

PRE-OWNED

LINEAR

ACCELERATOR

Buyer's Guide

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## CONSIDERATIONS FOR BUYING PRE-OWNED

If you want to choose the right linear accelerator for your budget and clinical needs, you have come to the right place. We created this Buyer's Guide to help you sort out the steps needed for your next equipment project.

### **When is purchasing a pre-owned linear accelerator a good idea?**

Purchasing a pre-owned linear accelerator system is not recommended for every facility. New equipment is more often a better solution for many customers. If your center requires the latest technology available in the market today, or if you are planning on installing a machine that will not be replaced for a longer period of time (at least in the next 10-15 years) then a brand-new machine, or an almost-new machine, is often the better choice.

However, it's important to note that unless a linear accelerator was installed in the past week, it's already a "used machine." This means that virtually every linear accelerator system in operation today is already used.

Insurance companies, governments, private individuals and other payers do not differentiate payments based on the age of the equipment.

## Pre-owned linear accelerator systems may be suitable for customers under these circumstances:

1. If you are **treating few patients** (less than 8 or 10 per day, as a general rule) and may not have the revenue to sustain a more expensive machine.
2. If you live in a country or region where **reimbursement rates are low**, and you are a clinic that must operate profitably to exist (vs. a public clinic that is not concerned with profitability).
3. If you will be using the linear accelerator in a limited manner, without the need for all of its technologies. For example, if you are treating pets or other animals and do not require advanced technologies, such as in the **veterinarian or research** fields; or if you are using only electrons to treat skin cancer for humans; or even if you are using it for **non-medical, industrial** purposes to image materials.
4. If you intend on buying new, more expensive equipment and technology in the next 4-7 years but cannot afford it now and want to **build up the revenue base** of the practice.
5. If you are starting a new center and **do not have a lot of capital** or cannot secure financing to cover the costs of a new machine, or if you don't have a clear understanding of patient volume just yet and want to wait.
6. If you have only one linear accelerator in your center, **need to move locations**, and can't afford to have any down time.
7. If you want a **backup machine** to protect your practice in case the main linear accelerator becomes inoperable or must be replaced.
8. If you need a **temporary solution** while your new center is being built.

When given the option, some buyers would prefer a brand new, state of the art linear accelerator with the latest treatment technologies. But with the realities of economics and current political policies, this is not always possible.

Purchasing pre-owned equipment may not mean using dated technology. Newer machines often make it into the pre-owned equipment market, offering customers the ability to acquire the latest technology at a more affordable price. And many machines are also upgraded over time, as most original equipment manufacturers, as well as some third-party manufacturers, offer upgrade platforms for pre-owned systems. Besides, many brand-new machines are sold without the latest technologies.

Pre-Owned equipment is often a good strategy when building a new center where patient volume is uncertain. Many of R.O.S.'s customers that initially purchased pre-owned equipment to build or start a radiation oncology practice, have later gone ahead to purchase brand new systems as their practices have grown. In fact, the first-ever Varian Unique Linear Accelerator system sold in the Americas was sold to a radiation oncology clinic that R.O.S. helped launch with affordable, refurbished equipment.

# WHAT SHOULD I CONSIDER BEFORE DECIDING ON A PURCHASE?

**Before you purchase a pre-owned linear accelerator, it is important to consider a variety of factors.**

- How long do I intend to keep it?
- What energies do I require?
- What is my current vault space and shielding?
- Which hardware and software options do I require?
- What manufacturers do I prefer?
- What are my refurbishment options?
- What are the service and maintenance options available to me?
- Will I be selling or replacing existing equipment?
- Do I want accessories and upgrades?



Careful planning can maximize your investment dollars while still providing your patients with quality treatment options.

# LOW ENERGY VS. HIGH ENERGY VS. ELECTRON ENERGY

A linear accelerator (LINAC) uses microwave technology to accelerate electrons in a waveguide, which then allows the electrons to collide with a heavy metal target. High-energy x-ray photons are produced as a result.

## INTERESTING FACT

*Varian brought in the experts at BMW Group DesignWorks USA to design a less intimidating linear accelerator for its line of high-energy X-ray machines.*

*The result is the Varian TrueBeam.*



"Low-energy linacs" are those that can produce a maximum of 6MV photons. "Mid-energy linacs" produce up to 10MV. "High-energy linacs" produce 15MV photon energies and higher. The MV energies utilized will determine how deeply the radiation beam can treat the tumor inside the body. A higher photon energy will penetrate and treat tumors deep within the body.

Electron energies are used primarily for superficial or skin tumors and do not penetrate deeply into the body, making them a preferred tool for dermatology and skin cancer treatments.

# SOFTWARE AND HARDWARE TERMS

## Terms to know when reviewing linear accelerator technology options:

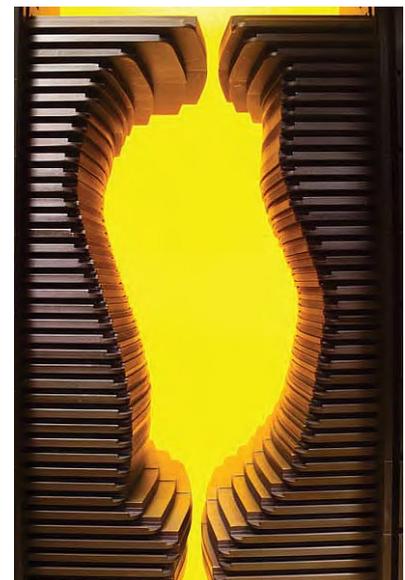
- MLC (Multi-leaf Collimator)
- IMRT (Intensity Modulated Radiation Therapy)
- OBI (On-Board Imaging): KV Imaging Device -- Only Varian
- XVI: KV Imaging Device -- Only Elekta
- EPID (Electric Portal Imaging Device)
- IGRT (Image Guided Radiation Therapy)
- CBCT (Cone Beam CT)
- SRS (Stereotactic Radiosurgery), SBRT (Stereotactic Body Radiosurgery)
- VMAT (Volumetric Arc Therapy)

## HARDWARE COMPONENT OPTIONS

### Multi-Leaf Collimators or MLC's

Since the early 1990's, technological advancements have led to the addition of various components that have improved the precision, speed and targeting of tumors.

An MLC is a device that is affixed to the collimator of the linear accelerator system. It contains several sets of metallic leaves, that when open and closed, can shape the beam of radiation as it exits the linear accelerator.



MLCs are found on virtually all linear accelerator systems sold today. A MLC on a linear accelerator eliminates the need for using block cutting devices to produce beam shaping effects. MLCs are particularly useful when treating patients using IMRT (Intensity Modulated Radiation Therapy).

## Portal Imaging Devices

A Portal Imaging device (often referred to as an EPID or “electronic portal imaging device”) is a device that extends and retracts from the foot of the linear accelerator. It is used for patient positioning and to perform IGRT (Image Guided Radiation Therapy). It is also used for Quality Assurance (QA) by physicists in order to test the linear accelerator and its beam.

Portal imaging devices, when extended in the out position, produce an image when its detector panel is hit by the photon beam emitted from the linac. The EPID uses a detector panel that captures and digitizes the image of either the patient (when used for positioning or IGRT) or the phantom (when used for QA).



*Portal imaging device  
on Elekta linear  
accelerator.*

## KV-Imaging Devices

A KV-Imaging Device (kilovoltage system) looks like right and left “arms” that extend from the gantry of a linear accelerator. One arm contains an x-ray tube, and the other arm contains a detector.

When the gantry of the machine, and its arms, rotate around the patient, images of the tumor are produced. This device allows for much higher quality images than the EPID device. It also allows not just for IGRT, but also CBCT (Cone-Beam CT). With the right hardware and software upgrades, a KV-Imaging Device is essential in performing VMAT (Volumetric Arc Therapy).

Varian and Elekta each have unique brands for their respective KV-Imaging devices. Varian’s is called the “OBI” or “On Board Imager.” Elekta’s is called the “XVI.”

## Beam Stoppers

A beam stopper is a device that is used to replace the foot of the linear accelerator, where the EPID is normally found. Beam stoppers are constructed of steel and are used to provide additional shielding for the machine when vault shielding is not sufficient. Very few, if any, newer machines are manufactured with beam stoppers. Beam Stoppers are often used in older vaults that were originally constructed to have cobalt-60 radiotherapy machines.

## SOFTWARE OPTIONS

Selecting software that easily scales to fit the needs of your applications is important. Below are software options available on select models of pre-owned linear accelerators.

### **IMRT Software**

IMRT (Intensity-Modulated Radiation Therapy) is used to treat harder-to-reach tumors. This advanced software is used to administer the precise dose of radiation, based on tumor size, shape, and location, as to minimizing the damage to healthy tissue. Most pre-owned linear accelerators sold today include IMRT software.

*Hardware requirements for IMRT: An MLC (multileaf collimator) or compensators.*

An MLC (Multileaf Collimator) is used to “shape the beam” of radiation. For linear accelerators that do not have MLCs, IMRT can be utilized by using compensators that are custom designed for each patient.

### **IGRT Software**

IGRT (Image Guided Radiation Therapy) software is found on many pre-owned linear accelerators today. It can also be added as a separate add-on software package.

The IGRT application works by verifying patient exact positioning before starting treatment using imaging devices (MV or KV) on the linear accelerator. The image is compared to a reference image to determine whether the patient is positioned correctly. Any needed adjustments to the patient's position can be made.

*Additional hardware requirements for IGRT: An EPID (electronic portal imaging device) and/or a KV imaging device*

## CBCT Software

CBCT (Cone-Beam Computed Tomography) has increased in usage for radiotherapy due to widespread implementation of KV systems on linear accelerators. Cone Beam acts as an Image- Guided Radiotherapy (IGRT) tool. Not all linear accelerators come with CBCT software.

*Additional hardware requirements for CBCT: A KV-Imaging device or an MV- Imaging device.*

## VMAT Software

VMAT (Volumetric Modulated Arc Therapy) delivers radiation by rotating the gantry of the linear accelerator through one or more arcs while continuously emitting radiation. Compared with conventional radiation therapy techniques, VMAT can improve target volume coverage and spare normal tissue.

VMAT software provides an extremely quick delivery of radiation to the tumor with remarkable precision and accuracy. This software upgrade is expensive but allows patients to complete an entire treatment in as little as two to three minutes. This feature is particularly valuable in centers with a very high patient load.

Facilities with Varian linear accelerators that utilize Varian VMAT software in combination with Varian's other proprietary software packages call their VMAT "RapidArc."

*Hardware requirements for VMAT: Special linear accelerator hardware upgrades, an EPID (electronic portal imaging device) and a KV-Imaging device.*

## "OIS" or Oncology Information System

Most facilities that are using IMRT, IGRT, CBCT, VMAT, or any other advanced radiation therapy protocol, will require an OIS system to organize, manage, and store the vast amounts of information. Varian's ARIA system and Elekta's MOSAIQ system are the two most commonly used OIS systems. Prowess also makes an OIS system.

## "TPS" or Treatment Planning System

TPS is offered by most manufacturers of linear accelerator systems, as well as various independents. The TPS is not an integral part of a linear accelerator system, but it's an essential tool in any practice because it's used to calculate how the dose of radiation prescribed by the radiation oncologist is to be delivered to the patient.

Some popular Treatment Planning Systems include Pinnacle, Varian's "Eclipse", Elekta's "Monaco", Ray Search Lab's "Ray Station", Prowess "Panther".

## LINAC MANUFACTURERS

Current linear accelerator manufacturers include Elekta, Varian, Accuray, ViewRay and Shinva among others. Varian has by far the largest market share of linear accelerators in the U.S., followed by Elekta. Siemens linear accelerators are still bought, sold and installed in the secondary market, although Siemens stopped manufacturing the devices in 2011.

We have compiled a list of popular linear accelerator system that are currently available on the secondary market. You can also view the various linear accelerator comparison charts on the [R.O.S. Website](#).

## Elekta Products

- **Axesse** - A completely integrated solution for SRS/SBRT combined with full featured versatility.
- **VersaHD** – All the capabilities of the Axesse and delivers 3 times the dose rate while maintaining increased precision.
- **Synergy** - First of Elekta's linear accelerators to provide IGRT, CBCT & VMAT with the development of its XVI, KV-Imaging Device.
- **Infinity** - All the same imaging and treatment delivery capabilities of the Synergy, the Agility 160 leaf multi-leaf MLC is introduced for even more beam precision.
- **Synergy S** - Designed with a focus on SRS-Stereotactic Radiosurgery and SBRT-Stereotactic Body Radiation Therapy, but with same IGRT/CBCT/VMAT capabilities as the Synergy.
- **Precise** - A fully digital solution with multiple photon/electron beams, 80 leaf MLC and iView-MV based portal imaging system delivering both 3D and IMRT treatments.
- **Synergy Platform** - All the capabilities of the Precise plus the prerequisites required for an upgrade to XVI (i.e. Synergy).
- **Compact** - Designed for simplicity and high-volume throughput. Smaller footprint enabling installation where vault space is limited, but with similar capabilities of the Precise (Note: sold only in select markets).
- **SL Series (15,18,25,75/5)** - Original Elekta design with basic photon/electron beam delivery and upgradeable to Precise. No longer manufactured.



## Varian Products

- **Edge** - Varian's integrated solution for SRS and SBRT.
- **TrueBeam STx** - Combines BrainLab hardware and software further advancing stereotactic abilities and treatment accuracy.
- **TrueBeam** - Fully digital system with ultra-high, adjustable dose rates, 3 photon energies, and the 120 leaf HD-MLC for increased precision (i.e. SRS/SBRT).
- **Trilogy** - Essentially a 21iX, with a higher dose rate for SRS/SBRT.
- **Halcyon** - Introduced in 2017 as a 6MV only machine with no electrons, with a smaller footprint and an IGRT-exclusive delivery system. The successor to the 600 C/D and 6EX.
- **Clinac 21/23 iX** - With a focus on IGRT, this accelerator if fully loaded comes equipped with OBI, CBCT and RapidArc/VVMAT.
- **Clinac 21/23 EX** - One of the most commonly pre-owned linear accelerators, it comes equipped with 80/120 leaf MLC, IMRT and portal imaging. Upgradeable to OBI, CBCT and RapidArc/VVMAT.
- **Clinac 21/2300C/CD** - Reliable dual photon high energy accelerator with electrons. Upgradeable to an 80 or 120 leaf MLC and portal imaging, this system can delivery 3D and IMRT treatments with precision.
- **Unique** - Similar to the 600 C/D and 6EX with RapidArc capabilities. Not sold in the United States.
- **Clinac 600C/CD/EX** - Can be used in smaller vaults, this is a low energy 6 MV photon accelerator with no electrons, similar to Halcyon with MLC, IMRT and Portal Imaging.

## Accuray Products

- **Cyberknife (G4, G5, VSI & M6)** - The first and only non-evasive robotic surgery designed linear accelerator specializing in SRS/SBRT.
- **Tomotherapy (Hi-ART, HD, H series, Direct & Helical)** - Leading technology that combines a 6MV linear accelerator system with CT imaging capabilities allowing daily precision for 3D and IMRT treatment delivery.

### Key Points:

- This complex and state of the art technology carries high relocation and annual maintenance costs
- Although precise within its own specialty (i.e. SRS/SBRT), the Cyberknife has limited versatility
- Tomotherapy machine's smaller footprint and 6MV maximum energy is ideal for when there are vault space and shielding limitations

## ViewRay Products

- **MRIdian** - The world's first ever MRI – guided linear accelerator suitable for SRS and SBRT.

## Shinva Products

- **XHA600D** - is a Chinese-manufactured, low-energy linear accelerator and consists of the machine, treatment couch, and control system.

## SIEMENS PRODUCTS (Available on Secondary Market)

- **Artiste** - the last and most advanced linac manufactured Siemens, typically equipped with 160 leaf MLC, IMRT and MV based CBCT for IGRT (i.e. M- Vision).
- **Oncor** - an upgraded MLC to 82 leaves combined with a new portal imaging system (i.e. OptiVue 500/1000) and the option of M-Vision CBCT launched Siemens' MV based IGRT.
- **Primus** - development of the 58 leaf MLC and BeamView portal imaging helped introduce IMRT.
- **Mevatron (MD, KD, Mev 6740)** - offering either a magnetron or klystron source these linacs include one to two photon energies for 3D conformal treatment delivery.

### Key points:

- Siemens is no longer manufacturing linear accelerators and has announced its exit from the radiation oncology space
- Various 3rd party service and parts support are still available
- Lower equipment value compared to OEM's still active in radiation oncology



**Comparison charts** for pre-owned Varian, Accuray, Siemens and Elekta linear accelerators can be found on our [website](#).



**Pricing Guidelines** for pre-owned Varian, Accuray, Siemens and Elekta linear accelerators can be found on our [website](#).

# REFURBISHMENT PROCESS

A LINAC can undergo mechanical, electrical and cosmetic refurbishment. Exact refurbishment process will vary depending on modality, make, model and pre-existing condition of equipment.

## 1. MECHANICAL

- Motors, switches, cooling fans, locks and gears, bearings and track surfaces are inspected and replaced as needed
- Components replaced as needed
- Inspected for mechanical imperfections and wear
- Dismantled and thoroughly cleaned
- System calibration

## 2. ELECTRICAL

- Check all emergency stops for operation
- Relays, boards, lamps, meters, indicators, controls and knobs are tested and replaced as needed
- Monitors, keypads, LEDs are tested and replaced as needed
- Check all cables and connectors and replace as needed
- Electrical components checks

## 3. COSMETIC

- Covers are removed, sanded and all imperfections are repaired
- System is disassembled, cleaned, and vacuumed
- Painted to original OEM color or the custom colors of your choice. Optional custom paint.
- Reassembly and final inspection.

# PROJECT CONSIDERATIONS

**Before deciding on the purchase of a linear accelerator, there are a number of other important project considerations:**

## **1. Vault Construction**

It's best to work with an experienced company in the design and development of your linear accelerator vault.

## **2. Servicing the Equipment**

Linear accelerators require routine maintenance and upkeep. R.O.S. can help you find the right maintenance solution in your market, and can help train your in-house engineers.

## **3. Medical Physics Support**

Operation of a linear accelerator requires a qualified physicist (either full-time or part-time) to ensure the system is commissioned properly, tested regularly and for the development of treatment plans.

## **4. Software**

Utilization of a linear accelerator requires a treatment planning system, and in most cases, an Oncology Information System. You can see the various options for treatment planning systems on the R.O.S. website. OIS systems are available from Elekta, Varian and Prowess.

## **5. Accessories**

To operate the linear accelerator, various accessories are highly recommended, including a power conditioner, a water chiller, patient positioning lasers (such as CYRPA or LAP), an in-room camera/monitoring system, and physics equipment for daily QA (Quality Assurance).

## 6. CT Simulation

For radiation therapy clinics, a CT Simulator is required to image patients and to develop the treatment plan for each patient. The key manufacturers of CTs are GE, Philips, Siemens, Toshiba/Cannon, and several others. R.O.S. sells a variety of large-bore CT Simulators.

## 7. Removal of Existing Equipment

The following section provides various options to dispose of your existing equipment:

# WHAT ARE MY EQUIPMENT REMOVAL OPTIONS?

If your facility is considering selling or replacing existing diagnostic imaging or radiation therapy equipment, there are several options to choose from. We have highlighted the “pros” and “cons” of each.

## OPTION 1: SELL YOUR PRE-OWNED EQUIPMENT

Who doesn't like 'cash in hand'? By selling your equipment you will have the benefit of knowing how much your pre-owned equipment is worth.

### Pros of the Selling Option

- Receive the maximum cash value for the equipment.
- Cash payment provides value and flexibility. Use the funds in any area of your department.
- Extends the life of equipment by placing it in areas where it is needed, since most buyers' will re-use or recycle the equipment.
- Humanitarian value when equipment is used in developing areas of the world, which is where much recycled equipment is used.

### **Cons of the Selling Option**

- Requires inspection from the purchaser of the equipment.
- Requires gathering information and service history and taking photos
- Requires the equipment to be complete and usually in operational condition.
- The proceeds of the sale are often kept by the hospital's general fund and not retained by the department.

## **OPTION 2: CONSIGN YOUR PRE-OWNED EQUIPMENT**

Some sellers choose to consign their equipment, which allows them time to find the “right” buyer.

### **Pros of the Consignment Option**

- Frees up space quickly. You can have your equipment removed without going through the longer sales process.
- More time to market and sell often yields a higher price and more value recovered.
- Hiring a qualified company to work with will make the process seamless.

### **Cons of the Consignment Option**

- Some equipment often loses value after it is de-installed.
- There is no guarantee of whether it will sell at the price you want.
- Equipment ages and loses value the longer it is stored.

## **OPTION 3: REMOVE AND DISPOSE OF YOUR PRE-OWNED EQUIPMENT**

A removal and disposal is sometimes the only option to choose if your equipment has no value on the secondary equipment market.

### **Pros of the Remove and Dispose Option**

- Opens up space that can be used for other equipment, offices, storage, conference rooms.
- Eliminates liability and risk of older equipment on site.
- Often allows your building to be sold with fewer complications.

### **Cons of the Remove and Dispose Option**

- Removal companies will charge a fee to professionally remove your old equipment.
- Requires skilled professionals to remove safely.
- There is a chance you will need the equipment at a later date.

## OPTION 4: PART-OUT YOUR PRE-OWNED EQUIPMENT

Cash payment for individual parts can often help offset or even completely cover the costs of removal and disposal of the old machine.

### Pros of the Part-out Option

- Some value can be recovered from the equipment by selling its parts first, before disposal.
- Some parts may be used to support your older units and lower service and maintenance costs of those units.
- Parts can often be used to reduce cost of removal and disposal.
- You may be helping medical facilities in developing countries with your pre-owned parts.

### Cons of the Part-out Option

- Service life ends when machine is disassembled.
- Removal and disposal services are still required to remove the rest of the equipment.
- Parts-only machines tend to have little residual value.

## OPTION 5: TRADE-IN YOUR PRE-OWNED EQUIPMENT

A trade-in, as the name implies, is the replacement of an older piece of equipment with a newer, more technologically advanced, new or refurbished system.

### Pros of Trade-in Option

- Reduce downtime by swapping out machines simultaneously. The old machine comes out immediately before the new one is installed.
- Upgrade to new technology using the value of your old machine to cover some of the costs.
- Reduce time by wrapping everything into one transaction with one party - eliminates the headache of dealing with several parties.
- Allows budget dollars to be applied to the department's equipment vs. the general hospital fund. Therefore, your department retains the trade-in value.

### Cons of Trade-in Option

- Value of older equipment may not be significant, so the trade-in allowance may be negligible.
- Selling your older equipment on the secondary equipment market may provide more value than a vendor is willing to provide on trade-in.
- Discounts from trade-in equipment are often overstated to make the new system quotation appears more attractive. Many of these discounts can be negotiated anyway.

## OPTION 6: AUCTION YOUR PRE-OWNED EQUIPMENT

An auction is a great method to ensure maximum sales price of pre-owned equipment, assuming the auction is highly targeted to qualified buyers.

### Pros of the Auction Option

- Greater exposure to a larger audience of buyers. Increased competition can result in a higher price.
- The sales process is completely transparent to the seller, so you know who is offering what for your equipment.
- Auctions are good for large volumes of sales, or sales in large lots, especially for lower priced equipment.

### Cons of the Auction Option

- There can be time constraints. The auction process is limited if buyers require more time to gain approvals and secure financing.
- Opens the buying to non-professionals, which can pose great risks when removing equipment.
- Auctions are generally not very flexible and may not allow for equipment to be inspected at the appropriate time(s).

R.O.S. is here to help make the most of your decision to sell or replace your pre-owned equipment. If you are ready to find out how much your pre-owned equipment is worth, we can provide you with a [fair market valuation](#).

# ACCESSORIES & UPGRADES

Extending the life of your equipment is essential for success in today's current healthcare climate. It is often possible to upgrade an existing system with accessories or replacements to achieve the equivalent performance of the latest technology.

We offer a variety of equipment upgrades and accessories to extend the life and enhance the capabilities of your linear accelerator.

## **MLC Upgrades**

Linear accelerators that lack MLC's can be retrofitted with MLC's. However, most linacs sold today in the pre-owned equipment market already have MLC's.

## **Treatment Couch Upgrades**

Carbon fiber treatment tables reduce beam attenuation and are essential for effective IGRT.

## **Positioning Lasers**

Precise patient positioning is important for successful radiation therapy treatment. Movable or fixed laser solutions can be added to a Linear Accelerator for your treatment planning needs.

## **Water Chillers**

The most common medical applications for water chillers involve cooling Linear Accelerator machines and MRIs. You can buy water chillers new or pre-owned.

## **Power Conditioners**

Highly developed equipment like linear accelerators and other medical devices are susceptible to damage from power quality problems. Power conditioners can protect your investment from unexpected power surges.

## FINAL THOUGHTS

We hope that you found the information in this Buyer's Guide useful as you plan for your next Linear Accelerator project.

To request a valuation for your current equipment, a custom price quote for a replacement machine or a pre-owned machine, please email **Info@OncologySystems.com** or call **+1 858-454-8100**

Be sure to also check out our website [www.OncologySystems.com](http://www.OncologySystems.com), which contains resources, tips and insights from our equipment and project experts.

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