THE CIP REPORT

CENTER FOR INFRASTRUCTURE PROTECTION VOLUME 8 NUMBER 9

March 2010
Nuclear Energy

Editorial Staff

Editors
Devon Hardy
Olivia Pacheco

Staff Writers
Joseph Maltby

JMU Coordinators
Ken Newbold
John Noftsinger

Publisher
Liz Hale-Salice

Contact: CIPP02@gmu.edu
703.993.4840

Click **here** to subscribe. Visit us online for this and other issues at http://cip.gmu.edu

GEORGE MASON UNIVERSITY

School of Law

CENTER for INFRASTRUCTURE PROTECTION

This month's issue of *The CIP Report* highlights nuclear energy. Nuclear energy is an advanced and challenging technological solution for clean, safe, and more efficient energy.

The Branch Chief of the Nuclear Sector provides an overview of the Nuclear Sector. Then, former Chairman of the U.S. Nuclear Regulatory Commission, currently serving as Commissioner, discusses the future of nuclear power in the United States. Next, representatives from the Argonne National Laboratory describe the research being conducted at this Department of Energy facility. A Distinguished Visiting Professor from George Mason University reviews the Nuclear Renaissance. A Professor of Physics from George Mason University then examines the advantages of thorium reactors. Finally, the Deputy Associate Laboratory Director for Nuclear Programs at the United States Department of Energy's Idaho National Laboratory highlights Generation IV, a new generation of reactor technologies.

In this month's *Legal Insights,* federal regulations that pertain to safeguarding nuclear reactors from intentional aircraft attacks are analyzed.

We also include an announcement about the forthcoming conference, *The Relevance of Risk Management and Information Sharing to Homeland Security*. This one-day conference, originally scheduled in February, has been rescheduled for March 30th.

We would like to take this opportunity to thank the contributors of this month's issue. We truly appreciate your valuable insight.

We hope you enjoy this issue of *The CIP Report* and find it useful and informative. Thank you for your support and your feedback on this publication.

Mick Kicklighter
Director, CIP
George Mason University, School of Law

Working Together for a More Secure and Resilient Nuclear Sector

by Marc Brooks, Nuclear Branch Chief
Sector Specific Agency Executive Management Office
Department of Homeland Security Office of Infrastructure Protection

American infrastructure in the 21st century is a complex array of national, regional and local assets, systems, networks, and functions, which are essential to the Nation's security, public health and safety, economic vitality, and way of life. Whether natural or manmade, disruptions to the Nation's critical infrastructure have the potential to cause grave consequences in the areas of public health and safety, the economy, public confidence in institutions, and the functioning of government. In recognition of this risk, the U.S. Department of Homeland Security (DHS) created the National Infrastructure Protection Plan (NIPP), a coordinated and unified approach for establishing national infrastructure protection priorities.

DHS recognizes that the private sector owns and operates the vast majority of critical infrastructure and key resource (CIKR) assets, systems, and networks in the United States. Homeland Security Presidential Directive – 7 (HSPD-7) designates a Federal department with which each sector coordinates CIKR protection policy and efforts. This ensures that CIKR protection policy accounts for the unique characteristics of each sector. For the Nuclear Sector, DHS serves as the Sector-Specific Agency (SSA). The Nuclear SSA works with its stakeholders throughout the Federal, State, local, tribal, and territorial governments and the private sector to ensure their assets, systems, networks, and functions are well defended and resilient.

As described in the NIPP, SSA responsibilities include collaborating with private sector security partners, as well as Federal, State, local, tribal, and Territorial officials on CIKR protection efforts. SSAs facilitate and implement programs that help prevent and mitigate the consequences of terrorist attacks or natural hazards using risk-based assessments, industry best practices, protective measures, comprehensive partnership and information sharing between industry and government, and robust incident response mechanisms. Additionally, the Nuclear SSA works to coordinate, facilitate, and support comprehensive risk assessment and risk management resilience programs, identify protection priorities, and incorporate CIKR protection activities as a key component of the all-hazards approach to domestic incident management and increased resilience within the sector.

The Nuclear Sector consists of commercial nuclear power reactors, research and test reactors, radioisotopes used in medical and industrial processes, and other products and facilities integral to the nuclear and radiological supply chain. It does not include Department of Defense or Department of Energy (DOE) nuclear facilities or radioactive material associated with defense-related activities.

Nuclear Sector partners, in coordination with the Nuclear SSA, are responsible for the preparedness, protection, and resilience of assets including nuclear power plants, research and test reactors, nuclear fuel cycle facilities, radioactive waste management facilities, nuclear material transport systems, deactivated nuclear facilities, radioactive material users, and radioactive source production and distribution facilities. A vital component in this partnership is the development and utilization of the Sector-Specific Plan (SSP). The SSP establishes a unified sector security strategy and guides programmatic prioritization and resource allocation.

The cornerstone of national CIKR protection and resilience efforts are the relationships built among Federal, State, local, tribal and territorial governments, and the private sector. The SSA acts as a liaison between the private sector, through the Sector Coordinating

(Continued on Page 3)

Nuclear Sector *(Cont. from 2)*

Council (SCC), and the public sector, through the Government Coordinating Council (GCC). Each SSA strengthens these trusted relationships through formal meetings, conferences, and events, through education and outreach materials, and via valuable tools which provide guidance in efforts to improve security and resilience.

The Nuclear SCC is comprised of the following:

- Six members from companies owning or operating at least one commercial nuclear power reactor;
- One member from the owners of fuel manufacturing or fuel fabrication facilities;
- One member from the manufacturers of nuclear reactors or components;
- Two members from the National Organization of Test, Research, and Training Reactors;
- One member from a nuclear waste management or transportation company; and
- One member from the Nuclear Energy Institute.

These members are devoted to promoting a mechanism through which the nuclear industry may provide input into nuclear CIKR protection and resilience policy development and implementation. Additionally, they provide a forum for companies and key organizations involved in nuclear security to collaborate with the government on nuclear CIKR issues.

Members of the Nuclear GCC are:

- U.S. Department of Homeland Security
- Nuclear Regulatory Commission
- Federal Bureau of Investigation
- U.S. Department of Energy
- U.S. Department of State
- U.S. Department of Transportation
- Environmental Protection Agency
- State Radiation Control Program Directors

These partners must work with public and private stakeholders to coordinate and implement civilian nuclear security strategies, activities, and policies. Additionally, they strive to facilitate effective communications across the government, and between the government and the private sector to support the Nation's nuclear homeland security mission. Finally, they must coordinate with the existing emergency management and public health and safety communities regarding response and recovery issues associated with a terrorist act.

Together, all these components must work together to support national security, public health and safety, public confidence, and economic stability by enhancing, where necessary and reasonably achievable, its existing high level of readiness to promote the protection and resiliency of the Nuclear Sector in an all hazards environment; and to lead by example to improve the Nation's overall critical infrastructure readiness.

This can be accomplished by striving towards three sets of goals as set by the SSA.

- **Awareness:**
  - Establish permanent and robust collaboration and communication among sector partners having security and emergency responsibilities for the Nuclear Sector.
  - Obtain information related to dependencies and interdependencies of other CIKR to the Nuclear Sector and share it with sector partners.
  - Increase public awareness of sector protective measures, consequences, and proper actions following a release of radioactive material.

- **Prevention**:
  - Improve security, tracking, and detection of nuclear and radioactive material in order to prevent it from being used for malevolent purposes.
  - Coordinate with sector partners to develop protective measures and procedures to prevent,protect, respond, and recover from all hazard disasters impacting Nuclear Sector assets.

- **Protection, Resilience, Response, and Recovery**
  - Protect against the exploitation of the Nuclear Sector's cyber assets, systems, networks, and the functions they support.
  - Use a risk-informed approach that includes protection and resilience considerations to make budgeting, funding, and grant decisions on potential protection

(Continued on Page 14)

The Future of Nuclear Power: A Regulatory Perspective

by Dale E. Klein, Commissioner
United States Nuclear Regulatory Commission

Across the globe, the pattern is clear and unmistakable — the nations of the world are increasingly turning to nuclear power to meet projected energy needs. This phenomenon is being driven by the promise of new reactor designs, by environmental concerns, by the need to be less dependent on fossil fuels, and by the recognition that demand for electricity will likely double no later than mid-century. At present, approximately 61 new plants are scheduled to open by 2015. China alone is building 21 new plants. Even nations with no existing nuclear power plants or programs are exploring the nuclear power option.

The United States is part of this worldwide trend. Since the late 1990s, the United States nuclear industry has expressed a renewed interest in nuclear energy and is currently submitting the first applications to construct and operate new nuclear power plants in more than three decades. Although various groups and individuals have expressed differing views on the merits of this development, at least one legitimate question is whether the United States government's regulatory structure is prepared to handle this increased activity. Another question is whether regulatory issues are likely to have a significant negative impact on the future development of nuclear power in the United States. As a former Chairman and current Commissioner at the United States Nuclear Regulatory Commission (NRC), I would like to briefly address both of these issues. While the NRC has the responsibility for both nuclear power plants and nuclear materials, in this paper I will only discuss nuclear power plants.

The NRC is the U.S. government's agency for regulating the commercial uses of nuclear energy in this country. Created in 1975, the NRC assumed the regulatory authority of the former Atomic Energy Commission (AEC) in order to separate the regulatory functions of the NRC from the nuclear power development and weapons program activities of the AEC, which are now the responsibility of the DOE. As a result, the NRC is an independent regulatory agency that takes no position for or against the commercial uses of nuclear energy, including the construction and operation of new nuclear power plants.

The NRC's regulatory role is to ensure the safety and security of the Nation's 104 currently licensed operating nuclear power plants and overseeing the design, construction, and operation of any new plants that may be licensed by the NRC in the future. Interestingly enough, the NRC's history as an agency is viewed somewhat differently by three separate audiences — to the nuclear industry, the NRC seems to be viewed as a necessary partner in ensuring the safety of the plants but also as one of the most intrusive regulatory bodies on the planet; to the general public, the NRC is the statutory body charged with protecting the public health and safety, a body that has largely restored its credibility over the years since the Three Mile Island accident but still perceived to be at times too close to the industry it regulates; and to the international community, the NRC is the first and most experienced independent nuclear regulatory body in the world, but one that no longer is necessarily at the forefront of innovation and new construction activities as it once was considered.

This last perception is changing because the NRC now has received 18 applications for 28 new nuclear power plants from the U.S. nuclear industry. Of these 18 applications, 13 have been docketed and at one site, the Vogtle Plant in Georgia, the licensee has already broken ground on some early site construction activities. Five applications have been suspended or deferred temporarily at the applicant's

(Continued on Page 5)

Nuclear Power *(Cont. from 4)*

request for various reasons that are unrelated to the regulatory process.

Given the NRC's role as the national independent regulator of U.S. commercial nuclear activities, it is largely in a reactive mode in responding to the new interest in nuclear power generation. I view the NRC's role as the enabler of commercial nuclear activities, provided that our safety and security requirements and our high standards for engineering, construction, and quality components are met. In order to perform this role effectively, the NRC needs to constantly anticipate new directions in commercial nuclear activity and to prepare for them.

In the case of new nuclear plant applications, the NRC has taken a number of steps to be prepared to conduct its extensive technical reviews of these applications. First, the agency substantially modified its licensing process, which had not changed since the early days of the NRC's existence. The new process, contained in the Commission's regulations as 10 CFR Part 52, potentially involves three steps: certifying a plant design, obtaining an early site permit, and submitting an application for a combined license to construct and operate a plant. The purpose of this new process was to provide both applicants and the public the opportunity to resolve site and design issues before construction begins and to provide a more predictable and stable licensing environment. Under the old process contained in 10 CFR Part 50, the NRC first authorized construction by issuing a construction permit, then addressed all final technical issues at the operating license stage after the plant was already built. Applications for a combined license under the new process are expected to take the NRC about 30 months for the technical review plus about 12 months for public hearings.

The NRC has strongly encouraged applicants to use Early Site Permits, which authorize the general appropriateness of a location for a potential reactor. In addition to establishing an improved licensing process, the NRC has hired hundreds of new employees to assist the existing NRC staff to review designs and applications for combined construction and operating licenses. The Commission also reorganized the agency to create a separate Office of New Reactors to handle the application review process and to ensure that the existing Office of Nuclear Reactor Regulation is focused solely on the safe and secure operation of the existing 104 licensed power reactors. In my view, the NRC has the regulatory infrastructure to handle these applications and is fully ready for the task ahead.

As for the second question, whether regulatory issues are likely to impact the future development of nuclear power in the United States, we are too early in the process to say for sure. The fact that the NRC has docketed 13 new reactor license applications means that the agency has found, on initial review, that the applications are complete enough to warrant more extensive detailed technical and environmental reviews of these applications. In addition, we have certified four reactor designs, with four more under review or being amended. If applicants use the pre-approved designs, the licensing process would be expedited, but so far, only one of the applications we have received is making use of a currently approved certified design. The others reference new designs currently under review or a previously certified design that is currently being amended to incorporate new features. At present, it is not clear whether there are any regulatory issues that would have a significant negative impact on the future of nuclear power in the United States.

However, that does not mean that there are no regulatory issues at all. The NRC review process is designed to ensure that any safety concerns are identified and resolved as early in the process as possible. In that regard, I would like to offer one example of the NRC's careful and extensive review process, in this case involving a design certification review. On October 15, 2009, the NRC staff informed Westinghouse that its current AP1000 shield building design lacked a sufficient basis for the staff to make a finding that certain features of the AP1000 design shield building would perform their safety function under design base loads. The NRC initially approved the design for the Westinghouse AP1000 in January 2006, but Westinghouse

(Continued on Page 14)

Nuclear Energy Research and Development at Argonne National Laboratory

by Hussein Khalil, Director, Nuclear Engineering Division, Argonne National Laboratory
and James Peerenboom, Director, Infrastructure Assurance Center, Argonne National Laboratory

Nuclear energy has gained renewed acceptance worldwide as a proven, large-scale energy supply option. It has an abundant and secure resource base that can be employed safely, reliably, and with negligible emission of the pollutants or greenhouse gases responsible for global climate change. Nuclear energy is currently used to produce 16% of electricity generated worldwide and has great potential to produce significantly more, as well as to supply or co-generate heat for a variety of applications, including production or refinement of transportation fuels and desalination of seawater.

Due to the rapidly growing energy needs of developing countries and the need to add or replace generation capacity in many developed countries, it is expected that in the coming years a significant number of nuclear plants will be ordered, built, and operated. As nuclear energy generation increases worldwide, it will be essential to improve upon the performance of current-generation reactors and fuel cycle systems through reduced waste generation and improved waste management, improved use of fuel resources, enhanced proliferation resistance and physical protection, increased safety and reliability, and improved economics.

With support from the DOE Office of Nuclear Energy, Argonne National Laboratory is applying its expertise in nuclear and chemical engineering to the development of efficient fuel recycle technologies and fast-spectrum reactors needed for sustainable use of nuclear energy. Nuclear engineering expertise, particularly in the behavior of irradiated fuels and materials, supports the NRC in the regulation of industry initiatives to extend the operational lifetime and optimize the operation of existing and evolutionary nuclear reactors. The laboratory's world-class capabilities in materials science, actinide chemistry, and separations science, along with its scientific user facilities, including the Advanced Photon Source (APS) and the Argonne Leadership Computing Facility (ALCF), are major assets for discovery and improved understanding of phenomena and processes in reactors and fuel cycle facilities. These capabilities and facilities are used primarily in programs supported by the DOE Office of Science.

Argonne's expertise in nuclear science and technology — its scientific user facilities — uniquely positions the laboratory to advance a new science-and simulation-based approach to improve the performance and enhance acceptance of future nuclear energy systems. Key elements of this approach involve:

- Increasing the understanding of the diverse physical phenomena underlying reactor and fuel cycle system behavior;
- Developing advanced materials, processes, and designs for reactor and fuel cycle systems;
- Increasing the ability to predict (hence optimize) behavior for operating and off-normal situations; and
- Entering partnerships with industry to translate present and future advances to commercial practice.

Argonne's efforts to advance this approach are organized into three interrelated technical thrusts:

Advance the scientific and technical basis for innovative nuclear energy systems. Argonne is recognized worldwide for its expertise in nuclear reactor physics, materials science, actinide chemistry, and separations science directed toward advancing the scientific basis for nuclear energy systems and integrating discoveries and innovations in realizable concepts for future systems. Argonne's facilities, including APS, ALCF, and the Electron Microscopy Center, are major assets for discovery and improved understanding of relevant

(Continued on Page 15)

Issues for Nuclear Renaissance

by Dr. KunMo Chung, Distinguised Visitng Professor
George Mason University

During the next 20 years, existing operational nuclear power plants are expected to double both in number and generation capacity. Energy experts have been predicting this revolution in the nuclear power industry, or Nuclear Renaissance, in view of increasing concerns regarding potential climate change and environmental degradation; the volatile and increasing prices of oil, natural gas, and coal; and the persistent high cost and decreased reliability of solar photo-voltaic and wind power electricity. In order to meet the rapid growth of the worldwide electricity demand, it is inevitable that many nations will consider nuclear electric power generation for green energy growth and sustainable development. According to the International Atomic Energy Agency, more than 70 nations are considering building and/or expanding their nuclear power generation capacity. If these predictions are correct, the Nuclear Renaissance has indeed begun and as a result deserves our attention.

In order to prepare for the Nuclear Renaissance, we should ascertain and satisfy several outstanding issues. These issues include the safety of nuclear power plant operation, security of critical nuclear facilities, supply of nuclear fuel and fuel services, safeguard of critical nuclear technologies and materials, and storage of radioactive wastes. However, safety and security are the most important issues. Prior to the Nuclear Renaissance, many countries cancelled their planned construction of nuclear power plants and reduced investment, development, and preparation of nuclear power programs due to the accidents that occurred at Three-Mile Island in 1979 and the Chernobyl Nuclear Power Station in 1986. Considering that the public insists upon exemplary safety and security measures at nuclear power generation plants, it took almost a quarter century of successful operation and management of existing nuclear power plants for a number of countries to regain favorable public support of the construction and maintenance of nuclear power plants. The public requires, and rightfully so, convincing performance records of safety and security at nuclear power generation plants. The current global interest in nuclear electricity is a reflection of the public's approval of the stringent international efforts to upgrade nuclear safety and security and the outstanding success of the leading nations in nuclear power generation. For example, we should recognize the exemplary work by the NRC, the excellent record of European nuclear power reactors, and the recent award of a major nuclear power project to the South Korean nuclear industry by the United Arab Emirates (UAE).

The core principle of nuclear safety in nuclear power plants is the 'Defense-in-Depth' principle. In order to prevent any leakage of radioactivity into the biosphere, radioactive materials in nuclear power plants must be secured and protected by multiple layers of physical barriers such as fuel cladding, reactor vessel, and containment building, etc. The basic principle of reactor safety calls for negative temperature and void coefficients, which fundamentally prevent a runaway fission reaction. Also, nuclear power reactors are equipped with multiple mechanisms of reactor shutdown and cooling so that there will be absolute containment of radioactive materials. In other words, it is highly unlikely that there will be another incident similar to the accident at the Chernobyl Nuclear Power Station, where the lack of a containment building failed to prevent leakage of radioactivity. Under the current safety regulation regime, nuclear power plants must comply with rigorous risk-based safety regulation. In addition, the International Nuclear Regulators Association (INRA) is striving to increase international cooperation for risk-based safety regulation. It should be noted that, among

(Continued on Page 8)

Nuclear Renaissance *(Cont. from 7)*

many electricity generation schemes, nuclear power generation is monitored under comprehensive safety regulations. In nuclear power generation, risk identification, risk assessment, risk mitigation, risk management, and risk governance have received intensive consideration. In fact, many scientific methods, practical findings, and measures in connection with risks were the results of nuclear safety studies and regulatory activities. In addition, as society encounters emergent threats in other fields, the risk governance of nuclear energy reflects the need to enhance nuclear safety. The recent regulatory requirement regarding the impact of an aircraft crash into a nuclear power plant expresses the concern raised by the 9/11 attack. The design, construction, operation, maintenance, and management activities of nuclear power plants reflect the most advanced engineering practices of safety and security.

Security measures applied to nuclear energy facilities are also of the most advanced and comprehensive practices. From the selection of sites to the operation of nuclear facilities, security measures have been in place in conjunction with strict record keeping. In addition, due to advancements in IT technologies, accounting and protection of nuclear materials have become more comprehensive and advanced. Furthermore, in order to protect cyber security, nuclear power plants are equipped with multiple channels of communication and information engineering. Full protection of nuclear energy installations from internal failures and external threats is required in order to receive the regulatory approval of operation for any nuclear facility.

However, the unique feature of nuclear energy is the safeguard requirements for sensitive nuclear technologies and the accounting of nuclear materials and equipment to provent the proliferation of nuclear weapons. Despite on-going diplomatic debates and economic sanctions against North Korea and Iran, international efforts for strict enforcement of the Nuclear Non-proliferation Treaty (NPT) have generally been regarded as successful. The universal desire to prevent the development of new nuclear-weapon states and the elimination of existing nuclear warheads has been the basis of safeguard measures for nuclear energy. The global zero (of nuclear warheads) movement is gaining stronger public support. The international community and nuclear industry will continue to relentlessly safeguard goals which include the elimination of illegal trafficing of nuclear sensitive materials and equipment. Ultimately, the Nuclear Renaissance will result in 'burning off' weapon's grade fissile materials and development of non-proliferating nuclear fuel cycles. The utilization of mixed oxide (MOX) fuel and the thorium nuclear fuel cycle offer the technical solution for ultimate non-proliferation safeguard.

Although the issues of safety, security, and safeguard are important to continue the Nuclear Renaissance, the supply of competent professionals who can handle the design, construction, operation, maintenance, and management of nuclear power stations is a critical issue for the reliable and robust development of nuclear energy. In order to achieve the projected nuclear power capacity for the next 20 years, a minimum of 20,000 capable professionals is required in the United States. Current educational and training programs are insufficient to provide the projected need. Furthermore, the past practices of educating and training professionals are rather routine and lack in-depth understanding of comprehensive systems engineering of nuclear power plants, and supporting facilities. With the advancement of simulation techniques and educational practices, we can provide the education and training necessary to produce leadership professionals in much less time and on-the-job experience. Human resources and improved training are key issues in the expansion of the Nuclear Renaissance and the nurturing of the culture of safety and security. In view of the rapid growth of the human resource demand, new educational and training programs are being organized, such as the KEPCO International Nuclear Graduate School and the Virginia Initiative for Nuclear Education Consortium.

In order to accelerate and solidify the Nuclear Renaissance,

(Continued on Page 16)

Thorium Reactors

by Robert Ehrlich, Professor of Physics, George Mason University

All existing nuclear reactors produce energy by the splitting or fissioning of nuclei of very heavy atoms, including certain isotopes of uranium, such as U-235 (the number after the chemical symbol refers to the relative atomic weight on the scale hydrogen, the lightest element being 1). Fissions in a reactor occur after the nuclei absorb neutrons released from other fissions, thereby creating a chain reaction. Unlike a nuclear bomb, the arrangement of the fuel is such that it is on the verge of becoming a "critical mass," where a runaway reaction would occur. The energy released in fissions is roughly a million times greater than those in ordinary chemical reactions, such as burning coal. The released energy is a consequence of converting roughly 1% of the mass of the nuclei into energy, based on Einstein's famous equation $E = mc^2$. One alternative nuclear reaction currently receiving a great deal of study involves the element thorium. The two most likely places that you may have encountered the element is as an additive to the high index glasses some people prefer or the mantle of a camping lantern. Unlike uranium, thorium is not 'fissile,' or capable of fission, but rather it is 'fertile,' meaning that it can breed or be transformed into a fissile nucleus, (i.e., U-233). One method of doing this is to surround a uranium-fueled reactor with thorium that then becomes fissile after absorbing the neutrons that other nuclei emit during fission. An even simpler approach is to seed the thorium with some other fissile material to start the process.

In the 1960s, the United States opereated an experimental thorium reactor at Oak Ridge National Laboratory. However, the reactor was phased out in 1976 due to the belief that the great abundance of uranium worldwide would reduce the need for any alternative reactor type. In that experiment, the thorium was in the form of molten salt, which obviated the need to fabricate fuel elements often in the form of pellets in conventional reactors. For various reasons, today there is much interest in reviving thorium reactors (now being pursued very actively in India). Perhaps these reactors will eventually be used as the basis for 3rd and 4th generation nuclear reactors that solve many of the problems attributed to the current (second) generation nuclear reactors, which in the United States produce 20% of our electricity. Here are some of the advantages of these reactors:

Fuel abundance. Thorium is 3-4 times as abundant as uranium in the Earth's crust, and it is widely distributed around the globe. This fact stretches out the fuel supply to many hundreds of years.

No enrichment needed. Almost all thorium in nature is in a single isotope, unlike uranium, where only 0.7% consists of the fissionable U-235. What this means is that all the thorium can be used, not just 0.7% of it, so that the fuel supply is stretched out by another factor of 100 / 0.7 = 141. Also, the difficult process of enriching the fuel (to increase the fraction of the fissionable isotope) is completely avoided. In the case of uranium, this process is sometimes prepared using thousands of gaseous centrifuges, similar to the gaseous centrifuges Iran is currently running in its presumed pursuit of the bomb — enrichment levels for a bomb need to be far higher than for use in a reactor.

Breeding properties. Ordinary uranium-238 can be used to breed new fuel in the form of plutonium; thorium possesses the same ability. However, thorium consists of much better properties, making it much more suitable for this purpose. For example, the fuel is bred much faster than is the case for uranium. Even more important, the fuel that is bred in a thorium reactor is 'poisoned' from the point of view of making a bomb, and there need be no such worry, as there is in the case of a breeder reactor that creates plutonium that can be reprocessed and possibly stolen by terrorists.

(Continued on Page 17)

The Future of Nuclear Power: The Generation IV International Forum

Today, nuclear power relies upon a series of reactor technologies that, in some cases, were developed as far back as the 1960s. The plants presently in operation, especially those in the United States, are built around categories of technologies now labeled Generation II or Generation III. However, a new generation of technologies is currently in development. These technologies, called Generation IV, are viewed as a way of implementing a nuclear power infrastructure that lacks the drawbacks of existing technologies without losing the benefits of decreased carbon emissions and lower energy prices. Indeed, it would be ideal if these technologies could form the basis of a sustainable nuclear energy infrastructure for the future. Harold McFarlane, Deputy Associate Laboratory Director for Nuclear Programs of the DOE's Idaho National Laboratory and Technical Director of the Generation IV International Forum, explains how the Forum works.

Research into Generation IV is a massive endeavor and is being managed cooperatively by an international group of nations, the Generation IV International Forum (GIF). The Forum began as an agreement between nine countries who signed the GIF Charter: France, Argentina, Brazil, Canada, Japan, South Korea, South Africa, the United States, and the United Kingdom. This group eventually expanded to include Russia, China, Switzerland, Canada, and the nations of the European Atomic Energy Community. Of these members, all but Argentina, Brazil, the United Kingdom, and Russia have signed a further Framework Agreement that implements mechanisms to begin collaborating, on an individual level, on nuclear technology research. Member nations finance their own research and can choose which of the prospective next generation technologies they believe has the most potential for further investigation. At present, $500 million has already been dedicated to this research by GIF member countries.

There are six systems currently in development: the Very High Temperature Reactor, the Gas-Cooled Fast Reactor, Supercritical Water Reactor, the Lead-Cooled Fast Reactor, the Sodium-Cooled Fast Reactor, and the Molten Salt Reactor. It is envisioned that these systems will possess several specific benefits over existing technologies, such as a more manageable waste stream, a lower risk of catastrophic failure, a strong reliability record, a decreased need for off-site emergency response resources, a low attractiveness as a source of nuclear weapons materials, and a need for less fuel for generation. Currently, four of the six systems have implemented systems arrangements, which describe how to break down the research to be completed on that technology.

The research itself is largely performed inside member countries, although some have chosen to collaborate on certain technology projects. Some members also share facilities and coordinate between teams in different nations. The GIF is an entirely voluntary system, focused on providing resources for collaboration. Members do not have any specific obligations for research and there are no enforcement mechanisms. Research is still being conducted primarily at the national level, as international participation has not yet been required. The overarching research plan is the GIF's technology roadmap, developed by a group of subject matter experts nominated by each of the member nations and confirmed by the GIF's policy committee.

The research being conducted now focuses upon system feasibility and viability. McFarlane speculates that this is due to a perceived need to maintain focus and protect intellectual property. Future research may include other issues covered by the GIF's Charter, such as fuel cycle research, which are not currently being pursued. The research itself has been proceeding more slowly than had been hoped, including national research programs, and there have been delays in the negotiation process between the GIF and competing bilateral or trilateral research

(Continued on Page 18)

LEGAL INSIGHTS

Safeguarding Nuclear Power from Intentional Aircraft Attacks

by David Repka and Tyson Smith, Winston & Strawn LLP

Nuclear power plays a critical role in the energy infrastructure of the United States. Approximately 20% of the Nation's electricity is generated by the 104 individual reactor units currently in operation. There is currently a push by the industry and the government for more nuclear plants to reduce reliance on fossil fuels and to reduce greenhouse gas emissions. Given the importance of nuclear energy today and in the future, protection of nuclear assets from damage inflicted by external causes, such as terrorist attacks, is vital to our economy and national security.

Security at Nuclear Power Plants

Since the early days of the commercial nuclear industry, the NRC has required that nuclear plants establish security measures more robust than any other type of energy generation facility — both to preclude diversion of nuclear material and to protect the plants from sabotage that might result in a release of radiological material.

Protection of public safety and the environment starts with the plant design itself. The structures that contain the reactors and critical systems are built to withstand natural events such as earthquakes, hurricanes, tornadoes, fires, and floods. Robust physical barriers and sophisticated detection technologies protect against unauthorized personnel and vehicle intrusion. As threats have evolved over the years, so too have NRC security requirements. For example, physical protection features now include truck bomb barriers, first required after terrorists employed truck bombs in the 1990s.

WINSTON & STRAWN LLP

The layers of protection required at nuclear plants also include plant access authorization requirements, involving detailed background checks and evaluations for plant workers. Nuclear plant licensees must also maintain professional armed security forces, trained to implement detailed defensive strategies utilizing 'contingency weapons' and hardened defensive fighting positions located throughout the plant. The NRC routinely tests these security forces through 'force-on-force' simulated attack exercises.

Following the events of September 11, 2001, the NRC took additional steps to review its security requirements and particularly to address the potential risks associated with intentional or accidental aircraft crashes at nuclear facilities. The comprehensive assessment of nuclear plant security raised significant policy issues. Most importantly, the NRC and the industry evaluated the nature and the degree of the threat that nuclear plants are expected to withstand. This issue certainly necessitates consideration of the international threat environment based on intelligence information. But as a more practical matter, it also involves consideration of how secure a nuclear plant must be relative to other infrastructure facilities. It also includes consideration of how much a private licensee and a private security force can be expected to do, versus how much responsibility for national defense rests with the government and military.

Aircraft Hazards at Operating Power Reactors

In February 2002, as a first step after the September 11 attacks, the Commission ordered all operating power reactor licensees to

(Continued on Page 12)

Legal Insights *(Cont. from 11)*

implement 'interim compensatory' security measures. The NRC also ordered licensees to promptly address the risk of fire and explosions resulting from any cause, including aircraft impacts. These orders, which have since been incorporated into 10 C.F.R. § 73.55, focused on how well the plants could withstand and mitigate the impacts of airplane crashes. The NRC directed licensees to evaluate and address potential vulnerabilities to reactor core cooling, to the containment building, and to the spent fuel pool stored on site — and to develop specific guidance and strategies to respond to an event that damages large areas of the plant due to explosions or fires. The strategies are intended to help licensees utilize surviving onsite or offsite equipment and capabilities to suppress fires and prevent a release of radiological material outside the containment building.

The NRC also recognized that some protective measures are beyond the capabilities of a private licensee and that some threats require a more integrated response, involving Federal, state, and local authorities. There are limits to what can be expected from a private security force, even assisted by local law enforcement. For example, the NRC has maintained that licensees cannot be expected to acquire and operate anti-aircraft weaponry. Protection against some types of threat must be provided by the Federal government. This was a reaffirmation of a policy that the NRC first articulated during the Cold War, related to threats perceived to exist at that time from foreign governments.

In this regard, the NRC specifically recognized and credited a number of steps taken by the government in the aftermath of September 11 to improve aviation security to minimize the threat of terrorists gaining control of airplanes and using them to damage facilities critical to our nation's infrastructure. The NRC accepted that the focus of the effort to protect against terrorist attacks by air should focus on steps to enhance security at airports and on airplanes, such as enhanced passenger and baggage screening, hardened cockpit doors, and the Federal Air Marshal Program. Indeed, protecting nuclear plants in isolation would do little to forestall attackers from simply selecting non-nuclear targets. The NRC has nonetheless continued to work with the Federal Aviation Administration and DOD to identify potential terrorists, prevent potential attacks before they occur, and protect airspace above plants as needed.

Revised Design Basis Threat

As part of its security reassessment, and in response to an explicit Congressional directive included in the Energy Policy Act of 2005 (EPAct 2005), the NRC also undertook a review of the so-called "design basis threat" (DBT). The DBT is characterization, established by regulation, and amplified in non-public guidance, of the adversary force which a nuclear power plant licensee's security plan (including design features and defensive capabilities) must address. The DBT and supporting guidelines specify the nature and size of the attack force, their range of vehicles and weaponry, and aspects of their strategy. The DBT, in many cases, defines the point of division in responsibility for protecting the plant between the private plant operator and the government.

In March 2007, the NRC approved the final rule that enhanced the security regulations and revised the DBT.[1] The revised DBT significantly increased the range of threats included within its scope (and which, for the most part had already been required by plant-specific orders issued by the NRC). The revised DBT incorporated many, but not all, of the factors that Congress, in EPAct 2005, had required the NRC to consider. The revised DBT requires licensees to design their physical protection systems and response strategies to address attacks by multiple groups attacking through multiple entry points, individuals willing to kill or be killed, water vehicles and water-based vehicle bomb assaults, and cyber attacks.[2] The revised DBT, 10 C.F.R. § 73.1(a)(1), does not explicitly include a September 11 type deliberate aircraft attack scenario.
At the time the DBT was proposed,

(Continued on Page 13)

[1] *See* 72 Fed. Reg. 12,705 (Mar. 19, 2007).

[2] *See* 10 C.F.R. § 73.1.

Legal Insights *(Cont. from 12)*

some public interest groups advocated that the plants be specifically designed and retro-fitted to provide passive protection from aircraft and missile attacks. One such proposal was a 'beamhenge' concept. The 'beamhenge' would involve a lattice constructed of I-beams with steel or other cabling and netting between them, at stand-off distances around key structures at nuclear plants, intended to break apart a suicide airliner before impact into the plant. The NRC rejected requiring this concept because the agency determined it to be unnecessary to protect the plant. The NRC relies instead on the government's measures to forestall attacks in the first place, coupled with the ability of the plant to withstand and mitigate the effects of aircraft crashes.

Several organizations challenged this revised DBT in the United States Court of Appeals for the Ninth Circuit. The principal challenge to the rule revolved around the failure to include deliberate air attacks. The challengers focused on NRC's explanation, in discussing the allocation of security responsibility between the private licensees and the government, that air defense protection is more than 'can reasonably be expected of private licensees.' Petitioners argued that the final rule was inadequate because it did not assure 'adequate protection' of public health and safety and because the NRC, in violation of the Atomic Energy Act, improperly considered the costs to licensees by considering what can reasonably be expected of private licensees.

Determining New Reactor Designs

For new reactor designs, applicants must perform two analyses:

(1) Prepare an assessment of the impacts of an aircraft crash; and

(2) Conduct an evaluation of the design features, functional capabilities, and strategies to avoid or mitigate an aircraft crash.

The Ninth Circuit rejected the appeal.[3] The Court recognized the NRC's reasonable division of defense responsibilities between private and government forces (e.g., that there is a significant difference in the practicality of defending against an aircraft or missile attack and constructing a vehicle barrier). The Court also acknowledged that the NRC's previous adversary characteristics had only been included within the scope of the DBT rule if they represented a class of threat that private forces could actively engage, such as militant individuals or vehicles. According to the Court, an airplane attack is different in kind than attacks by militant individuals or vehicles. Unlike other vehicles, airplanes are not used as an intrusionary device to gain access to secure portions of the facility. Instead, an airplane is used as an explosive weapon, more analogous to a missile. When facing an attack from a vehicle, a private force can engage those persons who seek to intrude upon the facility. In an aircraft crash, there are no surviving attackers for private forces to engage following impact. The Court concluded that, once the Commission made the general determination that air-based threats were outside the scope of the DBT, the Commission was under no obligation to consider passive protective measures, such as the beamhenge concept, as part of the rulemaking.

Enhancements for New Reactor Applicants

In light of the fact that no new plants have been licensed or constructed in the United States in the last 10 years, the NRC also decided to require new reactor designers to assess and address aircraft impacts in their designs. On October 3, 2007, the NRC

(Continued on Page 19)

[3] *Public Citizen v. NRC*, No. 07-71868 (9th Cir. July 24, 2009).

Nuclear Sector *(Cont. from 3)*

and emergency response enhancements.

- Enhance the ability of sector partners to effectively respond to nuclear and radiological emergencies.

These goals are all clearly illustrated in the Nuclear Sector Comprehensive Review Outcomes Working Network (CROWN). Between 2005 and 2007, Federal, State, local, and private stakeholders united to conduct comprehensive reviews at all domestic commercial nuclear power plants. This initiative brought public and private stakeholders together to discuss beyond-regulatory security enhancements that would further increase the site's ability to respond to a security incident. CROWN, an interagency working group comprised of comprehensive review participants, was developed to reach out to participating stakeholders to determine if identified enhancements have been addressed and facilitate future implementation. Through this partnership, CROWN not only facilitated communication between stakeholders of all levels and provided valuable grant and risk assessment data, but was also able to recognize the voluntary efforts taken by first responders. While CROWN as a stand-alone project concluded in 2009, similar efforts will continue through various integrated response initiatives.

The Nuclear SSA is currently working with sector partners on a series of initiatives designed to further increase security in the sector. The Nuclear SSA has recently stood up a Research and Development (R&D) Working Group, designed to identify sector mission essential needs, as well as share information on existing R&D initiatives. This will not only give private sector partners the opportunity to articulate specific capability needs directly to R&D components, but also allows the sector to coordinate and streamline R&D efforts to reduce redundancy while keeping the needs of the end user paramount.

In addition to power reactors and R&D, the Nuclear SSA continues to coordinate with Federal, State, local, and private partners on myriad initiatives targeting various parts of the sector, such as medical and industrial isotopes, research and test reactors.

Working to accomplish these eight goals will help in successfully confronting the many varied threats, both manmade and natural, which confront the United States every day. All require a strong public-private partnership based on trust, understanding, and mutual respect. Working together to secure and protect America, the Nuclear SSA and its partners highlight the real value inherent in these critically important relationships. ❖

For more information on DHS' critical infrastructure protection efforts, please visit www.dhs.gov/criticalinfrastructure.

Nuclear Power *(Cont. from 5)*

subsequently submitted an application to amend the AP1000 design certification in May 2007 and submitted an additional amendment to its application in September 2008. These modifications were needed to address additional safety features and requirements.

Although this issue is still being resolved and will delay final design certification of the AP1000 in the United States, I want to emphasize that this is the normal, iterative process used by the NRC and the industry to resolve outstanding issues. The end result will be greater assurance of safety, which is the ultimate purpose of the NRC's review.

Although there will undoubtedly be further regulatory, social, political, and economic challenges ahead, I am confident that the United States has the needed regulatory structure to handle the new interest in nuclear power and to ensure that safety concerns are addressed and resolved. The NRC's role is to be a firm, decisive, effective, and fair regulator, and we are carrying out this role consistent with our mission to protect public health and safety. The American people are counting on us and expect nothing less of us. ❖

National Laboratory *(Cont. from 6)*

phenomena in reactor plants and fuel cycle facilities.

Advance the modeling and simulation of nuclear energy systems. Argonne's leading-edge computing capabilities and expertise in nuclear science and engineering are being integrated to advance the modeling and simulation of nuclear energy systems. The targeted advances and closely coupled validation efforts will improve the predictive capability of tools used for system design and safety verification. They promise to reduce reliance in the future on large-scale, dedicated experiments or mock-up facilities for reactor development than is the case today and may ultimately allow rapid 'numerical prototyping' of reactor and fuel cycle processes, components, and systems.

Demonstrate technologies for fuel cycle closure and improved waste management. Fast-spectrum reactor and fuel recycle technologies are essential for sustainable use of nuclear energy. Actinide multi-recycle in fast reactors greatly improves fuel resource utilization and by eliminating the long-term radiotoxic constituents from discharged waste, greatly eases the challenges associated with nuclear waste disposal. Argonne's research aims to demonstrate the economic competitiveness, safety, and proliferation resistance of advanced fast reactors, fuel recycle, and waste management technologies.

Background on Argonne

Argonne National Laboratory, one of the DOE's oldest and largest national laboratories for science and engineering research, employs roughly 2,900 employees, including approximately 1,000 scientists and engineers, three-quarters of whom hold doctoral degrees. Argonne's annual operating budget of around $630 million supports upwards of 200 research projects.

Argonne's mission is to apply a unique mix of world-class science, engineering, and user facilities to deliver innovative research and technologies. Argonne creates new knowledge that addresses the nation's most important scientific and societal needs.

Research at Argonne centers around three principal areas:

- Energy, including nuclear energy, energy storage, and alternative energy and efficiency;
- Biological and environmental systems; and
- National security.

In the area of national security, Argonne provides critical security technologies that prevent and mitigate events with potential for mass disruption or destruction through the nonproliferation and forensics of weapons of mass destruction, decision sciences, new sensors and materials, and cyber security. For the past decade, Argonne's Infrastructure Assurance Center has been developing advanced modeling and simulation techniques and applying risk analysis methods to determine vulnerabilities and protective measures, in support of the DOE, DHS, and DOD. This effort includes evaluating interdependencies among various types of infrastructures (e.g., between electric power and natural gas or between electric power and telecommunications); the potential for cascading impacts resulting from disruptions to one or more types of infrastructure; better methods of detecting events affected by infrastructure interdependency; and improved technologies and procedures for preventing, responding to, and recovering from such events. ❖

Nuclear Renaissance *(Cont. from 8)*

the pending techno-economic issues must be considered. The first, is the establishment of more practical action-oriented safety standards and regulatory practices. Although safety regulation is a nation's sovereign activity, the international nuclear market is increasingly demanding a globally accepted safety standard system as a pre-requisite for international export-import activities on nuclear plants and facilities. A global safety system and regulatory approval are becoming mandatory requirements. For example, the recent contract between the UAE and Korea calls for the provision of Design Certificate of the Korean nuclear power plant by the NRC. Since safety and security of nuclear power plants and facilities are issues of trans-boundary and global concerns, it is inevitable that a global regime of safety and security will progress.

Another pending techno-economic issue is the issue of multi-national or international nuclear materials facilities, which would handle the sensitive processes of enrichment and reprocessing. For light water reactors, we need low enriched nuclear fuel. Enrichment is a necessary process but a sensitive one from the point of nuclear non-proliferation. Similarly, reprocessing the spent fuel is a most sensitive process in terms of nuclear non-proliferation, although the reprocessing of spent fuel can result in acquiring valuable nuclear fissile materials. In order to meet the strict non-proliferation requirement as well as utilization of valuable nuclear fuel left in the spent fuel, there have been proposals and active studies of multi-national and international nuclear materials handling facilities. In view of the Nuclear Renaissance, there should be reactivation of such ideas as well as international planning.

The emergence of the Nuclear Renaissance was triggered by the need for non-carbon electricity. Nuclear power generation is capable of supplying non-carbon electricity economically and reliably. However, it should be noted that there is room for optimization and innovation for improving the design, construction, and operation of nuclear power generation. For example, we can optimize the system design of nuclear power plants by further utilization of modularization. Modular manufacturing and construction of major nuclear systems would reduce the cost and time in construction of nuclear power plants. Instead of the traditional custom design and custom construction at the site, modularization will enable manufacturing by experienced engineers and technicians at quality-assured factories. Standardization and modularization are the immediate challenges for the Nuclear Renaissance. Quality improvement and cost savings would strengthen the cause for nuclear energy. Furthermore, the shorter implementation of a nuclear power program will attract more nations in need of electricity.

Nuclear energy is a product of the current science-driven technological civilization. Since President Eisenhower delivered the milestone speech 'Atoms for Peace' in 1953 and the International Atomic Energy Agency was established in 1958, nuclear energy has become a global issue. In order to minimize the potential negative aspects of nuclear energy, such as the threat of proliferation and trans-boundary contamination, we have to maximize the positive benefits of nuclear electricity. As a practical 'green' energy solution for concentrated large loads and at a lower cost, nuclear electricity generation will expand rapidly in the years to come. The Nuclear Renaissance is a reality with hope and promise for the 21st century electricity dominated civilization. With advanced engineering and a solid safety culture, we can enhance the Nuclear Renaissance for the benefit of those less fortunate around the world. ❖

Thorium Reactors *(Cont. from 9)*

This was a principal reason that the United States abandoned breeder reactors in 1982.

Minimal little waste problem. The problem of the final disposition of the long-lived radioactive wastes (or spent fuel) from reactors has not been resolved in the United States, although many observers believe it to be more of a NIMBY problem than a technical one, since these wastes can be encased in glass and buried. The repository that had been slated for Yucca Mountain Nevada is now on indefinite hold. In any case, the long-lived waste products from thorium are less than 1% than those from a uranium reactor. This greatly simplifies the problem because with thorium one can be assured of safety if the spent fuel stays out of the biosphere for 300 years as opposed to 25,000 years, which is the case of uranium reactors. In fact, much of the spent fuel can, in the case of thorium, be blended back with the new fuel greatly reducing the volume for disposal.

No catastrophic accidents. Although it is absolutely impossible for a nuclear reactor to explode like a nuclear bomb, serious accidents can occur. The worst of these is a nuclear meltdown in which the controls fail and the nuclear fuel melts and a conventional explosion occurs. In the case of the Chernobyl reactor, this led to a massive release of radiation that contaminated a large area. By way of contrast, Chernobyl released 200,000 times the radioactivity into the environment as Three Mile Island (TMI), and that radiation was in the form of radioactive dust ("fallout"), whereas for TMI it was gaseous and did not reach ground level. Thorium reactors (unlike many others) tend to shut themselves off rapidly if they start to overheat, making a meltdown virtually impossible.

Nuclear reactors have some interesting similarities with renewable sources like wind and solar. All nuclear reactors have virtually no CO^2 emissions, and no other emissions in their normal operation— coal plants for example emit far more radioactivity. Additionally, while their fuel is certainly not free, given its highly concentrated energy content, it is very cheap on a per kiloWatt-hour generated basis. Moreover, reactors based on the thorium cycle are extremely safe, would have little waste disposal problem, and would have a fuel supply lasting many thousands of years. ❖

Generation IV *(Cont. from 10)*

agreements in which some member nations were already involved.

Implementation of these systems is still 10 to 20 years away, says McFarlane. He believes that, in the meantime, large investments in maintaining power plants and extending their life span should continue. Utilities are willing to invest $1-2 billion in a plant to replace and upgrade its key components, an investment that is relatively low-risk and high-yield. The switch from analog to digital control systems should be completed within the next five to ten years. The next five years should also witness a burst of construction for Generation III power plants worldwide, with the possibility that some will even be built in the United States. Initial investment has been slow, however, if the plants currently under development are successful, then growth in the sector will most likely occur. Globally, McFarlane is more confident in the spurt of new plant construction. Many states that do not have existing nuclear power infrastructure are looking to diversify their generation and there are countries like India and China that need to keep growing their power supply to sustain economic growth. One side effect of this development will be that vendors of Generation III expertise will include many foreign firms.

These Generation III and proposed Generation IV reactors will continue to be designed to handle major disasters. McFarlane pointed out that existing plants are already designed to be resilient and protect the public from the risk of a major nuclear disaster, even when confronted with natural or man-made hazards like storms, earthquakes, power outages, accidents, and terrorist attacks. The difference with new plant technologies is that they go further in preventing damage to the plant arising from such incidents. McFarlane characterized this as protecting both the public and the owner's investment. As it stands with today's technologies, the harm to the public from a malfunction is minimal, but the financial loss can exceed $1 billion. Nevertheless, McFarlane believes that the development of these new technologies is unlikely to change U.S. public opinion of nuclear power because he believes that complex technological differences are likely to be unimportant to the average citizen. However, he believes that the growing demand for clean power will push the development for more nuclear power sites and that these new technologies will be provided with an opportunity to impress the public with the advantages of their operation. The GIF is a key piece of the roadmap towards implementing Generation IV. ❖

Note: This article is based in part on an article, "Generation IV Advanced Nuclear Energy Systems" by Jacques Bouchard & Ralph Bennett, published in the September-October 2008 issue of Nuclear Plant Journal.

Legal Insights *(Cont. from 13)*

published a proposed rule that would require applicants for certifications for certain new standard plant designs to assess the effects of the impact of a large, commercial aircraft on the plant.[4] The purpose of the assessment would be to identify design features that could provide additional protection to avoid or mitigate the effects of an aircraft impact, while at the same time reducing or eliminating the need for operator response. In the Commission's view, incorporating the new security measures at an early state in the design process for new plants would allow a reactor designer to include security enhancements that might be difficult or impossible to retro-fit.

The final rule at 10 C.F.R. § 50.150 adopts the requirement for an aircraft impact assessment (AIA) for a new plant, but consistent with the revised DBT, emphasizes that such an attack is as 'a beyond-design-basis event.'[5] The assumptions to be used in the AIA (e.g., the characteristics of the aircraft, including its speed and angle of impact) are classified information and subject to change based on ongoing threat assessment. They will be provided by the NRC directly to reactor designers.

When performing an AIA, designers are expected to examine the effects of a crash on the key safety functions of plant containment, core cooling capability, and spent fuel cooling capability. If these capabilities can be maintained with the design's current features and capabilities, then the applicant does not have to consider further options. If, however, there are no practical means to maintain these capabilities, the applicant must consider other design options. The NRC intends this standard to include those design features, functional capabilities, and strategies which are realistically and reasonably feasible from a technical engineering perspective.

Conclusion

Nuclear power plants are certainly among the most hardened and protected industrial facilities in the United States. Since September 11, 2001, the NRC has required licensees to take steps to address the hazards associated with intentional aircraft impacts. For the plants currently in operation, the NRC required licensees to evaluate and address potential vulnerabilities to core cooling, containment integrity, and spent fuel storage and to develop specific guidance and strategies to respond to an event that damages large areas of the plant due to explosions or fires. The NRC has required similar assessments for proposed new nuclear power plants.

As part of its comprehensive review and revision of security requirements, the NRC revised its DBT that defines the most severe threat to be considered in the plant protection measures and defended against by the plant licensee's security force. The NRC — recognizing the limits on what can reasonably be expected of a private plant operator and its private security force — has stopped short of requiring that privately-owned facilities be capable of defending against intentional aircraft attacks. In the end, the NRC has concluded that it is not necessary, wise, or practical for nuclear reactor licensees to install and maintain the design features, weaponry, and security forces that would be required to provide further defense against a full range of modern weapons, including aircraft and missiles. Ultimately, some responsibility for protecting against terrorist attacks, and indeed other international security threats, must lie with the Federal government and military. ❖

4 *See* 72 Fed. Reg. 56287 (Oct. 3, 2007).
5 74 Fed. Reg. 28112 (June 12, 2009).

The Relevance of Risk Management and Information Sharing to Homeland Security

One-Day Conference

March 30, 2010

at

George Mason University - Arlington Campus
Original Building, Room 329
3401 Fairfax Drive
Arlington, VA 22201

Click Here to Register, view Agenda, and view Fees.

Co-hosted by:

George Mason University School of Law Center for Infrastructure Protection

SARMA Security Analysis and Risk Management Association

Sponsored by:

PricewaterhouseCoopers

The Center for Infrastructure Protection works in conjunction with James Madison Univerity and seeks to fully integrate the disciplines of law, policy, and technology for enhancing the security of cyber-networks, physical systems, and economic processes supporting the Nation's critical infrastructure. The Center is funded by a grant from the National Institute of Standards and Technology (NIST).

If you would like to be added to the distribution list for *The CIP Report*, please click on this link:
http://listserv.gmu.edu/cgi-bin/wa?SUBED1=cipp-report-l&A=1