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of collaboration,
innovation and
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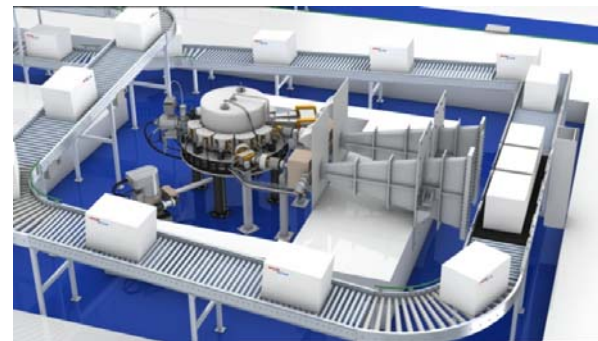
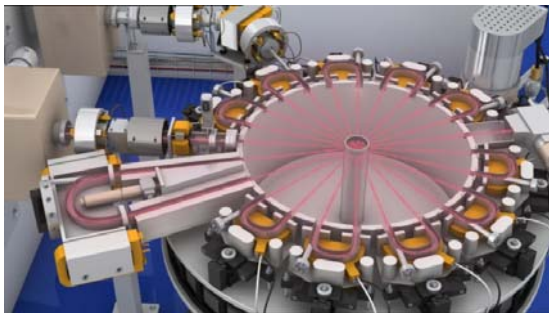
A Novel Process Control Method for a DUO E-Beam/X-Ray System

Josef Mittendorfer, Consultant, Mediscan



Mediscan - Irradiation Services in Perfection

- Highly Appreciated Irradiation Service Provider since 1995
- Three Technologies: E-Beam – Gamma – X-Ray
- Devoted to Quality of Services and Innovation



TT-100 Rhodotron 10 MeV and TT-100 10 MeV/6.6 MeV E-Beam/X-Ray



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Design Goals for a new E-Beam/X-Ray Irradiator:

- High Dose Accuracy
- Excellent Dose Uniformity
- Allows Narrow Dose Windows
- High Throughput
- Quick Turn Around – Just-in-Time Processing Redefined
- Immediate Change between E-Beam/X-Ray Mode
- Competitive Cost



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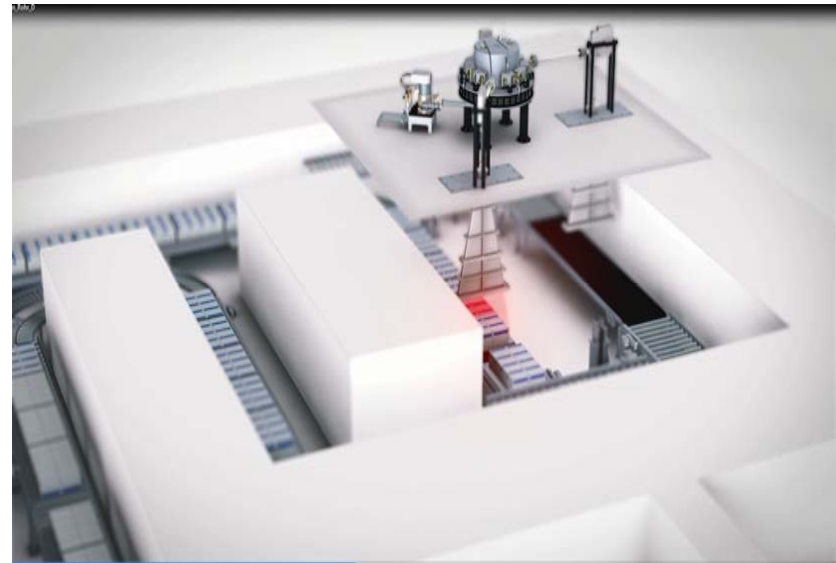
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TT-300 “Duo” E-Beam “Workhorse” X-Ray “Special Products”



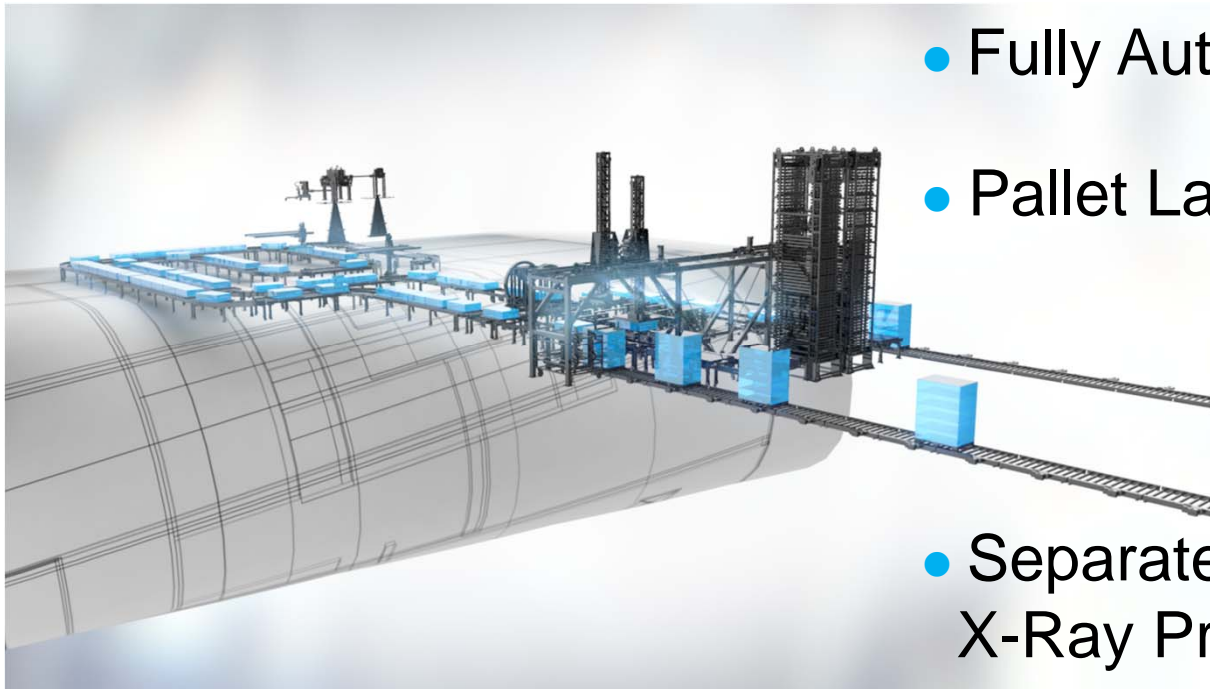
190 kW Power E-Beam: 10 MeV 19 mA



X-Ray: 7 MeV 27 mA



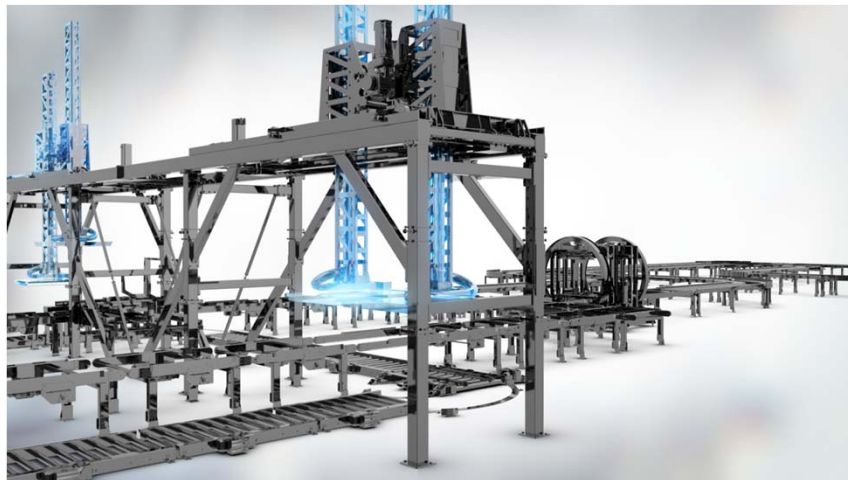
Mediscan Design: Seamless Integration of Accelerator, Product Handling and Process Control



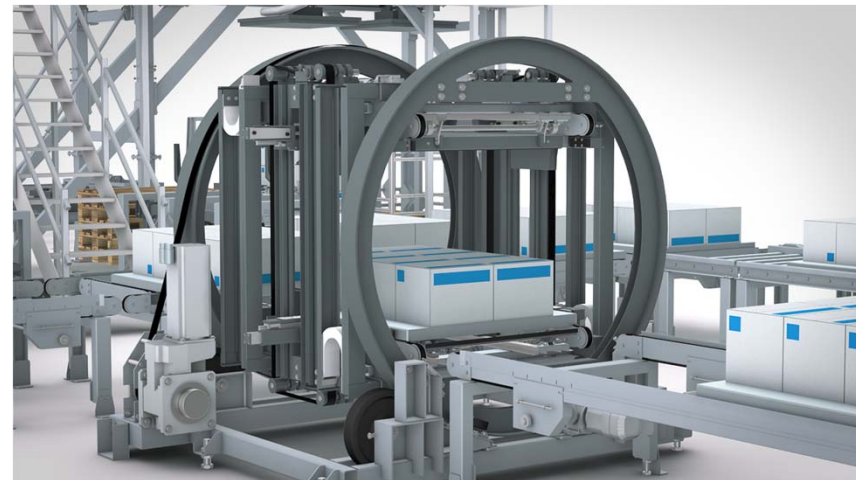
- Fully Automatic
- Pallet Layers on Trays
- Separate E-Beam and X-Ray Process Conveyors



Fully Automated Depalleting and Palleting



Depalletizer/Palettizer



Product Turning



Process Control – A Twofold Approach

Reference Dose Monitoring

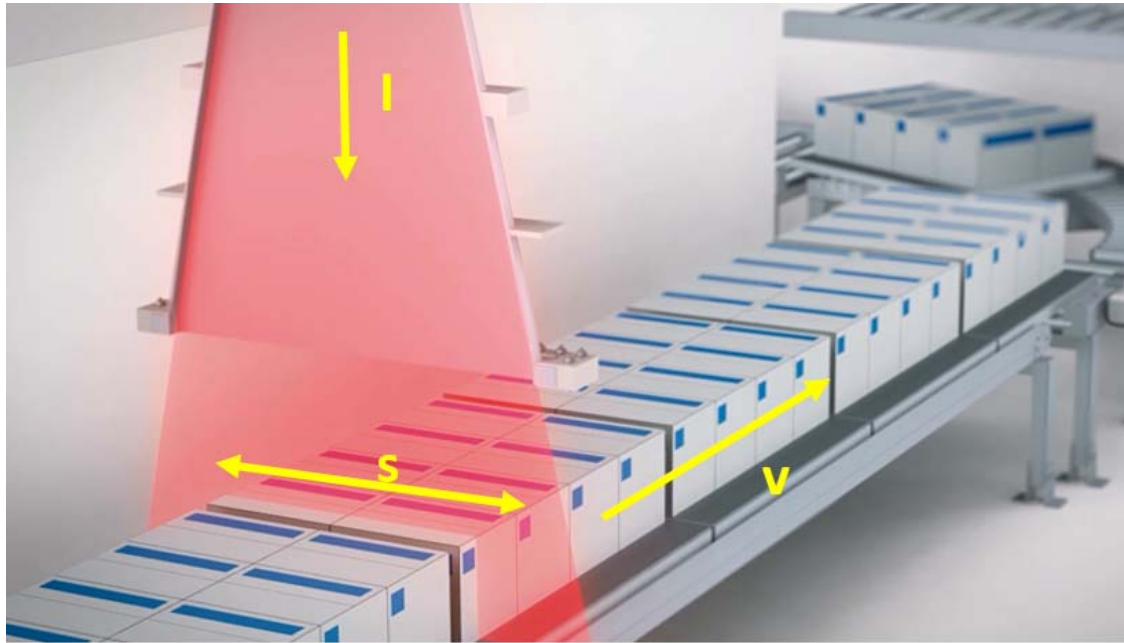
- Alanin Pellet Dosimeters with Barcode
- Manual Placement - Automatic Retrieval

Process Parameters

- Measurement and Logging of Process Parameters for each Tray
- Data Recording at Tray Center



Process parameters effecting dose



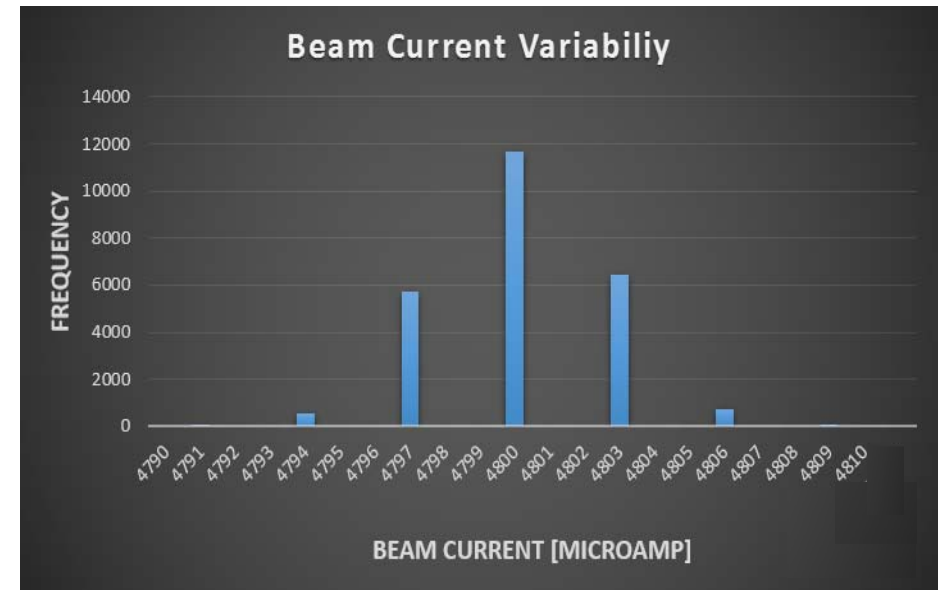
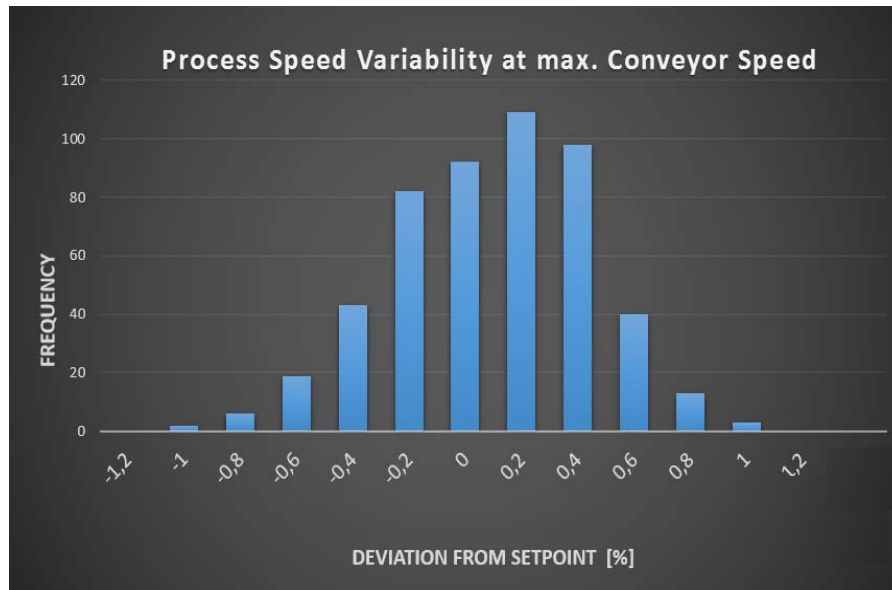
$$D = k \cdot \frac{I}{v \cdot s}$$

D Dose in kGy
I Beam Current
v Process Speed
s Scan Width

$$k = D_e(0) \cdot F$$



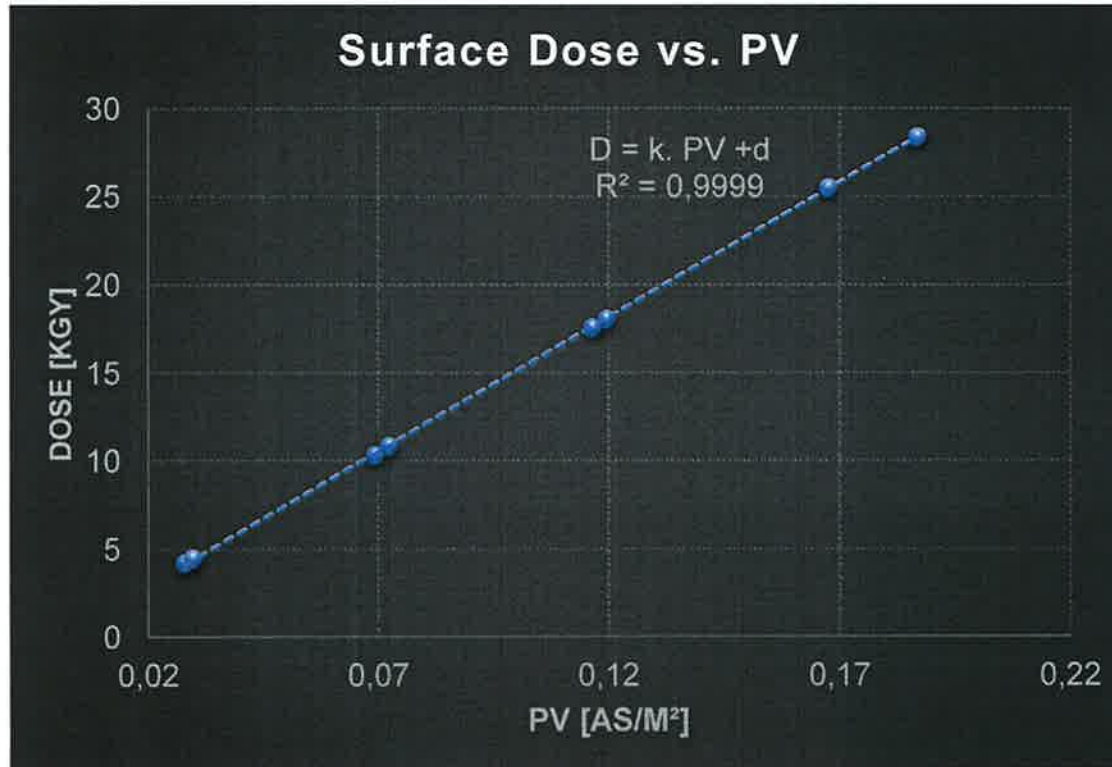
Process Parameter Characterization & Validation



Overall Process Process Parameter Uncertainty $\approx 0.5 \%$ (k=1)



Surface Dose – Process Parameter Relationship



Process Value:

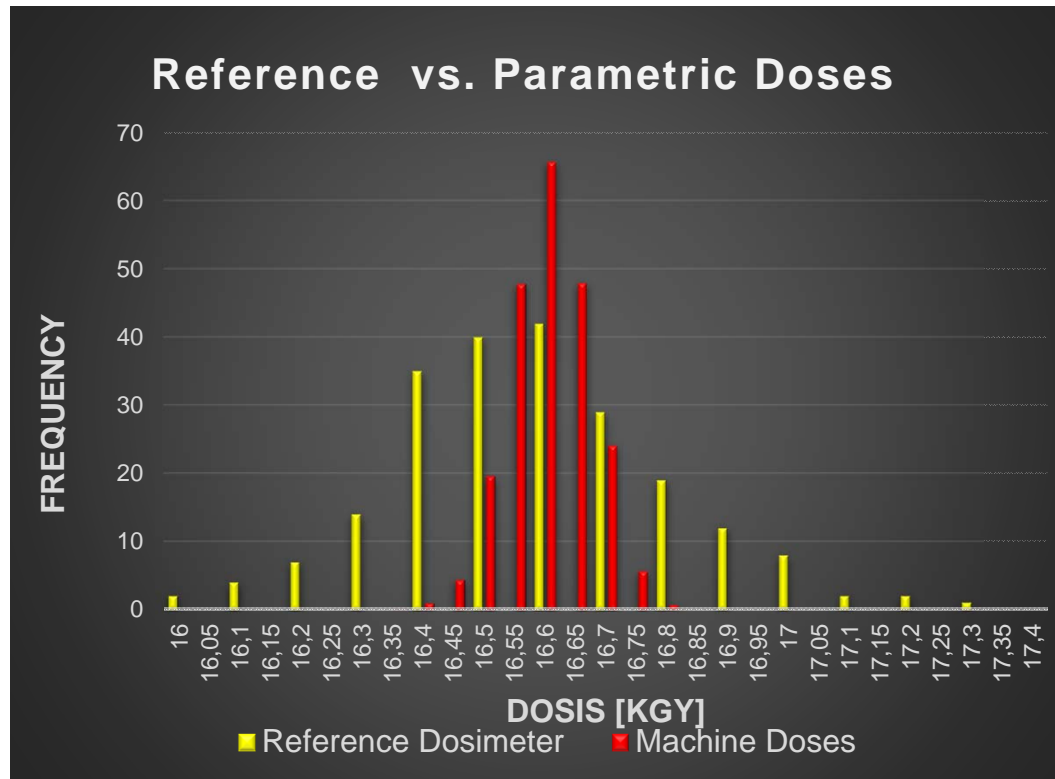
$$PV = \frac{I}{v.s}$$

Parametric Dose
Machine Dose:

$$D_p = k.PV$$



Surface Dose – Beam Parameter Relationship



Reference Dose:

RSD \approx 1.4 % (k=1)

Parametric Dose:

RSD \approx 0.5 % (k=1)



Process Control – Control Chart

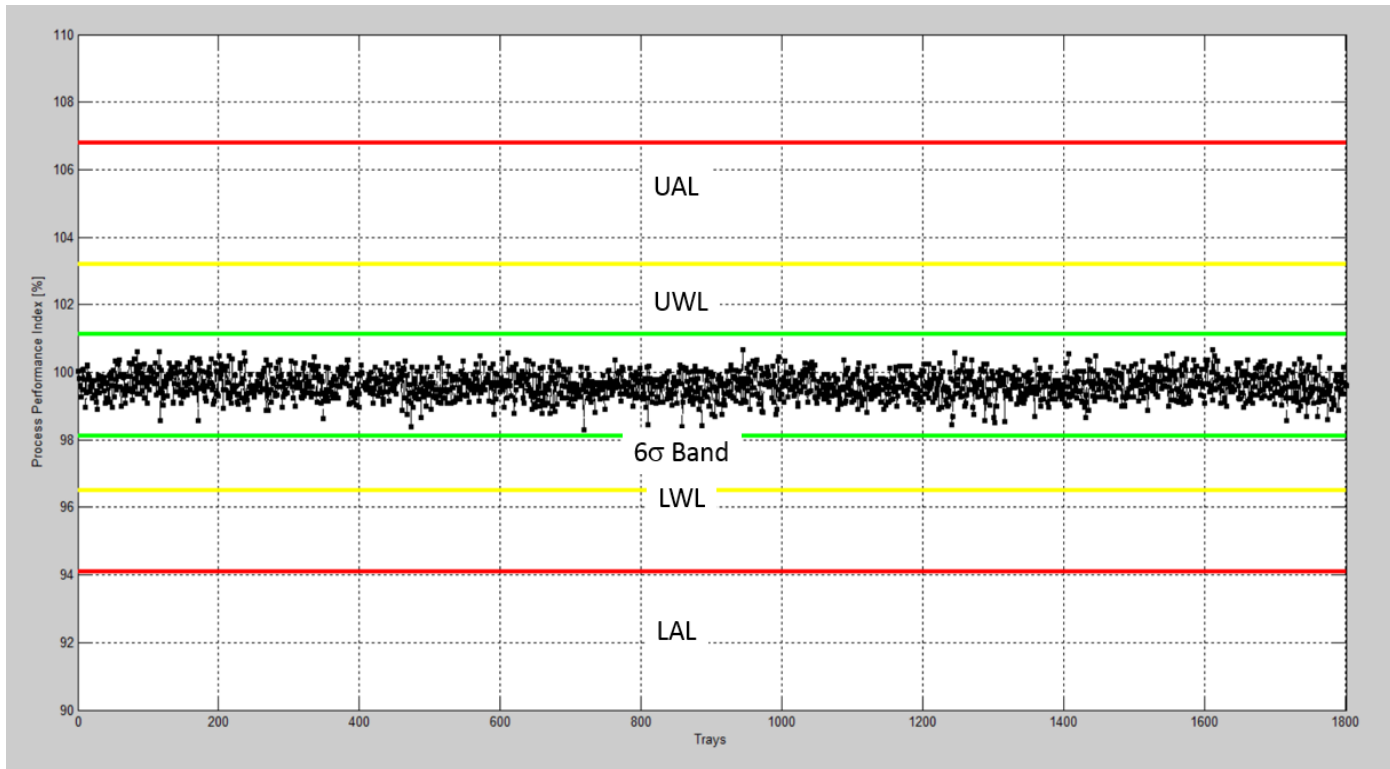
$$PV = \frac{I}{v \cdot S} \quad \text{Process Value}$$

$$PV_0 = \frac{I_0}{v_0 \cdot S_0} \quad \text{Process Value Setpoint}$$

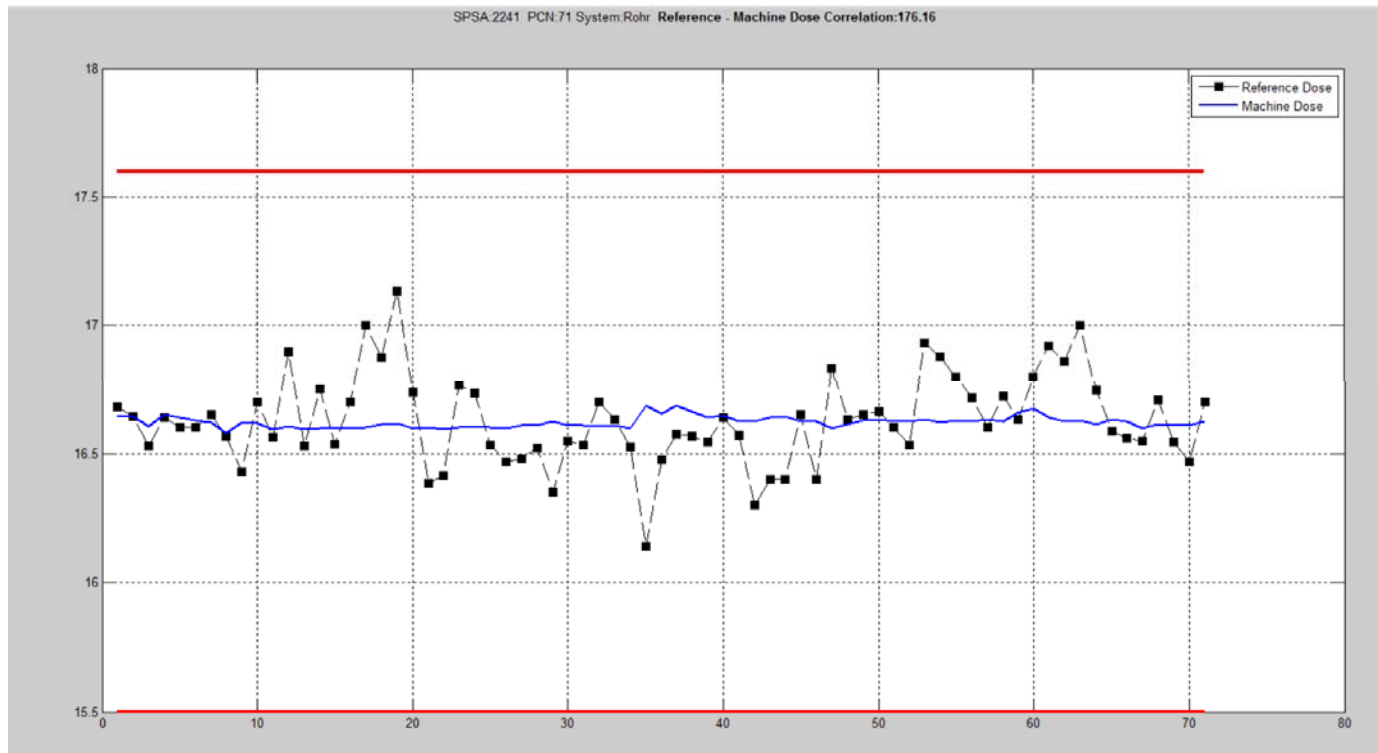
$$PPI = 100 \frac{PV}{PV_0} \quad \text{Process Performance Index [\%]}$$



Product Batch Control Chart



Long Term Reference Dose Analysis



Conclusion

- A state-of-the-art E/Beam X-Ray Facility has been successfully installed and commissioned
- Requirements in E-Beam and X-Ray Dose Uniformity and Throughput achieved or surpassed
- Process Control in place as designed
- Highly appreciated by customers for accuracy, precision and throughput
- X-Ray Treatment well accepted and rapidly growing



THANK YOU!