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Study an Improvement of Electrostatic Prescipitator (ESP) Interference Protection Systems PLTU Pangkalan Susu Units 1 and 2

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ABSTRACT
The problem of air pollution in this technological era has reached an alarming level. This is in line with the increasing number of pollutants produced from daily activities. Some industrial factories, power plants, and motorized vehicles that every day always produce harmful pollutants that pollute clean air. Coal-fired power plants could be a source of air pollution if coal combustion was not handled properly. Where the ash from coal combustion in the boiler produces fly ash and bottom ash. Based on these conditions, a tool is needed to reduce or control fly ash. This study describes the reliability of the equipment in the generating unit so that the reliability of the ESP system can be guaranteed and maintained. With the results of cases that occurred in ESP during the review, 90% of the problems in ESP were found in ESP. This problem is closely related to other equipment which can later cause the ESP field to stop. It is necessary to pay attention to the readiness of the inside for the long term because the repair process takes a long time and when the unit is off (offline). To minimize problems on the inside, we can monitor the ESP performance chart itself by paying attention to the points in the cases described above. It is recommended that the inner parts such as stopper plates, etc., which are related to the mounting parts are expected to be welded to avoid loss. we can monitor the ESP performance chart itself by paying attention to the points in the cases described above. It is recommended that the inner parts such as stopper plates, etc., which are related to the mounting parts are expected to be welded to avoid loss. we can monitor the ESP performance chart itself by paying attention to the points in the cases described above. It is recommended that the inner parts such as stopper plates, etc., which are related to the mounting parts are expected to be welded to avoid loss.

Keywords : ***Electrostatic Precipitator (ESP), Case, PLTU***

INTRODUCTION

Steam Power Plant (PLTU) is a provider of electricity that can produce large enough electrical power for consumers compared to other generators. However, the results of coal combustion in the boiler can produce ash particles with sizes between 1 to 100 m(Hamdani et al., 2018). The ash is easily visible to the human eye, and can even interfere with visibility if scattered in the air. In addition, fly ash is very dangerous if it is inhaled by humans because it can injure important parts of the human respiratory system(A. Kumalawati, 2013).

Where air pollution is one of the types of pollution that is categorized as very dangerous pollution and has a large enough impact. This is because the pollutant particles from this pollution are so small that the public is not aware of it(Faroqi, Adam Hadisantoso, et al., 2017). Due to its physical form, pollutants in the air are not only in the form of gas or steam, but can also be solid objects as particles, namely in the form of dust, smoke, and odors. The increasing number of industries that are currently emerging causes the electricity demand to increase. At this time in Indonesia, the most widely used power plant is the Steam Power Plant (PLTU). This is because in Indonesia there are still many coal, oil, and gas mines. However, what is more widely used is coal, because the amount is still quite a lot compared to oil and natural gas. Coal is an organic mineral that can burn, formed from the remains of ancient plants that settle and then change shape due to physical and chemical processes that last for millions of years. (Trilaksani et al., 2006).

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In this regard, the preservation of the surrounding environment must still be considered, because coal-fired power plants can be a source of air pollution if the rest of the coal combustion is not handled properly. The ash from coal combustion is a small particle whose size is mostly about 10 m. The ash from coal combustion in the boiler produces fly ash and bottom ash. Fly ash called fly ash is a material that cannot be burned out and is carried away by hot gases. Meanwhile, bottom ash is residual material from coal combustion that is not carried away by hot gases. Fly ash from coal combustion is generally released into the atmosphere without any control, so it can cause air pollution. Therefore, it is necessary to pay attention to the environment and control pollution of the fly ash before it is released into nature. Based on this, a tool is needed to reduce or control fly ash.

The most effective tool to use is the Electrostatic Precipitator (ESP). (Solly & Lubis, 2019). Many Steam Power Plants (PLTU) in Indonesia are already using Electrostatic Precipitator (ESP) as an effort to reduce the amount of pollution from coal combustion, one of which is PLTU Pangkalan Susu, Langkat Regency, North Sumatra Province. During the operational period of the Electrostatic Precipitator (ESP) system, a scalable performance review is required. This aims to determine the performance of each part of the tool during operation so that effective actions can be taken such as repair or replacement of tool parts during overhaul. Based on the above background, an observation will be carried out with the title Disturbance Analysis in the Electrostatic Precipitator (ESP) PLTU Pangkalan Susu Units 1 and 2(Ilyas et al., 2017).

Where the Electrostatic Precipitator (ESP) is a necessary tool in PLTU in capturing and controlling gas emissions from combustion in the boiler using electrostatic principles. PLTU Indramayu has an ESP design that can reduce combustion dust to an efficiency value of 99.58%, thus only 0.42% of dust escapes, so it is quite safe for humans and the surrounding environment. The performance of the ESP will be disturbed when there is interference(Nurhayati, 2013).

To continue to maintain optimal performance and reduce and avoid damage to the ESP, maintenance is required. The maintenance that is currently being carried out is maintenance based on the condition of the equipment known as equipment assessment. Testing is part of the assessment which in practice consists of simple tests to complete and comprehensive tests so that the overall condition of the ESP can be known and can identify problems that exist in the ESP. (Phoungthong et al., 2013).

Figure 1. Electrical Precipitator (ESP)

LITERATURE REVIEW

Construction of ESP Electrostatic Precipitator (ESP)

Discharge Electrode and Collecting Plate Discharge Electrode is part of the ESP in the form of elements that are straightened and hung on a frame, while the collecting plate is grounded on the ESP. Discharge electrodes must be kept clean, industrially and functioned to reduce pollution caused by

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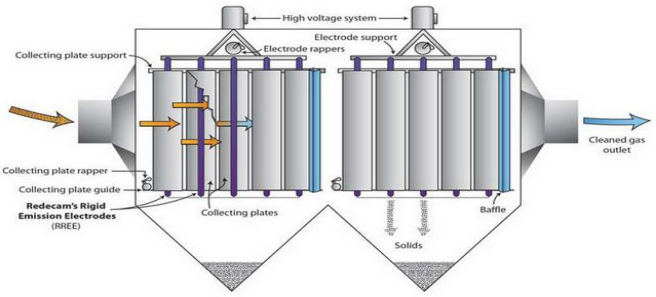
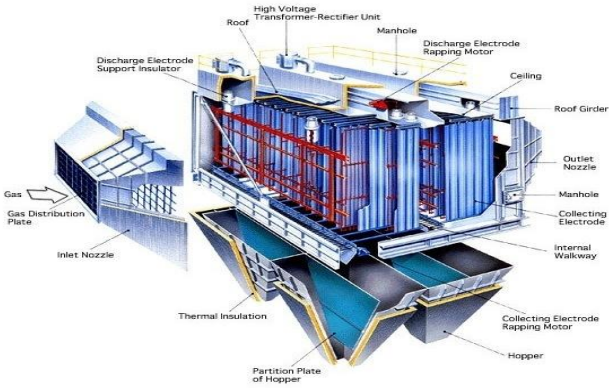
burning coal in the furnace (Aldillah, 2016) .



Figures 2. Electrostatic Precipitator (ESP) working principle

The following is a list of the main components or parts of the Electrostatic Precipitator:



Figures 3. Electrostatic Precipitator (ESP) Components

a. *Case*
*case*ESPs are usually manufactured from a durable material such as ASTM A-36 steel or other similar material. This casing is made airtight so that exhaust gases from combustion do not leak. In the casing there is an expansion chamber, a heat-resistant insulator is installed, and there is a door for access in and out of people to carry out maintenance on the ESP so that it is always in top condition.

b. Electrode
The electrodes on the Electrostatic Precipitator are steel plates which have the main function of generating a high-intensity electric field and ionizing the particles in the flue gas. In simple terms, the ESP electrode becomes a gathering place for negatively charged ash before falling into another part called the hopper. The electrodes on one ESP and another can have different shapes depending on the type of electrostatic precipitator used, but they are generally in the form of bars, metal wires, or plates inside the pipe or chimney itself.

c. *Hopper*
Usually the hopper is also made of the same steel as the casing, with an isosceles triangle shape but upside down. So the taper is at the bottom, and the hopper itself is at the very bottom of the ESP. However, the pointed part is not in direct contact

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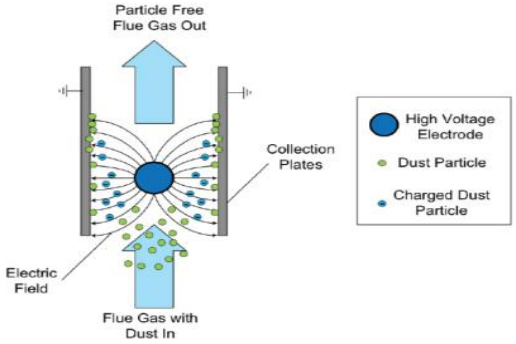
with the ground, but is above the ESP support. The dust or ash that has accumulated on the electrode will be transferred to the hopper when the steel plate removes particles from the electrode. After the hopper reaches its maximum capacity, the ash / dust will be removed through the hole at the bottom of the hopper.

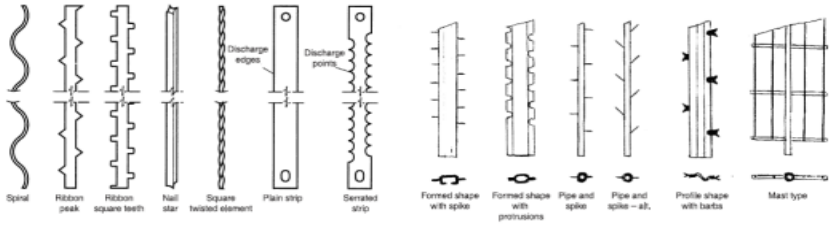
Discharge electrode

It is a component in the electrostatic precipitator which functions to provide a negative charge on the exhaust gas so that it can be captured by a positively charged collecting plate.



Figures 4. Particle Collection Process in Electrostatic Precipitator

There are various forms of discharge electrodes that have been designed and used in electrostatic precipitators, as follows:



Figures 5. Discharge Electrode

METHODS

The method used is a direct observation which is taking observation data by taking observation by taking observation data through site inspection.

The observation steps carried out are as follows:

a. Data collection
b. Determine the object of review of the problem
c. Checking the Electrostatic Precipitator (ESP) system by conducting ESP field resistance tests, rapping system inspections, heater system inspections, and taking inside wire and collecting range data.
d. Determine the appropriate solution through previous research

Some of the data needed in this study are as follows:

a. Specification*Electrostatic Precipitator*(ESP) at the Steam Power Plant (PLTU) Pangkalan Susu Units 1 and 2.

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b. Previous research as a reference for determining problem-solving.
c. Inside Field Data, Rapping system, Heating system, and Control system.

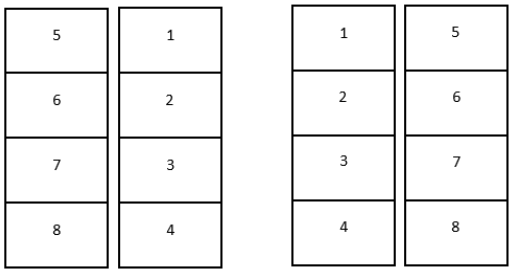
The processing of data that has been obtained from the results of data collection. Data processing is processed manually. The data processed are the efficiency of the working voltage of the electrostatic precipitator and the efficiency of the electrostatic precipitator. This aims to be able to analyze the efficiency of the electrostatic precipitator unit 2 PLN in the Pangkalan Susu. Where in calculating the efficiency, using the design standards that have been set by the manufacturer of the electrostatic precipitator. The stages are: doing an overhaul of the electrostatic precipitator unit 2 where there are findings of several things which then need to be overhauled such as inspection of the position of the collecting plate and discharge electrode, an inspection of the installation of the rapper that is not in position, temperature analysis when the electrostatic precipitator is working and setting the voltage on the electrostatic precipitator.

RESULTS AND DISCUSSION

Electrostatic Precipitator (ESP) Performance Data

From the results of field observations obtained as follows:

a. ESP Field Position



Figures 6. ESP Field Position

*b. Range Inside*between Collecting

Table 1. Sample data taking Range Inside between Collecting

Field 1		*Field 2*		*Field 3*		*Field 5*	
No	**Plate Distance (cm)**	**No**	**Plate Distance (cm)**	**No**	**Plate Distance (cm)**	**No**	**Plate Distance (cm)**
1	21	1	23	1	26	1	21
2	22	2	16	2	19	2	18
3	17	3	21	3	21	3	21
4	22	4	16	4	19	4	18
5	17	5	23	5	22	5	21
6	22	6	17	6	23	6	18
7	19	7	24	7	23	7	20
8	23	8	16	8	22	8	19
9	15	9	22	9	21	9	22
10	16	10	17	10	19	10	17
11	22	11	24	11	22	11	22
12	20	12	15	12	23	12	17
13	21	13	23	13	22	13	20
14	18	14	16	14	21	14	18
15	22	15	21	15	22	15	22
16	18	16	17	16	21	16	17
17	22	17	24	17	23	17	21
18	17	18	17	18	21	18	18
19	19.5	19	23	19	21	19	
20	20	20	15	20	22	20	

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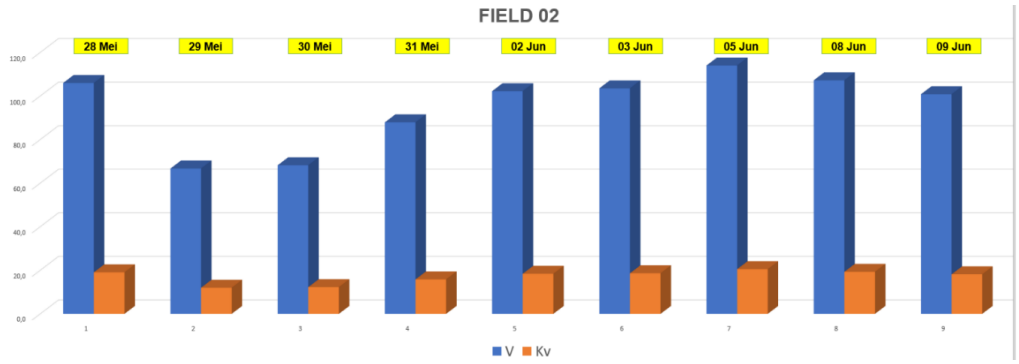
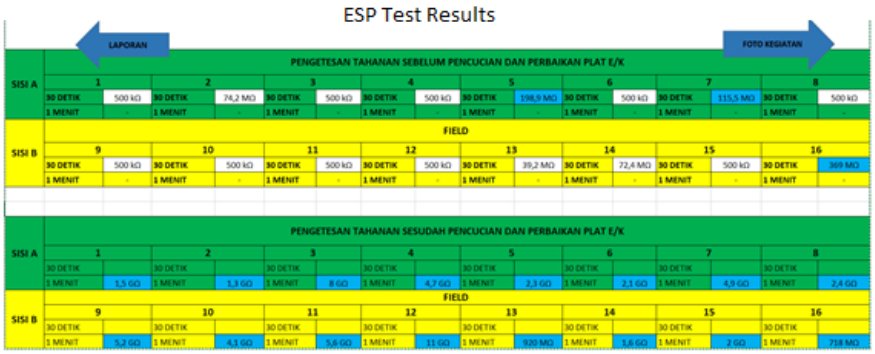
21	20	21	23	21	19	21	
22	20	22	16	22	22	22	
23	21	23	23	23	20	23	
24	18	24	15	24	25	24	
25	22	25	22	25	20	25	
26	17	26	17	26	22	26	
27	22	27	22	27	20	27	
28	17	28	17	28	24	28	
29	20	29	24	29	19	29	
30	19	30	16	30	23	30	
31	21	31	21	31	20	31	
32	18	32	18	32	25	32	
33	20	33	22	33		33	
34	18	34	16	34		34	
35	20	35	22	35		35	
36	17	36	17	36		36	



Figures 7. Performance Unit Chart

ESP Resistance Testing

Table 2. Resistant test results before and after washing and repair



Case on the Electrostatic Precipitator (ESP)

There are several cases that occur in ESP as follows:

- *Case*1
  U2 and I2 Hunting (Up and Down)
  There has been a change on the inside, namely the range between the collecting plate

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and the discharge electrode.
- Occur *swing* due to fluegas
- Accumulation of ash on *collecting*plate

- *Case*2
  U1 and U2 Normal, But I2 Decrease
  There has been a thickening of ash at the discharge electrode
  - *Rapping failure*
- *Case*3
  U1 against I1 is about 55% up, U2 goes down and I2 goes up to the maximum value. There has been a short to ground.
  - Contact between *collecting plate*and discharge electrode
  - Insulator on fire
- *Case*4
  U2 hunting (20-50 Kv for 1 second) or U1 Down (150-250)
  There has been a change on the inside, namely the range between the collecting plate and the discharge electrode.
  - Occur *swing* due to fluegas
  - *Appeal*shaft
- *Case*5
  A large spark occurs 5-15 seconds every 30 minutes or a certain time (U2 and I2)
  - There is thickening between *collecting*plate and discharge electrode (back corona event, the stack rises suddenly in a short time)
  - There is a buildup of ash that is almost touching *shaft*collecting plate and discharge electrode because it has exceeded the hopper level limit
- *Case*6
  U2 decreases, I2 increases (occurs continuously) There has been a short to ground
  - Insulator*burn*
  - Level *hopper*high touching shaft
- *Case*7
  U1 high, I1 low, I2 low Abnormal in line supply
  - The cable has low resistance
  - Part support has low resistance
  - The terminal on the transformer is problematic
- *Case*8
  *Display*blank or when the on selector breaker trips.
  - There is an abnormal cable (*controller*) from dcs
  - Module error

CONCLUSION

From some of the research procedures above, the conclusions from several cases that have been obtained in overhaul and I relate it to the ESP problem case that has been obtained from several Electrostatic Precipitator (ESP) experts, as follows:

- 90% of the problems that exist in ESP are in the*inside*ESP,

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- Every problem is closely related to other equipment which later can cause it to stop *field* the ESP,
- Problem withinside a result of supporting equipment such as heaters and rapping,
- To minimize problems withinside can monitor the graph of the performance of the ESP itself by paying attention to the points in the case described above.

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