requires burial in a geological repository. Further, they say, plutonium and other transuranic elements do not "burn up"; the products of reprocessing could still be used in nuclear weapons and explosive devices. UCS urges that 80% of nuclear waste be moved from cooling pools to dry storage in casks constructed of steel and concrete. These casks use passive air cooling which does not require power or a back-up system. UCS claims that, in case of severeaccident or attack, dry cask storage would reduce potential cancer rates by 90% and potential uninhabitable land by 98%.

Several American companies are currently working to develop alternative nuclear technology, which originated in the 1960's, namely fluoride liquid thorium reactors. Thorium is an abundant, inexpensive source of uranium; it apparently can create 2,000 times the energy invested in it, is very stable and safe, and would not create a plutonium stockpile.

Conclusion

As the current generation of nuclear reactors reach the end of their use, they will no doubt be replaced by smaller portable reactors now in development, and perhaps, newer, more economically competitive and safer nuclear technology. It remains to be seen how large a role nuclear will continue to play in the production of carbon-free electricity. The problem of what to do with nuclear waste may continue to challenge future generations, however.

www.energy.gov; www.eia.gov.; www.energyinformation.org; www.nuclearconnect,org; www.world-energy.org; www.news-gazette.com; www.nirs.org; www.ucsusa.org.

"Thorium Remix 2016", Documentary by Kirk Sorenson

THE PROS AND CONS OF NUCLEAR AS A SOURCE OF ELECTRIC ENERGY IN THE U.S.

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The use of nuclear energy for electricity in the United States has been hotly debated since Three Mile Island occurred in 1979. We will consider the main arguments made by all sides – pro and con – as well as those who recognize nuclear as an important source of carbon-free energy, while they advocate for stricter inspection and safety enforcement.

Nuclear as a carbon-free fuel

Nuclear has provided approximately the same percentage, 20% of total U.S. electricity, since l995. Eleven percent is provided by Non-biomass renewables (hydropower, geothermal, solar and wind). The majority (67%) of electricity is generated by the most polluting sources, including coal, natural gas and petroleum.

Of the Ninety-nine nuclear reactors operating in 2015, fifty-two were at least 30 years old. Older plants have been closing due to increasing costs, competition from cheaper sources of energy, and safety issues. Five new reactors are under construction at existing plants. A smaller pre-fabricated reactor is planned to be sited by 2020 by the Tennessee Valley Authority.

Nuclear proponents assert that the nation will be unable to reduce CO2 emissions, which remain at 6% above 1990 levels, simply by using sustainable sources. Wind power, which

produced 4% of the nation's electricity in 2014 is expected to double by 2040. Solar which provided .5% is expected to grow five-fold by 2030. They also argue that nuclear must be subsidized to survive.

Proponents support New York's agreement to subsidize the continued operation of the 6 nuclear plants which provide 30% of the State's electricity. Opponents say that these plants will have to be replaced upon expiration of their licenses in 2030, and that subsidies will cost twice as much and create half as much energy as developing renewable energy.

Greenhouse gases rose in California after the San Onofre plant was shut down unexpectedly for safety problems. They hope to avoid that situation when the last remaining plant in California, at San Diablo, closes in 2025. The operator, Pacific Gas and Electric has pledged to replace the lost power through energy efficiency and renewables.

The Issue of Safety

Nuclear proponents recognize the grave potential for harm, due to the accidental release of radioactivity into the atmosphere, or an accidental loss of coolant which could cause a catastrophic core meltdown. They take pride, however, in the fact that no member of the public has been injured or killed as a result of a nuclear accident in the United States.

Human error or malfeasance is a significant factor in all nuclear accidents. Partial meltdown occurred at Three Mile Island when operators failed to realize for 80 minutes that coolant was escaping from the unit. The 2011 Fukushima disaster resulted as a consequence of the operator Tepco's failure, despite numerous warnings, to move cooling generators uphill, and seal parts of the building as a precaution against a tsunami, which reached 15.7 meters. The full extent of long-term health damage is unknown; however, by March, 2016, the number of children suffering from thyroid cancer in Fukushima Prefecture is five times what is normally expected.

In 2007, the employees of Entergy Nuclear Vermont Yankee plant requested expedited Nuclear Regulatory Commission action to address structural collapse of a cooling tower module and other conditions which the operators had failed to remedy. Vermont Yankee closed in 2014.

The U.S. Department of Energy is currently studying the possibility of using low-pressure liquid salt as a reactor coolant, since it does not have the same risk of over-heating as water does.

The Issue of Nuclear Waste

The United States has over 65,000 metric tons of nuclear waste, from all sources including discarded equipment components. Most is stored in cooling pools which require electricity to prevent overheating. One of three Americans live within 50 miles of this waste. Nuclear proponents claim that re-processing and recycling will reduce this waste.

The Union of Concerned Scientists (UCS), who do not oppose nuclear energy per se, do oppose reprocessing and recycling nuclear waste. UCS cites studies demonstrating that reprocessing actually increases lower level waste, which still