**Amanda Greenwell**: Good morning. Thank you for joining us to discuss the National Science Foundation's plans regarding the recent damage to the 305-meter telescope at the Arecibo Observatory.

I'm Amanda Greenwell, head of the NSF Office of Legislative and Public Affairs. On the line we have Sean Jones, NSF's Assistant Director for the Mathematical and Physical Sciences Directorate, Ralph Gaume, Director of our Astronomy Division, and Program Officer for Arecibo, Ashley Zauderer. We will begin delivering brief remarks, and then we're going to open up the call to your questions. Our operator Alyssa is going to provide instructions on how to ask a question when we're ready. And now I'd like to turn it over to Sean for our briefing.

**Sean Jones:** Thanks Amanda. Good morning everyone. As you are aware, the Arecibo Observatory's 305-meter telescope suffered damage due to one cable failing in August and another breaking earlier this month. After reviewing all of the engineering assessments, NSF has concluded that this recent damage to the 305-meter telescope cannot be addressed without risking the lives and safety of work crews and staff and NSF has decided to begin the process of planning for controlled decommissioning of the 305-meter telescope. This decision is intended to preserve [the] life and safety of people and prevent the loss of the entire Arecibo Observatory, including the Visitor Education Center, in the event of an unexpected and uncontrolled collapse.

The decommissioning is only intended to affect the 305-meter telescope, not the rest of the observatory. NSF would seek to resume operations of assets, including the UCF facility, the Visitor Education Center, and the offsite facility after the decommissioning of the 305-meter telescope is completed and the site is secure.

This decision is not an easy one for NSF to make, but the safety of people is our number one priority. Our leadership and our staff working on this issue are actually astronomers and geospatial scientists who have deep connections to the research community.

We understand how much Arecibo means to this community and Puerto Rico. Our goal has been to find a way to preserve the telescope, without placing anyone's safety at risk.

However, after receiving and reviewing the engineering assessment we have found no path forward that would allow us to do so safely. And we know that a delay in decision-making leaves the entire facility at risk of an uncontrolled collapse, unnecessarily jeopardizing people, and also the additional facilities.

We are dedicated to working with UCF and Arecibo to secure the safety of its employees, preserve assets at the facility, and looking forward to the future capabilities of Arecibo. As Amanda mentioned, here also on the call are the Division of Astronomical Sciences Division Director Ralph Gaume and Program Officer Ashley Zauderer. I will now turn it over to Ralph for additional details.

**Ralph Gaume:** Thank you very much, Sean. My name is Ralph Gaume and I'm the Division Director of the Division of Astronomical Sciences. And allow me to state as forcefully as I can we are decommissioning the observatory's 305-meter telescope, **not** closing Arecibo Observatory. NSF intends to work with the Puerto Rican community, the scientific community, Congress, and all Arecibo Observatory stakeholders to chart a path forward from this unfortunate event. To chart this path forward for the future of Arecibo Observatory. The decision to decommission the 305-meter telescope as Sean said, was based on placing health and safety as NSF's top priority.

So, the telescope is currently at serious risk of an unexpected, uncontrolled collapse. According to engineering assessments, even attempts at stabilization or testing the cables could result in accelerating the catastrophic failure. Engineers cannot tell us the safety margin of the structure, but they have advised NSF that the structure will collapse in the near future on its own. So what we're facing and what we’re challenged with, is a structure for which we don't understand the safety margins; the engineering approaches to better understand the safety margins involve considerable risk; and the engineering approach to repair the structure appears to be highly unsafe.

Such an uncontrolled collapse could damage valuable remaining assets of the observatory. Very important buildings are located in just under one of the three main support towers, Tower 12. And uncontrolled decommissioning, which we are planning and are announcing, rather a controlled decommissioning which we are announcing today, gives us the opportunity to preserve these valuable remaining assets that the observatory has. This decommissioning process will involve several weeks of clearances, planning, further gathering of information, developing a technical execution plan, and working with stakeholders. We're just at the beginning of this process.

NSF of course recognizes the cultural and economic significance of Arecibo to Puerto Rico. We intend to move through this process and as I mentioned, find ways to maintain the STEM educational capabilities the observatory provides. And this controlled decommissioning, which we're announcing today, provides the opportunity to preserve critical observatory infrastructure that is a key component of future STEM educational capabilities.

And in closing, just let me emphasize that this decision has nothing to do with the scientific merits of Arecibo observatory. That is not a consideration. It's all about safety. For 57 years this facility has served as a resource for radio astronomy, solar system radar astronomy, space, and atmospheric science. The Arecibo 305-meter telescope has powerful unique capabilities that made it especially valuable. That said, we're confident in the resilience of the astrophysics community and that NSF will be encouraging other facilities it funds to work directly with the Arecibo scientific community and investigators to provide them with appropriate support. Now I'll turn the briefing over to Ashley Zauderer. Ashley.

**Ashley Zauderer**: Thank you, Ralph, and good morning everyone. I wanted to provide just a few more details on the engineering process and what has occurred since August. As you're aware on August 10, an auxiliary cable slipped from its socket. Immediately after that, NSF authorized UCF to use operations funding to address the situation, emphasizing safety to be the highest priority. UCF began very quick action planning for stabilization. An engineering plan was completed and approved by NSF at the end of September for the procurement of materials to stabilize the auxiliary cable system and replace the failed cable. NSF had authorized UCF to extend millions to fund repair activities while emphasizing safety throughout that process, and UCF took very quick action to do so. The Arecibo Observatory had arranged for the delivery of two replacement auxiliary cables and two temporary cables to aid in installation and they were also set to begin installation of some emergency stabilization when the main cable connected to the same tower broke on November 6.

This main cable broke very unexpectedly, carrying just above 60% of its minimum break load. Previous engineering assessments have found the remaining cables should have been able to support the instrument platform, which is 900 tons. The breaking of this main cable, along with additional new wires that were observed to break on the exterior and two remaining cables of that tower suggests that all of the main cables, all of which are decades old and have stood through storms, earthquakes and constant heavy moisture may no longer be capable of supporting the loads that they were designed to carry.

Engineers revised their assessments after the second cable break. Prior to the second cable break there was a firm plan to move forward to stabilize the facility and repair it, but after the second cable break they had to revise and consider that they did not know what the cables were capable of carrying. Now all of the cables are considered suspect, including the auxiliary cables, several of which have shown signs of slippage at their sockets.

After the August incident, UCF had hired three engineering firms to oversee the stabilization, including structural analysis, forensic evaluation and engineering. Additionally, NSF had hired its own engineering consultant and worked closely with the US Army Corps of Engineers. These engineering firms provided an assessment after the most recent main cable break. Three of the assessments, including the engineer of record, recommended a controlled decommissioning of the telescope.

**Amanda Greenwell**: Okay operators. I think we're ready to take some questions I think we lost Ashley.

**Operator**: Thank you, we will now begin the question and answer session. If you'd like to ask a question, please press star one on your phone. Make sure your phone is unmuted and record your name clearly when prompted. To withdraw your question, you may press star to undo; limit yourself to one question and one follow up; again, to ask a question, please press star one and record your name. We'll take a moment for questions to come through. Please stand by. And the first question comes from Loren Grush with The Verge. Your line is open.

**Loren Grush:** Hi. Thank you so much. I'm curious if you can describe exactly what parts of the observatory you are decommissioning -- so it's the giant disk, as well as the long platform above it? And also, if the structure is on the brink of collapse, how do you intend to ensure the safety of those decommissioning the structure?

**Ralph Gaume**: So, this is Ralph Gaume, let me answer that question. So decommissioning, what we are decommissioning is the 305-meter telescope itself. As I mentioned, it is at risk of collapse. The cables that Ashley described in her discussion, support that platform. Two of those cables that support that platform, have broken. Tower Four has four remaining cables out of the original six that are holding up that part of the platform. The engineers have advised us that the break of one more cable will result in an uncontrolled collapse of the structure. What that means is that the platform will come crashing down, the entire 900-ton platform will come crashing down into the main dish. And it's possible that the three main towers themselves which are over 300 feet tall, will potentially topple over in one direction or another. As I mentioned, Tower 12, if you have a picture of the observatory you'll see that Tower 12 is very close to these very important buildings, such as the visitor center that I mentioned in my discussion.

So what we are looking at doing, what decommissioning really means in this context, is that we will put our engineering team together, and they're working on this right now to develop a plan to bring down the platform in a controlled way such that we can protect and prevent any of the cables whipping into the building, or that Tower Four from falling into the building so that we can preserve the remaining assets. The 305-meter telescope itself will be a loss. The rest of the observatory will be preserved.

Now the second part of your question was how we preserve the safety of the crews that are working at the observatory now. One of our contractors is in charge of developing safety plans. With the failure of the first cable on August 10th, they developed a safety exclusion zone. And with the failure of the second cable, they expanded that safety exclusion zone. So, at this point, nobody is allowed to enter these safety zones that would be at risk of being damaged with an uncontrolled collapse of the structure.

So, let me turn it over to Ashley to add a little bit about the immediate steps that are being taken Ashley.

**Ashley Zauderer**: Thank you, Ralph. As Ralph mentioned, currently, the most dangerous place is in that area where the reflector is, where other cables could fall, each cable weighs about 15,000 pounds and you can see the damage it did to the dish so that would be a high-risk area for humans, also on the platform, which is in danger of crashing the ground. Additionally, the keep-out zone does include the part around the towers.

Prior to this main cable failure I mentioned there were some stabilization actions that had been planned and approved, including some friction clamps on the backstay cables to help prevent some cables from slipping from their socket that had been observed. There's also some suggestions from the engineering firm that is responsible for safety to do what is referred to as a tower lean adjustment so if they can slightly loosen the backstay cables and slightly tilt the towers by a couple inches, it will take some of the load off of the main cable.

And so, these were the kinds of actions that we were planning on moving forward with when we were working towards the stabilization and a full repair. And so, we are currently in the process of still looking at these actions as a means to slow down the uncontrolled collapse, so that it will take, we will have more time to plan it. And so you know these things are being very very carefully planned out, the work order and sequence and the safety to ensure that people can do that, no action will be taken until it is very clear that the work can be done safely.

So as the decommissioning progresses, it will take several weeks, and you know likely it may involve the use of helicopters and ways to get certain actions performed, while ensuring that there is a way to make sure that the people doing those actions are safe. Thank you.

**Ralph Gaume:** This is Ralph again, let me jump in just for a second to clarify one of my previous statements. I mentioned that the loss of one more cable could result in the catastrophic collapse of the entire structure in an unplanned way. Let me clarify to say that the engineers advised this, that, that was specific to losing one more cable on Tower Four. I mentioned that there were originally six cables. We're down to four. The engineers have advised us loss of one more cable on tower four would likely result in a catastrophic, uncontrolled collapse. Thank you.

**Operator**: And the next question comes from Alexandra Witze with Nature magazine. Your line is open.

**Alexandra Witze:** Hi, thanks very much for doing this call. I think my question is for Ralph. Can you talk a little bit more about how all the engineering teams, kind of, I mean it sounds like they didn't really see the second break coming, everyone described it as surprise, but how did they miss that given that, number one, reports over the years have flagged the aging and maintenance of the cables as a potential problem? And number two, I mean the August break, presumably intensified scrutiny of that. So, I guess I'm just wondering how, how did you guys miss this?

**Ralph Gaume**: Right, well I'll absolutely to say a couple of words and then turn it over to Ashley Zauderer to talk more about the engineering teams, and their findings. When the cables were originally installed, the load capacity of those cables is well known. The main cables were installed many, many years ago, the auxiliary cables, which was the first cable to pop, were installed in the 1990s. So, you're absolutely right, the cables are quite, or have been there for quite a long time. However, we have done, when we brought these engineering teams on after the August 10 collapse, they did a full engineering assessment. And these, the teams that we brought in are very experienced teams in cable, with cable structures, such as bridges and other large structures. So, they have a lot of experience. And they, you're quite correct, they did not see this main cable as being an issue. And all of the focus was on these 12 auxiliary cables and the potential that they can pull out of the socket and would be a real problem. And so from August, from the August 10th problem with that auxiliary cable until November 6 when that main cable broke, all of the focus really was on how do we mitigate and prevent further auxiliary cables from pulling out of their sockets. And the engineering team, NSF, and our manager organization, University of Central Florida, we all focused on designing, as Ashley was mentioning, designing these mitigating capabilities to apply and to install on the auxiliary cables. So, Ashley, let me turn it over to you, to describe a little bit more about the engineering teams. Ashley.

**Ashley Zauderer**: Thank you Ralph. The one thing that is probably some important background that I'll just mention is that one of the main cables was actually slated to be replaced. So, Arecibo had received an appropriation of $14.3 million to make some repairs after Hurricane Maria. One of the original main cables that goes to Tower Eight was too short when it was initially installed and had been spliced and repaired over the years. So that was one of the engineering recommendations that you know after the hurricane that that cable definitely needed to be repaired. And so that's something that had been very carefully studied, designed and UCF had actually issued an RFP and had gotten bids to do that work essentially exactly when the August cable failure occurred.

So, the cables had been looked at and that was seen as the highest priority and the highest risk in terms of the number one thing that needed to be replaced. When the auxiliary cable failed and, as Ralph mentioned, of course immediately the team began even more frequent monitoring of the situation with drones, with photographs, they had installed some strain gauges and other monitoring devices on the auxiliary system and there was a plan to install some acoustic monitors so that they can, you know, hear the breaking even if it was internal. They never got a chance to get that installed before this main cable broke unexpectedly.

Now to address your question, they had observed some wires breaking on the main cables that eventually failed, they counted approximately 12 broken wires on the exterior. This was reviewed by the engineering firms. Each cable has approximately 160 wires and so it was determined that there was sufficient redundancy in the system with four main cables; the fact that, you know, it was holding; you know, I believe it was around 700 [*sic*] is what it had to hold and it was rated for much higher than that. And so it was actually included in the plan that the full repair would include not just the replacement of the auxiliary cables but that we would plan to replace this main cable as well that had those broken wires.

But it was determined by the engineering firms and also by the engineers that NSF contracted with to help us do that review that it was not sufficient to be an immediate emergency, that that needed to be replaced right away. Rather, the fact that we had seen some of these auxiliary cables with socket slippages beyond the half inch that is acceptable by the engineers, as the first thing to immediately to shore up, and then, get those main cables ordered and then as soon as they could be delivered, have those installed once the first aux cable was replaced.

So it was identified as an issue that needed to be addressed, it was just not as an immediate threat and I don't think anyone understand that clearly the cable has deteriorated much below just those broken wires.

**Operator:** And the next question comes from Danica Coto with Associated Press. Your line is open.

**Danica Coto:** Yes, hi, thank you for hosting this call, including a follow up to the last one. So just wanted to confirm the main cable that broke was the one that was too short when it was installed and the one with the 12 broken wires. And also, two other questions, wanted to know what kind of specific research does LIDAR allow for, and where are the parts of the telescope that are being decommissioned go, do they get recycled or where do they end up. Thank you.

**Ashley Zauderer:** This is Ashley. I’ll quickly respond to your first question, the cable that broke was not the one that was too short when it was installed. That one is at Tower Eight. There still is plans in place, that was part of the hurricane repairs, to replace that, and that cable is still holding strong and has not broken.

It was a main cable at Tower Four, the towers eight, four and twelve are like the hands on a clock, so it was the one at Tower Four, the southernmost main cable that broke. And this one, as I mentioned they had observed wires breaking after the August incident of the auxiliary cable that failed. But again, it was not expected that it would fail, it still was thought that it had the capacity to hold until we got the auxiliary system shored up.

I'll pass it over to Ralph to address the LIDAR question and the recycling.

**Ralph Gaume:** Sure. Thanks Ashley. So let me just expand on that a little bit. The main scientific utilization of Arecibo Observatory is actually threefold. Astronomy and astrophysics is one of those three areas. A second area, which was the focus of your question, is upper atmospheric and ionospheric studies. And then the third aspect is solar system astronomy of solar system bodies and asteroids, things like that.

So, to specifically mention, or address your question. The LIDAR is used for upper Atmospheric and Ionospheric Research, so a LIDAR is a laser that shot up into the atmosphere to provide upper atmospheric and ionospheric scientists with information. There is a LIDAR on the observatory site itself, as Sean Jones mentioned at the very beginning, and then the Arecibo Observatory also operates a LIDAR facility on the island of Culebra, which is just off the, as many of you know, is an island just off to the east of the island of Puerto Rico.

So, there are two working LIDARs. Those LIDARs will continue to work. What will be lost from the ionospheric and atmospheric work is the Arecibo, the 305-meter telescope itself was involved as I mentioned in upper atmospheric and ionospheric work with what's called an ionospheric heater. So, it was a transmitter, which modified and, the ionosphere, which transmitted radio waves into the ionosphere to learn more about the ionosphere. So that answers, that's my answer to the second part of your question.

The third part of your question is, what happens to the 305-meter telescope, is it recycled, and I don't have a complete answer to your question or maybe a 100% satisfactory answer to your question. Part of the answer to your question depends upon whether the collapse occurs in a controlled or uncontrolled fashion. An uncontrolled collapse will result in the platform crashing down into the dish. And the platform is 900 tons. And that's the scenario we're advised by our engineering teams.

So everything in the platform, or most things in the platform, and the receivers, the dome that's up there, would be a complete loss, as would be a loss of part of the surface of the dish which the platform collapses into, and the cables. And probably in an uncontrolled platform there may be a collapse of the three towers that we've been mentioning, Tower 12, four and eight, and maybe the buildings that Tower 12 would fall in and so any of that collapse would need to be salvaged.

A controlled collapse, or a controlled decommissioning, the platform itself, again, would be lowered, probably, perhaps in freefall, we don't have a complete plan for this controlled decommissioning. That's what we're asking the engineers to develop over the next five or six weeks. But the platform would probably be a loss. What we would hope to salvage, perhaps, would be the towers, no guarantees, but we would put the highest priority on preserving those buildings under Tower 12 that will be an anchor for the observatory going forward. Thanks.

**Operator:** The next question comes from Dan Clery with Science Magazine. Your line is open.

**Dan Clery**: Hi, thanks for speaking with us today. I wanted to ask about the cables. A cable engineer I spoke with said that cables of this type are machines that need to be properly maintained. And the only reason they would fail in this way, was inadequate maintenance. So, have these cables been properly maintained over the decades of use?

**Ashley Zauderer**: I can take this one to start with, and then, Ralph may have some further perspective. I've been the Program Officer for just over two years now, and the maintenance schedules that are set up for this particular telescope, to our knowledge, had all been completed according to schedule. Additionally, regular inspections did occur after any significant events, such as the hurricane and the earthquake. So, they went to inspect after there was you know a large series of large earthquakes and small aftershocks beginning December of last year, and so they went and did additional inspections after each of those. They did not report any unusual findings. That is something that the company is examining that is engaged with a forensic evaluation. Of course, we'll be continuing to look into. We will also examine maintenance records, but to our knowledge in the last two years, the standard maintenance procedures were indeed followed.

But yeah, it's a very good question. I know also that one thing that was being considered in the ordering of the new cables is that cables designed in the '50s and '60s that were used for the structure, were designed in such a way that it was hard, even with regular maintenance such as painting to keep moisture and other things from seeping in. There's also things that lead to vibrations that can lead to the kind of fatigue and bears that may be seen. This is all being evaluated at present.

The new cables that they were looking to procure for the repair and stabilization before the second cable break had a very different design in terms of the way the wires were manufactured, to prevent any kind of seepage into the core of the cable. So I think technologies have changed a lot since the '50s and '60s. But that’s my knowledge of the maintenance over the past two years and the way the inspections took place. I'll pass it over to Ralph who might be able to say a few more words.

**Ralph Gaume**: Thanks Ashley and thanks for the question Dan. As you probably know, I'm an astronomer not a structural or cable engineer, but I can reiterate what Ashley said that all required maintenance to this telescope has been completed according to schedule by our three managing companies. Our three managing companies throughout the history or managing organizations throughout the history, 57-year history of the observatory, that they've done everything to the best of our knowledge they've done everything that they were required to do, and to inspect the cables as necessary. Paint the cables and monitor the cables after hurricanes, or earthquakes, events that one would be concerned about.

And I would just add an observation and reiterate what I, what I've said in response to a previous question, was that this was completely unexpected and unanticipated that the main cables would be suspect. And as I said I don't have any credentials for judging that one way or the other. But NSF and the University of Central Florida, our current managing organization for the observatory, brought in three world-class organizations that do have the engineering experience. We brought them in after the August 10th event with the auxiliary cable. None of them suspected, or provided any indication whatsoever, that there was concern about those main cables. So I don't want to cast any shadow on the person you consulted with Dan, but at least the three expert companies that we brought in didn't provide any input or any inkling that there's an issue.

Sean or Ashley, do you have anything to add to that?

**Ashley Zauderer**: Yeah, one other thing that I did want to add is that, you know, this particular situation we are dealing with, with this main cable that broke, this was precipitated first by an auxiliary cable that was installed in the '90s. So something that is much younger, definitely should not have failed in the way it did. So, you know, the forensic evaluation is ongoing as to why that cable failed at its socket. So, it wasn't the fact that the cable itself broke, it actually slipped right out of its socket and so the team is looking very closely at why that happened, and it should not have happened.

Clearly it was not a maintenance issue, why it slipped out of its socket. And so that was something that, you know, of course that the working hypothesis was that we were likely to have to replace all of the auxiliary cables with new sockets. It was very difficult to actually inspect inside of those sockets, especially if there was not a cause for concern, because you have inches and inches of steel. They were looking at ways of doing that with X-rays for example, but it was a type of installation that was not conducive easy inspection of what was happening on the inside, and there was no reason to think that there was any problem with that particular type of installation. So that is what precipitated having an extra load on the main cable to begin with on Tower Four.

You know, and hopefully, you know, if that had not happened and we'd have been able to get that fixed, potentially inspections and future, modern, methods would have been able to catch the main cables so that we could start replacing those.

As part of the full repair plan that the team had started to lay out when they were working on the stabilization effort included a much more modern monitoring system to keep installed permanently at the observatory moving forward, so that has been part of the remediation plan. So, it is just I think truly unfortunate that this main cable failed before we had a chance to get things stabilized.

**Operator:** Thank you. And our next question comes from Leonard David with Scientific American. Your line is open.

**Leonard David:** Thank you very much. I just want to clarify a little bit on controlled decommissioning. I mean, is there any potential to detonate any parts of this to bring it down in some controlled way. And the second part would be, because Arecibo is so unique is there a kind of a blueprint that you'd be putting together on having your portfolio of other facilities pick up some of the science slack. What's your feeling about that?

**Ralph Gaume:** This is Ralph. Let me take that answer, or attempt to answer that question. So, we don't, at the current time we don't have a plan, a fully formed plan, the engineers, for decommissioning, the engineers are working on that now. We have given them the go ahead, to develop that plan, that plan will take, we have a guesstimate of a number of weeks to fully develop that plan and as we mentioned before, there's a lot of things that need to be done before we do a controlled decommissioning. But from my layman's perspective, at least, you know, one has seen explosive demolitions of buildings in the middle of downtown areas, so I would imagine that that would be something that our engineers would be looking at very carefully, to see if that can be done in a safe manner, meeting the requirements of NSF or the priorities of NSF, which are the buildings to be safe, to do it safely and to preserve to the extent possible, the buildings that are under Tower 12.

The exact methods, the technical plan for executing this controlled decommissioning. I don't have the details on that yet, and the engineers are busy on that.

With regards to a blueprint, or having our portfolio address some of the science that can be done at Arecibo, certainly some subset of the science that is being done on Arecibo could potentially transfer to other facilities, and in particular other NSF facilities. I will leave that up to the individual investigators and individual proposers that have proposed to do science on Arecibo. But NSF will be working with our awardees of our other radio facilities and that awardee of Associated Universities Incorporated, the National Radio Astronomy Observatory, and Green Bank Observatory, to work with investigators, that have proposed to use Arecibo to see what parts of their scientific investigations could be transferred.

Some investigators, of course, propose to use both, they write proposals to observe, to use both, for example, our large single dish radio telescope in Green Bank, West Virginia, the Green Bank Observatory and Green Bank Telescope, and Arecibo. So, on a case by case basis, investigators and scientists are going to have to look at what their objectives are, what could be transferred and what couldn't be transferred. Certainly, Arecibo in its collecting area and its transmitter capabilities offers unique capabilities to the scientific community, not all of those capabilities are going to be able to be transferred to other NSF facilities, or to other facilities worldwide.

**Ashley Zauderer**: This is Ashley. I just wanted to emphasize one more time that this decision is entirely based on safety and the structural stability of the structure. So just a couple of months ago before that first cable failed, we had awarded a supplement in partnership with the Gordon and Betty Moore foundation to fund a brand new ultrawide-band receiver that was going to bring incredible new technology for very very sensitive, wideband observations to help with multi-messenger astrophysics.

In addition, we had funded the multi beam ALPACA receiver that was due to be commissioned quite soon and added to the facility. So, there was definitely I think a lot of enthusiasm about some of the science that could be done, the geographic location is very important for atmospheric science. So again, just wanted to emphasize that this decision is very much based on the safety of the structure and that every intention had been making an award for this brand new ultrawide-band receiver to continue with the science operations there in August, when that award was made.

**Ralph Gaume:** Let me just add very quickly that there was that ultrawide-band receiver award that we made just a couple of months ago, and then as Ashley mentioned, a year or so, a little over a year ago, we made almost a six million dollar award to provide this ALPACA -- it's a forty-beam, cooled receiver, that was going to be built and installed up in the Gregorian Dome of Arecibo. That is part of the unique capabilities that I was mentioning that are not available anywhere else in the world. A forty-beam cooled receiver would have been the largest with the most number of beams in a cooled receiver on any telescope anywhere in the world. Combine that with the very large collecting area, second largest telescope radio telescope in the world, that's a unique capability that can't be duplicated, or is not available at this point anywhere in the world. So, some of the Arecibo science will transfer. Some of it will not. Thank you.

{{The following was missing from the transcript, for understandable reasons:

Amanda Greenwell: I want to flag this, this is Amanda, we’ve got time for just a few more questions.

Operator: The next question comes from Phil Plait, with SciFi Wire, your line is open.

Phil Plait: Thank you, my questions had been asked, and answered So I’ll pass, thank you.}}

**Operator**: Thank you. The next question comes from Jeff Foust with Space News. Your line is open.

**Jeff Foust:** Good morning. I know you're still working on the plan, but I wanted to see if you had at least a first order estimate of how long the controlled decommissioning process will take, and how much it will cost, and the assumption being that NSF would cover all the costs of that process.

**Ralph Gaume:** Let me take that and I'll have Sean or Ashley kick in to supplement my response. So, the actual controlled decommissioning, when somebody begins that process the execution of that controlled decommissioning is unknown at this point. If it's something explosive it could happen very rapidly. It could happen over a very short period of time. Any information I'm giving you right now is pure speculation until that technical plan is developed, accepted by our engineering teams. So, it's believed that that preparation of that technical execution plan will take a number of weeks. So, it's going to be awhile before we can tell you how long the development of that plan will take or how long the execution of that plan will take, and I'll turn it over to Sean, Ashley or perhaps Amanda for the costing question and who would be responsible for paying for the controlled decommissioning.

**Amanda Greenwell:** This is Amanda. I would just say to that we obviously have key stakeholders like OMB and Congress that we would need to work through with that, once we have a better idea of that number.

**Operator:** Thank you, and our next question comes from George Dvorsky with Go Media, your line is open.

**George Dvorsky:**

Hi. Thanks everybody for doing this today and I know it's a pretty sad day for all of us involved. I guess I'm going to be the guy who asks the dumb question here. And I'm wondering if you guys are already thinking ahead to after the demolition. And I, for one, look at this as a remarkable opportunity to build something even better at Arecibo. And what I'd like to ask the NSF in particular here is are you prepared to, not just support STEM research in general but the people in Puerto Rico and the community there, and commit to the rebuilding what could be a world-class radio facility. And again, I realize it's still early days but I'm hoping that you guys are in fact thinking ahead to something like this. Thank you.

**Sean Jones:**

This is Sean I'll actually start, then to kick it over to Ralph and to Ashley. Thank you very much for this question. As people have iterated on the call today, we're actually taking these measures to preserve Arecibo assets to ensure the facility does move forward. We've been working with Arecibo for years. It is run by talented and dedicated people, and the folks at UCF have been amazing during this time. And NSF will be working with them throughout this whole process to identify next steps. Right now, as you've heard, we’re laser-focused on preserving the assets in the safest possible means possible, but we have been and we remain dedicated to the people of Puerto Rico and the future of Arecibo, and the kind of science that can be done in the future at Arecibo. We are also looking forward to that. It will take some time. We’ll focus on the decommissioning and then we'll pivot to start working with the community on what can be done science-wise at the observatory. I don't know if Ralph or Ashley want to add anything.

**Ralph Graume:**

I don't have a lot to add to what Sean said, but to reemphasize what I said up at the top. We're not closing the Observatory, we're hoping that we can execute a controlled decommissioning of the telescope, in the sense that it's going to take a little bit of time for us to do and to execute this controlled decommissioning and we're hoping that there's not an uncontrolled collapse in the meantime. But the very essence of our plan is looking toward the future of the observatory in preserving those critical buildings around Tower 12. Ashley?

**Ashley Zauderer:**

One thing that I just wanted to say very clearly is that, you know, we're discussing the decommissioning of a structure made of steel and cables. But it truly is, I think, the people that had the ideas. It's the idea of discovery that led to the construction to start with. It's the passion of the people that work at the observatory, that are dedicated, that come to work under incredibly challenging circumstances. They got up, you know, working again after Hurricane Maria, coming back to work to inspect after the earthquake, coming back again under incredibly challenging times, you know we're still working under COIVD quarantine. And there's an incredibly diverse and amazing group of scientists and dedicated staff and engineers at the observatory.

And I mean I think it is their passion to continue to explore, to learn, and that is the true heart and soul of Arecibo. I think it's easy to say that it's the telescope, but it's not the telescope that’s the heart and soul, it's the people, and you know so I think that's where, you know, NSF has truly prioritized the safety of what is truly the treasure and looking to continue to operate the observatory, but decommission this telescope, and so, looking to the future of what ideas come forward and valuing what truly is the most meaningful. So, I really just wanted to emphasize that, working with UCF and all of those scientists and all the folks who have worked there for decades and decades, from Arecibo, from Puerto Rico. People who grew up, visiting as children, and they got jobs there working as operators and moved up. It is truly a remarkable place and that is what we value at NSF. Just really wanted to emphasize that.

**Sean Jones:**

Thank you, Ashley. I think that really does capture the spirit and essence of what NSF believes about Puerto Rico and its people.

**Operator**: And the next question comes from Toni Feder with Physics Today. Your line is open.

**Toni Feder:** Thank you for hosting this. I wanted to ask more about the path forward. So, I know the LIDAR is going to continue at the two sites. What other science is possible, or being considered? I know the near-Earth asteroid watch, I’m sure that’s out but what does that mean, and in terms of the continued cultural, educational aspects. What’s the plan for figuring out how to move forward? Thank you.

**Ralph Gaume:** So, we can't really speak to the NASA program. I would refer you to NASA. We've been working very closely with them, they're well informed of our assessment of the situation, and our approach that safety is the number one priority. So, I would refer you to NASA to discuss the solar system radar and asteroid planetary defense mission which Arecibo has been executing over the years and how that will move forward. Sean or Ashley did you want to contribute to the first part?

**Sean Jones:** Thanks, Ralph I'll add a little bit to the first part of the question on the path forward on the science. As we mentioned before, we will be working with the dedicated folks at the Arecibo Observatory as well as our awardee, UCF, to come up with ideas for paths forward on science. Right now again we're focused on the stable decommissioning so that we can preserve assets so that we can envision science going forward, and that will take some time, that will be a process, and we hope to get the community involved as well as Ralph mentioned earlier in some of his talking points. Thank you for that question.

**Operator:** The next question comes from, Meghan Bartels with Space.com. Your line is open.

**Meghan Bartels:** Thanks so much for taking my question, as far as I'm aware, there are existing environmental impact surveys, studies of the site, that have looked at the potential decommissioning, and I was hoping someone could talk a little bit about both what those plans looked like and what their costs were and then also what, if anything you can pull from those plans given the current situation and the instability. Thanks.

**Ralph Gaume:** So, let me begin to, to address that, Meghan, thanks for that question. We did do a full environmental impact, preparation of an environmental impact statement, back in 2016, if I remember correctly, and we did take a very close look at a number of options.

One of those options in that environmental impact statement was to continue on with the observatory as we had been doing for decades now. One of those options was decommissioning the observatory, and a number of those options involved other things in the middle, finding partners or decommissioning parts of the observatory, buildings that haven't been used for decades. What we ended up doing, and this was of course a very public process, and no decisions were made in this process until very late in the process, but our ultimate decision was not to decommission Arecibo, or but our record of decision which we signed out in 2017, if I remember correctly, was to continue to operate the observatory with partners taking a greater interest in the observatory.

And that's how we've been proceeding from this point on. There were cost estimates that were developed as part of this process, for decommissioning parts of the observatory. I don't want to provide those costs, I'm not prepared to provide those cost estimates right now, they were several years old, and I would want our engineers to take a look at, in greater detail, at the parts of just decommissioning the 305-meter telescope. So, I think it would be misleading at this point, and I'm not prepared to give those cost estimates, but we have looked at it. And I think the fact that we've looked at it before will accelerate our ability to jump right in and develop plans for the decommissioning forward, particularly because time is a factor. Our engineers are not able to tell us when the structure would collapse on its own and so we're working against the clock, basically, to develop plans for controlled decommissioning with the priorities being safety, and the safety and preservation of the rest of the assets of the observatory.

**Ashley Zauderer:** I’ll quickly add in here, all of these things are public on the NSF astronomy website, so they're available to the press. And one other positive thing that did come out of the environmental impact study is that endangered species including plants and birds and a boa on site were identified, so those will be taken under great consideration as activities proceed to make sure that there is no harm to any endangered species. Additionally, there was historical buildings identified on site and that is one of the reasons that you know we're, very carefully want to proceed, to make sure that buildings that are identified as historical are preserved and do not get damaged in an uncontrolled collapse. So, all of that was identified and I think that's really important information for a plan moving forward.

**Ralph Gaume:** I would add if I could, that our environmental impact statement, and all those preparatory documents are publicly available on the NSF website.

**Amanda Greenwell:** We're over the ten o'clock time, I know we still have a few questions in the queue so we're going to extend just a little bit. But I want to give a flag we're going to do two, three more max. And if you would like the audio, please contact our media team at media@nsf.gov.

**Operator:** Thank you. The next question comes from Alexandra Witze with Nature Magazine, your line is open.

**Alexandra Witze**: Hi, I just wanted to follow up a bit on that last point from Ralph. What are the odds in your engineering team’s view that there might be an uncontrolled collapse before you can figure out a way forward, and related, how large is that evacuation zone for safety around the dish?

**Ralph Gaume:** Right, thank you for that question. The engineering teams are not able to give us a prediction as to when this uncontrolled collapse could occur because they don't have a good estimate for the safety margin. The structure, as far as I know, is currently standing so that implies that it is currently stable. But we did see a gap of about two and a half months between that August 10th, pull--out of that auxiliary cable, and it was about two and a half months later, or almost three months, when that main cable broke.

So, that indicates to the engineering team that there was some ongoing degradation in that main cable. As Ashley said before, the main cable, there wasn't any… the main cable broke on August 6 in calm weather conditions, there wasn't any identifiable event that happened. The telescope wasn't moving, the platform wasn't moving, there weren't strong winds. There seems to be, according to the engineering team is telling us that these cables have undergone an accelerated degradation, particularly in that cable that broke. But they can't provide us with an estimate because they don't know the remaining capacity of those existing cables. And as I mentioned, any engineer, as I mentioned in the beginning, any engineering approach to better understanding the strength left as the main cables involves considerable, our engineering teams have advised us, involve considerable risks risk for human, for human life, and could, in fact, accelerate the uncontrolled collapse of the structure. So, we don't know the answer to that question, the engineers don't know the answer to that question.

The safety zone after the November 6 collapse was expanded to several hundred feet around each of the three towers. Ashley did you want to jump in and add to that in any way?

**Ashley Zauderer:** Yeah, thanks Ralph, I mean that's essentially the correct answer. So after August, immediately they had said the main reflector, but the towers are different heights, so essentially, if they were to fall in any direction, draw a circle around their height, that's essentially the keep-out zone. After the August event, after careful analysis, they determined that one more cable failure is not going to be catastrophic, so hence the towers and the backstay region was safe, so only the platform and the dish was considered a keep-out zone the last couple of months, but again, after the November main cable failure, it’s now expanded again to include essentially the main dish. But you know that radius around each tower if it were to collapse in any direction.

**Amanda Greenwell**: Okay so that ends our press conference. Thank you all again for making the time this morning. Again, session by emailing media@nsf.gov. The embargo is lifted at 11:30 am.