

WEBVTT

1

00:00:01.275 --> 00:00:02.645

Next presenter is Mr.

2

00:00:02.675 --> 00:00:04.085

Dave Weber from the FAA.

3

00:00:04.105 --> 00:00:07.325

And again, you have his bio in the handout, uh,

4

00:00:07.425 --> 00:00:10.965

as you can see from that experience in a lot

5

00:00:11.065 --> 00:00:13.845

of different types of air vehicles.

6

00:00:14.485 --> 00:00:15.865

And the thing that stood out

7

00:00:15.965 --> 00:00:19.025

for me the most is the very last sentence, which says,

8

00:00:19.505 --> 00:00:22.425

A passionate supporter of aviation safety.

9

00:00:23.885 --> 00:00:26.015

We need more of those.

10

00:00:26.865 --> 00:00:29.205

So without any further ado, Mr.

11

00:00:29.205 --> 00:00:30.685

Dave Weber, the stage is yours.

12

00:00:47.065 --> 00:00:49.045

Oh, okay.

13

00:00:49.225 --> 00:00:52.135

So, uh, I'm, uh, DA Dave Weber.

14

00:00:52.135 --> 00:00:53.575  
So I'm a, a flight test engineer

15

00:00:53.835 --> 00:00:56.535  
and, uh, have the, uh, uh, the dubious honor

16

00:00:57.195 --> 00:01:00.535  
of being a test conductor on a pretty high visibility

17

00:01:01.215 --> 00:01:04.255  
accident that happened hard to believe almost 30 years ago,

18

00:01:05.075 --> 00:01:06.695  
out at Edwards Air Force Base.

19

00:01:07.615 --> 00:01:11.355  
Um, so for 30 years, I've kind of, uh, thought back to

20

00:01:11.355 --> 00:01:14.835  
that time and, and tried to figure out, uh, uh, what,

21

00:01:16.305 --> 00:01:17.795  
what, what were my human failings?

22

00:01:17.795 --> 00:01:19.355  
What were the group's human failings,

23

00:01:19.735 --> 00:01:21.355  
and what could we have done about that?

24

00:01:21.815 --> 00:01:23.515  
Not sure I have an answer, but I think, uh,

25

00:01:23.615 --> 00:01:25.955  
I'm gonna present a couple ideas today and,

26

00:01:25.955 --> 00:01:27.395  
and hopefully that that'll be useful.

27

00:01:27.775 --> 00:01:29.155

So this is a little unconventional.

28

00:01:29.295 --> 00:01:32.715

I'm going to, um, uh, chat a little bit, set the stage, uh,

29

00:01:32.735 --> 00:01:35.755

and then I'm gonna play the, uh, breaking the chain video.

30

00:01:35.935 --> 00:01:37.555

I'm sure a lot of you have seen the X

31

00:01:37.555 --> 00:01:38.875

31 breaking the chain video.

32

00:01:39.415 --> 00:01:42.375

I'm gonna limit it to about the first 20 minutes I to,

33

00:01:42.395 --> 00:01:43.935

to get the story out.

34

00:01:44.115 --> 00:01:47.335

And then I'm gonna come back into the PowerPoint slide, uh,

35

00:01:47.555 --> 00:01:50.215

and, and chat about a couple things there.

36

00:01:50.315 --> 00:01:54.585

So I, I hope you find this, um, worthwhile.

37

00:01:56.115 --> 00:01:59.695

Uh, it's a bit of a, there I was story, uh, and, and, uh,

38

00:02:00.155 --> 00:02:02.175

and there I don't want to be again.

39

00:02:02.395 --> 00:02:04.935

And a couple ideas, uh, how we could maybe do that.

40

00:02:07.395 --> 00:02:09.855

So this, this is where I, where I was on January 19th,

41

00:02:09.855 --> 00:02:14.015  
90 95, uh, in the control room at, at,

42

00:02:14.015 --> 00:02:15.695  
at Edward Edwards Air Force Base.

43

00:02:16.295 --> 00:02:17.475  
Uh, we're having an issue,

44

00:02:17.475 --> 00:02:19.675  
you're gonna see all this in the video shortly if you,

45

00:02:19.675 --> 00:02:21.725  
if you're not familiar with this accident.

46

00:02:22.305 --> 00:02:24.705  
Uh, and, and we basically had about two minutes

47

00:02:25.085 --> 00:02:26.105  
to solve a problem.

48

00:02:26.765 --> 00:02:28.345  
Uh, now if I put a problem up there,

49

00:02:28.525 --> 00:02:30.105  
you could probably solve it in two minutes,

50

00:02:30.365 --> 00:02:33.945  
but it's hard to solve a problem when you haven't identified

51

00:02:33.945 --> 00:02:35.225  
that you actually have a problem.

52

00:02:35.405 --> 00:02:38.905  
And that's really the problem we had, is we, we weren't sure

53

00:02:39.335 --> 00:02:40.345  
what was going on.

54

00:02:41.045 --> 00:02:44.585

And, uh, and even if we had figured that out, uh,

55

00:02:44.585 --> 00:02:45.945  
we would've had to figure out how

56

00:02:45.945 --> 00:02:47.105  
to get out of that problem.

57

00:02:47.485 --> 00:02:49.105  
And, uh, that, which would've been another

58

00:02:49.105 --> 00:02:50.825  
problem, all with two minutes.

59

00:02:51.045 --> 00:02:52.665  
Uh, and, and that, that, that's where we were.

60

00:02:53.585 --> 00:02:56.355  
Um, uh, so lemme set,

61

00:02:56.375 --> 00:02:57.755  
set the stage a bit and then we'll play the video.

62

00:02:58.255 --> 00:03:01.825  
So, so it's like I said, January 19th, 1995.

63

00:03:01.975 --> 00:03:04.785  
This is the last flight, uh, of the day.

64

00:03:05.175 --> 00:03:08.065  
It's also the planned last flight for the aircraft one.

65

00:03:08.685 --> 00:03:11.105  
Um, it's, uh, seventh flight of the week.

66

00:03:11.605 --> 00:03:14.385  
Uh, we had a pretty high ops tempo on the X 31 program

67

00:03:14.565 --> 00:03:18.285  
and on, and this one was, uh, uh, conventional flight.

68

00:03:18.305 --> 00:03:20.605

So less than 30 degrees angle of attack was

69

00:03:21.285 --> 00:03:23.205

considered conventional flight for the X 31.

70

00:03:23.505 --> 00:03:24.685

We didn't spend a lot of time there.

71

00:03:24.785 --> 00:03:26.565

Uh, this was a aircraft design

72

00:03:26.565 --> 00:03:27.885

for a high angle of attack flight.

73

00:03:28.385 --> 00:03:32.485

We were used to doing max ab up down type of flights.

74

00:03:32.485 --> 00:03:35.285

We didn't do much, uh, level flight conditions,

75

00:03:35.345 --> 00:03:36.725

but that, that, that's what this one was.

76

00:03:37.345 --> 00:03:39.115

And so, so here's the situation.

77

00:03:39.335 --> 00:03:42.635

Uh, the, this is the test information sheet.

78

00:03:42.635 --> 00:03:44.395

That picture there, I've got that in my old books.

79

00:03:44.535 --> 00:03:46.075

But the, uh, the plan was

80

00:03:46.075 --> 00:03:48.435

to fly these test points at 28,000 feet,

81

00:03:48.855 --> 00:03:53.195

but we had a cloud deck, uh, at that base was about 21,000

82

00:03:53.195 --> 00:03:54.435  
or 22,000 feet.

83

00:03:55.175 --> 00:03:58.555  
Uh, so we couldn't go up to 20, 28,000 feet.

84

00:03:59.165 --> 00:04:00.905  
So we're talking with the customer,

85

00:04:00.925 --> 00:04:02.745  
and that was DLR, that's na, uh,

86

00:04:02.745 --> 00:04:04.385  
Germany's equivalent of, of nasa.

87

00:04:05.165 --> 00:04:09.045  
And, and, and DLR said, uh, just give us as high as you can.

88

00:04:09.705 --> 00:04:12.315  
Well, we're, we're can do people, uh,

89

00:04:12.315 --> 00:04:14.515  
we had a temporary operating procedure for our

90

00:04:15.235 --> 00:04:17.075  
modified FLUTER test box.

91

00:04:17.295 --> 00:04:20.355  
Uh, and in that, in that top, uh, it was shown

92

00:04:20.355 --> 00:04:22.595  
that the modified Fluter test box has been cleared

93

00:04:22.595 --> 00:04:23.915  
for 20,000 feet and above.

94

00:04:24.475 --> 00:04:28.135  
So you can see the situation starting to, to, to grow here.

95

00:04:28.745 --> 00:04:30.055

We're kind of painted into the corner,

96

00:04:30.155 --> 00:04:31.255

but we're, can do people,

97

00:04:31.255 --> 00:04:32.375

it's the last flight of the program.

98

00:04:32.945 --> 00:04:35.015

Let's see if we can get this low risk, uh,

99

00:04:35.015 --> 00:04:36.055

flight, flight test off.

100

00:04:36.195 --> 00:04:37.775

And I imagine every one

101

00:04:37.775 --> 00:04:40.135

of us has been in similar situations like this where you,

102

00:04:40.595 --> 00:04:43.645

uh, decide that you can, uh, see about getting a,

103

00:04:43.765 --> 00:04:45.525

a test done, particularly a low risk one.

104

00:04:47.405 --> 00:04:50.265

So this is the control room layout at, uh, at nasa, Dryden,

105

00:04:50.725 --> 00:04:52.585

uh, I'm not sure whether in the blue or the gold room,

106

00:04:52.585 --> 00:04:54.465

but it was a layout laid out something like this.

107

00:04:54.465 --> 00:04:56.425

This is, uh, this picture's taken around this

108

00:04:56.425 --> 00:04:57.545



around 30 years ago.

109

00:04:58.125 --> 00:04:59.905

And, uh, just, just wanna point out a couple things.

110

00:05:00.045 --> 00:05:02.745

Uh, for me, I was one of the test conductors.

111

00:05:02.935 --> 00:05:05.185

I've been on the program for quite a while from about,

112

00:05:05.185 --> 00:05:06.545

since about 1991.

113

00:05:06.575 --> 00:05:08.425

This accident happened in 1995.

114

00:05:09.165 --> 00:05:11.825

Uh, I wasn't with the air airplane from first flight.

115

00:05:11.885 --> 00:05:13.265

We just talked about first flights.

116

00:05:13.705 --> 00:05:15.965

The, those happened in Palmdale, but shortly

117

00:05:15.965 --> 00:05:18.005

after Palmdale, they moved out, moved out to Edwards.

118

00:05:18.105 --> 00:05:20.645

But I, I joined as a Air Force civilian.

119

00:05:21.385 --> 00:05:25.125

Uh, and, uh, I had become a test conductor, uh,

120

00:05:25.705 --> 00:05:26.885

by NASA's blessings.

121

00:05:26.905 --> 00:05:28.285

Uh, and, and, uh,

122

00:05:28.985 --> 00:05:30.885  
the way we worked is we had a test conductor

123

00:05:30.885 --> 00:05:31.885  
and a note taker.

124

00:05:32.385 --> 00:05:33.885  
Uh, we worked in ops.

125

00:05:33.885 --> 00:05:37.945  
We would sit in the same, uh, office with, uh, uh, the likes

126

00:05:37.945 --> 00:05:40.185  
of Carl Lang, Fred Knox, uh, and Kim.

127

00:05:40.245 --> 00:05:43.425  
And, and the other, uh, uh, test pilots for the,

128

00:05:43.425 --> 00:05:45.945  
for the X 31, uh, over, near, near the aircraft.

129

00:05:46.365 --> 00:05:47.385  
And the way we would work it is,

130

00:05:47.485 --> 00:05:48.505  
is you would either take notes

131

00:05:48.525 --> 00:05:49.985  
or you'd be the test conductor.

132

00:05:50.065 --> 00:05:52.705  
So I con I had been test conductor on the previous flight,

133

00:05:53.125 --> 00:05:55.265  
and on the accident flight, I was taking notes.

134

00:05:55.445 --> 00:05:57.965  
And, uh, Jim was sitting there n next to me.

135

00:05:59.825 --> 00:06:02.045

So we would have a senior ops rep next to us.

136

00:06:02.225 --> 00:06:04.885

Uh, people like Bill, Dana, Milt Thompson, some very, um,

137

00:06:05.505 --> 00:06:08.885

uh, or, or any of the, uh, NASA research PI pilots or,

138

00:06:08.885 --> 00:06:11.365

or ops managers would be, be next to us here.

139

00:06:11.985 --> 00:06:14.085

And, uh, behind, behind us would be the

140

00:06:14.085 --> 00:06:15.125

flight controls and systems.

141

00:06:15.125 --> 00:06:18.245

They were kind of key on, on this particular flight.

142

00:06:18.825 --> 00:06:21.565

And, uh, we had discipline engineers, propulsion structures,

143

00:06:21.565 --> 00:06:23.885

what have you, and project management might be in there.

144

00:06:24.225 --> 00:06:26.525

In this case, I think our, uh, as I recall, our,

145

00:06:26.545 --> 00:06:29.005

our DLR data customer was sit sitting next to us.

146

00:06:30.805 --> 00:06:33.665

So a couple other situations, uh, you know, we'd,

147

00:06:33.885 --> 00:06:36.065

we had 500 flights on both ships.

148

00:06:36.205 --> 00:06:37.745

One ship two, like I mentioned.

149

00:06:37.745 --> 00:06:42.145

This was the, the 290, the, the, the last flight plan,

150

00:06:42.175 --> 00:06:43.345

last flight for ship one.

151

00:06:43.485 --> 00:06:45.225

And it was flight 2 92 for that.

152

00:06:45.225 --> 00:06:47.785

That particular aircraft, we've been pretty successful.

153

00:06:47.785 --> 00:06:51.025

Our tactical utility evaluation had been completed

154

00:06:51.025 --> 00:06:52.505

after we'd done envelope expansion.

155

00:06:52.725 --> 00:06:55.785

Uh, we, we had carefree flying quality is up

156

00:06:55.785 --> 00:06:57.225

to 70 degrees angle of attack.

157

00:06:57.685 --> 00:07:00.865

Uh, we'd, we'd flown against, uh, hornets n fourteens

158

00:07:00.865 --> 00:07:02.825

and n fifteens and n sixteens and, and,

159

00:07:02.885 --> 00:07:07.225

and, uh, uh, proven out the concept of, uh,

160

00:07:07.405 --> 00:07:09.545

low speed thrust vectoring, high angle of attack,

161

00:07:09.645 --> 00:07:11.025

um, uh, close in combat.

162

00:07:11.895 --> 00:07:14.795

Uh, the other thing that's going on around this time is, uh,

163

00:07:15.575 --> 00:07:19.575

the Rockwell and MBB, we had teamed up for the X 31 program.

164

00:07:19.925 --> 00:07:21.375

They're searching for new business.

165

00:07:21.475 --> 00:07:24.015

And the j Pats programs going on, uh,

166

00:07:24.045 --> 00:07:26.535

they were specifically supporting the Ranger 2000.

167

00:07:26.835 --> 00:07:30.015

You might recall the lost one of those aircraft in 1993.

168

00:07:30.565 --> 00:07:34.495

There's a, a lot of work going on on the Ranger 2000 to,

169

00:07:34.795 --> 00:07:38.095

to keep that program alive, uh, and fix the problems.

170

00:07:38.115 --> 00:07:40.495

And, and so a lot of the key personnel

171

00:07:40.495 --> 00:07:42.675

that were involved in the first flight, uh,

172

00:07:42.675 --> 00:07:44.755

they're all now working new business.

173

00:07:45.135 --> 00:07:49.035

And so, so, so we're, uh, so they're bringing in the B team.

174

00:07:49.295 --> 00:07:51.515

You, you'll hear us all called the A team.

175

00:07:51.915 --> 00:07:53.755

I was probably the B team quite honestly.

176

00:07:53.935 --> 00:07:57.075

We, we had the, um, the key personnel from Rockwell and MBB

177

00:07:57.075 --> 00:07:59.435

or probably your a team, your first flight personnel, people

178

00:07:59.435 --> 00:08:00.435

who were with it from Palmdale.

179

00:08:01.015 --> 00:08:04.555

Uh, and, uh, I was now young,

180

00:08:04.895 --> 00:08:06.835

but kind of an old timer on the program.

181

00:08:07.535 --> 00:08:11.675

So, uh, uh, I was training, uh, I was past training, uh,

182

00:08:11.735 --> 00:08:15.635

Jim, the, uh, replacement, uh, test conductor from Rockwell.

183

00:08:16.055 --> 00:08:19.995

And, and as a note of interest, uh, Jim was from the, uh,

184

00:08:19.995 --> 00:08:22.315

he was one of the fired, uh, Reagan, uh,

185

00:08:22.455 --> 00:08:23.635

air traffic controllers.

186

00:08:23.695 --> 00:08:24.995

And, and, and, uh, but very,

187

00:08:24.995 --> 00:08:27.075

really sharp guy, private pilot.

188

00:08:27.575 --> 00:08:29.355

Uh, but it's kind of interesting,

189

00:08:29.815 --> 00:08:31.275

and I think it plays into this a bit.

190

00:08:31.855 --> 00:08:34.155

He didn't have the, the, he was part

191

00:08:34.155 --> 00:08:35.435

of the B one program was not part

192

00:08:35.435 --> 00:08:36.635

of the X 31 from the start.

193

00:08:38.135 --> 00:08:41.835

He didn't have the corporate history of the X 31.

194

00:08:42.175 --> 00:08:43.235

And that plays out, I think,

195

00:08:43.275 --> 00:08:44.675

a bit in what we'll see in the video.

196

00:08:46.535 --> 00:08:48.195

So I'm gonna shift gears just a little bit,

197

00:08:48.395 --> 00:08:50.315

and I want to plant this thought in your head

198

00:08:50.315 --> 00:08:51.315

before we watch the video.

199

00:08:51.535 --> 00:08:53.955

So think about problem solving. We got a problem.

200

00:08:55.165 --> 00:08:57.505

We know we have a problem. The hairs are up on the back

201

00:08:57.505 --> 00:08:58.505

of our neck.

202

00:08:58.605 --> 00:09:00.865

Uh, if, if, if the video makes you think

203

00:09:00.865 --> 00:09:03.465

that the people were not concerned, that's not true.

204

00:09:03.565 --> 00:09:05.225

We were concerned. We knew there was a problem,

205

00:09:05.285 --> 00:09:06.425

we just didn't know what it was.

206

00:09:07.215 --> 00:09:10.435

So, um, uh, we needed our access to the smart brain,

207

00:09:10.575 --> 00:09:12.245

the front of the brain, uh,

208

00:09:12.425 --> 00:09:15.405

but under stress, I want to, uh, point out that, you know,

209

00:09:15.505 --> 00:09:18.605

we got the emotional brain that, that that's kicking in, uh,

210

00:09:18.605 --> 00:09:19.965

in these, uh, in these two minutes.

211

00:09:20.715 --> 00:09:24.455

And, and I make a point, I think we all know this, that, uh,

212

00:09:24.635 --> 00:09:25.655

you know, there, there's trained

213

00:09:25.975 --> 00:09:27.375

responses that we go through.

214

00:09:27.875 --> 00:09:30.895

Uh, we're trained to fight, and, uh, uh, and, and we fight.

215

00:09:30.895 --> 00:09:33.095

We fight like we, like, we're trained.

216

00:09:33.435 --> 00:09:34.975



Uh, and that's because we're,

217

00:09:34.975 --> 00:09:36.615

we're using the emotional part of our brain.

218

00:09:37.275 --> 00:09:39.495

And I think in a real sense, that's why we,

219

00:09:39.515 --> 00:09:40.775

we often talk about, you know,

220

00:09:40.975 --> 00:09:42.655

dropping IQ points when we walk out of the,

221

00:09:42.655 --> 00:09:44.135

uh, the pre-flight brief.

222

00:09:44.355 --> 00:09:46.455

Uh, and, and it's a real, it's a real thing.

223

00:09:46.455 --> 00:09:47.855

And I think it's probably related to this.

224

00:09:48.275 --> 00:09:52.175

So one of the common stressors, well, uh, if you,

225

00:09:52.175 --> 00:09:55.015

if you read the psychology books, anger, fear, anxiety,

226

00:09:55.015 --> 00:09:59.015

extreme excitement, perception of danger, um,

227

00:09:59.635 --> 00:10:02.015

tribal acceptance is a real important thing for us.

228

00:10:02.155 --> 00:10:03.735

You got a control room situation.

229

00:10:04.235 --> 00:10:06.895

Uh, we always talk about, uh, everybody has the no vote.

230

00:10:06.895 --> 00:10:09.935

We talk about making people at ease to speak up.

231

00:10:10.395 --> 00:10:12.935

Uh, 'cause you, you, people cont tend

232

00:10:12.935 --> 00:10:14.295

to not speak up if they feel

233

00:10:14.295 --> 00:10:15.335

like they're saying something wrong.

234

00:10:15.565 --> 00:10:17.175

They don't want to be kicked out of the tribe.

235

00:10:17.315 --> 00:10:20.375

In our emotional brain, uh, we are,

236

00:10:20.825 --> 00:10:22.735

we're wired for survival.

237

00:10:22.955 --> 00:10:26.135

And survival in the old days meant being part of the tribe.

238

00:10:26.515 --> 00:10:29.715

So, kind of describes flight test, doesn't it?

239

00:10:29.715 --> 00:10:30.835

This is the situation.

240

00:10:31.415 --> 00:10:34.555

And, and I, I would offer that we're in this

241

00:10:34.625 --> 00:10:36.275

because we like using the front part

242

00:10:36.275 --> 00:10:37.875

of our brain before we fly.

243

00:10:37.875 --> 00:10:39.755

But I think we are all emotionally attached

244

00:10:39.775 --> 00:10:41.755  
to this business and flight test.

245

00:10:41.825 --> 00:10:44.035  
It's a, it's a, it is a very emotional thing for us.

246

00:10:44.535 --> 00:10:48.215  
And, uh, there's so common stressors and some,

247

00:10:48.435 --> 00:10:50.055  
and some, uh, failings that we have.

248

00:10:50.685 --> 00:10:53.535  
So here we are getting ready to play this video, uh,

249

00:10:53.555 --> 00:10:56.015  
and I'm gonna sit down for 20 minutes and watch it with you.

250

00:10:56.075 --> 00:10:57.415  
But, but think of this.

251

00:10:57.415 --> 00:10:59.735  
We got, we got holes due to latent failures.

252

00:11:00.115 --> 00:11:01.455  
We got some things that are, that are in,

253

00:11:01.455 --> 00:11:03.555  
that are in the system, uh, and,

254

00:11:03.555 --> 00:11:05.595  
and we've got holes due to active failures, things

255

00:11:05.595 --> 00:11:08.075  
that are happening right there in the flight.

256

00:11:08.655 --> 00:11:10.185  
And here's us.

257

00:11:10.415 --> 00:11:11.905

This, this is where we are,

258

00:11:12.365 --> 00:11:16.065

and we've gotta close our holes, uh, in our human failings

259

00:11:16.645 --> 00:11:19.465

in order to deal with, with what we're about to deal with.

260

00:11:19.485 --> 00:11:20.905

So I wanna just leave that with you.

261

00:11:21.605 --> 00:11:24.105

I'm gonna play the video, uh, for about 20 minutes.

262

00:11:24.205 --> 00:11:26.425

I'm gonna sit down, have some coffee with you, and then, uh,

263

00:11:26.445 --> 00:11:28.825

and, and play this, not come back and, and finish this up.

264

00:11:37.155 --> 00:11:38.895

I'm gonna click it again. Claude, hold on. Let's see.

265

00:11:38.895 --> 00:11:39.895

This starts it.

266

00:11:45.315 --> 00:11:47.455

NA one, we have an ejection. We have an ejection.

267

00:11:51.395 --> 00:11:54.405

The aircraft is descending over the north base area.

268

00:11:59.545 --> 00:12:04.425

I have a shoot. The pilots out

269

00:12:04.445 --> 00:12:05.825

the seat and the shoot is good.

270

00:12:11.445 --> 00:12:12.945

We had a highly competent team,

271

00:12:13.495 --> 00:12:16.065

very experienced many flights under their belt.

272

00:12:16.605 --> 00:12:18.705

We had a number of pilots that flew the airplane.

273

00:12:19.245 --> 00:12:21.185

The pilot in particular that was flying that day,

274

00:12:21.525 --> 00:12:23.545

had been on the program from the very beginning,

275

00:12:24.085 --> 00:12:26.745

highly experienced, uh, with the X 31.

276

00:12:27.175 --> 00:12:28.985

Each mishap has its own set

277

00:12:28.985 --> 00:12:31.625

of circumstances in its own sequence of events.

278

00:12:32.645 --> 00:12:36.265

But you find similar issues, communications,

279

00:12:37.455 --> 00:12:39.705

complacency, assumptions

280

00:12:39.705 --> 00:12:42.105

that haven't been warranted, human frailties.

281

00:12:43.485 --> 00:12:46.265

And you have to account for these things in a program,

282

00:12:47.015 --> 00:12:48.025

Just like a chain.

283

00:12:49.085 --> 00:12:50.145

You make a chain.

284

00:12:50.415 --> 00:12:53.825

When you have any of these accidents, a chain of events,

285

00:12:54.765 --> 00:12:57.425

any link of the chain, if it were broken,

286

00:12:57.685 --> 00:12:58.945

you would not have an accident.

287

00:12:59.375 --> 00:13:00.385

This was the, A team.

288

00:13:00.725 --> 00:13:03.665

We had the best people from every discipline,

289

00:13:03.815 --> 00:13:06.465

from every organization, and we lost an airplane.

290

00:13:07.485 --> 00:13:09.825

So if it can happen to the best team,

291

00:13:09.845 --> 00:13:11.385

it can happen to any team.

292

00:13:24.355 --> 00:13:27.975

The X 31 research effort began in the late 1980s

293

00:13:27.995 --> 00:13:31.975

as an international program involving darpa, the US Navy,

294

00:13:32.295 --> 00:13:35.815

Deutsche Aerospace, the German Federal Ministry of Defense,

295

00:13:36.075 --> 00:13:37.535

and Rockwell International.

296

00:13:38.455 --> 00:13:41.115

The program's goal was to explore the tactical utility

297

00:13:41.135 --> 00:13:42.555

of a thrust vectored aircraft

298

00:13:42.745 --> 00:13:44.755

with advanced flight control systems

299

00:13:45.485 --> 00:13:46.915

using an aircraft designed

300

00:13:46.915 --> 00:13:48.675

and built specifically for that task.

301

00:13:50.775 --> 00:13:53.475

Uh, the X 31 was a real pioneering program.

302

00:13:54.445 --> 00:13:58.065

And in fact, the X 31 program pretty much wrote the book on

303

00:13:58.365 --> 00:14:00.625

thrust vectoring, along with its sister program.

304

00:14:00.845 --> 00:14:02.705

The F 18 Harv.

305

00:14:03.945 --> 00:14:07.645

The initial X 31 flight tests were conducted at Rockwell's

306

00:14:07.845 --> 00:14:09.205

facility in Palmdale, California.

307

00:14:09.625 --> 00:14:12.045

But in 1992, NASA

308

00:14:12.265 --> 00:14:15.725

and the US Air Force joined the X 31 research team,

309

00:14:16.145 --> 00:14:18.045

and the test flight program was moved

310

00:14:18.045 --> 00:14:20.285

to the Dryden Flight Research Center on

311  
00:14:20.315 --> 00:14:21.525  
Edwards Air Force Base.

312  
00:14:22.585 --> 00:14:23.845  
And before too long,

313  
00:14:24.145 --> 00:14:27.885  
the X 31 was turning in some extremely impressive results.

314  
00:14:32.585 --> 00:14:36.405  
By any measure, the X 31 was a highly successful program.

315  
00:14:37.185 --> 00:14:39.325  
It regularly flew several flights a day,

316  
00:14:39.645 --> 00:14:43.005  
accumulating over 550 flights during the course

317  
00:14:43.005 --> 00:14:45.965  
of the program with a superlative safety record.

318  
00:14:46.705 --> 00:14:49.965  
And yet, on the 19th of January, 1995,

319  
00:14:50.585 --> 00:14:54.005  
on the very last scheduled flight of the X 31 ship,

320  
00:14:54.005 --> 00:14:56.405  
number one disaster struck.

321  
00:14:57.005 --> 00:14:59.935  
This particular flight had been on the books for

322  
00:15:00.485 --> 00:15:01.895  
some time to get done.

323  
00:15:02.075 --> 00:15:05.575  
And it was, by our standards, an absolutely routine flight.

324  
00:15:06.275 --> 00:15:07.815



We were not expanding the envelope.

325

00:15:08.115 --> 00:15:09.775

We were not trying anything new.

326

00:15:10.355 --> 00:15:12.295

We, we were flying a new pedostatic tube.

327

00:15:12.355 --> 00:15:16.615

But this was in a routine, uh, mission,

328

00:15:17.015 --> 00:15:19.975

a routine task, routine flight environment

329

00:15:20.165 --> 00:15:22.495

with an experienced pilot and experienced crew.

330

00:15:23.775 --> 00:15:25.195

But while the flight was routine,

331

00:15:25.565 --> 00:15:28.075

there had been some changes to the configuration

332

00:15:28.075 --> 00:15:32.505

of the X 31 since its initial flights, in particular,

333

00:15:33.165 --> 00:15:34.665

the original pedo tube,

334

00:15:34.675 --> 00:15:37.345

which supplies airspeed information to the plane's.

335

00:15:37.345 --> 00:15:40.745

Flight control computers had been replaced with another kind

336

00:15:40.745 --> 00:15:43.385

of pedo tube known as a keel probe.

337

00:15:44.455 --> 00:15:47.955

The keel probe gave more accurate airspeed data at high

338

00:15:48.075 --> 00:15:51.595  
angles of attack, but it was more vulnerable to icing,

339

00:15:52.045 --> 00:15:56.075  
especially since the keel probe on the X 31 did not have

340

00:15:56.175 --> 00:15:57.275  
any PTO heat.

341

00:15:57.695 --> 00:15:59.315  
We were never to fly the airplane in ice.

342

00:15:59.505 --> 00:16:00.715  
That was a prohibited maneuver.

343

00:16:00.895 --> 00:16:02.515  
So if you're prohibited from flying in ice,

344

00:16:03.055 --> 00:16:04.135  
you don't need a heater.

345

00:16:05.595 --> 00:16:07.755  
Normally, the conditions at Edwards are warm

346

00:16:07.755 --> 00:16:11.395  
and dry enough that icing or pedo heat isn't a concern.

347

00:16:12.915 --> 00:16:17.335  
But January 19th, 1995 was not a normal day.

348

00:16:19.395 --> 00:16:22.055  
The usual part of the day was we had a, uh,

349

00:16:22.365 --> 00:16:23.575  
high humidity at altitude,

350

00:16:23.895 --> 00:16:25.775  
actually conducive of freezing conditions.

351

00:16:26.075 --> 00:16:30.255

Uh, and, and airplane, uh, was operated for in

352

00:16:30.255 --> 00:16:32.175

and out of some fairly high moisture content

353

00:16:32.355 --> 00:16:34.735

for extended periods of time, uh, led

354

00:16:34.735 --> 00:16:36.655

to some indications in the cockpit in the control room

355

00:16:36.655 --> 00:16:38.575

that it was causing problems with the air data system.

356

00:16:45.725 --> 00:16:49.615

This particular airplane had a limit, uh, to not fly

357

00:16:49.615 --> 00:16:52.915

through clouds, through visible moisture that day.

358

00:16:53.335 --> 00:16:57.075

Uh, we were flying very close to, and occasionally in

359

00:16:57.075 --> 00:16:59.715

and out of very thin serious cloud.

360

00:17:00.375 --> 00:17:02.035

Uh, it didn't particularly worry me

361

00:17:02.035 --> 00:17:05.275

because, uh, everything seemed

362

00:17:05.495 --> 00:17:07.315

to be going along quite normally.

363

00:17:08.585 --> 00:17:11.115

But some minutes, like five

364

00:17:11.735 --> 00:17:14.835

before the airplane went out of control

365

00:17:14.855 --> 00:17:15.955  
and the pilot jumped out.

366

00:17:16.835 --> 00:17:19.565  
The pilot observed that

367

00:17:20.135 --> 00:17:22.205  
there was some moisture around where he was.

368

00:17:22.545 --> 00:17:24.525  
So he turned the Peter heat switch on.

369

00:17:26.075 --> 00:17:28.375  
Now, clearly, when he turned the petto hit switch on,

370

00:17:28.395 --> 00:17:32.055  
he expected that the petto heat would be working about, uh,

371

00:17:32.055 --> 00:17:33.895  
two and a half minutes later, which is two

372

00:17:33.895 --> 00:17:35.575  
and a half minutes before the accident.

373

00:17:36.555 --> 00:17:40.215  
Uh, he mentioned that fact to the control room.

374

00:17:42.825 --> 00:17:45.235  
Okay, remind me. I just put the Peter hit on,

375

00:17:45.235 --> 00:17:46.395  
remind me to put it off.

376

00:17:46.625 --> 00:17:48.915  
Copy that. Ready?

377

00:17:49.265 --> 00:17:51.285  
The PE heat's not hooked up on a kill prob,

378

00:17:53.275 --> 00:17:57.815

Uh, you got an on On mysteriously to this day.

379

00:17:58.815 --> 00:18:00.875

The control room gave him no response.

380

00:18:01.465 --> 00:18:03.035

They had an internal discussion

381

00:18:03.695 --> 00:18:05.595

as time the clock clicked down,

382

00:18:06.655 --> 00:18:09.825

and internally it was commented

383

00:18:09.825 --> 00:18:11.865

that the pedal heat was not hooked up.

384

00:18:12.625 --> 00:18:16.005

But this vital piece of information was not relayed

385

00:18:16.005 --> 00:18:17.885

to the pilot for more than two minutes.

386

00:18:18.545 --> 00:18:21.885

And even when it was, the information was not stated

387

00:18:21.945 --> 00:18:24.645

as clearly or strongly as it could have been. And

388

00:18:24.665 --> 00:18:27.845

The pedal heat, Well, I leave it on for a moment.

389

00:18:28.515 --> 00:18:30.205

Yeah, we think it may not be hooked up.

390

00:18:31.425 --> 00:18:34.605

It may not be hooked up. That's good. I like this.

391

00:18:35.565 --> 00:18:38.425

We had side discussions that should have been going on,

392

00:18:38.425 --> 00:18:39.705  
on the intercom so

393

00:18:39.705 --> 00:18:40.985  
that everybody in the control room

394

00:18:41.405 --> 00:18:42.585  
was part of the conversation.

395

00:18:43.095 --> 00:18:45.345  
Instead, we'd pulled our headsets aside so

396

00:18:45.345 --> 00:18:46.425  
that we could talk to each other

397

00:18:46.425 --> 00:18:48.265  
because we're sitting adjacent to each other.

398

00:18:48.565 --> 00:18:51.105  
And that's another part of just control room discipline

399

00:18:51.105 --> 00:18:52.465  
that, that we broke down on.

400

00:18:52.815 --> 00:18:54.625  
Meanwhile, the first signs

401

00:18:54.625 --> 00:18:56.465  
of trouble were beginning to appear.

402

00:18:57.165 --> 00:18:59.965  
So now the pilot, um,

403

00:19:00.355 --> 00:19:03.765  
sees an anomaly in his air speed is at 20

404

00:19:03.765 --> 00:19:05.045  
degrees angle of attack.

405

00:19:06.515 --> 00:19:09.295

And he can see that. And he says to the ground,

406

00:19:09.475 --> 00:19:13.735

and I briefed this many times, he said, I'm at 277,

407

00:19:13.935 --> 00:19:15.575

I mean 207 knots,

408

00:19:16.845 --> 00:19:18.505

And the air speed is off.

409

00:19:18.605 --> 00:19:22.345

Uh, reading 277 knots at 20 a a.

410

00:19:24.615 --> 00:19:25.615

Okay, pick dub.

411

00:19:27.615 --> 00:19:30.065

Well, anybody that's been on the program

412

00:19:30.245 --> 00:19:31.825

and there, less of people who have been on many years,

413

00:19:31.825 --> 00:19:34.265

would know that 20 degrees angle attack is somewhere

414

00:19:34.265 --> 00:19:37.265

around 135 knots, 140 knots.

415

00:19:37.265 --> 00:19:39.705

Doesn't matter. It's not 207 knots.

416

00:19:40.585 --> 00:19:43.985

Apparently no one in the control room caught the possible

417

00:19:43.985 --> 00:19:45.785

significance of that discrepancy.

418

00:19:46.695 --> 00:19:48.395

And perhaps even more importantly,

419  
00:19:48.825 --> 00:19:52.245  
neither did the chase pilot for the simple reason

420  
00:19:52.245 --> 00:19:54.965  
that he couldn't hear any of the pilot's transmissions.

421  
00:19:55.865 --> 00:20:00.325  
We had a, a mechanism of hot mic, very important

422  
00:20:00.345 --> 00:20:02.765  
to the pilot in the X 31, that he'd be able to talk

423  
00:20:02.765 --> 00:20:04.765  
to the control room without having

424  
00:20:04.765 --> 00:20:06.525  
to press buttons at certain key times,

425  
00:20:07.095 --> 00:20:08.685  
especially at high angle attack,

426  
00:20:09.645 --> 00:20:11.595  
which was not gonna be a factor in this flight,

427  
00:20:12.335 --> 00:20:14.415  
'cause it was gonna go to about 20 degrees angle of attack.

428  
00:20:15.085 --> 00:20:18.825  
But it was a general operating procedure

429  
00:20:20.125 --> 00:20:21.295  
that was compounded

430  
00:20:21.415 --> 00:20:24.615  
because our hot mic system didn't work always very well.

431  
00:20:25.155 --> 00:20:26.575  
And when it didn't work, it put a lot

432  
00:20:26.575 --> 00:20:30.855



of static in the earphones of the chase pilot who wanted

433

00:20:30.855 --> 00:20:33.625

to hear the hot mic to know what's going on.

434

00:20:34.125 --> 00:20:37.105

So it was the one-sided nature of the communication

435

00:20:37.105 --> 00:20:40.465

that kept me from having the situational awareness

436

00:20:40.965 --> 00:20:45.345

to be able to step in and say, Hey, I'm reading X knots.

437

00:20:45.805 --> 00:20:48.125

Uh, and you guys are reading why nots

438

00:20:48.125 --> 00:20:49.965

and these two numbers should be the same, and they're not.

439

00:20:50.895 --> 00:20:53.955

The X 31 did indeed have an air data problem.

440

00:20:54.695 --> 00:20:58.115

The unheated keel probe had frozen over in the cool moist

441

00:20:58.115 --> 00:20:59.835

conditions, causing it

442

00:20:59.835 --> 00:21:02.075

to start giving incorrect airspeed information

443

00:21:02.075 --> 00:21:04.795

to the X 30 ones flight control computers.

444

00:21:06.075 --> 00:21:09.765

In terms of the accepted risk, the failure

445

00:21:09.865 --> 00:21:13.965

of the pedo static system, or damage to it was well known.

446

00:21:14.065 --> 00:21:15.085  
It was well understood.

447

00:21:15.835 --> 00:21:19.895  
The, uh, pilot himself had simulated the failure in

448

00:21:19.895 --> 00:21:22.175  
simulations, uh, before we even got the airplane.

449

00:21:22.635 --> 00:21:25.295  
And it probably helped him understand that he had to get out

450

00:21:25.335 --> 00:21:27.295  
of the airplane because the time is short when the

451

00:21:27.455 --> 00:21:28.815  
airplane is diverging.

452

00:21:29.745 --> 00:21:32.365  
And we went through quite a thorough review of,

453

00:21:32.985 --> 00:21:36.015  
of the hazards, uh, that we knew

454

00:21:36.195 --> 00:21:38.655  
or could come up with based upon the design of the,

455

00:21:38.655 --> 00:21:39.815  
uh, the flight control system.

456

00:21:39.875 --> 00:21:41.335  
And we thought we had a good handle on that,

457

00:21:41.355 --> 00:21:43.455  
and we thought we could lose the whole no spoon.

458

00:21:43.475 --> 00:21:44.775  
We could take a bird strike,

459

00:21:45.365 --> 00:21:47.855

wipe out the whole nose boom, and fly home safe.

460

00:21:49.335 --> 00:21:51.435

As a result of that, we thought we had a pretty

461

00:21:51.575 --> 00:21:52.955

robust system.

462

00:21:53.915 --> 00:21:56.695

The reason the team thought they had a robust system

463

00:21:57.235 --> 00:22:00.095

was the X 30 ones flight control system was designed

464

00:22:00.095 --> 00:22:02.015

with three backup reversionary modes.

465

00:22:02.015 --> 00:22:05.655

The pilot could select in the event of an air data problem

466

00:22:05.795 --> 00:22:07.335

or other systems failures.

467

00:22:08.485 --> 00:22:12.025

So in the case of if you saw something that was

468

00:22:13.005 --> 00:22:15.025

not right, or the control room saw something

469

00:22:15.025 --> 00:22:17.225

that was not right with respect to the airspeed system,

470

00:22:17.735 --> 00:22:20.105

they could tell the pilot to go to R three.

471

00:22:21.275 --> 00:22:23.115

R three was a reversionary mode

472

00:22:23.265 --> 00:22:25.675

that would've removed within two seconds.

473  
00:22:26.295 --> 00:22:29.475  
The airspeed data inputs into the flight control system.

474  
00:22:30.175 --> 00:22:31.715  
The control surface response

475  
00:22:31.735 --> 00:22:35.395  
to pilot inputs would then be independent of airspeed,

476  
00:22:35.995 --> 00:22:37.955  
allowing the airplane to remain controllable

477  
00:22:37.955 --> 00:22:40.355  
for the remainder of the flight back to the landing.

478  
00:22:41.865 --> 00:22:44.245  
The accepted risk was probably reasonable,

479  
00:22:44.745 --> 00:22:46.045  
but here's the kicker.

480  
00:22:46.945 --> 00:22:50.685  
The consequences of a failure are so high here

481  
00:22:51.235 --> 00:22:52.285  
that you really needed

482  
00:22:52.385 --> 00:22:54.605  
to put some special attention on this.

483  
00:22:55.545 --> 00:22:58.165  
The designer did by putting R three in,

484  
00:22:58.665 --> 00:23:02.645  
But nobody on the test team, including the pilot, realized

485  
00:23:02.645 --> 00:23:05.845  
that the X 31 was experiencing an air data problem

486  
00:23:06.195 --> 00:23:08.605

that would require implementing the R three

487

00:23:08.605 --> 00:23:09.765  
reversionary system

488

00:23:10.345 --> 00:23:11.345  
For several minutes. We

489

00:23:11.345 --> 00:23:15.505  
had indications that the airspeed was becoming poor,

490

00:23:15.815 --> 00:23:17.505  
both in the cockpit, in the control room,

491

00:23:18.445 --> 00:23:19.945  
and in our last ditch catch.

492

00:23:19.965 --> 00:23:20.985  
Nobody stood up

493

00:23:20.985 --> 00:23:24.055  
and yell, wait a minute, this can't be right.

494

00:23:24.325 --> 00:23:26.815  
Because Had we realized what was going on, the,

495

00:23:26.915 --> 00:23:28.935  
the control system had the ability to go

496

00:23:28.955 --> 00:23:30.535  
to fixed flight control gains,

497

00:23:31.115 --> 00:23:33.255  
and it, with fixed flight control

498

00:23:33.255 --> 00:23:34.295  
gains, it would not have been a problem.

499

00:23:34.325 --> 00:23:36.095  
They would've been able to land the airplane safely.

500  
00:23:36.915 --> 00:23:40.105  
Uh, what we just never got enough information to,

501  
00:23:40.205 --> 00:23:41.785  
to make the decision to do that.

502  
00:23:43.445 --> 00:23:45.845  
We had an alternate airspeed indicator

503  
00:23:45.845 --> 00:23:48.085  
that used a different peto tube,

504  
00:23:48.535 --> 00:23:50.245  
which would be less susceptible

505  
00:23:50.245 --> 00:23:52.205  
to icing than this special tube.

506  
00:23:53.225 --> 00:23:56.165  
It was at the pilot's right hand knee,

507  
00:23:57.335 --> 00:23:58.475  
and he never looked at it.

508  
00:23:59.015 --> 00:24:02.195  
We had a lack of attention to the reversionary modes.

509  
00:24:03.015 --> 00:24:05.545  
Gradually, we were not thinking, we learned

510  
00:24:05.545 --> 00:24:06.985  
to depend on the control room.

511  
00:24:06.985 --> 00:24:10.305  
They're gonna tell us when we need to go to R two

512  
00:24:10.445 --> 00:24:11.865  
or R one, or R three.

513  
00:24:13.255 --> 00:24:17.115

We need to know as pilots, which we kind of forgot,

514

00:24:17.565 --> 00:24:18.835

where are the safety nets?

515

00:24:19.175 --> 00:24:22.395

The safety nets pushed the right button.

516

00:24:23.735 --> 00:24:27.225

Didn't get the test data, but you bring the aircraft back.

517

00:24:27.405 --> 00:24:32.205

So if you didn't understand, uh, what was happening, uh,

518

00:24:33.025 --> 00:24:34.885

we should have been constantly reminded,

519

00:24:35.115 --> 00:24:36.685

push the button and talk about it.

520

00:24:37.315 --> 00:24:38.745

Pilot obviously wasn't concerned.

521

00:24:39.265 --> 00:24:40.765

He was, is experienced

522

00:24:41.285 --> 00:24:43.165

probably if you look at the control room, the pilot

523

00:24:43.185 --> 00:24:44.805

and everybody involved in that day's activity,

524

00:24:44.865 --> 00:24:46.645

he was the most experienced X 31 in the,

525

00:24:47.275 --> 00:24:48.735

in the, in that day's activity.

526

00:24:48.755 --> 00:24:50.775

He had been on a program since Palmdale.

527

00:24:51.235 --> 00:24:53.655

So he, he had a, he noticed something,

528

00:24:53.655 --> 00:24:55.655

but he wasn't concerned, and he didn't ask

529

00:24:55.655 --> 00:24:56.695

for help that I was aware of.

530

00:24:57.195 --> 00:24:59.455

Uh, and so I think the control room said,

531

00:24:59.455 --> 00:25:00.535

well, he's not that panicked.

532

00:25:00.535 --> 00:25:01.935

I'm not that panicked. And I think

533

00:25:01.935 --> 00:25:03.935

that fed off each other a little bit.

534

00:25:04.475 --> 00:25:07.215

The team moved on to the final test point of the day,

535

00:25:07.735 --> 00:25:10.175

a simple automatic control response test

536

00:25:10.365 --> 00:25:13.575

that required only a command from the pilot to initiate.

537

00:25:14.355 --> 00:25:18.335

But once again, the airplane did not respond as expected.

538

00:25:19.035 --> 00:25:21.655

He hits the box, presses the button,

539

00:25:22.955 --> 00:25:25.275

and he says, I don't get anything.

540

00:25:26.155 --> 00:25:27.165



Well, I didn't get anything

541  
00:25:27.165 --> 00:25:30.395  
because the box was designed not

542  
00:25:30.455 --> 00:25:33.155  
to put any input if you went beyond a certain speed,

543  
00:25:33.155 --> 00:25:34.235  
like 200 knots.

544  
00:25:34.575 --> 00:25:38.475  
So it was seeing the false air speed of 200 plus knots.

545  
00:25:39.255 --> 00:25:41.515  
And it, when he pushed the button, it didn't work.

546  
00:25:42.005 --> 00:25:43.995  
3, 2, 1, go

547  
00:25:49.025 --> 00:25:49.955  
doesn't do anything.

548  
00:25:51.755 --> 00:25:54.925  
But it didn't work because something was wrong.

549  
00:25:55.875 --> 00:25:58.295  
And the control room came back

550  
00:25:58.395 --> 00:26:00.615  
and finally just kind of ignored that

551  
00:26:00.635 --> 00:26:02.055  
and said, it's all okay.

552  
00:26:02.315 --> 00:26:03.615  
You know, RTB. Now,

553  
00:26:04.125 --> 00:26:08.455  
It's almost like expecting to hear that went fine.

554

00:26:08.555 --> 00:26:11.575

You know, after this program with hundreds of flights

555

00:26:11.575 --> 00:26:13.935

and everything going perfectly in your mind,

556

00:26:13.955 --> 00:26:15.855

you're hearing things that weren't happening,

557

00:26:15.855 --> 00:26:18.295

everything's fine and worked fine, let's come home.

558

00:26:18.715 --> 00:26:21.655

The normal operation of the system was expected that the,

559

00:26:22.075 --> 00:26:24.255

the system would identify the problems itself.

560

00:26:24.255 --> 00:26:26.735

That it would not be the people on the ground

561

00:26:27.295 --> 00:26:30.255

identifying an air data problem and calling for fixed gains,

562

00:26:30.615 --> 00:26:32.815

although it was certainly capable of putting that.

563

00:26:32.875 --> 00:26:34.175

The expectation would be

564

00:26:34.175 --> 00:26:36.775

that the system would do its own self-diagnosis

565

00:26:36.775 --> 00:26:38.055

and identify failures.

566

00:26:38.435 --> 00:26:40.935

But the failure we had was a slow failure

567

00:26:41.075 --> 00:26:43.465

of the tube slowly building the ice up.

568

00:26:43.805 --> 00:26:45.545

So the changes in the speed were within

569

00:26:46.195 --> 00:26:48.525

perfectly reasonable numbers for a real airplane.

570

00:26:49.045 --> 00:26:51.125

Software is just not capable of detecting that failure,

571

00:26:51.505 --> 00:26:53.085

uh, for that system.

572

00:26:53.255 --> 00:26:56.325

There was one or two people that actually knew

573

00:26:57.505 --> 00:27:00.275

that there was these little tiny areas that, yeah,

574

00:27:00.295 --> 00:27:02.475

it couldn't handle it, but that word never got out.

575

00:27:02.475 --> 00:27:04.585

They never stood up and said, oh,

576

00:27:04.615 --> 00:27:05.785

boss, that's not quite right.

577

00:27:05.845 --> 00:27:10.025

You know, uh, you can handle it over 95 or 99% of the area,

578

00:27:10.045 --> 00:27:11.345

but there's really a couple little areas.

579

00:27:11.565 --> 00:27:13.185

The automated system can't handle it.

580

00:27:13.675 --> 00:27:15.695

And that didn't come out till after the accident.

581

00:27:15.915 --> 00:27:17.975

Uh, I never did get talked to 'em about it,

582

00:27:17.975 --> 00:27:19.135

but I just kind of felt they,

583

00:27:19.325 --> 00:27:22.175

they didn't wanna stop the program, thought it was

584

00:27:22.595 --> 00:27:26.345

of no real issue because, uh, of the difficulty of getting

585

00:27:26.365 --> 00:27:27.785

to such small area of the envelope.

586

00:27:28.585 --> 00:27:31.885

But as the X 31 began to descend on its return to base,

587

00:27:32.465 --> 00:27:34.045

the problems caused by the failure

588

00:27:34.145 --> 00:27:37.325

of its air data system became far more pronounced.

589

00:27:38.355 --> 00:27:42.275

We have frozen the petto tube now, and it's stuck.

590

00:27:42.865 --> 00:27:44.195

It's got what it had in it,

591

00:27:44.215 --> 00:27:46.875

and it's gonna hold that, that pressure.

592

00:27:47.455 --> 00:27:52.135

Now, when you start down with a frozen petto tube, the,

593

00:27:52.635 --> 00:27:56.265

the air speed, what you see, the false air speed

594

00:27:56.265 --> 00:28:00.625

that he saw will decrease as he decreases altitude.

595

00:28:02.595 --> 00:28:05.695

But we are seeing, we, the control room is seeing,

596

00:28:06.005 --> 00:28:10.035

they have a big display this big, the pilot is seeing,

597

00:28:10.325 --> 00:28:12.035

every time he turns his head,

598

00:28:12.185 --> 00:28:14.555

he's seeing the airspeed in the hud.

599

00:28:16.125 --> 00:28:19.985

And now it's perhaps at one point it's at 150 knots.

600

00:28:21.215 --> 00:28:25.685

It cannot be at 150 knots, and then it's at 100 knots,

601

00:28:26.285 --> 00:28:28.705

and it cannot be at 100 knots

602

00:28:29.295 --> 00:28:32.355

and going on down it finally, right just

603

00:28:32.355 --> 00:28:35.635

before the accident, it gets to, you know, 48 knots,

604

00:28:35.635 --> 00:28:36.955

which is the minimum it's gonna read.

605

00:28:37.695 --> 00:28:42.535

But the control system in the airplane is getting this

606

00:28:43.675 --> 00:28:44.705

wrong information.

607

00:28:45.635 --> 00:28:48.215

And this is a complex closed loop system.

608  
00:28:48.235 --> 00:28:51.655  
And when you put too much gain in, it will start

609  
00:28:51.675 --> 00:28:54.895  
to get unstable and it will start moving the controls,

610  
00:28:54.895 --> 00:28:56.255  
which it did a matter of seconds.

611  
00:28:56.515 --> 00:29:00.575  
And finally, it dramatically pitches up.

612  
00:29:01.075 --> 00:29:03.695  
The pilot, of course, tries to prevent that.

613  
00:29:03.795 --> 00:29:06.455  
And I'm sure the instant that he hit the forward stop

614  
00:29:06.475 --> 00:29:08.855  
and realized he, he was out of control,

615  
00:29:09.475 --> 00:29:12.575  
he did the natural thing, was eject from the airplane.

616  
00:29:13.075 --> 00:29:14.855  
We were, uh, RTB return to base,

617  
00:29:15.515 --> 00:29:18.335  
and I started to rejoin on the X 31.

618  
00:29:19.135 --> 00:29:21.795  
Uh, as I came up on his right side,

619  
00:29:22.325 --> 00:29:24.035  
about a hundred yards away

620  
00:29:24.335 --> 00:29:26.595  
and closing, I saw the airplane start

621  
00:29:26.595 --> 00:29:28.155

to go into a small wing rock

622

00:29:28.265 --> 00:29:30.155

that progressively got larger and larger.

623

00:29:30.855 --> 00:29:33.435

And as I got within about 200 feet of him,

624

00:29:33.655 --> 00:29:36.315

the airplane pitched up, uh, vertical.

625

00:29:36.935 --> 00:29:40.555

And, uh, approximately the time that I passed a beam him,

626

00:29:41.045 --> 00:29:42.965

I saw the, uh, the pilot eject.

627

00:29:44.155 --> 00:29:45.765

Okay, NA one, we have an ejection.

628

00:29:45.765 --> 00:29:50.725

We have an ejection NA one. Do you read?

629

00:29:52.395 --> 00:29:53.405

Yeah, we copied in.

630

00:29:53.425 --> 00:29:56.085

We copy and sport na uh,

631

00:29:57.235 --> 00:29:59.445

5 84 has ejected the aircraft

632

00:29:59.465 --> 00:30:01.925

as descending over the north base area.

633

00:30:06.045 --> 00:30:06.725

I have a shoot

634

00:30:10.575 --> 00:30:12.485

8 5 0 8 5 0.

635

00:30:12.545 --> 00:30:14.005

Say again, please. Yes, sir.

636

00:30:14.005 --> 00:30:16.765

NASA 5 84 has ejected from its aircraft.

637

00:30:17.725 --> 00:30:20.165

Aircraft is descending north of north base.

638

00:30:20.305 --> 00:30:22.085

The pilot is in the chute at this time,

639

00:30:22.135 --> 00:30:25.685

descending approximately one mile north of north base.

640

00:30:28.185 --> 00:30:30.165

So there was, there was the knowledge

641

00:30:30.165 --> 00:30:31.445

and training in the simulation

642

00:30:31.445 --> 00:30:33.285

that taught the pilot to that.

643

00:30:33.435 --> 00:30:35.885

When he started seeing the airplane was oscillate

644

00:30:35.885 --> 00:30:38.325

and was not controlled, he knew that he had

645

00:30:38.325 --> 00:30:39.725

to get outta the airplane very fast,

646

00:30:39.865 --> 00:30:41.925

or else the airplane would go into a tumble.

647

00:30:42.545 --> 00:30:44.925

And he did do that, and that saved his life.

648

00:30:45.965 --> 00:30:47.125



I also know that the pilot,

649

00:30:47.305 --> 00:30:50.365

as he was ejecting from the airplane, had thoughts

650

00:30:50.365 --> 00:30:52.845

of maybe I should have tried every reversionary mode.

651

00:30:53.465 --> 00:30:57.485

Um, but at that point, if he would've hesitated any longer,

652

00:30:57.665 --> 00:31:00.165

he would've been probably lost with the airplanes.

653

00:31:00.775 --> 00:31:03.455

I did not connect until after the plane departed.

654

00:31:03.455 --> 00:31:06.495

And while the plane was tumbling, I made the connection.

655

00:31:07.395 --> 00:31:08.695

PETA's system had to be frozen

656

00:31:09.595 --> 00:31:12.295

and just didn't come to the realization soon enough to,

657

00:31:12.295 --> 00:31:13.975

to do anything about it in the control room.

658

00:31:15.005 --> 00:31:16.135

Less than four minutes

659

00:31:16.185 --> 00:31:19.015

after the first comment about pedo heat was recorded

660

00:31:19.015 --> 00:31:20.815

between the pilot and the control room,

661

00:31:21.395 --> 00:31:24.935

the X 31 crashed just north of Edwards Air Force Base.

662

00:31:26.355 --> 00:31:29.255

How could such a routine operation have ended in disaster

663

00:31:29.645 --> 00:31:33.575

when flights with far higher risk had been completed safely?

664

00:31:34.675 --> 00:31:35.815

And more importantly,

665

00:31:36.325 --> 00:31:39.255

what can we learn from the answers to that question?

666

00:31:40.225 --> 00:31:43.855

Every person involved in an experimental flight research

667

00:31:43.855 --> 00:31:46.855

program should actually study the mishaps

668

00:31:46.995 --> 00:31:50.015

of all experimental aircraft, uh,

669

00:31:50.015 --> 00:31:51.575

in the past 20 to 30 years.

670

00:31:52.045 --> 00:31:53.855

There's a lot of things you can learn

671

00:31:54.205 --> 00:31:55.895

because human nature doesn't change,

672

00:31:55.955 --> 00:31:57.135

the processes don't change.

673

00:31:57.245 --> 00:32:00.095

It's always the same set of contributing factors,

674

00:32:00.645 --> 00:32:02.615

just the names and the details change.

675

00:32:03.725 --> 00:32:07.305

Of the 10 things, for example, that I, uh, describe as

676

00:32:09.085 --> 00:32:12.585

causes contributing causes of the mishap, six

677

00:32:12.585 --> 00:32:14.985

of them occurred prior to the day of flight.

678

00:32:15.375 --> 00:32:18.375

Four occurred within about two minutes.

679

00:32:19.635 --> 00:32:21.015

So we had a better chance

680

00:32:21.015 --> 00:32:23.575

of working on the six than we did on the four.

681

00:32:24.605 --> 00:32:28.345

In some senses, the X 31 accidents started six years

682

00:32:28.345 --> 00:32:30.465

earlier when the plane was first developed

683

00:32:30.465 --> 00:32:31.945

and tested at Rockwell.

684

00:32:32.565 --> 00:32:35.585

We, we had a hazard analysis from the initial design, uh,

685

00:32:36.485 --> 00:32:38.745

and in the accident that had to actually get dusted off.

686

00:32:38.765 --> 00:32:40.405

You should never have to dust off one of those.

687

00:32:40.835 --> 00:32:43.785

Everybody familiar with the program that

688

00:32:44.325 --> 00:32:46.705

all those levels need to have a really good,

689  
00:32:46.705 --> 00:32:49.145  
comfortable feeling of what those hazards are

690  
00:32:49.365 --> 00:32:51.425  
and, uh, what is accepted in the risk.

691  
00:32:51.565 --> 00:32:53.305  
Uh, there was a redo of that analysis

692  
00:32:53.305 --> 00:32:54.625  
as we moved to NASA in 92.

693  
00:32:55.285 --> 00:32:57.905  
And I think, uh, and it was clear

694  
00:32:57.905 --> 00:33:00.425  
after the accident, not everybody really understood what

695  
00:33:00.455 --> 00:33:03.345  
that design was to the detail you needed to,

696  
00:33:03.345 --> 00:33:04.905  
to understand the full risk of the program.

697  
00:33:05.575 --> 00:33:07.785  
Clearly, uh, from 1990 to 95,

698  
00:33:07.785 --> 00:33:09.265  
you have a large team turnover.

699  
00:33:09.485 --> 00:33:10.505  
We change locations,

700  
00:33:10.605 --> 00:33:11.985  
we expanded the objectives of the program.

701  
00:33:13.485 --> 00:33:15.065  
And as time rolls on

702  
00:33:15.065 --> 00:33:17.705

and the new people come in, not everybody, uh,

703

00:33:18.045 --> 00:33:19.145  
has the same understanding

704

00:33:19.365 --> 00:33:21.625  
or appreciation of the kind of vehicle we're operating.

705

00:33:22.135 --> 00:33:23.145  
It's a special airplane.

706

00:33:23.775 --> 00:33:26.385  
It's not the same risk as any other airplane

707

00:33:26.685 --> 00:33:28.865  
and operate it every day.

708

00:33:28.865 --> 00:33:30.585  
You really ought to have the same appreciation for the risk.

709

00:33:30.585 --> 00:33:33.705  
And I don't think we as a team did a good job, uh,

710

00:33:33.705 --> 00:33:35.585  
keeping everybody that came to the program

711

00:33:35.775 --> 00:33:38.425  
with the same level of understanding of both the design

712

00:33:38.425 --> 00:33:39.425  
and the risk on the airplane.

713

00:33:39.725 --> 00:33:42.185  
We shouldn't have had a control room, a pilot,

714

00:33:42.285 --> 00:33:44.225  
and a team that day that didn't understand

715

00:33:44.225 --> 00:33:45.745  
that fundamental fact.

716

00:33:47.205 --> 00:33:49.265

And it's not elaborate, it's just straightforward.

717

00:33:49.485 --> 00:33:51.425

The airspeed I see in the HUD is the air

718

00:33:51.425 --> 00:33:52.505

speeded computer uses.

719

00:33:52.885 --> 00:33:54.605

If the airspeed I see has got a problem,

720

00:33:55.145 --> 00:33:56.205

the airplane's got a problem.

721

00:33:56.625 --> 00:34:00.685

And that fact, it didn't get communicated correctly from old

722

00:34:00.685 --> 00:34:02.005

team members to the new team members.

723

00:34:02.265 --> 00:34:03.905

And if it had have,

724

00:34:03.905 --> 00:34:05.305

I don't think there would've been anybody in that room

725

00:34:05.305 --> 00:34:06.345

that wouldn't have yelled, stop

726

00:34:06.345 --> 00:34:07.825

and jumped off the bridge to make it happen.

727

00:34:10.095 --> 00:34:14.915

There were errors made, the peto heat.

728

00:34:18.345 --> 00:34:20.435

Okay, so we'll, we'll stop at there.

729

00:34:20.535 --> 00:34:23.795

The, um, the, the video goes on for probably another

730

00:34:24.305 --> 00:34:26.555  
16 minutes or so, and, uh, and, and,

731

00:34:26.555 --> 00:34:29.605  
and talks a bit about, uh, about

732

00:34:29.605 --> 00:34:31.525  
how we recovered from it took the aircraft

733

00:34:31.525 --> 00:34:33.165  
to the Paris Air Show, but to, um,

734

00:34:33.915 --> 00:34:36.265  
but I wanted to bring us back now to,

735

00:34:36.365 --> 00:34:37.625  
to this, uh, this brief.

736

00:34:37.725 --> 00:34:40.385  
So, so, so here, here I am. Here we are here.

737

00:34:40.385 --> 00:34:43.755  
The team is, um, you, we, you can see

738

00:34:43.755 --> 00:34:44.835  
where the latent failures

739

00:34:44.835 --> 00:34:47.355  
and the active failures, uh, are in place.

740

00:34:48.195 --> 00:34:51.095  
Uh, and once again, we, we failed, we fail,

741

00:34:51.115 --> 00:34:54.095  
or we, we failed to identify an issue.

742

00:34:54.675 --> 00:34:58.135  
And even if we had identified that issue, uh, we needed

743

00:34:58.155 --> 00:34:59.295  
to do something about it.

744

00:34:59.515 --> 00:35:03.115  
The, uh, the, basically the, the,

745

00:35:03.215 --> 00:35:05.275  
the air data was acting like an altimeter.

746

00:35:05.535 --> 00:35:08.635  
So, uh, if, if, if we descend, we're gonna drop speed,

747

00:35:08.685 --> 00:35:11.915  
we're gonna, our gains are gonna take us into an unstable

748

00:35:12.315 --> 00:35:13.835  
situation, and the aircraft's gonna depart.

749

00:35:14.175 --> 00:35:18.625  
So, so, uh, Ken,

750

00:35:18.885 --> 00:35:21.185  
Ken Sole, who's the center director at the time, uh,

751

00:35:21.185 --> 00:35:23.225  
he was talking on there, he talks about 10 failures.

752

00:35:23.325 --> 00:35:25.905  
Um, you never hear in this video what, what,

753

00:35:25.905 --> 00:35:27.345  
what 10 failures he had in mind.

754

00:35:27.405 --> 00:35:29.025  
So I came up with six latent

755

00:35:29.025 --> 00:35:30.945  
and four active, just to kind of fill the square.

756

00:35:31.565 --> 00:35:35.345



Uh, but the, you know, the PTO heat was removed clearly.

757

00:35:35.525 --> 00:35:38.725

Uh, the, the problem was, is

758

00:35:38.725 --> 00:35:40.165

that the installation was not complete.

759

00:35:40.305 --> 00:35:42.285

The, uh, the switch was still in there.

760

00:35:42.285 --> 00:35:44.325

It was not labeled an op, even though the,

761

00:35:44.655 --> 00:35:45.805

there was no heater element,

762

00:35:46.065 --> 00:35:48.245

and the wires were capped and stowed at both ends.

763

00:35:48.795 --> 00:35:53.375

Um, there was no pedo heat, uh, hot mic was substandard.

764

00:35:53.375 --> 00:35:54.815

That was definitely a contributing factor.

765

00:35:55.515 --> 00:35:59.335

And we didn't have any real published procedures on

766

00:35:59.365 --> 00:36:01.895

selecting R three, our reversionary mode,

767

00:36:01.915 --> 00:36:03.935

our fixed gain mode, our get home mode.

768

00:36:04.395 --> 00:36:07.135

Uh, I know when we went to Paris, we, that, that became part

769

00:36:07.135 --> 00:36:08.815

of our procedures, what it was to, uh,

770  
00:36:09.235 --> 00:36:12.415  
if you have any air data issues, then, then select R three

771  
00:36:12.835 --> 00:36:15.055  
and, and, and make a, make a landing

772  
00:36:15.055 --> 00:36:16.255  
with, with, with fixed gains.

773  
00:36:16.275 --> 00:36:19.215  
It was, it was perfectly fine in a limited envelope.

774  
00:36:20.435 --> 00:36:23.025  
There was a temporary operating procedure that sat in, uh,

775  
00:36:23.025 --> 00:36:25.545  
one of the engineer's, uh, um, uh,

776  
00:36:25.865 --> 00:36:28.515  
computers was never printed, uh,

777  
00:36:28.735 --> 00:36:29.995  
for removal of the PTO heat.

778  
00:36:30.585 --> 00:36:34.285  
And, uh, the a FM, uh, was not updated.

779  
00:36:34.705 --> 00:36:37.625  
The, and our return to base checklist, uh,

780  
00:36:37.625 --> 00:36:41.025  
which is pretty interesting, for 200, 300 flights,

781  
00:36:41.695 --> 00:36:43.995  
we had continued to tell the pilot to, uh,

782  
00:36:44.145 --> 00:36:46.915  
turn off pedo heat on, on the descent, the land.

783  
00:36:47.295 --> 00:36:48.475

She wouldn't burn up the heater

784

00:36:48.495 --> 00:36:49.675

and you wouldn't burn the, uh,

785

00:36:49.895 --> 00:36:51.875

the ground crew when they recovered the aircraft.

786

00:36:52.355 --> 00:36:55.575

Uh, and we continued to say that for 200 to 300 times.

787

00:36:57.245 --> 00:37:00.415

Um, why is that? I, I, it's hard.

788

00:37:00.445 --> 00:37:03.015

It's a hard one to answer, uh, uh, now.

789

00:37:03.875 --> 00:37:05.215

So, uh, and,

790

00:37:05.215 --> 00:37:07.815

and what that did is it, it instilled in everybody

791

00:37:07.815 --> 00:37:08.895

that we had pedal heat.

792

00:37:09.155 --> 00:37:13.355

Uh, and as far as the active failures, uh,

793

00:37:14.095 --> 00:37:18.635

you know, Jim didn't relay immediately the necess very

794

00:37:18.635 --> 00:37:21.035

necessary configuration in information.

795

00:37:21.095 --> 00:37:22.995

Uh, Eric Barnum was our systems engineer.

796

00:37:23.015 --> 00:37:24.755

He was one right behind me. He had had been

797

00:37:24.755 --> 00:37:26.155  
with the aircraft since Palmdale.

798

00:37:26.795 --> 00:37:28.255  
Uh, so he was a key personnel.

799

00:37:28.255 --> 00:37:30.815  
He had a, uh, an engineering personality.

800

00:37:31.235 --> 00:37:35.175  
Uh, the, he was, uh, very bright.

801

00:37:35.835 --> 00:37:38.175  
He just stated the fact the Petto heat's not

802

00:37:38.175 --> 00:37:39.255  
hooked up there.

803

00:37:39.275 --> 00:37:41.135  
No, there was no emotion in his voice.

804

00:37:42.415 --> 00:37:45.235  
And I had actually, I can recall turning around

805

00:37:45.235 --> 00:37:46.955  
and saying, you sure it's not hooked up?

806

00:37:47.395 --> 00:37:48.915  
'cause I had forgotten. Uh,

807

00:37:49.055 --> 00:37:51.595  
and, uh, he said, it's not hooked up.

808

00:37:51.595 --> 00:37:54.495  
So I'm telling Jim, Jim, you need to tell Carl

809

00:37:55.115 --> 00:37:56.725  
that the pedal heat's not hooked up.

810

00:37:57.155 --> 00:37:59.765

Well, Jim's looking at me like I'm from Mars,

811

00:37:59.835 --> 00:38:02.205  
because all the documentation that,

812

00:38:02.205 --> 00:38:05.365  
that Jim had read since he came on board the program,

813

00:38:05.585 --> 00:38:07.125  
had mentioned nothing about this.

814

00:38:07.825 --> 00:38:10.755  
He's a, uh, air traffic controller talking to a pilot.

815

00:38:10.985 --> 00:38:13.795  
He's a, he's a private pilot himself, uh, uh,

816

00:38:14.055 --> 00:38:16.675  
and with quite a few mean thousands of hours.

817

00:38:17.335 --> 00:38:20.685  
And he, um, he found it hard to believe.

818

00:38:20.785 --> 00:38:23.485  
So in that moment, uh, it was very hard for him

819

00:38:23.485 --> 00:38:25.765  
to relay something that he didn't believe and,

820

00:38:25.785 --> 00:38:27.085  
and what would make him believe it.

821

00:38:27.725 --> 00:38:31.685  
Probably if it was written down that, that, I think, um,

822

00:38:32.905 --> 00:38:35.605  
we failed to avoid visible moisture, for sure.

823

00:38:36.305 --> 00:38:39.185  
Uh, but when you hear Dana,

824  
00:38:39.365 --> 00:38:42.025  
the Chase pilot talking about the situation on that day,

825  
00:38:42.405 --> 00:38:44.145  
we couldn't see that from the control room.

826  
00:38:44.485 --> 00:38:47.365  
But, uh, it sounds like it was, I don't know,

827  
00:38:47.365 --> 00:38:49.645  
maybe it was a icy virga kind

828  
00:38:49.645 --> 00:38:50.845  
of thing that, that, that they were flying through.

829  
00:38:50.845 --> 00:38:52.405  
It's, it's hard, hard to tell.

830  
00:38:53.145 --> 00:38:55.125  
Uh, but it looked then they could probably, I,

831  
00:38:55.205 --> 00:38:56.885  
I remember the, uh, discussions afterwards.

832  
00:38:56.885 --> 00:39:00.525  
They could see through it. It was never in a, uh, uh,

833  
00:39:01.505 --> 00:39:03.965  
you know, a whiteout type type of sit situation.

834  
00:39:04.385 --> 00:39:07.565  
But that was enough with the Kelo probe geometry, uh, to,

835  
00:39:07.585 --> 00:39:08.765  
to ice it, ice it up.

836  
00:39:10.135 --> 00:39:14.735  
And, uh, the fact that Chase was not privy to the air data,

837  
00:39:15.155 --> 00:39:17.975

uh, or the modified fluter test box

838

00:39:17.975 --> 00:39:19.575

discrepancy, we weren't sure what it was.

839

00:39:19.635 --> 00:39:21.775

Was it air data? Was it modified Fluter test box?

840

00:39:21.835 --> 00:39:25.095

We couldn't figure out what the discrepancy, what the source

841

00:39:25.095 --> 00:39:26.295

of the discrepancy was.

842

00:39:26.935 --> 00:39:28.275

And the chase knew none of that.

843

00:39:28.575 --> 00:39:30.475

And if he had just heard a little bit

844

00:39:30.475 --> 00:39:35.315

of us talking about air data, uh, certainly as a pacer,

845

00:39:35.315 --> 00:39:36.635

he could have been a pacer for us

846

00:39:36.655 --> 00:39:39.395

and said, well, I'm seeing this, and what are you seeing?

847

00:39:39.495 --> 00:39:42.765

But we had no idea as, as test conductors

848

00:39:43.075 --> 00:39:44.645

that there was a workaround procedure

849

00:39:44.645 --> 00:39:46.885

that had been developed for the, for Chase flying.

850

00:39:47.455 --> 00:39:50.875

Uh, and, and because of the hot mic was so scratchy,

851

00:39:51.175 --> 00:39:52.955  
and you needed to hear the, uh, the,

852

00:39:52.955 --> 00:39:57.255  
the controller calls in, in the, uh, in the 25 0 8 area.

853

00:39:57.955 --> 00:40:01.175  
Uh, we had no idea that the Chase pilot was not part

854

00:40:01.175 --> 00:40:03.415  
of the team, really was not completely part of the team.

855

00:40:05.805 --> 00:40:07.585  
So, I just want to touch on a, on one thing.

856

00:40:07.585 --> 00:40:12.425  
There's, there's a, a statement, uh, in, in the video

857

00:40:12.815 --> 00:40:15.985  
that we were out, uh, flight test, there's no changes,

858

00:40:16.085 --> 00:40:18.785  
but we were just changing the, uh, the pedo probe.

859

00:40:19.165 --> 00:40:20.545  
Uh, that's not quite true.

860

00:40:20.925 --> 00:40:23.905  
Uh, the, the pedo prob probe was actually changed about 20

861

00:40:23.905 --> 00:40:25.265  
months prior to this accident.

862

00:40:25.465 --> 00:40:26.545  
I think it's an important point.

863

00:40:27.005 --> 00:40:29.665  
So just a little bit on the timeline, you can see it here.

864

00:40:29.945 --> 00:40:30.945



I don't need to read it to you.

865

00:40:31.045 --> 00:40:35.105

But the, basically, in, in, uh, summer of 1992, uh,

866

00:40:35.105 --> 00:40:38.795

that's when we were, we were doing our, uh, maneuvers

867

00:40:38.795 --> 00:40:40.555

that would get us ready for tactical utility.

868

00:40:40.575 --> 00:40:41.875

So that was the focus. Let's,

869

00:40:41.875 --> 00:40:43.395

let's get this envelope expanded

870

00:40:44.015 --> 00:40:47.555

and, uh, let's get into, uh, accelerated g

871

00:40:48.295 --> 00:40:49.475

inputs to post stall.

872

00:40:50.095 --> 00:40:51.155

Uh, and, uh,

873

00:40:51.405 --> 00:40:53.595

after we do that, then we can get into the

874

00:40:54.505 --> 00:40:56.705

tactical utility demonstration, which was the whole point,

875

00:40:56.805 --> 00:40:59.305

the whole reason to be for, for this aircraft.

876

00:40:59.885 --> 00:41:03.425

We ran into some problems around 55 alpha at, at elevated g,

877

00:41:03.885 --> 00:41:05.785

uh, and we had to stand down for a little bit and,

878

00:41:05.885 --> 00:41:08.425  
and make some modifications to, to the airframe,

879

00:41:08.695 --> 00:41:12.025  
including the, uh, keel probe strikes, all sorts of stuff

880

00:41:12.205 --> 00:41:15.745  
to get this thing to fly like the sim 'cause.

881

00:41:15.745 --> 00:41:19.265  
Uh, and, and so we, we finished those hardware mods in April

882

00:41:19.265 --> 00:41:22.005  
of 1993, and they worked.

883

00:41:22.385 --> 00:41:25.525  
We got care carefree postal handling qualities.

884

00:41:25.985 --> 00:41:28.085  
What's interesting is, is, uh, shortly

885

00:41:28.085 --> 00:41:30.445  
after that, we went straight into tactical

886

00:41:30.445 --> 00:41:31.725  
utility evaluation.

887

00:41:31.785 --> 00:41:33.365  
And this included guest pilots.

888

00:41:33.925 --> 00:41:36.815  
This included, uh, uh, an ops tempo of, uh,

889

00:41:36.815 --> 00:41:39.975  
four flights a day, uh, four flights a day,

890

00:41:39.975 --> 00:41:41.735  
sometimes three days a a week.

891

00:41:41.995 --> 00:41:45.135

So we would have 12 flights in a week, very high ops tempo.

892

00:41:45.675 --> 00:41:46.935

Um, very successful.

893

00:41:46.935 --> 00:41:51.015

There's Aerospace America, uh, presentation done

894

00:41:51.015 --> 00:41:52.095

by Colonel Mike Francis.

895

00:41:52.275 --> 00:41:53.975

It was put out, uh, uh,

896

00:41:53.975 --> 00:41:56.335

literally it came out in February of 95.

897

00:41:56.675 --> 00:41:58.535

And it had to have a little caveat on the fact

898

00:41:58.535 --> 00:41:59.695

that we had crashed an airplane.

899

00:42:00.075 --> 00:42:01.175

It didn't talk about the crash.

900

00:42:01.235 --> 00:42:05.015

It talked about all the programmatic successes of this, uh,

901

00:42:05.015 --> 00:42:07.135

rapid prototyping international cooperation.

902

00:42:07.135 --> 00:42:10.295

And it was by all, um, uh, technical standards,

903

00:42:10.415 --> 00:42:11.815

a very successful program.

904

00:42:13.465 --> 00:42:15.605

But here's the thing, there's a, uh,

905

00:42:15.745 --> 00:42:20.085

we had been 300 flights in 20 months since the modification.

906

00:42:20.745 --> 00:42:23.125

And, uh, without updating the documentation,

907

00:42:23.125 --> 00:42:24.485

this was completely forgot.

908

00:42:24.825 --> 00:42:26.645

And I, I had an opportunity to talk to one

909

00:42:26.645 --> 00:42:29.485

of the accident investigators, uh, just a couple weeks ago,

910

00:42:30.025 --> 00:42:32.525

who was supporting one of our FAA safety stand down.

911

00:42:32.585 --> 00:42:34.165

And, and he, and he told me that, that,

912

00:42:34.165 --> 00:42:36.575

that when he quizzed the, uh, pilots

913

00:42:36.575 --> 00:42:38.175

that were either current or,

914

00:42:38.315 --> 00:42:41.615

or recently flown the X 31, not a single one of them

915

00:42:42.335 --> 00:42:43.935

remembered that the pedal heat had been removed.

916

00:42:44.375 --> 00:42:48.065

Carl actually gave the brief at the a f uh, SRB in 1993.

917

00:42:48.725 --> 00:42:51.825

Uh, so at one point he knew as we, as we all did,

918

00:42:51.885 --> 00:42:53.745

but every one of us had forgot about it

919

00:42:53.745 --> 00:42:54.825

except for Eric Barnum.

920

00:42:57.455 --> 00:42:59.915

So the International test organization was pretty unique.

921

00:42:59.915 --> 00:43:01.515

This was one of the success things.

922

00:43:01.535 --> 00:43:05.285

We had seven distinct entities, uh, each functional area,

923

00:43:05.745 --> 00:43:09.365

uh, was, it didn't matter what badge you wore, uh,

924

00:43:09.525 --> 00:43:11.525

we all intermixed quite, quite well.

925

00:43:11.585 --> 00:43:15.665

We had a very common, uh, goal to, to get this, uh,

926

00:43:15.805 --> 00:43:17.425

get this testing done, to get this tactical

927

00:43:17.425 --> 00:43:18.745

utility demonstration done.

928

00:43:19.245 --> 00:43:21.025

Uh, everybody, everybody bought into it.

929

00:43:21.085 --> 00:43:22.785

We met daily, we all talked.

930

00:43:22.805 --> 00:43:26.785

We had a very good communication, uh, on, on the project,

931

00:43:27.485 --> 00:43:30.745

but this was a low cost technology demonstrator.

932

00:43:30.965 --> 00:43:32.665  
And every decision we made on this

933

00:43:32.905 --> 00:43:33.945  
aircraft had that in mind.

934

00:43:34.445 --> 00:43:36.745  
So, uh, when we didn't have a,

935

00:43:37.265 --> 00:43:39.825  
a heated keel probe, well, that's okay.

936

00:43:40.205 --> 00:43:42.345  
Uh, we, we, we don't need a heated keel probe.

937

00:43:42.345 --> 00:43:44.305  
This is a low cost technology demonstrator.

938

00:43:44.315 --> 00:43:49.245  
Let's get the tactical utility, just a,

939

00:43:49.405 --> 00:43:50.405  
because we're all engineers.

940

00:43:50.425 --> 00:43:52.685  
The, the, the envelope expansion.

941

00:43:52.685 --> 00:43:54.245  
This, this just talks about, uh,

942

00:43:54.545 --> 00:43:57.485  
we had a difference in the simulator model, uh, compared

943

00:43:57.505 --> 00:43:59.125  
to the actual vehicle.

944

00:43:59.745 --> 00:44:03.085  
Uh, not unusual. Uh, you don't really, it's hard to go back

945

00:44:03.085 --> 00:44:04.285

and change all your simulator models.

946

00:44:04.305 --> 00:44:08.205

So we made the aircraft fly, like, like the simulator.

947

00:44:08.785 --> 00:44:10.605

And, uh, in order to do that, uh,

948

00:44:11.065 --> 00:44:15.305

and also to get the air data, uh, to give us the quality

949

00:44:15.335 --> 00:44:17.785

that we needed for the very tight control of beta,

950

00:44:17.785 --> 00:44:20.105

which was a hallmark of this flight control system design,

951

00:44:20.565 --> 00:44:23.025

uh, we had to camp that, uh, nose boom down

952

00:44:23.025 --> 00:44:25.505

and use, use the keel probe, which turned the flow

953

00:44:25.505 --> 00:44:29.345

of the air day of, of the, um, total pressure, uh,

954

00:44:29.445 --> 00:44:31.645

and gave us a, a better reading at high angle of attack.

955

00:44:34.175 --> 00:44:36.635

But the program, programmatic risks, I mean, those,

956

00:44:36.725 --> 00:44:38.395

those were pretty obvious.

957

00:44:38.535 --> 00:44:41.395

The, uh, the unheated keel probe was a quick mod.

958

00:44:41.775 --> 00:44:44.155

The hot mic was a known issue. We hated it.

959

00:44:44.215 --> 00:44:46.315  
It was regularly acted up, uh,

960

00:44:46.315 --> 00:44:48.475  
but there was never time to fix it.

961

00:44:48.815 --> 00:44:50.515  
So it got, it got worked around.

962

00:44:52.325 --> 00:44:54.385  
And, uh, the, the one thing

963

00:44:54.385 --> 00:44:56.225  
that I think is really important, uh,

964

00:44:56.245 --> 00:44:59.105  
in this accident is the fact that the, the key members,

965

00:44:59.245 --> 00:45:01.265  
the first flight members, the ones that are moving on

966

00:45:01.265 --> 00:45:03.545  
to the next project, a lot of them were not around anymore.

967

00:45:04.205 --> 00:45:08.185  
Uh, and they had certain knowledge in their brain, uh, uh,

968

00:45:08.255 --> 00:45:09.705  
that was either nested in their brain

969

00:45:09.725 --> 00:45:12.985  
or it was also in the, um, uh, documentation

970

00:45:13.515 --> 00:45:15.185  
other than the ops documentation.

971

00:45:15.365 --> 00:45:17.265  
So you could find, if you read

972

00:45:17.265 --> 00:45:19.625



through the flight control system description,

973

00:45:19.645 --> 00:45:21.225

you could look at the Fal tree analysis,

974

00:45:21.225 --> 00:45:24.385

and you could arrive at the conclusion, uh, that, uh,

975

00:45:24.405 --> 00:45:27.305

of this, uh, how catastrophic, uh, loss of air data was.

976

00:45:27.885 --> 00:45:31.505

But quite frankly, I think a lot of us, I think myself, uh,

977

00:45:31.505 --> 00:45:36.105

maybe if this had happened three, two years prior, uh,

978

00:45:36.235 --> 00:45:38.025

maybe I could have put the pieces together.

979

00:45:38.085 --> 00:45:41.865

But two years later, after, with this high ops tempo, uh, I,

980

00:45:41.865 --> 00:45:43.305

and a lot of other people had forgotten.

981

00:45:43.405 --> 00:45:46.625

But what's interesting is, uh, shortly

982

00:45:46.625 --> 00:45:48.945

after the air aircraft apart parted,

983

00:45:48.945 --> 00:45:51.905

and you could hear Pat Staller say the same thing, uh,

984

00:45:52.055 --> 00:45:54.945

magically, uh, your brain starts working again.

985

00:45:55.205 --> 00:45:57.785

And you go, oh, I know what happened.

986

00:45:58.375 --> 00:45:59.735

I know what happened, but it's too late.

987

00:45:59.835 --> 00:46:02.095

And, uh, that was the same for Carl as well

988

00:46:02.945 --> 00:46:05.375

as he was riding the, uh, the ejection seat.

989

00:46:05.455 --> 00:46:07.375

I believe that's when he thought he should

990

00:46:07.375 --> 00:46:08.455

have selected R three.

991

00:46:10.745 --> 00:46:12.245

So we had reliance and automation.

992

00:46:12.325 --> 00:46:13.805

I want to touch on this just a little bit.

993

00:46:13.835 --> 00:46:16.365

This is the, uh, the R one, R two R three panel.

994

00:46:16.465 --> 00:46:19.885

You saw that in the video. Um, the, the,

995

00:46:19.905 --> 00:46:22.605

the way this worked, and the only bold face we had was if,

996

00:46:22.665 --> 00:46:26.235

if these things, uh, blinked at you, that you flew

997

00:46:26.235 --> 00:46:29.485

to a certain envelope, and then you engaged the R one,

998

00:46:29.485 --> 00:46:31.885

the R two or the R three, whichever one was required,

999

00:46:32.415 --> 00:46:34.115

but it would only illuminate if the

1000

00:46:34.115 --> 00:46:35.275

system recognized the failure.

1001

00:46:35.375 --> 00:46:37.715

And it was never gonna recognize the failure that we had.

1002

00:46:39.765 --> 00:46:41.265

And we didn't have, uh,

1003

00:46:41.625 --> 00:46:43.905

anything published in the A FM, uh, uh, about this.

1004

00:46:43.905 --> 00:46:45.705

We didn't have pitch power airspeed.

1005

00:46:46.205 --> 00:46:49.225

Uh, granted, uh, you, you, you could have known that.

1006

00:46:49.645 --> 00:46:53.895

But when you're faced with an unexpected failure, uh, it's,

1007

00:46:53.955 --> 00:46:56.055

it would be kind of nice if we had, uh, some

1008

00:46:56.055 --> 00:46:58.655

of this documentation, uh, updated,

1009

00:46:59.675 --> 00:47:02.815

and we never did train to select our modes outside of a,

1010

00:47:03.155 --> 00:47:04.255

of a test requirement.

1011

00:47:04.715 --> 00:47:09.495

So Fred Knox, uh, makes a, a, I think just a great point.

1012

00:47:09.595 --> 00:47:11.175

You know, how do, how do you need

1013

00:47:11.175 --> 00:47:13.655

to think about making your new people as good as the old?

1014

00:47:13.675 --> 00:47:15.215

You're naturally gonna have turnover.

1015

00:47:15.795 --> 00:47:18.695

Uh, your, your key players, your ringers, the, the people

1016

00:47:18.695 --> 00:47:20.535

that did the first flight stuff are gonna move

1017

00:47:20.535 --> 00:47:21.655

on to the next first flight.

1018

00:47:22.195 --> 00:47:23.815

And if you have a, uh,

1019

00:47:23.965 --> 00:47:25.895

even if the research aircraft like this

1020

00:47:26.575 --> 00:47:29.325

whose life lifespan was only supposed to be a couple years,

1021

00:47:29.345 --> 00:47:32.035

but here we are five years down the road, uh,

1022

00:47:32.535 --> 00:47:33.555

you need to plan for that.

1023

00:47:33.855 --> 00:47:36.415

And, uh, I, I, I would, uh,

1024

00:47:38.045 --> 00:47:39.965

I offer myself up as an example here,

1025

00:47:39.965 --> 00:47:42.285

because on this day, uh, I was there

1026

00:47:42.285 --> 00:47:43.845

with another test conductor and,

1027

00:47:43.985 --> 00:47:48.565

and was unaware of changes that I was part of, uh, to,

1028

00:47:48.745 --> 00:47:49.845

to two years prior.

1029

00:47:50.105 --> 00:47:54.475

So, uh, it's really important to update the documentation.

1030

00:47:55.215 --> 00:47:58.115

And because you have a replacement air group

1031

00:47:58.115 --> 00:48:00.435

that's gonna come in and take over from you,

1032

00:48:00.435 --> 00:48:04.145

and if you get hit by a bus tomorrow, the show must go on.

1033

00:48:04.145 --> 00:48:07.025

It's, it's, it's important to take some time to,

1034

00:48:07.085 --> 00:48:09.745

to update the documentation and, and,

1035

00:48:09.765 --> 00:48:12.385

and fix, uh, the, some of the things that are broken.

1036

00:48:15.815 --> 00:48:18.155

So we talked about stressors, anger, fear, anxiety,

1037

00:48:18.585 --> 00:48:21.395

extreme excitement, perception of danger, tribal acceptance.

1038

00:48:21.455 --> 00:48:23.635

So how do we compensate for those things?

1039

00:48:23.745 --> 00:48:25.755

Well, you hear proper r

1040

00:48:25.755 --> 00:48:27.915

and r, healthy lifestyle, good organizational culture.

1041

00:48:28.065 --> 00:48:30.315

Well, we, we don't always have control of all those things.

1042

00:48:30.965 --> 00:48:32.425

Um, but what can we do in ops?

1043

00:48:32.575 --> 00:48:37.355

Well, we can get proper training and, uh, we can correct

1044

00:48:37.575 --> 00:48:40.315

and can and complete our procedures and checklists.

1045

00:48:41.125 --> 00:48:45.515

Uh, as far as the perception of danger, uh, I know in the,

1046

00:48:45.515 --> 00:48:46.955

in the FAA who I'm working with now,

1047

00:48:46.955 --> 00:48:50.075

we have a pretty robust, uh, training program that, that,

1048

00:48:50.075 --> 00:48:53.715

that gets us all to train to cope with dangerous situations.

1049

00:48:53.715 --> 00:48:55.235

That's, that's a critical thing to do.

1050

00:48:55.935 --> 00:48:58.035

And, and appropriate risk management.

1051

00:48:58.055 --> 00:49:01.925

So we, we wanna make sure that we highlight some

1052

00:49:01.925 --> 00:49:05.205

of the key issues with a given, given aircraft

1053

00:49:05.205 --> 00:49:08.445

or a given program and make sure that you see it.

1054

00:49:08.625 --> 00:49:11.565

We talked a bit, uh, earlier in the previous session about,

1055

00:49:11.565 --> 00:49:13.845

about the fidelity of, uh, simulations and,

1056

00:49:13.845 --> 00:49:15.205

and working out for first flight.

1057

00:49:15.625 --> 00:49:18.405

That's absolutely important, uh, to see these things

1058

00:49:18.405 --> 00:49:20.925

before they actually happen to you, if possible.

1059

00:49:21.735 --> 00:49:22.775

I wanna talk a little bit about this

1060

00:49:22.775 --> 00:49:23.935

tribal acceptance thing.

1061

00:49:24.055 --> 00:49:25.815

'cause I think it's a critically important.

1062

00:49:26.315 --> 00:49:28.335

Um, we did have a common mission.

1063

00:49:28.435 --> 00:49:30.535

We had, we had really good lines of communication.

1064

00:49:30.675 --> 00:49:33.775

Uh, I believe, uh, our, our control room,

1065

00:49:34.115 --> 00:49:35.615

uh, protocol was pretty good.

1066

00:49:35.635 --> 00:49:36.655

We made some failures,

1067

00:49:36.655 --> 00:49:39.575  
but I, I'd never felt like anybody was,

1068

00:49:39.635 --> 00:49:40.695  
was afraid to speak up.

1069

00:49:41.115 --> 00:49:44.255  
But one thing I do dwell on a little bit is I think about

1070

00:49:44.445 --> 00:49:48.415  
Eric Barnum and the fact that he sat in, in the control room

1071

00:49:48.475 --> 00:49:51.925  
and heard us go through that, that, uh, that, that return

1072

00:49:51.925 --> 00:49:54.935  
to base checklist, talking about the pedal heat, uh,

1073

00:49:54.935 --> 00:49:58.455  
make sure you turn it off 200 times, be be before this.

1074

00:49:59.155 --> 00:50:02.735  
And I wonder, I have to ask myself if, uh, Eric,

1075

00:50:02.875 --> 00:50:04.095  
in his characteristic way,

1076

00:50:04.095 --> 00:50:05.535  
it was a pretty low gain kind of guy.

1077

00:50:06.335 --> 00:50:09.155  
If he had said a couple times in those, those two years,

1078

00:50:09.215 --> 00:50:11.715  
Hey, you guys really ought to update that checklist.

1079

00:50:12.295 --> 00:50:13.965  
Maybe he did. Maybe we didn't hear it.

1080

00:50:13.965 --> 00:50:16.805



Maybe we didn't do it. Uh, or maybe he never said it.

1081

00:50:16.905 --> 00:50:19.325

But regardless, uh, I think, uh, uh,

1082

00:50:19.325 --> 00:50:22.045

programmatically it's really important to, uh,

1083

00:50:22.075 --> 00:50:25.245

have a plan pause before you raise your ops tempo.

1084

00:50:25.795 --> 00:50:29.005

Uh, and when you're moving into that ops temple, you need

1085

00:50:29.005 --> 00:50:31.725

to grab these critically important things

1086

00:50:31.745 --> 00:50:34.605

for a given aircraft and make sure that your

1087

00:50:35.125 --> 00:50:36.725

procedures now reflect the,

1088

00:50:36.755 --> 00:50:39.405

what the vehicle has become, not what it was.

1089

00:50:41.965 --> 00:50:43.265

And that's what I'm basically saying here.

1090

00:50:43.285 --> 00:50:45.545

The organization's gotta evolve with the aircraft.

1091

00:50:46.535 --> 00:50:49.925

You're gonna separate, uh, the reel from the imagined

1092

00:50:49.985 --> 00:50:52.165

as you go through, go through first flights, and you,

1093

00:50:52.165 --> 00:50:53.165

and you gain all that stuff.

1094

00:50:53.665 --> 00:50:56.565

Uh, it's critically important to, to share that knowledge

1095

00:50:56.985 --> 00:50:59.885

and talk with your, uh, uh, other disciplines to,

1096

00:50:59.905 --> 00:51:01.285

to make sure that you're getting all the

1097

00:51:01.285 --> 00:51:02.725

knowledge that you need.

1098

00:51:03.115 --> 00:51:04.445

There's been a couple of, um,

1099

00:51:04.635 --> 00:51:07.045

high visibility experimental aircraft accents

1100

00:51:07.325 --> 00:51:08.405

over the last several years.

1101

00:51:08.945 --> 00:51:12.405

And, and I think I see a common theme in, in, in, in some,

1102

00:51:12.465 --> 00:51:16.415

uh, uh, some areas where, where you miss the criticality of,

1103

00:51:16.415 --> 00:51:18.255

of certain very important things.

1104

00:51:19.695 --> 00:51:22.905

And at some point fairly soon, I think in a,

1105

00:51:22.905 --> 00:51:24.665

in a program's evolution,

1106

00:51:24.665 --> 00:51:27.585

you've gotta switch from a reactive approach, which works

1107

00:51:27.685 --> 00:51:29.025

for early on.

1108

00:51:29.205 --> 00:51:32.305

Uh, but you've gotta get into a proactive approach

1109

00:51:32.645 --> 00:51:36.215

and, uh, make sure that you capture the, the pearls

1110

00:51:36.215 --> 00:51:40.055

of wisdom and, and move them into very simple, easy

1111

00:51:40.075 --> 00:51:42.495

to understand, uh, actions

1112

00:51:43.155 --> 00:51:45.115

and practice those actions so you're not afraid

1113

00:51:45.115 --> 00:51:46.995

to use them on the day day that you need them.

1114

00:51:53.875 --> 00:51:56.855

And that's why I advocate perhaps a plan pause

1115

00:51:56.855 --> 00:51:59.895

before the ops tempo gets, gets going too, too quickly.

1116

00:52:00.435 --> 00:52:03.215

And I think with a program like ours, uh, with the,

1117

00:52:03.215 --> 00:52:06.495

the X 31 program with our ITO, well-oiled machine,

1118

00:52:07.035 --> 00:52:08.435

it would've been less than a week.

1119

00:52:08.695 --> 00:52:10.115

It wouldn't have, would not have slowed us

1120

00:52:10.115 --> 00:52:11.275

down at all to do that.

1121

00:52:11.415 --> 00:52:14.195

I'm, I'm sure we would've hopped to, uh, we hopped to

1122

00:52:14.195 --> 00:52:15.475

after the accident

1123

00:52:15.475 --> 00:52:17.835

and got the aircraft off to Paris in 84 days.

1124

00:52:17.935 --> 00:52:22.475

So, um, a a a good functioning program can do this, but,

1125

00:52:22.475 --> 00:52:23.875

but it needs a commitment to do it,

1126

00:52:23.875 --> 00:52:25.075

and it needs to be a priority.

1127

00:52:25.455 --> 00:52:29.765

So you two minutes to solve a problem,

1128

00:52:30.505 --> 00:52:32.285

um, I use the term boldface.

1129

00:52:32.485 --> 00:52:33.965

I don't mean that literally, uh,

1130

00:52:34.025 --> 00:52:38.005

but the, the, the boldface the important things that need

1131

00:52:38.005 --> 00:52:39.325

to be written down because it,

1132

00:52:39.325 --> 00:52:41.405

when you're in an emergent situation, this is,

1133

00:52:41.405 --> 00:52:42.405

this was my experience

1134

00:52:42.405 --> 00:52:44.045

and I think this is the conclusion I've drawn

1135

00:52:44.435 --> 00:52:47.445

with thinking about this for, for 30 years, is it,

1136

00:52:47.515 --> 00:52:50.245

it's really important to have those things trained

1137

00:52:50.305 --> 00:52:53.765

and captured, because in the emergency situation,

1138

00:52:53.795 --> 00:52:55.165

it's the emotional part of your brain

1139

00:52:55.165 --> 00:52:56.205

that's gonna do the thinking.

1140

00:52:56.705 --> 00:52:58.845

And if it's not, if it doesn't have access,

1141

00:52:59.075 --> 00:53:01.365

it's not gonna give you access to that smart brain,

1142

00:53:01.365 --> 00:53:02.805

which has all the stuff that you read

1143

00:53:03.075 --> 00:53:04.165

when you're sitting in your room.

1144

00:53:04.825 --> 00:53:08.235

So that's what I would leave, uh, this group with.

1145

00:53:08.575 --> 00:53:11.555

And, and with that, I'll see if there's any questions.

1146

00:53:19.565 --> 00:53:21.105

Hey, Dave, I'm not sure if you mentioned it

1147

00:53:21.125 --> 00:53:24.905

or, uh, so during a good briefing, obviously you're going

1148

00:53:24.905 --> 00:53:26.110  
to brief limitations.

1149

00:53:26.945 --> 00:53:29.725  
So the, the, uh, no pedo heat

1150

00:53:29.905 --> 00:53:32.845  
and don't fly in visible moisture was not briefed,

1151

00:53:32.945 --> 00:53:34.085  
or was it briefed

1152

00:53:34.085 --> 00:53:37.045  
and they, he thought he had petto heat, obviously,

1153

00:53:37.045 --> 00:53:38.125  
since he turned it on.

1154

00:53:38.675 --> 00:53:41.205  
Yeah, so, so, so, uh, there's two, two things there.

1155

00:53:41.715 --> 00:53:43.645  
What we didn't brief, uh, is

1156

00:53:43.645 --> 00:53:45.925  
that we didn't have petto heat that was lost.

1157

00:53:46.035 --> 00:53:48.725  
That, that, that procedure never got published

1158

00:53:48.725 --> 00:53:51.665  
after the configuration change was made.

1159

00:53:51.775 --> 00:53:54.785  
Yeah, that was a huge, huge latent failure.

1160

00:53:55.085 --> 00:53:58.405  
Um, uh, but as far as the, uh, no flight

1161

00:53:58.405 --> 00:54:00.485

and visible moisture that was briefed all the time.

1162

00:54:01.185 --> 00:54:04.805

Uh, but like I, when I set the stage, there was a,

1163

00:54:05.715 --> 00:54:06.885

what Carl went

1164

00:54:06.885 --> 00:54:10.755

and did is he tried to sniff up at the, at cloud base

1165

00:54:10.775 --> 00:54:14.235

and see if, uh, uh, see if he could find some level routes

1166

00:54:14.235 --> 00:54:15.795

where he could get the data for DLR.

1167

00:54:16.135 --> 00:54:18.155

He had to be above 20,000 and below cloud base.

1168

00:54:18.215 --> 00:54:22.905

And, and, uh, you know, there's a finite length of each one

1169

00:54:22.905 --> 00:54:25.465

of these test points and that picked up moisture.

1170

00:54:27.545 --> 00:54:29.765

Yes, sir. Scott LER 96 test wing, uh,

1171

00:54:29.805 --> 00:54:31.245

I just wanna bring up ergonomics

1172

00:54:31.245 --> 00:54:32.685

of design as a possible failure.

1173

00:54:33.405 --> 00:54:36.405

R one, two and three were clearly identified as critical

1174

00:54:36.405 --> 00:54:38.205

because their front row center on the instrument panel,

1175  
00:54:38.425 --> 00:54:41.125  
but the alternate airspeed indicator is low into the right

1176  
00:54:41.185 --> 00:54:42.965  
behind the person's right knee.

1177  
00:54:43.345 --> 00:54:45.085  
So I know this is between us

1178  
00:54:45.085 --> 00:54:46.205  
and lunch, just something

1179  
00:54:46.205 --> 00:54:47.965  
to think about when you're designing a system.

1180  
00:54:48.035 --> 00:54:49.685  
Clearly the switches were important,

1181  
00:54:49.865 --> 00:54:52.485  
but, uh, the pilots may not have considered the alternate

1182  
00:54:52.565 --> 00:54:54.325  
airspace indicator in their scan,

1183  
00:54:54.545 --> 00:54:55.645  
and also where the placement

1184  
00:54:55.645 --> 00:54:57.165  
of the gauge relative to the switches.

1185  
00:54:57.165 --> 00:54:58.565  
But thank you much. It was an excellent brief,

1186  
00:54:58.945 --> 00:55:01.845  
and I love the X 31 program, so thanks, sir.

1187  
00:55:02.475 --> 00:55:04.255  
Now that's a good point. And interestingly enough,

1188  
00:55:04.255 --> 00:55:06.815



when we went to Paris, we, we, as we swapped, we had the,

1189

00:55:07.235 --> 00:55:09.135

the alternate airspeed down by the right knee,

1190

00:55:09.515 --> 00:55:12.095

and we had the standby, so to speak, if the HUD failed on,

1191

00:55:12.095 --> 00:55:14.215

on the right side, but those were given the same source.

1192

00:55:14.835 --> 00:55:17.335

Uh, when we went to Paris, we moved the, uh,

1193

00:55:17.595 --> 00:55:19.215

the same source down by the right knee

1194

00:55:19.555 --> 00:55:22.895

and put the, uh, alternate, uh, to, to the right.

1195

00:55:22.915 --> 00:55:24.495

So you can compare the two speeds

1196

00:55:30.465 --> 00:55:31.465

That something for you.

1197

00:55:38.975 --> 00:55:41.905

Okay, so lunch is going to be in the same place.