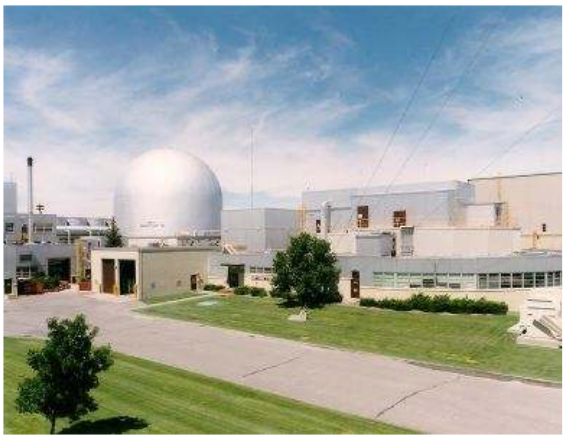
Argonne National Laboratory

With the Fast Breeder Reactor system there is enough fissionable fuel to last forever. Without it, not so. With no Fast Reactors the present Once Through today's power plants will need 25 million metric tons of uranium ore. But Fast Breeder Rectors started in the year 2020 require only about 2.0 million metric tons of uranium ore and the curve flattens out after that. We need no further uranium ore. It is obvious that we need the Fast Breeders now. Read on to the see why we do not have them.



EBR II in Idaho

I am an engineer who was on the team that designed, built, and started the Experimental Breeder Reactor (EBR II) in Idaho. EBR II operated for 30 years to prove its safety and durability. It was shut down and destroyed by president Bill Clinton as pay back to the environmentalists who voted for him. More on this later.

Dr. Charles E Till, formally of of Argonne National Lab, sums it up this way:

The hard truth is this: Only nuclear power can satisfy humanity's long-term energy needs while preserving the environment. For large-scale, long-term nuclear energy, the supply of nuclear fuel must be inexhaustible. That means the power system must have characteristics very similar to those of the IFR.

It is those very characteristics that led the proponents of this reactor type to single it out for development, and are also precisely what caused, and very likely will continue to cause, its opponents to single it out to be stopped.

I am an engineer who was on the team that designed, built, and started the Experimental Breeder Reactor (EBR II) in Idaho. EBR II operated for 30 years to prove its safety and durability. It was shut down and destroyed by president Bill Clinton as pay back to the environmentalists who voted for him. More on this later.

How does the Fast Breeder Reactor produce this fissionable fuel?

Recall that there is unlimited supply of natural uranium in the earth as well as a huge amounts in sea water. But natural uranium is made up of two isotopes: U 238 and U 235. The mass ratio of these is 99.3% U238 and 0.7% U 235. Only U235 is a useful isotope the will fission in a reactor. U238 will not fission or produce heat energy. In a fast reactor during operation there are about 2.5 neutrons produced during each fission process. One neutron keeps the chain reaction going and the others can strike a U238 atom and convert it to plutonium Pu 239. The isotope Pu 239 is a fissionable fuel that produces heat.

Due to breeding, a Fast Breeder Reactor can generate enough fissile fuel to replace that used up plus enough fuel for other reactors. In other words it compounds the amount of fuel similar to the growth of money under compound interest. The reactor fuel elements must be taken out periodically because of fuel element clad damage. The remaining U 235 and bred plutonium Pu 239 in the old fuel elements is then put into new fuel rods for the original reactor as well as others. In this manner a kilogram of uranium could produce 3.5 million kWh of electricity energy rather that the 50,000 kWh it does now in the non-breeder commercial water cooled reactor plants.

Plutonium is the best fuel for a reactor as well as for the hydrogen bomb. President Jimmy Carter decreed that the fuel coming out of the commercial reactors can not be reprocessed and used again. He was afraid that the plutonium could be stolen by foreign agents (a highly unlikely event) and made into a atomic bomb. It cannot really be stolen, but reprocessing is

not allowed in the US. Other countries such as France do reprocess fuel. France is about 90% nuclear power as of this writing and does not suffer the energy shortage the US does. Carter's move is one of the must stupid acts he committed as well as many others. It is said that the spent fuel currently in the storage pits at each of the 103 commercial reactor sites is sufficient to supply the electric energy needs of the US for a 1,000 years. And it does not contribute any green house gases in the process. But the environmentalists are willing to trade off an abundant fuel supply against the possibility of an enormous fuel supply for the human race.

At the present time there are no plans to recycle the fuel coming out of commercial reactor plants. They plan to bury it in Yucca Mountain. More on this in the web page under Fuel Cycle.

Where is the Fast Breeder Reactor today?

The concept does not exist today thanks to Jimmy Carter and Bill Clinton. I suspect Al Gore also had something to do with its demise.

First a little history. Argonne National Lab built the first Breeder plant in Arco, Idaho in the early 1950's. It was a small capacity nuclear power system about 5 MWe. It proved the concept and worked well. In fact it was the first power reactor system built in the United States.

Based on its success, two Fast Breeder projects were started. A combine of utilities and power equipment companies such as Westinghouse, General Electric, Babcock-Wilcox, Atomics International, etc, started a project to design and build a 150 MWe fast Breeder Reactor close to Detroit, Michigan. It was named the Enrico Fermi Plant after the great scientist who conceive the first atomic pile under the football stands at the University of Chicago. I joined the Fermi project after graduating from Michigan State University in 1956 and performed some of the original design work on the heat transport systems.

The second Fast Reactor project, named **Experimental Breeder Reactor II (EBR II)** was started by Argonne National Lab to design and build a 20 MWe Fast Breeder system. The plant was designed with a complete power system including a fuel cycle manufacturing facility. After three years with the Fermi project I witnessed too many design mistakes and as a fledging young engineer could not convince upper management to correct so I joined the Argonne team at Lemont, Illinois. Upon the initial startup phase, the Enrico Fermi plant had too many failures and was not continued because the failures could not be satisfactorily corrected.

EBR II was a complete success. It started operating about 1963, during the JFK administration. EBR II operated flawlessly for 30 years. It was a valuable demonstration and research facility for future reactor system as well as supplying the electrical energy to operate the entire Idaho Reactor test site where the Navy also had an operating nuclear power mock up to train its future submarine and aircraft carrier reactor operators. In fact EBR II was the worlds most successful Fast Breeder Reactor demonstration. England failed, and Russia, Germany, and Japan experienced problems with their first Fast breeder experimental plants. But now Russia is 50 years ahead of the US.

In the early 1970's the country started the design and construction of a commercial demonstration 350 MWe Fast Breeder Reactor power plant to be built at the Clinch River site in Tennessee. This was an industry wide participant project including nuclear power manufacturers and utilities. The project was financed by industry and received a small amount of funding from the US government. I joined General Electric in 1975 and participated in the design of the Clinch River project.

Enter Jimmy Carter

During the start of Carter's presidency, the Clinch River plant project was about 80% complete. Jimmy Carter used the power of the presidency to terminated it. This was payback to the environmentalists who helped get him elected president. Carter did not care that cancellation was a great waste. At the time he canceled the project at least half of the capital cost was already spent. Carter also stopped fuel reprocessing. He was afraid of proliferation. He asserted that if fuel was taken out of a reactor and reprocessed and placed in new fuel bundles, some plutonium could be stolen by rouge countries and used for bomb material.

EBR II was proving that this did not have to happen. They were demonstrating the Integral Fuel Reprocessing (IFR). This is the method where the fuel is taken out of the reactor in a shielded cask, transported to a fuel cycle facility, reprocessed into new fuel elements and returned to the reactor in a continuous process. No one could steal the plutonium during this process. Unfortunately this development process was terminated when EBR II was shutdown. A true travesty. The environmentalists reading this are probably celebrating. They are a egregious bunch in my opinion.

Enter Bill Clinton

As soon as Bill Clinton became president in 1992 he staffed the US Department of Energy (DOE) with environmentalists and placed them in controlling positions. They immediately ordered EBR II shut down and requested that it be destroyed so it could never run again. This too was pay back for supporting Clinton's election. In my opinion this was one of the most egregious acts ever

supporting Clinton's election. In my opinion this was one of the most egregious acts ever perpetrated on the scientific and engineering community.

How does the fast breeder reactor produce this fissionable fuel?

Recall that there is unlimited supply of natural uranium in the earth as well as a huge amounts in sea water. But natural uranium is made up of two isotopes: U 238 and U 235. The mass ratio of these is 99.3% U238 and 0.7% U 235. Only U235 is a useful isotope the will fission in a reactor. U238 will not fission or produce heat energy. In a fast reactor during operation there are about 2.5 neutrons produced during each fission process. One neutron keeps the chain reaction going and the others can strike a U238 atom and convert it to plutonium Pu 239. The isotope Pu239 is a fissionable fuel that produces heat.

Due to breeding, a Fast Breeder Reactor can generate enough fissile fuel to replace that used up plus enough fuel for other reactors. In other words it compounds the amount of fuel similar to the growth of money under compound interest. The reactor fuel elements must be taken out periodically because of fuel element clad damage. The remaining U 235 and bred plutonium Pu 239 in the old fuel elements is then put into new fuel rods for the original reactor as well as others. In this manner a kilogram of uranium could produce 3.5 million kWh of electricity energy rather that the 50,000 kWh it does now in the non-breeder commercial water cooled reactor plants.

Plutonium is the best fuel for a reactor as well as for the hydrogen bomb. President Jimmy Carter decreed that the fuel coming out of the commercial reactors can not be reprocessed and used again. He was afraid that the plutonium could be stolen by foreign agents (a highly unlikely event) and made into a atomic bomb. It cannot really be stolen, but reprocessing is not allowed in the US. Other countries such as France do reprocess fuel. France is about 90% nuclear power as of this writing and does not suffer the energy shortage the US does. Carter's move is one of the must stupid acts he committed as well as many others. It is said that the spent fuel currently in the storage pits at each of the 103 commercial reactor sites is sufficient to supply the electric energy needs of the US for a 1,000 years. And it does not contribute any green house gases in the process. But the environmentalists are willing to trade off an abundant fuel supply against the possibility of an enormous fuel supply for the human race.

At the present time there are no plans to recycle the fuel coming out of commercial reactor plants. They plan to bury it in Yucca Mountain. More on this in the web page under **Fuel Cycle.**

Where is the Fast Breeder Reactor today?

The concept does not exist today thanks to Jimmy Carter and Bill Clinton. I suspect Al Gore also had something to do with its demise.

First a little history. Argonne National Lab built the first Breeder plant in Arco, Idaho in the early 1950's. It was a small capacity nuclear power system about 5 MWe. It proved the concept and worked well. In fact it was the first power reactor system built in the United States.

Based on its success, two Fast Breeder projects were started. A combine of utilities and power equipment companies such as Westinghouse, General Electric, Babcock-Wilcox, Atomics International, etc, started a project to design and build a 150 MWe fast Breeder Reactor close to Detroit, Michigan. It was named the Enrico Fermi Plant after the great scientist who conceive the first atomic pile under the football stands at the University of Chicago. I joined the Fermi project after graduating from Michigan State University in 1956 and performed some of the original design work on the heat transport systems.

The second Fast Reactor project, named **Experimental Breeder Reactor II (EBR II)** was started by Argonne National Lab to design and build a 20 MWe Fast Breeder system. The plant was designed with a complete power system including a fuel cycle manufacturing facility. After three years with the Fermi project I witnessed too many design mistakes and as a fledging young engineer could not convince upper management to correct so I joined the Argonne team at Lemont, Illinois. Upon the initial startup phase, the Enrico Fermi plant had too many failures and was not continued because the failures could not be satisfactorily corrected.

EBR II was a complete success. It started operating about 1963, during the JFK administration. EBR II operated flawlessly for 30 years. It was a valuable demonstration and research facility for future reactor system as well as supplying the electrical energy to operate the entire Idaho Reactor test site where the Navy also had an operating nuclear power mock up to train its future submarine and aircraft carrier reactor operators. In fact EBR II was the worlds most successful Fast Breeder Reactor demonstration. England failed, and Russia, Germany, and Japan experienced problems with their first Fast breeder experimental plants. But now Russia is 50 years ahead of the US.

In the early 1970's the country started the design and construction of a commercial demonstration 350 MWe Fast Breeder Reactor power plant to be built at the Clinch River site in Tennessee. This was an industry wide participant project including nuclear power manufacturers and utilities. The project was financed by industry and received a small amount of funding from the US government. I joined General Electric in 1975 and participated in the design of the Clinch River project.

To see a Web page that that answers almost all questions one could ask. click on the following:

Nuclear Energy is the most certain future source

The new Administration Should Accelerate Nuclear Renaissance, Institute Says

Congress should increase U.S. Department of Energy loan guarantees for new nuclear plants and take prompt action to address used fuel storage and recycling, according to the U.S. Chamber of Commerce's Institute for 21st Century Energy.

The institute's transition plan for securing America's energy future offers 88 recommendations and timelines for President-elect Barack Obama and the 111th Congress that will "foster economic growth, strengthen national security and ensure a better energy future."

"Nuclear power is currently the least-cost and largest source of zero-emissions base load electricity, and it must be significantly expanded," according to the Institute. The federal loan guarantee program should be expanded to include building more reactors, the plan said."

My comment: We will see what Barack Obama does with this one

Benefits of Nuclear Power

- **Safety** - No form of electricity generation is completely safe but nuclear power has a good record. In the last forty years of using nuclear power there have been no fatalities occurring as the result of operation in the United States.
- **Decreased Dependency on Oil** - Decreasing our dependency on imported oil is beneficial from a political and environmental stand point.
- **Economical** - "Fuel costs for an equivalent amount of power run from 1/3rd to 1/6th the cost for fossil production, and capital and non-fuel operating costs are roughly equivalent, resulting in the overall cost of nuclear generation of electricity running 50% to 80% that of other sources.
- **Reliability** - Nuclear power plants and fossil run plants are equivalent in their reliability. "Nuclear power plant capacity factors average about 90%.
- **Sustainability** - Through the use of Breeder Reactors the generation of electricity could continue for over thousands of years at present levels. Nothing else can provide this amount of energy. To remain on this earth, mankind must ultimately choose nuclear power.

How does the fast breeder reactor produce this fissionable fuel?

Recall that there is unlimited supply of natural uranium in the earth as well as a huge amounts in sea water. But natural uranium is made up of two isotopes: U 238 and U 235. The mass ratio of these is 99.3% U238 and 0.7% U 235. Only U235 is a useful isotope the will fission in a reactor. U238 will not fission or produce heat energy. In a fast reactor during operation there are about 2.5 neutrons produced during each fission process. One neutron keeps the chain reaction going and the others can strike a U238 atom and convert it to plutonium Pu 239. The isotope Pu239 is a fissionable fuel that produces heat.

Due to breeding, a Fast Breeder Reactor can generate enough fissile fuel to replace that used up plus enough fuel for other reactors. In other words it compounds the amount of fuel similar to the growth of money under compound interest. The reactor fuel elements must be taken out periodically because of fuel element clad damage. The remaining U 235 and bred plutonium Pu 239 in the old fuel elements is then put into new fuel rods for the original reactor as well as others. In this manner a kilogram of uranium could produce 3.5 million kWh of electricity energy rather that the 50,000 kWh it does now in the non-breeder commercial water cooled reactor plants.

Plutonium is the best fuel for a reactor as well as for the hydrogen bomb. President Jimmy Carter decreed that the fuel coming out of the commercial reactors can not be reprocessed and used again. He was afraid that the plutonium could be stolen by foreign agents (a highly unlikely event) and made into a atomic bomb. It cannot really be stolen, but reprocessing is not allowed in the US. Other countries such as France do reprocess fuel. France is about 90% nuclear power as of this writing and does not suffer the energy shortage the US does. Carter's move is one of the must stupid acts he committed as well as many others. It is said that the spent fuel currently in the storage pits at each of the 103 commercial reactor sites is sufficient to supply the electric energy needs of the US for a 1,000 years. And it does not contribute any green house gases in the process. But the environmentalists are willing to trade off an abundant fuel supply against the possibility of an enormous fuel supply for the human race.

At the present time there are no plans to recycle the fuel coming out of commercial reactor plants. They plan to bury it in Yucca Mountain. More on this in the web page under **Fuel Cycle.**

Where is the Fast Breeder Reactor today?

The concept does not exist today thanks to Jimmy Carter and Bill Clinton. I suspect Al Gore also had something to do with its demise.

First a little history. Argonne National Lab built the first Breeder plant in Arco, Idaho in the early 1950's. It was a small capacity nuclear power system about 5 MWe. It proved the concept and worked well. In fact it was the first power reactor system built in the United States.

Based on its success, two Fast Breeder projects were started. A combine of utilities and power equipment companies such as Westinghouse, General Electric, Babcock-Wilcox, Atomics International, etc, started a project to design and build a 150 MWe fast Breeder Reactor close to Detroit, Michigan. It was named the Enrico Fermi Plant after the great scientist who conceive the first atomic pile under the football stands at the University of Chicago. I joined the Fermi project after graduating from Michigan State University in 1956 and performed some of the original design work on the heat transport systems.

The second Fast Reactor project, named **Experimental Breeder Reactor II (EBR II)** was started by Argonne National Lab to design and build a 20 MWe Fast Breeder system. The plant was designed with a complete power system including a fuel cycle manufacturing facility. After three years with the Fermi project I witnessed too many design mistakes and as a fledging young engineer could not convince upper management to correct so I joined the Argonne team at Lemont, Illinois. Upon the initial startup phase, the Enrico Fermi plant had too many failures and was not continued because the failures could not be satisfactorily corrected.

EBR II was a complete success. It started operating about 1963, during the JFK administration. EBR II operated flawlessly for 30 years. It was a valuable demonstration and research facility for future reactor system as well as supplying the electrical energy to operate the entire Idaho Reactor test site where the Navy also had an operating nuclear power mock up to train its future submarine and aircraft carrier reactor operators. In fact EBR II was the worlds most successful Fast Breeder Reactor demonstration. England failed, and Russia, Germany, and Japan experienced problems with their first Fast breeder experimental plants. But now Russia is 50 years ahead of the US.

In the early 1970's the country started the design and construction of a commercial demonstration 350 MWe Fast Breeder Reactor power plant to be built at the Clinch River site in Tennessee. This was an industry wide participant project including nuclear power manufacturers and utilities. The project was financed by industry and received a small amount of funding from the US government. I joined General Electric in 1975 and participated in the design of the Clinch River project.

Georgia Institute of Technology, Education, Research and Development Association of Georgia Universities, Inc., 900 Atlanta Drive, Mail Stop 0425, Atlanta, GA 30332-0425, USA

Abstract

Scoping calculations have been performed for a very high temperature (1000 °C) helium-cooled fast reactor involving two distinct options: (1) using graphite foam into which UC (12% enrichment) is embedded into a matrix comprising UC and graphite foam molded into hexagonal building blocks,, and encapsulated with a SiC shell covering all surfaces, and (2) using UC only (also 12% enrichment) molded into the same shape and size as the foam–UC matrix in option 1. Both options use the same basic hexagonal fuel matrix blocks to form the core and reflector. The reflector contains natural uranium only. Both options use 50 μm SiC as a containment shell for fission product retention within each hexagonal block.

The calculations show that the option using foam (option 1) would produce a reactor that can operate continuously for at least 25 years without ever adding or removing any fuel from the reactor. The calculations show further that the UC only option (option 2) can operate continually for 50 years without ever adding or removing fuel from the reactor. Doppler and loss of coolant reactivity coefficients were calculated. The Doppler coefficient is negative and much larger than the loss of coolant coefficient, which was very small and positive.

This might be a good system for the US energy needs.

Here is a piece written by a university professor. It is typical of the ignorance about Fast Breeder Reactors.

"An adequate long term fuel supply for nuclear energy is dependent upon reprocessing spent nuclear fuel to "burn" a larger fraction of U235 and upon using breeder reactors to upgrade abundant U238 to Plutonium. So far, both reprocessing of spent fuel and breeder reactors have been problem plagued and are far from being reliable commercial technologies. "

My comment: Fast Breeders have been problem plagued and are far from commercial technologies? It is a fact that EBR II operated at full power for thirty years without any problems. We also had a prototype 150 MWe Fast Breeder power plant 80% completed. Bill Clinton and Jimmy Carter used the power of their presidencies to stop both of these activities and due to an ignorant congress, our representatives did not even know it happened.

I repeat, in future year or so there will be no fossil fuels remaining. If the human race is to continue to survive there will be Breeder Reactor running world wide. We need to get started today. With the Breeders operating there is enough energy to supply humans until the sun burns out. Russia, Japan, and France are underway with further development of Fast Breeders. At one time we were ahead of them. Now we have dropped the entire program. Under the Eisenhower administration the US knew the importance of developing the Fast Breeder. Now we do not have presidents with that knowledge.

The Integral fast Reactor (IFR)

One design of fast neutron reactor, specifically designed to address the waste disposal and plutonium issues, is the Integral Fast Reactor.

Go to these links for more information about the IFR.

(http:// www.ucb.berekeley.edu)

(http://www.nationalcenter.org/NPA378.html).

To solve the waste disposal problem, the IFR system consisted of the EBR-II reactor power plant integral to the reprocessing plant, termed the fuel cycle faculty FCF, to process the fuel discharged from of the reactor. At Argonne National Lab, both of these systems were in place,

The FCF is an on-site electro refining fuel reprocessing unit that processes the discharged fuel via electroplating. The recycled uranium and all the transuranics (not just plutonium) results in just short half-life fission products in the waste. Some of these fission products could later be separated for industrial or medical uses and the rest sent to a waste repository (where they would not have to be stored for anywhere near as long as wastes containing long half-life transuranics). It is thought that it would not be possible to divert fuel from this reactor to make bombs, as several of the transuranics spontaneously fission so rapidly that any assembly would melt before it could be completed.

Integral Fast Reactor

The Integral Fast Reactor was an advanced nuclear reactor and complete nuclear fuel cycle technology development program. The goal of the IFR program has been to provide a proven advanced nuclear technology capable of overcoming the major technical issues confronting today's generation of nuclear power plants. However, the principal features of IFR technology have proven remarkabley adaptable to solving other problems of nuclear waste and weapons plutonium disposition.

The heart of an IFR power plant is a liquid-sodium-cooled reactor loaded with a new type of metal-alloy fuel. A new recycle technology called pyroprocessing is used to close the fuel cycle by separating the unused fuel from most of the radioactive waste. New fuel rods are fabricated by an inexpensive metal casting process.

Improved assurance of reactor safety was a major objective of the IFR program. Compared to today's reactors, safety of the IFR takes more advantage of the natural characteristics of the materials and the system design, and depends much less on proper mechanical and electric functioning of complex engineered systems or operator actions. This was demonstrated in EBR-II (Argonne's small prototype of the IFR) in 1986. In these tests, conditions were created that would be expected to lead to severe core melt-down in most types of reactors. EBR-II simply shut itself down without the operation of any active safety systems, without operator intervention, and without damage of any kind.

Improved management of high-level nuclear waste was another important goal of IFR technology development. The pyroprocess naturally keeps the most toxic long-lived radioactive materials (the transuranics) locked up in the recycled fuel material, where ultimately they are beneficially destroyed to produce electricity. The IFR process reduces the volume, heat generation, and longevity of nuclear wastes, making deeply buried high-level nuclear waste as benign as uranium ore within a few hundred years.

The Integral Fast Rector is very safe

The **Integral Fast Reactor (IFR)** design gains safety advantages through a combination of metal fuel (an alloy of uranium, plutonium, and zirconium), and sodium cooling. By providing a fuel which readily conducts heat from the fuel to the coolant, and which operates at relatively low temperatures, the IFR takes maximum advantage of expansion of the coolant, fuel, and structure during off-normal events which increase temperatures. The expansion of the fuel and structure in an off-normal situation causes the system to shut down even without human operator intervention.

In April 1986, two special tests were performed on the EBR-II, in which the main primary cooling pumps were shut off with the reactor at full power (62.5 megawatts, thermal). By not allowing the normal shutdown systems to interfere, the reactor power dropped to near zero within about 300 seconds. No damage to the fuel or the reactor resulted. This test demonstrated that even with a

seconds. No damage to the fuel of the reactor resulted. This test demonstrated that even with a loss of all electrical power and the capability to shut down the reactor using the normal systems, the reactor will simply shut down without danger or damage. The same day, this demonstration was followed by another important test. With the reactor again at full power, flow in the secondary cooling system was stopped. This test caused the temperature to increase, since there was nowhere for the reactor heat to go. As the primary (reactor) cooling system became hotter, the fuel, sodium coolant, and structure expanded, and the reactor shut down. This test showed that an IFR type reactor will shut down using inherent features such as thermal expansion, even if the ability to remove heat from the primary cooling system is lost.

Doctor Charles Till

Nuclear physicist and associate lab director at Argonne National Laboratory West in Idaho. He is co-developer of the Integral Fast Reactor, an inherently safe nuclear reactor with a closed fuel cycle.

Dr. Till pointed pointed the following:

IFR development was terminated before the principal element in the fuel processing could be proven – successful, full-scale separation and collection of the new fuel product mixture from the spent fuel. This mixture is composed of plutonium, americium, neptunium and curium, the so-called man-made elements, as well as some residual uranium. It is a mixture most unsuitable for weapons but ideally suited to fuel reactors such as the IFR.

The process was demonstrated successfully at small, laboratory scale. But it is a very big step to scale up to practical amounts. And this is precisely where the development was aborted; the large scale equipment was largely in place, as were the skilled personnel, but the work had not yet started.

My comments:

The IFR could have been the key to a successful nuclear power plant system which solves the waste problem, the proliferation problem, as well as breeding fuel cycle for eternity.

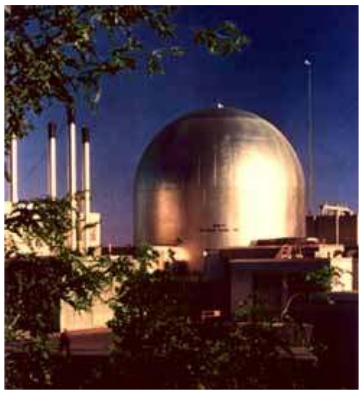
When the IFR project was on the verge of unparalleled success in nuclear fuel recycling, the project was canceled in 1994, at the behest of then-Secretary of Energy Hazel O'Leary. Hazel, a lawyer, was just following orders from Bill Clinton.

This was the final payoff to the the environmentalists by the Clinton administration.

What did Clinton care about the future of energy or the United State's energy progress? Getting elected president was all that mattered along with chasing every skirt he could find. And he made the environmentalist ecstatically happy. They finality destroyed the most valuable nuclear energy systems of our modern era. Clinton also cancelled all research and development activity concerning the Fast Breeder Reactor.

Today, France, Japan, and Russia are all making progress on the Fast Breeder system. At GE we had a modular Fast Breeder system under development when the DOE stopped the project. And where did the funding go. And billions of dollars were spent during the Clinton administration on renewables and not a single economical renewable energy system has ever been developed. Nor will there ever be in my opinion.

Argonne National Laboratory's Integral Experimental Breeder Reactor (EBR II) nuclear power plant and Fuel Cycle Facility.



The picture is EBR II located in the desert about 40 Miles North of the city of Idaho Falls, Idaho The dome at the right houses the nuclear reactor and the building on the left house the steam-turbine electric power plant. The Fuel Cycle facility is linked by a tunnel to the right of the reactor building. EBR-II was a sodium-cooled fast reactor in which all the primary coolant system componets were inside a single vessel containing sodium at atmospheric pressure. It began operating in 1964 and for 30 years operated safely and reliably producing and selling electricity to the local utility as well as serving as a irradiation facility for hundreds of advanced fuel and material development tests. In April 1986, two landmark tests were conducted on EBR-II demonstrating inherently passive responses to unprotected loss-of-flow and loss-of-heat-sink accident simulations.

I was on the staff of Argonne National Lab from 1960 to 1975 and participated in the construction of the EBR II Secondary Sodium System and the Power Plant System. I wrote a good share of the operating manual and participated in the shake down, start up, and initial operation of EBR II.

Experimental Breeder Reactor-II (EBR-II) had been the backbone of the U.S. breeder reactor effort since 1964. The EBR-II plant consists of a sodium-cooled reactor with a thermal power rating of 62.5 megawatts (MW), an intermediate closed loop of secondary sodium, and a steam plant that produces 19 MW of electrical power through a conventional turbine generator. The original emphasis in the design and operation of EBR-II was to demonstrate a complete breeder-reactor power plant with on-site reprocessing of metallic fuel. The demonstration was successfully carried out from 1964 to 1969. The emphasis was then shifted to testing fuels and materials for future, larger, liquid metal reactors in the radiation environment of the EBR-II reactor core. It is now operating as the IFR prototype.

It all sits quietly by now, a stark reminder of a facility that could have been operating supplying kilowatts as well as performing valuable fuel experiments.

Thanks to Bill Clinton the environmentalists won this one and we all lost. Our future has been set back at least 25 years, but the concept will reappear in the future, but maybe too late to head off an energy disaster.

More Advantages of the Fast Breeder Reactors

Nearly 100% of the uranium that is introduced into the fuel cycle can be used to produce energy. This means that by utilizing our present stockpiles of depleted uranium, Fast Reactors could produce all of our Nations electricity for the next 1500 years without the need for additional mining or CO2 production. The impact on the energy reserves that the U.S. has within its boarders is enormous. Because the minor Actinides are not separated from the Plutonium but are utilized in the creation of new fuel pins the fuel is always intensely radioactive and must be remotely fabricated in inerted heavily shielding hot cells. This assures that the overall system is highly diversion resistant. **Comment: Jimmy Carter would like this.**

More Spectacular Safely Characteristics of EBR II

The environmentalists complained that EBR II, being a Fast Reactor, would not control as well and could easily run away. A Fast Reactor gets its name because the neutrons are much more energetic and thus higher in velocity than those of the commercial water cooled reactors. This could be dangerous they asserted. Also loss of coolant flow would be disastrous since the coolant is sodium with a lot greater heat transfer coefficient.

Argonne National Laboratory personnel said it would not be bothered by the same conditions that blew up the Chernobyl Reactor in Russia. So they demonstrated a loss of coolant and failure of the control rods to shut the reactor down. They locked out the controls rod safety limits and pulled the control rods out of the reactor. At the same time shut off the reactor coolant pumps. The reactor heated up a little and shut itself off. Embarrassing to the environmentalists, it did exactly what ANL said it would do. It had a negative coefficient of reactivity due to heating up.

They had no China syndrome accident as predicted by the environmentalists. As you can see the environmentalists wanted to shutdown EBR II in anyway they could. It took a political hack like Clinton to do it. And don't bother them with the truth.

The following was taken from a Department of Energy (DOE) report about General Electric's Advanced Liquid Metal Reactor (ALMR).

Breeding Capability

Though not desired by DOE at present (contract breeding ratio is 1.018), the ALMR core can be loaded so that it will breed significant amounts of Pu-239 which can then be used to fuel itself and many other ALMR plants. Thus, the ALMR system forms a complete fuel cycle which can last for centuries.

Below is an interview with George Stanford, Ph.D., a nuclear reactor physicist, now retired from Argonne National Laboratory after a career of experimental work pertaining to power-reactor safety.

Strongest Points for the Integral Fast Reactor.

What is the best argument for the IFR?

Proliferation prevention. Near-term, the IFR makes PUREX illegitimate and plutonium inaccessible. Long term, it relieves future generations of the responsibility to guard the plutonium mines, and of the risks of not guarding them adequately.

There's another huge benefit, of course. If nothing better comes along, the IFR can supply the world with pollution-free energy for thousands of years.

Since the IFR has so much going for it, research should be steaming full speed ahead, right?

Wouldn't you think so? Nevertheless, at the Clinton administration's urging, Congress terminated the research on October 1, 1994. The Senate voted to continue it, but the House prevailed in conference.

Well, I suppose at least we saved some of the taxpayers' money.

Wrong. Termination cost as much over the ensuing four years as finishing the research would have done, especially since the Japanese were all set to chip in $60 million.

You're kidding. Why would our government do what it did?

Combination of factors, but the main one is plain misunderstanding of the facts I have just explained to you. Well-meaning but ill-informed people claiming to be experts confused pyroprocessing with PUREX, and convinced so many administrators and legislators that the IFR was a proliferation threat that the project was killed.

Below are excerpts from Chuck Till's write up of the IFR demise.

A process that accomplishes what is required must proven at scale before any IFR type reactor system could go forward.

The hard truth is this: large scale nuclear energy needs an IFR type characteristic to give nuclear power inexhaustible fuel. That, in turn, gives nuclear power its long term future.

It is that characteristic that leads its proponents to single out this reactor type for development, and it is also precisely this that caused, and very likely will cause, its opponents to single it out to be stopped.

The end of the IFR was signaled in Bill Clinton's second State of the Union address in early 1994. Development of the reactor that consumed much of its own waste, was largely proof against major accident, and was so efficient that existing fuel supplies would be inexhaustible, was to be terminated immediately. The bright promise of an energy future with a new, much improved reactor system was to be extinguished.

The anti-IFR forces were led by John Kerry. He was the principal speaker and the floor manager of the anti forces in the Senate debate. He spoke at length, with visual aids; he had been well prepared. His arguments against the merits of the IFR were not well informed, more, many were clearly wrong. But what his presentation lacked in accuracy it made up in emotion. He attacked from many angles, but principally he argued proliferation dangers from civilian nuclear power.

My Comments: The anti-nuke forces stopped the most promising energy system the world has ever known. And Clinton could care less since they voted for him.

China realizes the need for the Fast Breeder and has their program well under way. Their initial Faster Breeder plant system has about the same parameters as those of our destroyed EBR II. And you can bet that no one will destroy China's plant as Clinton did ours.

Beloyarsk, Leningrad Nuclear Plants

Russia's federal target program gives an enormous boost to innovation projects, e.g., the fast neutron reactor BN-800. This reactor type solves the problem of fuel self-sufficiency, a paramount issue which will determine the future of the global nuclear power industry. Along the way, this technology solves the spent fuel problem because there will be practically no spent fuel. Under the program, a new-generation BN-800 reactor will be constructed beside the old BN-600 reactor at the Beloyarsk Nuclear Power Plant in the Sverdlovsk Region, Urals.

"Russia has a unique position in the area of fast neutron reactors; They are the leaders in their development, and this means they are uniquely competitive,"

Jul 06 - BBC Monitoring Former Soviet Union Igor Konyshev, adviser to the head of Russia's atomic energy agency, has said that a fast neutron BN-800 reactor will be built for the Beloyarsk nuclear power plant by 2012. He told a news conference in St Petersburg that the project is part of the federal programme for the development of the nuclear energy industry. He said that BN-800 reactor "is one of the most efficient and safe innovative projects". He couldn't give the cost of the project, but experts estimate it at about 2bn dollars, ITAR-TASS said on 6 July.

Russian experience with the Fast Breeder. They lead the world in Fast Breeder experience and they work well. Russia does not let environmentalist destroy Fast Breeder Reactors.

The BN-350 prototype generated power in Kazakhstan for 27 years to 1999 and about half of its 1000 MW(thermal) output was used for water desalination. It used uranium enriched to 17-26%. Its design life was 20 years, and after 1993 it operated on the basis of annual license renewal

design life was 20 years, and after 1995 it operated on the basis of annual license renewal. Russia's BOR-60 was a demonstration model preceding it.

The Russian BN-600 fast breeder reactor - Beloyarsk unit 3 - has been supplying electricity to the grid since 1980 and is said to have the best operating and production record of all Russia's nuclear power units. It uses chiefly uranium oxide fuel, some enriched to over 20%, with some MOX in recent years. Russia plans to reconfigure the BN-600 by replacing the fertile blanket around the core with steel reflector assemblies to burn the plutonium from its military stockpiles and to extend its life beyond the 30 year design span.

US ENERGY

Who said we have an energy shortage? The following fast reactor characteristics are meaningful as a future energy supplier: Proven- Operation of FFTF (Fast Flux Test Facility) successfully for over 10 years, operation of EBR-II (Expermental Breeder Reactor – II) successfully for over 30 years, SEFOR's (SouthEast Fast Oxide Reactor) operation and successful proof of the fast reactor Doppler Coefficient, and the development operations and design of CRBRP (Clinch River Breeder Reactor Project), have all been more than enough to indicate that the fast reactor concept has been proven.

Safe - SEFOR and EBR-II proved beyond a doubt Dr. Paul Greebler's fast reactor Doppler Coefficient predictions, and the world then included the Doppler Coefficient in all their fast reactor designs. The Doppler Coefficient turns around the fast reactor's large power surge without any external safety functions or any damage to the reactor. Too bad Chernobyl wasn't a fast reactor. If it was it would not have destroyed itself.

Environmentally Friendly-The fast reactor does not contribute to CO2 contamination in the atmosphere and minimizes the nuclear storage products produced by existing reactors.

Anti-proliferation-The IFR (Integral Fast Reactor) program could prove its nonproliferation characteristics. The IFR approach in addition to its nonproliferation characteristics could minimize the fuel waste required for storage.

700 years of total US electrical energy fuel is already mined and milled - This fuel, depleted Uranium Hexafluoride, a relatively non-radioactive waste product of the WW-II enrichment process, is the greatest quantity of fast reactor fuel available in any country of the world. See the attached chart showing United States Energy Resources.

Let's see: ***Proven; Safe; Environmentally Friendly; Anti-proliferable; and 700 years of fuel already mined and milled.*** The fast reactor's economical characteristics compare with existing light water reactors, especially when you take into account the 700 year fuel supply that already exists. What more could we ask for?

To make the fast reactor meaningful in the future, we need to develop fast reactor technical and manufacturing manpower and evolve associated fast reactor programs.

Do you want meaningful amounts of and meaningful costs for energy in the future? The only rational course at this point in time is following through with the fast reactor. No other solution appears on the horizon. Either we initiate the fast reactor course or we all go down the drain. Just observe what is going on and check the facts before you act.

Yes , my answer is the following: Fast Breeders are safe and we know how to build them as demonstrated by EBR II. The Fast Breeder Reactor control is done by the delayed neutrons, not the fast ones, they are very controllable. Other countries such as China, Russia, France and Japan have Fast Breeder Reactors. South Korean is starting to develop them. These countries will bring us into the world of Fast Breeders. We need plutonium in order to live in the 30,000 year world. No other fuel will do that. Either we develop the Fast Breeder Reactor or the human race will perish long before 30,000 years. We live in a dangerous world where as the Bible says there will always be wars and rumors of wars. Without the Fast Breeder the world will fight more over the lack of oil and other energy resources.

Return to Top