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design office

DISPOSAL OF RADIOACTIVE WASTE INTO SPACE

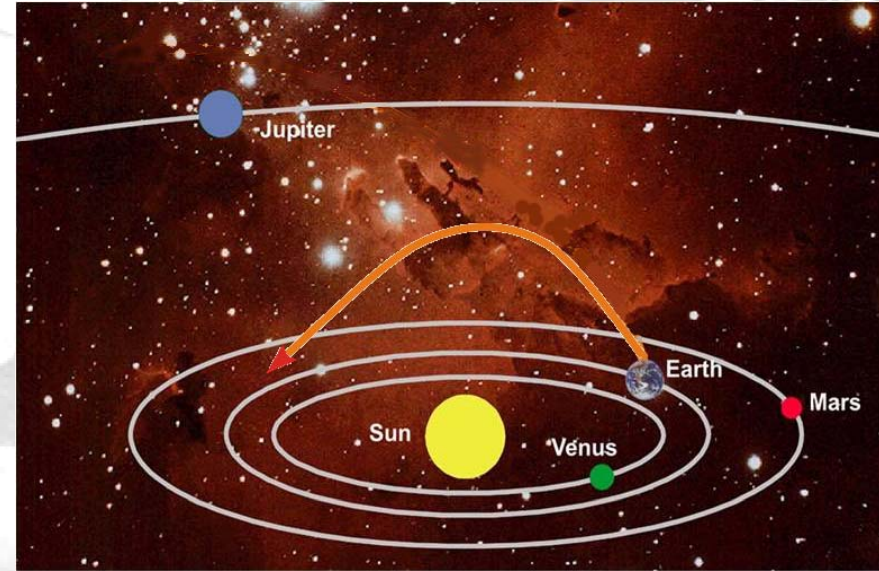
PREREQUISITES



- The problem of Radioactive Waste removal (RW) is one of the three major problems of nuclear power engineering alongside with its safety and economic indicators. One of the ways to cope with the problem is burial of part of RW in space. It is assumed that long-live isotopes, including highly diffusive ones, are to be the subject of space burial. The portion of long-life isotopes in exhausted nuclear fuel (ENF) is approximately 1%. About 10500 tons of ENF are annually being discharged from tanks throughout the world.
- Conceptual studies of burial of ENF in space, mostly by efforts of enthusiasts, have being carried out for more than 20 years. The outcome of these studies is definition of the tasks to be solved, preliminary proposals on the range of technical aspects, recognition of interdisciplinary and intergovernmental level of the problem.
- Thoroughly elaborated proposals from rocket-space industry can considerably expedite the process of decision making on the necessity of space disposal of a part of ENF by nuclear industry specialists.



THE PROPOSED APPROACH



For the purpose of disposal of a part of ENF into space, the following sequence of operation is to be performed:

- Launch vehicle is injecting a special disposal orbital stage (with humidified ENF, placed in safety capsule) into reference circular Earth orbit.
- The disposal orbital stage provides space maneuvering and injection of ENF into the burial orbit by its onboard propulsion system.
- Application of multilaunch scheme is possible. This scheme provides a number of capsules with ENF injected into reference orbit and gathered into a single structure which is placed into the burial orbit by a special tug module.

KEY ASPECTS

Four groups of issues have to be solved to implement radioactive waste space disposal:

- 1. Radiation-chemical utilization of exhausted nuclear fuel (ENF) for separation of isotopes mixture, that should be disposed; bringing isotopes to the state appropriate for using them as a payload of a space vehicle; the technology of handling such payload at all stages, including possible emergency situations.
- 2. Determination of burial orbit and development of space-rocket system for injection of RW into this orbit, that would be competitive with alternative burial options by costs and safety criteria.
- 3. Personnel, public, environmental safety assurance (acceptable risk levels), both during the ground operations with radioactive waste, and in possible emergency situations during injection into a burial orbit, with practical demonstration of injection technology safety through full-scale simulation of off-nominal situations.
- 4. International legal basis development for practical launching of vehicles with radioactive waste; making international legal and political decisions to support corresponding programs.

PROPOSED SOLUTIONS

- Yuzhnoye SDO proposes to initiate Research and Development Project devoted to the aforementioned subject under International Academy of Astronautics that will join efforts of international experts in space-rocket field as well as other fields of science.
- It is expected to focus on the second and the third groups of issues related to the Project implementation within the framework of IAA.
- Major contribution into solution of the second and the third groups of issues shall be made by experts in space-rocket area. Their participation is also required for solution of the first and the fourth groups of issues. Available expertise related to this subject (in Ukraine, Russia and other countries) will become the basis for "rocket-space" part of works under the Project, which is proposed to be implemented under IAA.
- Level of Study details of the first and the fourth groups of issues will substantially depend on the feasibility to involve qualified experts in the field of nuclear technology, and international law.

Solution of the third and the fourth groups of issues has an independent value, regardless of implementation of RW disposal into space.

Necessity in solar system exploration in the next 10-20 years will require utilization of electrorocket or nuclear engines, for which nuclear reactor will be indispensable (either as a part of engine itself or as a source of energy) to perform interplanetary missions.

It will require injection of significant amount of fissile material into space – which means a solution of the third and fourth groups of issues.

EXPECTED RESULTS OF THE PROJECT

The main results of Project implementation will be the following:

- **Determination of expediency of full-scale deployment of scientific-and-research as well as design-and-development works with the purpose of creation of rocket-space system for radioactive waste disposal into outer space, specification of these works directions, scope and possible duration of works implementation;**
- **Proposals on the basic technical solutions within the second and the third groups of issues;**
- **Overview and establishment of conceptual approaches under the first and the fourth groups of issues (results of this item will considerably depend on a possibility to involve appropriate experts into these works);**
- **Costs estimation of the full-scale implementation of the Project;**
- **Proposals on the composition of international scientific-industrial cooperation necessary for the Project implementation.**