Prabhat Jain

CEO-CTO of Virginia
Transformer Corp

Interview with **Prabhat Jain**

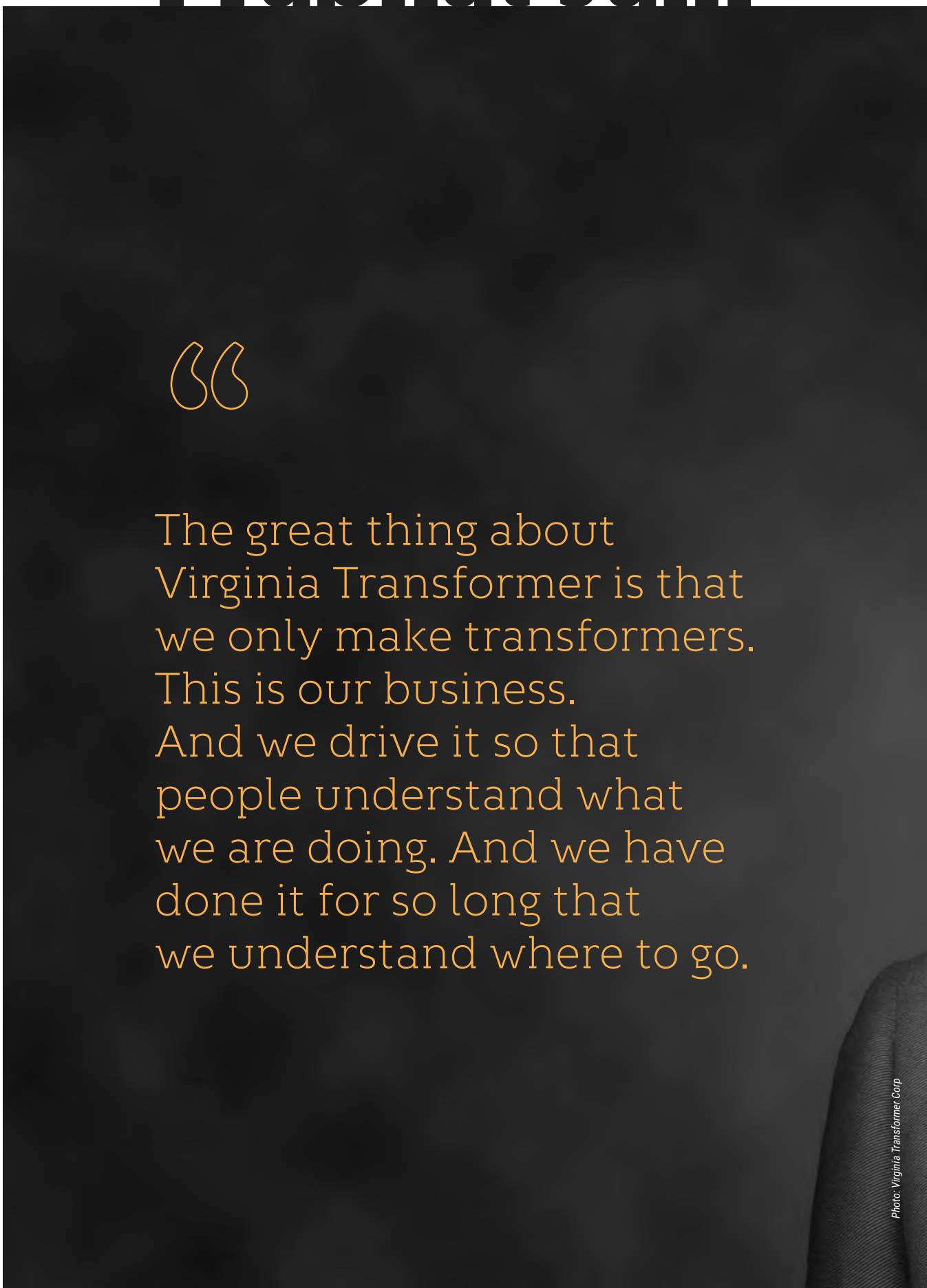

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Photo: Virginia Transformer Corp

Transformer Technology talked to Prabhat Jain, CEO-CTO of Virginia Transformer Corp, a leader with a fascinating biography, a mechanical engineer with an MBA who originally worked in the company and had nothing to do with transformers but then turned into a *transformer guru* as Virginia Transformer and Georgia Transformer, formerly Efacec, became arguably one of the very largest power transformer manufacturers in the world and the largest US-owned manufacturer in North America.

Photo: Virginia Transformer Corp

Alan Ross: In this interview I am hosting a frequent guest, or at least he's been a guest more than some other people. Prabhat Jain, the CEO and President of Virginia Transformer and Georgia Transformer, as well as a new plant coming online in Chihuahua, Mexico, and then another new plant that will come online near their existing plant in Virginia. Prabhat, it's so good to have you here.

Prabhat Jain: You're quite welcome, Alan. I am very excited about the interview and the opportunity to tell your readership and the industry community gathered around Transformer Technology and Power Systems Technology about Virginia Transformer and what we are doing.

AR Normally, when we do the interviews, we try to keep them purely editorial. However, it is impossible to do that with you because you are a forward-thinking leader and you've done some amazing things within Virginia Transformer and Georgia Transformer, which used to be Efacec.

There are a couple of things I want to talk about. The first is, you have a very unique approach to quality and quality assurance. And since we are still in an industry where transformers are pretty much built by hand, uniquely, there is no mass production, can you talk a little bit about when you started to think about quality and quality assurance? How do you go about controlling quality and how do you make a difference doing quality?

The transformer is a handmade product. So, we have to get people to produce quality, think quality and build quality all the way across in every step.

PJ I would start by saying it's all about people. As you said, a transformer is a handmade product. So, we have to get the people to produce quality, think quality and build quality all the way across in every step. Another factor is that the transformer is a technological product, and technology is not obvious. You can't see the electrons and the field running around when you're building a transformer. So, I will start from the fact that it's down to the people.

That being said, over the last 50 years the work ethic of the people has changed. In fact, the norm has changed. People used to work in a plant for ten, 20 or 30 years. But not anymore. Now it's like five years. That produces a huge challenge in terms of how we maintain the skill level that it takes to produce a custom manufactured product and custom designed product. We don't have as much of an issue with the designers. They see the opportunities of the technology and the development we do in the company. So, they attach value to that and stay with us longer. However, our hourly worker typically does not have what you call a broader view of the industry. They just look at it from their own perspective, basically speaking, and they realize the challenge of manufacturing. So, this is how I have approached it over the last seven to nine years, when we became a major force in the transformer production scene in our country, and we took steps to overcome the short tenure of trained, skilled employees.

There are several avenues we have pursued. One is training. That has given us some edge, but not really as much as it takes to maintain the high level of quality.

The second thing we did was installing technicians who are actually subject matter experts - 20-year-knowledge people, and we have taken them offline, so to speak, to monitor what is being done on the floor. Therefore we assured the processes are being followed because there is someone who understands them.

The technicians must be trained. They are as good as our designers in understanding insulation, dielectric spacing clearance and the tying down of the cable so the cable won't fly away when the short circuit hits it, etc. All these things are known to them. Some five years ago, we made an addition to that as I realized that everything we do in transformer manufacturing is mechanical. The diameter of the coil is mechanical. The strength and the tension on the wire is mechanical. The clearance between the coil and the inner diameter ID and the core outer diameter iOD is mechanical. The 2-mm gap that we have to maintain on the core corners is mechanical. No waviness in the three-meter long core legs is mechanical. Everything is mechanical. So, for years and years we had electrical inspectors on the floor because a transformer is an electrical product.

But when it comes to mechanical issues, what tools to use, how to calibrate, and then think mechanically in terms of forces, friction and handling; how to lift a 20,000 pound coil and bring it down straight onto the court so it doesn't scrape the sides and damage the insulation, how to make sure the coating coil assembly is vertical if it leans one degree, et cetera - these things are very easily understood by mechanical engineers and mechanical inspectors. I also sent our mechanical inspectors to American Quality Association courses to get them certified for mechanical inspection. So, these are examples of very simple ground changing initiatives. Just by realizing that the transformer making is mechanical, I started building up to the higher level of leadership, also mechanical.

To ensure quality, you need people. There are 250 engineers in the company today, and we are going to add more. They are the ones who are our assurance that we will continue to deliver and build a quality product. This takes a lot of drive from the CEO because it takes a lot of money. But if I am going to add 100 people, I know that's the right thing to do.

Another important area when we speak about quality is, of course, that we need more quality assurance people. Quality control is inspection. Quality assurance means that already at the

Photo: Virginia Transformer Corp

design and then the production stage we ensure the product is made so that it doesn't need much inspection in the first place. So, we are continuously adding more people.

If you want to have a better product consistency and a reliable product, as we are continuing to grow, we need a lot more people in the layers of technical and engineering knowledge. So, we have 250 engineers in the company today, and we're going to continue to add more engineers. My direction to all my leaders is hire any engineer that you can find to come and work in our company, because we have so much going on, and they are the ones who are our, what you call, assurance that we will continue to deliver and build a quality product. It's very simple. However, it takes a lot of drive from the CEO because it takes a lot of money. If I'm going to add 100 people, I know that's the right thing to do.

I don't need to go to Sweden and get permission to add 100 engineers. I don't have to go to GE Prolec headquarters saying I need to add 100 people. I just add them. And that's the great part about Virginia Transformer - we only make transformers. This is our business. And we drive it so that people understand what we are doing. And we have done it for so long that we understand where to go.

AR It's very interesting what you just explained. Yes, the transformer is part of the electrical system, but it's mechanically built, and some mechanical engineers think differently than electrical engineers. So, the idea that we can get mechanical engineers into production is an interesting approach.

The second thing I want to talk about is the history of transformers that is going back to pre-Westinghouse days, but the technology has not really changed that much. One of the things that has changed is that we used to design them using slide rules. We did it with our eyes. Today, we have better ways of doing design and we are much more exact. We build to specification. We don't overbuild anymore.

You talked about some changes that are happening in the technology of building transformers. What do you see are the current and future technology changes in transformer design and manufacturing?

PJ Design is a very vast field, and in designing, electrical engineers are kings. They are the ones who see, who understand the forces and the maximal equation, the electromagnetic, etc.

In any system, there are many safety factors, or margins, as we call them. So, there is a margin in force, there is a margin on field strength, there is a margin on thickness of insulation, there is a margin on the tolerances of the conductor, there are margins everywhere. And sometimes the margin in the system can vary from 1.5 safety factor to something like ten safety factors, just by nature and by practices that have occurred. So, what we have done at Virginia Transformer over the last seven or eight years is having a development department that consists of very analytically oriented, highly skilled engineers, who try to bring that safety factor to more nominal numbers, raise the one and a half, and lower the ten. The system is only as strong as the weakest link.

So we try to optimize and we have done a lot of work in that area in terms of the hot spot, the directive margin, the stresses, insulation, top oil rise, the velocity of the oil, the number of oil driving washers, how many we need to place to optimize them so we don't impede the flow, etc. Every time you have the oil making 180-degree turn, you lose some head and thus you lose velocity. We have done a lot of fundamental analysis using CFD, and using, of course, just very simple temperature gradient calculations with finite element analysis. So, we have improved that and this is one area of technological development that we have furthered in the last seven to ten years. And we are continuing to work on that.

The other technology area is materials. Materials are becoming more and more expensive. Millstone used to cost thirty cents a pound, now it costs sixty cents a pound. So, there were times when it was okay to use half an inch wall thickness, but now we are saying, instead of using 36,000 PSI, we would like to use 80,000 PSI steel which is available for a small premium. However, it saves a lot of cost. But then other issues emerge, and we have to manage those. The deflection goes up. We can manage deflection by putting it where it doesn't hurt. For instance, if bushings deflect, then they are going to come closer and that's not good. So, we want to design accordingly, and this is about materials, the dialectic design, and the temperature design.

Sound reduction is another very important area where we have made progress, which, believe it or not, gives you longer life because sound comes from vibrations. Vibration means that there is something that is rubbing against something else and the rubbing is going to eventually lead to abrasion and failure. So, these are the areas that we have improved in terms of technology.

Looking down the road, there is much coming at us and we have to evolve beyond just the mechanical and electrical spheres. There is EV charging and data centers, which are becoming important very exponentially, rising faster and faster. And, of course, solar and wind that has given rise to battery storage.

Battery storage uses a lot of computers, and harmonics. So, all of these together are pushing us in an area of what I would call solid-state electronics. Certainly, the solid-state transformer is the next step, if you will, from just normal inversion and conversion. Essentially, EV charging is about taking AC and taking DC out of that. We are going to need a lot of that. And then the electrical vehicle is another area where we're going to use a lot of solid-state electronics in order to drive the motors in the wheels, to drive the wheel directly, and eliminate a lot of mechanical systems from there.

This shift towards solid state electronics will apply to transformers in various aspects of its application. The transformer will exist as an electromagnetic device like we have today. However, it will be combined with a lot of solid-state electronics in order to make the transformer continue to serve the application. Our knowledge of harmonics is very deep. Virginia Transformer's foundation is in variable speed drive isolation transformers.

Photo: Virginia Transformer Corp

So that is growing nicely. There are so many other areas that we are working on as an engineering company to reduce the weight of the transformer, and then by using different materials and smoothening the fields. Very far-reaching developments are underway right now.

Here I would like to mention ester fluids and vegetable oil, which has been around for a long time. Now we are able to take the technology to 200 MVA, so we can supply transformers for data centers, particularly very large transformers for data centers, which are mostly located in urban areas. We want to keep them safe and ester is very powerful for that. And we're going to take this technology to 230 KV now. We are planning to do that. We have many PhDs on our staff who are chemistry and electrical engineering specialists in order to combine the knowledge and then see how we can take that technology forward.

Another area is the dry type transformer, which is again a safe device in terms that it has no oil and of course, no leaks. We can make dry type transformers up to 35 kV, 150 bil, 15 MVA, which is a fairly good size transformer to serve most of the industries.

AR Prabhat, you always leave me with so many questions to ask that we have to do another one of these interviews. And I have to comment on this. Most of the people that I have talked to who are leading transformer companies, don't know much about transformers. They know a lot about business. You happen to know a lot about business but, boy, do you know a lot about transformers, too! I really appreciate that, because you can tell that transformer is in your blood, and that's good to see, because I think that's what brings things forward.

So thank you from the industry, because I appreciate it very much.

PJ Thank you, Alan. And I always like to finish by saying one has to have passion. And passion brings excellence, and excellence will serve the industry better. Absolutely.

AR That's what we're going to end with. Passion. Thank you so much, Prabhat, and we will talk again.

PJ Thank you.