Dam-break Emergency Planning in Portugal. The role of the National Service for Civil Protection

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Portuguese background

More than 1000 dams in Portugal

- 140 large dams, and
- > 800 medium size

Large dams owners

- Electricity of Portugal
- Water Authority

No legislation on dam safety until 1990
Portuguese background

**RSB, 90 - Regulation on dam safety**
- dam-break flood analysis, and
- emergency planning

**NPB, 93 - Guidelines for dam design**
- evaluation of inundation areas

**NOIB, 93 - Guidelines for dam observation and inspection**
- warning in case of earthquakes, floods, and dam abnormal behaviour
Criteria for dam safety application

RSB, 1990

\[ H > 15 \text{ m}, \text{ or } \]

\[ V > 100 \, 000 \, \text{m}^3 \]

Special other cases may be considered, if potential risk exist.
Role of SNPC

To assure the Emergency Planning

Rescue and relief actions coordination
Internal and External Emergency Planning

IEP  Dam’ owner

EEP  Civil Protection
Definition of alert levels

Alert and warning systems
### Alert levels

<table>
<thead>
<tr>
<th>ALERT LEVEL</th>
<th>SITUATION</th>
<th>Dam Owner</th>
<th>Civil Protection</th>
<th>Others …</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td></td>
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<tr>
<td>Dam break</td>
<td></td>
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</tr>
</tbody>
</table>
## Alert levels

<table>
<thead>
<tr>
<th>ALERT LEVEL</th>
<th>Situation</th>
<th>DAM Manager Entity ACTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue</td>
<td>Normal or routine situation, or Detection of anomalies in the dam, or other events: that do not compromise the structural dam safety, nor its operational elements, and do not make unviable the dam observation system. The gravity of existing problems must let belief that no consequences are expected in the valley downstream the dam.</td>
<td>MEASURES to solve problem. ALERT:  - Authority (INAG)  - Dam owner</td>
</tr>
</tbody>
</table>
Existence of anomalies or events that might compromise up to some degree the structural and/or operational dam safety or the dam observation system, assuming that eventual small consequences downstream the dam can happen:

1. Existence of meteorological adverse conditions;
2. Detection of anomalies in:
   - dam structural elements, or;
   - dam operational elements, or;
   - dam observation system;

**Alert levels**

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</thead>
</table>
| YELLOW      | Existence of anomalies or events that might compromise up to some degree the structural and/or operational dam safety or the dam observation system, assuming that eventual small consequences downstream the dam can happen:  
1. Existence of meteorological adverse conditions;   
2. Detection of anomalies in:   
   - dam structural elements, or;
   - dam operational elements, or;
   - dam observation system;
**ALERT:**  
- Authority (INAG)  
- Dam owner  
- Civil Protection |
**Alert levels**

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<thead>
<tr>
<th>ALERT LEVEL</th>
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<th>DAM Manager Entity ACTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORANGE</td>
<td>Situation with high probability of dam failure, letting belief it might not be possible to control the situation, what might cause serious consequences downstream the dam:</td>
<td>MEASURES to solve problem.</td>
</tr>
<tr>
<td></td>
<td>1. Detection of severe anomalies in:</td>
<td>ALERT:</td>
</tr>
<tr>
<td></td>
<td>- dam structural elements, or;</td>
<td>- Authority (INAG)</td>
</tr>
<tr>
<td></td>
<td>- dam operational elements;</td>
<td>- Dam owner</td>
</tr>
<tr>
<td></td>
<td>2. Existence of severe foundations problems;</td>
<td>- Civil Protection</td>
</tr>
<tr>
<td></td>
<td>3. Occurrence of floods with high recurrence interval.</td>
<td>WARNING:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Population downstream the dam to be ready for evacuation</td>
</tr>
</tbody>
</table>
### Alert levels

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</tr>
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</table>
| RED         | Situation of **inevitable catastrophe:**  
  1. Imminence of dam failure;  
  2. Dam failure. | **ALERT:**  
  - Authority (INAG)  
  - Dam owner  
  - Civil Protection  
  **WARNING:**  
  Population downstream the dam to evacuate quickly |
Internal and External Emergency Planning

Rapid warning
99% of the casualties usually occur in the first 15 km.

\[ D_{\text{min}} = \min \{D \ (T = 90 \text{ min}); \ D = 30 \text{ km} \} \]
Emergency planning main actions

Detection
Decision making
Alert
Warning
Evacuation

Internal Emergency Plan (PEI)
External Emergency Plan (PEE)
Emergency Planning

**PROJECT:** *Dam brake flood risk management*
(NATO PO-FLOOD risk management)

Portugal, Algarve
Key points for emergency planning

**Inundation maps** – Dam’ owners - PEI
- dam-break flood simulations;
- flash floods, abrupt waves and numerical models

**Risk zoning criteria**
- water levels
- velocities
- times of flood arrival

**Valley vulnerability criteria**
- land use
- social and
- economical characterizations
EEP - Downstream zoning criteria

Valley vulnerability indicators

**Physical vulnerability of the buildings**
- number of stages, construction materials, age

**Social vulnerability of the population**
- age, % of elderly people and children
- existence of support infra-structures like hospitals and health centres

**Economical vulnerability of the valley**
- land use
- Activities
- % of illiteracy and % of unemployment

**Vulnerability of preparation of population & agencies**
- existence of an revised emergency plan and training
External Emergency Planning

ACTING PRINCIPLES

Permanent situations surveillance

Articulation with:

Special National and District Plans for Flood management

Meteorological Institute
Water Institute
Dam’s Manager Institutions
Civil Protection Agents
External Emergency Planning

Means and resources allocation

» for each vulnerable zone

Actions of entities involved in crises management

» Water Authority (Water Institute – Ministry of Environment)
» Meteorological Institute
» National Service for Civil Protection
» Dam Safety Commission
» Dam-owner

Actions of entities involved in emergency

» National Service for Civil Protection
» All Civil Protection Agents
» Municipalities

Type of evacuation

» by own people means
» help of civil protection agents
Information System

DamInfo

PLANO DE EMERGÊNCIA
NIVEL 3
BARRAGEM DO ARADE

Lista de procedimentos

SIPROC
External Emergency Planning

Funcho and Arade EEP

Model, or example
for all other dam’ emergency plans
Conclusions

Legislation requirements have not been achieved yet (5 years)

Believe that in the next two or three years, all dams covered by the legislation will dispose of internal and external emergency plans, with proper alert and warning systems, in compliance with the legislation.
END

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