Wolfgang Krüger – Dr. Volker Nitzki – Dr. Oliver Rabe
TÜV NORD EnSys Hannover

Proceeding from the Safety Philosophy to Safety Requirements –

Experience Feedback of TÜV NORD Group from Non-domestic Licensing Processes

Table of Contents

- New Build Projects and Licensing
- Observed Inconsistencies in the Approach to Safety
- The Safety Concept
  - Features
  - Technical Requirements
  - Procedural Aspects
  - Integral Approach
- Conclusions

- New Build Projects and Licensing
- Observed Inconsistencies in the Approach to Safety
- The Safety Concept
  - Features
  - Technical Requirements
  - Procedural Aspects
  - Integral Approach
- Conclusions

Common Features of Licensing New Build Projects

No common licensing approach: As many licensing processes as countries with nuclear projects
Regulatory framework and codes & standards: As currently established, they are usually applicable only to the already existing nuclear power plants
New reactor concepts: New and unique plant concepts (e.g. Generation IV reactors) under development; usually, they are not enveloped by the existing codes and standards
Licensing of new build projects: Not a day-to-day exercise, i.e. handling this as a routine has to be regained

What Needs to Be Done and how?

Evidently, existing gaps in the regulatory framework as well as codes & standards need to be filled.
An update or a completely new implementation of these regulations according to the state of the art would be the most appropriate approach.
This would require considerable time and effort both of which are not commonly available in large scale projects like a nuclear power plant.
Experience shows: Taking "short-cuts" is the common practice in many new build projects.
➢This inevitably leads to inconsistencies in the licensing effort!

The Objective of this Presentation

The objective of this presentation is to give an outline how under the given circumstances the preparatory steps in the licensing process can be organised such that the observed deficiencies can be removed from the start such that the plant design will have a solid basis, even without having implemented a full set of acceptance criteria beforehand. The tool which we propose for application is the "Safety Concept".

- New Build Projects and Licensing
- Observed Inconsistencies in the Approach to Safety
- The Safety Concept
  - Features
  - Technical Requirements
  - Procedural Aspects
  - Integral Approach
- Conclusions

Observed Inconsistencies

TÜV NORD Nuclear involved in licensing processes in a variety of countries: Argentina, Belgium, Brazil, Finland, South Africa, South Korea and Sweden.
We observed a number of inconsistencies clearly indicating missing or inconsistent requirements.
Such inconsistencies occurred both in the technical and in the procedural areas.
Examples of such inconsistencies are addressed next.

Findings Exemplifying Deficiencies and Inconsistencies in the Technical Area (1)

These findings mainly go back to insufficiently defined technical requirements to be applied in design and safety assessment. Typical examples for such findings are:
An insufficient or even lacking definition as well as an inappropriate application of the single failure criterion
Missing requirements on the design of redundant system trains of safety systems
A missing concept for the consideration of repair activities during operation

Findings Exemplifying Deficiencies and Inconsistencies in the Technical Area (2)

An inappropriate or even missing methodology for determining the safety significance of the systems, structures, and components (SSC)
Unawareness of the safety significance of objects to be licensed other than SSC, e.g. site characteristics or the topics to be considered in commissioning
Missing requirements if and to what extent inherent safety features might be credited in design and safety assessment

Findings Exemplifying Deficiencies and Inconsistencies in the Procedural Area

Unawareness of the necessity to provide for post-licence processes which supplement the pre-licence activities of preparing and assessing the Safety Case. These post-licence processes are necessary constituents of implementing the licensed scope once the licence has been granted.

Insufficient understanding of the licensing process as a logical sequence of discrete steps which are interlinked. In the end, such lack of compliance would give rise to serious gaps and flaws in the licensing process and ultimately "undermine" the licensing basis.

- New Build Projects and Licensing
- Observed Inconsistencies in the Approach to Safety
- The Safety Concept
  - Features
  - Technical Requirements
  - Procedural Aspects
  - Integral Approach
- Conclusions

Safety Concept and Safety Philosophy

According to our knowledge, there is no binding definition of the term Safety Concept.
It has to be distinguished from the term Safety Philosophy.

We understand as the Safety Philosophy
the safety features of the plant and their role in managing and accommodating the consequences of initiating events.

The Safety Concept
describes and governs the implementation of the Safety Philosophy.

In other words:
The Safety Philosophy defines WHAT needs to be implemented for safety,
whereas the Safety Concept determines HOW to implement safety.

Some Remarks on the Term "Safety Concept"

The term "Safety Concept" as used in this presentation reflects our understanding and use of this term. Other definitions or another terminology might exist for the same issue.
The detailed Safety Concept is co-determined by the respective licensing approach and environment, i.e. each licensing environment has its own Safety Concept. However, the basic logic of the Safety Concept is universal.
In this presentation, we introduce the Safety Concept from a top-down perspective; i.e. we do not expand on its details. A full Safety Concept would compile a lot of information and become more and more detailed during the life cycle of a nuclear facility.

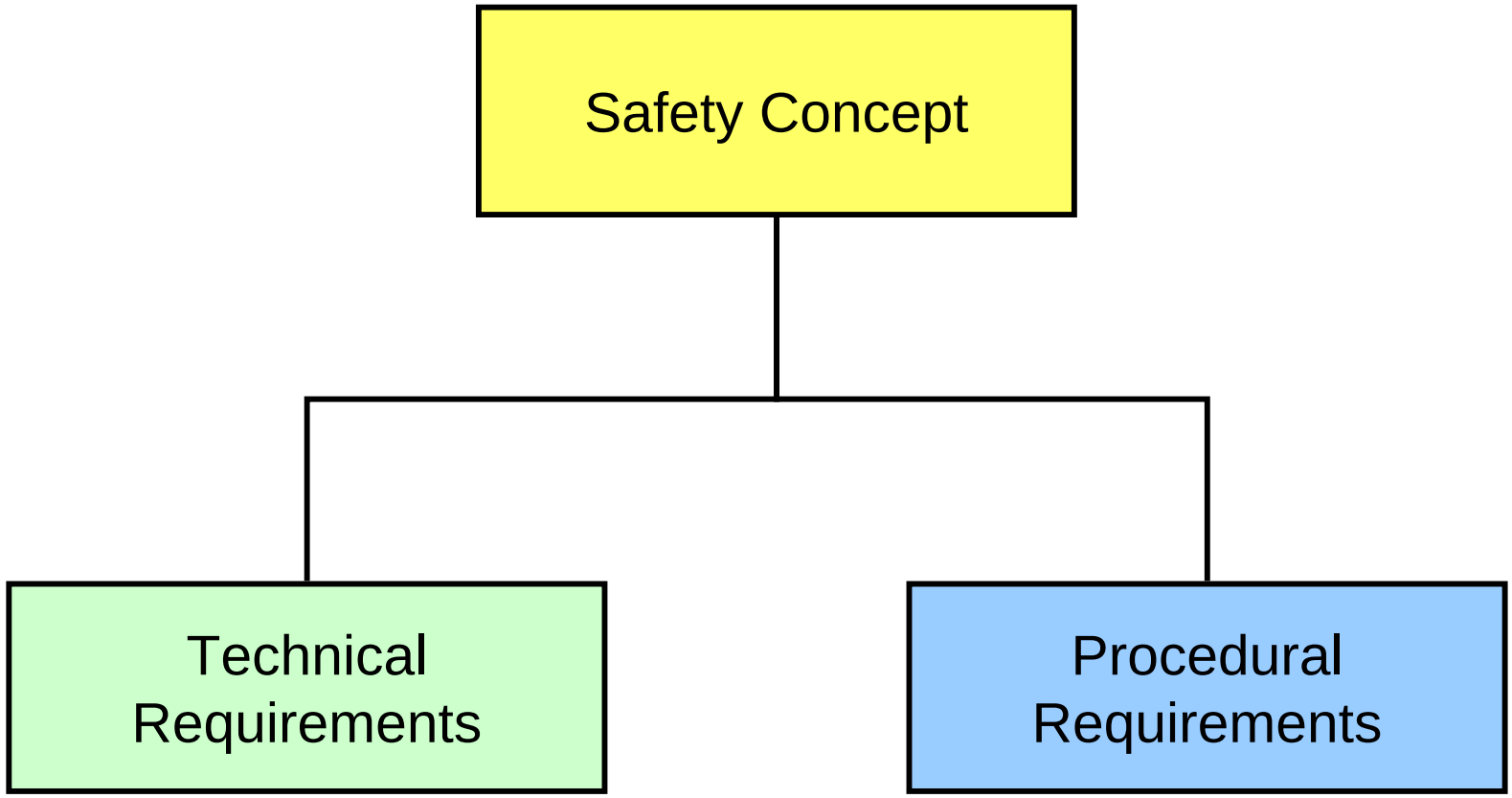
Approach to the "Safety Concept"

The Safety Concept derives the technical requirements for a nuclear facility to be built, commissioned and operated in a systematic approach. It provides for adequate processes for the fulfillment of requirements and credibly demonstrates that these requirements are actually met.
In a first step, the binding technical requirements governing safety are determined.
In the next step, these requirements are implemented in the design and safety assessment of the plant.
During construction and erection, the proper implementation of the design requirements needs to be verified on the hardware side. This requires suitable processes in this part of product realisation.
To be continued for the whole life cycle of the plant (construction, commissioning, operation etc.).

Technical and Procedural Requirements (1)

The Safety Concept necessarily compiles both technical and procedural requirements. The technical requirements are used as technical input to the design, the commissioning instructions, the operation instructions etc., whereas the procedural requirements govern the processes to implement the technical requirements and verify their achievement.

Technical and Procedural Requirements (2)



- New Build Projects and Licensing
- Observed Inconsistencies in the Approach to Safety
- The Safety Concept
  - Features
  - Technical Requirements
  - Procedural Aspects
  - Integral Approach
- Conclusions

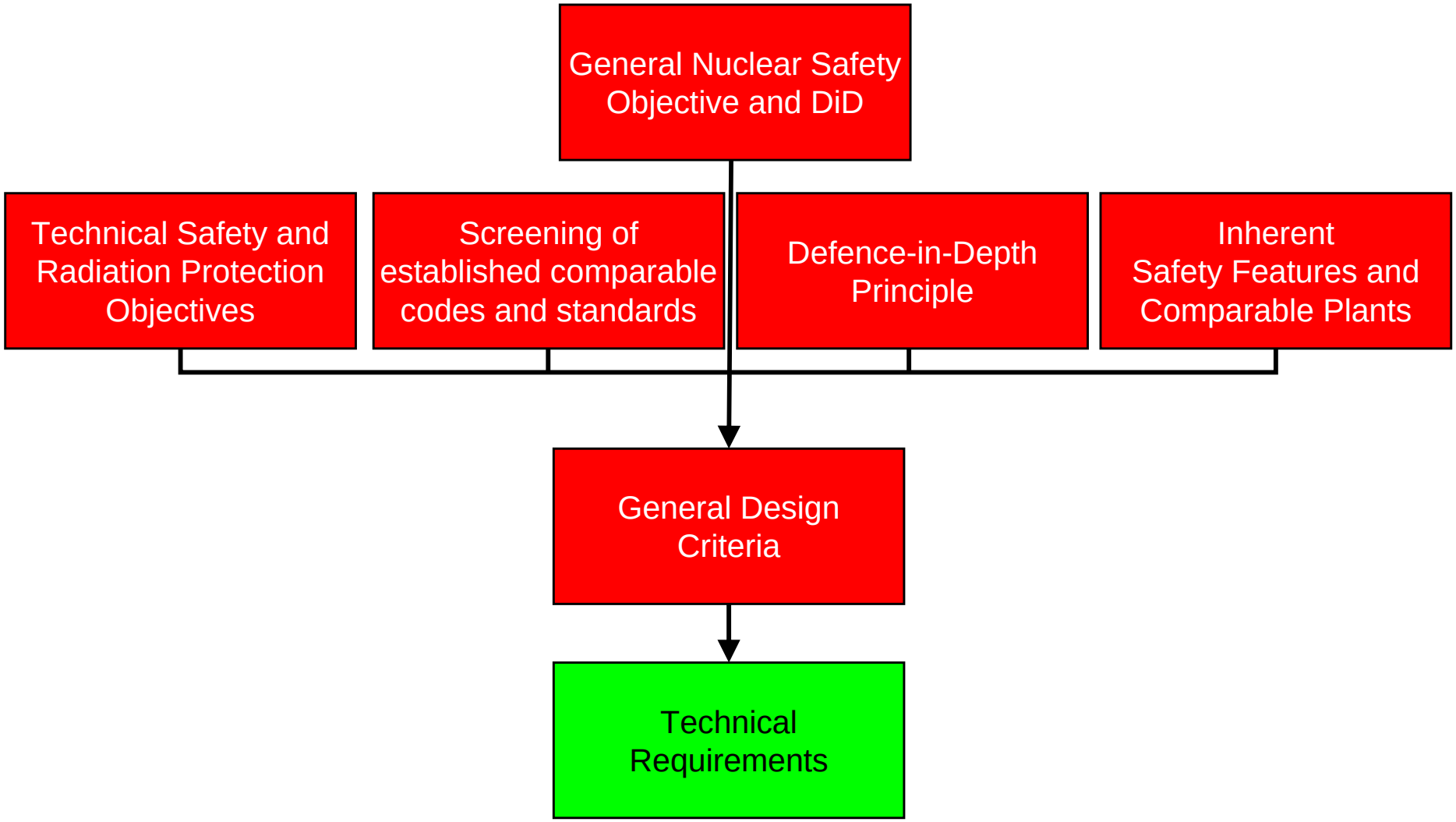
Approach to the Technical Requirements Part

We distinguish two approaches to the Technical Requirements part:

- The "evaluating-the-experience-based approach"
- The "functional analysis approach"

These approaches may also be combined.

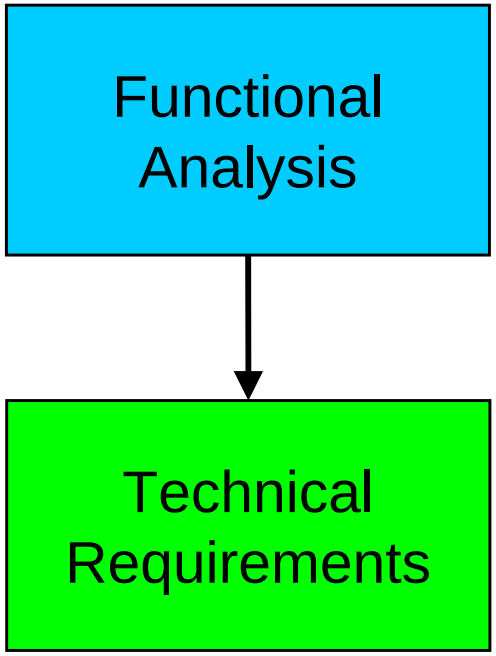
Technical Requirements:
The "Evaluating-the-Experience-Based Approach"



The "Evaluating-the-Experience-Based Approach": Benefits and Drawbacks

Benefits:
Easy to perform with early available results Outcome: A set of high-level design requirements (GDC)
Drawbacks:
Quantification of safety margins doubtful Uncertain safety significance of the individual General Design Criteria Uncertain completeness of the General Design Criteria

Technical Requirements:
The "Functional-Analysis Approach"



The "Functional-Analysis Approach": Benefits and Drawbacks

Benefits:
Systematic, analytical methodology Completeness of the derived design requirements Compatibility with safety classification Transparency
Drawbacks:
Intricate nature necessitating a time-consuming analysis before the actual design and safety assessment processes can be initiated.

- New Build Projects and Licensing
- Observed Inconsistencies in the Approach to Safety
- The Safety Concept
  - Features
  - Technical Requirements
  - Procedural Aspects
  - Integral Approach
- Conclusions

Procedural Part of the Safety Concept (1)

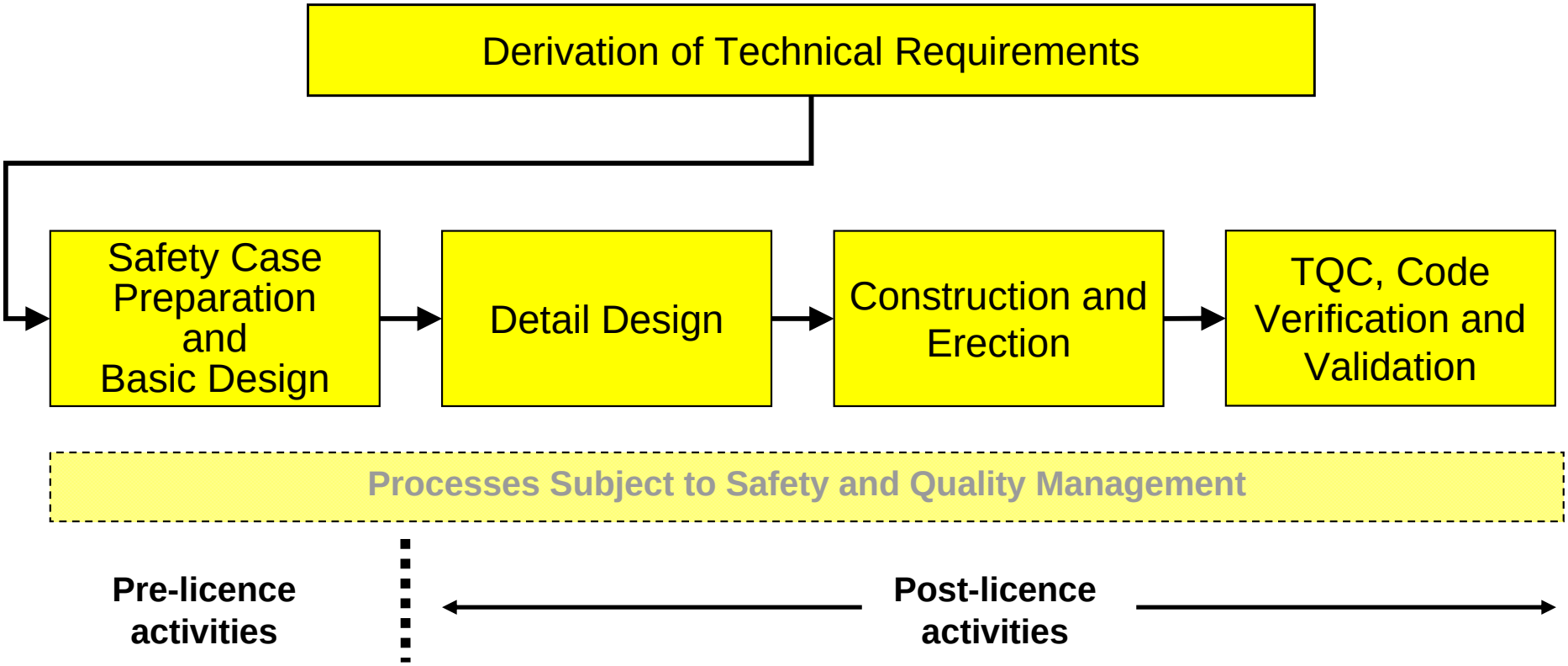
We see only one approach to the Procedural Part of the Safety Concept.

A timely definition and implementation of all processes to be considered in the overall process of product realisation.

In this context, timely means beforehand and at the right time at the latest.

It depends largely on the specific licensing environment.

Procedural Part of the Safety Concept (2)

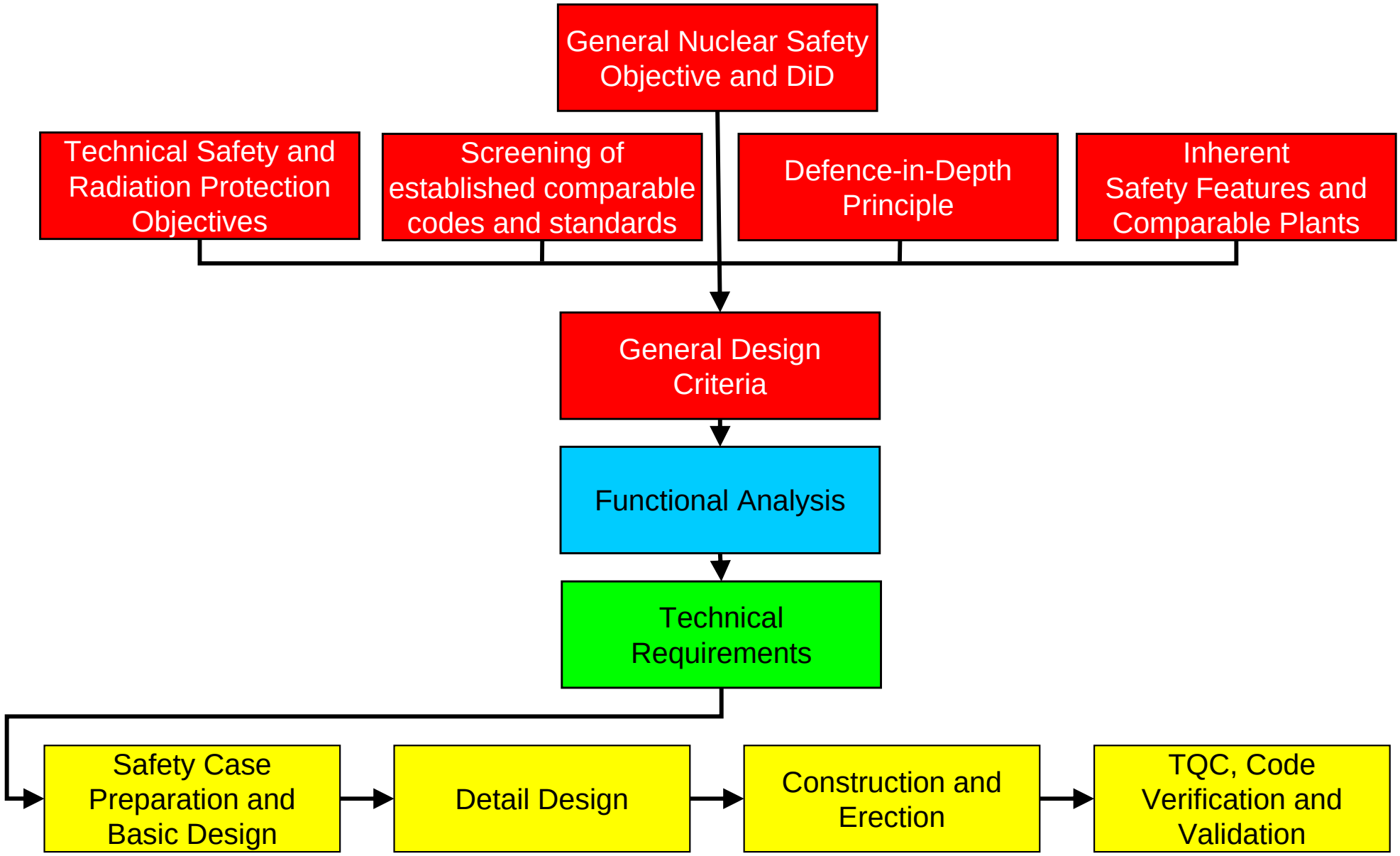


Processes to Be Followed (Common Practice) (1)

In line with the common practice, at least the following processes need to be considered :
Determination of the technical requirements (as outlined in the technical requirements part)
Safety Case preparation and basic design
Detail design
Construction and erection (including manufacture)
Testing, qualification and commissioning (TQC) as well as code verification and validation (V&V)

- New Build Projects and Licensing
- Observed Inconsistencies in the Approach to Safety
- The Safety Concept
  - Features
  - Technical Requirements
  - Procedural Aspects
  - Integral Approach
- Conclusions

The Overall Safety Concept



- New Build Projects and Licensing
- Observed Inconsistencies in the Approach to Safety
- The Safety Concept
  - Features
  - Technical Requirements
  - Procedural Aspects
  - Integral Approach
- Conclusions

Why a Safety Concept?

At the end of this presentation, the question might come up: "What is really new about the Safety Concept?"
An honest answer would be: "Actually nothing."
Next question: "So, why do we discuss the topic at all?"
Again an honest answer: "Because we have observed that in a number of licensing attempts for new build NPP the proven practice evidently seems to have been forgotten.
This should be reason enough to reconsider the implementation of a Safety Concept where this term stands for a systematic approach to safety.

What Are the Benefits?

The Safety Concept as proposed closes a gap in licensing which is evidently existing given the experience referred to at the beginning of this presentation.
It can be used as a tool to remove obstacles on the way forward to a licence and it will promote the necessary transparency in the licensing process.
Implementing a Safety Concept should not be an exclusive issue for the licensee. We expect that it would be most efficient if an agreement between the licensee and the regulator on implementing such concept could be reached.


Thank you for your attention!