THE WWER FUEL ELEMENT SAFETY RESEARCH UNDER THE DESIGN AND HEAVY ACCIDENT IMITATION ON THE "PARAMETR" STAND

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ИССЛЕДОВАНИЕ БЕЗОПАСНОСТИ ТВЭЛОВ ВВЭР ПРИ ИМИТАЦИИ НА МОДЕЛЬНЫХ СБОРКАХ НА СТЕНДЕ «ПАРАМЕТР» ПРОЕКТНЫХ И ТЯЖЕЛЫХ АВАРИЙ

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Analysis of fuel element behavior in the course of the design and heavy accidents is the component of reactor facility safety prevention. Many tasks of fuel element behavior research may be solved with the help of thermophysical stands. One of such stands implemented in 1991 was thermophysical stand «PARAMETER». It helps to conduct:

- researches of WWER model assemblies behavior under conditions imitating incidents with long-term partial or complete drainage of reactor core;
- experimental researches of the WWER fuel element behavior (of 7, 19 and 37) including different new constructional materials for fuel and absorbing elements under conditions imitating emergency states with melting of reactor core component;
- experimental researches of the WWER fuel element behavior (of 7, 19 and 37) in stream-water medium and in the course of different temperature-power loading;
- researches of fuel element and model assemblies destruction dynamics under heavy accident conditions with partial model assembly melting and the following flood of assembly by water;
- researches of hydrogen release dynamics during water vapor and constructional materials interaction.

«PARAMETER» stand's working section is equipped with the systems of combined jet flooding and slow-rate flooding from above and below and of inner pressure support in every fuel element with its automatic control during tests. Also it is equipped with computerized means of principal test parameters control (temperatures of fuel claddings and shell, vapor temperatures and pressures and others).

Several experiments on model assemblies chiefly imitating both heavy accident and design basic accident have already been conducted in «PARAMETER» stand. There were obtained data about fuel claddings seal failure and deformation condition. In particular it was defined that seal failure of all fuel claddings occurs on stage of fuel element warming, in temperature range (770-900)°C and almost does not depend on inner pressure level.

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INTRODUCTION

The United States and the Russian Federation are collaborating on a number of initiatives related to the nuclear fuel cycle. These include materials protection, control and accountability, excess weapons materials disposition, and storage of fissile materials. Each of these efforts contributes to key bilateral national goals in both countries. In addition to these important activities, another effort focuses on nuclear materials facility safety.

BACKGROUND

Safety in any facility in the nuclear fuel cycle is a fundamental goal. However, it is recognized that, for example, should an accident occur in either the U.S. or Russia, the results could seriously delay joint activities to store and disposition weapons fissile materials in both countries. To address this, plans are underway jointly to develop a nuclear mate-

rials facility safety initiative. The focus of the initiative would be to share expertise which would lead in improvements in safety and safe practices in the nuclear fuel cycle.

SCOPE

The program has two components. The first is a lab-to-lab initiative. The second involves university-to-university collaboration.

Built on the proven model, the lab-to-lab program involves collaborative projects which are undertaken by scientists and engineers at national labs in the U.S. and research institutes and industrial sites in the Russian Federation. The projects would be focused on safety aspects of facilities related to the weapons plutonium disposition activities. A joint task force has identified several specific areas. These include:

1. Study of radiation exposures to workers and the public resulting from long term storage of excess weapons plutonium.
2. Fire and explosion problems in using anion exchange for plutonium waste treatment processes in Pu conversion and MOX fabrication facilities.
3. Improvement of detection and filtration of off-gas release of effluents containing airborne radioactive particulates.
4. Study of safety issues associated with weapons MOX fuel fabrication.
5. Preliminary safety analysis for Pu conversion and immobilization.
6. Comparison of the U.S. Integrated Safety Management System and the Russian Safety Management System.

All of the projects are meant to contribute to the success of the joint weapons plutonium disposition program.

The second component of the initiative involves preparing young engineers and scientists with an academic background which would enable them to work in the fields of nuclear materials facility safety. This is to be undertaken in several ways. The Moscow Engineering Physics Institute (MEPhI) is an institution of higher education which prepares scientists and engineers for employment in the Ministry of Atomic Energy (Minatom) facilities. MEPhI has instituted a new Master of Science degree in Nuclear Material Safe Management. This is a two year program which covers disciplines which prepares the students in safe materials management. Also included in the program is a practical experience in which the students experience first hand the safe handling, processing, treatment, storage, shipment and disposal of nuclear materials.

MEPhI also envisions a second M.S. program on Radiation Safety for Man and the Environment. This program will cover topics of health physics and radiation safety for both workers and members of the public. The Obninsk Institute for Nuclear Power Engineering is considering a similar program dealing with the safe decontamination and decommissioning of nuclear facilities, both reactors and other components of the nuclear fuel cycle. Finally, the St. Petersburg State Technical University may initiate a related program in radiochemical safety for those facilities dealing with radiochemical processes.

In conjunction with these efforts, the participating U.S. and Russian universities envision collaborative research projects as well. The research efforts will be focus to support the academic programs.

CONCLUSION

The lab-to-lab and university-to-university programs will contribute to increased safety in facilities dealing with nuclear materials and related processes. These programs will support important bilateral initiatives, develop the next generation of scientists and engineers which will deal with these challenges, and foster the development of a safety culture.

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Section #1

NUCLEAR SAFETY & NUCLEAR TECHNOLOGIES

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