

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.

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 study of your interest. Make the project become fully international.

FBNR Letter No. 02 June 25, 2004

FBNR meets all the requirements of the IAEA

Qualifying the FBNR as an innovative small nuclear reactor without the need for on-site refueling by meeting all the requirements set by the IAEA:

The draft of the minutes of the IAEA Technical Meeting on Innovative Small and Medium Sized Reactors held in Vienna during June 7-11, 2004, includes the following information

on the requirements for such reactors (pages 10-11). They are transcribed below in *italic* letters and the comments in relation to FBNR are written in ordinary letters.

The following revised design goals for a Small Reactor without On-Site Refuelling were accepted by the participants:

1. Small Reactor without On-site Refuelling should have the following essential features:

1.1. Capability to operate without refuelling for a reasonably long period consistent with the plant economics and energy security;

The FBNR achieves long life core by having its reserve reactivity in the form of fresh fuel elements stored outside the core in the fuel chamber. The fuel elements will enter the core module as the core level limiter is raised up. This eliminates the need for burnable poison and causes better neutron economy which eventually translates into better fuel and operational economy.

1.2. Minimum inventory of fresh and spent fuel being stored at the site outside the reactor during its service life;

For the FBNR, there is no need for storage of fresh or spent fuel at the site. The fuel elements will come from the factory already in the sealed reactor modules and will go back in the like manner.

1.3. An enhanced level of safety, consistent with the scale of global deployment of such reactors, through wider implementation of inherent and passive safety features and systems;

The FBNR has the characteristics of inherent safety and passive cooling. The fuel elements in the suspended core will leave the reactor automatically by the force of gravity under any undesirable condition. They simply become stored in the fuel chamber where they remain under sub critical condition and become cooled by natural heat convection.

1.4. Economic competitiveness for anticipated market conditions and applications;

There are many factors that contribute to the economy of FBNR; namely, simplicity in design thus lower capital investment; no burnable poison thus better fuel economy; modular thus investment made according to the energy need; utilization of existing technologies thus no need to develop new technologies, etc.

1.5. Difficult unauthorized access to fuel during the whole period of its presence at the site and during transportation, and design provisions to facilitate the implementation of safeguards;

The fresh and spent fuels leave and return to the factory in the sealed modules of the FBNR. The sealing is done and inspected by the national or IAEA authorities. Thus there is no possibility of any abuse of the fuel elements.

1.6. Capability to achieve higher manufacturing quality through factory mass production, design standardization and common basis for design certification.

The modules and the fuel elements of FBNR are produced in the factory under most convenient conditions. The small reactor in its “turn-key” condition is transported to the reactor site.

2. Small Reactor without On-Site Refuelling may have the following additional desirable features:

2.1. Factory fabrication and fuelling to facilitate delivery of a sealed core to the plant site;

The FBNR modules and its fuel elements are factory fabricated and the modules are sealed before being delivered to the plant site.

2.2. Capability to survive all postulated accident scenarios, including those caused by natural or human-induced external events, without requiring emergency response actions arising out of unacceptable radiological consequences in the public domain and without compromising the transportability of reactor back to the manufacturers.

The fuel elements of FBNR are in the reactor core only when the reactor is in the state of normal operation. Any possible scenario of an accident causes the surging of various signals from all types of the detectors provided in the reactor. Any of such signals is sufficient to act on a fail-safe safety switch to cut the electric power from the pump. Consequently, due to the stop of the coolant flow that holds the core suspended, the fuel elements leave the reactor core by the force of gravity and become stored in the fuel chamber in a highly sub critical and passively cooled condition.

2.3. An overall reactor and fuel cycle enterprise that is highly unattractive for weapons purposes, e.g. offering limited overall amount of material, high degree of contamination providing noticeable radiation barriers, fuel forms that are difficult to reprocess and/ or types of fuel that make it difficult to extract weapons-grade fissile material;

The fuel elements of FBNR are made of TRISO type coated particles. The irradiated coated particle fuel discharged from the reactor is very resistant against heat and nitric acid,

thus it is difficult to reprocess. Reprocessing technology has not been developed as yet for high temperature micro sphere fuel elements. It is not easy to acquire this technology. The commercial grade plutonium contained in the spent fuel micro spheres is less accessible than from standard LWR spent fuel.

Adopting a thorium cycle as an intrinsic measure will hinder the possibility of misuse of nuclear materials for nuclear weapons. The mixing of thorium with low enriched uranium or plutonium results in the production of U-233 that is diluted along with U-235 in U-238. The access to uranium will only be possible through isotope separation techniques. The high Pu-238 to Pu-239 ratio and the production of gamma emitting Tl-208 in the thorium cycle are hindrances to nuclear proliferation.

2.4. A variety of applications, including generation or co-generation of electricity, heat, potable water, or hydrogen production;

The FBNR is equally appropriate for electricity generation, district heating, seawater desalination, process steam production, or any such combined applications.

The combination of a nuclear power reactor with water desalination plant can most economically be utilized because the higher the temperature and pressure of steam used in a turbine, the lower the cost of electricity produced. For fractional distillation, on the other hand, steam at low temperature and pressure is needed and the greater part of input heat is the latent heat of steam. Therefore, the power production and desalination systems may be advantageously combined. A 100 MWe FBNR power plant when employed in a dual purpose plant for producing both power and water will produce 70 MWe of electricity and about 130,000 m³/day of desalinated water.

2.5. A variety of options for siting, including those close to population centers, as well as remote and hardly accessible areas, dispersed islands, etc;

The safety features of the FBNR allow it to be built within or near urban areas. The long fuel life of the reactor makes it appropriate for isolated remote places without infrastructure. It can supply energy to the floating power plant.

2.6. Simplified operation procedures and robustness with respect to human errors;

The inherent safety feature of FBNR allows the possibility of having it operate totally by computers avoiding human operating errors and reducing costs. Only an inspection and maintenance group is required to periodically do check up and maintenance of various reactors located in different localities.

2.7. Minimum reliance on sophisticated local infrastructure.

The FBNR modules are transported to the reactor site ready to operate. They are returned to the factory in sealed condition. Therefore, there is no need for a sophisticated local infrastructure.

2.8. An overall reactor and fuel cycle enterprise that contributes to effective use of resources in a sustainable way

The spent fuel from FBNR is in a form and size that can directly be used as a source of radiation for irradiation purposes in agriculture and industry. Therefore, the spent fuel from FBNR may not be considered as waste, in a peaceful world of the future, as it can perform a useful function.

The various options for FBNR make the utilization of all types of fissile and fertile materials such as uranium, plutonium, and thorium possible. This allows that besides uranium one uses plutonium resulting from the dismantling of nuclear weapons and the enormous quantity of thorium available in countries like Brazil and India. Therefore, the fuel resources for FBNR are sufficient for centuries.

Your critical comments are most welcomed.

Farhang.Sefidvash@ufrgs.br

[Return to FBNR](#)