UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

January 28, 2010

#1494

MEMORANDUM TO: Chairman Jaczko
Commissioner Klein
Commissioner Svinicki

FROM: Brian Sheron
Brian W. Sheron, Director
Office of Nuclear Regulatory Research

SUBJECT: REVISED COMMUNICATION PLAN AND PROJECT SCHEDULE FOR STATE-OF-THE-ART REACTOR CONSEQUENCE ANALYSES

This memorandum provides the Commission with a revised communication plan (Enclosure 1) and revised project schedule (Enclosure 2) for completing the State-of-the-Art Reactor Consequence Analyses (SOARCA) pilot project. On November 5, 2009, the staff requested that the Executive Director for Operations extend the due date for submitting the results of the SOARCA pilot project to the Commission from January 29, 2010, to October 29, 2010. In the extension request, the staff indicated that a revised communication plan and revised project schedule will be provided to the Commission by January 29, 2010. This communication plan and revised schedule reflect the project activities to be conducted and thus the need for the requested extension.

The extension for completing the project is needed to complete additional analyses as a result of comments made by an independent peer review committee. In addition, the extension will allow more public involvement in the SOARCA process including the release of a draft of the complete project documentation (NUREG report) for public review and comment. A peer review committee comprising an external group of subject matter experts was contracted to perform in-depth review and evaluation of the methodology, results, and conclusions of the SOARCA study. Early drafts of the NUREG have undergone two reviews by the committee. To address the committee's comments, the SOARCA project staff has expanded and revised the documentation and has conducted additional analyses to address some of those comments. A final peer review committee meeting and Advisory Committee on Reactor Safeguards (ACRS) meetings will be conducted through early fall 2010. The ACRS meetings will be open to the public.

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After internal review and approval, the staff intends to release the draft NUREG for public review and comment and to conduct public meetings as necessary to allow interested individuals and groups to engage in discussions on the project methodology and results. Absent the need for substantial revision or additional analyses, the staff expects to complete the project and provide the proposed final NUREG to the Commission in October 2010.

Enclosures:
1. Revision 4 of the SOARCA Communication Plan
2. SOARCA Project Schedule as of January 27, 2010

cc: SECY
EDO
OGC
OCA
OPA
CFO

Enclosure 1

Communication Plan for the State-of-the-Art Reactor Consequences Analyses (Revision 4)

Overview

The State-of-the-Art Reactor Consequence Analyses (SOARCA) project involves the reanalysis of severe accident consequences to develop a body of knowledge regarding the realistic outcomes of severe reactor accidents. In addition to incorporating the results of over 25 years of research, the objective of the SOARCA study is to include in this updated plant analysis the significant plant improvements and updates (e.g., system improvements, training and emergency procedures, and offsite emergency response) that have been made by plant owners and are not reflected in earlier U.S. Nuclear Regulatory Commission (NRC) assessments. These improvements to plant safety also include those enhancements recently made in connection with security-related events.

This initial phase of the SOARCA project analyzes two plants that are typical examples of the two types of commercial nuclear power plants used in the United States today. The Peach Bottom Atomic Power Station (Peach Bottom) is a boiling-water reactor (BWR) near Lancaster, Pennsylvania, and the Surry Power Station (Surry) is a pressurized-water reactor (PWR) near Newport News, Virginia.

The NRC staff completed a detailed technical evaluation of both Peach Bottom and Surry and provided a summary of the preliminary results to the Commission in March 2009. The draft report is currently undergoing review by an independent peer review panel of subject matter experts. The staff will revise the report to address the peer review panel's comments before initiating internal and external reviews. After all comments have been addressed, the staff will provide the SOARCA NUREG to the Commission for review.

Goals

The goal of the SOARCA project is to determine best estimates of the offsite radiological consequences for severe accidents at U.S. operating reactors using a methodology based on state-of-the-art analytical tools and to present those results using risk communication techniques to achieve informed public understanding of the important factors. These factors include the extent and value of defense-in-depth features of plant design and operation as well as mitigation strategies that are employed to reduce risk. As a result, the SOARCA project will update analyses such as NUREG/CR-2239, "Technical Guidance for Siting Criteria Development," dated November 1982.

Background

To develop information that will help in its regulatory mission to protect the public, NRC has performed several research studies to understand probabilities and potential consequences of severe accidents at nuclear plants. They were based on then existing limited information and

assumptions about how the plants would behave. To improve public understanding, the SOARCA project seeks to produce more realistic and likely estimates.

Over the past 25 years, NRC, industry, and international nuclear safety organizations have completed substantial research on plant response to hypothetical accidents that could damage the core and containment. That research has significantly improved NRC's ability to analyze and predict how nuclear plant systems and operators would respond to severe accidents. During that same time, reactor owners have improved plant designs, these emergency procedures, maintenance programs, and operator training, all of which have enhanced plant safety. Plant owners and local governments also have refined and improved emergency preparedness measures to further protect the public in the event of a severe accident. Often, research has increased our understanding of how radiation exposure affects humans. The SOARCA team applied this accumulated research and incorporated plant enhancements to achieve a more realistic evaluation of consequences from severe nuclear accidents. The results of this research will become the foundation for communicating aspects of severe accidents and updating information from older research studies.

The NRC staff used state-of-the-art information and computer modeling tools to develop best estimates of accident progression and, for scenarios in which accidents proceed to core damage, what radioactive material could potentially be released into the environment. The staff then assessed those releases to realistically estimate the potential consequence to the public. The staff considered the following data in these new analyses:

- Credit for operator actions based on emergency operating procedures, severe accident management guidelines, and post-9/11 and other mitigation measures that were in place at the time of the assessment.
- Design-specific reactor accident sequence progression, taking into account the plant's current design configuration.
- Design-specific potential containment failure timing, location, and size.
- Site-specific emergency planning assumptions, including evacuation and sheltering.
- Site-specific meteorological conditions and updated population data.

The agency has found that a rigorous and realistic evaluation of a few important events provides better and more detailed accident consequence information than a less intense assessment of a larger number of events. With this in mind, the project set technical criteria to determine which scenarios were important and focused its resources accordingly. The project team included scenarios having an estimated core damage frequency of 10^{-6} per reactor year (1 in a million) or greater. Also, containment bypass scenarios having an estimated core damage frequency of 10^{-7} per reactor year (1 in 10 million) or greater were included.

As noted above, the accident analysis for each scenario included credit for operator mitigation actions. Also, to quantify the benefits of the mitigation measures the SOARCA project analyzed

these same scenarios assuming the event proceeded as unmitigated, leading ultimately to an offsite release.

An independent, external peer-review committee will examine the approach and underlying assumptions and results obtained for Peach Bottom and Surry to ensure that they are defensible and state of the art.

Key Messages

General Messages

- In carrying out its mission to protect public health and safety, NRC performs research to determine the risk of commercial nuclear power plant operation to the public. The SOARCA research project realistically estimates the potential consequences to the public given the state-of-the-art understanding of accident phenomena and plant performance under accident conditions and radiation effects on humans.

- The results of this project indicate that reactor safety has improved over the years as a result of efforts by industry to improve plant design and operation and by NRC to develop improved regulations to enhance safety. In addition our understanding of reactor response has improved which has led to predictions of smaller releases.

- The SOARCA individual latent cancer risk values are all significantly smaller than the NRC-established safety goal that "individual members of the public should be provided a level of protection from the consequences of nuclear power plant operation such that individuals bear no significant additional risk to life and health."

- Both mitigated and unmitigated cases predict that essentially no early fatalities will occur and average individual latent cancer fatality risks are very low for the unmitigated scenarios examined.

- Our analyses indicate that potential radiation releases would occur several hours later than earlier thought, and they would be substantially smaller; as a result, our best estimate of early fatalities from severe accidents at nuclear power plants would be far fewer than previously calculated.

- The results of this consequence analysis provide the public, NRC, and other government agencies with a more realistic picture and a better understanding of potential consequences in the unlikely event of an accident.

Additional Key Messages for the Scientific Community

- Information developed from years of research has been incorporated into the tools and the input that NRC uses to evaluate potential accidents. These tools are the Standardized Plant Analysis Risk (SPAR), Method for Estimation of Leakage and Consequence of Release (MELCOR), and (MELCOR Accident Consequence Code System, Version 2 (MACCS2) computer codes. These codes were used to select the

scenarios, model nuclear power plant systems and operator responses to severe accident conditions, and produce a best estimate of consequences to the public.

- This study focuses on those accidents estimated to have a one in a million chance per year or greater of core damage (a core damage frequency of about equal to or greater than 10^{-6} per reactor year). SPAR models were used to identify those potential scenarios for further evaluation.

- In addition, the project placed emphasis on sequences that may be slightly less likely to occur but with the potential for more severe consequences. Containment bypass events have the potential for more severe consequences and, therefore, those bypass sequences estimated to have a 1 in 10 million chance per year or greater to result in core damage (a core damage frequency equal to or greater than 10^{-7} per reactor year) were included within the scope of SOARCA. The project teams used the SPAR models to identify the included potential bypass scenarios.

- Plant-specific MELCOR analyses reflected design-specific features. The MELCOR code modeled the nuclear power plant behavior, the progression of the accident, and the radioactive material released into the environment. This includes the timing of fuel damage, component failures, and releases to the environment.

- Structural analyses determined the expected containment performance during accidents.

- MACCS2 calculations used updated risk information; non-site-specific parameters, site-specific actions, emergency planning, weather data, population data, and evacuation times (including sheltering) to estimate consequences such as individual risk of early fatalities and latent cancer fatalities.

Communication Team

(U) The communication team includes the following members and will be responsible for facilitating communication activities for the SOARCA project:

Team Manager:

- Jimi Yerokun, Office of Nuclear Regulatory Research

Team Members:

- Scott Elkins, SOARCA Project Manager, Office of Nuclear Regulatory Research
- Charles Tinkler, Office of Nuclear Regulatory Research
- Richard Guzman, Office of Nuclear Reactor Regulation
- Scott Burnell, Office of Public Affairs
- Susan Bagley, Office of the Executive Director for Operations
- David Decker, Office of Congressional Affairs

As the project progresses, other NRC staff members are expected to participate in communication activities as needed.

Audiences

External Stakeholders include:

- General public
- Public interest groups
- Media
- Congress
- Licensees
- Nuclear industry organizations (e.g., Nuclear Energy Institute, Institute of Nuclear Power Operations, Electric Power Research Institute)
- Department of Homeland Security and other Federal and State agencies
- State regulators and Agreement States
- International groups

Internal Stakeholders include:

- The Commission
- Advisory Committee on Reactor Safeguards (ACRS)
- NRC staff

Communication Tools

The following tools will be used to communicate with external stakeholders:

Public Website	SOARCA information will be placed on the external Web site.
Questions and Answers	This contains information that highlights aspects of the project that audience members may inquire about. These questions and answers are given at the end of this Communication Plan.
Fact Sheet	A fact sheet will be prepared to provide the public with an overview of the project.
Information booklet	A summary of the SOARCA project will be presented in a separate NUREG/BR booklet using plain language and applying risk communication techniques. This booklet is a tool to enable a high level understanding about risk, for those not interested in technical details. It will be issued after the peer review is completed.
Public Meetings	Meetings will be held to publicly share information at key phases of the project.
Press Releases	A press release will be issued after the peer review is completed and at other times as appropriate. Press releases will be coordinated with the Office of Public Affairs.
Technical Reports	Technical information about the process and results will be

	documented in a NUREG and will be made publicly available through the Agencywide Documents Access and Management System (ADAMS) and the NRC's external Web site. This NUREG is being developed and will be issued after the peer review is completed and public comments have been addressed.
External Briefings	Briefings will be provided to congressional and State stakeholders as requested.
Internal Briefings	Prior to releasing the results, the SOARCA staff will hold briefings for technical staff in NRC regional offices and other interested NRC staff to help prepare them to communicate about the results.

MILESTONES OF COMMUNICATION ACTIVITIES

The following table identifies the planned or actual completion dates for the SOARCA documents.

Action	Finish Date
Semi-annual briefing of Commission TAs	Ongoing
Quarterly briefing of DEDO	Ongoing
Periodic Steering Committee briefing	Ongoing
First review of draft SOARCA NUREG by independent peer reviewers	Completed 07/29/2009
Second review of draft SOARCA NUREG by independent peer reviewers	Completed 09/17/2009
Revise SOARCA NUREG per reviewer comments	Completed 01/19/2010
Third review of draft SOARCA NUREG and draft NUREG/BR by independent peer reviewers	2/9/2010 – 3/20/2010
First review of draft SOARCA NUREG and draft NUREG/BR by NRC Headquarters and Regional Offices	2/9/2010 – 3/20/2010
Distribute draft SOARCA NUREG and NUREG/BR to Surry & Peach Bottom for fact checking	3/29/2010 – 4/11/2010
Incorporate reviewer comments and RES internal review comments	3/11/2010 – 4/20/2010
First review of draft SOARCA NUREG and NUREG/BR by ACRS and OGC (May 2010 ACRS Subcommittee meeting w/ full ACRS meeting in June)	4/26/2010 – 6/10/2010
Incorporate ACRS comments	6/11/2010 – 7/27/2010
Distribute updated SOARCA NUREG and NUREG/BR to NRC HQ and NRC field offices for review	7/28/2010
Review of draft SOARCA NUREG and NUREG/BR by ACRS and OGC (Possible September 2010 ACRS meeting)	7/30/2010 – 9/10/2010
Release draft SOARCA NUREG and NUREG/BR for public review	8/5/2010
Public Meetings at Surry and Peach Bottom NPPs	8/25/2010 – 8/31/2010
Address public comments	8/31/2010 – 10/01/2010
Incorporate ACRS and OGC comments on draft NUREG and NUREG/BR	9/10/2010 – 10/01/2010
RES Mgmt review of final SOARCA NUREG and NUREG/BR	10/4/2010 – 10/22/2010

Action	Finish Date
Brief Steering Committee on final SOARCA NUREG and NUREG/BR	10/22/2010
Proposed final NUREG and brochure to Commission with recommendations	10/29/2010

Evaluation and Monitoring

The communication plan continues to be updated to reflect key ideas being communicated to stakeholders and key decision points in the project's progress. Communication from these venues will be reflected in responses to key questions and ideas during the project's progress. As communications with stakeholders take place, key questions and their responses will be revised and expanded as necessary, based on feedback during stakeholder interactions. New versions of the communication plan will be posted in ADAMS and on the agency's internal Web site list of active communication plans.

Questions and Answers

What is the State-of-the-Art Reactor Consequences Analyses (SOARCA) project?

SOARCA is a research project that develops realistic estimates of the potential public health effects from a nuclear power plant accident where low-likelihood scenarios could release radioactive material into the environment and potentially cause offsite consequences. The project also evaluates and improves, as appropriate, methods and models for realistically evaluating both the plant response during such severe accidents and the potential public risk including evacuation and sheltering.

Why is the U.S. Nuclear Regulatory Commission (NRC) performing this study?

NRC is doing this study to develop the most realistic evaluations possible for the potential consequences of severe nuclear accidents. Over the years, NRC, industry, and international nuclear safety organizations have completed substantial research on plant response to hypothetical accidents that could damage the core and containment. The results have significantly improved NRC's ability to analyze and predict how nuclear plant systems and operators would respond to severe accidents. Also, plant owners have improved the plant design, emergency procedures, maintenance programs, and operator training, all of which have improved plant safety. Emergency preparedness measures also have been refined and improved to further protect the public in the highly unlikely event of a severe accident. Combining all of this new information and analysis will improve the realism of accident consequence evaluations.

How will this study be different from earlier studies?

The SOARCA project will:

- Use an improved understanding of source terms and severe accident phenomenology.
- Credit the use of severe accident mitigation strategies and procedures.
- Use updated emergency preparedness modeling.
- Account for plant improvements.
- Use modern computer resources and advanced software to yield more accurate results.

In addition, the SOARCA project is designed to be a more realistic estimate. Some of the earlier studies also were designed to be best estimates; however, because they were limited by the available knowledge of accident phenomenology, these older studies were conservative (particularly the very improbable severe accidents) in their estimates of off-site releases and early fatalities. The SOARCA project will provide the latest basis from which the public and decision makers can assess the consequences of severe reactor accidents.

What are the potential uses of the SOARCA study?

The overarching purpose of this study is to provide more realistic information about potential nuclear power plant consequences to the public and other stakeholders including Federal, State, and local authorities. This study also will increase understanding of the value of defense-in-depth features of plant design and operation, including the use of mitigative strategies.

What consequence measures are being estimated?

This study assesses the health effects of a potential radiation release to the general public. State-of-the-art analytical models estimate the individual risk of prompt fatality and latent cancer fatality that could occur in the remote event that a severe reactor accident occurs. Prompt fatalities are those resulting from exposure to very high doses of radiation as the result of a release. These fatalities occur days to months after exposure. Latent cancer fatalities are those resulting from the long-term effect of radiation exposure. The estimates of public health effects in this new study realistically account for the emergency planning measures in place at each reactor site, unlike some of the past studies that used generic assumptions.

The results from both mitigated and unmitigated cases predict that essentially no early fatalities will occur and average individual latent cancer fatality risks are very low for the unmitigated scenarios examined.

Which plants are participating in the SOARCA project?

The first phase of SOARCA analyzes examples of two major types of nuclear reactor in the United States: (1) Peach Bottom Atomic Station, a boiling-water reactor (BWR) in Pennsylvania, and (2) Surry Nuclear Power Plant, a pressurized-water reactor (PWR) in Virginia. After the first phase has been completed, NRC will consider whether analyses are needed for other reactor types and sites.

Does this study consider new reactors that may be built?

No. New reactor designs and containments are not part of the project. The project analyzes existing reactors.

Are terrorist acts, such as aircraft impacts, being analyzed as part of SOARCA?

No. The focus of this study is on accident scenarios—not terrorist-related ones—that could potentially lead to a radiological release into the environment. NRC addresses security-related events in a separate, nonpublic analysis.

Are accidents at spent fuel pools considered in this study?

No. This study does not consider spent fuel pools. The project is focused on evaluating the severe and very unlikely reactor core accidents that may occur at operating power reactors.

Why are the early fatality numbers different from the results predicted by earlier research?

NRC is providing the most realistic, most accurate estimates calculated to date. When NRC published previous studies, the available analytical methods and data about nuclear plant operation were cruder and the source terms for offsite releases were generally larger for the risk important scenarios. Since then, NRC and the industry have improved safety and mitigation measures in the plants. In addition, NRC has improved methods to calculate consequences. Therefore, the SOARCA project is an update to the previous research based on the information known today.

How much different would the numbers be if NRC did the calculations the same way they were done in the past?

So many things have changed in the source terms and consequence analyses that it is not obvious what few parameters to change to provide a "comparison" to past analyses. A detailed report (available through Agencywide Documents Access and Management System [ADAMS]) will describe the justifications for the changes in both input values and calculation methods—regardless of their impact on the final number.

Why does NRC report individual latent cancer fatality risk from the selected scenarios and not total cancer fatalities?

Reporting the individual latent cancer fatality risk from the selected scenarios promotes better understanding and meaning to individuals. Latent cancer fatality risk from the selected scenarios provides easier comparison to other kinds of cancers and context to what the accident scenarios mean to individuals. The U.S. Environmental Protection Agency and others also commonly use individual latent cancer fatality risk as a way to report consequences from scenarios.

If I live within one of the reported distances in the results of SOARCA, how do I interpret my specific risk relative to the average value reported?

The human health risks calculated in SOARCA are very small. To interpret the average individual cancer risk results from SOARCA, it is helpful to consider the NRC safety goal for cancer risk of 2 in 1 million per year. The average individual cancer risks calculated in SOARCA within the 10-mile emergency planning zone are all in the 1 in a billion to 1 in a 100 billion per year range. The average individual risk numbers decrease the further the distance out from the plant (e.g., 50 and 100 miles). The SOARCA cancer risk values are all significantly smaller than the NRC-established safety goal that "individual members of the public should be provided a level of protection from the consequences of nuclear power plant operation such that individuals bear no significant additional risk to life and health."

Is this study being reviewed by outside experts?

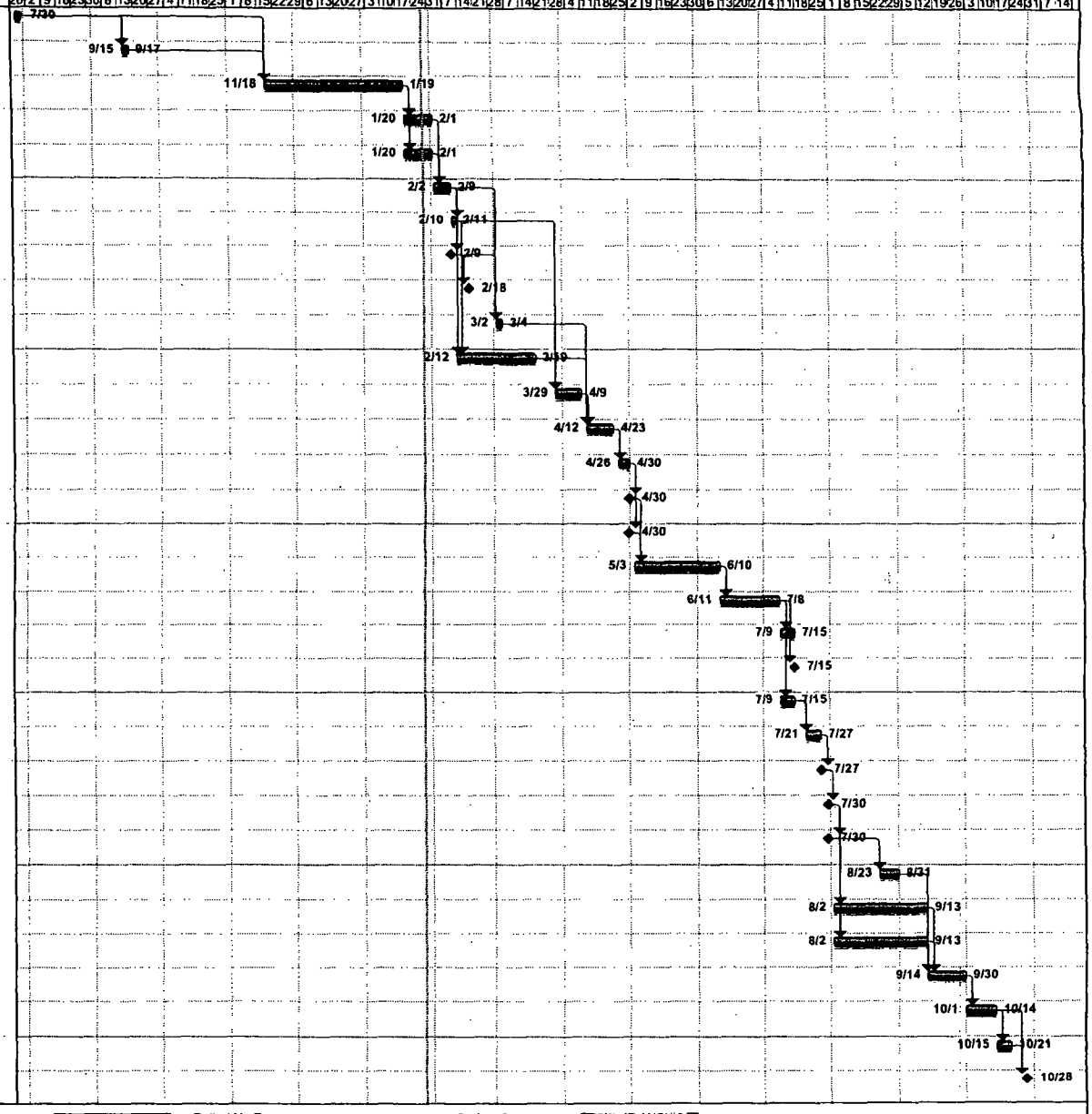
Yes. In addition to the peer review afforded by NRC's Advisory Committee on Reactor Safeguards (ACRS), an independent external peer review of scientific and technical experts has assessed the methods used in this study, its underlying assumptions, and results

obtained for Peach Bottom and Surry to ensure that they are defensible and state of the art. This peer review cycle is a common practice in research and is used to identify the strengths and weaknesses of the techniques used in this research project and improve the final output of this task as well as future research activities. This type of independent assessment helps the agency produce a superior product in a more efficient manner.

Enclosure 2

SOARCA NUREG and NUREG/BR Review and Approval Process

ID	Task Name
1	First mtg of Peer Reviewers to review SOARCA NUREG
2	Second mtg of Peer Reviewers to review SOARCA NUREG
3	Incorporate Peer Review Comments into Vol 1 & 2
4	Technically edit SOARCA NUREG - Rev. 1
5	NRC technical review of SOARCA NUREG Rev. 1
6	Incorporate NRC Technical Comments
7	DSA Mgmt review of draft SOARCA NUREG
8	Send SOARCA NUREG Rev. 1 to Peer Review Comm
9	Brief Commissioners' TAs
10	Third mtg of Peer Reviewers to review SOARCA NUREG
11	Internal NRC review of SOARCA NUREG Rev 1
12	Fact-Check of NUREG, NUREG/CR, NUREG/BR by plants
13	Incorporate comments from Peer Reviewers, NRC, & plants
14	Review of NUREG Rev. 2 by DSA Mgmt & Steering Comm
15	Issue SOARCA NUREG Rev.2 to ACRS for review
16	Issue SOARCA NUREG Rev. 2 to OGC for review
17	Review of Draft SOARCA NUREG by ACRS & OGC
18	Incorporate ACRS & OGC Comments
19	Review of NUREG Rev 4 by DSA Mgt & Steering Comm
20	Brief EDO's Office on Status of SOARCA NUREG
21	NRC Regional Office Review of Rev 3
22	Incorporate comments from reviewers
23	Review of NUREG Rev 3 by DSA Mgt & Steering Comm
24	Brief RES Mgmt on Rev 3
25	Release SOARCA NUREG for public review
26	Public Meetings at Surry & Peach Bottom
27	Submit Final SOARCA NUREG to ACRS for review
28	Submit final SOARCA NUREG to OGC for review
29	Incorporate ACRS & OGC Comments
30	RES Mgmt review of final SOARCA NUREG
31	Brief Steering Committee on final SOARCA NUREG
32	Present final SOARCA NUREG to Commission



Project: SOARCA NUREG Schedule 1
Date: Thu 1/28/10

Task		Summary		Rolled Up Progress		Project Summary	
Progress		Rolled Up Task		Split		Group By Summary	
Milestone	◆	Rolled Up Milestone	◇	External Tasks		Deadline	⇩