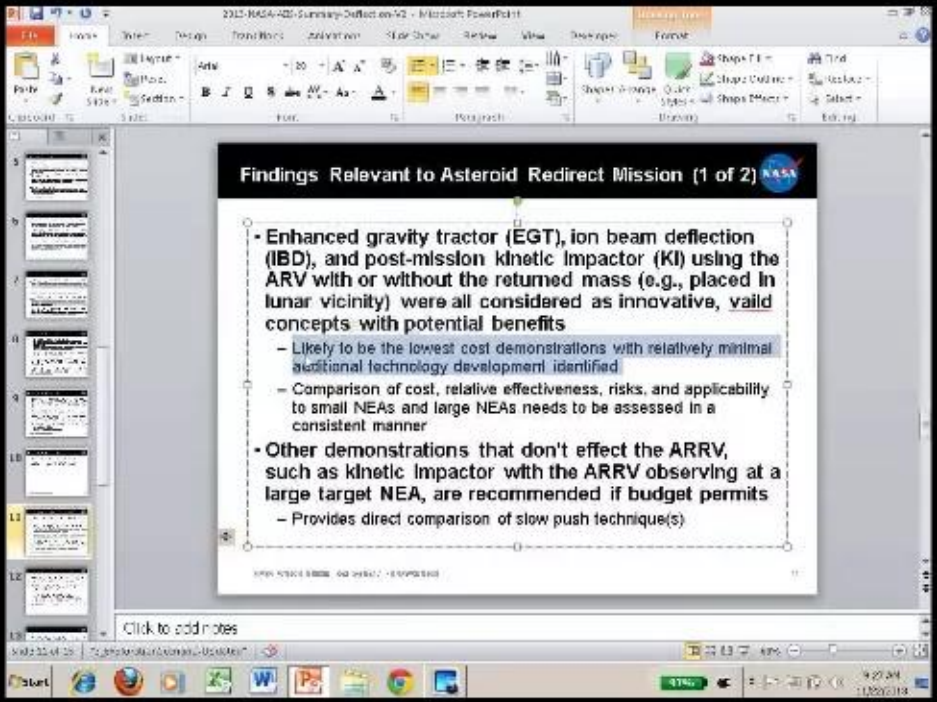
Findings Relevant to Asteroid Redirect Mission (1 of 2)
• Enhanced gravity tractor (EGT), ion beam deflection (IBD), and post-mission kinetic impactor (KI) using the ARV with or without the returned mass (e.g., placed in lunar vicinity) were all considered as innovative, valid concepts with potential benefits
– Likely to be the lowest cost demonstrations with relatively minimal additional technology development identified
– Comparison of cost, relative effectiveness, risks, and applicability to small NEAs and large NEAs needs to be assessed in a consistent manner
• Other demonstrations that don't effect the ARRV, such as kinetic impactor with the ARRV observing at a large target NEA, are recommended if budget permits
– Provides direct comparison of slow push technique(s)
Click to add notes

1
00:00:03,290 --> 00:00:01,280
we're 40 minutes into our two-hour

2
00:00:05,749 --> 00:00:03,300
session and we haven't gotten through

3
00:00:07,130 --> 00:00:05,759
the summaries here yet that does not

4
00:00:08,480 --> 00:00:07,140
bode well you're doing so good yesterday

5
00:00:11,780 --> 00:00:08,490
that have a little concerned right now

6
00:00:13,249 --> 00:00:11,790
so what I like to do is is kind of speed

7
00:00:15,589 --> 00:00:13,259
things along if there's something

8
00:00:17,240 --> 00:00:15,599
critical Brian you want to say I mean I

9
00:00:19,760 --> 00:00:17,250
think we could probably you know this is

10
00:00:21,500 --> 00:00:19,770
an argument or discussion let's say a

11
00:00:25,040 --> 00:00:21,510
passionate discussion that's been going

12
00:00:27,650 --> 00:00:25,050
on for at least a decade or two I'll

13
00:00:30,380 --> 00:00:27,660

actually longer I think make a point

14
00:00:32,510 --> 00:00:30,390
that gravity tractors were were promoted

15
00:00:35,389 --> 00:00:32,520
mostly for avoiding keyholes which were

16
00:00:38,420 --> 00:00:35,399
using very precise motion to guide

17
00:00:40,639 --> 00:00:38,430
yourself regular nest appeals and not

18
00:00:43,549 --> 00:00:40,649
for general purpose deflection right but

19
00:00:45,770 --> 00:00:43,559
again with this enhanced mode it may be

20
00:00:48,170 --> 00:00:45,780
possible to extend that applicability

21
00:00:50,810 --> 00:00:48,180
past keyholes well the amount of mass

22
00:00:53,360 --> 00:00:50,820
that you need to pick up is is much

23
00:00:55,430 --> 00:00:53,370
larger than the demonstration that's

24
00:00:56,930 --> 00:00:55,440
been proposed which is pick up 20 tons

25
00:00:59,119 --> 00:00:56,940
which really doesn't do you much good

26
00:01:00,979 --> 00:00:59,129
you need to pick up a thousand tons or

27
00:01:01,970 --> 00:01:00,989
tens of thousands of times well again we

28
00:01:04,579 --> 00:01:01,980
have to remember that this is a

29
00:01:06,820 --> 00:01:04,589
demonstration of techniques it doesn't

30
00:01:09,260 --> 00:01:06,830
have to be the final actual

31
00:01:11,240 --> 00:01:09,270
implementation and certainly but if it's

32
00:01:14,420 --> 00:01:11,250
not really relevant at no one questions

33
00:01:16,420 --> 00:01:14,430
Newton's laws okay so I'll take you know

34
00:01:18,830 --> 00:01:16,430
I'll just comment that 20 tons is not

35
00:01:22,280 --> 00:01:18,840
necessarily the the maximum that can be

36
00:01:25,429 --> 00:01:22,290
picked up upward of 200 tons can easily

37
00:01:27,170 --> 00:01:25,439
be picked up with the a RM or the ARV

38
00:01:29,780 --> 00:01:27,180

spacecraft as it's currently proposed

39
00:01:33,560 --> 00:01:29,790
now whether or not you can get that back

40
00:01:35,870 --> 00:01:33,570
and return that as part of the a RM

41
00:01:39,020 --> 00:01:35,880
that's another issue because of the the

42
00:01:43,190 --> 00:01:39,030
target selection but the in in practice

43
00:01:46,190 --> 00:01:43,200
you know 20 tons is by no means the

44
00:01:47,899 --> 00:01:46,200
limit okay well you use the term easy

45
00:01:49,580 --> 00:01:47,909
and I need to react because we've been

46
00:01:52,880 --> 00:01:49,590
working on Comets surface sample return

47
00:01:55,550 --> 00:01:52,890
for all of my career and no one thinks

48
00:01:58,340 --> 00:01:55,560
that's easy even picking up a few grand

49
00:02:00,440 --> 00:01:58,350
is not easy i think i believe you use me

50
00:02:02,510 --> 00:02:00,450
if I did I didn't mean i think i did

51
00:02:03,649 --> 00:02:02,520
it's we need to move on yeah I didn't

52
00:02:05,450 --> 00:02:03,659
mean to reply that it's easy there's

53
00:02:06,620 --> 00:02:05,460
obviously technological challenges and

54
00:02:09,520 --> 00:02:06,630
engineering challenges but it is

55
00:02:11,830 --> 00:02:09,530
possible so

56
00:02:13,780 --> 00:02:11,840
yeah let's go ahead and move on Josh's

57
00:02:16,000 --> 00:02:13,790
in here I think we got this one and I'm

58
00:02:21,760 --> 00:02:16,010
sorry Jeff and folks online this will be

59
00:02:24,160 --> 00:02:21,770
there will be a lag in the ustream okay

60
00:02:25,840 --> 00:02:24,170
we were on this slide I think yeah and

61
00:02:27,910 --> 00:02:25,850
and the reason I originally came to the

62
00:02:29,650 --> 00:02:27,920
mic was not much to fix slide 2 which

63
00:02:33,309 --> 00:02:29,660

sort of started some crazy cats gate

64
00:02:35,800 --> 00:02:33,319
here but two and we don't need to do it

65
00:02:38,490 --> 00:02:35,810
now but the the general focus of that

66
00:02:41,740 --> 00:02:38,500
presentation was on a osiris-rex

67
00:02:44,229 --> 00:02:41,750
incarnation of a low cost of the vector

68
00:03:00,180 --> 00:02:44,239
should be somehow captured ok Don do it

69
00:03:20,690 --> 00:03:02,150
how about

70
00:03:27,080 --> 00:03:22,790
for a large near-earth asteroid using a

71
00:03:31,699 --> 00:03:27,090
RV as the observing spacecraft and I

72
00:03:33,350 --> 00:03:31,709
could I could actually let me how about

73
00:03:43,420 --> 00:03:33,360
Abbott this because this is this was the

74
00:03:48,110 --> 00:03:43,430
bulk of the presentation this mission

75
00:03:48,120 --> 00:04:08,900
supper

76
00:04:16,670 --> 00:04:11,480
that work that would have been easy

77
00:04:19,970 --> 00:04:16,680
Steve now good I mean all this is good

78
00:04:22,430 --> 00:04:19,980
discussion please don't don't get things

79
00:04:26,170 --> 00:04:22,440
wrong ok so now actually I think we're

80
00:04:29,000 --> 00:04:26,180
still okay on this is this is what

81
00:04:32,120 --> 00:04:29,010
parlor Pat and I pulled together from

82
00:04:36,110 --> 00:04:32,130
yesterday's discussion and this is all

83
00:04:37,520 --> 00:04:36,120
open for editing and tweaking and but

84
00:04:40,730 --> 00:04:37,530
what we try to first of all want to

85
00:04:42,770 --> 00:04:40,740
capture the key topics discussed um we

86
00:04:44,990 --> 00:04:42,780
certainly can add a page here for what

87
00:04:48,140 --> 00:04:45,000
gets discussed this morning if we

88
00:04:50,120 --> 00:04:48,150

haven't captured anything and since I'm

89
00:04:51,590 --> 00:04:50,130
not keeping notes over here I'm going to

90
00:04:53,840 --> 00:04:51,600
rely on Paul to make some note of

91
00:04:55,640 --> 00:04:53,850
something that we need to capture um I

92
00:04:59,420 --> 00:04:55,650
think there was a lot of discussion but

93
00:05:02,090 --> 00:04:59,430
I'm not sure at this point we need to to

94
00:05:03,500 --> 00:05:02,100
rehash that but basically it was pointed

95
00:05:04,990 --> 00:05:03,510
out yesterday I led off with this that

96
00:05:07,850 --> 00:05:05,000
there's kind of three classes of

97
00:05:10,070 --> 00:05:07,860
demonstrations deflection demos with

98
00:05:12,170 --> 00:05:10,080
little or no additional costs so

99
00:05:16,310 --> 00:05:12,180
basically the idea is the use of the ARR

100
00:05:19,040 --> 00:05:16,320
em assets so we don't have at least

101
00:05:21,080 --> 00:05:19,050
minimally modification or changes that

102
00:05:22,520 --> 00:05:21,090
that would affect that there are

103
00:05:24,680 --> 00:05:22,530
deflection downloads with additional

104
00:05:26,330 --> 00:05:24,690
costs those for example would be a

105
00:05:28,250 --> 00:05:26,340
kinetic impact solar collector

106
00:05:31,580 --> 00:05:28,260
microsatellites etc things that are not

107
00:05:34,340 --> 00:05:31,590
currently in the planned approaches um

108
00:05:36,020 --> 00:05:34,350
and and would would result in some

109
00:05:37,370 --> 00:05:36,030
incremental cost it might be smart I

110
00:05:40,880 --> 00:05:37,380
might not be that large but it would be

111
00:05:43,130 --> 00:05:40,890
something maybe a little you know first

112
00:05:45,500 --> 00:05:43,140
one says little or no so the emphasis

113
00:05:51,170 --> 00:05:45,510

there is really on minor and then the

114
00:05:55,760 --> 00:05:51,180
third class of demonstrations and maybe

115
00:05:59,960 --> 00:05:55,770
actually qualify this presented just to

116
00:06:01,400 --> 00:05:59,970
be completely clear we're demonstration

117
00:06:03,340 --> 00:06:01,410
of devices that are applicable to future

118
00:06:05,930 --> 00:06:03,350
planetary defense approaches but are not

119
00:06:11,290 --> 00:06:05,940
deflection demos based on the AR RM

120
00:06:14,120 --> 00:06:11,300
concept so for example you know a a

121
00:06:17,420 --> 00:06:14,130
transponder right now is not in in

122
00:06:19,770 --> 00:06:17,430
either the a RM concepts

123
00:06:21,390 --> 00:06:19,780
but could be applicable planetary

124
00:06:25,530 --> 00:06:21,400
defense if we did decide to to

125
00:06:27,780 --> 00:06:25,540
incorporate one second bullet captures

126
00:06:30,180 --> 00:06:27,790
Andy's comment and I think I think we

127
00:06:31,590 --> 00:06:30,190
can all get behind that there's

128
00:06:32,610 --> 00:06:31,600
potential of complying approaches and

129
00:06:36,270 --> 00:06:32,620
techniques to provide a more effective

130
00:06:39,360 --> 00:06:36,280
or comprehensive demonstration if it

131
00:06:41,550 --> 00:06:39,370
makes sense in order to implement

132
00:06:43,170 --> 00:06:41,560
deflection demonstrations analyses of

133
00:06:44,550 --> 00:06:43,180
the time required to develop necessary

134
00:06:46,950 --> 00:06:44,560
technology should be performed with

135
00:06:52,650 --> 00:06:46,960
respect to any impacts of the overall

136
00:06:55,320 --> 00:06:52,660
our mission budget and schedule but I

137
00:06:56,520 --> 00:06:55,330
don't remember who stated that yesterday

138
00:06:58,860 --> 00:06:56,530

but I want to make sure i hope we

139
00:07:00,450 --> 00:06:58,870
captured that that accurately i think

140
00:07:01,860 --> 00:07:00,460
that that is what was conveyed makes

141
00:07:07,910 --> 00:07:01,870
sense we don't want to stick something

142
00:07:11,070 --> 00:07:07,920
in in the arm mission that ends up

143
00:07:19,060 --> 00:07:11,080
causing a programmatic issue problem

144
00:07:19,070 --> 00:07:26,320
yep thank you

145
00:07:31,869 --> 00:07:28,929
enhanced gravity tractor ion beam

146
00:07:34,809 --> 00:07:31,879
deflection and post-mission kinetic

147
00:07:36,429 --> 00:07:34,819
impactor using the air V and return mass

148
00:07:42,640 --> 00:07:36,439
we're all considered as deserving

149
00:07:48,159 --> 00:07:42,650
further study for the arm mission oh d

150
00:07:49,420 --> 00:07:48,169
fection thank you good eyes it's funny

151
00:07:56,220 --> 00:07:49,430
how you can just see what you want to

152
00:08:02,380 --> 00:07:59,130
well the post-mission kinetic impactor

153
00:08:07,360 --> 00:08:02,390
yeah it could be an or yep you're up so

154
00:08:22,980 --> 00:08:07,370
right with or without yeah good big

155
00:08:29,220 --> 00:08:25,500
about that should we get this back up a

156
00:08:30,960 --> 00:08:29,230
bit ago now that that's a good point

157
00:08:33,960 --> 00:08:30,970
again Jinna just make sure it's cleared

158
00:08:38,760 --> 00:08:33,970
everybody in the audience the there is a

159
00:08:40,800 --> 00:08:38,770
separation capability on between the

160
00:08:44,040 --> 00:08:40,810
capture mechanism or capture system and

161
00:08:46,440 --> 00:08:44,050
the set bus so that whatever material is

162
00:08:49,230 --> 00:08:46,450
brought back can be can be jettisoned

163
00:08:51,480 --> 00:08:49,240

either for an emergency or if it's

164
00:08:53,760 --> 00:08:51,490
desirable to repurpose the SEP for

165
00:08:55,860 --> 00:08:53,770
something else at the end and if if

166
00:08:57,570 --> 00:08:55,870
we're low on propellant which is likely

167
00:08:59,610 --> 00:08:57,580
we probably wouldn't have enough

168
00:09:04,020 --> 00:08:59,620
propellant left in the tanks to to push

169
00:09:05,400 --> 00:09:04,030
a large mass out of the lunar of distant

170
00:09:12,120 --> 00:09:05,410
retrograde orbit or wherever we have it

171
00:09:14,610 --> 00:09:12,130
at the time okay capture the discussion

172
00:09:16,500 --> 00:09:14,620
about the incremental improvement that

173
00:09:19,970 --> 00:09:16,510
bond we brought up with respect to

174
00:09:21,990 --> 00:09:19,980
kinetic impactor navigation and that is

175
00:09:23,730 --> 00:09:22,000
incremental improvement in kinetic

176
00:09:24,900 --> 00:09:23,740
impactor navigation accuracy is needed

177
00:09:26,880 --> 00:09:24,910
to be effective against smaller

178
00:09:28,470 --> 00:09:26,890
near-earth asteroids but this can be

179
00:09:36,400 --> 00:09:28,480
mitigated by observer spacecraft at

180
00:09:46,600 --> 00:09:40,329
Oh bee bee thank you I said it right

181
00:09:48,100 --> 00:09:46,610
yeah I think there's a point relative to

182
00:09:49,869 --> 00:09:48,110
that that needs to be made which is that

183
00:09:52,780 --> 00:09:49,879
people have proposed of course taking

184
00:09:55,389 --> 00:09:52,790
large rocks and using them as as kinetic

185
00:09:57,699 --> 00:09:55,399
impactors but if you look at the Delta V

186
00:10:00,369 --> 00:09:57,709
in the terminal phase of deep impact

187
00:10:02,259 --> 00:10:00,379
they had you know 25 or more meters per

188
00:10:04,329 --> 00:10:02,269

second of Delta V right at the end

189
00:10:07,269 --> 00:10:04,339
available and I don't think anybody

190
00:10:10,749 --> 00:10:07,279
believes that we can do that with a

191
00:10:15,910 --> 00:10:10,759
thousand ton or you know rock we pick up

192
00:10:18,999 --> 00:10:15,920
so so the proposals that call for using

193
00:10:22,960 --> 00:10:19,009
in situ rocks you know institue mass

194
00:10:24,939 --> 00:10:22,970
from asteroidal mass as kinetic

195
00:10:29,769 --> 00:10:24,949
impactors need to really think hard

196
00:10:37,510 --> 00:10:29,779
about that terminal guidance face how

197
00:10:37,520 --> 00:10:50,170
for mass augmented impactor

198
00:10:56,230 --> 00:10:53,680
so for example 500 plus tons I think

199
00:10:58,930 --> 00:10:56,240
Brian Zeb's we write that that's a very

200
00:11:01,120 --> 00:10:58,940
difficult problem engineering-wise for

201
00:11:03,760 --> 00:11:01,130
that for the using the asteroid as a

202
00:11:06,730 --> 00:11:03,770
projectile on the other hand I think and

203
00:11:08,560 --> 00:11:06,740
I'd like to know bong we agrees this is

204
00:11:10,930 --> 00:11:08,570
something that a technology

205
00:11:12,760 --> 00:11:10,940
demonstration that is the terminal

206
00:11:15,040 --> 00:11:12,770
guidance rather than a technology

207
00:11:17,199 --> 00:11:15,050
development that we know how to do the

208
00:11:18,880 --> 00:11:17,209
targeting and there's not there's not a

209
00:11:21,760 --> 00:11:18,890
technology development issue that should

210
00:11:26,380 --> 00:11:21,770
be raised by by this it's just a matter

211
00:11:27,880 --> 00:11:26,390
of demonstrating the capability I don't

212
00:11:30,600 --> 00:11:27,890
think there's a development issue so

213
00:11:33,519 --> 00:11:30,610

that as it reads right now it looks like

214
00:11:36,160 --> 00:11:33,529
we're not sure how to do it I don't

215
00:11:39,160 --> 00:11:36,170
think that's quite right okay I agree

216
00:11:41,680 --> 00:11:39,170
that that somehow their deity navigation

217
00:11:45,010 --> 00:11:41,690
guidance or targeting issue is a

218
00:11:47,889 --> 00:11:45,020
demonstration whether we can do it or

219
00:11:50,350 --> 00:11:47,899
not also for the realistic situation we

220
00:11:53,500 --> 00:11:50,360
will not have observer satellite rang

221
00:11:55,630 --> 00:11:53,510
the views I waiting for impact so

222
00:11:57,490 --> 00:11:55,640
somehow we have to adjust they depending

223
00:12:00,250 --> 00:11:57,500
on are we talking about flight a

224
00:12:03,250 --> 00:12:00,260
demonstration or technology to be used

225
00:12:04,690 --> 00:12:03,260
in actual situation so yeah that's still

226
00:12:06,190 --> 00:12:04,700
not clear we could end up having an

227
00:12:08,019 --> 00:12:06,200
observer spacecraft we could have a very

228
00:12:11,530 --> 00:12:08,029
small satellite that's that sent out

229
00:12:13,210 --> 00:12:11,540
beforehand that helps provide accurate

230
00:12:15,040 --> 00:12:13,220
orbit knowledge so that we can improve

231
00:12:17,290 --> 00:12:15,050
the accuracy if it may be critical to

232
00:12:22,870 --> 00:12:17,300
have that again depends on warning time

233
00:12:24,760 --> 00:12:22,880
and when you apply it so um so if I

234
00:12:26,740 --> 00:12:24,770
restructure this as sub bullets does

235
00:12:29,170 --> 00:12:26,750
that make it better so it's not all in

236
00:12:32,500 --> 00:12:29,180
one one thought I think I think the key

237
00:12:39,060 --> 00:12:32,510
and maybe here what bond we was bringing

238
00:12:47,750 --> 00:12:42,920

when he when he was saying it as we did

239
00:12:50,490 --> 00:12:47,760
user might use microphone Steve sorry I

240
00:12:53,310 --> 00:12:50,500
read it to say that we need the

241
00:12:54,450 --> 00:12:53,320
technology development and don't think

242
00:12:59,090 --> 00:12:54,460
that's right so I would just say that

243
00:13:02,310 --> 00:12:59,100
demonstrating improvement is needed not

244
00:13:04,140 --> 00:13:02,320
developing their there are a lot of

245
00:13:05,490 --> 00:13:04,150
folks who think that we don't know how

246
00:13:07,020 --> 00:13:05,500
to do this and I don't think that we

247
00:13:09,030 --> 00:13:07,030
should be reinforcing those

248
00:13:11,070 --> 00:13:09,040
misconceptions okay so how do you

249
00:13:13,380 --> 00:13:11,080
suggested beware demonstrate improvement

250
00:13:29,340 --> 00:13:13,390
are demonstrated and premise rating the

251
00:13:31,590 --> 00:13:29,350
capability for higher accuracy about

252
00:13:34,310 --> 00:13:31,600
demonstrating adequate navigation

253
00:13:43,170 --> 00:13:34,320
accuracy miss Quade demonstrating

254
00:13:48,630 --> 00:13:43,180
adequate navigation accuracy for kinetic

255
00:14:05,369 --> 00:13:48,640
impactor losses for kinetic impactor

256
00:14:05,379 --> 00:14:08,410
good

257
00:14:08,420 --> 00:14:16,450
about that

258
00:14:19,960 --> 00:14:18,730
and then got a comment on the second sub

259
00:14:23,560 --> 00:14:19,970
bullet there where you're editing right

260
00:14:26,740 --> 00:14:23,570
now okay the problem with a high-mass

261
00:14:29,350 --> 00:14:26,750
impactor is not the accuracy it's the

262
00:14:34,150 --> 00:14:29,360
impulse you have on board and the amount

263
00:14:35,710 --> 00:14:34,160

of well the amount of propellant and the

264
00:14:37,420 --> 00:14:35,720
amount of thrust because you made have

265
00:14:39,190 --> 00:14:37,430
to write big maneuvers late and I don't

266
00:14:41,650 --> 00:14:39,200
think that that belongs as a sub bullet

267
00:14:44,800 --> 00:14:41,660
under accuracy it's okay so a different

268
00:14:48,100 --> 00:14:44,810
engineering concern ya know it is and it

269
00:14:50,350 --> 00:14:48,110
was not well you might saw that just by

270
00:14:52,660 --> 00:14:50,360
saying you know terminal phase maneuvers

271
00:14:54,420 --> 00:14:52,670
for mass autumn and at impact or

272
00:14:57,910 --> 00:14:54,430
something like that because it's it's

273
00:15:01,870 --> 00:14:57,920
it's not an accuracy problem it's a

274
00:15:07,150 --> 00:15:01,880
impulse problem okay let me let me see

275
00:15:08,740 --> 00:15:07,160
if we can backtrack no I think I think

276
00:15:10,780 --> 00:15:08,750
it just belongs as a different bullet I

277
00:15:12,520 --> 00:15:10,790
agree yeah i just think obviously i

278
00:15:14,680 --> 00:15:12,530
treated with some with you know say

279
00:15:17,850 --> 00:15:14,690
terminal phase maneuvering for mass

280
00:15:26,230 --> 00:15:17,860
augmented impactor and leave it at that

281
00:15:40,840 --> 00:15:26,240
terminal phase maneuvering for mass

282
00:15:40,850 --> 00:15:43,980
what size

283
00:16:01,470 --> 00:15:46,170
thank you doesn't remember how to get

284
00:16:14,360 --> 00:16:11,100
ok I like clean this up all right I pull

285
00:16:22,769 --> 00:16:20,550
all right um donít good I'm sorry on the

286
00:16:24,689 --> 00:16:22,779
first bullet the first supple it can be

287
00:16:31,680 --> 00:16:24,699
mitigated by observer spacecraft at

288
00:16:35,280 --> 00:16:31,690

target will be an example that maybe I'm

289
00:16:41,129 --> 00:16:35,290
just a little confused with that drop it

290
00:16:43,050 --> 00:16:41,139
just leave it alone okay okay I just I I

291
00:16:46,680 --> 00:16:43,060
thought it'd be more confusing if you

292
00:16:49,680 --> 00:16:46,690
kept it but I agree with you yeah so so

293
00:16:51,660 --> 00:16:49,690
more accurate orbit determination of the

294
00:16:59,400 --> 00:16:51,670
target you're trying to hit is not that

295
00:17:02,100 --> 00:16:59,410
helpful for that terminal phase I've got

296
00:17:04,289 --> 00:17:02,110
me nothing I think I think that with it

297
00:17:06,720 --> 00:17:04,299
with a 510 spacecraft if you had

298
00:17:10,409 --> 00:17:06,730
somebody already there then the terminal

299
00:17:15,929 --> 00:17:10,419
phase gets to be a lot easier but I yeah

300
00:17:17,069 --> 00:17:15,939
I think this is fun okay so we could we

301
00:17:19,669 --> 00:17:17,079
could turn it around and have it as part

302
00:17:23,460 --> 00:17:19,679
of that bullet is what you're saying

303
00:17:44,159 --> 00:17:23,470
yeah let me see did I lose it I keep

304
00:17:44,169 --> 00:17:48,500
ok

305
00:17:48,510 --> 00:17:52,919
to do this

306
00:17:52,929 --> 00:17:57,550
ok

307
00:18:04,460 --> 00:18:00,710
I'll clean up spacing and stuff just

308
00:18:05,960 --> 00:18:04,470
make a little bit more readable the next

309
00:18:09,950 --> 00:18:05,970
one is deflection demos need to be bend

310
00:18:11,420 --> 00:18:09,960
into the a RM or the grand challenge to

311
00:18:13,580 --> 00:18:11,430
make sure that ideas are not discarded

312
00:18:20,630 --> 00:18:13,590
dear tuner near-term budgetary

313
00:18:22,640 --> 00:18:20,640

constraints their typo okay I think that

314
00:18:24,500 --> 00:18:22,650
captures the discussion there in what

315
00:18:27,380 --> 00:18:24,510
Steve brought up and you'll see we've

316
00:18:30,770 --> 00:18:27,390
got it bend into two in the in the

317
00:18:32,270 --> 00:18:30,780
findings part demos don't need a large

318
00:18:34,190 --> 00:18:32,280
deflection to prove they're up to prove

319
00:18:36,020 --> 00:18:34,200
their effectiveness for example a few

320
00:18:40,640 --> 00:18:36,030
tenths of a millimeter per second thank

321
00:18:43,340 --> 00:18:40,650
God Tim made that point than others hey

322
00:18:45,800 --> 00:18:43,350
Ted yeah I mean clearly you have to be

323
00:18:48,500 --> 00:18:45,810
observing that or it's the numbers much

324
00:18:49,790 --> 00:18:48,510
much larger but i don't know i mean if

325
00:18:55,170 --> 00:18:49,800
that's obvious enough we don't need to

326
00:19:03,510 --> 00:19:00,870
how about 10 you have to be there to

327
00:19:06,570 --> 00:19:03,520
measure your not use the microphone

328
00:19:07,860 --> 00:19:06,580
please yeah if you're not there if

329
00:19:15,540 --> 00:19:07,870
you're not there then that number is

330
00:19:18,800 --> 00:19:15,550
much much larger so well it is they've

331
00:19:24,170 --> 00:19:18,810
hit it this place back went away right

332
00:19:28,500 --> 00:19:24,180
it's not a very good demonstration if

333
00:19:30,690 --> 00:19:28,510
observing spacecraft about well actually

334
00:19:32,340 --> 00:19:30,700
you do if you miss then the spacecraft's

335
00:19:36,720 --> 00:19:32,350
still there and you can download tons of

336
00:19:38,760 --> 00:19:36,730
telemetry and say oops you know but if

337
00:19:44,280 --> 00:19:38,770
you get a glancing blow then you don't

338
00:19:49,590 --> 00:19:44,290

know why and yeah and how about how

339
00:19:53,090 --> 00:19:49,600
about how about that no that's very good

340
00:19:55,440 --> 00:19:53,100
point and then we have a couple comments

341
00:19:57,330 --> 00:19:55,450
some we may have addressed these but I

342
00:20:00,120 --> 00:19:57,340
wanted to couple comments from people

343
00:20:02,460 --> 00:20:00,130
online okay good so Rob Mueller asks

344
00:20:04,350 --> 00:20:02,470
please tell Dan to capture broader

345
00:20:06,210 --> 00:20:04,360
planetary defense ideas under the Grand

346
00:20:07,860 --> 00:20:06,220
Challenge even if they don't meet the AR

347
00:20:10,670 --> 00:20:07,870
are men so I think we're doing about

348
00:20:15,030 --> 00:20:10,680
that and then another one from online

349
00:20:17,040 --> 00:20:15,040
and my personal feeling is the direct

350
00:20:19,710 --> 00:20:17,050
push has been to neglected gravity

351
00:20:21,750 --> 00:20:19,720
tractor to emphasized so it's a comment

352
00:20:23,250 --> 00:20:21,760
right and so that we have that

353
00:20:26,160 --> 00:20:23,260
discussion a few minutes ago we'll see

354
00:20:29,690 --> 00:20:26,170
if it see if we capture it in here um I

355
00:20:32,100 --> 00:20:29,700
think we actually may need to add that

356
00:20:40,000 --> 00:20:32,110
so what I'm going to do real quick is

357
00:20:45,110 --> 00:20:43,790
it's interesting how you can't use a

358
00:20:47,600 --> 00:20:45,120
keyboard that's a little bit different

359
00:20:51,710 --> 00:20:47,610
than your own okay so we're going to go

360
00:20:59,980 --> 00:20:51,720
up to three of three on key topics

361
00:21:04,970 --> 00:21:02,750
right now and I apologize to the folks

362
00:21:08,540 --> 00:21:04,980
that are online sausage-making with the

363
00:21:14,480 --> 00:21:08,550

PowerPoint is probably very painful with

364
00:21:19,010 --> 00:21:14,490
a 15 second delay so let's let's capture

365
00:21:20,900 --> 00:21:19,020
that read me that one again this one was

366
00:21:22,880 --> 00:21:20,910
the direct push has been to neglected

367
00:21:26,750 --> 00:21:22,890
gravity tractor to emphasize so I think

368
00:21:32,330 --> 00:21:26,760
just some some emphasis or some

369
00:21:35,000 --> 00:21:32,340
acknowledgement that direct push needs

370
00:21:37,040 --> 00:21:35,010
further or further analysis of further

371
00:21:38,930 --> 00:21:37,050
investigation of what is direct push in

372
00:21:41,330 --> 00:21:38,940
this case is that the ion beam or is

373
00:21:43,100 --> 00:21:41,340
that the anchoring and thrusting i'm not

374
00:21:44,750 --> 00:21:43,110
sure what it means i think it could it's

375
00:21:48,620 --> 00:21:44,760
not clear from this but it could mean

376
00:21:50,480 --> 00:21:48,630
all of those so i would take it to mean

377
00:21:52,730 --> 00:21:50,490
a direct interaction with the surface

378
00:21:58,160 --> 00:21:52,740
which is another point that we headed

379
00:22:00,110 --> 00:21:58,170
down here yeah how about how about let's

380
00:22:06,740 --> 00:22:00,120
let's call it out and if someone if

381
00:22:07,970 --> 00:22:06,750
whoever online made that comment i would

382
00:22:10,100 --> 00:22:07,980
leave it like that dan just because i

383
00:22:11,630 --> 00:22:10,110
think that's that's my interpretation of

384
00:22:15,490 --> 00:22:11,640
what that yeah yeah until unless we hear

385
00:22:19,330 --> 00:22:15,500
otherwise so I'm going to say approaches

386
00:22:25,520 --> 00:22:19,340
let's be explicit here deflection

387
00:22:29,820 --> 00:22:25,530
approaches that utilize direct push by

388
00:22:29,830 --> 00:22:39,170

need further assessment

389
00:22:39,180 --> 00:22:41,980
two

390
00:22:51,520 --> 00:22:44,400
determine

391
00:23:04,410 --> 00:22:55,080
and Dan just a time check we are at 90

392
00:23:10,630 --> 00:23:07,870
alright going back to hear capture the

393
00:23:12,520 --> 00:23:10,640
comment that planetary defense

394
00:23:15,250 --> 00:23:12,530
demonstrations can can be performed on

395
00:23:17,380 --> 00:23:15,260
very small less than 10 metre Nia's but

396
00:23:34,760 --> 00:23:17,390
they're more applicable to larger 100

397
00:23:40,160 --> 00:23:36,650
well the I think relevance the right

398
00:23:41,750 --> 00:23:40,170
word if I mean the current our current

399
00:23:45,100 --> 00:23:41,760
understanding is that you know below

400
00:23:47,000 --> 00:23:45,110
quote unquote 30 meters or 20 meters

401
00:23:50,920 --> 00:23:47,010
typically they're they're not a threat

402
00:23:54,940 --> 00:23:50,930
so and Chelyabinsk may be that that

403
00:23:58,550 --> 00:23:54,950
example of that you know unique New

404
00:24:01,400 --> 00:23:58,560
such-and-such a sigma event that that

405
00:24:03,230 --> 00:24:01,410
size caused a ground effect I mean you

406
00:24:09,800 --> 00:24:03,240
could just say but actual threats are

407
00:24:14,180 --> 00:24:09,810
larger he is now I think I like the we

408
00:24:17,620 --> 00:24:14,190
don't work that way is because so

409
00:24:23,060 --> 00:24:17,630
telecon line we got suit we just lost

410
00:24:25,700 --> 00:24:23,070
okay so okay so Dan we the clarification

411
00:24:28,370 --> 00:24:25,710
was uh yeah direct push equals anchoring

412
00:24:31,180 --> 00:24:28,380
and thrusting okay so I think oh I think

413
00:24:35,300 --> 00:24:31,190

we captured that we got it I think okay

414
00:24:37,010 --> 00:24:35,310
interacting with the classrooms can you

415
00:24:38,660 --> 00:24:37,020
use the microphone please sorry people

416
00:24:39,710 --> 00:24:38,670
on hang on let me do this last one on

417
00:24:41,510 --> 00:24:39,720
this page and then we'll go to the new

418
00:24:43,280 --> 00:24:41,520
page and then we'll get I think after

419
00:24:45,500 --> 00:24:43,290
that we've got findings I got findings

420
00:24:48,440 --> 00:24:45,510
and nuggets and we can walk through that

421
00:24:49,940 --> 00:24:48,450
um no go ahead come on good microphone

422
00:24:51,650 --> 00:24:49,950
we just do this one real quick so i

423
00:24:53,180 --> 00:24:51,660
captured three other ideas that were

424
00:24:55,430 --> 00:24:53,190
discussed they were just kind of

425
00:24:58,430 --> 00:24:55,440
mentioned not a lot of discussion on

426
00:25:02,480 --> 00:24:58,440
members you or andy or combination but

427
00:25:03,950 --> 00:25:02,490
an esper based sep module as an idea use

428
00:25:07,370 --> 00:25:03,960
of the launch vehicle upper stage for

429
00:25:10,490 --> 00:25:07,380
impact or mass come and solar sails for

430
00:25:12,050 --> 00:25:10,500
passive deflection but there's just you

431
00:25:14,260 --> 00:25:12,060
know there's no meat on those bones so

432
00:25:18,020 --> 00:25:14,270
there's a few other things you could do

433
00:25:20,960 --> 00:25:18,030
for the impactor you could have subsets

434
00:25:22,790 --> 00:25:20,970
you know cubesat like that you could

435
00:25:25,370 --> 00:25:22,800
have some Delta V and send them out

436
00:25:27,440 --> 00:25:25,380
ahead of the main vehicle and use that

437
00:25:31,400 --> 00:25:27,450
to refine you know sort of like to do

438
00:25:34,400 --> 00:25:31,410

with failings they have tracers and you

439
00:25:39,470 --> 00:25:34,410
refine your trajectory based on the

440
00:25:41,720 --> 00:25:39,480
success and the of those for kinetic

441
00:25:43,220 --> 00:25:41,730
impactor yeah so I think I think we kind

442
00:25:44,720 --> 00:25:43,230
of answered that they okay we probably

443
00:25:47,730 --> 00:25:44,730
if we were going to do a kinetic

444
00:25:49,830 --> 00:25:47,740
impactor to a target with

445
00:25:51,180 --> 00:25:49,840
orbit knowledge that we wouldn't

446
00:25:56,070 --> 00:25:51,190
necessarily need the observer spacecraft

447
00:25:58,770 --> 00:25:56,080
or some some recon satellite to help

448
00:26:03,000 --> 00:25:58,780
that well this would ya this would be

449
00:26:05,940 --> 00:26:03,010
subsets on that satellite anyway don't

450
00:26:07,770 --> 00:26:05,950
worry about it ok I'm trying it could be

451
00:26:11,040 --> 00:26:07,780
lined up it could be useful in some

452
00:26:14,280 --> 00:26:11,050
cases that suppose but yeah it's not

453
00:26:16,380 --> 00:26:14,290
necessary so I think I mean I think you

454
00:26:19,260 --> 00:26:16,390
know a situational awareness observation

455
00:26:21,150 --> 00:26:19,270
PR all that is always good to have so I

456
00:26:22,440 --> 00:26:21,160
think I think that's kind of I think

457
00:26:24,360 --> 00:26:22,450
that's kind of understood if you could

458
00:26:27,390 --> 00:26:24,370
come up with a constant James Cameron

459
00:26:30,990 --> 00:26:27,400
was going to do this mission to the moon

460
00:26:33,570 --> 00:26:31,000
and he insisted that there be two

461
00:26:35,700 --> 00:26:33,580
satellites attacked two Landers one that

462
00:26:38,130 --> 00:26:35,710
was the actor and one that was

463
00:26:41,310 --> 00:26:38,140

absolutely as any good director would do

464
00:26:43,290 --> 00:26:41,320
yeah what you want it on film and so in

465
00:26:45,630 --> 00:26:43,300
JP I'll is a requirement that you have

466
00:26:47,490 --> 00:26:45,640
telemetry all the way in and so you

467
00:26:50,100 --> 00:26:47,500
basically want to have confirmation

468
00:26:52,140 --> 00:26:50,110
anyway yeah I didn't come up to make

469
00:26:54,060 --> 00:26:52,150
that kind i think that's that's probably

470
00:26:57,510 --> 00:26:54,070
in the in the in the weeds here in terms

471
00:27:00,320 --> 00:26:57,520
of yep the bigger picture so we've got

472
00:27:03,870 --> 00:27:00,330
this last key topic that we just added

473
00:27:05,850 --> 00:27:03,880
and let's tell you what let's get

474
00:27:06,990 --> 00:27:05,860
through all these and then if we went to

475
00:27:08,730 --> 00:27:07,000
come back and have some more discussion

476
00:27:10,049 --> 00:27:08,740
this is all good discussion if you want

477
00:27:12,540 --> 00:27:10,059
to add something we've got a page here

478
00:27:14,910 --> 00:27:12,550
to put it and and i can go back if

479
00:27:18,360 --> 00:27:14,920
something comes up and put it as a quick

480
00:27:22,770 --> 00:27:18,370
parking topic or paul can jot it down so

481
00:27:24,419 --> 00:27:22,780
I and I don't know how we're going to

482
00:27:25,950 --> 00:27:24,429
get through this in 15 minutes I'm

483
00:27:31,220 --> 00:27:25,960
probably going to jump directly to the

484
00:27:33,060 --> 00:27:31,230
findings for the plenary session but um

485
00:27:34,860 --> 00:27:33,070
let me let me just show you what I've

486
00:27:36,900 --> 00:27:34,870
got we've got relevant findings there's

487
00:27:38,460 --> 00:27:36,910
two pages relevant to the asteroid

488
00:27:40,770 --> 00:27:38,470

redirect mission they'll try to read it

489
00:27:44,600 --> 00:27:40,780
yet findings relevant to the grand

490
00:27:47,190 --> 00:27:44,610
challenge and then I've got two pages of

491
00:27:49,110 --> 00:27:47,200
nuggets that I pulled out just things

492
00:27:50,640 --> 00:27:49,120
that caught my that I put down in my

493
00:27:52,860 --> 00:27:50,650
notes then we can walk through those

494
00:27:55,380 --> 00:27:52,870
real quick so that's that's where at we

495
00:27:57,060 --> 00:27:55,390
got 15 minutes to do this and add

496
00:27:58,570 --> 00:27:57,070
anything else can we just throw out a

497
00:28:01,870 --> 00:27:58,580
few other ideas

498
00:28:05,080 --> 00:28:01,880
go ahead I thought there was a consensus

499
00:28:08,259 --> 00:28:05,090
on containment of the asteroid as being

500
00:28:10,810 --> 00:28:08,269
critical so you don't lose you know

501
00:28:12,639 --> 00:28:10,820
don't leave a trail of material across

502
00:28:14,529 --> 00:28:12,649
the I don't think that's a consensus

503
00:28:16,990 --> 00:28:14,539
okay I think it could be desired but we

504
00:28:20,470 --> 00:28:17,000
don't know enough about are you saying

505
00:28:22,120 --> 00:28:20,480
for the retrieve an entire one yeah okay

506
00:28:23,649 --> 00:28:22,130
so yes there is but I don't think we

507
00:28:25,360 --> 00:28:23,659
need to capture that in this I think

508
00:28:27,940 --> 00:28:25,370
that's been captured in the capture

509
00:28:31,830 --> 00:28:27,950
system intercessions and then the other

510
00:28:35,320 --> 00:28:31,840
one was the fact that in track gravity

511
00:28:36,909 --> 00:28:35,330
was the tracking was the preferred

512
00:28:39,519 --> 00:28:36,919
approach and that was more but said

513
00:28:41,379 --> 00:28:39,529

multiple times yeah and and so I don't

514
00:28:45,759 --> 00:28:41,389
think I agree with that I wanted to come

515
00:28:47,379 --> 00:28:45,769
back to that statement there are I think

516
00:28:49,240 --> 00:28:47,389
it's actually probably if i had to guess

517
00:28:51,129 --> 00:28:49,250
or I fighting in my opinion I think it's

518
00:28:54,340 --> 00:28:51,139
the exact opposite because the in track

519
00:28:56,529 --> 00:28:54,350
you have to camp the thrusters away

520
00:28:58,509 --> 00:28:56,539
which gives you cosign losses in order

521
00:29:01,870 --> 00:28:58,519
to not plume for the gravity tractor

522
00:29:07,539 --> 00:29:01,880
going into this halo orbit the spiral

523
00:29:09,700 --> 00:29:07,549
orbit then I miss miss the point of the

524
00:29:11,500 --> 00:29:09,710
discussion of the comment this this is

525
00:29:13,539 --> 00:29:11,510
this is the direction that you're trying

526
00:29:16,960 --> 00:29:13,549
to push the asteroid with respect to its

527
00:29:18,610 --> 00:29:16,970
orbit and which approach you use you

528
00:29:21,820 --> 00:29:18,620
know doing the orbit thing around it is

529
00:29:23,110 --> 00:29:21,830
fine there's no issue that okay this is

530
00:29:25,500 --> 00:29:23,120
just you know the thing is that if you

531
00:29:27,879 --> 00:29:25,510
have a long time you want to do a period

532
00:29:29,440 --> 00:29:27,889
period change if you have a short time

533
00:29:30,730 --> 00:29:29,450
as you said you know you can't get

534
00:29:33,549 --> 00:29:30,740
sideways but generally that means you're

535
00:29:34,870 --> 00:29:33,559
doing an impactor anyway so for for slow

536
00:29:39,460 --> 00:29:34,880
stuff you generally always want to do

537
00:29:44,770 --> 00:29:42,940
I don't think I mean that's yes I think

538
00:29:47,020 --> 00:29:44,780

that I think that's pretty I already

539
00:29:49,600 --> 00:29:47,030
standard put they are down there sorry

540
00:29:51,549 --> 00:29:49,610
yeah the okay notion that you want to

541
00:29:53,980 --> 00:29:51,559
push along or against the direction of

542
00:29:57,100 --> 00:29:53,990
travel of the asteroid to get the most

543
00:29:58,840 --> 00:29:57,110
deflection for if you have months more

544
00:30:00,789 --> 00:29:58,850
than months of warning time that that's

545
00:30:03,220 --> 00:30:00,799
20 years old yeah yeah it's been known

546
00:30:05,110 --> 00:30:03,230
for a long time here's a paper by Clark

547
00:30:08,710 --> 00:30:05,120
Chapman and Tom errands I think yeah I

548
00:30:10,320 --> 00:30:08,720
think it's Leon al harris so that goes

549
00:30:13,240 --> 00:30:10,330
back to like 1993 or something like that

550
00:30:15,250 --> 00:30:13,250
I just want to correct a misconception

551
00:30:19,539 --> 00:30:15,260
though the halo orbit gravity tractor

552
00:30:22,270 --> 00:30:19,549
has the same cosine laws the the thrust

553
00:30:25,720 --> 00:30:22,280
vector the thrust isn't candid off but

554
00:30:27,370 --> 00:30:25,730
the spacecraft is is pulling sideways i

555
00:30:28,960 --> 00:30:27,380
was in addition to forward and all the

556
00:30:30,730 --> 00:30:28,970
sideways is canceled out and all you're

557
00:30:33,279 --> 00:30:30,740
left with is the same cosine theta so i

558
00:30:36,340 --> 00:30:33,289
think it's the same ball of wax correct

559
00:30:39,070 --> 00:30:36,350
thank you good remember to use the

560
00:30:41,919 --> 00:30:39,080
microphone please yeti yes yeah these

561
00:30:44,230 --> 00:30:41,929
member audience comments please use the

562
00:30:45,640 --> 00:30:44,240
microphone stand it up that is a very

563
00:30:48,730 --> 00:30:45,650

good point unless of course the can't

564
00:30:51,610 --> 00:30:48,740
angle of the thruster is different than

565
00:30:53,740 --> 00:30:51,620
the the angle that the orbit makes with

566
00:30:55,240 --> 00:30:53,750
respect to dad yeah so it honestly right

567
00:30:56,799 --> 00:30:55,250
that's not the main driver has to miss

568
00:30:58,899 --> 00:30:56,809
the asteroid and it all depends on the

569
00:30:59,980 --> 00:30:58,909
divergence angle of that ion beam I

570
00:31:02,110 --> 00:30:59,990
think it's going to end up being the

571
00:31:08,680 --> 00:31:02,120
same cosine theta yep you probably are

572
00:31:12,549 --> 00:31:08,690
correct good yeah sir comment or can we

573
00:31:14,919 --> 00:31:12,559
new topics or yet Oh for discussion okay

574
00:31:15,850 --> 00:31:14,929
yeah let's let's do five more minutes of

575
00:31:20,529 --> 00:31:15,860
this and then let's get through the

576
00:31:22,210 --> 00:31:20,539
slides go ahead okay so I want to bring

577
00:31:24,549 --> 00:31:22,220
up something new that maybe we want to

578
00:31:26,049 --> 00:31:24,559
address maybe not people my time

579
00:31:27,640 --> 00:31:26,059
Marshall eubanks here by the way people

580
00:31:29,409 --> 00:31:27,650
may not be aware you might not have

581
00:31:32,830 --> 00:31:29,419
clock I posted this on Twitter yesterday

582
00:31:34,990 --> 00:31:32,840
the US do e which is our nuclear people

583
00:31:37,000 --> 00:31:35,000
and the Russian Ross atom which is their

584
00:31:40,360 --> 00:31:37,010
nuclear people sign a memo of

585
00:31:43,570 --> 00:31:40,370
understanding back in September on among

586
00:31:46,149 --> 00:31:43,580
other things defensive asteroids now if

587
00:31:47,680 --> 00:31:46,159
you know anything all these people when

588
00:31:49,120 --> 00:31:47,690

they say defense against asteroids

589
00:31:52,340 --> 00:31:49,130
they're talking about sending nukes

590
00:31:54,200 --> 00:31:52,350
against them and I would dare say that

591
00:31:56,570 --> 00:31:54,210
no one in this room has had any contact

592
00:31:59,360 --> 00:31:56,580
with any of those people about any of

593
00:32:01,400 --> 00:31:59,370
this and you know I know I've asked

594
00:32:03,680 --> 00:32:01,410
around and nobody most people don't know

595
00:32:05,960 --> 00:32:03,690
about it and to me that's something that

596
00:32:09,740 --> 00:32:05,970
should that she have a flag raised I

597
00:32:11,930 --> 00:32:09,750
mean I would yeah I I hear you and and I

598
00:32:13,730 --> 00:32:11,940
was not connected with our documents but

599
00:32:16,460 --> 00:32:13,740
I'm under the onshore it's relevant to

600
00:32:19,400 --> 00:32:16,470
this discussion right now so let's I

601
00:32:22,190 --> 00:32:19,410
think you know I think I think NASA

602
00:32:23,870 --> 00:32:22,200
headquarters is aware of it I'm sure

603
00:32:27,200 --> 00:32:23,880
Lindley Johnson for example is aware of

604
00:32:28,970 --> 00:32:27,210
it so but I don't think it's relevant

605
00:32:31,279 --> 00:32:28,980
for this I think at some point

606
00:32:33,710 --> 00:32:31,289
scientists and engineers here have got

607
00:32:35,390 --> 00:32:33,720
to say hey you know this could be cool

608
00:32:37,460 --> 00:32:35,400
but you really need to coordinate with

609
00:32:39,919 --> 00:32:37,470
us contact you know so i think the

610
00:32:41,779 --> 00:32:39,929
expertise is here not there so i think

611
00:32:44,419 --> 00:32:41,789
what will happen is that i think Lindley

612
00:32:45,980 --> 00:32:44,429
is aware of the situation and and we'll

613
00:32:48,260 --> 00:32:45,990

make sure that that's taken up through

614
00:32:50,779 --> 00:32:48,270
headquarters and yes let's hold that

615
00:32:52,010 --> 00:32:50,789
there may be a little parenthetical we

616
00:32:53,690 --> 00:32:52,020
can add to one of the top of the

617
00:32:56,419 --> 00:32:53,700
comments later on that may be applicable

618
00:32:57,950 --> 00:32:56,429
or apropos I just wanted to bring it in

619
00:33:00,200 --> 00:32:57,960
front of people's attention sure to do

620
00:33:03,529 --> 00:33:00,210
with it ya know and folks should be

621
00:33:06,110 --> 00:33:03,539
aware that you can't have a global

622
00:33:07,730 --> 00:33:06,120
discussion of Grand Challenge a serrated

623
00:33:09,289 --> 00:33:07,740
response without saying nuclear is an

624
00:33:10,190 --> 00:33:09,299
option and then you just leave it but I

625
00:33:12,409 --> 00:33:10,200
mean I don't think you can just

626
00:33:13,789 --> 00:33:12,419
completely throw that off the table well

627
00:33:15,320 --> 00:33:13,799
I don't get some of that some of them

628
00:33:17,480 --> 00:33:15,330
yeah we were throwing it off the day

629
00:33:19,190 --> 00:33:17,490
okay so even though we didn't talk about

630
00:33:21,350 --> 00:33:19,200
it in this session you know and I mean

631
00:33:23,480 --> 00:33:21,360
some of the impactor stuff you know is

632
00:33:28,299 --> 00:33:23,490
when we were saying our are relevant to

633
00:33:30,500 --> 00:33:28,309
the nuclear side of things and so they

634
00:33:33,110 --> 00:33:30,510
yeah no I think that's right it's just

635
00:33:35,299 --> 00:33:33,120
that I don't think we need to start

636
00:33:38,180 --> 00:33:35,309
talking about how how we interact with

637
00:33:42,430 --> 00:33:38,190
other agencies and things like that yeah

638
00:33:45,470 --> 00:33:42,440

okay so so again we got 45 minutes um

639
00:33:48,200 --> 00:33:45,480
let's go through the relevant findings

640
00:33:49,970 --> 00:33:48,210
and and I know Chris Moore and Chris is

641
00:33:52,510 --> 00:33:49,980
probably not in the room but um oh yeah

642
00:33:56,779 --> 00:33:52,520
you are chris is looking for

643
00:33:58,130 --> 00:33:56,789
recommendations and so I think I think

644
00:34:02,990 --> 00:33:58,140
we're couching these as as

645
00:34:04,370 --> 00:34:03,000
recommendations I don't know if I didn't

646
00:34:05,580 --> 00:34:04,380
use the word necessarily recommending

647
00:34:07,680 --> 00:34:05,590
except

648
00:34:10,379 --> 00:34:07,690
some sentences but we can see if we need

649
00:34:12,089 --> 00:34:10,389
to word it more strongly but but

650
00:34:14,940 --> 00:34:12,099
basically the enhanced gravity tractor I

651
00:34:16,680 --> 00:34:14,950
am beam deflection and post-mission

652
00:34:18,899 --> 00:34:16,690
kinetic impactor using the air via

653
00:34:20,250 --> 00:34:18,909
return mass for example place in Luna

654
00:34:21,810 --> 00:34:20,260
vicinity where are considered as

655
00:34:24,659 --> 00:34:21,820
innovative concept with potential

656
00:34:26,310 --> 00:34:24,669
benefits likely to be the lowest cost

657
00:34:28,139 --> 00:34:26,320
demonstrations with relatively minimal

658
00:34:31,050 --> 00:34:28,149
additional technology development

659
00:34:33,089 --> 00:34:31,060
identified comparison of relative

660
00:34:35,250 --> 00:34:33,099
effectiveness risks and applicability to

661
00:34:38,609 --> 00:34:35,260
small Nia's and large Nia's needs to be

662
00:34:39,960 --> 00:34:38,619
assessed in a consistent manner we've

663
00:34:42,300 --> 00:34:39,970

got different studies with different

664
00:34:44,579 --> 00:34:42,310
assumptions but these were these were

665
00:34:48,500 --> 00:34:44,589
the three that I think that I think that

666
00:34:51,149 --> 00:34:48,510
the group can I in consensus can say are

667
00:34:53,369 --> 00:34:51,159
probably the lowest cost planetary

668
00:34:54,990 --> 00:34:53,379
defense techniques because we have in

669
00:34:56,849 --> 00:34:55,000
essence we have all the stuff we don't

670
00:35:00,570 --> 00:34:56,859
have to do much may have some difference

671
00:35:03,750 --> 00:35:00,580
in computer algorithms obviously if you

672
00:35:05,220 --> 00:35:03,760
do the the post-mission kinetic impact

673
00:35:07,109 --> 00:35:05,230
if you have a large mass we may not have

674
00:35:11,190 --> 00:35:07,119
enough propellant to do that so you may

675
00:35:12,750 --> 00:35:11,200
jettison the mass yeah you got a

676
00:35:14,250 --> 00:35:12,760
defection on the top line there again

677
00:35:18,000 --> 00:35:14,260
another defection yeah going over to the

678
00:35:20,130 --> 00:35:18,010
enemy I will do a could you put a little

679
00:35:23,130 --> 00:35:20,140
note for to do a word search on

680
00:35:24,599 --> 00:35:23,140
defection versus deflection you want to

681
00:35:26,490 --> 00:35:24,609
make the same comment about not

682
00:35:33,210 --> 00:35:26,500
necessarily with the return Mass using

683
00:35:40,290 --> 00:35:33,220
the ARV with or without return mess yep

684
00:35:42,000 --> 00:35:40,300
I just like to point out that of the

685
00:35:43,560 --> 00:35:42,010
three options there one is relatively

686
00:35:45,570 --> 00:35:43,570
easy and two were relatively difficult

687
00:35:47,940 --> 00:35:45,580
and so I'm not sure lumping them

688
00:35:50,940 --> 00:35:47,950

together really makes sense the you know

689
00:35:53,880 --> 00:35:50,950
picking up tons of mass is a highly

690
00:35:56,280 --> 00:35:53,890
non-trivial and maneuvering you know

691
00:35:59,760 --> 00:35:56,290
late stage maneuvering even if it's just

692
00:36:02,849 --> 00:35:59,770
the RV you know the RV was not designed

693
00:36:05,040 --> 00:36:02,859
as a kinetic impactor and would be very

694
00:36:11,430 --> 00:36:05,050
difficult to provide that 25 meters per

695
00:36:12,930 --> 00:36:11,440
second of late terminals well we got 22

696
00:36:15,720 --> 00:36:12,940
Newton thrusters right now which is not

697
00:36:19,320 --> 00:36:15,730
enough to really do that job so so the

698
00:36:21,510 --> 00:36:19,330
the ion beam deflection is a

699
00:36:25,260 --> 00:36:21,520
straightforward thing to do the other

700
00:36:28,109 --> 00:36:25,270
two have serious risks that would need

701
00:36:29,700 --> 00:36:28,119
to be addressed yes that's where I think

702
00:36:32,540 --> 00:36:29,710
the comparison of relative effectiveness

703
00:36:36,870 --> 00:36:32,550
risks and applicability is captures that

704
00:36:39,630 --> 00:36:36,880
well that's a soft way I mean it all

705
00:36:42,000 --> 00:36:39,640
three sound co-equal in the main bullet

706
00:36:44,990 --> 00:36:42,010
and then you go well and we need to look

707
00:36:48,960 --> 00:36:45,000
at risks and that's not really true well

708
00:36:50,550 --> 00:36:48,970
again and I hear you and I get your that

709
00:36:52,260 --> 00:36:50,560
that's your opinion I'm not sure that we

710
00:36:58,349 --> 00:36:52,270
got enough data on the ion beam

711
00:37:02,540 --> 00:36:58,359
deflection at this point to to know all

712
00:37:06,210 --> 00:37:02,550
of that um you know for example you know

713
00:37:08,220 --> 00:37:06,220

and collecting a multi-ton Boulder you

714
00:37:10,230 --> 00:37:08,230
know how risky is that versus capturing

715
00:37:12,650 --> 00:37:10,240
an entire small one there's there's a

716
00:37:15,810 --> 00:37:12,660
lot of risk in there that that has to be

717
00:37:19,290 --> 00:37:15,820
understood further so I don't think I

718
00:37:21,150 --> 00:37:19,300
mean I'm an opening to the to the floor

719
00:37:23,430 --> 00:37:21,160
but i don't know that i heard enough

720
00:37:25,320 --> 00:37:23,440
that that would necessarily isolate the

721
00:37:28,380 --> 00:37:25,330
ion beam deflection as the number one

722
00:37:29,849 --> 00:37:28,390
approach but I'm dice is certainly ripe

723
00:37:32,190 --> 00:37:29,859
for demonstration it looks it looks

724
00:37:34,950 --> 00:37:32,200
pretty impressive on paper and then it's

725
00:37:37,589 --> 00:37:34,960
a great demonstration topic I think

726
00:37:41,060 --> 00:37:37,599
maybe what sticking here is the word

727
00:37:43,020 --> 00:37:41,070
minimal in the first sub bullet that I

728
00:37:45,870 --> 00:37:43,030
don't know that that's necessarily true

729
00:37:47,630 --> 00:37:45,880
for enhanced gravity tractor if we're

730
00:37:49,949 --> 00:37:47,640
trying to collect a lot of math

731
00:37:51,890 --> 00:37:49,959
but if it's part of a pinko pick up a

732
00:37:56,729 --> 00:37:51,900
boulder perhaps perhaps as part of the

733
00:38:00,420 --> 00:37:56,739
baseline and the kinetic impact are

734
00:38:04,170 --> 00:38:00,430
using the ARV with out the returned mass

735
00:38:06,569 --> 00:38:04,180
is certainly modest I think the the one

736
00:38:10,799 --> 00:38:06,579
big technological gap there would be

737
00:38:14,699 --> 00:38:10,809
having enough mass on your ARV with the

738
00:38:17,910 --> 00:38:14,709

the massive asteroid yeah what if what

739
00:38:21,299 --> 00:38:17,920
if the mass of that a RV is instead of

740
00:38:23,609 --> 00:38:21,309
10 tons is 50 tons or 30 tons not five

741
00:38:25,589 --> 00:38:23,619
hundred or thousand tons so with the

742
00:38:27,420 --> 00:38:25,599
with the alternate approach to pick up a

743
00:38:28,979 --> 00:38:27,430
boulder you're not talking about

744
00:38:31,579 --> 00:38:28,989
maneuvering a 500-ton netmask

745
00:38:33,930 --> 00:38:31,589
necessarily you have your choice so

746
00:38:36,259 --> 00:38:33,940
again trying to capture both approaches

747
00:38:40,049 --> 00:38:36,269
in there I thought it left it fairly

748
00:38:41,459 --> 00:38:40,059
agnostic and not not choosing since we

749
00:38:43,559 --> 00:38:41,469
don't I don't think we clearly have a

750
00:38:45,930 --> 00:38:43,569
good apples to apples comparison at this

751
00:38:47,900 --> 00:38:45,940
point based on the RFI responses I think

752
00:38:50,849 --> 00:38:47,910
there are worthy of further

753
00:38:54,029 --> 00:38:50,859
investigation i mean i guess i would say

754
00:38:56,939 --> 00:38:54,039
that to my mind I'm bleeding deflection

755
00:39:02,430 --> 00:38:56,949
demonstration is a slam dunk everything

756
00:39:05,130 --> 00:39:02,440
else has you know minor as issues with

757
00:39:06,989 --> 00:39:05,140
it that need to be explored but I'm

758
00:39:08,609 --> 00:39:06,999
being deflection I think you know you

759
00:39:10,319 --> 00:39:08,619
can motor up to the thing and just do it

760
00:39:12,779 --> 00:39:10,329
and there's no I don't think there's any

761
00:39:14,459 --> 00:39:12,789
issues there that people are generally

762
00:39:15,809 --> 00:39:14,469
worried about okay so i'll give you the

763
00:39:18,150 --> 00:39:15,819

issues actually for the alternate

764
00:39:21,630 --> 00:39:18,160
approach why we we have not considered

765
00:39:24,150 --> 00:39:21,640
it so far and that is because of our

766
00:39:25,620 --> 00:39:24,160
desire to minimally affect the ARV which

767
00:39:29,160 --> 00:39:25,630
right now does not have opposing

768
00:39:31,319 --> 00:39:29,170
thrusters and for a large asteroid where

769
00:39:33,479 --> 00:39:31,329
you're doing a boater pick up you have a

770
00:39:35,910 --> 00:39:33,489
series of slewing that you have to do

771
00:39:37,650 --> 00:39:35,920
you don't have the ability to maintain

772
00:39:40,949 --> 00:39:37,660
position for the ion beam deflection

773
00:39:43,799 --> 00:39:40,959
maneuver so it fort for the alternate

774
00:39:45,719 --> 00:39:43,809
approach of pick up or Iraq it is it is

775
00:39:49,859 --> 00:39:45,729
not a slam dunk and since we are already

776
00:39:52,680 --> 00:39:49,869
picking up a rock on it's it's not as

777
00:39:54,299 --> 00:39:52,690
clear-cut for for the small guy for

778
00:39:57,059 --> 00:39:54,309
returning the entire smart one it may be

779
00:39:59,099 --> 00:39:57,069
a slam dunk well it is because there's

780
00:40:00,870 --> 00:39:59,109
there is no choice to pick well I guess

781
00:40:03,030 --> 00:40:00,880
now there's no choice to pick a part of

782
00:40:05,070 --> 00:40:03,040
do the gravity tractor there except with

783
00:40:06,810 --> 00:40:05,080
the spacecraft itself the enhanced

784
00:40:09,780 --> 00:40:06,820
gravity tractor I just want to make a

785
00:40:13,800 --> 00:40:09,790
quick comment I think it's my personal

786
00:40:16,650 --> 00:40:13,810
view ion beam deflection concept

787
00:40:18,990 --> 00:40:16,660
approach or someone oversold without any

788
00:40:21,980 --> 00:40:19,000

technical evidence and that vehicle

789
00:40:26,010 --> 00:40:21,990
concept has nothing to do with a are we

790
00:40:29,250 --> 00:40:26,020
am I correct or wrong I am beam

791
00:40:33,060 --> 00:40:29,260
deflection concept approach satellite

792
00:40:36,390 --> 00:40:33,070
whatever it's not related to a are we

793
00:40:38,100 --> 00:40:36,400
well the arv because of the fact that it

794
00:40:40,920 --> 00:40:38,110
has an ion propellant system you know

795
00:40:43,280 --> 00:40:40,930
that it anything to be called SCP we are

796
00:40:46,530 --> 00:40:43,290
not we are here to talk about possible

797
00:40:51,210 --> 00:40:46,540
application or asteroid redirect a

798
00:40:55,380 --> 00:40:51,220
vehicle test our scope here right and

799
00:40:57,990 --> 00:40:55,390
with with the current reference ARV we

800
00:41:00,690 --> 00:40:58,000
can demonstrate the the ion beam

801
00:41:02,610 --> 00:41:00,700
deflection right yeah so I think that

802
00:41:03,960 --> 00:41:02,620
statement is exactly wrong which is to

803
00:41:06,780 --> 00:41:03,970
say that you can do a very nice

804
00:41:08,520 --> 00:41:06,790
demonstration you have to thrust on the

805
00:41:10,770 --> 00:41:08,530
asteroid for a period of time of order

806
00:41:13,170 --> 00:41:10,780
an hour before you get for too far away

807
00:41:14,880 --> 00:41:13,180
then you do a flip turn and you thrust

808
00:41:17,760 --> 00:41:14,890
in the other way for about an hour and

809
00:41:19,320 --> 00:41:17,770
then you do it again and and it's you

810
00:41:21,660 --> 00:41:19,330
know that's not that difficult to do

811
00:41:23,490 --> 00:41:21,670
furthermore it you know at this stage in

812
00:41:25,680 --> 00:41:23,500
the planning you could put the

813
00:41:27,870 --> 00:41:25,690

collimated gridded ion thruster that

814
00:41:29,970 --> 00:41:27,880
John Brophy described yesterday as part

815
00:41:33,600 --> 00:41:29,980
of the mission which would add cost and

816
00:41:36,720 --> 00:41:33,610
mass but you know without you know it's

817
00:41:38,880 --> 00:41:36,730
relatively minimal so in the right so we

818
00:41:42,060 --> 00:41:38,890
have we deny their term relatively

819
00:41:44,280 --> 00:41:42,070
minimal I mean those thrusters exist

820
00:41:48,120 --> 00:41:44,290
they've been developed or not really a

821
00:41:49,410 --> 00:41:48,130
technology risk so I'm missing the point

822
00:41:52,710 --> 00:41:49,420
Brian what do you want me to well you

823
00:41:54,510 --> 00:41:52,720
made you made the point that that you

824
00:41:56,310 --> 00:41:54,520
these maneuvers that would allow you to

825
00:41:59,820 --> 00:41:56,320
use the single thruster of the existing

826
00:42:02,070 --> 00:41:59,830
baseline armed vehicle you know to do

827
00:42:03,390 --> 00:42:02,080
the ion beam deflection I you know we've

828
00:42:05,580 --> 00:42:03,400
looked at that and I just believe that's

829
00:42:07,230 --> 00:42:05,590
not true and you've looked you've looked

830
00:42:11,790 --> 00:42:07,240
at that for a large target as well as a

831
00:42:14,010 --> 00:42:11,800
small one well yet again right now there

832
00:42:16,200 --> 00:42:14,020
are two approaches on the table so

833
00:42:18,840 --> 00:42:16,210
I'm trying to be on compass scene of

834
00:42:21,210 --> 00:42:18,850
both of those approaches to to Newton's

835
00:42:23,040 --> 00:42:21,220
of thrust you know if you have a huge

836
00:42:24,720 --> 00:42:23,050
asteroid to Newton's of thrust is not

837
00:42:28,620 --> 00:42:24,730
going to help you but it's going to be a

838
00:42:30,900 --> 00:42:28,630

lot more than a gravity tractor well we

839
00:42:33,150 --> 00:42:30,910
we've done some quick calculations based

840
00:42:34,830 --> 00:42:33,160
on the duty cycle in that that

841
00:42:36,900 --> 00:42:34,840
maneuvering around and it's not clear

842
00:42:40,170 --> 00:42:36,910
that it's it's better than the gravity

843
00:42:42,560 --> 00:42:40,180
tractor for what size are your time up

844
00:42:46,050 --> 00:42:42,570
for a two to three hundred meter class

845
00:42:50,160 --> 00:42:46,060
target asteroid with a given boulder

846
00:42:51,630 --> 00:42:50,170
size of say twenty to a hundred tons so

847
00:42:53,940 --> 00:42:51,640
I'm just saying that there are a lot of

848
00:42:56,670 --> 00:42:53,950
factors certain assumptions will lead

849
00:42:57,750 --> 00:42:56,680
you to one conclusion other assumptions

850
00:43:01,080 --> 00:42:57,760
will lead you to another conclusion

851
00:43:03,720 --> 00:43:01,090
because we have not done a an

852
00:43:05,960 --> 00:43:03,730
apples-to-apples comparison I think that

853
00:43:09,420 --> 00:43:05,970
this statement is actually fairly

854
00:43:12,660 --> 00:43:09,430
accurate Stan can you go ahead we're

855
00:43:15,390 --> 00:43:12,670
just go ahead I'm just turn it on I

856
00:43:17,640 --> 00:43:15,400
think you're here we go so just based on

857
00:43:19,800 --> 00:43:17,650
the text on the slides I think based on

858
00:43:23,610 --> 00:43:19,810
the previous comment that you can

859
00:43:26,640 --> 00:43:23,620
demonstrate the ion beam deflection with

860
00:43:27,810 --> 00:43:26,650
the arrv vehicle just pipes so blown it

861
00:43:29,040 --> 00:43:27,820
back and forth it's going to be a pain

862
00:43:30,210 --> 00:43:29,050
in the butt but you don't have to change

863
00:43:31,860 --> 00:43:30,220

the design of the thing you're only

864
00:43:34,020 --> 00:43:31,870
going to have a less than fifty percent

865
00:43:36,720 --> 00:43:34,030
duty cycle plus maneuver time but you

866
00:43:39,660 --> 00:43:36,730
can demonstrate the concept and I think

867
00:43:41,520 --> 00:43:39,670
that as it stands on the slide I think

868
00:43:43,260 --> 00:43:41,530
we've said what we want to say now what

869
00:43:45,840 --> 00:43:43,270
I'm hearing is a lot of debate about

870
00:43:47,990 --> 00:43:45,850
which method is best right and I don't

871
00:43:49,890 --> 00:43:48,000
think it's our duty to decide that I

872
00:43:51,690 --> 00:43:49,900
think the statement that we're going to

873
00:43:53,490 --> 00:43:51,700
compare the relative effectiveness risks

874
00:43:54,990 --> 00:43:53,500
and applicability and let the

875
00:43:57,390 --> 00:43:55,000
engineering studies sort out which is

876
00:43:59,430 --> 00:43:57,400
best I think the statement we have is

877
00:44:01,200 --> 00:43:59,440
good based on that and I have no problem

878
00:44:05,700 --> 00:44:01,210
putting ion beam deflection first if

879
00:44:07,170 --> 00:44:05,710
that if that it all helps I mean if the

880
00:44:09,720 --> 00:44:07,180
stuff was just how it got typed in last

881
00:44:14,630 --> 00:44:09,730
night so I'd say it's alphabetical right

882
00:44:16,800 --> 00:44:14,640
now go with it okay yeah now Dan I I

883
00:44:18,660 --> 00:44:16,810
think we need to be state kind of

884
00:44:20,730 --> 00:44:18,670
agnostic about the solution so i would i

885
00:44:23,370 --> 00:44:20,740
would suggest baby say considered as

886
00:44:25,050 --> 00:44:23,380
valid concepts and then drop this first

887
00:44:26,230 --> 00:44:25,060
sub bullet likely to be lowest cost

888
00:44:28,420 --> 00:44:26,240

demonstration

889
00:44:31,990 --> 00:44:28,430
but the next symbol of comparison is

890
00:44:36,100 --> 00:44:32,000
certainly exactly right okay so native

891
00:44:37,750 --> 00:44:36,110
comma valid yeah concepts and then the

892
00:44:40,180 --> 00:44:37,760
lowest-cost demonstration I think that's

893
00:44:42,040 --> 00:44:40,190
to be proven I think we might all agree

894
00:44:43,600 --> 00:44:42,050
with that but what is the lowest cost I

895
00:44:45,400 --> 00:44:43,610
don't think that adds any value to your

896
00:44:47,830 --> 00:44:45,410
to the point the point is we've got more

897
00:44:51,280 --> 00:44:47,840
work to do on all of these yeah well I

898
00:44:53,140 --> 00:44:51,290
mean the issue here is we had we has

899
00:44:58,480 --> 00:44:53,150
caught readers why is none of my issue

900
00:45:01,300 --> 00:44:58,490
yeah the point is right and if you look

901
00:45:03,700 --> 00:45:01,310
at the next finding other demonstrations

902
00:45:05,100 --> 00:45:03,710
that that don't affect the arv such as

903
00:45:08,230 --> 00:45:05,110
kinetic impactor with the air view

904
00:45:09,940 --> 00:45:08,240
observing at the large target Nia at a

905
00:45:12,310 --> 00:45:09,950
large target Nia are recommended if

906
00:45:16,660 --> 00:45:12,320
budget permits so that is that is an

907
00:45:18,640 --> 00:45:16,670
example of a an additional cost because

908
00:45:21,930 --> 00:45:18,650
if you do bring in kinetic impactor

909
00:45:24,370 --> 00:45:21,940
that's going to be an additional

910
00:45:25,840 --> 00:45:24,380
spacecraft that has to be costed yeah

911
00:45:28,000 --> 00:45:25,850
but exam I'm not sure that's more or

912
00:45:29,800 --> 00:45:28,010
less expensive than than a kinetic

913
00:45:31,960 --> 00:45:29,810

impactor that's augmented with you know

914
00:45:34,810 --> 00:45:31,970
that's using the ARV as a kinetic

915
00:45:36,460 --> 00:45:34,820
impactor with augmented mass okay I son

916
00:45:38,470 --> 00:45:36,470
I think that's in a kind of a different

917
00:45:42,370 --> 00:45:38,480
class than the gravity tractor of the

918
00:45:47,620 --> 00:45:42,380
imb it may be in a different class so i

919
00:45:50,770 --> 00:45:47,630
get so comparison of relative effect

920
00:45:54,150 --> 00:45:50,780
costs how about add costs into here ok

921
00:45:58,090 --> 00:45:54,160
and then strike this bullet there you go

922
00:45:59,650 --> 00:45:58,100
unless there is something and we're

923
00:46:01,330 --> 00:45:59,660
trying to make the point that if we use

924
00:46:03,880 --> 00:46:01,340
what we have and I can do it verbally if

925
00:46:06,280 --> 00:46:03,890
we take advantage of of the equipment

926
00:46:08,710 --> 00:46:06,290
and the development and the fuel that we

927
00:46:10,780 --> 00:46:08,720
have then that's going to be the the

928
00:46:11,980 --> 00:46:10,790
lowest class thing yeah but again we're

929
00:46:18,640 --> 00:46:11,990
talking about relatively small

930
00:46:21,070 --> 00:46:18,650
increments here right so so okay just

931
00:46:24,460 --> 00:46:21,080
the only that it's getting close to nine

932
00:46:28,320 --> 00:46:24,470
thirty yep so I went ahead and stated

933
00:46:34,460 --> 00:46:30,210
I kind of hate having single sub ballots

934
00:46:45,810 --> 00:46:37,920
thank you I'm an engineer not an English

935
00:46:49,350 --> 00:46:45,820
major and I do that all the time okay so

936
00:46:54,180 --> 00:46:49,360
here on this second one I try to capture

937
00:46:55,850 --> 00:46:54,190
the discussion yesterday on that and one

938
00:46:58,430 --> 00:46:55,860

we in half and I had a little bit

939
00:47:02,300 --> 00:46:58,440
additional discussion and I got a

940
00:47:05,310 --> 00:47:02,310
comment there that I can delete that

941
00:47:09,240 --> 00:47:05,320
demonstration of a nuclear device is not

942
00:47:12,450 --> 00:47:09,250
compatible with the AR RM mission both

943
00:47:14,610 --> 00:47:12,460
budgets schedule etc programmatic

944
00:47:16,650 --> 00:47:14,620
seeeeee all of the issues associated

945
00:47:19,230 --> 00:47:16,660
with having something nuclear in the in

946
00:47:20,820 --> 00:47:19,240
the program I think that I think we can

947
00:47:23,210 --> 00:47:20,830
all agree that that's probably not

948
00:47:25,440 --> 00:47:23,220
something that we want to do however

949
00:47:28,020 --> 00:47:25,450
some of the hardware and operations

950
00:47:30,270 --> 00:47:28,030
needed could be tested for example

951
00:47:32,250 --> 00:47:30,280
testing of a blended kinetic impact and

952
00:47:37,920 --> 00:47:32,260
subsurface nuclear nuclear explosion as

953
00:47:41,520 --> 00:47:37,930
proposed in the H a IV concept could be

954
00:47:44,160 --> 00:47:41,530
done so the point is is that we don't

955
00:47:46,020 --> 00:47:44,170
necessarily if if someone wants to have

956
00:47:47,970 --> 00:47:46,030
something that's tested as part of a

957
00:47:50,370 --> 00:47:47,980
another approach that we can't actually

958
00:47:51,990 --> 00:47:50,380
do a demonstration mission on that we

959
00:47:53,880 --> 00:47:52,000
could accommodate we could accommodate

960
00:47:56,850 --> 00:47:53,890
that now that we want to or not that's

961
00:48:01,140 --> 00:47:56,860
another issue so I'll throw that out for

962
00:48:02,430 --> 00:48:01,150
the floor for for discussion well you

963
00:48:03,870 --> 00:48:02,440

know the first sense basically says

964
00:48:05,580 --> 00:48:03,880
we're not going to do a nuclear

965
00:48:07,770 --> 00:48:05,590
demonstration and the last sentence

966
00:48:09,690 --> 00:48:07,780
implies that you might do a nuclear

967
00:48:11,940 --> 00:48:09,700
demonstration so I already word the last

968
00:48:15,150 --> 00:48:11,950
sentence to make it clear that you're

969
00:48:20,340 --> 00:48:15,160
not actually using a nuclear explosive

970
00:48:22,340 --> 00:48:20,350
and the test about but right i mean it

971
00:48:25,260 --> 00:48:22,350
basically says and yeah right and

972
00:48:27,510 --> 00:48:25,270
however i would recommend you just just

973
00:48:29,280 --> 00:48:27,520
started stay with the first bullet and

974
00:48:31,970 --> 00:48:29,290
drop everything else because you really

975
00:48:35,880 --> 00:48:31,980
don't want to get into the business of

976
00:48:36,420 --> 00:48:35,890
even appearing to promote the idea of a

977
00:48:41,930 --> 00:48:36,430
nuclear

978
00:48:44,760 --> 00:48:41,940
test because the you know the the issues

979
00:48:47,220 --> 00:48:44,770
the issues of the nuclear

980
00:48:48,960 --> 00:48:47,230
non-proliferation treaty China and

981
00:48:51,120 --> 00:48:48,970
Russia both want to violate the treaty

982
00:48:53,880 --> 00:48:51,130
to get testing time on their weapons and

983
00:48:55,500 --> 00:48:53,890
we do not want them to get testing time

984
00:48:57,480 --> 00:48:55,510
on their weapons so this is a huge

985
00:49:00,180 --> 00:48:57,490
foreign policy issue and for a group

986
00:49:04,860 --> 00:49:00,190
like this to come out and even appear to

987
00:49:09,830 --> 00:49:04,870
to be moving in the direction undermines

988
00:49:12,990 --> 00:49:09,840

the policy of the United States okay I

989
00:49:15,300 --> 00:49:13,000
just want a very quick comment based on

990
00:49:17,940 --> 00:49:15,310
your location but yes i agree with you

991
00:49:20,760 --> 00:49:17,950
everyone feeling about the sensitivity

992
00:49:24,870 --> 00:49:20,770
issue so that the phrase needs to be

993
00:49:27,450 --> 00:49:24,880
sort of modified so all the concept we

994
00:49:30,360 --> 00:49:27,460
account studying is not to have actual

995
00:49:32,700 --> 00:49:30,370
flight demonstration using the black box

996
00:49:35,820 --> 00:49:32,710
device so somehow we have to rephrase

997
00:49:40,440 --> 00:49:35,830
that we will we will need to test

998
00:49:43,380 --> 00:49:40,450
everything except nuclear warhead so we

999
00:49:46,550 --> 00:49:43,390
clear now so that needs to be changing

1000
00:49:49,950 --> 00:49:46,560
all the concept concept all the

1001
00:49:51,960 --> 00:49:49,960
mechanism timing except a nucleus right

1002
00:49:53,700 --> 00:49:51,970
and that and that was the point yes this

1003
00:49:58,050 --> 00:49:53,710
and and considering the fact that we

1004
00:50:00,510 --> 00:49:58,060
have a Nayak nasa sponsored nayak study

1005
00:50:02,700 --> 00:50:00,520
that's exactly doing this yes that

1006
00:50:06,000 --> 00:50:02,710
advocates i mean you could say we've

1007
00:50:07,800 --> 00:50:06,010
already violated international whatever

1008
00:50:08,880 --> 00:50:07,810
we haven't done it because we actually i

1009
00:50:10,590 --> 00:50:08,890
mean we haven't violated anything

1010
00:50:13,830 --> 00:50:10,600
because we have never bought anything we

1011
00:50:18,180 --> 00:50:13,840
don't have to worry about to me can you

1012
00:50:20,790 --> 00:50:18,190
use the microphone please sir no you

1013
00:50:24,540 --> 00:50:20,800

have to use the microphone I can't think

1014
00:50:27,000 --> 00:50:24,550
they can't hear you online so that's the

1015
00:50:29,490 --> 00:50:27,010
difference nyek is a study this is not a

1016
00:50:31,020 --> 00:50:29,500
study if you if you guys are advocating

1017
00:50:33,120 --> 00:50:31,030
going to do this then we're actually

1018
00:50:35,070 --> 00:50:33,130
going to do you know take hardware

1019
00:50:36,810 --> 00:50:35,080
somewhere and do something with it that

1020
00:50:40,380 --> 00:50:36,820
is a problem I think that you should

1021
00:50:43,140 --> 00:50:40,390
drop everything from from however down

1022
00:50:45,150 --> 00:50:43,150
okay so drop it and you're fine that's

1023
00:50:47,460 --> 00:50:45,160
okay that's okay that's fine it that's

1024
00:50:48,829 --> 00:50:47,470
absolutely fine I Jimmy people you

1025
00:50:52,160 --> 00:50:48,839
understand

1026
00:50:54,229 --> 00:50:52,170
that's sensitivity well then death is

1027
00:50:57,709 --> 00:50:54,239
very misleading then this group is

1028
00:50:59,599 --> 00:50:57,719
denying the availability that option

1029
00:51:02,089 --> 00:50:59,609
look at the demonstration is not cowboy

1030
00:51:04,579 --> 00:51:02,099
it's not comparable but demonstration of

1031
00:51:06,620 --> 00:51:04,589
our other kinetic impact guidance

1032
00:51:10,880 --> 00:51:06,630
navigation technol timing is everything

1033
00:51:14,930 --> 00:51:10,890
needs to be flight students Steve can

1034
00:51:17,539 --> 00:51:14,940
you go I think that the hardware and

1035
00:51:20,870 --> 00:51:17,549
operations can be tested without as an

1036
00:51:22,400 --> 00:51:20,880
example for Isis I've been talking with

1037
00:51:25,880 --> 00:51:22,410
the Lawrence Livermore people who really

1038
00:51:28,940 --> 00:51:25,890

would like to put a radar ranging timer

1039
00:51:30,440 --> 00:51:28,950
on the spacecraft as a test right they

1040
00:51:32,989 --> 00:51:30,450
can determine whether or not they can

1041
00:51:35,120 --> 00:51:32,999
trigger at the right time with enough

1042
00:51:36,349 --> 00:51:35,130
confidence and so that's a technology

1043
00:51:38,299 --> 00:51:36,359
that it really doesn't have anything to

1044
00:51:39,920 --> 00:51:38,309
do with nuclear so I I think maybe the

1045
00:51:41,749 --> 00:51:39,930
last sentence could be struck but the

1046
00:51:45,709 --> 00:51:41,759
middle one about however some could be

1047
00:51:48,650 --> 00:51:45,719
tested is fine for instance testing

1048
00:51:51,620 --> 00:51:48,660
timing and arranging devices is a big

1049
00:51:53,930 --> 00:51:51,630
deal for these kinds of problems yeah I

1050
00:51:56,299 --> 00:51:53,940
mean that was my that was my feeling

1051
00:51:58,729 --> 00:51:56,309
during the discussion that you know I

1052
00:52:02,180 --> 00:51:58,739
certainly understand the sensitivities

1053
00:52:05,209 --> 00:52:02,190
to the whole nuclear issue however of a

1054
00:52:07,549 --> 00:52:05,219
we may find that it doesn't work that it

1055
00:52:09,620 --> 00:52:07,559
and that it's not an option so therefore

1056
00:52:11,469 --> 00:52:09,630
that's good to know that we have to

1057
00:52:14,599 --> 00:52:11,479
invoke something other than a nuclear

1058
00:52:16,519 --> 00:52:14,609
approach to solve this problem on the

1059
00:52:19,009 --> 00:52:16,529
other hand we may be presented with a

1060
00:52:21,430 --> 00:52:19,019
short impact a short warning time impact

1061
00:52:23,719 --> 00:52:21,440
where that is the only option and i

1062
00:52:25,459 --> 00:52:23,729
don't know i think i think the the

1063
00:52:27,469 --> 00:52:25,469

nations of the world will come together

1064
00:52:31,519 --> 00:52:27,479
and say if we needed to do that we would

1065
00:52:32,809 --> 00:52:31,529
do that so that that's that's my

1066
00:52:35,569 --> 00:52:32,819
personal opinion I don't want to be a

1067
00:52:38,269 --> 00:52:35,579
dinosaur so again I guess if you leave

1068
00:52:39,589 --> 00:52:38,279
Steve's second sentence in here I think

1069
00:52:43,430 --> 00:52:39,599
you want to take out the word device

1070
00:52:46,039 --> 00:52:43,440
demonstration of a nuclear planetary

1071
00:52:49,880 --> 00:52:46,049
defense capability is not compatible

1072
00:52:52,849 --> 00:52:49,890
with this mission but we could

1073
00:52:54,289 --> 00:52:52,859
demonstrate some hardware or operations

1074
00:52:55,969 --> 00:52:54,299
that when you say device i think that

1075
00:52:59,290 --> 00:52:55,979
second next sentence opens you up to all

1076
00:53:08,000 --> 00:53:06,140
capability yeah yeah okay I knew this

1077
00:53:13,910 --> 00:53:08,010
would be a hot-button topic here I knew

1078
00:53:16,370 --> 00:53:13,920
it but it was like okay everybody and

1079
00:53:18,380 --> 00:53:16,380
and again I'm fully appreciative of all

1080
00:53:21,620 --> 00:53:18,390
the comments here I mean that this is so

1081
00:53:24,890 --> 00:53:21,630
this is a sticky subject so can you get

1082
00:53:29,660 --> 00:53:24,900
closer to thank you he's the black your

1083
00:53:32,330 --> 00:53:29,670
phone pitbull so so I don't know if this

1084
00:53:34,700 --> 00:53:32,340
is you know I understand the intent of

1085
00:53:38,720 --> 00:53:34,710
what you want to be able to include in

1086
00:53:43,250 --> 00:53:38,730
this but in the context of what we're

1087
00:53:45,320 --> 00:53:43,260
trying to do you know with international

1088
00:53:51,430 --> 00:53:45,330

collaboration options and having this

1089
00:53:55,550 --> 00:53:51,440
really be about human exploration and

1090
00:54:00,110 --> 00:53:55,560
you know maybe science and planetary

1091
00:54:03,350 --> 00:54:00,120
defense of secondary objectives you know

1092
00:54:07,550 --> 00:54:03,360
you're opening up a can of worms by even

1093
00:54:12,050 --> 00:54:07,560
saying you're going to allow for testing

1094
00:54:13,220 --> 00:54:12,060
of some hardware yeah just you know

1095
00:54:15,830 --> 00:54:13,230
there's a big difference again between

1096
00:54:18,700 --> 00:54:15,840
studies like nayak words just to study

1097
00:54:21,620 --> 00:54:18,710
and saying that we're going to consider

1098
00:54:25,000 --> 00:54:21,630
this I actually think it's going to

1099
00:54:27,530 --> 00:54:25,010
cause problems with support and

1100
00:54:38,470 --> 00:54:27,540
continued efforts how about a hell out

1101
00:54:46,460 --> 00:54:43,579
no I believe fine fine yeah yeah you're

1102
00:54:51,109 --> 00:54:46,470
going to cause all so this is the

1103
00:54:54,440 --> 00:54:51,119
planetary defense session yeah right so

1104
00:54:56,150 --> 00:54:54,450
yeah my proposed will be would be that

1105
00:55:00,260 --> 00:54:56,160
we are offering this to the plenary

1106
00:55:01,730 --> 00:55:00,270
session now the quicker and then and

1107
00:55:04,400 --> 00:55:01,740
then let them to make a decision at that

1108
00:55:06,349 --> 00:55:04,410
point and maybe I move this bullet like

1109
00:55:08,780 --> 00:55:06,359
to the very end so we can get through

1110
00:55:10,579 --> 00:55:08,790
every patient did I just make a

1111
00:55:13,280 --> 00:55:10,589
suggestion here those of a different

1112
00:55:15,710 --> 00:55:13,290
nature how about however then some of

1113
00:55:19,220 --> 00:55:15,720

these however the results of some of

1114
00:55:22,910 --> 00:55:19,230
these arm test might provide insight

1115
00:55:24,620 --> 00:55:22,920
into those capabilities that's really

1116
00:55:27,109 --> 00:55:24,630
what we're talking about here now we're

1117
00:55:29,750 --> 00:55:27,119
talking about specifically putting you

1118
00:55:32,650 --> 00:55:29,760
could if you wanted to expend the budget

1119
00:55:36,079 --> 00:55:32,660
to put like Steve said some timers

1120
00:55:37,790 --> 00:55:36,089
understanding of that of that impact

1121
00:55:38,900 --> 00:55:37,800
that would be above and beyond what we

1122
00:55:40,520 --> 00:55:38,910
would normally do for an impact because

1123
00:55:42,109 --> 00:55:40,530
now we're just trying to hit it here

1124
00:55:44,480 --> 00:55:42,119
we're trying to understand the physics

1125
00:55:46,900 --> 00:55:44,490
of the surface collision the penetration

1126
00:55:49,700 --> 00:55:46,910
into the surface the timing of all that

1127
00:55:53,260 --> 00:55:49,710
which is which is an important part of

1128
00:55:56,690 --> 00:55:53,270
of a subsurface kinetic impact or hybrid

1129
00:56:00,010 --> 00:55:56,700
okay yes so that i think would get you

1130
00:56:04,150 --> 00:56:02,470
I'm difficulty I tell on that all right

1131
00:56:06,160 --> 00:56:04,160
nothing else I agree with Steve this is

1132
00:56:08,050 --> 00:56:06,170
a planetary defense so let's take it to

1133
00:56:09,520 --> 00:56:08,060
the planetary and plundering let other

1134
00:56:12,130 --> 00:56:09,530
people well i would like to second what

1135
00:56:14,110 --> 00:56:12,140
James said but you know it's true that

1136
00:56:15,400 --> 00:56:14,120
livermore in Los Alamos would like to do

1137
00:56:17,050 --> 00:56:15,410
this there are people in the trenches

1138
00:56:19,270 --> 00:56:17,060

there that would love to have you know

1139
00:56:21,430 --> 00:56:19,280
be able to work on this but you know the

1140
00:56:24,190 --> 00:56:21,440
State Department is going to kill all

1141
00:56:26,050 --> 00:56:24,200
this we both know this is what we take

1142
00:56:27,370 --> 00:56:26,060
it to the plenary and like the decision

1143
00:56:29,440 --> 00:56:27,380
yeah I mean again I think this was a

1144
00:56:32,890 --> 00:56:29,450
request an international request for

1145
00:56:36,370 --> 00:56:32,900
ideas and that's what we're supposed to

1146
00:56:37,450 --> 00:56:36,380
to put forward and and James I think

1147
00:56:40,530 --> 00:56:37,460
you're okay with sending this to the

1148
00:56:42,940 --> 00:56:40,540
plenary letting them yeah I you know it

1149
00:56:46,570 --> 00:56:42,950
represents what is being brought forth

1150
00:56:48,790 --> 00:56:46,580
in the rfis you know it does not

1151
00:56:51,790 --> 00:56:48,800
necessarily represent what will go

1152
00:56:56,110 --> 00:56:51,800
forward absolutely right so it'll get

1153
00:56:59,320 --> 00:56:56,120
killed but that's okay hey Dan I think

1154
00:57:02,350 --> 00:56:59,330
we're making seven years ago we did a

1155
00:57:04,690 --> 00:57:02,360
study where I put seven w82 warheads on

1156
00:57:07,650 --> 00:57:04,700
the Ares 5 and published it there's a

1157
00:57:10,270 --> 00:57:07,660
video out there and the world didn't end

1158
00:57:11,320 --> 00:57:10,280
we're still here and you know what I

1159
00:57:13,240 --> 00:57:11,330
didn't get a call from the State

1160
00:57:15,190 --> 00:57:13,250
Department I didn't get a call from doee

1161
00:57:17,530 --> 00:57:15,200
I didn't get anything like that we did a

1162
00:57:19,840 --> 00:57:17,540
pretty good modeling program we showed a

1163
00:57:21,640 --> 00:57:19,850

lot of effectiveness their nuclear is an

1164
00:57:23,080 --> 00:57:21,650
option the Europeans are not going to be

1165
00:57:25,090 --> 00:57:23,090
happy about talking about nuclear than

1166
00:57:26,680 --> 00:57:25,100
never have been but in general this is

1167
00:57:27,970 --> 00:57:26,690
an option that has to be discussed we're

1168
00:57:32,230 --> 00:57:27,980
talking planetary defense we're not

1169
00:57:35,980 --> 00:57:32,240
talking nuclear at some level then we're

1170
00:57:39,820 --> 00:57:35,990
taking out a large ability to defeat the

1171
00:57:41,290 --> 00:57:39,830
threat so I mean I really don't see the

1172
00:57:43,120 --> 00:57:41,300
State Department throwing a fit I don't

1173
00:57:45,010 --> 00:57:43,130
see any of these other tests okay Stan

1174
00:57:47,500 --> 00:57:45,020
oh yeah go ahead guys stand second the

1175
00:57:49,000 --> 00:57:47,510
last okay yeah okay so the State

1176
00:57:50,110 --> 00:57:49,010
Department if they if the State

1177
00:57:51,940 --> 00:57:50,120
Department wants to shut it down that's

1178
00:57:53,830 --> 00:57:51,950
their job and let them do it but this is

1179
00:57:56,410 --> 00:57:53,840
a technical solution that needs to be

1180
00:57:57,850 --> 00:57:56,420
discussed for planetary defense okay all

1181
00:58:00,010 --> 00:57:57,860
right so the two line could lose move on

1182
00:58:01,240 --> 00:58:00,020
time okay look the next one I think

1183
00:58:03,130 --> 00:58:01,250
we'll be okay but there may be a little

1184
00:58:04,780 --> 00:58:03,140
word change that we need to do robotic

1185
00:58:06,640 --> 00:58:04,790
spacecraft mechanisms in support of

1186
00:58:08,410 --> 00:58:06,650
planetary defense efforts for example

1187
00:58:10,780 --> 00:58:08,420
surface sampler animatic sampling and

1188
00:58:12,020 --> 00:58:10,790

excavation snare system self opposing

1189
00:58:15,020 --> 00:58:12,030
multi-mode anchor

1190
00:58:18,740 --> 00:58:15,030
could be used or evaluated maybe that

1191
00:58:22,220 --> 00:58:18,750
should say on during ar-ar-ar em

1192
00:58:23,990 --> 00:58:22,230
if additional costs can be shared or is

1193
00:58:25,970 --> 00:58:24,000
acceptable or something like that i put

1194
00:58:36,110 --> 00:58:25,980
shared just because trying to minimize

1195
00:58:38,900 --> 00:58:36,120
costs any problems with i don't know if

1196
00:58:41,750 --> 00:58:38,910
it has to be well shared is it it can be

1197
00:58:43,220 --> 00:58:41,760
one percent ninety-nine percent before

1198
00:58:54,310 --> 00:58:43,230
something posing shouldn't that be or

1199
00:58:54,320 --> 00:59:02,660
okay and there's a sticky coming in

1200
00:59:08,440 --> 00:59:05,000
okay we have two comments from the the

1201
00:59:10,880 --> 00:59:08,450
Twitter universe and ustream mike helton

1202
00:59:12,680 --> 00:59:10,890
NASA needs to identify two families of

1203
00:59:14,150 --> 00:59:12,690
asteroid deflection one to avoid impact

1204
00:59:16,700 --> 00:59:14,160
and one for capture and science

1205
00:59:18,170 --> 00:59:16,710
investigation and I think that's I think

1206
00:59:20,650 --> 00:59:18,180
some of that we're I think we've got

1207
00:59:22,970 --> 00:59:20,660
that and then from a ustream comment is

1208
00:59:26,240 --> 00:59:22,980
first to study then its consideration

1209
00:59:28,820 --> 00:59:26,250
for test then is utilization so just in

1210
00:59:30,650 --> 00:59:28,830
terms of so I think we've we can

1211
00:59:32,540 --> 00:59:30,660
probably address both of those in what

1212
00:59:34,670 --> 00:59:32,550
we what we have here yeah yeah I think

1213
00:59:38,060 --> 00:59:34,680

those those are good comments but

1214
00:59:42,260 --> 00:59:38,070
they're pretty germane to what needs to

1215
00:59:47,240 --> 00:59:42,270
be done um okay so findings relevant to

1216
00:59:48,710 --> 00:59:47,250
Grand Challenge many demonstrations such

1217
00:59:50,530 --> 00:59:48,720
as solar collector and use of in situ

1218
00:59:54,020 --> 00:59:50,540
materials for mass driver or propulsion

1219
00:59:55,670 --> 00:59:54,030
could be important to addressing and it

1220
00:59:58,520 --> 00:59:55,680
left off the kinetic impactor I can't

1221
01:00:00,260 --> 00:59:58,530
believe I did that well because I guess

1222
01:00:07,460 --> 01:00:00,270
because we had already covered it before

1223
01:00:08,780 --> 01:00:07,470
so but let me I'm going to put it back

1224
01:00:14,120 --> 01:00:08,790
up here because it is the number one

1225
01:00:18,530 --> 01:00:14,130
according India NRC report and I'll put

1226
01:00:22,620 --> 01:00:21,210
could be important to addressing the

1227
01:00:24,450 --> 01:00:22,630
grand challenge but may impose

1228
01:00:27,180 --> 01:00:24,460
additional constraints for example cost

1229
01:00:31,020 --> 01:00:27,190
schedule etc on the AR RM that are

1230
01:00:34,950 --> 01:00:31,030
unacceptable the word unacceptable is

1231
01:00:36,690 --> 01:00:34,960
unacceptable but these constraints

1232
01:00:38,190 --> 01:00:36,700
should be analyzed in more detail given

1233
01:00:40,230 --> 01:00:38,200
the wide range of ideas and uncertainty

1234
01:00:43,350 --> 01:00:40,240
and how or if they could be accommodated

1235
01:00:44,730 --> 01:00:43,360
on the AR RM and these ideas could be

1236
01:00:48,750 --> 01:00:44,740
pursued if additional funding is

1237
01:00:51,000 --> 01:00:48,760
available so this is this is to capture

1238
01:00:53,760 --> 01:00:51,010

you know everything that we I mean as

1239
01:00:57,090 --> 01:00:53,770
much as I'd love to test out a 50 meter

1240
01:00:58,920 --> 01:00:57,100
solar collector and zap aah zap an

1241
01:01:01,890 --> 01:00:58,930
asteroid with it to see how effective it

1242
01:01:04,230 --> 01:01:01,900
is we've got to be able to bear the cost

1243
01:01:07,980 --> 01:01:04,240
and unless there is some cost-sharing

1244
01:01:09,330 --> 01:01:07,990
but then there's also a in effect on the

1245
01:01:12,150 --> 01:01:09,340
flight system that has to be looked at

1246
01:01:14,610 --> 01:01:12,160
well the test a 50 meter test a 5 meter

1247
01:01:17,820 --> 01:01:14,620
yeah so I mean a five-metre solar

1248
01:01:20,670 --> 01:01:17,830
collector would be so incredibly small

1249
01:01:22,830 --> 01:01:20,680
hear it it's hard for me to accept the

1250
01:01:25,080 --> 01:01:22,840
unacceptable statement here because I

1251
01:01:29,670 --> 01:01:25,090
mean you're talking probably something

1252
01:01:32,070 --> 01:01:29,680
on the order of 300 kilograms I mean

1253
01:01:34,830 --> 01:01:32,080
that would be a fraction of the AR RM

1254
01:01:37,620 --> 01:01:34,840
and it would be a lot of advantages to

1255
01:01:40,710 --> 01:01:37,630
having a you know that is part of the

1256
01:01:42,150 --> 01:01:40,720
test program again with the capabilities

1257
01:01:45,540 --> 01:01:42,160
that the solar collector brings to the

1258
01:01:49,020 --> 01:01:45,550
table I just think you know it's a good

1259
01:01:50,700 --> 01:01:49,030
demonstrator ok so is it acceptable to

1260
01:01:53,160 --> 01:01:50,710
remove the unacceptable does that read

1261
01:01:55,920 --> 01:01:53,170
all right to you that just maybe putting

1262
01:02:00,210 --> 01:01:55,930
those have to contend and just drop the

1263
01:02:03,950 --> 01:02:00,220

the r and make that at may as well may

1264
01:02:14,460 --> 01:02:11,280
put back what you had There that that

1265
01:02:19,020 --> 01:02:14,470
may prove unacceptable you know just as

1266
01:02:21,900 --> 01:02:19,030
opposed to the art well I understand

1267
01:02:24,300 --> 01:02:21,910
that but my objection is to have the

1268
01:02:26,400 --> 01:02:24,310
solar collector in this bullet because I

1269
01:02:29,490 --> 01:02:26,410
mean of course that's what I'm going to

1270
01:02:33,030 --> 01:02:29,500
say but I just don't see that as being a

1271
01:02:35,270 --> 01:02:33,040
hard thing to do I mean good grief i

1272
01:02:39,540 --> 01:02:35,280
could go take nano sale and redesign it

1273
01:02:41,640 --> 01:02:39,550
and meet the time and cost constraints

1274
01:02:44,520 --> 01:02:41,650
and have this be a you know a small

1275
01:02:47,250 --> 01:02:44,530
demonstrator mission where we see if we

1276
01:02:50,580 --> 01:02:47,260
can nudge this asteroid around yeah but

1277
01:02:52,350 --> 01:02:50,590
right now in the AR RM there is not a

1278
01:02:55,050 --> 01:02:52,360
solar collector there is not a kinetic

1279
01:02:56,550 --> 01:02:55,060
impactor and we actually for the

1280
01:02:59,280 --> 01:02:56,560
alternate approach we were asked by

1281
01:03:00,870 --> 01:02:59,290
headquarters to defer the impactor for

1282
01:03:02,340 --> 01:03:00,880
right now because of cost reasons any

1283
01:03:05,160 --> 01:03:02,350
anything that's additional of the

1284
01:03:08,220 --> 01:03:05,170
program I got a double may here now may

1285
01:03:10,980 --> 01:03:08,230
impose that may be unacceptable no it's

1286
01:03:13,740 --> 01:03:10,990
not already on the a RM then it adds

1287
01:03:16,530 --> 01:03:13,750
cost and schedule today our RM but at a

1288
01:03:17,940 --> 01:03:16,540

RM is kind of an arbitrary baseline in

1289
01:03:19,770 --> 01:03:17,950
the first place absolutely and that's

1290
01:03:22,560 --> 01:03:19,780
the whole point of this RFI is to see if

1291
01:03:24,810 --> 01:03:22,570
there are ideas except I thought that

1292
01:03:28,290 --> 01:03:24,820
the point of this slide with the title

1293
01:03:31,020 --> 01:03:28,300
is to take the a RM out of the equation

1294
01:03:33,420 --> 01:03:31,030
well is that not true well the point

1295
01:03:36,270 --> 01:03:33,430
with this is saying that if it's

1296
01:03:38,640 --> 01:03:36,280
unacceptable on the AR RM they are still

1297
01:03:42,030 --> 01:03:38,650
important for the grand challenge that's

1298
01:03:46,110 --> 01:03:42,040
the intent why are we kind of you know

1299
01:03:48,570 --> 01:03:46,120
making using a RM as a as a litmus test

1300
01:03:50,190 --> 01:03:48,580
here on these that's the reason why the

1301
01:03:51,870 --> 01:03:50,200
hell out of this category because we

1302
01:03:55,230 --> 01:03:51,880
didn't think they'd fit under the a RM

1303
01:03:58,860 --> 01:03:55,240
findings but we want to make sure that

1304
01:04:00,060 --> 01:03:58,870
they're captured so I could just um we

1305
01:04:02,100 --> 01:04:00,070
could just let me under the grand

1306
01:04:04,110 --> 01:04:02,110
challenge is a program these are things

1307
01:04:05,790 --> 01:04:04,120
that are worth you investigate it and

1308
01:04:07,950 --> 01:04:05,800
I'm fine with that if we just want to do

1309
01:04:09,120 --> 01:04:07,960
that well damn instead of doing that why

1310
01:04:11,520 --> 01:04:09,130
don't you put another bullet on there

1311
01:04:16,260 --> 01:04:11,530
saying you know there's recommendations

1312
01:04:22,230 --> 01:04:19,710
uh okay so like what let's welcome no

1313
01:04:23,760 --> 01:04:22,240

one likes that one I think I think what

1314
01:04:25,110 --> 01:04:23,770
which steve said is probably right it

1315
01:04:26,520 --> 01:04:25,120
eliminates the confusion I know that's

1316
01:04:27,840 --> 01:04:26,530
what we were trying to do is yap on it

1317
01:04:29,400 --> 01:04:27,850
make it so that these were captured

1318
01:04:33,120 --> 01:04:29,410
under the grand challenge and not

1319
01:04:42,120 --> 01:04:33,130
relevant for fur the AR m how about this

1320
01:04:44,430 --> 01:04:42,130
I think we've captured it there in the

1321
01:04:45,960 --> 01:04:44,440
sub bullets it says it's they should be

1322
01:04:48,030 --> 01:04:45,970
looked at to see if they how work they

1323
01:04:49,920 --> 01:04:48,040
could be accommodating the RM and they

1324
01:04:52,140 --> 01:04:49,930
should be pursued if additional funding

1325
01:04:54,630 --> 01:04:52,150
it could say additional funding or

1326
01:04:59,790 --> 01:04:54,640
cost-sharing is available they could be

1327
01:05:02,130 --> 01:04:59,800
um guess payloads that's fair I just I'm

1328
01:05:04,410 --> 01:05:02,140
a little confused why the AR m is like a

1329
01:05:06,390 --> 01:05:04,420
gentleman here said the litmus test it's

1330
01:05:09,480 --> 01:05:06,400
a study that was done in a couple months

1331
01:05:11,670 --> 01:05:09,490
and it seems like there's you know why

1332
01:05:13,530 --> 01:05:11,680
is this the gold standard well so so

1333
01:05:15,930 --> 01:05:13,540
rather than focusing on the specific

1334
01:05:17,970 --> 01:05:15,940
design of the current ARR m baseline

1335
01:05:20,520 --> 01:05:17,980
think about it a little bit higher level

1336
01:05:22,980 --> 01:05:20,530
the purpose of the mission is to

1337
01:05:24,480 --> 01:05:22,990
demonstrate whether we agree with the

1338
01:05:26,220 --> 01:05:24,490

purpose or not the purpose of the our

1339
01:05:29,130 --> 01:05:26,230
mission is to demonstrate that somebody

1340
01:05:30,540 --> 01:05:29,140
can collect a large quantity of asteroid

1341
01:05:32,040 --> 01:05:30,550
material and bring it back to the

1342
01:05:36,260 --> 01:05:32,050
vicinity of the earth in a controlled

1343
01:05:40,440 --> 01:05:36,270
way so some kinds of asteroid defense

1344
01:05:44,730 --> 01:05:40,450
demonstrations are compatible with that

1345
01:05:48,390 --> 01:05:44,740
and others like a kinetic impactor or I

1346
01:05:50,730 --> 01:05:48,400
think the solar collector our

1347
01:05:53,760 --> 01:05:50,740
potentially viable asteroid defense meth

1348
01:05:55,560 --> 01:05:53,770
or another loss or potentially useful

1349
01:05:58,430 --> 01:05:55,570
asteroid deflection mechanisms but

1350
01:06:00,840 --> 01:05:58,440
they're not things that would work as

1351
01:06:03,180 --> 01:06:00,850
means of bringing back and asked right

1352
01:06:04,380 --> 01:06:03,190
and again and so they disagree with us

1353
01:06:07,260 --> 01:06:04,390
maybe I can get this in the blood

1354
01:06:10,410 --> 01:06:07,270
because right now planetary defense is

1355
01:06:12,930 --> 01:06:10,420
not a primary objective of the asteroid

1356
01:06:16,380 --> 01:06:12,940
redirect robotic mission okay so

1357
01:06:19,440 --> 01:06:16,390
therefore this was included as again a

1358
01:06:21,180 --> 01:06:19,450
request for ideas to see how how maybe

1359
01:06:22,860 --> 01:06:21,190
that objective could change there's a

1360
01:06:25,110 --> 01:06:22,870
lot of discussion right now is whether

1361
01:06:27,090 --> 01:06:25,120
it should be a primary objective or it

1362
01:06:28,110 --> 01:06:27,100
should remain a secondary objective that

1363
01:06:30,630 --> 01:06:28,120

decision has now

1364
01:06:34,280 --> 01:06:30,640
been made so at this point you know

1365
01:06:39,120 --> 01:06:34,290
again the pond the RFI was particular

1366
01:06:42,360 --> 01:06:39,130
for the ARV so the AR RM mission it was

1367
01:06:45,450 --> 01:06:42,370
not specifically to the Grand Challenges

1368
01:06:47,550 --> 01:06:45,460
all right well like I spoke yesterday

1369
01:06:49,860 --> 01:06:47,560
you know the solar collector or 50

1370
01:06:51,810 --> 01:06:49,870
meters more than capable of pushing a

1371
01:06:54,240 --> 01:06:51,820
six-metre asteroid through a delta v of

1372
01:06:58,050 --> 01:06:54,250
a kilometer a second so absolute pushing

1373
01:07:00,360 --> 01:06:58,060
a you know a small asteroid into high

1374
01:07:03,750 --> 01:07:00,370
Earth orbit is is totally within the

1375
01:07:07,650 --> 01:07:03,760
solar collectors of capability so I

1376
01:07:09,630 --> 01:07:07,660
think you know it could be a retrieval

1377
01:07:11,730 --> 01:07:09,640
mission whether you know it's an add-on

1378
01:07:14,460 --> 01:07:11,740
to the existing one or if it's one by

1379
01:07:16,710 --> 01:07:14,470
itself you know is another yeah so so I

1380
01:07:18,540 --> 01:07:16,720
hear you absolutely and I know if this

1381
01:07:20,730 --> 01:07:18,550
is formulated differently and if we were

1382
01:07:22,440 --> 01:07:20,740
in the capture system or the I'm sorry

1383
01:07:24,300 --> 01:07:22,450
the redirect system which actually

1384
01:07:27,480 --> 01:07:24,310
happened on September 30th before we had

1385
01:07:30,300 --> 01:07:27,490
the break um if if someone was proposing

1386
01:07:33,390 --> 01:07:30,310
using a solar ablation technique for

1387
01:07:35,430 --> 01:07:33,400
redirecting that could be a viable

1388
01:07:37,860 --> 01:07:35,440

approach first there's issues with that

1389
01:07:39,360 --> 01:07:37,870
um well since the last element said that

1390
01:07:41,550 --> 01:07:39,370
he didn't think it was useful for

1391
01:07:43,350 --> 01:07:41,560
redirecting an asteroid into or but I

1392
01:07:45,600 --> 01:07:43,360
just wanted to emphasize that I get

1393
01:07:47,370 --> 01:07:45,610
would know a it definitely could be hey

1394
01:07:49,020 --> 01:07:47,380
we have to move on to ya stand real

1395
01:07:51,360 --> 01:07:49,030
quick piece I think as it stands it

1396
01:07:53,100 --> 01:07:51,370
addresses the last concern we heard okay

1397
01:07:56,790 --> 01:07:53,110
so let's move on we only have ten

1398
01:07:58,620 --> 01:07:56,800
minutes yep okay um I think this might

1399
01:08:00,720 --> 01:07:58,630
be easy but I just want to capture these

1400
01:08:02,400 --> 01:08:00,730
these nuggets and I can remove these

1401
01:08:05,160 --> 01:08:02,410
these are you know they're not

1402
01:08:06,900 --> 01:08:05,170
necessarily asked for but um I try to

1403
01:08:08,730 --> 01:08:06,910
capture couple suggestions or thoughts

1404
01:08:11,840 --> 01:08:08,740
that struck me that may have some

1405
01:08:13,980 --> 01:08:11,850
applicability Howard suggested

1406
01:08:14,910 --> 01:08:13,990
suggesting to auto point solar rays to

1407
01:08:18,090 --> 01:08:14,920
provide high-bandwidth communications

1408
01:08:19,590 --> 01:08:18,100
using the astro rate concept I don't

1409
01:08:23,550 --> 01:08:19,600
know that we can do anything like that

1410
01:08:25,380 --> 01:08:23,560
with with the mega flex but but that was

1411
01:08:27,420 --> 01:08:25,390
that was kind of a nugget that I thought

1412
01:08:30,450 --> 01:08:27,430
because we're depending on the mission

1413
01:08:33,210 --> 01:08:30,460

profile we you know high bandwidth calm

1414
01:08:35,910 --> 01:08:33,220
would be very helpful and and we may

1415
01:08:37,980 --> 01:08:35,920
have some pointing constraints that that

1416
01:08:40,470 --> 01:08:37,990
that's just an idea so again that's why

1417
01:08:42,780 --> 01:08:40,480
I call these nuggets

1418
01:08:45,570 --> 01:08:42,790
comment on that good how it's not here

1419
01:08:47,190 --> 01:08:45,580
so I guess we can go forward and ease up

1420
01:08:50,280 --> 01:08:47,200
the microphone but I had put down i'll

1421
01:08:51,450 --> 01:08:50,290
just read it and you can comment and he

1422
01:08:53,039 --> 01:08:51,460
mentioned the concept of having sep

1423
01:08:54,479 --> 01:08:53,049
thrusters on booms so that the some

1424
01:08:56,849 --> 01:08:54,489
thrust errs can be rotated to perform

1425
01:09:00,329 --> 01:08:56,859
the IBD demonstration more efficiently

1426
01:09:03,300 --> 01:09:00,339
could require more thrusters it's not

1427
01:09:05,999 --> 01:09:03,310
what i said that no no what I referred

1428
01:09:07,650 --> 01:09:06,009
to I'm just going to say what is that

1429
01:09:09,900 --> 01:09:07,660
what I was saying and then we'll have to

1430
01:09:11,640 --> 01:09:09,910
rephrase Oh guys up there what I was

1431
01:09:13,829 --> 01:09:11,650
saying is that the way we build our

1432
01:09:16,530 --> 01:09:13,839
spacecraft today language have electric

1433
01:09:18,809 --> 01:09:16,540
propulsion we have thrusters on two

1434
01:09:21,840 --> 01:09:18,819
sides of the spacecraft they're actually

1435
01:09:23,820 --> 01:09:21,850
mounted on arms not booms okay but

1436
01:09:26,579 --> 01:09:23,830
anyway so that arm is short okay boom is

1437
01:09:28,229 --> 01:09:26,589
long okay they're on arms now there is a

1438
01:09:30,720 --> 01:09:28,239

big difference there's no deployment of

1439
01:09:32,849 --> 01:09:30,730
the orange shirt culture so so they can

1440
01:09:35,460 --> 01:09:32,859
the two thrusters can be directed in the

1441
01:09:37,680 --> 01:09:35,470
same direction what we call aft on our

1442
01:09:40,950 --> 01:09:37,690
spacecraft right okay then we can rotate

1443
01:09:42,479 --> 01:09:40,960
them 90 degrees so that one can point in

1444
01:09:44,490 --> 01:09:42,489
the way the way we fly them actually one

1445
01:09:46,079 --> 01:09:44,500
point north and one point south because

1446
01:09:48,870 --> 01:09:46,089
we're doing north south station keeping

1447
01:09:50,910 --> 01:09:48,880
in geosynchronous orbit so we can the

1448
01:09:53,039 --> 01:09:50,920
way our spacecraft are built today we

1449
01:09:55,320 --> 01:09:53,049
can push in in both opposing directions

1450
01:09:58,890 --> 01:09:55,330
right so one of our spacecrafts the way

1451
01:10:02,010 --> 01:09:58,900
it's built today could be used to it has

1452
01:10:04,470 --> 01:10:02,020
the right geometry for the ion

1453
01:10:06,690 --> 01:10:04,480
propulsion to be used okay for the zone

1454
01:10:08,370 --> 01:10:06,700
beaming so the way we should rephrase

1455
01:10:14,190 --> 01:10:08,380
that is is that you can still like you

1456
01:10:16,470 --> 01:10:14,200
said you got arms so the the if you're

1457
01:10:20,010 --> 01:10:16,480
requiring more thrusters that if you

1458
01:10:21,690 --> 01:10:20,020
include that phrase there I'm not sure

1459
01:10:23,670 --> 01:10:21,700
that's the case because you will

1460
01:10:29,000 --> 01:10:23,680
probably have multiple electric

1461
01:10:31,890 --> 01:10:29,010
thrusters anyway right for your ARV okay

1462
01:10:33,960 --> 01:10:31,900
yeah that would be fine okay know what I

1463
01:10:35,580 --> 01:10:33,970

had envisioned is is the way we fly our

1464
01:10:37,890 --> 01:10:35,590
spacecraft today's we have two thrusters

1465
01:10:39,780 --> 01:10:37,900
and you probably would have to or some

1466
01:10:42,060 --> 01:10:39,790
higher number anyway yeah okay yeah

1467
01:10:45,210 --> 01:10:42,070
let's run it on three with with one

1468
01:10:47,430 --> 01:10:45,220
spare so it doesn't it doesn't hurt that

1469
01:10:48,870 --> 01:10:47,440
doesn't hurt okay okay so let me look at

1470
01:10:55,680 --> 01:10:48,880
it one last time because I think you

1471
01:11:01,629 --> 01:10:59,530
yeah that's that's okay okay um it is a

1472
01:11:03,250 --> 01:11:01,639
concept that's come up many times it

1473
01:11:05,740 --> 01:11:03,260
came up again separable spacecraft

1474
01:11:07,479 --> 01:11:05,750
concept provide operations near a larger

1475
01:11:12,160 --> 01:11:07,489
near-earth asteroid or I could just say

1476
01:11:14,379 --> 01:11:12,170
a large missing here is the notion of

1477
01:11:16,780 --> 01:11:14,389
having thrusters on arms is is already a

1478
01:11:18,580 --> 01:11:16,790
TRL maybe you put this in somewhere else

1479
01:11:20,439 --> 01:11:18,590
but it's TRL nine because we already do

1480
01:11:22,030 --> 01:11:20,449
it it's not it's not something new you

1481
01:11:28,680 --> 01:11:22,040
have to develop putting thrusters on

1482
01:11:31,390 --> 01:11:28,690
arms okay how the heritage heritage arms

1483
01:11:34,300 --> 01:11:31,400
how about I'll just put it current

1484
01:11:36,790 --> 01:11:34,310
currently TRL ninth apparently too long

1485
01:11:37,930 --> 01:11:36,800
okay okay and again I don't know that

1486
01:11:42,669 --> 01:11:37,940
going to read through these Nuggets but

1487
01:11:44,350 --> 01:11:42,679
I wanted to have them available the

1488
01:11:46,419 --> 01:11:44,360

possible you so again separable

1489
01:11:48,879 --> 01:11:46,429
spacecraft we've talked about that many

1490
01:11:51,220 --> 01:11:48,889
times it would be it could be desirable

1491
01:11:52,840 --> 01:11:51,230
particularly for the large one it could

1492
01:11:55,240 --> 01:11:52,850
be desirable for the small one too but

1493
01:11:58,149 --> 01:11:55,250
it's an additional cost that would have

1494
01:12:00,729 --> 01:11:58,159
to be looked at in complexity rendezvous

1495
01:12:03,850 --> 01:12:00,739
re rendezvous etc etc but I think that's

1496
01:12:06,129 --> 01:12:03,860
a nugget possible use of Earth Moon l4

1497
01:12:09,310 --> 01:12:06,139
l5 points as long-term storage locations

1498
01:12:11,320 --> 01:12:09,320
for use of a RV material a RB plus

1499
01:12:13,780 --> 01:12:11,330
material for future kinetic impact demo

1500
01:12:15,970 --> 01:12:13,790
or actual planetary defense I think Jeff

1501
01:12:17,800 --> 01:12:15,980
Landis was advocating that we would

1502
01:12:20,169 --> 01:12:17,810
actually keep it there and potentially

1503
01:12:25,930 --> 01:12:20,179
use it whether or not that's realize

1504
01:12:27,700 --> 01:12:25,940
realisable is is another thing Tim at

1505
01:12:30,700 --> 01:12:27,710
the suggestion of leaving mask close to

1506
01:12:34,209 --> 01:12:30,710
the NIA for the pick up a boulder called

1507
01:12:36,610 --> 01:12:34,219
it pub approach now because I think I

1508
01:12:44,169 --> 01:12:36,620
want a beer after that when we're done

1509
01:12:46,060 --> 01:12:44,179
with this but I think that has some

1510
01:12:48,610 --> 01:12:46,070
potentially interesting merit I don't

1511
01:12:50,800 --> 01:12:48,620
know you know keeping that mask close to

1512
01:12:54,340 --> 01:12:50,810
the body could be beneficial it adds

1513
01:12:55,720 --> 01:12:54,350

complexity it could it could reduce

1514
01:12:57,790 --> 01:12:55,730
operational risk by keeping the

1515
01:13:01,000 --> 01:12:57,800
spacecraft further away might introduce

1516
01:13:07,180 --> 01:13:01,010
other operational risks

1517
01:13:12,870 --> 01:13:07,190
you short tether / boom well no but we

1518
01:13:16,299 --> 01:13:12,880
definitely need a boom here ok and then

1519
01:13:19,270 --> 01:13:16,309
again I thought John brophy's comment

1520
01:13:22,240 --> 01:13:19,280
about via auntie Thomas suggestion to

1521
01:13:24,640 --> 01:13:22,250
use the IBD to slow down the spin of a

1522
01:13:35,140 --> 01:13:24,650
small sub 10 meter size near to improve

1523
01:13:36,879 --> 01:13:35,150
capture dynamics is okay I mean I was

1524
01:13:47,259 --> 01:13:36,889
just trying to give credit to to Andy

1525
01:13:51,700 --> 01:13:47,269
parenthetical vmi okay what did you say

1526
01:13:58,000 --> 01:13:51,710
Thomas how about circa / / Andy Thomas

1527
01:14:00,009 --> 01:13:58,010
okay there you go thank you cube SAP to

1528
01:14:01,330 --> 01:14:00,019
provide a low-cost transponder to test

1529
01:14:06,339 --> 01:14:01,340
tracking capability for future

1530
01:14:09,759 --> 01:14:06,349
monitoring of hazardous thank you it's

1531
01:14:11,229 --> 01:14:09,769
even read transponder to test tracking

1532
01:14:13,089 --> 01:14:11,239
capability for future monitoring of

1533
01:14:17,649 --> 01:14:13,099
hazardous Nia again I think that's a

1534
01:14:19,629 --> 01:14:17,659
good idea can we afford it you know the

1535
01:14:21,580 --> 01:14:19,639
the ISIS kinetic impactor could be a

1536
01:14:24,640 --> 01:14:21,590
very low cost approach for demonstration

1537
01:14:25,990 --> 01:14:24,650
on arm if it's you know if it's been

1538
01:14:29,049 --> 01:14:26,000

built already and we're flying another

1539
01:14:33,330 --> 01:14:29,059
one then it could be I think and Steve

1540
01:14:38,469 --> 01:14:33,340
said that and that's it we have anymore

1541
01:14:43,459 --> 01:14:41,120
Wow okay I didn't think we're going to

1542
01:14:45,410 --> 01:14:43,469
get there but um what do y'all think I

1543
01:14:47,149 --> 01:14:45,420
mean you know in general do you think

1544
01:14:50,029 --> 01:14:47,159
I've we've captured what's been

1545
01:14:51,919 --> 01:14:50,039
discussed here I know I know there were

1546
01:14:59,479 --> 01:14:51,929
dissenting opinions on some of the

1547
01:15:04,729 --> 01:14:59,489
subtopics but um okay with that thank

1548
01:15:06,500 --> 01:15:04,739
you I'll put that right back to the

1549
01:15:08,660 --> 01:15:06,510
whole group I appreciate everything that

1550
01:15:10,850 --> 01:15:08,670
you guys did and and Jonathan for

1551
01:15:14,089 --> 01:15:10,860
capturing this morning and I didn't

1552
01:15:17,330 --> 01:15:14,099
thank Pedro yesterday to the group and

1553
01:15:19,069 --> 01:15:17,340
Pedro for capturing the the online feed

1554
01:15:21,969 --> 01:15:19,079
and again thank you to everybody that

1555
01:15:26,060 --> 01:15:21,979
joined us in in the ether in the cloud

1556
01:15:28,339 --> 01:15:26,070
we appreciate it and thanks very much