

QUE FAUT-IL POUR CONSTRUIRE UN SYSTEME DE GESTION DES RISQUES ?

Un consensus sur :

- La relation exposition / risque
- Les règles de protection
- L'application des règles

ETAPE 1: RELATION DOSE / EFFET

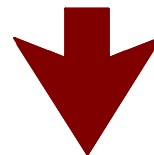
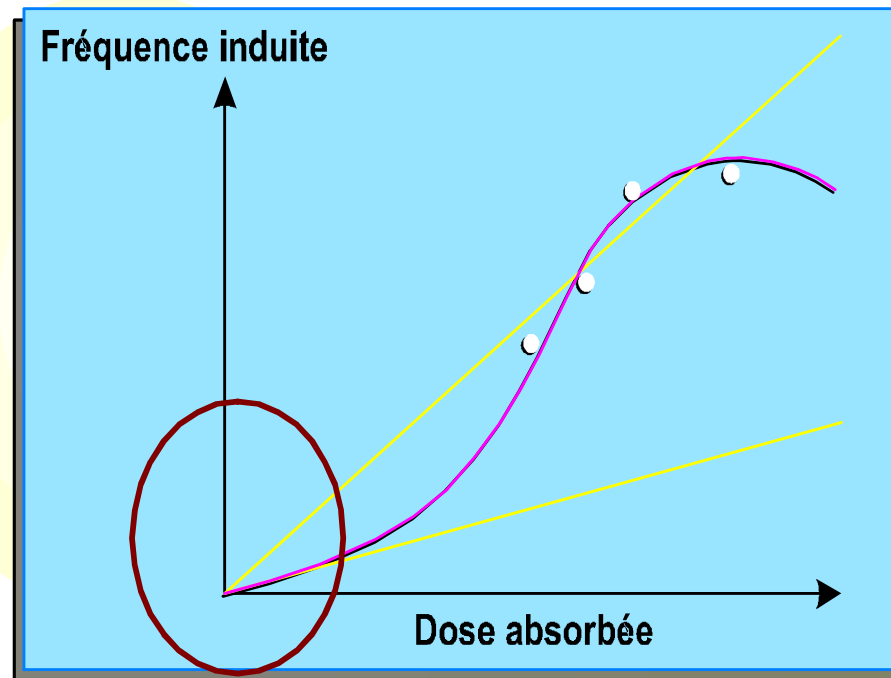
MODELE DE PRECAUTION

DONNÉES DE BASE

- ▶ Cancers observés
- ▶ Doses reçues

EXTRAPOLATION

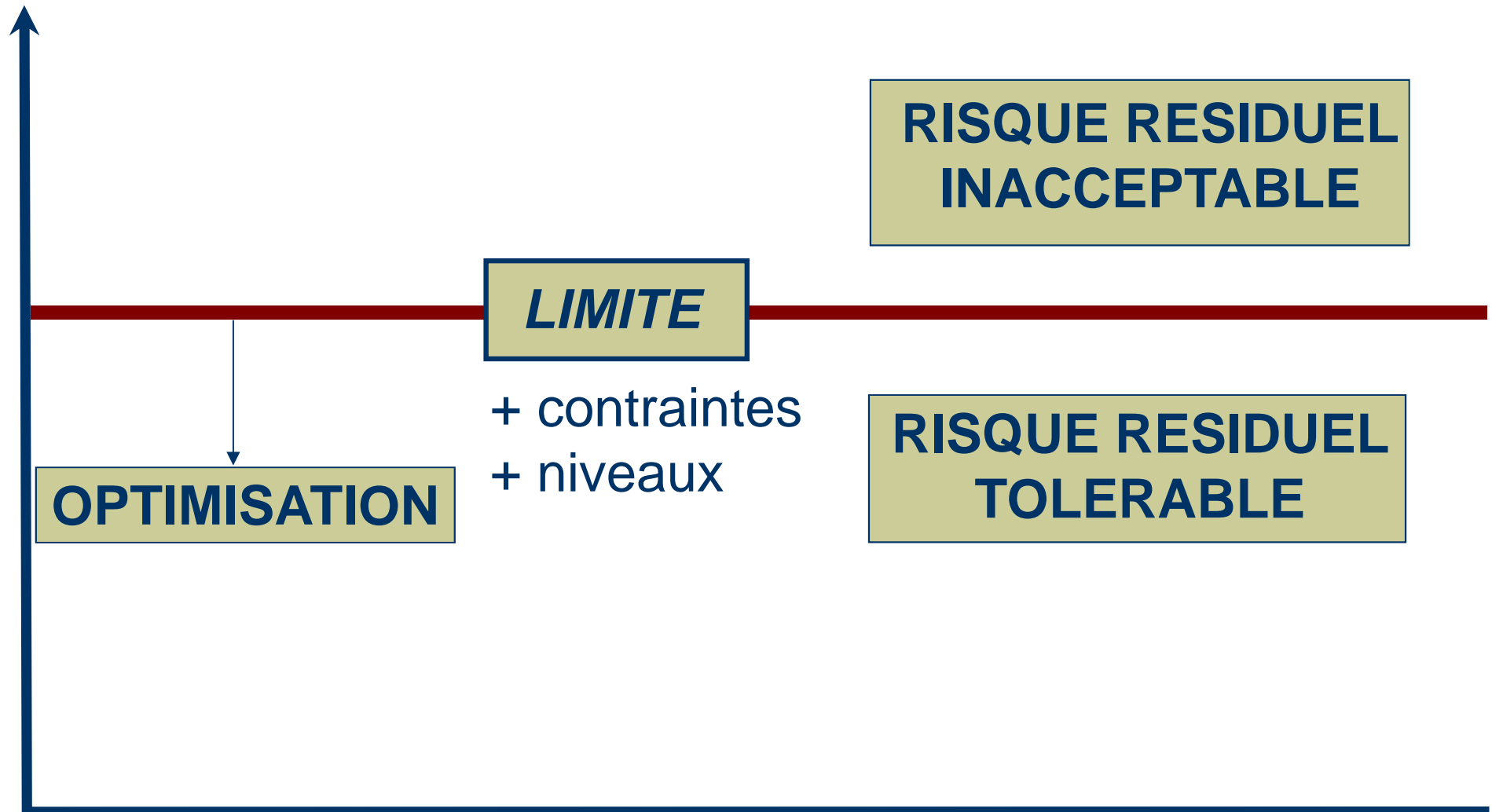
- ▶ Cancers vie entière
- ▶ Faible dose, faible débit
- ▶ Population standard



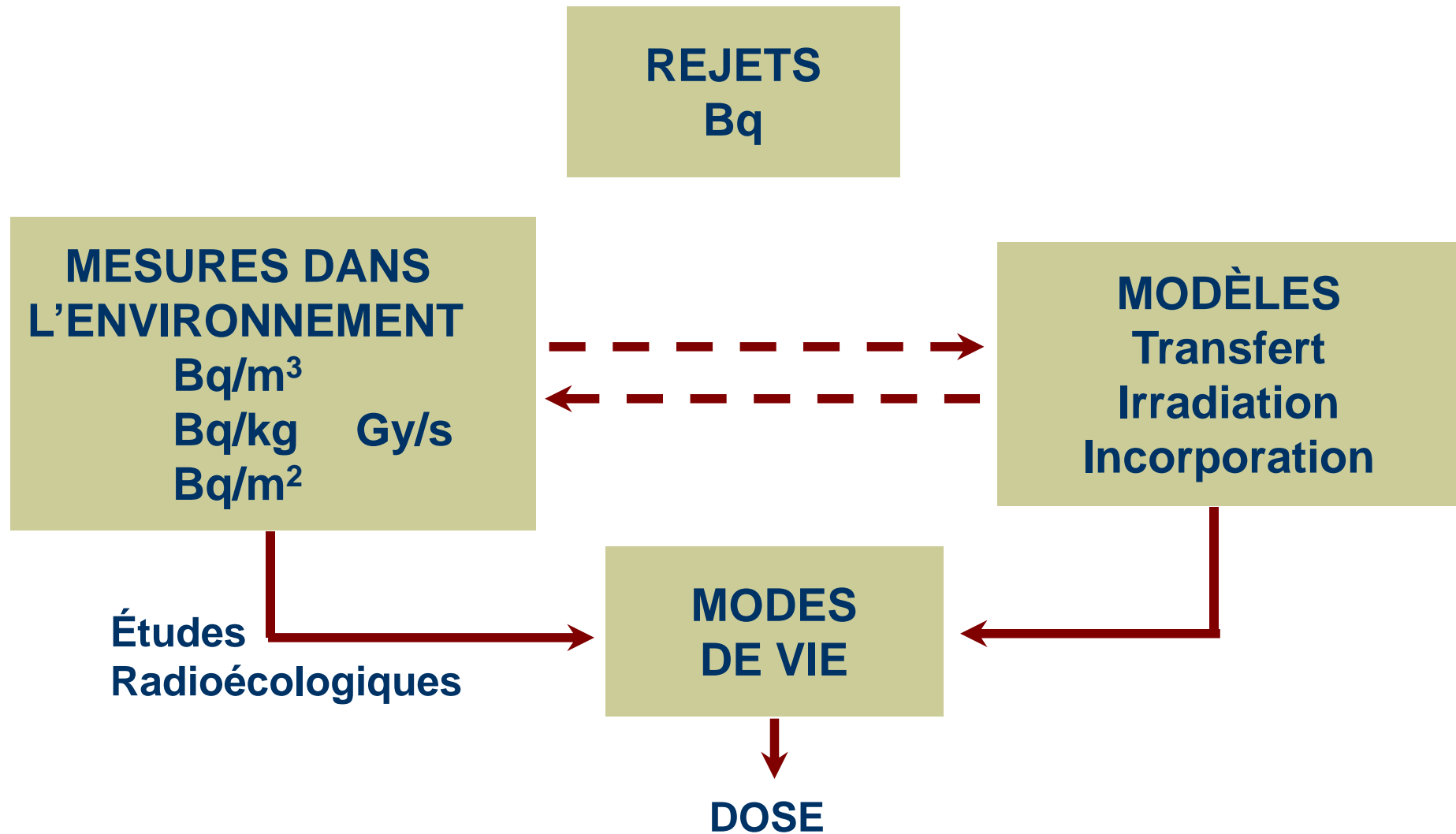
Les risques associés aux rayonnements peuvent seulement être réduits
et non pas totalement éliminés

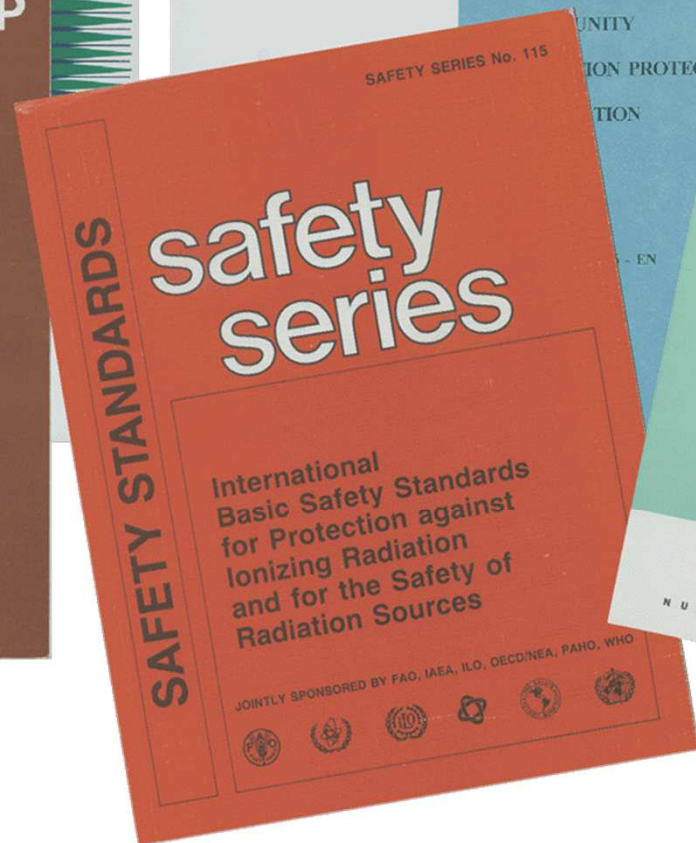
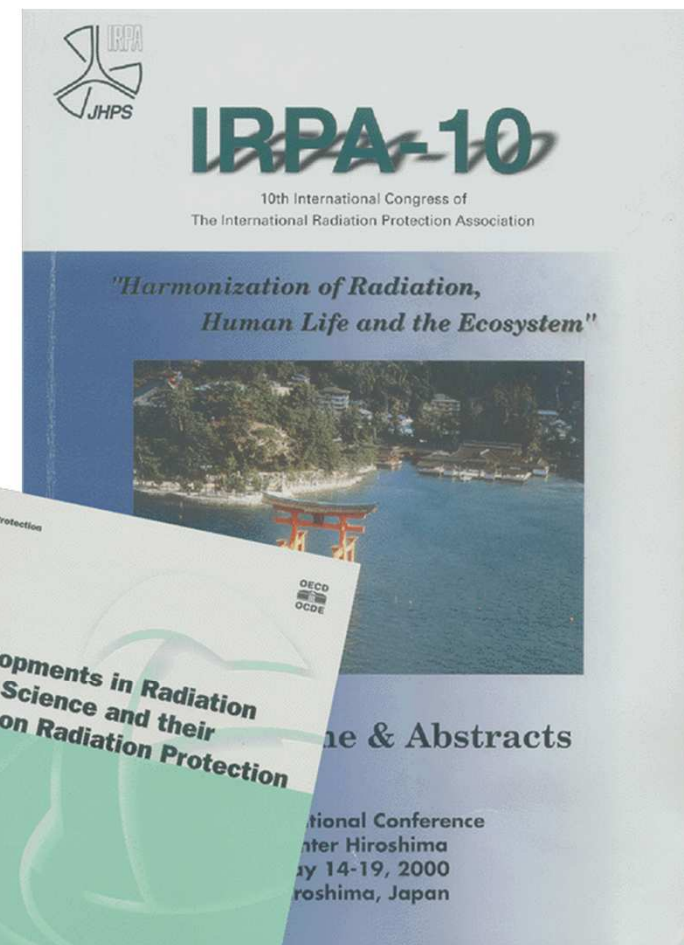
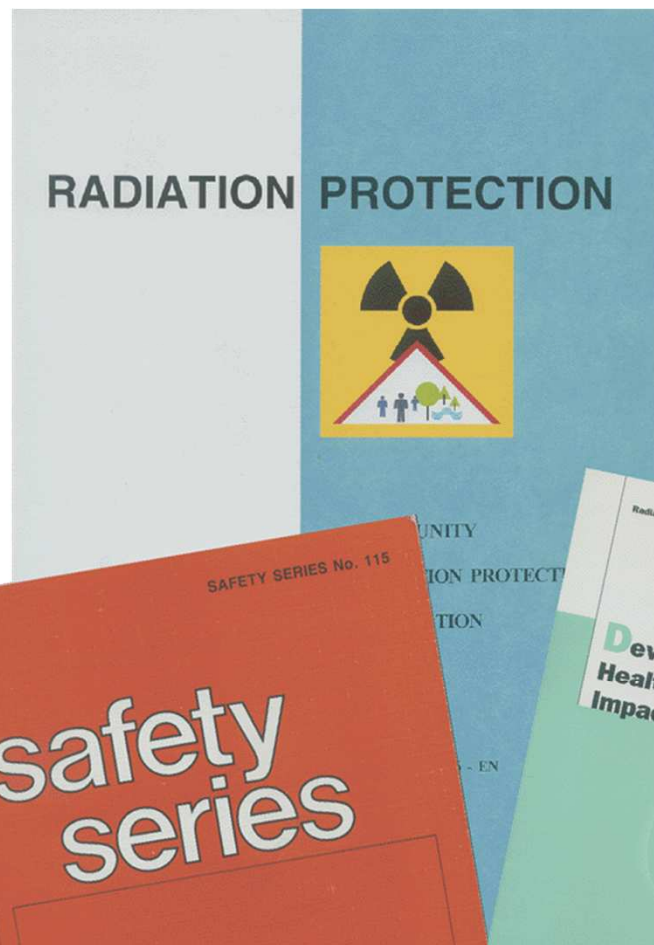
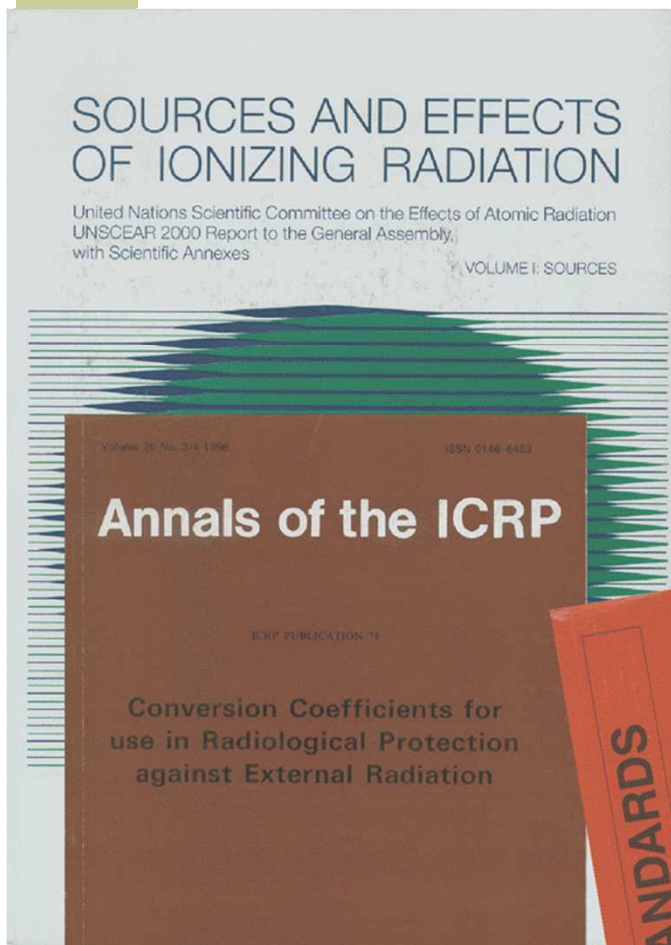
ETAPE 2: LES REGLES DE PROTECTION LE MODELE DE PRECAUTION

Niveau d'exposition individuel



ETAPE 3: L'APPLICATION REALISME OU PRECAUTION





Nouvelles recommandations de la CIPR 28 octobre 2003

DEVELOPMENT OF ICRP RECOMMENDATION

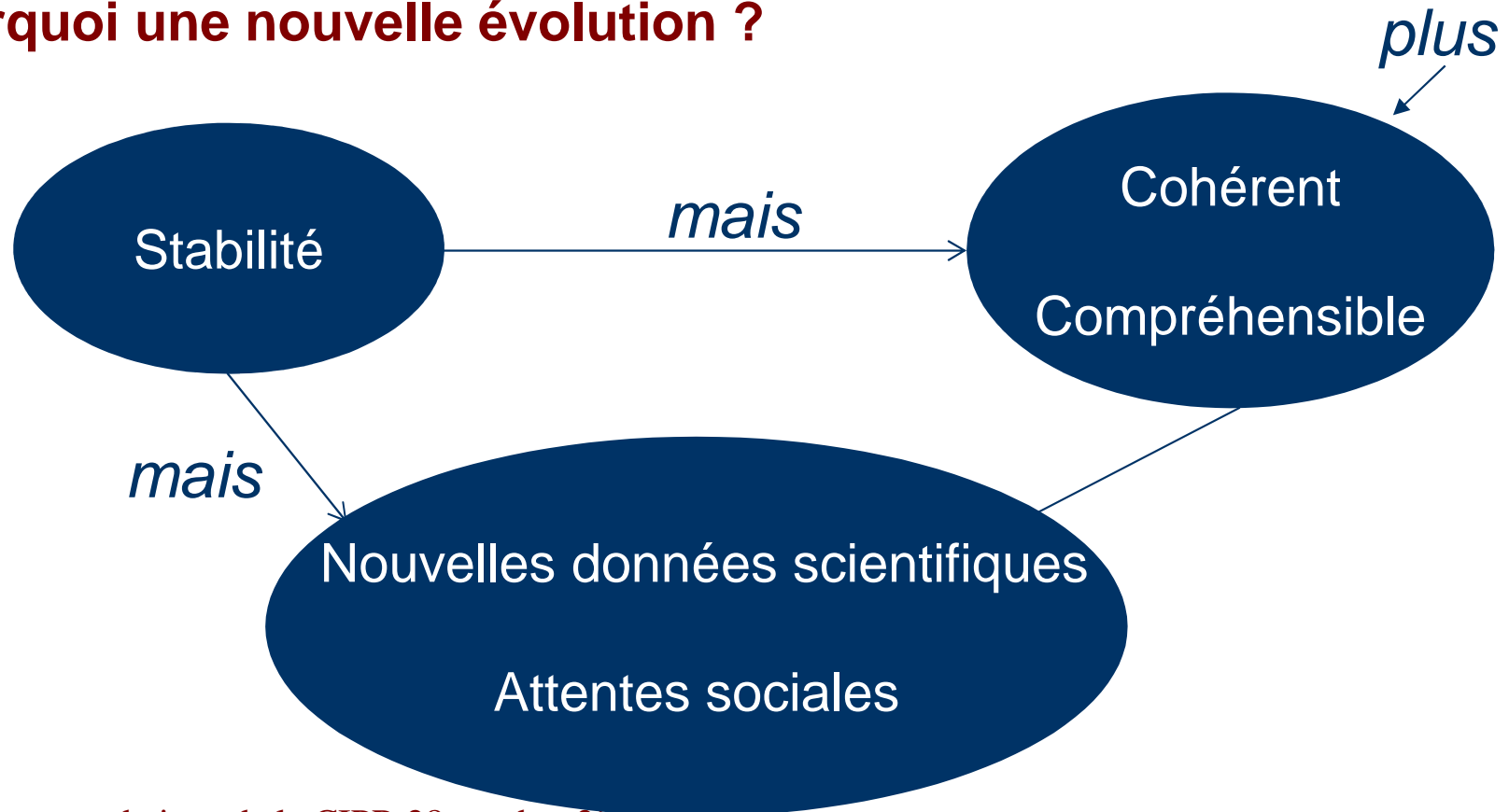
First report		1928	} general recommendations + amendments 78, 80, 83, 84, 87
Publication	1	1959	
	6	1964	
	9	1966	
	26	1977	
	60	1990	

- ❑ **Systeme moderne de radioprotection**

Depuis la CIPR 26 - 1977

- ❑ **Evolution vers une complexité croissante** (nombreux types de situations)

- ❑ **Pourquoi une nouvelle évolution ?**



AGENDA DE LA CIPR

MC et Comités	Argentine Buenos Aires Bariloche	2-6/11/03 7-8/11/03
MC	VIP Vienne (avant UNSCEAR) 1ère présentation des recommandations IRPA-11-Madrid May, 2004	23-24/11/04
MC et Comités	Chine Beijing Suzhon	10-14/10/04 15-18/10/04
MC	?	Printemps 05
MC et Comités	Suisse Genève	11-15/9/05 16-19/9/05

ETAT D'AVANCEMENT DES TRAVAUX DE LA CIPR

Recommandations 2005

- nouvelle version mi octobre 2003
circulation MC et Comité
examen à Buenos Aires 2003 et Vienne 2004

Rapports publiés

- C2: irradiation prénatale
- TG/MC Protection de l'Environnement

Rapports en cours de discussion

- C3 gestion de la dose en radiologie numérique
- C3 sortie des patients en médecine nucléaire
- C2 HAT (modèle digestif)
- C2 unités dosimétriques (document fondateur)
- C1 nouveaux développements scientifiques, (document fondateur)
- C4 optimisation, individu de référence,
champ du système, protection dans l'espace (documents fondateurs)

☐ Protection des êtres humains et des autres espèces

“Sans limiter de façon indue les effets bénéfiques [...] “

☐ Niveau minimum standard de protection

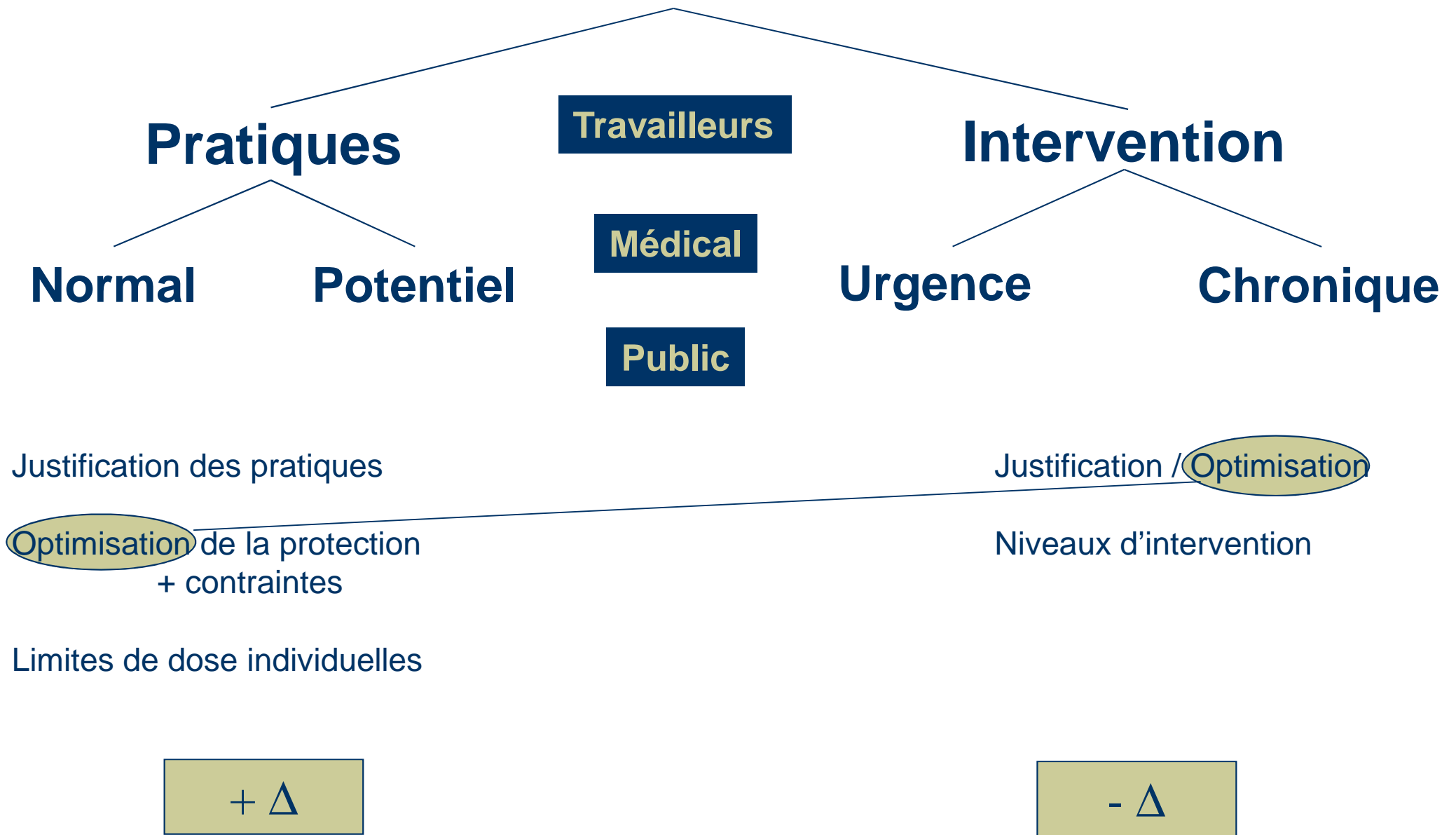
Individu et société

Extension du concept de contrainte

☐ Révision des facteurs de pondérations

☐ Approche cohérente des expositions naturelles

SYSTEME DE PROTECTION RADIOLOGIQUE DE 1990



62	Recherche biomédicale
63	Intervention
64	Exposition potentielle
65	Radon 222
73	Médical
75	Travailleurs
76	Sources médicales / industrielles
77	Evacuation des déchets
81	Déchets solides à vie longue
82	Exposition prolongée

ARGUMENTAIRES RELATIFS AUX 30 VALEURS NUMERIQUES EXISTANTES

- a. Risque individuel de décès
- b. Niveaux d'exposition naturelle
- c. Multiples ou fraction du fond naturel
- d. Analyse coût / bénéfice
- e. Raisons qualitatives
- f. Effets déterministes

VALEURS EXISTANTES

Situation 1 <i>Fonctionnement normal d'une pratique</i>	Situation 2 <i>Exposition prolongée</i>	Situation 3 <i>Recherche biomédicale</i>	Situation 4 <i>Evènement isolé</i>
			<u>1000*</u> Relocation
			<u>500*</u> Evacuation exigée
	<u>100</u> Intervention toujours justifiée		<u>50*</u> Mise à l'abri exigée
<u>20</u> Limite travailleurs		<u>20</u> Bénéfice substantiel pour la société	
<u>10</u> Contrainte max Rn 222 pour les travailleurs	<u>10</u> - Intervention optionnelle - Contrainte max pour Rn 222 habitation	<u>10</u> Bénéfice modéré pour la société	<u>10*</u> Valeur optimisée pour les aliments
<u>2</u> Surface abdomen Femme enceinte			
<u>1</u> - Dose au fœtus - Limite public	<u>1</u> Niveau d'intervention exemption	<u>1</u> Bénéfice intermédiaire pour la société	
<u>0.3</u> Contrainte public			
<u>0.1</u> Contrainte déchets à vie longue		<u>0.1</u> Bénéfice mineur pour la société	
<u>0.01</u> Exemption			

Nouvelles recommandations de la CIPR 28 octobre 2003

* Dose évitée ?

* Dose à l'organe ? (ex: thyroïde)

Exemples

CIRP 60 **Fonctionnement normal d'une pratique**

Limite de dose pour les travailleurs **20 mSv/an**

- a) "niveau inacceptable de conséquences"
"jugement basé sur : réduction d'espérance de vie, taux de mortalité, probabilité de décès, effets héréditaires sévères, morbidité ... "

CIRP 65 **Exposition prolongée**

Niveau d'action pour le radon dans les habitations **3 - 10 mSv/an**

- b) "réduction par un facteur 5 ou 10 signifierait un niveau d'action < que le fond naturel"
"il semble clair que au dessus de 10 mSv des mesures sont presque toujours justifiées"

CIRP 62 **Recherche biomédicale**

Niveau d'action (bénéfice sociétal substantiel) **> 10 mSv/an**

- a) "niveau de risque (10-3 ou plus) proche de l'inacceptable pour des expositions continues ou répétées > que la limite travailleurs"

CIRP 63 **Evènements isolés ou accidents**

Evacuation estimée sur des bases génériques **500 mSv**

- a) "en dessous des seuils déterministes"
c+e) "estimé sur des bases génériques (qualificatif, fond naturel)"

§ 13 du texte *“Evolution”*

“La question à considérer est la suivante :

Peut-on dans l’avenir recommander un nombre réduit de contraintes suffisants pou répondre aux besoins de la protection radiologique

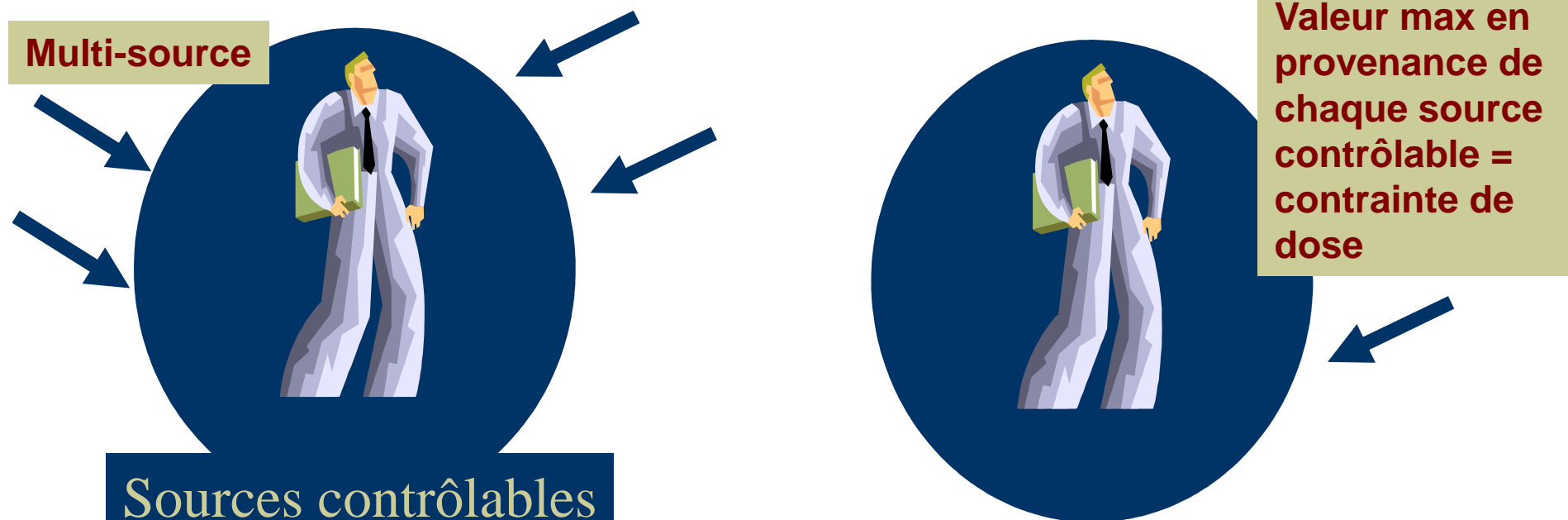
et

Ces contraintes peuvent-elles être établies sur des bases plus uniformes et cohérentes ?

OPTIMISATION 1^{ER} PRINCIPE = Action à la source

CONTRAINTE DE DOSE COMME LIGNE DE DEPART DE L'OPTIMISATION = protection de l'individu

“La procédure d'optimisation doit être contrainte par des restrictions sur la dose aux individus (contrainte de dose) ... afin de limiter l'iniquité pouvant résulter de jugements économiques et sociaux”.



“La procédure d’optimisation doit être contrainte par des restrictions sur la dose aux individus (contrainte de dose) ... afin de limiter l’iniquité pouvant résulter de jugements économiques et sociaux”.
(CIRP 60 § 112)



“En tant que niveau standard minimum de protection de l’individu” (Texte “Evolution” § 7)

“Une restriction initiale sur la dose max individuelle, en tenant compte des situations d’exposition, suivie par une exigence d’optimisation” (Texte “Evolution” § 9)

❑ **Systeme actuel**

Valeurs max. des contraintes et des limites
x 10 fond naturel

❑ **Nouvelles recommandations**

La préoccupation que l'on peut raisonnablement avoir vis à vis du fond naturel d'exposition

La fait que le fond naturel varie d'un facteur au moins 10 autour du monde et même plus si l'on inclut les niveaux les plus élevés des expositions au radon, est un argument allant dans le sens d'une préoccupation accrue lorsqu'on atteint les valeurs hautes du fond naturel.

Une dose en provenance d'une source correspondant à x 100 (s) le fond naturel est un sujet de préoccupation.

VALEURS EXISTANTES

Système basé sur le contrôle
des sources

Situation 1 <i>Fonctionnement normal d'une pratique</i>	Situation 2 <i>Exposition prolongée</i>	Situation 3 <i>Recherche biomédicale</i>	Situation 4 <i>Evènement isolé</i>
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<u>0.1</u> Contrainte déchets à vie longue		<u>0.1</u> Bénéfice mineur pour la société	
<u>0.01</u> Exemption			

4 valeurs
déterminantes

Nouvelles recommandations de la CIPR 28 octobre 2003

* Dose évitée ?

* Dose à l'organe ? (ex: thyroïde)

QUEL ARGUMENTAIRE POUR LES 4 VALEURS ?

Nouveau système (mSv/an)		Situations
<u>500</u>		- Accident – phase d’urgence
<u>20</u>	Valeur maximale pour tout type de sources	<ul style="list-style-type: none"> - bénéfice direct – compensation et/ou - surveillance et/ou - information – formation et/ou - situations où les expositions sont difficiles à contrôler
<u>0,3</u>	Valeur maximale pour les sources contrôlables introduites de façon délibérée	<ul style="list-style-type: none"> - pas de bénéfice direct – pas de compensation, mais bénéfice social et/ou - surveillance de l’environnement mais pas individuelle et/ou - information mais pas de formation
<u>0,01</u>	Exclusion	

VERIFICATION DU SYSTEME BASE SUR LE CONTRÔLE DES SOURCES

Type d'exposition	Durée (années)	Délibéré	Dose annuelle maximum (mSv/an)	Dose sur la vie (mSv)	Dose types (mSv/a)	Dose sur la vie (mSv/a)
Public	75	Oui	0,3	~ 25	0,001	0,001
Expositions Prolongées (ex. Radon)	75	Non	20	1500	~ 2 -	150
Professionnel	20 – 30	Oui	20	400	~ 2 -	150
Naturel (hors Rn)	75	Non	1	75	1	75
Médical	75	≈ Non	2	150	2	150
TOTAL				≈ 2000		≈ 500

Nouvelles recommandations de la CIPR 28 octobre 2003

S'applique aux :

- o Pratiques justifiées
- o Sources contrôlables

PRINCIPES	RESPONSABILITES
<input type="checkbox"/> Contraintes fondamentales	CIPR
<input type="checkbox"/> Contraintes spécifiques	Agences internationales
<input type="checkbox"/> Optimisation	Exploitants Autorités

ICRP – 2005 RECOMMENDATIONS

❑ **Recognising**

Where the responsibility for justifying the introduction of a new practice lies

❑ **Maintaining and clarifying**

the dose limits for individuals

boundary of unacceptable risk for the individual in normal situations

❑ **Developing**

the concept of dose constraints

basic standards of protection for workers and the public from single sources

❑ **Improving on that basic standard**

by requiring ALARA from any source

❑ **Including**

a policy for radiological protection of non human species

❑ **Clarifying the dosimetric quantities**

CHARACTERISTIC OF THE SYSTEM OF RP

Sources of ionizing radiation

Universal feature and capable of damaging health

Human action: additional source

Introduce artificial sources

Reinforce natural sources

Where and how much protection should be sought?

Primary aim of the recommendations

Contribute to the establishment and application of

- an appropriate standard of protection for human population and, where necessary for other species
- without unduly limiting the desirable human actions and lifestyles that give rise to or increase radiation exposure

This aim cannot be achieved solely on the basis of scientific data (value judgements)

THE SCOPE OF THE RECOMMENDATIONS

☐ Controllable sources

- direct action at the source
- environmental action at the pathways

☐ Justified activities

- | | | | |
|------------|---------------------------------------|---|---|
| - practice | deliberately introduced or maintained | increases or potentially increases the exposure | government responsibility
RP = one input |
| ↓ | | | |
| normal | | | |
| - abnormal | introduced unintentionally | already existing (accident, past practices, abandoned, natural) | justification not needed |

- | | | | |
|-----------|--|---------------------|--------------------------|
| - medical | . medical use of radiation
. procedures within the practice
. particular use of a particular procedure | particular practice | 3 steps of justification |
|-----------|--|---------------------|--------------------------|

☐ Excluded sources

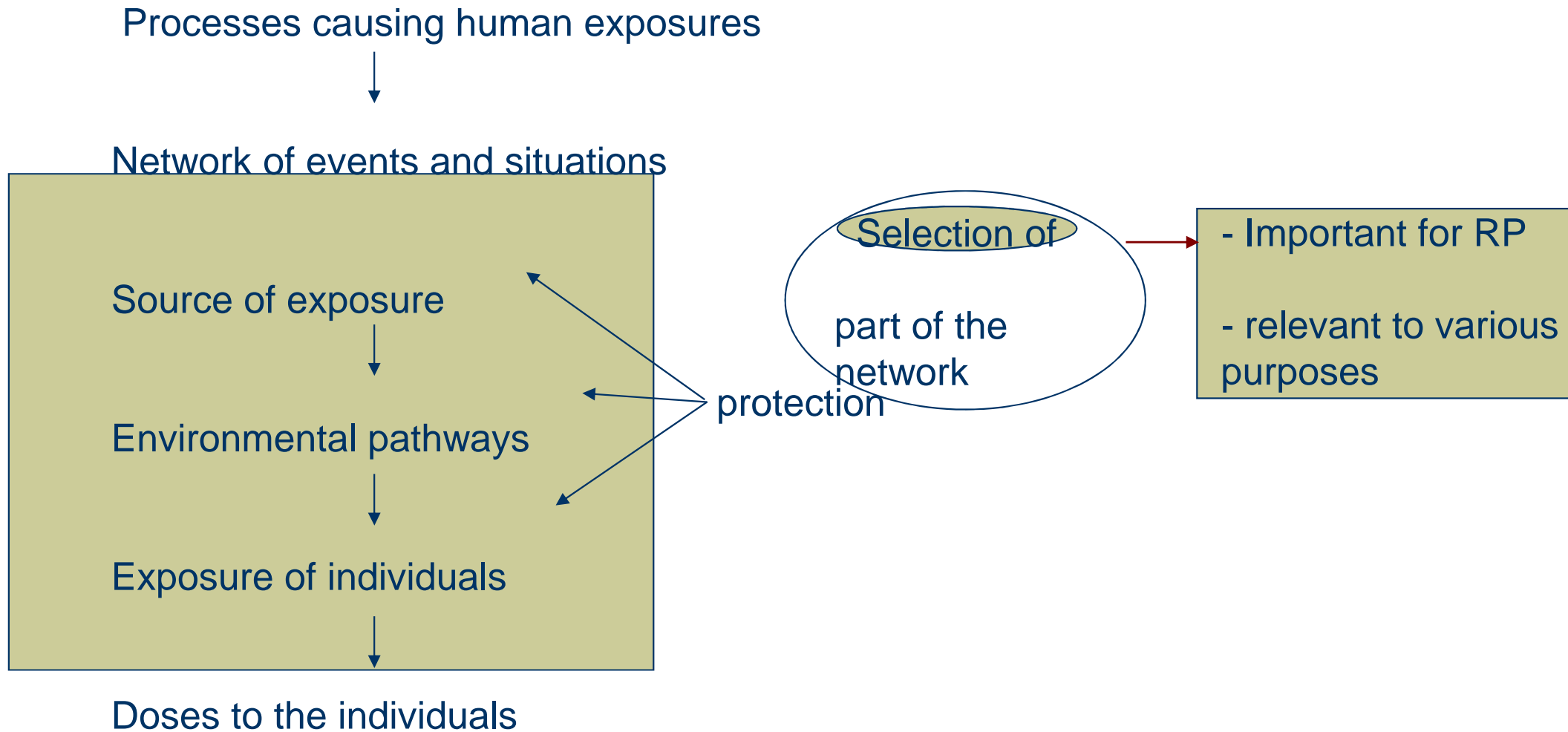
- | | | | |
|---|---|-----------|------------|
| annual effective dose | → | very low | } excluded |
| or
combination of [dose and difficulty to control] | | such that | |

☐ Exemption

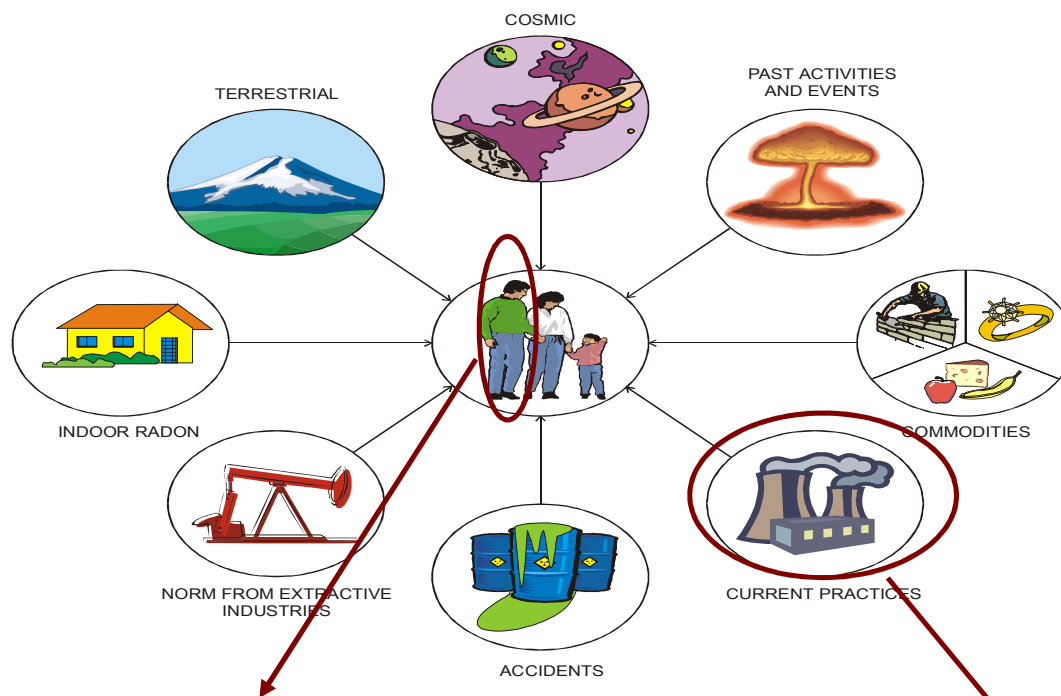
Regulators provisions may be unnecessary

Nouvelles recommandations de la CIPR 28 octobre 2003

ICRP APPROACH OF RADIOLOGICAL PROTECTION



INDIVIDUAL RELATED VERSUS SOURCE RELATED APPROACH



- representation of an individual
Total exposure from the defined
group of sources

- maximum standard
for an individual
Dose limit

↓
ICRP recommendation

Nouvelles recommandations de la CIPR 28 octobre 2003

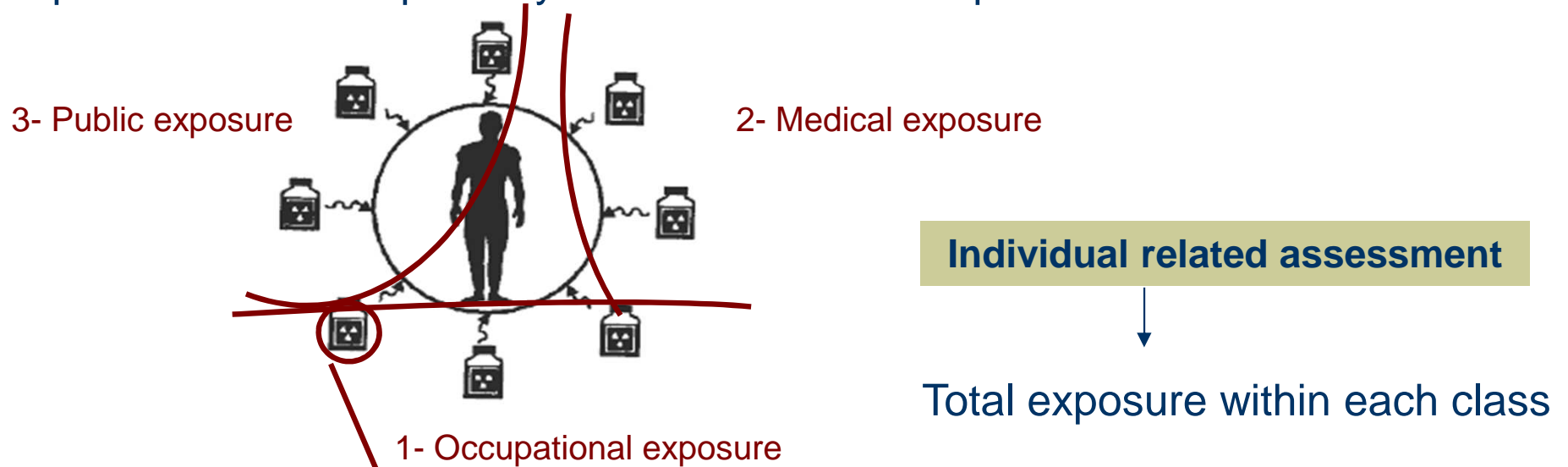
- selected source
part of the whole

- maximum standard for an
individual
Dose constraint

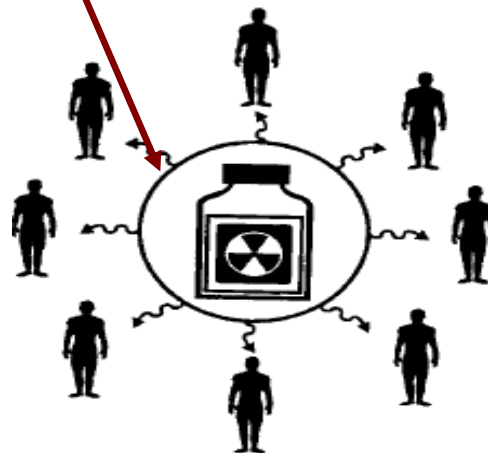
↓
ICRP recommandation

ICRP APPROACH OF RP

- 1st simplification: deal separately with each class of exposures



- 2nd simplification: each source or group of sources } of a class can be treated on it's own



Source related assessment

ICRP APPROACH OF RP

→ **QUANTITATIVE STANDARDS** of protection for practices in all normal situations

Below : unacceptable level of risk

Restrictions on individual doses

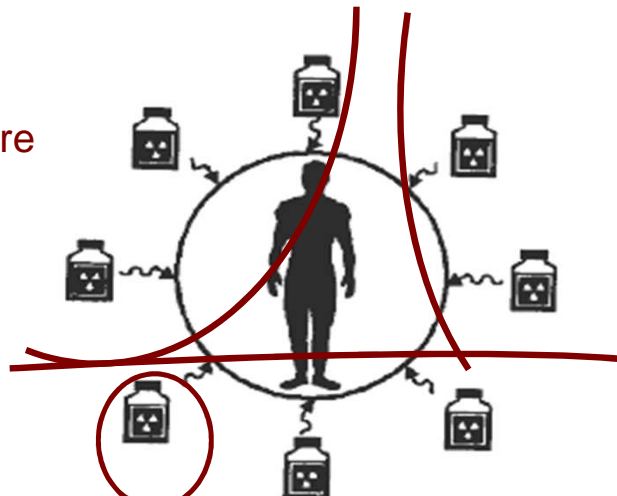


when applied to doses from all sources

↳ called dose limits

ICRP recommends values for dose limits

Public exposure



Occupational exposure

- when applied to the dose from a specified single source

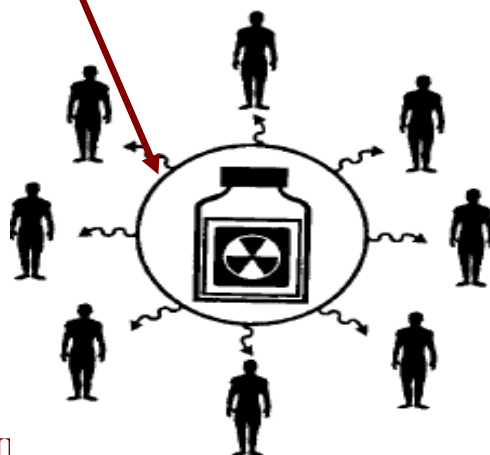
↳ called dose constraints

Related to one source under each particular circumstance either normal or abnormal situation



ICRP recommends maximum values for dose constraints [and ranges below the max values]
(level of dose where action is usually certain to be justified)

→ **COMPLEMENTED BY ALARA**



Public exposure

Very large number of
 - controllable sources
 - individuals

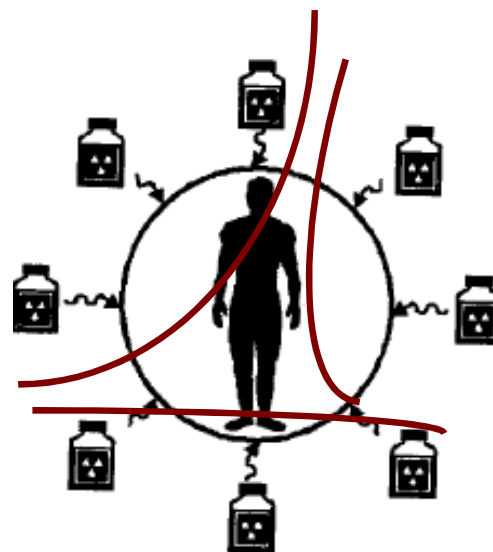
Select

- single or small group of sources
 - critical group

If selected sources include most
 of likely sources
 limit can be applied

If part of the whole
 fraction of the limit
 ie the. dose constraint

Nouvelles recommandations de la CIPR 28 octobre 2003

**Medical exposure****Occupational exposure**

Sources easily identified

Total exposure

Limit

Each source

Constraints

PRINCIPLES OF PROTECTION

Principles of radiological Protection

Once the practice is justified by the appropriate authorities

- Use of LIMITS and CONSTRAINTS
ensure the primary standard of protection
- Complemented by OPTIMIZATION
to enhance the level of protection achieved

ICRP quantified recommendations

ICRP 60 limits
+ Max constraints for sources

(operators based on policy
established by RA)

- ❑ As expressed in ICRP 60
- ❑ Within a class of exposure
occupational or public
the dose limits apply to the sum of the sources related to justified practices in normal conditions

For occupational exposure:

“A limit on effective dose of 20 mSv per year, averaged over 5 years (100 mSv in 5 years), with the further provision that the effective dose should not exceed 50 mSv in any single year” (paragraph 166 Pub 60).

For public exposure:

“The limit should be expressed as an effective dose of 1 mSv in a year. However, in special circumstances a higher value of effective dose could be allowed in a single year, provided that the average over 5 years does not exceed 1 mSv per year” (paragraph 192 Pub 60).

SOURCE RELATED CONSTRAINTS

apply to both normal and abnormal situations not to be confused with ALARA

☐ Exposed individuals

Deal separately with :

patients – voluntary risk and benefit to the patient

workers in controlled areas – volunteers well informed, specially trained

public and general workers – exposure imposed, little influence on exposure

Distribution of doses over many individuals

“notional individual to represent the more exposed individuals”

☐ Single Sources

To be used in a broad sense

cosmic ray at the ground level

X ray equipment in a hospital

releases of radioactive materials from an installation

Most situations



One predominant source of exposure

Nouvelles recommandations de la CIPR 28 octobre 2003

SCALE OF CONCERN

Level of concern	Fraction or multiple of background	Typical range of effective dose
HIGH	>100 x	Above several 100 mSv
RAISED	>10 x - <100 x	Several 10s –several 100 mSv
MODERATE	<10 x	Several mSv to several 10s mSv
LOW	Natural background	Fractions of mSv to several mSv
VERY LOW	>1/100 - < 1	Several 1/100s to several 1/10s mSv
NEGLIGIBLE	<1/100	Below 0.01 mSv

SELECTION OF CONSTRAINTS

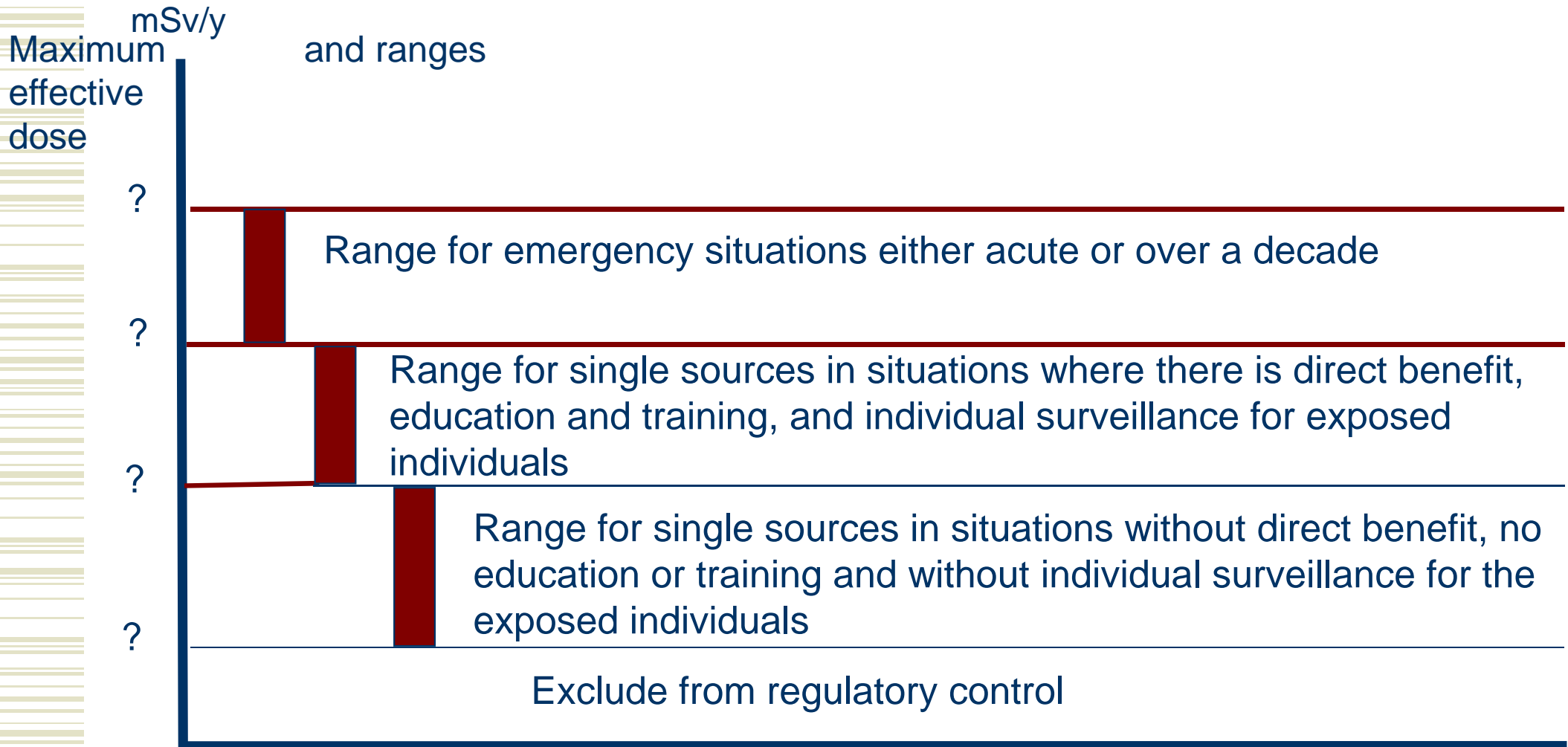
- **Factors which characterise the source and its environment**
 - number of other sources
 - distribution of individual doses (equity)
 - level of controllability of the source

- **Consistent with the scale of concern**

- **Quantified values of the current system**

- **Easily understood**

INDICATIVE SCALE FOR THE SELECTION OF DOSE CONSTRAINTS FOR INDIVIDUAL SOURCES FOR ALL TYPES OF EXPOSURES THAT CAN BE CONTROLLED



DEFINITION OF THE INDIVIDUAL

Greater emphasis on individual-related criteria

Assessment of doses to the individual

Comparison with individual dose criteria

Optimization

planning for and decision in emergency situations

Dose constraints

based on lifetime risk

Evaluation of continuing exposures

↳ age-specific dose coefficients

↳ age-specific intakes of radionuclides

= age-weighted approach

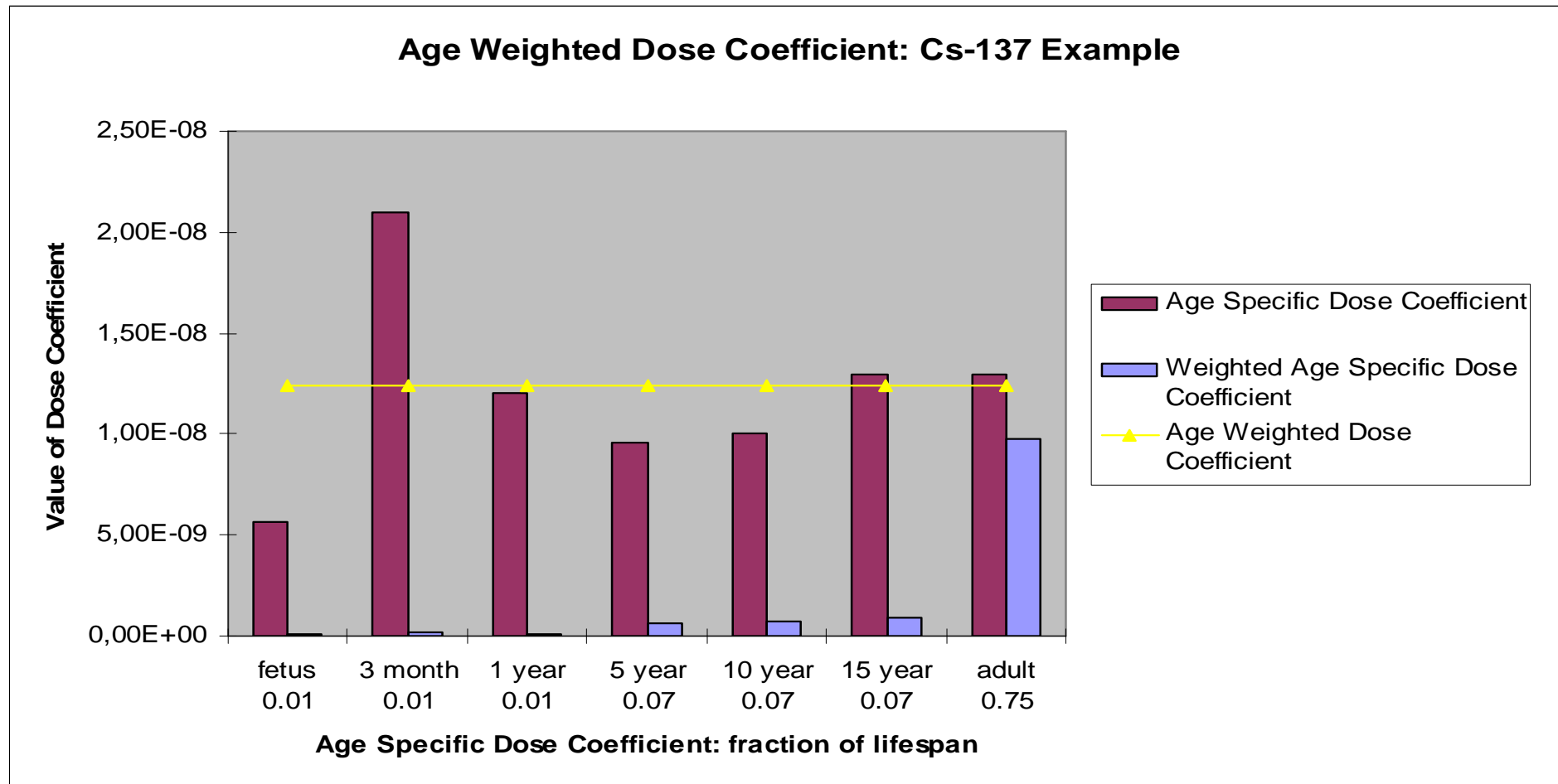
Substitute = adult dose coefficient

Habit data

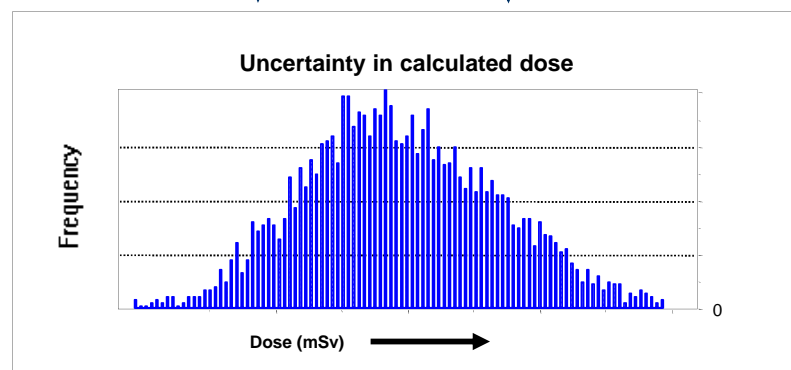
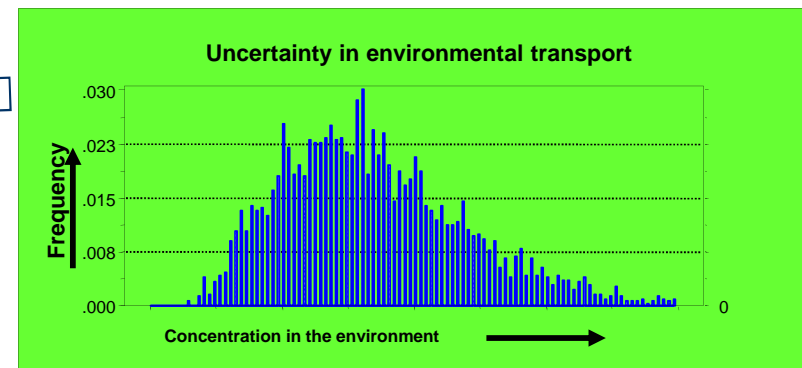
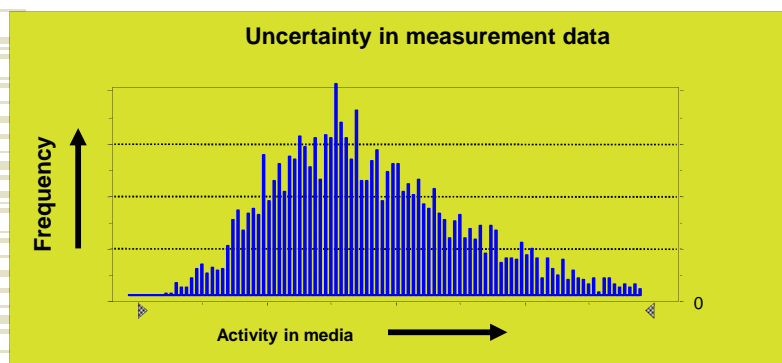
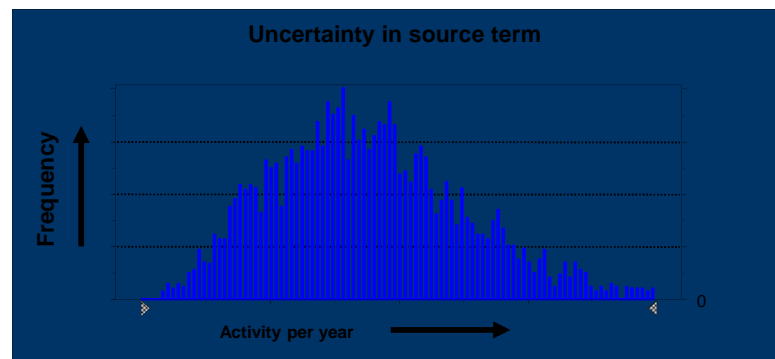
constraints apply to doses derived from mean characteristics in a reasonably homogeneous group

sustainability – consistency

AGE WEIGHTED DOSE COEFFICIENT: CS-137 EXAMPLE



UNCERTAINTIES IN DOSE ESTIMATES



What dose on this distribution do we compare to the constraint?

ICRP60 definition

- magnitude of individual doses
- number of people exposed
- likelihood of incurring exposures



Applies to
- Individual
- groups

As low as reasonably achievable social and economic factors being taken into account

New

- after compliance with the constraints
- no longer linked to C/B judgement
co-operation (as a minimum) between

{ O.M
R.A

- foster a safety culture
- collective dose no longer used on it's own
matrix composed of a set of elements describing the various components of the exposure

Nouvelles recommandations de la CIPR 28 octobre 2003

MATRIX FOR OPTIMIZATION

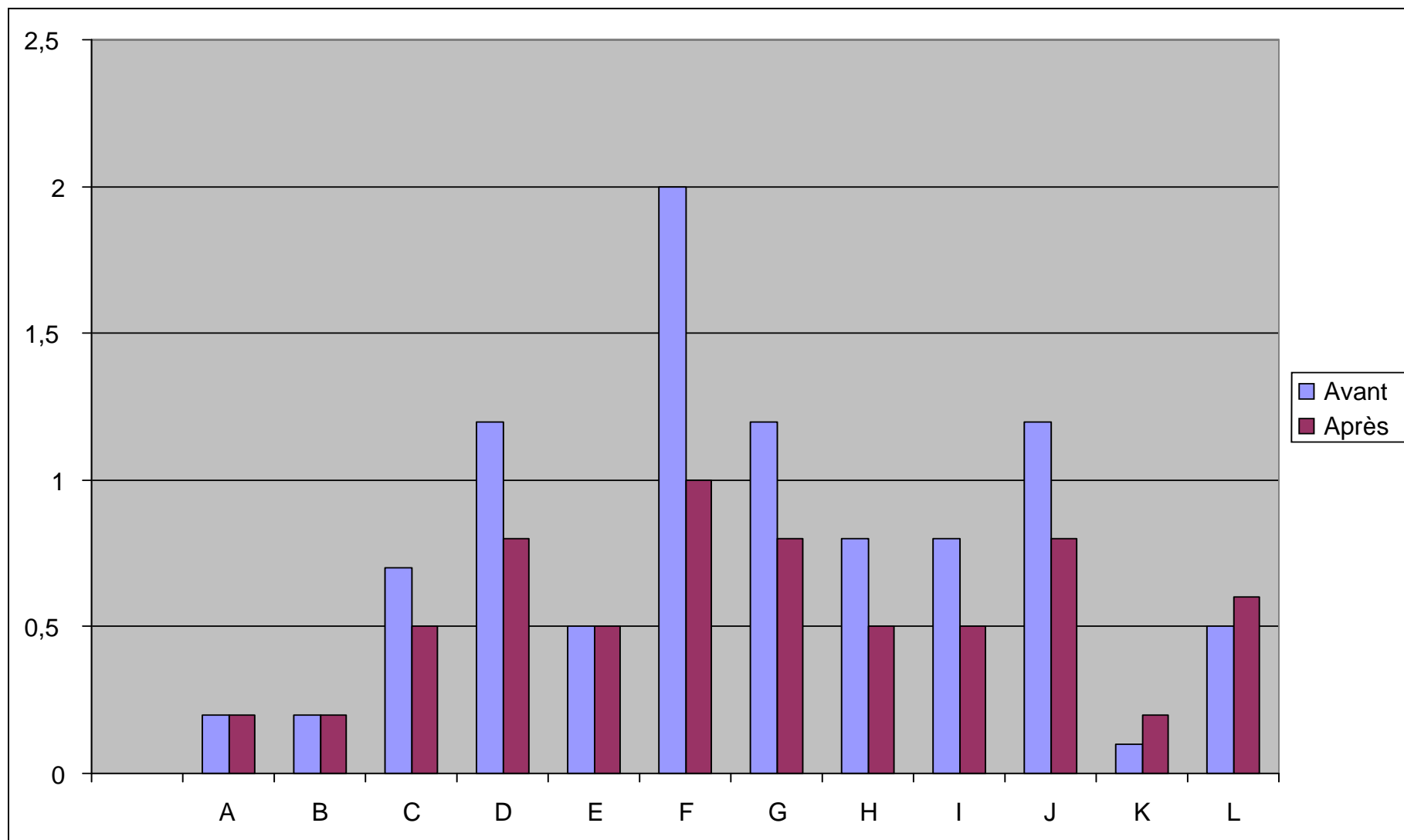
Key components:

- a) Number of exposed individuals
- b) Magnitude of individual doses
- c) Dose distribution in time
- d) Age and gender dependent risks as modifiers to dose distributions
- e) Equity considerations (achieving a balanced dose distribution)
- f) Real or potential exposure

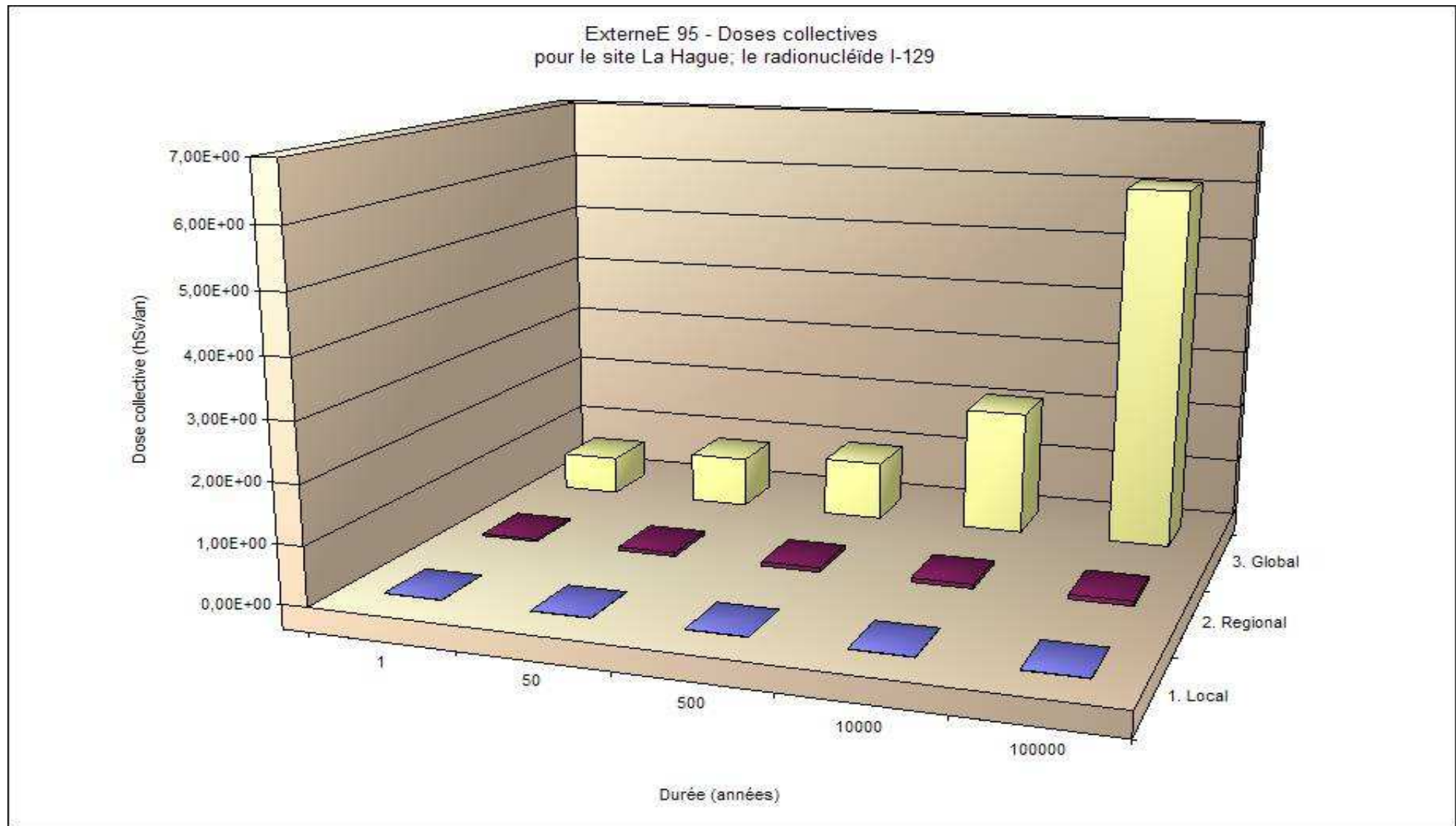


Weighting of these elements will depend on the preferences and values of those involved in the decision making process as well as on the feasibility of action considered

EVOLUTION OF THE INDIVIDUAL DOSE DISTRIBUTION



RELEASE OF IODINE – DISAGREGATION OF THE DISTRIBUTION OF INDIVIDUAL EXPOSURES IN TIME AND SPACE



SHAKEHOLDERS INVOLVEMENT

flexibility is needed in optimization due to the broadening acceptance of stakeholder involvement in the process of decision- making

GOALS

incorporating values into decisions

Improving the substantive quality of decisions

Resolving conflicts among competing interests

Building trust in institution

Educating and informing the workers and the public

Key elements

- Inclusion and consensus of relevant stakeholders for decisions/solutions

A clear understanding of the distinct roles and input of the various stakeholders in the decision-making process; and

- The boundaries between the scientific aspects of risk assessment, the social aspects of risk evaluation and management, and the regulatory aspects of risk management.

1990 Recommendations

«The Commission believes that the standards of environmental control needed to protect man to the degree currently thought desirable will ensure that other species are not put at risk ».

Weak points

- applies only to global populations
local populations have been severely damaged by practices

- level of ambition
protection of complete species
what about individuals in species?

- standard of protection of humans is the more restrictive
what demonstration?

example of situation:

humans not present or removed
other organism receive higher level of exposure than
humans

PROTECTION OF NON HUMAN ENVIRONMENTAL SPECIES

New ICRP approach

Systematic approach for radiological assessment of non human species to support the management of radiation effects in the environment

Rather

Not intended to set regulatory standard

framework as practical tool to provide guidance and help DEMO compliance with existing legislation

provides bases for the derivation of standard

Harmonization with protection of human beings

- an agreed set of quantities and units for a limited reference fauna and flora
- reference dose models
- reference dose per unit intake

To apply to area and situation specific approaches

effect analysis

Notes et recommandations de la CIPR 28 octobre 2003

PROTECTION OF NON HUMAN ENVIRONMENT SPECIES

(175) The Commission proposes that the objectives of a common approach to the radiological protection of non-humans organisms are:

(176) to safeguard the environment by preventing or reducing the frequency of effects likely to cause early mortality or reduced reproductive success in individual fauna and flora to a level where they would have a negligible impact on conservation of species, maintenance of biodiversity, or the health and status of natural habitats or communities.