

October 18, 2006

MEMORANDUM TO: Chairman Klein
Commissioner McGaffigan
Commissioner Merrifield
Commissioner Jaczko
Commissioner Lyons

FROM: Luis A. Reyes /RA/
Executive Director for Operations

SUBJECT: PARTICIPATION IN THE SETH, SERENA AND ThAI RESEARCH PROGRAMS

On January 10, 2006, the staff briefed the Commission on the topics of international research and bilateral agreements. In a Staff Requirements Memorandum (M060110) dated February 2, 2006, the Commission indicated that, "the staff should continue its practice of evaluating individual programs and projects for their relevance to nuclear regulation, i.e., their contribution to Commission decision making." The purpose of this memorandum is to inform the Commission of changes to the status of NRC participation in two international research programs, and our response to an Organization for Economic Cooperation and Development (OECD) invitation to participate in a new program.

The Office of Nuclear Regulatory Research (RES) has completed participation in two international programs sponsored by the OECD Nuclear Energy Agency (NEA). The first program is the Senior Group of Experts on Severe Accident Research Thermal Hydraulics (SETH) and the second program is Steam Explosion RESolution for Nuclear Applications (SERENA). OECD/NEA is sponsoring the next phase for both programs and is requesting NRC participation. RES also received an invitation from OECD to participate in the ThAI (Thermalhydraulics, Aerosols, and Iodine) experiment.

SETH utilizes the PANDA facility, located at the Paul Sherrer Institute in Switzerland, and the PKL facility, located at Framatome ANP in Germany. PANDA is a large-scale facility originally built to study containment thermal hydraulic processes in the simplified boiling water reactor (SBWR) design. The facility was extended to include studies on the economic simplified boiling water reactor (ESBWR).

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The SETH (PANDA) Phase I program involved performing 25 separate effects tests in order to generate data to benchmark computational fluid dynamics containment codes. The SETH (PKL) Phase I program involved performing integral testing of the reactor coolant system of a large, 4-loop pressurized water reactor (PWR) similar in design to the Westinghouse plants. The PWR tests were focused on boron dilution, mixing, and transport. RES used this data to help resolve Generic Safety Issue 185 concerning boron dilution effects during small break, loss-of-coolant accidents (LOCAs). A PKL follow-on effort was pursued under a separate international program (OECD-PKL) and is currently underway with NRC participation.

The SETH Phase II program will commence in 2007 for 4 years. It will use the PANDA facility to continue to refine containment thermal-hydraulic data. The projected NRC cost associated with the program would be \$80K and 0.6 FTE per year. RES staff believes that sufficient information has been generated by the SETH Phase I effort to fulfill the agency's needs for separate effects data on containment phenomena. Therefore, RES does not intend to participate in the SETH Phase II program.

The SERENA Phase I program provided a comparative assessment of the capabilities of fuel-coolant interaction codes to quantify steam explosion loads and identified areas of modeling uncertainties. The program demonstrated that the safety margin associated with in-vessel explosions was adequate despite significant phenomenological and modeling uncertainties. The calculated in-vessel steam explosion loads, with uncertainties, were substantially lower than the maximum loads a reactor vessel can withstand. With regard to ex-vessel steam explosions, the resulting load to containment is not likely to be threatening to containment integrity for operating U.S. reactors as well as for new reactors.

The SERENA Phase II program will commence in 2007 for 4 years. The projected NRC cost associated with SERENA Phase II would be \$140K and 0.2 FTE per year. While this is an area where there is international interest for additional research, RES does not intend to participate in the SERENA Phase II program because of the low likelihood of steam explosions that will challenge reactor vessels or containment integrity.

OECD proposes to use the ThAI facility (Gesellschaft für Anlagen - und Reaktorsicherheit mbH in Germany) to conduct experiments on severe accident phenomena in containment. The ThAI facility has an internal volume of 60 cubic meters, which is a bit small for containment tests. It can operate at pressures up to 1.4 MPa (13.8 atmospheres) and temperatures up to 450°K. The NRC cost share for the ThAI program would be \$230K and 0.2 FTE per year.

Even though the ThAI facility would produce data for model development, most of the major issues of containment response under severe accident conditions have been addressed. Experience from the Phebus-FP test program suggests that the current models are quite capable in most areas of safety interest. Lumped-node codes such as CONTAIN and MELCOR acceptably predict the temperature, condensation rate, aerosol concentration, and relative humidity in the Phebus-FP containment volume. There is nothing that indicates that these models need more validation.

For the reasons discussed above, RES plans to inform OECD/NEA that NRC does not intend to participate in the SETH Phase II, the SERENA Phase II and the ThAI programs. These decisions are based on the ongoing efforts of RES to evaluate research programs, international

and domestic, to ensure that they are aligned with regulatory needs and are providing an appropriate return on resources invested.

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