Kernkraft

# Plant Life Management in German Nuclear Power Plants

## Status of Current Utilities Activities

Dr. Erwin Fischer, Dr. Ulrich Wilke
E.ON Kernkraft, Hanover, Germany

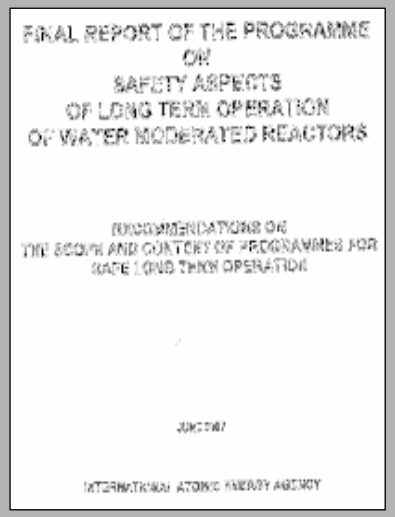
2nd IAEA Symposium Nuclear Power Plant Lifetime Management,
15-18 October 2007, Shanghai, China

## Scope of Presentation

1. **LTO – PLIM – AM : International and German Status**
2. General aspects - German PLIM and AM Approach
3. Plant Specific PLIM and AM Application
4. Reports and Documentation
5. Comparison to IAEA-Recommendations
6. Summary and Conclusions

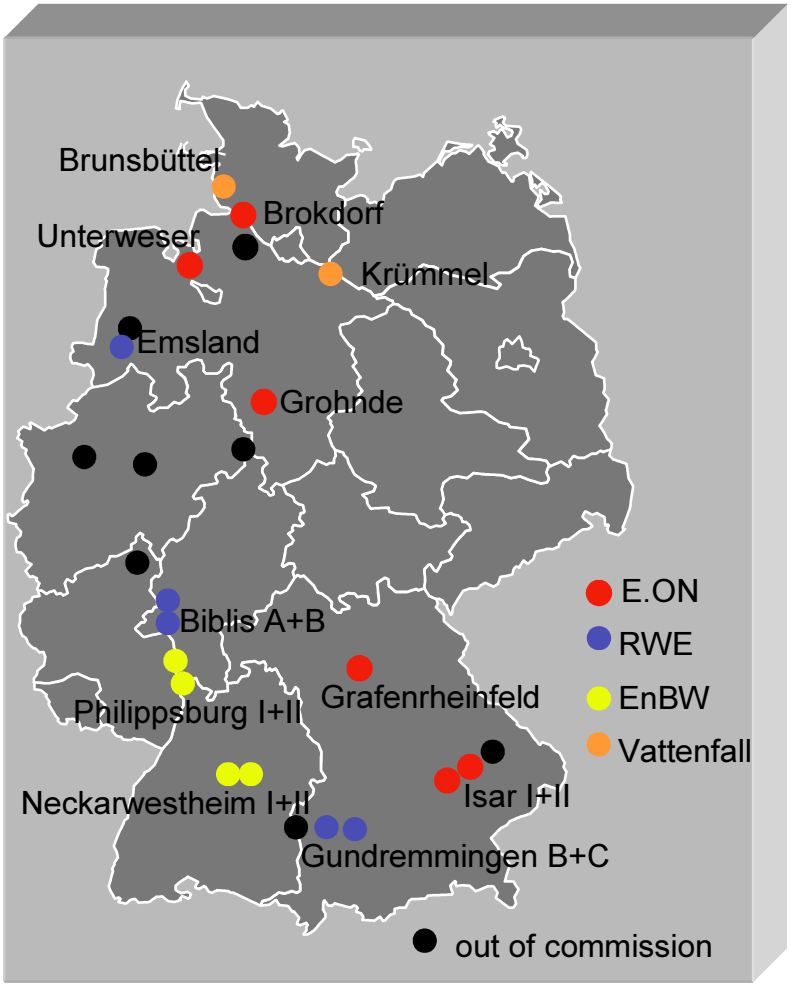
# International Status – IAEA Recommendations

- June 2007: IAEA published the "**Final Report of the Programme on Safety Aspects of Long Term Operation (LTO) of Water moderated Reactors**"
- Term "**LTO**":
  - accommodates various approaches in different countries
  - is defined as operation **beyond an initial time period** set by design, standards, licence or regulations
- **Main items** to keep the ageing effects in safety and availability relevant structures and components under control are:
  - Equipment qualification
  - Surveillance
  - In-service testing
  - In-service inspection
  - Maintenance


FINAL REPORT OF THE PROGRAMME
ON
SAFETY ASPECTS
OF LONG TERM OPERATION
OF WATER MODERATED REACTORS

- **PLIM** and **AM** Programs are elements to guarantee safe **LTO**

# German Status (1) – German Plants – Long Term Operation



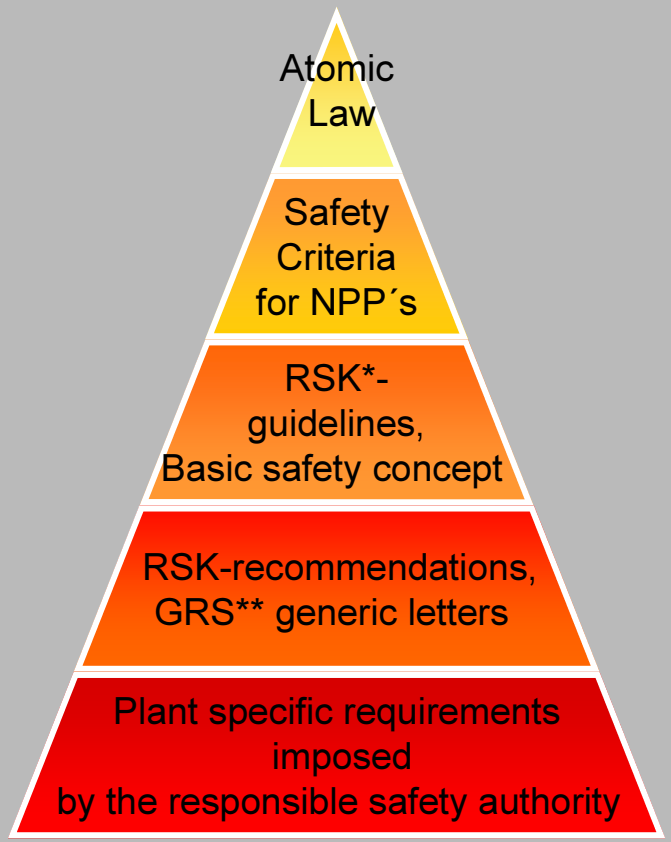

In Germany LTO in terms of plant life extension is today not a key subject because of a political driven phase-out agreement.

But even without LTO, PLIM and AM of safety and availability SSCs is determined by safety requirements and plant specific regulations

- beginning already with the plant commissioning
- demanding for **continuous precaution measures** according to the current "state of the art"

# German Status (2) – Authority Requirements established

Requirements for design + **continuous precaution measures** = according to the state-of-the-art

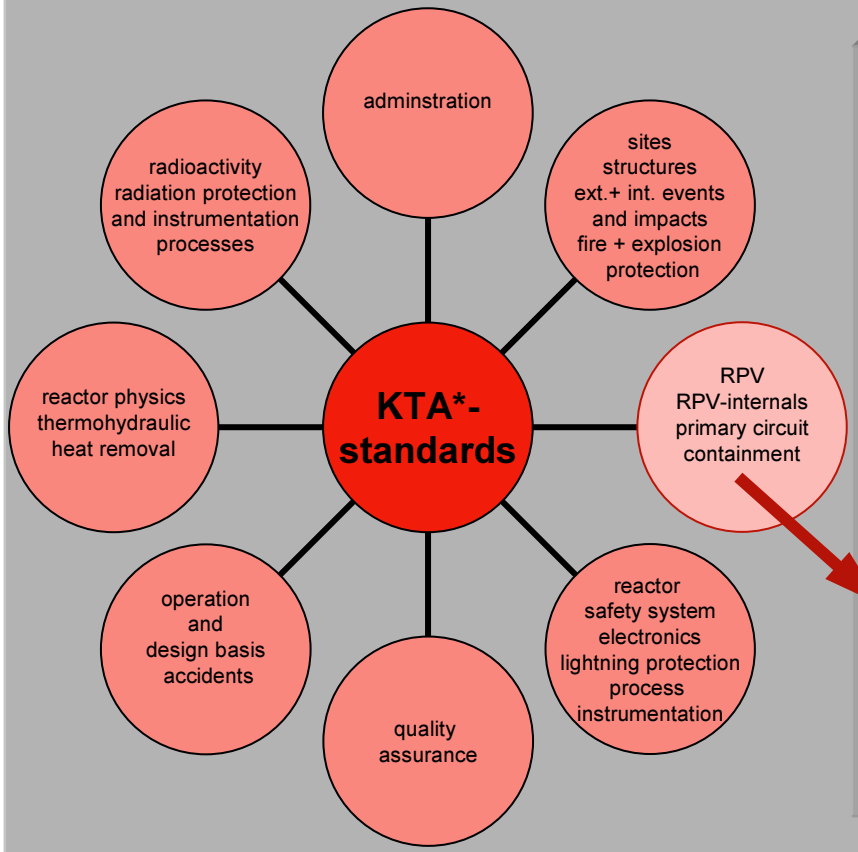



Including demands for surveillance and safety measures concerning the **effectiveness of safety relevant SSC´s** starting with the beginning of the plant operation

*RSK = Reactor Safety Commission

**GRS = Association for Reactor Safety

# German Status (3) – German KTA Safety Standards




Fulfilment of these requirements
is
fixed in codes and standards
or
plant specific regulations
e.g. for

**Class 1 mechanical components:**

- KTA 3201.1 - Materials
- KTA 3201.2 - Design and Analysis
- KTA 3201.3 - Fabrication,
- KTA 3201.4 - In-Service Inspection and Operational Monitoring

KTA* – German Nuclear Safety Standards Commission

# German Status (4) – Established Operational Procedures

On the basis of a **proven quality of the SSCs after design and fabrication** the relevant precaution measures are

- Keeping qualification of SSCs
- Surveillance measures
- In-service cyclic testing
- In-service cyclic inspections
- Cyclic maintenance measures
- Know-how keeping and development of plant stuff
- Permanent optimization of administration documents

# German Status (3) - Requirements established

**Generic Ageing Management Activities** have been initiated by German Utilities in 1997, to frame the various activities mentioned above under the head line "Ageing Management" providing a conceptual und structural framework for plant specific AM-application.

**German KTA-Rule "Ageing Management" in preparation**

to ensure a harmonized understanding of involved partners and to provide a harmonized basic AM-structure

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# General Aspects (1) - German PLIM and AM Approach

**Plant Life Management**

Know-how driven

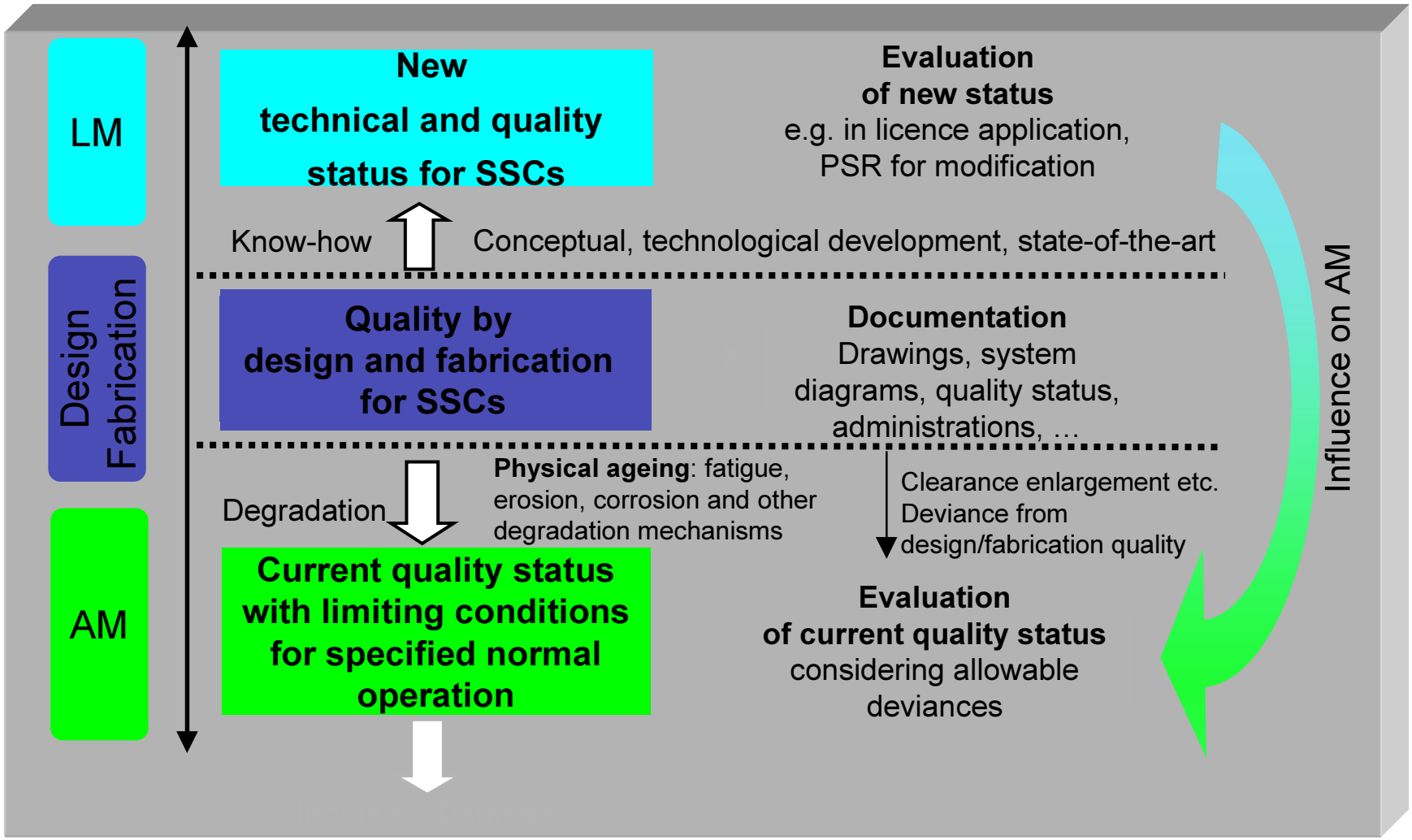
operational time driven

**Ageing Management**

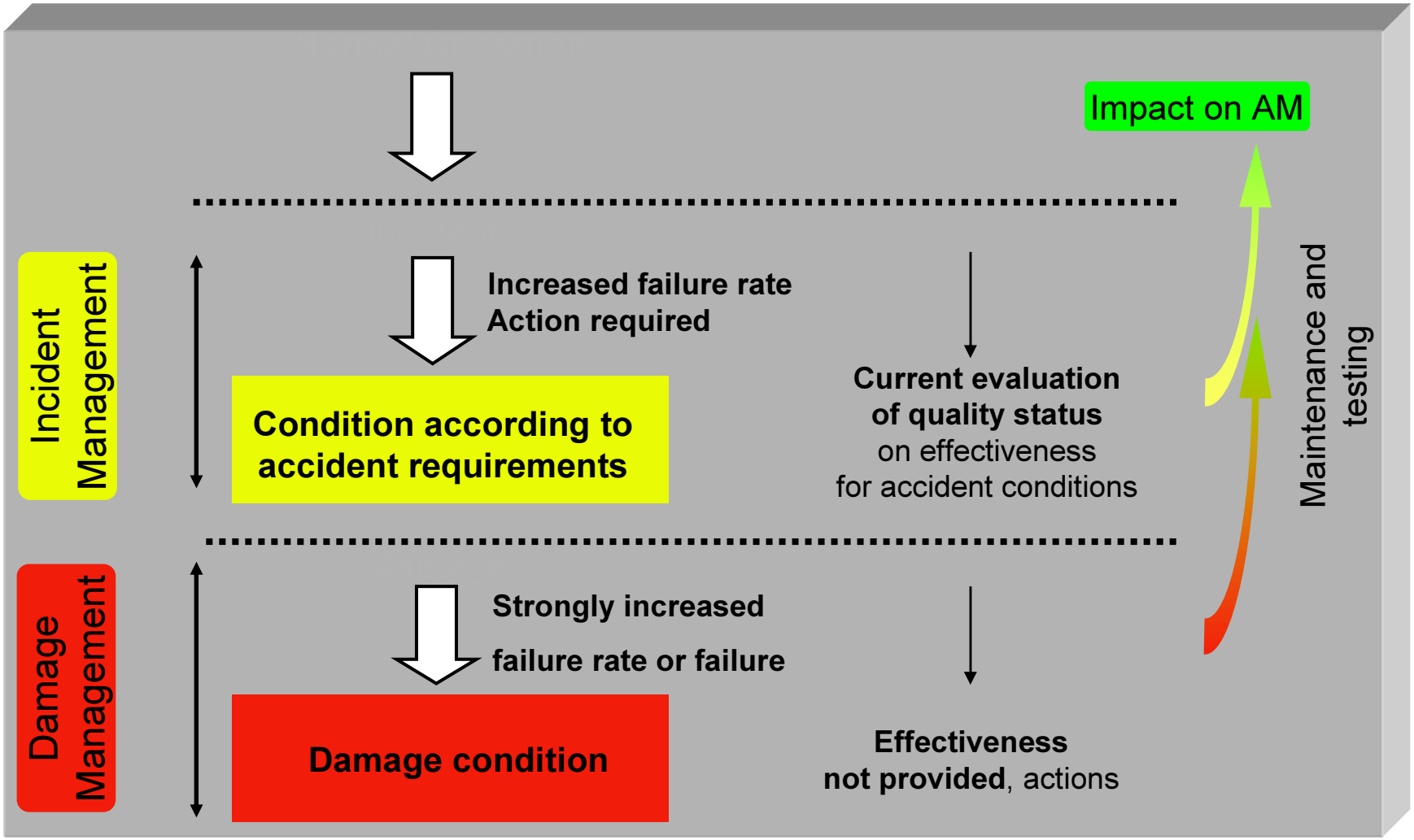
…refers to the entire NPP for safety and availability reasons
(primarily under utility responsibility)
**conceptual further development**
**→ changes in design philosophy**
**technological further development**
**→ changes of state-of-the-art**

…refers to the safety relevant systems, structures and components, is done by utilities and under supervision of the responsible safety authority
**Physical/ material ageing**
**→ Operational ageing mechanism**

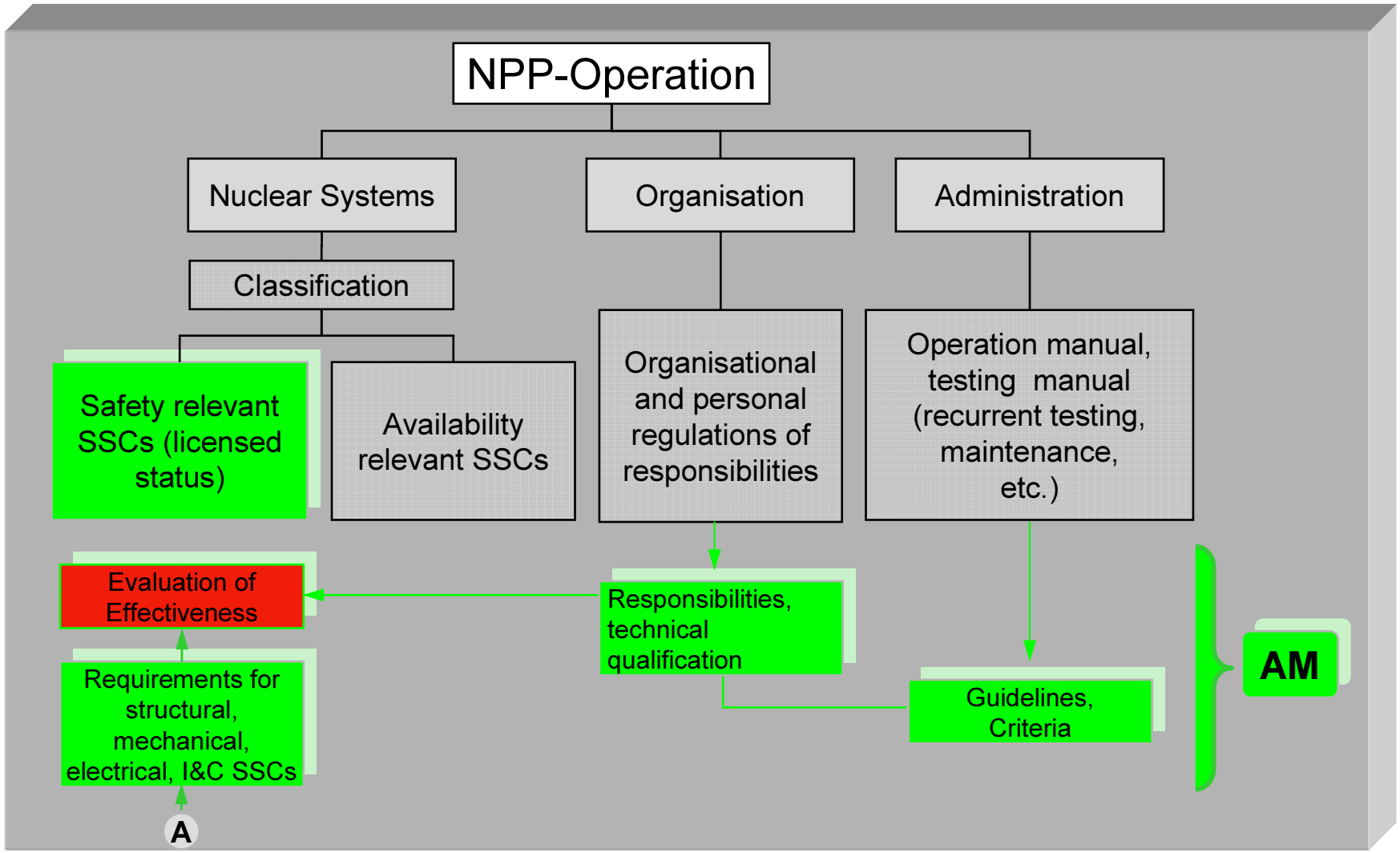
# General Aspects (2) - Lifetime- versus Ageing- Management



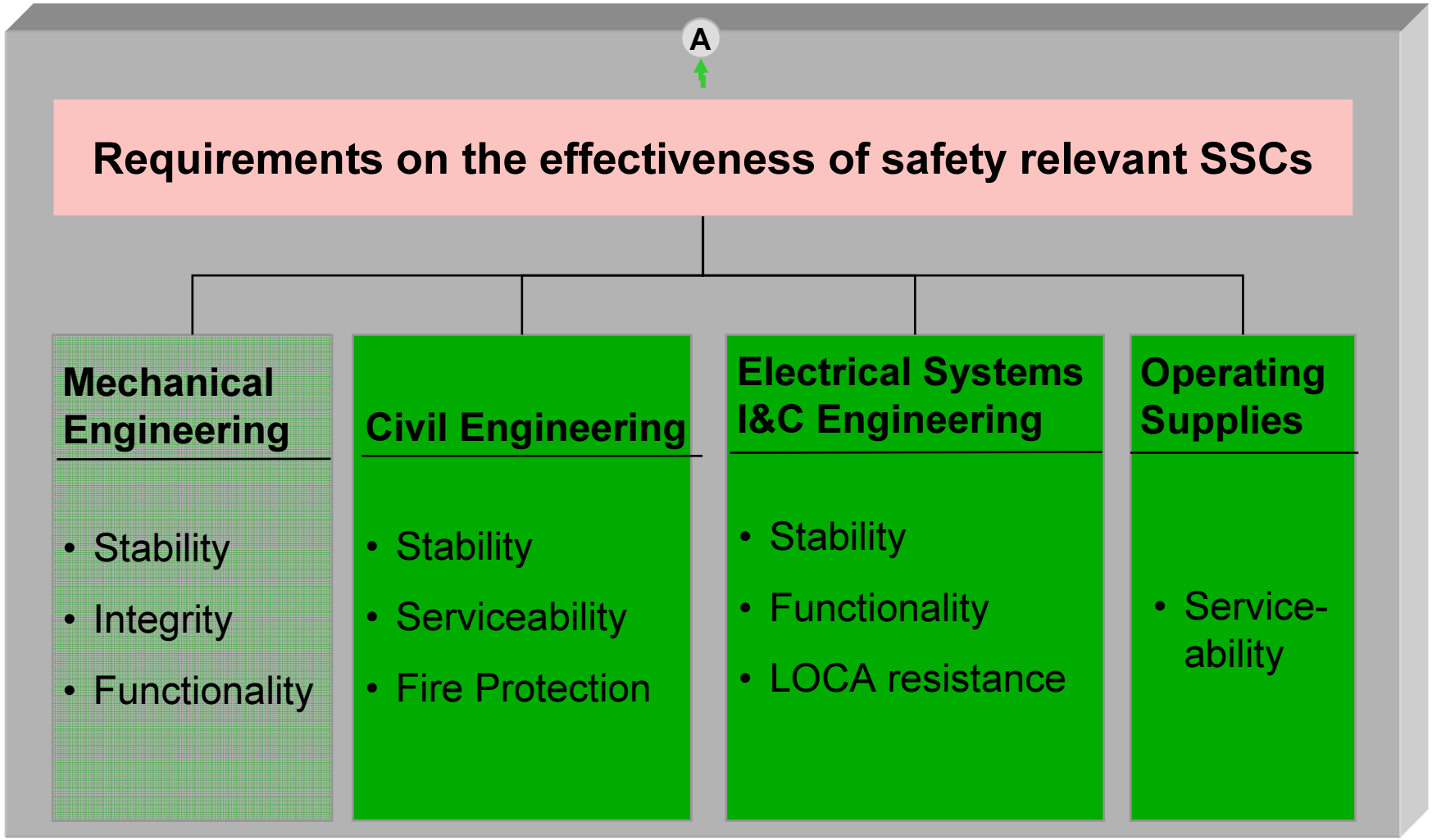
# General Aspects (3) - Incident and Damage Management



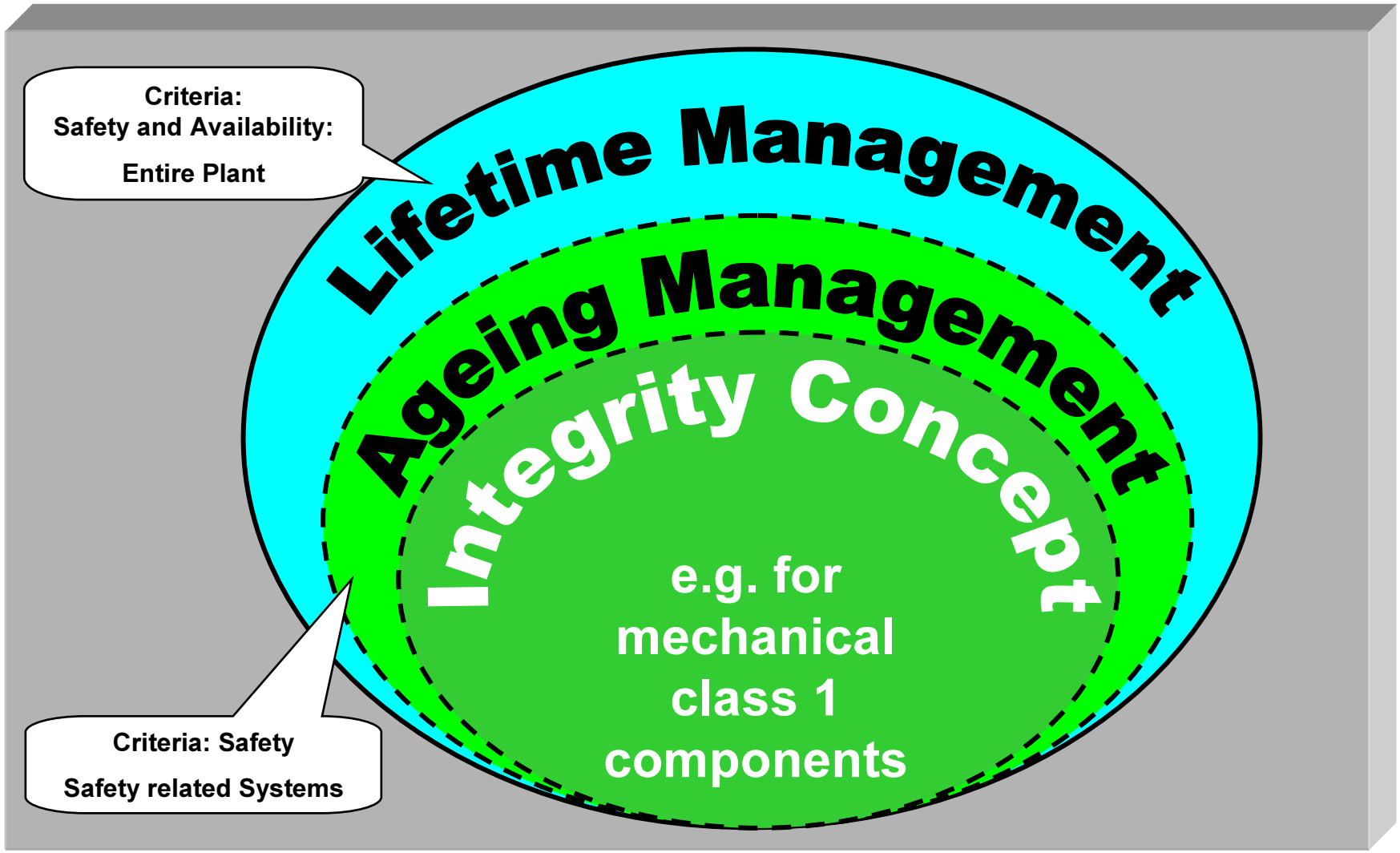
# General Aspects (4) - Evaluation of Effectiveness (1)



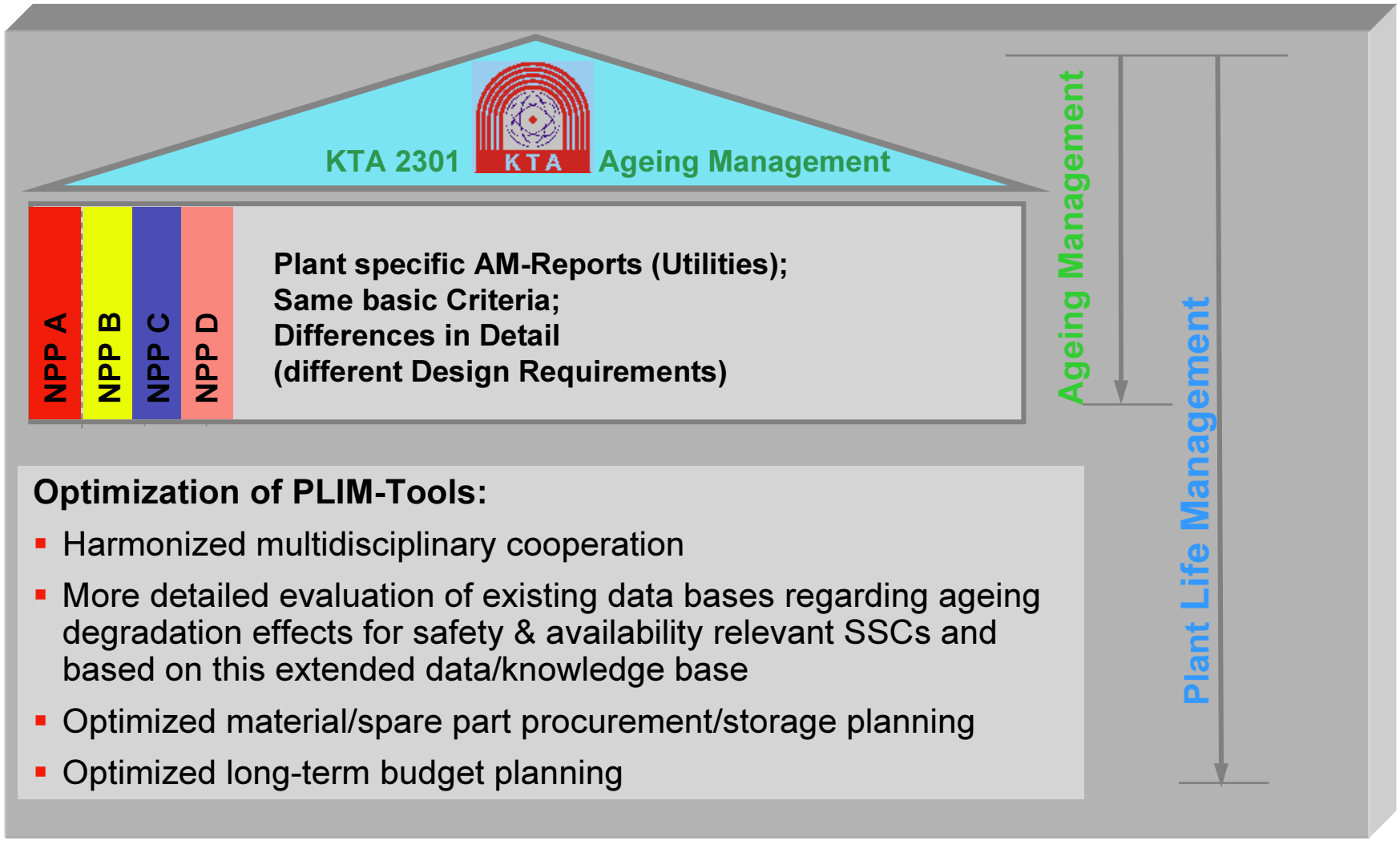
# General Aspects (5) - Evaluation of Effectiveness (2)



# General Aspects (6) - Plant Life and Ageing Management



# General Aspects (7) - Plant Life and Ageing Management




**Optimization of PLIM-Tools:**

- Harmonized multidisciplinary cooperation
- More detailed evaluation of existing data bases regarding ageing degradation effects for safety & availability relevant SSCs and based on this extended data/knowledge base
- Optimized material/spare part procurement/storage planning
- Optimized long-term budget planning

# General PLIM and AM Approach

- The **protection measures** to ensure an adequate component quality during the plant operation life time are **different related to the respective safety or availability** concern.

- PLIM and AM issues (e.g. for the mechanical, I & C- and building structure components) cover the following topics:

  ➔**Classification** of safety / availability significant SSCs

  ➔**Review of the current system / component quality** status based on original design / fabrication related to the relevant degradation mechanisms and

  ➔**Review of applied measures** to assure the required component quality during the intended plant operation life time.

  ➔In parallel, relevant **changes in the "state of the art"** are considered.

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# Classification of Safety Relevant SSCs

| Component Criteria | Safety Requirement / Measure | Objective |
|---|---|---|
| **Group 1**<br><br>→ **"Avoid / minimize premature Ageing"** | **Highest**<br><br>Surveillance of Root Causes and Consequences of Degradation Mechanisms | „Guarantee" required SSCs quality, SSC must not fail:<br>RPV, LBB-Systems, others (specific safety or plant availability reasons?) |
| **Group 2**<br><br>→ **"Minimize Degradation Effects"** | **high**<br><br>Preventive Maintenance | "Maintain" required component quality, for redundant components -> single case failure no safety problem, no common cause acceptable:<br>valves, pumps, E/I & C-components, building, others (specific safety or availability reasons?) |
| **Group 3**<br><br>→ **"Component Replacement after Failure"** | **Low (no)**<br><br>Condition/Failure orientated Maintenance | Redundant SSCs<br>(single case failure is no safety problem): valves and others |

# General Classification of SSCs

- **Mechanical components**
  - Group M 1 — e.g. classified fatigue significant components/systems
  - Group M 2 — e.g. safety relevant valves, pumps, vessels
  - Group M 3 — e.g. availability relevant valves etc.

- **E / I&C components**
  - Group I 2.1 — components with functional requirements in emergency/faulted conditions
  - Group I 2.2 — other components

- **Buildings / Structures**
  - Group B 2.1 — building structures with specific requirements for emergency/faulted conditions
  - Group B 2.2 — other buildings

# SSC Specific Measures to Control Degradation (Ageing)

- **Basis: proven quality of the SSCs after design and fabrication (Remark: including equipment-qualification)**
- Relevant degradation effects are known (e.g. experience)
- On this basis precaution measures are:
  - → **surveillance measures,**
  - → **in-service inspections,**
  - → **cyclic testing and**
  - → **maintenance activities**

- The **results of these measures are assessed** on the SSC basis including operation experience and work reports

# Assessment of the Effectiveness of Precaution Measures (1)

**Performed continuously regarding:**

- Scope and remedial actions to control root causes and consequences of potential degradation mechanisms,
- Monitoring results of root causes,
- Maintenance and in-service inspection results,
- Evaluation of incidents with relevant degradation,
- Non-conformity notification / notice of malfunction and other relevant incidents (if any),
- „State of the art“ information incl. R & D,
- Information about incidents in NPPs worldwide (IAEA, WANO, GRS Generic Letters, VGB-Plant Info Exchange, Supplier Information, etc.)

**If necessary, scope and intensity of surveillance, in-service inspection and/or maintenance is adjusted**

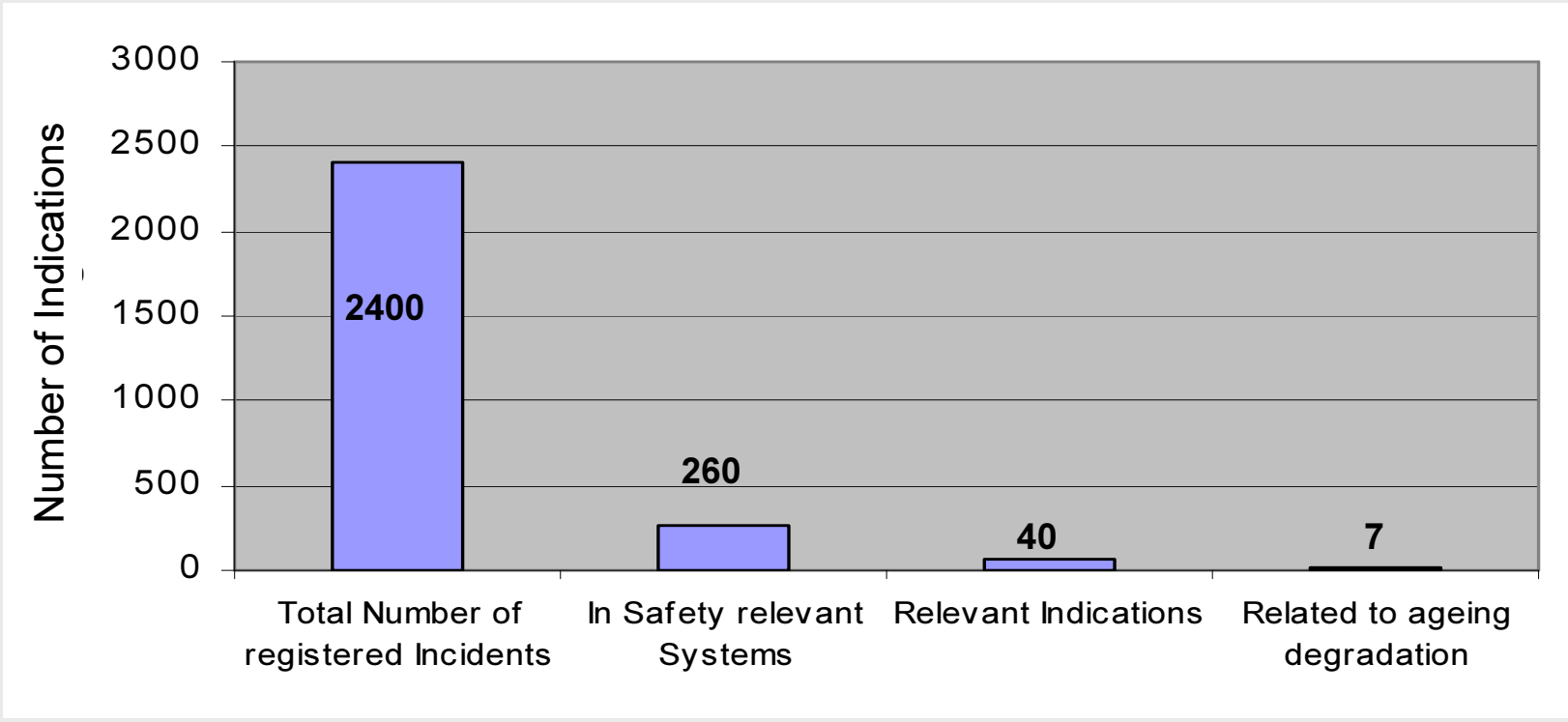
# Assessment of the Effectiveness of Precaution Measures (2)

- The sum of the precaution measures and the assessment procedures show, that known degradation mechanisms are controlled and new (if there are any) are discovered in time.
- Compiled information from German NPPs show a very small number of ageing-related indications demonstrating that the present safety requirements are met and that sufficient precaution against ageing degradation has been taken.

- These positive plant experiences demonstrate that the protection measures already taken are appropriate to ensure the long term safety and availability of German NPPs.

# Plant Specific Assessment – Results Year 2005 (Mechanical Components)

| | |
|---|---|
| Total Number of registered Indications (approx.) | 2400 |
| In Safety relevant Systems (approx.) | 260 |
| Relevant Indications (approx.) | 40 |
| Related to ageing degradation (approx.) | 7 |



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# Reports and Documentation - Regarding Safety Relevant SSCs (1)

- **”Basic Report“** containing
  - ➔General Criteria,
  - ➔Scope of evaluation component classification in Groups 1 - 3,
  - ➔Identification of relevant degradation mechanisms,
  - ➔Description of PLIM / AM-related measures,
  - ➔Assessment of effectiveness of PLIM / AM-measures,
  - ➔Reports/Documentation, extent of information data base.

- Periodic **“Progress Report“** (e.g. annually) containing the “Delta”-information compared to the “Basic Report“ content → e. g. relevant results from in-service inspections, maintenance and surveillance measures

# Reports and Documentation - Regarding Safety Relevant SSCs (2)

- **Additional reports** are being submitted to responsible safety authorities:

  - ➔ yearly results of maintenance activities,
  - ➔ yearly results of in-service-inspections,
  - ➔ yearly results of surveillance measures,
  - ➔ yearly assessments of other plant specific or national / international PLIM or AM-related information.

- Furthermore, comprehensive **Periodic Safety Reviews** (PSR) are being carried out.

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# Comparison to IAEA Recommendations - Draft Safety Guide 382 "AM For Nuclear Power Plants" - Safety Relevant SSCs (1)

- A **systematic ageing management** process is necessary to achieve **continuous** improvement ✓
- Within AM as framework all programs and activities to understand, control and mitigate ageing degradation have to be coordinated. ✓
- Organizational arrangements (AM coordinator, AM task force / ad-hoc teams) ✓

**In German plants:**

→ AM is part of PLIM as a continuous process

→ All measures especially those for surveillance / in-service inspection / maintenance and testing are coordinated

→ AM organisation is part of PLIM organisation

## Comparison to IAEA Recommendations - Draft Safety Guide 382

## "AM For Nuclear Power Plants" - Safety Relevant SSCs (2)

- Effective AM bases on knowledge about design / fabrication and operation / maintenance history incl. experience ("understand ageing") ✓
- On this basis appropriate measures like monitoring and trending have to provide a timely detection of ageing degradation ("monitoring of ageing") ✓
- Existing measures have to be checked for effectiveness regarding "mitigation of ageing" ✓
- AM reviews have to be performed, regularly; report on reviews ✓

**In German plants:**

➔ The PLIM procedures fully comply with these requirements

➔ Knowledge gained based on established requirements (law, codes, standard etc.), precaution measures according to state of the art

➔ SSCs assessment, surveillance and mitigation measures kept up to date, incl. reports

# Comparison to IAEA-Recommendations -

# Safety Aspects on Long Term Operation (June 2007)

- A defined programme scope ✓
- Identification of preventive actions or parameters to be monitored or inspected ✓
- Detection of ageing degradation / effects ✓
- Monitoring and trending including frequencies and methodologies ✓
- Pre-establish acceptance criteria ✓
- Corrective actions if a component fails to meet acceptance criteria ✓
- Confirmation that required actions have been taken ✓
- Administrative controls that document the programme's implementation ✓
- Operation experience feedback ✓

→ **Requirements according to AM (Draft) Safety Guide**

→ **German PLIM procedure complies**

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# Summary and Conclusions (1)

**KTA-Rule 2301** "Ageing Management in Nuclear Power Plants" in preparation to harmonize differing interpretations between the institutions involved in AM-activities:

- Objective of the KTA 2301 is to state basic AM-Criteria and an AM approach based on the existing state of knowledge
- Consideration of international experiences and approaches in AM, e.g. IAEA-recommendations.

**"Basic AM-reports"** have been submitted to safety authorities for many German NPPs

**"Periodic AM-progress reports"** will be prepared demonstrating

- that existing AM is effective and
- relevant ageing degradations will not induce safety relevant incidents in future operation of the NPPs up to the next inspections.

## Summary and Conclusions (2)

German Utilities continue their PLIM-activities in order to provide a comprehensive summarized compilation of all relevant information considering the co-operation of different technical disciplines and persons involved.

This information should be used to for other related purposes as

- optimized material, spare part procurement and storage
- and for long term budget planning.

**German utilities AM-application is in good agreement with the IAEA recommendations.**

**Nuclear Power Plant**
**Isar II**

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PWR 1474 MWe
generated 220 TWh
in 19.5 years with
Operational Excellence

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In the last 10 years 8
times No. 1 in operation
in worldwide top ten

# Thank you for your interest and attention!