THORIUM PROPONENT KIRK SORENSEN ON THE GLOBAL RACE TO MARKET

Kirk Sorensen is one of the many enthusiasts who believes that the real future of nuclear power lies in developing thorium. A former NASA engineer who is now working on his Ph.D. in nuclear engineering, Sorensen operates the website www.energyfromthorium.com, which has become a gathering ground for thorium enthusiasts. We asked him to explain the basis of his optimism.

NTH: In 100 words or less, can you tell us just exactly what is so fabulous about thorium?

SORENSEN: There are two natural fuels for nuclear power uranium and thorium. Only thorium can be completely consumed in a "thermal-spectrum" reactor. Uranium can't. All of our reactors today are "thermal-spectrum" reactors, and they're that way because they can be built in their most stable configuration and with the minimum amount of fuel. If you want to minimize nuclear waste even to the point of nearly eliminating it you must be able to completely consume your nuclear fuel and thorium is the fuel that can do this in a thermal reactor.

NTH: That was only 90 words so we're already ahead of the game here. The story we've always heard is that the early giants such as Enrico Fermi believed thorium would make a better fuel but the need for a bomb pushed everyone in the direction of uranium. Is there truth to that?

SORENSEN: Fermi and other early nuclear pioneers thought that we needed to move towards a nuclear-powered world very quickly, and they also thought that fissile material (Pu-239, U-235, U-233) would be in very short supply. So Fermi favored a "fast-breeder" reactor where more than enough plutonium would be made to operate the reactor. Since the prime goal of the Atomic Energy Commission at that time was to make highly enriched uranium and plutonium for weapons, it is likely that their needs had something to do with the route that he favored. But his colleague, Eugene Wigner, thought thorium was a better option, even though using thorium would mean there wouldn't be lots of extra fissile fuel. Wigner knew that thorium could keep itself going indefinitely in a thermal-spectrum reactor, and he thought that using thorium would be superior in the long run to using plutonium in a fast-spectrum reactor.

NTH: Say we decided tomorrow that thorium was a better route to sustainable nuclear power than uranium. What would be the first steps we should take?

SORENSEN: The first thing we should do is to stop plans to destroy the modest amount of uranium-233 that we currently have. We have about a thousand kilos of U-233 and we're planning on spending $500 million to destroy it permanently. We should use that material and money instead to develop thorium reactors that will use U-233 to make electrical power. The next thing we should do is to restart research in liquid-fluoride reactors. They're the key to using thorium. We researched this technology very successfully in the U.S. from 1950 to 1976, but then we stopped in favor of plutonium and the fast-breeder reactor, which went on to be cancelled in the late 1970s anyway. We should start the research up again and work rapidly towards using thorium in a modern version of a fluoride reactor.

NTH: In 75 words or less, what is liquid-fluoride technology and how does it differ from what we consider the convention systems. What are the fuel rods made of? Does the thorium require a moderator? What is the coolant? You can add the ten words you didn't use in your previous answer.

SORENSEN: Liquid-fluoride reactor technology uses fuel in a liquid form (specifically 7LiF-BeF2-233UF4) that is pumped through a graphite-moderated core region where it is heated by fission. The heated fuel salt then passes out of the core and into a heat exchanger, giving up its heat to a coolant salt, which carries the heat to the power conversion system where electricity is generated. The expansion and contraction of the liquid fuel (and automatic gaseous xenon removal) makes the reactor very responsive to changes in electrical demand.

NTH: The complexity theorists out at the Santa Fe Institute have worked out an idea called “path dependence.” They say that once a technological path has been chosen – no matter how inferior it may be – it’s often very difficult to get off it and onto a better one. The “QWERTY” design of the typewriter keyboard is often sued as an example. Supposedly it was originally designed to slow down the fingers - although there are people who dispute this. Anyway, are we in this position with thorium? Since we’re already committed to a uranium infrastructure, could it just be too expensive to switch over, even though thorium may be a superior technology?

SORENSEN: I simply don’t believe that is the case. We’ve built a number of uranium-fueled reactors but there hasn’t even been talk of any new construction until very recently. Even then, the plans to build new uranium reactors - and I favor continuing those plans - will only help us "keep up" our level of nuclear energy in this country as older reactors are shut down. If we want to become energy independent, we’ll need to build nearly a thousand new reactors. Uranium technology wouldn’t be able to meet the demand. We don’t even mine uranium in our country anymore and a typical uranium reactor only uses half of one percent of the energy in uranium. With thorium and fluoride reactors, we can use almost all of the energy in thorium and mine far less material. I don’t think we’re locked in a "path dependence" at all. I think we just need to get to work on thorium because our current uranium approach is going to start running up against limitations.

NTH: What about thorium mining? Are there any advances there? Has it made as much progress as uranium mining?

SORENSEN: Thorium mining is going to be the least of our problems. Thorium is three to four times more common than uranium and is almost always found with rare-earth minerals. I have a friend who is starting up a rare earth mine in Missouri. He is learning all about thorium because he will end up mining it as he mines materials like neodymium and samarium that are needed in advanced batteries and other electronic goods. I asked him how much the thorium would cost from his mine. He laughed at me and asked me if I was serious. I discovered he will have to "dispose" of the thorium as radioactive waste, so his cost to sell thorium to anyone who wants it is essentially nothing. He joked with me that he would pay me to take the thorium! His mine, by the way, would produce about 10,000 tonnes of thorium each year – enough to meet the total demand for world energy almost twice over. And his situation is not unique.

NTH: As the Nuclear Renaissance gathers steam, what we’re finding is that what happens in the United States isn’t really crucial anyway. We’re still nursing our 1970s fears over fuel recycling while the rest of the world is going ahead without us. It’s the same way with new construction. So here’s a scenario. Let’s say India pioneers thorium technology because they have such ample thorium reserves. Is it possible that they’ll do the work of developing thorium technology and find out if it really has all the advantages that you claim?

SORENSEN: I wish the Indians were pursuing the most efficient thorium technology, but they’re still planning to use thorium in solid-oxide form instead of in liquid-fluoride. That puts them at a big disadvantage. So there’s still a good chance for us to get into a leadership position in liquid-fluoride technology. But India’s not the only game in town. The French, the Czechs, the Russians, the Brazilians, and the Japanese are all looking into thorium-fluoride reactors. Any one of them could master the

technology before we get around to using it.

NTH: In all your efforts to proselytizing thorium technology, what's the most difficult obstacle you encounter?

SORENSEN: The most difficult thing is not apathy but ignorance about the benefits of liquid-fueled thorium reactors. People are very motivated to find an answer to our energy crisis. Once they find out about this technology, they get very excited because it is the most realistic approach to meeting our goal of energy independence. I know someone in the world is going to make it happen. I hope we get there first.

NTH: Kirk, thanks very much for your time and good luck with your efforts. You're doing great work.