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IDENTIFICATION OF INDUCED DRAFT FAN (IDF) DAMAGE IN BOILER WASTE GAS SYSTEM

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ABSTRACT

Induced Draft Fan (IDF) is a fan that sucks air from inside the boiler out to the chimney, producing negative pressure on the boiler, keeping the circulation of combustion air in the boiler normal. IDF is one of the main components in the exhaust gas system which serves to maintain the temperature and vacuum of the furnace in the boiler. This report will identify IDF damage using vibration indication control instruments by looking at vibration indication trending data through the Distributed Control System (DCS) in the Central Control Room (CCR). The results of the trending data will then be identified whether the vibration in Induced Draft Fan has increased, if the vibration ≥ 5.6 mm/s is declared an alarm and if the vibration ≥ 7.1 mm/s then the unit trip or must be stopped. Based on the results of research during industrial practice in Banten 2 PLTU Labuan there were 2 conditions in the IDF, namely when there was a disturbance with a height of X and Y side vibrations of 22.5 mm/s, and conditions after improvement with the height of X vibration side that is, an average of 4.2 mm/s and Y side averaging 4.1 mm/s. The high vibration is affected by the damage of several IDF components, caused by the amount of ash remaining combustion that enters the IDF which causes abrasion of the impeller blade.

Keywords: Induced, Draft, Fan, Indications, Vibration

INTRODUCTION

The Steam Power Plant (PLTU) in Banten Province has a total capacity of 4,945 MW which is divided into three regions namely Banten 1 PLTU Suralaya located in Suralaya Village, Pulo Merak District, Cilegon City, Banten 2 PLTU located in Sukamaju Village, Labuan Subdistrict, Pandeglang Regency, and Banten 3 PLTU Lontar located in Lontar Village, Kemiri District, Tangereng Regency. Banten 2 Labuan PLTU is the second steam power plant in Banten with a capacity of 600 MW. Banten 2 PLTU Labuan is owned by a subsidiary of PT. PLN (Persero), namely PT. Indonesia Power, has 2 generating units, each of which has a capacity of 300 MW. The first PLTU in the Banten area, namely the 1 suralaya PLTU which has 7 generating units with each 4 units having a capacity of 400 MW and 3 units having a capacity of 600 MW which supply national electricity needs as much as 20%, while the Banten PLTU 2 supplies only 7% National electricity needs every year and Banten 3 PLTU Lontar with a capacity of 3x315 MW supplying state electricity as much as 11%.

Based on the results of observations in the field, there are problems caused by disruption to the exhaust gas system, resulting in a considerable impact, one of which is a reduction in production of around 100 MW from a total of 300 MW per unit. Because the system at the Banten 2 PLTU Labuan has a closed system (balance draft), the heat energy of the remaining burners or exhaust gas in the combustion chamber must be utilized optimally.

Therefore, the exhaust gas system is needed to suck and manage the heat from the combustion residue, so that the remaining combustion heat is released into the atmosphere which can damage the environment because the temperature can reach 300 degrees Celsius. and serves to maintain a vacuum in the furnace. The furnace pressure must be smaller than the atmospheric pressure which is around (-30) Pa. During the past 1 week there were problems in the exhaust gas system caused by damage to induced draft fans as one of the main components in the exhaust gas system which caused a reduction in production of unit 2 to around 100 MW from a total of 300 MW.

Induced Draft Fan

Induced Draft Fan is a fan that sucks air from inside the boiler out into the chimney, producing negative pressure in the boiler and maintaining air circulation in the boiler Khakam & Hendriawan (2010) and Nurtanto, Sari, Ramdani, & Fawaid, (2018). Each unit has two IDFs for each side, namely side A and side B, in operation IDF must continue to work to maintain vacuum pressure on the boiler.

According to Nurul, K. M., & Akhmad, H. (2010). Induced Draft Fan (IDF) functions to maintain the temperature and pressure of the vacuum furnace in the boiler. IDF is used to suck the gas and combustion ash in the boiler for further disposal through the chimney. Fan ID has a workload of 50% of the Unit's total workload. So, if one ID Fan trip then the unit load will derating 50% because it affects the vacuum pressure of the furnace pressure boiler.

Induced Draft Fan is equipped with instrument and control equipment which functions as an indication of monitoring important parameters so that the operation of induced draft fan is reliable and safe to operate. Instrument instruments on induced draft fan include the appointment of vibration parameters on induced draft fan monitored in the Central and Room Control Room (CCR) through the Distributed Control System (DCS). These parameter limits are listed in the following table:

Table 1. Indicating Vibration Indications

Number KKS BVE	Name	Alarm (mm/s)	Trip (mm/s)
X0HNC11CY001X	Bearing fan vibration X	≥5,6	≥7,1
X0HNC11CY001X	Bearing fan vibration Y	≥5,6	≥7,1

If the vibration is at an altitude of ≥ 5.6, the IDF is declared alar, whereas if the vibration reaches a height of ≥ 7.1 mm/s then the IDF must be stopped or trip while the vibration standard used is ISO 10816-13.

This vibration indication indicator control instrument used by Banten 2 PLTU operators as a reader in identifying Induced Draft Fan (IDF) damage through tranding data that can be seen through DCS.

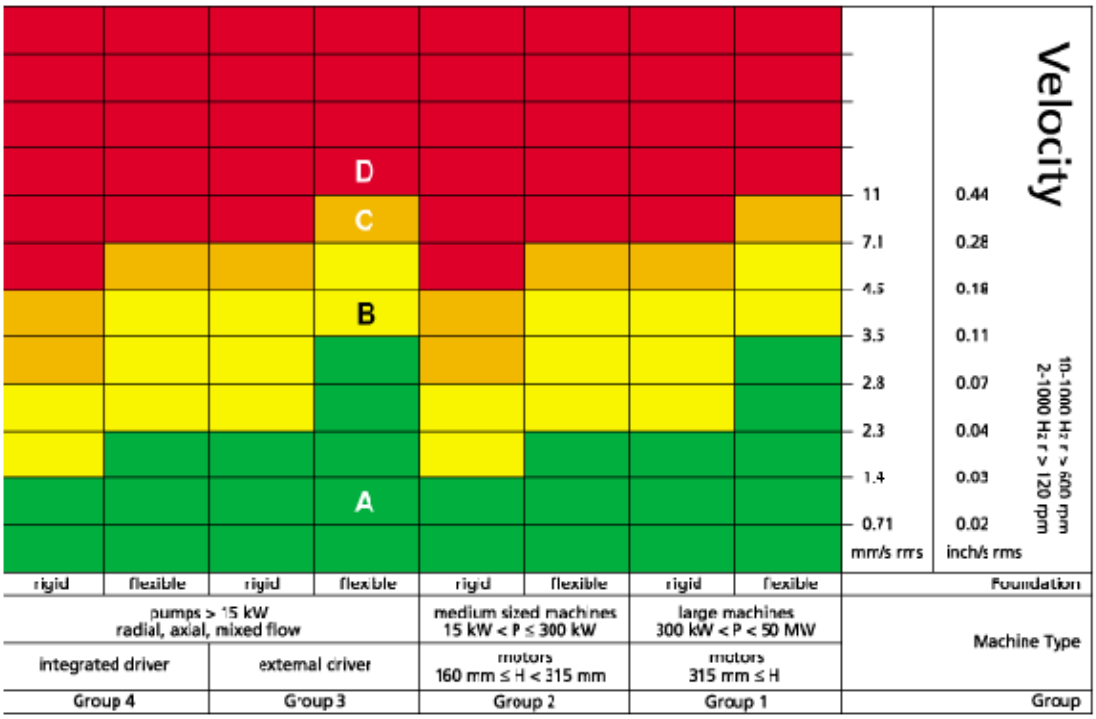

Figure 1. ISO 10816-3 Vibration Standard
(Source: ejurnal3.undip.ac.id)

Because induced draft fan motors have an output power of 2100 KW with a rigid type base plate, so the standard vibration of ISO 10816-13 is included in the Group 1 category, where if the vibration height is more than 7.1 mm/s then the vibration is in the Setyawan (D) category , HP, & Suryadi, D. (2018).

RESEARCH METHODOLOGY

The method used in this study is to use the literature study method, observation and check list to find out the indication of vibration parameters every time through the tranding data in the Central Control Room (CCR).

The data collection procedure is by checking trending data in the Distributed Control System (DCS), by looking at the height of the vibration parameter based on time.

RESULT AND DISCUSSION

Result

The results of the study were identification of induced draft fan damage in boiler unit 2 gas system PT. Indonesia Power PLTU Banten 2 Labuan is as follows:

Table 2. IDF 2B Vibration Parameters When Damage Occurs

No	Day	IDF indication vibration Unit 2B (mm/s)		Normal conditions		Info
		Side X	Side Y	Yes	No	
1	Day 1	XB = 4,5	YB = 5,3		✓	Alarm
2	Day 2	XB = 4,5	YB = 5,1		✓	Alarm
3	Day 3	XB = 4,8	YB = 6,3		✓	Alarm
4	Day 4	XB = 5,0	YB = 6,5		✓	Alarm
5	Day 5	XB = 5,3	YB = 6,7		✓	Alarm
6	Day 6	XB = 5,6	YB = 7,6		✓	Alarm
7	Day 7	XB = 22,5	YB = 22,5		✓	Trip

Information:
XB = Vibration bearing fan side X IDF 2B
YB = Vibration bearing fan side Y IDF 2B

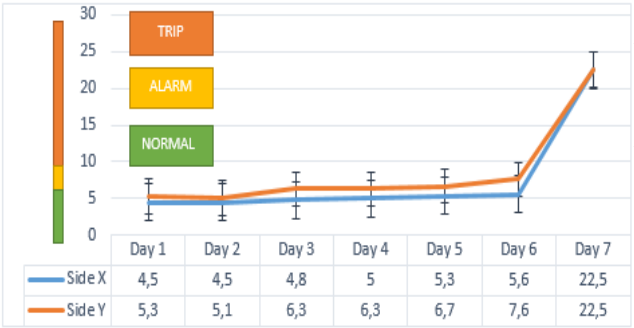

Figure 2. Vibration Indication Parameter Chart

Discussion

Based on the table and graph of the vibration parameters above in induced draft fan 2B within 1 week from day 1 to day 6 of high vibration for side X which is an average of 4.9 mm/s and side Y height of average vibration reaching 6.2 mm/s, the indication of vibration at this altitude indicates an alarm indication, on day 6 on the Y side the vibration is on the indication of trip, but the operator based on the results of the daily meeting has not decided to stop the unit. While on the 7th day the unit is stopped or trip, because it experiences an increase in vibration reaching 22.5 mm/s. Based on the control instrument equipment indicating vibration indication if the height of vibration side X or Y side is, 65.6 mm/s then the condition is stated in an alarm state, whereas if at an altitude of ≥7.1 mm/s then the unit trip.

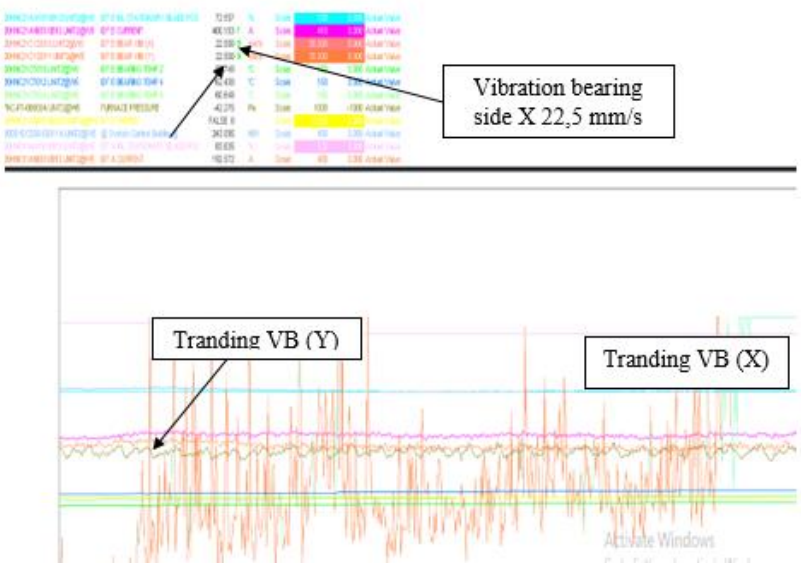

Figure 3. Tranding Indicator for Vibration

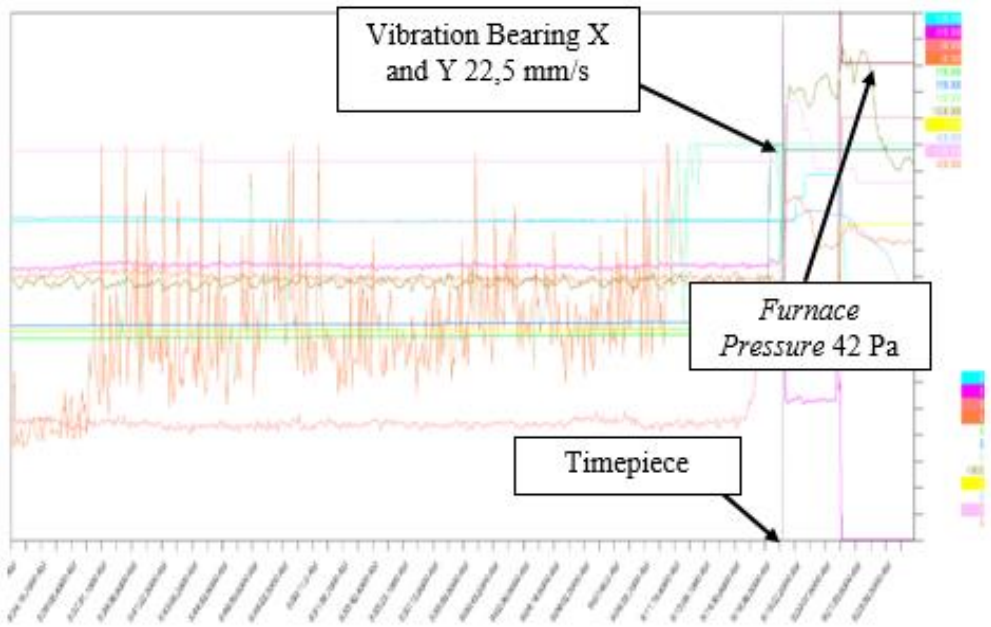

Figure 4. Vibration Parameters by Time

Then based on the Distributed Control System (DCS) data above the IDF 2B vibration on the 7th day of the X side which is shown by the brick red color graph and the Y side shown by the Pict color graph, the increase is very significant with a height of 22.5 mm / s which almost reaches the maximum limit of 30 mm / s. In addition to the breaking signal indication (Signal Bad), the Ampere rises for 2 seconds from 213 A to 400 A, the Furnace Pressure rises to 42 Pa which is shown by the brown chart, it should be at -30 Pa. So, IDF 2B was stopped from the Central Control Room (CCR) because it was based on information from local high vibration and broken damper isolation.

1. History of Damage to Induced Draft Fan Unit 2B Components Based on Inspection Results

   From the results of the examination on IDF 2B, there was damage to a) insulating the outer and inner cover damaged, b) static and dynamic blade, c) support main bearing disengaged, d) support playing bearing assembly detached and torn at the base plate, e) bolt support coupling cut off entirely, namely 3 pieces. Static and dynamic blade IDF 2B that have been damaged have been repaired in OH in 2017.

The following is a history of damage that occurred in the induced draft fan component based on identification through the indicator control instrument indicating vibration and the results of the inspection directly after the IDF was demolished.

a. Cover of Outer and Inner Insulation Damage

Figure 5. Damaged Cover Insulation

Damaged insulation cover may be due to the release of static basic blade and high vibration of 22.5 mm/s for 45 minutes causing main bearing to exit its position.

b. Static Blade Regardless of its Position

Figure 6. Damage to Static Blade

Static blade detached from its position, the fixing bolt was cut off and part of the casing plate was damaged due to thinness which was 15 mm to 5 mm.

c. Broken Blade Impeller

Figure 7. Damage to the Blade Impeller

The condition of the blade impeller is completely bent and broken 4 pieces, bent and broken due to changes in the position of the bearing so that the blade touches the casing, so that the trigger of vibration increase to 22.5 mm/s.

d. Support Main Bearing Tear

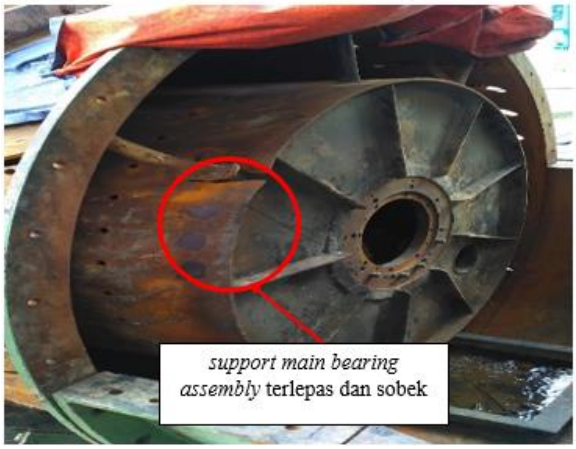

Figure 8. Damage to the Main Bearing Assembly Support

The support conditions for the main bearing assembly are detached and torn on the base plate, so the possibility of causing the main bearing housing to drop or out of position causes the impeller blade to touch the casing and bend.

e. Disconnected Support Coupling Bolt

Figure 9. Damage to the Support Coupling Bolt

The condition of the bolt support coupling is cut off from its position, possibly due to the shaft and coupling down, support is bent and dragged by the impeller blade so that it is cut off.

2. Causes of Induced Draft Fan Damage

From the results of the identification and discussion above it can be concluded that the high vibrations that occur in IDF 2B are due to the abrasion of the static and dynamic blade IDF 2B. This is in accordance with the analysis of the vibrational spectrum that there is a blade pass frequency indication (problem in the blade). Abrasion that occurs in static and dynamic blade is caused by:

a. Abrasion caused by the high amount of ash in the exhaust gas, this is due to the 8 ESP transformers on the IDF 2B side only 3 operating. With the large amount of ash in the exhaust gas causing an abrasion rate that occurs in static and high dynamic blades. So that the remaining ash is not filtered properly in ESP and causes a large amount of ash to enter the IDF. As a matter of fact, the incoming ash is only 0.16%, because ESP has the ability to filter the remaining ash from burning up to 99.84%. Other causes that cause damage to IDF equipment are as follows:

1) The number of blades on the impeller is added from 13 to 19 so that it is not in accordance with the standard.
2) X and Y side bearing vibrations increased from 5 mm to 22.5 mm/s.
3) Ampere IDF 2B high 400 A (for 2 seconds) initially 213 A.
4) The increase in sudden vibrations to the level of 22.5 mm/s rms is likely due to the breakdown of a blade, 45 minutes of high vibration causing detachment and damage to support stiffness of main bearing.
5) The discharge of the static blade is likely due to a broken blade impeller.
6) The release of support plays the bearing and static blade causing the impeller to drop and the touch blade to bend.
7) The drop of the shaft causes the support coupling to bend and be dragged by the impeller blade and break up three pieces.
8) High vibration > 7.1 mm/s in category (D) based on ISO 10816-13 vibration standards.
9) Weakening support for playing bearings due to erosion and eroded weld seam.

Meanwhile according to Yustika, F., Putri, K., Nainggolan, B., & Jannus, P. (2017). Over vibration is caused by an indication of unbalance, so that balancing problems must be overcome. In addition, high vibration can be

caused due to bearing and misalignment damage. This can be seen from the values of X and Y side vibrations which reached 22.5 mm / s. Due to the high vibration, the fan cannot function.

3. Impact of Induced Draft Fan Damage

The impact of IDF damage can be said to be quite fatal because it will affect the production, where the performance of the boiler to produce electricity will be reduced by around 75-100 MW from 300 MW. Another impact is that it requires substantial repair costs if there are components that are damaged.

CONCLUTION

From the above discussion it can be concluded below is the method for identifying Induced Draft Fan damage in the boiler exhaust gas system, one of which is by using a vibration indication control instrument that can be seen from the data trending Distributed Control System (DCS) with parametric boundary specifications, namely ≥ 5.6 mm/s to indicate alarm and 1 7.1 mm/s to indicate trip. While the ISO 10816-13 vibration standard is in the Group 1 category, because the induced draft fan motor has an output power of 2100 KW with a rigid type base plate. So, if the vibration height is more than 7.1 mm/s then the vibration is in the category (D) Setyawan, H. P., & Suryadi, D. (2018). Based on the results of observations in the field, there is a problem of increasing vibration in induced draft fan unit 2B which reaches 22.5 mm/s. Thus, the unit was stopped by the operator through the Central Control Room (CCR), because it was based on information from local high vibrations and the isolation of broken dampers. The high vibration is caused by damage to several induced draft fan components, including: a) isolation of the outer and inner cover damaged, b) static and dynamic blade, c) support main bearing disengaged, d) support for playing bearing assembly detached and torn on the base plate, e) the bolt support coupling is completely cut off, which is three pieces.

The damage to the IDF component was triggered by the non-operation of 5 Electrostatic Precipitator (ESP) transformers from the 8 units of the unit. So that ESP cannot filter the remaining ash burning maximally, which should be able to filter ash reaching 99.84%.

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