WWR-K research reactor upgrades related to HEU/LEU conversion

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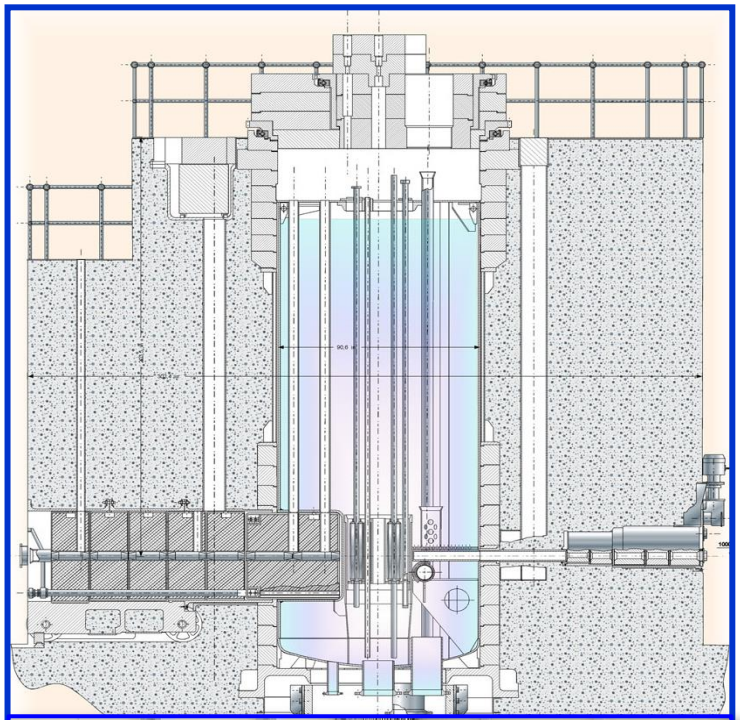
WWR-K Research Reactor (HEU)



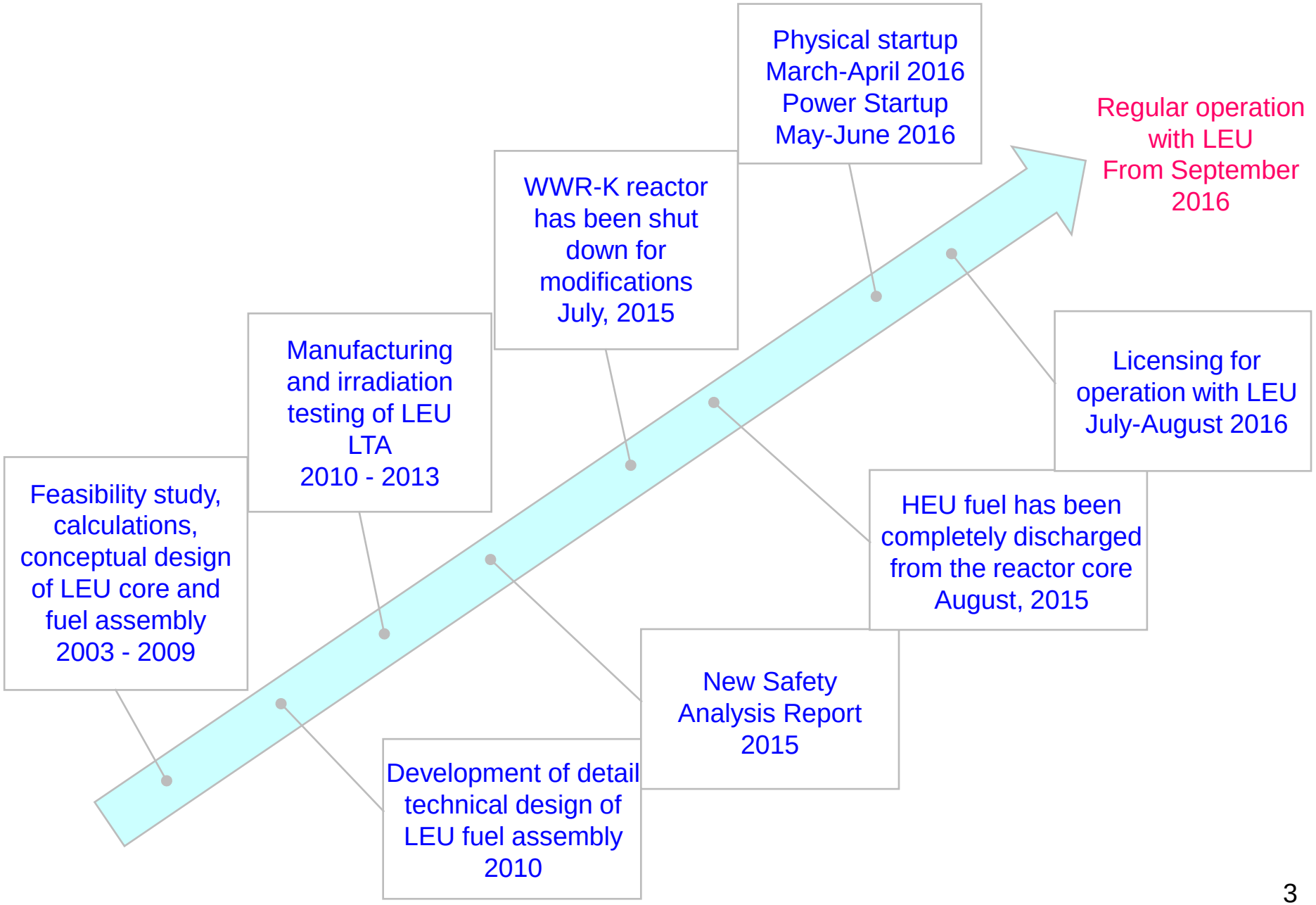
- 1967 started in operation
- Until 1988 works for 10 MW
- 1988-1998: modernization, licensing
- in 1998 operation resumed
- Thermal Energy: 6 MW
- Max. thermal neutron flux: $1.2 \cdot 10^{14}$ см$^{-2}$с$^{-1}$
- Fuel Enrichment: 36% ^{235}U
- The moderator, coolant and reflector: light water

Reactor is 48 years old,
38 years worked on power

Using:

- Production of radioisotopes;
- Radiation testing of materials and components;
- Neutron activation analysis;
- Scientific research
- Radiopharmaceuticals

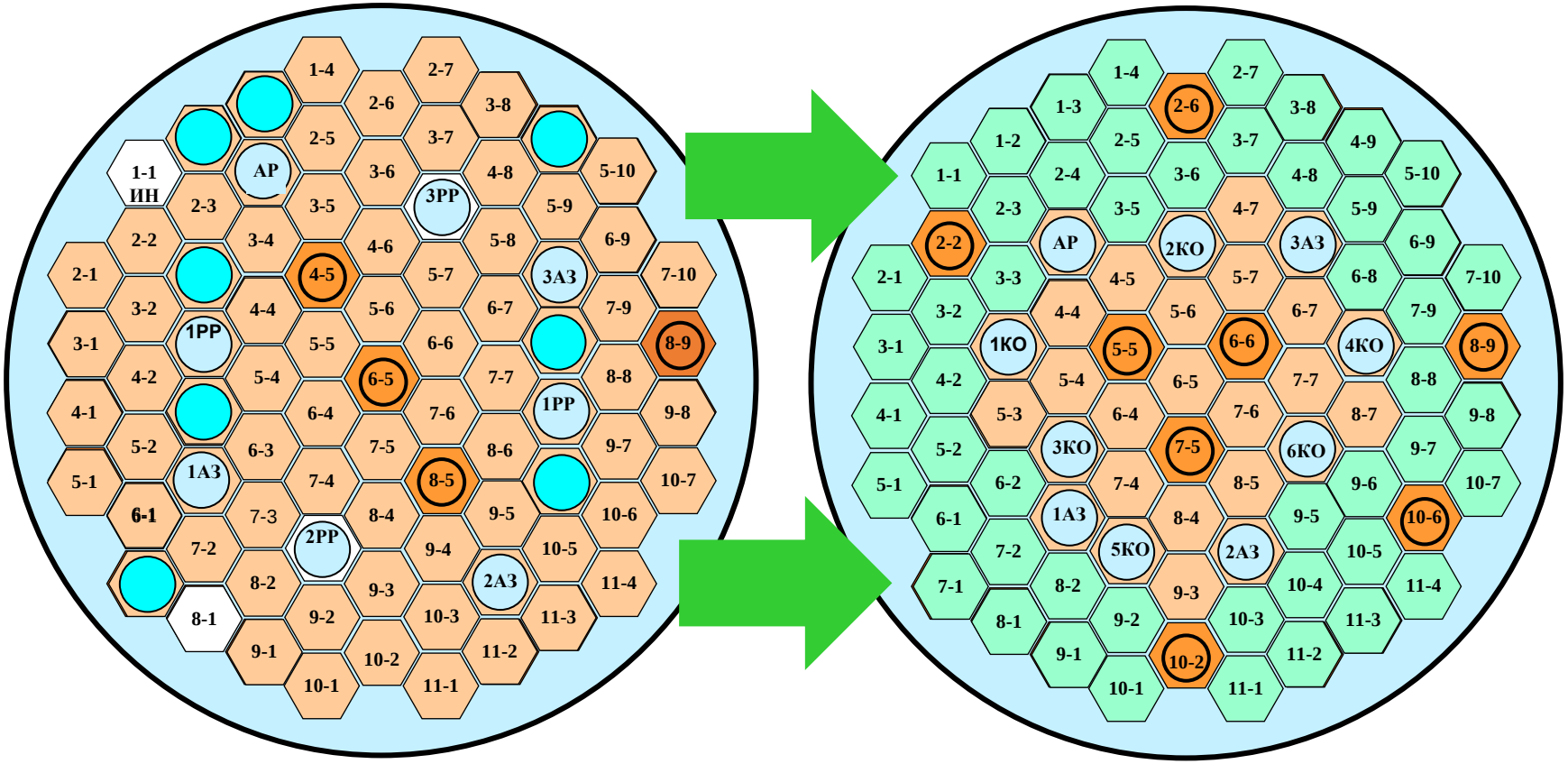
MILESTONES OF WWR-K RR HEU/LEU CONVERSION



WWR-K Research Reactor HEU/LEU conversion

71 FA-1 VVR-C and 6 FA-2 VVR-C

17 FA-1 VVR-KN and 10 FA-2 VVR-KN



7-5 FA-1

FA-2 with CPS rod

Irradiation channel

FA-2 with Be

1-1 Displacer

UPGRADES OF REACTOR SYSTEMS

- **I&C system**
  - Replacement of electronics
  - Replacement of control rod drive mechanisms
- **Emergency cooling system**
  - Replacement of pumps, some tubes and valves
  - Installation of uninterrupted power supply
- **Emergency core sprinkling system**
  - Replacement of sprinkler and pumps
- **Primary cooling system**
  - Replacement of gaskets
  - Inspection of vessel and piping
- **Secondary cooling system**
  - Installation of additional new cooling towers
- **Radiation monitoring system**
  - Complete replacement
- **Gas and aerosol emissions monitoring system**
  - Complete replacement

I&C SYSTEM - ELECTRONICS

- Designed and manufactured by JSC SNIIP-Systematom (Moscow, Russia)
- The factory acceptance tests carried out in May 2015
- It was delivered in Almaty in July 2015
- Initial visit the manufacturer's experts in September 2015
- Installation startted in October 2015
- Testing and commissioning – February, March, 2016

I&C SYSTEM - ELECTRONICS

- Dismantling of old instrumentation and control system
- Installation of new equipment

I&C SYSTEM - ELECTRONICS

Replacing the control panel

I&C SYSTEM – CONTROL ROD DRIVE MECHANISMS

CRD Mechanism includes drive, control rod and housing channel

- **Designed and manufactured by ŠKODA JS a.s. (Plzen, Czech Republic)**
- **Factory acceptance testing in May 2015**
- **Delivered to Almaty in September 2015**
- **Installed and tested in February 2016**

I&C SYSTEM – CONTROL ROD DRIVE MECHANISMS

Control rod and housing channel:
Absorber - natural Boron Carbide, 1.8 g/cm3
Housing – AlMg3

Travel range 700 mm
Nominal speed 4 mm/s
Max. weight 26 kg
Load capacity 8 kg, tested for 12 kg

Control rod drop time less than 0.8 s

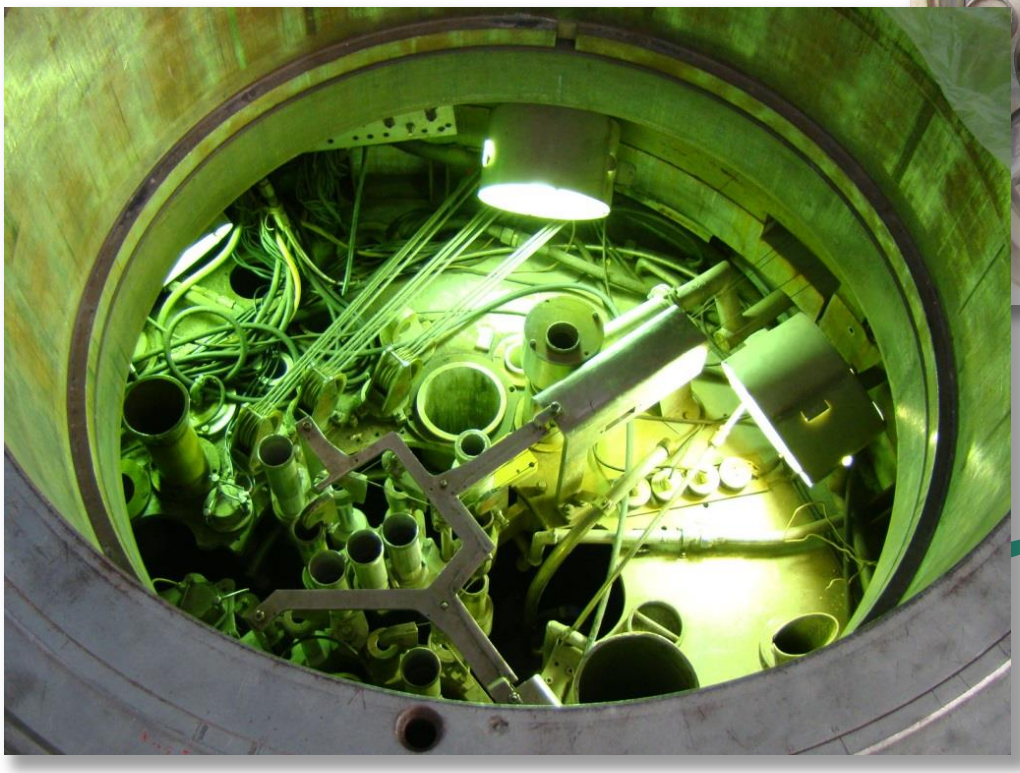
I&C SYSTEM – CONTROL ROD DRIVE MECHANISMS

Dismantling of the reactor plug

Dismantling of old cabling in the reactor hall
Installation of new communication lines and cables.

I&C SYSTEM – CONTROL ROD DRIVE MECHANISMS

Dismantling of old control rod drives and core channels

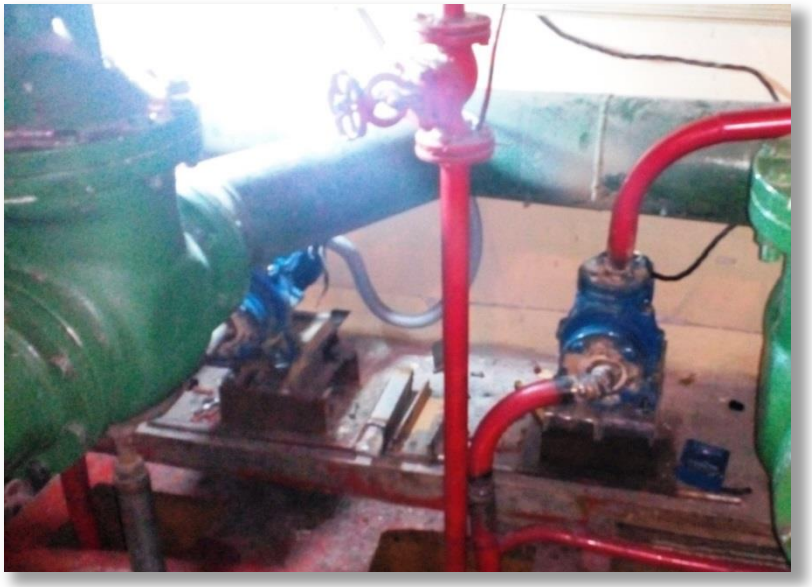


Prepared for installation of the new equipment

EMERGENCY COOLING SYSTEM AND CORE SPRINKLING SYSTEM

- **Replacement of pumps, valves and pipe parts**
- **Modification of one of two core sprinkling devices**
- **Installation of additional uninterrupted power supply**

The core with LEU has a smaller size and higher power density



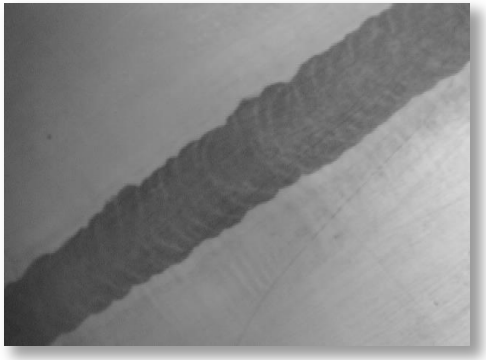
2 pumps, 45 m3/h each, instead of 10 m3/h for HEU zone

The batteries 30 kW, 6 hours

PRIMARY AND SECONDARY COOLING SYSTEMS

- **Technical inspection of piping and reactor tank**
- **Complete replacement gaskets**
- **Replacement of some valves**
- **The installation of new cooling towers**

The wall of the tank and weld



4 new water towers
replace 8 old ones

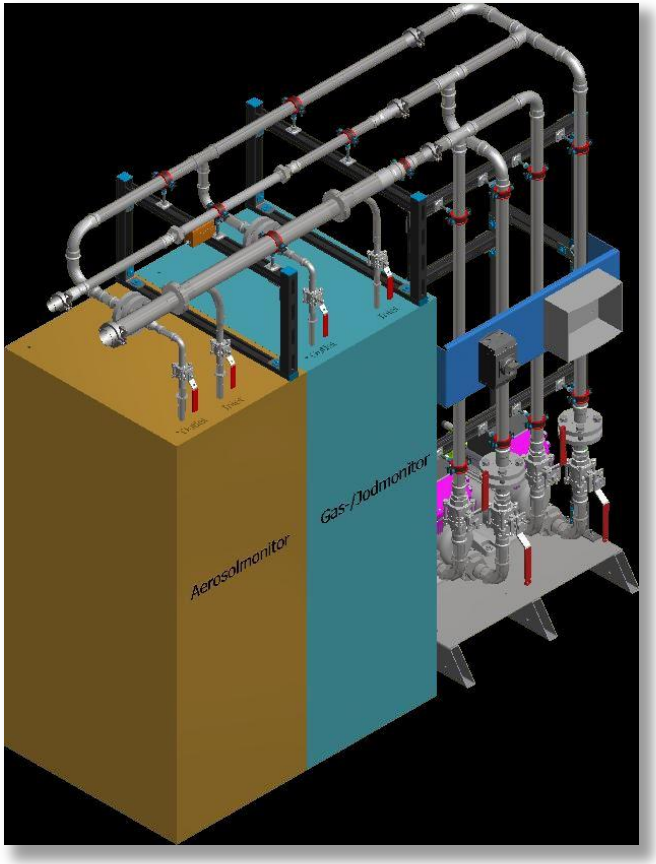
RADIATION, GAS AND AEROSOL EMISSIONS MONITORING SYSTEMS

- Complete replacement

The new system will provide:

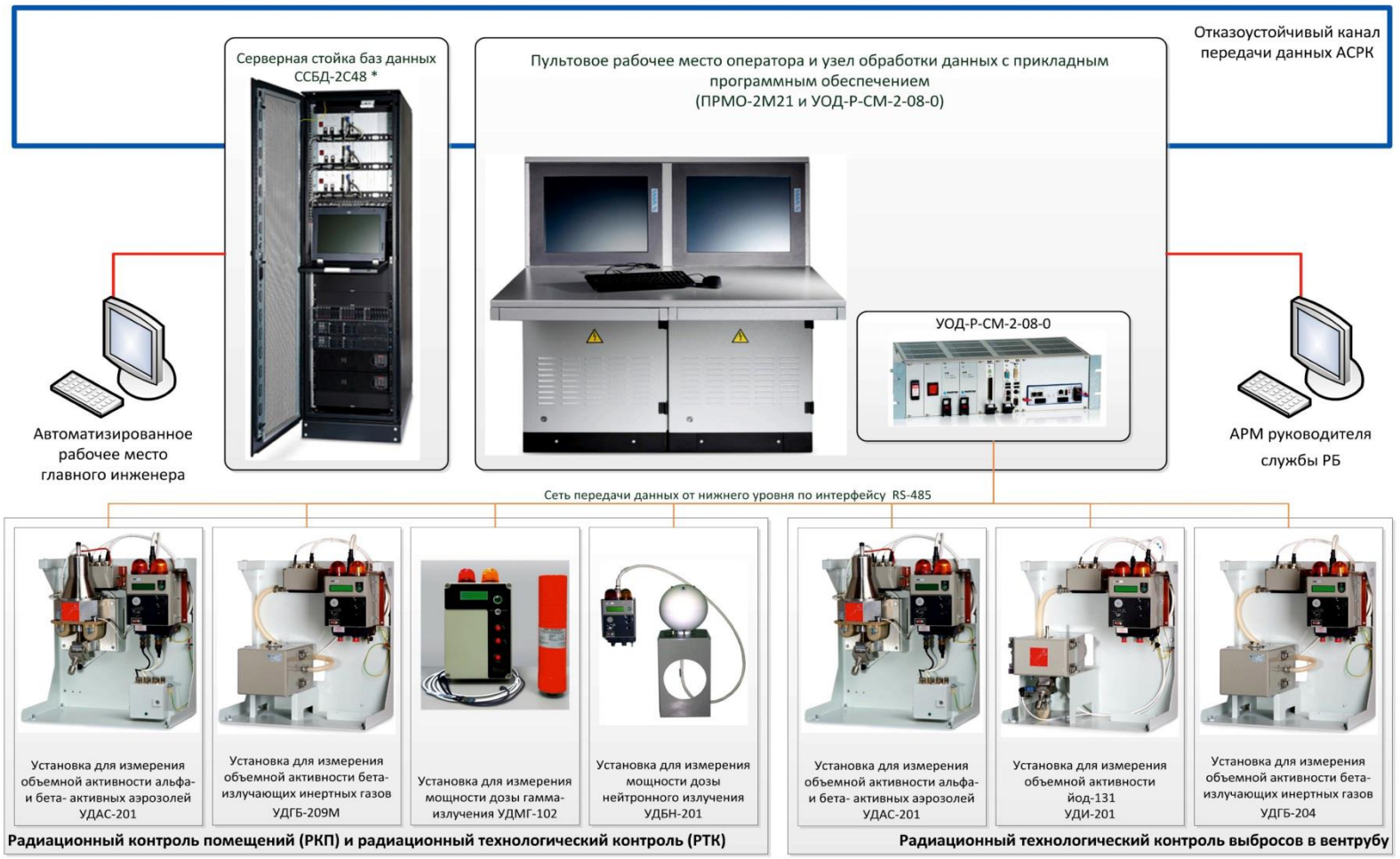
- Continuous monitoring of the dose rate of gamma radiation in the rooms of the reactor building
- Continuous monitoring of the alpha, beta and gamma activity aerosols, inert gases and iodine-131 in ventilation systems and push the cuttings through the pipe
- Continuous monitoring of the dose rate of gamma radiation in the water of the first and second circuits.

  all> 50 detectors
- Periodic measurement of alpha, beta and gamma activity in water
- The alarm on exceeding specified levels
- Data collection and archiving



RADIATION, GAS AND AEROSOL EMISSIONS MONITORING SYSTEMS

Автоматизированная система радиационного контроля ИР ВВР-К ИЯФ



* ССБД-2С48 содержит два сервера (основной и резервный), два источника бесперебойного питания, консоль оператора, коммутаторы, систему контроля климата и открытия дверей

Thank you for your attention!