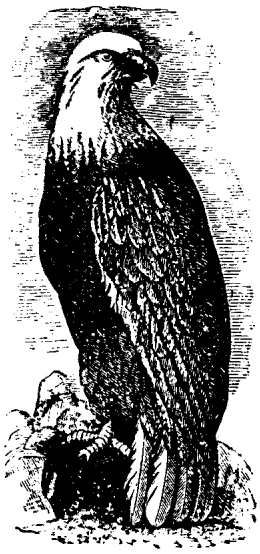


Frontiersman

Facing the truth, however great the cost.

January 2022

A Port in the Storm

Sam Aurelius Milam III

This is a brief description of a design for a nuclear power reactor. So far as I'm aware, I'm the only person who's ever proposed this design. I first documented it on Tuesday, December 19, 2000. I posted it on the internet, and declared it to be public domain, on Saturday, July 30, 2005. I intend that it shall never be patented or monopolized in any way. I intend that it shall be available for use by anybody who's capable of using it.

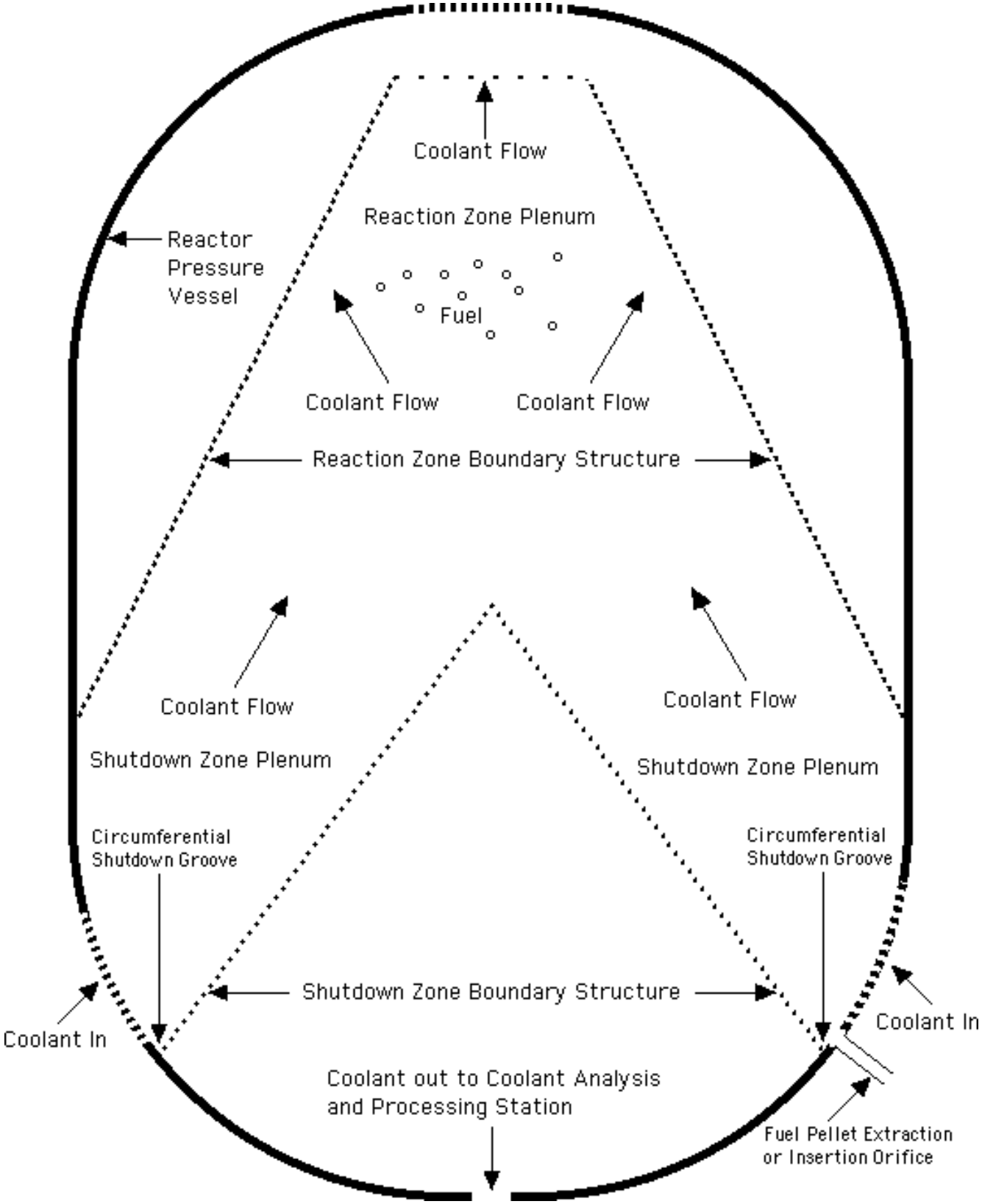
If reactors built according to this design operate as I expect them to, then they would seldom need to be shut down. Fuel could be loaded or withdrawn in any quantity, at any time. All necessary power management could be performed more simply and reliably than in conventional reactors. Compared to conventional reactors, they would be simpler and less expensive to build. They would be more stable, reliable, and safe. They would have an essentially unlimited life expectancy, and would be easier to repair and maintain. Except for the fuel pellets, which would float freely in the coolant, there wouldn't be any internal moving parts. Although the design might provide lower power levels than those that are provided by conventional reactors, I believe that, in the long run, the political and bureaucratic advantages of having many small facilities, rather than a few large ones, would offset the so-called economies of scale that are used to justify big facilities.

Detailed calculations would be necessary to determine if the design will work as I expect it to and, if that's confirmed, to optimize the design. For example, it would be necessary to determine if the fuel should be uranium clad with Zircaloy or glass, an unclad metallic alloy of uranium, or some other configuration. The reactors might be designed to operate with enriched uranium and natural water moderator, or with natural uranium and heavy water moderator. That decision would probably be more political than technical because heavy water reactors can be used to produce plutonium. The anti-proliferation people don't like either plutonium or enriched uranium.

I believe that the reactors should be pressurized water reactors (PWRs) instead of boiling water reactors (BWRs). The difference is that, in a PWR, boiling happens in a separate steam generator, rather than in the reactor itself. I believe that would make the reaction more stable and easier to control. Also, the simpler PWR coolant loop, which includes a steam generator instead of a turbine, would reduce the risk of leaks. Another advantage is that the coolant loop could be subdivided into two branches, each with its own steam generator. Such a reactor could be operated at full power, 100% of the time. One steam generator could drive a turbine and electric generator. Load following could be accomplished by redirecting surplus steam, during periods of low electrical demand, to the second branch of the coolant loop and, thus, to the second steam generator. The second steam generator could be used to boil sea water or contaminated water, to produce fresh water. With the world population growing exponentially, and the available supplies of fresh water being depleted or polluted, the fresh water that such reactors could produce might actually be more valuable than the electricity. Maybe we could even save a few water tables from depletion. The residue from the distillation of sea water would be replete with the minerals and other chemicals that are dissolved in sea water, another treasure trove.

The reaction zone plenum, where the nuclear reaction would occur, is the volume enclosed by the reaction zone boundary structure. See the sketch on page 2. That structure would be situated in the upper portion of the reactor pressure vessel. I've shown it in the sketch as a cone shaped structure with the large end below and the small end above. That shape is adequate for the sketch but studies might show that a different shape would provide better performance. I also recommend that the structure should be made of glass. It might not be obvious to some people, but glass is extremely versatile. Properly formulated, it can be equal to or superior to Zircaloy, a structural material commonly used in nuclear reactors, with regard to such properties as parasitic thermal neutron absorption, elasticity, corrosion resistance, and high temperature integrity. See my comments about glass fuel channels, in my personal website. →

The shutdown zone plenum is the volume inside of the lower portion of the reactor pressure vessel but outside of the shutdown zone boundary structure. As with the reaction zone boundary structure, I've shown the shutdown zone boundary structure as a cone. Studies might show that a different shape would provide better performance. I recommend that glass containing boron, or some other poison (reaction inhibitor) should be considered as a material from which to construct the shutdown zone boundary structure. →



Unlike in a conventional reactor design, the fuel pellets in this design would not be constrained in a fixed fuel array. Instead, they'd be suspended in the coolant. See the sketch. Each fuel pellet should probably be spherical. I expect that spherical pellets would be easier to manufacture. There might be a reason to use some other shape but I don't know what it would be. The optimum size and shape of the pellets would be a function of various related parameters. For example, smaller pellets might require less coolant flow to keep them suspended. There might be reasons to use pellets of different sizes and shapes at the same time. The determination of the optimum pellet configuration would be a complex calculation, involving the effects of many variables.

The nuclear reaction rate would be easily controllable by variation of the coolant flow rate. At a higher flow rate, coolant flow would force the fuel pellets together into the small part of the reaction zone plenum, tending to produce a critical mass and a nuclear reaction. At a low flow rate, the fuel, lacking buoyancy, would settle away from the small end of the reaction zone plenum, and sink toward or into the shutdown zone plenum. As the pellets moved downward, and drifted apart, the reaction rate would decrease. In this reactor design, the dreaded loss of flow accident would simply shut down the reactor. That is, in response to a loss of coolant flow, the pellets would simply disperse. If boron or some other such poison was used in or near the shutdown zone boundary structure, then that would increase the effectiveness of the shutdown process. The shutdown zone boundary structure would have, at its lower edge, a circumferential shutdown groove into which the fuel pellets would settle after they dropped into the shutdown zone plenum. In the circumferential shutdown groove, pellet dispersal would be such that the nuclear reaction would stop. As long as fuel pellets didn't stick together in a big clump, melting of the fuel would be impossible.

Using appropriate plumbing, fuel pellets could be transferred through the reactor pressure vessel wall during full power operation, or at any other time. In the sketch, for simplicity, I've shown an orifice that would allow the insertion of pellets at any time, but removal of them only during reactor shutdown. However, other orifices, at other locations in the reactor pressure vessel, could allow the removal or insertion of fuel during any operating condition.

It might be a good idea if all fuel management responsibilities were subcontracted. The fuel could even be owned by the subcontractor. Then, the owner of the reactor could be responsible only for reactor operation. Fuel management could be provided by the subcontractor. Administrative controls and reactor design could insure that only the subcontractor would have access to the fuel. The way the world is becoming a one-world enforcement authority, the subcontractor would probably be the International Atomic Energy Agency. By the way, it's *nuclear energy*, not *atomic energy*. See *Milam's Dictionary of Distinctions, Differences, and Other Odds and Ends*, in *The Sovereign's Library*.

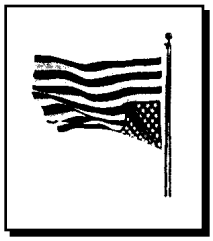
Electricity generated by such reactors could be used to produce hydrogen for fuel, and to run electrified railroads. It could be used to address such problems as global warming and resource depletion. Of course, those kinds of problems are merely consequences of human overpopulation. See *Problem One*, in the July 2021 issue. Because of human overpopulation, it seems likely to me that we're facing a global extinction event. Whatever the case, and until the overpopulation problem corrects itself, we're going to need a lot of food. Growing that much food is going to require a lot of energy and a lot of water. Doing it with only so-called green energy is a pipe dream. The kind of reactors that I'm suggesting could produce both electricity and clean water. They could do it when the wind isn't blowing, when the sun isn't shining, and without releasing greenhouse gas. Some people don't like nuclear energy but, as the old saying goes, any port in a storm.

> Beyond a critical point within a finite space, freedom diminishes as numbers increase. This is as true of humans in the finite space of a planetary ecosystem as it is of gas molecules in a sealed flask. The human question is not how many can possibly survive within the system but what kind of existence is possible for those who do survive. —from *Dune*, 1965 by Frank Herbert

> I can understand the impatience of youth and the world is in a sad state so you want to do things, however, there are too many people already so don't be in too much of a hurry to increase the population. I am very concerned about the future welfare of the young people now growing up. I try to never predict because if I'm right, no one remembers it, and if I'm wrong, no one ever forgets it. If the present trend does not reverse very soon, I can see only cannibalism as the final conclusion.
>
> —Sam Aurelius Milam, Jr.
> Monday, March 17, 1969

Current World Population
https://www.census.gov/popclock/world
Population Curve
http://frontiersman.org.uk/Population/Curve.html

Frontiersman
c/o 4984 Peach Mountain Drive
Gainesville, Georgia 30507



Nation in Distress

The longer we wait to solve an environmental problem, the fewer choices we will have. If we wait long enough, then we probably won't have to make any choices at all. However, the resulting environment might be one in which we're not included.

—Thursday, August 1, 1974
in *Milam's Notes*

Acknowledgments

My thanks to the following: El Dorado Bob; and Betty. —editor

Websites

http://frontiersman.org.uk/
http://moonlight-flea-market.com/
http://pharos.org.uk/
http://sam-aurelius-milam-iii.org.uk/
http://sovereign-library.org.uk/

Humorous Quotes

Original Source Unknown. Forwarded by Marilyn B.

By all means, marry. If you get a good wife, you'll become happy; if you get a bad one, you'll become a philosopher. —Socrates

Last week, I stated this woman was the ugliest woman I had ever seen. I have since been visited by her sister, and now wish to withdraw that statement. —Mark Twain

Signs That You're a Hillbilly

Original Source Unknown. Forwarded by Don G.

- The dog catcher calls for backup before he visits your house.
- You're still scalping tickets after the concert is over.
- You think you're an entrepreneur because of the "Dirt for Sale" sign in the front yard.
- You think that the French Riviera is a foreign car.
- You watch the cartoons long after your kids get bored.
- You think a turtleneck is a key ingredient in soup.
- You filled your deer tag on the golf course.
- The hood and one door of your car are different colors than the car.
- You refer to the time you won a free case of oil as "the day my ship came in." ∞

Frontiersman

Availability — Assuming the availability of sufficient funds, subscriptions to this newsletter in print, copies of past issues in print, and copies of the website on CDs are available upon request. Funding for this newsletter is from sources over which I don't have any control, so it might become necessary for me to terminate these offers or to cancel one or more subscriptions at any time, without notice. All past issues are presently available for free download at the internet address shown below. Contributions are welcome.

Cancellations — If you don't want to keep receiving printed copies of this newsletter, then return your copy unopened. When I receive it, I'll terminate your subscription.

Reprint Policy — Permission is hereby given to reproduce this newsletter in its entirety or to reproduce material from it, provided that the reproduction is accurate and that proper credit is given. I do not have the authority to give permission to reprint material that I have reprinted from other sources. For that permission, you must apply to the original source. I would appreciate receiving a courtesy copy of any document or publication in which you reprint my material.

Submissions — I consider letters, articles, and cartoons for the newsletter, but I don't pay for them. Short items are more likely to be printed. I suggest that letters and articles be shorter than 500 words but that's flexible depending on space available and the content of the piece.

Payment — This newsletter isn't for sale. If you want to make a voluntary contribution, then I prefer cash or U.S. postage stamps. For checks or money orders, please inquire. You can use editor@frontiersman.org.uk for PayPal payments. In case anybody's curious, I also accept gold, silver, platinum, etc. I don't accept anything that requires me to provide ID to receive it.

—Sam Aurelius Milam III, editor

Time flies like an arrow. Fruit flies like a banana.