



Episode 8: Commercial Crew: Space Flight's Next Chapter

March 2019

@NASAKennedy
#NASARocketRanch

New episodes every month!

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00:00:00,680 --> 00:00:04,740

Making your morning commute across the sea of tranquility.

2

00:00:04,740 --> 00:00:06,729

Waking up to a Martian sunrise.

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00:00:06,729 --> 00:00:10,940

Vacationing on Jupiter's moon Europa.

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00:00:10,940 --> 00:00:14,730

Pure science fiction...

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00:00:14,730 --> 00:00:15,730

Or is it?

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00:00:15,730 --> 00:00:19,400

EGS Program Chief Engineer, verify no constraints to launch.

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00:00:19,400 --> 00:00:24,650

EGS Chief Engineer team has no constraints.

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00:00:24,650 --> 00:00:27,830

I copy that.

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00:00:27,830 --> 00:00:33,149

You are clear to launch.

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00:00:33,149 --> 00:00:40,580

Five, four, three, two, one, and lift-off.

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00:00:40,580 --> 00:00:41,580

All clear.

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00:00:41,580 --> 00:00:44,309

Now passing through max q, maximum dynamic pressure.

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00:00:44,309 --> 00:00:45,559

Welcome to space.

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00:00:45,559 --> 00:00:49,650

While the idea of space travel is a staple of countless science fiction novels and motion

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00:00:49,650 --> 00:00:54,820

pictures, the reality is that you, or someone you know, could very well find themselves

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00:00:54,820 --> 00:00:57,670

walking on the surface of Mars in their lifetime.

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00:00:57,670 --> 00:01:02,390

You're listening to the Rocket Ranch and I am your host, Joshua Santora.

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00:01:02,390 --> 00:01:06,810

2019 is gearing up to be an exciting year for human space travel here at the Kennedy

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00:01:06,810 --> 00:01:08,070

Space Center.

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00:01:08,070 --> 00:01:11,720

Taking their cues from the Shuttle Program, which captured the imagination of the world

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00:01:11,720 --> 00:01:17,640

through their last launch in 2011, the Commercial Crew Program, or CCP for short, is poised

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00:01:17,640 --> 00:01:19,670

to reignite that passion.

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00:01:19,670 --> 00:01:25,060

Working in cooperation with NASA, Boeing alongside

United Launch Alliance, and SpaceX, combine

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00:01:25,060 --> 00:01:29,560

their innovative technology with the heritage
forged from previous NASA launches.

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00:01:29,560 --> 00:01:34,890

The overarching goal is to, one day soon,
make space travel as common and safe as flying

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00:01:34,890 --> 00:01:37,840

on an airplane, for everyone on planet Earth.

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00:01:37,840 --> 00:01:42,130

In this episode, I spoke with three members
of the Commercial Crew Program during their

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00:01:42,130 --> 00:01:49,130

preparation for SpaceX's Demo-One Mission,
which successfully launched on March 2.

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00:01:49,130 --> 00:01:54,040

First up is the NASA Mission Manager for Space
X's uncrewed flight test, Demo-1.

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00:01:54,040 --> 00:01:55,890

All right, welcome.

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00:01:55,890 --> 00:01:59,700

I am in the booth today with Mike Lee of NASA's
Commercial Crew Program.

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00:01:59,700 --> 00:02:00,840

Mike, thanks for being here.

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00:02:00,840 --> 00:02:02,370

Yeah, thank you very much.

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00:02:02,370 --> 00:02:06,670

So, give us a little bit of background on what brought you here today and where you

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00:02:06,670 --> 00:02:07,670

came from.

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00:02:07,670 --> 00:02:10,229

It had always been my dream to be an astronaut.

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00:02:10,229 --> 00:02:13,030

So that's what I decided I wanted to do in high school.

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00:02:13,030 --> 00:02:14,540

I wanted to be an astronaut.

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00:02:14,540 --> 00:02:17,120

And I went to college with that in mind.

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00:02:17,120 --> 00:02:22,340

Had an unforeseen incident happen to me in college that basically made it such that I

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00:02:22,340 --> 00:02:26,719

could not qualify to be an astronaut, due to a head injury that I experienced.

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00:02:26,719 --> 00:02:31,790

However, I had already been studying for three years as an aerospace engineer, focusing on

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00:02:31,790 --> 00:02:33,810

space, and so I continued that.

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00:02:33,810 --> 00:02:38,730

And then wound up getting a job here at the Kennedy Space Center right out of college,

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00:02:38,730 --> 00:02:41,439

and so I moved down here right after that.

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00:02:41,439 --> 00:02:45,669
People probably have -- I hope they've heard about the Commercial Crew Program, but it's

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00:02:45,669 --> 00:02:48,799
so much different than anything NASA's ever done before.

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00:02:48,799 --> 00:02:51,219
How is Commercial Crew so different?

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00:02:51,219 --> 00:02:56,349
The Commercial Crew Program and the commercialization approach, the individual companies actually

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00:02:56,349 --> 00:03:01,269
own their hardware, they own their designs, and the government is buying rides on their

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00:03:01,269 --> 00:03:02,269
hardware.

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00:03:02,269 --> 00:03:07,730
This, of course, will keep our nation's ability to stay in space and keep humans in space

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00:03:07,730 --> 00:03:13,120
and expand our capabilities beyond just low Earth orbit from there to going beyond to

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00:03:13,120 --> 00:03:16,339
the moon and to Mars and potentially other locations.

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00:03:16,339 --> 00:03:20,659
This is truly an exciting time for human spaceflight and our nation.

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00:03:20,659 --> 00:03:24,319
And believe me, it's only going to get better
as we charge off into the future.

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00:03:24,319 --> 00:03:29,699
It will also allow the advancement and development
of science that exists on the Space Station

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00:03:29,699 --> 00:03:31,359
today.

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00:03:31,359 --> 00:03:36,799
And is there some application for -- Thinking
about people who live across America, so,

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00:03:36,799 --> 00:03:39,090
why is this important for them?

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00:03:39,090 --> 00:03:40,709
Why should they care about this?

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00:03:40,709 --> 00:03:47,400
Well, because these commercial providers exist
and consist not only of themselves, not only

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00:03:47,400 --> 00:03:52,510
of Boeing and SpaceX, but also of their contractors
and their subcontractors and their partners,

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00:03:52,510 --> 00:03:56,900
and so because of that, they engage companies
across the United States.

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00:03:56,900 --> 00:04:04,959
So you're keeping many people employed, returning
energy and business back into the United States,

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00:04:04,959 --> 00:04:07,510
keeping people here employed and achieving

the goals that the United States has set.

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00:04:07,510 --> 00:04:14,969
So, again, we're trying to keep all this capability domestically, within the United States, without

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00:04:14,969 --> 00:04:22,740
having to vector our funds to outside countries to be able to achieve the goals of the program.

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00:04:22,740 --> 00:04:27,810
Together we are delivering on the critical task of providing a capability to fly our

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00:04:27,810 --> 00:04:34,720
crews on a U.S. built rocket and spacecraft from U.S. soil on Florida's Space Coast

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00:04:34,720 --> 00:04:40,020
to the International Space Station so we no longer have to rely on our Russian partners

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00:04:40,020 --> 00:04:41,680
to get our crews to space.

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00:04:41,680 --> 00:04:46,240
To be involved in that is inspiring.

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00:04:46,240 --> 00:04:56,200
If I look back on an equivalent time, back in the early 1900s, and think about the people

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00:04:56,200 --> 00:05:02,490
that were involved in the transition of government aircraft to commercialization of aircraft

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00:05:02,490 --> 00:05:08,669
and look at where commercialization of aircraft is today, it is a huge industry.

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00:05:08,669 --> 00:05:16,150

To think that I'm involved in that part of a transition in space is just really cool.

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00:05:16,150 --> 00:05:23,310

Do you see a future where what we know to be true of the commercial-airline market becomes

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00:05:23,310 --> 00:05:26,759

true of the space-traveling market?

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00:05:26,759 --> 00:05:27,759

Sure.

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00:05:27,759 --> 00:05:29,690

Why not?

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00:05:29,690 --> 00:05:36,590

I would imagine, in the nearer term, you're gonna get low-Earth-orbit flights, sub-orbital

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00:05:36,590 --> 00:05:40,639

flights, where people are able to fly from one continent to another in a matter of a

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00:05:40,639 --> 00:05:42,830

few hours.

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00:05:42,830 --> 00:05:48,570

Over time, I think we're gonna possibly develop hotels in space.

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00:05:48,570 --> 00:05:51,800

I know there's been some discussion of that in other areas.

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00:05:51,800 --> 00:05:55,250

And, so, in order to be able to do that, you're gonna have to have a way to get people there.

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00:05:55,250 --> 00:06:01,199
And, so, sure, as that, as an industry, develops,
I think that the transportation of people

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00:06:01,199 --> 00:06:04,680
to space is going to develop right along with
it.

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00:06:04,680 --> 00:06:11,569
So, in order to buy that ride, I would assume
that we have standards that have to be met

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00:06:11,569 --> 00:06:13,759
for us to be okay putting a human on board.

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00:06:13,759 --> 00:06:15,110
So, what does that process look like?

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00:06:15,110 --> 00:06:17,449
And how do those standards get set?

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00:06:17,449 --> 00:06:19,150
How are they established?

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00:06:19,150 --> 00:06:27,150
Yeah, so, we have a set of requirements that
were levied on the contractors, or on the

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00:06:27,150 --> 00:06:32,729
providers, both Boeing and SpaceX, for them
to build their spacecraft to in order to be

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00:06:32,729 --> 00:06:36,460
able to certify their hardware for carrying
humans on board.

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00:06:36,460 --> 00:06:39,080
So, we levied those requirements.

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00:06:39,080 --> 00:06:41,560
They proposed what their designs are.

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00:06:41,560 --> 00:06:42,720
And that's what the government does.

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00:06:42,720 --> 00:06:44,300
That's what Commercial Crew Program does.

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00:06:44,300 --> 00:06:48,819
We stay along with them during their design
to make sure that they are actually staying

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00:06:48,819 --> 00:06:51,949
compliant with what those requirements are
to be able to make sure that humans are able

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00:06:51,949 --> 00:06:53,539
to fly safely on their spacecraft.

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00:06:53,539 --> 00:06:56,840
So, are we dictating things to them as they're
developing?

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00:06:56,840 --> 00:07:01,120
So, we identify what the requirements are
that they have to meet, but we don't dictate

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00:07:01,120 --> 00:07:04,560
what their design is to be able to meet those
requirements.

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00:07:04,560 --> 00:07:09,629
The requirement, for example, to be able to
return humans safely from Earth orbit.

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00:07:09,629 --> 00:07:11,560
Obviously, getting there is half the task.

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00:07:11,560 --> 00:07:13,699

Getting home is the second half, so kind of a big deal.

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00:07:13,699 --> 00:07:14,699

Exactly, exactly.

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00:07:14,699 --> 00:07:15,699

Yeah, a big deal.

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00:07:15,699 --> 00:07:21,610

The method by which that return occurs could be a land landing or a water landing or a

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00:07:21,610 --> 00:07:25,199

landing under a parachute or a landing on our wings.

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00:07:25,199 --> 00:07:26,879

So the implementation is different.

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00:07:26,879 --> 00:07:30,740

The objective to get people safely back to Earth is what the common thing is.

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00:07:30,740 --> 00:07:31,990

What does the rocket look like?

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00:07:31,990 --> 00:07:34,069

What does the spacecraft itself look like?

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00:07:34,069 --> 00:07:37,710

What are the capabilities within the spacecraft?

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00:07:37,710 --> 00:07:44,460

Capabilities are fairly requirements-driven, but the providers actually have the ability

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00:07:44,460 --> 00:07:47,669

to vary some of what they can provide.

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00:07:47,669 --> 00:07:51,659

They can go above and beyond what is being required from a government perspective, for

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00:07:51,659 --> 00:07:52,659

example.

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00:07:52,659 --> 00:07:57,430

And, so, thinking about where you guys started and where you are today, can you give us kind

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00:07:57,430 --> 00:08:01,139

of a brief fly-by of the history of the program.

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00:08:01,139 --> 00:08:04,229

How did we get to this point where we're about to see two people launching -- two companies

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00:08:04,229 --> 00:08:05,729

start launching spacecraft?

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00:08:05,729 --> 00:08:13,620

So, back in around 2010, we had several Space Act Agreements, called SAAs, with multiple

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00:08:13,620 --> 00:08:16,710

companies across the nation.

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00:08:16,710 --> 00:08:22,169

Those were essentially study contracts, where they came up with initial design ideas.

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00:08:22,169 --> 00:08:26,770

Those initial design ideas were developed to a certain level of maturity, and those

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00:08:26,770 --> 00:08:33,930

were down-selected, ultimately, to the final two, Boeing and SpaceX, in 2014.

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00:08:33,930 --> 00:08:39,180

As we went through the initial parts of those SAAs, we had several different design concepts

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00:08:39,180 --> 00:08:42,149

-- capsules, winged vehicles.

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00:08:42,149 --> 00:08:50,500

And, again, the down-select occurred in 2014 for the two primary competitors that had the

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00:08:50,500 --> 00:08:57,130

most successful design implementations to achieve the mission objectives and minimize

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00:08:57,130 --> 00:08:58,750

risk, essentially, to achieve that.

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00:08:58,750 --> 00:09:03,890

So, Mike, you talked about -- You mentioned primary, and I want to kind of ping on that

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00:09:03,890 --> 00:09:04,890

for a second.

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00:09:04,890 --> 00:09:06,870

So, are there secondary partners you're working with?

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00:09:06,870 --> 00:09:09,680

So, there are other partners that we're working with.

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00:09:09,680 --> 00:09:15,410

The original group of competitors under the

SAAs -- two of them are still continuing on.

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00:09:15,410 --> 00:09:18,680

One of them is Sierra Nevada, and the other one is Blue Origin.

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00:09:18,680 --> 00:09:24,601

So, although neither Sierra, nor Blue actually won the Commercial Crew contract, they do

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00:09:24,601 --> 00:09:28,410

continue on performing operations under their own SAAs.

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00:09:28,410 --> 00:09:35,459

They are actually doing their own internal development to continue the ability for human

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00:09:35,459 --> 00:09:37,440

space flight down their own paths.

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00:09:37,440 --> 00:09:41,501

Although they're not getting funded by the government at this point in time, they're

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00:09:41,501 --> 00:09:44,000

continuing to do those study works.

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00:09:44,000 --> 00:09:49,410

They're also interacting with the government so that we have exchange, data exchange, and

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00:09:49,410 --> 00:09:54,720

engineering types of level of discussions between us and Blue Origin and Sierra Nevada.

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00:09:54,720 --> 00:10:00,680

So, is there a difference in the assistance that we're providing Boeing and SpaceX, as

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00:10:00,680 --> 00:10:03,070

opposed to Sierra Nevada and Blue Origin?

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00:10:03,070 --> 00:10:07,920

Well, with Sierra Nevada and Blue, we don't have requirements that we have levied on them.

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00:10:07,920 --> 00:10:14,360

So they are no longer designing to the Commercial Crew Program requirements that we have levied.

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00:10:14,360 --> 00:10:18,769

We do provide engineering-level communication with them.

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00:10:18,769 --> 00:10:24,959

So if they have questions regarding design solutions, we can give them what our experience

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00:10:24,959 --> 00:10:25,959

is.

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00:10:25,959 --> 00:10:28,959

We can talk to them about what our experiences is in these similar areas.

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00:10:28,959 --> 00:10:32,541

We can't, again, levy requirements on them, so we can't tell them whether or not they're

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00:10:32,541 --> 00:10:36,160

meeting our requirements, 'cause we haven't levied any on them.

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00:10:36,160 --> 00:10:39,870

But we do maintain the ongoing engineering discussions with them.

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00:10:39,870 --> 00:10:45,920

They use the data that they gather from those discussions to develop their own designs.

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00:10:45,920 --> 00:10:52,250

With Boeing, with SpaceX, we maintain those interactions, but our communications with

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00:10:52,250 --> 00:10:54,579

them is not intended to drive their designs.

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00:10:54,579 --> 00:10:58,860

So, again, we can look at what their design is, identify whether or not their designs

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00:10:58,860 --> 00:11:02,759

are meeting our requirements or not, but we don't give them what their design solution

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00:11:02,759 --> 00:11:03,800

needs to be.

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00:11:03,800 --> 00:11:10,139

So, thinking about Commercial Crew from this point forward, obviously, 2019 is an enormous

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00:11:10,139 --> 00:11:11,399

year for Commercial Crew.

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00:11:11,399 --> 00:11:12,970

What's 2019 look like?

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00:11:12,970 --> 00:11:16,660

2019 is gonna be real busy for us.

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00:11:16,660 --> 00:11:21,220

Every few months, essentially, we've got a launch flying for Commercial Crew from Kennedy

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00:11:21,220 --> 00:11:23,269

Space Center to the Space Station.

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00:11:23,269 --> 00:11:27,730

And I understand that you're kind of helping call the shots here for this first one.

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00:11:27,730 --> 00:11:28,860

Is that true?

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00:11:28,860 --> 00:11:29,860

Yeah.

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00:11:29,860 --> 00:11:33,519

I'm the mission manager for the SpaceX Demo-1 mission.

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00:11:33,519 --> 00:11:39,550

Demo-1 is gonna be the first flight of the SpaceX's Crewed Dragon vehicle.

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00:11:39,550 --> 00:11:42,880

Although, in this particular flight, it's a test flight and will not have a crew on

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00:11:42,880 --> 00:11:44,040

board.

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00:11:44,040 --> 00:11:48,470

It will still be flying to the Space Station and still dock to the Space Station, where

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00:11:48,470 --> 00:11:53,140

we plan on transferring cargo off the spacecraft and then, at the end of the mission, transferring

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00:11:53,140 --> 00:11:56,389

cargo back to the spacecraft and bringing it back to the ground.

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00:11:56,389 --> 00:11:59,579

And, so, what exactly is your role as the mission manager?

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00:11:59,579 --> 00:12:01,860

It's an awesome title.

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00:12:01,860 --> 00:12:03,270

What's your function?

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00:12:03,270 --> 00:12:10,279

So, I'm responsible for coordinating the ground support and ground activities for the launch.

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00:12:10,279 --> 00:12:15,850

Then I am also responsible for being a primary interface to the Space Station program during

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00:12:15,850 --> 00:12:17,769

on-orbit operations.

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00:12:17,769 --> 00:12:24,339

So, we're engaged as interfacing between the Station program and the provider, SpaceX,

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00:12:24,339 --> 00:12:28,200

to ensure that all the objectives are achieved on the mission.

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00:12:28,200 --> 00:12:32,290

If there are any issues identified during the execution of the mission, we help and

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00:12:32,290 --> 00:12:37,920

resolve any of those problems and make sure we've got the right folks engaged to resolve

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00:12:37,920 --> 00:12:40,630

any issues that may come up.

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00:12:40,630 --> 00:12:45,880

Thinking about objectives for the mission,
what are -- It may be too many to kind of

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00:12:45,880 --> 00:12:50,889

list them all, but what are the main things
that we're really keeping a close eye on before

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00:12:50,889 --> 00:12:52,310

we get to flying crews?

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00:12:52,310 --> 00:12:57,750

So, we're trying to use somewhat of a building-block
approach before we fly a crew on the next

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00:12:57,750 --> 00:12:58,949

mission, which is the Demo-2 mission.

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00:12:58,949 --> 00:13:03,709

We want to make sure that the spacecraft operates
the way that it's supposed to and operates

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00:13:03,709 --> 00:13:09,170

safely, such that the crew on board in Demo-2
will survive, of course.

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00:13:09,170 --> 00:13:14,089

So, we do things such as some demonstrations
as we're approaching the Space Station to

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00:13:14,089 --> 00:13:20,449

make sure that the spacecraft is controllable,
can be operated in such a way that it can

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00:13:20,449 --> 00:13:24,750

approach the Space Station safely, it can
back away, if necessary, under control,

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00:13:24,750 --> 00:13:30,579

On the board the station, two astronauts Canadian David Saint-Jacques and NASA astronaut Anne

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00:13:30,579 --> 00:13:32,740

McClain, inside monitoring the vehicle.

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00:13:32,740 --> 00:13:39,889

You'll hear them refer to the RPOP, which is the Rendezvous Proximity Operations Program.

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00:13:39,889 --> 00:13:44,100

That's just the name of the program that they're using on a laptop inside of the

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00:13:44,100 --> 00:13:46,170

station, to actually monitor Dragon.

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00:13:46,170 --> 00:13:51,230

And as they just demonstrated a little while ago, the crew has the ability to send commands

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00:13:51,230 --> 00:13:55,880

to make Dragon hold or retreat or even abort if they see anything that looks a little out

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00:13:55,880 --> 00:13:57,800

of sorts with its approach.

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00:13:57,800 --> 00:13:59,630

But everything going real smoothly so far.

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00:13:59,630 --> 00:14:02,100

We should be just about two minutes away.

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00:14:02,100 --> 00:14:08,860

That it can actually perform a successful docking and mating with the Space Station.

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00:14:08,860 --> 00:14:14,640

Capture confirmed.

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00:14:14,640 --> 00:14:17,529

[cheers]

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00:14:17,529 --> 00:14:21,129

You can hear the cheers behind us at SpaceX headquarters in Hawthorne, CA.

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00:14:21,129 --> 00:14:25,639

We have confirmation of a soft capture of the Dragon spacecraft to the International

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00:14:25,639 --> 00:14:26,920

Space Station.

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00:14:26,920 --> 00:14:31,339

Also, while we're docked to the Space Station, the crew on board the Space Station will be

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00:14:31,339 --> 00:14:35,829

stowing equipment, transferring equipment back and forth to the Space Station, as well

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00:14:35,829 --> 00:14:39,940

as demonstrating some of their operational procedures on orbit.

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00:14:39,940 --> 00:14:46,660

And at the end of the mission, again, we un-birth, or undock, from the Space Station and perform

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00:14:46,660 --> 00:14:50,569

a safe departure and a return.

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00:14:50,569 --> 00:14:56,110

And, so, we know that there's no people on board this mission, so is somebody on the

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00:14:56,110 --> 00:14:58,790

ground with a joystick, flying this thing,
or how does that work?

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00:14:58,790 --> 00:15:05,629

So, during the performance of this mission,
the great deal of the operations of the spacecraft

230

00:15:05,629 --> 00:15:07,139

are automated.

231

00:15:07,139 --> 00:15:14,779

So as the spacecraft approaches the Space
Station, the docking is an automated function,

232

00:15:14,779 --> 00:15:19,380

to a certain degree, although there is override
capability from the people that are on the

233

00:15:19,380 --> 00:15:20,380

ground.

234

00:15:20,380 --> 00:15:24,060

There is also communication with the Space
Station so that the folks on board Space Station

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00:15:24,060 --> 00:15:27,959

are able to see and monitor the spacecraft
as it approaches, as well as seeing the telemetry

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00:15:27,959 --> 00:15:29,910

that comes from the spacecraft.

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00:15:29,910 --> 00:15:33,720

A lot of people may be thinking, "Cargo Dragon,
Crew Dragon -- no big deal.

238

00:15:33,720 --> 00:15:37,100

You just put a seat in there -- right? -- and
you fly somebody on board."

239

00:15:37,100 --> 00:15:38,649

Is it harder than that?

240

00:15:38,649 --> 00:15:39,829

It is harder than that, yeah.

241

00:15:39,829 --> 00:15:43,520

There are life-support systems that have to fly on the Crew Dragon that aren't present

242

00:15:43,520 --> 00:15:45,189

on the Cargo Dragon.

243

00:15:45,189 --> 00:15:50,310

You also have to factor in the sensitivity of the human body to G-forces.

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00:15:50,310 --> 00:15:55,870

And, so, the forces that are exerted on the Crew Dragon is gonna be different than the

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00:15:55,870 --> 00:16:01,740

forces that are exerted on the Cargo Dragon, due to the nature of the flight profile that

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00:16:01,740 --> 00:16:09,030

is followed and also what is capable of the cargo on board, versus people on board.

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00:16:09,030 --> 00:16:13,870

And past 2019 -- Obviously, for SpaceX, we mentioned a few missions in there.

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00:16:13,870 --> 00:16:19,060

We know that Demo-1 and Demo-2 are big milestones for certification.

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00:16:19,060 --> 00:16:20,910

But what happens past 2019?

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00:16:20,910 --> 00:16:26,930

So, after certification, we start flying what generically is called the post-certification

251

00:16:26,930 --> 00:16:27,930

missions.

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00:16:27,930 --> 00:16:33,029

So far, with SpaceX, we have three of them baseline -- Crew 1, Crew 2, and Crew 3.

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00:16:33,029 --> 00:16:37,560

They are scheduled to fly on about one-year intervals.

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00:16:37,560 --> 00:16:44,199

Likewise, for Boeing, also, you have two pre-certification missions, the first one being an un-crewed

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00:16:44,199 --> 00:16:46,050

mission, the second one being a crewed mission.

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00:16:46,050 --> 00:16:48,470

Then, after that one, we go into certification.

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00:16:48,470 --> 00:16:53,829

And, so, then you also have post-flight, or post-certification, missions on the Boeing

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00:16:53,829 --> 00:16:54,829

side, as well.

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00:16:54,829 --> 00:16:58,360

Mike, as you think about the day coming up where we're gonna be launching, what are the

260

00:16:58,360 --> 00:17:00,920

things that -- Where does your mind go?

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00:17:00,920 --> 00:17:02,060

Is this an exciting time?

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00:17:02,060 --> 00:17:03,910

Is this -- Are you nervous?

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00:17:03,910 --> 00:17:09,051

Like, what's this like, from a human perspective, to know that we're about to start flying commercial

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00:17:09,051 --> 00:17:10,051

crew?

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00:17:10,051 --> 00:17:11,500

It's all of those things.

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00:17:11,500 --> 00:17:12,610

It's a little bit of nerves.

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00:17:12,610 --> 00:17:14,660

It's very exciting.

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00:17:14,660 --> 00:17:21,140

As we watch, again, the first mission of this design, of this crewed capability, it's very

269

00:17:21,140 --> 00:17:26,000

exciting because we're on the front end of a big step forward for us as a nation.

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00:17:26,000 --> 00:17:31,230

It's nerve-racking a little bit because it is the first flight of something new.

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00:17:31,230 --> 00:17:36,270

Fortunately, most of this has been demonstrated -- or a lot of this technology has been demonstrated

272

00:17:36,270 --> 00:17:38,640
previously by SpaceX.

273

00:17:38,640 --> 00:17:44,150
So, there are new modifications that are flying
in this design, but a lot of it is being demonstrated

274

00:17:44,150 --> 00:17:46,910
before it actually reaches the point of launching.

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00:17:46,910 --> 00:17:50,000
So we have fairly high confidence of the success
of this mission.

276

00:17:50,000 --> 00:17:53,580
But it's still a little bit nerve-racking.

277

00:17:53,580 --> 00:17:57,920
And, so, Mike, I don't want to dig into your
personal life too much, but, obviously, like,

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00:17:57,920 --> 00:18:02,450
a little bit of heartburn, probably, over
missing out on an opportunity to be an astronaut,

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00:18:02,450 --> 00:18:08,650
but you're here today helping to enable astronauts
and space flight.

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00:18:08,650 --> 00:18:14,450
Thinking about the people who may be listening
who either have a dream or have missed out

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00:18:14,450 --> 00:18:18,520
on a dream or lost a dream, what would you
encourage them with, as far as their pursuit

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00:18:18,520 --> 00:18:23,050

of working for NASA or other things of that nature?

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00:18:23,050 --> 00:18:29,280

I would totally encourage anyone who has a dream or a goal to pursue that goal as far

284

00:18:29,280 --> 00:18:31,340

as you can.

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00:18:31,340 --> 00:18:36,120

The only thing that will stop you from achieving that kind of a goal is closing doors on yourself,

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00:18:36,120 --> 00:18:37,120

really.

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00:18:37,120 --> 00:18:40,550

And if a door closes, then you look for another open door.

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00:18:40,550 --> 00:18:45,880

Go down a path of advancing your education so that you can achieve greatness.

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00:18:45,880 --> 00:18:47,890

Mike, I want to just say "thank you."

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00:18:47,890 --> 00:18:49,390

Appreciate you being here today.

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00:18:49,390 --> 00:18:50,920

And good luck this coming year.

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00:18:50,920 --> 00:18:52,230

It's a big year for you.

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00:18:52,230 --> 00:18:53,770

I know you're gonna do great.

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00:18:53,770 --> 00:18:54,910

Thank you so much.

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00:18:54,910 --> 00:19:00,660

We wanted to make sure you knew, we had a lot of successful milestones during that mission,

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00:19:00,660 --> 00:19:06,650

including docking, testing while attached to station, undocking, reentry and splashdown.

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00:19:06,650 --> 00:19:10,780

We're looking forward to seeing their future successes as they continue working alongside

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00:19:10,780 --> 00:19:12,880

the Commercial Crew Program.

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00:19:12,880 --> 00:19:16,410

Next up is Carol Scott, who serves as the Deputy Manager at the Launch Vehicle Office

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00:19:16,410 --> 00:19:18,400

for CCP.

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00:19:18,400 --> 00:19:22,540

As one of the original members of the program, she gives us a firsthand account of how Commercial

302

00:19:22,540 --> 00:19:25,510

Crew has grown and adapted since its inception.

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00:19:25,510 --> 00:19:29,310

All right, I am joined now by Carol Scott.

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00:19:29,310 --> 00:19:30,600

Carol thank you so much for joining me.

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00:19:30,600 --> 00:19:34,160

We are in the throes of getting ready for a rocket launch.

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00:19:34,160 --> 00:19:36,650

So tell us a little bit about yourself and what you do here.

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00:19:36,650 --> 00:19:42,951

All right, so I am the deputy for the Launch Vehicle System Office here within the Commercial

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00:19:42,951 --> 00:19:44,210

Crew program.

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00:19:44,210 --> 00:19:51,270

And it's my job to be able to help this incredible team that I have, that's loaded with engineers

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00:19:51,270 --> 00:19:59,332

and safety personnel, to be able to certify our two partners, SpaceX and Boeing, certify

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00:19:59,332 --> 00:20:04,810

their Rockets so that they'll be ready to take crew members up to Space Station and

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00:20:04,810 --> 00:20:09,280

be able to do future missions for so long as they're associated with Space Station.

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00:20:09,280 --> 00:20:11,860

Carol, so tell me about yourself and kind of how you got here.

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00:20:11,860 --> 00:20:17,130

I know it's an interesting story that's related to aeronautics, which is that definitely near

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00:20:17,130 --> 00:20:21,040

to NASA's heart but definitely a non-traditional path to get here.

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00:20:21,040 --> 00:20:23,390

I grew up in Warner Robins, Georgia.

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00:20:23,390 --> 00:20:26,130

Were you, were you a NASA kid growing up?

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00:20:26,130 --> 00:20:30,770

No, I was not a NASA kid but I was an aviation kid.

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00:20:30,770 --> 00:20:36,760

My dad is a pilot, not a, he's a private pilot my dad built his own airplane.

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00:20:36,760 --> 00:20:37,760

He's built two.

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00:20:37,760 --> 00:20:42,950

We had her own plane while I was growing up, nothing fancy or anything, but you know to

322

00:20:42,950 --> 00:20:44,780

get you from point A to point B.

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00:20:44,780 --> 00:20:51,440

We would go to Oshkosh and every year that was our family vacation and I've even like

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00:20:51,440 --> 00:20:53,050

slept under the wing, okay.

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00:20:53,050 --> 00:20:55,620

I have pictures of that.

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00:20:55,620 --> 00:21:00,420

So I grew up in this aviation world, all you know, all my life and all.

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00:21:00,420 --> 00:21:06,030

So I will tell you, I am a third generation engineering graduate at Mississippi State

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00:21:06,030 --> 00:21:13,850

University and my, so my grandfather went there he was a mechanical engineer, my great-uncle

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00:21:13,850 --> 00:21:15,820

went there he's electrical engineer.

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00:21:15,820 --> 00:21:21,160

My dad was an aeronautical, they didn't have aerospace at that time and then myself, a

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00:21:21,160 --> 00:21:22,420

chemical engineer.

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00:21:22,420 --> 00:21:29,170

So one of my really good friends that I co-opted with, her sister worked here, and so it was

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00:21:29,170 --> 00:21:32,330

right after Challenger so she was getting on with NASA.

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00:21:32,330 --> 00:21:38,930

She was also a chemical engineer from USF and she was able to get me a job interview

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00:21:38,930 --> 00:21:41,290

here, which was a phone interview right.

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00:21:41,290 --> 00:21:47,150

And so you know, I'm talking to my potential supervisor and he's offered me a job right

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00:21:47,150 --> 00:21:51,940

over the phone, and I was like well, can I come see the place, right?

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00:21:51,940 --> 00:21:53,960

So I come out here for a tour.

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00:21:53,960 --> 00:21:58,410

I'm crawling around inside of Columbia at the time.

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00:21:58,410 --> 00:22:01,510

We went inside Atlantis, inside the VAB.

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00:22:01,510 --> 00:22:07,790

And I remember coming out of Atlantis and just going oh my god, where do I sign up?

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00:22:07,790 --> 00:22:09,650

And you get paid to do this, too, right?

343

00:22:09,650 --> 00:22:11,630

It was pretty incredible.

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00:22:11,630 --> 00:22:13,460

So he definitely gave you the sell on the tour there.

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00:22:13,460 --> 00:22:17,290

I don't think there was any sell and I think the orbiter kind of sold itself.

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00:22:17,290 --> 00:22:22,790

And then you know, we're sitting down at the dinner table and just talking about stuff.

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00:22:22,790 --> 00:22:27,410

My parents, they had no idea you know that I'd been out here, or you know they knew I

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00:22:27,410 --> 00:22:30,170

was looking for something else, but and I told my dad.

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00:22:30,170 --> 00:22:36,450

I said, "hey, I was crawling around you know inside the Space Shuttle this past week

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00:22:36,450 --> 00:22:38,440

and I'm gonna go work for NASA."

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00:22:38,440 --> 00:22:42,520

And I'm telling you, that literally my dad, he had like his fork you know here in the

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00:22:42,520 --> 00:22:45,530

mouth - literally fell to the floor.

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00:22:45,530 --> 00:22:49,640

So I've never ever surprised my family or my dad like that before.

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00:22:49,640 --> 00:22:52,980

But anyway, so yeah, and it's been awesome ever since.

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00:22:52,980 --> 00:22:56,260

I have never, you know I've always loved working out here.

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00:22:56,260 --> 00:23:02,710

This has been, working at KSC is super incredible between all the you know the rocket stuff

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00:23:02,710 --> 00:23:07,320

that goes on here, all the wildlife - coolest part is the people, right.

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00:23:07,320 --> 00:23:08,320

Sure.

359

00:23:08,320 --> 00:23:09,320

The people are awesome.

360

00:23:09,320 --> 00:23:10,320

Sure.

361

00:23:10,320 --> 00:23:11,890

And so for Commercial Crew, has your role evolved?

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00:23:11,890 --> 00:23:12,890

Yes.

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00:23:12,890 --> 00:23:13,890

Since you've been a part of the program?

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00:23:13,890 --> 00:23:19,030

Yeah, so when I first came in, I was kind of more on I would say, like the program side.

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00:23:19,030 --> 00:23:24,140

So like one of my jobs to start off with, focused on strategic communications.

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00:23:24,140 --> 00:23:29,000

Coming up with a logo, coming up with you know how to interface with the partners, how

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00:23:29,000 --> 00:23:32,560

to go have the meetings that we needed to have you know with the partners.

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00:23:32,560 --> 00:23:37,160

How to tell our story to Congress so that they would understand that this is the next

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00:23:37,160 --> 00:23:42,960

logical step, you know, and a very vital step not only just for NASA, but this is what you

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00:23:42,960 --> 00:23:45,530

know, the United States should go do next.

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00:23:45,530 --> 00:23:49,570

Kennedy Space Center has made an amazing transformation.

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00:23:49,570 --> 00:23:55,770

Transitioning from a single government program funded installation to a true multi-user spaceport

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00:23:55,770 --> 00:23:56,770

of the future.

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00:23:56,770 --> 00:24:01,630

I did that for a year, and then it was time for me to go back and do some more technical

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00:24:01,630 --> 00:24:02,630

work.

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00:24:02,630 --> 00:24:08,660

So I went back to what was the Ground Systems, I said Ground and Launch Systems, and started

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00:24:08,660 --> 00:24:14,090

working with the planning and that interface to the commercial partners.

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00:24:14,090 --> 00:24:17,020

Basically to answer your question, I went from working the Ground and Launch Systems

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00:24:17,020 --> 00:24:22,170

to coming over and becoming the deputy manager for the Launch Vehicle Office.

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00:24:22,170 --> 00:24:27,210

So are you working with Boeing and SpaceX
or one more heavily than the other?

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00:24:27,210 --> 00:24:30,050

So no, I would say it's pretty even.

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00:24:30,050 --> 00:24:36,250

We do try, so I know I am, my area of emphasis
is with Boeing and ULA right, and then we

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00:24:36,250 --> 00:24:39,450

have Steve Gaddis who works on the SpaceX
side.

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00:24:39,450 --> 00:24:41,940

But we find out, we got to help each other
out right there.

385

00:24:41,940 --> 00:24:46,370

Let me tell you, when you get really close
to being ready to launch there's a lot of

386

00:24:46,370 --> 00:24:47,700

work to be done.

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00:24:47,700 --> 00:24:54,160

So our office had started off with trying
to work both partners but not be assigned

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00:24:54,160 --> 00:24:56,090

specifically just to one.

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00:24:56,090 --> 00:24:57,490

It takes all of us to do this.

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00:24:57,490 --> 00:25:00,090

This one definitely takes a village to go
make this work.

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00:25:00,090 --> 00:25:02,130

Yeah so what does that work look like day to day?

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00:25:02,130 --> 00:25:05,430

Are you reviewing documents, are you talking to the partners?

393

00:25:05,430 --> 00:25:06,810

What are you doing?

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00:25:06,810 --> 00:25:12,751

So I would say more doing a lot of strategic planning, talking with the partners, interfacing

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00:25:12,751 --> 00:25:14,510

with them a lot.

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00:25:14,510 --> 00:25:18,670

Interfacing with our office to make sure that the work that we need to have done, you know,

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00:25:18,670 --> 00:25:23,390

we have a plan or schedule.

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00:25:23,390 --> 00:25:28,980

It's really hard to get it out beyond about 60 days at this point, because the work comes

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00:25:28,980 --> 00:25:35,310

in, you know the works got to come in, and then you're gonna have issues or questions

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00:25:35,310 --> 00:25:38,490

and all about you know the work that's coming in.

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00:25:38,490 --> 00:25:41,100

So you have a lot of dialogue with the partners.

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00:25:41,100 --> 00:25:43,240

So is it fair to say, you're kind of shepherding the process?

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00:25:43,240 --> 00:25:47,620

Helping make sure that like all the people play their role and all the people get everything

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00:25:47,620 --> 00:25:48,820

done that needs to get done.

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00:25:48,820 --> 00:25:49,820

I would say that, yeah.

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00:25:49,820 --> 00:25:52,090

And I would say guiding too, right.

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00:25:52,090 --> 00:25:57,560

Guiding and then I try to stay out ahead of them, so that I keep them working toward you

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00:25:57,560 --> 00:26:02,110

know the strategic plan that's out here right and trying to keep ahead of them with the

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00:26:02,110 --> 00:26:06,120

goals so that you know we're actually getting to where we need to be.

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00:26:06,120 --> 00:26:08,600

So yeah, a little bit of that.

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00:26:08,600 --> 00:26:10,200

Yeah, you mentioned kind of planning out ahead.

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00:26:10,200 --> 00:26:14,720

Obviously we're right here on top of Demo-1,

our first Commercial Crew launch, which is

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00:26:14,720 --> 00:26:15,720

great.

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00:26:15,720 --> 00:26:19,080

So are you still kind of planning out, because obviously the mission isn't done...

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00:26:19,080 --> 00:26:20,080

...Oh my gosh...

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00:26:20,080 --> 00:26:21,080

When you fly Demo-1.

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00:26:21,080 --> 00:26:28,310

Okay, so yes, I've got a real intense team going on right now with Demo-1, trying to

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00:26:28,310 --> 00:26:32,570

make sure you get through all the reviews to say yes we can go fly.

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00:26:32,570 --> 00:26:40,530

So and then at the same time, I've got another team working on OFT and that's the Boeing

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00:26:40,530 --> 00:26:41,980

ULA launch.

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00:26:41,980 --> 00:26:48,010

So you know, I'm trying to get them to start their engineering assessments of how is this

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00:26:48,010 --> 00:26:56,270

rocket getting ready to fly and so, and then at the same time we have another team that's

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00:26:56,270 --> 00:27:00,160

working on Demo-2 that's doing all the planning for Demo-2.

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00:27:00,160 --> 00:27:05,770

And the work that we need to do for Demo-2 has got to be one of the things we're seeing

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00:27:05,770 --> 00:27:10,070

is, let's put a little more logic into what we work first.

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00:27:10,070 --> 00:27:14,630

And I know that sounds easy, but you know when you've got a lot of data coming in, you

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00:27:14,630 --> 00:27:18,810

kind of gotta sort through and go hey I need to do this chunk first, chunk A before I go

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00:27:18,810 --> 00:27:25,610

do chunk B. So we're doing a little bit more planning of that way to be able to go manage

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00:27:25,610 --> 00:27:26,610

it.

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00:27:26,610 --> 00:27:31,210

And then with all of that, you got to go de-conflict right.

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00:27:31,210 --> 00:27:36,400

Make sure your resources aren't, you know you're not stretching them too thin and then

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00:27:36,400 --> 00:27:41,030

that they can actually go do this work, because there's a lot of, obviously the launch vehicle

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00:27:41,030 --> 00:27:42,380

has a lot of propulsion.

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00:27:42,380 --> 00:27:48,250

There's a lot of work on the prop side and so that's the group we got to make sure is

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00:27:48,250 --> 00:27:52,790

able to get it done and not have them on top of each other.

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00:27:52,790 --> 00:27:56,740

So I'm asking you now to kind of imagine the future a little bit, because obviously we

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00:27:56,740 --> 00:28:02,710

don't know until we fly, but how much do you think that the data from Demo-1 will really

438

00:28:02,710 --> 00:28:04,100

impact that process?

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00:28:04,100 --> 00:28:08,840

Because I could see that, things could go like swimmingly...

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00:28:08,840 --> 00:28:09,840

Every day...

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00:28:09,840 --> 00:28:13,090

...And it's perfect and it's great, or it's like kind of, there are issues and you gotta

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00:28:13,090 --> 00:28:15,460

kind of take steps back to deal with those.

443

00:28:15,460 --> 00:28:18,720

Josh I'm gonna tell you, every week we learn something.

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00:28:18,720 --> 00:28:19,720

Right?

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00:28:19,720 --> 00:28:20,720

And that's...

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00:28:20,720 --> 00:28:21,720

Only every week?

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00:28:21,720 --> 00:28:25,650

Well yeah, really, it's not until the end of the week that you realize, all right you

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00:28:25,650 --> 00:28:29,740

start off with this plan on Monday and by Thursday you're doing some adjustment.

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00:28:29,740 --> 00:28:34,900

But you know, that's when you have test flight, what's the cool thing about test flight?

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00:28:34,900 --> 00:28:36,450

You find stuff, right?

451

00:28:36,450 --> 00:28:37,450

Exactly.

452

00:28:37,450 --> 00:28:41,520

So you all know, you don't know exactly what that issue is but you know there's gonna be

453

00:28:41,520 --> 00:28:45,660

something, and it's gonna be fun to work on, it's gonna be something exciting, it's gonna

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00:28:45,660 --> 00:28:49,570

drive you crazy, but you gotta go fix that, you know.

455

00:28:49,570 --> 00:28:53,510

And I'm so, you just kind of put a little
block in your plan to, all right whatever

456

00:28:53,510 --> 00:28:56,540

this unknown is I gotta go do that.

457

00:28:56,540 --> 00:28:59,760

Do you build in a block for unknown things
like that or do you just like subconsciously

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00:28:59,760 --> 00:29:01,570

do that knowing like it's gonna happen?

459

00:29:01,570 --> 00:29:03,780

I kind of do it more subconsciously.

460

00:29:03,780 --> 00:29:04,780

Okay.

461

00:29:04,780 --> 00:29:07,120

It's hard to put on paper, the block of unknown
unknown.

462

00:29:07,120 --> 00:29:09,930

When the program manager wants to go, "You
can't do that.

463

00:29:09,930 --> 00:29:10,930

What is that?

464

00:29:10,930 --> 00:29:11,930

Why don't you know that?"

465

00:29:11,930 --> 00:29:17,290

You know, so, but I know from experience right,
I know experience from shuttle from doing

466

00:29:17,290 --> 00:29:21,160

Ares I-X, you always have those unknown unknowns.

467

00:29:21,160 --> 00:29:23,060

That's what part of test flight is.

468

00:29:23,060 --> 00:29:24,460

That's what's the fun part of it.

469

00:29:24,460 --> 00:29:27,210

Yeah there's constant learning all the time.

470

00:29:27,210 --> 00:29:30,070

The partner is doing what we did in shuttle.

471

00:29:30,070 --> 00:29:35,910

They're the ones that are, you know, loading it up and you know, make flipping switches

472

00:29:35,910 --> 00:29:40,320

or, you know, or making sure it's gonna be able to go launch.

473

00:29:40,320 --> 00:29:46,370

Our role is more of an advisory, making sure that the requirements set that we set up for,

474

00:29:46,370 --> 00:29:52,600

that they are working within that, you know, box for lack of a better word, in that it

475

00:29:52,600 --> 00:29:54,300

is safe to go fly that day.

476

00:29:54,300 --> 00:29:57,070

So that's what our job is.

477

00:29:57,070 --> 00:30:03,220

My role is more of the management side, you know leading up to like L Minus four hours.

478

00:30:03,220 --> 00:30:07,280

And if there's any kind of issues that's got to be resolved, you know, I've got to make

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00:30:07,280 --> 00:30:14,910

sure the team can go do that, but after -- when the Launch Support Team starts up, and that's

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00:30:14,910 --> 00:30:20,750

that real small-scoped engineering team that's under the direction of Steve Stich of our

481

00:30:20,750 --> 00:30:23,030

program, and that's when that gets invoked.

482

00:30:23,030 --> 00:30:29,510

I'll tell you what I'm doing right now is because in case the unknown unknown happens,

483

00:30:29,510 --> 00:30:35,380

right, and that cool problem is going to sneak out, so I'm working on contingency planning,

484

00:30:35,380 --> 00:30:38,860

making sure I've got Group "B" ready to come in.

485

00:30:38,860 --> 00:30:43,270

So when the "A" Team is off, 'cause they've been working all night, I've got "B" Team

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00:30:43,270 --> 00:30:46,353

set up to go work the issues, and so --

487

00:30:46,353 --> 00:30:47,800

And "B" Team not the lesser team, just the next team.

488

00:30:47,800 --> 00:30:48,900

No, just the next team.

489

00:30:48,900 --> 00:30:49,900

Right.

490

00:30:49,900 --> 00:30:50,900

[Laughs]

491

00:30:50,900 --> 00:30:51,900

The next team.

492

00:30:51,900 --> 00:30:52,900

I know.

493

00:30:52,900 --> 00:30:54,260

I was trying to figure out what else to kind of call them there, but have them ready to

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00:30:54,260 --> 00:31:00,000

go so they can make sure the issue's getting resolved while folks that worked the night

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00:31:00,000 --> 00:31:04,860

before are able to sleep, and we can get ready for the next attempt.

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00:31:04,860 --> 00:31:09,830

So, like I said -- always that constant planning kind of going on.

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00:31:09,830 --> 00:31:14,220

And we know we talked about this very different role that NASA's playing in these launches.

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00:31:14,220 --> 00:31:15,220

Mm-hmm.

499

00:31:15,220 --> 00:31:16,820

How do you characterize, in summary, this

mission?

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00:31:16,820 --> 00:31:18,530

Is it a NASA mission?

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00:31:18,530 --> 00:31:24,530

So, I would say it is all of it, okay?

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00:31:24,530 --> 00:31:25,530

[Laughs]

503

00:31:25,530 --> 00:31:26,530

So it's a NASA mission.

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00:31:26,530 --> 00:31:28,350

This one is a SpaceX mission.

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00:31:28,350 --> 00:31:32,330

But, more importantly, this is a mission for
United States of America.

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00:31:32,330 --> 00:31:33,930

This is for all of us.

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00:31:33,930 --> 00:31:35,180

I'll tell you.

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00:31:35,180 --> 00:31:39,731

Being able to launch to the International
Space Station from U.S. soil - I can't imagine

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00:31:39,731 --> 00:31:40,731

a better honor.

510

00:31:40,731 --> 00:31:42,050

And we're ready.

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00:31:42,050 --> 00:31:49,370

So, it is an introduction test flight to be able to go get crews to I.S.S., right?

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00:31:49,370 --> 00:31:53,870

So, initially, from the NASA standpoint, and that's what it is.

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00:31:53,870 --> 00:32:00,420

For SpaceX, this is probably proving out that eventually they can go have their tourists

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00:32:00,420 --> 00:32:08,140

to go whether it's to Mars or the Moon -- wherever SpaceX wants to go take people, this is providing

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00:32:08,140 --> 00:32:09,770

that avenue for them.

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00:32:09,770 --> 00:32:14,470

And then I'm going to tell you, from the bigger, all-of-us, picture standpoint, this is the

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00:32:14,470 --> 00:32:20,720

only way we're going to get our grandkids or, you know, whatever have the ability to

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00:32:20,720 --> 00:32:27,090

be able to go into space, and so that's why I say this is -- It's more than just NASA,

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00:32:27,090 --> 00:32:29,120

it's more than just SpaceX.

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00:32:29,120 --> 00:32:34,110

It's for all of us so that, eventually, we're getting space flight as common as air travel

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00:32:34,110 --> 00:32:35,110

is today.

522

00:32:35,110 --> 00:32:36,110

Awesome.

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00:32:36,110 --> 00:32:38,960

Well, Carol, I appreciate you being with me today.

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00:32:38,960 --> 00:32:40,250

Good luck to you and your entire team.

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00:32:40,250 --> 00:32:41,250

Oh, thank you.

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00:32:41,250 --> 00:32:42,290

Obviously, it's going to be an exciting couple weeks here.

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00:32:42,290 --> 00:32:43,870

I'm sure busy, but lots of fun.

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00:32:45,870 --> 00:32:44,870

Yeah.

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00:32:45,870 --> 00:32:46,870

Absolutely.

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00:32:46,870 --> 00:32:47,870

Thank you.

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00:32:47,870 --> 00:32:48,870

I appreciate it, too.

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00:32:48,870 --> 00:32:50,720

On our last podcast we said we'd answer a question from a listener, so we wanted to

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00:32:50,720 --> 00:32:53,400

tackle this one from on Twitter from @teslaprince.

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00:32:53,400 --> 00:32:59,200

“On average, how long does an astronaut spend on the ISS on any given mission?”

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00:32:59,200 --> 00:33:01,570

Well the truth is, it varies pretty wildly.

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00:33:01,570 --> 00:33:07,340

With the shuttle program we saw stays as short as 7 or 10 days, but most expeditions on station

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00:33:07,340 --> 00:33:10,040

are spent up there for about six months at a time.

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00:33:10,040 --> 00:33:13,890

Astronaut Scott Kelly spent almost a full year up there for science research.

539

00:33:13,890 --> 00:33:15,970

Great question.

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00:33:15,970 --> 00:33:20,200

Despite beginning her career toward the end of the Shuttle Program, Misty Snopkowski carried

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00:33:20,200 --> 00:33:25,810

over a youthful energy into her role as the Launch Site Integrator for Commercial Crew.

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00:33:25,810 --> 00:33:30,170

Working directly with SpaceX, she spoke with me about the joys and challenges she faces

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00:33:30,170 --> 00:33:31,500

leading up to launch.

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00:33:31,500 --> 00:33:36,390

All right, so I am joined now by Misty Snopkowski.

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00:33:36,390 --> 00:33:40,930

We are on the brink of launching the first ever, Commercial Crew launch.

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00:33:40,930 --> 00:33:42,500

Misty thank you for making time for us today.

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00:33:42,500 --> 00:33:43,970

Thanks for having me.

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00:33:43,970 --> 00:33:48,690

So we're obviously talking about Commercial Crew and Demo-1, which is the first flight

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00:33:48,690 --> 00:33:51,860

of SpaceX's Crew Dragon, which is super exciting.

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00:33:51,860 --> 00:33:53,750

So what job do you hold right now?

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00:33:53,750 --> 00:33:55,110

What are you, what are you doing for Commercial Crew?

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00:33:55,110 --> 00:34:02,520

So now, now I am in the group that's called Ground and Mission Operations.

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00:34:02,520 --> 00:34:04,980

Our nickname is G-Mo.

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00:34:04,980 --> 00:34:06,000

I was against that.

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00:34:06,000 --> 00:34:07,000

[laughs\}

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00:34:07,000 --> 00:34:08,330

It kind of stuck.

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00:34:08,330 --> 00:34:13,169

But we could spend days talking about like naming procedures and acronyms, but...

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00:34:13,169 --> 00:34:20,700

Yes yes so G-Mo, yeah, is the short, the short name for the office but essentially, my role

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00:34:20,700 --> 00:34:23,240

is the Technical Integrator for G-Mo.

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00:34:23,240 --> 00:34:30,740

So what that means is, because the scope of the group is so big, it covers launch operations,

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00:34:30,740 --> 00:34:33,149

mission operations and recovery operations.

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00:34:33,149 --> 00:34:38,720

And so they really needed somebody as an integrator to kind of look across all operations and

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00:34:38,720 --> 00:34:42,659

make sure that all the requirements and standards were being integrated properly and, and just

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00:34:42,659 --> 00:34:47,579

kind of have that that big integrated picture for all the, for all the operations.

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00:34:47,579 --> 00:34:51,839

Cool so you kind of get play, "make it all work together."

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00:34:51,839 --> 00:34:52,839

Is that kind of...

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00:34:54,839 --> 00:34:53,839

Right.

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00:34:54,839 --> 00:34:55,839

...summarize that?

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00:34:55,839 --> 00:34:59,130

Yeah, yeah, and it's, it's a pretty big job because we have, we have the folks here at

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00:34:59,130 --> 00:35:04,110

Kennedy who obviously are involved more in the ground and lawn shops portion of it.

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00:35:04,110 --> 00:35:11,630

And then we have our major stakeholders over in Houston who are obviously very heavily

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00:35:11,630 --> 00:35:15,010

involved in the mission operations side when we were when we're actually flying in space.

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00:35:15,010 --> 00:35:20,310

And then there's the recovery portion, which is kind of a mix of Houston and then obviously

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00:35:20,310 --> 00:35:25,539

SpaceX is involved in the recovery part as well and that's out here again in the Atlantic,

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00:35:25,539 --> 00:35:27,549

so it's a big, it's a big job.

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00:35:27,549 --> 00:35:33,480

I should probably also, I don't know if I mentioned that, but within the G-Mo org there's

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00:35:33,480 --> 00:35:36,049

my position on SpaceX and then there's another one for Boeing.

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00:35:36,049 --> 00:35:40,660

So I, I'm exclusively responsible for the SpaceX operations.

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00:35:40,660 --> 00:35:44,470

Tell me about being a kid and growing up.

580

00:35:44,470 --> 00:35:47,210

You wanted to, you always want to work in the space industry?

581

00:35:47,210 --> 00:35:51,589

Um, I don't know if I always wanted to work in the space industry.

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00:35:51,589 --> 00:35:54,109

Just because, I mean, when you're little you don't really know what that means.

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00:35:54,109 --> 00:35:56,450

I wanted to be a motorcycle policeman, that was my thing.

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00:35:56,450 --> 00:35:57,450

So did you have like a thing?

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00:35:57,450 --> 00:35:58,730

I wanted to be a veterinarian.

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00:35:58,730 --> 00:35:59,730

Yes, awesome.

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00:35:59,730 --> 00:36:00,950

I loved animals.

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00:36:00,950 --> 00:36:07,210

It probably wasn't until like high school timeframe where I started learning like what

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00:36:07,210 --> 00:36:12,869

an engineer is through my physics teacher and so that kind of struck my interest.

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00:36:12,869 --> 00:36:17,000

And then, I was always a huge fan of Star Trek The Next Generation.

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00:36:17,000 --> 00:36:20,700

Okay, very good, right who's not.

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00:36:20,700 --> 00:36:27,060

Right, so anyways, so that was always a fun thing for me in high school and then I just

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00:36:27,060 --> 00:36:32,180

kind of found out what an aerospace engineer was and that seemed like a cool thing to do

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00:36:32,180 --> 00:36:34,339

so I started pursuing that and learning more about

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00:36:34,339 --> 00:36:35,740

what that would entail.

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00:36:35,740 --> 00:36:36,840

And then that's what I ended up majoring in.

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00:36:36,840 --> 00:36:41,050

And so what does your job look like on a daily basis?

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00:36:41,050 --> 00:36:42,580

Are you spending time in meetings?

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00:36:42,580 --> 00:36:43,960

Are you doing design work?

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00:36:43,960 --> 00:36:45,210

Are you evaluating things?

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00:36:45,210 --> 00:36:49,940

Like obviously we'll talk about approaching launch week, but yeah not approaching launch

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00:36:49,940 --> 00:36:53,009

week, what's kind of a normal week or day look like?

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00:36:53,009 --> 00:36:59,049

It's kind of a mix of all that, you know there is the program side of it where you're in

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00:36:59,049 --> 00:37:05,210

meeting at the program control board, or engineering review board.

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00:37:05,210 --> 00:37:10,259

Leading up to this timeframe we've had several milestones with SpaceX as far as the designs

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00:37:10,259 --> 00:37:16,750

go, because also what's included in my roles and responsibilities is making sure that the

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00:37:16,750 --> 00:37:23,080

launch pad, or LC-39a, as some folks might know it as, that all gets designed according

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00:37:23,080 --> 00:37:28,049

to our requirements that we need for crew as well.

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00:37:28,049 --> 00:37:32,789

So we had several what we called launch site

operational readiness reviews with SpaceX

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00:37:32,789 --> 00:37:36,450

where we went over all their designs.

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00:37:36,450 --> 00:37:40,119

There is some fun stuff in the day-to-day to where you'll get to go out to the pad and

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00:37:40,119 --> 00:37:45,420

actually do walk down to the pad or see how they perform their vehicle processing.

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00:37:45,420 --> 00:37:47,390

So those are always fun days.

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00:37:47,390 --> 00:37:54,109

And then also along the way we've observed a lot of their static fire and launch operations,

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00:37:54,109 --> 00:37:58,430

so that's always fun to get behind a console and see how they're doing that operation as

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00:37:58,430 --> 00:37:59,430

well.

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00:37:59,430 --> 00:38:04,509

So it's not always in the conference rooms but sometimes we get to do some fun things

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00:38:04,509 --> 00:38:05,840

out in the field.

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00:38:05,840 --> 00:38:10,619

So just asking you very personally, is that a disappointment?

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00:38:10,619 --> 00:38:12,960

Is the work for NASA all you had hoped that it would be?

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00:38:12,960 --> 00:38:19,380

Oh yeah, I mean the things I've gotten to do my whole career have been really awesome.

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00:38:19,380 --> 00:38:21,960

Really, like more than I could have ever expected.

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00:38:21,960 --> 00:38:27,720

I mean just to even be, to say you know, to tell you my career history and to say that

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00:38:27,720 --> 00:38:31,730

I got to fly the last shuttle launch and then I was part of a brand new program that got

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00:38:31,730 --> 00:38:32,730

stood up.

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00:38:32,730 --> 00:38:36,630

There's not a lot of people that get that kind of opportunity in their career, so I

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00:38:36,630 --> 00:38:40,859

do feel very fortunate to experience that.

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00:38:40,859 --> 00:38:45,830

And then and just seeing all the things that this company, SpaceX because that's who I'm

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00:38:45,830 --> 00:38:49,160

closest with at this point but just to see all the things that they've accomplished in

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00:38:49,160 --> 00:38:52,210

the last few years under TCAP has been amazing.

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00:38:52,210 --> 00:38:57,200

Yeah and so what's life been like leading up to launch, so kind of a little bit everything

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00:38:57,200 --> 00:39:02,400

in the day-to-day but obviously when we get close to launch it's a whole different game.

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00:39:02,400 --> 00:39:05,820

Yes it's been insane.

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00:39:05,820 --> 00:39:11,259

You know and a lot of it is because this is our first launch as a program to, so you know

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00:39:11,259 --> 00:39:16,519

we're kind of figuring a lot of things and learning a lot of things as we go.

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00:39:16,519 --> 00:39:23,289

But yeah, it's been, the last I would, say two months, have been pretty intense just

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00:39:23,289 --> 00:39:25,880

trying to get to this point.

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00:39:25,880 --> 00:39:29,609

You know, once the hardware, and I kind of knew this already because shuttle was kind

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00:39:29,609 --> 00:39:33,210

of the same way, but once the hardware gets to Kennedy Space Center, like that's when

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00:39:33,210 --> 00:39:35,540

things turn on around here.

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00:39:35,540 --> 00:39:36,540

Yeah.

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00:39:36,540 --> 00:39:42,329

And kick into a different gear and so you kind of step away from the paperwork aspect

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00:39:42,329 --> 00:39:46,720

of it and you're and you're more trying to follow what's happening with the hardware

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00:39:46,720 --> 00:39:49,839

and getting that vehicle stacked.

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00:39:49,839 --> 00:39:56,089

I think it was right before the end of last year, we were mating the vehicles, and then

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00:39:56,089 --> 00:40:02,019

as soon as we got back from the new year, you know, we had folks here on the second

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00:40:02,019 --> 00:40:07,569

working so that we could get ready to roll out the vehicle and do the first dry dress.

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00:40:07,569 --> 00:40:14,230

So I think public saw that when the when the vehicle rolled out to the pad, but ever since

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00:40:14,230 --> 00:40:20,140

then it's just been like super high-speed, you know we had a static fire...

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00:40:20,140 --> 00:40:24,089

[sound of SpaceX static fire test]

651

00:40:24,089 --> 00:40:30,619

...a couple weeks ago, or more, it all kind of blurs together.

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00:40:30,619 --> 00:40:31,619

[laughs]

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00:40:31,619 --> 00:40:37,150

So yeah, I'm really excited about the launch happening, like it's been a long time to get

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00:40:37,150 --> 00:40:41,009

to this point, a lot a lot of work.

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00:40:41,009 --> 00:40:43,710

And sometimes it's kind of funny like sitting here like thinking about it, you know, you've

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00:40:43,710 --> 00:40:46,339

just kind of been in the mix of it running as hard as we can.

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00:40:46,339 --> 00:40:47,339

Yeah next Saturday.

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00:40:47,339 --> 00:40:49,040

Yeah like that's weird to say, right?

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00:40:49,040 --> 00:40:53,960

Yeah, yeah, and the team's been getting ready, you know we've fit in some sims since the

660

00:40:53,960 --> 00:40:58,430

beginning of the year to get the launch team ready.

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00:40:58,430 --> 00:41:01,089

So it's pretty exciting to be this close.

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00:41:01,089 --> 00:41:06,490

So Misty, thinking about launch day, very early morning, where are you planning to be

663

00:41:06,490 --> 00:41:07,490

when we fly?

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00:41:07,490 --> 00:41:08,490

That's a good question.

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00:41:08,490 --> 00:41:10,259

I was actually just talking about it this morning.

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00:41:10,259 --> 00:41:15,480

So you get things you have to figure out when launching a vehicle for the first time.

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00:41:15,480 --> 00:41:20,310

Yeah well, so by the design, I'm not gonna be in the control room.

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00:41:20,310 --> 00:41:26,779

You know SpaceX is the operator for this mission but there is a whole NASA team that's supporting

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00:41:26,779 --> 00:41:33,060

our launch manager who's gonna be Steve Stich for this mission.

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00:41:33,060 --> 00:41:37,089

And so there's a team behind him that's giving him inputs to anything that might be happening

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00:41:37,089 --> 00:41:46,009

during the count but that's mostly an engineering team that had helped stand up and get them

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00:41:46,009 --> 00:41:47,009

ready.

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00:41:47,009 --> 00:41:49,440

I'll probably be over in Hangar AE.

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00:41:49,440 --> 00:41:56,049

It's a big facility that we use for NASA to house some of the folks who are around during

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00:41:56,049 --> 00:41:57,260

day of launch.

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00:41:57,260 --> 00:42:00,030

That's probably where I'll be.

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00:42:00,030 --> 00:42:04,440

Good and so will you be playing a specific role or will you really just become kind of

678

00:42:04,440 --> 00:42:05,440

enjoying this?

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00:42:05,440 --> 00:42:07,079

Are you watching data?

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00:42:07,079 --> 00:42:08,280

What's your function at that point.

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00:42:08,280 --> 00:42:11,569

I don't have a specific day of launch function.

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00:42:11,569 --> 00:42:12,569

Okay.

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00:42:12,569 --> 00:42:17,480

Like I said, that's mostly covered by the engineering teams.

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00:42:17,480 --> 00:42:21,839

So I'm probably more there for moral support and then to be with the team, right?

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00:42:21,839 --> 00:42:27,319

Like we're at this very end point and so you

know I kind of want to be with everybody when

686

00:42:27,319 --> 00:42:28,319

it happens.

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00:42:28,319 --> 00:42:29,319

Awesome.

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00:42:29,319 --> 00:42:33,220

How much do you interface with SpaceX, or is it more focused on working with our NASA

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00:42:33,220 --> 00:42:35,319

team make sure things are in order?

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00:42:35,319 --> 00:42:39,369

I talk to them like every day, all throughout the day, to be able to pull something like

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00:42:39,369 --> 00:42:44,089

this off you have to have a pretty good working relationship with your counterparts.

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00:42:44,089 --> 00:42:48,650

We've got folks that are here local from SpaceX.

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00:42:48,650 --> 00:42:53,079

I talked to people at SpaceX in Houston and then also in Hawthorne.

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00:42:53,079 --> 00:42:58,580

So you know, over the years you kind of form a pretty good working relationship with them.

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00:42:58,580 --> 00:43:00,049

But yeah, we talk all the time.

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00:43:00,049 --> 00:43:07,220

And you mentioned that your work kind of focuses

on the launch pad and a lots of things going

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00:43:07,220 --> 00:43:08,400

on there.

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00:43:08,400 --> 00:43:16,009

So speaking from a uneducated perspective,
how complicated is a Launchpad?

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00:43:16,009 --> 00:43:20,000

Because there's on one hand like, I'm like
you just need a big mound to like fire a rocket

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00:43:20,000 --> 00:43:21,000

into space off.

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00:43:21,000 --> 00:43:22,000

Yeah.

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00:43:22,000 --> 00:43:23,700

And on the other hand, I'm like, there's no
way it's that simple.

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00:43:23,700 --> 00:43:24,700

[laughs]

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00:43:24,700 --> 00:43:25,700

No, it's pretty complicated.

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00:43:25,700 --> 00:43:36,019

So well, SpaceX wasn't starting with a complete,
you know, just mound of concrete, they inherited

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00:43:36,019 --> 00:43:39,390

the old shuttle launch site.

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00:43:39,390 --> 00:43:45,390

So they really kind of had a pretty good foundation
there, but if you look at, if you were to

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00:43:45,390 --> 00:43:51,260

walk out there today and look at that pad compared to when the shuttle was flying, it

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00:43:51,260 --> 00:43:53,420

looks very different now.

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00:43:53,420 --> 00:43:57,930

But as far as all the systems out there, you have to think about every system that's onboard

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00:43:57,930 --> 00:44:01,799

the vehicle has a ground interface to it.

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00:44:01,799 --> 00:44:06,610

And so when you when you put it in that context you start to think about, ok all the fluid

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00:44:06,610 --> 00:44:12,269

connections that have to be made at the launch site going into the vehicle, all the electrical

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00:44:12,269 --> 00:44:15,550

connections, all the command and control.

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00:44:15,550 --> 00:44:18,770

There's also the sound suppression system out there.

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00:44:18,770 --> 00:44:24,720

When it launches, to catch all the sound vibrations, you know.

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00:44:24,720 --> 00:44:30,400

From a crew perspective, they had that to add the crew access arm, which is a pretty

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00:44:30,400 --> 00:44:33,769

beefy, complicated, hydraulic system.

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00:44:33,769 --> 00:44:38,680

The emergency egress system is also being installed out there for the crew.

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00:44:38,680 --> 00:44:43,559

There's also all the supporting GSC just to get the vehicle out there.

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00:44:43,559 --> 00:44:50,829

They call that the transporter erector, so that's a really big complex piece of GSC that

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00:44:50,829 --> 00:44:51,960

had to get designed and built.

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00:44:51,960 --> 00:44:57,720

So there's, and the thing is, it's kind of funny that you give that perspective on the

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00:44:57,720 --> 00:45:03,200

launch site because if that's the case, if people think that, then we did our job right.

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00:45:03,200 --> 00:45:06,460

Because from our perspective the launch site should just be ready.

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00:45:06,460 --> 00:45:07,460

Yeah.

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00:45:07,460 --> 00:45:11,180

And you shouldn't think about it, and the vehicle should just arrive, so...

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00:45:11,180 --> 00:45:12,480

...that's awesome.

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00:45:12,480 --> 00:45:16,400

So just kind of spitball, and I know that this would be that you're kind of just spitballing

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00:45:16,400 --> 00:45:19,970

a number here, at least I think you would, how many systems are we talking about?

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00:45:19,970 --> 00:45:24,319

You talk about each one needs an integration point on the ground, like how many systems

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00:45:24,319 --> 00:45:25,319

are in a rocket?

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00:45:25,319 --> 00:45:33,670

Oh man, if I had to like put a SWAG on it, you know, just kind of thinking about all

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00:45:33,670 --> 00:45:38,620

the lead engineers that I have on the ground, there's probably like between, you know, if

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00:45:38,620 --> 00:45:43,910

we were to hash it, up maybe 35 to 40 different subsystems.

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00:45:43,910 --> 00:45:44,910

Okay.

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00:45:44,910 --> 00:45:47,710

But we group them into probably four or five major systems.

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00:45:47,710 --> 00:45:53,029

So we got the fluids and that's a huge system just because there's so many different types

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00:45:53,029 --> 00:45:54,029

of fluids.

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00:45:54,029 --> 00:46:01,019

There's the electrical, a command and control, and mechanical, which is also a pretty big

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00:46:01,019 --> 00:46:06,499

beefy area, but under those four titles there's a whole bunch of other things happening under

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00:46:06,499 --> 00:46:07,499

there.

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00:46:07,499 --> 00:46:14,160

And then you have to think also what we call facilities, which is kind of like where the

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00:46:14,160 --> 00:46:16,270

water comes from.

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00:46:16,270 --> 00:46:20,569

Kennedy Space Center will supply the water or where we call you know big power comes

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00:46:20,569 --> 00:46:22,839

from, AC power.

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00:46:22,839 --> 00:46:28,140

So those things fall into what we call facilities out here and so that's a whole other area

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00:46:28,140 --> 00:46:29,900

of things that gets applied to the launch site.

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00:46:29,900 --> 00:46:33,769

So there's a lot going on out there that most people realize.

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00:46:33,769 --> 00:46:36,910

And is there any area that you in particular have focused on in your time?

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00:46:36,910 --> 00:46:42,509

Um no, I've always, I mean within the program I've always played more the integration rule

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00:46:42,509 --> 00:46:43,509

for all that.

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00:46:43,509 --> 00:46:49,069

So I mean if an issue comes up in a particular system then you know we go off and work it,

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00:46:49,069 --> 00:46:53,730

but from a program perspective I'm more the integrator for everything.

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00:46:53,730 --> 00:46:56,269

So what does the Commercial Crew program mean for you?

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00:46:56,269 --> 00:46:59,529

And I'm thinking about its goals and vision and mission.

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00:46:59,529 --> 00:47:01,099

What does that mean to Misty?

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00:47:01,099 --> 00:47:08,740

You know, because I was hired on at the very beginning of the program, it did kind of take

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00:47:08,740 --> 00:47:17,150

a little bit of like shifting your mindset on what your purpose was compared to shuttle.

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00:47:17,150 --> 00:47:24,720

Because the goals of Commercial Crew are more to spawn a new industry for space, and to

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00:47:24,720 --> 00:47:31,480

kind of teach these commercial providers on how to do human spaceflight.

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00:47:31,480 --> 00:47:37,799

And it's kind of one of those things where you know you're the mama bird and you want

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00:47:37,799 --> 00:47:40,990

the baby birds to go off and do this on their own eventually, right.

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00:47:40,990 --> 00:47:46,119

And so you know that took a little while to, I think for everyone in the program to kind

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00:47:46,119 --> 00:47:52,349

of adjust to kind of go into the program with that mindset.

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00:47:52,349 --> 00:47:57,039

I was actually just thinking about this a couple days ago, but looking back from when

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00:47:57,039 --> 00:47:59,980

we first started to where we are now, and just kind of reading the headlines and all

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00:47:59,980 --> 00:48:06,549

the news about all these different space companies that are out there doing it and wanting to

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00:48:06,549 --> 00:48:14,589

start to provide services for just regular folks - it's pretty cool to be able to kind

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00:48:14,589 --> 00:48:16,920

of like see that progression happen.

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00:48:16,920 --> 00:48:22,220

And I think that was like the one big goal that Commercial Crew and then obviously the

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00:48:22,220 --> 00:48:29,040

other goal is to get these vehicles done so that we will launch our own astronauts.

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00:48:29,040 --> 00:48:34,999

So that's how I how I see the program and its purpose.

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00:48:34,999 --> 00:48:37,790

That's what I think about when I'm doing my job every day, you know, how can I help these

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00:48:37,790 --> 00:48:41,520

providers to get where they need to be so that they can get certified and do this on

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00:48:41,520 --> 00:48:42,520

their own.

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00:48:42,520 --> 00:48:47,490

So a really important question, if you could be any character on Star Trek Next Generation,

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00:48:47,490 --> 00:48:49,950

who would it be?

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00:48:49,950 --> 00:48:54,859

Oh my goodness, Geordi was always my favorite.

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00:48:54,859 --> 00:48:56,230

Who doesn't love Geordi.

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00:48:56,230 --> 00:48:58,970

Yeah, yeah, he had those cool glasses.

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00:48:58,970 --> 00:49:01,270

Which you don't really know what they did.

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00:49:01,270 --> 00:49:03,640

That's right, doesn't matter, they're really cool.

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00:49:03,640 --> 00:49:04,640

Yeah, yeah.

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00:49:04,640 --> 00:49:06,829

All right Misty, thank you so much for joining us today.

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00:49:06,829 --> 00:49:08,019

Oh thanks for having me.

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00:49:08,019 --> 00:49:12,490

I like to think of launch days as payoff days for years of hard work.

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00:49:12,490 --> 00:49:15,309

Nothing provides a jolt of energy like seeing your work fly into space.

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00:49:15,309 --> 00:49:16,309

Right.

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00:49:16,309 --> 00:49:20,529

So good luck to you and your team, and the entire program and thank you.

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00:49:20,529 --> 00:49:24,550

Thank you, appreciate it.

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00:49:24,550 --> 00:49:28,170

I'm Joshua Santora, and that's our show.

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00:49:28,170 --> 00:49:32,039

But before you go, remember that we'd like to hear from you, our listeners.

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00:49:32,039 --> 00:49:34,069

Do you have a question about space exploration?

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00:49:34,069 --> 00:49:39,289

Tweet us your question using the hashtag #rocketranch and we'll plan to answer a listener's

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00:49:39,289 --> 00:49:41,519

question at the end of the next episode.

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00:49:41,519 --> 00:49:46,359

Also, please be sure to subscribe to the Rocket Ranch so you never miss an episode, and tell

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00:49:46,359 --> 00:49:48,039

your friends.

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00:49:48,039 --> 00:49:49,720

Thanks for stoppin' by the Rocket Ranch.

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00:49:49,720 --> 00:49:55,769

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801

00:49:55,769 --> 00:50:00,859

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802

00:50:00,859 --> 00:50:05,539

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