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Lessons learned from dam removal experiences in France

- Some (brief) insights -

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Outlines

- The regulatory background in France
- Dam removal decision :

  non-integration of issues
- 3 dam removal experiences :

  some brief facts & lessons learned
- Concluding remarks

The regulatory background in France (1/2)

2 kinds of Hydro power projects license (Hydro Power Act, 1919) :

- **« Concessionnary » license :**
  - P > 4.5 MW – initial duration : 75 years – Renewals for 30 years
  - At license expiration, projects are given back to Government Authority :
    - ✓ renewal of license (based on revised requirements and water rights)
    - ✓ or project may also be devoted to other water uses
    - ✓ or dam removal decision – costs are beared by Government Authorities
- **« Authorized » license :**
  - P < 4.5 MW – initial duration : 75 years – Renewals for 75 or 30 years
  - At license expiration, licensee remains the owner of facilities.
    If license renewal is rejected :
    - ✓ « restoration to natural river conditions » is required with costs beared by licensee
    - ✓ or licensee may deliver back facilities to Government Authorities

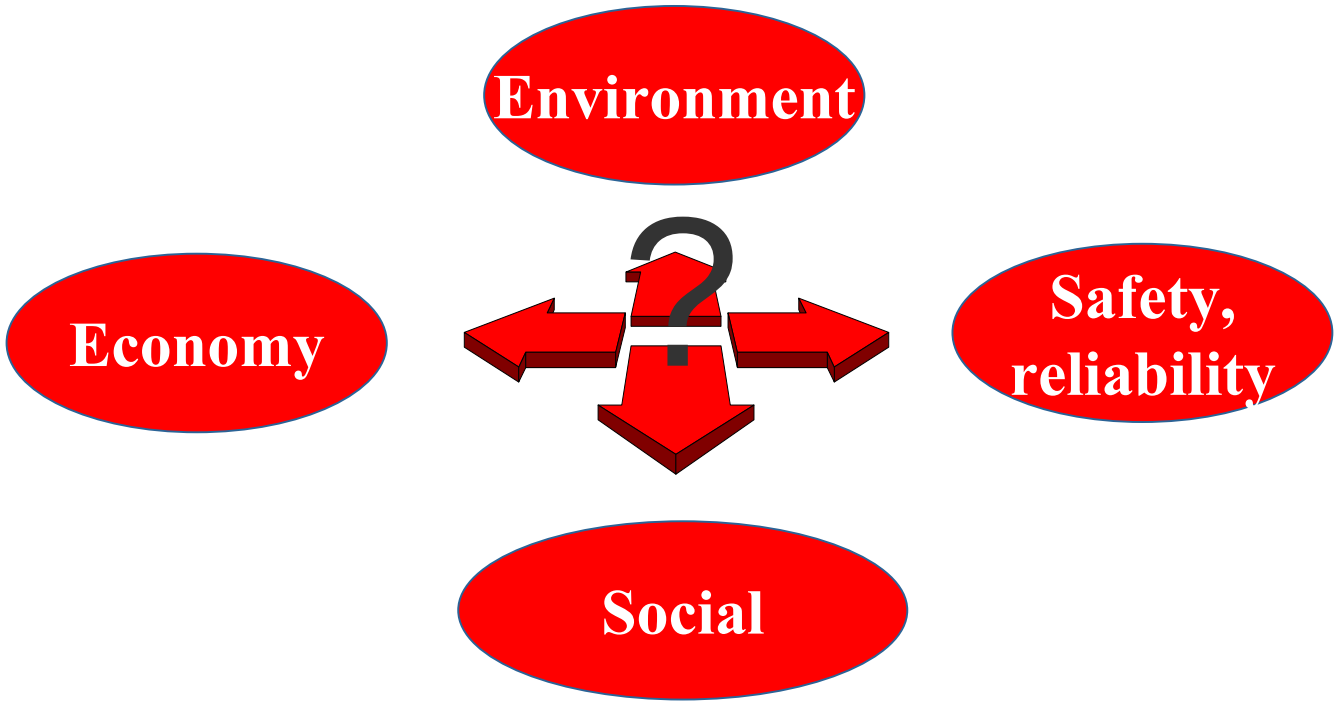
The regulatory background in France (2/2)

Fish protection - Water & Fish Act, 1984 :

- **determines Instream Flow conditions requirements, through a progressive approach :**
  - New projects must comply with new requirements
  - For existing projects, a progressive increase of instream flow is requested until relicensing time when full compliance is required
- **imposes an « effectiveness » requirement for fish passage facilities, as opposed to previous regulatory statements which implicitely suggested that « administrative » facilities would be Ok …**
  - … « facilities **MUST ENSURE** effective upstream and downstream fish migration … »

Dam removal decision issue … (1/2)

- Dam removal is primarily resulting from a lack of integration of predominant issues or priorities



- … and lack of integration of their foreseen evolution over time

Dam removal decision issue … (2/2)

- **Consequence : the project can no longer meet its assigned goals under cost-effective conditions**
- **Some reasons for the « lack of integration » :**
  - Lack of past knowledge about physical processes & environmental issues : e.g. watershed approach (vs) local analysis
  - Evolution in social concerns & priorities : e.g. energy development needs (vs) environmental impacts
  - Centralisation & technical « mono-culture » in former decision-making processes
  - No technical and/or economical possibilities for adaptive measures, due to irreversible past technology solutions
  - …

3 main dam removal experiences in France

Kernansquillec
Léguer river
(1922-1996)

Maisons-Rouges
(EdF)
Vienne river
(1920-1998)

St-Etienne du Vigan (EdF)
Allier river
(1950-1998)

Kernansquillec, *Léguer river* (1996)

Key facts :

- **H = 15 m ; V = 300 acre-feet (400 000 m^3) ; Vol. sed = 50% ; P = 1.3 MW**
- **Dam removal reasons :**
  - ➢ Safety issues : spillway under-designed + dam highly susceptible to overtopping (huge safety concern during floods in 1995)
  - ➢ Environmental issues :
    - ✓ fish passage facility not effective
    - ✓ Reservoir eutrophication + sediments generate poor downstream WQ (water-supply withdrawal ; fish-habitat)

  ⇒Cost estimation to comply with Env + safety requirements too high
- **Main dam removal issue : management of sediment !!**

Kernansquillec, *Léguer river* (1996)

Sediment management process (started Apr 96) :

- **1st phase : main channel Hydrodredging + slow draining of reservoir**
  - Q = 300 l/s diverted into 2 decantation-ponds – 94000 m^3 of sed. removed
  - dZ/dt = - 3 cm/day over 4 months
- **2nd phase : implementation of 4 downstream siltation-weirs (12000 m^3 of total capacity) + rapid final reservoir draining (flushing) :**
  - dZ/dt = - 25 cm/day in 1 day
  - 10000 m^3 sediments have been trapped ; dredged in 8 days in Oct 1997

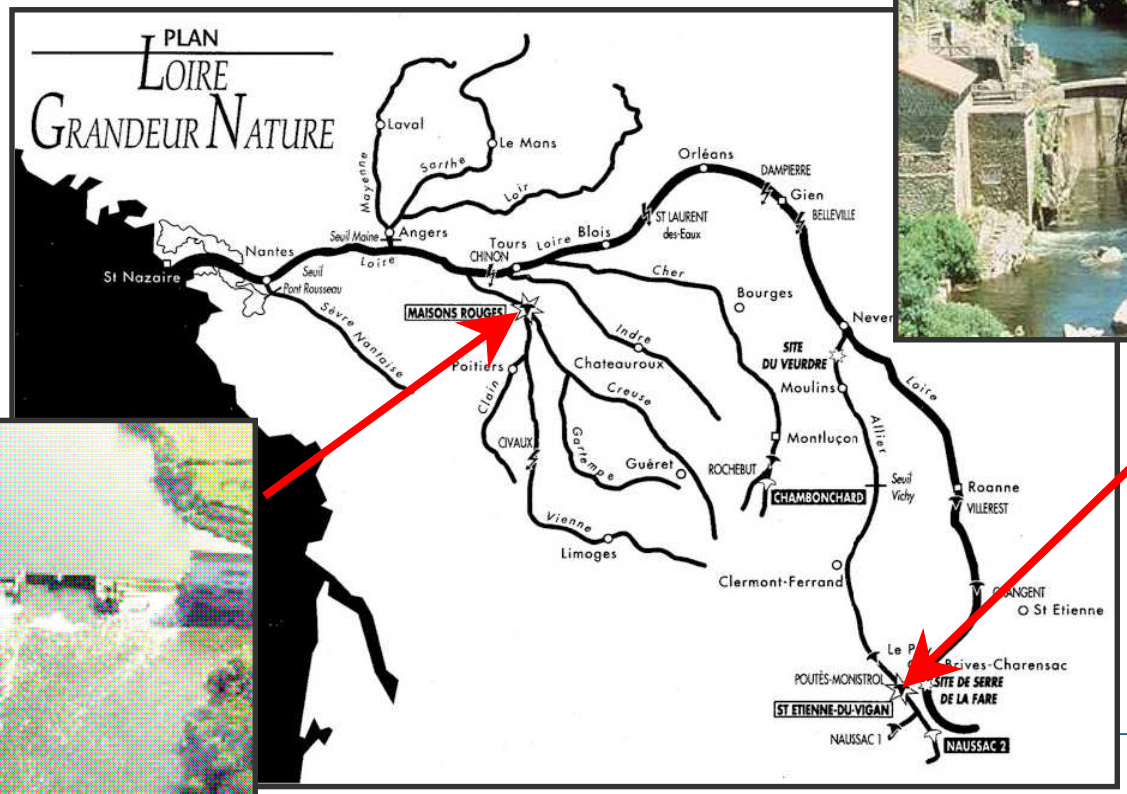
Dam removal lessons learned :

- **Total cost = $1.2 M – Sediment dredging = 65% => $7 / m^3**
- **Continuous monitoring of Water Quality (O2, NH4)**
- **Preventive over-treatment at downstream water-supply withdrawal unit**
- **Social acceptance ; New recreational opportunities**
- **Fish population restoration : Salmon : Ok ; Eel : ??**

St-Etienne du Vigan, *Allier river* (1998)
Maisons-Rouges, *Vienne river* (1998)

Dams removal decision based on a Watershed approach :

Gov. plan for migratory fish restoration (+ flood protection, & drought management) over the Loire watershed – Jan. 1994



St-Etienne du Vigan, *Allier river* (1998), & Maisons-Rouges, *Vienne river* (1998) main lessons learned

	St-Etienne du Vigan	Maisons-Rouges
	H = 12 m ; P = 1 MW	**H = 4 m ; P = 2.5 MW**
Sediments	**sand, gravels (30 000 m³ : not an issue) ; draining during flood**	**mainly sand : not an issue**
Costs	**$1.3 M for decomissiong** **$1.2 M for compensatory measures**	**$2.7 M for decomissioning** **$5.3 M for compensatory measures** NB : $9.5 M for dam upgrading solution (rejected)
Other main issues	**Loss of taxes** **No real local planning to design an alternative project for the area : recreation and related activities**	**Reservoir uses :** **- Water intakes for irrigation** **- Water sports, campground** **=> Reservoir became part of the local « natural » / cultural legacy** **Loss of taxes => huge local reluctance**
Fish migration benefits	**- Significant increase of upstream spawning areas** **- slight progressive increase of salmon adults passages**	**- Shad : + +** **- Marine Lamprey : + + +** **- Salmon : +**

Bottom line

- **Lack of issues integration often resulted in the dam removal decision**

  => don't miss integration of issues for the dam removal business itself !

- **Economics :**
  - Sediment management + Social compensatory measures : potential big parts
  - Cost-benefit analysis of multiple scenarios, including full-cost accounting, were never used to support removal decisions
- **Watershed approach (vs) local concern :**
  - Local social reluctance and conflict : loss of taxes ; dam/reservoir became part of cultural, economical, and « natural » legacy
  - Tranformation of the Hydro business from local « turbine operator » towards « water resources managers »
- **Need for decision-support framework to handle « integration of issues » when dam removal is envisioned or questioned :**
  - Full-cost accounting (externalities) if « 1D » metrics (economy) makes sense ?
  - How to find a consensus about priorities among issues/perspectives when multiple metrics are necessary ?

Thank you !