



ICOLD EUROPEAN CLUB

DAM LEGISLATION

Working Group on Dam Legislation

FINAL REPORT



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 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 Section 2,
 - 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 – without any modification - from the 2001 Report. It contains “almost static” information, only marginally involved in an updating process.

CURRENT UPDATING

Country	Updating Date <i>2001 : by Working Group</i> <i>2007 : by Working Group</i> <i>after 2007 : by National Committees</i>
Netherlands	2017
United Kingdom	2016
France	2015
Sweden	2015
Italy	2014
Ireland	2014
Finland	2014
Switzerland	2014
Slovenia	2014
Spain	2013
Sweden	2012
Norway	2012
Portugal	2007
Austria	2001
Germany	2001
Romania	2001

UPDATING PROCESS – Notes

2011 - Switzerland: confirmation that the information are still up-to-date

2011 – Ireland: information that there is no Dams Legislation

2011 – Finland: full updating

2012 – Norway: full updating

2012 – Sweden: full updating

2013 – Spain: full updating

2014 – Slovenia: full updating

2014 – Switzerland: updating

2014 – France: updating

2014 – Finland: updating

2014 – Ireland: confirmation of information

2014 – Italy: updating

2014 – Netherlands: updating

2015 – Sweden: updating

2015 – France: full updating

2016 – United Kingdom: full updating

2017 – Netherlands: updating

INDEX

SECTION 1 : BASIC LEGAL FRAMEWORK

SECTION 2 : BASIC INFORMATION

- A. Dams subjected to Regulation
- B. Entities concerned
- C. Dam projects
- D. Construction and first filling
- E. Dams operation
- F. The repair of dams
- G. Rules for the protection of the population
- H. Dam decommissioning

SECTION 3: MAIN DOCUMENTS

List and synopses - Files of the legislation documents

ANNEX 1: Some Data about Dams

SECTION 1

Basic Legal Framework

FINLAND

Dam safety legislation covers all dams in Finland, although not all dams are classified. There are some 420 classified dams in Finland.

The first Dam Safety Act and Decree were enacted in 1984. In 1985, the first guidelines for design, construction, operation and inspection of dams (Dam Safety Code of Practice) were published. The legal framework for dam safety has been reformed and the new Dam Safety Act was enacted in 2009 and the new Government Decree on Dam Safety in 2010. In addition, the new Dam Safety Guide is now on trial and will be published in 2012. The Dam Safety Guide will also be translated into English and Swedish.

The Dam Safety Guide explains and describes the contents of the Dam Safety Act and the Government Decree on Dam Safety more in detail. The Guide contains recommendations on how to meet the dam safety legislation requirements and gives some general guidelines e.g. about planning, design, construction, operation, inspection and maintenance of a dam.

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 was largely renewed in 2007 (in particular a general decree of 11th December 2007) and later, following the general law on water (December 2006) even if there are not yet detailed prescriptions for dimensioning and conception. The rules were modified in 2015 (decree of 12th May 2015). All the regulations can be found in “Environment Code” (<http://www.legifrance.gouv.fr/affichCode.do?cidTexte=LEGITEXT000006074220>). State of art is the main guide for the projects of new dams or the checking of the safety of existing dams.

IRELAND

There is currently no specific Dams Legislation in Ireland
Dam safety practised are the responsibility of the dam owners

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 for the design and construction of dams: currently both the Technical Rules issued in 1982 (updating the Part II of the 1959 Regulation) and the new Technical Rules issued in 2014 are applicable (for a 18 months “co-existence period”). Projects under construction, or already approved before the date of entry into force of the updated Technical Rules, can be completed making reference to the old Technical Rules until the end of works and relative acceptance tests.

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.

The “*Part I*” of the Dam Regulation (“General Rules”) is currently under revision. A final draft of the updated “*Part I*” was addressed in 2007 to the political authorities for the issuing process.

There are no Guidelines/Recommendations without legal obligation.

NORWAY

Until the 1980s the safety level for planning, construction and operation of dams was given by technical standards and good engineering practice. In addition there were specific requirements for protection of hydropower facilities against war actions, which also included many dams, given by a Committee for Civil Defense for the Hydropower Sector in Norway (KSFN). The first regulations for dam safety in Norway were issued in 1981 with focus on technical requirements for construction of dams. In the 1990s, requirements for dam owner’s internal control, classification and qualifications were introduced. In 2001, the legal framework for dam safety was revised and 3 new regulations were issued with a legal basis in the Water Resources Act.

In January 2010, a new regulation on safety of dams and other hydraulic structures was issued with a legal basis in the Water Resources Act. This regulation replaces the previous regulations issued in 2001 as well as requirements for protection of dams against war and terrorist actions which had a legal basis in The Energy Act and in the Civil Defence Act. All requirements regarding dam safety have thereby been assembled in one regulation, the dam safety regulation of 2010. There are

requirements for qualifications (of dam owner personnel, consultants and contractors), dam owner organization (presence and responsibility of key personnel), classification, design, construction and operation. In addition to the dam safety regulation of 2010, there are several technical guidelines on dam safety.

The dam safety regulation covers all dams and appurtenant structures, for all purposes (water supply, hydropower etc), and also headrace tunnels and penstocks for hydropower production. The dams are classified in 5 classes according to consequences in case of failure, and requirements are given according to the consequence class. Thus, only a few requirements are given to dams in the lowest consequence class (class 0), while most requirements and also the most severe requirements are given to dams in the highest consequence class (class 4).

The Water Resources Act is approved by the Norwegian parliament, while the dam safety regulation is approved 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. NVE are also responsible to develop guidelines, which extend the requirements in the regulation, and to supervise the dams and the dam owners.

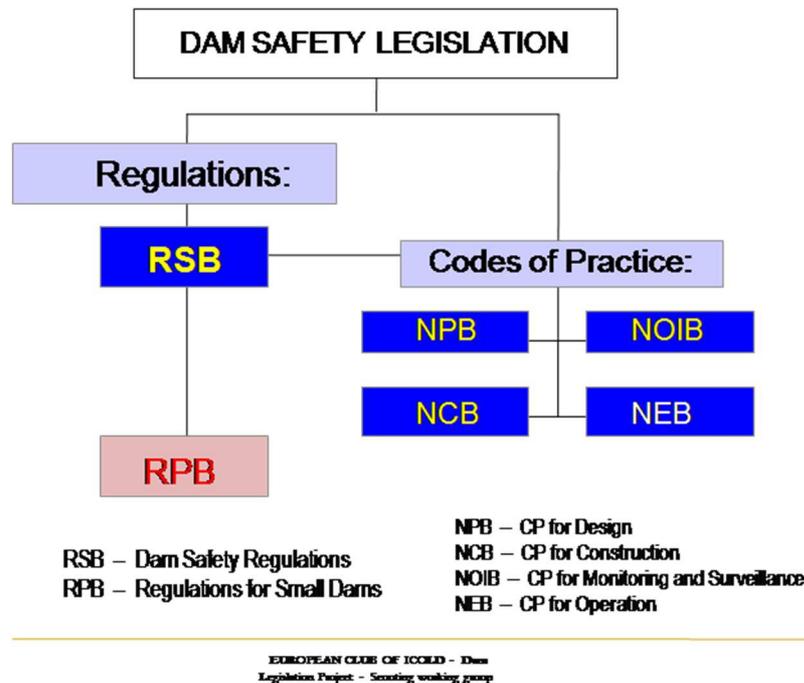
PORTUGAL

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.

SLOVENIA

The legislation covering the dam safety in Slovenia is very loose and scattered, however it sets basic rules for both the planning process, as for the construction and operation of dams and civil protection in extreme situations. Area that is not covered by legislation is the decommissioning of dams.

Dam safety in Slovenia can be divided in 3 levels: structural safety (design and construction phase), operational safety and functionality (exploitation phase, in normal conditions), operation in extreme conditions (emergency action planning and alarming).

The basis for dam safety is given by two acts: Water act from 2002 (for operational phase) and Construction act from 2000 (for design and construction phase). Apart the two mentioned laws there is also the Act of defence against natural and other disasters, which sets as obligatory the elaboration

of Emergency action plans. The acts mentioned above are accompanied by several decrees-standards and rules that regulate more precisely the phase of design, monitoring and elaboration of emergency action plans. However there is no act or regulation that ensembles all the aspects of dams safety in one place.

The regulation that covers the part of spatial planning and the requirements for elaboration refers also to medium and smaller dams, but the regulation of the operational phase (operation and maintenance) mostly applies to large dams, according to old ICOLD classification (definition of large dams used before 2011: dams higher than 15m and dams higher than 10m with reservoir exceeding 1million m³, spillway capacity 2000m³/s, dam crest longer than 500m). However the extent of care can be expanded by rules for operation and maintenance which (according to the water law) should be prepared for a single dam.

SPAIN

The main basic public safety around dams is called *Basic guideline for civil protection against risk of flooding (1994)*, whose main points are the classification of all dams/ponds depending on the potential downstream damages in case of failure or malfunctioning (A, B and C) and the need of emergency action plans for risky dams/ponds (A and B dams).

Furthermore, Spain currently has three dam safety regulations: *Instruction for the project, construction and operation of large dams (1967)*, which applies only to large dams (H > 15 m or between 10 and 15 m and V = 100,000 m³) of private owners, the *Technical Regulation about safety of dams and reservoirs (1996)*, which applies to large dams and dams classified on A and B categories state owned, and since January 2008, the amendment of the Public Water Regulation, which includes the need of developing three Safety Technical Standards which once approved, they will be the only applicable regulations on dam safety.

In the three cases, the dam owner is the main responsible of dam safety.

And as complement to these three regulations, a total of eight Technical Guidelines have been developed by the Spanish National Committee on Large Dams, all of them representing the current state of the art in safety, design, construction and operation of dams.

SWEDEN

Sweden has no specific law concerning dam safety. Rather, several different statutes are applicable to dams and dam safety issues. The most important regulations are found in the Environmental Code and the Civil Protection Act.

The central principle in the Environmental Code is that the owner of an enterprise shall continuously plan and monitor the operations through self-regulation in order to prevent or counteract harm to human health or the environment. He is obliged to acquire the required knowledge, investigate and evaluate the risks related to the enterprise, draw up and follow routines for self-regulation, as well as to take the measures required and have preparedness in order to avoid damage. The Owner is obliged to maintain the dam and in doing this he shall use the best available technology and the precautionary principle. Should a dam failure nevertheless occur, then the owner is liable for damage caused by the dam failure. Within this set of rules and regulations there are also government ordinances concerning owners' self-regulation and the role of supervisory authorities.

In 2014 new legal requirements on dam safety was introduced in the Environmental Code and a Dam Safety Ordinance was enacted. The main revisions include the introduction of a consequence classification system, with dam safety classes A, B and C, for dams based on an assessment of the societal consequences of a dam failure. (Dam safety class A – severe national consequences, B - severe regional and local consequences, C – severe local consequences from a societal point of view in the event of a dam failure.) Furthermore the owners of classified dams are required to establish and work according to a safety management system, to conduct safety reviews and to submit annual dam safety reports and to pay an annual fee to the supervisory authority.

The aim with the Civil Protection Act is to give equal protection against accidents for people's life and health as well as for property and environment in the whole country, taking local circumstances into consideration. Dams and other facilities where an accident may result in serious damage to people or the environment are classified as dangerous activities, with special demands on emergency preparedness.

The power industry and the mining industry have drawn up technical guidelines for dam safety. The guidelines address design, construction, operation, maintenance, surveillance and emergency preparedness planning for dams. Guidance on dam safety and dam safety management are set in relation to the assessed consequences of a dam failure-

UNITED KINGDOM

The United Kingdom comprises four regional administrations, England, Wales, Scotland and Northern Ireland. Reservoirs in England and Wales are regulated under the Reservoirs Act 1975, as amended by the Flood and Water Management Act 2010, and this is enforced by the Environment Agency in England and Natural Resources Wales, in Wales.

In Scotland the Scottish Environmental Protection Agency enforces the Reservoirs (Scotland) Act 2011.

Reservoirs in Northern Ireland are regulated by The Reservoirs Act (Northern Ireland) 2015. This act is being implemented in phases by a division within the Competent Authority referred to as the Reservoirs Authority.

SECTION 2

Basic Information

- A. Dams subjected to Regulation**
- B. Entities concerned**
- C. Dam projects**
- D. Construction and first filling**
- E. Dams operation**
- F. The repair of dams**
- G. Rules for the protection of the population**
- H. Dam decommissioning**

A. DAMS SUBJECTED TO REGULATION

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 apply to all dams in Finland regardless of its height. This includes watercourse dams, flood embankments, tailings dams and waste dams that are used to impound liquids or solids that are harmful or dangerous to health or the environment.

Dams are classified by the type of hazard they pose if an accident occurs:

- Class 1 dam, which in the event of an accident causes danger to human life and health or considerable danger to the environment or to property.
- Class 2 dam, which in the event of an accident may cause danger to health or greater than minor danger to the environment or to property.
- Class 3 dam, which in the event of an accident may cause only a minor danger.

The dam safety authority makes a decision on the classification of a dam based on the documentation provided by the dam owner. The classification is not needed if the dam safety authority considers that the dam does not cause any danger.

All dams, including non-classified dams, have to be kept in such a condition that the dam is safe. The dam owner is always responsible for the dam.

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 (decree of December 2007) divided the dams into three classes (A, B and C) according to the height H of the dam above ground level and the normal volume V of the reservoir. The index C is so calculated :

$$C = H^2 \times V^{0.5} \text{ where } H \text{ is in meter and } V \text{ in millions of cubic meters}$$

Class A : dams with H above or equal to 20m and with C above or equal to 1500.

Class B : dams not in class A and with H between 10m and 20m and with C above or equal to 200.

Class C : dams following one of the 2 conditions :

- not in class A and B and with H higher than 5m and C above or equal to 20
- not in class A,B and with H higher than 2m and $V > 50000 \text{ m}^3$ and with at least one inhabitant within 400m downstream of the dam.

When this is imposed by a special level of risk, the authorities can modify the class of a dam. Furthermore, dams higher than 20 m and with a reservoir above $15,000,000 \text{ m}^3$ (and other dams when needed) are subjected to a regulation for emergency planning.

The inventory of the dams is still in progress (especially for smaller ones). There are about 220 dams of class A, 420 of class B, 2000 dams of class C and several dozens of thousands of dams not classified but with H above 2m.

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. $h > 5 \text{ m}$ and $V > 100,000 \text{ m}^3$ 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
$h > 5 \text{ m}$ and $V \geq 100.00 \text{ m}^3$	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.

ITALY

The "large dams" subjected to the national Dam Authority are defined by the following dimensional parameters: height $H > 15 \text{ m}$, or reservoir volume $V > 1.000.000 \text{ m}^3$. 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 m^3).

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.

NETHERLANDS

In the Netherlands the vast majority of dams are flood protection structures. Depending on the nature of the threat, where a distinction is made between large open water bodies and more regulated bodies of waters, these flood protection structures are divided into two classes :

- primary flood protection structures of national interest (over 3500 kilometres in length, varying in height (above mean water level) from 3 to 13 metres) ;
- secondary structures, mostly smaller dikes, about 15000 km in length.

The latter class is not considered in this paper.

The Water Act (2009) integrates a range of former water-related legislation including the Flood Defences Act of 1996. In relation to water defences, the Water Act contains an Annex with an overview of primary water defences, and 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. The contents of the Annex has recently been changed because of a safety standard update (standards in terms of flooding probabilities rather than water level exceedance probabilities, and referring to dike stretches rather than full dike rings to allow for differentiation).

Primary water defences (including large dams) which directly protect the hinterland, are directly assigned a safety standard from the Water Act. For (mainly estuarine) dams which separate two water bodies, it generally has been not the Water Act itself but the underlying regulations which assign the safety standards.

The Netherlands has only one large dam which is not assigned (and does not serve) as a water defence properly speaking: the ring dike surrounding the IJsselooq sludge depot in Lake Ketelmeer, between the Dutch towns of Dronnten and Emmeloord. For this particular dam, the General Provisions Act on Environmental Law is the most relevant, together with the Environmental Management Act and the water-quality related parts of the Water Act.

NORWAY

The dam safety regulation is valid for all dams in Norway, independent of the purpose of the dam, but requirements are to some extent adjusted to the consequence classes. Thus the most severe requirements are given to dams in the highest consequence class. However, for dams and waterways in the lowest consequence class (0) only a few specific requirements are valid, for example requirements about classification (chapter 4), safety measures related to public traffic on and around dam sites (§ 7-6) and reporting of accidents (§ 7-11).

Dams impounding a reservoir volume < 10.000 m³ AND with a dam height < 2 m are automatically placed in consequence class 0 (minor consequences). All other dams have to be classified based on an assessment of failure consequences, in one of the classes, class 0 to 4. Class 0 represents minor failure consequences. The criteria for class 1-4 are given in the table below:

Consequence class	Criteria for assessment of danger to life, property and environment		
	Housing units	Infrastructure	Property/environment
4	>150		
3	21-150	Road/railway with heavy traffic, other infrastructure of very high importance to life and health	Extensive damage to very important environmental values/property
2	1-20	Road/railway with medium traffic, other infrastructure of high importance to life and health	Extensive damage to important environmental values/property

1	<1	Road with less traffic, other infrastructure of importance to life and health	Damage to environmental values/property
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The dam owner is responsible for proposing a class for every dam or waterway (penstocks or headrace tunnels to power plants), and NVE is responsible for controlling the classification documentation and approve the class. The dam owner has to evaluate both direct consequences to life, property and the environment, as well as any secondary effects from the dam break flood.

Today (2012) the public dam register contains data for approximately 3100 dams, whereof 341 dams are large dams ($h > 15$ m). Approximately 370 dams are in the highest consequence classes (class 3 and 4). Approximately 150 dams in the register are not classified yet, and many of the small dams in Norway are still not included in the register (but they will probably be put in class 0).

PORTUGAL

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

- dams with more than 15 metres of height, measured from the lowest part of the general surface of the foundations to the crest;
- dams with a reservoir capacity of over 100.000 m³;
- 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.

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

There are three official categorizations of dams.

The first categorization is brought up by Regulation on the classification of structures and facilities of national importance (Official Gazette RS No.119/2011) and it applies to dams in design phase - more specifically to placement of the dam into space (environmental issues and impacts) and extent of necessary preliminary research and studies. The categorization refers to dams and to dykes.

Dams:

Very demanding structures		Demanding structures
H> 10m	with crest length L>50m	All the dams and water retaining structures which don't apply with the listed conditions for large dams
H> 4m and:	with storage capacity exceeding 100.000 m ³	
	with exceptionally difficult or problematic foundation conditions which can threaten populated areas, Important public transport ways, utilities and energy infrastructure or good ecological status of areas downstream the dam	

Dykes:

Very demanding structures		Demanding structures
H> 10m	with crest length L>50m	All the dams and water retaining structures which don't apply with the listed conditions for large dams
H> 4m and:	With storage capacity exceeding 100,000 m ³	
	with exceptionally difficult or problematic foundation conditions	
H>2m and:	Failure can threaten populated areas, important public transport ways, utilities and energy infrastructure or good ecological status of areas downstream the dam	

The second categorization defined by Regulation for classification of very demanding, demanding and simple engineering structures, about the conditions for construction of simple engineering structures that do not need building permit and about the type of construction works that are in reference with structures and appurtenant land (Official Gazette RS No.114/ 2003 and completion) refers to extent of elaboration in design phase – specifically to accuracy of elaboration and requirements for the design documentation and projects.

Very demanding structures		Demanding structures
H> 10 m and:	For earth fill dams with crest length L>250m	All the dams and water retaining structures which don't apply with the listed conditions for large dams
	Concrete dams with crest length L>50m	
	All dams with crest length L>300 m	

The third classification is presented by The Former Yugoslav monitoring and surveillance regulations – the classification is derived from categorization but is also taken into account by Protection against natural and other disasters act. It refers to operational phase and to Emergency preparedness:

Large dams		Other dams
H > 15 m		All the dams and water retaining structures which don't apply with the listed conditions for large dams
H > 10 m and:	Length of the crest L > 500m	
	Volume of reservoir V > 1.000.000 m ³	
	Spillway capacity Q _{sc} > 2.000 m ³ /s	
	Special foundation conditions	
Special design		

SPAIN

Dams/Ponds covered by the new legislation are:

- Dams/Dikes of ponds of height (H, above foundation) ≥ 15 m or dams/dikes $10 \geq H \geq 15$ m and volume of reservoir ≥ 1 Mm³

SWEDEN

The Environmental Code applies to all dams irrespective of size, purpose and consequences in case of dam failure. In 2014 new requirements were introduced for dams with a minimum height of 5 m and/or dams where a dam failure would result in the release of 100.000 m³ of water, tailings etc. For these the owner should give an assessment of the consequences of failure to the supervisory authority, who should decide if the dam should have a dam safety class or not.

Classification of existing dams is currently an ongoing process 2015-2018. Additional requirements in the Dam Safety Ordinance apply to classified dams. Svenska kraftnät (the national authority for dam safety) has issued regulations and guidance on consequence assessment and classification, and will issue regulations and guidance on the new requirements on classified dams.

In total there are some 10 000 dams in Sweden. For about 500 dam facilities a dam failure would result in significant damages such as loss of human life and health and/or serious damage to the environment, infrastructure or services vital to society and/or major economic damage. These dams will be assigned a dam safety class A, B or C. A large majority of these dams where a dam failure could result in major consequences belong to enterprises within the hydropower and mining industries.

According to the Civil Protection Act special requirements are put on establishments where the activity implies a risk that an accident will result in serious damage to people or the environment (dangerous activities). About 100 dam facilities (with one or more dams) are classified as such.

SWITZERLAND

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

$h \geq 10$ m

or

$h \geq 5$ m and $V \geq 50,000$ m³

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

- i. In England, reservoirs that are capable of holding 25,000m³ or more of water are regulated under the Reservoirs Act 1975. The undertakers (owners or operators) of these reservoirs are required to register them with the Enforcement Authority (the Environment Agency) following which a designation of 'high-risk' or 'not high-risk' will be given. Those designated high-risk will be subject to inspection and supervision by reservoir engineers. Not high-risk reservoirs must be registered but are not subject to the same degree of inspection and supervision.
- ii. In Wales, reservoirs that are capable of holding 10,000m³ or more of water are regulated under the Reservoirs Act 1975. The undertakers (the legal terms for the reservoir owners or operators) of these reservoirs are required to register them with Natural Resources Wales (NRW). NRW has a duty to designate reservoirs as high-risk reservoirs where they consider, in the event of an uncontrolled release of water, human life could be endangered. Reservoirs designated high-risk are subject to inspection and supervision by reservoir engineers. Reservoirs not considered to be high-risk remain registered but are not subject to the same degree of inspection and supervision.
- iii. In Scotland, reservoirs that are capable of holding 25,000m³ or more of water are regulated under the Reservoirs (Scotland) Act 2011. Managers of these reservoirs are required to register them with the Scottish Environment Protection Agency (SEPA) following which a risk designation of 'high', 'medium' or 'low' will be given. Those designated high-risk will be subject to inspection and supervision by reservoir engineers. Those designated medium risk will be subject to supervision. Low risk reservoirs must be registered but are not subject to the same degree of inspection and supervision. The Act is being implemented in a phased approach with reservoirs over 25,000m³ being brought under the new regime first and the smaller reservoirs between 10,000 and 25,000m³ being brought under the Act at a later date.
- iv. In Northern Ireland, reservoirs that are capable of holding 10,000m³ or more of water are controlled reservoirs and are regulated under the Reservoirs Act (NI) 2015. The managers of these reservoirs are required to register them with the Competent Authority following which a designation of either 'high', 'medium' or 'low' depending on the consequences of failure will be given. Those designated high or medium will be subject to inspection and supervision by reservoir engineers. Low consequence reservoirs must be registered with the competent authority, but are not subject to the same degree of inspection and supervision.

B. THE ENTITIES CONCERNED

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

The dam safety authorities are the following:

- The Ministry of Agriculture and Forestry is responsible for the general steering, follow-up and development of activities under the Dam Safety Act.
- The Centre for Economic Development, Transport and the Environment (ELY Centre) which is competent in dam safety matters functions as the dam safety authority. There are 15 ELY Centres in Finland and the dam safety supervision is centralized in three regional centres, the ELY Centres for Häme, Kainuu and Lapland. They officially supervise all aspects of dam safety, except rescue procedures.

Regional rescue authorities:

- Rescue services.

b) Owners

Owners have total responsibility for their dams. The owner of a dam is obligated to know the regulations concerning his dam, and on his own initiative, ensure that they are followed.

c) Civil engineers

There are no formal competence requirements specifically for dam design engineers. According to the Dam Safety Act a person who is the designer of the dam structures and a person who is responsible for the operation, monitoring and inspections of the dam shall have sufficient expertise in dam safety matters. The type of the dam and the hazard it may cause must be taken into account.

FRANCE

a) Administrative organisation

The Ministry of Ecology, Sustainable Development and Energy (MEDDE - <http://www.developpement-durable.gouv.fr/>) has the responsibility for the safety of dams.

An ad hoc committee with highly qualified and independent experts gives an opinion on projects 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 in so-called *Regional Direction of Ecology, Planning, Housing* (DREAL, in French).

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); however there are many small owners (manufacturers, cities, unions of farming concerns,...).

c) Civil engineers

Since 2010, there is an official procedure for qualification of engineering consulting firms dealing with dams. The ministry delivers an agreement for specific activities defined by the Environment Code.

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.

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.

NETHERLANDS

a) Administrative organisation

The primary flood protection structures are mostly managed by local authorities, regional water authorities formally called water boards. The water boards, democratically elected bodies with the equivalent status as a municipality (presently 21) have the authority to raise taxes on the inhabitants of the low lying polders for maintenance and construction of the structures.

The national Inspectorate of Environment and Transport has the supervision over all aspects of Flood Risk Management by the water boards.

The national government, more specifically, the Ministry of Infrastructure and Water Management, has the overall responsibility for Flood Risk Management in the Netherlands, both for policy, policy implementation and inspection. The ministry issues the safety standards for primary flood defences, and the hydraulic boundary conditions associated to the safety standards, and makes sure guidelines for design, safety assessment and

maintenance are made available, whilst promoting (and providing significant funding for) research in the fields of dams and flood protection. The ministry is also responsible for environmental legislation.

The department in charge with the policy implementation and other actions on a national level is the Directorate General of Public Works and Water Management, also known as the “Rijkswaterstaat” (or briefly: “RWS”). Most of the large dams (especially the estuarine storm surge barriers) in the Netherlands are owned and maintained by Rijkswaterstaat. Rijkswaterstaat also maintains the coastline by sand nourishments. The maintenance of the adjacent water defences (dunes, dikes, structures) is generally the responsibility of the water boards.

b) Owners

Flood protection in the Netherlands is a public matter. The majority of the flood protection structures is 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 board or the ministry. Maintenance responsibility and (sometimes private) ownership may be separated, but this situation is mainly restricted to small (and secondary) structures, rather than large dams.

NORWAY

a) Administrative organisation

The Ministry of Petroleum and Energy is responsible for the publication of dam safety regulations, 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 rehabilitation, approval of reassessment reports, and supervision of construction, operation and maintenance of dams and hydraulic structures. NVE is also responsible for giving information about dam safety and legal framework, and for developing regulations and guidelines for dam safety. Public supervision of dam safety in Norway has been performed by NVE since 1909. Today (2012) there are 21 dam safety officers working all over the country, located in the main office in Oslo as well as in the 5 regional offices of NVE.

b) Owners

The owners have the overall responsibility for the dam safety. The main owners in Norway are hydropower companies, industrial companies and municipalities (water supply).

c) Civil engineers

Each owner must employ a dam safety engineer who 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. 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.

Civil engineers (consultants) working with dam design and reassessments need an approval from NVE. They are approved for specific fields;

1. Concrete and masonry dams
2. Embankment dams
3. Gates, valves, penstocks and other appurtenant structures
4. Flood hydrology
5. Hydraulics for dams and spillways

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.

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

Two ministries are involved in dam safety:

- Ministry of Agriculture and Environment
- Ministry of Defence

The Ministry of Agriculture and Environment (MAE) is the supreme water and natural resources authority. The MAE appears in role of the owner and in role of the auditor for projects and of the supervisor (construction) and it gives the consent and conditions for all types of use of land and water. But the phases are controlled by different bodies within the same ministry.

The Supreme office for water resources gives the consent and permits for use of water.

The Department for water found is the entity that appears in role of the investor for the most important water infrastructure projects.

The external supervision of the projects and design can be performed by different groups of experts within the Ministry of Agriculture and Environment – this group reviews the projects, the application of principles defined by laws and the fulfilment of the requirements for projects defined by laws, and regulations.

The investor has to engage a team of independent supervisors, which controls the construction and the realisation of a project, but an additional external supervision is normally performed also by the Inspectorate of civil engineering.

The Ministry concedes the management of constructed dams to concessionaires (private or state owned companies).

Procedures and activities defined in instruction for operation, maintenance and monitoring are applied. However there is no quality supervision of regular and periodical reports. Furthermore, the safety reassessment is not obligatory by law, therefore it is rarely performed.

The Ministry is also in charge of legislation – it proposes new laws and regulations or modification for old ones to the parliament or government.

b) Owners

The dams are mostly owned by the state (only few are owned by private companies or municipalities). According to the law (Construction act and Water act) the owner is responsible for dam safety, but in most cases the management and operation is entrusted to different public and semi-private companies (Hydro power companies and Water management companies). These companies take care of the operation and maintenance of the dams as well as of the monitoring.

The procedures mentioned above and smaller refurbishment works are normally performed by different sectors of the same company (visual inspections, equipment tests etc.) and in part by specialized consulting companies (geotechnical inspections, specialized controls of the equipment etc.). The coordination of these inspections is organized by the company responsible for management of the dam. The supervision of performance of a dam (monitoring, operation) is normally performed by appointed engineer. The companies who manage dams for hydropower purposes often engage external companies.

The operation, maintenance and monitoring of dams is organized and performed in accordance to Regulation for operation and maintenance of a dam, which is compulsory by the Construction act.

c) Civil Engineers

There are no special requirements for the engineers or companies who are managing or designing the dams. The only requirement is the license for Independent project manager and at least 5 years of experience. For the engineers who are in charge for the operation of the facilities, the acquisition license for operators of the water infrastructure (according to the national vocational Qualifications system) is compulsory.

SPAIN

a) Administrative organisation

The supervision of dam/pond safety depends on where the dam/pond is located. Generally speaking, dam safety is a responsibility of the Ministry of Agriculture (Department of Water Affairs/Dam safety office), which represents the “Authority”. Autonomic governments are in charge of pond safety, but also of dam safety when they have competences on water affairs.

Ministry of Interior is in charge of public safety around dams/ponds and on emergency preparedness.

b) Owners

Dam owner could be the public administration or a public or private company with a concession or an authorisation according to the dictates of the water act.

The owner is always the main responsible of the dam/pond safety during all the stages of its life.

c) Collaborating Entities

According with the new standard (2008), Collaborating Entities on dam and reservoir safety, are public or private companies that, by obtaining the corresponding title, are authorized to work with the public administration in dam/pond control safety tasks.

SWEDEN

a) Administrative organisation

The entities concerned with the supervision of dam safety in Sweden:

- Svenska Kraftnät (Swedish National Grid) has the function as a national authority for dam safety. The tasks include promoting dam safety in Sweden, acting for research, development and capacity building, and acting for emergency preparedness for dam failure or floods. The role is also to provide supervision guidance on issues related to dam safety to the regional supervisory authorities - the county administrative boards. In practice supervisory guidance includes development of uniform routines for dam safety supervision, to coordinate, follow-up and evaluate the supervision as well as to provide advice and support to the regional supervisory authorities.
- The 21 county administrative boards are the operative supervisory authority for water operations, according to the Environmental Code, and dams and dam safety are part of this. The supervision comprises among other things to check that the regulatory framework and the terms of permits allotted by the Environmental Court are adhered to, that actions are taken by the owner/operator when necessary to improve safety. The county administrative boards are also assigned to supervise the compliance of the municipalities with the Civil Protection Act.
- The approx. 290 municipalities are responsible for planning for and providing rescue service for example concerning flood situations caused by dam failure or heavy rainfall. The municipalities are responsible for supervision of the dam owner's compliance with the Civil Protection Act for dams classified as dangerous facilities.

River groups constitute a regional network for regulated rivers, linking all organizations involved in or affected by water regulation and floods. The main participants are the county administrative boards, municipalities, water regulating enterprises, dam owners, emergency service centres, the National Road and Rail Administrations, Swedish Meteorological and Hydrological Institute etc. They constitute an important element in the development of regional networks, information exchange and competence in respect of floods, dam safety and emergency preparedness.

b) Owners

The owners have overall responsibility for their dams including a strict liability for consequences of dam failure. The main dam owners in Sweden are hydropower companies. Mining companies are also important dam owners. The trade organisations SwedEnergy (power industry) and SveMin (mining industry) have important roles in supporting their member companies with guidelines, research and development, education etc.

c) Civil engineers

There is no formal approval by Authority for engineers dealing with dams. According to the industry guidelines for dam safety the dam owner should appoint a dam safety engineer with appropriate theoretical and practical education, as well as experience from working with dams, for each dam. Appropriate education and experience is also required for e.g. consultants appointed to carry out surveillance activities such as inspections and periodic dam safety reviews.

SWITZERLAND

a) Administrative organisation

The Federal Office of Energy (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

i. England

Administrative organisation

In England the Environment Agency monitors compliance with the amended Reservoirs Act 1975. This Act establishes panels of reservoir engineers who are suitably qualified to provide the reservoir undertakers with recommendations and/or directions on actions that should be taken to reduce the risk of dam failure.

Reservoir undertakers are required to follow these recommendations and/or directions. The Environment Agency ensures that the reservoir undertakers of a high-risk reservoir commissions the correct engineer from the panels of suitably competent engineers to perform the inspection or supervision functions as required.

The Environment Agency monitors compliance with the recommendations of an inspection report and where necessary take such action as will ensure the recommendations are observed. To perform this role, the Environment Agency maintains a register of regulated reservoirs and acts as a repository for the various reports and certificates that will be completed by the reservoir engineers in the execution of their functions.

Owners

In common law, the owner of a reservoir is liable for any damage caused should there be an uncontrolled release of water from a reservoir. The Reservoirs Act 1975 allocates responsibility for reservoir safety to a reservoir undertaker. This reservoir undertaker can be the owner, operator or a nominated representative of a group of owners or company, or other organisation. The reservoir undertaker is responsible for day to day monitoring of the reservoir in line with the recommendations made by the inspecting or the supervising engineer.

The reservoir undertaker of a high-risk reservoir must ensure that the reservoir is under the supervision of a supervising engineer at all times. They are also required to commission an inspecting engineer from the panel of approved engineers to inspect the reservoir at least every 10 years. The reservoir undertaker of a not high-risk reservoir is not required to commission a supervising or an inspecting engineer.

Reservoir Engineers

These are qualified civil engineers who are appointed by the government Department for Environment Food & Rural Affairs (Defra) as either Inspecting Engineers or Supervising Engineers to reservoir engineer panels based on recommendations, provided by the Institution of Civil Engineers, as to their suitability and competence. These reservoir engineers inspect and supervise reservoirs and where appropriate design and supervise the construction or enlargement of new or existing reservoirs or the decommissioning or abandonment of existing reservoirs.

Inspecting Engineers commissioned to perform a reservoir inspection provide inspecting reports to the reservoir undertaker, encompassing the whole of the reservoir basin. These reports are copied to the Environment Agency and provide a condition assessment of the impounding structures, spillways; outlet and inlet facilities. Crucially they provide recommendations in the interests of safety and maintenance.

The supervising report or annual statement is provided by the Supervising Engineer, who is commissioned by the reservoir undertaker of a high-risk reservoir to supervise the reservoir at all times. The statement will detail the actions taken by the reservoir undertaker and compliance with any directions or recommendations given by the Supervising Engineer or the Inspecting Engineer.

A Construction Engineer need only be commissioned where construction or alteration of a reservoir is planned. This engineer will be on the Inspecting Engineers' panel and be responsible for safety throughout the works. He will provide certificates at various stages to permit filling of the reservoir and notify completion of works to the Environment Agency.

ii. Wales

Administrative organisation

The Reservoirs Act 1975 is also the principal legislation in Wales which sets the minimum standards for the construction, supervision, maintenance, inspection and ultimately reservoir decommissioning activities. The same system of panel engineers is used as in England.

Natural Resources Wales (NRW) is the enforcement authority in Wales, which seeks to ensure that undertakers observe and comply with the law. NRW maintains a public register of reservoir information, and monitors the actions required by undertakers. The law provides powers for NRW to act in default of an undertaker or in an emergency. NRW reports to the Welsh Ministers every two years on the steps taken in fulfilling its role.

Owners

A reservoir 'undertaker' is the legal term for the operators of the reservoir, where they have the authority to manage or control the reservoir. Where there is no operator, the owners are the undertakers. Undertakers are responsible for day-to-day monitoring and maintenance of the reservoir and compliance with the law, which entails the appointment of engineers and implementing their recommendations.

Undertakers of high-risk reservoirs must ensure that the reservoir is under the supervision of a Supervising Engineer at all times. They are also required to commission an Inspecting Engineer from the appropriate panel of engineers to inspect the reservoir at intervals not exceeding 10 years. The reservoir undertaker of a 'not high-risk' reservoir is not required to commission a Supervising Engineer or an Inspecting Engineer.

Reservoir Engineers

These are qualified civil engineers who are appointed by Defra with the agreement of Welsh Ministers to reservoir engineer panels, based on recommendations of suitability and competence provided by the Institution of Civil Engineers. The reservoir engineers inspect and supervise reservoirs and where appropriate design and supervise the construction or enlargement of new or existing reservoirs or the decommissioning or abandonment of existing reservoirs. Engineers are commissioned to perform a variety of key reservoir activities, which are detailed below.

iii. Scotland

Administrative organisation

In Scotland, SEPA monitors compliance with the Reservoirs (Scotland) Act 2011. This Act establishes panels of reservoir engineers who are suitably qualified to provide the reservoir managers with requirements and/or directions in relation to measures that should be taken to reduce the risk of dam failure. Reservoir managers are required to follow these requirements and/or directions.

SEPA ensures that the reservoir manager of a high or medium consequence reservoir commissions the correct engineer from the panels of suitably competent engineers to perform the inspection or supervision functions as required. SEPA, in conjunction with the Supervising Engineer, will also monitor compliance with the recommendations of an inspection report and where necessary take such action as necessary to ensure the recommendations are observed. To perform this role, SEPA maintains a register of controlled reservoirs and acts as a repository for the various reports and certificates that will be completed by the reservoir engineers in the execution of their functions.

Owners

In common law, the owner of a reservoir is liable for any damage caused should there be an uncontrolled release of water from a reservoir. The Reservoirs (Scotland) Act 2011 allocates responsibility for reservoir safety to a reservoir manager. The reservoir manager will be the person who controls or operates the reservoir or, if no such person exists, the owner of the reservoir. It is possible that a controlled reservoir may be managed by one reservoir manager or by more than one (multiple) reservoir managers.

The reservoir manager is responsible for day-to-day monitoring of the reservoir in line with the recommendations made by the Inspecting Engineer or the Supervising Engineer. The reservoir manager of a high or medium consequence reservoir must ensure that the reservoir is under the supervision of a Supervising Engineer at all times. Managers of high risk reservoirs are also required to commission an Inspecting Engineer from the panel of approved engineers to inspect the reservoir at intervals not exceeding 10 years. Managers of medium risk reservoirs are only required to commission an Inspecting Engineer to inspect the reservoir when recommended by the Supervising Engineer. The reservoir manager of a low consequence reservoir is not required to commission a Supervising Engineer or an Inspecting Engineer.

Reservoir Engineers

These are qualified civil engineers who are appointed by Scottish Ministers to reservoir engineer panels based on recommendations as to their suitability and competence provided by the Institution of Civil Engineers. The reservoir engineers inspect and supervise reservoirs and where appropriate design and supervise the construction or enlargement of new or existing reservoirs or the decommissioning or abandonment of existing reservoirs.

Inspecting Engineers commissioned to perform a reservoir inspection provide inspecting reports to the reservoir manager, encompassing the whole of the reservoir basin. These reports are copied to SEPA and set out measures that must be taken in the interests of safety and maintenance and also contain recommendations on other matters.

An annual statement is provided by the Supervising Engineer, who is commissioned by the reservoir manager of a high or medium designated reservoir to supervise the reservoir at all times. The statement will detail the actions taken by the reservoir manager and compliance with any directions or recommendations given by the Supervising Engineer or the Inspecting Engineer.

A Construction Engineer need only be commissioned where construction or alteration of a reservoir is planned. This engineer will be on the Inspecting Engineers' Panel and be responsible for safety throughout the works. He will provide certificates at various stages to permit filling of the reservoir and notify completion of works.

iv. Northern Ireland

Administrative organisation

In Northern Ireland the competent authority monitors compliance with the Reservoirs Act (NI) 2015. This Act establishes panels of reservoir engineers who are suitably qualified to provide the reservoir managers with recommendations and/or directions on actions that should be taken to reduce the risk of dam failure.

Reservoir managers are required to follow these recommendations and/or directions. The competent authority ensures that the reservoir manager of a high or medium consequence reservoir commissions the correct engineer from the panels of suitably competent engineers to perform the inspection or supervision functions as required. The competent authority in conjunction with the supervising engineer will also monitor compliance with the recommendations of an inspection report and where necessary take such action as will ensure the recommendations are observed. To perform this role, the competent authority maintains a register of controlled reservoirs and acts as a repository for the various reports and certificates that will be completed by the reservoir engineers in the execution of their functions.

Owners

In common law, the owner of a reservoir is liable for any damage caused should there be an uncontrolled release of water from a reservoir. The Reservoirs Act (NI) 2015 allocates responsibility for reservoir safety to a reservoir manager. This reservoir manager can be the owner or a nominated representative of a group of owners or company, or other organisation. The reservoir manager is responsible for day to day monitoring of the reservoir in line with the recommendations made by the inspecting or the supervising engineer.

The reservoir manager of a high or medium consequence reservoir must ensure that the reservoir is under the supervision of a Supervising Engineer at all times. They are also required to commission an Inspecting Engineer from the panel of approved engineers to inspect the reservoir at intervals not exceeding 10 years.

Where a reservoir has been designated medium consequence, a single inspection by an Inspecting Engineer is required. Subsequent inspections will only be required on the recommendation of a Supervising Engineer or an Inspecting Engineer. The reservoir manager of a low consequence reservoir is not required to commission a Supervising Engineer or an Inspecting Engineer.

Reservoir Engineers

These are qualified civil engineers who are appointed by the competent authority to reservoir engineer panels based on recommendations as to their suitability and competence provided by the Institution of Civil Engineers. The reservoir engineers inspect and supervise reservoirs and where appropriate design and supervise the construction or enlargement of new or existing reservoirs or the decommissioning or abandonment of existing reservoirs.

Engineers commissioned to perform a reservoir inspection provide inspecting reports to the reservoir manager, encompassing the whole of the reservoir basin. These reports are copied to the competent authority and provide a condition assessment of the impounding structures, spillways; outlet and inlet facilities. Crucially they provide recommendations in the interests of safety and maintenance.

The supervising report or annual statement is provided by the Supervising Engineer, who is commissioned by the reservoir manager of a high or medium designated reservoir to supervise the reservoir at all times. The statement will detail the actions taken by the reservoir manager and compliance with any directions or recommendations given by the Supervising Engineer or the Inspecting Engineer.

A Construction Engineer need only be commissioned where construction or alteration of a reservoir is planned. This engineer will be on the Inspecting Engineers' panel and be responsible for safety throughout the works. He will provide certificates at various stages to permit filling of the reservoir and notify completion of works.

C. DAM PROJECTS

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

According to the Dam Safety Act, the dam safety requirements under the Act must be taken into account and presented in the plan and design prepared for building a dam. In a permit application, the dam owner shall describe, in sufficient detail, the potential dam hazard and its impact on dam dimensioning and design criteria. When resolving a matter concerning the construction of a dam, the permit authority shall request a statement from the dam safety authority concerning the fulfilment of the dam safety requirements laid down in the Act.

The hydrological design of a watercourse dam (design flood) depends on the classification of the dam: class 1 dam with a return period of 5000-10000 years, class 2 dam 500-1000 years, class 3 dam 100-500 years.

The structural stability of a dam and the functioning and dimensions of the structural components must be sufficient to ensure the safety of the dam in all operational situations. Effective transport connections to the dam must be available. And the possibility for dam maintenance also in case of flood and dam accidents must be planned and ensured. The dam owner must submit the plans of the technical safety requirements and of the first filling of the reservoir to the dam safety authority.

The dam must be classified (based on the hazard) and monitoring programme must be approved by the dam safety authority before the dam is in operation. The owner of a class 1 dam must prepare a more detailed dam break hazard analysis and the emergency action plan for a dam.

In addition to the Dam Safety Act:

- the provisions of the Water Act and under it apply to construction in watercourses
- the provisions of the Environmental Protection Act and under it concerning the prevention of environmental pollution and the provisions of the Waste Act and under it on preventing and combating the risk to health and the environment arising from wastes apply to waste dams
- as regards mine safety, the provisions of the Mining Act and under it also apply
- the provisions of the Land Use and Building Act concerning the permits required for building activities, structures and other action apply to dams.

FRANCE

There are not yet definite rules for the design calculations of dams (loadings, resistance,...). It is planned to publish a new version of the legislation with some official rules for loadings.

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 this Committee and the publications of the CFBR (French National Committee on Large Dams - <http://www.barrages-cfbr.eu>) 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, risk assessment...).

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

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

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.

A Decree issued in July 2014 provides updated technical rules for the design and safety assessment of dams to be considered (loads, loading combinations, calculation methods, etc...), referring to the limit states approach and criteria.

NETHERLANDS

There are no particular regulations about dam projects and/or projects involving flood protection structures, except for the prescribed safety standards.

From 2017 onwards, safety standards for primary water defences are expressed in terms of allowable flooding probabilities. The new standards are based on standards for individual (external) risk, and considerations on costs-benefits, group risk and critical infrastructure. The resulting safety standards for dike stretches range from 1/300yr flooding probability for areas with low flood risk to 1/30000yr and occasionally even up to 1/1000000yr for vulnerable areas (like heavily urbanised/industrialized areas or very deep polders).

NORWAY

All new projects and rehabilitation of existing projects are approved by the Norwegian Water Resources and Energy Administration (NVE). The planning process shall be conducted by a consultant approved by NVE for the relevant consequence class and relevant subject area.

The dam safety regulation and guidelines include specification of load combinations, safety coefficients, design (freeboard etc), operation of important constructions (for example spillway and outlet gates), surveillance during construction and operation etc. The regulation also refers to general standards in the field of civil engineering.

The regulation and guidelines have detailed requirements for design and operation of different dam types and other hydraulic structures and for the different consequence classes. In addition to the safety and technical requirements given in the dam safety regulation, dam projects must also be in accordance with environmental requirements given in the concessions or in the Planning and Building Act or other relevant acts or regulations.

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).

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 that concerns dam projects only. General rules for important infrastructure brought up by Construction act are used. In addition to the act, there are regulations defining the content of the projects and the extent of elaboration, depending on the complexity of the project.

The construction act requires supervision (review) of the projects and designs. The supervision can be performed by different groups of experts within the Ministry – this group reviews the projects, the application of principles defined by laws and the fulfilment of the requirements for projects defined by laws, and regulations.

SPAIN

Dams under the supervision of the Ministry of Agriculture: The department of water affairs, according with the report of the dam safety office, is the main responsible of the approval of their projects. The Technical Safety Standard for dam project, construction and first filling describes the general studies (use of the reservoir, climatology, geology, seismicity of the site), detailed studies (drawings, flood flow, calculations of the structures), and environmental studies (incidence on the population, quality of water, sediment inflow, etc) to be included in the project.

The National Committee on Large Dams (SPANCOLD) helps to this process through their technical guidelines, addressed to some particular points of interest.

SWEDEN

The Environmental Code and the Civil Protection Act contains no detailed requirements for the design, construction and upgrading of dams.

Construction of structures in water needs a permit issued by an Environmental Court. Most of the large dams in Sweden have been examined under the old Water Act from 1918 by the former Water Court. There were no specific regulations about dam safety in that legislation. The main structure and layout was normally described in the application to the Water Court, but it was left to the dam owner to take responsibility for the detailed aspects of design and construction of their dams. Most of the Swedish dams are consequently designed and constructed without intervention by the authorities on technical aspects.

For new dams a permit (by an Environmental Court which has replaced the former Water Court) must be obtained for water operations within the meaning of the Environmental Code. A judgement granting a permit for an activity shall, where appropriate, include provisions concerning among other things the purpose, location, scope, safety and technical design of the activity as well as supervision, inspections and checks.

The planning and construction act and the corresponding ordinance are to some part applicable also to dams. All constructions erected or changed shall adhere to essential technical requirements on their physical properties such as load-bearing capacity, stability and durability, during their economically reasonable life span.

The industry guidelines on dam safety comprises, among other things, guidance on dam design and construction including determination of design loads and detailed requirements on embankment dams, concrete dams and discharge facilities.

Guidelines for the determination of design floods for dams have been issued by the national authority and the industry organisations in co-operation. Dams are classified in design flood categories based on their potential failure consequences during a flood.

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

i. England

The Reservoirs Act 1975 does not attempt to set in law such technical standards that may be liable to change as a result of research or recommendations for best practice. The Act does however require the reservoir undertaker to commission a suitably competent reservoir engineer from the panel of reservoir engineers established by the Defra where a project falls within the definition of relevant works and / or has the potential to affect the safety of the reservoir.

Any engineer who is commissioned to design and supervise the construction, alteration, repair or any other relevant works will be familiar with the latest technical guidance relating to reservoir construction as published by various professional bodies.

ii. Wales

The Reservoirs Act 1975 does not attempt to set in law such technical standards that may be liable to change as a result of research or recommendations for best practice. The Act does however require the reservoir undertaker to commission reservoir panel engineers for certain works and activities specified by the law.

These engineers are familiar with the latest technical guidance relating to reservoir construction as published by various professional bodies and apply these to the reservoirs to which they are appointed.

iii. Scotland

The Reservoirs (Scotland) Act 2011 does not attempt to set in law such technical standards that may be liable to change as a result of research or recommendations for best practice. The Act does however require the reservoir manager to commission a suitably competent reservoir engineer from the panel of reservoir engineers established by Scottish Ministers for certain works and activities specified by law.

These engineers are familiar with the latest technical guidance relating to reservoir construction as published by various professional bodies and apply these to the reservoirs to which they are appointed.

iv. Northern Ireland

The Reservoirs Act (NI) 2015 does not attempt to set in law such technical standards that may be liable to change as a result of research or recommendations for best practice. The Act does however require the reservoir manager to commission a suitably competent reservoir engineer from the panel of reservoir engineers established by the Competent Authority where a project falls within the definition of relevant works and / or has the potential to affect the safety of the reservoir.

Any engineer that is commissioned to design and supervise the construction, alteration, repair or any other relevant works; will be familiar with the latest technical guidance relating to reservoir construction as published by various professional bodies.

D. CONSTRUCTION AND FIRST FILLING

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, a dam must be designed and so constructed that its operation does not pose any threat to safety. According to the Government Decree on Dam Safety, the dam owner must provide the dam safety authority with plans that show how the technical safety requirements of the dam are implemented and how the first filling will take place. The dam owner must arrange an opportunity for the dam safety authority to verify the technical safety requirements in different stages of the dam construction work. The owner must prepare monitoring programme of the factors that may affect dam safety when the dam is brought into operation. The monitoring programme presents the dam monitoring frequency, which objects are to be monitored and measures relating to monitoring.

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.

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

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).

NETHERLANDS

The ministry recommends guidelines for the design, construction and maintenance of flood protection structures. Where necessary, the guidelines refer to specific building codes. 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, consultancies and research institutes. For Quality assurance the parties involved co-operate in the framework of the Expertise Network on Flood Risk Management ENW who advise on all guidelines (www.enwinfo.nl) The final responsibility remains however with the central government. . It is important to note that some first steps towards a major updating and restructuring action of the above guidelines have recently been taken. In addition to the ENW guidelines, the ministry is also working on a specific tool/guideline to allow quick access to all information needed for design of new water defences or water defences that need upgrading.

Since the dams in the Netherlands are mostly designated for flood protection purposes, there is no specific regulation on the matter of first filling.

Besides this, Chapter 5 of the Water Act (on project plans and consultation) is important. Also, environmental legislation applies for all major construction works, notably the obligations related to Environmental Impact Assessments and environmental permits.

NORWAY

Dams must be constructed in accordance with plans approved by NVE. Any important modifications of plans during construction must also be approved by NVE. Before construction starts, documentation of the following must be sent to NVE;

- Time schedule for important activities during construction
- Organization of construction work
- Qualifications of contractor company, site manager and controller
- Plan for control including manning, measurements (of water level, leakage, deformations, pore pressure etc.) and sampling, preparing of results from measurements and sampling, sampling equipment and check points.

In addition the following documentation must be present at the construction site;

- Emergency plan for the construction phase
- Design basis (loads etc) for coffer dams and other provisional constructions.

A plan for first filling must also be prepared, including time schedule for important activities, rate of filling, instructions for disruption of filling if necessary etc. After constructions work is completed a final report must be sent to NVE, summing up the construction work, the control, measurements, first filling etc. The final report must also include “as built”-documentation.

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.

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

a) Construction

In addition to the Construction act there is a number of rules and standards (Eurocodes and other European standards) that define the requirements for the organisation of construction site and performance of construction. According to the Construction act the investor has to engage a team of independent supervisors, which controls the construction and the realisation of a project, but additional supervision is normally performed also by Inspectorate of civil engineering.

b) First filling

The authorities (Ministry of Agriculture and Environment) approve the final design and the program of the first filling. The program of the first filling includes the monitoring of the works and of the performance of the dam. This 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

The dam safety office supervise all the construction works.

The current regulation establishes that a first filling plan, including surveillance and monitoring of dam/foundation, shall be provided and approved by the dam safety office previously the first filling starts

In addition to this, the first filling cannot begin if the Emergency Action Plan has not been approved and implemented.

Dam safety office check the dam behaviour during the first filling, and once it has been finished issue the final test certificate that allows the beginning of the normal operation of the dam.

SWEDEN

In Sweden, there are no special requirements from the authorities regarding construction or first filling, unless specified in the court permit.

SWITZERLAND

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

Following information is 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

i. England

The Reservoirs Act 1975 requires those who wish to construct a reservoir to commission the services of a reservoir Construction Engineer from the panel of Inspecting Engineers established by Defra. Once construction has advanced to a state where the reservoir can be safely filled, or partially filled, the reservoir Construction Engineer will provide a preliminary certificate which sets out the level to which the reservoir can be filled and any further recommendations in relation to the safety of the reservoir that are appropriate.

This certificate can be revised and re-issued as often as the Construction Engineer considers necessary until the reservoir construction is complete. The commission of the Construction Engineer terminates with the issue of the final certificate, which normally will be issued three years after the preliminary certificate. This final certificate starts a two-year monitoring period, at the end of which the reservoir must be inspected by a reservoir Inspecting Engineer.

The Environment Agency will ensure that all safety and preliminary certificates are supplied by the Construction Engineer to the reservoir undertaker prior to each stage of construction and filling of the reservoir, and that all safety monitoring operations are conducted as recommended by the reservoir Construction Engineer in the two-year period following completion.

ii. Wales

The Reservoirs Act 1975 requires those who wish to construct a reservoir to commission the services of a reservoir Construction Engineer from the panel of reservoir engineers established by the Defra.

A Construction Engineer must be appointed for the initial construction or subsequent alteration of a large raised reservoir. This engineer is responsible for safety throughout the construction period and until he is satisfied that the reservoir is performing correctly. He provides certificates at various stages to permit filling of the reservoir and will notify completion of works.

Once construction has advanced to a state where the reservoir can be safely filled, or partially filled; the reservoir Construction Engineer will provide a preliminary certificate which sets out the level to which the reservoir can be filled and any further recommendations in relation to the safety of the reservoir that are appropriate.

This certificate can be revised and re-issued as often as the Construction Engineer considers necessary until the reservoir construction is complete. The commission of the Construction Engineer terminates with the issue of the final certificate, which normally will be issued three years after the preliminary certificate. This final certificate starts a two-year monitoring period, at the end of which the reservoir must be inspected by a reservoir Inspecting Engineer. NRW ensures all certificates are supplied by the engineer to the reservoir undertaker prior to each stage of construction and filling.

iii. Scotland

The Reservoirs (Scotland) Act 2011 requires those who wish to construct a reservoir to commission the services of a reservoir Construction Engineer from the panel of reservoir engineers established by Scottish Ministers. Once construction has advanced to a state where the reservoir can be safely filled, or partially filled; the reservoir Construction Engineer will provide a preliminary certificate which sets out the level to which the

reservoir can be filled and any further recommendations in relation to the safety of the reservoir that are appropriate. This certificate can be revised and re-issued as often as the Construction Engineer considers necessary until the reservoir construction is complete.

The commission of the Construction Engineer terminates with the issue of the final certificate. This final certificate starts a two-year monitoring period, by the end of which the reservoir must have been inspected by a reservoir Inspecting Engineer. SEPA will ensure that all certificates are supplied by the Construction Engineer to the reservoir manager prior to each stage of construction and filling of the reservoir and that all safety requirements are conducted as recommended by the reservoir Construction Engineer during the two-year period following completion.

The Reservoirs Act (NI) 2015 requires those who wish to construct a reservoir to commission the services of a reservoir Construction Engineer from the panel of reservoir engineers established by the Competent Authority. Once construction has advanced to a state where the reservoir can be safely filled, or partially filled; the reservoir Construction Engineer will provide a preliminary certificate which sets out the level to which the reservoir can be filled and any further recommendations in relation to the safety of the reservoir that are appropriate.

This certificate can be revised and re-issued as often as the Construction Engineer considers necessary until the reservoir construction is complete. The commission of the Construction Engineer terminates with the issue of the final certificate. The reservoir manager must arrange for the reservoir to be inspected by An Inspecting Engineer within two years from the date of the final certificate. This final certificate starts a two-year monitoring period, at the end of which the reservoir must be inspected by a reservoir inspecting engineer, or earlier if recommended to do so by the final certificate.

The competent authority will ensure that all safety and preliminary certificates are supplied by the engineer to the reservoir manager prior to each stage of construction and filling of the reservoir and that all safety monitoring operations are conducted as recommended by the reservoir engineer during the two-year period following completion.

E. DAMS OPERATION

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 dam owner is obliged to keep the dam in such a condition that it functions as intended and is safe. A dam shall be operated in such a way that it causes no danger to human life and health. Sufficient safety arrangements shall be in place to ensure public safety and the safety of the operation of the dam.

The owner of a dam must organize the monitoring of a classified dam in accordance with the monitoring programme. The owner of a dam shall inspect the condition and safety of a class 1 and 2 dam at least once a year. The written report of annual inspection of a class 1 dam must be sent to the dam safety authority.

The owner of a dam must organize a periodic inspection of classified dam at least every five years. The dam safety authority and rescue authority have the right to participate in this inspection. The monitoring data and the assessment of the condition of the dam must be sent to the dam safety authority in advance. The owner of class 1 and 2 dam must notify a written report prepared of the inspection to the dam safety authority.

Based on a periodic inspection, the dam safety authority may order the owner of a dam to update a dam break hazard analysis prepared for the dam.

FRANCE

The regulation imposes several prescriptions to the owners of dams, according to the class of the dams:

The dams of class A or class B must have a safety review that identifies the various scenarios for dam failure, the probability of these events, the consequences and gravity on people and property.

This document is reviewed every ten years for class A, every 15 years for class B.

- The owner (or the concessionaire) must 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 owner or the operator must carry out periodical visual surveys (including detailed technical visits yearly for dams of class A, every 5 years for dams of class B...)
- The operator must implement suitable monitoring unless the authority accept an exemption.
- The operating instructions for exceptional events (floods, ...) and surveillance are mandatory.
- The owner or the operator publishes an annual report of the surveillance, the monitoring and the operation of the dams. Every two years (less frequently for dams under class A), the report includes a detailed analysis of the results given by the monitoring.
- For dams of class A or B, the regulations imposes a risk assessment study, and a review of this study every ten years. This study must include a general safety review including special detailed inspections.
- Each event concerning dam safety must be reported to the authority.

The administration inspects the dam every year for class A, every 5 years for class B. 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 administration must formally approve many documents.

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.

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".

NETHERLANDS

According to the Water Act, the manager which is not necessary the owner of primary water defences (water boards, or Rijkswaterstaat) is obliged to carry out a safety assessment every twelve years. The instruments for safety assessment are provided by the ministry and are known as the "WBI" Legal Assessment Instrument; the WBI consists of hydraulic boundary conditions and guidelines for safety assessment. The local water boards are to report the results of the safety assessment to the ministry (and the Inspectorate on Environment and Transport). In turn, the ministry reports to parliament. Besides in-depth safety assessments every 6/12 years, there are also regular maintenance actions and frequent visual inspections, the latter especially around flood events.

The operation of the IJsselooog sludge depot is mainly governed by environmental legislation; its environmental permit contains a large amount of regulations, one of which is to provide a broadly scoped environmental monitoring report each year.

In all cases, one must be aware that office-like appurtenant structures are treated like any other building, and need a permit-for-use from the municipality, to assure for example fire safety and quick evacuation of people working in (or visiting) the building.

During building and operations, one must also take into account the Health and Safety Regulations ("ARBO-regels") for workers.

NORWAY

According to the Internal Control Regulation from 2011 the dam owner is required to have an internal control system to ensure that the dam owners comply with the requirements in the dam safety regulation and any concessions.

The internal control system shall contain a description of the organization, reporting routines, qualification requirements, responsibilities etc. Further, the internal control system must include a description of the legal framework and an archive system for documentation of the dam, and routines for updating of the system and correction of deviations from the regulations.

The dam safety regulation, chapter 7, includes various requirements for operation of dams, including;

- operating procedures for normal situations as well as unusual events (large floods, gate failure etc.)
- surveillance
- dam break flood calculations (for emergency planning and classification)
- emergency preparedness
- regular reassessments
- safety measures for the public (public safety)
- access obstruction
- securing of information
- direct warning to the public in case of dam failure
- special safety measures
- notification of accident or undesired event

Regular inspections of the dam are conducted at different levels (according to consequence class) with trained personnel; periodic inspections every year, main inspections every 5-7 year and special inspections during and after unusual events (large floods etc). Every 15-20 years (depending on the dam class) a reassessment of the dam is conducted, comparing the present standard of the dam and previous flood calculations etc with requirements given in the latest edition of the dam safety regulation. In many cases the previous calculations must be updated, and as a standard rule, design floods based on data older than 15-20 years must be recalculated. Often this results in new values for design flood and/or safety check floods, and subsequently also new calculations of the stability. When recalculating the flood levels, new hydrological observations are included, securing 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. Many reassessments conclude with a need of upgrading the dam and/or the spillway.

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.

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 monitoring of the large dams (higher than 15m, or higher than 10m and with crest length longer than 250 m for embankment dams and 50 m for concrete dams or with discharge higher than 2000 m³/s is compulsory by Regulation on monitoring of large dams. The regulation provides basic rules for the organization of monitoring of the dam and of the reservoir, but does not give detailed rules (monitoring system, frequency). The detailed rules for the large dams are given in the Project for monitoring of each specific dam.

According to the Construction act the owner must keep the file with all the information about the operation of the dam (diary or register). The basic rules for the operation must be given in design and in instructions for operation and maintenance of the equipment. These requirements are also summarized in the Rules for the operation and maintenance of each specific dam.

The operation of dam is organized and performed by the companies who manage a dam in accordance to Regulation for operation and maintenance of a dam, which is compulsory by the Construction act. The application of procedures and activities defined in Rules for operation and maintenance is controlled by Inspectorate of environment.

SPAIN

a) Operation

The dam must be operated according to Standard Operation Procedures approved by the dam safety office, which must include:

- operating plan for use of the water
- seasonal freeboards
- operational, maintenance & conservation instructions for the plugs, operating and measuring installations
- connexion with Emergency Action Plan

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

b) Periodic inspections

Detailed deep periodic safety inspections will be carried out by multidisciplinary teams unrelated with the owner, depending in which category the dam/pond had been classified: every 5 years in the case of A and B dams and 10 years for dams classified in C category.

SWEDEN

The Environmental Code includes government ordinances concerning owners' self-regulation. The owner must continuously analyse the risks and shall have the necessary knowledge to establish and follow routines for self-regulation and surveillance of the dam. The routines and the findings should be documented. The owner must also have knowledge of the consequences that may occur in case of failure and use the best available technology to avoid damage to others. Nevertheless should a dam failure occur the owner is fully liable for the consequences.

The Dam Safety Ordinance includes requirements for owners with dams classified in a dam safety class to establish and work in accordance to a safety management system and to perform an overall dam safety assessment every 10 years. The system should among other things describe the operational responsibilities and the routines for operation, surveillance and maintenance.

For tailings dams classified as risk facilities ("Category A facility" according to the EU directive on mining waste) corresponding requirements on safety management systems are in place through the Ordinance on Mining Waste.

The industry guidelines on dam safety comprise among other things guidance on operation, maintenance and surveillance. The dam safety work should follow documented routines, which should be available in an OMS-manual for each dam facility. The guidelines include guidance on basic surveillance including visual inspections, monitoring of dam performance, functional tests, periodic detailed inspections and dam safety reviews on certain intervals.

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 water table 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

i. England

Reservoirs in England are designated high-risk or not high-risk based on the impacts of an uncontrolled release of water. High-risk reservoirs must be supervised by a reservoir Supervising Engineer at all times. The Supervising Engineer, using any recommendations that may be made by an Inspecting Engineer, will direct the reservoir undertaker to perform various monitoring and maintenance operations as appropriate to the reservoir.

The performance of these operations is reported annually to the reservoir undertaker and copied to the Environment Agency. High-risk reservoirs are also inspected by an Inspecting Engineer at least every ten years but the Supervising Engineer can call for such an inspection at any time. Not high-risk reservoirs are not formally monitored, but the designation can be reviewed, at any time, where the Environment Agency considers the designation may have ceased to be appropriate. All reservoir undertakers must report any incidents at their reservoirs to the Environment Agency.

ii. Wales

Amendments to the Reservoirs Act 1975 in Wales places a new duty on NRW to designate reservoirs as high-risk reservoir where it considers, in the event of an uncontrolled release of water, human life would be endangered. The designation considers the consequences of a flood from the reservoir but does not consider the likelihood of a dam failure.

High-risk reservoirs must be supervised by a reservoir Supervising Engineer at all times. The Supervising Engineer, guided by recommendations that may be made by an Inspecting Engineer, will advise and direct the undertakers to perform various monitoring and maintenance operations as appropriate to the reservoir. The Supervising Engineer provides the undertakers and NRW with an annual statement detailing the overall behaviour of the reservoir and any actions taken, or not taken, by the undertakers. The Supervising Engineer may also provide directions to the undertakers and may recommend a statutory inspection by an Inspecting Engineer – these are enforceable recommendations.

High-risk reservoirs must be inspected by an Inspecting Engineer, at intervals not exceeding ten years, to provide a condition assessment of the impounding structures, spillways, outlet and inlet facilities. The inspection encompasses the whole reservoir basin, with consideration for the water body catchment. The Inspecting Engineer provides a report to the undertakers and a copy to NRW. The report may include the Inspecting Engineer's recommendations as to measures to be taken in the interests of safety and maintenance, which become statutory duties on the undertakers.

Reservoirs which are not designated as high-risk reservoirs are not formally monitored, but their designation can be reviewed at any time when NRW considers the designation may have ceased to be appropriate.

All reservoir undertakers must report incidents that may affect the safety of their reservoir to NRW.

iii. Scotland

Reservoirs in Scotland are designated either; high, medium or low risk depending on the likely consequences of an uncontrolled release of water. High and medium risk reservoirs must be supervised by a reservoir Supervising Engineer at all times. The Supervising Engineer, using any recommendations that may be made by an Inspecting Engineer, will direct the reservoir manager to perform various monitoring and maintenance operations as appropriate to the reservoir. The performance of these operations is reported annually to the reservoir manager and copied to SEPA.

High risk reservoirs are also inspected by an Inspecting Engineer at intervals not exceeding ten years, but the Supervising Engineer can call for an inspection at any time. A similar inspection of a medium risk reservoir must be carried out if one is recommended by the Supervising Engineer. Low risk reservoirs are not formally monitored. The risk designation of a reservoir is reviewed at least every six years or at any time where SEPA considers the designation may have ceased to be appropriate.

iv. Northern Ireland

Reservoirs in Northern Ireland are designated as high, medium or low consequence depending on the likely consequences of an uncontrolled release of water. High and medium consequence reservoirs, following an inspection by an Inspecting Engineer, must be supervised by a reservoir Supervising Engineer at all times. The Supervising Engineer, using any recommendations that may be made by an Inspecting Engineer, will direct the reservoir manager to perform various monitoring and maintenance operations as appropriate to the reservoir. The performance of these operations is reported annually to the reservoir manager and copied to the Competent Authority.

High consequence reservoirs are also inspected by an Inspecting Engineer at intervals not exceeding ten years, but the Supervising Engineer can call for an inspection at any time.

Low consequence reservoirs are not formally monitored, but the designation as low consequence is reviewed at least every ten years or at any time where the Competent Authority considers the designation may have ceased to be appropriate.

All reservoirs must display emergency information, maintain records, prepare a flood (emergency) plan and report any incidents to the Competent Authority.

F. THE REPAIR OF DAMS

FINLAND

When the owner of a dam wants to undertake alterations and repair work that significantly affect the structures of the dam or are otherwise significant as regards dam safety, all laws that relate to issue must be followed. The Dam Safety Act Chapter 2, on the planning, design and construction of a dam, and Chapter 3, on the classification and dam safety documents, shall apply where relevant. The dam safety authority must be notified before alterations or repair work is undertaken.

FRANCE

The local authority can impose to the owner a diagnosis of the safety of a dam and impose the repair or rehabilitation works (or safety measures like a lower level in the reservoir, the decommissioning of the dam...). The authority has the power to make the works at the owner's expense.

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.

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.

The new Technical Rules issued in 2014 classify the following categories of intervention:

- “adjustment works”, in order to achieve safety standards and functionality required by the Decree for new dams;
- “improvement works”, in order to improve safety of structures without reaching levels required for new ones;
- “repair works”, which interest localised elements and which brush up existing safety conditions;
- “declassing works”, which consist in the reduction of dam height or reservoir volume.

NETHERLANDS

Minor repairs are part of regular inspection and maintenance efforts.

Major damage is rare.

Major upgrading is less rare and is generally initiated by an unsatisfactory result of a periodic safety assessment. The procedures for upgrading are by and large the same as described in Section D on construction and first filling. The Central Government used to subsidize the full cost of upgrading for a short period of time (2005-2015) if the upgrading was necessary because of changes in the Safety Assessment Instrument, but from 2015 onwards, these costs are shared between Central Government and water defence owners.

NORWAY

Major repair/rehabilitation of dams which affects the structure or the safety of a dam is done according to the same procedures as for construction of new dams. This implies that the planning of the repair/rehabilitation work must be carried out by a consultant approved by NVE and that the plans must be approved by NVE prior to construction work. Often a major repair/rehabilitation is the result of a reassessment 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.

SLOVENIA

There is no regulation that concerns the repair of a dam. According to the Construction act the refurbishment or the repair must be performed in such way that conserves or improves the quality of the construction and ensures the normal performance of it. A project for the refurbishment or repair works must be presented and approved by the Ministry of Agriculture and Environment. Smaller refurbishment works are normally performed by different sectors of the owner (or managing) company, the contractor for the bigger refurbishment works or projects must be selected through public procurement.

SPAIN

The Dam Authority can impose to the owner the repair or rehabilitation works necessary for increasing the safety of the dams.

The current Dam Regulation has no specific rules devoted to this topic and doesn't distinct between "repair work" and "rehabilitation works", but in both cases the owner must present a project to the Authority of the works to be carry out, for its approval.

SWEDEN

The owner is responsible for maintenance of the dam. When the dam owner undertakes significant alterations or repairs of a dam a permit by an Environmental Court must be obtained within the meaning of the Environmental Code. In urgent cases, if necessary due to occurred damage or to prevent damage, work may commence without prior permission. However, the owner shall as soon as possible submit an application for approval of the measures.

The industry guidelines and the guideline for the determination of design floods for dams include new demands and demands that in many cases are stricter than those of the time when the majority of the dams were constructed (before 1980). In many cases the guidelines have triggered and still trigger dam safety measures and major upgrading of existing high consequence dams.

UNITED KINGDOM

i. England

The Reservoirs Act 1975 recognises various types of work that may be undertaken on a reservoir:

- Construction or alteration works that reduce or enlarge the capacity of a reservoir must be undertaken under the supervision of a Construction Engineer commissioned from the approved panel of Inspecting Engineers established by Defra. Completion of this type of work is certified by the Construction Engineer.
- Repair works recommended by an Inspecting Engineer as a result of the ten year inspection must be supervised by a Qualified Civil Engineer (i.e. an Inspecting Engineer) who will supply a certificate once satisfied that the works have been successfully completed.
- Maintenance works are supervised by the Supervising Engineer who will report on this type of work in the annual statement. This type of work is ongoing and as such does not require a completion certificate.
- Where works of any type are not undertaken as required or completed to the satisfaction of the reservoir engineer, the Environment Agency has powers to require by notice the undertaking or completion of the works. In extreme cases, or emergency situations, the Environment Agency can perform the works or take other appropriate emergency actions, under the supervision of a Qualified Civil Engineer, to ensure the safety of the reservoir.

ii. Wales

The Reservoirs Act 1975 recognises various types of work that may be undertaken on a reservoir:

- Construction or alteration works that reduce or enlarge the capacity of a reservoir must be undertaken under the supervision of a Construction Engineer commissioned from the approved panel of Inspecting Engineers. Completion of this type of work is certified by the construction engineer.
- Repair works recommended by an Inspecting Engineer as a result of a periodic inspection must be supervised by a Qualified Civil Engineer who will supply a certificate once satisfied that the works have been successfully completed.
- Maintenance works are supervised by the Supervising Engineer who will report on this type of work in the annual statement. This type of work is ongoing and as such does not require a completion certificate.
- Where works of any type are not undertaken as required or completed to the satisfaction of the reservoir engineer, NRW has powers to require the undertakers to implement the works or recommendation. In extreme cases, or emergency situations, NRW can undertake the works or take other appropriate action, under the supervision of a Qualified Civil Engineer, to ensure the safety of the reservoir.

iii. Scotland

The Reservoirs (Scotland) Act 2011 recognises various types of work that may be undertaken on a reservoir:

- Construction or alteration works that reduce or enlarge the capacity of a reservoir must be undertaken under the supervision of a Construction Engineer commissioned from the approved panel of Inspecting Engineers established by Scottish Ministers. Completion of this type of work is certified by the Construction Engineer.
- Repair works recommended by an Inspecting Engineer as a result of the ten year inspection must be supervised by a Qualified Civil Engineer who will supply a certificate once satisfied that the works have been successfully completed.
- Maintenance works are supervised by the Supervising Engineer who will report on this type of work in the annual statement. This type of work is ongoing and as such does not require a completion certificate.
- Where works of any type are not undertaken as required or completed to the satisfaction of the reservoir engineer, SEPA has powers to require by notice the undertaking or completion of the works. In extreme cases, or emergency situations, SEPA can take appropriate emergency measures, under the supervision of a Qualified Civil Engineer, to ensure the safety of the reservoir.

iv. Northern Ireland

The Reservoirs Act (NI) 2015 recognises various types of work that may be undertaken on a reservoir:

- Construction or alteration works that reduce or enlarge the capacity of a reservoir must be undertaken under the supervision of a Construction Engineer commissioned from the approved panel of Inspecting Engineers established by the Competent Authority. Completion of this type of work is certified by the Construction Engineer.
- Repair works recommended by an Inspecting Engineer as a result of the ten year inspection must be supervised by an Inspecting Engineer who will supply a certificate once satisfied that the works have been successfully completed.
- Maintenance works are supervised by the Supervising Engineer who will report on this type of work in the annual statement. This type of work is ongoing and as such does not require a completion certificate.
- Where works of any type are not undertaken as required or completed to the satisfaction of the reservoir engineer, the Competent Authority has powers to require by notice the undertaking or completion of the works. In extreme cases, or emergency situations, the Competent Authority can perform the works or take other appropriate emergency actions, under the supervision of an inspecting engineer, to ensure the safety of the reservoir.

G. PARTICULAR RULES FOR THE PROTECTION OF THE POPULATION

AUSTRIA

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

FINLAND

Sufficient safety arrangements shall be in place for class 1 and 2 dams to ensure the safety of the operating of the dam. The safety of the dam operation is ensured by:

- 1) arrangements to ensure the operation of the dam in case of disturbances
- 2) warning and other arrangements concerning the discharge of a watercourse dam to prevent danger to those above or below the dam
- 3) arrangements to prevent damage caused by sabotage or vandalism.

Safety arrangements are for example warning signs, booms, warning signals before starting discharging from the spillway, emergency hoisting system, fences or gates to prevent entrance and so on.

The owner of dam shall prepare and regularly update a plan of measures in case of accidents and disturbances concerning a class 1 dam (emergency action plan of a dam). An emergency action plan presents the measures to be taken by the owner of the dam:

- 1) to prevent accidents in case of disturbances as well as to prevent and limit damage at the dam
- 2) to protect humans, property and the environment against damage
- 3) to report an accident.

The emergency action plan also presents the materials and equipment to be kept ready for preventing an accident and the available staff. In addition, an emergency action plan for a waste dam presents the type of the impounded substance, properties causing hazard, volume, contents, movement and conversion as well as other special characteristics of the dam.

The provisions on rescue service arrangements are laid down in the Rescue Act.

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. Smaller dams can also have an emergency plan if so decided by the authority.

The plans are prepared according to the results of a risk analysis based on the safety review that are mandatory for this category of dams. 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).

The population is informed of the measures included in the plan.

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.

GERMANY

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

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.

The 2014 Technical Rules are aimed to ensure that, even in case of extreme events, dams maintain their main feature as water retaining capability. Moreover, dams “with strategic interests” must assure their operative functionality during emergencies.

The Directive, also published in 2014:

- establishes updated conditions to activate alert phases for dam safety and management of downstream hydraulic risk, defining the actions to be implemented in these phases and the people involved;
- identifies the subjects who must develop emergency plans.

NETHERLANDS

The Water Act 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 plans and train their personnel and equipment regularly. Local communities, however, are responsible for preparing disaster management plans. Depending on the scale and severity of the threat, Provinces and the Ministry of Safety and Justice (and possibly the Interior) will also be involved; details on crisis management procedures can be found in the Safety Regions Act. An important liaison between the ministries and the crisis organisation

consists of the Departmental Crisis Centres in each ministry, and the National Crisis Centre of the Ministry of Safety and Justice.

NORWAY

Both according to The Water Resources Act, § 5, and according to the dam safety regulation chapter 7, the dam owner must establish and maintain safety measures to reduce any risk to the public connected to normal use and traffic on, nearby and downstream of the dam. Typical safety measures are fences, information signs and advertisements about any danger zones/situations.

For dams in class 2-4 it is also required to develop an emergency action plan for major accidents related to the dams, to perform regular exercises of the emergency action plan and to inform relevant rescue authorities about warning routines and affected areas in case of dam failure or any other hazard connected to the dams.

For all dams in consequence class 4, 3 and 2, a dam break flood calculation is required to serve as a basis for emergency action planning, including downstream evacuation plans made by local authorities.

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.

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

According to the Act against natural and other disasters an Emergency action (or preparedness) plan must be elaborated for all the dams higher than 15m or 10m with crest longer than 250m for embankment dams and 50m for the concrete dams or for dams with a maximum discharge that exceeds 2000m³/s. In this plans the consequences of a dam failure must be presented –therefore a study must be carried out for all the important dams. The EAP must define protocols of operation and alarming in extreme cases (dam failure.)

SPAIN

According with the *Basic guideline for public protection* Emergency preparedness plans are required for dams/ponds classified on categories A and B. The plans are prepared according to the results of a hypothetical dam failure and this analysis estimates the limits and the delay of the inundation after that.

But the Emergency Action Plan contains at least the following topics also:

- Analysis of dams safety
- Inundation map and associated damages
- Instructions to third parties into the four situations of vigilance defined by the regulation:
 - Scenario 0: Abnormal situation
 - Scenario 1: Application of corrective measures
 - Scenario 2: Exceptional situation
 - Scenario 3: Limit situation (activation of the sirens).
- Organisation of the owner

The owner 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 thirty minutes after the failure of the dam).

The population is informed of the measures included in the plan.

SWEDEN

The Dam Safety Ordinance includes requirements for owners with dams classified in a dam safety class to establish and work in accordance to a safety management system. The system should among other things include routines for identifying risks that can lead to dam failure and emergency preparedness planning.

According to the Civil Protection Act special requirements are put on establishments where the activity implies a risk that an accident will result in serious damage to people or the environment (dangerous activities). At such establishments the owner or the undertaker of the activities at the establishment is bound obliged to keep or pay for preparedness with personnel and property to a reasonable extent and take other measures necessary to prevent or mitigate such damage. The one pursuing the activities is obliged to analyse the risks for such accidents.

According to the Civil Protection Act the owner of a high consequence dam shall keep or pay for emergency preparedness to complement the resources of the local rescue authority, and take what other measures necessary to prevent or mitigate damage to people or the environment. The owner and the municipality must determine what measures that are needed for an effective rescue.

The industry guidelines on dam safety comprise guidance on emergency preparedness for the dam owner.

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

i. England

The Environment Agency uses detailed reservoir flood maps as part of the reservoir risk designation process. These flood maps are shared with local authority emergency planners to inform their emergency (off-site) plans. The Reservoirs Act 1975 makes reference to the need for reservoir undertakers to prepare emergency (on-site) plans but this is not a legal requirement under the Reservoirs Act 1975.

Such plans will set out the actions to be taken by the reservoir undertaker in order to control or mitigate the effects of flooding likely to result from any escape of water from the reservoir. These plans will be specific to each reservoir and shared with local authority emergency planning personnel.

ii. Wales

NRW uses reservoir flood maps to identify the potential consequences of a reservoir flood. These flood maps are shared with local authority emergency planners to inform their emergency (off-site) plans. The Reservoirs Act 1975 makes reference to the need for reservoir undertakers to prepare emergency (onsite) plans but this is not a legal requirement under the Reservoirs Act 1975.

Such plans set out the actions to be taken by the reservoir undertaker in order to respond to and mitigate the effects of a flood from the reservoir. These plans will be specific to each reservoir. Inspecting engineers may also recommend undertakers prepare an onsite flood plan and in these circumstances it becomes a statutory requirement. Reservoir flood maps also provide detail to inform reservoir risk designation.

iii. Scotland

SEPA uses detailed reservoir inundation maps as part of the reservoir designation process. The Reservoirs (Scotland) Act 2011 allows the Scottish Government to make further regulations requiring the preparation of flood (emergency on-site) plans. Such plans will set out the actions to be taken by the reservoir manager in order to control or mitigate the effects of flooding likely to result from any escape of water from the reservoir.

iv. Northern Ireland

The Competent Authority uses detailed reservoir inundation maps as part of the reservoir designation process. These inundation maps are shared with local council emergency planners to inform their emergency plans and supplied to town planning officials to inform their approvals for development of lands for residential or commercial use. The Reservoirs Act (NI) 2015 allows the Competent Authority to make further regulations requiring the preparation of flood (emergency on-site) plans. Such plans will set out the actions to be taken by the reservoir manager in order to control or mitigate the effects of flooding likely to result from any escape of water from the reservoir. These plans will be specific to each reservoir and shared with local council emergency planning personnel.

H. DAM DECOMMISSIONING

FINLAND

According to the Dam Safety Act, a dam is recorded as removed from service to the dam safety authority information system when it is established in the inspection that the dam structure has been demolished or the dam has been decommissioned in such a way that it can no longer cause any hazard referred to in Dam Safety Act. The inspection is performed in the presence of the dam safety authority after the obligations, relating to the pulling down of a dam structure or dam decommissioning under other law, have been met. The obligations under the Dam Safety Act cease to be applicable when the dam has been recorded as removed from service.

FRANCE

No technical rules about 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 must be approved by the authority (NVE). The procedures for receiving a permit for decommissioning are similar to the procedures for receiving a license/concession to construct a dam.

NVE may, as an alternative to decommissioning, 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.

SWEDEN

A permit from the environmental court is needed before a dam can be decommissioned. The owner applies for the permit.

SLOVENIA

The treatise (elaborate) for the demolition containing the elaborate on construction waste management should be made in case of demolition of the structure. Apart from this there is no other special obligation for decommissioning of dams.

SPAIN

The dam regulation establishes in a very brief manner that the first step is to present to the dam authority for its approval, a project which includes all the works to be developed. In the last 5 years more than 100 small dams have been removed as a consequence of their presence disturbing the natural river flows.

UNITED KINGDOM

i. England

The Reservoir Act 1975, within its definition of construction or alteration of a reservoir, includes the term 'discontinuance' which is where the reservoir is altered so that it is incapable of holding 25,000m³ of water. It also includes the term 'abandonment' which is where the reservoir is altered so that it is incapable of filling accidentally or naturally of any water.

Such works are to be conducted under the supervision of a Construction Engineer who will certify completion as appropriate. Other approvals are required from environmental and planning authorities and the reservoir Construction Engineer is expected to be sufficiently competent and familiar with these to provide advice to their client.

ii. Wales

The Reservoirs Act 1975, within its definition of construction or alteration of a reservoir, includes the term 'discontinuance' which is where the reservoir is altered so that it is incapable of holding 10,000m³ of water. It also includes the term 'abandonment' which is where the reservoir is altered so that it is incapable of filling accidentally or naturally of any water to such an extent that it poses a risk.

Such works are to be conducted under the supervision of a Qualified Civil Engineer who will certify completion. Other approvals may be required from environmental and planning authorities and the engineer is expected to be competent with these to provide advice to their client.

iii. Scotland

The Reservoir (Scotland) Act 2011, within its definition of construction or alteration of a reservoir, includes the term 'discontinuance' which is where the reservoir is altered so that it is incapable of holding 25,000m³ of

water. It also includes the term ‘abandonment’ which is where the reservoir is altered so that it is incapable of holding any water.

Such works are to be conducted under the supervision of a Construction Engineer who will certify completion as appropriate. Other approvals are required from environmental and planning authorities and the reservoir Construction Engineer is expected to be sufficiently competent and familiar with these to provide advice to their client.

iv. Northern Ireland

The Reservoir Act (NI) 2015, within its definition of construction or alteration of a reservoir, includes the term ‘discontinuance’ which is where the reservoir is altered so that it is incapable of holding 10,000m³ of water. It also includes the term ‘abandonment’ which is where the reservoir is altered so that it is incapable of holding any water.

Such works are to be conducted under the supervision of a Construction Engineer who will certify completion as appropriate. Other approvals are required from environmental and planning authorities and the reservoir Construction Engineer is expected to be sufficiently competent and familiar with these to provide advice to their client.

SECTION 3

Main Documents

(list, synopsies, files)

FINLAND

Summary Table

	Doc n.	Topics								
		A	B	C-a	C-b	D	E	F	G	H
Laws	1									
	2									
	3									
	4									
	5									
	6									
	7									
Other legal directions	8									
Guidelines	9									

- A. *Dams subjected to Regulation*
- B. *Entities concerned*
- C. *Dam Projects*
 - a) *General Directions*
 - b) *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 (Legal Obligations)

1. *Dam Safety Act (494/2009)*

The objective of Act is to ensure safety in the construction, maintenance and operation of a dam and reduce the hazard that may be caused by a dam. The Act has been valid from 1 October 2009.

<http://www.finlex.fi/en/laki/kaannokset/2009/en20090494.pdf>

2. *Water Act (587/2011)*

Act enters into force on 1 January 2012.

The law is applied to construction in watercourses.

3. *Environmental Protection Act (86/2000)*

The law is applied to waste dams and it is concerning the prevention of environmental pollution.

4. *Waste Act (646/2011)*

Act enters into force on 1 May 2012.

The law is applied to waste dams and it is preventing and combating the risk to health and the environment arising from wastes.

5. *Mining Act (621/2011)*

As regards mine safety, the provisions of the Mining Act and under it also apply.

6. *Land Use and Building Act (132/1999)*

The provisions of the law concerning the permits required for building activities, structures and other action apply to dams.

7. *Rescue Act (379/2011)*

The provisions on rescue service arrangements are laid down in the Rescue Act.

II - Other Legal Directions

8. *Government Decree on Dam Safety (319/2010)*

The Decree gives further provisions on hydrological dimensions, general technical safety requirements, dam break hazard analysis, emergency action plan, monitoring programme, dam safety arrangements and on the competence requirements concerning person who is planning, operating, monitoring and inspecting of the dam. The Decree also includes provisions on the type of information the owner of a dam has to provide to the dam safety authority. The Decree was issued on 5 May 2010.

<http://www.finlex.fi/en/laki/kaannokset/2010/en20100319.pdf>

III – Guidelines

9. *Dam Safety Guide*

The objective of the guide is to make clear and explain, by a number of examples, the contents of the Dam Safety Act and Decree. The Guide includes general and detailed recommendations which are not legally binding.

In 2012 the Guide has been translated into English, and it is published on the internet, at:

http://www.environment.fi/en-US/Waters/Use_of_water_resources/Dams_and_dam_safety/Dam_Safety_Guide

The Guideline (English version) is also included in the Annexes of this Report

**ANNEXED FILES: Dam_Safety_Act, Government_Decree_on_Dam_Safety,
patoturvallisuuslaki, valtioneuvoston_asetus_patoturvallisuudesta. Dam Safety Guide**

FRANCE

Summary Table

	Doc n.	Topics								
		A	B	C-a	C-b	D	E	F	G	H
Laws	1									
	2									
	3									
	4									
	5									
	6									
	7									
	8									
	9									
	10									
	11									
	12									
	13									
	14									
	15									

A. Dams subjected to Regulation

B. Entities concerned

C. Dam Projects

a) General Directions

b) 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 (Legal Obligations)

The basis is the “Law on water” – 01/03/1992– modified in 1995 “Loi sur l’eau” [France 01]

This general law defines the rules and obligations for the use of water. The field is a huge panel from pollution, fish... to the construction of hydraulic works in a river. It defines some general topics in the field of dam safety. For major hydroelectric power plans, the law is completed by a special old legislation (law of 10/16/1919) on hydroelectric concessions.

[France 02] gives the rules to make the declaration before the construction of new dam.

The law itself is detailed by a very important decree of 11th December 2007 [France 06] that:

- defines the classes of dams (and also dikes and levees) from A (larger ones) to D (smaller ones)
- gives the obligations of the owner of each class of dams
- defines the role of the participants
- creates the official committee that is consulted on the projects of new dams, the projects of rehabilitation works and general document, regulations... in the field of dams

Later, this decree was re-detailed by some general orders [France 08 and France 12] that give further rules on the prescriptions of the decree.

Furthermore there are also specialized orders that complete the decree on some particular points:

- [France 09] on risk assessment : plan of document “risk assessment for a dam”
- [France 13] on the agreement of engineering consulting firms: conditions, activities,...
- [France 14] for the report on incidents and accidents : the incidents or accidents with an impact (or a potential impact) on the public safety must be reported in specified delays to the local administration.
- The decree [France 06] has been partially changed by decree of 12th May 2015 [France 15].

II - Internal instruction for the administration

The ministry gives orders to local authorities by the mean of circulars :

- [France 07] for hydroelectric dams and [France 10] for the other dams that define the role of the administration, prescribe periodical inspections...
- [France 11] explains what should be included in the risk assessment study of a dam and how to read and approve this kind of document (it can also be considered as a continuation of the previous order [France 09]).

III- Emergency planning

The 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*” - [France 03]) fixes the conditions where the establishment of an emergency plan is mandatory and defines the studies that the owner must supply the results needed the plan (especially inundation maps). This decree is completed by two orders (order of 12/01/1994 [France 04] and order of 02/22/2002 [France 05]).

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 01, France 02, France 03, France 04, France 05, France 06, France 07, France 08, France 09, France 10, France 11, France 12, France 13, France 14, France 15

ITALY

Summary Table

	Doc n.	Topics								
		A	B	C-a	C-b	D	E	F	G	H
Laws	1									
	2									
	3									
	4									
	5									
	12									
	13									
Other Legal Obligations	6									
	7									
	8									
	9									
	10									
	11									

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

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)..

12. 2014, “*Norme tecniche per la progettazione e la costruzione degli sbarramenti di ritenuta (dighe e traverse)*” Decree, 26 June 2014. - [File: Italy 12]

Synopsis

This Decree contains the updated technical rules for the design and construction of dams. It replaces the previous D.M. 1982 (item n.3). In these technical rules the criteria of the limit state approach are applied. For 18 months until the end of 2015 the old technical rules D.M. 82 will be still valid together with the new ones. A Commission should check the proper application of the new rules identifying possible improvements that may be judged necessary.

13. 2014, “*Indirizzi operativi inerenti l’attività di protezione civile nell’ambito dei bacini in cui siano presenti grandi dighe*” Directive, 8 July 2014. - [File: Italy 13]

Synopsis

The Directive gives operative directions for the management of emergency situations (e.g. related to flood and seismic events). The “Documento di Protezione Civile” (Civil Protection Document) of each dam will have to be updated according to these directions.

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, Italy 12, Italy 13

NETHERLANDS

As of 2017, the Dutch dam-related legislation is as indicated in the table and explanations below. In the longer run, all environmental legislation, including the Water Act and the two Environmental Acts mentioned below, will probably be integrated into one overall Environmental Act. Probably, the safety standards will then no longer be part of the law itself, but rather of an underlying Order of Council.

Summary Table

	Doc n.	Topics								
		A	B	C-a	C-b	D	E	F	G	H
Laws	1	Y	Y	Y	(y)	(y)	Y	Y	Y	
	2	(y)	(y)	Y		Y	(y)	Y		Y
	3			(y)		Y	(y)	Y		Y
	4		(y)						Y	
	5					Y	Y	Y	Y	Y
Other Legal Obligations	6			(y)	Y	Y	Y	Y	(y)	
	7					(y)	Y			

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

- 1. Water Act**
- 2. Act on Environmental Management**
- 3. General Provisions Act on Environmental Law**
- 4. Safety Regions Act**
- 5. Health and Safety Regulations for workers (“ARBO”)**
- 6. Guidelines for assessment and design (“WTF” and “ENW”)**
- 7. Permit-for-use from municipality (for appurtenant structures)**

References and useful websites

1. **Formal law texts as of Oct. 2014** (in Dutch; up to date translations are rarely available or not at all) can be accessed through the following links

a. **Water Act:** <http://wetten.overheid.nl/BWBR0025458/2017-01-01>

i. The Water Act contains provisions related to Flood Risk Management and to Water Management in a general sense. By and large, the Water Act contains the following elements:

1. Chapter 1 – General provisions, mainly definitions
2. Chapter 2 – Aims and Standards: refers to general aspects of the safety standards and the safety assessment, hydraulic boundary conditions for safety assessment and guidelines for design,
3. Chapter 3 – Roles of different organisations involved in water and flood risk management, and provisions related to flood warnings
4. Chapter 4 – Policy and implementation plans
5. Chapter 5 – Construction, operation and maintenance of water works
6. Chapter 6 – Water permits and related issues
7. Chapter 7 – Financial issues
8. Chapter 8 – Law enforcement
9. Chapter 9/10 – various issues
10. Annex I + II: Dike rings and safety standards for those dike rings

b. **Act on Environmental Management:**
<http://wetten.overheid.nl/BWBR0003245/2017-08-30>

i. This act contains a very large amount of provisions on several issues. By and large, the Act on Environmental Management contains the following elements:

1. Chapter 1 - General provisions and definitions
2. Chapter 2 - Provisions related to key environmental authority organisations
3. Chapter 4 - Policy and implementation plans for central and local governments
4. Chapter 5 – Environmental Standards
5. Chapter 7 – EIA / Environmental Impact Assessment
6. Chapter 8 – Provisions related to polluting entities
7. Chapter 9 – substances and products (and permits)
8. Chapter 10 – Waste materials
9. Chapter 11 – Sound-related legislation
10. Chapter 12 – Reporting obligations
11. Chapter 13 – Procedures (for permits, exemptions etc.)
12. Chapter 14 – Co-ordination (for permits, EIA's etc.)
13. Chapter 15 – Financial issues
14. Chapter 16 – Emission trade
15. Chapter 17 – Environmental incidents
16. Chapter 18 – Law enforcement
17. Chapter 19 – public accessibility of environmental information
18. Chapter 20 – legal security and transitional legislation
19. Chapter 21/22 further issues

- c. **General Provisions Act on Environmental Law:**
<http://wetten.overheid.nl/BWBR0024779/2016-07-01>
- i. This act focusses specifically on the environmental permit that is needed when activities are planned that may affect the entities protected by environmental legislation. Both environmental legislation, specific nature conservation legislation, monument legislation and housing legislation and specific laws on for example nuclear energy or Antarctica may require environmental permits and therefore refer to the present act. The Act gives all details about the procedures for obtaining such an environmental permit, the inspection-related issues after a permit has been granted, etc.
- d. **Safety Regions Act:** <http://wetten.overheid.nl/BWBR0027466/2017-06-10>
- i. By and large, this act contains the following sections
1. General provisions and definitions
 2. Role and activities of the municipal authorities
 3. Role and activities of the safety regions
 4. Role and activities of the fire brigade
 5. Role and activities of the regional authority for medical assistance
 6. Emergency room
 7. Co-ordinating representative
 8. National aims
 9. Emergencies and crises beyond local scale; upscaling procedures
 10. Information and communication
 11. Request for assistance
 12. Exceptional circumstances
 13. Financial provisions
 14. Supervision
 15. Access to property
 16. Sanctions
 17. Provisions related to role, governance and finance of Institute for Physical Safety
 18. Further issues

2. Useful documents on www.helpdeskwater.nl

- a. **English translation (2009) of the original Dutch Water Act**, more recent modifications not yet included: <https://www.helpdeskwater.nl/secundaire-navigatie/english/legislation/@176675/dutch-water-act/>
- b. **Brief brochure on the Water Act (2009)**, not yet updated: <https://www.helpdeskwater.nl/secundaire-navigatie/english/legislation/@176676/the-dutch-water-act/>
- c. Relatively recent (2012) though not fully updated **overview of Flood Risk and Water Management Policies in the Netherlands** – <https://www.helpdeskwater.nl/secundaire-navigatie/english/water-and-safety/@178463/flood-risk-and-water/>
- d. Booklet describing the **main insights from the FLORIS Flood Risk Study**, major source of inspiration for the “WTI” Legal [water defence safety] Assessment Instrument, which is now under development:

- <https://www.helpdeskwater.nl/onderwerpen/waterveiligheid/programma-projecten/veiligheid-nederland/english/flood-risk-the/>
- e. Background documents in Legal water defence Safety Assessment Instrument WBI: see <https://www.helpdeskwater.nl/onderwerpen/waterveiligheid/primaire/beoordelen-wbi/producten-wbi/> (the vast majority of the documents is in Dutch, but the list also contains some documents in English, see especially the end of this web page).
- f. In Dutch language only:**
- i. **Present version of the “WBI” Legal [water defence safety] Assessment Instrument**, used for the present safety assessment: <http://www.helpdeskwater.nl/onderwerpen/waterveiligheid/primaire/toetsen/wti2006-vigerend/>
 - ii. **Formal design tool “OI2014”** to be used for the present dike reinforcement round (in <http://www.hoogwaterbeschermingsprogramma.nl/Nieuwe+normering/Ontwerpinstrumentarium+2014/default.aspx>
 - iii. **References to other/various documents related to design:** <https://www.helpdeskwater.nl/onderwerpen/waterveiligheid/primaire/ontwerpen-beheer/>

3. Useful Guidance documents

Fundamentals of Flood Protection the the Dutch Expertise Network on Flood Risk Management ENW: https://www.enwinfo.nl/images/pdf/Grondslagen/GrondslagenEN_lowresspread.pdf
ENW Guidelines and Technical Reports on Design and Management of Flood Defences. The ENW web site is currently being reconstructed, for ENW Guidelines etc., the reader is referred to: <http://kennisbank-waterbouw.nl/dicea/TAW-ENW.htm> . Most documents are in Dutch, but there are also some English translations. Please note that these documents may not be fully in accordance with the present legislation and the present type of safety standard, since both have changed recently.

NORWAY

Summary Table

	Doc n.	Topics								
		A	B	C-a	C-b	D	E	F	G	H
Laws	1									
	2									
Regulations	3									

- A. Dams subjected to Regulation
- B. Entities concerned
- C. Dam Projects
 - a) General Directions
 - b) 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 (Legal Obligations)

1. Act related to Watercourses and Groundwater (The 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 of watercourse structures” (**The dam safety regulations**), laid down by Royal Decree 18 December 2009 with authority in the Act of 24 November 2000 No. 82 on Watercourses and Groundwater (The 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.
3. “Regulations governing internal quality control on how to fulfil the Act on Watercourses and Groundwater” (**Internal Control Watercourses**), laid down by Royal Decree 28 October 2011 with authority in the Act of 24 November 2000 No. 82 on Watercourses and Groundwater (The Water Resources Act), Sections 53, 54 and 58. Proposed by the Ministry of Petroleum and Energy.

III - Guidelines (available by 2012)

1. Flood calculations
2. Planning and construction
3. Inspection and reassessment
4. Concrete dams
5. Spillways
6. Masonry dams
7. Embankment dams
8. Gates, valves and penstocks
9. Determination of loads
10. Surveillance and instrumentation
11. Dam break flood analysis

ANNEXED FILES:

A description of the dam safety regulation is given in the paper “New Norwegian Dam Safety Regulations”, by G. Holm Midttømme, L. Grøttå and E. Hyllestad, presented at the ICOLD European Club Symposium in Innsbruck, 2010. The Water Resources Act, The Dam Safety Regulation, The Internal Control Regulation and the technical guidelines are available in Norwegian at www.nve.no.

PORTUGAL

Summary Table

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

- A. *Dams subjected to Regulation*
- B. *Entities concerned*
- C. *Dam Projects*
 - a) *General Directions*
 - b) *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

1. 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.

2. 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

SLOVENIA

Summary Table

		A	B	C-a	C-b	D	E	F	G	H
Laws	1									
	2									
	3									
	4									
	5									
	6									
	7									
Other Legal Obligations	8									
	9									
	10									
	11									
	12									
	13									
	14									
	15									
	16									
	17									
	18									
	19									
	20									
	21									

- A. *Dams subjected to Regulation*
- B. *Entities concerned*
- C. *Dam Projects*
 - a. *General Directions*
 - b. *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 (*Legal Obligations*)

1. *Construction act (Official gazette RS No.110/2002, completion 2012)*

Synopsis

This Regulation defines the general and administrative rules (together with Water act, Energy act and Spatial planning act) for the design, construction and operation of all types of the constructions including dams. The rules apply to:

- content of the various design level (preliminary, for approval, for construction, as constructed),
- approval and authorisation process,
- construction phase,
- supervision activity of the Authority in construction phase (Inspectorate for civil engineering - jurisdiction),
- first filling and the final test for starting the normal operation,
- Safety control during the operation stage (partially).

NOTE: Some fields relevant to environment, water management and power generation are defined more in details by other act in force.

2. *Water act (Official Gazette RS No.67/2002; completion in 2010)*

Synopsis

This Regulation defines the general and administrative rules for use of water (together with Environment, Energy and Spatial planning act) the necessary permits that should be obtained for water structures (including dams), the obligations of owners of water structures that should be fulfilled in the operational phase. The rules apply to:

- content of the various design level (preliminary, for approval),
- approval and authorisation process (approval of projects by supreme water office, department for water),
- construction phase (for the all the construction works in specific areas where the ground water can be affected),
- supervision activity of the Authority in the construction, operation and reconstruction phase (Inspectorate for environment - jurisdiction),
- safety control during the operation stage (partially).

3. *Spatial planning act (Official Gazette RS No.33/2007; completion 2012)*

Synopsis

This Regulation defines the general and administrative rules (together with Water act, Construction act, Environment act) for the design, construction and operation of all types of the constructions including dams. The rules apply to:

- Insertion of important infrastructure into space (additional rules for dams for power generation)and its impact of the dam to the environment, space and population
- content of the various design level (preliminary, for approval, for construction),
- approval during the authorisation process,
- construction phase(indirectly),
- supervision activity of the Authority in construction phase (Inspectorate for civil engineering - jurisdiction),

4. *Environment act (Official Gazette RS No.31/2000; completion 2004)*

Synopsis

This act defines the general and administrative rules for environment and species protection – it transmits the requirements for Environment protection set by different EU regulations and conventions into Slovene legislation. It also sets the basis for establishment of special protected areas and puts basic restrictions for any type of construction in these protected areas. The rules apply to all type of constructions in:

- content of the various design level (preliminary, for approval, for construction-indirectly),
- approval and authorisation process,
- construction phase (indirectly),
- supervision activity of the Authority in construction(Inspectorate for civil engineering - jurisdiction),
- Control of operation and refurbishment during the operation stage (in protected areas – for example: NATURA 2000, special protected areas).

5. *Protection Against Natural and Other Disasters Act (Official Gazette RS No.51/2000 and completion 2010)*

Synopsis

This regulation defines the general and administrative rules for the protection against natural disasters and it refers to large dams (according to previous ICOLD categorisation). It sets basis for the preparation and organization of Emergency Action Plans and organization of civil protection. The act refers to:

- Operational phase,
- To the dams and reservoirs that are used also for irrigation and recreation,
- Potential dam failure
- Organisation of civil protection in case of operation in extreme conditions and natural disasters

6. *Energy act (Official Gazette RS No.79/1997 and completion 2007)*

Synopsis

This act defines the general and administrative rules for infrastructure for power generation. Together with rules for preparation of EAP it sets basis for the preparation and organization of Emergency action plans and organization of civil protection: The act refers to:

- content of the various design level (preliminary, for approval, for construction, as constructed),
- the insertion into space phase
- approval and authorisation process,
- necessary permits that should be obtained before the operation
- special requirements that should be fulfilled before the operation
- supervision of operation of power generation infrastructure

7. *Law on Construction Products (Official Gazette No.52/2000)*

The rules define the attestation of in-built materials and type of controls that should be performed during the construction and after the completion of the construction.

II - Other Legal Directions

8. *Regulation for classification of very demanding, demanding and simple engineering structures, about the conditions for construction of simple engineering structures that do not need building permit and about the type of construction works that are in reference with structures and appurtenant land (Official Gazette RS No.114/ 2003 and completion)*

The regulation defines more in details which dams need more accurate elaboration and processing during the phase of design and approval.

9. *Regulation on the classification of types of structures and facilities of national importance (Official Gazette RS No.109/2011)*

The regulation defines which dams and dykes should undertake the complete process of insertion into space.

10. *Former Yugoslav monitoring and surveillance regulations (Official Gazette SFRY No.7/ 1966)*

The regulation defines which dam should be subjected to constant monitoring and sets basis for extent of monitoring and report elaboration.

11. *Regulations for seismic monitoring of large dams (Official Gazette RS No.92/1999, completion in 2003)*

The regulation sets basis for the monitoring of seismic activities in the influence area of the dams.

12. *Regulation for preparation of emergency action plans (Official Gazette RS No.24/2012)*

The regulation gives detailed rules and instruction for preparation of Emergency action plans and organisation of civil protection in case of natural disasters including dam failure.

13. *Regulation on the environmental report and the detailed procedure of comprehensive assessment of certain plans and programs on the environment (Official Gazette RS No.73/2005)*

14. *Rules on the content, form and method of preparation of the National spatial plan and the method of preparation proposed solutions of the spatial arrangement their evaluation and comparison (Official Gazette RS No.99/2007; completion 2011)*

15. *Rules on design documentation (Official Gazette RS no. 66/2008)*

Detailed information about content of the designs

16. *Rules on proof of the reliability object (Official Gazette RSno. 55/2008)*

17. *Rules on the format and content of the evidence of the reliability object (Official Gazette RS, no. 55/2008)*
18. *Rules on the criteria for spatial planning and spatial interventions in agricultural land outside the urban areas (Official Gazette RS no. 110/2008)*
19. *Rules concerning the presentation of spatial status (Official Gazette RS no. 50/2008)*
20. *Regulations regarding authorization of energy permit (Official Gazette RS no. 5/2007)*
21. *Regulation on classification of objects according to the complexity of the construction (Official Gazette RS no. 18/2013)*

NOTE: Listed above are the main rules and regulations – there are several others referring to particular parts of the process of insertion into space and protection of endangered species.

In addition to the Act, Regulations and Rules that are in force- there are also the European and national standards that give technical requirements

III - Guidelines *(No Legal Obligations)*

Guidelines on the elaboration of contingency plans

NOTE: Guidelines for dam safety in preparation.

SPAIN

Summary Table

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

- A. *Dams subjected to Regulation*
- B. *Entities concerned*
- C. *Dam Projects*
 - a. *General Directions*
 - b. *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 (Legal Obligations)-

1. *Instruction for the project, construction and operation of large dams (1967)*. Public Works Ministry Order [File: Spain 1]

Synopsis

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

- Only large dams are subjected to the regulation;
- Contents, hypothesis 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;
- safety control during the operation stage;.

2. *Basic guideline for civil protection against risk of flooding (1994)*, Ministry of Interior. Cabinet agreement. [File: Spain 2]

Main points: Classification of all dams/ponds depending on the potential downstream damages in case of failure or malfunctioning (A, B and C) and the need of emergency action plans for risky dams/ponds (A and B dams).

3. *Technical Regulation about safety of dams and reservoirs (1996)*. Ministry Order. [File: Spain 3]

This Regulation defines the general and administrative rules for the design, construction and operation of large dams or dams classified on A, B categories. The rules are relevant to the following subjects:

- Only large dams are subjected to the regulation;
- Contents, hypothesis 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;
- safety control during the operation stage.

4. Amendment of the Public Water Regulation. 2008. Real Decree. [File: Spain 4]

Synopsis: This Regulation defines the general and administrative rules for the design, construction and operation of large dams or dams classified on A or B categories. The rules are relevant to the following subjects:

- supervision activity of the Authority in all stages of the dam life cycle;
- safety control in the construction stage;
- safety control during the first filling;
- safety control during the operation stage;.

It includes also the need of developing three Safety Technical Standards which once approved, they will be the only applicable regulations on dam safety.

SWEDEN

Summary Table

	Doc n.	Topics								
		A	B	C-a	C-b	D	E	F	G	H
I - Laws	1									
	2									
II - Other Legal Obligations Regulations	1									
	2									
Guidelines	1									
	2									
	3									

- 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 (Legal Obligations)-

1. 1999, “*The Swedish Environmental Code*” (SFS 1998:808)
Synopsis
 A general set of rules and regulations for activities, which may have environmental consequences. The Environmental Code also governs water rights and dam safety. In 2014 new legal requirements on dam safety were added.

2. 2003, “*The Civil Protection Act*” (SFS 203:778)
Synopsis
 The aim with the Civil Protection Act is to give equal protection against accidents for people’s life and health as well as for property and environment in the whole country, taking local circumstances into consideration.

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

1. 1998, “*The ordinance about owners’ self-regulation*” (SFS 1998:901)

2. 2014, “The Dam Safety Ordinance” (Förordning om dammsäkerhet, SFS 2014:214)
3. 2003, “The ordinance about civil protection” (Förordning om skydd mot olyckor, SFS 2003:789)

III - Guidelines (*guidelines are not binding from a legal point of view*)

1. 2012, “RIDAS, *The hydropower industries guidelines for dam safety*”, provided by SwedEnergy.
Synopsis
Dam safety guidelines drawn up by the hydropower industry, first published in 1997. RIDAS comprises guidance on consequence classification, organisation, competence and documentation, dam design and construction, operation, surveillance and monitoring, and maintenance, emergency preparedness and dam safety audits (by SwedEnergy).
2. 2012, “GruvRIDAS, dam safety guidelines of the mining industry” (Gruvindustrins riktlinjer för dammsäkerhet), provided by SveMin.
Synopsis
The mining industry’s version of RIDAS, first published in 2007.
3. 2015, “Swedish Guidelines for Design Flood Determination for Dams” (Riktlinjer för bestämning av dimensionerande flöden för dammar). Guidelines drawn up by Svenska Kraftnät, SwedEnergy and SveMin.
Synopsis
The guideline on design flood for dams was first published in 1990. It specifies design criteria for design floods in relation to consequences of a dam failure during a flood event, and is primarily directed to dam owners and consultants who carry out design flood calculations.

ANNEXED FILES:

I-1 - Changes to Environmental Code and Ordinances_2014
I-1 - Environmental Code and Ordinances - a resume_English (1999 version)
I -1 - Environmental Code_English (1999 version)
I -1 and II - 2 - Changes to Environmental Code and Ordinances_2015
I-2 – Civil Protection Act_English brief presentation
I-2 – Civil Protection Act_Swedish
II-2 - Förordning om dammsäkerhet_Swedish 2014
II-2 – Ordinance on Civil Protection_Swedish
II-2 – Ordinance on Owner’s Self Regulation_Swedish
III - 3 - Guidelines design flood_English 2007 version
III - 3 - Riktlinjer dim flöden_Swedish with English summary 2015

SWITZERLAND

Summary Table

	Doc n.	Topics								
		A	B	C-a	C-b	D	E	F	G	H
Laws	1									
Ordinance	1									
Guidelines	1	Under revision (2014)								

- A. Dams subjected to Regulation
- B. Entities concerned
- C. Dam Projects
 - e) General Directions
 - f) 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 (Legal Obligations)-

1. October 2010, “Federal Law on Water Storage Structures” (LOA 721.101)

Synopsis

A general set of rules regarding safety of water storage structures and liability linked to the damages incurring from water releases.

General dispositions – Safety of water storage structures (Construction and operation, Emergency plan) – Liability – Surveillance and legal procedures – Penal provisions and data treatment – Final dispositions.

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

1. October 2012, “Federal Ordinance on Water Storage Structures” (OSOA 721.101.1)

Synopsis

General dispositions – Safety of water storage structures (Construction, Commissioning and Operation, Emergency plan) – Surveillance – Final dispositions.

III - Guidelines (guidelines are not binding from a legal point of view)

Synopsis

The Guidelines regarding dam safety are currently under revision and being adapted to the new legislation.

ANNEXED FILES:

I-1 – LOA Loi fédérale sur les ouvrages d'accumulation

II-1 – OSOA Ordonnance sur les ouvrages d'accumulation

UNITED KINGDOM

i. England

Law: Reservoirs Act 1975 [UK 01], as amended by the Flood and Water Management Act 2010 [UK 02]

Summary Table:

Law	Applicable section(s) of Act	Topics							
		A	B	C	D	E	F	G	H
Reservoirs Act 1975	A1 & 5: Define a controlled (regulated) reservoir								
	1, 21 – 24: Role and responsibilities of the reservoir undertaker								
	4: Establish engineer panels and appoint suitably competent engineers								
	6 – 9, 21: Define construction works and provide administrative procedure to certify such works								
	10 – 12, 19: Inspection & supervision requirements for high-risk reservoirs								
	2 - 3, 15 – 18, 25 – 26: Regulatory powers and duties to require and carry out works to a reservoir								
	12A, 12AA - 12B, 20 - 21: Other requirements, flood plans, maintenance of records, reports and incident reports								
	13 - 14: Discontinuance or Abandonment								

- A. Dams subjected to Regulation
- B. Entities concerned
- C. Dam projects
- D. Construction and first filling
- E. Dams operation
- F. The repair of dams
- G. Rules for the protection of the population
- H. Dam decommissioning

ii. Wales

Law: Reservoirs Act 1975 [UK 01], as amended by the Flood and Water Management Act 2010 [UK 02]

Summary Table:

Law	Applicable section(s) of Act	Topics							
		A	B	C	D	E	F	G	H
Reservoirs Act 1975	A1 & 5: Define a large raised reservoir subject to regulation								
	1, 21–24: Role and responsibilities of the reservoir undertaker								
	4: Establish engineer panels and appoint suitably competent engineers								
	6–9, 21: Define construction works and provide administrative procedure to certify such works								
	10–12, 19: Inspection & supervision requirements for high-risk reservoirs								
	2-3, 15-18, 25-26: Regulatory powers and duties to require and carry out works to a reservoir								
	12A, 12AA-12B, 20-21: Other requirements, flood plans, maintenance of records, reports and incident reports								
	13-14: Discontinuance or Abandonment								

- A. Dams subjected to Regulation
- B. Entities concerned
- C. Dam projects
- D. Construction and first filling
- E. Dams operation
- F. The repair of dams
- G. Rules for the protection of the population
- H. Dam decommissioning

iii. Scotland

Law: Reservoirs (Scotland) Act 2011 [UK 03] - <http://www.legislation.gov.uk/asp/2011/9/contents>

Summary Table

Law	Applicable section(s) of Act	Topics							
		A	B	C	D	E	F	G	H
Reservoirs (Scotland) Act 2011	1 & 2: Define a controlled reservoir								
	3-5: Define who is reservoir manager								
	27-31: Establish engineer panels and appoint suitably competent engineers								
	32-42: Define construction works and provide administrative procedure to certify such works								
	45 – 51: Inspection & supervision requirements for high & medium consequence reservoirs								
	36, 40,48, 69,71, 74, 77 & 82: Powers to require works to a reservoir								
	54-57: Other requirements - incident reports, flood plans, maintenance of records, display of emergency response information								
	50: Supervision of draw down by a supervising engineer 32: Meaning of relevant works requiring commission of a construction engineer.								

- A. Dams subjected to Regulation
- B. Entities concerned
- C. Dam projects
- D. Construction and first filling
- E. Dams operation
- F. The repair of dams
- G. Rules for the protection of the population
- H. Dam decommissioning

iv. Northern Ireland

Law: Reservoirs Act (Northern Ireland) 2015 [UK 04]
<http://www.legislation.gov.uk/nia/2015/8/contents/enacted>

Secondary regulations will be introduced in line with phased commencement of the Reservoirs Act (NI) 2015.

Summary Table

Law	Applicable section(s) of Act	Topics							
		A	B	C	D	E	F	G	H
Reservoirs Act (NI) 2015	1-5 Define a controlled reservoir								
	6-10 Define who is reservoir manager								
	102-105 Establish engineer panels and appoint suitably competent engineers								
	41-51 Define construction works and provide administrative procedure to certify such works								
	25-37 Inspection & supervision requirements for high & medium consequence reservoirs								
	36,41,71,73,75,77 & 81 Powers to require works to a reservoir								
	56-59 Other requirements: incident reports, flood plans, maintenance of records, display of emergency response information								
	26 Supervision of draw down by a supervising engineer								
42 Meaning of relevant works requiring commission of a construction engineer.									

- A. Dams subjected to Regulation
- B. Entities concerned
- C. Dam projects
- D. Construction and first filling
- E. Dams operation
- F. The repair of dams
- G. Rules for the protection of the population
- H. Dam decommissioning

ANNEXED FILES: UK 01, UK 02, UK 03, UK, 04

