Project of RF System for 2.2 GeV Electron Storage Ring – Zelenograd SR Source.

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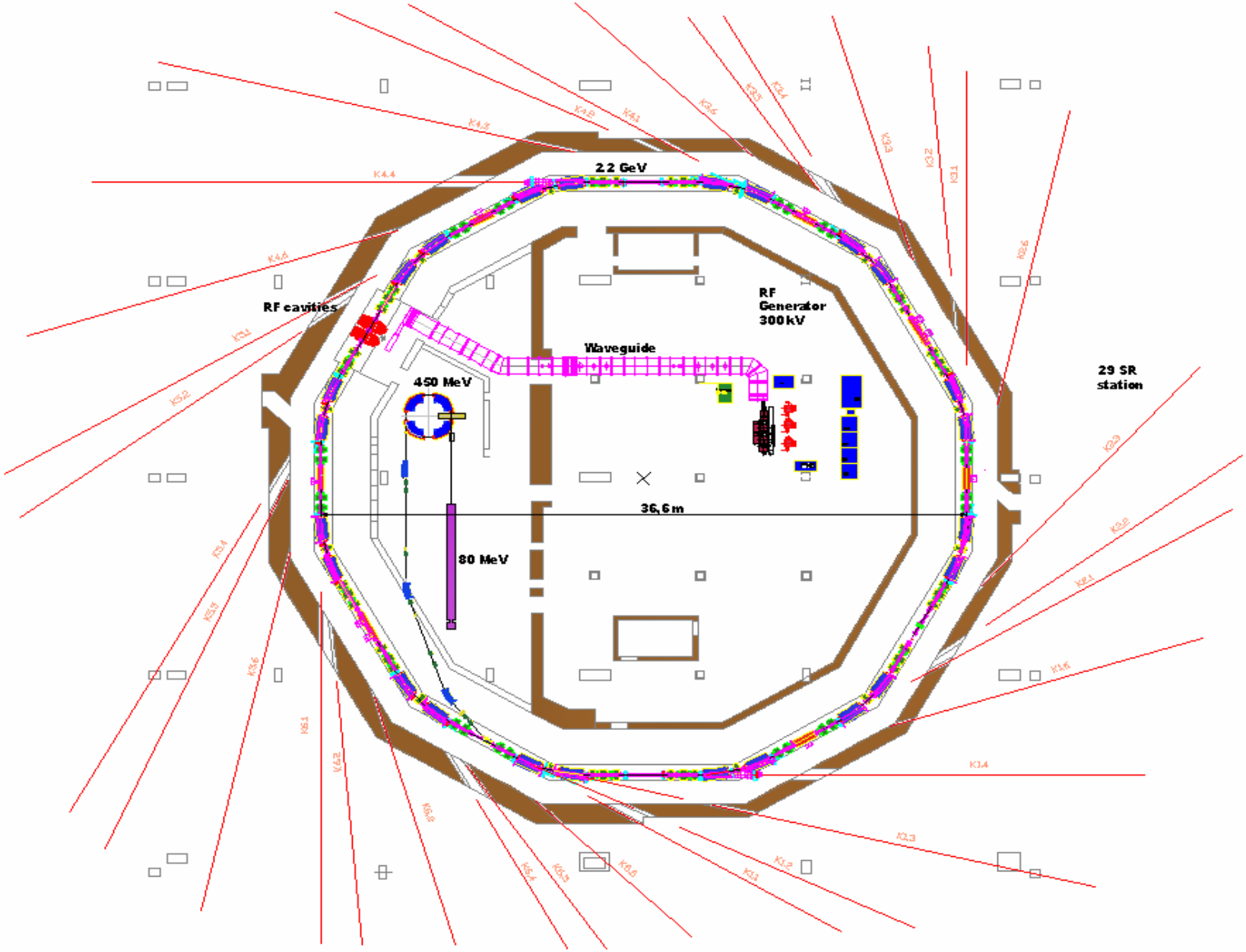
New electron storage ring designed at BINP SB RAS is being built in Zelenograd, Russia as dedicated technological synchrotron radiation (SR) source.

This machine will provide SR in the range of 0.1÷2000 Å.

Maximum electron beam energy – 2.2 GeV.
SR energy loss at this energy - 409 keV per turn.
Energy loss due to insertion devices - + 105 keV.

In single bunch mode average beam current -0.1 A
In multi-bunch mode average beam current - 0.3 A.



Layout of Zelenograd Synchrotron Radiation Source (Russia)

RF system consists of:

1. Two bi-metal cavities. The cavities are placed in the storage ring at a distance between their centers of half-wavelength.

2. Single generator with CW output power of 300 kW.

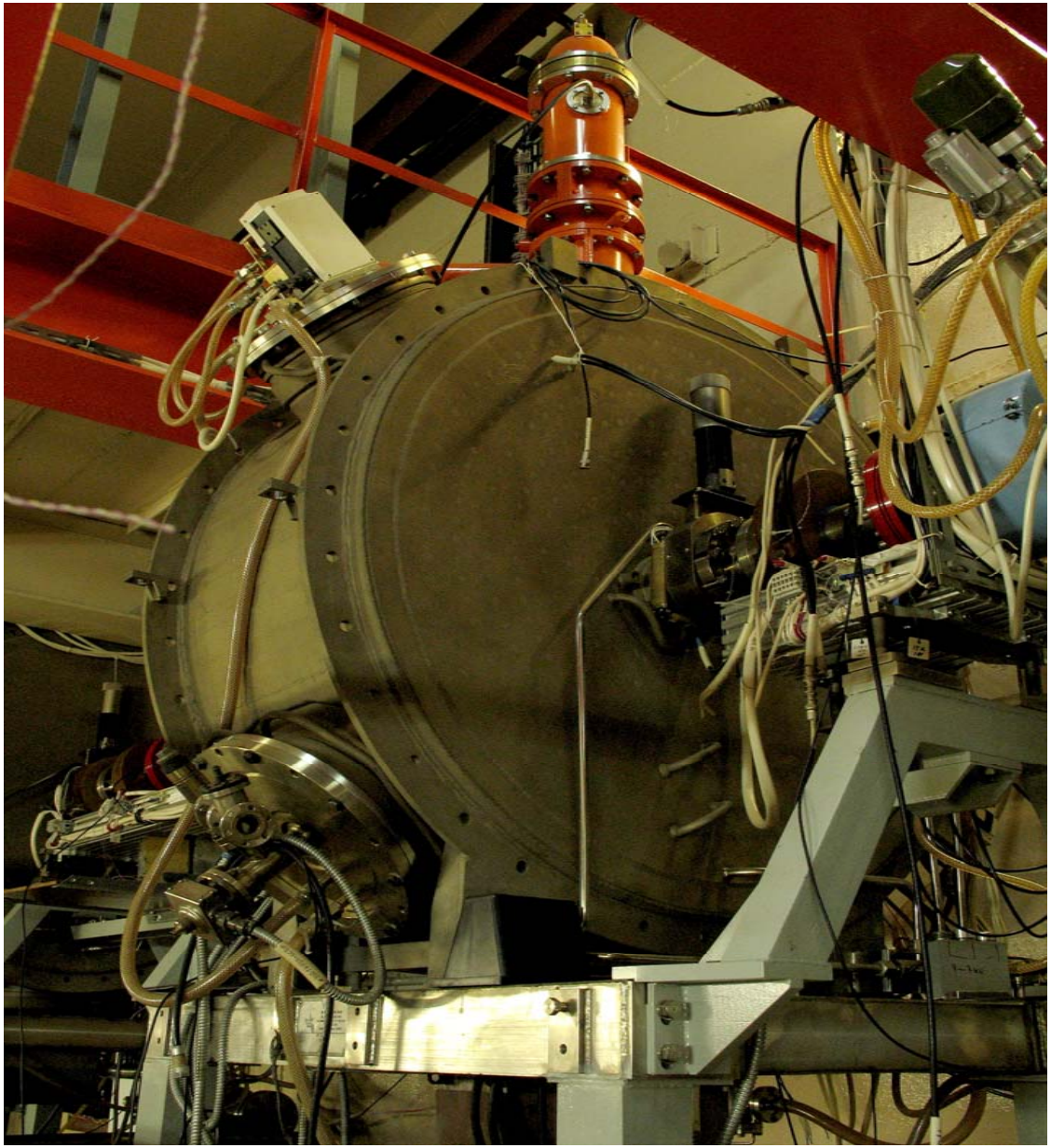
3. One waveguide (986mm × 150mm). The generator and the cavities are connected to the waveguide through waveguide-to-coaxial transitions.

4. Accelerating voltage and phase are controlled by control sub-system.

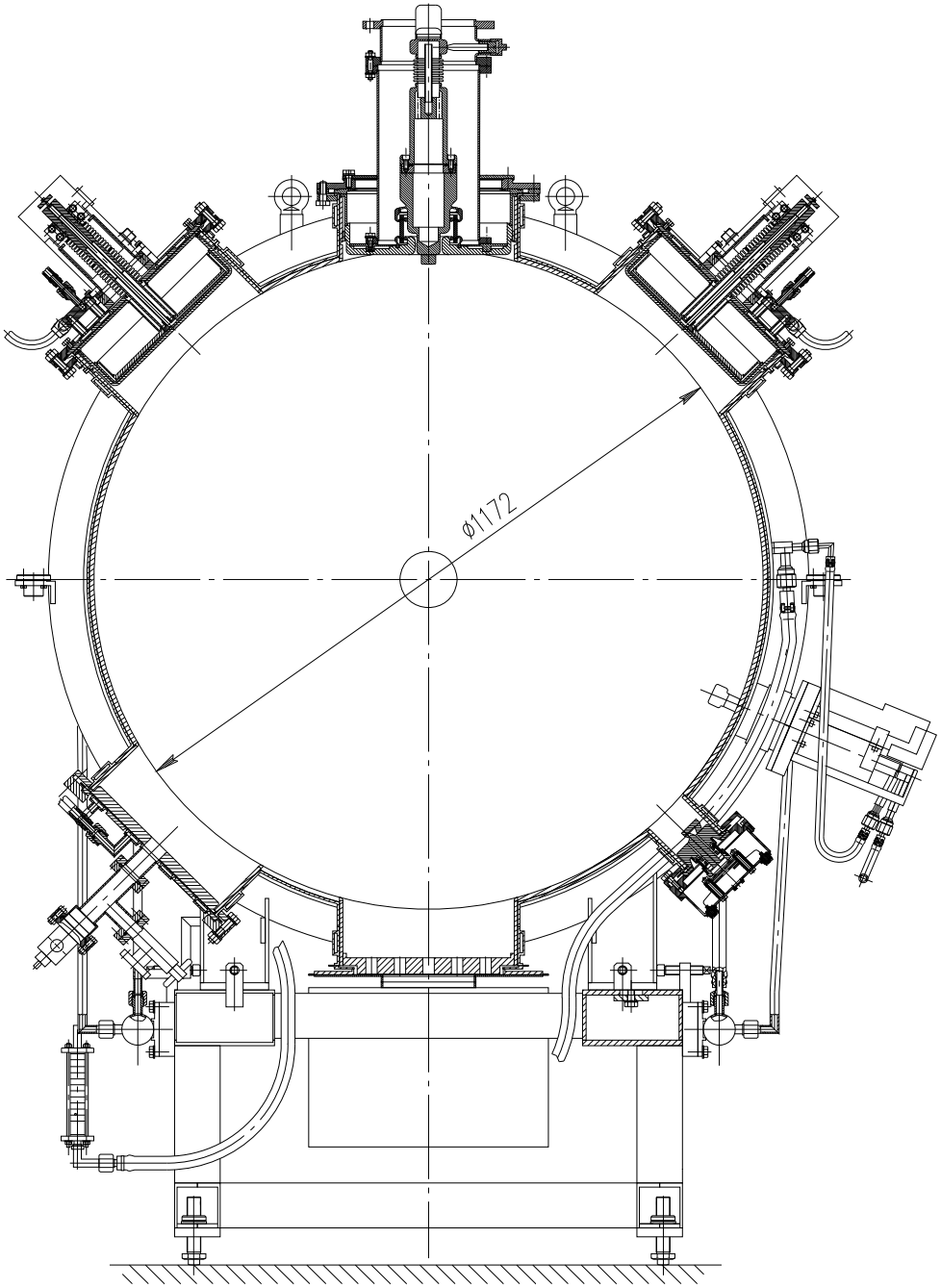
Main parameter of the RF system are listed in table 1.

Table 1: Parameters of the storage ring RF system

Operating frequency	**181.33 MHz**
Harmonic number	**70**
Number of cavities	**2**
Total accelerating voltage	**0.2÷1 MV**
Cavity frequency tuning range	**±180 kHz**
Gap voltage U (ampl.) per cavity	**0.1÷0.6 MV**
Transit time factor	**0.9**
Cavity quality factor	**39000**
Cavity shunt impedance $R= U^2/2P$	**5.2 MOhm**
Power loss per cavity at U_{max}	**35 kW**
Generator output power	**300 kW**

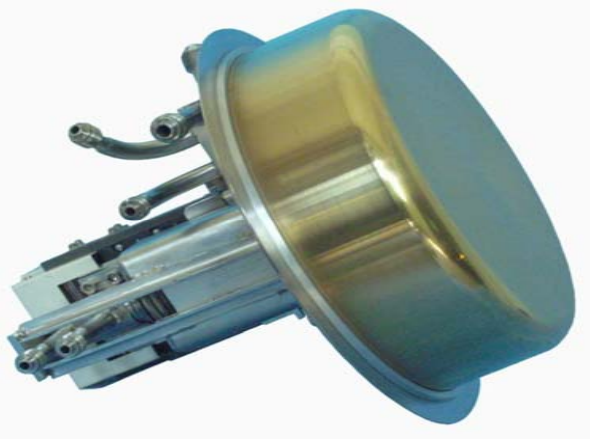


Bi-metallic cavity of Novosibirsk FEL injector analogous to the cavity of Zelenograd storage ring.

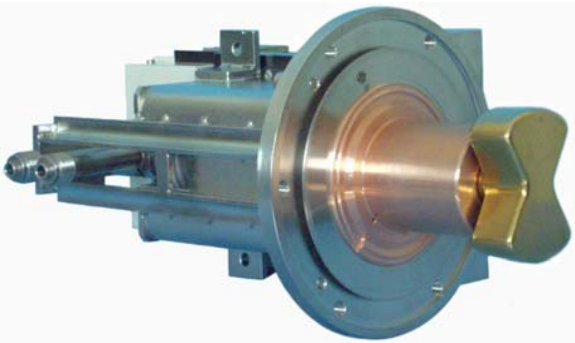


Schematic view of accelerating bi-metallic cavity

2 contactless fundamental mode tuners



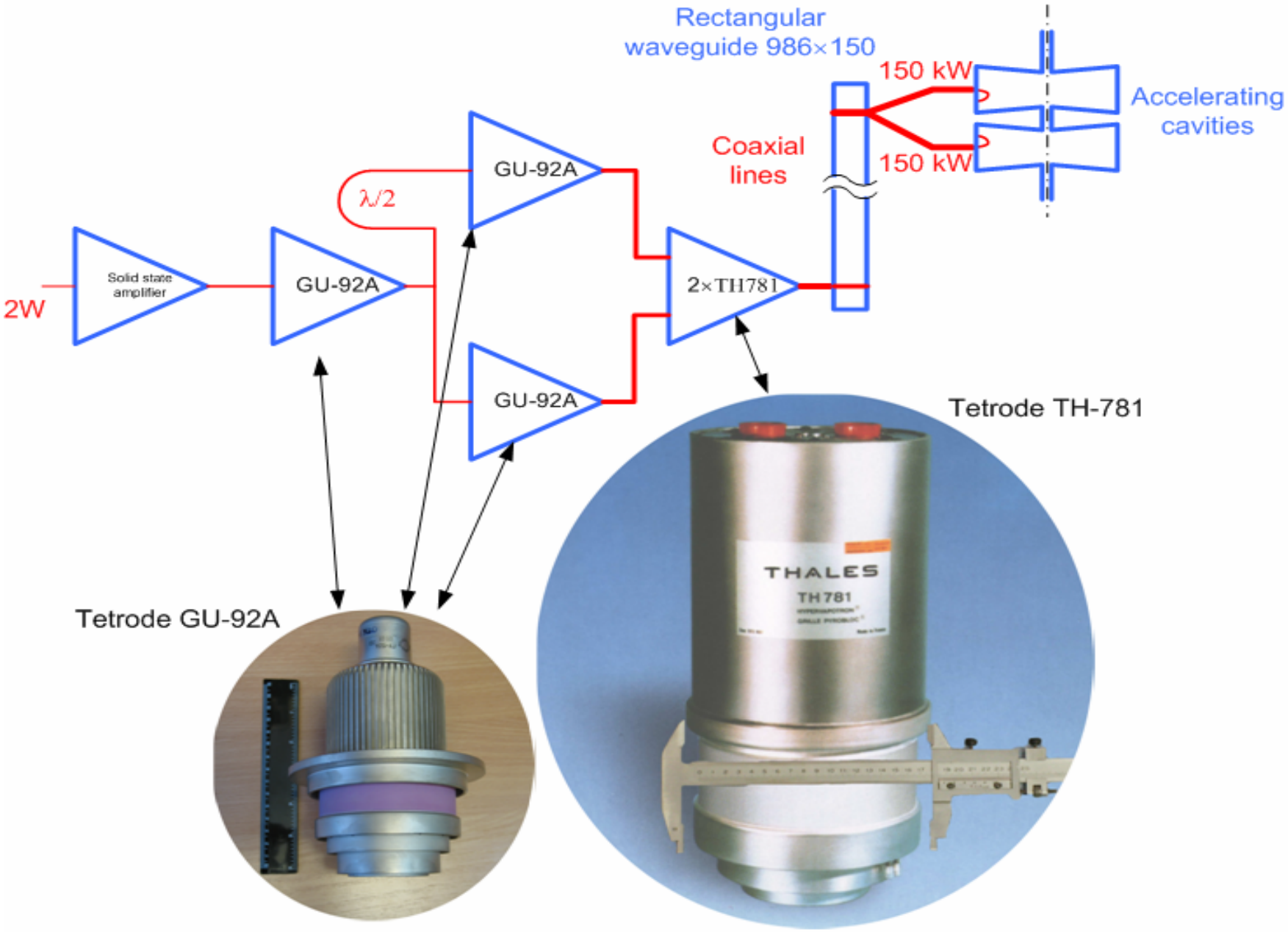
2 higher order modes tuners



Coaxial power coupler

Inductive probe

Coaxial power coupler (side-view)



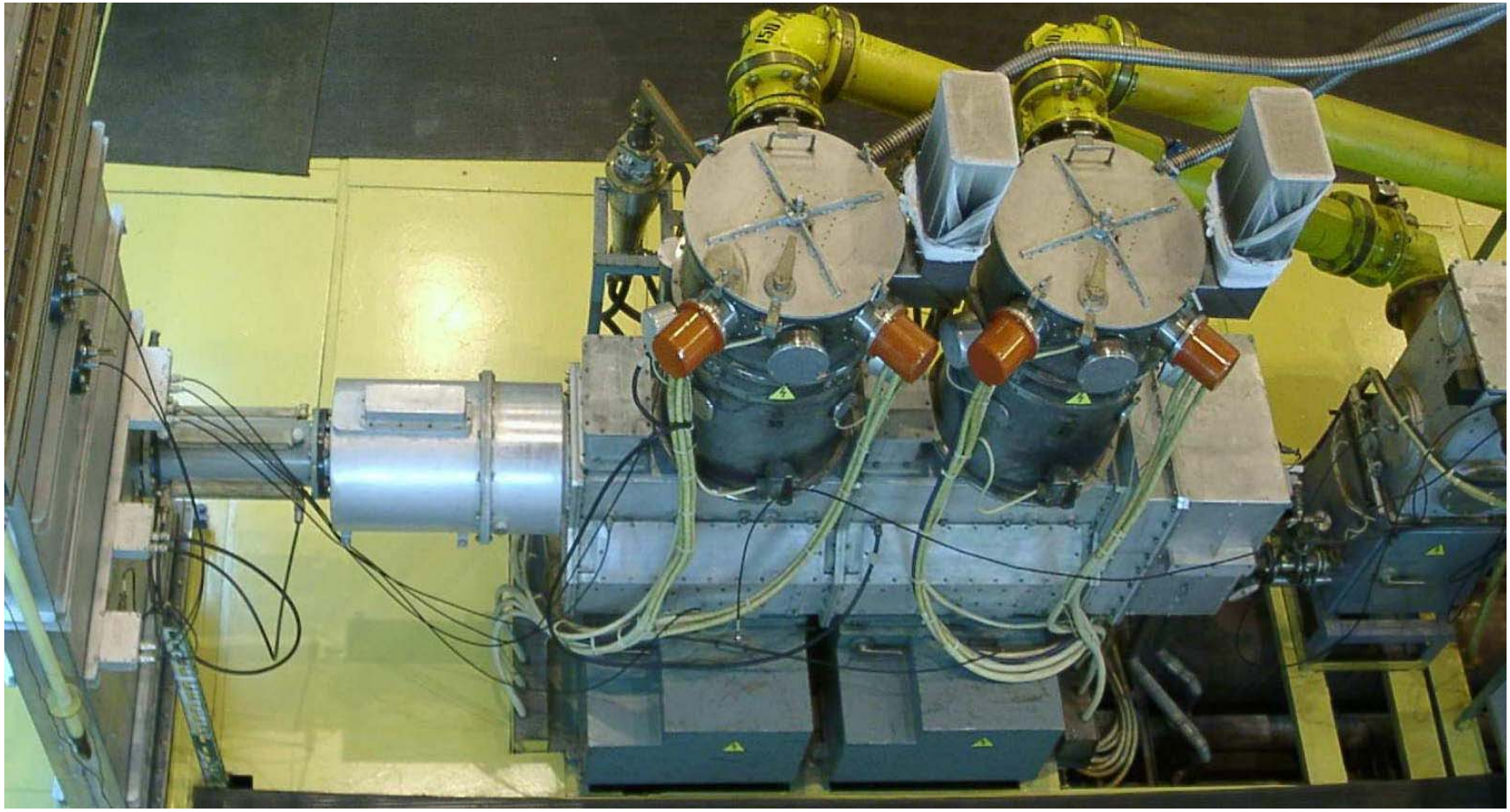
Accelerating RF system 180 MHz 300 kW

Test tube T H 781
Regime CW, testing Frequency of 176 MHz
RF output power of 150 kW

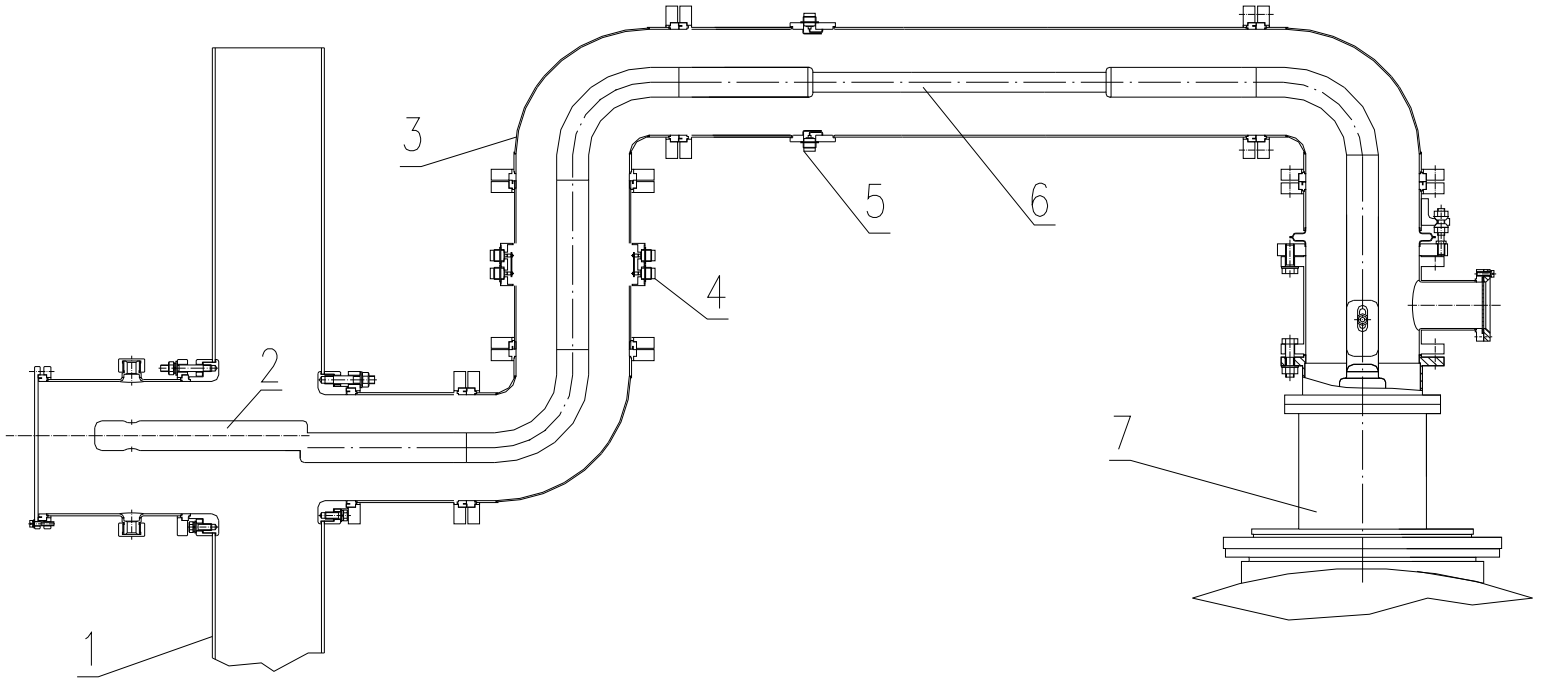
V fil	I fil	V anode	V screen grid	V control grid	I anode	P rf input	P anode dissipation
V	A	kV	V	V	A	kW	kW
9.5	330	10	1200	-350	22	7	77

Calculated Regime CW, Performance for TNK
Frequency of 181 MHz
RF output power of 150 kW

V fil	I fil	V anode	V screen grid	V control grid	I anode	P rf input	P anode dissipation
V	A	kV	V	V	A	kW	kW
9.5	330	9	1200	-350	25	9	84

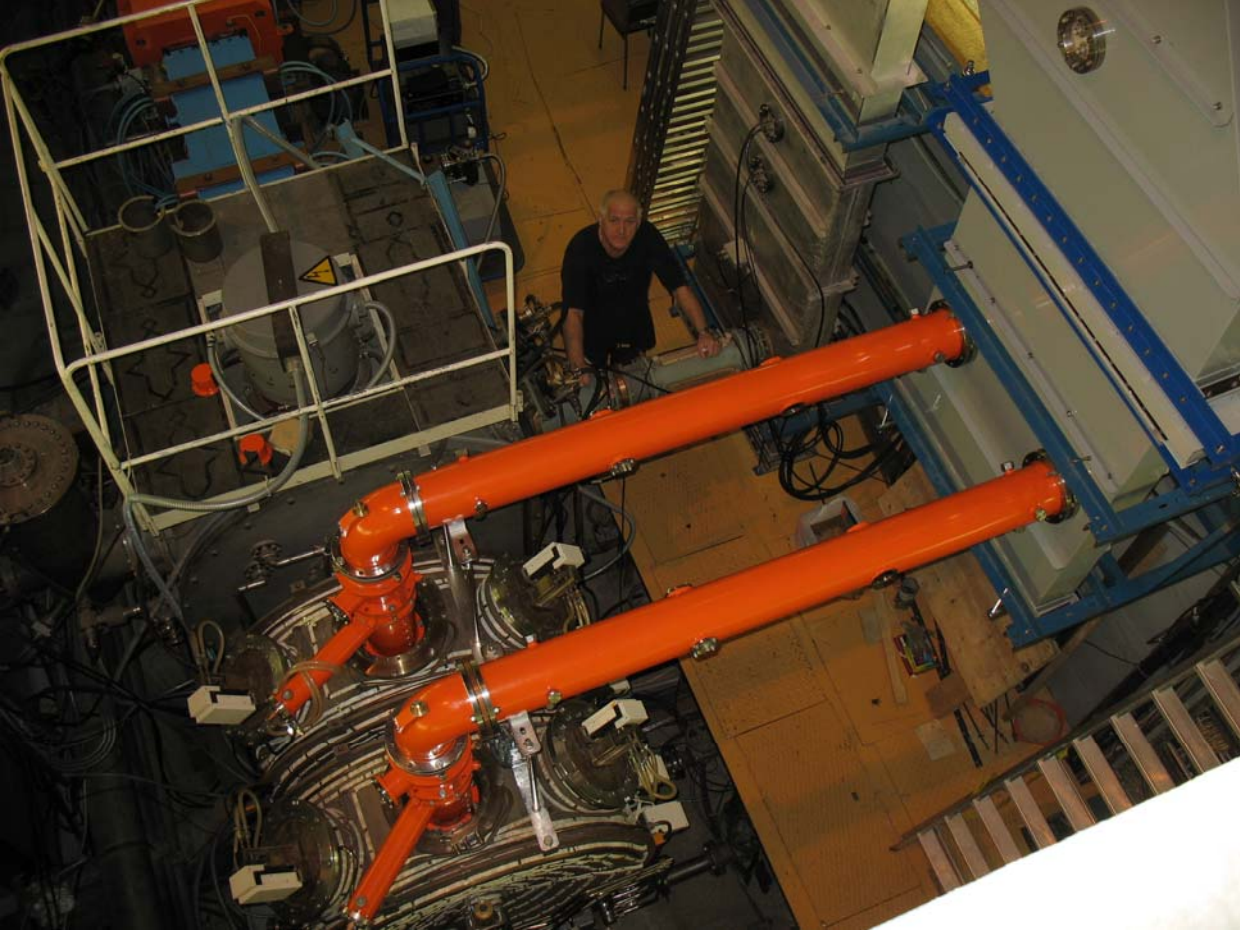


View from above to the output stage of RF generator of Siberia-2 storage ring in Moskow, which design is analogous to one of Zelenograd.



Scheme of RF feeder between the waveguide and one of the cavities.

1- waveguide, 2- waveguide-to-coaxial transition, 3-coaxial feeder of 75 Ohm, 4-directional couplers, 5- current pick-up loops, 6- quarter wavelength transformer, 7- cavity.



View of feeders between the waveguide and two cavities of Siberia-2 storage ring, which design is analogous to Zelenograd

The cavities are driven in anti-phase due to proper rotation of the coupler Loops.

Both feeders are connected to the waveguide at the same cross-section symmetrically relative to the middle of its wide wall.

The distance between the waveguide and the cavities is multiple odd number of quarter wavelengths.

Control sub-system

Control sub-system has feedback loops for adjustment and stabilization of the total accelerating voltage. Time constant of 100μs.

Control sub-system has feedback loop for resonant frequency tuning. Time constant of 0,1s.

The total accelerating voltage is phased by the storage ring master oscillator signal at 181,33 MHz.
Also the RF voltage of the injector is phased by the same master oscillator which ensures precise synchronization of the Injection to the storage ring.

Control sub-system has an interlock board that protects the equipment and personnel in case of failure.

Conclusion

RF system that allows obtaining the design parameters of the technological electron storage ring -SR source has been developed.

The design work is being completed.

A new RF generator had been developed using Thales tetrode TH781

Parts of the RF system are in production at the moment.

After assembling and testing at BINP the 2 cavities and generator will sent to Zelenograd.

Commissioning of the RF system is scheduled for the 1st half of 2009.