Inspection stand for monitoring of spent fuel in Bohunice (SVYP- 440)
Nuclear power plant WWER-440 Jaslovske Bohunice
- 3 units 440 MW in operation
- 1 unit 440 MW out of service

Intermediate spent fuel storage
Jaslovske Bohunice

Nuclear power plant WWER-440 Mochovce
- 2 units 440 MW in operation
- 2 units 440 MW under construction

Nuclear power plant A-1 Jaslovske Bohunice
- 150 MW out of service
MSVP- Intermediate spent fuel storage (exterior)
Shaft 02 - Place for inspection stand for monitoring the nuclear spent fuel
Inspection stand for monitoring the WWER-440 type spent fuel

Is designed for monitoring the condition of WWER-440 fuel and control fuel assemblies in intermediate spent fuel storage in Jaslovske Bohunice

Currently is in the process of gradual putting in to service in accordance with the technological process operations from non-destructive to inspection after dismantling the fuel assembly
Analysis of structural characteristics and profile of spent fuel assemblies using gamma spectrometry
measurement of the fuel column height in the bundle of fuel rods with gamma spectrometry
- part of gamma spectrometry is currently in active service
remote visual inspection of selected surfaces of the fuel assemblies and their parts
measuring of deflection, torsion and length of the fuel assemblies optically, using the evaluation software
- these operations are currently being processed for entry into service along with the process of dismantling the fuel assembly
Planned operations

- measuring the diameter and ovality of individual fuel rods using the inductive method
- measuring the thickness of oxide on coverage of the individual fuel rods by the eddy currents method
- checking the integrity of the covering material on individual fuel rods by the method of eddy currents
- sampling oxide deposits from the coverage of individual fuel rods and the following analysis
- measuring the space between fuel and coverage in individual fuel rods mechanically
- measuring the fuel column height on individual fuel rods using gamma spectrometry
THE CONCEPT OF INSPECTION STAND

- Inspection stand with column construction and carriage vertically traveling along its whole height.

- The carriage carries an exchangeable modules for technological and inspection operations which are transported by carriage to required position of defined operation.
Overview of modules of technological operations
Rotation drive module

For drilling and milling operations which are necessary during dismantling fuel assembly and the fuel elements.

Cam for opening the pliers of tool container

Opening for capture of tool
Linear drive module

Ensures the interconnection of the wrapping tube with the fuel assembly bottom by riveting

Pneumatic cylinder for formation of riveting force

Riveting head
Tool container

For permanent storage of contaminated technological tools with possibility of their safe placement above water level

Opening for insertion of contaminated tool

The pliers for capture of contaminated tool
Container of cuts serves for capture of contaminated waste – metallic cuts which occur during drilling and milling technological operations.
Overview of modules of inspection operations
Visual inspection module

Serves for visual inspection of fuel assembly and fuel element integrity, for measurement of deflection, torsion and length of fuel assembly.
Visual inspection module

Supervisory TV figures
Visual inspection module

Supervisory TV scales

KM-ČIAROVÝ TEST

KM-ROZMERY
Ultrasonic inspection module

Serves for ultrasonic inspection of water presence inside fuel element cluster
Ultrasonic inspection module

UT-probe placement on measuring arm

Display of UT signals during inspection of water presence in fuel element
The linear record of measurement in line among the fuel elements by reflectoscope USN 60 of ECHO 330 system
Reflectoscope USN 60 of ECHO 330 system
Ultrasonic inspection module

Calibration of UT-probe on model of fuel assembly

Tank with water

Model of fuel assembly
Gamma-spectrometry measurement module for fuel assembly
Gamma-spectrometry measurement module for fuel assembly

Principle diagram of device for gamma-spectrometry measurement
Gamma-spectrometry measurement module for fuel element

Serves for inspection of individual fuel elements by gamma-spectrometry measurement
Gamma-spectrometry measurement module for fuel element

Principle diagram for measurement of fuel in fuel element by gamma-spectrometry method
VPP- 440 is equipment for manipulation with fuel elements.

- **Tie rod for pulling the fuel elements**
- **Electric drives located above water level**
- **The grooved shafts for transfer of movement under water level**
Eddy-current inspection module

Serves for eddy-current inspection of oxid depositions and of integrity of individual fuel elements.
Appliance for cleaning the fuel element before measurement
Eddy-current inspection module

Principle diagram for measurement by Eddy-currents

1. Manipulator VPP-440
2. Fuel element
3. Guiding pulleys
4. Probe for measurement of oxid thickness
5. TV camera
6. Probe for non-integrity detection
7. Sensor for measurement of fuel element diameter
Eddy-current inspection module

Table stand for ET system calibration
Module for measurement of the clearance between the fuel and fuel element clad

- Opening for insertion of fuel element
- Fixed supporting stop
- Measuring tip
- Pressure pneumatic cylinder
Module for measurement of the clearance between the fuel and fuel element clad

Schematic representation of fuel pellets in fuel element before measurement of clearance
Module for measurement of the clearance between the fuel and fuel element clad

Ekvivalent tensions [MPa] during measurement in contact of fuel element clad with pellet with loading of 1200 N
Module for measurement of the clearance between the fuel and fuel element clad

The graph introduced in figure represents the course of strength during compression (red color) and release green color) of fuel element.
Module for measurement of the clearance between the fuel and fuel element clad

The screen menu of clearance measurement between fuel and fuel element clad
Module for deposition samples and oxid layers intake

Serves for intake of defined amount of deposition sample and oxid layers from surface of clad of individual fuel elements.
Module for deposition samples and oxid layers intake

Sample transport container

Sample container serves for transport of deposition samples and oxid layers from clad surface of individual fuel elements
Module for deposition samples and oxid layers intake

Sample container in dismantled condition

- **Handle**
- **Place for placement of diamond scraper with samples of depositions**
- **Upper cover of container**
- **The screws for handle fixation on container and upper cover**
SVYP equipment control unit

The control unit with industrial PC and application software serves for remote programmable control of all movements of basic SVYP – 440 equipment, VPP – 440 equipment and exchangeable modules.
Functional test of visual inspection and of drilling the screws
Functional test of pulling the container with tool and the withdrawal of clad of the fuel element assembly.
Thank you for attention

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