



**French Experience with PWR
Reactor Vessel Head Inspection,
Repair and Replacement**

Didier LHomme

Risk Prevention Manager

Belleville Nuclear Power Plant

France

1- HISTORY

- **1991** : *during a hydrotest on the Bugey 3 main primary system, detection of cracks on the vessel head penetrations*
- **1994** : *decision to replace all the vessel heads (55) of 900 MW et 1300 MW units*
- **2002** : *41 vessel heads replaced*
- **2008** : *replacement operations completed*

1 - HISTORY : Measures taken

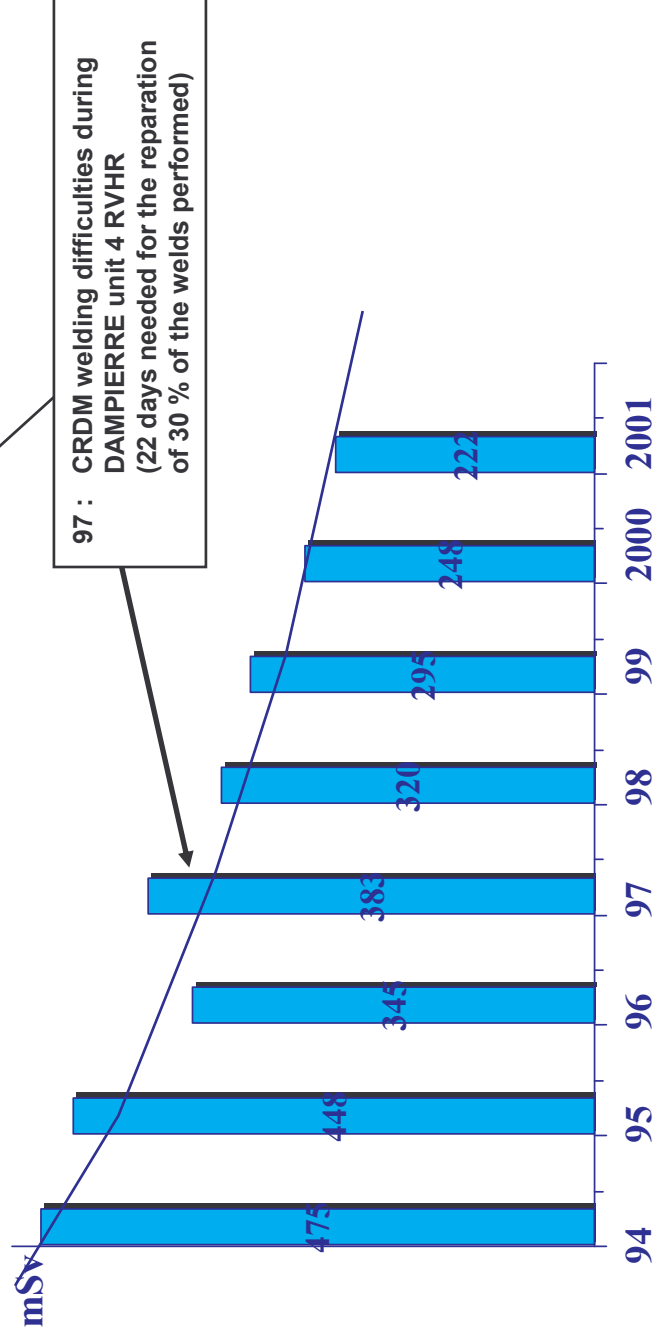
- ***Materials replacement***
 - ***Of the vessel head penetration by the Inconel 690***
 - ***Of the welding material by Inconel 152***
- ***Reduction of temperature stresses***
 - ***Passage of hot dome to cold dome by an increase in the flow of by-pass under the vessel head***
 - ***Reduction of 26 to 30°C.***
- ***Reduction of mechanical stresses***
 - ***Reduction of the shrink-fitting, to facilitate the assembly of the adapters on the New Vessel Head.***

1 - HISTORY : RVHR performed

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
	BUG 4	BUG 5	BUG 2 BUG 3 GRA 4 BLA 1	BLA 2 SAL 1 GRA 3 FLA 1 BLA 3 TRI 1	PAL 4 SLB 2 DAM 1 FES 1 SAL 2 BLA 4 TRI 4	DAM 2 DAM 4 BUG 4 BEL 2 CRU 4 GRA 5	FLA 2 DAM 3 PAL 3 CAT 2 FES 2 CRU 2	CAT 1 GRA 1 TRI 2 CAT 3	BEL 1 GRA 2 NOG 1 CHB 2	PAL 2 GRA 6 NOG 2	
1	1	4	6	7	6	6	6	4	4	3	0

5 – RADIOPROTECTION : Collective Doses Evolution (man.mSv)

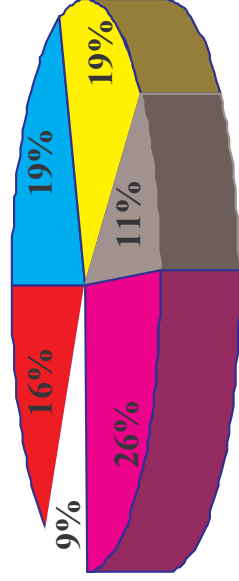
	1994	1995	1996	1997	1998	1999	2000	2001
Total doses	1900	2690	2414	2299	1918	1180	993	665
RVH Nb	4	6	7	6	6	4	4	3
Average Dose/RVHR	475	448	345	383	320	295	248	222
Evolution	-	-6 %	-23 %	+11 %	-8 %	-16 %	-16 %	-10 %



5 – RADIOPROTECTION : RVHR Doses Distribution in 2001 (man.mSv)

	Collective Dose, mishaps excluded (mSv)	Mishaps dose (mSv)
UVH de-equippping	37	8
UVH defitting	36	1,3
CRDM machining	21	4,2
NVH fitting	48	2,4
NVH re-equippping	18	0,05
Nuclear services	31	7
TOTAL	191	23
		214

Collective Dose distribution (mishaps excluded)



Mishaps dose distribution

