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Guideline DWA-M 514E

Dam Surveillance

July 2011

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The German Association for Water, Wastewater and Waste (DWA) is strongly committed to the development of secure and sustainable water and waste management. As a politically and economically independent organisation it is professionally active in the field of water management, wastewater, waste and soil protection.

In Europe DWA is the association with the largest number of members within this field. Therefore it takes on a unique position in connection with professional competence regarding standardisation, professional training and information. The approximately 14,000 members represent specialists and executives from municipalities, universities, engineering offices, authorities and companies.

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Foreword

Dams and reservoirs are generally perceived by the public as aesthetic landmarks in a natural or near-natural environment. Usually they are highly appreciated by the residents as open spaces offering a range of recreational and leisure opportunities, so that the technical aspects for their existence retreat a little to the background. Public awareness of the fact that dams hold large amounts of energy, carrying in themselves a certain risk potential, is less pronounced. Dams are generally considered to be safe.

Consistent monitoring plays an essential role in dam safety management. Individually adjusted measuring and monitoring systems are employed for the purpose. Being applied in combination with periodical visual inspections, these measuring efforts provide plant operators with a comprehensive and differentiated picture of the structural and operational safety status of their dams. Focus and intensity of monitoring actions are a function of the purposes assigned to the dams and their specific structural features.

Naturally, dam monitoring is geared to providing valid, practical evidence of the dam´s reliability through all construction and operating phases. That means, the behaviour of the dam is to be captured, by appropriate monitoring measures, under actual static, hydraulic, hydrological and operational conditions as well as under actual load and stress conditions.

Basic principles governing the monitoring of dams are set out in DIN 19700-10 and Part 11; however, the respective sections have intentionally been kept rather short. This Guideline provides supplementary information and also serves as a basis for the planning, approval, design, implementation and validation of dam surveillance concepts established for both new and old dams.

Structural safety is essentially ensured by application of the generally accepted rules of technology in the planning, construction and monitoring of dam structures. Whereby it is crucial to detect, early enough, any potential changes in the safety status with the aid of an appropriate measuring and monitoring system, so as to enable implementation of rapid response measures and to maintain with that the dam's safety. The monitoring results serve as basis for the annual safety reports and the in-depth verifications to be established at regular intervals (according to Guideline DVWK-M 231).

Every single dam represents an individual entity as regards location (topography and geography), design and construction, which is to be taken into account in the relevant monitoring programmes. Whereby a distinction should be made between measurements carried out during normal operations and those performed during construction and test operations. Usually, more frequent measurements and more in-depth analyses are required during the construction phase and during test runs.

Compared to Guideline DVWK-M 222 'Mess- und Kontrolleinrichtungen zur Überprüfung der Standsicherheit von Staumauern und Staudämmen' as of 1991, the actual version comes along in a modified form and with an updated and extended content. Already the new heading 'Dam Surveillance' indicates that the new Guideline addresses the subject more widely. Guideline DWA-M 514 'Dam Surveillance' replaces the preceding Guideline DVWK-M 222.

While the old Guideline has essentially been based on the experiences gained from 83 dams, the new Guideline includes all relevant types of construction commonly used in Germany. And while the older version presents standard features for just one type of graving dam and one type of embankment dam, respectively, the new equipment recommendations embrace the most frequently realised types of construction. Additionally, the updated Guideline gives an overview of the most widely used measuring procedures and systems. Also digitalisation, that has long since arrived in instrumentation and control technology, has been taken into account.

The increase in information made it necessary to extend the scope of the Guideline. The new version includes the following priorities:

- general principles of dam monitoring
- description and hints for the observation of influence quantities and measurands
- visual inspections
- recommendations for the measuring equipment of embankments and impounding dams

Measuring procedures and measuring systems needed to observe the influence quantities (effects) and measurands of structural monitoring are introduced in Sections 3 and 5. The DWA currently plans to provide further information about the specific measuring procedures and systems and design-related guidelines in a separate Guideline. Selected examples relating to the issue of dam monitoring at reservoirs are presented on the internet-website of the Deutsches Talsperren-Komitee e. V. (http://www.talsperrenkomitee.de).

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Luisenthal, June 6, 2010 Jochen Mehl

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User Notes

This Guideline has been produced by a group of technical, scientific and economic experts, working in an honorary capacity and applying the rules and procedures of the DWA and the Standard DWA-A 400. Based on judicial precedent, there exists an actual presumption that this document is textually and technically correct.

Any party is free to make use of this Guideline. However, the application of its contents may also be made an obligation under the terms of legal or administrative regulations, or of a contract, or for some other legal reason.

This Guideline is an important, but not the sole, source of information for solutions to technical problems. Applying information given here does not relieve the user of responsibility for his own actions or for correctly applying this information in specific cases. This holds true in particular when it comes to respecting the margins laid down in this Guideline.

Introduction

In the Federal Republic of Germany, dams have to be built and operated in accordance with the generally accepted rules of technology. The safety concepts established on the basis of these provisions, encompass the following elements:

- **Structural safety**
  (planning phase, construction phase)

  Structural safety covers all issues of relevance for water management, for geotechnical and for structural planning, including the site supervision by the engineer and/or completion of refurbishment measures.

- **Proper and competent operation and maintenance**
  (test operation, operating phase)

  Proper operation of dams implies to safeguard the officially approved and licensed use of the dam under normal operating conditions, without affecting the safety of third parties.

- **Safety monitoring**
  (test operation, operating phase)

  Safety surveying encompasses all measures of internal monitoring and control deemed necessary by the responsible plant operators, as well as all external monitoring and control actions carried out by the competent supervisory authorities.

- **Precautionary measures**
  Precautionary measures to be taken when the safety of dam operations can no longer be guaranteed.

Dam surveillance, as it is described in this Guideline, is an integral part of overall safety monitoring for dams and reservoirs.

1 Scope

This Guideline deals with dam surveillance. It describes **measuring procedures** and **measuring systems**, it formulates recommendations for the individual configuration of surveillance systems in the facilities and it considers their implementation in greater detail.

Dams within the meaning of this Guideline are those dams defined by DIN 19700-11 that impound a watercourse by blocking the entire cross-valley profile. They consist, in principle, of a dam structure, operating facilities and a reservoir (main barrage), and where necessary of pre-impoundment basins as well as of all ancillary facilities needed to maintain proper serviceability. The Guideline deals with on-site monitoring of dam structures and, in Section 8, with monitoring of ancillary concrete structures, ancillary and appurtenant plants.

Application of this Guideline is also recommended for other dams as defined by DIN 19700, Parts 10 and 12 to 15. Section 9 provides information concerning application in case of flood control reservoirs, weirs, pumped storage reservoirs and sedimentation reservoirs.