RESCDAM PROJECT

RECOMMENDATIONS TO UPDATE
THE FINNISH DAM SAFETY CODE OF PRACTICE

EMERGENCY AND RESCUE ACTIVITIES

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1 INTRODUCTION

One of the main goals of the RESCDAM project was to prepare recommendations to update the current Finnish Dam Safety Code of Practice (Publications of the Ministry of Agriculture and Forestry 7b 1997, http://www.vyh.fi/eng/orginfo/publica/electro/damsafet/damsafe.htm), particularly concerning emergency and rescue actions in the event of a dam accident. A dam is classified according to the Dam Safety Code of Practice as a P dam if, in the event of an accident, it may manifestly endanger human life or health or manifestly seriously endanger the environment or property (definition from the Dam Safety Act). For P dams, an emergency action plan shall be drawn up jointly by the dam owner or holder and the rescue authorities. A basis for an emergency action plan is always a dam break flood analysis (hazard assessment).

The DSCP includes also the current Dam Safety Act and Decree. The authority of the Ministry of Agriculture and Forestry to issue the DSCP is based on the Dam Safety Act. Under the Act on the measures concerning the rules and regulations of authorities, codes of practice are general rules that are not prescriptive. The Act and the provisions and regulations issued thereunder, but not those referring to rescue services, are supervised by the regional environment centres under the supervision and guidance of the Ministry of Agriculture and Forestry. The rescue services fall under the Ministry of the Interior and their subordinate authorities (the State Provincial Offices and municipal rescue authorities). The duty of the Finnish Environment Institute is to develop dam safety and participate in the preparation of the DSCP.

The Act on Rescue Services (see Appendix of this text) applies to rescue activities with reference to the emergency measures to be taken in the event or under threat of accidents in order to protect and rescue people, property and environment, to limit the damage and to minimise the consequences. Because of the amendment of the Act on Rescue Services there is also a need to revise the current DSCP concerning emergency and rescue actions.

The legislation of rescue services will also change in the near future, since, regional rescue services will be created in Finland in keeping with a decision by the Finnish government. Municipal and regional responsibilities will be re-evaluated in the regional system. About 30 regional rescue service agencies will be created to replace some 450 municipal service agencies.

2 RECOMMENDATIONS TO UPDATE THE FINNISH DAM SAFETY CODE OF PRACTICE (DSCP)

It is easier to understand the following changes and additions, if the current DSCP and the Act on Rescue Services are available while examining this demonstration (see the DSCP and the Act on Rescue Services at the end of this text). This demonstration follows the current DSCP. Text in italics is a direct quote from the current DSCP. Proposed changes or additions are written in bold characters.
2.1 Safety monitoring and inspections (Chapter 6 of the DSCP)

To reduce the hazard risk from a dam, a safety monitoring programme, subject to the Dam Safety Act, shall be drafted for each dam. The monitoring programme is drafted by the dam owner or holder and shall be subject to approval by the regional environment centre. The programme may include rules concerning the monitoring proper and inspections made at regular intervals.

2.1.1 Monitoring (Chapter 6.2)

Although each dam subject to the Dam Safety Act has a safety monitoring programme, it should be considered, when revising the current DSCP, an addition concerning an automatic monitoring system. Particularly in cases where the consequences of a possible dam accident would be considerable or catastrophic, an automatic monitoring system (AMS) should be considered. Some of the P dams in Finland would be the principal candidates needing an AMS – P dams such as the embankment dam of the Kyrkösjärvi reservoir (the pilot project dam of RESCDAM). A primary function of an AMS is to reveal abnormalities in real-time and thus provide an early warning of a potentially serious incident or a dam failure.

2.1.2 Annual inspection (Chapter 6.3.1)

There is no mention of the checking or updating of an emergency action plan (EAP) in the annual inspection agenda. The contact information expires fast and that information is very important in the event of an accident.

The observation of dam damage and the operation of the equipment for warning the population are of critical importance in the event of an accident. An annual inspection would therefore include the checking of this equipment as well as the telecommunication links for them. The following should be added to the text:

Contact information as well as other information essential to rescue operations must be controlled and updated during the annual inspection. The observation of dam damage and the operation of alarm systems as well as the alarm links, must be checked during the annual inspection. The operation of facilities must be checked with test runs during the inspection. The municipal rescue authority must be informed two weeks prior to an annual inspection.

If defects are found in the annual inspection, instructions for remedial action shall be issued. If the defects cannot be remedied immediately, a time limit shall be set for remedying them. Remedying of the defects is subject to re-inspection if necessary.

2.1.3 Regular inspection (Chapter 6.3.2)

A regular inspection is made at intervals not exceeding five years. There is an agenda in Chapter 6.3.2 for regular inspection.

Instruction and training are of major importance in the maintenance of the dam as well as in the event of a dam accident or serious incident. An addition to the agenda should be made as follows:
• Educational needs are considered concerning the emergency action plan and operations in the event of a dam accident. An educational programme is to be prepared.

• In addition to the checking of the emergency action plan, equipment for observation of dam damage, warning of population and alerting different organisations and persons are to be checked. Facilities operation must be checked with test runs during the inspection.

Also an addition should be made as follows:

If defects are found in the regular inspection, instructions for remedial action shall be issued. If the defects cannot be remedied immediately, a time limit shall be set for remedying them. Remedying of the defects is subject to re-inspection if necessary.

2.1.4 Disturbances (Chapter 6.4)

“The disturbance report shall be delivered to the dam safety authority without delay”.

Disturbance reports can be utilised for the development of dam safety and for educational purposes, if they are gathered in one place and summarised. The following should be added to the text:

The disturbance report shall be delivered to the regional environment centre and the Finnish Environment Institute without delay.

2.2 Results of a dam break flood analysis (Appendix 16 of the DSCP)

Results of a dam break flood analysis (hazard assessment) are the basis for planning emergency and rescue activities. The results of the hazard assessment shall be presented in such a way, that both rescue authorities and other authorities participating in rescue operations are able to plan their own activities according to the assessment results.

"The results of each flood case assessment, derived from either calculations or scale model tests, shall be presented on a map (1:20 000) and in tables listing water level and flow data at different stages of flood by cross-section."

The following should be added to the text concerning the inundation maps:

Results of dam break flood analysis intended for the use of rescue authorities shall be presented in such a way, that they can be utilised by rescue authorities in the most useful way. Inundation maps shall include at least the following flood data:

• A map derived from the propagation speed of flood. This map presents the arrival time of a flood wave to the area and the flood situation in 0.5, 1, 2 and 3 hours after the failure as well as maximum flood level.
• A damage parameter map derived from the water depth d (m) and flow velocity v (m/s) of flood (flow velocity times depth = vd). Values are presented as follows: < 0.5; 0.5 - 1.0; 1.0 - 3.0; 3.0 - 7.0; >7.0.
• A map of water depth. Water depths of a flood are presented as contours of 0-0.5 m; 0.5-1.0 m; 1.0-2.0 m; 2.0-3.0 m and > 3.0 m.
• The moment at which the water reaches the maximum level in the cross-section given in hours from failure.

The flood data shall be presented in such a way that the data is easily read on the map (1:20 000). In addition to the flood data, the names of the area, road network, bridges, buildings, terrain conditions etc shall be presented on the map. Rescue authorities may suggest different styles of expression to show the results of the dam break flood analysis.

2.3 Emergency action planning and advance information

2.3.1 How to take a P dam into account when planning the rescue services (Chapter 8.2 of the DSCP)

According to the Act on Rescue Services (ARS, Section 9) the rescue authorities as well as other authorities and organisations referred to in Section 6, that are responsible for tasks of the rescue services or for executive assistance tasks, shall be required to draw up the necessary emergency plans in co-operation with each other.

According to Section 13 of the ARS, a municipality shall, in co-operation with the neighbouring municipalities, the district chief fire officer, the authorities participating in rescue activities and those giving executive assistance as well as with the emergency response centre, draw up alarm instructions for alerting the resources necessary for rescue activities and for the provision of inter-municipal assistance. The alarm instructions shall be drawn up in such a way that the emergency response centre may alert the closest appropriate units regardless of their municipality of origin. The service level of the rescue services shall correspond to the accident threats present in the municipality.

According to Section 15 of the ARS, the municipality shall ascertain and assess the threats present in the area of the municipality and determine, based on the assessment, the service level of the rescue services comprising the personnel and equipment of the fire brigade as well as the full-readiness time of the fire brigade. The service level also covers planning, prevention of accidents, civil defence as well as support measures necessary for rescue activities.

Chapter 8.2 should be substituted with the following text:

The risk of a P dam causing an accident shall be taken into account in the planning of rescue services as well as in the alarm instructions. Planning must be executed in such a way, that alerted resources are adequate considering the size of the accident.

The owner or holder of each P dam is obliged to help the rescue authorities in drawing up this plan and, in accordance with the emergency action plan, to take precautions against accidents. Under Section 4 of the Dam Safety Decree the following shall be available in the event of an accident caused by a P dam to extent required by the conditions:

• A plan concerning measures to be applied to a water body or hydraulic structures in the event of an accident.
• An account of stores of materials kept in case of accident.
• An account of the alarm system and communication links to the emergency response centre.
• An account of the personnel of the dam owner or holder available in the event of an accident.
• An account of other measures to be taken by dam owner or holder, necessary to protect people and property, in the event of an accident caused by damming.
• An account of the type and quantity of the substance enclosed by waste dams.

In addition to the above, which must mainly be noted by the dam owner or holder of a P dam, other basic data needed for the planning of rescue services are the results of the hazard risk assessment (dam break flood analysis) dealt with in the Chapter 7 of the DSCP and matters that are the responsibility of the rescue authorities.

The main responsibility for an emergency action planning concerning P dams belongs to municipal rescue authorities (chief fire officer). According to the Dam Safety Act (Section 9), the dam owner or holder shall be obliged to assist rescue authorities in drawing up the plan, to draft the relevant assessments and necessary action plans for his part, and to acquire and maintain the facilities and materials referred to in the action plan and to take other measures to safeguard people and property against the risk posed by the dam and to participate in the implementation of the action plan. However, a dam failure event requires actions from many other authorities and voluntary organisations. These authorities participating in rescue operations may be required to participate in drawing up the emergency action plan (Act on Rescue Services: Sections 6, 7 and 9).

Addition to Chapter 8.2 of the DSCP

In the planning of the rescue services for the event of a dam accident rescue authorities are required to define the organising of rescue actions and assist executive assistance authorities in drawing up the sector-by-sector plans. Rescue authorities are responsible for the following items:

• Alerting, organising and leading rescue services units.
• Alerting and evacuating the population in the danger area.
• Drawing up the alarm instructions of the possible dam accident for the emergency response centre.
• Defining tasks of responsibility areas of each authorities.
• Assisting in drawing up of sector plans.
• Managing the whole operation.
• Organising communications.
• Providing information to the public.
• Maintaining operational readiness.

Emergency planning concerning a P-dam is summarised in an emergency action plan. The municipal rescue authority, in co-operation with the dam owner or holder, are responsible for drawing up this plan. The personnel data with contact information and the warning system of the emergency action plan shall be checked during the annual inspection. The entire emergency action plan shall be checked and updated during the regular inspection.

If there are several P dams in the same water course and the failure of one dam may cause the failure of other dams located downstream of the first dam or cause considerable danger for
population, property and environment, the serious failure of dams as well as the emergency discharge exceeding the permitted amount must be taken into account in the dam owner’s or holder’s plan concerning the operation of the discharge system of the water course.

An emergency action plan shall be drawn up before the implementation of the dam i.e. before the level of water or other enclosed substance is raised. The latest updated emergency action plan shall be available for the person in charge of dam maintenance and dam safety, the chief fire officer of the municipality and the regional environment centre.

2.3.2 Remedying defects of emergency action plan
(a new Chapter 8.2.1 of the DSCP)

Structural defects of a dam are dealt with in Chapter 3.2 of the DSCP. Should a dam be considered deficient, it shall be subject to intensified monitoring, or repaired or made subject to operating restrictions, depending on the severity of the deficiencies.

An emergency action plan has a great importance in successful rescue operations in the event of a dam failure.

A new Chapter 8.2.1 of the DSCP should be as follows:

If an emergency action plan of a P-dam is found to be defective, it shall be remedied immediately or within a set time limit.

2.3.3 Advance information about the emergency action plan and the possibility of a dam failure (a new Chapter 8.3 of the DSCP)

Circumstances in the event of a dam failure are very difficult from a rescue action point of view, that the population should be evacuated before the arrival of a flood wave. This requires that a failure is noticed at an early enough stage for advance planning of warning operations and choice of warning methods so that people can be convinced of the reality of a threat.

If there are people living in the immediate vicinity of the dam in the potential downstream hazard area and rescue services cannot guarantee their safety, escaping from the danger area also has to include personal action. People must be informed in advance about the possibility of a dam failure so that they are able to protect themselves on their own and to behave in the appropriate manner in the event of an accident (see Safety bulletin of Kyrkösjärvi dam in Appendix 24). The information distribution is based on the fact, that controlling of risk factors and protection against risks also requires actions from the population in the danger area in addition to rescue services operations. The population is given the opportunity to prepare themselves for an emergency and to form an idea about the protection instructions prepared by authorities. The population is also given adequate information on the measures that they should take in case of a dam failure.

The issuing of information has a special meaning due to the nature of a dam failure. In case of chemical or radiation accident, the population can protect themselves in their homes, but in case of a dam accident this would depend on whether the buildings remain intact and reach above the flood level. The issuing of information is of the greatest importance to the
credibility of the warning and for operational decisions of different parties. The giving of
information significantly reduces the need of a person to find proof about the threatening
danger and gives a ready operational model to rescue oneself from the danger area. This
allows us to conclude, that even in a short period of time, people may act correctly according
to the operational decisions given by the authorities.

The following should be added to the text (a new Chapter 8.3 of the DSCP which substitutes
the Chapter 10 of the Appendix 18 of the DSCP):

The population subject to a hazard risk shall be informed in advance about the emergency
action plan and the possibility of the dam failure. Information about the dam hazard risk
is issued by bulletin to the population in the danger area in advance and by organising an
information meeting if necessary. The notification shall be compiled jointly by the rescue
authority, the regional environment centre and the owner or holder of the dam.

The possibility of a dam accident shall be notified as an external risk in the safety plan of a
building, an industrial or commercial entrepreneur, an agency, institution or other
organisation (Act on Rescue Services, Sections 8 and 9 and Decree on Rescue Services,
Sections 10,11 and 13).

The safety bulletin shall contain at least the following information:
• Name and location of the dam.
• Contact information on the persons responsible for the contents of the bulletin.
• A statement that the dam is classified as a P dam. The definition of a P-dam.
• A general description of the type of dam hazard risk and possible effects of the hazard on
the population and environment. The inundation map of the dam.
• Assurance that the dam is monitored constantly as stated in the safety monitoring
programme approved by the regional environment centre and in keeping with the Dam
Safety Act.
• Adequate information on how people will be warned in the event of a dam failure and how
the information service will be run during the emergency.
• General instructions on the measures people should take in the event of a failure and how
they should behave.
• Information that an emergency action plan has been compiled for the eventuality of a dam
failure. A brief description about the warning and evacuation procedure.
• Contact information and persons for further information.

2.3.4 Emergency action plan (=site plan) for a P dam and precautions
against accidents (Appendix 18 of the DSCP)

This chapter deals with the contents of the emergency action plan (EAP) presented in
Appendix 18 of the DSCP. When reading this text it should be noted that dams and their
various danger areas are very individual. Consequently the contents of the EAP cannot be
determined in detail and plans will be formed according to existing conditions.

Appendix 18 of the DSCP is not rewritten in this text. This text presents the observations
about the contents of the EAP and drawing up the plan during the RESCDAM project. See
also the EAP of the Kyrkösjärvi dam (Appendix 24 of the final report). This text contains
recommendations to update Appendix 18 of the current Finnish Dam Safety Code of Practice.
EAP in general

The EAP of a P dam is drawn up jointly by the municipal rescue authority and the dam owner or holder. The other authorities referred to in the Act on Rescue Services (Sections 6 and 9) also have a responsibility to participate in the planning of emergency and rescue operations of their own field.

It is practical to draw up the outline of the EAP in such a way that alterations and updated information are in appendices. The layout of the EAP should be drawn up in such a way, that different updates can easily be done. The traditional page numbering is replaced by numbering the chapters in the EAP of the Kyrkösjärvi dam. In this way a certain part of the plan can easily be removed or changed and it is easier to add new information without disturbing the whole.

Proposal for the contents of the EAP:

CHAPTERS 1-10

Contents
Contents of the EAP.

Chapter 1
Information about the author of the EAP and distribution as well as updating of the plan.

Chapter 2
General information about a dam and reservoir, results of a dam break hazard analysis and a description of monitoring.

Issuing information in the event of a dam failure should be a point to consider when drawing up this summary. It is easier to give information about an accident, if a brief and unambiguous summary about the dam and reservoir can be distributed to the media.

Chapter 3
How to obtain and check information about an accident. Alarm levels.

Description on how information about a dam accident or a threat of an accident is received and how the information is handled by the receiver i.e. an emergency response centre.

Actions required in the event of a dam failure are divided into alarm levels according to the seriousness of the accident. An alarm level is determined by the dispatcher of an emergency response centre or a person responsible for the safety of the dam in question or a rescue authority according to the emergency call.

Alarm levels for the EAP of Kyrkösjärvi dam were defined on the basis of the population at risk. The alarm level model applied in Portugal was a basis for defining alarm levels for Finnish practice (see Fernanda Rocha’s paper for the RESCDAM seminar, October 2000).
Chapter 4
Measures to be applied to the water course and dam structures, and the repair of dam damage. Personnel and equipment and materials needed to forestall an accident including necessary updated contact information.

It should be noticed that emergency dam repairs by rescue authorities may not cause any harm to warning, evacuation, rescuing and rescue services management activities. This shall be noticed when starting the repairing activities.

Chapter 5
Rescue operations. Warning and evacuation and rescuing people in danger. Management and co-operation during emergency and rescue activities. Supplying personnel and maintenance of equipment.

Chapter 6
Isolation of the flood area and traffic control.

Chapter 7
Emergency medical care.

Chapter 8
Supplying the evacuated population.

Chapter 9
Informing about an accident.

Information contains an advance information (see Safety bulletin for residents of Seinäjoki in Appendix 12 of the EAP of Kyrkösjärvi dam.), an emergency bulletin (see Emergency bulletin for the people of Seinäjoki in Appendix 2 of the EAP of Kyrkösjärvi dam) to be read immediately in the beginning of a dam failure, and general information to the media during emergency and rescue activities.

Chapter 10
Guarding of the flood area and prevention of additional damages.

APPENDICES 1-12 (see the EAP of Kyrkösjärvi dam)

Appendix 1(1,2,3,4)
Alarm instructions.

Instructions for the emergency response centre are very important with respect to the right decisions in the beginning of a dam failure event. Alarm instructions include names of persons alerted, method of alerting and contact information. Instructions for organisations which seldom participate in rescue operations shall also include information about the person they should report to and the place to obtain the necessary instructions. Special equipment needed for the operation should also be mentioned. Instruction may be marked with an emergency symbol.
Appendix 2
Emergency bulletin of rescue services.

A emergency bulletin drawn up in advance to be issued to the population in danger through radio.

Appendix 3
Radio traffic chart.

Appendix 4(1,2,3)
Request for executive assistance from the Army.

Appendices 5-8
A map of the water depth in the flood area. Water depths of a flood are presented as contours of 0-0,5 m; 0,5-1,0 m; 1,0-2,0 m; 2,0-3,0 m and > 3,0 m.

A map of the flood propagation speed. This map presents the arrival time of a flood to the area and the flood levels at 0,5, 1, 2 and 3 hours after the failure as well as the maximum flood.

A map showing the maximum level in the cross-section given in hours from the failure.

A damage parameter map. A damage parameter map derived from the water depth d (m) and flow velocity v (m/s) of the flood (flow velocity times depth = vd). Values are presented as follows: 0 - 0,5; 0,5 - 1,0; 1,0 - 3,0; 3,0 - 7,0; >7,0.

Appendix 9
Planning map for rescue services.

An enclosed map with the plan of rescue services concerning the organising of warning, evacuation and rescuing of population.

Appendix 10
A location map for materials needed for repairing of a dam and routes from material storage sites to the dam.

Appendix 11
Explanations for inundation maps.

Instructions for interpreting inundation maps and flood information.

Appendix 12
A safety bulletin for the population in the danger area.
3 RESCUE AND CO-OPERATIONAL EXERCISES

3.1 Training frequency for dam failure cases

Dam accidents are not emphasised in the training programmes of rescue services, because they are so rare. However, training and operational practice is necessary for the personnel to be able to implement necessary action in case of accidents. The training should be organised for all fire brigades that will be alerted in the event of a dam accident.

The internal training and exercise of fire brigades, personnel of emergency response centres as well as dam operators, should include dam accidents once or twice a year to maintain a sufficient operational capacity.

Co-operation training exercises for different authorities, emergency response centres and dam owners or holders involved in dam accidents, shall be organised every 3-5 years. The training could be either a map or a field exercise. The co-operation training should be organised as a field practice every ten years. If many P dams are located in the same area of services co-operation, it is not necessary to organise training for each P dam separately, the training can be organised by turns for each dam.

3.2 Training content

The basis of rescue operations in the event of a dam failure shall be the warning and evacuation of the population in such a way, that actual rescue work is not necessary. Therefore, the training and exercises should emphasise warning and evacuation of the population in danger.

Theoretical training

Well-organised and managed co-operation between different authorities is essential to a successful rescue operation in dam failure situation. The rescue services have an important role as leader of the co-operative work. Personnel at every operational level (crew, sub fire officer, fire officers) should understand their tasks as a part of a whole. The theoretical training shall include an illustration of operational areas, tasks of different authorities, warning and evacuation arrangements, communications and reactions of the population to warnings.

Practical training

A knowledge of the target (dam), installation and operation of public announcement equipment for warning the population, surface rescuing, boating skills and treatment of hypothermic patients are all part of training skills. A surface rescue operation in flowing water should also be the subject of exercise.

Co-operative training

P dams shall be noticed in the co-operative plans of rescue services according to the Finnish Dam Safety Code of Practice. This means that P dams are a part of the co-operative training for maintaining the capacity to prevent disaster and co-ordinated by the State Provincial
Offices. Dam accidents should be the object of co-operational training every 3-5 years, because only through practice will an adequate sureness be achieved for a successful operation in a real accident event.

The training of management of rescue services and co-operational authorities includes examination and development of operational plans and familiarising with the danger area. A dam accident case can be the subject of an exercise with maps and situation descriptions and field exercises with the leadership of a game centre. The personnel of an emergency response centre should be a part of the co-operational training in order to test the warning and alerting communications as well as emergency instructions.
Act on Rescue Services

Pursuant to the decision of Parliament, made in the manner provided for in section 67 of the Parliament Act, the following is enacted:

Chapter 1
General provisions
Section 1
Scope of application of the Act

This Act shall apply to:
1) the prevention of fires and other accidents unless otherwise provided for in another Act or Decree;
2) rescue activities referring to the emergency measures to be taken in the event or under threat of accidents in order to protect and rescue people, property and the environment, to limit the damage and to mitigate the consequences; and to
3) civil defence referring to the protection of people and property, the safeguarding of the operations of agencies, institutions and production plants important to the operations of society and to attending to the tasks referred to in subparagraph 2 under exceptional conditions referred to in section 2 of the Readiness Act (1991/1080) and section 1 of the State of Defence Act (1991/1083) as well as preparedness thereto.

The service consisting of the activities referred to in paragraph 1 shall be referred to as rescue services.

This Act shall not apply to the activities referred to in the Act on Prevention the Pollution from Ships (1979/300), the Act on Prevention of Oil Damage on Land (1974/378), the Maritime Rescue Service Act (1982/628), the Maritime Act (1994/674) or the Aviation Act (1995/281).

Chapter 2
Responsibility for rescue services
Section 2
Rescue authorities

The State rescue authorities shall be the Ministry in charge of rescue services and the State Provincial Offices.

The municipal rescue authorities shall be the chief fire officer and the rescue officials designated to these tasks by the municipality as well as the competent collegiate municipal body.

Further provisions on the tasks of the rescue authorities shall, where necessary, be provided for by Decree. Provisions on the uniforms and the identity card intended as identification of the official position of the rescue authorities shall be issued by Decree.

Section 3
The tasks of the State rescue authorities

The Ministry in charge of rescue services shall be responsible for the nation-wide rescue-service preparations and arrangements as well as for the coordination of the tasks of rescue services and civil defence belonging to the spheres of operation of different ministries, direct the rescue services as well as supervise the availability and level of the rescue services.

The State Provincial Office shall be responsible for the tasks provided for in paragraph 1 in the area of the province.

Section 4
Tasks of the municipal rescue service

The municipality shall be responsible for the rescue services in its area and, for that purpose, it shall:
1) attend to the tasks belonging to rescue activities;
2) maintain civil-defence readiness and, where necessary, attend to the tasks belonging thereto;
3) coordinate the rescue service tasks belonging to the different authorities and other parties participating in these services;
4) attend to fire inspections and other prevention of accidents belonging to the rescue authorities;
5) for its part, attend to the training of rescue service personnel; as well as
6) attend to the provision of information and advice relating to rescue services.
Section 5  
Arrangement of rescue services in a municipality

A municipality shall have a fire brigade and a full-time chief fire officer. The fire brigade of the municipality may be a municipal fire brigade or a volunteer fire brigade, an institutional fire brigade or an industrial fire brigade that has concluded a contract with the municipality.

The mayor of the municipality shall be responsible for the coordination of the activities of the different spheres of operation belonging to civil defence.

Municipalities may carry out their rescue-service tasks in cooperation as provided for in the Local Government Act (1995/365). Municipalities may also have a joint office of the chief fire officer.

Section 6  
Tasks of other authorities

In addition to the rescue authorities, the police, the Frontier Guard, the Defence Forces, the social and health authorities, the authorities and institutions in charge of agriculture and forestry as well as business enterprises, environmental authorities, authorities in charge of passenger and goods transport and communications, agencies and institutions in charge of radiation and nuclear safety and weather services shall be responsible to participate in rescue activities and civil defence as provided for on their tasks in the relevant provisions governing each sphere of operations.

The Defence Forces shall be responsible to participate in rescue activities by providing equipment, manpower and special expert services necessary for rescue activities where this is deemed necessary with regard to the extent and special nature of the accident. Participation in rescue activities may not endanger the national defence operations of the Defence Forces.

The Forest and Park Service shall be liable to provide the rescue authorities with expert assistance in the fighting of forest fires and to make, at its own initiative, preparations for the prevention and fighting of forest fires on State land in its management in cooperation with the rescue authorities.

The State and municipal authorities and institutions shall also, on request, provide the rescue authorities with executive assistance belonging to their sphere of operations or otherwise applicable thereto.

Further provisions on the participation and executive assistance referred to in paragraphs 1 - 4 shall be issued by Decree.

Section 7  
Volunteer activities

The rescue authorities may delegate training, advice and information tasks to organizations operating in the field of rescue services. Voluntary people and organizations may be used to assist in rescue services’ tasks, however, not in tasks involving significant exercise of public authority.

Section 8  
Self-preparedness

The owner or holder of a building, an industrial or commercial entrepreneur, an agency, institution or other organization shall be liable to prepare to protect people and property in the said premises as well as the environment in danger situations as well as to prepare for rescue measures which they can take at their own initiative.

Section 9  
Planning obligation

The rescue authorities as well as the other authorities and organizations referred to in section 6 which are responsible for tasks belonging to rescue services or for executive assistance tasks shall be liable to draw up the necessary emergency plans in cooperation with each other.

Municipalities with a nuclear plant referred to in section 3, subparagraph 5 of the Nuclear Power Act (1987/990) or a plant causing a danger of a major accident as defined separately in a Decree shall draw up an emergency plan for an accident taking place in the plant. The population exposed to the danger shall be heard when drawing up the plan and informed thereof.

The owner or holder of a building, an industrial or commercial entrepreneur, an agency, institution or other organization to be provided for in a Decree shall draw up a plan on the measures referred to in section 8.
Chapter 3

Municipal cooperation

Section 10

Assistance

A municipality shall, where necessary, assist another municipality in rescue activities and civil defence.

Section 11

Regional division

In order to organize alarm and dispatching operations, the country shall be divided into alarm districts to be decided by the Council of State.

In order to ensure the leadership of rescue activities and to enhance cooperation in rescue services, a province shall be divided into cooperation districts. The State Provincial Office shall decide on the cooperation-district division as well as determine the central municipality of the cooperation district.

Section 12

District chief fire officer

Each cooperation district shall have a district chief fire officer in charge of the coordination of rescue-service planning and, where necessary, leadership of rescue activities in the cooperation district. The municipalities may also agree on the delegation of other tasks to the district chief fire officer.

The State Provincial Office shall designate a district chief fire officer and the necessary number of his deputies from among the full-time municipal officials of the cooperation district.

The costs arising from the tasks of the district chief fire officer shall be distributed between the municipalities in a manner agreed upon by them. If the municipalities cannot reach an agreement thereon, the distribution of costs shall be decided by the State Provincial Office.

Section 13

Alarm instructions

A municipality shall, in cooperation with the neighbouring municipalities, the district chief fire officer, the authorities participating in rescue activities and those giving executive assistance as well as with the emergency response centre, draw up alarm instructions for alerting the resources necessary for rescue activities and for the provision of inter-municipal assistance. The alarm instructions shall be drawn up so that the emergency response centre may alert the closest appropriate units notwithstanding their municipality of origin.

Chapter 4

Readiness of the rescue services

Section 14

General readiness requirement

Rescue services shall be planned and arranged so that the measures belonging thereto may be taken efficiently and without delay.

Section 15

Service level of the municipal rescue services

The service level of the rescue services shall correspond to the accident threats present in the municipality.

The municipality shall ascertain and assess the threats present in the area of the municipality and determine, on the basis thereof, the service level of the rescue services comprising the personnel and equipment of the fire brigade as well as the full-readiness time of the fire brigade. The service level also covers planning, prevention of accidents, civil defence as well as support measures necessary for rescue activities.

The Ministry in charge of rescue services shall, where necessary, issue orders on the minimum service level.

Section 16

Supervision of the service level of municipal rescue services

The State Provincial Office shall supervise that the service level of the municipal rescue services complies with the provisions and orders. In this capacity, the State Provincial Office shall have the right to obtain the necessary information and reports from the municipalities and joint municipal organizations.
If the service level of municipal rescue services has significant defects and the municipality fails to amend the defects within the time limit set by the State Provincial Office, the State Provincial Office may, in the manner provided for in section 81, obligate the municipality to bring the services to the level required in the Act.

Section 17
Inspection of readiness

Rescue authorities may conduct inspections in order to supervise the preparedness for major accidents and civil defence provided for in this Act. The body conducting the inspection shall have the right to enter the premises subject to inspection, however, with the exception of residential premises and places referred to in section 34, paragraph 4, and obtain accounts on plans and other arrangements relating to preparedness required by this Act or the decrees or orders issued thereunder.

Section 18
Participation of the State in the maintenance of readiness

The State may participate in the maintenance of readiness necessary for the rescue services by acquiring special equipment or by financing operations, the acquisition or financing of which from State funds is deemed appropriate for a special reason.

Chapter 5
Rescue-service training and qualifications

Section 19
State responsibility for training

The State shall be responsible for the professional training of the rescue services as well as for the training of the leaders and experts of civil defence. Further provisions on the arrangement of the training shall be issued in the Emergency Services College Act (1994/1165) and Decree (1994/1237). The Ministry in charge of rescue services may authorize also an institution other than the Emergency Services College to provide professional training in rescue operations.

Section 20
Municipal responsibility for training

A municipality shall:
1) arrange training for the civil-defence personnel of residential buildings and municipal institutions as well as for persons belonging to the municipal civil-defence organizations other than those referred to in section 19, paragraph 1;
2) supervise the training of enterprises and institutions aiming at self-preparedness; as well as
3) ensure that the personnel of a contractual fire brigade and the part-time personnel of the municipal fire brigade have sufficient training.

Section 21
Qualifications of rescue-service personnel

The qualifications of full-time rescue-service personnel shall be issued by Decree. Where necessary, the Ministry in charge of rescue services shall issue orders on the training required from other than full-time personnel.

Chapter 6
Prevention of accidents

Section 22
General prevention of accidents

The task of the rescue authorities shall be to prevent fires and, for their part, also other accidents as provided for below.

Section 23
Safety of use of buildings and equipment

A building, structure and its environment shall be planned, built and maintained so that the ignition and spreading of fires is minimal and that, in case of an accident, rescue activities are possible. With regard to common premises, the owner or holder of a building as well as, with regard to the premises in his use, the holder of an apartment shall ensure that:
1) the fire-fighting, rescue and preventive equipment, equipment facilitating fire-fighting and rescue activities, fire detectors and alarm equipment as well as other equipment indicating any danger of an
accident, exit signs and safety markings as well as the equipment and installations of shelters ordered by authorities or required by the law are in working order and that they are serviced and inspected as ordered by the Ministry in charge of rescue services;
2) fire-places and chimneys are swept regularly; as well as that
3) ventilation channels and equipment are serviced and cleaned at regular intervals.

Section 24

Duty of diligence

Fire and an inflammable or explosive or other dangerous substance shall be handled with diligence and sufficient care.

When undertaking repair or other work due to which the danger of a fire or another accident is considerably increased, sufficient precautions shall be taken.

Each person shall, to the extent possible, be liable to supervise that provisions and orders issued for the prevention of a fire or another accident are complied with within his sphere of authority.

Section 25

Making an open fire

A campfire or another open fire may not be made in a forest or in its vicinity if the circumstances due to a dry spell, wind or another reason are such that the danger of a forest fire is evident.

An open fire may not be made on the land of another without permission unless there is a compelling need thereto.

Controlled burning may take place on forest land even during a dry spell by observing special care under the supervision of a forestry professional.

Section 26

Notifying of controlled burning

The emergency response centre shall be notified of controlled burning on forest land and also other controlled burning in advance.

Section 27

Fire safety in peat production areas

Due to the danger of a fire, fire prevention shall be paid special attention to in peat production. Peat production shall be interrupted if the danger of a fire is evident due to a wind or to another reason.

Section 28

Forest-fire lookout and forest-fire alert

When the danger of forest fires is evident, the State Provincial Office shall arrange efficient forest-fire lookout in scarcely populated areas.

The authority in charge of weather-forecast services shall ensure that a forest-fire alert is given in areas where the danger of forest fires due to weather conditions is deemed evident.

Section 29

Water for fire-fighting

The municipality shall ensure that an adequate amount of water is available for the rescue activities of a fire brigade.

Section 30

Everyman’s duty to act

Anyone who notices or learns that a fire has broken out or another accident has occurred or is threatening and who cannot immediately extinguish the fire or prevent the danger shall be liable without delay to notify those in danger thereof, make an emergency call and start rescue activities within his abilities.

Section 31

Special safety requirements

Residential premises as well as accommodation and institutional-care premises shall be equipped with a sufficient number of smoke alarms or equipment at least equivalent thereto in their protection level.
The Ministry in charge of rescue services may order that appropriate fire-extinguishing equipment and other equipment facilitating rescue activities be acquired to premises where the operations carried out or the circumstances cause an unusually great danger to fire safety or personal safety or to the environment, as well as that also other preventive measures necessary for the protection of people and property in case of an accident are taken in the said objects. The municipal rescue authority may issue a corresponding order to an individual object.

Arrangements to be made in order to prevent a major accident caused by dangerous substances and to limit any consequences thereof shall be provided for by Decree. The Ministry in charge of rescue services may issue further orders on the implementation of the arrangements.

Section 32
Placing of rescue-service equipment in a building

The owner of a building shall be liable to allow the municipal rescue authorities to place equipment necessary for rescue services in the building if it does not cause unreasonable harm. If no agreement can be reached on the placing of the equipment, the authority granting the building permit shall decide thereon.

Chapter 7
Fire inspection

Section 33
Contents of a fire inspection

The purpose of a fire inspection is to prevent danger caused by a fire or another accident to people, property or the environment.

The fire inspection shall be conducted so as to supervise that a building or a structure, its surroundings and other circumstances in the inspection object are safe and that the owner or holder of the real estate is prepared for the prevention of accidents, mitigation of damage and civil defence in the manner required in the provisions and orders.

The shelter of the real estate and the operability of its equipment shall also be inspected in the fire inspection.

Advice relating to the prevention of fires and other accidents shall, where necessary, be given in the course of the fire inspection.

Section 34
Inspection objects

Fire inspections shall be conducted:
1) in residential buildings and in objects comparable thereto with regard to personal and fire safety at intervals decided by the municipality;
2) in objects to be provided by Decree where the danger to personal safety or fire safety or to the environment can be estimated to be greater than usual, annually or, where necessary, more frequently; as well as
3) at objects to be provided by Decree prior to the commencement of operations or when the operations change essentially.

Compliance with orders issued in connection with the inspections shall, where necessary, be monitored by follow-up inspections.

For a special reason, a fire inspection may be conducted also at other times.

The provisions of paragraph 1 shall not apply to an area or property in possession of the Defence Forces which, due to national safety, shall be kept secret and the fire inspection of which is taken care of by the Defence Forces in accordance with their notification.

Section 35
Conduct of a fire inspection

A municipal rescue authority may conduct a fire inspection.

The person conducting the fire inspection shall be allowed access to all the premises subject to the inspection. The representative of the inspection object shall, in addition, present the plans, other documents and arrangements required by this Act and the Decrees and orders issued thereunder.

A record shall be drawn up of the fire inspection and the owner or holder of the target or their representative shall be notified thereof.

Section 36
Right to receive information on buildings

Notwithstanding the provisions on secrecy, the municipal rescue authority shall have the right to obtain information from the building data of an authority on the building as well as on its owner or holder also in
the form of lists by regions, types of building or grouped in another manner, however, with the exception of build-
ing data relating to property referred to in section 34, paragraph 4.

Section 37
Repair order and interruption of operations

If defects are found in the fire inspection, they shall be ordered to be remedied. If the defects
cannot be remedied immediately, a time limit shall be set for remedying them.

If a defect or erroneous action detected during a fire inspection or otherwise causes imminent
danger of an accident, the municipal rescue authority shall have the right to interrupt the operations without delay
and to order measures necessary for the prevention of an accident. The order shall be complied with without
delay.

Chapter 8
Chimney sweeping

Section 38
Arrangement of chimney sweeping

The municipality shall decide on the arrangement of chimney sweeping services in the
municipality.

The municipality may:
1) carry out the chimney sweeping itself; or
2) acquire chimney-sweeping services from a private service provider; or
3) allow the owner or holder of a building to agree on chimney sweeping with a private service
provider in the whole municipality or part thereof.

When the municipality arranges the chimney-sweeping services in the manner referred to in
paragraph 2, subparagraph 1 or 2, it may also decide on the fee to be collected for the chimney sweeping.

A municipal rescue authority may, with regard to an individual object, permit chimney sweeping
to be conducted also by another person than a chimney sweep.

Section 39
Qualifications of a chimney sweep

A chimney sweep or a person in charge of chimney sweeping shall have a vocational chimney-
sweep degree. The qualifications of a chimney sweep or a person in charge of chimney sweeping as well as the
competence and training qualifications of persons employed by the chimney sweep shall, where necessary, be
further provided for by Decree.

Section 40
Notification of defects

If the chimney sweep detects that fireplaces or chimney flues have defects or faults that may
cause a danger of a fire, he shall notify the representative of the sweeping object and the municipal rescue au-
thority thereof in writing.

Section 41
Sweep list

The person engaged in sweeping shall keep a list of the targets he has swept and, on request,
issue information from the list to the rescue authority without charge. The information shall be kept for ten years
from the performance of the measure.

Chapter 9
Emergency response centres

Section 42
Emergency response centres

The municipalities belonging to an alarm district referred to in section 11 shall establish and
maintain an emergency response centre for the reception of emergency calls and for alerting. The emergency
response centre shall be located in a municipality ordered by the Ministry in charge of rescue services.

The experimental State emergency response centres shall be governed by separate provisions.

If the municipalities cannot agree on the establishment, maintenance and division of costs of a
emergency response centre, the State Provincial Office shall decide thereon.

The State shall be liable to arrange and maintain the communication connections between
emergency response centres as well as between them and the State Provincial Offices.
Section 43
Tasks of an emergency response centre

The task of the emergency response centre shall be to receive emergency calls and accident notifications 24 hours a day and to alert the necessary help as well as to function as the communication centre of rescue activities. An emergency response centre may undertake also other tasks if they do not impair the operations of an emergency response centre under this Act.

Notwithstanding the secrecy obligation, the emergency response centre shall have the right, for the execution of its tasks, to receive, free of charge, from a telecommunications operator referred to in the Telecommunications Markets Act (1997/396) identification information on the subscription from which an emergency call has been made. The emergency response centre shall have the right to receive the corresponding information on the subscriptions from a telecommunications operator also using a technical user connection or otherwise in electric form.

The tasks of emergency response centres shall, where necessary, be further governed by Decree.

Section 44
Nation-wide tasks of emergency response centres

The Ministry in charge of rescue services may order a suitable emergency response centre to assist the State Provincial Office as the province communications and command centre as well as a suitable emergency response centre to assist the Ministry as the national communications and command centre. The province emergency response centre and the national emergency response centre shall be paid a reasonable annual compensation from State funds.

Chapter 10
Rescue activities
Section 45
Contents of rescue activities

The rescue activities include the receipt of emergency calls, dispatching of rescue units and other help, warning of the population, prevention of threatening accidents, protection and rescue of people, the environment and property in danger, fire-fighting and the prevention and limiting of other accidents, post-fire clearing and guarding as well as leadership, information, servicing and other support measures relating thereto.

Section 46
Leadership of rescue activities

The leader of rescue activities shall be from the municipality where the accident or emergency situation has originated unless the municipalities have agreed upon otherwise. The rescue activities shall be lead by a rescue authority or another person belonging to a municipal fire brigade until the rescue authority takes charge of the leadership of the activities.

The district chief fire officer may undertake to lead rescue activities in a cooperation area. For a special reason, the State Provincial Office and the Ministry in charge of rescue services shall have the right to issue orders relating to the rescue activities and designate also another person than the person referred to above in this paragraph to lead the rescue activities.

If authorities of several spheres of operation participate in rescue activities, the overall leadership of the situation shall belong to the leader of the rescue activities.

Section 47
Competence of the leader of rescue activities

To extinguish a fire and to prevent its spreading as well as to prevent another accident and to limit the damage, the leader of rescue activities and the authority referred to in section 46, paragraph 2 shall, if the situation cannot be controlled in another manner, have the right to:

1) order people to take shelter as well as to evacuate people and property;
2) undertake necessary measures which may cause damage to real property or movables;
3) order that buildings, communication and data connections and equipment as well as equipment, tools and supplies, foodstuffs, fuel and lubricants as well as extinguishing substances needed in rescue activities be made available; as well as to
4) take also other measures necessary in rescue activities.

Property referred to in paragraph 1, subparagraph 3, which the owner or holder of the property himself needs simultaneously for the prevention of a fire or another accident, may not be ordered to be conveyed unless this is necessary to save a human life. The municipality shall compensate the property taken into use in full as well as compensate any damage caused to the property taken into use.
Section 48
Duty to participate in rescue activities

If it is necessary to save a human life or to prevent another accident, the leader of rescue activities shall have the right to order any person who is at the scene of the fire or accident or in its vicinity and is capable of work and not hindered by a valid cause, to assist in the rescue activities. If the situation cannot be controlled in another manner, the rescue authority shall, in a corresponding situation, have the right to order people who are capable of work and are staying in the municipality to arrive at the scene of the fire or accident without delay and to assist in the rescue activities. The task may be refused only for a valid reason.

In accident or emergency situations, also fire brigades other than municipal fire brigades shall be under the general command of the leader of the rescue activities; an industrial or other institutional fire brigade, however, only if the safety of the plant is not impaired thereby.

A person ordered to assist in rescue activities may not leave the scene of the fire or accident before the leader of the rescue activities has given him permission thereto.

Section 49
Post-fire clearing and guarding

Post-fire clearing and guarding shall be the responsibility of the owner or holder of the target after the situation no longer requires measures by the fire brigade. The time shall be decided by the leader of the rescue activities.

If the owner or holder of the object cannot be reached or if he does not undertake the post-fire clearing and guarding, the leader of the rescue activities shall have the right to have the necessary measures taken at the expense of the owner or holder.

Section 50
International rescue activities

In addition to what has been agreed upon between States, the Ministry in charge of rescue services may, on the basis of a request of another State or an international organization, decide to give assistance belonging to rescue services abroad when the giving of assistance is justified in order to protect people, the environment or property. Correspondingly, the Ministry may request necessary assistance from abroad.

Chapter 11
Civil defence

Section 51
Preparation for civil defence

The civil-defence preparations to be undertaken in normal conditions include planning and training relating to exceptional conditions, building of shelters, maintenance of leadership, supervision and alarm systems and communications connections as well as preparation for evacuations, rescue activities, first aid, servicing the population as well as for post-accident clearing and cleaning operations.

Section 52
Right of the authorities to receive information

Notwithstanding the secrecy obligation, the rescue authority shall, for the purpose of reserving personnel, have the right to obtain
1) the necessary population information from the authorities referred to in the Register Management Act (1996/166);
2) from the Defence Forces, free of charge, information as to whether a conscript is exempted from war-time duty; as well as
3) from other authorities and organizations, free of charge, information on persons in their employment also relating to the age, training, profession and capability of work of a person to be reserved as well as to the reservation of a person by an authority or organization to ensure its own operations under exceptional conditions.

Notwithstanding the secrecy obligation, the rescue authority shall, for the purpose of civil defence, have the right to obtain information from a register in the possession of an authority on buildings, real estate and room premises, their owners and holders as well as on their use itemized and grouped in a manner that is necessary for civil defence and its planning.

A rescue authority as well as the Ministry in charge of passenger and goods transport shall, notwithstanding the secrecy obligation, have the right to obtain, free of charge, for the purpose of evacuation and other civil defence, information from
1) the vehicle register referred to in section 3 of the Act on the Data System of Road Traffic (1989/819) relating to a vehicle and its type with identification information and information on the owner and holder as well as their contact information;
2) the driver’s licence register referred to in the section referred to in subparagraph 1 relating to
the holders of driver’s licences with contact information as well as on the right to drive together with driver’s li-
cence classes as well as from
3) other information systems of the traffic administration as agreed upon with the registrar.
The information referred to in this paragraph may be obtained also through a technical user
connection or otherwise in electric form.

Section 53

Duty to participate in training

The Ministry in charge of rescue services and the State Provincial Office may order that the
leaders and other special civil-defence personnel participate in civil-defence training for a maximum of ten days
annually.

Section 54

Civil-defence tasks relating to an employment relationship

Civil defence tasks under the responsibility of the State, a municipality, a joint municipal organi-
zation or another public organization, agency or institution or a State business enterprise and the preparation
thereof shall belong to the official duties of the holders of office or officials serving thereunder or to the duties of
contract-based employees. The above provision shall also apply to the participation in training necessary for the
execution of these duties.

Section 55

Protection targets

For the purpose of the preparation and execution of civil defence, the Ministry in charge of res-
cue services may order that a residential, industrial, transport or other comparable centre be declared a protec-
tion target.

Section 56

Obligation to build shelters in new buildings

In connection with building a new building, the owner of the building shall build in the building or
in its vicinity a shelter, the size of which may be estimated to be sufficient for the persons residing or otherwise
staying in the building as further provided for by Decree. The obligation to build a shelter shall, however, not
apply to a temporary building which is not to be used for more than five years.
A shelter shall be built for a building or a group of buildings on the same lot or construction site,
the floor area of which is at least 600 square meters and which is used as a permanent dwelling or working
place.
Buildings already on the same lot or construction site which already have a shelter, shall not be
taken into consideration when determining the obligation to build a shelter in a new building nor shall buildings
which have been completed more than five years prior to applying for the building permit.
The authority granting the building permit may allow a joint shelter to be built for two or more
buildings on condition that the shelter is built within five years from the completion of the first building.

Section 57

Obligation to build a shelter in connection with alteration or renovation work

If alteration or renovation work comparable to new construction, comprising at least 1 000 square
meters and subject to a building permit is carried out in a finished building with no shelter and located on a pro-
tection target, and if the building will thereafter be used as a permanent dwelling or working place, a shelter shall
be built in connection with the work if this is possible without great difficulties and with reasonable costs.
If the purpose of use of a finished building which is located on a protection target and the floor
area of which is at least 1 000 square meters and which is not used as a permanent dwelling or working place, is
changed subject to a building permit and the building will thereafter be used as a permanent dwelling or working
place, a shelter shall be built in connection with the alteration work if this is possible without great difficulties and
with reasonable costs.

Section 58

Exemption relating to the building of a shelter

The provisions of this Act on the obligation to build a shelter shall not apply to the constructional
protection of the production facilities of a farm.
The production buildings of a farm shall not be taken into consideration when determining the
obligation to build a shelter as referred to in this Act.
Section 59
Public shelters

If the protection of persons residing or staying in or moving about a protection target cannot be
deemed to be sufficiently ensured, taking into consideration the provisions of this chapter, and if this cannot be
otherwise ensured, the municipality shall have to build the necessary shelters for them.

Section 60
Command centres

A municipality shall have a civil-defence command centre.
The emergency response centres and the civil-defence command centres shall be built so that
their operations are possible also under exceptional conditions.
The civil-defence command centre of the central municipality of a cooperation district shall be
equipped so that it may, where necessary, assist the State Provincial Office in leading the civil defence of the
cooperation district (district command centre).

Section 61
Structural requirements of shelters

A shelter shall provide those in the shelter protection from possible effects of weapons. More
detailed structural requirements shall be issued by Decree and in the technical orders issued by the Ministry in
charge of rescue services.

Section 62
Granting of easements

The State Provincial Office may in individual cases, for an exceptionally weighty reason, grant an
exemption from the obligation to build a shelter provided for in the Act.
The authority granting the building permit may grant an exemption from the requirements pro-
vided for shelters in the Decree or in structural orders if there are weighty grounds thereto and if the granting of
the exemption does not materially reduce the possibilities for protection.

Section 63
The use of shelters and civil-defence equipment in normal conditions

Shelters as well as civil defence equipment and installations may be used for other purposes if
they are available for civil-defence purposes without delay.

Section 64
Leadership of preparedness planning

The Ministry in charge of rescue services may issue orders on the number of personnel and the
amount of material for civil defence as well as on other grounds for civil-defence arrangements.
The Ministry may also issue general guidelines to authorities and private persons on the
preparation for and carrying out of civil defence as well as on the cooperation required therein. The State
Provincial Office shall have the corresponding right within the area of the province.

Section 65
Special authority relating to exceptional conditions

If the rescue services and the preparedness thereto need to be intensified under exceptional
conditions referred to in section 2 of the Readiness Act or in section 1 of the State of Defence Act, the Council of
State may, by Decree, be authorized to order:
1) that every Finnish citizen who is 17 but not yet 65 years of age shall be liable to carry out any
work within his capability and necessary for the protection of the population, taking into consideration his physical
strength and state of health;
2) that the population or a part thereof, production plants, agencies and institutions and property
shall be transferred elsewhere from an area to the extent required by the situation;
3) that the right to stay in a designated location or to leave the location is forbidden or restricted;
4) that necessary protective structures and installations, in addition to those provided for in this
Act, will have to be built and arranged for the protection of people or property;
5) that buildings and apartments, transportation, fire-extinguishing, clearing, first-aid, communica-
tion and other equipment may be taken into use for civil-defence purposes as well as property and supplies for
the purposes of accommodating, feeding and other servicing of evacuated population;
6) other measures necessary for the protection of people and property; as well as
7) the duties and tasks of the rescue authorities and other authorities as well as the leadership and subordination relations in civil defence.

The provisions of chapters 2 and 3, sections 36 and 41 - 46 of the Readiness Act shall, where applicable, correspondingly apply to the decision-making and exercise of authority referred to in paragraph 1.

Chapter 12
Personal data files of the rescue services

Section 66
Alarm register

An emergency response centre may keep a personal data file on emergency calls received and the measures taken on the basis thereof for the purpose of monitoring and assessing the operations of the emergency response centre. The following may be recorded in the register:

1) the names of the caller and the receiver of the call;
2) the manner in which the call was made together with telephone identification information and address information;
3) an account of the event and the subject of the call together with name and address information;
4) the rescue measures taken where necessary for the monitoring and assessing the operations of the emergency response centre;
5) complementary information which the emergency response centre has acquired for the rescue task;
6) the technical recording of the emergency call; as well as
7) sensitive data referred to in section 11, subparagraph 3 or 4 of the Personal Data File Act where they may be of essential importance for the safe execution of the task.

Register information may be delivered to a rescue authority to be included in the register of measures.

Personal data shall be erased from the alarm register when its maintenance for the said purpose cannot any longer be considered justifiable, however, at the latest five years from the receipt of the emergency call or other notification. The data referred to in paragraph 1, subparagraph 7 shall, however, be erased at the latest after two years unless otherwise provided for a justifiable reason relating to the tasks of the emergency response centre.

Section 67
Register on measures

The municipal rescue authority may, for the purpose of monitoring and development of the rescue services as well as for the investigation of an accident, keep a personal data file into which the following may be recorded:

1) the data to be recorded in the alarm register referred to in section 66 also to the extent that the emergency response centre has delivered the data under section 66, paragraph 2;
2) more detailed information on the measures taken and their subject as well as on the resources used and the success of the rescue activities as ordered by the Ministry in charge of rescue services;
3) information on the type, technical details and progress of the accident;
4) information on the damage caused by the accident; as well as
5) information on the causes of the accident.

The data in the register may be delivered to the emergency response centre or rescue authority for rescue-activities or supervisory purposes and also to other authorities or research institutes for accident investigation or scientific research purposes. The register on measures may be used to compile statistics provided that the identification of persons is not possible therefrom.

The data in the register on measures taken shall be kept for the time referred to in section 66, paragraph 3.

Section 68
Personal data file of civil defence

The authority, institution or organization in charge of civil-defence tasks or the preparedness therefor may, for the purpose of maintaining a civil-defence unit, establish a personal data file of the persons belonging to or reserved for the unit. The data file may, in addition to the name of the person, contain also his date of birth, marital status, profession, educational background, address and other contact information as well as information on his driver’s license with the license class, his ability to work and custody of minor children.

The data in the personal data file of civil defence shall be checked at five-year intervals from the making and checking of an entry or be erased.
Section 69
The real-estate register of civil defence

The authority in charge of the civil defence and its preparation may for the said purposes establish a register on shelters as well as on real estate, buildings and room premises which can be used to accommodate evacuated population or to store transferred property. The register may contain information on the ownership or holding of the premises as well as their state and present use with numbers of residents. Correspondingly, the register may contain information on buildings which under exceptional conditions are suitable as temporary locations of production plants, authorities and institutions, as command centres and as placement of units. Files delivered by the authority in charge of the registration of real estate, buildings and room premises may be used in the establishment of the registers. The data in the register shall be checked at five-year intervals from the making and checking of an entry or be erased.

Section 70
Supervision register

The municipal rescue authority may, for the purpose of executing fire inspections as well as for the supervision of the safety of use of buildings and equipment, establish a personal data file in which data on the supervision objects as well as on their owners or holders shall be entered. Information received for supervisory purposes under sections 36 and 41 and section 52, paragraph 2 may be used in the establishment of the register.

Information in the supervision register shall be checked in connection with fire inspections or otherwise within five years from the making of an entry or be erased.

Chapter 13
Funding, fees and remunerations of rescue services

Section 71
Liability for the costs of the rescue services

Unless otherwise provided in this Act, the costs of the rescue services shall be the liability of the party who is responsible for the execution of a measure or a task or for taking care of it.

Section 72
Compensation for the assistance for rescue services

A municipality which has received equipment, personnel or other assistance from another municipality shall be liable to compensate the assistance in full unless otherwise agreed upon.

The issuer of executive assistance shall agree upon the compensation for the executive assistance referred to in section 6, paragraph 2, if any, with the rescue authority.

Section 73
Fire-extinguishing costs of forest and terrain fires

If a forest or terrain fire has extended to the area of more than one municipality, the municipality in the area of which the fire started shall pay the fire-extinguishing costs unless otherwise agreed upon. The other municipalities shall compensate the said municipality their share of the costs calculated in accordance with the burned area or other reasonable grounds.

Section 74
State subsidy for municipal civil-defence expenses

A municipality may be granted a subsidy for the civil-defence costs subject to the limits decided in the State budget if they become a special burden on the municipality.

The rescue-service State grants to be paid to municipalities shall be separately provided for.

Section 75
Compensation of rescue costs from State funds

If a rescue task has caused a municipality, taking into consideration its financial capacity, exceptionally great costs, the municipality shall have the right to compensation from the State for the extra costs arising from the rescue activities for the part exceeding its own-risk limit. The compensation shall be granted by the State Provincial Office.

The own-risk limit shall be one percent of the aggregate amount of the computed tax revenue of the municipality and the equalization based thereon as referred to in section 7 of the Act on State Grants (1996/1147). The own-risk limit shall be determined on the basis of the equalization of State grants tax revenue for the financial year during which the costs to be compensated have arisen and the tax revenue forming the basis of the equalization.
If the costs of the rescue task have been incurred from a terrain or forest fire which has taken place entirely or mainly on State-owned land, the own-risk limit of the municipality shall, in derogation from the provisions of paragraph 2, be half a percent of the aggregate amount of the computed tax revenue of the municipality and the equalization based thereon as referred to in section 7 of the Act on State Grants.

If municipalities operate rescue services mainly in cooperation, the own-risk limit shall be determined on the basis of their aggregate computed taxes and equalizations referred to in paragraph 2.

Section 76
Compensations paid under exceptional conditions

If anyone has suffered damage due to an order issued under section 65, paragraph 1, subparagraph 5 of this Act which he is not compensated for under another Act, he shall be fully compensated for the damage from State funds.

If the damage, taking into consideration the financial and other circumstances of the person who has suffered the damage, is deemed minor or if reasons of public finance or national economy so demand due to the large number of events causing damage, a reasonable compensation shall be paid for the damage.

The Council of State shall, where necessary, issue further provisions on the grounds and the procedure for determining the compensation.

The Council of State shall, where necessary, order that compensation may be paid from State funds also due to another order than that referred to in paragraph 2 or in derogation from the provisions of this Act on the division of costs. If a municipality receives a State grant or subsidy under another Act for the costs arisen from performing a task, the provisions on the said State grants or subsidies shall be applied to the compensation of the costs.

Section 77
Damages

The compensation of damage shall otherwise be governed by the provisions of the Damages Act (1974/412).

Section 78
Fees and remunerations of persons ordered to rescue and civil-defence tasks

A municipality shall pay a reasonable fee for a person ordered to rescue tasks under section 48. A person ordered to civil-defence tasks under section 65 shall be paid a fee in accordance with the same principles as for those ordered to work duty under section 24 of the Readiness Act.

A municipality shall compensate spoilt or lost clothes, equipment and tools for persons who have participated in rescue activities provided that the damage has been reported to the leader of the rescue activities without delay. Compensation shall be applied for from the municipality in writing within three months from the occurrence of the damage.

Section 79
Compensation for an accident occurred during rescue activities and civil defence

Compensation for an accident occurred in rescue activities or civil-defence tasks or an occupational disease got therein shall be paid from State funds in accordance with the same principles as for an occupational accident or disease to the extent that the injured party does not have the right to a compensation of at least the same size under another Act, to persons who:
1) have been ordered to assist in rescue activities under section 48;
2) have been ordered to civil-defence tasks under section 65;
3) have been ordered to participate in civil-defence training under section 53;
4) belong to a municipal contractual fire brigade but are not entitled to compensation under section 1 of the Accident Insurance Act; or who
5) belong to an industrial fire brigade which is not a municipal contractual fire brigade and the accident has occurred when the fire brigade has participated in rescue activities outside the plant.

A member of the municipal contractual fire brigade referred to in paragraph 1, subparagraph 4 shall be paid a compensation from State funds also for an accident which has occurred during the training of the municipal fire brigade, the servicing of real estate or equipment or the transportation of patients.

If the employer of the injured party has paid a salary, an advance or other payments relating to the accident to be compensated under this Act, the provisions of the Accident Insurance Act on the right of the employer shall apply to the right of the employer and the municipality.

A matter relating to compensation from State funds under this section shall be handled by the State Treasury as the first instance.
Chapter 14
Appeal, enforcement and sanctions

Section 80
Appeal

Appeal against a decision made by a State authority under this Act shall be sought as provided for in the Procedure in Administrative Matters Act (1996/586). The Procedure in Administrative Matters Act shall also govern appeal against a decision made by a municipal rescue authority under section 31, paragraph 2, section 37, section 47, paragraph 2 as well as section 78 of this Act as well as against a decision made by the leader of rescue activities under section 49, paragraph 2 of this Act.

An administrative decision shall be complied with immediately despite an appeal unless the appeal authority orders otherwise.

An administrative decision made by the Council of State which shall be submitted to Parliament may not be appealed.

A decision made by an authority in charge of building permits under this Act shall be subject to appeal in accordance with the provisions of the Building Act (1958/370).

Section 81
Conditional imposition of a fine and threat to have something done at the expense of another

If anyone takes action in violation of the provisions of section 9 or 16, section 23, paragraph 2 or section 31, 37, 41, 56, 59 or 60 of this Act or of provisions or orders issued thereunder or neglects his duty based thereon, the rescue authority may obligate the refractory to rectify his action or neglect within a set time. A prohibition or order issued by an authority may be enforced with a conditional fine or by a threat that the neglected action shall be ordered done at the expense of the person guilty of the neglect.

The provisions of the Act on Conditional Fines (1990/1113) shall otherwise be applied to an issue relating to a conditional fine, an order to have something done and a threat of interruption based on this Act.

Section 82
Sanctions

Anyone who
1) violates a duty referred to in section 23, 24, 26, 27, 30, 31 or 37 or in section 48, paragraph 1 or in an order issued under the said provisions or otherwise acts in violation of a duty provided for by the said provisions or orders issued thereunder; or who
2) acts in violation of a prohibition referred to in section 25 or in section 48, paragraph 3, shall, unless the act is subject to a more severe punishment elsewhere in the law, be sentenced for a rescue offence to a fine.

Anyone who neglects the duty to participate in training in accordance with section 53 shall, unless the act is subject to a more severe punishment elsewhere in the law, be sentenced for a civil-defence offence to a fine.

Anyone who neglects the duty set in an order issued by the Council of State under section 65, paragraph 1, subparagraphs 1 - 5 or otherwise acts in violation of a prohibition or restriction set in the order shall, unless the act is subject to a more severe punishment elsewhere in the law, be sentenced for a civil-defence crime to a fine or to imprisonment not exceeding six months.

Section 83
Waiving of sentence

Sentence may be waived in the case of a person who acts in violation of a prohibition enforced with a conditional fine ordered under this Act.

Chapter 15
Miscellaneous provisions

Section 84
Secrecy obligation

A person employed by rescue services or participating in rescue activities may not in any manner not belonging to rescue services make use or without permission disclose to a third party a fact he has learnt in his task and ordered to be kept secret by the law or under the law or relating to a private business or trade secret, financial status, private circumstances or state of health.

The disclosure of secret information to authorities or to a body attending to a public task shall be governed by an Act. The secrecy obligation shall not prevent the disclosure of information when the disclosure
may in individual cases be necessary to protect lives or health or to prevent considerable environmental or prop-
erty damage.

Punishment for the breach of the secrecy obligation laid down in this section shall be sentenced
in accordance with chapter 38, section 1 or 2 of the Penal Code unless the act is punishable under chapter 40,
section 5 of the Penal Act.

Section 85

Liability to submit statistical data

The municipal rescue authority shall submit information on the outputs, resources, arrangements
and other preparedness of the rescue services as well as on facts registered in the register of measures to the
Ministry in charge of rescue services and the State Provincial Office for statistical purposes.

Section 86

Investigating an accident

The municipal rescue authority shall assess the cause of the ignition of a fire. Should there be
reason to suspect that a fire or another accident has been caused willfully or through negligence, the rescue
authority shall notify the police thereof.

By order of the Ministry in charge of rescue services, a special investigation may be carried out
to investigate a fire or another accident.

The person performing the investigation shall have the right to access to the accident target, to
receive documents needed in the investigation from the representative of the accident target and information
from the municipal rescue authorities as well as to take samples of the accident target. The municipal rescue
authority assessing the cause of a fire shall have the corresponding right.

Section 87

Executive assistance by the police

The police shall be liable to provide executive assistance necessary for the performance of in-
spections referred to in sections 17 and 35 and for the prevention of a threat of accident referred to in section 37,
paragraph 2.

Section 88

Authorization to issue orders

The Ministry in charge of rescue services may, in addition to the provisions of above in this Act,
issue technical and executive orders supplementing this Act on the plans referred to in section 9, the fire-safety
of peat production areas, the amount and location of equipment and installations required by this Act for the
prevention and fighting of accidents, the performance of fire inspections and chimney sweeping, the cleaning of
ventilation channels and equipment as well as on the statistical data referred to in section 85.

Section 89

Further provisions

Further provisions on the implementation of this Act shall, where necessary, be issued by De-
cree.

Chapter 16

Provisions on entry into force and transitional provisions

Section 90

Provision on entry into force

This Act shall enter into force on 1 September 1999.

This Act shall repeal the Act on Fire and Rescue Services of 4 July 1975 (1975/559) and the Act
on Civil Defence of 31 October 1958 (1958/438) with later amendments.

Orders of the Ministry of the Interior issued under the repealed Acts and relating to the qualifica-
tions of part-time fire-brigade personnel, the arrangements in special targets to increase fire and personal safety,
the technical requirements of certain equipment and the quality requirements of equipment and material, chim-
ney sweeping and cleaning of ventilation equipment, civil-defence planning, arrangement of self-preparedness,
the minimum requirements of civil-defence personnel and material and other operating requirements thereof,
the structural requirements of shelters as well as the Decision of the Council of State on protection targets shall
remain in force until their periods of validity terminate or until they are repealed by the Ministry in charge of res-
cue services, however, for a maximum of two years from the entry into force of this Act.

Measures necessary for the implementation of this Act may be undertaken prior to its entry into
force.
Section 91

Determination of the service level and alarm instructions

The decision relating to the alarm instructions in accordance with section 13 as well as the assessment and decision relating to the service level referred to in section 15, paragraph 2 shall be ready within one year from the entry into force of the Act.

Section 92

Smoke alarms

The smoke alarms or corresponding equipment referred to in section 31 shall be installed within one year from the entry into force of the Act.

Section 93

Building of shelters and the structural requirements of certain premises

The provisions of sections 56 and 57 on the duty to build a shelter shall be applied to buildings for which building permits are applied for after the entry into force of this Act.

The arrangements relating to the command centres of civil defence and referred to in section 60 shall be implemented within three years from the entry into force of the Act.

The requirements laid down in section 60 of the Act shall be applied to projects for which building permits are applied after the entry into force of this Act.

Section 94

Remunerations

The provisions of section 75 of the Act as well as the provisions of chapter 13 on other remunerations payable by the State shall be applied to costs arising from accidents that have originated after the entry into force of the Act.

The projects referred to in section 22 of the Act on Civil Defence for which a building permit has been applied for prior to the entry into force of this Act shall be compensated from State funds as provided for in the Act on Civil Defence when the shelter has been completed and the inspection on its taking into use has been conducted within one year from the entry into force of the Act.

Section 95

Appeal

Appeal in accordance with section 80, paragraph 1 of the Act shall not be applied when appealing against a decision issued prior to the entry into force of this Act.
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PREFACE

In Finland, dams have been constructed mainly for flood control, hydroelectric power production, water supply and fish culture, and for storing waste detrimental to health or the environment. Most of Finland’s dams have been built since the Second World War. Regular monitoring of the safety of dams owned by State power companies was started in 1962 and that of dams owned by the environment administration in 1972.

The Act and Decree on Dam Safety were enacted in 1984 to improve the safety of all dams, waste dams included. For the execution of the dam safety legislation, a Dam Safety Code of Practice applying the statutory regulations as practical guidelines was issued in 1985. At the same time the dam safety regulations were extended to cover all old dams. The third revised Dam Safety Code of Practice was issued in 1997.

Some 450 of Finland’s dams are covered by the legislation. Of these, 85% are waterbody dams and 15% waste dams. It is considered that in the event of an accident, 36 of the dams would endanger human life or health or cause considerable damage to the environment or property. Most of the dams are embankment dams, and a few are massive concrete dams. Concrete structures have been used in association with regulation structures. Some dams are provided with an overflow structure for high flood.

When considering the possibility of applying the Finnish dam safety model elsewhere, it must be remembered that Finland differs markedly from other countries in topography, soil and climate but also in administrative procedures and civil engineering practices. Finland is a rather flat country characterized by glacial formations. Typical features of the climate are the long, cold winters, the freezing of soil and the spring thaw. The ground is tranquil seismically, and earthquakes presenting a threat to dams do not occur. Administration and engineering are of the same standard as in other western industrialized countries.

The emphasis of Finnish dam safety is on the prevention of dam accidents and on the effective reduction of hazards should it not be possible to prevent an accident. The careful design, construction and surveillance of dams and their appropriate maintenance play a key role in preventing dam damage. Long-term changes in conditions and the ageing of structures can be taken into account by regular safety monitoring. Rare exceptional physical conditions, human error or some other cause (e.g. internal erosion) may, nonetheless, still lead to dam failure. The objective of the Finnish dam safety system is to restrict any damage that might be caused by dam failure and to prevent loss of human life in the event of an accident. To achieve this we must bring our dams up to a very high standard, arrange regular surveillance and draft plans for the emergency repair of dams and for warning the downstream population.

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1 INTRODUCTION

The authority of the Ministry of Agriculture and Forestry to issue the Dam Safety Code of Practice is based on the Dam Safety Act (413/84). Under the Act on the measures concerning the rules and regulations of authorities (573/89), codes of practice are general rules that are not prescriptive. The Dam Safety Code of Practice has been compiled for the enforcement and supervision of the Dam Safety Act (413/84) and Decree (574/84). This code replaces the Dam Safety Code of Practice issued by the National Board of Waters and the Environment on 22.6.1991 (Publications of the Water and the Environment Administration - series B 9E). The present Code of Practice is to be applied to dams that come within the scope of the Dam Safety Act.

The Act and the provisions and regulations issued thereunder, but not those referring to rescue services, are supervised by the regional environment centres with highest supervision and guidance by the Ministry of Agriculture and Forestry. The rescue services come under the Ministry of the Interior and the authorities subordinate to it (provincial governments and municipal fire authorities).

For each dam subject to the Act the dam owner or holder draws up a safety monitoring programme, which is approved by the regional environment centre. Before approving the programme for a P dam, however, the regional environment centre acquires experts opinions on the monitoring programme from the Finnish Environment Institute. As the dam class dictates the dimensioning of dams, the class must be established at the initial stage of planning and, if necessary, provided with a hazard risk assessment. Note, however, that due to changes in local conditions or for some other reason the class may change after completion of the dam, e.g. an N dam may be redesignated as a P dam. The programme may contain both monitoring proper and regular inspections. For special reasons the regional environment centre may exempt the body or person in question either entirely or in part from the above monitoring obligation.

The dam qualification is established in a commissioning inspection which entails at least one field inspection before a start is made on raising the water or other material to be impounded. The dam owner or holder must store the documents relevant to dam safety in a special safety file. A special site plan taking different potential accidents into account must be drawn up for a P dam by the dam owner or holder in cooperation with the fire authority.

The dam safety measures are summarized in Appendix 19 and the check list for the owner or holder of a dam is given in Appendix 20.
2 APPLICATION OF DAM SAFETY LEGISLATION

2.1 Acts and Decrees

The Dam Safety Act (DSA) and Dam Safety Decree (DSD) are given at the end of the Code of Practice. Included are the parts of the Water Act and Decree, and of the Fire and Rescue Services Act and Decree that deal with dam safety.

As well as the above acts and decrees, reference is made to the following Acts and Decrees:
- Administrative Procedure Act (598/82)
- Waste Act (1072/93)
- Mining Law (503/65)
- Primary Health Care Act (66/72)
- Administrative Judicial Procedure Act (586/96)
- Act on the Environmental Administration (55/95)
- Police Act (493/95)
- Health Protection Act (763/94)
- Act on Measures Concerning Official Regulations and Guidelines (573/89)
- Civil Defence Act (438/58).

2.2 Application of legislation

2.2.1 Definition of a dam

A dam as defined by the Dam Safety Act is a dam with the associated structures and facilities intended for permanent use irrespective of the materials of and the manner in which the dam has been constructed or of the substance to be impounded in the dam basin (DSA Section 2). Unless stated otherwise, a dam in this code is considered to include all the dam and impound structures of one dam basin.

The normative definition of a dam is as follows:

A dam is an embankment-like or wall-like structure the purpose of which is to prevent, permanently or temporarily, a liquid, a substance in liquid form or substances that dissolve from solids in liquids (e.g. rainwater) behind the structure from flowing into land or a waterbody downstream and/or to regulate the flow and/or the level of the impounded substance.

2.2.2 Scope of application and exceptions

The Dam Safety Act and Decree and this Code of Practice shall be applied to a dam which is at least three metres high. They shall also be applied to a lower dam if the volume of the substance in the basin impounded by the dam is so large or the basin contains a substance which, in the event of an accident, may manifestly endanger human life or health or manifestly seriously endanger the environment or property (DSA Section 3).

The height of a dam referred to in the DSA is the difference between the lowest point of the external boundary of the dam structure and the highest intended surface for the impounded substance. Contrary to the above, the height of a submerged dam in a waterbody is the difference in height between the lowest point of the external boundary of the dam structure and the dam crest (DSD Section 1). The determination of height in different cases is clarified in the figures of Appendix 11.

The maximum height defined in the permit decision is the highest design height of the dammed substance. If this height level is not
defined in the permit, the height defined in the construction documents shall be taken as the maximum level of the impounded substance.

The DSA does not refer to dams to which the provisions of the Mining Law (503/65) shall be applied, mainly those concerning safety in Sections 56 and 57, which refer to the safety of the work to be carried out at a mine, open pit or excavation site and of the equipment, facilities and dams associated with mining and concentrating processes. A dam related to mining and concentrating activities and located outside the mine patent or its ancillary area is also subject to the Mining Law.

The safety requirements stated in the Mining Law correspond to those of the DSA. The Dam Safety Code of Practice can also be applied to the safety analyses of mine dams. The supervision of dams subject to the Mining Law is undertaken by the Safety Engineering Centre of the Ministry of Trade and Industry.

The Dam Safety Act is not applied to the canal service referred to in the Decree on Canal Service (157/63) (DSA Section 3).

Cofferdams are subject to the Act as applicable (DSA Section 3).

2.2.3 Supervision of the Act and special authority

Supervision of the DSA and the provisions and supreme regulations issued by virtue of it rests with the regional environment centres, and the supreme supervision and guidance rest with the Ministry of Agriculture and Forestry, the rescue services excluded. The rescue services come under the rescue department of the Ministry of the Interior and the authorities subordinate to it (provincial governments, municipal fire authorities). The provisions of Chapter 21 Section 2 (the obligation of a supervisory authority to take measures and the right to undertake inspections and investigations) and of Section 3 Paragraphs 1 and 2 (executive assistance given by a water court) and of Section 4 (recovery of costs for the State) of the Water Act shall be observed as applicable to rectification of non-compliance with the provisions or the regulations issued by virtue of them concerning the construction and maintenance of a dam (DSA Section 4).

If a dam or its use poses immediate danger to public safety the provincial government and a police authority (Water Act Chapter 21 Section 3 Paragraph 3) and the regional environment centre (DSA Section 11 Paragraph 2) shall be empowered to take the necessary measures to eliminate the danger.

2.2.4 Obligations of the dam owner or holder

The owner or holder of a dam shall familiarize himself with the regulations concerning his dam and, on his own initiative, ensure that they are observed. The regional environment centres help in matters concerning interpretation of the provisions and guidelines. In technological issues help is also available from the Finnish Environment Institute. The regional environment centres inform the owners or holders of dams about relevant provisions, regulations and guidelines, which does not, however, lessen the obligation of the dam owner to keep himself well informed about issues pertinent to dam legislation.
3 DAM REQUIREMENTS

3.1 Dam classification

Dams are classified by the type of hazard risk they pose in the event of an accident or because of their temporary nature (cofferdams). In addition to the risk of damage downstream from the dam the risk due to a sudden drop in water level upstream from the dam should also be considered. As the classification affects the properties required of the dam (Appendices 12-15), the class must be established at the planning stage. The class is checked at the commissioning inspection before the dam is brought into use (chapter 5) and also later if conditions change. The dam classification referred to in the Dam Safety Act concerns both waterbody and waste dams. The dam classes are as follows:

P dams
A dam is classified as a P dam if, in the event of an accident, it may manifestly endanger human life or health or manifestly seriously endanger the environment or property (DSA Sections 3 and 9). A P dam may be less than three metres high.

The above danger may arise from a flood wave caused by dam failure. A risk typical of a P dam may also be caused by a dam which, in the event of an accident, may manifestly endanger health or manifestly seriously endanger the environment owing to the impounded liquid, to a substance behaving like a liquid, or to the type and quantity of materials washed along with them.

A dam is classified as a P dam on the basis of a hazard risk assessment, the drafting of which is dealt with in detail in chapter 7.

The provisions of Section 9 Paragraph 2 of the DSA concerning the readiness to prevent accidents shall apply to P dams (chapter 8).

N dams
A dam is classified as an N dam if, in the event of an accident, it constitutes a smaller risk than a P dam, but nevertheless cannot be considered an O dam.

O dams
A dam that in the event of an accident constitutes only a minor hazard risk is classified as an O dam. A dam can be considered to constitute only a minor risk if, in the event of an accident, it quite manifestly cannot endanger human life or health or, minor damage excluded, the environment or the property of another.

T dams
A temporary dam (cofferdam) is classified as a T dam.

3.2 Basis for dam assessment

The structural and operational reliability of a dam must be such that the dam does not pose a safety risk. The basic reliability of a dam is obtained through design and construction. Later reliability is affected by changes that take place over time, by repairs made, by maintenance, and by changes in operational conditions.

Dam reliability shall be assessed from data available in the dam design and construction documents and from dam monitoring and inspection data. If this information is insufficient for the assessment of dam reliability or if the monitoring and inspection data so warrant, the owner of the dam must verify the information.
with investigations to the extent necessary. The reliability assessment can be undertaken only by a person with sufficient competence and experience. If the regional environment centre considers the person who assessed the condition of the dam incompetent and inexperienced, the said environment centre should require a new assessment from the owner or holder of the dam.

Dams must be designed and constructed in accordance with the design and construction codes in force at the time. Dams must be assessed against how well their design and condition meet the requirements set for the dam at the moment of inspection. Should a dam be considered deficient, it shall be submitted to intensified monitoring, or repaired or made subject to operating restrictions, depending on the severity of the deficiencies.

3.3 General design requirements

The planning of a waterbody dam is subject to the specifications required for petition plans to the Water Court as referred to under Sections 43 and 45 of the Water Decree. The corresponding specifications shall also be observed in designing other dams referred to in the DSA.

The body which has the dam constructed is responsible for ensuring that the dam is designed under the direction and responsibility of a competent and experienced enough person (chief designer). The chief designer shall have sufficient expertise in dam design and construction. If necessary the regional environment centre helps in assessing the competence of the designer.

The chief designer is responsible for the various sub-areas such as hydrological dimensioning, the design of embankment and concrete dams, the design of regulation and discharge structures, and the compatibility of the designs. The design and dimensioning requirements are dealt with in Appendices 12-15. In addition to the structures proper, the plan shall contain the dam safety monitoring devices installed in the course of dam construction.

3.4 Functional assessment

The functional assessment of a dam is made to the extent required by conditions. The items to be assessed under different conditions are the function of the dam and channels and the magnitude and duration of a possible overimpoundment. The different conditions are the usual operational conditions in summer and in winter, floods such as design floods (Appendix 12), and situations arising from operating disruptions and errors.

Overimpoundment, and consequently the risk of dam failure, may arise from malfunctioning of the gates due to power failure or some other reason. The dam shall thus be provided with a system that permits the gates to be opened within the time margin before the risk of collapse is imminent (Appendix 15). The system includes the means to acquire information on overimpoundment (Appendix 15: water level monitoring, information on the position of the gate).

3.5 Dam construction

The regional environment centre shall be informed in writing about the start of dam construction so that it has time to study the design documents beforehand.

The dam shall be constructed in accordance with good construction practice. Construction shall proceed as required by the plan and with experienced and competent personnel. The quality control of the work shall be independent of the constructing body. The person responsible for supervising the work shall have the right to suspend work if necessary. Construction and quality control are dealt with in Appendices 13-15.
3.6 Modifications to the dam and changes in conditions

Any impact on dam safety arising from modifications to the dam shall be taken into account when assessing alternatives at the design and construction stages. A record is kept of gradual changes in conditions and structures by monitoring and regular inspections.

If the changes have no clear impact on dam safety a new monitoring programme need not be approved. It is sufficient if the safety documents are updated at a regular inspection.

Should the changes affect dam safety, the changes shall be reviewed as required in chapter 5 (commissioning inspection). If it is necessary to revise the monitoring programme, the same procedure shall be followed as when drafting a new monitoring programme.

Changes affecting dam safety may include:

- new structures in a dam such as new openings, overflow sills, and under- or through-passes
- renovation or renewal of and modifications to an embankment or concrete dam or a hydroelectric power plant structure acting as a dam
- changes in the use and control of the operating facilities and the structural changes thereby required
- changes in conditions affecting dimensioning such as those affecting high water level and maximum discharge
- changes in conditions in the downstream area affecting the classification (e.g. an N dam becomes a P dam)
- for a waste dam, changes in the type of impounded substance or new information on its harmfulness affecting the classification.
4 THE DAM SAFETY FILE

4.1 General

Under Section 5 of the DSA the dam owner or holder shall store all the documents relevant to dam safety in a special safety file. The dam safety file shall be kept in such a manner that when there is a threat of an accident it is readily available for the persons who need it and, if necessary, for inspection by the supervisory authorities. The file could be kept for instance in the office of the dam surveillance personnel.

The content of the safety file to the extent dictated by conditions is defined under Section 2 of the DSD. The content of the file is described in greater detail in 4.2 - 4.9. There is no need to compile and keep a file for cofferdams (T dams).

It is appropriate to include in the dam safety file the documents which a competent person considers essential for the preliminary assessment of the safety and reliability of the dam. However, the completion documents of the dam (Appendix 3) shall be collated and appropriately arranged elsewhere for the safety evaluation, and for dam repairs and maintenance.

Three copies of the safety file are sent to the regional environment centre together with a draft of the safety monitoring programme as it is at that moment. The missing parts are added to the file within a reasonable time in conjunction with the completion of the commissioning inspection. One copy of the safety file is returned to the owner or holder of the dam.

4.2 Cover page, contact information, contents, list of completion documents and decisions

The cover page shall show the name of the project and the dam, and the name and index number of the waterbody and waterbody area, permit decisions, the name of the permit holder, and the names of the owner and holder of the dam. It shall also indicate when and by whom the file was compiled. The cover page shall be made as in the model in Appendix 1.

The cover page shall be followed by a current list of the staff of the owner or holder of the dam with responsibility for the safety monitoring, operation and maintenance of the dam together with their contact information. The list shall also contain contact information on the regional environment centre (Appendix 1a).

The contents shall follow. They shall show the documents kept in the file including those added later, with date of entry. The documents can be arranged in the same order as in the list in Section 2 of the Dam Safety Decree.

Next, the file shall have a list of completion documents (Appendix 2). This list shall contain information about the subject of drawings, assessments and investigations, the date they were made and by whom, and the place in which they are kept.

Decisions issued by courts and other authorities related to the dam shall be included in the file where relevant.
4.3 Design values

4.3.1 Main dimensions of the dam and the reservoir area

The main dimensions of the dam and the data on openings and sills shall be marked in a form as in Appendix 4. Should significant variation exist, the more detailed information referred to in the appendix shall be given as the need arises for the different parts of the dam or dam sections. The main dimensions of the reservoir area shall be marked in a form as in Appendix 5. In addition, the safety file shall contain the following documents:

- discharge rating curves of controlled and uncontrolled spillways
- discharge rating curves of the starting sills of the inflow and bypass channels of the regulation reservoir
- volume and area curves of the regulation reservoir
- damming and discharge provision, regulation instruction (e.g. as a drawing).

4.3.2 Hydrological design

The hydrological parameters are presented in a form as in Appendix 6. The numerical values of the parameters are determined to the extent appropriate following the instructions in Appendix 12. In addition to the time series analysis, dimensioning methods based on model calculation (Appendix 12) and estimation of the probable maximum flood (PMF) can be used. For extensive and regulated waterbodies the model calculation is often the recommended way of assessing the advance of a design flood. However, in these cases, too, a design flood value derived from its return period corresponding to the dam class, and its calculation procedure shall always be given.

The design flood is not the same as the design value of the discharge structures, but a flood that, at this site in the waterbody, occurs with a given return period. The selection of the return period depends on the dam class and the conditions in the area affected by the dam (Appendix 12).

The safety file shall be provided with a description of the procedures used to reach the design values presented in Appendix 6.

4.4 Map of the area affected by the dam, a site map of the dam, and drawings and assessments of the dam structure

The documents referred to in the heading, the guidelines for which are given in Appendix 7, shall be included in the safety file provided with the appropriate information about completion. Maps showing the location of and access to the dam etc. shall be in colour. The safety file shall also contain summaries of the supervision investigations of earth, concrete and foundation works during the construction.

4.5 Monitoring programme with amendments referred to under Sections 6 and 7 of the Dam Safety Act

The guideline concerning the drafting of the monitoring programme is given in chapter 6. The model form is shown in Appendix 9. A monitoring programme approved by the regional environment centre is part of the safety file.

4.6 Inspection and monitoring documents

The documents of the dam commissioning inspection shall be included in the safety file to the extent appropriate. A record shall be kept of the regular and annual inspections required by the safety monitoring programme and shall be included in the safety file of the dam owner.

The records of the regular inspections shall be sent to the regional environment centre and
for P dams also to the provincial government, the regional fire commander and the municipal fire authority. A record shall also be kept of the monitoring.

4.7 Letters from the authorities

Letters from the authorities or records of inspections undertaken by the authorities shall be included in the file if they are specifically prescribed for inclusion therein.

4.8 Assessments and action plans referred to under Section 9 of the Dam Safety Act

Assessment of a hazard risk is dealt with in chapter 7. The hazard risk assessment and its outcome shall be included in the completion documents, but not in the safety file.

If a dam is considered as one referred to under Section 9 Paragraph 2 of the DSA (P dam), its owner or holder shall, together with a fire authority, draw up a site plan containing the accounts and action plans of the owner or holder of the dam referred to under Section 9 of the DSA and Section 4 of the DSD. The drafting of the site plan is described in chapter 8.

4.9 Waste dams

Waste dams differ in type of impounded substance from dams constructed in waterbodies.

Waste dams are used to impound liquids or solids harmful or dangerous to health or the environment. A waste dam safety file shall contain an assessment of the functioning of the waste dam and the health and environmental consequences in the event of its failure. An assessment of health and environmental impacts shall be made for all waste dams subject to the Act. The content of the impact assessment is described in Appendix 17. Note that in the event of an accident a waste dam may endanger people and property below the dam in the same way as any other dam.

Seepage of the impounded substance shall also be assessed. To this end, data on the permeability of the dam materials and the dam foundation shall be given and the volume of seepage water and the concentrations and amounts of harmful substances transported by the seepage water to the environment calculated. A possible collection and back-pumping system for the seepage water shall also be given. Seepage into the environment of the harmful substances in the basin is restricted and supervised under the Water Act, the Waste Act and the Health Protection Act. The waste dam hazard risk assessment is dealt with in 7.1.4.
The commissioning inspection of a dam shall be made in such a manner that all issues relevant to dam safety are adequately considered. The quality of the dam structures shall be assessed on the basis of the requirements given in Appendices 12 - 15. The commissioning inspection is the responsibility of the chief dam designer (3.3) or another competent person.

The commissioning inspection is based on data in the dam plans, the quality control programme and, if necessary, the hazard risk assessment.

In the case of a P dam, the assessments and action plans referred to under Section 9 of the Dam Safety Act shall be compiled in such a manner that they can be included in the site plan drafted under the supervision of a fire authority before the dam is brought into use (chapter 8 and Appendix 18). The dam is considered to have been brought into use when the water or other impounded substance has started to rise.

The commissioning inspection begins with a written notification to the regional environment centre, which must be sent before construction of the dam starts. At the same time the dam plans and quality monitoring programme are delivered to the regional environment centre to the extent required. The commissioning inspection continues with the necessary field inspections, which can be reviews of structures and foundations conducted during different stages of the work. In any case, a field inspection must be made before a start is made on raising the water, once the structures are ready for this procedure. The timetable for raising the water appropriate to the state of completion of the structures is established in the course of the inspection. Representatives of the regional environment centre can participate in the field inspections, as can, at least for P dams, representatives of the provincial government, the fire authorities and the Finnish Environment Institute. The owner/holder of the dam informs the regional environment centre, provincial government and fire authorities about the date of the field inspection.

The commissioning inspection is completed when all the structures are operationally ready, have been brought into full-scale use and have been approved to function as planned. At the closing of the commissioning inspection the records of the field inspections and the completion documents are collected, and a summary (final statement) and a proposal for dam qualification (Appendix 8) are compiled from them and included in the dam safety file.
6 SAFETY MONITORING AND INSPECTIONS

6.1 Drafting and processing a safety monitoring programme

To reduce the hazard risk from a dam, a safety monitoring programme shall be drafted for each dam subject to the Dam Safety Act. The programme is drafted or acquired by the dam owner or holder. The person who drafts the programme shall have the same competence as the designer of the corresponding structure. The programme shall be so compiled that all issues related to dam safety shall be subjected to monitoring and inspection. The programme may include guidelines concerning the monitoring proper and regular inspections (DSA Section 6).

The safety monitoring programme or its amendments are approved by the regional environment centre (DSA Section 7). Before approving the programme for a P dam the regional environment centre obtains an expert opinion from the Finnish Environment Institute (DSD Section 3). For a special reason the regional environment centre may grant total or partial exemption from the monitoring obligation referred to in Section 6 (DSA Section 7). Appropriate records shall be kept of the monitoring and inspections referred to in the programme. These records, together with the monitoring programme, shall be kept in the safety file referred to in Section 5 of the DSA.

The monitoring programme shall be drawn up well in advance of completion of the dam so that it can be approved for compliance before the dam is brought into use. A draft safety monitoring programme shall be sent to the regional environment centre (DSA Section 7, DSD Section 3). The draft monitoring programme contains sub-programmes covering both the implementation and post-implementation periods.

The monitoring programme for a P dam shall be sent to the regional environment centre three months before the implementation and that for N and O dams, and a T dam (cofferdam) comparable to a P dam in hazard risk, two months before implementation unless otherwise agreed in the schedule. For other T dams it is not necessary to draw up or apply for approval of a monitoring programme proper. However, all T dams shall be monitored as appropriate taking prevailing conditions into account.

The draft monitoring programme that is part of the safety file shall be sent to the regional environment centre in three copies. After processing it, the regional environment centre returns one copy of the safety file and the monitoring programme to the dam holder. An amendment to the monitoring programme is subject to the same procedure as the drawing up of a new monitoring programme. The draft monitoring programme can be drawn up in the form shown in Appendix 9, supplementing it if necessary.

6.1.1 Appeal against a monitoring programme decision and correction of a factual error

An appeal against the decision on the monitoring programme can be submitted to the Provincial Administrative Court as stated in the Administrative Judicial Procedure Act (586/96). The decision of the Provincial Administrative Court may be appealed to the Supreme Administrative Court.

To correct a factual error the authority may delete his erroneous decision and review the
case on the basis of the Administrative Procedure Act (598/82, Section 26) with the consent of the parties involved.

6.2 Monitoring

The measures relevant to dam monitoring are set out in the form in Appendix 9. The set of measures given in the form is for guidance only, and the person who drafts the monitoring programme may change and supplement them as necessary.

Dam monitoring involves the following procedures (embankment dams in detail in Appendix 13):

- monitoring the height of water or other substance impounded in the basin
- inspection of the visible parts of the dam structures (embankment and concrete dams, regulation and discharge structures, etc.) and the dam downstream area during each inspection visit
- the observations and measurements listed in the monitoring programme and other issues relevant to the dam
- for waste dams, other special items, if any, related to dam safety.

The persons undertaking monitoring shall be instructed adequately so that they are aware of the likely dam damage and hazards and their manifestations. They shall also be made aware of the measures they have to take if factors endangering the safety of the dam are noted. The dam owner shall train his operating and maintenance staff to watch the changes that occur in structures in dam areas and dams and make sure that they know whom they should inform about the changes observed. The member of the dam owner’s staff responsible for dam safety decides whether or not the changes observed are significant for dam safety. The surveyor who undertakes measurements shall be well informed about the limits of the normal values and, if these limits are broken either upwards or downwards, he shall immediately inform the person responsible for the dam. A record shall be kept of the monitoring and observations.

The normative periodicity of the inspections depends on the dam class (P, N or O dam) as stated in Appendix 10. Deviations from the normative periodicity are allowed if a system replacing the inspections is in use (e.g. remote monitoring cameras, telemetric apparatuses and computers with the alarm systems based on them). The use and function of the replacement systems shall be described in the draft monitoring programme.

In addition, and if necessary, during floods and after exceptionally heavy rainfall and storms, inspection visits shall be made to dams which are or may have been subject to extra strain.

6.3 Inspections

6.3.1 Annual inspection

The annual inspection of a dam shall be made when the soil is not frozen. In the course of the annual inspection the measurements and observations made during the year are reviewed, taking into account the changes that have occurred; the operational state of the measuring devices is checked; and the parts of the dam and the associated facilities requiring repair are investigated in the field.

In the annual inspection special attention shall be paid to checking the condition, performance and alarm systems of the dam spillways and sills and power plant discharge facilities. The operation of the facilities must be checked with test runs. In flood years in particular, the flood preventive measures taken are reviewed, so that even in abnormal flood years the operating personnel have the correct instructions for handling the situation. Likewise, on the basis of data on impacts caused by ice, their effect on discharge structures and other possible risk factors are assessed. In addition, the checking measures taken by the operating personnel during sudden heavy rainfall are reviewed.

The filling and discharge channels of the basins and associated structures should be in-
spected when the spring flood has subsided. Correspondingly, the structures and facilities of waste dams, such as the inflow and outflow systems, are inspected once a year.

A record is made of the annual inspection and test runs and included in the safety file of the dam owner.

### 6.3.2 Regular inspection

A regular inspection is made at intervals not exceeding five years. The date of the first regular inspection is counted from the date of the commissioning inspection.

A representative of the dam owner or holder and a competent person participate in the regular inspection.

The regional environment centre and, for a P dam, the provincial government, the regional fire commander and the municipal fire authority shall be informed about the date of the inspection so that the authorities can, at their discretion, participate in the inspection.

In the regular inspection the agenda is at least as follows:

- the compiled observational data and other results are gone through
- repairs made and the reasons for them are checked
- structures are inspected as considered necessary and the working conditions of the facilities important for dam safety (e.g. gates and their emergency hoisting system) are checked
- trees and other plants are checked for dam safety
- it is verified that the hazard risk assessment is up-to-date
- it is checked that the assessment of the impact of waste dams on health and the environment is up-to-date (Appendix 17)
- the site plan (Appendix 18) and the associated action plans referred to under Section 9 Paragraph 2 of the DSA are inspected and the viability of the arrangements required by them is evaluated and the site plan revised if necessary
- it is established whether changes have taken place in conditions or, in the case of waste dams, in the type of impounded substance affecting the dam class
- the dam classification is verified, which may imply that the existing hazard risk assessment has to be supplemented or, if the situation so requires, the regional environment centre may have to order a hazard risk assessment to be made for the dam
- the dam safety monitoring programme is checked and necessary changes, if any, recorded,
- it is verified that the safety file is up-to-date also in every other respect and that any amendments needed are recorded
- if necessary, decisions are made on the follow-up measures and investigations.

A record is made of the regular inspection and included in the dam safety file. The record can be made more graphic with drawings, photographs, videos, etc.

A copy of the record is sent to the regional environment centre and, for a P dam, also to the provincial government, the regional fire commander and the municipal fire authority even if these did not participate in the inspection. Amendments and supplements to the safety file are sent to the regional environment centre (for a P dam in two copies).

### 6.4 Disturbances

Structural and operational disturbances affecting dam safety and observed during monitoring must be reported. The report must present the cause of the disturbance, the investigations conducted and the measures undertaken. Measures pertinent to normal dam maintenance need not be reported. The disturbance report shall be delivered to the dam safety authority without delay.
7 HAZARD RISK ASSESSMENT

7.1 Assessment of a hazard risk

7.1.1 General

To assess and chart the hazard risk of a dam the regional environment centre may stipulate, when necessary, that the party having the dam constructed, or the dam owner or holder shall acquire or compile an assessment of the hazard risk posed by the dam, in particular to the people and property in the dam downstream area. The hazard risk due to a sudden fall in water level upstream from the dam shall also be taken into account. The hazard risk assessment is necessary if the dam may be classified as a P dam, i.e. in the event of an accident the dam may manifestly endanger human life or health or manifestly seriously endanger the environment or property (DSA Section 9).

The main objectives of the hazard risk assessment are:

• to provide facilities for organizing rescue operations in the event of an accident,
• to create a basis for the measures needed to prevent or contain an accident or a threat of an accident, and
• to establish the dam class at the design stage of the dam, and the standards of the dam and its monitoring which depend on this class.

Subsections 7.1.2 and 7.1.3 deal mainly with the assessment of a flood due to failure of a waterbody dam (hazard risk for human life or property). The special features associated with the failure of a waste dam are dealt with in 7.1.4 (hazard risk for health or the environment).

7.1.2 Comparison of breach cases

The damage caused by a dam breach is usually proportional to the volume and abruptness of the discharge flow and the discharge capacity of the flood path. The impact of a dam breach is assessed for normal and flood situations. An operational examination is also made (3.4). The most dangerous discharge site in terms of the above shall be established for each dam section and the main discharge path. In addition to the most dangerous discharge site, a number of less dangerous breach sites are established so that in the event of an accident the extent of the damage will be known accurately irrespective of the location of the dam breach.

Different possible dam breach cases shall be compared with each other at the discharge sites. The events resulting in breaches shall be defined by assuming that the breaches take place and develop as dictated by the structure of the dam. The assumptions shall be based on known breach cases or on the results of a computation model tested experimentally or with true cases, or on scale model tests taking into account the structure of the dam and its resistance to erosion.

The discharge shall be determined with the aid of appropriate computation methods or model tests. The method and computation procedure or test arrangement used shall be described and arguments presented for their applicability considering the properties of the basin. The initial values and assumptions shall be given.
7.1.3 **Assessment of flood advance**

Flood advance in the above cases can be assessed with scale model tests or computationally.

In scale model tests a discharge corresponding to the dam breach is arranged at an appropriate site in a terrain model. The flood heights and the flood advance are established, recording the data in an appropriate manner and interpreting them to correspond to the terrain. Equations of irregularly changing flow (dynamic flow equations) shall mainly be applied to the calculation of channel flows with the aid of an appropriate computer program. Reservoir equations may also be used for side reservoirs and basin-like channel sections. Flows over sills or through gates can be calculated using formulas of a wide sill or surface and bottom gate flows, depending on the shape of the flow path.

Estimations have to be made as to whether the dams and bridges located in the channel will resist the flood or fail.

The advance of a flood shall be followed to the extent necessary for assessing the hazard risk.

7.1.4 **Hazard risk of a waste dam**

Substances discharging from a breach of a waste dam may pose a risk to health and the environment.

In that case the issues to be considered are the harmful or hazardous substances in impounded waste or waste water, their properties, mode of influence and migration paths and the functions endangered by these substances in the event of an accident (water supply, waterbodies, settlement, etc.).

The items to be included in the assessment of a hazard risk are detailed in Appendix 17, “Assessment of the impact of waste dam functioning and failure on health and the environment”.

The hazard risk assessment of a waste dam shall also contain estimates of the hazard risk to the population and property in the area down-stream from the dam by applying the guidelines in 7.1.1 - 7.1.3.

7.2 **Results of the hazard risk assessment**

The results of the hazard risk assessment shall be delivered to the regional environment centre, provincial government, regional fire commander and municipal fire authority (DSA Section 9). The regional environment centre decides, on the basis of the hazard risk assessment, whether or not the dam shall be classified as a P dam after having obtained an expert opinion from the Finnish Environment Institute (DSD, Section 5).

The results shall contain:

- A specification of the assessment method and guidelines for interpreting the results.
- The data used in the assessment that remain constant in different cases, such as initial discharges, coefficients and the cross-section data given in digital form.
- A summary of the comparison of different dam breach cases, which for each breach case tabulates
  - the inclination of the walls of the breach opening and the final height and width of the bottom
  - the time of the breach
  - the water level in the basin at the onset of breach
  - the cause of the breach (internal erosion, scouring, intentional damage or surface erosion)
  - maximum discharge.
- The results of each flood, either calculated or measured from a scale model test, shall be given for the first 5 km of the flood path at cross-section intervals of at least 1 km and thereafter at least at every 5 km (Appendix 16).
• Assessment of hazard risk caused by each flood case to human life and property (fixed structures and buildings). The objects affecting the classification are listed. The list shall contain information about the elevations of the objects and the height and flow rate of the water at each object.

• An assessment of the health and environmental risks caused by a waste dam breach in accordance with Appendix 17.

• The dam class proposal of the person who made the assessment.
8 PREVENTION OF AND PRECAUTIONS AGAINST A DAM ACCIDENT

8.1 Prevention of a dam accident

Anyone who notices or is informed that a dam accident has happened or liable to happen and cannot at once prevent the danger is obliged without delay to inform those in danger, to make an accident report to the authorities, and to proceed with rescue operations in so far as he or she is able (Fire and Rescue Services Act 559/75 Section 28, referred to under Section 8 of the Dam Safety Act). This obligation concerns particularly the dam owner or holder and the dam management personnel in their service. They shall also take immediate action, in so far as they are able, to prevent and contain the accident.

The responsibility of the various authorities for rescue operations and their obligation to give executive assistance is based on the relevant legislation. The duties are defined in the directive on the planning of public rescue services issued by the Ministry of the Interior on 1.12.1988 (Publication Series A:26 of the Rescue Department of the Ministry of the Interior, 1184/701/88). When this directive is applied to dam accidents the duties of the authorities are as follows:

- The fire authorities see to the measures called for by the dam breach and the resulting flood in so far as is appropriate for fire brigades (Fire and Rescue Services Act 559/75 Section 1). The measures appropriate for fire brigades are those that have to be taken urgently, and which require a fire brigade’s good operational readiness, facilities, and professional skill and expertise in rescue operations in accident situations.

Should the fire brigades be considered capable of undertaking other urgent measures called for by a dam accident (Water Act 264/61 Chapter 21 Section 3 Paragraph 3), such as starting to repair the dam, they shall be instructed in advance about the measures required by each dam. The fire authorities are also responsible for directing rescue operations and for seeing that the rescue service plans are compatible with each other.

The plans to be made for emergency conditions are prescribed separately in the Civil Defence Act (438/58) and Decree (237/59). Prevention of a dam accident in a state of emergency calls for special preventive measures which are the duty of the dam owner or holder. When plans are made for a state of emergency, special attention shall be paid to the new risks involved in dam accidents that occur under such conditions.

- The police authorities see to public order and safety, isolation of the danger zones, traffic control, organization of the search for missing persons, and other measures appropriate for them (Police Act 493/95 Sections 1, 18 and 26, and Water Act 264/61 Chapter 21 Section 3 Paragraph 3).

The main duties of the police in the event of a dam accident are to warn people and remove them from the danger zone. The police, too, shall be instructed in advance about their duties in the event of a dam accident.

- The health authorities are responsible for organizing first aid and emergency care, ambulance services and other medical care and environmental health services (Primary Health Care Act 66/72, Health Protection Act 763/94).
The regional environment centres see to dam safety surveillance and the measures needed to eliminate a danger arising from the dam (Act on Amending the Dam Safety Act 90/95 Sections 10 and 11) and from flood prevention and protection (Act on the Environmental Administration 55/95, Act on Amending the Water Act 79/95 Chapter 12 Sections 17 and 19).

The measures taken by the regional environment centres in the event of a dam accident mainly concern the waterbody and hydraulic structures, the advance planning of these measures, the expertise needed to implement them, and, as allowed by local conditions, participation in the measures. The measures are defined in greater detail in plans drawn up in advance to cover specific cases, as applies to the other authorities, too.

The Finnish National Road Administration offers help with clearance and rescue operations, with particular responsibility in the event of a dam accident for road repairs and the maintenance of communication with the sites of action.

8.2 How to take a P dam into account when planning the rescue service

The comprehensive action plan needed by the local authorities for organizing rescue services (the municipal rescue service plan) contains a basic rescue service plan and supplementary plans for different sectors, types of accident and sites. Preparation of these plans is the duty of the municipal fire chief.

The coordination plan for a cooperation region composed of several municipalities deals with subjects such as intermunicipal assistance, cooperation with fire brigades and other authorities, and the capability of corporations and companies to participate in the rescue service. The coordination plan covers the rescue service plans of individual communities. It is drawn up by the provincial government together with the management group of the cooperation region.

On the basis of the coordination plans of the different cooperation regions, the provincial government also draws up a coordination plan for the fire and rescue services, the provincial coordination plan, which covers the whole province. The above plans drawn up in municipalities, cooperation regions and provinces complement each other and form the basis of the rescue operations under all conceivable accident conditions. The plans and their compatibility with each other are shown in Table 1.

The risk of a P dam causing an accident shall be taken into account in the planning of rescue services. Whether the planning has to cover the cooperation region or even the whole province or only a municipality depends on the magnitude of the accident on which the planning is based.

Table 1. General rescue service plans.

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<tr>
<th>Provincial coordination plan</th>
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<tr>
<td>Development of fire and rescue services (and other rescue administration)</td>
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<table>
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<tr>
<th>Coordination plan for the cooperation region</th>
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<tbody>
<tr>
<td>Basic plan for rescue service</td>
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<td>Plan for different sectors</td>
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<tr>
<td>Site plans</td>
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<td>Plans for different types of accident</td>
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<tr>
<th>Municipal rescue service plan</th>
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<td>Plan for different sectors</td>
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<tr>
<td>Site plans</td>
</tr>
<tr>
<td>Plans for different types of accident</td>
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</tbody>
</table>
The owner or holder of each P dam is obliged to help the fire authorities in drawing up this plan and, in accordance with the site plan, to take precautions against accidents. Under Section 4 of the Dam Safety Decree the following shall be available in the event of an accident caused by a P dam to the extent required by the conditions:

- a plan concerning the measures to be applied to a waterbody or to hydraulic structures in the event of an accident
- an account of stocks of materials kept for an accident
- an account of the alarm system and communication links to the regional alarm centre
- an account of the personnel of the dam owner or holder available in the event of an accident
- an account of the other measures to be taken by the dam owner or holder, necessary to protect people and property, in the event of an accident caused by damming
- an account of the type and quantity of the substance impounded by waste dams.

In addition to the above, which must mainly be seen to by the owner or holder of a P dam, other basic data needed for the planning of rescue services are the results of the hazard risk assessment dealt with in the previous chapter and matters that are the responsibility of the fire authorities. The fire authorities are mainly responsible for organizing rescue operations, that is, for:

- direction of the whole operation
- communications
- medical care
- servicing
- alerting the population
- providing information.

In practice, the planning of rescue services for a P dam starts with the drafting of a site plan. This plan and the precautions against accidents are dealt with in detail in Appendix 18. The site plan shall be checked and updated in the course of the regular inspections.

The basic plan of a municipal rescue service shall take into account the site plans drawn up for all the P dams in the municipality. The content of the basic rescue service plan, which is dealt with in the aforementioned directive on the planning of public rescue services, will not be described further in this context. Note, however, that P dams should be included in the list of special objects in the basic plan and that the arrangements and information concerning operation organization, special apparatuses, experts, intermunicipal cooperation and subtasks of the rescue service, which are required by P dams and differ from those called for by other types of accident, should also be taken into account. The special arrangements are described in detail in the site plan for each P dam referred to in the basic plan.

An accident to a P dam affecting several municipalities shall be taken into account in the coordination plan of a cooperation region. This is done on the basis of the site plan of the dam in question. If there are P dams in the same waterbody within areas of different municipalities their site plans shall be coordinated if necessary so that accident prevention can be undertaken as an entity. The accident situation may affect several cooperation regions. Therefore, the rescue service planning concerning all P dams in the waterbody shall be coordinated at provincial level. To this end, the site plans of individual P dams are combined to form a field-of-activity plan for each waterbody. This calls for cooperation between the fire authorities and dam owners.
APPENDIX 1. MODEL FOR THE COVER PAGE OF A DAM SAFETY FILE

Index number and name of dammed waterbody

Location municipality and site of dam

____________________________________
SAFETY FILE AND MONITORING PROGRAMME
(Name of dam)

Purpose of use

Permit (issuing body, date, name of project)

Date of implementation

Owner

Holder

Address and tel. no. of holder

Proposed dam class

Safety file completed on

Safety monitoring programme sent for inspection

Date and signature (of dam holder)

Amendments and additions:

For official use:

Dam class

Safety monitoring programme approved on

Other measures ordered to be carried out:
APPENDIX 1A. CONTACT INFORMATION ON THE DAM OWNER OR HOLDER AND AUTHORITIES

NAME OF DAM:
OWNER/HOLDER OF DAM:
ADDRESS AND TELEPHONE:

A. PERSONS RESPONSIBLE FOR SAFETY MONITORING, OPERATION AND MAINTENANCE OF THE DAM FOR THE DAM OWNER/HOLDER

1. name and job description:
   tel. (work, mobile, home):
   address (work, home):

2. name and job description:
   tel. (work, mobile, home):
   address (work, home):

3. name and job description:
   tel. (work, mobile, home):
   address (work, home):

SUPPLEMENTARY INFORMATION (stand-by etc.):

B. CONTACT INFORMATION ON AUTHORITIES

   Regional environment centre of__________________________________________________
   Address:
   Telephone:

PERSONS RESPONSIBLE FOR DAM SAFETY

1. Person responsible for dam safety
   name:
   tel. (work, mobile, home):
   address (work, home):

2. Deputy responsible for dam safety
   name:
   tel. (work, mobile, home):
   address (work, home):

3. Waste dam expert
   name:
   tel. (work, mobile, home):
   address (work, home):
APPENDIX 2. LIST OF COMPLETION DOCUMENTS

Project __________________________ Regional environment centre __________________________
Object __________________________ Municipalit y __________________________
Where and by whom the documents are kept __________________________

<table>
<thead>
<tr>
<th>Contents</th>
<th>Scale</th>
<th>Drawing No.</th>
<th>Date</th>
<th>Designer</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>
APPENDIX 3. DAM COMPLETION DOCUMENTS

The completion documents of a dam may be compiled as one or several files if necessary. They include the design documents of structures with any changes made during construction marked on them, or these documents without changes but supplemented with an account and drawings concerning the changes. A summary of work supervision and records of inspections and the commissioning inspection are also needed.

The following is an example of the items the dam completion documents should contain and how they might be grouped.

Hydrological design
- observational data
- design flow and water level and basis for their assessment
- design functioning of structures under design conditions

Earth and rock structures
- results of soil and bedrock studies, laboratory data
- construction materials data
- dimensioning of structures, stability calculations and settlement assessments
- reinforcements made for soil, bedrock and slope with completion drawings and data on materials used
- longitudinal profiles showing the areas to which the type cross-sections have been applied
- type cross-sections
- work specifications with supplements
- work supervision data
- maintenance instructions

Concrete structures
- design and stability calculations, and quality requirements of materials and work
- drawings of permitted load levels
- founding of structures and their linkage to the earth and rock structures
- structural and reinforcement drawings
- specifications for the materials and works at different sites
- work supervision data
- maintenance instructions

Steel structures
- design calculations, materials and work specifications
- linkage to other structures and machinery
- assembly drawings and the main structural drawings with data on materials
- installation drawings
- certificates of materials
- corrosion protection and surface treatment
- instructions for use and maintenance

Machinery
- design
- technical specifications of the machinery with performance values
- assemblage and major work drawings with information on materials
- installation drawings
- reports on test runs
- surface treatment
- certificates of materials
- instructions for operation and maintenance
- list of spare parts

Electrical facilities
- design of electrical installations
- final drawings
- instructions for operation and maintenance
- records of an inspection in which the electrical installations were approved

Monitoring and control facilities
- system plans and diagrams
- reports on facilities
- description of failure and malfunction alarm system
- drawings for connections and installations, permits for telephone and other extensions
- operation, test and maintenance instructions
Permit decisions, contracts and compensations

- permit decisions
- contracts for use and maintenance of structures
- other legal issues relevant to dam safety and its upkeep

Records of inspections and of significant repairs and modifications shall be added to the existing completion documents, ensuring that the documents of the entities grouped as above are kept in the same place. The completion documents shall be well protected.
APPENDIX 4. MAIN DIMENSIONS OF DAM

The main dimensions of the __________________________ dam (including all dams within the same reservoir system)

DAMS AND DAMMED SECTIONS (including dam-like embankments)

<table>
<thead>
<tr>
<th>Dam section, its materials and type (e.g. a homogenous earthfill dam, zoned earthfill dam, concrete dam)</th>
<th>Stationing or length of section (m)</th>
<th>Width of dam crest (m)</th>
<th>Maximum height (m)</th>
<th>Lowest elevation of crest</th>
<th>Lowest level of core</th>
<th>Smallest free-board (m)</th>
<th>Slope inclinations</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

GATES AND SILLS (within the above dammed sections or separate)

<table>
<thead>
<tr>
<th>Structure and functional type (e.g. turbine gate, flood spillway, bottom outlet, sill, log chute)</th>
<th>Location within dam</th>
<th>Length of sill (m)</th>
<th>Maximum discharge at HW (m³/s)</th>
<th>Elevation of sill and the upper edge of bottom outlet</th>
<th>Type</th>
<th>Source of power</th>
<th>Control</th>
<th>De-icing of closing installations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX 5. MAIN DIMENSIONS OF RESERVOIR AREA

MAIN DIMENSIONS OF THE ________________________________________ RESERVOIR AREA (name of dam)

<table>
<thead>
<tr>
<th>Permitted water level</th>
<th>elevation</th>
<th>area</th>
<th>volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical NW</td>
<td>_____ m</td>
<td>_____ km²</td>
<td>_____ million m³</td>
</tr>
<tr>
<td>Technical NW</td>
<td>_____ m</td>
<td>_____ km²</td>
<td>_____ million m³</td>
</tr>
<tr>
<td>Emergency HW</td>
<td>_____ m</td>
<td>_____ km²</td>
<td>_____ million m³</td>
</tr>
</tbody>
</table>

Elevation system applied: ______________

Technical NW = elevation of lowest sill

NW = the lowest permitted upstream water level or, if not determined, the lowest design water level when the dam is in use

HW = the highest permitted upstream water level or, if not determined, the highest design water level when the dam is in use

Emergency HW = the lowest elevation of the top of the dam core, excluding the sills

Reservoir storage capacity (HW - NW): _________ million m³
Emergency storage capacity (emergency HW - HW): _________ million m³
APPENDIX 6. HYDROLOGICAL PARAMETERS

1. THE TOTAL CATCHMENT AREA ABOVE THE DAM (*):
   catchment area ________ km$^2$
   lake percentage ________ %
   the mean of annual maximum discharges ________ m$^3$/s

2. CATCHMENT AREA OF THE DAM BASIN:
   catchment area ________ km$^2$
   lake percentage ________ %
   the mean of annual maximum discharges ________ m$^3$/s

3. DESIGN FLOOD AT DAM:
   A. From the whole catchment area
      return period ________ y
      maximum discharge (inflow) ________ m$^3$/s
      maximum water level ________ m (elevation system: ___________)
      maximum discharge (outflow) ________ m$^3$/s
   B. With any by-pass discharges subtracted (see item 4)
      return period ________ y
      maximum discharge (inflow) ________ m$^3$/s
      maximum water level ________ m (elevation system: ___________)
      maximum discharge (outflow) ________ m$^3$/s

4. IF WATERS FROM A PART OF THE UPSTREAM CATCHMENT AREA CAN BE
   CHANNELLED TO BY-PASS THE DAM, THE FOLLOWING INFORMATION SHALL
   BE GIVEN ABOUT EACH BRANCHING SITE  (in a separate appendix if necessary)

   location of branch _______________________________________
   catchment area ________ km$^2$
   lake percentage ________ %
   return period of design flood ________ y
   rate of design flood ________ m$^3$/s
   maximum water level ________ m (elevation system: ___________)
   water can be channelled past the dam at ________ m$^3$/s

(*) Includes the catchment area of the dam basin itself.

5. DISCHARGE AT THE DAM:
Maximum permitted discharge __________ m³/s

Other regulations included in the permit (if necessary):

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

Discharge capacity of dam sills and flood gates (without flows through power plant facilities):

at design high water level __________ m³/s
at emergency high water level __________ m³/s

The shortest time for lowering the water level of the reservoir from the HW level to the technical NW level when the inflow equals the mean of annual maximum discharges __________ days

Instructions given in Appendix 12 are applied when determining the design parameters. The data on which the calculation was based and the time curves of the design flood, outflow and water level shall be given in an appendix if necessary (i.e. if the damping effect due to the reservoir is taken into consideration in the design)
## APPENDIX 7. MAPS AND DRAWINGS IN SAFETY FILE

<table>
<thead>
<tr>
<th>Maps, scale</th>
<th>Sections</th>
<th>Content (minimum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:10 000...1:100 000</td>
<td>1:100/1:1 000...1:500/1:5 000</td>
<td>Location, name, names of construction objects, roads and road maintenance units</td>
</tr>
<tr>
<td>1:50/1:1 000...1:500/1:5 000</td>
<td>1:50...1:500</td>
<td>Shape and size of structure, elevation system, bench marks, dam line with pile numbers, boundaries between dam types, monitoring and other facilities, levels of dam crest and core, types of foundation with reinforcement, regulation limits, drainage system with discharge gates, material requirements</td>
</tr>
<tr>
<td>1:500...1:10 000</td>
<td>(1:100/1:1 000...1:500/1:5 000)</td>
<td>Location, type cross-sections with foundation reinforcements and facing, monitoring facilities</td>
</tr>
<tr>
<td>1:500 (1:100/1:1 000)</td>
<td>1:50...1:500</td>
<td>The information of the above entry as applicable</td>
</tr>
</tbody>
</table>
APPENDIX 8. PROPOSAL FOR DAM QUALIFICATION

PROPOSAL FOR QUALIFICATION OF ____________________________________________ DAM

On the basis of the hazard risk constituted by the dam in the event of an accident or its temporary nature, it is proposed that the dam be classified as a P/N/O/T dam referred to in the Dam Safety Code of Practice on the following grounds: ____________________________________________
_______________________________________________________________________________________________
_______________________________________________________________________________________________
_______________________________________________________________________________________________

The proposed qualification is based on

☐ a commissioning inspection
☐ the following other investigations and inspections: ____________________________________________
_______________________________________________________________________________________________
_______________________________________________________________________________________________

The following properties affecting the dam qualification have been investigated:

PROPERTY CONCLUSION
_______________________________________________________________________________________________
_______________________________________________________________________________________________

The other factors affecting the dam qualification have been taken into account as follows:

______________________________________________________________________________________
______________________________________________________________________________________
______________________________________________________________________________________
______________________________________________________________________________________
______________________________________________________________________________________

Summary concerning dam qualification:
______________________________________________________________________________________
______________________________________________________________________________________
______________________________________________________________________________________
______________________________________________________________________________________
______________________________________________________________________________________

Date Signature and name of person who made the dam qualification proposal
profession:
contact information:

Officially approved:

Regional environment centre of_____________________________________________________
______________________________________________________________________________________
______________________________________________________________________________________

Date Signatures
Names
APPENDIX 9. DAM SAFETY MONITORING PROGRAMME

SAFETY MONITORING PROGRAMME FOR _______________________________ DAM

The conditions of the structures and facilities, and for waste dams, the type of impounded material, and changes in them that affect dam safety shall be established by regular inspections (to be held at intervals not exceeding five years) with measurements, analyses of observational data, test runs of the equipment, and other investigations considered necessary.

The annual inspection shall establish the state of the structures and changes in them visually and by means of equipment test runs. The structures shall be inspected in spring or early summer after the flood and thaw.

The regular and annual inspections shall check each structure for the following (in a separate appendix if necessary):

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>INSPECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The dam shall be monitored as follows (periodicity):

________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________

In addition, monitoring shall be made when the structures are subjected or may have been subject-
ed to special stress during the breakup of the ice or a flood or as a result of heavy rainfall or a
storm.

The following monitoring measures shall be taken:

<table>
<thead>
<tr>
<th>MEASURES</th>
<th>PERIODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. inspection of visible parts of dam structures</td>
<td>every time</td>
</tr>
<tr>
<td>2. checking of internal inspection galleries and wells</td>
<td></td>
</tr>
<tr>
<td>3. visual inspection of collection wells and discharge</td>
<td></td>
</tr>
<tr>
<td>points of dam filter system (performance of drains</td>
<td></td>
</tr>
<tr>
<td>and colour of seepage water)</td>
<td></td>
</tr>
<tr>
<td>4. reading the stand pipes, measuring weirs and other gauges</td>
<td></td>
</tr>
<tr>
<td>5. inspection of drains in the downstream area</td>
<td></td>
</tr>
<tr>
<td>6. the type and amount of impounded waste or waste water</td>
<td></td>
</tr>
<tr>
<td>7. ___________________________________________ ________________________</td>
<td></td>
</tr>
</tbody>
</table>

The monitoring includes the following measures for individual structures (in separate appendix if
necessary):

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>MEASURES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The above should be observed

☐ until _______________
☐ until further notice

________________________________________________
_________________________ ________________________________________________
Date Signature and name of person who compiled
the monitoring programme
profession: contact information:

Officially approved:

Regional environment centre of

________________________________________________
_________________________ ________________________________________________
Date Signatures Names
APPENDIX 10. PERIODICITY OF DAM INSPECTIONS UNDER NORMAL CONDITIONS

PERIODICITY OF EMBANKMENT DAM INSPECTIONS UNDER NORMAL CONDITIONS (RECOMMENDATIONS)

<table>
<thead>
<tr>
<th>AGE OF DAM</th>
<th>DAM CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P dam</td>
</tr>
<tr>
<td>First filling</td>
<td></td>
</tr>
<tr>
<td>Once a day - several times a day (depending on degree of fullness and water level)</td>
<td>Once a week - several times a day (depending on degree of fullness and water level)</td>
</tr>
<tr>
<td>Five first years after the first filling</td>
<td>April: two times a month April-June: two times a month April-June: once after the flood</td>
</tr>
<tr>
<td>May-June: once a week July-March: once a month</td>
<td></td>
</tr>
<tr>
<td>Over five years after the first filling</td>
<td>Frequency of inspection is determined on the basis of monitoring data. If less frequent monitoring is justified, an amendment of the monitoring programme shall be approved by the authorities.</td>
</tr>
</tbody>
</table>

PERIODICITY OF CONCRETE DAM INSPECTIONS UNDER NORMAL CONDITIONS (RECOMMENDATIONS)

<table>
<thead>
<tr>
<th></th>
<th>DAM CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P DAM</td>
</tr>
<tr>
<td>First filling</td>
<td>Daily</td>
</tr>
<tr>
<td>Once a year</td>
<td>Visual inspection of structures and waterline when water as low as possible. Inspection of leakages and seepages when water as high as possible.</td>
</tr>
<tr>
<td>Once in five years or after great releases</td>
<td>Inspection of the bottom downstream from flood gates either visually or with measurements</td>
</tr>
<tr>
<td>Once in ten years</td>
<td>Submerged structures with the help of a diver</td>
</tr>
<tr>
<td>When necessary</td>
<td>Waterways of powerhouse in connection with maintenance</td>
</tr>
</tbody>
</table>
APPENDIX 11. EXAMPLES OF HOW TO MEASURE THE HEIGHT OF A DAM

$H =$ height

See 2.2.2 and section 3 of the Dam Safety Act and section 1 of the Dam Safety Decree.
Measuring the height of a submerged dam.
1 HYDROLOGICAL DESIGN CONSTRAINTS TO BE MET BY DAMS

The design flood values given in Table 1/12 based on the hazard risk class of the dam are applied when designing the spillways. In designing the basins and dams off the channel proper the value of the design flood can be deduced from the catchment of the basin, provided that the inflow channels of the basin can be shut if necessary. It is imperative to ascertain whether the inflow channels can also be shut under abnormal flood conditions. Determinations of the discharge capacity of the dam spillways shall take into account the size of the reservoir and the discharge capacity of any channel between the basin and dam. At the initial stage of dam planning it is important to ensure that the class and dimensioning of the dam are compatible with existing dams in the waterbody. Data on them are available from the owners of these dams and from regional environment centres.

At discretion, lower design values can be used in designing cofferdams, but in certain cases, e.g. when determining freeboard, special attention shall be paid to the effect of ice, e.g. of frazil ice, in winter. There are no strict design rules for cofferdams because the needs and requirements of these dams vary greatly depending on local conditions.

Table 1/12. Return periods of design flood by dam class.

<table>
<thead>
<tr>
<th>Class</th>
<th>Return period in years</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>5 000 - 10 000</td>
</tr>
<tr>
<td>N</td>
<td>500 - 1 000</td>
</tr>
<tr>
<td>O</td>
<td>100 - 500</td>
</tr>
</tbody>
</table>

2 DETERMINATION OF DESIGN FLOOD

The selection of the method to determine the design flood depends primarily on the hydrological data available. The selection is also influenced by the properties of the basin, the type of regulation, the regulations implemented in the upstream area, and other changes in the catchment.

Depending on the data available the determinations are made as follows:

1) If more than 20 years of maximum discharge data are available on the dam site a frequency analysis is made using the Gumbel distribution of extreme values.

2) If a record of maximum discharge data covering 5-20 years is available on the site the data are submitted to frequency analysis. It is recommended that a similar analysis be made on a long sequence of maximum discharge data from an adjacent waterbody using the same years as for the target waterbody.

3) If a set of data covering more than five years is available on the same waterbody close to the dam site (less than 20% change in catchment size, no major lakes in between), its maximum discharge data can be converted into those on the dam site directly in proportion to the catchment areas, thereafter proceeding as described in 1 or 2, depending on the length of the observation sequence.

4) If a set of data covering more than five years is available on the same waterbody (but not from unreasonably far off), but which, however, does not meet the criteria of 3 above, its maximum discharge data are converted into those on the dam site using nomograms, other sets of data and general hydrological knowledge, thereafter proceeding as in 1 or 2, depending on the length of the observation sequence.
5) Otherwise, frequency analyses made using the Gumbel distribution on data sets of over 20 years on the two most appropriate reference waterbodies are used. The results are corrected by taking into account the difference in hydrology between the reference and target waterbodies. Even a short data set on the target waterbody, preferably on the dam site, is then of particular importance.

6) If there are no appropriate reference waterbodies, the assessment has to be based on nomograms, the hydrological properties of the catchment and discharge data collected at the dam site during the design period.

7) Coefficients listed in Table 3/12 can be used to determine a design flood flow corresponding to a return period of over 100 years.

The influence of other factors is taken into account as follows:

A. If the volume of a basin is so large that the design flood can be assumed to be damped out, the entire design flood shall be determined (Fig. 1/12):
   1 Maximum discharges of different durations (e.g. 1, 3, 5, 10 and 20 days) and their occurrence in relation to the flood peak are calculated from the annual maximum discharge peaks.
   2 An analysis of return periods is made on maximum discharges of different durations using the Gumbel distribution of extreme values.
   3 A hydrograph is compiled in which the maximum discharges of different durations are those referred to in A.2, and their relative occurrence corresponds to the average occurrence in A.1.

   If it is manifest from A.1 that the temporal distribution of major floods differs from that of minor floods, this fact can be taken into account when dating maximum discharges of different durations.

   It is not necessary to compile a hydrograph if the dimensions of the dam allow undamped floods.

B. Analysis of return periods of rare flood cases cannot usually be based on a set of data on regulated flows. In that case, the inflow from the upstream area of the regulation structure, the bulk of which at least comes from the unregulated region, shall be taken as the basis.

C. If major regulation works have been made in the upper catchment, calculation of the design flood should start with the uppermost regulation. The effect of each regulation on the magnitude of the design flood is then assessed by moving downstream (taking into account the impact of a dam breach, if necessary). In practice this usually requires data on dams in the waterbody and the effect of the dams on the advance of the flood to be obtained from the dam owners and water authorities.

D. Any extensive draining and other measures affecting runoff made in the upper catchment must be taken into account when determining the design flood. Before the analysis of return periods is conducted the maximum discharges predating the project are corrected to present-day conditions with a coefficient based on the estimated impact of the project. If the changes in the catchment continue and their final magnitude can be estimated, this can be taken into account when determining the value of the coefficient.

E. If a dam (and the associated basin) is located off the main channel or if, in the upper course of the waterbody, the flow has been directed from one part of the waterbody to another using canals or other structures, the distribution of the flow between the channels in the event of rare floods should be assessed for each branching point. The distribution should be based on the prevailing conditions, because the value used in design is rarely compatible with reality. If one of the channels at a branch can be completely closed, this can be taken into account when determining the design flood. However, it is imperative to know that the channel can be closed if necessary. During rare floods water may be directed into abnormal paths in some watercourses even if there are no structures such as those mentioned above.
3 DETERMINATION OF DESIGN HIGH WATER LEVEL AND DESIGN OUTFLOW

Design high water level and design outflow are determined from the design flood, the water level at the onset of the flood and the surface area curve of the reservoir. For existing dams the design high water level depends ambiguously on the design flood and the initial water level. The best combination of design high water level and design outflow is sought for the dams under design. In both cases allowance must be made for wind, flow changes and impact due to ice and added to the calculated design high water level if considered necessary. Determinations of the discharge capacity of the dam omit the flow through the power station machinery.

If the volume of the reservoir is small, the design outflow equals the design flood. In that case the initial water level does not play a significant role and the design high water level is controlled by the design flood, the channel and the discharge capacity of the dam.

For larger reservoir volumes the design high water level and the design outflow are calculated with either a simple water balance method or a method that takes into account the inclination of the water level in the reservoir. The latter shall be applied to long, narrow reservoirs. The length of the time step used in the calculation depends on the surface area of the reservoir and the magnitude of the inflow. The results can be presented graphically as shown in Figure 1/12. For summer and winter floods and for reservoirs with minor water resources it is recommended that the highest permitted water level of the reservoir be taken as the initial water level of the reservoir and, for the spring flood, the water level that existed before the flood, determined from the operational data.

An ice jam or frazil ice in a river may cause a high water level with a return period significantly longer than that of the maximum discharge occurring during the existence of the ice jam or frazil ice. The high water level in the reservoir may be markedly affected by the volume of ice gathered in the reservoir or by the impact of ice on the discharge structures.

The return period of the inflow chosen for use in dimensioning the spillways depends not only on the safety factor against the dam breach but also on dam construction costs. The return period is a statistical parameter and the probability that the design flood will be exceeded increases along with the operational age of the dam. If it is assumed that the operational life of a dam, for instance, is 100 years, then there is a 63% probability that a flood with a frequency of less than once in 100 years will occur during this time and an 18% probability that a flood with a frequency of less than once in 500 years will occur (Table 2/12). As dams, excluding temporary ones, are designed to last for a long time, there is no sense in dimensioning them on the basis of short return periods.

Dam design is facilitated by the fact that the change in the design flood decreases in relation to the increase in the return period. If a flood with a frequency of once in 1000 years is taken as the design flood the design discharge is only 30% greater than if a flood with a frequency of once in 100 years had been selected.

Figure 1/12. An example of reservoir routing.
Table 2/12. Probability (%) of design flood being exceeded during return period as a function of design operational life of structure.

<table>
<thead>
<tr>
<th>Flood return period (yr)</th>
<th>Design life of dam (yr)</th>
<th>10</th>
<th>50</th>
<th>100</th>
<th>200</th>
<th>500</th>
<th>1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td></td>
<td>66</td>
<td>99</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>50</td>
<td></td>
<td>18</td>
<td>64</td>
<td>87</td>
<td>98</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>100</td>
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<td>1</td>
<td>2</td>
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Table 3/12. Ratios of maximum discharges at some observation sites determined using the Gumbel distribution of extreme values.

<table>
<thead>
<tr>
<th>Observation site</th>
<th>HQ1000</th>
<th>HQ5000</th>
<th>HQ10000</th>
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<tbody>
<tr>
<td>HQ100</td>
<td>HQ100</td>
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</tr>
<tr>
<td>4:6 Lieksanjoki, Ruunaa</td>
<td>1.28</td>
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<td>1.55</td>
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<tr>
<td>4:24a Koitajoki, Lylykoski</td>
<td>1.27</td>
<td>1.46</td>
<td>1.54</td>
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<tr>
<td>4:8087 Kallavesi, Konnus+Karvio</td>
<td>1.28</td>
<td>1.48</td>
<td>1.57</td>
</tr>
<tr>
<td>14:9 Vuosjärvi, Huopanankoski</td>
<td>1.27</td>
<td>1.46</td>
<td>1.54</td>
</tr>
<tr>
<td>14:29 Nilakka, Äyskoski</td>
<td>1.28</td>
<td>1.48</td>
<td>1.56</td>
</tr>
<tr>
<td>14:40 Petäjävesi, outlet</td>
<td>1.30</td>
<td>1.51</td>
<td>1.60</td>
</tr>
<tr>
<td>16:1a Koskenkylänjoki,Pyhäjärvi</td>
<td>1.35</td>
<td>1.59</td>
<td>1.70</td>
</tr>
<tr>
<td>28:3 Aurajoki, Hypöistenkoski</td>
<td>1.32</td>
<td>1.55</td>
<td>1.65</td>
</tr>
<tr>
<td>35:94 Loimijoki, Maurialankoski</td>
<td>1.30</td>
<td>1.50</td>
<td>1.59</td>
</tr>
<tr>
<td>42:10 Kyrönjoki, Lansorsund</td>
<td>1.26</td>
<td>1.44</td>
<td>1.51</td>
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<tr>
<td>44:5 Lapuanjoki, Pappilankari</td>
<td>1.29</td>
<td>1.49</td>
<td>1.57</td>
</tr>
<tr>
<td>51:2 Lestijoki, Lestijärvi</td>
<td>1.28</td>
<td>1.47</td>
<td>1.56</td>
</tr>
<tr>
<td>54:4 Pyhäjoki, Pyhâkoski</td>
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<td>1.58</td>
</tr>
<tr>
<td>57:7 Siikajoki, Länkelä</td>
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<td>1.51</td>
<td>1.60</td>
</tr>
<tr>
<td>59:19 Lammasaari, outlet</td>
<td>1.29</td>
<td>1.49</td>
<td>1.58</td>
</tr>
<tr>
<td>60:4 Kiiminginjoki, Haukipudas</td>
<td>1.30</td>
<td>1.50</td>
<td>1.59</td>
</tr>
<tr>
<td>61:19 Iijoki, Merikoski</td>
<td>1.26</td>
<td>1.45</td>
<td>1.52</td>
</tr>
<tr>
<td>65:17 Keminhaara, Kumnativi</td>
<td>1.26</td>
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<td>1.51</td>
</tr>
<tr>
<td>65:36 Ounasjoki, Marraskoski</td>
<td>1.31</td>
<td>1.48</td>
<td>1.56</td>
</tr>
<tr>
<td>67:8 Muonionjoki, Muonio</td>
<td>1.25</td>
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<td>1.51</td>
</tr>
<tr>
<td>67:22 Tornionjoki, Karunki</td>
<td>1.25</td>
<td>1.42</td>
<td>1.49</td>
</tr>
<tr>
<td>71:8 Juutuanjoki, Saukoniva</td>
<td>1.28</td>
<td>1.48</td>
<td>1.56</td>
</tr>
</tbody>
</table>

As the design flood (Table 3/12), therefore, the dam construction costs do not usually increase much when the return period of the design flood is lengthened.

4 DETERMINATION OF DESIGN FLOOD WITH MODEL CALCULATIONS

Should a hydrological model comprising runoff, river, flood area and lake models already have been made for the waterbody for prognosis or planning purposes, this model can be used for calculating the design flood. Care should then be taken that the calculations of water...
height and discharge are based on the exceptionally large water volumes of a design flood, for example, by calculating the advance of discharge within and outside the river channel using a hydraulic river model.

The use of hydrological and hydraulic models is recommended in extensive and regulated waterbodies. If necessary, the design high-water level and design outflow of reservoirs and lakes can also be calculated with the models. If there are insufficient hydrological observations of the dam site, model calculations can be used instead of the comparative waterbody method.

With the hydrological model, the design precipitation and the water equivalent of snow to be used must be determined. The values given in Table 4/12, which are based on those used in Sweden (Riktlinjer för bestämning av dimensionerade flöden för dammanläggningar, 1990), can be used as design precipitation, or then corresponding values can be determined from precipitation values recorded in Finland. The design precipitation values shown in Table 4/12 were deduced from the highest daily rainfall and two-week precipitation sums over a 60-year period in an area covering 1000 km² in Sweden and part of Finland, from which two-week design precipitation was then determined. The highest daily precipitation, which corresponds to the highest daily precipitation (120-150 mm) recorded in the 1000 km² area, was set on the ninth day of the design precipitation period.

The annual correction of precipitation reduces precipitation by 50% from November 16 to April 30 (Fig. 2/12). Design precipitation in winter is therefore half of that in summer. The spring and autumn corrections are shown in Fig. 2/12. Design rainfall is determined for a 1000-km² area. The area correction coefficient given in Fig. 3/12 is used for areas smaller or larger than that. The design precipitation is corrected upwards with a height coefficient if the waterbody is at an elevation above 500-700 m. The height correction is 5-10% per 100 m.

In design flood calculations the highest water content of snow in winter is the value occurring in an area once in 30 years, which, together with precipitation once in 10 000 years, makes for a sufficiently rare case. The water equivalent of snow can usually be taken direct from publication A 56 of the Finnish Environment Institute (Perälä & Reuna 1990).

The design flood is found by moving the design rainfall one day at a time over the whole calculation period available. The greatest flood detected in the period is the design flood. If the design flood is due to snowmelt or rainfall, the snowmelt should not be halted by a cold period; instead temperatures should be raised to ensure that the design flood does not decrease. The temperatures used in the calculation are thus mainly those recorded during the period.

The ground moisture content in the hydrological model must be sufficient when the design flood is calculated. There must not be an unusually high shortage of ground moisture before the design flood.

A design flood determined from precipitation, snow or temperature data with the hydrological model cannot be given exact return periods. The estimated frequency of the design rainfall recommended above is once in 10 000 years, based on a 63-year observation period and 200 survey areas 1000 km² in size in Sweden. The probability of rainfall of this magnitude falling on an area in the course of one year is 1/63 × 1/200 = 1/12 600. The frequency of the water equivalent of snow is once in 30 years. The design flood frequency is thus sufficient for P dams, too, and corresponds well to international frequency values.

The design flood calculated with the waterbody model should be checked as far as possible with frequency analyses based on discharge or water height observations as specified in section 2.

REFERENCES


Table 4/12. Design precipitation (mm/d), Lapland and the rest of Finland.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<td>6</td>
<td>6</td>
<td>6</td>
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<td>10</td>
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<td>25</td>
<td>10</td>
<td>10</td>
<td>6</td>
<td>6</td>
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<td></td>
</tr>
<tr>
<td>The rest of Finland</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>10</td>
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<td>10</td>
<td>6</td>
<td>6</td>
<td>297</td>
<td></td>
</tr>
</tbody>
</table>

Figure 2/12. Annual correction of the design precipitation.

Figure 3/12. Area correction coefficient of the design precipitation.
APPENDIX 13. REQUIREMENTS FOR EMBANKMENT DAMS

1 PLANNING

1.1 Competence of designer

A designer of embankment dams is expected to have previous experience in the geotechnical planning and implementation of very demanding earth structures (Guidelines for Foundation Construction RIL 121-1988). A designer of P and N dams and of the T dams comparable to them is further expected to have sufficiently extensive experience in the design of embankment dams. This requirement applies to alterations and repairs to existing embankment dams and also to evaluations of dam condition.

1.2 Loads and calculations

The different parts of the dam are dimensioned taking into account the weight of the materials in the structure, the loads due to seepage (pore water pressures), the forces caused by waves and frost, and the traffic load on the dam crest. Vibrations due to blasting may also create loads during construction. Depending on the case, other external loads shall also be taken into account in calculations.

The stability of a dam is calculated at least for the construction period (the risk is usually highest at the end of the work), normal operational conditions and after a rapid fall in water level (the risk is usually highest when the water level drops from HW to the technical NW). Other loading cases should be considered individually. The stability calculation includes the stabilities of the dam and foundation.

Dam and foundation settlements are dealt with in accordance with conventional calculation procedures.

1.3 Calculation of seepage flow

Seepage flows through embankment dams via the foundation or rock and from the side are assessed for different cross-sections. The calculations are performed using methods of proven reliability. The sites where the dam joins rock or concrete structures shall be inspected separately. Seepage flows shall also be inspected on the boundary surfaces of all other structures associated with or running through the dam. Flows on these surfaces must be cut off or restricted to ensure that the flow is smaller than in the enveloping dam. The site where a dam is connected to a river bank shall usually be assessed in terms of seepage flow.

The seepage flow rate and flow concentrations (maximum flow rate and maximum gradients) are calculated.

1.4 Stability calculations

Stabilities are calculated for different cross-sections at least for the loads referred to in 1.2. The calculation can be made either with the total safety method or using partial safety coefficients. Total safety is the ratio of shear strength to the shear stress prevailing in the assumed fracture plane. The Guidelines for Foundation Construction (RIL 121-1988) are applied when the method of partial safety coefficients is used at the rupture limit.

The rupture limit analyses should be supplemented with calculations on strain under the conditions prevailing when the dam is in use, at least if the dam is made of materials whose maximum strength is mobilized at very different strain values (an extreme case: clay core/blasted rock shoulder). In the above cases calculations of the total safety or the limit state of failure may give too favourable a picture of dam stability.

1.5 Minimum requirements for dams

1.5.1 Stability

The total safety of dams in a state of constant seepage flow should be at least 1.5. At the final stage of construction and on a sudden fall in water level (HW-NW) total safety should not be less than 1.3.
1.5.2 Freeboard of dam

The freeboard of N and P dams (difference between the dam crest and the HW level) is deduced from the maximum wave height at HW or the depth of frost penetration based on design cold content. A preliminary calculation of wave height can be made solely from the length of open water using the formula \( h = 0.36 \sqrt{L} \), where \( h \) is the height of the wave (m) and \( L \) the length of open water (km). The freeboard should then be at least 1.75 times the height of the maximum wave. More detailed dimensioning, and always when the length of open water exceeds 10 km, takes account of the direction, duration and velocity of the prevailing winds, for instance, as set out in the publication ‘Rockfill Dams, Design and Construction’.

The freeboard shall, however, always equal the depth of frost penetration that occurs at least once in ten years (in general the dominant factor of the freeboard). Cold content is determined from cold content compiled on the basis of temperature observations made in the period 1961-1990. These charts are shown in RT 81-10590.

For O dams the freeboard is determined by the maximum wave height or depth of frost penetration occurring once in five years.

To establish that existing embankment dams have sufficient freeboard, frost depth can be determined separately on the basis of the cold contents in the observation period 1931-1960 that occur once in ten (P and N dams) or five years (O dams).

In Table 1/13 the depth of frost penetration of a homogeneous till dam, a clay-core zoned earthfill dam and a till-core zoned earthfill dam is determined with the square root of the cold content and values of coefficient \( k \) of the dam type from the formula \( Z = k \times \sqrt{F} \). The values in the table can be applied to determine the freeboard of the crest in embankment dams built of natural materials.

The freeboard of zoned earthfill dams fitted with filtering structures meeting filtering criteria and with sufficient permeability can be determined by applying the value of coefficient \( k \) for homogeneous embankment dams.

Determined as above, freeboard can be reduced by insulating the crest against frost. In that case the frost insulation must, however, be dimensioned separately. It is recommended that extruded polystyrene cellular plastic boards at least 50 mm thick should be used for insulation. Boards thinner than that are not recommended due to the risk of fracture and the decline in thermal insulation capacity due to more rapid waterlogging.

The impact of traffic as a factor augmenting frost depth must be taken into account separately when dimensioning the freeboard of dams with a public road running along the crest.

For dams without regular traffic, freeboard determined on the basis of frost penetration can be reduced by ensuring that the upper part of the dam is sufficiently watertight down to the frost penetration depth estimated as above. The dam can be made watertight with insulation film, bentonite matting or fill, or some other structure. This structure must be located so as not to impair dam stability.

Table 1/13 Estimation of frost depth on snow-free dam crest with the square root of the cold content from the formula \( Z = k \times \sqrt{F} \).  

<table>
<thead>
<tr>
<th>Cold content F (h °C)</th>
<th>Homogeneous till dam</th>
<th>Zoned earthfill dam clay core</th>
<th>Zoned earthfill dam till core</th>
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<td></td>
<td>k=1.20</td>
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<td>10 000</td>
<td>1.20</td>
<td>1.05</td>
<td>1.30</td>
</tr>
<tr>
<td>15 000</td>
<td>1.47</td>
<td>1.29</td>
<td>1.59</td>
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<td>2.81</td>
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<tr>
<td>60 000</td>
<td>2.94</td>
<td>2.57</td>
<td>3.18</td>
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</table>
The impact of any snow accumulating on the dam crest as a factor reducing frost penetration is not usually taken into account when the freeboard is dimensioned. In exceptional cases, e.g. levees and dams for fish ponds, the insulating effect of snow can be taken into account separately.

1.5.3 Safety margin of dam
The safety margin of P and N dams (difference between the top of the core and the HW level) should be no less than 0.4 m, and for O dams 0.3 m. Allowance must also be made for settlement of the structure and foundation.

1.5.4 Wet slope facing
The size of boulders in wet slope facing and the thickness of the facing are determined from the maximum wave height. The range of the variation in high water dictates the extent of the facing. If the damaging effect of ice loads is to be taken into account, the average diameter of the boulders should be 0.4 - 0.6 m. If smaller boulders are used, the structures may need to be repaired from time to time.

1.5.5 Dam crest
The crest width of P and N dams should be at least 4 m. The width must be increased by 0.5 m if the height of the dam exceeds 10 m, and by a further 0.5 m for each successive 10 m. For special reasons the crest width of N dams less than 4 m high can be 3.5 m. The crest of O dams should be no less than 3 m wide.

The crest should be passable over its entire length.

1.5.6 Filtering structures and drainage system of a dam
The filtering structures and the drainage system should be so dimensioned that they are capable, in all circumstances, of protecting the core against erosion and of discharging the waters seeping through, under or around the dam and to smooth any peaks in flow gradients. The filtering structures must meet the grain size criteria, and their permeability must be 100 times that of the protected structure. The drainage system must be able to put through a volume which is ten times that of the calculated total seepage water.

1.5.7 Vegetation
The amenity of the dam area and its impact on the landscape can be enhanced with trees, bushes and ground vegetation. Vegetation prevents erosion of the dam surface. The vegetation must not, however, endanger the structure or impede dam maintenance. Figure 1/13 shows a scheme for the lay-out of vegetation on a dam.

Figure 1/13 Scheme for lay-out of vegetation on dam.
Wet slope

As a rule, no trees with trunks are allowed on the wet slope. Bushes growing on the bend between the wet slope and the crest are, however, advantageous for the accumulation of snow. In exceptional cases, larger trees can be permitted after separate investigations. Trees can grow on wider sections built during the construction or repair of a dam. Such sections can also serve to shelter boats or lessen the impact of the dam outline on the landscape.

Dam crest and dry slope

Trees are not as a rule permitted on the dam crest. Low bushes may grow at the bend between the slope and the crest, outside the access area of machines. On the dry slope, trees with trunks may grow downslope from a height corresponding to high-water level as long as they do not endanger the structure. Trees and bushes on the slope should be so sparse that there is an unimpeded view of the dam for inspection purposes. The area of dam and background subsurface drains that are part of drainage systems should be kept free of trees and bushes for a width of at least 5 m, depending on the conditions. In the dam background, trees at the foot of the dry slope must not prevent maintenance or inspection.

Levees

On levees, trees and bushes can be on the wet slope as well as the dry slope, chiefly in the freeboard area. Vegetation must be removed from the water fluctuation area to the extent it interferes with water flow in the channel. The impact of ice and the visibility required for maintenance supervision must also be taken into account. In terms of landscaping and recreational use it is recommended that open parts of the levees where trees grow and views are possible should vary according to the type of background terrain.

Care of vegetation

Stands of trees intended to grow permanently on dams and levees should be thinned and the branches cut as necessary to enable them to withstand strong winds.

Plans for protection against surface erosion should take the benefits of landscaping, e.g. grassing over, into account. Stones used to protect the ground should be rounded natural ones as far as possible and the growth of surface vegetation should be promoted by till or peat soil covering.

1.6 Filing the design documents

Calculations and data on materials and other design documents are filed so as to be available for later repairs should the need arise. The main design information is filed together with the completion documents as required by this Code of Practice.

2 CONSTRUCTION

2.1 Management and supervisory personnel

The management and supervisory personnel shall have sufficient experience of carrying out demanding earthworks, and the persons responsible for these works shall have experience of previous works on embankment dams.

The supervisory personnel and management shall not be dependent on each other, and the supervisor shall have the right to halt construction should the conditions, materials used or work methods differ from those specified in the design documents.

The designer shall participate in supervision by overseeing the most demanding work stages and inspecting the site records.

2.2 Quality control of work and materials

Work is controlled by continually monitoring its progress. The quality of work and materials is controlled at least as stated in the control programme compiled in association with the design documents. The programme must give the minimum standards for investigations of materials and control tests of the structure.
Records are kept of the control tests. They shall record the date and results of the tests, any deviations and the corrections made, etc. in such a manner that the sites of the tests can be unambiguously located afterwards.

2.3 Filing of work documents
All results of quality control tests and control reports are collated and filed. A summary is made of them and added to the dam completion documents.

Record drawings showing all the structures made including the foundation works and any changes in plans implemented during the work are made on the basis of measurements undertaken during the work.

3 MONITORING

3.1 Monitoring personnel
The personnel participating in the commissioning and regular inspections are referred to in chapters 5 and 6. It is recommended that the dam designer or a person with the corresponding expertise should participate in the annual inspections (at least for P dams).

Personnel undertaking the monitoring proper shall be trained at the dam, appropriate attention being paid to the special features of each dam.

3.2 Monitoring of seepage waters
Seepage waters can be monitored with pore water pressure gauges, groundwater wells, drain structures or drainage ditches. Special emphasis should be placed on changes in pore water pressure, water level or rate of water flow, and on water quality (colour, turbidity, etc.). After completion of the dam (by the first regular inspection at the latest) alarm limits should be set for pore water pressure, the water level in groundwater tubes and/or the measured water volumes, which, if over- or undershot, would call for inspection by an expert at least.

Objects subject to special surveillance are springs, wet areas in the downstream area, changes in vegetation (e.g. proliferation of willow) and areas that remain ice-free in winter or become snow-free early in spring.

In areas where the tail water extends to the dry slope of the dam it is not usually possible to measure seepage water flow. To determine the quality of seepage waters the inspections should be made when there is no flow in the downstream channel.

The concentrations of seepage flows can be studied with ground-penetrating radar. The first such radar study should be made as soon as the dam has been completed and thereafter in conjunction with the regular inspections. The radar results enable the monitoring instruments (pore water pressure gauges, groundwater wells etc.) to be placed more accurately in dam cross-sections, which improves the quality of monitoring.

3.3 Monitoring the structure
The structure can be monitored with measurements (levelling, settlement observations, frost depth measurements etc.) and visually. The visual monitoring should concentrate above all on changes that have taken place (settlements/cracks in the crest or slopes, state of facing, unusual frost heaves etc.). Wheel track grooves on the dam crest may not exceed 50 mm in depth.

Embankment dams shall be kept free from vegetation as specified in section 1.5.7, so that any deformations or waterlogged sites in the dam slope are readily visible. The drainage ditches in the background area in particular shall be kept clean.

Should the freeboard only just meet the dimensioning requirements, the frost depth on the dam crest should be monitored regularly in a few cross-sections. After a winter harsher than that corresponding to the design cold content used in determining the depth of frost, inspections during the spring thaw should be intensified.

3.4 Filing the monitoring data
Monitoring data are filed and summaries are made for the annual and regular inspections.
4 COFFERDAMS

4.1 Design
The same requirements apply to cofferdams as to permanent dams. However, stability during the life-time of the dam need not be more than 1.3 (total safety). Stability must then be calculated applying the maximum water level that occurs during the period the dam is in use and the traffic loads during the construction of the dam.

4.2 Construction
The supervisory instructions for embankment dams proper are applied, as appropriate, to the construction of cofferdams, construction and quality control.

4.3 Monitoring
Cofferdams are monitored mainly by site personnel. A monitoring programme must always be drafted for a dangerous cofferdam comparable to a P dam. For other cofferdams a monitoring programme is drafted at the discretion of the designer.

REFERENCES
APPENDIX 14. REQUIREMENTS FOR CONCRETE DAMS

1 DESIGN

1.1 Competence of the designer

The designer of a concrete dam shall have sufficient training and competence as required by the dam class and structure, and appropriate experience in designing concrete structures. These demands also apply to the modification and repair of concrete dams and the assessment of the condition of these dams. For the planning of a dam a chief designer must be nominated, with responsibility for dam design and coordination of the plans of different design sectors and parties. Concrete dams classified as P and N dams shall be designed as class 1 structures. The designer of concrete structures in class 1 shall have the competence of the designer required by this class as established by a committee of experts nominated by organizations in the construction and concrete sectors.

1.2 Loads and their calculation

The loads of concrete dams are calculated as stated in the Guidelines for Structural Loads RIL 144-1997. For stability assessments the weight of the concrete structure is calculated by using a volume weight of 23 kN/m$^3$. Should higher values of the weight volume be used, they must be assessed case by case.

The design discharges and corresponding water levels can be calculated from the statistical data as shown in Appendix 12. The buoyant force on the bottom of the dam can be calculated from the seepage flow analysis, provided experimental permeability values are available for the basement rock/soil. The calculation can be made in two or three dimensions. The computer software must be well-tested and approved for these applications. If necessary, the results should be checked with measurements.

1.3 Combining the loads

The loads determined by applying the Guidelines for Structural Loads are combined in such a manner that loads with a simultaneous effect constitute the combination most dangerous to the structure.

The design of concrete dams must take the loading cases listed below into account and these must include at least the following combinations. Loading situations 1 and 2 are treated as normal and 3 and 4 as exceptional.

1. During construction
   - dead load
   - restraint actions caused by temperature variations (if relevant)
   - earth pressure
   - loads due to construction machinery and installation cranes
   - machinery loads (included or not)
   - roof structures (included or not)

2. Normal operation
   - dead load
   - restraint actions caused by temperature variations (if relevant)
   - earth pressure
   - normal high water (HW)
   - normal or minimum low water (whichever causes the highest stress)
   - buoyancy
   - loads due to machinery and facilities
   - ice load

3. Unusual operation (flood)
   - dead load
   - maximum high water (emergency HW)
   - maximum low water
   - buoyancy
   - collision load of ice float if relevant

4. Maintenance
   - dead load
   - earth pressure
   - maximum high water
   - maximum or minimum low water (whichever causes the highest stress)
   - buoyancy
   - crane loads
• waterways when empty (powerhouse, flood gate)
• without machinery and equipment
• ice load

1.4 Dimensioning the structures and calculating their stability

The structures must be designed and dimensioned in such a manner that they are sufficiently safe against breach. The structures must also have sufficient safety against deformations, settlements, cracks, vibrations or other damaging effects.

The safety of a structure on bedrock foundation against overturning or sliding as determined with the total safety method is considered sufficient if it is $\geq 1.5$ under normal and $\geq 1.3$ under exceptional loading conditions. The safety values are calculated using service life loads.

When the total safety method is applied to the dam foundation and the boundary surface between the dam and its foundation, the safety of concrete dams on bedrock against sliding can be calculated from the following formula (Design of Small Dams, United States Department of the Interior, Bureau of Reclamation, 1987):

$$Q = \frac{CA + (\sum N + \sum U) \tan \phi}{\sum V}$$

where

- $C$ = cohesion value of concrete or rock
- $A$ = area of base considered
- $\sum N$ = sum of normal forces
- $\sum U$ = sum of buoyant forces
- $\tan \phi$ = internal friction coefficient
- $\sum V$ = sum of horizontal forces

In formula (1) all the parameters are given in uniform units and must be determined case by case. Buoyant forces are entered into the formula provided with the minus sign.

The safety of the structures against overturning and sliding can also be determined with the boundary condition method, for example, by applying the Norwegian dam design code of practice (Forskrifter for dammer, Norges vassdragss- og elektrisitetsvesen 1982).

Concrete dams on an earth foundation must always be checked more carefully against overturning, sliding and settlement.

Safety against overturning and sliding can also be established with the appropriate FEM models.

1.5 Measures to improve stability

The stability of concrete dams can be improved with prestressed rock anchors. If these anchors are such that their stress cannot be checked afterwards, the safety of the structure, without the contribution of anchors, must be $\geq 1.25$ under normal load conditions and $\geq 1.1$ under exceptional load conditions. If the need to calculate the anchor forces is minor, at least two anchors must still always be installed.

Should the contribution of the prestressed anchors to safety be higher than stated above, anchors must be used whose stress can be checked later at regular intervals. The anchors must be placed so that their stress can be readily checked and non-functional anchors replaced with new ones if necessary. The number of anchors must be so high that the safety of the structure is not endangered during checking or when a new anchor is installed. Only double-protected anchors can be used as prestressed anchors.

Conventional grouted deformed steel rock bolts, whether prestressed or not, are not taken into account as a stabilizing factor in the stability assessment of the structure unless their long-term duration and the displacement ability of the structure have been secured. The contribution of the anchors to safety shall not exceed that of the unchecked prestressed anchors.

The pore pressure acting under the structures can be reduced with subsurface drains. It is important, however, that the functioning of the subsurface drains can be checked with pore pressure or other pressure gauges installed under the structure. If the bedrock is unfractured and very dense throughout, the development of pore pressure and the feasibility of lowering it must always be established case by case.
1.6 Properties of materials

In the design of dam structures the requirements set by long-lasting durability, watertightness and frost resistance must be taken into account. To ensure the durability of the concrete structures guidelines by 32, Betonirakenteiden säilyvyys-ohje ja käyttökäyttöitoitus 1992 (Durability Guideline and Service Life Dimensioning of Concrete Structures 1992) shall be applied. However, instead of the value of the protective pore ratio given in Table 3.3, all the parts of the dam subject to frost action shall be made of concrete with a protective pore ratio of ≥ 0.25. Owing to the inaccuracy of the protective pore ratio test the resistivity to frost should also be checked with thin section studies or a frost salt test.

In massive concrete structures the harmful effect of restraint action due to hydration heat and the impact of high temperature on the properties of concrete binder must be taken into account and attempts made to minimize them with the aid of concrete technology and appropriate working techniques.

1.7 Mode of function of the structure

The dam structure must be divided into parts with movement joints to prevent the cracks caused by thermal and drying shrinkage from becoming too large. Adjacent structures linked to each other must be designed in such a manner that the deformation and displacement differences across the joints in structures caused by loads are not so large that the sealing is damaged or so that the displacing structure does not load another structure in a way not considered in calculations.

The adverse effects of restraint action on structures caused by temperature differences during construction can best be eliminated by dividing the structures into casting blocks and making the casting sequence as appropriate as possible.

Concrete structures connected with embankment dams and lateral fillings must be designed in cooperation with the geotechnical designer of the facility.

1.8 Design documents

The design materials are documented as stated in the instructions for structural calculation, and information about the place where they are filed is entered in the list of completion documents.

2 SUPERVISION DURING CONSTRUCTION

2.1 Competence of management

The foreman responsible for concrete works shall have the competence required by the structural class and, in general, the competence of a foreman supervising demanding works.

2.2 Supervision of work quality

The quality control of the concrete structures is made in accordance with the concrete standards. Matters essential for dam safety should be checked as construction proceeds. A record should be kept of inspections to an extent considered appropriate. Matters to be supervised and recorded include the type and permeability of the basement rock/soil, the stress and pressure grouting of the prestressed anchorage, temperature changes in cast structures and their junctions, information on the composition and reinforcement of the concrete, etc.

2.3 Recording work information

The results of the quality control tests and inspections made during the construction stage are summarized and added to the commissioning inspection documents. The quality control reports are filed with the completion documents.

3 MONITORING DURING USE

Monitoring objects important for dam safety during use include the waterlines, movement and work joints of the structures, the functioning of drains and anchors, the amount and type of leaks, and changes in them. Waterways and submerged structures are inspected when possible during maintenance while the structures are visible. If this is not possible the inspection is
carried out with the aid of a diver and video recording. A record is kept of the inspections and added to the documents for regular inspections.

REFERENCES


APPENDIX 15. REQUIREMENTS FOR GATES AND WATER LEVEL MEASUREMENT

1 STEEL STRUCTURES
The steel structures of gates shall be designed in accordance with the Guidelines for the Design of Steel Structures (RIL 90 - 1996), taking into account the strength specifications required by conditions during use.

The loads shall be considered as stated in the Guidelines for Structural Loads (RIL 144-1997).

2 MACHINERY

Devices to prevent overloading:
If the structure is such that the machinery or gate can get damaged at overload, the machinery shall include a safety device provided with an appropriate alarm system.

To prevent slanting:
The slanting of gates shall be prevented either mechanically or electrically. The machinery shall have a detector to record any slanting that interferes with operations, and a system for straightening the gate.

Functioning of chains:
If the force acting on the gate is transmitted by chains, it must be verified that the chains and winding drum work in winter, too.

Greasers:
It is important that the gate can be readily and safely greased, and that the person responsible for the functioning of the gate sees to the necessary greasing in accordance with the maintenance programme.

Test run:
Functioning of the machinery and monitoring facilities shall be verified annually with a test run the results of which are be entered in the annual inspection record.

3 ELECTRICAL DEVICES
The design and use of the electrical devices shall comply with the regulations for electrical safety.

Limit switches:
The machinery shall be fitted with reliable limit switches which stop the movement at the extreme gate positions and in certain special circumstances.

Heating:
If it is necessary to use the gate at subzero temperatures, too, the gate and its reveal shall be provided with a heating system. If the machinery and electrical devices require a warm room or operation centre these must be provided with effective heating facilities.

Information about the attitude of the gate:
The user of the gate and the monitor of gate use must be fully informed about the attitude of the gate. If the gate is controlled remotely or by devices that monitor the water level its attitude shall be on display in the remote-control/monitoring room.

Warning devices:
If unexpected opening of the gate endangers human life, people shall be warned about the opening with a siren or the like.

4 WATER LEVEL MEASUREMENT
To monitor the water level of the dammed area, remote-controlled dams and dams at which the water level may change rapidly shall be provided with a reliable measuring system, a double one if necessary, that is functional under all weather conditions. Irrespective of any automation, the measuring data shall be transferred to the place where dam use is monitored and
where use of the gates is possible, if necessary. The system shall be provided with appropriate alarm devices.

5 EMERGENCY HOISTING SYSTEM

In addition to the hoisting system proper, the gate must have a separate emergency hoisting system with a hoisting time sufficiently short in relation to the time margin allowed by the dam. The time margin is the period during which malfunction or damage may develop into a dangerous situation, for example, the time during which water rises from HW to emergency HW. The time margin depends on the volume of the upper reservoir, the rate of influx and the discharge capacity available.

The emergency hoisting system shall be such that the gate can be opened even during a power failure or fire. If the emergency hoisting system is electrical, its cables and power source shall be separated from those of the hoisting system proper. The emergency hoisting system may also be a separate combustion engine-run electrical or hydraulic unit which can be readily connected to the gate system. Emergency hoist can also be accomplished with a truck or other crane if available quickly enough under all conditions.

6 USE AND MAINTENANCE INSTRUCTIONS

Use and maintenance instructions shall be drawn up for the gate and stored in an appropriate manner.

REFERENCES


APPENDIX 16. PRESENTATION OF FLOOD RESULTS OF A HAZARD RISK ASSESSMENT

The results of each flood case assessment, derived from either calculations or scale model tests, shall be presented on a map (1:20 000) and in tables listing water level and flow data at different stages of flood by cross-section.

Flood map

The map shall show:
- the path of the flood peak as a maximum water level contour
- the boundaries of the flooded area half an hour and two hours after the failure
- the locations and code numbers of the computed cross-sections
- the point of time of maximum water level at each cross-section in hours from the failure.

Tabulated flood data

The flood data on the calculated cross-sections should be presented in tables as follows:
- water level (W), discharge (Q) and flow velocity (v) at each cross-section at different moments during the flood
- a summary table giving for each cross-section:
  - the initial discharge (m$^3$/s) before the onset of the flood
  - maximum discharge (m$^3$/s)
  - the moment at which the maximum discharge occurred in hours from the failure
  - the initial water level (+m) before the flood
  - maximum water level (+m)
  - the moment at which the maximum water level was reached in hours from the failure
  - the difference between the maximum water level and the initial water level
  - maximum flow velocities (m/s).

The flood data tabulated as above should be appended to the flood map so that the flood data on each cross-section are easily readable.

Figure 1/16 gives an example of a flood map.
Figure 1/16. Flood map of a hazard risk assessment.
APPENDIX 17. ASSESSMENT OF IMPACT OF WASTE DAM FUNCTIONING AND FAILURE ON HEALTH AND THE ENVIRONMENT

1 GENERAL

1.1 Year in which basin filling started
1.2 Year in which filling was completed (if known)
1.3 Volume of basin (m$^3$)
1.4 Estimated maximum amount of waste in basin (m$^3$)
1.5 Amount of liquid waste as proportion of basin volume (%)  
1.6 Recycling of process water (%)
1.7 Is the basin under load or waterbody monitoring
   1.7.1 Amount and quality of outflow waste and seepage waters (an estimate or according to the annual summary of compulsory monitoring programme)
   1.7.2 Areas affected by waste and seepage waters and an estimate of the hazard risk to structures, health and the environment
   1.7.3 Measures and plans, if any, to prevent dangerous seepages (collecting and repumping systems)

2 TYPE OF WASTE IN BASIN

2.1 Substances harmful or dangerous to health and the environment in the impounded waste or waste water

<table>
<thead>
<tr>
<th>Harmful and dangerous substances</th>
<th>Mode of formation, e.g. process</th>
<th>Concentration and amount</th>
<th>Date and mode of disposal</th>
<th>Substances as proportion (%) of total to be washed into environment in dam failure</th>
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</table>
2.2 Danger of impounded substances to health and the environment
2.2.1 Possible health risks and toxicity to organisms (e.g. LC$_{50}$, LD$_{50}$, EC$_{50}$ and LOEC to different species, hazard risk classification according to chemicals legislation)
2.2.2 Migration and accumulation ability (e.g. Kow and BCF, solubility in water, adsorption properties)
2.2.3 Biological or abiotic decomposition/alteration (e.g. OECD or EU decomposition tests, BOD$_5$/COD ratio, hydrolytic decomposition)

2.3 Other substances in waste basin

2.4 Chemical and biological determinations of waste if the health and environment risks of the waste dam cannot be assessed otherwise
2.4.1 pH value
2.4.2 Electrical conductivity
2.4.3 Total nitrogen concentration
2.4.4 Total phosphorus concentration
2.4.5 Chemical oxygen demand (COD$_{cr}$)
2.4.6 Other determinations (e.g. direct toxicity to aquatic organisms)

3 ASSESSMENT OF DANGER CAUSED BY DAM FAILURE

If calculations or scale model tests have been made of the flood wave caused by failure of the waste dam, use must be made of the results
3.1 The area over which waste would spread in the event of failure and the objects at risk in this area are drawn on a basic map
3.2 The imminent danger to human life, health, the environment or property caused by dam failure or e.g. unpleasant smell or aesthetic nuisance
3.3 Health and environment risks due to long-term exposure to the harmful or dangerous substances that spread in the environment in connection with dam failure (effects on waterbodies and their catchment areas, groundwater and groundwater aquifers, surface and groundwater intake plants, household wells, settlements, agricultural and recreation areas, flora and fauna) (if there are several failure paths, each should be treated separately)

4 PRELIMINARY ACTIONS AND PREVENTIVE MEASURES TO PROTECT OBJECTS AT RISK IN THE EVENT OF FAILURE

The assessment may include
4.1 Information about ditches, landforms in the valley with which the waste can be stopped from spreading and from which it can be collected
4.2 Plans and materials for building temporary dams at suitable sites, or the closing of ditches with a dam to prevent the waste from spreading
4.3 Assessment of a need for a protective embankment around the objects at risk

5 OTHER ITEMS TO BE CONSIDERED
APPENDIX 18. SITE PLAN FOR A P DAM AND PRECAUTIONS AGAINST ACCIDENTS

1 OUTLINE AND DRAFTING OF A SITE PLAN

A site plan is drawn up jointly by a fire authority and the dam owner or holder and it shall be ready before implementation of the dam (Dam Safety Decree Section 5) i.e. before a start is made on raising the level of water or other impounded substance. The general outline of the site plan is as follows.

Components of site plan (DO = dam owner or holder, FA = fire authority)
1) Description of hazard risk (DO)
   • general description of dam and waterbody
   • examination of hazard risk assessment
2) Information about accident (DO and FA)
3) Measures applied to hydraulic structures and waterbody, and the repair of dam damages (DO)
4) Provision of personnel and equipment to forestall an accident
   • those of dam owner (DO)
   • others (FA)
5) Materials needed to forestall an accident (DO)
6) Other precautionary countermeasures taken (DO and FA)
7) Account of type and amount of the substance impounded by a waste dam and the hazard risk due to it (DO)
8) Rescue operations in the event of an accident (FA)

The following are appended to the site plan:
   • a diagram showing the alarm connections (FA)
     - alert of authorities
     - alert of population
   • personnel of the dam owner (DO)
   • equipment resources (DO and FA)
   • a map (1:20 000) of the dammed area and roads and of sites from which repair materials can be extracted (DO).

A site plan of this nature would contain the accounts and action plans referred to under Section 4 of the Dam Safety Decree. The original is held by the fire authority and a copy is kept in the dam safety file. The fire authority is also provided with an operative map of the results of the hazard risk assessment (cf. chapter 7).

The procedures defined in the site plan may be carried out as illustrated in Fig. 1/18. The contents of the site plan are described in detail in the following.

2 DESCRIPTION OF HAZARD RISK

The dam owner or holder draws up a brief general description of the dam and the associated waterbody at the beginning of the site plan. The description should be restricted to those items that must be known in the event of an accident.

This part includes the dam owner’s general description of the significant results of the hazard risk assessment.

3 HOW TO OBTAIN AND CHECK INFORMATION ABOUT AN ACCIDENT

Together with the fire authority the dam owner or holder shall ascertain how information about damage to a dam, an imminent risk of an accident or an accident can be expressed and how it will be conveyed to the fire authorities (regional alarm centre and fire brigades), to those responsible for water regulation (regional control centres and dam supervisors), the dam holder (responsible persons), regional environment centres, the major users of the water and waterbody (downstream water intake plants and dams), and the road and traffic control authorities (endangered bridges, the Finnish National Road Administration and the police).

In this context an explanation is given of the information that should be solicited from the people reporting the event and how it should be checked. The information should be presented in an alarm diagram, which may be append-
**Figure 1/18. Action required by the site plan.**
ed to the site plan (to facilitate updating of the data). The personnel responsible for dam maintenance shall be instructed about giving the alarm. In this respect the regional control centres, which are on round-the-clock duty, are in a key position.

4 MEASURES TO BE APPLIED TO THE WATERBODY AND HYDRAULIC STRUCTURES, AND THE REPAIR OF DAM DAMAGE

In the site plan the dam owner or holder shall set out the measures that, in the event of a dam failure or likely occurrence of one, can be taken forthwith to prevent or limit the damage that would otherwise result from the accident. Depending on the conditions, these measures include repair of the damaged dam or repair to prevent or slow down the spread of the damage, and adjustment of filling and discharge flow.

The site plan shall show whether water can be channelled elsewhere with emergency measures. Measures that change structures and the need for and consequences of them shall be listed. It must also be shown where and how emergency measures such as opening the dam, and closing or diverting a channel can be taken, and who is authorized to undertake these measures (Dam Safety Act Section 11). The equipment and materials required by the emergency measures and the expertise to use them and the training of rescue personnel in advance must also be defined.

It is imperative that the filling and discharge flow can be adjusted immediately the alarm is given. To this end, measures must be taken to ensure that those responsible for adjustments, such as a power plant, remote control centre (e.g. regional control centre) or the dam manager, can immediately be informed about the event by the regional alarm centre. The dam owner explains in advance how adjustments are made, and in his plan lists the adjustments to be made and the consequences to the waterbody of using adjustments differing from those in the permit. It shall also be shown which of the downstream waterbody regulating bodies shall be informed simultaneously about the accident and the adjustment measures they should take.

The dam owner shall also give preliminary instructions in the site plan about repairs to the dam. Dam damage can be temporarily repaired by:

- closing the breach part with blasted rock, sandbags or other heavy objects and materials transported to the site, or with materials taken from the dam crest close to the breach
- protecting the breach part with geotextiles or other fabrics preventing displacement of the materials piled up on top of it
- sealing the breach part by spreading tarpaulins and plastic sheeting over the wet slope of the dam
- closing the gates with stoplogs, needles, plates, etc., and
- reinforcing concrete or earth structures with toe weights and shoulders.

The initial repairs to a damaged dam may be urgent. In some cases the necessary speed can be achieved only with the aid of the fire authorities and their equipment. Therefore, the availability of appropriate equipment shall be taken into account in the site plan, and the fire brigade should be sufficiently instructed in emergency dam repair measures.

5 PERSONNEL AND EQUIPMENT NEEDED TO FORESTALL AN ACCIDENT

The dam owner or holder shall provide information about the personnel he has available, such as their number, their occupations and their work sites. The data on those responsible for the dam shall include their name, field of expertise, home address and alarm connections. To facilitate updating of the plan particulars likely to change should be given in appendices.

The dam owner or holder shall also ascer-
tain what machinery, e.g. excavators, bulldozers, wheel loaders, chassis, dump lorries, mobile cranes, and grouting equipment and materials, are required by the repairs in the preliminary instructions and what machinery he himself has. A record of the above machinery owned by outsiders is kept and updated by the fire authority with the assistance of the dam owner. To ease the updating, changing data should be given in an appendix.

6 MATERIALS NEEDED TO FORESTALL AN ACCIDENT

The dam owner of the holder shall make sure that blasted rock or natural boulders to be used in repairs are stored or otherwise available near the dam. The blasted rock storage or the boulder extraction site shall be so located that repairs can be started at any place on the dam crest within an hour from the beginning of loading.

The total volume of blasted rock or boulders shall be \( \geq 3H^3 \) (m\(^3\)), where \( H \) stands for the maximum height of the dam in metres. However, no more than 2000 bulk m\(^3\) need be reserved for the dams of one basin. The average size of the blasted rock shall be at least 0.1 m\(^3\) and that of the natural boulders at least 0.2 m\(^3\), with the maximum sizes of both not exceeding 1 m\(^3\), which is the size of a boulder that can be handled by a 10-t wheel loader.

If materials suitable for sealing (e.g. glacial till) are not available within the above transport distance from the dam, they, too, shall be stored in amounts corresponding to those of blasted rock. Information about the availability of gravel and sand shall be included in the site plan.

The site plan shall include a map of materials intended for accident prevention showing the extraction sites for blasted rock and glacial till. The map shall also show the roads and ascents along which the materials can be transported to the dam. In addition, the availability of other materials needed for repairs, such as geotextiles must also be established.

7 OTHER COUNTER-MEASURES IN THE EVENT OF A DAM BREACH

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

The need for such a system shall be ascertained by the fire authority, and the conclusion given in the site plan. Under the Fire and Rescue Services Act the fire authority can order the necessary equipment to be acquired.

If for some other reason it is unnecessary to establish an alarm system in the area in question (see the Ministry of the Interior directive of 30.4.1979 on local alarm systems, Publication of the Rescue Department, MI 5/1979), the dam owner must set up an alarm system. The alarm devices of the system must be such that, if necessary, they can be activated from the dam, an appropriate remote control centre and the regional alarm centre. Use can be made of the above Ministry of the Interior directive on local alarm systems when planning the alarm system. The function of the special alarm system shall be set out in the site plan.

8 AN ACCOUNT OF THE TYPE AND AMOUNT OF MATERIALS IMPOUNDED BY A WASTE DAM AND THE HAZARD RISK IT PRESENTS

The dam owner or holder shall assess the health and environmental effects of a waste dam failure and the measures needed to combat the danger. The items to be dealt with are detailed in Appendix 17 (cf. 7.1.4)
9 RESCUE OPERATIONS IN AN ACCIDENT

The fire authority draws up for the site plan his account of the rescue operations to be undertaken in an accident caused by a P dam. The account deals with the supplementary and special arrangements which the rescue operations may entail in a dam accident.

The special arrangements, to which reference shall be made in the basic plan of the rescue service at local authority level and, if necessary, also at cooperation area level, may be needed for:

- defining the duties of the authorities and bodies participating in the rescue service
- intermunicipal cooperation and assistance
- command in the event of an accident
- communications
- nursing and environmental health care
- service activities (meals, temporary accommodation, materials service, acquisition of service materials)
- alerting the population (warning, directing the move from the danger area and evacuation)
- providing information in an accident.

The above plans are drawn up in accordance with instructions from the Ministry of the Interior. The planning is based on the hazard risk assessments of a P dam or several successive P dams, which define the worst possible accident situation.

10 ADVANCE INFORMATION

The people subject to a hazard risk should be informed in advance about the compiled site plan and the possibility of the dam failure. The notification shall be compiled jointly by the fire authority, regional environment centre and the owner or holder of the dam and it shall be signed by the fire authority. The notification shall contain at least the following information:

- Name and location of dam.
- Contact information on the person responsible for the content of the notification.
- A statement that the dam is classified as a P dam. A dam is classified as a P dam if, in the event of an accident, it may manifestly endanger human life or health or manifestly seriously endanger the environment or property. (Dam Safety Act 1.6.1984/413, Dam Safety Code of Practice).
- Assurance that the dam is monitored constantly as stated in the safety monitoring programme approved by the regional environment centre on the basis of the Dam Safety Act.
- A general description of the type of dam hazard risk and possible effects of the hazard on the population and environment.
- Adequate information on how these people will be warned in the event of a hazard and how the information service will be run during the hazard.
- Adequate information on the measures these people should take in the event of a hazard and how they should behave.
- Information that a site plan has been compiled in the event of a dam hazard.
- A reference to the rescue plan drawn up by the municipal rescue authorities in the event of accidents. People should also be urged to follow the directives and appeals issued by the rescue service authorities in the event of an accident.
- Detailed instructions on where supplementary information is available.
APPENDIX 19. SUMMARY OF DAM SAFETY MEASURES

1 DESIGN
- under the direction and responsibility of a person with a sufficient competence and experience (chief designer)
- determination of dam class
- hydrological specifications
- hazard risk assessment if necessary
- structural design

2 CONSTRUCTION
- advance notification to the regional environment centre on the date construction is to begin
- good construction practice and quality control

3 COMMISSIONING INSPECTION
- starts with advance notification of the beginning of construction to the regional environment centre
- all items affecting dam safety are assessed
- at least one field inspection before starting to raise the water or other impounded materials
- final statement and proposal for dam qualification

4 SAFETY MONITORING PROGRAMME
- proposal in three copies to the regional environment centre, for a P dam 3 months and for other dams 2 months before the dam is taken into use
- monitoring proper
- annual and regular inspections
- the regional environment centre approves the monitoring programme
- for the monitoring programme of a P dam the regional environment centre acquires an expert opinion from the Finnish Environment Institute

5 DAM SAFETY FILE
- three copies of it are sent together with the proposed monitoring programme to the regional environment centre
- missing items are added to the file at the commissioning inspection
- the file is kept up-to-date by supplementing it at regular inspections and in special cases

6 PREVENTION OF AND PRECAUTIONS AGAINST A DAM ACCIDENT

A P dam (before starting to raise the water or other impounded materials):
- hazard risk assessment (dam owner or holder)
- other accounts and actions plans as stated in the Dam Safety Act Section 9 and the Dam Safety Decree Section 4 (dam owner or holder)
- site plan (fire authority and dam owner or holder)

DAM SAFETY AUTHORITIES

Ministry of Agriculture and Forestry:
- supreme supervision and guidance
- granting guidelines for dam safety

Regional environment centres
- official decisions
- supervision of observance of rules and regulations issued in and by virtue of the Dam Safety Act excluding the rescue service
Ministry of the Interior and its authorities (provincial governments and municipal fire authorities):

- rescue service
- compiling a site plan (fire authorities)

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- Expert opinions to regional environment centres on the safety monitoring programmes for P dams and hazard risk assessments
- development of dam safety and participation in preparation of the dam safety code of practice.
APPENDIX 20. CHECK LIST FOR DAM OWNER OR HOLDER

OLD DAM

- Let the person responsible for dam safety at the regional environment centre know when a regular inspection is to be held (6.3.2).
- For a P dam, let also the provincial government and fire authorities (regional fire commander, municipal fire authority) know when a regular inspection is to be held.
- Send the record of the regular inspection and changes in the dam safety file to the regional environment centre (two copies for P dam) and the record for a P dam also to the provincial government and fire authorities even if these parties did not participate in the inspection. The regional environment centre informs the Finnish Environment Institute about the date of the regular inspection whose expert may participate in the inspection of P dams and, if necessary, also in those of other dams.
- Do not inform the authorities about the annual inspection (6.3.1) nor send its record to them unless something unusual has happened.
- Inform the regional environment centre if there is a change of owner (holder), and for a P dam, also the provincial government and fire authorities.
- Transfer the dam documents to the new owner (holder).

NEW DAM

- Contact the regional environment centre at the planning phase so that all issues pertinent to dam safety can be taken into account.
- The regional environment centre may order the owner or holder of the dam to make a hazard risk assessment (section 7). Make sure that the hazard risk assessment is ready in time.
- Should the dam be classified as a P dam on the basis of the hazard risk assessment, make a site plan for accidents together with the fire authority (section 8, Appendix 18). The site plan shall be ready before the raising of water or other impounded material is started.
- Inform the regional environment centre about the beginning of construction well in advance so that the commissioning inspection can be started (section 5).
- The commissioning inspection entails at least one field inspection before the raising of water or other material is started.
- The same parties can participate in field inspections as in regular inspections (see OLD DAM).
- Send a preliminary safety monitoring programme (section 6) in three copies to the regional environment centre so that it can be approved before dam impounding. At the same time send three copies of the safety file to the regional environment centre (section 4). The file, which includes the monitoring programme, shall be sent such as it is at the time of sending.
- Add any missing items to the safety file at the closing of the commissioning inspection (sections 4 and 5).

DAM REPAIR AND ALTERATION WORKS AND A COFFERDAM

- Contact the regional environment centre well in advance before starting the work so that any dam safety measures that may be needed can be evaluated.
PLANNING, CONSTRUCTION AND INSPECTIONS

- Use experts in planning and in commissioning and regular inspections.
- Make sure that those undertaking construction, repair and alteration works are sufficiently competent and experienced.
- In unclear cases the regional environment centre will offer its help in assessing competence.
APPENDIX 21. TERMS WITH EXPLANATIONS

DOCUMENTS

Completion documents
Needed in dam maintenance and for assessing the dam qualification, the completion documents of a dam listed in Appendix 3 are the key design and construction documents.

Safety file, DSA Section 5 and DSD Section 2
The dam safety file is a collection of documents which should contain all the material significant for dam safety defined in DSD Section 2.

Safety monitoring programme, DSA Sections 6-7
The dam safety monitoring programme states how all issues pertinent to dam safety should be monitored and regularly inspected.

Hazard risk assessment, DSA Section 9 Paragraphs 1 and 3
The hazard risk assessment is an estimate of the hazard risk that the dam may pose in an accident, particularly to the people and property in the downstream area. The regional environment centre may, if the need arises, order the body who has had the dam constructed or the dam owner or holder to acquire or draw up a hazard risk assessment.

Results of hazard risk assessment, DSA Section 9 Paragraph 1
The results of the hazard risk assessment, which summarize the damage, its extent and timetable, are the basis for the site plan drawn up by the fire authority. The results shall be sent to the regional environment centre, provincial government, regional fire commander and municipal fire authority by the body which has had the dam constructed or the dam owner or holder who has acquired the assessment.

The dam owner’s or holder’s accounts and action plans in the event of an accident, DSA Section 9 Paragraph 2 and DSD Section 4
The accounts and plans of the dam owner or holder as listed in DSA Section 4 form the basis of the fire authority’s site plan.

Coordination plan (of the fire and rescue service), Fire and Rescue Services Act Section 7, Fire and Rescue Services Decree Section 6 and DSA Section 9 Paragraph 2
In a municipality the fire chief shall draw up a comprehensive operational plan which includes the general principles for operations in different accidents and basic information about the objects at special risk. The provincial government, in cooperation with the municipal authorities, shall draft a plan for assistance and other joint action within the cooperation region including the capability of other authorities, bodies and private citizens to participate in the fire-fighting and rescue operations. The dams referred to in DSA Section 9 Paragraph 2 are taken into account as hazard objects in the coordination plans of the local authorities and cooperation regions.

Site plan, Fire and Rescue Services Decree Section 6 and DSA Section 9 Paragraph 2
A site plan is drawn up as part of the coordination plan under the direction of the fire authority for the dam hazard referred to in DSA Section 9 Paragraph 2, on the basis of the accounts and plans of the dam owner or holder referred to in DSA Section 9 and the DSD Section 4.
HYDROLOGICAL TERMS

High water level, HW
High water level is the maximum water level during a certain period. As a rule, it is the HW during 24 h (either the daily average or that recorded once a day). In addition to the water level data, the period should also be given during which the data were collected and on which the water level value is based, e.g. 87.50 m (1960-1980).

Low water level, NW
Low water level is the minimum water level during a certain period. In general it refers to the NW recorded during 24 h. In addition to the water level data, the period should also be given during which the data were collected and on which the water level value is based, e.g. 86.50 m (1960-1980).

Emergency high water level, emergency HW
Emergency high water level is the water level which, when exceeded, may cause changes in dam structures.

Technical low water level, tech. NW
Technical low water level is the lowest possible water level structurally allowed by spillways, syphons or natural sills.

Maximum discharge, HQ
Maximum discharge is the highest discharge during a given period. As a rule, it refers to the discharge during 24 h, but e.g. HQ (5 d) is the highest value of the mean discharge of five consecutive days.

In addition to the discharge data the period should also be given during which the data were collected and on which the maximum discharge value is based, e.g. 150 m³/s (1960-1980). If the part of the waterbody under consideration is a lake or other basin smoothing the flow peaks, the terms HQ (inflow) and HQ (outflow) are used with reference to the maximum discharge entering or leaving the basin, respectively.

Hydrograph
The hydrograph is a time curve of the discharge, i.e. a curve that illustrates the discharge on consecutive days, usually during flood peaks.

Return period, frequency, 1/Tr
Return period is a statistical term and means the period during which a given HQ value is exceeded once on average. For example “HQ (1/1000) is 200 m³/s” means that a maximum discharge with a rate of at least 200 m³/s will occur, on average, once in 1000 years.

Design flood
Design flood is an inflow hydrograph corresponding to the return period chosen on the basis of the dam properties and safety classification, i.e. the time curve of the inflow.

Design high water level
Design high water level is the maximum water level that occurs during the design flood, when the total discharge capacity of the dam is in use, excluding the flow through the power plant machinery.

Design outflow
Design outflow is the hydrograph of the dam outflow calculated from the design flood, the storage volume of the basin and the discharge capacity of spillways, with the initial water level value determined by the mode of use of the dam.

STRUCTURAL TERMS

Height of dam, DSD Section 1
The height of a dam is the difference in height between the lowest point of the external boundary of the dam structure and the highest intended surface for the impounded substance. The height of a submerged dam is calculated as the
difference in height between the lowest point of the external boundary of the dam structure and the dam crest.

**Submerged dam**
A submerged dam is a dam with water flowing over its crest.

**Waste dam**
A waste dam is a dam impounding waste.

**Freeboard**
Freeboard is the height difference between the HW level of the impounded substance and the dam crest.

**Safety margin**
The safety margin of a dam is the height difference between the top of the core and the HW level.

### DAM CLASSIFICATION TERMS

**P dam**
A dam is classified as a P dam if, in the event of an accident, it may manifestly endanger human life or health or manifestly seriously endanger the environment or property. A P dam may be less than three metres high.

**N dam**
A dam is classified as an N dam if, in the event of an accident, it constitutes a smaller risk than a P dam, but nevertheless cannot be considered an O dam.

**O dam**
A dam that in the event of an accident constitutes only a minor hazard risk is classified as an O dam. A dam can be considered to constitute only a minor risk if, in the event of an accident, it quite manifestly cannot endanger human life or health or, minor damage excluded, the environment or the property of another.

**T dam**
A temporary dam or cofferdam, is classified as a T dam.

### SAFETY MONITORING TERMS

**Commissioning inspection**
The commissioning inspection examines the qualification of a dam in terms of dam safety. The inspection may be undertaken in several steps.

**Regular inspection**
Regular inspections are made of the P, N and O dams subject to DSA provisions at least once every five years. Changes in the state of the dam, and changes in conditions affecting the stability of the dam are then examined on the basis of monitoring, field inspections and completion data. Regular inspections also check the functionality of the site plan.

**Annual inspection**
Annual inspections are made of dams subject to DSA provisions once a year. It is then checked that there have been no changes to the state or functioning of the structures and facilities.

**Monitoring**
Monitoring is the continuous surveillance of the dam at regular intervals.

**Approval of the dam safety monitoring programme, DSA Section 7 and DSD Section 3**
The regional environment centre approves the monitoring programme or its amendments. The monitoring programme shall be sent to the regional environment centre not later than two months before the dam is taken into use, that of
P dams, however, not later than 3 months beforehand.

**MISCELLANEOUS**

**Time margin**

The time margin is the period during which a disturbance or damage may develop into a dangerous situation.

**Dam accident, DSA Section 3 Paragraph 1, DSA Section 9 Paragraph 2**

A dam accident is an event in which the dam or auxiliary facilities are damaged or subject to failure to such an extent that the impounded substance is discharged or liable to be immediately discharged.

Dam terms and definitions are dealt with in greater detail in the Technical Dictionary on Dams published by ICOLD and in the relevant literature.
DAM SAFETY ACT AND
DECREE

_Dam Safety Act 1.6.1984/413_

**Section 1**

With a view to securing and increasing safety, the provisions of this Act shall apply to the building and use of a dam.

**Section 2**

By a dam this Act means a dam intended for permanent use with the associated structures and facilities regardless of the construction materials or methods or the type of substance impounded in the basin.

**Section 3**

This Act shall be applied to a dam not less than three metres high. The Act shall, however, also be applied to a lower dam, if the volume of the substance in the basin impounded by the dam is so large or if the substance in the basin is of such a type that in the event of an accident it manifestly endangers human life or health or manifestly seriously endangers the environment or property.

This Act shall not, however, refer to dams subject to the provisions of the Mining Act (503/65) or to a canal structure as referred to in the Decree on Canal Structures (157/63).

This Act concerns cofferdams as applicable. For these dams there is no need to compile and store the safety file referred to under Section 5.

**Section 4**

The construction of a dam shall be carried out such that in structure and strength it meets the requirements that a safety risk shall not arise from either the dam itself or its use.

The owner of a dam shall be obliged to keep the dam in a condition such that it is safe and it will not cause a hazard or have damaging or harmful effects on public or private interest.

**Section 5**

The dam owner or holder shall store documents relevant to dam safety in a special safety file.

The dam safety file shall be kept in a place where, if there is a threat of an accident, it is readily accessible to those concerned and can be inspected by the supervisory authorities when necessary.

More detailed provisions on compiling the safety file, on updating it to correspond to changes in circumstances, and on acquiring and compiling the supplementary data considered necessary will be issued by decree.

**Section 6**

To reduce the risk of damage from a dam a safety monitoring programme shall be drafted for each dam referred to in this Act.

The dam safety monitoring programme shall be drafted by the dam owner or holder. The programme shall be drafted in such a manner that all the issues relevant to dam safety shall be subjected to surveillance and inspection.

The programme may include rules concerning the monitoring proper and the inspections made at regular intervals.

**Section 7**

The approval of the safety monitoring programme or its amendments shall be decided by the regional environment centre as provided by decree.

The Ministry of Agriculture and Forestry may issue further instructions about the compiling of the monitoring programme. The regional environment centre may, for a special reason, grant complete or partial exemption from the monitoring obligation laid down under Section 6. (24.1.1995/90)
Appropriate records shall be kept of the monitoring and inspections referred to in the programme and they, as well as the monitoring programme, shall be kept in the safety file referred to under Section 5.

Section 8
The provisions of Section 28 of the Fire and Rescue Services Act (559/75) apply to the obligation to report and to act if a dam accident occurs or is imminent.

Section 9
To determine and assess the risk arising from a dam the regional environment centre may order, whenever so required, the party having the dam constructed or the dam owner or holder to acquire or draft an assessment of the risk posed by the dam to the downstream population and property in particular (hazard risk assessment) and to communicate the findings of the assessment to the regional environment centre, the provincial government, the regional fire commander and the municipal fire authority.

A dam referred to in this Act that in the event of an accident may manifestly endanger human life or health or manifestly seriously endanger the environment or property shall be included as a risk site in the coordination plan referred to in the Fire and Rescue Services Act. The dam owner or holder shall be obliged to assist the fire authorities in drawing up the plan, to draft the relevant assessments and necessary action plans for his part, and to acquire and maintain the facilities and materials referred to in the action plan and to take other measures to safeguard people and property against the risk posed by the dam and to participate in the implementation of the action plan.

The Ministry of Agriculture and Forestry may issue more detailed instructions for the drafting of the hazard risk assessment referred to in Paragraph 1 and for compiling the assessments and action plans referred to in Paragraph 2. (24.1.1995/90)

Section 10
Supervision of this Act and the rules and regulations issued by virtue of it, with the exception of the rescue service, shall be the responsibility of the regional environment centres and the supreme supervision and guidance that of the Ministry of Agriculture and Forestry. (24.1.1995/90)

Section 11
In the event of non-compliance with the provisions of Sections 4 and 5 or the regulations issued by virtue of them, measures shall be taken as applicable as stated in the Water Act (264/61) Chapter 21 Section 2, Section 3 Paragraphs 1 and 2, and Section 4.

If a dam or its use, which clearly takes place in violation of this Act or the provisions of the Water Act or regulations issued by virtue of them, directly endangers public safety, the provisions of Chapter 21 Section 3 Paragraph 3 shall be observed as applicable. However, in addition to the provincial government and police authority the regional environment centre may take the necessary measures (24.1.1995/90).

Section 12
The punishment for damaging the environment contrary to this Act or rules or regulations issued by virtue of it shall be as stated in the Penal Code Chapter 48 Sections 1-4.

The punishment for destruction, serious destruction, causing general danger or serious general danger by bringing about a flood is as prescribed in the Penal Code Chapter 34 Sections 1, 3, 7 and 8. (21.4.1995/596)

Section 13
A person who violates this Act or the rules or regulations issued by virtue of it in cases other than those referred to under Section 12 shall be sentenced to a fine for a dam safety offence unless a more severe punishment is prescribed elsewhere in law. (21.4.1995/596)

Section 14
More detailed provisions on the implementation and application of this Act will be issued by decree.
Section 15

This Act will come into force on August 1, 1984. Actions can be taken to implement this Act before it comes into force.

**Dam Safety Decree 27.7.1984/574**

On the submission of the Minister of Agriculture and Forestry, the following is enacted under Sections 5, 7 and 14 of the Dam Safety Act issued on 1.6.1984(413/84):

Section 1

The height of a dam referred to under Section 3 of the Dam Safety Act (413/84) shall be the difference in height between the lowest point of the external boundary of the dam structure and the highest intended surface for the impounded substance.

For a submerged dam the height shall be, contrary to Paragraph 1, the difference in height between the lowest point of the external boundary of the dam structure and the dam crest.

Section 2

The safety file referred to under Section 5 of the Dam Safety Act shall contain to the extent required by circumstances the following documents:

1) an account of the main dimensions of the dam and dammed area and the hydrological parameters used in planning;
2) a map of the area affected by the dam, the location drawing of the dam, and drawings and documents of the dam structure in so far as they are needed to assess dam safety;
3) the safety monitoring programme with the amendments referred to under Sections 6 and 7 of the Dam Safety Act;
4) the monitoring and inspection records;
5) the letters from the authorities required to be included in the file; and
6) the assessments and action plans referred to under Section 9 of the Dam Safety Act as prescribed under Section 4.

Section 3

The safety monitoring programme referred to under Sections 6 and 7 of the Dam Safety Act shall be drawn up in good time before completion of the dam so that it can be approved for observation before the dam is brought into use.

The safety monitoring programme of a dam referred to under Section 9 Paragraph 2 of the Dam Safety Act shall be approved by the regional environment centre after having acquired an expert opinion on it from the Finnish Environment Institute. The safety monitoring programme of other dams and cofferdams shall be approved by the regional environment centre.

The proposal for a safety monitoring programme of a dam shall be submitted to the regional environment centre. (24.1.1995/91)

Section 4

The assessments and action plans referred to under Section 9 Paragraph 2 of the Dam Safety Act shall contain to the extent dictated by circumstances:

1) a plan of measures to be taken with regard to the waterbody and hydraulic structures in the event of an accident;
2) an account of the materials to be reserved in advance to forestall an accident;
3) a description of the manner in which the regional alarm will be given and communication will be maintained with the regional alarm centre;
4) information about the personnel of the dam owner or holder available to prevent the damage in the event of an accident;
5) an account of other measures of the dam owner or holder necessary to protect people and property in the event of an accident caused by the damming; and
6) in respect of waste dams, a description of the type and quantity of the impounded substance.

Copies of the documents containing the action plans and assessments referred to under Paragraph 1 shall be kept in the safety file of the dam in question.
Section 5

The assessments and action plans referred to under Section 9 of the Dam Safety Act concerning dams that will be brought into use after the said Act has come into force shall be compiled so that they can be included in the coordination plan referred to under the Fire and Rescue Services Act before the dam is brought into use. The regional environment centre shall acquire an expert opinion on the hazard risk assessment referred to in the Dam Safety Act Section 9 Paragraph 1 from the Finnish Environment Institute. If the regional environment centre considers the dam as one referred to under Section 9 Paragraph 2 of the Dam Safety Act it shall inform the provincial government thereof. Likewise, the regional environment centre shall inform the provincial government if a dam, which was not previously considered as one referred to under Section 9 Paragraph 2 of the Dam Safety Act is regarded as such due to changes in conditions or for some other reason. (24.1.1995/91)

Section 5 a

The duty of the Finnish Environment Institute is to develop dam safety and participate in the preparation of the code of practice of the Ministry of Agriculture and Forestry issued by virtue of the Dam Safety Act. (24.1.1995/91)

Section 6

This Decree will come into force on August 1, 1984.

WATER ACT AND DECREE

At least the following parts of the Water Act and Decree apply to dam safety.

Water Act 19.5.1961/264

Chapter A

General provisions concerning construction in a waterbody

Construction and the conditions for it

Section 1

Unless separate provisions have been enacted for a certain measure, the provisions in this chapter concern the constructing of a fixed or non-fixed structure or building or other structure such as a dam, embankment, bridge, cable, transport facility or jetty in a waterbody or across it, cleaning, pile driving or filling in the waterbody, excavating a new channel and other similar activities as well as the measures referred to under Chapter 1 Section 15. (30.4.1987/467)

Construction includes construction on land that may cause a change in the water flow or water level of the waterbody.

Section 3

The construction work shall be done in such a manner that the strength of the structure meets reasonable requirements.

Beginning the construction work and changing the permit terms

Section 28

Should compliance with the stipulations in the permit granted under this Act cause inconvenience due to a change in conditions, these stipulations can be amended if application is made by the party suffering the inconvenience or, if the inconvenience is against the public interest, if the application is made by the appropriate authority irrespective of the time stat-
ed in Section 27 of this chapter, provided the amendment will not markedly diminish the profit to be obtained from construction. The assignee of the permit shall not be entitled to compensation from the applicant either for a loss of benefit caused by the amendment or for the expenses, should they be of a minor nature.

Should the amendment to the permit referred to in this section or the granting of new stipulations be necessary for reasons of safety, the stipulations can be amended or new stipulations can be issued irrespective of the change in conditions, otherwise observing the provisions of Paragraph 1. (1.6.1984/414)

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Chapter 12

Miscellaneous provisions

Section 17

The owner of a plant or structure, organizer of timber floating and the relevant government authority have the right to blast ice taking due precautions, install provisional booms or undertake other necessary measures to prevent damage or harm caused by freezing or ice. If an ice obstacle is removed by blasting, it must be done without unnecessarily cutting a public winter road or one in public use unless compelling reasons so require, or significantly damaging the fish stock.

Before the blasting referred to in Paragraph 1, the appropriate police authority and the regional environment centre shall be informed of the procedure. (24.1.1995/79)

Section 19

When exceptional natural conditions or other force majeure give rise to flood or other changes in a waterbody or its water conditions that may cause general danger to human life or health or great damage to private or public welfare the Water Court can, on application of the regional environment centre, the provisions of Section 1 of this Act and any permit decisions notwithstanding, order necessary temporary measures to be taken to eliminate or alleviate damages (hazard preventive measures). The regional environment centre is permitted to submit the above application after having received the approval of the Ministry of Agriculture and Forestry. (24.1.1995/79)

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Chapter 13

Penal provisions

Section 4

A person who neglects either deliberately or through carelessness his obligation based on this Act or a provision issued by virtue of it to main-
tain a dam or other structure in a waterbody, an embankment, channel, canal or waterway constructed within or without a waterbody or a facility, ditch, flume or sewer associated with hydrological conditioning or regulation of water flow in a waterbody shall be sentenced to a fine for violating the maintenance provisions of the Water Act unless a more severe punishment is prescribed elsewhere in law. (21.4.1995/697)

Chapter 21

Special provisions

Section 1

The general supervision of the observance of this Act and the rules and regulations issued by virtue of it shall be the duty of the regional environment centres (legality control). The Ministry of the Environment may issue general regulations and guidelines to the regional environment centre concerning the legal control. (24.1.1995/79)

(The local water board) shall act as the local supervisory authority, as provided in Chapter 20 Sections 3 and 8.

Punishable acts shall be dealt with by the police authority and the public prosecutor as part of their regular duties.

(The local water board) has been replaced by the environmental protection board.

Section 2

If the supervisory authority referred to under Section 1 of this chapter finds that the provisions of this Act or regulations issued by virtue of them within his area of competence are not observed, the authority shall, if the public good so requires or if so informed by the interested party, inform the public prosecutor or take other measures to rectify what has been done illegally or neglected.

On his own initiative or at the request of the Water Court the supervisory authority shall be entitled to inspect facilities, buildings and other structures and to undertake the necessary investigations within his area.

The inspections and investigations referred to above under Paragraph 2 shall be made, if possible, without causing inconvenience to the owner of the facility or structure or disturbing the activity of the enterprise and without betraying any business or professional secrets.

Section 3

If a person makes an attempt or undertakes a measure contrary to the provisions of this Act or regulations issued by virtue of them or the rules of the corporations referred to in this Act or neglects his obligations as stated in the Act or in the said provisions or rules or otherwise disregards the Act the Water Court may, on the notification of an authority or on application by the party whose right or interest it concerns, after the party in question has been given the opportunity to provide an explanation, by imposing the threat of a fine or by threatening that what has been neglected will be done at the expense of the defaulting party, order that what has been done illegally or neglected shall be rectified. A supervisory authority or other interested party can be authorized to undertake the necessary action.

Application for a change to the Water Court judgement in a matter referred to in Paragraph 1 shall be made to the Supreme Water Court as prescribed in Chapter 17 Section 1. The Water Court may, on special grounds and despite appeal, order the decision to be enforced. Once an appeal has been made, the Supreme Water Court may correspondingly order that the decision subject to appeal be enforced before the matter is resolved. The Supreme Water Court may also ordain the enforcement order to have expired. (5.4.1991/629)

If the above measure or default may manifestly endanger the life, health or property of the other party or the public interest, the provincial government or the police authority shall be empowered to take the necessary measures to eliminate the danger. The decision of the provincial government cannot be appealed. However, the party against which the measures have been taken may on application appeal to the Water Court as stated under paragraph 1.
If the maintenance obligation of a structure referred to in Chapter 2 Section 31 Paragraph 1 is neglected, and the owner of the structure or the party responsible for it cannot be identified without difficulty, the Water Court may on application entitle the supervisory authority referred to under Section 1 to take the necessary steps to eliminate the inconvenience or danger at the expense of the State. The provisions concerning application shall apply concerning the handling of the matter, however, for the enforcement the provisions concerning executive assistance in Paragraph 2 shall apply. (5.4.1991/629)

Separate provisions have been enacted concerning the competence of police authorities to prevent crimes and to prosecute for them. (1.6.1984/414)

**Section 4**

That which is provided in Section 17 of the Act on the conditional imposition of a fine applies to the payment and collection of the costs due to an authority who has obtained the right to order something to be done at the defaulter’s expense under Section 3. If the above right to order has been given to an environmental protection board the said section shall, however, be applied as in a case in which the decision about the order has been made by a municipal authority. If the right to order has been granted to a private person the section shall be applied to the collection of the costs (20.7.1992/646).

In the cases referred to above under Section 3 Paragraph 4 the Water Court can, on application by the supervisory authority, order the expenses borne by the State to be recovered fully or partly from the party defaulting on maintenance if he has later been identified. (1.6.1984/414)
16 shall be informed before the measure starts. The notification shall contain a description of the measure and its impact on waterbodies and where and when the measure is to begin.

When a permit to construct a dam referred to in the Dam Safety Act (413/84) has been obtained, the regional environment centre and the local environmental protection board shall be informed of the start of construction and commissioning of such a dam at least one month beforehand. (24.1.1995/80)

FIRE AND RESCUE SERVICES ACT AND DECREE

At least the following parts of the Fire and Rescue Services Act and Decree shall apply to dam safety.

Fire and rescue services act 4.7.1975/559

Chapter 1

Fire and Rescue Services

Section 1

That which is provided and stipulated in this Act and by virtue of it shall apply to fire and rescue services.

Fire services entail fire prevention intended to prevent an outbreak of fire or to facilitate extinguishing or containing the fire, combating the danger caused by the fire, and fire-fighting and other measures called for by the fire.

Under this Act rescue services entail the measures necessary to save the victims and to prevent or contain the damage due to an accident caused by an explosion, oil hazard, landslide, traffic accident, gas or liquid leak, flood, heavy rainfall or comparable hazards or natural disasters, which can be appropriately undertaken by the fire service authorities.

Furthermore, the provisions enacted separately in the Prevention of Oil Hazards in Vessels Act (668/72) and the Prevention of Oil Hazards on Land Act (378/74) shall be observed.

Section 2

The fire and rescue services shall be planned and implemented so that the appropriate measures can be undertaken immediately and effectively under the conditions in which they are needed.

Chapter 2

Administration

Section 3

The supreme command, control and supervision of the fire and rescue services rests with the Ministry of the Interior. For this purpose the Ministry has a department whose area of competence also includes other tasks handled by the Ministry.

Section 6

The country shall be divided into alarm areas to receive emergency reports and to give the alarm. The division shall be decided by the Ministry of the Interior. The alarm areas shall be defined so that all parts of the area can make contact with the regional alarm centre at any time of the day or night. The Ministry of the Interior shall define the location of the regional alarm centre. The function of the regional alarm centre is to act as general emergency report centre. (8.4.1983/355)

The local authorities in the alarm area shall see to it that the regional alarm centre is built and maintained. If the local authorities are not unanimous about this issue or the sharing of costs for establishing and maintaining a regional alarm centre, the issue shall be decided by the provincial government.

Section 7

The fire and rescue services within a province are controlled and supervised by the appropriate provincial government. The provinces are
divided into fire and rescue service cooperation regions is such a manner that the division follows in so far as is possible the alarm area division referred to under Section 6. The division shall be confirmed by the Ministry of the Interior.

The provincial government together with the local authorities shall draft plans for giving help and for other cooperation in fire and rescue services within the cooperation region (a coordination plan).

The coordination plan shall include, to the extent found necessary, orders concerning cooperation with a local authority in another cooperation region or even in another province.

The provincial government shall appoint the regional fire commander of the cooperation region from among the fire chiefs of the local authorities in the region, and one or more deputies as needed from the full-time officers of the fire brigades within the region to draft the coordination plan and command the fire and rescue services. If necessary, more detailed provisions on the duties of the regional fire commander will be issued by decree. (29.12.1989/1338)

Chapter 3

Fire brigades, cooperation between them and other cooperation

Section 19

State authorities and agencies are obliged to give executive assistance to the fire authorities in the fire and rescue services referred to in this Act. The procedure to be followed for requesting and giving executive assistance shall be stipulated by the Council of State if necessary.

Chapter 4

Fire prevention

Section 21 (8.4.1983/355)

The Ministry of the Interior may issue regulations concerning arrangements to improve fire and personal safety at fair, exhibition, entertainment, camp-sites, camping grounds, holiday camps and other like areas and on furnishing and decorating buildings, structures, flats or spaces susceptible to fire hazards or posing a danger to personal safety.

The Ministry of the Interior, and for a single object, the municipal fire authority, may order the owner or holder of a building, structure or flat, and of storage, transport and other areas dangerous in terms of fire and personal safety to be obliged to acquire and maintain appropriate fire-fighting equipment and other contrivances that facilitate rescue to an extent considered reasonable under prevailing conditions and in regard to the fire risk and to take other necessary precautionary measures to protect people and property in the event of an accident. (29.12.1989/1338)

Chapter 5

Fire-fighting and rescue operations

Section 28

A person who sees or is informed that a fire has broken out or that another accident has happened or is liable to happen and cannot immediately extinguish the fire or prevent the danger shall be obliged immediately to inform those in danger about it, to make a fire or accident report and to undertake fire-fighting and rescue measures in so far as he is able.

Section 29

The fire-fighting and rescue operations shall be under the command of the fire authority of the municipality within which the fire broke out or other accident happened, unless provided or stipulated otherwise.

A provincial government or the Ministry of the Interior may order their appropriate official or other State authority or a municipal fire authority to command the fire-fighting and rescue operations, whenever the fire or other accident is one of those referred to under section 18, paragraph 2. A provincial government or the Ministry of the Interior may also invite ex-
Section 30
To extinguish a fire and to prevent its spread and in other accidents referred to in this Act the authority in charge of operations has the right to evacuate people, animals and properties and to order buildings, stores and other properties to be demolished, doors to be broken open, fences to be removed, earth to be dug up, gravel, sand or earth to be extracted, ditches to be filled, trees to be felled, backfires to be lit and any other appropriate measures to be taken.

To extinguish a fire everyone shall be allowed to take water from a well or source of water belonging to another.

A person who, by reason of his position or for another reason, ends up in charge of the operation can use the power of an authority in charge of fire-fighting and rescue operations to the extent dictated by the situation until the authority has assumed command.

Fire and Rescue Services Decree 31.12.1975/1089

Chapter 2
Planning and development of fire and rescue services

Section 9
The coordination plan shall determine:

1) the personnel and equipment of the fire brigades in the region;
2) the personnel and equipment, other than those referred to under Subparagraph 1, of the local authorities in the region and of the State authorities and agencies and corporations that can be used in fire-fighting and rescue operations;
3) the availability of water for extinguishing and other fire-fighting and fire-prevention materials;
4) any privately owned equipment appropriate for fire-fighting and rescue operations and the operational personnel;
5) objects which the coordination may concern in particular and the type and amount of help then needed;
6) organization of first aid, ambulance services and other care; and
7) the procedure used in requesting, alerting and giving help.

To plan the coordination the provincial government shall appoint a management group for each cooperation region, whose chairman is the appropriate regional fire commander. The duty of the regional fire commander shall be to command the fire-fighting and rescue operations in the situations referred to under Section 18 Paragraph 2 of the Fire and Rescue Services Act. The Ministry of the Interior shall issue further instructions concerning the composition and duties of the management group.

Chapter 3
Alarm centres and alarm service

Section 12
In addition to what is provided under Section 6 Paragraph 1 of the Fire and Rescue Services Act the regional alarm centre shall, if necessary, act as a communication and command centre for fire-fighting and rescue operations, rescue work and civil defence.

If necessary the regional alarm centre shall also see to warning the population about accidents or other hazardous situations.

An officer of the fire brigade in the municipality in which the regional alarm centre is located shall be appointed head of the said centre, unless the duty is otherwise prescribe the service regulations.
Chapter 5

Fire prevention

Section 24

The fire chief may order the owner or holder of a facility or store posing a special fire, explosion, gas or other risk to be obliged to draft a report on the precautionary measures referred to under Section 21 Paragraph 2 of the Fire and Rescue Services Act necessary for saving personnel, customers and property, extinguishing the fire, calling for help and preventing danger.

What is provided in Paragraph 1 refers as applicable to hospitals, nursing and care institutions, hotels, department stores, supermarkets and other like facilities.

The personnel shall be informed about the plan.
Abstract

The Dam Safety Code of Practice should be observed in the enforcement and supervision of the Dam Safety Act (413/84) and the Dam Safety Decree (574/84). This code issued by the Ministry of Agriculture and Forestry will replace the Dam Safety Code of Practice issued by the National Board of Waters and the Environment on 12.6.1991 (Publications of the Water and Environment Administration - Series B 9e). The code was edited by the Finnish Environment Institute.

The Code classifies dams into categories on the basis of the risk they present in the event of an accident (P, N and O dams) or their temporary nature (cofferdams). The code also deals with the planning and construction of dams. The owner or holder of any dam subject to the dam safety legislation (in the case of cofferdams only those that can be correlated with P dams in risk) must devise a safety monitoring programme, which will be approved by the regional environment centre. The programme may contain regulations concerning the monitoring proper and regular inspections (annual and regular inspections). The qualification of a dam is verified at the commissioning inspection, in addition to which at least one field inspection is held before starting to raise the water or any other material to be impounded. The dam owner or holder shall keep the material pertinent to the safety of the dam in a special safety file.

To assess the hazard risk of a dam the regional environment centre may order the party which has the dam constructed, or the dam owner or holder to draft a hazard risk assessment. The drafting of this assessment is dealt with in the Dam Safety Code of Practice. For P dams a site plan taking different potential accidents into account should be drawn up jointly by the dam owner or holder and the rescue authorities.

Keywords
Dams, waste dams, safety, code of practice, monitoring programmes, safety files, commissioning inspection, hazard risk assessment, accidents

Other information

The Regulation Collection of the Ministry of Agriculture and Forestry no. 84/97
Tekijä(t) (toimielimestä: nimi, puheenjohtaja, sihteeri)

Julkaisun nimi
Dam Safety Code of Practice
Patoturvallisuusohjeet

Tiivistelmä


Padosta aiheutuvan vahingonvaaran selvittämiseksi alueellinen ympäristökeskus voi määätä padon rakennutajan, omistajan tai haltijan laatimasta vahingonvaaran selvityksestä, jonka laatimista ohjeissa myös käsitetään. P-padolle on onnettomuusilanteiden varalta laadittava kohdesuunnitelma padon omistajan tai haltijan ja paloviranomaisen yhteistyönä.

Asiasanat (avainsanat)
padot, jätepadot, turvallisuus, ohjeet, tarkkailuohjelmat, turvallisuuskansiot, käyttöönottotarkastus, vahingonvaara,

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Referat

I anvisningarna behandlas klassificeringen av dammar på basis av den risk som en dammolycka försor sakar (P-, N- och O-dammar) eller dammens tillfällig karaktär (arbetsdammar), dammarnas planering och byggande. För varje damm som omfattas av dammsäkerhetslagen (av arbetsdammarna endast de som har liknande risker som P-dammar) bör dammens ägare eller innehavare göra upp ett säkerhetskontrollprogram, som godkänns av den regionala miljöcentralen. Programmet kan innehålla bestämmelser om både ordinarie kontroll och tidsbestämda granskningar (årsgranskningar och tidsbestämda granskningar). Dammens duglighet utreds vid ibruktagningskontrollen och åtminstone en fältgranskning ordnas innan man börjar höja vattnet eller annat uppdämbart ämne. Ägaren till eller innehavaren av en damm skall förvara med tanke på dammsäkerheten betydelsefullt material i en särskild säkerhetsmapp.

För att utreda skaderiskerna som en damm kan orsaka kan den regionala miljöcentralen bestämma att den som låter bygga, äger eller innehar en damm uppgör en riskutredning. I anvisningarna behandlas också uppgörandet av utredningen. För P-dammar bör man för eventuella olycksfall uppgöra en objektplan i samarbete med dammägaren eller innehavaren och brandmyndigheterna.

Sakord (nyckelord)
dammar, avfallsdammar, säkerhet, anvisningar, kontrollprogram, säkerhetsmappar, ibruktagningskontroll, riskutredning, olyckor

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