Allan Carson of World Nuclear Association interviews Gilles Rodriguez, Technical Director of Generation IV International Forum (GIF).

Allan:

Hello, everyone. I am Allan Carson and welcome to the latest installment of the World Nuclear Association video series on innovation. In this series, we will be asking leading industry figures about what is needed to facilitate nuclear innovation and bring new technologies to market quicker. The demonstration of advanced and small modular reactors over the next few years will mark the beginning of a profound change in the nuclear technology landscape. However, innovation is not only about technology but also encompasses areas such as regulation, financing, and communication—all areas that are currently preventing nuclear energy from reaching its full potential. With that I am pleased and excited to be joined today by Gilles Rodriguez, technical director of the Generation IV International Forum. Gilles, welcome and thank you very much for taking this time to talk to us.

Gilles:

Okay, thank you Allan. I am very pleased to attend this innovative way of exchanging. I am working at CEA, Atomic Energy Commission. Since 2019, I am the technical director of the Generation IV International Forum which name is GIF. We are working on six systems for the next generation of nuclear reactors. From our whole life, I am specialized in sodium fast reactors and Gen IV reactors, working on design, operating these reactors, [and] decommissioning these reactors. I have had a lot of things on this kind of reactors, sodium fast reactors, gas fast reactors, and lead fast reactors as well. Another thing also I made is some studies [of] a massive production of hydrogen with nuclear heat. This is something that is seen as an innovative process for the future for these Gen IV reactors. Since 2019, I have been trying to make the animation of the Gen IV as a technical director, which is a challenge, very interesting challenge, so moving forward for the six system for the future.

Allan:

Okay great. Thank you. It is very interesting and diverse background you have Gilles. I would like to start by asking you about your role as technical director at GIF. You're very much at the forefront of supporting the development of the technology that will support the next generation of nuclear reactors. I was wondering if you could elaborate further on some of the areas of innovation that are being researched, and what benefits they may bring.

Gilles:

In fact, on Generation IV International Forum, we are working in parallel to six systems, six innovative systems that we believe to be important or interesting for the fourth generation of reactors. So today, PWR, pressurized water reactors, I consider that Gen III reactors, and Gen IV are advanced reactor, we call them also like, sodium fast reactor, lead molten salt reactor, gas fast reactor, super critical water reactor, and I always forget one, very high temperature reactors. We are working in parallel with these six systems, and we are making innovation. Some of these systems are quite mature because they already have some operating systems: sodium fast reactor, for instance, or high temperature reactors. Some others are challenging, and there are some innovative systems by themselves. Molten salt reactor was studied in the 50s [on] a small scale, but we want to raise them at higher scales, and so it is

quite a challenge. Some of these systems are already innovative by their concept. Even for the mature systems, of course, we are making to improve them so to make some innovation to improve in the way of having higher safety, higher efficiency, or sometimes cost reduction, so higher benefits also. So we are going and making some R&D roadmap, considering the technical readiness level of every systems also to see the target. We want to have to every systems. But this is not the case because this is not only the fact, because in that case, we'll say that we have only six systems working in parallel with no interconnection between them. So we have made also some cross-cutting working groups or task force where there was some common, shared challenges on reactor safety on economics, on safety design criteria, safety design standards, proliferation resistance and physical protections. So we have some kind of cross-cutting systems where we can share the knowledge and when we can see beyond some innovative system that could gain to all the six systems. Two specific task forces are completely devoted to innovation: one is called advanced manufacturing and material engineering task force. So we are thinking that all the things that we can do on materials, the new way of buildings, materials, will be again for all the six systems for the future. The second one, which has been created just one month before, is called non-electrical application of nuclear heat, because we all believe that tomorrow we will not have to deliver only electricity but nuclear heat also for all the systems to decarbonize all the energy mix.

Allan:
Thank you. It is really sounds like there's some fascinating research going on across all technological areas including new areas and new markets for nuclear power to develop into. I was also wondering if there are any non-technical aspects that will require innovation to support these new designs coming to market.

Gilles:
Yes, of course there is. When we think about the future nuclear energy context on energy mix, the role of nuclear reactor will be also to provide flexibility. This is when you said not flexibility is not technical, but after you have to translate this word into technical systems. So the flexibility of this reactor will be to adapt to the energy grid to see how we can adjust the intimacy of renewables, for instance, because in the first generation in 2030s, in 2040s, the amount of renewables will be very increasing and very important, and so we have to adjust it with the nuclear reactor flexibility. Another one, which is not completely defined to technical, is a lifetime extension of these reactors. It is much more related when you think about economics, of course. If you can extend the lifetime of a reactor from 10 years, of course, money earning is very important. So you have to define after and to determine technically what is a lifetime extension. Another point which is also very important is to see how we can manage to work with regulators and to make them accepted what we are doing with regulators, so working on code and standards. Working on knowledge transmission for me is also a way to make some innovation. We are always working with long times where we talk about nuclear reactors, roughly 10 year’s construction. We hope to have 60 year’s operating and then 10 to 20 years decommissioning. So this long time is longer than a job a man working. So we have to make this transmission. It is very important to think about the long time, and this is also where we have to make some innovation about the knowledge transmission from the old generation to the young generation, because you do not have one person who will live from the first day until the last day of a nuclear reactor. This is very important.

Allan:
Well that's very true. And you know we have sort of touched on the technical challenges and the non-technical challenges. I just wonder if just to follow on from that if I was to ask you to identify one challenge that you thought was critical to the success of accelerating deployment of these reactor types and getting them to market more quickly. What would that one challenge be.

Gilles:
What is very interesting in your questions that you with innovation to the concept of time. You say quickly and you say to accelerate. So I am showing your views that today the difficult point is a relationship of nuclear reactor with time. When I came at the Generation IV International Forum, I had presented my point of view of what I wanted to develop on this organization, and I was saying our first enemy is time, because time is raining so fast. It is changing very quickly, at the same time, as I said, a nuclear reactor has to be seen for very long time. Some people have the possibility to stop the time: regulators, safety authorities. They can stop your time, and it can give you in different difficult situation. So I try to think what could be our relationship with time, and it was for me for nuclear reactors something which is the main challenge. We are talking about climate crisis, climate urgency. So we say going fast, fast, faster, and faster and faster, but you have to manage how I can behave in front of time. So now if you allow me, I will make a little bit of philosophy. We are only talking of time in French, le temps, in English, time. In the Greek mythology, there are three aspects of time: Chronos, Kairos, and Aion. Chronos is a physical time [and] is a god to say that this is a physical time that you can measure by days, by minutes, by seconds, and by years. So this is what we call time usually. Chronos is this one so this is the one we try to follow and when you make some management, you make road map, you make these kind of things scheduled, et cetera. Kairos is opportunist time [and] is a god to say at this present time, you have to grab Kairos, because it is a right place at the right moment, and this is where you have to put your innovation. I have to find the key ideas right now because this is the context we say now I need to make this exactly. Kairos is very important to make innovative action, to see the trends, to see how it will evolve, and to say for instance, we have to change our vision of nuclear reactors to make small modular reactors, for instance, to dedicate them for non-electrical application of nuclear heat. This kind of things was not discussed 20 years ago because Kairos was not here 20 years ago. It was not the context; now it is a context. So we have to grab Kairos for SMRs coupled with non-electrical application of nuclear heat. So, this is another god of time that we have to respect when you want to make innovation. But there is the third one which is also very important. It is called Aion. Aion is a god of the cyclic time, of the long time. So you have to compare Aion to knowledge capitalization and knowledge management. And if you ignore Aion, you can reinvent the will and this is not innovation. So, we do not have to run with against the time. But we have to work with the three gods of time: Chronos, Kairos, and Aion. And this is something you have still to keep in mind when you want to make innovation. You have to see the schedule on the roadmap. You have to grab with the opportunist time. But you have also to take care not to forget what you have done before.

Allan:
Fantastic. That's a really interesting and fascinating perspective. I really didn't think I would be talking about Greek mythology today. And I like the way that you've linked the different concepts of time with the different phases of

research and different phases of the project. I think that works really well. I would love to discuss it in more detail with you. But unfortunately, I think we're somewhat limited by time today.

Gilles:
We can spend hours making philosophy, but it is not the context. Sorry.

Allan:
No worries. It is great. And thank you for the perspective but just keep in that concept of time in mind. You know today there appears to be two main approaches to innovation. On the one hand you've got the state-based approach with what is prevalent in Russia and China, and on the other hand you've got the startup public-private partnerships that we see in in the U.S. and Canada. I would be really interested from your perspective. Which of these two approaches do you think will be most successful at accelerating innovation and getting these new designs to market?

Gilles:
Your question is difficult. You know I am technical director. I am representing several countries more than about 13 countries. So I will not say you who is the best. First, because I really do not know and it is not my job to say who is the best. But I will try to explain you a little bit. Maybe with an analogy what is the thing. My view is we are all in a race. And this race cannot be compared like a 100 meters race because it is not a straight line with all the person on the same line, and the first who arrives has win. We have to consider it as a sailboat race. When you think about a sailboat race, you go from one point to another point. But the road is not defined because the world is depending of the external context and constraints also. And all these countries do not have the same policy. They do not have the same constraints. So of course on the sailboat, the weather is the same for everybody. But here they do not have the same constraints, the same policy, and the same approach about industry. So it is very difficult to say who will arrive first. And maybe the objective is not to say who will arrive first but who will arrive safely to the end point. We do not have one unique solution, but we have several. So in the U.S., of course it is very filled with the political organization of this country. In Russia and China, what they are developing is very connected with their political development. And in France, we are in the middle situation, say, that some part of R&D is paid by the government and you have also a part which is private. So this race, you have to consider it as a sailboat race with external constraints. And we will see at the end who will win or who will arrive first at the end point. Our job in GIF is not to say you have win, [or] you have lost. [It] is just to provide to all these countries some tools to arrive safely to the end point and for sure to the endpoint. So to provide them some white papers on safety on proliferation resistance and physical properties to think about new technologies that we can share etc. So we are not, we know that we are in a race, but in GIF we have to help them and not to design who will win at the end.

Allan:
Thank you very much. I think that analogy about the sailboat race is very true and it is a very helpful reminder that we must be cognizant of the impact that external factors can have on the route that we end up taking to the finish line. Now finally I am going to ask you to look into your crystal ball, if that's okay. And if we were to repeat this discussion in 10 years' time, what topics are areas of nuclear innovation would you like to be discussing or do you

think would be most prevalent?

Gilles:

If we say that we can list the huge amount of innovative systems that we have implemented in a nuclear reactors. But all these innovative systems were not developed only for nuclear but for science in general. I think it will be the best thing that we have done, because in that case, it would mean that we have taken the opportunity to all the efficient worldwide R&D that was developed in technique to implement it inside a nuclear reactor. In that case, we saved time, we saved money, and we were efficient. So, it is some things we really would like to have. Of course we are talking about and we are thinking about advanced manufacturing which is not only devoted to nuclear reactor. We are talking also about artificial intelligence and we all this kind of cross-cutting subject. And we can say that the huge list of system has been implemented now in nuclear reactors, so we have made a good job in that case 10 years after. If I am coming back to 10 years before, when I was younger 10 years before, and I am going back to what I was doing. At that time I was a project leader in nuclear technology. My feeling is 10 years before sometimes I was a little bit frustrated because I was developing a very interesting and innovative system but that was not accepted for budget for the future. So in fact I had developed some systems but Kairos was not here. So it was not the opportunist time. And so there was no continuation of the system at least in France and where the labs that I was developing. I can say one of them, for instance it was super critical CO_2 cycles. I was very fond of these systems, but the budget was not extended in France. It was extended in some other countries. So when I was younger, I was saying they do not understand what I was making and so I do not have the budget. I was very frustrated. Now I am 10 years old, so I get a little bit more wisdom. I should say that sometimes what is making the decision is to be attractive and communicative and not being only in science because the decision makers and the financers, they are sometimes not scientists, and you have to spend time to be attractive. That's all. So this is something 10 years ago. I should have made better in order to develop my ideas. So once again a relationship with time you have of course to define what is important, what is interesting for the future, but you have also to define how I will sell this but selling not with money but with attractivity to say pieces and this is Kairos to say I am taking this opportunity because I am trusting to these innovative systems. And so this is a big challenge when you talk about innovation. We are starting with a small budget. You see that it is very interesting and after you want to increase your budget to develop it. And when the slope is rising and going up, in that case, you have to be very convincing to have the money back and to have the money makers supporting you. And it is a big challenge that you have to take into account any time. Innovation and science is good thing, but you have to be convincing to the other person that what you are making is the best solution for the future.

Allan:

That's great and another really interesting insight. And you know, I am for one I am really happy that you are in forefront and center of trying to take advantage of Kairos. Now that it is here or nearly here and hope that we can we can drive some of these innovations to market as soon as possible. I would like to thank you again for you. A really interesting scholarship discussion and I hope that everybody watching has taken as much from it as I definitely have. It is certainly not every day that I get to talk about the Greek gods of time during working hours. So thank you again.

Gilles:

Okay, thank you. Maybe final words. Two years before, maybe I will not make so many philosophy or analogy. I think that COVID situation has changed our life a lot, because the relationship with time has very changed. And today just to draw a conclusion. I would say something which is quite complex so the COVID has made a very complex relationship with time because we were all or most of us at home and all the day was very usually the same. And so the relationship was time was very complex. At the same time, because of COVID, there was an urgency to say we need very quickly the vaccines etc. In fact everything has changed our relationship with time has changed and for me it was necessary to go back to a little bit to philosophy to understand what I was living right now. Because I could not understand what I was living. So I just wanted to show you a very nice last philosophy approach. Going back to the gods of time. Today the situation in all the society is we are dedicating everything to the present time. Right now we want everything right now. I want something. I take it on amazon. I upload it. I have it right now. The vaccine I want it right now, because I have the urgency. And everything is right now. So we are working in a phase that the only time which is matter is the present time. But if you are living like this, you cannot live. You cannot survive because you have to integrate the whole time. And the present time is giving you stress and angst. And you have to be a little bit more relaxed from this one; otherwise you will drive crazy. So it is a reason why when you feel stressed or angst, think about the gods, Chronos, Kairos, and Aion, to reposition your situation with time. So if we are talking about project management, Chronos is the management time. Kairos opportunist time, and Aion knowledge management time. And you have to dedicate a part of your time to with three gods in order to feel a little bit relaxed. And this is also how you can see the future and innovation.

Allan:

Well thank you Gilles. I think I might be spending some of my weekends thinking about my relationship with time. So uh if you enjoyed this video, I would like to hear more about nuclear innovation. Don't forget to checkout further videos in this series on World Nuclear Association social media platforms. In addition, this video will be available on www.worldnuclearforum.com where you can also find out more information about our upcoming e-forum on innovation taking place on the 23rd of June, during which the exciting panel will be elaborating further on some of these topics. Well, unfortunately that's all we have time for. I would like to thank you again for watching and stay safe.