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Phased Implementation for Coordinate System Conversion of a Multi-Linac Radiation Medicine Department from IEC 60601 to IEC 61217

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ABSTRACT

A five-linac radiotherapy program underwent phased conversion from IEC 60601 to IEC 61217 while transitioning to a new treatment planning system and maintaining uninterrupted patient care.

- Patient-volume analysis guided treatment-site migration between TPS pathways.
- Machines and treatment sites were incrementally migrated to the IEC 61217/RayStation pathway while maintaining sufficient treatment capacity in the remaining IEC 60601/Pinnacle pathway.
- Each converted linac underwent geometric, imaging, dosimetric, and end-to-end QA before clinical release.
- All five linacs were transitioned over 16 months with no coordinate-system-related safety incidents or IEC-related replanning.
- The phased approach maintained clinical capacity while supporting safe coordinate-system and treatment planning system conversions.

INTRODUCTION

- Coordinate systems define the shared geometry used by planning, imaging, QA, and treatment delivery systems.
- IEC 61217 is the modern standard, but many departments still operate legacy IEC 60601 workflows.
- Mixed coordinate systems can create risk if systems interpret jaws, couch shifts, imaging, or beam geometry differently.
- A multi-linac IEC conversion affects more than the linac: TPS models, R&V configuration, imaging systems, QA tools, and clinical workflows all need validation.
- We describe a phased IEC 60601-to-IEC 61217 conversion performed alongside transition from Pinnacle to RayStation.

METHODS AND MATERIALS

- Five Elekta linacs used MosaiQ 3.1 as the record-and-verify system.
- Two pathways were maintained during transition: IEC 60601/Pinnacle and IEC 61217/RayStation.
- Historical patient-volume data guided which treatment sites moved to RayStation during each phase.
- Linacs were converted in phases, with workload reduced and redistributed shortly before each changeover.
- A conversion simulation tested feasibility, same-day rollback, and the post-conversion QA process.
- Each converted linac completed geometric, imaging, dosimetric, and end-to-end QA as well as incompatibility testing before clinical release.
- A multidisciplinary working group coordinated readiness, training, workflow separation, and phase-specific tasks.

RESULTS

- Pre-conversion simulation was completed, confirming feasibility and same-day rollback capability.
- All five linacs were converted to IEC 61217 over a 16-month phased transition. (Figure 1)
- Phase 3 was intentionally delayed to complete TPS scripting, beam modelling, and validation before final conversion.
- QA was completed before clinical release of each converted linac. (Table 1)
- Machine utilization remained balanced as sites migrated progressively to the IEC 61217/RayStation pathway.
- Clinical downtime was limited to a half-day interruption on one linac.
- No IEC-related replanning was required.
- No coordinate-conversion safety incidents occurred.

QA DOMAIN	KEY VALIDATION ACTIVITIES
TPS & Dosimetry	• Beam model PSQA • 3DCRT/IMRT/VMAT ArcChecks • Plan quality & dose accuracy
R&V System (MosaiQ)	• RTP import verification • Jaw/MLC/energy/MU/label checks • CBCT preset availability
Beam Delivery Accuracy	• 3DCRT & VMAT delivery tests • L-shape aperture verification • Jaws/MLC/collimator integrity
Imaging & Isocentre Shifts	• ISO shift transfer verification • Image orientation verification • Large and small shift accuracy
End-to-End Workflow	• Pentaguide: CBCT & shifts • 2D imaging verification: AP/Lat • Data transfer and recording
Safety Testing IEC Incompatibility	• Wrong IEC plan-loading attempts • Override attempts • Error/warning review
QA Platform SunCHECK	• Mechanical & dosimetric QA • Daily output & beam checks • Monthly/annual QA program

Table 1. QA validation matrix by domain.

DISCUSSION

- The 16-month timeline reflected the full IEC/TPS transition, not the coordinate swap alone.
- The main pacing factors were RayStation readiness, beam modelling, protocols, scripts, documentation, training, and site migration.
- Running IEC 60601/Pinnacle and IEC 61217/RayStation in parallel allowed gradual clinical migration.
- Phased implementation allowed staff training, commissioning, and validation to occur incrementally.
- Parallel pathways required strict workflow separation, machine-specific protocols, and independent QA templates.
- Patient-volume analysis helped match site migration to available machine capacity.
- Lower-complexity, high-volume sites moved earlier; SBRT and 6DoF-dependent workflows were deferred until the final phase.
- Regular interdisciplinary communication was essential while both systems were clinically active.

CONCLUSIONS

- IEC 60601-to-IEC 61217 coordinate conversion alongside TPS transition can be safely achieved in an active multi-linac department using a phased implementation strategy.
- Data-informed sequencing, strict workflow separation, and comprehensive post-conversion QA were critical to maintaining clinical capacity.
- QA must verify coordinate interpretation across the full pathway: TPS, R&V, imaging, couch motion, beam delivery, and QA software.
- Centres planning similar transitions should account for technical validation, staff training, workload strain, and interdisciplinary communication.

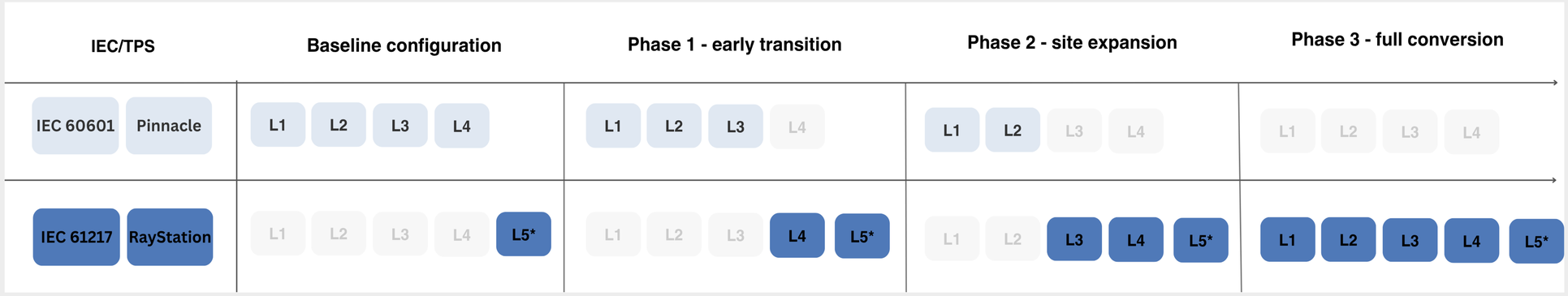

Figure 1. Two operational pathways available during the transition phases for migration of a radiotherapy department from IEC 60601/Pinnacle to IEC 61217/RayStation. Linac 5 (L5*) was commissioned directly into the IEC 61217/RayStation configuration.

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