Advanced Oncotherapy readies first linear proton beam accelerator system for debut

December 9, 2019

By Nuala Moran

LONDON – Advanced Oncotherapy plc is starting verification and validation of the world’s first linear proton beam accelerator system, which is assembled and ready for testing at the Daresbury particle physics laboratory in Cheshire, U.K.

At the same time, the building that will be the permanent home of the accelerator is nearing completion in central London.

The company expects the first patients will be treated at Daresbury before the end of 2020, after which the Linac for Image Guided Hadron Technology (LIGHT) system will be moved to London to start commercial operation.

Completion of the tests at Daresbury will enable Advanced Oncotherapy to get FDA 510(k) and EU CE marking for LIGHT, and also help confirm the promised competitive and therapeutic advantages of the next-generation linear technology over traditional circular proton accelerators.

Circular accelerators, based on 1950s technology, are “highly, highly, inefficient,” said Nicolas Serandour, CEO of Advanced Oncotherapy. When protons emerge from the machine they are at full energy, travelling at 60% of the speed of light and have to be slowed down with mechanical absorbers. “For 100 protons generated in the machine, one or two reaches the patient,” Serandour said.

Not only is that inefficient in therapeutic terms, it means circular accelerators need 6 to 7 meters of concrete shielding to protect against the radiation that is released.

“That’s the challenge of the current technology. You need a large machine and a huge building,” Serandour told BioWorld MedTech.

In contrast, Advanced Oncotherapy’s LIGHT system can be finely controlled, removing the need for absorbers and reducing the amount of shielding required. “We accelerate protons in a straight line. The energy is increased as the protons move through the machine, and when the energy is right, acceleration stops,” said Serandour.

In the LIGHT system, which is based on technology developed at European Organization for Nuclear Research (CERN), the international particle physics laboratory in Geneva, Switzerland, the beam can be manipulated to deposit more than 200 pulses of protons of differing energy per second. In contrast, legacy systems can deliver only one to two pulses of differing energy per second.

Advanced Oncotherapy says the fast energy modulation will be particularly useful for targeting tumors that move as the patient breathes, opening the opportunity to treat a
much wider range of cancer types, such as lung tumors. It also is expected that treatment cycles will be much shorter.

These features will give greater flexibility to adjust the treatment plan, to factor in changes such as tumor shrinkage or weight reduction. Working with Raysearch AB, a specialist in treatment planning software, LIGHT has been tuned to deliver sub-millimeter proton beam sizes. That is expected to make for improved accuracy and ensure healthy tissue is not irradiated.

A further advantage is that rather than a single heavy unit, the LIGHT linear accelerator is compact and modular, making it easier to install.

The proof of this superior profile is being played out in London currently, where University College London Hospital (UCLH) is building a conventional proton beam therapy center just five blocks away from the home-to-be of the first LIGHT system, in Harley Street.

Both are on constrained and hemmed in sites in the city, but the system UCLH is installing has made for a much more expensive project. In addition to a 90-ton cyclotron, the three gantries that deliver the proton beam to the treatment suites are three stories high and each weigh 120 tons.

LIGHT’s linear format means each module of the accelerator can be installed without the need for specialist lifting equipment. There is no need for gantries, rather, patients are treated on a robotic chair, which moves as necessary to get best access to a tumor.

While UCLH has built on a vacant site, Advanced Oncotherapy is installing its machine in the basement of a town house in a conservation area. “It’s a grade II listed building,” Serandour said. “We had to keep all the windows.”

The two projects are not exactly like-for-like – in addition to the proton beam treatment center, UCLH’s project includes a specialist hematology hospital. But converting the building to house the LIGHT system cost Advanced Oncotherapy £10 million; the construction costs for UCLH’s building were £195 million.

During 2019, Advanced Oncotherapy has raised £16 million (US$20.8 million) in equity and £14 million in debt. More capital will be needed to scale up once the first system has regulatory approval, said Serandour.

The London-based company is laying the ground. Production of the components of LIGHT systems is outsourced, and talks are ongoing with suppliers in Asia, Europe and the U.S. The aim is to build the capacity to deliver eight machines per year.

Rather than selling the machines, it is planned to operate a leasing scheme, reducing the upfront capital investment for customers.

“We are in discussions with financial institutions on leasing arrangements to accelerate the pipeline,” Serandour said. “We’ve got strong commercial traction. I’m confident of [soon] announcing purchase orders.”

His thesis is that the arrival of more powerful and lower cost accelerators will be a tipping point in the development of the proton beam market. The superior clinical performance of
proton therapy over conventional radiotherapy is not in question, but the high cost of housing and operating circular accelerators has held back commercial development.

According to Serandour, there are currently 200 proton beam treatment rooms worldwide, treating 160,000 patients per year. The clinical need is for 10,000 treatment rooms.

“It’s not different from what happened with MRI. It took time for the market to develop because the machines were so bulky. Then the machines got smaller, and the leasing model developed. We have an opportunity to do the same in proton therapy,” Serandour said.