



RADIATION PROTECTION SUCCESS OF SGR

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BLAYAIS UNIT 3

ISOE Brussels 2016

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DIPDE

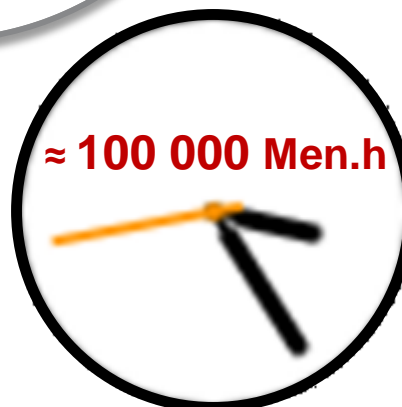
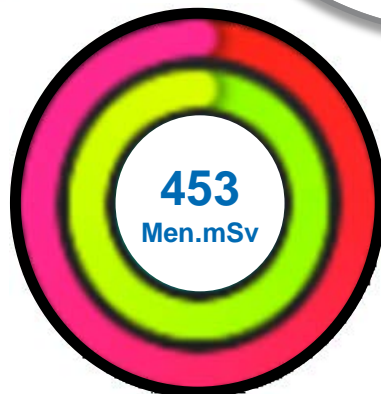
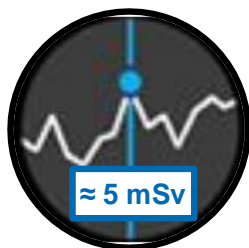
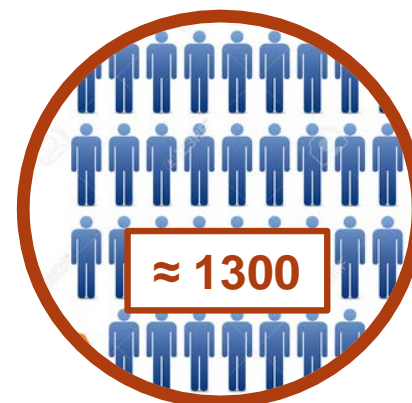
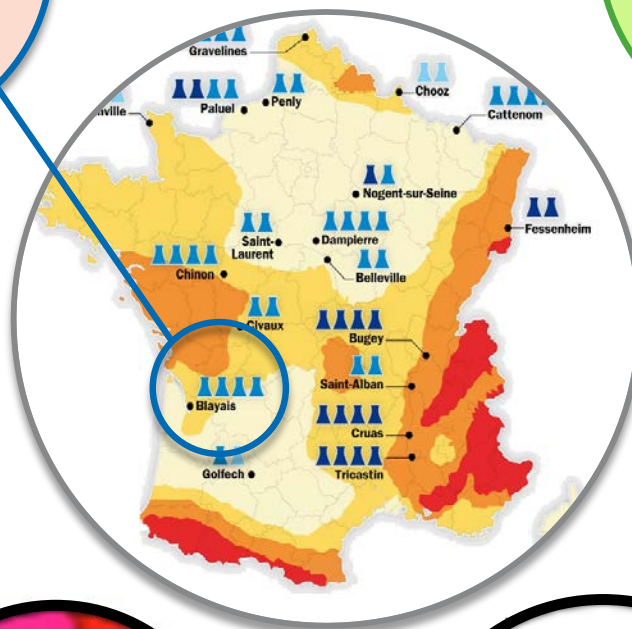
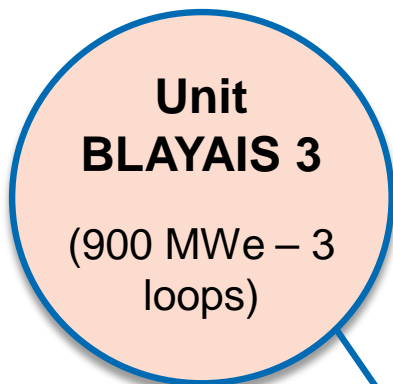
FLEET, DISMANTLING AND
ENVIRONMENT ENGINEERING
DIVISION



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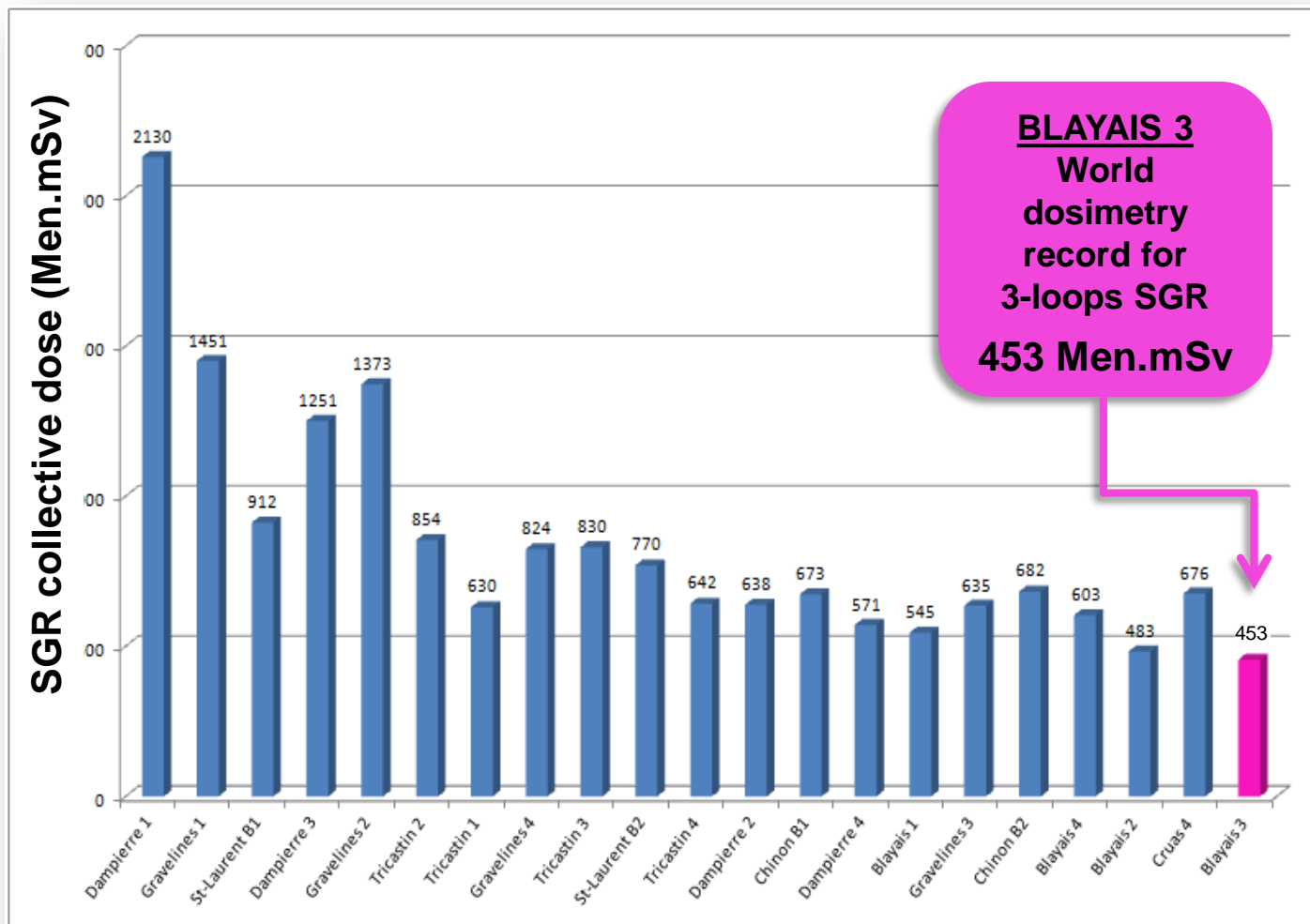
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KEY FIGURES



3-loops SGR COLLECTIVE DOSES

Evolution of SGR collective doses on 900 MWe – 3 loops SGR



Best USA
SGR
(2001)
Farley2
1290

Best SGR
(UE without FR)
(1998)
Tihange3
630

French SGR
average
(10 last)
596

Best SGR
World
(2015)
Blayais3
453

H.mSv

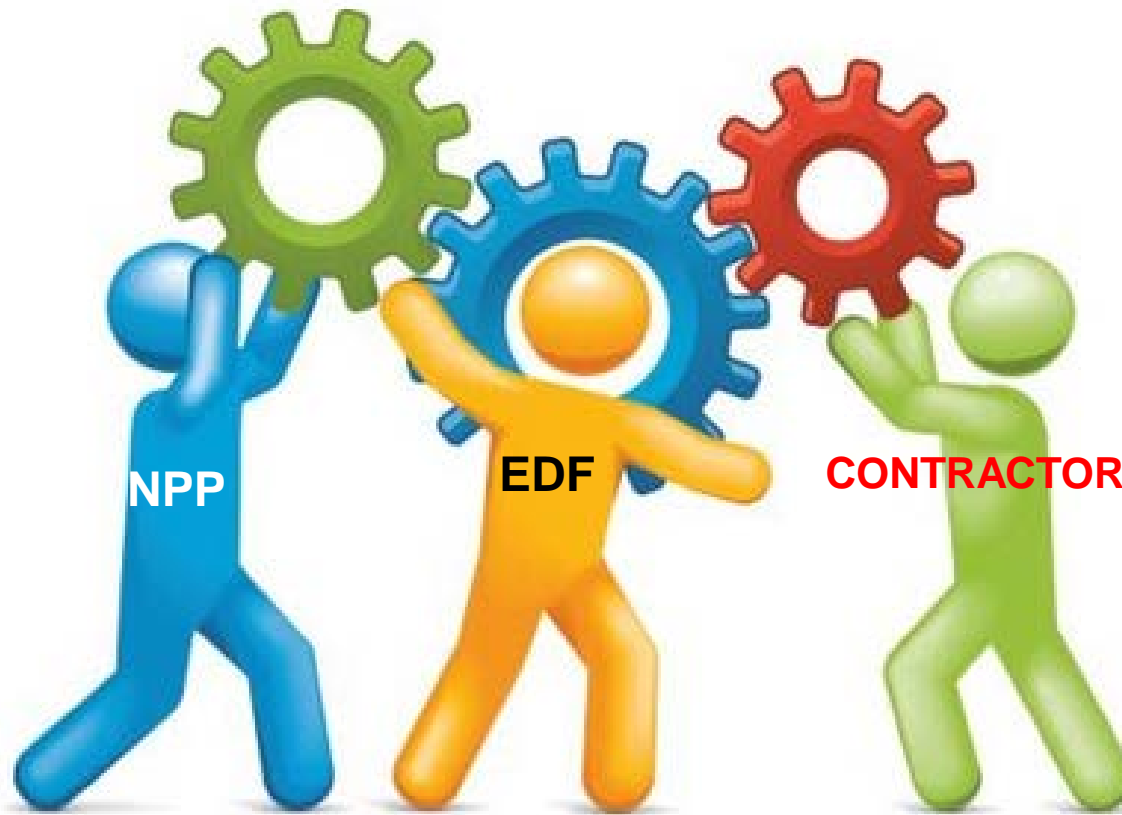
1990 → 2015



RADIATION PROTECTION IN SGR PREPARATION

ALARA Working Group

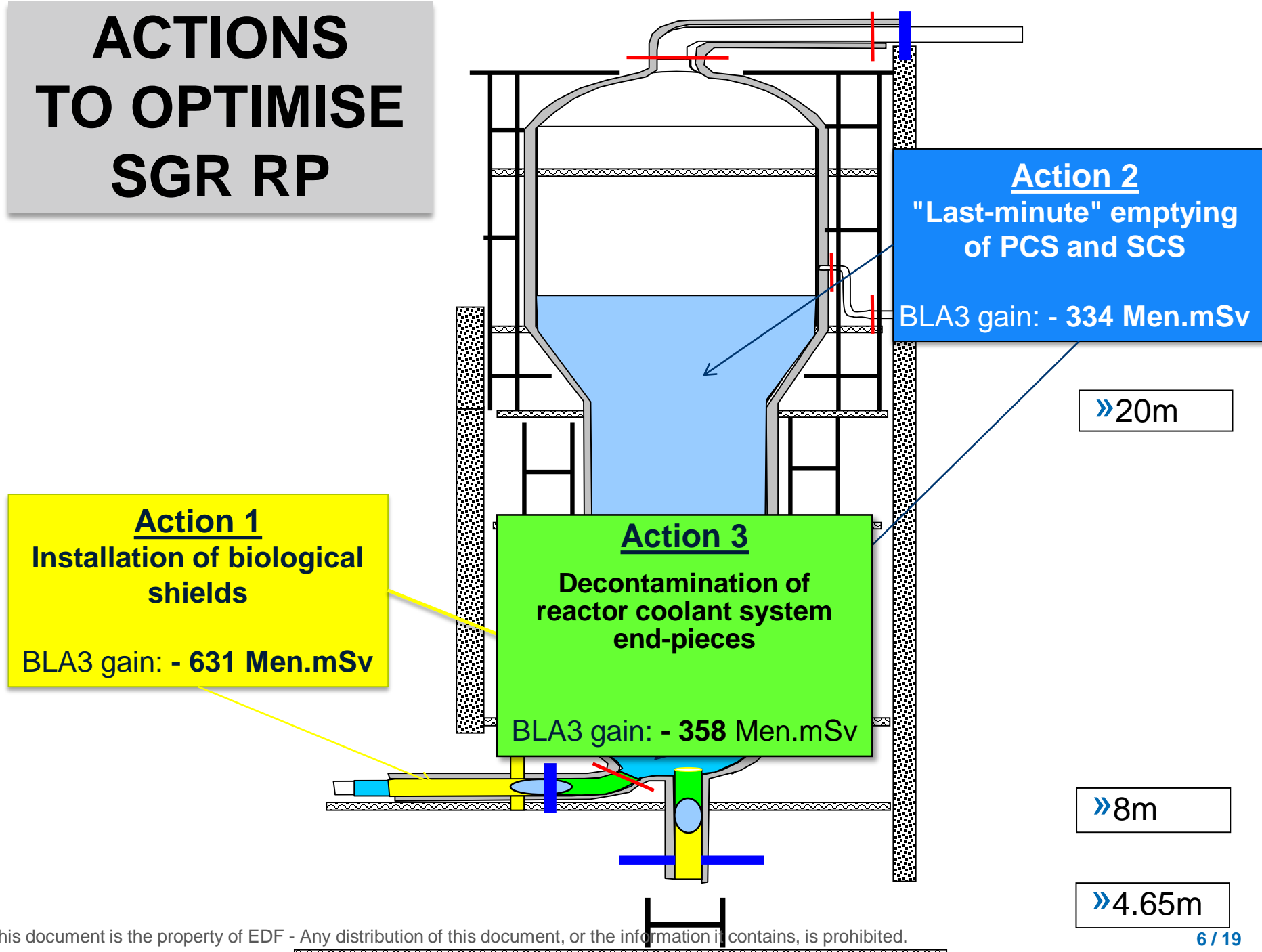
- Radiation protection preparation SGR managed by 5 ALARA Working Groups



Collaborative worksite preparation with all stakeholders focused on same objectives

ALARA Working Groups are important to ensure a continued application of optimisation actions and good practices from previous SGR

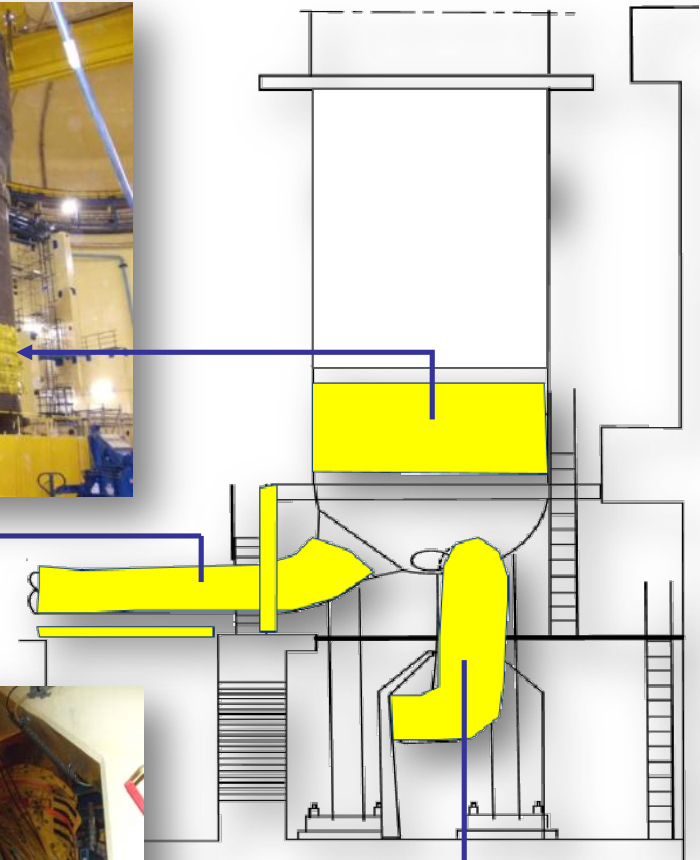
ACTIONS TO OPTIMISE SGR RP



MANAGEMENT OF SGR BIOLOGICAL SHIELDS

Key figures

- Almost 100 tonnes of biological shields

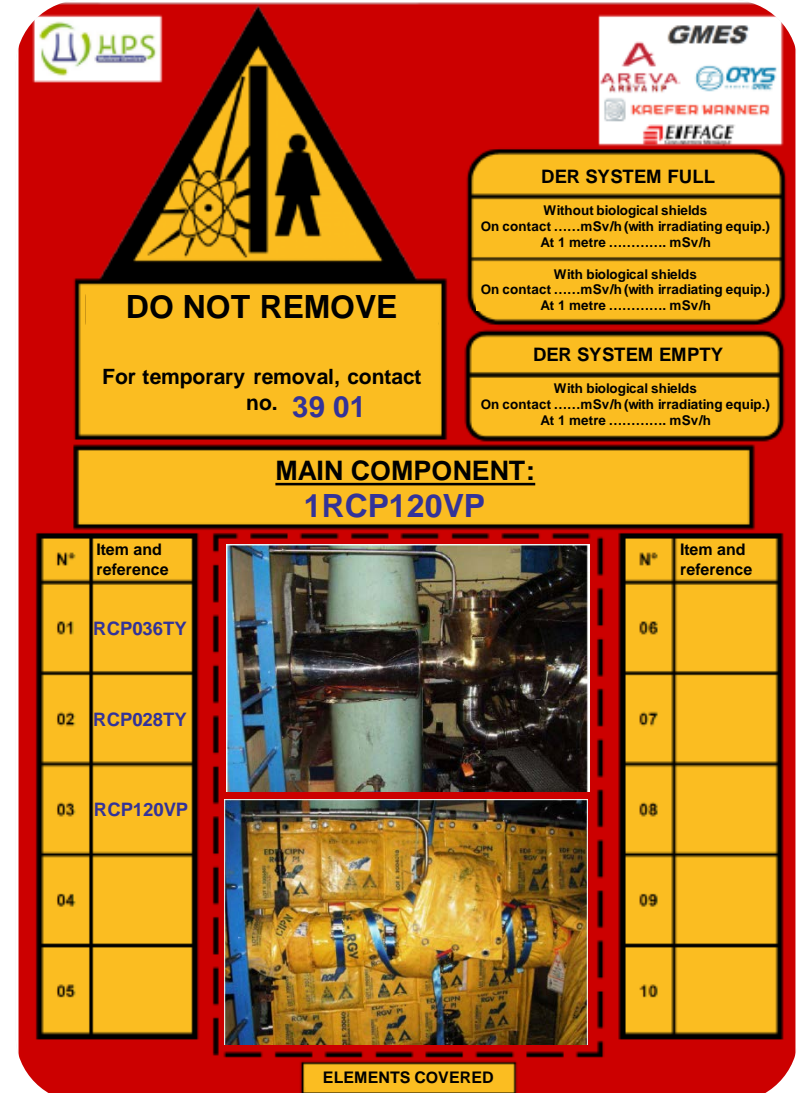


- Installation/removal dose cost: $\approx 45 \text{ Men.mSv}$
- Net dose gain: $\approx 650 \text{ Men.mSv}$
- 9 - 12 shifts ($\approx 5 \text{ days}$) at the start of outage
- 500 pages catalogue showing each installation option
- Around 200 outage activities that interact with biological shields



MANAGEMENT OF SGR BIOLOGICAL SHIELDS

Action plan for biological shielding management



MANAGEMENT OF SGR BIOLOGICAL SHIELDS

Results of SGR biological shielding management action plan

- Rapid integration of feedback (over less than 3 years)



		Displays	Leakage paths	Biological shields affected by unplanned removal	No. of temporary removal sheets produced
2012	GRA3 SGR	0%	Multiple	50%	22
2012	CHB2 SGR	70%	Some	30%	43
2013	BLA4 SGR	90%	Some	20%	115
2013	BLA2 SGR	100%	Rare (and corrected)	5%	160
2014	CRU4 SGR	95%	Rare (and corrected)	5%	103
2015	BLA3 SGR	95%	Rare (and corrected)	5%	311

OTHER EXAMPLES OF BEST PRACTICES

Good practices for biological shields

- Designed and adapted ramp (strength/width)
- Large format displays on SGR biological shield

Unadapted ramp

Type of outage	10-yearly outage			
Insulation removal on SG bypass lines? <i>Problem: Direct installation on insulation not permitted</i>	YES			
Elbow replacement? <i>Problem: Requires removal of sarcophagus</i>	YES		NO	
NPP operation on SG bypass check valves? <i>Problem: Removal of sarcophagus on top</i>	YES	NO	YES	NO
Best installation option	Install directly		Sarcophagus	



MAIN SECONDARY SYSTEM WATER LEVELS

Water level management

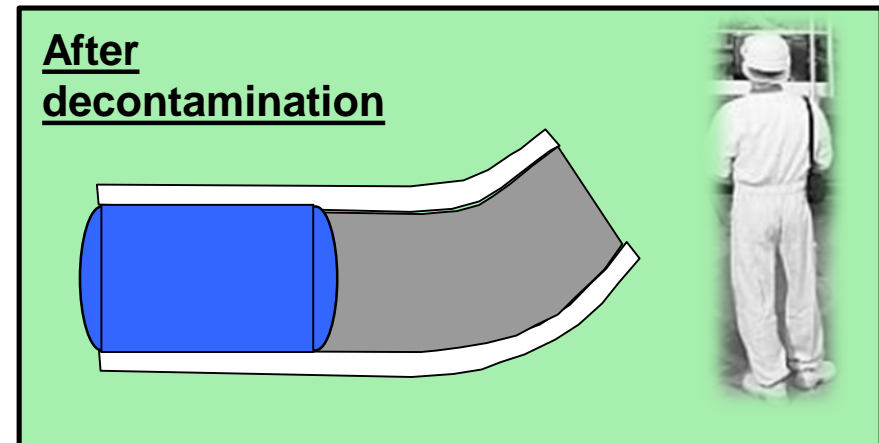
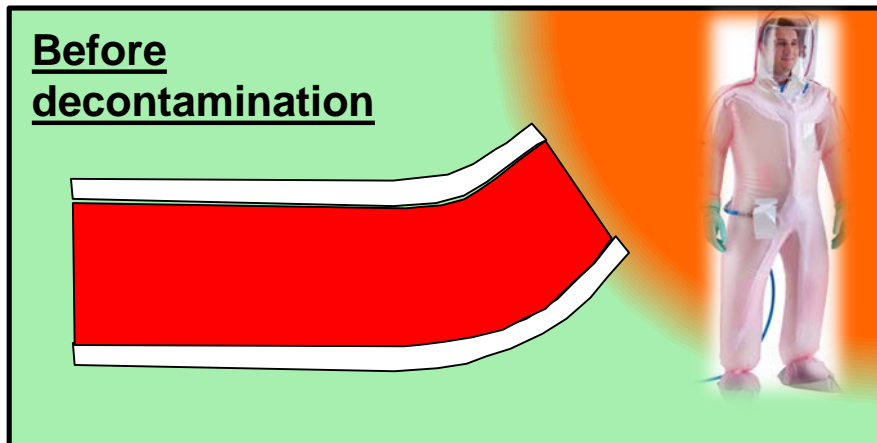
- **Essential optimisation action**
 - Zero dose cost and net dose gain: $\approx 400 \text{ Men.mSv}$ (schedule management)
 - Optimisation of dose up to 1st cutting activities on PCS/SCS
- **Observation: untimely emptying of SGs during certain SGR operations**
 - **Schedule error:** main secondary system drained too soon (before emptying signal)
 - **Contractor human error:** emptying signal given to NPP without consulting the other Contractor partners (quick reaction from NPP: SG refilled)
- **Action: Integration of feedback**
 - Sub-lockout procedure (1 per SG) on the emptying valves to keep the main secondary system water level at "FULL"
 - Portable gamma monitors installed to detect early emptying



DECONTAMINATION OF RCS END-PIECES

Radiation protection objectives

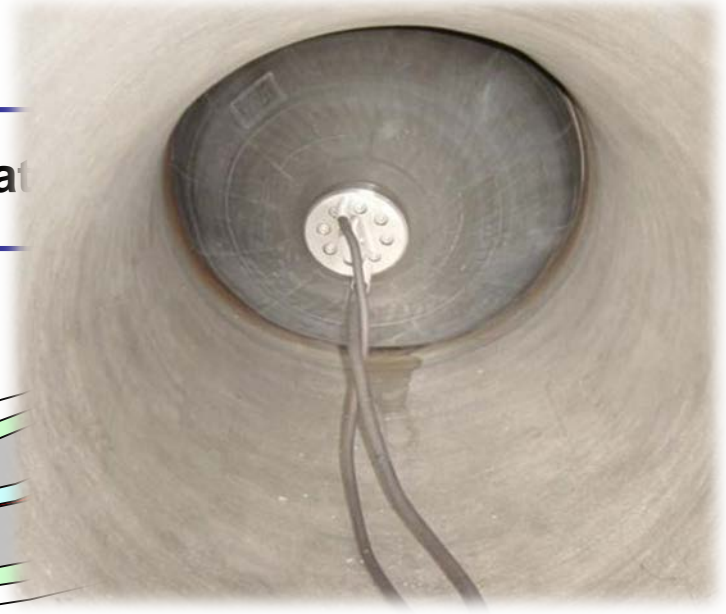
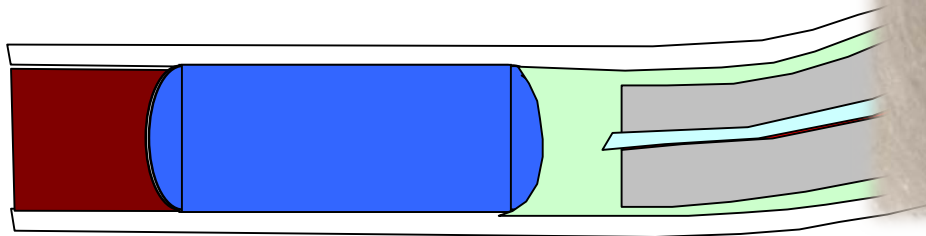
- Radiation protection gains made by decontaminating the reactor coolant system end-pieces
 - Remove surface contamination
 - Reduce dose equivalent rate inside and on the side of the leg
 - Reduce the risk of internal exposure
 - Allow operators to work without breathing clothes
 - ➔ *Work with less restrictive protective equipment*
 - ➔ *Reduce the exposure time for machining, welding, logistics and inspection activities*



DECONTAMINATION OF RCS END-PIECES

Decontamination results

» Decontamination



- Criteria reached after 2 decontamination cycles

	Before decontamination	After decontamination
DER inside leg (mSv/h)	> 5	< 0.1
Average dose rate reduction factor	70 (varies from 50 to 100 depending on 900 feedback)	

REDUCTION OF SOURCE TERM

Purification and hot spots management

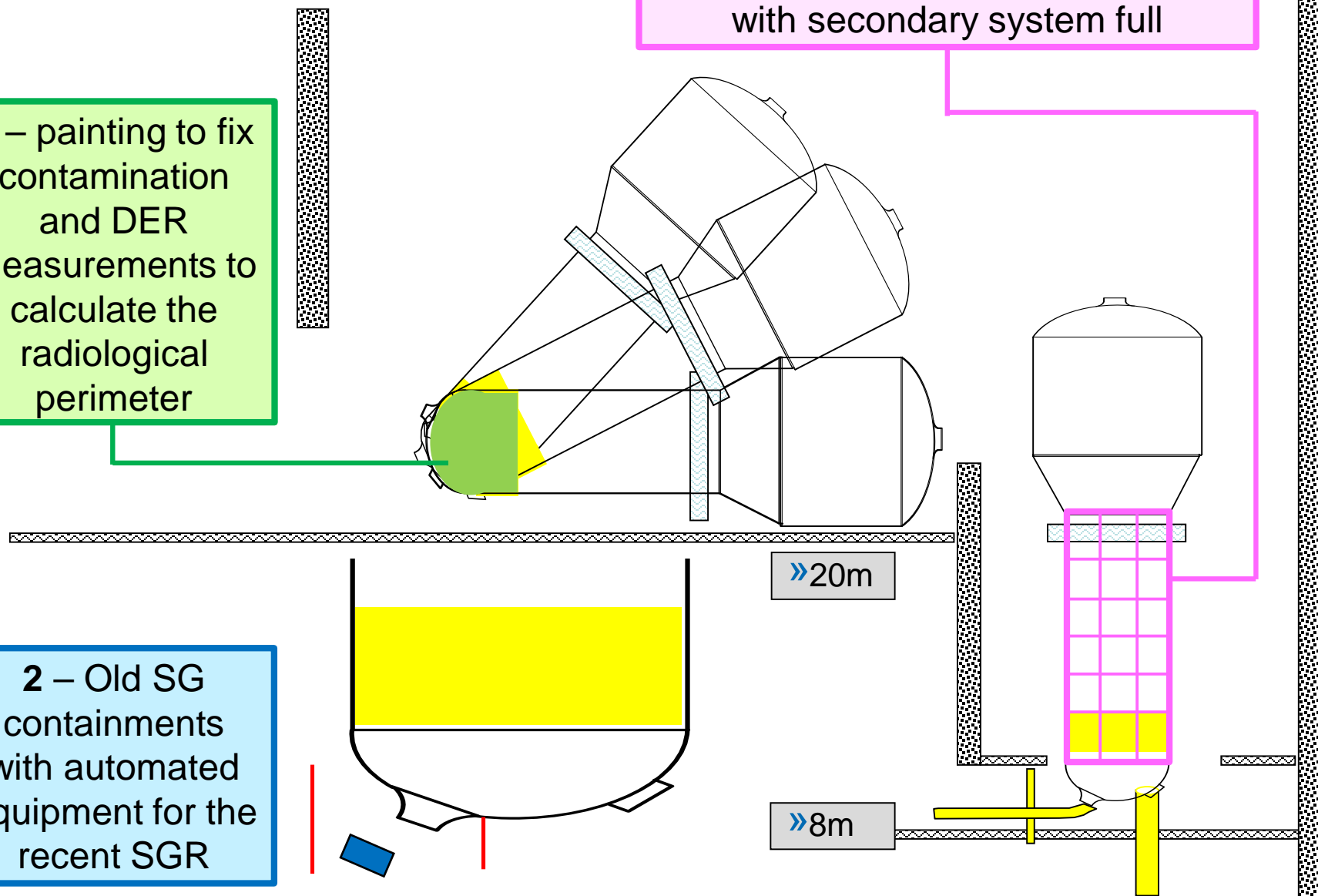
- Cold shutdown is effectively controlled under chemistry management.
- The number of hot spots is reduced. It is prepared two outages beforehand, with flushing or cutting welding performed during the previous outage
- Crossover legs flushed at each outage, with waste sent to TEU [LWPS] after passing through a preconfined filter : gains of between 30 and 40% on the ambient dose rate.
- Management of RCV [CVCS] flow rate before and after the last Primary coolant POMP shutdown.

SG EVACUATION

1 - Deposited contamination measurements in vertical position with secondary system full

3 – painting to fix contamination and DER measurements to calculate the radiological perimeter

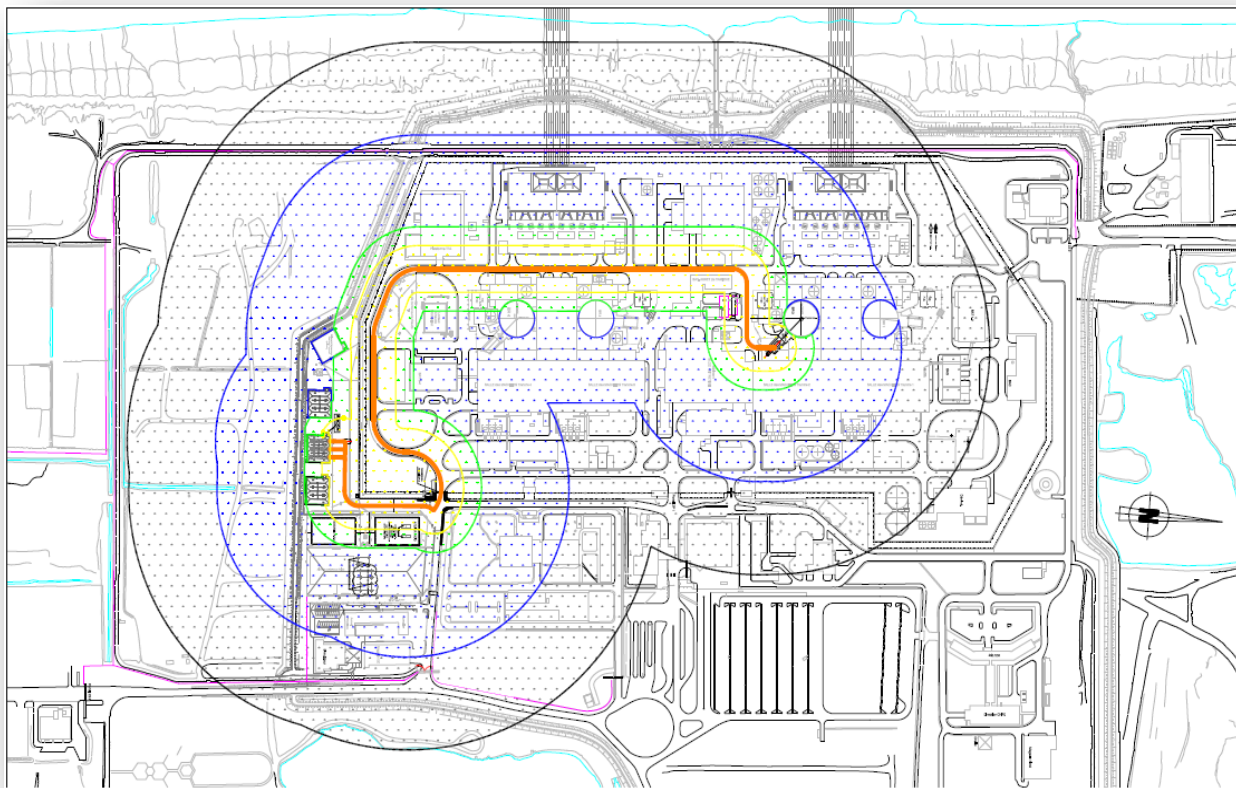
2 – Old SG containments with automated equipment for the recent SGR



SG TRANSPORT AND ISODOSES

Calculation of isodoses/Marking before lowering SG

- **Isodoses transmitted in preparation phase and adjusted just before the transport**
 - Preparation Phase : marking based on dose equivalent rate (DER) from N-1 walkdown
 - Evacuation Phase : marking adjusted with DER measurements performed when SG is horizontal (before it is moved)



SUMMARY

SUMMARY OF BLA3 SGR RP SUCCESS

- Collaborative worksite preparation (ALARA working group) with all stakeholders focused on single radiation protection objectives
- Experienced SGR and NPP teams
 - 2 CPY SGR/year over the past 3 years => experience for teams
 - 4th Blayais SGR, 3rd in less than 2 years
- Continuous integration of feedback
 - Preparation for BLA3 SGR in parallel with an other SGR execution
=> instantaneous integration of feedback
 - Continued application of optimisation actions and good practices from previous SGR
- Highly favourable radiological environment
 - Work on hot spots managing
 - Managed purification to reduce activity concentration as quickly as possible
- 150 hold points : ensure the optimisation actions and good practices application

**BLAYAIS 3 SGR = New dosimetry world record for 3-loop SGR
453 Men.mSv (1200 Men.mSv saved)**



THANK YOU FOR YOUR ATTENTION

