

## BACKGROUND

# REGREASING WICKET GATES

### 1. INTRODUCTION

A lubricant for the bearings is necessary but it is only prudent to use the right amount. The purpose being to ensure that the equipment will continue to operate as intended but also to make sure that not too much grease is being used. The latter are not necessarily driven by costs because the amount of grease is likely less than a thousand dollars per unit per year which is much less than the cost of repairs and possibly outages if the bearings are not greased. On the other hand, using less could have some environmental benefits even though there are apparently few specific regulations pertaining to the discharges of grease as part of routine maintenance activities. But, using too little has no benefit.

In any case, the amount of grease is very small and periodic grease relubrication is not known to form visible oil sheens. The presence of such sheen is one of the criteria reportedly used by the EPA as to what is a reportable spill. Further, the percentages of the hydrocarbons in the water are calculated to be orders of magnitude below the limits for oil and grease for other applications. As an example, the discharge water limit in some jurisdictions is 15 ppm for oil in water which can be increased to 150 ppm for a vegetable oil. In comparison, the amount of grease from the wicket gates is thousands of times less. Further, the main constituent of VSG is a biodegradable vegetable oil so that the "limits" can often be on the higher side. The natural oil in VSG has the added advantage of being renewable and hence can be part of sustainable development efforts. In addition, the vegetable oil used does not tend to form the rainbow sheens on the water which can be highly visible.

One other important point is that not all the grease supplied by the greasing system ends up in the water. Depending on the actual design considerable amounts will be used for the regulating mechanism, the thrust bearings and the upper guide bearings. These should not be directly exposed to the water. In addition, it is expected that at the most only half of the grease being delivered to the wicket gate bearings will be lost. This is the grease on the water side and hence pressure side while the rest should go into internal spaces. Some designs also have a groove in the bearing and a piped collection method for this grease. Consequently, it is estimated that 80-90% of the grease supplied will be retained.

In any case, the grease lost through the bearings should be considered in relation to other sources of hydrocarbons such as mineral oil solvents, main bearing lubricants, transformer fluids, leaks/drips from off-road equipment, outboard motors, chain saws, oil-based paints, vehicle exhaust emissions and the like. This being said, it is only prudent to use a better grease such as VSG and to use it in moderation.

## **REGREASING WICKET GATES**

### **2. ADVANTAGES OF GREASE**

First, it is considered better to apply slightly too much rather than too little because of the consequences of subsequent failures. This is very important because proper functioning of the wicket gates can be critical to prevent overspeeds and to the economic operation of the turbines. Also, very little grease is actually being lost and the grease in the wicket gate bearings serves many important functions. These include the following;

1. To lubricate the bearings so that the coefficient of friction and therefore the torque/forces required for movement are not excessive.
2. To provide a seal to keep silt out of the bearings to prevent binding.
3. To provide a water seal to control in-leakage.
4. To provide corrosion protection for the steel journals.

In view of the above the proper lubrication and use of the right grease are essential.

### **3. REGREASING FREQUENCY**

Some original grease recommendations were apparently based on a Trabon calculation method dating from at least 1971. In addition, these seem to have been only for base loaded stations because the regreasing frequency was just dependent on the head. The higher the head the more frequent the greasing with the intervals ranging from every three hours to every six hours. This would seem excess for units that are not used frequently or where the wicket gates are seldom operated. The reason being that the movement of the gates and hence the rotation of the journals in the bearing is one method whereby grease can be lost. The other factor is water washout which will be largely dependent on the water velocity at the exposed end of the bearing and on the characteristics of the grease.

Some operators have reduced the frequency to weekly or to before the wicket gates are operated. However, it is not known whether this has had a negative affect. It has also been reported that a few have taken the decision to stop using grease all together. The rationale is not clear but the consequences, which might not be apparent for a few months or even years, will be costly and irreversible.

It is very unlikely that they can just start regreasing again because the grease lines will likely be plugged and there may be considerable damage to the bearings and/or to the steel journals. There could even be damage to the regulating mechanisms because it is not unusual for the levers to be distorted when the forces are too high.

## **REGREASING WICKET GATES**

In addition, the subsequent loss of control might have safety and regulatory implications especially for automated stations. Consequently, whatever the perceived benefits, a decision to stop greasing should be considered carefully in view of possible personal injuries or damage other than to 'just' the equipment.

### **4. RELUBRICATION CONSIDERATIONS**

The thickener technology for VSG is considerably better than that of 20-30 years ago when the recommendations were last prepared. VSG has many more desirable performance characteristics including the following;

1. VSG 'thickens' up in the presence of water so that there should be less water washout. The result being that replenishment can possibly be less often.
2. VSG can provide excellent corrosion protection for steel surfaces so again it should be possible to replenish it less often and still prevent rusting of the steel journals.
3. VSG has very little oil separation or oil bleed so that it should be less susceptible to grease line plugging when the regreasing frequency is reduced.
4. VSG is an extreme pressure rated grease so that a bit less should still provide adequate wear protection for the bearings.

### **5. FUTURE ACTIONS**

While it is expected that less VSG could be used and used less often, it is not yet possible to be more definitive. Plus, because VSG is considered 'readily' biodegradable and less harmful, the environmental implications of the greasing could be less significant.

However, comments on this document and feedback on actual regreasing practises would be greatly appreciated. Then, as additional information becomes available it will be brought to the attention of our customers with the intention of developing some sort of consensus.

The original equipment suppliers could also be encouraged to review their maintenance recommendations to take into account the improved performance of some of the newer greases.