

**Nuclear Energy Research Initiative (NERI) Program  
DE-FG03-99SF21898/A000  
Technical Progress Report  
February through April 2000**

**The Development of Advanced Technologies to Reduce Design, Fabrication,  
and Construction Costs For Future Nuclear Plants**

**A. Status Summary of NERI Tasks – Year 1**

Year 1 Project Initiation Activities

<b>Milestone/Task Description</b>	<b>Planned Completion Date</b>	<b>Actual Completion Date</b>
Project Kick Off Meeting	10/01/99	10/01/99
Revised PM Plan and Issue	10/14/99	10/14/99
Project Web Site On Line	10/15/99	10/02/99
Issue Detailed Schedule	10/18/99	10/18/99
Adjust Tasks to Schedule and Budget	12/10/99	12/10/99
Complete Project Startup Activities	12/10/99	12/10/99

Year 1 Project Research Activities

<b>Milestone/Task Description</b>	<b>Planned Completion Date</b>	<b>Actual Completion Date</b>
Y-1.1 Deconstruct DPCIT	5/30/00	
Y-1.2 Develop Metrics	5/30/00	
Y-1.3 Develop 3D Model	5/30/00	
Y-1.4 Research other Industries' Practices	5/30/00	
Y-1.5 Examine Modularity	9/30/00	
Y-1.6 Examine Key Technologies	5/30/00	
Y-1.7 Evaluate Excess Margin	5/30/00	
Y-1.8 Requirements for Shorter Cycles	5/30/00	
Y-1.9 System Dynamics	5/30/00	
Y-1.10 Finite Element Code Links	5/30/00	
Y-1.11 Containment Margins	5/30/00	

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**B. Narrative**

Project Initiation Activities (PM 1.4 through PM 1.12)

1. Status: Project initiation was completed and all sub-contractors are engaged in their work scopes.
2. Issues/Concerns: None

Research Activities (Y-1.1 through Y-1.11)

**Y1-1. Deconstruct DPCIT (ABB-CENP)**

1. Status: A baseline schedule has been produced by combining schedules for proposed System 80+ plants in Europe and Taiwan. The schedule has been linked to the 3D design tool described below which allows construction to be simulated.
2. Issues / Concerns: None

**Y1-2 Develop Metrics (DE&S)**

1. Status: A set of metrics is under development to evaluate the impact of technologies on the capital cost of new plant construction. These metrics are based on methodologies described in "Measure Up," by Lynch and Cross. A list of guiding metrics is being constructed and will be available next quarter. A baseline cost estimate for nuclear plants is important to application of the metrics. Potential sources of this information are being examined and a draft baseline is expected next quarter.
2. Issues / Concerns: None

**Y1-3 Develop 3D Model of Base Plant (Westinghouse Nuclear Systems)**

1. Status: A 3D model of the chosen base plant, System 80+, has been developed based on converting an earlier model from the PASCE software to CSA's Plant/CMS software. The CSA software provides methods for detailed examinations of construction schedule alternatives.
2. Issues / Concerns: None

#### **Y1-4 Research Other Industry Practices (DE&S)**

1. Status: Research on the work practices and principles used by aerospace, automotive and other big manufacturing organizations such as Boeing, Airbus, Chrysler, and Caterpillar has been performed. Some of these practices have reduced their product cycle times by more than 50%. A number of key approaches and tools have been identified such as Design-build Team (Concurrent Engineering), Modularization, 3-D Design, Lean Thinking, JIT, and Information Management System.
2. Issues / Concerns: None

#### **Y1-5 Examine Modularity (MIT)**

1. Status: -Plan of attack has been formulated to find best space frames for modularity.
  - 1<sup>st</sup> drawing of one dimension of space frames produced.
  - Need for computer-aided drafting identified.
  - Learning how to use software begun.
2. Issues / Concerns: None

#### **Y1-6 Examine Upcoming Technologies (ABB-CENP)**

1. Status: The Combustion Engineering Owners Group is funding a task to develop a digital I&C safety grade platform and application, Common Q. The feasibility study is complete and the I&C group is ordering the digital equipment required to mock-up one channel of the Core Protection Calculator trip functions and the Post-Accident Monitoring system. We will continue to monitor progress of this effort to determine potential benefits for DPCIT.

The codes and standards applicable to I&C technology have received a preliminary review and evaluation for their DPCIT implications. The documentation of the recommended changes in requirements or interpretations of the licensing requirements and/or codes and standards resulting from this evaluation are in progress.

2. Issues / Concerns: None

#### **Y1-7 Evaluate Excess Margin (NCSU)**

1. Status: The seismic behavior of electrical control panels, switchgear and motor control centers are being studied. Detailed studies are being used to develop simple and easy-to-use methods that can be implemented into spreadsheets or by web-based tools. Such a tool can be employed for evaluating realistic qualification requirements.

The information on structural details and other data needed in this study has been obtained from nuclear utilities that are members of Center for Nuclear Power Plant

Structures, Equipment and Piping at NC State University. Additional work is needed in further developing these methods and extending them to qualification of mechanical equipment. Later, these methods will be used for developing risk-based evaluation stages of design, construction, procurement, installation and operation and qualification studies.

As regards the modeling of structural systems with heterogeneous sub-systems, the emphasis of the research is on developing computational and numerical methods that would account for interaction between individual sub-systems leading to a significant reduction in seismic qualification requirements.

2. Issues / Concerns: None

#### **Y1-8 Requirements for Shorter Cycles (DE&S)**

1. Status: Review of mechanical equipment codes and standards required to permit the use of non-safety pumps and valves in safety applications has been initiated. A preliminary review of safety vs. non-safety procurement schedules and costs has been completed. Documentation of this effort is in progress.
2. Issues / Concerns: None

#### **Y1-9 Develop System Dynamics Model for DPCIT (MIT)**

1. Status: A basic causal loop diagram has been constructed and first stock and flow diagram has being constructed. A construction subject matter expert from DE&S has been interviewed to validate the loop diagrams. Based on this effort and internal validation, the proposed model improvements will require a more powerful version of Vensim software which is now being purchased
2. Issues / Concerns: None

#### **Y1-10 Examine Linkage Between Finite Element Codes and 2D/3D Design Software (SNL)**

1. Status: The automated process involves: (1) creating a solid model to represent/define the design geometry; (2) translating the solid model representation to a format compatible with a finite element meshing tool; and (3) meshing the solid model to generate a finite element analysis model. The pressurizer, a part of the reactor cooling system of the System 80+, has been selected for demonstration and implementation purposes of this task. The CSA (Construction Systems Associates, Inc.) has been chosen to provide the solid model implementation of the pressurizer, Sandia will be responsible for translating the solid model representation and generating the finite element mesh, and ABB will provide the design and analysis support.
2. Issues / Concerns: None

## Y1 11 Examine Containment Margins and Uncertainties (SNL)

1. Status: There is a continuous effort to examine the structural designs and the safety margins of containments and to review a series of NUREG reports covering the Proceedings of the Workshops on Containment Integrity. The review process focuses on identifying a key set of design parameters of containments and evaluating their performance envelopes with respect to a postulated range of variations.
2. Issues / Concerns: None

### C. Cost Performance

