

FBNR Letter

FIXED BED NUCLEAR REACTOR – FBNR

<http://www.rcgg.ufrgs.br/fbnr.htm>
Farhang.Sefidvash@ufrgs.br



Dear coworkers and potential coworkers around the world,

As number of coworkers is increasing, we are issuing a common letter to communicate about the matters of general interest related to the FBNR project. Please consider this as a personal letter to yourself. Those who are not involved in the project as yet may participate at any appropriate moment. The project has manifold aspects including scientific, technological, economical, political, and sociological.

The FBNR may be called People's Reactor. It is intended to be developed by the peoples for the peoples of the world in the spirit of cooperation and service to humanity. It is intended to be a near term deployment project. Let us form an international consortium to develop this reactor where all members are stakeholders.

The objective is to develop an innovative nuclear reactor to be inherently safe, passively cooled, small, modular, and simple in design with integrated primary circuit. Safety is achieved by design, and has reduced adverse impact on environment. It is to meet the requirements of GEN IV and IAEA-INPRO as being economic, safe, proliferation resistant and sustainable.

An IAEA Coordinated Research Project (CRP) includes FBNR in its program.

Participate in the project and make a proposal on a particular activity of your choice.

FBNR Letter 03 July 2, 2004

How are the innovative nuclear reactors?

This letter is directed specially to our non-technical coworkers who will contribute politically and economically to the deployment of the FBNR project.

A new era of nuclear energy is emerging. The International Atomic Energy Agency has committed itself to “Help to ensure that nuclear energy is available to contribute in fulfilling energy needs in the 21st century in a sustainable manner; and to 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 fuel cycles.”

The advent of innovative nuclear reactors is a shift in paradigms. It is based on a new safety philosophy. It will make the occurrence of accidents such as TMI and Chernobyl impossible. It challenges the scientists and technologists of the world to invent a new nuclear reactor where practically “total safety” is achieved. It promotes inherent safety philosophy meaning that the law of nature should govern the safety of the future reactors and not the manmade safety systems. For example, the safety of FBNR is obtained by utilizing the law of gravity that is inviolable. The cooling of residual heat produced by the radioactive fission products is done by natural heat convection.

There are two sources of heat generation in a nuclear reactor. One is the heat produced by nuclear fission and the other by decay of radioactive materials that are produced by the fission of nuclear fuel. The reactor safety requires that the fission process be under control and the cooling of residual heat due to the decay of fission products is achieved by natural convection.

The process of fission occurs through the interaction of particles called neutrons with the nucleus of the atoms of a nuclear fuel element such as uranium. As the result of this interaction, new radioactive elements called fission products, some neutrons, and a relatively large amount of heat are produced. These neutrons in turn are capable of causing further fissions and thus producing what is called chain reaction. The fission products are kept inside the fuel cladding in order to avoid contamination. The main concern of the reactor designers and operators in respect to safety is to guarantee that the cladding temperature will not go above its designed temperature and thus the integrity of the fuel cladding is maintained.

Controlling the population of neutrons in the reactor controls the power generation. The balance of the neutrons is achieved by balancing the amount of neutrons produced through fission, the number of neutrons absorbed by control elements, and the neutrons that escape from the reactor. When the neutron population, thus energy generation, remains constant with time, the reactor is called to be in the critical condition, meaning that the reactor is generating power constantly under control. When the energy generation increases with time, the reactor is in the state of super criticality and if it is not controlled, it may result in superheating of the reactor. The superheating can damage the fuel cladding and cause the release of radioactive fission products into the environment. If the neutron population decreases with time, then the subcritical state is reached that leads to the shutting down of the reactor. These states of criticality, supercriticality, and subcriticality of the reactor are functions of both material composition and geometry of the reactor core.

The FBNR core is in suspended state; namely the flow of water coolant keeps the spherical fuel elements inside the core in a fixed and appropriate condition to make the reactor critical. In the case of any malfunction of the reactor, any signal from any of the numerous detectors that do the surveillance of the reactor will cut electricity from the coolant pump. The stop in flow will result in falling out of fuel elements from the reactor core by the force

of gravity into the fuel chamber where they are stored in a subcritical condition and cooled by natural convection. This practically results in total safety for the FBNR concept.

The IAEA is providing valuable assistance in fostering cooperation among the nations and coordinating joint research programs. A coordinated research project has already become operational to develop small innovative nuclear reactors without the need of refueling on site. They are to be economic, safe, proliferation resistant and sustainable.

The IAEA has chosen the FBNR as a candidate for such reactors. It is now a challenge for the coworkers around the world to be creative and cooperative in forming a truly international consortium to transform the FBNR concept into a reality at the service of humanity.

For details see the papers on the site: <http://www.rcgg.ufrgs.br/fbnr.htm>

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