Project Title: Evaluation of nanotechnology products through pilot tests in the power industry

Department:	Plan of nanotechnology applications in materials and equipment of power plants	***Employer:***	Niroo Research Institute
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Project Necessity:

In summary, the major goals of using nanotechnology in the electricity industry are:
• Manufacture and production of equipment required by the electricity industry with better efficiency and properties and lower costs
• Construction and production of equipment that is not possible with conventional technologies
• Development of methods of operation, repair, maintenance, improvement and modernization of facilities and equipment of the electricity industry
• Reduce losses, increase equipment efficiency and increase power generation capacity
The benefits of piloting the project can be summarized as follows:
1-Hidden obstacles and limitations that limit the ability of the system to achieve the expected goals are identified.
2- It is possible to monitor and control the ability of users to adapt to the new situation.
3- It is a very good option for evaluating the performance of the system, because the pilot can be run faster and at a lower cost.

Project Goals:

Among the most important initial goals for this project are the following:
1. Investigating and evaluating the performance of new products based on nanotechnology in the field and under load in conditions of severe pollution and corrosion and ...
2. Improving the quality and standardization of nanotechnology products in the electricity industry
3. Validation of nanotechnology products in the electricity industry with their catalogs
4. Provide technical criteria in the correct selection of nano products to improve the properties of equipment
5. Solving common problems in power generation, transmission and distribution systems
6. Performing test services and providing a certificate confirming the proper performance of nano products in modifying the equipment used in the electrical industry
7. Comparing the performance of products offered by different manufacturers in the world

Abstract:
Nanotechnology has been recognized in the last two decades as a key and applied technology to solve scientific and industrial challenges in the world, and advanced countries and industries in the world have made many investments to develop this technology. In our country, fortunately, this technology is known as one of the national priorities, and with the planning and efforts made by the end of December 2017, Iran has been able to become the fourth in the world with the release of 8,791. According to the plans made based on the 20-year vision of the country, two ten-year documents were prepared in the Special Headquarters for Nanotechnology Development in the Vice President for Science and Technology. Nanotechnology, while in the second document, this approach was changed to scientific authority, selection and development of key technologies, establishment of nanomodel system, creation of nanotechnology, promotion of existing industries through nanotechnology and market development and export of nanotechnology. Accordingly, the groundwork has been laid for the entry of researchers and knowledge-based companies into the production of nano-products. Currently, 257 technology companies in the field of nanotechnology have been set up in the country, most of which are active in the field of nanomaterials and laboratory equipment manufacturing, and this number and variety of products is increasing rapidly.
Nanotechnology is the ability to design, manufacture, control and use materials, tools and systems in the dimensions of 1 to 100 nanometers. In this range, ie atomic and molecular dimensions, physical, chemical and mechanical properties are different from the properties of matter mass in common forms. In general, this technology consists of three stages. First, the design and engineering of structures at the atomic level; Then combine these structures and convert them into new materials with nanostructures with special properties and finally use such materials and turn them into useful tools. This new technology, due to its ability to work at the molecular and atomic levels and the possibility of precise control of dimensions and composition, has made it possible to make materials and equipment more durable and durable, stronger, lighter, consume less energy and have better mechanical and chemical properties. Or even produced a lower cost.
One of the important issues in the electricity industry is the use of new equipment and devices based on reducing losses and increasing efficiency, and identifying and developing technical knowledge to replace them is an important research topic. Nanotechnology on the one hand promotes and optimizes products and processes and on the other hand creates new and special capabilities in materials and parts that these two potentials can be well used to improve the performance of materials and equipment in the electricity industry. In summary, the major goals of using nanotechnology in the electricity industry are:
Manufacturing and producing equipment required by the electricity industry with better efficiency and properties and lower costs
• Construction and production of equipment that is not possible with conventional technologies
• Development of methods of operation, repair, maintenance, improvement and modernization of facilities and equipment of the electricity industry
• Reduce losses, increase equipment efficiency and increase power generation capacity
Nanomaterials can be used in various areas of the electrical industry such as production, transmission, distribution and in various forms such as nano additives and nano-coatings. Among the important applications of this category of products in the electricity industry can be hydrophobicity of high voltage insulator surfaces using polymer nanocoatings and also improve the anti-corrosion properties of cement-based concrete towers and power transmission equipment, using additives. Nano pointed. Providing new solutions to combat the damage caused by pollution and corrosion requires accurate determination of the conditions of the region and the selection of materials or nanomaterials, appropriate to the working conditions. Therefore, the necessary considerations should be considered regarding the selection of suitable materials with the existing conditions, which unfortunately, this is often not intended and has caused significant amounts of damage to the country's electricity industry. Prevention of such cases can be minimized by a series of preventive activities in the process of production or modification of equipment.
"Pilot" is a study or review that is done on a preliminary and small scale before the implementation of the main project to evaluate the feasibility of the project, or to improve the implementation of the project. Often, pilot projects are implemented prior to the implementation of large-scale projects, in order to avoid wasting time and money on projects that are not yet complete. During the implementation of a pilot project, the shortcomings and problems in the implementation are identified and reviewed in order to complete the main study project. The benefits of piloting the project can be summarized as follows:

- Hidden obstacles and constraints that limit the system's ability to achieve the expected goals are identified.
- It is possible to monitor and control the ability of users to adapt to the new situation.
- It is a very good option for evaluating the performance of the system, because the pilot can be run faster and at a lower cost.

Implementing a project as a pilot allows the executors to carefully monitor the implementation process of the project in smaller dimensions, and after getting acquainted with the obstacles and shortcomings of the project and modifying and completing it, with more readiness of the main project in large dimensions to To be implemented. The implementation of a pilot project also helps to provide some necessary grounds for the acceptance of the project in the industry, so that the industry can accept the changes that are required to implement the project in a gradual process. Therefore, the implementation of pilot projects is generally one of the important components of the knowledge management implementation strategy in industries and organizations.

Nano-products used in nanocoatings or composites with reinforcing nanoparticles should be tested in two ways; One in terms of accuracy and validity of imported foreign products compared to their catalogs and the other in terms of how nanomaterials work in service conditions

Steps and Methodologies:

1- Study phase and feasibility: review of resources, review of available facilities, review of potentials and conceptual feasibility

2- Design and procurement phase: In this phase, the specifications of equipment and devices in the industry that need to be improved and also the necessary equipment for field tests of nano products are determined. Necessary designs are also made for measurement and evaluation systems. The required raw materials and equipment are purchased or made according to the designs made.

3- Pre-pilot review phase

4- Pilot implementation phase: In this phase, pilot test and necessary evaluations are performed to evaluate the properties of products in the industry)

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

To reduce other pilot costs such as travel, one of the selected sites for power plant projects in Tehran is the Tarasht (Shahid Firoozi) power plant, formerly known as Alstom. This power plant has four Alstom France heat units with a nominal capacity of 12.5 MW. The reason for choosing Tarasht power plant is the small power plant and having small turbines and compressors that have low lubrication consumption. Therefore, the performance of nano-lubricant can be done with less difficulty. In addition, the location of the power plant is located in Tehran and the possibility of periodic control and inspections is increased. Also factors such as: quick and easy access for monitoring and data collection, the existence of a closed cycle of heat exchanger for nanofluid injection, previous experience of using nanofluids in Tarasht power plant, familiarity of experts with nanofluid concepts and the existence of a small system suitable for pilot testing and rapid evaluation. Caused the nanofluid additive pilot project to be carried out in the same power plant.

Pilot test of nano-coating and hydrophobic and anti-dust cloud paint for insulation equipment, due to the proximity of Mashhad Cement Factory with 63 kV Rezvan post in Khorasan Razavi province, will be performed at this site. This test will also be performed at the 63 kV substation of Tehran Moshirieh, which is adjacent to the cement factory and the cement mine on Bibi Shahrbanoo Mountain.

The pilot test of nano-protective concrete coating is also performed in Parand post due to the announcement of cracks in concrete foundations by Parand Regional Electricity and their desire to apply superhydrophobic coating as a pilot. The results of the pilot test of the power plant cooling nanofluid showed that the use of nanofluid in the shell-tube heat exchanger of the cooling unit of Tarasht power plant leads to increasing the efficiency and improving the performance of the cooling system. It is necessary to pay attention to a few points here.

• Ambient temperature is one of the most important and influential factors on the performance of cooling systems. It is clear that the initial design of the test system is such that in normal temperature conditions it responds well to the need and will easily provide the appropriate temperature difference in the inlet and outlet gas (ΔT). Therefore, strengthening the system under normal operating conditions will not have much effect on its performance. This is while nanofluids will perform better in the difficult operating conditions of the system and the increase in system efficiency will be more tangible. Unfortunately, despite the repeated emphasis of the project team to conduct field testing in July and August, when the temperature is maximum and the cooling system is under pressure and needs to

be strengthened, but the time for field testing was postponed to late summer. The results show that the average ambient temperature in the whole test period is about 28 degrees Celsius, which is normal. Based on the previous experiences of the project team, it is clear that the performance of nanofluids will be much better at higher temperatures that approach the system performance limit conditions.

Gas temperature changes (ΔT) during the field test period were selected as the main parameter for measuring and evaluating nanofluid performance. Since various factors such as ambient temperature, inlet gas temperature, ambient humidity, inlet gas flow intensity, water temperature of towers, how the towers operate, etc. affect the overall performance of the cooling system and it is not possible to separate them. Therefore, it can be said that the parameter of gas temperature changes (ΔT) indicates the overall efficiency of the cooling system. In other words, a 5% increase in ΔT in the case of nanofluid use indicates an increase in system efficiency by the same amount.

From an economic point of view, a 5% increase in system efficiency, which leads to reduced fuel consumption, increased production capacity and reduced emissions of environmental pollutants is very important.

The results of the pilot nano coating of hydrophobic insulation equipment also showed that after six months of coating the insulators, no trace of dust settling and contamination was observed on the surface of the insulators. Also in Rezvan post of Mashhad, the process of examining the properties of coated insulators will continue for a period of six to evaluate the effect of adding silica nanoparticles in RTV resin as a coating on insulators.

The results of the pilot test of nano-concrete coating showed that water remained on the surface of the coatings and concrete was not adsorbed, which indicates that the super-hydrophobic coating still retains its corrosive properties after three months. The output of this research is currently to prepare the necessary patent reports. In order to commercialize this coating, it is suggested that since the superhydrophobic coating has been able to pass the weather resistance test after 1000 hours, the pilot coating should be performed again, taking into account the problem of mixing the components of the superhydrophobic coating last time.