Prophylactic Monitoring of Impedanca of Turbogenerator's Rotor Winding at Unit 3 of TPP Bitola

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Abstract: **In this paper is elaborated prophylactic monitoring of impedance of turbogenerator's rotor winding at unit 3 of TPP Bitola. It is explained the measuring principle. The results are given from last 8 years, they are anylized, diagrams are made and the conclusion is given for the meaning of prophylactical monitoring of impedance. I must mention that the impedance of rotor winding performed only one of the important parametars relevant for objective estimation for condition of insulating system of the generator.**

Keywords: **generator, insulating system, prophylactic monitoring, impedance**

I. INTRODUCTION

Statistical research shows that insulating system is the weakest point of turbogenerator. Therefore nessesity for better care for this part of genetator.

This paper is only a part of whole project which consist of prophylactic monitoring of insulating system of large turbogenerators. During every annual repair mesuring are made at advanced determinating program with basic purpose for diagnosting condition of insulating system. That increase efficiency and reliability during exploatation. Basic characteristics and parameters for determineting state of insulation are: impedances, inductances, electrical insulating rezistance R_{iz}, koeficient of absorption K_a and factor of dielectric power loses wich depends of voltage $tg\delta = f(U)$, intensity of partial discharge, current in insulating system, dieletric strenght e.t.c.

One of these parametars is impedance of rotor winding that is the main issue at this work. All results and analyses are conserned to turbogenerator at unit 3 of TPP Bitola.

According to prophylactical research of impedance of rotor's winding at period of 1997 till 2004 sistematization is made, comparison of results and grafical diagrams are given. Also is estemed behavier of impedance at past eight years.

II. MEASURING OF IMPEDANCE OF ROTOR'S WINDING OF TURBOGENERATOR

Rotor's impedance is one of the basik values which are examinated during the annual repair for following of insulating systems condition.

Current - voltage method is used for measuring in two cases:

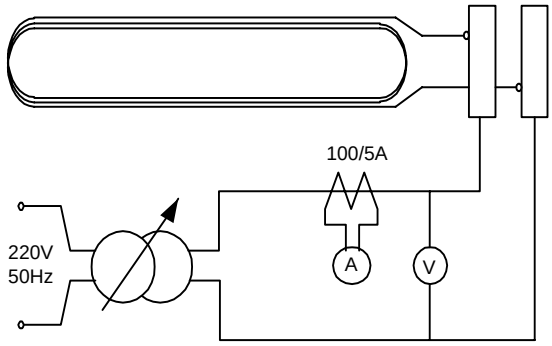

Fig.1 Survey of the measuring of rotor's impedance

1. while rotor is moving
2. while rotor doesn't move

At first case impedance is measured in dependense of number of rounding of turbogenerator Z=f(n) and at second case impedance is depending of voltage Z=f(U).

Measuring is performed according to Fig.1

Next instruments and equipment are used:

- current transformer	accuracy class 0.2	tupe TK-20
- ammeter	accuracy class 0.2	tupe E 514
- voltmeter	accuracy class 0.2	tupe E 515
- switch	50A	tupe AP 50
- megeohmmeter	M 4100/3	500V

As a source of alternating current is used autotransformer.

During turning off the generator primary and secundary current are measured by ammeter and the voltage too. So we calculated the impedance by Eq. 1

$$Z=U/I \quad [\Omega] \quad (1)$$

Method is the same for turning on the work where have enlargement of speed of rotation within $500min^{-1}$.

Measuring of characteristics Z=f(n) while rotor is moving is made two times during the retair. Once when rotor is turning off and the second time when the turbogenerator is turning on with increasing the speed of rotation within $500min^{-1}$.

III. RESULTS OF MEASURING OF ROTOR'S IMPEDANCE OF TURBOGENERATOR

The prophylactic monitoring of impedance in this paper is made since 1997 till 2004year. Rezults are sistematized by years and are given in Tables I and II. Table I is conserned to measuring of impedance during turning off the turbogenerator and Table II during turning on.

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TABLE I

RESULTS OBTAINED FROM OBSERVATION OF IMPEDANCE OF ROTOR'S WINDING DURING TURNING OFF THE TURBOGENERATOR

n [min^{-1}] / year	3000	2500	2000	1500	1000	500
1997	3.500	3.500	3.505	3.527	3.561	3.692
1998	3.516	3.603	3.633	3.580	3.636	3.695
1999	3.516	3.603	3.633	3.580	3.636	3.695
2000	3.867	3.953	3.953	3.953	3.973	4.192
2001	3.389	3.517	3.541	3.547	3.610	3.798
2002	-	3.714	3.714	3.714	3.763	3.887
2003	3.544	3.544	3.607	3.607	3.673	3.923
2004	3.525	3.525	3.508	3.538	3.552	3.679
Z_{sr} [Ω]	3.568	3.620	3.637	3.631	3.676	3.820

TABLE II

RESULTS OBTAINED FROM OBSERVATION OF IMPEDANCE OF ROTOR'S WINDING DURING TURNING ON THE TURBOGENERATOR

n [min^{-1}] / year	500	1000	1500	2000	2500	3000
1997	3.894	3.745	3.712	3.699	3.706	3.706
1998	3.994	3.850	3.775	3.768	3.754	3.741
1999	3.994	3.850	3.775	3.768	3.754	3.741
2000	2.825	2.860	2.860	2.895	2.900	2.940
2001	3.960	3.960	3.870	3.850	3.790	3.790
2002	4.090	3.980	3.980	3.970	3.860	3.850
2003	-	-	-	-	-	-
2004	-	-	-	-	-	-
Z_{sr} [Ω]	3.739	3.708	3.662	3.658	3.627	3.628

Measuring are made when increasing and discreasing the speed of rotation for 500 min^{-1}.

The Table II shows that in 2003 and 2004 yaer characteristics Z=f(n) when turbogenerator is tirning on are not taken. So that years are not calculated in the diagrams.

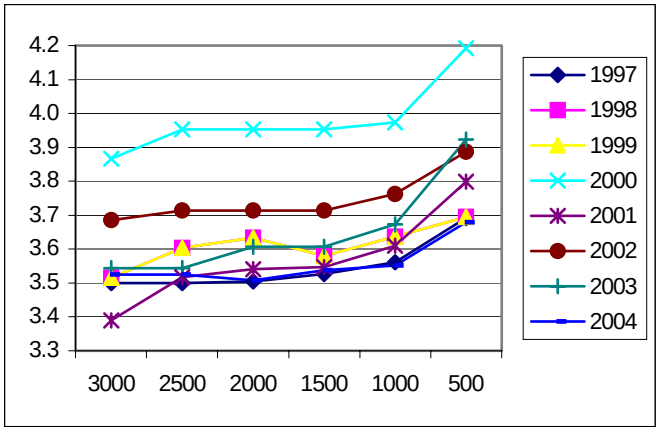

Fig.2 Dependance of impedance from speed of rotation Z=f(n) during turning off the turbogenerator

On the base of these Tables are created following diagrams, whereby is presented dependance of rotor impedance of speed of rotation for each yaer continualy, fig.2 and fig.3.

Characteristics Z=(n) should not have sudden leaps. That will indicate that there is some mistake in measuring or winding, that is nessesery further ezamination to remove it.

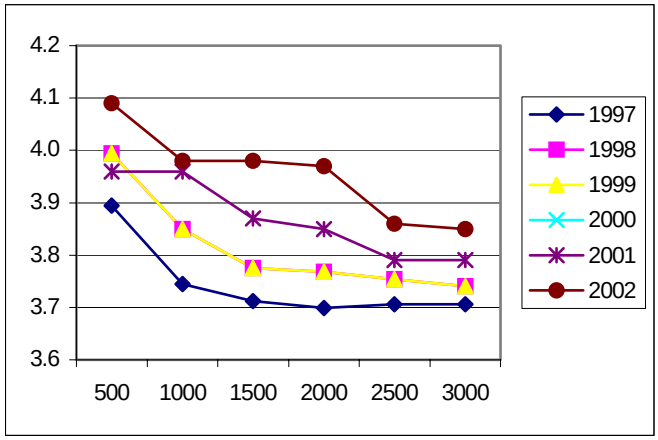

Fig.3 Dependance of impedance from speed of rotation Z=f(n) during turning on the turbogenerator

IV. ANALYSES OF RESULTS OF IMPEDANCE OF ROTOR'S WINDING AT UNIT 3 OF TPP BITOLA

In experimental part of this paper work is measured impedance of rotor's winding of sinchronous turbogenerator at unit 3 of TPP Bitola with special view to results of past eight years. Their sistematization is given in Tables I and II and are created the diagrams according that tables.

With purpose for better view and analyse of measuring, an average value of impedance is calculated for characteristic Z=(n) in both cases. Then in dependence of speed of rotation is created diagram with trend of direction (linear), given on Figs.4 and 5. with that a comparison is made for all following years.

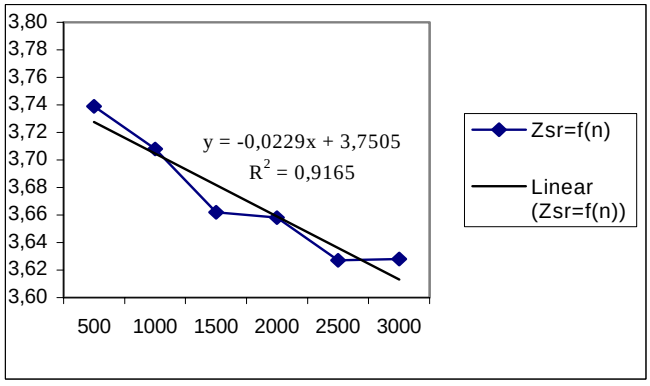

Fig. 4 Trend of direction of Z=(n) during turning on the turbogenerator

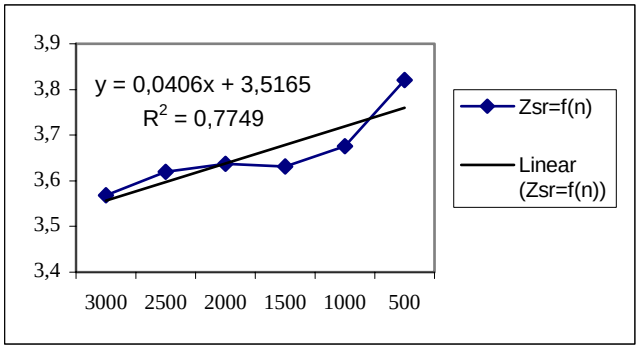

Fig. 5 Trend of direction of Z=(n) during turning off the turbogenerator

From previous diagrams can be noticed that in all past years impedance value of rotor winding is moving in the frame that is allowed and that is no sudden leaps. Also there are no big diferences from the trend direction.

From analyse and comparison of mesured and calculated values we can accepte that this way of prophylactical following is usefull for investigation and observation of insulation system.

V. CONCLUSION

In this paper widely is presented a method of exzamination of insulating system of large sinchronous turbogenerators. A detailed veiw is given for observation for
impedance of rotor's winding and prophylastic monitoring of it.

As it refers in introduction there are two cases of measuring: while rotor is moving characteristics Z=f(n) ang when it stops characteristics Z=f (U). But I can notice that the second type of measuring Z=f (U) is not done from 1997 till now or that informations were not available to me. What is the reason for that I can not tell, maybe timing for repair doesn't allow or the research team thought that is not nessesery.

This year 2005 repair is not predicted for unit 3 of TPP. That means that none of relavent parametars from nessesery examinations will be measured.

It is proposed for doing constantly repairs every year, to complete the documentation and making comparison of rezults from the previous years. The purpose is complete review of behaviour of insulating system and faster predicting of potentially critical condition of any of relevant parametars which defined the system.

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