

# NPSAG/NKS: Interpretation and Evaluation of the Technical Specification Criteria

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# Presentation Outline

- **Aim of the project**
- **What is PSA?**
- **Technical Specification (TS)**
  - What is TS?
  - Current TS, basis
  - Why use PSA in the evaluation process
- **Some general issues with regard to use of PSA in evaluation of TS**
- **Technical issues with regard to use of PSA in evaluation of TS**
- **Ongoing work**

## Aim of the project

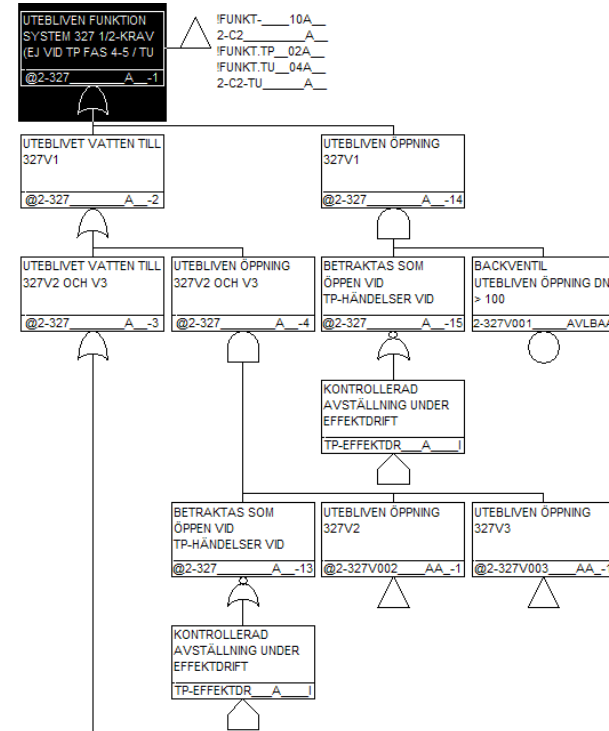
- **Use risk-informed methods for evaluation changes in the Technical Specification**
  - Allowed outage times
  - Surveillance test intervals
    - Not included, example: relaxation/removal of demands
- **Risk informed methods have been applied on a case by case basis**
- **There a several ongoing projects at the NPPs**
  - Modernization
  - Power upgrade
  - These projects will require modification of the TS. The requirements on a risk analysis to verify exceptions will be a natural part of the TS update
- **No generally accepted methodology**



# PSA, what is that?

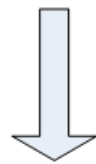
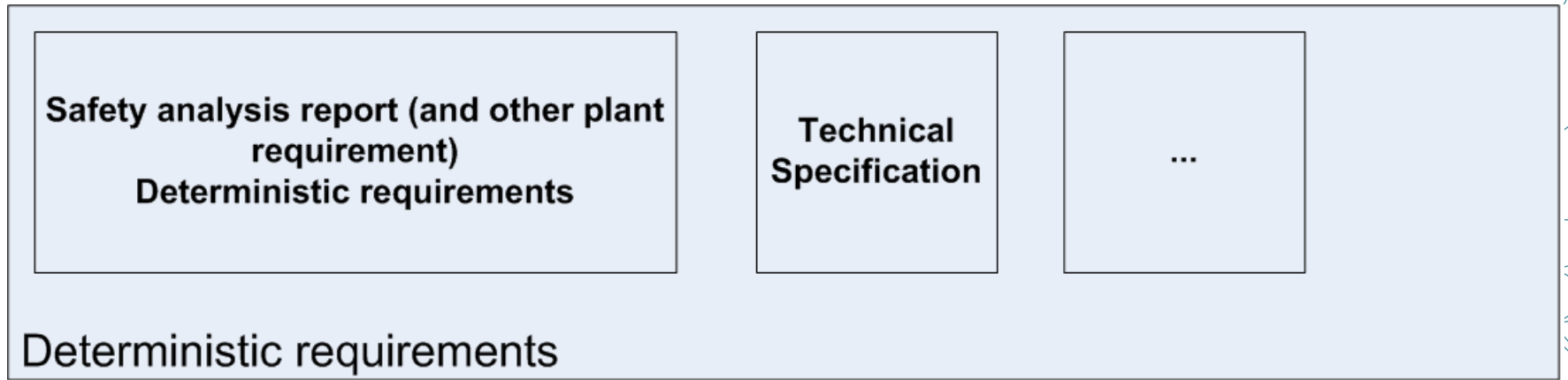
- Probabilistic safety assessment
- Systematic approach studying all failures including probability of failure
- "Complete representation" of plant core damage or release to environment frequency
- Very complex models
- Hence, the importance of each SSC can be estimated from a plant perspective.
- Are by some considered to be a play with figures.

LARGE LOCA CATEGORY	REACTOR SHUTDOWN WITH	PS-FUNCTION	PRESSURE RELIEF OF CONTAINMENT (SYSTEM)	CORE SPRAY SYSTEM (SYSTEM 323)	RESIDUAL HEAT REMOVAL WITH 322	No.	Freq.	Conseq.
AB	354							
LAB	A	I	C1	D1	D2	V	W1	
								LAB__RH
								HS2, HS2L...
								OK
								LAB__RH
								HS2, HS2L...
								HS2, HS2L...
								HS1

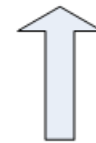
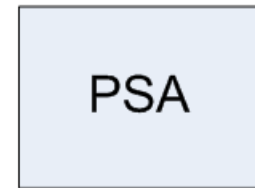
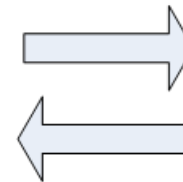


# Technical Specification, what is that?

- **The rules for a safe operation of a nuclear power plant**
- **Mainly representing the Safety Analysis Report (SAR) requirements (define the initial conditions for the safety analysis)**
- **Example:**
  - Define how many components/trains that, at least, shall be available
    - Define exemptions, AOT: How long time can continued operation with components out of service (acceptable risk)
  - Define test interval for emergency core cooling system (acceptable probability of failure)
  - Administrative requirements
- **A constraint: Shutdown is also a challenge to the plant**



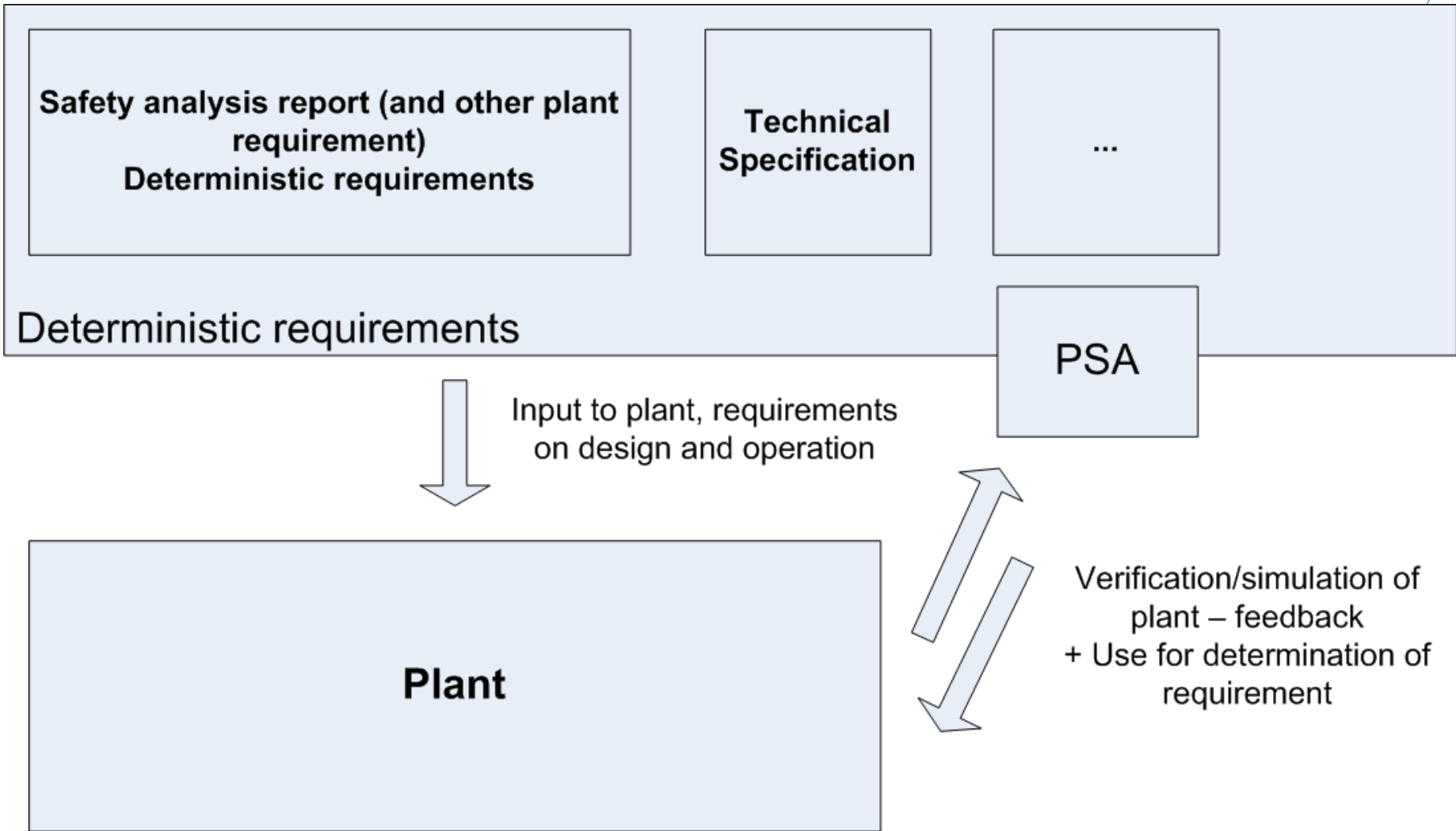
Input to plant, requirements on design and operation



Verification/simulation of plant – feedback

# Current TS

- **Current TS mainly based on deterministic evaluations**
  - Deterministic – means rule based criteria
  - PSA may have formed some basis
    - Evaluation of STI/AOT for some system and then used as "template"
    - Based on tolerated risk level
    - Exemption – RAB PWRs actually used continued operation versus shutdown





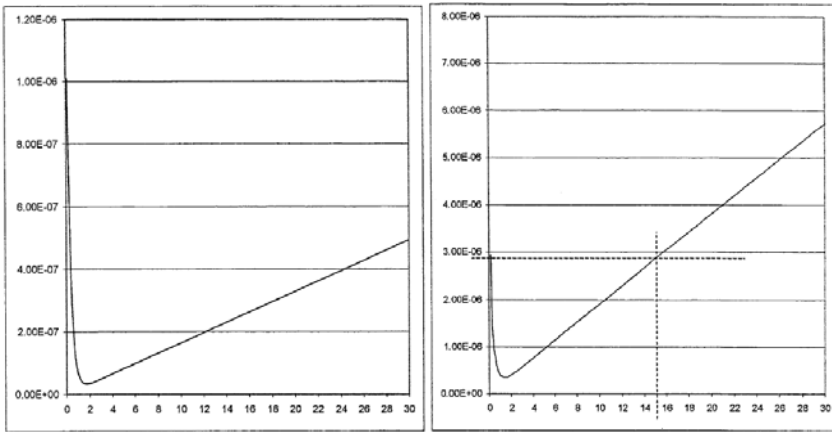
# PSA in the evaluation process, why?

- **Do we need PSA in the evaluation of TS?**
  - Requirement by STUK
  - SSM practice
  - US influence? (Regulatory guides 1.17x)
  - What is the option?
- **Is there a common acceptance on how and what to include in an evaluation?**
- **There are requirements, should there be a guideline?**

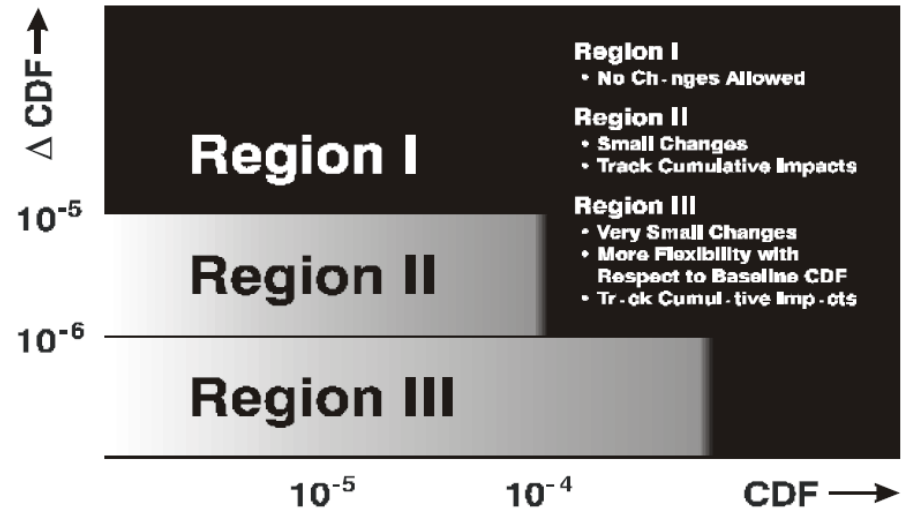
# General issues with regard to use of PSA

- **Contents of TS**
  - What equipment shall be analyzed with PSA?
  - Shall the PSA affect the contents of the TS?
- **What is the evaluation criteria**
  - Core damage frequency?
  - Release frequency?
  - ...
- **Type of events to include in the analysis**
- **Quality issues on the PSA model**
- **Acceptance criteria**

# Acceptance Criteria



*Risk curve for two and three diesels unavailable*



*Acceptance guidelines for Core Damage Frequency (CDF) according to RG1.174*

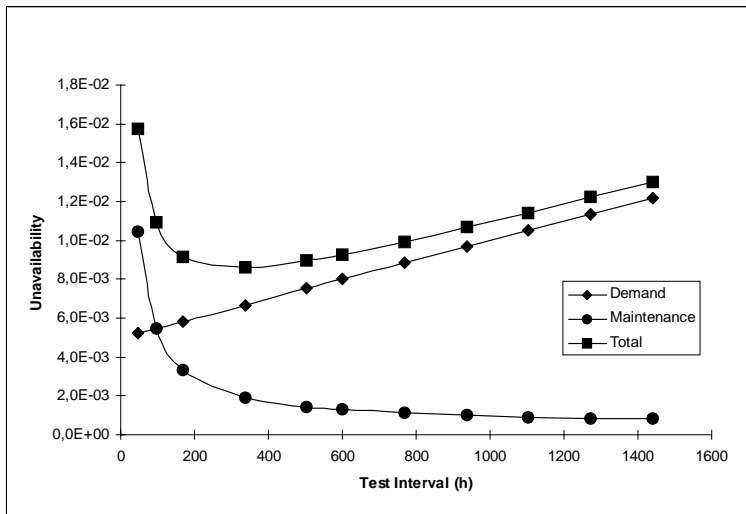
- **Challenge: To define generally acceptable criteria (facilitate)**
- **Not to remove the responsibility from the individual organisations**

# Technical issues with regard to use of PSA

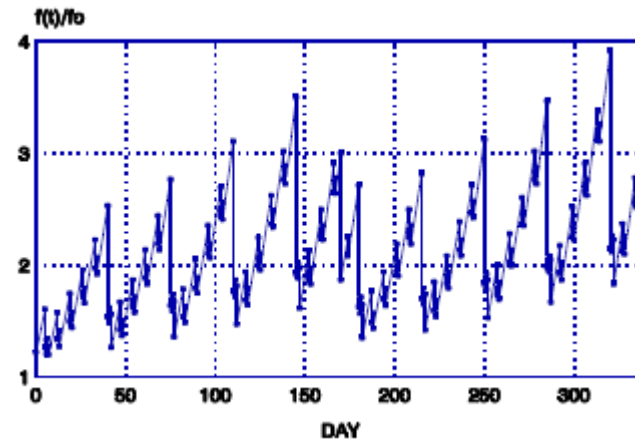
- **Methods to be applied**
- **Analysis assumptions**
- **Treatment of uncertainties**
- **Quality of model and documentation**

# Methods, STI

## Component level optimization



## Plant level optimization



$$R_{Tot} = \sum_{j=1}^n R_{Dj}$$

Where:

$R_{Tot}$  = Total change in risk of a complete test program

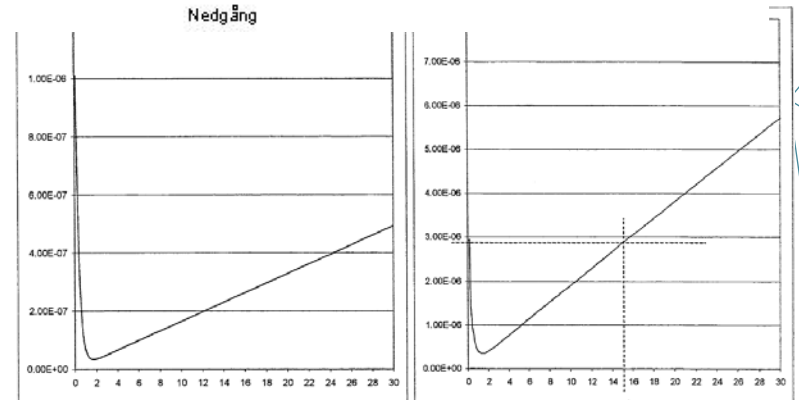
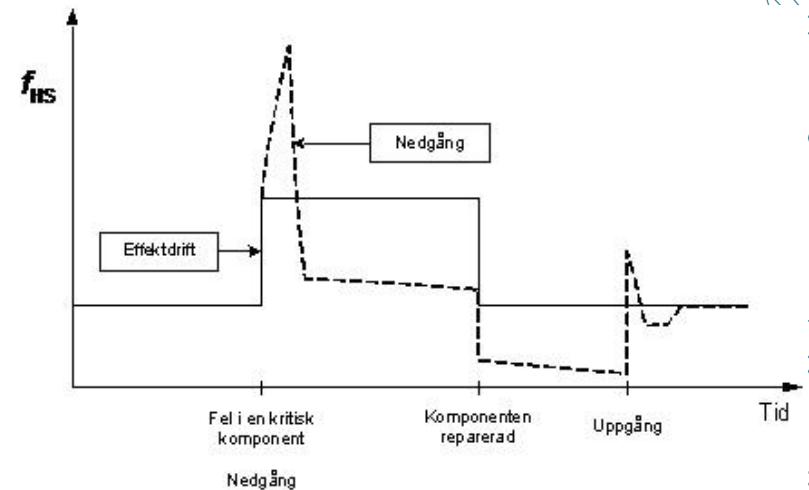
$R_{Dj}$  = Change in risk due to change in one test interval

# Methods, AOT

## Risk budget

$$AOT_x = \frac{P_{Acceptedriskprobability}}{f_{power,x}}$$

## Continued operation vs plant shut down



# Ongoing work: Guidance document

- **Develop Guidance document**
  - Focus on the PSA application process
  - Discuss the requirements on the process
    - Some interesting areas:
      - Treatment of non-safety systems
      - Treatment of accident mitigation system
  - Define what methods that are appropriate
    - Not on a detailed level, but general scope
    - How to address situations where:
      - Components are not part of the PSA
      - Shall consequence mitigation systems be included?
      - Shall systems not included in the SAR be included in the PSA?
  - Acceptance Criteria shall be defined
  - Discuss quality requirements on PSA
    - Not the main target

# The Project

- **Two Phases:**
  - Phase 1:
    - Information gathering, check of performed projects
    - Definition of aspects to be considered in a TS evaluation. Both positive and negative aspects shall be included.
    - Describe the background of the TS today. What was the intention when the TS was written. What would the NPP like the TS to define? What would the authority like the TS to define?
  - **Phase 2:**
    - Development of guidelines for evaluation of TS changes (with regard to the aspects defined in step 1).
    - If necessary, propose changes of the TS (or similar), to satisfy the needs.



# Conclusions from interviews, Using PSA for TS Changes

- **On an overarching level, it seems that there is a reasonable agreement on what type of methods that are existing and what they represent.**
  - The application of STI analyses are also fairly converging.
  - However, the convergence is not that clear for AOT analyses
- **There is not a common agreement on the basis for the analyses**
  - Initiating events
  - Risk measures
  - In Finland the general agreement is to include all initiators and to study both PSA level 1 and 2.

# Conclusions from interviews, Using PSA for TS Changes

- **STI**
  - It seems to be a general acceptance for STI evaluation on plant level, i.e. making trade offs between different systems.
- **AOT**
  - Common understanding in Finland. The same is not valid for Sweden.
  - STUK has actively participated in the development of the method, which may be a reason for its adoption

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