

Advancements in Cancer Treatment Spur  
New Proton Therapy Facilities Nationwide  
— Are You Ready?

# PROTON POWER



It's been called a "new nuclear arms race" by The New York Times. As proton therapy continues to be proven a safe and highly effective tool for fighting cancer, more and more hospitals, medical centers and clinical consortiums across the United States are working to develop facilities that will allow them to offer this powerful treatment option to their patients. Since 2000 — when only one hospital-based proton therapy center operated in the United States — five additional centers have come online, four are under construction and several more are in the planning stage.

This boom is spurring significant changes in how proton facilities are developed. As proton therapy has shifted from primarily research-based protocols to a substantial set of proven treatment procedures, financing has become more available and earlier slowdowns due to Federal Drug Administration approvals have been largely eliminated. Innovations in equipment and experience in building design are removing much of the uncertainty from the development process, leading to more efficient and attractive facilities, and cutting the time from the start of planning to the first patient treatment from five years to three. New technologies for beam delivery coupled with novel techniques borrowed from other branches of radiation oncology are yielding new, more responsive protocols for a wider variety of cancers, including lung and breast cancer, that are

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**Photos by Jonathan Hillyer**



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Clinical demand coupled with a growing body of benchmark information, more choice of equipment vendors, and a wider variety of financing options is leading more organizations to consider building proton facilities like The University of Texas M. D. Anderson Cancer Center Proton Therapy Center in Houston.

**Welcoming arrival sequences, ample natural light, views to the outdoors, comfortable furnishings, and interaction spaces allow recent proton therapy facilities such as the University of Florida Proton Therapy Institute in Jacksonville, Fla. to create a feeling of hope and recovery in a technology-intensive environment.**

helping to grow demand and allay fears of overbuilding.

Still, there are many challenges associated with developing proton facilities. Even the most experienced healthcare providers, administrators, facilities managers, architects and engineers will find themselves in unfamiliar terrain when it comes to developing a proton therapy facility. In terms of technical complexity, proton facilities are in a class of their own. With unusually rigorous tolerances, nuclear-level shielding requirements and large-scale, highly sensitive equipment, they require a level of collaboration and precision in planning, design and construction that is unparalleled in any other kind of healthcare or medical research facility.

### **Deciding what to build — and where**

After the essential business model is established — which should include the range of protocols and corresponding number and type of treatment rooms — a critical next step in any proton project is to determine whether the facility will be free-standing or integrated within a larger medical center. Free-standing centers offer the ability to establish a separate identity for the facility, greater flexibility in siting the building and easier access to the site during construction. On the downside, such facilities may inconvenience patients if they do not house other radiation treatment protocols or related specialists essential to a patient's care.

By allowing all radiology treatments — including the imaging essential to planning proton therapy — to be delivered under one roof, integrated facilities not only offer one-stop care for patients but also can improve interaction and collaboration among research and clinical staff.



In addition, they require less equipment redundancy than their free-standing counterparts. Drawbacks include the challenges of providing ample shielding within the confines of an existing building, accommodating installation and maintenance of the massive proton equipment, and allowing for future growth.

In the case of both free-standing and integrated facilities, site conditions will largely influence the decision to build above or below grade. Building a proton facility at least partially below grade, including in the lower levels of a larger building, allows the surrounding earth

to act as shielding but requires creative design to bring in natural light. Bringing the facility above grade, particularly on sites where there are poor soil conditions or a high water table, mitigates the risk of a 'basement feeling' but requires more extensive concrete shielding.

### **Choosing the proton equipment vendor**

The equipment is the costliest element of any proton therapy facility — comprising as much as two times the cost of the building itself. Equipment specifications in large part dictate the design of the build-

# PROTON THERAPY AT A GLANCE

Proton therapy is on the cutting edge of cancer treatments available today. It offers new hope to patients with some of the most challenging cancer types, including pediatric cancers as well as tumors of the eye, brain, spine and prostate. Administered over multiple visits, the treatment uses proton beams to deliver a powerful dose of radiation directly to well-defined tumors while minimizing damage to surrounding healthy tissues. This higher degree of precision results in fewer and less severe side effects than those associated

with conventional radiation therapy.

Proton technology relies on an accelerator — a cyclotron or synchrotron — to energize protons, which are simply hydrogen atoms whose electrons have been removed. This proton accelerator lies at the heart of any proton therapy facility and is the primary design driver for the building. The complexity and precision of the technology present a host of design and construction challenges that include setting a 200-ton cyclotron in place within a tolerance of a few millimeters,

ensuring zero structural movement once the beam is calibrated, providing heavy shielding that sometimes must be 15 feet of concrete in order to keep stray particles from escaping, and ensuring access to the equipment to allow for repair, replacement or ongoing maintenance. Most importantly, to keep them financially viable, proton facilities must be designed to be extraordinarily efficient yet flexible enough to adapt to advances in technology — all while remaining highly sensitive to the patient experience.

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ing, so a vendor must be chosen at the very outset of the project. Upon selection — and ideally before schematic design begins — a vendor will provide documentation that details the interface between the equipment and the building, including equipment weight, floor leveling tolerances, shielding, electrical power needs and other technical requirements.

As the field of proton therapy has expanded, several equipment manufacturers have emerged to meet the growing demand, and advances in the development of smaller-scale equipment may soon allow for a more limited range of treatment options at a lower cost and space requirement. When choosing a vendor, keep in mind that the complexity of the equipment and related maintenance results in a long-term relationship. Criteria to consider include a firm's production schedule from manufacture of the equipment to calibration of the beam, the strength of their research division — which will allow them to keep up with changes in technology — their staffing levels and the availability of replacement parts.

### Creating an environment for healing

The business plan for any proton therapy facility relies on a high patient throughput that can be achieved only through full integration of the building and the technology it houses. An efficient layout is a key element. Proton therapy requires multiple patient visits — as many as 45 visits for prostate cancer, for instance — so achieving optimal patient flow is vital. From parking to check-in to treatment, patient travel must be logical, direct and deliberate without ever seeming hurried. Likewise, staff flow and access to treatment-support services and equipment must be organized to promote peak operational efficiency.

By virtue of their technical and shielding requirements, proton facilities could look like massive concrete bunkers. The high throughput required to keep proton facilities viable places pressure

on architects to achieve almost industrial efficiency in a patient-care setting.

Meeting these technical and operational challenges while also creating an environment for healing represents the essence of proton facility design. Recent facilities, including the University of Florida Proton Therapy Institute in Jacksonville, Fla., The University of Texas M. D. Anderson Cancer Center Proton Therapy Center in Houston and the University of Pennsylvania Health System in Philadelphia, as well as ProCure Treatment Center facilities underway in Oklahoma City and Chicago, illustrate several ways of achieving this balance in a technology-intensive environment. They aim to convey a sense of hope and recovery and to offer a spa-like rather than a clinical atmosphere through welcoming arrival sequences, ample natural light in both patient and staff areas, comfortable furnishings and various interaction spaces.

Perhaps no other building type brings together — or tests — the disciplines of physics, medicine, planning, architecture, engineering and construction in the way that proton therapy facilities do. While innovation will continue to refine the development of proton facilities, organizations that are considering adding a proton therapy service line now have more benchmark information, equipment vendors and financing options than ever before, and can take advantage of the advancements in this cutting-edge treatment option by thoroughly educating themselves and their institutions before diving in. ■



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