Reconsideration of PRA Framework
— Addressing Level 3 PRA Coverage and Multi-Unit Issues —

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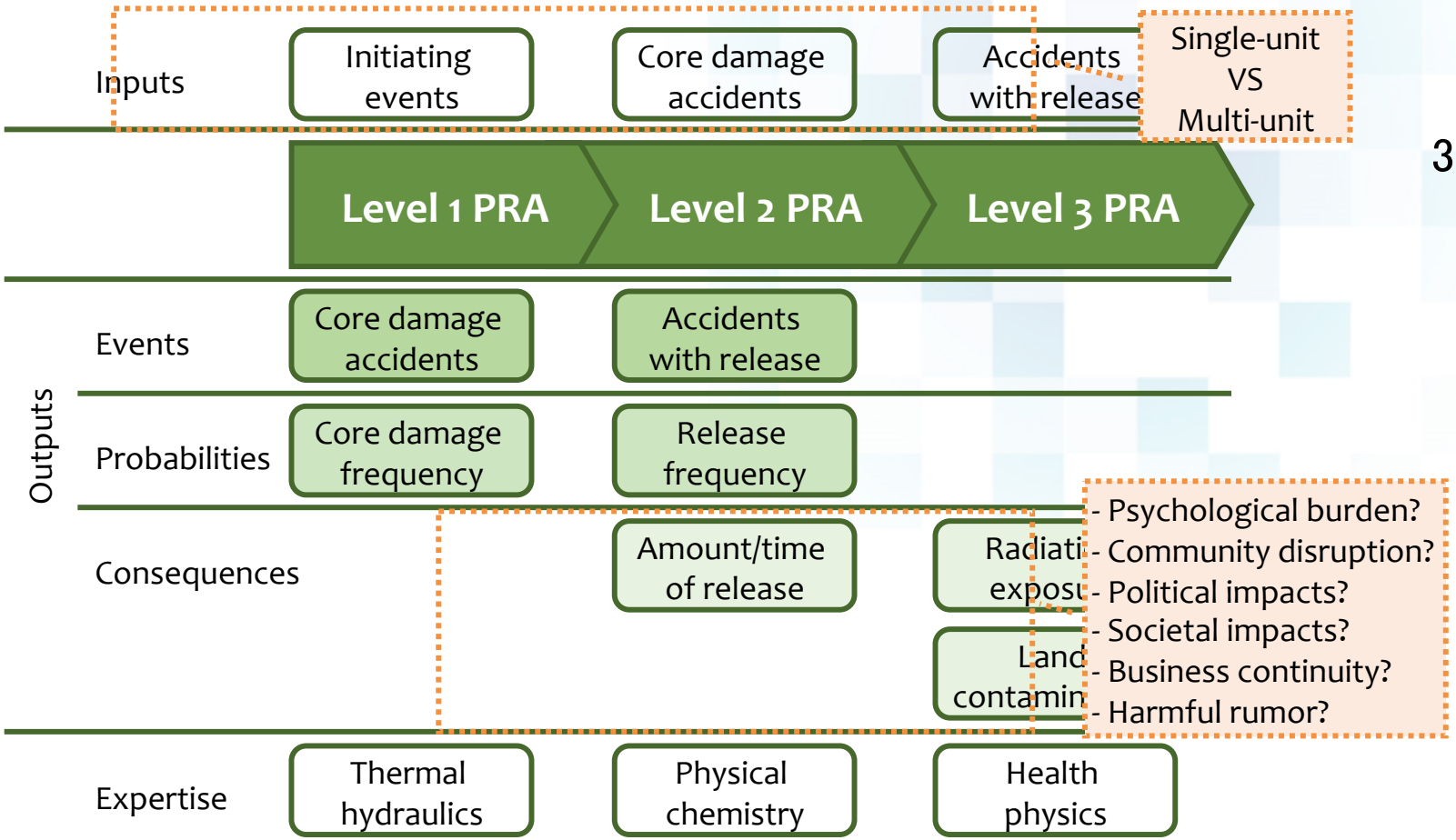
Probabilistic Risk Assessment (PRA)

Note

This study focuses on PRA performed as ***a series of PRAs*** *from level 1 to level 3 PRA, and* ***deliver accident consequences*** *represented by radiation exposure and land contamination as their outputs.*

Not those used to satisfy regulatory requirements or to justify facility modification.

Probabilistic Risk Assessment (PRA)



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How has the community been addressing the issues?

"Quantification of total risk of accident"

- Enlarge the coverage of level 3 PRA
  - Accident cost estimation
  - Non radiation-induced health effects
- Multi-unit PRA
  - Accidents initiated by external events e.g. earthquake, tsunami, flood
- From *academia* to *industry* and *regulator body*
- *Justifiable* and *evidence-based* risk-related discussion

Will this lead to NEW ISSUES?

Objective

*"To **identify foreseen issues** arising from the enlargement of PRA coverage,*

*and to **propose an alternative approach** to tackle the issue on quantification of the total risk of accident."*

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Foreseen Issues from the Enlargement of PRA Coverage

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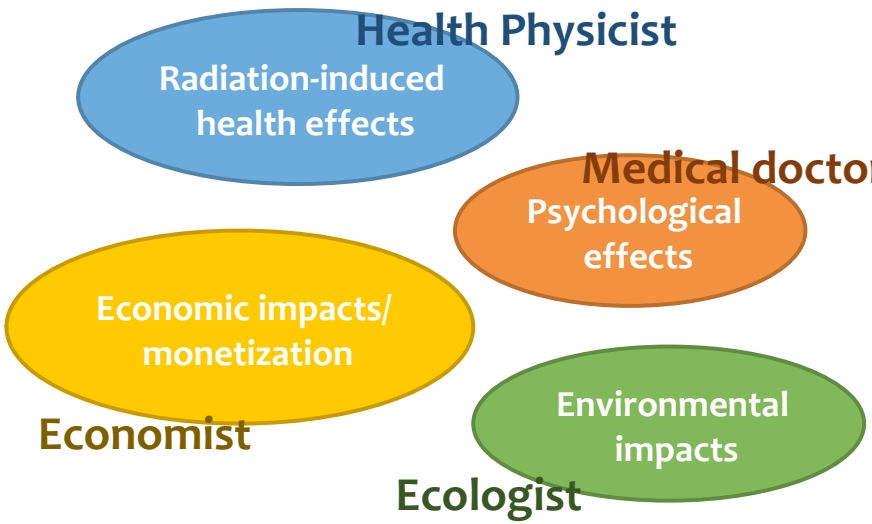
1. Difficulty Attributed to Multidisciplinary Approach

Level 3 PRA



Not affordable

→ Level 3 PRA incompletely covering more categories of consequences

Multi-unit PRA

- Data management skills
- Understanding of downstream assessments

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2. Acquisition and Management of Excessive Amount of Data

Level 3 PRA

- **Quantification of accident consequences** means…
  - Health, economic, environment, society, …
  - Meteorological data, land use data, population data, economic data, …
- How to **integrate the data**?
  - Monetization?
  - Normalized unit?
  - Can public/decision makers understand?

Multi-unit PRA

- Single-unit PRA itself needs a great deal of data.
- Multi-unit PRA
  - **Common cause failures** for all possible combinations
  - Several-fold of data
- Grouping of inputs from upstream results require efforts.

→Limited scope multi-unit PRA

Hardly contribute to quantification of total risk of accident…

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3. Difficulty in Decision Making

Results

+

Assumptions

Uncertainties

Risk Assessor **Risk Manager**

Larger amount and higher quality of information makes PRA even more difficult for decision makers to deal with

4. Difficulty in Communicating with Stakeholders

- Post-Fukushima: *Risk information* has to be shared with *various stakeholders*
  - Likelihood, consequences
  - Local community, public, decision maker, regulatory body, etc.
- **Challenge: How to communicate calculated risks with great uncertainties?**
  - It differs from concept of so-called ***"safety myth"***.
  - It can lead to negative and/or sensitive societal reactions.
  - Enlarged scope and increased uncertainties increase complexity.

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Proposal of Alternative Framework

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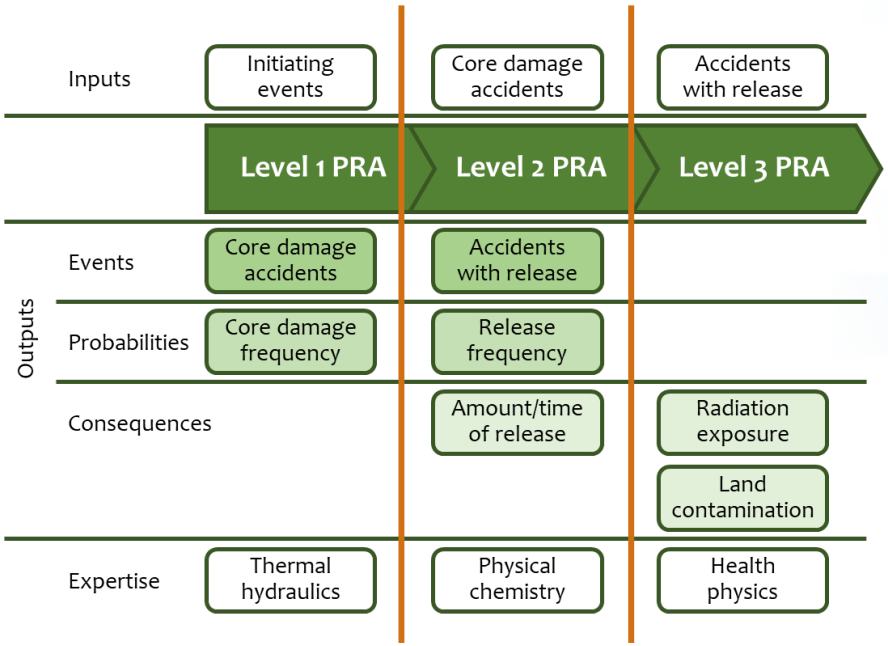
1. Following Traditional PRA Scope



Perform single unit PRA separately

- Work within own territory
  - Solution to *difficulty attributed to multidisciplinary approach*
- Limited amount of data
  - Solution to *acquisition and management of excessive amount of data*
- Complexity is reduced
  - Solution to *Difficulty in Communicating with Stakeholders*

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2. Qualitative or Semi-Quantitative Impact Assessment

- Quantify all quantifiable consequences using ***suitable units***.
- Cover other consequences by qualitative or semi-quantitative impact assessment.
- Show ***trade-offs*** among different consequences.

Solution to *issues from 1F accident (level 3 PRA coverage and multi-unit consideration)*

- Qualitative assessment
  - Participatory analysis
  - Questionnaire survey
  - Delphi method
  - Qualitative impact assessment protocol
- Semi-quantitative impact assessment
  - Likert scale
  - Overall percentage score

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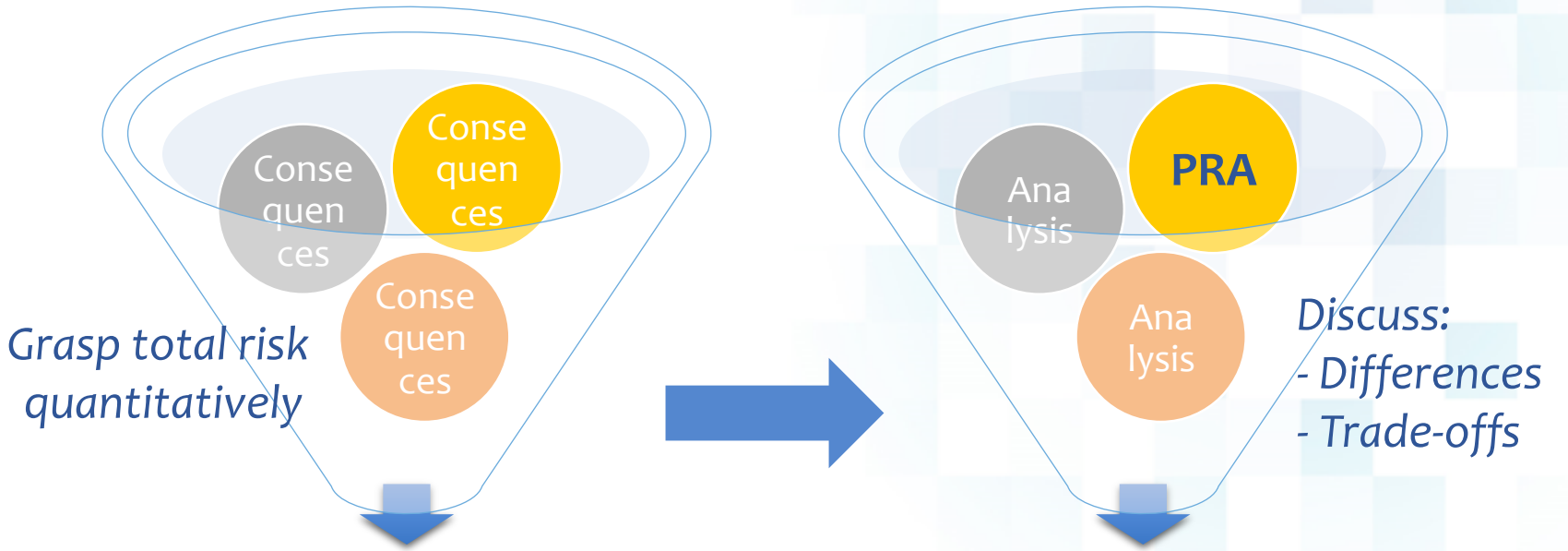
3. Establishing a Deliberation Phase



Grasp total risk quantitatively

Discuss:
- Differences
- Trade-offs

PRA

Techno-centrism

Deliberation

Integration of diverse professions
Discussion b/w technical and non-technical

Solution to *difficulty in decision making and also difficulty in communicating with stakeholders*

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Conclusions

- Foreseen issues arising from the enlargement of PRA coverage in order to quantify the total risk of accident were identified.
  - Difficulty attributed to ***multidisciplinary approach***
  - Acquisition and management of ***excessive amount of data***
  - Difficulty in ***decision-making***
  - Difficulty in ***communicating with stakeholders***
- An alternative approach was proposed to tackle aforementioned issues.
  - Stick with ***traditional PRA scope***
  - Cover non-quantifiable consequences by ***qualitative or semi-quantitative assessment***
  - Go through ***deliberation*** process

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"The essence of map consists in abstraction and highlighting desiderata. The same is true for risk assessment. While overlooking necessary risk insights is never allowed, ambition to reproduce all the physical phenomena will not serve its original purpose. PRA may lead to prudent decisions when allocating limited resources to high priority issues."

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