SEO | Société Electrique de l'Our

Windsim User Meeting 2011

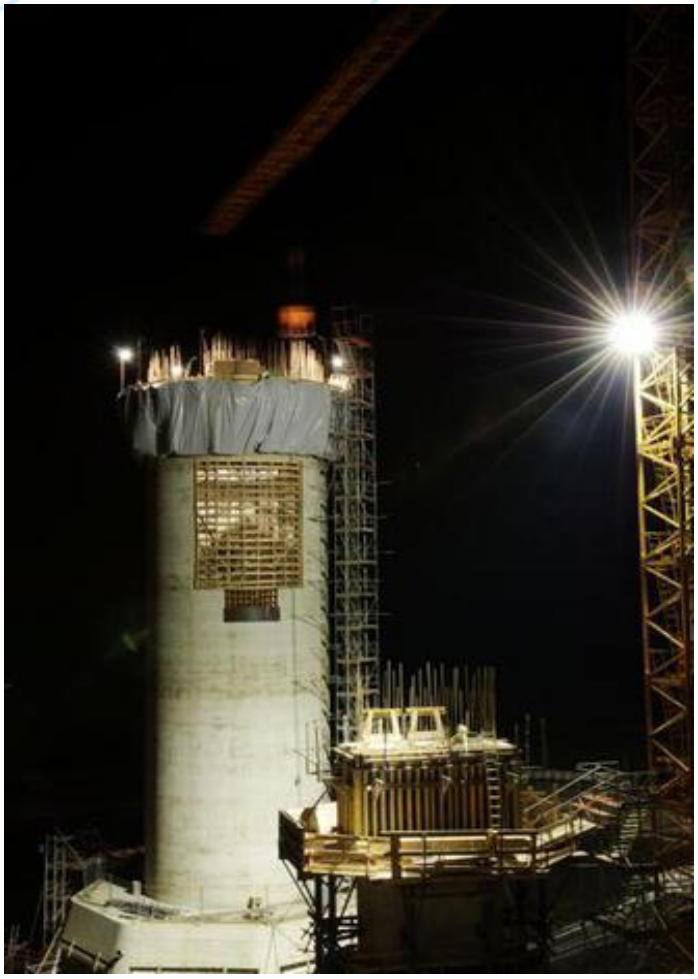
Towards a better understanding of complex Windsim simulations

**Sensitivity Study of Windsim,
starting with simple testcases
and increasing complexity step-by-step**

By Patrick Biwer / SEO S.A.

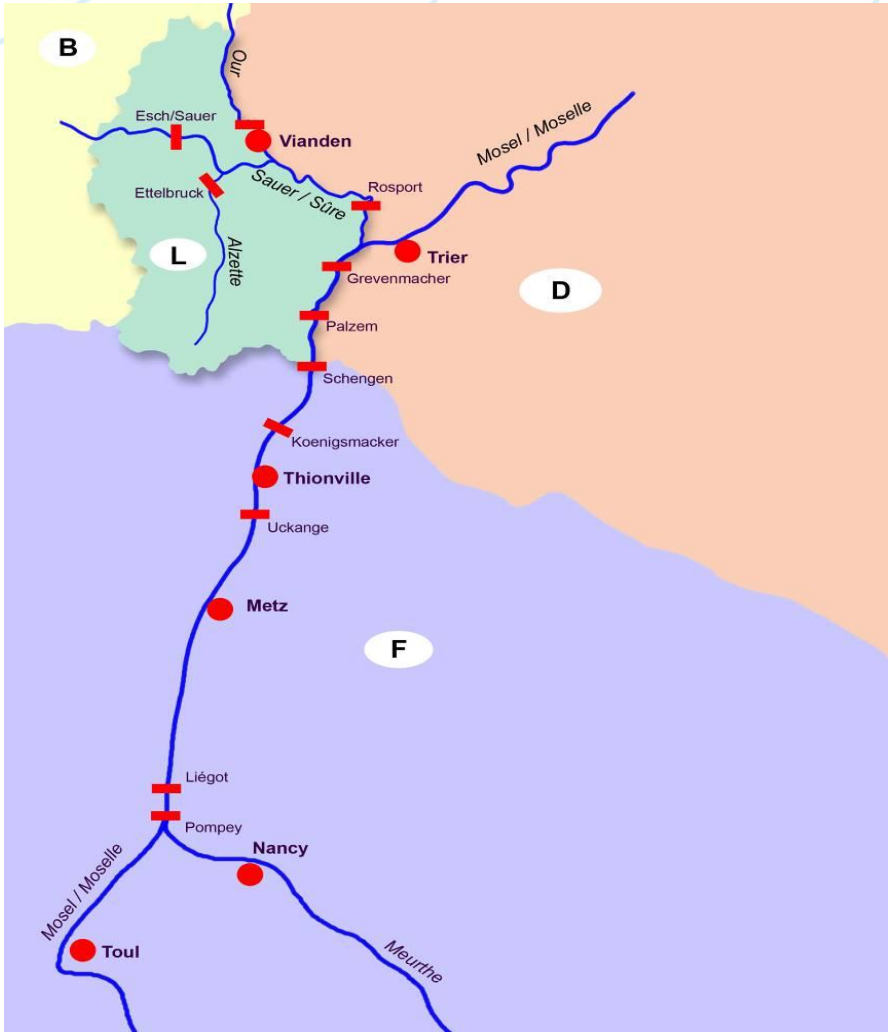
Presentation of the company SEO

- Founded in 1951 with a concession to exploit the hydro-electric potential of the Our valley
- Core activity: pump storage power station next to Vianden
- Stakeholdings in several companies operating in the renewables energy sector; stands for 95% of the electricity produced from renewable energy sources in Luxembourg
- Listed company with the Luxembourg Government and RWE Power AG as main shareholders (40,3% each)
- Employs today 201 people



Hydroelectric power plants

- 10 separate run-of-river power stations
- total installed capacity: 47,4 MW (ranging from 13,0 MW in Esch s/Sure to 0,2 MW in Ettelbruck)
- production in 2010: 135 GWh
- feeding the grids of RWE (Germany), Enovos (Luxembourg) and EDF (France)
- 20 people in charge of the maintenance



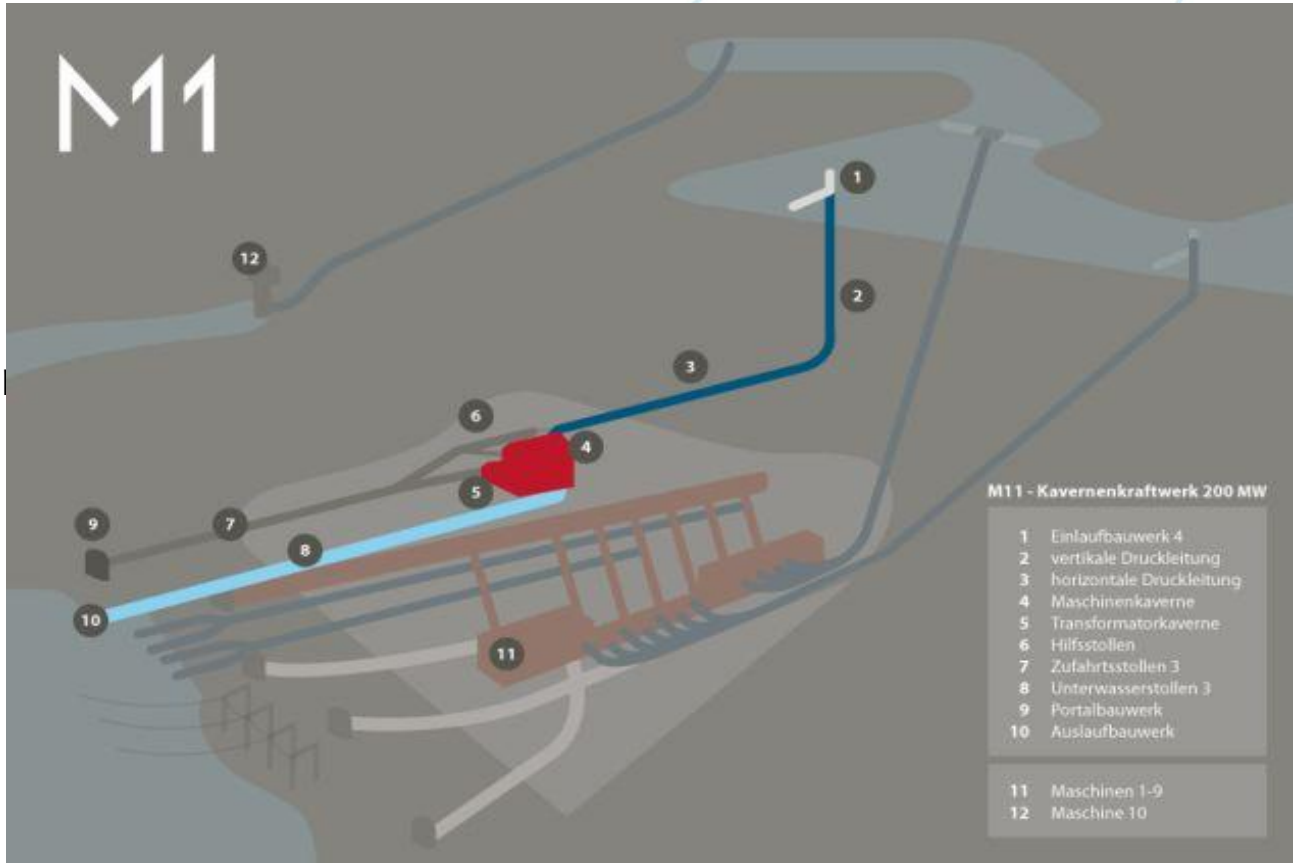
The Vianden power station

- Located at the river Our on the German border, next to Vianden
- 3 main works, the upper & lower basin and the powerhouse
- in service since 1964/1965
- extension in 1976
- further extension in process

SEO - Investment project

EXTENSION OF THE VIANDEN PLANT BY M11

- Vertical shaft pump turbine of 200 MW
- increasing the reservoir capacity by 500.000 m^3
- separate underground power house
- 155 MM€ Investment
- 100 MW + 500.000 m^3 conceded to Enovos (on a virtual basis)



SEO - Investment project
More pictures available at website : www.seo.lu

The Vianden power station (cont'd)

Installed capacity	1100 MW (turbine power output) 836 MW (pumping power intake)
Type of installation	pump storage
Water Volume	6,8 million m^3 (equiv. of 4,6 GWh)
Head	280 m
Production	> 800 GWh p.a.
Grid connection	220 kV (RWE grid)
Unit management (Essen)	RWE

Wind Farms

Site	Share	Since	Capacity	Prod. ‘10
Mompach	100%	2004 (1996)	4 x 500 kW (Vestas)	1,8 MWh
Heinerscheid I - III	20%	1998 - 2004	- 3 x 600 kW (Nec Micon) - 5 x 1000 kW (Vestas) - 3 x 1800 kW (Enercon)	16,8 MWh
Kehmen	30%	2005	7 x 1800 kW (Enercon)	18,3 MWh
Burer Bierg	36,25 %	2008	4 x 2000 kW (Enercon)	8,8 MWh
			34,8 MW	**45,7 GWh**

Windsim User Meeting 2011

- Introduction
- Presentation of company
- Problem description & Motivation
- Solution proposal
- Questions & Comments

Windsim User Meeting 2011 / Motivation 1

- SEO S.A. uses Winsim :
  - for metmast position selection
  - to evaluate the ongoing collection of meteo data
  - Windfarm ernergy prediction and site optimization

Windsim User Meeting 2011 / Motivation 2

- But …
- How to explain the results of a complex simulation to a board of directors with no or few konwledge about CFD ?
- What about the parameters, does the end result change a lot when a sensitive parameter varies a little ?
- What about the sensitivity of the predicted AEP (€€€) or (€)?

Windsim User Meeting 2011 / 4-step strategy

- **Step 3 :**
  Varying the different 'important' parameters
  - angle of steepness
  - angle of windspeed & direction
  - terrain roughness

and ....

- **Step 4 :**
  Planting the hill and surroundings with forest
  (by modifying the C2 parameter)

Windsim User Meeting 2011 / Solutionproposal 1

- Creation of temporary sub user group
  - Logistics provided by SEO, Windsim
  - Common playground needed for file sharing , Blogs and user comments
  - Number of (virtual) meeting : 3-4
- Time schedule :
  - Start : no later than one month after current user meeting.
  - Finish: to be done with everything not later than one month before the next user meeting in 2012.

Windsim User Meeting 2011 / Solutionproposal 2

- Tools to be used :
  - Global Mapper
    (for creating and editing the different maps)
  - OpenSource GIS : Quantum & Grass GIS
  - Windsim 5.0.1 (5.1 if available)
  - Common Webspace or FTP-Server for file sharing
  - Teleconferencesystem with toll-free 800 #
    provided by PTT Luxembourg .
  - Just bring your time and laptop ...

Windsim User Meeting 2011 / Solutionproposal 3 / Actions

- Defining roles of Sub-Usergroupmembers
- Agree on common testcases
  (use of Windsim-cosine-hill testcase as first reference)
  - Variation of steepness
    (e.g. from 1 degree to 16 in 2 degree-steps)
  - Variation of roughness
    (e.g. from 0.02 to 0.2 in 0.02 steps)
  - Adding forest (in the valley, slope and plateau)
- Creating, running the simulations, controlling (QC) and sharing the results in the Windsim User Group
  (Closed Group = Benefit for Licensed Users)
- Conclusions at the next Usermeeting in 2012.

Windsim User Meeting 2011 / Questions and Comments

Windsim User Meeting 2011 / Thank you for your attention