Chapter 18

Maintenance of Power Equipment System Based on the Methods of Diagnosis and Control of Technical Condition

Dmitry Strebkov
Federal Scientific Agroengineering Center VIM, Russia

Alexey Nekrasov
Federal Scientific Agroengineering Center VIM, Russia

Anton Nekrasov
Federal Scientific Agroengineering Center VIM, Russia

ABSTRACT

Maintenance of the power equipment system is based on the industry standard of averaged volumes of standard maintenance and repair of power equipment, frequency and duration of the preventive measures, the nomenclature and consumption of materials and spare parts to perform operations. One of the more efficient uses of electrical equipment is to improve its maintenance system through the development and implementation of service strategies for the actual condition. The work proved the necessary conditions for the realization of electric service strategy on defining the main diagnostic parameter. The general mathematical model is proposed to implement the service strategy. The model is based on a study of basic parameters using random monotone normal type of process and diagnostic controlled parameter with three discrete product states (working, the state of preventive actions, and failure) and continuous operating time. The results of studies of the new techniques development for improving the operation of electrical systems are presented.

DOI: 10.4018/978-1-5225-3867-7.ch018
INTRODUCTION

Systems and Concepts of Electric Equipment Maintenance Service

In modern economy management conditions, when agricultural producers suffer a shortage of material resources, condition-based maintenance of electrified machinery evaluated with the use of diagnostics maintenance methods and prediction of its total service and remaining operational lifetime has to be considered as the most effective concept. First of all, it applies to electric motors that are commonly used as basic power drive units in agriculture. Their failures much more often, compared to other equipment components, lead to long-term maintenance time-outs in technological cycles associated with substantial economic damage. Annually, up to 25% of all installed electric motors, depending on type of equipment stock appear a subject of failure, while motor windings cause up to 80% of all failures. Agricultural production can be characterized by rather wide range of maintenance factors that in various combinations affect operation of electric motors and contribute to their wear (Lachuga, Yu.F., Strebkov D.S., Nekrason A.I., etc. 2001, Nekrasov, A.A. 2010, Strebkov, D.S. 1995, Syrykh, N.N., Rabdin, M.Ye. 2007). In rural areas, only about 20% of all electric motors are operated in friendly environment conditions while approx. 35% and 20% are exposed, respectively, to moist and damp conditions, extremely wet environment with corrosive gases and agents. About 15% of electric motors operate in dusty premises and 10% of them are installed outdoors. Besides, electric motors operation reliability and safety may depend on installation works quality, alarm mode protection, varying loads and many other factors. In squirrel-cage type electric motors, windings and bearing assemblies are the major resource-forming components whose failures make a principal contribution to electric drivers’ inoperability. That is why monitoring of operational status of these components is one of the first-priority tasks of maintenance service units.

Trends in critical components’ operational status shall be analyzed on the basis of data acquired by regular sampling of most important parameters of electric motors including winding insulation resistance and clearance of bearings and their beds. In this work, generic requirements are considered related to winding insulation resistance and bearing assemblies of electric motors, trends of change in winding insulation resistance and clearance of bearings and their beds in real conditions of agricultural production. New prediction methods have been developed for current values of winding insulation resistance and radial clearance in bearing assemblies.

Electric equipment preventive maintenance and repair system at agricultural enterprises (EEPMR System) is based on standardized industry-averaged scope of maintenance and repair operations carried out regularly on electric equipment, their periodicity and duration, stock list of materials and spare parts and their consumption rate for each operation (Agropromizdat, 1987, Yashura, A.I. 2008). One of the important integral components of this system is the maintenance and repair concept that, in accordance with GOST 24212-80, presents a system regulating conditions and procedures of preventive maintenance activities and equipment operational status control, in the course of its operation. The major investigated and commonly applied in agriculture strategies are the following:

After failure maintenance strategy of electric equipment does not include any preventive activities. Thus, failed electric equipment or its components are subject to replacement only upon a failure.

Intermittent-duty service strategy includes due equipment maintenance activities performed at specified intervals independing on its current operational status and factual running time after recovery following the previous failure.