**COST BENEFIT ANALYSIS**

**FOR**

**THE INSTALLATION OF AUTO-LUBRICATION SYSTEM PROJECT**

**ON SELECTED COOLER FANS AT OKOLOMA INTEGRATED OIL & GAS PLANT**

**APRIL 2018**

Okoloma Integrated Oil & Gas Plant is the primary gas supplier to the Afam VI Power Plant. In processing the supplied gas, several coolers are used to ensure the gas is conditioned to such a state as required by the customers. Some key cooler fan systems in use at the Gas Plant are the Inlet Cooler Fans and the Flash Gas Compressor After-Cooler Fans.

In recent past, several failures have been observed on the cooler fans as well as the cooler fan motors of the Flash Gas Compressor (K-5601) in the facility. This has the potential to trip the compressor due to high temperature of the process gas leading to increased flare; tantamount to environmental pollution and wastage of gas that could have been recycled to the plant’s inlet for re-processing. With legislations/regulations becoming stringent on the limit of tolerable flare volumes as well as the strategy of control on greenhouse gas (GHG) emission of Royal Dutch Shell, any effort in ensuring the availability of the FGC (whether through the ensuring the integrity of the cooler fans as obtained in this case) is a right step in the right direction.

There are several failure modes identifiable for the Cooler Fans such as belt failure, bearing failure, motor winding failure etc. However, the case study for this project is to address the failures associated to bearings either on the fans or the motors driving them. To analyze the benefit that may be derived from this project, CMMS (SAP) maintenance history download was made for all Cooler Fans in the Plant. The history downloaded was for 2017 only; hence the analysis is set to determine what savings could be made per annum by the implementation of the project.

From the download, a total of 159 maintenance activities were carried out on the coolers within the period under review. Of this, 136 were executed as preventive maintenance while 23 were corrective maintenance carried out to repair/address a fault identified on the fans. This accounted for over 14% of the total activities carried out on the equipment; with an average of about 2 failures per month recorded on these coolers. Find a brief summary in the table below:

|  |  |  |  |
| --- | --- | --- | --- |
| **S/N** | **Activity Type** | **Frequency** | **Percentage (%)** |
| 1 | Preventive Maintenance (72FP) Activities | 136 | 86 |
| 2 | Corrective Maintenance (72FC & 72RE) Activities | 23 | 14 |
|  | **TOTAL** | **159** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Order | Order Type | Basic start date | Description | Estimated costs | Functional Location |
| 22434206 | 72FC | 20-Mar-17 | TROUBLESHOOT AND RECTIFY FAULT ON EM-110 | 760.00 | NG.OKOG1.E-1101-EM-1101C |
| 22498555 | 72FC | 3-Mar-17 | Install and Terminate Power cable on EM- | 3,344.00 | NG.OKOG1.E-5603-EM-5603A |
| 22514350 | 72FC | 11-Jan-17 | Cut fan belt on EM5601A (FGC 1st stage) | 0.00 | NG.OKOG1.E-5601-E-5601FAN |
| 22514351 | 72FC | 11-Jan-17 | Cut Belt on FGC 1st Stage fan EM5601B | 0.00 | NG.OKOG1.E-5601-E-5601FAN |
| 22514777 | 72FC | 16-Mar-17 | RE-INSTALL REPAIRED FGC MOTOR EM5603B | 1,672.00 | NG.OKOG1.E-5603-EM-5603B |
| 22515352 | 72RE | 31-May-17 | EL-2025 REPAIR WORK ON FGC FAN MOTOR EM5 | 0.00 | NG.OKOG1.E-5603-EM-5603A |
| 22515851 | 72RE | 1-May-17 | EL-2024 REPAIR OF OKGP FGC FAN MOTOR EM5 | 760.00 | NG.OKOG1.E-5603-EM-5603B |
| 22536775 | 72FC | 19-Sep-17 | Replace Cut Fan Belt on E-5603D | 10,130.92 | NG.OKOG1.E-5603-E-5603FAN |
| 22548952 | 72FC | 1-May-17 | Replace belt on FGC Fan Cooler E5601A | 980.40 | NG.OKOG1.E-5601-E-5601FAN |
| 22555738 | 72FC | 12-Jun-17 | Replace Cut Fan Belt on FGC Fan Cooler E | 1,064.00 | NG.OKOG1.E-5601-E-5601FAN |
| 22557550 | 72FC | 6-Jun-17 | Rectify high Noise on EM-5601A -Aftercoo | 912.00 | NG.OKOG1.E-5601-EM-5601A |
| 22573266 | 72FC | 17-Jul-17 | Replace Cut Belt on FGC CoolerFan E5601B | 790.40 | NG.OKOG1.E-5601-E-5601FAN |
| 22575223 | 72FC | 24-Jul-17 | Cut Belt on FGC 1st Stage Fan E5601A | 1,086.80 | NG.OKOG1.E-5601-E-5601FAN |
| 22581359 | 72FC | 9-Aug-17 | T/shoot EM-5603B failed to run on demand | 1,900.00 | NG.OKOG1.E-5603-EM-5603B |
| 22584932 | 72FC | 12-Sep-17 | Install & Terminate Power cable on EM-56 | 1,444.00 | NG.OKOG1.E-5603-EM-5603B |
| 22584939 | 72RE | 24-Aug-17 | Bearing Failure on EM-5603B -FGC OKOG1 | 0.00 | NG.OKOG1.E-5603-EM-5603B |
| 22595637 | 72FC | 9-Dec-17 | Replace worn out belt on E-5603B | 1,520.00 | NG.OKOG1.E-5603-E-5603FAN |
| 22597311 | 72FC | 2-Oct-17 | Replace worn out belt on E5605B@ FGC Oil | 1,216.00 | NG.OKOG1.E-5605-E-5605FAN |
| 22599474 | 72FC | 18-Oct-17 | Rectify unusual noise on EM-5601B | 1,824.00 | NG.OKOG1.E-5601-EM-5601B |
| 22601418 | 72FC | 11-Oct-17 | Replace Cut Fan Belt on FGC E-5601A | 942.40 | NG.OKOG1.E-5601-E-5601FAN |
| 22607550 | 72FC | 4-Nov-17 | Replace belt on E5601B@ FGC cooler | 623.20 | NG.AFA.OKOG1.GC.E-5601 |
| 22607551 | 72FC | 6-Nov-17 | Replace Cut fan belt on EM5601A | 638.40 | NG.AFA.OKOG1.GC.E-5601 |
| 22624634 | 72FC | 26-Dec-17 | EM-5606A COOLER FAN UNUSUAL NOISE | 684.00 | NG.OKOG1.E-5606-EM-5606A |
|  | **TOTAL** | | | **32,292.52** |  |

As shown in the table above, of all the 23 corrective maintenance activities carried out on the coolers, 22 of them were executed on FGC Coolers (Unit 56). As such, this presents an area of high focus. The total cost associated with the maintenance as shown in the table was **$32,292.52** in the year 2017. Of these, at least **$3,420.00** are directly attributable to bearing failures (highlighted in red) with another **$6,460.00** (highlighted in yellow the table above) having possibilities of failures related to bearing-induced faults.

Also within the year 2017, there were a total of 136 preventive maintenance activities carried out on these coolers. These preventive maintenance activities resulted into a total cost of **$177, 254.92**. A key element of these preventive maintenance activities is largely related to the lubrication of the bearings on both the fans and motors. Hence, installing an auto-lubrication system can significantly reduce the man-hour resources required in executing these activities a significant savings in the preventive maintenance cost. It is comfortable to assume a savings of about one-quarter of the time used in executing these maintenance activities which translates to nothing less than **$20,000.00** savings per year.

In conclusion, it can be deduced from the foregoing that other than improved efficiency that could be obtained as a result of the implementation of this project, the potential for cost savings from both preventive and corrective maintenance activities post implementation of this project. The minimum savings that could be realized from this initiative can be comfortably put at nothing less than **$25,000.00.**