

IRSN

INSTITUT
DE RADIOPROTECTION
ET DE SÛRETÉ NUCLÉAIRE

Faire avancer la sûreté nucléaire

Safety assessment of nuclear reactors ageing

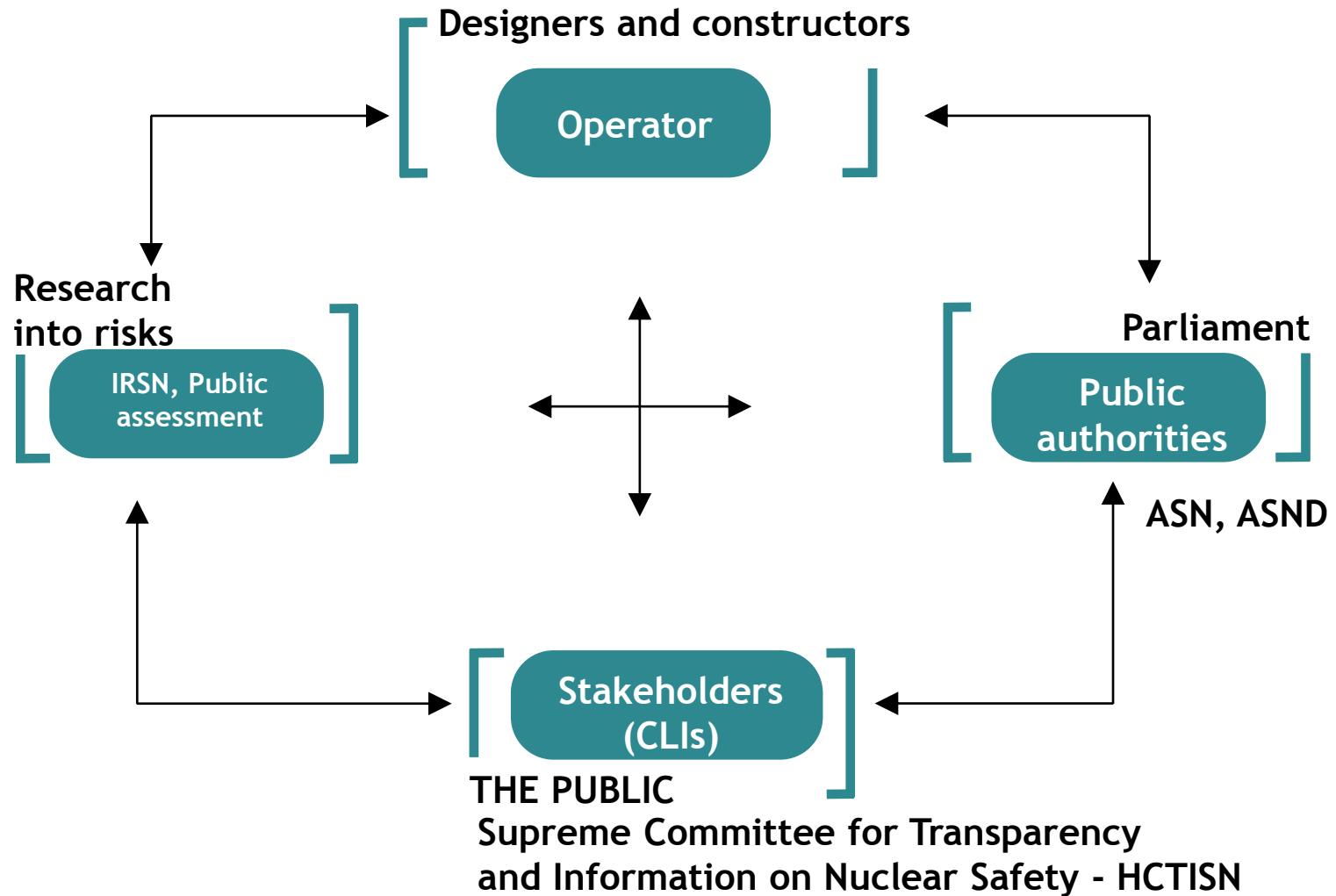
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NTW - Exploratory workshop

"Ageing of nuclear power
plants: a threat to nuclear
safety? "

19th March 2014

Who is IRSN?



Who is IRSN?

- The French TSO,
- Independent from operators
- Detailed knowledge of installations
- “Safety watchtower” (operational experience feedback monitoring)
- Conducts its own independent research on safety issues, including ageing management

Introduction

- Most NPPs have been designed with a given lifetime in mind (e. g. 40 years in France)
- For economical reasons, most operators want to operate NPPs beyond this timespan
- Meanwhile...



Increasing knowledge

■ EXPERIENCE
FEEDBACK

■ R&D

Opportunities for
improvement

New designs

- MORE STRINGENT SAFETY OBJECTIVES

Coexistence of old and new reactors

Under what safety conditions can a prolonged reactor operation be accepted, taking into account the fact that safer technology is available ?



Managing time dependent effects

Reducing the safety gaps between old and new plants

Managing time-dependent effects

- Ageing management
- Ability to prevent, anticipate and cope with discrepancies
- Plant modifications
- Obsolescence management
- Human resources and knowledge management
- Coping with industrial and environmental changes

Reducing the safety gaps between old and new plants

- Operating experience feedback
- Periodic safety reviews
- Enhancing prevention of accidents
- Reducing radiological consequences of accidents
- Enlarging the scope of PSA studies
- Improving operation conditions

A detailed close-up photograph of a pocket watch's internal mechanism. The watch face is visible in the background with Roman numerals and the brand name 'Waltham' partially legible. The foreground shows intricate metal gears, a balance wheel, and other mechanical components. A blue rectangular box is overlaid on the top left, and a red rectangular box is overlaid on the bottom center.

**Managing time-
dependent effects**

Ageing management

Ageing management : objectives



To maintain availability and effectiveness of all SSCs important for safety

Replaceable SSCs

Non-replaceable SSCs

Ageing management : key issues

- Knowledge of degradation mechanisms
 - Experience feedback, R&D
- Evaluating the effectiveness of scheduled maintenance to detect these mechanisms
- If necessary enhancing maintenance effectiveness
- Plant monitoring (especially when degradation mechanisms are not well known)
- Repairing/replacing before safety issues occur

Expanding qualification durability

- **Qualification : demonstrating the ability of SSCs to work in extreme conditions resulting from accidents (pressure, temperature, dampness...)**
- **Usually these demonstrations make assumptions about the lifetime of the SSC**
- **If the lifetime is extended, so shall be the demonstration.**

Reducing the gap between old and new plants



Periodic safety reviews



Periodic safety reviews : objectives



- To assess the cumulative effects of plant ageing and plant modifications, operating experience, technical developments and siting aspects.
- Including an assessment of plant design and operation against current safety standards and practices
- To ensure high level of safety throughout the plant's operating lifetime.

Periodic safety reviews

By nature, PSRs are the most efficient way to reduce the gap between old and new plants

Reducing the gap between old and new plants



Enhancing prevention of accidents



Enhancing prevention of accidents : objectives



Design basis accidents

To enlarge the scope of “design” accidents and the robustness of their assessment

Severe accidents

To search for high impact solutions, able to prevent severe accidents (i.e. core melt) and mitigate consequences more efficiently

Enhancing prevention of accidents

: key issues

Design basis accidents

- Adding new plausible accident scenarii to the safety analysis report
 - For example, accidents specific to shutdown states
- Lengthening the time limit for operator actions.
 - 20' → 30'

Enhancing prevention of accidents : key issues

Severe accidents

- Using PSAs to identify ways of improvement and check their effectiveness.

- Ways of improvement depend on the state of the design :
 - Improving the reliability of electrical sources
 - Increasing water storage for safety functions...

- Post Fukushima improvements