ISOE Working Group on Radiological Protection Aspects of Decommissioning Activities at Nuclear Power Plants (WGDECOM) – Outcomes and feedback

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Background and objectives of ISOE WGDECOM

- Decommissioning of NPPs is a subject of growing importance for the nuclear industry and meets some economical, technical and organisational challenges. WGDECOM created in 2014.
- Membership: 30 members from 13 countries from NPPS in decommissioning or in preparation for decommissioning
- **Objective:** improve sharing of operational RP data and experience collected through benchmarking visits (1 to 2 per year) in NPPs under decommissioning
- Topics of interest:
  - Areas of RP most relevant for management of occupational exposure.
  - Collection of operational data
  - Create a **network** of operational RP experts for decommissioning activities
  - Factors and aspects that play key roles in achieving **good RP practices** in decommissioning.

Topics discussed during WGDECOM meetings

- Regulatory context and decommissioning strategy
- Transition phase
- Collective doses analyses for high dose works
- Management of risk of internal exposure
- Radioactive waste management
- Integrated risk management

Decommissioning strategy

- **Immediate dismantling** (France - from 2000, Switzerland, Spain, Sweden and USA)

- **Deffered dismantling** (Spain, Sweden and USA): plants in safe store after removal of nuclear fuel and kept under surveillance for a period depending on the site: 20 years at Barsebäck, 50 years at Kewaunee. Allows:
  => Decay of some radionuclides
  => Decrease of radiological exposure
  => Option generally selected for economical and technical issues

Transition phase

- Key factors for success of decommissioning project :
  - **Characterisation** strategy
  - Determine **beginning** of decommissioning work
  - **Organisational** aspects to be considered in transition phase, in particular:
    - Evolution of organisation to adjust to decommissioning specifities
    - Need for a cultural change of management and operators to take into account the decrease of personnel, the integrated risk management, general RP culture,etc.
    - Changes of regulatory requirements between operation and decommissioning

Collective doses for decommissioning (1)

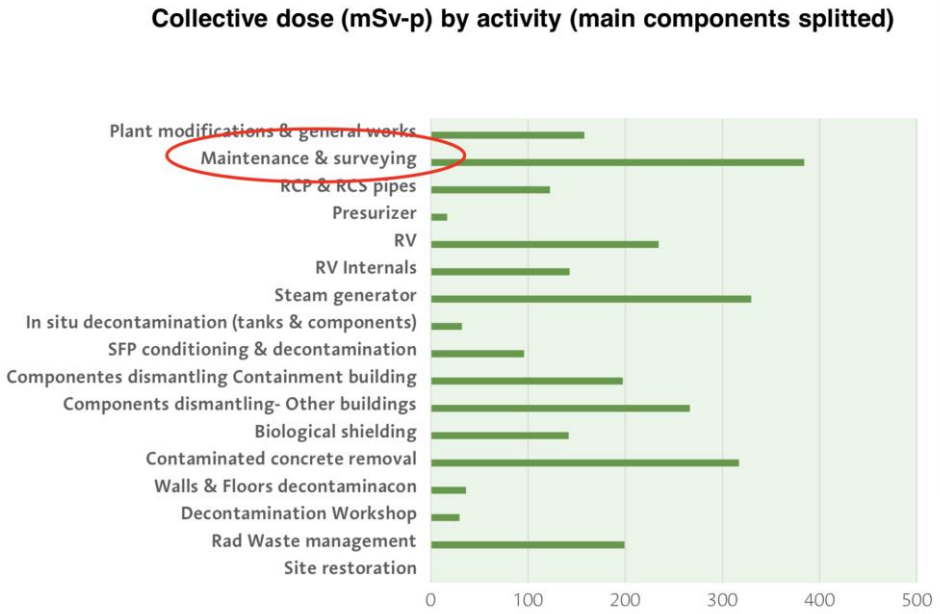
- Are not linked to power of reactors

Country	Site	Type and power	Safe storage	Decom. duration	Dose
Spain	Jose Cabrera	PWR 160 MWe		10 years	2,7 H.Sv
	Vandellos 1	GCR 500 MWe	15 years	5 years	0,4 H.Sv
USA	San Onofre 1	PWR 450 MWe	8 years	17 years	3 H.Sv
	Zion 1 & 2	PWR 1100 MWe	10 years	7 years	4,4 H.Sv

- Collective exposures easily reach a few man.Sv per reactor
  => some hundreds of mSv per year of dismantling : more than some annual outage doses for operational reactors

Collective doses for decommissioning (2)

ACTIVITIES	Collective dose (mSv-p)	
Plant Modifications & General Works	157,84	5,8%
Maintenance & Surveying	384,16	14,2%
Main Components	846,00	31,3%
In situ decontamination(tanks/components)	31,96	1,2%
Spent Fuel Pool conditioning & decontamination	95,79	3,5%
Components dismantling - Containment building	197,47	7,3%
Components dismantling - other buildings	266,43	9,9%
Biological shielding	141,79	5,2%
Contaminated concrete removal	316,92	11,7%
Walls & floors decontamination	36,07	1,3%
Decontamination workshop	29,38	1,1%
Rad Waste management	199,12	7,4%
Site restoration	0,00	0,00
total	2702,93	



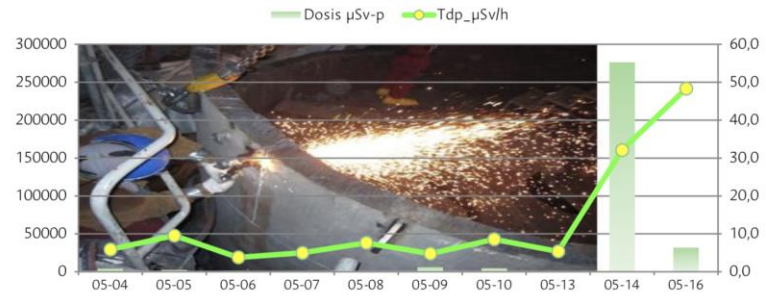
ACTIVITY:	Collective Dose Man-mSv	man-h
SURVEILLANCE & MAINTENANCE	384,16	191550

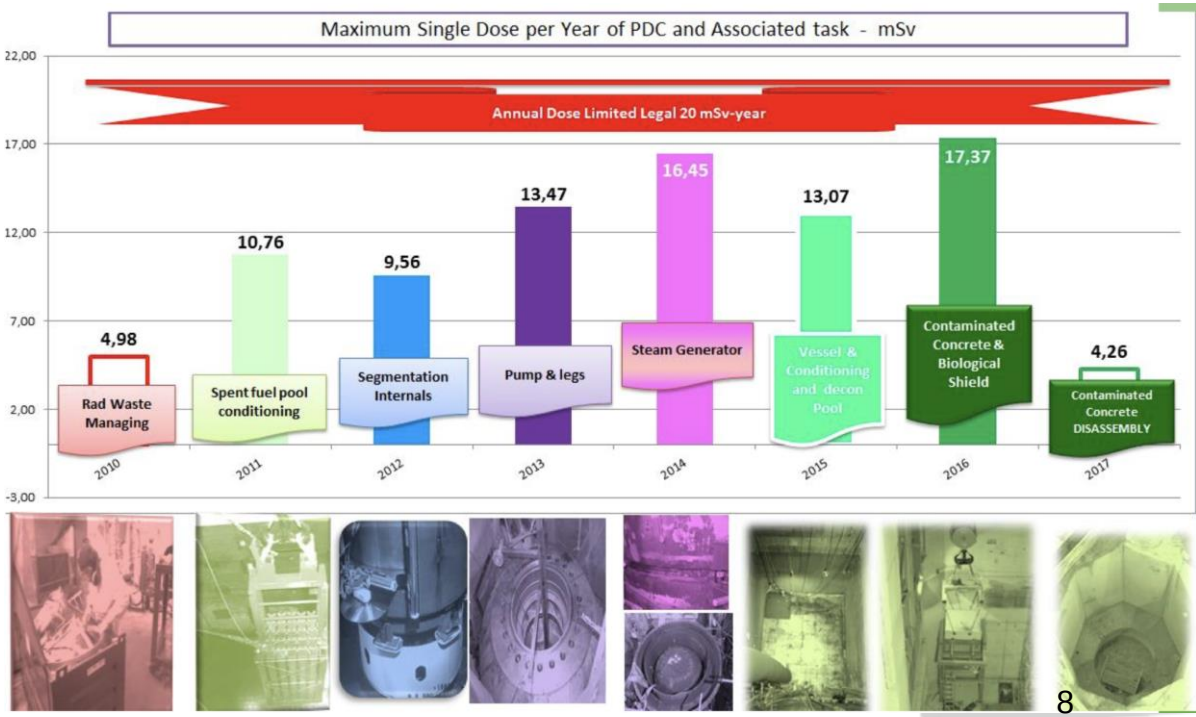
02 - SURVEILLANCE & MAINTENANCE		H-p	Dosis µSv-p	Tdp_µSv/h
02-01	Ocupational Health & Safety	11443	16251	1,4
02-02	Medical Services	58	104	1,8
02-03	Instrumentation Maintenance	4294	9982	2,3
02-04	Mechanical Maintenance	6136	26270	4,3
02-05	Electrical Maintenance	4403	10254	2,3
02-07	Security	1440	1032	0,7
02-08	Radiation Protection	69444	204044	2,9
02-09	Fire Protection	13283	6532	0,5
02-10	Decontamination & Housekeeping	73890	104538	1,4
02-11	General Services	5883	5155	0,9

Collective doses for decommissioning (3)

ACTIVITY:	Collective Dose Man-mSv	man-h
Main Components_STEAM GENERATOR	329,71	12090

05 MAIN COMPONENTS : Steam Generator		H-p	Dosis µSv-p	Tdp_µSv/h
05-04	Scaffolding	*704*	**4143**	5,9
05-05	Isolation removal	*278*	**2655**	9,6
05-06	Stem pipe removal	*364*	**1381**	3,8
05-07	Water supply pipe removal	*163*	**815**	5,0
05-08	Instrumentation removal	*104*	**796**	7,7
05-09	Steam section removal	*1294*	**6191**	4,8
05-10	Supports removal	*551*	**4724**	8,6
05-13	Confinement & filtration equipment	*187*	**1006**	5,4
05-14	SG Segmentation in situ	*8605*	**276252**	32,1
05-16	SG Segmentation in the SAS	*657*	**31742**	48,3





Management of risk of internal exposure

- **Higher risk** of internal contamination in decommissioning than in operational plants.
- Surface contamination:
  - Decommissioning plants: **dry contamination**
  - Operational plants: wet contamination
- Specific attention to the management of collective and individual protective equipment
- Evaluation of risk of **alpha** contamination and specific management

Radioactive waste management

- Significant impact on decommissioning project
- Possibility of **clearance** of some materials with a very low level of radioactivity taken into account in waste management plan except in France and USA.
- **Temporary storage** of high level radioactive wastes on site due to lack of disposal

Integrated risk management

- **Final end-state**: essential input to define decommissioning plan
- **Complex** and evolutive environment:
  - Asbestos, lead
  - Heavy load transport
  - Cutting works
  - Works at height
  - …
- A lot of **simultaneous works** that can induce complementary risks
- Huge challenge for RP staff

Integrated risk management
Example alpha - asbestos

- Example France: difficulty of management of works in a contaminated area (alpha) with asbestos. In France, there is **no common regulation** for management of these two risks:
  - **Asbestos**: Use of water to remove contamination and decrease quantity of asbestos dust during work with asbestos,
  - **In controlled areas**, avoid use of water:
    - Can spread the contamination,
    - Production of liquid radioactive effluents,
    - Production of radioactive wastes containing asbestos,
    - Not possible to monitor alpha emitters…
  - French utilities proposal: use of a red surfactant instead of water to fix asbestos and identify transfer of contamination during undressing.

Specificities of decommissioning

- **Historical knowledge** of the site has to be known to define decommissioning strategy and assess relevance of actions during transition phase
- Assessment of **contamination** levels and associated radiological spectrum for purposes of RP and waste management.
- Use of **adapted** technologies and operating procedures: works in complex environment with management of highly radioactive materials and address difference of organisation factors with operational phase
- Need of a **specific training** of workers and RP technicians

Conclusion

- Importance of **transition phase** for the success of the project: characterization and evolution of organisation
- **Waste management** and **final end-state** identified as driving factors of the overall decommissioning project.
- Identify requirement for RP staff and workers skills (contamination) to maintain **RP culture** to adequate standards,
- **Integrated** approach for a relevant risk management
- **Collective doses** from decommissioning not linked to unit power and may not be negligible

Thanks for your attention