Nuclear Safety and How it is Ensured

Nuclear Science and Technology Symposium – SYP2022
Helsinki, 1-2 November 2022
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The Core Team
of Nuclear Experts

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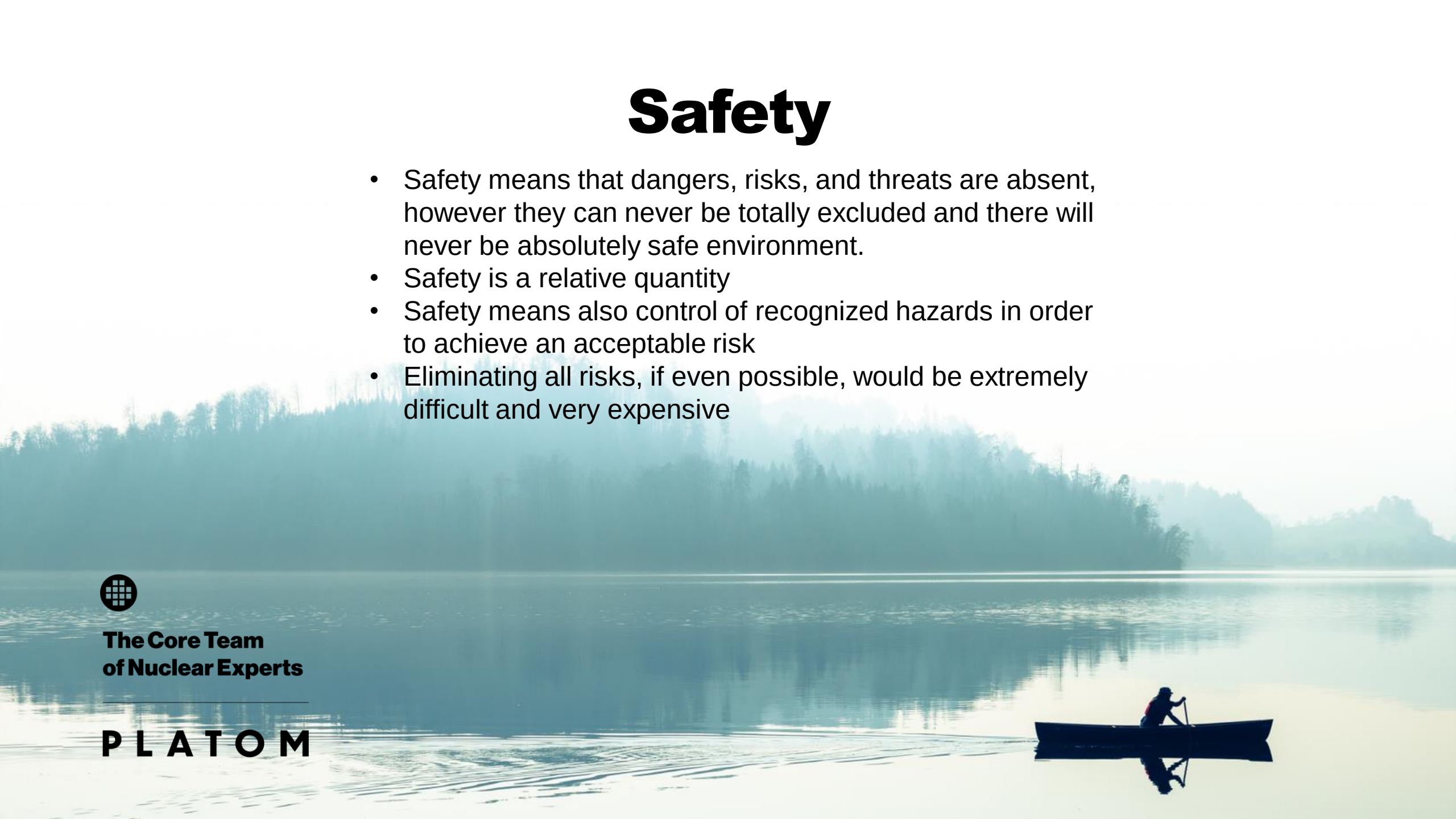
Safety

- Safety means that dangers, risks, and threats are absent, however they can never be totally excluded and there will never be absolutely safe environment.
- Safety is a relative quantity
- Safety means also control of recognized hazards in order to achieve an acceptable risk
- Eliminating all risks, if even possible, would be extremely difficult and very expensive



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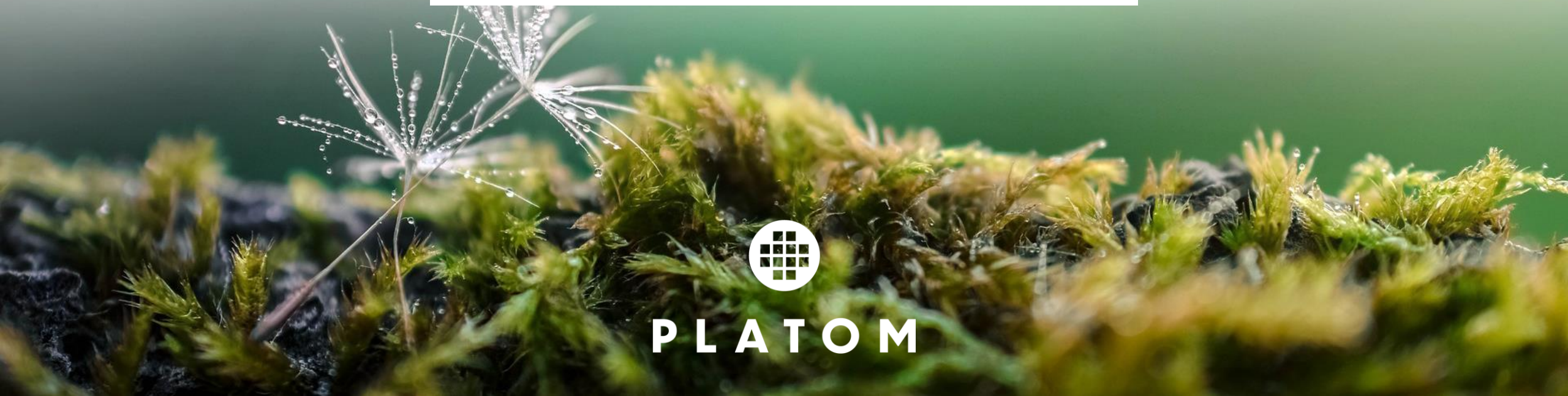
Nuclear safety directive

2. 'nuclear safety' means the achievement of proper operating conditions, prevention of accidents and mitigation of accident consequences, resulting in protection of workers and the general public from dangers arising from ionizing radiations from nuclear installations;



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Role of Safety Analyses

- Describes the plant behaviour in transient and accident conditions
- An integral part of the design process to verify and measure the level of safety
- To confirm that the design meets relevant safety and licensing requirements
- Best conducted in parallel with the design process, with iteration between the design and the analysis
- Demonstrate to the regulatory body that the design features and operational limits and conditions have been selected to ensure that the fundamental safety functions i.e. **reactivity control, decay heat removal and activity localization**, are met and to **ensure the protection of workers, the public and the environment from unacceptable radiological consequences**.
- Provides the inputs necessary to specify the operator actions to be taken in transient conditions

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What is analysed

- Nuclear power plant is designed against postulated initiating events i.e. design basis accidents
- **List of postulated initiating events** is composed through systematic process and includes all events that could challenge the fundamental safety functions and result in unacceptable consequences
- Postulated initiating events are categorized according to their frequency and analysed according to the rules of each category
  - (Normal Operation)
  - Anticipated Operational Occurrences (DBC 2)
  - Class 1 Postulated Accidents (DBC 3)
  - Class 2 Postulated Accidents (DBC 4)
  - Design Extension Conditions (DEC A, DEC B, DEC C)
  - Severe Accidents
- Each category does have predetermined acceptance criteria and the results must show that acceptance criteria limits are not exceeded
- If the limits are exceeded, then the design need to be corrected

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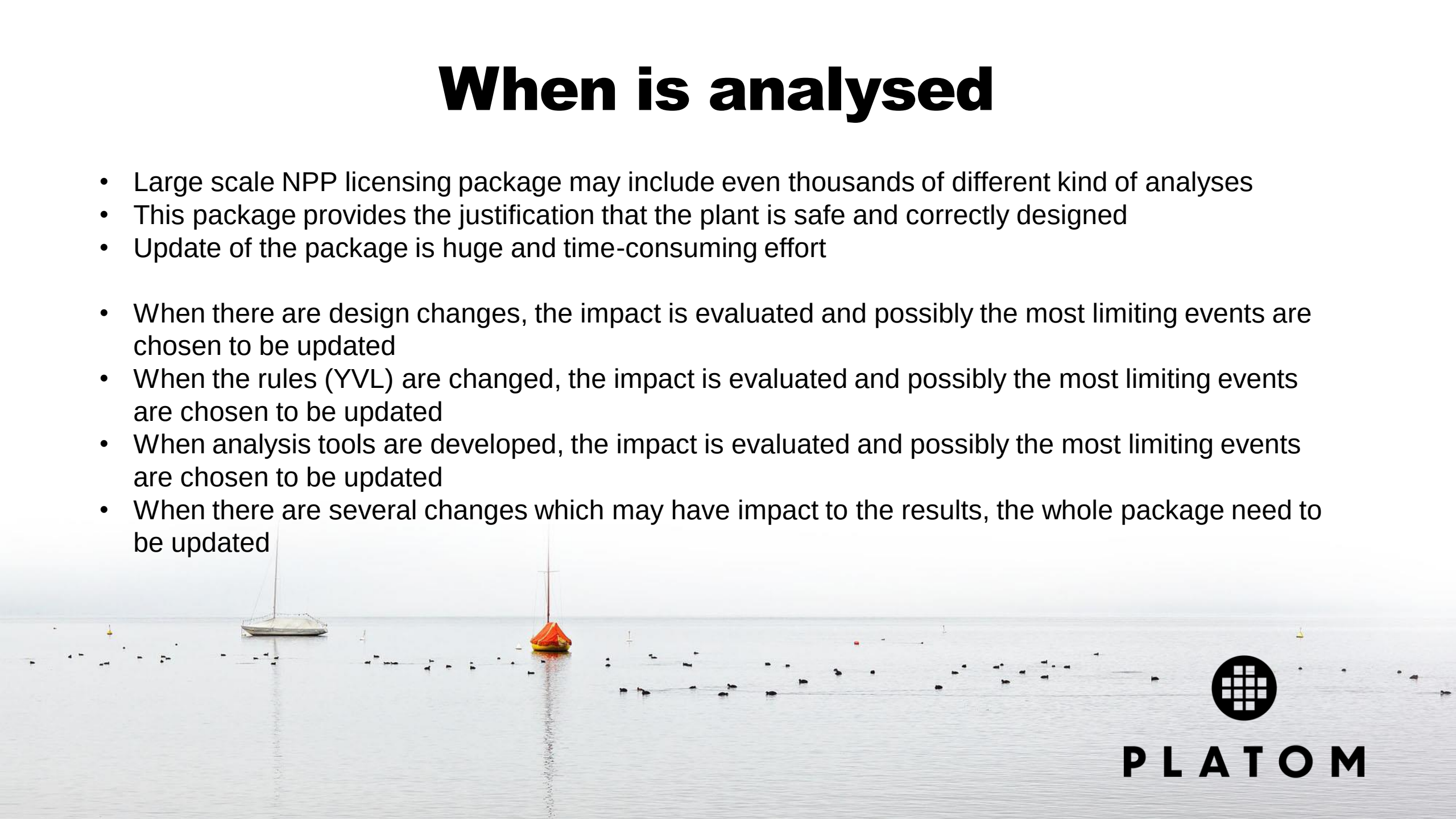
When is analysed

- Large scale NPP licensing package may include even thousands of different kind of analyses
- This package provides the justification that the plant is safe and correctly designed
- Update of the package is huge and time-consuming effort

- When there are design changes, the impact is evaluated and possibly the most limiting events are chosen to be updated
- When the rules (YVL) are changed, the impact is evaluated and possibly the most limiting events are chosen to be updated
- When analysis tools are developed, the impact is evaluated and possibly the most limiting events are chosen to be updated
- When there are several changes which may have impact to the results, the whole package need to be updated



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Why is analysed

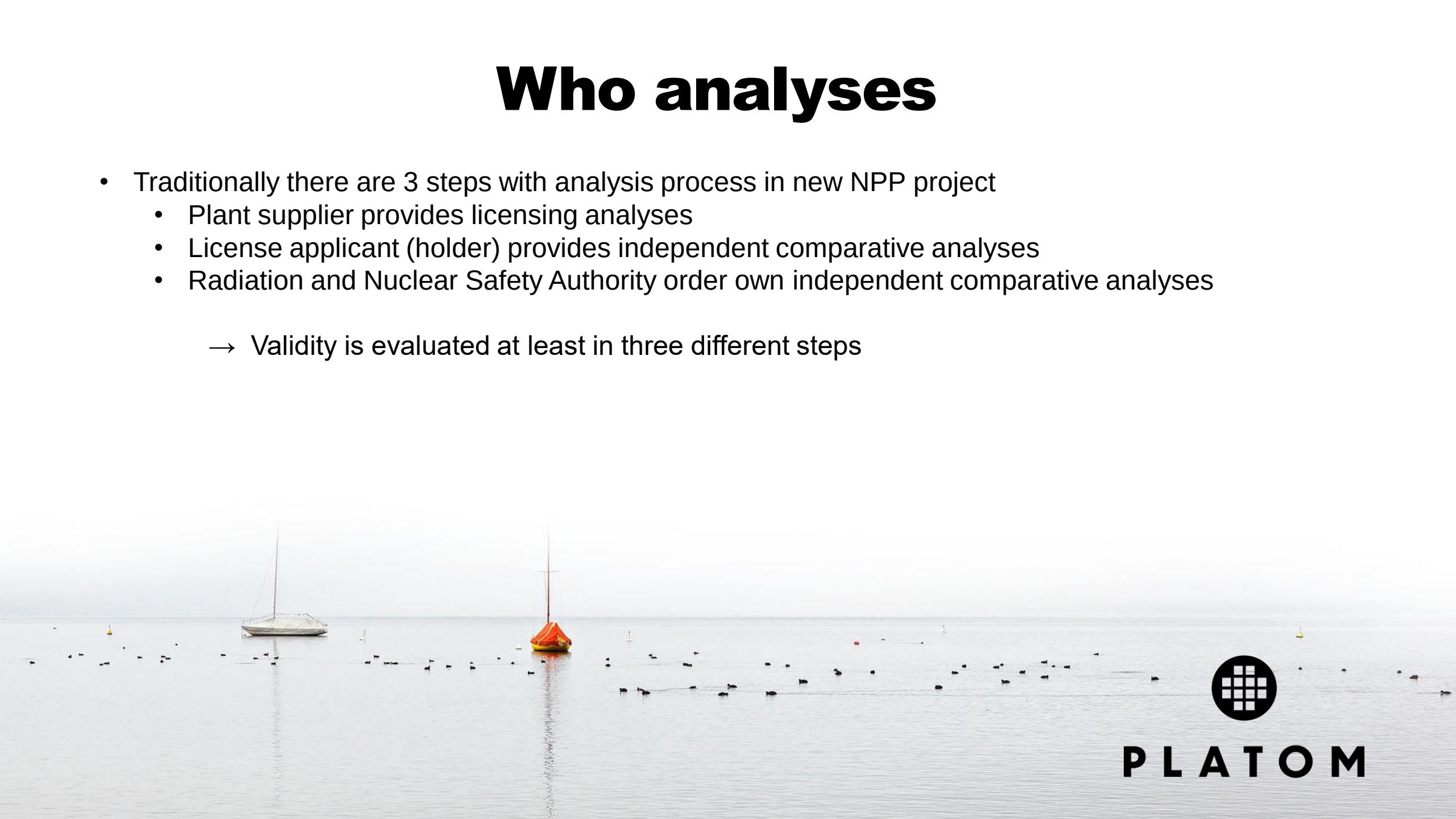
- To provide justification that safety system design is correct

- Acceptance criteria for nuclear fuel, pressure control, overpressure, radiological consequences are fulfilled
- The ultimate safety target is to protect the general public and workers from radiation

Who analyses

- Traditionally there are 3 steps with analysis process in new NPP project
  - Plant supplier provides licensing analyses
  - License applicant (holder) provides independent comparative analyses
  - Radiation and Nuclear Safety Authority order own independent comparative analyses

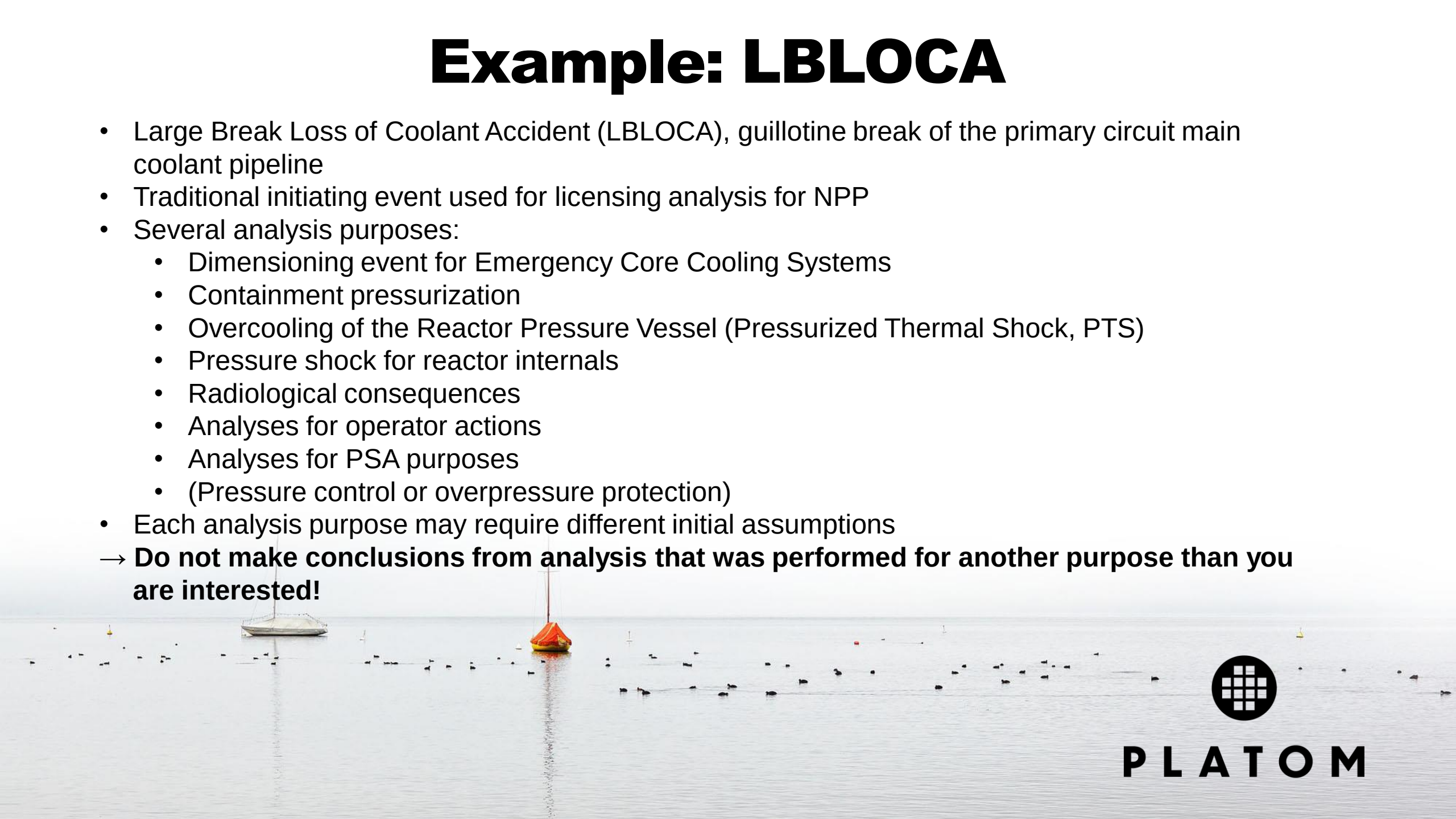
→ Validity is evaluated at least in three different steps



Example: LBLOCA

- Large Break Loss of Coolant Accident (LBLOCA), guillotine break of the primary circuit main coolant pipeline
- Traditional initiating event used for licensing analysis for NPP
- Several analysis purposes:
  - Dimensioning event for Emergency Core Cooling Systems
  - Containment pressurization
  - Overcooling of the Reactor Pressure Vessel (Pressurized Thermal Shock, PTS)
  - Pressure shock for reactor internals
  - Radiological consequences
  - Analyses for operator actions
  - Analyses for PSA purposes
  - (Pressure control or overpressure protection)
- Each analysis purpose may require different initial assumptions

→ **Do not make conclusions from analysis that was performed for another purpose than you are interested!**



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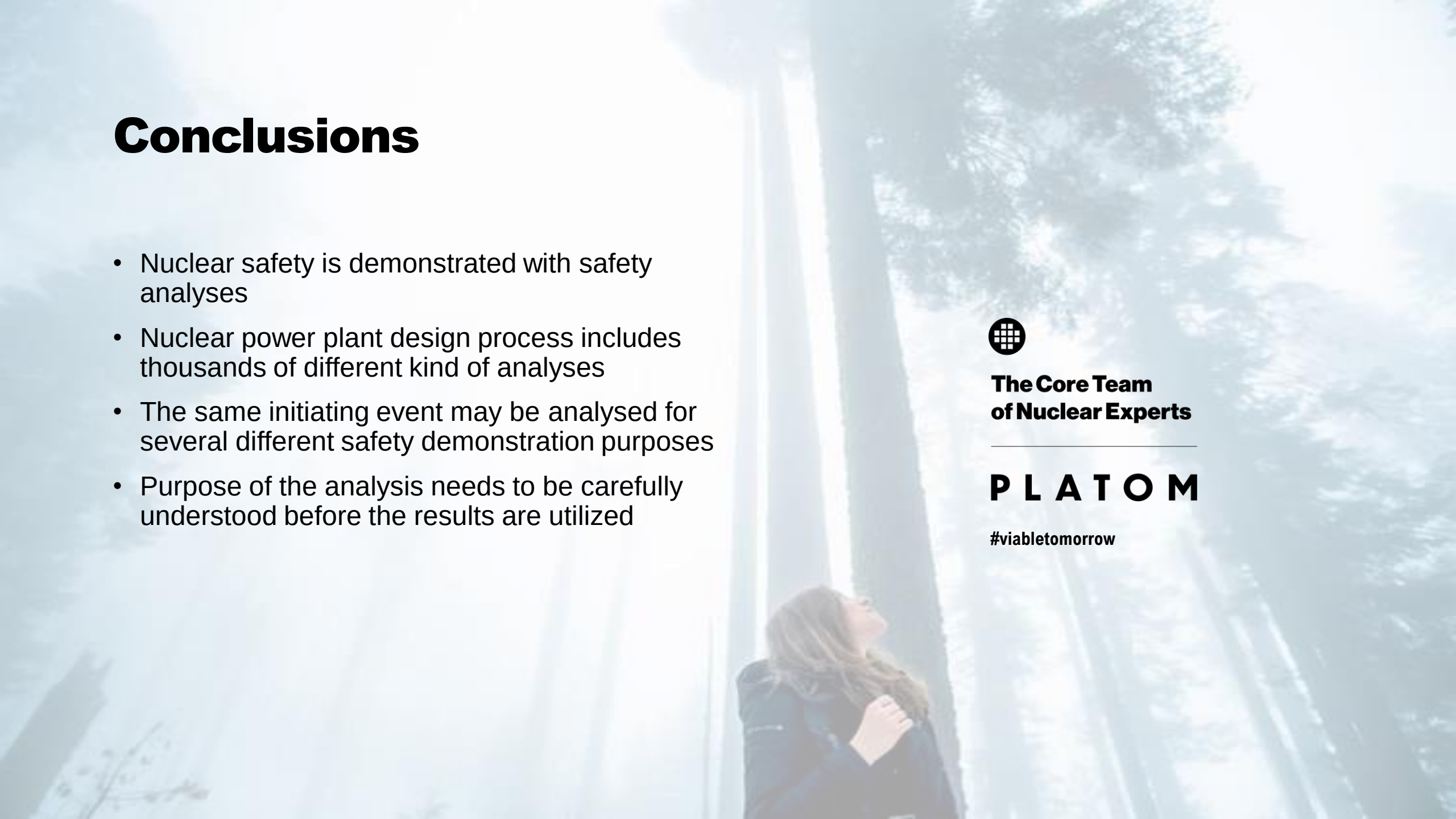
Conclusions

- Nuclear safety is demonstrated with safety analyses
- Nuclear power plant design process includes thousands of different kind of analyses
- The same initiating event may be analysed for several different safety demonstration purposes
- Purpose of the analysis needs to be carefully understood before the results are utilized



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Thank you!

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