

FLOOD PROTECTION IN THE CZECH REPUBLIC AND INTERNATIONAL

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Abstract : Eight large floods occurred on the territory of the Czech Republic from 1997 and caused catastrophic impact (118 life losses, damages over 174 billion CZK). As the response to these circumstances the Strategy of flood protection for the territory of the Czech Republic was developed in 2000 and the prevention non-structural measures have been implemented- namely, the new specific legislation, the hydro-meteorological forecast was substantially improved and the information system on flow rates, precipitation and management of dam-reservoirs (available on web to public) has been introduced since 2000 year. In addition, programmes of subsidies were prepared for both – the flood damages rehabilitation and realisation of structural protection measures

As the water courses flow out of the territory of the Czech Republic, the effective international co-operation with the neighbouring countries has been developed for improvement of management of flood situations. In addition, the specific attention is paid to flood protection planning in the activities of the International Commissions for Protection of the River Elbe the River Oder and the River Danube, in which strategies were elaborated for systematic flood defence and the implementation of “flood directive” (2007/60/EC) started.

Overview and data on these activities as well as the Czech information system on flow rates (www.voda.gov.cz) are presented.

Keywords: large floods, prevention non-structural measures, dam-reservoirs, flood defence

Introduction

The territory of the Czech Republic was repeatedly hidden by large floods from 1997 – after the period of hundred years without floods occurrence. Some of these floods had catastrophic dimensions and caused large damages and, moreover, lost of lives – as indicates Tab. 1.

The activity for improvement of flood prevention and for realisation of flood protection measures started immediately. The “Strategy of protection against floods for the territory of the Czech Republic” was prepared and approved by the Czech Government (Res. No. 382 in 2000). This document formulates the activities for improvement of flood defence and it is accompanied by several programmes, which contain proposals of protection measures of both structural and non-structural character.

The hilly character of the territory causes very quick run-off of storm waters and, as the consequence, the time interval between the rainfall and development of flood waves is mostly a rather short. Thus, the high-tech meteorological forecasting has been of primarily importance as well as measures for retardation and accumulation of water in watersheds. The improvement of information transfer and their dissemination to the public using the mobile phones and internet are essential for prevention of lives and damages.

The new legislation for flood management and for rescue/crises management have been introduced in 2000 – 2001 years, too.

Several programmes for both rehabilitation of flood damages on water management infrastructure and realisation of measures for the effective flood defence were implemented using the subsidies from the state budget (supported by loans from the European Investment Bank and from the Solidarity Fund of the EC). In addition, outputs of several international projects have also been used for the strengthening of flood prevention in the Czech Republic. As practically all water

leaves the country to neighbouring countries, the development of active co-operation in flood prevention activities started using the existing international collaboration in international commissions for protection of the important European rivers as well as standard bi-lateral transboundary commissions established between the Czech Republic and neighbouring countries. The following text briefly summarizes the content of oral presentation at the Symposium.

Tab. 1

Flood in the year	Flood damages (mil. CZK)	Lost of lives
1997	62 600	60
1998	1 800	10
2000	3 800	2
2001	1 000	0
2002	75 100	19
2006	6 200	9
2009	8 500	15
2010	15 000	8
In total	174 000	123

1. The implementation of the Strategy of protection against floods for the territory of the Czech Republic

1.1. The improvement of legislation

Completely new legislation and several new acts were approved by the Czech Government and, consequently, by the Parliament during 2000 – 2001:

- Act No. 238/ 2000 Coll., on fire brigades
- Act No. 239/ 2000 Coll., on integrated rescue management
- Act No. 240/ 2000 Coll., on crisis management
- Water Act No. 254/ 2001 Coll., and its amendments (namely No. 20/2004 Coll., No. 181/ 2008 Coll., and No. 150/ 2010 Coll.)
- Decree on Flood Areas (No. 236/ 2002 Coll.)
- Status of Central Flood Commission (Res. Government No. 1059/ 2002 Coll.)

These legislation issues were applied for the floods occurred after the year 2000 and/or 2001 and 2002. The positive consequences can be seen on the range of damages and numbers of casualties (see Tab. 1).

The most important improvement of flood prevention activities follow from the establishment of “flood commissions” (local, district, regional and central levels). The commissions have their duties not only during the flood management, but – in particular – in the period without flood, which has to be understood as the “period before a next flood”. In this time a detail preparation of “flood plans” has to be made – on the level of municipalities and even for individual (physical) bodies and entities (when they are located in the flood areas).

Flood prone areas were identified (by the River Boards, state enterprises) along about 80% of lengths of important water courses. The advanced early warning systems (based on applications of the mathematical forecasting models) were developed at the Czech Hydrometeorological Institute and at the River Boards, s. e. The number of monitoring (gauge) stations substantially increased and

on line data transfer systems were introduced for the immediate transfer of information via internet/mobile (see article 1.3.). All these activities are essential for well prepared flood management and preparation of appropriate measures in regions of emergency. Similarly, the manipulation on the existing dam reservoirs (accumulation of flood waves, indication of free space, regulating of discharge in outflow) brings the positive effects for decrease of flood damages and it offers advantages in prolongation of the flood progress along the water courses. The information on these manipulations are continuously transferred to the internet (see 1.3.) This obviously increase the time for the preparation activities in towns, villages etc.

The close collaboration of flood commissions of respective levels and involvement of fire brigades proved to be extremely advantage as well as transfer of flood and rescue managements to “crises commissions” when necessary.

1.2. Programmes of flood protection

The most important for flood defence is the “Programme of prevention against floods” under the responsibility of Ministry of Agriculture. Realisation of approved measures (after the assessment of economic efficiency, feasibility and minimum impact on the environment) is made by the state administrators of water courses (River Boards s. e. and Forests of the Czech Republic, s. e.). The final goals of the respective phase of the Programme are mainly to increase the protection to at least Q_{50} in urbanised and to Q_{20} in rural areas. The identification of flood areas and studies of outflow and run-off conditions (using the mathematical modelling) from specific watersheds were also involved. These data allow prepare proposals of the effective protection measures.

The Programme is structured into phases:

- First phase (2002 – 2006) marked as “Introduction” had investment volume of 4.2 bill. CZK. The assessed effects resulted in protection of property over 300 bill. CZK and over 240 thousand of inhabitants.
- Second phase (2007 – 2013) marked as “Development” is currently running and the amount of available money for investments is 11 bill. CZK.
- Third phase (marked as “Retention”) is planned for the ears 2014 – 2020 and the amount of invested money is estimated for 10 – 15 bill. CZK. It will be focused primarily for accumulation and retention of water in watershed – in polders, reservoirs, ponds and determined flood prone areas.

The parallel programme for flood protection using the ecologically plausible measures is processed under the competence of Ministry of the Environment. It uses European funds via the “Operational Programme Environment” in the measure of the “Water management infrastructure improvement and reduction of flood risks”. This programme is applied for 2007 – 2013 years.

The Ministry of Agriculture processes also following two programmes, which contribute for the flood protection activities:

- Programme “Renewal, dredging and rehabilitation of fishponds and constructions of water reservoirs” with the total budget of 3.1 bill. CZK is run from 2007 to 2013. The objective of the Programme is to improve technical status of fishponds and increase their safety during the occurrence of floods.
- The specific programme is for the support of the “improvement of the structure of farmer grounds and their exchange for integration”, which brings important activities for increase of retention of water in watershed and – at the same time – decreases the soil erosion. The programme is opened for 2008 – 2013 with the support of 1,0 bill. CZK.

Besides these “flood protection” activities there are programmes for remediation of impacts of individual floods on water management infrastructure in water courses and/or reservoirs, which is the state owned property under the management of River Boards s. e. and Forests of the Czech Republic, s. e.

1.3. Information systems in water management of the Czech Republic important for flood protection

Ministry of Agriculture and the Ministry of the Environment, in cooperation with other central water authorities (Ministry of Traffic and Ministry of Defence) provide comprehensive information about waters in the portal, which is clearly arranged, easily accessible and easy to understand. This water information system was officially launched in 2005 year and it is supplied by the information from River Boards, s. e., Forests of the Czech Republic s. e., the Czech Hydrometeorological Institute and the T. G. Masaryk Water Management institute, public research institution.

The addresses are as following: www.voda.gov.cz (the Czech language only), www.water.gov.cz (the English application), www.voda.gov.cz/wap (available for mobile phones). There are available following data and information:

- Water level stages and flow rates on watercourses from 180 sites with the frequency of actualisation 1 hr. or 30 minutes (during floods). These data are given in 6 language versions – Czech, English, German, Slovak, Polish, Hungarian. Monitored indicators – water level (cm), flow rate ($\text{m}^3 \cdot \text{s}^{-1}$), flood activity degrees (1 – 3 and extreme danger) and also a “drought indicator” (it characterises the stream flow recession below a certain limit).
- Water levels in reservoirs – monitored indicators: water level in the reservoir (in m above sea level), volume of water in the reservoir (mill. m^3), water inflow and discharge ($\text{m}^3 \cdot \text{s}^{-1}$), precipitation and air temperature. The data are accompanied by the schemes of reservoirs showing the water level and filling the reservoir.
- Precipitation – current information about one-hour precipitation amounts and air temperature, which are generated from 180 sites operated by the Czech Hydrometeorological Institute or River Boards, s. e. There are data about dily precipitation amounts during the last seven days (in mm).

This information system contains more other data on water courses, on water management infrastructures located on them, water quality of surface and ground waters etc ., which are not directly relevant for the flood protection.

It should be, however, mentioned that this portal is unique system even on the European level and it is highly appreciated not only by the Czech public, but – in particular – in all neighbouring countries. Nevertheless, there are other available information about flow rates and water levels available in the Czech Republic: www.chmi.cz (web site of the Czech Hydrometeorological Institute, also in English version), web sites of River Boards s. e. in Czech (www.pvl.cz; www.pla.cz; www.pmo.cz; www.poh.cz; www.pod.cz).

In addition, a new service has been introduced by the Czech Television broadcasting – www.krizovamapa.cz (in Czech only), which will be in operation only during emergency or crisis situations (not only floods – e.g. fires, large traffic crashes etc.). All the public can joint this web and send reports, information, photos, videos etc.

2. International co-operation in the flood prevention of the Czech Republic

2.1. International commissions for the protection of transboundary rivers

More than 30% of boundaries of the Czech Republic are formed by water courses (“wet frontier”) and practically all water outflows from the territory being drained by the three important European rivers – the Elbe, the Oder and the Morava (tributary of the Danube), which belongs to the river basins of Northern Sea, Baltic Sea and Black Sea, respectively. The international commissions for protection of the rivers Elbe, Oder and Danube were established in 90ties after the political changes in Europe, which were followed by the enlargement of the EU. In spite of the fact that the primary goal of the commissions has been improvement of the water quality (later improvement of water ecosystems according objectives of the Water Framework Directive – 2000/60/ES) the flood occurrence in Europe shift the scope of their programmes to the “integrated flood protection in the international basins”. Thus, the specific working groups were created and focused on the flood protection strategies. The progress on their activities can be followed in publications prepared in secretariats of the respective commissions, which are available on the web sites (www.ikse-mkol.org; www.icpdr.org; www.mkoo.eu).

2.1.1. The International Commission for Protection of the River Elbe

The Commission was established in 1990 and the flood activity has been started after 1997 as the consequence of the flood occurrence in the basin. The working group for the “Flood protection” together with the “expert group on hydrology” produced 11 publications, namely the “Strategy of flood protection in the Elbe River basin” (1998) and the “Action Plan of flood protection in the River Elbe basin” (2001). Reports No. 1 and No. 2 on the fulfilment of the latter were already issued and recently is prepared the 3rd, the last report, which will be presented on the occasion of the 10 years anniversary of catastrophic flood in the River Elbe basin in 2002.

2.1.2. The International Commission for Protection of the River Oder against pollution

The Commission was established in 1996 and immediately in the next year was created the working group for the flood protection – as the consequence of the extreme flood in the River Oder basin in 1997. The common “Strategy for flood protection” was adopted in 1999 and it was followed by the agreement of the “Action programme of flood protection in the Oder River basin” in 2004. Several publications on floods, which occurred from that time, were issued (2001 and 2007) on the base of the collaboration of experts of all contracting parties.

2.1.3. The International Commission for Protection of the Danube River

The Commission was established by signatures of contracting parties in 1994. The Action Programme for the “Sustainable Flood Protection in the Danube River Basin” was adopted in 2004. The report on catastrophic flood in the Danube River basin in 2006 was published in 2007. The close collaboration of all contracting parties is necessary for realisation of integrated (system) flood protection measures, which will not have negative consequences downstream and this is the essential aim of the respective working group.

2.2. Bilateral co-operation in management of transboundary waters of the Czech Republic

2.2.1. The cooperation with the Federal Republic of Germany

The Czech Republic shares with the Federal Republic of Germany the longest international boundary (811 km and 290 km is formed by watercourses). The transboundary waters are divided into those falling into Saxon and Bavarian Boundary reach. The cooperation with Saxony was established in 1955 and with Bavaria in 1970. The supreme body of these co-operations is Czech-

German Commission for Transboundary Watercourses, which was established in 1998. The main activity containing the flood protection is involved in the expert groups No. 1 –“ Water Management Planning and Balancing “ and No. 3 –“Hydrology”.

2.2.2. The cooperation with the Republic of Poland

The co-operation between the countries is governed by Agreement between Governments of the Czechoslovak Republic and the Polish People's Republic, which was signed in 1958. The working group on “Hydrology, Hydrogeology and Flood Protection“ co-ordinates cooperation between the Czech Hydrometeorological Institute and the Polish Institute of Meteorology and Water Management and, in addition, the co-operation of management bodies of water courses realise concrete solution in the Oder River basin. Progress is obvious namely in the organisation of flood warning and forecasting services, implementation of the ALADIN meteorological forecasting model, the use of radar information and improvement in the automation of precipitation and water gauging reporting stations including the use of rainfall-runoff forecasting models in the Oder River basin.

2.2.3 The co-operation with the Republic of Austria

The co-operation with Austria was launched already in 1928 when Joint Technical Commission was established. At present, the co-operation is governed by Convention signed in 1967. The Commission discusses problems associated with maintenance of watercourses, quality and quantity of water, water abstraction etc. For a long period, the Commission has been involved in assessing impacts of Nové Mlýny Reservoirs (on the River Dyje – Thaya) on conditions in transboundary reaches. This issue includes assessment of the reservoirs effects on the flood management and the close collaboration finalised in improvement of the flood situation on Austrian site due to retention of flood waves in mentioned reservoirs.

2.2.4 The co-operation with the Slovak Republic

The co-operation in managing transboundary waters was preliminary agreed in 1992 as the consequence of the division of The Czech and Slovak Federative Republic in two independent countries from 1993. Expert negotiations concerning preparation of the Agreement between Governments of the Czech Republic and the Slovak Republic on co-operation in transboundary waters were launched in 1996 and finalised in 1999. Joint assessment of water quality, management of watercourses in the Morava River basin and the co-operation on flood protection activities are running continuously.

2.3. The other international collaboration improving flood protection in the Czech Republic

Several international projects were launched after the catastrophic floods on the Czech territory. The project of “Flood Management in the Czech Republic” I. and II. has been realised with the support of Denmark (1998 – 2001).. Both phases of the project were focused on the implementation of mathematical models for the Morava River basin, transfer know-how and training the Czech staff of River Boards s.e.

Another two projects supported by the Netherlands have implemented new technologies (modelling of management of flood by reservoir manipulation, the delivery of gauge monitoring stations with on line transfer of data, identification of “active zone” in flood prone areas) in the years 1999 – 2004.

The Ministry of the Environment is participating at the “Operational programme for Central Europe” which contains two projects: “LABEL” for the Elbe River basin (2009 – 2012) and “CEframe” for the Danube River basin (2010 – 2013). More info is available on web site (www.label-eu.eu).

Conclusion

The experience of the Czech Republic with the flood management and the flood prevention lead to the following most important activities/actions:

- The adoption of strategic (conceptual) documents and relevant legislation for improvement of flood prevention
- The improvement of the advanced forecast and early warning systems using high-tech procedures and equipments (radar, ALADIN, mathematical models of run-off etc.)
- The implementation of a robust information systems for dissemination of data from databases of water management bodies and fire-brigades using modern communication technologies (internet, mobiles, TV, wireless)
- Well prepared activities of bodies responsible for flood, rescue and crisis management (flood commissions, crisis comities, mayors, municipalities), which follow from appropriate legislation for the flood prevention and flood defence
- Continuous upgrading of flood plans and activity of flood commissions, their training and checking the communication between the bodies responsible for flood management and flood protection activities
- The identification of flood areas (including determination of “active zones”) and transfer these information to the inhabitants (namely in small municipalities)
- The realisation of flood protection measures combining structural technical, non-technical (nature plausible) measures as well as improvement non-structural measures
- Well prepared management of flood flow rates by use of manipulation on dam-reservoirs, polders, removable walls installation etc.
- Development of the close collaboration with the neighbouring countries on flood management and on realisation of flood defence measures in integrated plans of respective watershed

References

Web sites of Czech ministries (www.mze.cz; www.mzp.cz), River Boards s.e., the Czech Hydrometeorological Institute and www.voda.gov.cz (used in the above text).