Steam turbine anti-motoring (reverse power)
Rotor damage risk

Steam turbine are used to drive synchronous alternators for electricity production.

Motoring can happen when a turbine’s steam supply is lost whilst the generator is still coupled to a network (or operated in parallel with another generator). The generator will then become a synchronous motor and will actually drive the steam turbine with the potential for significant mechanical damage. A reverse power protection device should be inserted within the generator protection scheme, in compliance with Institute of Electrical and Electronics Engineers standard IEEE C37.102-2006 – Guide for AC Generator Protection (Section 4.5.5).
**Facts**

1. A large paper mill has a steam turbo-generator connected to the public network or can be operated in island mode.

2. In order to increase its power output, the steam turbo-generator was refurbished/upgraded in 2012.

3. The upgrade focused on mechanical components, as the electrical components were overhauled/upgraded some years earlier by another contractor.

4. During re-commissioning; the sequence of power disconnection and power reconnection to the public network induced motoring of the steam turbine.

**Main causes**

- Failure of protection relay on anti-motoring chain (partially wired)
- Generator running as synchronous motor
- Client agreement on testing without environment analysis
- Lack of bearings lubrication causing significant wear/vibration to rotor shaft and thermal stresses
- Lack of formalized procedures for testing protection systems on re-start up/commissioning.

**Aggravating factors**

- Operator waited more than 15 minutes before calling an electrical technician to open the main generator breaker.
- Lack of a dedicated electrical technician during the commissioning/test procedures.

**Suggested recommendations**

- Annual testing of reverse power (anti-motoring) protection. It should provide backup for sequential tripping schemes.
- Control the presence of safety chains, test safety valves, surge valves on steam supply, pressure/level devices on lubrication system, bearing temperature, over speed protection, vibration monitoring, earth fault, loss of field, over voltage/current instrumentation, including anti-motoring. Annual testing and calibration is recommended.
- Operators should be trained on identifying generator motoring conditions and on subsequent shutdown/isolation procedures.