NPP Refueling Process Monitoring Based on the Refueling Machine Current Signals

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Registration of Refueling Machine Current Signals

Signal release scheme

The registered signal

Test bench "Krona 517"
Presentation of the Refueling Machine Diagnostic Parameters in the Principle Component Space

Signal processing order relevant for different operations

1) Calculation of parameters: oscillation coefficient, operating current, harmonic coefficient, phase asymmetry coefficient.

2) Presentation of parameters of various operations in the form of a matrix

3) Singular value decomposition of the parameter matrix

4) Selection of two principle components. Reference space formation

5) Initial data mapping in reference space

6) Statement identification in reference space

Operations:
- lowering without load at high speed;
- lowering with load at high speed;
- lifting without load at high speed;
- lifting with load at high speed;
Control of the Main Hoist Weight Loads when Extracting Fuel

Signal processing order for fuel extraction

1) Signal demodulation by Hilbert method

2) Presentation of envelopes in the form of trajectory matrices

3) Singular value decomposition of the trajectory matrices

4) Selection of two principle components. Reference space formation

5) Trajectory matrices mapping in the reference space

6) Signal identification when extracting different fuel assemblies in the reference space

Mapping of current signals when extracting fuel assemblies
Results of the Refueling Machine Current Signals Analysis

• It is proposed to build operation portraits based on current parameters to control the correspondence of RM operations to standard modes.

• The approach that provides the presentation of diagnostic parameters in such a space where the distance between the operation parameters is greater than that in the initial one is developed to increase the sensitivity.

• The method for clustering current signals is developed to control the weight loads developed by the RM drive when extracting fuel assemblies

• The clustering result can be used to establish hidden trends in the parameter changes in further diagnostics.

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