Analysis of Predictive Maintenance of Accelerator Beam Uniformity Using Statistical Process Control

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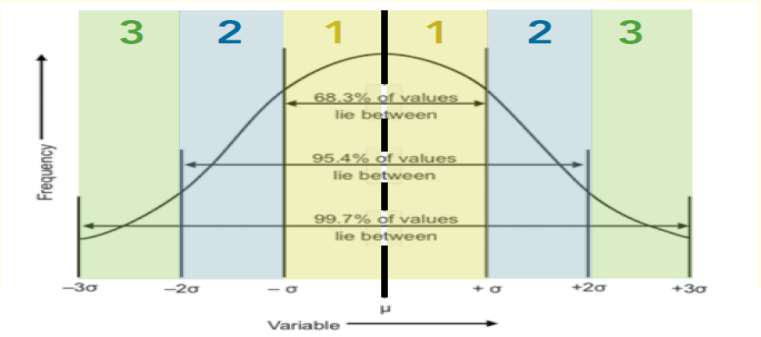
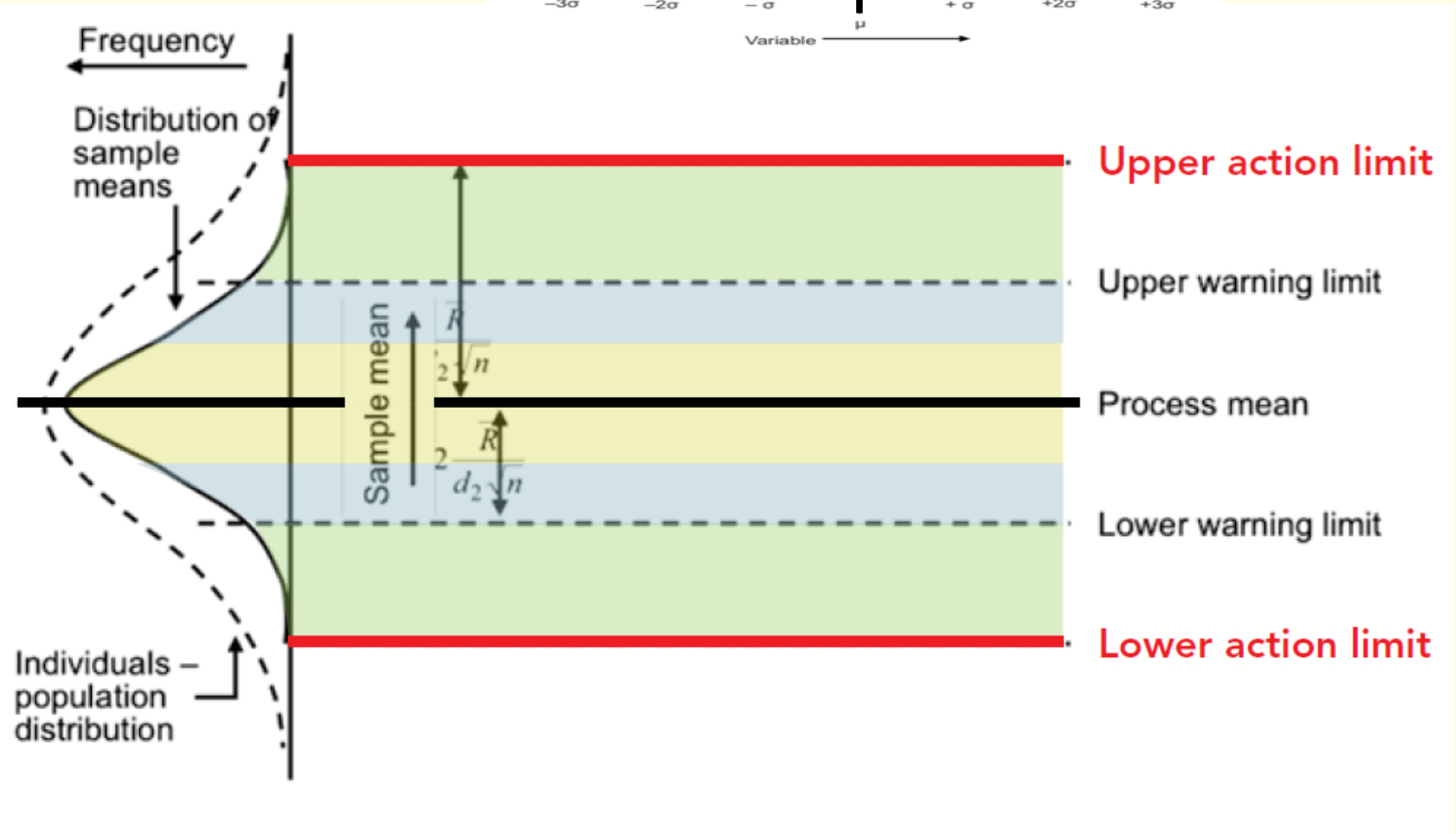
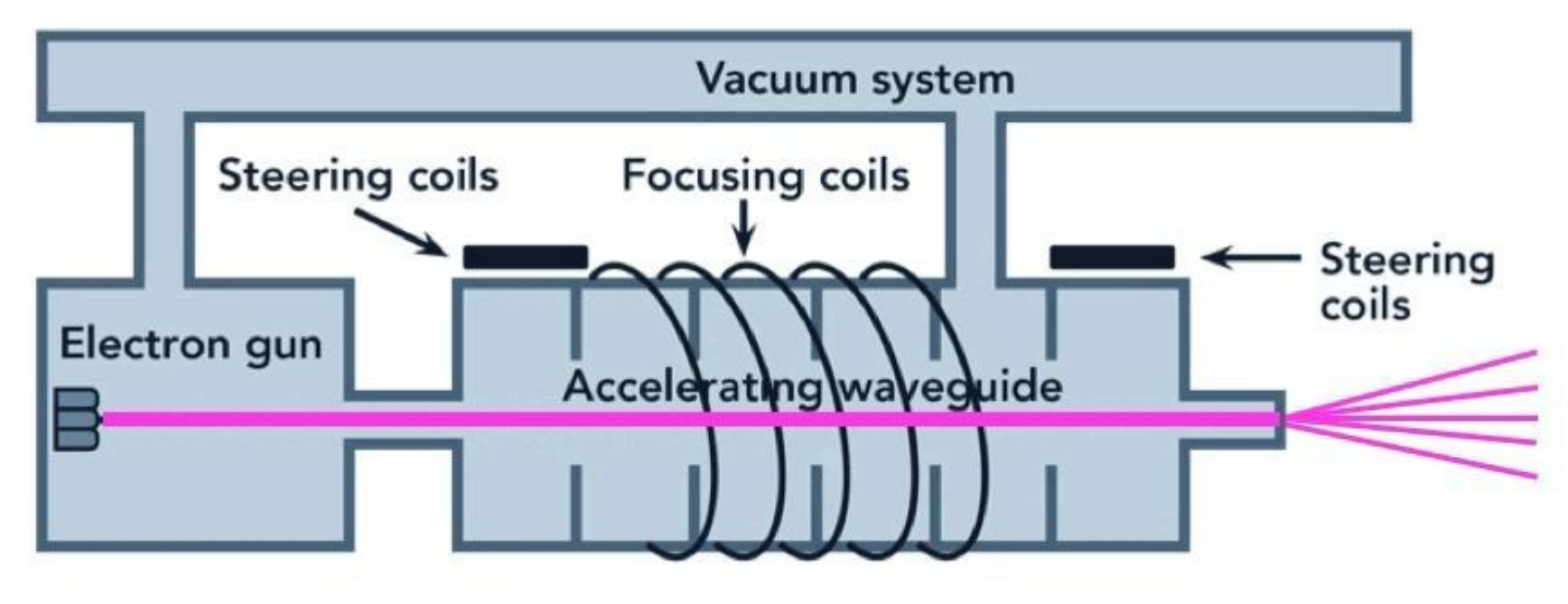
Predictive Maintenance: Beam Uniformity Statistical Process Control (SPC)





PdM: Beam Uniformity



We sampled the Steering Coil Current (SCC) to evaluate optimal operation of beam uniformity.

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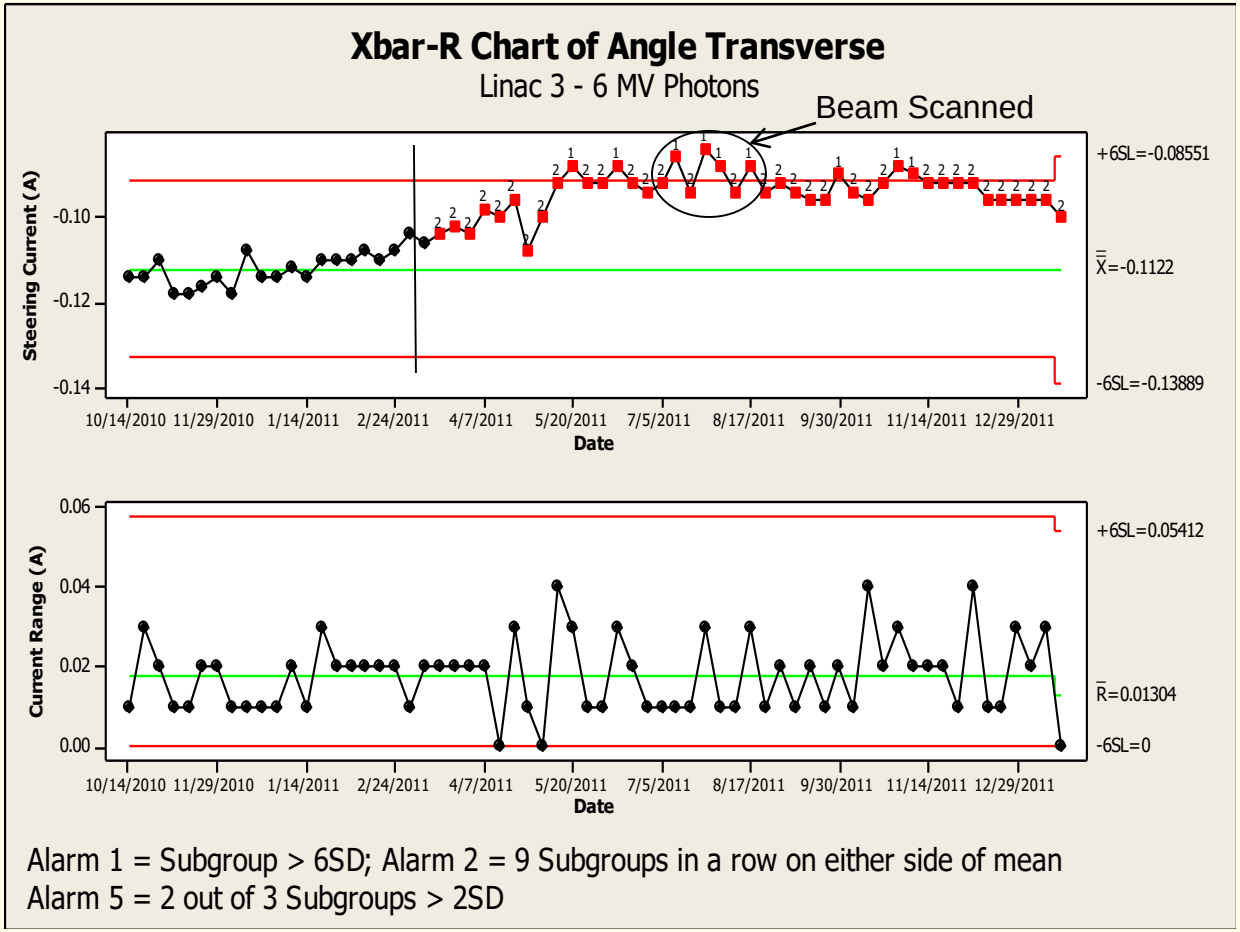
PdM: Beam Uniformity



- 3 Linacs were tracked for >15 months
- Mock intervention was initiated after SCC exceeded control limit
- Overall, results ranged from minimal change to no measurable change in beam uniformity

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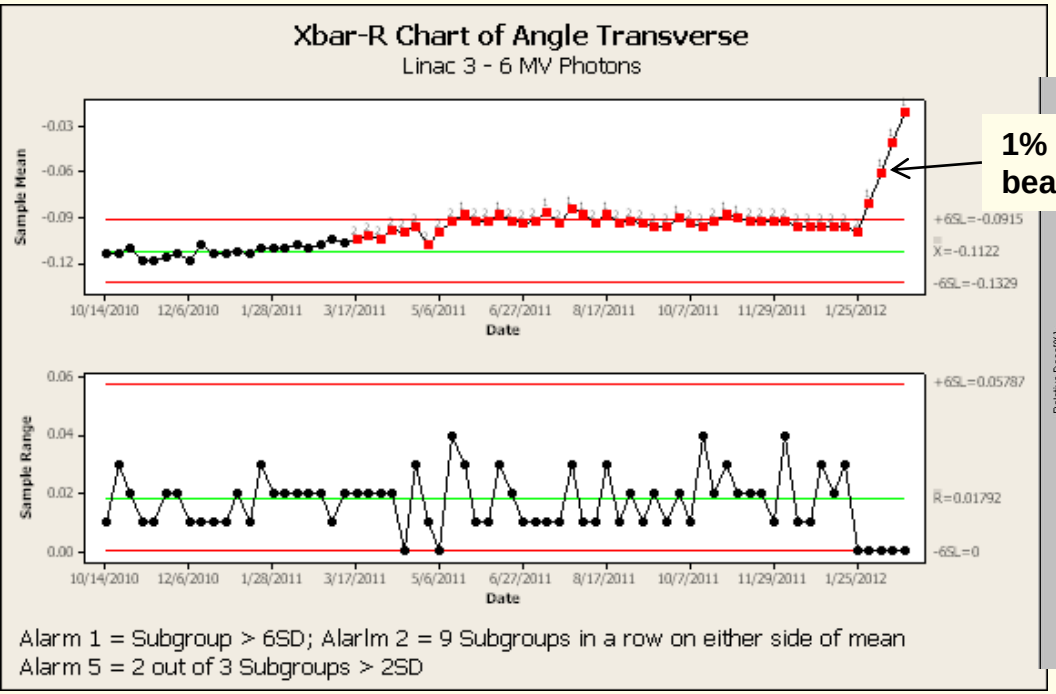
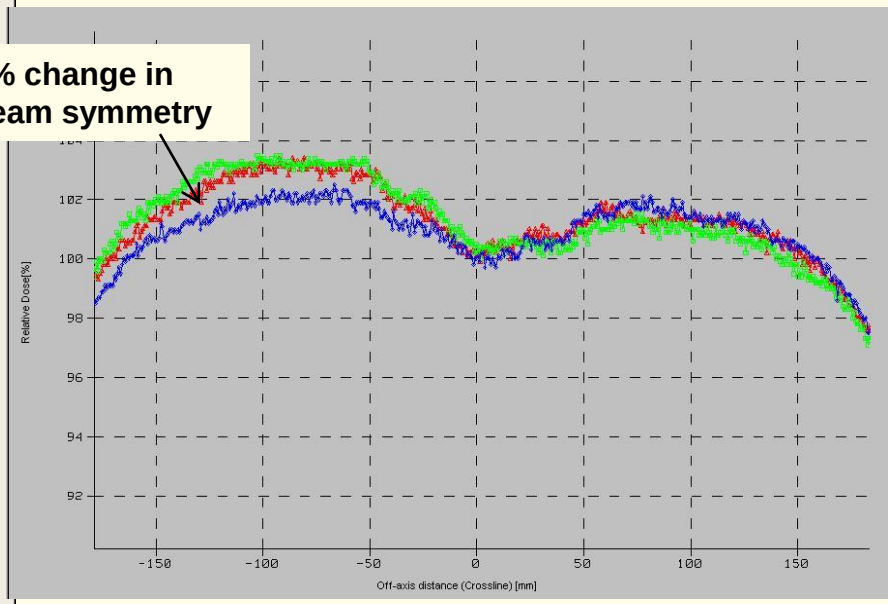
Controlled Experiment: Single SCC change vs Beam Uniformity





- Based on experimental observations the control limits were reformulated

- Goal was to reduce false positive rate but ensure detection of 1% change in beam uniformity

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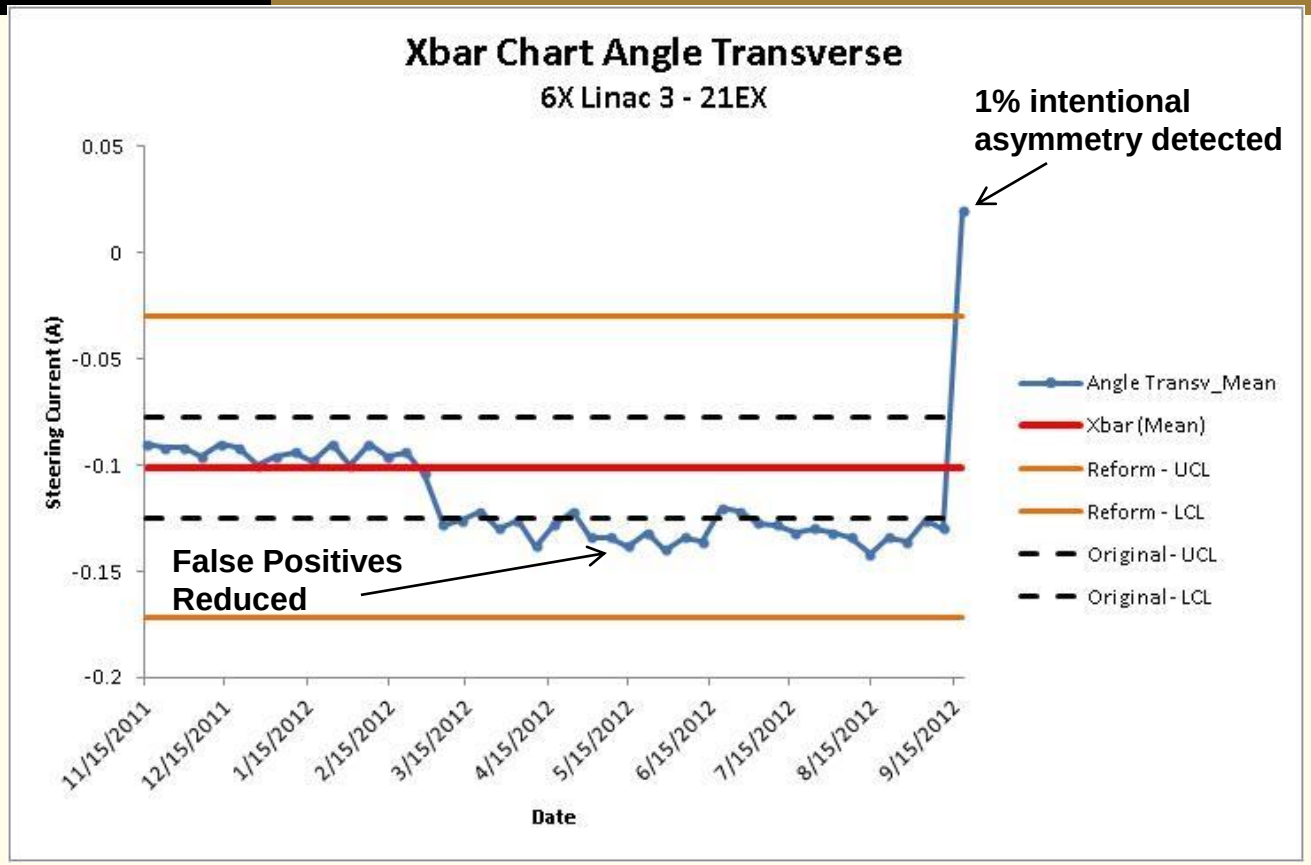
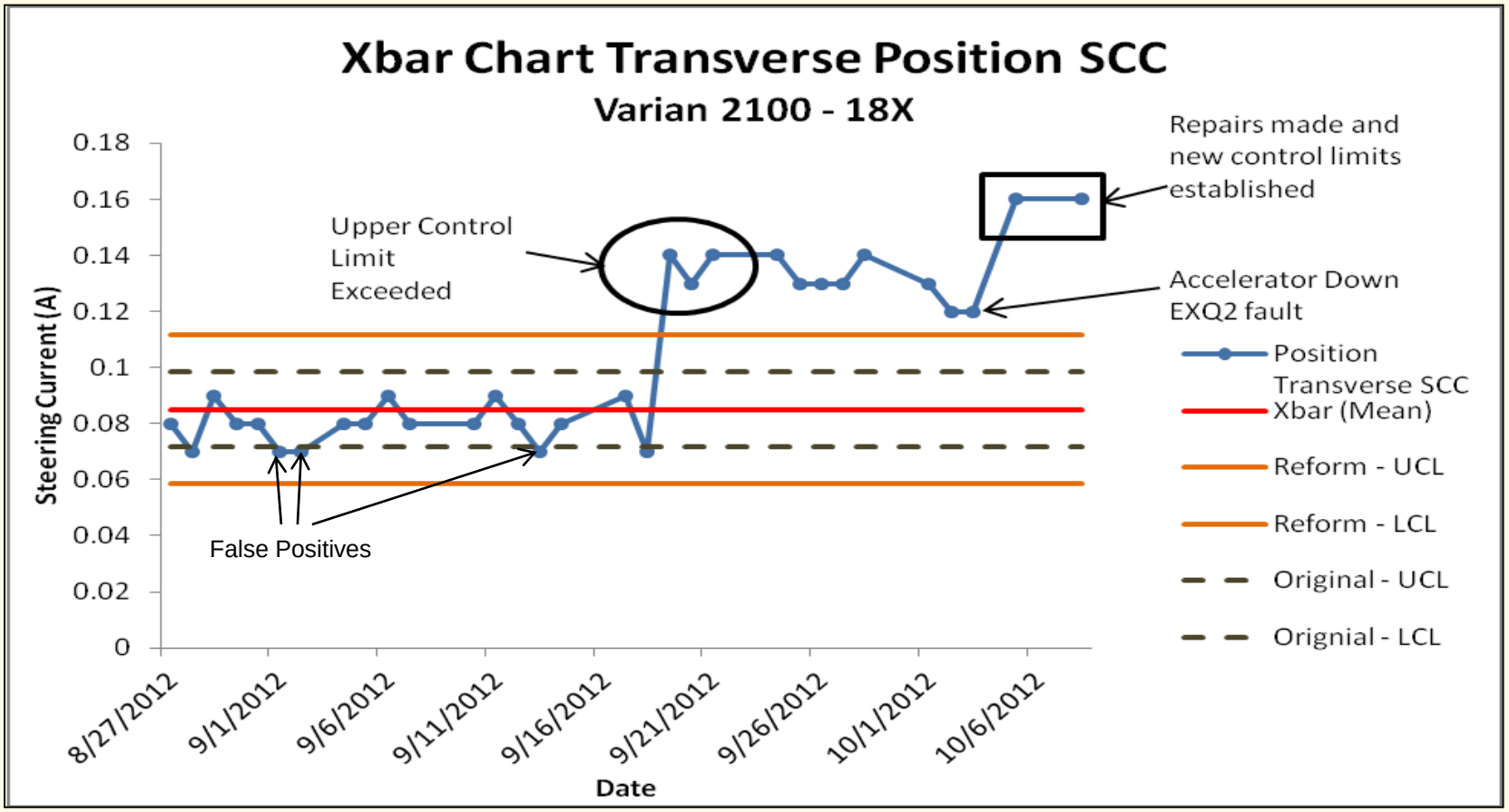
Comparison of Original Limits & Reformulated Limits



- 3 Linacs tracked for another 8 months with no limits exceeded
- Beam scanning confirmed no change in beam uniformity
- 1% intentional asymmetry results in control limit alarm

Beam Uniformity Problem Predicted



The reformulated upper control limit was exceeded on Sept 19 but the accelerator did not go down until Oct 3.

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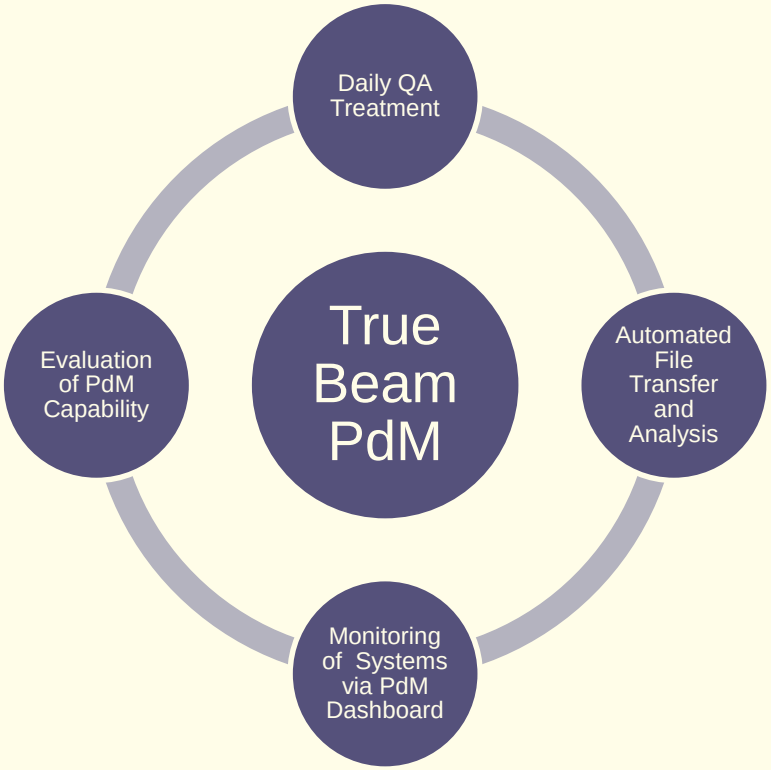
Predictive Maintenance: Next Steps



We are in the process of developing first generation software for a TrueBeam predictive maintenance program.