### 2NC CP Solvency

#### Streamlining government regulations key to SMR

Szondy, Writer for GizMag, ’12

[David Szondy, Writer for GizMag, “Small modular nuclear reactors - the future of energy?,” February 16th 2012, http://www.gizmag.com/small-modular-nuclear-reactors/20860/]

So it is with the current stable of SMRs. Many hold great promise, but they have yet to prove themselves. Also, they raise many questions. Will an SMR need fewer people to run it? What are its safety parameters? Will they fulfill current regulations? Will the regulations need to be changed to suit the nature of SMRs? Will evacuation zones, insurance coverage or security standards need to be altered? What about regulations regarding earthquakes? Indeed, it is in government regulations that the modular reactors face their greatest challenges. Whatever the facts about nuclear accidents from Windscale to Fukushima, a large fraction of the public, especially in the West, is very nervous about nuclear energy in any form. There are powerful lobbies opposed to any nuclear reactors operating and the regulations written up by governments reflect these circumstances. Much of the cost of building nuclear plants is due to meeting all regulations, providing safety and security systems, and just dealing with all the legal barriers and paperwork that can take years and millions of dollars to overcome. Modular reactors have the advantage of being built quickly and cheaply, which makes them less of a financial risk, and factory manufacturing means that a reactor intended for a plant that missed approval can be sold to another customer elsewhere. And some SMRs are similar enough to conventional reactors that they don't face the burden of being a "new" technology under skeptical scrutiny. However, red tape is still a very real thing. Only time will tell if the small reactor becomes a common sight on our power grids, if it falls by the wayside like other technological dreams, or if it falls victim to the bureaucrats' rule book.

#### Fixing safety, staffing and evacuation regulations solve

Marston, CTO Electric Power Research Institute, ’12

[Dr. Theodore U. Marston, Former Chief Technology Officer of the Electric Power Research Institute, PhD Mechanical Engineering from the University of Michigan, Fellow of the American Society of Mechanical Engineers, “Status of Small Modular Light Water Reactors in the US,” The Nuclear Decarbonization Option: Profiles of Selected Advanced Reactor Technologies, March 2012]

l Staffing – Current control room staffing requirements are based on large reactors with fully analog control room technology. The control rooms and I&C systems for the smLWRs should be fully digital, possibly with a separate analog system to provide redundancy and diversity in the shutdown of the smLWRs. The inherent safety of the new smLWR designs in conjunction with the fully digital control systems with a high degree of automation should permit the safe operation of the smLWRs without the tradition one control team for each reactor, used in the existing plants. Alternative staffing requirements are under discussion. l Security – Security requirements for US LWRs have increased substantially since the terrorist events of 11 Sept 2001. The requirements are based on new threats and the ability for existing reactors to respond to those threats. The smLWR designs include security in the design and have taken major steps to reduce the security needs. For example, the entire nuclear steam supply system (NSSS), spent fuel pool and containment for all designs are located below grade. The access to control and radioactive material areas is significantly reduced over the existing plants. State of the art security and intrusion detection systems are part of the design. Therefore, it is believed that adequate security of a smLWR can be maintained with simplified security requirements. Proposed simplifications are under development for smLWRs. l Emergency planning – size of emergency planning zones – The emergency planning and the zone of evacuation for US plants is based on the existing fleet. The smLWRs are significantly different in terms of source term in the case of a core melt event. The smLWR core damage frequencies are orders of magnitude lower than what is required in the NRC regulations. 10 The containments are located below grade and the long term cooling needs of a beyond design basis core damage event are much less. For these reasons, the industry believes the current emergency planning zones and notification requirements can be greatly simplified and still protect the health and safety of the public. Proposed simplifications of emergency planning for the smLWRs are currently under development. Such simplification is required to locate a smLWR near regions of high populations, such as those surrounding the existing coal plants that will likely be shut down. This simplification will be a major challenge in light of the 2011 Fukushima accident in Japan. Regulatory challenges could make smLWRs noncompetitive. If the licensing of smLWRs become protracted affairs, the attractiveness of such small plants will vanish. The best hope for smLWRs to be competitive lies in the assumption that they can be licensed, built and commissioned quickly. The primary economic challenge to the commercialization of smLWRs is whether the electricity production costs are (1) affordable and (2) competitive with other forms of generation. With regard to affordability, smLWRs offer potential optionality to the US electric utilities, when the only real options for large generation additions are gas fired, coal fired or large nuclear plants. SmLWRs, being smaller and modular, potentially offer a more manageable nuclear option. SmLWRs are more ‘affordable’, i.e. less of a fiscal risk. They can be deployed in much smaller increments, matching the utilities’ load growths better and reduce the ‘single shaft’ generation risk to an acceptable level. Competing with other forms of electricity generation is a much greater challenge today. Vast amounts of natural gas are being discovered across the US in so-called tight gas (shale) deposits, resulting in cheap and abundant natural gas. The current spot market price of natural gas is less than $3.00/MMBTU. Carbon restraints (taxes or credits), which would improve the competitiveness of smLWRs, appear unlikely to arise in the near future. However it is expected that carbon emissions from large stationary sources will be reduced systematically over time one way or another, and US utilities are very interested in reducing their ‘carbon footprints’. If the economics of the smLWRs are what some of the designs claim, there is a real chance to compete with natural gas fired plants, particularly when carbon constraints are in place. The cost competitiveness of smLWR depend heavily on achieving the following opportunities: lStreamline design and manufacturing are necessary to ffset the economies of scale of other generation op- tions, particularly nuclear plants. ALWRs are becoming larger and larger due to the economies of scale. The only prospect to reverse this effect for the smaller smLWRs is to streamline the shop fabrication of the NSSS and other modules, ship them to the site and install them rapidly. The requisite quality standards must be maintained throughout the entire process. l Modularity of the smLWRs provides the opportunity to transform how we design, build, operate and decom- mission nuclear power plants. lReduce construction time by modularization and con- struction efficiencies. SMRs do not require loan guarantees. This sets the smLWR apart from the larger ALWR, which currently benefit from federal loan guarantees, especially for regulated utilities. Experience shows the loan guarantee process to be a protracted and expensive affair, requiring the expenditure of significant political and fiscal capital. How the impacts of the Fukushima accident affect smLWR development and deployment is unclear. The passive nature of the safety systems and the reduced need for AC power following shutdown should be positive at- tributes. Likewise, the depth of the containment should mitigate certain security concerns, but may raise flooding concerns. However, the idea of locating a number, up to twelve, of smLWRs at a single plant site may become a liability in the eyes of the public. The sequential failure of the Fukushima reactors followed by the hydrogen explo- sions will be long lasting memories for the public. It may be difficult to convince the public that more reactors at a site is safe, in spite of the fact that the single reactor fail- ure source term is much smaller than current reactors and that there is little chance for system interaction in the new designs. US Market Potential for smLWRs The potential smLWR market in the US is quite large, with three primary opportunities for deployment. The nearest term opportunity is to build the initial plants to provide low emission electricity to DOE and DoD facilities that are subject to the Executive Order. This opportunity will be part of the current DOE SMR Program. The second opportunity for smLWR deployment is to provide baseload (or near baseload) generation capacity resulting from general load growth. Baseload generation has not been installed to any degree since the 1970s and 1980s in the US. Most of the recent generation additions have been combined cycle turbines fueled by natural gas. The net demand for the US will grow by 30% in the next 20 years, however. There are renewable portfolio standards in 30 states in the US, so some of this growth will be met with renewable generation, but others, like Ohio, have clean energy standards which include the traditional renewables and other forms of non-emitting generation, such as nuclear plants and large dams. Even with renewables and some gas, a role for nuclear could emerge due to general demand growth.

### 2NC Solvency

#### You should feel bad for lying

RSC, 2011

[Royal Society of Chemistry, Visual Elements Periodic Table: Beryllium, http://www.rsc.org/periodic-table/element/4/Beryllium]

Beryllium is used as an alloying agent in producing beryllium copper, which is used for springs, electrical contacts, spot-welding electrodes and non-sparking tools. When alloyed in small amounts with copper and nickel the ability for this element to conduct electricity and heat is increased. It has found application as a structural material for high-speed aircraft, missiles, spacecraft and communication satellites, and is also extensively used in the space shuttle. Because beryllium is relatively transparent to X-rays, ultra-thin beryllium foil is finding use in X-ray lithography for the reproduction of micro-miniature integrated circuits. Beryllium is also used in nuclear reactors as a reflector or moderator. The oxide has a very high melting point and is also used in nuclear work as well as having ceramic applications.

#### Marginal electricity cost

Davis, Prof. at Haas School of Business, 2011

[August 2011, Lucas W., Assistant Professor at the Haas School of Business, UC Berkeley, “Prospects for U.S. Nuclear Power After Fukushima,” http://ei.haas.berkeley.edu/pdf/working\_papers/WP218.pdf]

In addition to these regulatory risks, investors in nuclear power also face numerous forms of market risk. Perhaps most importantly, nuclear plants face the risk that fossil fuel prices will decrease. In the United States natural gas prices typically determine the marginal cost of electricity, so a decrease in natural gas prices reduces proﬁts for nuclear power plants who sell power in wholesale electricity markets. Figure 3 plots average monthly U.S. natural gas wellhead prices during 1990-2010. The shaded area indicates the time period between September 2007 and June 2009 during which the NRC received applications for new nuclear plants. It is no coincidence that during the long period of relatively low natural gas prices there was little activity in nuclear power. The surge of nuclear orders during 2007 and 2008 corresponds to the highest U.S. natural gas levels ever in real terms, and only one order has been received since prices fell in 2009. The U.S. Department of Energy (2011a) predicts that average natural gas prices in the United States will remain under $5 through 2022 which, if true, represents a signiﬁcant challenge for nuclear power.

#### Tech changes

Davis, Prof. at Haas School of Business, 2011

[August 2011, Lucas W., Assistant Professor at the Haas School of Business, UC Berkeley, “Prospects for U.S. Nuclear Power After Fukushima,” http://ei.haas.berkeley.edu/pdf/working\_papers/WP218.pdf]

Finally, investments in nuclear power face considerable technology risk. Over the 40+ year lifetime of a nuclear power reactor the available sources of electricity generation could change and there is risk that an alternative, lower-cost technology could come along. This could be a technology that is known today such as wind or solar that quickly becomes more cost-eﬀective or some other technology that is currently unknown. Alternative forms of carbon abatement represent another form of technology risk, including, for example, carbon capture and storage or energy eﬃciency technologies that reduce electricity demand.

#### Regulations and safety concerns

US News, 2012

[3/30/12, US News, in an interview with Mark Cooper, researcher at the Vermont Law School Institute for Energy and the Environment, “Expert: Nuclear Power Is On Its Deathbed,” http://www.usnews.com/news/articles/2012/03/30/expert-nuclear-power-is-on-its-deathbed]

But according to a report by the Union of Concerned Scientists, 80 percent of America's nuclear reactors are vulnerable to at least one of the factors involved in the Fukushima disaster, including vulnerability to earthquakes, fire hazard and elevated spent fuel.¶ Retrofitting existing reactors with the latest safety equipment is extremely expensive, Cooper says.¶ "Regardless of what Congress does, the NRC has put on the table very serious and important changes in how we look at safety after Fukushima," Cooper says. "There was one permit [for a new reactor] issued recently, and there's a second one expected in the near future. Frankly, that's about it. I don't see any other reactors moving forward. The economics are so unfriendly that I don't think the rest of the [proposals] are very active."

#### Uranium Sustainability

Zyga, Science Reporter for PhysOrg, quoting analysis by Abbott, Prof. of Electrical Engineering, 2011

[5/11/11, Lisa, BA in rhetoric from University of Illinois at Urbana-Champaign, known science reporter for PhysOrg, Derek Abbott, Professor of Electrical and Electronic Engineering at the University of Adelaide in Australia, “Why nuclear power will never supply the world’s energy needs,” PhysOrg, <http://phys.org/news/2011-05-nuclear-power-world-energy.html>]

Uranium abundance: At the current rate of uranium consumption with conventional reactors, the world supply of viable uranium, which is the most common nuclear fuel, will last for 80 years. Scaling consumption up to 15 TW, the viable uranium supply will last for less than 5 years. (Viable uranium is the uranium that exists in a high enough ore concentration so that extracting the ore is economically justified.) Uranium extraction from seawater: Uranium is most often mined from the Earth’s crust, but it can also be extracted from seawater, which contains large quantities of uranium (3.3 ppb, or 4.6 trillion kg). Theoretically, that amount would last for 5,700 years using conventional reactors to supply 15 TW of power. (In fast breeder reactors, which extend the use of uranium by a factor of 60, the uranium could last for 300,000 years. However, Abbott argues that these reactors’ complexity and cost makes them uncompetitive.) Moreover, as uranium is extracted, the uranium concentration of seawater decreases, so that greater and greater quantities of water are needed to be processed in order to extract the same amount of uranium. Abbott calculates that the volume of seawater that would need to be processed would become economically impractical in much less than 30 years.

#### SMRs won’t catch on – not cost-competitive

Forbes, 2012

[5/23/12, “Small Modular Nuclear Reactors By 2022 – But No Market For Them,” http://www.forbes.com/sites/jeffmcmahon/2012/05/23/small-modular-reactors-by-2022-but-no-market-for-them/]

“This would allow SMR technology to overcome the hurdle of NRC certification – the ‘gold standard’ of the international nuclear industry, and would help in the proper development of the NRC’s regulatory framework to deal with SMRs,” according to Paul Genoa, Senior Director of Policy Development at the Nuclear Energy Institute. Genoa’s comments are recorded in a summary released today of a briefing given to Senate staff earlier this month on prospects for small modular reactors, which have been championed by the Obama Administration. DOE defines reactors as SMRs if they generate less than 300 megawatts of power, sometimes as little as 25 MW, compared to conventional reactors which may produce more than 1,000 MW. Small modular reactors can be constructed in factories and installed underground, which improves containment and security but may hinder emergency access. The same summary records doubt that SMRs can compete in a market increasingly dominated by cheap natural gas. Nuclear Consultant Philip Moor told Senate staff that SMRs can compete if natural gas costs $7 to $8 per million BTU—gas currently costs only $2 per MBTU—or if carbon taxes are implemented, a scenario political experts deem unlikely. “Like Mr. Moor, Mr. Genoa also sees the economic feasibility of SMRs as the final challenge. With inexpensive natural gas prices and no carbon tax, the economics don’t work in the favor of SMRs,” according to the summary.

#### That argument relies on a market existing for SMRs that doesn’t today, and alternatives are sapping focus

The Economist, 2012

[3/10/12, The Economist, “Nuclear power: The dream that failed,” http://www.economist.com/node/21549936]

Whether it comes to benefit from carbon pricing or not, nuclear power would be more competitive if it were cheaper. Yet despite generous government research-and-development programmes stretching back decades, this does not look likely. Innovation tends to thrive where many designs can compete against each other, where newcomers can get into the game easily, where regulation is light. Some renewable-energy technologies meet these criteria, and are getting cheaper as a result. But there is no obvious way for nuclear power to do so. Proponents say small, mass-produced reactors would avoids some of the problems of today's behemoths. But for true innovation such reactors would need a large market in which to compete against each other. Such a market does not exist.

### Leadership

#### Prolif doesn’t cause conflict- it induces caution

Knopf National Security Affairs Naval Postgraduate School ‘2

(Jeffrey W., October, “Recasting the proliferation optimism-pessimism debate,” Security Studies, Vol. 12, No. 1, p. 45-46)

The dread of suffering nuclear devastation has two implications. First, states “have every incentive”16 to meet the three criteria for stability. Because of the possible consequences if they do not, they will make sure that they have second-strike forces and that their command and control arrangements are adequate to prevent accidents and unauthorized use. The second implication of great costs is caution. Optimists argue that states will be exceedingly careful not to take actions that risk nuclear war. They will not attempt preventive attacks if there is even the remotest chance that the other side already possesses a few nuclear weapons. Moreover, states will not launch major conventional attacks against a nuclear-armed adversary. Because of the risk of escalation to the nuclear level, states will be wary of direct military clashes of any kind. This is where optimists get the positive case for proliferation. Once stable nuclear deterrence exists, optimists claim, major conventional war either becomes impossible or at minimum its likelihood is greatly reduced. As a second broad assertion underpinning their case, optimists contend that meeting the three criteria for stability is easy. Nuclear weapons are relatively small and can easily be made mobile, meaning that survivable forces can readily be created by moving or hiding weapons.17 Because even a single nuclear weapon can cause enormous destruction, effective deterrence will exist if just a few of them are survivable. Finally, survivability is in the eye of a potential attacker. If a state is not 100 percent certain that it knows the location of all of another side’s weapons and that it can successfully destroy all of them, then any attack simply becomes too dangerous to consider. In short, in the optimist view, a little uncertainty goes a very long way.

#### No impact to meltdowns

Strupczewski, Institute of Atomic Energy, 03

[1/28/03, A., Institute of Atomic Energy, Swierk, Poland, Applied Energy, “Accident risks in nuclear-power plants,” vol. 75, ScienceDirect]

\*\*\*NPP = nuclear-power plant

\*\*\*TMI = Three Mile Island

\*\*\*OECD = Organisation for Economic Co-operation and Development

1. Safety goals for nuclear power The general safety objective for nuclear-power plants (NPPs) is to protect the individual, society and the environment by establishing and maintaining in NPPs effective measures against radiological hazards. To reach this objective, safety goals for nuclear power were established from the very beginning of its development, and made more demanding as the technology matured. The initial qualitative targets were that no individual should bear a significant additional risk due to nuclear-power plant operation and the societal risks from power-plant operation should not be a significant addition to other societal risks [1]. They were followed by quantitative requirements, which according to US rules set the design targets so that the calculated plant core-damage frequency (CDF) should be less than 10-4 events per reactor year (R–Y) [2], and the calculated large release frequency (LRF) less than 10-6/R–Y for sequences resulting in a greater than 0.25 Sv whole-body dose over 24 h at one-half mile from the reactor. These requirements for NPP design corresponded to the cancer risk to the people in the critical population group equal to 10-10/R–Y [3]. Presently the safety objectives developed by the US and European utilities for the new generation of NPPs include a maximum permissible CDF equal to 10-5/R–Y [4]. It must also be demonstrated that early containment failure is avoided for all risk-significant scenarios. The cumulative LRF must be less than 10-6/R–Y. In parallel with the development of these targets, the nuclear industry and regulators in the countries leading in nuclear safety have developed the contemporary nuclear safety philosophy, which resulted in reducing risks in NPPs far below those risks typical for other power-industry branches. It places the principle ‘safety first’ as its cornerstone and includes several principles that are today the basis of NPP design and operation in all western countries. 2. Nuclear-power plant safety indicators The progress in the safety level of NPPs is reflected in the probabilistic safety analyses (PSAs), initiated in the US in 1975 by the Rasmussen Study and systematically developed to become standard tools used for safety analysis of every NPP. The importance of PSA in the evaluation of NPP safety is due to the fact that there has been only one severe core damage accident in water-moderated reactors, namely the Three Mile Island accident in the USA in 1978, so there are no historical statistical data as for coal-mine accidents, oil-transport accidents, gas explosions or dam breaks. Minor incidents that do happen in NPPs, although they are eagerly publicized by the media, usually are far below the level at which any hazard to the plant or the public would be involved. Moreover, in view of fast improvements of NPP technology, the analysis of the safety of the plants to be built cannot be based on historical experience with the plants put into operation 20 or even 10 years ago, but must reflect the actual safety features of the upgraded new designs. PSA makes it possible to study the new design features and evaluate which of the safety improvements will bring the required safety upgrading. The main condition for preventing massive releases of radioactivity is to maintain the reactor containment integrity, first of all in the early stage of the accident, then in the later stages when the releases of radioactivity would be less but still significant. In the middle of the 1990s, several mechanisms were considered as possible contributors to an early containment failure. Over the last decade, the intensive research and development of the technical means of coping with severe accidents have resulted in our being able to treat these issues as resolved. The results of several reactor-safety studies performed in Western countries show that the safety of the modern NPPs is very high. For example the German risk-study phase B [5] indicated that the frequency of core melt in Biblis B NPP was 10-4/(R– Y) and that of large radioactive releases 2.6x10-5/(R–Y). After taking into account operator actions preventing the reactor’s pressure-vessel melt-through under high pressure, the frequency of the core melt frequency was reduced to 2.6x10-6/(R–Y). Subsequent analyses performed for KONVOI plants [6] gave similar results, with absolute numbers lower due to improvements in the KONVOI type plants as compared to the Biblis B. Core-damage frequency without bleed and feed in KONVOI plants was 1.4x10-6/R–Y, and after considering the effects of operator actions in those plants, the CDF was reduced to 3.5x10-7/R–Y. These results can be considered as typical for modern PWRs. The project for the European Pressurized-Water Reactor (EPR) assumes that the design will limit the maximum possible releases so that the following safety objectives will be reached: 1. No need for short-term (about 24 h) off-site countermeasures 2. No need for population evacuation beyond 2–3 km 3. For long-term countermeasures, limited restriction of the consumption of agricultural products for a limited period (about 1 year) in a limited area is acceptable [7]. This is the level of safety of NPPs expected as a reference base in the future. Specific designs, which have been already licensed for construction, include reactors with passive safety-features AP 600 or Advanced BWR [8], for which the CDF is below 2x10-7/R–Y. The releases of radioactivity are at least ten times smaller and the health risks are negligible. 3. Radiological effects of nuclear-power plant accidents The level of safety of modern NPPs is surprisingly far from the mass-media picture of consequences of a nuclear accident. Actually, the only accidents with radioactive releases in NPPs were those in TMI and in Chernobyl. In TMI there was a reactor-core melt, but the integrity of the remaining barriers (reactor pressure vessel and containment) was maintained and the releases were so limited that the average effective dose to the public was 0.015 mSv [9]. The corresponding cancer risk was below 10-6 per lifetime, less than the risk due to NORMAL yearly emissions from a coal-fired power plant at that time [10], and no health effects have ever been identified. In Chernobyl, the quantities of released fission products were significant, from 100% of noble gases down to about 4% of solid fission-products. The doses in the early phase after the accident were high. In the rescue team, 28 men died in consequence of exposure to radiation and several more of those who were treated for radiation sickness died from illnesses that may have been associated with their exposure. However, as confirmed in the UNSCEAR report of 2000, there has been no statistically significant increase in the incidence of leukaemia or any other form of cancer among workers or the public (except for child thyroid cancer), nor of deformities of babies born to members of the public [11]. An increase in the incidence of occult thyroid cancer was predicted to occur after 10 years, but actually it was found already in the first year after the accident [11]. This shows that the screening effect can be largely responsible for this observed increase. Generally the occult thyroid cancer is not fatal and can be successfully treated. Although some 2000 cases of thyroid cancer are attributed to the accident, less than 10 fatal cases have been observed. Much greater damage to health has been caused by well meaning but misguided attempts to protect and help people living near Chernobyl at the time of the accident. The evacuation of hundreds of thousands of them is now seen as an over reaction, which in many cases did more harm than good. The first reaction was to move people out. Only later, was it realized that many of them had not needed to be moved. The relocation of people destroyed communities, broke up families, and led to unemployment, depression, hypochondria and stress-related illnesses. Among the relocated populations, there has been a massive increase in stress-related illnesses, such as heart disease and obesity, unrelated to radiation. A major factor causing distress has been uncertainty about risks and in particular belief that all radiation doses can lead to cancer, as stated in the Linear No Threshold hypothesis presently used for the purpose of radiological protection. The recent report of UNPD and UNICEF [12] confirms the above statements and acknowledges that the people living in the contaminated areas receive low doses of radiation, being less than those occurring naturally in many other parts of the world. This is illustrated in Fig. 1 taken from [13] comparing lifetime doses to people around Chernobyl with the doses in European countries including Finland and Sweden, in which the population enjoys very good health and low cancer rates in spite of the high radiation background. According to Russian sources, medical monitoring of the clean-up staff has shown no increase of cancer rate and no relationship between the dose and the mortality. The overall mortality rate among the clean-up staff was statistically lower than the mortality rate of the control group from the public [14]. The UNSCEAR report also confirms that no radiation illnesses (with the exception of child thyroid diseases) have been found in the exposed population [11]. Thus, although it should be acknowledged that the effects of the Chernobyl accident are important, it should be also stressed that most of them are due to excessive fear motivated and politically expedient decisions, not to the radiation doses themselves. The NPPs planned to be built are completely different from RBMKs. The negative temperature reactivity coefficient ensures that, in accident conditions, their power will decrease, not increase as in Chernobyl, the containment (which did not exist in Chernobyl) would remain intact even after severe accidents and the accidentmanagement procedures and safety-upgrading measures implemented in the NPPs would prevent such large releases of radioactivity as was the case in Chernobyl. Thus, the radiological results of Chernobyl cannot be treated as representative of nuclear accidents in NPPs. The estimates of probable releases are made for each NPP separately within PSA studies and generally show that the hazards are much smaller than for other energy sources. 4. Comparison of nuclear-power risks with accident risks due to other energy sources The risks of electricity generation should be evaluated considering the whole cycle, from fuel mining to plant construction, to waste management and site recultivation. While in the case of the nuclear-fuel cycle, the accident risks are mostly connected with the power plant, in other fuel cycles the dominant contribution can be made by other fuel stages. For example, in the case of coal mining, the fatality ratio in the US is about 0.1 death/million tons or 3.5 death/GW(e).a [15]. In very large regions of the world, the situation can be much worse. In China, the average value for the country was about 4.6 deaths per MT in 1997 [16] and the number of mining fatalities per unit of energy produced from coal was 17 deaths/GW(e).a. In addition to that, the accident death rate in coal-fired power plants was about 2 deaths/GW(e).a [17] and in coal transport sector 8.5 deaths/GW(e).a [17]. These numbers add up to the accidental mortality in China coal power system being equal 27.5 deaths/GW(e).a. The number of fatalities due to severe accidents (involving more than 5 fatalities each) for the coal chain in OECD countries is 0.13 per GW(e) [19]. In non-OECD Fig countries, it is much higher. The everyday occupational hazards for the coal chain will be taken as 1.27 fatalities/GW(e).a according to [18], that is for European countries. It is seen, that the small accidents involve more fatalities than the large ones, so both numbers must be taken into account. The differences of the safety of hydropower in OECD and non-OECD countries are most pronounced. While the fatality ratio for OECD countries is only 0.004, it is 2.187 for non-OECD countries [15]. The data on dam safety show that differences in technology and safety practices influence very much the risk of power generation from a given facility. These differences are taken into account while discussing risks of the conventional power industry and nobody discussing the safety of a dam to be erected in the twenty-first century would base its safety indicators on accidents of dams built in say 1920. In a recent ExternE report on hydropower, the authors do not include any risk due to damfailures in the overall health risks due to hydropower [18], because they maintain that the dams built in Norway provide ‘‘negligibly small risk’’. Similarly, the progress in coal-mining safety is taken into account while estimating the number of fatalities per GW(e).a. Of course this is a correct approach. However, if we take into account the progress in dam construction before and after 1930, then the differences in NPP technology existing between RBMK reactors and LWR NPPs should be also considered. Similarly, if introducing strict regulations requiring qualified engineering supervision had a strong effect on dam safety, it is evident that the whole concept of safety culture implemented in Western NPPs has also a significant influence on nuclear-reactor safety. As the differences in design between modern PWRs and the Chernobyl RBMK are much more significant that any differences in dams erected in Norway versus those built in the USA, Italy, France etc., then following the logic accepted by EC ExternE study, the hazards due to Chernobyl should not be considered as the basis for evaluating the safety of future NPPs.

#### SMR designs are flawed and accidents are inevitable – radiation damage outweighs any benefit

Smith, Earth Island Journal, 2011

[Summer 2011, Gar, Environmental journalist and former editor of Earth Island Journal, currently edits Earth Island Institute’s weekly “eco-zine” The-Edge, “Don’t Mini-mize the Dangers of Nuclear Power,” Earth Island Journal, http://www.earthisland.org/journal/index.php/eij/article/dont\_mini-mize\_the\_dangers\_of\_nuclear\_power/]

And that’s just a partial list. The problem with nuclear power is simple: It’s too complex. When things go wrong – as they inevitably do, because humans are fallible – the consequences can be deadly. The Fukushima disaster has severely hobbled the atomic industry’s hopes for a big-ticket nuclear renaissance. So the American Nuclear Society has proposed a mini-renaissance based on “Small Modular Reactors,” or SMRs. Cheaper, quicker to build, and small enough to fit in a garage, SMRs could power homes, factories, and military bases. South Carolina’s Savannah River National Laboratory hopes to start building SMRs at a New Mexico plant and is taking a lead role in a GE-Hitachi demonstration project. Even as Japanese engineers were working to contain the radiation risks at Fukushima, an international SMR conference in South Carolina in April attracted representatives from Westinghouse, AREVA, GE, the International Atomic Energy Agency, China National Nuclear Corp., Iraq Energy Institute, the US Army, and many US utilities. But SMRs still depend on designs that generate intense heat, employ dangerous materials (highly reactive sodium coolant), and generate nuclear waste. SMRs also retain all the risks associated with supplying, maintaining, safeguarding, and dismantling large nuclear reactors – only now those risks would be multiplied and decentralized. The planet can’t afford nuclear energy – be it mega or mini. As Dave Brower observed 30 years ago: “Is the minor convenience of allowing the present generation the luxury of doubling its energy consumption every 10 years worth the major hazard of exposing the next 20,000 generations to this lethal waste?