Expert Group on Accident Tolerant Fuels for LWRs (EGATFL)

Chair	K. Pasamehmetoglu, United States
Members:	All NEA Member countries
Invitee:	P.R. of China
Observers (International Organisation):	International Atomic Energy Agency (IAEA) (*by agreement*)
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Scope

Under the guidance of the Nuclear Science Committee, the Expert Group will primarily act as a forum for scientific and technical information exchange on advanced light water reactor (LWR) fuels with enhanced accident tolerance. The Expert Group will focus on the fundamental properties and behaviour under normal operations and accident conditions for advanced core materials and components (fuels, cladding, control rods, etc.). The materials considered will be applicable to generation II and generation III light water reactors, as well as generation III+ reactors under construction.

Objectives

The objective of the Expert Group will be to define and co-ordinate a programme of work to help advance the scientific knowledge needed to provide the technical underpinning for the development of advanced LWR fuels with enhanced accident tolerance compared to currently used zircaloy/UO_2 fuels, as well as other non-fuel core components with important roles in LWR performance under accident conditions.

In particular, the Expert Group will foster information exchange on material properties and relevant phenomenological experiments, carry out state-of-the-art reviews, organise benchmark studies and foster international collaboration regarding the development of core materials and designs which provide an improved tolerance to accidents. Conditions such as those experienced during the Fukushima Daiichi accident will be considered, but the considerations will not be limited to events similar to Fukushima.

Ideally the new designs will provide enhanced tolerance to extended station blackout conditions with loss of active cooling, while maintaining or improving the fuel performance and safety characteristics during normal operations and for other design-basis-accident (DBA) or beyond-design-basis-accident (BDBA) scenarios.

Desired characteristics of these enhanced materials and designs include:

- improved reaction kinetics with steam;
- reduced hydrogen generation rate;
- improved fuel and cladding thermo-mechanical properties to retain coolable and controllable geometry for an extended period of time without cooling;
- enhanced fission product retention.

The following items may be included in the programme of work:

- data and characteristics of candidate materials, including:
  - advanced claddings: coated Zr-based alloys, SiC/SiC ceramic composites, advanced steels, refractory metals (e.g. molybdenum), etc.;
  - advanced fuels: doped UO_2 for enhanced thermo-mechanical properties, high density fuels such as U-silicide and U-nitride, dispersion fuels with coated particles, etc.;
  - non-fuel core components such as fuel channels, control rods and blades, and fuel assembly hardware;
- issues related to the modelling of the advanced materials (fuel/cladding behaviour in normal and transient conditions, including DBA and BDBA);
- a review of the needs related to an experimental validation of the most promising materials: available facilities, opportunities for joint experiments (including out-of-pile and in-pile experiments), identification of gaps;
- the establishment of appropriate metrics to help prioritise between the accident-tolerant fuels (ATF) candidates;
- the definition and evaluation of reference scenarios to evaluate the effectiveness of ATF candidates.

It is anticipated that the Expert Group may organise the programme of work through activities carried out by individual task forces dedicated to specific technical issues such as:

- systems assessment (evaluation of metrics and technical readiness level for ATF, identification of illustrative accident scenarios, parametric studies, system codes);
- cladding/core materials (properties of candidate materials, evaluation under normal operation and under illustrative scenarios, testing needs and gaps, modelling needs and gaps, experimental infrastructure);
- fuel concepts (properties of fuel materials, evaluation under normal operation and under illustrative scenarios, testing needs and gaps, modelling needs and gaps, recommendations on priorities).

Deliverables

A detailed technical programme of work will be identified by the established Expert Group.

Key deliverables during the first phase of work may include multiple reports such as state-of-the-art reports on candidate materials/designs, the available data on fundamental properties, technical readiness level definition and evaluations, modelling methods, definitions of standard scenarios for evaluation of candidates' performance, availability of experimental data and experimental facilities, desired characteristics/performance metrics.

The preparation of these reports, along with the outcomes of periodic discussions at information exchange meetings will form the basis of the overall programme of work.

Links with other activities

Synergistic links may be established (participation to common meetings, expert advice and/or review of reports, joint membership in multiple groups, etc.) with other bodies and stakeholders[1] within and outside the OECD/NEA:

- OECD/NEA Nuclear Science Committee:

1. Key external non-governmental stakeholders include vendors, utilities, independent research organisations (such as EPRI) and academic institutions.

    - Working Party on Multi-scale Modelling of Fuels and Structural Materials for Nuclear Systems (WPMM), on the issue of advanced modelling techniques;
    - Working Party on Scientific Issues of Reactor Systems (WPRS), for nominal and accidental behaviour, fuel modelling;
    - Working Party on Scientific Issues of the Fuel Cycle (WPFC), Expert Group on Innovative Fuels (EGIF), for innovative fuels and cladding;

- OECD/NEA Committee on the Safety of Nuclear Installations:
    - Working Group on Fuel Safety (WGFS);
    - Working Group on Analysis and Management of Accidents (WGAMA), for accident scenarios modelling;
    - Benchmark Study of the Accident at the Fukushima Daiichi Nuclear Power Station (BSAF), for the accidental sequences on Fukushima Daiichi Units 1-3;

- IAEA, which foresees establishing a Coordinated Research Project on ATF from 2015.