



UNITED STATES  
NUCLEAR REGULATORY COMMISSION

WASHINGTON, D.C. 20555-0001

SEP - 4 2003

Information Systems Laboratories, Inc.  
ATTN: James Meyer  
11140 Rockville Pike, Suite 500  
Rockville, MD 20852

SUBJECT: TASK ORDER NO. 11 UNDER CONTRACT NO. NRC-04-02-054

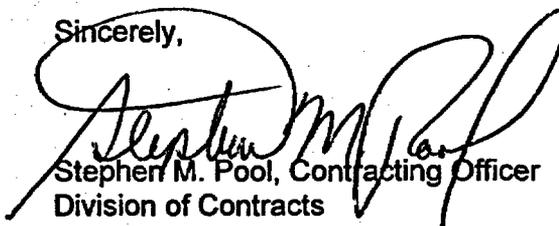
Dear Mr. Meyer:

This letter definitizes Task Order No. 11 in accordance with the enclosed statement of work. The period of performance for Task Order No. 11 is September 4, 2003 to April 30, 2004. The task order estimated cost and fixed fee is set forth as follows: Estimated Costs:\$278,075 Fixed Fee:\$20,775 CPFF Total:\$298,850. \$298,850 in funds is hereby allotted to this task order. The accounting data for this task order is set forth as follows: RES ID: RES-C03-439 APPN: 31X0200 B&R:36015110201 JCN:Y6522 BOC: 252A Amount Obligated This Action:\$298,850.

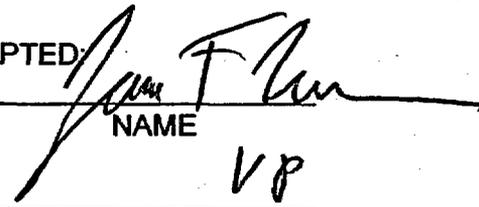
Please indicate your acceptance of Task Order No.11 by having an official authorized to bind your organization execute three copies of this document, by signing in the space provided, and return two copies to me. You should retain the third copy for your records. All other terms and conditions of this task order remain unchanged.

Should you have any questions, regarding this task order, please contact me on (301) 415-8168.

Sincerely,

  
Stephen M. Pool, Contracting Officer  
Division of Contracts  
Office of Administration

ACCEPTED:

  
NAME

TITLE

VP  
9/5/03

DATE

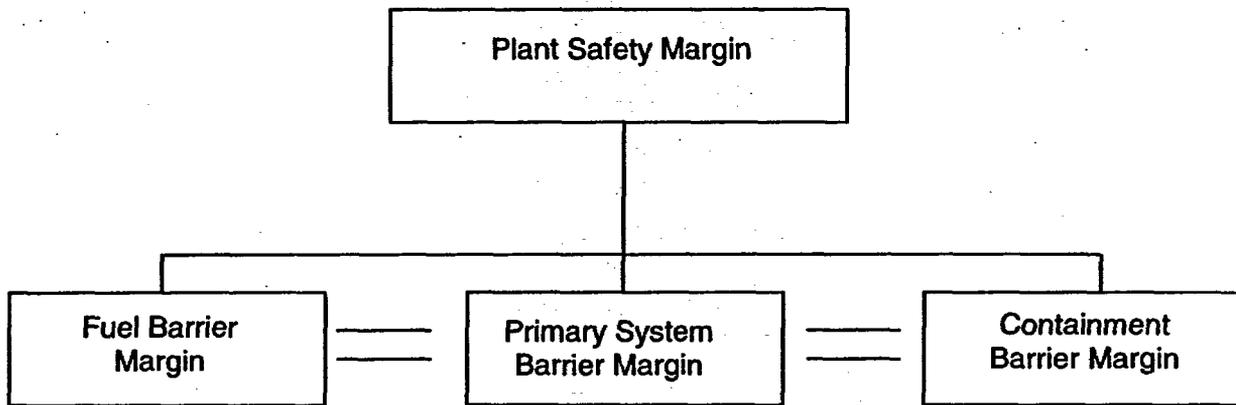
**Office of Nuclear Regulatory Research  
NRC 04-02-054 Job Code Y6522  
Statement of Work  
Task Order # 11**

**TITLE: Safety Margins and Impact of Plant Changes on Margins/CSNI**

**I. BACKGROUND**

This Statement Of Work (SOW) describes a project which builds upon the work performed under Task Order 3 of the Synergy project. Under Task Order 3, a "Trial Vertical Slice" task was completed that yielded lessons learned<sup>1</sup> for modifying the continuing "Synergy" effort. While this work was being performed, a project was initiated by the Nuclear Energy Agency Committee on the Safety of Nuclear Installations (CSNI) to address safety margins and the impact of plant changes on safety margins. Since this CSNI project is very similar to and builds upon and expands the Synergy project, the NRC staff has decided to end the Synergy project. NRC is leveraging its limited research resources by initiating in this new project which supports and conforms with the CSNI Safety Margins project and builds upon the prior Synergy effort and associated lessons learned.

The relationship between the Plant Safety Margin and the subordinate margins is shown below:



Double lines indicate interdependencies  
Human Factors influence all margin boxes

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<sup>1</sup> "Status Report on Synergy Project, 6/3/03"

## II. OBJECTIVES OF PROPOSED WORK

The goal of the CSNI project is to develop a guidance document describing how to determine a plant safety margin metric (performance measure) and subordinate fuel, primary system, and containment margin metrics that will allow for safety decision-makers to assess deterioration or enhancement of overall safety margin as a function of changes to the plant. Changes to be considered include, but are not limited to, those involving power uprate, longer fuel cycle, higher burnup, and aging.

The challenge in developing such guidance is to create a methodology that will determine the changes to the plant safety margin metric (performance measure) and subordinate fuel, primary system, and containment margin metrics and determine the limiting factors in each. Factored into this methodology should be a way of ascertaining whether or not plant changes are causing an over reliance on operator actions. The methodology should:

- be usable by decision-makers.

The guidance should provide a methodology that uses available data and analysis capabilities.

- be understandable to the nuclear community stakeholders.

The guidance should allow the informed nuclear community stakeholders to understand the basis, methodology, and the process sufficiently so that margin measures derived from the guidance will be acceptable.

- take full account of uncertainties.

The guidance should demonstrate that the full spectrum of uncertainties, which are part of safety and risk assessment, have been properly addressed.

- be sufficiently flexible to address margins and changes to margins in design basis accident (DBA) space, beyond DBA space, and severe accident (beyond core damage) space.
- be complete.

The guidance should provide a methodology: (a) that sufficiently covers the full spectrum of effects on safety margins of given changes to the plant, (b) from which definitive claims can be made about the effects on the margins, and (c) allow for a determination whether the effects are significant or negligible.

- allow for a measure of how the overall plant margin is affected by a change in any one margin or in changes for a combination of the subsidiary margins.

## **The Relationship of the Task Order 11 to the CSNI Project**

An appendix to the planned CSNI Guidance Document<sup>2</sup> will be "Examples of Potential Use of Guidance." This appendix will present actual cases of applications of the guidance presented in the report, with contributions from the US and other countries. It is the US contribution that is the content to the work described here. The initial US work will focus on BWR 4 reactors with Mark I containments. The work is very closely coupled to the work and builds upon work performed under the Synergy project. The work described below is a natural extension of the previous work. It encompasses the first phase of the planned 30-month CSNI project.

### **III. SCOPE OF WORK**

#### **Task 1. Develop and Expand Methodology**

This is further development and expansion of the Synergy methodology development effort originated under the Synergy project. It will be expanded to accommodate the CSNI approach to assessing and measuring the impact of plant changes.

Estimated Level of Effort: 80 staff-hours  
Estimated Completion Date: 10/31/03

#### **Task 2. Define "Failure" and "Success" for Success Paths (Success Criteria) and Define Margins**

This is further development of the "definitions" development effort originated under the Synergy project. This task will develop a definition of "failure," and the associated margins and screening and failure criteria for consistent use throughout the CSNI project. (Key thoughts to consider are fragility, the exceeding of ASME limits or actual failure values, service levels, DBA margins, and seismic PRA analogs.) Existing path success criteria will be supplemented.

Estimated Level of Effort: 100 staff-hours  
Estimated Completion Date: 10/31/03

#### **Task 3. Complete the "Identify and Scope Out Effort"**

This is further development to completion and documentation of the scoping and identification effort performed originated under the Synergy project. For a typical BWR-4 with a Mark I containment, complete the documentation of the initial IEs, success paths, failure paths, and the PRA and non-PRA "Systems" that the paths comprise. For each of the "Systems" document the sub-systems, trains, components and support systems that make up the "Systems." Correlate these SSCs to the set of SSCs used in a license renewal effort for a typical BWR-4.

Estimated Level of Effort: 120 staff-hours

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<sup>2</sup> "Safety Margins and the Effect of Plant Changes on Safety Margins: A CSNI Guidance Document," Working Draft, 6/4/03

Estimated Completion Date: 10/31/03

#### Task 4. Review Operational History

This is further development to completion and documentation of the "Operational History" effort originated under the Synergy project. For all BWRs, complete the search of GALL, ADAMS and other data sources (e.g., RI-ISI data) for operational and design data that have a nexus with any of the operational changes under consideration. Document the data sources for each of the "Systems" defined in Task 3. Include the reporting of the operational history in the Task 3 writeup.

Estimated Level of Effort: 120 staff-hours

Estimated Completion Date: continuous reporting until April 30, 2004

#### Task 5. System-Level Assessment of Impact of Changes

This is further development to completion and documentation of the "System-Level Assessment of Impact of Changes" effort initiated under the Synergy project. For each "System," a preliminary assessment has been made of the effects of the changes on the systems. The assessment will continue to distinguish between performance effects and mission effects. The assessment will go one step further than the original Synergy assessment in that the assessment will draw preliminary conclusions regarding the effects of plant changes on "Systems" that are mitigative in nature, that is, systems that are only called on to mitigate the consequences of AOOs, DBAs, and PRA Initiating Events. The assessment will be provided to the expert panel for their consideration of the overall effects (considering all the affected systems) on success paths and failure paths.

Estimated Level of Effort: 160 staff-hours

Estimated Completion Date: 12/31/03

#### Task 6. Develop of Background Information for Deterministic Analysis

A similar task was completed under the Synergy project. However, in order to conform the deterministic analysis to the CSNI project, further background information and development will be needed. As in the Synergy project, the impact of synergistic effects needs to be translated into input values for the deterministic analyses. Depending on the accident scenario, the BWR-4 models for TRACE, RELAP5, RELAP/SCDAP, CONTAIN, or MELCOR should continue to be used. This task will continue to be focused on determining the best code or combination of codes to use for determining the changes in margins, as a function of plant changes (The former "Synergy" issues.).

Estimated Level of Effort: 100 staff-hours

Estimated Completion Date: 2/29/04

#### Task 7. Determine Input to the HAZOP Experts' Panel

One of the lessons learned from the Synergy project was that the use of the HAZOP Experts' Panel should be limited to a subset of systems. Thus, this task should focus on a subset of "Systems" that are "operational" in nature, compared to "Systems" that are "accident-mitigation"

in nature. It should also focus more in determining new initiating events (IEs), although consideration of the impact of changes on existing IEs will also be important. The determination will be qualitative and based on expert judgment regarding the potential for success paths evolving into failure paths, the potential for new IEs, and the potential for significant increases in frequency for existing failure paths. The information developed should be sufficient for the HAZOP panel to do its job effectively and efficiently.

Estimated Level of Effort: 100 staff-hours

Estimated Completion Date: 10/31/03

#### **Task 8. Expert Panel Discussions Including HAZOP As Appropriate**

The HAZOP team will be given a document summarizing the work products (Task 7). Under the guidance of an individual who is trained in conducting HAZOPs, the team will work through all the issues consistent with the HAZOP process. The end product of the process is the identification of new IEs, if any, and/or failure modes, if any, that are unique to multiple changes in the plant.

Estimated Level of Effort: 240 staff-hours

Estimated Completion Date: 1/31/04

#### **Task 9. Perform Deterministic Analysis**

This is further development of the "Deterministic Analysis" effort initiated under the Synergy project. Selected analyses should be performed to determine success criteria and the deterioration in original safety margin or the outright failure for selected scenarios. Where possible, uncertainties in the analyses will be determined to aid in assessing a particular "success" path's contribution to a new failure path. The focus should be on changes in safety margins as a function of changes in the plant assessed in other parts of the project. TRACE, RELAP5, and/or MELCOR should be used as appropriate, applying lessons learned from the Synergy effort.

Estimated Level of Effort: 600 staff-hours

Estimated Completion Date: 2/29/04

#### **Task 10. Determine the Risk Significance of Plant Changes**

Upon completion of Tasks 8 and 9, the contractor will be in a position to state whether or not changes in the plant will have an impact on (increase in) CDF and/or LERF for a typical BWR-4 with a Mark-1 containment. Depending on the success of Task 8 and Task 9, these impacts can be expressed quantitatively in terms of reduced or exhausted safety margins for what were initially success paths. Quantification of the change in CDF (loss of margin associated with loss of coolable geometry), loss of margin associated with primary system failure, and the change in LERF (loss of margin associated with early containment failure) should be explored by modifying logic models and performing risk analysis using an augmented SPAR model (if possible).

Estimated Level of Effort: 400 staff-hours

Estimated Completion Date: 10/31/03

**Task 11. Integration of the project tasks with the CSNI Activity**

The CSNI project plan assumes five tasks. The first four CSNI tasks have a nexus with the ten tasks described above, as shown in the table below. The CSNI project will span 30 months. The schedule for the US NRC project, described above, will allow for timely input to the initial phases of the CSNI effort.

The CSNI project calls for a number of meetings of generalists and specialists over the 30-month period. During the time period of this Task Order, namely September 1, 2003 to April 30, 2004, it is estimated that there will be two "generalist" meetings and two "specialist" meetings. Task 11 will be dedicated to working on the CSNI Safety Margins project, advancing the goals of the project and presenting the relevant results of Tasks 1 through 10 to the CSNI.

**Estimated Level of Effort: 200 staff-hours**

**Estimated Completion Date: 4/30/04**

**Estimated Foreign Travel: Two one-person two-day trips for attendance at meeting of generalists**

**Two two-person two-day trips for attendance at meeting of specialists**

| <b>Project Tasks</b><br><b>CSNI Tasks</b>                    | <b>A. Definition of Safety Margin and Related Tasks</b> | <b>B. Assessment Process for Safety Margins</b> | <b>C. Safety Margin Evaluation Methods</b> | <b>D. Quantification of Safety Margins</b> | <b>E. Preparation of CSNI Guidance Document</b> |
|--|---|---|--|--|---|
| 1. Develop Methodology                                       | 1 is needed to do all                                   | 1 is needed to do all                           | 1 is needed to do all                      | 1 is needed to do all                      |   |
| 2. Define "Failure" for Success Paths                        | 2 is needed to do A                                     |   |  |  |   |
| 3. Identify and Scope Out Effort                             | 3 is needed to do A                                     |   |  |  |   |
| 4. Review Operational History                                |   | 4 is input to B                                 |  |  |   |
| 5. System-Level Assessment of Impact of Changes              |   | 5 is input to B                                 |  |  |   |
| 6. Develop Background Information for Deterministic Analysis |   |   | 6 is input to C                            |  |   |
| 7. Determine Input to the HAZOP Experts' Panel               |   | 7 is input to B                                 |  |  |   |
| 8. Expert Panel Discussions Including HAZOP as Appropriate   |   | 8 is input to B                                 |  |  |   |
| 9. Perform Deterministic Analysis                            |   |   | 9 is input to C                            |  |   |
| 10. Determine the Risk of Significant Changes                |   |   |  | 10 is input to D                           |   |
| 11. Integration of the project task with CSNI Activity       | N/A   | N/A   | N/A  | N/A  | N/A   |
| 12. Write Interim Report                                     |   |   |  |  | 12 is input to E, Appendix                      |

**Task 12. Write Interim Report**

The report will present the methodology used, report on the results to date for a typical BWR-4 with a Mark I containment, the applicability of the BWR-4 results for other like plants, the contribution to the CSNI project, and discuss the utility of using the developed methodology for assessing other plant types. The report will also discuss the next phases of the US contribution to the CSNI project.

Estimated Level of Effort: 160 staff-hours

Estimated Completion Date: 4/30/04

**IV. REPORTING REQUIREMENTS**

**Tasks 1 through 11**

Letter report due at the end of the task period of performance Task 11 Foreign Travel reports as required, within 30 days of completion of trip

**Task 12**

Interim Report as described in Task 12, due 4/30/03.

**PUBLICATIONS NOTE**

NRC encourages the publication of the scientific results from NRC-sponsored programs in refereed scientific and engineering journals as appropriate. If the contractor proposes to publish in the open literature or present the information at a meeting in addition to submitting the required technical reports, approval of the proposed paper or presentation should be obtained from the NRC Project Manager prior to expending effort on the writing of the paper or presentation. When the writing is completed, the NRC Project Manager shall either approve the material as submitted, approve it subject to NRC-suggested revisions, or disapprove it. In any event, the NRC Project Manager may disapprove or delay publication or presentation of papers on information that is subject to Commission approval that has not been ruled upon or which has been disapproved. Additional information regarding the publication of nRC sponsored research is contained in NRC Management Directives 3.8, "Unclassified Contractor and Grantee Publications in the NUREG Series," and 3.9, "NRC Staff and Contractor Speeches, Papers, and Journal Articles on Regulatory and Technical Subjects."

If the paper or presentation is in addition to the required technical reports and the NRC Project Manager determines that it will benefit the NRC project, the Project Manager may authorize payment of publishing and/or travel costs, if any, from the project funds. If the Project Manager determines that the paper or presentation would not benefit the NRC project, the costs associated with the publication or presentation will be borne by the contractor. For any publications or presentations falling into this category, the NRC reserves the right to require that such publication or presentation will not identify the NRC's sponsorship of the work.

## **V. Deliverables and Delivery Schedule**

1. A forecast milestone chart is required within 2 months after contract award.
2. Letter reports describing work performed under each task are due upon task completion, except Foreign Travel Reports which are due within 30 days of completion of the travel.
3. A Monthly Letter Status Report is to be submitted to the NRC Project Manager by the 20th of the month with copies provided to the following:

Office of Nuclear Regulatory Research Project Manager and Technical Monitor

Division of Contracts and Property Management, Office of Administration (Mail Stop T-712)

The Monthly Letter Status Report will identify the title of the project, the job code, the Principal Investigator, the period of performance, the reporting period, summarize each month's technical progress, list monthly spending, total spending to date, and the remaining funds. Any administrative or technical difficulties which may affect the schedule or costs of the project shall be immediately brought to the attention of the NRC Project Manager.

**Note:** (1) NRC has implemented a new document management system, Agencywide Documents Access and Management System (ADAMS). For the present, contractors' mail will not be placed in ADAMS. All documents mailed to NRC (e.g. letters, technical reports, monthly letter reports, and other mail) should have "Addressee Only" on the envelope to keep it from being entered into ADAMS. Send mail for the addressee and cc's as separate mailings.

### **(2) NEW STANDARDS FOR CONTRACTORS WHO PREPARE NUREG-SERIES MANUSCRIPTS**

The U.S. Nuclear Regulatory Commission (NRC) is capturing its official records electronically. These records will be saved electronically in ADAMS. The NRC is currently scanning each final NUREG-series publication from the printed copy. Therefore, submit your final manuscript that has been approved by your NRC Project Manager in both electronic and camera-ready copy.

All format guidance, as specified in NUREG-0650, Revision 2, will remain the same with one exception. You will no longer be required to include the NUREG-series report number (designator) on the both of each page of the manuscript. The NRC will assign this designator when we send the camera-ready copy to the printer and will place the designator on the cover, title page, and spine. The NRC Project Manager will forward a copy of the cover and title page so the contractor can prepare an image file to include in the electronic manuscript. For the electronic manuscript, convert the file to Portable Document Format (pdf).

## **VI. MEETING AND TRAVEL REQUIREMENTS**

Two one-person two-day trips and two two-person two-days trips to attend CSNI meetings. Other travels may be considered if needed, but must be approved by the NRC Project Manager. Foreign travel must be approved by processing NRC Form 445, in addition to being provided as part of the approved proposal.

## **VII. PERIOD OF PERFORMANCE**

The period of performance of this task order is September 4, 2003 to April 30, 2004.

## **VIII. QUALITY ASSURANCE**

Section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001 (Public Law 106-554) directs the Office of Management and Budget (OMB) to issue government wide guidelines (FR Vol. 67, No. 36, pp. 8452-8460) that "provide policy and procedural guidance to federal agencies for ensuring and maximizing the quality, objectivity, utility, and integrity of information (including statistical information) disseminated by federal agencies." NRC Information Quality Guidelines are provided in FR Vol. 67, No. 190, pp. 61695-61699.

The Contractor shall cite contractor quality assurance procedures used in the conduct of this work that provide for compliance with OMB and NRC guidelines.

## **IX. NRC-FURNISHED MATERIAL**

None

## **X. TECHNICAL AND OTHER SPECIAL QUALIFICATIONS REQUIRED**

The contractor shall provide engineers and probabilistic risk assessment practitioners with the skill and experience necessary for the tasks detailed in the SOW. The NRC will rely on representations made by the contractor concerning the qualifications of the personnel assigned to the task order including assurance that all information contained in the technical and cost proposal, including resumes, is accurate and truthful.