

BUILDING A DECISION SUPPORT SYSTEM FOR THE TERNEUZEN LOCKS: COMBINING OPTIMAL MANAGEMENT FOR WATER AND SHIPPING

by

Chantal Martens¹, Gert-Jan Liek², Dré Maes³, Herman Haas², Maarten Deschamps¹, Leen Dekker², Harry van 't Westeinde², Mario Vermeirssen², Harm Verbeek², Kees Storm²

1. Introduction: construction of a new lock on the Ghent-Terneuzen Canal

The Ghent-Terneuzen Canal is situated on Belgian and Dutch territory and was constructed between 1823 and 1825. It links the Harbours of Ghent and Terneuzen (North Sea Port) to the Western Scheldt and thus to the sea.

The Canal ends, through the locks at Terneuzen, in the Western Scheldt.

In 2017 the construction of a New Lock for the Lock Complex in Terneuzen was started. The New Lock at Terneuzen is a Flemish-Dutch project, carried out by the Flemish-Dutch Scheldt Commission. The lock is expected to be completed in 2022. In order to optimize the use of the lock and to balance the shipping requests with requests for water quality and quantity, the Flemish-Dutch authorities decided to build a decision support system. The development of the system was carried out a two phased approach, determining first the necessary guidelines and thresholds were determined, and defining in a second phase the technical translation for those guidelines.

2. Formulation of the guidelines and thresholds

A Flemish-Dutch group of experts was asked for guidelines to optimize the lock operations in function of minimum waiting times, optimal discharge planning and controlled salt intrusion. In the first instance the expert group focused on salinity, but given the issues concerning high discharges and low freshwater availability, and the necessary coordination needed for this between Flanders and the Netherlands, it was decided to take a broader approach in order to arrive at a number of guidelines for the operational management of the entire lock complex.

The final guidelines aim to:

- Respect the minimal and maximal canal level, as stipulated in the 1960 treaty
- Respect the norm for salinity, with respect to the Water Framework Directive
- Ensure that ships pass through the complex as quickly as possible, with minimal waiting time

Summarizing, the aim was to provide guidance for pro-active water and navigational management, based on the relevant variables. The guidelines focus on scenarios for high discharges, low water levels and high chloride levels.

The expert group also came to the conclusion that, in order to be able to apply these agreed guidelines properly, a decision support system (DSS) would be a welcome aid. This DSS checks the boundary conditions for water management with the requests for shipping and delivers all information to the operator so that an objective choice for the optimal use of the lock complex can be made. In addition to this, the DSS also gives feedback to the operator on the consequences of the chosen lock operations on water quality (salinity) and water levels in the Canal.

3. Preparation for technical implementation

A technical preparation group looked further into the technical requirements to implement the guidelines formulated by the expert group in a decision support system. As with the expert group, the technical

¹ Flemish Government, Department of Mobility and Public Works, Chantal.martens@mow.vlaanderen.be

² Ministry of Infrastructure and Water Management, Rijkswaterstaat, The Netherlands

³ Flemish Waterways NV, Belgium

group consisted of specialists in shipping and water management for both countries, and representatives for the management of the lock complexes.

As a first step, the necessary data streams and their respective frequency updates were identified. The DSS needs information on the hydrodynamic boundary conditions (water levels, predicted and expected discharges), water quality information (mainly for salinity) and shipping information. This information is provided by operational models and forecasts, in-situ measurements and existing tools for planning of the lockage.

In a second step development options were worked out, from relatively simple (1) to very complete (3) (Deltares, 2017):

- (1) A hydraulic model, where the choices the operators make for lockage are checked against the operational preconditions. This should be considered a feedback module, rather than a decision support module
- (2) An advisory module that performs optimization on hydraulics and water quality (advice discharge, lockage) under a certain distribution of ships in the lock complex.
- (3) An advisory module that maximally optimizes both hydraulics and shipping (advice discharge, lockage and distribution of ships over the locks).

For further development, option 2 was chosen. Not only because the cost for option 3 was considerably higher, but also because the expertise of the operators have with regard to the optimal distribution of the ships should be used maximally, which expertise is very difficult to capture in an algorithm.

The development of the DSS is expected to start 2nd half of 2018 in order to possess an operational system when the New Lock is taken into use in 2022. Testing of the DSS is expected to take place during the construction of the New Lock

4. References

VNSC Nieuwe Sluis, 2015, expertgroep schutten, spuien en verzilting : Advies Water- en schutbeheer voor Kanaal Gent-Terneuzen voor de situatie na het gereed komen van de Nieuwe Sluis Terneuzen, unpublished

VNSC, 2015a, Hoofdrapport MER Nieuwe Sluis Terneuzen

VNSC, 2015b, Aanvulling deelrapport MER Water

Deltares, 2017 Ontwikkelopties en, eisen voor een Beslissingsondersteunend Systeem Kanaal GentTerneuzen, 53 pp

De Boeck, K., Michielsens, S., Pereira, F., Mostaert, F. , 2012, "Opmaak van modellen voor onderzoek naar waterbeschikbaarheid en -allocatiestrategieën in het Scheldestroomgebied: Deelrapport 4 - modellering van de huidige toestand op regionaal niveau ", versie 3.0, WL Rapporten, 724_04, Waterbouwkundig Laboratorium, Antwerpen WL

Belgium & Netherlands, 1960, Verdrag tussen het Koninkrijk België en het Koninkrijk der Nederlanden betreffende de verbetering van het kanaal van Terneuzen naar Gent en de regeling van enige daarmee verband houdende aangelegenheden, 1960; met updates in 1985. (" Treaty between the Kingdom of Belgium and the Kingdom of the Netherlands concerning the improvement of the canal from Terneuzen to Ghent and the settlement of some related matters, 1960; with updates in 1985.")