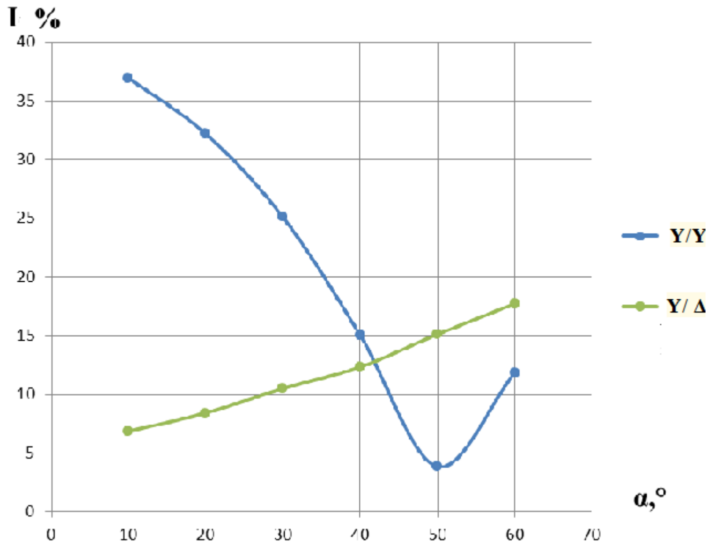

which is tuned to the frequency of the 5 harmonic. Problem of energy saving is one of the most important moment in the world. Therefore, improving the power factor can significantly reduce the loss of electricity.

Figure 8 (left) – Dependence of the percentage of the third harmonic on the input current from the control angle α.

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Power apparatus and systems malfunction diagnostic on the basis of its own electromagnetic emission analysis

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With the modern strategies development in order to organize the main electrical substation equipment, power lines maintenance and repair there appears so called "on-condition" [1] repairs concept. In this respect, technical diagnostics becomes extremely important in any industries. The Economic Effect of high voltage equipment diagnosis is associated with its ability to determine the current technical condition and equipment residual life for detecting defects at an early stage of their development and the really required repair works. Nowadays there are a lot of different technical diagnostics methods but the most preferable are the automated methods of controlling the state of the energized equipment [2-4].

One of the perspective diagnosis methods that are able to determine the technical state of the object and track the defects dynamics is to analyze the changes in the electrical equipment electromagnetic radiation.

The main idea of this work is to study autotransformer technical state via spectral analysis of the electromagnetic radiation changes.

Problem Statement:.

1. Get an array of diagnostic information about the object electromagnetic field;.
2. Create the data processing algorithm;.
3. Identify diagnostic feature of the defect specific type.

The idea of monitoring frequency high voltage equipment electromagnetic radiation is based on the revealed electrical discharges manifestations intensity from increasing insulation degradation and the defects appearance in structural elements.

Equipment technical condition assessment is based on the high-frequency component spectral analysis of the electromagnetic radiation signal that has a number of distinct advantages over usual methods.

- data about the defect appears at a very early stage of its occurrence when it is impossible the register it by any other methods.
- in the high frequency area is almost impossible to tune out noises, which are the corona discharges (CR) source, superficial partial discharge (PD), high-frequency communication, etc.
- techniques development is possible with extensive capabilities in terms of the both internal and external equipment defects registration.

CR, as well as the surface PD duration is usually ten nanoseconds or more, while the duration of the current flow in the PD internal insulation is a few nanoseconds. Natural electromagnetic radiation emitters are elements of the equipment design which essentially act as the dipole antennas. Taking into consideration these antennas characteristics and their resonance frequencies allows us to specify the defect location. Thus, the upper part of its own electromagnetic radiation can be divided into sections specific to the individual radiation sources. Pulses from discharges have different amplitudes and time constants, so the electromagnetic spectrum due to a pulses series is polymodal.

Transformer diagnosis device consists of the electromagnetic radiation receiving antenna, input connector, I / O board, laptop. The object of study is autotransformer ATDCTN 500000/500/220 located in Kazakhstan hydroelectric power station.

Information about the defects presence in autotransformer insulation windings should immediately appear in the registered electromagnetic field spectrum.

Radiating elements are the structures isolated from the grounded tank high voltage bushings, discharges, enclosed in insulators conductors, etc. In our case, the radiating antenna input is 500 kV, 220 kV and power groung.

Inputs dimensions acting as radiating conductors are: 4.24 m., 2.72 m. and 0.59 m.

Inputs in this case are radiating antennas with resonant frequencies of the radiation level.

$$(f_{pi})_n = nc / (4h_i),.$$

at i = 1, 2, ..., i_{max} – input; n = 1, 2, 3, ... is the number of harmonic Fourier series; c – light velocity in m/s; h_i – height of the i-th input, m.

Useful information possess bandwidth (Δf_p) n which can be defined as (Δf_{pi}) n = $(f_{pi})_n$ / Q_{in}, at Q_{in} – the equivalent Q factor of the antenna being in the range 2 to 5.

Table 1 shows informative frequency bands for the first resonant frequency of 500 kV autotransformer bushings.

Table 1. Range of frequencies and frequency bands for the information of 500 kV autotransformer.

Input №	Inform. frequency band width in MHz	Frequency band boundaries in MHz	The main resonance frequency in MHz
Input 1, 500 kV	$(\Delta f_{p1})_1=5$	от 15,2 до 20,2	$(f_{p1})_1=5$
Input 2, 220 kV	$(\Delta f_{p2})_1=8$	от 23,6 до 31,6	$(f_{p2})_1=8$
Input 3, power ground	$(\Delta f_{p3})_1=36$	от 110 до 146	$(f_{p3})_1=36$

Monitoring procedure is as follows:

1. Incoming inputs definition.
2. Resonance frequencies emitting antennas calculation.
3. Informative frequency bands for the first resonant frequency determination.
4. Resonance frequencies and informative frequency bands for the higher harmonics calculation.
5. Electromagnetic waves integral power factor determination.
6. Equipment assessment.

As a receiver, it is desirable to use standard industrial receiver with integrated analog-digital converter and microprocessor, enabling them to handle with the electromagnetic waves energy spectrum in the desired frequency range.

The equipment assessment for the integrated power factor electromagnetic oscillations is calculated in a given informative band. Integrated power factor K_n of the spectrum qualifying characteristics is the most revealing and is determined for each n-th informative frequency band as the ratio of the integrated power to the equipment $P_{n.\mathrm{monit}}$ reference to the integrated power $P_{n.st}$:

$$K_n = P_{n\ monit} / P_{n\ st},.$$

at $P_n = \int_{f_{n.\min}}^{f_{n.\max}} S_n^2(f)df$ – equipment integral power factor; $S_n(f)$ – integrated radiation power density.

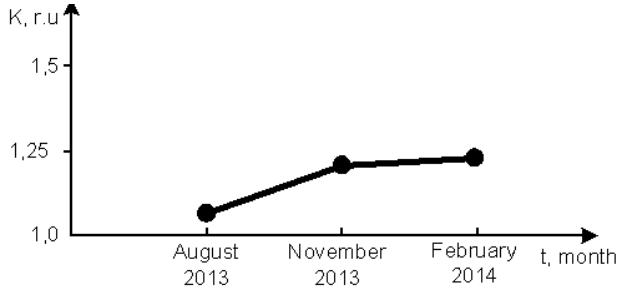

Fig.1 Integral power factor changes.

The figure 1 shows integral power factor changes during 6 month period. As you can see it describes the stable operation of the equipment that the variation coefficient ranging from 1.06 to 1.23. These data is confirmed by the regulatory tests results.

In conclusion it is necessary to add that the electromagnetic emission analysis can serve as the basis for technical diagnostics creation. The high-voltage equipment assessment criteria can be the integral radiation power and integral power factor.

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Supercritical water reactor

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INTRODUCTION

Current scenarios predict a global demand for electricity 2-3 times higher in the next 50 years compared to nowadays. Today there are about 440 nuclear power reactors operating in 30 countries, most of which will exhaust their resources by 2050. If nuclear's energy share of the worldwide energy production will remain unchanged at a level of 14%, at least 1,000 nuclear reactors would have to be built.

Thus in 2001, nine countries (Argentina, Republic of Korea, Brazil, Canada, Republic of South Africa, United Kingdom, France, United States and Japan) signed the founding document of Generation IV International Forum (GIF) in order to develop nuclear systems that can fulfill the increasing world electric power needs.

SCWR

Currently, there is a number of Generation IV SCWR concepts under development worldwide. It is a high-temperature, high-pressure water-cooled reactor that operates above the thermodynamic critical point of water (above 374°C, 22.1 MPa). The main advantage of the SCWR is improved economics due to increase in thermal efficiency from 30 – 35% to approximately 45 – 50%. Moreover, the use of a high-temperature, single-phase coolant allows to simplify plant’s operations and lower expenses by decreasing its electrical-energy costs [1].

SCWR DESIGN OPTIONS

The reactor core may have a thermal or a fast-neutron spectrum, depending on the core design. The concept may be based on current pressure vessel or on pressure tube reactors, and thus use light water or heavy water as a moderator. It opens the way for a number of concepts.

LIGHT WATER REACTOR

The SCWR concept was developed at the University of Tokyo in 1989 and became a global concern after being selected by the Generation IV International Forum in 2002. It’s Pressure-vessel, since 1989 (thermal version) and 2005 (fast version) [2].

CANDU-SCWR

Another concept proposed by Canada is generically called CANDU-SCWR, It is a pressured tube type reactor with fuel channels separating the light water coolant from the heavy water moderator [2].

CONCLUSION.

Nuclear energy systems are essential to meet the world’s growing energy demand while providing competitively-priced and reliable energy in a safe and sustainable way.