PROPOSAL FOR THE IMPLEMENTATION OF NEST PROJECTS IN FIDES

This draft proposal is currently under discussion among the FIDES Framework organisations and partners who recognise the importance of launching a NEST component within FIDES.

1 BACKGROUND OF THE NEST FIDES PROJECT

In order for nuclear fuel and materials (F&M) technology to evolve and for their performances to be optimised, experimental evidence obtained from test facilities where it is possible to perform neutron irradiation under representative steady state or transient conditions is essential for the safe, reliable and efficient operation of nuclear power plants (NPP). It is widely accepted that F&M test facilities will continue to be essential in order to validate safety margins and demonstrate operational performance, to assess material behaviour in the context of the long-term operation programmes, to develop advanced F&M, and to validate simulation tools, etc.

However, test facilities are in significant decline worldwide. In the past five years, several major research reactors providing testing services for the nuclear community were shut down after over fifty years of service: the Halden reactor in Norway, OSIRIS in France, JMTR in Japan, NRU in Canada, and others. Regulators and their technical support organisations, research organisations, as well as industry, all require F&M testing capacities on an ongoing basis. In particular, they have stressed that the availability of test facilities, particularly for loss-of-coolant accidents, reactivity-initiated accidents and power ramps, is crucial.

In this context, the NEA is developing a new multinational framework for in-pile fuels and material testing as an NEA joint research undertaking - the Framework for Irradiation ExperimentS (FIDES). FIDES will gather a broad community (including utilities, fuel vendors, regulatory bodies and their technical support organisations, research institutes, and experimentalists) to address current and future experimental needs in the field of F&M testing.

The FIDES framework will address the following objectives:

- Identify and prioritise the needs of the nuclear energy community, including regulators and their technical support organisations, industry and research organisations;
- Identify and assure access to research facilities around the world in the most efficient way and facilitate high priority experiments at those facilities;
- Define and implement a co-ordinated multilateral programme that meets short- and long-term experimental needs;
- Promote and sustain relevant state of the art capacities by identifying relevant investments in research infrastructure, developing advanced experimental technology, and fostering multinational and multidisciplinary education capacities skills through a Nuclear, Education, Skills and Technology Framework (NEST) component.
FIDES is currently under discussion among interested parties, with the objective to set up the related agreements and engage the FIDES activities in 2021. However, it is widely agreed among interested parties that the NEST FIDES component should start as soon as possible in order to contribute to the FIDES dynamic and launch synergetic activities related to the development and use of state of the art experimental technologies for F&M testing.

The FIDES community is preparing a number of Joint Experimental Projects (JEEPs) to be implemented within FIDES. Each JEEP will be implemented in a testing reactor and associated hot cells. Currently several JEEPs are being proposed for implementation in five to six facilities operated by different organisations in different countries, which provide, in essence, the multinational framework. Each JEEP will be implemented in a given facility and it offers valuable opportunities for welcoming NEST Fellows who will be managed by the organisation operating the facility, the so-called JEEP Hosting Organisation.

Six JEEPs at different stages of maturity have so far been proposed:

- Programme for quantifying thermomechanical clad load mechanisms during LWR slow transient (P2M) at the BR2 reactor in Belgium and at the CEA hot cells in France.
- Programme for studying fuel rod behaviour under LOCA conditions at the MIR.M1 reactor in Russia.
- In-pile Creep Studies of ATF Claddings (INCA) at the LVR-15 material test reactor in Czech Republic.
- Programme for studying PWR fuel rods behaviour under LOCA conditions at the CABRI reactor in France.
- International NSRR Test Programme for LWR fuels (INSTEP) which considers possible RIA tests on additive fuels at the newly restarted NSRR facility in Japan.
- Missing Pellet Surface (MPS) experimental programme using conventional LWR fuel to support 3D modelling and simulation.

Of the JEEP proposals set out above, the most mature are intended to be started by the end of 2020. To avoid discontinuities in F&M testing and maintain momentum with the prompt conclusion of a framework agreement, JEEPs will be developed in parallel based on the most mature proposals. The NEA is engaging on both fronts, developing agreements to connect the interested parties with the current experimental programme proposals, while further developing the new Framework concept.

2 DESCRIPTION OF THE NEST FIDES PROJECT

The current document describes a proposal to the NEST Management Board (MB) aiming at developing a “NEST FIDES Project”.

There is value to launch the NEST FIDES Project rapidly since it will contribute to the maturing phase of the FIDES Framework.

The NEST FIDES Project’s Scope of Work will be managed by the MB within the NEST Framework. The NEST FIDES Project will be supported by the FIDES Framework, when it
will be set up, by providing further opportunities for NEST activities, mentorship and possibly financial support.

The NEST FIDES Project’s Scope of Work is related to the development and use of state of the art experimental technologies for F&M testing.

- For each FIDES JEEP, the NEST FIDES Project will address a number of interconnected activities such as:
  1) **Definition of needs** in relation to industry, and the regulatory bodies and their technical support organisations.
  2) **Definition of a sound experimental programme** with regards to i) state-of-the-art material and fuel science; and ii) the use of multi-physics modelling and computation of the full experimental process.
  3) **Design of experimental devices** (rigs, loops, …) including integration studies, core physics calculation, manufacturing challenges, life cycle assessment and licensing process.
  4) **Operation** related to the use of experimental devices in experimental campaigns and the management of the raw data produced by the campaigns.
  5) **Evaluation of the raw data** to produce high quality data and to participate in the management of the Fides related databases.

- In addition, the NEST FIDES Project will address topics cross-cutting all the experimental programmes such as:
  6) **Development of sensors** and measurement systems.

To start with, the following organisations are keen to welcome NEST fellows to implement the NEST FIDES Project’s Scope of Work:

- To prepare the P2M JEEP, CEA and SCK.CEN propose to address:
  …

- To prepare the LOCA JEEP in MIR.M1, RIAR proposes to address:
  …

- To prepare the INCA test at LVR15, the NRI proposes to address:
  …

- To mature PWR LOCA tests in CABRI, the IRSN proposes to address:
  …

- To develop an international NSRR Test Programme for LWR fuels (INSTEP), JAEA proposes to address:
  …

- Further opportunities may be developed in INL (Idaho, US) or in ENEA-Casaccia and INFN (Italy).
3 LEADING ORGANISATION

- To be determined

Overview of the Leading Organisation: Structure, capacities, experimental infrastructure, experience in expertise in specific area,… Capabilities with regard to the number of Fellows who can study at the same time, the duration of training,…

Contact Point in the Leading Organisation

4 PARTICIPATING ORGANISATIONS

- CEA, IRSN
- SCK.CEN
- ROSATOM-RIAR
- US DOE INL
- NRI
- NRG
- ENEA, INFN
- JAEE
- KAERI
- GRS
- AECL/Chalk River Labs
- Universities
  - TUM
  - Aix Marseille
  - MEPHI
  - University of New South Wales
  - …..

5 CONSISTENCY WITH THE NEST PURPOSE AND CRITERIA

- NEST Criterion 1: be multinational, i.e. including at least three (3) NEST Countries;
  - The activity within the NEST FIDES Projects and more generally within the FIDES Framework is by its own nature multinational, gathering half-a-dozen countries who will open access to their domestic experimental capacities and several additional countries where end-users will participate in the dynamic of the activities.

- NEST Criterion 2: address concrete and multidisciplinary challenges in the field of nuclear science, technology and applications, including both technical and non-technical aspects;
  - The NEST FIDES Project’s Scope of Work, as described in Section 2, details tasks of different natures and requiring different type of competences, all of them to be integrated
in well-identified technical projects. The understanding of the motivations related to each experimental programme will require some insight in the technical and non-technical aspects, such as the stakeholders’ needs and context.

- NEST Criterion 3: offer hands-on training opportunities in the field of nuclear science, technology and applications to NEST Fellows. The Parties are also encouraged to offer skills development and education programmes;

  The NEST FIDES Project aims at supporting the implementation of experimental programmes in existing testing facilities, from the design to the management of the data. Each experimental campaign will provide opportunities to develop ambitious theoretical work and technology development that will be challenged by a reality-check through the experiment implementation.

6 PROGRAMME OF WORK AND DURATION OF THE NEST PROJECT

The NEST FIDES Programme of Work will be composed of Research Tasks and cross-cutting activities.

The Research Tasks are implemented in relation to future FIDES JEEPs programmes. It is foreseen that the Fellows will spend a few weeks in a JEEP facility site once or twice per year. Exceptionally, a Fellow could be welcomed on the JEEP facility site for a longer period. The NEST Programme of Work offers the opportunity for the Fellows to develop their research work within their home organisations while continuously liaising with the other organisations involved in the NEST FIDES Project’s JEEP programmes.

The community operating research and testing facilities in the field of material and fuel is quite integrated and provides a number of opportunities (conferences such as IGORR, RRFM..., workshop, …) for welcoming NEST FIDES Project’s cross-cutting activities.

The definition and implementation of material and fuel experiments rely on a broad scope of tacit knowledge that is currently at risk following the decrease of the related infrastructures. This shows the added-value of this NEST proposal and justifies the development of multinational and multidisciplinary specialised curricula. The NEST FIDES Project provides a suitable framework and dynamic to develop both these strategic educational curricula and related cross-cutting activities, which will provide the complementary educational and training component to the hands-on training activities of the NEST FIDES Project.

NEST FIDES educational curricula will consist of dedicated workshops, summer schools and international conferences.

- NEST project workshops will be organised periodically by each NEST FIDES JEEP to allow the NEST Fellows who contributed in the NEST FIDES Project’s research activities to share their experiences with other NEST Fellows within each NEST FIDES JEEP, and across several JEEPs Projects.

- NEST Summer schools (one or two weeks) will allow the NEST Fellows to gain a broad knowledge of nuclear science and technology beyond the research areas covered by the FIDES Project. The organising institution that will be hosting such events, with the contribution of all other Participating Organisations, will propose the lectures. These events will also be open to other NEST Fellows who participated in other NEST Projects, besides FIDES.
Participation in international conferences and presentation of the NEST FIDES Project work by the NEST Fellows. Below is a list (non-exhaustive) of events that NEST Fellows could attend:

- International Group on Research Reactors (IGORR), 1-4 September 2020, Kazan, Russia
- Research Reactor Fuel Materials Conference
- Nuclear Research Reactors Conference
- IAEA International Conference on Research Reactors
- ……

7 NEST PROJECT’S MANAGEMENT STRUCTURE

The NEST FIDES Project will gather a number of Participating Organisations (still to be fully identified).

At the official-kick off meeting of the NEST FIDES Project, foreseen early 2020, a Project Management Board (PMB) is to be established. Each Participating Organisation will be represented therein by a single member. The PMB will elect a chairperson and a deputy chairperson during its constituency meeting.

The authors of the proposal welcome the participation of additional Participating Organisation joining the NEST FIDES Project, who will then also be invited to delegate a representative to the PMB.

The PMB shall meet once per year, either via a physical meeting or by teleconference.

8 NEST FELLOWS

Each organisation participating in the NEST FIDES Project can propose candidates for a NEST Fellowship. The nomination process requires the submission of a CV, and the proposed research plan of the candidate to the NEST FIDES PMB. The PMB nominates the candidates for a NEST fellowship by unanimous decision only, based on the following preconditions and criteria:

- the candidate is affiliated to one of the Participating Organisations, and is a Master student, a PhD student, or holds a postdoctoral position or a young professional;
- the topic of the research plan is either directly linked to the FIDES research programme, or delivers scientifically relevant contributions to closely related topics, as described in Section 2;
- the work programme outlined in the research plan corresponds to at least six months’ full-time research work;
- the research plan clearly states whether the NEST Fellow is supposed to conduct research work at his/her home institution/Participating Organisation only, or whether an extended internship at a FIDES Leading or another Participating Organisation is envisaged.
After nomination by the PMB, the candidates have to await formal approval of their NEST fellow status by the OECD NEA NEST secretariat. If extended internships are foreseen in the research plan, additional approval by the FIDES PMB is required.

In addition to the demonstration of a successfully completed research task, the NEST Fellow has to attend and actively participate in at least two events out of the list described in Section 6.

Upon successful completion of the research work, and participation in the above mentioned NEST events, the NEST FIDES PMB will recommend the candidate to the OECD-NEA for being awarded the NEST Skills Passport, as established by the NEST Framework.

9 BUDGET

The NEST FIDES Project’s first phase will correspond to the maturing phase of FIDES and contributing to FIDES momentum in the multinational collaboration. It is proposed to have a first phase of three years, from early 2020 to the end of 2022.

In 2023, a second phase of the NEST FIDES Project could be designed and launched, according to the status of FIDES and the willingness of the FIDES Governing Board to provide additional resources and opportunities.

The NEST FIDES Project will benefit from access to half-a-dozen of facilities around the world. The NEST FIDES Project will manage about 20 Fellows per year in order to have on average three Fellows per FIDES JEEP.

The average cost per fellow on a JEEP site is about 3000€ for two weeks. The real cost varies from one welcoming countries to another one. It is anticipated that performance of the NEST FIDES programme will require, on average, two trips per year per fellow. The corresponding total cost would be in the range of 120000-140000 € per year (through various contributions).

For the NEST FIDES Project’s first phase, the direct contribution of the OECD NEA through the NEST membership fees is expected to be:

- 40000€ for the first year, allowing the ramp up of the programme;
- 60000€ for the second year;
- 40000€ for the third year with the assumption that an additional funding of 80000€ will be leveraged from the countries hosting the JEEP facilities and from the FIDES Framework.

10 ORGANISATIONAL ISSUES

The JEEP Hosting Organisation will define the suited conditions for welcoming Fellows (Visa support, check of the medical insurance with the sending organisation, accommodation, IPR and confidentiality information, etc).