NUCLEAR ENERGY RESEARCH INITIATIVE (NERI) PROGRAM

QUARTERLY TECHNICAL PROGRESS REPORT

PROJECT TITLE:	**DEVELOPMENT AND VALIDATION OF TEMPERATURE DEPENDENT THERMAL NEUTRON SCATTERING LAWS FOR APPLICATIONS AND SAFETY IMPLICATIONS IN GENERATION IV REACTOR DESIGNS**
GRANT NUMBER:	**DE-FG03-02SF22514/A000 (NERI PROJECT 2001-140)**
PRINCIPAL INVESTIGATOR:	**AYMAN I. HAWARI**
INSTITUTION(S):	**NORTH CAROLINA STATE UNIVERSITY (NCSU), OAK RIDGE NATIONAL LABORATORY (ORNL), AND INSTITUTE BALSEIRO (IB)**
REPORT PERIOD:	**9/1/2002 – 11/30/2002 (PHASE II)**

The overall objectives of this project are to critically review the currently used thermal neutron scattering laws for various moderators as a function of temperature, select a well documented and representative set of experimental data sensitive to the neutron spectra to generate a data base of benchmarks, update models and models parameters by introducing new developments in thermalization theory and condensed matter physics into various computational approaches in establishing the scattering laws, benchmark the results against the experimental set, and in the case of graphite, perform a validation experiment by observing neutron slowing down as a function of temperatures equal to or greater than room temperature, and understand the implications of the obtained results on the ability to accurately determine the operating and safety characteristics (e.g., the moderator temperature coefficient of reactivity, buildup and depletion of transuranium elements) of given reactor designs, which include generation IV nuclear power systems, advanced research reactors and power reactors for space applications.

MILESTONES AND TASK STATUS IN PHASE II

The following table lists the tasks for this phase:

An update of project schedule and task status

Milestone/Task Description	Planned Completion Date	Actual Completion Date
(a) Perform Calculations of graphite benchmarks, including sensitivity analysis.	May 30, 2003	On going
(b) Perform Calculations of Be and BeO benchmarks, including sensitivity analysis.	May 30, 2003	On going
(c) Perform Calculations of ZrH benchmarks, including sensitivity analysis.	May 30, 2003	On going
(d) Continue work on thermal neutron scattering laws	August 31, 2003	On going
(e) Begin study of effect of scattering law on safety performance of a given reactor design	August 31, 2003	Begins in the third quarter
(f) Finalize the computational designs for the graphite experiments, and begin preparations and setup for performing it	February 28, 2003	On going
(g) Order equipment needed to perform graphite experiment	February 28, 2003	On going

NARRATIVE OF PROGRESS

During this quarter a meeting was held on the NCSU campus between the NC State group and the ORNL group. Based on this meeting it was decided that we continue working on solid moderators/reflectors. Therefore, the materials that we will continue to emphasize during phase 2 will be graphite, Be, BeO, and ZrH. In the case of ZrH, it was noted that it is being mentioned as the possible moderator of choice for the supercritical water reactor (a Generation IV concept). Therefore, working on it would be of considerable interest. In addition, in early December Dr. Victor H. Gillette arrived successfully from Argentina to join the NC State group for the remainder of phase 2 and for phase 3 of this project.

Tasks (a), (b), and (c):

Work on the graphite benchmarks started at ORNL and NCSU during phase 1. This work is continuing during the second phase. In addition, during this quarter we added experimental graphite data that is based on pulsed neutron slowing down measurements that were performed at the University of Texas-Austin in the late nineties. This data is being compared to computational predications using the new graphite libraries that were generated during phase 1 of this project. Since the PI is highly familiar with the conditions of this experiment, it represents a unique opportunity for establishing a benchmark. Furthermore, we are currently identifying and sorting the appropriate benchmarks for Be, BeO, and ZrH. In the case of Be and BeO, several pulsed slowing down experiments that took place in the early seventies were identified and are currently being examined to assess their suitability for Monte Carlo modeling. In the case of ZrH, there seems to be a lack in the amount of published experimental benchmarks. However, we continue to search for appropriate data.

Task (d):

During this quarter we continued the tasks that were started during phase 1. Specifically, we continue to work on including the GASKET code in NJOY. We expect to have a self-contained version of NJOY that is capable of calculating the thermal neutron scattering kernel using both the GASKET approach and the LEAPR approach during the second quarter of phase 2. In addition, we have perfected further our ab initio calculations of the graphite phonon spectra and are currently developing the models for ZrH. Notice that once our graphite models are frozen, this effectively establishes the methodology for generating ab initio data for Be and BeO.

Task (e):

Work will begin on this task during the second quarter and it will be fully addressed during the third and fourth quarters of phase 2.

Tasks (f) and (g):

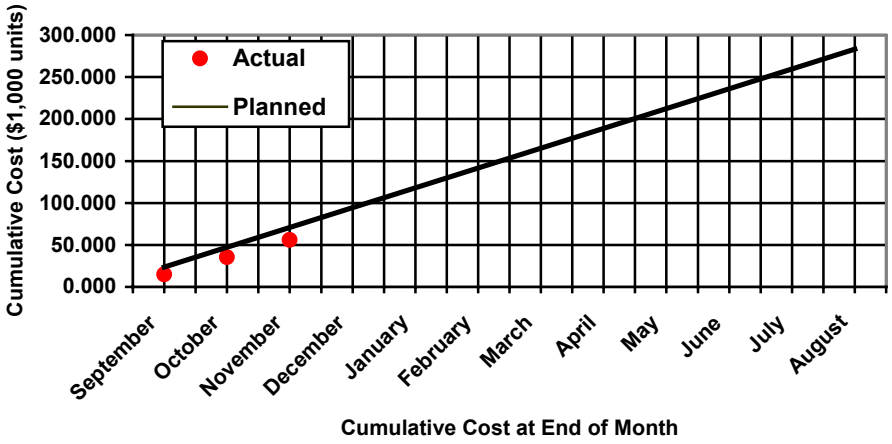
During this quarter we continued the communication with ORELA's director (S. Raman) at ORNL to setup a review meeting for the graphite experiment. This meeting is currently expected to take place in late January. In addition, in consultation at a meeting with the vendor, we reached an advanced engineering design stage for the heating system, which takes into account the neutronic aspects. We are

currently performing MCNP calculations to ensure that the latest design preserves (as much as possible) some of the experimental observables that are helpful to this work. We are currently in the process of ordering the data acquisition system (we have manufacturer's quotes) and the detectors needed to perform the experiment.

COST PERFORMANCE

The figure below details the cost performance for this project. We expect that, starting with the second quarter, the arrival of Dr. Gillette and the order of the experimental equipment will bring the spending levels to the expected values.

At ORNL the spending from the account continues at its regular levels. The figure below shows the cumulative cost of the project for both institutions.



Project cost performance at the end of each month at NCSU and ORNL