

SHIN-1: First Commercialization of Cyclotron-based BNCT System “NeuCure”

Shin Masui, Toshinori Mitsumoto

Sumitomo Heavy Industries, Ltd., Tokyo 141-6025, Japan

An accelerator-based BNCT system developed by Sumitomo Heavy Industries, Ltd. (“SHI”) has recently received an approval of medical device from the competent Japanese Healthcare Authority. A groundbreaking treatment system named “NeuCure” is the first commercialized system for hospitals in BNCT history. The approved indication is unresectable locally advanced or locally recurrent head and neck cancer.

The key of the development was the consistent and reasonably tolerable realization of the system design throughout the whole treatment process rather than just an accelerator development. In this respect, NeuCure includes both a neutron irradiation system and a Monte Carlo Dose Engine (“NeuCure Dose Engine”) for treatment planning. SHI chose a combination of a 30MeV cyclotron and a beryllium target to obtain the necessary amount of neutron flux for human treatment because of its excellent track record of cyclotron developments and chemical/physical stability of beryllium against high energy proton bombardment. In addition, a patient positioning system plays an important role in the actual irradiation system. Neutrons intrinsically diffuse and low energy neutrons (thermal and epithermal components) in particular easily leak and are lost at the treatment position if there is an unacceptable spatial gap between the patient and the collimator at the exit of the neutron port; therefore, a facility for NeuCure has a preparation room to secure planned positioning and the accurately and appropriately positioned patient is automatically transferred to the treatment room. With 1mA proton beam, the treatment duration is less than 1 hour.

A treatment planning system dedicated for BNCT was also developed and approved as a medical device simultaneously with the accelerator system. The calculation is executed by NeuCure Dose Engine with the help of a Monte Carlo calculation code, PHITS (Particle and Heavy Ion Transport code System), developed by Japan Atomic Energy Agency (JAEA), and a commercially available software, RayStation, is used as a graphical user interface.

As is always the case with new medical devices, SHI spent a long embryonic time, more than 15 years of development and clinical trials in total up until the official approval, and BNCT has set in motion for medical treatment covered by the national insurance in Japan. In the poster, the outline of NeuCure system, its development history and the current operating facilities are presented.