March 27, 2006

MEMORANDUM TO: John T. Larkins, Executive Director
Advisory Committee on Reactor Safeguards

FROM: David A. Matthews, Director ***/RA L. Dudes for:/***
Division of New Reactor Licensing
Office of Nuclear Reactor Regulation

SUBJECT: ACRS REVIEW OF THE GRAND GULF EARLY SITE PERMIT APPLICATION - FINAL SAFETY EVALUATION REPORT CHANGED PAGES

On December 23, 2005, the Advisory Committee on Reactor Safeguards (ACRS) sent the Nuclear Regulatory Commission (NRC) staff a letter regarding the final safety evaluation report (FSER) on System Energy Resources, Inc.'s (SERI's) application for an early site permit (ESP) for the Grand Gulf site. In this letter, the ACRS expressed concern about the staff's conclusions regarding the nature of the proposed site. The ACRS stated that the technical basis for the staff's conclusion on hazards to the proposed site by explosions in transportation accidents on the Mississippi River needed to be more explicit.

The staff agreed with the ACRS's concern and asked the applicant to provide additional information to demonstrate compliance with 10 CFR Part 100. In a February 22, 2006, response, the applicant stated that it had decided not to follow Regulatory Guide (RG) 1.91, "Evaluations of Explosions Postulated to Occur on Transportation Routes Near Nuclear Power Plants." Instead, the applicant proposed an alternate methodology which no longer takes credit for the existing 60-foot bluff as a shield against any potential blasts along the Mississippi River.

Using data provided by the U.S. Army Corps of Engineers (USACE), Waterborne Commerce Statistics Center, the applicant performed an initial screening of commodities shipped on the Mississippi River past the ESP site. As a result of this initial screening, the applicant identified materials that could potentially create an explosion resulting in a blast overpressure on the order of 1 psi or greater at the western edge of the ESP site power block area. The applicant did an analysis for each of these commodities to determine the overpressure at 1.1 miles, taking into account the chemical and physical properties, the state of the material shipped, the assumed progression of events following the incident that releases the material, the reaction kinetics, and the release rates.

The analysis considered three different types of explosions: a confined space detonation, a local vapor cloud explosion, and vapor cloud formation and dispersion downwind toward the ESP site with a delayed detonation. For the commodities that resulted in either a potential overpressure greater than 1 psi or in predicted concentrations at the site above the lower explosive limit as determined by version 5.4 of the ALOHA (Areal Locations of Hazardous Atmospheres) computer program, the applicant performed a risk assessment to determine if the probability of occurrence of the event was acceptably low.

The staff reviewed SERI's February 22, 2006, submittal and determined that the proposed alternate methodology is acceptable and demonstrates compliance with the regulations. The staff will document its evaluation and the minor changes that resulted from SERI's submittal of Revision 3 to the Grand Gulf ESP application in the forthcoming NUREG. The staff plans to publish the FSER as a NUREG by April 14, 2006. If you have any questions about the attached changes to the Grand Gulf FSER please contact Christian Araguas, the project manager for the Grand Gulf ESP application, at (301) 415-3637.

Enclosure: Grand Gulf Early Site Permit FSER Changed Pages

Docket No. 52-009

The staff reviewed SERI's February 22, 2006, submittal and determined that the proposed alternate methodology is acceptable and demonstrates compliance with the regulations. The staff will document its evaluation and the minor changes that resulted from SERI's submittal of Revision 3 to the Grand Gulf ESP application in the forthcoming NUREG. The staff plans to publish the FSER as a NUREG by April 14, 2006. If you have any questions about the attached changes to the Grand Gulf FSER please contact Christian Araguas, the project manager for the Grand Gulf ESP application, at (301) 415-3637.

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Safety Evaluation of Early Site Permit Application in the Matter of System Energy Resources, Inc., a Subsidiary of Entergy Corporation, for the Grand Gulf Early Site Permit Site

Docket No. 52-009

~~Octobe~~April 200~~5~~6

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, DC 20555-0001

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In accordance with U.S. Nuclear Regulatory Commission Review Standard (RS)-002, "Processing Applications for Early Site Permits," the chapter and section layout of this safety evaluation report is essentially consistent with the format of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (hereafter referred to as the SRP), Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants," and the applicant's site safety analysis report. Numerous sections and chapters in the SRP are not within the scope of or addressed in an early site permit (ESP) proceeding. The reader will therefore note "missing" chapter and section numbers in this document. The subjects of chapters and sections in the SRP not discussed herein will be addressed, as appropriate and applicable, in other licensing actions (design certification, construction permit, and/or combined license) for a reactor(s) that might be constructed on the Grand Gulf ESP site.

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analysis and evaluation of the major structures, systems, and components of the facility that bear significantly on the acceptability of the site, and (3) the proposed major features of emergency plans. The application describes how the site complies with the requirements of Subpart A of 10 CFR Part 52 and the siting criteria of 10 CFR Part 100, "Reactor Site Criteria."[3]

This SER presents the conclusions of the staff's review of information the applicant submitted to the NRC in support of the ESP application. Additionally, the staff has reviewed the information SERI provided to resolve the open and confirmatory items identified in the draft safety evaluation report (DSER) for the Grand Gulf ESP, issued on April 7, 2005. In Section 1.6 of this SER, the staff provides a brief summary of the process used to resolve these items; specific details on the resolution for each open item is presented in the corresponding section of this report.

The staff has identified, in Appendix A to this SER, the proposed permit conditions that it will recommend the Commission impose, should an ESP be issued to the applicant. Appendix A also includes a list of COL action items or certain site-related items that will need to be addressed should this ESP be referenced as a part of a COL or construction permit application. The staff determined that these deferred items do not affect the staff's regulatory findings at the ESP stage and are, for reasons specified in Section 1.7 of this SER, more appropriately addressed at later stages in the licensing process. In addition, Appendix A lists the site characteristics and the bounding parameters identified by the staff for the ESP site.

NRC inspections have verified, where appropriate, the conclusions in this SER. The scope of the inspections consisted of selected information in the ESP application and its references. This SER identifies applicable inspection reports as reference documents.

The NRC's Advisory Committee on Reactor Safeguards (ACRS) also reviewed the bases for the conclusions in this report. The ACRS independently reviewed those aspects of the application that concern safety, as well as the ~~DSER~~safety evaluation report, and provided the results of its review to the Commission in an interim report dated June 14, 2005, and in a final report dated December 23, 2005. This SER incorporates the ACRS comments and recommendations, as appropriate. ~~Additional comments from the final ACRS full committee meeting, if any, will be addressed in an addendum to this SER before it is formally issued as a final NRC technical report (i.e., a NUREG). The final ACRS report~~Appendix E includes a copy of the report by the ACRS on the final safety evaluation, as required by 10 CFR 52.~~53~~23, "Referral to the ACRS," ~~will be included in the addendum as an additional appendix to this SER.~~ and a copy of the two memoranda the staff sent the ACRS responding to their comments and recommendations.

[3]SERI also submitted information intended to partially address some of the general design criteria (GDC) in Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50. Only GDC 2, "Design Bases for Protection Against Natural Phenomena," applies to an ESP application, and it does so only to the extent necessary to determine the safe-shutdown earthquake (SSE) and the seismically induced flood. The staff has explicitly addressed partial compliance with GDC 2, in accordance with 10 CFR 52.17(a)(1) and 10 CFR 50.34(a)(12), only in connection with the applicant's analysis of the SSE and the seismically induced flood. Otherwise, an ESP applicant need not demonstrate compliance with the GDC. The staff has included a statement to this effect in those sections of the SER that do not relate to the SSE or the seismically induced flood. Nonetheless, this report describes the staff's evaluation of information submitted by SERI to address GDC 2.

1. INTRODUCTION AND GENERAL DESCRIPTION

1.1 Introduction

System Energy Resources, Inc. (SERI or the applicant), filed an application with the U.S. Nuclear Regulatory Commission (NRC), docketed on October 16, 2003, for an early site permit (ESP) for a site the applicant designated as the Grand Gulf ESP site. The proposed site is located near Port Gibson, Mississippi, approximately 25 miles south of Vicksburg, Mississippi.

The staff has completed its review in the areas of seismology, geology, meteorology, and hydrology, as well as in the area of hazards to a nuclear power plant that could result from manmade facilities and activities on or in the vicinity of the site. The staff also assessed the risks of potential accidents that could occur as a result of the operation of a nuclear power plant(s) at the site and evaluated whether the site would support adequate physical security measures for a nuclear power plant(s). The staff evaluated whether the applicant's quality assurance measures were equivalent in substance to the measures discussed in Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to Title 10, Part 50, "Domestic Licensing of Production and Utilization Facilities," of the *Code of Federal Regulations* (10 CFR Part 50). The NRC has found that such measures provide reasonable assurance that any information derived from ESP activities that could be used in the design and/or construction of structures, systems, and components (SSCs) important to safety would support satisfactory performance of such SSCs once in service. The staff also evaluated the adequacy of the applicant's program for compliance with the requirements of 10 CFR Part 21, "Reporting of Defects and Noncompliance." Finally, the staff reviewed the proposed major features of the emergency plan that SERI would implement if a new nuclear unit(s) were eventually to be constructed at the ESP site.

The SERI ESP application includes the site safety analysis report (SSAR), which describes the safety assessment of the site, as required by 10 CFR 52.17, "Contents of Applications." The public may inspect copies of this document via the Agencywide Documents Access and Management System (ADAMS)[1] using ADAMS Accession No. ~~ML042590081~~ MLXXXXXXXXX. The documents are also available for public inspection at the NRC Public Document Room at One White Flint North, 11555 Rockville Pike, Rockville, Maryland, and at the Harriette Person Memorial Library in Port Gibson, Mississippi. This SER is available on the NRC's new reactor licensing public Web site at http://www.nrc.gov/reactors/new-licensing/esp/grand-gulf.html. This SER is also available in ADAMS under Accession No. ML052860041. SERI revised its application to address the NRC staff requests for additional information (RAIs); updated versions of the ESP application are also available at these same locations. The NRC verified that revision of the SERI ESP application is consistent with information provided in the

[1]The Agencywide Documents Access and Management System (ADAMS) is the NRC's information system that provides access to all image and text documents that the NRC has made public since November 1, 1999, as well as bibliographic records (some with abstracts and full text) that the NRC made public before November 1999. Documents available to the public may be accessed via the Internet at http://www.nrc.gov/reading-rm/adams/web-based.html. Documents may also be viewed by visiting the NRC's Public Document Room at One White Flint North, 11555 Rockville Pike, Rockville, Maryland. Telephone assistance for using Web-based ADAMS is available at (800) 397-4209 between 8:30 a.m. and 4:15 p.m., eastern standard time, Monday through Friday, except Federal holidays. The staff is also making this SER available on the NRC's new reactor licensing public Web site at http://www.nrc.gov/reactors/new-licensing/esp/grand-gulf.html.

applicant's RAI responses. This verification closed Confirmatory Item 1.1-1 identified in the draft safety evaluation report (DSER) for the Grand Gulf ESP site, issued April 7, 2005.

This ~~SER~~report summarizes the results of the NRC staff's technical evaluation of the suitability of the proposed Grand Gulf ESP site for a nuclear power plant or plants falling within the plant parameter envelope (PPE) that SERI specified in its application. This SER delineates the scope of technical matters the staff considered in evaluating the suitability of the site. NRC Review Standard (RS)-002, "Processing Applications for Early Site Permits," issued May 2004, provides additional details on the scope and bases of the staff's review of the radiological safety and emergency planning aspects of a proposed nuclear power plant site. This review standard contains regulatory guidance based on NUREG-0800, Revision 3, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," issued July 1981 (hereinafter referred to as the Standard Review Plan). The Standard Review Plan reflects the many years of experience the NRC staff has had in establishing and promulgating guidance to enhance the safety of nuclear facilities, as well as in evaluating safety assessments. In addition, this SER documents the resolution of the open and confirmatory items identified in the DSER.

The applicant also filed an environmental report for the Grand Gulf ESP site in which it evaluated those matters relating to the environmental impact assessment that can be reasonably reviewed at this time. The staff discussed the results of its evaluation of the environmental report for the Grand Gulf ESP site in a draft environmental impact statement issued on April 21, 2005 (ADAMS Accession No. ML051110531; also available on the NRC reactor licensing public web site). The applicant has no plans to perform activities at the Grand Gulf ESP site under 10 CFR 50.10(e)(1) after receiving an ESP; therefore, it did not provide a site redress plan.

As described above, the applicant supplemented the information in the SSAR by providing revisions to the document. The staff reviewed these revisions to determine their impact on the conclusions in this SER. On October 21, 2005, the NRC issued its SER for the Grand Gulf ESP site and in light of a concern raised by the ACRS on the nature of the proposed site, the staff requested that SERI provide additional information to demonstrate compliance with 10 CFR Part 100. By letter dated March XX, 2006, SERI provided Revision 3 to the Grand Gulf ESP application. The changes reflected in Revision 3 of the application include SERI's alternate methodology for demonstrating compliance with 10 CFR Part 100. The majority of the differences between the October 21, 2005 FSER and this report are documented in section 2.2.3 of this report. The staff completed its review of the most recent version, Revision ~~2~~3 of the SSAR, as documented throughout this report and, for the reasons set forth herein, finds it to be acceptable.

Appendix A to this SER contains the list of site characteristics, permit conditions, combined license (COL) action items, and the bounding parameters that the staff is recommending that the Commission include in any ESP that might be issued for the proposed site. Appendix B to this SER details a chronology of the principal actions and correspondence related to the staff's review of the ESP application for the Grand Gulf ESP site. Appendix C lists the references for this SER ~~and~~, Appendix D identifies the principal contributors to this report, and Appendix E includes a copy of the report by the ACRS.

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2.2.3 Evaluation of Potential Accidents

In SSAR Section 2.2.3, the applicant identified potential accident situations on and in the vicinity of the ESP site. The staff reviewed this information to determine its completeness, as well as the bases upon which these potential accidents may need to be considered in the design of a nuclear power plant(s) that might be constructed on the proposed site (see SER Section 2.2.1–2.2.2).

The applicant elected to use the PPE approach for analyzing potential accidents. As such, it has not determined the specific design of the ESP facility, including control room habitability systems. Some potential accidents on or in the vicinity of the ESP site may have the ability to affect control room habitability (e.g., toxic or asphyxiating gases). The design of the actual facility that might be constructed on the proposed site must address those accidents that are to be accommodated on a design basis (as determined through a review conducted using Section 2.2.3 of RS-002). The staff will review these potential accidents at the COL stage using the guidance in Section 6.4 of NUREG-0800, Revision 3, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," issued July 1981 (also referred to as the Standard Review Plan (SRP)).

The staff reviewed the applicant's analyses of the probability of potential accidents involving hazardous materials or activities on and in the vicinity of an ESP facility that might be constructed on the proposed site to determine whether these analyses used the appropriate data and analytical models. The staff also reviewed the analyses of the consequences of accidents involving nearby industrial, military, and transportation facilities to determine if any should be identified as design-basis events (DBEs).

2.2.3.1 Technical Information in the Application

Section 2.2.3 of the SSAR presents information concerning potential accidents, including flammable vapor clouds, toxic chemicals, fires, collisions with the intake structure, and liquid spills. ~~In general~~With one exception, the applicant found that the separation distances between the ESP site and the potential hazards identified in Section 2.2.1–2.2.2 of the SSAR are large enough that the effects of potential accidents would not affect the safety-related systems of the ESP facility.

~~Specifically, in~~ The exception is with respect to barges carrying hazardous commodities on the Mississippi River, which will be discussed later in this section as well as in Technical Evaluation, Section 2.2.3.3.

In SSAR Section 2.2.3.1.1, the applicant stated that, because of the separation distance between the closest point of State Route 61 and the ESP site (4.5 miles), under the conservative assumption of an accident involving delayed detonation of a flammable vapor cloud, the peak reflected pressure would be well below 1 pound per square inch (psi) at the ESP site. ~~The applicant stated that the Mississippi River transportation corridor lies 1.1 miles west of the ESP site. Using the guidelines of RG 1.91, the applicant noted that the largest probable quantity of explosive material to be transported by ship is approximately 5000 tons equivalent TNT. On the basis of the river barge accident case analyzed in the GGNS UFSAR, the applicant found that, because the new plant and associated safety-related systems would be located on a bluff about 65 feet above normal river level, the bluff would provide significant~~

~~shielding against the explosive effects of any potential cloud originating from river barges or ships in the shipping channel. The applicant also~~

The applicant determined that the separation distance between the 4-inch, 225-psi natural ~~gasline~~gas line and the ESP site (closest approach of 4.75 miles) is great enough that the pipeline would pose no hazard to proposed facilities at the ESP site.

The

applicant also evaluated the case of onsite delivery of liquified hydrogen by truck and determined that delivery operations would be separated from the proposed ESP facility by at least 400 feet, which is less than the minimum safe distance of 1285 feet given in ~~RG 1~~R.G. 1.91. However, ~~T~~the applicant estimated the probability of an explosive event in such a case to be 4.1×10^{-7}, which falls below the RG 1.91 threshold for considering trucked liquid hydrogen as a DB~~A~~E. The applicant also evaluated the effects of onsite storage of 20,000 gallons of liquid hydrogen at the GGNS site. On the basis of analyses performed for the GGNS UFSAR, the applicant reported minimum separation distances of 737 feet for a tank explosion and 1340 feet for a gaseous cloud formation based on a pipe break or leak. The applicant indicated that the proposed ESP powerblock location and the locations of the safety-related systems are beyond these minimum distances.

Section 2.2.3.1.2 of the SSAR describes the applicant's analysis of potential accidents involving toxic chemicals. The applicant noted that no significant industrial facilities or toxic chemical storage facilities currently exist within 6 miles of the ESP site. In response to staff RAIs, the applicant analyzed toxic chemical hazards using the following guidelines in RG 1.78:

- chemicals transported on routes (including river routes) within a 5-mile radius of the site, at a frequency of 10 or more per year, and with weights outlined in RG 1.78; and

- chemicals stored within 0.3 miles of the control room in quantities greater than 100 pounds.

For the first case above, on the basis of analyses in the UFSAR, the applicant found that the large separation distance between the ESP site and the nearest highway would mitigate any highway transportation accidents involving the release of toxic chemicals. SSAR Table 2.2-4 indicates the amount of hazardous material transported past the ESP site on the Mississippi River in the year 2000. The applicant based its assessment of accidents involving river barges on barge mishap analyses presented in the UFSAR. In addition, the applicant submitted additional analyses that estimated the likelihood of a barge accident leading to an explosion and an overpressure in excess of 1 psi at the proposed site. The applicant also considered fuel fires from barge accidents, chlorine spills, and toxic chemical releases. In the case of gaseous chemical or hot plumes from fuel fires, ~~T~~the applicant stated that the separation distance and topographic barriers are sufficient to eliminate these types of accidents from further consideration. The applicant estimated that the probability of a significant chlorine spill in the river is 1.8×10^{-7} per year.

For the second case, SSAR Table 2.2-5 lists the hazardous materials stored at GGNS. The specific chemicals to be stored at the ESP facility are not currently known and will be evaluated at the time of the COL application. The applicant relied on the GGNS UFSAR to

~~hypothesize~~postulate the explosion of an underground diesel fuel storage tank at GGNS, concluding that, because of plume rise from fire conditions, the control room habitability systems would be affected only if extreme wind events accompanied the explosion. The UFSAR analysis of hazards from other stored chemicals at GGNS resulted in estimated concentrations affecting control room habitability that are within RG 1.78 limits. The applicant also found, on the basis of analyses in the GGNS UFSAR, that a hydrogen or oxygen release from the GGNS hydrogen water chemistry system would not adversely affect control room habitability.

In SSAR Section 2.2.3.1.3, The applicant stated that forest fires originating locally from accidents could produce a maximum concentration of 45 pounds of particulate matter per ton

and that the toxicity of such fires falls well below the acceptable limits for the GGNS control room air intake system. In SSAR Section 2.2.3.1.4, the applicant noted that the water intake structure in the Mississippi River is positioned away from the shipping channel, and that it did not consider ship impact a DBE. In Section 2.2.3.1.5 of the SSAR, the applicant found that chemical spills in the river could force the shutdown of the water intake of the ESP facility and thus the shutdown of the ESP facility itself. Such an event would require spilling toxic chemicals that would sink below the river surface and reach the water intake. The applicant stated that it will develop appropriate procedures to ensure safe shutdown in the event that raw water makeup is unavailable.

The applicant found that some commodities being shipped by barge on the Mississippi River past the site may exceed the R.G. 1.91 criterion of 1 psi overpressure due to insufficient separation distance between the potential explosions of hazardous substances and the proposed site. However, the applicant claimed there was sufficient reduction in overpressure due to the existence of a 65-foot elevation bluff between the river and the proposed site. The applicant submitted a revised analysis of the explosion hazards associated with barge shipments of hazardous cargoes on the Mississippi River. The revision was in response to the staff's view that there was insufficient quantitative evidence for the overpressure reduction that could be credited to the existence of a 65-foot elevation bluff between the river and the proposed site. The revised analysis was based on a best estimate assessment of hazardous cargo shipments in terms of quantities, shipping frequencies, barge accident rates, and the estimation of potential explosion overpressures of specific commodities. The latter included modeling of on-board confined explosions as well as vapor cloud formation ensuing a spill leading to ignition and detonation. The applicant's analysis indicates that the likelihood of a barge mishap leading to an explosion that could exceed 1 psi overpressure at the proposed site is on the order of 10^{-8} per year.

2.2.3.2 Regulatory Evaluation

In SSAR Section 2.2, The applicant identified the following applicable NRC guidance regarding potential hazards in the vicinity of the proposed ESP site:

- RG 1.91
- RG 1.78
- RG 1.70

In SSAR Section 2.2, the applicant referenced the GGNS UFSAR and RG 1.70. The staff considered the following regulatory requirements in its review of information regarding potential accidents that could affect the safe design and siting of a nuclear power plant(s) falling within the applicant's PPE that might be constructed at the proposed site:

- 10 CFR 52.17(a)(1)(vii), with respect to information on the location and description of any nearby industrial, military, or transportation facilities and routes

- 10 CFR 100.20(b), with respect to information on the nature and proximity of human-related hazards

- 10 CFR 100.21(e), with respect to the evaluation of potential hazards associated with nearby transportation routes and industrial and military facilities

The following RGs identify methods acceptable to the NRC staff to meet the Commission's regulations identified above:

- RG 1.91
- RG 1.78

Sections 2.2.1–2.2.2, 2.2.3, and 3.5.1.6 of RS-002, as well as RG 1.70, provide guidance on the information appropriate for identifying, describing, and evaluating potential accidents.

2.2.3.3 Technical Evaluation

The staff evaluated potential accidents in the vicinity of the proposed ESP site by reviewing (1) the information provided by the applicant in SSAR Section 2.2.3, (2) the applicant's responses to staff RAIs, (3) information obtained during a visit to the proposed ESP site and its vicinity, and (4) other publicly available reference material, including topographic maps (see DeLorme 2003 and *Mississippi Atlas and Gazetteer* 1998), airport data (see GCR and Associates), aerial imagery (Topozone 2004), and GIS coverage files (see the Platts POWER map GIS spatial data, 2004).

Section 2.2.1–2.2.2 of this SER describes potential hazards that might be identified in the future in association with a currently vacant industrial development in Claiborne County Port, just south-west of the ESP site.

The staff reviewed the applicant's analysis of the effects of potential explosions and the formation of flammable vapor clouds. Using the guidance provided in RG 1.91, the staff found that the distance of U.S. Highway 61 is sufficiently far from the potential ESP facility that no significant damage is expected with respect to safety-related SSCs that may be located on the ESP site for the worst-case truck-tank explosion accident scenario.

Table 2.2-4 of the SSAR characterizes the type of commodities typically transported on the Mississippi River by listing specific hazardous materials and quantities. The hazards posed by these materials are ~~in the form of~~ potential explosions, fires, or the release of airborne gases that are toxic.

~~The GGNS UFSAR addresses hazards caused by potential explosions. The nearest bank of~~

~~the river is 1.34 miles from the power station. Using RG 1.91, the largest probable quantity of explosive material to be transported on the river (approximately 5000 tons equivalent TNT) would require a safe standoff distance of about 11,000 feet, or about 2.1 miles. However, the GGNS safety-related structures are on top of a bluff, approximately 65 feet above the normal river level. The UFSAR notes that the bluff will provide a partial shield against the explosions of potential river-traffic cargo. Hence, it was not anticipated that potential explosions would be a hazard at a distance of 1.34 miles. The staff agreed that the combined effect of the 1.34-mile distance and the shielding effect of the bluffs was sufficient, such that an explosion hazard resulting from the shipments of hazardous materials along the river past GGNS was acceptably low.~~

The proposed ESP site would be about 1.1 miles from the nearest bank of the river. ~~The location of a facility on the proposed ESP site would also be located on the bluffs, about 65 feet above the normal river level. Current analyses of blast mitigation with respect to buildings support the expectation that blast barriers of comparable height can reduce the overpressure behind the barrier by at least a factor of 2 (Arthur D. Little, "Facility Siting—Case Study Demonstrating Benefit of Analyzing Blast Dynamics," *Proceedings of the International Conference and Workshop on Process Safety Management and Inherently Safer Processes*, October 1996). At a distance of 1.1 miles~~At this distance, an explosion of a 5000 ton TNT-equivalent charge (representing a bounding quantity of explosive cargo) would produce a peak positive normal reflected pressure of about 4 psi. ~~The effect of the 65-foot bluffs would be to reduce this by at least a factor of 2, so that the peak reflected incident pressure would be less than 2 psi. This is equivalent to a peak incident pressure of 1 psi, which is~~On this basis, the hazardous cargo explosion hazard exceeds the acceptance ~~threshold~~criteria of RG 1.91. ~~This estimate is conservative since the expected pressure~~The applicant initially postulated an overpressure reduction ~~effect of the 65-foot bluffs is greater than a factor of 2. There is also conservatism associated with the assumption that all explosions would have the maximum efficiency of TNT equivalency associated with the 5000-ton charge assumed in RG 1.91. As noted in the study by Arthur D. Little cited above, explosions of dispersed vapor clouds, even under the most favorable dispersion conditions, will be relatively inefficient, so that the actual TNT-equivalent quantity would be significantly less than the assumed 5000 tons. In view of the~~

~~above, the staff agrees that~~due to the existence of a 65-foot elevation bluff between the river and the proposed site. However, there was insufficient basis for quantifying this effect. Hence, the applicant submitted additional analyses that estimated the likelihood of exceeding a 1 psi overpressure at the proposed site on the basis of actual shipment quantities and shipping frequencies.

The revised analyses considered available historical data on barge shipments on the Mississippi River in terms of type of hazardous commodities, quantities, and shipping frequencies. In estimating the likelihood of a barge mishap leading to a spill and explosion that would exceed 1 psi at the proposed site, the applicant estimated the likelihood of a major spill in the event of a barge mishap, as well as the probability of a detonation given a spill. Specifically, for each identified hazardous commodity the applicant evaluated the likelihood of a series of sequential events (i.e., barge mishap, spill, and detonation leading to an overpressure at the proposed site in excess of 1 psi). Explosion modeling included consideration of confined explosions at the mishap site as well as vapor cloud formation and subsequent ignition. The applicant estimated the total probability of exceeding a 1 psi overpressure at the proposed site

to be on the order of magnitude of 10^{-8} per year.

In estimating the likelihood of spill frequencies and explosion probabilities the applicant's analyses used some assumptions that are difficult to verify. Hence, the staff did a confirmatory analysis regarding the explosion hazard ~~from potential accidents involving shipping~~of barge shipments on the Mississippi River. The staff's confirmatory analysis is described below. The staff used information provided by the applicant, as well as data from independent sources.

With respect to barge mishaps leading to confined onboard explosions, the applicant's analyses indicate that none of the commodities have the potential of exceeding a 1 psi overpressure at the proposed site. The staff reviewed the applicant's analyses of confined explosions. The staff confirmed that the analyses contained the upper bound blast energy potentially available recommended by Regulatory Guide 1.91. The staff also confirmed that the licensee calculated distances from a confined blast to a 1 psi overpressure were less than the 1.1 miles from ESP site to the Mississippi river. Accordingly, the staff finds the analysis to be reasonable. Hence, the staff concludes that potential onboard confined explosions would not pose an undue hazard with respect to the proposed site.

The two other types of explosion hazards identified by the applicant are associated with delayed ignition of an unconfined vapor cloud in the vicinity of the proposed ~~ESP site is acceptably low.~~ site and unconfined cloud explosions where ignition takes place before the cloud can drift away from the barge mishap site.

With respect to delayed ignition of unconfined vapor clouds, the applicant's analyses identify only one specific commodity, acetylene, that has the potential of exceeding 1 psi overpressure at the proposed site. This commodity is identified by the applicant as a subset of the general category identified as Acyclic Hydrocarbons (Table E-1 of Attachment 1 of the applicant's SERI letter to USNRC - Response to Request for Additional Information Regarding the Grand Gulf Early Site Permit Final Safety Evaluation Report (ADAMS Accession No. ML060760443), dated February 22, 2006). The shipping frequency of Acyclic Hydrocarbons was 14 barges per year in 2003 and 9 barges per year in 2004. To account for possible variations in shipping frequency, the staff conservatively assumed 20 shipments of acetylene per year. An added conservatism is that acetylene is only a subset of this group of commodities. An independent study of tanker accident rates, including tanker barges (Mark Abkowitz and Jorge Galarraga, "Tanker Rates and Expected Consequences in U.S. Ports and High Seas Regions," TRB State-of-the-Art Report 3), shows tanker accident rates ranging from about 3.6×10^{-5} per mile-year to 2.6×10^{-7} per mile-year. These rates are for tanker movements in ports, intra-coastal waterways and open seas. On this basis, it reasonable to assume an order-of-magnitude rate of 10^{-5} mishaps per river mile-year for the barge mishap rate.

With respect to the likelihood of a spill in the event of a mishap, the applicant has presented U.S. Coast Guard data (Ref. 37 in the applicant's SERI letter to USNRC - Response to Request for Additional Information Regarding the Grand Gulf Early Site Permit Final Safety Evaluation Report (ADAMS Accession No. ML060760443), dated February 22, 2006, on spill frequency of combustible materials on the Mississippi River. Page 24, Equation 1 and Figure H-1 in the applicant's analyses present a linear curve fit for the spill frequency versus spill size. Using the maximum barge capacity of 4260 tons of acetylene, the spill frequency is estimated from Equation 1 to be about 1.98×10^{-5} spills/river mile-year. Also, using the same U.S. Coast Guard data, the applicant estimates the mishap rate for barges on the Mississippi in the vicinity of the

proposed site to be about 0.009 collisions/river mile-year. The staff estimated the spill rate per mishap from the ratio of these two quantities, that is

$$\frac{1.98\times 10^{-5}\dfrac{spills}{river\ mile-year}}{0.009\dfrac{collisions}{river\ mile-year}} = 2.20\times 10^{-3}\frac{spills}{collision}$$

The applicant estimates the explosion probability as 0.008 explosions per spill on the basis of one reported boiling liquid expanding vapor explosion (BLEVE) on the Mississippi or Ohio Rivers. However, the applicant reduces this value by a factor of ten, yielding a value of 0.0008, on the basis that "there is no evidence that all the fuel detonated in that event." While the possibility that not all the fuel detonated may add to the conservatism in using the 0.008 rate, there is no apparent means of verifying that the factor of ten reduced value of 0.0008 is appropriate. Hence, the staff's analysis assumes the 0.008 rate is applicable. The length of river (referred to as 'at risk length') that needs to be considered is determined by the modelling of a vapor cloud plume and estimating the furthest distance from the site at which a 1 psi overpressure may be exceeded. The applicant estimated the at risk length for acetylene as 2.74 miles.

On the basis of the above, the staff estimated the annual frequency of exceeding 1 psi due to barge mishaps near the proposed site involving the release and detonation of acetylene to be

$$P\frac{\text{explosions}}{\text{year}} = F_1\frac{\text{haz. barges}}{\text{year}} * F_2\frac{\text{mishaps}}{\text{haz. barge - river mile}} * F_3\frac{\text{spills}}{\text{mishap}} * F_4\frac{\text{explosions}}{\text{spill}} * L_{\ river\ mile}$$

$$P = (20)*\left(10^{-5}\right)*(2.2E-3)*(0.008)*(2.74) \cong 1\times 10^{-8}\frac{\exp losions}{year}$$

With respect to unconfined vapor cloud explosions occurring at the barge mishap location, the applicant's analyses determined that some hazardous commodities that pass the plant have the potential for exceeding a 1 psi overpressure at the proposed site. Based upon the following description of the staff analysis, the staff calculated the probability of an unconfined vapor cloud explosion exceeding 1 psi overpressure at the proposed site. The staff used the results of this calculation to assess the applicant's calculation.

The staff reviewed the applicant's list of identified commodities and confirmed the applicant's calculated values for the distances to yield a 1 psi overpressure at the proposed site. The staff notes that the applicant has not included LNG shipments in the screening analysis since an LNG detonation exceeding the 1 psi overpressure at the proposed site, while possible, is not credible on the basis of low likelihood. Specifically, the applicant notes that a) it takes a substantial amount of initiating energy (significantly more, for example, than that associated with a spark) for detonation to occur, and b) transition from deflagration to detonation is unlikely

due to relatively slow flame propagation velocities observed even with maximum laboratory induced flame acceleration. The staff agrees that there is no reasonable basis for postulating sources of ignition of sufficient size in the vicinity of the barge or the site. However, the relative likelihood of deflagration transition to detonation for LNG is difficult to assess. Therefore, the staff also considered LNG in addition to the crude petroleum, gasoline, naphtha, acyclic hydrocarbons, benzene and toluene considered by the applicant.

The staff estimated the shipping frequency (F_1) using the maximum yearly frequency for each commodity passing the proposed site during 2003 and 2004. The staff estimated the spill frequency for each of these commodities using the applicant's correlation between spill frequency and spill size. For this estimate the staff used the maximum barge cargo size for each commodity passing the proposed site during 2003 and 2004. The spill rate for each commodity was divided by 0.009 collisions/river mile-year, discussed above, to determine the spill rate per collision (F_2). The staff used the barge mishap rate of 10^{-5} per year (F_3) and the conditional probability of detonation of 0.008 (F_4) discussed above. Finally, the staff determined the length along the river (L) that exposes the plant to a postulated 1 psi overpressure assuming a vapor cloud explosion at the river.

Using the equation above for the estimated annual frequency of exceeding 1 psi due to barge mishaps (P), the staff estimated the probability for each commodity. The total probability of exceeding a 1 psi overpressure, obtained by summing over all of the analyzed commodities, is 10^{-6} per year.

The staff performed several checks of the parameters used to determine this probability. First, the staff determined the sensitivity of the analysis to assumed barge size. The staff performed another calculation assuming the mass of each barge is 70% of the maximum barge size of each commodity. This calculation determined that for this smaller cargo barge, the decrease in river length (exposing the plant to a 1 psi overpressure) approximately offsets the increased likelihood of a smaller spill. Therefore, based upon this calculation the probability is relatively insensitive to the assumed mass size of the barges.

The staff also performed an analysis to check the validity of the applicant’s model relating the size of the barge and the likelihood of a spill. The staff calculated the frequency of a 100,000 gallon spill (300 tons at 0.72 specific gravity) using the applicant's model. The staff compared this value to the applicant's review of nine years of U.S. Coast Guard (USCG) Safety Management System data. The staff calculated value of 1.6 spills per year is conservative with respect to the actual number of 100,000 gallon spills on the Mississippi river (zero spills) during the nine years researched.

Lastly, the likelihood of a collision or grounding on the Mississippi river in the area of the proposed site appears to be low as compared to other areas along the river. The applicant stated that the proposed site is adjacent to the river between river mile marker 406 and 407. Except for sedimentation control dikes on the west bank (down river of marker 405), there are no bridges within several miles of the proposed site. The nearest bridges are at Vicksburg and Natchez. The staff concurs with the licensee’s assessment that obstructions create a higher probability of collisions. Quantitatively, this view is supported by the applicant’s review of USCG incident data which indicated that there were no spills events reported for this area of the river in the last four years. Therefore, the staff agrees with the applicant that this area of the river should be exposed to fewer accidents than other areas of the river included in the above

analysis.

On the basis of the above analysis, the information provided by the applicant and the staff's calculated total probability of exceeding a 1 psi overpressure of about 10^{-6} per year for all commodities considered above, the staff agrees with the applicant's conclusions that the explosion hazard due to barge traffic on the Mississippi River meets the acceptance criterion of RS-002 (Chapter 2.2.3, "Evaluation of Potential Accidents," Section II, "Acceptance Criteria").

With respect to potential fires caused by accidental releases of flammable substances on the river, the staff estimates that the incident thermal flux is sufficiently low so as not to pose a hazard to safety-related structures. Specifically, using the methodology of NUREG/CR-3330, "Vulnerability of Nuclear Power Plant Structures to Large External Fires," dated August 1983, the staff estimates that the incident thermal flux at 1.1 miles from a large gasoline vapor cloud fire would be less than 5 kilowatts per square meter (kW/m^2). At this thermal flux, the allowable wall exposure time is well in excess of 12 hours in duration. Hence, potential fires caused by accidents on the river do not pose a significant hazard to a plant on the proposed ESP site.

The staff reviewed the applicant's analysis of potential toxic chemical accidents. The applicant used the UFSAR inventory of toxic chemicals in its analysis. The staff notes that the principal commodities posing a potential hazard are shipments of anhydrous ammonia and chlorine. The applicant analyzed the potential for the release of these chemicals for GGNS and found the estimated toxicity levels at the control room to be acceptably low. However, the staff finds that, since the PPE does not specify a control room design, it cannot make a determination with respect to control room habitability in the event of a toxic chemical accident at the site or in its vicinity. Accidents involving such materials cannot be evaluated for the ESP facility at the ESP stage without a specific set of plant design parameters. Therefore, the staff will evaluate such accidents at the COL application stage. This is **COL Action Item 2.2-1**.

2.2.3.4 Conclusions

As set forth above, the applicant identified potential accidents related to the presence of hazardous materials or activities on or near the proposed ESP site that could affect a nuclear power plant(s) falling within the applicant's PPE. The staff finds that the applicant selected those potential accidents that should be considered as DBEs at the COL stage, in accordance with 10 CFR Part 100. The applicant identified and evaluated hazards from nearby facilities and the staff concludes that such facilities pose no undue risk to the type of facility proposed for the site, subject to confirmation at the COL stage regarding design-specific hazard interactions. Therefore, the staff concludes that the ESP site location is acceptable with regard to potential accidents that could affect such a facility or facilities built on the site, and that it meets the requirements of 10 CFR 52.17(a)(1)(vii), 10 CFR 100.20(b), and 10 CFR 100.21(e).

WordPerfect Document Compare Summary

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18. REVIEW BY THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

The Advisory Committee on Reactor Safeguards (ACRS) completed its review of the application from System Energy Resources, Inc. (SERI), for an early site permit (ESP) for the Grand Gulf ESP site, as well as the U.S. Nuclear Regulatory Commission (NRC) staff's draft safety evaluation report (DSER) for this application. The ACRS ESP subcommittee began a detailed review of the Grand Gulf ESP application and the staff's DSER in April 2005. The ACRS ESP subcommittee met with representatives from SERI and the NRC staff on May 16, 2005.

The ACRS held its full committee meeting on the Grand Gulf ESP DSER on June 2, 2005. The discussions during these meetings focused on the open items identified in the DSER. On the basis of its review, the ACRS issued an interim letter report, dated June 14, 2005, which addresses the portions of the Grand Gulf ESP application that concern safety. The staff responded to the interim letter report in its letter dated August 12, 2005 (ADAMS Accession No. ML052210235). This final safety evaluation report (SER) documents the actions the staff took in response to the comments and recommendations the ACRS identified in its interim report of June 14, 2005, as described in the staff's response letter of August 15, 2005. The staff issued its final SER after the resolution of open items discussed in the DSER and after receiving the ACRS interim letter report to the Commission related to its review.

During its meeting with the ACRS on December 8, 2005, the staff ~~will~~ discussed the resolution of open items and responses to ACRS comments on the major elements of the ESP review. At the ~~final ACRS~~528th meeting ~~for~~of the ~~Grand Gulf ESP SER~~ACRS, the full committee ~~will~~ considered the staff's ~~report~~FSER, as well as the SERI Grand Gulf ESP application, and ~~it will~~ issued its final letter report to the ~~Commission. The staff issued its final SER after the resolution of open items discussed in the DSER and after receiving the ACRS interim letter report to the Commission related to its review. The staff will address any comments from the ACRS in its final letter report to the Commission and will include the ACRS final~~NRC Executive Director for Operations (EDO) on December 23, 2005. In this letter, ACRS concluded that the safety evaluation report should be issued once the staff has made more explicit its analysis of the hazards posed to the proposed site by explosions in transportation accidents on the Mississippi River. By memorandum dated March XX, 2006, the staff addressed the ACRS' comments, the changes of which are reflected within this report. Both the ACRS' letter report ~~as an appendix~~and the NRC staff's memorandum are included as Appendix E to this report. The NRC staff's initial response dated February 1, 2006, to the ACRS is also included in Appendix E.

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APPENDIX B

CHRONOLOGY

This appendix contains a chronological listing of routine licensing correspondence between the staff of the U.S. Nuclear Regulatory Commission and System Energy Resources, Inc., regarding the review of the Grand Gulf early site permit application under Project No. 720 and Docket No. 52-009.

Revisions to the Grand Gulf Early Site Permit Application

Rev.	Date	Accession Number
0	10-16-2003	ML032960315
1	07-04-2005	ML052420635
2	10-03-2005	ML052780449
3	03-xx-2006	ML#

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The document was marked with 1 Deletion, 3 Insertions, 0 Moves.

— — — — —, Early Site Permit for the Grand Gulf Nuclear Station Site Part 2, Revision 0, "Site Safety Analysis Report." SERI: Jackson, Mississippi. October 2003.

— — — — —, Early Site Permit for the Grand Gulf Nuclear Station Site—Part 3, Revision 0, "Environmental Report." SERI: Jackson, Mississippi. October 2003.

— — — — —, Early Site Permit for the Grand Gulf Nuclear Station Site—Part 4, Revision 0, "Emergency Planning Information." SERI: Jackson, Mississippi. October 2003.

— — — — —, Early Site Permit for the Grand Gulf Nuclear Station Site—Part 4, Revision 1, "Emergency Planning Information." SERI: Jackson, Mississippi. July 2005.

— — — — —, Early Site Permit for the Grand Gulf Nuclear Station Site—Part 4, Revision 2, "Emergency Planning Information." SERI: Jackson, Mississippi. October 3, 2005.

— — — — —, Early Site Permit Application for the Grand Gulf Nuclear Station Site—Revision 3. SERI: Jackson, Mississippi. March, 2006.

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WordPerfect Document Compare Summary

Original document: P:\Christian's Pdrive\NEW REACTOR LICENSING\ESP Stuff\Grand Gulf\Grand Gulf NUREG\AppenD.wpd
Revised document: @PFDesktop\Completed NUREG files\AppenDnew.wpd
Deletions are shown with the following attributes and color:
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Insertions are shown with the following attributes and color:
Double Underline, Redline, Red RGB(255,0,0).

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APPENDIX D

PRINCIPAL CONTRIBUTORS

Name	Responsibility
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Araguas, Christian	Project Management
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Campe, Kazimieras	Site Hazards
Mark Blumberg	Site Hazards
Bret Tegeler	Site Hazards
John Mckirgan	Site Hazards
Cheng, Thomas	Geotechnical Engineering
Harvey, Robert B.	Meteorology
Klementowicz, Stephen	Normal Radiological Dose Analyses
Lee, Jay	Accident Analyses
Li, Yong	Geology and Seismology
Prescott, Paul	Quality Assurance
Segala, John	Project Management
Tardiff, Albert	Security

Contractors	Technical Area
Federal Emergency Management Agency	Emergency Planning
Pacific Northwest Laboratory	Emergency Planning, Hydrology, Meteorology, and Site Hazards
U.S. Geologic Survey	Geology and Seismology
Brookhaven National Laboratory	Geology and Seismology

APPENDIX E

REPORT BY THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

December 23, 2005

Luis A. Reyes
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

SUBJECT: EARLY SITE PERMIT APPLICATION FOR THE GRAND GULF SITE AND THE ASSOCIATED FINAL SAFETY EVALUATION REPORT

Dear Mr. Reyes:

During the 528th meeting of the Advisory Committee on Reactor Safeguards, December 7-10, 2005, we met with representatives of the NRC staff and System Energy Resources, Inc. (SERI), the applicant for an early site permit (ESP) for the Grand Gulf site, and discussed the application and the NRC staff's final Safety Evaluation Report (FSER). We provided an interim report on this application and the draft Safety Evaluation Report on June 14, 2005. We reviewed this application to fulfill the requirement of 10 CFR 52.23 that the ACRS report on those portions of an ESP application that concern safety. We also had the benefit of the documents referenced.

CONCLUSIONS AND RECOMMENDATIONS

- The NRC staff has written a very readable and comprehensive Safety Evaluation Report. The three permit conditions the staff proposes for the early site permit and the 26 action items for the combined license phase are appropriate.
- This Safety Evaluation Report should be issued once the staff has made more explicit its analyses of the hazards posed to the proposed site by explosions in transportation accidents on the Mississippi River.
- The staff needs to provide additional guidance to applicants concerning the discussion in an application of "Major Features" of the emergency planning for a proposed site.

DISCUSSION

SERI seeks an early site permit for a reactor or a set of reactor modules of total power up to 4300 MW_{th} on a site adjacent to the current Grand Gulf Nuclear Power Station, a BWR/6 with a Mark III containment. With the additional unit or modules, the total nuclear generating capacity at the Grand Gulf site could be as high as 8600 MW_{th}. The Grand Gulf site had previously been approved for two units, but the second unit was never completed.

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The SERI application for an early site permit does not specify a particular power plant technology for the new reactor or reactor modules to be placed on the site. The early site permit application, instead, uses a "plant parameter envelope" of power plant characteristics that is intended to bound the reactor technology that could eventually be selected.

- Nature of the Proposed Site

The proposed site is located on the eastern side of the Mississippi River about 25 miles south of Vicksburg, Mississippi. The site is rural in nature. There is little industrial activity and no military base near the site. There is a natural gas pipeline somewhat more than 4 miles from the site.

The nearest major airport is at Jackson, Mississippi, about 65 miles from the proposed site. The staff has determined that the air traffic corridors near the site pose no undue risk. There is a highway 4½ miles from the site. The principal ground transportation hazard is thought to be the delivery of hydrogen to the site for use in the currently operating boiling water reactor. The staff has found that the delivery and storage of this hydrogen would pose no undue risk to the proposed new power plant site.

The most important transportation route near the site is the Mississippi River. The nearest bank of this river is about 1.1 miles from the proposed site. Explosions and releases of toxic gases and vapors could pose threats to the proposed site. The staff and the applicant have agreed to defer consideration of the threats posed by the accidental releases of toxic vapors and gases until a specific plant for the site has been chosen and the habitability of the control room can be evaluated.

The staff has concluded that the detonation of 5000 tons TNT-equivalent bounds the explosion threat to the proposed site. According to staff-approved methods of analysis, such a detonation would require a standoff distance of about 2.1 miles from the facility. The staff concludes, however, that because the site is located behind a 65-foot bluff, the 1.1 mile standoff is adequate. The technical basis for this conclusion needs to be made clear in the Safety Evaluation Report prior to its issuance. This clarification should include a description of the reliability of the calculational method adopted by the staff.

The staff has concluded also that the detonation bounds the explosive hazard posed by vapor explosions such as might occur in the release of liquefied natural gas during a transportation accident on the river. The technical basis for this conclusion should also be made clear in the Safety Evaluation Report. The clarification should include a discussion of whether the staff used the TNT-equivalent method to analyze vapor explosions and the conservatisms associated with such an approximation if it was adopted.

- Population in the Vicinity of the Site

The permanent population around the site is low. The nearest town, Port Gibson, Mississippi, is about 6 miles from the proposed site and has a population of about 1750. The nearest population center, Vicksburg, Mississippi, is 25 miles to the north and has a current population of about 27,000. The projected population growth in the area to the year 2070 is expected to be small, perhaps less than 20%.

- Geology and Seismicity of the Site

The proposed site is located on consolidated river sediments. Geological investigations show no evidence of significant ground deformation for at least the last 500,000 years and perhaps for the last 5 million years. Salt domes in the area are 6 and 8 miles from the proposed site.

The site is in an area of little seismic activity. The nearest historical seismic event occurred more than 25 miles away. The limiting earthquake source is the New Madrid seismic zone over 200 miles away. SERI has performed a probabilistic seismic hazard analysis that takes into account recent revisions made by the U.S. Geological Survey to the frequencies and intensities of events in the New Madrid seismic center. The analysis also considers the possibility of seismic activity along the suspected faults on the Saline River which may not be capable faults. The proposed site is a deep soil site (bedrock is at a depth of about 10,000 feet). SERI has done sufficient characterization of the site to produce analyses of the soil amplification factors. The probabilistic seismic hazard curve developed for the site is bounded by the design safe shutdown earthquake curves adopted in the plant parameter envelope.

- Meteorology

Vigorous storms such as hurricanes and tornados are the principal weather threats to a reactor located on the proposed site. SERI and the staff have used historical information to characterize these and other weather features of the site. In our review of the Safety Evaluation Report, we examined the applicability of hurricane frequency data on the prediction of future storm activity. There is evidence that storm activity is increasing in the Gulf of Mexico due to known weather cycles. The staff and the applicant have used historical data over a sufficient period to capture data from previous weather cycles. We find no definitive evidence that storm intensities in excess of the bounds established by the applicant and accepted by the staff will develop. These bounds may not be especially conservative. Representatives of SERI informed us that inland wind gusts produced by the recent hurricane Katrina at the latitude of the proposed site were somewhat less than 92 mph which can be compared to the 96 mph maximum three-second wind gust adopted for the site characterization. The staff has stated that should future weather evidence indicate site characteristics accepted in the Safety Evaluation Report are not adequate, these characteristics will be amended as needed.

The proposed site is located on a bluff about 65 feet above the normal river level. Land on the opposite bank of the river is more easily flooded than the proposed site. Consequently, major river flooding is not a threat to the site. Local, onsite flooding will have to be addressed if the permit is granted and a decision is made to construct a power plant on the site.

- Emergency Plans

The applicant has elected to submit for review just the "major features" of emergency planning for the proposed site, as is allowed by the regulations. The staff has concluded that these major features are largely adequate. The applicant has stated that the remaining information would be submitted with a combined license application. The applicant and the staff encountered challenges in defining the limitations that should exist on descriptions of major

features of emergency planning, especially for a site where reactors currently exist. These challenges could be avoided in the future by providing additional guidance to the applicants.

Sincerely,

Graham B. Wallis

Graham B. Wallis
Chairman

References:

1. U.S. Nuclear Regulatory Commission, Final Safety Evaluation Report, "Safety Evaluation of Early Site Permit Application in the Matter of System Energy Resources, Inc., a Subsidiary of Entergy Corporation, for the Grand Gulf Early Site Permit Site," October 21, 2005.

2. System Energy Resources, Inc., Grand Gulf Early Site Permit Application, Revision 0, October 2003.

3. Letter dated June 14, 2005, from G. B. Wallis, Chairman, ACRS, to L. A. Reyes, Executive Director for Operations, NRC, Subject: Interim Letter: Draft Safety Evaluation Report on Grand Gulf Early Site Permit Application.

RESPONSES TO THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

February 1, 2006

Dr. Graham B. Wallis, Chairman
Advisory Committee on Reactor Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: EARLY SITE PERMIT APPLICATION FOR THE GRAND GULF SITE AND THE ASSOCIATED FINAL SAFETY EVALUATION REPORT

Dear Chairman Wallis:

Thank you for your letter dated December 23, 2005, regarding the final safety evaluation report (FSER) of the System Energy Resources, Inc. (SERI), application for the Grand Gulf early site permit (ESP). The staff of the U.S. Nuclear Regulatory Commission (NRC) will reproduce your letter as Appendix E to the FSER for the Grand Gulf ESP which will be issued as a final NRC technical report in an upcoming NUREG. In your letter, the Advisory Committee on Reactor Safeguards (ACRS) agreed with the staff's proposed permit conditions, but expressed concern over some of the staff's conclusions associated with the nature of the proposed site.

Specifically, your letter stated that the technical basis for the staff's conclusion on its analyses of the hazards posed to the proposed site by explosions in transportation accidents on the Mississippi River needed to be more explicit. The staff has noted the ACRS concern and has asked the applicant to provide additional information to demonstrate how it meets Regulatory Guide (RG) 1.91, "Evaluations of Explosions Postulated to Occur on Transportation Routes Near Nuclear Power Plants." The staff's evaluation of this information will be documented in the NUREG. Prior to issuance of the NUREG, the staff plans to inform the ACRS of the proposed changes.

Lastly, ACRS recommended that the staff provide additional guidance to applicants concerning "Major Features" of emergency planning for a proposed site. The staff agrees with the ACRS recommendation and is working to establish additional guidance, which will be included in a revision of Supplement 2 to NUREG-0654/FEMA-REP-1. It is the staff's understanding that industry does not plan to submit a "Major Features" ESP application in the near future and therefore the priority for this work is considered low. Currently, the staff's focus is on activities related to updating the emergency planning sections of the standard review plan and creation of guidance for future combined license applicants.

The NRC staff appreciates the insights that the ACRS has provided concerning the safety review of the Grand Gulf ESP. These insights are a valuable contribution to the NRC staff's review and development of the FSER.

Sincerely,

/RA/

Luis A. Reyes
Executive Director
for Operations

cc: Chairman Diaz
Commissioner McGaffigan
Commissioner Merrifield
Commissioner Jaczko
Commissioner Lyons
SECY

March 24, 2006

MEMORANDUM TO: John T. Larkins, Executive Director
Advisory Committee on Reactor Safeguards

FROM: David A. Matthews, Director
Division of New Reactor Licensing
Office of Nuclear Reactor Regulation

SUBJECT: ACRS REVIEW OF THE GRAND GULF EARLY SITE PERMIT APPLICATION - FINAL SAFETY EVALUATION REPORT CHANGED PAGES

On December 23, 2005, the Advisory Committee on Reactor Safeguards (ACRS) sent the Nuclear Regulatory Commission (NRC) staff a letter regarding the final safety evaluation report (FSER) on System Energy Resources, Inc.'s (SERI's) application for an early site permit (ESP) for the Grand Gulf site. In this letter, the ACRS expressed concern about the staff's conclusions regarding the nature of the proposed site. The ACRS stated that the technical basis for the staff's conclusion on hazards to the proposed site by explosions in transportation accidents on the Mississippi River needed to be more explicit.

The staff agreed with the ACRS's concern and asked the applicant to provide additional information to demonstrate compliance with 10 CFR Part 100. In a February 22, 2006, response, the applicant stated that it had decided not to follow Regulatory Guide (RG) 1.91, "Evaluations of Explosions Postulated to Occur on Transportation Routes Near Nuclear Power Plants." Instead, the applicant proposed an alternate methodology which no longer takes credit for the existing 60-foot bluff as a shield against any potential blasts along the Mississippi River.

Using data provided by the U.S. Army Corps of Engineers (USACE), Waterborne Commerce Statistics Center, the applicant performed an initial screening of commodities shipped on the Mississippi River past the ESP site. As a result of this initial screening, the applicant identified materials that could potentially create an explosion resulting in a blast overpressure on the order of 1 psi or greater at the western edge of the ESP site power block area. The applicant did an analysis for each of these commodities to determine the overpressure at 1.1 miles, taking into account the chemical and physical properties, the state of the material shipped, the assumed progression of events following the incident that releases the material, the reaction kinetics, and the release rates.

The analysis considered three different types of explosions: a confined space detonation, a local vapor cloud explosion, and vapor cloud formation and dispersion downwind toward the ESP site with a delayed detonation. For the commodities that resulted in either a potential overpressure greater than 1 psi or in predicted concentrations at the site above the lower explosive limit as determined by version 5.4 of the ALOHA (Areal Locations of Hazardous Atmospheres) computer program, the applicant performed a risk assessment to determine if the probability of occurrence of the event was acceptably low.

J. Larkins

The staff reviewed SERI's February 22, 2006, submittal and determined that the proposed alternate methodology is acceptable and demonstrates compliance with the regulations. The staff will document its evaluation and the minor changes that resulted from SERI's submittal of Revision 3 to the Grand Gulf ESP application in the forthcoming NUREG. The staff plans to publish the FSER as a NUREG by April 14, 2006. If you have any questions about the attached changes to the Grand Gulf FSER please contact Christian Araguas, the project manager for the Grand Gulf ESP application, at (301) 415-3637.

Enclosure: Grand Gulf Early Site Permit FSER Changed Pages

Docket No. 52-009