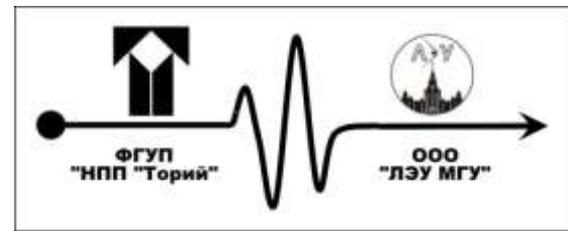




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Main Parameters and Operational Experience with New Generation of Electron Accelerators for Radiography and Cargo Inspection

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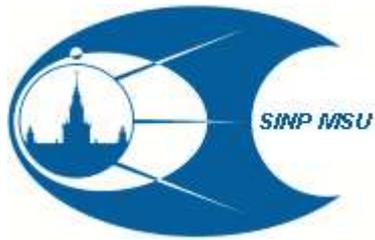
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MSU ELECTRON ACCELERATORS

- 1959-1984 – Photonuclear reactions study with 35 MeV betatron
 - 1985-1992 – 175 MeV race track microtron project
6.7 MeV CW injector built
 - 1992-1996 – several 1- 2 MeV high power CW accelerators built
 - 1996-2001 – 70 MeV pulsed race track microtron built
 - 1998-2003 – 35 MeV high brightness beam accelerator built
 - 1999-2001 – 60 kW, 1.2 MeV compact CW linac built
 - 2000-now – Vacuum laser acceleration theoretical and experimental study
 - 2003-2007 – 50 kW, 10 MeV technological linac
 - 2003-2010 – 55 MeV pulsed race track microtron built
 - 2007-present time – 3/6 MeV linac with pulse to pulse energy switch for cargo inspection built
 - 2009-present time – 3-8 MeV industrial linac for ROSATOM plants
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DESIGN FEATURES

- the energy and the dose rate change
- the standing wave on-axis coupled accelerating structure with capture efficiency more than 60%
- the sealed-off linear accelerator
- the pulse multi-beam klystron KIU-168
- solid state high voltage modulator
- beam spot size < 1 mmv



Figure 1: Accelerating system.



Figure 2: Klystron KIU-168, pulsed power 3.5 MW.

DESIGN FEATURES

- the radiation shielding better 10^{-5}
- intensively cooled bremsstrahlung target
- automatic isolated gas system
- Ethernet network control system

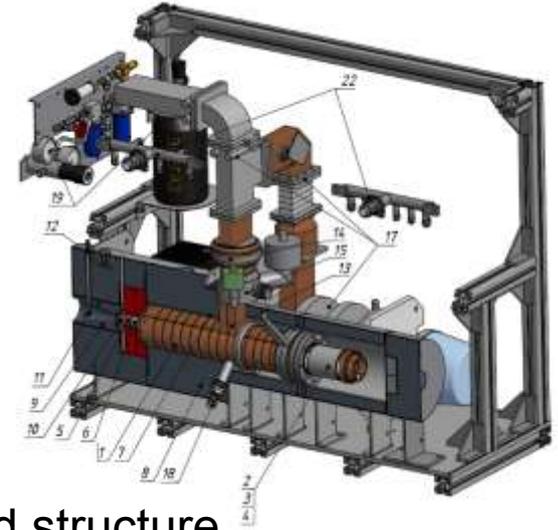


Figure 4.: X-ray head structure.



Figure 3: Radiation shielding and collimator.



Figure 5.: Control system.

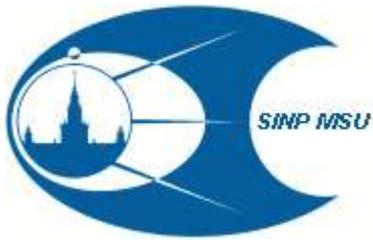
Accelerator for radiography UELR-8-2D

Table 1: Radiographic accelerator parameters



Parameter	Value
Beam energy	3 - 8 MeV
Dose rate	1 – 15 Gy/min
Beam spot size	< 1 mm
Dimensions W×L×H	640×1090×1460
Weight	1025 kg

Figure 6: Accelerator for radiography.



Accelerator for cargo inspection

UELR-6-1-D-4-01

Table 2: Cargo inspection accelerator parameters.



Parameter	Value
Beam energy	3.5/6 MeV
Energy stability	0.5 %
Dose rate	4 Gy/min
Dose rate stability	2 %
Repetition rate	2×200 Hz
Beam spot size	< 1 mm
Dimensions W×L×H	640×1090×1460
Weight	1250 kg

Figure 7: Accelerator for cargo inspection.

Accelerator for cargo inspection

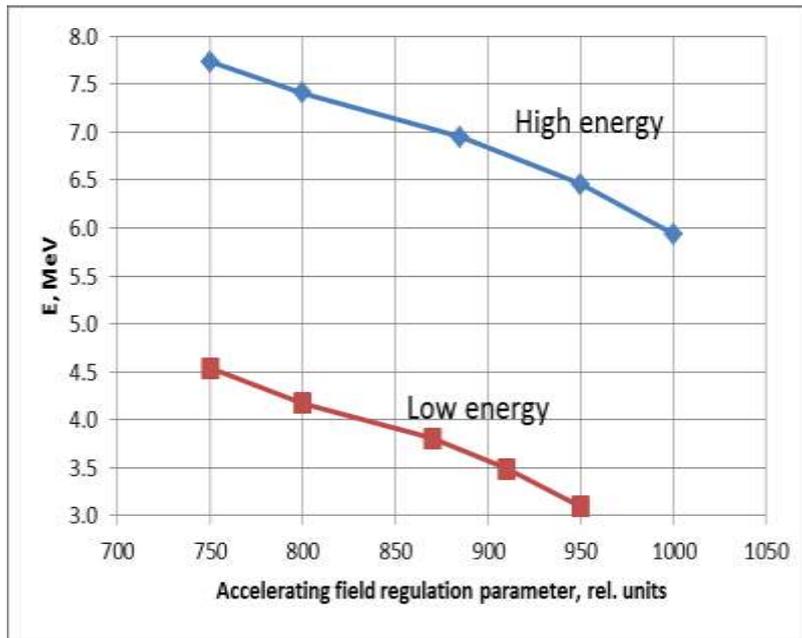


Figure 8: Low and high beam energy regulation.

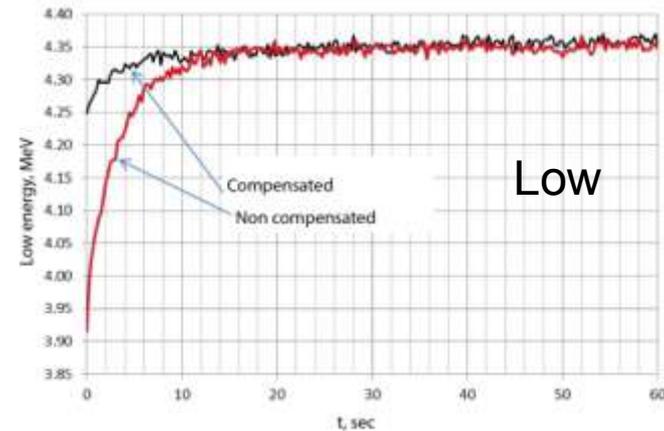
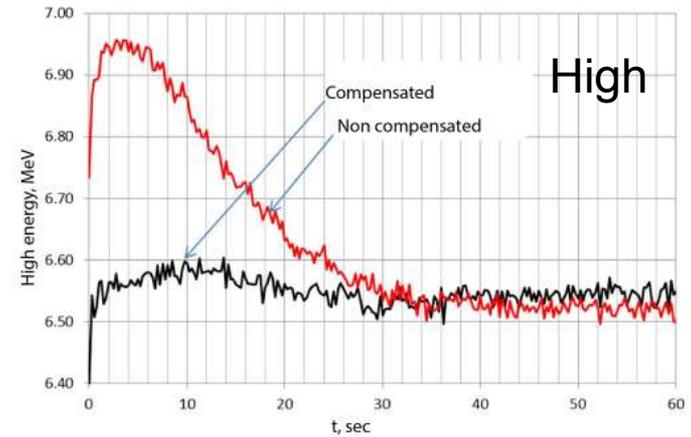


Figure 9: Time dependencies in energy switching mode with compensating mechanism switched off and on.

COMMISSIONING



In Petrozavodskmash OJSC X-ray camera
Petrozavodsk, Republic of Karelia, Russia



In ST-6035 inspection, which is installed on
reconstructed Pogranichny check point
(Primorsky Krai)

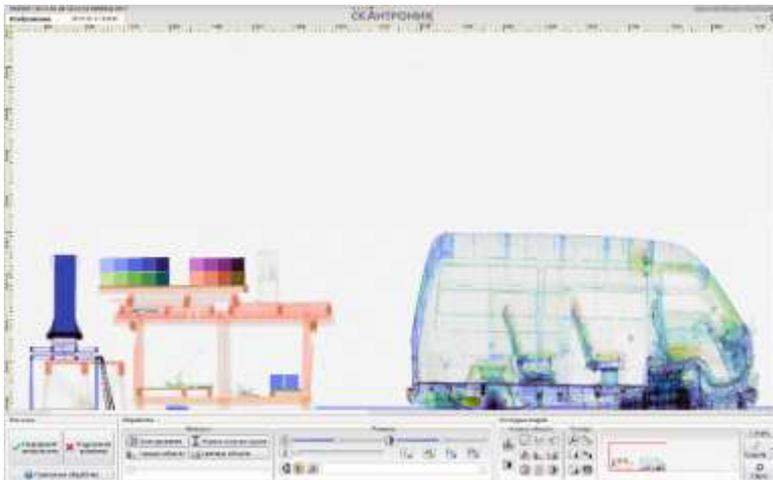
Operation time > 10000 h

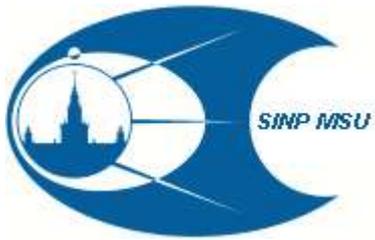
COMMISSIONING



28-29 of May, 2014, by request of Government of Russian Federation from February 18, 2014, Interdepartmental Commission formed by order of Rosgranitza from May 14, 2014, carried out complex site acceptance tests of technological equipment of ST-6035 inspection system based on linear electron accelerator, which is installed on reconstructed Pogranichny check point (Primorsky Krai).

During the complex site acceptance tests Interdepartmental Commission confirmed technical and operational characteristics and performances of ST-6035 inspection system. Site acceptance tests of technological equipment were carried according to the all items of agreed SAT Program with positive issues.





FUTURE

- 3-8 MeV radiography accelerator for CJSC Branch in Volgodonsk, Rostov Region, Russia (contract)
 - 3-8 MeV radiography accelerator for ZiO-PODOLSK (ready)
 - Cargo inspection systems???
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THANKS
