OPERATING AND MAINTENANCE PROCEDURES

FOR

RETURNING SUBMERGED GEAR DRIVES TO TEMPORARY SERVICE

Provided by

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Why Submerged Gearboxes Need Emergency Service

When a gear drive is submerged in water, the primary damage to critical components (specifically rolling element bearings and gear elements) occurs when those critical components are exposed to the atmosphere, which accelerates the corrosion process. When the gear drive is submerged, corrosion can only occur at a relatively slow rate based on the oxygen content of the water. However, when the gear drive is drained of all water and not immediately and properly serviced, exposure to the atmosphere can result in corrosion damage within a very short period of time. This condition elevates the risk of premature operational failure to unacceptably high levels.

Corrosion damage can be incurred in as little as 24 hours under certain atmospheric conditions: high humidity, high ambient temperature, high night-to-day temperature differentials, highly corrosive environment, i.e. salt water contamination. The step-by-step emergency procedure outlined below, if followed immediately after the gear drive is drained of contaminated water can render the unit operational for a significant period of time before unit rebuild is required.

Step-By-Step Procedure

1. Immediately upon draining the gear drive, remove all inspection covers and thoroughly flush the gear drive with hot (150-180 degrees F), fresh water. If available, deionized water is the optimal choice and the unit should be continuously flushed until acceptable levels (.02 mg/25cm3) of chloride are obtained. The primary consideration here is to limit accelerated corrosion damage that occurs when the gear drive's critical components (bearings, gear elements and housing internal surfaces) are not coated with oil and are exposed to the atmosphere or chlorides contained in the water.

2. Immediately following the fresh water flush, flush the unit again with a low viscosity flushing oil. There are several flushing products on the market that are relatively low viscosity products that will penetrate close tolerance components like rolling element bearings, and remove water and debris as the fluid is circulated throughout the unit. Some of these products also include additives that actually absorb water and remove it during the flushing process.

3. During both water and flushing oil processes, maximum exposure of the flushing fluid to all gear drive critical surfaces and internal housing areas is required. Completely filling the gear drive with flushing fluid and immediately draining the fluid is the best way to get maximum benefit from the flushing process. If this is not feasible due to gear drive size or location then the gear drive internals should be thoroughly lanced through inspection ports. When lancing, do not direct lance at RTD wires or at hydrodynamic bearings (sleeve type Babbitt bearings). Direct impingement of flushing fluid under pressure on all accessible rolling element bearings, gear elements and internal housing areas should be accomplished.

4. During the flushing process, the gear drive input shaft should be slowly rotated at regular intervals to permit the draining or lancing operations to dislodge any debris or moisture pockets that might be trapped in the gear mesh and/or in rolling element bearings.

5. In the event that flushing oil is not immediately available, the unit should be flushed with fresh or deionized water and then submerged in fresh or deionized water. This will prevent any rapid corrosive activity due to metal surfaces being exposed to the air. At such time that flushing oil is again available, repeat steps one and two above.

6. The gear drive lubrication system must also be cleaned and flushed in a fashion similar to the gear drive. All water-oil coolers, unit piping, relief valves, pumps, motors and filters should be either disassembled, cleaned and reassembled or replaced as required. All electrical equipment including electric motors, switches and any other electrical devices should be either replaced or serviced in accordance with equipment manufacturer's recommendations to ensure safety of operation.

7. Once all cleaning procedures are accomplished, the gear drive should be operated as soon as is practical. Prior to operation, lubrication oil should be circulated through the unit and the unit lubrication system until the filter elements remain clean since last inspection. If a centrifugal oil purifier is available, circulating the new oil charge through the purifier will aid in the removal of any residual water and/or debris that might be dislodged during the flushing or oil circulating processes. After the lubrication oil shows clean in the filters, acceptable minimal levels of both water and chloride contents should be verified by either taking an oil sample or replacing the oil charge that was utilized during the oil circulating process. If the chloride content level is above acceptable minimum levels, subsequent gear drive operation at normal operating temperatures can result in accelerated metallic component corrosion.

8. Once the system is operational, the unit should be operated at the lowest possible speed and load conditions, depending on the nature of the prime mover. Any noted unusual noise or vibration will indicate that significant damage has been done and the unit should be shut down immediately and properly reconditioned by a qualified repair facility. During initial operation, all regularly monitored parameters (oil pressures, oil inlet and outlet temperatures, bearing oil temperatures, vibration levels, etc.) should be monitored and compared to previously recorded parameters taken under similar operating conditions. If there is no significant divergence in previous and current parameter magnitudes, the gear drive can be operated until such time that the gear drive can be removed from service and properly inspected and overhauled. This work should be scheduled at the earliest feasible opportunity.

Gear Drive Operations After Submersion

It should be understood that this procedure is intended to be an emergency action to be employed when gear drive operation is required in an emergency situation. Corrosion damage to critical gear drive components will limit the useful operating time of the gear drive. As an example, corrosion damage to rolling element bearings will significantly reduce the calculated B-10 bearing life. Similarly, corrosion damage to gear teeth can significantly reduce the load transmitting surface area of the gear teeth. An effective overload of the remaining tooth surface areas could result in some form of overload damage or progressive wear.

Finally, during operation following unit flooding and prior to unit overhaul, gear drive operation should be closely monitored to ensure that premature bearing or gear element degradation is not occurring. Periodic condition monitoring (vibration monitoring, temperature monitoring, gear tooth inspection, lubrication system monitoring, inspection of filters, oil sample analysis, etc.) should be performed on an accelerated schedule to avoid potential equipment conditions that could result in unscheduled downtime or represent an undesirable safety condition.

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