January 26, 2022

To: Matthew Lanctot, Program Manager, U.S. Department of Energy
Cc: Eric S. Lander, Science Advisor to President Biden and Director of the White House Office of Science and Technology Policy

Subject: https://www.energy.gov/science/doe-explainsdeuterium-tritium-fusion-reactor-fuel

Dear Dr. Lanctot,

Thank you for making some corrections to the Department of Energy's Web page on deuterium-tritium fusion reactor fuel. More corrections are necessary.

As an example of why they are needed, note that Eric S. Lander, President Biden's science advisor, recently said that "fusion reactors would use a virtually limitless source of fuel, basically water." Dr. Lander, who is not a nuclear expert, could very well have obtained his information from your article.

I want to encourage you to make improvements so that your article complies with the Information Quality Act, "ensuring and maximizing the quality, objectivity, utility, and integrity of information disseminated by Federal agencies."

The key problematic paragraphs are these:

> Fortunately, deuterium is common. About 1 out of every 5,000 hydrogen atoms in seawater is in the form of deuterium. This means our oceans contain many tons of deuterium. When fusion power becomes a reality, just one gallon of seawater could produce as much energy as 300 gallons of gasoline.
>
> Tritium is a radioactive isotope that decays relatively quickly (it has a 12-year half-life) and is rare in nature. Fortunately, exposing the more abundant element of lithium to energetic neutrons can generate tritium. A working fusion power plant would need enriched lithium to breed the tritium it needs to close the deuterium-tritium fuel cycle. Current R&D efforts are focused on advanced designs of tritium breeding blankets using lithium originally obtained from Earth-based sources.

> Sources of tritium on Earth include natural production from interactions with cosmic rays, energy-producing nuclear fission reactors such as the heavy-water CANDU reactor, and nuclear weapons testing.

I'll break the problems down separately.

1. "When fusion power becomes a reality."
I don't believe that the Department of Energy has the ability to see the future. So this phrase needs to be removed or modified.

2. "just one gallon of seawater could produce as much energy as 300 gallons of gasoline."
Seawater can, of course, provide the deuterium.

I know of no existing technology that can extract tritium in sufficient quantities from seawater for fusion reactors.

Although people are working on seawater lithium extraction concepts, I know of no existing technology that can do so in sufficient quantities for fusion reactors.

Unless you have references to support the "one gallon of seawater could produce as much energy" claim for tritium or lithium, the phrase needs to be removed or modified.

3. "Fortunately, exposing the more abundant element of lithium to energetic neutrons can generate tritium."
Deuterium-tritium fusion reactor designs will need lithium enriched to a 30-to-90 percent concentration of the lithium-6 isotope, primarily depending on whether a beryllium or lead neutron multiplier is used.

It is therefore misleading to imply that natural lithium will suffice. That part of the phrase needs to say "exposing lithium enriched in the lithium-6 isotope to energetic neutrons."

4. "Fortunately, exposing the more abundant element of lithium to energetic neutrons can generate tritium."
Furthermore, according to tritium breeding experts, there is no known method of breeding lithium in a fusion reactor faster than tritium will be consumed and lost inside that reactor. Therefore, the word "fortunately" must be removed because it implies that a solution exists. The remainder of the sentence must be revised from "can generate tritium" to "may eventually be able to generate enough tritium."

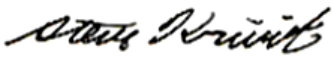
5. "A working fusion power plant would need enriched lithium to breed the tritium it needs to close the deuterium-tritium fuel cycle."

The fuel cycle will never be closed. A DT reactor would need yearly replenishment of enriched lithium. Therefore, the sentence needs to be modified to say "partially close."

6. "Current R&D efforts are focused on advanced designs of tritium breeding blankets using lithium originally obtained from Earth-based sources."
The phrase "using lithium originally obtained from Earth-based sources" hides the fact that natural lithium must be enriched in commercial lithium processing plants. A more transparent, accurate, and informative statement would be "tritium breeding blankets using lithium enriched in the lithium-6 isotope. This is not the form found in nature and it requires complex, biologically and environmentally hazardous processing methods which are no longer legal in the U.S." *I caution you strongly against failing to disclose this information.*

7. "Sources of tritium on Earth include natural production from interactions with cosmic rays, energy-producing nuclear fission reactors such as the heavy water CANDU reactor, and nuclear weapons testing."
The tritium produced by cosmic rays and the remaining atmospheric traces of tritium from nuclear weapons testing are not sources of tritium for anything. The only commercial sources of tritium are the heavy-water CANDU-type reactors. Military agencies produce their own tritium from specially configured fission reactors. You must remove cosmic rays and nuclear weapons testing as sources of tritium.

I realize that you will need time to research these issues and review the provided references. Can I expect a response in one month?



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