



ICOLD EUROPEAN CLUB

DAM LEGISLATION



NOTICE - DISCLAIMER:

The information, analyses and conclusions in this document have no legal force and must not be considered as substituting for legally-enforceable official regulations. They are intended for the use of experienced professionals who are responsible to judge their pertinence and applicability.

It is emphasised that the purpose is not to prepare the basis of a common legislation.

This document has been drafted with care but we cannot guarantee that it covers all aspects of the discussed topics.

One must pay attention to the fact that the report gives only a summary of the legislation in use in each Country. It is impossible to explain all the details and the intricacies of the laws, standards, etc.

We decline all responsibility whatsoever for how the information herein is interpreted and used.

Do not read on unless you accept this disclaimer without reservation.

Dam Legislation Report

2001 Report

- A *2001 Report* was prepared by a Working Group chaired by Patrick Le Delliou, composed of members from 14 Countries, with the purpose of comparing the dam legislation in European Countries. It is emphasised that the purpose was not to prepare the basis of a common legislation.
- The *2001 Report* was divided in two main parts :
 - Description of the Regulations. The Group decided to focus on some pre-selected items.
 - Comments on the similarities and differences.
- Note: Germany has a federal organisation and all the German states have their own legislation. The requirements described in the report are those of the state of North-Rhine - Westphalia.
- In *Annex 1* some data about the dams in each Country were given, according to the ICOLD's Dam Register.

2007 Report

- A *2007 Report* was prepared by a “scouting” Working Group chaired by Giovanni Ruggeri, composed of members from 4 Countries (France, Italy, Norway, Portugal), having the purpose of defining the activities to be proposed for a possible subsequent “Legislation Project” aimed to make available updated information on “Dam legislation” in European Countries.
- The frame of the *2001 Report*, confirmed as a valuable basic platform, was slightly revised:
 - two additional “Sections” were introduced (Section 1, Section 3),
 - item “*H – Dam Decommissioning*” was added in Section2,
 - it was decided to annex the files of the legislation documents (original language, English translation if available).
- The information relevant to the four Countries (France, Italy, Norway, Portugal) was updated.

2001 and 2007 Working Groups

| <i>Country</i> | <i>Working Groups</i> | |
|----------------|-----------------------------------|--------------------------------|
| | 2001 | 2007 |
| France | P. Le Delliou (<i>Chairman</i>) | P. Le Delliou |
| Italy | R. Paolina, L. Tomasi | G. Ruggeri (<i>Chairman</i>) |
| Norway | Traagstad | T. Konow |
| Portugal | F. Teixeira Direito | J.A. Rocha |
| Austria | R. Melbinger | |
| Finland | E. Loukkola, T. Majjala | |
| Germany | J. Kängeter, K. Rettemeier | |
| Netherlands | Tj. De Haan, R. E. Jorissen | |
| Romania | D. Hulea | |
| Slovenia | A. Kryzanowski | |
| Spain | J.A. Herreras | |
| Sweden | A. Lindh | |
| Switzerland | H. Pougatsch | |
| United Kingdom | J.A. Charles, R. Vincent | |

Dam Legislation Report

Updating process

- The activity of the 2001 and 2007 Working Groups confirmed the widespread interest for an easy access to information on the dam legislation applied in European Countries. A significant evolution in dam legislation was also confirmed, and a “continuous” updating of the information was therefore recognised to be necessary.
- **Following the completion of the 2007 Report, the information updating process is therefore entrusted to the direct responsibility of the National Committees of the European Club of ICOLD.**
- Note: the Annex 1 of the *Report* (“*Data about Dams*”) is taken from the 2001 Report. It contains “almost static” information, only marginally involved in an updating process.

CURRENT UDATING

| Country | Updating Date <i>2001 : by Working Group</i> <i>2007 : by Working Group</i> <i>after 2007 : by National Committees</i> |
|----------------|--|
| France | 2007 |
| Italy | 2007 |
| Norway | 2007 |
| Portugal | 2007 |
| Austria | 2001 |
| Finland | 2001 |
| Germany | 2001 |
| Netherlands | 2001 |
| Romania | 2001 |
| Slovenia | 2001 |
| Spain | 2001 |
| Sweden | 2001 |
| Switzerland | 2001 |
| United Kingdom | 2001 |

Dam Legislation Report

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SECTION 1

Basic Legal Framework

FRANCE

According to legal point of view, the owner of a dam is responsible for any damage that the dams, directly or not, can create in case of a problem, incident, failure or during normal operation. The general obligations of the owner are defined in few laws, especially a law on water, and laws and decrees for public safety.

But the authority takes also his part to guarantee the general public safety and, for that, the authority (French government and its representatives) supervises the action of the owner for dam safety. For some dams (industrial ones) there is also a control of the administration due to the concession system.

The French regulation is constituted of a huge intricate amount of laws, decrees, orders, circulars and so on. However, very few are directly connected to dams. In fact, the legal basis particularly for dam safety is very poor, without any detailed prescription for dimensioning, conception. State of art is the main guide for the projects of new dams or the checking of the safety of existing dams.

A total renewal of the legal framework for dam safety is in progress. The first results are planned in 2007 or 2008.

ITALY

The use of water by means of dams is regulated by a general Act issued in 1933, Royal Decree. n° 1775. The authority for the concession to the use of water is currently assigned to the Regional Administrations (Italy is subdivided in 21 regions).

The Owner has the legal responsibility for any damage the dam can create in case of problems, incidents, failure or during its normal operation.

For the “large” dams” a national Authority is responsible of the technical evaluation and approval of new projects, and supervise the actions of the owner for the safety of the dams in operation. From 2003 to 2006 the Dam Authority was as an autonomous organisation (named “*Registro Italiano Dighe - RID*”); in 2006 it returned to be part of the Ministry of the Public Works, as it was in the past.

The “small” dams” refer to the Regional Authorities and regional laws.

The basic legislation for the large dams is the “Dam Regulation”, regulating the design, construction and operation of dams. It is composed of two parts:

- Part I, issued in 1959, (“*Regulation for the Design, Construction and Operation of Dams – Part I*”, DPR n° 1363) defining the general and administrative rules.
- Technical Rules, issued in 1982 (updating the Part II of the 1959 Regulation), for the design and construction of new dams (DM n° 44).

More recent national laws updated some parts of the basic Regulation, and/or integrated it addressing some additional specific subjects. In particular in 1994 the Law n. 584 updated the definition of the “large dams” (which refer to national legislation and Authority) increasing the lower limit of the basic dimensional parameters (dam height ≥ 15 m, reservoir volume ≥ 1 Mm³). Smaller dimensional parameters were used before (10 m, 100.000 m³).

In addition to Laws, legal directions concerning some specific topics are defined in “Circulars”, usually issued by a Ministry. The Circulars have a hierarchic level lower than Laws; in case of discrepancies with a Law, the Law prevails.

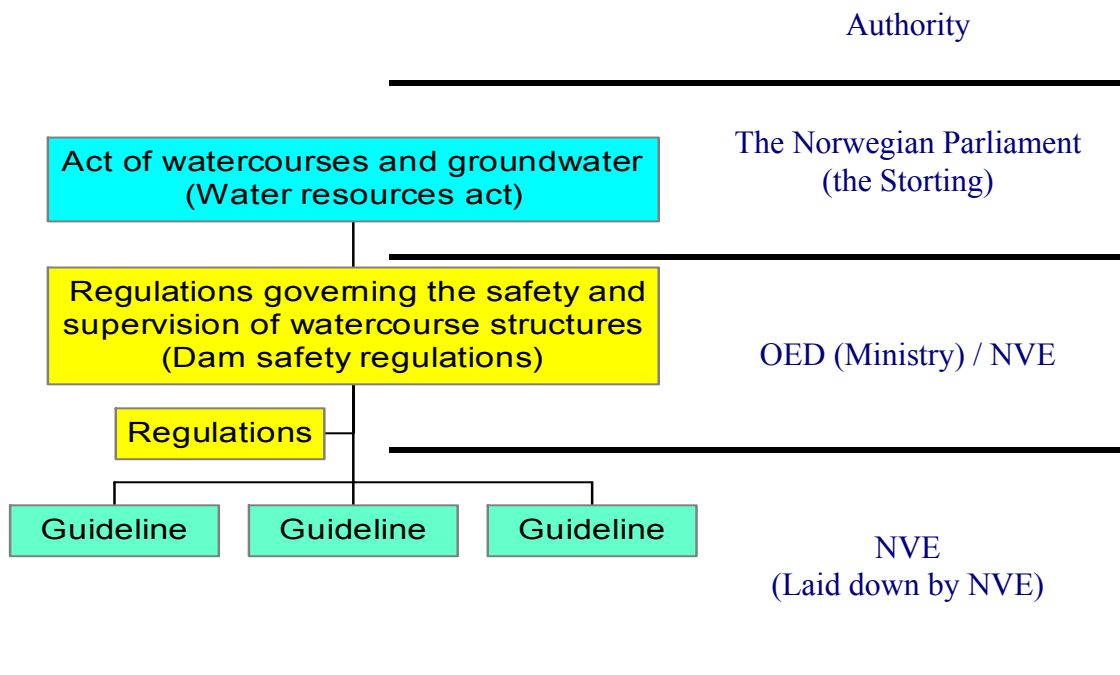
Both the “Part I” and the “Technical Rules” of the Dam Regulation are currently under revision. A final draft of the updated “Part I” was addressed in 2007 to the political authorities for the issuing process. The preparation of updated Technical Rules is still (2007) in progress.

There are no Guidelines/Recommendations without legal obligation.

NORWAY

The legal framework on dam safety in Norway can be divided into 4 levels (see figure below):

1. The Act of water courses and groundwater (Water Resources Act)
2. Regulations governing the safety and supervision of watercourse structures (Dam Safety Regulations)
3. Subsidiary regulations with authority in the Dam Safety Regulation, section 11-1.
4. Guidelines



Regulations

The law and the regulations contain **requirements** that have to be fulfilled, and also contains a chapter with enforcement in cases of violation (e.g. chapter 10 - Implementation and penalties, in the Dam Safety Regulations).

Guidelines

The guidelines contain **recommendations** on how to fulfil the regulations and specify one solution to fulfil the regulations. If an alternative solution is chosen, then it must be proven that this alternative gives the same level of safety as the solution specified in the guideline.

Authority

The Water Resources Act is approved by the Norwegian parliament, while the Dam Safety Regulations are laid down by Royal Decree. The Ministry of Petroleum and Energy is given the formal responsibility of these, while the Norwegian Water Resources and Energy Directorate (NVE) have the executive authority to administer the regulation.

The Dam Safety Regulations also gives NVE the authority to develop subsidiary regulations within specific predefined areas (i.e. classification, emergency plan, qualifications etc.). NVE are also responsible to develop guidelines, which extend the requirements in the regulations.

Revisions

The Water Resources Act and the Dam Safety Regulations include general requirements laid down by Royal Decree. A revision will therefore need a formal approval from the highest level in the administration, a very time-consuming and complicated process. This is not the case with the subsidiary regulations and guidelines, which are developed and managed by NVE. These can therefore easily be revised and amended.

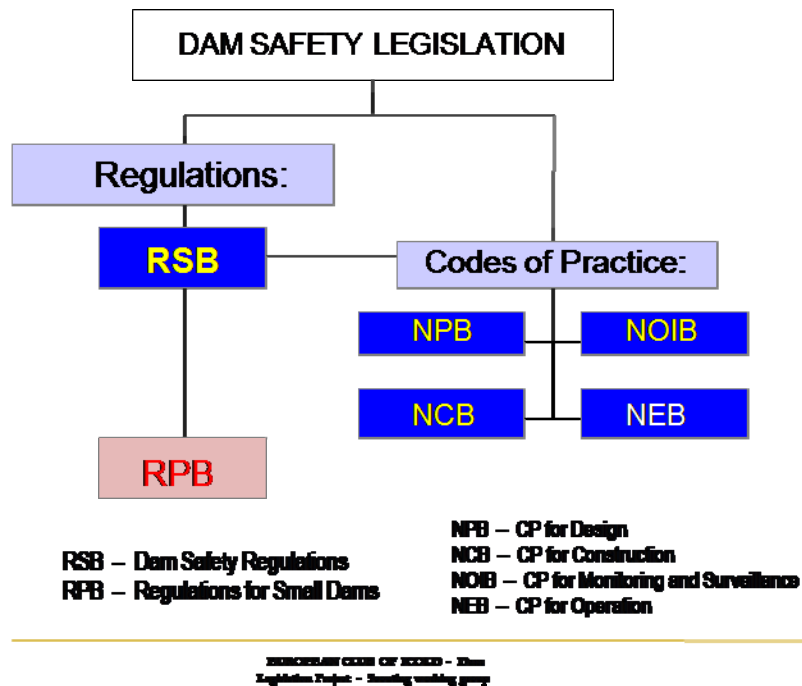
PORTUGAL

Dam safety has been a subject of concern for many years, owing to the potential damage often associated to scenarios of failure or to other serious accidents. The first Portuguese legal document dealing with dam safety dates from 1968.

At present the main binding document regarding dam safety is the “Portuguese Regulations for the Safety of Dams” (RSB), first issued as a Decree-Law in 1990 and afterwards revised and re-issued in 2007.

There are also codes of practice for design, construction and observation and inspection of dams (the one for the operation of dams has not yet been published) for due and proper execution of the above mentioned Regulations.

The mentioned documents are mandatory, and constitute legal obligations for all dam owners concerned within the scope of the Regulations.



RSB applies to a number of dams defined on the basis of a dimensional criteria of dam height greater than 15m (“large dams”) or reservoir capacity greater than 100.000 m³ (10⁵ m³). Additionally, it also applies to smaller dams with a high potential damage associated to the downstream inundation zone, in the event of an accident (Class I).

RSB establishes the forms of controlling dam safety, namely in the stages of design, construction, first filling of the reservoir, operation, abandonment and demolition, including in particular surveillance and emergency planning measures. Due to the spectrum of dams concerned, provisions for differentiating obligations according to dam size and potential damage are included.

The Water Institute (INAG, I.P.), from the Ministry of Environment, is vested with the role of Dam Safety Authority, having general competence in supervising Owners’ compliance with the Regulations.

For smaller dams a “Regulations for Small Dams” apply.

The Water Law incorporates in its provisions the need for compliance with dam safety regulations.

SECTION 2

Basic Information

- I. Dams subjected to Regulation**
- J. Entities concerned**
- K. Dam projects**
- L. Construction and first filling**
- M. Dams operation**
- N. The repair of dams**
- O. Rules for the protection of the population**
- P. Dam decommissioning**

A. DAMS SUBJECTED TO REGULATION

FRANCE

According to the law on water, an authorisation by the administration is needed before construction of a dam whatever its height may be. For that authorisation, a technical file is presented by the owner. However, the French regulation is much more specific for dams whose height above the ground is more than 20 m or which represent a hazard for the population. About 15 % of the dams affected by this particular regulation are less high than 20 m. A new classification of a hundred of dams or so will increase this percentage to 35 %.

The concession of hydroelectric dams can add supplementary rules especially for medium dams (higher than 10 m). Furthermore, dams higher than 20 m and with a reservoir above 15 hm³ are subjected to a regulation for emergency planning.

Smaller dams

Special rules for small dams are under consideration.

ITALY

The “large dams” subjected to the national Dam Authority are defined by the following dimensional parameters: height $H > 15$ m, or reservoir volume $V > 1.000.000$ m³. The dam height is the difference between the elevation of the crest and the elevation of the lowest intersection point between the upstream/downstream face and the ground level.

Before 1994, lower dimensional parameters were used (10 m, 100.000 m³).

Smaller dams

The responsibility for smaller dams is assigned to the Regions (Italy is subdivided in 21 Regions). The situation is consequently not homogenous. Some Regions have defined their regulation (both General Directions and Technical Directions). Other Regions haven't done anything, yet. In some of the regional Regulations issued till now, some criteria related to the “risk level” (just in terms of “consequences in the exposed downstream areas”) are used, while they are totally absent in the current national regulation for large dams.

NORWAY

Dams subjected to public supervision are classified according the consequence a dam break may cause. The consequence class constitutes a basis for deciding on the design requirements on the particular dam. Individual requirements on the dam owner like qualification requirements on personnel and requirements for dam break calculations are also founded on the classification system.

Each consequence class is defined on basis of the number of houses that are affected by a dam break (Table 1). One “housing unit” is defined as a house where 2.4 people are living (average statistical number of people living in a Norwegian house). Other buildings, e.g. schools and offices, can be converted into number of “housing units”, as described in an appendix to the regulations on classification. This method is only used when there is doubt about the final consequence class.

Table 1. Classification of dams – definition

| Consequence Class | | Affected Housing Units |
|-------------------|-------------------------|------------------------|
| Class 1 | Low hazard dams | 0 |
| Class 2 | Significant hazard dams | 1-20 |
| Class 3 | High hazard dams | More than 20 |

Potential economic and environmental damages, like loss of reservoir, loss of electrical production, damage on infrastructure and properties are of particular interest for classification of low hazard dam, but also when there are doubts about the final consequence class. If there are no consequences at all, then the dam will be unclassified and thereby not subjected to public supervision.

At the moment 260 dams are defined as high hazard dams, while 540 dams are placed in hazard class 2 and 1700 in class 1.

PORTUGAL

The “Regulations for the Safety of Dams” (RSB) applies to:

- a) dams with more than 15 metres of height, measured from the lowest part of the general surface of the foundations to the crest;
- b) dams with a reservoir capacity of over 100.000 m³;
- c) smaller dams presenting a high potential damage associated to the downstream inundation zone (Class I)

Smaller dams

The “Regulations for Small Dams” applies to the design, construction, operation and observation of the small dams not subjected to the above mentioned RSB.

For dams with less than 8 m of height the Authority may accept that compliance with some of the dispositions of the Regulations may be overruled.

AUSTRIA

There is a Federal Water Law in Austria. All dams operating water, including of course river barrages, are subject to this law - i.e. the Water Authority (the administration body enforcing the Law) authorises construction and operation and also exerts supervision as to the state and behaviour of the dam and the owner's activities concerning dam safety.

FINLAND

The Dam Safety Act and Decree and the Dam Safety Code of Practice have to be applied to a dam not less than three metres high. The height of a dam is the difference between the lowest point of the external boundary of the dam structure and highest intended surface for the impounded substance. However, the Act should also be applied to a lower dam, if the volume of the substance in the basin impounded by the dam is so large or if the substance in the basin is of such a type that in the event of an accident it manifestly endangers human life or health or manifestly seriously endangers the environment or property. This Act is, however, not to be referred to dams subject to the provisions of the Mining Law or to a canal structure as referred to in the Decree on Canal Structures. The safety requirements stated in the Mining Law correspond to those of the Dam Safety Act. The Dam Safety Act concerns both waterbody and waste dams.

GERMANY

As Germany is a federal republic each state has its own "Law of Water". The following explanations are exemplary limited to the state North Rhine-Westphalia (NRW) as for this review not all of the 15 states can be considered.

The "State Water Law" covers dams defined by height and volume, e.g. $h > 5$ m and $V > 100,000$ m³ for the State of NRW. Furthermore the state of the art for planning, construction, maintenance and operation is defined in the "Law of Water". The Law defines six different types of dams (figure 1). All states consider the DIN 19700 and additional guidelines as state of the art. For the technical requirements the DIN 19700 distinguishes five types of dams but does not include a restriction by height or volume (figure 1). A classification (e.g. according to risk) does not exist.

| TYPES OF DAMS | |
|---|---|
| State Water Law (NRW) legal requirements | DIN 19700 technical requirements |
| $h \geq 5$ m and $V \geq 100.00$ m ³ | all dams |
| . Type 1 : dams and weirs | . Part 10 : all dams * |
| . Type 2 : tailing dams (within waters) | . Part 11 : reservoirs |
| . Type 3 : similar safety measures like type 1 | . Part 12 : flood control reservoirs |
| . Type 4 : flood control reservoirs | . Part 13 : weirs |
| . Type 5 : pumped storage reservoirs (upper reservoir) | . Part 14 : pumped storage reservoirs |
| . Type 6 : tailing dams (outside of waters) | . Part 15 : tailing dams |

* Part 10 refers to the section number 10 of the standard DIN 19700.

NETHERLANDS

In the Netherlands the vast majority of dams are flood protection structures. Depending on the potential flooding damages and/or casualties these flood protection structures are divided into two classes :

- primary flood protection structures of national interest (about 2500 kilometres in length, varying in eight from 3 to 13 metres, 1984b) ;
- secondary structures, mostly smaller dikes.

The Flood Defences Act (1996a) sets conditions for the primary flood protection structures in terms of the responsibilities of the authorities involved, the safety standards, the regular safety assessment, the procedure for reconstruction of structures and the framework for financing of reconstruction and maintenance.

ROMANIA

The legislation contains specific rules according to the class of the dams

| Class | Height (m) | Volume (hm ³) |
|---------|----------------------|---------------------------|
| Class 1 | $h \geq 100$ | $V \geq 500$ |
| Class 2 | $25 \leq h \leq 100$ | $20 \leq V \leq 500$ |
| Class 3 | $10 \leq h < 25$ | $1 \leq V < 20$ |
| Class 4 | $h < 10$ | $V < 1$ |

SLOVENIA

The dams covered by legislation are those which are considered as large dams by ICOLD.

- h (above foundation) ≥ 15 m
or
h ≥ 10 m, and
- length of crest ≥ 500 m
- volume of reservoir ≥ 1 hm³
- flood ≥ 2000 m³/s

SPAIN

The instructions existing since 1967 have been replaced a few months ago by a new regulation called “standard on the safety of dams and reservoirs” for the dams dependent on the Ministry of Public Works, Transports and Environment. The dams are divided into three classes according to the level of potential hazard in case of breaking or faulty operation.

- **Class A** : risk of human loss - damage on urban area - important material or environmental damage.
- **Class B** : limited risk of human loss - damage on sparsely population area or not very important infrastructures.
- **Class C** : risk of human loss only in exceptional circumstances - low damages.

The rules apply to dams that are of class A or class B or that fit the criteria of ICOLD :

- h ≥ 15 m
or
h > 10 m and length of crest ≥ 500 m
or
volume of reservoir ≥ 1 hm³
or
flood above 2000 m³/s.

The other dams are subjected to the instruction of 1967 if their height is greater than 15 m or if their height is greater than 10 m with a volume above 100,000 m³.

SWEDEN

The regulation does not specify a lower limit for dams that are classified according to the potential hazard downstream (human loss, damage on infrastructures or environment, economic loss).

The inventory of dams begins with :

$$h \geq 5 \text{ m or } V \geq 50,000 \text{ m}^3.$$

SWITZERLAND

The dams subjected to the supervision by the "Authority of surveillance" (Confederation or cantons) correspond to the criteria :

$$h \geq 10 \text{ m}$$

or

$$h \geq 5 \text{ m and } V \geq 50,000 \text{ m}^3$$

or

important danger for people or goods.

Are not subjected to inspection dams for which it is shown that they don't represent a particular danger for people or goods.

UNITED KINGDOM

The "Reservoirs Act" of 1975 concerns all dams with a volume above 25,000 m³. Special rules are applied to canal banks, quarry tips and effluent waste.

B. THE ENTITIES CONCERNED

FRANCE

a) Administrative organisation

Three ministries have responsibility for dams:

- Ministry of Transport for the reservoirs that supply the canals
- Ministry of Industry for major hydroelectric power stations and tailing dams
- Ministry of Environment for the other dams.

A committee with representatives of three ministries gives an opinion on every project concerning new dams or repair of dams higher than 20 m above the ground level. Its opinion is also required for every subject of general interest.

The inspection of the administration is organised at a regional level (dams for industry) or at a departmental level (all the other dams).

The civil defence prepares the emergency plans associated with highest dams.

b) Owners

Some companies own a great number of dams (especially Electricité de France) but there are many small owners (manufacturers, cities, unions of farming concerns,...).

c) Civil engineers

There is no official procedure for qualification of engineers dealing with dams except for the choice of the project manager.

ITALY

a) Administrative organisation

The following main organisations are in charge of dams:

- National Dams Authority (named in the past “*Servizio Nazionale Dighe*”, then “*Registro Italiano Dighe*”): examination and technical approval (after the opinion of the Superior Council) of projects relevant to large dams; survey of the construction and first filling phases; supervision of the surveillance and control activities carried out by the owner during the operation, evaluation of the results of safety re-assessment for existing dams; evaluation and approval of rehabilitation or repair works; supervision of technical activities related to the preparation of emergency plans; participation to the updating of Regulation and technical standards.
- Regional Administrations: Approval of the concessions. Approval of projects involving “small dams”. Supervision of the activities relevant to the construction and operation of “small dams”.
- Commission of acceptance: During and at the end of dam construction: verification of the compliance of the dam with the design; examination of the dam behaviour during each stage of the first filling. The commission gives the final test certificate for the dam operation.

The Civil Protection Authorities are in charge of the management of possible emergency situations and of the rescue of the population in case of incidents.

b) Owners

About 60% of the Italian dams are owned by private owners (including Enel, the main Italian dam owner). The remaining dams are owned by public entities (public "Consortiums" or Companies, Municipalities, State).

The Italian dams are about 550, considering those still under construction. The distribution of the dams among various uses is the following:

- Enel (hydroelectric owner) : ~ 40% of the Italian dams
- Other Hydroelectric Owners : ~ 20% of the Italian dams
- Irrigation : ~ 25% of the Italian dams
- Potable Water Supply : ~ 5% of the Italian dams
- Other Uses : ~ 10% of the Italian dams

c) Civil engineers

For each large dam in operation a "*Responsible Engineer*" must be appointed by the owner. He is responsible for the safety and the proper operation of the dam. He can be a professional, or an engineer belonging to the dam organisation. Each six months, the owner must send to the National Dam Authority a "*Certification*" issued by the Responsible Engineer which asserts safe conditions for the dam, the diagrams of the main monitoring measurement data are annexed to the "*Certification*"

There is no formal approval by Authority for engineers dealing with dams.

NORWAY

a) Administrative organisation

The Ministry of Petroleum and Energy is given the formal responsibility of these, while the Norwegian Water Resources and Energy Directorate (NVE) have the executive authority to administer the dam safety regulation. This includes approval of plans for construction and repair, and supervision of construction, operation and maintenance of dams and hydraulic structures. NVE is also in charge of developing regulations and guidelines for dam safety.

b) Owners

The owners have overall responsibility for the dams. The main owners in Norway are hydropower companies.

c) Civil engineers

Each owner must employ a dam safety engineer needs a formal approval from NVE. For owners of high hazard dams the engineer must be a civil engineer with a master degree. The dam safety engineer must also take a 10-day course on university level, which is concluded with an exam. The course has emphasis on design, planning, construction and operation of dams and appurtenant structures. A passed exam from this course is a criterion for public approval of engineers in charge of the overall safety of dams.

PORTUGAL

a) Concerned entities

The entities concerned with the control of dam safety are:

- Owners, which have overall responsibility for the dams;
- Water Institute (INAG, I.P.), from the Ministry of Environment, that acts as Dam Safety Authority, having general competence in supervising the owners compliance with the Regulations.

- National Laboratory of Civil Engineering (LNEC), that provides the Authority with technical support for chosen dams of Class I (high potential damage);
- National Authority for Civil Defence, regarding the preparation of emergency plans;
- Dam Safety Commission (CSB), that analyses the overall Portuguese dam safety progress, at least once a year, and gives its view on owners' complaints about Authority decisions.

b) Owners

The main owners are the following:

- Energias de Portugal (EDP) – private company, owner of the largest hydropower dams;
- Ministry of Environment;
- Ministry of Agriculture and Irrigation Associations – for irrigation dams;
- EDIA - public company, owner of the multipurpose scheme of Alqueva (irrigation, hydropower, water supply, tourism), that includes the largest Portuguese reservoir (Alqueva dam) and other dams;
- Águas de Portugal (AdP) (public company) and Municipalities – for urban supply dams;
- Other private owners – namely for smaller dams (agriculture, other purposes).

c) Civil engineers

Under RSB each owner must have a technical person responsible for dam safety, submitting his appointment to the Authority.

AUSTRIA

a) Administration

These are three levels or stages of authorities enforcing the Water Law :

- Supreme Water Authority (Federal Minister of Agriculture and Forestry) :
 - for dams $h > 30$ m (h: height above foundation level)
or $V > 5$ hm³ (V reservoir volume)
 - for river barrages on the River Danube
 - for measures affecting severely the water affairs of foreign countries
- Provincial Governor for most of the other dams
- District Authority for structures of minor importance.

The **Austrian Commission on Dams** is a board made up by renowned experts of all disciplines involved in dam engineering. The main task of this group is to give expert judgement on dam projects – especially concerning safety. Furthermore it provides the background for the work of the Federal Dam Supervisory Section.

The **Federal Dam Supervisory Section** is an office established within the Federal Ministry of Agriculture and Forestry working on behalf of the Water Authority (ies). It examines the owner's annual safety reports and carries out inspections on site. (scope : dams with $h > 15$ m or $V > 500,000$ m³).

Dam Supervisory Officers are especially appointed by the Provincial Governors, to carry out checks periodically.

Civil protection measures or programmes are enforced by provincial and district authorities.

b) Owners

Primary responsibility for dam safety rests with the owner of the plant (appropriate monitoring, maintenance and provision for emergency measures). In case of a dam with $h > 15$ m or $V > 500,000$ m³, it is especially for this task that he has to appoint qualified civil engineers who also must be vested with appropriate executive powers in order to be able to take all measures necessary in the interest of safety - the "Dam Safety Engineers"

c) Civil engineers

Special qualification of engineers who are in charge of dams is considered important. However there is no formal approval, except for the "Dams Safety Engineers".

FINLAND

a) Administrative organisation

Dam safety authorities are as follows :

- Ministry of Agriculture and Forestry: supreme supervision and guidance, granting guidelines for dam safety
- the supervision of dams subject to the Mining Law is undertaken by the Safety Engineering Centre of the Ministry of Trade and Industry
- regional environment centres: official decisions, supervision of observance of rules and regulations issued in and by virtue of the Dam Safety Act excluding rescue services
- Ministry of the Interior and its authorities (provincial governments and municipal rescue authorities): rescue services, emergency action planning.

The role of the Finnish Environment Institute is to give expert opinions to regional environment centres on the safety monitoring programmes for P dams (1) and hazard risk assessments, to improve dam safety and participate in preparation of the dam safety code of practice.

(1) A dam is classified as a P dam if, in the event of an accident, it may manifestly endanger human life or health or manifestly seriously endanger the environment or property.

b) Owners

The owner (or holder) bears primary responsibility for the dam safety. The owner of a dam is obliged to make himself acquainted with the regulations concerning his dam, and on his own initiative, ensure that they are followed.

c) Civil engineers

There is no formal approval for engineers dealing with dams. According to the Dam Safety Code of Practice, a body constructing a dam is responsible for ensuring that the dam was designed under the direction and responsibility of a competent and experienced person.

GERMANY

a) Administration organisation

In NRW the "Ministry of Environment, Environmental Planning and Agriculture" (MURL) is the supreme water authority which has to be informed by the subordinate water authorities and technical departments.

According to § of the "State Water Law" the regional administration (upper water authority) is the enforcing supervisory authority. In detail the supervision divides

- State Environmental Authorities (all reservoirs except for tailing dams)

- State Mining Authorities (tailing dams)

b) Owners

Water associations and in some cases private enterprises own dams. They have the whole responsibility. The operators set up a safety report every year and submit it to the appropriate authority (State Environmental Authorities or State Mining Authorities). The operators have to guarantee that the dam is operated by qualified staff.

c) Civil Engineers

There is no formal approval for engineers dealing with dams. However it is very important to appoint professional qualified engineers with dam projects.

NETHERLANDS

a) Administrative organisation

The primary flood protection structures are mostly managed by local authorities, called water boards. The water boards (presently about 60) have the authority to raise taxes on the inhabitants of the low lying polders for maintenance and construction of the structures.

The provincial governments (11) supervise the local water boards from an administrative, financial and technical point of view. The provincial governments also subsidise the construction of primary flood defences, co-ordinate the activities of local water boards and local communities and finally issue safety standards for secondary flood protection structures.

The national government, especially the Ministry of Transport, Public Works and Water Management, supervises the provincial governments. The department in charge with the actions on a national level is the Directorate General of Public Works and Water Management, also known as the "Rijkswaterstaat". The national government is responsible for flood protection policy (1997a) and supervises provincial governments in administrative, financial and technical matters. The ministry issues the safety standards for primary flood defences, issues the hydraulic boundary conditions associated to the safety standards (1996b), issues guidelines for design, safety assessment and maintenance (1984a, 1985, 1989, 1996c, 1997b, 1997c, 1997d), conducts research in the fields of dams and flood protection (1997b).

Finally the ministry maintains the coastline and manages some primary flood defences, such as the large dams and storm surge barriers which protect large areas along the coast.

b) Owners

Flood protection in the Netherlands is a public matter. The majority of the flood protection structures is also owned by the local water boards or the ministry. Private ownership of flood protection structures however is possible, but the owner has to comply to regulations issued by the local water of the ministry.

ROMANIA

a) Administration organisation

The organisation is governed by several laws which are planned to be modified. The coordination of the administration is the National Commission for the Safety of Dams which is a part of the Ministry of Water, Forest and Protection of the Environment.

The supervision of the dams is done at a central level or by local authorities.

The Department of Mines has a particular responsibility for tailing dams.

b) Owners

Almost all the large dams in Romania are the concern of two companies :

- Romanian Electricity Authority (RENEL)
- Romanian Water Authority (APELE ROMANE S.A.)

These companies have their own commission for the assessment of the safety of dams. The commissions develop internal standards for design, construction, operation and survey of dams.

SLOVENIA

a) Administration organisation

Three ministries are concerned with dams :

- Ministry of Economic Activities
- Ministry of Environment and Regional Planning
- Ministry of Defence.

There does not exist a governmental authority for the control of dams.

b) Owners

All large dams for hydropower systems are owned by the State and operated by public companies.

Private industrial companies are also among the users and owners of some large dams.

The user or the owner can entrust the monitoring of large dams to an institution (design engineering companies, institute, laboratory,...).

SPAIN

a) Administrative organisation

The supervision of the safety level of dams is the responsibility of the General Department of Hydraulic Works which represents the "Authority" for the law. The service for survey and inspection of dams is a specialised service of this department. The Ministry of the Interior is in charge of civil defence and emergency planning.

b) Owners

The owner can be the State, a public or private company with a concession or an authorisation according to the dictates of the law on water. The owner is responsible of the safety of a dam during all the stages of its life.

SWEDEN

a) Administration organisation

In Swedish law, the owner has the main responsibility for safety. The Water Rights Court examines the projects and gives permission for a dam to be built. The Water Rights Court determines the compensation for a third person's property.

The County Council is responsible for the public inspection of water installations and for the preparation of plans for the rescue services in case of accidents.

b) Owners

50 percent of the dams are the property of Vattenfall AB (hydropower producer). A dam safety commission is established in each major hydroelectric producer but it is not required by the law.

SWITZERLAND

a) Administrative organisation

The Federal Office of Water Management (Dams section) attends to the enforcement of the ruling on the safety of accumulation works and carries out the actions of which the Confederation is directly responsible.

The Confederation carries out the surveillance of accumulation works :

- with a height above 25 m
- higher than 15 m and with a storage capacity above 50 000 m³
- higher than 10 m and with a storage capacity above 100 000 m³
- with a storage capacity above 500 000 m³

The cantons carries out the survey for the other accumulation works.

The administration can resort to independent experts at the owner's expense.

The civil defence is consulted for alarm systems. The concern with defence has an important impact of the legislation.

b) Owners

The majority of the dams covered by the legislation have hydroelectric purpose.

The owners can be private or semi public companies. Some installations are the property of industrial companies, cities, cantons, etc..

c) Civil engineers

There is no official approval of design companies. However the owners must call on experienced professionals each year and furthermore on recognised specialists, independent of the owners, for the dams subject to five year appraisals.

UNITED KINGDOM

a) Administrative organisation

The Department of the Environment Transport and the Regions (DETR) is responsible for reservoir safety legislation. The DETR has a reservoir safety research programme of which a principal objective is the publication of engineering guides.

The supervision of the activity of the owners is the role of local authorities. They can require repair works to be carried out by the owner. They have a register for the dams and a file for each of them.

b) Owners

They are usually also in charge of the operation. The operator is responsible for the safety of the dam. He must employ qualified civil engineers for all the stages of the projects.

c) Civil engineers

After consultation with the Institution of Civil Engineers, the Secretary of State for the Environment makes appointments to panels of qualified civil engineers for a five year period. The four panels are :

- All reservoirs
- Non impounding reservoirs
- Service reservoirs
- Supervising engineers.

C. DAM PROJECTS

FRANCE

There are no definite rules for the design calculations of dams (loadings, resistance,...).

The projects involving the highest dams (more than 20 m above the ground level) are examined by the Standing Technical Committee of Dams. The conclusions of the Committee constitute the state of art which creates informal design rules and avoids the heaviness of a regulation.

The projects submitted to the Committee must include a certain number of headings (geology, earthquake, floods, materials,...).

Following the examination by the Committee, the files are approved by local authorities or by the ministry.

ITALY

The evaluation and technical approval of dam projects for large dams (new dams; rehabilitation of existing dams) is carried out by the National Dams Authority (in most case, after the opinion of the Superior Council of the Ministry).

The current Dam Regulation is divided into two parts. The first part (issued in 1959) deals with the formal and administrative procedures and general technical aspects to be followed. The second part (issued in 1982) are the "Technical Rules" defining all the technical details to be considered in the dam design and construction: definition of static and dynamic loads, loading combinations, calculation methods, allowable stresses, factors a safety, minimum freeboard, indications about important construction details, etc.

The Dam Regulation is relevant to the design and construction of new dams. It is also used for the design of rehabilitation works of existing dams. The reference to the current Dam Regulation in safety assessment of existing dams, where no rehabilitation projects are involved, is a controversial matter which has not yet a clear regulatory frame.

The preparation of a complete revision of the current Dam Regulation is currently in progress.

NORWAY

The projects are approved by the Norwegian Water Resources and Energy Administration (NVE). The planing process shall be conducted by a consultatnt approved by NVE.

This regulations and guidelines include specification of load combination and applied safety coefficients for ultimate limit state and serviceability limit state. The regulations also refer to general standards in the field of civil work.

The regulations and guidelines have detailed requirements for design of i.e. embankment dams, concrete dams, hydraulic works and flood calculations, among others. Elements that the design shall include are:

- Determination of loads according to the guideline. This includes design flood levels, Ice pressure loads, earth quake loads, abnormal leakage, etc.
- Stability calculations of the structure
- Design of spillways and diversion works

- Foundation conditions and dam design
- Monitoring during construction and operation
- Safety precautions
- Drawings
- Measures to reduce the impact on the landscape

PORTUGAL

The safety Authority approves the dam design, from the safety point of view, and communicates its approval to the basin Authority responsible for water licensing.

The Regulations and the Code of Practice for Design set guides to the contents of the projects, describing in some detail the needed studies. In some specific cases they set mandatory values (e.g. safety factors, flood return periods).

AUSTRIA

According to the Water law :

- Public interests (especially with a view to safety) and rights of third parties must not be violated
- Plants have to correspond to the current state of the art and have if necessary to be adjusted accordingly.

The approval procedures are the following :

- Water Rights Hearing including all parties involved, examination of the project is carried out by experts
- In case of dams with $h > 15$ m or $V > 500,000$ m³ or in case of special foundation problems, loads or stresses or in cases of unusual design or construction technique, an expertise of the Commission on Dams is mandatory
- Decree of approval, stating the special conditions which will have to be kept during construction and operation of the dam.

As design and operation must correspond to the current state of the art and current engineering practice, there are very few written technical rules (rules concerning evaluation of seismic stability of dams and concerning stability evaluation of embankment dams have been issued, but are not directly part of the Law).

The task of safety assessment mainly lies with people having an excellent professional knowledge and profound experience – “expert principle”.

FINLAND

The planning of a waterbody dam is a subject to specifications for petition plans to the Environmental Permit Authorities as referred to in the Water Decree:

- A plan shall be drawn up by a person of sufficient competence and experience in such a manner that it can be inspected without difficulty. It shall be clear what data, computational procedures and formulas were used to draw up the plan. A short summary of the project and its impacts shall be appended to the application.

- Drawings and accounts shall be made of the structures and facilities to be constructed giving the main dimensions of the structures and any information necessary for the assessment of the strength and safety of the structures and facilities and their impact on the waterbody or use of water.

The corresponding specifications have to be also observed in designing other dams referred to in the Dam Safety Act. There are detailed requirements in the Dam Safety Code of Practice concerning dam classification, hydrological design parameters, embankment and concrete dams and gates.

GERMANY

The MURL by decree established the following technical standards as state of the art :

- DIN 19700 (Dams)
- DIN 19702 (Stability of solid constructions in water engineering)
- Guideline 222/1991 (measuring and control instruments) of the DVWK (Deutscher Verband für Wasserwirtschaft und Kulturtechnik e.V.)

Dam projects are approved by the MURL. Construction, first filling and operation require a state authorisation. The planning process includes environmental impact assessment and planning permission hearings. The DIN 19700 provides additional details. This technical requirement will be published in a revised edition soon.

Dam construction, maintenance and operation have to be carried out according to the state of the art at the minimum. If a dam does not correspond these requirements, it is to be adapted (adaptation commandment of the operators).

With regard to the technical requirements, detailed dimensioning rules exist for every type of dam. The DIN 19700 (part 11) distinguishes loading conditions as well as different abutment states. Furthermore earthquakes are taken into account (DIN 19702). The design flood depending on the type of the dam have a return period of up to 1000 years (figure). A sufficient freeboard including the PMF must be considered.

| TYPE OF DAM | RETURN PERIOD OF THE DESIGN FLOOD |
|---------------------------|-----------------------------------|
| Reservoirs | 1000 |
| Flood control reservoirs | up to 1000 |
| Weirs | 100 |
| Pumped storage reservoirs | 100 - 1000 |
| Tailing dams | 1000 |

NETHERLANDS

There are no particular regulations about dam projects and/or projects involving flood protection structures, except for the prescribed safety standards. These safety standards are expressed as the mean annual frequency of exceedance of the hydraulic loads to be withstood safely. The safety standards range from 1/1,250 per year in the upper river area to 1/10,000 per year in the densely populated coastal areas (1996a).

ROMANIA

State Standards (STAS) define the content of projects and some rules for the design (spillway capacities, resistance in case of earthquake,...).

For example the spillway is designed according to the flood flow and the stability of the dam, the flood probabilities depend on the class of the dam and are set by a special standard.

All the projects must have formal approval, whatever the class of the dam.

SLOVENIA

There is no special regulation to establish the dam projects. General rules for civil work are used.

SPAIN

The Authority according to the opinion of the survey agency approves each dam project where necessary. The regulation describes the minimum content for general studies (use of the reservoir, climatology, geology, seismicity of the site), detailed studies (drawings, flood flow, calculations of the structures), environmental studies (incidence on the population, quality of water, sediment inflow,...).

The National Committee on Large Dams publishes technical guides on some particular points to complement the regulation.

SWEDEN

The owners have the entire responsibility for the design of the dams. Major companies have their own rules.

Vattenfall AB, which represents 50 % of Swedish dams, has an internal commission for the safety of dams. This commission defines rules and procedures for instance for the evaluation of the flood flow. These methods and procedures rely on USBR standards and on ISO 9000 norm for quality assurance.

SWITZERLAND

The projects and the modifications during the construction must be approved by the Authority in charge of the survey (Authority of "High Surveillance" for the dams subject to the supervision of the Confederation, authority of the cantons for other dams).

The regulations describe the general content of the studies but do not give precise rules for the design or the calculations.

UNITED KINGDOM

There are no official rules for the calculation and design of dams. However, technical guides are published on some particular points : earthfill dams, flood flow, seismic, concrete and masonry dams.

The design must be carried out by a qualified civil engineer.

D. CONSTRUCTION AND FIRST FILLING

FRANCE

The Standing Technical Committee on Dams gives an opinion about the construction programme of dams higher than 20 m, especially about the programme of first filling and the choice of the construction supervisor.

The administration in charge of the supervision attends the main stages of the works, for instance the acceptance of the excavation level. The modifications of the project that may be necessary during the works must be described in a supplementary file that is approved by the administration.

The first filling is considered a very important stage. The construction supervisor is responsible for the first impounding of the reservoir. For dams with possible effects on public safety, it is compulsory to organize a continuous survey. The programme of monitoring and the programme of filling, which includes intermediate plateau, is approved by administration.

ITALY

The National Authority supervises the construction works. An agent of the public administration is at the construction site during all the works.

The regulation provides for specific surveillance and monitoring during the first filling.

A Commission of Acceptance is nominated by the Ministry, to verify the compliance of the dam with the design, evaluate the dam behaviour during the first filling, issue the final test certificate that allows the normal operation of the dam (after approval by the National Dam Authority).

NORWAY

Construction shall not start before the plans has been approved by NVE, and shall only be carried out in accordance with the approved plans. Before construction is started, a construction programme must be prepared, indicating all the important phases of the work.

A detailed program for supervision during construction is required. The programme shall include, specifications for the laboratory and testing equipment - and the procedures for the tests to be carried out.

Site organization plan are required. The plan must contain specifications of the manning, responsibility apportionment and routines for reporting.

Other requirements for the construction also include:

- Satisfactory qualifications for the site management staff
- Written instructions for monitoring of for example leakage, pore pressure and deformations during the construction period, - and
- Landscape protection in order to reduce the environmental impact of the construction

Reports containing information on the progress of the work, test results with the inspector's evaluation and other conditions of significance for the works, shall be sent to NVE at agreed intervals.

A program for first filling of the reservoir must be prepared and presented to NVE for approval. The program should include testing of spillway gates, valves and diversion works. A report with results from the initial impounding and the tests shall be prepared.

A summary report containing information from the construction shall be sent NVE. The report shall contain a description of the dam and the construction works, including test results, achieved quality and as built drawings.

PORTUGAL

Final design and modifications during construction must be approved by the safety Authority.

The Authority may perform inspection visits during construction.

The programme of first filling must be approved. Depending on dam size, it may include provisions for a specific monitoring plan, for continuous visual surveillance and for keeping some constant levels in the reservoir for monitoring purposes.

After first filling completion a dam inspection is carried out by the Authority.

AUSTRIA

As a rule the Water Authority supervises the construction.

Before first filling or impoundment the authority carries out a preliminary technical acceptance examination.

The respective decree states the special conditions for impounding (or the impounding programme respectively - e.g. filling in stages, special monitoring programmes).

As a rule, after a couple of years of operation (and impoundment/draw down cycles, respectively), when sufficient experience and data have been gained to prove that the dam behaves according to expectation and that it can be considered safe and reliable, the Water Authority, after a final examination, authorizes "normal operation" (final decree of acceptance).

In all the procedures mentioned experts are involved.

FINLAND

According to the Dam Safety Act, the construction of a dam has to be carried out in such a way that in structure and strength it meets the requirements that a safety risk would not arise from either the dam itself or its use.

According to the Water Decree, when a permit to construct a dam referred to in the Dam Safety Act has been obtained, the regional environment centre and the local environmental protection board have to be informed of the start of construction and commissioning of such a dam at least one month beforehand.

According to the Dam Safety Code of Practice, the commissioning inspection of a dam has to be made in such a manner that all issues relevant to dam safety are adequately considered. The commissioning inspection is the responsibility of the chief dam designer or another competent person. The commissioning inspection is based on data in the dam plans, the quality control programme and , if necessary, the hazard risk assessment. In the case of a P dam, the emergency action plan have to be made before the first filling.

The commissioning inspection includes necessary field inspections during construction. In any case, a field inspection must be made before a start is made on raising the water, once the structures are ready for this procedure. Representatives of a regional environment centre can participate in the field inspections; in the case of P dams also representatives of the provincial government, the rescue authorities and the Finnish Environment Institute can participate.

The safety monitoring programme has to be drawn up well in advance of completion of a dam so that it can be approved for compliance before the first filling.

GERMANY

Dams have to be built according to the approved plans. After the construction is finished, the building diary with the remaining documents (dimension, stock records, control measurements, etc) has to be kept by the owner. All inspections must be documented in a dam safety file.

All installations like operating equipment and measurement instruments are inspected and tested before the beginning of the first filling. Before the first filling starts, the responsible authorities and persons involved (residences downstream) must be informed. During the first filling the tightness of the dam construction has to be controlled. The first filling is carried out step by step (if the conditions permit it) up to a defined storage level according to a determined plan. After the evaluation of all controls and of measurements during the first filling the commissioning can be approved or the first filling must be repeated.

Tailings dams generally do not need a first filling.

NETHERLANDS

The ministry issues guidelines for the design, construction and maintenance of flood protection structures (1984a, 1985, 1989, 1996c, 1997b, 1997c, 1997d). The guidelines are to be used as a general framework and may be adapted to specific local circumstances. The guidelines are prepared in co-operation with local water boards, provinces and research institutes. These parties involved cooperate in the framework of the Technical Advisory Committee on Water Defences.

Since the dams in the Netherlands are mostly designated for flood protection purposes the matter of first filling is not indicated.

ROMANIA

Members of the corps for the quality of constructions carry out inspections of the construction site, which is dependent on the Ministry of Public Works.

During this stage, the owner of the dam keeps an up to date description of the progress of the operations. This is required for the final acceptance of the works.

A favourable opinion from the Commission of Acceptance is needed before the filling of the reservoir begins.

For major dams, the Prime Minister appoints this Commission.

SLOVENIA

The authorities approve final designs. The programme of first filling includes the monitoring of the works.

The monitoring concerns the dam and the zone of influence of the reservoir. It is implemented before and during construction. Special attention is paid to the seismicity of the site before and after the construction of large dams.

SPAIN

a) Construction

During construction, the owner appoints a team directed by a qualified engineer. This appointment is approved beforehand by the authority.

The authority with preliminary information of the agency of surveillance must approve modifications to the design.

The dossier of the works is kept up to date during the construction.

Temporary works follow the same rules.

b) First filling

For the first filling, a technical team directed by a qualified engineer specifies the programme which is approved by the authority at the suggestion of the agency of surveillance.

In case of filling before the end of the works, the construction team is responsible for this operation.

The programme of first filling includes intermediate stages with a constant level of the reservoir, maximum speed of filling and the programme of monitoring and surveillance.

The report on first filling is inserted in the technical dossier of the dam.

SWEDEN

No indication.

SWITZERLAND

The Authority checks that the construction is in accordance with approved drawings.

Following informations are given to the authority :

- geological data and the results of tests on soils
- results of injections in the foundations
- results of tests on concrete
- results of all the measures
- drawings of the constructed works and a report on the construction.

The programme for first filling must be approved.

At the end of the construction, the owner draws up a final report on the behaviour of the dam.

UNITED KINGDOM

The regulation provides that only qualified engineers have responsibility.

During construction, the owner informs the administration on the progress of the works.

Qualified engineer only permits the first filling after acceptance of the dam.

E. DAMS OPERATION

FRANCE

A specific regulation covers dams in operation with possible consequences for public safety.

The local service of the administration in charge of the dam keeps up to date a file comprising all the useful documents (final drawings, inspection reports, monitoring reports,...).

The owner (or the concessionaire) must also have a detailed file with all the documents concerning the dam. The operator has a register for all the events, incidents, maintenance activities, etc.

The operator must carry out periodical visual surveys and implement suitable monitoring. The regulation indicates (but does not impose) frequencies of inspections and monitoring. Every fault must be reported to the administration.

The operating instructions for exceptional events (floods, ...) are established by the operator and approved

by the administration.

The operator publishes an annual report of the surveillance, the monitoring and the operation of the dams. Every two years, the report includes a detailed analysis of the results given by the monitoring.

The administration inspects the dam every year. Five years after the first filling and every ten years, the reservoir is, in principle, emptied in order to inspect the upstream face of the dam. As an exemption underwater inspections are carried out.

ITALY

By law, personnel of the owner must be present continuously the dam site, living in a warden house located next to the dam. Non continuous presence of personnel at the dam site has been allowed only in some particular cases.

The owner must implement monitoring of the dam. The monitoring system is approved by the administration. All dams are provided with more or less complete monitoring systems.

The control and surveillance activities (inspections, monitoring,) to be carried out for the structures (dam, foundation, reservoir slopes, appurtenant works, ...) are detailed in a document named "FECM-Foglio di Condizioni per l'Esercizio e la Manutenzione" ("Sheet of Conditions for Operation and Maintenance"), issued, for each dam, by the Dam Authority and subscribed by the dam owner. Type, extension, frequency, etc. of each surveillance activity are defined in the FCEM.

Every month, the owner must send to the Dam Authority a list of the results of the monitoring system and observations. All the observations are also listed in a register at the dam site.

For each large dam in operation a "Responsible Engineer" must be appointed by the owner, to assess the safety and the proper operation of the dam. Each six months, for each dam, the owner must be send to the Dam Authority an "Asseveration" issued by the Responsible Engineer, which asserts safe conditions for the dam and its operation. The diagrams of the main measurement data are annexed to the "Certification".

NORWAY

The dam owner is required to have an internal control system to ensure systematic safety inspection and safety assessment of dams. The system shall also ensure that the dam owners comply with the requirements in the regulations.

The internal control system shall contain a description of the organization identifying reporting routines, qualification requirements and which authority they have. Further, the system includes a description of the legal framework and an archive system for documentation. Other elements of the system are:

- inspection program, including a detailed description (who, when and how)
- an emergency action plan, including a training program
- continuously updating and correction of errors

The dam owners have to inspect their dams with qualified personnel, at least once every year. This inspection is usually carried out with a checklist.

Dependent on the size, complexity and condition of the dam a main inspection should be carried out at intervals of about 5 years. Main inspection includes a detailed inspection of the dam and an assessment of the monitoring system. The overall dam safety compared to the regulations is also evaluated.

Every 15 years reevaluation of the dam is conducted, where the dam is evaluated and controlled after the latest design requirements. This includes a re-estimate of the load conditions and flood levels, and a reevaluation of the strength and stability of the dam and appurtenant structures. When re-estimating the flood levels, new hydrological observations are evaluated in order to estimate if the basis for the flood calculations has been altered. This secures that possible long-term climate changes are evaluated and included in the flood predictions. Further, the material quality of the dam is controlled against deterioration and compared to the test results from the construction. An inspection of the upstream face of the dam is also required, if necessary as an under-water inspection.

A plan for monitoring and instrumentation of the dam during operation have be prepared including a program for measurements and observations for water levels combined with pore pressure, leakage and deformations.

PORTUGAL

During operation lifetime the Owner must ensure compliance with the Regulations and Codes of Practice.

Control of structural safety is to be carried out according to the surveillance plan, namely concerning inspection visits, monitoring, behaviour analysis and assessment of dam safety.

Control of hydraulic safety is to be carried out by application of the Code of Practice for Operation and by review of compliance with design criteria.

Control of operational safety is carried out as regards to operation of equipment, maintenance procedures and conservation procedures.

The Authority will periodically, and whenever it deems opportune, carry out inspections with the presence of the owner.

The Owner shall keep permanently up-to-date and at the disposal of the Authority a technical archive with the pertinent data related to the dam, including namely:

- a) dam project;
- b) specific safety rules for the dam;
- c) data and reports on monitoring and inspections carried out after construction;
- d) data relating to the repairs, complementary works and modifications done after construction;
- e) data relating to warning systems and to emergency plans.

AUSTRIA

Operation rules are defined in the decrees of approval and the final decree of acceptance. These rules comprise, among others, the monitoring and surveillance programmes (scope, intervals).

The state of the art for monitoring and surveillance comprises :

- periodical visual inspections, carried out by attendants
- periodical measurements/data acquisition on site, carried out by attendants
- automatic acquisition, teletransmission and processing of significant behaviour data (generating data alarms, if data exceed allowable reach)
- periodical calibration and tests of automatic monitoring systems (alarm tests)
- periodical tests of appurtenant devices (operational equipment like spillway and outlet gates) - at least once a year
- overall inspection of dam and reservoir by the Dam Safety Engineer (in many cases supported by a geologist) at least once a year
- drawdown of reservoir at ten years intervals is good practice at most of the plants defined by the operation rules which have been approved by the Water Authority.

Two principles are essential :

- The **Principle of Experts** : safety assessment is mainly based on expert knowledge and “sound engineering judgement”
- The **Multi-level Principle** : technical knowledge, detailed knowledge of the plant, problem awareness and ability to take decisions are indispensable on the level of the dam owner. Supervision by experts independent from the owner is to prevent “operational blindness” and to gain results as objective as possible.

For dam with $h > 15$ m or $V > 500,000$ m³ the procedures are the following :

- surveillance by the owner (continuous)
- overall check and safety assessment by the owner (Dam Safety Engineer), safety report to the authority (1 year interval)
- check by the Dam Supervisory Officer acting on behalf of the Provincial Governor (1 year interval)
- overall check and safety assessment by the Federal Dam Supervisory Section (5 years interval)

For other dams (including river barrages) surveillance lies with the owner, periodical checks are carried out by the Dam Supervisory Officer of the respective province.

In case of extraordinary events, the Dam Safety Engineer must be informed immediately. He has to decide upon the measures to be taken and has to contact the authorities.

Therefore it is necessary, that at least one Dam Safety Engineer is always in a “stand by” service.

For the repair, or the upgrading of safety, the activities result from the owner's liability to keep the plant in a condition which :

- complies with the decrees of the authority
- can be considered safe
- is in accordance with the state of the art.

For each dam all relevant information (e.g. design drawings, geology, behaviour data documentation of maintenance and repair works, as well as the decrees of the Authority) has to be collected systematically (“Talsperrenbuch-Dam Documentation”).

FINLAND

According to the Dam Safety Act, the owner of a dam is obliged to keep the dam in a condition such that it is safe and it will not cause a hazard or have damaging or harmful effects on public or private interest.

To reduce a risk of a dam damage, a safety monitoring programme has to be drafted for each dam referred to in the Dam Safety Act. The dam safety monitoring programme has to be drafted by the dam owner. The programme has to be drafted in such a manner that all the issues relevant to dam safety are subjected to surveillance and inspection. The programme may include rules concerning the monitoring proper, annual inspections and the inspections made at regular intervals (not exceeding five years).

A safety monitoring programme or its amendments are approved by a regional environment centre. Before approving the programme for a P dam the regional environment centre obtains an expert opinion from the Finnish Environment Institute.

According to the Dam Safety Code of Practice, structural and operational disturbances affecting dam safety must be reported. The report must present the cause of the disturbance, the investigations conducted and the measures undertaken. The disturbance report has to be delivered to the dam safety authority (regional environment centre)

The dam owner (or holder) is obliged to store documents relevant to dam safety in a special safety file.

GERMANY

The supervision authority can obligate the operator to test the construction or to let it be checked by an expert at the owner's expense. The measurements in regular intervals are carried out not only in operation but also during the construction and the first filling. All the results of the measurements, control and surveillance must be registered, evaluated immediately and kept. Thereby special operating conditions must be registered.

a) Operation

The dam must be operated according to the approved documents including

- operating plan for use of the water
- operational and maintenance instructions for the plugs, operating and measuring installations
- instructions for dangerous situations with the required communication

All the controls and measurements must be registered in the dam safety file.

b) Surveillance

The operator must set up the dam safety file. It includes relevant instructions for the surveillance, operation and maintenance. The valid regulations for the surveillance and maintenance in NRW are determined in additional guidelines published by the DVWK. They are defined as the state of the art in the "State Water Law".

The maintenance distinguishes in continuous, frequent and intensive surveillance. The operator practises the continuous surveillance. With respect to the frequent surveillance the operator must raise a safety report (1 year interval) and submit it to the appropriate authority. An intensive surveillance takes place every 10 years and after unusual events. It also includes a check, whether the measuring and control system still fulfils the state of the art.

NETHERLANDS

Every five years the local water boards are obliged to assess the actual safety of the primary flood defence structures (1996a). Both hydraulic boundary conditions and the guideline for safety assessment are supplied by the ministry. The local water boards are to report the results of the safety assessment to their provincial government. The provincial governments report to the ministry. The ministry reports to parliament.

ROMANIA

The operator keeps up to date a file comprising all the documents about the construction of the dam and a register for the operation.

Important owners (RENEL and APELE ROMANE) have their own inspection department which define methods of surveillance and monitoring.

The “National Committee for the Safety of Dams and Hydraulic Structures” and the corps of inspectors for the quality of construction carry out periodical inspections.

Special inspections, with the help of experts if necessary, can be made after exceptional events (floods, earthquakes, etc.).

The monitoring is defined by particular regulations. The methods of data analysis are to be modified.

SLOVENIA

The regulation provides for a monitoring of the dam and of the reservoir but does not give detailed rules (monitoring system, frequency).

The owner keeps the file of data collected during the construction.

The owner or the operator maintains the operating system and informs the authorities of unusual events. He keeps up to date a register with all important events.

SPAIN

The owner is responsible for the safety of the dam. He must implement means of detection and, if possible, of repair of the defects that can occur on the works.

The operating director is a qualified engineer.

The authority approves the beginning of operation of the reservoir.

The operating instructions must include the following items :

- procedures in case of exceptional events
- programme of monitoring and periodical inspections
- information procedure for water releases
- alarm system.

These instructions are included in the file of the dam.

The operator keeps up to date a register of the dam.

SWEDEN

Vattenfall has defined an internal regulation with rules about maintenance and operation. Procedures resorting to quality assurance (ISO 9001) are elaborated.

County Councils carry out inspections of dams with, if necessary, the support of experts at the owner's expenses.

The general policy of inspecting of dams suggested by the “Commission of safety of dams” and followed by Vattenfall provides for :

- weekly visual inspection made by the operation team
- annual inspection made by a qualified engineer. This inspection includes a test of the gated spillways. The report of the inspection is sent to the County Council.
- every four years, a detailed examination is made by an engineer independent of the local operation team.

It is considered to organize an evaluation of the safety level of the dams every fifteen years.

SWITZERLAND

Monitoring equipment which is suited to the importance of the dam is installed in order to measure the deformations of the dam and its foundation, the seepages, the uplifts, the temperatures, the pore pressures and, possibly, the phreatic surface in earthfill dams.

The owner is responsible for :

- the control of the working order of the outlet gates and the spillway gates
- the visual surveillance and the reading of the monitoring system. Data must be immediately analysed (control of the behaviour of the dam)
- the annual inspection by a experienced professional (regular control of the state)
- the publication of annual reports about the results of surveillance and monitoring. These reports are intended for the Authority of Surveillance
- the expert evaluations of the dams (at least every five years) by confirmed experts in the field of dams (engineer, geologist,...). These evaluations include an opinion on the condition of the dam, an analysis of its behaviour, an examination of the monitoring system with a proposed programme of monitoring. A special evaluation can be required (for instance safety in case of flood)
- setting up the register of the dam.

Some events are considered as exceptional by the regulation concerning dams :

- unusual deformations of the dam or of its foundation
- unusual uplifts
- increase of seepage
- new resurgence or increase in the flow from springs
- a slope movement or a speeding up of a sliding
- a risk of slipping into the reservoir (rock mass, ice, avalanche)
- an important flood
- an earthquake.

If one of these events occurs, the operator must take all appropriate measures. If necessary, the reservoir is emptied as a precaution.

Operating instructions in case of floods are required.

UNITED KINGDOM

A qualified supervising engineer is appointed by the dam operator to check the safety level and inform the owner of dangerous events. To this end, one or several inspections are made every year.

At least every ten years, a qualified inspecting engineer makes an expert evaluation.

The regulation provides for the measurement of the reservoir level.

Most of the major dams are subjected to daily visual surveillance.

F. THE REPAIR OF DAMS

ITALY

The Dam Authority can impose to the owner the repair or rehabilitation works necessary for the safety of the dams, both to remove problems related to deterioration processes or to increase the safety margins according to the results of safety reassessment.

The Dam Regulation has no specific rules devoted to the repair of dams. For the design of rehabilitation works or significant repairs the Dam Regulation relevant to the design and construction of new dams is usually applied. When minor repair works are involved a case-by-case approach is used, being the safety assessment of existing dams a controversial matter which has not yet a clear regulatory frame.

In the current draft of a new Dam Regulation, a distinction is made between “repair work” (to restore the original safety condition) and “rehabilitation works” (to increase the safety conditions). For the “repair works”, reference should be made to the Regulation applied for the original design of the dam. For the rehabilitation works, reference to the updated Regulation rules is foreseen, at least for the parts of the dam involved in the rehabilitation. For rehabilitation works involving extensive modifications of the dam configuration a full application of the current Regulation is foreseen.

NORWAY

Major repair of dams are treated after the same procedures as for construction of new dams. This implies that the planning of the repair must be carried out by a NVE approved consultant and that NVE will have to approve the plans and the design of the repair. In theory, a major repair will be the result of a reevaluation of the dam.

PORTUGAL

The rehabilitation or the repair works on dams can be proposed by the dam owner or imposed by the Dam Authority to restore or to improve the safety conditions due to the deterioration process or the safety reassessment of dams.

There are no specific guides or rules to be applied, but the Dam Safety Regulation applies in general. In cases where a rehabilitation or repair project is needed, it must be presented to the Authority for approval.

G. PARTICULAR RULES FOR THE PROTECTION OF THE POPULATION

FRANCE

Emergency preparedness plans are required for dams or dikes higher than 20 m above the ground level and with a reservoir volume above 15,000,000 m³.

The plans are prepared according to the results of a risk analysis. This analysis estimates the limits and the delay of the inundation after a failure of the dam. This analysis examines also the risk of earthquake or landslide into the reservoir, and the risk during extreme floods.

The owner (or the concessionaire) must install and maintain at his own expense:

- technical devices for detection and surveillance (surveillance building, lighting of the downstream face, means of information and communication...).
- alarm devices for the authorities and for the population (means of communication, sirens within the area reached by the flood fifteen minutes after the failure of the dam).

Two situations of vigilance and one stage of alarm are defined by the regulation :

- reinforced vigilance
- serious worry
- alarm (activation of the sirens and information of the authorities).

The sirens are tested every three months. Simplified plans can be prepared for smaller dams. A new regulation is under consideration

ITALY

The possible emergency conditions arising during the dam operation are ranked in three levels: Alert, Alarm1, Alarm2. For each level, the communication process between the owner and the involved administrations/authorities is defined.

The following installations have to be carried out by the dam owner, at each dam site:

- a siren that can be heard 1000 m downstream, to be activated before voluntary opening of the gates
- alert signs along the river, for ten kilometres downstream the dam, alerting about sudden floods due to water discharge from the dam.
- water level recorder immediately downstream the dam.

Emergency Action Plans (EAP) have to be set up by local Civil Protection Authorities coordinated by the Prefecture, for various types of risk (hydro-geological, seismic, volcanic, industrial, fire).

The risk related to the presence of dams is included in the hydro-geological risk.

For the preparation of the EAP, flood propagation studies for all the large dams have been carried out by the dam owners, to determine the downstream areas affected by the flood wave generated by: 1) - the dam collapse; 2) - the full opening of the dam outlets.

The studies were reviewed by the National Dam Authority; when approved, they were transmitted to the involved Prefectures for the preparation of the EAP.

Currently the EAP involving some tens of dams have been completed.

NORWAY

The dam owner shall establish and maintain safety measures to take care of normal use and traffic on, nearby and downstream the dam. Measures can be fences, information plates, advertisement etc. NVE can decide on such measures.

The dam owner is required to develop an emergency action plan in order to deal with major accidents in river basins and to reduce damage in river basins subjected to regulations. Key elements in the emergency action plan include; start phase, organization and management, available resources, information and alternative communications.

Training and exercise of the emergency action plan is essential to identify that the plan works in practice. In Norway, the authority requires training exercise to be carried out every third year by owners of large dams.

For all dams in hazard class 3 and 2, a break flood calculation is required. Inundation mapping of the dam break flood will be the basis for developing plans for evacuation. These evacuation plans are managed by the local rescue organisation and the municipalities.

PORTUGAL

For dams of Class I (RSB, 2007) an emergency preparedness plan is required to deal with situations that might lead to dam failure.

The mapping of the downstream flooded areas, presented by the owner in the project, is the basis for defining the protection strategy to be adopted at different zones.

The emergency preparedness plan is to be done with direct participation of the Owner (“internal plan”) and the Civil Defence Services (“external plan”). The internal plan is approved by the Authority and the National Authority for Civil Defence.

The emergency plan will indicate when training is periodically to be carried out for the envisaged operations.

Important dams should be fitted with a permanent communications system between the dam and the operations decision centre. An alarm system is also required at the dam site, to give an alert to the nearby affected areas. It is the owner's responsibility to install and operate the alarm system. Civil Defence services are in charge of warning all affected people, namely in the areas not covered by the dam alarm system.

If a possible danger is detected, the information should immediately be communicated to the civil defence services. In case that an imminent danger occurs at the dam, which should require the immediate evacuation of the population, the alarm system and the transmission of the information to the authorities are to be simultaneously activated.

AUSTRIA

Emergency plans based on dam break analyses are available for most of the largest dams.

FINLAND

According to the Dam Safety Act, the emergency action plan has to be made for a dam which in the event of an accident may manifestly endanger human life or health or seriously endanger the environment or property . The plan is based on a dam-break flood analysis (hazard risk assessment). The municipal rescue authority is responsible for the emergency action planning. The dam owner is obliged to assist the rescue authorities in drawing up the plan, to draft the relevant assessments and necessary action plans for his part.

The dam owner bears also the responsibility to acquire and maintain the facilities and materials referred to in the action plan and to take other measures to safeguard people and property against the risk posed by the dam and to participate in the implementation of the action plan.

If there are people living so close to a dam in a potential downstream hazard area that an alarm given by the rescue services could not possibly reach them in time, the area at particularly high risk must be provided with a system capable of sounding the alarm in time. The normative time limit for an area at particular high risk is two hours from a dam failure. The need for such a system has to be ascertained by the rescue authority.

GERMANY

The legal requirements and technical rules do not include statements about emergency plans in NRW.

NETHERLANDS

The flood defences Act (1996a) prescribes that the ministry shall issue warnings to local water boards when water levels exceeding so called alarm levels are expected. Local water boards are obliged to prepare emergency plan and train their personnel and equipment regularly. Local communities, however, are responsible for preparing disaster management plans.

ROMANIA

According to a regulation signed in 1992, dam owners must install an alarm system for the population and for the authorities.

Emergency plans are required for dams higher than ten meters, with a reservoir greater than 10,000,000 m³ and with inhabited areas closer than 10 km downstream of the dam.

SLOVENIA

The consequences of a dam failure must be studied for all the important dams. There are three classes of consequences. In the class 1 (important risks of human loss and of economic effects), the study must use a physical or a computerized model. If there is a risk to a dam, the operator warns a local centre of information which is linked to other services (civil defence,...).

The alarm for the dams is a part of a general automated alarm system for the population.

SPAIN

For all of the dams of class A or B, the legislation provides for an emergency plan approved by the administration. This document contains at least the following topics :

- analysis of the safety of the dam
- inundation map and analysis of the risks
- instructions
- organisation
- rescue means.

SWEDEN

Each town has a plan for the organisation of emergency help in case of an accident. County Councils have the responsibility of emergency plans for major accidents like the failure of a dam.

SWITZERLAND

Alarm systems are required and installed for all the dams whose failure can create a danger for the population.

According to the importance of the reservoir (volume > 2,000,000 m³) and of the flooded area, alarm systems can be different. To avoid wrong alerts, one person takes the decision to activate the alarm.

The regulation for dams specifies that the area affected by the flood after a total and instantaneous failure is divided in a near part and in a far one. In the near area (that is to say in the area reached by the flood in less than two hours), the alarm is given by sirens which are activated from a central location near the dam. In the far area, a general alarm system (acoustic signal) invites the population to listen to the radio that gives the instructions for the evacuation.

In some cases, the general alarm system is the only way to invite the population to evacuate the area. If only few houses are concerned, the evacuation is made by mobile alarm teams.

UNITED KINGDOM

There is no special regulation for emergency plans related to the safety of the population that lives downstream of a dam.

However, for many large dams, there are inundation maps in case of a failure. Emergency preparedness plans are arranged in close collaboration with the civil defence.

H. DAM DECOMMISSIONING

ITALY

No technical directions about decommissioning are given in the “Dam Regulation”.

General administrative directions are given in the “*Water and hydroelectric power plants Consolidation Act*”, 1933. According to such directions, at the end of the concession the public administration can become proprietary of the works, in regular state of functioning and maintenance, or it can order the past owner to remove the works and to restore the site conditions as requested by the public interest.

In the law n. 139/2005 it is stated that the decommissioning of a large dam means demolition and removal of the dam, total or partial (in this last case, the safety of the site must however be assured).

More detailed directions are given in the current draft of new Dam Regulation where it is stated that: the dam decommissioning has to be approved by the Concession Authority (Region), the approval process including the evaluation by the National Dam Authority and, when necessary, the environmental assessment. The execution of the approved works is supervised by the Concession Authority.

NORWAY

According to the Water resources act, decommissioning of a dam can first occur after a permit has been granted on the basis of an application to decommission the installation. The Norwegian Water Resources and Energy Directorate (NVE) handle the application. The procedures for receiving a permit for decommissioning are very similar to the procedure for receiving license to construct a dam.

NVE may also transfer the ownership to a new owner if the application process identifies others that may have interests in maintaining the dam.

PORTUGAL

Decommissioning of a dam is to take place in compliance with adequate safety requirements (RSB), and a specific project to that purpose has to be presented and approved by the Authority.

The project must notably contain the explanation of the decommissioning option, the assessment of stability and safety controls for the remaining structures, the hydraulic studies of the river regime and the proposed measures for minimizing negative impacts.

SECTION 3

Main Documents

(list, synopsises, files)

FRANCE

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- B. Entities concerned*
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I - Laws (*Legal Obligations*)

1. Law on water – 01/03/1992 – “*Loi sur l’eau*” - [File: France 1, France 2]

Synopsis

This general law (and the subsequent decrees, especially the decree n° 93-743 of 03/29/1993, File: France 2) defines the rules and obligations for the use of water. The field is a huge panel from pollution, fish... to the construction works in a river. It defines also the needed permissions to modify the level of a river but without a precise definition of a dam (in the present version, a dam begins with a height of 0.35 m!).

NOTE: A new version of this law is in preparation and debate in the French Parliament.

For major hydroelectric power plans, the law is completed by a special old legislation (law of 10/16/1919) on hydroelectric concessions.

2. Decree of 06/13/1966 for the creation of a permanent technical committee on dams - "*Décret du 13/06/1966 portant création du CTPB*" - [File: France 3]

Synopsis

The Committee is constituted of members of the French administration with a high level of expertise in the field of dams. The laws, decrees, circulars... dealing with dams are also looked into by the committee.

The dams concerned are all the dams with a height over 20 m above ground level, but also all the dams if a ministry wishes a expert advise.

This committee is consulted for the projects of news dams (preliminary studies and final projects) and the advice must be taken into account by the owner. The judgement of the Committee is also required for the major rehabilitation projects of dams in operation.

The danger studies prepared by the owner in order to establish emergency preparedness plan are also submitted to the committee.

3. Circular n° 70/15 of 08/14/1970 for inspection and supervision of dams with a potential impact on public safety - "*Circulaire sur l'inspection et la surveillance des barrages intéressant la sécurité publique*" - [File: France 4]

Synopsis

This document is the basis of the French technical regulation for dam safety. It defines the obligations of dam owners for the construction, operation (surveillance, monitoring, periodical reports...) and rehabilitation. It defines also the action of supervision by the administration, especially (but not solely) by periodical in site inspections (annual inspection, normally after a total draw down of the reservoir every ten years).

The dams concerned by the circular are dams with potential important impact on public safety. Unfortunately the circular does not give a precise numbered definition of this. It is the responsibility of the administration to establish and decide if a particular dam is, or not, in the field of the circular. As a minimum, the list includes dams higher than 20 m above ground level, but also many smaller dams.

The circular mainly deals with the control, monitoring, surveillance of dams in operation and with the supervision, by the administration at a local level, of the action of the owner. It is noteworthy that the circular does not precise a particular ability to intervene neither for the operator, nor for the supervision.

NOTE: Several precise points of this quite old circular are not appropriate for the present state of art. Furthermore the legal status of this document is not convenient. So it is planned to re-write entirely the text, in decrees and circulars.

4. Circular of 05/23/1997, for the supervision of dams of a medium importance - "*Circulaire du 23/05/1997 relative à la surveillance des barrages faisant partie de concessions de forces hydrauliques de moyenne importance*" - [File: France 5]

Synopsis

This circular deals with the control and supervision of medium dams with lightened rules with regard to the previous one.

The text applies exclusively to dams in hydroelectric concessions. The dams are not considered as having an important potential impact of public safety, have a height above 10 m and follow a condition on height and volume of the reservoirs.

5. Circular of 11/29/1996 for the safety of the zones downstream of dams and hydraulic works - "*Circulaire du 29/11/1996 relative à la sécurité des zones situées à l'aval des barrages et aménagements hydrauliques*" [File: France 6]

Synopsis

This circular has been completed by an additional circular of 07/13/1999 [File: France 7]. It is the result of a dreadful accident causing the death of seven persons downstream of a dam after the normal opening of the gate. The circular gives the rules, the potential measures that can be taken (warning, prohibited or reduced access, changes in operation process...) to reinforce the security.

All the dams are in the field of this circular, especially gated dams. But it concerns also of types of hydraulic works.

6. Decree n° 92-997 of 09/15/1992, on particular intervention plans for some hydraulic works - "*Décret n° 92-997 du 15/09/1992 relatif aux plans particuliers d'intervention concernant certains aménagements hydrauliques*" - [Files: France 8, France 9, France 10]

Synopsis

This decree is completed by two orders (order of 12/01/1994 (File: France 9) and order of 02/22/2002 (File: France 10). This regulation defines which dams are submitted to emergency preparedness plans, what are these plans, what are the preliminary studies the owner is charge of to give the authorities an estimation of the risks and of the flooded area in case of a failure. It defines the limits of the dam break study, the warning system implemented by the owner for the authorities and for the near downstream population in a zone named "zone of close nearness" (normally by the use of sirens). The entity responsible for the preparation of the emergency plans is the local authority.

The dams concerned by emergency plans are dams with a height above 20 m and a volume above 15.000.000 m³. A new decree (n° 2005-1158 of 09/13/2005) slightly changes that by adding the possibility offered to local authorities to prescribe a plan for less important dams if it appears useful.

ANNEXED FILES: France 1, France 2, France 3, France 4, France 5, France 6, France 7, France 8, France 9, France 10

ITALY

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Laws (Legal Obligations)

1. 1933, “Testo unico delle disposizioni di legge sulle acque e sugli impianti elettrici” (Water and hydroelectric power plants Consolidation Act), R.D. n°1775. [File: Italy 1]

Synopsis

This basic law regulates the use of the surface and underground water.

It introduced a competitive system for the concessions to the use of the water.

A specific section is devoted to the artificial reservoir, with particular attention to the hydroelectric purpose.

2. 1959, “Regolamento per i progetti, la costruzione e l’esercizio delle dighe di ritenuta - Parte I” (Regulation for the Design, Construction and operation of Dams – Part I), DPR n° 1363. - [File: Italy 2]

Synopsis

This Regulation defines the general and administrative rules for the design, construction and operation of dams. The rules are relevant to:

- content of the various design level (preliminary, for approval, for construction),
- approval and authorisation process,
- construction phase,
- supervision activity of the Authority,
- first filling and the final test for starting the normal operation,
- safety control during the operation stage.

NOTE: A complete update of this Regulation is currently (2007) in progress.

3. 1982, “*Technical Rules for the Design and Construction of Dams*” (“*Norme Tecniche per la progettazione e la costruzione delle dighe*”), D.M. LL.PP. n°44. - [File: Italy 3]

Synopsis

This law defines the technical rules for the design and construction of the dams.

New dams are considered, no directions are given about existing dams already in operation. Specific rules are given for the different dam types: gravity, hollow gravity, buttress, arch, multiple arches, gate-structure, earth and rockfill dams.

Static and seismic loading factors, load combinations, allowable limits (factors of safety, max stresses, min freeboard, etc) are defined, together with directions to be followed during the construction works, in particular for the foundation treatment and for the qualification and control of the construction materials.

NOTE: A complete update of this Regulation is currently (2007) in progress.

4. 1994, “*Misure urgenti in materia di dighe*” (“*Urgent Measures concerning Dams*”), Law n° 584. [File: Italy 4]

Synopsis

This law updates the definition of the “large dams” subjected to national legislation and authority: they are those having height $H > 15$ m, or reservoir volume $V > 1.000.000$ m³. The previous definition was based on lower dimensional parameters ($H > 10$ m, $V > 100.000$ m³).

It also defines the procedure to be followed for the regularisation of dams that were put in operation without having fulfilled the authorization process required by the Regulation. The technical and non-technical documents requested for the regularisation are defined, as well as the measures to be taken by the authority if the regularisation procedure is not fulfilled.

It introduces the obligation for the owner to appoint, for each dam, an engineer who is responsible of the safety of the dam and of its regular operation

5. 2003, “*Regolamento concernente l’organizzazione, i compiti ed il funzionamento del Registro Italiano Dighe RID*” (“*Organisation, duties and activities of the Italian Dam Authority*”), DPR n° 136. - [File: Italy 5]

Synopsis

The national authority for dams was constituted by this law as a public autonomous body (“Registro Italiano Dighe” - RID), with its own organisational, administrative and financial

position. The decree defines the RID organisation. The “Council of the dam owners” is also introduced, to be consulted about subjects of main interest for the dam owners.

The RID competence is extended to the ancillary works (diversion galleries and channels, penstocks, etc): approval of projects and supervision of the surveillance activities of the owner. For the detailed definition of this additional competence reference is made to an updated “Dam Regulation” to be issued afterwards.

NOTE: the RID as an autonomous body was cancelled by the subsequent Law n. 286 - 24.11.2006 -*Financial Act for the year 2007*, which brought again the RID within the organisation of the Ministry of Public Works (as it was, for a long period, in the past).

II - Other Legal Directions

6. 1986, “*Sistemi di allarme e segnalazioni di pericolo per le dighe di ritenuta*” (*Warning and Alarm Systems for Dams*), Ministry of Public Works, Circular n° 1125 - [File: Italy 6]

Synopsis

This Circular gives directions about:

- installation of warning signs along the stream, downstream the dam, to alert about the possibility of sudden increase of the water flow related to the opening of the dam outlets;
 - installation of a siren at the dam site, to be activated before any voluntary opening of the outlets;
 - installation of an hydrometric measuring station, immediately downstream the dam;
 - flood propagation study, related to the water discharge when the gated outlets are opened.
- All the above stated activities have to be carried out by the dam owner

7. 1987, “*Prescrizioni inerenti l’applicazione del regolamento dighe approvato con DPR n° 1363 del 1959*” (“*Directions concerning the application of the Regulation about Dams n° 1363/1959*”), Ministry of Public Works, Circular n° 352. - [File: Italy 7]

Synopsis

This Circular updates some specific elements of the 1959 Regulation (doc. n.2), among which the following:

- also the large dam not constructed in the riverbed are subjected to the Regulation;
- the dam break analysis to determine the flood propagation and the inundation maps is required, for both new projects and existing dam, to be carried out by the dam owner;
- the “*Foglio di Condizioni per l’Esercizio e la Manutenzione*” (“*Sheet of Conditions for Operation and Maintenance*”) is introduced, defining the monitoring, inspections and surveillance activities to be carried out by the dam owner. The *Sheet* is issued by the Dam Authority and undersigned by the dam owner;
- a classification of the alert/alarm conditions is given.

8. 1995, “*Disposizioni attuative ed integrative in materia di dighe*” (“*Operational Directions pertaining to Dams*”), Circular letter n° DSTN/2/22806. - [File: Italy 8]

Synopsis

This Circular gives operative directions about various subjects, among which the following:

- appointment of the engineer responsible for the safety of the dam and its regular operation;
- detailed technical directions for the flood propagation studies (for the outlets opening scenario and for the dam collapse scenario);
- obligation of a half-yearly asseveration, by the appointed “responsible engineer”, about the safe conditions and operation of the dam;
- clarifications about the modalities for the evaluation of the basic dimensional parameters (dam height and reservoir volumes).

9. 1996, “*Disposizioni inerenti l’attività di protezione civile nell’ambito dei bacini in cui siano presenti dighe*” (“*Directions for Civil Protection activities in basins where dams are present*”), Circular Letter n° DSTN/2/7019. - [File: Italy 9]

10. 2004, “*Indirizzi operativi per la gestione organizzativa e funzionale del sistema di allertamento nazionale e regionale per il rischio idrogeologico ed idraulico ai fini della protezione civile*” (“*Operational directions for the management of the national and regional alert systems for the hydro-geological and hydraulic risk, for Civil Protection purposes*”), Presidency of the Council of Ministers. [File: Italy 10]

11. 2005, “*Verifiche Idrauliche*” (“*Hydraulic Assessment*”), Circular n. 3199 of the Dam Authority, - [File: Italy 11]

Synopsis

This Circular requires the execution, by the dam owner, of updated hydrological analyses for the evaluation of the maximum floods corresponding to increasing return period (up to 1000 years return period) and the corresponding assessment of the hydraulic safety of the dams. The evaluation is requested also for a scenario of limited efficiency of the spillway and outlets.

III - Guidelines (*No Legal Obligations*) : None

ANNEXED FILES: Italy 1, Italy 2, Italy 3, Italy 4, Italy 5, Italy 6, Italy 7, Italy 8, Italy 9, Italy 10, Italy 11

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I - Laws (Legal Obligations)

1. Act on Watercourses and Groundwater (water resources act) of 24 November 2000, No. 82.

II - Other Legal Directions – Regulations (lower hierarchic level than Laws; in case of discrepancies with a Law, the Law prevails)

2. *“Regulations governing the safety and supervision of watercourse structures” (The dam safety regulations)*, laid down by Royal Decree 15 December 2000 with authority in the Act of 24 November 2000 No. 82 on Watercourses and Groundwater (water resources act) subsection 2 fourth paragraph, letter e, Sections 36 and 38 second paragraph letter d, Sections 39, 53, 54 and 58. Proposed by the Ministry of Petroleum and Energy. [File: Norway 1 – English]
3. *“Regulations governing the classification of watercourse structures”*, laid down by the Norwegian Water Resources and Energy Directorate (NVE) on 18 December 2000 with legal authority in section 11-1 (chapter 11) in the dam safety regulations. [File: Norway 2 – English]
4. *“Regulations governing the qualifications of those undertaking the planning, construction and operation of watercourse structures”*, Laid down by the Norwegian Water Resources and Energy Directorate (NVE) on 18 December 2000 with legal authority in section 11-1 (chapter 11) in the dam safety regulations. [File: Norway 3 – English]
5. *“Regulations governing internal quality control on how to fulfil the Act on Watercourses and Groundwater”*, laid down by Royal Decree 21 February 2003 with authority in the Act of 24 November 2000 No. 82 on Watercourses and Groundwater (water resources act), Sections 53, 54 and 58. Proposed by the Ministry of Petroleum and Energy. [File: Norway 4 – English]

III - Guidelines (available by 2005)

1. Flood calculations
2. Planning and construction
3. Inspection and reassessment
4. Concrete dams
5. Spillways
6. Masonry dams
7. Determination of loads
8. Monitoring and instrumentation
9. Dam break flood analysis

ANNEXED FILES:

Norway 1 - English, Norway 2 - English, Norway 3 - English, Norway 4 - English

PORTUGAL

Summary Table

| | | Topics | | | | | | | | |
|------|---|--------|---|---|-----|-----|---|---|---|---|
| | | Doc n. | A | B | C-a | C-b | D | E | F | G |
| Laws | 1 | | | | | | | | | |
| | 2 | | | | | | | | | |
| | 3 | | | | | | | | | |
| | 4 | | | | | | | | | |
| | 5 | | | | | | | | | |

- A. Dams subjected to Regulation
 B. Entities concerned
 C. Dam Projects
 c. General Directions
 d. Technical Rules
 D. Construction - First Filling
 E. Operation
 F. Repair – Rehabilitation
 G. Protection of the population (Emergency action plan, Emergency management, etc.)
 H. Decommissioning

I - Laws

- 15/10/2007, “Regulation for Safety of Dams” (*Regulamento de Segurança de Barragens*), Decree Law 344/2007 - [Files: Portugal 1]

Synopsis

This Regulation defines the general and administrative rules for the design, construction and operation of dams. The rules are relevant to the following subjects:

- dams subjected to the regulation;
- entities involved in the control of dam safety;
- contents and documents to be included in dam projects;
- safety control in the construction stage;
- supervision activity of the Authority;
- safety control during the first filling, and final test for starting the normal operation;
- safety control during the operation stage;
- safety control in cases of abandonment and demolition;
- Civil Defense measures.

- 14/12/1993, “Regulation of Small Dams” (*Regulamento de Pequenas Barragens*), Decree Law 409/93 - [File: Portugal 2]

Synopsis

This law is devoted to small dams (those not subjected to the Dam Regulation, doc. n. 1). It defines both general and technical rules, relevant to the design, construction, first filling and operation stage.

3. 10/09/1993, “Code of Practice for Dam Design” (*Normas de Projecto de Barragens*), Decree 846/93 - [File: Portugal 3]

Synopsis

This law defines the principles to be applied for the design of dams.

It defines the content of the design in its various phases (preliminary design, design for approval, design for construction) and the technical rules to follow in the design of different dam types: static and dynamic loads, load combinations, safety conditions to be ensured (factors of safety, freeboard, etc), discharge outlets and spillways.

4. 10/09/1993, “Code of Practice for Observation and Inspection of Dams”, (*Normas de Observação e Inspeção de Barragens*), Decree 847/93 - [File: Portugal 4]

Synopsis

This law defines the principles to be applied for the control of dam behaviour and condition through instrumental monitoring and visual inspection.

It defines the entities involved and the criteria for the definition of the monitoring and inspection plan in the design stage, the construction stage, the operation stage, the decommissioning stage.

Rule are given about: measurement data collection, storage, processing and analysis; flow of communication in case of anomalous behaviour; controls related to exceptional conditions (floods, earthquakes, rapid drawdown); professional qualification of the involved personnel.

Specific direction are devoted to the application of the law to the existing dams.

5. 21/04/1998, “Code of Practice for Construction of Dams”, (*Normas de Construção de Barragens*), Decree 246/98 - [File: Portugal 5]

Synopsis

This law defines the general principles and criteria to be applied during the construction stage. Various topics addressed by the law, such as: involved professional figures and documentation, temporary diversion of the river, excavation, construction plant and equipment, foundation treatment, qualification and control of the construction materials.

- “Code of Practice for Operation of Dams”, not yet published
- “Regulation for the Management of Reservoir”, not yet published

ANNEXED FILES: Portugal 1, Portugal 1 - English, Portugal 2, Portugal 3, Portugal 4, Portugal 5

DAM LEGISLATION

ANNEX 1

DATA 2001

Some data on dams in each country

ICOLD register provides a database on dams with a common definition of large dams. The data hereafter are included in the last version of the register.

Six items are selected to allow direct comparisons between the countries.

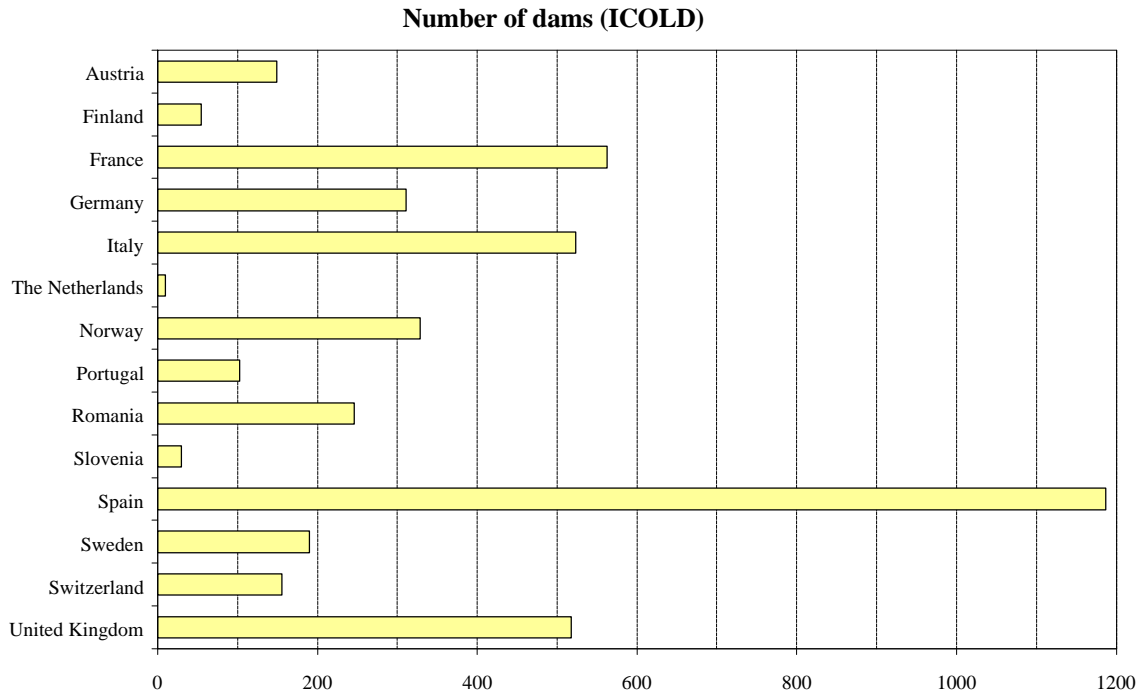
The last one plotted as $H^2 \times \sqrt{V}$ with H in meter and V in hm^3 is a gauge of a potential danger in case of dam break (without taking into account the density of population downstream !).

Of course, these dams do not represent all the dams subject to legislation. For instance, Reservoirs Act in United Kingdom concerns about 2500 dams with only 20 % of them in ICOLD's database.

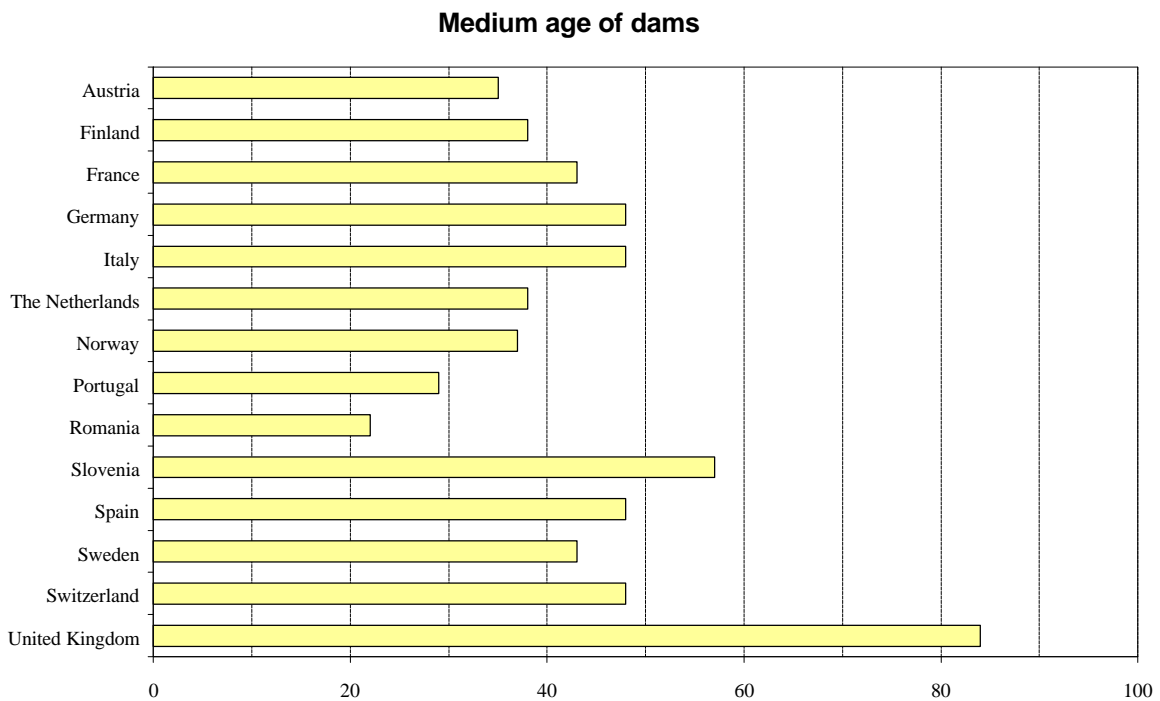
Table 1 gives for each country the number of dams related to the surface and the population :

| Country | Number | Dams/1,000 km | Dams/1,000,000 inh |
|-------------------|--------|---------------|--------------------|
| . Austria | 149 | 1.8 | 18.6 |
| . Finland | 55 | 0.2 | 10.7 |
| . France | 563 | 1.0 | 9.7 |
| . Germany | 311 | 0.9 | 3.8 |
| . Italy | 524 | 1.7 | 9.2 |
| . The Netherlands | 10 | 0.3 | 0.6 |
| . Norway | 330 | 1.0 | 75.7 |
| . Portugal | 103 | 1.1 | 10.5 |
| . Romania | 246 | 1.0 | 10.8 |
| . Slovenia | 30 | 1.5 | 15.7 |
| . Spain | 1187 | 2.4 | 29.9 |
| . Sweden | 190 | 0.4 | 21.5 |
| . Switzerland | 186 | 4.5 | 25.6 |
| . United Kingdom | 518 | 2.0 | 8.9 |

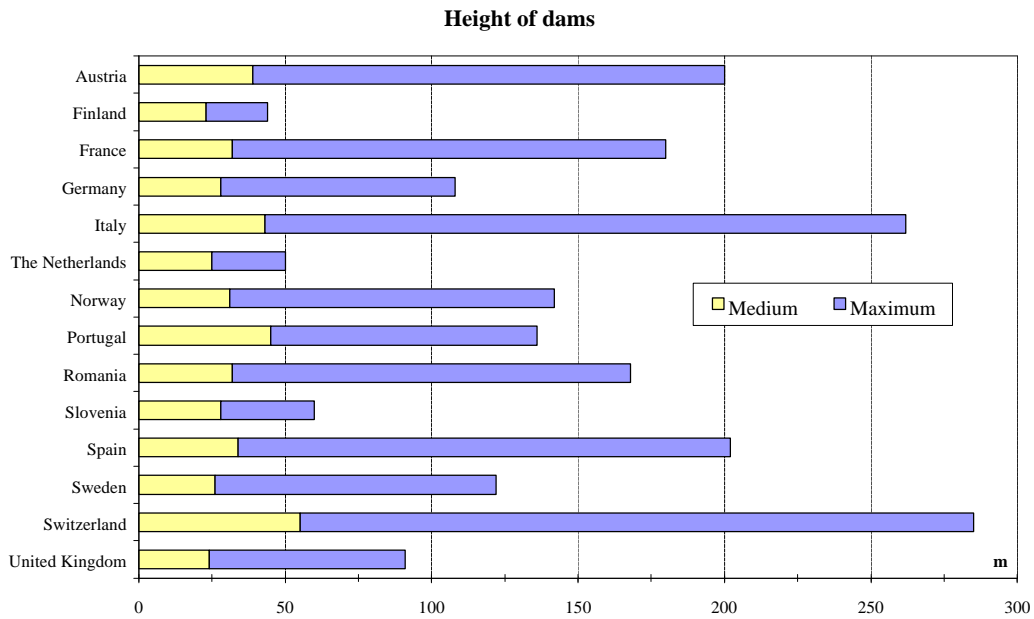
Diagrams 1 to 5 summarise the main characteristics of large dams.



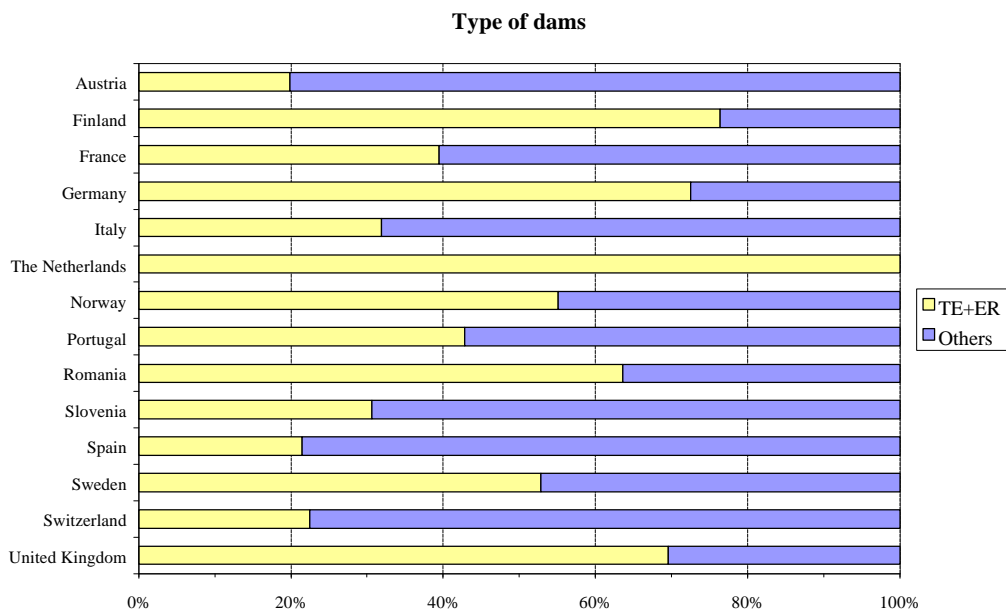
Spain is far from other countries for number of large dams. At the other end, Dutch dams are mainly dikes smaller than 15 m.



Spain has very old dams. It is also noticeable that 50 % of dams in United Kingdom have been built about 80 years ago.

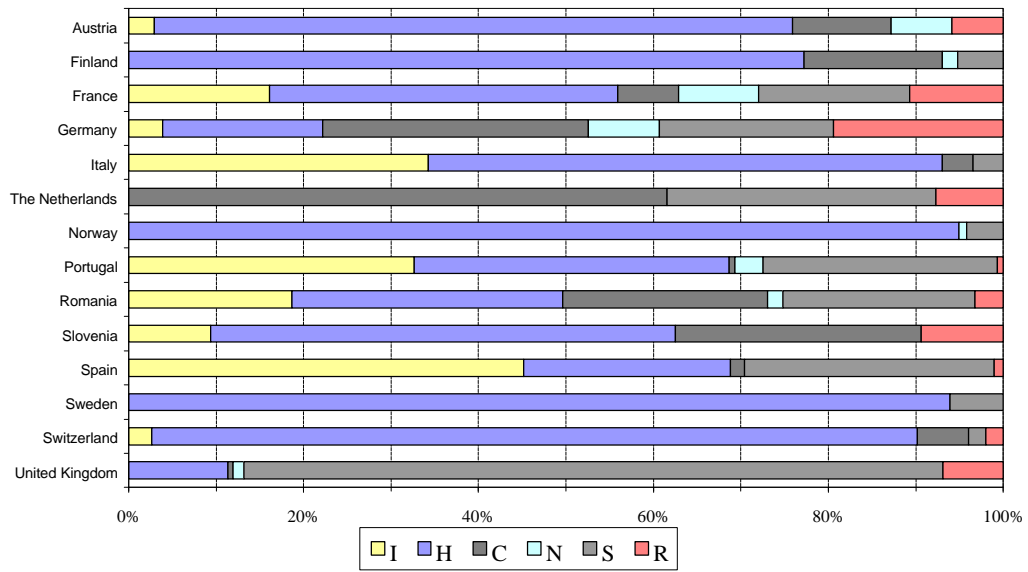


The medium height of the dams is quite homogeneous. However mountainous countries have some of high dams.



For 3 countries (Germany, United Kingdom and The Netherlands), 2/3 of the dams are earthfill or rockfill dams. This percentage is probably higher for small dams.

Purposes

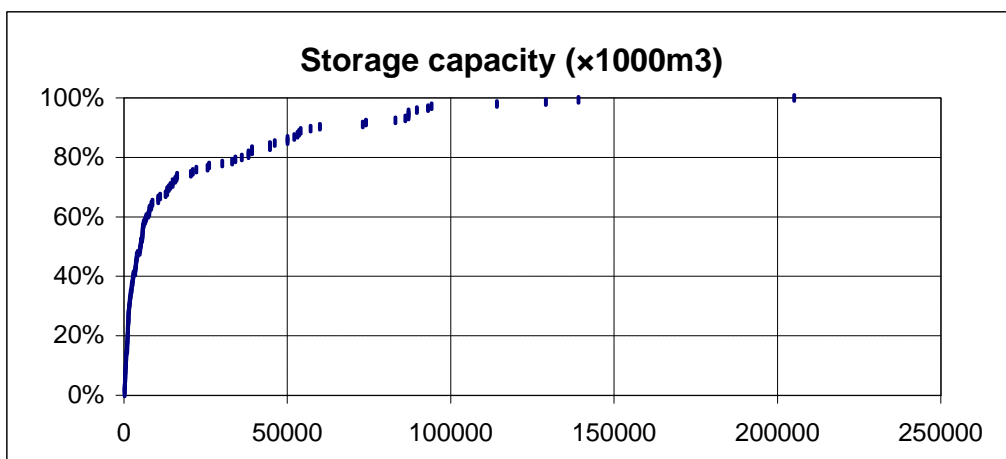
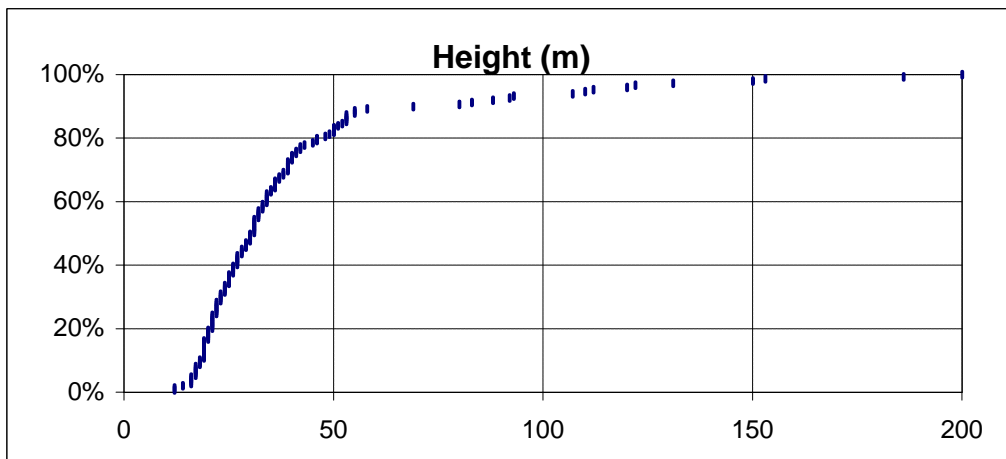
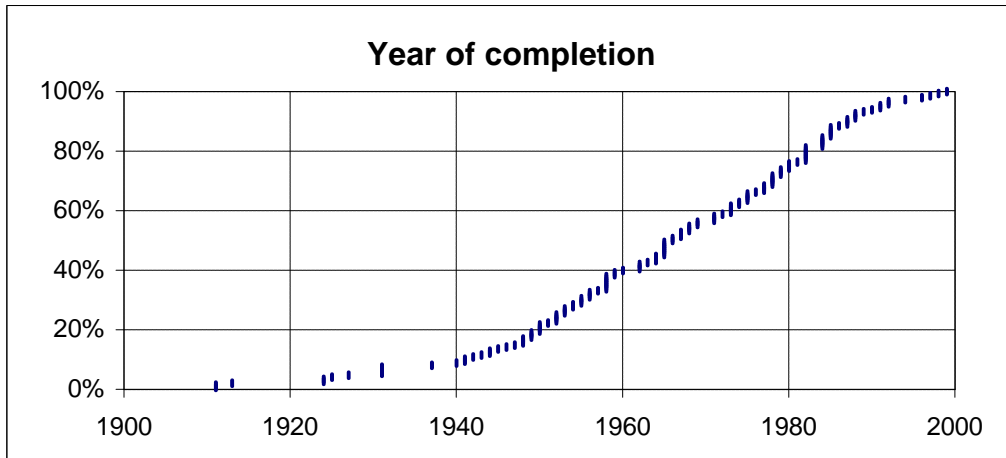


The purposes correspond to the definition of ICOLD :

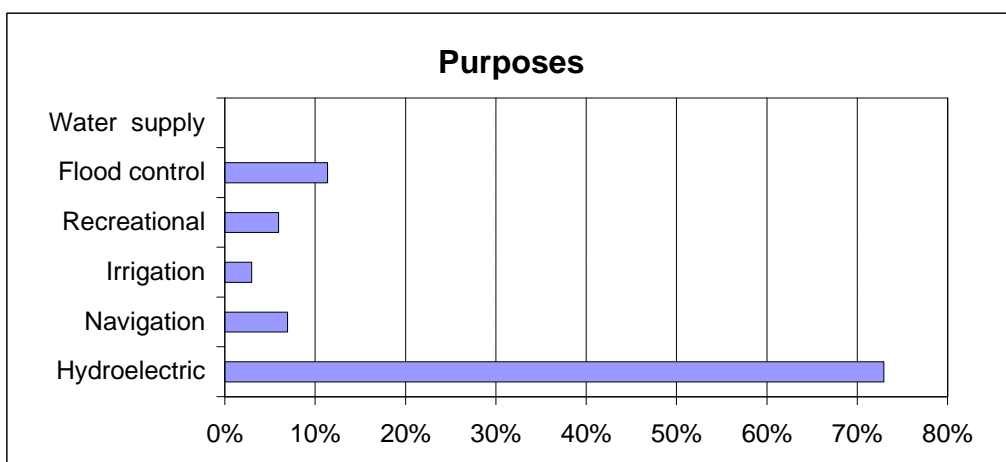
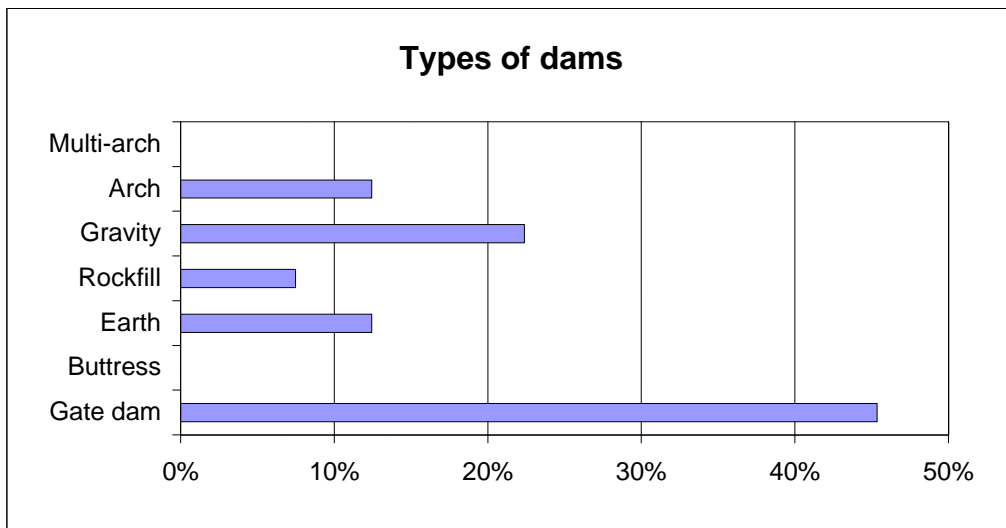
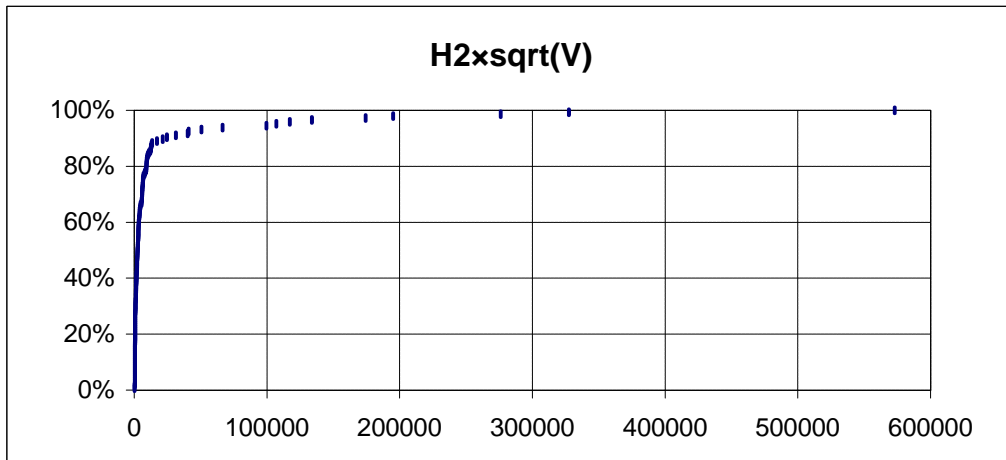
- I = Irrigation
- H = Hydroelectric
- C = Flood control
- N = Navigation
- S = Water supply
- R = Recreational.

Of course, dams can have simultaneously several purposes. Irrigation and water supply are more important in the South of Europe.

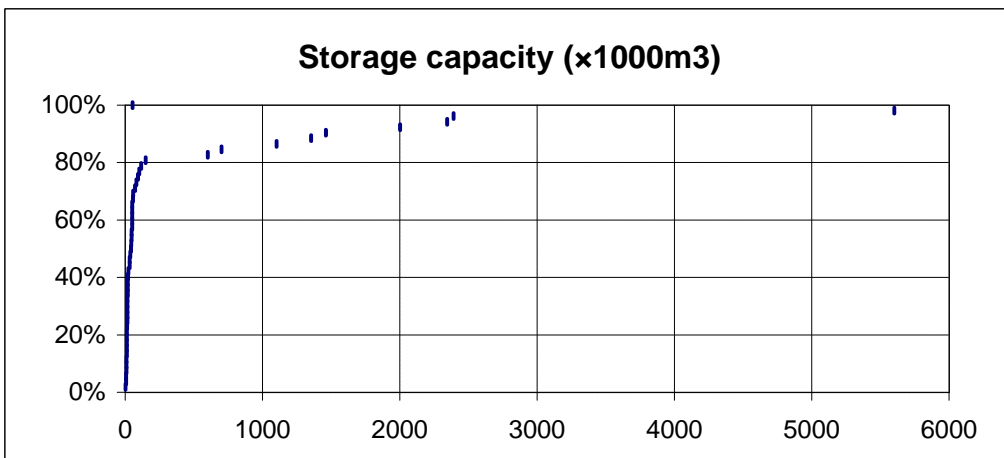
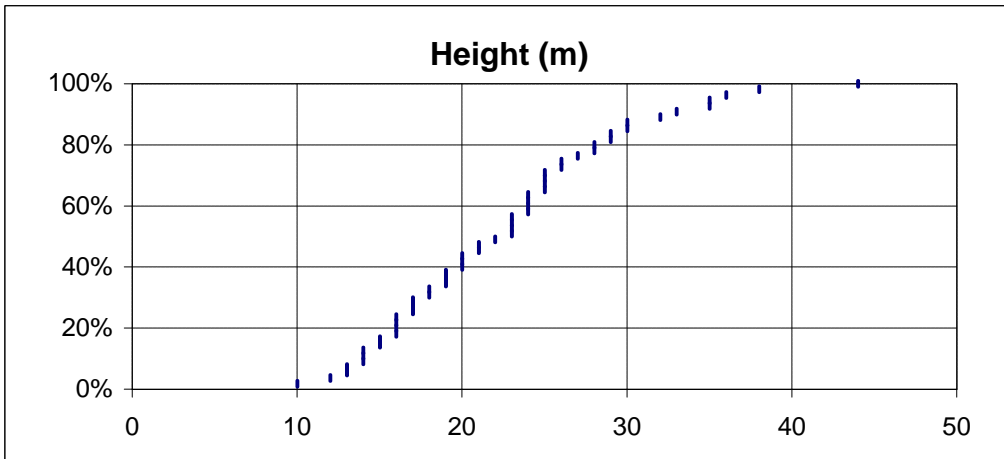
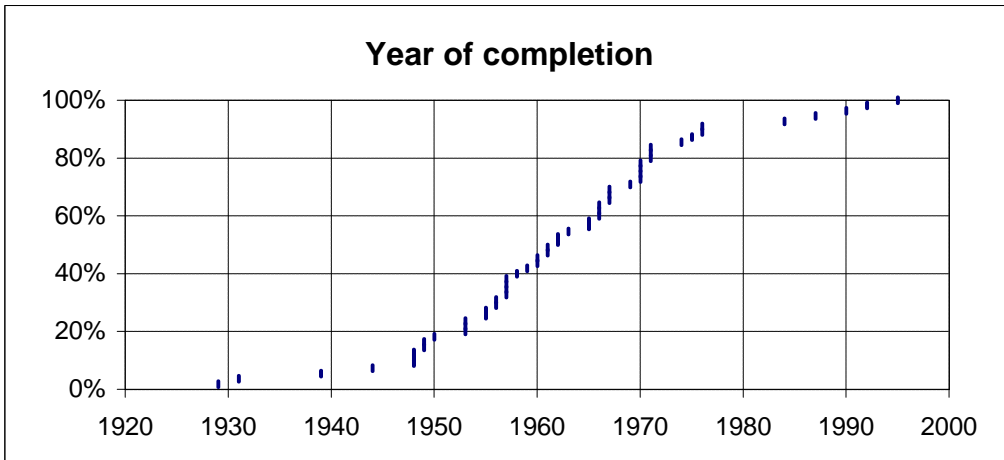
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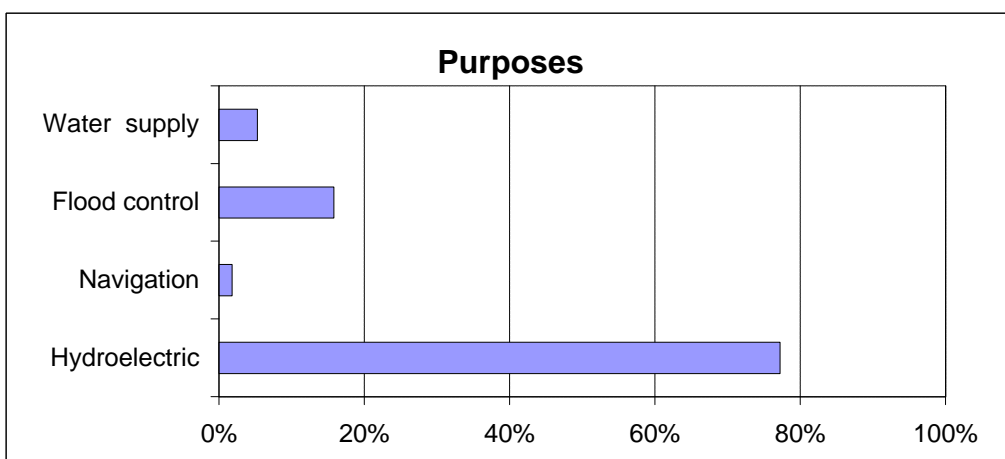
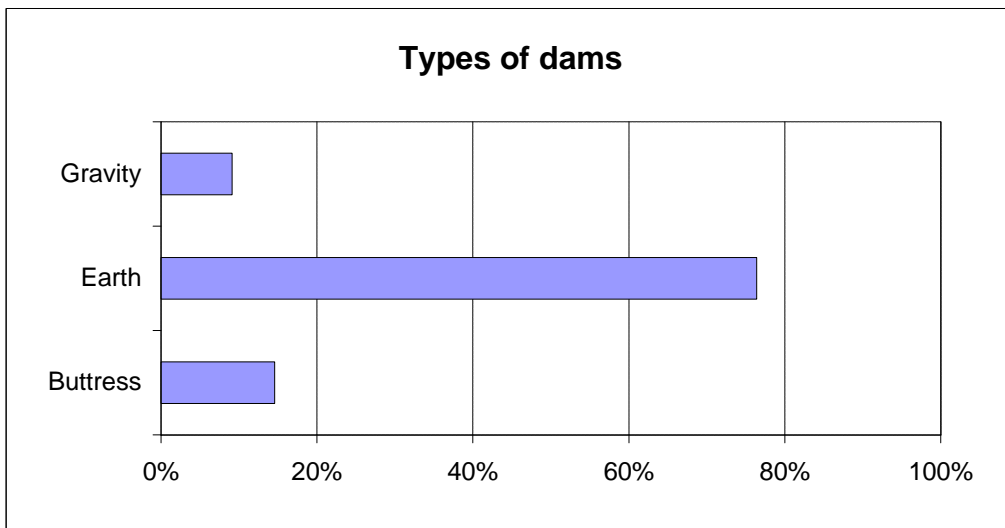
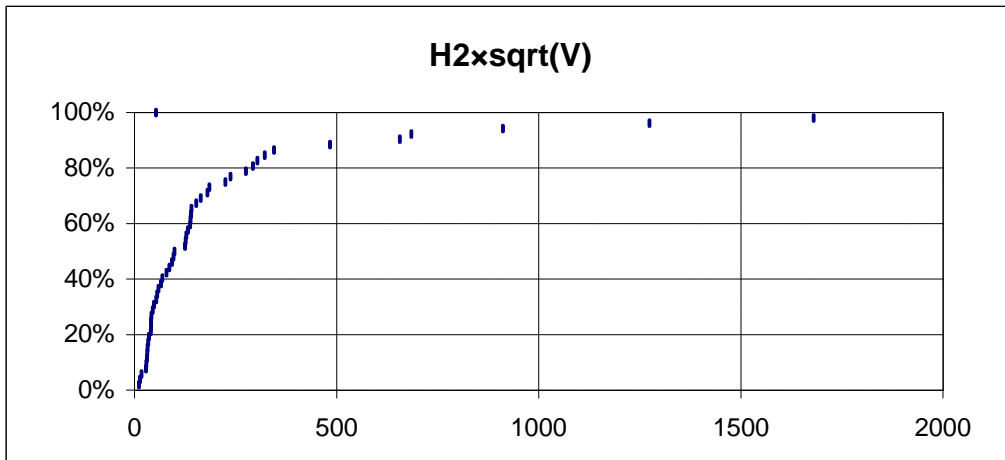
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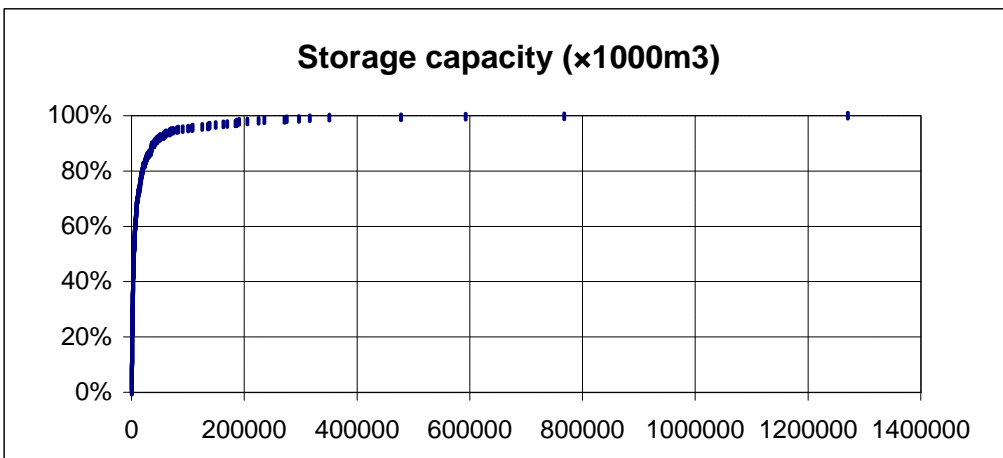
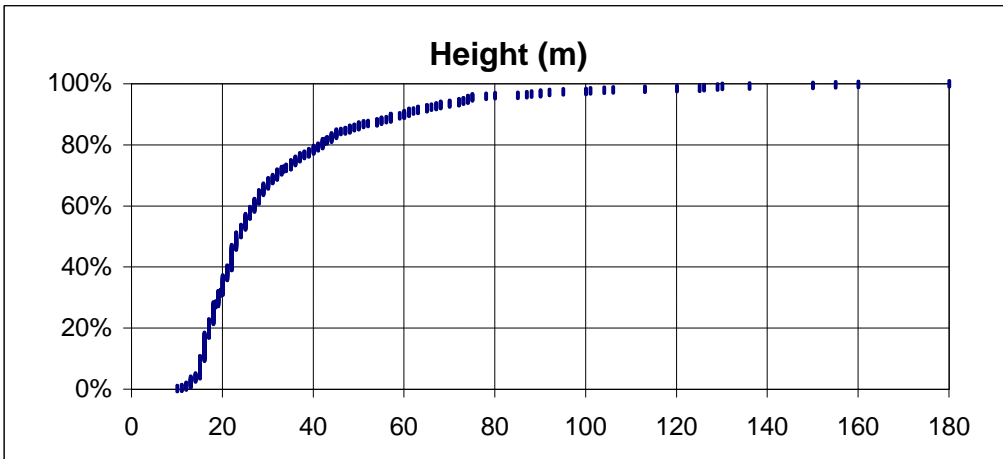
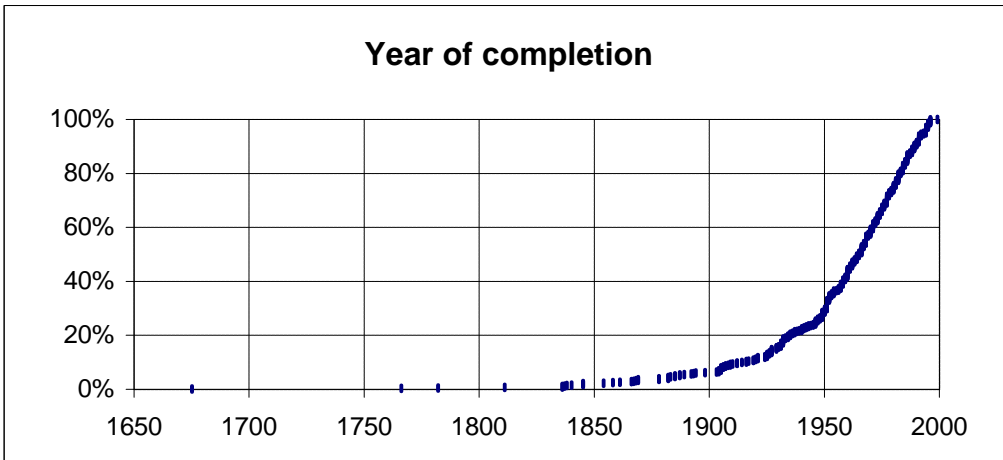
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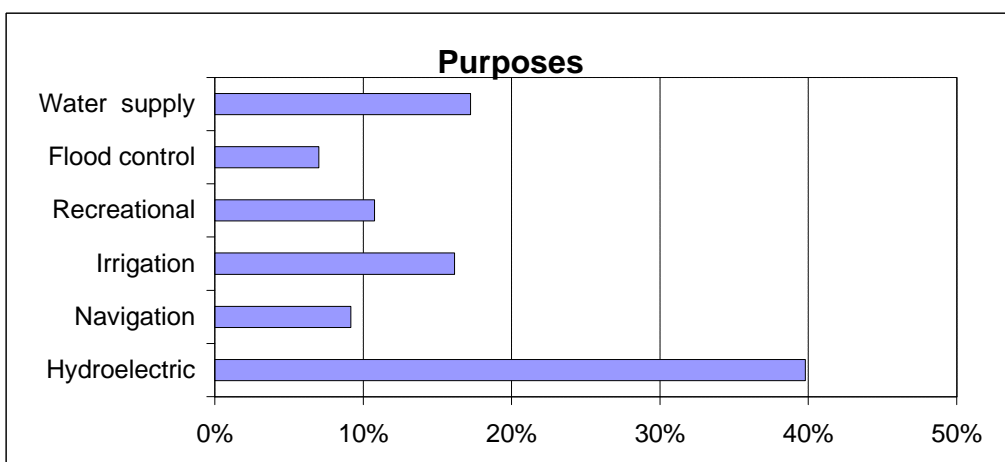
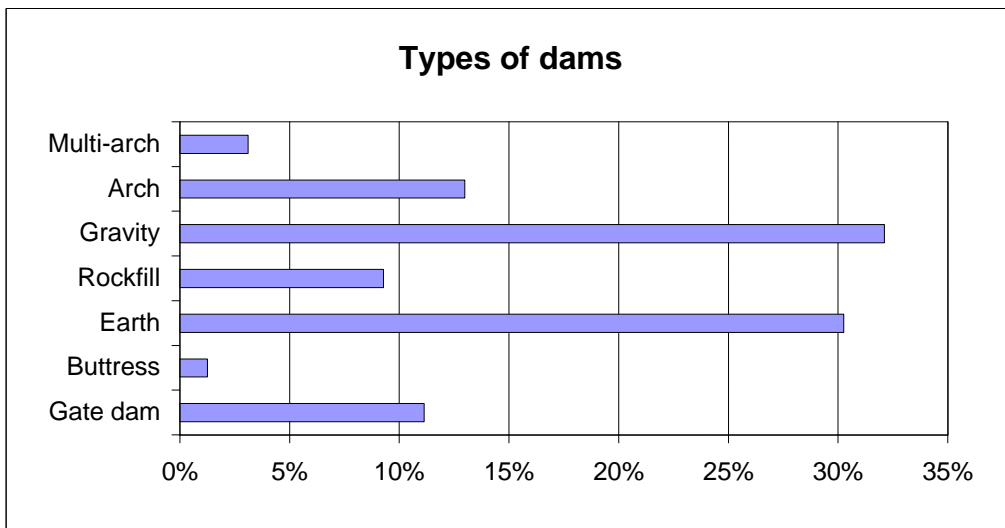
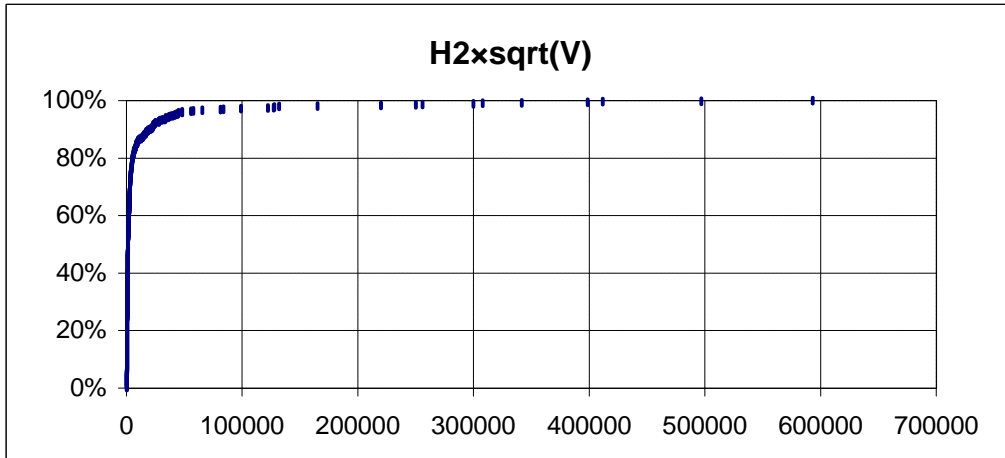
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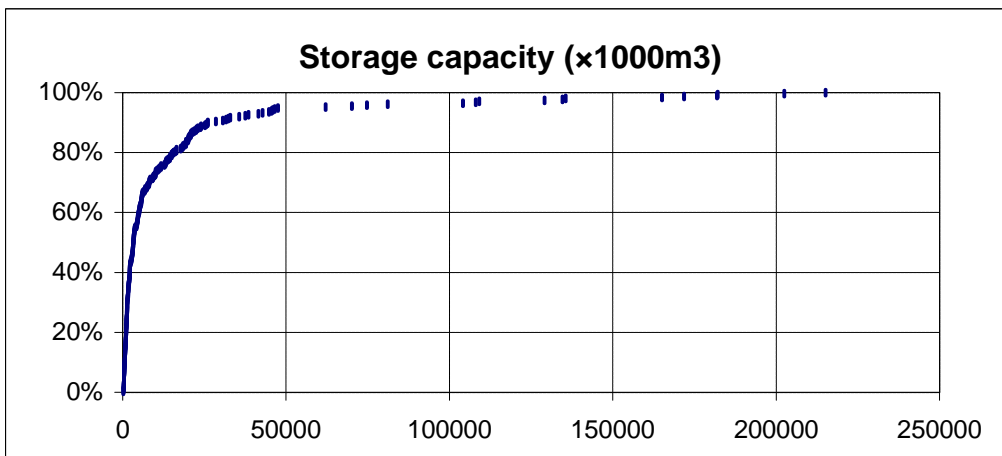
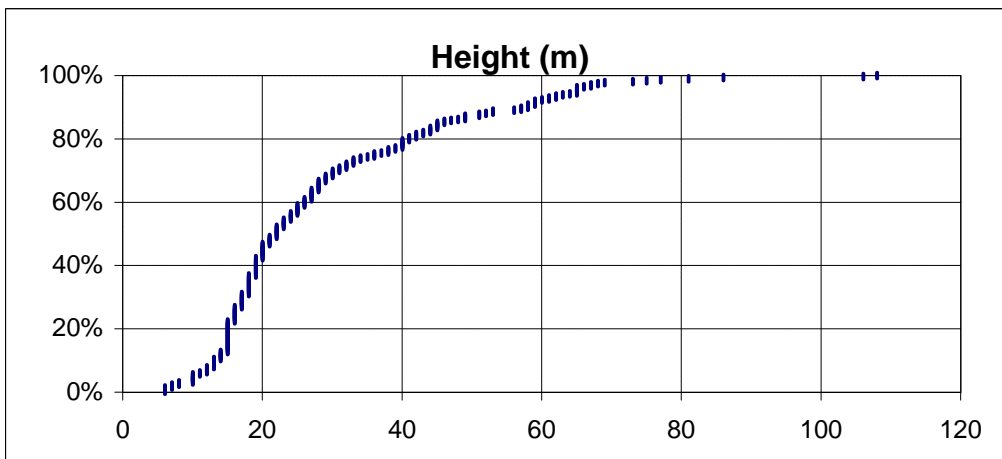
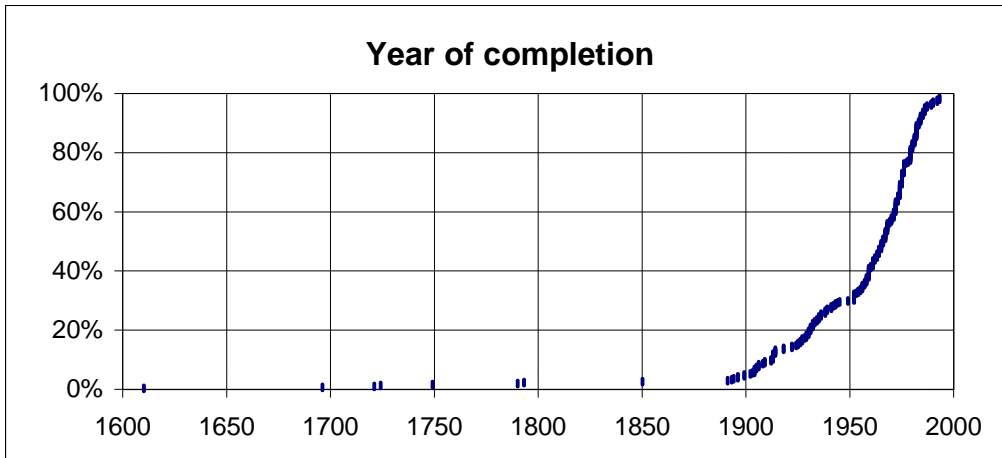
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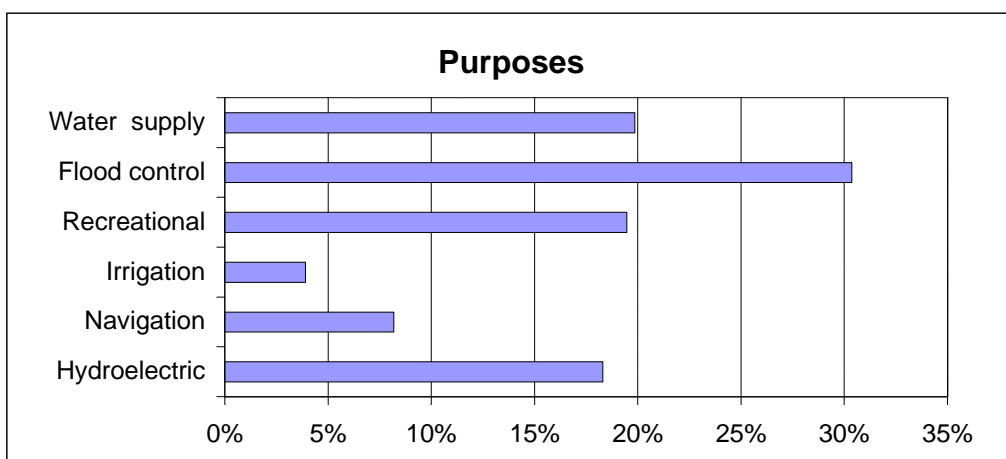
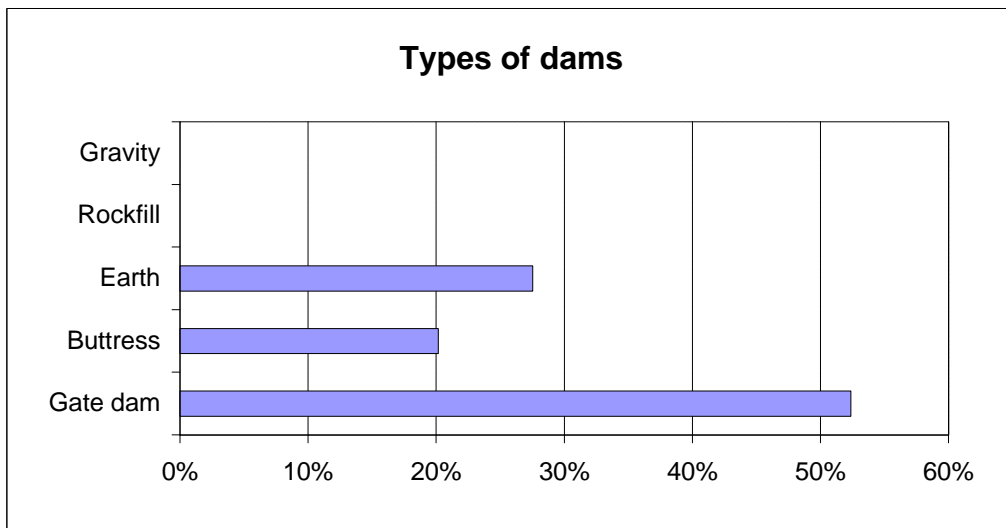
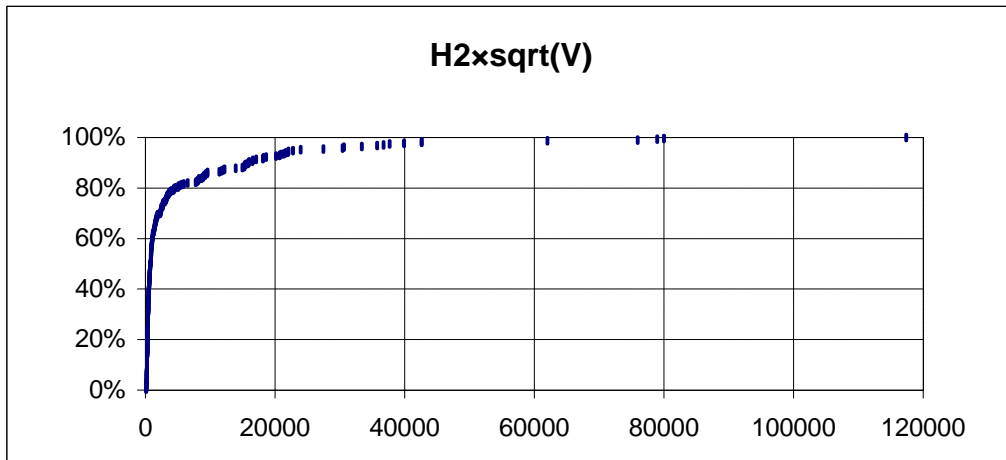
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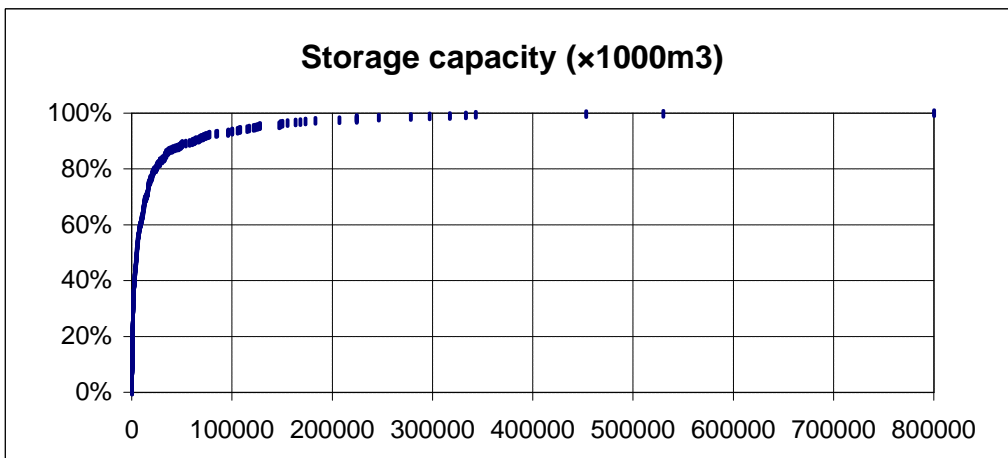
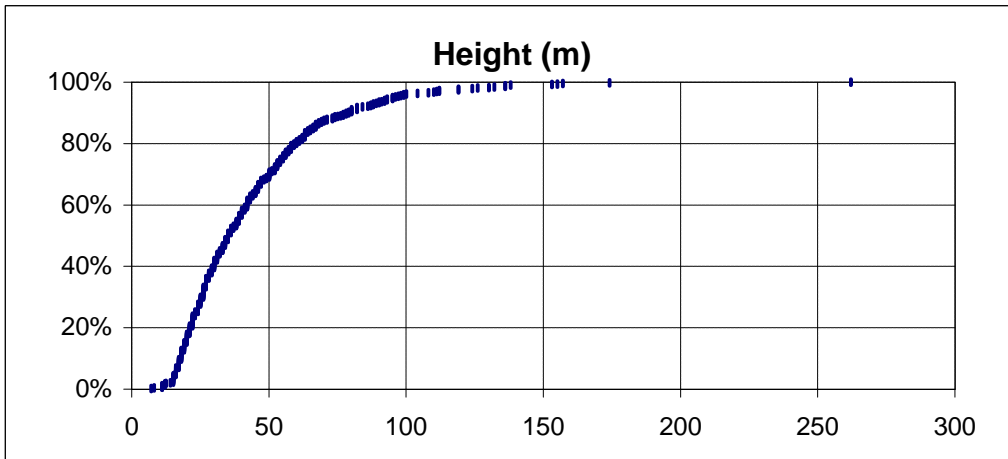
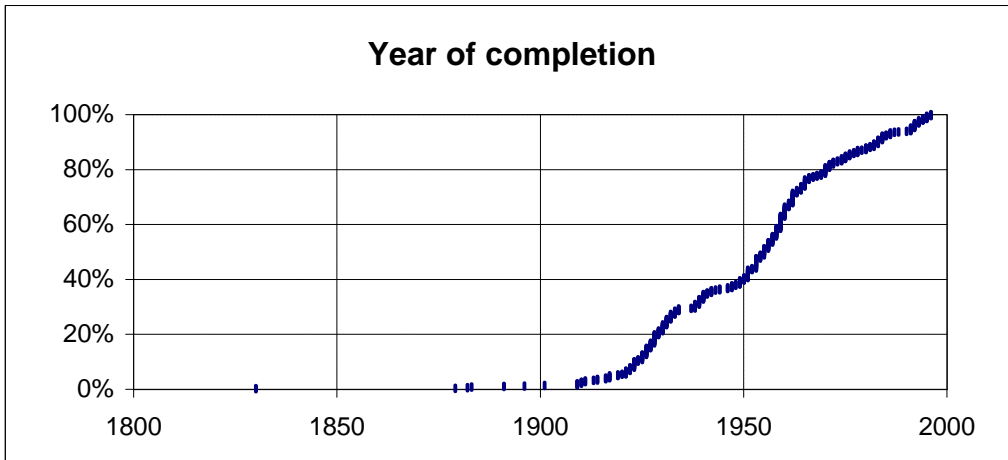
GERMANY



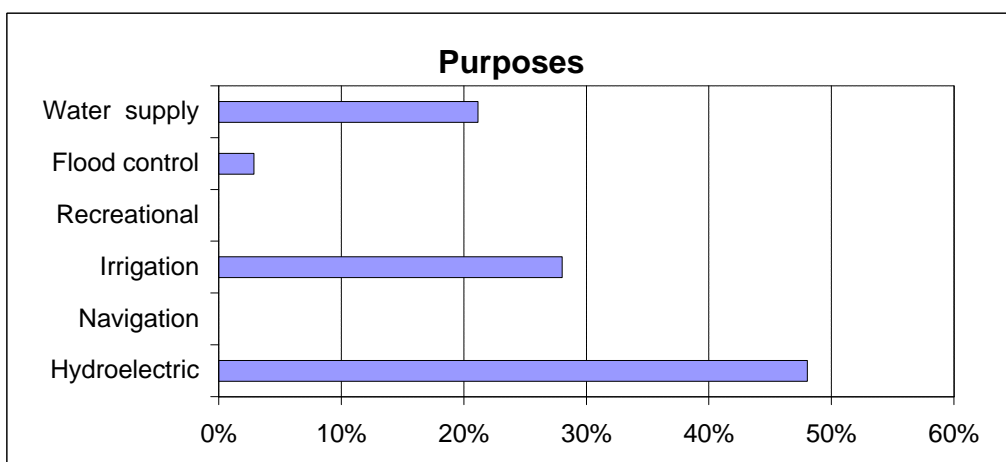
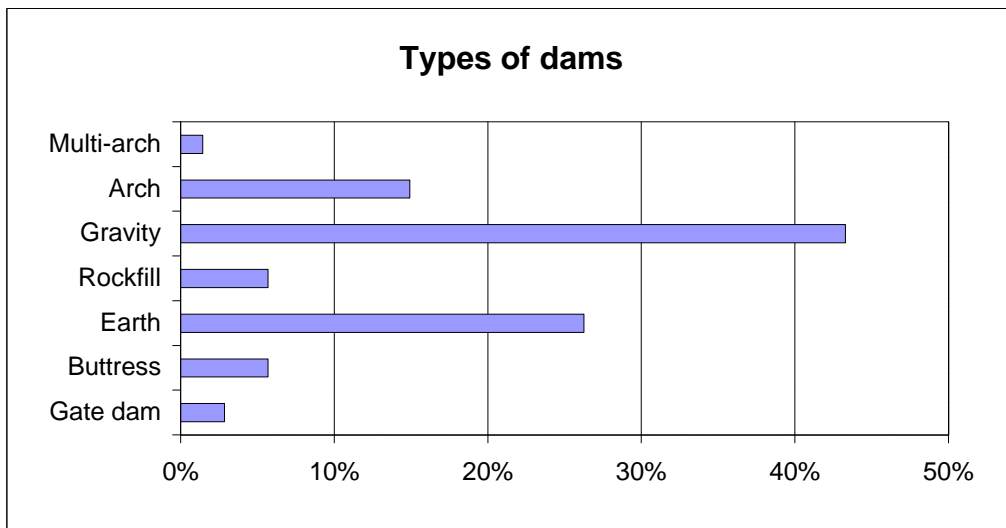
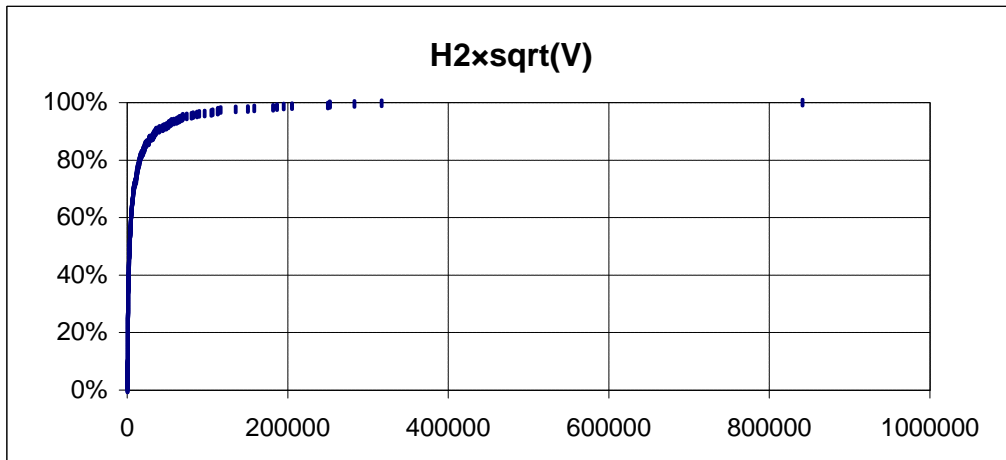
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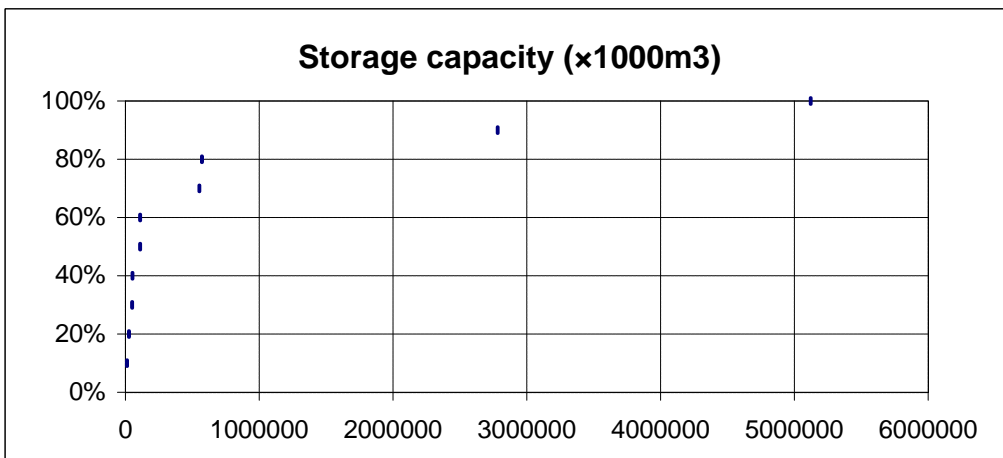
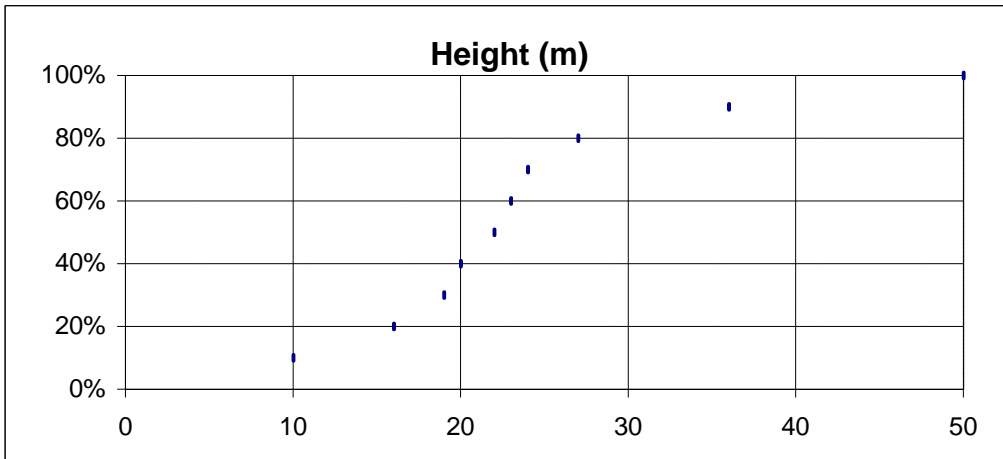
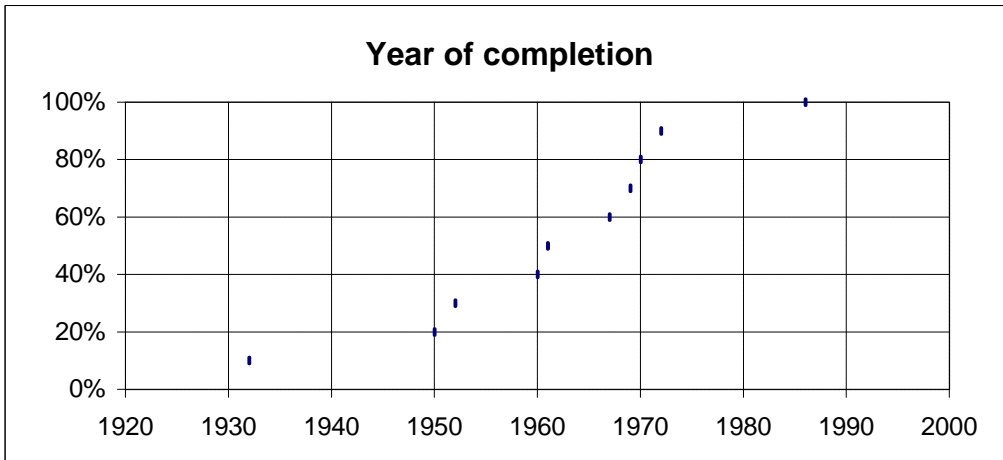
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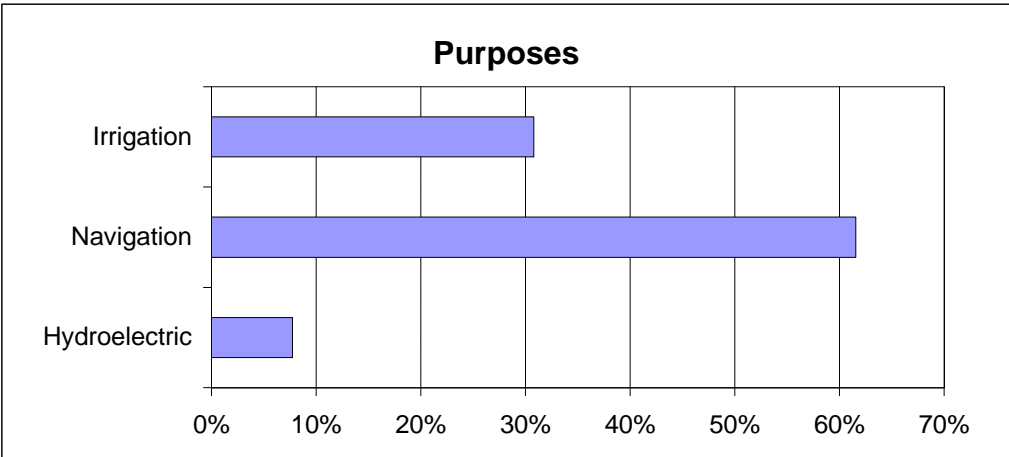
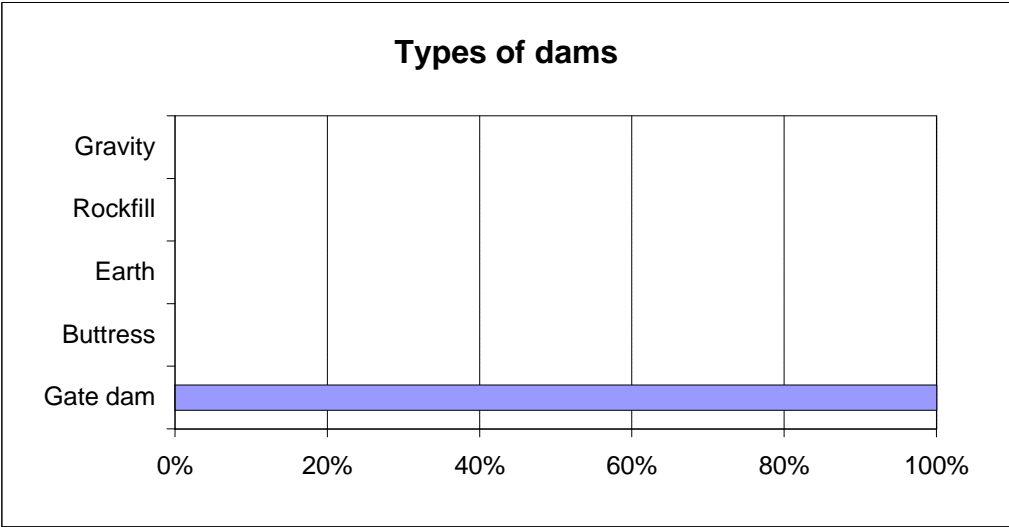
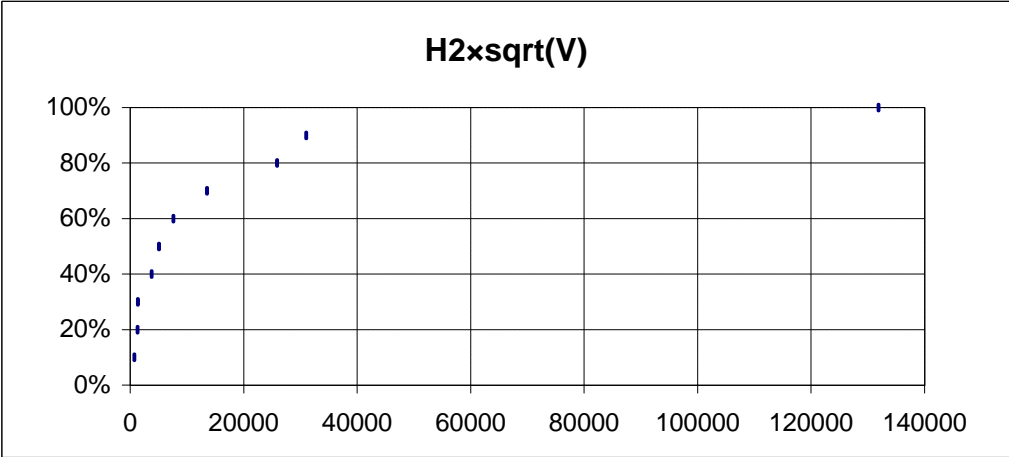
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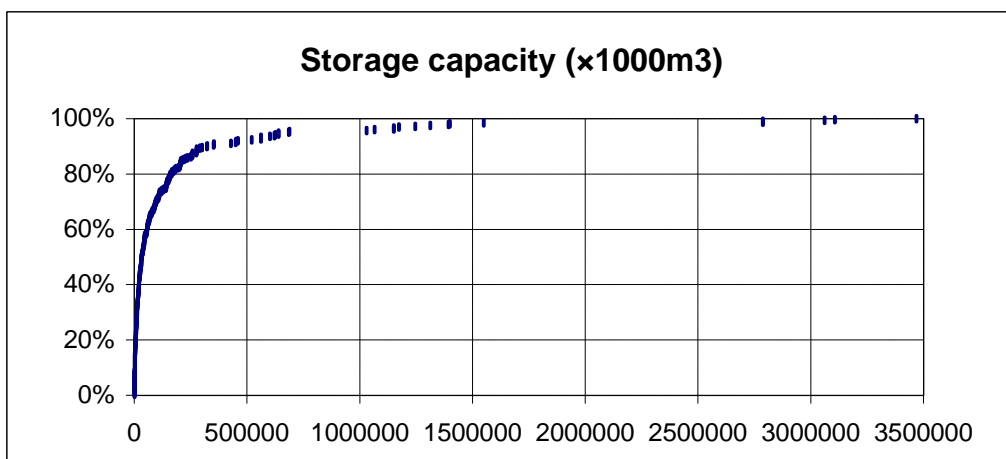
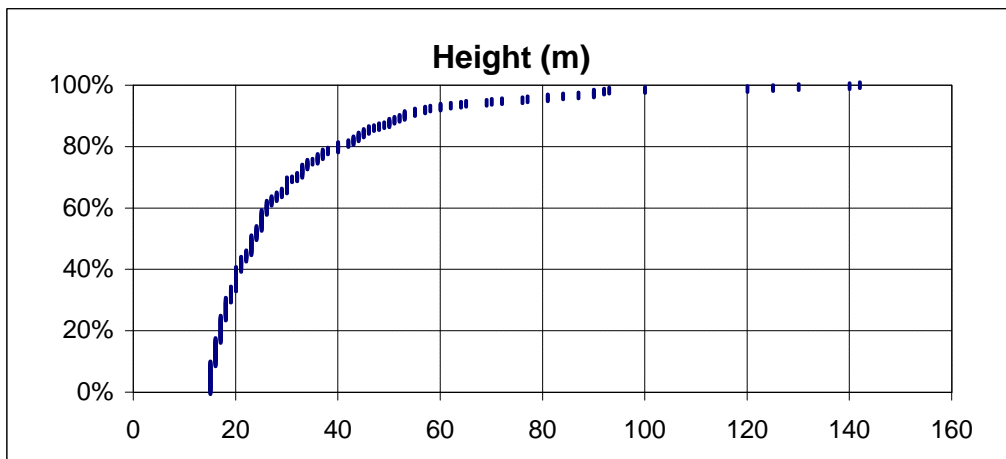
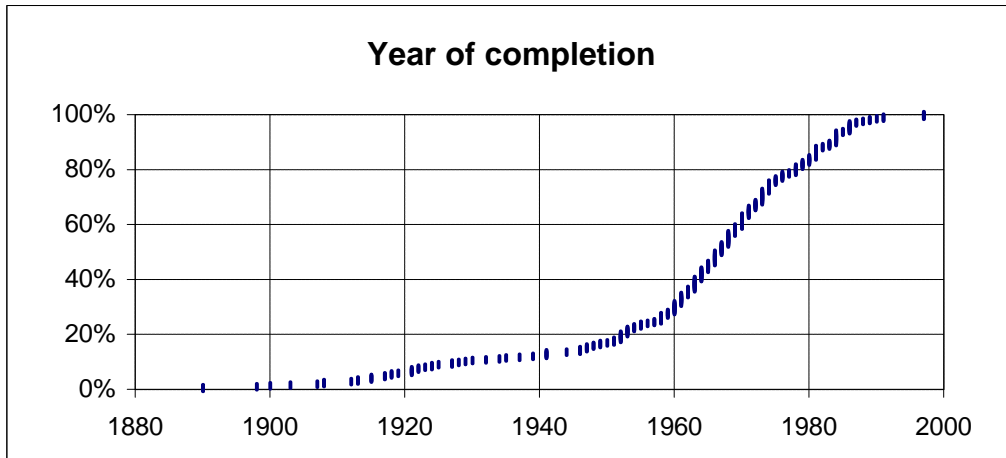
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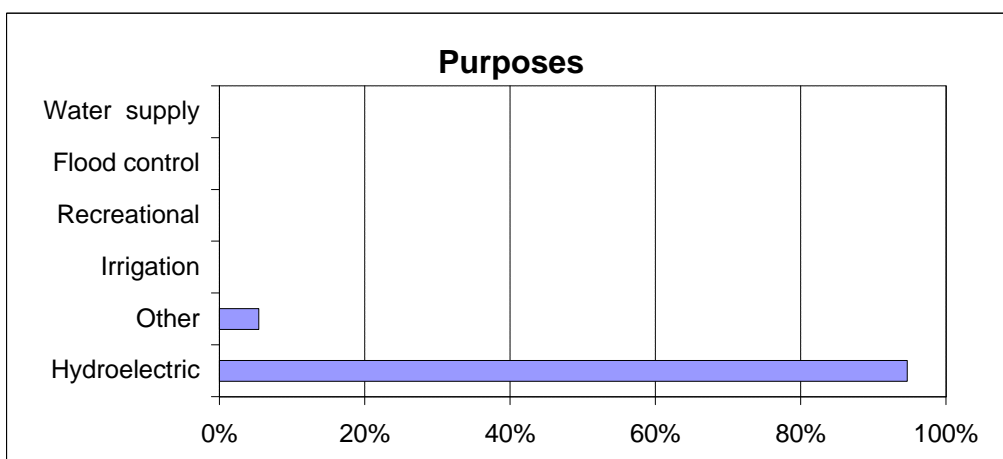
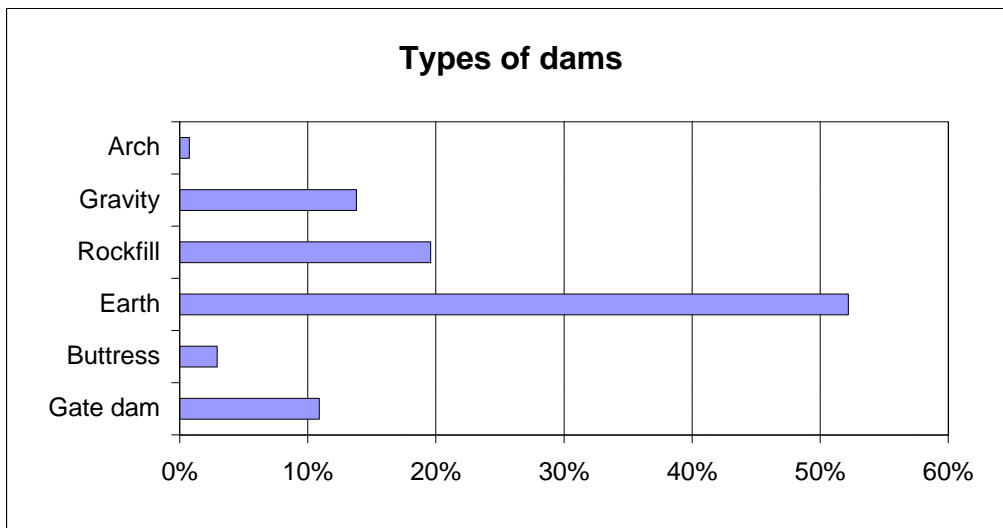
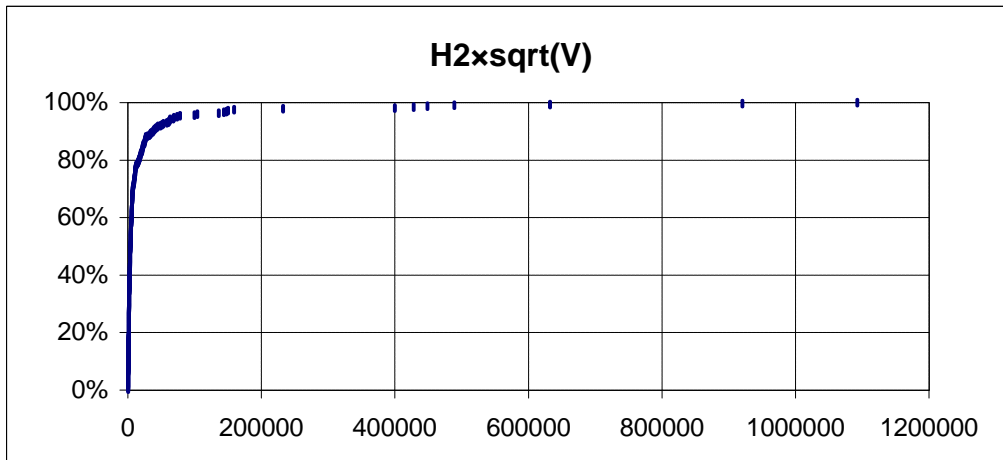
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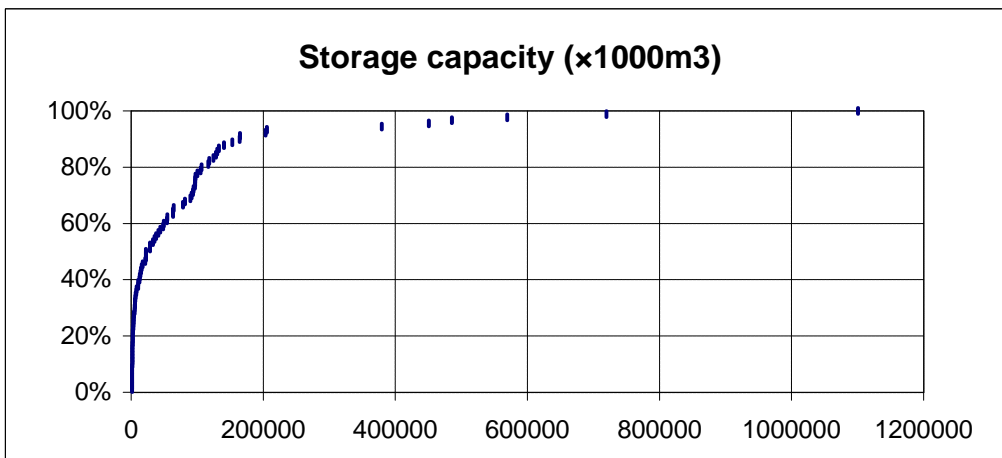
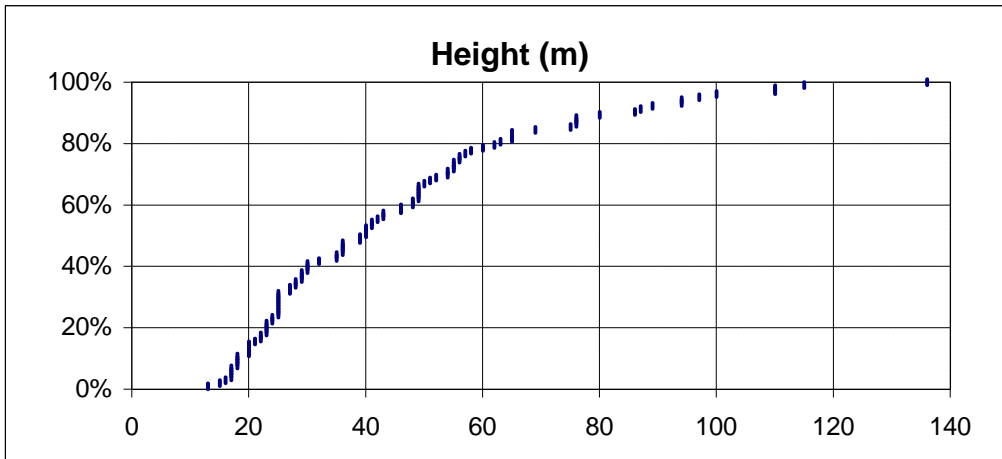
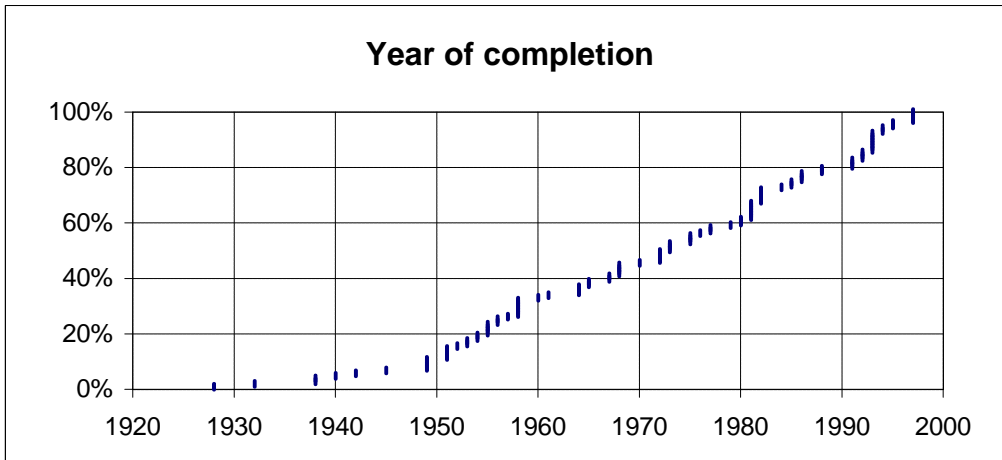
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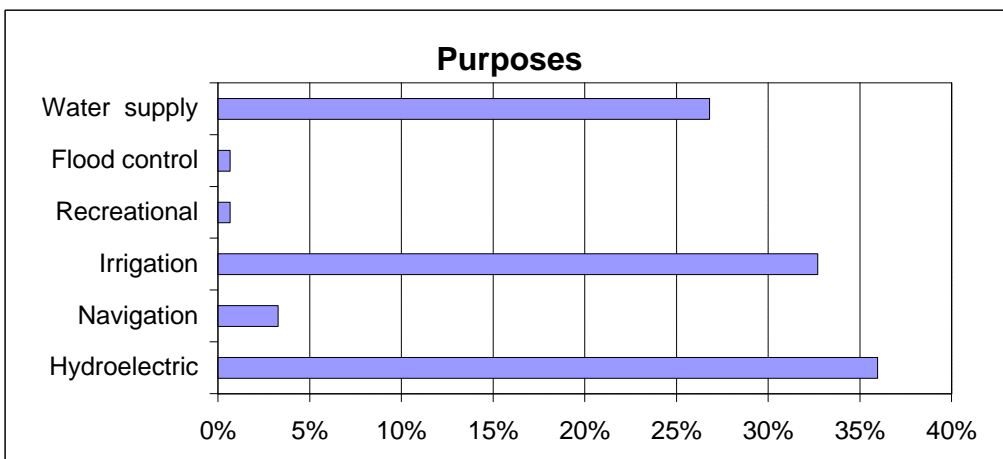
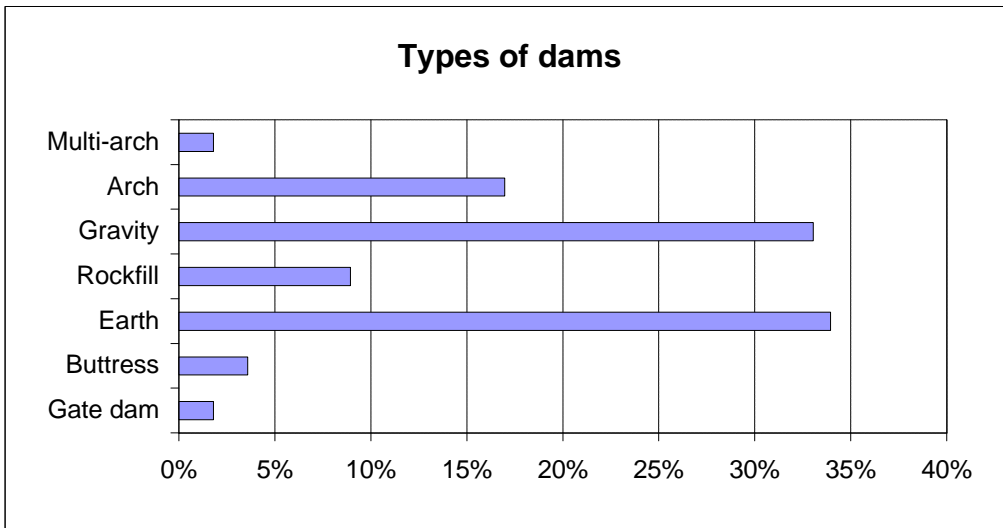
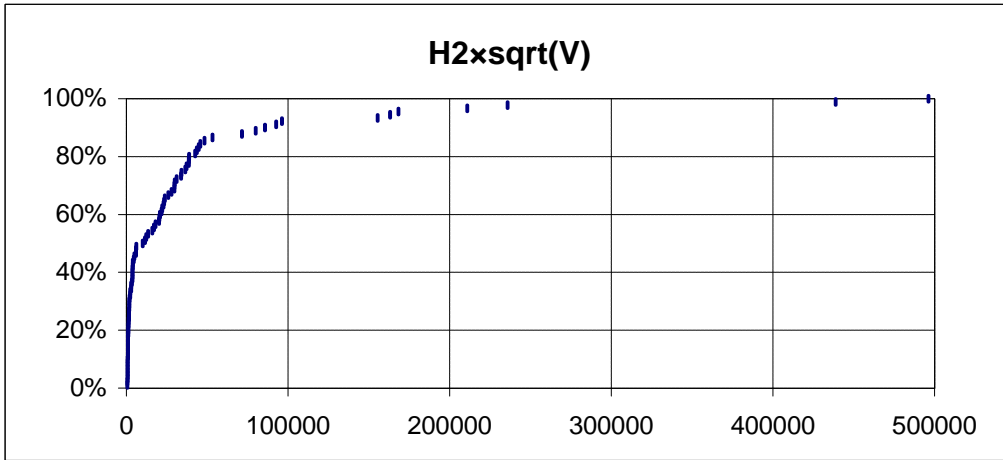
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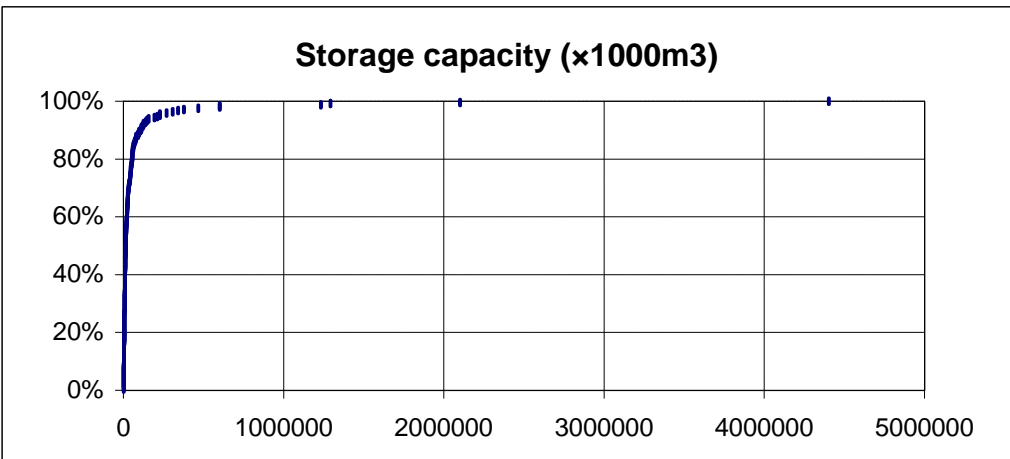
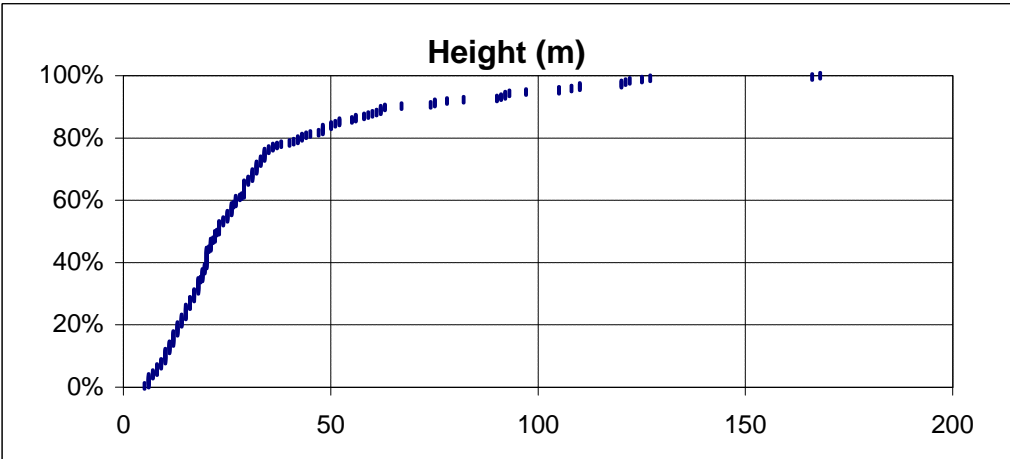
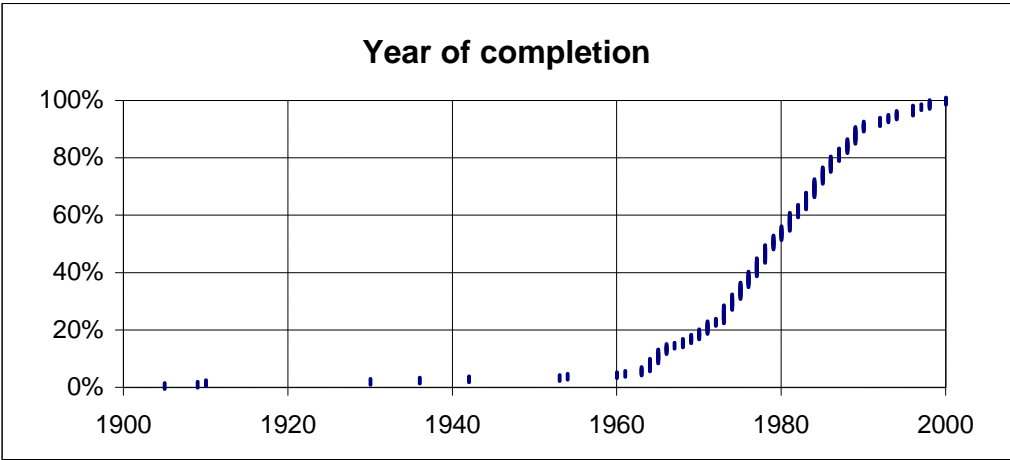
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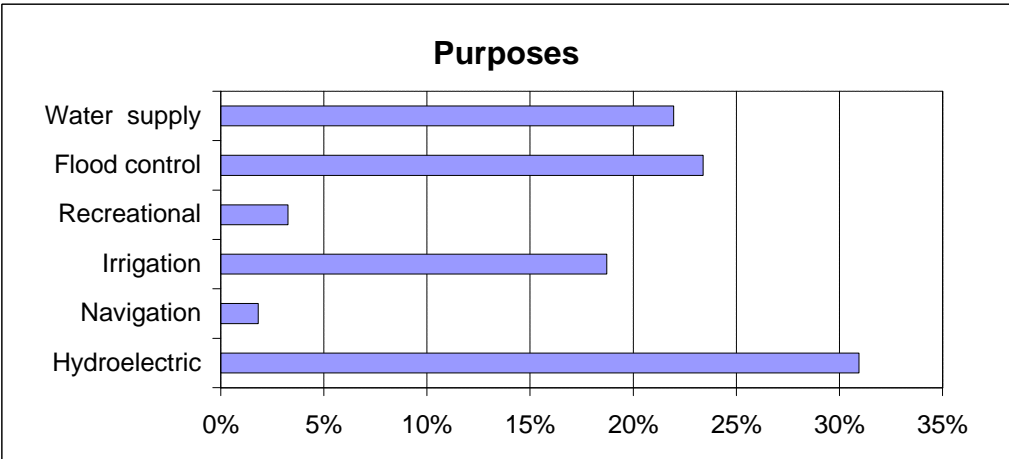
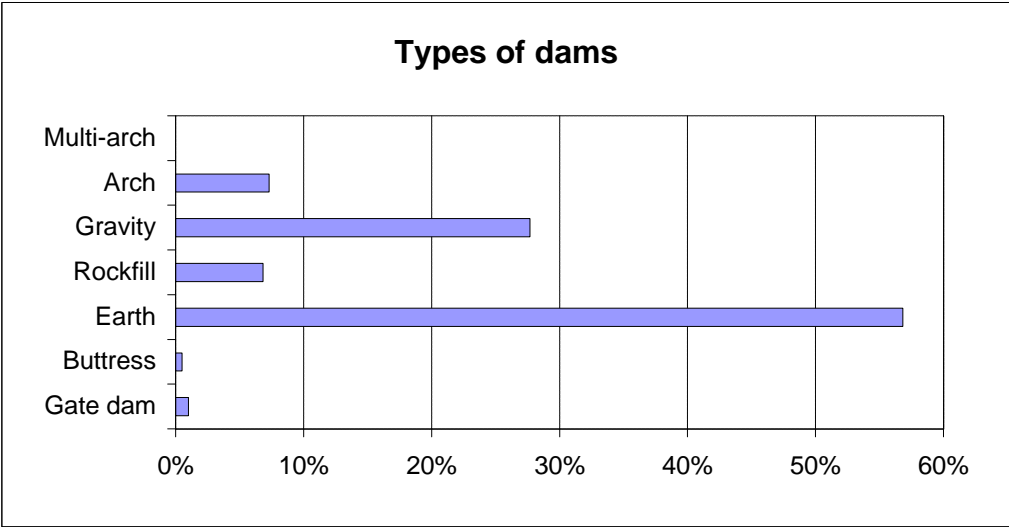
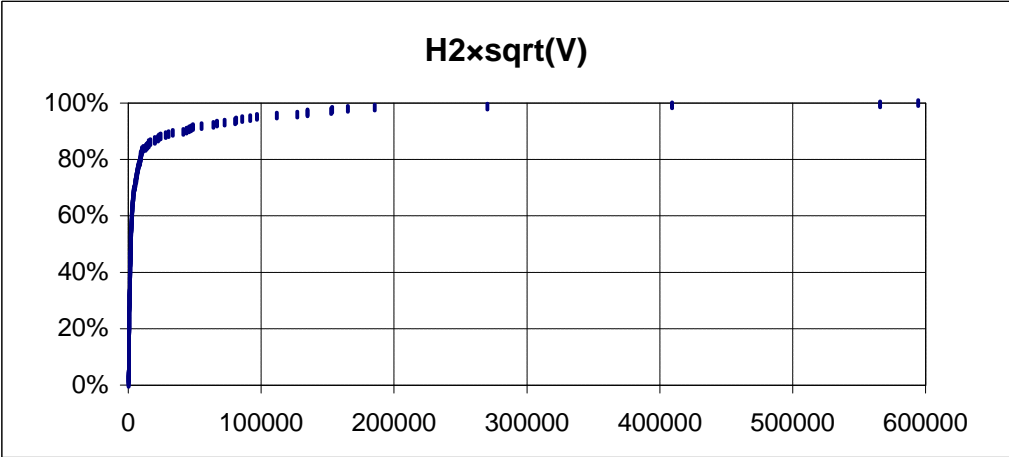
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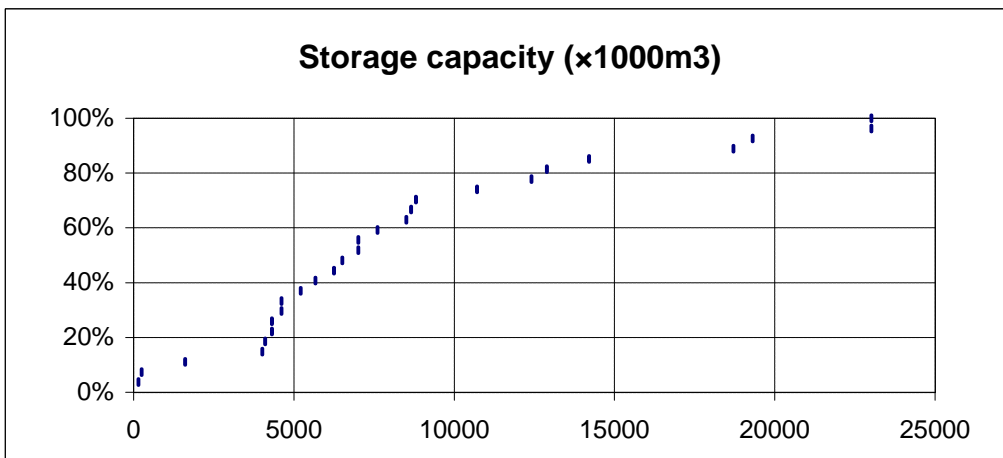
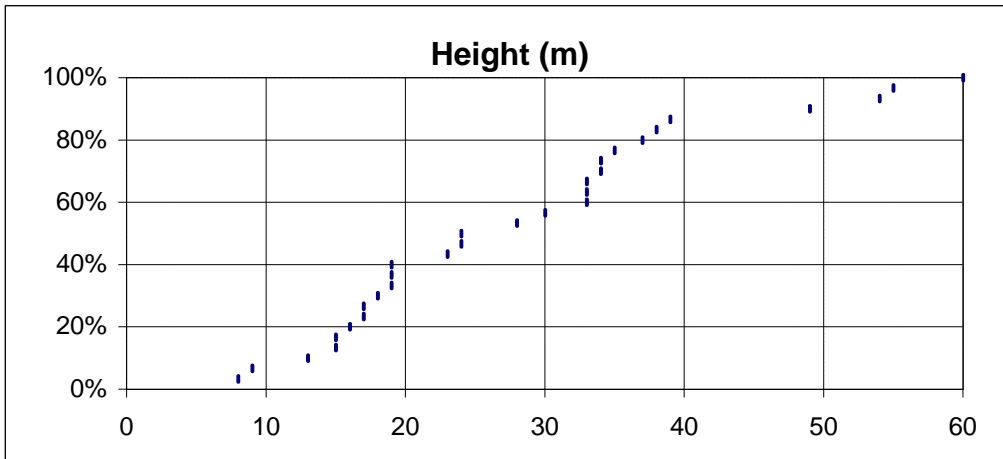
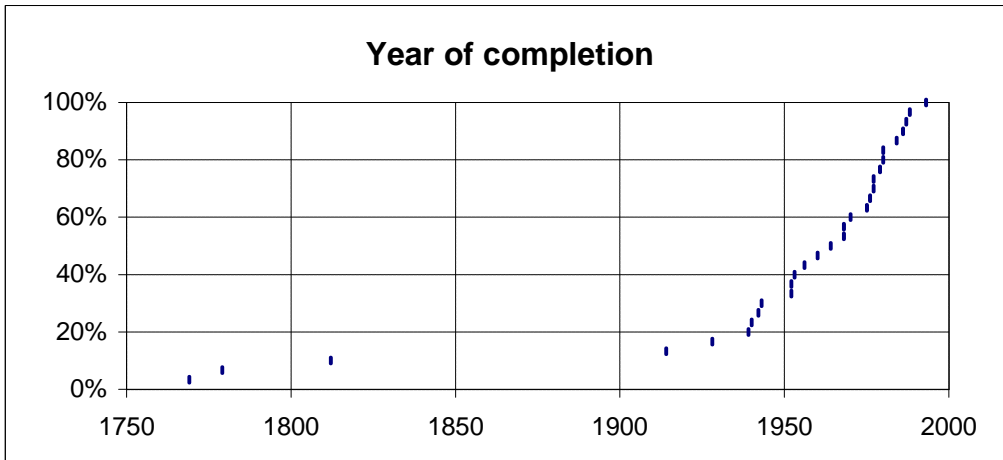
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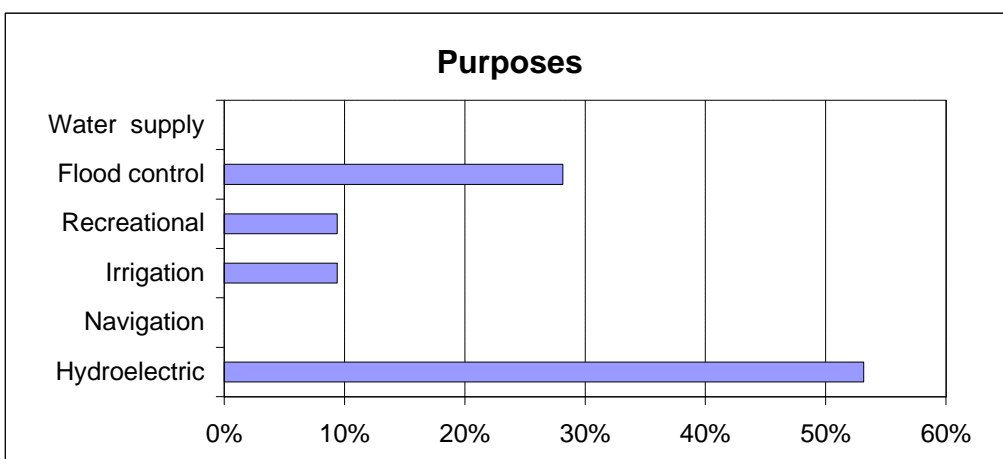
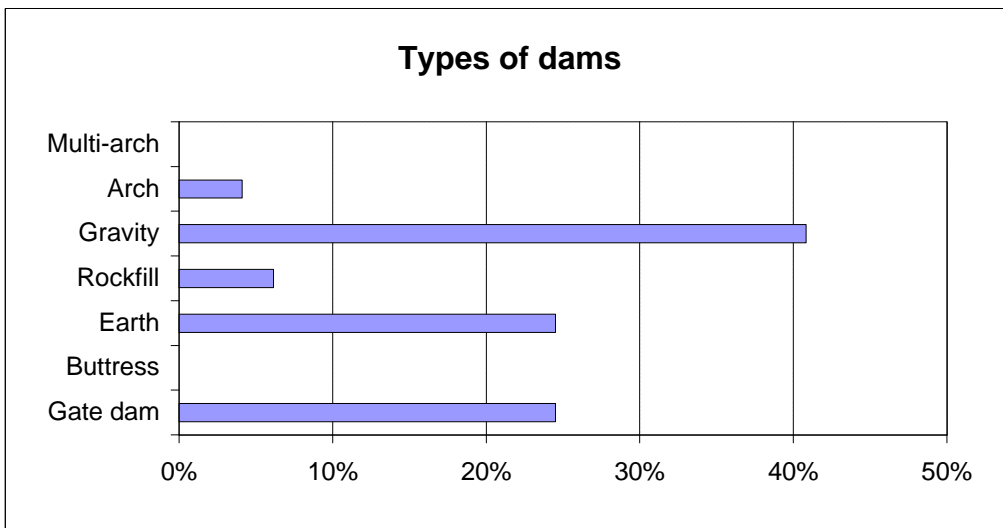
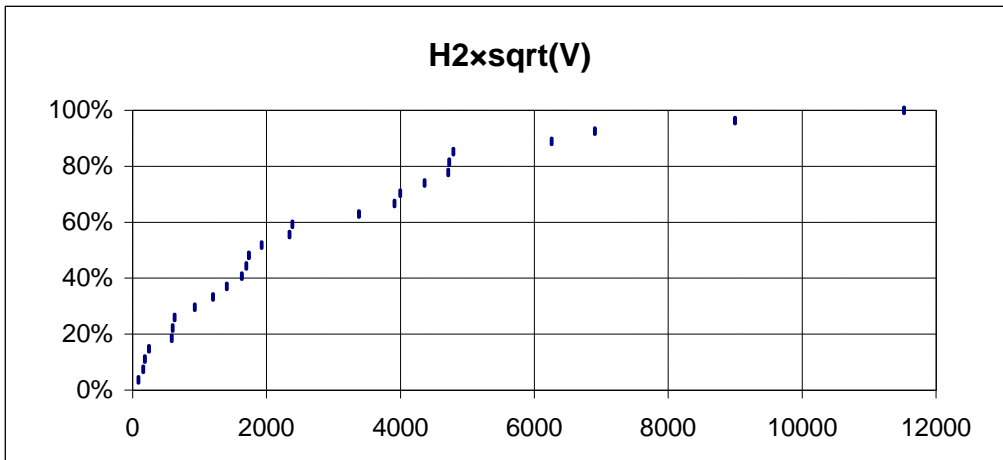
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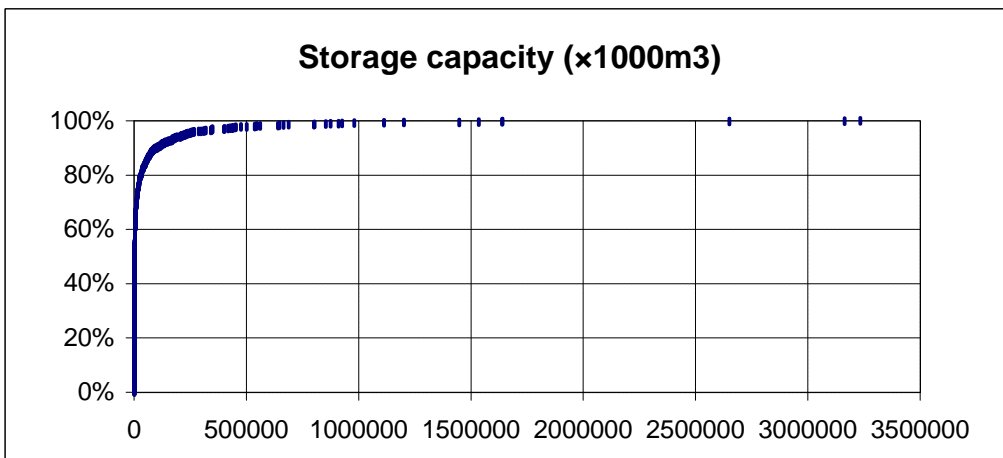
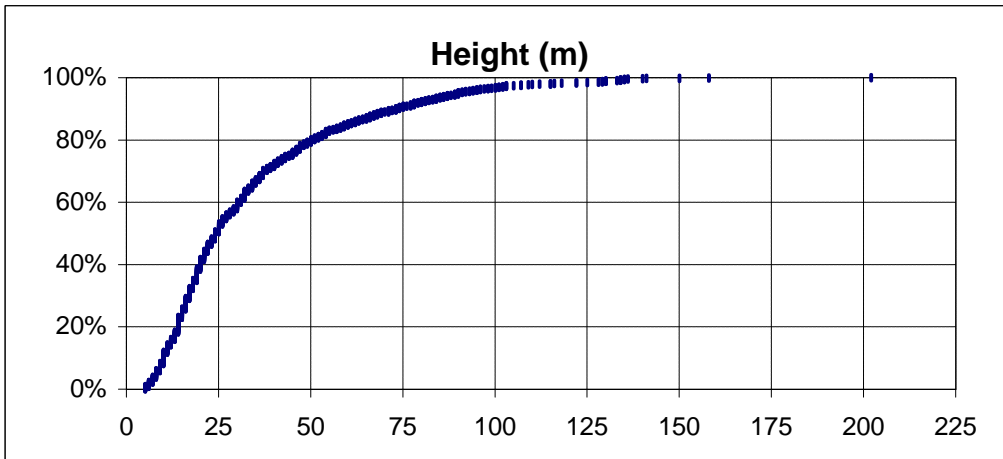
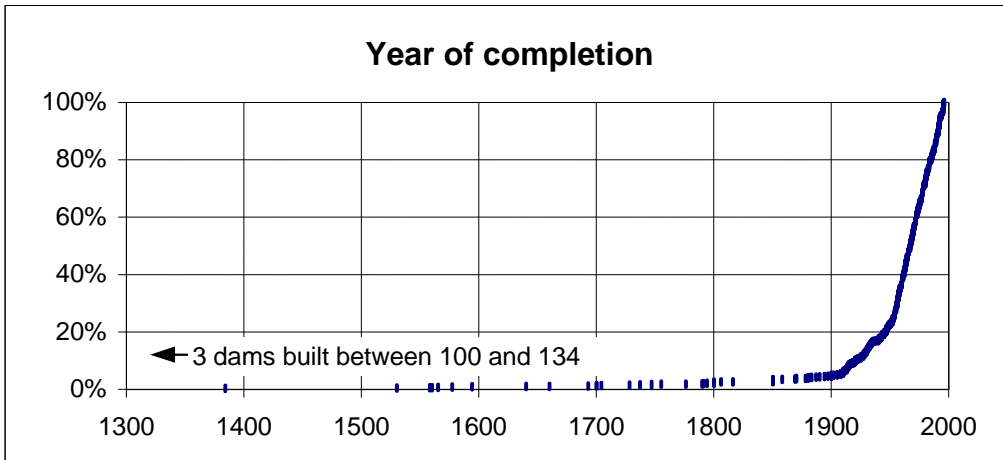
SLOVENIA



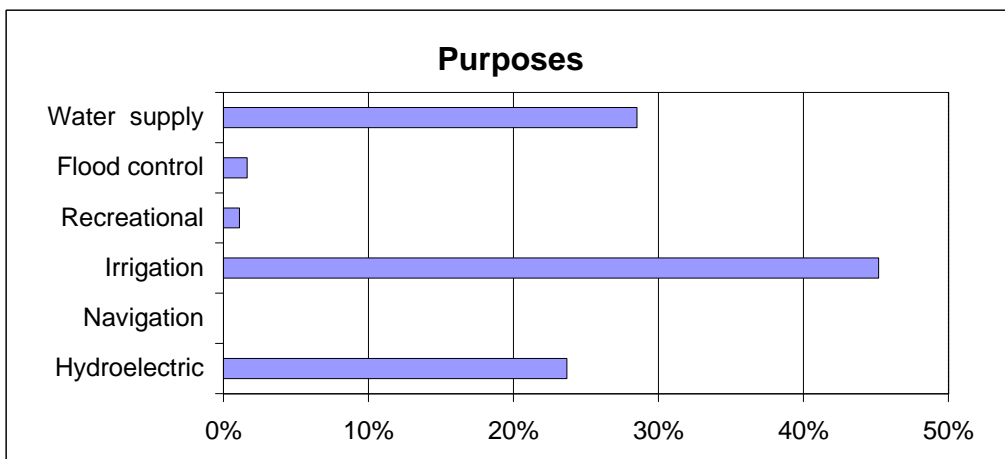
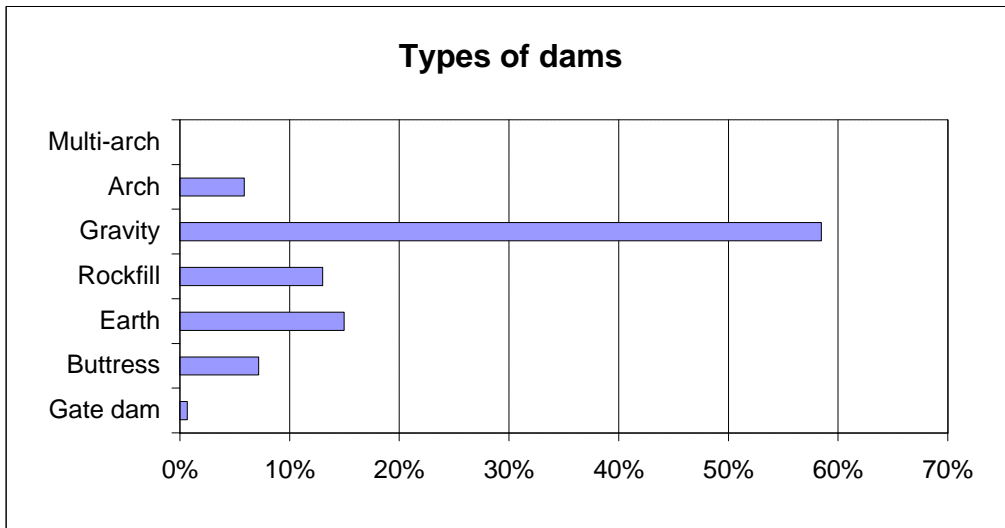
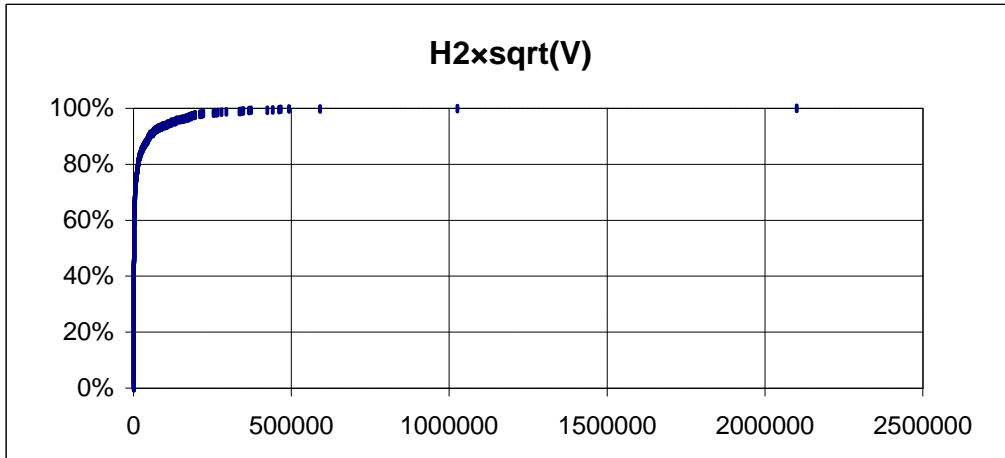
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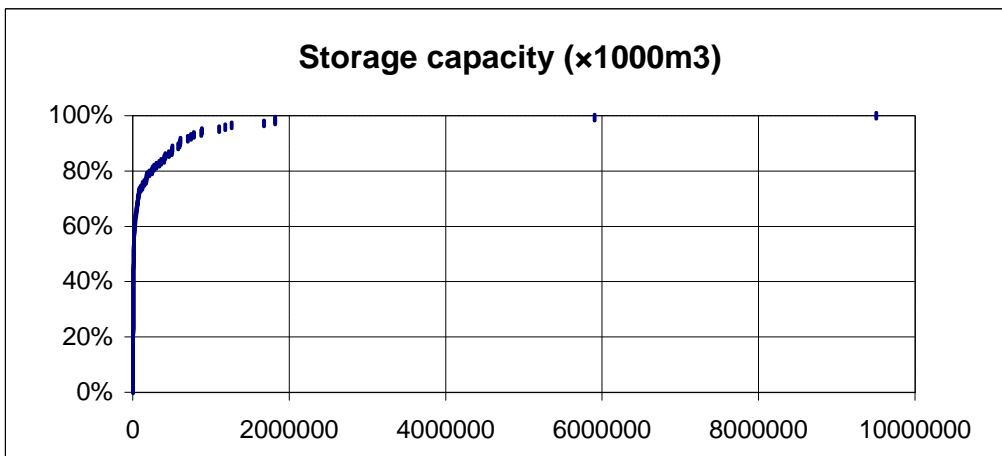
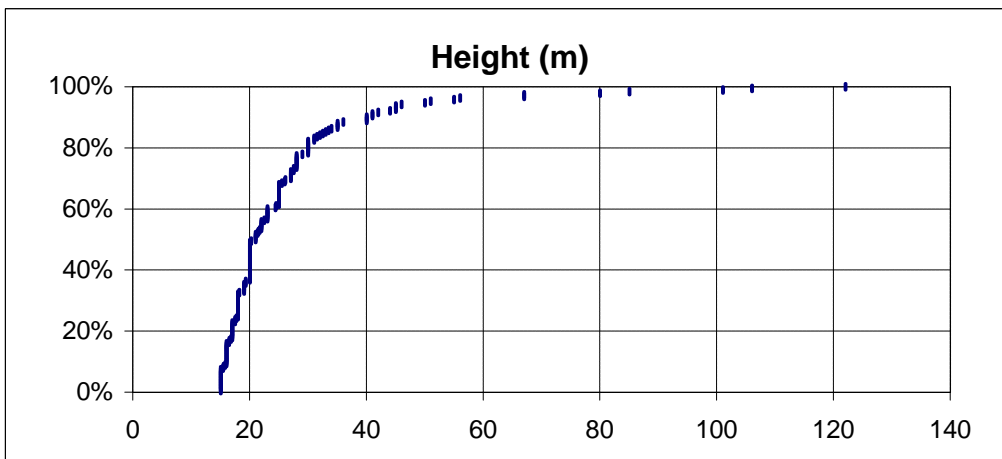
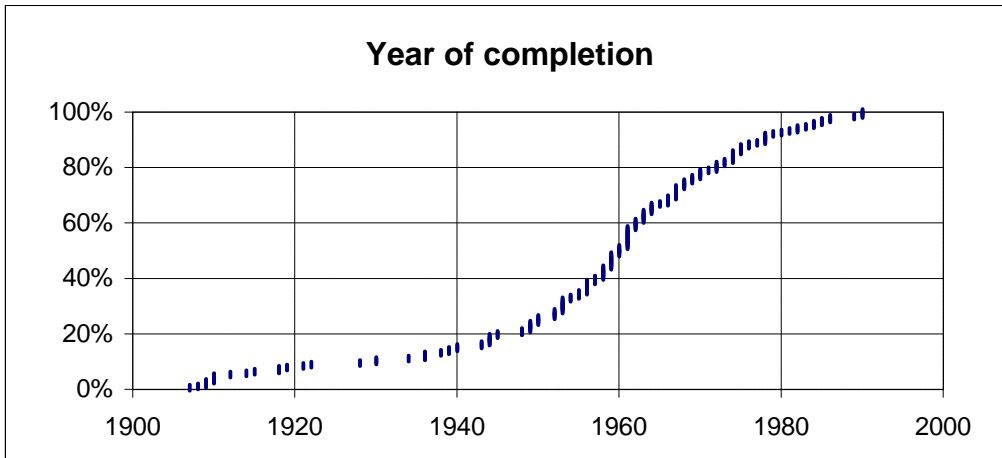
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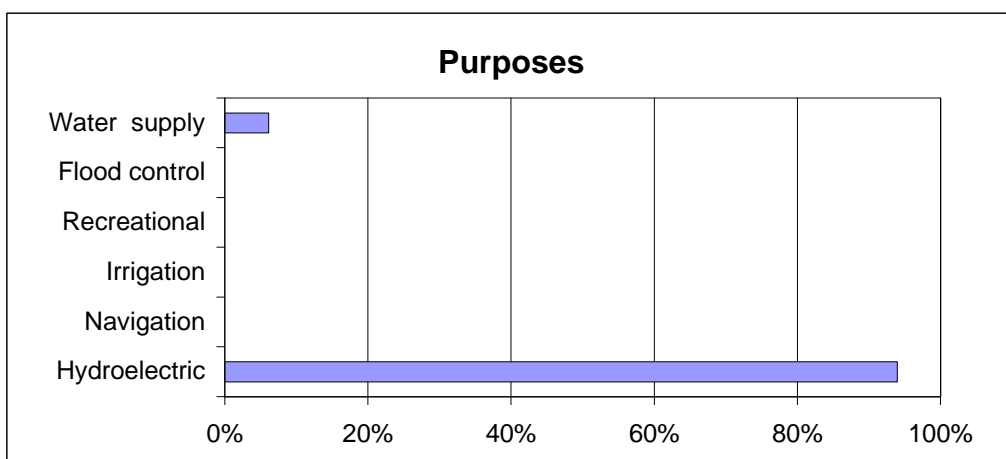
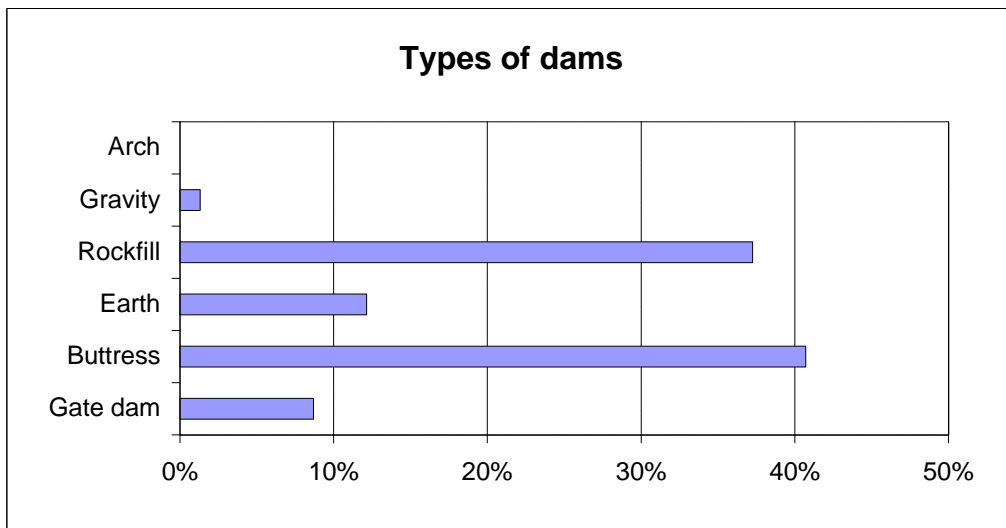
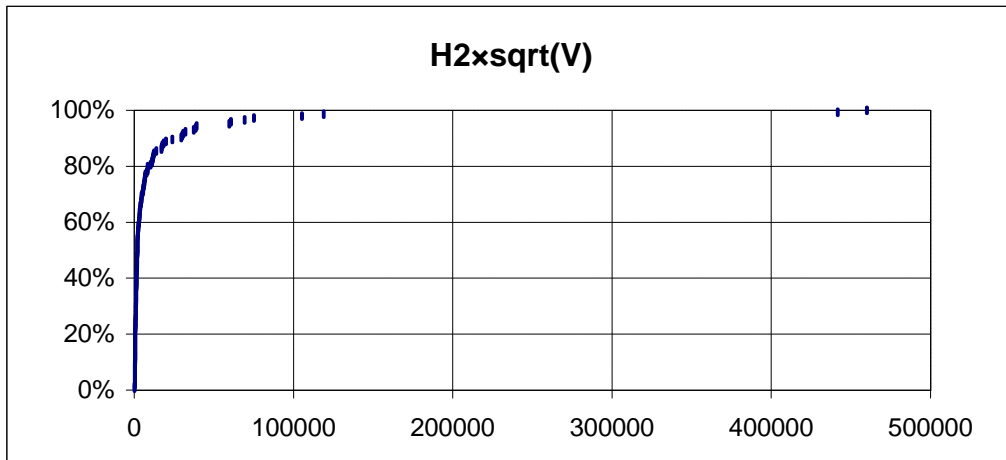
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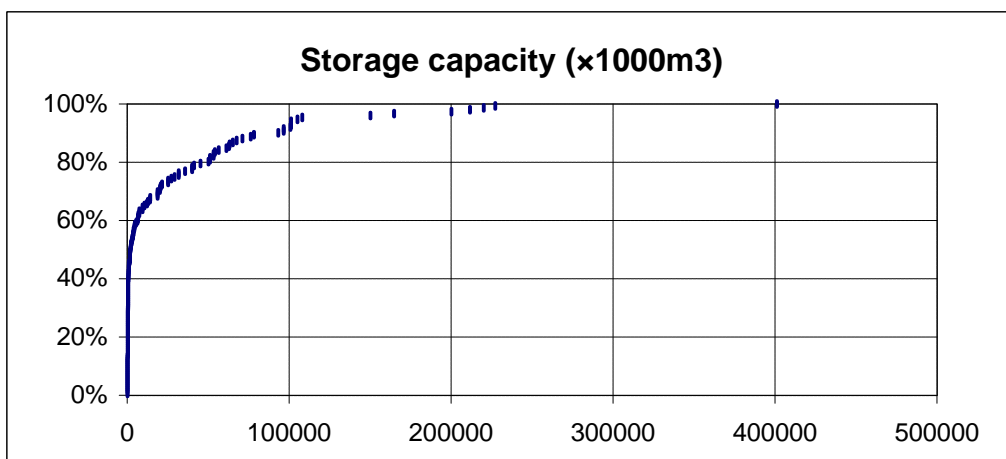
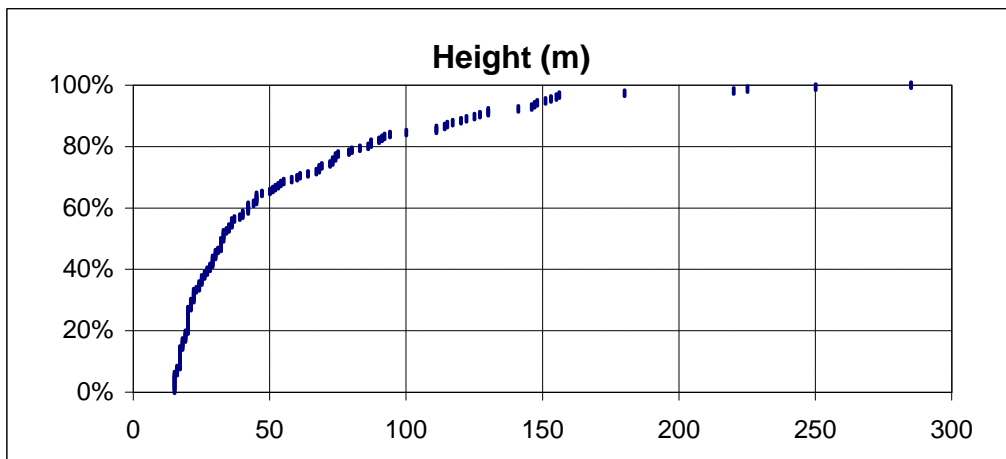
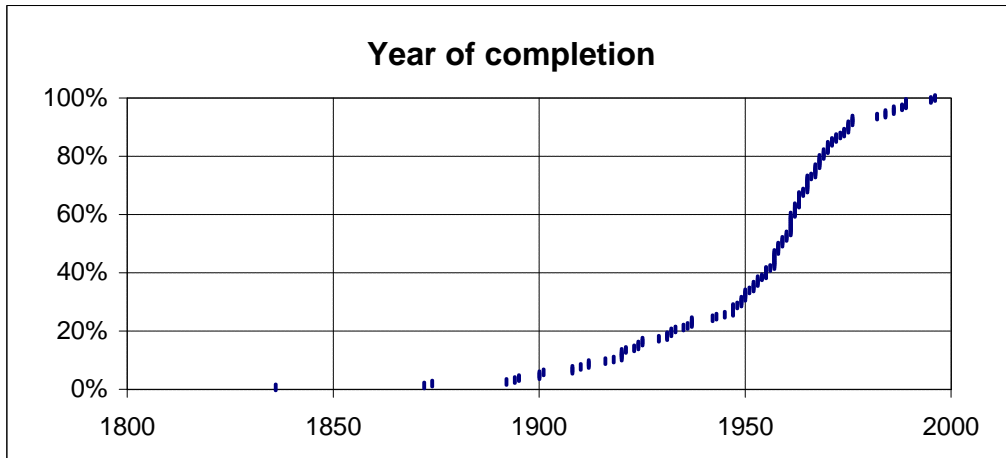
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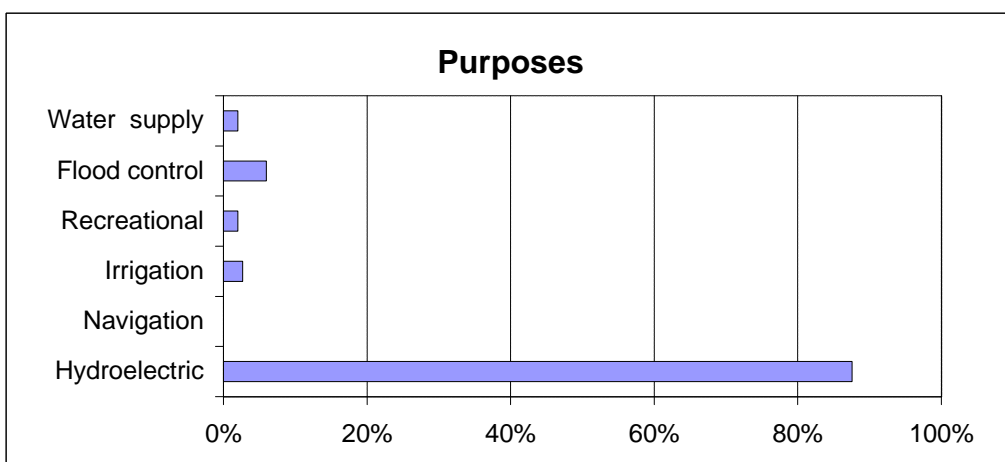
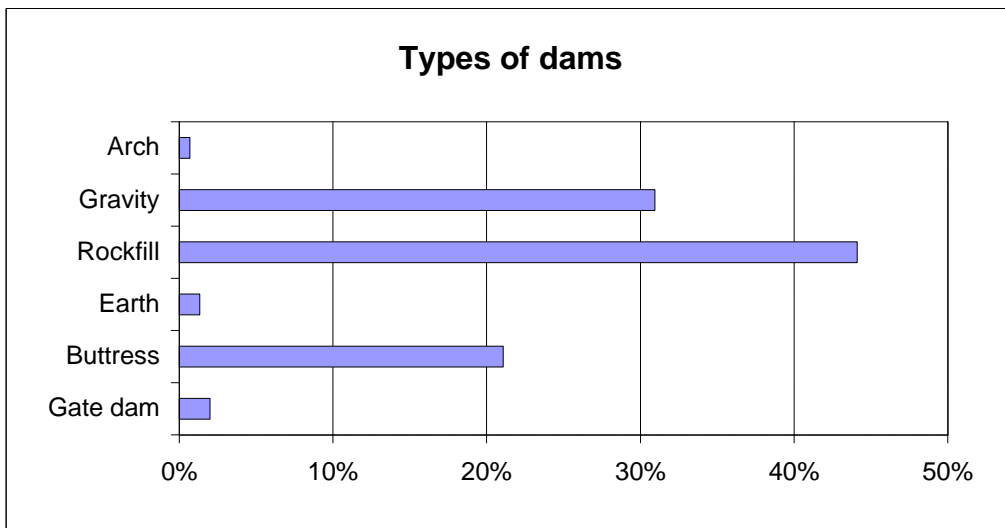
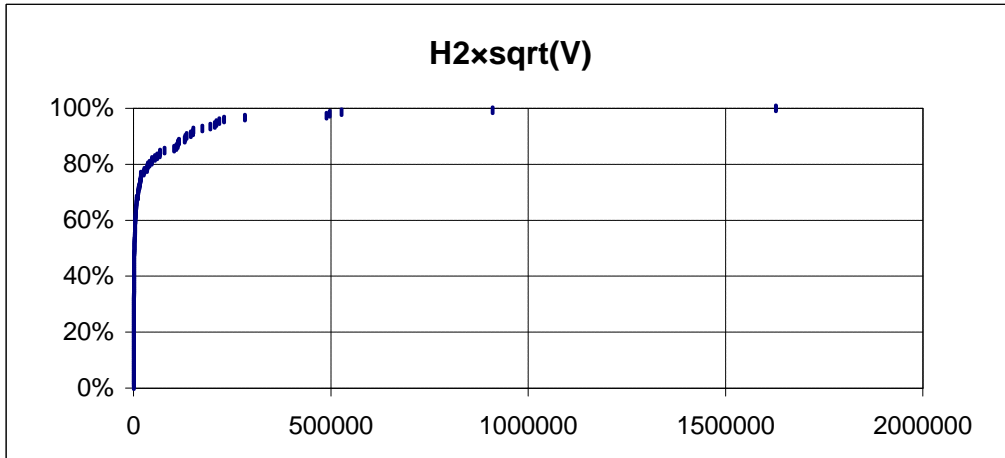
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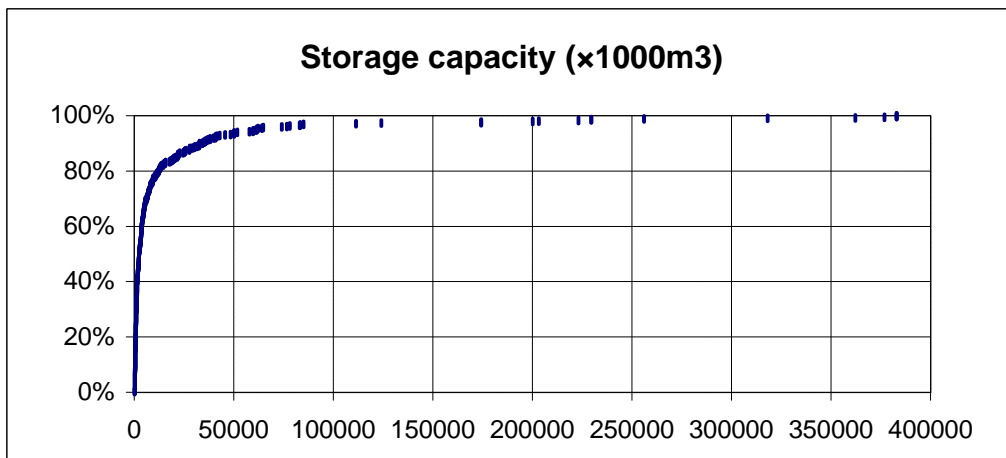
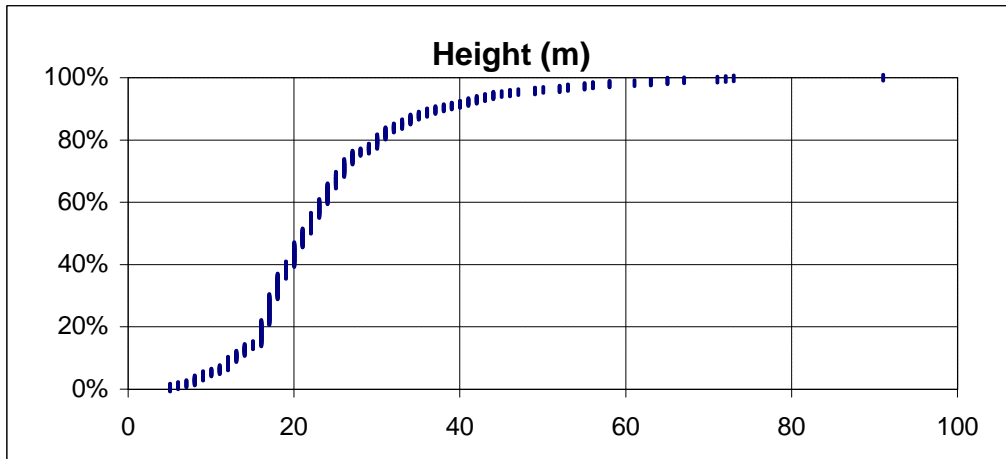
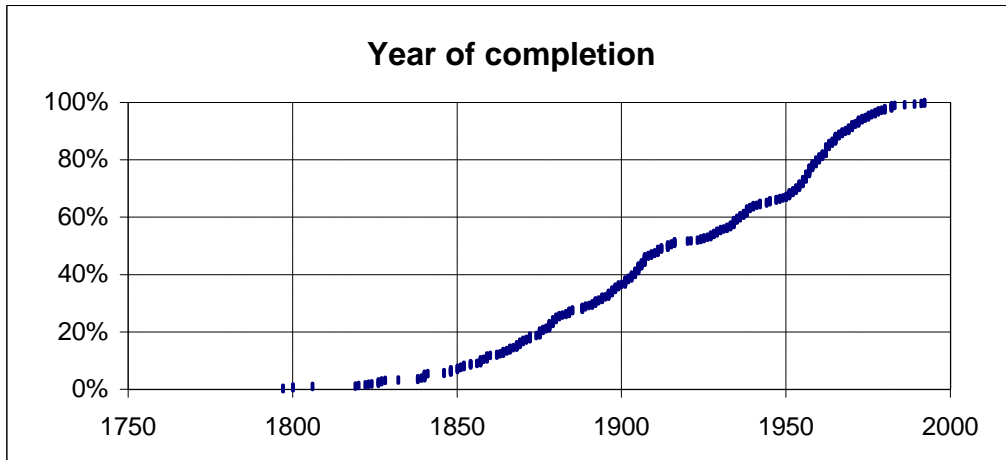
SWITZERLAND



SWITZERLAND



UNITED KINGDOM



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