



**USNRC**

RIC 2010  
External Flood and  
Extreme Precipitation  
Hazard Analysis for  
Nuclear Plant Safety  
Session

**LESSONS LEARNED FROM  
1999 BLAYAIS FLOOD :  
OVERVIEW OF EDF FLOOD RISK  
MANAGEMENT PLAN**

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11<sup>th</sup> MARCH 2010

**EDF**  
LEADING THE ENERGY CHANGE

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**SUMMARY**

1. EDF NPP LOCATION
2. DECEMBER 1999 BLAYAIS FLOOD
3. A COMPREHENSIVE REVIEW OF THE FLOOD RISKS :
  1. OUTLINE OF THE MANAGEMENT PLAN
  2. EXAMPLES OF MODIFICATIONS IMPLEMENTED
4. OVERALL SCHEDULE OF THE REVIEW PROCESS
5. CONCLUSION : LESSONS LEARNED

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**1. EDF NUCLEAR POWER PLANTS LOCATION**



- ★ location of NPPs
- 14 riverside site
- 4 seaside site
- 1 estuary site

58 units in operation  
1 under construction

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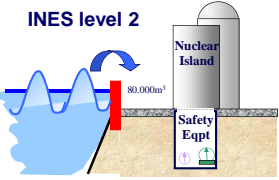
## 2. DECEMBER 1999 BLAYAIS FLOOD

1999 Storm  
↓  
« Le Blayais »  
NPP partial  
flooding





**INES level 2**



High water level in the river Gironde :  
high tide + storm surge (+2m)  
and waves (2m) generated by the wind  
on the estuary (200 km/h )

→ Waves came over the dyke and  
caused flooding on site and in units 1  
and 2

→ On-site Emergency plan (36 hours)

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### Protection of French NPPs against external flooding before Blayais flood (Safety Rule RFS I.2.e – Issued 1984)

- ❖ **Maximum design flood level to be assessed considering :**
  - River flood
  - Dam rupture
  - Littoral flood (tide + storm surge)
  - Estuary sites
- ❖ **Protection is ensured by :**
  - Nuclear Island Platform level ≥ maximum design flood level
  - Below the platform: closure of all possible pathways to the rooms containing equipment required for safe shutdown .

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### BLAYAIS (1999) : Examples of damages



Door deformation



Failure of Cable opening

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**Protective measures** **PROTECTION OF EQUIPMENT (1/2)**  
 → Set up of a compact “watertight area”

■ At all NPPs, protection against water ingress of the substructures of the buildings containing equipment to be protected (plugging of openings, reinforced doors,...)

Qualified material to plug the waterpaths and openings

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**Protective measures** **PROTECTION OF NI AND PUMPING STATION PLATFORMS (2/2)**

Protection of structures/devices reviewed : type, height, margins, settling, stability, safety classification, seismic resistance, power-supply, maintenance... → Improvements where required

→ Dykes/walls raised or extended or reinforced at some sites

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**Protective measures** **FLOODING PROCEDURES** **Flooding effects on NPP's support functions and surroundings**

Warning based for predictable hazards, Procedures adapted to site vulnerability (platform submersion, site isolation, loss of the external power supplies, heat sink filtration affected by flooding)

	Stand-by phase
T0	Vigilance phase (early actions)
T0 + 12h	Early warning phase (site protection preparedness)
T0 + 24h	Alert phase (→ safe state)

At most sites, implementation of “flooding” procedures :

- Prepare site protection during the warning phases (closure of paths/openings through dykes and “watertight area”, tanks filling-up,...)
- Bring the plants to safe shutdown state if required

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