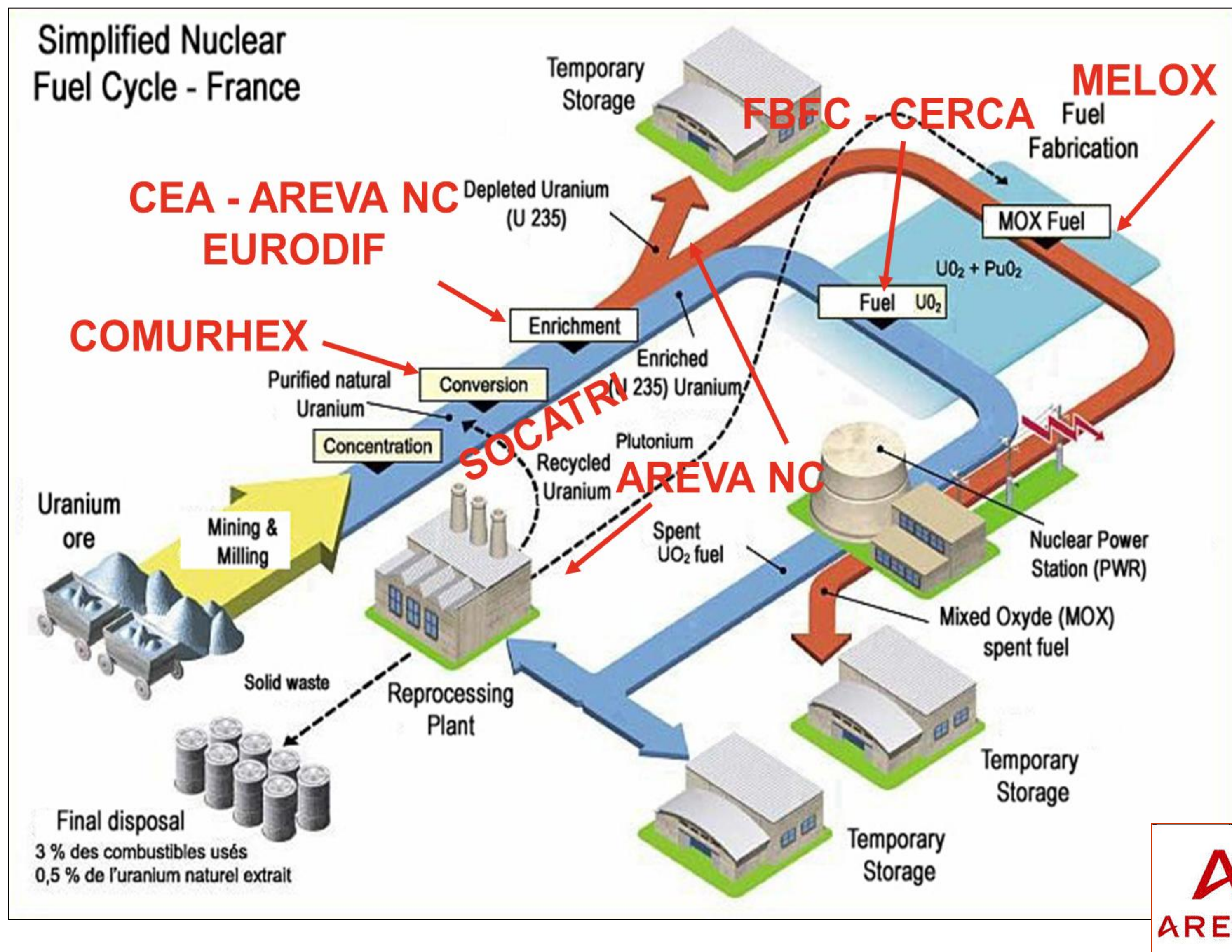


TRACY U: THE FRENCH COHORT OF URANIUM CYCLE WORKERS

Context and objectives

The objective is to set up a longitudinal cohort for investigating the risk of mortality from cancer and non cancer diseases (mainly cardiovascular) in relation to uranium and other occupational exposures.



Materials and Methods

Population:

- Workers involved in the French nuclear uranium cycle employed by AREVA and subsidiaries or CEA. The cohort is limited to workers employed for at least 6 months between 1958 and 2006.

Occupational exposure:

- Assessed by two complementary methods:
 - Individual measurements (from medical files): radio-toxicology analysis for internal doses assessment and individual dosimeters for external radiation exposure.
 - Plant-specific Job-Exposure Matrixes: assessment of a score based on quantity and frequency of handling (both coded from 0 to 3) for the different uranium compounds, chemicals agents, physical parameters (heat, noise) at each place of work, taking into account the time variations.

Other risk factors (from medical files):

- Tobacco consumption, BMI, blood pressure, blood cells count and other blood bio-chemical parameters (cholesterol, blood glucose ...)

Vital status and causes of death:

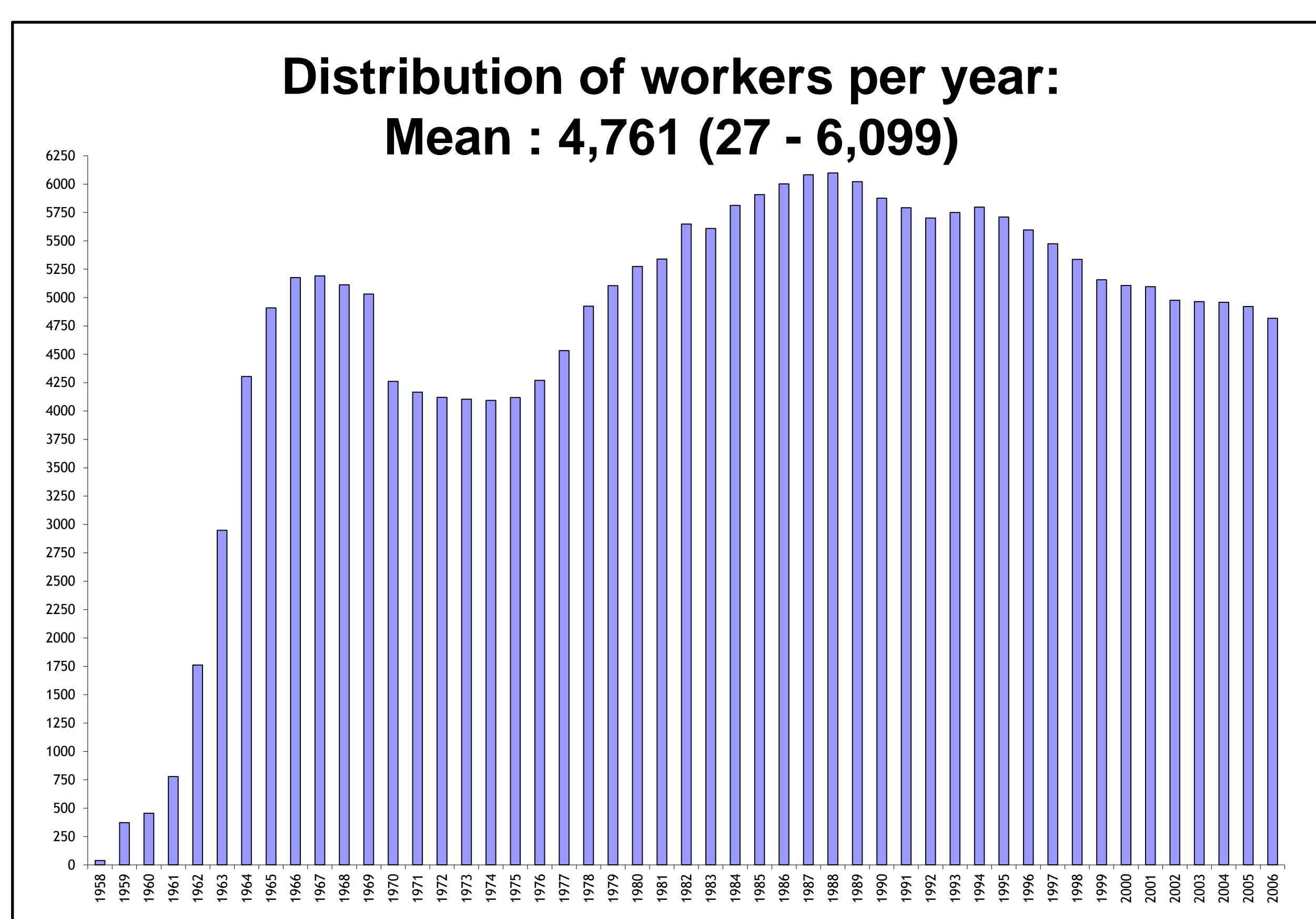
- Collected from the French National Mortality registers.

Results

- Identification and administrative information have been collected for each company and the files have been merged. The cohort TRACY contains 12,657 workers from COMURHEX (n=1,597), EURODIF (n=2,014), AREVA NC (n=2,879), SOCATRI (n=567), FBFC (n=1,982), MELOX (n=779) and CEA (n=2,839).
- Research of vital status and causes of death is ongoing.

- For the period 1986 to 2004, radio-toxicology analyses and other biological measurements data were computerized. For the other periods, the collection is ongoing.
- Historical external dosimetry data were gathered for most of the companies.
- Job-exposure matrixes for the AREVA NC Pierrelatte and Eurodif plants have been constructed and validated. Exposure assessment for respectively 22 and 26 pollutants were performed.

Description of the cohort TRACY (N=12,657)		
Sex	Men / Women	88.0 % / 12.0 %
	Still at work / Ex worker	38.6 % / 61.4 %
	Mean (Min – Max)	
	Year of birth	1946 (1897 - 1986)
	Age at hiring (years)	30.3 (17.0 – 63.9)
	Age at leaving (years)	50.1 (19.0 – 67.5)
	Age at end-point (31/12/2006) (for workers still at work)	45.8 (20.9 – 67.2)
	Length of employment (years)	17.2 (0.5 – 42.3)



Example of exposure agents evaluated in the Job exposure matrix, AREVA NC Pierrelatte (N= 2,709)

Exposure agents	Detail	Exposed workers n (%)
1. Natural U compounds f ^a	UF ₆ , UF ₄ , UO ₂ (NO ₃) ₂ , (UO ₄ , nH ₂ O)	2253 (83.23)
2. Natural U compounds m ^a	(U ₂ O ₇)(NH ₄) ₂ , U ₃ O ₈ , UO ₂ F ₂ , UO ₃	1815 (67.05)
3. Natural U compounds s ^a	UO ₂	992 (36.65)
4. Reprocessed U compounds f ^a	UF ₆ , UF ₄ , UO ₂ (NO ₃) ₂ , (UO ₄ , nH ₂ O)	851 (31.44)
5. Reprocessed U compounds m ^a	(U ₂ O ₇)(NH ₄) ₂ , U ₃ O ₈ , UO ₂ F ₂ , UO ₃	656 (24.23)
6. Reprocessed U compounds s ^a	UO ₂	475 (17.55)
7. Chlorinated agents	Perchloroethylene, tetrachloroethene, trichloroethene, dichloromethane, polychlorinated biphenyls (PCBs), carbon tetrachloride	1784 (65.90)
8. Fluoride agents	Fluorhydric acid, tungsten hexafluoride, fluorine, potassium fluoride	1652 (61.03)
9. Nitrogenous agents	Ammonia, ammonia anhydride, nitrogen acid, nitrous vapours	1415 (47.80)
10. Solvents containing aromatic hydrocarbons	Benzene, toluene, xylene, styrene	1255 (46.36)
13. Asbestos	Asbestos fireproofing, insulation, and braids	1894 (69.97)
17. Trichloroethylene (TCE)		1685 (62.25)
18. Lead	Paints, plates, and dust	331 (12.23)
19. Mercury	Vapours	827 (30.55)
22. Heat	Temperature at the workstation > 30 °C	2361 (87.22)

^aUranium compounds were classified in terms of absorption types (f – fast, m – moderate or s – slow) according to the Human Respiratory Tract Model described in ICRP Publication 66 (1994).

Discussion and Conclusions

Data collection for the 12,657 workers is well progressing. This cohort will be very informative for the investigation of uranium related risks, taking account of multiple exposure patterns of the workers involved in the nuclear fuel cycle. It will allow investigating cancer and non cancer effects, in particular cardiovascular risks. As a pilot study, an analysis of uranium exposure effects on cancer mortality was performed among a sub-cohort of the AREVA NC Pierrelatte plant workers, which provided promising results (I. Guseva-Canu and al., OEM 2012, IJHEH 2009 and 2010, Health Phys. 2010, IAOEH 2009).