

1)

b) It must be clear when looking at EL & I equipment of which are safety critical. This equipment can still be affected by the same degradation as mechanical equipment like corrosion, erosion, fatigue etc.

There are 3 steps to evaluate the aging of electrical equipment;

- * An audit programme is in place to ensure all elements of a management system related to the controlling of aging plant and equipment.
- * An operational inspection regime which highlights the need to identify aging mechanisms such as corrosion, vibration, exposure to elements and identifying dead legs
- * Clearly developed corrective action plans with closeout tracking systems.

Tom Blizard - 1402861

1)

a) Figure 1 shows general corrosion as you can see there is a uniform loss of wall thickness which is observed over ~~the~~ the entire surface area of the metal exposed to the same conditions. Externally, general corrosion is easily identified at exposed structures by the distinctive orange coloured iron oxide corrosion product deposits seen on the surface of uncoated carbon steel.

Figure 2 shows corrosion under insulation. If there are no damaged weather proofing visible then there are several causes. These are:

- * Surfaces exposed to frequent hot and cold cycles
- * Cold temperature equipment with parts that project through the insulation
- * Interfaces between hot and cold equipment
- * Horizontal pipework especially where there are joints and branches extending from the base.

The corrosion under the insulation could be from moisture trapped under the insulation causing general corrosion.

2)

a) Consumption data is the first component. This data can come from meters, delivery and stock level figures and proxy measures like run hour counters or ammeters. Three critical factors are that the data are synchronised as close as possible with assessment intervals, the repeatability is more important than the accuracy and meter reading should be done internally.

Driving factor data is second. This can include degree day statistics, production figures, mileages and the hours of darkness. This data needs to be synchronised with the assessment intervals and where production data is used, they should be gross volumes because scrap uses as much energy as salable product.

Finally, methods of calculating expected consumption.

2)

b) An energy audit is a feasibility study to establish and quantify the cost of various energy inputs to and ~~and~~ flaws within a facility over a period of time. The goal of an energy audit is to identify viable and cost effective measures which reduce operational costs.

Energy audits involve collecting data from energy invoices and meters, and undertaking surveys of the plant, equipment and buildings, as well as information from managers and staff. The audit should identify ways of enhancing an organisations efficiency and a decrease in its maintenance costs.

Energy audits should help resolve any occupant comfort issues. An energy audit should also be the foundation on which any energy management programme should be built.

An energy audit can help manage energy usage by identifying energy management opportunities, which when implemented will result in financial benefit. These financial benefits aren't dependant on capital investment and many situations can be achieved through low cost measures.

These measures are:

- * Changing energy tariff
- * Re-scheduling production activities to take advantage of preferential tariffs.
- * Good housekeeping policies to avoid wasteful practices.

2)

b) Continued..

- * Investment in small cost items like thermostats and time switches
- * Adjusting existing controls so plant operation is the same as actual requirements of the building or manufacturing process.

4)

a) A 3-phase AC motor is self starting due to induced rotating magnetic field in the rotor. The similarities between AC and DC are that both need an auxiliary means or equipment to start the single phase induction motor.

b) An electronic AC drive is to change a fixed incoming line voltage (V) and frequency (Hz) to a variable voltage and frequency output. The output frequency determines how fast the motor rotates and the volts and hertz will determine the torque. An advantage of this drive is the ability to operate an AC motor in bypass mode. This means that when a drive is not functioning, the motor can still be operating. The motor will operate at full speed because of the line power input, but the system continues to operate with little or no downtime.

c) Power transmissions require ~~flexibility and elasticity~~ ~~flexibility and elasticity~~ in its mechanical properties but a disadvantage of using belts and pulleys is that they wear over time. Systems which overcome the above issue are chain and sprocket drive systems which is a compact design and less wear and also a gear drive system as gears are robust, durable and efficient.

4)

d) Helical spur gears use teeth that are set at an angle to the gear axis and can engage more gradually between the teeth of the gear, hence why this gear acts smoother and quieter than spur gears when in operation.

Due to angular teeth it also has greater tooth strength and a higher load capacity than a spur gear. Helical gears are used in high speed or high loading like vehicle transmissions, washing machines, fuel pumps and mills.

A disadvantage of helical gears is they produce an axial thrust that needs to be accounted for due to the engagement.

Spur gears are the most common and utilize straight teeth on the outer diameter, this mates to other spur gears which are mounted on parallel shafts. Many spur gears are used together to create very large gear reductions also known as a gear train.

Every time a gear tooth engages with another the engagement makes a noise. This gets louder at higher speeds. Spur gears are used for a wide range of speed ratios. These gears are used in clocks, pumps, watering systems and power plant machinery.

4)

c)

i) Compound gears: $A \& B - \omega_A = \omega_B$
 $D \& C - \omega_D = \omega_C$

What is the speed output of C.

We know

$$\omega_B = \omega_A \text{ and } G_{CD} = \frac{t_C}{t_D} = \frac{\omega_D}{\omega_C}$$

$$\therefore G = \frac{\omega_D}{\omega_C} = \frac{t_A}{t_B} \times \frac{t_D}{t_C}$$

$$\text{Now, } \frac{\omega_D}{\omega_C} = \frac{80}{20} \times \frac{60}{20} = 12.$$

$$\text{So, if } \omega_A = 100 \text{ RPM}$$

$$\omega_C = \frac{100}{12} = \underline{8.33 \text{ RPM}}$$

ii) Overall gear ratio, $G = G_{AB} \times G_{DC}$

$$G = \frac{t_A}{t_B} \times \frac{t_D}{t_C} = \frac{80}{20} \times \frac{60}{20} =$$

$$G = \underline{12/1} \text{ or } \underline{12:1}$$