Reduction and Resource Recycle of High Level Radioactive Wastes with Nuclear Transmutation

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1982 Received Ph.D from the Graduate School of Interdisciplinary Science and Engineering, Tokyo Institute of Technology
1983 Joined Toshiba Corporation (Nuclear Technology Research Laboratory)
2012 - present
Chief Engineer, Power and Industrial Systems Research and Development Center, Power Systems Company, Toshiba Corporation

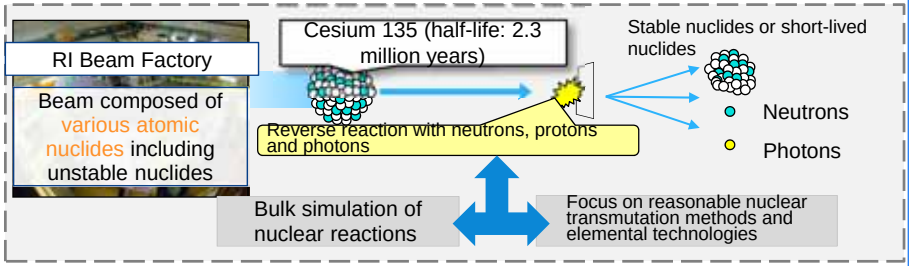
Profile

A leading figure in the development of pyrochemical reprocessing technologies for the metallic fuel cycle, whose proposals have been selected six times in open competitions held by the Ministry of Education, Culture, Sports, Science and Technology for innovative nuclear power systems. Has pursued joint research at institutions that include the Central Research Institute of Electric Power. Recipient of many awards including the Atomic Energy Society of Japan Award for Distinguished Technology in 1995, and the same institution's Best Paper Award in 1999. Has served as a Director of the Atomic Energy Society of Japan since 2010, and was appointed President in 2014. Doctorate of Science.

Disruptive Innovation

✓ Keys to Breakthrough

・To be the first in the world to obtain nuclear reaction data for long-lived fission products, and to confirm the world's first nuclear reaction path for conversion to short lived nuclides or stable nuclides



The Challenges for the PM and the Impact of Success

✓ Overview and background

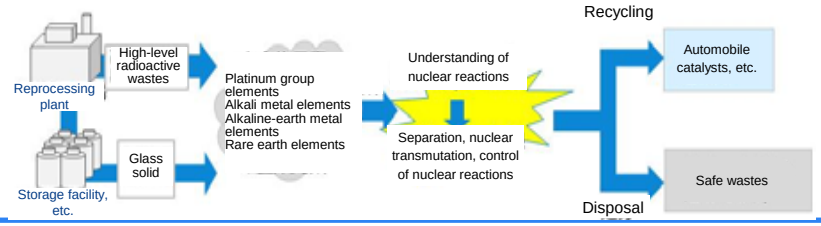
・The high level radioactive wastes that are produced when spent fuel from nuclear power plants is reprocessed are vitrified in glass and disposed of through geological disposal. These high level radioactive wastes include long-lived fission products, and the concerns regarding long-term storage have not been removed. As a result, the difficulty in deciding on disposal sites for these wastes is an issue facing society.

・The goal is to reduce the burden on future generations resulting from the processing and disposal of high level radioactive wastes, and to recycle the recovered platinum group elements, rare metals and other materials in order to keep a supply of resources that is not affected by overseas markets.

✓ Impact on industry and society in the event of achievement

・The long lived fission products (LLFP) included in high level radioactive wastes will be separation and recovered and then converted through nuclear transmutation into short-lived nuclides or stable nuclides.

・Following nuclear transmutation, platinum group nuclides will be recycled into automobile catalysts and so on. In addition, through nuclear transmutation, alkali metal and alkaline-earth metal elements will be recycled into nuclear medicines, etc. and rare earth elements will be recycled into rare metals in magnetic materials.に左右されない



Scenario for Success and Achievement Targets

✓ Method of resolution leading to achievement (approach)

・In order to propose and confirm optimal nuclear reaction paths, data must be obtained by the most advanced facility using a large-intensity beam + reverse reaction study method. Bulk simulations of nuclear reactions will be conducted based on the data that have been obtained.

・Technologies for separating even number nuclides from odd number nuclides, nuclear transmutation methods that do not involve isotope separation, and methods that enable control of the neutron reactions produced by the nuclear reactions will be developed.

・The team will collaborate with the development groups at minor actinide nuclear transmutation test facilities and propose to develop a practical process concept.

✓ Management strategies

・There will be integration and collaboration with the most advanced nuclear physics and nuclear engineering.

・Multiple companies will participate from the initial stages onward with a view to future development.

・Following data obtained (a world first), engineering development will be promoted rapidly.

✓ Achievement Targets

・A study will be proposed of practical processes for separating long lived nuclides from high level radioactive wastes and wastes vitrified in glass, and using nuclear transmutation to convert them to nuclides with a short lived or stable nuclides.

✓ Risks

・In order to propose nuclear transmutation systems capable of achieving reasonable costs and energy balance, it will be necessary to discover or invent several technologies, including accelerator technologies, target technologies and neutron control technologies, and this will be extremely difficult.

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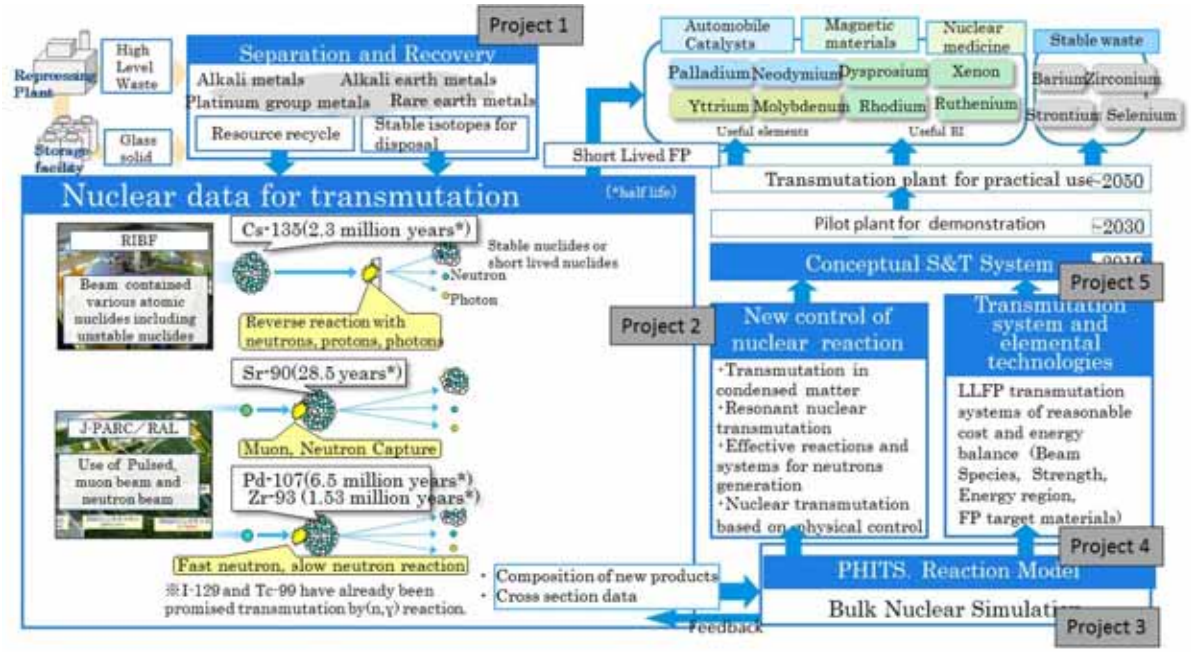
Overall R&D Program Structure Created by the PM



・The program is composed of the following five projects. Each project consists of multiple research topics.

Project 1: Development of separation and recovery technologies

Project 2: Obtained nuclear reaction data & new nuclear reaction control method

Project 3: Reaction theory modeling and simulation

Project 4: Evaluation of nuclear transmutation system and development of elemental technologies

Project 5: Process concept for design

・The critical path is Project 4. Cooperation with the other projects and transition from scientific discovery to engineering deployment.

・After this program, system development should be continued for the goal of practical implementation using a pilot plant.

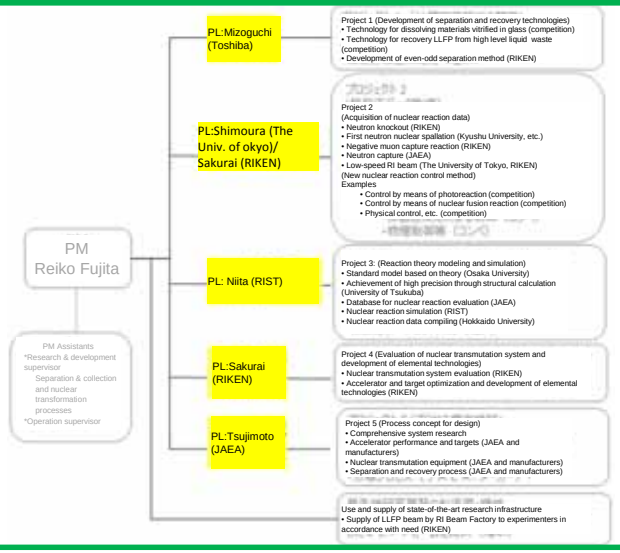
Total R&D Program Cost

JPY3.4 billion

* May increase/decrease depending on development progress

* Expenses required for PM activities and support will be provided as a separate allowance.

Implementation Structure as Assembled by the PM



✓ Key points for implementing organization

・A Project Leader will be arranged for each project. The Project Leader will be involved in the overall operation of the Program under the PM and will make integration and collaboration with the other projects in the progress of research. Several PM Assistants will also be arranged to work under the PM to assist in management in the view point of promoting cross-departmental research.

✓ Approach to institution selection

・The advanced research institutes and research institutes with a enough knowledge of the unique theoretical models, simulations, etc. or the advanced facilities needed for the program will be selected in order to achieve the goal.

・An open competition system will be introduced for the separation and recovery technologies which have been made some progress in research in the field, and for new control systems of nuclear reactions required innovative ideas, in order to ensure the overall program concept.

・The team will collaborate with facilities already conducted experiments on transmutation of minor actinides.

・From the beginning of this program, multiple companies will be participated in the prospects of the future implementation.