Updated Status on Boeing Un-Crewed Orbital Flight Test Teleconference

SPEAKERS:
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TELECONFERENCE OPERATOR: Welcome, and thank you for standing by. Today's conference will now begin. All lines have been placed on a listen-only mode until the question-and-answer session. At that time, if you would like to ask a question, you would press Star, 1, and record your first and last name. If you need to withdraw your question, you would press Star, 2. Today's call is being recorded. If there are any objections, you may disconnect.

I will now turn the call over to Bettina Inclán. Thank you. You may begin when ready.

BETTINA INCLÁN: Thank you, Operator. Good afternoon, everyone. Again, this is Bettina Inclán, NASA Associate Administrator for Communications. Thank you for your patience. We had some little technical difficulties. I'd like to thank you for joining the call this afternoon for an updated status on the Boeing un-crewed orbital flight test following yesterday's successful launch of the CST-100 Starliner at 6:06 a.m. on the United Launch Alliance Atlas V rocket. The spacecraft is in a stable orbit on Mission Day Two and is good health and will be able to meet several mission objectives for the flight test.

Teams from NASA, Boeing, and the U.S. Army have been preparing for a landing tomorrow morning at White Sands in New Mexico, and NASA will carry the coverage live on the landing beginning at 6:45 a.m., Eastern. For more on the current Day Two mission status and landing, I am joined by Jim Bridenstine, NASA Administrator; Jim Chilton, Boeing's senior vice president, Space and Launch Division; and Steve Stich, deputy manager, NASA Commercial Crew program. We'll start with updates from each of them, and then we'll take questions from the media that are participating on the call.

So, with that, I'm going to turn it over to NASA Administrator Jim Bridenstine.

ADMINISTRATOR JIM BRIDENSTINE: Well, thank you, Bettina, and I appreciate everybody continuing to follow the Starliner mission. As Bettina said, we do have a healthy spacecraft. The NASA team and the Boeing team have been working hand-in-glove to accomplish as many of the test objectives as we can accomplish ahead of tomorrow's entry descent and landing, and I think there's some really good milestones that we have been able to achieve.

We want to make sure that we are continuing as much as possible our effort to be transparent, to share information as early as possible when we have it, but we also want to be accurate when we share information. So there's still a lot that we need to learn, a lot of data that we need to collect, and we'll be sharing that once we get all the information we need to be accurate.

But, certainly, we're thrilled that people are on the line, and we want to answer questions, and with that, I'll turn it over to Jim Chilton with Boeing.

JIM CHILTON: Thank you, Administrator Bridenstine, and I'll echo the thanks to everybody for their interest in our flight test.

But let me start by saying that one of the biggest things we've learned is how good this team is. The Boeing-NASA team on our very first flight got a little surprise immediately upon reaching space, and their reaction and professionalism has been really inspiring. And what it inspires is confidence for future missions. This is quite a team.

I'll give you a quick status. We're in a circular orbit not, 250-by-250 kilometers. That's lower than we expected to be but fine, and we chose that because it gives you the most chances to come home while continuing to run tests.

The vehicle status is really excellent. All of our avionic systems are good. Our life support systems in the cabin all look great, the thermal management. Power is neutral or better, meaning we're able to orient the spacecraft. We have full attitude control and can move it around. We have all the instruments working. In fact, we're able—as a matter of learning—remember this is a flight test—we're able to now start changing the redlines, and we start real tight. And we can move those around a little bit, and we're doing that and making sure we learn as much as we can before the next flight. So that's very encouraging.

And regarding data, we are just going to get an enormous amount of data. We're getting it now. We've established a link with the Space Station, which is super important because we want the Station to be able to take the vehicle when necessary, and we've also got Rosie the Rocketeer, in the vehicle, an anthropometric test dummy, and we have boxes in the vehicle that when she returns, another large pile of data about what happened in the cabin, what happened on the whole thermally, what happened structurally. So we're real excited to already collect an enormous amount of information, so real happy there.

Let me kind of pivot on to objectives of the flight test. From a flight test standpoint, it's a brand-new human space system. The most difficult things we do are the launch. You've got to get to space safely, and then we've got to enter, descend, and land safely. So we're real happy with the Atlas V human-rated performance. It had a different aero shape. That all worked fantastic. Emergency detection system was active, but—I shouldn't say active—was on but not active to override anything. So the engineers all got a great chance to see that data.

In space, we've already been ticking off some objectives. I'll talk about a couple. One is the link with the Space Station. That's real important because in the future, as we approach the Station, we want the Station crews to be able to stop the vehicle if they choose to or push it back or maybe bring it in. So that was great to see that link because we're not in the position we expected to be in, so sort of a stress test.

All our guidance is working. I'll give you an example. Our vision system, which we use to dock—our term is VESTA. It's an acronym. I won't bore you with it, but it has four sensors. And it's like our eyes. So once we get to space, VESTA can be like a sextant from the celestial navigators, the sailors of old, and we've proven that VESTA can look at the stars. She can tell you right where the spacecraft is and feed the inertial and GPS-based navigation devices. So the spacecraft can figure out where it is and orient itself quite fine. We've checked off those test objectives.

And we've also extended and retracted the docking system, the mechanical ways you would go get yourself attached to the Station. We've mechanized that, and we know that will work. And that was a good thing to get done and make sure next time when we fly and approach the Space Station that we know that; we won't get any surprises there.

There's a longer list, but I would summarize our objective performance by not all objectives are created equal. I started by saying the launch and the entry descents and landing are really big safety issues. So we've got the first of the big ones, and we've got a great proportion of the objectives for in space.

Now I'll temper my comments a little bit. The entry descent and landing is not for the faint of heart, and this vehicle has not entered. We have not gone from space to the atmosphere. We have tested all the functions that you need after you get into the atmosphere during our Pad Abort Test, but make no mistake, we still have something to prove here on entry tomorrow. And, again, we think our team has done a fantastic job being ready for that.

I'd like to address a few things, maybe get ahead of questions. One is yesterday in my remarks, I talked about the orbital insertion burn. I told you what I did know but didn't have a complete understanding. Our best understanding 24 hours later now—or maybe more—is our spacecraft needs to reach down into the Atlas V and figure out what time it is. Where is the Atlas V in its mission profile? And then we set the clock based on that. Somehow we reached in there and grabbed the wrong spot. This doesn't look like an Atlas problem. This looks like a "we reached in and grabbed the wrong coefficient." More to learn that, but that's—it's not more complicated than that. And we started the clock at the wrong time.

As a result of starting the block at the wrong time, the spacecraft upon reaching space thought she was later in the mission and being autonomous started to behave that way, and so it wasn't in the orbit we expected without the burn. And it wasn't in the attitude expected and was, in fact, adjusting that attitude, and so when you talk about—yesterday I talked about the delay we had in some minutes of linking to the tracking data relay satellites, TDRS. We think that combination of getting between a couple satellites, but more so, we were moving the vehicle and not in the attitude to get an easy link. So we think that contributed to the delay. Again, a little more work to do, but we know more today and so that is an explained and understood thing, not something we want to do again. But we designed the system to be able to hold onto TDRS all the time, and now we think we know why she didn't.

As a result of going into that position in space, the spacecraft needed to work pretty hard to hold attitude. We talked yesterday a little bit about how the dead bands—you come down around the sensors, and it controls itself much more finely. That means we gave the propulsion system on the service module quote a workout, and we have a lot of duty cycles on it. From the good side, it's a great test for the durability of the service module. So we put a lot of duty cycles on it. In an un-crewed test, that's a good thing. It wasn't part of the plan, but it turns out being a good thing. On the negative side, it gives the engineering team a lot to go look at before we choose to declare for entry. That's been done. We've looked at the behavior of the sensors, and I would characterize our choices on the prop system. We have a lot of redundancy. So anywhere there was question or one of the sensors was telling us they were either hot or unhappy, we just shut those down, and then we have incrementally reactivated them. And things looked real good. It looks like we might have a couple sensor problems, but we have no thrust or propulsion problems. Although it's fair to say the team had to do a lot of work to prove that because we chose to assume we had bad hardware until we could prove otherwise, and an excellent job by the technical team and flight ops team proving otherwise.

So, with that, I'll say the state of our propulsion system as we ready ourselves for entry tomorrow is—and I'll give you a little detail. There are separate propulsion systems on the crew module and the service module. The service module will position us for entry, and then the service module is discarded and goes into the ocean. These challenges I've talked about are all on the service modules.

The crew module propulsion system, which then will be active after the service modules goes and take care of us during reentry, we've had no duty cycles on that. It will get a short test some hours before we declare for reentry and activate the service module functionality. So we don't see any problems so long as we remain happy like we are with the service module.

So, in closing, we have more to prove. We've got to prove this spacecraft will enter and be a healthy system, but the launch works great. We had an unexpected event, and our team reacted fantastic. I look forward to Steve Stich's remarks on that.

In space, Starliner has proven to be an able vessel. She is performing great, and we are looking forward to getting her home and getting all that data and saying hello to Rosie.

STEVE STICH: Okay. Thanks, Jim. I would say the team work, as Jim has already alluded to, between the Boeing and NASA team, it was phenomenal all the way up through the launch preparation over the last couple of months, working side by side, our Boeing engineers and NASA engineers. I would echo Jim's comments that during the flight, this fairly stressful timing issue that's caused us to work more closely together than ever for the last 24 hours and will continue to do so as we prepare for deorbit and entry. The engineering teams are working side by side, evaluated the data, evaluating the spacecraft, and that has been one thing that is extremely positive about this whole OFT mission.

As Jim said yesterday, the team optimized the orbit and did two burns with orbital maneuvering thrusters and got us into this approximately 250-kilometer circular orbit. Those two burns give us a lot of confidence as we come up for entry. We'll use a lot of the same systems for the deorbit burn to start entry into the atmosphere. So we'll use the RCS thrusters and the orbital maneuvering thrusters for the deorbit burn. Those two burns give us a lot of confidence for that deorbit burn coming up.

As Jim also said, the spacecraft from a NASA perspective is working really well, except for this timing issue which was corrected once we got on orbit. The time is working fantastic for the rest of the mission. All the burns are happening, as they should. We're acquiring sensors as we should. We've having TDRS communications, as we should. All the vehicle events are happening just the way they should. The interior of the cabin temperature has been perfect for the crew the whole time. The cooling system on the vehicle is working well. The propulsion system is working well. The guidance navigation control, all those systems that we need for a crewed mission are working as expected. So we're getting a lot of really good data as we fly the vehicle on orbit.

The power margins are good. We're pointing at the sun with the solar arrays and charging those batteries. That's actually been a little bit better than expected. Even though we used a little extra prop after launch with the timing error, we have really good prop margins heading into the deorbit burn and entry for both the service module and the crew module.

We're setting up for an entry tomorrow. The orbit burn for White Sands on Orbit 33 is at 6:23 a.m. That's Central Time, and landing should occur at 6:57 there at the White Sands Space Harbor.

The Boeing teams and the NASA teams are out at the site, getting the site ready and prepared for that landing, and between now and landing, we're doing the final checks of all the systems on the spacecraft and also ensuring that the guidance navigation controls work as expected not only for that deorbit burn for entry over the next 16 to 18 hours.

I would say so far, it's been a great mission, and as Jim said, the part that's ahead of us, if you break up spaceflight into the chunks, the ascent part with launch went very well, both from a Starliner and the Atlas launch vehicle perspective, and now we're going to embark upon a really tough and challenging face, executing the deorbit burn, having the service module, the disposal burn, and entering into the water, and then having the crew module execute the entry, firing its thrusters and then going to the parachute deploy sequence and landing at the White Sands Space Harbor.

So it's a system that we have to test. The only way to test it really is to do an entry, and we have that in front of us. We're being very diligent as we plan for that entry.

I think I'll stop now and see if there's any questions.

TELECONFERENCE OPERATOR: We will now begin our question-and-answer session. If there are any questions, please press Star, 1, and record your first and last names. One moment for our first question.

BETTINA INCLÁN: Thank you. Operator, we now will take questions from the media. Please remember to state your name, affiliation, and whom you're directing your question. We request one question per person to make sure we get as many people as possible.

Our first question is from Chris Davenport, Washington Post.

CHRIS DAVENPORT (Washington Post): Thank you for taking my question. I know you kind of touched on it, but I was wondering what your concerns are, what your confidence level is about pulling off the landing successfully. Also, especially after there was one pin on the Pad Abort on the parachute systems. I also wonder if you could give us some details on the landing itself, the trajectory that it will be taking, where they'll fly over, its maximum velocity, and the temperature too that the heat shields will have to withstand. Thanks.

JIM CHILTON: Thanks, Chris. This is Jim Chilton. I'll start with the parachute. You're referring to—for everybody listening, you're referring to during our Pad Abort Test, we had a—intended to have three shoots, and it was in New Mexico, first week of November. The toughest design case for us is low atmosphere to get the capsule off a vehicle. So we ran it as if it was sitting on the pad. What happens is you fire the—you push your abort system on the bottom of the service module, and you go from the ground at the speed of sound pretty high in about 5 seconds. And then you go through our descents and pop the chutes.

We had a mis-rig, which means a pin that holds some of the rigging for a pilot chute that pulls out the mains, the pin—the operators who assembled that thing, it appeared the pin was in, but our design allows that to be misread. And so, of course, we've diagnosed that when we found the stuff. We didn't have any kind of failure. We just had a mis-rig. What we've done is verify for this vehicle that is not the case. So our confidence in that case is high.

Another part of your question was what about—what's tough about reentry. Obviously, we had something unexpected happen for orbital insertion. So we brought in some independent teams, and NASA has done the same, and said, "Okay. Not just what exactly happened with their timers, is there anything like that where you're retrieving data or anything else that could affect us on entry?" And so over the last 24 hours, we have had teams working that very hard, and right now, we think we're ready to go.

STEVE STICH: I'll comment a little bit to Jim's responses. On the parachute rigging issue on Pad Abort, we did have a NASA team go through, an independent look at all of the closeout photos for this particular spacecraft that's on orbit today. We went and meticulously looked at those photos and could clearly see that the parachutes on this spacecraft were rigged correctly, and we don't have any concerns about that issue.

We went and looked also at other areas in the parachute system, where the rigging was also a little bit difficult. We looked at those closeout photos and ensured that we had a good configuration for deorbit and entry.

In terms of the predictor or trajectory, we're going tot fly into White Sands on what's called an ascending approach, and that trajectory comes up over the Baha Peninsula of just over Mexico, just west of the El Paso area and then up into the White Sands Space Harbor. The deorbit burn will be about 150 meters per second or so. It takes about 50 seconds, and then the entry is much like any other entry where at entry interface will be going about 25 times the speed of sound, and then by the time we get down into the 30,000-foot altitude range will be parachutes. The vehicle will be going less than the speed of sound, less than Mach 1.

I don't have exact temperatures for you, but it's kind of the standard kind of entry—

JIM CHILTON: We can get back to them, yeah. This is Jim again. From a deorbit timeline, between four and five in the morning, we'll run some tests on those crew module thrusters. As I talked about, in U.S. Central Time, it will be 6:23 when we do a deorbit burn, and we think we're going to touch down somewhere just ahead of 7 a.m., with sunrise at about 7:05. So that's the timeline.

The entry, Steve described it well. Coming in out over a lot of Pacific Ocean lets us have a little timeline flexibility on the surface module deorbit burn and make sure it comes down. So we've kind of set this up for a first flight to give us as much ability to learn and react as possible.

STEVE STICH: Thank you.

TELECONFERENCE OPERATOR: Our next question comes from Emre Kelly with Florida Today. Emre, your line is open.

EMRE KELLY (Florida Today): Folks, thanks for doing this. I know it's right before the holidays, so I appreciate that.

I guess more my question is a little less technical and more of a historical one. I'm just trying to gain some understandings. You know, I know this is new technology. I know these are new vehicles, but at the same time, you know, it was more than 50 years ago that Gemini was able to accomplish a lot of these things. I'm just wondering some of your professional lookback on that and what you see as some of the differences—funding, technology, safety. And maybe that's one for Administrator Bridenstine.

ADMINISTRATOR JIM BRIDENSTINE: Yeah. So I would say, certainly, there's a lot of history here and a lot of successes and a lot of tests that were unsuccessful where we had to learn and make modifications. The biggest challenge with this particular test is it's all automated. Some of the automation is what failed, and when I say failed, we're just talking about it had the wrong timing.

As a Navy pilot by trade, I can tell you before I take off an aircraft carrier, we have to get the aircraft aligned with the ship, and that requires navigation and timing. Otherwise, your airplane is dumb. But we have to get it. We have to get it aligned, and you have to have a timing signal to do that. In this case, the timing signal was incorrect.

I do believe—and I think this is important, Emre, which is had we had an astronaut on board the spacecraft, an astronaut could have provided Mission Control with a lot of options that very well could have put us in a position to go to the International Space Station. I can't say that definitively because it didn't happen that way, but certainly, I think the challenge here was just the timing signal. And the good thing is we fairly early in this process understand it, and we can get it fixed. And so I think that's very positive.

STEVE STICH: And, Jim, I'll add a couple things. This is Steve Stich. With these new vehicles, there's a couple things that we're doing differently than we did in Gemini. First of all, Boeing has chosen to land on land with a capsule. That's the first time that we've done that with a U.S. spacecraft. It has a landing airbag system that's new and that we're testing on this flight.

And then the technology is a little different than for Gemini in terms of how the computers talk to each other, and it may even more complicated. The spacecraft is certainly more capable of doing more things but a little bit more complicated.

And then I would also say these flights—if I look across U.S. industry and how we're putting these spacecraft and launch vehicles together, it's almost reinvigorating industry in terms of we flew the Space Shuttle for 30-plus years, and that was an operational program. But now we have this development program, and what I see from my perspective, I see us learning once again with a new generation of engineers, how to design, development, and put together these human space vehicles, which will help us not only for these Space Station mission but also as we embark upon our journey back to the lunar surface.

And, again, with parachutes, we flew the winged Shuttle for 30 years, and we're almost relearning now how to do these large-scale, ring-sail human parachutes again. There was a generation that learned that for Apollo and Gemini, and now we're on a different generation today.

EMRE KELLY (Florida Today): Great. Thank you.

TELECONFERENCE OPERATOR: Our next question comes from Jackie Wattles with CNN. Jackie, your line is open.

JACKIE WATTLES (CNN): Folks, thanks so much for doing this. I had a couple questions—or as a follow-up as the communication link issues, the TDRS. I know, Jim, you've said that there was an attitude issue that caused that communication gap. I wanted to know if you could explain that a little bit more and if there's been, you know, any more black stones that you've encountered.

And then I also wanted to follow up on exactly what happened in terms of diagnosing the onboard clock. You mentioned the communicating with the rocket problem. Do we know yet exactly how easy that will be fixed, and have you ruled out a more systemic problem with the software? Thanks, guys.

JIM CHILTON: Okay. First part of this—Jim Chilton. The first part of that question was say a little more about the attitude and the com link. Of course, we expect this system to have coms at all times. With TDRS, contributing factors is we got off the Atlas V, not where we expected to be, and the spacecraft didn't—this is a point in the mission where we tell the spacecraft where it is, not where it opens its eyes and looks, which is most of the rest of the mission. And so it was not where it expected to be, and it was further from TDRS than it thought. It was also starting to move between satellites, which is a zone where it can take a little more time to get a link, but that doesn't mean you shouldn't have a link.

From an attitude perspective, there's a series of antennas around the vehicle, and because the vehicle wasn't where we expect it to be and it was not where it thought it was, it wasn't pointing the antennas quite right at TDRS. So you add those factors together, and it took a little more time to connect than we expected. Does that—if there's—

JACKIE WATTLES (CNN): Yeah. That—I also wanted to just follow up about, you know, the onboard timing system and if there was any indication yet that there was more systemic problem with the software and how diagnosing that issue is going.

JIM CHILTON: Oh, okay. So, first, I'll say with containment, it was as simple as just sending a signal to the spacecraft saying, "Hey, it's this time, not that time," so that was corrected immediately.

From a "so far" standpoint—and again, it's early, but I just want to say it doesn't look like anything more than a data retrieval issue where we went and retrieved data that we thought was one place. It was actually another. So it seems like a pretty narrow thing, although, you know, full disclosure, we're trying to say, "No, let's not assume it's narrow, and let's not assume it's only that kind of issue. Where else could our test not have perceived something like this?" And we're wringing that out pretty hard. But so far, it doesn't look like a major systemic issue.

JACKIE WATTLES (CNN): All right. Thanks, guys.

TELECONFERENCE OPERATOR: Our next question comes from David Kerley. David, your line is open.

DAVID KERLEY: Thanks, gentlemen, on a Saturday. Several questions. I think what you just said, Mr. Chilton, is that the timing error caused the communication problem as well since the craft didn't know it was in the position. Could you just confirm that for me?

And then two other questions. One, I know General Dynamics made your computers for you. Who wrote the software? Is that Boeing software? And number two, with respect to this, was there ever any thought of you didn't have enough fuel to dock but maybe flying to the Station—and could you have done a capture? Thank you.

JIM CHILTON: I think your characterization that the timer and the results of where the spacecraft was, both from position and attitude, is fair. Probably wouldn't have seen any issue if the spacecraft had operated as expected.

The software answer is yeah, that's Boeing code. We authored that software, so that's—

STEVE STICH: And relative to the question about did we have enough fuel to go up to the ISS and dock, we did evaluate that very carefully. And we look at the propellant margins, and we just didn't have enough fuel. We used quite a bit of fuel that first day when we were firing the thrusters, as Jim has talked about, and we didn't have enough propellant to go up close to Station, even to approach. And so once we looked at that and saw that that was the case, we thought the best thing to do with the rest of the flight was to set up for a good landing, make sure that the thrusters and the rest of the spacecraft were performing nominally, take some time to evaluate this timing error that we saw during ascent, and verify with computer runs that the computers are going to be working fine for the deorbit and entry. And that's how we decided to proceed with the rest of the mission.

JIM CHILTON: I think it's fair to say we have more propellant to stay longer and do more—

STEVE STICH: Absolutely.

JIM CHILTON: —if we chose to, but we just see that the objectives we're getting now—you know, we're getting really good at launch. We're going to get entry and learn. We've done all this with the spacecraft. To go fly a few days further, not really necessary to get what we want, and we don't have the prop to go rendezvous. So we're going to come on home.

DAVID KERLEY: Thank you.

ADMINISTRATOR JIM BRIDENSTINE: So, David, your question was spot on. The mission-elapsed timing error did absolutely result in a number of follow-on challenges. The spacecraft thought it was in a position that I was not in, and so it was trying to get into the right position. So the engines were firing. The reaction control was trying to put the spacecraft in the right position, and that resulted in some of these engines exceeding their limitations from both a temperature perspective and from a duty cycle, where the engines are only supposed to run a certain number of times and in a certain amount of time. And those were exceeded. But had the mission-elapsed timing been correct, none of that would have happened.

But you're also right in that if these activities were not going on, making a data link with TDRS probably would have happened according to plan as well. So the mission-elapsed timing challenge is the challenge, that if that didn't happen, this very well could have been a very smooth mission.

DAVID KERLEY: Thanks, all.

TELECONFERENCE OPERATOR: We are wanting to remind the participants that the questions should be limited to one, one question per participant, please. Our next question comes from Mike Wall. Mike, your line is open.

MIKE WALL: Thank you, guys. Just a quick question about the landing tomorrow. Yeah. Like there is a backup opportunity. Could you just talk a little bit about what—what would like make you decide to sort of go for that backup opportunity? Like what are the factors that you'll weigh and sort of when that decision will be made, whether to sort of go for the—like the initial one, like kind of early in the morning? Thanks.

JIM CHILTON: Okay. Yes. There are backup opportunities from—this is Jim Chilton. From memory, we have one at White Sands, about 8 hours away. So, you know, there are another series of them, but we prefer to go to White Sands. We've deployed teams there.

I'll interject here you didn't see Chris Ferguson with us yesterday on the Boeing team. He would have been there with us. We kind of divided and conquered. Chris—once we realized we were off nominal—we have a contingency plan, and we start to deploy teams where we might bring the spacecraft down sooner than planned. Chris is kind of the leader of our landing team. So we said, "Hey, get in your car. Go to the airport, and head for White Sands." He did that.

You know, frankly, I don't want to speak too much for NASA. Kathy Lueders and my program manager immediately started monitoring the technical details. Steve and I kind of got over top of that, watching it, and you ended up seeing us at the press conference. But there was no intended insult to anybody.

So the way we've laid this out is we prefer to go to White Sands. We've deployed our crew there. We have a landing at about sunrise and another one at about 8 hours. Everything is working fine. If something comes up and we want to pause and think or delay and have another MMT meeting, we'll just pause and take the 8 hours later. And we have the people there, and we have the time and prop.

STEVE STICH: And from my perspective, typically, you have a backup opportunity to test in case something is not quite right either at the landing site or we find something on the spacecraft that we have concern about, or in these runs that we're doing offline to verify these particular deorbit opportunities, if we saw something anomalous in those, then we could delay. And, as Jim said, there's a backup opportunity about six orbits later to White Sands also as well. Instead of coming up across the Baha, it's a descending approach into White Sands, and we would take that opportunity if the NASA and the Boeing teams together would see something that would give us pause. We can kind of stop, reset, and then come in on that backup opportunity.

The batteries are doing great on the spacecraft. The solar arrays are charging them very well. We have plenty of consumables, so we would set up for that backup opportunity if we had to.

MIKE WALL: All right. Thanks.

TELECONFERENCE OPERATOR: Our next question comes from Bill Harwood. Bill, your line is open.

BILL HARWOOD (CBS): Thank you very much. Bill Harwood with CBS. Yesterday you all said that the orbit insertion burn didn't happen at all and then later heard it had happened but didn't go full duration. Can you clarify that for me? Did it fire at all?

And Mr. Chilton was talking about during test of the thrusters in the service module, you ran into some sensor issues. You shut some things down and brought them back up. Can you give me a little more detail on that? Were there problems with any manifolds or anything like that, that you had to deal with? Thanks.

JIM CHILTON: Sure. So thanks, Bill. As to the first question, it's probably a matter of how you describe it. We did not do the intended orbital insertion burn, you know, no-fuss full stop. What we did choose to do once we had—once we got the link with TDRS and said, "Okay. Here's where you are. Here's your new clock," we chose—we had put a lot of duty cycles on the prop system. So we chose to go to the circular orbit incrementally. We did a small series of burns, not one big orbital insertion burn. So that may be the difference you're asking about, but it's definitely different than what we intended. So we haven't talked about that as one orbital insertion burn, and therein may lie the difference.

Regarding your propulsion system question, the duty cycle on the thrusters, they were used a bunch of times, controlling attitude early in the mission, and they were also used frequently. We started and stopped them in certain positions on the service module rapidly. So we saw—in one case or more than one case, we saw the pressure transducers no those. We think they got hot, and they started reporting errors. And then they'd stop reporting errors; intermittent data, if you will. And, in one case, we used the thrusters a bunch, and you take—we used them enough where pressure goes low, and the system will close a valve and say, "Hey, we have a redundant prop system." So the system will say, "Hey, I don't like that pressure. So I'm just going to turn off that leg of the manifold and stop using those thrusters."

All of that appears to be just as sensors, and to prove that over the last 24 hours, the flight control team has been incrementally turning off the transducers, firing the thrusters, and letting the guidance system say was there an effect on the spacecraft when I hit fire on that thruster. And so far, they're all working. So we think we heated up some sensors by stepping on the gas hard.

STEVE STICH: And, yeah, Bill, one of the manifolds did end up—because the thrusters were firing so much, it depleted a propellant in that manifold, and today the team is going to work to recover that manifold by slowly opening a series of valves and repressing that manifold. And we think we can recover four of the RCS thrusters on that manifold. The firings were so much in this one manifold, and they were so hot that it kind of depleted that manifold. And that manifold is down, and so we're going to recover that today.

JIM CHILTON: I will say that with the thrusters we have, the ones without any of these issues, we're safe to go enter, descend, and land. We want to learn about our spacecraft. We want to hand the flight control team all we can. So good forum to go learn how to gas one back up, to refill a manifold, and we think all the thrusters will be on coming home, but even if we didn't turn them on, we have enough to come home.

TELECONFERENCE OPERATOR: The next question comes from Eric Berger. Eric, your line is open.

ERIC BERGER: Hi and Happy Holidays to everyone there. A question for Mr. Chilton. I know Boeing denied the recent IG report that raised questions about the company's commitment to commercial crew, and I guess I just wanted to ask. If NASA needs a second un-crewed test flight and Boeing has to pay for it, are you going to reconsider your participation in the program, or are you here through the sort of—here through it all?

JIM CHILTON: Hey, Happy Holidays to you too, Eric. That was nice. Thanks. And, no, we're in, simple as that.

STEVE STICH: And from a NASA perspective, I have never seen anything other than Boeing is full in on this program, the commitment they've made to run the tests required, to do the engineering required, to have the flight control team in place to execute these flights. The management team has been outstanding, very transparent, and issues that they encounter as they get the vehicles ready and the same has transpired during this mission. I think we've been working very well side by side, and we look forward to continuing to do that with all the missions that Boeing is going to fly for us.

ERIC BERGER: Okay. Well, good luck with the landing. Thank you.

JIM CHILTON: Thanks.

STEVE STICH: Thank you.

TELECONFERENCE OPERATOR: Our next question comes from Jeff Foust with SpaceNews. Jeff, your line is open.

JEFF FOUST (SpaceNews): Good afternoon. I wanted to ask either Jim Chilton or Steve Stich, what sort of mission objectives do you know at this point you will not be able to achieve, like ISS docking, because of this mission? And related, are there mission objectives you're going to try and achieve in alternative ways, given this different mission? Thanks.

JIM CHILTON: So thanks, Jeff. Jim Chilton here. The first question, it's generally around the proximity operations of the Space Station. You already know we're not going to rendezvous and dock. We're not going to fly around the Station. We're not going to do some of the things we're going to do and look at the Station from different angles and give our algorithms in the software a chance to understand what—you know, match what the sensors see with how the algorithms process it. We've been looking at some things. We've taken a look at the Space Station. So we're getting some of that.

Relevant to the second part of your question, we're looking around at things that really weren't in the baseline when we thought we were going to rendezvous and dock. So we're getting some data but not the complete set.

STEVE STICH: And I would say the mission objective that we're not going to achieve is the rendezvous and the docking, and as Jim said, checking out those rendezvous sensors. But I would say the joint Boeing and NASA team has done a good job at looking at things that we can do to go ahead and buy back some mission objectives.

Like just today, before Jim and I came to this event, we did extend the docking system and checked that out and make sure that system which is needed for docking will work just as expected. We've done a couple of tests. We did a test of the abort system so that when you're flying in close to Station, there are certain conditions, if they're not met, the vehicle would autonomously either stop and hold its position or execute a maneuver to move away from the Space Station. We did execute that. That was yesterday. We executed a test to make sure that system worked. So we're trying to take those things that we would normally do and fold those into this mission and get as many things and learn as much as we can about the spacecraft.

The real point of the OFT mission is to learn about the spacecraft and its operations as soon as we can to set us up for those future crewed flights, and I think the team has done a really good job of trying to look ahead.

One thing that we're going to get tremendous data on for the entry and landing, Rosie the astrometric test dummy has accelerometers on her, and she has various force measurements on her. And so we're going to be able to measure how the human would receive the G's during entry and also as the parachutes deploy and as we land, we can measure that environment on Rosie and then extrapolate how a human would do in that environment. So that's another important objective that's still in front of us.

JIM FOUST (SpaceNews): Thanks.

TELECONFERENCE OPERATOR: Our next question comes from Irene Klotz. Irene, your line is open.

IRENE KLOTZ: Thanks very much. I hope this doesn't repeat anything. I was disconnected for a couple minutes there. I think this is probably for Jim Chilton but possibly for Steve Stich as well. Can you describe what sort of integrated testing took place before launch and why the pickup wasn't found before? And also, where in the countdown or during ascent was the—did the error—do you think the error occurred?

JIM CHILTON: Well, you know, as to the first question, if I knew, it wouldn't have happened. We're surprised. We did extensive testing, all the software runs in a system integration lab. We actually did testing once we had a real Starliner on the Atlas V. So I'll just say I don't know. We are surprised that a very large body of integrated tests approved by NASA didn't surface this. So we have something to learn there, you know, just to be as clear about that as possible.

Unlike perhaps some satellite launches, un-crewed satellite launches where the mission elapse timer could start when the rocket releases it, because we have abort profiles and things like that, the spacecraft is reaching in before we even leave the ground to try to start the timer, so that we're counting whatever the spacecraft may have to do, even on the pad or during ascent. So it's in that time frame pre-launch that we're reaching in to registers and finding, and in that time is where our mistakes happened.

IRENE KLOTZ: And was there any way to detect this before liftoff? Like was there any point in the countdown where there was a comparison of spacecraft timing and countdown ground control timing?

JIM CHILTON: I don't know at this point. I mean, we're going to go fix it. So there's going to be a way to detect it. You know, if you're implying that some counter or screen didn't work, we're unaware of that at this time.

STEVE STICH: Yeah. I'm not aware of anywhere that that was displayed that anybody could have seen to compare those times, Jim. And, again, as Jim said, it's pretty early in this investigation. We've basically focused for now on, okay, understanding the time error that happened, and trying to ensure that the rest of the mission is protected from any kinds of similar errors, I don't think neither the Boeing or NASA team has had time to do a really thoroughly root-cause investigation yet as to when this happened, why it happened, what the corrective actions would be. That's work in front of us to do. We've really been focused on trying to make this mission successful, understanding how the systems are performing on orbit, and making sure that the software, the computer parameters are all safe to go execute the deorbit burn and the entry.

IRENE KLOTZ: Thanks very much, and good luck tomorrow.

JIM CHILTON: Thank you.

STEVE STICH: Thanks.

TELECONFERENCE OPERATOR: We have time for one final question. Our last question will come from Keith Cowling with the NASAWatch.com. Keith, your line is open.

KEITH COWLING (NASAWatch.com): Yeah. I wanted to go back to the timer thing for one moment. This is kind of a basic Spacecraft 101 thing that we've been doing for a half a century, and I'm just wondering why there wasn't a redundancy string or a backup system that would kick in or have the different systems bode with each other to see if the time was correct.

And moreover, this issue of the crew possibly, you know, being in a position, had there been a crew to do something, how would they have known the timing if the timing was wrong? I mean, would they have to look at their wristwatches?

And another question. You know, there's no live video from this mission, and I'm kind of wondering why because SpaceX and Russia Soyuz program do it all the time. Why is Boeing so shy about in mission—[audio break].

ADMINISTRATOR JIM BRIDENSTINE: Did we lose him?

JIM CHILTON: Is he still on?

ADMINISTRATOR JIM BRIDENSTINE: I'm sorry. If he's speaking, we can't hear him.

BETTINA INCLÁN: I think something happened with the system. Everyone from our end, there's nothing on the screen. So.

KEITH COWLING (NASAWatch.com): Hello?

BETTINA INCLÁN: Hi. Can you hear us? Can you hear me?

KEITH COWLING (NASAWatch.com): Can you hear me?

BETTINA INCLÁN: Yes.

KEITH COWLING (NASAWatch.com): Okay. Do I have to ask the question again?

BETTINA INCLÁN: I guess where you left off.

KEITH COWLING (NASAWatch.com): I don't know where I left off. Very simply, the timing system on the spacecraft, this is basic technology that we've been doing half a century. Why is it that there wasn't a redundancy string or a backup system that could detect the error like boding with one system or another to check the time? There has been mention that a crew, had there been one on the spacecraft, could have noticed this, and how would they have known the proper mission time if it was wrong? I mean, would they have had to look at their wristwatches?

And, secondly, why is there no live video from this mission? Soyuz and SpaceX do it all the time. Why is Boeing so shy about providing live video?

JIM CHILTON: Okay. I'll kind of start, and then I'll turn it over to Steve if he wants to go deep on the—we haven't—we haven't delved into this deep enough to answer the redundancy question, Keith. So I just don't know. Obviously, that's a great idea, and in fact, we'll go see why what we had in there didn't perform as expected.

On the crew, they wouldn't have been timer activated. They would have been on a mission profile and said, hey, I didn't—they would have known based on spacecraft instruments, "I didn't leave where I wanted to be," and we would have had voice-to-ground and said, "Go do an orbital insertion burn." And they would have done that manually. This spacecraft lets the crew take over at any time. So we wouldn't have been as dependent on those com links.

From a Boeing video standpoint, the choice we made on this flight test was just to record it, and had—once we were docked with the Station, all that could have come down through the Station. We just chose to record it and then release it once we land. We thought we'd be sending it down from the Station at about the time we opened the hatch, but since we didn't rendezvous, unfortunately, we don't have it. So it wasn't a "we're not transparent." It was just we architected the avionics not to—on this very first live test not to send it in real time.

And, Steve?

STEVE STICH: And I'll add a little bit more to the crew. I mean, what the crew would have done when the spacecraft separated from the launch vehicle, they would have noticed an extreme amount of jet firings. They would have noticed that the guidance mode was in the wrong mode for where they should have been. They could have went free drift and stop those thruster firings and just kind of flown the spacecraft manually. This spacecraft has a manual capability to bypass the flight computers, which is a very elegant design. They could have gone to the manual mode.

And then the crew is also trained to know that "I need to execute a maneuver at about 31 minutes to get the vehicle into orbit," and so they could have gone to a manual mode of the software and executed a—or manual mode and executed a burn at approximately 31 minutes to just get the vehicle into orbit safely and at that point then work to recover com.

They also—there's a manual capability with the com system to where if there's something going off nominal with pointing to TDRS, the crew can actually command various antennas and decide to get a com link. So having been in the ops world in the past, I think the crew would have methodically worked those steps, recovered com, talked about executing a burn if they got com back with the ground, and then executed that burn and got us in a safe orbit. And then we can recover the rest of the mission.

BETTINA INCLÁN: We'll ask one more question from Joey, Reuters.

[No audible response.]

BETTINA INCLÁN: Joey from Reuters? Is he still on?

JOEY ROULETTE (Reuters): Hello?

BETTINA INCLÁN: Yep. Joey? Joey?

JOEY ROULETTE (Reuters): Hello? Can you hear me? Can you hear me?

BETTINA INCLÁN: Yep. Yes, we can. Go ahead.

JOEY ROULETTE (Reuters): Awesome. So sorry. So for Jim Chilton, can you kind of summarize real quick what would be different about this upcoming landing opportunity and opportunity originally planned a week from now? At what max temperatures will Starliner endure upon reentry?

And for Jim and Steve Stich, I was wondering what the root cause investigation will look like after this. Is it a formal anomaly investigation, and will it involve simulations of the software? Thanks so much.

JIM CHILTON: Okay. This is Jim Chilton. Regarding the landing, we're going to go execute basically the landing we planned in ascending mode coming out of the Southwest towards—over El Paso and down to Las Cruces. Another reason we like what we've chosen, it's basically what was planned and trained for.

As far as the software anomaly goes, I don't—I'll defer on labeling, but what we have done is said let me get some independent people, you know, running through. This is something that happened that we don't like, and so our protocol is to go take an independent team and start looking through that. What that gets labeled or named, I don't know, but that's what's going to happen.

STEVE STICH: Yeah. In terms of the landing, the temperatures and the entry profile itself will be the same as we were going to execute for the nominal. The orbit is just a little bit lower, but once you get into the entry profile into the atmosphere, it's about the same.

And, certainly, Jim, I know, you'll include NASA on the investigation, will be part of it. Just like any anomaly that we have, we'll build kind of a fault tree and start working through what happened.

And then you asked the next question, why does that happen, why did that happen, try to understand the root cause of the problem. I'm very confident the way we've participated in several of those with Boeing.

JIM CHILTON: Just to be no doubt, your flight crews are going to be on this, and you're entirely welcome to look at every bit of it.

STEVE STICH: Yep. Appreciate that.

BETTINA INCLÁN: Well, thanks, everyone, for joining on this call. We're going to close it with Administrator Bridenstine with some closing remarks and then some housekeeping items from our end. Mr. Bridenstine?

ADMINISTRATOR JIM BRIDENSTINE: Well, I just thank everybody for continuing to follow this test flight. I want to emphasize that we have had a lot of successes. We've gotten a lot of test objectives complete.

I would also emphasize that tomorrow is a really big day. Tomorrow is—people want to know what percentage of the test objectives have been complete. I hear that a lot, but not every test objective is weighted equally. I think Jim Chilton mentioned that earlier. They're not all the same. Launch, of course, is a big one, and entry descent and landing is another really big one.

So tomorrow is a big day. We have to be on our A game. Certainly, there's going to be a lot of data that needs to be reviewed when this is over, but from the Boeing and NASA perspective, I want us to focus like a laser on this entry, descent, and landing for tomorrow, and I appreciate everybody for being on this phone call.

BETTINA INCLÁN: Thank you, everyone, for participating. You can listen to the replay of this teleconference by dialing 1-800-568-6411. As a reminder, NASA and Boeing will have live coverage of landing starting at 6:45 a.m., Eastern, on NASA TV and the agency's website. Following the landing coverage, NASA will host a media conference with Boeing. More information about the media conference will be provided on NASA.gov later today. Thank you, and we'll talk soon.

TELECONFERENCE OPERATOR: That does conclude today's conference. Thank you all for participating, and you may not disconnect.

[End of recorded session.]