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3 Kv Conveyor Motor Maintenance At PT. PLN Nusantara Power Up Paiton Units 1 And 2

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Abstract

Preventive Maintenance, Predictive Maintenance, Corrective Maintenance in induction motor 3 phase is one of the equipment that is highly used to support the various processes. In general, induction motors are used to rotate pumps, blowers or compressors. Maintenance is a combination of various action taken to maintain an asset and repairs that is always in a ready to use condition to carry out productivity effectively and efficiently in accordance with standards. To improve the performance of the generator in the PLTU, and maintain the working performance of the motor routine maintenance needs to be carried out. Motor maintenance is one of the most important things to increase the reliability of the production process in an industry. In various industrial activities which are full of exciting processes, motor motors are one of the equipment or tools that are highly used to support these various processes. In large industries, induction motor, are the main control for driving other equipment.

Keywords:
Maintenance Preventive and Predictive Induction Motor

Abstrak

Perawatan bentuk preventif, prediktif, korektif pada pemeliharaan motor induksi 3 fasa, dimana perawatan motor induksi 3 fasa merupakan salah satu peralatan yang banyak digunakan untuk menunjang berbagai proses tersebut. Pada umumnya motor induksi digunakan sebagai pemutar pompa, blower, atau juga compressor. Pemeliharaan adalah kombinasi dari berbagai tindakan yang dilakukan untuk menjaga suatu aset dan memperbaikinya agar selalu dalam keadaan siap pakai untuk melaksanakan produktivitas secara efektif dan efisien sesuai dengan standar. Dalam meningkatkan performa pembangkit dalam PLTU, dan menjaga performa kerja dan pada sebuah motor perlu dilakukan maintenance secara rutin. Perawatan motor listrik merupakan salah satu hal yang paling penting untuk meningkatkan realibility keandalan proses produksi dalam suatu industri. Dalam berbagai kegiatan industri yang tentunya penuhdengan proses-proses yang ada, motor listrik merupakan salah satu equipment atau peralatan yang banyak digunakan untuk menunjang berbagai proses tersebut. Pada industri-industri besar, motor listrik motor induksi menjadi penggerak utama untuk menggerakkan peralatan-peralatan lainnya

***Kata kunci**: Pemeliharaan, Preventif dan Prediktif, Motor Induksi*

INTRODUCTION

In this modern era, human need for electrical energy is increasing. Not only for daily needs, but all industrial processes in this era require quite a bit of electrical energy. Therefore, the role of electricity generation in Indonesia is very important in supporting the life of the nation and state. PLTU Paiton, is one of the steam power generating companies (PLTU) in Indonesia which is located in Paiton, Probolinggo, East Java. This power plant supplies 2 x 400 MW of electrical energy to PLN, and plays an important role in the process of providing electrical energy in the Java-Bali interconnection network. To produce electrical energy, PLTU Paiton uses coal as fuel to heat fresh water until it becomes steam which will spin the turbine in the main unit.

The coal used is sent via ship and will be transported via various conveyor lines to reach the main unit. However, not all incoming coal will be directly transported to the main unit, when the coal capacity in the main unit has reached the limit, the coal will be forwarded to the coal yard for storage.

The aim of this research is to understand and develop the knowledge gained by applying it in the world of work, providing a deeper understanding of the Steam Power Plant (PLTU) process at PT PLN Nusantara Power UP Paiton Units 1 and 2 and understanding the parts and working principles of the motor. 3 kV conveyor.

METHOD

PLTU Electricity Production Process

Steam Power Plants (PLTU) are plants that utilize heat energy which is then converted into steam which is later used to rotate turbines and drive generators to convert kinetic energy into electrical energy. Steam power plants use various types of fuel, especially coal and fuel oil. PLTU uses steam water working fluid which circulates in a closed manner. Closed cycle means using the same fluid repeatedly.

Paiton PLTU Electrical System Units 1 and 2

PLTU Paiton Units 1 and 2 with a capacity of 2 x 400 MW generate electrical power to be supplied to the Java - Bali grid as well as for own use within the generating unit environment. In general, the electricity supply flow generated by PLTU Paiton units 1 and 2 can be seen in the following picture:

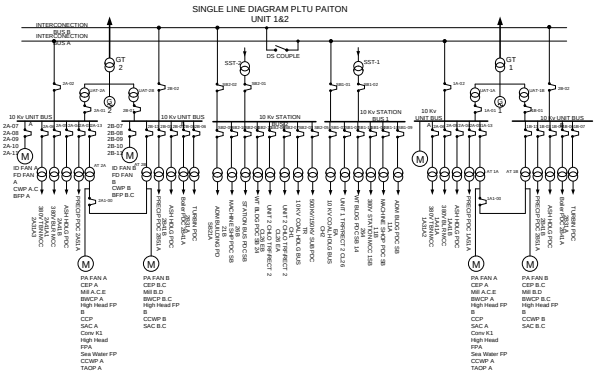

Figure 1 Paiton electrical system units 1 and 2

- 18 kV Voltage System

  The output voltage of generator units I & II is 18 kV which is distributed to the 500 KV Substation via Generator Transformer (GT 18/500 kV, 470 MVA).
- 10 kV Voltage System

  The generator output voltage is also distributed for the 10 kV Bus Unit's own use via the Auxiliary Transformer Unit (UAT 1A, UAT 1B, UAT 2A, UAT 2B) 18/10 kV, 33.4 MV.
- 3 kV Voltage System

  This 3 kV voltage system is distributed from the Auxiliary Transformer (AT 1A, At 1B, At 2A, and At 2B) which is taken from the 10 kV Bus Unit.Sistem Tegangan 380 V
  The 380 Volt system voltage comes from a 10 kV/380 V PDC-PDC Transformer and is distributed through the MCC to serve auxiliary equipment with a voltage of 380 Volts.
- System Voltage 220 VDC

  The 220 VDC voltage system comes from the station battery, to serve, among other things, the Turbine Emergency Oil Pump, Generator Emergency Seal Oil Pump, DC Emergency Lighting, Distributed Control System, and UPS.
- System Voltage 125 VDC

  The 125 VDC voltage system comes from the station battery, to serve 10 kV Switchgear Units, 10 kV Station Switchgear Units, 3 kV Switchgear Control Panel Units, Control Panels for GT, UAT, and so on.

Sub Station 500 kV

- Channeled via SUTT 500 kV Krian 1 and Krian 2 to GITET Krian
- Channeled via Tie Transformer (TT1 and TT2) 500/150 kV each, 500 MVA to 500 kV Substation.

Sub Station 150 kV

- Distributed via SUTT 150 kV Situbondo 1 and Situbondo 2 to Situbondo GI
- Channeled via SUTT 150 kV Kraksaan 1 and Kraksaan 2 to GI Kraksaan
- Channeled via Feeder Town Transformer (FT 150/20 kV, 40 MVA)

Distributed via Station Service Transformer (SST 1 and SST 2) each 150/10 kV, 60 MVA to Station Bus SB 1 and SB 2 for use of the Unit at start time and also to supply Inter Connection Bus A from SST 1 and Inter Connection Bus B from SST 2.

Conveyor

Conveyors are tools that can be used in production processes, factories and mining. In this condition it can be used because it speeds up production power and is quite economical compared to transporting heavy equipment such as dump trucks. The conveyor used is a belt conveyor type. The belt conveyor has high load power and a large transportation path length, simple design, easy maintenance, and high operational reliability.

Conveyors can also transport loads or materials in large quantities for transportation from one place to another. The movement of loads or materials must have a strategic location so that it is easy to load.

Conveyor Components

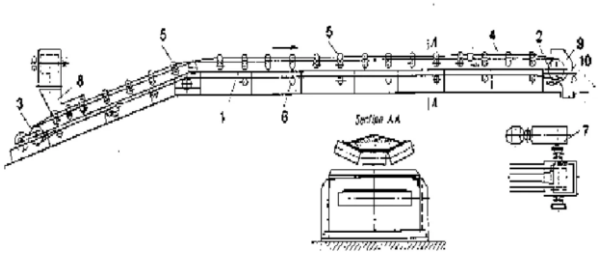

Figure 2 Conveyor components

A conveyor is a large ribbon system made of rubber and stretched between two or more pulleys at a certain speed carrying a certain amount of material. Each conveyor system consists of eight elements, namely:

1) Conveyor belts
   In the form of a moving surface where the material is placed.
2) Pulleys
   Belt drives and maintains the tension level on the conveyor.
3) Motor drive
   Provides power to one or more pulleys to move the conveyor.
4) Idler structure
   Provides support and regulates rolling position.
5) Chutes
   Serves to help unload coal in an emergency. Equipped with a chute to prevent flying coal ash during demolition
6) Cleaner
   Functions to clean the belt and prevent coal from entering the tail pulley.

7) V-plow
Functions to clean spilled material on the reverse side of the belt.
8) Inverters
Functions as a DC current regulator.

Maintenance

The function of maintenance is to extend the useful and economic value of a machine, as well as ensuring that machines and other production equipment can always operate as optimally as possible according to what is needed.

a. Preventive Maintenance

This form of policy is care or maintenance that is carried out as a precaution, so that it is carried out before machine damage occurs. Preventive maintenance can be further divided into two types, namely routine or daily maintenance and maintenance within a certain period of time.

b. Predictive Maintenance

Predictive Maintenance is included in preventive maintenance, namely before the machine experiences damage. However, what is different is that this policy is based on a strategy for the machine itself.

c. Corrective Maintenance

Corrective Maintenance is care and maintenance carried out after a machine is damaged in order to correct or return all machine activities to operational conditions. In the electrical maintenance section itself, maintenance is only divided into two, namely preventive and corrective. Because the maintenance section applies the WO (Work Order) issued by the engineering division.

RESULTS AND DISCUSSION

Conveyor Motors

In industry, the materials used are sometimes heavy or dangerous for humans. For this reason, transportation equipment is needed to transport these materials considering the limited capacity of human power, both in terms of the capacity of the materials to be transported and the work safety of employees. One type of transportation equipment that is often used is a conveyor which functions to transport industrial materials in solid form.

Figure 3. 3 phase induction motor

The conveyor is a tool that functions to transport coal unloaded by the ship unloader to the silo. The conveyor is driven by electric motors located at one end of the conveyor belt. The electric motor used on the belt conveyor is a 3 phase induction motor. The construction of a 3 phase induction motor generally consists of a stator and rotor. The stator is the non-rotating part while the rotor is the moving part.

The use of induction motors on conveyors is more widely used because induction motors have several advantages, including:

- Has simple construction
- Relatively cheaper compared to other types of motors. Produces constant rotation
- Easy to maintain
- For starting, no other motor is needed as a starter drive

Conveyor Motor Parts and Specifications

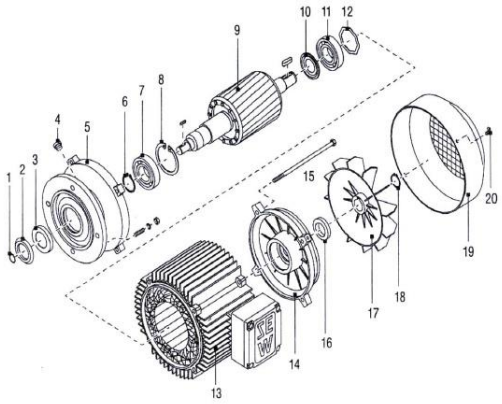

Figure 4 Parts of a 3 phase induction motor

The parts of the induction motor include:

1. Snapring
2. Oil Flinger
3. Oil Seal
4. Screw Plug
5. Bearing dan Shield
6. Snap Ring
7. Ball Bearing
8. Snap Ring
9. Rotor
10. Nilos Ring
11. Ball Bearing
12. Equalizing Ring
13. Stator
14. Bearing dan Shield
15. Hex Head Screw
16. V-Ring
17. Fan
18. Snap Ring
19. Fan Guard
20. Housing Screw

Induction motors basically have 3 important parts as follows.

Stator: Is a stationary part and has coils that can induce an electromagnetic field in the rotor coils.
Gap: This is an air gap: The place where energy moves from the starter to the rotor.
Rotor: Is a part that moves due to magnetic induction from the stator coil which is induced into the rotor coil.

Table 1 Specifications of 3 kv conveyor motor

Description	**3 Phase Induction Motor**
Type	*YKK630 – 4TH – W*
Voltage	*3000 V*
Full Load Ampere	*74 A*
HP	*423 HP*
Frequency	*50 Hz*
Rotor Speed	*1473 rpm*
Serial	*7144BA – 1*
Year	*1993*
Isolation Class	*F*

DC Resistance Test

DC resistance (RDC) measurements aim to obtain the DC resistance value of the winding and compare the value for each phase, with previous measurements and with windings from similar machines. Differences in resistance values can indicate an abnormality in the winding.
The method for carrying out an RDC test on a 3 phase motor is to remove the motor terminal connections and the phase connections. Then measure the resistance value in each winding R, S, T. The tool for measuring DC Resistance must have a minimum accuracy of 1% in order to detect any abnormalities in the winding.
The purpose of carrying out the RDC Test is to see the resistance value in the winding with a standard deviation of 2% in accordance with IEEE standard std.62 – 2004.

Insulation Resistance Test

The insulation resistance test is used to determine the insulation resistance of electrical equipment. This test uses Megger. For IR measurements, use a time setting of 1 minute. The measured voltage table below is the working voltage phase to phase for 3 phase motors and phase to ground for 1 phase motors.

Table 2 Equipment measuring voltage

Tegangan Kerja Motor	Tegangan Test
<1000	500
1000 – 2500	500 – 1000
2501 – 5000	1000 – 2500
5001 – 12000	2500 – 5000
>12000	5000 – 10000

IR test results must be above the minimum value based on IEEE 43 standards or based on the manual of the equipment being measured.

Table 3 Minimum IR test values with IEEE std 43-2013 standards

Minimum Value IR (M)	*Electric Motor Specifications*
IR = Kv + 1	*For all types of windings whose manufacture date is less than the 1970s or which are not mentioned below.*
IR = 100	*For the majority of AC and DC windings, the year of manufacture was over the 1970s (from wound coil).*
IR = 5	*For most random wound stator coil and wound coil machines the rating is below 1 Kv.*

The IR above is the minimum recommended value, when the temperature is 40˚C evenly distributed throughout all windings. Kv is the working voltage value of the electric motor phases in rms.

Polarity Index (PI) Testing

Polarity Index (PI) testing is a variation of IR testing, PI measurements are carried out for 10 minutes, by comparing the results of the 10th minute isoal resistance measurement to the results of the first minute measurement, namely:

$$PI = \frac{R_{10}}{R_1}$$

Information :
PI = Polarization Index
R_{10} = Resistance Insulation Value after 10 minutes
R_1 = Resistance Insulation Value after 1 minutes

If the insulation resistance measurement results for 1 minute are above 5000 MΩ then the PI calculation results can be ignored (IEEE Std 43-2000). If the Pl value is low, it indicates that the winding conditions are dirty, damp, etc. So it is necessary to carry out treatment first to get good winding conditions by cleaning and/or heating.

Greasing Inspection

Greasing inspection is carried out to ensure the grease on the bearing is in good condition. Grase is a solid lubricant with units of grams of energy (gE). The checks carried out are checking the DE (front body of the motorbike) and NDE (rear body of the motorbike).

Figure 5 Applying grease to the bearing

Cleaning

Cleaning is done to clean the motorbike body from dust or other things that can interfere with the motorbike's performance.

Figure 6 Routine conveyor motor cleaning

CONCLUSION

PLTU Paiton units 1 and 2 are steam power plants that use coal as the main fuel. The total capacity of unit 1 and unit 2 is 2 x 400 MW or the same as 800 MW which must be used frequently. Maintenance is to maintain an asset and repair it so that it is always in a ready-to-use condition to carry out productivity effectively and efficiently in accordance with standards. Maintenance of electrical equipment is a series of action processes to maintain its condition and ensure that the equipment can function as it should. The aim of maintenance is to maintain high equipment safety, high equipment reliability, optimal efficiency and power output, extending the life of the generating installation. Based on its nature, equipment maintenance consists of Predictive Maintenance (Conditional Maintenance), Preventive Maintenance (Time Base Maintenance), Corrective Maintenance. Preventive Maintenance in the practical work that we carry out includes motorbike maintenance and circuit breaker inspections. Maintenance of 3 kV conveyor motor at PT. PJB PLTU Paiton Units 1 and 2 generally include motor inspection and cleaning, greasing inspection, RDC test, IR Test and PI (Polarization Index).

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