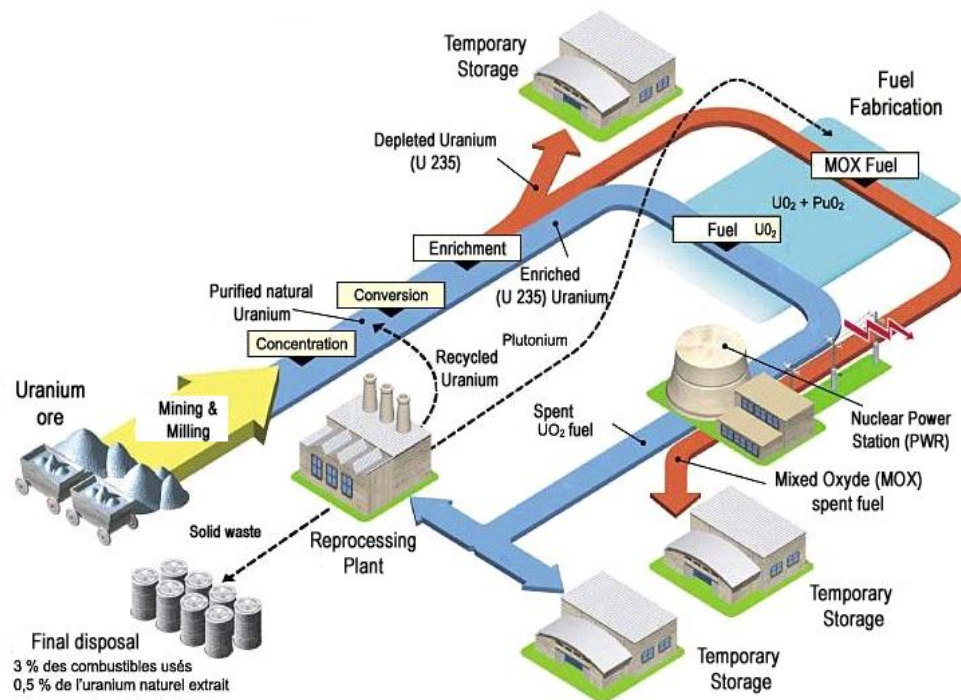
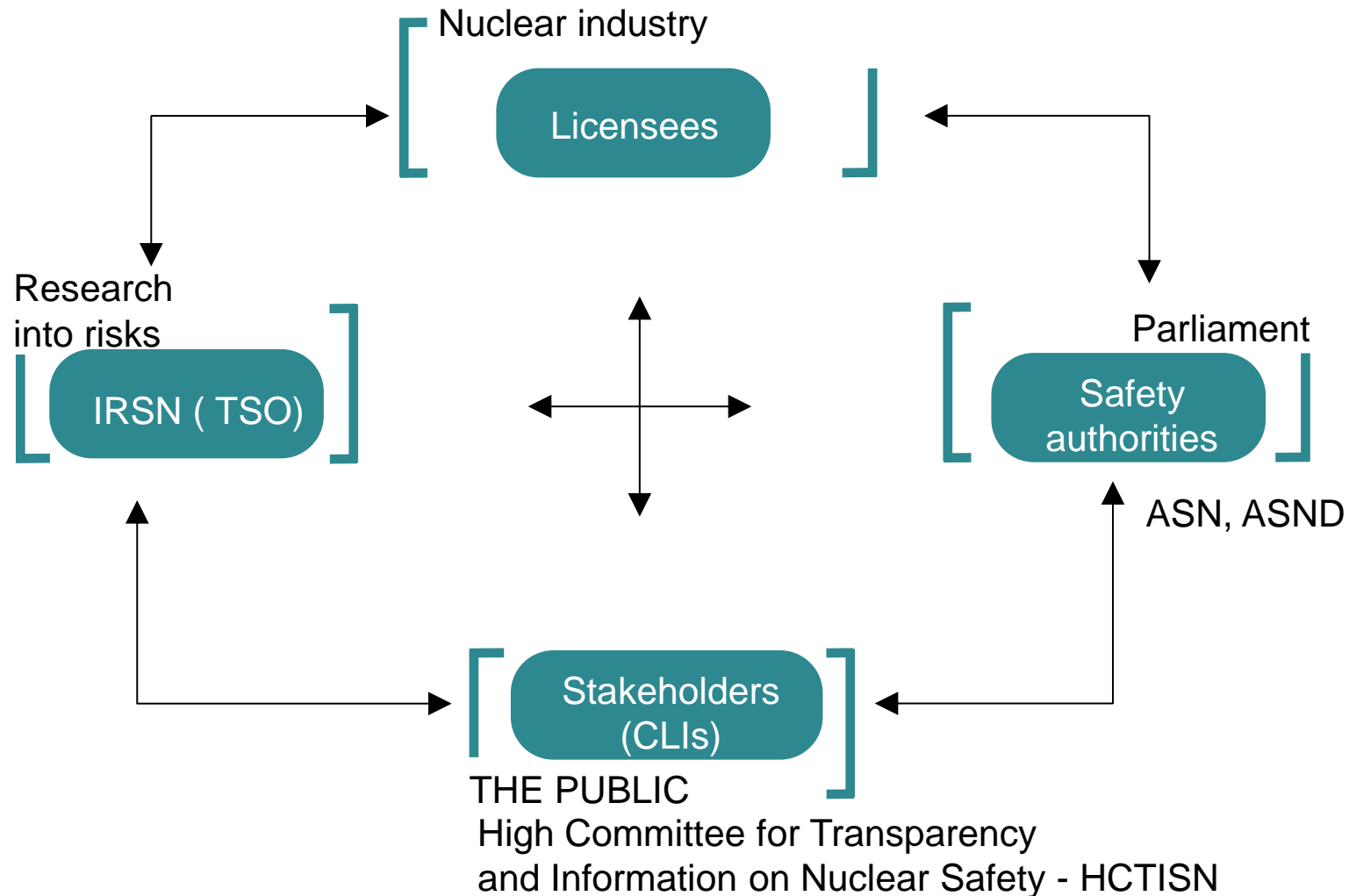


Radiological impacts of French nuclear installations on workers and nearby population

Jacques REPUSSARD



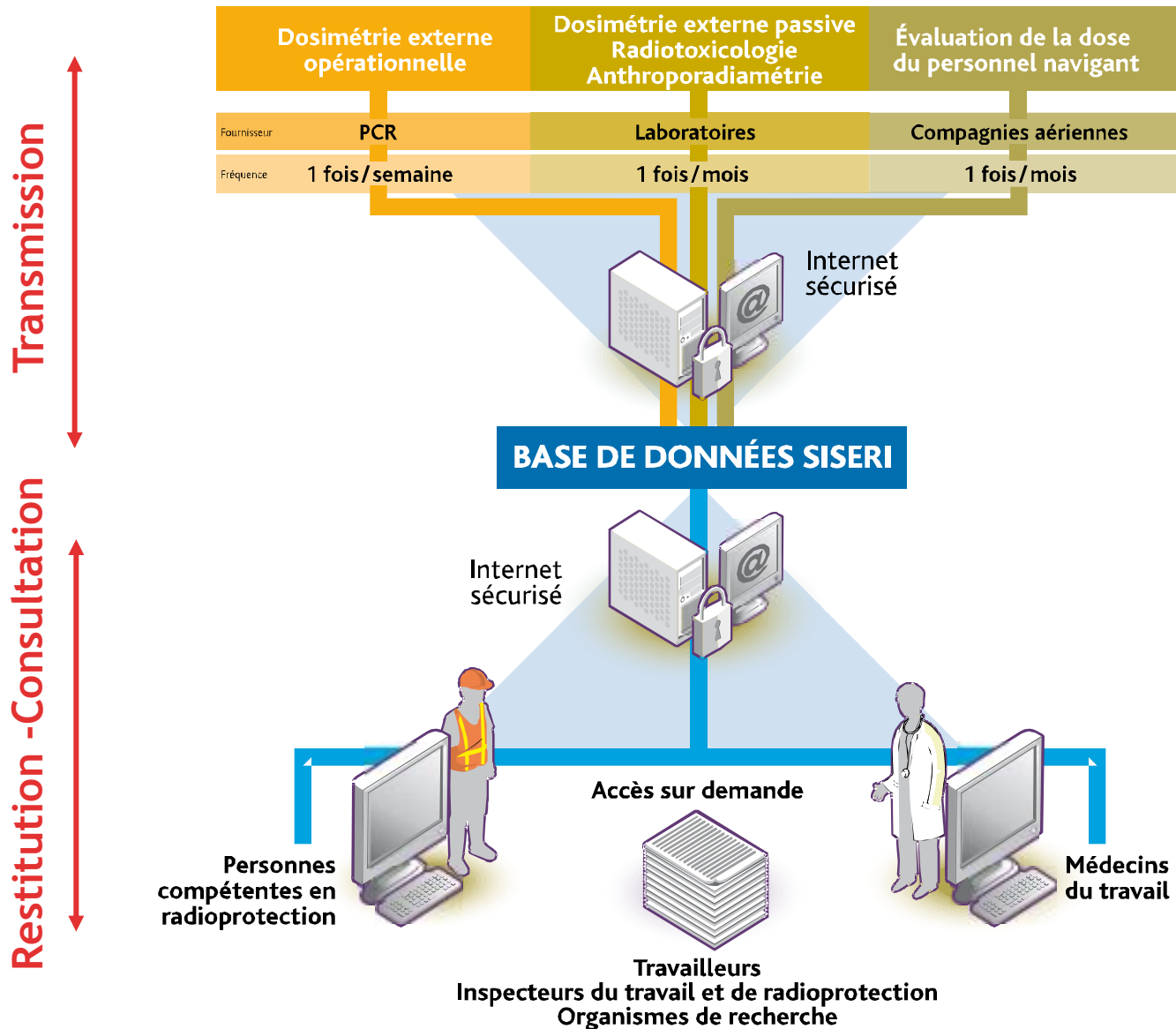
Nuclear safety in France: 4 complementary pillars



Radiation protection for nuclear installations: a Defense-in-Depth national Strategy

- Optimization of the sources and the processes
- Radiological controls of the installations (workplaces, wastes and releases)
- Individual radiation exposure monitoring (SISERI) and measurements of radioactivity in the environment (RNME)
- Evaluation of the health impact (epidemiological studies of workers and the public)
- *R&D supporting expertise and further optimization goals*
- *Emergency response measures*

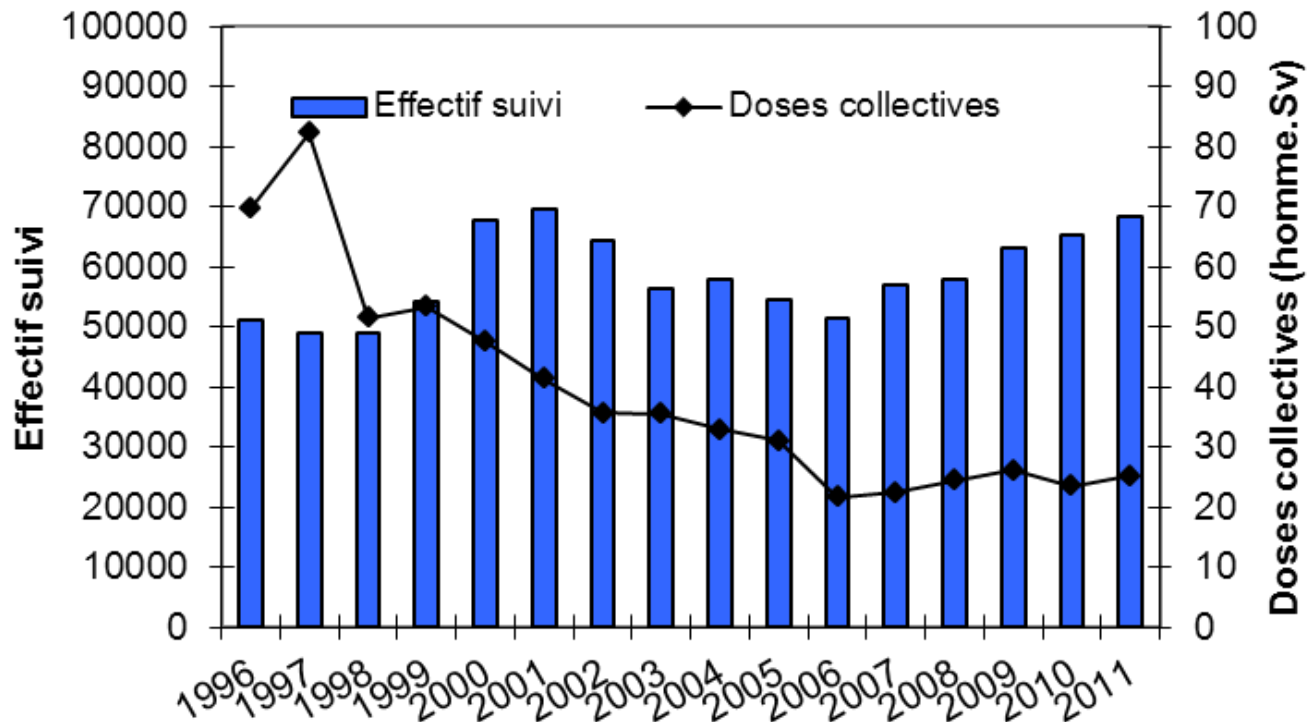
Operating principle of SISERI



Monitoring of nuclear workers (1)

Trends in external exposures

- Number of nuclear workers monitored: **68 344** [20 % of workers monitored in France]
- Collective dose: **25.12 man.Sv** [39 % of the total collective dose]



Monitoring of nuclear workers (2)

Main results in 2011

External exposure

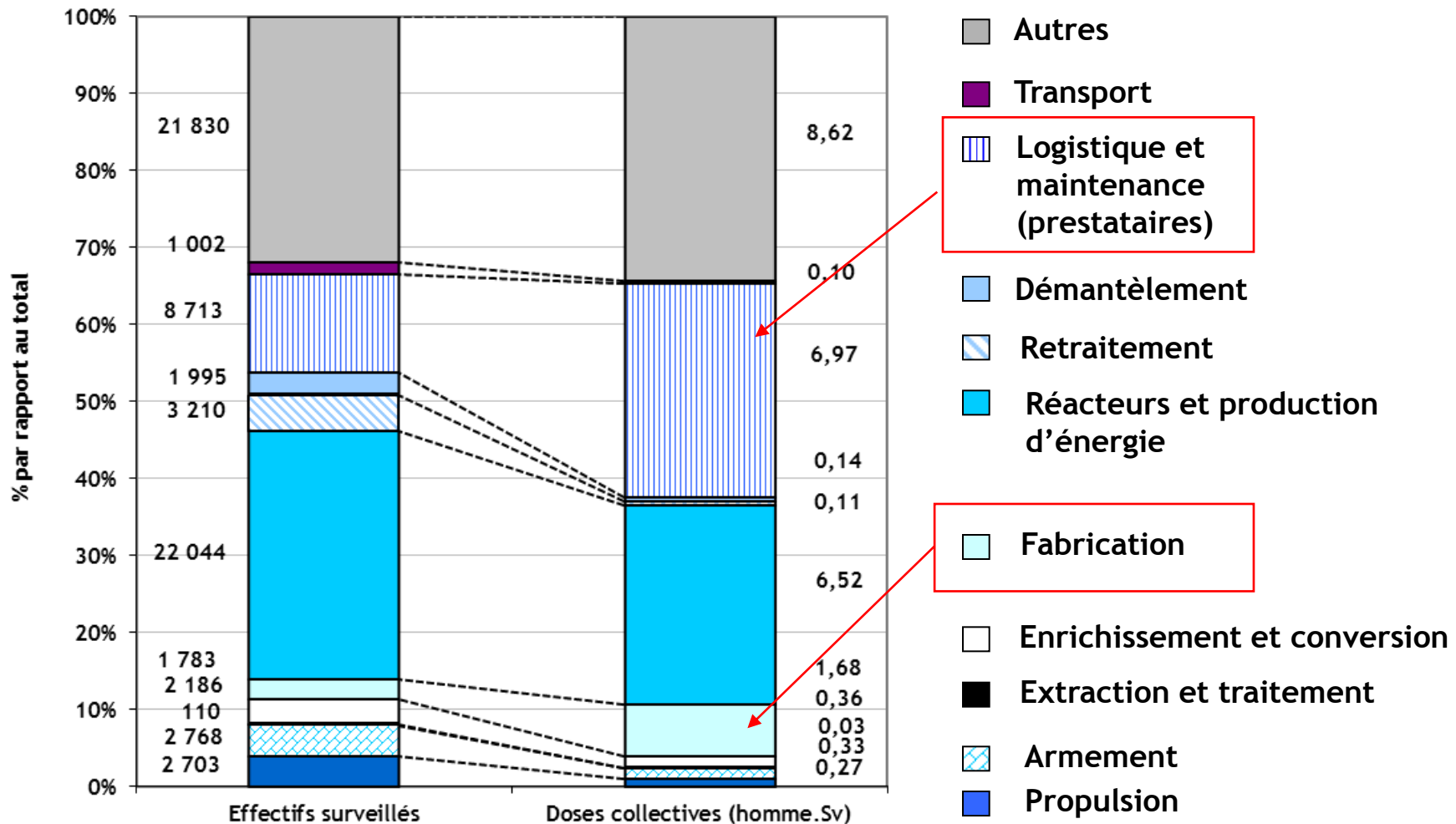
- Average individual dose of the exposed workers : 1.2 mSv
- 1 external dose > regulatory annual limit of 20 mSv
(5 external doses > 15 mSv)
- 9.5% nuclear workers > 1 mSv

6 internal doses > 1 mSv (max = 2.2 mSv)

No extremity dose > regulatory annual limit of 500 mSv/year

Monitoring of nuclear workers (3)

Exposure in the different nuclear sectors



Epidemiology of workers (1)

■ Follow-up of workers with external exposure

- Cohorts CEA + AREVA + EDF
- More than 59 000 workers
- Follow-up > 20 years
- Average cumulated dose \approx 22 mSv

■ Main results

- Strong Healthy Worker Effect (mortality globally lower than in the reference population)
- Significant excess of pleural cancers and melanoma, but not associated with cumulative external dose
- Non significant dose-risk relationship for all solid cancers and leukaemia excluding chronic lymphocytic leukaemia
- Significant association with cumulated dose found for myeloid leukaemia.

Epidemiology of workers (2)

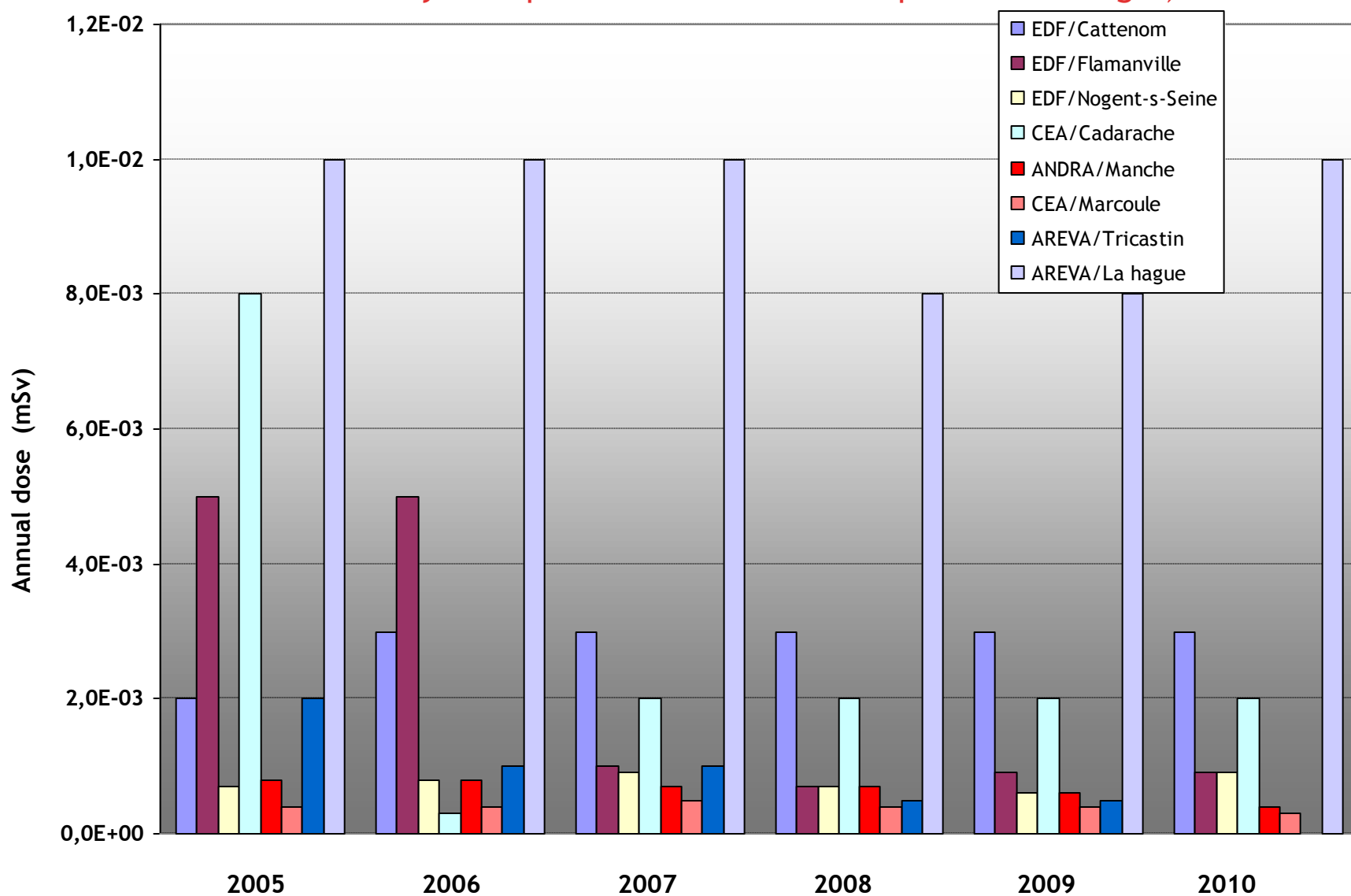
■ Follow-up of workers with internal exposure

- Cohort of Pierrelatte AREVA workers : 2 900 workers
- Cohort of workers from the nuclear fuel cycle (TRACY, under development) :
 - ✓ 12 000 workers
 - ✓ Job exposure matrix (type of uranium compounds, chemical exposure, heat...)
 - ✓ Reconstruction of internal contamination

■ Follow-up of uranium miners

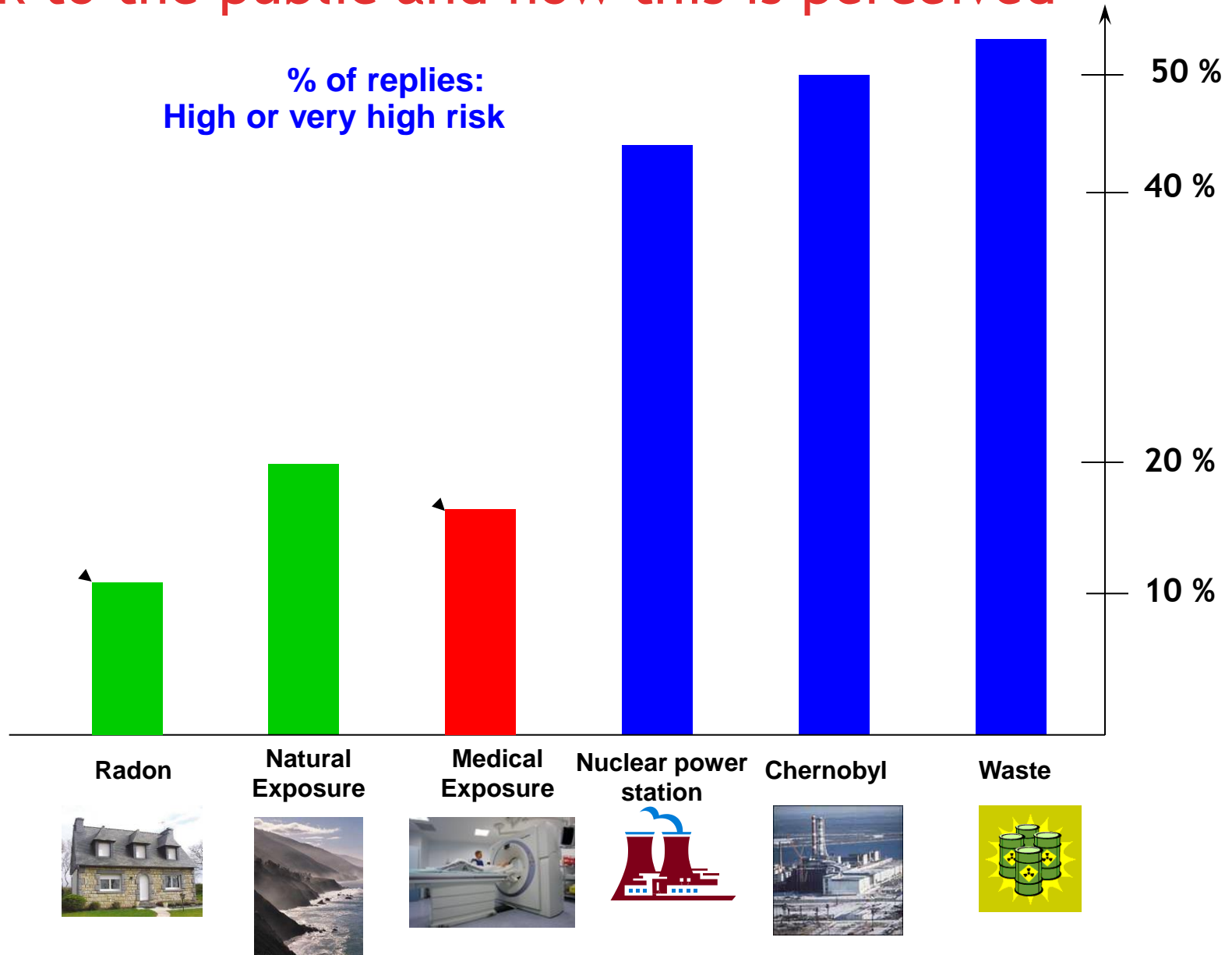
- 5 086 miners CEA-COGEMA
- Follow-up > 30 years, exposure at least 1 year between 1946 and 1990
- Dose-response relationship for Lung cancer risk
- Other cancers and cardio-vascular diseases

Radiological impact on the public (examples of doses to the Reference Groups calculated by the operators based on the reported discharges)



Risk to the public and how this is perceived

% of replies:
High or very high risk

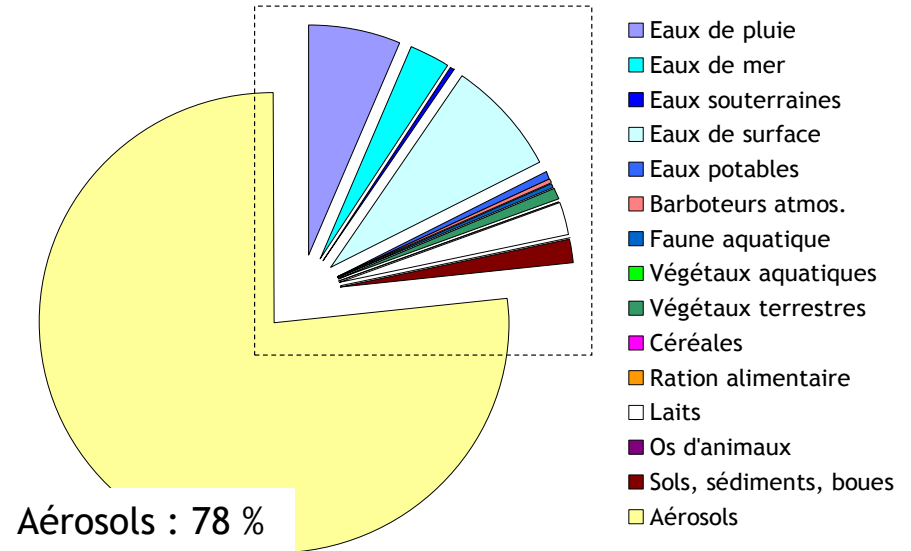


Environment monitoring by IRSN: 3 principles

- **Ensure a flexible monitoring system based on scientific excellence**
 - Keeping IRSN as a reference body at national and international levels
 - Producing indisputable monitoring results
 - Rapid adaptation capability in response to any incidental situation
 - In-depth investigation capability for specific situations
- **Strengthen societal usefulness of the IRSN monitoring**
 - Develop regional monitoring approaches, taking into account specific parameters of relevance for stakeholders,
 - On line availability of monitoring data and reports (including in incidental situations)
 - Detailed presentations to the local CLI's of regional reports
- **Ensure the independence and transparency of the IRSN monitoring**
 - Own IRSN capability of sampling and measurement
 - Transparency on monitoring results and their interpretation (public and media)

□ Network of sampling in the environment

- ≈ 600 stations of sampling in France
- 28 000 samples of various nature and 40 000 analyses
- 900 locations with ambient integrated dose rate measurement (TLDs)



□ Automatic telemonitoring

> 190 detection systems measuring and transmitting in real-time

- Measurement of ambient gamma-ray (158 TELERAY detectors + 6 detectors in ultramarine locations)
- Aerosol (SARA) and watercourse (HYDROTELERAY) characterisation



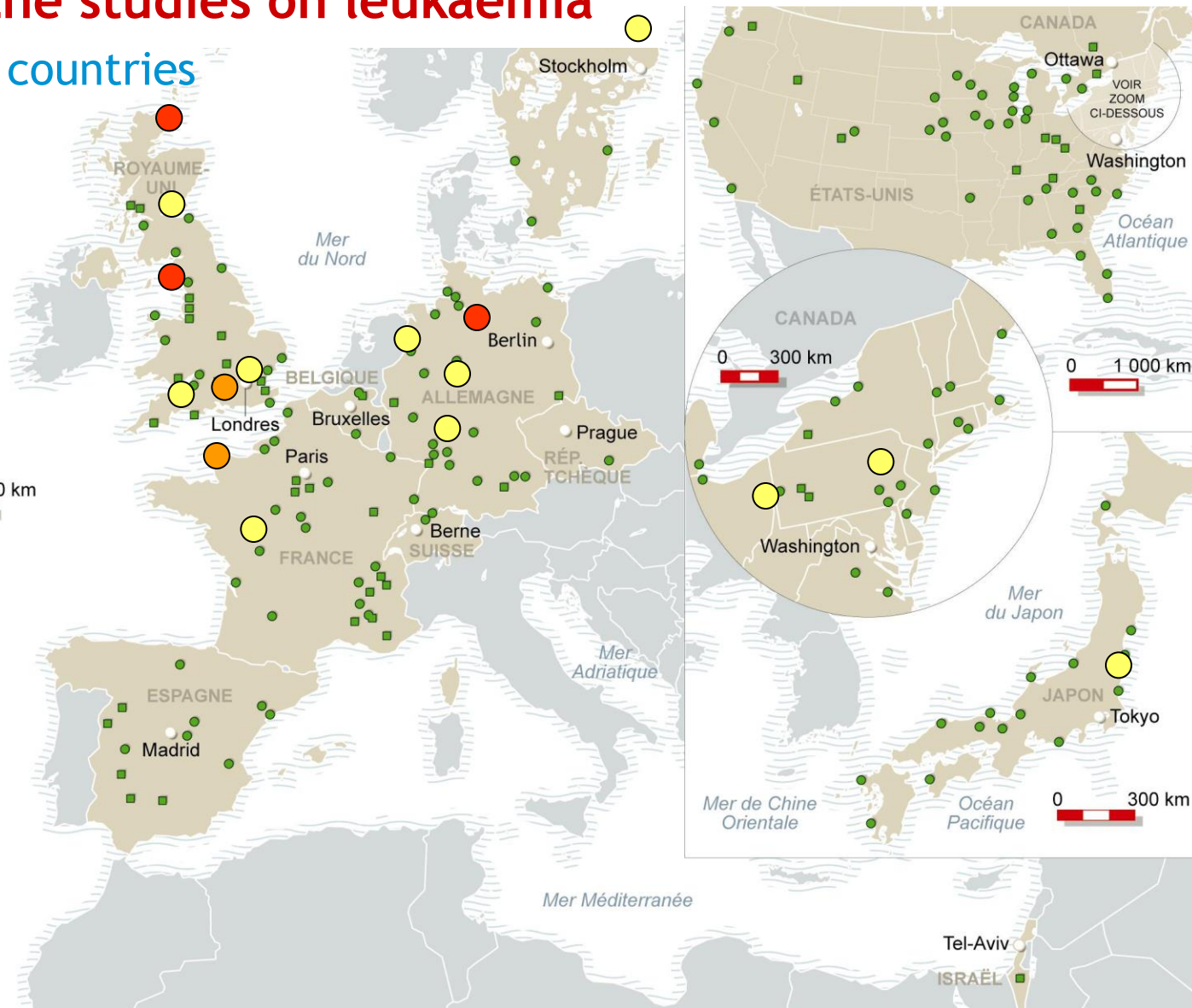
Review of the studies on leukaemia

198 sites - 10 countries

- CNPE
 - Autre
- Résultat des études épidémiologiques:
- Pas d'excès observé
 - Excès non confirmé
 - Excès possible
 - Excès confirmé

0 900 km

Océan Atlantique



Scientific expertise

Pluralist working group « *Nuclear installations and childhood leukaemia* »
leded by Pr Sommelet

➔ 6 recommendations in terms of
monitoring, research and
communication



Report published in
April 2011 (www.asn.fr)

On-going work within Europe
(MELODI)



Workshop in conclave
in Bombon - France
(18-22 June 2012)

Points of consensus:

- Existence of a few well-documented clusters near specific nuclear sites
- No excess of childhood leukaemia in general near nuclear installations, but consistent excess risk in the 0-4y age range less than 5 km
- Need for a continuation of the surveillance of childhood leukaemia incidence

Conclusion

IRSN contributes to control radiation risks to the nuclear workers and the population around the nuclear installations through:

assessments on sources and processes involved in these installations



radiological monitoring of the French territory and workers exposed to ionizing radiations



Surveillance

epidemiological studies on the workers and the population

research on health effects of low-doses of radiation (MELODI, EPICE)



Research