InCom WG 241

Handling Accidents and Calamities in Navigation Hydraulic Structures

Terms of Reference

Background

While the prior objective of hydraulic structures (such as lock gates, navigation river weirs and storm surge barriers) is to remain in service, engineers must also be capable to adequately handle their failures. Despite the ongoing development of expertise, design tools, norms, and construction methods, there are still a considerable number of accidents and calamities that happen to such structures. In addition, the costs of losses as result of these so-called "upset events" are growing due to the growing complexity of waterborne infrastructure.

Accidents to hydraulic structures, like locks, navigation weirs and flood barriers, happen not only as result of strength excess. Other possible causes are, e.g., unforeseen conditions, lack of maintenance, improper operation, and navigation errors. There are often combinations and complex sequences of events that lead to disastrous results.

Various PIANC WGs have, so far, provided guidance for preventing accidents from happening, particularly the accidents resulting from strength excess. While this should remain the engineer's main concern, there is also a demand for guidance how to effectively handle the accidents and calamities that have actually happen. This is a matter of combined effort of not only engineers. Nevertheless, engineers can and should contribute to the solutions in such cases. This WG should provide guidance on this the task.

Objective of the Working Group (WG)

The objective of the WG is to assess the process of the accident and to develop recommendations to mitigate the effects of accidents. This task should be undertaken with an international group of structural and mechanical professionals, specialized in hydraulic structures such as navigation locks, river

navigation weirs, shipyard docks, flood and tide barriers. Let the group collect, assess and systemize the existing know-how on handling accidents and calamities in such structures, including failure mechanisms and their influence on an effective handling. The causes for such accidents, such as unforeseen conditions, lack of maintenance, improper operation and navigation errors have to be evaluated. The know-how should be focused on engineering aspects, but with a strong correlation to the multi-task and multi-disciplinary actions to be taken after accidents. These actions can be optimized if the route cause of the accident is taken into account. Depending on the WG's expertise, other than engineering issues may also be addressed.

Earlier reports to be reviewed

Unlike preventing, the handling actual accidents and calamities has not yet been systematically addressed by a PIANC WG. Nevertheless, specific aspects of this issue might have been handled in other contexts in the reports of diverse previous WGs.

The newly established WG is encouraged to review existing reports, particularly:

- WG 112: Mitigation of Tsunami Disasters in Ports;
- WG 119 Inventory of inspection and underwater repair techniques of navigation structures (concrete, masonry, and timber) both underwater and in-the dry
- WG 137: Navigation Structures – their Role within Flood Defense Systems;
- WG 151: Design of Lock Gates for Ship Collision;
- WG 155: Ship Behavior in Locks and Approaches;
- WG 175: A Practical Guide to Environmental Risk Management for Navigation Infrastructure Projects;
- WG 192: Developments in the Automation and Remote Operation of Locks and Bridges;
- TG 193: Resilience of the Maritime and Inland Waterborne Transport Systems.

and also the ongoing Working Groups:

- WG 182 Underwater acoustic imaging of waterborne transport infrastructure
- WG 199 Health monitoring for port and waterway structures
- WG 215 Accidental impact of ships on fixed structures – Update of InCom WG 19
- WG 233 Inspection, maintenance, and repair of waterfront facilities

In addition, appropriate authoritative literature from the countries of the WG members should be consulted. The WG should also consider reviewing a number of actual accidents and calamities in navigation hydraulic structures, their investigation reports (e.g. by Boards of Investigations in the USA), and evaluation reports of the recovery from the damage.

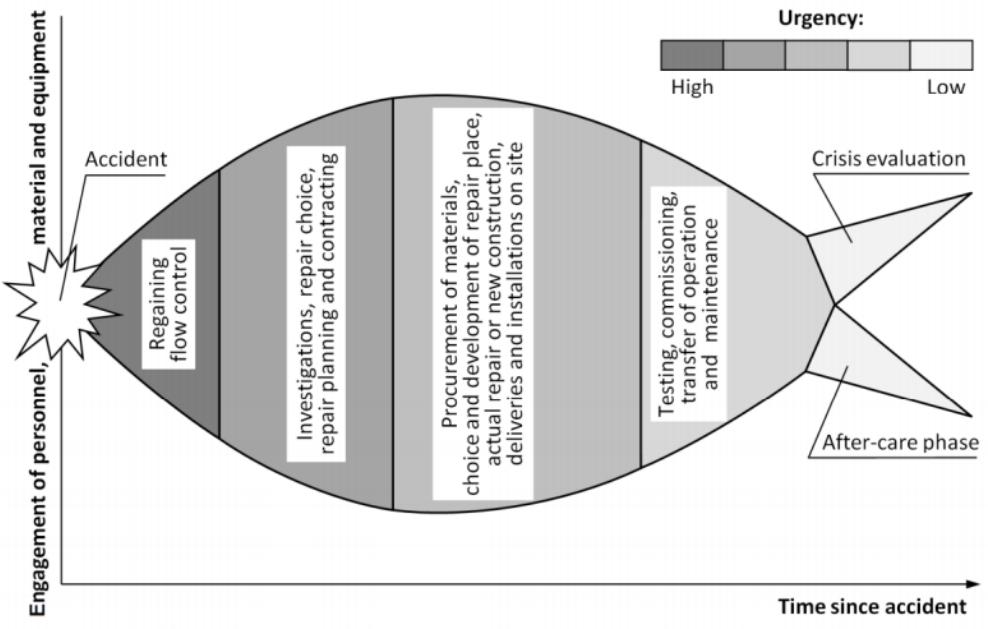
Final product

The final product of the WG should be a comprehensive report that offers guidelines for an approach to handling accidents and calamities in navigation hydraulic structures. Such approach should be careful and effective. The report should draw clear distinctions between emergencies and regular procedures in face of a calamity, describing the factual and legal conditions for the use of both. The report should by no means be received by the engineering community as imposing bureaucratic or other limits to the intended handling methods. It must rather provide awareness of the consequences of different approaches; and recommend good practices.

Below are the main points to be addressed by the WG, along with some notes that may help to streamline the discussion:

1. Context and classification of accidents:
   - As far as helpful to activate appropriate procedures, do not bureaucratize;
   - Keep it simple, there is normally no time to loose.
2. Identifying and reducing the risks:
   - Although the subject is handling accidents that actually happen (i.e. not preventing them from happening), some general references to risk assessment are desired.
   - Focus on construction, operation, maintenance, not (only) the strength of structure;
3. Investigation of accidents:
   - When, by whom, and how deep? Relation with classification of accidents.
   - Knowledgeable, interdisciplinary, impartial, specific, detailed, …
   - Why the design did not prevent the accident from happening?
4. Handling life safety risks:
   - Life safety as an absolute priority.
   - Approach is widely used (risk assessment): in design, operation, maintenance, …
5. Recovering from the damage:
   - Differences from 'routine' projects.
   - Discuss (further develop?) the "fish diagram" (see drawing next page), proposing a command structure: who is managing what and when.
6. Evaluation and lessons learned:
   - Focus on the process of handling, do not repeat the investigation;
   - When, by whom, how deep? Distance from the "issues of the day".

"FISH DIAGRAM":



Source: R.A. Daniel, T.M. Paulus, *Lock Gates and Other Closures in Hydraulic Projects*, Butterworth-Heinemann, Oxford UK, Cambridge MA, 2019.

How the timescale can be managed must be discussed by the WG because in some cases it can be a very long time before any lessons learned are made public. This in itself can create risk such as in the case of fatigue failure in metal components that

may also occur in similar structures/loading conditions, and actually require an immediate warning to other asset owners.

Similarly, the WG should discuss the reluctance by organisations in admitting problems especially where prosecution, civil action or an insurance claim is being made. There are good examples of this. Nobody is usually prepared to put forward a reason/cause for the problem because of the possible liability issues. But at the end, through a meeting without lawyers and "off the record", the answer to the problem and the steps to solve it can usually be identified.

Working Group membership

The desirable expertise of the WG members includes the following profiles:

- Structural and/or mechanical design engineers with, additionally, large field experience
- Field operation engineers and/or managers experienced in handling critical situations;
- Technical experts of various disciplines with a record of participation in boards of investigations launched after accidents;
- Scientists and technological university employees with relevant expertise;
- Young professionals willing to enhance their skills in the field of the Working Group;
- Experts in insurance and risks, maybe from ship classification societies.

Relevance for the Countries in Transition

The investigation field of the WG – Handling Accidents and Calamities – is relevant for any country that has waterborne infrastructure. This includes the Countries in Transition.

Climate Change

There is no direct link between handling accidents and calamities in hydraulic structures and the issues brought upon by the climate change. Indirectly, there is a link because climate change leads to extreme conditions that increase the likelihood and impact of accidents and calamities. The WG may find more correlation between the two issues. In this case, the WG should feel encouraged to address this correlation in detail.