



1  
00:00:00,506 --> 00:00:15,636  
[ Music ]

2  
00:00:16,136 --> 00:00:19,406  
>> Our world is full of  
new and exciting inventions

3  
00:00:19,526 --> 00:00:21,396  
that continue to  
push the boundaries

4  
00:00:21,396 --> 00:00:22,716  
of technology forward.

5  
00:00:23,176 --> 00:00:26,806  
Every day, it seems something  
new is announced, developed,

6  
00:00:26,806 --> 00:00:29,956  
and implemented that  
changes how humans interact.

7  
00:00:30,626 --> 00:00:34,016  
Just in the past few decades,  
cell phones, internet speed,

8  
00:00:34,316 --> 00:00:36,536  
medical breakthroughs,  
and the reinvention

9  
00:00:36,536 --> 00:00:40,046  
of basic infrastructure is  
beginning to change the norms

10  
00:00:40,046 --> 00:00:40,836  
in our everyday lives.

11  
00:00:41,466 --> 00:00:44,376  
But have you considered how

these changes in science,

12

00:00:44,636 --> 00:00:46,686

engineering, and medicine occur?

13

00:00:47,226 --> 00:00:50,596

To most of us on the outside of  
these revolutionary practices,

14

00:00:51,016 --> 00:00:53,196

it seems like magic  
when innovations appear

15

00:00:53,226 --> 00:00:54,276

in our lives overnight.

16

00:00:54,956 --> 00:00:57,966

In reality, it's years  
of painstaking work,

17

00:00:58,526 --> 00:01:00,386

trial and error,  
and rigorous testing

18

00:01:00,456 --> 00:01:03,156

that occurs before a finished  
product is ever realized.

19

00:01:03,976 --> 00:01:06,986

Researchers in the world of  
engineering and science move

20

00:01:06,986 --> 00:01:10,446

in small incremental steps,  
slowly building a case

21

00:01:10,556 --> 00:01:11,906

for these new revelations

22

00:01:12,226 --> 00:01:14,476  
until they are sure  
technologies are ready

23

00:01:14,476 --> 00:01:15,576  
to be shared with the world.

24

00:01:16,476 --> 00:01:19,916  
In fact, there is an old saying  
in research, "An amateur works

25

00:01:19,916 --> 00:01:23,116  
on a task until they get it  
right, but a professional works

26

00:01:23,116 --> 00:01:25,296  
on a task until they  
can't get it wrong."

27

00:01:26,626 --> 00:01:30,156  
Fortunately for all of us  
over the past few years, NASA,

28

00:01:30,316 --> 00:01:34,386  
the FAA, and industry have been  
engineering the next big idea

29

00:01:34,796 --> 00:01:37,456  
that may completely change  
how we interact in our world

30

00:01:37,456 --> 00:01:41,106  
with the implementation  
of unmanned aircraft.

31

00:01:41,106 --> 00:01:44,006  
The idea for inclusion of  
these aircraft is not new.

32

00:01:44,526 --> 00:01:47,516

The basic concept for small flying vehicles has been

33

00:01:47,516 --> 00:01:50,886

in popular culture and in the limelight for quite some time.

34

00:01:51,116 --> 00:01:52,646

But until recently,

35

00:01:52,946 --> 00:01:56,246

these vehicles have rapidly accelerated off the drawing

36

00:01:56,246 --> 00:01:57,876

board and into the skies.

37

00:01:58,386 --> 00:02:01,146

Over the past few years, NASA has been testing

38

00:02:01,206 --> 00:02:03,436

and validating research associated

39

00:02:03,436 --> 00:02:07,216

with unmanned aircraft through a project called Unmanned Aircraft

40

00:02:07,446 --> 00:02:10,216

System integration in the National Airspace System

41

00:02:10,456 --> 00:02:13,156

or UAS in the NAS project.

42

00:02:13,506 --> 00:02:17,086

This project spanned several years and addressed many

43

00:02:17,086 --> 00:02:18,456

of the early concerns

44

00:02:18,456 --> 00:02:20,736

of how unmanned aircraft  
would be integrated

45

00:02:20,736 --> 00:02:21,976

into our National Airspace.

46

00:02:22,386 --> 00:02:26,686

After years of study, the UAS in  
the NAS project has tackled many

47

00:02:26,686 --> 00:02:27,856

of the early concerns.

48

00:02:28,116 --> 00:02:30,706

But one last big hurdle remains

49

00:02:31,106 --> 00:02:34,476

to successfully demonstrate  
how unmanned aircraft will work

50

00:02:34,606 --> 00:02:36,846

in harmony within the  
National Airspace.

51

00:02:37,786 --> 00:02:39,686

With this in mind,  
the final phase

52

00:02:39,686 --> 00:02:42,156

of testing called the  
Systems Integration

53

00:02:42,156 --> 00:02:45,026

and Operationalization  
demonstration activity

54

00:02:45,296 --> 00:02:47,996  
or SIO has begun in earnest.

55

00:02:49,616 --> 00:02:52,076  
Throughout our country at  
various NASA field centers

56

00:02:52,156 --> 00:02:53,736  
and other testing locations,

57

00:02:54,016 --> 00:02:57,306  
NASA has assembled a core  
strategic group of researchers

58

00:02:57,566 --> 00:03:00,286  
to analyze and test  
unmanned aircraft

59

00:03:00,426 --> 00:03:02,156  
through the SIO demonstration.

60

00:03:02,856 --> 00:03:05,446  
Some of the key flight  
activities will include using

61

00:03:05,446 --> 00:03:08,066  
various sized unmanned  
aircraft built

62

00:03:08,066 --> 00:03:09,606  
by three different companies

63

00:03:09,886 --> 00:03:13,406  
to highlight commercial UAS  
missions that have the potential

64

00:03:13,626 --> 00:03:16,836  
to provide economic and public

benefit to the American people.

65

00:03:17,156 --> 00:03:20,886

Throughout the testing, NASA plans to document best practices

66

00:03:20,886 --> 00:03:24,346

and lessons learned from the SIO activity and provide it

67

00:03:24,396 --> 00:03:26,786

to the UAS community to prepare us

68

00:03:26,786 --> 00:03:29,996

for routine commercial Unmanned Aircraft Operations

69

00:03:29,996 --> 00:03:31,586

in our communities.

70

00:03:32,536 --> 00:03:36,496

On this episode of NASA X, we will take a look back at years

71

00:03:36,496 --> 00:03:38,336

of testing and development that have led

72

00:03:38,336 --> 00:03:40,306

up to the SIO demonstration flights.

73

00:03:40,786 --> 00:03:42,756

And we'll meet the companies that are helping

74

00:03:42,756 --> 00:03:43,946

to make these flights happen.

75

00:03:44,126 --> 00:03:47,116

This research and engineering has the potential

76

00:03:47,286 --> 00:03:50,626

to influence a massive shift in how we receive products

77

00:03:50,756 --> 00:03:53,586

and services and may ultimately make an impact

78

00:03:53,786 --> 00:03:56,716

on how people travel and interact in our world.

79

00:03:57,516 --> 00:04:18,366

[ Music ]

80

00:04:18,866 --> 00:04:21,346

To understand why the NASA team has set

81

00:04:21,346 --> 00:04:24,156

up the SIO demonstrations, we first have to look

82

00:04:24,156 --> 00:04:27,556

at why integrating unmanned aircraft into the NAS is

83

00:04:27,586 --> 00:04:28,746

such a herculean effort.

84

00:04:29,446 --> 00:04:30,886

Here in the United States,

85

00:04:31,136 --> 00:04:34,326

we arguably have the best

air traffic management system

86

00:04:34,326 --> 00:04:35,396  
in the entire world.

87

00:04:35,786 --> 00:04:39,306  
During normal times around  
50,000 flights take off

88

00:04:39,306 --> 00:04:42,926  
and land daily, with nearly  
3 million airline passengers

89

00:04:42,956 --> 00:04:46,026  
traveling across the more  
than 29 million square miles

90

00:04:46,256 --> 00:04:48,626  
that make up the U.S.  
National Airspace System.

91

00:04:49,296 --> 00:04:52,976  
In that system, close to  
15,000 air traffic controllers,

92

00:04:52,976 --> 00:04:58,736  
4,500 aviation safety inspectors  
and 5,800 technicians operate

93

00:04:58,736 --> 00:05:01,826  
and maintain services for  
our National Airspace System,

94

00:05:02,126 --> 00:05:02,456  
or NAS.

95

00:05:04,556 --> 00:05:06,706  
It has more than 19,000 airports

96

00:05:06,966 --> 00:05:09,536  
and 600 air traffic  
control facilities.

97  
00:05:10,206 --> 00:05:14,356  
In all, there are 41,000  
NAS operational facilities

98  
00:05:14,746 --> 00:05:17,106  
and over 71,000 pieces  
of equipment,

99  
00:05:17,706 --> 00:05:21,446  
ranging from radar systems to  
communication relay stations.

100  
00:05:22,296 --> 00:05:23,916  
With all of this infrastructure,

101  
00:05:24,256 --> 00:05:26,166  
integrating unmanned  
aircraft systems

102  
00:05:26,236 --> 00:05:28,676  
into the NAS will be  
demanding to say the least.

103  
00:05:29,356 --> 00:05:32,516  
But this integration is of  
vital importance to our country

104  
00:05:32,516 --> 00:05:36,046  
because these new vehicles will  
be part of the next revolution

105  
00:05:36,256 --> 00:05:39,776  
in national security and  
defense, emergency management,

106  
00:05:39,776 --> 00:05:42,846

science, and in commercial applications.

107

00:05:43,046 --> 00:05:47,256

For these reasons and more NASA set out in 2009,

108

00:05:47,256 --> 00:05:49,836

to work on several main objectives for the project

109

00:05:50,166 --> 00:05:52,326

that included providing research findings

110

00:05:52,356 --> 00:05:54,636

that utilized simulation and flight tests.

111

00:05:55,396 --> 00:05:58,736

Supporting the development and validation of detect and avoid,

112

00:05:58,736 --> 00:06:00,796

and command and control technologies.

113

00:06:00,936 --> 00:06:04,436

And finally, the SIO demonstrations themselves.

114

00:06:05,196 --> 00:06:06,586

Two of the biggest challenges

115

00:06:06,726 --> 00:06:10,076

that needed solutions before the SIO demonstrations could take

116

00:06:10,156 --> 00:06:13,326

place was in the key

areas of detect and avoid,

117

00:06:13,516 --> 00:06:14,796  
and command and control.

118

00:06:15,416 --> 00:06:18,666  
For detect and avoid, one of  
the primary safety concerns

119

00:06:18,666 --> 00:06:21,826  
with integrating these new  
systems is the inability

120

00:06:21,826 --> 00:06:25,806  
of remote operators to see  
and avoid other aircraft.

121

00:06:25,876 --> 00:06:30,206  
On all flights with pilots on  
board, the FAA requires the crew

122

00:06:30,236 --> 00:06:33,016  
to be aware of all other  
surrounding aircraft,

123

00:06:33,016 --> 00:06:35,526  
either visually or using  
onboard instrumentation.

124

00:06:36,126 --> 00:06:39,536  
So in addition to instruments,  
the pilot physically looks

125

00:06:39,596 --> 00:06:42,356  
out of the window to help  
safely avoid other aircraft.

126

00:06:43,106 --> 00:06:45,966  
Because unmanned aircraft  
literally don't have a pilot

127

00:06:45,966 --> 00:06:49,496  
on board, NASA and its partners  
worked on concepts and designs

128

00:06:49,836 --> 00:06:52,916  
that allowed safe operation  
within the National Airspace.

129

00:06:54,046 --> 00:06:56,336  
>> What detect and avoid  
is, is since the pilot

130

00:06:56,336 --> 00:06:58,896  
for an unmanned aircraft  
is either remote --

131

00:06:59,276 --> 00:07:02,816  
off the aircraft, or not  
there at all in the case

132

00:07:02,856 --> 00:07:05,716  
of an autonomous aircraft,  
there is no human eyeballs

133

00:07:05,716 --> 00:07:08,096  
to go see other aircraft.

134

00:07:08,666 --> 00:07:13,866  
So the technology needs to be  
developed to use other means

135

00:07:13,866 --> 00:07:17,496  
such as radars or cameras  
to be able to detect

136

00:07:17,886 --> 00:07:21,106  
where other aircraft are  
flying in the proximity

137

00:07:21,106 --> 00:07:23,196  
of your aircraft --  
your unmanned aircraft.

138

00:07:23,256 --> 00:07:24,746  
And then be able to somehow,

139

00:07:24,746 --> 00:07:27,966  
like a pilot would avoid  
those other aircraft.

140

00:07:28,246 --> 00:07:29,786  
And the way that's done is

141

00:07:29,816 --> 00:07:32,736  
through developing some  
mathematical algorithms

142

00:07:32,736 --> 00:07:35,236  
to be able to direct  
the aircraft

143

00:07:35,826 --> 00:07:37,346  
to a location that  
would be safe.

144

00:07:38,046 --> 00:07:40,746  
And so that's the kind of  
research that NASA wanted

145

00:07:40,746 --> 00:07:44,526  
to focus on because that was  
the most critical aspect of how

146

00:07:44,526 --> 00:07:46,466  
to safely integrate  
unmanned aircraft

147

00:07:46,466 --> 00:07:47,566

into the National Airspace.

148

00:07:48,056 --> 00:07:51,306

That industry at large  
could not really understand.

149

00:07:52,046 --> 00:07:55,266

>> The second hurdle was  
with command and control.

150

00:07:55,616 --> 00:07:58,586

Because unmanned aircraft  
are completely different

151

00:07:58,586 --> 00:08:01,676

from crewed aircraft,  
new techniques needed

152

00:08:01,676 --> 00:08:05,266

to be developed, including  
improving the avionics onboard

153

00:08:05,266 --> 00:08:07,836

the UAS and on the ground.

154

00:08:08,366 --> 00:08:11,206

These aircraft must  
have reliable, safe,

155

00:08:11,206 --> 00:08:14,616

and secure data connections  
at all times while operating

156

00:08:14,616 --> 00:08:17,686

in the complex environment  
of controlled airspace.

157

00:08:18,436 --> 00:08:21,456

>> Similarly, the command  
and control part of the U.S.

158

00:08:21,456 --> 00:08:23,516  
and the NAS project  
is based on the fact

159

00:08:23,516 --> 00:08:27,326  
that most radio communications  
that are operated

160

00:08:27,446 --> 00:08:31,746  
in the airspace now with  
pilots are voice communication.

161

00:08:32,186 --> 00:08:35,026  
So it's a pilot talking to  
an air traffic controller

162

00:08:35,226 --> 00:08:36,286  
or talking to other pilots.

163

00:08:36,706 --> 00:08:38,406  
And they use voice to do that.

164

00:08:38,696 --> 00:08:41,256  
Well, so the aviation  
spectrum that's been set aside

165

00:08:41,256 --> 00:08:46,126  
for voice control doesn't  
work for an electronic control

166

00:08:46,576 --> 00:08:48,796  
because if you're going  
to control the aircraft

167

00:08:48,996 --> 00:08:52,086  
through some sort of  
communication and methodology,

168

00:08:52,166 --> 00:08:53,636

it's got to be done  
electronically.

169

00:08:54,666 --> 00:08:58,856

Because you're sending a message  
to the aircraft to be able

170

00:08:58,856 --> 00:09:02,416

to turn or to be able to  
climb or descend, etcetera.

171

00:09:02,936 --> 00:09:07,086

And so the technology that NASA  
worked on was to develop a radio

172

00:09:07,606 --> 00:09:10,036

that could be used  
in that bandwidth --

173

00:09:10,036 --> 00:09:13,396

that spectrum bandwidth to be  
able to send electronic messages

174

00:09:13,396 --> 00:09:17,646

to and from the vehicle and thus  
be able to command the vehicle.

175

00:09:18,066 --> 00:09:21,456

So that's why the command and  
control work that's been done

176

00:09:21,836 --> 00:09:23,976

under the UAS and the NAS  
project is so important.

177

00:09:24,516 --> 00:09:40,276

[ Music ]

178

00:09:40,776 --> 00:09:43,866

>> Over the years, researchers  
time and time again showed

179

00:09:43,866 --> 00:09:46,786  
that they had developed the  
detect and avoid, and command

180

00:09:46,786 --> 00:09:48,846  
and control technology  
to the point

181

00:09:49,086 --> 00:09:52,396  
where it could be reliably  
tested in real-world conditions.

182

00:09:53,076 --> 00:09:55,996  
Although there were other flight  
demonstrations throughout this

183

00:09:55,996 --> 00:09:58,326  
project, the last major hurdle

184

00:09:58,326 --> 00:10:01,606  
of flying the SIO  
demonstration is now at hand.

185

00:10:03,046 --> 00:10:05,126  
NASA in partnership with the FAA

186

00:10:05,126 --> 00:10:08,336  
and industry partners have  
begun the demonstrations

187

00:10:08,336 --> 00:10:11,586  
of potential commercial  
applications using different

188

00:10:11,586 --> 00:10:13,626  
sizes of unmanned  
aircraft systems

189

00:10:13,746 --> 00:10:15,686  
for the SIO demonstrations.

190

00:10:16,806 --> 00:10:20,886  
The goal of SIO is to work  
toward commercial UAS operations

191

00:10:20,886 --> 00:10:21,896  
in the NAS.

192

00:10:22,206 --> 00:10:25,206  
In order to accomplish this  
goal, NASA has partnered

193

00:10:25,206 --> 00:10:29,206  
with three pioneering companies  
to conduct flight demonstrations

194

00:10:29,206 --> 00:10:32,096  
in the NAS that emulate  
commercial missions

195

00:10:32,096 --> 00:10:35,506  
and begin working toward  
Federal Aviation Administration,

196

00:10:35,786 --> 00:10:37,656  
or FAA type certification.

197

00:10:40,146 --> 00:10:42,996  
>> When NASA was selecting  
the partners for SIO,

198

00:10:42,996 --> 00:10:45,766  
we went through a  
partnership process

199

00:10:45,766 --> 00:10:49,636

that included the evaluation of  
a number of candidate partners.

200

00:10:50,476 --> 00:10:53,196

And we were looking  
for some key aspects

201

00:10:53,196 --> 00:10:54,706

that these partners  
could bring to the table.

202

00:10:55,346 --> 00:10:58,416

And so the first was really  
great domain knowledge

203

00:10:58,416 --> 00:11:01,676

in unmanned aircraft and  
associated technologies.

204

00:11:02,596 --> 00:11:06,856

The second attribute was  
knowledge of certification

205

00:11:07,086 --> 00:11:08,916

and the knowledge that's  
really needed to kind

206

00:11:08,916 --> 00:11:11,306

of take these vehicles  
from the concept

207

00:11:11,306 --> 00:11:12,816

and early development stages

208

00:11:13,186 --> 00:11:15,176

through to becoming  
a commercial product.

209

00:11:16,536 --> 00:11:17,716

And then the third

thing we were looking

210

00:11:17,786 --> 00:11:21,236  
for are viable commercial  
missions,

211

00:11:22,026 --> 00:11:23,656  
that would be publicly  
beneficial.

212

00:11:24,156 --> 00:11:27,766  
We really wanted to showcase  
how unmanned aircraft can play a

213

00:11:27,816 --> 00:11:32,706  
role in the future of the world  
and have a positive impact.

214

00:11:35,346 --> 00:11:37,156  
There's three different  
companies that are participating

215

00:11:37,156 --> 00:11:38,116  
in the SIO activity;

216

00:11:38,436 --> 00:11:43,376  
Bell General Atomics  
Aeronautical Systems, and AATI.

217

00:11:43,376 --> 00:11:47,316  
Bell is bringing their APT70  
unmanned aircraft, which is --

218

00:11:47,446 --> 00:11:50,046  
weighs approximately 300  
pounds and is capable

219

00:11:50,046 --> 00:11:51,706  
of vertical takeoff and landing

220

00:11:52,136 --> 00:11:53,816

and operations around  
urban areas.

221

00:11:54,286 --> 00:11:55,586

The primary mission  
that they're focused

222

00:11:55,586 --> 00:11:59,356

on is emergency medical supply  
transportation in an urban area.

223

00:12:00,216 --> 00:12:02,936

General Atomics is utilizing  
their SkyGuardian unmanned

224

00:12:02,936 --> 00:12:05,226

aircraft for multimodal  
long-endurance

225

00:12:05,226 --> 00:12:05,976

infrastructure inspection.

226

00:12:06,836 --> 00:12:09,256

That unmanned aircraft weighs  
approximately 12,000 pounds

227

00:12:09,256 --> 00:12:11,256

so it's much bigger than the  
others that are participating

228

00:12:11,256 --> 00:12:12,816

in SIO, and is intended

229

00:12:12,896 --> 00:12:14,776

for an infrastructure  
inspection mission

230

00:12:14,776 --> 00:12:16,716

at altitudes above 10,000 feet.

231

00:12:17,656 --> 00:12:20,806

ATTI is using their  
AiRanger unmanned aircraft,

232

00:12:20,976 --> 00:12:22,556

which is approximately  
180 pounds

233

00:12:22,886 --> 00:12:26,086

for a pipeline inspection  
mission at lower altitudes

234

00:12:26,216 --> 00:12:28,066

between 1,000 and 5,000 feet.

235

00:12:28,066 --> 00:12:30,976

And then lastly,  
throughout this process,

236

00:12:30,976 --> 00:12:32,356

we've been collaborating  
with the FAA

237

00:12:32,396 --> 00:12:36,426

who has provided extraordinary  
support and helped us

238

00:12:36,526 --> 00:12:39,966

to navigate the regulatory  
process that's in place

239

00:12:40,106 --> 00:12:41,976

for these demonstration  
activities.

240

00:12:42,596 --> 00:12:45,576

>> The three partner companies  
are each using various-sized

241

00:12:45,576 --> 00:12:48,286  
and different types of  
unmanned aircraft configured

242

00:12:48,496 --> 00:12:50,106  
for the SIO demonstrations.

243

00:12:51,046 --> 00:12:52,366  
>> For the past several years,

244

00:12:52,436 --> 00:12:54,646  
actually going back  
probably a couple of decades,

245

00:12:54,696 --> 00:12:58,736  
NASA has been working  
on UAS first,

246

00:12:58,736 --> 00:13:00,376  
more in the technical side,

247

00:13:00,376 --> 00:13:02,496  
and now maybe more  
on the standard side.

248

00:13:03,366 --> 00:13:10,726  
And I think SIO activity was  
looking or the objective was

249

00:13:10,766 --> 00:13:13,236  
to address some of the  
gaps that still remained.

250

00:13:14,136 --> 00:13:18,176  
And one of the ways that we were  
able to do that is by partnering

251

00:13:18,176 --> 00:13:21,136

with some companies to go  
after some of these things.

252

00:13:22,196 --> 00:13:25,116

The outcome of the  
demonstrations is to try

253

00:13:25,116 --> 00:13:28,746

to help the companies really  
get their arms around some

254

00:13:28,746 --> 00:13:31,476

of these barriers  
that still exist.

255

00:13:32,386 --> 00:13:36,626

Work with the FAA to develop  
the processes and solutions

256

00:13:36,626 --> 00:13:40,416

to be able to address some of  
these gaps and then bring it

257

00:13:40,606 --> 00:13:45,226

to a place where the industry  
can learn off of those lessons.

258

00:13:46,166 --> 00:13:48,556

The aircraft that  
are participating

259

00:13:48,556 --> 00:13:51,116

in the SIO activity  
are pretty unique,

260

00:13:51,116 --> 00:13:54,426

and they span quite a range.

261

00:13:54,536 --> 00:13:57,156

You've got airplanes

and propulsion systems

262

00:13:57,156 --> 00:13:58,166  
that are all-electric.

263

00:13:58,626 --> 00:14:00,186  
You got a turboprop.

264

00:14:00,706 --> 00:14:02,296  
Another one is a piston-powered.

265

00:14:02,296 --> 00:14:05,986  
So from a propulsion side,  
they're pretty distinct.

266

00:14:06,166 --> 00:14:09,016  
And then even if you look at  
the way that they just operate,

267

00:14:09,536 --> 00:14:10,526  
you know, one takes off,

268

00:14:10,936 --> 00:14:13,096  
like a conventional  
airplane would take off

269

00:14:13,246 --> 00:14:14,916  
from a commercial airport.

270

00:14:15,756 --> 00:14:19,526  
Another one can basically  
launch off of almost anywhere

271

00:14:19,666 --> 00:14:21,736  
and just land on some clearing.

272

00:14:22,116 --> 00:14:25,106  
And then another one actually  
can take off also from anywhere,

273

00:14:25,166 --> 00:14:28,056  
just vertically and then --  
and again, landing vertically.

274

00:14:28,636 --> 00:14:31,056  
So quite a range  
even in altitudes

275

00:14:31,056 --> 00:14:32,196  
in the way that they operate.

276

00:14:32,196 --> 00:14:35,036  
Some of them were designed  
to operate lower altitude.

277

00:14:35,106 --> 00:14:38,366  
Some of them were designed  
to be able to go pretty high

278

00:14:38,726 --> 00:14:40,976  
than maybe 40,000 feet.

279

00:14:41,076 --> 00:14:45,166  
>> Each company offers a unique  
perspective and engineering goal

280

00:14:45,416 --> 00:14:47,116  
in performing the SIO tests.

281

00:14:48,406 --> 00:14:50,876  
>> So Bell's participation  
in NASA SIO is really

282

00:14:50,876 --> 00:14:54,926  
about making sure we get the  
data that the regulators need

283

00:14:55,226 --> 00:14:58,276

to be able to understand not  
just the aircraft requirements,

284

00:14:58,316 --> 00:15:00,266

but the system environments  
for being able

285

00:15:00,266 --> 00:15:02,646

to get advanced aerial  
mobility actually

286

00:15:02,746 --> 00:15:07,496

into commercial space integrated  
with the rest of aviation

287

00:15:07,496 --> 00:15:08,566

in the National Airspace.

288

00:15:08,856 --> 00:15:11,036

Bell's actually been doing  
unmanned aerial vehicles

289

00:15:11,036 --> 00:15:11,946

for quite some time.

290

00:15:11,946 --> 00:15:13,806

From a commercial  
standpoint, APT is,

291

00:15:13,806 --> 00:15:15,016

you know, a sizable vehicle.

292

00:15:15,576 --> 00:15:16,986

You know, a little  
over 300 pounds

293

00:15:16,986 --> 00:15:18,556

to carry 70 pounds of payload.

294

00:15:19,046 --> 00:15:21,696

It's critical that we get  
this right so that we are safe

295

00:15:21,696 --> 00:15:23,136

and compliant in the airspace.

296

00:15:23,136 --> 00:15:24,736

And that's a part of what  
NASA science is about.

297

00:15:24,986 --> 00:15:28,806

They're a trusted data provider  
for the FAA and other regulators

298

00:15:29,096 --> 00:15:32,696

to be able to help us understand  
what really is required

299

00:15:32,816 --> 00:15:36,586

for the aircraft, for the  
airspace requirements,

300

00:15:36,586 --> 00:15:38,756

and then for the integration  
of those systems together.

301

00:15:39,116 --> 00:15:41,796

So NASA's involvement  
helps drive the technology

302

00:15:41,796 --> 00:15:44,066

to a high enough level that  
we have sufficient data

303

00:15:44,066 --> 00:15:45,336

for the FAA to make regulations.

304

00:15:46,046 --> 00:15:48,706

I would say the way it's being

done right now is innovative.

305

00:15:48,706 --> 00:15:52,046

You see NEO-NASA leaning forward with electric

306

00:15:52,046 --> 00:15:55,576

and hybrid propulsion, as well as you know detect and avoid

307

00:15:55,576 --> 00:15:57,206

and some of the things that we need for the airspace.

308

00:15:57,206 --> 00:15:58,936

You see the FAA leaning forward based

309

00:15:58,936 --> 00:16:01,836

on their small unmanned experience and knowing

310

00:16:02,146 --> 00:16:04,646

that we need to get out in front of this, this time to make sure

311

00:16:04,646 --> 00:16:06,526

that we do it right as we get to larger vehicles.

312

00:16:07,046 --> 00:16:10,376

And so that partnership and kind of active arrangement

313

00:16:10,376 --> 00:16:12,286

of let's discover together

314

00:16:12,286 --> 00:16:14,836

and work together towards what's both safe

315

00:16:14,836 --> 00:16:19,576

and economically viable as an overall community is really new.

316

00:16:20,516 --> 00:16:37,866

[ Music ]

317

00:16:38,366 --> 00:16:41,856

>> On this particular mission, the APT70 was armed

318

00:16:41,936 --> 00:16:44,996

from a ground control station, then was instructed

319

00:16:44,996 --> 00:16:47,036

to initiate a vertical takeoff.

320

00:16:47,726 --> 00:16:51,136

Per its design, it then rotated to fly on its wings,

321

00:16:51,506 --> 00:16:54,356

where it was nearly silent to the researchers below.

322

00:16:54,766 --> 00:16:57,696

It flew at an altitude of 500 feet above ground level.

323

00:16:57,936 --> 00:17:01,686

Transitioned in and out of class B airspace, all while staying

324

00:17:01,686 --> 00:17:04,336

in constant communication with the ground station

325

00:17:04,336 --> 00:17:05,976  
through a redundant data link.

326

00:17:06,726 --> 00:17:10,026  
Onboard was the prototype  
airborne detect and avoid system

327

00:17:10,346 --> 00:17:13,526  
that provided the remote pilot  
with awareness of air traffic

328

00:17:13,526 --> 00:17:16,256  
in the vicinity and  
recommended flight maneuvers.

329

00:17:17,136 --> 00:17:20,686  
Initial results were promising  
with more validation and testing

330

00:17:20,686 --> 00:17:22,046  
to continue in the future.

331

00:17:23,026 --> 00:17:26,526  
Another partner General Atomics  
aeronautical systems Inc,

332

00:17:26,746 --> 00:17:30,096  
or GA flew their sky  
guardian aircraft.

333

00:17:31,306 --> 00:17:33,796  
It had been used for unmanned  
missions for many years,

334

00:17:34,166 --> 00:17:36,466  
totaling more than 6  
million flight hours.

335

00:17:37,366 --> 00:17:40,696  
For this NASA mission, a demo

aircraft piloted remotely

336

00:17:40,696 --> 00:17:43,016  
from California flew  
for nine hours

337

00:17:43,016 --> 00:17:45,786  
from its great youth flight  
operations facility near

338

00:17:45,786 --> 00:17:48,306  
Palmdale California  
to Yuma Arizona.

339

00:17:49,016 --> 00:17:51,566  
Data was collected from  
the detect and avoid system

340

00:17:51,566 --> 00:17:53,536  
to provide situational awareness

341

00:17:53,796 --> 00:17:55,776  
of air traffic near  
the sky guardian.

342

00:17:56,946 --> 00:17:58,816  
This system includes  
a traffic alert

343

00:17:58,816 --> 00:18:01,736  
and collision avoidance  
system, used unmanned aircraft

344

00:18:02,146 --> 00:18:03,666  
which fly in civil airspace.

345

00:18:04,166 --> 00:18:07,816  
And air-to-air radar to detect  
and track nearby aircraft

346

00:18:08,016 --> 00:18:09,976

that may not have  
active transponders.

347

00:18:10,516 --> 00:18:15,156

[ Music ]

348

00:18:15,656 --> 00:18:18,756

The particular aircraft in  
this test may provide services

349

00:18:18,786 --> 00:18:22,066

that include hundreds of  
miles of inspections of rail,

350

00:18:22,416 --> 00:18:25,526

power line communication,  
and canal infrastructure,

351

00:18:25,946 --> 00:18:28,726

agriculture monitoring  
and topological surveys,

352

00:18:29,186 --> 00:18:31,556

as well as wildfire  
and flood monitoring.

353

00:18:32,246 --> 00:18:35,226

According to GA CEO Linden Blue,

354

00:18:35,586 --> 00:18:39,106

"GA's work with NASA is  
opening the eyes of regulators

355

00:18:39,196 --> 00:18:42,586

to the safety and utility  
of unmanned aircraft systems

356

00:18:42,586 --> 00:18:44,316

in the performance  
of certain tasks

357

00:18:44,796 --> 00:18:47,276  
for public and commercial good."

358

00:18:48,046 --> 00:18:49,626  
Researchers believe these types

359

00:18:49,626 --> 00:18:53,066  
of aircraft will also play an  
important role during crisis

360

00:18:53,116 --> 00:18:55,696  
management events such  
as wildfire containment.

361

00:18:56,256 --> 00:18:59,716  
The onboard airborne sensors  
can see through thick smoke,

362

00:18:59,986 --> 00:19:02,596  
enabling the craft to  
inform ground personnel

363

00:19:02,846 --> 00:19:04,856  
about the location of fire lines

364

00:19:05,096 --> 00:19:07,756  
so they can deploy  
resources more efficiently.

365

00:19:08,166 --> 00:19:11,786  
The SIO demonstration also  
highlighted how the aircraft can

366

00:19:11,786 --> 00:19:15,786  
be used for many other civilian  
and commercial missions as well.

367

00:19:19,606 --> 00:19:22,236

The third demonstration  
flight was a team

368

00:19:22,236 --> 00:19:25,476

from American aerospace  
technologies Incorporated

369

00:19:25,476 --> 00:19:26,376

or AATI.

370

00:19:26,996 --> 00:19:30,356

Although AATI's craft  
was considerably smaller

371

00:19:30,356 --> 00:19:33,806

than the other test vehicles,  
its use case was invaluable.

372

00:19:34,216 --> 00:19:38,486

It can fly at medium altitudes  
and carry advanced sensors used

373

00:19:38,486 --> 00:19:41,646

to patrol our nation's  
more than 500,000 miles

374

00:19:41,646 --> 00:19:43,116

of midstream pipelines.

375

00:19:43,556 --> 00:19:46,966

Providing a fundamentally  
new and unique capability

376

00:19:47,296 --> 00:19:50,296

that changes the way we  
manage health, safety,

377

00:19:50,296 --> 00:19:54,766

and the environment, respond to disasters, optimize operations

378

00:19:54,876 --> 00:19:56,416  
and leverage human capital.

379

00:19:57,046 --> 00:19:59,156  
>> So the mission itself serves multiple purposes.

380

00:19:59,156 --> 00:20:02,036  
We're proving out the capability of beyond visual line

381

00:20:02,036 --> 00:20:04,166  
of sight UAS and the National Airspace.

382

00:20:04,626 --> 00:20:07,486  
And the specific applicability for this mission is

383

00:20:07,486 --> 00:20:08,866  
that we are looking for ways

384

00:20:08,866 --> 00:20:12,656  
to make critical infrastructure inspection processes safer

385

00:20:12,656 --> 00:20:13,596  
and more efficient.

386

00:20:14,126 --> 00:20:17,346  
And so for this specific mission, the AiRanger took off

387

00:20:17,346 --> 00:20:19,776  
from our launch and recovery site.

388

00:20:20,266 --> 00:20:24,796

And we flew downrange  
along an oil pipeline,

389

00:20:24,796 --> 00:20:25,906

which is buried underground.

390

00:20:26,186 --> 00:20:28,826

And we performed an  
inspection of the right

391

00:20:28,826 --> 00:20:29,826

of way of that pipeline.

392

00:20:30,016 --> 00:20:32,606

And we are proving out  
not only the applicability

393

00:20:32,606 --> 00:20:35,286

for critical infrastructure  
itself, but we're proving

394

00:20:35,286 --> 00:20:39,206

out the safety case for actually  
operating UAS and the NAS.

395

00:20:39,476 --> 00:20:42,276

Not only utilizing the  
aircraft technology for flight,

396

00:20:42,616 --> 00:20:45,606

but also utilizing different  
technologies for safety,

397

00:20:45,646 --> 00:20:49,046

such as detecting  
avoid systems ADS-B,

398

00:20:49,226 --> 00:20:51,716

and flight radar  
notification systems

399  
00:20:51,716 --> 00:20:54,786  
for having situational  
awareness of not only what's

400  
00:20:54,786 --> 00:20:57,126  
in the airspace around us,  
but being able to tell others

401  
00:20:57,126 --> 00:20:58,736  
in the airspace that  
we're flying as well.

402  
00:20:59,046 --> 00:21:03,456  
In my opinion, to safely  
regulate and certify these types

403  
00:21:03,456 --> 00:21:06,176  
of aircraft to fly,  
you have to prove

404  
00:21:06,176 --> 00:21:07,446  
out three different things.

405  
00:21:07,876 --> 00:21:10,066  
You have to prove out that  
the aircraft itself is

406  
00:21:10,066 --> 00:21:11,366  
mission capable.

407  
00:21:11,366 --> 00:21:15,156  
You have to prove that the  
aircraft is dynamically capable

408  
00:21:15,156 --> 00:21:16,866  
to change for different  
conditions.

409

00:21:17,196 --> 00:21:18,806

And you also most importantly,

410

00:21:18,806 --> 00:21:19,986

have to prove out  
the safety case.

411

00:21:20,466 --> 00:21:22,866

And so utilizing different  
types of technology,

412

00:21:22,906 --> 00:21:25,226

utilizing different  
processes and workflows,

413

00:21:25,496 --> 00:21:28,446

building the safety case  
around operating procedures,

414

00:21:28,756 --> 00:21:30,976

and integrating all of  
these different components.

415

00:21:31,476 --> 00:21:33,476

Aside from the actual  
flight itself,

416

00:21:33,736 --> 00:21:37,476

really build the roadmap, really  
set the stage for the rest

417

00:21:37,476 --> 00:21:38,956

of the industry to  
say, "Hey look,

418

00:21:39,446 --> 00:21:41,266

this is what the  
infrastructure looks like.

419

00:21:41,316 --> 00:21:43,716

This is what the framework  
looks like to do this

420

00:21:43,716 --> 00:21:45,976

on an operational  
basis in the future."

421

00:21:46,056 --> 00:21:49,006

>> Although the SIO  
demonstrations are now complete,

422

00:21:49,056 --> 00:21:52,426

NASA and industry will  
continue to move forward

423

00:21:52,566 --> 00:21:55,956

with exciting new  
technologies and hardware built

424

00:21:55,956 --> 00:21:59,726

on the foundation of successful  
data collection and testing

425

00:21:59,956 --> 00:22:01,476

from the SIO activity.

426

00:22:01,706 --> 00:22:04,376

The future of unmanned  
aircraft is bright.

427

00:22:04,376 --> 00:22:08,126

UAS will continue to  
advance scientific research,

428

00:22:08,126 --> 00:22:10,636

benefit environmental  
protection,

429

00:22:10,636 --> 00:22:15,356  
assist with disaster mitigation,  
and move more people and goods

430  
00:22:15,596 --> 00:22:18,226  
to their desired  
destinations safely

431  
00:22:18,506 --> 00:22:20,846  
and efficiently for  
decades to come.

432  
00:22:21,146 --> 00:22:24,506  
>> This was just the results of  
a project with a specific goal

433  
00:22:24,506 --> 00:22:27,256  
that we had within  
NASA aeronautics,

434  
00:22:27,746 --> 00:22:28,946  
but it's certainly not the end.

435  
00:22:29,076 --> 00:22:32,826  
I mean, integrating UAS into  
the National Airspace is an

436  
00:22:32,886 --> 00:22:33,936  
evolving thing.

437  
00:22:33,936 --> 00:22:35,306  
There are many more challenges.

438  
00:22:35,336 --> 00:22:36,576  
There are many more use cases

439  
00:22:36,576 --> 00:22:37,876  
that the industry is  
going to come up with.

440

00:22:38,516 --> 00:22:39,836

And so we're sensitive to that.

441

00:22:39,936 --> 00:22:41,636

And we're keeping an eye on that

442

00:22:41,636 --> 00:22:43,706

so that we can really  
align our research

443

00:22:43,706 --> 00:22:45,906

with those areas  
that are emerging.

444

00:22:45,906 --> 00:22:49,696

And hopefully, so that we can  
enable those to really be --

445

00:22:49,776 --> 00:22:52,886

to come into fruition for the  
benefit of the American public.

446

00:22:53,546 --> 00:22:56,216

And so as we start up  
new projects, you know,

447

00:22:56,216 --> 00:22:59,586

we'll leverage our experience  
with UAS in the NAS project.

448

00:23:00,056 --> 00:23:03,316

But we'll do it into new  
areas, whether it's autonomy

449

00:23:03,316 --> 00:23:06,676

or other areas of research,  
that will really enable a lot

450

00:23:06,676 --> 00:23:08,916

of these use cases and bring