

DE LA RECHERCHE À L'INDUSTRIE



# METHODOLOGY FOR SAFETY REASSESSMENT OF CEA FACILITIES AND SITE

## CEA Cadarache

## 1. Context

Usually French safety provisions

Context

Organisation

## 2. Methodology Overview

Safety reassessments methodology

## 3. Consequences for Cadarache Facilities and Site

Cadarache facilities taken into account

Cadarache site consequences

# 1. CONTEXT

## Usually French safety provisions

- For each facility, the CEA applies a « safety approach » during the whole facilities lifetime, from the basis design and the operating to the dismantling :
  - Some successive barriers must be implemented
  - Defence in depth concept must be applied with some defence levels to :
    - Prevent : basis design, execution and operating quality
    - Protect : condition monitoring, stay in authorized field
    - Limit the accident consequences : an accident is postulated, capabilities to detect it, face it and limit the consequences are established

=> technical and organisational provisions
- Crisis organisation :
  - PUI : internal emergency plan for each site, to cope with crisis situations and limit the consequences of potential accidents, this plan is regularly tested
- Every ten years, for each facility, operators have to carry on a safety review :
  - Compliance status
  - Safety review to take into account recent requirements

=> periodic improvements for facilities safety

# 1. CONTEXT

## French safety reassessments

- 5th may 2011 decision of the French safety regulatory body :
  - Safety reassessments for CEA facilities in light of Fukushima power plant accident
  - First safety reassessments expected for 15th September 2011
  
- For CEA facilities, methodology and organisation established by CEA-DPSN (Protection and Nuclear Safety Department) :
  - Based on WENRA specifications for nuclear power plants
  - Based on existing safety studies and engineering judgement
  - Depends on risks associated with facilities and the remaining operating time of those facilities
  - Define **the potential cliff-edge effect** : a strong discontinuity in a facility behaviour which leads to a sudden and severe accident sequences deterioration, especially in terms of radioactive release or dangerous products release in cause

# 1. CONTEXT

## CEA Organisation

- Specific organisation against short milestones

national level :

steering committee

review committee

sites level :

drafting groups

experts support :

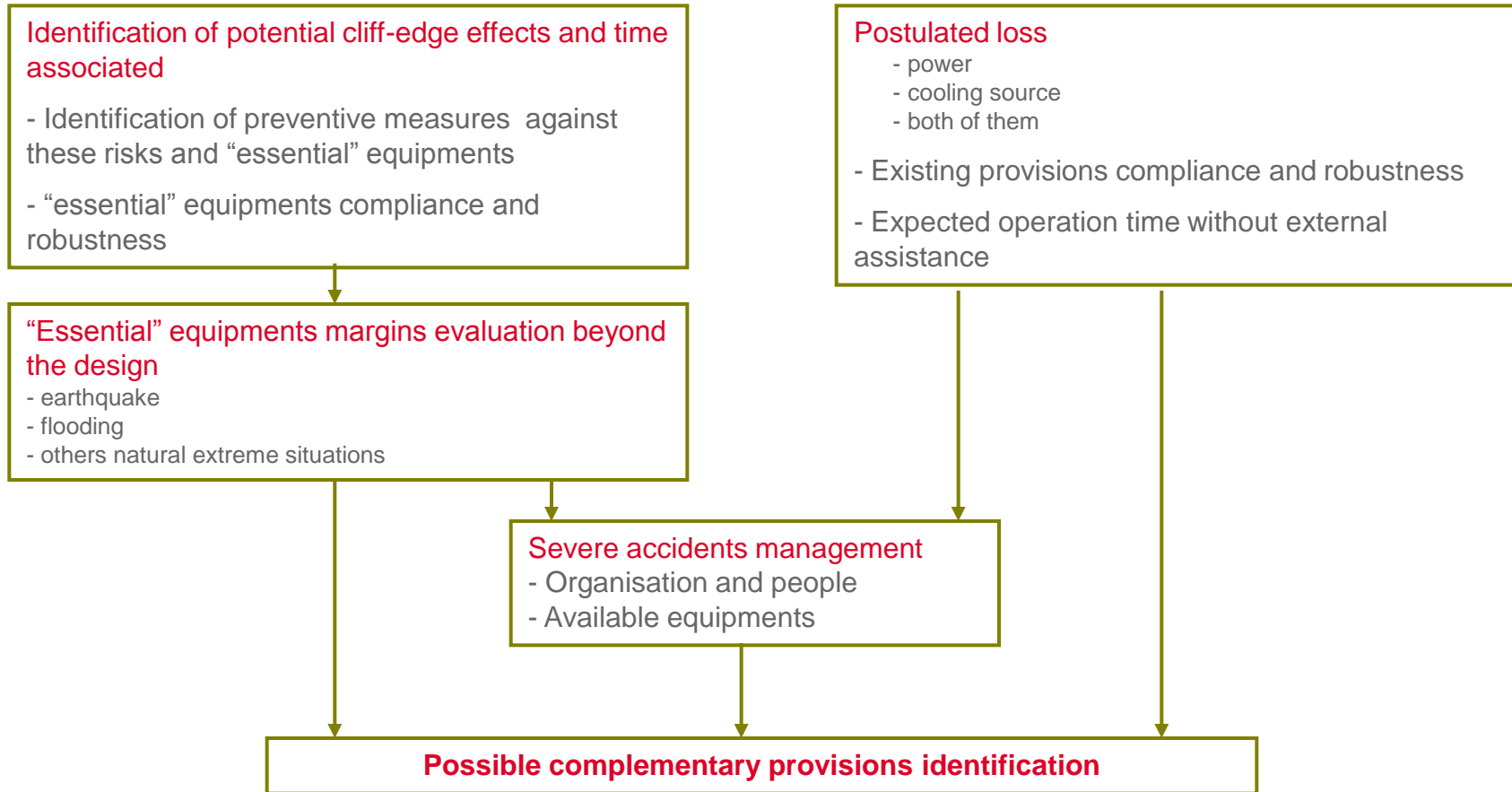
« hazards » task force

« equipments and structures »  
task force

- Task forces :
  - “hazards” : earthquakes and flooding experts
  - “equipments and structures” : civil engineering and equipments basis design experts

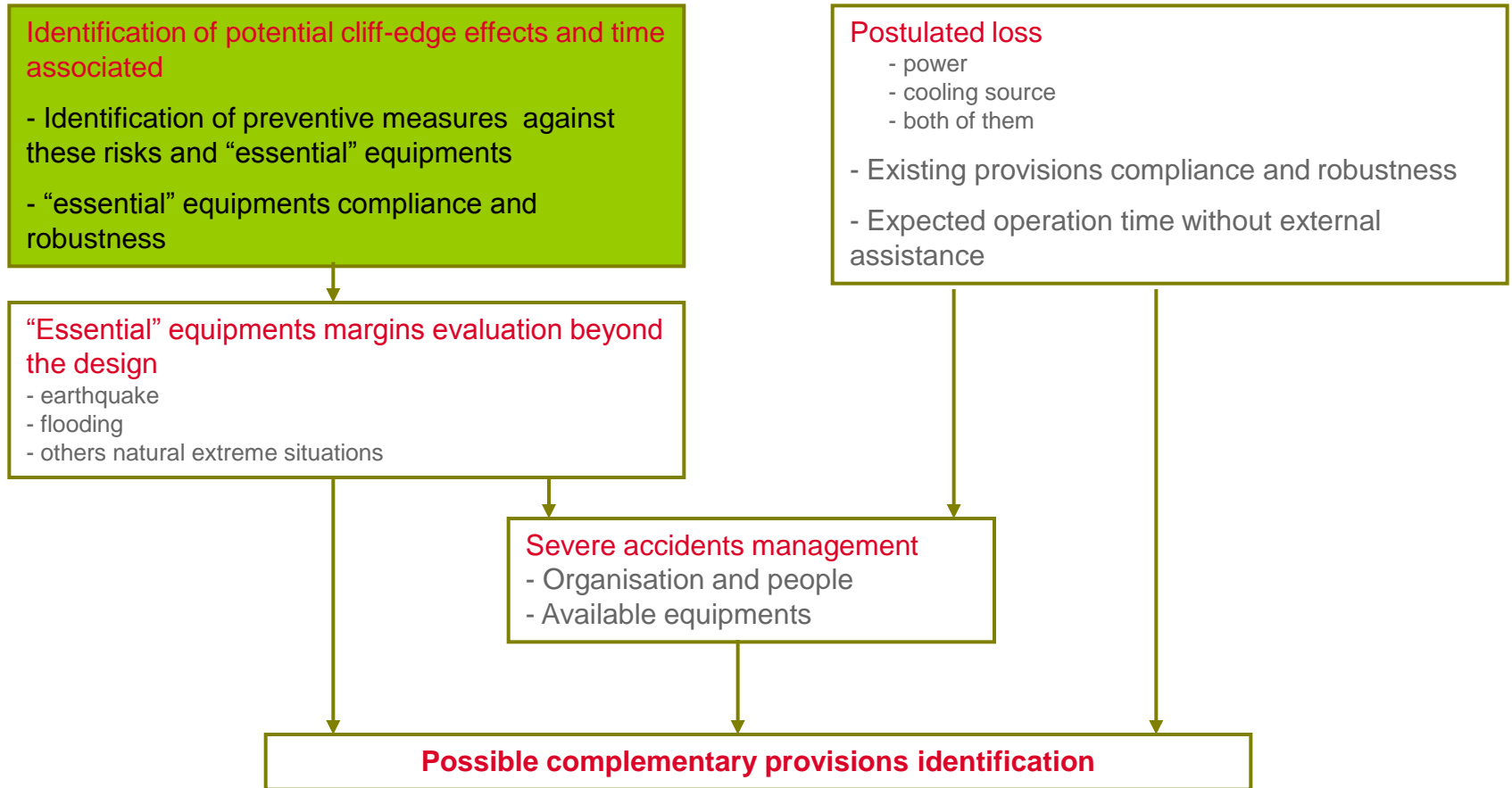
## 2. METHODOLOGY OVERVIEW

### Safety reassessments methodology



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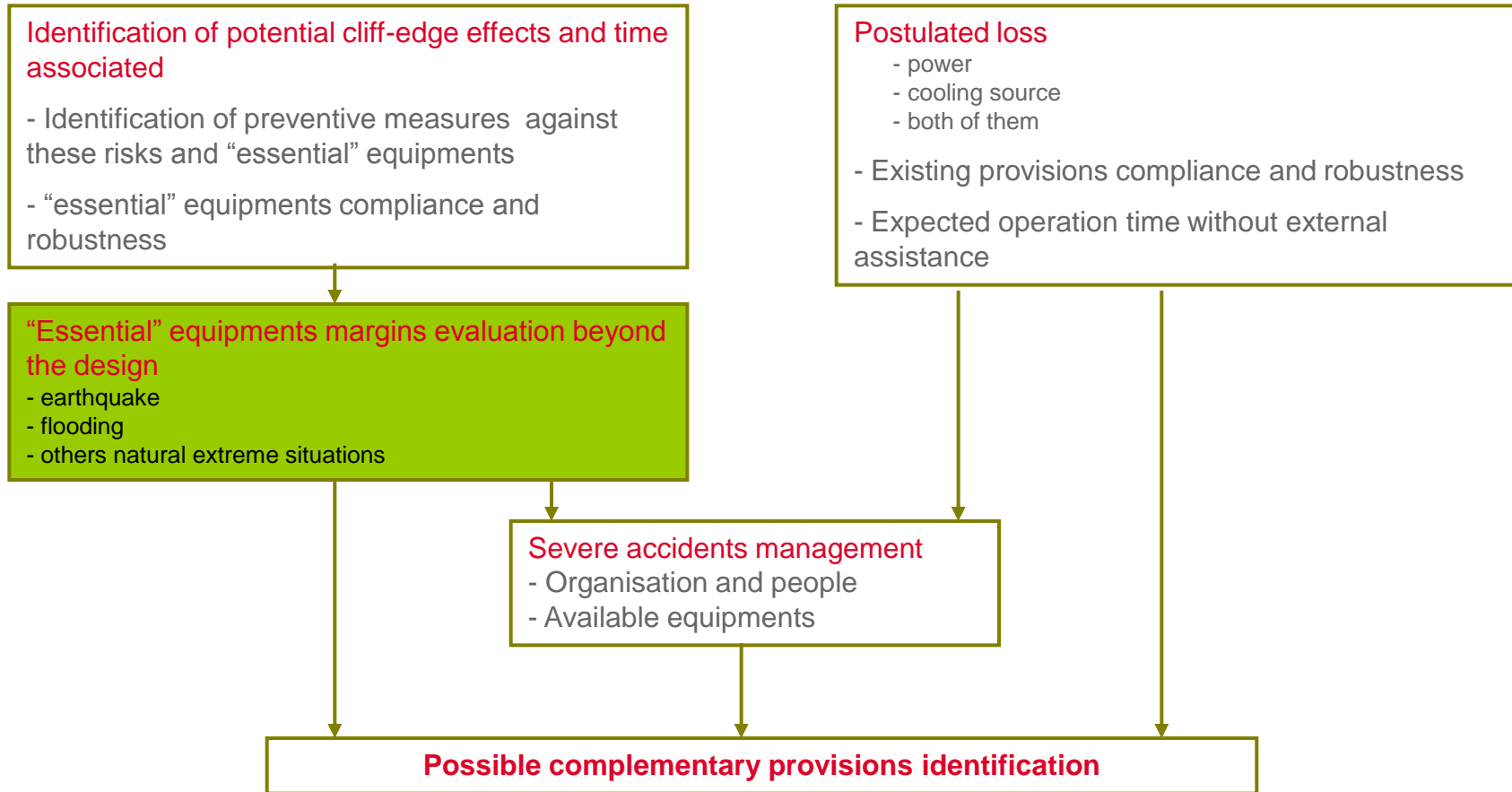
### Cliff-edge effect

- Identification of potential cliff-edge effect :
  - A strong discontinuity in a facility behaviour which leads to a sudden and deep accident sequences deterioration, especially in terms of radioactive release or dangerous products release in cause
- Evaluation against :
  - Some hazards : earthquake, flooding
  - Some loss : power, cooling source, both
- Identification :
  - Preventive measures, compliance and robustness
  - Equipments which can aggress some important elements, compliance and robustness of these equipments
  - Time available before reaching a cliff-edge effect



## 2. METHODOLOGY OVERVIEW

### Safety reassessments methodology



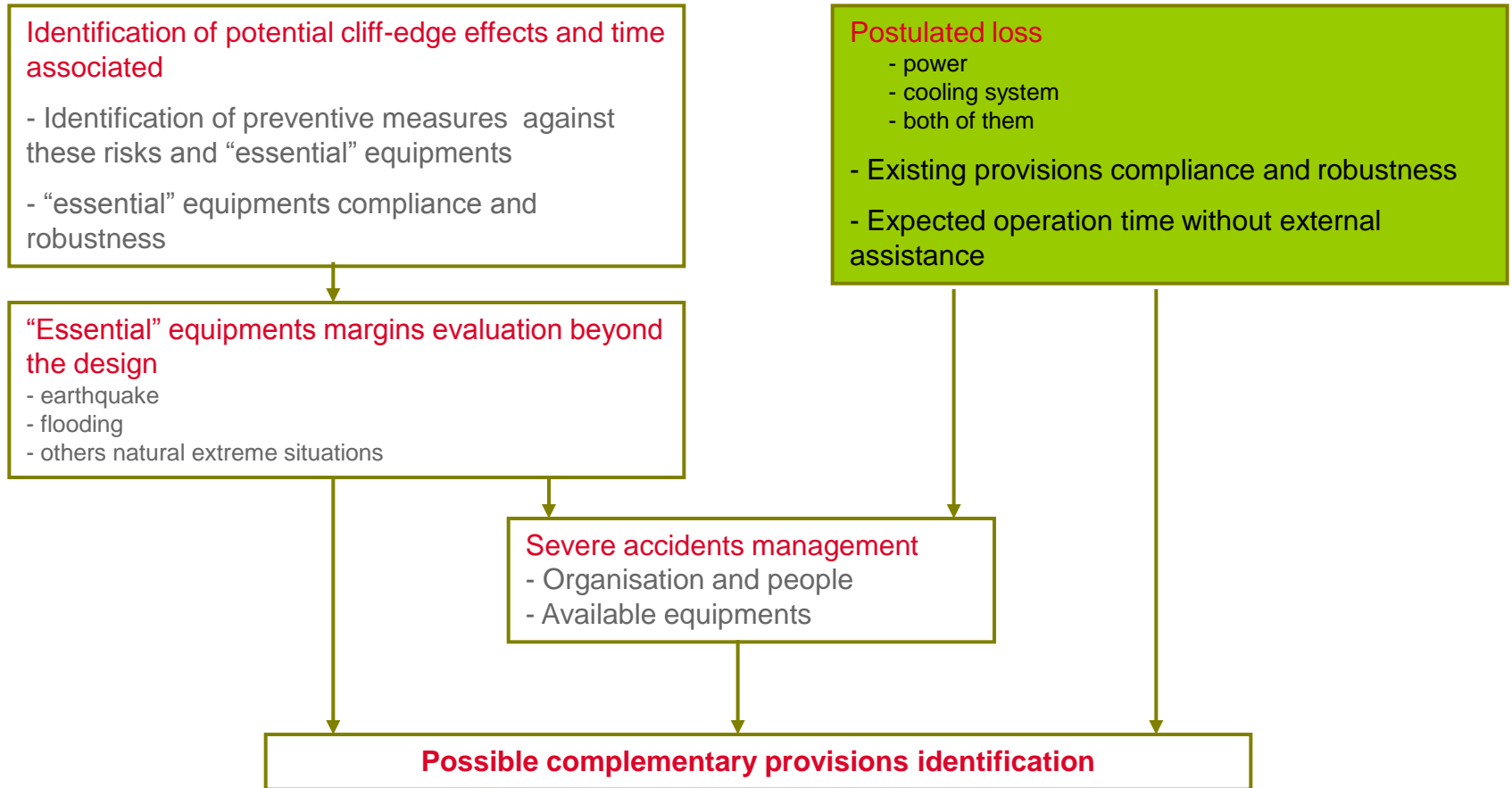
## 2. METHODOLOGY OVERVIEW

### Margins evaluation

- Task-force members are involved in margins evaluation :
  - Facilities visits and walk-down
  - Engineering judgments and examination of :
    - Design assumptions and margins considered during the conception or the last safety review
    - Conservatisms in the basis design rules
    - Existing documentation (calculation, plans, formworks, reinforcement...)
    - Structures behaviour analysis
    - Lessons learn of structure behaviour during earthquake (testing...)
- Other natural extreme situations :
  - Flooding after meteorological extreme conditions, exceeding the design water level
  - Earthquake exceeding the level of design for facilities

## 2. METHODOLOGY OVERVIEW

### Safety reassessments methodology



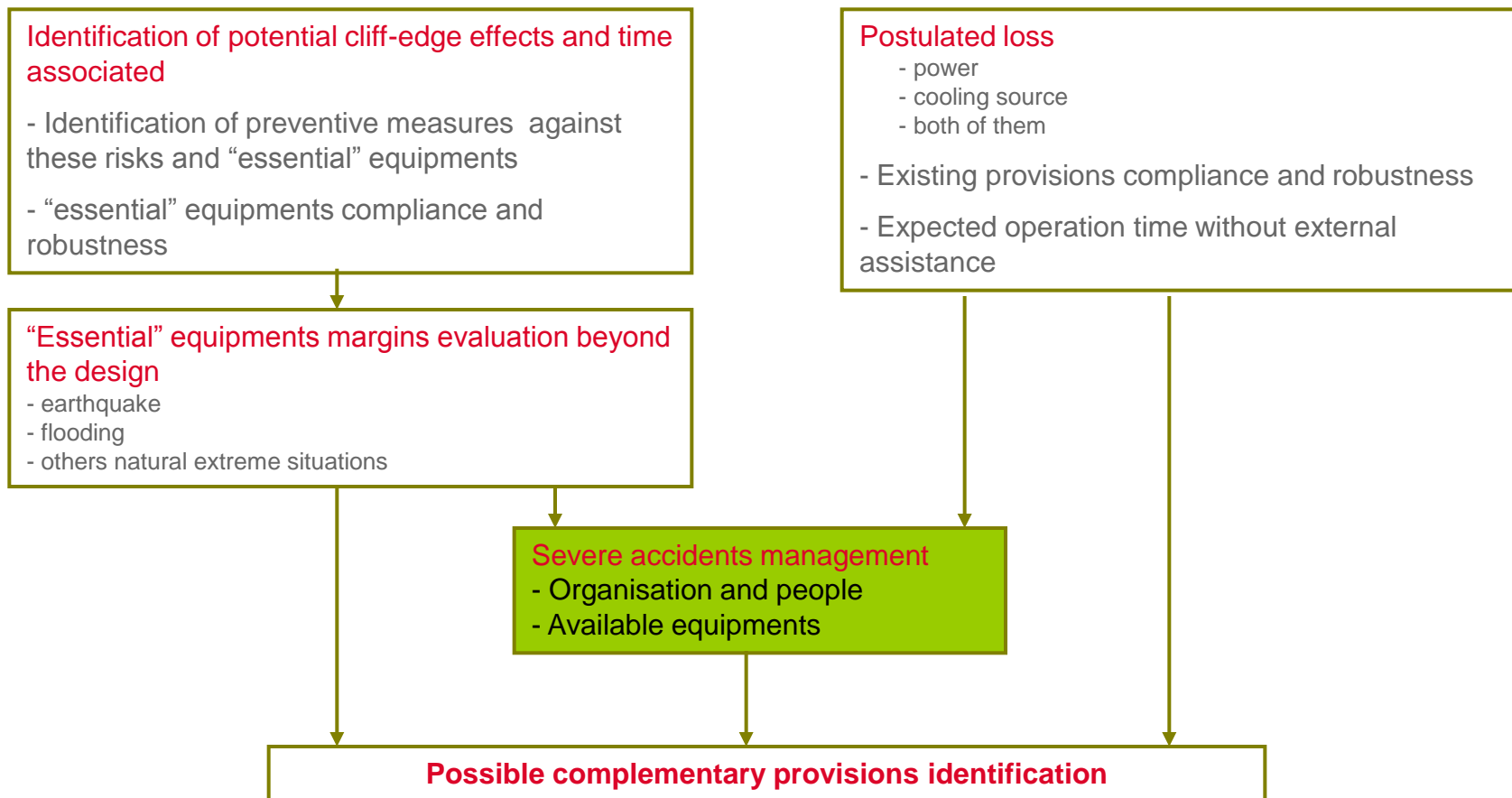
## 2. METHODOLOGY OVERVIEW

### Postulated loss

- Assessments of postulated loss :
  - External power loss
  - External and internal power loss
  - Cooling system loss
  - Cooling system and external and internal power losses
- Identification of mitigation provisions (available site equipments, people...)
- Compliance and robustness beyond the design of the provisions
- Time available without external support, before meltdown, severe accident or cliff-edge effect

## 2. METHODOLOGY OVERVIEW

### Safety reassessments methodology



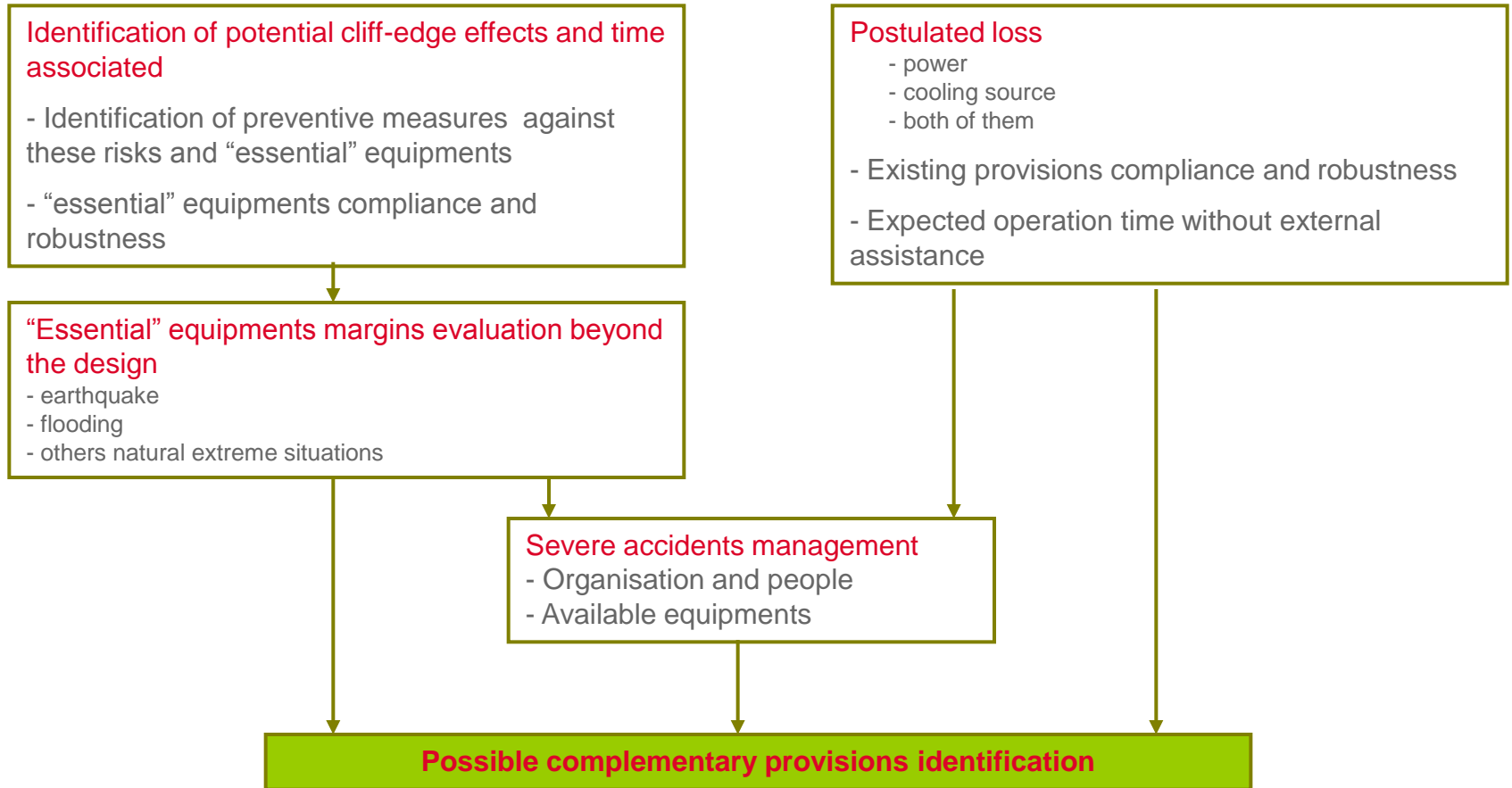
## 2. METHODOLOGY OVERVIEW

### Accidents management

- Explanation of the severe accidents management :
  - Organisational and human factors
    - Availability and skills of people, external assistance
    - Procedures, training, exercises
    - External and internal communications
  - Technical capabilities
    - Available equipments
    - Moving means
    - Supplying
  
- Situation on the site must be take into account :
  - Infrastructure deterioration (roads...)
  - Power unavailability
  - Instrumentation design
  - Other facilities impact

## 2. METHODOLOGY OVERVIEW

### Safety reassessments methodology



## 2. METHODOLOGY OVERVIEW

### Safety reassessments methodology

- Identify some possible complementary provisions :
  - To prevent potential cliff-edge effects
  - To reinforce the facilities robustness (defence in depth concept)
    - By improving the strength of equipments
    - By reinforcing the level of defence in depth independence
  - To improve the crisis management



## 2. METHODOLOGY OVERVIEW

### Hardened safety core

- After instruction, 26th June 2012 decision of the French safety regulatory body : operators must define, for each facility, equipments and organisational robust provisions, called **hardened safety core**, whose aim is, for extreme reassessments situations :
  - To prevent severe accidents or to limit the progress
  - To limit important rejects
  - To help the operators to secure the crisis management
  
- For the CEA, the hardened safety core elements :
  - Must prevent cliff-edge effects situations with important release
  - Correspond to one or several levels of defence in depth
  - Could some safety or ultimate elements
  - Include some instrumentation
  - Should be independent and different of those already existing (if possible)
  - Must be robust against extreme situations studied

### 3. CONSEQUENCES FOR CADARACHE FACILITIES AND SITE

#### Facilities taken into account - Nuclear reactors

##### ■ RJH

In construction

Pool and power reactor for experiences and medical radioelements production

##### ■ CABRI

Built in 1978, renovation 2003-2010

Experimental reactor, study of nuclear fuel behaviour in case of reactivity accident

##### ■ MASURCA

Built in the 1960th, renovation until 2017

Low power reactor, neutron studies for fast neutron reactors

##### ■ RAPSODIE

Built in the 1960th, definitive stop until 1982

Neutron studies for fast neutron reactors

### 3. CONSEQUENCES FOR CADARACHE FACILITIES AND SITE

#### Facilities taken into account - Factories and laboratories

- ATPu  
Built in 1969, in dismantling  
Production of nuclear fuel with plutonium
- LECA  
Built in the early 1960th  
After irradiation studies, transformation of fuel, conditioning
- PEGASE  
Built in the 1960th  
Gaz and graphit reactor, definitive stop until 1975  
Poll for storage, destorage ongoing
- MCMF  
Built in the early 1960th, destorage ongoing  
Non-irradiated nuclear materials storage
- INB56  
Radioactive wastes storages
- CHICADE  
Built in the 1960th, the 1980th and 2000  
Experiments on nuclear wastes

### 3. CONSEQUENCES FOR CADARACHE FACILITIES AND SITE

#### Cadarache site consequences

- Each CEA site has performed a document which essentially deals with capability for crisis management
  - => Need to reinforce some tools and equipments for crisis, especially **a new central control station** and **a logistics base** design for extreme earthquake and flooding
- Complementary provisions :
  - Water supply for fire
  - Fuel reserve
  - Tools to prevent flooding
  - Accommodations for interventional staff...
- For organisational provision :
  - Adaptation of training and operational procedures for crisis management and its preparation
  - Evaluation of availability and management of skills needed during crisis

# THANK YOU FOR YOUR ATTENTION

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