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FUEL COMPANY OF ROSATOM

TVEL



STATE ATOMIC ENERGY CORPORATION ROSATOM

Fuel Company TVEL: 20 Years on The International Market

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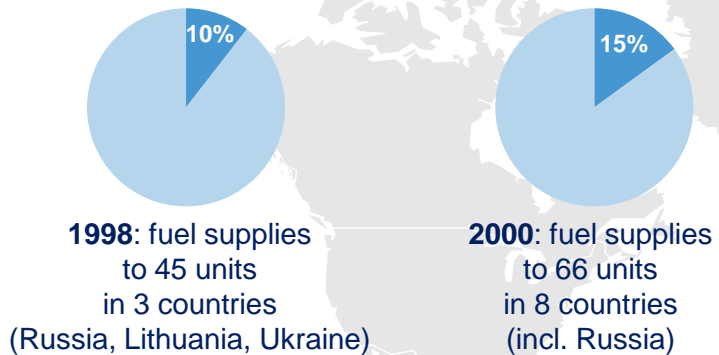
TVEL on The International NFC Market till 2000



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World Market Share

fabrication market

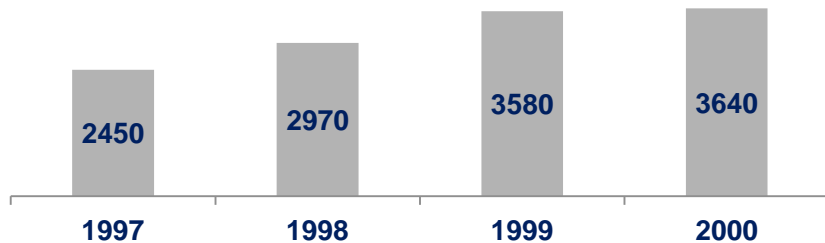


- fabrication facility
- conversion facility (UF4)
- Zr-facility



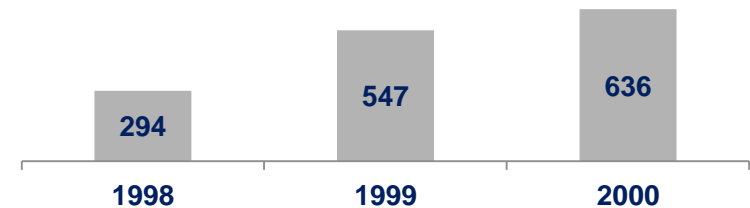
International Backlog, \$ M

Backlog < \$4 bn



International Revenue, \$ M

Revenue ~ \$500-600 bn

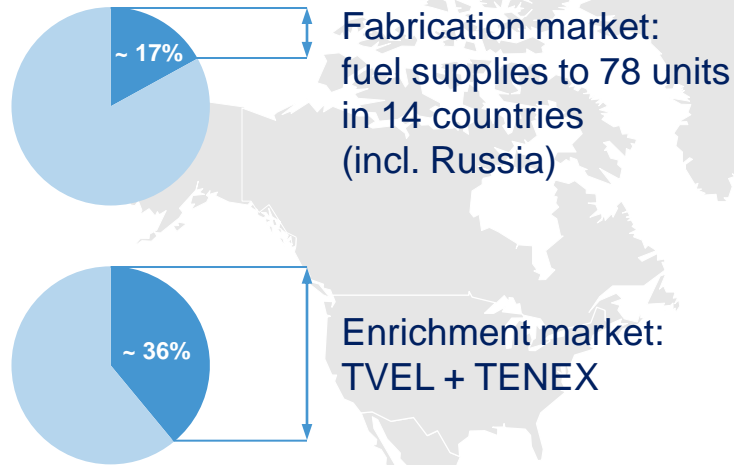


TVEL on The International NFC Market in 2015

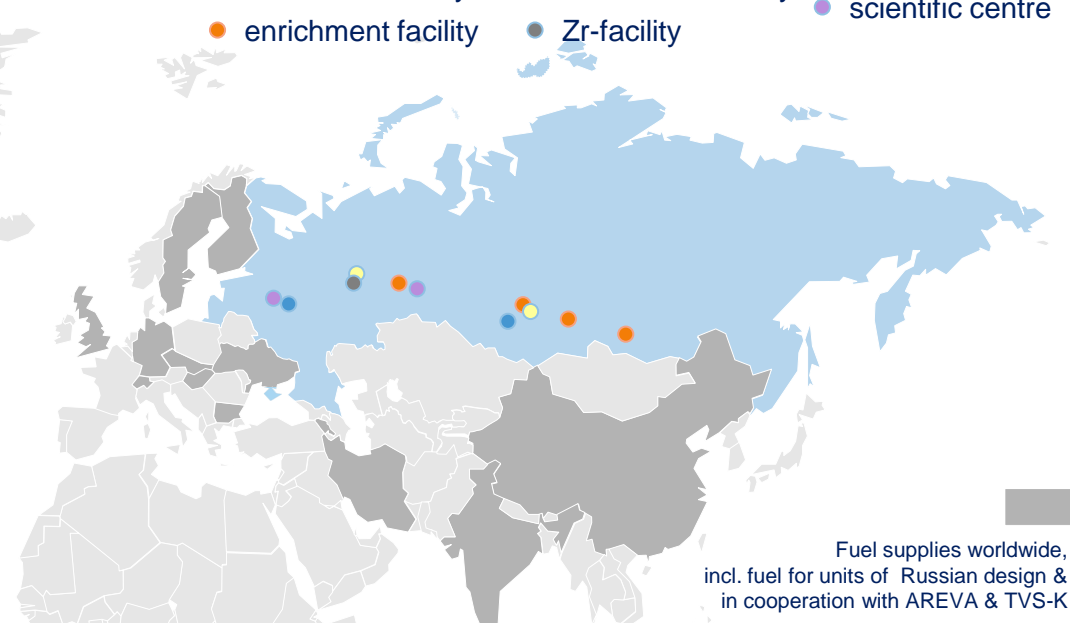


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World Market Share

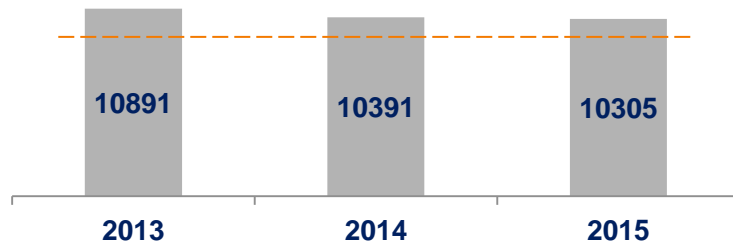


- fabrication facility
- enrichment facility
- conversion facility
- Zr-facility
- scientific centre



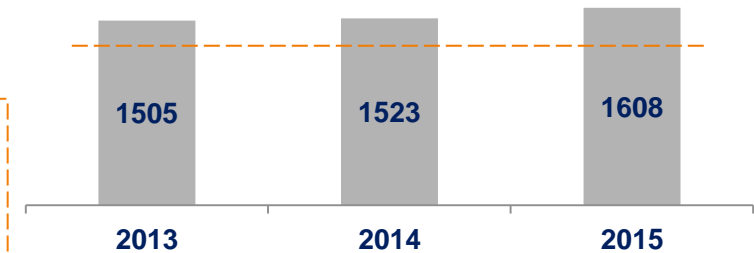
International Backlog, \$ M

Stable at > \$10 bn



International Revenue, \$ M

Stable at > \$1.5 bn



Tripled
international
backlog & revenue
within 20 years

20 Years: Main Achievements on The International Market



Wins in international tenders for fuel supplies

- 2002:** Kozloduy NPP (Bulgaria).
- 2003, 2008, 2009, 2013:** Mochovce & Bohunice NPPs (Slovakia).
- 2006:** Temelin NPP (Czech Republic) – all the Westinghouse fuel replaced by TVEL fuel assemblies.
- 2006:** Loviisa NPP (Finland).
- 2010:** on construction of fuel fabrication plant in Ukraine.
- 2015:** fuel assemblies & Zr-components for research reactor Maria (Poland).

total
> \$50 bn



Long-term contracts for nuclear fuel supply

- 2009:** supply of 2000 t NatU pellets for PHWR – Rajasthan NPP and 58 tU (enrichment up to 2.66%) for BWR – Tarapur NPP (both India).
- 2010:** supply of fuel assemblies to 15 Ukrainian units till ~ 2042.
- 2013:** supply of fuel assemblies and Zr-components for Tianwan NPP (China) till 2025.

total
> \$16 bn



New segments of international fuel market

- 2014:** first 4 LTAs of TVS-K loaded in the Western European PWR reactor.
- 2014:** first contract for supply of plate fuel for research reactor of Western design – for NRG's High Flux Reactor in Petten (the Netherlands).
- 2016:** TVEL-GNFA agreement to work together toward licensing, marketing and fabrication of fuel for US PWRs.

This outcome is a logical result of TVEL's close interaction with Customers and the fair competition due to engineering and commercial advantages of the Russian fuel

Our Partners Today



Utilities and NPP Operators



NFC Companies



Research Reactors & Propulsion Reactors



Some Details of Cooperation with Partners (1/3)



2003: TVSA fuel introduced at VVER-1000s.



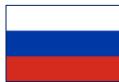
2015: TVSA-12 delivered to the Kozloduy NPP site.



2010: TVSA-T fuel introduced at Temelin NPP.

2011: formation of TVEL-ALTA JV – Centre for engineering services ALVEL.

2012: uprate up to 104% facilitated at Temelin NPP .



2012: TVEL launched Project “Driving to Zero Failure” with participation of Rosenergoatom, NNEGCEnergoatom, ČEZ, Kozloduy NPP .



The Project contemplates analysis of TVSA and TVS-2 and their modifications operation at 26 VVER-1000 units.



Constant modernization of VVER-440 fuel in cooperation with partners.



2014: introduction of the following fuel types for VVER-440:

(1) 2nd generation profiled UGd nuclear fuel, 15-month fuel cycle, operating at 108% thermal power.



(2) nuclear fuel with higher U content, 5-year fuel cycle, operating at 105% thermal power.

Continuous technological advance – merit of our partnership and close interaction with Customers:
TVEL meets Customers' requirements for fuel development

Some Details of Cooperation with Partners (2/3)

2004: fuel assemblies and other core components manufactured for China Experimental Fast Reactor (CEFR).



2010: Yibin Nuclear Fuel Plant qualified by TVEL's experts to manufacture UTVS fuel using Russian components.

2013: TVS-2M introduced at Tianwan 1 and 2 Units, 18-month fuel cycle.

2013: contract to supply TVS-2M fuel for Tianwan 3 and 4 Units and technology transfer to the partner.



2008: fuel for Kudankulam start, the first Russian NPP in India, delivered.

2009: contracts to supply fuel pellets for Rajasthan (PHWR) and Tarapur (BWR) NPPs.



2007: first fuel delivery for Buser NPP completed.

2015: removal of enriched uranium from Iran completed in exchange for Russian raw uranium as part of implementation of Joint Comprehensive Plan of Action ensuring the exclusively peaceful nature of Iran's nuclear program.

Continuous technological advance – merit of our partnership and close interaction with Customers:
TVEL meets Customers' requirements for fuel development

Some Details of Cooperation with Partners (3/3)

1994: start of MSZ cooperation with AREVA NP GmbH regarding fuel assemblies and components manufacturing at MSZ facilities for foreign design PWR and BWR reactors

1996: first 4 fuel assemblies manufactured for Obrigheim NPP in Germany



2005: 1000th fuel assembly fabricated

2009: 2000th fuel assembly fabricated

2013: 3000th fuel assembly fabricated

No delays in deliveries under the project, further manufacturing process improvement ongoing.

2009: contract for manufacturing and delivery of lead test assemblies for reactor testing in HFR research reactor (Petten, the Netherlands).



2011: two LTAs manufactured at NCCP delivered to the Netherlands for 2-year qualification tests.

2013: successful qualification, test results confirmed NCCP LTAs specifications compatibility with reference fuel.


2014: contract for the delivery of NCCP-manufactured low-enriched uranium fuel assemblies for HFR research reactor.

Continuous technological advance – merit of our partnership and close interaction with Customers:

TVEL meets Customers' requirements for fuel development

Competitive Advantages: Factors of Reliable Relationships with Partners

 We offer **fuel with a proven track record** in Russia

 We offer **package fuel supply** and **flexible pricing** due to consolidation in TVEL of all NFC stages (except uranium)

 We use **unique fuel components and materials** for better commercial terms

 We adhere to **customer-oriented approach** and aim to **meet partners' requirements**

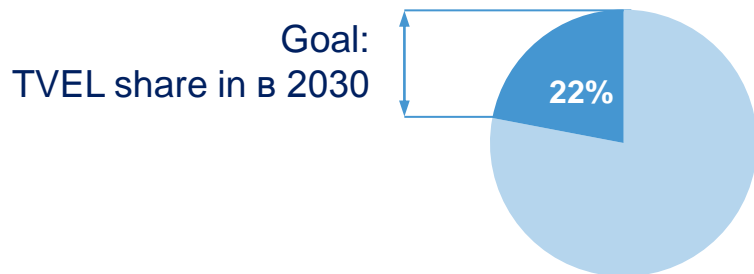
 We provide **ongoing fuel development** and **advanced strategies of fuel cycle management** according to external conditions

 We provide **continuous R&D support of nuclear fuel operation**

 We offer fuel enabling **maneuvering modes** and **reactor uprates**

TVEL's Goals on The World Market by 2030

World Fabrication Market



World Enrichment Market



Drivers for growth and goal achievement

-  Fuel supply for new VVERs in Russia and abroad
-  Enhancement of cooperation with Chinese and Indian partners
-  Commercialization of TVS-K
-  Utilization of reprocessed material
-  Supply of fuel and components for research reactors of Russian and western design
-  Expansion of Zr-components supply



Old comrades cannot be manufactured

(Antoine de Saint-Exupéry)