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The Reactor Safety Division focuses its programme on the development of expertise on materials behaviour under irradiation for fission and fusion oriented applications.

Furthermore, as nuclear energy needs international public acceptance with respect to safety and efficient management of natural resources and wants to reduce the burden of nuclear waste, the Reactor Safety Division enhanced its efforts to develop the MYRRHA project. MYRRHA, an accelerator driven sub-critical system, might have the potential to cope in Europe with the above mentioned constraints on acceptability and might serve as a technological platform for GEN IV reactor development, in particular the LFR (Liquid Metal Fast Reactor).

The Reactor Safety Division gathers three research entities that are internationally recognised: the Reactor Materials Research department (RMR), the Reactor Physics and MYRRHA department (RF&M) and the Instrumentation department (INSTR).

The objectives of Reactor Materials Research are:

- to evaluate the integrity and behaviour of structural materials and nuclear fuels used in present and future nuclear power industry;
- to perform research to unravel and understand the parameters that determine the material and fuel behaviour under or after irradiation;
- to contribute to the interpretation and modelling of the materials and fuels behaviour in order to develop and assess strategies for optimum life management of nuclear power plant components.

The programmes within the Reactor Materials Research department concentrate on four distinct disciplines:

- Reactor Pressure Vessel Steel (RPVS) embrittlement
- Stress corrosion cracking in reactor coolant environment, including Irradiation Assisted Stress Corrosion Cracking (IASCC);
- Nuclear Fuel characterisation and development of new fuel types for commercial and test reactors;
- Development of materials for Fusion and advanced nuclear fission reactors.

The safe operation of present nuclear power plants relies primarily on the integrity of the reactor pressure vessel. Neutron exposure induces temperature dependent embrittlement of the vessel and alters the mechanical properties of the vessel materials. It is, therefore, of prime importance to monitor the material degradation by surveillance programmes. SCK•CEN is in charge of the RPVS surveillance for the Belgian nuclear power reactors and runs in parallel a research project called the Electrabel-SCK•CEN Framework agreement that supports the development of tools and methodologies for use for the Belgian NPP's or international community. Important efforts are made to integrate the discipline of mechanistic material modelling into the research programmes and to support experimental projects for RPVS, candidate fusion, ADS and GEN IV reactor materials with modelling tools.

The corrosion research programme aims to clarify the mechanisms that contribute to (IA)SCC and since a few years also addresses corrosion due to heavy liquid metal (HLM), in particularly Pb-Bi, on structural materials. Four complementary activities are developed:

- experimental studies of (IA)SCC in LWR conditions in order to generate reference data for modelling;
- the experimental assessment of HLM-induced corrosion on pre-selected steels for ADS applications;
- the modelling of (IA)SCC and related phenomena in a computer code, that takes crucial parameters of the material, its environment and their interaction into account;
- the development of dedicated instrumentation to detect and monitor the occurrence of (IA)SCC.

The fuel research activities combine both applied and fundamental aspects. The investigations focus on solid state research of nuclear fuel, on modelling of fuel behaviour and on the definition, technical preparation and execution of in-pile instrumented irradiation experiments. The applied research essentially remains market-driven and concentrates on post-irradiation evaluation of fuel elements. The tendencies of future research are the long-term intermediate storage of spent fuel and issues related to further increase discharge burn-ups.

On the microscopic side, most RMR programmes are supported by an extensive battery of state-of-art microscopes and on multi-scale modelling to unravel the material degradation. The BR2 reactor plays a major role to accomplish the RMR objectives.

The objectives of the Reactor Physics & MYRRHA department are:

- to design, to complete and to analyse benchmark experiments in SCK•CEN facilities (VENUS, BR1, BR2) or elsewhere, leading to reference data for code validation in the fields of:
  - reactor dosimetry;
  - core physics;
  - reactor physics;
  - neutron and gamma shielding;
  - accelerator driven system physics;;

  and for specific conditions or new situations such as:
  - MOX fuel in LWR;
  - transmutation of trans uranics (TRUs) and long lived fission products (LLFPs) in burner reactors;
  - development of MYRRHA;
  - burn-up credit.
- to maintain, improve and develop experimental and computational capabilities and tools in the above fields and new areas such as:
  - high energy particle physics;
  - reactor physics in sub-critical systems.
- to deliver services to:
  - Belgian and Spanish nuclear power plants in the field of reactor dosimetry
  - Belgian nuclear power plants for criticality verification during loading and start-up operations
  - Different companies in the field of Neutron Activation Analysis (NAA) at BR1

To comply with these objectives RF&M has, in collaboration with RMR, completed the international programme REBUS (Reactivity tests for a direct evaluation of the Burn-Up credit on selected irradiated BWR fuel bundles) for the investigation of the burn-up credit. The programme aims at establishing a neutronic benchmark for reactor physics codes that calculate the burn-up credit.

Maintaining high level skills in the nuclear field can only be ascertained if ambitious and innovative projects with clear objective and milestones are conducted. This is the main objective behind the MYRRHA project that in a first phase aims to design an experimental ADS followed by its construction if the technical and financial requirements are met. As such it was decided to open the finalized DRAFT-2 conceptual design of MYRRHA to European partners of the FP6 IP EUROTRANS projects to serve as a basis for the development of an advanced design of the so-called XT-ADS experimental accelerator driven system. The R&D-activities on the topics that could lead to significant changes in the chosen options are:
- the hydraulic flow design of the window-less target;
- the vacuum interface compatibility for the window-less design;
- the corrosion behaviour of the structural materials in liquid metal;
- the structural material behaviour under irradiation;
- the visualisation under liquid metal;
- the remote-handling operation of MYRRHA.

Within the FP6 IP EUROTRANS project, the MYRRHA-team is coordinating the Domain 1 (DM1) treating the design of the XT-ADS experimental ADS and the conceptual design of EFIT an industrial scale ADS.

In all irradiation experiments, appropriate instrumentation technology is of paramount importance. The Instrumentation department evaluates the potentials of novel instrumentation technologies for data acquisition, processing and transmission under severe constraints of nuclear applications, such as the control of nuclear power plants, the remote monitoring of waste repositories and the remote handling of hazardous materials.

The Instrumentation department pays particular attention to:
- the application of optical fibre technology for both remote-handling and plasma diagnostic applications for future fusion reactors;
- the radiation hardening of remote-handling and plasma diagnostic systems;
- the study and development of new reactor instrumentation.

Its projects also cover:
- assessments of radiation-hardened sensors;
- developments of new approaches for dose, temperature and strain measurements;
- space radiation effect studies for the European Space Agency;
- studies of cable ageing in nuclear power plants.

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