IRSN
INSTITUT
DE RADIOPROTECTION
ET DE SÛRETÉ NUCLÉAIRE

Faire avancer la sûreté nucléaire

Evolution of the French Safety Regulatory System and impact on the Back End

法国安全监管系统的演变以及对后端的影响

I. LE BARS

IRSN

法国辐射防护与核安全研究院

Plan 主目录

1) **Regulatory framework in France**

   法国的监管框架

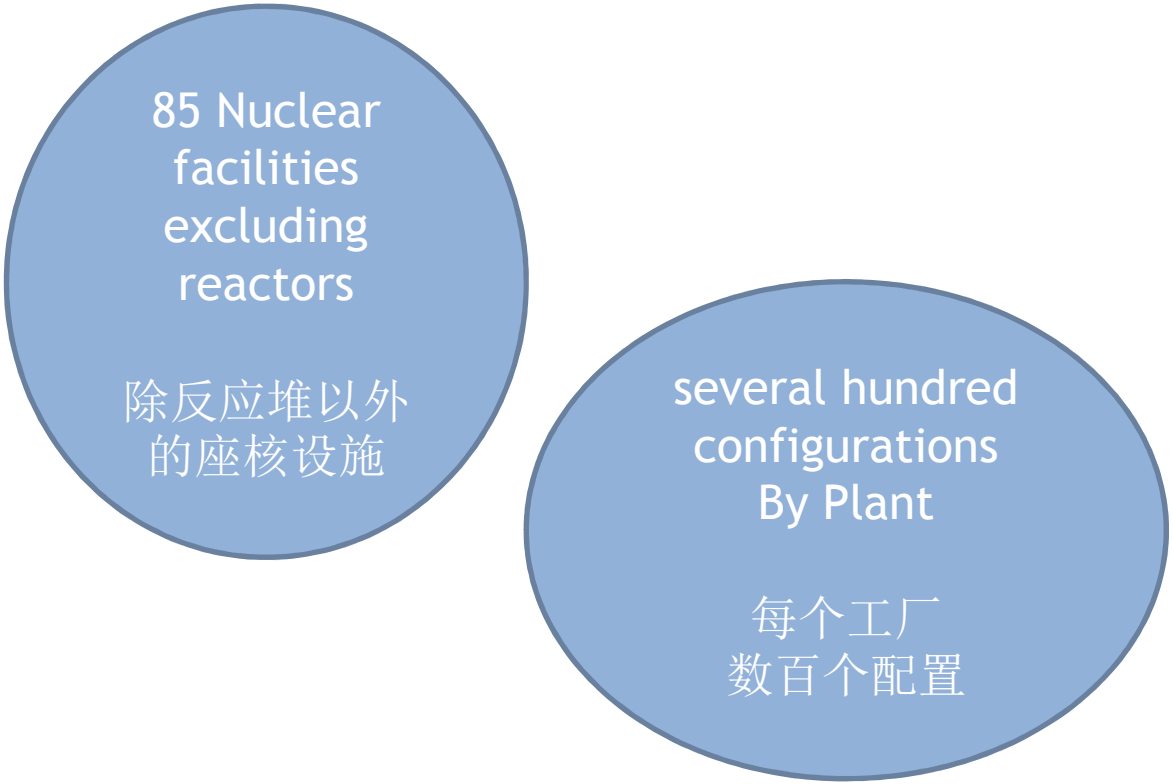
2) **The periodic safety reviews**

   定期安全检查

3) **The Fukushima accident feedback**

   福岛事故反馈

CONTEXT - Safety of nuclear fuel facilities
背景 - 核燃料设施的安全



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Approach 方法

✓**The specificities of each facility is taken into account**

考虑每个设施的独特性

✓**The safety is studied case by case**

对安全进行具体问题具体分析

✓**as safe as reasonably achievable**

可合理达到的尽量安全

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Safety principles 安全原则

- ✓This approach is essentially **deterministic** and based on the **defense in depth** principle.

  该方法几乎是**确定性**的，以**纵深防御**原则为基础

- ✓The outcomes of the safety assessment are the **safety requirements**, which are reached through **safety functions**, insured by **Structures, System or Components**

  安全评估的输出即为安全要求；安全要求通过安全功能实现，具体由构筑物、系统或部件来 执行

- ✓This leads to the defining several **accidental scenarios**.

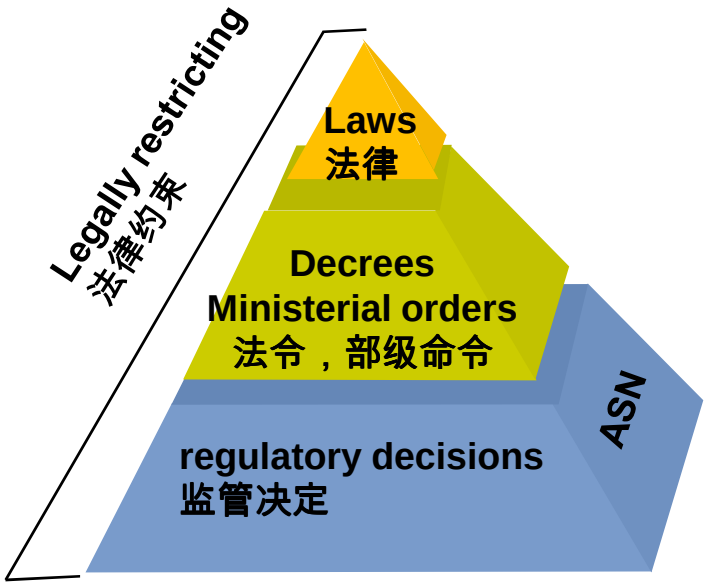
  由此可以确定几种**事故情形**

The regulatory in France 法国的监管

Safety organisation General Objectives
安全组织总目标

administrative organisation (procedures, documents...), topics to be addressed in this documents
行政组织（程序，文件……），本文件将讨论的内容

Methods for safety analyse (fire, criticality...)
安全分析方法（火灾，监界……）



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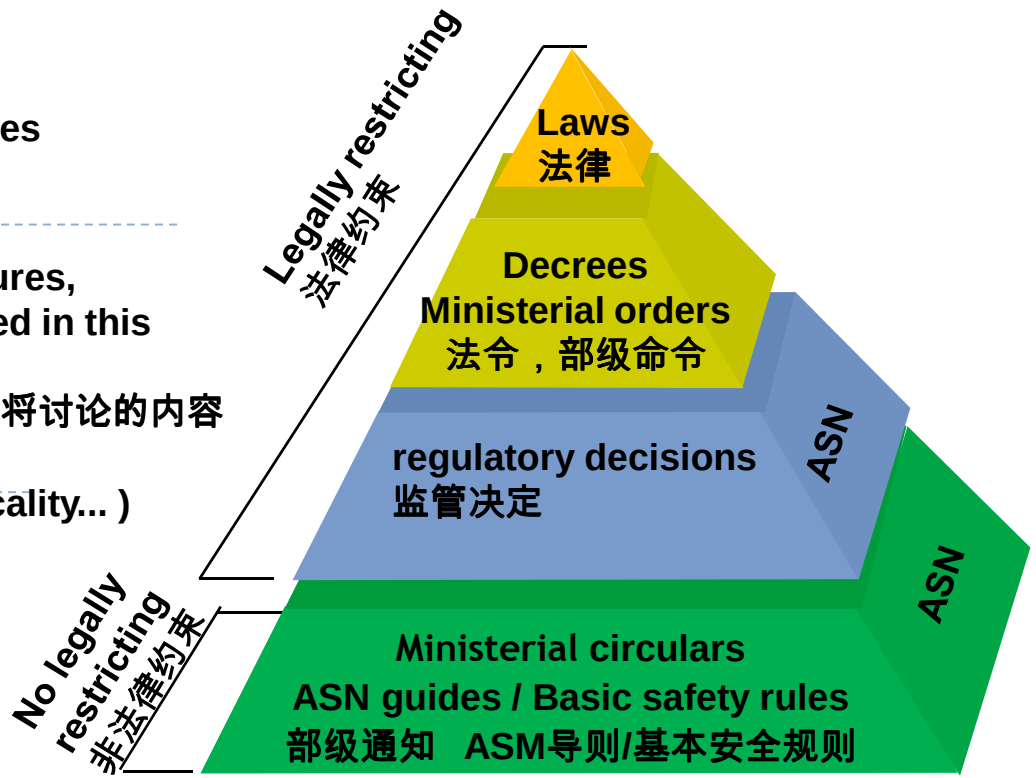

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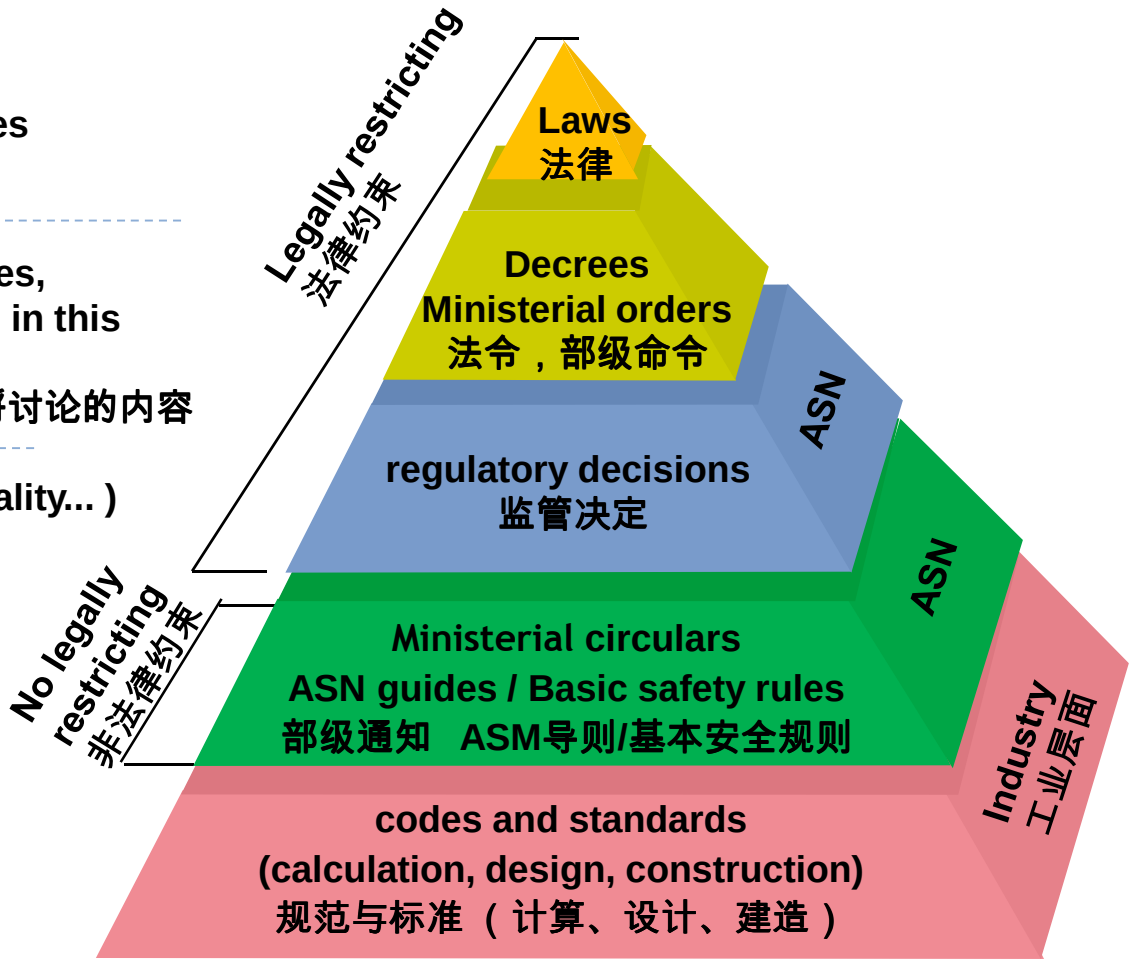
Safety analyses studiesTechnical and safety requirements
安全分析研究，技术以及安全要求



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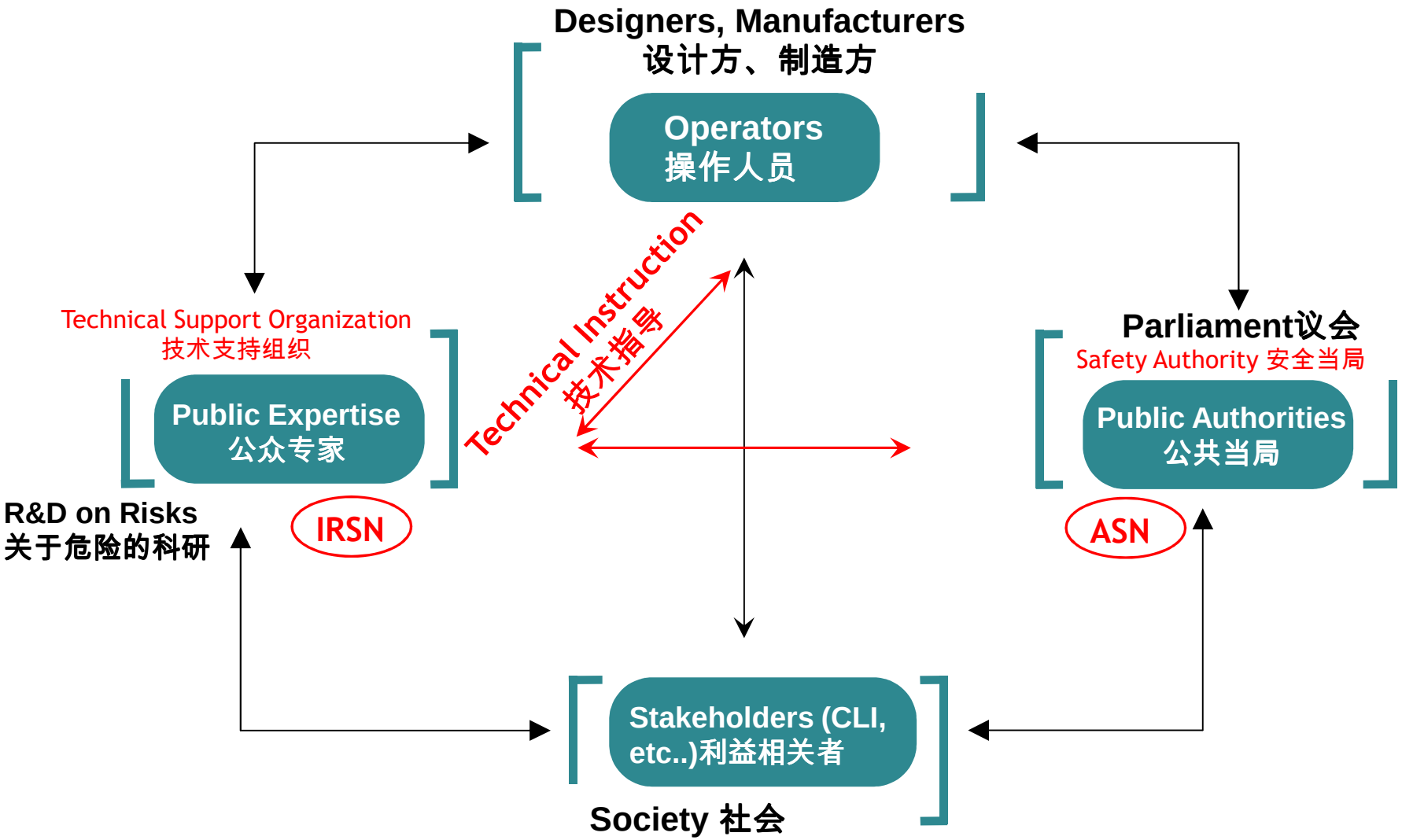


The regulatory in France法国的监管

Operator
运营商

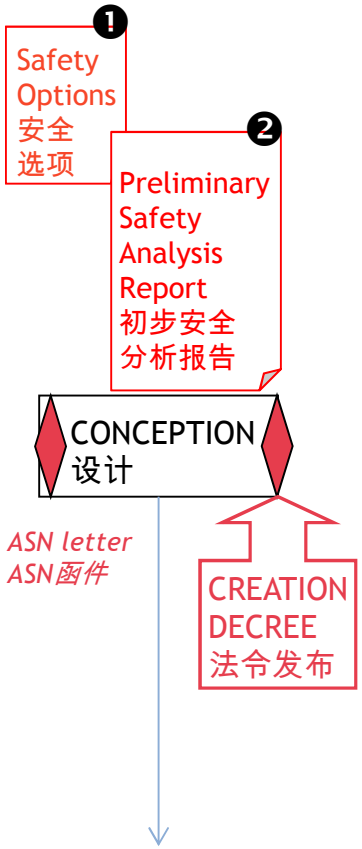
ASN letter
ASN函件

ASN
based on
IRSN
Assessment

ASN基于
IRSN的评估

codes and standards
规范与标准
(calculation, design, construction)
（计算、设计、建造）

The regulatory in France法国的监管



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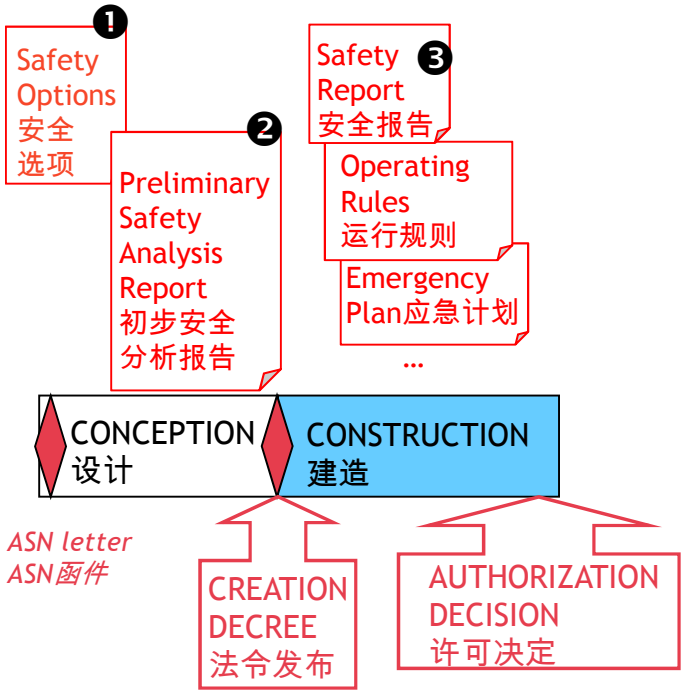

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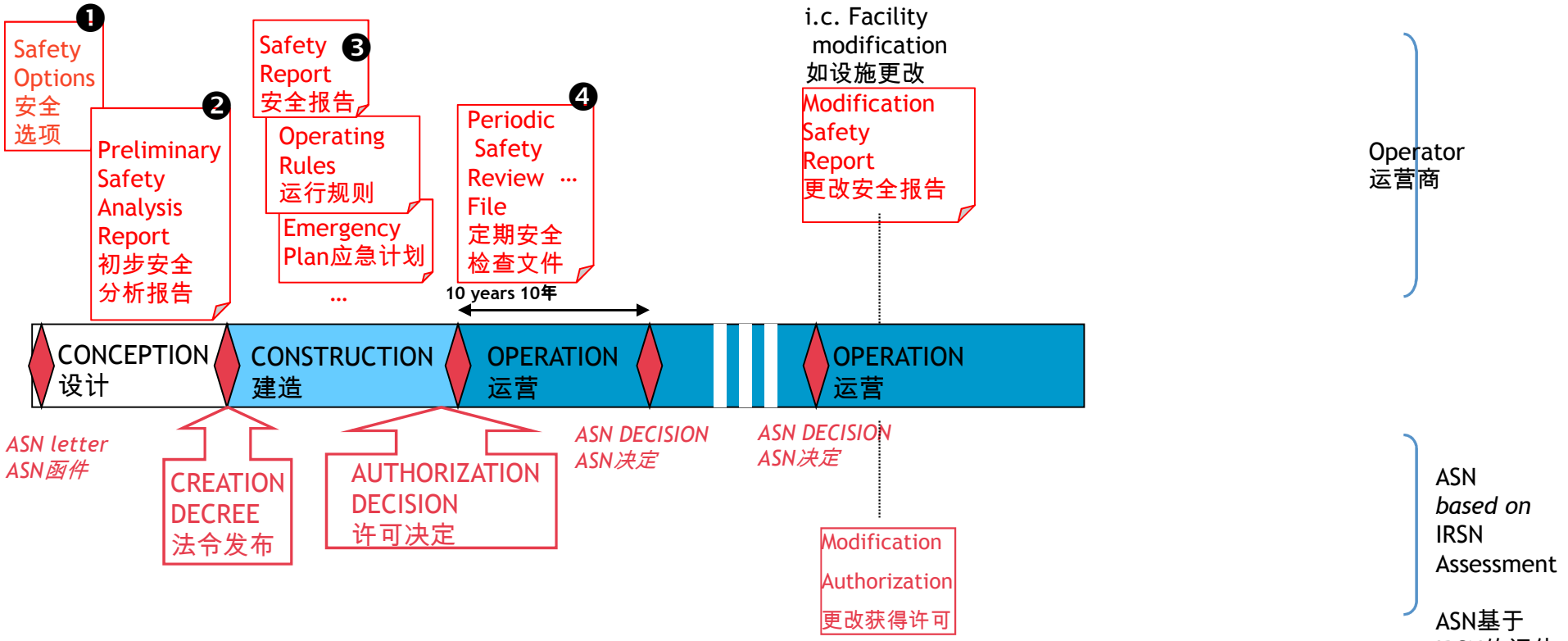

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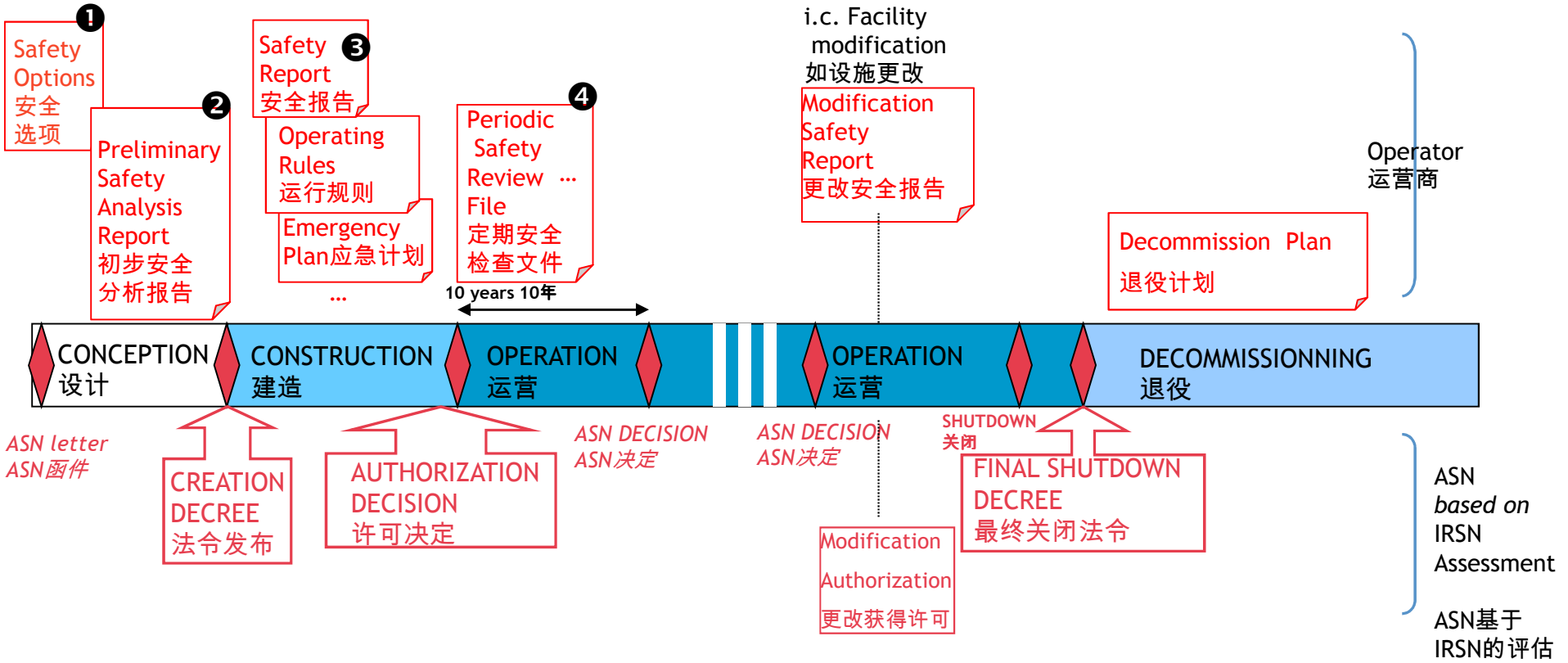

Periodic safety reviews (every 10 years)
定期安全检查（每10年）

- **The objectives of the safety reviews were significantly increased since 2007**
  从2007年开始，显著地增加了安全检查的目标

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    查询关于**老化**检查的条款

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  - **update the safety assessment** in the light of :

    更新安全评估，根据以下：

    - the **feedback**,

      反馈，

    - the **evolution of regulations**,

      法规的变化，

    - the **latest state of the art** and of the **best Practices**,

      最新技术情况和最好的实践经验，

Evolution of Regulations
法规的变化

- The regulation has strengthened the identification of structures, systems and components important for the safety and of the safety requirements. This work is underway including the La Hague and MELOX sites.

安全重要的构筑物、系统和部件以及相关安全要求的识别，都通过法规得到了提高。

  - aim to increasing the robustness of the control provisions of these elements

    目标是提高这些物项的检查条款的稳固性

- The ASN's guides are progressively updated since 2007 (flooding risk, fire risk...). The new methods deployed by AREVA have been checked in the framework of periodic safety reviews.

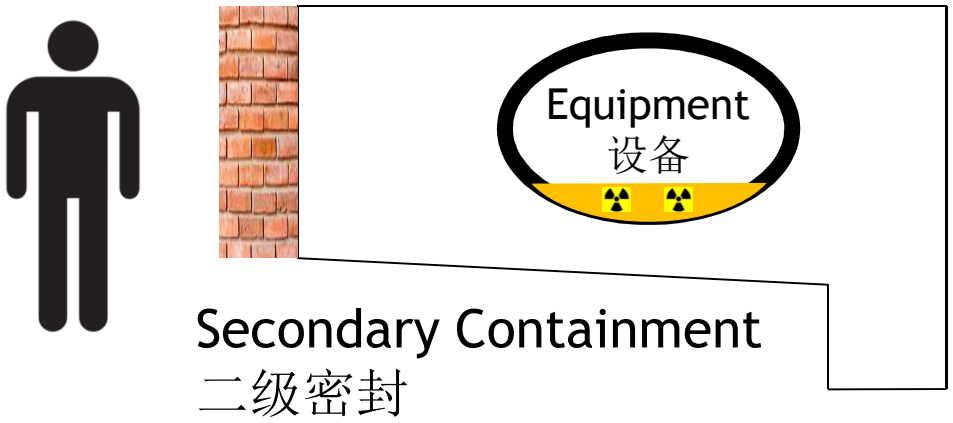
从2007年开始，ASN的导则（水淹风险、火灾风险……）不断地更新。阿海珐实施的新方法在定期安全检查的框架内接受检查。

Conformity of the facility
设施的合格性

- Margins are taken at the design stage concerning the degradation phenomena (corrosion, erosion…)

  考虑到退减现象（腐蚀、冲蚀……等），设计阶段留了裕度

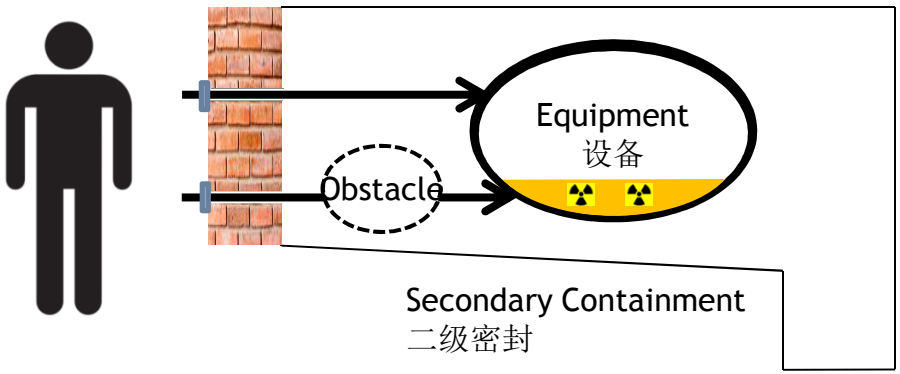
  - Especially in closed hot Cells where no Access is Possible
    尤其是在封闭的不可能进入的热室内



Conformity of the facility
设施的合格性

- For example, need to monitor the corrosion kinetics (Thickness Measurements)
- 例如，需要对腐蚀动力学进行监测（厚度测量）
  - New Tools developed, introduced through existing Holes in the Walls
    开发新的工具，从墙上原有的孔引入

How to carry out such verification Measures should be better considered in the Future Design of nuclear Facilities.
在以后的核设施设计中，应考虑到如何执行此类检查测量。

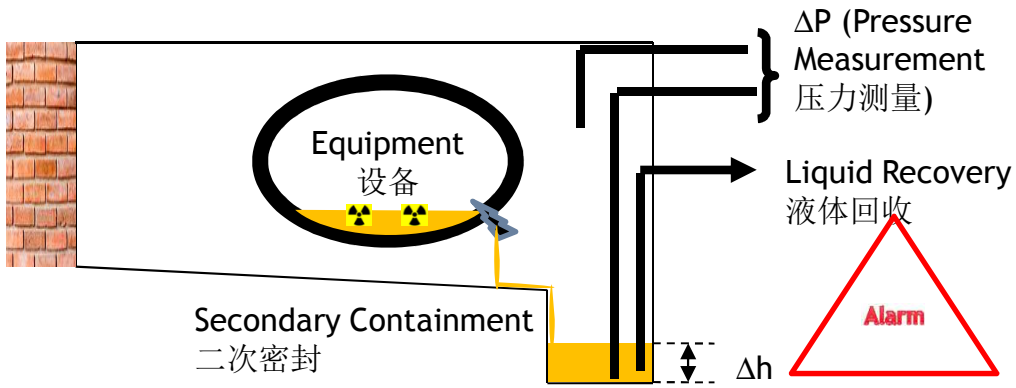


closed hot Cells
封闭的热室

Feedback : anticipate the Means of Detection
反馈：检测手段的预先考虑

- slow accumulation of fissile materials (hot cells, glove box...)
  可裂变材料的缓慢积聚（热室、手套箱……）

- Leak detection devices designed to detect the arrival of a large amount of liquid in the secondary Containment located under the Equipment
  泄露检测设备用于探测位于设备下方的二级密封容器是否有大量液体



International feedback : red-oil reaction
国际反馈：红油反应

- reaction between TBP and Nitric Acid at elevated temperatures
  磷酸三丁酯（TBP）与硝酸在高温下的反应

- 4 Major accidents in spent fuel processing plants before 1975 (in evaporator of solution)
  1975年前发生在乏燃料后处理厂的4个主要事故（在溶液蒸发器中）

↳ This feedback shows that temperature below 135 °C excludes any runaway reaction
  反馈表明，温度低到135 °C可避免失控反应

International feedback : red-oil reaction
国际反馈：红油反应

- The security parameters used :
  所用的安全参数：
  - the temperature limit (135 ° C evaporators walls)
    温度限值（蒸发器壁135 ° C ）
  - limiting to a low level the amount of TBP in the nitric acid solutions
    把硝酸溶液的磷酸三丁酯（TBP）含量限制在较低水平

International feedback : red-oil reaction
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- 1993 : accident Tomsk (Russia), occurred in a tank, at significantly lower temperatures than 135 °C

  1993年： Tomsk （俄罗斯）事故，某个槽的温度远远低于135℃

- From 1993, numerous international studies for understanding the causes of this accident

  1993年开始，为找出该事故的原因，国际上进行了大量的研究

  - Analysis of safety margins for factories (just after Tomsk accident and in the framework of the safety review)

    工厂安全裕度分析（紧接着Tomsk事故后，和在安全检查的背景下）

International feedback : red-oil reaction
国际反馈：红油反应

- In the framework of periodic safety review, development of a new program to refine the operating field of operation of evaporators

  在定期安全检查的前提下，开发数个程序，以细化蒸发器的操作

The Fukushima accident feedback
福岛事故反馈

March 11 2011 2011年3月11日	Fukushima Accident 福岛事故
March 23 2011 2011年3月23日	Declaration of the French Prime minister asking for national audit (CSA) 法国总理宣布要求开展全国范围的检查（CSA）
June 1st 2011 2011年6月1日	French licensees' CSA methodologies sent to ASN and assess by IRSN and French advisory expert committees 法国运营单位将CSA方法寄送至ASN，由IRSN及法国顾问专家委员会作评估
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The Fukushima accident feedback
福岛事故反馈

Extreme event

极端事件

(Flooding, earthquake…)

(水淹, 地震…)

+

Loss of power supply

供电失效

+

loss of cooling systems

冷却系统失效

On several facilities over the nuclear site

核场址的多个设施

The Fukushima accident feedback
福岛事故反馈

- The facilities ensure a sufficient safety level such that none of them have to be immediately shut down.

  设施保证了足够的安全等级，使得设施不会立刻停运

- Their continued operation requires to increase their robustness towards extreme situations

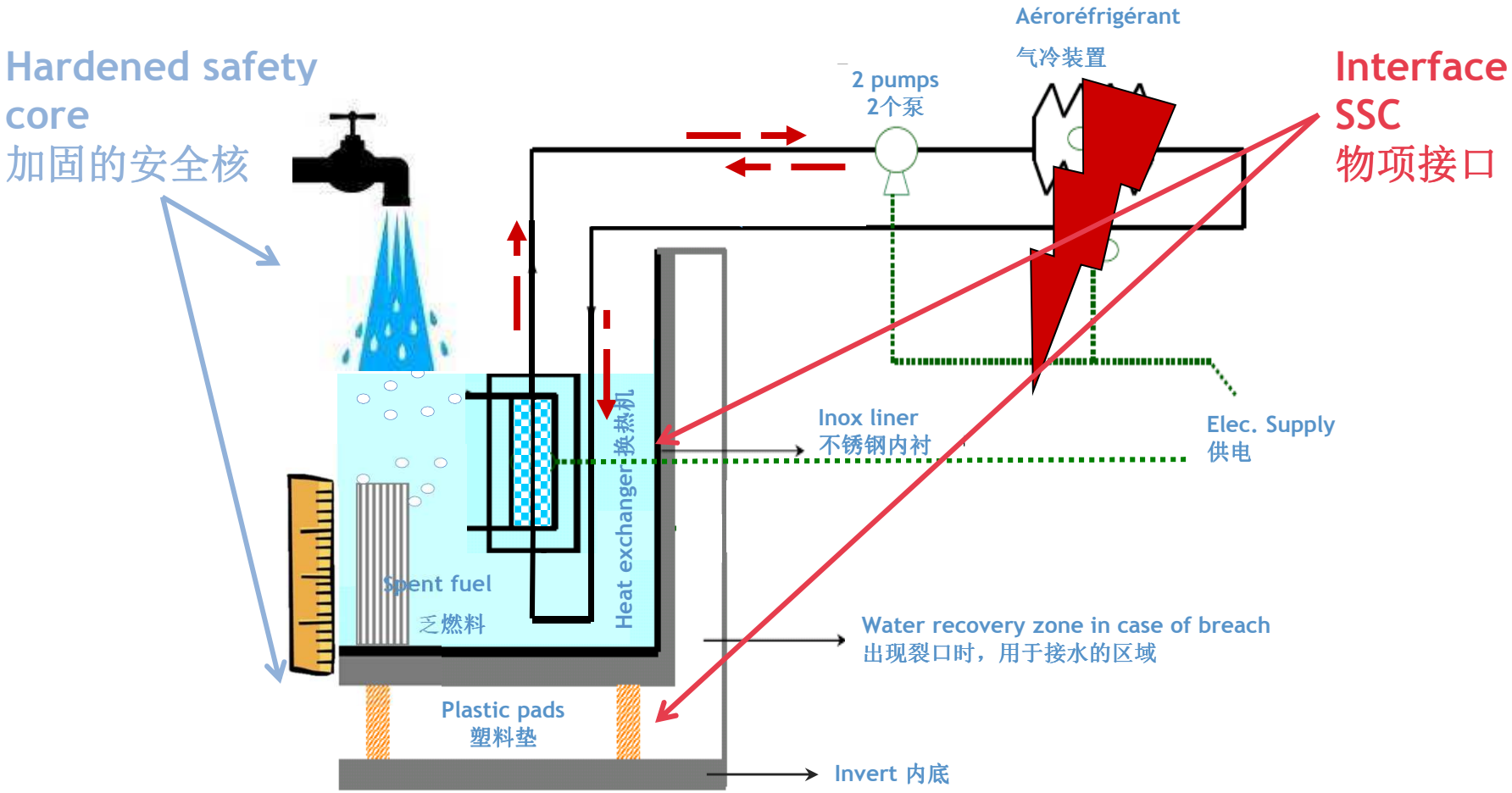
  其连续运行要求提高坚固性以应对极端情况

- It is necessary to implement an « hardened safety core » of robust material and organisational measures with the aim, for extreme situations, to :

  为应对极端情况，有必要实行稳固的实物及组织措施《强化的安全核心》，以达到如下目标：

  - Prevent a severe accident or limit its progression,
    避免严重事故或限制其扩展，
  - limit massive discharges resulting from a non controlled accident,
    限制失控事故引起的大量释放，
  - enables the licensee to fulfil its duties in the crisis management.
    让运营商履行危机管理相关的责任。

Hardened safety core
加固的安全核



THANKS YOU FOR YOUR ATTENTION

非常感谢