

ÚJV Řež, a. s.
**Hydrogen Technologies
for Energy Storage
Applications**

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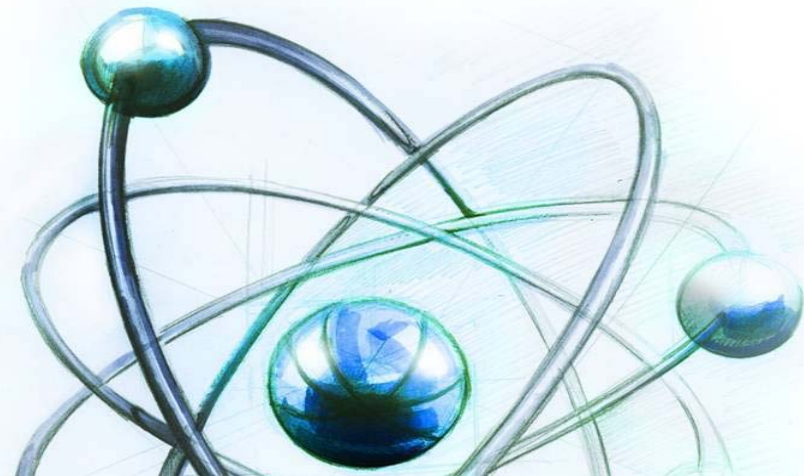


Highly qualified and technologically-equipped service provider in the field of particularly applied research and engineering for more than 58 years.

Successful implementer of wide range of complex projects-specifically, in energy and nuclear installations and radiopharmaceuticals.

A renowned member of international organisations and a professional authority in the field of nuclear energy and the use of ionising radiation.

The proud employer of more than 800 skilled workers of various professions, almost all with university degrees.





- **Energy accumulation**

- Flywheels, super capacitors, accumulators
- Systems based on hydrogen technologies

- **Research and Development of Hydrogen Technologies**

- Photovoltaic energy storage system
- Alkaline electrolysis
- High temperature steam electrolysis (HTSE)
- **Hydrogen Technologies for Transportation**

- **Solution for conventional energy industry**

- Flue gas desulphurization and denitrification
- CO2 Capture and Storage (CCS)
- Waste to Energy
- Heat accumulation

Projects



■ Successfully finished

- TriHyBus – Triple Hybrid Hydrogen Bus (consortium Škoda Electric, Proton Motor etc.)
- First hydrogen refueling station in the Czech Republic (Neratovice, contractor Linde Gas)
- ZEMSHIP – Zero Emission Ship (Hamburg)

■ Ongoing

- Research and development of advanced hydrogen technologies for power industry and transport
 - Main result: System for energy storage using hydrogen technologies
- Research and Development of Advanced Control Systems for Hydrogen Technologies.
 - Main result : Power management for hybrid vehicles
- Research and development of advanced technology of hydrogen production by high temperature water electrolysis
 - Main result : Test bench for high temperature electrolysis.



TriHyBus



- Bus with hydrogen fuel cell (PEM 50kW)



Project Part-Financed
by the European Union

European Regional
Development Fund

TriHyBus – history



■ Project history

- Idea – October 2005
- 2008 – Ministry of Transport co-financing agreement
- Project duration: 2008 – 2009

■ Consortium

- ÚJV Řež, plc. – coordinator
- Proton Motor Fuel Cell GmbH
- Škoda Electric, a. s.
- Linde Gas
- IFE Halden

■ Financing

- Overall cost 3.2 mio Euro (including the filling station)
- ERDF: 56.25 %, MoT: 18.75 %, Consortium: 25 %

■ Hannover Fair 2010

- Hermes award nomination

■ Brno International engineering Fair

- Gold medal



TriHyBus - Hannover Fair 2010



Hydrogen refueling station



■ Location Neratovice (20 km from Prague)

■ Parameters

- Compressed gas
- Filling pressure 40 MPa
- Storage 125 kg H₂
- Filling time 10 min
- Gas supplier Linde Gas
- TK-16 a TK-25



Zero Emission Ship Hamburg



Hydrogen Technologies for Energy Storage Applications

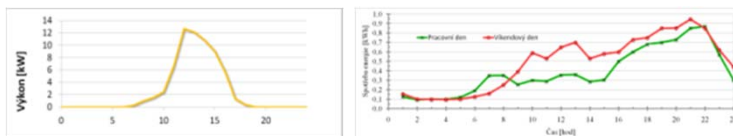
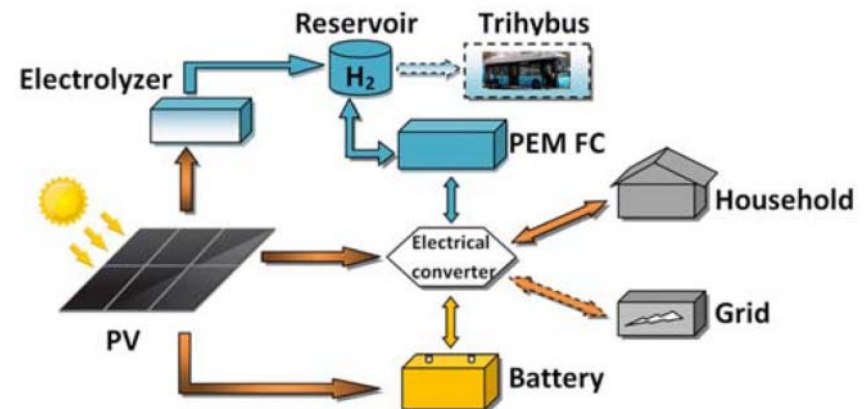


■ Principle

- Hydrogen production from water using cheap electricity
- Hydrogen storage
- Conversion of hydrogen to electricity

■ Applications

- Grid-independent operation
- Load profile management
- Uninterruptible Power Supply (UPS)
- Fuel production for hydrogen vehicles

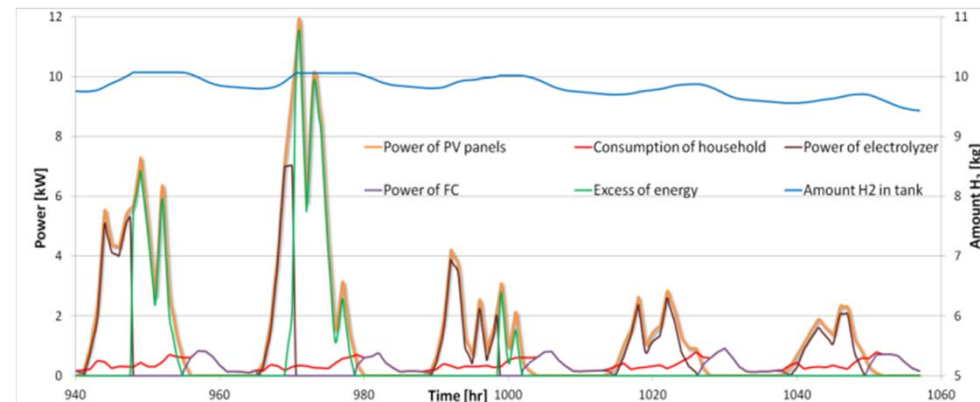
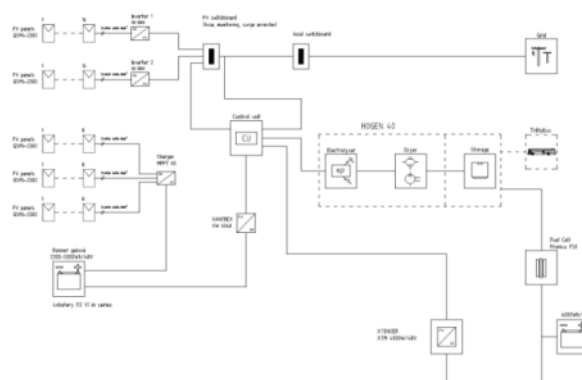


Pilot Plant for Energy Storage in ÚJV Řež, Czech Republic



Main Parts

- Photovoltaic plant, electrolyzer (electricity \rightarrow hydrogen), pressure tank 10 m³(N), fuel cell (hydrogen \rightarrow electricity)

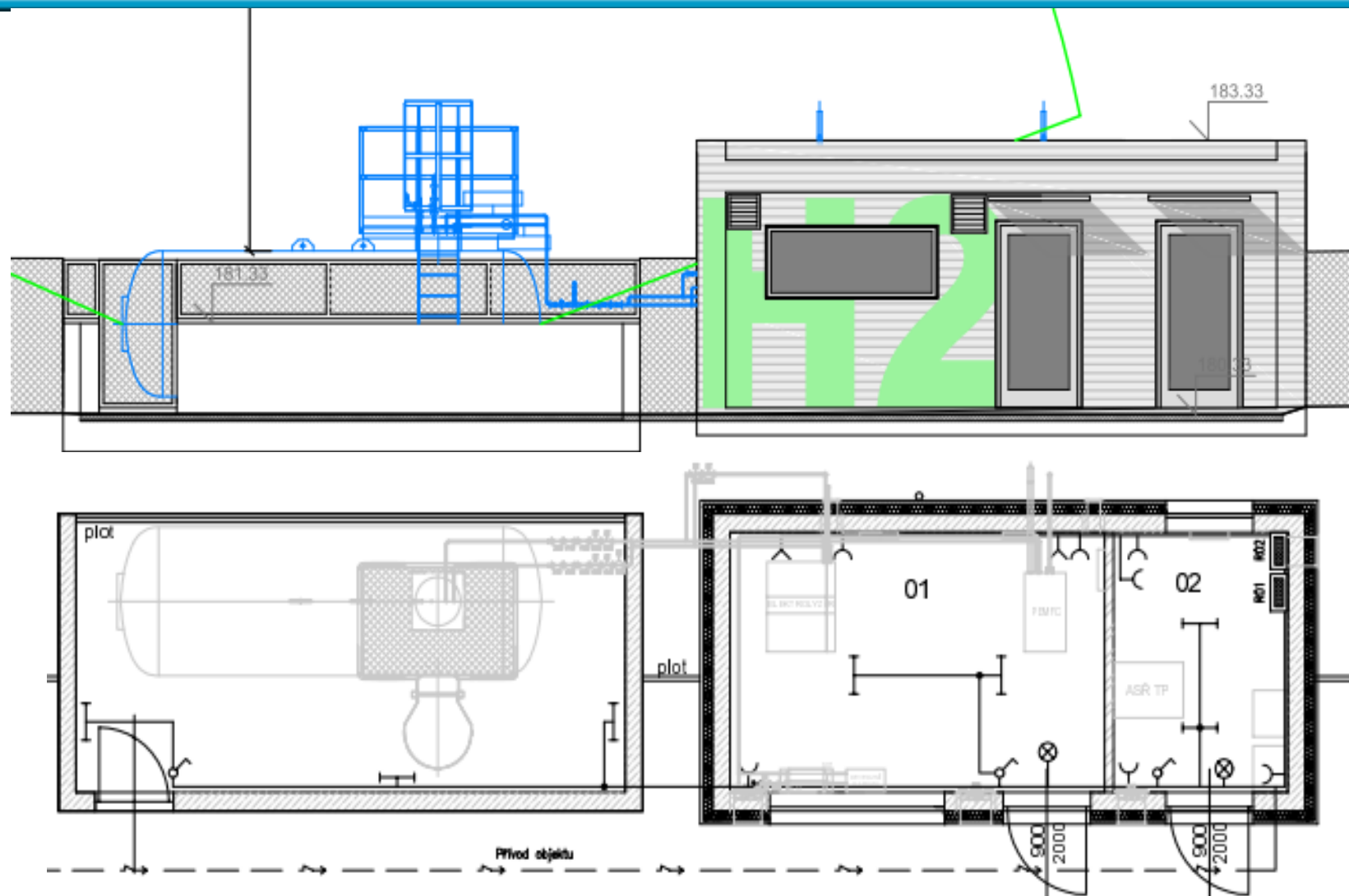


Piloti plant parameters



Device	Characteristic	Parameters
Photovoltaic power plant	polycrystalline PV cell	12 kWp (230 W per module)
Battery	Lead-acidgel accumulators	45 Ah (2.2 kWh)
Electrolyzer	PEM electrolyte	6.7 kW
Fuel cell	PEM cell	4 kW
H ₂ storage	Compressed gas (5 – 15 bar)	10 kg

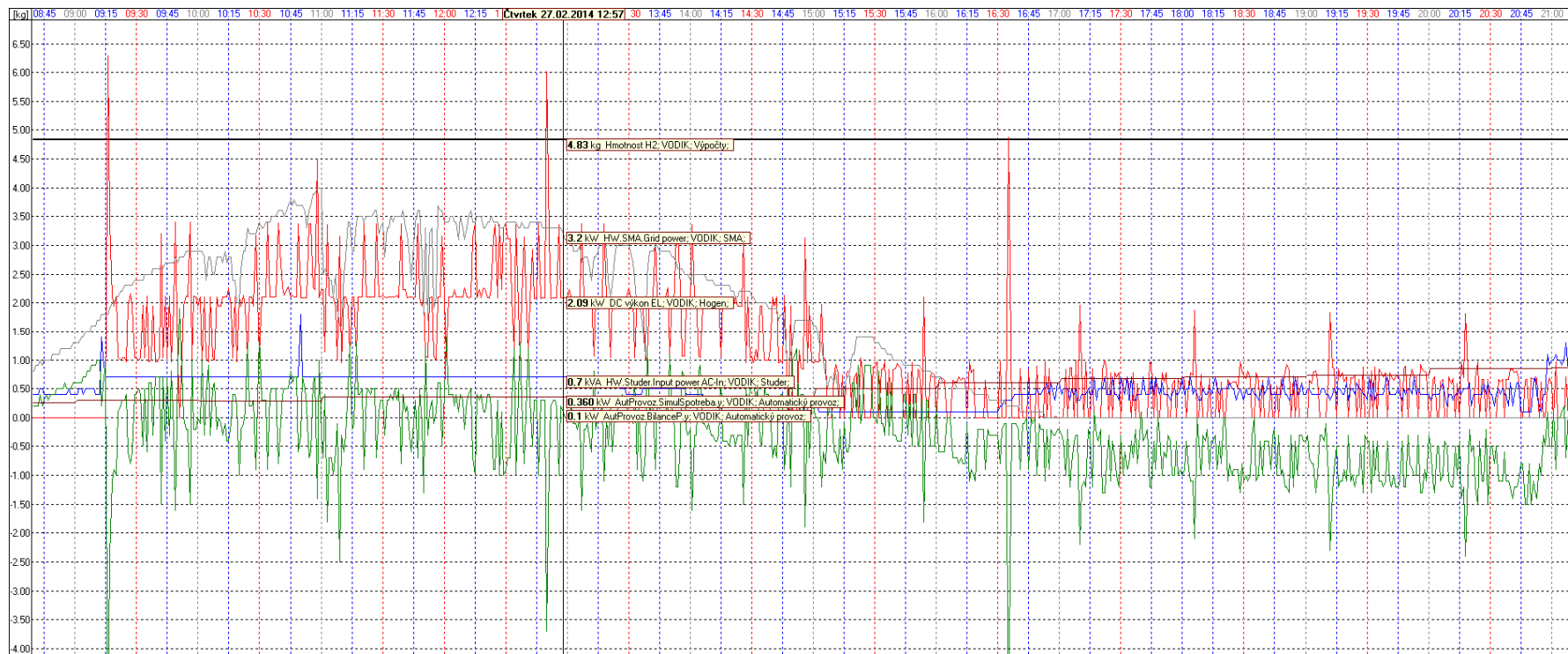
Energy storage in ÚJV Řež



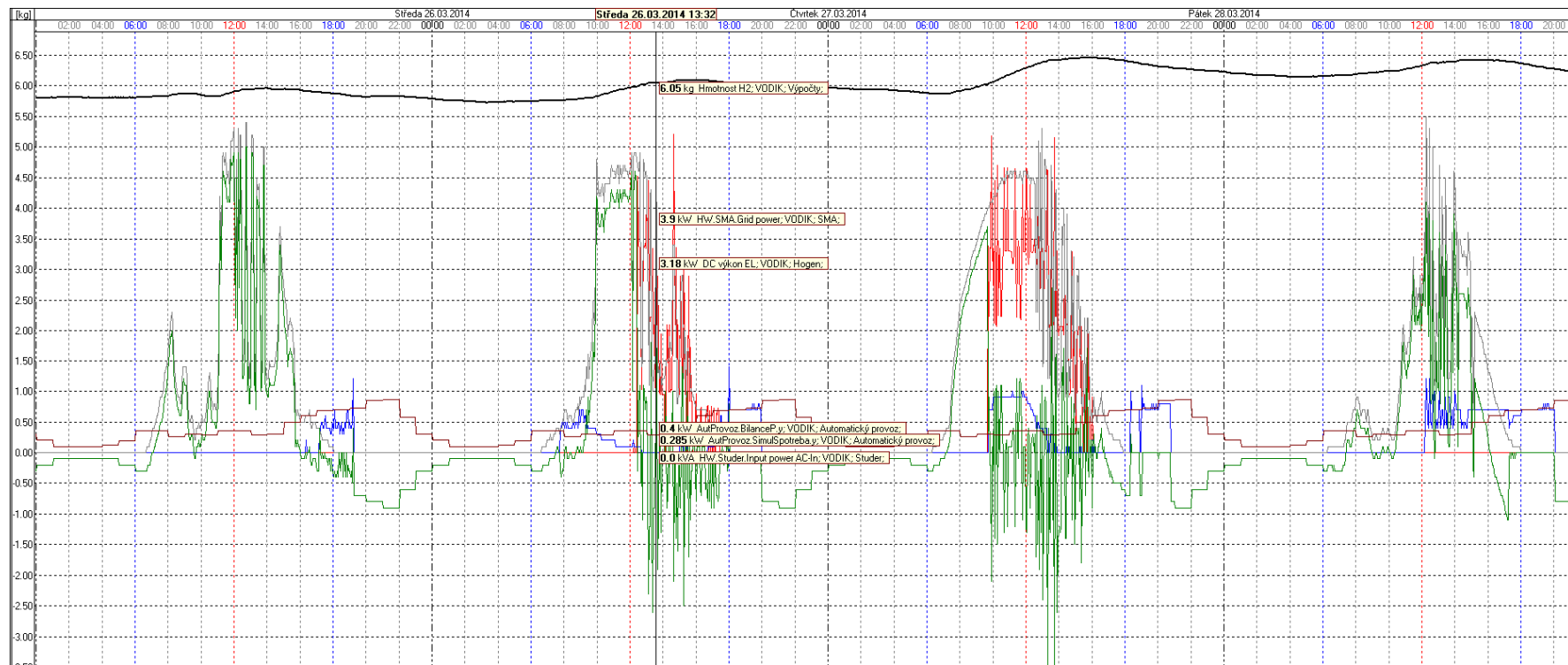
Photovoltaic power plant



Preliminary results



Preliminary results



Preliminary conclusions



- Dimensions of pilot are sufficient for level management for average household

- Strengths of hydrogen storage
 - Electricity cannot be easily stored
 - Renewable power cannot be scheduled
 - Efficient conversion of electricity to hydrogen and back using electrolysis and fuel cells
 - Balancing supply with demand
 - Hydrogen can be store for long periods

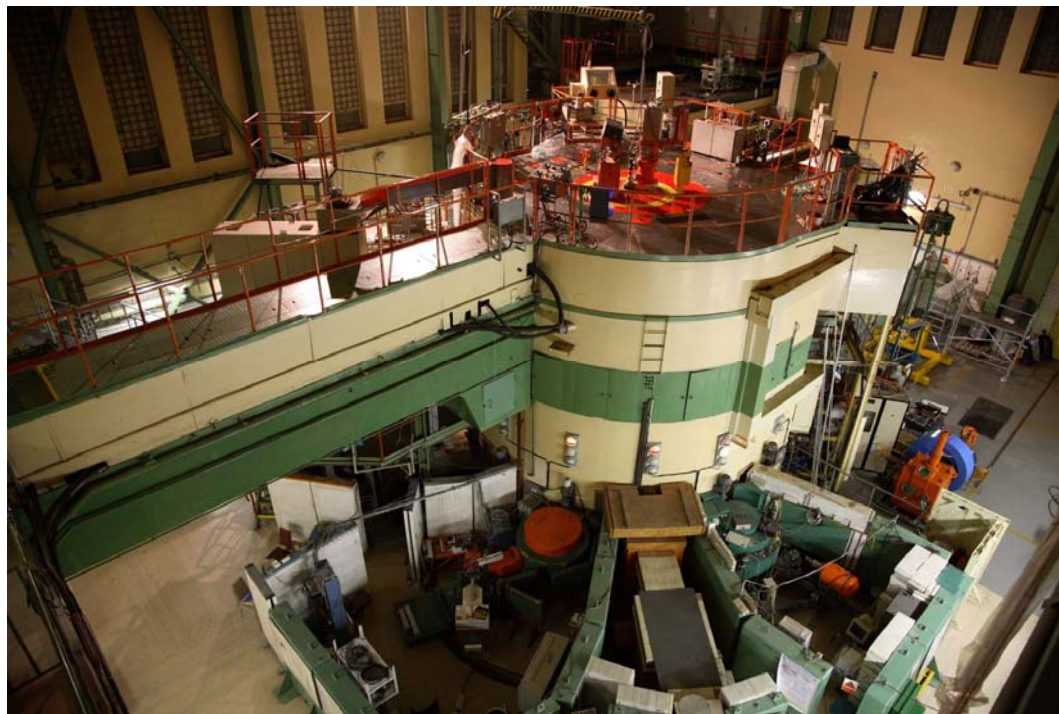
Technical excursion to ÚJV Řež



- TriHyBus – hydrogen fuel cell powered bus (from Dejvice to Řež)
- Nuclear reactor
- Pilot plant for energy storage to hydrogen



Nuclear reactor



Pilot plant for energy storage to hydrogen



Thank you for your attention!

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