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GEN IV International Forum

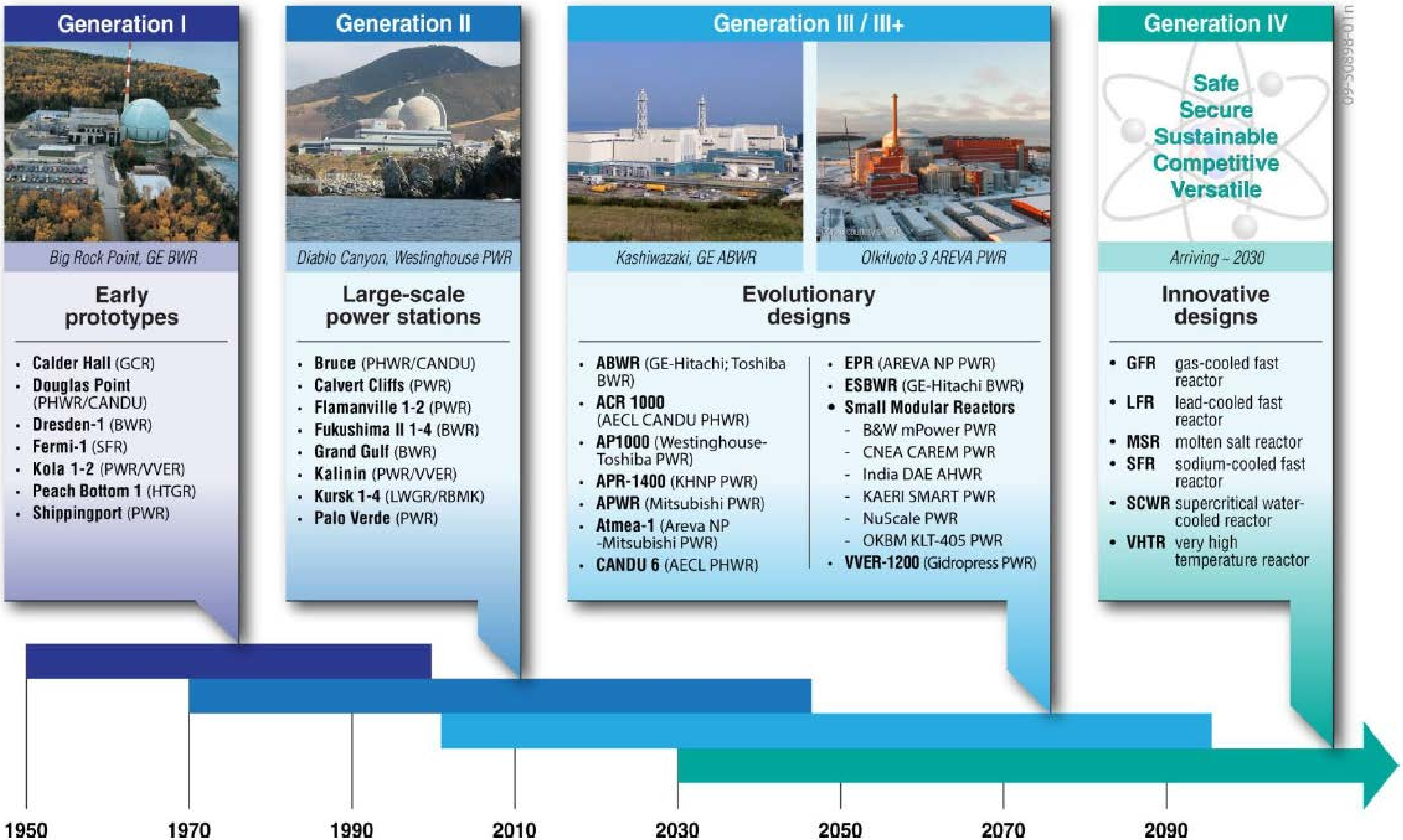
RISK AND SAFETY WORKING GROUP
RSWG

Paul Gauthé, CEA

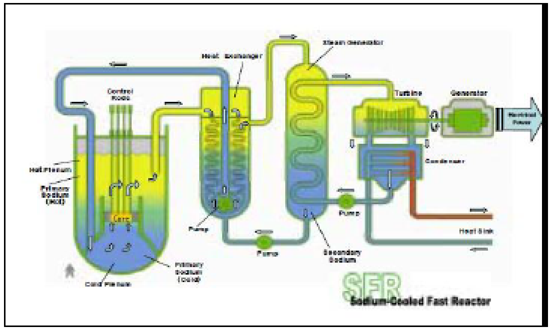
24/11/14

ATELIER NEEDS – SURETÉ MSR

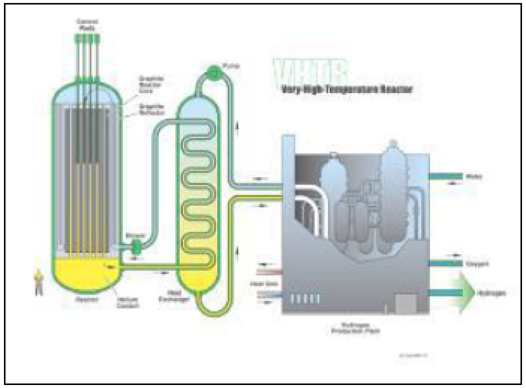
GENERATION IV



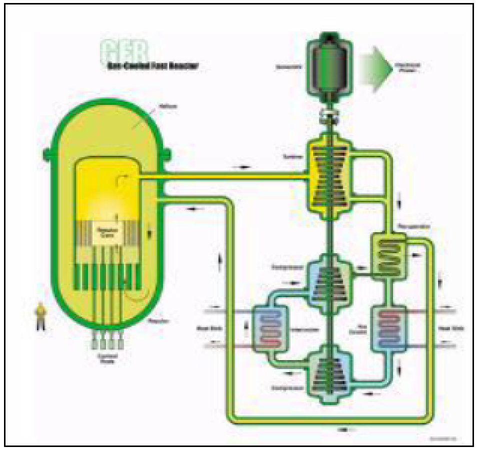
SYSTEMES DE GENERATION IV



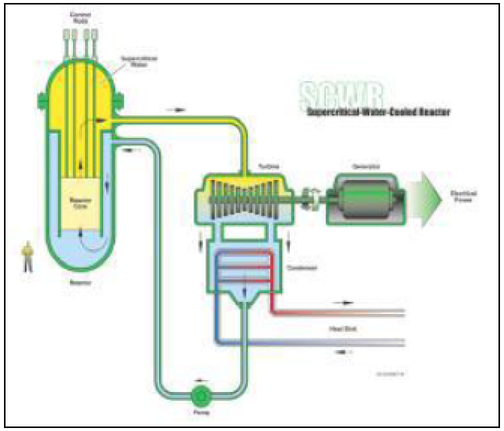
Sodium-cooled Fast Reactor (SFR)



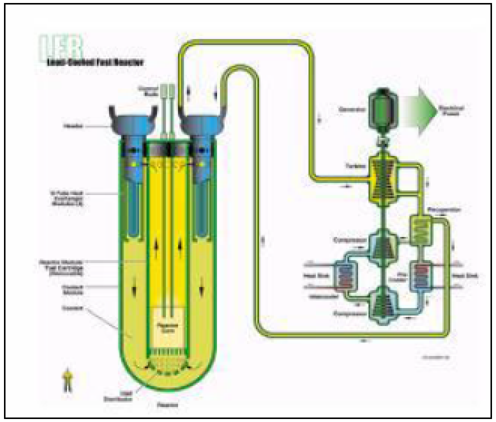
Very High Temperature Reactor (VHTR)



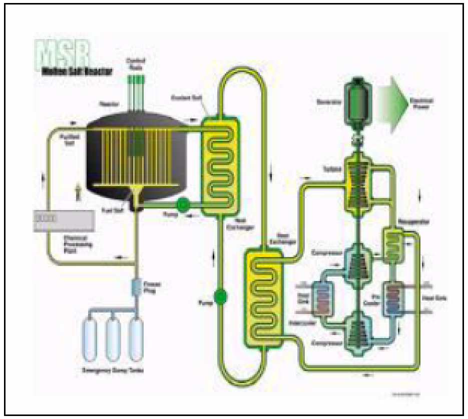
Gas-cooled Fast Reactor (GFR)



Supercritical Water-cooled Reactor (SCWR)



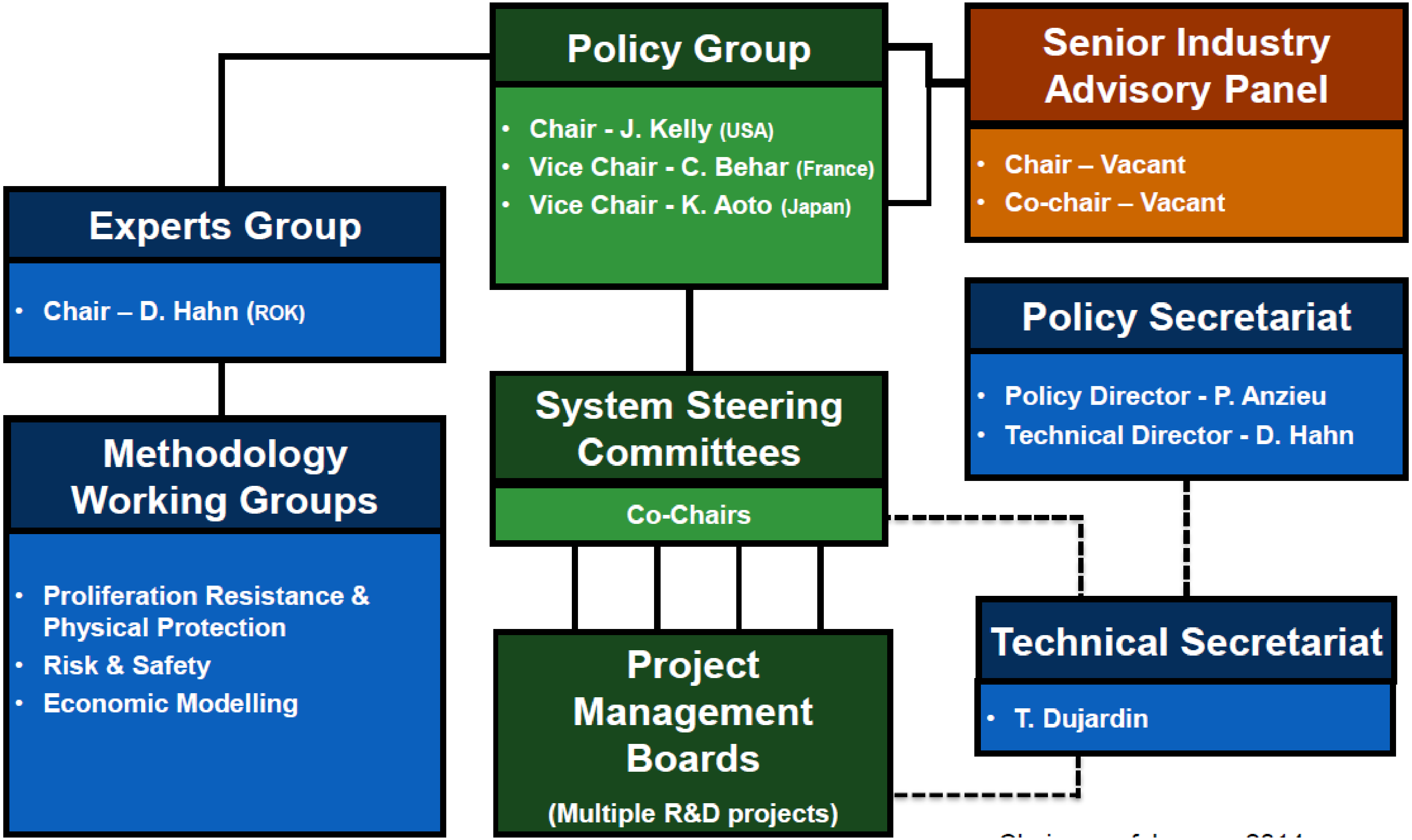
Lead-cooled Fast Reactor (LFR)



Molten Salt Reactor (MSR)

- **Sustainability**
  - Long term fuel supply
  - Minimize waste and long term stewardship burden
- **Safety & Reliability**
  - Very low likelihood and degree of core damage
  - Eliminate need for offsite emergency response
- **Economics**
  - Life cycle cost advantage over other energy sources
  - Financial risk comparable to other energy projects
- **Proliferation Resistance & Physical Protection**
  - Unattractive materials diversion pathway
  - Enhanced physical protection against terrorism

ORGANISATION DU GIF



ORGANISATION DU GIF

GEN IV International Forum

System Steering Committees

Sodium-Cooled Fast Reactor

- Chair – P. Dufour (France)
- Co-Chair – R. Hill (USA)
- Co-Chair – H. Kamide (Japan)

Supercritical-Water Cooled Reactor

- Chair – T. Schulenberg (EURATOM)
- Co-Chair – H. Matsui (Japan)

Lead Fast Reactor

- Chair – A. Alemberti (EURATOM)

Molten Salt Reactor

- Chair – J. Serp (France)

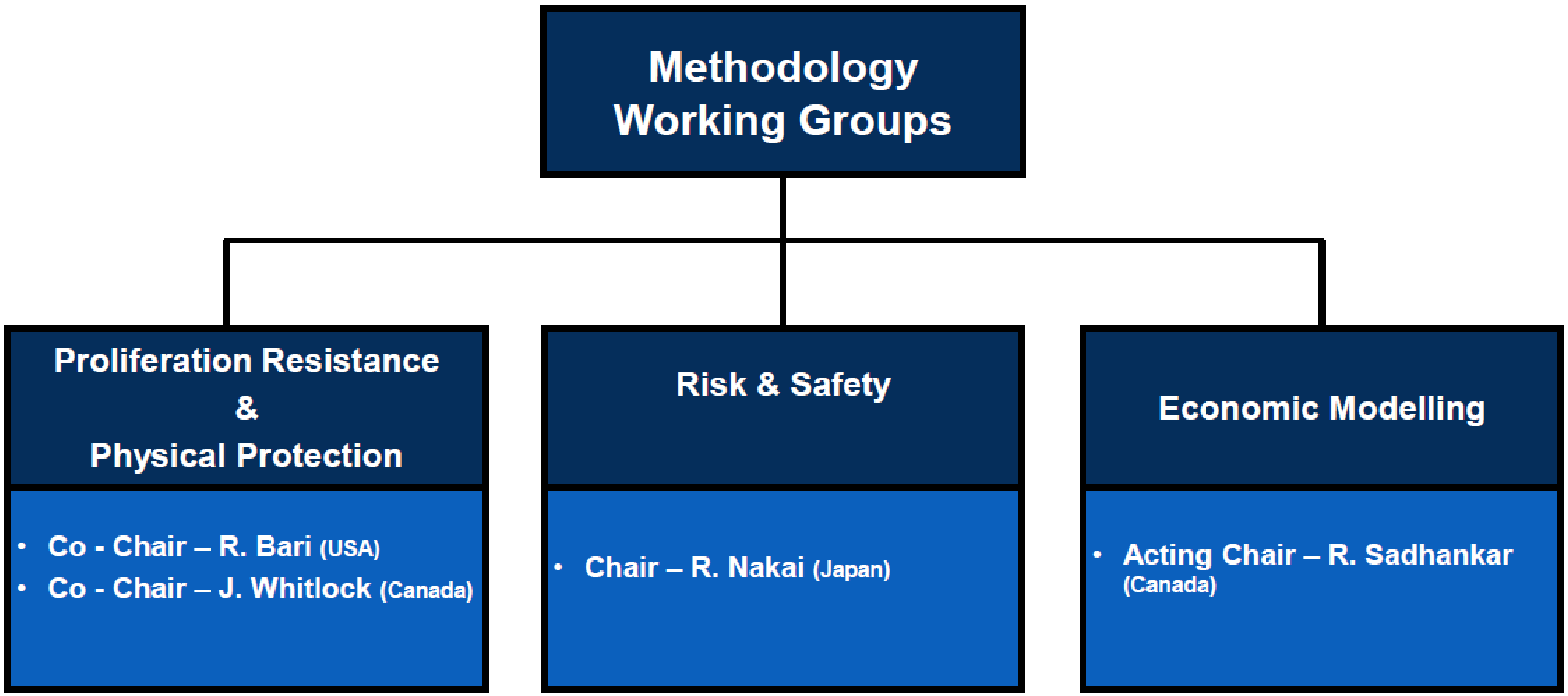
Gas-Cooled Fast Reactor

- Chair – R. Stainsby (EURATOM)

Very High Temperature Reactor

- Chair – F. Li (China)
- Co-Chair – C. Sink (USA))

ORGANISATION DU GIF



Membres du RSWG

- Japon (JAEA) : chair (R. Nakai)
- UE : co-chair (L. Ammirabile)
- AIEA
- Chine
- Corée du Sud
- Etats-Unis (ANL)
- Russie
- France x3 : CEA, AREVA, EDF

Reporte à l’Expert Group du GIF

~2 réunions par an

OBJECTIFS DU RSWG

L'objectif principal du RSWG est de promouvoir une approche de sûreté cohérente entre les systèmes GenIV :

- Etablir les objectifs et principes de sûreté Gen IV
- Produire des méthodologies d'évaluation de sûreté «technology neutral » pour guider les conceptions et la R&D
- Tester l'application de ces méthodes et critères de sûreté aux différents systèmes GenIV
- Supporter les SSC sur les aspects sûreté
- Interagir avec le PRPPWG
- Soutenir des interactions appropriées avec les régulateurs, l'AIEA ou d'autres entités supranationales
- Reporter annuellement à l'Expert Group

SR-1: Excel in Operational Safety and Reliability

- Safety and reliability during normal operation, and likely kinds of operational events that set forced outage rate

SR-2: Very low likelihood & degree of reactor core damage

- Minimizing frequency of initiating events, and design features for controlling & mitigating any initiating events w/o causing core damage

SR-3: Eliminate the need for offsite emergency response

- Safety architecture to manage & mitigate severe plant conditions, for making small the possibility of releases of radiation

Préconisations de design :

Combination of active & passive safety systems to enhance safety against wide-ranging events (incl. DBA and DEC)

> *DBA : reliable safety systems based on proven technologies*
>
> *DEC : diversity with different principle without further multiplexing measures for DBAs. Using passive & inherent features for termination or mitigation, even in postulated failure of active systems.*

Situations pratiquement éliminées :

Severe accidents that could lead to a significant and sudden radioactive release due to a possible cliff edge effect, not reasonably manageable by design improvement, shall be practically eliminated by appropriate provisions.

1. Basis for the safety approach for design and assessment of Generation IV nuclear systems – Novembre 2008

2. Integrated Safety Assessment Methodology (ISAM) – Juin 2011

3. Guidance document for ISAM – Mai 2014

RSWG – ACTIONS EN COURS

- Superviser et soutenir la Task Force sur les SFR Safety Design Criteria
- Compléter les **“White Papers” de chaque SSC**
- Développer le guide pour l’application d’ISAM
- Considerer les impacts de Fukushima event sur les aspcets sûreté de Generation IV
- Continuer les interfaces avec IAEA, INPRO, MDEP, PRPP …
- Débuter la rédaction des **“System Safety Assessment”** avec les SSC

Objectifs des White Papers

- Identifier les liens entre conception et sûreté
- Evaluer la cohérence de l'architecture de sûreté
- Dégager des pistes de R&D
- Proposer une application de la méthode ISAM
- Emettre des recommandations de design pour garantir les fonctIons de sûreté

Plan type d'un White paper

1. Overview of Technology
2. Overview of the Safety Architecture's characteristics and performances
3. Current System Development Status

Statuts des White paper

- LFR : Disponible sur le site du GIF
- SFR, VHTR : en cours de validation
- SCWR, GFR, MSR   : en cours d'écriture ?

Objectifs des “system safety assessment”

- Identifier les principaux avantages de sûreté de chaque système
- Fournir un état des lieux des préoccupations de sûreté et des verrous à lever
- Sélectionner les pistes de R&D prometteuses pour améliorer la sûreté

Plan type proposé

General overview of the performance aimed at.
Historical review and feedback experience of construction and operation.
Level of ongoing research and development.
Achievement of safety function:
- Reactivity control (Control system, Risk of criticality)
- Decay heat removal (Thermal inertia and grace period, Diversification, active and passive systems
- Confinement of radioactive materials (Materials, safety barriers, by-pass, source term …
- Radiation protection
- Chemical risk

Management of severe accidents
- Prevention
- Protection
- Situation to practically eliminate

Safety of the fuel cycle
- Type of fuel
- Management of waste (quantity, quality)
- Radiation protection

Others
Summary of progress needed

Rédaction d'un white paper MSR

Echanges sur l'approche de sûreté MSR au prochain RSWG 9-10 juin 2015 à Petten, Pays-Bas

QUESTIONS ?