UPGRADING OF EMERGENCY ALARM SYSTEM ABOUT A SELF-SUSTAINING CHAIN REACTION IN THE «FRESH» FUEL STORAGE AT THE RESEARCH NUCLEAR REACTOR IRT-T

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The results of works on upgrading of the self-sustained chain reaction alarm system (hereinafter referred to as SSAS) in the "fresh" nuclear fuel storage (hereinafter referred to as "Storage") at the IRT-T nuclear research reactor (hereinafter referred to as NRR IRT-T) are presented.

The storage facility is part of the IRT-T nuclear research reactor nuclear fuel storage and transportation system, is located in the reactor building and is designed to store fuel assemblies after they are received from the manufacturing plant before they are loaded into the reactor core.

In accordance with clause 4.1.9 of NP-061-05 [1] the storage facility shall be equipped with EAS SSCR. The system is designed to quickly detect and notify the personnel about the occurrence of SCR in the NFZ. In case of accidental criticality in the IRT-T nuclear fuel storage the system generates light and sound emergency signals of the necessity of immediate evacuation of the personnel from the NFC to the assembly point.

According to NP-016-05 [2] the EAS SSCR is a system of normal operation important for safety. Every year more and more stringent requirements are put forward to it, which are regulated by STO 95 12004-2017 [1]. At the present time works on its modernization are performed at the IRT-T.

Specialists of "Instrument Plant "Signal" developed the design documentation, passed expert review and received a positive expert opinion on nuclear safety of IPPE JSC. The design provides for one control point located in the storage room.

In accordance with the requirements of clause 4.2 Industry Standard 95 12004-2017 [3], during the system design the boundaries of NHZ and the zone of greatest danger in case of SSCR, as well as its triggering thresholds were determined.

The basic element and self-sufficient control point of the EAS SSCR was chosen as a measuring-signalizer emergency DRG-1MK-02 (hereinafter - the meter). The meter has the OIAE Certificate of Conformity valid for the entire operation period of the meter. Additionally, the function of continuous remote monitoring of gamma radiation dose rate at the location of SCR detector units is provided for external NWD diagnosis of radiation situation, including after SSCR.

The developed set of technical means of EAS SSCR based on the measuring-signalizer of emergency DRG-1MK-02 corresponds to the existing normative-legal base regulating the issues of EAS SSCR design and operation and meets the latest standards in this area.

REFERENCES

1. NP 061-05 Federal Standards and Rules in the Field of Use Atomic Energy. Safety Rules for Storage and Transportation of Nuclear Fuel at Nuclear Facilities. Entered into force on May 01, 2006.
2. NP 016-05 Federal Standards and Rules in the Field of Use Atomic Energy. General Safety Provisions for the Nuclear Fuel Cycle Facilities (OPB OYaTTs). Entered into force on May 01, 2006.
3. Industry Standard 95 12004-2017 General rules for design and operation of alarm systems for self-sustaining nuclear fission chain reaction and organization of measures to limit its consequences. Entered into force on April 24, 2017.

INVESTIGATION OF THE RESISTANCE OF AlGaInP LEDs (λ = 630 nm) TO IRRADIATION WITH FAST NEUTRONS

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The results of a study of the durability of industrial light-emitting diodes (LEDs) fabricated on the basis of the AlGaInP heterostructure (λ = 630 nm) for the detection of fast neutrons at the IRT-T reactor are obtained.

In the process of research, for each LED, the direct branch of the current-voltage characteristic (CVC) and the watt-ampere (WAC) characteristic in the photometric sphere were measured by using a special measuring complex before and after irradiation. The measuring complex made it possible to measure the direct voltage of the LED in the range from 0 to 5 V for the range of direct currents (0 - 500) mA in increments of at least 1 mA. In this case, the error in setting the direct current from the set level is ± 3%, and the error in measuring the radiation power of the LED is ± 5%. The obtained measurement results were processed by methods of mathematical statistics.

LED irradiation in the passive power supply mode (without passing the operating current, while the LED contacts are open) was carried out on a setup for studying the effect of fast neutrons on various materials and products, which was mounted on a horizontal experimental channel (GEK-6) of the IRT-T reactor [1]. This setup is based on the use of a thermal neutron filter made of boron and cadmium carbide [2].

Regularities have been established that describe the change in the CVC and WAC of LEDs based on AlGaInP heterostructures (λ = 630 nm) upon irradiation with fast neutrons. The obtained experimental results are compared with known literature data.

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A PRELIMINARY ANALYSIS OF HIGH-BURNUP THORIUM-BASED FUELS FOR INCINIRATION OF WEAPON-GRADE STOCKPILES

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The potential advantages of thorium-based fuel cycles, such as improved fissile fuel utilization, increased resistance to proliferation of nuclear explosives, and a reduction in long-lived minor actinide production, have been influential motivations for using thorium-based fuels in power generation since the advent of nuclear reactors [1]. However, low uranium prices, long experience with uranium-based fuels, and complex procedures of licensing new fuel types have always impeded extensive use of thorium in the nuclear industry [2]. However, spotting the uranium market reveals that political tension could adversely affect the availability of uranium at reasonable prices in the future, and diversification of the fuel cycle is considered a wise decision [3]. Moreover, thorium can help transform large stockpiles of weapon-grade uranium and plutonium into nuclear fuels, alleviate public concerns over nuclear apocalypse, and pave the way for increasing the share of nuclear energy in the market. In this work, the lattice code WIMS-ANL and 172-group nuclear data library ENDFB-VI was used to compare neutronic performance of selected thorium-based oxide fuels under operational conditions of VVER reactors. The