5th

2642
01:34:39,110 --> 01:34:37,679
we will be evaluating the proposals in

2643
01:34:41,990 --> 01:34:39,120
the

2644
01:34:45,030 --> 01:34:42,000
may and june time frame and

2645
01:34:47,270 --> 01:34:45,040
awarding contracts and then the

2646
01:34:49,590 --> 01:34:47,280
work would begin on the contracts

2647
01:34:51,990 --> 01:34:49,600
around the first of july

2648
01:34:54,470 --> 01:34:52,000
and these studies would run

2649
01:34:56,470 --> 01:34:54,480
six months they would conclude in

2650
01:34:57,910 --> 01:34:56,480
december

2651
01:34:59,990 --> 01:34:57,920
we've adjusted

2652
01:35:02,149 --> 01:35:00,000
the schedule so that it lines up with

2653
01:35:05,669 --> 01:35:02,159
the

2654
01:35:07,510 --> 01:35:05,679
review because we really

2655
01:35:09,350 --> 01:35:07,520
are going to be using these

2656
01:35:12,229 --> 01:35:09,360
studies to inform the machine concept

2657
01:35:14,470 --> 01:35:12,239
review and we we value your inputs

2658
01:35:16,870 --> 01:35:14,480
through that process

2659
01:35:18,629 --> 01:35:16,880
next slide please

2660
01:35:21,270 --> 01:35:18,639
so if you have any general questions

2661
01:35:23,270 --> 01:35:21,280
about the solicitation

2662
01:35:25,350 --> 01:35:23,280
please email me

2663
01:35:28,310 --> 01:35:25,360

and if it's a technical question i'll

2664
01:35:29,750 --> 01:35:28,320
refer to one of our technical experts in

2665
01:35:31,590 --> 01:35:29,760
the appropriate area

2666
01:35:36,550 --> 01:35:31,600
and we will try to give you a

2667
01:35:42,790 --> 01:35:39,510
all the answers that we give will be

2668
01:35:44,629 --> 01:35:42,800
posted on the web for other people to

2669
01:35:45,910 --> 01:35:44,639
access and read

2670
01:35:49,110 --> 01:35:45,920
and

2671
01:35:51,430 --> 01:35:49,120
the ba website

2672
01:35:52,229 --> 01:35:51,440
has a lot of useful information about

2673
01:35:54,310 --> 01:35:52,239
the

2674
01:35:55,590 --> 01:35:54,320
system studies that have been done today

2675
01:36:00,550 --> 01:35:55,600
and some of the

2676
01:36:05,830 --> 01:36:03,350
okay so now i'm going to turn it over to

2677
01:36:08,149 --> 01:36:05,840
our panelists and

2678
01:36:11,030 --> 01:36:08,159
first is jason reboyne and he's going to

2679
01:36:13,189 --> 01:36:11,040
talk about asteroid capture systems

2680
01:36:14,709 --> 01:36:13,199
thank you chris um good afternoon ladies

2681
01:36:16,629 --> 01:36:14,719
and gentlemen it's my pleasure to be

2682
01:36:17,750 --> 01:36:16,639
here as chris said my name is jason

2683
01:36:19,030 --> 01:36:17,760
raboyan i'm from the structural

2684
01:36:20,790 --> 01:36:19,040
engineering division at the johnson

2685
01:36:22,470 --> 01:36:20,800
space center and i'll be talking about

2686
01:36:25,830 --> 01:36:22,480
the capture systems portion of the

2687
01:36:27,830 --> 01:36:25,840
broader rod agency announcement

2688
01:36:29,910 --> 01:36:27,840

before i begin i'd like to

2689
01:36:31,510 --> 01:36:29,920
recap some of the key events

2690
01:36:35,110 --> 01:36:31,520
that led us up to today next slide

2691
01:36:40,390 --> 01:36:38,070
back in september of 2011 and up to

2692
01:36:42,870 --> 01:36:40,400
april 2012 the keck institute for space

2693
01:36:45,510 --> 01:36:42,880
studies uh conducted in the initial

2694
01:36:48,229 --> 01:36:45,520
asteroid retrieval feasibility study

2695
01:36:49,910 --> 01:36:48,239
involving multiple centers in academia

2696
01:36:51,750 --> 01:36:49,920
the outcome of that study

2697
01:36:53,990 --> 01:36:51,760
resulted in an initial concept that used

2698
01:36:55,830 --> 01:36:54,000
a mechanical deployable bag to capture a

2699
01:36:57,109 --> 01:36:55,840
small near-earth asteroid you can see

2700
01:36:58,470 --> 01:36:57,119
that depicted just to the right of that

2701
01:37:02,070 --> 01:36:58,480
bullet

2702
01:37:03,510 --> 01:37:02,080
then later in january 2013 jpl started

2703
01:37:05,189 --> 01:37:03,520
further developing the concept and

2704
01:37:07,189 --> 01:37:05,199
evolving it into the inflatable system

2705
01:37:09,030 --> 01:37:07,199
that you saw mr muir head present

2706
01:37:11,990 --> 01:37:09,040
earlier

2707
01:37:15,189 --> 01:37:12,000
then between february 2012

2708
01:37:18,070 --> 01:37:15,199
and april 2013 nasa conducted its own

2709
01:37:20,629 --> 01:37:18,080
independent internal

2710
01:37:24,229 --> 01:37:20,639
assessment of capture systems to look at

2711
01:37:27,270 --> 01:37:24,239
alternate ways to conduct this mission

2712
01:37:29,109 --> 01:37:27,280
the study resulted in two concepts an

2713
01:37:31,830 --> 01:37:29,119

alternate inflatable design as well as a

2714
01:37:33,990 --> 01:37:31,840
mechanical manipulator or robotic arm

2715
01:37:37,510 --> 01:37:34,000
concept that would either retrieve an

2716
01:37:39,510 --> 01:37:37,520
entire nia or a small portion of boulder

2717
01:37:41,030 --> 01:37:39,520
off a larger neo

2718
01:37:42,709 --> 01:37:41,040
following that study the langley

2719
01:37:44,790 --> 01:37:42,719
research center then began developing

2720
01:37:45,590 --> 01:37:44,800
the alternate concept

2721
01:37:47,830 --> 01:37:45,600
for

2722
01:37:49,669 --> 01:37:47,840
using robotic arms to retrieve the small

2723
01:37:52,149 --> 01:37:49,679
boulder off the larger

2724
01:37:54,070 --> 01:37:52,159
the larger parent body which mark masnic

2725
01:37:56,550 --> 01:37:54,080
also presented earlier

2726
01:37:58,070 --> 01:37:56,560
finally in the summer 2013 nasa then

2727
01:37:59,910 --> 01:37:58,080
released a request for information so

2728
01:38:02,070 --> 01:37:59,920
listing your ideas

2729
01:38:04,790 --> 01:38:02,080
for the reference mission which

2730
01:38:06,390 --> 01:38:04,800
culminated into the uh workshop at the

2731
01:38:09,189 --> 01:38:06,400
lunar planetary lunar planetary

2732
01:38:11,669 --> 01:38:09,199
institute in november of 2013.

2733
01:38:13,430 --> 01:38:11,679
related to capture systems over 40 ideas

2734
01:38:14,629 --> 01:38:13,440
were actually submitted 10 of which were

2735
01:38:17,189 --> 01:38:14,639
reviewed

2736
01:38:18,070 --> 01:38:17,199
and presented so over the course of this

2737
01:38:20,229 --> 01:38:18,080
time

2738
01:38:21,910 --> 01:38:20,239

period the majority of the ideas that

2739
01:38:24,950 --> 01:38:21,920
we've received both internally and

2740
01:38:26,870 --> 01:38:24,960
externally can be basically uh

2741
01:38:30,229 --> 01:38:26,880
formed into two groups

2742
01:38:32,709 --> 01:38:30,239
one around a deployable bag or net which

2743
01:38:35,189 --> 01:38:32,719
encapsulates the asteroid and retrieves

2744
01:38:38,470 --> 01:38:35,199
it or the utilization of sort of large

2745
01:38:42,310 --> 01:38:38,480
manipulator robotic arm to capture the

2746
01:38:43,750 --> 01:38:42,320
knee or portion of it off a parent body

2747
01:38:45,669 --> 01:38:43,760
there were also many other what we

2748
01:38:47,830 --> 01:38:45,679
called subsystem concepts that could be

2749
01:38:49,669 --> 01:38:47,840
utilized in conjunction with the main

2750
01:38:51,590 --> 01:38:49,679
concept either improve its performance

2751
01:38:53,189 --> 01:38:51,600
or enhance its capability and i'll

2752
01:38:55,189 --> 01:38:53,199
mention a few here in a minute next

2753
01:38:57,270 --> 01:38:55,199
slide please

2754
01:38:59,510 --> 01:38:57,280
also as kristin mentioned he some of the

2755
01:39:01,990 --> 01:38:59,520
objectives of the baa is to build upon

2756
01:39:03,750 --> 01:39:02,000
the rfi inputs and the recommendations

2757
01:39:05,990 --> 01:39:03,760
coming out of the workshop

2758
01:39:06,950 --> 01:39:06,000
related to capture systems

2759
01:39:09,030 --> 01:39:06,960
the

2760
01:39:11,350 --> 01:39:09,040
we wanted to go investigate trades

2761
01:39:13,030 --> 01:39:11,360
trades against how to actually deploy

2762
01:39:15,030 --> 01:39:13,040
the capture bag

2763
01:39:16,470 --> 01:39:15,040

using a non-inflatable method so we

2764
01:39:18,070 --> 01:39:16,480
could contrast that against the

2765
01:39:19,990 --> 01:39:18,080
reference concept

2766
01:39:22,790 --> 01:39:20,000
while taking an in-depth look into the

2767
01:39:25,350 --> 01:39:22,800
complexity uh the mass of those systems

2768
01:39:26,470 --> 01:39:25,360
the d tumble and dynamics of the capture

2769
01:39:28,629 --> 01:39:26,480
event itself

2770
01:39:31,510 --> 01:39:28,639
as well as how to restrain and retract

2771
01:39:33,189 --> 01:39:31,520
the asteroid against the spacecraft

2772
01:39:35,830 --> 01:39:33,199
also at that time there was perceived

2773
01:39:37,910 --> 01:39:35,840
risk of damaging the large arrays and

2774
01:39:40,390 --> 01:39:37,920
antennas on the spacecraft during the

2775
01:39:42,709 --> 01:39:40,400
actual capture event and any tumbling

2776
01:39:44,310 --> 01:39:42,719
the asteroid so we are looking at

2777
01:39:46,390 --> 01:39:44,320
investigating ways to pre uh

2778
01:39:48,229 --> 01:39:46,400
precondition or detumble the asteroid

2779
01:39:50,149 --> 01:39:48,239
prior to the capture event

2780
01:39:52,229 --> 01:39:50,159
or look at ways to make the spacecraft

2781
01:39:53,590 --> 01:39:52,239
itself more robust against the event

2782
01:39:56,790 --> 01:39:53,600
itself

2783
01:40:02,070 --> 01:39:59,350
so now focusing in on the small asteroid

2784
01:40:04,709 --> 01:40:02,080
capture option

2785
01:40:06,870 --> 01:40:04,719
the key technical challenges here are

2786
01:40:09,910 --> 01:40:06,880
capturing and obviously de-spinning the

2787
01:40:12,550 --> 01:40:09,920
asteroid that has an uncertain mass

2788
01:40:14,390 --> 01:40:12,560

size shape and spin rate

2789
01:40:15,990 --> 01:40:14,400
while being composed of material that

2790
01:40:17,430 --> 01:40:16,000
may be made up of loose rocks or a

2791
01:40:19,590 --> 01:40:17,440
rubble pile

2792
01:40:21,990 --> 01:40:19,600
to mitigate some of that risk

2793
01:40:23,910 --> 01:40:22,000
related to this very low trl system nasa

2794
01:40:25,750 --> 01:40:23,920
is interested in developing

2795
01:40:27,910 --> 01:40:25,760
alternate designs for packaging

2796
01:40:29,750 --> 01:40:27,920
deploying closing and restraining the

2797
01:40:31,350 --> 01:40:29,760
capture bag

2798
01:40:33,030 --> 01:40:31,360
this would all be done in parallel with

2799
01:40:34,870 --> 01:40:33,040
the internal efforts here going at nasa

2800
01:40:37,109 --> 01:40:34,880
on the the reference concept of the

2801
01:40:39,430 --> 01:40:37,119
inflatable design and then would help us

2802
01:40:41,270 --> 01:40:39,440
inform ourselves in down selecting to a

2803
01:40:43,270 --> 01:40:41,280
single flight system for flight system

2804
01:40:47,109 --> 01:40:43,280
development

2805
01:40:50,149 --> 01:40:47,119
nasa is particularly interested in

2806
01:40:51,430 --> 01:40:50,159
looking at non-inflatable or hybrid ways

2807
01:40:53,350 --> 01:40:51,440
of deploying

2808
01:40:55,510 --> 01:40:53,360
and retracting the capture bag as well

2809
01:40:57,109 --> 01:40:55,520
as the materials that are used for those

2810
01:41:00,229 --> 01:40:57,119
systems that are compatible with deep

2811
01:41:02,470 --> 01:41:00,239
space long duration missions

2812
01:41:04,550 --> 01:41:02,480
some of the key driving requirements

2813
01:41:06,950 --> 01:41:04,560

for acquiring an entire nia

2814
01:41:09,590 --> 01:41:06,960
are being able to handle an asteroid

2815
01:41:12,149 --> 01:41:09,600
with a mean diameter between 4 and 10

2816
01:41:13,350 --> 01:41:12,159
meters with a maximum dimension up to 13

2817
01:41:15,109 --> 01:41:13,360
meters

2818
01:41:17,590 --> 01:41:15,119
it's expected that these asteroids could

2819
01:41:19,430 --> 01:41:17,600
have a mass up to a thousand metric tons

2820
01:41:21,189 --> 01:41:19,440
with rotational rates up to a half a

2821
01:41:23,109 --> 01:41:21,199
revolution per minute

2822
01:41:25,350 --> 01:41:23,119
and again the integrity of the asteroid

2823
01:41:27,510 --> 01:41:25,360
is unknown

2824
01:41:29,590 --> 01:41:27,520
proposals need to focus on the detail

2825
01:41:32,390 --> 01:41:29,600
technical approach of the design the

2826
01:41:34,950 --> 01:41:32,400
analysis the fabrication methods the

2827
01:41:36,950 --> 01:41:34,960
laboratory testing of a subscale concept

2828
01:41:38,790 --> 01:41:36,960
especially those

2829
01:41:41,109 --> 01:41:38,800
those techniques on how to validate the

2830
01:41:43,510 --> 01:41:41,119
system and the zero g operations in a 1g

2831
01:41:44,830 --> 01:41:43,520
environment

2832
01:41:47,350 --> 01:41:44,840
next

2833
01:41:48,950 --> 01:41:47,360
slide for the robotic bowler capture

2834
01:41:51,030 --> 01:41:48,960
option the key technical challenges here

2835
01:41:52,950 --> 01:41:51,040
are obviously the autonomous operations

2836
01:41:54,950 --> 01:41:52,960
in capturing of the extracting the

2837
01:41:56,870 --> 01:41:54,960
boulder from the surface while flying in

2838
01:41:59,669 --> 01:41:56,880

formation with the large impair the

2839
01:42:00,470 --> 01:41:59,679
larger parent body again the boulder

2840
01:42:02,550 --> 01:42:00,480
will be

2841
01:42:04,629 --> 01:42:02,560
characterized prior to capture but its

2842
01:42:07,189 --> 01:42:04,639
precise friability is likely to be

2843
01:42:09,430 --> 01:42:07,199
unknown in the capture process until the

2844
01:42:10,950 --> 01:42:09,440
capture process is underway

2845
01:42:13,750 --> 01:42:10,960
again here nasa is particularly

2846
01:42:16,229 --> 01:42:13,760
interested in the autonomous operations

2847
01:42:18,149 --> 01:42:16,239
refining the boulder capture sequence

2848
01:42:20,149 --> 01:42:18,159
including nominal and contingency

2849
01:42:21,590 --> 01:42:20,159
operation scenarios

2850
01:42:22,629 --> 01:42:21,600
development of end effectors and

2851
01:42:24,310 --> 01:42:22,639
grippers

2852
01:42:27,030 --> 01:42:24,320
supporting sensors and six stop

2853
01:42:28,629 --> 01:42:27,040
simulations of all operational phases

2854
01:42:31,430 --> 01:42:28,639
approaches for determining mechanical

2855
01:42:33,109 --> 01:42:31,440
strength of the boulder prior to capture

2856
01:42:34,470 --> 01:42:33,119
and contingency sample collection

2857
01:42:35,990 --> 01:42:34,480
concepts

2858
01:42:37,750 --> 01:42:36,000
some of the key driving requirements for

2859
01:42:40,629 --> 01:42:37,760
this option are here to accommodate a

2860
01:42:42,390 --> 01:42:40,639
bowler between one and five meters

2861
01:42:45,109 --> 01:42:42,400
extent in any direction

2862
01:42:47,990 --> 01:42:45,119
with a mass of up to 30 metric tons

2863
01:42:49,990 --> 01:42:48,000

a compressive strength of greater than

2864
01:42:52,310 --> 01:42:50,000
0.3 megapascals

2865
01:42:54,870 --> 01:42:52,320
and with a parent asteroid rotation rate

2866
01:42:56,390 --> 01:42:54,880
less than one-third revolution per hour

2867
01:42:58,149 --> 01:42:56,400
you'll also notice on the chart and in

2868
01:42:59,189 --> 01:42:58,159
the broad area or the broad agency

2869
01:43:00,070 --> 01:42:59,199
announcement

2870
01:43:04,070 --> 01:43:00,080
that

2871
01:43:06,709 --> 01:43:04,080
can be expanded or extended up to larger

2872
01:43:09,430 --> 01:43:06,719
asteroid and those increased driving

2873
01:43:12,870 --> 01:43:09,440
requirements are specified

2874
01:43:14,629 --> 01:43:12,880
again with this proposal uh the options

2875
01:43:17,189 --> 01:43:14,639
i need to focus on the technical design

2876
01:43:18,870 --> 01:43:17,199
approach uh launch packaging including

2877
01:43:19,830 --> 01:43:18,880
launch analysis will be critical to the

2878
01:43:22,390 --> 01:43:19,840
system

2879
01:43:24,149 --> 01:43:22,400
simulation analysis fabrication and

2880
01:43:25,669 --> 01:43:24,159
laboratory testing of a subscale system

2881
01:43:28,149 --> 01:43:25,679
again to validate these zero g

2882
01:43:29,990 --> 01:43:28,159
operations in a 1g environment

2883
01:43:31,669 --> 01:43:30,000
that's all i have today thank you very

2884
01:43:33,270 --> 01:43:31,679
much next i'd like to introduce my

2885
01:43:35,590 --> 01:43:33,280
colleague from jsc heather hinkle we'll

2886
01:43:36,950 --> 01:43:35,600
talk about rendezvous sensors thanks

2887
01:43:38,470 --> 01:43:36,960
jason

2888
01:43:40,310 --> 01:43:38,480

i'm heather hinkle i have the privilege

2889
01:43:42,310 --> 01:43:40,320
to talk to you today about rendezvous

2890
01:43:45,430 --> 01:43:42,320
sensors and it's one of the appendices

2891
01:43:46,229 --> 01:43:45,440
in the baa next slide please

2892
01:43:48,950 --> 01:43:46,239
so

2893
01:43:51,910 --> 01:43:48,960
over the formulation of these missions

2894
01:43:54,390 --> 01:43:51,920
it occurred to us that as dan and brian

2895
01:43:56,070 --> 01:43:54,400
mentioned earlier autonomous renewing

2896
01:43:57,750 --> 01:43:56,080
docking and capturing these asteroids

2897
01:43:59,350 --> 01:43:57,760
are all very similar docking and

2898
01:44:01,990 --> 01:43:59,360
capturing those asteroids and all the

2899
01:44:03,669 --> 01:44:02,000
precision that you need to do those

2900
01:44:05,590 --> 01:44:03,679
operations are very similar so we

2901
01:44:07,510 --> 01:44:05,600
stepped back and formed a multi-center

2902
01:44:10,470 --> 01:44:07,520
team and we looked at

2903
01:44:12,229 --> 01:44:10,480
can we if we step back and and look at

2904
01:44:13,430 --> 01:44:12,239
all the missions needs from across their

2905
01:44:16,070 --> 01:44:13,440
ar d

2906
01:44:17,669 --> 01:44:16,080
can we get a set of sensors that can

2907
01:44:20,149 --> 01:44:17,679
operate for all of these missions and

2908
01:44:21,990 --> 01:44:20,159
meet their needs so

2909
01:44:24,229 --> 01:44:22,000
along with the rfis that we received

2910
01:44:26,229 --> 01:44:24,239
from the community we really

2911
01:44:28,870 --> 01:44:26,239
discovered that everybody is using a

2912
01:44:30,870 --> 01:44:28,880
very similar set of things so what we we

2913
01:44:32,629 --> 01:44:30,880

came down to is yeah we think we can do

2914
01:44:34,550 --> 01:44:32,639
this with a common suite of sensors for

2915
01:44:37,430 --> 01:44:34,560
all of these missions both the robotic

2916
01:44:38,870 --> 01:44:37,440
concepts and the crude mission so

2917
01:44:40,470 --> 01:44:38,880
what it came down to were visible

2918
01:44:42,950 --> 01:44:40,480
cameras were a very important part of

2919
01:44:44,709 --> 01:44:42,960
all of the sensor suites and we kind of

2920
01:44:46,470 --> 01:44:44,719
pared it down to medium resolution high

2921
01:44:48,310 --> 01:44:46,480
resolution you could also think of those

2922
01:44:49,910 --> 01:44:48,320
as narrow angle cameras and wide angle

2923
01:44:51,189 --> 01:44:49,920
cameras based on the job that they're

2924
01:44:54,070 --> 01:44:51,199
doing during their portion of the

2925
01:44:55,750 --> 01:44:54,080
mission so we tried to separate that out

2926
01:44:58,310 --> 01:44:55,760
from what kind of lens you're using

2927
01:45:00,950 --> 01:44:58,320
because the lenses is very specific and

2928
01:45:02,550 --> 01:45:00,960
configurable permission needs but medium

2929
01:45:04,709 --> 01:45:02,560
and high resolution cameras were an

2930
01:45:06,629 --> 01:45:04,719
important part of the suite um also

2931
01:45:09,830 --> 01:45:06,639
three-dimensional lidars whether

2932
01:45:12,390 --> 01:45:09,840
scanning or flash um that's a critical

2933
01:45:14,149 --> 01:45:12,400
part of the near operations for docking

2934
01:45:17,669 --> 01:45:14,159
or capturing the asteroid or capturing

2935
01:45:19,990 --> 01:45:17,679
the boulder so when

2936
01:45:21,669 --> 01:45:20,000
when you get into that phase having that

2937
01:45:24,390 --> 01:45:21,679
knowledge in three dimensions is very

2938
01:45:26,070 --> 01:45:24,400

important um another part of the mission

2939
01:45:28,390 --> 01:45:26,080
and it was in many of the rfis we

2940
01:45:30,390 --> 01:45:28,400
received were infrared cameras and nasa

2941
01:45:32,790 --> 01:45:30,400
recognizes there's a very good potential

2942
01:45:34,709 --> 01:45:32,800
for infrared cameras for the future and

2943
01:45:36,229 --> 01:45:34,719
there's a lot of capability there and

2944
01:45:38,149 --> 01:45:36,239
they're really kind of considered as a

2945
01:45:40,070 --> 01:45:38,159
robustness and situational awareness for

2946
01:45:41,910 --> 01:45:40,080
these missions so we've included that as

2947
01:45:44,790 --> 01:45:41,920
a part of the suite and in looking

2948
01:45:46,550 --> 01:45:44,800
forward so offers to the baa are welcome

2949
01:45:48,950 --> 01:45:46,560
to submit for a single sensor or

2950
01:45:51,350 --> 01:45:48,960
multiple sensors the whole suite we're

2951
01:45:53,270 --> 01:45:51,360
very open to whatever your company has

2952
01:45:55,030 --> 01:45:53,280
to offer

2953
01:45:57,270 --> 01:45:55,040
what nasa did was create a common

2954
01:45:59,590 --> 01:45:57,280
specification based on the needs of the

2955
01:46:02,550 --> 01:45:59,600
three missions and picked what were the

2956
01:46:04,550 --> 01:46:02,560
driving things per each mission in the

2957
01:46:06,709 --> 01:46:04,560
areas of environment and in the areas of

2958
01:46:09,590 --> 01:46:06,719
performance to do rendezvous proximity

2959
01:46:11,270 --> 01:46:09,600
operations and docking or capture next

2960
01:46:13,189 --> 01:46:11,280
slide please

2961
01:46:15,189 --> 01:46:13,199
so this is just a very high level

2962
01:46:17,030 --> 01:46:15,199
concept of operations and the appendix

2963
01:46:19,510 --> 01:46:17,040

has a lot more detail about the concepts

2964
01:46:21,669 --> 01:46:19,520
of operation for a r d for all three of

2965
01:46:23,830 --> 01:46:21,679
the missions so as you can see for the

2966
01:46:26,709 --> 01:46:23,840
crude operations in the long and and

2967
01:46:28,629 --> 01:46:26,719
medium range there's a couple of

2968
01:46:30,709 --> 01:46:28,639
specific things that are needed because

2969
01:46:33,030 --> 01:46:30,719
a crew timeline is so short during this

2970
01:46:35,030 --> 01:46:33,040
phase so they have a matter of hours to

2971
01:46:35,990 --> 01:46:35,040
perform this whole thing versus weeks or

2972
01:46:38,149 --> 01:46:36,000
days

2973
01:46:39,910 --> 01:46:38,159
for the robotic missions so there's an

2974
01:46:41,910 --> 01:46:39,920
s-band transponder that's not a part of

2975
01:46:43,669 --> 01:46:41,920
the common suite the far right column

2976
01:46:45,669 --> 01:46:43,679
will show you which of these missions

2977
01:46:47,590 --> 01:46:45,679
what they use from the common suite so

2978
01:46:49,430 --> 01:46:47,600
s-band transponder star tracker for

2979
01:46:51,109 --> 01:46:49,440
bearing

2980
01:46:52,790 --> 01:46:51,119
instead of flying a narrow angle camera

2981
01:46:54,870 --> 01:46:52,800
and then a high-resolution camera for

2982
01:46:57,270 --> 01:46:54,880
bearing as well as a backup then as you

2983
01:46:59,189 --> 01:46:57,280
get closer as mentioned the 3d lidar

2984
01:47:00,629 --> 01:46:59,199
comes into play and this is to allow

2985
01:47:02,550 --> 01:47:00,639
precise alignment of the docking

2986
01:47:04,390 --> 01:47:02,560
mechanisms to perform the docking we

2987
01:47:07,030 --> 01:47:04,400
also use the high resolution camera to

2988
01:47:09,270 --> 01:47:07,040

perform this operation so then moving

2989
01:47:11,350 --> 01:47:09,280
into the small asteroid capture

2990
01:47:13,030 --> 01:47:11,360
they have a narrow angle camera where we

2991
01:47:15,109 --> 01:47:13,040
call medium resolution camera in the

2992
01:47:17,109 --> 01:47:15,119
common suite and that's used for all the

2993
01:47:19,350 --> 01:47:17,119
far out operations starting at 50 000

2994
01:47:20,790 --> 01:47:19,360
kilometers for acquiring the asteroid

2995
01:47:22,870 --> 01:47:20,800
for characterizing it and determining

2996
01:47:24,550 --> 01:47:22,880
the spin rate and all the things as they

2997
01:47:26,709 --> 01:47:24,560
move closer

2998
01:47:29,270 --> 01:47:26,719
and then transitioning over again into a

2999
01:47:31,590 --> 01:47:29,280
3d lidar so that

3000
01:47:33,510 --> 01:47:31,600
as the bag is starting to get closer and

3001
01:47:35,830 --> 01:47:33,520
closer you are able to see the entire

3002
01:47:37,189 --> 01:47:35,840
asteroid and the edges of that asteroid

3003
01:47:38,870 --> 01:47:37,199
as you enter the bag and someone

3004
01:47:40,070 --> 01:47:38,880
mentioned in a question

3005
01:47:41,910 --> 01:47:40,080
about the fields of view of these

3006
01:47:44,790 --> 01:47:41,920
sensors that is one of the key drivers

3007
01:47:47,270 --> 01:47:44,800
that comes out of this common uh spec

3008
01:47:48,709 --> 01:47:47,280
that we came up with is that is

3009
01:47:50,070 --> 01:47:48,719
something that's necessary it's a wider

3010
01:47:52,070 --> 01:47:50,080
field of vc you can see that whole

3011
01:47:54,070 --> 01:47:52,080
asteroid entering the bag

3012
01:47:55,270 --> 01:47:54,080
and moving into the robotic boulder

3013
01:47:57,270 --> 01:47:55,280

capture

3014
01:47:58,629 --> 01:47:57,280
there's sort of two ar d's here one you

3015
01:48:00,550 --> 01:47:58,639
have to get yourself to the larger

3016
01:48:02,229 --> 01:48:00,560
asteroid and during that use a medium

3017
01:48:04,470 --> 01:48:02,239
resolution camera you're getting bearing

3018
01:48:07,350 --> 01:48:04,480
to the asteroid as you get closer you do

3019
01:48:09,590 --> 01:48:07,360
those flybys and you start transitioning

3020
01:48:10,470 --> 01:48:09,600
to multiple cameras so that now not only

3021
01:48:11,990 --> 01:48:10,480
are you

3022
01:48:14,229 --> 01:48:12,000
navigating yourself around but you're

3023
01:48:15,990 --> 01:48:14,239
also identifying features on the surface

3024
01:48:18,310 --> 01:48:16,000
identifying target boulders that you can

3025
01:48:19,830 --> 01:48:18,320
go and grab then as you get closer and

3026
01:48:21,910 --> 01:48:19,840
you start getting ready to approach a

3027
01:48:23,990 --> 01:48:21,920
boulder you transition again to a 3d

3028
01:48:26,870 --> 01:48:24,000
lidar and you get all the

3029
01:48:28,950 --> 01:48:26,880
precise ranging and attitude information

3030
01:48:30,950 --> 01:48:28,960
to go and approach that asteroid at

3031
01:48:33,669 --> 01:48:30,960
those slow rates you saw in the video

3032
01:48:35,910 --> 01:48:33,679
and grab that asteroid with your arms

3033
01:48:38,229 --> 01:48:35,920
and capture it to leave the surface

3034
01:48:40,149 --> 01:48:38,239
so their cameras and lidars are used in

3035
01:48:42,310 --> 01:48:40,159
that phase as well and again infrared

3036
01:48:44,149 --> 01:48:42,320
cameras are being looked at as a part of

3037
01:48:46,390 --> 01:48:44,159
robustness for these

3038
01:48:47,510 --> 01:48:46,400

all these mission concepts next slide

3039
01:48:51,350 --> 01:48:47,520
please

3040
01:48:53,910 --> 01:48:51,360
so in the baa we intend to fund

3041
01:48:55,750 --> 01:48:53,920
vendors to look at existing

3042
01:48:58,310 --> 01:48:55,760
sensors out there cameras and 3d

3043
01:49:00,870 --> 01:48:58,320
lighters and infrared cameras and design

3044
01:49:02,470 --> 01:49:00,880
and risk reduction technology maturation

3045
01:49:04,229 --> 01:49:02,480
so we've included a lot of information

3046
01:49:06,149 --> 01:49:04,239
for you about the concepts of operation

3047
01:49:07,430 --> 01:49:06,159
we have further details if needed on the

3048
01:49:08,550 --> 01:49:07,440
website

3049
01:49:10,229 --> 01:49:08,560
we've included those common

3050
01:49:13,270 --> 01:49:10,239
specification tables i mentioned for the

3051
01:49:15,590 --> 01:49:13,280
environmental and the performance

3052
01:49:18,470 --> 01:49:15,600
we also are requesting as part of the

3053
01:49:20,470 --> 01:49:18,480
baa ideas since we know as technology

3054
01:49:22,550 --> 01:49:20,480
increases how are we able to go ahead

3055
01:49:24,870 --> 01:49:22,560
and feed these technologies into this

3056
01:49:27,430 --> 01:49:24,880
common suite and maybe incrementally

3057
01:49:29,669 --> 01:49:27,440
upgrade as time goes on we have other

3058
01:49:31,750 --> 01:49:29,679
missions like satellite servicing

3059
01:49:33,669 --> 01:49:31,760
very similar to descent and landing

3060
01:49:35,109 --> 01:49:33,679
missions and hazard avoidance there's a

3061
01:49:36,229 --> 01:49:35,119
lot of other nasa missions out there

3062
01:49:38,229 --> 01:49:36,239
that could take advantage of these

3063
01:49:40,709 --> 01:49:38,239

things we'd like to see what your ideas

3064
01:49:42,229 --> 01:49:40,719
are to evolve this suite as technology

3065
01:49:43,910 --> 01:49:42,239
advances

3066
01:49:45,430 --> 01:49:43,920
we also have a lot of detail in there

3067
01:49:47,750 --> 01:49:45,440
about what we'd like you to answer as a

3068
01:49:49,109 --> 01:49:47,760
part of your proposal

3069
01:49:50,870 --> 01:49:49,119
so we're really looking forward to your

3070
01:49:53,510 --> 01:49:50,880
ideas i think this is a great way for

3071
01:49:55,990 --> 01:49:53,520
the agency to find collaboration and

3072
01:49:58,229 --> 01:49:56,000
save money across the programs and we

3073
01:50:00,310 --> 01:49:58,239
look forward to your responses thank you

3074
01:50:03,830 --> 01:50:00,320
i'd like to next introduce mike barrett

3075
01:50:05,350 --> 01:50:03,840
from glenn thanks thanks heather

3076
01:50:07,109 --> 01:50:05,360
so i'm mike barrett i'm from glen

3077
01:50:09,430 --> 01:50:07,119
research center i'm leading the

3078
01:50:10,790 --> 01:50:09,440
development activity for the sap module

3079
01:50:12,149 --> 01:50:10,800
in the reference configuration and then

3080
01:50:13,830 --> 01:50:12,159
also coordinating

3081
01:50:15,590 --> 01:50:13,840
the portion of the baa related to the

3082
01:50:16,950 --> 01:50:15,600
adaptation of commercial spacecraft or

3083
01:50:19,030 --> 01:50:16,960
capabilities

3084
01:50:22,709 --> 01:50:19,040
primarily to reduce development costs

3085
01:50:26,390 --> 01:50:24,790
and so you can see in the baa

3086
01:50:28,229 --> 01:50:26,400
the primary objective of this section

3087
01:50:30,709 --> 01:50:28,239
appendix c in the baa is to reduce

3088
01:50:32,550 --> 01:50:30,719

development cost so you heard earlier

3089
01:50:34,470 --> 01:50:32,560
with the first panel brian and dan gave

3090
01:50:36,390 --> 01:50:34,480
you a brief summary of the reference

3091
01:50:38,790 --> 01:50:36,400
configurations that we have

3092
01:50:41,270 --> 01:50:38,800
for the internal design work uh the the

3093
01:50:42,950 --> 01:50:41,280
message here for related to sap

3094
01:50:45,430 --> 01:50:42,960
particularly the set module in both of

3095
01:50:47,510 --> 01:50:45,440
those designs is essentially the same so

3096
01:50:49,350 --> 01:50:47,520
we have those reference configurations

3097
01:50:52,070 --> 01:50:49,360
um and then we have the associated cost

3098
01:50:54,310 --> 01:50:52,080
and schedule estimates uh with them so

3099
01:50:55,830 --> 01:50:54,320
really what appendix c of this baa

3100
01:50:57,430 --> 01:50:55,840
allows us to do is it affords the

3101
01:50:59,590 --> 01:50:57,440
opportunity for us to solicit u.s

3102
01:51:01,750 --> 01:50:59,600
industry for your input

3103
01:51:03,590 --> 01:51:01,760
and to assess whether or not we can take

3104
01:51:05,590 --> 01:51:03,600
advantage of some existing commercial

3105
01:51:08,229 --> 01:51:05,600
assets whether it's spacecraft whether

3106
01:51:10,310 --> 01:51:08,239
it's spacecraft design modified or other

3107
01:51:12,229 --> 01:51:10,320
capabilities again to reduce development

3108
01:51:16,070 --> 01:51:12,239
costs as we move forward in developing

3109
01:51:19,830 --> 01:51:18,149
these the appendix is looking for

3110
01:51:20,790 --> 01:51:19,840
industry-led studies their concept

3111
01:51:22,149 --> 01:51:20,800
studies

3112
01:51:24,390 --> 01:51:22,159
and so

3113
01:51:26,390 --> 01:51:24,400

that appendix will allow us

3114
01:51:28,390 --> 01:51:26,400
to get your your inputs for that compare

3115
01:51:30,470 --> 01:51:28,400
them to the baseline we do intend to use

3116
01:51:32,870 --> 01:51:30,480
the results of

3117
01:51:35,030 --> 01:51:32,880
these proposals uh in the mcr in the

3118
01:51:37,189 --> 01:51:35,040
mission concept review in the february

3119
01:51:38,950 --> 01:51:37,199
15 time frame

3120
01:51:40,310 --> 01:51:38,960
you'll notice in the in the wording in

3121
01:51:42,790 --> 01:51:40,320
the baa

3122
01:51:43,589 --> 01:51:42,800
it talks about the feed forward aspects

3123
01:51:45,589 --> 01:51:43,599
of

3124
01:51:48,470 --> 01:51:45,599
not just an sap module but perhaps a

3125
01:51:50,470 --> 01:51:48,480
combined scp module and mission module

3126
01:51:52,390 --> 01:51:50,480
i think it uses the word spacecraft or

3127
01:51:55,350 --> 01:51:52,400
scp-tug

3128
01:51:57,990 --> 01:51:55,360
but some type of transport vehicle

3129
01:51:59,910 --> 01:51:58,000
with definitely applicability to arm but

3130
01:52:01,990 --> 01:51:59,920
you've heard the recurring theme

3131
01:52:04,390 --> 01:52:02,000
all afternoon about the feed forward

3132
01:52:05,830 --> 01:52:04,400
aspects of the mission and the vehicle

3133
01:52:08,390 --> 01:52:05,840
particularly with respect to our ability

3134
01:52:10,950 --> 01:52:08,400
to move assets for future exploration

3135
01:52:12,629 --> 01:52:10,960
activities so definitely we would like

3136
01:52:14,070 --> 01:52:12,639
the proposals to focus

3137
01:52:15,270 --> 01:52:14,080
not only on arm but on how it feeds

3138
01:52:16,950 --> 01:52:15,280

forward based on the material that

3139
01:52:18,709 --> 01:52:16,960
you've heard today and you've been given

3140
01:52:20,470 --> 01:52:18,719
on the website

3141
01:52:22,550 --> 01:52:20,480
i just do need to note so in terms of

3142
01:52:24,790 --> 01:52:22,560
eligibility of the participants

3143
01:52:27,030 --> 01:52:24,800
this is restricted to u.s industry and

3144
01:52:29,030 --> 01:52:27,040
for our industry friends in the audience

3145
01:52:31,030 --> 01:52:29,040
we also do not want you to team with a

3146
01:52:32,870 --> 01:52:31,040
nasa center over with jpl

3147
01:52:34,149 --> 01:52:32,880
in your preparation of these proposals

3148
01:52:35,430 --> 01:52:34,159
so there were some questions that we got

3149
01:52:37,350 --> 01:52:35,440
earlier about that

3150
01:52:39,510 --> 01:52:37,360
and so it's not only just a u.s

3151
01:52:40,870 --> 01:52:39,520
industry-led proposal activity but

3152
01:52:42,790 --> 01:52:40,880
there's no teaming

3153
01:52:44,550 --> 01:52:42,800
that's allowed on these proposals with

3154
01:52:47,109 --> 01:52:44,560
other nasa entities

3155
01:52:48,870 --> 01:52:47,119
next chart please

3156
01:52:50,870 --> 01:52:48,880
so i just wanted to point out some of

3157
01:52:52,550 --> 01:52:50,880
the uh i won't call them requirements

3158
01:52:53,669 --> 01:52:52,560
i'll call them considerations

3159
01:52:55,350 --> 01:52:53,679
at this point

3160
01:52:57,270 --> 01:52:55,360
but it lets you know what we're doing

3161
01:52:59,430 --> 01:52:57,280
internally in terms of how we're

3162
01:53:01,030 --> 01:52:59,440
assessing different design options

3163
01:53:02,709 --> 01:53:01,040

so you need to be aware of these as you

3164
01:53:04,790 --> 01:53:02,719
look at how to adapt

3165
01:53:07,430 --> 01:53:04,800
or to just basically use the spacecraft

3166
01:53:09,030 --> 01:53:07,440
designs that you may have in pocket

3167
01:53:10,470 --> 01:53:09,040
certainly the arv needs to be capable

3168
01:53:11,430 --> 01:53:10,480
being launched on a single launch

3169
01:53:13,109 --> 01:53:11,440
vehicle

3170
01:53:15,430 --> 01:53:13,119
and currently we've looked at atlas 5

3171
01:53:16,870 --> 01:53:15,440
delta iv heavy falcon heavy or sls for

3172
01:53:18,070 --> 01:53:16,880
those launch vehicles

3173
01:53:19,669 --> 01:53:18,080
brian showed you a chart earlier about

3174
01:53:21,510 --> 01:53:19,679
what that launch vehicle selection does

3175
01:53:23,669 --> 01:53:21,520
in terms of ability to return mass or

3176
01:53:25,270 --> 01:53:23,679
timelines as well

3177
01:53:26,629 --> 01:53:25,280
the solar electric propulsion system in

3178
01:53:29,669 --> 01:53:26,639
the module

3179
01:53:31,350 --> 01:53:29,679
is a end-user of about 40 kilowatts

3180
01:53:33,430 --> 01:53:31,360
at the beginning of life

3181
01:53:35,589 --> 01:53:33,440
the thrusters that are being used are

3182
01:53:37,589 --> 01:53:35,599
hall thrusters on the reference design

3183
01:53:39,189 --> 01:53:37,599
but the specific impulse that we're

3184
01:53:41,109 --> 01:53:39,199
working to is between two and 3000

3185
01:53:44,310 --> 01:53:41,119
seconds the vehicle in terms of

3186
01:53:45,510 --> 01:53:44,320
environments has to handle 0.7 to 1.7 au

3187
01:53:48,229 --> 01:53:45,520
regarding

3188
01:53:50,310 --> 01:53:48,239

radiation temperature control com

3189
01:53:52,709 --> 01:53:50,320
currently the design that we're looking

3190
01:53:54,470 --> 01:53:52,719
at has a maximum capacity of 10 metric

3191
01:53:56,470 --> 01:53:54,480
tons of storage of xenon

3192
01:53:58,709 --> 01:53:56,480
a lot of the mission designs for arm

3193
01:54:01,189 --> 01:53:58,719
don't require that much mass of xenon

3194
01:54:02,550 --> 01:54:01,199
but again as you heard earlier

3195
01:54:03,750 --> 01:54:02,560
not only is the architecture being

3196
01:54:05,189 --> 01:54:03,760
capability

3197
01:54:06,709 --> 01:54:05,199
driven in terms of design but all the

3198
01:54:08,629 --> 01:54:06,719
way down to the module right in this

3199
01:54:10,390 --> 01:54:08,639
mission it's very much a capability

3200
01:54:12,709 --> 01:54:10,400
driven design at this point and so the

3201
01:54:14,790 --> 01:54:12,719
maximum is 10 metric tons

3202
01:54:17,350 --> 01:54:14,800
but certainly as low as two metric tons

3203
01:54:18,709 --> 01:54:17,360
we would entertain looking at

3204
01:54:20,470 --> 01:54:18,719
operational lifetime is six years in

3205
01:54:22,709 --> 01:54:20,480
deep space all right so that also

3206
01:54:23,750 --> 01:54:22,719
affects in terms of red tolerance of the

3207
01:54:24,950 --> 01:54:23,760
systems

3208
01:54:26,550 --> 01:54:24,960
and then

3209
01:54:28,550 --> 01:54:26,560
certainly depending on which mission we

3210
01:54:31,270 --> 01:54:28,560
end up with how we would implement a

3211
01:54:34,470 --> 01:54:31,280
highly reliable system would be open

3212
01:54:36,470 --> 01:54:34,480
to design consideration in trades but

3213
01:54:38,870 --> 01:54:36,480

at this point you need to take a look at

3214
01:54:40,790 --> 01:54:38,880
both of the references

3215
01:54:42,629 --> 01:54:40,800
in terms of capturing a smaller asteroid

3216
01:54:45,109 --> 01:54:42,639
or going in

3217
01:54:46,390 --> 01:54:45,119
to a larger asteroid in terms of proxops

3218
01:54:47,669 --> 01:54:46,400
in either case

3219
01:54:49,189 --> 01:54:47,679
and think about the what's an

3220
01:54:50,870 --> 01:54:49,199
appropriate level of redundancy in which

3221
01:54:52,310 --> 01:54:50,880
systems in the designs that we might

3222
01:54:54,470 --> 01:54:52,320
need so that we have an acceptable

3223
01:54:56,870 --> 01:54:54,480
reliability at the system level

3224
01:54:58,149 --> 01:54:56,880
next chart

3225
01:55:00,790 --> 01:54:58,159
so this is my one chart just to

3226
01:55:03,270 --> 01:55:00,800
emphasize in terms of capability driven

3227
01:55:05,109 --> 01:55:03,280
aspects of the design all right so the

3228
01:55:07,990 --> 01:55:05,119
set module obviously is a modular

3229
01:55:10,070 --> 01:55:08,000
element in the overall arv

3230
01:55:11,750 --> 01:55:10,080
the feed forward aspects of the design

3231
01:55:13,350 --> 01:55:11,760
it needs to have the smarts that are on

3232
01:55:15,189 --> 01:55:13,360
the mission module in our reference

3233
01:55:17,510 --> 01:55:15,199
configuration as well as we as we think

3234
01:55:18,709 --> 01:55:17,520
about that but primarily in terms of how

3235
01:55:20,390 --> 01:55:18,719
applicable and i'm trying to help you

3236
01:55:23,189 --> 01:55:20,400
here with your relevance

3237
01:55:24,550 --> 01:55:23,199
assessment criteria in the baa um we

3238
01:55:27,109 --> 01:55:24,560

need to be able to look at again not

3239
01:55:28,229 --> 01:55:27,119
only an armed mission and the asteroids

3240
01:55:29,750 --> 01:55:28,239
that are noted here for arm these are

3241
01:55:31,669 --> 01:55:29,760
notional curves but it gives you an idea

3242
01:55:34,550 --> 01:55:31,679
so that current capability that we have

3243
01:55:36,629 --> 01:55:34,560
in terms of maximum 3000 second thruster

3244
01:55:38,470 --> 01:55:36,639
specific impulse and a 10 metric ton

3245
01:55:40,870 --> 01:55:38,480
storage capacity right that puts us up

3246
01:55:43,589 --> 01:55:40,880
in the upper right corner of that chart

3247
01:55:46,550 --> 01:55:43,599
and as we deviate from that maximum

3248
01:55:48,709 --> 01:55:46,560
capacity we do two things that are

3249
01:55:50,950 --> 01:55:48,719
significant one we significantly reduce

3250
01:55:53,430 --> 01:55:50,960
the design space that we have for the

3251
01:55:54,950 --> 01:55:53,440
arm mission itself right and we're still

3252
01:55:55,830 --> 01:55:54,960
searching for the right asteroid to go

3253
01:55:58,310 --> 01:55:55,840
get

3254
01:56:00,070 --> 01:55:58,320
so maintaining the flexibility in that

3255
01:56:01,669 --> 01:56:00,080
design space is important but the other

3256
01:56:04,149 --> 01:56:01,679
thing that you do is you also begin to

3257
01:56:05,750 --> 01:56:04,159
limit how the sep

3258
01:56:08,070 --> 01:56:05,760
tug if you want to call it that how this

3259
01:56:09,589 --> 01:56:08,080
set tug feeds forward for exploration

3260
01:56:10,709 --> 01:56:09,599
and enables us to do different missions

3261
01:56:12,870 --> 01:56:10,719
downstream

3262
01:56:15,109 --> 01:56:12,880
so as you're looking at adapting your

3263
01:56:17,189 --> 01:56:15,119

existing spacecraft or a modification to

3264
01:56:19,510 --> 01:56:17,199
the design please do try to consider

3265
01:56:22,629 --> 01:56:19,520
that and how it feeds forward

3266
01:56:24,709 --> 01:56:22,639
that's all i had thank you

3267
01:56:27,030 --> 01:56:24,719
okay i'm andy petrow and i'm going to be

3268
01:56:29,510 --> 01:56:27,040
talking about potential future

3269
01:56:31,910 --> 01:56:29,520
partnerships for secondary payloads

3270
01:56:33,189 --> 01:56:31,920
next chart

3271
01:56:35,109 --> 01:56:33,199
okay the

3272
01:56:37,270 --> 01:56:35,119
payloads that we're talking about could

3273
01:56:38,310 --> 01:56:37,280
address commercial interests such as

3274
01:56:40,310 --> 01:56:38,320
asteroid

3275
01:56:41,910 --> 01:56:40,320
resource prospecting

3276
01:56:44,950 --> 01:56:41,920
demonstration of planetary defense

3277
01:56:47,189 --> 01:56:44,960
capabilities uh or address strategic

3278
01:56:50,709 --> 01:56:47,199
knowledge gaps for future human

3279
01:56:53,030 --> 01:56:50,719
exploration uh next chart

3280
01:56:55,109 --> 01:56:53,040
okay these are the types of secondary

3281
01:56:57,350 --> 01:56:55,119
payloads we're talking about uh they

3282
01:56:59,350 --> 01:56:57,360
could be a science instrument that is

3283
01:57:00,870 --> 01:56:59,360
attached to the armed vehicle mission

3284
01:57:02,950 --> 01:57:00,880
module

3285
01:57:04,709 --> 01:57:02,960
and that's something up to about 10

3286
01:57:07,109 --> 01:57:04,719
kilograms

3287
01:57:08,070 --> 01:57:07,119
and that's illustrated in the drawing

3288
01:57:09,910 --> 01:57:08,080

below

3289
01:57:12,310 --> 01:57:09,920
the envelope for that on the side of the

3290
01:57:14,310 --> 01:57:12,320
vehicle

3291
01:57:17,030 --> 01:57:14,320
it could be a spacecraft deployed from

3292
01:57:19,669 --> 01:57:17,040
the armed vehicle or launched separately

3293
01:57:21,589 --> 01:57:19,679
in the case of launching from the armed

3294
01:57:23,830 --> 01:57:21,599
vehicle we're talking about

3295
01:57:25,270 --> 01:57:23,840
cubesat payloads

3296
01:57:26,390 --> 01:57:25,280
and

3297
01:58:01,750 --> 01:57:26,400
a

3298
01:58:03,669 --> 01:58:01,760
regolith

3299
01:58:06,310 --> 01:58:03,679
or contingency sample collection

3300
01:58:08,550 --> 01:58:06,320
concepts that could uh be part of the

3301
01:58:10,950 --> 01:58:08,560
armed vehicle and again the drawing

3302
01:58:12,709 --> 01:58:10,960
below shows where those secondary

3303
01:58:15,430 --> 01:58:12,719
payloads could be accommodated on the

3304
01:58:18,790 --> 01:58:15,440
arm vehicle in the reference concept and

3305
01:58:20,790 --> 01:58:18,800
then on the right just show the

3306
01:58:24,310 --> 01:58:20,800
launch vehicle adapter for the space

3307
01:58:26,790 --> 01:58:24,320
launch system and the concept for

3308
01:58:29,189 --> 01:58:26,800
accommodating secondary payloads on that

3309
01:58:32,070 --> 01:58:29,199
launch vehicle uh these would be six to

3310
01:58:34,870 --> 01:58:32,080
12 view type payloads that would be

3311
01:58:38,149 --> 01:58:34,880
deployed from the vehicle

3312
01:58:39,750 --> 01:58:38,159
on an earth escape type trajectory

3313
01:58:41,189 --> 01:58:39,760

so we go to the next

3314
01:58:43,350 --> 01:58:41,199
chart

3315
01:58:44,550 --> 01:58:43,360
the awards for this we

3316
01:58:47,669 --> 01:58:44,560
would

3317
01:58:49,510 --> 01:58:47,679
consider preliminary feasibility studies

3318
01:58:51,669 --> 01:58:49,520
that would be funded

3319
01:58:53,270 --> 01:58:51,679
up to 50 000

3320
01:58:54,950 --> 01:58:53,280
each

3321
01:58:57,430 --> 01:58:54,960
under this baa

3322
01:58:59,510 --> 01:58:57,440
any future partnership agreement so

3323
01:59:00,950 --> 01:58:59,520
would be selected under a separate

3324
01:59:03,350 --> 01:59:00,960
solicitation

3325
01:59:05,750 --> 01:59:03,360
following this one

3326
01:59:07,589 --> 01:59:05,760
for the actual

3327
01:59:08,950 --> 01:59:07,599
partnership there would be no funding

3328
01:59:10,629 --> 01:59:08,960
provided for the development of the

3329
01:59:12,629 --> 01:59:10,639
payload

3330
01:59:15,669 --> 01:59:12,639
but for any selected

3331
01:59:18,550 --> 01:59:15,679
payloads nasa would be providing the

3332
01:59:20,550 --> 01:59:18,560
integration launch and mission operation

3333
01:59:22,229 --> 01:59:20,560
support at no cost

3334
01:59:24,629 --> 01:59:22,239
to the partner

3335
01:59:27,750 --> 01:59:24,639
the eligible partners

3336
01:59:29,430 --> 01:59:27,760
participants are listed there

3337
01:59:32,149 --> 01:59:29,440
i think we're

3338
01:59:33,510 --> 01:59:32,159

very anxious to see the ideas that all

3339
01:59:35,030 --> 01:59:33,520
of you are able to

3340
01:59:35,830 --> 01:59:35,040
provide for this

3341
01:59:37,270 --> 01:59:35,840
and

3342
01:59:38,950 --> 01:59:37,280
with that i'll turn it over to mark

3343
01:59:40,950 --> 01:59:38,960
mcdonald the next speaker

3344
01:59:43,109 --> 01:59:40,960
thank you

3345
01:59:44,470 --> 01:59:43,119
hi my name is mark mcdonald i lead the

3346
01:59:45,830 --> 01:59:44,480
advanced mission development group

3347
01:59:47,189 --> 01:59:45,840
supporting steve stitch on the crew

3348
01:59:48,709 --> 01:59:47,199
mission and i'm here to talk to you

3349
01:59:50,629 --> 01:59:48,719
today about the potential future

3350
01:59:53,030 --> 01:59:50,639
partnership supporting the crew mission

3351
01:59:55,189 --> 01:59:53,040
uh next slide please

3352
01:59:57,350 --> 01:59:55,199
i'm very excited about this particular

3353
01:59:59,830 --> 01:59:57,360
portion of the baa because we get to do

3354
02:00:02,070 --> 01:59:59,840
the fun stuff that looks forward to what

3355
02:00:02,950 --> 02:00:02,080
what mr bolden talked about and going to

3356
02:00:04,550 --> 02:00:02,960
mars

3357
02:00:06,390 --> 02:00:04,560
steve stitch had a

3358
02:00:09,109 --> 02:00:06,400
slide in his chart that showed how we

3359
02:00:12,070 --> 02:00:09,119
can use these arm technologies

3360
02:00:14,629 --> 02:00:12,080
to extend to a crude mission to phobos

3361
02:00:16,390 --> 02:00:14,639
the first human mission to a mars moon

3362
02:00:18,709 --> 02:00:16,400
to me that's really exciting when i when

3363
02:00:20,470 --> 02:00:18,719

i talk to the kids from intermediate

3364
02:00:22,870 --> 02:00:20,480
schools that's where they get pumped up

3365
02:00:25,189 --> 02:00:22,880
that's where my kids get pumped up so in

3366
02:00:27,109 --> 02:00:25,199
this in this portion of the baa we get

3367
02:00:29,510 --> 02:00:27,119
to listen to your ideas

3368
02:00:32,390 --> 02:00:29,520
so jason kruzan had some pitches in his

3369
02:00:34,870 --> 02:00:32,400
where he showed different modules using

3370
02:00:37,109 --> 02:00:34,880
these arm sep vehicles where we could do

3371
02:00:38,550 --> 02:00:37,119
deep space missions all right to go

3372
02:00:40,550 --> 02:00:38,560
farther than humans have ever gone

3373
02:00:43,030 --> 02:00:40,560
before to partner with international

3374
02:00:44,870 --> 02:00:43,040
partners to pursue interest with the

3375
02:00:46,390 --> 02:00:44,880
global exploration roadmap to go to the

3376
02:00:48,310 --> 02:00:46,400
back to the moon

3377
02:00:49,589 --> 02:00:48,320
so there's a lot of opportunity here for

3378
02:00:51,669 --> 02:00:49,599
partnerships

3379
02:00:53,510 --> 02:00:51,679
on a smaller scale there's partnership

3380
02:00:56,229 --> 02:00:53,520
opportunities on the crude mission to do

3381
02:00:59,270 --> 02:00:56,239
things like isru to utilize the asteroid

3382
02:01:01,830 --> 02:00:59,280
that we're capturing to do more with it

3383
02:01:03,430 --> 02:01:01,840
so next slide please

3384
02:01:04,950 --> 02:01:03,440
the challenge and that's that's what

3385
02:01:07,109 --> 02:01:04,960
makes it fun to work at nasa is they

3386
02:01:09,270 --> 02:01:07,119
don't give us easy stuff to do

3387
02:01:11,510 --> 02:01:09,280
all deep space missions are very mass

3388
02:01:13,589 --> 02:01:11,520

challenged and this one is no different

3389
02:01:15,350 --> 02:01:13,599
the crew mission is is limited to two

3390
02:01:17,189 --> 02:01:15,360
crew in order to get the mass down so

3391
02:01:19,270 --> 02:01:17,199
that the sls rocket can deliver the

3392
02:01:20,709 --> 02:01:19,280
orion to this distant retrograde over

3393
02:01:21,669 --> 02:01:20,719
farther than humans have ever gone

3394
02:01:24,709 --> 02:01:21,679
before

3395
02:01:26,550 --> 02:01:24,719
so adding more mass to do a partnership

3396
02:01:28,149 --> 02:01:26,560
payload or to do something on this

3397
02:01:30,310 --> 02:01:28,159
mission is challenging

3398
02:01:32,390 --> 02:01:30,320
so in the baa we not only want to hear

3399
02:01:33,510 --> 02:01:32,400
your ideas for partnering on the crew

3400
02:01:35,669 --> 02:01:33,520
mission

3401
02:01:37,430 --> 02:01:35,679
for things like isru and things to

3402
02:01:39,830 --> 02:01:37,440
better utilize the initial asteroid

3403
02:01:41,510 --> 02:01:39,840
mission but those ba proposals have to

3404
02:01:42,629 --> 02:01:41,520
consider how are we going to get the

3405
02:01:43,510 --> 02:01:42,639
mass there

3406
02:01:45,189 --> 02:01:43,520
so

3407
02:01:47,510 --> 02:01:45,199
there has to be consideration of the

3408
02:01:50,149 --> 02:01:47,520
total problem that we're solving

3409
02:01:52,149 --> 02:01:50,159
so on the extensibility things it opens

3410
02:01:54,310 --> 02:01:52,159
up more because now we can be we can

3411
02:01:56,149 --> 02:01:54,320
talk about concepts of adding modules

3412
02:01:58,229 --> 02:01:56,159
with additional launches in order to

3413
02:02:00,550 --> 02:01:58,239

enable future exploration missions like

3414
02:02:02,470 --> 02:02:00,560
i mentioned before for the moon and mars

3415
02:02:05,030 --> 02:02:02,480
so the eligibility requirements are

3416
02:02:06,950 --> 02:02:05,040
similar to what andy described so we

3417
02:02:08,950 --> 02:02:06,960
want to hear your ideas and we look

3418
02:02:10,229 --> 02:02:08,960
forward to a bright future with that

3419
02:02:13,669 --> 02:02:10,239
so with that i'm going to hand it back

3420
02:02:17,830 --> 02:02:15,910
okay thank you

3421
02:02:20,149 --> 02:02:17,840
these are some frequently asked

3422
02:02:23,189 --> 02:02:20,159
questions that we received in advance of

3423
02:02:24,870 --> 02:02:23,199
this forum so i'd like to go over the

3424
02:02:26,310 --> 02:02:24,880
answers to those

3425
02:02:28,870 --> 02:02:26,320
first and then we'll

3426
02:02:31,510 --> 02:02:28,880
open it up to further questions

3427
02:02:34,709 --> 02:02:31,520
so the first question was

3428
02:02:38,070 --> 02:02:34,719
can an organization submit more than one

3429
02:02:39,189 --> 02:02:38,080
proposal yes you can there's no limit on

3430
02:02:41,030 --> 02:02:39,199
the number of

3431
02:02:43,270 --> 02:02:41,040
proposals

3432
02:02:44,950 --> 02:02:43,280
per organization

3433
02:02:47,750 --> 02:02:44,960
the second question is can an

3434
02:02:48,950 --> 02:02:47,760
organization be awarded a study in more

3435
02:02:50,709 --> 02:02:48,960
than one

3436
02:02:52,950 --> 02:02:50,719
topic area

3437
02:02:55,830 --> 02:02:52,960
the answer is yes it depends on the

3438
02:02:57,830 --> 02:02:55,840

quality of proposals that we receive

3439
02:02:58,950 --> 02:02:57,840
but there is no restriction on having

3440
02:03:00,629 --> 02:02:58,960
multiple

3441
02:03:01,750 --> 02:03:00,639
awards from

3442
02:03:04,950 --> 02:03:01,760
the same

3443
02:03:11,750 --> 02:03:07,189
will each proposal be expected to

3444
02:03:14,149 --> 02:03:11,760
address only one of the baa topic areas

3445
02:03:18,149 --> 02:03:14,159
yes because we have different

3446
02:03:22,149 --> 02:03:18,159
eligibility and funding requirements

3447
02:03:25,109 --> 02:03:22,159
for each topic area so it's hard to

3448
02:03:27,990 --> 02:03:25,119
to span those different areas with a

3449
02:03:30,310 --> 02:03:28,000
single proposal

3450
02:03:32,470 --> 02:03:30,320
number four can an organization partner

3451
02:03:34,229 --> 02:03:32,480
with the nasa center or jpl on a

3452
02:03:35,910 --> 02:03:34,239
proposal

3453
02:03:36,870 --> 02:03:35,920
uh the answer is no

3454
02:03:39,350 --> 02:03:36,880
and

3455
02:03:41,510 --> 02:03:39,360
our intent is

3456
02:03:44,550 --> 02:03:41,520
not to have the government competing

3457
02:03:47,589 --> 02:03:44,560
with industry or academia the main

3458
02:03:49,189 --> 02:03:47,599
objective of this baa is to get

3459
02:03:51,589 --> 02:03:49,199
ideas and

3460
02:03:54,790 --> 02:03:51,599
system concepts from

3461
02:04:00,550 --> 02:03:57,350
we're also funding the nasa centers and

3462
02:04:04,070 --> 02:04:00,560
jpl for the asteroid redirect mission

3463
02:04:06,550 --> 02:04:04,080

internally so for those reasons

3464
02:04:10,709 --> 02:04:06,560
we've restricted participation by nasa

3465
02:04:13,270 --> 02:04:10,719
civil servants and jpl employees number

3466
02:04:15,990 --> 02:04:13,280
five can federally funded research and

3467
02:04:17,070 --> 02:04:16,000
development centers submit proposals

3468
02:04:19,830 --> 02:04:17,080
no

3469
02:04:22,470 --> 02:04:19,840
ffrdc's are government sponsored

3470
02:04:24,149 --> 02:04:22,480
organizations and again we don't

3471
02:04:26,790 --> 02:04:24,159
intend to have the government compete

3472
02:04:29,990 --> 02:04:26,800
against industry

3473
02:04:31,669 --> 02:04:30,000
we realized that the ba is not exactly

3474
02:04:33,350 --> 02:04:31,679
clear on this point

3475
02:04:36,629 --> 02:04:33,360
so we're going to

3476
02:04:38,950 --> 02:04:36,639
post the modification to clarify that

3477
02:04:40,470 --> 02:04:38,960
later today

3478
02:04:42,790 --> 02:04:40,480
so those are some of the common

3479
02:04:43,750 --> 02:04:42,800
questions we've received so far

3480
02:04:45,830 --> 02:04:43,760
um

3481
02:04:47,750 --> 02:04:45,840
and now we can open it up

3482
02:04:48,790 --> 02:04:47,760
for further questions

3483
02:04:50,149 --> 02:04:48,800
take some questions we have some

3484
02:04:52,070 --> 02:04:50,159
microphones

3485
02:04:55,669 --> 02:04:52,080
moving through the audience and we'll

3486
02:04:59,109 --> 02:04:57,109
with me all right

3487
02:05:01,350 --> 02:04:59,119
marshall events here

3488
02:05:03,669 --> 02:05:01,360

yes um so i have a couple of questions

3489
02:05:04,709 --> 02:05:03,679
which are also probably frequently asked

3490
02:05:06,550 --> 02:05:04,719
and they have to do with forum

3491
02:05:08,470 --> 02:05:06,560
participation

3492
02:05:10,310 --> 02:05:08,480
if your organization has arranged

3493
02:05:12,950 --> 02:05:10,320
relationships with foreign

3494
02:05:14,950 --> 02:05:12,960
entities like say subcontractors is that

3495
02:05:19,109 --> 02:05:14,960
an issue here and the related question

3496
02:05:26,790 --> 02:05:23,430
so foreign institutions may propose in

3497
02:05:28,709 --> 02:05:26,800
most cases except for

3498
02:05:31,430 --> 02:05:28,719
appendix c which is

3499
02:05:34,709 --> 02:05:31,440
restricted only to u.s industry

3500
02:05:38,950 --> 02:05:36,790
our relationship with a foreign

3501
02:05:40,070 --> 02:05:38,960
institution would be on a no exchange

3502
02:05:41,430 --> 02:05:40,080
funds

3503
02:05:43,669 --> 02:05:41,440
basis

3504
02:05:45,350 --> 02:05:43,679
so we would have to work out you know

3505
02:05:46,390 --> 02:05:45,360
international

3506
02:05:47,990 --> 02:05:46,400
agreements

3507
02:05:49,750 --> 02:05:48,000
that's not quite what i asked what i

3508
02:05:52,709 --> 02:05:49,760
asked was could a company for example

3509
02:05:54,550 --> 02:05:52,719
one of the companies i deal with has a

3510
02:05:56,310 --> 02:05:54,560
has a partnership or not a partnership

3511
02:05:59,030 --> 02:05:56,320
it has a subcontractor that's a foreign

3512
02:06:00,550 --> 02:05:59,040
country that's in the eu

3513
02:06:04,790 --> 02:06:00,560

is that

3514
02:06:08,470 --> 02:06:06,310
uh i

3515
02:06:10,229 --> 02:06:08,480
believe that's okay i i need to get back

3516
02:06:13,270 --> 02:06:10,239
to you on that there are restrictions in

3517
02:06:14,550 --> 02:06:13,280
the baa against uh having subcontractors

3518
02:06:17,189 --> 02:06:14,560
from china

3519
02:06:19,669 --> 02:06:17,199
so be sure and read that section

3520
02:06:23,109 --> 02:06:19,679
and then there is an explanation of the

3521
02:06:24,950 --> 02:06:23,119
itar regulations in the paa that you

3522
02:06:26,310 --> 02:06:24,960
must comply with

3523
02:06:28,149 --> 02:06:26,320
but i will i will

3524
02:06:31,350 --> 02:06:28,159
get back to you on that

3525
02:06:33,430 --> 02:06:31,360
subcontractor question

3526
02:06:35,189 --> 02:06:33,440
okay here in the middle section close to

3527
02:06:40,870 --> 02:06:35,199
where we just took a question

3528
02:06:48,149 --> 02:06:44,790
hi on the secondary payloads section

3529
02:06:51,189 --> 02:06:48,159
there's a very broad range of activities

3530
02:06:55,189 --> 02:06:51,199
from precursors out to

3531
02:06:57,350 --> 02:06:55,199
unrelated asteroids to helper spacecraft

3532
02:06:58,790 --> 02:06:57,360
for the arv

3533
02:07:01,510 --> 02:06:58,800
would you

3534
02:07:04,950 --> 02:07:01,520
allow encourage or discourage multiple

3535
02:07:06,069 --> 02:07:04,960
proposals from a single company in that

3536
02:07:08,149 --> 02:07:06,079
section

3537
02:07:11,109 --> 02:07:08,159
because the the range of things to be

3538
02:07:13,270 --> 02:07:11,119

addressed is very broad well again

3539
02:07:15,669 --> 02:07:13,280
referring back to the frequently asked

3540
02:07:18,149 --> 02:07:15,679
questions that i just answered

3541
02:07:21,189 --> 02:07:18,159
you can submit as many proposals as you

3542
02:07:23,589 --> 02:07:21,199
like and there's no limit per area even

3543
02:07:28,390 --> 02:07:23,599
in a single topic even in a single topic

3544
02:07:32,709 --> 02:07:30,550
hi joe cassidy aerojet rocketdyne i

3545
02:07:34,229 --> 02:07:32,719
guess this is for appendix c so i guess

3546
02:07:35,910 --> 02:07:34,239
for you mike

3547
02:07:37,990 --> 02:07:35,920
you mentioned that

3548
02:07:40,470 --> 02:07:38,000
your interest is in looking at these

3549
02:07:43,430 --> 02:07:40,480
concepts from cost reduction standpoint

3550
02:07:45,910 --> 02:07:43,440
or cost savings standpoint

3551
02:07:47,910 --> 02:07:45,920
what is the mechanism by which we can

3552
02:07:50,550 --> 02:07:47,920
get the data to be able to compare

3553
02:07:53,589 --> 02:07:50,560
against the government internal concepts

3554
02:07:57,430 --> 02:07:53,599
i'm not sure i'm not sure that you can

3555
02:08:00,790 --> 02:07:59,030
well what i would just say is make sure

3556
02:08:05,830 --> 02:08:00,800
that your offer is as competitive as you

3557
02:08:05,840 --> 02:08:10,310
other questions in the audience

3558
02:08:13,350 --> 02:08:11,669
okay let's go to twitter i think we have

3559
02:08:15,589 --> 02:08:13,360
one there we do we actually have a

3560
02:08:18,470 --> 02:08:15,599
couple of other questions on eligibility

3561
02:08:20,790 --> 02:08:18,480
which i'll kind of combine here

3562
02:08:22,149 --> 02:08:20,800
are not-for-profit institutions and

3563
02:08:24,870 --> 02:08:22,159

universities precluded from

3564
02:08:26,790 --> 02:08:24,880
participating in what about

3565
02:08:31,030 --> 02:08:26,800
individuals or

3566
02:08:35,109 --> 02:08:32,149
so

3567
02:08:36,550 --> 02:08:35,119
universities and non-profits may submit

3568
02:08:37,350 --> 02:08:36,560
proposals

3569
02:08:40,790 --> 02:08:37,360
they're

3570
02:08:43,830 --> 02:08:40,800
non-government institutions so those are

3571
02:08:49,589 --> 02:08:47,830
individuals may submit proposals if they

3572
02:08:50,790 --> 02:08:49,599
think they have the capabilities to

3573
02:08:52,069 --> 02:08:50,800
perform

3574
02:08:55,910 --> 02:08:52,079
the

3575
02:08:58,629 --> 02:08:55,920
have demonstrated experience but we will

3576
02:08:59,830 --> 02:08:58,639
look at that in the evaluation

3577
02:09:01,910 --> 02:08:59,840
and

3578
02:09:03,990 --> 02:09:01,920
i'm sorry what was the

3579
02:09:05,589 --> 02:09:04,000
other question small companies smaller

3580
02:09:06,950 --> 02:09:05,599
small companies absolutely they may

3581
02:09:08,149 --> 02:09:06,960
propose

3582
02:09:09,189 --> 02:09:08,159
there's no

3583
02:09:10,149 --> 02:09:09,199
limit

3584
02:09:18,310 --> 02:09:10,159
on

3585
02:09:18,320 --> 02:09:22,709
okay it's all the way in the back

3586
02:09:26,950 --> 02:09:25,270
hi quick question about the requirements

3587
02:09:29,430 --> 02:09:26,960
for the

3588
02:09:30,950 --> 02:09:29,440

space segment the scp

3589
02:09:34,149 --> 02:09:30,960
segment

3590
02:09:36,629 --> 02:09:34,159
you mentioned 3000 seconds and uh 10 000

3591
02:09:38,310 --> 02:09:36,639
kilograms of xenon as

3592
02:09:39,589 --> 02:09:38,320
the desired

3593
02:09:41,350 --> 02:09:39,599
level

3594
02:09:43,030 --> 02:09:41,360
that you'd like to see

3595
02:09:44,310 --> 02:09:43,040
i guess could encompass many of the

3596
02:09:46,550 --> 02:09:44,320
missions but

3597
02:09:49,030 --> 02:09:46,560
the question i have for you is um will

3598
02:09:52,149 --> 02:09:49,040
you make something more specific that

3599
02:09:54,470 --> 02:09:52,159
says that here are like the minimums

3600
02:09:58,229 --> 02:09:54,480
that you would like to see

3601
02:10:00,629 --> 02:09:58,239
as the solution space for this because

3602
02:10:03,030 --> 02:10:00,639
the differences can affect the system

3603
02:10:06,310 --> 02:10:03,040
dramatically as you can imagine so uh

3604
02:10:07,030 --> 02:10:06,320
having something a bit more specific to

3605
02:10:13,589 --> 02:10:07,040
to

3606
02:10:15,830 --> 02:10:13,599
so

3607
02:10:18,950 --> 02:10:15,840
in the current uh release of the baa

3608
02:10:21,830 --> 02:10:18,960
there are minimums so the 2 000 second

3609
02:10:23,750 --> 02:10:21,840
isp and the 2 000 kilogram

3610
02:10:24,709 --> 02:10:23,760
storage capacity are the low end of the

3611
02:10:25,910 --> 02:10:24,719
range

3612
02:10:27,589 --> 02:10:25,920
right

3613
02:10:29,030 --> 02:10:27,599

so

3614
02:10:33,669 --> 02:10:29,040
i'm not trying to be vague it's just

3615
02:10:37,109 --> 02:10:35,589
uncertainty of the objectives and what

3616
02:10:39,109 --> 02:10:37,119
would eventually be requirements right

3617
02:10:41,669 --> 02:10:39,119
so our current design

3618
02:10:43,910 --> 02:10:41,679
has picked that uh 10 metric ton and

3619
02:10:45,350 --> 02:10:43,920
3000 second design point which is on

3620
02:10:46,790 --> 02:10:45,360
that chart that i showed you but the

3621
02:10:48,390 --> 02:10:46,800
range that we've looked at and it's not

3622
02:10:51,030 --> 02:10:48,400
to say that there are not some missions

3623
02:10:52,709 --> 02:10:51,040
that would come in well below that

3624
02:10:54,390 --> 02:10:52,719
in fact most of the the mission studies

3625
02:10:57,510 --> 02:10:54,400
that we've done don't require 10 metric

3626
02:10:59,589 --> 02:10:57,520
tons of xenon but as soon as we again as

3627
02:11:02,390 --> 02:10:59,599
soon as we start to deviate from that

3628
02:11:04,550 --> 02:11:02,400
design space or to start to narrow that

3629
02:11:06,790 --> 02:11:04,560
that design space even just for arm we

3630
02:11:10,310 --> 02:11:06,800
also impact downstream so the range is

3631
02:11:12,310 --> 02:11:10,320
in there and um there may be you know a

3632
02:11:14,390 --> 02:11:12,320
degree of modification to existing

3633
02:11:15,750 --> 02:11:14,400
capabilities that would vary and i

3634
02:11:17,030 --> 02:11:15,760
imagine cost and schedule would vary

3635
02:11:18,310 --> 02:11:17,040
with that as well

3636
02:11:20,069 --> 02:11:18,320
and i can't tell you where the

3637
02:11:22,950 --> 02:11:20,079
attractive point would be at this point

3638
02:11:24,709 --> 02:11:22,960

because frankly for arm in particular

3639
02:11:26,149 --> 02:11:24,719
the observation campaign will be a huge

3640
02:11:27,350 --> 02:11:26,159
factor right on what drives us to a

3641
02:11:28,390 --> 02:11:27,360
final set of requirements for that

3642
02:11:29,109 --> 02:11:28,400
mission

3643
02:11:30,550 --> 02:11:29,119
so

3644
02:11:31,750 --> 02:11:30,560
i'm kind of talking around that i can

3645
02:11:33,589 --> 02:11:31,760
tell you the answer is yes there is a

3646
02:11:35,430 --> 02:11:33,599
minimum it's specified in the baa that's

3647
02:11:36,790 --> 02:11:35,440
the 2000 seconds and the

3648
02:11:37,589 --> 02:11:36,800
two metric tons

3649
02:11:40,310 --> 02:11:37,599
um

3650
02:11:42,069 --> 02:11:40,320
but i do think it would be useful

3651
02:11:43,750 --> 02:11:42,079
for the for us to see if you think

3652
02:11:45,270 --> 02:11:43,760
there's a parametric you know type of

3653
02:11:47,030 --> 02:11:45,280
extrapolation or something like that on

3654
02:11:49,030 --> 02:11:47,040
an existing capability that you have

3655
02:11:50,629 --> 02:11:49,040
that might be something that would uh

3656
02:11:53,189 --> 02:11:50,639
would certainly be helpful for us not

3657
02:11:54,550 --> 02:11:53,199
required um and the range that is

3658
02:11:57,189 --> 02:11:54,560
specified in there is what we're talking

3659
02:11:58,550 --> 02:11:57,199
about in terms of design space

3660
02:11:59,669 --> 02:11:58,560
i just want to put out a reminder that

3661
02:12:01,750 --> 02:11:59,679
you can find the broad agency

3662
02:12:03,430 --> 02:12:01,760
announcement at nasa.gov asteroid

3663
02:12:05,350 --> 02:12:03,440

initiative we have a link there to the

3664
02:12:08,390 --> 02:12:05,360
procurement site where you can read the

3665
02:12:11,589 --> 02:12:08,400
the entirety of it let's go back here

3666
02:12:14,550 --> 02:12:11,599
uh for the crude mission partnerships uh

3667
02:12:16,629 --> 02:12:14,560
it's very mass constrained as you noted

3668
02:12:19,189 --> 02:12:16,639
do you have any way to bound that

3669
02:12:22,629 --> 02:12:19,199
is it a one kilogram add-on is okay but

3670
02:12:25,750 --> 02:12:22,639
a 10 kilogram add-on would be impossible

3671
02:12:29,990 --> 02:12:27,750
i would i would say that anything more

3672
02:12:32,149 --> 02:12:30,000
than 100 kilograms would be extremely

3673
02:12:34,149 --> 02:12:32,159
problematic less than that it would be a

3674
02:12:36,629 --> 02:12:34,159
value proposition on what the payload

3675
02:12:43,350 --> 02:12:36,639
was offering to the mission for its

3676
02:12:48,470 --> 02:12:46,470
this might be for all the appendix it

3677
02:12:50,790 --> 02:12:48,480
wasn't entirely clear

3678
02:12:54,709 --> 02:12:50,800
what the expectation of the final

3679
02:12:57,910 --> 02:12:54,719
product was in december is it a set of

3680
02:13:01,109 --> 02:12:57,920
drawings just a a concept

3681
02:13:05,030 --> 02:13:01,119
with you know summary an actual model

3682
02:13:09,750 --> 02:13:06,950
well we have uh

3683
02:13:12,310 --> 02:13:09,760
three deliverables listed in the baa

3684
02:13:15,510 --> 02:13:12,320
there's an initial kickoff meeting at

3685
02:13:16,870 --> 02:13:15,520
one of the nasa centers

3686
02:13:20,390 --> 02:13:16,880
where you would

3687
02:13:21,990 --> 02:13:20,400
brief your proposed study and get some

3688
02:13:24,310 --> 02:13:22,000

guidance from the

3689
02:13:25,830 --> 02:13:24,320
nasa technical experts

3690
02:13:28,470 --> 02:13:25,840
there's an interim

3691
02:13:30,310 --> 02:13:28,480
report that's due at the end of

3692
02:13:32,229 --> 02:13:30,320
october

3693
02:13:35,189 --> 02:13:32,239
uh that's just a

3694
02:13:36,790 --> 02:13:35,199
summary of the work you've done uh today

3695
02:13:37,990 --> 02:13:36,800
that's it's a

3696
02:13:40,069 --> 02:13:38,000
briefing

3697
02:13:41,510 --> 02:13:40,079
and that's to help inform our mission

3698
02:13:42,550 --> 02:13:41,520
concept review

3699
02:13:47,910 --> 02:13:42,560
and then

3700
02:13:52,310 --> 02:13:49,350
there's a

3701
02:13:55,589 --> 02:13:52,320
statement of work for an optional phase

3702
02:13:59,189 --> 02:13:57,510
and the cost estimate you know

3703
02:14:04,149 --> 02:13:59,199
associated with that

3704
02:14:07,990 --> 02:14:07,189
let's go back to an online question

3705
02:14:10,229 --> 02:14:08,000
um

3706
02:14:12,870 --> 02:14:10,239
we have a question on rendezvous sensors

3707
02:14:14,550 --> 02:14:12,880
are you also interested in algorithms

3708
02:14:16,390 --> 02:14:14,560
and software associated with the

3709
02:14:18,709 --> 02:14:16,400
rendezvous sensors

3710
02:14:19,990 --> 02:14:18,719
so in the baa we've limited it to the

3711
02:14:22,870 --> 02:14:20,000
sensors

3712
02:14:23,589 --> 02:14:22,880
when we did our commonality assessment

3713
02:14:27,750 --> 02:14:23,599

the

3714
02:14:29,910 --> 02:14:27,760
sharing algorithms across missions but

3715
02:14:31,510 --> 02:14:29,920
every mission the way they apply the

3716
02:14:33,990 --> 02:14:31,520
measurements from the sensors was very

3717
02:14:36,709 --> 02:14:34,000
specific the flight software process was

3718
02:14:38,870 --> 02:14:36,719
very specific to each mission so we

3719
02:14:41,109 --> 02:14:38,880
determined at this point we really where

3720
02:14:43,030 --> 02:14:41,119
we felt the government could get a key

3721
02:14:44,709 --> 02:14:43,040
amount of savings was in the commonality

3722
02:14:49,430 --> 02:14:44,719
of the rendezvous sensors

3723
02:14:55,990 --> 02:14:51,189
great any further questions here in the

3724
02:14:59,510 --> 02:14:58,069
anything else online go ahead we have a

3725
02:15:01,109 --> 02:14:59,520
couple of other questions

3726
02:15:04,069 --> 02:15:01,119
um

3727
02:15:06,149 --> 02:15:04,079
one is may nasa develop technology be

3728
02:15:07,830 --> 02:15:06,159
considered in the proposals

3729
02:15:12,069 --> 02:15:07,840
and how will the details of that be

3730
02:15:17,270 --> 02:15:14,390
well again we

3731
02:15:21,030 --> 02:15:17,280
have prohibited you from partnering with

3732
02:15:24,470 --> 02:15:21,040
nasa centers or jpl

3733
02:15:26,470 --> 02:15:24,480
you are free to look at the

3734
02:15:29,189 --> 02:15:26,480
study team

3735
02:15:31,830 --> 02:15:29,199
presentations and reports to get an idea

3736
02:15:33,510 --> 02:15:31,840
of the types of things nasa is working

3737
02:15:38,709 --> 02:15:33,520
on

3738
02:15:41,510 --> 02:15:38,719

will be working closely with nasa people

3739
02:15:43,990 --> 02:15:41,520
in the course of your study

3740
02:15:45,669 --> 02:15:44,000
so we really want to see what your ideas

3741
02:15:48,229 --> 02:15:45,679
on the outside are we know what our

3742
02:15:50,470 --> 02:15:48,239
ideas are

3743
02:15:51,830 --> 02:15:50,480
the whole purpose again of this baa is

3744
02:15:58,550 --> 02:15:51,840
to

3745
02:15:58,560 --> 02:16:04,709
do you have one more

3746
02:16:08,550 --> 02:16:06,069
i do actually

3747
02:16:11,189 --> 02:16:08,560
uh have any solar electric propulsion

3748
02:16:17,030 --> 02:16:11,199
robotic prototypes been tested

3749
02:16:20,310 --> 02:16:18,870
um well i'll take a stab at the solar

3750
02:16:22,470 --> 02:16:20,320
electric propulsion part of it i mean

3751
02:16:24,310 --> 02:16:22,480
when you say that it's at what level

3752
02:16:25,910 --> 02:16:24,320
right that make the mission feasible um

3753
02:16:27,510 --> 02:16:25,920
so there have been

3754
02:16:28,470 --> 02:16:27,520
technology efforts

3755
02:16:30,470 --> 02:16:28,480
um

3756
02:16:33,190 --> 02:16:30,480
that have uh

3757
02:16:34,950 --> 02:16:33,200
culminated in test situations

3758
02:16:36,309 --> 02:16:34,960
um

3759
02:16:38,230 --> 02:16:36,319
it's it's public knowledge right the

3760
02:16:39,030 --> 02:16:38,240
stmd is funding two

3761
02:16:42,230 --> 02:16:39,040
um

3762
02:16:43,830 --> 02:16:42,240
solar array technology efforts right now

3763
02:16:46,790 --> 02:16:43,840

though one of them is already in thermal

3764
02:16:47,910 --> 02:16:46,800
vacuum test the other one goes into test

3765
02:16:51,429 --> 02:16:47,920
early next

3766
02:16:55,509 --> 02:16:52,230
the

3767
02:16:58,549 --> 02:16:55,519
poking on in terms of prototype we've

3768
02:17:00,629 --> 02:16:58,559
also done several electric propulsion

3769
02:17:02,870 --> 02:17:00,639
internal developments uh as well that

3770
02:17:03,910 --> 02:17:02,880
have been uh tested uh generally that

3771
02:17:05,669 --> 02:17:03,920
data is

3772
02:17:08,230 --> 02:17:05,679
publicly available right through

3773
02:17:11,190 --> 02:17:08,240
research publications um you go to the

3774
02:17:12,950 --> 02:17:11,200
stmd website all right seriously right

3775
02:17:15,030 --> 02:17:12,960
and find a lot of links uh to the

3776
02:17:16,230 --> 02:17:15,040
information there and for the folks on

3777
02:17:18,629 --> 02:17:16,240
the earlier question as well in terms of

3778
02:17:19,990 --> 02:17:18,639
incorporated nasa technology um i think

3779
02:17:21,270 --> 02:17:20,000
for you to get an idea on what nasa

3780
02:17:23,190 --> 02:17:21,280
technology we've incorporated in the

3781
02:17:25,349 --> 02:17:23,200
reference as to go over the material

3782
02:17:26,309 --> 02:17:25,359
that's being posted based on brian and

3783
02:17:28,469 --> 02:17:26,319
dan's

3784
02:17:30,309 --> 02:17:28,479
brief overview of the reference earlier

3785
02:17:33,589 --> 02:17:30,319
it shows you what we think is needed or

3786
02:17:36,709 --> 02:17:34,950
okay so chris if there's anybody out

3787
02:17:37,910 --> 02:17:36,719
there that had questions and and didn't

3788
02:17:39,429 --> 02:17:37,920

quite get to them today where do you

3789
02:17:42,230 --> 02:17:39,439
want them to send those questions again

3790
02:17:45,750 --> 02:17:42,240
yeah so please email your questions to

3791
02:17:49,990 --> 02:17:45,760
me at the email address listed both in

3792
02:17:51,509 --> 02:17:50,000
the synopsis and in the baa it's hq dash

3793
02:17:53,629 --> 02:17:51,519
asteroid

3794
02:17:55,990 --> 02:17:53,639
baa at

3795
02:18:01,270 --> 02:17:56,000
mail.nasa.gov okay please help me thank

3796
02:18:04,950 --> 02:18:02,790
and again we'll uh we'll get the charts

3797
02:18:07,030 --> 02:18:04,960
that you just saw up on nasa.gov

3798
02:18:09,429 --> 02:18:07,040
asteroid forum in the baa you can find

3799
02:18:11,589 --> 02:18:09,439
at nasa.gov asteroid initiative and i'm

3800
02:18:13,589 --> 02:18:11,599
going to ask andy petro to stay up here

3801
02:18:15,429 --> 02:18:13,599
he's the program executive

3802
02:18:16,950 --> 02:18:15,439
for the space technology mission

3803
02:18:18,870 --> 02:18:16,960
directorate he's going to talk to us a

3804
02:18:23,349 --> 02:18:18,880
little bit more about technology needs

3805
02:18:33,509 --> 02:18:25,190
okay

3806
02:18:38,629 --> 02:18:33,519
um

3807
02:18:41,030 --> 02:18:38,639
you a brief overview of some of the

3808
02:18:42,389 --> 02:18:41,040
technology needs some of the ongoing

3809
02:18:44,950 --> 02:18:42,399
technology work

3810
02:18:46,790 --> 02:18:44,960
in relation to this mission

3811
02:18:49,750 --> 02:18:46,800
and also

3812
02:18:53,190 --> 02:18:49,760
some additional technology development

3813
02:18:55,830 --> 02:18:53,200

that could enhance the asteroid mission

3814
02:18:57,830 --> 02:18:55,840
as well as extend our capabilities for

3815
02:18:59,990 --> 02:18:57,840
exploration missions and

3816
02:19:01,750 --> 02:19:00,000
commercial applications go to the next

3817
02:19:03,990 --> 02:19:01,760
chart please

3818
02:19:06,629 --> 02:19:04,000
uh this is an outline of the topics i

3819
02:19:09,030 --> 02:19:06,639
was going to talk about today

3820
02:19:10,549 --> 02:19:09,040
first under solar electric propulsion

3821
02:19:12,629 --> 02:19:10,559
you have the solar arrays the electric

3822
02:19:15,349 --> 02:19:12,639
propulsion thrusters power processing

3823
02:19:17,429 --> 02:19:15,359
units and propellant tanks

3824
02:19:18,950 --> 02:19:17,439
these topics

3825
02:19:22,230 --> 02:19:18,960
are not specifically addressed in the

3826
02:19:23,830 --> 02:19:22,240
baa although as we just discussed

3827
02:19:27,190 --> 02:19:23,840
looking at

3828
02:19:29,990 --> 02:19:27,200
adaptations of commercial vehicles

3829
02:19:32,389 --> 02:19:30,000
you know would relate to

3830
02:19:35,509 --> 02:19:32,399
systems that would incorporate

3831
02:19:38,549 --> 02:19:35,519
some or all of these components or

3832
02:19:40,790 --> 02:19:38,559
variations of these components

3833
02:19:41,910 --> 02:19:40,800
then the next area asteroid rendezvous

3834
02:19:43,990 --> 02:19:41,920
and capture

3835
02:19:45,830 --> 02:19:44,000
that is addressed in baa we just heard

3836
02:19:47,429 --> 02:19:45,840
some detailed discussion of the

3837
02:19:49,670 --> 02:19:47,439
rendezvous sensors and the asteroid

3838
02:19:51,349 --> 02:19:49,680

capture systems

3839
02:19:54,070 --> 02:19:51,359
then under crude missions we have the

3840
02:19:56,950 --> 02:19:54,080
eva suits

3841
02:19:58,790 --> 02:19:56,960
and then under the topic of enhancing

3842
02:20:01,990 --> 02:19:58,800
and extending technologies we have

3843
02:20:04,550 --> 02:20:02,000
in-situ resource utilization and other

3844
02:20:06,389 --> 02:20:04,560
additional technologies those

3845
02:20:08,630 --> 02:20:06,399
can be addressed through the partnership

3846
02:20:12,309 --> 02:20:08,640
opportunities in the bia

3847
02:20:13,990 --> 02:20:12,319
as well so we can go to the next

3848
02:20:15,670 --> 02:20:14,000
which is to

3849
02:20:16,630 --> 02:20:15,680
talk a little bit about the solar arrays

3850
02:20:19,910 --> 02:20:16,640
system

3851
02:20:23,349 --> 02:20:19,920
um what's needed for the mission um

3852
02:20:25,190 --> 02:20:23,359
is about 50 kilowatt solar array

3853
02:20:26,550 --> 02:20:25,200
and that could be of course

3854
02:20:27,990 --> 02:20:26,560
laid out as two

3855
02:20:29,510 --> 02:20:28,000
two wings

3856
02:20:31,030 --> 02:20:29,520
um

3857
02:20:33,750 --> 02:20:31,040
and uh you know we're looking at an

3858
02:20:36,070 --> 02:20:33,760
operating voltage of 300 volts for the

3859
02:20:40,230 --> 02:20:36,080
uh reference concept and you can see

3860
02:20:41,030 --> 02:20:40,240
illustrated there two of the um

3861
02:20:42,710 --> 02:20:41,040
the

3862
02:20:45,270 --> 02:20:42,720
contracted

3863
02:20:49,349 --> 02:20:45,280

developments under underway now

3864
02:20:52,309 --> 02:20:49,359
a a roll out and a fold-out system

3865
02:20:53,910 --> 02:20:52,319
as mike said earlier those are

3866
02:20:56,389 --> 02:20:53,920
being tested

3867
02:20:57,510 --> 02:20:56,399
at this time

3868
02:21:09,429 --> 02:20:57,520
the

3869
02:21:10,469 --> 02:21:09,439
in lower cost

3870
02:21:12,389 --> 02:21:10,479
solar

3871
02:21:13,670 --> 02:21:12,399
cell technology that could be applied

3872
02:21:17,510 --> 02:21:13,680
here

3873
02:21:19,349 --> 02:21:17,520
both for the asteroid mission and beyond

3874
02:21:20,790 --> 02:21:19,359
so we can go to the next

3875
02:21:21,990 --> 02:21:20,800
chart

3876
02:21:24,630 --> 02:21:22,000
um

3877
02:21:26,870 --> 02:21:24,640
on electric propulsion thrusters the

3878
02:21:27,990 --> 02:21:26,880
reference concept in the work that the

3879
02:21:30,710 --> 02:21:28,000
space

3880
02:21:34,469 --> 02:21:30,720
technology mission directorate is doing

3881
02:21:35,670 --> 02:21:34,479
is a magnetically shielded hall thruster

3882
02:21:39,110 --> 02:21:35,680
the

3883
02:21:42,070 --> 02:21:39,120
addressed is a

3884
02:21:42,950 --> 02:21:42,080
12.5 kilowatt thruster that of course

3885
02:21:45,110 --> 02:21:42,960
would be

3886
02:21:46,790 --> 02:21:45,120
multiplied by three to four uh

3887
02:21:47,910 --> 02:21:46,800
individual thrusters in the overall

3888
02:21:50,630 --> 02:21:47,920

system

3889
02:21:51,750 --> 02:21:50,640
and they're targeting an isp of 3000

3890
02:21:53,349 --> 02:21:51,760
seconds

3891
02:21:55,590 --> 02:21:53,359
the

3892
02:21:57,750 --> 02:21:55,600
total amount of propellant needed again

3893
02:21:59,270 --> 02:21:57,760
for this reference concept is about 10

3894
02:22:01,990 --> 02:21:59,280
000 kilograms

3895
02:22:03,190 --> 02:22:02,000
of xenon

3896
02:22:07,030 --> 02:22:03,200
the

3897
02:22:08,469 --> 02:22:07,040
system that's being developed at this

3898
02:22:10,950 --> 02:22:08,479
point is considered

3899
02:22:13,429 --> 02:22:10,960
adequate uh assuming rel you know the

3900
02:22:14,630 --> 02:22:13,439
reasonable amount of further development

3901
02:22:16,710 --> 02:22:14,640
however

3902
02:22:19,190 --> 02:22:16,720
you know there would be interest in

3903
02:22:20,309 --> 02:22:19,200
other types of systems

3904
02:22:22,710 --> 02:22:20,319
that could

3905
02:22:24,550 --> 02:22:22,720
address this mission or be extensible

3906
02:22:26,389 --> 02:22:24,560
for

3907
02:22:29,030 --> 02:22:26,399
other exploration missions and

3908
02:22:30,950 --> 02:22:29,040
commercial applications beyond that

3909
02:22:32,630 --> 02:22:30,960
the next chart

3910
02:22:35,349 --> 02:22:32,640
is power processing units these are the

3911
02:22:37,270 --> 02:22:35,359
units that that provide power to the

3912
02:22:38,550 --> 02:22:37,280
individual thrusters

3913
02:22:40,550 --> 02:22:38,560

the

3914
02:22:42,950 --> 02:22:40,560
reference concept here is an input

3915
02:22:45,190 --> 02:22:42,960
voltage of 300 volts and an output of

3916
02:22:47,030 --> 02:22:45,200
800 volts

3917
02:22:48,790 --> 02:22:47,040
and that that work again is under

3918
02:22:51,910 --> 02:22:48,800
underway as well

3919
02:22:53,910 --> 02:22:51,920
and next chart is on the propellant

3920
02:22:56,950 --> 02:22:53,920
tanks

3921
02:22:59,990 --> 02:22:56,960
as i mentioned the requirement

3922
02:23:01,349 --> 02:23:00,000
is about 10 000 kilograms of xenon

3923
02:23:03,990 --> 02:23:01,359
the reference

3924
02:23:06,469 --> 02:23:04,000
mission design has our vehicle design

3925
02:23:07,750 --> 02:23:06,479
has that divided into eight individual

3926
02:23:10,230 --> 02:23:07,760
tanks

3927
02:23:13,030 --> 02:23:10,240
and of course a key parameter there is

3928
02:23:15,910 --> 02:23:13,040
the mass traction the goal is to get

3929
02:23:18,389 --> 02:23:15,920
that as low as possible they feel 3.7

3930
02:23:20,230 --> 02:23:18,399
percent is achievable again any

3931
02:23:22,389 --> 02:23:20,240
improvement there would be extremely

3932
02:23:24,469 --> 02:23:22,399
beneficial to the overall mission and

3933
02:23:26,630 --> 02:23:24,479
for any other application of of this

3934
02:23:29,510 --> 02:23:26,640
type of propulsion

3935
02:23:30,950 --> 02:23:29,520
so moving on to the next uh chart uh

3936
02:23:33,349 --> 02:23:30,960
rendu essentials we heard quite a bit

3937
02:23:36,309 --> 02:23:33,359
about that both the you know looking at

3938
02:23:37,750 --> 02:23:36,319

visible and irr cameras and

3939
02:23:39,750 --> 02:23:37,760
3d lidar

3940
02:23:40,950 --> 02:23:39,760
systems

3941
02:23:43,349 --> 02:23:40,960
again

3942
02:23:45,910 --> 02:23:43,359
that would be applied to this mission or

3943
02:23:48,790 --> 02:23:45,920
to a variety of other missions as well

3944
02:23:50,630 --> 02:23:48,800
and we can go to the next chart

3945
02:23:54,150 --> 02:23:50,640
the asteroid capture systems again we

3946
02:23:56,469 --> 02:23:54,160
heard some detail on that

3947
02:24:01,429 --> 02:23:56,479
of course the work is under some work is

3948
02:24:03,429 --> 02:24:01,439
underway in inflatable systems and also

3949
02:24:06,070 --> 02:24:03,439
also space trust type

3950
02:24:09,030 --> 02:24:06,080
systems that could be used

3951
02:24:11,030 --> 02:24:09,040
and again this is a topic that would be

3952
02:24:13,830 --> 02:24:11,040
addressed in the baa

3953
02:24:18,389 --> 02:24:16,550
under the crude systems um main topic

3954
02:24:20,710 --> 02:24:18,399
area is eva suits

3955
02:24:23,670 --> 02:24:20,720
the work underway that we did here

3956
02:24:25,510 --> 02:24:23,680
described in the first panel

3957
02:24:27,830 --> 02:24:25,520
is in the

3958
02:24:30,790 --> 02:24:27,840
portable life support systems for those

3959
02:24:32,150 --> 02:24:30,800
suits for the eva activities and also

3960
02:24:34,070 --> 02:24:32,160
the suits

3961
02:24:37,510 --> 02:24:34,080
that are being developed are

3962
02:24:40,230 --> 02:24:37,520
modifications of the advanced space

3963
02:24:42,070 --> 02:24:40,240

advanced crew escape suits

3964
02:24:43,750 --> 02:24:42,080
this is again considered adequate for

3965
02:24:48,150 --> 02:24:43,760
the mission that that

3966
02:24:51,590 --> 02:24:50,070
mission however

3967
02:24:54,070 --> 02:24:51,600
i'll talk in a moment about

3968
02:24:55,670 --> 02:24:54,080
extensibility of that as well

3969
02:24:58,230 --> 02:24:55,680
next chart

3970
02:25:02,309 --> 02:24:58,240
uh in-situ resource utilization and here

3971
02:25:03,990 --> 02:25:02,319
you have the the prospecting

3972
02:25:08,710 --> 02:25:04,000
and then the

3973
02:25:14,950 --> 02:25:11,910
collected and then manufacturing and

3974
02:25:17,270 --> 02:25:14,960
there is work underway

3975
02:25:19,110 --> 02:25:17,280
at least in terms of looking at a lunar

3976
02:25:22,870 --> 02:25:19,120
mission

3977
02:25:26,150 --> 02:25:22,880
to prospect for volatiles and

3978
02:25:27,349 --> 02:25:26,160
also to process those into usable

3979
02:25:28,230 --> 02:25:27,359
materials

3980
02:25:29,990 --> 02:25:28,240
and

3981
02:25:31,510 --> 02:25:30,000
the other area that is just really at

3982
02:25:33,830 --> 02:25:31,520
the very beginning

3983
02:25:35,990 --> 02:25:33,840
is 3d manufacturing

3984
02:25:37,590 --> 02:25:36,000
there'll be a 3d printer

3985
02:25:38,550 --> 02:25:37,600
tested on the international space

3986
02:25:41,429 --> 02:25:38,560
station

3987
02:25:44,469 --> 02:25:41,439
of course that is um just the beginning

3988
02:25:47,590 --> 02:25:44,479

of of what is a

3989
02:25:49,750 --> 02:25:47,600
very uh potentially very productive way

3990
02:25:52,070 --> 02:25:49,760
of ensuring that eventually we'll be

3991
02:25:53,750 --> 02:25:52,080
able to be self-sufficient in space so

3992
02:25:55,190 --> 02:25:53,760
again this is something in terms of

3993
02:25:58,309 --> 02:25:55,200
partnerships

3994
02:25:59,270 --> 02:25:58,319
that could be addressed from the baa

3995
02:26:04,389 --> 02:25:59,280
and

3996
02:26:06,550 --> 02:26:04,399
is just talking about some of the

3997
02:26:11,030 --> 02:26:06,560
additional

3998
02:26:11,990 --> 02:26:11,040
technologies that address both enhancing

3999
02:26:14,710 --> 02:26:12,000
the

4000
02:26:17,429 --> 02:26:14,720
capabilities for our mission

4001
02:26:19,270 --> 02:26:17,439
to the asteroid but also

4002
02:26:21,750 --> 02:26:19,280
addressing things that

4003
02:26:24,309 --> 02:26:21,760
enhance our capabilities for missions

4004
02:26:25,750 --> 02:26:24,319
well beyond that

4005
02:26:26,950 --> 02:26:25,760
anything that would reduce the mass

4006
02:26:29,990 --> 02:26:26,960
volume

4007
02:26:31,910 --> 02:26:30,000
the power or improve the

4008
02:26:33,349 --> 02:26:31,920
risk posture for the crew

4009
02:26:36,389 --> 02:26:33,359
for the orion vehicle would be

4010
02:26:38,469 --> 02:26:36,399
beneficial for the asteroid mission

4011
02:26:39,910 --> 02:26:38,479
such as the logistics packaging dust

4012
02:26:42,469 --> 02:26:39,920
mitigation

4013
02:26:44,790 --> 02:26:42,479

crew exercise equipment sample sample

4014
02:26:47,429 --> 02:26:44,800
containers those types of things would

4015
02:26:49,670 --> 02:26:47,439
be very beneficial

4016
02:26:51,510 --> 02:26:49,680
in terms of the eva suits

4017
02:26:54,790 --> 02:26:51,520
as i said what's being developed is

4018
02:26:56,309 --> 02:26:54,800
adequate but uh for other missions uh

4019
02:26:58,950 --> 02:26:56,319
there is interest in

4020
02:26:59,910 --> 02:26:58,960
much more capable uh both life support

4021
02:27:03,510 --> 02:26:59,920
and

4022
02:27:08,550 --> 02:27:06,230
in terms of the

4023
02:27:10,550 --> 02:27:08,560
propulsion systems again as i mentioned

4024
02:27:13,110 --> 02:27:10,560
earlier

4025
02:27:14,469 --> 02:27:13,120
the systems being developed

4026
02:27:16,550 --> 02:27:14,479
should be adequate for what we want to

4027
02:27:19,349 --> 02:27:16,560
do in terms of the asteroid mission

4028
02:27:21,429 --> 02:27:19,359
however there is a great interest in

4029
02:27:23,830 --> 02:27:21,439
more capable systems

4030
02:27:25,510 --> 02:27:23,840
higher power systems 100 kilowatts and

4031
02:27:26,389 --> 02:27:25,520
beyond

4032
02:27:28,070 --> 02:27:26,399
and

4033
02:27:29,670 --> 02:27:28,080
in addition to all thrusters other

4034
02:27:32,070 --> 02:27:29,680
propulsion technologies that might be

4035
02:27:34,309 --> 02:27:32,080
applicable

4036
02:27:37,190 --> 02:27:34,319
again and then just going on a few other

4037
02:27:39,429 --> 02:27:37,200
things closed life support

4038
02:27:42,830 --> 02:27:39,439

would of course be valuable radiation

4039
02:27:45,990 --> 02:27:42,840
shielding long duration food storage

4040
02:27:48,710 --> 02:27:46,000
um automated vehicle and uh crew

4041
02:27:50,630 --> 02:27:48,720
operations for the more distant

4042
02:27:51,990 --> 02:27:50,640
exploration missions

4043
02:27:55,190 --> 02:27:52,000
um

4044
02:27:57,349 --> 02:27:55,200
and a variety of other things that that

4045
02:27:58,469 --> 02:27:57,359
would enhance our ability to do these

4046
02:27:59,670 --> 02:27:58,479
missions

4047
02:28:01,830 --> 02:27:59,680
so

4048
02:28:04,309 --> 02:28:01,840
i think that concludes what i wanted to

4049
02:28:05,270 --> 02:28:04,319
summarize i hope this has been helpful

4050
02:28:07,270 --> 02:28:05,280
and

4051
02:28:08,630 --> 02:28:07,280
gives you an idea of

4052
02:28:11,349 --> 02:28:08,640
what we need

4053
02:28:13,670 --> 02:28:11,359
in the near term for this mission and

4054
02:28:15,270 --> 02:28:13,680
what this could lead to

4055
02:28:27,670 --> 02:28:15,280
well beyond that

4056
02:28:32,870 --> 02:28:29,750
okay thanks andy

4057
02:28:35,510 --> 02:28:32,880
now we will hear from jason kessler who

4058
02:28:43,110 --> 02:28:35,520
is the asteroid grand challenge program

4059
02:28:48,710 --> 02:28:45,590
thank you trent

4060
02:28:51,030 --> 02:28:48,720
one of the great things about my job

4061
02:28:53,190 --> 02:28:51,040
also one of the challenging things

4062
02:28:55,429 --> 02:28:53,200
is i get to follow such brilliant

4063
02:28:56,309 --> 02:28:55,439

dedicated people

4064
02:28:57,990 --> 02:28:56,319
it's

4065
02:29:01,110 --> 02:28:58,000
really been fantastic to see the

4066
02:29:03,110 --> 02:29:01,120
progress that's been made i want to

4067
02:29:04,309 --> 02:29:03,120
extend a special thanks to michelle

4068
02:29:06,870 --> 02:29:04,319
gates

4069
02:29:10,630 --> 02:29:06,880
and chris moore for leading their teams

4070
02:29:15,030 --> 02:29:10,640
to get us here so successfully so

4071
02:29:15,040 --> 02:29:18,870
if i could have my next slide please

4072
02:29:22,710 --> 02:29:20,870
as a refresher the grand challenge

4073
02:29:24,230 --> 02:29:22,720
statement uh

4074
02:29:28,870 --> 02:29:24,240
fairly simple

4075
02:29:31,030 --> 02:29:28,880
uh in its words but pretty powerful uh

4076
02:29:33,270 --> 02:29:31,040
and profound in its meaning

4077
02:29:36,630 --> 02:29:33,280
uh we announced this grand challenge

4078
02:29:38,710 --> 02:29:36,640
back in june of last

4079
02:29:40,870 --> 02:29:38,720
year

4080
02:29:42,870 --> 02:29:40,880
to reiterate the question that lindley

4081
02:29:44,710 --> 02:29:42,880
answered we didn't

4082
02:29:47,429 --> 02:29:44,720
announce this grand challenge because

4083
02:29:49,670 --> 02:29:47,439
there was an impending threat or

4084
02:29:51,670 --> 02:29:49,680
based on fear but but rather a

4085
02:29:53,990 --> 02:29:51,680
recognition that we have a unique

4086
02:29:56,070 --> 02:29:54,000
opportunity

4087
02:29:57,190 --> 02:29:56,080
lindley johnson and the team he has

4088
02:29:59,030 --> 02:29:57,200

built

4089
02:30:00,469 --> 02:29:59,040
a global community has been working on

4090
02:30:02,070 --> 02:30:00,479
this problem

4091
02:30:04,950 --> 02:30:02,080
for quite some time

4092
02:30:08,790 --> 02:30:04,960
and as he identified we're

4093
02:30:09,910 --> 02:30:08,800
above 95 percent in terms of identifying

4094
02:30:11,190 --> 02:30:09,920
the

4095
02:30:13,190 --> 02:30:11,200
planet killer

4096
02:30:15,270 --> 02:30:13,200
size asteroids

4097
02:30:18,150 --> 02:30:15,280
but as nasa has done successfully in the

4098
02:30:20,790 --> 02:30:18,160
past we've utilized open innovation as a

4099
02:30:22,309 --> 02:30:20,800
means to engage

4100
02:30:25,030 --> 02:30:22,319
a community

4101
02:30:29,750 --> 02:30:25,040
to assist and and see things in a

4102
02:30:33,110 --> 02:30:31,110
partnerships

4103
02:30:34,790 --> 02:30:33,120
crowdsourcing citizen science we've seen

4104
02:30:37,510 --> 02:30:34,800
that this is successful

4105
02:30:39,830 --> 02:30:37,520
and we live in an age when

4106
02:30:41,830 --> 02:30:39,840
the computing power in your hands

4107
02:30:44,150 --> 02:30:41,840
the network connectivity

4108
02:30:45,910 --> 02:30:44,160
and the educational

4109
02:30:48,630 --> 02:30:45,920
skills that we've attained or are

4110
02:30:49,990 --> 02:30:48,640
unsurpassed in human history and so we

4111
02:30:51,670 --> 02:30:50,000
believe that there's a cognitive

4112
02:30:53,110 --> 02:30:51,680
resource that's out there that we can

4113
02:30:54,870 --> 02:30:53,120

tap into

4114
02:30:56,469 --> 02:30:54,880
to help accelerate the great work that

4115
02:30:58,630 --> 02:30:56,479
we're already doing

4116
02:31:01,110 --> 02:30:58,640
and so the grand challenge was a

4117
02:31:02,790 --> 02:31:01,120
recognition that

4118
02:31:04,870 --> 02:31:02,800
we're doing great work

4119
02:31:06,150 --> 02:31:04,880
globally

4120
02:31:08,950 --> 02:31:06,160
but they're folks that we're not

4121
02:31:11,030 --> 02:31:08,960
currently engaged with and can we

4122
02:31:12,710 --> 02:31:11,040
through those conversations help

4123
02:31:14,309 --> 02:31:12,720
accelerate the work that's already being

4124
02:31:18,950 --> 02:31:14,319
done

4125
02:31:18,960 --> 02:31:23,510
here is an international update

4126
02:31:28,389 --> 02:31:24,469
the

4127
02:31:29,429 --> 02:31:28,399
action team 14 out of un copuos has been

4128
02:31:30,870 --> 02:31:29,439
working

4129
02:31:33,910 --> 02:31:30,880
for many years

4130
02:31:35,349 --> 02:31:33,920
really significantly the last seven

4131
02:31:38,550 --> 02:31:35,359
and

4132
02:31:40,630 --> 02:31:38,560
the recommendations that were accepted

4133
02:31:42,070 --> 02:31:40,640
led to

4134
02:31:44,230 --> 02:31:42,080
the creation of the international

4135
02:31:46,550 --> 02:31:44,240
asteroid warning network

4136
02:31:49,349 --> 02:31:46,560
as well as the space mission planning

4137
02:31:51,910 --> 02:31:49,359
advisory group

4138
02:31:54,150 --> 02:31:51,920

2014 has been an exciting year on those

4139
02:31:57,670 --> 02:31:54,160
fronts because the first charter meeting

4140
02:31:58,790 --> 02:31:57,680
was held in boston in january

4141
02:32:00,710 --> 02:31:58,800
and

4142
02:32:02,870 --> 02:32:00,720
the same page

4143
02:32:07,510 --> 02:32:02,880
shortly thereafter got together for a

4144
02:32:13,270 --> 02:32:11,030
the findings out of that charter meeting

4145
02:32:15,349 --> 02:32:13,280
of iwan two of them

4146
02:32:17,590 --> 02:32:15,359
uh i wanted to draw attention to the

4147
02:32:19,349 --> 02:32:17,600
first is to encourage additional

4148
02:32:21,110 --> 02:32:19,359
participation

4149
02:32:22,150 --> 02:32:21,120
in the international asteroid warning

4150
02:32:25,030 --> 02:32:22,160
network

4151
02:32:27,510 --> 02:32:25,040
and expand recruitment of other nations

4152
02:32:29,110 --> 02:32:27,520
to the effort

4153
02:32:31,670 --> 02:32:29,120
the second finding

4154
02:32:33,429 --> 02:32:31,680
uh that i want to draw attention to is

4155
02:32:35,110 --> 02:32:33,439
to enhance

4156
02:32:37,190 --> 02:32:35,120
near-earth object discovery and

4157
02:32:40,469 --> 02:32:37,200
follow-up observations whether it's

4158
02:32:41,830 --> 02:32:40,479
astrometry photometry or spectroscopy

4159
02:32:43,910 --> 02:32:41,840
through further international

4160
02:32:48,389 --> 02:32:43,920
cooperation and coordination

4161
02:32:53,590 --> 02:32:50,790
and the purpose of the same page the

4162
02:32:55,190 --> 02:32:53,600
space mission planning advisory group

4163
02:32:57,270 --> 02:32:55,200

is to prepare for an international

4164
02:32:59,510 --> 02:32:57,280
response to a neo threat through the

4165
02:33:01,830 --> 02:32:59,520
exchange of information

4166
02:33:04,150 --> 02:33:01,840
development of options for collaborative

4167
02:33:06,309 --> 02:33:04,160
research and mission opportunities and

4168
02:33:09,750 --> 02:33:06,319
to conduct neo-threat mitigation

4169
02:33:14,950 --> 02:33:12,389
i had the good fortune of

4170
02:33:16,710 --> 02:33:14,960
being able to present to uncopuos

4171
02:33:19,110 --> 02:33:16,720
in february

4172
02:33:24,630 --> 02:33:21,110
that led to an opportunity to meet with

4173
02:33:27,190 --> 02:33:24,640
the space generation advisory council

4174
02:33:28,550 --> 02:33:27,200
a great group of

4175
02:33:30,309 --> 02:33:28,560
up-and-coming

4176
02:33:32,230 --> 02:33:30,319
space employees whether they're

4177
02:33:33,110 --> 02:33:32,240
engineers or scientists they even have a

4178
02:33:34,389 --> 02:33:33,120
neo

4179
02:33:36,070 --> 02:33:34,399
working group

4180
02:33:38,630 --> 02:33:36,080
got really excited about what we're

4181
02:33:39,830 --> 02:33:38,640
talking about

4182
02:33:41,429 --> 02:33:39,840
additionally

4183
02:33:44,230 --> 02:33:41,439
the

4184
02:33:46,309 --> 02:33:44,240
ideas behind iwan and same page i think

4185
02:33:49,190 --> 02:33:46,319
you can see in that last bullet

4186
02:33:51,349 --> 02:33:49,200
we started moving out on my boss deputy

4187
02:33:55,030 --> 02:33:51,359
chief technologist jim adams

4188
02:33:58,070 --> 02:33:55,040

led a group to south africa

4189
02:34:00,070 --> 02:33:58,080
and in collaboration with the iau's

4190
02:34:02,870 --> 02:34:00,080
minor planet center

4191
02:34:05,190 --> 02:34:02,880
worked on developing some curriculum

4192
02:34:08,630 --> 02:34:05,200
that we hope will be able to replicate

4193
02:34:09,990 --> 02:34:08,640
as we expand the conversation globally

4194
02:34:13,190 --> 02:34:10,000
south africa

4195
02:34:16,230 --> 02:34:13,200
as noted in the iowan

4196
02:34:18,710 --> 02:34:16,240
recommendations is

4197
02:34:19,590 --> 02:34:18,720
in the southern hemisphere and we feel

4198
02:34:22,950 --> 02:34:19,600
like a

4199
02:34:24,710 --> 02:34:22,960
a prime opportunity for us to engage in

4200
02:34:26,950 --> 02:34:24,720
conversations with astronomers there

4201
02:34:28,870 --> 02:34:26,960
that aren't currently looking for nia's

4202
02:34:30,790 --> 02:34:28,880
to help with that effort

4203
02:34:32,389 --> 02:34:30,800
additionally south africa

4204
02:34:33,910 --> 02:34:32,399
has great ties into the rest of the

4205
02:34:37,429 --> 02:34:33,920
continent and as you can see burkina

4206
02:34:40,150 --> 02:34:37,439
faso gabon namibia and zambia

4207
02:34:41,910 --> 02:34:40,160
had scientists all represented at that

4208
02:34:43,270 --> 02:34:41,920
initial meeting

4209
02:34:46,870 --> 02:34:43,280
pretty exciting

4210
02:34:49,990 --> 02:34:46,880
first step there next slide please

4211
02:34:51,590 --> 02:34:50,000
you may recall at the

4212
02:34:55,270 --> 02:34:51,600
idea synthesis

4213
02:34:58,150 --> 02:34:55,280

we got to announce under

4214
02:34:59,910 --> 02:34:58,160
collaboration in the grand challenge the

4215
02:35:01,830 --> 02:34:59,920
first space act agreement that was with

4216
02:35:03,910 --> 02:35:01,840
planetary resources

4217
02:35:06,550 --> 02:35:03,920
uh today i'm excited to be able to

4218
02:35:07,429 --> 02:35:06,560
announce our second space act agreement

4219
02:35:08,870 --> 02:35:07,439
under

4220
02:35:10,550 --> 02:35:08,880
uh the

4221
02:35:12,630 --> 02:35:10,560
asteroid grand challenge and that and

4222
02:35:13,990 --> 02:35:12,640
that's with space gambit

4223
02:35:17,510 --> 02:35:14,000
space gambit

4224
02:35:20,389 --> 02:35:17,520
is a darpa funded activity and they are

4225
02:35:23,190 --> 02:35:20,399
uh working to engage the maker and

4226
02:35:23,990 --> 02:35:23,200
hacker spaces around the world

4227
02:35:29,270 --> 02:35:24,000
to

4228
02:35:31,830 --> 02:35:29,280
frontiers of space

4229
02:35:34,550 --> 02:35:31,840
former nasa chief technologist mason

4230
02:35:35,830 --> 02:35:34,560
peck recognized the value of the maker

4231
02:35:38,309 --> 02:35:35,840
community

4232
02:35:39,429 --> 02:35:38,319
he recognized that all of us here at

4233
02:35:41,270 --> 02:35:39,439
nasa

4234
02:35:46,870 --> 02:35:41,280
and the industries that we work with are

4235
02:35:52,070 --> 02:35:48,710
we see a movement

4236
02:35:53,670 --> 02:35:52,080
an energy and an engagement by

4237
02:35:56,309 --> 02:35:53,680
people that are getting

4238
02:35:58,389 --> 02:35:56,319

tools that they have available to start

4239
02:36:00,710 --> 02:35:58,399
building on their own and so the second

4240
02:36:03,030 --> 02:36:00,720
space stack agreement was a recognition

4241
02:36:05,190 --> 02:36:03,040
of the power of this community

4242
02:36:08,550 --> 02:36:05,200
our first couple of steps we want to

4243
02:36:10,230 --> 02:36:08,560
engage in virtual maker meetups

4244
02:36:13,030 --> 02:36:10,240
recognizing that we need to hear from

4245
02:36:15,110 --> 02:36:13,040
community how they want to move forward

4246
02:36:18,230 --> 02:36:15,120
we also expect to

4247
02:36:20,469 --> 02:36:18,240
call for projects to help with education

4248
02:36:22,950 --> 02:36:20,479
and outreach how do we communicate this

4249
02:36:25,110 --> 02:36:22,960
story in this message more clearly and

4250
02:36:28,230 --> 02:36:25,120
tap into that know how

4251
02:36:30,070 --> 02:36:28,240
within the maker community

4252
02:36:32,230 --> 02:36:30,080
another really exciting opportunity

4253
02:36:33,349 --> 02:36:32,240
we're exploring with them is

4254
02:36:36,469 --> 02:36:33,359
spacex

4255
02:36:39,429 --> 02:36:36,479
space exploration badges for young

4256
02:36:41,910 --> 02:36:39,439
citizen scientists how can we build a

4257
02:36:44,710 --> 02:36:41,920
program of skill development that

4258
02:36:48,309 --> 02:36:44,720
enables recognition

4259
02:36:50,950 --> 02:36:48,319
and growth as we build the the next

4260
02:36:53,030 --> 02:36:50,960
group of asteroid hunters

4261
02:36:55,990 --> 02:36:53,040
and then finally in the very near term

4262
02:36:58,309 --> 02:36:56,000
we look to do a remotely controlled

4263
02:37:01,910 --> 02:36:58,319

telescope hackathon the idea of how does

4264
02:37:03,670 --> 02:37:01,920
one build controllers to

4265
02:37:09,030 --> 02:37:03,680
improve the ability of

4266
02:37:11,590 --> 02:37:10,710
now turning back to

4267
02:37:13,429 --> 02:37:11,600
our

4268
02:37:15,910 --> 02:37:13,439
first space act agreement

4269
02:37:17,110 --> 02:37:15,920
i'd like to have the next slide in and

4270
02:37:19,429 --> 02:37:17,120
the movie

4271
02:37:21,349 --> 02:37:19,439
to show you where we've gotten with

4272
02:37:22,710 --> 02:37:21,359
the planetary resources space act

4273
02:37:26,070 --> 02:37:22,720
agreement so if i could have the movie

4274
02:37:29,670 --> 02:37:27,670
our solar system is filled with

4275
02:37:31,270 --> 02:37:29,680
asteroids while most like to hang out in

4276
02:37:33,270 --> 02:37:31,280
the asteroid belt roughly between the

4277
02:37:35,030 --> 02:37:33,280
orbits of mars and jupiter many have

4278
02:37:36,710 --> 02:37:35,040
orbits to come close to or sometimes

4279
02:37:38,230 --> 02:37:36,720
even impact earth

4280
02:37:39,910 --> 02:37:38,240
with asteroids being the most plentiful

4281
02:37:41,750 --> 02:37:39,920
objects in our solar system you'd think

4282
02:37:43,510 --> 02:37:41,760
they'd be easier to find

4283
02:37:45,110 --> 02:37:43,520
but if you look up at the night sky even

4284
02:37:46,710 --> 02:37:45,120
with the powerful telescope the best

4285
02:37:49,270 --> 02:37:46,720
you're gonna get is a small dot that

4286
02:37:51,030 --> 02:37:49,280
looks just like a star

4287
02:37:52,630 --> 02:37:51,040
well then how do scientists find

4288
02:37:54,309 --> 02:37:52,640

asteroids

4289
02:37:55,990 --> 02:37:54,319
they compare a series of telescope

4290
02:37:58,630 --> 02:37:56,000
images to see if anything in the picture

4291
02:38:00,389 --> 02:37:58,640
moved relative to the others if it does

4292
02:38:02,389 --> 02:38:00,399
then it might be an asteroid

4293
02:38:04,710 --> 02:38:02,399
scientists used to do this comparison by

4294
02:38:06,469 --> 02:38:04,720
hand but there is now so much data that

4295
02:38:07,750 --> 02:38:06,479
they need to use computer algorithms to

4296
02:38:10,070 --> 02:38:07,760
sift through the data to try to make

4297
02:38:11,830 --> 02:38:10,080
these initial detections if they spot

4298
02:38:13,990 --> 02:38:11,840
something a scientist will then review

4299
02:38:15,670 --> 02:38:14,000
the results to make sure it's accurate

4300
02:38:16,950 --> 02:38:15,680
and now there are two potential issues

4301
02:38:19,190 --> 02:38:16,960
with this process

4302
02:38:20,870 --> 02:38:19,200
one if the computer misses something

4303
02:38:22,870 --> 02:38:20,880
then that asteroid won't get discovered

4304
02:38:24,950 --> 02:38:22,880
this time around leaving us vulnerable

4305
02:38:26,630 --> 02:38:24,960
to potential asteroid impacts or missing

4306
02:38:28,550 --> 02:38:26,640
out on opportunities like mining the

4307
02:38:29,750 --> 02:38:28,560
asteroids for resources

4308
02:38:31,830 --> 02:38:29,760
the other is if you turn up the

4309
02:38:33,750 --> 02:38:31,840
sensitivity on these algorithms you end

4310
02:38:35,910 --> 02:38:33,760
up with a lot of detections called false

4311
02:38:37,349 --> 02:38:35,920
positives where the computer mistakenly

4312
02:38:38,630 --> 02:38:37,359
thinks some noise in the image or a

4313
02:38:40,630 --> 02:38:38,640

speck of dust on the lens of the

4314
02:38:42,230 --> 02:38:40,640
telescope is an asteroid

4315
02:38:43,990 --> 02:38:42,240
this causes a lot more work for the

4316
02:38:45,670 --> 02:38:44,000
scientists who have to go back over all

4317
02:38:47,429 --> 02:38:45,680
these images and correct any of those

4318
02:38:49,270 --> 02:38:47,439
false positives

4319
02:38:50,870 --> 02:38:49,280
we need your help to improve the

4320
02:38:52,950 --> 02:38:50,880
algorithms that are used to detect

4321
02:38:54,870 --> 02:38:52,960
asteroids without grossly increasing the

4322
02:38:56,790 --> 02:38:54,880
number of false positives

4323
02:38:58,469 --> 02:38:56,800
during these challenges we will ask you

4324
02:38:59,990 --> 02:38:58,479
to create algorithms that mimic how

4325
02:39:02,469 --> 02:39:00,000
humans sort through data to discover

4326
02:39:04,630 --> 02:39:02,479
asteroids so organizations like nasa and

4327
02:39:07,110 --> 02:39:04,640
planetary resources can rely on having

4328
02:39:09,590 --> 02:39:07,120
the most accurate data in the world

4329
02:39:11,349 --> 02:39:09,600
this is why nasa and planetary resources

4330
02:39:12,550 --> 02:39:11,359
are asking you to help with the hunt for

4331
02:39:14,230 --> 02:39:12,560
asteroids

4332
02:39:16,230 --> 02:39:14,240
join the competitors in the asteroid

4333
02:39:18,309 --> 02:39:16,240
data hunter challenge being launched on

4334
02:39:21,510 --> 02:39:18,319
the topcoder platform brought to you

4335
02:39:23,270 --> 02:39:21,520
through the harvard nasa tournament lab

4336
02:39:25,510 --> 02:39:23,280
your algorithm just might be what helps

4337
02:39:27,590 --> 02:39:25,520
us detect an asteroid headed for earth

4338
02:39:29,670 --> 02:39:27,600

or one of valuable resources that helps

4339
02:39:30,870 --> 02:39:29,680
fuel future space missions deep into our

4340
02:39:48,389 --> 02:39:30,880
solar system

4341
02:39:52,870 --> 02:39:50,070
so we announced in

4342
02:39:54,870 --> 02:39:52,880
november the space act agreement

4343
02:39:55,910 --> 02:39:54,880
uh and then my colleague jen gestetek

4344
02:39:58,469 --> 02:39:55,920
and i

4345
02:40:00,150 --> 02:39:58,479
had the privilege of announcing this

4346
02:40:01,429 --> 02:40:00,160
challenge contest

4347
02:40:03,510 --> 02:40:01,439
on the 10th

4348
02:40:05,190 --> 02:40:03,520
of march

4349
02:40:07,030 --> 02:40:05,200
as you can see it's a pretty exciting

4350
02:40:08,870 --> 02:40:07,040
opportunity taking advantage of some of

4351
02:40:11,190 --> 02:40:08,880
the open innovation resources that nasa

4352
02:40:13,670 --> 02:40:11,200
already has in place

4353
02:40:15,429 --> 02:40:13,680
utilizing the nasa tournament lab and

4354
02:40:16,870 --> 02:40:15,439
the partnership with harvard and

4355
02:40:18,870 --> 02:40:16,880
topcoder

4356
02:40:21,190 --> 02:40:18,880
to engage people that might not think

4357
02:40:23,349 --> 02:40:21,200
that they can contribute to

4358
02:40:25,830 --> 02:40:23,359
solving this problem or improving our

4359
02:40:29,670 --> 02:40:25,840
ability to solve this problem

4360
02:40:32,870 --> 02:40:29,680
so we announced on the 10th and by uh by

4361
02:40:35,190 --> 02:40:32,880
monday of this week on the 24th we had

4362
02:40:36,950 --> 02:40:35,200
almost 28 000 unique visitors to the

4363
02:40:38,710 --> 02:40:36,960

website

4364
02:40:40,870 --> 02:40:38,720
you can see that's roughly about five

4365
02:40:44,230 --> 02:40:40,880
times the level of interest that a

4366
02:40:47,349 --> 02:40:44,240
contest earlier in the fall had received

4367
02:40:49,429 --> 02:40:47,359
we also have gotten nearly 400

4368
02:40:51,510 --> 02:40:49,439
registrants that are competing in the

4369
02:40:54,870 --> 02:40:51,520
first set of 10

4370
02:41:00,230 --> 02:40:57,429
at this point the first phase has not

4371
02:41:01,349 --> 02:41:00,240
closed so we haven't paid out any money

4372
02:41:03,830 --> 02:41:01,359
but the

4373
02:41:06,630 --> 02:41:03,840
uh really exciting and probably the area

4374
02:41:09,750 --> 02:41:06,640
the the of the contest that'll get a lot

4375
02:41:11,590 --> 02:41:09,760
of the traction is on the 18th when we

4376
02:41:13,510 --> 02:41:11,600
release the

4377
02:41:14,309 --> 02:41:13,520
preliminary beta algorithm

4378
02:41:16,950 --> 02:41:14,319
where

4379
02:41:19,190 --> 02:41:16,960
people will start competing to develop

4380
02:41:25,670 --> 02:41:19,200
that algorithm that will hopefully

4381
02:41:25,680 --> 02:41:29,670
and could i get the next slide please

4382
02:41:34,070 --> 02:41:32,150
so if you're not a coder or

4383
02:41:43,270 --> 02:41:34,080
a

4384
02:41:46,309 --> 02:41:43,280
with some epo funds out of lindley

4385
02:41:49,830 --> 02:41:46,319
johnson's organization to bob holmes

4386
02:41:51,750 --> 02:41:49,840
many years ago was a an effort started

4387
02:41:54,309 --> 02:41:51,760
called isaac

4388
02:41:56,070 --> 02:41:54,319

bob holmes then started working with dr

4389
02:41:59,030 --> 02:41:56,080
patrick miller

4390
02:42:00,710 --> 02:41:59,040
who launched this isaac program

4391
02:42:04,550 --> 02:42:00,720
in 2006

4392
02:42:06,950 --> 02:42:04,560
they only had five schools signed up

4393
02:42:11,429 --> 02:42:06,960
today they have

4394
02:42:15,590 --> 02:42:13,349
you've heard about some of our guests

4395
02:42:18,389 --> 02:42:15,600
that are in the audience today

4396
02:42:20,150 --> 02:42:18,399
and it is uh my great privilege to be

4397
02:42:22,230 --> 02:42:20,160
able to invite up

4398
02:42:41,190 --> 02:42:22,240
the dillard drive middle school asteroid

4399
02:42:45,830 --> 02:42:43,830
hi my name is catherine rorbaugh and i'm

4400
02:42:48,309 --> 02:42:45,840
a third year seventh grade science

4401
02:42:50,870 --> 02:42:48,319
teacher at dillard drive middle school

4402
02:42:53,190 --> 02:42:50,880
located in raleigh north carolina to say

4403
02:42:55,510 --> 02:42:53,200
that we are excited to be here today is

4404
02:42:57,510 --> 02:42:55,520
a little bit of an understatement

4405
02:42:59,590 --> 02:42:57,520
with me here today i have four of my

4406
02:43:01,830 --> 02:42:59,600
brilliantly talented seventh grade

4407
02:43:04,469 --> 02:43:01,840
students who i get to teach every day

4408
02:43:07,990 --> 02:43:04,479
seventh grade science first i have ryan

4409
02:43:13,270 --> 02:43:10,870
emily hiller

4410
02:43:22,469 --> 02:43:13,280
stephen powell

4411
02:43:27,990 --> 02:43:24,710
i began this asteroid team back in

4412
02:43:30,389 --> 02:43:28,000
november and in january we first did our

4413
02:43:32,710 --> 02:43:30,399

first maine belt asteroid search and

4414
02:43:35,110 --> 02:43:32,720
just two days ago we began our first

4415
02:43:37,190 --> 02:43:35,120
near-earth asteroid search with the pan

4416
02:43:42,230 --> 02:43:37,200
stars observatory

4417
02:43:46,630 --> 02:43:43,910
we work for the international

4418
02:43:48,630 --> 02:43:46,640
astronomical search collaboration during

4419
02:43:50,950 --> 02:43:48,640
our first main belt asteroid search

4420
02:43:53,269 --> 02:43:50,960
there are a total of 29 universities and

4421
02:43:55,590 --> 02:43:53,279
observatories participating we're the

4422
02:43:58,070 --> 02:43:55,600
only middle school in the world to

4423
02:44:00,790 --> 02:43:58,080
participate in this division alone there

4424
02:44:03,110 --> 02:44:00,800
were six other countries a total of 70

4425
02:44:05,190 --> 02:44:03,120
asteroids were observed and we found

4426
02:44:08,790 --> 02:44:05,200
four of those asteroids next slide

4427
02:44:12,710 --> 02:44:10,710
nasa's armed mission is something nasa

4428
02:44:14,870 --> 02:44:12,720
would like to achieve in the next decade

4429
02:44:17,429 --> 02:44:14,880
during this mission nasa wants to find

4430
02:44:19,030 --> 02:44:17,439
and overly capture a near-earth asteroid

4431
02:44:21,110 --> 02:44:19,040
we feel called by this asteroid

4432
02:44:22,630 --> 02:44:21,120
initiative to help out

4433
02:44:24,309 --> 02:44:22,640
through the asteroid grand challenge we

4434
02:44:26,389 --> 02:44:24,319
want to help find the missing unknown

4435
02:44:28,389 --> 02:44:26,399
asteroids we've been learning a lot

4436
02:44:30,150 --> 02:44:28,399
about these asteroids and by doing these

4437
02:44:32,070 --> 02:44:30,160
searches and potentially helping with

4438
02:44:33,830 --> 02:44:32,080

missions like arm and the asteroid grand

4439
02:44:35,510 --> 02:44:33,840
challenge

4440
02:44:37,590 --> 02:44:35,520
it allows us to grow our knowledge on

4441
02:44:41,190 --> 02:44:37,600
these incredible space rocks next slide

4442
02:44:45,429 --> 02:44:43,190
we were extremely excited to have been

4443
02:44:48,309 --> 02:44:45,439
invited to participate in the pan starr

4444
02:44:49,830 --> 02:44:48,319
search it's a big deal in the last

4445
02:44:51,190 --> 02:44:49,840
search we had four asteroid

4446
02:44:52,630 --> 02:44:51,200
confirmations

4447
02:44:54,870 --> 02:44:52,640
we are even more excited to be in the

4448
02:44:57,110 --> 02:44:54,880
pan star search because of the higher

4449
02:44:59,349 --> 02:44:57,120
power telescope which raises the chances

4450
02:45:01,670 --> 02:44:59,359
of having an original discovery

4451
02:45:03,750 --> 02:45:01,680
also it's amazing that we are seventh

4452
02:45:06,070 --> 02:45:03,760
graders participating in real life

4453
02:45:07,429 --> 02:45:06,080
science like nasa's arm and asteroid

4454
02:45:09,269 --> 02:45:07,439
grain challenge

4455
02:45:11,190 --> 02:45:09,279
it really is a great opportunity for all

4456
02:45:12,710 --> 02:45:11,200
of us and i think i speak for everyone

4457
02:45:13,910 --> 02:45:12,720
in our group when i say that we've

4458
02:45:15,190 --> 02:45:13,920
learned a lot from this amazing

4459
02:45:19,750 --> 02:45:15,200
experience

4460
02:45:27,510 --> 02:45:22,469
on february 28th pan starts located a

4461
02:45:29,110 --> 02:45:27,520
new asteroid called 2014 dx 110 which

4462
02:45:31,269 --> 02:45:29,120
was discovered

4463
02:45:33,030 --> 02:45:31,279

i mean which was an earth flyby

4464
02:45:35,190 --> 02:45:33,040
that is pretty cool because they found

4465
02:45:37,429 --> 02:45:35,200
it an asteroid with the same telescope

4466
02:45:39,590 --> 02:45:37,439
we use and it gives us motivation and

4467
02:45:44,230 --> 02:45:39,600
confidence that will let us try to find

4468
02:45:48,230 --> 02:45:46,469
and that it will lead us

4469
02:45:50,870 --> 02:45:48,240
and not only did it get discovered it

4470
02:45:52,790 --> 02:45:50,880
flew by earth that really puts into

4471
02:45:54,630 --> 02:45:52,800
perspective that what we are doing is

4472
02:45:57,030 --> 02:45:54,640
real science and how much of a big deal

4473
02:46:01,670 --> 02:45:57,040
it is it leads us to find

4474
02:46:07,750 --> 02:46:03,590
and now for the exciting part what have

4475
02:46:07,760 --> 02:46:15,990
on january 14 2014 we located 2005 xja

4476
02:46:16,000 --> 02:46:24,070
on january 16 2014 we located 2013 tbal

4477
02:46:31,750 --> 02:46:25,429
slide please

4478
02:46:39,590 --> 02:46:35,910
on january 30th 2014 we located 2013

4479
02:46:44,950 --> 02:46:41,750
we are extremely grateful for nasa for

4480
02:46:46,950 --> 02:46:44,960
giving us oh sorry next slide please

4481
02:46:48,389 --> 02:46:46,960
we are extremely grateful for nasa for

4482
02:46:50,389 --> 02:46:48,399
giving us this once in a lifetime

4483
02:46:52,870 --> 02:46:50,399
opportunity

4484
02:47:17,670 --> 02:46:52,880
and we hope to see you next year thank

4485
02:47:22,469 --> 02:47:20,790
can i get my next slide please

4486
02:47:23,349 --> 02:47:22,479
pretty exciting to see that we're able

4487
02:47:27,830 --> 02:47:23,359
to

4488
02:47:31,269 --> 02:47:28,830

get the

4489
02:47:34,550 --> 02:47:31,279
enthusiasm and excitement to to

4490
02:47:36,790 --> 02:47:34,560
contribute in our missions so if you're

4491
02:47:39,110 --> 02:47:36,800
not a maker and you're not a coder and

4492
02:47:40,710 --> 02:47:39,120
you're not a middle school student

4493
02:47:42,550 --> 02:47:40,720
we've got some more ways for you to be

4494
02:47:44,389 --> 02:47:42,560
able to help with us

4495
02:47:47,429 --> 02:47:44,399
the international space apps challenge

4496
02:47:49,429 --> 02:47:47,439
will be running april 12 through 13.

4497
02:47:51,990 --> 02:47:49,439
just a couple of weeks from now now

4498
02:47:54,070 --> 02:47:52,000
there are five themes asteroids happens

4499
02:47:55,590 --> 02:47:54,080
to be one of those themes

4500
02:47:58,469 --> 02:47:55,600
you can see

4501
02:48:00,230 --> 02:47:58,479
six asteroid focused themes that we'll

4502
02:48:02,070 --> 02:48:00,240
be focusing on

4503
02:48:04,070 --> 02:48:02,080
it's a weekend weekend-long event where

4504
02:48:06,150 --> 02:48:04,080
people come together

4505
02:48:08,550 --> 02:48:06,160
drink a lot of coffee stay up late work

4506
02:48:10,630 --> 02:48:08,560
on solutions to problems that nasa has

4507
02:48:12,550 --> 02:48:10,640
submitted to the global community

4508
02:48:14,830 --> 02:48:12,560
they're almost there over a hundred

4509
02:48:17,990 --> 02:48:14,840
cities around the the world that will be

4510
02:48:21,110 --> 02:48:18,000
participating and in fact the create

4511
02:48:22,550 --> 02:48:21,120
your uh make your own asteroid movie

4512
02:48:25,990 --> 02:48:22,560
came out of the

4513
02:48:28,870 --> 02:48:26,000

rfi eric deyoung from jpl presented at

4514
02:48:32,309 --> 02:48:28,880
the idea synthesis workshop and we've

4515
02:48:33,429 --> 02:48:32,319
opened up that effort to a space apps

4516
02:48:35,349 --> 02:48:33,439
challenge

4517
02:48:38,150 --> 02:48:35,359
if interested in locations you can go to

4518
02:48:40,389 --> 02:48:38,160
that website down below and and find a

4519
02:48:41,830 --> 02:48:40,399
city near you or contribute virtually

4520
02:48:44,150 --> 02:48:41,840
online

4521
02:48:45,990 --> 02:48:44,160
next slide please

4522
02:48:47,429 --> 02:48:46,000
so looking forward

4523
02:48:48,870 --> 02:48:47,439
what do we have in front of us for the

4524
02:48:50,710 --> 02:48:48,880
grand challenge

4525
02:48:53,190 --> 02:48:50,720
i'd mentioned the makers we attended the

4526
02:48:55,110 --> 02:48:53,200
maker faire in new york city last fall

4527
02:48:57,110 --> 02:48:55,120
we'll be in san mateo

4528
02:49:00,230 --> 02:48:57,120
the 17th and 18th

4529
02:49:01,990 --> 02:49:00,240
expecting a bigger presence there it's a

4530
02:49:03,510 --> 02:49:02,000
almost double the size in terms of

4531
02:49:05,670 --> 02:49:03,520
attendees

4532
02:49:06,710 --> 02:49:05,680
just amazed at what we saw in fact there

4533
02:49:08,309 --> 02:49:06,720
was a

4534
02:49:10,550 --> 02:49:08,319
participant in

4535
02:49:13,110 --> 02:49:10,560
the announcement the rfi announcement

4536
02:49:15,349 --> 02:49:13,120
last june that ended up getting a team

4537
02:49:17,429 --> 02:49:15,359
together to build a cubesat that they

4538
02:49:18,950 --> 02:49:17,439

displayed in new york city so there's no

4539
02:49:21,110 --> 02:49:18,960
telling what we'll see

4540
02:49:23,349 --> 02:49:21,120
out in san mateo

4541
02:49:25,670 --> 02:49:23,359
additionally we started a grand

4542
02:49:27,429 --> 02:49:25,680
challenge seminar series virtually to

4543
02:49:28,230 --> 02:49:27,439
enable anyone around the world to tune

4544
02:49:29,830 --> 02:49:28,240
in

4545
02:49:32,950 --> 02:49:29,840
we've had great talks from david

4546
02:49:35,110 --> 02:49:32,960
morrison lindley johnson and paul chotis

4547
02:49:36,710 --> 02:49:35,120
we've got one this friday

4548
02:49:39,670 --> 02:49:36,720
tune in please

4549
02:49:43,030 --> 02:49:39,680
11 am al harris is going to talk about

4550
02:49:45,110 --> 02:49:43,040
the neo population and impact frequency

4551
02:49:47,510 --> 02:49:45,120
if you can't make it we are archiving

4552
02:49:49,990 --> 02:49:47,520
them so all those talks will be

4553
02:49:52,870 --> 02:49:50,000
available we've got about six more after

4554
02:49:54,710 --> 02:49:52,880
this friday at least scheduled for now

4555
02:49:56,870 --> 02:49:54,720
we have a planning wiki where we've been

4556
02:49:59,750 --> 02:49:56,880
engaging in two-way conversation ideas

4557
02:50:01,269 --> 02:49:59,760
collected uh help us figure out how the

4558
02:50:05,190 --> 02:50:01,279
community wants to move forward because

4559
02:50:06,710 --> 02:50:05,200
this is a group effort you can see the

4560
02:50:08,309 --> 02:50:06,720
link there

4561
02:50:10,150 --> 02:50:08,319
and then finally we're working towards

4562
02:50:12,389 --> 02:50:10,160
an anniversary event

4563
02:50:13,670 --> 02:50:12,399

on the 18th of june

4564
02:50:15,030 --> 02:50:13,680
not sure exactly what that's going to

4565
02:50:18,389 --> 02:50:15,040
look like but if you have some ideas

4566
02:50:20,870 --> 02:50:18,399
please share it with us either

4567
02:50:23,510 --> 02:50:20,880
online at thewiki or at our twitter

4568
02:50:26,790 --> 02:50:23,520
account asteroid gc

4569
02:50:29,990 --> 02:50:26,800
i get the next slide please

4570
02:50:32,870 --> 02:50:30,000
in closing um i'd like to read a quote

4571
02:50:34,950 --> 02:50:32,880
that i saw almost every day my initial

4572
02:50:37,910 --> 02:50:34,960
days at nasa when i started back in the

4573
02:50:39,750 --> 02:50:37,920
90s and it was really impactful and and

4574
02:50:42,230 --> 02:50:39,760
powerful for

4575
02:50:46,230 --> 02:50:42,240
my growth and and thinking and it's a

4576
02:50:52,469 --> 02:50:48,830
far better is it to dare mighty

4577
02:50:54,950 --> 02:50:52,479
things to win glorious triumphs

4578
02:50:57,990 --> 02:50:54,960
even though checkered by failure than to

4579
02:51:00,550 --> 02:50:58,000
rank with those poor spirits

4580
02:51:02,950 --> 02:51:00,560
who neither enjoy nor suffer much

4581
02:51:07,269 --> 02:51:02,960
because they live in a gray twilight

4582
02:51:08,950 --> 02:51:07,279
that knows not victory nor defeat

4583
02:51:10,230 --> 02:51:08,960
i can say

4584
02:51:13,750 --> 02:51:10,240
confidently

4585
02:51:16,469 --> 02:51:13,760
that we are daring mighty things today

4586
02:51:19,429 --> 02:51:16,479
and i can also say that i know that what

4587
02:51:21,030 --> 02:51:19,439
we're doing is the right thing because i

4588
02:51:23,830 --> 02:51:21,040

can look into the eyes of these young

4589
02:51:25,670 --> 02:51:23,840
students and see the fire and

4590
02:51:27,590 --> 02:51:25,680
enthusiasm that they're bringing to this

4591
02:51:29,510 --> 02:51:27,600
effort and

4592
02:51:32,870 --> 02:51:29,520
i want to thank them for coming up from

4593
02:51:35,349 --> 02:51:32,880
north carolina to participate with us

4594
02:51:38,150 --> 02:51:35,359
and everybody that has joined in the

4595
02:51:40,630 --> 02:51:38,160
grand challenge effort it has been

4596
02:51:43,030 --> 02:51:40,640
a wild ride so far and we look for

4597
02:51:54,230 --> 02:51:43,040
a great future together and so with that

4598
02:51:57,510 --> 02:51:56,309
thank you jason and let's hear one more

4599
02:52:02,870 --> 02:51:57,520
round of applause for the greatest

4600
02:52:07,910 --> 02:52:04,790
what were you doing in seventh grade

4601
02:52:10,150 --> 02:52:07,920
because i wasn't doing that um

4602
02:52:12,389 --> 02:52:10,160
all right so we're gonna go to uh to q a

4603
02:52:13,670 --> 02:52:12,399
and uh and exhaust uh the rest of your

4604
02:52:15,750 --> 02:52:13,680
questions that are out there and then

4605
02:52:17,349 --> 02:52:15,760
we'll start to close down the event but

4606
02:52:19,190 --> 02:52:17,359
do we have any further

4607
02:52:20,630 --> 02:52:19,200
uh community feedback or questions here

4608
02:52:25,349 --> 02:52:20,640
in the audience and let's get a

4609
02:52:28,710 --> 02:52:26,550
um

4610
02:52:31,110 --> 02:52:28,720
hi marshall lublin here again i had a

4611
02:52:32,710 --> 02:52:31,120
question about the secondary payloads

4612
02:52:34,950 --> 02:52:32,720
and i probably should have asked it then

4613
02:52:37,510 --> 02:52:34,960

but it didn't really occur to me is it

4614
02:52:39,590 --> 02:52:37,520
in the in this document is that just

4615
02:52:41,910 --> 02:52:39,600
does that describe anywhere

4616
02:52:44,550 --> 02:52:41,920
i know you said it was 6u i think for

4617
02:52:46,550 --> 02:52:44,560
inside the spacecraft and 12u for on the

4618
02:52:48,469 --> 02:52:46,560
bus or something like that is that

4619
02:52:50,550 --> 02:52:48,479
described anywhere in particular like if

4620
02:52:52,070 --> 02:52:50,560
you had a secondary instrument things

4621
02:52:53,750 --> 02:52:52,080
like the power available the

4622
02:52:56,469 --> 02:52:53,760
communications and all like that is that

4623
02:52:57,349 --> 02:52:56,479
is that describes clearly somewhere like

4624
02:52:59,830 --> 02:52:57,359
the way that

4625
02:53:00,790 --> 02:52:59,840
does it from the station

4626
02:53:01,750 --> 02:53:00,800
musk

4627
02:53:04,790 --> 02:53:01,760
you need to take that one from the

4628
02:53:07,830 --> 02:53:04,800
microphone here up front

4629
02:53:10,550 --> 02:53:07,840
and if not can it be

4630
02:53:13,190 --> 02:53:10,560
i believe it is described in the baa in

4631
02:53:16,469 --> 02:53:13,200
that section

4632
02:53:19,030 --> 02:53:16,479
as to what the reference concept would

4633
02:53:21,590 --> 02:53:19,040
could accommodate but i think in terms

4634
02:53:23,830 --> 02:53:21,600
of responses

4635
02:53:26,230 --> 02:53:23,840
i think you should come back with your

4636
02:53:28,230 --> 02:53:26,240
ideas understanding that there's

4637
02:53:30,070 --> 02:53:28,240
extremely limited

4638
02:53:32,550 --> 02:53:30,080

so if we need a watt we should just say

4639
02:53:35,910 --> 02:53:32,560
we need a watt and that yes okay thank

4640
02:53:35,920 --> 02:53:40,389
back behind you nicole

4641
02:53:45,750 --> 02:53:42,870
hello again rick dewitt i have a

4642
02:53:48,790 --> 02:53:45,760
question about solar electric propulsion

4643
02:53:50,389 --> 02:53:48,800
um how easily can it be throttled uh is

4644
02:53:51,830 --> 02:53:50,399
it basically turn it on and off like a

4645
02:53:53,990 --> 02:53:51,840
light switch or does it really need a

4646
02:53:55,590 --> 02:53:54,000
warm-up time i'm concerned about the

4647
02:53:57,590 --> 02:53:55,600
enhanced gravity tractor it's going to

4648
02:53:59,349 --> 02:53:57,600
have to operate at less than 100 percent

4649
02:54:03,429 --> 02:53:59,359
duty cycle

4650
02:54:07,429 --> 02:54:05,830
um there's not one answer for you but i

4651
02:54:09,349 --> 02:54:07,439
can tell you in terms of the technology

4652
02:54:10,309 --> 02:54:09,359
efforts that nasa is currently working

4653
02:54:12,389 --> 02:54:10,319
on

4654
02:54:14,150 --> 02:54:12,399
under stmd those hall thrusters are

4655
02:54:15,670 --> 02:54:14,160
throttlable

4656
02:54:17,349 --> 02:54:15,680
now you have to have the correct control

4657
02:54:18,309 --> 02:54:17,359
algorithms and electronics to do that

4658
02:54:20,309 --> 02:54:18,319
but

4659
02:54:23,429 --> 02:54:20,319
for instance that 2000 to 3000 second

4660
02:54:25,349 --> 02:54:23,439
range of isp we can throttle across that

4661
02:54:27,670 --> 02:54:25,359
range um it changes the thrust level

4662
02:54:29,750 --> 02:54:27,680
that it's more com i'm oversimplifying

4663
02:54:31,269 --> 02:54:29,760

but it's not just a binary switch it's

4664
02:54:33,429 --> 02:54:31,279
not just on and off you can throttle the

4665
02:54:34,790 --> 02:54:33,439
thrusters in an ep system i'm sure

4666
02:54:37,269 --> 02:54:34,800
you've looked at it i just wanted to

4667
02:54:39,670 --> 02:54:37,279
know thank you

4668
02:54:41,750 --> 02:54:39,680
uh let's go to twitter what do we have

4669
02:54:43,750 --> 02:54:41,760
we have a question about the

4670
02:54:47,110 --> 02:54:43,760
location of the asteroid after it's

4671
02:54:49,030 --> 02:54:47,120
redirected why lunar orbit or

4672
02:54:51,590 --> 02:54:49,040
the lagrange points wouldn't a high

4673
02:54:54,389 --> 02:54:51,600
earth orbit make investigation

4674
02:54:55,910 --> 02:54:54,399
or exploration simpler

4675
02:54:57,429 --> 02:54:55,920
steve

4676
02:54:58,710 --> 02:54:57,439
i'll try that one

4677
02:55:00,070 --> 02:54:58,720
yeah we

4678
02:55:02,950 --> 02:55:00,080
spent a lot of time looking at different

4679
02:55:05,429 --> 02:55:02,960
locations to take the asteroid to

4680
02:55:07,830 --> 02:55:05,439
and we selected this uh lunar distant

4681
02:55:08,870 --> 02:55:07,840
retrograde orbit for really two reasons

4682
02:55:10,550 --> 02:55:08,880
one

4683
02:55:12,070 --> 02:55:10,560
it was a very stable orbit so if we put

4684
02:55:14,150 --> 02:55:12,080
the asteroid there and the with the

4685
02:55:15,110 --> 02:55:14,160
spacecraft you could stay for about 80

4686
02:55:16,710 --> 02:55:15,120
years

4687
02:55:18,790 --> 02:55:16,720
without doing any maneuvers and secondly

4688
02:55:20,389 --> 02:55:18,800

you could get to it with orion

4689
02:55:21,590 --> 02:55:20,399
on these early missions so it was a nice

4690
02:55:23,349 --> 02:55:21,600
sweet spot

4691
02:55:25,750 --> 02:55:23,359
versus bringing it all the way into uh

4692
02:55:27,830 --> 02:55:25,760
to earth orbit a lot more energy

4693
02:55:28,790 --> 02:55:27,840
required to bring that big massive

4694
02:55:31,670 --> 02:55:28,800
asteroid

4695
02:55:34,309 --> 02:55:31,680
there

4696
02:55:36,710 --> 02:55:34,319
one here in the in the middle

4697
02:55:41,110 --> 02:55:39,110
hi my name is james wanga from go lab in

4698
02:55:44,150 --> 02:55:41,120
new york city and uh the question i had

4699
02:55:45,269 --> 02:55:44,160
was during the characterization phase

4700
02:55:47,349 --> 02:55:45,279
you mentioned that there would be these

4701
02:55:49,269 --> 02:55:47,359
one kilometer flybys at which you'd use

4702
02:55:51,030 --> 02:55:49,279
3d lidar to characterize the surface of

4703
02:55:52,550 --> 02:55:51,040
the asteroid i don't know a whole lot

4704
02:55:54,230 --> 02:55:52,560
about lidar but i'm concerned that at

4705
02:55:57,910 --> 02:55:54,240
one kilometer flyby you're not going to

4706
02:55:59,510 --> 02:55:57,920
be able to do a really precise submeter

4707
02:56:01,349 --> 02:55:59,520
characterization and i was wondering if

4708
02:56:04,150 --> 02:56:01,359
that is the case

4709
02:56:06,389 --> 02:56:04,160
and if it is is there uh plans for some

4710
02:56:08,469 --> 02:56:06,399
sort of secondary characterization

4711
02:56:10,150 --> 02:56:08,479
of you know being able to determine like

4712
02:56:11,910 --> 02:56:10,160
the gentleman earlier said whether or

4713
02:56:13,590 --> 02:56:11,920

not a boulder was indeed a small rubble

4714
02:56:18,469 --> 02:56:13,600
pile or something like that

4715
02:56:21,750 --> 02:56:20,309
so to answer the question with respect

4716
02:56:24,630 --> 02:56:21,760
to the characterization that's not done

4717
02:56:26,950 --> 02:56:24,640
using the lidar that's done using the um

4718
02:56:29,670 --> 02:56:26,960
the cameras the optical cameras um from

4719
02:56:31,670 --> 02:56:29,680
a different different uh angles um the

4720
02:56:33,910 --> 02:56:31,680
lidar would be done for the the uh the

4721
02:56:35,429 --> 02:56:33,920
close-up operations in in in both of the

4722
02:56:37,510 --> 02:56:35,439
scenarios

4723
02:56:39,110 --> 02:56:37,520
and i'm sorry was the second part was

4724
02:56:40,070 --> 02:56:39,120
there a second part of that question

4725
02:56:41,910 --> 02:56:40,080
yeah well

4726
02:56:50,790 --> 02:56:41,920
the question the question i had was are

4727
02:56:54,870 --> 02:56:52,550
yeah it's more of a navigation tool i'm

4728
02:56:57,510 --> 02:56:54,880
optically with with the cameras we'll

4729
02:56:59,190 --> 02:56:57,520
have sub-centimeter resolution i'm doing

4730
02:57:01,269 --> 02:56:59,200
while we do these dry runs for the the

4731
02:57:03,510 --> 02:57:01,279
boulder capture option

4732
02:57:05,590 --> 02:57:03,520
um we'll come down close

4733
02:57:07,269 --> 02:57:05,600
uh after we've selected a series of

4734
02:57:09,349 --> 02:57:07,279
candidate boulders and then we'll get

4735
02:57:12,469 --> 02:57:09,359
very high resolution images that we can

4736
02:57:14,150 --> 02:57:12,479
build shape models and and

4737
02:57:21,590 --> 02:57:14,160
before we do the actual collection

4738
02:57:26,230 --> 02:57:23,510

let's let's get you go um can you repeat

4739
02:57:27,349 --> 02:57:26,240
that lesson yeah um the reason i asked

4740
02:57:28,870 --> 02:57:27,359
the question is because i thought it

4741
02:57:31,110 --> 02:57:28,880
would be a great opportunity to do

4742
02:57:33,269 --> 02:57:31,120
something like using panoptic lenses

4743
02:57:35,030 --> 02:57:33,279
that allow you to do optical 3d

4744
02:57:36,469 --> 02:57:35,040
characterization without

4745
02:57:37,910 --> 02:57:36,479
without lidar and so if you're going to

4746
02:57:40,950 --> 02:57:37,920
take pictures with a high resolution

4747
02:57:41,590 --> 02:57:40,960
camera up close um doing something you

4748
02:57:43,269 --> 02:57:41,600
know

4749
02:57:44,790 --> 02:57:43,279
with a planoptic lens might might offer

4750
02:57:46,309 --> 02:57:44,800
some added advantage but that was i was

4751
02:57:48,710 --> 02:57:46,319
just curious yeah absolutely any

4752
02:57:50,870 --> 02:57:48,720
techniques that we can

4753
02:57:53,269 --> 02:57:50,880
get information including the shape 3d

4754
02:57:54,870 --> 02:57:53,279
the surface features will be

4755
02:57:57,110 --> 02:57:54,880
will be beneficial

4756
02:58:02,070 --> 02:57:57,120
okay

4757
02:58:07,030 --> 02:58:04,710
how about twitter we do have another one

4758
02:58:09,349 --> 02:58:07,040
uh from launch to humans exploring the

4759
02:58:15,110 --> 02:58:09,359
asteroid in lunar orbit how long will

4760
02:58:18,630 --> 02:58:17,030
that's a really good question so

4761
02:58:21,590 --> 02:58:18,640
we've looked at a lot of different uh

4762
02:58:23,349 --> 02:58:21,600
launch dates the mission takes around 26

4763
02:58:25,510 --> 02:58:23,359

to 28 days

4764
02:58:26,950 --> 02:58:25,520
so it basically takes uh nine or ten

4765
02:58:28,790 --> 02:58:26,960
days to get out

4766
02:58:30,870 --> 02:58:28,800
to the distant retrograde orbit then we

4767
02:58:33,670 --> 02:58:30,880
spend about five days there and

4768
02:58:36,790 --> 02:58:33,680
and roughly 10 or 11 days back so it

4769
02:58:40,870 --> 02:58:36,800
varies between 26 to

4770
02:58:46,070 --> 02:58:43,830
okay i think we're going to start to uh

4771
02:58:47,910 --> 02:58:46,080
to transition here from from q a to our

4772
02:58:49,190 --> 02:58:47,920
final speaker i really appreciate

4773
02:58:51,590 --> 02:58:49,200
everyone's questions that we've gotten

4774
02:58:53,910 --> 02:58:51,600
here so far in the audience of course

4775
02:58:55,030 --> 02:58:53,920
online using the hashtag asknasa and

4776
02:58:56,469 --> 02:58:55,040
just reminder you can find all the

4777
02:58:57,670 --> 02:58:56,479
presentations you saw today more

4778
02:58:59,190 --> 02:58:57,680
information

4779
02:59:00,790 --> 02:58:59,200
some of the videos that we showed at

4780
02:59:03,030 --> 02:59:00,800
nasa.gov

4781
02:59:04,710 --> 02:59:03,040
asteroid initiative and the

4782
02:59:07,269 --> 02:59:04,720
presentations to be at slash asteroid

4783
02:59:08,790 --> 02:59:07,279
forum so you've heard a lot of great

4784
02:59:10,790 --> 02:59:08,800
ideas here we've had a lot of great

4785
02:59:12,870 --> 02:59:10,800
feedback here to kind of help us put a

4786
02:59:15,030 --> 02:59:12,880
finer point on everything for concluding

4787
02:59:17,269 --> 02:59:15,040
remarks it's my pleasure to introduce

4788
02:59:27,670 --> 02:59:17,279

nasa's associate administrator robert

4789
02:59:31,110 --> 02:59:29,510
well a great day for you guys i've been

4790
02:59:32,469 --> 02:59:31,120
watching from my office up there in

4791
02:59:34,710 --> 02:59:32,479
between meetings

4792
02:59:36,309 --> 02:59:34,720
um i hope you're as excited as i was to

4793
02:59:38,790 --> 02:59:36,319
hear what these teams have been working

4794
02:59:40,870 --> 02:59:38,800
on they briefed me i guess we spent

4795
02:59:42,710 --> 02:59:40,880
10 hours one day going through those in

4796
02:59:44,790 --> 02:59:42,720
much more depth than you did than you

4797
02:59:46,389 --> 02:59:44,800
got to see and um

4798
02:59:47,750 --> 02:59:46,399
i left the room extremely excited about

4799
02:59:49,190 --> 02:59:47,760
what the team had done

4800
02:59:50,630 --> 02:59:49,200
um and where they're headed and what

4801
02:59:52,309 --> 02:59:50,640
they're thinking and and so i hope you

4802
02:59:53,830 --> 02:59:52,319
got to see the benefits of the the hard

4803
02:59:55,030 --> 02:59:53,840
work they've been doing

4804
02:59:56,630 --> 02:59:55,040
getting this mission refined getting

4805
02:59:58,230 --> 02:59:56,640
this concept refined as we get ready to

4806
03:00:00,469 --> 02:59:58,240
go do this

4807
03:00:02,070 --> 03:00:00,479
it's pretty exciting for me to stand

4808
03:00:03,750 --> 03:00:02,080
here and think about how far they've

4809
03:00:06,150 --> 03:00:03,760
come in just a year in terms of

4810
03:00:07,670 --> 03:00:06,160
developing these capabilities yes to do

4811
03:00:09,269 --> 03:00:07,680
this mission but also to make sure that

4812
03:00:10,790 --> 03:00:09,279
we make that all the things we're

4813
03:00:12,710 --> 03:00:10,800

working on are extensible to our real

4814
03:00:15,190 --> 03:00:12,720
destination which is mars so it's pretty

4815
03:00:17,750 --> 03:00:15,200
exciting to see that as we go forward

4816
03:00:20,550 --> 03:00:17,760
now i will say this what i didn't expect

4817
03:00:21,750 --> 03:00:20,560
when i came down here was to was to hear

4818
03:00:24,950 --> 03:00:21,760
you guys

4819
03:00:26,630 --> 03:00:24,960
how awesome is that um you know i

4820
03:00:28,389 --> 03:00:26,640
i literally got pulled out of a budget

4821
03:00:30,309 --> 03:00:28,399
meeting to come down here and you can

4822
03:00:33,110 --> 03:00:30,319
imagine budget meetings are

4823
03:00:35,429 --> 03:00:33,120
kind of interesting and so

4824
03:00:36,389 --> 03:00:35,439
so i so i come down here from a budget

4825
03:00:37,670 --> 03:00:36,399
meeting

4826
03:00:39,830 --> 03:00:37,680
and

4827
03:00:41,190 --> 03:00:39,840
i want to go back to the budget meeting

4828
03:00:43,030 --> 03:00:41,200
and tell them why we're doing what we're

4829
03:00:44,950 --> 03:00:43,040
doing for you guys

4830
03:00:46,469 --> 03:00:44,960
so you guys can take over for us one day

4831
03:00:47,750 --> 03:00:46,479
very excited to hear you guys and how

4832
03:00:49,110 --> 03:00:47,760
excited you are about what we're doing

4833
03:00:50,230 --> 03:00:49,120
so thank you for being here really

4834
03:00:51,429 --> 03:00:50,240
really neat

4835
03:00:53,670 --> 03:00:51,439
you know as charlie told you earlier

4836
03:00:54,950 --> 03:00:53,680
today we really are combining this into

4837
03:00:56,870 --> 03:00:54,960
one team now the teams are pulling

4838
03:00:58,150 --> 03:00:56,880

together the um

4839
03:00:59,670 --> 03:00:58,160
we're working on center assignments

4840
03:01:01,030 --> 03:00:59,680
we're getting those put out to who's

4841
03:01:02,389 --> 03:01:01,040
going to be working on what to get us to

4842
03:01:03,750 --> 03:01:02,399
the mission concept review all the

4843
03:01:05,830 --> 03:01:03,760
different pieces that you've seen that

4844
03:01:07,910 --> 03:01:05,840
the guys described earlier this baa is

4845
03:01:10,469 --> 03:01:07,920
just another step for us

4846
03:01:11,590 --> 03:01:10,479
in that process for getting ready to go

4847
03:01:12,630 --> 03:01:11,600
i'm

4848
03:01:14,230 --> 03:01:12,640
very confident that we're going to be

4849
03:01:15,349 --> 03:01:14,240
able to come in when we get our when we

4850
03:01:16,870 --> 03:01:15,359
finish all our estimates we're going to

4851
03:01:19,030 --> 03:01:16,880
come in at roughly half of what the keck

4852
03:01:20,070 --> 03:01:19,040
study said which was the 2.5 billion

4853
03:01:21,670 --> 03:01:20,080
we're going to come in about roughly

4854
03:01:23,590 --> 03:01:21,680
half of that that's what we're shooting

4855
03:01:24,710 --> 03:01:23,600
for from a gold perspective

4856
03:01:26,630 --> 03:01:24,720
and i think the teams are going to show

4857
03:01:28,150 --> 03:01:26,640
you that we can go do that

4858
03:01:29,510 --> 03:01:28,160
and frankly utilize a lot of the

4859
03:01:30,950 --> 03:01:29,520
existing things we're already working on

4860
03:01:32,870 --> 03:01:30,960
as you already heard so

4861
03:01:34,950 --> 03:01:32,880
it's a very exciting time for us we

4862
03:01:36,710 --> 03:01:34,960
think this does get us on the path

4863
03:01:39,110 --> 03:01:36,720

to getting to mars builds that next set

4864
03:01:40,710 --> 03:01:39,120
of capabilities is is steve or jason i

4865
03:01:42,309 --> 03:01:40,720
can't remember which one showed it the

4866
03:01:44,550 --> 03:01:42,319
the capabilities that we need to take

4867
03:01:45,990 --> 03:01:44,560
humans to mars and to that ultimate

4868
03:01:47,990 --> 03:01:46,000
destination

4869
03:01:49,510 --> 03:01:48,000
and uh pretty exciting and i'm just

4870
03:01:51,190 --> 03:01:49,520
thrilled to see how many folks are here

4871
03:01:53,190 --> 03:01:51,200
and glad you guys could come and be part

4872
03:01:55,030 --> 03:01:53,200
of this uh this great event so to

4873
03:01:56,950 --> 03:01:55,040
michelle and her team where's michelle

4874
03:01:58,309 --> 03:01:56,960
there's you michelle and jen all these

4875
03:01:59,830 --> 03:01:58,319
guys is fantastic let me give you a

4876
03:02:01,030 --> 03:01:59,840
couple of next steps that we've got just

4877
03:02:03,670 --> 03:02:01,040
to give you an idea what we're doing

4878
03:02:04,389 --> 03:02:03,680
next chart

4879
03:02:06,070 --> 03:02:04,399
so

4880
03:02:07,910 --> 03:02:06,080
as we as you've seen this chart many

4881
03:02:09,910 --> 03:02:07,920
many times i love the pictures of the

4882
03:02:13,030 --> 03:02:09,920
sls is there on the right uh headed

4883
03:02:14,550 --> 03:02:13,040
toward mars that's a lot of rockets

4884
03:02:16,469 --> 03:02:14,560
there's a rocket engine guy that's

4885
03:02:17,910 --> 03:02:16,479
that's good stuff so that's what but

4886
03:02:19,830 --> 03:02:17,920
that's what it takes this is the guy

4887
03:02:22,230 --> 03:02:19,840
showed you so this is our truly trying

4888
03:02:24,070 --> 03:02:22,240

to get to earth independence capability

4889
03:02:25,590 --> 03:02:24,080
that's what we want to go do um from an

4890
03:02:27,110 --> 03:02:25,600
agency standpoint but we truly think

4891
03:02:28,550 --> 03:02:27,120
this is the proving ground this is our

4892
03:02:30,790 --> 03:02:28,560
opportunity to do that from a proving

4893
03:02:33,510 --> 03:02:30,800
ground perspective in a in this area

4894
03:02:35,110 --> 03:02:33,520
around the moon next chart

4895
03:02:36,389 --> 03:02:35,120
so the next steps we've got and you've

4896
03:02:38,870 --> 03:02:36,399
heard most of these today we want to get

4897
03:02:39,590 --> 03:02:38,880
the inputs um through this baa to help

4898
03:02:40,870 --> 03:02:39,600
us

4899
03:02:42,070 --> 03:02:40,880
fold these into what we're going to be

4900
03:02:44,230 --> 03:02:42,080
doing

4901
03:02:47,349 --> 03:02:44,240
whether it's the capture systems the the

4902
03:02:49,030 --> 03:02:47,359
the arnd activity we're doing or even

4903
03:02:50,710 --> 03:02:49,040
how how can we turn it can we turn this

4904
03:02:54,230 --> 03:02:50,720
into a commercial bus can we go do these

4905
03:02:55,750 --> 03:02:54,240
kind of things to uh to enable more use

4906
03:02:56,710 --> 03:02:55,760
of the capabilities we're building down

4907
03:02:58,230 --> 03:02:56,720
the road

4908
03:03:00,150 --> 03:02:58,240
we it

4909
03:03:01,830 --> 03:03:00,160
fighting cold here guys so hang with me

4910
03:03:02,870 --> 03:03:01,840
um that so we're going to include the

4911
03:03:04,309 --> 03:03:02,880
the potential for the target

4912
03:03:06,389 --> 03:03:04,319
opportunities that may serve the

4913
03:03:09,190 --> 03:03:06,399

scientific and the partnership interest

4914
03:03:10,230 --> 03:03:09,200
via the baa you're going to see this

4915
03:03:12,389 --> 03:03:10,240
keep working with the science

4916
03:03:13,990 --> 03:03:12,399
communities and the key experts as we

4917
03:03:15,670 --> 03:03:14,000
move forward to just refine these

4918
03:03:17,670 --> 03:03:15,680
robotic concepts

4919
03:03:19,750 --> 03:03:17,680
and the approach we want to do we've got

4920
03:03:21,510 --> 03:03:19,760
to advance the solar electric propulsion

4921
03:03:23,349 --> 03:03:21,520
technology system it's not just the

4922
03:03:25,030 --> 03:03:23,359
thrusters it's the thrusters the arrays

4923
03:03:26,469 --> 03:03:25,040
the power systems all the pieces that go

4924
03:03:27,750 --> 03:03:26,479
with that and those have such

4925
03:03:29,110 --> 03:03:27,760
application

4926
03:03:30,230 --> 03:03:29,120
far beyond what we're trying to do with

4927
03:03:32,389 --> 03:03:30,240
them on this mission we really believe

4928
03:03:33,670 --> 03:03:32,399
that's that's a very important piece

4929
03:03:35,190 --> 03:03:33,680
by the way all these are things we were

4930
03:03:36,469 --> 03:03:35,200
already working on right now we're just

4931
03:03:38,070 --> 03:03:36,479
putting them together in a way that

4932
03:03:39,670 --> 03:03:38,080
allows us to do that we gotta do the

4933
03:03:41,030 --> 03:03:39,680
risk mitigation activities we're going

4934
03:03:42,230 --> 03:03:41,040
to be doing those over the next few

4935
03:03:44,790 --> 03:03:42,240
months

4936
03:03:47,349 --> 03:03:44,800
for the for the uh the capture and then

4937
03:03:49,429 --> 03:03:47,359
the boulder concept that they described

4938
03:03:50,550 --> 03:03:49,439

earlier and then as steve

4939
03:03:52,550 --> 03:03:50,560
said we're working a lot of the risk

4940
03:03:54,469 --> 03:03:52,560
assessment and risk reduction activities

4941
03:03:56,710 --> 03:03:54,479
associated with getting the crew to the

4942
03:03:59,269 --> 03:03:56,720
to the asteroid and hopefully we'll get

4943
03:04:02,950 --> 03:03:59,279
to a mission concept review um sometime

4944
03:04:04,870 --> 03:04:02,960
in early 2015. uh the teams again are

4945
03:04:06,790 --> 03:04:04,880
they we've pulled them we've turned them

4946
03:04:08,070 --> 03:04:06,800
from a teams to a team

4947
03:04:09,590 --> 03:04:08,080
and that's what we're going to go we're

4948
03:04:11,510 --> 03:04:09,600
going to go push forward for the next

4949
03:04:14,070 --> 03:04:11,520
few months here and get ready for that

4950
03:04:15,429 --> 03:04:14,080
mcr next chart

4951
03:04:17,590 --> 03:04:15,439
then on the grand challenge side of the

4952
03:04:18,790 --> 03:04:17,600
house as jason described earlier this is

4953
03:04:20,469 --> 03:04:18,800
exactly what we're going to be doing

4954
03:04:23,910 --> 03:04:20,479
we've got the seminar series

4955
03:04:26,790 --> 03:04:25,030
and we're going to support the

4956
03:04:28,230 --> 03:04:26,800
international space apps challenges as

4957
03:04:30,150 --> 03:04:28,240
jason said earlier

4958
03:04:33,269 --> 03:04:30,160
and then these educational materials for

4959
03:04:34,790 --> 03:04:33,279
the amateur astronomers for for nia's is

4960
03:04:36,469 --> 03:04:34,800
really important to us

4961
03:04:37,590 --> 03:04:36,479
again exactly what you heard earlier

4962
03:04:39,590 --> 03:04:37,600
from these guys we want to we want to

4963
03:04:41,030 --> 03:04:39,600

get more people more people involved

4964
03:04:42,550 --> 03:04:41,040
citizen science that's that's one of the

4965
03:04:44,710 --> 03:04:42,560
coolest things we're getting from from

4966
03:04:46,710 --> 03:04:44,720
this effort so again we appreciate you

4967
03:04:47,990 --> 03:04:46,720
guys being here i hope one day you'll be

4968
03:04:50,309 --> 03:04:48,000
able to sit here and say

4969
03:04:51,670 --> 03:04:50,319
hey i was i was in the web auditorium

4970
03:04:53,590 --> 03:04:51,680
when they took those first steps to

4971
03:04:54,790 --> 03:04:53,600
getting towards mars when they started

4972
03:04:56,070 --> 03:04:54,800
talking about this mission that we're

4973
03:04:58,389 --> 03:04:56,080
going to go do and all the things we're

4974
03:04:59,269 --> 03:04:58,399
doing so thanks for being here

4975
03:05:01,349 --> 03:04:59,279
and

4976
03:05:02,469 --> 03:05:01,359
work with us hard help us be successful

4977
03:05:03,990 --> 03:05:02,479
here because we need your help and we

4978
03:05:17,349 --> 03:05:04,000
want we want you guys to be part of this

4979
03:05:21,349 --> 03:05:19,429
okay so that's gonna wrap it for the uh

4980
03:05:23,190 --> 03:05:21,359
for the forum today i just really

4981
03:05:25,110 --> 03:05:23,200
appreciate everyone uh being here and

4982
03:05:26,710 --> 03:05:25,120
for those of you watching online and to

4983
03:05:29,110 --> 03:05:26,720
all our speakers so again you can follow

4984
03:05:30,870 --> 03:05:29,120
along as as we progress

4985
03:05:31,990 --> 03:05:30,880
uh in these these various components the

4986
03:05:33,269 --> 03:05:32,000
asteroid initiative by following

4987
03:05:35,190 --> 03:05:33,279
nasa.gov

4988
03:05:36,389 --> 03:05:35,200

asteroid initiative really appreciate

4989
03:05:38,550 --> 03:05:36,399
all your questions on twitter today

4990
03:05:40,550 --> 03:05:38,560
using the hashtag asknasa

4991
03:05:41,910 --> 03:05:40,560
uh just a big thank you again to all of

4992
03:05:43,670 --> 03:05:41,920
our speakers and the organizers of

4993
03:05:45,429 --> 03:05:43,680
today's forum and uh thank you for all