Algorithms & Power Systems Architecture:

Using Historical Analysis to Envision a Sustainable Future

Oral History Project

Interviewee: Jessica Bian

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Interviewer(s): Julie Cohn, Sairaj Dhople, Daniel Molzahn, Jess Slater

Transcriber: Temi

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***Abstract*:**

Jessica Bian, Ph.D., discusses her educational background and multiple professional positions in the field of power systems engineering. She describes her early work at Westinghouse on the flexible AC transmission system (FACTS), done in collaboration with the Electric Power Research Institute (EPRI), and on the unified power flow controller (UPFC). She later notes that FACTS was not widely adopted. She discusses working with NERC, when it was newly designated as the Electric Reliability Organization in 2007, on review and development of mandatory reliability standards. She uses a medical analogy several times to explain the data collection, monitoring, and analysis done. She describes the metrics used to assess reliability on all four major North American interconnections. She discusses one type of

problem – misoperation – at length. In 2015, twelve percent of 12,000 systems reported misoperations to NERC. Now the rate is 6 percent of all systems reporting. She discusses the stakeholders who work with NERC to develop standards – primarily transmission and generation companies. She describes the process of educating, negotiating, and reaching agreement amongst stakeholders for each new standard. Returning to the topic of misoperation, she explains that the primary cause is often incorrect settings on protection equipment. She describes the misoperations that caused cascading outages in 2003 and 2011. She notes that there have been zero cascading failures involving outages of 4,000 megawatts or more since 2011. She calls these "CNN events." Dr. Bian discusses the industry response to mandatory standards after 2007. She discusses who is involved in standard development. She explains the way in which markets and standards address the changes that resulted from industry restructuring in the 1990s and early 2000s. She offers that events like the 2003 Northeast Blackout engage public concern in power systems and trigger change. She talks about her time working for the Electric Reliability Council of Texas (ERCOT), and the Pennsylvania-New Jersey-Maryland Interconnection (PJM). She suggests that the transition to widespread use of distributed energy resources will be slow, but that the roles of regulators and legislators will make a difference. She offers anecdotes about the formation of the Women in Power group and her election to officer positions in IEEE-PES. She mentions the influence of her parents, who were both electrical engineers in Shanxi Province, China. She closes with advice to students to try everything that is of interest and "follow your path."

[This interview took place during the IEEE-PES General Meeting in Seattle Washington. Throughout the interview, Dr. Bian makes reference to activities underway at the General Meeting.]

Note regarding Transcript and Timestamps:

Timestamps appear in the transcript but may not align with the recording. Pauses and interruptions may have been removed and the overall length of the recording may be reduced.

Transcript:

Julie Cohn (00:00:00):

This is Julie Cohn. I'm conducting an interview with Jessica Bian on July 23rd, 2024 [*July 24, 2025*]at the Seattle Convention Center in Seattle, Washington. Sairaj Dhople will assist with the interview as will Daniel Molzahn, via Zoom, and Jess Slater, who is also here. Dr. Bian, during today's interview, we're especially interested in your early research and how it later was carried forward into your consulting

business. But we're also interested in your involvement in the IEEE and in the Women in Power Program. We'll begin with some introductory questions and general background information. If you would, please describe your educational background and your professional positions in the field of power systems.

Jessica Bian (00:00:45):

Sure. Thank you for having me. Right now, my day job is Vice President of Grid-X Partners. It's a private company and consulting firm. Before that I served at the Federal Energy Regulatory Commission, called FERC, and also at NERC, North American Reliability Corporation. And I also worked at ISOs, RTOs. One is called PJM, another one is called ERCOT, in Texas. And before that I designed generators, particularly excitation systems. I—my background is all from industry.

Julie Cohn (00:01:31):

What was your educational background?

Jessica Bian (00:01:33):

Oh, education. I got my PhD in electrical engineering in 1992.

Sairaj Dhople (00:01:40):

Where from?

Jessica Bian (00:01:41):

From Tulane University.

Sairaj Dhople (00:01:43):

I see.

Jessica Bian (00:01:43):

In New Orleans, Louisiana.

Sairaj Dhople (00:01:46):

And where, you said you were designing generators, what company was that for?

Jessica Bian (00:01:49):

Westinghouse. In Orlando, Florida, at the time.

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Julie Cohn (00:04:00):

Your professional trajectory is unusual in that you've participated in the equipment side of the business, the system operating side, the regulatory side, and now you're a consultant. Are there particular technical issues that you have addressed throughout that time? And if so, could you please describe what they are?

Jessica Bian (00:04:27):

Sure. There are a few things I did while I worked at Westinghouse. At the time, flexible AC transmission systems or FACTS started to get traction. Westinghouse had several EPRI projects, demo projects like TVA Statcom at Sullivan Station. And another one was <inaudible> power electronics program. Very close to what we talk about with grid-forming. Another project that I worked on is called Unified Power Flow Controller, UPFC. We had demo projects with NYPA and PGE. I did a lot of application modeling work. And the one I was involved with—another one is AEP—at the time, I got involved with the IEEE-PES technical committees and wrote the papers. I come to GM all the time every year, so, I see my friends.

Jessica Bian (00:05:27):

That's how I got involved. That was my first contribution. We had a couple of patents there. And lots of IEEE papers and panels like that. And the second—I would say more significant—is the work I did with NERC, when I was at NERC. You probably know the history of NERC. It was a voluntary reliability organization. After the 2003—August 14th, 2003—blackout, the US Congress made FERC, and then FERC certified NERC, to be the ERO, Electric Reliability Organization. They authorized NERC to develop mandatory standards. I was hired to, kind of, point out—let's say we have these—we had 87 reliability standards, mandatory—so what other standards do we need? Or how I can update, modify the current standard so we can always keep up with the system?

Jessica Bian (00:06:40):

NERC started a new kind of department called Metrics Working Group. They hired me as a first manager for that Metrics Working Group. That was in 2007. From 2007 to 2012, five years, I worked with the stakeholders, mainly the utility technical managers and directors. And we actually developed 18 reliability metrics. In other words, if you go visit your doctor's office—every year you do an annual checkup where I say, "okay, what's my cholesterol level, pulse rate and the other indicators"—and how good is your health? And the doctor will say, "Oh, you need to stop smoking or do exercise and take some pills, and all that," so, that was kind of my job. I was asked to develop a set of vital signs of the grid, especially on the transmission side.

Jessica Bian (00:07:40):

And to let standards folks know. Say: “Oh, there's a vulnerable threat or risk spot.” So, they can have more standards in that area, or less standards. If everything is okay, we can retire some standards. If something we already have is not good enough, then we can modify. More like a north star or guideline for the new standards. That was my job. We did, in five years, came up with 18 standards. Also in 2012, we first used that as a kind of trend analysis, as a baseline. We published the first State of Reliability Report for North America. We'd never done that before as an industry. We have four interconnections. The report actually covered the entire four interconnections: ERCOT, Eastern Interconnection, Western Interconnection, and Quebec. And it used those 18 metrics to say: “are they healthy?” Meaning are they healthy? Or if not, what are the things we have to do? Where the investment should go, where the standards should go. What are the best practices if they, the other three interconnections can learn from this interconnection. That was my contribution. They continued through all the years. If you look at NERC, their reports, State of Reliability comes out every year.

Sairaj Dhople (00:09:07):

Were these standards quantitative in nature?

Jessica Bian (00:09:11):

Yes.

Sairaj Dhople (00:09:11):

And they were, they were?

Jessica Bian (00:09:13):

You mean metrics?

Sairaj Dhople (00:09:14):

Yes. These metrics.

Jessica Bian (00:09:15):

We collected data. Great question. After we—so you can have lots of measures, but if you don't draw your blood, you still cannot tell. We have to get the data points. My team, the staff at the time, we have the metrics working group. We also have a data collection working group. We started with the TADS, which is transmission outage. It's called TADS: transmission availability data systems. That was the first system. We had a vendor help us. It was online submission. We have about, in North America, about 2,000 transmission companies. They're required, and because we have this authority, we made a mandate for them to send their outage information to us, to NERC, through this portal, once every quarter. At the time it was 200 KV and above. We would get about 4,000 transmission outages every year from all the four interconnections. It's a golden treasure; it's a gold mine. After that, we hired a statistician to look at patterns and trends. And so, to answer your question, yeah: there's trending and there's statistical significance analysis to guide standards, also guide these 2,000 companies, and where they can put their investment. I'll give you an example. Out of those 18 metrics, two actually stand out. One is called a protection system misoperation. When we started the TADS, and we found a lot of transmission outages—

Jessica Bian (00:11:09):

because it's transmission outage as caused by protection system misoperation, then we started to collect more misoperation data. Those transmission companies, they have to, every quarter as well, this happened in 2014-15, they were sending us the misoperation information. We have about 12,000—in entire North America—transmission protection systems in operation. Out of that, we find 12 percent misoperations at the time, in 2015. And so, you get lots of transmission outage data. You find out the cause—what are the root causes? If I have a heart attack: maybe I'm drinking a lot, or maybe I smoke, or

a lot of things. We try to find the root cause. What are the root causes? Then we find out: misoperation was one of the root causes.

Jessica Bian (00:12:05):

Then we started collecting information on misoperation. And then we find out that out of 12,000 operations on transmission—12 percent—so it's average NERC. And actually, some areas, they could go as high as 15 percent. Some of them, like ERCOT was doing pretty good, like 7 percent. Not even. So, that was the main, so, we started, so, we gave that information to standards, the PRC, right? Protection system standards group. They were able to revise the standards, collect more information, and find out: what are the causes. So, this being 10 years, we started in 2014-15. Now the rate has decreased from 12 percent to 6 percent. It's a significant achievement as an industry, because of the work that that we did. Because that—it's cost effective. You cannot do everything because the system is so huge. So, where we put money and resources into it, misoperation was the first one we did.

Sairaj Dhople (00:13:16):

Do the number and types of these standards evolve with time? Like are some of these retired as—

Jessica Bian (00:13:24):

Yes.

Sairaj Dhople (00:13:24):

Grid changes and—

Jessica Bian (00:13:25):

Correct.

Sairaj Dhople (00:13:25):

What is that process like?

Jessica Bian (00:13:27):

We have a five-year review process on the standards side. If we feel that—this has no relevance, or is not improving reliability, we will retire that. It's kind of red tape. We don't need more standards for that. And if it's something that we think—this PRC standard—we know it's one of the root causes—for the reliability, then we would put more standards in or revise it as we go. Process of once—

Sairaj Dhople (00:13:55):

Can you, off the top of your head, can you talk about a standard that was recently retired? That means we did something right?

Jessica Bian (00:14:02):

I don't, because I've not been with NERC for—I left NERC in 2013. I cannot recall. But if you go to search the NERC website on standards, they list every category, including retirement. That's a goal. Because it's a stakeholder group, they're very conscious about the resources they put into compliance. You always ask NERC: like these—They actually propose: these are the standards, can we retire them? Right? We don't see any value right now.

Julie Cohn (00:14:41):

Who are the stakeholders?

Jessica Bian (00:14:43):

The 2,000 transmission companies.

Julie Cohn (00:14:45):

Oh, but no one—.

Jessica Bian (00:14:46):

And some of the generators.

Julie Cohn (00:14:47):

Oh, the generators.

Jessica Bian (00:14:48):

Yeah. They're connected to the— We have a set of standards for generator owners as well. Because they have to provide AGC, right? Regular frequency and other reliability services.

Jess Slater (00:15:02):

Dan, do you have any questions?

Daniel Molzahn (00:15:06):

Yes. Well, thank you for calling me. One question I had about this was—if you could maybe take us into the room a little bit— about what was it like bringing all these different groups together to create these standards? Was there general agreement about what needed to be done and the way to do it? Or were there a lot of controversies? Or with 2,000 stakeholders, 2,000-plus stakeholders, it seems like there's at least the potential for some disagreements. How, how did that go?

Jessica Bian (00:15:37):

Like any standards development, even IEEE here, it's the same thing. You walk in with a different experience, different culture, different settings. And you sit down and then come up with a common goal. And you present the problem—let's say, for the PRC—so I present outage information and analysis and say, "This is very important, and we have to get a common understanding." There's a kind of an education/awareness piece. After they know, like after a couple of months, they know the data, they're comfortable with the analysis you have, and they kind of say: I agree with the analysis, the conclusion. Then we sit down: how do we come up with solutions? And there we have lots of debate because, say, well, this solution may cost a lot of money, and some solutions—we don't have the resources to do it because there is a compliance issue.

Jessica Bian (00:16:37):

If we put it into standards, there's compliance. And so, we spend a lot of time. And some of them, they will say a NERC standard is a common denominator. If you can do it, I can do it. And we vote yes. Two votes before we reach that level. Then we'll ask our CEO to come in. The NERC CEO says, "Can you give a talk because hopefully this person can have some influence, so, they can change their vote from no to yes. It takes all the—how is it: the wisdom, the tools, the influence—that we can get to get 75 percent. And also, our bonus is the NERC—we actually tie with the standards. We actually—it's teamwork; we ask everyone to help us. Sometimes we will call the utility CEOs and say, "Hey, you ought to support us. We

are just a couple of votes away. It seems like one of your directors is not willing to accept this language." It takes all that to get it through.

Daniel Molzahn (00:17:48):

Very interesting. Yes. If I can ask one more question. I'll maybe ask how much did you look at—what were the places you looked for guidance when you were developing these standards? Obviously, you talked to the stakeholders. That makes sense. But did you look at other countries? Did you look at practices elsewhere around the world? Did you talk with academics? Did you talk with National Lab folks? It seems like there's a lot of expertise you might bring in to develop these. I'm curious how that all came together.

Jessica Bian (00:18:19):

Again, each country, continent, we're all different. I just want—I'll go back to this protection system example. We also look at it: we have 12 percent in 2014. We look at our average data. First time we collected, it was pretty high. Just think about it, a hundred operations, fourteen of them are wrong. That was part of when we had this August 14th blackout. A blackout, but maybe 1 percent of load. But because of misoperation, it cascaded. And so, actually we dropped 8 percent of the entire nation's load on August 14th. That's still the highest or the worst blackout in North American history, which is 2000-, August 14th, 2003. And misoperation is one of them. And so, we ask around, okay, what's your average in from Europe, from South America, from Asian countries, and we are the highest in North America.

Jessica Bian (00:19:22):

And we said, why? Because Most of our projects, the companies, the industry is heavily regulated. if I am going to build a substation, new substation, I am not going to have lots of engineers in-house to do that. I'm going to turnkey to Siemens, all those big, big—GE, right? Schneider? Those companies and give it to them. And so, they don't know the settings. We find out the number one cause for misoperation was: the setting was wrong. An engineer actually did the wrong setting. And then we asked utilities, they say, “we never did it because we always sign a contract, ask the Siemens, the big companies that are the engineering companies, to do it. And they just—when they build it, they just do the commission test, and you sign the paper and they left.”

Jessica Bian (00:20:11):

They don't know: what was the setting? And I guess they assume that the setting was correctly done, based on whatever standards, whatever best practice. They didn't know until the outage happened. Then they find out the setting was wrong. The standards that we revised—it was to ask them to—because every misoperation, there's a record, there's a recording for it. They actually look at it as well. So, what the standard said: for every misoperation, they have to send us, send NERC, the full-blown report from the cause, and the operating condition, plus the mitigation plan. So, we know exactly what happened, the 12 percent out of that. The data we collected is the denominator, is how many operations you have, and then how many misoperations you have. For every one of the misoperations, they have to send it to us.

Jessica Bian (00:21:10):

It's like: I just had a heart attack, so, they have to do the scan of everything. Full blown report about this particular incident. Then we have the statisticians, we have the committees, they look at that and we do the tracking. And out of that, 33 percent of those misoperations are caused by wrong settings. And some of the technicians, when they put things together, there is some technician error. But those are less than 20 percent. The main cause is engineering setting. And so, we ask IEEE here—they have one of the biggest committees, the PSRC, which is the protection and relay control committee. We asked them. So, they said: when we did the survey about 20 years ago, the average age of protection system engineers in North America is 55 years old.

Jessica Bian (00:22:02):

And companies, they just don't hire them. Because, they said: “well, once I turn a key, right, and give it to them, I'm just going to run my system. If there's a misoperation, I may have two or three in-house engineers and fix that.” Because of that, whenever there's a big outage, it will cascade. Because it's like you're a mine, right underneath the surface, you don't know when it's going to come out. Because whenever there's an outage and an adjacent line, it's going to cause the next line going out, because there's a misoperation. Always. Because our work—I am actually happy to say the last biggest outage—if you go to FERC, they always say: do we have any CNN events this year? I mean, if you listen to CNN or there's some extreme weather events, like Houston, ERCOT, and whatever—

Jessica Bian (00:22:51):

But it's not a reliability event. We call it a resilience event. A reliability event, the last one we had was in San Diego, city blackout, 2011. This has been 13 years: we've never had any CNN event. I would like to say my contribution—and plus everybody else including you—made a difference. Because we were able to reduce that from 12 percent to 6 percent. Even though we still have 400 megawatts, which is a tenth of the San Diego city blackout. San Diego city is about 4,000 megawatts scale. That will go to CNN quickly. But 400 megawatts, who cares? We still have 10 events on average, North America-wide, every year, but those will be localized. It does not cascade anymore. Because I controlled it, it's just a localized event. And my next protection system will stop right there. They will react quickly and isolate the local event.

Julie Cohn (00:23:58):

Do you, if you look back over the last 50 years, do you see the total number of 400-megawatt and above events dropping? Or is the average still the same? 400 megawatt, 400 megawatts and below

Jessica Bian (00:24:18):

Dropping, like I said, it's dropping from last 13 years: Zero. Zero. But before that, before the mandatory standards came in, the standards came in in 2007. So, 2005, US Congress came up with the bill. As for 2007, 87 standards came out the first time. From 2007 to 2011, that period, we still had several, including the San Diego event.

Julie Cohn (00:24:46):

And was that consistent with the prior 30 or 40 years?

Jessica Bian (00:24:50):

Yeah, it's, right. It's mandatory—

Julie Cohn (00:24:52):

Since 1965 forward, it was roughly the same every year?

Jessica Bian (00:24:55):

Right. Right. We had—

Julie Cohn (00:24:56):

Or as a percent of the system?

Jessica Bian (00:24:57):

Yeah, we have all the, DOE has that data as well. You always hear: the blackout. Those are preventable. We call it preventable. If we have the standards right, ideally, we shouldn't have any. And that's what you have seen for the last 13 years.

Julie Cohn (00:25:13):

Okay. That's, that's significant.

Jessica Bian (00:25:14):

It is, because we can do the big scale with a cost-effective risk analysis.

Julie Cohn (00:25:21):

Yeah.

Jess Slater (00:25:21):

You've invented this analogy of being similar to a doctor giving checkups and vital signs. And you mentioned, just had a heart attack giving that report. Well, some people, when their doctors are giving them advice, either listen to what they're saying and revamp their health, or either go ahead and eat bacon every day. I'm curious, what were the attitudes to these mandatory standards?

Jessica Bian (00:25:44):

I love that question. Okay. When we had—2003—we had this huge blackout, so, Congress stepped in. Out of that that bill, it says they ask FERC, and FERC certified NERC, if there's a violation for the standards—because each standard has, let's say, 10 or 20 requirements—because for the PRC, you have number one, number two—. There are lots of requirements. Congress gives authority to FERC and NERC—for each violation of not just one standard, each violation of each requirement—Congress gave FERC and NERC authority to fine the utility company $1,000,000 per day for each requirement violation. That would be the attitude!

Jess Slater (00:26:35):

I'm curious. If you were having relationships with these industries, do—what were the conversations that were going on? Were people upset or were like—I'm curious—.

Jessica Bian (00:26:45):

Think about your CEO of the utility company. Would you be upset?

Jess Slater (00:26:49):

Oh, of course. Absolutely.

Jessica Bian (00:26:50):

But here's the—because like you mentioned, starting in '65, we had all these big outages. Congress, fed up, says, "Well, you guys just cannot self-discipline." And because First Energy was the one that actually started, and then AEP—they had lots of misoperations. Some of the companies did not cut the trees. Some of the operators didn't know how to react when the event happened. There were so many loopholes that when FERC, actually, and NERC did a joint report on the event analysis, they found so many holes that the company, they were not doing the job right. At the time, there were the best practices that NERC published and they do exchange. But it's still voluntary.

Jessica Bian (00:27:38):

If I don't have to do it, I don't have to do it. So, normally some companies they do it vigorously. Like a lot of Canadian companies, they just follow, even though it's voluntary. But the Canadian Energy Board required these of the Canadian companies. But a lot of companies, they don't. Like First Energy at the time, they just ignored the tree cutting and all that. Another story that you probably want to know, the energy infrastructure is local, and it is political as well. So, when 2003 came out, of course, Congress stepped in, said we want to do these reliability standards. The folks lobbied Congress. At the time we had, I think, eight Regional Entities, like MPCC—you probably heard of WECC—and so, they actually collect the fees from all the utility companies based on load ratio.

Jessica Bian (00:28:40):

Let's say, I'm Seattle City and Light. I have maybe 1 percent, let's say 1 percent of load. Then I pay a 1 percent fee to WECC. This is how the WECC is. And then NERC gets the money from these eight Regional Entities. NERC actually relies on Regional Entities to survive. Money actually moves things. That's how—when the 2003 blackout—Congress came up with this bill, and Congress wanted to say, "Oh, NERC actually is going to get the money," or "FERC is going to get the money and do the standards." But eventually, when the bill comes out, after all the lobbying, negotiation, and the CEOs, of course, and the lobbyists, they said, "Okay, we are going to have industry support this initiative." That's why, Dan's question is: how do you do that?

Jessica Bian (00:29:35):

Actually, it's still a committee from industry. They came up with a standards draft, and then then they voted. It's still an industry-driven process. It's not like independent regulator standards. From that point of view, some call NERC a quasi-regulatory or self-regulatory body, instead of a, just like a true regulator, like FERC. It is part of the, kind of—after negotiation between industry and Congress, this is the model we set up: NERC is a self-regulatory organization. We have about, I think, 200, right now, employees all funded through the industry, not through the taxpayer, like federal government.

Jess Slater (00:30:32):

Thank you.

Jessica Bian (00:30:32):

Does that help?

Jess Slater (00:30:33):

Yes. Thank you. Dan, do you have any questions?

Daniel Molzahn (00:30:37):

Well, maybe a quick follow up on that is, so, I'm just curious, what kind of, what were the types of people that are in the room? Are they engineers or they're lawyers? Are they economists or some of all of the above. Was it mostly technical decisions being—engineers talking to engineers? Or were there more translation across broader backgrounds that had to be happening?

Jessica Bian (00:30:59):

It depends. For instance, if it's planning standards, do we need to build more transmission lines? Those are the transmission, like utility transmission planning department managers or directors. Because They've done the work. They know the tools. They know if they change certain standards, what that will cost on that particular company. It's not like entry-level engineers. But they have a strong engineering background and they've done it. They know the cost impact. We don't have economists and there's no lawyers in the room either.

Daniel Molzahn (00:31:34):

Got it. Okay. That makes sense. Thanks.

Jessica Bian (00:31:35):

The SMEs or principal engineers or the managers.

Julie Cohn (00:31:43):

Historically, the industry was self-regulated in terms of reliability, like all the way back to the very, very beginning.

Jessica Bian (00:31:51):

That's right.

Julie Cohn (00:31:52):

And I'm curious about whether or not the efficacy of that changed because of disaggregation of the industry. Did the fact that regulated monopolies were required to sell off their generating companies in certain areas, for example, reduce the sense of responsibility across the industry for things like maintaining rights-of-way and that sort of thing?

Jessica Bian (00:32:22):

I would say, maybe there's a certain—but I don't think that's the main cause. Because if you think we have a—like I said, we had lots of policies, rules in the past, but those are voluntary. Right?

Julie Cohn (00:32:41):

Right.

Jessica Bian (00:32:41):

And the reason we had deregulation is because we want to have market competition, so, we can lower the cost to the consumers. And if, ideally, if we have the standards right, either voluntary or mandatory, everybody follows, we shouldn't have these, these issues at all. I don't think deregulation is—of course when we kind of deregulate it, they kind of protect their self-interest. There's more coordination needed to come up. And more talk, and more enforcement on how we coordinate, like, the data submission? And how do you follow dispatch signals? And—but we have the markets. We set up the—FERC set up the six wholesale markets in the country. That's the kind of, the tool to overcome the deregulation, the disadvantage that was brought by deregulation. Right?

Jess Slater (00:33:39):

You mentioned Congress giving authority and also this being a political issue. I'm curious, during this time, what role did the public perception play in the development or acceptance of these changes?

Jessica Bian (00:33:52):

Public. After the 2003 blackout, like New York City, everybody was like—some of them stuck in the elevator; it was for days—so there was—the public was kind of fed up. They talked to their congressmen, to congresswomen. Eventually Congress had no choice but to do something. But through the negotiation, like I said, they came up with a self-regulatory body concept. And this is what NERC is today. Otherwise, without that particular, the worst event, we wouldn't be here today. Sometimes it takes worst things to happen before it gets better. Right.

Jess Slater (00:34:32):

Thank you.

Jessica Bian (00:34:33):

Yeah, sure.

Sairaj Dhople (00:34:34):

Jessica, how different was your role at these regulatory agencies compared to what you did with the system operators? Can you take us to your time there?

Jessica Bian (00:34:42):

Yeah, sure. Right. So, when I was in the control room, like PJM, I was the—so speaking of deregulation, I joined ERCOT in 1997, right after deregulation. They wanted to do the ATC calculation—available transfer capability—because when they opened up the transmission line and said okay, what's my—what room is being left. If I want to sell my energy, electrons, carried to transmission, I have to know how much I can, I can sell—how many megawatts. My job when I was hired was to calculate ATC. And so, I supported the system operators, and if there was emergency outages, and we tried to find a way to kind of divert, to try to avoid congestion, and keep the lights up—that was my job.

Jessica Bian (00:35:31):

When I moved to the PJM, my work was more—work with the market side, make sure that the system operator has a solution, that uses the market solution, uses all the bids, to resolve all the reliability issues. I was a project manager for the dispatcher training program, with the market tool and plus the network, which is reliability. Like state estimators and reliability, stability analysis, transient and voltage and all that. And these are the two parallel systems: the market side, they do locational marginal calculation; and here we do load flow, state estimator. Somewhere they have to converge together in order to send a price signal every five minutes to the market. I'm in that middle. I try to bring the market tools and reliability tools together and help dispatch to run on a five-minute basis.

Sairaj Dhople (00:36:35):

Knowing what you know about the ongoing transitions of the grid, do you feel like these operations can persist in the way that they have? And what needs to maybe change going into the future with massively distributed generation?

Jessica Bian (00:36:51):

Yeah. I'm very cur—my curiosity is very high. You can tell I moved around. The way that I see it, it will change over time. But this industry has been with us 140 years. It won't be overnight. It will take some

time to change, including the grid-forming and others. And plus, this industry is a capital-intensive industry, heavily regulated. That's why—not like AI. You can have a startup company and do it quickly and get some investors. But this—every transmission line or generator, it takes millions, multimillion dollars to build. If I want to build the line from—let's say, I want to get more clean energy from Quebec Hydro all the way to New York City, it's over a billion-dollar investment. And no government will pay for that.

Jessica Bian (00:37:44):

Maybe China, India, they will do that. But not here. It's all through private investment. That's why change will be, will not be quick. You probably know that the utility business model is they only get 10 percent return based on these transmission investments or distribution investments. You have the DERs. You want to connect, you have grid-forming, and the utility company gets zero profit on that. If you are the CEO of the company, would you be willing to take the risk? Mess up my normal operation? You'd probably say no. If your investor said, "I'm willing to get Seattle, City of Seattle, or PG&E, to do the transmission build, I can solve the same problem. But it costs more." Right? And the regulator will guarantee, California PUC will guarantee, they get 10 percent return, by getting that investment. But if they install a hundred megawatts DER into the system, they get zero profit. if you were in the CEO world, what's your priority? You want to get the line built, because you get the return. You're going to help the shareholders. You look at your books, what's your KPI?

Jessica Bian (00:39:08):

So, new technology to a CEO, it's a hassle, because there's nothing. They are regulated—get zero. Unless you are passionate about the new technology, climate change—you welcome. But you still have to hire. You have to purchase the DERM. You have to upgrade your system. You have to get new engineers to come in, to learn things, train new operators. But that's all O&M costs. And the profit you get is nothing.

Julie Cohn (00:39:40):

Do you see it then as a regulatory problem to facilitate the transition that's underway?

Jessica Bian (00:39:50):

Yes. but it will take some time. If you look at the regulator's mission, they're non-discriminatory to all technologies versus—. There's a traditional solution—T and D—you build lines. And there's a new

technology, but new technology is always, always very costly. Their principle—they're regulators; they cannot—they have to be fair, just. They have to say okay, yeah, if you bring grid-forming, if your cost is the same or less, and keeps the same reliability, yeah, I'm going to get your case approved so you can do the grid-forming. But if your cost is more than the—my traditional solution, we cannot do that. Otherwise, they get a lawsuit.

Julie Cohn (00:40:36):

What I'm—I should have said, legislative problem. In other words, one could speed up Mm-Hmm, <affirmative> the transition through legislation?

Jessica Bian (00:40:46):

Right. They can do that, but they will get lawsuits as well, because the traditional fossil industry, they're going to say, "Oh, you cannot do that." Right? "You're discriminatory toward my industry." It's the same. If you look at Order 1920, that just came out in May, you see the battle between the green—we call it the green industry—and the traditional industry. Two Democratic commissioners voted yes, and the Republican voted no. And he wrote a dissent. You can read that. It's public on the website. He said, "this is discriminatory to the traditional industry and favors the green energy industry." Same thing if you go to the Congress, they get the same lawsuit. The lawsuit actually is already powered up for 1920.

Julie Cohn (00:41:34):

Can you take us back a little bit again to your—the period when you were working more directly as an engineer, and how the problems you worked on as an engineer translated into the work you did with the operators and regulators?

Jessica Bian (00:41:49):

Oh, sure. I think there's one portion—you said, "what's the difference between the regulator and NERC?" The NERC has—. At FERC, the regulatory body, the engineers, are only less than 10 percent of the workforce there. Our [NERC's] role is to make sure when an order comes out, it follows engineering principles, like Kirkchhoff's law. It's just as simple as that. Of course, if we see there are reliability issues, we will bring—but at the time, the process is: we have lawyers, economists, and they come in and they are the author. They have the pen, they write the orders. And then we may make sure that everything they publish goes out and follows engineering rules. That's the difference.

Jessica Bian (00:42:38):

We are not like the driving force, like in the control room. We are more like: providing a supporting role for each order. That ties to your question: the difference. What I do is: we look at each operator's profile, and based on their experience, when each operator joins us, we have the rotation program. Then we put them into the training simulator and say, "okay, I have this particular scenario. Three lines tripped, because of a storm, and then these other—then you can see the reaction from the simulators." And we would kind of monitor him or her, how to react to these situations, if he remembers all the procedures and it's—and how to use the different tools, and how to connect and communicate with the generators, and transmission system operators, and the utility company.

Jessica Bian (00:43:37):

Those are the training—. Throughout my career, I actually started with writing procedures: make sure the operator follows them. And more communication. More: make sure the tool works for them, and make it more efficient, easy to use. And eventually move into the management role, which is to try to provide a better learning environment for them, improve the retention, and get to know them. It was more on the people management. That's kind of my impact.

Sairaj Dhople (00:44:19):

Was your activity with the IEEE ongoing during this whole career journey that you had? Or was that a more recent—

Jessica Bian (00:44:29):

Ongoing, but more on the technical side. Not on the governance side. I was a student member. Well, right, a graduate student. The professor said, "well, go attend GM, publish papers, you need to present." That's how I got started. And when I was at Westinghouse, my first job was to publish, and because we have the new patents— it's like your grid-forming. We had EPRI, a demo project on the FACTS technology, so, we worked with EPRI, schools, and GE on the PSLF and PSEC and tried to get the models—like what you guys are doing exactly—so that the planners can use those models and find applications. That was my main role. And then I attended every GM. I go to the working groups, like FACTS working groups and others.

Jessica Bian (00:45:23):

And then by the time—2012—PES started the Women in Power Committee, I was one of the founding members of the committee. So, I remember that was in San Diego, just like this. We had a Women in Power first reception, on a Wednesday night. Three of us showed up: Wanda, myself, and Shay. That was like the founding. We were there and we had a different table. I represented FERC/NERC and there was industry, and there was one table—school. That covers the whole thing. We were trying to get more ladies, or more diverse workforce. That's how we started. Two years after that, at the time, Noel Schulz, she was the president. And by the time—2014—she became a past president. 2012 she was president, in 2014, she became past president.

Jessica Bian (00:46:23):

The past president has this responsibility to put a ballot together for the next two years' officers, including PES Secretary, PES Treasurer, and President-elect. Mostly in the past they were all males on the ballot, six candidates: two for each position. She said, "Well, we have the Women in Power. Let's get some candidates from the Women in Power committee. I got drafted and said—so she sent me an email, said, "do you want to run for the PES Secretary?" I didn't know what was that about, because I was more on the technical side. Well, the committee said, "You ought to go for it." My name was there, and I remember my competitor was Henry Louis.

Jessica Bian (00:47:14):

He was the VP of Membership and Image. I said, okay, I just put my name there. I know I'm going to lose. That's guaranteed, because I'm never on the membership side; I'm always on the technical side. And there's an unwritten rule in PES, or even IEEE, is if you have two candidates, one is a lady, another is gentleman. Normally most of the time, the lady will win. That's what happened to me that year. It's like, oh, we need more female engineers. And that's—I was just like, no brainer, everybody; I was surprised when I got the news. I started serving as a PES Secretary from 2017. It's a two-year term, '16, '17, '18, '19. The board has this bylaw that says if they feel that—because it takes a lot of learning—if they feel they've done good job for the prior term, they can continue.

Jessica Bian (00:48:06):

So, they asked me to continue a second term. I served as PES Secretary for four years from 2016 to 2019. '19. So, I got to know all the members. As Secretary, you know that—if they are late, their report, you send them a text, you become a pest that says, "oh, well?" You kind of organize, right? For this kind

of meeting, you make sure that you have an agenda, you make sure you get all the reports, you get to know the personalities, you become friends with them. I got to know all the board members. That was great experience.

Sairaj Dhople (00:48:40):

Jessica, what was the first General Meeting you attended, and how different has it been?

Jessica Bian (00:48:44):

Oh, General Meeting. That was, I think it was a winter meeting in New York City. It was, I would say 1990. Yeah, at the time we have summer and winter.

Julie Cohn (00:48:56):

Dan probably has another question at this point.

[REMOVED FROM THE TRANSCRIPT]

Daniel Molzahn (00:49:16):

Yeah, I was curious. You've kind of transitioned, stepping back a few minutes in the conversation, you've transitioned between a lot of fairly different organizations, and you've talked a bit about what it was like to work at each of them. I'm curious what the transition between them was like. You're working at NERC and then, or you go to FERC and like how, it seems like your mind shift or mindset has to shift. How does that work and what was that like in your career?

Jessica Bian (00:49:45):

Well, that's—so I actually thought about that as well. Being—I would say from technical side, once you get an advanced degree, technically you don't have to shift a lot. It's like, I can go to a grid-forming meeting, or I can go to another reliability meeting, because the fundamentals are the same. And it's just the culture; I kind of have to adjust to the culture. The focus, get to know my group and team and everyone—that takes some time to get to know. I have to kind of get to know how to—so what I learned a lot is: how to be a—how to get to know people, how to work with them better, more efficiently; so, that's the transition. But technically, once you get a PhD degree, you can go anywhere. That's my model. You agree?

Sairaj Dhople (00:50:36):

Yeah.

Jessica Bian (00:50:36):

It's like, okay, yeah, I can do any technical work. I can walk into any technical committee. I can read the book. I can, I can spend more time. It's a self-learning, but the people side, it's not. Because the personality, the culture, the background, the history of the company, they're all different. I got to learn a lot of those.

Jess Slater (00:50:58):

Do you have an example of like a lesson learned during that time that you can almost give as advice to students today?

Jessica Bian (00:51:06):

Students, yes. It is pretty much like what Dan says. They always wanted to dive into the—so I would say, yeah, get a PhD degree. If you think right, your curiosity, once you get to that level, and it's very easy. You learn all the new things. I am pretty sure if I pick up a book on AI, I can get to know it, right? In a general sense what that—because you kind of know the thinking, the critical thinking of the science, engineering, it's—you can do that. But the people side—so that's why I kind of like this IEEE environment. And NERC is the same. Because we have lots of stakeholders. You have committees, you work with people all over the world, and you get to know them. And if you walk into the company, it's just one set of people. It's 10 people in your team you work with. It's good, but it doesn't give you that worldwide perspective. And you cannot do a lot of great projects with every aspect. That I think is what IEEE and the big organizations can bring, the international organizations.

Jessica Bian (00:52:23):

Does that help? Does that help the lesson learned? I would say, "join IEEE and get—." And I also, I asked my daughter the same thing. You get to know people, you get more neurons in your brain. It's a science. If you do that, you know you can do more things and be happy.

Jess Slater (00:52:48):

Thank you so much.

Jessica Bian (00:52:50):

Sure.

Julie Cohn (00:52:50):

What do you see as the biggest challenges ahead for the industry and for the parts of the industry in which you've worked?

Jessica Bian (00:52:59):

To industry: I think grid-forming, that will be an example. We have to get everyone coming in—and the fast way is to change the regulatory framework. But, like I said earlier, energy is very political, so it's not that easy either. Always I'm optimistic with the next generation, like our young professors here, like Danny. Together, we can make it faster and make a difference. But just one technology sector or engineer will not make that happen. We have to work with the regulators, economists, and everybody together. And then lower the cost, because in the regulator's mind—if you lower the cost, it can make it happen. And so, if you talk to the regulator, they actually want to do it even faster than engineers. But they are bound by the political framework. And there's certain things Congress allowed them to do. Some of them, they cannot do it. And they are also based on votes. They know even if they want to move fast, they cannot do it. It takes a lot. But I know that with more young-generation students, and I think with more large-scale new technology coming into the grid, it will happen. But it won't be overnight.

Sairaj Dhople (00:54:24):

Jessica, I sense a sense of passion and mission and everything that you've talked about long storied career. Can you take us back to where this curiosity maybe came for electrical engineering? How it translated to wanting to give back? Anything you can share from your experiences?

Jessica Bian (00:54:44):

Yeah, I would probably trace back to my parents. My father was an engineer, but he was very curious about other things. And I actually asked him, I said, "If you want to live," after his retirement, I say, "if you wanted to live all over again, what would you do? Would you still be back to this, become an

engineer?" He said, "I would be a writer." He always read a lot. I—that—yeah, I have a lot of interests, not just in industry, like—I like the brain science, the neurons, to see what makes us change. Why people think this way and why other people think the other way, why they are different, even though we are from the same industry with the same education, why they talk differently, opinions different. I have that kind of curiosity. I would say, it's part of my gene, DNA.

Sairaj Dhople (00:55:33):

And what about the service aspect? Because you've contributed tremendously to PES and to IEEE.

Jessica Bian (00:55:40):

Oh, yeah, I would give a credit to my mom. She was just going to volunteer everywhere. Yes. I kind of followed her.

Julie Cohn (00:55:48):

And why electrical engineering and power systems in particular?

Jessica Bian (00:55:52):

They were electrical engineers.

Julie Cohn (00:55:54):

Oh, they were both electrical engineers? Both of them?

Jessica Bian (00:55:56):

Right, right. Yes.

Julie Cohn (00:55:57):

Oh, interesting. Okay. Where did they work?

Jessica Bian (00:55:59):

They actually there's a province in China, like 200—west of Beijing. It's like our Tennessee or West Virginia. Lots of coal mines. They—that was back late fifties—after they graduated, got their degrees,

they went to that particular province. And it's called Shanxi Province. They start to build power plants. My mom was a dispatcher in the control room. I would just sneak into—she would just bring me over the weekend. There's a shift. It's a shift work. I would just go and that's how I—part of my—

Julie Cohn (00:56:46):

What—when you were in the control room, what did you pay attention to?

Jessica Bian (00:56:50):

Well, lights. Well, see—and they would make phone calls. And at the time there was a rolling blackout. Because at the time they just didn't have enough electricity. My mom was on the call, “you have to go off because I need to—two hours, you're done. I'm going to shift electricity, to other, other customers.” That kind of discussion always.

Julie Cohn (00:57:09):

Was that pretty normal for the customers?

Jessica Bian (00:57:11):

Yeah. Very normal back then. Very normal. Because they just got used to it. We just don't have, we don't have enough to cover everyone at the same time.

Julie Cohn (00:57:19):

Did your parents have comments on the major US blackouts that you witnessed?

Jessica Bian (00:57:25):

Comments? They probably don't. At the time they were probably already retired. They don't know the English language, either. But I heard a lot of folks—if I go visit them right now, will say, "why the US have so many blackouts?" Because we're different—very. China, I know they have different planning criteria. We have a minus one. They have a different—and plus here is more investor-owned and there it's government-owned. It's very different. The money they get is from the country. Here we get it from private investors. It's a very different business model.

Julie Cohn (00:58:09):

I had a, oh, go ahead. Oh,

Jess Slater (00:58:11):

I was going to ask on a similar note because I was thinking the same thing. Did your parents influence your work or the way that you approached it or just seeing a different system completely internationally, like in China? Did it have an influence on your work?

Jessica Bian (00:58:25):

I think the environment they worked in, I was very familiar. I'm comfortable with it. Right? It's like if you have a doctor parents, and I go to the surgery room; I go to the hospital, I will be kind of used to it; otherwise, I would be scared. I think the environment—and they also encouraged me. They feel it's a good cause to get a degree, so, I just followed their advice and got a degree in that.

Jess Slater (00:58:56):

Thank you.

Jessica Bian (00:58:57):

But I think overall, I'm very curious in many senses, especially ask a lot why we are all different. that could take me to many different places.

Julie Cohn (00:59:08):

Dan?

Daniel Molzahn (00:59:10):

Well, one question I had—maybe going back a couple minutes in the conversation—was you had talked about kind of the other fields you're just very curious about. Other non-engineering topics. And we had asked this to a couple other interviewees about: if there was another field outside of kind of the obvious ones, like power electronics, or things that are sort of already having impact in, or computing, in this space. Are there other fields that you think will have an impact on our industry, or are having an impact on our industry, and it's maybe not so obvious what that—what those impacts are?

Jessica Bian (00:59:50):

Yeah. I would say the data for sure. And AI. Right now, I'm serving—I'm not a PES president anymore, but I am a volunteer as a chair of IEEE Industry Engagement Committee. Through that I got to know a lot of AI experts from Microsoft, Amazon, and all that. We're trying to provide the benefits, or help industry to use the—all the technologies we have. And for instance, I'm working on an AI project to try to increase student retention and attract more, a next generation to the IEEE, or to electrical engineering. The way we do it is to help, because we have a workforce shortage issue from industry. So, we bring industry, the big companies like Boeing, Airbus, and they have openings.

Jessica Bian (01:00:50):

Then we connect with the students, using AI tools. I think that would help. If we do a survey for industry executives in the utility company, number one is workforce shortage. Because there's fierce competition out there. If I ask this school of engineering dean why you cannot have more engineering students, they will tell me 75 percent of students, of the high school students in North America, Europe as well, they will go to biology, professional—or like pre-med and pre-law. And also, econ, financial degree. Because they don't have to study physics; there's no electromagnetic course they have to take. Those are hard courses. Most of the students, they think they can make money, equally, or more money. And they will just take those—. 75 percent of high school students—.

Jessica Bian (01:01:49):

The rest, 25, they go to STEM. And then our electrical, our industry has to compete with AI, the entire IT industry, and others. It's very hard for us to get electrical power engineers. I'm trying to use this particular tool to help us and to compete. Plus, we're heavily regulated. We're not paying. If you get a computer science degree or computer engineering degree, go to Microsoft, you get $100K, first year. For our industry, $75K. If your students—which— you want to go to computer engineering, right? And it's fancy, it's sexy, it's AI. But here's a 140-year-old, clunky infrastructure business. Who cares? So, there's that. We have to make it relevant. Getting to climate change and sustainability, all that. And there—yeah, if we get this into the awareness, into their education, they will come. That's part of the process.

Julie Cohn (01:02:54):

Do you think there's a special challenge in attracting smart women into this field?

Jessica Bian (01:02:59):

Yes, that too.

Julie Cohn (01:03:00):

And minorities too.

Jessica Bian (01:03:01):

Right, right. We, if you look at our PES numbers, we used to have: overall 15 percent female members, PES, right? We have about 43,000 members. Out of that, averaged 15. But if you look at student members, 30 percent female.

Julie Cohn (01:03:21):

Oh.

Jessica Bian (01:03:21):

Yeah. I'm very optimistic. We can have more.

Julie Cohn (01:03:24):

That, that's a big change.

Jessica Bian (01:03:26):

It is, It's just recent, the last year. I saw the numbers: 30 percent female students.

Julie Cohn (01:03:32):

Do you think it's the focus on a green future that has increased student interest in this field?

Jessica Bian (01:03:37):

Correct. Yes.

Julie Cohn (01:03:43):

Well, I think that's a leads us to a final question that Sairaj sometimes answers—I mean, asks; someday you'll answer.

Sairaj Dhople (01:03:53):

Yes.

Julie Cohn (01:03:54):

For these interviews. And then you'll be able to get to your next appointment.

Sairaj Dhople (01:03:57):

It's maybe an easy one, Jessica, and one you've heard many times before. Do you have any words of advice for future generations of power engineers who will listen to this?

Jessica Bian (01:04:06):

Yeah, sure. I like what—there's a professor in Stanford, he has a lab called Life Design Lab. For the future, like I said, if I'm thinking: my career, I'm very curious, and a lot of students—because climate change is really, is multi-disciplinary. If you feel that you're itchy, you want to do something; you want to—. Because when I started, I felt my—I have lots of papers, patents, and—but it's not widely used. The FACTS technology was never widely used. It's very expensive. That leads me to all these career paths. Now I know the answer. Why? I don't have any complaints. I know this is exactly what would happen. I would tell the students that, "Yeah, just follow your path.

Jessica Bian (01:04:54):

If you've hit the wall and you try to, you can find a solution. Maybe you can find a job and change a department and just follow your passion and just see. Eventually it's a self-discovery journey. And so, find something that you like, so you'll be happy forever. It's not work anymore. That's—that would be my—so this Stanford professor wrote a book on that. It's—you try a couple of years in every thing that you like, if you don't like it, move on to the next thing you like. Eventually after three tries, most people will find something they like and will stay there.

Jess Slater (01:05:34):

Can I ask just one more question on that note? By any chance? You mentioned something about how a lot of people may not go into electrical engineering versus some other institutes or some different departments. And so, I'm wondering what can electrical engineering departments do to make their programs more appealing or to help their students so that they're able to do better within the industry or doing research?

Jessica Bian (01:05:59):

Yeah, it's a fascinating question. it takes a lot to change. First of all, like I said, this industry is heavily regulated. Let's say, they want to pay a $100K for entry-level engineer, probably the PUC said, no, you cannot do that. Right? That's the first hurdle. Another one is, because, think about a utility, they're still a monopoly in the local area. You cannot—well, even though they open up for the resources for the energy—electrons. But for their territory, they're still the boss. I want to build this line. They're still kind of owner of monopoly for this area. The cultures within those companies are not like IT companies. They know it's a guaranteed 10 percent return. There's not like fierce competition or talent search within those companies. And if you go to IT companies, right, whoever's going to write the best code will be get promoted and paid a big bonus. But there in a utility company, there's no such culture. Those all need to change.

Jess Slater (01:07:07):

Thank you so much. Okay.

Julie Cohn (01:07:09):

Thank you very much for spending this time with us.

[End of Interview]