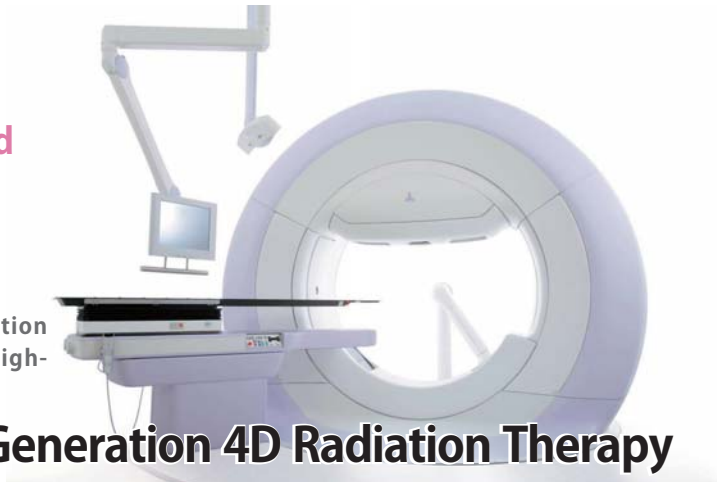
Mitsubishi Heavy Industries, Ltd
Kyoto University
Foundation for Biomedical Research and Innovation



Fundamental Technology Research Facilitation Program/Development and Research on a High-Precision 4D Radiation Therapy System

Development of a Next-Generation 4D Radiation Therapy System That Enables Irradiation of a Moving Cancer

Irradiation Precision Error: ± 0.1 mm
Realization of High-Precision and Safe Cancer Therapy

Today, the most common cause of death in Japan is cancer, which accounts for one out of every three deaths. Against this backdrop, NEDO has contributed to a reduction in the number of cancer patients through early social reintegration of cancer patients and improved quality of life (QOL) as a result of the development of cutting-edge medical equipment that enables early cancer diagnosis and therapy.

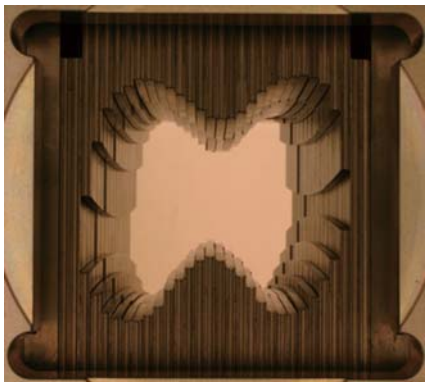
There are three types of cancer therapy: surgery, chemotherapy, and radiation therapy. Among them, greater expectations are placed on technological advancement of radiation therapy because it puts the least strain on the body and is highly effective as a cure. The greatest challenge in radiation therapy is to avoid damaging normal cells when irradiating cancer cells.

Mitsubishi Heavy Industries, Ltd. carried out NEDO's Fundamental Technology Research Facilitation Program/Development and Research on a High-Precision 4D Radiation Therapy System project for four years from 2003 in collaboration with Kyoto University Hospital's Department of Radiation Oncology and Image-applied Therapy and its Clinical Research Center for Medical Equipment Development to establish fundamental technology. It subsequently carried out the Subsidized Project for Practical Development of Next-Generation Strategic Technology/Analysis of the Behavior of Affected Parts and Development and Research of Feedback Technology Toward Adaptive 4D Radiation Therapy project for two years to resolve technical issues for practical application. This then led to the Vero4DRT, a next-generation 4D radiation therapy system that made it possible to irradiate a moving cancer for the first time in the world.

As a newcomer in the medical equipment business, Mitsubishi Heavy Industries initially carried out medical-related activities through intrapreneurship. In this situation, it was able to realize an innovative and safe high-precision radiation therapy system in which the irradiation precision error of therapeutic X-rays (referred to as "therapeutic beams") is within ± 0.1 mm. This was accomplished by combining know-how obtained through an industry-academia partnership, such as image diagnosis, with its technology for system integration of large equipment and its globally competitive technology for accelerating tubes.

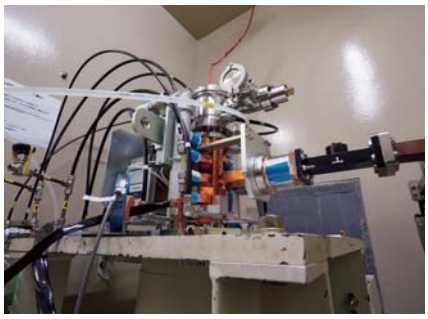
In order to cure a cancer that moves because of respiration or some other movement, the Vero4DRT was designed as a 4D high-precision radiation therapy system by adding temporal axis to the concept of 3D therapy that enables irradiation from various angles. As a result, the system has numerous new advanced functions not seen in previous radiation therapy systems.

As of February 28, 2015, 24 units of the system were installed in hospitals not only in Japan but also in Europe, the US, and Asian countries. These hospitals have successfully performed irradiation of lung, liver, and pancreatic cancers. The Vero4DRT is attracting attention as an innovative therapy system that enables a radical cure without putting much strain on the body.



Multileaf collimator enables irradiation suited to the shape of a cancer
(Photo courtesy of Mitsubishi Heavy Industries, Ltd.)

An infrared marker detects respiratory signals. The behavior of a cancer is determined using real-time X-ray images.



World's first small C-band accelerating tube designed for medical use

Q. Why did this project start?

To improve the fundamental technologies of private companies and disseminate their research results, NEDO has been carrying out the Fundamental Technology Research Facilitation Program since 2001. This program aims to support the development of technology that is beneficial to the nation's economy but which involves a high level of risk for individual companies and requires considerable investment and a long time period to realize results. The 4D radiation therapy system project was selected from applications submitted following a public solicitation for new projects in the life science field.

Q. What was the aim of the project?

When this project started, there were no domestic manufacturers developing radiation therapy systems. However, the project was expected to develop a radiation therapy system with a unique feature (i.e., irradiation of a moving cancer) that was the first of its kind in the world. This would enhance therapeutic efficacy and thereby contribute to the spread of diagnostic and therapeutic equipment that serves as a common base for radiation therapy systems, industrial development in related fields, and the creation of new markets.

Q. What is the role of NEDO?

Since this project involved new technology that required a large amount of investment, a long period of time to achieve results, and also posed a high level of risk to individual companies, NEDO recommended collaboration between industry, academia, and government. This facilitated the early realization of advanced fundamental technology. In addition, the fundamental technology that was developed in this project was subsequently incorporated into technology development for practical application in NEDO's Subsidized Project for Practical Development of Next-Generation Strategic Technology/Analysis of the Behavior of Affected Parts and Development and Research of Feedback Technology Toward Adaptive 4D Radiation Therapy (FY2006–FY2007). This support system from fundamental technology to practical application led to the early practical application of high-precision radiation therapy.