


کد سند: RO-S-F-28-04	معاونت پژوهشی	
تاریخ صدور: ۱۳۹۹/۴/۲۲		
تاریخ ویرایش: ۱۴۰۰/۰۳/۲۵	فرم خلاصه انگلیسی طرح / پروژه	پژوهشگاه نیرو

Project Title: Technology Review of Insulation System of Rotating Electric Machinery

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Project Financial Code:	720010	Project Quality Code:	PEMPN21
Type of Project/Program:	fiduciary	Assistant:	Distribution

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Keywords: Electric, Machine, Insulation, Rotating, Industry

Project Necessity:

Today, the importance and scope of insulation materials used in rotary electric machines are very high and widespread and are used in most areas related to the electricity and energy industry, aerospace, electronics, transportation industry and so on. Proper quality and structure of insulation can be resistant to high voltages and vice versa, poor quality of insulation will lead to phenomena such as insulation failure, which will eventually lead to insulation failure and short circuit and failure of the electrical machine.

The first insulation systems used in industry and electrical equipment were based on natural insulation materials, which later with the development of synthetic materials, significant improvements were made in insulation systems, and these advances are rapidly changing the electrical, thermal and It is the mechanics of insulation that determine the need to study the latest developments in this field and compare it with classical insulation.

Thermal, electrical, mechanical and chemical factors are the four main factors in the classification and classification of electrical insulation materials, including thermal capacity, operating voltage level, flexural and tear strength, and resistance. Noted against chemical reactions, acceptability of impregnating materials, resistance to abrasion and scratches, and voltage level of insulating material. Classifying electrical insulation materials based on each of these indicators is a difficult and complex task.

The index of permissible thermal range and thermal tolerance of insulation has been considered as the most important factor in the efficiency and service life of equipment as the main index of insulation materials classification. The material of old insulators used in the structure of electric machines has led to losses such as heat loss, which leads to a decrease in the efficiency of machines and shortens its life.

With the help of modern technologies such as nanotechnology in the manufacture of insulation materials, a new perspective has been opened to increase the efficiency, increase the service life and reduce the overhaul costs of electric machines. Therefore, the feasibility of using these technologies in the insulation structure of electric machines used in the country should be considered. One of the most important achievements in the development of the above technology is the improvement of reliability and increase of equipment life and reduction of maintenance and repair costs, and as a result, economic efficiency for the operator.

Project Goals:

The most important goal of this project is to observe the latest innovations in materials, structures and insulation systems used in each of the parts of rotating electric machines. More than 50% of the defects associated with rotating electric machines arise directly from insulation problems.

In the first phase of this project, negotiations and interviews will be conducted with the stakeholders of the insulation industry in the country in order to use the points of view, issues and problems of these industries in the continuation of the project and possibly correcting the process.

In this project, a complete classification in terms of insulation material, electrical endurance, thermal endurance, mechanical endurance will be done and the insulation characteristics of each category will be analyzed. The applications of each insulation class in the structure of electric machines and its place in the motor insulation system will be specified. The proposed standards and the occurrence of insulation are introduced and reviewed. This study will be done separately for voltage classes and at low and high pressure levels (for example, below 6.6 kV and above 6.6 kV) and the discussion of resins due to its widespread use and importance.

Efforts will also be made to pay attention to explosion-proof engines, agricultural water well or oil well engines and drive engines as much as possible. Power plant accident statistics will be used to identify the insulation materials and the quality of the insulation materials used in the generators. Manufacturers and manufacturers of insulation materials for electric machines in and outside the country will be identified and efforts will be made to compare the insulation systems of electric machines of foreign companies manufacturing electric machines (such as ABB, Siemens, etc.).

Major users of these insulating materials are also identified in domestic factories. In addition, efforts will be made to study as much as possible the latest technologies and research in the world in the field of insulation materials and the applications of these modern technologies in the structure of rotating electric machines. The following questions can be answered by examining how to use these materials in different parts of the engine insulation structure and the amount of improvement in the insulation performance of each part of the engine insulation system:

1- Based on the available information and as much as possible, what innovations in the field of electric machines are the world's leading manufacturers moving towards in their car insulation systems today?

2- Comparing these modern structures with the insulation structures of domestically produced machines, can any suggestions be made to upgrade the insulation structure of these machines and increase their lifespan?

3- What is the current research field in the world in relation to the improvement of electrical, thermal and mechanical properties of insulating structures and what insulating topics are of major technological and strategic importance today?

Finally, the social, economic and environmental effects of insulation technologies will be identified and introduced to pave the way for a broader analysis of these factors and their weighting in future projects.

Abstract:

Today, the importance and scope of insulation materials used in rotating electric machines is very high and widespread and is used in most areas related to the electricity and energy industry, aerospace, electronics, transportation industry, etc. To be. Insulation materials and design of insulation systems, with the increasing use of electric machines in special and unsuitable environments, have received increasing attention. These environments include high temperature, humidity, corrosion, low air pressure, etc.

Insulation with good quality and structure can be resistant to high voltages and vice versa, the poor quality of these insulations leads to phenomena such as insulation failure, which ultimately leads to insulation failure and short circuit and failure of the electrical machine. شد.

This project first addresses the issue of insulation materials and systems for electric machines. Then, insulation tests and test standards that have been used to evaluate insulation systems and diagnose insulation failures have been reviewed.

Insulation degradation factors and challenges of insulation systems in various applications have been studied and also insulation materials used in a wide range of industrial applications such as wind turbine generators, electric propulsion and hybrid birds, hydrogen generators, etc. Have been examined. A review of recent developments in insulation materials and systems used in electric machines is another case study in this project.

Also, the manufacturers and producers of insulation materials for electric machines in and outside the country have been identified and studied, and the major users of insulation materials for electric machines in domestic factories have been identified and the volume of the domestic market has been identified. Finally, the structure of insulation systems of rotating electric machines is summarized and presented.

Steps and Methodologies:

- 1- Monitoring the status of insulation used in various types of electric machines
 - 1-1- Negotiating and interviewing with stakeholders in the insulation industry in the country
 - 1-2- Identifying and classifying the types of insulation materials used in various types of electric machines and expressing their characteristics
 - 1-3- Identifying and classifying the types of insulation systems used in various types of electric machines
 - 1-4- Preparing a report
- 2- Identifying major producers and consumers (main actors) in the field of insulation materials
 - 2-1- Determining the manufacturers and producers of insulation materials for electric machines inside and outside the country
 - 2-2- Identifying the major users of these insulating materials in domestic factories and identifying the volume of the domestic market
 - 2-3- Preparing a report
- 3- Summarizing and presenting suggestions

Main Results (technical outputs, patents, papers, books, reports, etc.):

In the final technical report, a proposal has been made to introduce new insulation technologies to the country and develop their application and improve the insulation structures of electric machines in the country's electricity industry in connection with the following:

- Manufacture of epoxy resin insulation filled with insulating nanocomposite materials to improve the life, breakdown voltage and thermal conductivity of insulation in high pressure and low pressure electric machines
- Use of polyethylene glycol terephthalate (PET) reinforced tape
- Use of a body insulation with high intrinsic thermal conductivity
- Using a thinner body insulation based on the "flat glass" design of mica paper tape by increasing the mica content
- Use of liquid synthetic resins
- Use of winding insulation materials suitable for various aerospace applications and wind generators
- Use of polyurethane resins
- Use of fumigation gases
- Launch of mica production line
- Launching the Capton insulation production line in the country
- Launching Nomex insulation production line in the country