

IRSN

INSTITUT
DE RADIOPROTECTION
ET DE SÛRETÉ NUCLÉAIRE

Enhancing nuclear safety

Renewal of IRSN training in Nuclear Criticality Safety

Céline Lenepveu
Matthieu Duluc
Marie-Pierre Véran-Viguie
Jean-François Barbier



MEMBER OF

ETSON

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Summary

- 1) Introduction of IRSN
- 2) In-House University
- 3) Nuclear Criticality Safety Training
- 4) Conclusion

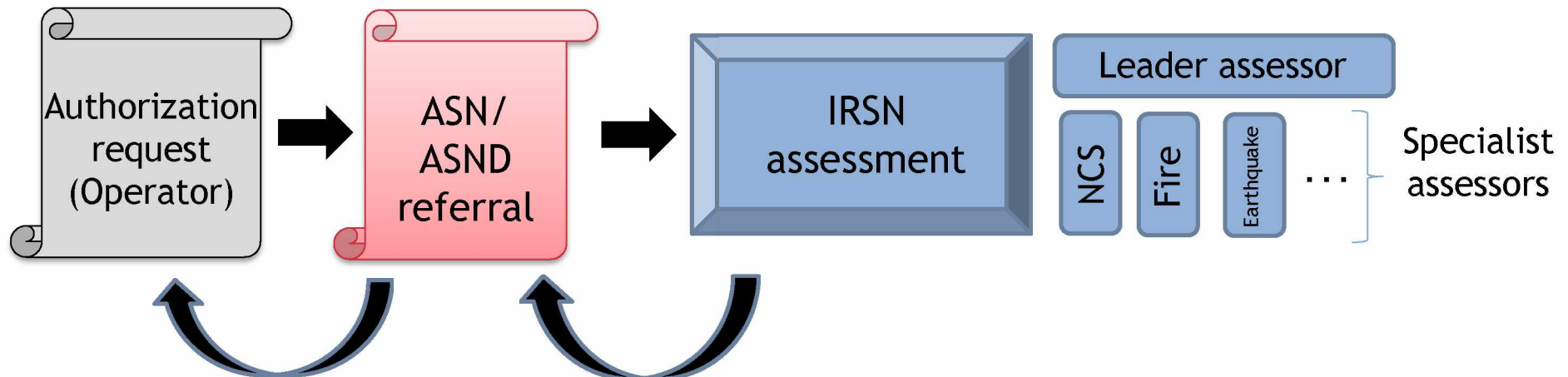
1) Introduction of IRSN

*The Institute for Radiation Protection and Nuclear Safety :
The French national public expert in nuclear and radiological risks*

IRSN main missions

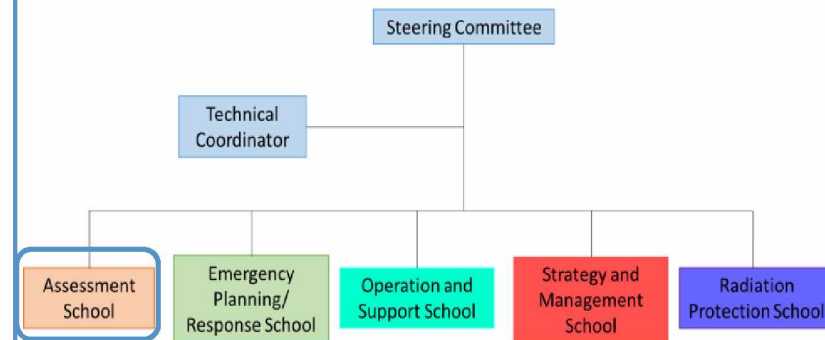
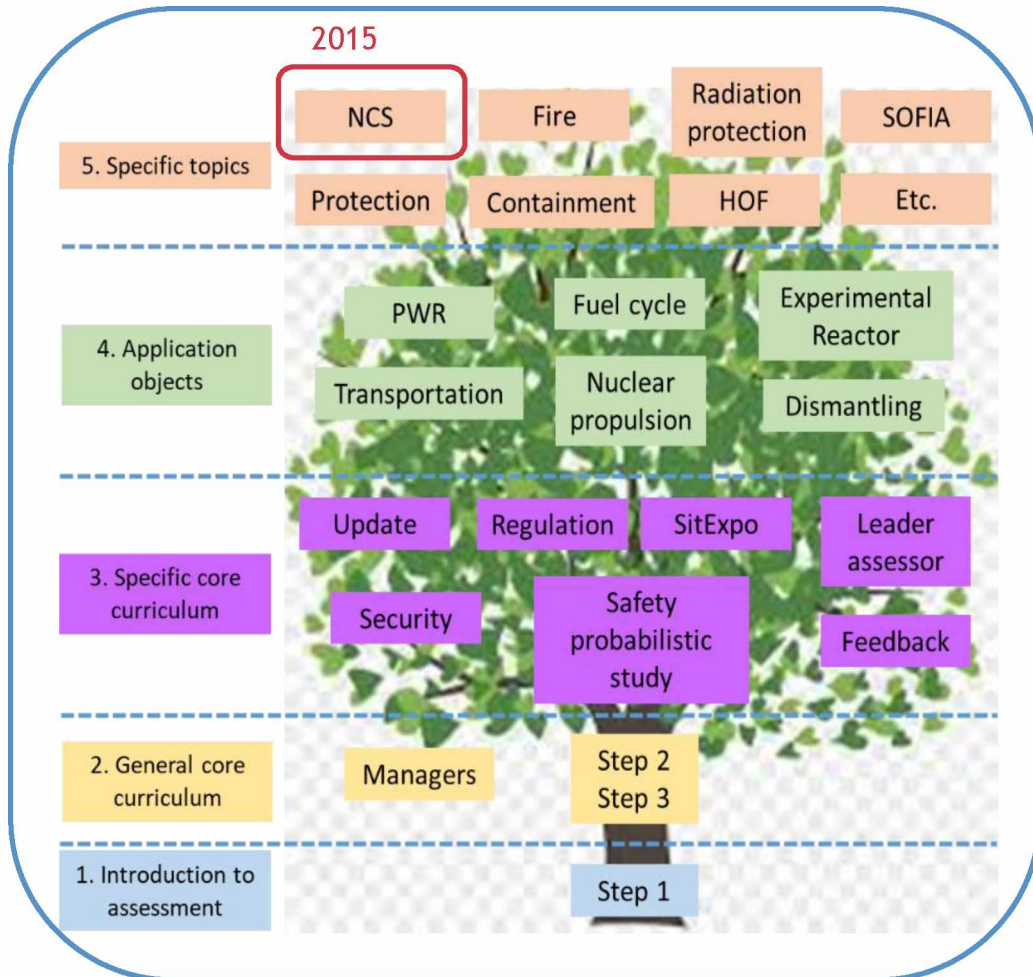
- **Assessment** (technical and operational support and assistance to public authorities -> **ASN/ASND : Nuclear Safety Authority**)
- **Research**

Assessment procedure



2) In-House University

New Version of IRSN in-house training - 2012



For IRSN employees, trainings given by IRSN skilled employees

2) In-House University

- New teaching methods based on andragogy (adult education)
 - IRSN employees receive a Special 2-days Training for Trainers



Educational Methods

Lectures



Pool of questions






Exercices in small groups or in a role game

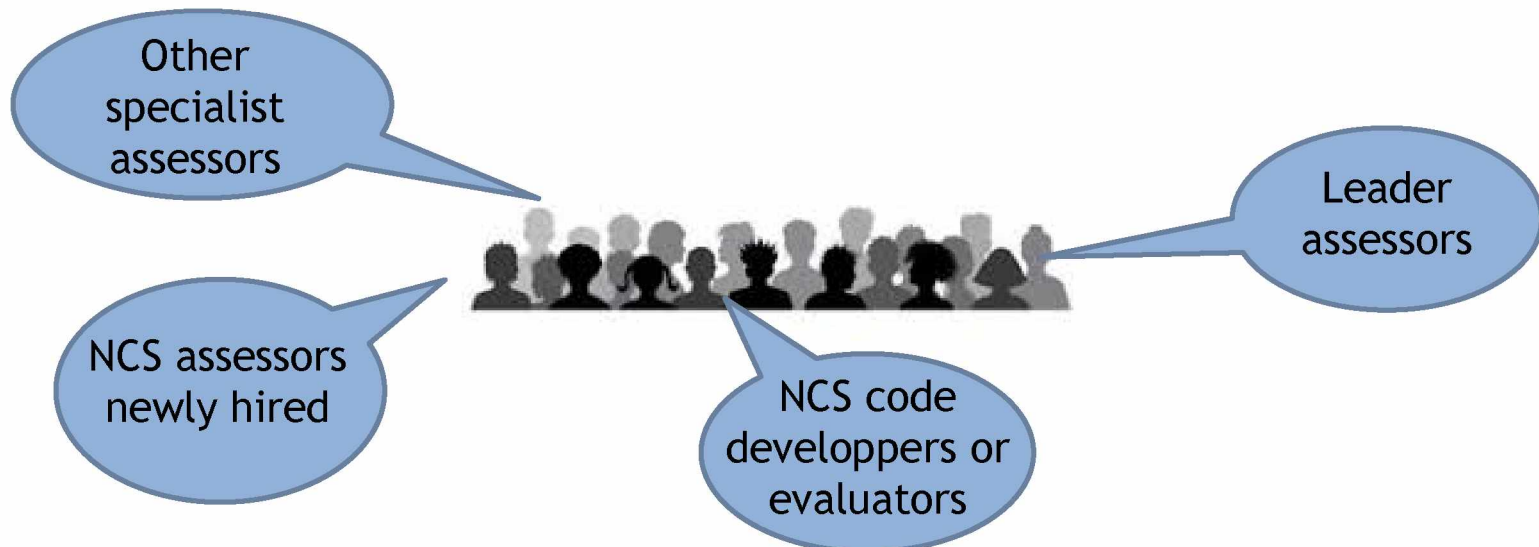


3) Nuclear Criticality Safety Training

Objectives

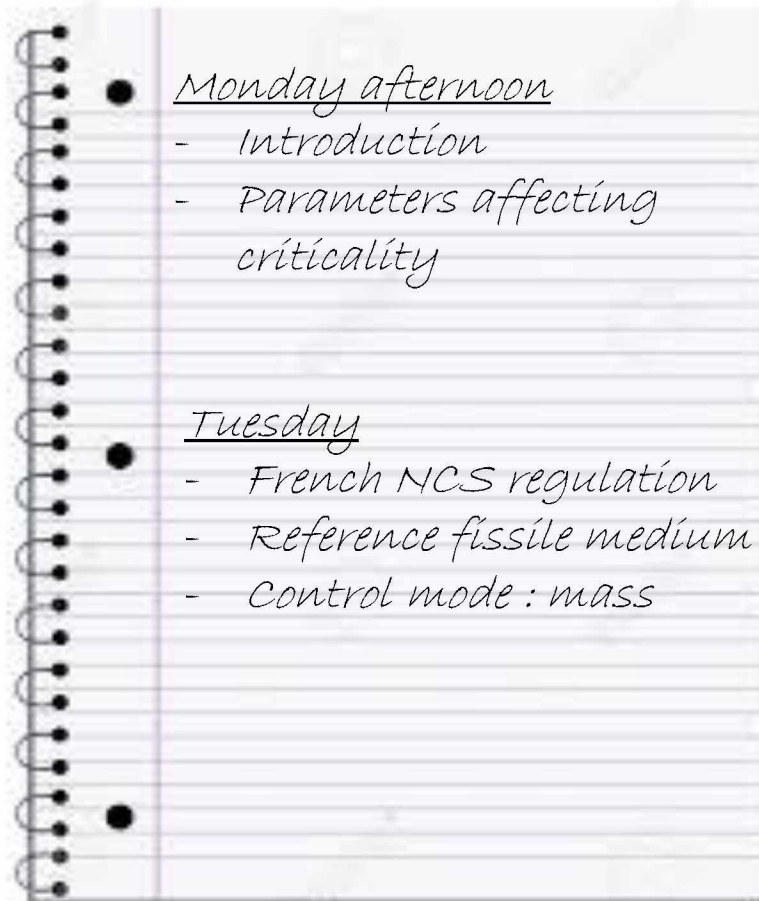
-  To identify the issues and key points of NCS
-  To understand the NCS vocabulary and assessment procedure
-  To understand the links between NCS and other risks (fire, flooding,...)

Target Audience : IRSN employees with a scientific background



3) Nuclear Criticality Safety Training

Program -> 1 week per year with 12 participants (Fontenay-Aux-Roses, near Paris)



3) Nuclear Criticality Safety Training

Organization

Each day : 1 expert lecturer in charge of the participants

Each sequence : 1 or 2 lecturers

Example :



Each lecturer comes from SNC (Neutronics and Criticality Safety)
Departement of IRSN

No exam at the end of the training

3) Nuclear Criticality Safety Training

Focus on specific sequences

▪ *Introduction (Monday afternoon)*

Question for the group : « What can be the consequences of a criticality accident ? » -> Discussions based on the audience answers

Lecture

 To understand why a criticality accident is not acceptable

 To have an idea of the trainee's background

▪ *NCS French Regulation (Tuesday morning)*

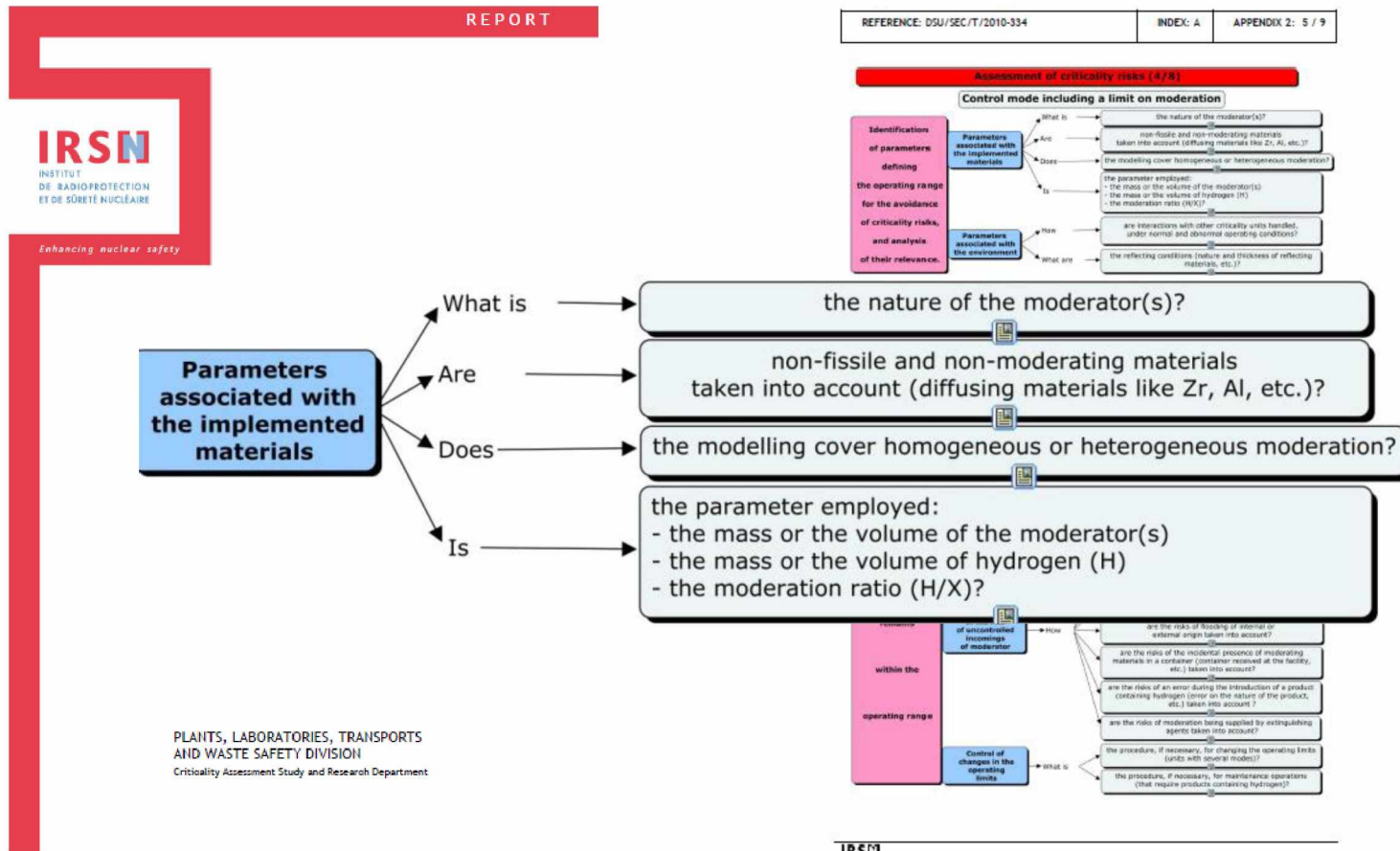
Lecture on the new regulation (2014) written by ASN

Introduction to the IRSN NCS guide used in the following sequences

 To understand the regulatory framework

3) Nuclear Criticality Safety Training

IRSN analysis guide in NCS



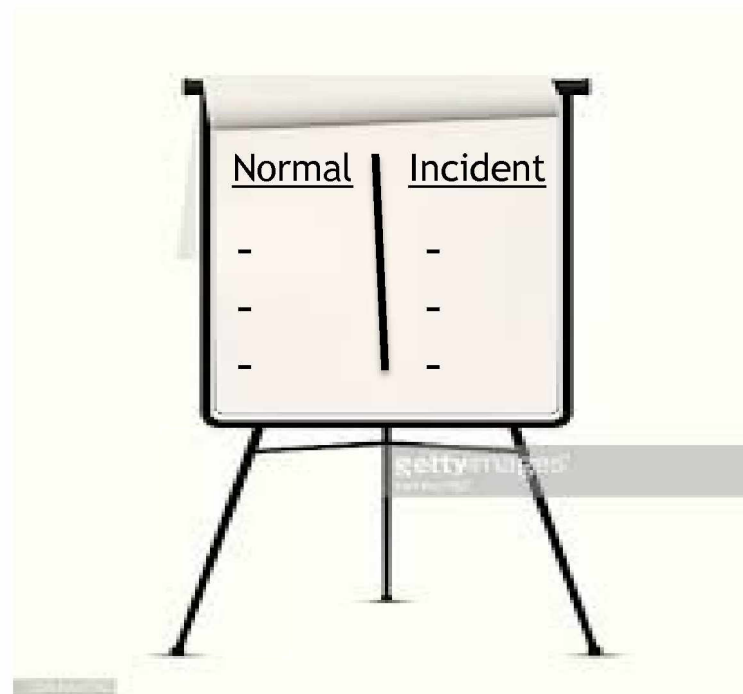
https://www.irsn.fr/EN/publications/technical-publications/Documents/IRSN_report_nuclear_criticality_risks.pdf

3) Nuclear Criticality Safety Training

Focus on specific sequences

- **Control mode including moderation (Wednesday afternoon)**

Question for the group : « What are the materials that could be a moderator in a fuel cycle? »

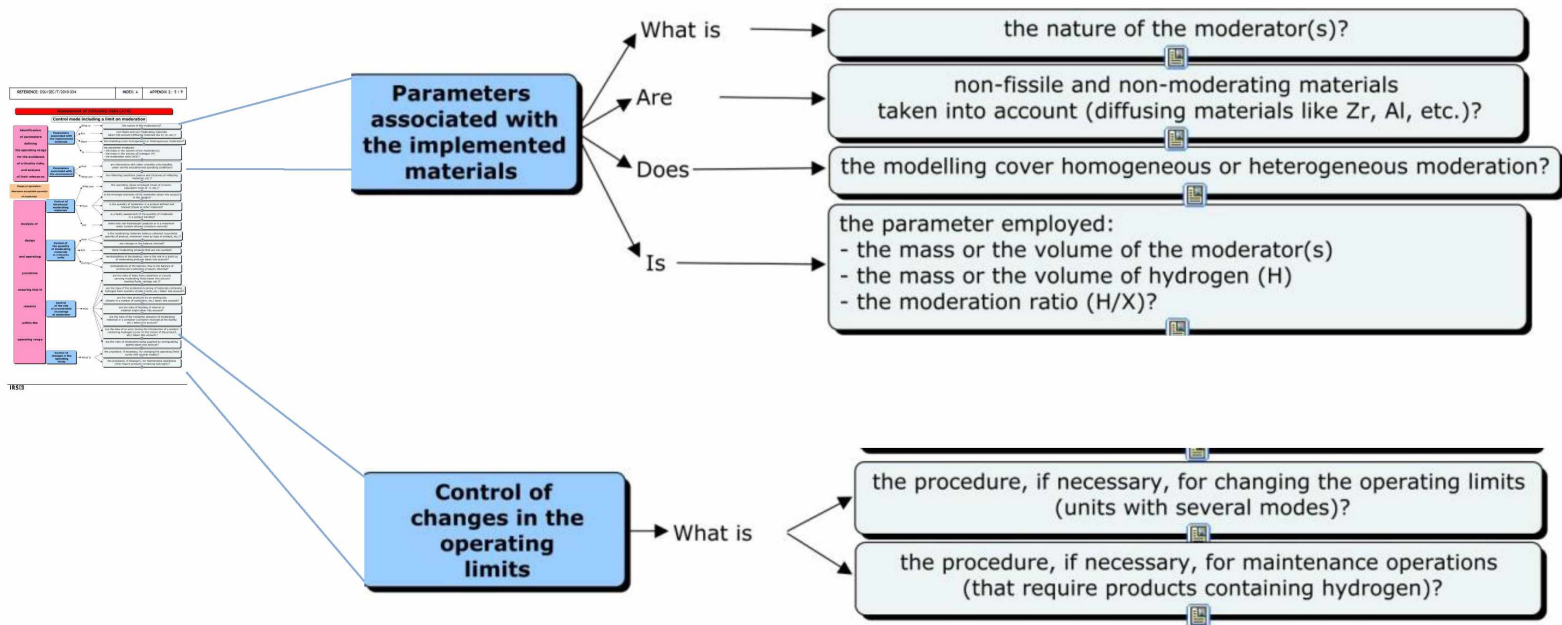


3) Nuclear Criticality Safety Training

Focus on specific sequences

- **Control mode including moderation** (*Wednesday afternoon*)

Lecture on physical properties of moderation, followed by the use of the guide.



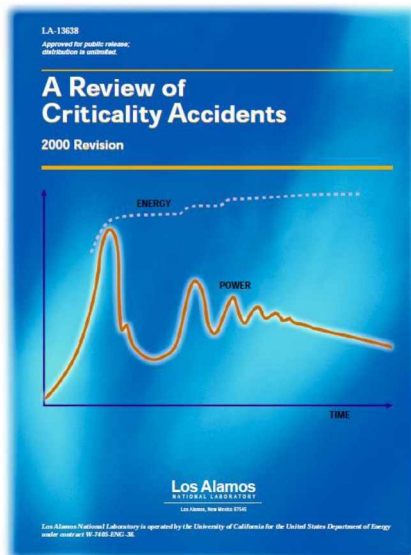
To show that human and organisational factor is of importance

3) Nuclear Criticality Safety Training

Focus on specific sequences

- **Criticality accidents** (*Thursday morning*)

Lecture on different criticality accidents that occurred worldwide, with a focus on the last one (Tokai-Mura in 1999), and on different devices available to detect a criticality accident.



3) Nuclear Criticality Safety Training

Focus on specific sequences

- **Criticality accidents** (*Thursday morning*)

Exercices in small groups, each group works on a past criticality accident, based on documents provided.

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Objectifs	
Modalités de formation	
Évaluation	
Autres informations	



At the end : each group gives a presentation of the criticality accident to the other groups



To identify failures associated with control modes and lines of defense that caused the criticality accident

3) Nuclear Criticality Safety Training

Focus on specific sequences

- Other risks (Friday morning)

Exercices in small groups

	MFI	Mass	Geometry	Concentration	Moderation	Poison homogène	Poison hétérogène	Réflexion/Interaction	Généraliste Spécialiste
RISQUES D'ORIGINE INTERNE NUCLEAIRE									

	Fissile reference medium	Mass	Geometry	Concentration	Moderation	Liquid poison	Solid poison	Reflection/ interaction
Fire	Chemical reaction		Loss of geometry	Evaporation Precipitation	Moderator supply	Evaporation Precipitation Dilution	Loss of geometry	Reflector supply

Inondation d'origine interne	réaction chimique			précipitation	apport de modérateur	dilution précipitation		meilleure réflexion	inondation Généraliste
Explosion d'origine interne			perte de géométrie				perte de géométrie		Explosion Généraliste
RISQUES D'ORIGINE EXTERNE NON NUCLEAIRE									
Séisme	déformation matière (hétérogène)	regroupement matière	perte de géométrie		apport de modérateur		perte de géométrie	déplacement objet	GC Généraliste
Inondation d'origine externe	réaction chimique			précipitation	apport de modérateur	dilution précipitation		meilleure réflexion	inondation Généraliste
Chute de projectiles (avions...)	déformation matière (hétérogène)	regroupement matière	perte de géométrie		apport de modérateur		perte de géométrie	déplacement objet	Généraliste
Perte de fourniture en énergie et en utilités	dérive de procédé	gestion bilan		perte de brassage	gestion bilan	perte de brassage			Généraliste



To identify other risks that can have an impact on NCS, to encourage exchanges with other specialists

4) Conclusion

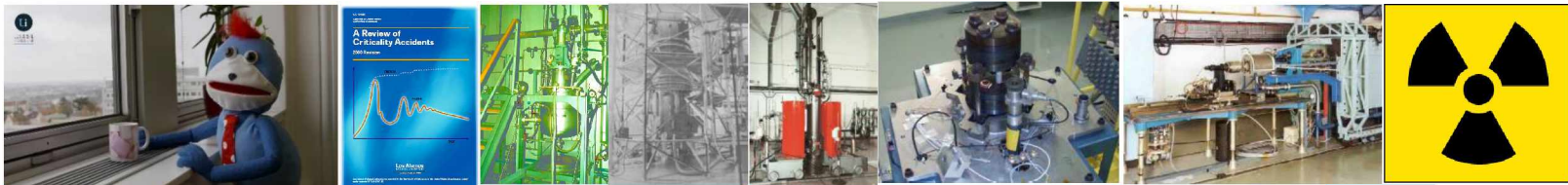
Conclusion

- 1 session per year since 2015 (47 participants trained)
- Evaluation performed by trainees in the form of a questionnaire and a discussion on Friday morning which allows to improve the training for the next session
- New educational methods are proved to be appreciated
- Better technical exchanges between NCS assessors and other assessors
- The coming IRSN session is planned the last week of November 2019

Perspectives

- Future trainings open to non IRSN participants :
 - In English : 14-18 September 2020
- Organized by ENSTTI <http://enstti.eu/wp/>

Thank you for your attention !



ICNC 2019 (15-20 SEPTEMBER), PARIS
RENEWAL OF IRSN TRAINING IN NUCLEAR CRITICALITY SAFETY

ICNC2019
11th International Conference on Nuclear Criticality safety

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