



Risk, hazard, probability, safety, reliability - using these concepts to assure nothing goes wrong in nuclear facilities

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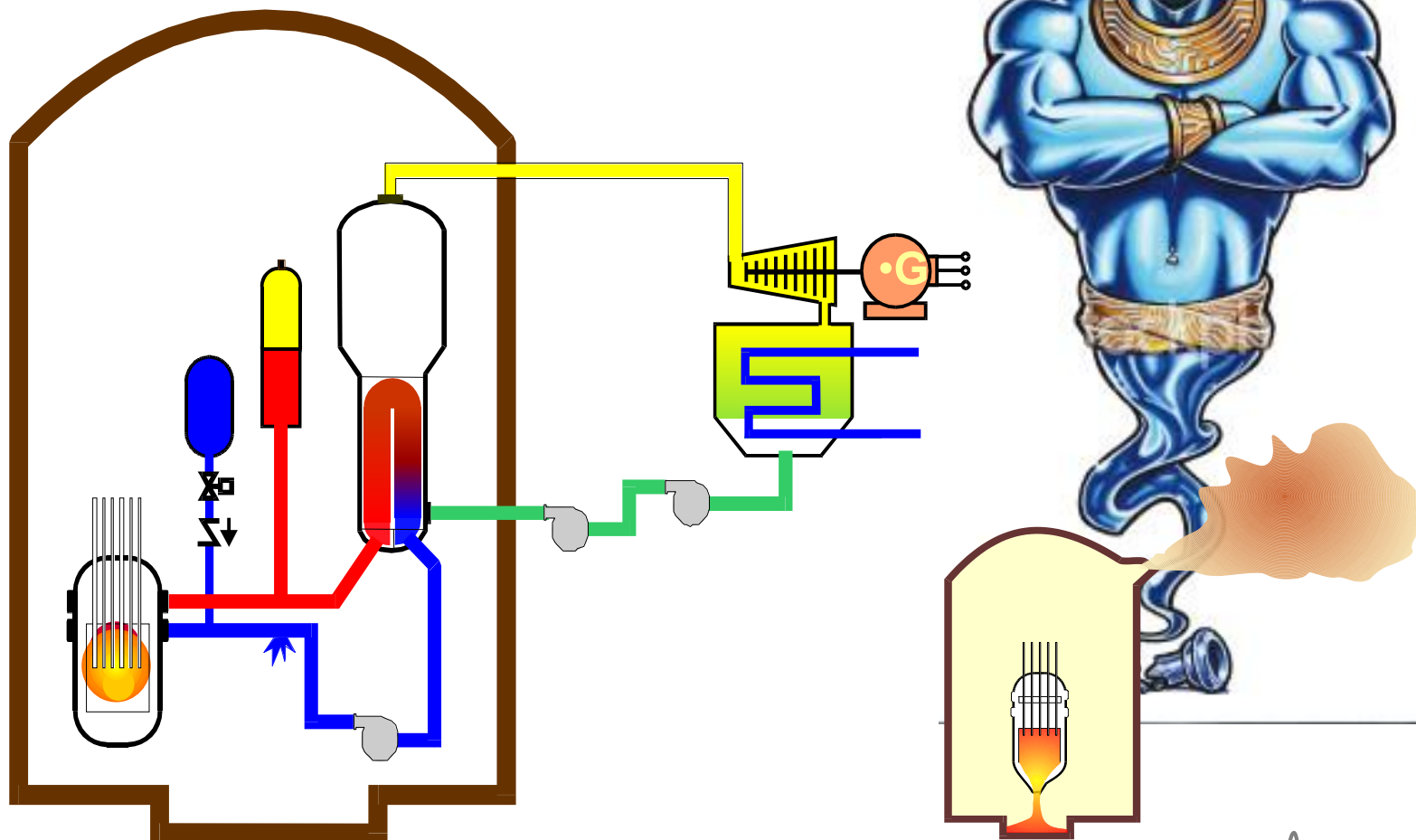
Slovenia – the smallest nuclear country



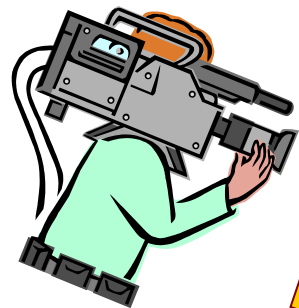
Krško Nuclear Power Plant



What are we trying to avoid?



Safety Assurance System

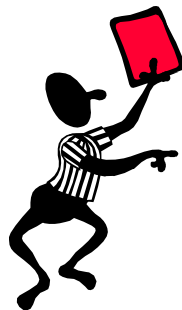


Independent
Media

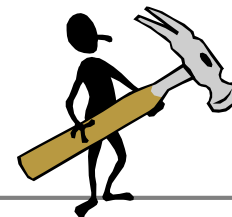
PUBLIC



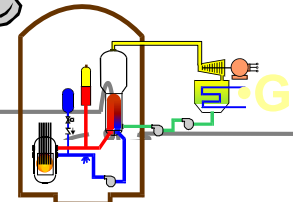
External - State
Supervision
REGULATOR



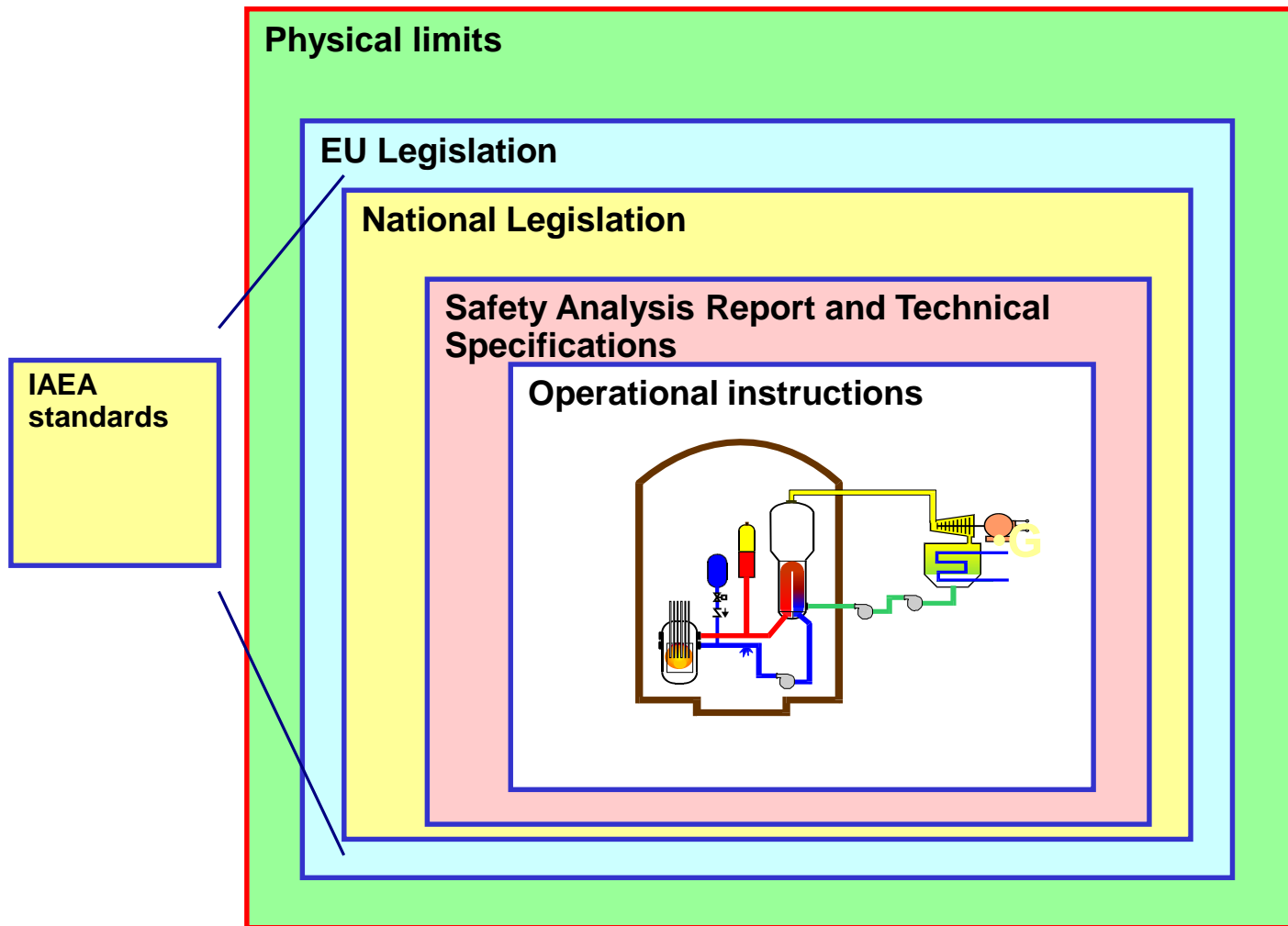
Internal
Quality
Control



Worker
OPERATOR

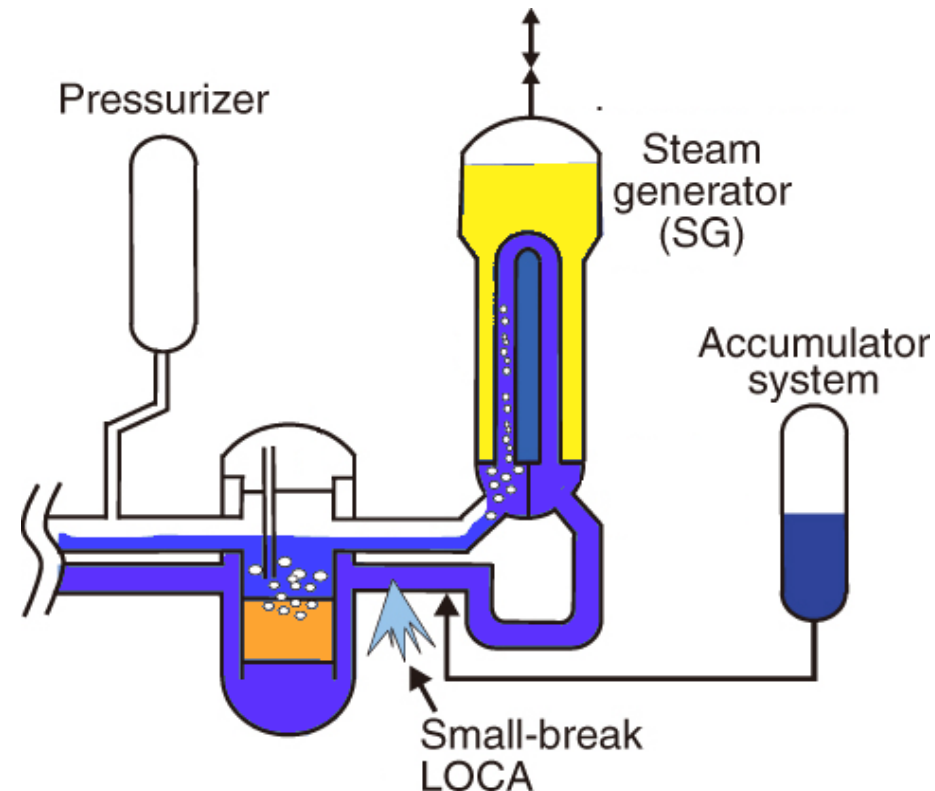


System of limits and control

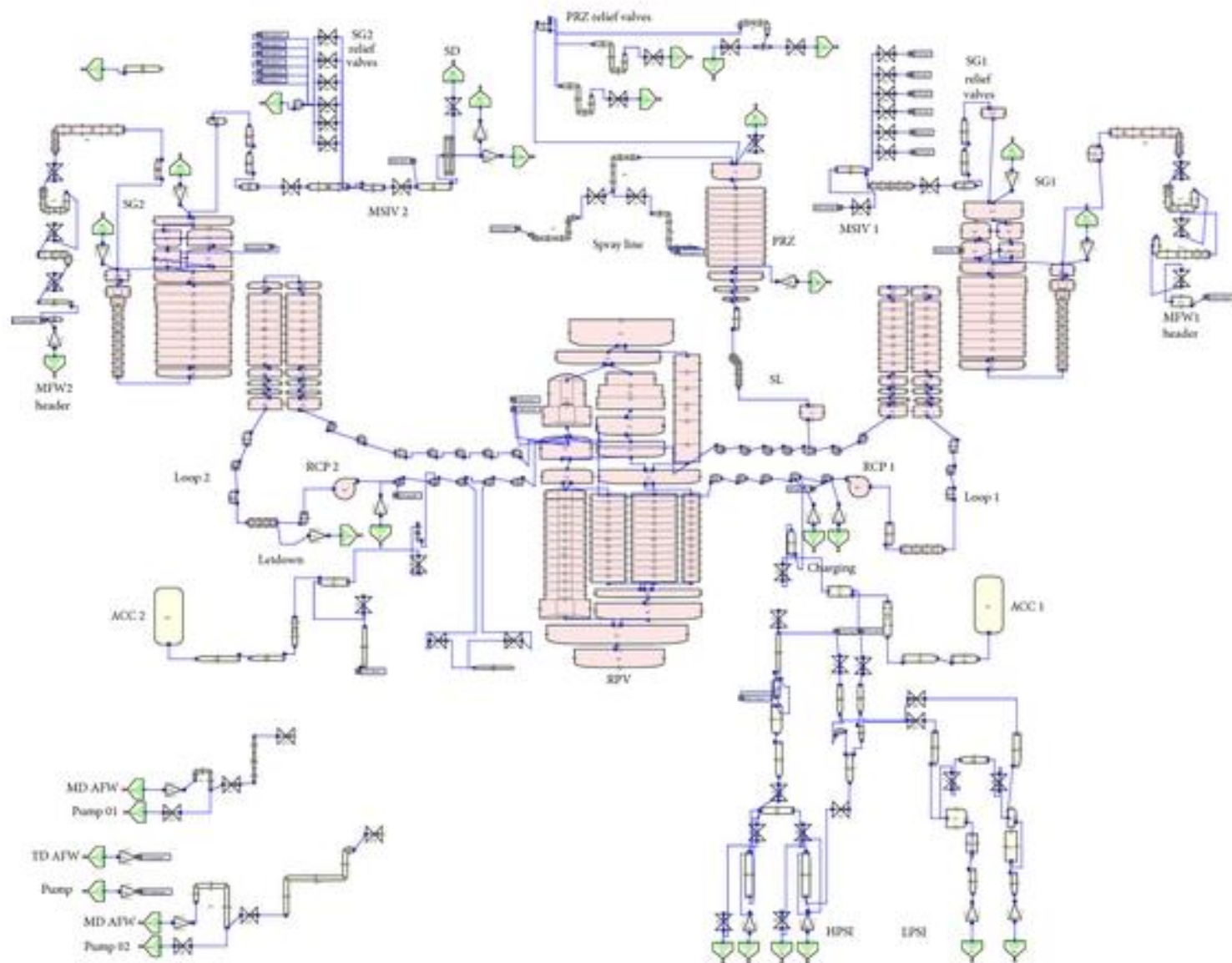


Deterministic safety analyses

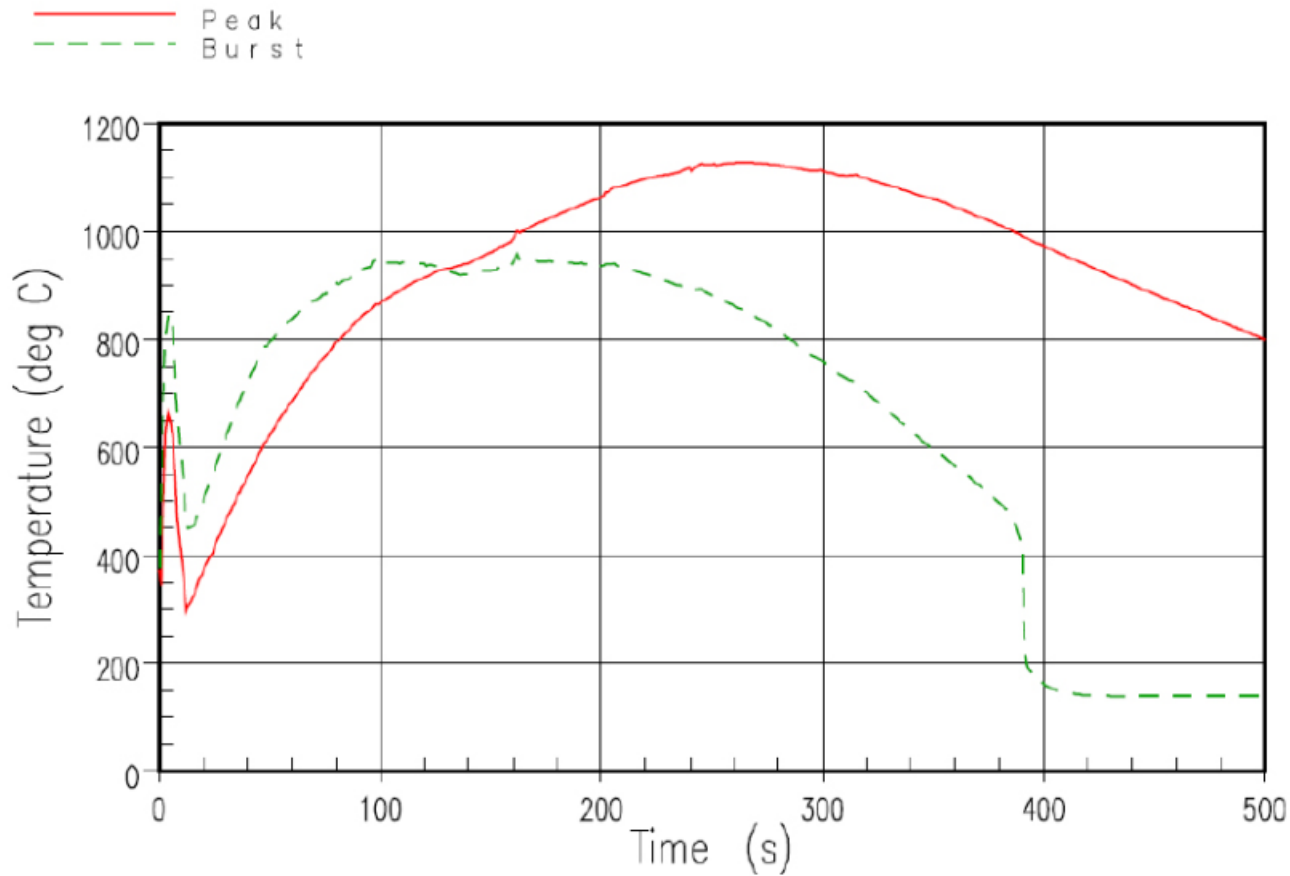
- What if scenarios
 - Breaks
 - Loss of coolant
 - No heat removal
 - Too much heat removal
 - No external power
 - ...



Deterministic safety analyses - modelling



Deterministic safety analyses - results

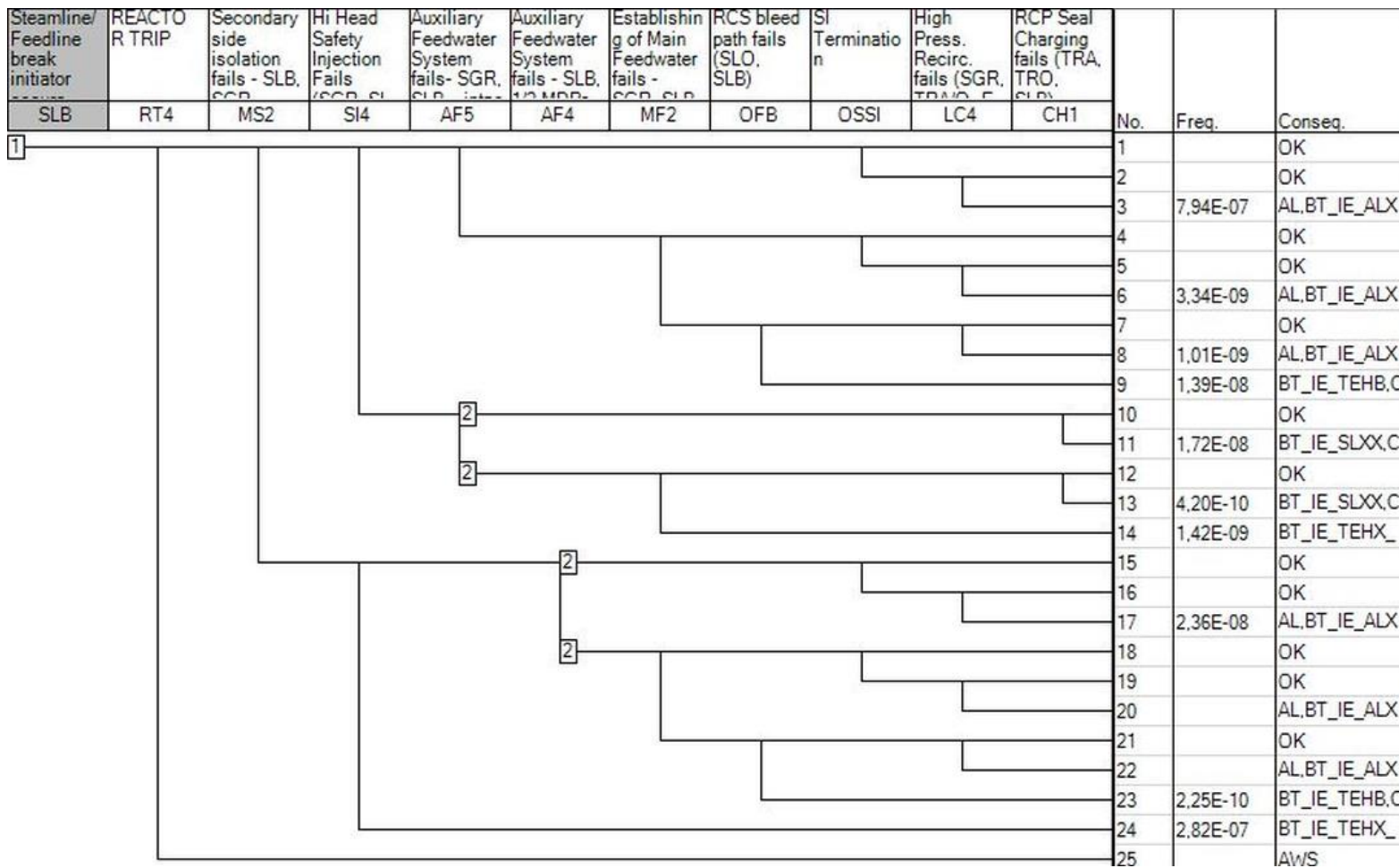


HOT SPOT CLAD TEMPERATURE
 $C_D = 0.4$ DECLG – High Tav
(Chopped Cosine) - UFC

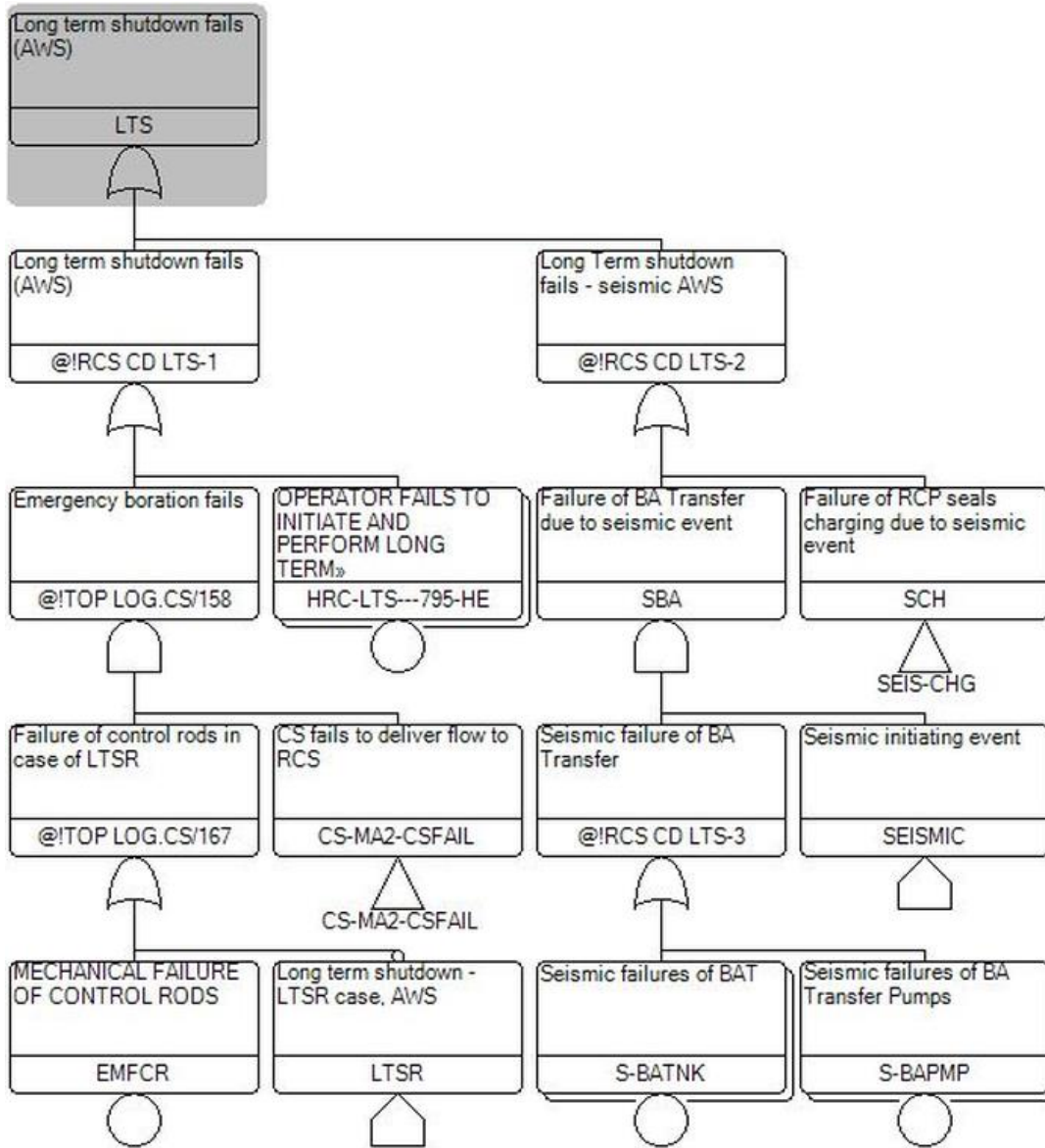


Probabilistic safety analysis – event tree

- Which events lead to the reactor core melt and radioactivity release?

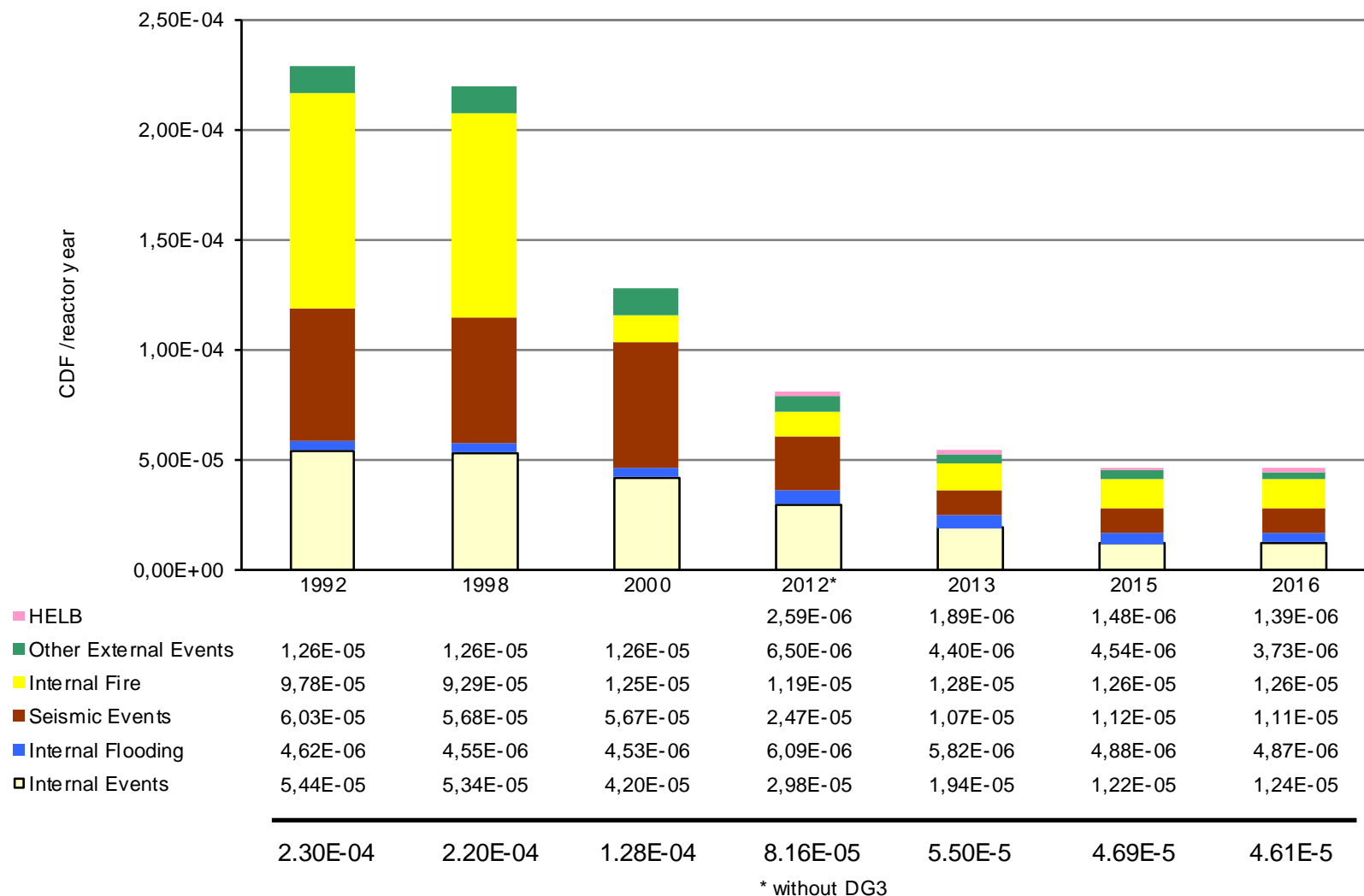


Probabilistic safety analysis – fault tree



- What contributes the most to the core damage frequency?

Probabilistic Safety Analysis



Technology is easy part...

- ... challenging is Safety Culture!
- **Is the operator trustworthy?**



- **Bad driver...**
- ...can be killed with the best car

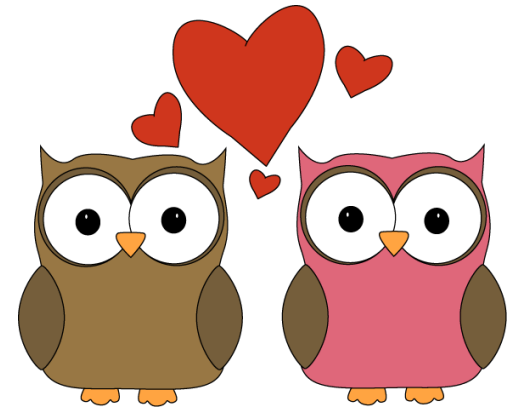


- **Careful driver...**
- ...may reach destination safely with any vehicle.



Safety Culture

- **Safety Culture** is like **love**!
- It is about emotions!
- Even if some love is there ...
- **... there could always be more of it!**
- **You can not measure love, you can just feel it!**
- You can not say to your wife: "Your love is at 73% today!"



Terms we like to use

- Quality control
 - Management system
 - Integrated management system
 - ISO 9001
 - Human factor
 - Man machine interface
 - Human-Technology-Organisation (HTO)
 - ...
-
- **It is all about us, people, and the way we behave!**
We are the biggest challenge!

Two challenges about probability for the end



First challenge for experts

- My wife was stopped in our town by a German tourist:

„Please, can you help me find this person?“

- That was her name and address!

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- He was a brother of our friend from Germany. He was first time in Ljubljana and my wife was the first person who he has asked for directions!
- What could be the explanation for such a coincidence?

Second challenge for experts

- I was driving my old Subaru when my relative, who was driving with me, asked me:



„How many kilometres does this car have?“

- I looked at the odometer and it was showing:

350.000

Exactly!

- What is the probability for such a coincidence?

For the end ...

- Understanding risks,
- knowing hazards,
- dealing with probabilities,
- aware of many uncertainties,
- ... we are doing everything we can to make any serious threat to safety

practically eliminated!