ASN Opinion 2015-AV-0226 of 8th January 2015 concerning the identification of research subjects to be taken further in various fields of nuclear safety and radiation protection

ASN (Autorité de Sûreté Nucléaire – French Nuclear Safety Authority),

Having regard to the Environment Code, in particular its Articles L.591-1 and following;

Having regard to ASN opinion 2012-AV-0147 of 10th April 2012 concerning the importance of research for ASN and the identification of initial research topics to be taken further in the fields of nuclear safety and radiation protection;

Having regard to the recommendations by the ASN Scientific Committee of 14th August 2012, 21st December 2012, 29th July 2013, 11th December 2013;

Whereas the Bill on energy transition for green growth confirms the role that ASN can play in overseeing the adaptation of public research to the needs of nuclear safety and radiation protection,

Issues the following opinion on the research topics to be taken further in the following fields of nuclear safety and radiation protection:
- packaging of radioactive waste,
- deep geological disposal,
- transport of radioactive substances ,
- severe accidents.

1 – In the field of packaging of radioactive waste, ASN:

Underlines that the diversity of the waste produced by the BNIs (physical-chemical nature, radiological activity, radioactive half-life of the radionuclides contained, etc.) demands a wide variety of packaging solutions appropriate to the waste but also to the subsequent management conditions for these packages (storage, transport, handling and disposal);

Considers that the licensees must continue their efforts to characterise the radioactive waste and search for packaging solutions appropriate to the radioactive substances. Moreover, for packages already produced and intended for disposal in a disposal facility still under consideration, research is required into their behaviour once in the disposal facility;

Recommends that research be taken further concerning:
- the characterisation of the chemical species contained in the radioactive waste and the waste radiological characterisation methodologies, more specifically as the result of the legacy waste retrieval and packaging operations (RCD),
- the long-term behaviour of the waste packages in disposal conditions, in particular the possible interactions between different types of packages (joint disposal) and the interactions with the engineered barriers or the natural environment of the disposal facility,

- the behaviour of bituminised sludge wastes;
- matrix-waste interaction, in particular in the case of a cement matrix,
- the production of hydrogen in the packages and in particular the determination of radiolytic yield and treatment solutions for organic matter,
- the characterisation and the long-term disposal behaviour of radioactive materials which are not at present considered to be waste (MOX fuels, depleted uranium, etc.).

2 – In the field of deep geological disposal, ASN:

Recalls that protecting the health of individuals and the environment is the fundamental safety objective of the deep geological disposal of radioactive waste. This protection must be guaranteed in terms of the risks linked to the dissemination of radioactive and toxic chemical substances. The characteristics of the chosen site, the layout of the disposal facility, the design of the artificial components (packages, engineered components) and the quality of their construction constitute the foundations underpinning the safety of the disposal facility;

Considers it necessary to encourage cooperation at various levels, on the one hand by promoting exchanges between research organisations and universities, licensees or future licensees of disposal facilities, representatives of civil society and producers of waste, both national and international, and on the other by continuing to look at new fields in order to gain a clearer understanding of the long-term safety aspects of disposal;

Recommends:
- expanding research into the identification and modelling of the physical-chemical, biological, mechanical and thermal phenomena occurring within a disposal facility, more specifically the transitional phases, paying particular attention to the qualification of these models and especially the management of the associated uncertainties,
- developing work on the design and qualification of observation and surveillance methods, in particular with a view to reversible management of a disposal facility,
- promoting research to target organisational and human factors over an operating period of a century and the transmission of expertise, know-how and memory over appropriate time-scales.

3 – In the field of the transport of radioactive substances , ASN:

Underlines that numerous parameters are involved in the safety of a transport package. Many of them concern the materials used for the biological shielding (type of steel), thermal protection (insulators, heat dissipating materials), mechanical protection (shock-absorbing materials) or containment (type of seals). Others concern the characterisation of the contents, the behaviour of the package over time or in the event of an accident;

Considers that there are safety margins on the packages to make up for the lack of available data. However, in the case of any shortcomings in the package model safety demonstration, maintaining these margins may lead to restricting the quantities to be transported, which would lead to an increase in the number of shipments and thus a higher probability of accidents;

Recommends:
- maintaining the research efforts into criticality, to avoid contributing to an increase in the number of shipments,
- encouraging research into the long-term behaviour of the materials used in the manufacture of transport packaging,
- continuing work to prevent the risk of radiolysis, a phenomenon which is hard to model,
- paying continued attention to the conditions in which waste already packaged and today stored could be transported,
- anticipating transport questions relating to future reactors, whether in terms of fuel or in terms of disposal of dismantling waste during future decommissioning operations.

4 – In the field of severe accidents, ASN:

Underlines the importance of understanding the phenomena which occur during severe accidents, both for management of existing reactors in such situations and for the design of the new generation of reactors;

Considers that the Fukushima accident confirms the need to continue to work in this direction;

Recommends expanding the following fields of research in particular:

- core cooling during reflooding: there are experimental data, but they still comprise significant uncertainties with respect to the ability to prevent core melt;
- corium cooling in the reactor vessel: experimental data are available, but considerable uncertainty remains as to the ability to cool the bed of debris in the vessel bottom head;
- vessel integrity in the event of external cooling: it is hard to demonstrate that for the large reactors, the corium will be maintained in the vessel. The programme concerning corium behaviour in the vessel bottom head must supplement the existing data, in particular concerning metal/oxide stratification and heat transfer to the vessel wall;
- corium cooling outside the vessel in order to preserve the containment: the experimental data available on top-down cooling of a corium bath in the reactor pit must be supplemented by technological research to demonstrate the effectiveness of bottom-up cooling of the bath, obtained by means of water injection systems positioned in the basemat;
- filtration of radioactive releases: research must be continued to develop highly efficient filtration systems for the various species of iodine and ruthenium liable to be released outside the containment in the case of venting for long periods of time.

Done in Montrouge, on 8th January 2015.

The ASN Commission,

Signed by:

Pierre-Franck CHEVET

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