MARTY ROSENBERG
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LEO DENAULT INTERVIEW

Q: Hi and welcome to Grid Talk. Today we have with us Leo Denault, the Chairman and CEO of Entergy. Hi, Leo. How are you today?

A: I'm doing well. How are you doing, Marty?

Q: Great. I'm really pleased to have you with us to talk about all kinds of things that are in the news, most recently the massive Hurricane Ida that afflicted your territory. How has your utility responded and what might you be doing differently in the future as a result of these weather events?

A: Yeah, well the response from the utility has been from our team has been what it typically is, it's been well-organized. The response has been well-carried out and executed. As you might guess, we've had a significant amount of damage done by storms that are really…when you think about Hurricane Laura and Hurricane Ida, the strongest storms to hit us since the 1800s so they are really are what you would think of as unique events. We assembled for example in Hurricane Ida, there's about 28,000 resources between ourselves, our contract partners and the significant mutual assistance that we've gotten from the

industry, from the supply chain issues we were able to manage the…

Q: Leo, just the resources you're talking about, 28,000 linemen that came in to help?

A: They were lineman, tool workers, vegetation workers as well as scouts, etc., so it's really a cross-functional team that has to come in and manage the entire process because as you might guess; One, we have to scout what's the damage, where is it, what's the extent, what's going to be required, where do we prioritize resources; there's a whole logistical challenge of making sure that we're capable of feeding and housing and supporting that many resources so it's…

Q: Let's talk about that. It that an unprecedented size of support and…

A: Yes, yes.

Q: And your company's invested on smart grid and lot of new technologies. Talk a bit about how that has enabled you to orchestrate this kind of a force and I'm sorry I interrupted you. It is the largest is it not?

A: Yes, yes, we've never…this was the largest one that we had ever assembled. The second largest was last year during Hurricane Laura, and we have; we just finished the deployment of our automated metering technology and we do…are in the process

of continuing to add new technologies to the distribution grid and those do help identify where outages are, what's occurred, where the circuits are, etc. As you might guess, some of the damage that we incurred with the size of these storms there's a lot of area taken out so we really; you do see the benefits of it but it's certainly those technologies will provide benefits even during just thunderstorms and other outages where they really help pinpoint where we need to go. But this situation as I said was 28,000 people, we had to make sure we could house them, feed them and some of those folks are linemen, some of those folks are vegetation workers because we've got a lot of clearing to do. As you might guess there's a significant amount of damage that's done. It's not only the winds on the poles but things like trees on poles and vegetation on wires and things like that where we need the vegetation workers, tool workers, etc.

Q: So, if these storms are getting more frequent and more devastating, does it call for a higher standard of resilience and how might you go about achieving that?

A: Yeah, it's not necessarily a higher standard of resilience, but because I see what we are finding is the standards that we're using today for our new investments work well even under these conditions. So, for example, we've spent nearly $10

billion over the last five years on new transmission and distribution infrastructure all of which meets or exceeds current standards so for example, our Class 1 poles on the distribution side, they can withstand 150 mile-an-hour winds and our new transmission structures that are designed to withstand 150 mile-an-hour winds. In both Hurricane Laura and in Hurricane Ida those new technologies and those new structures withstand those storms quite well, so I'll give you an example in Hurricane Ida. We had a section of our transmission system that was directly in the path of the storm that had been rebuilt and there's been roughly 380 new transmission structures in that new rebuilt area. Only three of them were damaged and they were damaged not by the winds but by debris, and when I say debris for example, one of them was hit by a barge, but debris, you say debris, people think pebbles or something like that but no, this debris was a barge and so, 377 of those structures were undamaged; however, we haven't replaced all of our, obviously, structures yet and so the ones that were primarily damaged in the storms have been. The older technology which still in the midst of its depreciable lives and still 99% of the time works quite well but they're designed to withstand winds of 110 miles-an-hour and what we saw in Hurricane Laura were guests of over

180 and you saw gusts of over 170 in Hurricane Ida so the new technology works. The older technology was struggling.

Q: So, let's talk about the eight pathways that we've heard about of power into New Orleans that were cut because of damage. Were those transmission lines capable of standing up to the 150 standard or were they older, 90 mile-an-hour?

A: The majority of that is the older structures but I will say there was a highly publicized tower that fell that was near the Mississippi River and the cable across the river was taken down and so that one path was impacted quite substantially. The other seven we were able to restore reasonably quickly. Now, it is unfortunate that all eight of them had issues and that's something that we need to work to rectify but even in that, those seven other lines comprised about 1,500 transmission structures; 99% of those structures were undamaged. What we saw was again, debris hitting wire, taking down cable, shield wire that was damaged that made contact, some structures on the lines that failed that made it, obviously, take longer to repair because we had those lines, we had to redo the structures, etc., so, for example, the one path that we did use coming in from the east to start to get lights on in the city within 48 hours, the structures were not damaged. That was more those shield wire insulators and that sort of thing that were damaged, which

allows for a pretty rapid rebuild of restoration of that system; that's how we were able to get between that and the New Orleans Power Station lights back into the city within 48 hours.

Q: Without getting into the weeds too much, we seem to have a confluence of two major things going on here. (1) The storms are getting much more virulent and damaging and, (2) We have the country focused on now the need for new infrastructure with possibly hundreds of billions or more come in into the electric grid. Is this the time for you to look at those pathways and to New Orleans and across the whole service territory and say, "We need to build to a higher standard?" and if so, what kind of investment do you think we need is needed?

A: Yeah, so I think really what we need to do is take a step back and again, the standards, the new infrastructure is proving to be robust against even the storms that we're seeing today but what we do need to look at because of the increasing severity and the increasing occurrence, the frequency, is to determine whether or not the cost-benefit relationship has changed. So, for example, there's those 1,500 structures that I mentioned on the seven lines that go into the city are all still within their originally determined useful lives and their regulatory determined recovery lives and so…

A: Let me stop you right there, Leo and just ask, maybe the depreciable lifetime is not valid for what we're in right now. Maybe those need to be reviewed. Would you like to talk with regulators and see if that needs to be changed?

A: Well, that's what we plan to do is look at the potential options for added resilience to the system, the cost of those different options and then come to an agreement on the cost-benefit discussion about should we do…should we look at poles that to their traditional standard would be considered perfectly fine and take them down and put-up new ones. It's not an uncommon way to look at different technologies as they progress. We just went through that. You had asked about that for example, smart infrastructure, our automated metering. We got to a point in time where automated metering as a cost-benefit relationship such that taking out old meters that are working just fine and putting in a new meter makes economic sense. It provides a better level of service and the cost savings make it worth doing. If storms are going to occur more frequently with more severity, then again that cost-benefit relationship to look it and say otherwise this pole would be perfectly fine and it's been here for 25 years and it might have another 10 or 15 years left on its "useful life" but now if we think the once in a hundred-year storm is once in 10 or once in 5 or once every

year, that cost-benefit relationship between changing it out and what makes more sense and we need to work with our regulators on doing that. Like I said over the last five years, we spent roughly $10 billion dollars in T&D equipment that meets or exceeds those standards and is showing that that works immediately if what hadn't happened since 1856, has happened twice, nearly $10 million last 12 months, maybe that cost-benefit relationship has changed and we need to come to some agreement with our stakeholders about if that's changed, how aggressive should we be in changing out millions of poles for example.

Q: Where would that dialogue be? I mean, you're a unique utility in the sense that your major metropolitan area is governed by the city council and you have state regulatory commissions in some of the states that you serve. How could you orchestrate that most effectively, and is there a need for some kind of joint oversight of this? Do we need to get FERC or NERC involved?

A: Well, obviously we through NERC and SERC, etc., have standards that we have to live up to and I think the planning of the system can be done between us and our regulatory jurisdictions. Obviously with the cooperation of MISO and others in the region but what we're going to see obviously is different

standards for different types of weather events in different parts of our service territory so if you think about where we sit, we're on the Gulf of Mexico within New Orleans and Texas but by the time we get up into Arkansas and Mississippi, we get all the way up basically to West Memphis, Tennessee. So, we are seeing the winter storms, we're seeing the hurricanes, tornadoes, etc., all across that system and so in some parts of our system what we'll be looking at is 150-mile-an-hour winds along the Gulf Coast with the I-10, I-12 corridor area and in another part of our service territory we'll be looking at increased need for anti-galloping devices on transmission because of ice. So, it really needs to be done across the entire system toward different types of events and we need to work obviously with our folks and with the regulatory jurisdictions to make sure that we're tailoring not only what it is that we're doing but how that serves and how that gets recovered and how far we should go in that jurisdiction. So, the Mississippi Commission will have, for example, the ability to work with us on how far do they want to go in Mississippi and here in Louisiana, we'll work with the Louisiana Commission and the city council as well on what options should we pursue and look at. Really, there's three sciences involved here: there's climate science which we all look at for two reasons: One is obviously

to make a more environmentally-sustainable footprint so we don't worsen the situation that we find ourselves in as well as adapt to the situation we find ourselves in. There's physics that has to do with how do you make sure you keep the lights on be based on how the properties are strategically placed along the grid system and then provide that resiliency. And then there's economics as well because none of this comes without a cost and again it's that cost-benefit relationship that we need to be rethinking to say we had a storm in 1856 that was the rival of Laura and Ida and it hadn't happened…Katrina was the closest thing we got to that in between which was 16 years ago and now we've had two what you would argue hundred-year storms within 12 months with that severity and that frequency is going to increase, well then, what we would have otherwise believed 10 years ago was too costly given the benefit you would have received, maybe the consensus would now be that the benefits are greater.

Q: So, if this all is not enough challenge for you, you also have the fact that of your 30,000 megawatts of generation, you've made a commitment to cease using coal generation by 2030. Is that correct?

A: It's 8% that is coal. So coal is a very, very small part of footprint now so we've already started to transition away from

coal and our intention is to be completely out of utilizing coal by 2030 and we'll replace that with primarily renewables and right now the best renewables resource that is for our region of the country is obviously as you know, renewables are somewhat regionally specific in terms of what works well and what doesn't. Solar works well in our service territory. Wind is not quite there yet. I will envision that it will improve where it gets to be a resource that we can utilize. We could utilize it more in the northern part of our service territory than we could in the south so primarily renewables in the form of solar battery storage and we've also started to develop the technology where we can blend and then ultimately solo-fire utilizing hydrogen in dispatchable units. So, we've got a project that we're developing in Texas right now that when it's developed, it will be able to blend 30% of its fuel utilizing hydrogen with the capability for us to develop it further to get it to 100% hydrogen at which point it would be dual fuel, either natural gas or hydrogen or anywhere in between.

Q: I believe you have plans to develop 3,500 to 4,000 megawatts of renewables by 2030, is that correct?

A: Yeah, we're right now targeting 5,000 megawatts by 2030. It would not surprise me if we don't exceed that level of renewables from a function of both our desire to deploy them

quickly as well as the desire of our customers to reduce their Scope 2 and even Scope 1 emissions by both using more and more of those renewables specifically potentially through some of our green tariffs accelerate some of that build or by electrifying things that are today running on fossil fuels on their side of the meter which we aren't involved in, to electrify those and we utilize renewables to meet that need, that could also accelerate and increase that number as well.

Q: So, is that really going to change the look and feel of your utility dramatically because there isn't that much solar…

A: Well, we already have…

Q: Go ahead.

A: Yeah, there isn't that much solar but we do already have one of the cleanest fleets in the United States for large-scale generation. It's because of our roughly 5,000 megawatts of nuclear power and the gas-powered generation that we have. We went to a portfolio transformation beginning in the early part of the 2000s where we built new, far more efficient, either bought or built new more efficient gas-fired units. So, for example, the new units that we just constructed several years ago are 40% more efficient in terms of the amount of CO_2 that they emit versus the legacy assets that we retired. So, we've used gas as a transition fuel. We will continue to need

dispatchable energy on the grid given if for no other reason, the size of our industrial customer base and the size of the facilities that they operate. While we add significantly more renewables and develop our potential for undispatchable renewable resource, such as hydrogen inside dispatchable units that can provide that long duration storage that's kind of missing right now. So, if you think about it, you've got renewables – wind and solar and battery storage. The battery storage is pretty limited in short bursts if you need to get what we did, for example, we would have needed for example for Winter Storm Uri, a week's worth of storage or if you need seasonal storage like you'll find you need in a lot of regions in the country. We need something more like hydrogen capability to be able to meet those needs without having emissions.

Q: Do you see given the unique makeup and problems of the New Orleans area where you have pumps that work very well and keeping floodwaters out during the last Hurricane Ida, the need for more kind of storage within the city so if you have a catastrophic failure of lines coming in again, those pumps can continue to work?

A: Yeah, I mean I think resiliency is really obviously taking on a bigger and bigger role in what we do again, because that cost-benefit relationship is changing given the increase in

energy and increased occurrence of these weather events of whatever kind they are and so as we look at that resiliency, we've already started to deploy things like backup generation on critical facilities. It's a product that we're offering in some of our jurisdictions where backup generation is something that we can alone operate, maintain. For example, we dispatch it into the grid when it's required to meet peak load but if there's an outage, the customer gets those back-up generating capabilities. Microgrids are another thing that we're looking at in some regions rather than beefing up the transmission infrastructure. A microgrid itself might be more applicable and certainly as we talked earlier, resiliency in the form of utilizing the higher, the new higher standards more broadly as we accelerate the replacement of what otherwise would be considered perfectly good equipment. We may need to go there because of that increased resiliency benefit that they want to have. And looking at other things that have been traditionally too costly to do on a wide scale like undergrounding and the like. Certainly there's a space for all of that and across the system, New Orleans included, in terms of making sure that we try as much resiliency as we can.

Q: Give me a sense of the relationship here; you've mentioned some promising new technologies that are playing out across the

country with increased deployments; renewables, microgrids, storage, use of hydrogen. Can it make an appreciable dent on your reliance on traditional T&D? Obviously, it's not going to go away but could you say maybe 25% of your customer need could be secured through these new technologies across your grid or is it going to be a smaller impact?

A: It's going to be a smaller impact on how much T&D is needed but I think what it will be is a bigger impact on how much system reliability that you provide and sustainability. For example, hydrogen, what we're developing for hydrogen today would be akin to gas-fired CCGT except that it would have no emissions because what you would be combusting in it is hydrogen. Now, what we need to do to get that hydrogen to get that to work effectively is to make sure that we're going through the process to make sure that we're making as green a hydrogen as we can. Cause today, obviously, grey hydrogen is a lot of emissions in the production of hydrogen and so stepping up the production of hydrogen so we can use it in the power plant that doesn't emit any CO_2 creates greenhouse gases that we want to avoid so hence, carbon capture and sequestration and then electrolysis as we progress through those to make those most cost effective. You'll get hydrogen technology that looks, acts, and feels like a gas-fired unit without emissions which

the grid desperately needs as I mentioned because the grid needs that inertia, you need those reserves and you need that duration for when if you go a week without the ability of access to renewables, you need something to make it last for a week and you can get that there. Same goes with new smaller modular reactors. That's technology that we're not actually developing any of that but certainly following it closely, where again, you have large-scale production of emissions-free electricity be really critical in addition to battery storage and renewables that can be more localized, we're looking at putting renewables on the distribution grid as opposed to the transmission level to be able to make sure that we're a little closer to the customer and then microgrids as I mentioned are another way where we will still have potentially transmission infrastructure into that system, that's that added level of reliability that the microgrid itself would be capable of operating should you lose that access.

Q: Um hum.

A: So, it's really a…you know, the electric grid is the largest, most complicated machine on earth so there's a lot of pieces and parts that all serve different uses and that's what we need to make sure that we do is fill in all the use cases with the appropriate emissions-free technology.

Q: Leo, you personally and your company were recently were honored by the Center for Climate and Energy Solutions, the Climate Leadership Award. Congratulations.

A: Thank you.

Q: I want to ask, how the whole debate over sustainability and emissions reductions is requiring a cultural change and you convened a group called the Gulf Coast Carbon Collaborative of Gulf Coast industry representatives to talk about the need for reducing greenhouse gas emissions. How hard of a sale is it to your customer base and how to you hope to make the sale?

A: You know, I think the whole group of stakeholders we deal with is more and more aligned on this topic every day and more now than we ever have been. You know, Marty, we were the first utility in the United States to voluntarily limit our greenhouse gas emissions. We did that back in 2001 where we set the target that we were going to cap our emissions at the 2000 levels. We came back years later and made that a reduction of 20%; we've exceeded those targets. Now, we've got to 2030, the 50% reduction in our emissions rate and then the 2050 net-zero commitment. We originally…when we originally made those commitments back in the early 2000s, I think the reaction was somewhere between "who cares" and "what are you doing?" But now, all of our customers, the large industrial customer base that we

have along the Gulf Coast, they all have carbon-reduction goals of their own and we're working with them to help them meet those carbon-reduction goals. So, I think in all areas whether it's investors or customers, the communities we serve, our employee base particularly as more and more younger people come into the company, there's a great alignment on what we want the outcome to be. And as I said earlier, there's three sciences at work here that we really need to make sure that we all keep abreast of. Climate science, which is driving us all on the resiliency path as well as the path to a greener, a greener operation. There's the physics piece of it; we need to keep the lights on and I think that's one of the things you hear out of folks like me in our industry a lot is we need to make sure that the system is still reliable and that we aren't creating a system where the plan has to be to shut the power off. I mean that obviously, unfortunately does happen but we don't want to plan that into the system so we've got to get the laws of physics right in terms of those different operational characteristics that are required to meet load on demand instantaneously all the time. And then economics has to come in to play because obviously we all talk about environmental justice. There's several forms of that as far as I'm concerned. One is to certainly make sure that how we locate our facilities and how we respond and how we

interact with our communities does not put anybody at a disadvantage but the price of the product is another thing that can be problematic when you do things that cost so much that customers can't afford to pay their bills. We've got to get all three of those sciences correct but one of the things that I've really seen, particularly over the course of the last couple of years is as more and more people come to the table to try and solve the problem of reducing carbon, more and more people coming to the table willing to investigate all options that allow you to do that in the most efficient, cost-effective way. I'll give you an example. By the time we hit our 2030 goal for Entergy New Orleans, it will be one of the cleanest cities in the United States and the emissions rate of Entergy New Orleans will be somewhere in the 270 to 290 pounds per megawatt hour if we go along the path we are now and don't do better than that. A ship sitting in port here in New Orleans, a cruise ship, for example, might emit 1,500 to 2,000 pounds per megawatt hour of the diesel engines that they run while they're parked to keep just electrifying that ship and plugging it into the grid in New Orleans can reduce from 2,000 to 270 the amount of CO_2 that comes out of the…that gets emitted into the air by just switching to our power. If we can go faster and get to zero faster by 2050, that will be zero. We should be going after those really

efficient, really cost-effective ways of reducing carbon so that we can take into account the laws of economics so that we don't put an undue price burden on our customer base, particularly those that live below the poverty line which for us, is now 25% of our customer base.

Q: Last question. Do you really see increased electrification of transportation happening in your service territory?

A: I do. I would say we're not a part of the country where the electric vehicle craze has taken off but it's going to for two reasons: (1) It's going to be more and more desired by customers themselves and if we're getting to the point where sometime within the next decade, 50, 60, to 70% of the cars put on the road by the automobile manufacturers are electric cars, you're going to transition cause that's what's going to be available and certainly, that's going to create the opportunity to really reduce emissions. In our service territory, particularly in Louisiana and Texas, in addition to the transportation sector, the industrial sector is a large emitter of greenhouse gases and there are significant amount of opportunities to electrify their process whether it's compression used in pipelines or L&G liquid action to create LNG to be able to export overseas. Whether it's to provide the energy to somebody to do carbon capture on the backend of the creation of industrial gases like hydrogen, where

we use renewable nuclear power to be able to create green energy that creates blue hydrogen, for example, and also the electrolysis which would create nuclear power renewables to be able to create green hydrogen. A lot of electrification opportunities that many of which you'll find are pretty economic even if you were to do it today with current emission's profile that we have as a utility.

Q: Okay. Well, it's been great talking to you, Leo. Thank you very much.

A: Thank you, Marty. It's something that we and Entergy have been passionate about for 20 years and I know we're excited about the opportunities of where we can go both in resiliency as well as with our sustainability objectives and particularly, not just meeting our sustainability objectives but meeting the sustainability objectives of our customers and the communities where we all live and work. So, thank you very much. I really appreciate the opportunity.

Q: Thanks, and thanks to our guest Leo Denault, who's the Chairman and CEO of Entergy Corporation in New Orleans for sharing his insights about the changes in his company and the industry. Please send us your feedback or questions to GridTalk@NREL.gov and we encourage you to give the podcast a

rating or review on your favorite platform. For more information about the series or to subscribe, please visit SmartGrid.gov.

END OF TAPE