



# Inflatable Structures in Hydraulic Engineering

## Terms of Reference

### Objective of the Working Group

The objective is gathering the experiences, showing the application range of inflatable structures and developing a compendium. The main objective of the WG is to define a general methodology for the analysis and design of inflatable structures, in particular of the membrane and the anchoring system. Therefore, it is necessary to review the research presenting it in a comprehensive publication to aid designers and operators in their preliminary tasks.

### Background

An inflatable dam is a relatively new gate type, which enables savings to be made on the capital spending and maintenance costs. It consists of a multi-ply rubber membrane, is filled with air or water and clamped to the weir body with one or two fixing bars. Inflatable dams have a number of advantages when compared with steel gates. Inflatable dams are mainly used at movable weirs enabling navigation and hydropower generation, but also at storm surge barriers. Related applications are bulkheads, cofferdams and temporary gates as well as combinations with flap gates, i.e. Obermeyer gates.

In USA, Japan and other countries inflatable dams are used for more than 50 years in conjunction with movable weirs. The first inflatable dam in the German water and shipping administration was installed after intensive investigations in 2006. Due to the positive experiences and the great economy a rapid increase of planned inflatable dams can be observed. Also in the French water and shipping administration a number of inflatable structures, a combination of flap gate and inflatable dam, has been installed in the last five years. Therefore, a working group should be established in order to share these experiences, techniques and methods worldwide.

### Final Product

The intent will be to provide a comprehensive summary of best practices that can be incorporated into future design of inflatable structures. Furthermore, a compilation of designs should be created for inflatable structures in conjunction with movable weirs, storm surge barriers and bulkheads. The Working Group will also aim to gather expert analysis on relevant problems in some countries during the implementation of such inflatable structures. Finally, the group will analyze the possible contribution of the use of these structures with climate change.

The compendium discusses the benefits and disadvantages, makes recommendations, and develops practical solutions for hydraulic structures.

This group will build upon the information provided by InCom WG 26 "Design of Movable Weirs and Storm Surge Barriers".

## **Matters to be investigated**

On the basis of case studies or existing compendiums, in particular in Japan, a design approach shall be developed considering also other standardization efforts, such as Voie Navigable de France/Centre d'études techniques maritimes et fluviales, Bundesanstalt für Wasserbau/Wasser- und Schifffahrtsverwaltung.

Some of the issues to be investigated include:

- a. Design of the membrane and the anchoring system: Providing methods to estimate the membrane forces, defining loads, stress concentration and safety factors
- b. Material requirements for the rubber and the fabric inlay.
- c. Defining application limits, recommendations for filling media
- d. Hydraulic design of the weir sill and the inflatable dam, energy dissipation and countermeasures against vibrations.
- e. use categories recommended for these inflatables structures and precautions for their implementation.

## **Desirable Background or Experience of Working Group Members**

The background and experience should include hydraulic and structural design engineers from various organizations: Operators, manufacturers, research and consulting engineers.

## **Relevance to countries in transition**

The results will help designers and operators throughout the world and provide guidance to develop and operate safe and economically inflatable hydraulic structures.