# PLANT LIFE MANAGEMENT IN GERMAN NUCLEAR POWER PLANTS*

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## Introduction

Programmes to manage the ageing effects of Nuclear Power Plants (NPP) have been launched in different countries to demonstrate the long term integrity of nuclear power plants in particular for plant life extension purposes often based on published IAEA-recommendations how to deal with the physical ageing of safety relevant systems.

As a consequence of these international developments, the ageing management aspect was introduced to Germany, too, although plant life extension is not the key subject in the German nuclear industry, today. The situation in Germany concerning long term integrity of safety relevant NPP-systems and components is determined by safety regulations and codes containing requirements for continuous precaution measures according to the current "state of the art" starting already with the plant commissioning (demands for redundant protection issues and for surveillance measures).

These precaution measures are performed under different names and may be grouped in surveillance measures, maintenance and in-service inspection (ISI) activities. In addition to these plant specific measures, potential changes of the general "state of the art" are considered.

The German utilities understand that ageing issues are comprehensively covered by the entirety of these different precaution and maintenance measures. However, as different institutions are involved in the ageing management business, divergent interpretations exist how to handle technical contents and administrative issues. Thus, a harmonised understanding is required. Consequently, the preparation of a specific German KTA-rule 2301 "Ageing Management in Nuclear Power Plants" has been initiated.

Bearing in mind that the above mentioned measures managing the ageing of NPP-components already exist, the objective of this KTA-work is to provide a framing guide line around these various activities under the headline "Ageing Management". To do so, the basic criteria to manage ageing effects in NPP have to be defined and the sound application of the related safeguarding measures has to be demonstrated.

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**Basic NPP Ageing Management Issues**

Basically, the "Management of Ageing" in NPP comprises conceptual, technological and physical ageing issues. Conceptual ageing aspects address potential changes in the design philosophy of NPP-systems. Technological ageing issues cover relevant changes in the state-of-the-art (e. g. in codes and standards). These long-term topics are mainly covered in periodical safety reviews (PSR). If necessary, relevant conceptual/technological aspects will be considered in the short term management of physical ageing. Thus, the managing of physical ageing in NPP is covered by

- the "Plant Life Management (PLIM)" of the entire nuclear power plant for safety and availability reasons primarily on the utility responsibility and
- the "Ageing Management (AM)" for the safety relevant systems, structures and components (SSCs) supervised by the responsible safety authority based on the issued licence of the plant.

As conceptual or even technological ageing issues usually lead to preventive plant safety/availability related precaution measures carried out by the utility voluntarily, these measures may be considered as part of the PLIM, even if they are safety related. Consequently, the same applies for the ageing management of physical degradation mechanisms. This leads to the fact that PLIM and AM of safety relevant systems/components are not strictly separated in practical NPP application. Very often utilities apply the same high level precaution for non safety relevant systems to ensure the plant availability as for safety significant SSCs. Hereby, one has to bear in mind that all power plant components are designed and fabricated with an appropriate quality level to fulfil the required tasks over the intended life time whether they are safety relevant or not.

**Basic PLIM/AM-Concept**

The safeguarding of quality requirements during plant operation lifetime is carried out by proactive and reactive measures depending on the graduated safety relevance (Group 1-3). The proactive measures cover the monitoring of root causes of potential operational degradation mechanisms (e.g. operational loadings, water chemistry). Hereby, the proactive approach, applied for Group 1-components, tries to avoid/minimise premature degradation effects. The reactive surveillance of consequences of potential operational degradation mechanisms deals with degradation effects after they have already occurred and been detected (e.g. by NDT, ISI, preventive maintenance). The component classification and the related PLIM/AM-activities are fixed in plant operation manuals and other documents approved by the responsible safety authority. The PLIM/AM-related precaution measures are surveillance measures, maintenance activities and ISI.

The PLIM-measures applied for SSCs during the plant operation to ensure the required quality usually correspond to the AM-measures. E.g. valves of the same quality are installed in safety and in availability relevant systems, which gives an extended data base about potential ageing effects.

**Plant specific PLIM/AM-application**

To compile all relevant ageing related information in one document, plant specific PLIM/AM-documentations have been prepared:

- **"Basic Report"** containing all general criteria plant specific component classification and the present status concerning the ageing management issues
- **"Periodic Status Reports"** (annual) documenting the "Delta"-information compared to the basic report.

Hereby, the plant specific "Basic Report" contains the following topics:

- Scope of evaluation component classification in Groups 1- 3,
- Identification of relevant degradation mechanisms,
- Depiction of PLIM/AM-related measures,
- Assessment of effectiveness of PLIM/AM-measures,
- Reports/Documentation, extent of information data base.

The annual "Periodic Status Report" contains relevant results from in-service inspection, maintenance and surveillance measures.