TRANSCRIPT

Event:	SpaceX SES-10 Press Conference
Participants:	Elon Musk, CEO and lead designer of SpaceX Martin Halliwell, chief technology officer of SES
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MODERATOR: Good evening, everyone. This is the post-launch news conference for the SpaceX SES-10 Mission. Here tonight to give us the status of the launch and our mission is Elon Musk, CEO and lead designer of SpaceX; and Martin Halliwell, chief technology officer, SES. We'll start now with Elon Musk.

ELON MUSK: All right, thanks. I already gave some basic remarks on the webcast, but this represents the culmination of 15 years' work at SpaceX to be able to refly a rocket booster. The most expensive part of the whole mission from a launch standpoint is the boost stage. It represents, depending on how you count it, up to 70 percent of the cost of the flight.

So being able to refly the rocket booster, ultimately with the only thing changing between flights being the propellant, means that at least for that portion of the flight, the cost reduction potentially is over 100 – over a factor of 100. In fact, all of the propellant cost for the flight is only .3 percent of the cost of the rocket – of the cost of the mission.

So even when you factor in maintenance and capitalization of the cost of the rocket, the potential is there, just as it is with air flights or road travel or really any means of transport. The potential is there for over 100-fold reduction in the cost of access to space, which means that it has – if we can achieve that – if SpaceX – and I think hopefully others will also do the same – it means that humanity can become a spacefaring civilization and is out there among the stars. This is what we want for the future.

So yeah. (Laughter.)

MODERATOR: Martin.

MARTIN HALLIWELL: Well, absolutely wonderful day, absolutely astounding. What an amazing mission for SES-10. It's a perfect mission. We have a perfect orbit. We have acquisition of the satellites. We actually got acquisition of the satellites around about 35 minutes earlier than we expected. And in fact, of all the three missions that we've had from SpaceX, this is absolutely the most calm, no problems whatsoever, absolutely smooth mission.

So it really couldn't have gone better, and we are hugely, hugely excited by this, to be part of this. I think we made a little bit of history today actually and just opened the door into a whole new era of spaceflight. And to be part of that, I feel very, very privileged. And it's great thanks to Elon and all of the people of SpaceX that have really made this possible, and just pushing us forward to the next stage.

So bring it on, fantastic.

ELON MUSK: And Martin, I'd just like to say thank you for taking a chance on SpaceX. This is not the first time you've taken a chance on us, and I just really want to say thank you for having the faith.

MARTIN HALLIWELL: Thanks, Elon. Actually, several people asked me the other day – they said, "Aren't you taking a big risk?" And I said, "Look" --

ELON MUSK: Right. SES got a lot of flak, by the way, for --

MARTIN HALLIWELL: No – we got a lot of flak, but it is – as I said to some of you guys the other day, I said, "You got to decouple the emotion from the engineering."

ELON MUSK: Right

MARTIN HALLIWELL: And that's the most important thing. And the engineering team that Elon has working for him is really second to none. And he asks very simple profound questions and he gets very good answers. And the proof is in the pudding. Here we are. We did it.

ELON MUSK: Yeah.

MARTIN HALLIWELL: We did it together and that was absolutely fantastic. (Applause.)

MODERATOR: So we're now going to take some questions here in the room. When you're recognized, please state your name and your affiliation. And I ask you that you also please wait until the microphone comes to you. We do have a limited amount of time this evening, but we'll – I do want to note that, but we'd like to begin now with Marcia Dunn.

QUESTION: Marcia Dunn, Associated Press, for Mr. Musk.

ELON MUSK: Hey, Marcia.

QUESTION: Will you refly this booster, and when is your next flight of a reused booster whether it's this one or another one?

ELON MUSK: We actually have several reflights planned for later this year. If all goes well, I think we may fly as many as six – maybe do as many as six reflights. For Falcon Heavy, two of the boosters, the two side boosters, are reflown boosters. So that alone will be two cores right there.

In fact, that'll be an exciting mission one way or another, hopefully in a good direction. (Laughter.) We're not going to fly anything on – we'll probably fly something really silly on the first flight of Falcon Heavy because it is quite a high-risk mission.

But in terms of things to look forward to later this year, I think that'll be quite fun. Because that'll – the two side boosters will come back and do sort of synchronized aerial ballet and land – the side boosters will land back at the Cape. So that will be pretty exciting to see two come in simultaneous, and the center core will land downrange on the drone ship if all goes according to plan, which – I don't know. Like, rockets --

QUESTION: And what about this one? Will you fly this one again?

ELON MUSK: Well, this one – we think this one sort of has some historic value, so we were thinking of seeing if perhaps the Cape might like to have it as something to sort of remember the moment. So we're going to present it as a gift to the Cape.

QUESTION: Okay, thanks.

QUESTION: Bill Hardwood, CBS News. Elon, I got an email from a retired shuttle engineer who goes all the way back to Apollo. And his email essentially said it ain't bragging if you do it. And what message do you think this mission gives to your competitors? You mentioned the space industry earlier, but it seems like – well, I'll ask you. I mean, do you think other people are going to follow in your footsteps, or do you think this is something you're going to be doing exclusively in the near term?

ELON MUSK: Well, I think hopefully this will inform the decisions of other space organizations and – because really this has been thought to be either really too hard or not really feasible. And I think we've shown that something that a lot of people thought was somewhere between impossible or you just shouldn't do it, to, hey, it works.

And then I think really in order to be competitive in launch costs, I think it's going to be necessary for other launch companies to do the same thing. Just as you can imagine that if we were an aircraft company selling aircraft that could be flown many times, and everyone else was selling aircraft that could be flown once, well, I mean, that's not a very competitive position to be in. Like, if you said like – so you really want to have the aircraft that can be flown lots of times.

And so I think that's – once it's clear that something can be done, then I think that that will encourage others in that direction, and I hope it does. Because I think there shouldn't just be SpaceX. Should be – there should be many launch companies that succeed.

MODERATOR: Irene Klotz.

QUESTION: Thank you. Hi, thanks for coming over and congratulations. Irene Klotz with Reuters.

ELON MUSK: Hey, Irene. I've known you for like 10 years. (Laughter.) Maybe more.

QUESTION: The – do you have other customers that were not as brave as Mr. Halliwell here that are now signed up?

ELON MUSK: It's safe to say --

QUESTION: And I think --

ELON MUSK: Yeah, sure.

QUESTION: Tell us a little bit about what you think the life-limiting factor will be now in the first stage, how many times you can be able to fly.

ELON MUSK: Sure. Well, it's – we're really at – I like to say NASA's been incredibly supportive in terms of pushing the envelope on new things. And then on the commercial side, SES has been by far the most supportive. And again, couldn't say enough to thank you enough.

So yeah. So the next thing is to try to figure out how do we achieve very rapid reuse with minimal refurbishment and minimal – without any sort of hardware changes on the vehicle.

Now, with this being the first reflight, we were incredibly paranoid about everything. So we sort of – the core airframe remained the same, the engines remained the same, but any sort of auxiliary components that we thought might be slightly questionable, we changed out.

So now our aspiration will be zero hardware changes, reflight in 24 hours. The only thing that changes is we reload propellant. We might get there towards the end of this year. But I think if not this year, I'm confident we'll get there next year.

QUESTION: So without inspections? No inspections? You just would refly, land, refly?

ELON MUSK: Oh, we'd look at it but you have a day to – (laughter). It'd also be inspected. And there will be quite a lot of onboard health monitoring. So a there's a lot of sensors onboard to say whether things are good or not. So the onboard health check system is a lot of – just a lot of sensors that confirm the health of the rocket, just like aircraft really.

MODERATOR: I'd like to take a question from a phone, please. I think we have on the line Chris Davenport from *The Washington Post*.

QUESTION: Hi, Elon. Thanks for taking the call.

ELON MUSK: Hey.

QUESTION: I just wanted to follow up on Bill Hardwood's question. You had said this was a real significant moment not just for SpaceX but for the industry as a whole. Blue Origin and others are obviously working on reusability. Blue recently just showed an artist's rendering of a ship that looked really a lot like your drone ship. And I wonder what your reaction to that was and for their plans, which really seem to be tracking yours. Thanks.

ELON MUSK: Well, it seems to be – I mean, what's that saying about the best form of flattery? (Laughter.) But actually, I think it's good. Frankly, I think if a company shows that a path is working, then other companies should do – should copy that. I mean, it's – it would be silly not to. You wouldn't want to arbitrarily not do the right thing simply because some other company has.

So I think it is the wise move to – well, obviously, we think it's a wise decision because it's the decision we made, but – is that rapid and complete reusability of rockets is just really the key to opening up space and becoming a spacefaring civilization, a multiplanet species, and having the future be something that's incredibly exciting and expiring that we'll all look forward to.

MODERATOR: All right. One more question from the phone please. It's Dave Mosher from Business Insider.

QUESTION: Can you guys hear me okay?

ELON MUSK: Oh, actually, one little bit of breaking news, which the – so we – the fairing, the big nose cone at the top of the rocket, that actually successfully landed as well. So that's – (applause). That's definitely a cherry on the cake.

So we actually have a parachute that – the fairing is – has its own thruster control system and a steerable parachute. It's like its own little spacecraft. So the thrusters maintain its orientation as it comes in, as it reenters, and then we throw out a parachute and the parachute steers into a particular location. And so I just was shown a picture of an intact fairing half floating in the ocean.

QUESTION: With the SES logo on it.

ELON MUSK: Yes, sure enough.

MARTIN HALLIWELL: It's the wrong half. It's the wrong half.

ELON MUSK: It's the half without the logo --

MARTIN HALLIWELL: It is the wrong half. (Inaudible) U.S. flag on it. (Laughter.)

ELON MUSK: But yeah, that's really exciting because – I mean, just that fairing, which is a – it's a – you have over five-meter diameter. It's just like you could fit like a bus inside that fairing. And it costs $6 million to make that fairing. And at one point we're like debating, "Should we try to recover it or not?" It's like, "Guys, imagine you had $6 million in cash in a palette flying through the air and it's going to smash into the ocean. Would you try to recover that?" Yes. Yes, you would. (Laughter.)

So rather than have it smash into tiny pieces, we – it looks – that's looking quite promising. So the – yeah. So like, what we'll have is kind of like a bouncy castle for it to land on, and then aim reuse the fairing is well.

And then the only thing left is the upper stage, which we didn't originally intend for Falcon 9 to have a reusable upper stage, but it might be fun to try to – try like a hail Mary and, I mean, what's the worst that could happen if it blows up? It blows up anyway.

MARTIN HALLIWELL: Elon, we need to discuss this. (Laughter.)

ELON MUSK: Yes, indeed.

MODERATOR: Dave, did that get to your question? Because I didn't want – I want to make sure you got your question.

QUESTION: You answered part of my question about the second stage, but I wanted to know like how this fits in – now that you've done this, how does it fit in with your grand scheme, you grand plan here to get to Mars, to launch astronauts and things like that? How does this affect those plans, and will you refly boosters with astronauts on top? And yeah, I guess how does this affect your Mars plan (inaudible)?

ELON MUSK: Well, I think this is really a critical part of the Mars plan if you consider the goal of Mars not to be a single mission but one where we establish a self-sustaining city on Mars. In

order to do that, there's some threshold cost in terms of the cost per ton to the surface of Mars that has to be achieved in order for that to be feasible. If that cost per ton exceeds the gross world product of Earth, which it currently does, then that's obviously not going to happen.

There needs to be at least a 100-fold, if not perhaps 1,000-fold reduction in the cost per ton to Mars. Actually, maybe 10,000-fold. And reusability is absolutely fundamental to that goal.

So this, I think, is a very helpful proof point that it's possible. And I hope people start to think of it as a real goal to which we should aspire to establish a civilization on Mars. It's really – it's not – this is not just about humanity. It's about all the life that we care about.

MODERATOR: I'd like to go back to the room for questions. Stephen Clark, please.

QUESTION: Hi, Elon. Stephen Clark from the Spaceflight Now. Thanks for coming by. A couple of questions. First of all, do you have customers who have signed up for a reused rocket (inaudible) future reused booster?

ELON MUSK: We have one sitting right here.

QUESTION: Well, beyond --

ELON MUSK: Besides --

QUESTION: Beyond Mr. Halliwell.

ELON MUSK: Besides the (inaudible) SES? Yeah, there's currently – excluding Falcon 9 – excluding the Falcon Heavy flight, which is just basically on SpaceX's dime that nobody's paying us back because it's a demonstration flight – it's essentially a test flight – that's – that gets two of the reused boosters. There are I think three or four others that have signed up on a contingency basis, like, "If this one works, then sure."

And so I think probably we'll see more of those customers being willing to do on a – and I should use the right terminology – flight-proven booster. That's right. Flight-proven booster.

QUESTION: Touché. And I have a follow-up as well. Can you update us on where Falcon Heavy is? I know you're testing things in McGregor right now.

ELON MUSK: Sure.

QUESTION: Where are you at with qualification of hardware and what – what's driving the launch date and when do you expect it to debut here?

ELON MUSK: Sure. Falcon Heavy is one of those things that sounds – at first it sounded easy: We'll just take two first stages and use them as strap-on boosters. And like, actually, no, this is crazy hard and will require redesign of the center core and a ton of additional hardware. It was actually shockingly difficult to go from single-core to a triple-core vehicle.

And – but we're now done with the testing and the cores are in final fabrication. I think they finish in about two or three months. So our expectation is probably a late summer launch of Falcon Heavy.

MODERATOR: James Dean.

QUESTION: Oh, thank you. James Dean, *Florida Today*.

ELON MUSK: I just will say, like, our priority is launching our – since we have a backlog because of the – we had a whole gap of time as we recovered from the issue that we had last year, our priority is, of course, making sure that our – that we launch our customers. So Falcon Heavy necessarily is a second priority to making sure that our customers' needs are met.

QUESTION: Thanks. James Dean, *Florida Today*. Elon, how confident were you going into the countdown and through that first booster phase?

And then just regarding usability, one of the concerns, I guess, is about the flight rate you'll need to make it pay off. Even those who are for it say, "Well, you got to launch this many times to make it worth it."

ELON MUSK: Sure.

QUESTION: So for you, what do you think – is today the day to celebrate or are we maybe years from – what flight rate do you need to reach and how long would it take?

ELON MUSK: Well, I think just a little celebration is in order, yeah. (Laughter.) The – it's certainly true that – if you just say how much effort has SpaceX put into Falcon reusability – and nobody was paying us for reusability. So this is – it had to be on our own dime. I think we – it's probably at least a billion dollars that we spent developing this, so it would take us a while to pay that off.

And then we need to get really efficient with the reuse of the booster and with the fairing. So I would expect the economics to start becoming sensible next year. That's, yeah, pretty close. And we expect the boosters to, I mean, with no refurbishment be capable of 10 flights, and with moderate refurbishment be capable of 100 flights.

So you can imagine that if the cost of the rocket is, say, $60 million – I mean, admittedly, we're not reusing the whole thing, but with the fairing – assuming the fairing reuse works out and we – and as we optimize the cost to reuse the booster, you're really looking at maybe three-quarters of the rocket cost dropping by an order of magnitude and maybe more.

MODERATOR: Loren Grush.

QUESTION: And were you confident going into today?

ELON MUSK: Well – (laughter) – I did have like two boxes of Xanax. (Laughter.) That might have helped. So I was oddly – I felt calmer than I should, but I was thinking, "Why am I – I should really feel" – I was actually – oddly enough, I was nervous that I wasn't nervous enough, sort of a nested level of fear – nested fear. But I felt oddly calm. And yeah, it worked out as well as one could expect it to. It's really credit to the SpaceX team for doing an amazing job.

MODERATOR: Go ahead.

QUESTION: Loren Grush with The Verge. I was wondering if you could talk about the new facility that you guys have on the Cape and how that will work into the refurbishment process of the rockets. And if we're addressing rumors here today, I was wondering if you might be able to talk about the robot that we've seen on the drone ships lately.

ELON MUSK: What robot? What are you talking about? (Laughter.)

Yeah, we have a refurbishment facility at the Cape. Most of the refurbishment we've done at the launch site itself. So we've got the space at 39A and we're building space at 40, and then there's also a whole separate sort of rocket hangar actually for the rocket fleet. Rocket fleet's getting kind of big. So there will be sort of like a forest of rocket boosters.

Because we've got another 20 flights or something this year, something on that order. If most of those succeed, we're going to need quite a big hangar. And that's – yeah. It's – so yeah, there's facilities for that.

And the robot thing is in order to secure the rocket remotely. Because we can't put – we can't put any people onboard if the rocket's sliding around because it's too dangerous. So the – those little droids that people have seen are in order to remotely secure the legs of the rocket and so the rocket is stabilized, doesn't move around. And even in high seas, we can still have a crew board the drone ship and safe the rocket.

QUESTION: Do we – can you say when we'll see that one in action?

ELON MUSK: Actually, it might be – well, certainly within the next few months. But today was fine. Like, because the seas were so calm the rocket's not moving around. And so it's not – you don't really need the droids. But it's kind of more like in the heavy seas situation.

We had that one case where it was quite stormy and the booster was like sliding from one side of the drone ship to the other. (Laughter.) It's like the only thing that stopped it from going overboard was there was like a lip on the edge. So it'd just like bang against the lip and then slide to the other side, bang against the lip. But it made it to port. (Laughter.)

MODERATOR: Robin.

QUESTION: Hello. Robin with the New York – Robin Seemangal with the New York Observer. Can you give us an update on the development of the Interplanetary Transport System? And what's next in terms of – what's the next component that'll be tested? Following the carbon fuel tank and the Raptor engine, what's next?

ELON MUSK: Yeah. So we're – I think we'll probably provide an update on the design of the Interplanetary Transport System. The Interplanetary Transport System also includes the propellant depot on Mars. That's why it's sort of – like, I actually don't usually like the word "system," but we can't call it a rocket if it includes a propellant depot.

So the Mars Colonial Transporter or Mars Transporter or Interplanetary Transporter – we would come up with a number of design refinements. And I think we'll probably be ready to put that on the website within a month or so. Yeah.

QUESTION: Just one follow-up. The timeframe has kind of shifted since Guadalajara. I was wondering if you guys had any updated timeframe of when you think that first mission will be launched. And if I'm correct, the first one is uncrewed, correct?

ELON MUSK: Yeah. The first ones will be uncrewed. I don't want to steal thunder from that announcement because I think it's – like, I'm pretty excited about the updated strategy since Guadalajara. I think it's – it makes a lot more sense and it's – and we have to not just get it done technically, but figure out how to get this done without going bankrupt.

So it's like our goal is to get people on Mars before we're dead and the company is dead. So like those – neither one can die ideally. Because we don't want to be so – it takes so long that we're dead by the time it happens, and we don't want to kill the company in the process.

So we have to figure out – not just solve the technical issues, but the economic issues. And I think the new approach is going to be able to do that hopefully.

QUESTION: Cool.

MODERATOR: I'd like to go back and take some more questions on the phone. I think next on the line is Alex Knapp from Forbes. Go ahead, Alex.

QUESTION: Hi, Elon. Thanks for taking my call. I have to ask since I'm – so I got the (inaudible) question. What's the pricing discount on a flight-proven launch option versus a standard option?

ELON MUSK: I would actually – we're trying to figure that out. But it will be a meaningful discount. The – we do have to pay off – we'll figure out some way to pay off the development costs of the – of reusability. So the price discount won't be as – the price discount won't be as much as the cost savings because we need to kind of repay the massive development cost.

But it'll be – it'll certainly be less than the current price of our rockets, obviously. And it will be far lower than any other rocket in the world.

QUESTION: Thank you.

MODERATOR: The next question is also on the phone. It's Kerry Sheridan from Agence France-Presse.

QUESTION: Hi, thanks for taking my call. Could you just repeat for me – I'm not sure if I heard you correctly about the – how many times might you be able to reuse one of the boosters, both for one that's been reworked, a lot like this one, and one that has undergone minimal refurbishment? Thanks.

ELON MUSK: Sure. The design intent is that the rocket can be reflown with zero hardware changes. In other words, the only thing that changes is you reload propellant 10 times. And then with moderate refurbishment that doesn't have a significant effect on the cost, it can be reflown at least 100 times. Actually, really, I mean, we could make it 1,000 but it's probably not – there's no point in that, I think. (Laughter.)

The Mars vehicle, the booster is designed – will be designed for 1,000 flights or more.

MODERATOR: Let's go back into the room. Ken Kremer please.

QUESTION: Hi, thanks. Ken Kremer, Universe Today. Thanks for doing this and congratulations on the flight. So my question is about the refurbishment. What are the lessons that you've learned? You got eight cores back and you got one today. There has to be some things that are used more, that are more prone to failure.

ELON MUSK: Yeah.

QUESTION: So what are those? What are the things that keep you up at night? What are lessons you've learned and implemented?

And the second question would be for your moonshot. Are you going to have a vigorous science program, any science program, and can you tell us about it? Thanks.

ELON MUSK: Sure. Well, I want to make sure we, like – we don't widen this press conference into the all things. Because today is really about the fact that the rocket booster was reflown and succeeded. And so I don't want to contain things to that because there's lots of other exciting things in the future. This would be a very long press conference, I think if we did all that.

Some of the technical elements that are the most tricky, I think, for reuse is the base heatshield of the rocket, the grid fins. If you saw in the – on the webcast, you may have noticed that the grid fins were lighting on fire.

So we actually have a new design for the grid fin which is quite a bit more advanced than the current one. And it's – I think – I believe it'll be the largest titanium forging in the world. So it's a special alloy titanium that's very good at high heat flux, whereas this grid fin is made of aluminum but it's covered in thermal protection. So it's – but it gets so hot the thing lights on fire a little bit, which is not great for reuse. But the new grid fins will be – should be capable of taking a scorching and being fine.

And then we'll also have significantly more control authority, so that should improve the reusability of the rocket. Well, actually, improve the payload to orbit by being able to fly it at a higher angle of attack and use the aerodynamic elements of the rocket to effectively glide like a big cylinder. Like, it actually does have a L over D of roughly one if flown at the right angle of attack. But you need control authority, particularly pitch control authority, that's higher than we currently have to achieve that.

So grid fins, base heatshield, paint, I guess. Paint can get a little toasty, so maybe having more of a thermal barrier coating instead of paint. It's like – and there's a million little things. But I think we've got the base heatshield thing addressed. We've got the grid – we've got a good plan for the grid fins. And then there's like a bunch of little things that need to ironed out.

But overall, I think we've got a plan to achieve the 24-hour, zero-hardware-charge reusability by next year.

QUESTION: Next year, okay.

MODERATOR: Another question in the room please.

QUESTION: Thank you.

MODERATOR: How about Brendan Byrne from WMFE, the (inaudible) affiliate here and the Space Coast.

QUESTION: Yeah, thanks for taking my question. With that said with those challenges, and I know it's still a little bit early, with the data that you're getting back from this booster, is there anything that stands out in your mind that you're worried about? Or how's the – how's this booster doing? How do you know?

ELON MUSK: I mean, I was looking at the telemetry all the way up and down; everything looked great. It looks – I mean, it looks really good. I mean, just kind of eyeballing it, I think the – like, the only things that would need to be addressed on this booster to refly it would be to replace the thermal protection on the grid fins and on the base heatshield and to repaint areas of the rocket where the paint fell off.

I'm not aware of anything else that would need to be --

QUESTION: So fixable.

ELON MUSK: Yeah, yeah, absolutely. And we've got a plan for all those elements.

QUESTION: Okay, thank you.

MODERATOR: More questions in the room? How about Tim Fernholz from Quartz?

ELON MUSK: Yeah, if I – I would just elaborate on that fact. The – one thing that's not sort of well understood about spaceflight is that altitude is really not the thing that matters. It's velocity. It's a little counterintuitive, because people see a rocket pointing up and it goes straight up. And you think, "Well, okay, that – the way rockets go to space is they go straight up and then suddenly gravity stops at some point, and that's how you get to space." That's not at all how it works.

That's why we have the word "orbit." So the way that things go up and stay up is they zoom around the Earth so fast that the outward acceleration – outward radial acceleration is equal to the inward acceleration of gravity, they null out, and that's why you don't fall down.

And the thing that really is most – is incredibly difficult to deal with is the heat of reentry. Now, like, generally this is a good thing because it means like we don't get pummeled by meteors all the time because they get burned up in the upper atmosphere, so that's good. But then if you want to make a rocket come back and not also be vaporized, that's hard. And you can't have this really heavy heatshield or you won't get any payload to orbit.

So the trick is to figure out just the right level of armor in just the right places with advanced materials and the best analytical techniques so that it's – you have all the thermal protection you need, but it's not so much that you don't have any payload to orbit. That's really the trick of it.

And actually, missions like the one we just did are the hardest missions because the – anything going to geosynchronous transfer orbit means it's a high-velocity mission. And that means the booster is coming in really hot. It's coming in fast, which means it's coming in really hot.

The peak heating is as the cube of velocity, which is really nutty to think about. It means, like, say, the heating difference between Mach one and Mach eight is 500 roughly. There's a crazy heating difference. And then, of course, once you pass the melting point of metals, then, well, your thing melts and explodes.

So that's really the – it's dealing with that velocity of reentry that is the difficult thing.

QUESTION: Hi, gentlemen. Tim Fernholz from Quartz. Martin, I wanted to ask you to follow up on something you said earlier about SES deciding to back SpaceX. You said you had to separate the emotion from the engineering. What emotion are you talking about? Is that about SpaceX or about innovation in the aerospace industry generally?

MARTIN HALLIWELL: No, it was really referring to the comments that we had over the last couple of days when we spoke to the press and we spoke to the people and made a little press conference and such. Like, a lot of people came back and said, "You're taking an inordinate risk here. You have an extremely expensive spacecraft. It has a very important mission to do in Latin America. Aren't you taking a huge chance here?"

And what I was trying to react to there is to say, "Actually, I don't think we are because we'd actually worked through this problem." We worked very, very closely together with SpaceX. And that's really probably why we've done more of these type of missions with SpaceX than anybody else. We'd been the first on Proton, but – all this type of stuff.

But with SpaceX, we have a certain transparency and we have a certain depth of relationship and also access to engineering specifics through our U.S. citizens that allow us to be able to have that confidence in the fact that the engineering is good and that we can go ahead with such a mission and make that investment and be happy that this hugely expensive spacecraft can fly on this particular booster.

So that's really where I'm coming from. You got to get away from the idea that it's second-hand, it's --

ELON MUSK: Flight-proven. (Laughter.)

MARTIN HALLIWELL: -- yeah, yeah, flight-proven – it may make it, it may not. None of that. That doesn't interest us whatsoever. You actually have to go into this really with sang-froid. You have to go into this really cold-blooded and just work through the various different issues, understand the testing, understand the engineering associated with this, and then you make your decision. That's exactly what we did.

We have three more flights this year with SpaceX. On two of those flights we're considering now moving them to pre-flown.

ELON MUSK: Great, that's good. I didn't know that. (Laughter.)

MARTIN HALLIWELL: (Inaudible.)

ELON MUSK: Good. Yeah, yeah (inaudible).

MARTIN HALLIWELL: (Inaudible.)

QUESTION: Just a question for you, Elon.

ELON MUSK: Absolutely.

QUESTION: In Mexico you showed us a photo in your presentation of a very early days at SpaceX with a mariachi band and 12 people in a hallway. And since that --

ELON MUSK: Right. From mariachi band to here. (Laughter.).

QUESTION: Since that time – you mentioned 15 years, it's been a lot of work --

ELON MUSK: Yeah.

QUESTION: -- I'm just curious, is this a day of personal satisfaction for you? Do you feel vindicated in this mission to lower the cost of space access?

ELON MUSK: Yeah, this is a huge day. My mind's blown, I mean, frankly. Yes, I was really quite speechless after it all happened. And it's a culmination of a tremendous amount of work by a very talented team. I can't credit the engineering team and production team at SpaceX enough for – and launch team for what they've achieved.

MARTIN HALLIWELL: Maybe just coupled to that, I think after – well, when we did the SES-8, which was the first commercial GTO mission that we did with SpaceX, I made the comment that the industry would be shaking in its boots. Oh, I think it's shaking now. I really do.

ELON MUSK: It will spur change for the better.

MARTIN HALLIWELL: Hey, that's good.

MODERATOR: Another question in the room. How about Marco Santana from *Orlando Sentinel*.

QUESTION: Hey. I was wondering a little bit off of what you just said. Can you try to put this in perspective? I mean, you've had a successful career; obviously successes and failures as an entrepreneur. But can you put this in perspective on where this fits in with all that?

And the second question I wanted to ask briefly is: Why are you keeping the rocket at the Cape? When did that decision to keep it here come?

ELON MUSK: Well, it just – it's just this one booster, I mean, because it has some historic significance. So we thought having it remain at the Cape would be good. The future ones would be – well, actually, the future ones would probably remain at the Cape too. They would just be going through a – just flying a lot as we – building up the space fleet. Yeah.

I'm sorry, what was the second?

QUESTION: Where do you fit this into your whole career milestones, I guess?

ELON MUSK: Definitely one of the best things ever. (Laughter.) Not sure. That's 15 years of like a lot of – a lot of blood, sweat, and tears.

MODERATOR: More questions in the room, please?

QUESTION: Hi, Thaddeus Casari with the Utica Phoenix. And there's been a lot of history – there's been quite a lot of history made from LC-39A.

ELON MUSK: Yeah. I mean, it's like Times Square. I mean, it's like the – it's – we're – I mean, when NASA said that they would lease it to us and allow us to use that pad, it was a total honor. Because I mean, that's obviously where the Apollo 11 moon landing – that's where they launched from. Yeah. Coolest launch location that I can possibly think of, yeah.

MODERATOR: And (inaudible).

QUESTION: Was this part of your design to lease this pad, or is it – did this kind of pop up quickly?

ELON MUSK: No, I mean, I – it sort of – it came up. And NASA asked us if we had interest and we're like, "Hell yeah." (Laughter.)

MODERATOR: More questions in the room, please. How about Zuberoa Marcos from *El Pais* in the back?

QUESTION: Thank you. Elon, as SpaceX currently launches satellites and cargo to the International Space Station, so today's achievement – how could open the door to many new endeavors in space?

ELON MUSK: Well, I think the key is going to be a reduction of the cost of access to space. I mean, if – I think over time the current architecture of Falcon 9, I think, will certainly allow for a dramatic reduction in the cost of access to space.

But then looking ahead to our next-generation vehicle, the big rocket – actually, internal code name of BFR, Big Falcon Rocket. (Laughter.) I don't know why people laugh (inaudible). That vehicle, I think, is really taking all of what we've learned and create something which is fully reusable. And it really – the primary booster is being designed to reflight within less than an hour. So you could do – you could fly once per hour with the primary booster.

And I'm really confident that that architecture with a high flight rate, which I think will occur, can achieve 100-fold reduction in the cost per unit mass to space – to orbit or really anywhere in the solar system.

So I think it's – what today really – what the significance of today is I think proving that it's possible to do that, at least with the primary booster and then we'll show next with the upper stage as well.

And that – at this point I'm highly confident that it is possible to achieve a 100-fold reduction in the cost of space transport and maybe more, maybe better than that. And so it means for the same budget, we could do 100 times more things. Mind-blowing. Really, it's like next level.

MODERATOR: Next question from Greg from Channel 13. Greg Pallone, please, in the back.

QUESTION: Congratulations. Greg Pallone, News 13. Was wondering with kids here, is this an example of recycling, the environment, recycling boosters, teaching them about the environment, personal dad thing? (Laughter.)

ELON MUSK: Well, I thought there was like this potential for a historic moment, so it's good to have the kids and have them see it directly. And we've been having a good time.

QUESTION: We can tell. (Laughter.)

QUESTION: He's sleeping.

MODERATOR: More questions in the room, please? How about --

ELON MUSK: We'll just take a couple more questions, I think, if – yeah.

MODERATOR: Stephanie Siegel from NBC News, please.

QUESTION: Hi, Elon. With reusability now an option, how will you decide which missions will be using these flight-proven rockets versus first time, or is it solely based on customer request?

ELON MUSK: Well, it's the customers that are willing to take a flight-proven booster or – some will still want to see a lot more flights before they – they're comfortable with what we call a flight-proven booster. They may use a different term, but so – but I – it does seem as though we're – we're like – we may do maybe half a dozen or more flights of a reflown booster this year, and then next year probably double that. And I would expect that – yeah. For the Falcon architecture over time, probably three-quarters of our missions or more are with the reflown booster.

MARTIN HALLIWELL: Maybe as an operator I could add to that. My belief is within 24 months, people like SpaceX or SpaceX specifically will offer a service to orbit and it'll be irrelevant. It'll be irrelevant if it's new or it's pre-flown.

ELON MUSK: Yeah.

MARTIN HALLIWELL: It'll be irrelevant within 24 months. That's what this means today.

ELON MUSK: Yeah. I – the goal is to make this normal. It's just normal. Like, what are you talking about? Like, of course everything comes back and lands. Why wouldn't it?

MODERATOR: We have time for one more question, I think, in the room here, please. How about in the very back right there? Yes.

QUESTION: Chris Gebhardt with NASA Spaceflight. In terms of more short-term reusability efforts, how does this sort of conform to the Block 5 upgrade to Falcon 9? And for the Falcon Heavy side boosters, is late summer also an indicator of when SLC-40 will be back, since we heard that Falcon Heavy wouldn't go from 39A until SLC-40 was back up?

ELON MUSK: Wow, you really understand the detail. You're really in the details there. Yes. That's all approximately correct. So we need to get 40 up and running again so that we can start

doing single-stick flights from 40, which allows us to do the Heavy flights 39A. So that – necessarily 40 would have to be reactivated before 39A was up in use for Falcon Heavy.

And Falcon Heavy, I really want to emphasize, is a high-risk – that's a high-risk flight. Twenty-seven engines are lighting simultaneously. That's a lot of engines. I mean, technically it should be called the Falcon 27. And we thought that maybe that would sound too scary, so we called it Falcon Heavy. Yeah.

So certainly, we wouldn't want to take the risk of something going wrong with that pad and then having no pad on the East Coast. So we've got to get 40 up and running, confirm that's good, and then we can launch Heavy from 39A.

And Block 5 – the nomenclature, I think, is – I think we're probably not using the right nomenclature because it's more like a point release than – I mean, it's – Block 5 would be more like version 2.5 of Falcon 9 is probably the most accurate way to think about it.

And the most important part of Block 5 will be operating the engines at their full thrust capability, which is about 7 or 8 percent – almost 10 percent more than what they currently run at; a number of other improvements to have reusability go smoothly as well, like the forged titanium grid fins.

So the – that'll – it'll bring in a bunch of other factors. Block 5 or likely just version 2.5 will also incorporate a number of elements that are important to NASA for U.S. spaceflight.

MODERATOR: All right. With that we'll conclude our post-launch news conference for the SpaceX SES-10 Mission. For more information, you can go to spacex.com or ses.com and follow us both on social media. Thank you.

ELON MUSK: Thank you, everyone. (Applause.)

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