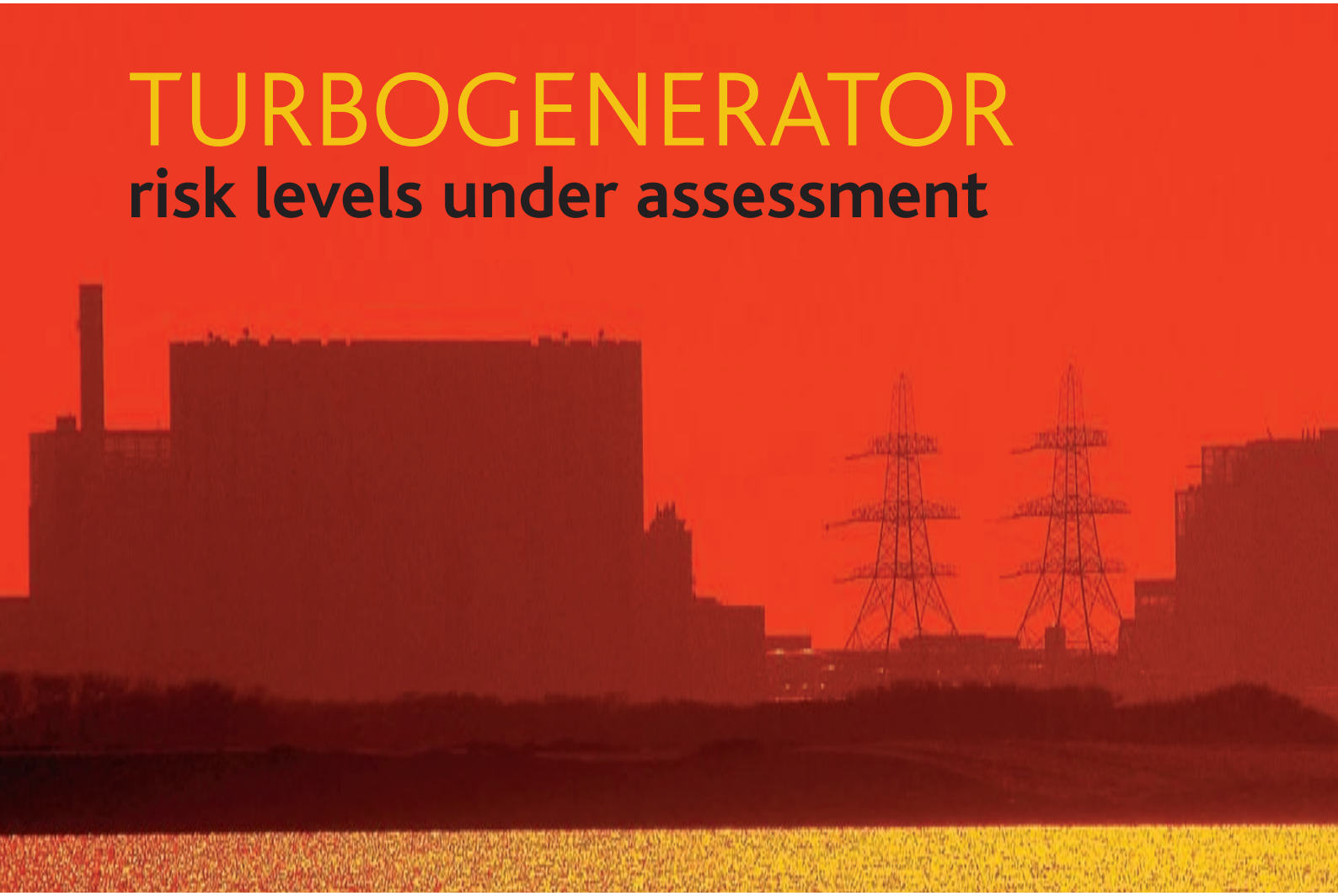
TURBOGENERATOR
risk levels under assessment



The turbines and generators in a thermal power station present continuous maintenance challenges for owners and risk status, and pricing issues for insurance companies. Equipment may vary considerably in the risk it presents, even if the size or engine life are the same.

There are no detailed statistics on the number of damage claims or compensation costs concerning turbines and generators. However, by combining information from various sources, we can build a picture of the frequency and seriousness of damage. According to the latest statistics from IMIA (The International Association of Engineering Insurers), turbogenerators remain one of the most significant causes of property damage payouts among members. In the 2004 statistics, they represented the third largest property type in terms of compensation costs. By breaking down the causes of damage, based on damage statistics or experience, we can conclude how damage can be avoided and risks reduced.

In new thermal power stations, automation takes care of critical situations, controlling and resolving them. Older stations are now up to current standards, being automated as part of their modernisation. This has decreased malfunctions, sometimes eliminating them, but also reduced the amount of practice for malfunctions and emergencies.

For automated control to function successfully, the final controlling device must operate correctly during an emergency. In most new systems, automated control is secured (through redundancy systems), but its ultimate operation can still depend on a single valve or switch.

If a turbogenerator rotates in overdrive, the turbine will become damaged very quickly and finally be destroyed unless halted. This is why stations should have triple overdrive protection, although the decisive factor is the successful operation of controlled components in reaction to control commands.

The most serious damage to a generator arises when the isolation of the stator or rotor is reduced or mechanical damage occurs. Using effective measurement methods, the first problem can be detected years before any damage occurs, while preventing mechanical

damage requires sufficient, regular overhauls.

Two cases of damage in power stations

A power station was forced to shut down, including steam production and the connected electricity generation. In addition, the turbine was shut down as normal, according to instructions. Once the steam valve was closed, the 10 kV generator switch did not disconnect the generator from the mains, due to its failure to operate, the generator being left rotating as a motor, a situation which can only safely last a few minutes. In this case, the turbogenerator rotated for approximately 40 minutes until it seized up. The turbine was seriously damaged and repair costs reached EUR 2.6 million, while production-related losses totalled approximately EUR 2.4 million.

The direct cause of the generator switch malfunction was corrosion damage. Moisture had entered the pneumatic switch's pneumatic system and the switch's inner part had rusted severely. The station also had a button with which the generator could have been disconnected from the mains, but due to insufficient instructions and practice, the control room staff were not aware of its location. A bus coupler circuit-breaker disconnected the generator from the mains, but only upon the turbine seizing up.

When another, even larger power station was shutdown over Christmas, the generator did not disconnect from the mains due, again, to a malfunctioning generator switch. The generator was left rotating as a motor in so-called back up power mode. Finally, the generator broke down, allowing the hydrogen used for cooling to leak from the coolant channels and combust, destroying the entire generator at a cost of EUR 110 million.

Maintenance and staff standards crucial

Since the above-mentioned examples are not unique, much emphasis is given to the standard of maintenance and various maintenance control operations when the risk level of a turbogenerator is assessed. The older the station, the more important this is.

Also, in older stations the standard of automation is lower than in modern ones, but even in old stations, staff should be able to make decisions in situations in which outdated automation fails. This requires continuous staff training and 'live' practice.

Issues affecting the risk level

When assessing the risk level of thermal power station turbogenerators, If Insurance Company considers the following main issues:

Turbogenerator's failsafe
The turbine's failsafe is assessed according to several criteria, including the level of overdrive protection, the on-line level of vibration measurements and separate vibration measurements and their number, a range of temperature measurements, the structure of the lubrication oil system and check-ups etc.

Turbogenerator overhaul programme
These programmes should be implemented according to the manufacturers' instructions. If the instructions are deviated from, there must be valid reasons for doing so and the manufacturers' estimates of the consequences should be ascertained.

Testing the turbine quick-closing valve
The steam quick-closing valve should be simulation tested every week, if the automation system allows this. If this is not possible, it should be tested during each shutdown and start-up. The valve should be opened every two years, or at least during turbine overhauls.

Endoscopic inspections of the turbine
The turbine should be regularly inspected with an endoscope, at a minimum of every two years. If the turbine has no inspection holes, this is considered a defect.

Generator's condition control measurements and their results
This includes electrical and mechanical measurements during operation, shutdown and start-up measurements as well as electrical condition measurements during maintenance.

Operation of the generator switch
The operation of the switch must be tested according to the manufacturer's instructions.

Generator's cap material
Even the generator's manufacturer is not always fully aware of the material used in the cap. If this issue is not clear, the cap material must be identified during the next overhaul to ensure that it is not subject to stress corrosion cracking (as in 18Mn-5Cr retainer rings). If this is so, the material should be changed during an overhaul.

Risk level assessments of turbogenerators are time and resource intensive, beginning with co-operation between the customer and inspection and maintenance organisations providing special services. In such assessments, the insurance company can share experiences garnered from its own operating environment with others. This results in risks being more identifiable and the formulation of direct procedures for their reduction. •

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