

# a fuel cycle for the 21<sup>st</sup> Century

*At a time of nuclear revival, the need for ensuring best practices throughout the entire fuel cycle is greater than ever. Hans Forsström, a leading nuclear fuel cycle and waste technology expert, spoke with IAEA Bulletin Editor Giovanni Verlini about the latest developments in this field.*

**Question:** *Many experts are predicting a so-called 'renaissance' in nuclear power generation over the coming years. What would be the consequences of this renaissance — should it actually materialise — on the nuclear fuel cycle?*

**Hans Forsstroem:** The most important thing to consider is that all these reactors in the planning will need fuel. Essentially, fuel means the uranium that you mine, enrich and make it into fuel. Therefore, it's important that the capacity for producing uranium and fuel matches the needs. Presently, we are witnessing an increase in uranium exploration, and it is widely believed that we will be able to match future needs.

The second issue in this nuclear renaissance is that it will probably lead to more fuel being recycled. In the longer term, this might be done in fast reactors which utilise fuel more efficiently. But in the shorter term, over, say 20 years, it's clear that most of the reactors will be of the same kind as those that we have today, as will be the fuel cycle.

**Q:** *What is the IAEA doing to develop the nuclear fuel cycle?*

**HF:** There are several aspects to the IAEA's work that need to be considered. First of all, today we have an efficient market that provides the services

and the fuel needed. The IAEA is ensuring that this market operates safely and under safeguards.

In a longer time perspective, many countries might want to develop enrichment or reprocessing facilities, which could lead to a spreading of sensitive technology. This is why the IAEA's Director General has proposed that in the future enrichment facilities should be under international control. This would also provide improved assurance of supply. Still the most important assurance will continue to be provided by the market.

**Q:** *In some cases, uranium mining activities carried out in the past created legacies that, perhaps, could have been avoided. What can be done to avoid repeating the same mistakes in the future?*

**HF:** First of all, one should acknowledge the fact that uranium mining today is done in an environmentally-controlled way. Having said that, it is also true that there are legacy sites from the past that are being remediated, both in the West and in the former Soviet Union. But the important thing is to learn the lessons from the past, making sure that when a new country gets into uranium mining the appropriate legislation is in place and

the right technology is used. There are several activities going in this direction. One is being done through the IAEA's technical cooperation programme, with the Agency giving advice to Member States on these issues. Another one is the cooperation between the IAEA and the World Nuclear Association to provide a code of practice for uranium mining companies, making sure that those who are working in the uranium/mining industry are working in a proper way. If one company misbehaves, it will have an influence on all the others.

**Q:** *Some pundits say that for nuclear energy to become really sustainable, fast reactors need to be introduced in the market. However, fast reactors raise a number of questions relating to efficiency and non-proliferation, for example. What is your opinion on this issue?*

**HF:** It's obvious that if you're going to have nuclear power over several hundred years at some point you will need to utilise resources better, and that is where fast reactors come in. They have been under development for many years, but it will still take quite sometime to see them introduced commercially.

There are a number of issues which need to be dealt with: there are safety issues as well as proliferation issues.



Photos: G.Verlini/IAEA

With fast reactors and the recycling of spent fuel you will have more material being moved, transported and used. A crucial point will be the development of a safeguard control system and of a fuel cycle that are in themselves proliferation-resistant.

**Q:** *Waste management issues remain a factor of concern in many countries. Are there developments in this area?*

**HF:** Waste management is a broad issue, involving taking care of the low level waste from the operation of reactors, as well as the spent fuel. There are several countries that already have disposal facilities for low level waste. Others do not, often because there has been political or public opposition to it. There is, however, no disposal facility in operation for spent fuel or high level waste from reprocessing of spent fuel. This waste is long lived, highly active and produces heat. All those who work in this area agree that this type of waste should be disposed of at depth in geological formations. Crucially, in the case of both spent fuel and high level waste is that the volumes are fairly small, and the material can be easily stored. We have 50 years of experience of storing nuclear waste, and we have a good record: from a technical point of view, it's clear how it can be done — it's being done in several countries.

The developing time of disposal facilities is also a critical factor. It takes at least 40

years to come from a concept for disposal to actually doing the work. And that's not only bad. During those 40 years quite a lot of the heat load of the waste is lost through normal radioactive decay. That means that you can pack the waste more tightly in the rock.

In Sweden, where I worked earlier, we made the planning in the 1980s saying that the first disposal should take place in 2020. The plan is still that the first disposal will take place in 2020.

**Q:** *Another important aspect of the nuclear fuel cycle is the decommissioning of nuclear power stations. Have there been advancements there?*

**HF:** There are several nuclear reactors in the world which have been completely dismantled. At present, a total of 10 large nuclear power plants have been completely decommissioned and the sites released for unconditional use. This means that everything that was radioactive in the area has been removed, taken to a disposal facility and disposed of. Today you can actually get a contractor to come in and do the work, so the technology is clearly there.

In addition, some of the reactors which have stopped operating are kept under control but they are not being dismantled because there is no place for the waste for the time being. In some cases, some operators are also waiting for the

radioactivity in the plant to decrease. Having said that, in most countries nowadays the plan is to go quite rapidly to dismantling — this means starting operations within 10 to 20 years after stopping the reactor.

Another issue is the dismantling of research reactors, where the technology is available but perhaps the funding and the staff are not there. The IAEA is providing advice to Member States that do not have nuclear power but have nuclear research reactors, helping them plan for the decommissioning, assessing how much the operation will cost and who should fund it.

**Q:** *The nuclear sector has been calling for stronger international cooperation, in areas such as waste management and decommissioning for years now. What is the IAEA doing to achieve this goal?*

**HF:** The IAEA is supporting work toward cooperation on disposal. For the time being, cooperation on waste management and decommissioning is mostly of the kind of information exchange though, in the future, it might be possible that countries agree to develop multinational storage facilities and repositories. The IAEA has done a number of studies of what that would mean. But right now, such a project would have a number of political and public acceptance problems.

**Q:** Nuclear technology is a topic that engages the public like few others. What can be done to involve public opinion in a positive manner?

**HF:** The first issue is to acknowledge that there are fears around nuclear power and to understand that fears are legitimate. It could be said that they exist where there is not enough knowledge, but it has to be acknowledged that the fears are there.

The second point is that openness is extremely important. The nuclear industry has a record of not being very open to the public, partly because some of the nuclear industry comes from the mili-

tary side. But the situation has improved a lot. It's clear that in a modern society, if you want to achieve something, you need to involve the public and let them have their say. You cannot just say: "This is good, let's do it."

Good experience is also another important element. When you operate reactors for a long time in a good way, people see that nuclear works well and it is safe. In my country, Sweden, we had a strong debate on nuclear power in the 1970s and early 1980s and there was strong opposition to nuclear power at the time. Today, people have seen the reactors operating well, providing electricity at

a reasonable price and the whole issue being handled in a responsible way. If you look at the polls today, Sweden is almost the most positive nuclear country in Europe. Discussions have restarted, although a decision is far from having been reached, on whether the country should have new nuclear power plants built.

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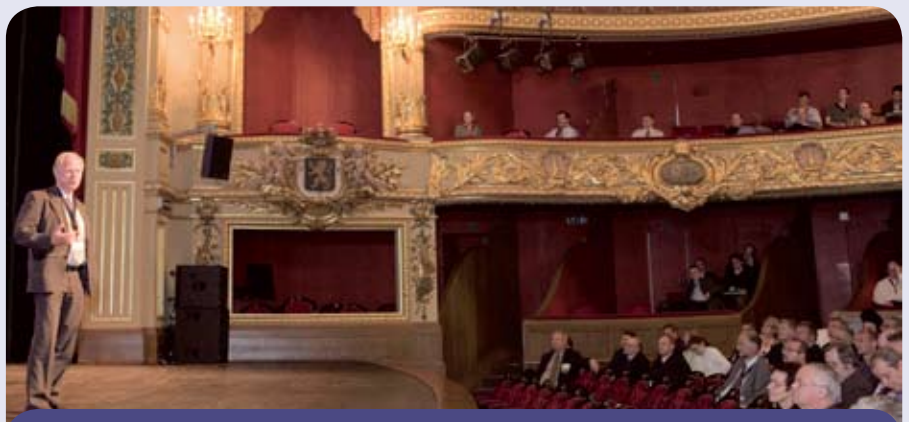
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## Nuclear Waste and Old Laces

In the historic Flemish city of Bruges, famous its medieval buildings and lace craftsmanship, top nuclear experts and regulators met to discuss the future of environmental remediation and radioactive waste management.

Global partnering for the the nuclear sector was the focus of the five-day 11th *International Conference on Environmental Remediation and Radioactive Waste Management* (ICEM '07). At a time when preoccupations for the environment and energy security are driving a renewed interest in nuclear power, more needs to be done to promote international cooperation and share information and experience amongst authorities and companies within the nuclear sector itself as well as with the public.

Setting up global environmental partnerships and cooperative agreements is essential to demonstrate good governance in a society that demands to be actively informed and participate in the decision-making process around nuclear issues. As Anibal Taboas, Conference General Chair, reminded the audience of, in today's society, education, energy, the environment and the economy are inextricably linked,



The IAEA's Hans Forsström delivering his keynote speech in Bruges. Photo: ICEM'07

and the nuclear sector has an invaluable opportunity to recast the way it is perceived throughout the world.

Focusing on uranium mine and mill remediation issues, the *Uranium Mining Remediation Exchange Group* (UMREG) Roundtable also took place during ICEM '07. During the roundtable, Peter Waggitt, a consultant in mining environmental issues, reported on the IAEA Central Asian Project, which is looking at developing a regulatory framework and a plan of action to deal

with legacy problems in former Soviet sites. "Good progress has been made so far, and I am happy to be able report that the situation is not as bad as originally estimated," Waggitt commented. "However, it is still too early to draw a conclusion for the project."

The 11th *International Conference on Environmental Remediation and Radioactive Waste Management* (ICEM'07) was held in Bruges, Belgium, from 2-6 September 2007.