RUSSIAN SPENT MARINE FUEL AS A GLOBAL SECURITY RISK

K. GUSSGARD
E-plan Knut Gussgard, Oslo, Norway

O. REISTAD
Norwegian Radiation Protection Authority (NRPA), Oslo, Norway

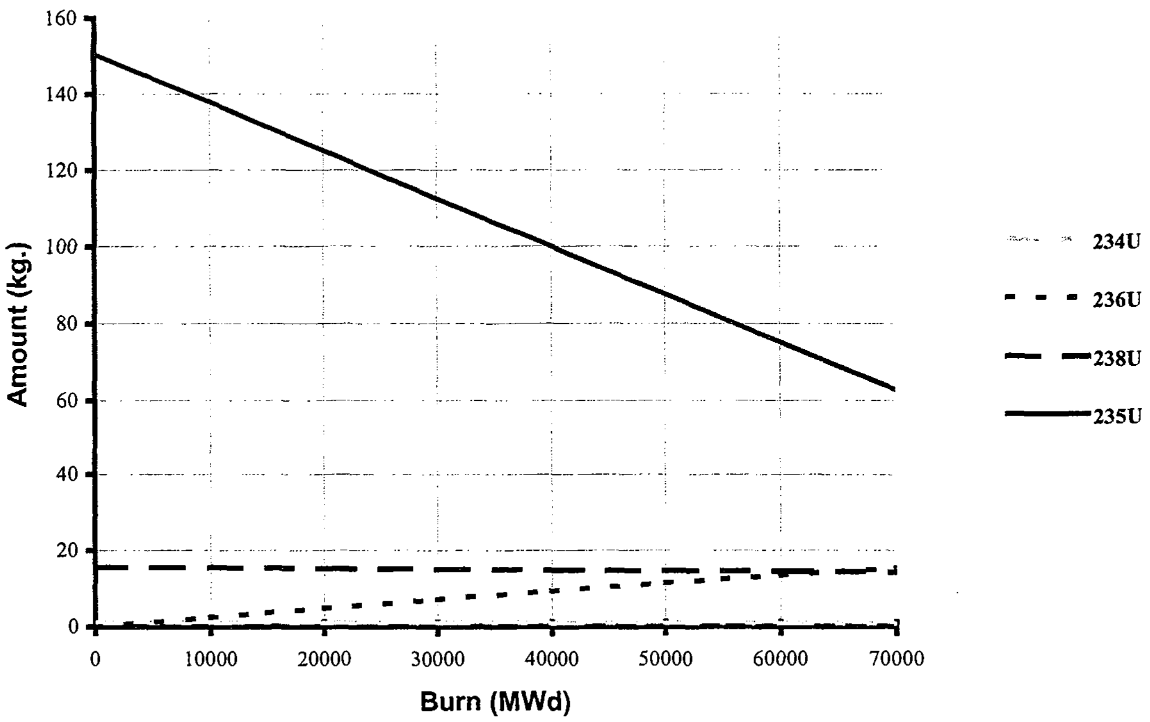
Russian marine fuel is a trans-national security concern. This paper focuses on specific technical properties of Russian marine nuclear fuel especially relevant for evaluating different aspects on nuclear proliferation, in addition to risks associated with regional environmental degradation and illegal diversion of radiological substances. Russian fresh fuel for marine reactors has been involved in several significant cases of illicit trafficking of special nuclear materials. The amount and quality of nuclear materials in Russian spent marine fuel give also reason for concern. Not less than 200 marine reactor cores are ready for having their spent fuel unloaded and preliminary stored on shore in the Far East and North West of Russia, and large amounts of spent naval fuel have been stored at Russian military bases for decades. [1]

In order to assess the security risks associated with Russian spent marine fuel, this paper discusses the material attractiveness of spent fuel from all types of Russian marine reactors. The calculations are based on a model of a light water moderated Russian icebreaker reactor. The computer tool HELIOS, used for modelling the reactor and the reactor operations, has been extensively qualified by comparisons with experimental data and international benchmark problems for reactor physics codes as well as through feedback from applications. Some of these benchmarks and studies include fuel enrichments up to 90% in Russian marine reactors. [2]

Several fuel data cases are discussed in the paper, focusing especially on 1) early fuel designs with low initial enrichment, 2) more modern fuel designs used in third and fourth generation of Russian submarines probably with intermediate enriched fuel, and 3) marine fuel with initial enrichment levels close to weapon-grade material. In each case the fuel has been burned until k_{eff} has reached below 1. Case 1) has been evaluated in [3], the calculations made as basis for this paper have concentrated on fuel with higher initial enrichment of ^{235}U as put forward in case 2) and 3), and to compare and discuss the data taking into account the assumed presence of each of the groups of material in the Russian marine fuel cycle.

The calculations show that in fuel with initial enrichment close to weapon grade, i.e. 90 %, the enrichment of a burned core may be as high as 75 % and the amount of ^{235}U some 63 kg as seen in FIG 1. The amount of ^{239}Pu reaches in this case 0,4 kg before the consumption rate passes the production rate in the reactor. Further evaluations of the weapons quality of the special nuclear materials are included in the paper. Included in the paper are also more extensive graphical description of the amounts of isotopes of U, Pu and other actinides in the different types of marine fuel, including initial enrichments levels from 20-97%, initial loads of ^{235}U from 100 to 200 kg, also including different kinds of fuel and absorber material. The results include a ranking of the proliferation risk for different kinds of Russian spent marine fuel. The most serious proliferation concerns in this context are related to spent fuel with particular low and particular high initial enrichment. Other, more general security concerns exist when considering spent fuel removed from the vessels with little or no indication of operation history and isotopic concentrations. The results show also that, after more than 30 years storage after decommissioning, the fuel assemblies can hardly be regarded as being self-protected. This fact has not been taken into account when international protective measures at the Russian bases have been implemented, a major flaw in the efforts to increase physical protection at the Russian naval bases.

FIG 1. Seleted isotopes in a Russian marine reactor with fuel enriched to 90%, initial load 150 kg. U-235



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