Laborelec

Laborelec Ageing Approach

Preventing costly surprises on the long run

01

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Preventing costly surprises on the long run

With plants reaching the end of their design life, the following questions will be raised:

- **What is the current condition of the plant ?**
- **What consequences can be expected in the upcoming years as a result of equipment ageing ?**
- **What maintenance actions need to be taken to ensure a reliable and safe further operation ?**
- **What is the impact of operational modifications**

To answer these questions, and to support the plant management in taking strategic decisions towards the future, a specific ageing methodology has been developed.

How did it start?

The concept of Ageing projects was initially set up for Belgian nuclear power plants. Later on it has been transposed to Electrabel's conventional power plants including coal fired, biomass and CCGT plants. With the experience gained throughout these projects, it was possible to improve the inspection methodologies and to identify the necessary maintenance actions and/or investments to tackle typical ageing problems. This knowledge build-up can now be used to assist other plants in- or outside the GDF Suez group in their ageing assessments. Laborelec has already been involved in ageing projects in the Netherlands, United Arab Emirates, Pakistan, Bahrain, Chili and Thailand.

Concept

Ageing is defined as a continuing time-dependent degradation of material due to service conditions, including normal operation and transient conditions. Ageing is not only of concern for active components but also for passive ones, since the safety margin is being reduced towards the lowest allowable level. Ageing is more than the simple sum of life assessments for each component, it aims for a more global approach, including optimization of inspection strategies, spare parts management, knowledge build-up etc.

Scope

Laborelec's multi-disciplinary team is composed of experts in all important power plant related domains such as material technology, water chemistry, oils, electricity, combustion, I&C, civil works etc. These competences enable us to cover most of the plant's critical assets. Laborelec focuses primarily on boilers, steam piping, steam turbines, condensers, generators and transformers. For ageing of conventional power plants, the typical work groups are as follows:

Mechanical equipment
Boiler & steam piping
Steam turbines
Condensers
Gas turbine
BOP

Electrical equipment
Generator
Transformers
HV equipment
Motors

I&C
I&C

Civil Works
Steel structure
Chimney
Cooling tower

02

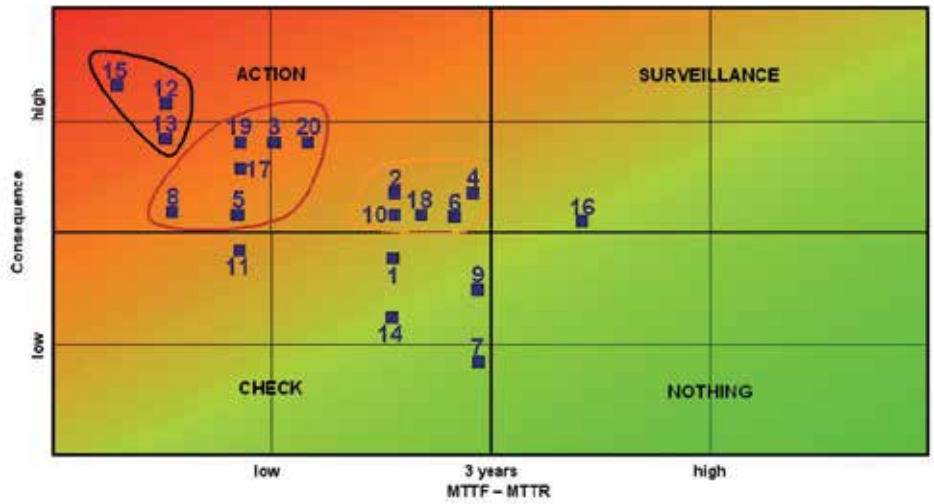
INPUT - What kind of information is needed?

In the framework of an ageing study, 3 types of information are needed, which we identify as three essential ‘pillars’ on which the reliability of the ageing outcome will depend. The pillars cannot be seen as independent from each other since information from one pillar will affect the other.

- **Design and Modeling:** design calculations, OEM information, drawings and procedures, FEM analysis.
- **History:** operational data, maintenance actions, maintenance business plan (Repair & Replacement program), inspection programs and reports, overhaul results.
- **Inspection:** non destructive measurements, metallographic replica, visual inspection, mapping, pictures, and destructive tests on samplings.

OUTPUT - What kind of result can be expected?

To clearly visualize the priorities for actions to take, Laborelec uses a risk matrix in which issues/equipments will be allocated depending on the Mean Time to Failure (MTTF) and the consequence of a possible failure.
The goal of the complete Ageing Study is to draw up lists of actions needed to bring points from the critical red area into areas where the situation is under control, by checks or surveillance. In the report itself each of the findings and actions are discussed in detail.



03

Process lay-out Every step is essential

In the Laborelec Ageing approach 4 phases can be identified, as shown in the graph below. The time it takes to go through each phase will depend largely on the inspection maturity of the plant, and of the opportunities for additional inspections.

First phase

In the first phase the emphasis lies on the collection of information from the plant, both in the form of documents and data as well as, and even more important, during extensive discussions with plant operators and maintenance staff. Particular attention will be given to issues already identified during past inspections and historical data. Laborelec will then compile these data to reveal generic problems and propose additional inspections. A first version of the Laborelec risk matrix will be generated.

Second phase

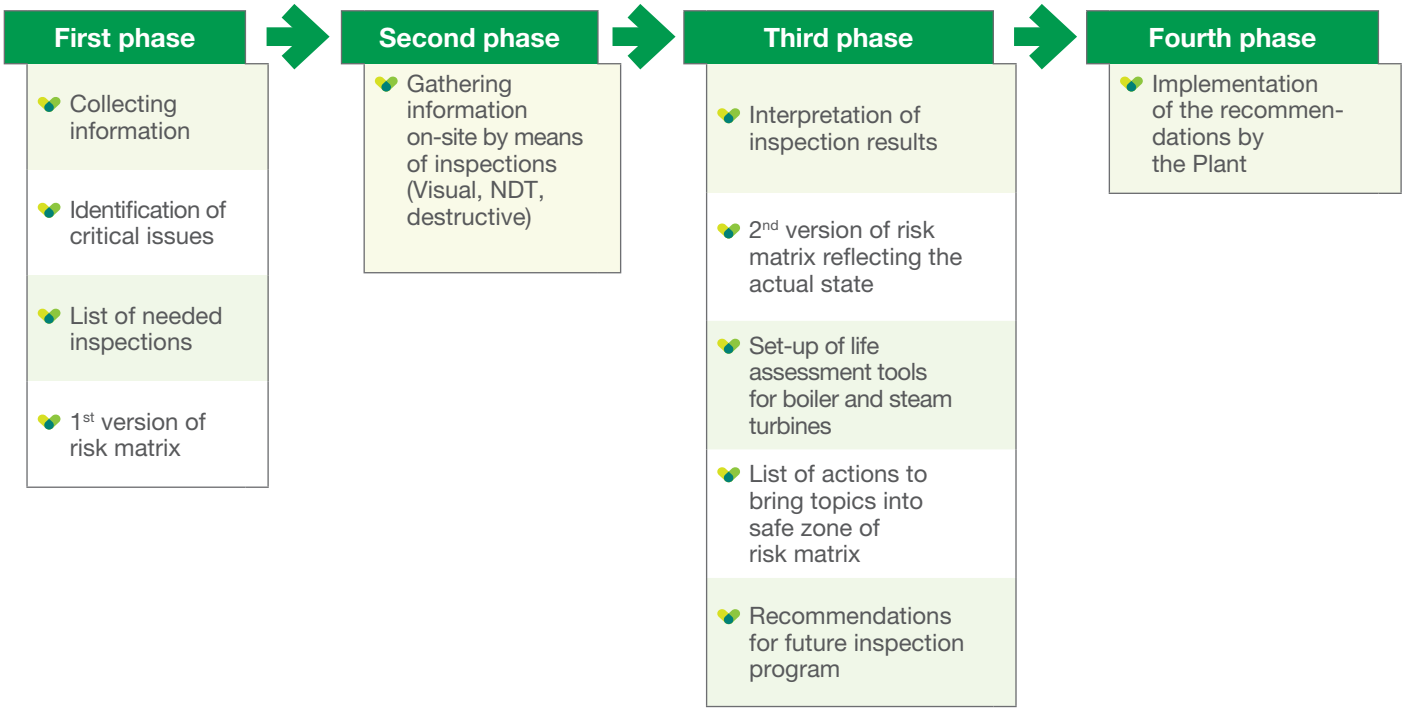
The inspections defined in the first phase will now be performed on-site, usually during a scheduled overhaul. This will consist mainly of spot-checks on critical items, by means of thickness measurements, replication, hardness measurements etc. In some occasions also samples can be taken for laboratory analysis.

Third phase

The inspection results from the previous phase will now be gathered and interpreted by Laborelec, using in-house developed life assessment tools. Depending on the results, the inspection priorities for the critical equipments will be redefined in the risk matrix. The final output will be a comprehensive list of actions needed to bring critical items under control.

Fourth phase

The final phase is the implementation on-site of the action lists proposed by Laborelec.



04

REX - Lessons learnt from previous ageing studies

- One of the striking conclusions of the numerous ageing projects we conducted, is the fact that ageing phenomena can differ widely even between similar power plants. These variations can be due to differences in operating conditions, maintenance/overhaul programs or inspection strategies for some parts of the installation.

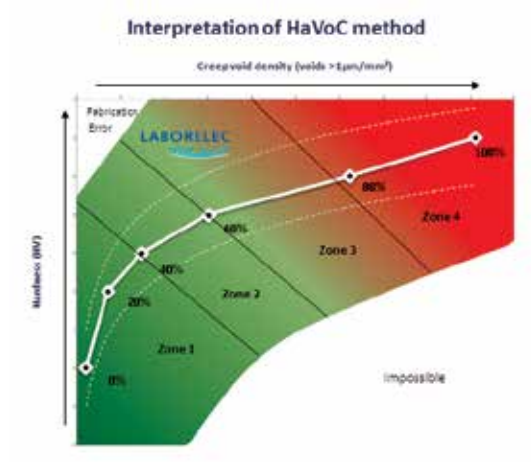
- Estimating the ageing impact of an installation cannot be reduced to an exact science and requires discussion between the points of view of both the Laborelec experts as well as from the maintenance and operational staff.

- In coal fired boilers, pulverized coal supply lines have been identified as possible hot issues with respect to ageing. During the ageing study, alternative inspection techniques such as thermography have proven to be successful to identify critical locations.

- The ageing approach has underlined the importance of (zero-)reference measurements, to enable a monitoring of critical phenomena throughout the years. Examples of these kinds of measurements are :

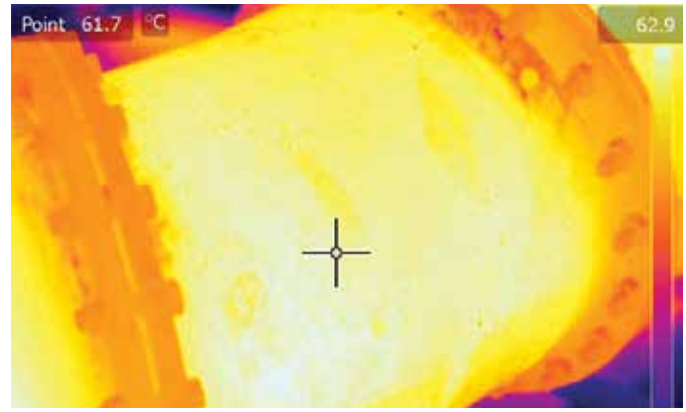
    - Wall and coating thickness measurements on aero-condensers
    - Hardness measurements and replication on Grade 91 steam lines. This has lead to the development of the in-house life assessment technique HaVoC.
    - Wall thickness measurements on flue gas ducts outlet HRSG

Wall and coating thickness measurements on aero-condensers



Interpretation of HAVOC method for grade 91 material

Flue gas duct



Hot spot on pulverized coal supply line identified by thermography

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