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October 26, 2011
Contract No. NRC–02–07–006
Project No. 14004.05.001
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SUBJECT: Rev 2, Chg 1—Operations Plan for Technical Assistance in Calvert Cliffs Independent Spent Fuel Storage Installation License Renewals

Dear Mrs. Whipple:

As requested in the interim guidance for fiscal year 2012, enclosed are the change pages to the Rev 2, Chg 1 for the Center for Nuclear Waste Regulatory Analyses (CNWRA®) Operations Plan for Technical Assistance in Calvert Cliffs Independent Spent Fuel Storage Installation License Renewals. Only the spending plans have been revised to incorporate the new provisional overhead rates. CNWRA will revise the operations plan when additional tasks are identified.

If you have any questions concerning the contents of the subject plan, please contact Dr. Todd Mintz at (210) 522-5282 or me at (210) 522-5252.

Sincerely yours,

Budhi Sagar
President

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Enclosure

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OPERATIONS PLAN FOR TECHNICAL ASSISTANCE IN CALVERT CLIFFS INDEPENDENT SPENT FUEL STORAGE INSTALLATION LICENSE RENEWALS

Prepared for

U.S. Nuclear Regulatory Commission
Washington, DC

Prepared by

Geosciences and Engineering Division
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October 2011

Approved by:

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Vice President
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CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES	Revision: 2 Change: 1 Date: October 26, 2011

Title: OPERATIONS PLAN FOR TECHNICAL ASSISTANCE IN CALVERT CLIFFS INDEPENDENT SPENT FUEL STORAGE INSTALLATION LICENSE RENEWALS

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iii through v	0	08/04/2011
1-1	0	08/04/2011
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Spending and Labor	1	11/09/2011
Résumés	0	08/04/2011

Supersedes: Rev 2 Chg 0—July 21, 2011

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1 INTRODUCTION

This section provides information regarding (i) the statutory authority and regulatory foundation for U.S. Nuclear Regulatory Commission (NRC) licensing activities within the Division of Spent Fuel Storage and Transportation (SFST) and (ii) the purpose of the Center for Nuclear Waste Regulatory Analyses (CNWRA®) in supporting the NRC SFST on projects related to its charter.

1.1 Statutory Basis for the Scope of Work

The Atomic Energy Act of 1954 established the policy basis for regulating the development, use, and control of nuclear energy in a manner that would maximize its contribution to the general welfare of the nation, promote peace, and ensure the health and safety of the public and workers in affiliated industries. Although the responsibilities for developing and regulating nuclear energy were initially vested in a single entity—the Atomic Energy Commission—the need to separate these functions was recognized and fulfilled in the Energy Reorganization Act of 1974. As a result of this statute, NRC was established in 1974 and given authority to establish and enforce regulations for the issuance of licenses to receive, possess, use, transfer, or deliver source and byproduct materials.

The Energy Reorganization Act gave NRC broad licensing authority for all commercial or private activities involving radioactive materials. Commercial facilities subject to NRC licensing include (i) utility-operated independent spent fuel storage installations (ISFSIs) at individual power reactor sites, (ii) ISFSIs that may not be colocated with power reactors, (iii) privately developed centralized interim storage facilities, (iv) single- and multiple-purpose casks associated with such facilities, (v) related transfer equipment and facilities, (vi) packaging and transportation of nuclear materials, and (vii) commercial transportation and storage cask design. In addition, the Nuclear Waste Policy Act specifically requires that NRC licenses any monitored retrievable storage system the U.S. Department of Energy (DOE) develops. NRC performs licensing actions for such storage facilities in accordance with 10 CFR Part 72, and NRC transportation regulations are defined in 10 CFR Part 71.

The technical assistance tasks to be authorized under this proposal address the review of the license renewal for Calvert Cliffs ISFSI.

1.2 Center for Nuclear Waste Regulatory Analyses

CNWRA was established in 1987 as an NRC-sponsored, federally funded research and development center. The mission of CNWRA is to provide sustained high-quality technical assistance and research in support of the NRC high-level waste and spent fuel management program. CNWRA was charged with developing and maintaining an organization that possesses high technical competence characterized by permanence, stability, and capability to provide independent objective recommendations on complex technical issues. The management and organization of CNWRA is detailed in Section 3 of this operations plan.

CNWRA will provide technical assistance to SFST to support the review of the license renewal application and Safety Analysis Report (SAR) for Calvert Cliffs ISFSI.

2 TASK DESCRIPTIONS

The description of each task includes task-specific objectives, scope, technical approach, deliverables, and schedule and travel requirements.

2.1 Calvert Cliffs Independent Spent Fuel Storage Installation License Renewal

2.1.1 Objectives

The CNWRA staff will support NRC SFST staff in the review of the license renewal application and SAR of an ISFSI at Calvert Cliffs. The CNWRA staff will help NRC SFST staff (i) prepare requests for additional information (RAIs), (ii) review applicant responses to RAIs, (iii) develop the Safety Evaluation Report (SER), (iv) develop revised technical specifications for the Calvert Cliffs ISFSI, and (v) perform confirmatory analyses, as appropriate with prior approval of NRC project element manager (PEM).

2.1.2 Scope

Technical review of the Calvert Cliffs ISFSI license renewal application and SAR as well as preparation of the SER will be in accordance with the requirements of 10 CFR Part 72; NUREG–1536 (Standard Review Plan for Dry Cask Storage Systems) and NUREG–1567 (Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors); and staff guidance, including the draft standard review plan for ISFSI license renewals. An important aspect of the CNWRA staff review will be the evaluation of the potential effects of component aging on the performance of structures, systems, and components (SSCs) important to safety (ITS). The CNWRA staff will review the effect of component aging on (i) the structural design and performance of the fuel canister and concrete overpack; (ii) shielding, criticality, and confinement systems; (iii) sealing systems; and (iv) loading/unloading compatibility with wet and dry spent fuel loading.

The CNWRA staff will discuss with NRC SFST staff the depth of review in each area and the need for confirmatory analyses prior to development of the draft SER. The CNWRA staff will review the license renewal application and SAR and provide input for a draft SER. This draft will include potential deficiencies in the SAR, including information about RAIs according to SFST Office Instructions 2 and 4. CNWRA staff may also contribute to the drafting of revised technical specifications for the ISFSI renewal. The CNWRA staff will review the applicant's responses to RAIs, which could provide additional input to the draft SER. To ensure regulatory consistency, CNWRA staff may review the SERs and RAIs from other recent NRC SFST license renewal applications.

As part of the ISFSI license renewal process, the CNWRA staff will attend teleconferences and public meetings with the applicant, resolve technical comments, and if necessary, provide support during the adjudicatory process and expert testimony. As discussed with NRC management, CNWRA project participants will attend a project-kick off meeting with NRC staff with the objective of clearly understanding NRC expectations and also for receiving any required training.

2.1.3 Technical Approach

Based on the regulatory requirements from 10 CFR Part 72 and associated staff guidance, the CNWRA staff will conduct the reviews using some or all of the following approaches, as needed.

- Principal Design Criteria. Review and evaluate whether (i) the design criteria stated in the SAR are acceptable for the external conditions during normal and off-normal operations, design-basis accident conditions, and natural phenomena events; (ii) the design criteria properly incorporate the potential effects of aging components in the evaluation; (iii) the limiting characteristics of spent nuclear fuel (SNF) to be stored are acceptably defined; and (iv) the SAR adequately identifies the SSCs, and the equipment and controls ITS.

- Structural Components. Review and evaluate whether the confinement, subcriticality, and radiation shielding requirements for the stored materials are appropriately maintained by the aged structural components under credible loads for normal and off-normal conditions, design-basis accidents, and natural phenomena (i.e., accident-level) events.

- Thermal. Review and evaluate whether the SSCs ITS and the fuel material temperatures remain within the allowable values or criteria for normal, off-normal, and design-basis accident conditions, considering aged components. This review will evaluate whether (i) acceptable cladding temperatures are properly maintained throughout the storage period at the ISFSI; (ii) adequate decay heat removal is allowed under normal, off-normal, and accident conditions; (iii) fire protection measures are adequate; and (iv) acceptable analytical and/or test methods are used to analyze the thermal design, among others.

- Shielding. Review and evaluate whether the shielding features of the aged structural systems and components adequately protect against direct radiation from the cask contents, and whether the dose to the operating staff and public from direct radiation remains within regulatory limits during normal operating, off-normal, and design-basis accident conditions.

- Criticality. Review and evaluate whether the nuclear material will remain subcritical under normal, off-normal, and design-basis accident conditions during all operations, transfers, and storage at the site. Evaluate the effects of aging on the criticality system.

- Confinement. Review and evaluate whether (i) the aging of the confinement system, including the sealing system adversely affects the confinement of the components; (ii) radiological releases to the environment are estimated and are within the limits established by the regulations; (iii) public exposures to radiation resulting from the installation are estimated and are within regulatory limits for normal and accident-level events and conditions, and will remain as low as reasonably achievable (ALARA); and (iv) SNF cladding and fuel assemblies are protected during storage against degradation caused by the environment.

- Radiation Protection. Review and evaluate whether (i) the design features of the facility will meet NRC criteria for exposures to direct radiation; (ii) the ISFSI facility radiation protection program for occupational exposures to workers is consistent with NRC radiation protection standards; (iii) the radiation doses to the general public will meet regulatory standards during normal, off-normal, and design-basis accident situations; and (iv) doses to workers and members of the public will be ALARA.

- Operating Controls and Limits. Evaluate the acceptability of the operating controls and limits or the technical specifications (including bases and justifications) that the applicant has established.

During the review of Calvert Cliffs ISFSI, the CNWRA staff may, propose and if approved by the NRC PEM, conduct selected independent analyses to confirm the applicant conclusions. The scope of these analyses will be determined in consultation with the NRC, taking into consideration the schedule and cost. If needed, CNWRA staff will use codes such as ABAQUS, SAP2000, and LS-DYNA for mechanical, structural, or thermal calculations. For radiation shielding, criticality, or atmospheric release calculations, CNWRA will utilize common industry-accepted codes, such as MCNP5 and SCALE. The CNWRA staff will use applicable design codes and standards, such as the American Concrete Institute (ACI), American Institute of Steel Construction (AISC), and American Society of Mechanical Engineers (ASME).

2.1.4 Milestones and Schedule

Table 2-1 presents a schedule of milestones for the Calvert Cliffs license renewal. Additional milestones related to the adjudicatory process will be identified and prepared in coordination with the NRC PEM. The CNWRA input to the NRC staff positions on contentions will be delivered as administrative items. CNWRA staff participation in the preparation for hearings and in the hearings will be managed according to guidance from the Office of the General Counsel (OGC). Any required revision to deliverable dates will be coordinated with NRC PEM.

Table 2-1. Milestones for Calvert Cliffs Independent Spent Fuel Storage Installation License Renewal Activities

Number	Type	Milestone	Date*
14004.05.001.101	AI†	Kick-off meeting and training session	TBD‡
14004.05.001.102	AI	Recommendation on the depth of review and the need for confirmatory calculations in the Calvert Cliffs ISFSI—Teleconference or Face-to-Face Meeting	Start Date +1.0 months§
14004.05.001.103	AI	RAIs, Calvert Cliffs ISFSI—Draft Letter Report	Start Date +2.0 months
14004.05.001.104	AI	Identification of major technical issues in the Calvert Cliffs ISFSI—Email Letter	Start Date +2.5 months
14004.05.001.105	IM	RAIs, Calvert Cliffs ISFSI—Final Letter Report	Start Date +3.0 months
14004.05.001.111	AI	Second round RAIs, Calvert Cliffs ISFSI (if needed)—Draft Letter Report	First round of RAIs +4 months
14004.05.001.112	IM‖	Second round RAIs, Calvert Cliffs ISFSI (if needed)—Final Letter Report	First round of RAIs +4.5 months
14004.05.001.113	AI	Calvert Cliffs ISFSI SER—Draft Letter Report	Receipt of NRC comments on draft SER +0.5 months
14004.05.001.114	AI	Presentation of the SER to an NRC Peer Review Group	TBD
14004.05.001.115	IM	Calvert Cliffs ISFSI SER—Final Letter Report	Receipt of NRC comments on draft SER +1.5 months

*The schedule is subjected to approval by SFST management
†Administrative Items are generally submitted without quality assurance reviews
‡To be determined
§The start date corresponds to the receipt of the license application and supporting materials
‖Intermediate Milestones are submitted after quality assurance reviews

2.1.5 Travel

The anticipated travel requirements for fiscal year 2011 are summarized in Table 2-2. The travel cost estimates by task are presented in the spending and labor plans section. These data are best estimates of the nature and scope of the required travel. Actual travel requirements may change during the review process.

Table 2-2. Travel Requirements for Calvert Cliffs Independent Spent Fuel Storage Installation License Renewal

Fiscal Year	Destination	Number of Trips	Number of Travelers	Trip Duration, Days
2011	Washington, DC	1	3	2
2011	Washington, DC	4	5	5

CNWRA staff trips will be limited to those approved in advance by the NRC contracting officer and that are directly related to this project description. All travel will be coordinated with the NRC PEM.

3 MANAGEMENT AND ORGANIZATION

In 1987, CNWRA was established as an NRC-sponsored federally funded research and development center, identified within Southwest Research Institute® (SwRI®) as Division 20. In 2005, with NRC approval, Division 20 was reorganized as the Geosciences and Engineering Division (GED), and a separate Department of Earth, Material, and Planetary Sciences was formed. CNWRA remains a separate business entity and forms an autonomous department within SwRI Division 20. The CNWRA president reports directly to the GED vice president. In turn, the division vice president reports to the SwRI president, who provides general direction to and broad oversight of the CNWRA operations and monitors all aspects of its performance (Figure 3-1). Because CNWRA staff will manage and conduct the activities in this operations plan, the following sections focus on the management and organizational structure of CNWRA.

3.1 Organizational Structure and Responsibilities

CNWRA deploys its personnel in a matrix management approach. Staff members are located in specific elements of the line organization but are assigned in a matrix fashion to work on the various projects and tasks CNWRA undertakes on behalf of NRC and other clients (Figure 3-2). This matrix approach provides maximum flexibility for conducting the diverse scope of work within the resource and schedule constraints of the various projects and tasks. CNWRA has used this structure for a number of clients during times of major programmatic change, and the structure has demonstrated our ability to provide highly responsive and effective application of personnel to accomplish assigned scopes of work.

Although CNWRA can accommodate various modes of interactions with a particular client based on the character of the work and the needs and interests of that client, a ladder of communication is generally advocated. Table 3-1 defines a proposed ladder of communication for this project. Although not intended to restrict other avenues of communication, the ladder identifies the minimum appropriate points of contact to effectively implement contractual provisions and to ensure technical direction, final product reviews, and concerns are brought to the attention of the appropriate individuals within each organization.

The basis for management control of all CNWRA projects is a set of technical, schedule and cost, and quality objectives that are established in general terms in the NRC-approved CNWRA Management Plan. Once approved, the content of this operations plan will establish specific technical, schedule and cost, and quality baselines. Management controls currently in place will also be applied to this project, as needed, to ensure conformance to project-specific baselines, taking into consideration that the CNWRA technical staff will be detailed to appropriate SFST branch chief. Adherence to technical scope and quality baselines will be addressed through ongoing interactions with NRC and between the CNWRA management and staff. As discussed in Section 3.5, the NRC-approved quality assurance (QA) program will ensure that all products delivered to NRC under this contract have received appropriate technical, programmatic, and QA reviews in accordance with QA Procedure–002, Review of Documents, Reports, and Papers. The CNWRA management will monitor deliverable schedules weekly using the deliverables management system. Costs will be evaluated at the task level biweekly and addressed in detail every 4 weeks. Significant variances between planned and actual costs will be reported to NRC in the Program Manager's Periodic Report (PMPR) and discussed with the appropriate staff. Progress toward completing deliverables will be tracked, technical issues will be discussed, and problems will be identified in the PMPR for each task. This QA program will be accommodated without impacting deliverable schedules.

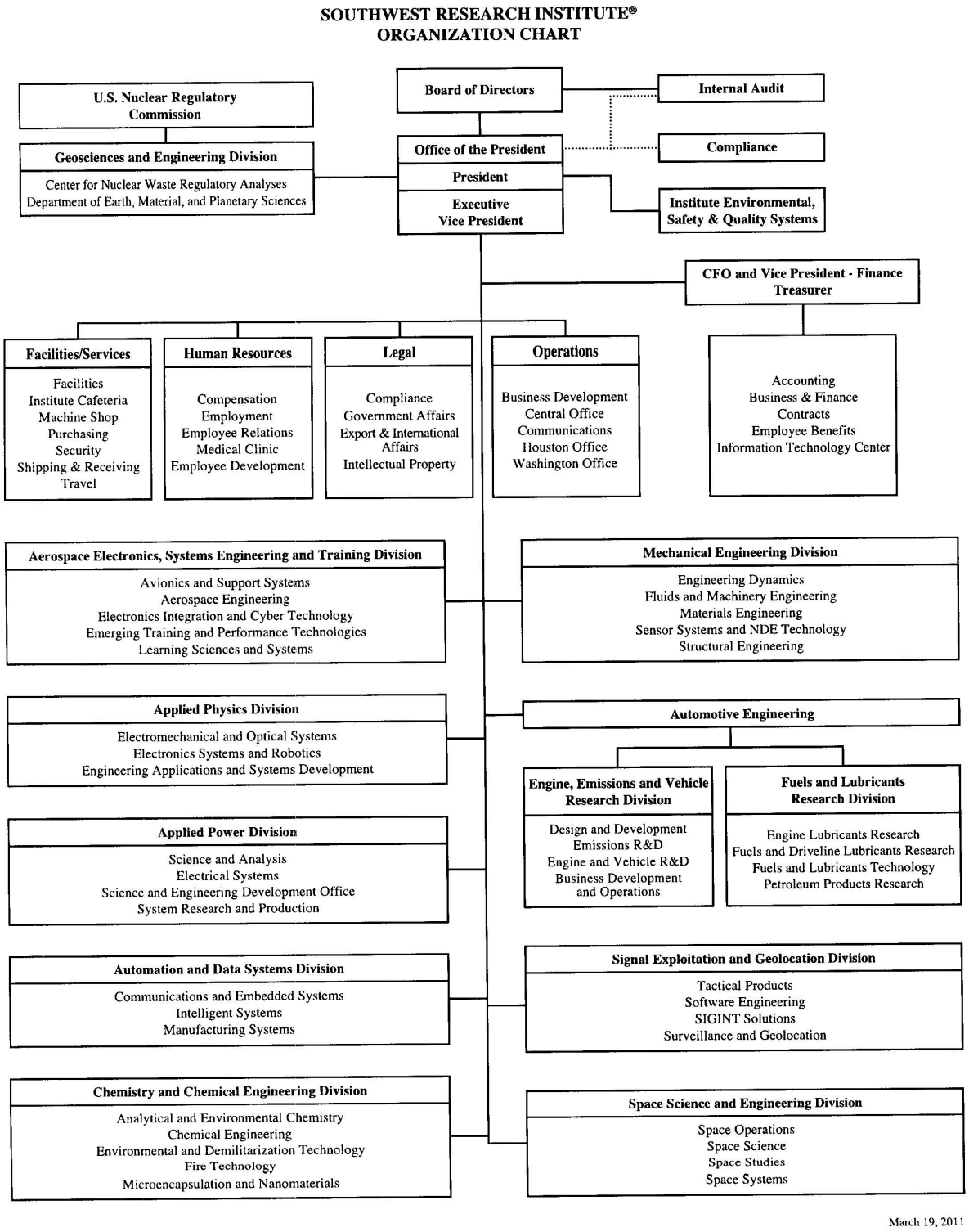

Figure 3-1. Organization of Southwest Research Institute® and Relationship with Geosciences and Engineering Division

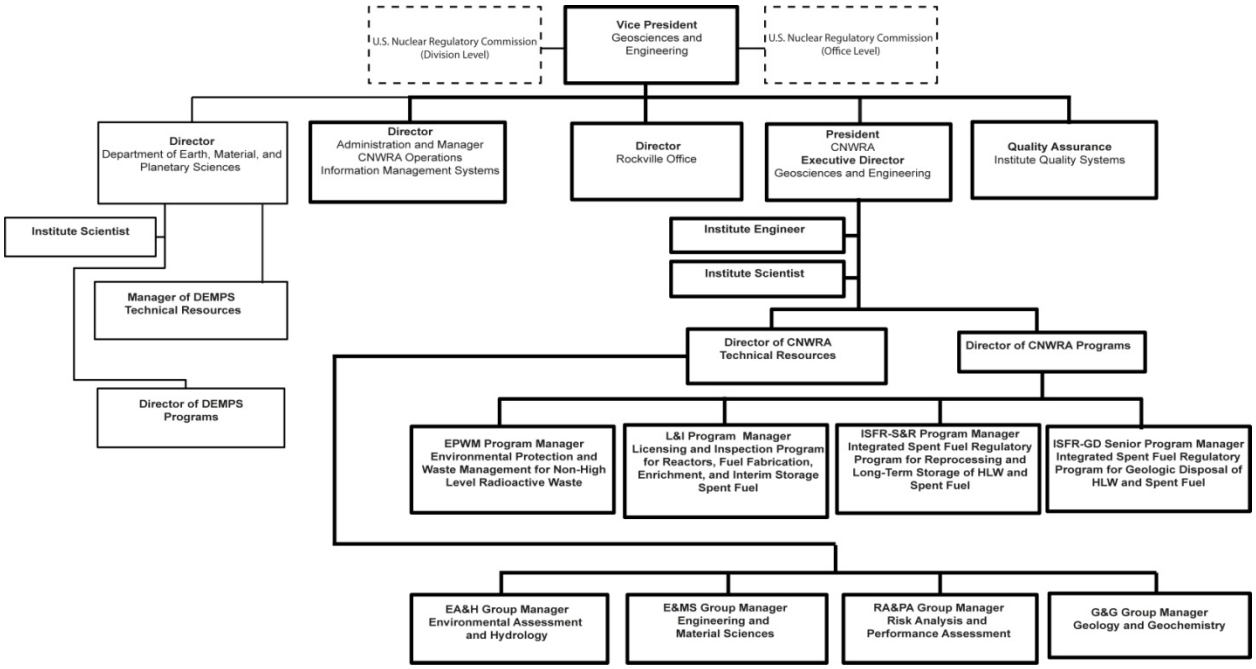

Figure 3-2. Organization of Geosciences and Engineering Division and Center for Nuclear Waste Regulatory Analyses

Table 3-1. Ladder of Communication for the Calvert Cliffs Independent Spent Fuel Storage Installation License

U.S. Nuclear Regulatory Commission (NRC) Point of Contact	Center for Nuclear Waste Regulatory Analyses Counterpart
Deputy Director, Spent Fuel Storage and Transportation (SFST) Division	Director of CNWRA Programs
NRC Contracting Officer	Director of Administration
Program Management, Policy Development, and Analysis Staff Project Manager	Licensing and Inspection Program Manager
SFST Project Element Manager	Licensing and Inspection Program Manager
SFST Technical Monitor	Licensing and Inspection Program Manager/Principal Investigator

CNWRA will address changes in the scope of work—either directed by NRC or necessary because of cost variances—in accordance with Administrative Procedure (AP)–009, Work Authorization and Control. These techniques have proven effective for avoiding cost growth in previous NRC work assignments.

Details about management and organization are provided in the CNWRA Management Plan. A current version is available from the NRC contracting officer. Lessons learned from ongoing operations, input received from management oversight groups, changes in staffing requirements, and suggestions for improving the organizational structure are evaluated and incorporated annually in revisions to the CNWRA Management Plan.

3.2 Staffing and Key Personnel

CNWRA will provide the services of staff who has knowledge of NRC practices for licensing activities associated with 10 CFR Parts 71 and 72 for license renewals and with IAEA Safety Standard TS–R–1 for DOT revalidation of foreign transportation packages.

The key CNWRA personnel for this project are as follows:

- Dr. Todd Mintz (Program Manager; Licensing and Inspection Programs) will serve as project manager for this project. In this capacity, he will be fully responsible for all technical, schedule, cost, and quality aspects of the project. He will be in frequent contact with NRC PEM either by telephone or in person through visits to the NRC headquarters. Dr. Mintz has extensive experience in license renewal activities associated with nuclear power plants and in managing regulatory review projects.

- Dr. Asad Chowdhury (Staff Engineer; Engineering and Materials Sciences Group) will serve as principal investigator for this project. Dr. Chowdhury has extensive experience as a structural engineer. Dr. Chowdhury has been involved in many license review activities related to onsite dry storage systems. Dr. Chowdhury has an NRC Q clearance.

- Dr. Yi-Ming Pan is the program manager in the Integrated Spent Fuel Regulatory Program for Reprocessing and Long-Term Storage of High Level Waste and Spent Fuel. Dr. Pan will lead the review related to materials engineering. He has extensive experience in performing technical assessments for various nuclear safety programs, including experience with material aging review in license applications for the Office of Nuclear Reactor Regulation. He has expertise in materials processing and characterization, predicting corrosion and degradation behavior of aged materials.

- Dr. Earl Lynn Tipton is a research engineer in the Performance Assessment Group, Engineering and Systems Assessment Section and will lead the review on criticality and shielding design. Dr. Tipton is a nuclear engineer and has familiarity with running the MCNP5 and SCALE codes. He has expertise in transport theory, kinetic theory of gases, and computational methods. His experience includes research in very high temperature reactors, computation of high-order approximations for transport coefficients of gas mixtures (viscosity, thermal conductivity), and experimental measurement of the thermal transpiration effect for gas mixtures.

- Dr. Thomas E. Wilt is a senior research engineer in the Mining, Geotechnical, and Facility Engineering Group and will lead the review on heat transfer and containment analysis. Dr. Wilt has more than 20 years' experience in the field of computational mechanics. His experience spans constitutive modeling of a variety of materials such as metals at high temperatures and composites. Dr. Wilt's extensive experience includes thermomechanical modeling, composite micromechanics, and large-scale life prediction computations. He has experience in ABAQUS and LS-DYNA modeling.

More information about the CNWRA key personnel can be found in the professional data sheets section. If additional key personnel are necessary, individuals will be identified based on their education and experience relative to the work scope and will work under the direction of Dr. Todd Mintz, who is the project manager for this task. Dr. John Stamatakos

(Director of CNWRA Programs); Dr. Budhi Sagar (President, CNWRA); and Dr. Wesley Patrick (Vice President, Geosciences and Engineering Division) will provide management oversight.

3.3 Consultants and Subcontractors

Specialized skills may occasionally be needed to ensure that all critical aspects of the tasks are addressed. When these cases arise, CNWRA will augment its core staff to the extent appropriate with other skilled staff. Sources will include other divisions of SwRI, independent consultants, and subcontractors. When required, subcontracts will be established in accordance with AP–001, Source Selection and Evaluation, and applicable SwRI Operating Policies and Procedures. The NRC contracting officer has a current version of applicable procedures available for inspection. Selection and assignment of subcontractors to specific activities will be based on consideration of technical expertise, availability in the context of the schedule and priority of work, and freedom from potential conflict of interest (COI) for the assigned scope of work. Once assigned, any subcontractor(s) will report to the CNWRA project manager or principal investigator, as appropriate. Required consultant agreements will be established in a similar manner. Selection and assignment of particular individuals will be based on consideration of technical expertise, availability in the context of the schedule and priority of the work, and freedom from potential COI for the assigned scope of work. Once assigned, any consultant(s) will report to the CNWRA project manager or principal investigator, as appropriate.

3.4 Support Facilities and Services

A wide range of SwRI administrative and technical support services is available to help CNWRA conduct this project (on a regular or as needed basis). These services include, but are not limited to

- SwRI Human Resources department services, including recruiting and hiring core staff and securing consultants and subcontractors
- SwRI Quality Systems department services, including annual oversight review concerning the implementation of CNWRA QA requirements
- Legal counsel and general administrative services, including payroll, employee benefits, internal auditing, accounting financial data systems, contracts, purchasing, inventory control, and mail collection and distribution
- Physical and information security, including protection of classified, predecisional, and company confidential materials; an electronic communications firewall
- Safety, health, and fire protection, including radiological health and safety
- Professional support services, including library, photographic laboratory, machine shop, publication services, telecommunication and videoconferencing, and computer systems
- Communications department, including editorial services, and assistance in public affairs matters in accordance with AP–004, Public, Media, Organizational, and Congressional Inquiries

- Access to all SwRI facilities, laboratories, equipment, buildings, and other physical assets, as required

A statement of qualifications (SOQ) is available for the NRC staff to review in the Division of High-Level Waste Repository Safety. The SOQ contains information regarding the CNWRA staff expertise and experience, facilities, and equipment. Scientific and engineering areas of special competency are also described in the SOQ.

3.5 Quality Assurance

Implementation of an appropriate QA program is important to the successful accomplishment of the technical and programmatic objectives of the proposed change. GED has established a QA manual that describes and implements a program designed to be compliant with applicable NRC regulations. The QA manual, associated QA procedures, technical operating procedures (TOPs), and APs comprise the policy and implementation components of the QA program that will provide confidence in the results of the CNWRA work conducted under this operations plan. The NRC contracting officer maintains copies of these documents.

QA will be implemented by applying the criteria set forth in the QA manual. Procedures governing reviews of CNWRA documents are contained in QAP–002, Review of Documents, Reports, and Papers, and results of reviews are maintained as QA records. The requirement and rationale for NRC-requested revisions and associated scope of changes will be documented in technical direction from NRC to CNWRA and in CNWRA transmittal letters to NRC that will accompany revised documents.

Existing computer programs that have been verified and have precedent of use by NRC will be used whenever possible to perform any computer-generated calculations required. The CNWRA project manager will inform the NRC project element manager of the names and version numbers of computer programs that will be used. Computer codes used for calculations will be controlled in accordance with TOP–018, Development and Control of Scientific and Engineering Software. QAP–014, Documentation and Verification of Scientific and Engineering Calculations, will be applied to the appropriate project activities, including specification of responsibilities of document technical reviewers for verifying calculations. Other procedures will be used to control technical studies as appropriate.

3.6 Management Oversight and Controls

SwRI will use three principal means to provide management oversight of the CNWRA performance on the proposed contract. The GED vice president provides primary management oversight for overall CNWRA performance. This responsibility is executed by frequent meetings with the CNWRA president, regularly scheduled meetings with the SwRI president and other SwRI vice presidents, frequent informal communication, and periodic formal reviews of CNWRA. In addition, the SwRI Quality Systems Department reports directly to the SwRI president and gives management oversight in quality-related matters. The CNWRA Advisory Board provides management oversight independent of SwRI. This board, which advises the SwRI and CNWRA presidents and division vice president, is composed of recognized leaders from industry, government, and academia.

In addition, it is anticipated that NRC will provide three sources of oversight, control, and evaluation. The NRC program element manager and staff supply the first, in accordance with

provisions of NRC Contract No. NRC 02–07–006. The second, provided by the NRC Center Review Group, will continue to monitor and appraise the overall performance of CNWRA. This includes assessment of the CNWRA ability to fully satisfy requirements of the NRC high-level waste contract and work for others, including the proposed contract. The third is the evaluation of individual products and deliverables supplied to NRC under the proposed contract and compliance with schedule and cost baselines that the NRC program element manager and other appropriate NRC technical staff ascertain on an ongoing basis.

4 SPENDING AND LABOR PLANS

Cost estimates for technical assistance to the Division of Spent Fuel Storage and Transportation are provided on the basis of thirteen 4-week periods per fiscal year. Planned expenditures are summarized. Estimated labor requirements are also provided.

SPENDING AND LABOR PLANS

DRAFT

Spending Plan FY2012

Rev 2 Chg 1
10/21/2011

14004.05.001 Calvert Cliff Independent Spent Fuel Storage Installation License Renewal - Task 1

	PD 1	PD 2	PD 3	PD 4	PD 5	PD 6	PD 7	PD 8	PD 9	PD 10	PD 11	PD 12	PD 13	Total
Center Pl-4	444	89	177	89	177	89	177	89	177	89	177	89	177	2,041
Center Pl-3	2,030	2,627	2,627	2,567	2,567	1,194	478	478	478	478	478	478	478	16,955
Center Pl-2	217	695	695	868	825	174	0	0	0	0	0	0	0	3,474
Center Pl-1	668	534	534	634	601	134	0	0	0	0	0	0	0	3,104
Center Tech	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Center Clerical	109	350	350	175	175	88	44	44	44	44	44	44	44	1,554
Center Labor	3,468	4,295	4,383	4,334	4,346	1,678	699	610	699	610	699	610	699	27,128
Center Burden	1,699	2,104	2,148	2,123	2,129	822	342	299	342	299	342	299	342	13,293
Center Overhead	4,960	6,143	6,270	6,199	6,216	2,400	1,000	873	1,000	873	1,000	873	1,000	38,804
SwRI Pl-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI Pl-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI Pl-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI Pl-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI Tech	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI Clerical	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI Labor	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI Burden	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI Overhead	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Materials and Supplies	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subcontracting	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machine Shop Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Quality Assurance	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Travel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Consultants	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Communications	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Premium Pay	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Adjustments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Est excl. CFC, Fee	10,127	12,542	12,801	12,656	12,691	4,899	2,041	1,782	2,041	1,782	2,041	1,782	2,041	79,224
Center CFC	81	100	102	101	102	39	16	14	16	14	16	14	16	634
SwRI CFC	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tot Estimate Cost	10,208	12,642	12,903	12,757	12,792	4,938	2,057	1,796	2,057	1,796	2,057	1,796	2,057	79,858
Fee	1,013	1,254	1,280	1,266	1,269	490	204	178	204	178	204	178	204	7,922
Tot Cost with Fee	11,221	13,896	14,184	14,023	14,061	5,428	2,261	1,974	2,261	1,974	2,261	1,974	2,261	87,781
% Completion	12.78%	15.83%	16.16%	15.97%	16.02%	6.18%	2.58%	2.25%	2.58%	2.25%	2.58%	2.25%	2.58%	100.00%
Cumulative Cost	11,221	25,117	39,301	53,323	67,384	72,813	75,074	77,048	79,310	81,284	83,545	85,519	87,781	
Cumul Completion	12.78%	28.61%	44.77%	60.75%	76.76%	82.95%	85.52%	87.77%	90.35%	92.60%	95.17%	97.42%	100.00%	

DRAFT

Labor Plan FY2012

Rev 2 Chg 1
10/21/2011

14004.05.001 Calvert Cliff Independent Spent Fuel Storage Installation License Renewal - Task 1

Center Labor	PD 1	PD 2	PD 3	PD 4	PD 5	PD 6	PD 7	PD 8	PD 9	PD 10	PD 11	PD 12	PD 13	Total
Center Pl-4	5	1	2	1	2	1	2	1	2	1	2	1	2	23
Center Pl-3	34	44	44	43	43	20	8	8	8	8	8	8	8	284
Center Pl-2	5	16	16	20	19	4	0	0	0	0	0	0	0	80
Center Pl-1	20	16	16	19	18	4	0	0	0	0	0	0	0	93
Center Technical	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Center Clerical	5	16	16	8	8	4	2	2	2	2	2	2	2	71
Total Center Labor	69	93	94	91	90	33	12	11	12	11	12	11	12	551

SwRI Labor	PD 1	PD 2	PD 3	PD 4	PD 5	PD 6	PD 7	PD 8	PD 9	PD 10	PD 11	PD 12	PD 13	Total
SwRI Pl-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI Pl-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI Pl-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI Pl-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI Tech	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SwRI ClericalTech	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total SwRI Labor	0	0	0	0	0	0	0	0	0	0	0	0	0	0

RÉSUMÉS

ASADUL H. CHOWDHURY

Staff Engineer
Engineering and Material Sciences Group
Geosciences and Engineering Division

Ph.D., Structural Mechanics, Cornell University, Ithaca, New York, 1974
M.S., Structural Mechanics, Cornell University, Ithaca, New York, 1971
B.S., Civil Engineering, E.P. University of Engineering & Technology, 1966

Dr. Asadul H. Chowdhury is a structural engineer with more than 40 years of teaching, research, consulting, and industrial experience in the areas of structural and geotechnical engineering. He has conducted structural and geotechnical research under seismic, blast, impact, and thermal loads. His studies include field and laboratory investigations and modeling on a variety of structural and geotechnical engineering systems and components. Dr. Chowdhury is particularly experienced in evaluating the analysis, design, and operations of various nuclear facilities dealing with the enrichment of uranium; fabrication of nuclear fuel; spent fuel storage; and storage, handling, and disposal of high-level radioactive waste.

Dr. Chowdhury has managed a team of experts in structural, mechanical, geotechnical, and mining engineering; rock mechanics; and risk and reliability analysis; providing research and technical services in geotechnical and facility engineering and infrastructure areas. He has conducted research in the areas of seismic rock mechanics involving discrete and finite element numerical studies, full and small scale experimental studies, and field investigations of weapons effects and rockburst-induced seismic effects; structural analyses of transportation and storage casks subjected to explosive and missile loads; and analyses of building structures under aircraft crash impact and seismic loads. Dr. Chowdhury contributes to Safety Evaluation Reports for licensing and renewal of independent spent fuel storage installations, Yucca Mountain respository, and fuel cycle facilities. Ongoing studies include evaluations of long-term performance of underground engineered barriers, and design and safety of preclosure operational facility of Yucca Mountain repository; and structural design and construction of fuel cycle facilities, including onsite inspections.

Before joining Southwest Research Institute, Dr. Chowdhury worked in the nuclear power plant industry, leading a group of structural and mechanical engineers for conducting seismic, dynamic, and thermal analyses of piping systems and torus of a boiling water reactor, including design to ASME Boiler and Pressure Vessel Codes. He provided technical support to users of proprietary piping analysis and design computer programs. In the field of soil/rock mechanics, Dr. Chowdhury's emphasis has been in the analysis and design of underground openings subjected to transient loads such as seismic, dynamic, impact, and shock loads; nuclear weapons effects; and transient thermal loads. He worked on various projects such as Repository Design in Basalt and Deep Underground Openings Under Nuclear Weapons Effects.

Dr. Chowdhury is the author or co-author of more than 100 papers and reports.

PROFESSIONAL CREDENTIALS: Registered Professional Engineer in the Province of Ontario, Canada.

PROFESSIONAL CHRONOLOGY: E.P. Agricultural University: senior lecturer, 1967–8; Cornell University: IDA fellow, 1968–71; teaching and research assistant, 1971–4; University of Newcastle: lecturer, 1974–7; McMaster University: post-doctoral fellow, 1977–8; University of Wisconsin-Madison: visiting lecturer, 1978–9; EDS Nuclear, Inc.: lead engineer, 1978–81; North Dakota State University: assistant professor, 1981–7; EWA Inc.: computational mechanics scientist, 1987–9; Southwest Research Institute: 1989—[manager, 1989–2010; staff engineer, 2010–present]; University of Texas at San Antonio: adjunct faculty, 1991–present.

MEMBERSHIPS: Earthquake Engineering Research Institute, American Society of Civil Engineers, ASCE technical committee, and EERI technical committee.

September 2011

TODD S. MINTZ
Program Manager
Licensing and Inspection Program for Reactors, Fuel Fabrication, Enrichment, and Interim Storage Spent Fuel
Geosciences and Engineering Division

Ph.D., Materials Science and Engineering, University of California, Berkeley, 2003
B.S., Chemical Engineering, Washington University, St. Louis, 1998

Dr. Mintz is corrosion and materials science engineer with research experience in corrosion of nuclear components. His expertise includes the fields of electrochemistry, including aqueous corrosion, high temperature oxidation, localized corrosion, and coatings. His background encompasses electrochemical testing in various environments, including high temperature and pressure, and stress corrosion cracking analysis and testing. Dr. Mintz applies his expertise to investigate the long-term performance of engineered materials for nuclear power plants and for disposal of nuclear material. He has experience characterizing corrosion-resistant coatings for both concrete and metallic structures, and has experience performing ASTM standard methods to evaluate coating properties. Dr. Mintz has developed and applied corrosion sensors, including a frequency-based sensor to monitor external corrosion of underground pipelines.
Dr. Mintz is experienced in the fields of materials engineering and electrochemistry, including aqueous corrosion, high temperature oxidation, localized corrosion, and coatings. His background encompasses electrochemical testing in various environments, including high temperature and pressure, and stress corrosion cracking analysis and testing.

As program manager, Dr. Mintz manages the programs involving licensing and inspection of nuclear reactors, fuel fabrication facilities, enrichment facilities, and interim storage spent fuels sites. Dr. Mintz manages and provides day-to-day interactions with the U.S. Nuclear Regulatory Commission on projects in these technical areas. Currently, Dr. Mintz manages programs related to the license renewal of nuclear power plants, license renewal of independent spent fuel storage installations, environmental assessments of electric power upgrades, verification and validation of fracture mechanics codes, license reviews of nuclear fuel fabrication facilities, license reviews for nuclear fuel enrichment facilities, and thermal analyses of nuclear transportation canisters. Dr. Mintz has also managed experimental projects used to evaluate the aging of concrete exposed to boric acid and the effects of wet and dry cycling on the degradation of medium voltage electric cable insulation.

At the Geosciences and Engineering Division, Dr. Mintz evaluates the long-term performance of engineered barrier materials for geological disposal of high-level radioactive waste. He assesses engineered materials to predict their performance in corrosive environments. In addition, Dr. Mintz has conducted accelerated corrosion testing of various stainless steels for nuclear waste dry storage containers under simulated operational conditions. He also brings his expertise to bear evaluating materials aging and other issues related to extension of operating periods for commercial nuclear power reactors. He has experience characterizing corrosion-resistant coatings for both concrete and metallic structures, and has experience performing ASTM standard methods to evaluate coating properties. Dr. Mintz has developed an uphill diffusion model to evaluate the susceptibility of welded metals to hydrogen embrittlement. He also studies the effects of severe roadway fires on containment systems used for hazardous materials transportation. He is currently developing of non-invasive methods to survey wear using surface metrological equipment. Dr. Mintz develops and applies corrosion sensors, including a frequency-based sensor, to monitor external corrosion of underground pipelines.

Before joining Southwest Research Institute, Dr. Mintz worked at the U.S. Nuclear Regulatory Commission (NRC), where he was the project manager for the International Steam Generator Tube Integrity Program. This program examined steam generators with respect to inspection reliability, integrity analysis, and corrosion prediction. His responsibilities included writing the steam generator research plan, reviewing programmatic technical reports, developing a 5-year research program, and writing statements of work for research programs. Dr. Mintz interacted with various international governments and private agencies to coordinate international steam generator research efforts.

While obtaining his Ph.D., Dr. Mintz evaluated the correlation between surface oxide films and stress corrosion cracking. He used *in-situ* surface-enhanced Raman spectroscopy to evaluate the characteristic films that form on ferrous and nonferrous metallic alloys in various environments. The research provided insight into how stress corrosion cracking phenomena may occur at nuclear power plants.

Dr. Mintz has coauthored more than 20 peer-reviewed journal and conference proceedings papers, 7 industrial technical reports, and 1 book chapter. He has coauthored more than 15 peer-reviewed journal and conference proceedings papers, 5 industrial technical reports, and 1 book chapter.

PROFESSIONAL CHRONOLOGY: Thies Technology: internship, 1997; University of California, Berkeley: graduate student instructor and researcher, 1998–2003; U.S. Nuclear Regulatory Commission: materials engineer, 2003–7; Southwest Research Institute: 2007–[research engineer, 2007–9; senior research engineer, 2009–2010; manager, 2010–present].

MEMBERSHIPS: NACE International, ASME International, and ASTM International .

September 2011

YI-MING PAN, Ph.D.

Program Manager

Integrated Spent Fuel Regulatory Program for Reprocessing and Long-Term Storage of HLW and Spent Fuel
Geosciences and Engineering Division

Ph.D., Materials Science and Engineering, Northwestern University, 1990
M.S., Ceramic Science and Engineering, Cheng-Kung University, 1981
B.S., Mining and Metallurgical Engineering, Cheng-Kung University, 1977

Dr. Pan is a materials engineer and has demonstrated experience in performing technical assessments for various nuclear safety programs. He has diverse technical skills in the field of materials and metallurgical engineering, including materials processing and characterization, predicting corrosion and degradation behavior, and thermodynamic modeling.

In his current position as a program manager in the Center for Nuclear Waste Regulatory Analyses (CNWRA®), Dr. Pan is responsible for project management and new business development in the areas of spent fuel reprocessing and extended storage and transportation. He manages all technical, schedule, cost, and quality aspects of the assigned projects and serves as the principal contact with the U.S. Nuclear Regulatory Commission matters associated with these projects. Dr. Pan's technical work focuses on long-term performance of materials, including materials aging and degradation in extended-life nuclear power plants, interim storage of spent nuclear fuel, and geological disposal of high-level radioactive waste. He was As the principal investigator for the Degradation of Engineered Barriers Project. In that capacity, he led , he leads a team of materials and corrosion experts reviewing the license application for a potential high-level radioactive waste repository at Yucca Mountain by conducting independent analyses and evaluations of degradation processes affecting engineered barrier materials. He has formulated modeling and experimental studies to assess waste package corrosion performance, including the effects of fabrication processes on Alloy 22 phase stability, sensitization kinetics and intergranular corrosion, and stress corrosion cracking. Dr. Pan has applied computational tools to predict metallurgical stability of nickel-based alloys using computational thermodynamic tools such as Thermo-Calc and DICTRA and has developed a reliability model for assessing the probability of hydride-induced failure in zirconium alloy fuel cladding. He also contributes actively to evaluations of corrosion and materials engineering related to aging management of structures and components for nuclear reactor and independent spent fuel storage installation license renewal application reviews.

Previously, Dr. Pan's work at Southwest Research Institute on materials and tribology included ultrastructure processing of nanostructured materials, microstructure characterization and fracture behavior in a wide variety of materials, and product development of ceramics and coatings for wear applications. He investigated natural uraninite alteration and nanostructured TiAl alloys at atomic levels using analytical electron microscopy and characterized pore evolution in ceramics during densification and creep failure using a number of advanced small-angle neutron scattering techniques.

At Northwestern University, he studied the physics and chemistry of engineered materials responsible for the improved tribological performance. In his doctoral dissertation, he developed an in-depth, fundamental understanding of the friction and wear behavior of aluminum-based metal-matrix composites through experimental studies.

Dr. Pan is active in professional societies and technical committees. His present roles include chair of the TMS-ASM Joint Corrosion and Environmental Effects Committee and He is a key reader of the Board of Review of Metallurgical and Materials Transactions and has served as chair of the TMS-ASM Joint Corrosion and Environmental Effects Committee. He also is author or coauthor of more than 50 published articles.

PROFESSIONAL CHRONOLOGY: Northwestern University: research assistant, 1987–90; Southwest Research Institute: 1990–[postdoctoral fellow, 1990–1; senior research engineer, 1991–4; consultant, 1994–8; senior research engineer, 1998–2005; principal engineer, 2005–2010; program manager, 2010–present].

MEMBERSHIPS: The Materials Research Society and The Minerals, Metals & Materials Society.

September 2011

EARL LYNN TIPTON

Research Engineer
Risk Analysis and Performance Assessment Group
Geosciences and Engineering Division

Ph.D. Nuclear Engineering, University of Missouri, 2008
M.S. Nuclear Engineering, University of Missouri, 2005
B.S. Chemical Engineering, University of Missouri, 2002

Dr. Tipton is a nuclear engineer with expertise in transport theory, kinetic theory of gases, and computational methods. His experience includes research in very high temperature reactors, computation of high-order approximations for transport coefficients of gas mixtures (viscosity, thermal conductivity), and experimental measurement of the thermal transpiration effect for gas mixtures.

Dr. Tipton assists the U.S. Nuclear Regulatory Commission (NRC) by assessing the performance of a potential geologic repository for high-level radioactive waste and reviewing license renewal applications for independent spent fuel storage installations. In particular, he independently evaluates how applicants address criticality, source term generation, and shielding. He uses MCNP and SCALE codes to model radiation transport and nuclear criticality. As part of a cooperative effort with NRC, he assisted in developing a flexible and generic performance assessment model using GoldSim™ software for scoping computations of risk for high-level waste repository concepts. Dr. Tipton has provided independent review and comparison of NRC codes developed in Python, FORTRAN, and GoldSim™ for modeling probabilistic fracture mechanics of nuclear reactor coolant system components. He has worked in software development, authoring a user interface for visualization and analysis of radionuclide transport in fractured rock.

Before joining SwRI, Dr. Tipton was a post-doctoral fellow supporting a research group on very high temperature reactors. During this time and throughout his Ph.D. studies, he worked in developing algorithms for obtaining the Chapman-Enskog solutions of the Boltzmann equation for predicting transport coefficients of gas mixtures (viscosity, thermal conductivity, diffusion, etc.). This work is applicable to a wide range of problems including those encountered in rarefied gas dynamics, aerosol transport, and micro-flows. He experimentally investigated the thermal transpiration effect for gas mixtures and compared the measurements with the relevant Chapman-Enskog theory. As an intern at Los Alamos National Laboratory, he worked on several projects including development of a coarse-scale vulnerability assessment of electric power substations and a Java-based computer program to support data collection and archival for the BioWatch project, which has provided early warning detection of biological agents for several U.S. cities.

Dr. Tipton has co-authored 10 peer-reviewed journal papers and conference proceeding papers.

PROFESSIONAL CHRONOLOGY: University of Missouri Environmental Health & Safety-Radiation Safety Office: student assistant, 2003–4; Los Alamos National Laboratory Decision Applications Division: intern, 2005; University of Missouri: post-doctoral fellow, 2008–9; Southwest Research Institute: research engineer, 2009–present.

MEMBERSHIPS: American Nuclear Society, Institute of Nuclear Materials Management, American Institute of Aeronautics & Astronautics, and American Vacuum Society.

September 2011

THOMAS E. WILT

Senior Research Engineer
Engineering and Material Sciences Group
Geosciences and Engineering Division

Ph.D., Civil Engineering, The University of Akron, Akron, Ohio; 1992
M.S., Civil Engineering, The University of Akron, Akron, Ohio; 1988
B.S., Civil Engineering, The University of Akron, Akron, Ohio; 1984

Dr. Wilt is a civil engineer with more than 20 years experience in the field of computational mechanics. His experience spans constitutive modeling of a variety of materials such as metal alloys at high temperatures and polymer-matrix and metal-matrix composites. A focal point of his work is numerical implementation of advanced non-linear, time-dependent, constitutive models into commercial finite element software, such as ABAQUS and MARC, and experimentally-based numerical characterization of these constitutive relationships. Dr. Wilt's extensive experience also includes general non-linear finite element code development, composite micromechanics, large-scale life prediction computations, and nonlinear thermomechanical finite element analyses.

Dr. Wilt has participated in computationally modeling the effects of aircraft impact into reinforced concrete structures. These impact analyses utilized the explicit finite element code LS-DYNA for modeling both the reinforced concrete structure and the actual aircraft. He also has experience in using LS-DYNA to model structures subject to blast loads. Dr. Wilt has participated in verification of the probabilistic fracture mechanics codes, Fracture Analysis of Vessels (FAVOR), and Extremely Low Probability of Rupture (xLPR) for the Nuclear Regulatory Commission. This activity involved verifying that the programming of the deterministic fracture mechanics models matched corresponding reference documents. Dr. Wilt has computationally modeled the structural behavior of components of the engineered barrier systems of the potential high-level waste geological repository at Yucca Mountain, Nevada. The finite element modeling has focused on the interaction of the drip shield and the waste package under static loading. He also has investigated the structural characteristics and drying and sealing processes of proposed Transportation, Aging, and Disposal canisters. Dr. Wilt has evaluated proposed spent nuclear fuel canisters for the US Nuclear Regulatory Commission. This work focused on deterministic structural design reviews and probabilistic reliability estimates for determining compliance with the Code of Federal Regulations. Dr. Wilt has participated in regulatory quality assurance evaluation audits. He has also participated in the development of the safety evaluation report for DOE's license application for the proposed high-level radioactive waste repository. Dr. Wilt is currently taking part in the review of the license renewal application for the Calvert Cliffs Independent Spent Fuel Storage Installation.

Before coming to Southwest Research Institute, Dr. Wilt participated in research pertaining to finite element analysis of aircraft engine components at high temperatures and the micromechanics analysis of composite materials at NASA Glen Research Center. Dr. Wilt was instrumental in developing a micromechanics-based deformation and damage code to simulate typical composite material response. His work was the runner-up in the selection for the NASA Software of the Year Award for the Generalized Method of Cells/Micromechanics Analysis Code, GMC/MAC.

Dr. Wilt's computer experience includes Unix- and Linux-based workstations. His PC-based operating systems include Windows Vista and 7, while office productivity software includes Word®, Power Point®, and Excel®, and programming languages include Fortran 77 and 90.

PROFESSIONAL CHRONOLOGY: University of Toledo at NASA Glenn Research Center: onsite resident research associate, 1992–4; University of Akron, Department of Civil Engineering: research associate, 1994–2005; Southwest Research Institute: senior research engineer, 2005–present.

MEMBERSHIPS: American Society of Civil Engineers and American Society of Mechanical Engineers.

September 2011