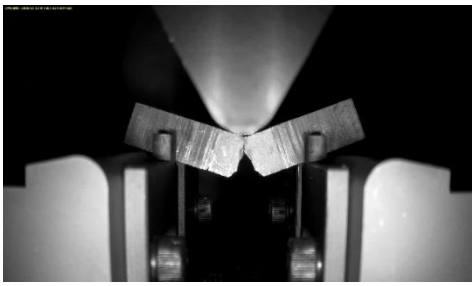
Centrum výzkumu Řež s.r.o.
Research Centre Řež

Hot-cells in CVR, Czech Republic

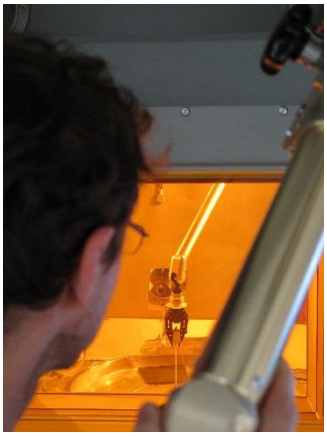
We provide a wide range of mechanical and corrosion properties evaluation and fracture mechanics of irradiated and non-irradiated materials

What we offer:



- **Surveillance programs**
- **Concrete studies**
- **Fuel cladding studies**
- **Testing of materials for reactor internal components**
- **Testing of reactor pressure vessel materials**
- **Study of corrosion and mechanical behavior in primary BWR/PWR water**
- **Design and construction of the Hot-cells**

Technical and expert capabilities:



- Fracture tests - tensile tests, fracture toughness test, low cycle fatigue, combined loading (axial)
- Fatigue tests - high cycle fatigue, pre-cycling of specimens (CTs and TPBs)
- Corrosion-mechanical tests - corrosion cracking, slow strain rate test (SSRT), crack initiation and growth measurement (RDCPD)
- Creep tests - thermal creep, combined creep-fatigue
- Assessment of degradation of metallic and non-metallic materials after mechanical, thermal, chemical and radiation loading
- Determination of material characteristics for evaluation of lifetime of components in the energy and chemical industry

Centrum výzkumu Řež s.r.o. (CVR) - Material and Mechanical Properties

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Instrumentation capacities in the CVR hot cells

Manufacturing instrumentation:

Electrical discharge machine (EDM)

Function: Cutting and machining of a specimen.
Main parameters: Max. weight of workpiece - 5 kg; dimensions of traversing table - 600x400 mm
Specimens shape: TPB, micro TPB, 1 CT, ½ CT, RCT, flat tensile specimens.

Electron beam welding machine (EBW)

Function: welding in vacuum using a high-velocity electrons beam.
Main parameters: vacuum chamber dimensions - 300x300x300 mm; maximum dimensions of a workpiece - 170x170x230 mm; accelerating voltage - 20-60 kV; vacuum conditions - 10^{-5} Pa.
Specimens type: Insert type specimens.

Computer numerical control (CNC) machining centre

Function: Grinding, machining and drilling.
Main parameters: maximum weight of a workpiece - 5 kg; maximum length of a workpiece - 200 mm, maximum diameter of a workpiece – 600 mm.
Specimens type: round-shape specimens

Size measurement instrumentation:

Automatic 3D multi-sensor measuring machine

Function: video contact probe for the precise size measurement of specimens with dimension up to 150x150x250 mm.

Testing instrumentation:

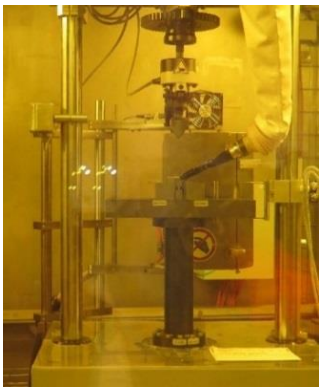
Universal servohydraulic tensile testing machine

Function: mechanical properties testing.
Main parameters: tension and compression up to 250 kN; testing temperatures: -150 - 350 °C (liquid nitrogen-air), RT – 800 °C (air), RT - 1200 °C (argon/vacuum);
Test types: Tensile test, compression test, fracture toughness test, low cycle fatigue testing (tension/compression), low cycle fatigue testing in tension at elevated temperatures
Specimens types: TPB, micro TPB, 1 CT, ½ CT, round-shape specimens (diameter 2-10 mm), flat tensile specimens (dog-bone), compression specimens according to the order.

Universal servohydraulic tensile testing machine for combined loading

Function: mechanical properties testing.
Main parameters: tension and compression up to 25 kN with combined axial-torsional loading with maximum load of 100 Nm; testing temperatures: -150 - 800 °C (air);
Test types: tensile test, fracture toughness test, low cycle fatigue testing (tension/compression) at RT, low cycle fatigue testing (uniaxial and combined loading), torsion, combined loading.
Specimens type: TPB, micro TPB, 1 CT, ½ CT, round-shape specimens (diameter 2-10 mm), flat tensile specimens (dog-bone), compression specimens according to the order.

High frequency resonance pulsator



Function: testing of mechanical properties at high frequencies.
Main parameters: combination of static and dynamic loading up to 50kN; frequencies up to 250Hz; testing temperatures: RT - 800 °C (air); maximum sample size: 1 CT; additional 5 kN load cell.
Test types: high cycle fatigue, pre-cracking of CTs and TPBs.
Specimens types: TPB, micro TPB, 1 CT, ½ CT, RCT.

Electromechanical creep machine

Function: mechanical properties testing.
Main parameters: loading up to 50 kN; maximum temperature: 800 °C (air).
Test types: high-temperature creep testing, creep-fatigue test in tension, tensile testing, fracture toughness test at elevated temperatures (400 °C -800 °C); NDT acoustic emission monitoring during mechanical loading at temperatures up to 540 °C.
Specimens types: TPB, micro TPB, 1 CT, ½ CT, RCT, flat tensile specimens (dog-bone), tubes (diameter 4, 6, 9 mm).

Autoclave with a water loop

Function: mechanical testing in controlled water environment at high temperature and high pressure.
Main parameters: loading up to 25kN; maximum testing temperature - 350 °C (water with controlled chemical composition); maximum sample size: 0.5” CT; RDCPD measurement system.
Test types: mechanical and corrosion resistance properties testing (stress corrosion cracking, slow strain rate testing), crack initiation and growth rate tests.
Specimens types: SENT, 1 CT, ½ CT, RCT, round-shape tensile specimens (diameter 1-4 mm) and other specimens with maximum length of 100 mm.

Scanning electron microscope

Function: microstructural and chemical analysis.
Main parameters: 0,2-30 KeV FEG source, detectors (SE, in-lens SE, BSE), EDS, EBSD, WDS system.
Test type: fracture surface, state of microstructure, chemical composition, grain orientation and texture analysis using EBSD technique.

Nanoindenter with Nano Scratch Tester

Function: nanoscale mechanical characterization of alloys, nanostructures and thin films.
Main parameters: load range from 70 nN up to 10 mN, Berkovich type indenter, quality optics and SPM imaging with resolution of 10 nm.
Moduls: Nano Scratch Tester for scratch resistance evaluation, critical delamination forces, friction coefficient, microhardness head.
Test type: static nanomechanical properties (nanohardness, Young's modulus, indentation creep), scratch resistance.

Hydraulic press for concrete samples

Function: mechanical properties testing.
Main parameters: compression up to 300 kN.
Test type: compression test, tensile splitting test, E-modulus and Poisson ratio
Specimens types: round-shape specimens (diameter 30 to 50 cm), cubes 30 to 70 mm.

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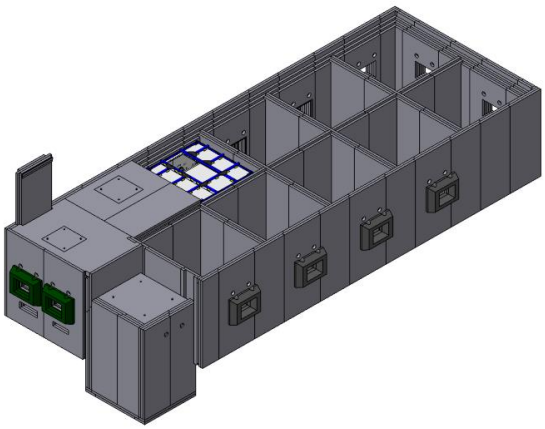
Hot-cell parameters:

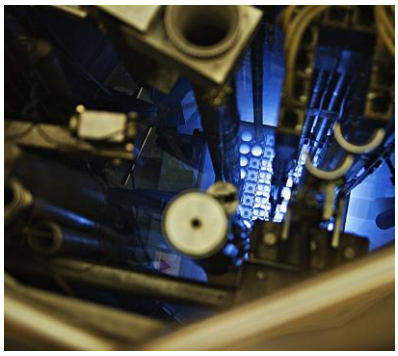


- **8 gamma hot cells, 2 alpha hot cells and 1 semi-hot cell**

Thickness of steel shielding:

- **perimeter shielding 500 mm**
- **ceiling shielding 400 mm**
- **floor shielding 300 mm**

- Max. **source activity -** up to **300 TBq ^{60}Co**
- **Dry pool** for cask opening
- Air atmosphere; **pressure -150 Pa** (γ-cell) and **-500 Pa** (α-cell)
- **Advanced design – "Modular system"** (2,7 x 2,9 x 3 m; w/d/h)
- **System for exchanging technologies** inside the chambers **within 2 days**
- **Off-cell fresh test preparation**
- Sample **reception, preparation, testing** and **investigation** in one facility
- Large scale device for advanced **material/waste in-out transportation**



Experimental irradiation reactor LVR-15 (chouca system) is close to hot-cell

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