Challenge for SMRs is to Find 'The Right Economic Model'

NucNet

Small Modular Reactors (SMRs) are being touted as the future of nuclear, but how close are they to deployment and what obstacles remain? *NucNet* spoke to *Stewart Magruder*, Senior Nuclear Safety Officer at the *International Atomic Energy Agency (IAEA)*.

NucNet: Can you give us a general update on the status of SMR development?

Stewart Magruder: *Several countries are building SMRs. The Argentinians have started construction of an SMR prototype called Carem and are expecting to complete it in a couple of years. This is a smaller version of a design they hope to develop further. The Russians have a barge under construction at a shipyard near St Petersburg on which they are mounting two SMRs. They are building on the reactor technology they have used for years on their icebreakers. They are planning to tow this barge to a harbour on the northern coast of Russia to provide power to remote areas. The Chinese are building a high-temperature gas-cooled reactor. Again, this is a smaller prototype version which they are hoping to scale up. In the US, there are plans by two utilities to build SMRs – one in Tennessee and one in Idaho. The Saudis recently signed an agreement with the South Koreans to complete the design of the 'Smart' reactor and potentially build some in Saudi Arabia. Other countries have also talked of SMRs, but these are the ones that have come closest to completion and eventual deployment.*

NucNet: What are the main differences between the regulatory process for SMRs and the process for traditional reactors?

Stewart Magruder: *The differences are small. For now at least, most SMR designs are of the light-water reactor type and most existing regulatory requirements are still applicable. The key point is that SMRs are considered to be nuclear power plants and the regulatory process is generally the same as for traditional reactors. There will potentially be only minor changes, related mostly to the unique features of SMRs – the fact that they may comprise multiple modules on one site that are operated from a single control room, and that they will likely be built underground and will have smaller cores, which may allow for smaller emergency planning zones around the reactor sites.*

NucNet: What are the main safety aspects of SMRs and how do they differ in terms of safety systems from conventional reactors?

Stewart Magruder: *Because SMRs are smaller and generally have more passive safety systems they – at least based on vendors' claims – allow for longer reaction time and less input from operators in the event of an accident. SMRs are being designed to be easier to operate than existing reactors. The fact that there is more water available to cool the core means that an emergency situation could develop more slowly.*

NucNet: What are the considerations when it comes to the decommissioning, disposal, and end-cycle issues related to SMRs?

Stewart Magruder: *This is a very good point. The nuclear industry has learned through experience that it is much better to plan for decommissioning before you start operating a reactor. So all these new designs take into account how they need to be decommissioned. Since SMRs are smaller, the idea is that you could first remove the fuel from the reactor and should then be able to remove the whole reactor vessel and (in some cases) also the containment and dispose of them somewhere else. Ideally, this would make the potential site much easier to clean up when you eventually want to finally decommission it.*

NucNet: What do you think are the major obstacles to SMR development?

Stewart Magruder: *I think the obstacles now are mostly related to the economic aspects of SMRs. The designs are being completed. However, before they start building SMRs, the vendors will need some assurance that they can sell them. And they would need this assurance before they invest in their factory. In other words, the business case may be the overriding factor for eventually deploying many SMRs.*

NucNet: And what about regulatory challenges?

Stewart Magruder: *The main issue is whether or not the emergency planning zone can be reduced significantly, which relates directly to where SMRs can be deployed. The SMR vendors are affected by this. They are hoping these zones can be reduced because it would mean they can sell more SMRs. The reason is that for many countries the appeal of SMRs is that they can be used to replace old, 'dirty' fossil plants, such as coal or oil plants. If you could simply remove the coal or oil plant and replace it with an SMR, you would already have the relevant infrastructure and transmission lines in place. But many of those fossil plants are close to population centres. So, I think the key regulatory decision for the deployment of SMRs is whether or not it can be proven that they are safe enough for a much-reduced emergency planning zone.*

NucNet: An IAEA meeting in September 2015 was told there are about 45 SMR designs under development around the world, half of them being prepared for deployment over the next 10 years, and the first three expected to become operational over the next four years. Is this an accurate assessment of the situation?

Stewart Magruder: *The information you have there as far as I know is still accurate. There are indeed a lot of conceptual designs now. I think some of them are really closer to deployment. Close to half of them could potentially be deployed in the next 10 years or so. The first three – in Argentina, Russia and China – will soon be deployed. The ones in Argentina and China, as I mentioned, are prototypes, smaller versions. In the nuclear industry it is common to build a prototype first to test the concept before building a larger plant.*

NucNet: Why is the development of SMRs seen as so important?

Stewart Magruder: *I think it depends from which side of the world is looking at it. We just had a workshop with countries belonging to the Arab network of nuclear regulators. In the Arab region many of the electrical grids are of fairly small capacity. So, building a 1,000-megawatt or 1,500-megawatt plant will be overwhelming for their grid and very expensive.*

A smaller reactor, maybe of 200 to 300 megawatts, which requires much less capital investment, and makes a lot more sense for these countries and other developing nations. One of the attributes of SMRs is that they can also provide steam for desalination plants, so they are potentially useful for countries that need fresh water. And if the safety case can be proven, SMRs can replace existing fossil fuel plants and significantly help reduce greenhouse gas emissions.

NucNet: What is the future of SMRs in developing countries? Could they realistically play a significant role in developing areas such as Africa?

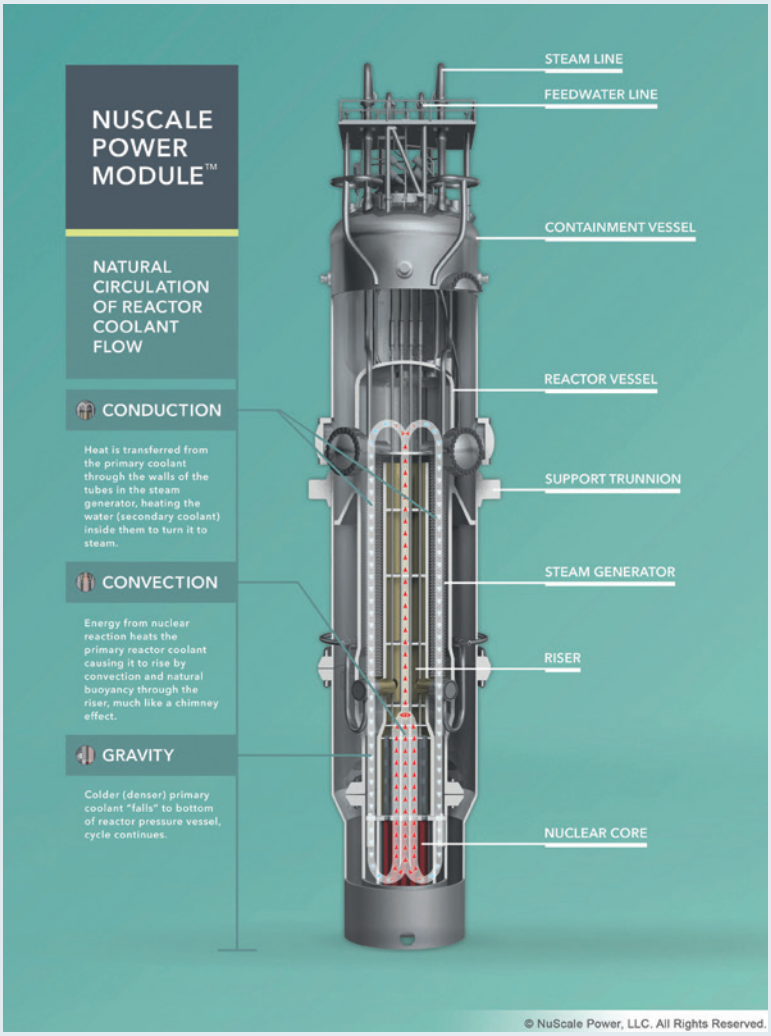
Stewart Magruder: *A very important point here is that the legal, regulatory, scientific, and technical infrastructure needed for SMRs is pretty much the same as it would be for a regular large nuclear power plant. There are no shortcuts for developing countries when it comes to SMRs. It could be a little bit easier because the financial investment is smaller and you need fewer operators and fewer inspectors. But still, all the safety infrastructure must be developed before an SMR can be deployed. So, the IAEA has been continuously sending this message to developing countries and, I think, it has been well received. Actually, the timing of the readiness of SMR designs aligns fairly well with the readiness of countries that are developing their nuclear programmes. Also, most developing countries have to wait for an SMR to be operational in a developed country so they can make sure it will function as advertised before they buy it. So most developing countries need to wait until China, Russia, or the US actually operate an SMR for a few years before they sign up to get one.*

NucNet: A few words on the IAEA's activities to facilitate SMR deployment?

Stewart Magruder: *We are indeed facilitating the process among experienced regulators who are thinking seriously about SMRs. The IAEA's SMR Regulators Forum meets to try to reach a common position on some of the outstanding issues such as the size of the EPZ [emergency planning zone], approaches to defence-in-depth, and a graded approach to the safety review. Because SMRs are seen as being more easily deployable, some of the leading nuclear countries wanted to talk to each other to make sure they could forge consistent approaches to SMR designs. The IAEA is facilitating these discussions between the different regulators. We are also reviewing our safety requirements and safety guidelines to see where they may need to be modified to allow for all member states to deploy the SMRs they want to.*

NucNet: We have spoken about plans for floating SMRs. Are there any additional security concerns surrounding this?

Stewart Magruder: *The idea of a floating nuclear power plant may present challenges that will eventually have to be addressed. Security is one of them. At the IAEA there have been several meetings on the conditions that would have to be met before deploying a floating nuclear plant. The main difference is that these plants would be fuelled and tested at the site where they are manufactured and then the reactors would be shut down and towed to the site where they would be deployed. And that has never been done. There are obviously international treaties that would have to be potentially revisited in the event of the worldwide deployment of floating SMRs.*



| Example for an SMR concept: The NuScale Power Module™

NucNet: Are SMRs the future of nuclear?

Stewart Magruder: *I don't think that SMRs will ever replace the need for large baseload nuclear plants. I think there are still a lot of countries which need large amounts of power and will continue to build large nuclear plants. However, in my opinion SMRs may fill another need, especially for countries with smaller grids. Potentially, SMRs could work in parallel with larger nuclear power plants, but are unlikely to replace them. They could eventually complement each other.*

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