Algorithms & Power Systems Architecture:

Using Historical Analysis to Envision a Sustainable Future

Oral History Project

Interviewee: Robert (Bob) Dent

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***Abstract*:**

Robert Dent, Past President of the IEEE Society on Social Implications of Technology and of the IEEE Power and Energy Society discusses his educational background professional experiences in power systems. He begins by describing his educational experiences, including witnessing the 1965 Northeast Blackout from New Jersey while he was at Stevens Institute. He talks about the effort of utilities to institute automatic load shedding after that blackout. He discusses his work for United Illuminating Company, including designing a system separation scheme that allowed the utility service area to operate as an electrical island. He worked on relay protection schemes. He reflects on work at Gibbs & Hill, and the challenge of developing transmission lines in railroad rights-of-way. He discusses work on multiple nuclear power plants while at the Power Authority of the State of New York. He describes the resolution of a lawsuit between Con Edison and the Fisherman's Association addressing overheating of water at the Indian Point 3 nuclear plant, and the use of adjustable speed drives to achieve

advantageous thermal conditions in the circulating water system. He discusses the Power Authority's later turn to conservation initiatives focused on customer use of their own emergency generating facilities to mitigate peak loads. Mr. Dent discusses moving from static facility ratings to dynamic facility ratings. He offers an anecdote about the Three Mile Island nuclear plant failure. He offers a critique of the practice of developing specialized nuclear plant designs for each new facility, rather than adopting a single design. He describes the diversity in his own education, including computer science, and encourages students to look for breadth in their training. He reflects on the Power Authority's decision to stop building 745 KV transmission lines. He discusses the advantages of a career in industry over academia. He talks about the IEEE PES scholarships that encourage students to focus on power systems engineering. He offers some history of IEEE and the Power and Energy Society. He closes with a reflection on the past transition from electromechanical relays to electronic relays, and the transition from analog network analysis to digital analysis.

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 (00:00:22):

This is Julie Cohn. I'm conducting an interview with Bob Dent on July 23rd, 2024, at the Seattle Convention Center in Seattle, Washington. Jess Slater and Babak Taheri will be joining me in the interview and may ask questions as will Daniel Molzahn, who has joined us via Zoom. Bob, during today's interview, we're especially interested in your early work in power systems, but we will also be interested in understanding how your work carried forward into standardized industry approaches. And we're also interested in your participation in the IEEE organization and the PES, the Power and Energy Society within IEEE. But, before we go into that, I'd like to ask you some introductory questions and learn a little bit about your background. So, if you would please describe your educational background and your professional positions in the power industry.

Robert Dent (00:01:25):

Well, I graduated from Stevens Institute of Technology and received a bachelor's degree in engineering. And then a while later I took some time off, but I went back to Pratt Institute and got a master's degree in computer science. I was always interested in computer science. And when I started at Stevens computers were actually at the beginning of their time. By the time I went 10 years later and got my master's degree, there was a fully developed computer industry by that time. I liked going to school, so I then changed over to Polytechnic Institute of New York and went and got a master's degree of electrical engineering, an MSEE. Liked that so much. I stayed there and then went for a master's degree in management. And really liked that an awful lot. And I did some post-master's degree work towards a doctorate at Rutgers and also at Pace University. I got to the point where I think academics call it ABD, which is all-but-dissertation. So that's my educational background. The one thing that I—Stevens—I probably took more mechanical engineering credits than electrical and probably just as many chemical and structural and industrial, because getting a general engineering education, they wanted to make sure you were prepared for looking at problems from all different angles, which really helped when I took the engineer-in-training exam, or, which could—now called, I believe, the intern engineer exam, which is the first half of the exam to become a professional engineer.

Jess Slater (00:03:02):

I have a question. So, I noticed that the Northeast Blackout of 1965 occurred during your bachelor's. What were the conversations that were going on during that time?

Robert Dent (00:03:13):

Yeah, I made a note of the fact that. Yes, I graduated in 1966. So, November 9th, 1965, was when the blackout occurred. And I remember I was in a fraternity and myself and three other fellas went down out for dinner, we had dinner, and we walked out from the place. It was down by the Lackawanna train station, and had to walk back onto the Stevens campus, and we all looked across into Manhattan and said, Manhattan is totally dark. It was a phenomenon you'd never really expect to see. The only lights you could see were the strings of lights that were on the ocean liners that had their own generation. So, they weren't affected. And New Jersey wasn't affected either, because from what I understand, the man who was manning the station where there was a connection between Con Ed and Public Service, he saw almost an overloaded transformer bringing in the power to New Jersey and he cut it off.

Jess Slater (00:04:10):

Did you notice within—when you went to your classrooms, and were talking with your professors, was there a shift after the occurrence had happened?

Robert Dent (00:04:20):

I would not say so. I do remember though, walking back and turning on the TV—there was no TV because all the transmitters for TV were based in New York City in Manhattan—so I had to turn on WPAT, which is a Paterson New Jersey station that usually played what I would call soft kind of music, and that's when we found out that there had been an outage that had occurred there. Funny thing in the investigation, I assume afterwards they found out that it was actually the tripping of the cross-state 345 KV lines. And at Stevens, they took us on what was called the senior trip. And the senior trip was supposed to get us out from the collegiate environment for at least a week, and we would go visit different companies. And I remember we went to Union Carbide where they were making these things called little micro-balls that were little Styrofoam balls that were used for packing to make sure that equipment that was shipped wouldn't get harmed.

(00:05:21):

We also stopped at a steel mill, and we stopped at the Power Authority of the State of New York too. And those were the lines from Niagara, that basically started the whole thing, the whole cascading, tripping of the system. And of course, the system responds when it's got too much load for the amount of generation. It starts out with a degradation of the frequency. So, one of the things that happened is almost every utility said we better have load shedding. And the load shedding would be phase one, phase two, and phase three. Each phase would be 10% of the load. So, you are always trying to get the generation to be matched to the amount of load that was being—demanding for it. But what happens is it spread from Western New York to Central New York to New York, and I think it went somewhat into Canada and but, it stopped for New Jersey.

(00:06:18):

It didn't happen. There wasn't really a lot of talk because I think more people were thinking mechanical engineering at that time than they were really electrical engineering. And of course, in the first few days, nobody knew really what happened also. So, they had to really investigate what happened. But that also was the impetus for founding of NERC, the North American Electric Reliability Council, which was really very good. In fact, the New York State had a coordinating authority that the man who was in charge of the Relay Division had to go there and submit his settings. So, his settings were appropriate and protective of the equipment, because—what I understand is—the lines that tripped off, they tripped off because the settings had never been modified. They were put in when the plant was originally built, the load built, and the settings never changed.

(00:07:15):

So, they tripped on what would be called normal load, as opposed to fault conditions as a result. So, but that was interesting. The other interesting thing is I saw the New York Power Authority, or the Power Authority of the State of New York. There was the blackout, and guess what happened in 1977? Who do I find a job with? The New York Power Authority? So I worked for the Power Authority from 1977 until 2002. So related though to the outlook and all that, my first job after college was at United Illuminating Company, which was in New Haven, Connecticut. And they were already implementing the load-shedding phases of the load reduction area. So, one of my first jobs, they said, well, UI was about a thousand megawatts load and about 1100 megawatts of generation. So, they knew that they could survive if they didn't get taken down with the system. So, they did phase one, two, and three of load shedding. And I was given the job of doing what they call "the system separation scheme." There was only three connections to Connecticut Light and Power, and the other utilities in that area. And if those three breakers were tripped, you'd then have an island. It wasn't very nice, maybe, for the other utilities in Connecticut, but as far as UI was concerned, it was a way of them surviving for their customers, because they had enough generation to supply those customers with.

Julie Cohn (00:08:50):

So, what was your job in addressing that?

Robert Dent (00:08:53):

Well, what happened is I got a job in the United Illuminating Relay Protection section. So, I was a kid. I needed on to job training, because when you get out with a bachelor's degree in engineering, when they first told me about the—"Oh, go down to English station and check out the bus, and I didn't know what a bus was, even, I thought it was a mode of transportation as opposed to a bunch of copper bars that would carry high currents in a, in a generating station. So, I did have a need for a lot of on-the-job training, which was—it was fine, and they were very patient. And so, they gave me things like, Go into this station and document every relay that's in the station.

(00:09:38):

So, of course, stations have a minimum excitation level on the generators. They have over-current protection on the feeders. They have all sorts of transformers have sudden pressure relays that would trip in case there's a lot of extra gas in the transformers, which means it's failing. So that gave me a lot of background. So, I started to remember the numbers and the names, like what's a 51 and what's a 52, which are the time overcurrent and the instantaneous overcurrent relays that are produced by either General Electric or Westinghouse or at the time from Boveri or ASEA or any of those. And so that was a very good, I guess, indoctrination into what was going happen, going to happen to me. I never got back into relay protection, though. I spent three years there. And then I went down to New York City.

(00:10:30):

A buddy of mine who was a fraternity brother had a two-bedroom apartment with a friend, and he lost that friend due to marriage. So, he needed another roommate to afford the apartment because it was right in 68th Street in Manhattan on the West Side. And he said, "Why don't you move down?" So, I said, "I'll move down." And I got a job then in 1969 at Gibbs & Hill, which is an engineering constructor consultant kind of organization. And in that role, I started out with doing analytical studies because the division I was in was called transportation and transmission. And so, the first job I got was in the transportation area. A utility wanted to overbuild on the railroad. So, the railroad was one of the alternatives that a utility could use to get through a right-of-way, which they might not be able to do in any other way.

(00:11:28):

But if a utility is building a 345 kV three-phase transmission line on a railroad right-of-way, the first thing that the railroad says, which is usually Penn Central, "How is it going to affect our electrical facilities?" Because there's electric fields that actually stop at the ground, and there are magnetic fields that even penetrate into the ground. So, I had to do the studies that would show that the signal power wires, the communication wires, the signal wires that were all embedded for the railroad, weren't going to be compromised and either deteriorating or giving them any false signals. So that was a very nice thing. Because what happens, especially with transformer action, which is the right-hand rule. One wire carries a current this way and induces a voltage in the other wire. And that's what can happen when you have a—especially a line to ground fault.

(00:12:25):

You get one current going one way, how does it affect all the other wires that are within the action that these magnetic fields can create? And then we would give some kind of recommendations for like surge protection or grounding at some time. So, you don't get a high voltage doing that. And then from there, I moved on into substation stuff, working on installation coordination, specification of breakers, specification of transformers, and all the equipment that might be in a switch yard or even in a, in a generating station. So, I stayed there until '77 when I joined the Power

Authority. And in the Power Authority, I started out as an engineer and moved up to a senior engineer, and then a supervisory engineer. Did some good work. When I was a supervisory engineer, we installed actually adjustable speed drives on one of the nuclear power plants on the circulating water system.

(00:13:28):

And we were required to do renovations on the plant, Indian Point 2 and 3, because of the Fishermen's Association that claimed there was too much fish kill going on in the Hudson. Because the plants were actually built in the circulating water system with single speed motors.

Julie Cohn (00:13:47):

Which plant was that?

Robert Dent (00:13:48):

Indian Point? Indian Point 2 and 3. So Indian Point 2 was owned by ConEd and Indian Point 3 was owned by the Power Authority. So, what would happen is if you, you, you either have the motor on or it's off, and they were 900-horsepower motors. And in the wintertime, bringing in the water from the Hudson River was cool. So that was really good to reduce the condensate in, in the temperatures as it went back into the boiler or exit into the reactor. But in the summertime, if you turned all six of those motors on, you were actually super cooling the condensate so that when it went back into the reactor, you had to unnecessarily then heat it up a little bit higher.

(00:14:34):

So the recommendation by the Fishermen's Association was to put in two-speed motors, and that's what ConEd did. But I looked at it and I said, "This is an excellent example where you could use adjustable speed drives." Because then instead of having one motor at 60%, one motor at a hundred percent, both at 60% or both at a hundred percent, if you needed a hundred percent, you put 'em all at a hundred percent, you needed 80%, you put 'em all at 80%, you needed 60%. And so, there was, I think, thermal advantages to it, because each one of the manifolds that got the water didn't have one, one flow of water at one level and another at a different level, made it more efficient. And I think it made it more reliable also, too. So, in fact, I wrote a transactions paper on that that got printed in 1994. The renovation I think took place in 1985, but myself and the lead mechanical engineer wrote a transactions paper on that.

Julie Cohn (00:15:29):

Was there a lawsuit involving the Fisherman's Association?

Robert Dent (00:15:33):

They might have started out with a lawsuit, and then they went to arbitration. And then the output of the arbitration was that the plants had to change their method of cooling the condensate by putting different motors into the—but the mechanical engineer looked at it and said, "We can really look at this, and we really need more horsepower." So, one of the problems I got hit with is he said, "instead of 900 horsepower, there should be six motors at 1,250 horsepower." That's quite a, 37%, as I remember, increasing the amount of horsepower. And so, I wanted to do anything I could in order to try to make it so there hadn't—there wouldn't be a—overall revamping of the entire plant just to account this new starting current. And so, if you put in induction motors, they have very low power factors and very high starting currents.

(00:16:26):

You put in a synchronous motor; they don't have as high starting currents. And if you make it adjustable speed drive with the power electronics, power electronics can control it. So, they have what they call soft start. So, it never maybe goes more than 10% above the normal running current. So, I knew the running current wouldn't be a challenge to the transformers or the bus work or the switch gear, but the starting currents on an induction motor would certainly cause a problem for the for those systems. So, we were able to do that by putting in the adjustable speed drives and not really affecting any other part of the plant at that time. I didn't follow up with what ConEd did as far as I—I don't think they increased the horsepower, so they just really just had a two-speed motor that they put in.

Julie Cohn (00:17:14):

Dan, did you have any questions you wanted to jump in with at this point?

Daniel Molzahn (00:17:19):

I guess one from a personal perspective, my dad worked at a nuclear power plant at Kewaunee in Wisconsin. And he would tell stories sort of like this about upgrades that they would do, not, not specifically for adjustable speed drives, but I'm just curious about your perspective as—was this common to be, sort of, installing relatively new technology, I suspect at the time, into these nuclear plants? Was that at all controversial? Or how was that seen, sort of, in the industry, to do that?

Robert Dent (00:17:55):

I would say the biggest pushback that I got was from the management of the nuclear plants and the management in the nuclear organization because they didn't really want to do much other than just change it out and get the plant back online. The one thing that was very good, on nuclear plants there's a Class 1E section, and then there are non-Class 1E sections. Class 1E is a lot of documentation and paperwork that has to follow every piece of equipment that goes through the plant. Well, luckily the circulating water system is not Class 1E, so that made it a lot simpler also, too I would say the installation, I never heard of any nuclear installation with adjustable-speed drives on before. There had been some in some other plants, especially industrial plants as well as fossil fuel plants there were some also too.

(00:18:50):

In fact, I had read several articles. Jim Oliver is one who I think wrote an awful lot on them also. But it was fought more by, I think the Power Authority powers-that-be than it did by anything in the industry. Fortunately, or unfortunately, Indian Point 2 and 3 are both now closed. And they were shut down because of, I guess, public support for shutting them down. Plus, they had reached the end of what they had predicted was their life. Usually it's a 40-year life. And the Power Authority installed Indian Point 3, actually finished the construction in about 1978, so 40 years later is 2018, I guess. And so, it closed-down as I remember in 2022, Indian Point 3.

Jess Slater (00:19:48):

I noticed that before you entered into the Power Authority, you saw a lot, like you talked about the Fisherman's Association and then we had like the Environmental Protection Agency being established, the Clean Air Act. How much was this conservationism movement affecting your work with the Power Authority?

Robert Dent (00:20:10):

I think it was maybe perpendicular to it. Energy conservation was really starting to get very, very important because there were a lot of people that said okay, we can conserve power or we can build more generating stations, wouldn't it be easier to conserve power? That sounds like an awfully really great idea. In fact, you just reminded me when you asked that, the Power Authority, and when I was in the last few years I was there, came out with a rate because they would, Power Authority was supposed to supply power to people of public benefit. So, like they provide power to the New York City subway system and all of the little towns in upstate New York that had a need for power. They might have been served by New York State Electric Gas or Niagara Mohawk, but they'd get power from the Power Authority at a better rate.

(00:21:05):

So, what the Power Authority eventually did though, especially in Manhattan, they said, we'll give you a specially low rate if, when we hit a peak—a lot of people are always concerned about peak shaving. So, they had customers, like hospitals have their own generation, they're called emergency backup generation. But suppose you want to cut down a peak, and you tell the hospital, turn on your emergency backup generation, so you'll save us a peak, because if you can't produce it yourself, you're going to have to buy it from somebody else. And it might be at a very high price too. So that was, I thought, an innovative way of trying to say instead of telling people to conserve or even build another power plant, to just ask them to put on their emergency gen, because they always say, there's base load, and that goes for seven days a week, 24 hours a day, 52 weeks a year. And then there's load that only—you only need that generation for a minute or maybe 10 minutes, and then this whole curve is dominated by that need for that power. So, this is what I thought was an innovative way of saving the need for any more generation.

Julie Cohn (00:22:17):

Oh, I would say, my next question has to do with sort of the span of your professional career. Did you focus on particular problems over that period? And was there any one technical challenge that really stands out as something that you had to address and found both interesting, difficult, satisfying—all of those things?

Robert Dent (00:22:49):

Yeah, well, after I was a supervisory engineer, I got promoted to be director of electrical engineering applications. And so that meant I did a lot of equipment, specification, and layout work, and all that. And the New York Power Authority was one that required that the drawings be sealed. So, in New York State, you had to have a New York State license, which I did have at the time. And then after about three or four years, I was then changed over to director of electrical system studies. That was somewhat of a very interesting change, but it was a very interesting thing. And I know I heard at the plenary session, they were talking once about static ratings versus dynamic ratings. And that's something that I think really helps out to run the grid in a much better way. Because when—in my job as the director, I had somebody who was doing what they called the facility ratings.

(00:23:44):

And the facility ratings would say, "Okay, you're at substation A, you want to go to substation B, you want the amount of power that flows through to be limited by the conductor. You don't want it to be limited by a disconnecting switch or a wave trap or a CT. So, you always made sure that all those auxiliary equipment things were at a certain level that the line was lower than that. But then we did static ratings. So, what does that mean? That means, well, sometimes it's cold out and sometimes it's warm out, so you gotta assume a certain temperature. Then you have some conductors that are very bright and they reflect sunlight, and some that are very dark and they absorb sunlight and have all these conditions to make sure that you never let the line fall lower than the National Electric Safety Code allows.

(00:24:41):

So you have to be conservative when you do that. And we used to give them full-time ratings and 15-minute ratings so that if you had an emergency and you did have to overload the conductor, you could do it for a specific amount of time and it would be in and a region that the conductor would then go back to its normal condition. So, you want it to be in the elastic range, I guess you would call it, as opposed to the plastic range of the conductor. But nowadays, what they're talking about, even in that plenary recession, they have CTs that monitor the exact current that's going through there. They have ways of knowing what the conductor temperature is so that the dynamic ratings more fully use the transmission system rather than having those all-static ratings, which were conservative, and you'd always make sure that your equipment was fine. But I can remember most times the equipment was being used at 60% of its capability, where with dynamic ratings you could get up into the 80 or 90% of its capability.

Julie Cohn (00:25:50):

What do you see as the risks and the benefits of using dynamic ratings?

Robert Dent (00:25:57):

Well, I think dynamic ratings could maybe give you a false sense of security. And if any one of these systems—as a relay engineer for the first three years of my career, they always used to say, “don't let the first contingency make the whole thing fall apart.” So that's why in relaying, especially in the Power Authority, they used to have a primary system, a secondary system, and a backup system. The primary system would be able to sense the fault and trip off the lines. The secondary system could do the same thing and just as fast, but it had to use a different technology. And then the backup system hopefully wouldn't be a third technology, but it would be well beyond, slower than the first one. But yeah, I think relying on systems like dynamic systems could have a burden that if anything fails, you have to go back maybe into a static system kind of control so that you don't—it reminds me of TMI, if you remember TMI, where the operator of a Three Mile Island saw a water level gauge that showed that there was not enough water to cover the containment.

(00:27:16):

And he even tapped on the gauge, because he didn't believe it. Unfortunately, the gauge was true, but he didn't believe it. And that was part of the accident that occurred; that he didn't believe what he was being told in it. The other thing that I thought was a very fascinating thing was, when you run a system, you have, you have a lot of different equipment. Some of it is capacitive, some of it is inductive or like transformers or inductive. So, some have plus jVARs and some have minus jVARs. And whenever you see an event that happens, you always kind of wonder, gee, that capacitor bank tripped out and the transformer tripped out, but which went first? So, you get a sequence-of-events recorder. So, the sequence-of-events recorder says this happened at this time. And at the other location you have a sequence-of-events recorder, and it tells you the time, but can you really trust it that much because somebody is setting that time in each location? They may be—it could be a matter of 15 cycles or even 10 cycles on a 60 hertz basis.

(00:28:30):

So what happened is in fact it was the relay guy who was really taking the lead. They went into a satellite. This was an, every project went into a satellite and the satellite had the same time. So, when the capacitor bank trip and the transformer trip, they both send data to the satellite. Then when you downloaded it, you could see which happened first: that the capacitor bank failed and caused the transformer trip, or did the transformer caused the trip of the capacitor bank. And I thought that was a pretty innovative way of using, I think, somewhat newer technology, and yet solving a problem that nobody ever knew, because in accident investigation, they needed to know.

Jess Slater (00:29:11):

Babak has a question that he wants to ask.

Babak Taheri (00:29:14):

Throughout these years, what technology was the most important, like, from your point of view? Like, like was a game changer in power systems?

Robert Dent (00:29:22):

I think one of the biggest things that's going to be coming around is going to be distributed generation. And it's because I don't want to see the responsible utilities have a problem. But I know in my own personal life, I have a backup generator from my house, and I have it because of storms. We lost power for six days at my house twice. And I said, "My wife and I are snowbirds". So, we go to Florida for three months. I don't want to have a hurricane come through, and suddenly the house doesn't have any power to circulate the hot water through the house, and I get frozen pipes. And I also wanted to make sure the basement gets pumped out, so the sump pump is working. And then I thought to myself, "It's also a good problem to solve for anybody that wants to hack into the system and do something mysterious and not so nice onto the power system."

(00:30:21):

And maybe it might not get into the distribution level, but I think it could, and I don't want it to affect my house. So that was my secondary, the security of knowing that I have a safe operation. But I think just distributed generation is going to become more important. In fact, the woman from Seattle Light mentioned that they were going to put in, to be environmentally friendly, they were going to put in nuclear power plants, but not of the type like Indian Point 3 that was 1100 megawatts. They were going to put them in the same kind of style that would be used in a nuclear reactor for a submarine. And therefore, you, you're not talking about mass effects that could obviously be detrimental to a local neighborhood. You're talking about—these have been perfected by the Navy and their propulsion systems for decades.

(00:31:14):

And the one thing I also would criticize the nuclear power industry about is there was Babcock and Wilcox, there was Combustion Engineering, there was Westinghouse, and there was GE, and they had, three of them were pressurized water reactors. And one of them was a boiling water reactor. And they all had different systems. They—there was no uniformity. It would be like if you bought a record years ago, you'd have to have three turntables because there were different standards as to how you could listen to the music as a result of it. And I think if they standardized it so that all the manufacturers had the same design—but they maybe improved them a little bit better, or they sold them for a little cheaper, or whatever—that would be a really vast improvement, because that's the way the Navy did it.

(00:32:02):

They said, "Here's our design, you bid on it." Otherwise, you'd have to, in the nuclear power industry—And the Power Authority, where I worked, they had one PWR. And then up on Lake Ontario, they had one BWR. Because we were the rescuer of kind that, when the New York State legislature saw Con Ed was going into some financial problems, they said, The Power Authority will buy Indian Point 3 from you. Oh, oh, Niagara Mohawk is having some problems, but the Power Authority will buy one of your BWRs also too, boiling water reactor, so it—we had one of each. And it's all—I always think to myself, wouldn't it be great if you had like 12 of each or 12 of one kind? Which is eventually what happened? The nuclear plant accumulators started to get 10 of each kind of generation, and then they could hire a crew that could be used.

(00:33:01):

Because almost all nuclear power plants had to have three-month outages for tweaking things back into line and making sure everything is renovated, making sure everything is working correctly. And so, the Power Authority used to hire, for three months, contractors to do it. They didn't want to hire permanent employees. Where if you have 10 nuclear plants, you could have a crew that would go from one to one to one to one and do the same thing on all of them too. So, but I think, yeah, distributed generation. What are photovoltaic cells other than distributed generation? And New Jersey, in fact, is one of the states that if you have PV cells on your roof, they give you two-way metering. And I talked to a guy just about three weeks ago, he said, "Yeah, my last bill was $3. They owed me!" It must have been a very sunny period of time, I guess, that had happened.

Julie Cohn (00:33:50):

I'd like to back up and ask a question we probably should have asked earlier on. Can you explain what the New York Power Authority was at the time you were working for them and how that changed over time?

Robert Dent (00:34:04):

Well, I do, I do notice that the Power Authority is one of the sponsors here, which is I think very good. I wanted to stop by and say hello to whoever is here. But the Power Authority was started, I think, in the early 1930s, by the New York governor at the time, which was Franklin Delano Roosevelt. And it was used in order to provide benefit to the people. Well, one of the purposes was to: good power to people upstate. Because a lot of people upstate would move there, they'd love the area, they'd love the weather, they'd love the skiing, they loved whatever, but then they would say, "Okay, we'll have kids" and the kids couldn't find jobs. So, what the Power Authority was doing is trying to give power at a really reduced rate to industries in order to encourage them to be upstate and give people jobs.

(00:34:54):

And then there was the failure of the Alcoa generating station on the New York side. And the Power Authority then took that over and built what they call the Robert Moses Generating Station. But since it was done with federal money, the Power Authority had to also distribute to more states than just New York State, which is fine. But I remember when I was in, in the management program, I wrote a paper on the New York Power Authority. And we were generating power that we sold for 1 cent a kilowatt hour. Now, if you know anything about power, you're probably thinking in most city areas, it's more like 20 cents a kilowatt hour. New Jersey is probably 18 cents a kilowatt hour. Con Ed is probably 20 cents a kilowatt hour. So, you know what is, but the charter of the New York Power Authority was to build a plant for the public benefit and provide the power at the lowest cost possible, with the only money that you would take out of that would be for a fund that would rebuild the facilities. And of course, they're not, they're exempt from the state taxes as far as real estate taxes. So that made the power somewhat, somewhat cheaper. I guess also—

Julie Cohn (00:36:15):

So, it was like the state level municipal power company?

Robert Dent (00:36:18):

It is, and it is the largest US state power group. There's BPA and there's Los Angeles Department of Water and Power. And, but as far as the state it goes, it's— but now, you asked me about the Power Authority. So, the Power Authority was more into generation. We had nuclear, the—now the two nuclears are gone. We had a fossil fuel power plant in Astoria, Queens, and that was changed to a combined cycle plant, which of course is much cleaner. We did some peaking power that I got involved with also, with it is a five-megawatt generator with a GE jet engine. So, it's a gas turbine. And when you need peaking power, it's expensive, but when you need it, you need it. And so, it's five megawatts, and they built 10 of them throughout New York City and—to solve the peaking problem. But now I read—I don't get a lot of stuff from them, but they're into conservation and they're into helping people to conserve energy, the cars that people drive, they would help to take the refrigerators that were inefficient reuses of power and help them to replace the refrigerators with the more efficient ones. So, the other mission is pretty much the same, but I think it's still—it's keeping up with the times.

Julie Cohn (00:37:38):

Dan, any questions on your list at the moment?

Daniel Molzahn (00:37:43):

Yeah, no. So, I apologize. My internet cut out right when you were answering my earlier questions. So, I'll check with Julie afterwards to hear about that. But maybe just circle back a little bit to the nuclear industry. And can you speak a little bit more about—you said it would be great if they had standardized designs or more standardized designs. Why did that not happen in your view? Was it, was it the industry itself? Was it the utility companies? Why were there so many different models of plants instead of one or a few standard models?

Robert Dent (00:38:23):

Yeah. In a way it's kind of like the same process, but it was left up to different manufacturers as to how to accomplish it. And I guess it was competition. I don't remember, I remember in fact, somebody used it on yesterday morning where this guy who was talking about power, he was a PhD guy and he said, "Nuclear power is going to be so cheap, it'll be useless to even meter it, because the nuclear fuel is there and the plant is running and the meter's going to cost you more than the power that you're actually taking out." I think it was just maybe, letting government—not really reigning in people and saying what the Navy did, which is say, "Here's the design, you build it for us." Cause there actually are—the principles are all the same.

(00:39:12):

It's just that the design details because a boiling water reactor is obviously different than a pressurized water reactor. And in the pressurized water reactor, they have these heat exchangers that always keep the nuclear radiated water from getting into the turbine. But in boiling water reactors, you basically are circulating the water from the reactor right into the turbine. So, if there's any radiation in that, it gets right into, into the turbine, which the turbine can be fine with. But you why radiate any more equipment than you would ever want to radiate, because it makes it into a nuclear waste then, which has always been a problem, I think. And I don't know how that's going to eventually get solved because the nuclear waste, whether you've got a 30-megawatt generator or 1,100 generator, you're still going to have nuclear fuel rods that are going to have to be recycled. I don't know how—well, the nuclear industry got the bulk of what I would call the reason to solve their problem, but there are medical nuclear wastes also. And nobody ever really talks about that, but they're getting rid of them somewhere. So, I don’t know. I hope I answered your question.

Daniel Molzahn (00:40:28):

No, that's great; I appreciate it. And I have one other question going back sort of closer to the beginning of the conversation. And I just thought when you're describing your educational background—really quite diverse and a lot of different institutions, a lot of different fields and computer science, engineering—you talked about mechanical engineering, so what aspects of that background helped you throughout your career? How did that influence your career in the decisions you made and technologies you worked on? Like, what was the impact of having such a diverse background?

Robert Dent (00:41:09):

I think one of the things that I became very interested in was computers. And when I first started at Stevens, they didn't have one. There was not even one computer course. So, in my second term, which would be the second half of freshman year, they had a computer science course, which they had a very rudimentary computer, an IBM computer. It had a dual-pass compiler, if you know what that means. But you would write your program. At the time it was FORTRAN 2. You'd write your program, and then you'd go into the O29 key punch and you punch all the cards, then you'd feed it into the computer center where they would run the cards and then another deck would come out, and that was the job control number, the JCL language. And then they'd have to run that because basically the computer was being used to translate FORTRAN 2 into JCL.

(00:42:05):

And then the machine knew how to handle job control language, and then you'd get your answer. Well, things have gone a lot from then. So, when I—I went out to New Haven and I took a course on computer science. By that time, it was FORTRAN 4, and it was FORTRAN 4, E and F. And I really liked that an awful lot. So, when I eventually went down to New York and got a job doing analytical work, I was happy as a pig in mud to be working with the computers all the time, because that's what I had to do. And so, the inductive interference studies were really good. I probably did about 12 of them during the time that I was there, and each one would maybe take about three months in order to get it done. And then I—it was very helpful when I became the director of electrical system studies at the New York Power Authority because I was using computers all the time, then also. And I still use computers a lot, even though I'm not working for it anymore.

Jess Slater (00:43:04):

How did you see the integration of digital computing, like transforming management, throughout your time in industry? How did you see the integration of computers changing the way that the business and the industry was performing?

Robert Dent (00:43:22):

Well, as far as the change, I remember when you would have to write your own program and then you'd have to implement it, and then you'd have to punch it out and run it through a main computer. And the main computer was this large computer that needed special air conditioning because of all the heat that was thrown into the room. Used to have false floors, because they had to run all the cables from the key punch machines to the computer and to the printer and to the magnetic disc readers and all that. Eventually, of course, everybody at the Power Authority, we all had personal computers on our desk. They were desktop computers. Then the last job I had was at IEEE, of course. I was the executive director for the Power and Energy Society, and I was there for five years.

(00:44:12):

And at that point, because I had to do some traveling, they didn't gimme a desktop, they gave me a laptop, which was very nice to be able to travel with, rather than a desktop. But I see the—when I went to Pratt Institute, they had a dual disc drive as a computer; in other words, they didn't have a hard disc, they had a dual tape drive, is what I really wanted to say. And so, it reminds me when I first got my first computer, there was a guy I worked with and he had this manual that said, "You could build your own computer." So, ten of us got together and we went out and we bought the metal case, and we bought the power supply, and we bought the CRTs, and we all took them home and did it all.

(00:44:56):

And we all compared notes. But at that time, it was two floppy drives. That's all it was, two floppy drives. Then eventually, of course you get a hard disc in there and you could have one floppy drive. Those were five-and-a-quarter inch drives. And eventually, of course, they went to, what, three and a half inch drives. And now of course you don't even use those anymore. You use a little thumb drive that you put in a USB port that probably has 500 times the capacity of the original floppies, but I think—I want to answer your question, but I'm not sure I'm going in the right direction, so—

(00:45:45):

I think— I had a young man who worked—came into the section—and said—. Now, I'm Director of Electrical System Studies—he comes in to me after three months, and says, "I studied electrical engineering. I didn't study computer science." I said, "What do you mean, Warren?" He said, "Well, I don't know. You guys do all your work on computers." I said, "Well, that's because we're the electrical studies section." And he really wanted to be an electrical engineer, but he really didn't want to do much on the computer. I said—well, I thought to myself, I don't know what else you would do if you wanted to study a system; you usually model it. And if you model it, then you put in the data that's relevant to the application and you get your answers that way. And because we had to do short circuit studies, we had electromagnetic transient studies we used to do in that. So that's when lightning hits or you get a switching surge as a result of switching on UHV lines.

(00:46:36):

Because The Power Authority had 765 KV lines. They were the second, and I think the last utility to have 765 KV lines. First one being American Electric Power. And then we did harmonic studies. So, it—people would say, “Well, what's the loading of the harmonics on the transformers?” Because sometimes you are very much aware of a pure sinusoidal wave, but if it's got any harmonics in it, they can heat as much or more than what the primary wave can actually heat. So, you want to see what's going on in those areas. One of the things that I thought was a really innovative thing using computers on the system is—. I had guys, as I said, that did transient network analysis, and the exciter failed at one of the power plants, the fossil fuel power plant, and the exciter failed.

(00:47:29):

And the exciter manufacturer was Westinghouse, and they came up with a kind of like an analysis of what happened, but they hired PTI, Powered Technology Incorporated. And they gave a scenario as to how it failed. And so, then they came into me, and they said, “Which one do you think is best?” So, I went to the two guys that did a lot of the transient network analysis, and they said, “We could study this with the transient network analysis.” And they did. And they came up with the answer that Westinghouse said, "I think you're right." PTI, being a consultant having been paid to do this, said, "We don't really think you're right." But that was one of the most crowning achievements I think that I remember that had been done and solved the question of what really happened.

Julie Cohn (00:48:30):

I have questions in two different directions, and maybe you can answer one of them very briefly, but why was the New York Power Authority the last to install 765 KV lines?

Robert Dent (00:48:43):

Well, they were second, and what happened is the Power Authority started to have the need for bringing power in, and they wanted to bring power. Where was their excess power? Well, there was excess power in Canada, and they have a lot of hydropower up in Canada. So, what the Power Authority negotiated with is that during the times that we need power, which would be more like the winter, we'll import power from there, and in the summertime, we'll send power up to you. And so, they needed to bring a lot of power down into the New York City area or central area. So, the 765 KV line went from more or less the Canadian border into central New York State in an area called Marcy, where we had the Marcy Substation. Then from Marcy, they transformed it down from 765 to 345 to bring it down into New York City.

(00:49:37):

But it was mainly built because of the fact that it was needed to—it was—they had 400—excuse me—4,000-amp capacity conductors. So, if you actually multiply 4,000 amps times the voltage—root 3, it comes out with a massive amount of power that you could actually bring in. But we never used it to that degree. In fact, most of the time we were the one importing power from there. However, 765 does have its problems. And there was one man that he was already assigned to it. When I joined the Power Authority, he had to do the analysis of the TVI, the television interference, the radio interference, and the audible noise that would occur from it. And if people had problems, he would go to them and say, "Well, what's your problem and how can we solve it?"

(00:50:30):

And so, the Power Authority would say, "Okay, you need like a master antenna. We'll get you an antenna that goes 15 feet up in the air and it'll do the signals, or you need cable tv, we can solve that. We'll give you cable tv or, so they were very much trying to bring a good face to the fact that there were some people that really were not happy with the 765 KV lines. And one of them was the structures were COR-TEN, if you know COR-TEN. So, it is like a regular structure made out of steel and then it rusts, but it rusts not to change any of the structural problems with it, but it does rust to like a reddish brown. And that's, I don't think people like that too much, anyway so—and then there were people that I think made false promises—not false promises, false complaints. Because they would say, “Oh, my chicken farm is no longer usable because of the line that goes through there.

(00:51:30):

And the chickens are all fighting with each other.” And I remember one woman too, if you know from the line, 765 is about 400 kV line to ground. So, if you take a fluorescent bulb, like a six-foot-long fluorescent bulb, the field at the top of the bulb versus the field at the bottom of the bulb is high enough to make the gas ignite inside the bulb. So, she would come in and she carry it like this way <gestures to illustrate> and then turn it 90 degrees and suddenly you get the bulb is glowing. And her—I guess her implication was, Gee, this is what's happening to your body. But it really isn't; that's not really what happens.

Julie Cohn (00:52:16):

So, the reason—perhaps the reason that nobody else built 765 KV lines after this was this set of aesthetic, social concerns?

Robert Dent (00:52:27):

Well, I know what—the Power Authority, we had a lawyer who was the head of the Power Authority Board of Trustees, and after he heard about all of the things that were happening, he said, "There shall not be any more 765 built by the New York Power Authority." We had no 500 kV, which is another popular voltage. We just had a bunch of 345 as our highest voltage. So, everything after that was built at 345. There might have been, maybe not. There are places like in the Pacific Northwest where they found, if you can go from point A to point B and it's like 500 miles, like down to Los Angeles, probably a HVDC link might be a better alternative than 765. You spend less on the conductors, and you just have to make sure there's no ground currents that are going and causing any problems. But you put up two wires, an eight, an anode and a cathode, and you send the power down. It's very effective—effective and efficient.

Julie Cohn (00:53:31):

The other direction I wanted to take you was, you were in and out of various academic institutions, but you stayed with the New York Power Authority for a long time. So, were you still maintaining communication with different researchers at universities as you were addressing various problems within the Power Authority?

Robert Dent (00:53:53):

Well, I always make a joke about it that no school should ask me to become a student because I put more schools out of business than I think anybody else. The grammar school I went to went out of business. The high school I went to went out of business, Pratt Institute where they, I got my computer science, that department was eliminated. In fact, Pratt eliminated their entire engineering program. And then Polytechnic Institute in New York—which was previously called Brooklyn Poly, because it was Polytechnic Institute of Brooklyn—transitioned from that to Polytechnic Institute of New York, Polytechnic University, until they were taken over by NYU.

(00:54:32):

I do remember though, contacting a few people, especially in the management program a few years after I got that degree. And that was a degree I really liked getting, because it was a good, practical. It was mostly adjunct professors that taught it, so these were people that were not pie-in-the-sky guys. They were very much people who were in the field, and they could tell you what was really going on, and so I really liked that part of it. But as far as—I didn't really keep up with many of the other people that I—partially because some of them were gone.

Jess Slater (00:55:13):

I have a quick question. So sometimes students often debate between pursuing a career in industry versus academia. What advice would you offer to students uncertain about this choice and how did you navigate this decision throughout your career? Essentially, staying with the Power Authority and not going back. What were those—?

Robert Dent (00:55:34):

Well, when I first started in my jobs, tuition refund was very much an incentive that companies had in order to keep employees. So, my father and mother paid for my degree at Stevens. After that, the companies that I worked at paid for all my degrees. I never paid any money in tuition. But I did remember though, when I finished with the management degree, and I went to Rutgers for a year, and that became a nightmare because I was working in White Plains and the Newark, New Jersey was where the campus was. It was like a rush. Like I was on the Indianapolis Freeway in order to get to the school on time for it to get started. But they said to me you can do all of your coursework as a part-time student, and you can continue working, but once you start your dissertation, you're going to have to work full-time on that.

(00:56:34):

You'll have to give up your job. So, I knew, I took that to heart and said, "Okay, I have to do that." But then I started reading about the opportunities for assistant professors, especially in a tenure-track position, and at the time it was like between $30- and $35,000 a year. I was making triple that at the time. So, I wasn't really it didn't really pull me in as an incentive. I was doing it not really to become an academic as much as to become a productive person that used my intellect to pursue new things and learn new things. And if I could, maybe I would do an adjunct job, but I really—at the time when I finished, I was 54, I think, when I finally dropped out of the Pace program, which was not a PhD, it was more of a professional doctorate.

(00:57:25):

And they were starting to move it more towards a research degree rather than a professional degree. So, I said, "I'm not sure I really want to stay with that. I was also working, and I was involved at IEEE. And so, when I dropped out in 1999, I had already been voted in as the vice President of Technical Activities for IEEE, which meant I was on the board, and it meant that I had to go to three meetings a year. It meant that I had to do this and that. And I just said, "Why am I complicating my life so much in order to get a degree that I probably won't even use?"

Jess Slater (00:57:59):

And then you said something about how there was—when you took on industry jobs, there was this need [for] job training and other technical benefits that you got. Particularly talking about the other student who said, "Hey, I didn't do computing during—in schooling." What skills do you think that engineers should take with this evolving industry, that they should make sure to have, to be equipped with going into the industries? Because you've got so many different degrees with so many different backgrounds. What things do you think could help support them throughout whatever they decide to go into?

Robert Dent (00:58:37):

Well, I think if I was really smart, I would've gone to maybe Rensselaer and got a master's degree in what they call their Electric Power Engineering Program, because that really set people up for a lot of knowledge that they would be able to use directly. It wasn't that—I went to a school that was noted to be a decent school, but it didn't prepare me for a specific job. In fact, the catalog, as I remember it at Stevens, said, "You're going to get a general engineering education to be supplemented with graduate work in your specific field." So that's what I did after I left. But if you really wanted to get into—there's a lot of things that you should know if you're going to work for a utility, especially in any analytical area. So, if you're in system planning, which is a very analytical area; relays: a very analytical area; you should probably take some of the courses that teach you how to do those component analyses that, that do it.

(00:59:37):

I don't see many. When I was in an area where I was writing specs and doing layouts, and you can do a layout for a substation with a breaker and a half scheme or a straight bus with just radio feeders or different schemes. You can learn those pretty well. And I don't think there's a school that would teach you that at all. It's something you have to learn. One of the most important books I ever had when I was working was the Westinghouse T & D book, which was a book about this size <gestures>. And it was maybe about two inches thick. And it was put together by Westinghouse engineers in their analytical studies group. Probably in the late fifties. It was a blue book.

(01:00:21):

And I still have it. I've gotten rid of a lot of the textbooks that I had. After a while, we haven't moved yet at all. But my wife always says, "Do you need all those books anymore?" I used to have my high school books. I used to have my college books. Then I had all the graduate courses books. And there's not really a lot of use for them anymore. You can't even give 'em to a library, because they won't accept them. But I think if a company is really good in power, there's two power courses that were available at the time. One was given by General Electric, which is the Power Systems Engineering Course, PSEC. And that would be for like—I think it was two days or three days a week for like, almost six months.

(01:01:09):

And one of the guys I worked with at the Power Authority had been sent to it. Not when he worked at the Power Authority, but when he worked at American Electric Power, they sent him to it. And so, those are courses that are specifically done. PTI had one, I'm not sure they still have one anymore. But those are specific courses you could take. And as I say, Rensselaer has a very, I'm not sure they still have the electric power program yet anymore, but that was a good program too. There's a lot of things that in the power industry, they don't really teach. I think one thing that's changed is the Power Authority, not the Power Authority. The Power and Energy Society started with this PES+ scholarship program that they encourage students to apply to get a fund to study power.

(01:02:05):

So suddenly then, PES is getting all these students that are asking to study power. Well, if you don't know, I'll tell you that 20 years ago, a lot of universities didn't really have many power engineering professors. And so, what happened is they started to have students that were asking for power. And so, they had to then tell some of the, maybe computer science guys, well, you got a PhD in electrical engineering, but we're going to ask you to teach power systems stability, or were, we're going to eat you to teach other courses in power. So that incentive of the students getting scholarships kind of caused the demand for professors in, in the universities in order to provide those, those students. Because one of the past presidents of PES did a workforce study, and it was kind of pretty much known at that time that in a workforce study, the age of the average engineer in a utility was going up quite quickly.

(01:03:10):

And the utilities were not hiring. They were very anxious about deregulation. They were very anxious about having overhead that they may not need and higher costs. So, they weren't hiring too much. Well, that's why then that's set in motion, the lack of need for power engineering professors, because nobody was really going into it. So now things have changed to the point that now there are professors and now the utilities and the industrial people are asking for power-smart people who know how to analyze power systems. So, I thought that was pretty innovative.

Julie Cohn (01:03:48):

Dan, I bet you have a follow-on question related to that.

Daniel Molzahn (01:03:52):

Yeah, that's a really interesting story and I hadn't thought about the implications of the PES scholarship. I have a lot of students that apply for the scholarship, get the scholarships, it's fantastic. Were there other things going on at the time in addition to that scholarship that were driving—? You gave a couple examples. I'm just curious, were there other examples of why we had, sort of, this renaissance in the universities' area of hiring more power professors, more students? I guess, just based on—were there other things besides the two things you mentioned?

Robert Dent (01:04:31):

Maybe this is anecdotal, but I remember reading something where somebody said that the newer, younger people that want to become engineers don't want to do it just for the money; they want to do it for what would be a public good. And the public good would be, yeah, to have facilities for people to have power in the future. And so, I think also one of the things that was very good about electric power, that got a good name to it, is the National Academy of Engineering. They did a study to find out the most significant improvement happened in the 20th century. You have computers, you have communications, you have cell phones, you have—they concluded it was the transmission system within the United States. The grid was the most important thing because obviously, yeah, if you have a cell phone, but you need to charge it, you have a computer, but you still need to plug it into the wall and have power for it, so they—that's what they chose for that.

(01:05:29):

So, I think when I first graduated from college and I told somebody who was in recruiting, she was a friend, and she was in recruiting, and I said, "I'm going to go to work for an electric utility, investor-owned utility in Connecticut. She said, "Oh, utilities, that's where they do everything by Xerox." In other words, what she said is: you build a substation, the next one you build, you just take out the old drawings, change the name, reproduce it, and that's it. And I cannot say that, at this point in my life, after 41 years in it, that—things are not static at all. The introduction of power electronics and the coming up of VAX controllers and adjustable speed drives, all, all being power electronics—all, all the things that are happening, such as even dynamic ratings rather than static ratings—The smart grid is another big thing that is really revolutionizing the area. They're so much different than when I first graduated from college. And I’ve got to learn a lot of those things too, in order to keep up with what's going on.

Daniel Molzahn (01:06:47):

So maybe to follow up on that, do you see differences in the engineering students that are coming in—I guess specifically at NYPA, but also elsewhere—more recently, versus, the sort of motivations and types of students you would see from decades past? Is there sort of a qualitative change that has happened in that direction?

Robert Dent (01:07:11):

Well, I do have to explain to you, I've been retired for 17 years, so I'm not running into new students very much anymore. But I think that students that are pursuing careers in power, I think are as much, if not more dedicated to the power industry than they ever were. And I say good for them and the utilities, I'm sure they're going to be very appreciative of what happens.

Daniel Molzahn (01:07:38):

It's nice to hear that. I have my set of students that come through Georgia Tech and I get to know them very well. But it's nice to hear this from a broader perspective too.

Jess Slater (01:07:51):

Do you have any questions? Oh, no worries. I did have— Do you have any?

Julie Cohn (01:08:08):

Yeah, I just wanted to pursue a little bit further, your role in IEEE, in particularly the Power and Energy Society. Before we began the interview, you mentioned something about the founding of the society. So, I was wondering if you could give us a little thumbnail sketch of when the society was formed, why, and what your role has been in the—?

Robert Dent (01:08:28):

Well, in 1884, the AIEE was founded. And of course they had a lot of people, Shay, our President, PES President, as she mentioned, Thomas Edison was there, and a lot of other people were there. And that progressed then to IRE, which was the Institute of Radio Engineers. I hate to say it, but AIEE was probably not receptive to the electronics people that were coming out with vacuum tubes. So, IRE started their own. But eventually in the fifties, it became a fact that why are, why are there two electrical engineering organizations? And some people had to join both of them in order to get the news or the information they wanted. So then on January 1st, 1963, they merged. Now one of the AIEE biggest technologies was power. In fact, I remember one of the volunteers, many years ago, got a copy of the first transactions of the AIEE and it talked about street lighting and all the stuff that was distribution, engineering and that kind of stuff.

(01:09:40):

So, when the—in 1963, they said we're going to have regions and we're going to have sections, but we need to have technical groups that address the different areas. So, they came up with the technical group called, The Power Professional Technical Group. And it got to be called normally the Power Group. So, from '63 to '70 was known as the Power Group, until the IEEE board of directors said that, "We want to make a few large societies, and so we are going to make one of the three societies that we want to see." One of them is called the Power Engineering Society. And so that's when we first started with our first presidents, which was in 1970. Before that we had chairmen. And there, there weren't any women at that time in charge of the Power Group. But they addressed the same issues that the Power Engineering Society addressed. And then eventually in 2009, they changed the name to the Power and Energy Society with the idea being that it probably sounded like it would appeal to more people than somebody who says there are some people involved with power systems that don't want to be called power engineers. I guess, I don't know, but—so that was how it really got started, so it really was a continuation of the old AIEE division.

Julie Cohn (01:11:12):

How was it of value for you to be involved in IEEE within your professional roles?

Robert Dent (01:11:20):

Well, I joined the IEEE in 1965, so I was a senior in college at the time. And the funny part about it is myself and another fraternity brothers at—we looked at our resumes and we said these are pretty measly resumes. What—you had summer jobs and you had this and you that, why don't we join the IEEE and we can put that down on our resumes when we go into interview with these companies. So, we both joined—I don't know, it was probably $5 or something at the time to join it—and I never dropped out. I'm sure he dropped out because he got into different areas of electrical engineering. And I just stayed with it. And one of the things that happened that was really good for me is that when I left United Illuminating in '69, I came down to New York City.

(01:12:09):

In 1970 I read about a course that was being given by the local chapter that was called The Fundamentals of Power Engineering. And it was a 10-week course, and they brought in people from ConEd, Public Service. They brought in people from Long Island Lighting Company. And one week would maybe be talking about manholes, and cable splicing in manholes and how do you avoid water. And the next week would be the guy, Bob Hasley, I remember from Long Island Lighting. And he came in, he was from LILCO, he talked about relaying, and then the next week it would be somebody talking about overvoltage studies or—and I really appreciate, I think it was like a hundred bucks at the time. In 1970, that was quite a bit of money, but it was like 10 weeks of really learning from the professionals in the field.

(01:12:56):

So, I joined the chapter, and I started to do volunteer work and putting together meetings and all that. Eventually became chairman of that chapter in '83 became, the chapter of course reported to the New York section, became chairman of the New York section. But then a guy who I knew from Gibbs & Hill said, "Hey, Bob, you've got some background in IEEE, would you like to join the PES board?" And you could be the chair of the publication department. So, I knew what the publications were, but I said, "Okay, I'll give it a try." So, I gave it a try and moved from there. The first two years I was publication chair, the next two years I was a member of the board of directors as Division 7 Director, and then the one and only vice president for two years, and then the president for two years.

(01:13:47):

So what did it do for me? I think it made a lot of networking for me. That was actually very good. In fact, when I eventually did apply for the job of executive director in 2001, everybody knew me, because I had been so active, and I had just finished as the past president in 1999. And so that helped me to get that job, because I think there were somewhere in the order of 70 other people that had applied for the job. But I also learned a lot how to work with people. IEEE is a consensus building organization. It's not the: you're going to do it this way because I'm the boss. Because if you do that too much in IEEE, you're not going to have much of a committee left. So, if you can build consensus, that's the way that you can really do things.

(01:14:38):

I also learned how to convince people how to make presentations, how to do some writing. Presentation skills are pretty important because you may be the brightest person in the world, but if you kind of like nervously get up and you can't really make your points. I still remember though, when I was in college, they had one course, it was the fifth term, and it was oral presentations. It was only a one credit course, but at Stevens, they made you take one humanities course, usually three credits every term. And this was—as my wife would say, "I bet you sounded like Ralph Cramden!" “Hummina, hummina, hummina—" So, I think those presentation skills and the progressive skills and the ability to get along with people, that they really don't teach those things in school. So, they're really things you sort of have to pick up and learn about.

Julie Cohn (01:15:31):

Thank you. We're about at the end of our allotted time, so I will see if anybody has a final question to ask. Dan, are you set?

Daniel Molzahn (01:15:40):

Yeah, I have one more I could ask. So going back to some of the discussion on computing and NYPA from a while ago or early in the conversation, how much from a, from other conversations we've had, it seemed like there was a lot of customization done by each utility company. That every organization kind of had their method of doing things. They customized their software tools, maybe developed their own software tools for solving problems. And I'm wondering how much of that was the case at NYPA versus how much did you bring in outside expertise and were, were there really specialized problems that you were trying to address? Or was it—and that's why you needed to do customization? Or there was sort of enough similarity across the industry that you could adopt lots of techniques other people had had done already?

Robert Dent (01:16:31):

Yeah, I would say a couple of things. One thing that brought a lot of—more standardization is after the Northeast Blackout of November of 1965; there was a need for more research and development to know what was going on. And there were some large utilities like American Electric Power that had their own R & D groups, but there were a lot of smaller companies that really didn't have a budget for R & D. So, with the establishment of EPRI, which is the Electric Power Research Institute, utilities in general just ask, why don't you give us some money? We can aggregate it all and then we could spend it on projects that you guys all agree with, should be the way that we should go. And their model was that the project manager would be an EPRI person. They would get a utility involved with it, and they had a contact person usually within R & D of a utility.

(01:17:25):

And then they did get an academic also. And that's probably where more of the work would be done in terms of analysis and trying to come up with the common ways of doing things. The other—I'm trying to think, there's one other point that I wanted to make also. Well, for me, in the Power Authority, when I joined the Power Authority, I joined what was called staff engineering, staff electrical engineering. And there was like four people in it, plus the principal, which was the boss. And they did everything by farming it out. They did all their transient network analysis, they did their short circuit studies by, by consultants or contractors that would do it. Until finally somebody finally said, "If we hired three or four more people, we could do all this stuff in-house and save a whole boatload of money."

(01:18:19):

And plus, if you hire a new consultant to do your short circuit study, you had to teach them for maybe a week what your system looked like, or what your transmission lines looked like if you're doing a transient network analysis. So, there was a lot of training and retraining and sometimes there was just a tendency of wanting to say, Let's hire the same people, they're familiar with us and they know how our system works, and they can do it almost immediately. So that was the beginning of when we got a new vice president and he said, "We're going to do everything in-house, including all projects." And they changed the staff engineering designation to design and analysis. I would've thought construction should have been in there too, maybe. But we started to do all of our own drawings. If there was going to be a modification in a power plant, we did it all.

(01:19:10):

If there was going to be an extension of a switchyard and new breakers had to be put in, there were, there were structural engineers to do the foundations, electrical engineers to do their BIL, basic installation level analysis, and short circuits. And what kind of breaking power did—was it a 63-amp breaker, 63 KA amp breaker that was needed, or could you get by with a 40 KA breaker? So that's what I've seen, that there's more uniformity, probably because of EPRI. And I think also because people were starting to—well, I think the more practical engineering people did write papers—better off it's going to be, because then—the whole fear of deregulation causing a lot of confusion and competition, I think has kind of waned quite a bit over the years. That cooperation really works a lot better competition. So, I think that's how I see, how it's kind of changed.

Daniel Molzahn (01:20:16):

Got it. No, I appreciate it. That's very, very interesting.

Jess Slater (01:20:19):

If possible. I wanted to just ask one final question. So, I noticed that, well, October 1977, FERC is established, and then in November you start your time at the New York Power Authority, in the 1978 PURPA was passed. And so, my question is that, how did you see these policies influencing the development and deployment of new technologies within the Power Authority?

Robert Dent (01:20:45):

Well, initially there was no new technologies. There eventually was a research and development group that was founded within the Power Authority. And they basically did a lot of work with EPRI and then they were the major contact with that. I found the Power Authority to be a bit resistant to new technology. And not that's unusual. When I worked at the Gibbs & Hill in the Transportation and Transmission Group, the most conservative engineers I ever met were the railroad engineers, especially the guys in signaling. Because signaling is almost as important, or it is—it's as important as relaying is to a utility guy. Signaling keeps the trains running and tells 'em when to stop and tells them whether they can proceed or not. And so that's a very vital function, and those were the most conservative guys I've ever met.

(01:21:42):

But in general, utility people are pretty conservative, so they're not going to change. One of the things that happened while I was doing it, they had electro-mechanical relays. Now electromechanical relays are relays that have like coils and then, then they energize them, and then there's a little solenoid that goes through. And it does, it reminds me of the first job I had. It was called SCADA, the word supervisory control and data acquisition. So, one of my first jobs, here I am, I'm 22, and I got there and the newest guy in the relay group gets to be the SCADA fixer. So that whenever the SCADA system failed, Bob, you're the guy, you go out there and you fix it. And it was a lot of these, what they call "telephone-type relays" that would— you know <makes signaling noise> like big <makes signaling noise> and send a signal out and it would do like handshaking.

(01:22:35):

So, it would send a signal out to a substation and get back from the substation. "Yes, I hear you." And it would get out and say, "Close breaker 73," and it'd come back and say, "73 is closed," and do all that stuff. And well, as you might think, solenoids fail, they're electrical and they have the insulation and the insulation fails if they wear out or they move—. So, I—that was my job for the two years that I stayed there after that. They all went to transistorized stuff though too. And in relay, there was the big thing about do we want to stay with electromechanical or should we get to electronics? Electronic people were buying electronics for listening to music and—but is it really safe enough for it to protect the system. And that's, I think one of the origins of primary and secondary relaying is one would be electromechanical and the other would be electronic. And I think eventually electronic found its home in the electric utility industry to be a safe way of doing things. And one you could rely upon. So, I don't even think you could find an electromechanical relay anymore in a relay system. So anyway, hopefully I answered your question.

Jess Slater (01:23:55):

Oh, yes. Thank you.

Julie Cohn (01:23:55):

Yeah. That's a very interesting point. I think we've reached the end of our time, and we've had a really interesting conversation with you. So, I'd like to thank you for spending time with us and sharing your reflections on the work that you've done.

Robert Dent (01:24:13):

No, thank you very much. Yeah, well, when I got the invitation, I said, "Yeah, I should show up. I should do that." I also too, the other thing is I did write a book a few years ago, "The age of electricity?" "Twenty-five years of electricity!" [*The Foundations of Electricity: 125 Years of Electricity*] And so, it goes through when 1882, Pearl Street started and goes to approximately 2007. And it got issued to be given out at a meeting, a PES meeting in India with the electrical, no, the Indian, Indian Electrical and Electronics Manufacturing Association. PES had a joint meeting with them, and they wanted to hand out something. So, I put something together for that. The only other large thing I would say: this change over the time frame is going from like network analyzers that were analog into digital. And the digital, you could basically solve anything on, especially the transient network analysis. Can you imagine? Analog, analog. They had to model the, all these little transformers and all these little surge arresters, and they had to model everything that was representative of the system and then run current through it to see, see what would happen. Anyway, it was good, I enjoyed it.

Jess Slater (01:25:34):

Of course.

Julie Cohn (01:25:36)

Thank you.

[End of Interview]