HET WATERLABORATORIUM

Early warning strategy for a drinking water company

Eric J.M. Penders
Haarlem
The Netherlands

Email: Eric.Penders@Hetwaterlaboratorium.nl

Aqualife 2006

Overview Presentation:

* Introduction – Het Waterlaboratorium Ltd.

* Introduction – Early Warning Systems

* Overview – EWS at Water Company, Amsterdam

* Online Data Management, Visualisation, Alarm Management

* Alarm protocol

* Concluding remarks

Introduction Het Waterlaboratorium Ltd.

* Established in 2002

* 4 drinking water laboratories (WRK, Water Company Amsterdam, Water Company The Hague and PWN) merged together (120 FTE)

* Drinking water analyses for:
  Water Company Amsterdam: 1.2 Million Inhabitants, 92 m m^3/year
  Water Company The Hague: 1.2 Million Inhabitants, 76 m m^3/year
  Water Company North Holland: 0.7 Million Inhabitants, 104 m m^3/year

* Service of online sensors and biological Early Warning Systems

Introduction – Early Warning Systems

* Implementation of EWS along the Rhine via the Rijnaktieplan (spill at Sandoz, November 1986)

* In 1987 the Kerren fishmonitor was introduced at RIZA and several water companies in The Netherlands

The used package of routine analyses was limited and not suitable as a tool for early warning (response time too long, more useful for trend analyses)

Demands of Early Warning Systems:

* The system should give a response within one hour (depending on the control of the process and the variation of the source)

* Early warning systems must be robust and technically reliable

* Early warning systems should automatically provide (semi-) continuous results

* The interpretation of the results should be clear

* Easy to maintain with low frequencies and low in costs

Chemical EWS -> SAMOS (System for Automatic
Monitoring of Organics in Surface water)
pH, Oxygen, Nitrate, and
other inorganic compounds

Drawbacks when using only chemical EWS:

* Chemical analyses are only possible for a small group of compounds (5 %)
* The concentration of compounds are below the detection limit of the used instruments
* The measured values do not give information about their bio-availability and their combined effects on aquatic organisms

Biological EWS -> fish monitors, daphnia monitors,
mussel monitors, algae monitor,
bacteria monitor

Additional demands of biological EWS:

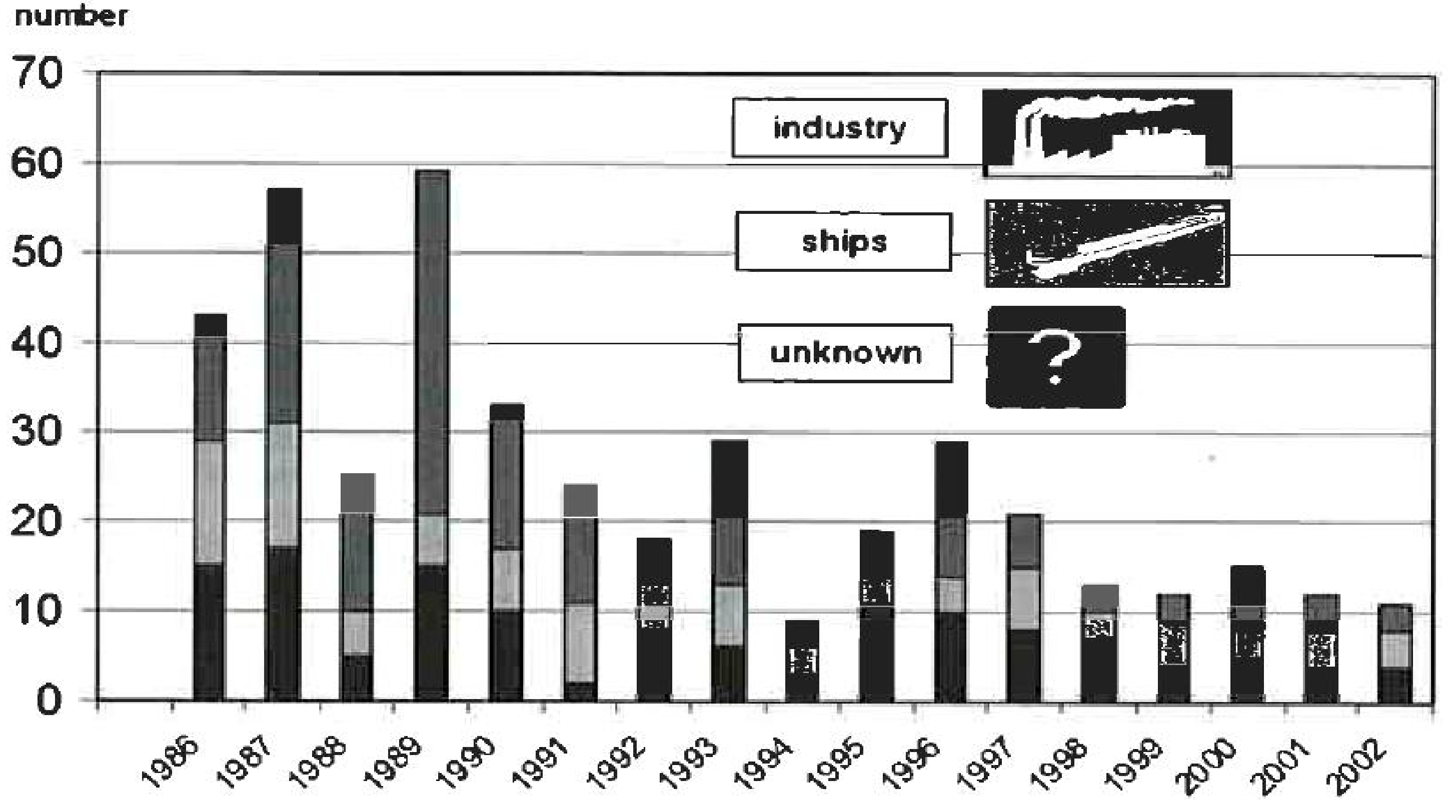
* The test organisms used can live a long period of time in the system, without deviation in behaviour, metabolism and sensitivity in relation to controlled circumstances
* The organisms used are easy to obtain or easy to cultivate with standardised procedures
* The biological responses are detected reliably

Overview use of EWS at Water Company Amsterdam

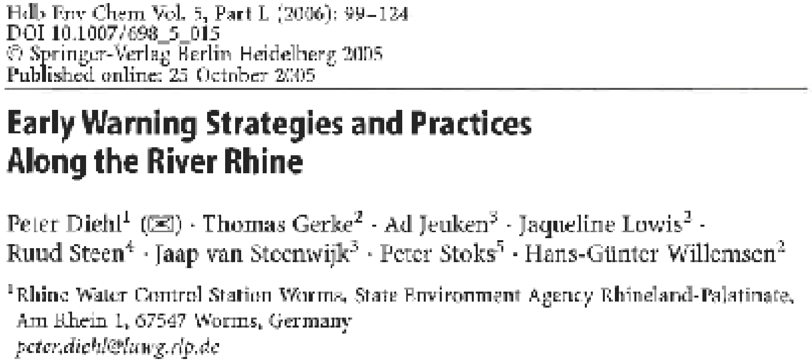
Risk Management: The River Rhine

- 1,320 km long
- river basin = 25,000 km^2
- industry & agriculture
- sewage water of 22 million inhabitants
- largest shipping traffic in the world
- > 16000 chemicals via European Inventory of Existing Chemical Substances (EINECS)
- > 100000 compounds present (estimated)

HET WATERLABORATORIUM



Number of reports according to the International Warning and Alarm Plan Rhine



Warning centers along the river

- mostly water police stations
- permanently manned
- hotline to regional / federal water authorities
- info transmitted by fax to downstream parties or by e-mail

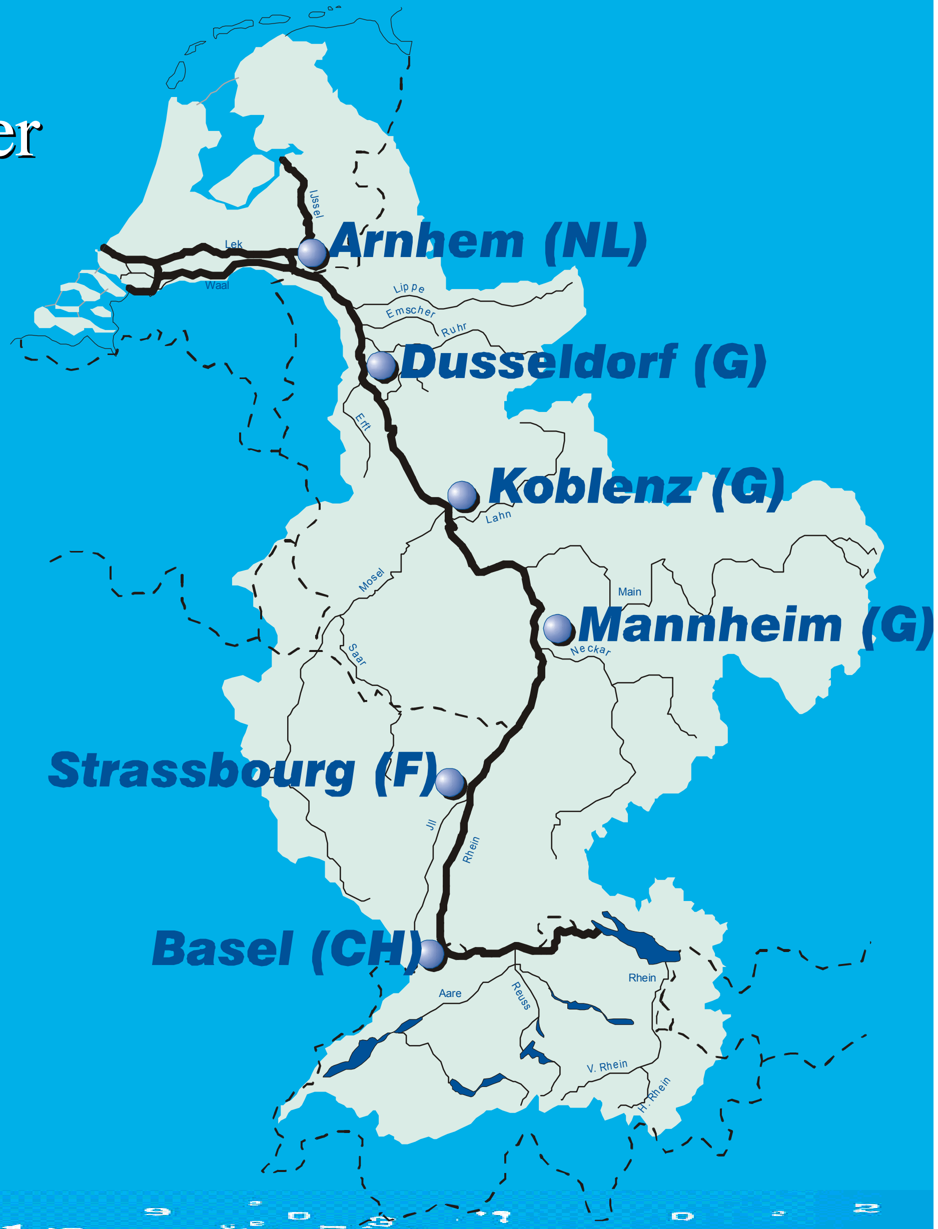


Table 3 Physical–chemical and biological early warning systems in use along the Rhine

Location	Physical–chemical Online sensors	Volatile	GC–MS	LC–UV	LC–MS
Weil am Rhein	x	x	x	x	x
Karlsruhe	x				
Worms	x		x		
Mainz	x				
Koblenz	x				
Bad Honnef	x	x	x	x	
Düsseldorf	x	x	x		
Bimmen/Lobith	x	x	x	x	x
Nieuwegein	x	x	x	x	x

Location	Biological Fish	Daphnia	Mussels	Algae	Bacteria
Weil am Rhein					
Karlsruhe	x	x		x	x
Worms		x		x	
Mainz		x			
Koblenz				x	
Bad Honnef		x	x		
Düsseldorf		x			
Bimmen/Lobith		x	x		
Nieuwegein	x	x		x	x

HET WATERLABORATORIUM

Threshold levels at German-Dutch border

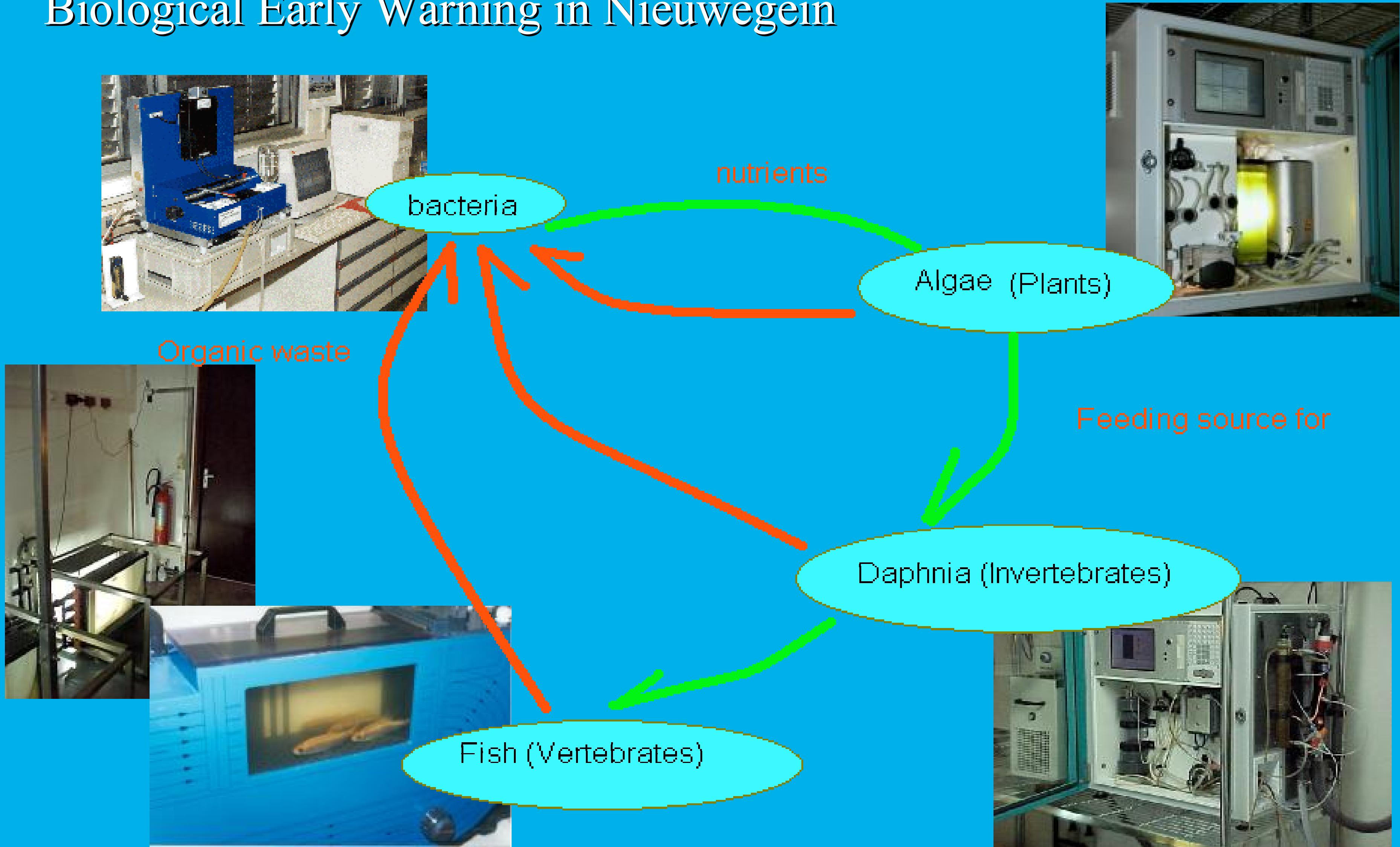
• pH	<6 or >9
• chloride (mg/l)	300
• individual volaties (µg/l)	20
(Diisopropylether	50)
• apolar organics (µg/l)	3
(tributylphosphate	5)*
(pesticides / metabolites	1)*
• polar organics (µg/l)	3
(pesticides / metabolics	1)*
• daphnids / algae / mussels	expert judgement

)* WRK prefers ≤ 0.3 µg/L

History BEWS at Nieuwegein

- 1988	**Kerren fish monitor**
- 1994	Kerren daphnia monitor
- 1995	Mussel monitor (Delta Consult)
- 1996	DF-algae monitor (University Regensburg)
	Kerren daphnia monitor out of use
- 1998	Test Microtox-OS (Azur)
	Test BBE daphnia monitor/Limco MFB
- 1999	BBE daphnia monitor (1-channel version)
	Test Regensburger Leuchtbacterientest (TOXcontrol)
	Mussel monitor out of use
- 2000	**BBE algae toximeter**
	BBE daphnia monitor changed to 2-channel version
	DF-algae monitor out of use
	BBE/WRK fish monitor
	Use of Projex software (data management)
- 2002	**ToxControl (Microlan)**

Biological Early Warning in Nieuwegein



Online Data Management

Default procedure with BEWS: signal output via 4-20 mA to operator
Drawbacks: * each parameter requires one channel
* BEWS can mostly provide only 1 or 2 channels for output
* signal translations to and from 4-20 mA is required on both sides (limited scales)

At Nieuwegein:
* Each BEWS is connected as a workstation to a central server
* Each BEWS provides an ASCII file (daily format) with **all data** (appending new data)
* The ASCII files are copied every minute to a central server

Online Data Management: Projex TableGrabber

F:\data\algae\060911at.dat

F:\data\daphnia\060911dp.cv1

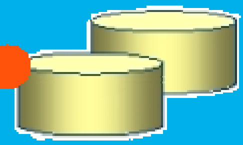
F:\data\daphnia\060911dp.cv2

F:\data\toxc\20060911.bac

F:\data\fish\20061109.vis

Database

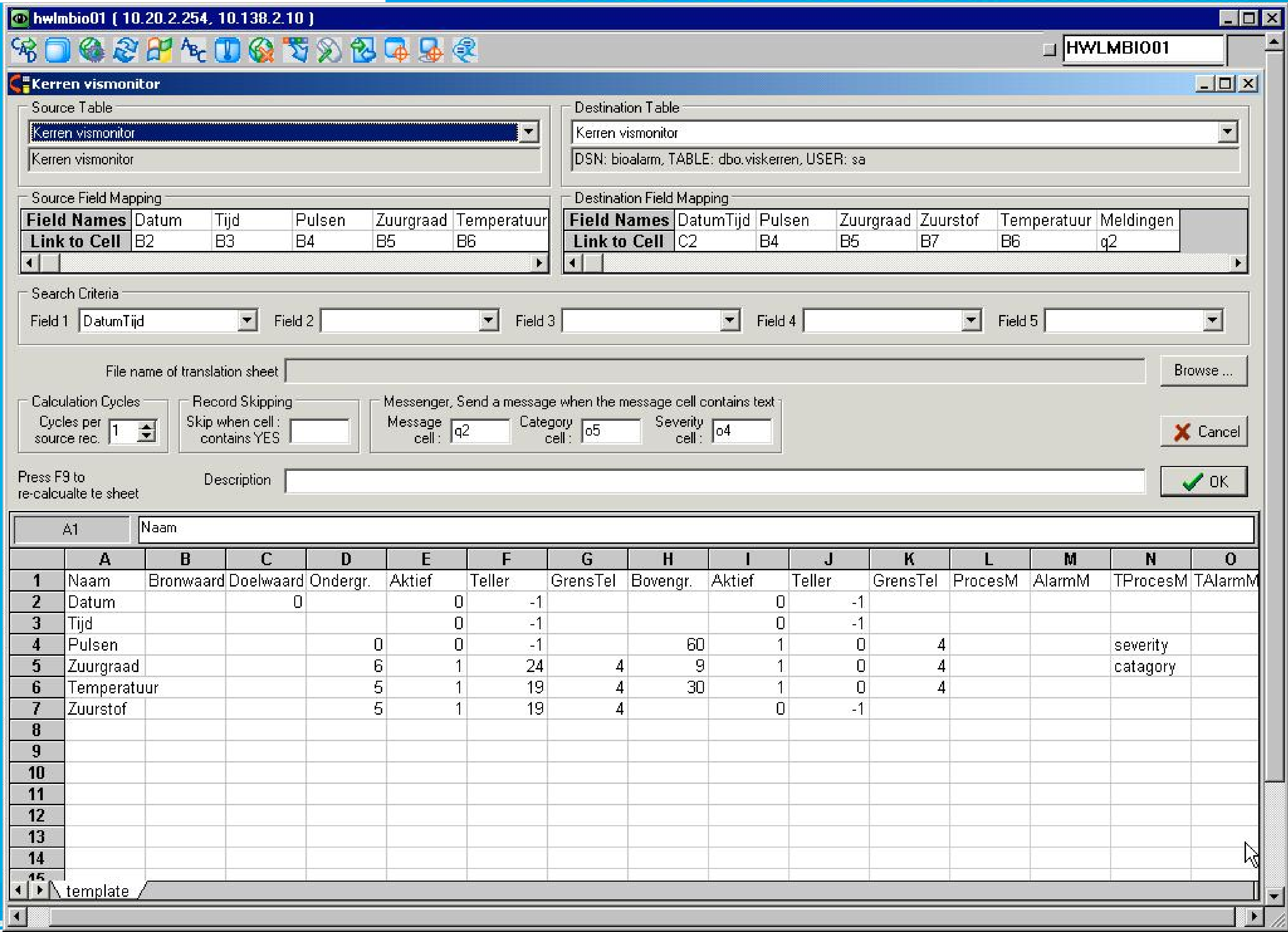
(SQL server)



Projex TableGrabber
(www.projex.nl)

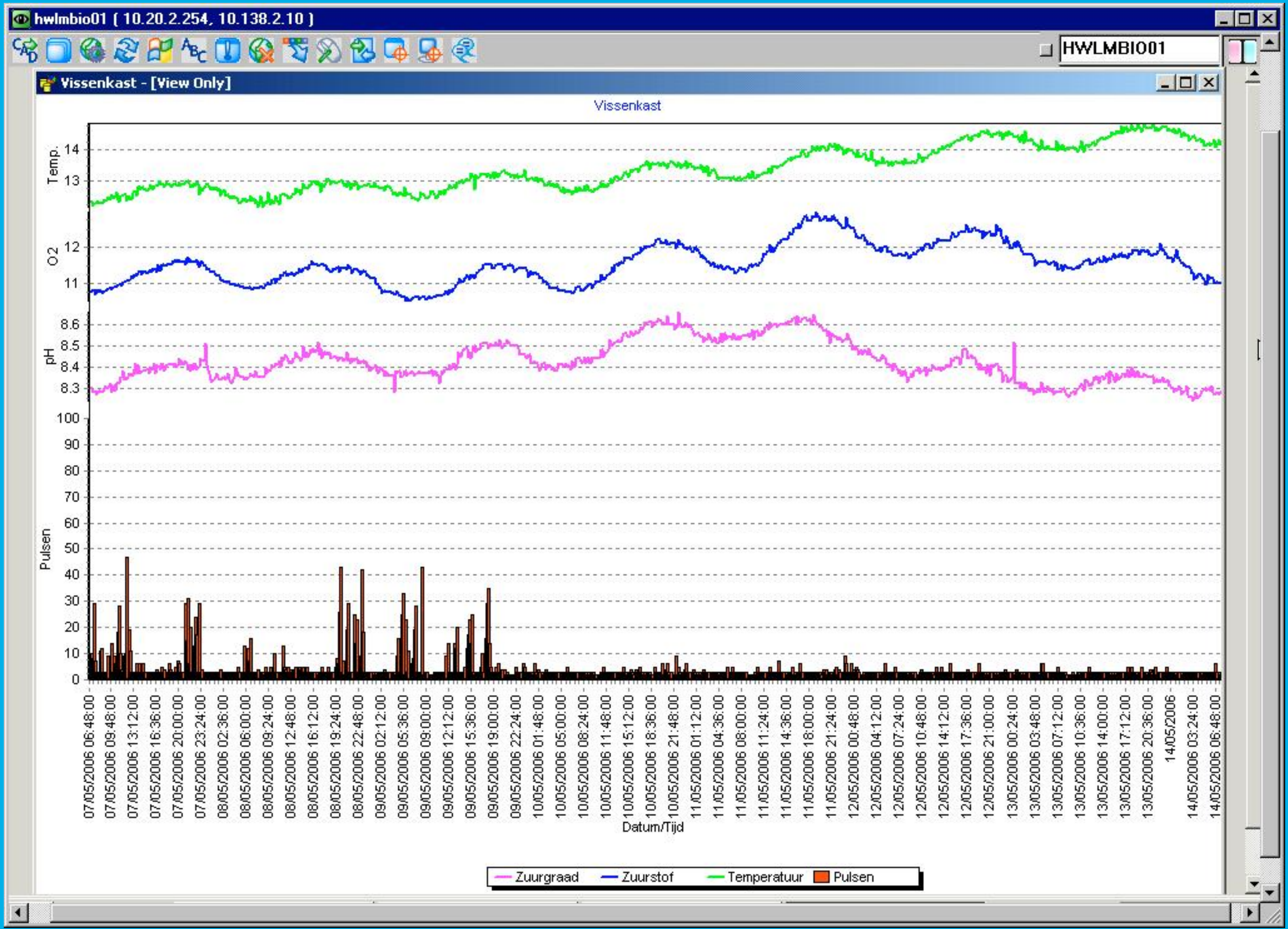
* Data selection possible
* Alarm or process thresholds can be set at each signal or data point
* Delays can be set before obtaining a real alarm
* Combination of data for 1 specific alarm can be set

HET WATERLABORATORIUM



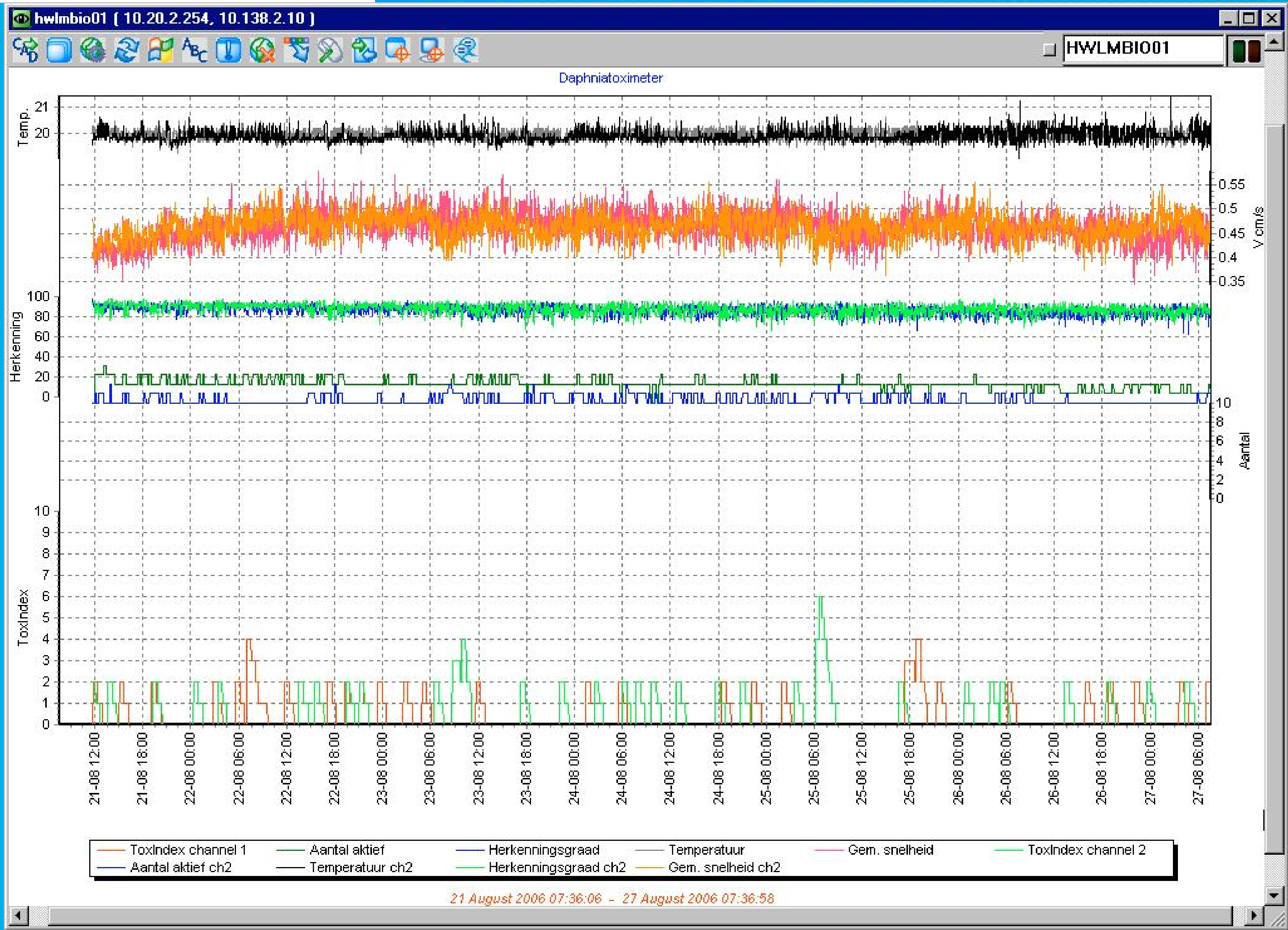
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Naam	Bronwaard	Doelwaard	Ondergr.	Aktief	Teller	GrensTel	Bovengr.	Aktief	Teller	GrensTel	ProcesM	AlarmM	TProcesM	TAlarmM
2	Datum		0		0	-1			0	-1					
3	Tijd				0	-1			0	-1					
4	Pulsen			0	0	-1		60	1	0	4			severity	
5	Zuurgraad			6	1	24	4	9	1	0	4			catagory	
6	Temperatuur			5	1	19	4	30	1	0	4				
7	Zuurstof			5	1	19	4		0	-1					
8															
9															
10															
11															
12															
13															
14															

Online Visualisation: Projex Graphigator



results are presented online; graphs are user-defined; stacks possible

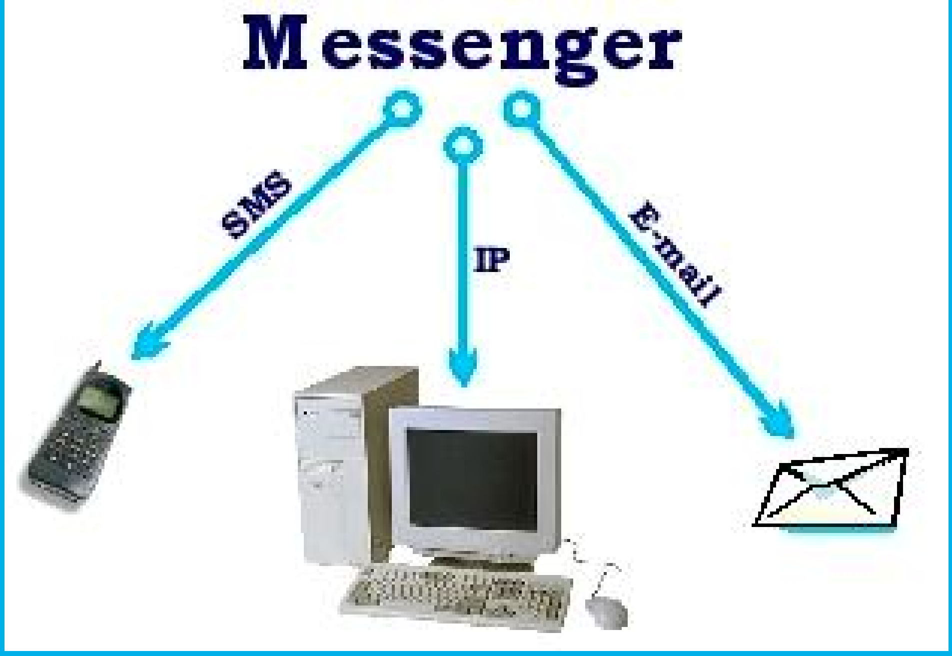
HET WATERLABORATORIUM



A well-ordered graph presentation of different end-points

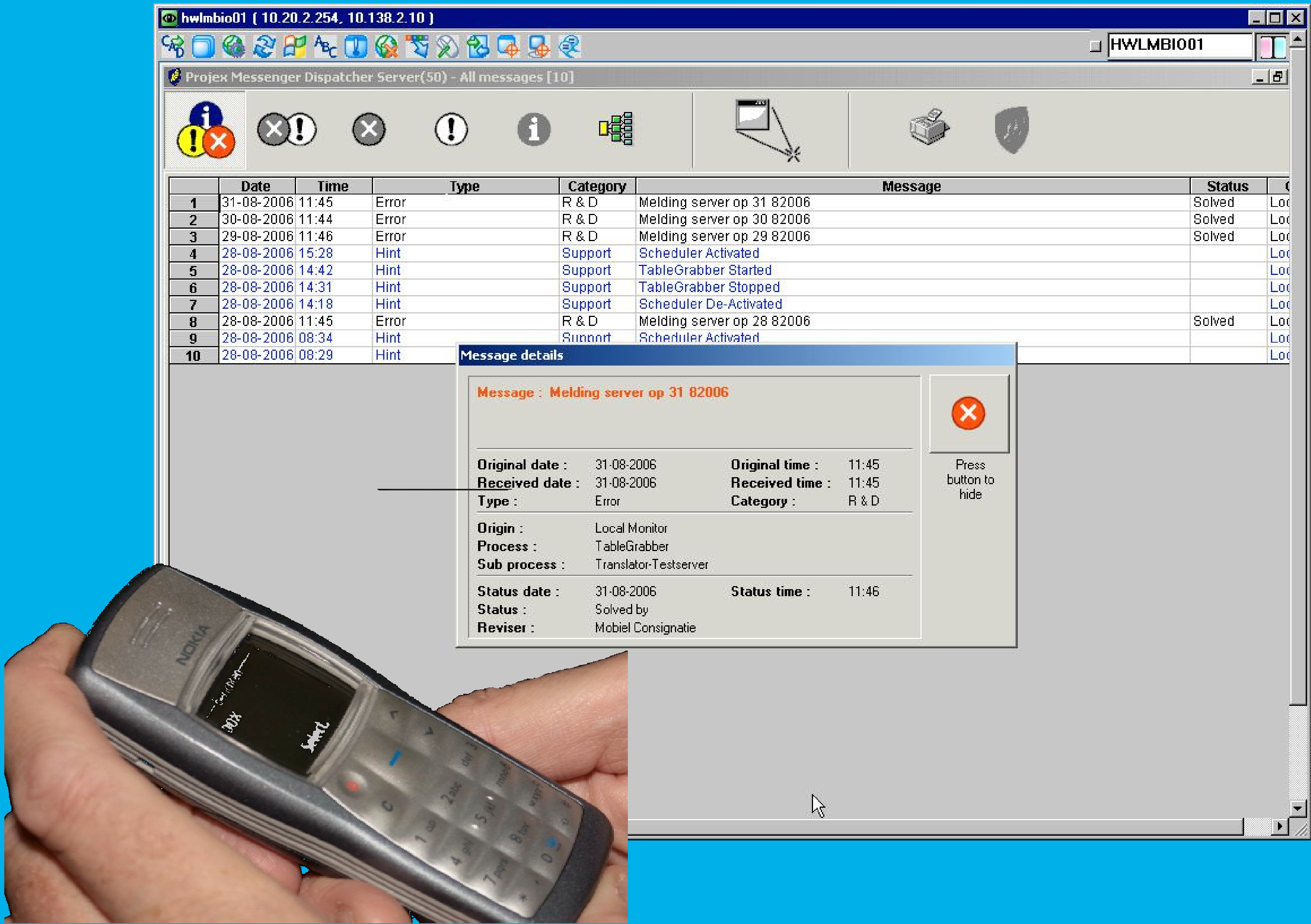
Online Alarm Management: Projex Messenger

TableGrabber
* Signal exceeds a threshold



* Each BEWS has a specific SMS message with the signal that presented the alarm
* Alarm or process signals can be sent to different users (Operator, R&D, Manager)
* Messenger can also present alarm when an application has been stopped
* All alarms are saved in history file

HET WATERLABORATORIUM



Alarm Protocol

☠ SMS message to laboratory technician (standby shift)

* Examination of data (via notebook and VNC viewer at a distance) using a checklist of the instrument that presented the alarm

When positive:
* Examination of instruments at location

When negative:
* Logged as false positive

Still positive (no malfunction of system(s))
* Message to advisor HWL (standby shift)
* Samples are taken for analysis on organics and metals

Must be performed within 3 hours

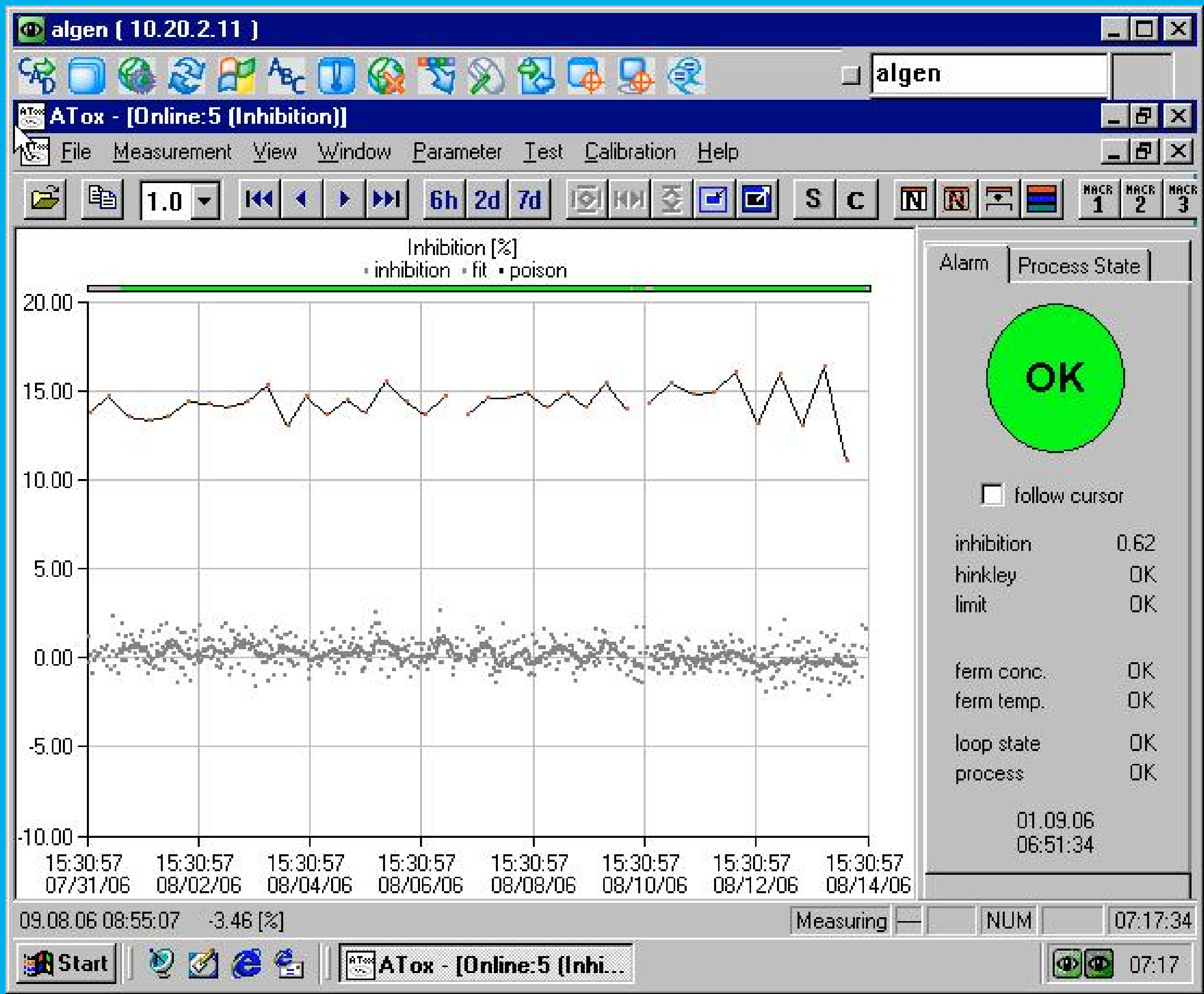
HET WATERLABORATORIUM

Reliability of the instrument:

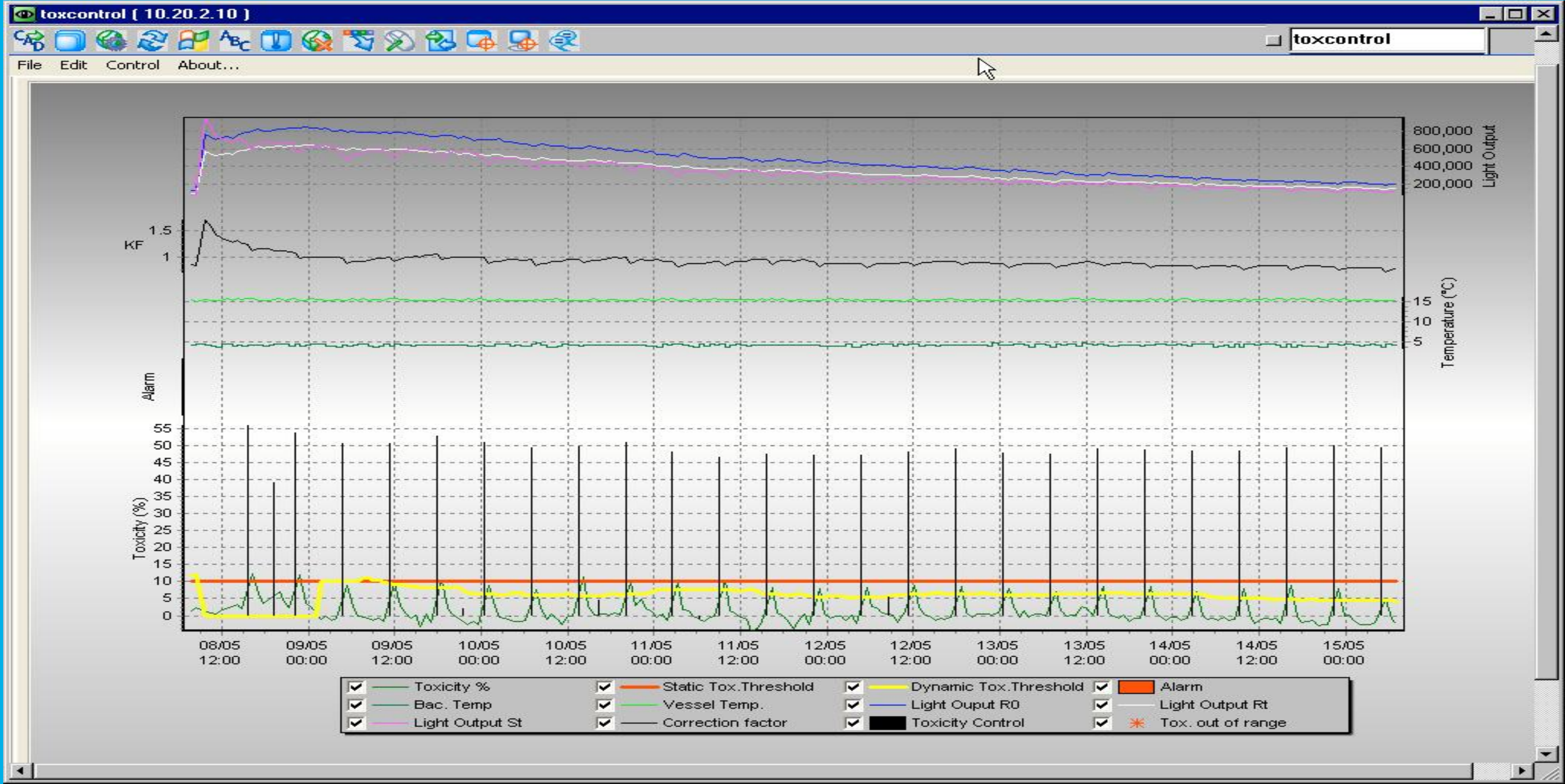
Algae Toximeter

control standard:
5 µg/l Diuron

measured automatically every 13 surface water measurements



Toxcontrol -> Control standard is 10 mg/l Zn^{2+}
(measured every 10 surface water measurements, automatically)



Fish monitor and daphnia monitor: no suitable control measurement present

Advice to the drinking water company (independent of analysis)

- if instrument(s) are still presenting alarms 3 hours after the alarm message*

Reduction of the inflow of surface water at the intake

- if instruments(s) are still presenting alarms 6 hours after the alarm message

Interruption of the abstraction

* = if analysis supports the alarm or when death of organisms is observed in the instruments (confirmed) -> advice to stop at once

Concluding Remarks

- Choice of EWS depends on risk assessment of the source
- Online data and alarm management when using EWS is crucial
- An evaluation procedure for a given alarm is required
- Use ofcontrol standard measurements is handy to verify if the instrument was performing correctly
- A protocol should be present for the follow-up and actions when a positive alarm is presented (24 hours a day, 365 days a year)

HET WATERLABORATORIUM