Saint-Petersburg Conference

Session 4. Drivers for Deployment of Sustainable and Innovative Technology

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Chairman,

Ministers,

Ladies and Gentlemen,

It is a great pleasure and honour to be given the opportunity to speak to you here today at this ministerial conference, an important event for the international community following those held in Paris and Beijing, to discuss the future of nuclear energy. I would like to thank the organizers, the International Atomic Energy Agency (IAEA), the OECD's Nuclear Energy Agency (NEA), the government of the Russian Federation and of course ROSATOM for the invitation to take part in this roundtable discussion on the drivers for deployment of sustainable and innovative technology. My speech will focus on the role of the closed fuel cycle and innovation for nuclear technology.

Following the Fukushima-Daiichi accident, the development of nuclear energy slowed slightly, but did not come to a stop. Many countries confirmed their nuclear option and are calling on this source of energy to meet their rapidly growing electricity needs. For them, nuclear energy is not just an option but a necessity. Indeed, nuclear energy remains the main non-GHG emitting energy source that enables mass production of electricity at affordable rates.

The responsible development of nuclear energy necessarily involves taking into account all the lessons learned from this accident as well as a strengthening of the international nuclear safety regime and a stepping up of security and non-proliferation measures. We must also ensure that nuclear energy can be implemented with the greatest heed for environmental protection, both with regard to nuclear reactors and to the nuclear fuel cycle.

The back end of the cycle today.

At present there are diverse situations:

- Spent fuel can be considered as waste, and therefore destined to be stored or disposed of in deep geological repositories following suitable cooling time in interim, above-ground storage.
- Spent fuel can be considered as a potential resource, and in that case it must be recycled. This is the aim of processing spent fuel and recycling it in light-water reactors to begin with – which is an industrial reality today – and in the future, much more efficiently and completely, in fast-neutron reactors, which are the subject of ambitious research and development in several countries across the world. Final waste from processing

operations is then conditioned in a particularly robust package – a vitrified matrix – and sent for disposal in deep geological repositories.

- Often, fuel is managed in long-term interim storage configurations. Technically, they can provide safe management of spent nuclear fuel over a period of time of the order of 50 years, but extending the period beyond this raises questions as to the long-term behaviour of nuclear fuel which was not initially designed for this type of situation.

More fundamentally, long-term interim storage should not turn into a long-term stop-gap situation because we have failed to define a more pro-active management policy and strategy.

The principles for responsible management of the back end of the cycle.

The international community agrees on the basic principle of not letting spent nuclear fuel build up in nuclear power plant sites. Indeed, the multiplication of this kind of storage is probably not conducive to nuclear safety, security or non-proliferation.

Nevertheless, the solutions which could be implemented must comply with the principle of responsibility also set out in the Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management. Countries which have authorized the commissioning of nuclear power plants within their borders remain responsible for the management of spent fuel and radioactive waste produced, without fixed time limits.

This is of course the primary responsibility of the nuclear operator which operates the power plant under the supervision of the State, as set out in the Fundamental principles of the IAEA. This is of course a major responsibility for a country which has committed to implementing a nuclear power programme over the very long-term.

French recycling and reprocessing policy.

From an early date France made the choice to reprocess and recycle spent nuclear fuel to promote the sustainable use of nuclear energy.

This strategy has enabled France to make savings of nearly 20% on the consumption of natural uranium. It also enables the production of plutonium-free waste, with high-level waste packaged in a high-quality vitrified matrix, the result of nearly 30 years of research and development work.

At present France operates 58 pressurized water reactors, including 24 which are MOX-compatible, which corresponds to the processing and recycling of more than 1,000 t / year of spent nuclear fuel.

Two major industrial facilities have been commissioned for this. These are the La Hague reprocessing plant, which has processed more than 25,000 t of spent nuclear fuel, and the MELOX fuel fabrication plant, which has produced more than 2,000 t of MOX fuel.

Furthermore, France continues to offer processing / recycling services, with the return of final waste.

This practice complies with French legislation, which enables the processing of spent waste from abroad but prohibits the storage of radioactive waste from spent fuel from abroad. It is also compliant with the principle of responsibility of the country which authorized the operation of nuclear power plants within its borders, since they take back their final waste. The benefit of this is that the waste is conditioned in an efficient way for the purposes of interim storage and geological disposal:

- The small volume of waste and near-absence of fissile materials enables compact storage, without the need for the implementation of specific non-proliferation measures.
- The reduction in radiotoxic inventory, in particular the elimination of plutonium, and quality of the packaging, should facilitate a demonstration of the safety of storage and disposal solutions.

The multinational storage of nuclear fuel and radioactive waste.

While it is necessary for the major nuclear countries to have national disposal sites, in the future we must also think about regional storage. The principle of responsibility and the practices in France for the back end of the nuclear fuel cycle are not in contradiction with the development of the concepts of geological disposal pooled between several countries. France actively takes part in the work of the IFNEC forum (International Framework for Nuclear Cooperation), and in particular for the fuel cycle. Current work is mainly carried out around the concept of CFS (Comprehensive Fuel Services), which aims to widen the scope of existing industrial services to multinational disposal. This is indeed an attractive goal, because it would avoid the accumulation over an indeterminate amount of time of spent nuclear fuel in production sites, but it is important to determine the conditions under which it could be implemented, in particular the role and responsibilities of the countries involved. Indeed, a consensus needs to emerge, in the main international forums, whether in the IAEA, the Joint Convention or the IFNEC, on the basic requirements relating to the creation and operation of a multinational storage or disposal centre. In particular, the host country and customer countries would have to guarantee their long-term commitment to:

- safety, security and non-proliferation measures, these being the primary responsibility of the host country, which must provide the international community with all necessary guarantees as to their high standard;
- the guarantee of the storage or disposal service, through inter-governmental agreements;
- the long-term financing for the storage or disposal of spent fuel and high-level waste.

The search for a consensus will require us to be demanding with regard to its content, and take into account all prior considerations, but this is a necessary condition if we hope to implement a multinational storage facility.

Towards more sustainable nuclear energy

Reprocessing / recycling as currently practiced is just a first step towards an effective closed cycle. To go further, the prospect of longer-term sustainable nuclear energy requires consideration of the following questions:

- The growth of the global nuclear fleet and the availability of uranium resources; the various growth scenarios show that towards the middle of the century tensions may arise on the uranium market. We must therefore find more efficient technology for the use of natural uranium.

- Control over the growth of the plutonium stockpile contained in spent fuel. It is incumbent upon us not to allow veritable plutonium mines to build up for the future.
- The issue of long-life waste. Beyond the issue of plutonium, with the separation and transmutation of minor actinides, a strong reduction in the radiological toxicity of radioactive waste to be placed in geological storage is possible.

The technology which enables concrete answers to these questions to be put forward is that of fast-neutron reactors. The Generation IV International Forum knew exactly what it was about when it selected the nuclear systems of the future: four out of the six systems selected are fast-neutron systems; reactor types are sodium, lead or gas-cooled, as well as molten-salt reactors in the longer term.

These reactors usher in the following types of performance:

- Unlike the reactors currently in operation which only use around 1% of the natural uranium, they are capable of using nearly all of it by multiplying the energy extracted from the same mass of uranium by a factor of 100.
- They are capable of burning plutonium, whatever its composition, and therefore enable its multi-recycling.
- Furthermore, fast neutrons also enable the effective transmutation into components with shorter lifecycles of minor actinides such a neptunium or americium.

In recent years many countries have embarked on such developments. The following recent events may be mentioned: Russia has launched a large-scale national programme which includes the construction of new prototypes, India is completing the construction of a prototype, South Korea has launched a prototype construction project, China has commissioned an experimental reactor, Japan is preparing to restart Monju, the USA are restarting a coherent basic research programme and Europe is structuring its resources under the SNETP technological platform for sustainable nuclear energy.
Within the context of the 2006 law on the sustainable management of nuclear materials and radioactive waste, France is also proactive in preparing the nuclear technology of the future with its commitment to the ASTRID programme – an innovative technological prototype sodium-cooled fast-neutron reactor – in addition to its involvement in an ambitious longer-term project, ALLEGRA – a gas-cooled fast-neutron reactor demonstrator, a project led by a consortium of central European countries.

The ASTRID prototype is a fourth-generation reactor with a capacity of 600 MWe. It is undergoing preliminary design until 2015 and detailed design is scheduled through to 2019, which is the key date for a construction decision. It should be commissioned in around 2025.

ASTRID's design takes into account the lessons learned from the Fukushima-Daiichi accident. It incorporates the benefits introduced by the "pool" type concept giving it a very high thermal inertia, diversified cold sources, a natural circulation capacity in the event of a total loss of electricity supply and cold source. The nuclear safety objectives applied to ASTRID are derived from those of the Western European Nuclear Regulators Association (WENRA). These safety requirements are also verified with regard to design criteria defined by the Generation IV International Forum.

At present around 500 people are working on this project as part of an organization involving national industrial partners such as EDF, AREVA, ALSTOM, Bouygues, COMEX Nucléaire and Jacobs France, and international groups such as Toshiba, Rolls Royce and ASTRIUM. The CEA has also developed cooperation with a number of countries and organizations: for example with Japan on core degradation and on fuel for fast-neutron reactors; with India on nuclear safety and serious accidents; with the U.S. Department of Energy on core safety, and of course with Russia in the fields of safety, materials and the qualification of fuel, for the moment.

Conclusions

In conclusion, I would like to share with you my strong belief that nuclear energy, with tightly controlled and continuously improving nuclear safety underpinned by a strong nuclear safety culture adopted by all stakeholders, first and foremost by the nuclear operators and the inspection authorities, will continue to play a major role in the 21st century and beyond, provided it meets the criteria for sustainable development.

This also requires the implementation of a responsible nuclear fuel cycle. To be sustainable and meet the challenges of the best possible use of uranium, minimize the radiological toxicity of radioactive waste and also enable control over plutonium stocks in spent fuel, the future of nuclear energy must eventually focus on the development of fast-neutron reactors and a closed cycle.

Thank you very much for your attention.