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**<MPC Plus>  
Vision & Scope Document**

**Version 2.0**

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## Revision History

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## Vision

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## 1. Introduction

We are tasked to work at and develop an internal website for our client to use to streamline the process of calibrating the Varian TrueBeam machine. The current software dumps .xim, .xml and .csv files on a network drive outputting all the measurements, values, information and charts that the Varian machine analyzes during the calibration phase. Our client wants to be able to view the output data in a better format that shows the true values and not based on a baseline, change the threshold values of the allowed data range of values, better visualization of trends of the data over time, ability to sign off on data seen for state compliance. All these functions are to be implemented to save the client a lot of time out of the day that it takes to run the Machine Performance Check on a daily, weekly, and monthly basis. We are to design a web interface which can easily view the true data values, graphically show trends of the data over time, display the images processed by the machine. The purpose of this system is to provide a user-friendly web interface that enables medical physicists and technicians to efficiently review, analyze, and verify calibration data from the Varian TrueBeam Linac machine. By automating data formatting, visualization, and compliance tracking, the system reduces manual effort, minimizes errors, and ensures state and federal regulatory standards are met.

### Background

Currently, the calibration process for the Varian TrueBeam machine generates output files in .xim, .xml, and .csv formats, which are stored on a network drive. These files contain all the measurements, values, and images that the machine produces during calibration. However, the current system that displays the data made by Varian is difficult to interpret, analyze, and view trends over time with confusing values representing how far off the machine is from a specific baseline.

Another challenge is the daily sign-off process required for compliance. Technicians must confirm the calibration data on a separate device, which takes approximately 25 minutes each day. Over the course of weeks and months, this manual step represents a significant time burden that detracts from other responsibilities. In addition, current methods provide limited visualization tools, making it difficult to track data trends over time or quickly identify values that fall outside acceptable thresholds.

These inefficiencies have created a clear need for a centralized system that can:

- Display the true calibration values in a user-friendly format.
- Provide customizable threshold ranges.
- Graphically visualize trends over time.
- Streamline and automate the compliance sign-off process.

By addressing these challenges, the new internal website will reduce wasted time, improve accuracy, and ensure compliance standards are consistently met.

## 1. References

### Varian TrueBeam System Calibration Output Files

- **Format:** .xim, .xml, and csv.
- **Description:** Raw calibration data generated by the Varian TrueBeam machine during performance checks.
- **Source:** Provided by client via secured Box folder link.

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**Client Calibration Data Folder**

- **Contents:** Historical calibration records, trend data, and compliance sign-off documentation.
- **Date Range:** October 2025 – November 2026
- **Source:** Online Box link (shared by client).

**State Compliance Guidelines for Radiation Therapy Equipment**

- **Description:** Regulations requiring daily, weekly, and monthly calibration checks, including documentation and sign-off requirements.

**Varian TrueBeam Machine Performance Check Documentation**

- **Description:** Vendor-supplied technical reference describing calibration procedures and output formats.
- **Publishing Organization:** Varian Medical Systems.

**2. Business Requirements**

The project addresses the **inefficient and limited Machine Performance Check (MPC)** functionality currently available for Varian TrueBeam linear accelerators. This issue affects **radiation oncologists and clinical physicists**, who often deal with redundant QA systems, longer testing times, weak reporting processes, and the absence of approval functionality. In addition, much of the valuable machine performance data generated by MPC remains underutilized, limiting its potential benefit. A successful solution would overcome these challenges by providing technically and clinically sound image processing, offering real-time visibility to MPC results through a web interface, and enabling stronger reporting capabilities that support regulatory compliance and improve overall quality assurance.

**1. Business Opportunity/Problem Statement**

The problem of	Inefficient and limited Machine Performance Check (MPC) functionality for Varian Truebeam linear accelerators
affects	Radiation therapists and medical physicists
the impact of which is	redundant QA systems, longer testing times, higher equipment costs, incomplete/relative-only data metrics, weak reporting, lack of approval functionality or audit trails, and underutilization of valuable machine performance data.
a successful solution would be	<ul style="list-style-type: none"> <li>• Providing technically and clinically sound image processing of MPC data.</li> <li>• Delivering real-time visibility of machine performance results through a user-friendly web interface.</li> <li>• Streamlining QA workflows to save staff time and reduce redundant testing.</li> </ul>

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	<ul style="list-style-type: none"> <li>• Generating stronger reporting and documentation to support regulatory compliance.</li> <li>• Enabling long-term data storage, trending, and analytics for performance improvement.</li> </ul>
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## 2. Business Objectives

- BO-1: Reduce costs of redundant QA systems and testing equipment by a measurable percentage within the first year.
- BO-2: Decrease overall operating costs of QA and reporting processes by at least 15% within 12 months.
- BO-3: Reduce QA software licensing and equipment expenses by eliminating the \$2,000 per-machine fee, generating savings of \$8,000 annually across 4 machines.

## 3. Success Metrics

- SM-1: Ensure adoption of CCBD for QA across all 4 clinics within 3 months of release, with at least 75% of radiation oncology staff actively using the system where adoption decisions are under clinic control.
- SM-2: Achieve a 50% reduction in average QA test review and approval time within 6 months of implementation, decreasing from 45 minutes to 25 minutes per test and saving approximately 25 minutes per user per day at each site.
- SM-3: Ensure 100% compliance with regulatory reporting standards in audits within the first year.

## 4. Vision Statement

For	radiation oncology clinics and clinical physicists
Who	need a more efficient and comprehensive way to perform and analyze Machine Performance Check (MPC) data on Varian TrueBeam linear accelerators
The (product name)	MPC Plus system
That	that provides real-time visibility, regulated reporting, and analytical insights to determine and improve machine reliability
Unlike	The current Varian MPC implementation, which has weak reporting and underutilizes collected data

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Our product	image processing, data integration, and clear reporting, while remaining easy to install and maintain.
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For radiation oncology clinics and clinical physicists who need a more efficient and comprehensive way to perform and analyze Machine Performance Check (MPC) data on Varian TrueBeam linear accelerators, MPC Plus is a web-based application that delivers real-time visibility, reliable reporting, and analytical insights to improve machine reliability and clinical confidence. Unlike the current Varian MPC implementation, which offers weak reporting and leaves much of the collected data underutilized, MPC Plus integrates advanced image processing, data management, and streamlined reporting into a solution that is both easy to install and simple to maintain.

### 5. Business Risks

**R1-1:** Because Varian is the dominant supplier of radiation oncology equipment (such as X-ray systems and TrueBeam linacs), the company maintains control over most of the MPC infrastructure and analytics. With that control comes risk that any changes Varian makes to data formats or analytics processes could directly impact this project's ETL pipeline. **(Probability = 0.2, Impact = 10)**

**R1-2:** As the system requires more setup than the redundant QA systems already in place, the adoption rate between physicists might not be as high as expected. **(Probability = 0.6, Impact = 4)**

**R1-3:** Security or compliance concerns raised late in development could require major rework to meet hospital IT standards. **(Probability = 0.2; Impact = 7)**

### 6. Business Assumptions and Dependencies

**AS-1:** The data from MPC machines will continue to be stored on a server (idrive) and remain accessible for ETL extraction.

- **Impact if not true:** If our client changes the storage method (e.g., local-only, encrypted, or cloud-hosted), the ETL pipeline may require re-engineering, delaying deployment and increasing costs.

**AS-2:** Historical MPC data stored over the past several years will be retrievable and usable for trending and analytics.

- **Impact of not true:** The system will only provide value moving forward, limiting its ability to show long-term trends or predictive insights.

**AS-3:** The project assumes that the chosen programming framework (C#/.NET) will remain supported and compatible with the hospital's IT environment.

- **Impact of not true:** The system will only provide value moving forward, limiting its ability to show long-term trends or predictive insights

**DE-1:** The system depends on Varian maintaining stable MPC data formats and file outputs.

- **Impact of broken dependency:** A format change or data encryption update from Varian could break the ETL process, requiring urgent rework.

**DE-2:** The project depends on consistent network access between MPC machines, the server, and the web interface.

- **Impact of broken dependency:** Missing or delayed data could reduce reliability and compromise trust in the system.

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### 3. Stakeholder Profiles and User Descriptions

#### 1. Stakeholder Profiles

Stakeholder	Major value or benefit from this product	Attitudes	Major features of interest	Constraints	End user or not?
Clinical Physicists	Faster and more reliable MPC results; fewer manual calculations; better regulatory documentation	Positive, want accurate and fast reporting	Real-time results, automated calculations, graphical reports	Must comply with clinical protocols;	Yes
Radiation Oncologists	Better confidence in machine performance; improved patient safety	Supportive but busy; prefer concise summaries	High-level dashboards, summary reports, notifications of issues	Limited time; need simple dashboards	Yes
Medical Physicist Assistants / QA Technicians	Reduced manual QA tasks; fewer errors	Receptive, may need training	Step-by-step workflow guidance, automated file import, error alerts	Limited experience with web apps; workflow must match current clinical routines	Yes
IT/Admin Staff	Easier system maintenance and data storage; fewer helpdesk tickets	Neutral; focused on system stability	User access management, server monitoring, backup procedures	Compliance with hospital IT policies	No
Department Head	Improved efficiency, audit compliance, better resource use	Supportive if ROI is clear	Overall reporting, audit-ready documentation	Budget constraints; ROI must justify implementation	No

#### 2. User Environment

The user, typically a medical physicist will be performing an MPC on the Varian machines in a lab/clinic and will have the application open to visualize the data dumped by the Varian machines. Currently, Varian's own software is

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used for visualizing the data and understanding it, as the MPC is running simultaneously. Additionally, another machine is used to carry out redundant QA, which is accompanied by its own software with sign off capabilities for data seen. The software developed by our team will be integrated to the data dumped by the Varian machines and run independently.

### 3. Alternatives and Competition

#### Vendor-Supplied Software (Varian Ecosystem Tools)

- **Description:** Varian provides software for calibration and machine performance monitoring (e.g., ARIA or related add-ons).
- **Strengths:** Fully integrated with the Varian machine; vendor supported.
- **Weaknesses:** May not offer customizable threshold ranges or the ability to extract/display true values rather than baseline comparisons. Licensing fees may also be high, and modifications for state compliance logging could be limited or unavailable.

#### State Compliance Software (“The Pad”/ DailyQA 3 & Phantom Devices)

- **Description:** A combination of Sun Nuclear’s Daily QA™ 3 device (a specialized hardware “pad” with integrated ion chambers and diodes) and phantom-based monthly checkers (such as cylindrical ionization chambers with electrometers). These systems are used for daily and periodic calibration, as well as state compliance verification.
- **Strengths:** Designed specifically for radiation therapy QA and compliance requirements; well-recognized by regulators and accrediting bodies; provides a straightforward way to meet mandated daily, monthly, and annual checks.
- **Weaknesses:** The associated compliance software is outdated and unintuitive, offering minimal visualization or automation. It does not integrate with modern data management systems (e.g., Box), creating workflow silos. Staff often spend ~25 minutes daily navigating the clunky interface just to complete required sign-off. Device costs (e.g., ~\$2,000 per unit) multiply across machines, and reliance on hardware pads/phantoms adds recurring expenses.

#### ImageOwl (Machine Performance Check Connector)

- **Description:** Cloud-based QA platform with integration for Varian’s Machine Performance Check (MPC). Provides centralized QA management, automated result collection, and web-based reporting.
- **Strengths:** Offers remote access and centralized data management; integrates with existing Varian MPC workflows; provides visualization and trending features.
- **Weaknesses:** Still tied to MPC limitations; may require subscription costs; cloud reliance could raise data security or compliance concerns in some clinics.

#### Sun Nuclear (SunCHECK Machine)

- **Description:** A commercial QA management platform from Sun Nuclear, designed to support daily, monthly, and annual QA with automation and reporting capabilities.
- **Strengths:** Broadly adopted in the market; integrates with Sun Nuclear’s QA devices; provides dashboards, trending, and customizable reporting.
- **Weaknesses:** Licensing and device costs can be significant; may create workflow silos if clinics use mixed vendor hardware; integration with Box or external data systems may be limited.

**Commented [BO1]:** ImageOwl competition. JPS demo he is sending us (Sunnuclear).

**Commented [BO2R1]:** <https://help.imageowl.com/hc/en-us/articles/360024370193-Connecting-Varian-Machine-Performance-Check-MPC>

**Commented [BO3R1]:** <https://www.sunnuclear.com/products/suncheck-machine>

**Commented [AM4R1]:** revised.

**Commented [BO5]:** DailyQA3 and The Phantom

**Commented [BO6R5]:** <https://www.sunnuclear.com/products/daily-qa-3>

**Commented [BO7R5]:** Monthly Checker: [https://www.researchgate.net/figure/Cylindrical-thimble-type-ionization-chamber-and-electrometers-13\\_fig8\\_324760886](https://www.researchgate.net/figure/Cylindrical-thimble-type-ionization-chamber-and-electrometers-13_fig8_324760886)

**Commented [AM8R5]:** revised.

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#### 4. Scope and Limitations

##### 1. Product Perspective

The proposed software operates as an independent, self-contained solution hosted on the clinic's local server. Its primary function is to execute a retrieval script that collects data files (.xml, .xim, .csv) generated by Varian systems. These files are deposited by Varian into their iDrive environment, from which the software retrieves and processes the data.

Unlike the prior design, the solution no longer depends on a local iDrive instance; instead, it securely accesses the Varian-managed iDrive for file collection. All supporting applications and utilities will be deployed centrally on the clinic's server (as part of a broader chart redesign), while image-processing functionality remains in its current dedicated location.

Because QA image data is larger than initially expected, the system may not store all images in the local database. Instead, the database will reference image files within the Varian iDrive, while selectively saving critical images locally for redundancy and reporting. This behavior can be configured to meet clinic-specific preferences.

Limitations include potential risks related to data format changes in Varian's output and the reliance on Varian's retention policies (currently at least one year, possibly longer). The software mitigates these risks by maintaining essential QA image subsets locally while leaving the bulk of image storage to Varian's infrastructure.

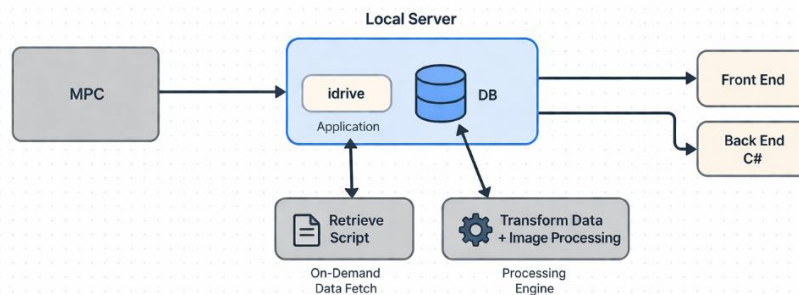
**Commented [BO9]:** Keep on local server. Remove Idrive from local server. Idrive is on a Varian server. All programs on server (chart redesign). Keep Image processing where it is.

**Commented [BO10R9]:** Data is larger than expected. Maybe not save all images. Instead, point to image to idrive. Risk of data format changes. However, still have your most important images on our DB

**Commented [BO11R9]:** Could make this a config option

**Commented [BO12R9]:** Currently varian holds data for atleast a year (Maybe longer).

**Commented [AM13R9]:** revised.



##### 2. Major Features / Scope

###### FE-1: Multi-Machine Data Ingestion and Standardization

The system will ingest performance check data from multiple Truebeam linear accelerators in varying formats (e.g., .csv, .xim, .xml). It will automatically convert the data into a standardized format (e.g., .json) and store it in a database to ensure compatibility across machine versions and consistent downstream analysis.

###### FE-2: Analytical Dashboard with Visualization Tools

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The system will provide an interactive dashboard displaying machine performance data in various formats (e.g., line charts, bar graphs, overlays). Users can visualize:

- **Multi-Leaf Collimator (MLC) Checks:** Detailed visualization of all MLC tests, showing how the leaves shape the treatment beam and highlighting deviations from expected positions.
- **Geometry Checks:** Full visualization of geometry-related QA tests, including beam alignment and mechanical accuracy, with side-by-side comparisons of current versus historical data.
- **Trend Analysis:** Historical vs. daily performance comparisons, enabling detection of gradual drifts and sudden anomalies.
- **Quick Assessment:** Use of thresholds, markers, or overlays to highlight performance deviations for fast identification.

### FE-3: Baseline and Tolerance Management

The system will enable users to configure baselines and tolerances on a per-machine basis. Performance results will be automatically compared to both traditional baseline standards and custom tolerances defined by the clinic.

### FE-4: Daily Performance Tracking and Historical Access

The system will archive daily performance check results, allowing users to review historical data across multiple machines. This feature supports both ongoing operational monitoring and long-term performance trend analysis.

### FE-5: Automated Alerts and Notifications

The system will generate automated alerts when performance results fall outside defined tolerances or statistical anomalies. Alerts will be categorized by severity (e.g., warnings vs. urgent notifications). Notifications will also be generated if daily machine checks have not been signed off.

### FE-6: User Sign-Off and Verification

The system will provide functionality for users to digitally sign off on daily machine performance checks, confirming machine readiness for clinical operations. Sign-off records will be tied to user roles, with auditability across all users, including supervisory oversight.

### FE-7: Compliance and Reporting

The system will generate compliance-ready reports containing daily machine performance check results and corresponding user sign offs. Reports can be presented to regulatory bodies as evidence of machine quality control.

### FE-8: On Premise, Web-Based Access

The system will be deployed as a secure, on premise, web-based application accessible via the clinic's network. This ensures data security while allowing access from any workstation within the clinic's environment.

### FE-9: Chamber Output / Absolute Dose Baseline Analysis

The system will optionally track and visualize chamber output and absolute dose measurements at baseline for each machine. Multiple results files (.csv) containing dose output data will be ingested and aggregated, allowing users to compare current measurements against baseline values. The dashboard will display these results in charts or tables, highlighting deviations from expected dose output and supporting both quality assurance and regulatory compliance.

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This feature provides additional insight into machine performance beyond standard geometry and MLC checks, enabling more comprehensive monitoring of treatment accuracy.

### FE-10: Configurable Chamber Output Correction

The system will provide an optional feature for applying chamber output correction factors to machine performance data. By default, Machine Performance Check (MPC) results report values relative to a baseline (e.g.,  $\pm 2\%$ ), which can lead to inflated or misleading readings if the baseline itself is not exactly 1. The corrected chamber output is calculated by multiplying the raw data by the baseline factor (e.g.,  $\text{Corrected Value} = 1.003 \times \text{Raw Data}$ ). Each clinic can configure whether to apply this correction and adjust the factor according to their physicist's judgment, ensuring flexibility while maintaining data integrity. This feature allows clinics to tailor QA analysis to their preferred methodology without imposing mandatory corrections.

#### 3. Deployment Considerations

Access to the system will be managed through a simple authentication process maintained by direct client. Users will log in using credentials created and managed specifically for this system. Only users with the appropriate permissions will be able to access the system's data and functionality. User accounts, including usernames and passwords, will be administered directly within the application, allowing for straightforward onboarding and flexible access control. This approach keeps the system lightweight while ensuring that user access remains secure and aligned with client requirements.

The deployment will be hosted locally on the on-site servers at The CenterTX to comply with organizational policies and data security requirements. System availability is planned to approach 100 percent uptime; however, actual uptime will depend on the reliability and maintenance of the local server infrastructure. Performance optimization and health-monitoring capabilities will be provided within the software to assist The CenterTX with ongoing operations and to minimize downtime to the greatest extent possible.

Following delivery of the software, all maintenance, updates, and operational support will become the responsibility of The CenterTX. Our team will provide deployment documentation, configuration details, and training materials at the time of handover to ensure a smooth transition. Post-deployment monitoring, server upkeep, and user support will be managed entirely by The CenterTX according to its internal processes and schedules.

By integrating with existing user management systems, hosting the solution within the organization's established infrastructure, and clearly delineating post-deployment responsibilities, the deployment process will reduce administrative overhead, simplify user access, and provide a stable foundation for ongoing operations.

### 5. Other Product Requirements

#### Applicable Standards and Legal Requirements

- The system must comply with state radiation calibration and performance verification requirements for medical equipment.
- All sign-off features must meet audit and traceability standards, allowing regulators to confirm data accuracy and technician approval.

#### Hardware and Platform Requirements

- The system will be a web-based application, accessible via modern browsers (Chrome, Edge, Firefox).

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- It must integrate with the client's internal network environment and retrieve calibration data from the iDrive.
- No specialized local hardware is required beyond standard workstation computers used by technicians.

**Performance Requirements**

- The system must be able to process and display calibration data within 5 seconds for a single data set.
- Trend visualization graphs should be interactive and update in near real-time when new data is uploaded.
- The system should handle at least 5 years of historical data without performance degradation.