

## Fretting and corrosion in turbo-alternator quill shaft, oil pump and governor gearing

One out of six identical 60 MW turbo-alternators installed in a power station, suffered from repeated failures of the oil pump and governor gearing by what appeared to be 'fretting corrosion'. The Quill shaft claw coupling to the HP turbine was similarly affected.

Gear teeth were found to be deeply pitted and worn, with thinning to a sharp edge at the tips. The claw coupling was also worn with pitting on the mating faces. This was accompanied by blackening of the white metal of the quill shaft bearings and excessive wear on the shaft journals. The damage was so serious that all the affected parts had to be renewed.

The problem developed usually over a period of about six months by which time the unit had to be shut down due to excessive noise and vibration.

Involvement of the governor and oil pump drives was also a serious safety issue as loss of control of the machine could have occurred. No 5 machine was the problem. During routine overhauls none of the other units showed any indication of wear or damage due to this puzzling and repetitive. After a number of failures on No 5, it occurred to me that an electrical discharge through the quill shaft and its bearing, which was 'ring oiled' boundary lubricated white metal and also a current passing through the splash lubricated governor and oil pump drive gears, might be the cause.

On inspection of all the machines, sure - enough, No 5 was the only one with no earthing brush in contact with the turbine shaft.

When an earthing brush was fitted the problem disappeared. With No 5, eddy currents generated in the shafting of the alternator and the steam turbines could not pass into their respective bearings because they were pressure fed and with the shafts 'floating' on oil the insulation was perfect. However the splash and boundary lubrication of the quill shaft bearings and the gearing, provided a pathway for these currents to discharge to earth.

Spark erosion seems to have been the cause of the rapid wear of the gear teeth and possibly the generation of 'carbides' could explain the black substance which coated the white metal of the quill shaft bearings and caused the excessive wear of the journals.

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