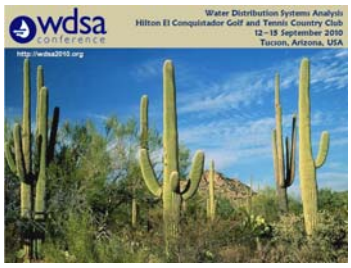
The Battle of the Water Calibration Networks (BWCN)



Water Distribution Systems Analysis 2010
Tucson, Arizona U.S.A.
September 12-15, 2010
http://wdsa2010.org/

Detailed Problem Description and Rules

November 13, 2009

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1. Introduction

The Battle of the Water Calibration Networks (BWCN) is the third in a series of "Battle Competitions" dating back to the Battle of the Water Networks (BWN) in 1985 and more recently the Battle of the Water Sensor Networks (BWSN).

The BWCN calls for teams/individuals from academia, consulting firms, and utilities to propose a calibration methodology and apply it to a real water distribution system. The results of the BWCN will be presented at a special session of the upcoming 12th Water Distribution Systems Analysis Symposium in, Tucson, Arizona in September 2010 (http://wdsa2010.org/).

It should be emphasized that none of the BWCN organizers listed above is taking part in the BWCN as participants. The organizers responsibility is to assemble the calibration approaches and results, make sure that the BWCN is objectively assessed, organize the session at the WDSA2010 event, and prepare a journal manuscript (as warranted) to be submitted to the Journal of Water Resources Planning and Management Division, ASCE.

The rest of this document describes the rules and framework of the BWCN.

2. How to participate

Each participating team/individual must submit by February 1, 2010 an on-line abstract for the WDSA2010 conference (http://wdsa2010.org/) that discusses briefly the proposed calibration approach (e.g., trial and error with simulation, evolutionary computation, heuristics, etc.) When submitting the abstract the topic area must be identified as "Battle of the Water Calibration Networks (BWCN)" – this will identify your team of authors as a participant in the BWCN.

Notifications of accepted/rejected abstracts will be made by March 1, 2010. Each successful team must summarize their final calibration results in a conference paper; these must be uploaded to the WDSA2010 web site by May 1, 2010. All conforming calibrations will be included in the public presentation of summary results at the conference and will be published as part of the conference proceedings. Submission of an abstract and paper for the BWCN does not, however, imply or require an oral presentation at the WDSA2010 conference.

Authors who wish to submit an abstract before the due date of February 1, 2010 are welcome to do so. The organizers will evaluate abstracts as they are submitted and will notify the authors of acceptance/rejection as soon as possible (upon submission at the conference web site please forward a copy of the submitted abstract to the BWCN organizers).

Submitted papers describing the final calibrations from each team should be brief and to the point. It is not necessary to describe the BWCN background. To allow efficient and fair assessment of contributed results, papers submitted to the BWCN are asked to include the following sections: Abstract; Introduction (brief); Methodology (whether qualitative or quantitative); Summary of calibration results for the tested network; Discussion of Results; Conclusions; and References.

An EPANET (version 2.00.12) *.inp file of the calibrated network for an Extended Period Simulation (EPS) of 168 hrs (see further details below) should be emailed to the BWCN organizers upon paper submission.

The Discussion of Results section should include method-specific information about the calibration effort (e.g., person-hours, computer type and execution time/memory requirements, scenarios used for calibration purposes, etc.). Calibrations submitted with incomplete information may be excluded from the comparison.

3. Event schedule

Table 1 lists the schedule for the BWCN.

Table 1: BWCN schedule

Date	Event
November 15, 2009	Publication of problem details and competition rules (i.e., this document + attached files)
February 1, 2010	Final date of team's abstract submission through the conference web site at http://wdsa2010.org/ **Authors who wish to submit an abstract prior to February 1, 2010 are welcome to do so. The organizers will evaluate abstracts as they are submitted and will notify the authors of acceptance/rejection as soon as possible (upon submission at the conference web site please forward a copy of the submitted abstract to the BWCN organizers)**
March 1, 2010	Notification of abstract acceptance/rejection
May 1, 2010	Participants submission of full paper calibration network results (i.e., a manuscript through the WDSA10 website and a *.inp file of the calibrated system to the BWCN organizers)
September 12-15, 2010	Public presentation of team results and comparison outcome at WDSA10
December 1, 2010	Submission of a jointly authored journal manuscript (as warranted) to the Journal of Water Resources Planning and Management Division, ASCE

4. Problem description

The municipality of C-Town is in need of a calibrated hydraulic simulation model of their water distribution system. To accomplish this task the city has performed fire flow tests and gathered data as provided below. Efforts were made to supply the most accurate data.

4.1 Data

4.1.1 Network topology (C-Town.inp, C-Town_DMA.pdf, C-Town_S.pdf)

The network topology was extracted from the C-Town GIS system and is available from the attached EPANET (version 2.00.12) C-Town.inp file. The municipality has also provided two PDF files: C-Town_DMA.pdf describing the C-Town DMA's (District Meter Areas) and C-Town_S.pdf for its mode of operation.

4.1.2 Elevations (C-Town.inp)

Junction elevations are available from a recent field survey. The accuracy of the elevation measurements is ± 1 meter.

4.1.3 Pipes

4.1.3a Diameters (C-Town.inp)
Diameters are available.

4.1.3b Lengths (C-Town.inp)
Pipe lengths are available via the GIS system. It should be noted that for some pipes the lengths are more than the Euclidian distance between the upstream and downstream nodes. This is due to the fact that intermediate vertices are not available via the GIS system.

4.1.3c Pipes type and age (C-Town.xls)
Pipe types and age are available.

4.1.4 Pump curves (C-Town.inp)

The original manufacturer pump curves are available.

4.1.5 Isolation valves

It may be assumed that every pipe in the network has an isolation valve. Unless explicitly stated, all valves may be assumed to be fully open. Construction activity was ongoing in DMA2 which required isolating portions of the system. It is entirely possible that one or more valves in this part of the system may not have been fully re-opened following the upgrades. Fire flow data were collected after the upgrades.

4.1.6 Control valves (C-Town.inp)

There are a few pressure reducing valves (PRV's) in the system whose settings are checked annually.

4.1.7 Tanks (C-Town.inp)

All of the tanks in the system are cylindrical. Tank diameters and minimum and maximum levels are available from the C-Town master plan document.

4.1.8 Sources (C-Town.inp)
The network is fed from a one constant head water source.

4.1.9 Demands (C-Town.xls)
Monthly estimated water demands are available at each junction.

4.1.10 SCADA (C-Town.xls)
Hourly tank levels and pumping station flows are available for a period of 168 hours (one week).

4.1.11 Control rules (C-Town.inp)
Control rules are programmed into the PLC's of the pumping stations. Records of the control rules are available.

4.1.12 Fire flow tests (C-Town.xls)
Fire flow tests were conducted at each of the DMA's separately during the evening. It is our understanding that the basic system demands (excluding the observed hydrant demands) at the time of the fire flow tests roughly correspond to the demands during hour 1 of the provided one week SCADA time series (i.e. see 4.1.10 above).

5. Results assessment
The calibration results will be assessed for the period of 168 hours corresponding to the times recorded in the SCADA data file. The following criteria will be used:

5.1 Maximum absolute relative error between:

- Estimated pipe roughness values
- Estimated node demands
- Estimated node pressures
- Fire flow pressure tests
- Tank levels
- Pipe flows
- Pumping station flow rates

5.2 Root mean squared error (RMSE) for the 5.1 measures.

5.3 Standard deviation error for the 5.1 measures.

5.4 Ability of the calibrated model to successfully predict the resultant pressure and flows associated with an independently applied demand pattern and operating conditions.

5.5 Ability of the calibrated model to successfully predict the resultant pressure and flows associated with random failure scenarios.

6. Questions

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