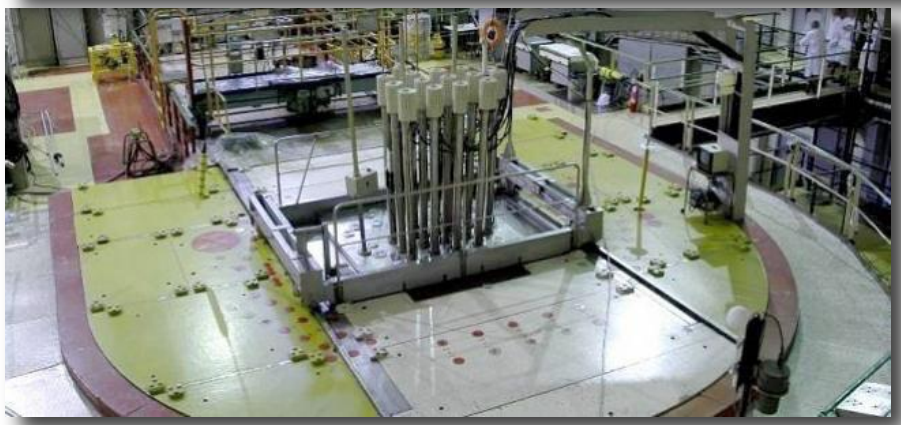
Narodowe Centrum Badań Jądrowych
National Centre for Nuclear Research
ŚWIERK

JRC collaboration partner

National Centre for Nuclear Research
Polish Research Reactor MARIA
Modernisation and Safety

Krzysztof Kurek

Nuclear research reactor MARIA



- built 1974, upgrade 1992, 2011
- pool type
- H_2O, Be moderated
- 30 MW thermal power
- neutron flux:
  - thermal $4 \cdot 10^{14}$ n/cm^{2}s
  - fast $2 \cdot 10^{14}$ n/cm^{2}s

One of the best neutron sources!

The scope of modernization of Maria Reactor during 1985-92:

- modernization of ventilation system;
- enlargement of beryllium matrix from 20 to 48 blocks;
- inspection of the graphite blocks;
- upgrading of temperature primary cooling control system;
- modernization of cooling towers in secondary cooling systems;
- upgrading of dismantling cell for spent fuel shipment;

The second step of upgrading the technological systems in MARIA reactor (during regular maintenance periods between 1996-2002):

- shipment of spent fuel from MARIA reactor to 19a nuclear facility;
- replacement of heat exchangers in primary cooling system;
- exchange of instrumentation and control system including ionization chambers;
- upgrading of the Fuel Element Integrity Monitoring System;
- modernization of radiation protection system;

Exchange of the main pumps (June-August 2013)

Access Control Systems: 2016 -2017

Conversion of MARIA reactor core from HEU to LEU fuel

- Conversion program of MARIA RR was closely associated with the „Global Threat Reduction Initiative” close collaboration with ANL, USA,
- In 2005 Poland decided to join the RERTR program and reduction of fuel enrichment in MARIA reactor,
- The MARIA reactor was a Russian-designed research reactor that operates with Russian highly enriched uranium (HEU) fuel,
- The proposed silicide fuel with a density of 4,8 g/cm^3 has been qualified to achieving very high burn ups,
- We decided that two lead test assemblies (LTA’s) should be qualified for the MARIA, operating condition.

Testing of LEU fuel

- IAE had to perform a number of theoretical analyses, measurements and calculations;
- The irradiation program of the MC fuel in MARIA:
  - insertion of 2 MC fuel assemblies into the core;
  - continuous irradiation them in the core until the final burn up of around 40% and 60%.
- The first MC001 fuel element was inserted in the core at August 10, 2009;
- The second MC002 fuel element was inserted into the MARIA core at October 2009 after acceptance by Regulatory Authority of Report of the first phase testing irradiation of MC001;
- The power generated in the MC001 was systematically increased toward the allowed maximum of 1.8 MW.

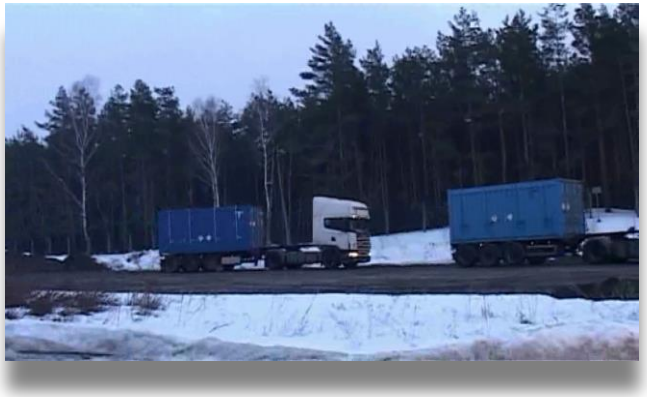
MARIA reactor conversion process:

- Delivery of LEU fuel from CERCA, May 2012;
- Approvals from Internal Safety Committee and NAEA for MARIA RR conversion from HEU to LEU fuel, August 2012;
- Beginning of conversion, September 2012;
- End of conversion, end of August 2014.

Repatriation of spent HEU fuel to Russian Federation

- This program was realized under GTRI program and with cooperation with our local partner Radioactive Waste Management Plant;
- Spent nuclear fuel shipment from MARIA reactor to Russian Federation was done in four steps:

- 2010 – 4 x 80 pcs – 320 pcs
- 2012 – 60 pcs,
- 2014 – 44 pcs,
- 2016 – 51 pcs.



MARIA reactor will be operated at least to 2035

- After core conversion from HEU to LEU fuel MARIA reactor has two potential fuel supplier (AREVA-CERCA, TVEL);
- The next delivery of LEU fuel type MR-6 (UO_2) from Russian Federation will be done in 2017.

Thank you for attention

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