MARTY ROSENBERG
JANUARY 19, 2023
GridTalk #320

LABAN COBLENTZ INTERVIEW

Hi and welcome to GridTalk. Today we have with us Laban Coblentz, who's the head of communications and one of the top U.S. delegates at the ITER Fusion Reaction in Cadarache, France, outside of Marseille.

Q: Hi, Laban. How are you today?

A: I'm doing well. Thank you for having me.

Q: Okay. Well, fusion has busted back into the news as the result of the experiment at Lawrence Livermore in December where they achieved a gain over power input in their fusion reaction which has electrified all those laboring in the field of fusion, so I thought it was a good time to revisit our friends at ITER and I'll let you tell me what ITER stands for. I know it's a Latin word; maybe you'll give us the name and what the acronym stands for and then we'll get rolling.

A: Sure, so ITER in Latin means "the way." I would say that you'll see many journalists harking to what ITER stood for originally which was International Thermonuclear Experimental Reactor. We sort of dropped that because the fusion/fission debate prompts a lot of fusion people to not want to talk about nuclear but of course, fusion is a nuclear process.

Q: Okay, so first off, give me your response in your community to what Lawrence Livermore reported in December. Is it with a touch of envy? Is it pride and something that you think you can leapfrog off of in your own work?

A: Oh, well, I mean the responses were probably all over the place. First of all, fabulous. You know, we're…sure, we envy but we're delighted when there is any fusion breakthrough. I think there was some, when we spoke to journalists, there was a period of sort of short misunderstanding and that's because it's a different approach to fusion than what we use. So, they're two general approaches and some subdivisions but the way that ITER does it, is that we have a gigantic circular device, a doughnut-shape device called a Tokomak, a big chamber and you put two to three grams of two forms of hydrogen into that chamber and then heat it up until it tries to replicate the reaction that occurs in the sun. If you look at the National Ignition Facility at Lawrence Livermore that had their breakthrough, they take a very different approach where they have a tiny pellet, a very, very round like…about the size of a sesame seed but perfectly round and they hit it with 192 massively energetic lasers from all sides. Think of a soccer ball if you put a laser at each one of those divisions of a soccer ball and what that does is it both compresses the pellet, hopefully keeps it round, that's essential, and it transmits heat, and in so doing, it provokes a more or less an explosion of fusion energy.

Q: So, this…I think one way to think of it, too, is a scale here. You're building something, a device that's got a million components and it weighs as much as much as three Eiffel Towers and is very complicated and as you said what they're doing in California is very close to pure research as the architect of that experiment described it to me last week on this podcast, it's similar to creating a star in the size of a human hair. So, give me a sense of what you folks at ITER think about approaching it, right, from what is closer to a utility-scale reality with what you're doing. Is that a fair assessment?

A: Sure, it is but there are those who would say it's not fair. I had a discussion actually with a number of private sector fusion initiatives a few weeks ago not long after the NIF results were announced and there are some private sector fusion initiatives that are taking inertial confinement and hope to make it commercial. At the press conference the Secretary of Energy held, the folks from the National Ignition Facility said, it will take a couple of decades to make this practical but it doesn't mean it can't be. It doesn't mean it's pure science. Certainly, the results of that experiment give scientific validation because it’s the first human-controlled breakeven getting more energy out than in than what’s been done before. But as they said, to make that a practical commercial device, they would have to get thousands of those reactions in a second, whereas right now, it takes them a few weeks to reset so there’s a lot of engineering involved there. In the commercialization of the Tokomak, which is a Russian acronym for toroidal or doughnut-shaped field magnetic device so in the Tokomak approach that ITER uses, there is far more research on not just the science, but also the engineering of making it practical. So, another big announcement earlier in 2022, although the experiments occurred at the end of 2021, came at JET, the Joint European Torus which was at that point was the largest, well still is, the largest completed fusion device and they had achieved a larger breakthrough of energy over a sustained five-seconds than ever before but it still was not breakeven but that would be but JET would be more akin to what ITER is doing as sort of a precursor Tokomak.

Q: Okay. Let’s dive in more closely on ITER which is all around you now as you sit in the South of France, alright. It stated in 2007. Experiments were supposed to start in 2016 and now that’s been pushed back to 2025. The original cost has escalated to some say to upwards of $65 billion, has multiplied several fold. Tell me what’s been going on.

A: Sure, I think the origin would go back even further to Ronald Reagan and Mikhael Gorbachev in 1985 conceiving of this idea and saying they wanted to build ITER and then France and all of Europe and Japan joining shortly thereafter, lots of conceptual designs and they came up with design and the politicians said at the end of the 90s, “No, that’s too expensive; that’s going to take too long. Make it smaller.” So, the size of ITER and is directly tied to the cost; directly tied to the complexity. Why? Because no matter how large you build a device, a Tokomak, the size of the particles that you are trying to contain don’t change. The positrons and the molecules and the atoms and so forth, are the same so that the weave of the magnetic field that you are trying to make with three different shapes of magnets made in Japan and Italy and San Diego and St. Petersburg and in Hefei, China, and a few here on the ITER site, the size of all of those magnets gets much bigger but the precision of how they’ve all got to fit together to make essentially an invisible magnetic cage conform precisely to the shape of the steel cage that is the Tokomak chamber. The weave of that magnetic field has to be – think of it like an Egyptian cotton only magnified by a million times. It’s got to be incredibly, incredibly precise. So, the size following the politicians saying, “Do it faster and cheaper,” the size was determined by a particular experimental goal, which is called the burning plasma. And a burning plasma basically means that you got two essential products from the fusion reaction. You get a neutron which is highly energetic and that is not; that’s the only particle that’s isn’t confined to a magnetic field, so it hits the walls and transfers it energies, kinetic energy to heat energy which in a commercial device would heat water, make it steam and drive a commercial machine, so the ITER product will also have a helium nucleus, what we call an alpha particle, that has a lot of energy as well and so the helium product will continue to heat this plasma and when more than 50% of your heat heating the device is coming from the fusion reaction itself, we call that a burning plasma. The ability to do that is influenced by three things: size, magnetic field strength, and plasma density.

Q: Wait a minute. To get into the question, and I appreciate this background, so more important…

A: Sure.

Q: Is the political pressure to keep the cost down resulting in energy compromises that has extended the price and cost; the time and cost?

A: I would say that it, it certainly influenced the design. I think then the second influence was because all of the countries wanted to get the benefits of the machine and wanted their companies to create these different parts, instead of giving this device to I don’t know, Areva or Westinghouse or Siemens or somebody, we decided it would be built, the components would be built on three different continents in thousands of factories so that added a level of complexity that made the initial estimates of cost and timeline unrealistic. They were round numbers and that has changed.

Q: So, two quick—one quick question and I don’t want to spend a lot of time on this but 35 countries are involved in some fashion with your project; 7 core countries. The one that I don’t think you mentioned in your list is Russia. With the problems going on with the Ukraine, what’s the practical impact of Russian and U.S. scientists when they pass in the hallway?

A: To be honest I would say that here at ITER we, we talk about a term, *ITERnational*. We drop our passports at home. We use them when we travel, but here, we’re just international civil servants working on a common goal. If you could look out my window you would see flags flying beside each other that you don’t normally see in any other context than maybe the FIFA World Cup soccer tournament or at the U.N. but here we’re actually building something. You see the EU and Chinese flags side-by-side. You see Russia and the U.S. side-by-side just because it’s alphabetical order and that’s where they fit in the ITER membership so when you see those countries or EU in the news, it’s mostly about trade wars, border disputes, competition of one sort of the other. But when that set of countries makes a 40-year commitment, of course you could anticipate that there might be conflicts of some sort, hopefully not armed conflicts like we see with the Russia/Ukraine circumstance, but it's not unanticipated and so in the ITER Agreement, there is no provision; none, for throwing out a member. We are committed to stay together. Why? Because ITER is not just a fusion device, it’s an exercise in what happens when the global community believes so much in a common goal and in a better future for our kids that we are willing to put aside our known ideological differences to try to pool our best expertise, something that science has done for a longtime.

Q: So, you probably get a lot of questions from journalists about cost overruns and I’m going to flip it on you and give you a softball which is in quick research, is the highest estimate I saw is potentially $65 billion and I heard that ITER might contest that figure but let’s assume it’s true for a second. That’s less than half of the cost of the International Space Station, so talk for a minute about what you and your colleagues out there think the potential of this technology. If it is successful, if you and Livermore and others like General Fusion in Vancouver, some of the private sector companies really achieve this technology, how would it alter the equation of global warming and sustainability?

A: It will change everything. I think if you look at the simple physics of it, renewables, which we strongly support, are using fusion energy but at a distance of from here to the sun. The sun is using fusion; that the stars use fusion. That's why we have light and heat and life on earth. The difference is that because they are diffuse and because they are intermittent, you need a huge amount of land mass which actually only increases our impact on the planet. The ability to use a concentrated source of energy first came with petroleum and we saw how that transformed everything in the early 1900s, late 1800s and so we're at a point of a revolution again because what we didn't understand about petroleum is that we're putting all the waste into the atmosphere and now we're having this sort of, 'Oh my God; look at what we've done? Look what legacy we've created.' So, fusion has the potential to give a baseload source of energy without the only a fraction of the waste concerns of fission, without the safety concerns of fission but with the ability to provide clean energy for a planet in a concentrated way and when I think of when I drive to work here every day I think of my daughter. I think of the potential to transform everything in terms of the legacy we leave.

Q: So, one of the key terms you alluded to earlier was to take away energy, the amount of energy required to ignite the fusion versus the amount that comes off of it and your goal is a 10-fold increase and I believe the folks at the National Infusion Facility in California are looking or they have achieved the 1.5, is that correct?

A: That's correct.

Q: So, are we getting within hailing distance? Everybody talks about fusion as being two decades off. Might it come faster?

A: You know if you ask 15 different scientists, they'll give you 15 different answers to that, but if you ask them a different question and you say, "If we had more funding, could we get there faster? What could we do better?" Their faces light up because the truth is, yes, we could get there faster in a couple of different ways. One is increased funding. You mentioned the $65 billion figure and yes, we dispute that but use this comparison. Europe imports $1 billion euros of petroleum products every day so if your cost at ITER is we say is around $25 billion, that would be paying for ITER in a month. The cost if we use your figure would be paying for it in two months, and so the point there is we can get there much, much sooner and I think that if we consolidate our efforts a lot of what the U.S. is now doing following the White House decadal commitment is focused on public/private partnerships. What would happen if we were treating an alien invasion? Look at all the movies; we'd all work together. We'd blur our lines of procurement. We'd work on public acceptance and regulation and the soft issues—the environmental policies, the deciding issues—we do all of that at the same time. And I think that if you look at the graft of private sector investment and the number of private fusion companies just over the last 10 years, everything has changed. That is a signal. Maybe you can fool one investor but you can' fool 35. That is a signal that we are making progress and that the commercialization of this is around the corner.

Q: So, many of our listeners are in the electric utility space. This podcast was created to talk about the future of the electric grid and the future of electricity. Do you have architects envisioning what the grid would look like once there are large-scale and small-scale fusion reactors available to power our electricity? Would it basically be the same grid and you just plug the wires into a different endpoint or might it be configured differently? Would these fusion devices be in office parks, in industrial parks? Would they be large, centrally located plants like the coal-fired plants today? What would it look like?

A: The biggest thing about fusion is that it gives you great versatility and options in some aspects and almost none at all on others. The way that it gives you versatility is that because of the safety aspects, the fact that the physics don’t allow a meltdown or that kind of thing; you could in fact place it in greater proximity to cities, to industry if you get the local—if you get the regulatory authorities to agree. In Europe there’s been quite a lot of push toward decentralization so if you decided that everything was going to be fit for purpose, so you use solar and wind and renewables to power residences and to power small towns, and then you use fusion for your more baseload energy, you could in fact use the existing grid, use it as one-for-one replacement for coal or some other type of plant or you could use more localized power supplies provided that if you take a city like Washington that uses roughly 6 gigawatts of installed electricity now you wouldn’t just want to build a 6 gigawatt plant, a fusion plant. You could but it would be smarter to build say three two-gigawatt plants so that as you do maintenance on one, you have a more reliable supply. But you have options. That’s the point. Where you don’t have options at least envisioned so far is you can’t go down in size in the way that you could. For example, in my days on a U.S. Navy submarine you had a much, much smaller fission device, and if you look at the *Ironman* comic, *Ironman* has got a Tokomak in his chest. That's probably not realistic. You're never going to get to something that's that small. Fusion demands a certain size.

Q: Talk about the waste issue. My understanding is there's concern about a nuclear waste for conventional nuclear plants. That largely goes away. Why is that?

A: Part of it is just volume. If you look at a one-gigawatt standard plant, a fission plant would have 200 to 300 tons of uranium loaded at any one time whereas at any one time in a fusion plant you would have two to three grams of two forms of hydrogen so that by itself tells you that the volumes, the sheer volumes of fuel used are much, much less. The second is that when you split a nucleus in fission you create a chain reaction which is a safety issue but you also create daughter products. You're actually creating other substances and those are radioactive in their decay, whereas with fission, sorry, with fusion, you're fusing literally tritium and deuterium, two forms of hydrogen. The tritium is radioactive and will and the neutrons you release from the reaction will make the metal of the Tokomak cage radioactive but the volumes are just a tiny fraction and the isotopic mix is much less complicated so fusion will not be without waste but it won't have any long-lived high activity radioactive waste. You could essentially; we probably wouldn't do this but you could essentially leave a fusion plant to stand in place for about a hundred years and then just recycle it, so the waste is not the same concern.

Q: So, help me for a second create the sense of awe that I bet you think about when you think about this technology, where as I remember on two visits to ITER it was described by some of your past colleagues as creating something hotter than the center of the sun or as hot as the center of the sun contained by superconducting magnets cool to as cool as the universe ever gets. This has been described as the most complex endeavor of humankind ever. Is that that sense of awe among all the people working on this project?

A: You captured it really well to be honest. I mean, I think there is both a technology awe and a human awe. On the technology side we would like to make it less complicated so what you talked about, 150 million degrees, 10-times the temperature of the center of the sun in the middle of the Tokomak and a few meters away at ITER we will have magnets cooled to about four degrees kelvin, just four degrees above about absolute zero so basically the temperature of interstellar space. That creates huge engineering challenges and yes, it's awesome to see it coming together and to just watch humans overcome all of these issues. But what we'd really like is slightly higher temperature magnets and this is what is being done at MIT and elsewhere so that they don't require the same amount of fusion, of engineering temperature transient. So, from that standpoint I would say the awe is great. We would love it to be—the more that we can overcome impossible challenges, the better. The human awe is in watching these countries that don't agree always, to come together and sort of do a reverse Tower of Babel. If you walk into our assembly hall, you're going to hear Mandarin and Italian and English and French at a minimum and often four or five other languages going on simultaneously and the common language that we speak, it that of mathematics and engineering and maybe super computers and CAD drawings. And the ability to come together and put a single project that yes, might be the most complex human endeavor of all time, it's pretty awesome.

Q: So, my last question for you really centers on your job and your title. You're head of communications at ITER which means you explain all this to the world and given at the time where young people in particular are extremely stressed and skeptical about where the world's headed in terms of conflict. We see the war; the Texas retrograde back to the worst of human instinct; we see climate change; we see the rise of quite Fascist governments in many parts of the world and political movements that we thought were gone from this scene are getting revived. What is the challenge of explaining what you very poetically described as the awe and the flags of rival nations standing one-by-one in this human endeavor? What's the challenge of making the world aware of everything that is happening out there and brushing pasts the criticisms that you get from journalists and others who always say, "Fusion; it's a long-term promise. It will never come." How do you deal with your job and give me one or two wins where you think you've really broken through.

A: Sure, I think it's very largely about conveying hope because a lot of what our younger generation is facing, my daughter and what will eventually be her children, is a pretty bleak prospect. There was a visit about a year ago from U.S. Senator Manchin and given his position at the middle of U.S. politics I wasn't sure what to expect, and he met with a bunch of U.S. passport ITER workers afterward and they asked him what he thought and he said, "Today I saw the possibility of world peace." And it's a funny reaction and you hear me saying repeatedly that there is both the technological promise and also the human promise. What I mean by that is if we had a perfect fusion device today it wouldn't just fix human nature. Manchin recalled that in the past in his lifetime, certainly and even before, he could not even recall a single war, armed conflict in which energy did not play some sort of a role. We see it weaponized in many respects so the idea of fusion as a place as a technology in which fuel is in seawater and so you would largely have the recipe for reducing geopolitical tensions fighting over petroleum access is certainly a great, great innovation. When I talk to kids and I do a lot of that discussion. I had a conference recently where we had high school and university students from something like 40 countries and every continent. You had Middle Eastern kids; you had African kids; you had Latin American kids. ITER doesn’t have a membership in any of those places but they were certainly eager to hear about this because it is conveying a message of hope. We don’t want to overpromise. We know that fusion is hard. We know that it could take decades for us to get to the final machine and yet, there’s much that we can do in parallel which is commercialization…which will help to pave the way for commercialization. But beyond that the lesson of ITER is how do we deal with the other? As Americans, how do we deal with people whose ideologies are different than ours? We see it in the partisan politics. When you’re going to other countries learning about how to deal with the other, I find that the generation that is coming is actually much, much better maybe than the generation that we share, Marty. The ability to reach across ideological divides and find ways to share common goals. And ITER's about fusion but ITER's also about that vision.

Q: Well, I think the anecdote that you just told exemplifies that because Senator Manchin and I don't think I need to remind our listeners, regarding the Senator and coal in the United States.

A: Right.

Q: Did he ask you to put a fusion plant in his home state?

A: Well, one of our American staff said to Manchin, "If we had a fusion device ready, would you put it in West Virginia?" and he said, "My God, do you recognize that what West Virginia is doing? Do you understand how unsustainable that is? Ninety-three percent of our electricity comes from coal. We cannot keep that going. We know we need something different. I've offered Bill Gates to build his small nuclear fission plant, TerraPower in West Virginia and yes, I would rapidly do anything we could to a bring fusion device to West Virginia and to the rest of the country as fast as you could."

Q: Thank you, Laban.

A: Thank you.

We've been talking to Laban Coblenz, who's the head of communications at ITER project in the South of France. We invite you to send feedback or questions to us at GridTalk@NREL.gov and we encourage you to give the podcast a rating or review on your favorite podcast platform. For more information about the series or to subscribe visit SmartGrid.gov. Thank you for listening.

END OF TAPE