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**Seminarium Zakładu Energetyki Jądrowej i Analiz Środowiska (UZ3)**
**Departament Badań Układów Złożonych (DUZ)**
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# Failure Mode and Reliability Study for HTGR Electrical System

**Abstract**:

The High Temperature Gas-cooled Reactor (HTGR) is the Generation IV nuclear technology that can be optimized for heat and power cogeneration. Commercial operation of the HTGR-based cogeneration plants is conditioned, however, by ensuring both safety and profitability which are of major interest for the whole industry. Improvement of the inherent reliability of the plant systems – nuclear and non-nuclear, can significantly enhance both these aspects.

This presentation is devoted to the reliability of the electrical power supply as the function supporting the safety and ensuring cogeneration continuity. The analysis to be presented during the seminar was based on the GEMINI+ design and consists of two main parts: (1) failure mode and effects identification and classification; and (2) failure probability calculation.

The single failure study of the GEMINI+ electrical system has been performed using the Failure Mode and Effect Analysis (FMEA) technique aimed at determining the frequency and severity of the identified failure modes. Afterwards, the FMEA-based Gradual Screening approach has been applied to select the most critical failures and associated consequences followed by proposing a risk matrix for all considered failure types. The application of such an approach for the reliability study of the system in the design process can result in the safety enhancement and reduction of the economic risks at the early stage, thus avoiding more expensive activities.

The FMEA study was followed by the calculation of the system failure probability. The fault Tree method was used for this task, where the probabilistic models corresponding to the component malfunctions were developed to address all possible combinations of events leading to the system failure. The models were developed and calculated using the U.S NRC SAPPHIRE code. The main source of the input data, i.e. the frequency of the component failures was the U.S. NRC report – NUREG-6928. The calculation has been performed in two variants: (1) normal operation and (2) LOOP (Loss of Offside Power) situation.

The initial results of the analysis confirm the high reliability of the electrical system of GEMINI+ to supply the electrical loads under both normal operation and emergency conditions. However, further reliability studies for the HTGR-based plant systems are needed for facility optimization in terms of safety and profitability.

Serdecznie zapraszamy
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