



1
00:00:01,510 --> 00:00:03,530
>> Rob Navias: Welcome back
inside the International Space

2
00:00:03,530 --> 00:00:05,550
Station flight control room.

3
00:00:05,550 --> 00:00:07,380
We're joined by astronaut
Cady Coleman.

4
00:00:07,380 --> 00:00:10,810
Cady, as we've been talking
throughout the past few days,

5
00:00:10,810 --> 00:00:15,210
the Japanese cargo ship,
the HTV-4, the Kounotori 4,

6
00:00:15,210 --> 00:00:17,460
is on route to the
International Space Station

7
00:00:17,460 --> 00:00:19,470
after its launch
back on Saturday

8
00:00:19,470 --> 00:00:22,040
from the Tanegashima Space
Center in southern Japan.

9
00:00:22,040 --> 00:00:25,460
A series of rendezvous burns
has fine-tuned its path,

10
00:00:25,460 --> 00:00:28,910
and it's set up for an arrival
at the station on Friday.

11

00:00:28,910 --> 00:00:32,210
Now, Karen Nyberg and Chris
Cassidy are in charge of trying

12

00:00:32,210 --> 00:00:35,980
to haul that cargo ship
in and to make it a part

13

00:00:35,980 --> 00:00:39,040
of the International
Space Station for a month.

14

00:00:39,040 --> 00:00:41,540
You had the honor and the task

15

00:00:41,540 --> 00:00:46,730
of actually grappling the
HTV-2 back in January of 2011,

16

00:00:46,730 --> 00:00:48,130
about a month after you arrived

17

00:00:48,130 --> 00:00:49,620
on the International
Space Station.

18

00:00:49,620 --> 00:00:52,580
Tell us a little bit about the
techniques and the complexity

19

00:00:52,580 --> 00:00:54,590
of what they're going
to be experiencing

20

00:00:54,590 --> 00:00:57,770
out of the cupola
on Friday morning.

21

00:01:01,080 --> 00:01:02,820
>> Cady Coleman: So this

idea, Rob of having, you know,

22

00:01:02,820 --> 00:01:05,210
two things come close together
in space and then reaching

23

00:01:05,210 --> 00:01:07,170
out with a robotic arm
and grabbing one of them

24

00:01:07,170 --> 00:01:09,610
and attaching it, you
know, it's not new

25

00:01:09,610 --> 00:01:11,980
in that we've done it a lot
of times on the space shuttle.

26

00:01:11,980 --> 00:01:14,000
For example, the
Hubble Space Telescope,

27

00:01:14,000 --> 00:01:15,890
we would go rendezvous
with that.

28

00:01:15,890 --> 00:01:16,410
Reach out.

29

00:01:16,410 --> 00:01:18,600
Grab it. Spend some
time repairing it.

30

00:01:18,600 --> 00:01:23,130
But the big difference here
on a space station is that,

31

00:01:23,130 --> 00:01:25,400
basically, the space
station can't move away.

32

00:01:25,400 --> 00:01:27,570

If things go wrong and
you tip off the telescope

33

00:01:27,570 --> 00:01:29,800

and it starts tumbling or it
just doesn't look right to you,

34

00:01:29,800 --> 00:01:31,590

the commander of that
space shuttle can fly

35

00:01:31,590 --> 00:01:34,260

that space shuttle away, but the
space station is way too big.

36

00:01:34,260 --> 00:01:36,250

So it makes it a more
critical operation

37

00:01:36,250 --> 00:01:38,300

to get things just right.

38

00:01:38,300 --> 00:01:42,260

So as this supply ship
comes closer and closer,

39

00:01:42,260 --> 00:01:45,270

we always have the ability
to tell it to go away

40

00:01:45,270 --> 00:01:48,580

if we need to, but it's going to
arrive at a place that's about,

41

00:01:48,580 --> 00:01:52,500

you know, I don't know,
five, 15, 30 feet away

42

00:01:52,500 --> 00:01:55,430
from the station, 15 feet
from the robotic arm,

43

00:01:55,430 --> 00:01:57,140
and that's pretty close.

44

00:01:57,140 --> 00:01:59,390
So it's going to arrive there,
and the robotic arm is kind

45

00:01:59,390 --> 00:02:02,590
of perched -- ready just
to move in like this,

46

00:02:02,590 --> 00:02:04,740
and that's Karen's job.

47

00:02:04,740 --> 00:02:06,660
You'll actually hear Chris
talking on the radio,

48

00:02:06,660 --> 00:02:09,860
because the person who is M2,
or robotics operator number two,

49

00:02:09,860 --> 00:02:13,750
who's backing Karen up, he'll
probably do most of the talking.

50

00:02:13,750 --> 00:02:16,770
Where Karen is at the controls,
and she's looking at a target,

51

00:02:16,770 --> 00:02:19,140
and there's a target, there's
a camera on top of the arm.

52

00:02:19,140 --> 00:02:22,640

So one and then two, and
that camera is moving in,

53

00:02:22,640 --> 00:02:24,000
looking at a target.

54

00:02:24,000 --> 00:02:25,910
Where the real arm,
the part of the arm

55

00:02:25,910 --> 00:02:27,810
that would actually
grab this thing,

56

00:02:27,810 --> 00:02:29,410
is actually about this big.

57

00:02:29,410 --> 00:02:31,100
I mean it's giant.

58

00:02:31,100 --> 00:02:32,760
So both of those
things are moving,

59

00:02:32,760 --> 00:02:35,310
and at the same time she's
lining up perfectly, you know,

60

00:02:35,310 --> 00:02:38,700
and if when we say,
okay, ready, set, go,

61

00:02:38,700 --> 00:02:40,570
that's when we don't
want that spacecraft

62

00:02:40,570 --> 00:02:43,230
to decide it wants
to go here or there.

63

00:02:43,230 --> 00:02:46,310

So we turn off the capability
of it to go anywhere.

64

00:02:46,310 --> 00:02:48,460

So if it was already kind

65

00:02:48,460 --> 00:02:50,220

of on its way sailing
a little bit left --

66

00:02:50,220 --> 00:02:52,320

because while it was waiting
it was kind of holding itself

67

00:02:52,320 --> 00:02:55,060

in a little box, back
and forth, up and down.

68

00:02:55,060 --> 00:02:58,500

If it was on it's way sailing
when we say, no more jet firings

69

00:02:58,500 --> 00:03:01,330

for you, that means that
Karen has to follow it

70

00:03:01,330 --> 00:03:04,190

with the robotic arm, and
that's where it could be tricky,

71

00:03:04,190 --> 00:03:08,270

and it can be even trickier
if it's on its way, you know,

72

00:03:08,270 --> 00:03:10,490

with a little more
force and motion,

73

00:03:10,490 --> 00:03:11,690
and we always have
to be ready for that.

74

00:03:11,690 --> 00:03:14,040
So that's what they've
been doing lately,

75

00:03:14,040 --> 00:03:15,980
is just getting ready
to, you know,

76

00:03:15,980 --> 00:03:21,110
practicing following something
that is racing away from you.

77

00:03:21,110 --> 00:03:24,180
>> Rob Navias: Does the mass
of HTV-4, 16 tons of mass,

78

00:03:24,180 --> 00:03:27,120
does that make it
even more complicated?

79

00:03:27,120 --> 00:03:28,790
>> Cady Coleman: It does
make it more complicated

80

00:03:28,790 --> 00:03:31,810
because we basically don't
want to hurt the robotic arm.

81

00:03:31,810 --> 00:03:34,560
We're going to have supply
ships arriving again and again

82

00:03:34,560 --> 00:03:37,800
at the International Space
Station, and if it was racing

83

00:03:37,800 --> 00:03:40,850

to fast and you, you know,
caught it in such a way

84

00:03:40,850 --> 00:03:44,560

that you didn't, you know,
didn't just kind of go with it,

85

00:03:44,560 --> 00:03:47,500

then that can strain the
arm, put forces on the arm.

86

00:03:47,500 --> 00:03:50,810

So it really has to be a
very precise, very much lined

87

00:03:50,810 --> 00:03:56,440

up operation, and you know,
I was nervous doing it.

88

00:03:56,440 --> 00:03:58,810

I'll tell you I was
certainly nervous doing it,

89

00:03:58,810 --> 00:04:01,220

and at the same time that's
where your training comes back

90

00:04:01,220 --> 00:04:03,170

into play, where you've
practiced this over

91

00:04:03,170 --> 00:04:05,500

and over again, and knowing
that you've done your best

92

00:04:05,500 --> 00:04:07,420

to be ready, that's when
you can put all that stuff

93

00:04:07,420 --> 00:04:09,330
out the window and
just kind of focus

94
00:04:09,330 --> 00:04:12,310
on doing what you've
done many times before.

95
00:04:12,310 --> 00:04:15,400
I'd say what's significant
is that in the training,

96
00:04:15,400 --> 00:04:19,220
in the sort of cartoon virtual
reality world that we train in,

97
00:04:19,220 --> 00:04:20,920
nothing looks that big.

98
00:04:20,920 --> 00:04:24,380
I mean, this thing is huge, and
it's right next to the window

99
00:04:24,380 --> 00:04:26,770
of the space station, and
it's pretty cool looking

100
00:04:26,770 --> 00:04:28,820
down at the Earth
as it gets bigger.

101
00:04:28,820 --> 00:04:31,420
You know, throughout
the day on their Friday,

102
00:04:31,420 --> 00:04:33,960
our Thursday night, that thing
is going to look like a tiny,

103
00:04:33,960 --> 00:04:36,250

little speck on the horizon,
and then it's just going

104
00:04:36,250 --> 00:04:38,860
to get bigger and
bigger and bigger,

105
00:04:38,860 --> 00:04:40,870
and by the time it
arrives and you're going

106
00:04:40,870 --> 00:04:43,430
to catch it, it is huge.

107
00:04:43,430 --> 00:04:44,490
>> Rob Navias: So they're
going to be operating

108
00:04:44,490 --> 00:04:46,510
out of the cupola, which
of course is the station's

109
00:04:46,510 --> 00:04:48,490
wonderful window on the world,

110
00:04:48,490 --> 00:04:50,620
but in reality it's
pretty cramped quarters.

111
00:04:50,620 --> 00:04:52,640
So you have Karen and
Chris side-by-side.

112
00:04:52,640 --> 00:04:56,860
Luca's right there monitoring
the spacecraft systems,

113
00:04:56,860 --> 00:04:59,900
making sure that it's doing
what it's supposed to do.

114

00:04:59,900 --> 00:05:06,040

How much of a kludge
is that for the crew?

115

00:05:06,040 --> 00:05:07,150

>> Cady Coleman:
It is challenging

116

00:05:07,150 --> 00:05:08,720

because it is physically close.

117

00:05:08,720 --> 00:05:12,310

There's really not any more room
than you and I sitting here,

118

00:05:12,310 --> 00:05:15,370

and yet they've actually
practiced just that.

119

00:05:15,370 --> 00:05:20,180

I mean, just yesterday morning
they practiced using the robotic

120

00:05:20,180 --> 00:05:21,890

arm and figuring out who
is going to be where,

121

00:05:21,890 --> 00:05:23,360

and when somebody needs
to reach that button,

122

00:05:23,360 --> 00:05:25,370

do they knock Karen
out of the way.

123

00:05:25,370 --> 00:05:27,860

You know, they will have figured
out their own way to sort of use

124

00:05:27,860 --> 00:05:31,150

that space and their own
communication together too,

125

00:05:31,150 --> 00:05:34,160

of saying, you know, wait, as
the arm is approaching we need

126

00:05:34,160 --> 00:05:37,130

to make sure that the spacecraft
is in a certain state.

127

00:05:37,130 --> 00:05:40,460

So, you know, Chris Cassidy
will be looking at that

128

00:05:40,460 --> 00:05:43,830

and telling Karen, you know, if
the spacecraft is free drift,

129

00:05:43,830 --> 00:05:44,890

you are go to proceed.

130

00:05:44,890 --> 00:05:47,970

So there's a lot of precise
communication back and forth,

131

00:05:47,970 --> 00:05:49,160

and you know, we're NASA.

132

00:05:49,160 --> 00:05:51,130

We practice that stuff,
and we practice what

133

00:05:51,130 --> 00:05:53,080

if this happens,
what if this happens?

134

00:05:53,080 --> 00:05:56,500

There'll be one more
significant practice session

135
00:05:56,500 --> 00:06:01,470
on basically their Thursday
morning, to just reinforce --

136
00:06:01,470 --> 00:06:03,710
you know, we have all
these what if situations.

137
00:06:03,710 --> 00:06:06,810
What if suddenly this spacecraft
shows that it's got some systems

138
00:06:06,810 --> 00:06:10,460
that are not ready and it
would be better to send it away

139
00:06:10,460 --> 00:06:13,840
and wait until we can understand
the state of the spacecraft?

140
00:06:13,840 --> 00:06:16,330
There's two things
that Chris can do.

141
00:06:16,330 --> 00:06:18,050
He can push a button
that says retreat,

142
00:06:18,050 --> 00:06:20,450
which means it goes back to
the last place it waited,

143
00:06:20,450 --> 00:06:22,400
which is about 100 feet away.

144
00:06:22,400 --> 00:06:25,010
Or he can push a

button that says abort,

145

00:06:25,010 --> 00:06:26,420

which actually sends
it, you know,

146

00:06:26,420 --> 00:06:29,130

to a very far away
waiting place.

147

00:06:29,130 --> 00:06:32,040

So -- excuse me --
they've got some options.

148

00:06:32,040 --> 00:06:34,480

We really talked through
and practiced those options,

149

00:06:34,480 --> 00:06:38,130

and also then, on top of that,

150

00:06:38,130 --> 00:06:39,980

you want to capture
these moments,

151

00:06:39,980 --> 00:06:43,640

both for an engineering reason
-- what if something goes wrong?

152

00:06:43,640 --> 00:06:44,500

You want to understand.

153

00:06:44,500 --> 00:06:46,230

You want the ground
to understand.

154

00:06:46,230 --> 00:06:49,610

What do we need to different
on the next supply ship?

155

00:06:49,610 --> 00:06:51,370

Also, you just want
to capture the fact

156

00:06:51,370 --> 00:06:56,200

that this is a significant thing
that real people are doing.

157

00:06:56,200 --> 00:06:58,180

>> Rob Navias: Then
once it's captured,

158

00:06:58,180 --> 00:07:02,100

the crew takes a quick
break, catch its breath,

159

00:07:02,100 --> 00:07:04,980

and then they go through this
finely choreographed procedure

160

00:07:04,980 --> 00:07:08,290

to maneuver it into place so
it can slowly, but surely,

161

00:07:08,290 --> 00:07:12,130

be mated to the Earth facing
port of the Harmony module.

162

00:07:12,130 --> 00:07:13,490

So how complex is that?

163

00:07:13,490 --> 00:07:15,370

How precise a maneuver is that,

164

00:07:15,370 --> 00:07:17,880

because in part it's
also ground assisted here

165

00:07:17,880 --> 00:07:21,380

by the robotics officer
in Mission Control?

166

00:07:21,380 --> 00:07:23,900

>> Cady Coleman: That's correct,
and you know, we're always torn

167

00:07:23,900 --> 00:07:26,680

in terms of who gets to do
the work on the space station.

168

00:07:26,680 --> 00:07:29,150

Ideally, as a crew
member, as an astronaut,

169

00:07:29,150 --> 00:07:31,770

we want to do all
the robotic arm stuff

170

00:07:31,770 --> 00:07:33,560

because we love to fly things.

171

00:07:33,560 --> 00:07:36,780

We like to do things, but
it's actually more efficient

172

00:07:36,780 --> 00:07:40,030

for the controllers down here
to make some of those moves.

173

00:07:40,030 --> 00:07:42,830

Where they take it from out
here where you captured it

174

00:07:42,830 --> 00:07:44,860

to then a position
that is all lined up,

175

00:07:44,860 --> 00:07:48,050

but about six feet away from

being mated to the station.

176

00:07:48,050 --> 00:07:51,060

So it's more efficient
for the ground

177

00:07:51,060 --> 00:07:52,600

to go ahead and make
those moves.

178

00:07:52,600 --> 00:07:53,850

So they probably will
make those moves,

179

00:07:53,850 --> 00:07:55,450

but whether the crew makes them

180

00:07:55,450 --> 00:07:59,330

or whether the ground
makes them, no matter what,

181

00:07:59,330 --> 00:08:01,650

there's math involved, and
those things have been figured

182

00:08:01,650 --> 00:08:05,960

out ahead of time, and it's
a precise set of coordinates.

183

00:08:05,960 --> 00:08:09,710

But then when you really are
going to put metal to metal,

184

00:08:09,710 --> 00:08:12,440

and you know, the HTV has
like these kind of, you know,

185

00:08:12,440 --> 00:08:15,890

little cutouts like this, and
then the space station has ones

186

00:08:15,890 --> 00:08:18,170
like this, and so those
things are going to touch,

187

00:08:18,170 --> 00:08:21,420
and they really have to
exactly kind of mesh together.

188

00:08:21,420 --> 00:08:23,410
That's where the
ground can do that.

189

00:08:23,410 --> 00:08:25,440
I mean, we're getting so
the ground could do that,

190

00:08:25,440 --> 00:08:26,370
where they bring it in

191

00:08:26,370 --> 00:08:29,110
and we see little indications
doing well, doing well.

192

00:08:29,110 --> 00:08:31,350
We can actually feel
with the robotic arm.

193

00:08:31,350 --> 00:08:34,020
It's got sensors that say,
hey, I'm being tugged this way.

194

00:08:34,020 --> 00:08:35,080
I'm being tugged this way.

195

00:08:35,080 --> 00:08:38,890
So as we do that we actually see
how much strain is on the arm.

196

00:08:38,890 --> 00:08:42,480

So we can make sure that even
if we think our math is correct,

197

00:08:42,480 --> 00:08:43,930

what if something's wrong?

198

00:08:43,930 --> 00:08:46,170

You know, are the mechanical
parts really meshing together

199

00:08:46,170 --> 00:08:49,210

without putting strain on the
space station, because we need

200

00:08:49,210 --> 00:08:51,590

that port again, and we need
to be able to undock safely

201

00:08:51,590 --> 00:08:55,340

and send our supply ship,
now a trash ship, away,

202

00:08:55,340 --> 00:08:57,490

and we need to make sure our
robotic arm isn't getting

203

00:08:57,490 --> 00:08:59,460

strain either.

204

00:08:59,460 --> 00:09:01,360

>> Rob Navias: So once in place,

205

00:09:01,360 --> 00:09:03,730

ready-to-latch indications
are seen by the crew,

206

00:09:03,730 --> 00:09:06,230

and then it's a matter
of bolting it in place

207

00:09:06,230 --> 00:09:09,310

in a two-stage fashion, and then
it's part of the space station

208

00:09:09,310 --> 00:09:14,290

for the next month so its
valuable cargo can be unloaded.

209

00:09:14,290 --> 00:09:17,440

Cady Coleman, 180 days in
space, on three flights,

210

00:09:17,440 --> 00:09:20,800

159 days in space as
part of expedition 26,

211

00:09:20,800 --> 00:09:25,440

27 and who captured HTV-2
about 2 1/2 years ago.

212

00:09:25,440 --> 00:09:28,660

Thanks for joining us today with
the insight, and just a note,

213

00:09:28,660 --> 00:09:31,150

our programming on Friday
morning, in two parts,

214

00:09:31,150 --> 00:09:36,390

will be on the air at 5 AM
Central Time, 6 AM Eastern Time

215

00:09:36,390 --> 00:09:39,570

for rendezvous and
grapple of the HTV-4,

216

00:09:39,570 --> 00:09:44,180

with the actual capture expected
just before 6:30 AM Central Time

217

00:09:44,180 --> 00:09:45,170
on Friday morning.

218

00:09:45,170 --> 00:09:47,700
We'll take a break, and then
we'll return for live coverage

219

00:09:47,700 --> 00:09:49,380
of its installation beginning

220

00:09:49,380 --> 00:09:52,300
at 8 AM Central Time,
9:00 Eastern time.

221

00:09:52,300 --> 00:09:54,350
All of that on Friday morning.

222

00:09:54,350 --> 00:09:55,040
Thanks very much, Cady.

223

00:09:55,040 --> 00:09:55,350
>> Cady Coleman: You're welcome.