



1
00:00:07,409 --> 00:00:05,760
the 16th edition of NASA's extreme

2
00:00:09,330 --> 00:00:07,419
environment mission operations mission

3
00:00:11,190 --> 00:00:09,340
is going on down off the coast of Key

4
00:00:13,770 --> 00:00:11,200
Largo Florida as we speak at last about

5
00:00:15,600 --> 00:00:13,780
two weeks the Aquarius undersea

6
00:00:17,790 --> 00:00:15,610
laboratory is the site of that mission

7
00:00:20,340 --> 00:00:17,800
we have an entire NASA and international

8
00:00:21,410 --> 00:00:20,350
partner crew living and working down

9
00:00:24,180 --> 00:00:21,420
there for the two week time period

10
00:00:26,130 --> 00:00:24,190
practicing what it's like to live and

11
00:00:28,110 --> 00:00:26,140
work out into the deepest reaches of

12
00:00:31,320 --> 00:00:28,120
space including asteroids in one day on

13
00:00:33,180 --> 00:00:31,330

to Mars we are joined now by one of the

14

00:00:35,009 --> 00:00:33,190

top side crew members astronaut Stan

15

00:00:36,720 --> 00:00:35,019

love a friend to all of us there that is

16

00:00:38,520 --> 00:00:36,730

part of the Nemo mission he is working

17

00:00:40,829 --> 00:00:38,530

with the rest of the crew helping the

18

00:00:43,290 --> 00:00:40,839

astronauts and our international partner

19

00:00:44,790 --> 00:00:43,300

astronauts down below so Stan welcome

20

00:00:47,700 --> 00:00:44,800

let us know how things are going down

21

00:00:50,639 --> 00:00:47,710

there at an emo 16 things are growing

22

00:00:53,069 --> 00:00:50,649

great down here at Nemo 16 we've been

23

00:00:55,169 --> 00:00:53,079

down here for about a week now getting

24

00:00:57,149 --> 00:00:55,179

everything ready to send the crew under

25

00:00:59,790 --> 00:00:57,159

the sea for their mission and yesterday

26

00:01:01,500 --> 00:00:59,800

their mission began with the space

27

00:01:03,119 --> 00:01:01,510

flight that would start at crew quarters

28

00:01:04,380 --> 00:01:03,129

and the crew would get into a van and

29

00:01:06,960 --> 00:01:04,390

drive out to the launch pad and launch

30

00:01:10,650 --> 00:01:06,970

into space here it was something pretty

31

00:01:13,710 --> 00:01:10,660

similar the crew left their dormitory

32

00:01:15,750 --> 00:01:13,720

room got onto a boat and drove out to

33

00:01:18,210 --> 00:01:15,760

the habitat which is about five miles

34

00:01:22,050 --> 00:01:18,220

offshore here from Key Largo Florida in

35

00:01:24,180 --> 00:01:22,060

about 60 feet of water and they splashed

36

00:01:26,130 --> 00:01:24,190

down now in the Apollo program

37

00:01:27,900 --> 00:01:26,140

splashdown meant the capsule came down

38

00:01:29,730 --> 00:01:27,910

and landed in the water you're an emo

39
00:01:31,650 --> 00:01:29,740
splashdown means the crew puts on scuba

40
00:01:34,980 --> 00:01:31,660
gear swims down 60 feet into the habitat

41
00:01:38,640 --> 00:01:34,990
climbs inside the air pressure inside

42
00:01:40,020 --> 00:01:38,650
that habitat is high high enough to

43
00:01:42,570 --> 00:01:40,030
counteract the pressure of the water

44
00:01:45,120 --> 00:01:42,580
outside so there's just a hole in the

45
00:01:46,350 --> 00:01:45,130
floor of a habitat with water and they

46
00:01:48,540 --> 00:01:46,360
come up through that hole and they're in

47
00:01:50,430 --> 00:01:48,550
the dry air of the habitat and they're

48
00:01:53,490 --> 00:01:50,440
going to live and work there for 12 days

49
00:01:55,320 --> 00:01:53,500
before they return to the surface stay

50
00:01:59,250 --> 00:01:55,330
and talk about training in the water now

51
00:02:00,390 --> 00:01:59,260
you get a spacewalk back on sts-1 22 and

52
00:02:01,860 --> 00:02:00,400
obviously you know anytime we do

53
00:02:03,660 --> 00:02:01,870
spacewalks we practice in the water here

54
00:02:05,460 --> 00:02:03,670
in Houston you know the water I think

55
00:02:07,320 --> 00:02:05,470
sort of is the closest thing we have

56
00:02:09,330 --> 00:02:07,330
here on earth to the environments of

57
00:02:10,589 --> 00:02:09,340
space so talk a little bit about what

58
00:02:12,660 --> 00:02:10,599
it's like to train what are the benefits

59
00:02:16,770 --> 00:02:12,670
of it in what are you know how are they

60
00:02:19,140 --> 00:02:16,780
not similar well the water as you say is

61
00:02:22,770 --> 00:02:19,150
the best simulator we have for doing a

62
00:02:25,290 --> 00:02:22,780
space walk in in weightlessness if you

63
00:02:27,270 --> 00:02:25,300

put on your suit get underwater you can

64

00:02:29,550 --> 00:02:27,280

hang weights on the suit so that you are

65

00:02:31,140 --> 00:02:29,560

neutrally buoyant which means that if

66

00:02:32,880 --> 00:02:31,150

you let go of anything you didn't you

67

00:02:34,920 --> 00:02:32,890

neither float toward the surface nor

68

00:02:36,479 --> 00:02:34,930

sink toward the bottom and if you're

69

00:02:38,490 --> 00:02:36,489

very good with the way outs as they are

70

00:02:43,080 --> 00:02:38,500

in our neutral buoyancy laboratory they

71

00:02:44,910 --> 00:02:43,090

can even make you neutrally or neutral

72

00:02:46,590 --> 00:02:44,920

in position which means that you can put

73

00:02:48,300 --> 00:02:46,600

your body into any orientation and

74

00:02:50,820 --> 00:02:48,310

you'll stay there rather than

75

00:02:52,740 --> 00:02:50,830

immediately writing up with your head up

76

00:02:55,380 --> 00:02:52,750

and your feet down and that's a great

77

00:02:57,720 --> 00:02:55,390

analog for space and that's what they're

78

00:02:59,789 --> 00:02:57,730

doing here at aquarius instead of the

79

00:03:02,490 --> 00:02:59,799

neutral buoyancy lab pool which is big

80

00:03:06,240 --> 00:03:02,500

it's not as big as the ocean so they're

81

00:03:08,130 --> 00:03:06,250

in the big pool we don't have fish in

82

00:03:11,280 --> 00:03:08,140

the NBL so it's kind of fun to watch the

83

00:03:12,870 --> 00:03:11,290

spacewalks going on underwater here at

84

00:03:14,580 --> 00:03:12,880

Key Largo and see the fish swimming by

85

00:03:15,690 --> 00:03:14,590

the camera when you used to seeing

86

00:03:19,319 --> 00:03:15,700

something similar in the neutral

87

00:03:22,560 --> 00:03:19,329

buoyancy lab but without the fish the

88

00:03:24,390 --> 00:03:22,570

similarities are too many to list it

89

00:03:25,650 --> 00:03:24,400

really is very very good training and

90

00:03:27,390 --> 00:03:25,660

without that kind of training i don't

91

00:03:30,120 --> 00:03:27,400

think we would be able to do much in

92

00:03:33,000 --> 00:03:30,130

space because the weightless environment

93

00:03:34,770 --> 00:03:33,010

and the constrictions of the suit make

94

00:03:36,330 --> 00:03:34,780

it very hard to do anything and sending

95

00:03:41,069 --> 00:03:36,340

an unprepared person up there I think

96

00:03:42,900 --> 00:03:41,079

would be dooming them to failure there

97

00:03:45,330 --> 00:03:42,910

are a couple of things that aren't the

98

00:03:48,449 --> 00:03:45,340

same when you come out of the airlock in

99

00:03:50,819 --> 00:03:48,459

Aquarius you have a steel grid deck

100

00:03:53,400 --> 00:03:50,829

about three feet below your below you

101
00:03:54,990 --> 00:03:53,410
and you swim out into you know blue

102
00:03:57,270 --> 00:03:55,000
water with the coral reef below you and

103
00:03:59,580 --> 00:03:57,280
fish swimming by in the neutral buoyancy

104
00:04:03,059 --> 00:03:59,590
laboratory you come out of the mock-up

105
00:04:05,400 --> 00:04:03,069
airlock hatch and you are looking at a

106
00:04:07,440 --> 00:04:05,410
cement pool floor about eight feet below

107
00:04:08,729 --> 00:04:07,450
you you come out of the real airlock in

108
00:04:12,000 --> 00:04:08,739
the space station you've got the earth

109
00:04:13,520 --> 00:04:12,010
going by 220 miles below 17,000 miles

110
00:04:16,590 --> 00:04:13,530
per hour so that's pretty different

111
00:04:18,449 --> 00:04:16,600
another thing is that no matter how well

112
00:04:20,490 --> 00:04:18,459
they weigh you out in the neutral

113
00:04:22,469 --> 00:04:20,500

buoyancy laboratory your body does tend

114

00:04:24,300 --> 00:04:22,479

to have a preferred orientation and

115

00:04:26,070 --> 00:04:24,310

usually that's with your head a little

116

00:04:29,040 --> 00:04:26,080

bit up and your feet a little bit down

117

00:04:32,249 --> 00:04:29,050

and if you do nothing you'll sort of end

118

00:04:33,570 --> 00:04:32,259

up in that position in space that is not

119

00:04:35,790 --> 00:04:33,580

true you don't have a preferred

120

00:04:38,640 --> 00:04:35,800

orientation and the tiniest touch of

121

00:04:40,709 --> 00:04:38,650

anything touch a handrail anything on

122

00:04:42,570 --> 00:04:40,719

the space station will not only move

123

00:04:45,929 --> 00:04:42,580

your body but it will start your body

124

00:04:49,170 --> 00:04:45,939

rotating and that is something that we

125

00:04:50,550 --> 00:04:49,180

cannot exactly simulate in the NBL and

126
00:04:52,860 --> 00:04:50,560
something that all first-time

127
00:04:54,510 --> 00:04:52,870
spacewalkers have to contend with and I

128
00:04:56,339 --> 00:04:54,520
certainly spent quite a lot of time and

129
00:04:58,830 --> 00:04:56,349
energy contending with it on my first

130
00:05:00,719 --> 00:04:58,840
base law so let's talk about each of the

131
00:05:02,219 --> 00:05:00,729
crew members tell us kind of what

132
00:05:03,809 --> 00:05:02,229
they're each doing down there and you

133
00:05:05,550 --> 00:05:03,819
know did they keep a normal schedule

134
00:05:08,879 --> 00:05:05,560
down there or is it something that sort

135
00:05:11,399 --> 00:05:08,889
of mimics what a mission would be they

136
00:05:12,959 --> 00:05:11,409
are keeping a mission timeline just like

137
00:05:14,700 --> 00:05:12,969
we would for a spaceflight in fact it's

138
00:05:17,249 --> 00:05:14,710

very much like a space shuttle flight in

139

00:05:19,439 --> 00:05:17,259

terms of the duration of the mission the

140

00:05:22,409 --> 00:05:19,449

difference is they are doing a lot more

141

00:05:24,990 --> 00:05:22,419

EV a every crew member is going outside

142

00:05:26,760 --> 00:05:25,000

at least once a day they always go out

143

00:05:29,550 --> 00:05:26,770

in pairs in case one runs into a problem

144

00:05:31,680 --> 00:05:29,560

their partner can help them out so we

145

00:05:33,269 --> 00:05:31,690

have a pair of space walkers going out

146

00:05:34,950 --> 00:05:33,279

in the morning then they come back in

147

00:05:36,600 --> 00:05:34,960

for lunch and then the other two people

148

00:05:39,869 --> 00:05:36,610

who are inside in the morning go out for

149

00:05:41,820 --> 00:05:39,879

a spacewalk in the afternoon on a

150

00:05:44,159 --> 00:05:41,830

shuttle flight you will have at most one

151
00:05:47,219 --> 00:05:44,169
spacewalk per day again we go out in

152
00:05:50,189 --> 00:05:47,229
pairs and we do add most five total

153
00:05:51,990 --> 00:05:50,199
spacewalks on an entire 12 or 13 de

154
00:05:54,240 --> 00:05:52,000
mission so these guys are going to be

155
00:05:56,100 --> 00:05:54,250
doing I don't know 16 EVs I guess they

156
00:05:58,350 --> 00:05:56,110
have eight days of e VA and 2e VA's per

157
00:05:59,820 --> 00:05:58,360
day now that's easy in Aquarius because

158
00:06:01,740 --> 00:05:59,830
again all you do is put on your dive

159
00:06:03,779 --> 00:06:01,750
suit which only takes a few minutes and

160
00:06:06,600 --> 00:06:03,789
you drop down into that what they call

161
00:06:08,040 --> 00:06:06,610
the wet porch that hole in the floor

162
00:06:09,719 --> 00:06:08,050
where it's just the ocean water there

163
00:06:12,209 --> 00:06:09,729

and then they swim out in there and

164

00:06:14,640 --> 00:06:12,219

they're working whereas for a space

165

00:06:16,350 --> 00:06:14,650

shuttle EV a it takes much longer to put

166

00:06:17,579 --> 00:06:16,360

on the spacesuit you need help to do it

167

00:06:20,219 --> 00:06:17,589

because it's very big and bulky

168

00:06:21,959 --> 00:06:20,229

difficult to get into there are there's

169

00:06:23,249 --> 00:06:21,969

a couple hours worth of system checks

170

00:06:24,809 --> 00:06:23,259

that you have to do to make sure that

171

00:06:27,899 --> 00:06:24,819

the suit is working right every time you

172

00:06:30,089 --> 00:06:27,909

go outside before you go and also the

173

00:06:33,540 --> 00:06:30,099

crew for a real space lock has to

174

00:06:35,010 --> 00:06:33,550

pre-breathe oxygen for a while before

175

00:06:36,439 --> 00:06:35,020

they get in the suit because when you

176

00:06:39,140 --> 00:06:36,449

get outside in that sea

177

00:06:41,529 --> 00:06:39,150

the air pressure in the suit is only

178

00:06:44,330 --> 00:06:41,539

about a third of the pressure in the

179

00:06:46,159 --> 00:06:44,340

room you're sitting in right now and if

180

00:06:47,689 --> 00:06:46,169

you go from normal pressure to one-third

181

00:06:51,200 --> 00:06:47,699

pressure really quickly you get the

182

00:06:54,290 --> 00:06:51,210

bends which is a risk that divers face

183

00:06:56,629 --> 00:06:54,300

and it's a risk that the habitat crew is

184

00:06:58,549 --> 00:06:56,639

getting around because the air pressure

185

00:07:00,019 --> 00:06:58,559

they're breathing in the habitat is just

186

00:07:01,429 --> 00:07:00,029

the same as the water pressure outside

187

00:07:05,779 --> 00:07:01,439

so they never have to worry about

188

00:07:07,640 --> 00:07:05,789

getting bent now there's a price they

189

00:07:08,959 --> 00:07:07,650

pay for that you get a lot of efficiency

190

00:07:10,129 --> 00:07:08,969

you can just go into the habitat come

191

00:07:12,140 --> 00:07:10,139

out of the habitat you don't have to

192

00:07:14,390 --> 00:07:12,150

worry about the bends at all but right

193

00:07:16,010 --> 00:07:14,400

now that crew has been down there for 24

194

00:07:17,860 --> 00:07:16,020

hours and their tissue their their

195

00:07:20,659 --> 00:07:17,870

bodies are saturated with nitrogen gas

196

00:07:24,439 --> 00:07:20,669

so if one of them went to the surface

197

00:07:26,149 --> 00:07:24,449

they would certainly get nitrogen gas

198

00:07:28,730 --> 00:07:26,159

bubbles coming out of solution in their

199

00:07:31,519 --> 00:07:28,740

bodies that can cause incredible pain in

200

00:07:32,929 --> 00:07:31,529

the joints it can give you gas bubbles

201
00:07:34,999 --> 00:07:32,939
in your bloodstream which you don't want

202
00:07:36,290 --> 00:07:35,009
it can cause problems in the lung it can

203
00:07:39,550 --> 00:07:36,300
cause problems in the nervous system

204
00:07:42,709 --> 00:07:39,560
very bad news so their motto here

205
00:07:44,480 --> 00:07:42,719
Aquarius is the surface is not an option

206
00:07:46,399 --> 00:07:44,490
much like at Johnson Space Center we

207
00:07:49,279 --> 00:07:46,409
have failure is not an option for the

208
00:07:51,439 --> 00:07:49,289
Mission Control teams so Stan talk about

209
00:07:52,519 --> 00:07:51,449
what you guys are doing up on topside I

210
00:07:54,079 --> 00:07:52,529
mean there's an entire team of people

211
00:07:56,119 --> 00:07:54,089
there you know supporting the crew

212
00:07:57,709 --> 00:07:56,129
that's down below so what do you guys do

213
00:07:58,879 --> 00:07:57,719

in each day and you know what are you

214

00:08:02,089 --> 00:07:58,889

sort of serving it sort of a pseudo

215

00:08:04,159 --> 00:08:02,099

Mission Control team or what is it we

216

00:08:06,110 --> 00:08:04,169

have actually a mobile Mission Control

217

00:08:08,059 --> 00:08:06,120

Center which is a converted semi-trailer

218

00:08:10,459 --> 00:08:08,069

and we can take it anywhere on the

219

00:08:12,589 --> 00:08:10,469

continent the last time I saw it in

220

00:08:15,639 --> 00:08:12,599

action it was a pavilion Lake British

221

00:08:17,600 --> 00:08:15,649

Columbia about 4,500 miles from here

222

00:08:19,839 --> 00:08:17,610

almost as far as you can get from

223

00:08:24,679 --> 00:08:19,849

Florida and still be in North America

224

00:08:27,379 --> 00:08:24,689

and that trailer is set up exactly Lanka

225

00:08:29,449 --> 00:08:27,389

Mission Control there are consoles for

226

00:08:31,159 --> 00:08:29,459

different operators each of whom is in

227

00:08:32,360 --> 00:08:31,169

charge of a different system you will

228

00:08:34,370 --> 00:08:32,370

have someone acting as a flight director

229

00:08:36,350 --> 00:08:34,380

you'll have a Capcom you'll have a

230

00:08:38,240 --> 00:08:36,360

medical officer and then experts for all

231

00:08:40,069 --> 00:08:38,250

the systems and it is precisely like a

232

00:08:42,469 --> 00:08:40,079

mission control center now it's not as

233

00:08:43,819 --> 00:08:42,479

big it doesn't have as many different

234

00:08:46,280 --> 00:08:43,829

flight controllers in it as a real

235

00:08:47,960 --> 00:08:46,290

control center and of course it's less

236

00:08:48,260 --> 00:08:47,970

complicated the real control center is

237

00:08:51,950 --> 00:08:48,270

Matt

238

00:08:54,140 --> 00:08:51,960

massively complicated but we have a real

239

00:08:55,670 --> 00:08:54,150

mission running here and we're treating

240

00:08:58,760 --> 00:08:55,680

it as such with a real mission control

241

00:09:01,940 --> 00:08:58,770

now that Mission Control runs about 14

242

00:09:03,710 --> 00:09:01,950

to 15 hours a day a lot of the folks in

243

00:09:05,390 --> 00:09:03,720

there are doing that as a single shift

244

00:09:06,800 --> 00:09:05,400

whereas in the real Mission Control we

245

00:09:08,180 --> 00:09:06,810

try to hand over shifts every eight

246

00:09:11,480 --> 00:09:08,190

hours to keep people from getting too

247

00:09:13,280 --> 00:09:11,490

tired then we also have a lot of people

248

00:09:16,190 --> 00:09:13,290

here who are not working in Mission

249

00:09:18,710 --> 00:09:16,200

Control but working other things today

250

00:09:21,490 --> 00:09:18,720

we have two little submarine

251
00:09:25,370 --> 00:09:21,500
submersibles that are going to be doing

252
00:09:27,350 --> 00:09:25,380
marine science for the next four days

253
00:09:28,550 --> 00:09:27,360
and the next four days after that

254
00:09:30,350 --> 00:09:28,560
they're going to be working with us on

255
00:09:31,940 --> 00:09:30,360
the asteroid exploration simulation as

256
00:09:33,800 --> 00:09:31,950
if they were little tiny spacecraft we

257
00:09:36,770 --> 00:09:33,810
had to work alongside our suited

258
00:09:38,860 --> 00:09:36,780
astronauts outside but they're doing

259
00:09:42,460 --> 00:09:38,870
reef science so we've got a bunch of

260
00:09:44,690 --> 00:09:42,470
marine biologists with us we also have a

261
00:09:46,190 --> 00:09:44,700
bunch of folks who are making sure that

262
00:09:47,630 --> 00:09:46,200
the systems and the Mission Control are

263
00:09:50,240 --> 00:09:47,640

working properly and that's true of a

264

00:09:52,190 --> 00:09:50,250

real mission control too we have a big

265

00:09:53,780 --> 00:09:52,200

team that you never see on screen

266

00:09:56,150 --> 00:09:53,790

working in the background of that

267

00:09:57,980 --> 00:09:56,160

building to make sure the lights stay on

268

00:10:00,590 --> 00:09:57,990

and the bathrooms work and the coffee

269

00:10:02,600 --> 00:10:00,600

machine is properly stocked and make

270

00:10:04,400 --> 00:10:02,610

sure all the electronic communication

271

00:10:06,080 --> 00:10:04,410

inside that building words setting

272

00:10:07,730 --> 00:10:06,090

something like that up on the fly as we

273

00:10:09,080 --> 00:10:07,740

do here in the field is very complicated

274

00:10:11,300 --> 00:10:09,090

we have a lot of people to help with

275

00:10:13,460 --> 00:10:11,310

that and then we also have a dedicated

276

00:10:17,000 --> 00:10:13,470

team of folks who are paying very close

277

00:10:19,610 --> 00:10:17,010

attention to our aquanauts spacewalks

278

00:10:21,530 --> 00:10:19,620

they have designed and built all of the

279

00:10:22,940 --> 00:10:21,540

tools for that themselves and if

280

00:10:24,470 --> 00:10:22,950

anything breaks which almost always

281

00:10:26,930 --> 00:10:24,480

happens on an eda things don't go quite

282

00:10:30,230 --> 00:10:26,940

right and also in the saltwater

283

00:10:32,960 --> 00:10:30,240

environment things that normally rotate

284

00:10:34,100 --> 00:10:32,970

don't and other difficulties so we've

285

00:10:35,780 --> 00:10:34,110

got a whole team of people paying

286

00:10:37,130 --> 00:10:35,790

attention to those eda tools and making

287

00:10:40,370 --> 00:10:37,140

sure that everything that crew is going

288

00:10:42,350 --> 00:10:40,380

to use is going to work properly well

289

00:10:43,460 --> 00:10:42,360

it's going to be important lessons as we

290

00:10:45,050 --> 00:10:43,470

look to going further than we've ever

291

00:10:46,430 --> 00:10:45,060

gone before to an asteroid and on to

292

00:10:47,630 --> 00:10:46,440

Mars and Stan we want to thank you for

293

00:10:48,560 --> 00:10:47,640

joining us under you guys are busy down

294

00:10:50,570 --> 00:10:48,570

there we're going to be following along

295

00:10:52,820 --> 00:10:50,580

if you would like to follow along with

296

00:10:55,640 --> 00:10:52,830

the NASA Nemo mission there on Twitter

297

00:10:56,690 --> 00:10:55,650

at NASA underscore Nemo sustained thank

298

00:10:59,140 --> 00:10:56,700

you so much for joining us you guys

299

00:11:01,110 --> 00:10:59,150

enjoy your time down there in Florida