Finnish Research Programme on Nuclear Waste Management KYT 2010
Steering Group guidelines for 2009 research project search

In the 2009 research project search, the KYT2010 programme focuses on assessing the long-term safety of the final disposal of spent nuclear fuel. The aim is to compile the programme and related projects in such a way that their topics and schedules take account of how soon the construction licence for the final disposal repository will be considered, while also making reference to the licence schedule. The various research sub-areas covered relate to the safety case in question and support an assessment of the final disposal facility's functional capacity. A survey of the various sub-areas' significance in terms of their objectives tells us that, towards the end of the programme period, research on engineered barriers will be emphasised when assessing the long-term safety of final disposal.

The final disposal canister is the single most important barrier in the Finnish final disposal concept regarding spent fuel. Such a canister is designed to isolate the spent fuel from its environment for a sufficiently long period of time. Research topics potentially suited to the KYT2010 programme, and related to assessing the operating life of the canister, include the stress corrosion and creep strength of copper. Another topic that may be assessed is the possible corrosion of copper, due to water in anoxic conditions, recently mentioned in literature within the field. A more precise assessment of the canister's operating life requires coupled modelling of various processes, whereby simultaneous processes influence not only each other but also jointly affect the canister's integrity. The significance of microbiological processes should also be examined as regards corrosion phenomena. Studies must be linked to research on near-field environment chemistry, in order to ensure test and modelling conditions in accordance with the best knowledge available.

Proving the functional capacity of the bentonite buffer is a key safety issue. The bentonite buffer installed in the final disposal repository must be fully saturated in high temperature conditions, after which it must retain its properties for a very long time, regardless of anticipated changes in conditions (groundwater chemistry and flow, temperature, rock displacements). These issues can be studied via mathematical modelling but, should the opportunity arise, such modelling should be linked to experimental studies, such as international experimental projects or a domestic one. In order to avoid overlaps, the research plan must be integrated with studies by other actors. Particular attention must be paid to the problems that may occur when laboratory-scale experimental data is used in full-scale modelling.

Future periods of permafrost represent key problems in terms of the functional capacity of the final disposal repository. For this purpose, studies should focus on the types of conditions required in order to enable permafrost to reach the final disposal depth and on the probability of such conditions occurring in the future. However, when studying permafrost, the fundamental question is how permafrost and its various phases influence the functional capacity and stability of engineered barriers, bentonite in particular and, in such a case, how significant this would be in relation to safety.

This year's KYT2010 programme includes projects on reactive transport modelling and geomicrobiology. Domestic expertise should be enhanced in these fields and some of the projects may comprise methodological research in support of the safety analysis. In particular, reactive transport modelling should be applied to chemical modelling of the final disposal environment, for example the transport of alkaline waters, of meltwaters containing oxygen, and of dilute glacial period meltwaters. Information on the applicability and benefits of reactive transport modelling is particularly required with respect to bentonite and the canister's functional capacity.

The degradation and dissolution of fuel is a key topic that has attracted very little attention in public research. Consideration of this topic would be justified with respect to the training of new experts. Reports on safety related, in particular, to the evolution of high burn-up fuel (such as EPR) may be included in the KYT2010 programme (e.g. degradation, dissolution, void fractions), because fuel constitutes the source term for waste management safety analyses. Projects must seek synergies with studies on EPR fuel high burn-up related to reactor safety, conducted both in Finland and abroad (e.g. France and the United States).

In addition to projects related to the safety of final disposal, the KYT2010 programme includes studies of alternatives in nuclear waste management and sociological research regarding the EIA and DIP processes of the final disposal facility to be constructed. Final disposal of low and intermediate level waste is included, on a fairly small scale, in the KYT2010 programme. Areas requiring further study concern e.g. predicting the behaviour of reinforced concrete structures. The topics of studies on alternatives in nuclear waste management should include issues such as monitoring of the GNEP and MNA programmes and reporting of key issues.

Closer networking of projects in the home country and international cooperation are recommended. Projects must seek practical means of integrating various sub-areas under the safety premises in question (e.g. utilisation of PRA or scenario analytics). In this context, cooperation and integration refer to an endeavour to examine the system in full, rather than examining the behaviour of individual sectors.

Abbreviations:
EPR- European pressurised water reactor
EIA- environmental impact assessment
DIP- Decision in Principle
PRA Probabilistic Risk Analysis
GNEP- Global Nuclear Energy Partnership
MNA- multilateral approaches for nuclear fuel cycles