The Energy Amplifier in Vermont

George Harvey

The problem of what to do with nuclear waste is enormous. The approach attempted by the US federal government, burial in geologically stable ground at Yucca Mountain, has failed. This should come without surprise – even if it were a good idea, and there are those who assert it is not, no state is willing to host such a site. But it is distressing that no alternative is being seriously pursued at present.

As it happens, other ideas range from dangerous to deadly. At one time it was believed nuclear waste could simply be dumped into the sea, and some of it has been, but high-level nuclear waste is a very bad pollutant because the elements present are very toxic and long-lived. It has been suggested that we shoot it into space, but given the amount we need to get rid of, a catastrophic accident would be nearly a certainty.

Every year we make millions of pounds of this waste, every year we argue over what to do about it, and every year we just add it to the stockpile of what has already been produced. Here in Vermont it sits on the banks of New England's largest river. The waste at Vermont Yankee (VY) is to be stored just out of the 500-year flood area, by elevating it five inches above the flood water line. While this is not good storage, it is at least better than shooting it into space.

Every once in a while technology comes to the rescue, and it seems this may be one of those occasions. Nobel Prize winning physicist Carlo Rubbia invented a type of reactor, called an Energy Amplifier, which reduces radioactive material into radiologically inert end products, mostly lead. This includes the waste of other types of reactors and material from atomic bombs.. The process produces heat as a by-product, and the heat can be used to drive turbines for electricity and to heat buildings.

The Energy Amplifier is a system that can generate electricity from radioactive substances, but is in a number of important aspects nothing like a conventional nuclear reactor as they currently exist. Most nuclear reactors operate by controlling nuclear fission at near 'critical mass'. The actual definition is rather complicated, but critical mass can be loosely defined as the amount of nuclear material that produces a chain reaction simply by being all in one place. Fission is a process that is quite rare in nature and consists of radioactive atoms dividing into two or more atoms of much smaller mass that usually are also radioactive.

By contrast the Energy Amplifier operates by using a constant external supply of high-energy protons to cause accelerated nuclear decay and nuclear fission at subcritical mass. The radioactive atom gives off a particle, according to its nature, and becomes an atom of a different element, and of only slightly smaller mass. This is the process of most nuclear decay. The difference is that in the Energy Amplifier, the decay that might require thousands of years, on average, takes only hours or days instead.

The advantages of the Energy Amplifier include the following:

- The waste is nearly free of radioactive material. After 500 years it would be about as radioactive as coal ash, at a fraction of the amount that coal power plants would produce to generate the same amount of energy.

- The design is subcritical, meaning it cannot melt down.

- Many different fuels can be used. It can consume nuclear waste, or it can use Thorium, of which we have an abundance sufficient for thousands of years. Thorium is also barely radioactive, having a half-life of 14 billion years, and requires no enrichment. Other fuel sources include depeated Uranium and the radioactive materials in nuclear bombs.

- Any fissile materials (i.e. material that can undergo fission) produced in the process will be consumed as fuel, and are never present in sufficient quantities to make nuclear weapons. In other words, this technology solves the enormous problem of nuclear proliferation associated with conventional nuclear power.

- Power generation is economical compared to current nuclear power, especially considering the costs of the whole fuel cycle, (safety/evacuation) and the decommissioning process.

- The design is suitable for use in lesser-developed countries. Small plants can be built and operation is less complex than conventional nuclear power. the system cannot be used to make nuclear bombs.

- The Energy Amplifier and its fuel are safe enough to make the design suitable for densely populated areas.

- The design elements have all been proven and require no new science to develop.

The Energy Amplifier seems to have been originally envisioned in the middle to late 1980's. European patents were applied for in 1993 and US patents in 1996. Since then, a number of organizations have done research and design work. Some of these were halted, apparently for political reasons. A complete set of designs has been produced in Italy, and a large utility company in Norway is working to produce a plant there.

The Italian design was for a plant producing approximately 650 megawatts of electricity, slightly larger than VY. Building such a plant is estimated to cost 500 million Euros, or about $650 million.

The estimated cost of the Energy Amplifier is only one fifth that of a new conventional nuclear plant of equivalent size, and it will be much cheaper to run. The conventional nuclear plant has to provide funds to deal with its waste, whereas this provides a potential revenue stream for the Energy Amplifier. In fact the cost is even considerably less than

that of a similarly sized coal burning plant. A pound of Thorium, which costs about $10, can produce as much power as 3000 gallons of oil.

It happens that of all places in the United States, Vermont may be among the best to develop the Energy Amplifier. Anti-nuclear activists who we have approached have usually supported the idea since the EA technology is the only way known to consume nuclear waste and render it relatively safe. The legislature in Vermont is well informed on the nuclear issue because of discussions on relicencing or closing VY. Vermont has important electricity contracts coming up, and is searching for ways to obtain power at reasonable rates. For these reasons, the political process required for development could potentially be shortened by years, even with the current anti-nuclear sentiment that is so strong here. Furthermore, the development of the Energy Amplifier in Vermont would make us a leader in this technology and bring substantial economic development to the state, especially if that development is done by local organizations.

A number of local people have been pursuing the idea of forming an organization to investigate the possibilites of building an Energy Amplifier in Vermont. Readers who are interested may contact Tad Montgomery at 802-251-0502 or eco@tadmontgomery.com.