Invitation to participate in an International Atomic Energy Agency's (IAEA) Coordinated Research Project (CRP) on Innovative Small Nuclear Reactors without On-site Refuelling

FBNR: Fixed Bed Nuclear Reactor Concept
http://www.rcgg.ufrgs.br/fbnr.htm

An IAEA Coordinated Research Project (CRP) has been formed to help the research and development of small nuclear reactors. The participations of the scientists and their institutions around the world are welcomed.

You are requested to kindly pass on the following information to the nuclear institutions and their scientists in your country.

The future of nuclear energy

In the recent years, several multinational initiatives looking at the future of nuclear energy have come about. These include the US-led Generation IV International Forum (GIF), which began its work in 2000, the Michelangelo network for competitiveness and sustainability of nuclear energy in European Union (MICANET) set up in 1997, and the IAEA´s International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) launched in 2001. The main objectives of INPRO are to (1) Help to ensure that nuclear energy is available to contribute in fulfilling energy needs in the 21st century in a sustainable manner; and (2) Bring together both technology holders and technology users to consider jointly the international and national actions required to achieve desired innovations in nuclear reactors and nuclear fuel cycles.

Small nuclear reactors without on-site refuelling

Some of the important advantages of the small reactors may be summarized as follows:

- They are adequate for countries with small electric grids and insufficient infrastructure.
- They are adequate for countries that have limited capacities for investment, especially in relation to hard currency, and small turnover of capital in the electricity market.
- They offer an option of electricity generation coupled with seawater desalination, which meets the urgent needs of many developing countries.
- They could offer a variety of passive safety features that may be difficult to obtain with large reactors. This fact makes them a good potential choice for countries with insufficient nuclear infrastructure and limited number of human resource.

- They provide an attractive domain for fuel leasing and facilitate an option of factory fuelled and transportable power plant, such as barge-mounted, which may be a solution for countries with limited capabilities in mastering nuclear fuel cycle, or for those who prefer to be just the end users of nuclear power.
- In industrialized countries, electricity market deregulation is calling for power generation flexibility that smaller reactors may offer.
- They are of particular interest for advanced future non-electric applications, such as hydrogen production, coal liquefaction, etc.
- They provide means for learning knowledge and technology from a small prototype plant.
- As nuclear reactors do not emit carbon dioxide, they will provide the developing and industrialized countries with sustainable development through both, electricity production and process heat applications.

The Reactor Description

The fixed bed nuclear reactor (FBNR) concept is modular in design such that any size of reactor can be constructed from the basic module. It is an integrated primary system design. The 8 mm diameter spherical fuel elements are held together in the core in a suspended manner by the flow of water. Any hypothetical accident will cut-off power from the pump causing the fuel elements leave the core and fall outside the reactor core by the force of gravity. They remain outside the reactor in a highly subcritical and passively cooled condition. For details see: http://www.rcgg.ufrgs.br/fbnr.htm .

A detailed heat transfer analysis of the fuel elements has shown that due to a high convective heat transfer coefficient and a large heat transfer surface to volume ratio, the maximum power extracted from the reactor core is not limited to the material temperature limits, but to the permitted mass flow rate of the coolant.

The proposed concept is very flexible and has the possibility of devising many types of designs. The proposal for the first stage of development is to have a “fixed” bed nuclear reactor and at a later stage will be designed to operate as a “fluidized” bed nuclear reactor.

Some of the characteristics of the proposed reactor

Some of the characteristics of the proposed reactor are as follows: The FBNR is based on pressurized light water reactor technology. It is a small, modular, and integrated primary circuit reactor. The fuel elements of FBNR are 8 mm diameter spherical uranium dioxide pellets cladded by zircaloy or made of compacted TRISO type fuel particles. The reactor core is suspended by the flow of water coolant. The stop in flow causes the fuel elements leave the reactor core by the force of gravity and fall into a passively cooled fuel chamber or even leave the reactor completely and become deposited in the spent fuel pool. It is an

inherently safe and passively cooled reactor concept. FBNR in its advanced versions can use supercritical steam or helium gas as coolant, and utilize MOX or thorium fuel.

The invitation

You and your institution are invited to participate in the research and development of the proposed nuclear reactor concept. The FBNR is one of the reactor concepts chosen by the International Atomic Energy Agency to be studied under the Coordinated Research Project on Small Reactors without on-site Refuelling. The groups will work directly under the coordination of the IAEA and will negotiate the scientific and financial aspects of the project with its coordinator. The Federal University of Rio Grande do Sul (UFRGS) is informally assisting the IAEA's CRP Coordinator in search for interested scientists and institutions that will engage in research and development of the FBNR concept.

Please contact Prof. Farhang Sefidvash [farhang@ufrgs.br] for arranging your participation in the project.

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