Assessment guidelines and certification scheme for ATES and BTES systems in the Netherlands

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ABSTRACT

In the Netherlands, a mandatory certification scheme for ATES and BTES systems is stated since 2014. By law, all companies are legally obliged to be certified for working on shallow geothermal systems. In this paper, a review is given of the development of the assessment guidelines, specific issues that are tackled in the guidelines, and some observations on the performance of the certification scheme in practice.

1. INTRODUCTION

To ensure sustainable and efficient use of subsurface space and maximize energy savings in practice, the Dutch developed a mandatory certification scheme for shallow geothermal systems. An assessment framework is made for the entire process of the design, realisation, operational management and maintenance of ATES (Aquifer Thermal Energy Systems) and BTES (Borehole Thermal Energy Systems), and the framework is enforced by law since 2014 (Ministerie van Infrastructuur en Milieu, 2013).

In this paper, a review is given of the development of the assessment guidelines, specific issues that are tackled in the guidelines, and some observations on the performance of the certification scheme in practice.

2. OBJECTIVE OF CERTIFICATION

An important incentive to develop a certification scheme was poor (insight in the) performance of previously implemented systems, and disappointing energy savings. Because these systems make use of the subsurface and affect it permanently, the Dutch legislator wants to ensure optimal and sustainable use of this common pool resource.

Important observations from prior to the certification were that ATES or BTES were sometimes implemented only to meet building legislation in the design phase, and not because of the wish to realise a real sustainable installation. In the realisation phase, it was noticed that the lowest price generally overruled sound quality. During operation there often was not much focus on real energy saving.

The government encourages the use of ATES and BTES and allows the use of the subsurface for storing heat and cold. Obviously, real emission reductions must be achieved; otherwise this use of the underground has no purpose.

Certification was meant to set a minimum quality standard for design, realisation, operational management and maintenance of shallow geothermal systems. Moreover, certification also aims to encourage an integrated approach, resulting in an installation in which each part fits well in the total system and the installation operates with optimum energy saving. The development of the certification scheme was commenced in 2009.

3. SCOPE OF APPLICATION

The scope of application of the scheme includes all shallow geothermal systems up to a depth of 500 meters below ground level. In the regulatory system, a definition is given for the ATES and BTES systems (Ministerie van Infrastructuur en Milieu, 2013):

- ATES: Installation where the soil is used to supply heat or cooling capacity for the purpose of heating and cooling in buildings, by extraction of groundwater and returning it back into the soil after use, including related source pumps and heat exchanger and, where these exist, heat pump and regeneration facility.
- BTES: Installation where, without extraction of groundwater and returning it back into the soil after use, the soil is used to supply heat or cold for the purpose of heating and cooling in buildings, by means of a closed circuit, including a related heat pump, circulating pump and regeneration facility, where these exist.

Important to note that in these definitions, the heat pump and regeneration facility is part of the shallow geothermal system. This emphasizes the fact that the underground wells or borehole system as such, cannot be considered as a complete installation: in order to control the subsurface energy balance or to support

emission reduction, the complete installation, including the above-ground parts, must be considered.

4. DEMARCATION AND INTERACTION

In the assessment guidelines, a demarcation is made between the underground and the above-ground section of the shallow geothermal system. Each of these sections has a separate certification scheme.

- The underground scheme is managed by SIKB, a Dutch network in which the private and the public sector strive to continuously and structurally enhance the standards of activities relating to soil management in the Netherlands.
- The above-ground section is managed by InstallQ (formerly KvINL), a similar organization to SIKB, but with a focus on installation technology.

The demarcation of the sections is at the heat exchanger (Fig. 1). This was a deliberate decision: the underground section could be commissioned and tested separately on aspects like circuit tightness and the control system. As a result, drilling companies have a broader scope than only drilling the wells or boreholes.

To ensure a design integrated with the building/climate installation, so-called communication models were developed. Here, a communication model is a table in which all necessary information is jointly documented by the designers of the underground and above-ground sections. Several tables exist, each for a different phase of the design process, to facilitate the data-exchange and formulating a clear base-of-design. In Figure 2, an example is given.

The current schemes are known as BRL SIKB 11000 (2014) and KvINL BRL 6000-00/21 (2017). New versions are prepared and expected to become effective at the outset of 2020.

In the Netherlands, a certification scheme for mechanical drilling already existed since 2010 (BRL SIKB 2100, last version 2018). This scheme is complementary to BRL SIKB 11000. In order to realize wells or boreholes for ATES or BTES, a certificate for both schemes is needed.

Figure 1: Installation with a shallow geothermal system, with the demarcation between the underground and above-ground section of the shallow geothermal system (SIKB Protocol 11001, version 3.0, to be published).

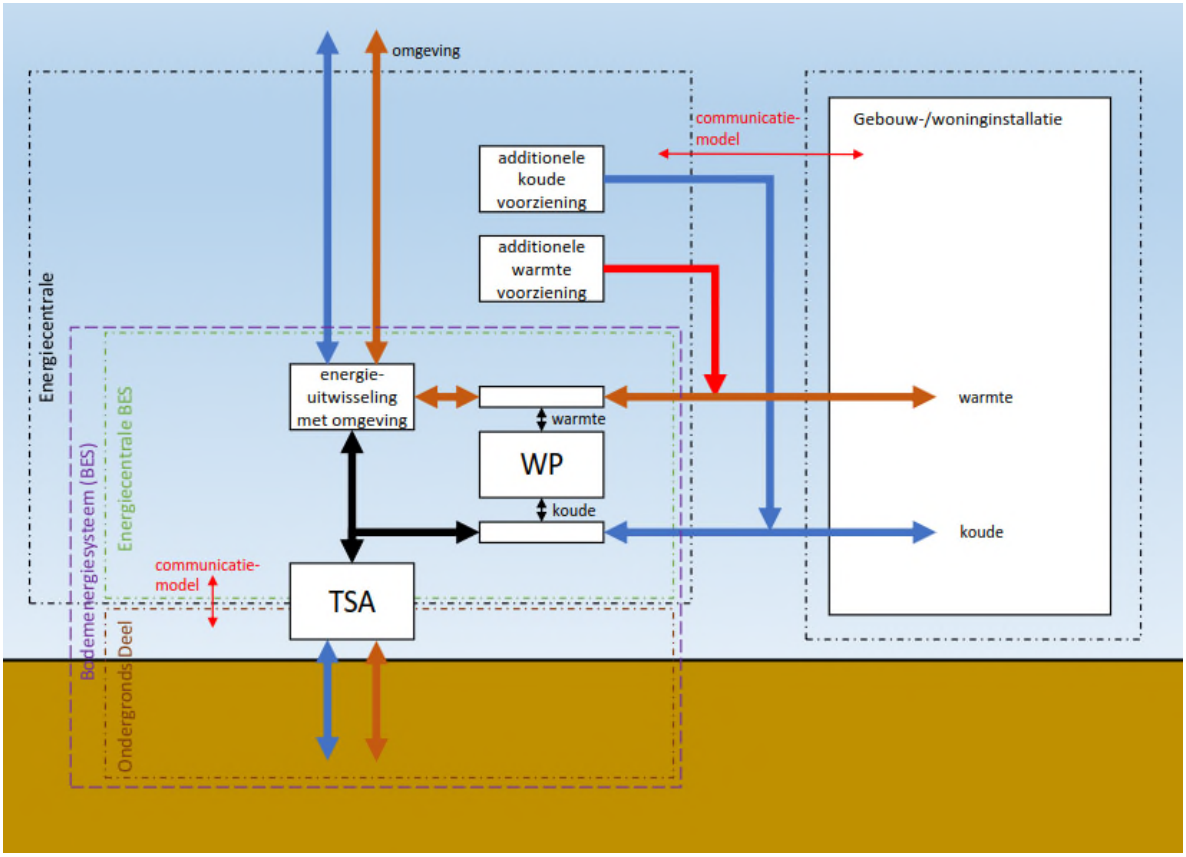

Figure 2: Example of a communication model that is used to facilitate data-exchange between underground and above-ground designers of the shallow geothermal system (SIKB Protocol 11001, version 3.0, to be published).

		ontwerpsituatie		minimaal		jaargemiddeld		maximaal	
Ontwerpgegevens	Eenheid	Warmte leveren = koude laden	Koude leveren = warmte laden	Warmte leveren = koude laden	Koude leveren = warmte laden	Warmte leveren = koude laden	Koude leveren = warmte laden	Warmte leveren = koude laden	Koude leveren = warmte laden
Energie									
Energiestroom warmte en koudelevering	MWh/jaar								
Aanvullende energiestroom regeneratie	MWh/jaar								
Aanvullende afvoer condensorwarmte bij warmtepomp als koelmachine	MWh/jaar								
Totaal energiestroom (inclusief bandbreedte)	MWh/jaar								
Netto overschot in de bodem (indusief bandbreedte)	MWh/jaar								
Vermogen									
Vermogen warmte en koudelevering	kW								
Aanvullend vermogen regeneratie	kW								
Aanvullend vermogen bij afvoer condensorwarmte bij WP als koelmachine	kW								
Totaal vermogen	kW								
Temperatuur									
Natuurlijke bodemtemperatuur	°C								
Onttrekkingstemperatuur	°C								
Infiltratietemperatuur	°C								
ΔT tussen onttrekking en infiltratie	°C								
Debiet									
Brondebiet	m^3/h								
Ontwerpcapaciteit bronpompen (vergunningaanvraag)	m^3/h								
Watervolume									
Grondwaterverplaatsing	$m^3/jaar$								
Grondwaterverplaatsing (vergunningaanvraag)	$m^3/jaar$								
Electrische energie									
Energiegebruik bronpompen	MWh/jaar								
Rendement									
SPF_{BES} (totaal verwarmen en koelen)	-								

5. TECHNICAL ASPECTS

A mandatory certification scheme will only uphold itself and work out positively, when the necessary requirements on sustainability are combined with a pragmatic approach. If not, the demands in the certification scheme are not workable and will not be obeyed in practice. Or, in case of excessive demands, ATES and BTES systems will become too expensive in relation to other sustainable techniques for heating and cooling. The certification scheme was developed in close cooperation between the private and the public sector, including end-users, certifying bodies and regional authorities. The input and know-how of drilling and constructing companies was needed to come up with workable and supported guidelines.

A few examples of how technical aspects were approached in the certification scheme and in the law:

- Energy performance: the question emerged whether it should be acceptable to state a minimum energy performance for shallow geothermal systems. Stakeholders agreed that a general performance level was not possible and not workable. For instance, when using the system for cooling, energy savings are higher than when heating is used (in combination with the heat pump). So the use of the system determines the energy performance. Moreover, the developer of a building must keep freedom of choice between investment level and energy saving goals. But despite these objections, some binding agreements on performance are desirable for all parties.
  The question was solved by introducing an energy performance factor, which can be seen as a private agreement between client and contractor. In the agreement, the conditions to meet this performance can also be elaborated.
  To ensure that this performance agreement is actually met in practice, the energy performance factor must be reported in the permit application of the shallow geothermal system. Authorities will roughly check whether the given performance factor is acceptable, but will not interfere with most choices made during installation design. In the certification scheme, the performance factor is one of the items in the communication model, that is documented during the design phase.
  The actual energy performance must be measured during exploitation and must be reported annually to the authorities. In case of poor performance, the client can address the contractor on this point. In addition, authorities can ask for an action plan to improve the systems performance. With the measurement of the energy performance factor, ATES and BTES systems are the first sustainable climate installations in the Netherlands that actually monitor their performance during exploitation.
- Technical and functional completion: in general, the completion of a climate installation system takes place after testing and acceptance that all technical requirements have been met. For shallow geothermal systems, it is important that after technical completion, the installation is properly adjusted to the actual energy demand and working conditions of the building installation. Fine tuning the building installation in combination with the shallow geothermal system will take about one or two years, in which all seasonal aspects have

passed and adjustments are made to ensure proper functioning and to get grip on the subsurface energy balance.

Active operational management of the installation needs to be taken up directly from the start. However, in the busy times while first occupying a building, the contracting of an operational management and maintenance (o&m) company may well be delayed.

In the certification scheme, this question is solved by adding two years of o&m to the realisation phase. This assures that after 'technical completion' the contractor remains involved and no gap develops in o&m. After two years, the installation is ready for so-called 'functional completion'. End-users fully supported this solution.

However, certifying bodies identified practical problems: realisation and o&m are two different scopes in the certification scheme, each with their own type of requirements. So, when certifying an installation company, is it necessary for the certifying body to assess it on both scopes, installation and o&m?

After discussing the item in the technical committee, parties agreed that a soundly performing installation, which is after all the key objective of the certification scheme, outweighs the justified concerns of the certifying bodies. In cooperation, a workable requirement was elaborated to properly certify the scope of installation, including two years of o&m.

6. DEVELOPMENT STAGES OF A SCHEME

The assessment guidelines for the underground section of ATES and BTES are managed by SIKB. SIKB maintains several certification schemes, and the one on shallow geothermal systems is one of the most recently developed. Based on their broad experience in the development of new certification schemes, according to SIKB three development stages can be identified:

- A first release, which can be seen as the first introduction of requirements. The guideline and protocol represent mostly a collection of practical know-how.
- A second phase follows after a few years, after applying the scheme and the first (technical) difficulties are encountered in practice. Any new set of requirements leads to frictions upon application in practice, and the recognition and gathering of these friction points is performed both in the private and in public sector. In one or more subsequent releases, adjustments are made to better attune the scheme to application in practise. We are currently in this phase.
- A third phase, perhaps ten years after the first release, to optimize the structure and content of the scheme, so that optimized readability and applicability is reached.

After these three releases, the certification scheme is kept up-to-date, but usually only small adjustments are needed. By then, the sector is used to the assessment guidelines and protocols, and working procedures are internalized by both the companies and the authorities.

In the Netherlands, the certification scheme for ATES and BTES systems is in the second phase. The scheme has been mandatory for five years now. The awareness among companies about the mandatory certification has grown. Whenever confusion about requirements arises, this is recognised and solved. It takes time to overcome these teething problems, and it is helpful if the authorities take this into account in their enforcement effort. However, the future need of authorities in their role of law enforcement is acknowledged, to identify the bad performers and to properly deal with them for the common good.

7. USEFUL EXPERIENCE

Recently, the development of a first release of European EN-standards for ATES and BTES systems has been initiated. The Dutch are prepared to share the knowledge and experience they have gained over the past decade in the development and hands-on application of the certification schemes dedicated to shallow geothermal energy systems. This can be used to develop sustainable and pragmatic European guidelines… and to save some time in improving them in the years to come.

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