March 14, 2005

The Honorable Pete V. Domenici, Chairman
Subcommittee on Energy and Water Development
Committee on Appropriations
United States Senate
Washington, D.C. 20510

Dear Mr. Chairman:

I am responding on behalf of the U.S. Nuclear Regulatory Commission (NRC) to a request contained in the Joint Conference report (H. Rept. 108-792) accompanying the *Consolidated Appropriations Act, 2005* (Pub. L. 108-447). The conferees indicated they expected the NRC, in response to the National Academy of Sciences (NAS) study on the safety and security of commercial spent nuclear fuel storage, to improve its analyses, including the preparation of site-specific models, and to work with utilities to ensure timely application of this information to mitigate risks. In this regard, I would like to inform you of the status of our activities related to the NAS study. Enclosed is the Commission's report addressing the Joint Conferees' and House Committee's directions. It should be noted that the attachment to the enclosed report refers to more detailed information and is classified at the secret level. I am providing the secret attachment by a separate letter.

As we informed the NAS in a letter of September 14, 2004, regarding their July 2004 classified report to Congress, the Commission appreciates the NAS Committee's insights into improving the safety and security of commercial spent nuclear fuel storage. The NRC agrees with many of the points raised by the NAS and is seriously considering the NAS report's recommendations. The NRC believes that the NAS study reinforces the validity of recent NRC studies, which indicate that spent fuel storage systems are safe and secure, and of NRC actions to improve the safety and security of such systems. Many of the NAS Committee's conclusions mirror the conclusions we have drawn from our previous work, which has guided our initiatives in this area. However, the NRC also identified a number of areas of disagreement with the NAS Committee's conclusions. We documented these concerns in our September 14, 2004, letter to the NAS. In summary, the NRC staff indicated that it believed, based on information developed in NRC vulnerability assessments, that the Committee has identified some scenarios that are unreasonable. The NRC staff also disagreed with some NAS recommendations and indicated its conclusion that they lacked a sound technical basis. The NAS finding that earlier movement of spent fuel from pools into dry storage would be prudent is one such example.

The NRC has been concerned, as has the NAS, with the failure to develop an appropriate unclassified summary consistent with the Congressional Appropriations language. The NRC continues to implement Homeland Security Presidential Directives including those that direct Federal agencies to protect appropriately information associated with carrying out critical infrastructure identification, prioritization, and protection. The NRC has informed the NAS Committee and NAS management that the proposed NAS reports provided to the NRC for review have not satisfied that requirement since the reports and their contents were inappropriate for public release.

The Commission itself has been involved in attempts to resolve the issues associated with the NAS report. On July 15, 2004, the Commission met with members of the NAS Committee and discussed the classified report. At that time, the Commission offered to meet again with the NAS Committee and assist in the resolution of the issues. In addition, I personally, on behalf of the Commission, offered to meet with NAS in November 2004. On January 24, 2005, the Commission met with members of the NAS Committee to discuss issues, including their request for the NRC to provide additional classified and sensitive unclassified information related to security measures previously taken by the NRC to increase the security of nuclear reactor sites and spent nuclear fuel storage. The Commission agreed, and the staff provided this additional information to the NAS Committee to facilitate the Committee's decision regarding whether or not the classified report should be revised or supplemented. We also continued to make efforts to resolve the disagreements regarding the sensitivity of some of the information in order for NAS to deliver an appropriate unclassified summary report.

With respect to information security, the Commission wants to ensure that the NRC is striking the right balance between making information publicly available and withholding information for homeland security reasons. As a result, the Commission has decided to establish an internal task force to review classification of information (e.g., classified, safeguards, and sensitive unclassified information that should be withheld from public disclosure under a Freedom of Information Act (FOIA) Exemption). Representatives of this task force will interact with appropriate members of the Executive Branch to confirm the NRC interpretation and practices for classification of the information. The enclosed report was reviewed by the Commission and reflects our current position on the difficult issue of what information can be made publicly available.

Independent of the NAS study, the NRC has taken numerous actions to enhance the security of spent nuclear fuel, and will take appropriate additional action if necessary. Prior to September 11, 2001, spent fuel was well protected by physical barriers, armed guards, intrusion detection systems, area surveillance systems, access controls, and access authorization requirements for employees working inside the plants. Since September 11, 2001, NRC has significantly modified its requirements, and licensees have significantly increased their resources to improve security at spent fuel facilities and nuclear power plants. For example, a February 25, 2002 Order to power reactor licensees dealt with spent fuel pool cooling capabilities in the event of a terrorist attack. In 2002, the NRC also initiated a classified program on the capability of nuclear facilities to withstand a terrorist attack. The early focus of that program was on power reactors, including spent fuel pools, and on dry cask storage/ transportation. As the results of that classified program and the findings of NRC security inspections that have become available, the NRC has provided power reactor licensees additional guidance on the Commission's expectations regarding the implementation of the February 2002 orders regarding spent fuel mitigation measures. The NRC again met with power reactor licensees in February 2005 on the NRC's spent fuel pool mitigation measures. At the end of February 2005, power reactor licensees were given until May 2005 to respond to the additional specific recommendations. The NRC is working with industry in conducting additional plant-specific damage assessments of a range of potential attacks.

The NRC continues to evaluate power reactor security, including spent fuel pool security, in force-on-force exercises, which the NRC will carry out at least once every three years at each of the power reactor sites. Today, spent fuel is better protected than ever. The results of security assessments completed to date clearly show that storage of spent fuel in both spent fuel pools and in dry storage casks provides reasonable assurance that public health and safety, the environment, and the common defense and security will be adequately protected.

Please contact me if you have any additional questions or concerns.

Sincerely,

/RA/

Nils J. Diaz

Enclosure:
U.S. NRC Report to Congress on the NAS Study on the
Safety and Security of Commercial Spent Nuclear
Fuel Storage

cc: Senator Harry Reid

Identical letter sent to:

The Honorable Pete V. Domenici, Chairman
Subcommittee on Energy and Water Development
Committee on Appropriations
United States Senate
Washington, D.C. 20510
cc: Senator Harry Reid

The Honorable David L. Hobson, Chairman
Subcommittee on Energy and Water Development
Committee on Appropriations
United States House of Representatives
Washington, D.C. 20515
cc: Representative Peter J. Visclosky

The Honorable George V. Voinovich, Chairman
Subcommittee on Clean Air, Climate Change,
and Nuclear Safety
Committee on Environment and Public Works
United States Senate
Washington, D.C. 20510
cc: Senator Thomas R. Carper

The Honorable Ralph M. Hall, Chairman
Subcommittee on Energy and Air Quality
Committee on Energy and Commerce
United States House of Representatives
Washington, D.C. 20515
cc: Representative Rick Boucher

The Honorable James M. Inhofe, Chairman
Committee on Environment and Public Works
United States Senate
Washington, D.C. 20510
cc: Senator James M. Jeffords

The Honorable Joe Barton, Chairman
Committee on Energy and Commerce
United States House of Representatives
Washington, D.C. 20515
cc: Representative John D. Dingell

U.S. NUCLEAR REGULATORY COMMISSION

REPORT TO CONGRESS ON THE NATIONAL ACADEMY OF SCIENCES STUDY ON THE SAFETY AND SECURITY OF COMMERCIAL SPENT NUCLEAR FUEL STORAGE

MARCH 2005

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EXECUTIVE SUMMARY

The U.S. Nuclear Regulatory Commission (NRC) is providing the U.S. House of Representatives and U.S. Senate Committees on Appropriations this report to address items raised in the Conference Committee's report accompanying the NRC's FY 2005 appropriation and the House Appropriations Committee's report accompanying the NRC's FY 2005 appropriation under the House Energy and Water Development Bill, 2005. This report summarizes the actions the NRC has taken, is taking, or is planning to take with respect to ensuring the safety and security of spent nuclear fuel storage and responds to the recommendations contained in the National Academy of Sciences (NAS) study on the safety and security of commercial spent nuclear fuel storage.

The Commission appreciates the NAS Committee's insights into improving the safety and security of commercial spent nuclear fuel storage. The NRC agrees with many of the points raised by the NAS and is seriously considering the NAS report's recommendations. The NRC believes that the NAS study reinforces the validity of recent NRC studies, which indicate that spent fuel storage systems are safe and secure, and of NRC actions to improve the safety and security of such systems. Many of the NAS Committee's conclusions mirror the conclusions we have drawn from our previous work, which has guided our initiatives in this area. However, the NRC also identified a number of areas of disagreement with the NAS Committee's conclusions. In summary, the NRC believes based on information developed in NRC vulnerability assessments, that the Committee has identified some scenarios that are unreasonable. The NRC also disagrees with some NAS recommendations and its conclusion lacks a sound technical basis. The NAS finding that earlier movement of spent fuel from pools into dry storage would be prudent is one such example.

Consistent with the approach taken at other categories of nuclear facilities and independent of the NAS study, the NRC responded to the terrorist attacks on September 11, 2001, by promptly developing and requiring security enhancements for both spent fuel storage in spent fuel pools and dry casks. The NRC also worked with the industry to develop guidance to ensure that the security enhancements provided adequate protection in the current threat environment until NRC completed more systematic assessments of potential vulnerabilities and mitigating measures. The NRC required power reactor licensees in February 2002 to enhance security and improve their capabilities to respond to a terrorist attack. The order included requirements for spent fuel pool cooling to deal with the consequences of potential terrorist attacks. These enhancements to security included increased security patrols, augmented security forces, additional security posts, increased vehicle standoff distances, and improved coordination with law enforcement and intelligence communities, as well as strengthened safety-related mitigation procedures and strategies. These mitigation procedures and strategies include requirements for spent fuel pool cooling for potential terrorist attacks. The NRC subsequently inspected each facility to verify the licensee's implementation, evaluated the inspection findings, and when necessary, required action to address any noted deficiencies.

The February 2002 order required licensees to develop specific guidance and strategies to maintain or restore spent fuel pool cooling capabilities using existing or readily available resources (equipment and personnel) that can be effectively implemented under the

circumstances associated with the loss of large areas of the plant due to large fires and explosions.

In 2002, the NRC also initiated a classified program on the capability of nuclear facilities to withstand a terrorist attack. The early focus of that program was on power reactors, including spent fuel pools, and on dry cask storage/ transportation. As the results of that classified program and the findings of NRC security inspections that have become available, the NRC has provided power reactor licensees additional guidance on the Commission's expectations regarding the implementation of the February 2002 orders regarding spent fuel mitigation measures. The NRC again met with power reactor licensees in February 2005 on the NRC's spent fuel pool mitigation measures. At the end of February 2005, power reactor licensees were given until May 2005 to respond to the additional specific recommendations. The NRC continues to evaluate power reactor security, including spent fuel pool security, in force-on-force exercises, which the NRC will carry out at least once every three years at each of the power reactor sites. Today, spent fuel is better protected than ever. The results of security assessments completed to date clearly show that storage of spent fuel in both spent fuel pools and in dry storage casks provides reasonable assurance that public health and safety, the environment, and the common defense and security will be adequately protected.

The NRC is working with industry in conducting additional plant-specific damage assessments of a range of potential attacks. These plant-specific assessments include the identification of possible additional mitigation measures and the collection of detailed design information on spent fuel pools for further evaluation.

INTRODUCTION

In the Conference Committee's report accompanying NRC's FY 2005 appropriation,[1] the conferees indicated they expected the NRC — in response to the National Academy of Sciences (NAS) classified study on the safety and security of commercial spent nuclear fuel (SNF) storage — to improve its analyses, including the preparation of site-specific models, and to work with utilities to ensure timely application of this information to mitigate risks. Separately, in the House Appropriations Committee's report accompanying the NRC's FY 2005 appropriation [approved by the House],[2] the Committee indicated that they expected the NRC to take the recommendations in the final NAS report seriously and to take actions to address these recommendations at the earliest possible date. The Committee directed the NRC to submit a report to the House and Senate Committees on Appropriations identifying the specific actions being taken by the NRC to address the NAS report's recommendations.

In the Conference Committee's Report accompanying the NRC's FY 2004 appropriation,[3] the conferees had directed the NRC to contract with the NAS for a classified study on the safety and security of commercial SNF storage. Conferees indicated the NAS study should assess: (1) potential safety and security risks of SNF presently stored in cooling pools, including the density of such storage; (2) safety and security advantages, if any, of dry cask storage versus wet pool storage at reactor sites; and (3) potential safety and security advantages, if any, of dry cask storage using various single-, dual-, and multi-purpose cask designs. The NRC arranged for the NAS study and the NAS subsequently provided a classified report to Congress in July 2004. The NAS report contains the full analysis findings and recommendations of NAS on the safety and security of SNF storage at that time.

The Commission is providing this report to Congress in response to the conferees' and committee's direction and is summarizing the actions the NRC has taken, is taking, or is planning to take with respect to improving the safety and security of SNF storage and to respond to the recommendations contained in the NAS study. This report is comprised of five major areas: (1) background information on NRC security requirements and programs for power reactors and spent fuel storage, (2) NRC actions taken in response to the events of September 11, 2001, to increase security for reactors and spent fuel storage, (3) NRC response to the issues raised in the Conference Report, (4) NRC response to the NAS report's recommendations, and (5) NRC discussion of the report's findings and other issues.

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[1] Conference Committee's Report (H. Rept. 108-792) accompanying the *Consolidated Appropriations Act, 2005* (Pub. L. 108-447; December 8, 2004).

[2] Appropriations Committee's Report (H. Rept. 108-554) accompanying the House Energy and Water Development Appropriations Bill, 2005 (H.R. 4614).

[3] Conference Committee's Report (H. Rept. 108-357) accompanying the *Energy and Water Development Act, 2004* (Pub. L. 108-137; December 3, 2003).

BACKGROUND

Spent Nuclear Fuel Production and Storage

Spent nuclear fuel (SNF) is produced during operation of nuclear reactors.[4] For power reactors, SNF is contained within fuel rods which are bundled into fuel assembles. When SNF is removed from a reactor it emits significant amounts of both radiation and thermal energy (i.e., decay heat); consequently, SNF must be stored under water for a period of time to provide for radiation shielding and effective removal of decay heat. Dedicated, water filled pools, called "spent fuel pools" (SFPs) are installed at power reactors to provide this radiation shielding and heat removal. SFPs are extremely robust structures that are designed to safely contain the SNF under a variety of normal, off-normal, and hypothetical accident conditions (e.g., loss of electrical power, floods, earthquakes, or tornadoes).[5] At the end of a typical reactor operating cycle (18 - 24 months), approximately one-fourth to one-third of the spent fuel assemblies are removed from the reactor and replaced with fresh, unirradiated, fuel assemblies. As time progresses, the radioactivity and thermal decay heat of SNF decreases. However, the decrease in thermal output occurs at a much faster rate than the decrease in radioactivity. Consequently, while older SNF can be safely stored in passive wet or dry systems (i.e., no forced or active heat removal is needed) radiation shielding is still required for a significant period of time.

The design of early commercial power reactors was based upon the concept that SNF would be discharged from reactors to SFPs, and would then be transported off-site to a facility for reprocessing (i.e., chemical and physical separation of the unburned and created special nuclear material (SNM) from the other fission products). The separated plutonium and unused uranium would be used for fuel in new mixed-oxide fuel assemblies and the waste would be solidified and stored for disposal in a permanent repository. Therefore, reactor SFPs were designed with a limited storage capacity.

This concept of operations was used in the United States and some SNF was reprocessed until the late-1970's. At that time, President Carter implemented a national non-proliferation policy barring reprocessing of commercial reactor fuel, and commercial reprocessing has not occurred since. With the design of SFPs incapable of storing all of the SNF produced during the operating life of a commercial reactor, the nuclear industry began developing alternate storage solutions. These solutions included: 1) shipping SNF to offsite storage locations, 2) installing

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[4] SNF is the term for fuel that has been withdrawn from a nuclear reactor following irradiation and has not been chemically separated into its constituent elements by reprocessing as defined under the *Nuclear Waste Policy Act of 1982*, as amended [U.S.C. 10101, Sec. 2(23)]. In 10 CFR Part 72, the NRC has expanded this definition of SNF to include the special nuclear material (SNM), byproduct material, source material, and other radioactive materials associated with fuel assemblies. New SNM is produced when U^{238} absorbs a neutron and is converted to Pu^{239}.

[5] SFPs are massive structures made of reinforced concrete with walls typically over six feet thick; lined with welded stainless-steel plates to form a leak-tight barrier; fitted with racks to store the fuel assemblies in a controlled configuration (i.e., so that the fuel is both sub-critical and in a coolable geometry); and provided with redundant monitoring, cooling, and makeup-water systems.

redesigned (i.e., more efficient) storage racks in existing SFPs to maximize pool storage capacity, and 3) storing SNF onsite in dry-storage casks. Dry-storage casks are massive canisters, either all metal or a combination of concrete and metal, and are inherently robust (e.g., some casks weigh over 100 tons). Storage casks contain the SNF in a sealed and chemically-inert environment.

The NRC regulates the safety and security of operating reactors with SFPs; decommissioning reactors with SNF solely in the SFP; dry-storage casks, or a combination thereof; and away-from-reactor SNF storage facilities (both wet and dry storage). Additionally, an application for an away-from-reactor dry storage facility in Utah is currently pending before the NRC.

Reactor Site and Spent Fuel Pool Security

SFPs are located at reactor sites within the fuel handling or reactor building. From a structural point of view, nuclear power plants are designed to protect against such external events as tornados, hurricanes, fires, and floods. These structural features, supported by the deployment of effective and visible physical protection measures, are also deterrents to terrorist activities. Additionally, the emergency procedures and severe accident management guidelines developed for reactor accidents also provide a means for mitigating the potential consequences of terrorist attacks should they occur. Reactor physical security systems use a defense-in-depth concept, involving: vehicle (external) barriers; fences; intrusion detection, alarm, and assessment systems; internal barriers; armed responders; redundant alarm stations with command, control, and communications systems; local law enforcement authority's (LLEA's) response to a site and augmentation of the on-site armed response force; security and emergency-preparedness procedure development and planning efforts with local officials; and personnel training and qualification. The NRC's regulations require licensees to develop security plans for NRC review and approval, to develop implementing procedures for these plans, and to periodically demonstrate proficiency through tests and exercises.

The NRC's regulatory approach for protecting the safety and security of power reactors and thus SFPs is based upon robust designs that are coupled with a strategic triad of preventive/protective systems, mitigative systems, and emergency-preparedness and response.[6] In this regard, the physical security systems and personnel at the reactor site perform both protective and mitigative functions. Furthermore, each licensee's security functions are integrated and coordinated with reactor operations and emergency response functions. Licensees develop protective strategies in order to meet the NRC design basis threat (DBT).[7]

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[6] Preventive/protective systems can be human or automatic and are designed to initiate when certain conditions or events occur and their function is to prevent an accident from occurring or operating limit from being exceeded. Mitigative systems can also be human or automatic and are designed to respond after an event has occurred or a limit exceeded and their function is to limit the damage to the reactor facility or equipment. Emergency-preparedness and -response systems are designed to respond to events where actual, or potential, offsite radiological consequences may occur and require preplanning and coordination with State and local officials.

[7] The Design Basis Threat (DBT) represents the largest threat against which a private sector facility must be able to defend with high assurance.

Finally, to address the issue of a passive or active insider providing assistance to an adversary, the NRC established trustworthiness requirements for individuals with access to certain areas of reactor sites or with access to sensitive security information. These measures include background investigations, limiting personnel access to certain systems and physical areas, and limiting personnel access to information without the requisite need to know.

Taken as a whole, these systems, personnel, and procedures provide reasonable assurance that public health and safety, the environment, and the common defense and security will be adequately protected. The NRC works with Federal partners, such as the Department of Homeland Security (DHS) and the Department of Defense (DOD),[8] to support an integrated national posture for protection of the Nation's critical infrastructure.

Threat Assessment

The NRC has systematically assessed threats to licensed nuclear facilities and activities since the 1970s to provide indications and warnings of potential attacks or other malevolent activities. To communicate threat information rapidly to licensees and response agencies, the NRC developed the Threat Advisory System, which has been in use since the mid-1980s. Advisories are non-public, rapid communications from the NRC to our licensees that provide information obtained from the Intelligence Community or law enforcement agencies on changes to the threat environment. Advisories also include guidance for licensees to promptly take specific actions to strengthen their capabilities to defend against the threat. Although advisories are not legally binding, they are effective in quickly conveying important information to large numbers of licensees. They are tailored to categories of licensees including power reactors, non-power reactors, and independent spent fuel storage installations (ISFSIs).

The NRC's threat assessment staff exchanges terrorism and threat information with law enforcement and intelligence communities including DHS, the Transportation Security Administration (TSA), the Federal Bureau of Investigation (FBI), the National Counter Terrorism Center (NCTC), and others. The NRC will continue to review intelligence and threat reporting to recommend any appropriate modifications to the DBTs. In addition, the NRC works closely with other Federal agencies and the Intelligence Community to ensure that the current threat environment and adversary characteristics are reflected in required security measures to protect public health and safety, the environment, and the common defense and security.

Performance Evaluation, Inspection, and Oversight

The NRC has permanently assigned resident inspectors at operating power reactor sites who inspect and assess all areas of a licensee's programmatic performance. The NRC also has inspectors at its four regional offices and headquarters office who possess specialized expertise and perform more in-depth inspections and assessments in individual program areas, including a licensee's security-related facilities, equipment, procedures, training, exercises, and LLEA coordination and planning. The results of licensee inspections and performance indicators are integrated and evaluated against performance metrics under the NRC's reactor oversight process (ROP).

[8] U.S. Department of Defense (DOD), U.S. Northern Command (USNORTHCOM) .

Through a sampling of licensees' security activities, the NRC assesses whether each licensee's security program complies with the NRC's security requirements and provides adequate protection against the DBT for radiological sabotage. Prior to September 11, 2001, the NRC's security oversight program focused on four key areas, which were: 1) access authorization, 2) access control, 3) response to contingency events, and 4) security plan changes.

NRC RESPONSE TO THE EVENTS OF 9/11

Advisories

Following the terrorist attacks on September 11, 2001, the NRC began conducting a thorough review of security to continue to ensure that nuclear power plants and other licensed facilities had robust security measures in place, including a classified vulnerability assessment program for nuclear facilities for a wide range of hypothetical attacks. The NRC recognized that some time would be necessary to conduct a thorough review, including threat and security assessments. Therefore, the NRC began issuing a series of Threat Advisories, and subsequent Safeguards Advisories, to NRC licensees providing the evolving threat picture, and advising licensees to consider implementing additional protective measures for a range of facilities and activities. Additionally, the NRC expanded its Threat Advisory System to include a broader range of licensees. Taken together, the interim enhancements made by licensees at the suggestion of the NRC increased security at nuclear power plants and other facilities with respect to physical barriers, access controls, armed response capabilities, emergency preparedness, and increased coordination with LLEA personnel responsible for response to a site and augmentation of the on-site armed response force. More details about the advisories can be found in the attachment.

In addition to the Threat and the Safeguards Advisories, the NRC issued Regulatory Issue Summaries (RISs) to reactor and spent fuel storage licensees in 2002. These RISs contained guidance on supplemental security measures to be taken with increasing threat condition levels under the Homeland Security Advisory System (HSAS), which is administered by DHS.

Reactor Facility Orders

Following the issuance of advisories in the Fall of 2001, the NRC began replacing these interim security enhancements with more stable and predictable requirements via orders that are consistent with an established regulatory framework and which are updated based on a periodic assessment of the current threat environment, technology, NRC-sponsored studies, and NRC inspections. During 2002 and 2003, the NRC issued five orders to reactor licensees, in the following areas:

Power Reactor Security - February 2002

The NRC required power reactor licensees to enhance security and improve their capabilities to respond to a terrorist attack. These enhancements to security for the reactors as well as spent fuel storage included increased security patrols, augmented security forces, additional security posts, increased vehicle standoff distances, and improved coordination with law enforcement and intelligence communities, as well as strengthened safety-related mitigation procedures and strategies. Most importantly from the perspective of this report, the February 2002 Order required licensees to develop specific guidance and strategies to maintain or restore SFP cooling capabilities using existing or readily available resources (equipment and personnel) that can be effectively implemented under the circumstances associated with the loss of large areas of the plant due to large fires and explosions.

From the results of the classified vulnerability assessment program and the findings of NRC security inspections, the NRC provided power reactor licensees additional guidance on the Commission's expectations regarding the February 2002 Security Order, including SFPs. In July 2004, additional spent fuel mitigation measures guidance was issued. The NRC also conducted a workshop in February 2005, with licensees on guidance for implementing SFP mitigation measures. The NRC issued this guidance to industry on February 25, 2005. The guidance required a written licensee response by May 31, 2005, on the appropriateness to their site of each NRC recommendation, and implementation of any additional measure by August 31, 2005.

The NRC subsequently inspected each facility to verify the licensee's implementation, evaluated the inspection findings, and when necessary, required action to address any noted deficiencies.

Access Authorization - January 2003

The NRC required licensees to enhance background investigations of persons applying for and holding unescorted access to power reactor facilities, including SFPs. The NRC also required additional oversight of employees holding or requesting unescorted access at these facilities or who have access to sensitive unclassified security information (i.e, Safeguards Information). In addition, the NRC coordinated with other Federal agencies to enhance the background investigation process. These enhancements have been in place since January 2004.

Supplemental Requirements Related to the DBT - April 2003

After soliciting and receiving comments from appropriate Federal, State, and industry stakeholders, the NRC issued new requirements supplementing the existing DBT that applies to reactor facilities, including SFPs, and providing additional details regarding specific adversary characteristics against which power reactors are required to protect with high assurance. In general, licensees responded to the supplemented DBT by implementing enhancements such as increased patrols, augmented security forces and capabilities, additional security posts, additional physical barriers, vehicle checks at greater standoff distances, enhanced coordination with law enforcement and military authorities, augmented security and emergency response training, equipment, and communication, and more restrictive site access controls for personnel, including expanded, expedited, and more thorough employee background checks.

The NRC's DBT for reactor facilities addresses more than terrorist attacks. It also includes radiological sabotage. Specifically, the DBT represents the largest threat against which private sector facilities must be able to defend with high assurance. This capability is tested in Force - on-Force (FOF) exercises described below. Nuclear utilities were required to reassess their security and contingency plans in view of these supplemental requirements associated with the DBT. In 2004, the NRC reviewed and approved revised security plans submitted by licensees for all operating reactor facilities to address the new DBT requirements.

Fitness for Duty/Fatigue - April 2003

The increased emphasis on security in the current threat environment initially translated into longer working hours for security force personnel. As a result, concerns arose as to whether these longer working hours adversely affected the performance of security personnel. In response to those concerns, the NRC required nuclear power plant licensees to impose enforceable work-hour limits on security force personnel and procedures to evaluate security force fatigue. These enhancements have been in place since October 2003 and covered both the reactors and spent fuel storage.

Training and Qualification of Security Force Personnel - April 2003

The NRC required nuclear power plant licensees to enhance training and qualification programs to ensure that armed security personnel are fit, properly trained, and qualified. The orders require enhancements that include fitness requirements, as well as drills and exercises that will encompass defensive strategies and capabilities for the DBT and the supplemental requirements. These enhancements have been in place since October 2004 and covered both the reactors and spent fuel storage.

Decommissioning Reactors and Wet Spent Fuel Storage Facilities - May 2002

The NRC required power reactors undergoing decommissioning (i.e., permanently shutdown) and wet independent spent fuel storage installations (ISFSIs) to enhance security and improve their capabilities to respond to a terrorist attack. These enhancements to security included: increased vehicle standoff distances, additional security posts, and improved coordination with law enforcement and intelligence communities, as well as strengthened safety-related mitigation procedures and strategies.

Dry Spent Fuel Storage Facilities - October 2002

The NRC also required dry ISFSIs to enhance security and improve their capabilities to respond to a terrorist attack. These enhancements to security included: increased vehicle standoff distances, additional security posts, and improved coordination with law enforcement and intelligence communities, as well as strengthened safety-related mitigation procedures and strategies.

Transportation of Spent Nuclear Fuel - October 2002

Similarly, the NRC required licensees transporting more than a specified amount of SNF to enhance security during transportation. These improvements to security included: enhanced preplanning and coordination with officials from affected States, advanced notification of shipments, enhanced communications and monitoring of underway shipments, and enhanced trustworthiness of drivers and escorts.

Updated Inspection Activities

Follow-up Inspections of Licensee Implementation of Orders

In 2003 and 2004, the NRC completed inspections of licensees' implementation of the power reactor security, access authorization, and fatigue orders to verify that licensees were complying with these requirements. Beginning in late 2004 and continuing through 2005, the NRC is inspecting licensees' implementation of the DBT and security guard training Orders, subsequent to their implementation on October 29, 2004.

Current Reactor Baseline Inspection Program

Drawing on insights gained during the inspections conducted from 2001 to 2003, the NRC revised and implemented the baseline inspection program for reactors, including SFPs, in February 2004. The new program includes: Access Authorization; Access Controls; Security Plan Changes; Contingency Response - FOF Testing (see discussion below); Equipment Performance, Testing and Maintenance; Protective Strategy and Evaluation, Security Training, the Fitness for Duty Program; Owner Controlled Area Controls; Information Technology Security; Material Control and Accountability; and Physical Protection of Shipments of SNF. The inspection oversight program will continue to evolve as a result of ongoing studies and experience with the program.

Force-on-Force Exercises

As discussed above, the five power reactor orders imposed supplemental requirements requiring licensees to enhance security, including their spent fuel storage facilities. As a result, the agency has expanded its FOF program to reflect these changes and to make the exercises more realistic, while ensuring the safety of both plant employees and the public. These changes have significantly increased the level of complexity for each exercise in terms of planning, preparation, and logistical support. In February 2003, the NRC initiated pilot FOF exercises that included additional participants and weaponry, more complex tactical approaches and defensive strategies, increased attention on the adversaries approach to the plant perimeter, and state-of-the-art exercise equipment. These enhancements have increased the realism associated with FOF exercises.

In 2003, the NRC conducted expanded FOF pilot exercises at 15 power reactors with a variety of designs, locations, and size characteristics. This signifies an increase in the frequency of FOF exercises and reflects the Commission's decision to conduct such exercises in the future at least once every three years at each site. In 2004, the NRC staff conducted the transitional FOF exercise program at a pace of approximately two exercises per month, enabling NRC staff to complete an additional 16 exercises by October 29, 2004. Based upon lessons learned from the pilot exercises and the transitional FOF program in 2003 and 2004, the NRC has revised the exercise program as of November 2004 and has fully implemented the expanded FOF program. The revised program tests the licensee's response and evaluates the conduct and control of the exercises, equipment, and the adversary force. As one of the enhancements to improve the realism of FOF exercises, the NRC incorporated the use of Multiple Integrated Laser Engagement System (MILES) equipment (i.e., mock weaponry) into these exercises. When used properly and with sufficient training, MILES equipment provides a much greater degree of

realism and reduces many of the artificialities of simulated combat. In addition, the use of MILES equipment provides a more accurate assessment of a licensee's security performance. The NRC has also revised its guidance by requiring that licensee-provided MILES equipment meet appropriate performance standards. The use of MILES equipment during the expanded FOF pilot greatly contributed to the transitional program's affectiveness.

A credible, well-trained, and consistent mock-adversary force is vital to the overall success of the NRC's FOF exercise program. Previously, licensees had assembled adversary teams from a variety of sources, including: security officers from their own sites, other licensees, and State police tactical team members. However, these diverse sources gave rise to inconsistencies in the adversary team's capabilities, training, and knowledge. In response to these concerns, the NRC interacted with the nuclear industry to develop a composite-adversary force, which would be trained to standards issued by the Commission. The specific adversary forces used in FOF exercises conducted since October 2004 are drawn from this composite-adversary force.

Security Assessments and Mitigation Strategies

In early 2002, NRC launched a classified vulnerability assessment program for nuclear facilities for a wide range of hypothetical attacks, using internal and Department of Energy (DOE) national laboratory resources. The early focus was on power reactors, including SFPs, and on dry cask storage/transportation. The NRC uses Security Assessments (SAs) as a systematic evaluation tool in which qualitative and quantitative techniques are applied to determine potential vulnerabilities to radiological sabotage, theft or diversion of radioactive material, as well as potential radiological consequences from such acts. As such, SAs can be used to identify a need for effective countermeasures or mitigating measures to protect specific targets. The NRC is also using the SA's results to confirm the effectiveness of the enhanced security measures the Commission imposed by order in February 2002 and subsequent orders for nuclear power plants. In addition, these assessments are used to develop additional mitigation measures for licensees to implement and to assist national efforts to enhance critical infrastructure protection.

The NRC previously conducted SAs for some operating nuclear power plants and SFPs in the 1970s and 1980s to establish the technical basis for security requirements. NRC staff also routinely evaluated the potential impacts of terrorist attacks on power reactors as part of the FOF exercise program on a plant-by-plant basis. In addition, as a result of increasing concerns about the threat and vulnerability of nuclear facilities to the threat of computer attacks, the NRC also initiated some cyber-security assessments in the late 1990s. At that time there was no consideration given to conducting SAs of an intentional aircraft attack at a nuclear power plant, although some evaluations of accidental crashes were completed during the licensing of nuclear power plants located relatively close to airports. The risk of accidental aircraft crashes into SFP structures was similarly evaluated. However, as discussed in the NRC's response to Recommendation 3E(1) below. In 2002, the NRC also initiated a classified program on the capability of nuclear facilities to withstand a terrorist attack. The early focus of that program was on power reactors, including SFPs, and on dry cask storage/ transportation. As the results of that classified program and the findings of NRC security inspections that have become available, the NRC has provided power reactor licensees additional guidance on the Commission's expectations regarding the implementation of the February 2002 orders regarding spent fuel mitigation measures. The NRC again met with power reactor licensees in February

2005 on the NRC's SFP mitigation measures. At the end of February 2005, power reactor licensees were given until May 2005 to respond to the additional specific recommendations. The NRC continues to evaluate power reactor security, including SFP security, in FOF exercises, which the NRC will carry out at least once every three years at each of the power reactor sites. Today, spent fuel is better protected than ever. The results of security assessments completed to date clearly show that storage of spent fuel in both SFPs and in dry storage casks provides reasonable assurance that public health and safety, the environment, and the common defense and security will be adequately protected. More details can be found in the attachment.

NRC RESPONSE TO THE CONFERENCE COMMITTEE REPORT'S ISSUES

Issues

In the Joint Conference report accompanying the NRC's FY 2005 appropriation, the conferees indicated they expected the NRC to "improve its analyses, including the preparation of site-specific models, and to work with utilities to ensure timely application of this information to mitigate risks."

Response

As noted above, after September 11, 2001, the NRC promptly assessed the potential for and consequences of terrorists targeting a nuclear power plant, including its spent fuel storage facilities, for aircraft attack, the physical effects of such a strike, and how compounding factors, such as meteorology, would affect the nature and impact of any potential radioactive releases. As a result of these preliminary assessments and consistent with prior orders, the NRC advised, in its July 2004 letter to nuclear power plant licensees, that they consider implementing interim enhancements to mitigate potential consequences in the unlikely event of a successful attack on a nuclear power plant (e.g., spent fuel management issues).

As part of a comprehensive review of security for NRC-licensed facilities, the NRC conducted detailed site-specific engineering studies (i.e., security assessments) of a limited number of nuclear power plants to assess additional mitigation features and their feasibility in thwarting the effects of deliberate attacks involving large commercial aircraft. The NRC performed these studies to achieve a representative cross section of the current power reactors.

In conducting these studies, the NRC drew on national experts from several U.S. DOE laboratories using state-of-the-art structural and fire analysis capabilities. The NRC also enhanced its ability to realistically predict accident progression due to the loss of large areas of reactor sites due to fires and explosions and any potential releases of radiation to the environment.

Additionally, the NRC has collaborated closely with the U.S. Coast Guard (USCG) with respect to the *Maritime Transportation Security Act of 2003* and associated waterborne SAs. The NRC's continuing interaction with the USCG includes developing Area Maritime Security Plans, participation in the USCG Underwater Assault Working Group, and developing an agreement with the USCG in this area.

Secondly, the NRC continues to work closely with DOD's USNORTHCOM and NORAD [9] commands in developing and implementing integrated response methods. Thirdly, the NRC continues to work with DHS and the FBI under National critical infrastructure protection. Finally, the NRC continues to interact with the USCG with respect to protection of the waterways adjacent to nuclear power plants. The NRC is also extensively involved in industry and government interagency working groups to identify technologies that may prove beneficial for securing the Nation's critical infrastructure.

[9] North American Aerospace Defense Command

As part of the follow on activities to the February 2002 orders, the NRC is working with the nuclear power industry to perform plant-specific analyses of potential impacts associated with the loss of large areas of the plant due to large fires and explosions. Plans for these plant-specific analyses had been developed in discussions with the nuclear industry. The February 2002 orders required licensees to develop specific guidance and strategies to maintain or restore core cooling, containment, and SFP cooling capabilities using existing or readily available resources (equipment and personnel) that can be effectively implemented under the circumstances associated with the loss of large areas of the plant due to large fires and explosions.

The NRC currently expects to complete these additional plant-specific analyses by mid-2006. Additional information on these assessments is contained in the Attachment. Additionally, to enhance protection of SFPs at reactors while the above mentioned security assessments are underway, the NRC, in a July 2004 letter, advised licensees to implement additional "spent fuel pool mitigative measures," as appropriate.

Additional details of the measures for spent fuel management and emergency water makeup are described in the Attachment.

Historically, the NRC has worked closely with individual reactor licensees, industry's security working group, and the Nuclear Energy Institute (NEI) to develop and apply clear, understandable, and implementable solutions to security challenges facing the commercial nuclear industry. The NRC continues to work closely with the nuclear industry to ensure timely application of risk mitigation measures. In this regard, the NRC conducted a workshop in February 2005 with licensees on additional guidance for implementing the SFP mitigation measures. The NRC issued this guidance to industry on February 25, 2005. The guidance requires written responses by licensees by May 31, 2005, and implementation of any additional mitigative actions by August 31, 2005. The NRC remains committed to working closely with individual licensees and industry groups to identify and implement effective solutions to SFP safety and security issues and to promptly communicate security information to appropriate stakeholders.

The Commission remains confident that NRC actions and their implementation by licensees have provided the level of protection to the public commensurate with the threat, the consequences and with full consideration of the implemented mitigation strategies. The Commission believes that the initiatives described above clearly demonstrate the NRC has taken and is taking concrete actions to improve its analyses, to consider site-specific information in these analyses, to work closely with the nuclear industry to identify and characterize security risks to nuclear facilities, and to ensure appropriate mitigative measures are implemented in a timely and responsive manner.

NRC RESPONSE TO NAS REPORT'S RECOMMENDATIONS

Overview

As requested by the House Appropriations Committee report accompanying the NRC's FY 2005 appropriation, the NRC is responding to the recommendations contained in the NAS report.

The Commission appreciates the NAS committee's insights into improving the safety and security of commercial SNF storage. The NRC is taking seriously the NAS committee's recommendations and believes the NAS study reinforces the validity of previous NRC studies and security measures, and mirrors many of the conclusions we have drawn from our own work.

The Commission also appreciates the NAS committee's insights into areas where the NRC should perform further analysis or expand upon previous initiatives. These insights will enhance existing Commission actions thus ensuring the protection of public health and safety, the environment, and the common defense and security at NRC-licensed facilities storing SNF.

Response to Recommendations

Recommendation 2B - The NRC should review and upgrade, where necessary, its security requirements for protecting spent fuel rods not contained in fuel assemblies by theft from knowledgeable insiders, especially in facilities where individual rods or portions of rods are being stored in pools.

Response - The NRC believes that the likelihood that an adversary could steal spent fuel from a SFP or storage cask is extremely low, given the security and radiation protection measures in place and the intense, physically disabling radiation from the spent fuel (see Finding 2B below). The actions the NRC has already taken as well as the actions being taken are adequate. Consequently, the NRC does not consider the threat of a knowledgeable, active insider stealing a spent fuel rod, or portion thereof, to be credible.

The NRC believes that even if an insider could overcome the multiple physical issues associated with removing a spent fuel rod or fragment from the pool,[10] the physically disabling radiation and sensitive radiation detectors, both around the pool and throughout the plant, would prevent an insider from surreptitiously removing the spent fuel from the reactor site for use in a radiological dispersal device (RDD).

[10] The systems and tools used to manipulate spent fuel in pools are designed to prevent an individual from inadvertently raising spent fuel to the surface of the pool, due to the dangerous levels of radiation. Consequently, an insider would have to circumvent specific design features of the tools and equipment, circumvent sensitive radiation detectors surrounding the spent fuel pool, circumvent radiation detectors in the remainder of the plant (e.g., the radiological control boundary), and circumvent radiation detectors at the protected area boundary egress points to successfully remove a spent fuel rod from a reactor site. Further, the sensitivity of these radiation detectors increases as one moves further away from the reactor, since these systems are part of the licensee's personnel radiation protection program. Finally, the radiation levels from unshielded spent fuel rods are typically physically incapacitating within a few minutes and lethal shortly thereafter.

The NRC recognizes some spent fuel segments have recently been reported missing from SFPs; but for the reasons listed above, there is no reason to conclude the missing material was removed for use in an RDD. Additionally, for all of the missing fuel segments identified to date, the initiating event occurred years ago under a previous accounting system. Nevertheless, in response to several recent events involving the accountability of spent fuel rods, or portions thereof, the NRC issued a generic communication to reactor licensees addressing their verification of compliance with existing applicable material control and accounting (MC&A) requirements for separated fuel rods or fuel rod fragments stored in SFPs (i.e., separated from fuel assemblies). The NRC will review licensees' responses to this communication and identify needed followup inspections.

Recommendation 2C - Although the committee did not specifically investigate the effectiveness and adequacy of improved surveillance and security measures for protecting stored spent nuclear fuel, an assessment of current security measures should be performed by an independent organization.

Response - The NRC agrees that independent assessment of the effectiveness, adequacy, and efficiency of programs, including security program requirements for protecting SNF is desirable. The NRC, as an independent regulatory agency, evaluates the performance of licensees in implementing these security requirements. The NRC is responsible for regulating licensees' performance in protecting spent fuel, not for directly protecting spent fuel itself.

The NRC's internal resources, for independent assessments of whether programs are efficient and effective and regulatory decisions are sound and realistic, resides with the NRC's Office of the Inspector General (IG) and with two standing advisory committees,[11] whose members are drawn from academia and related industries and typically have decades of experience. Externally, the NRC's performance has been, and is being, independently evaluated by the Government Accountability Office (GAO).

GAO has completed numerous reviews of NRC activities since 2000, including one review (GAO-03-752, September 2003) that is directly relevant to nuclear power plant security. Shortly after completing that review, GAO began further work to examine NRC's efforts to improve nuclear power plant security, which resulted in GAO testifying at a Congressional hearing in September 2004. Building on the work that led up to the September hearing, GAO has continued its review of this area, which is still ongoing, focusing on NRC's approach to defining the threat faced by nuclear power plants, identifying and characterizing plant vulnerabilities that would allow a threat to be realized, assessing the risks and determining priorities for protecting plants, and identifying counter-measures to reduce or eliminate the risks. The GAO has observed a FOF security exercise and a security baseline inspection in January 2005 at two licensed facilities in NRC Region I and Region II, respectively. GAO has indicated they anticipate observing additional FOF exercises and baseline inspections.

GAO is in the process of completing its review of the control and accounting of SNF at nuclear power plants. After extensive interactions with both the NRC and its licensees, GAO issued its

[11] The Advisory Committee on Reactor Safeguards (ACRS) and the Advisory Committee on Nuclear Waste (ACNW).

March 2005 draft report (GAO 05-339) on this subject. The draft report is presently being reviewed by the NRC.

The Commission will continue to rely upon the NRC's IG, ACRS, and ACNW to provide it with independent advice on the effectiveness and appropriateness of NRC programs and regulatory requirements. The Commission will consider the independent assessment recommendations by the GAO performed to determine whether changes are needed to security programs.

Recommendation 3E(1) - The NRC should undertake additional best-estimate analyses to more fully understand the vulnerabilities and consequences of loss-of-pool-coolant events that could lead to a zirconium cladding fire. Based upon these analyses, the Commission should take appropriate actions to address any significant vulnerabilities that are identified. The analyses of the BWR and PWR spent fuel pools should be extended to consider the consequences of loss-of-pool-coolant events that result in severe damage to the spent fuel, specifically for the following scenarios:

- *Attacks using large aircraft or large explosives.* [Additional details of the attacks are described in the Attachment.]

The consequence analysis [associated with analysis of these attacks] should address the following questions:

- *To what extent would such attacks damage the spent fuel pool, and what would be the thermal consequences of such damage?*
- *Is it feasible to reconfigure the spent fuel within pools to prevent zirconium cladding fires given the actual characteristics (i.e., heat generation) of spent fuel assemblies in the pool, even if the fuel were damaged in an attack? Is there enough space in the pools at all commercial reactor sites to implement such fuel reconfiguration?*
- *In the event of a localized zirconium cladding fire, will such rearrangement prevent its spread to the rest of the pool?*
- *How much spray cooling is needed to prevent zirconium cladding fires and preventing propagation of such fires? Which of the different options for providing spray cooling are effective under attack and accident conditions?*

Sensitivity analyses should also be undertaken to account for the full range of variation in spent fuel pool designs (e.g., rack designs, capacities, spent fuel burn-ups, and ages) at U.S. commercial nuclear power plants.

Response - The NRC agrees with the value of some additional analyses and as noted above has initiated plant-specific assessments on the loss of large areas of the plant to fire and explosions, including the identification of mitigation strategies and the collection of detailed design information on SFPs for further evaluation. However, the NRC considers the breadth and range of additional analyses and sensitivities recommended by the NAS report to be more than is needed for informed decision making, when considering what is currently well understood and the most effective and efficient use of NRC and licensee resources.

The NRC is performing additional analyses of spent fuel cooling for both pressurized and boiling water reactor fuel. The NRC has contracted with Sandia National Laboratories to perform these

studies and they are expected to be completed by the end of 2005. The NRC has also contracted with the Sandia National Laboratories to perform experimental work to confirm analytical modeling. Finally, the NRC is participating in a long-term international cooperative testing program to examine fuel heat-up behavior in an air environment.

Moreover, the NRC continues to believe that prevention of aircraft attacks is of paramount importance. The NRC continues to look to Federal agencies such as TSA, who are responsible for aircraft and airline security requirements, to prevent a highjacking and subsequent attack on a nuclear power plant. However, if a highjacking did occur, the NRC, as noted above, has worked closely with DOD's USNORTHCOM and NORAD commands to implement new and strengthened communications protocols to provide timely warning to licensees and response to a potential aircraft attack. Finally, the NRC has worked with licensees to develop and implement response and mitigation procedures and strategies to such potential attacks to promote a defense-in-depth strategy.

Recommendation 3E(2) - While the work described in the previous recommendation under Finding 3E, above, is being carried out, the NRC should ensure that power plant operators take prompt and effective measures to reduce the consequences of loss-of-pool-coolant events in spent fuel pools that could result in propagating zirconium cladding fires.

Response - The NRC agrees that prompt action should be taken to implement appropriate mitigation measures. Accordingly and pending the plant-specific assessments on the loss of large areas of the plant to fire and explosions that are underway, the NRC in the February 2002 and April 2003 Orders required licensees to enhance protection of reactor sites, including SNF storage. Additionally, the NRC, in a July 2004 letter, advised licensees to implement additional "spent fuel pool mitigative measures," as appropriate (see discussion above).

The NRC notes that licensees had previously addressed preplanning efforts for SFP makeup water supplies under severe accident management guidelines, for example, a loss of SFP cooling water due to natural events (e.g., an earthquake). Additional details of the measures for spent fuel management and emergency water makeup are described in the Attachment. The NRC also conducted a workshop in February 2005, with licensees on guidance for implementing SFP mitigation measures. The NRC issued this guidance to industry on February 25, 2005. The guidance requires a written licensee response by May 31, 2005 on the appropriateness to their site of each NRC recommendation, and implementation of any additional measures by August 31, 2005.

Recommendation 4B - The NRC should consider using the results of the vulnerability analyses for possible upgrades to the requirements in 10 CFR Part 72 for dry casks, specifically to improve their resistance to terrorist attacks.

Response - The NRC has evaluated the results of the security assessments involving large commercial aircraft attacks, which were performed on four prototypical spent fuel casks, and concluded that the likelihood is very low that a radioactive release from a spent fuel storage cask would be significant enough to cause adverse health consequences to nearby members of the public.

Additionally, the NRC is finalizing the security assessments for a number of prototypic spent fuel storage casks for additional attacks (including ground attacks) and expects to complete these security assessments by Fall-2005. The NRC will review the results of these ongoing security assessments for insights on whether changes are needed to applicable NRC security regulations. Similarly, the NRC will continue to review the results of future security assessments for insights on whether changes are needed to applicable NRC security regulations. The NRC's regulations for dry storage of spent fuel in casks are found in 10 CFR Part 72 (safety and licensing regulations) and 10 CFR Part 73 (security regulations). In addition, NRC has issued security orders on independent fuel storage installations, as described above.

Recommendation 5A - The NRC should improve the sharing of pertinent information on vulnerability and consequence analyses on spent fuel storage with power plant operators and dry cask storage system vendors on a timely basis.

Response - The NRC agrees that pertinent security information should be shared with reactor licensees and spent fuel cask vendors on a timely basis and has taken action to improve licensees' and dry storage cask vendors' access to security information. In the aftermath of the events of September 11, 2001, the NRC recognized an increased need to provide reactor licensees and vendors with additional information on security risks that could impact their facilities and cask designs. The NRC subsequently implemented actions to increase the sharing of such information to licensees and cask vendors and to share this information more quickly.

Historically, security information relating to power reactors has been controlled as Safeguards Information (i.e., sensitive unclassified information), rather than as classified national security information. Consequently, post-September 11, 2001, the NRC's ability to share classified information was constrained by the polices on access to classified national security information set forth in Executive Orders.[12] Therefore, providing reactor licensees access to classified information has been a complex task.

Specifically, the NRC implemented a program to provide non-possession facility clearances to operating reactor sites and NEI and personnel security clearances to a limited number of individuals (three to five) at each operating reactor site and to selected management and security personnel at NEI.[13] Facilities to store and transmit classified information are maintained at the NRC resident inspector offices located at operating reactor sites. Additionally, the NRC is issuing orders to cask vendors to permit them to possess safeguards information. The NRC is holding a series of meetings in the second week of March 2005, with the four cask vendors whose designs were evaluated by the NRC. Because of the limitations discussed above on sharing classified information, the NRC will provide these cask vendors with a redacted version

[12] E.O. 12958, as amended (68 FR 15314; March 28, 2003).

[13] A non-possession facility clearance permits an organization to have access to classified information at that facility — for individuals with a personnel security clearance and requisite need to know. However, these individuals may not create, store, receive, or transmit this classified information.

of the information from the preliminary security assessments for their particular spent fuel storage cask design.[14]

[14] Classified security analysis information for a specific spent fuel storage cask design was redacted to an SGI level, permitting the NRC to provide this information to the cask vendor.

NRC DISCUSSION OF NAS REPORT'S FINDINGS AND OTHER ISSUES

Overview

The NRC is providing the following comments on the NAS report's findings and other committee conclusions.

Comments on Findings

Finding 2A - The probability of terrorist attacks on spent fuel storage cannot be assessed quantitatively or comparatively. Spent fuel storage facilities cannot be dismissed as targets for such attacks because it is not possible to predict behavior and motivations of terrorists, and because of the attractiveness of spent fuel as a terrorist target given the well known public dread of radiation.

Comment - The NRC agrees with this finding. While probability is difficult to calculate in a meaningful way, NRC has since the 1970s regarded spent fuel storage a potential terrorist target and provided for appropriate security measures. As discussed in detail above, NRC has updated those security measures over the past three years.

Finding 2B - The committee judges that the likelihood terrorists could steal enough spent fuel for use in a significant radiological dispersal device (RDD) [at a location away from the storage site] is small. [Additional details of the committee's finding are contained in the Attachment.]

Comment - The NRC believes that the likelihood that an adversary could steal spent fuel from a SFP for use in an RDD is extremely low, given the security and radiation protection measures in place and the intense, physically-disabling radiation (i.e., lethal doses in a short time period) from the spent fuel. These safety and security systems and design features would prevent an insider from successfully removing spent fuel from a reactor site for use in an RDD. These systems and features include: multiple area radiation monitors around the SFP, portal monitors at plant radiological area and protected area egress points, guards, security cameras, locks, and equipment interlocks. Furthermore, an insider would have to overcome design features of spent fuel handling equipment that are intended to prevent inadvertently raising spent fuel to the surface of the SFP (due to the lethal radiation dose).

Finding 2C - A number of security improvements at nuclear power plants have been instituted since the events of September 11, 2001.

Comment - The NRC has aggressively pursued security improvements for reactor plants and spent fuel storage facilities since the events of September 11, 2001, thereby enhancing security for reactors and spent fuel storage.

Finding 3A - Pool storage is required at all operating commercial nuclear power plants to cool newly discharged spent fuel.

Comment - The NRC agrees.

Finding 3B - [The Committee's Finding 3B is contained in the Attachment.]

Comment - The NRC has performed additional analyses and, in general, considers the likelihood of a zirconium fire capable of causing large releases of radiation to the environment to be extremely low. Additional information related to Finding 3B is contained in the Attachment. Additional information on this topic could also be found on the NRC Web site at http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/reducing-hazards-spent-fuel.html.

Finding 3C - It appears to be feasible to reduce the likelihood of a zirconium cladding fire following the loss-of-pool-coolant event using readily implemented measures.

Comment - The NRC agrees that some of the measures identified by the committee in the report could be readily implemented. As discussed above, the NRC in the July 2004 letter had addressed the fuel reconfiguration issue by providing recommendations to licensees for consideration on fuel management strategies. As a result of a February 2005 followup letter, licensees will submit their responses to NRC's recommendations by May 31, 2005.

Additionally, the NRC considers that other measures identified by the committee are not necessary. For example, NAS recommends requiring longer shutdowns of the reactor before fuel is offloaded during a refueling outage. Typically, the physical disassembly of the reactor vessel (i.e., removal of the reactor vessel head) and preparation for fuel movement takes several days. The NRC considers any decay time beyond this is not necessary for safe and secure operation.

Finding 3D - The potential vulnerabilities of spent fuel pools to terrorist attacks are plant-design specific. Therefore, specific vulnerabilities can only be understood by examining the characteristics of spent fuel storage at each plant.

Comment - The NRC agrees that plant-specific analyses are needed and as noted above is working with licensees to conduct them and identify additional plant-specific mitigation strategies.

Finding 3E - The NRC and independent analysts have made progress in understanding some of the vulnerabilities of spent fuel pools to certain terrorist attacks and the consequences of such attacks for release of radioactivity to the environment. However, additional work on specific issues listed in the following recommendation [i.e., 3E(1)] is needed urgently.

Comment - The NRC agrees that the phenomena and consequences associated with potential attacks on SFPs requires further analysis. The NRC staff briefed the NAS committee that the NRC has contracted with Sandia National Laboratories to perform further studies in this area (see discussion on Recommendations 3E(1) and 3E(2) above).

Finding 4A - Although there are differences in the robustness of different dry cask designs (e.g., bare-fuel versus canister-based), the differences are not large when measured by the absolute magnitudes of radionuclide releases in the event of a breach.

Comment - The NRC agrees with the committee's conclusion that while differences exist with storage cask designs, the results of the most recent security assessments (i.e., the large aircraft attacks) indicate that any potential radioactive releases were consistently very low. As noted above in the response to Recommendation 4B, the NRC will continue to review the results of

future security assessments for insights on whether changes are needed to applicable NRC security regulations.

Finding 4B - Additional steps can be taken to make dry casks less vulnerable to potential terrorist attacks.

Comment - As discussed in the NRC's response to Recommendation 4B above, the NRC has concluded that the likelihood of radiological releases from spent fuel storage casks, significant enough to cause serious injury to nearby members of the public, is very low.

Finding 4C - Dry cask storage does not eliminate the need for pool storage at operating commercial reactors.

Comment - The NRC agrees that pool storage of spent fuel is required at operating reactor sites since current cask designs typically require a minimum of 3 to 5 years of pool cooling before the fuel can be placed in a cask.

Finding 4D - Dry cask storage for older, cooler spent fuel has two inherent advantages over pool cooling: (1) It is a passive system that relies upon natural air circulation for cooling; and (2) It divides the inventory of that spent fuel among a large number of discrete, robust containers. These factors make it more difficult to attack a large amount of spent fuel at one time and also reduce the consequences of such attacks.

Comment - The NRC agrees that distributing the contents of a SFP over many discrete storage casks limits the total quantity of spent fuel that could be potentially attacked at one time, due to limits on the number of adversaries and the quantity of equipment they can reasonably bring with them. The NRC also agrees that current cask designs rely on passive safety features. The Commission views the results of security assessments completed to date as clearly showing that storage of spent fuel in both SFP and in dry storage casks provides reasonable assurance that public health and safety, the environment, and the common defense and security will be adequately protected.

Finding 4E - Depending on the outcome of plant-specific vulnerability analyses described in Chapter 3 [of the NAS study], the NRC might determine that earlier movements of spent fuel from pools to dry storage would be prudent to reduce potential consequences of terrorist attacks on pools at some commercial nuclear plants.

Comment - The Commission views the results of security assessments completed to date as clearly showing that storage of spent fuel in both SFP and in dry storage casks provides reasonable assurance that public health and safety, the environment, and the common defense and security will be adequately protected. The NRC will continue to evaluate the results of the ongoing plant-specific assessments and, based upon new information, would evaluate whether any change to its spent fuel storage policy is warranted. Additionally, as noted above, the NRC has directed licensees to consider implementing additional mitigation measures for SFPs. Additional information on the mitigation measures is described in the Attachment.

Finding 5A - Security restrictions on sharing of information and analyses are hindering progress in addressing potential vulnerabilities of spent fuel storage to terrorist attacks.

Comment - The NRC agrees that sharing of security information and analyses is vital to maintaining appropriate levels of security for reactor licensees and for spent fuel storage cask vendors. The Commission has taken prompt action since the events of September 11, 2001, in increasing the sharing of classified and safeguards information with persons who have a need to know and can protect the information. Where the Commission has independent authority over dissemination of sensitive information (e.g., safeguards information), the NRC has moved forward expeditiously. However, where the Commission has been constrained by national policy (e.g., dissemination of classified information), the NRC has worked carefully with industry and other Federal agencies to provide greater access to this information.

Comments on Additional Issues

Maximum-Credible Scenarios - The NAS report endorsed analyses of consequences of "maximum-credible scenarios" as a particularly useful tool for obtaining a general understanding of the damage that could be inflicted, but would not necessarily apply to every spent fuel storage facility. In characterizing a maximum-credible scenario, the NAS report indicates that terrorists must be able to carry out the attack as designed — for example, to hit a spent fuel storage facility with an aircraft at its most vulnerable point. The NAS report indicated that this approach would rule out physically impossible scenarios, such as flying a large aircraft into a facility that is below ground level as well as using weapons that are not considered available to terrorists.

The NAS report indicates that in contrast, the NRC does not consider maximum-credible scenarios in performing its analyses. Instead, the NRC's analyses employ "reference scenarios" that are based upon either the characteristics of previous terrorist attacks or upon qualitative judgements of the technical means and methods terrorists might employ to attack a spent fuel storage facility. The NAS report provided examples of maximum-credible scenarios. Additional information on these scenarios is described in the Attachment.

Comment - The NRC considers that the maximum-credible scenario method is not an effective and efficient use of NRC and licensee resources. This method would direct analyses at an overly large scope of scenarios, including some unrealistic scenarios. Rather, the NRC focuses on realistic or credible scenarios. Additionally, the NRC considers that analysis of "bounding" or unrealistic scenarios can lead to a misinterpretation of the actual risk and this can cause confusion among the public and other stakeholders.

As discussed in the threat assessment section above, the NRC is continually evaluating law enforcement and intelligence community information and events to determine if the threat to NRC facilities has changed, including those storing SNF. In such cases the NRC will continue to take prompt action.

Appropriateness of NRC Thermal Analyses - The NAS study criticized the tools used by the NRC to perform its thermal analysis (e.g., MELCOR) as simplistic and overly conservative.

Comment - The NRC considers that the NRC staff's and Sandia National Laboratories' thermal analyses are not overly conservative. In response to the concerns raised by the NAS committee, NRC staff has performed additional calculations with more detailed methods, as suggested by the NAS committee, and confirmed the adequacy of our original work. The NRC provided this supplemental information on its thermal analyses to the NAS committee for their consideration. In addition, the NRC is performing experimental testing to further verify the accuracy of the analytical models being used in these efforts.

DBT Information and Inspection Metrics - The NAS committee indicated that the NRC had not provided all of the information the committee had requested related to the reactor DBT and inspection metrics.

Comment - The Commission met on January 24, 2005, with members of the NAS committee and staff from the Board on Radioactive Waste Management. The need for access to additional information was discussed. Based upon the NAS Committee's presentation, the Commission recognized that access to additional information was necessary. On February 18, 2005, NRC staff provided additional information to the NAS committee.

END

U.S. NUCLEAR REGULATORY COMMISSION

REPORT TO CONGRESS ON THE NATIONAL ACADEMY OF SCIENCES STUDY ON THE SAFETY AND SECURITY OF COMMERCIAL SPENT NUCLEAR FUEL STORAGE

ATTACHMENT: ADDITIONAL INFORMATION

(Provided separately)

MARCH 2005