Chairman Murkowski and Ranking Member Cantwell, thank you for the invitation to submit testimony for your hearing today. My name is Christina Back and I am the Vice President of Nuclear Technologies and Materials at General Atomics (GA). GA is a privately held company providing high-technology systems with over 60 years of experience in nuclear energy starting with the TRIGA research reactor. I will describe what “advanced reactors” are, and what we believe may be appropriate issues for you to consider when developing public policy for encouraging the development of new reactor concepts.

We believe that it is important for our country to increase its use of nuclear energy because it is critical to maintain a diversity of energy sources and nuclear provides emission-free, baseload electricity. If we could make nuclear energy cost-competitive it would provide thousands of years of safe, clean electricity for our country. In addition, remaining the technology leader in nuclear energy is critically important to minimize foreign dependence and strengthen national security.

Unfortunately, because nuclear energy using existing technology is currently too expensive to be competitive, the U.S. nuclear industry is in decline. To reverse this decline, the United States must do what we do best – call on the ingenuity of our scientists and engineers to create new ways to produce nuclear energy safely, cleanly, and at a considerably lower cost.

We are very pleased that there seems to be increased interest in this effort as shown by Members of this Committee, attention from the Administration, and efforts from industry.

It is extremely important that the U.S. resist the temptation to rely almost solely on improving existing technologies that may be at hand and, instead, take the time to develop new leapfrog technologies that may make nuclear energy truly desirable. Thus far, the term “advanced reactors” has been used rather loosely, and can mean different things to different people. Some people consider it to refer to any non-light water reactor, such as a gas-cooled, sodium-cooled, or molten salt-cooled reactor. Others use it to refer to a new light water reactor, such as a Small Modular Reactor (SMR).

To establish the context, let’s remember that, fundamentally, nuclear energy involves splitting an atom and using the heat energy released to turn a generator to produce electricity. At the end of the day, electricity is a commodity, and many consumers do not care whether it is made from nuclear fuels or from burning coal or gas, or from renewables; what matters is its cost. To provide that commodity in today’s world, an “advanced reactor” must improve over existing reactors in the following 4-core objectives. It must:

- produce significantly less costly, cost-competitive clean electricity,
- be safer,
- produce significantly less waste, and
- reduce proliferation risk.
We believe every worthy advanced reactor concept must address these 4-core objectives jointly. It is not sufficient to excel at one without regard to the others.

Now, I would like to discuss General Atomics’ reactor concept, the Energy Multiplier Module or EM², as a way to illustrate what “advanced” can really mean. EM² was designed, from the beginning, to meet the 4-core objectives I just mentioned.

In the design of EM², GA gave serious consideration to risk versus payoff, and we chose to employ innovative design and innovative engineered materials to reach our goals. What makes it compelling to rethink advanced reactors now, is that in the last 30 years scientists have made unprecedented advances in understanding materials. It is now possible to engineer and manipulate materials for specific applications. Use of customized materials and technologies is what we chose to do for EM². This is what sets GA apart.

Now I will go through each of the objectives. First is cost. The drive to minimize costs led to the design of a much smaller reactor that could produce much higher power output per reactor volume than today’s reactors. It also led to a push to higher efficiency, i.e., 50% more electric power from the same amount of heat. We do this by producing the electricity from higher temperature heat. This requires new materials.

Second is safety. For a radical improvement in safety, EM² uses engineered ceramic materials that are capable of working in higher radiation and higher temperature environments. The fuel is contained in materials that can survive accident temperatures over 2 times higher and would not be subject to failure like those in Fukushima. While challenges remain, our results so far have been promising. If they hold up, we will revolutionize this industry.

Third is waste. Minimizing waste products is linked to better fuel utilization. For EM², this is accomplished by the innovation of long-burn core physics and by higher conversion efficiency. Consequently, EM² will use only one fifth of the fuel and produce one fifth of the waste for the same amount of electricity than a current light water reactor.

Finally, fourth is non-proliferation. The innovative design of EM² keeps the fuel in the reactor for 30 years, without the need to refuel or reposition fuel rods. Less handling of the fuel, and tight security allowed by offsite core fabrication, significantly reduce proliferation concerns and lower operating costs.

As a guiding principle, we believe that to bring advanced nuclear power into the market, the cost of nuclear must be significantly reduced below the existing levels projected for new light water reactors. This reactor, if it performs as designed, would produce power at perhaps 40% lower cost than today’s existing nuclear reactors and, because it also is a modular reactor built in a factory and transported to the site, it would require a much lower capital investment per unit of below $1.5 billion. Because it would be built in a factory, it also would reduce proliferation concerns and reduce licensing costs. It would be shipped to the site and installed within 4 years, again keeping costs down.

EM² is only one way to get to the right answer. There may be many other interesting ideas, and many if not most will involve designing NEW materials for nuclear applications. We suggest many of these new advanced reactor concepts should be looked into, and several funded at affordable levels of $5 to $10 million a year for at least 4-5 years before a decision is made to go to the next level, or to drop them. Whichever are chosen are likely to involve radically new technology requiring upfront investments involving risk. Some of these investments may not pay off, and even those that are successful could require at least 10 years to make any revenue. While GA has already invested $40 million in the EM² concept, these commercial realities make it very difficult for any company to justify long lead development expenditures. So, if having future sources of cost-competitive, nuclear power is in the
interest of the United States, the Federal Government will have to increase its support of nuclear energy R&D. And it will have to target it toward the development of advanced reactors using leapfrog technologies, rather than concentrating nearly solely on developing minor improvements in existing nuclear technologies.

We very much appreciate your interest in this subject, and this opportunity to submit our testimony for the Record.