



GROUND REACH

HEATING AND COOLING WITH GEOTHERMAL HEAT PUMPS

Airotel Stratos Vasilikos, Athens

January 24, 2008

Quality control of borehole heat exchanger installations - the Swiss experiences

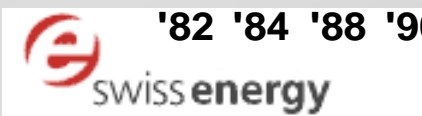
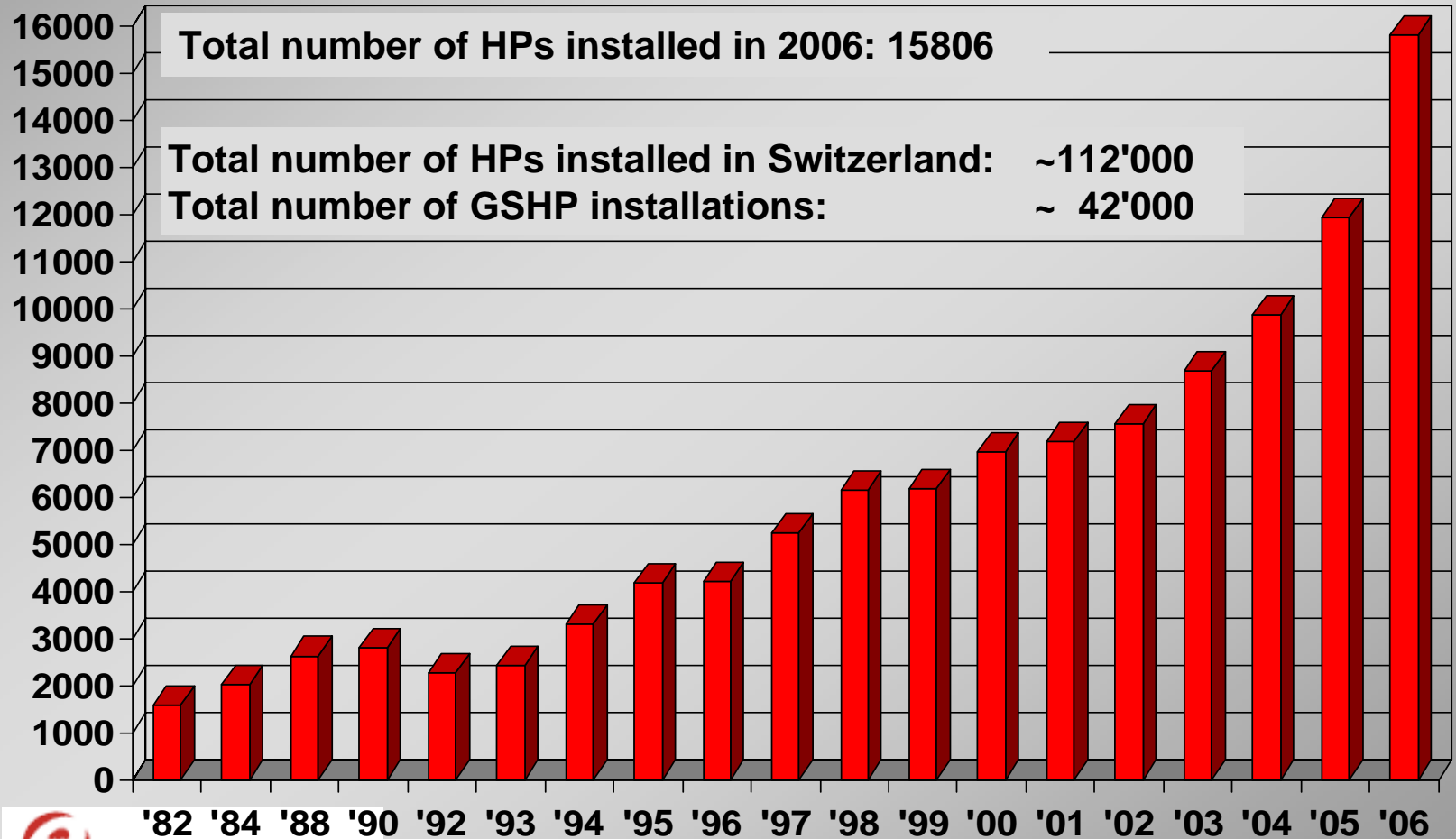
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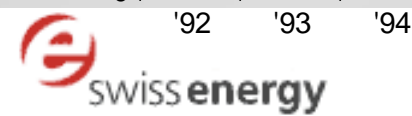
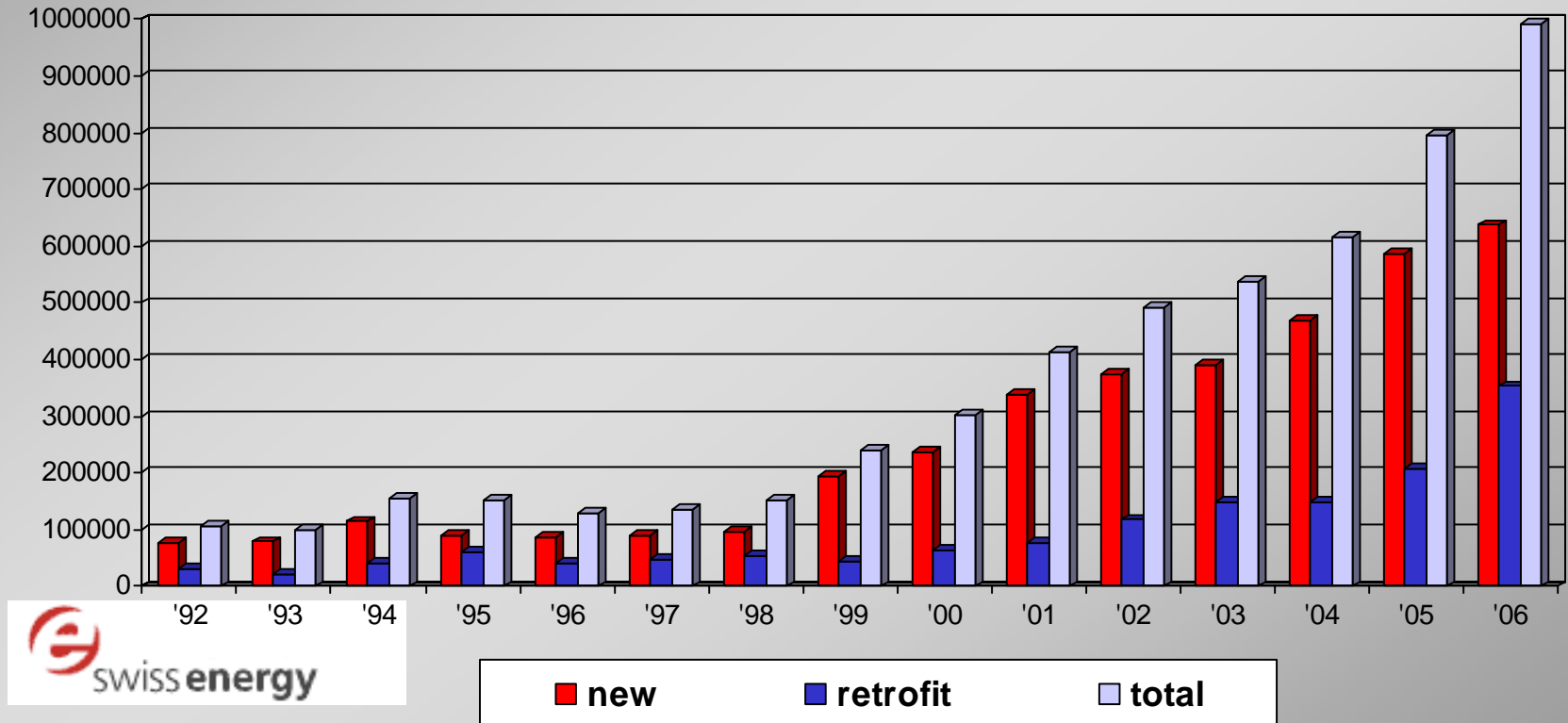
- **Introduction**
- Legislation and licensing
(ground water protection)**
- Design**
- Quality assurance of BHEs
(Swiss quality label)**
- Summary**



Heat pump market in Switzerland



Borehole heat exchanger market in Switzerland



Total number of meters drilled for BHEs per year



Swiss quality label for drilling companies



Introduction

→ Ground water protection and legislation

Design

Quality assurance of BHEs (Swiss quality label)

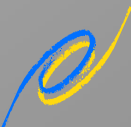
Summary



Legislation:

Water protection law of January, 24, 1991

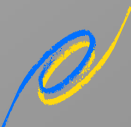
- due diligence for every one
- it's forbidden to pollute ground-water
- it's forbidden to connect different ground water storeys
- every drill hole in a ground-water protection area needs a licence





Licensing:

- Every BHE installation needs a license (applied for in advance) by the ground-water protection authority
- BHE's
 - are strictly prohibited in inner ground-water protection zones (near water well)
 - are licensed in all unprotected areas
 - could be licensed in outer protection areas



Licensing (suite):

- BHEs are not allowed in e.g.
 - karstic areas
 - areas with possible geogenic impacts
 - known contaminated sites
- BHE's could get a license under special conditions in areas with e.g.
 - different ground-water storeys
 - artesian ground-water
 - strongly mineralized water

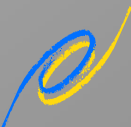


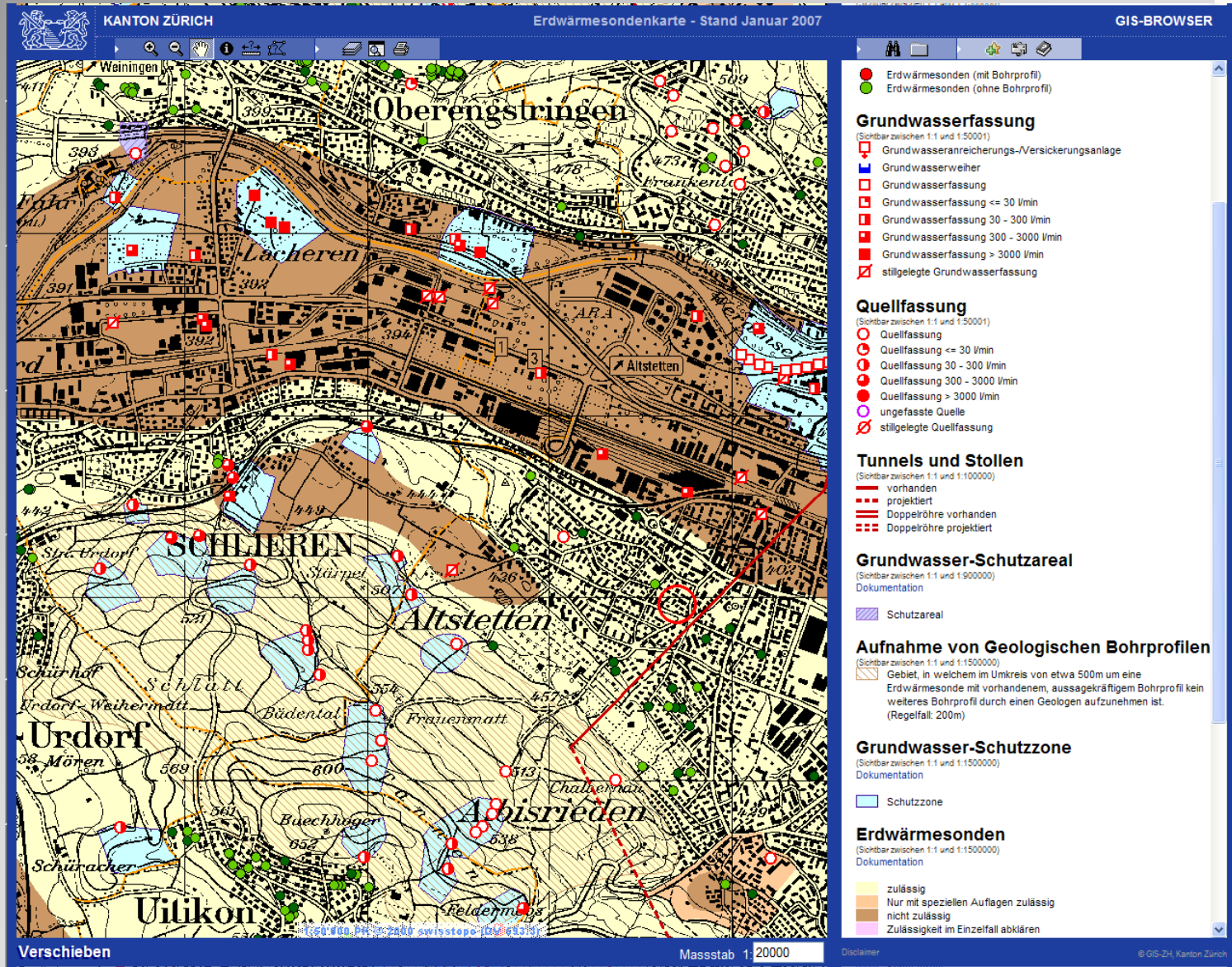


Licensing (suite):

Licensing authorities prepare BHE license maps (mainly web-based GIS applications) with indication at which location BHEs:

- are allowed
- are allowed under special conditions
- are not allowed







Standard licensing conditions (examples):

- announce the start of drilling work to authority
- announce all incidents that are relevant to ground-water and environment protection
- dispose drilling mud and fluids correctly
- BHEs have to be pre-fabricated and tested in factory
- BHEs are backfilled diligently and densely from the bottom to the top
- perform a pressure and flow test (SN EN 805)
- fill in a drilling and a testing record and send to authority



Standard licensing conditions (suite):

- only use heat carrier fluids without any threat to ground-water
- install a leakage alarm system

Special licensing conditions (e.g.)

- monitoring/supervision of drill work by a geologist
- limitation of BHE length
- permanent casing

Introduction

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(ground water protection)**

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(Swiss quality label)**

Summary



A correct dimensioning of BHEs

- assures a problem-free operation over the entire life cycle
- takes into account the real local conditions
 - real petrophysical conditions → e.g. thermal conductivity
 - real climatic conditions → e.g. temperature, operation time
 - real operation conditions → e.g. DHW, swimming pool, heating & cooling
- takes into account the real geometry of the BHE
 - diameter → 32, 40 or 50mm tubes
 - distance between BHEs, depth of BHEs
 - layout (line, rectangle etc.)



Consequences for simple installations

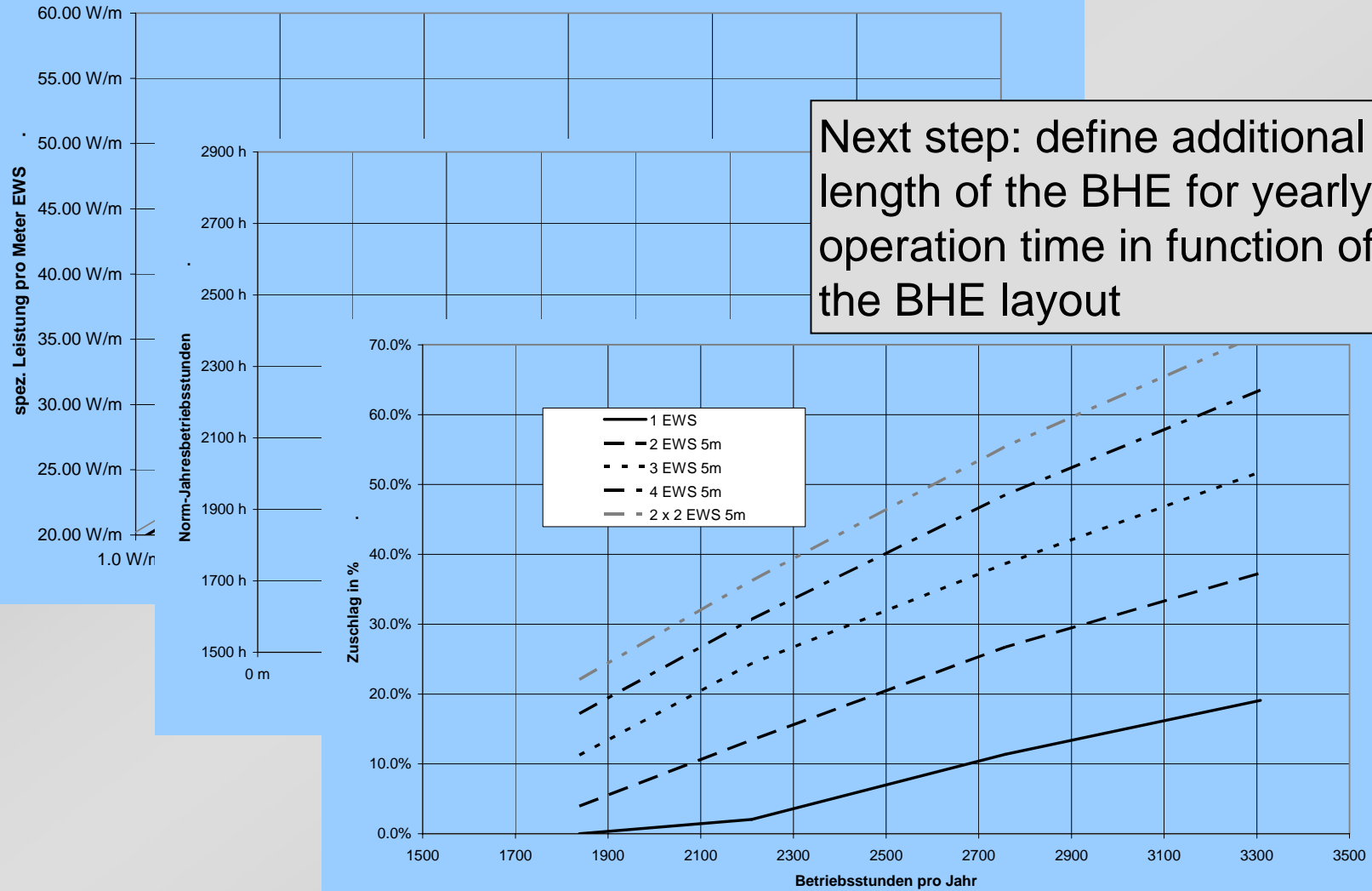
- no longer use the old-fashioned rules-of-thumbs

~~40 ... 45 ... 50 W/m~~

- dimension the BHEs according to SIA 384/6 → release in 2008
- BHEs dimensioned according to SIA 384/6 are a little bit longer than before

Example SIA 384/6

Next step: define additional length of the BHE for yearly operation time in function of the BHE layout



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(Swiss quality label)**

Summary

Quality control by client/owner

- commission only experienced planner or installer
- order a heat pump with quality label
- commission a drilling company with quality label
- ask for references



But: the personal experience and knowledge of each involved professional is essential





Quality control during drilling work

- **Drilling company with quality label**

- verified quality

- broad consulting of the owner by the drilling company

- clear communication of drilling risks and possible insurances

- yearly professional training of drilling staff

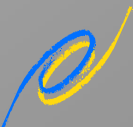
- yearly inspection of drilling staff on site

- technical coaching of drilling company

- drilling work conform with rules of ground-water and environment protection

- accurate intervention with a gaz / artesian water incident

- certified material and certified drilling work



Quality control during drilling work



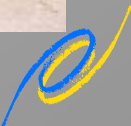
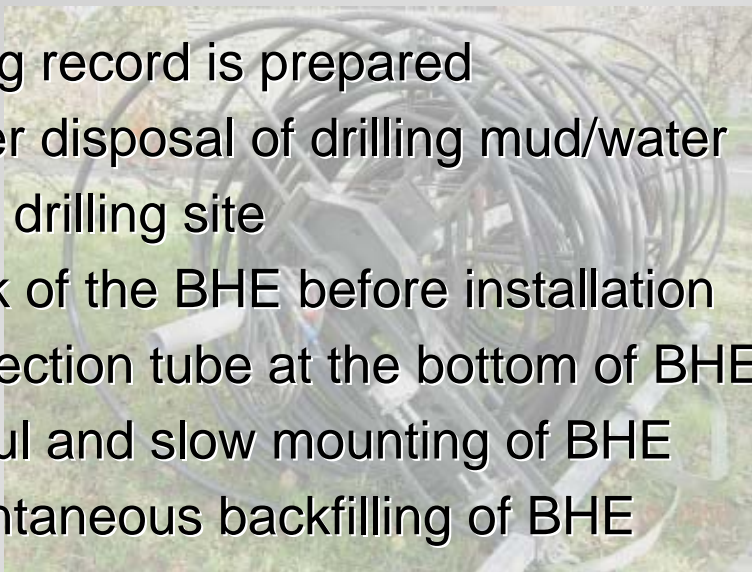
- no drilling without license
- accurate drilling equipment for local conditions
- trained drilling staff
- state-of-the-art drilling technique
- first intervention equipment on site
- complete backfilling equipment on site
- preventer or dense casing head



Quality control during drilling work



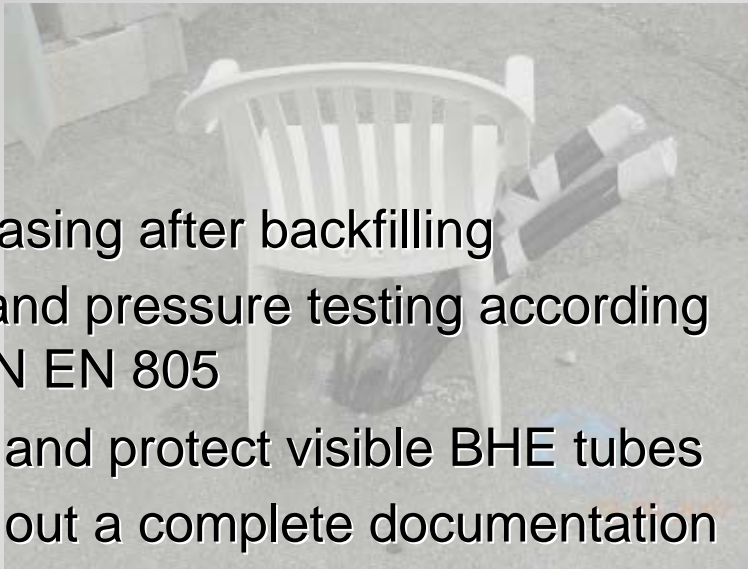
- drilling record is prepared
- proper disposal of drilling mud/water
- clean drilling site
- check of the BHE before installation
- fix injection tube at the bottom of BHE
- careful and slow mounting of BHE
- instantaneous backfilling of BHE



Quality control during drilling work



- pull casing after backfilling
- flow and pressure testing according to SN EN 805
- mark and protect visible BHE tubes
- hand out a complete documentation



Risks when drilling BHEs

- the landowner carries the risk of the underground
- the client carries the additional costs, induced by
 - repair of a gas or artesian water incident
 - drilling into karstic formations, ground-water layers, contaminated sites
 - all incidents relevant for ground-water and environment protection
 - drilling into special geological formations

It is highly recommended to effect an insurance which covers these risks.

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Summary

- each BHE needs a license (ground-water protection authority)
- the authority may impose special conditions
- commissioning of experienced professionals with a certain base knowledge (look for quality labels)
- correct dimensioning of the BHEs (SIA 384/6)
- insurances to cover the owners risks
- immediate grouting of the BHEs from the bottom to the top
- flow and pressure testing according to SN EN 805 with accurate test records





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