1
00:00:02,002 --> 00:00:08,008
[jet engine revving up]

2
00:00:08,008 --> 00:00:14,014
[sonic boom]

3
00:00:14,014 --> 00:00:20,954
[thunder/rain/jet flyover]

4
00:00:20,954 --> 00:00:23,023
[music]

5
00:00:23,023 --> 00:00:30,030
[coyote yipping]

6
00:00:30,030 --> 00:00:37,037
[elephant door opening]

7
00:00:37,037 --> 00:00:38,455
>> Robert Rivera: Engineering
is something I've always wanted

8
00:00:38,455 --> 00:00:39,139
to do.

9
00:00:39,139 --> 00:00:41,091
I originally started off looking
towards computer engineering

10
00:00:41,091 --> 00:00:43,844
but then eventually
transitioned to aerospace.

11
00:00:43,844 --> 00:00:46,446
What drew me to aerospace is
the fact that we're not limited

12
00:00:46,446 --> 00:00:49,316

to just mechanical engineering
or just electrical engineering.

13
00:00:49,316 --> 00:00:52,452
We handle everything that
has to do with airplanes.

14
00:00:52,452 --> 00:00:55,055
[Global Hawk taking off]

15
00:00:55,055 --> 00:00:58,075
[music]

16
00:00:58,075 --> 00:01:00,727
>> I'm Robert Rivera and I'm
the Lead Operations Engineer

17
00:01:00,727 --> 00:01:02,713
on Global Hawk.

18
00:01:02,713 --> 00:01:04,798
NASA's Global Hawks
are set up primarily

19
00:01:04,798 --> 00:01:06,183
for doing airborne research.

20
00:01:06,183 --> 00:01:08,135
All the sensors that are
normally on the airplane

21
00:01:08,135 --> 00:01:10,203
for the military mission
have been removed, so we

22
00:01:10,203 --> 00:01:13,173
fly just the payloads that are
required to do the mission.

23

00:01:13,173 --> 00:01:16,760
>>...Support, NASA 872...I need
to set up a left hand over here

24
00:01:16,760 --> 00:01:18,545
for a few minutes just
to collect some data.

25
00:01:18,545 --> 00:01:19,346
>>Copy that, thanks.

26
00:01:19,346 --> 00:01:21,765
>> Robert Rivera: One advantage
of doing this air based research

27
00:01:21,765 --> 00:01:23,517
that we do is we can get
to parts of the world

28
00:01:23,517 --> 00:01:25,469
where we can't put up
ground base systems.

29
00:01:25,469 --> 00:01:27,938
A lot of our research
happens out over the Atlantic

30
00:01:27,938 --> 00:01:30,007
or over the Pacific,
looking at the atmosphere,

31
00:01:30,007 --> 00:01:32,092
looking at the different
types of chemicals

32
00:01:32,092 --> 00:01:34,578
up in the tropopause, what kind
of pollutants we're seeing...

33
00:01:34,578 --> 00:01:38,348

we can spend 14 hours over
storm and watch it transition

34
00:01:38,348 --> 00:01:40,968
from a tropical storm
to a hurricane.

35
00:01:40,968 --> 00:01:43,704
It also allows us to go fly
satellite tracks and be able

36
00:01:43,704 --> 00:01:45,205
to calibrate the
weather satellites

37
00:01:45,205 --> 00:01:47,591
that are flying overhead
so we can verify

38
00:01:47,591 --> 00:01:50,010
that they're giving us
correct amount of information.

39
00:01:50,010 --> 00:01:53,747
So then we can better improve
the models of how we forecast

40
00:01:53,747 --> 00:01:56,116
the weather of the world.

41
00:01:56,116 --> 00:01:58,118
[music]

42
00:01:58,118 --> 00:02:02,122
>> There are conflicting
requirements on this campaign.

43
00:02:02,122 --> 00:02:04,274
And we're just going to have to
let the forecasters duke it out

44
00:02:04,274 --> 00:02:05,125
and workout with--

45
00:02:05,125 --> 00:02:07,127
>> An operations engineer is
essentially the aircraft manager

46
00:02:07,127 --> 00:02:07,544
here.

47
00:02:07,544 --> 00:02:09,946
We're responsible for the
configuration of the airplane,

48
00:02:09,946 --> 00:02:12,349
the air worthiness of the
aircraft and making sure

49
00:02:12,349 --> 00:02:13,867
that all the maintenance
is accomplished

50
00:02:13,867 --> 00:02:16,737
in a reasonable manner within
the schedule that's given to us.

51
00:02:16,737 --> 00:02:19,573
We're not specializing to
a particular discipline.

52
00:02:19,573 --> 00:02:23,343
We're allowed to basically
cross disciplines and work

53
00:02:23,343 --> 00:02:24,811
where we need to, to do the job.

54
00:02:24,811 --> 00:02:28,899

>> We'll come down and out of
the way with this.

55
00:02:28,899 --> 00:02:29,700
>> Robert Rivera:
What I've been doing

56
00:02:29,700 --> 00:02:31,685
on the Global Hawk is
integrating payloads

57
00:02:31,685 --> 00:02:32,853
onto the airplane.

58
00:02:32,853 --> 00:02:34,554
I'm basically given a payload.

59
00:02:34,554 --> 00:02:35,489
Here's the mounting points,

60
00:02:35,489 --> 00:02:36,890
here's where we're
putting it on the airplane, and

61
00:02:36,890 --> 00:02:38,692
then I have to figure out how
to put it on the airplane.

62
00:02:38,692 --> 00:02:42,012
Then cut the work orders to
have the shops build the parts

63
00:02:42,012 --> 00:02:43,397
and then get the technicians

64
00:02:43,397 --> 00:02:46,166
to install the parts
on the airplane.

65

00:02:46,166 --> 00:02:48,418
[music]

66
00:02:48,418 --> 00:02:50,637
We have two primary payloads
that we put on this airplane.

67
00:02:50,637 --> 00:02:52,672
The first type is an
in-situ instrument.

68
00:02:52,672 --> 00:02:54,891
The second type are called
remote sensing instruments.

69
00:02:54,891 --> 00:02:57,878
The CAST program we're currently
involved in is two instruments.

70
00:02:57,878 --> 00:03:00,263
One is a cloud particle
measurement instrument

71
00:03:00,263 --> 00:03:02,449
that actually takes
in cloud particles

72
00:03:02,449 --> 00:03:04,418
and through lasers
looks at the shape

73
00:03:04,418 --> 00:03:05,585
of the particles in the clouds.

74
00:03:05,585 --> 00:03:07,354
The other one is a
remote sensing instrument.

75
00:03:07,354 --> 00:03:10,724
It actually looks at the sun

glint off of the water and

76
00:03:10,724 --> 00:03:14,010
breaks down what's in the air
column that it's looking through

77
00:03:14,010 --> 00:03:15,796
what kind of chemicals are
there, the methane levels,

78
00:03:15,796 --> 00:03:17,714
the carbon dioxide levels.

79
00:03:17,714 --> 00:03:21,885
My part of the GHOST design was
taking the Northrop engineering

80
00:03:21,885 --> 00:03:24,421
installation and
adding in the cooling

81
00:03:24,421 --> 00:03:26,940
and ventilation system
for the instrument.

82
00:03:26,940 --> 00:03:30,293
You'll see here on my design is
that, you know, the air comes

83
00:03:30,293 --> 00:03:34,364
in to the airplane goes through
their computer for cooling,

84
00:03:34,364 --> 00:03:37,818
and then through a manifold,
which, the NO2 vents out,

85
00:03:37,818 --> 00:03:40,904
the liquid nitrogen vents out,
which is what they use to cool

86
00:03:40,904 --> 00:03:42,289
the instrument.

87
00:03:42,289 --> 00:03:43,807
[music]

88
00:03:43,807 --> 00:03:45,725
A lot of our science
teams that we get

89
00:03:45,725 --> 00:03:47,844
in here are not aircraft people.

90
00:03:47,844 --> 00:03:49,096
They build to laboratory
standards,

91
00:03:49,096 --> 00:03:50,497
not aircraft standards.

92
00:03:50,497 --> 00:03:54,351
One of the biggest challenges
is solving that difference

93
00:03:54,351 --> 00:03:57,421
between what they bring us and
what we can put on the airplane,

94
00:03:57,421 --> 00:04:00,707
and how to safely put something
that's built to one standard

95
00:04:00,707 --> 00:04:03,043
on the airplane and meet
the standards we have.

96
00:04:03,043 --> 00:04:04,711
>> It's in the hole there.

97
00:04:04,711 --> 00:04:05,045
>> OK.

98
00:04:05,045 --> 00:04:05,562
[background discussion]

99
00:04:05,562 --> 00:04:07,147
>>This one isn't yet.

100
00:04:07,147 --> 00:04:07,781
>> Yeah.

101
00:04:07,781 --> 00:04:08,265
>> OK.

102
00:04:08,265 --> 00:04:10,450
>> Mark where the foot's
going to go.

103
00:04:10,450 --> 00:04:14,004
[Music]

104
00:04:14,004 --> 00:04:14,771
>> Robert Rivera: That's
where your ATR is going to go.

105
00:04:14,771 --> 00:04:16,006
I know you guys are anxious

106
00:04:16,006 --> 00:04:18,325
to see this all up
there and flying.

107
00:04:18,325 --> 00:04:19,459
>> Yeah.

108
00:04:19,459 --> 00:04:22,012

>> It's the end of a long design
process for us.

109
00:04:22,012 --> 00:04:23,763
>> Robert Rivera: We're
basically using up every nook

110
00:04:23,763 --> 00:04:25,415
and cranny in the
airplane we can find,

111
00:04:25,415 --> 00:04:27,317
getting these instruments,
figuring out where to put them

112
00:04:27,317 --> 00:04:28,452
and making them all fit.

113
00:04:28,452 --> 00:04:30,454
Very much like Tetris.

114
00:04:30,454 --> 00:04:39,529
[music/instruments being
installed]

115
00:04:42,666 --> 00:04:44,985
>> Larry you want to pull
the pod your way?

116
00:04:44,985 --> 00:04:47,487
...And a quarter turn on the
back.

117
00:04:47,487 --> 00:04:50,757
Let's tighten the
outboard front again.

118
00:04:50,757 --> 00:04:52,559
Essentially what we're doing
is we're putting preload

119
00:04:52,559 --> 00:04:54,261
into the AITTS instrument pod.

120
00:04:54,261 --> 00:04:56,863
For flight what it does is
improves stiffness of the pod

121
00:04:56,863 --> 00:04:59,466
when we're flying so it
doesn't move around too much.

122
00:04:59,466 --> 00:05:08,525
[music/power drills]

123
00:05:15,966 --> 00:05:25,025
[engine noise]

124
00:05:30,997 --> 00:05:33,366
>> We got to roll call real
quick...two pilots are here...

125
00:05:33,366 --> 00:05:35,402
>> Robert Rivera: Typically
on a flight day I act as one

126
00:05:35,402 --> 00:05:36,736
of the mission directors
for the flight.

127
00:05:36,736 --> 00:05:38,438
>> Mission Director- I assume
that's going to be you?

128
00:05:38,438 --> 00:05:40,724
>> Myself and
Crystal will be in training.

129
00:05:40,724 --> 00:05:42,759

>> Our job as mission
directors is working

130
00:05:42,759 --> 00:05:44,728
with the scientists
and with the pilots.

131
00:05:44,728 --> 00:05:47,764
So when the scientists have
changing requirements we're the

132
00:05:47,764 --> 00:05:48,949
one who gets them first.

133
00:05:48,949 --> 00:05:50,433
And then we'll work with them

134
00:05:50,433 --> 00:05:52,002
to make sure they're
what the pilots can do.

135
00:05:52,002 --> 00:05:54,321
And then we pass them
on to the pilots.

136
00:05:54,321 --> 00:05:55,839
And we negotiate with the pilots

137
00:05:55,839 --> 00:05:59,409
to get what we can
for the scientists.

138
00:05:59,409 --> 00:06:01,461
>> Sounds like we're good to go.

139
00:06:01,461 --> 00:06:06,149
[music]

140
00:06:06,149 --> 00:06:08,451

>> Door is up, power is up,
vehicle is moving...

141
00:06:08,451 --> 00:06:11,454
>> NASA 872, roger, hold short
Runway 22 Right.

142
00:06:11,454 --> 00:06:13,990
>> Runway 22 Right, we'd like to
use 22 Left.

143
00:06:13,990 --> 00:06:17,160
>> Okay mission we're on the
runway and setting up for takeoff.

144
00:06:17,160 --> 00:06:19,996
>> Roger, we're still
go for takeoff.

145
00:06:19,996 --> 00:06:21,464
>> Okay, here we go.

146
00:06:21,464 --> 00:06:23,466
[music]

147
00:06:23,466 --> 00:06:29,990
[Global Hawk engine revving up]

148
00:06:29,990 --> 00:06:31,641
>> Sixty knots.

149
00:06:31,641 --> 00:06:36,463
>> Copy.

150
00:06:36,463 --> 00:06:40,984
[Global Hawk taking off]

151
00:06:40,984 --> 00:06:42,452
>> Vehicle is airborne.

152
00:06:42,452 --> 00:06:45,989
>> NASA 872 copies.

153
00:06:45,989 --> 00:06:47,040
>> Have a good flight.

154
00:06:47,040 --> 00:06:48,592
>> Robert Rivera: We're
also basically responsible

155
00:06:48,592 --> 00:06:51,811
for assisting the pilots in
any emergencies that happen

156
00:06:51,811 --> 00:06:54,698
on the airplane, any flight
planning that needs to be done.

157
00:06:54,698 --> 00:06:56,566
We do have a real
time downlink,

158
00:06:56,566 --> 00:06:58,985
so the scientists are
always looking at the data,

159
00:06:58,985 --> 00:07:01,004
if we ever change our mission
plan based off the data they're

160
00:07:01,004 --> 00:07:02,989
seeing come down real time.

161
00:07:02,989 --> 00:07:05,025
>> We're 15,000.

162
00:07:05,025 --> 00:07:06,459
>> 15,000.

163
00:07:06,459 --> 00:07:10,513
>> And for the cards, we're on
M2, step Mike 6.

164
00:07:12,560 --> 00:07:16,180
>> And I'm showing DC 13 and IR
13 off.

165
00:07:16,186 --> 00:07:18,154
>> Robert Rivera: We're also
the ones that have controls

166
00:07:18,154 --> 00:07:20,073
of the payload system for
turning on instruments

167
00:07:20,073 --> 00:07:22,342
and turning off instruments,
up in the front room.

168
00:07:22,342 --> 00:07:24,094
>> DC12 on please.

169
00:07:24,094 --> 00:07:26,463
>> DC12 on.

170
00:07:26,463 --> 00:07:31,518
[music]

171
00:07:31,518 --> 00:07:38,074
[Global Hawk landing]

172
00:07:38,074 --> 00:07:39,659
>> Robert Rivera: And once
we finished one campaign,

173
00:07:39,659 --> 00:07:42,095
we're prepping for the

next campaign or cleaning

174
00:07:42,095 --> 00:07:43,713
up doing maintenance
on the airplane.

175
00:07:43,713 --> 00:07:47,384
So we're pretty much constantly
busy from one to the next.

176
00:07:48,518 --> 00:07:50,770
Basically the favorite part of
my job is the whole process,

177
00:07:50,770 --> 00:07:52,739
seeing a project or
an integration effort

178
00:07:52,739 --> 00:07:54,140
from beginning to end.

179
00:07:54,140 --> 00:07:56,743
Basically being able
to take something

180
00:07:56,743 --> 00:07:58,662
that may never have been
designed to go on an airplane

181
00:07:58,662 --> 00:08:02,832
and then seeing it flying in
a reasonable amount of time.

182
00:08:04,880 --> 00:08:07,400
What I like about NASA is
that they're doing things

183
00:08:07,404 --> 00:08:09,172
that you would not
necessarily see done

184
00:08:09,172 --> 00:08:11,775
in private industry because
there's really no cost benefit

185
00:08:16,613 --> 00:08:12,642
to them.

186
00:08:16,613 --> 00:08:18,131
NASA can do the airborne
research,

187
00:08:18,131 --> 00:08:20,517
and improve our models to
better predict the weather,

188
00:08:20,517 --> 00:08:23,153
so we can get people out of the
way when storms come through.

189
00:08:23,153 --> 00:08:25,605
We can better predict how strong
a hurricane is going to get

190
00:08:25,605 --> 00:08:27,991
so you can make sure the
proper personnel are in place

191
00:08:27,991 --> 00:08:29,793
for response to that hurricane.

192
00:08:29,793 --> 00:08:32,933
We gather so much data, it takes years to process all the data,

193
00:08:32,933 --> 00:08:35,433
but all that will eventually end up in the public domain.

194
00:08:36,240 --> 00:08:37,440
I would tell kids

that are interested

195
00:08:37,440 --> 00:08:40,360
in engineering is learn your
math, learn your science,

196
00:08:40,360 --> 00:08:43,720
be interested, take
things apart,

197
00:08:43,720 --> 00:08:47,480
put things together,
work with your hands.