Vermilion Energy Netherlands B.V.

Middenmeer Gas 2 Geothermal

Public Report - application of project subsidy

Final

29 september 2020

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1 Introduction

1.1 Project Details

Project number	DEI1400007
Project title	G2G – Van Gas to Geothermal
Applicant and co-applicants	Vermilion Energy Netherlands BV and ECW Netwerk B.V.
Project period	April 2015 – February 2020

1.2 Project Description

There are thousands of oil & gas wells drilled in the Netherlands. These wells are comparable to geothermal wells in terms of subsurface layout and the reservoirs they aim for. It is logical to think that part of these wells can be used for geothermal after depletion of the gas.

However technically this has proven less simple. Adaptations are required to the well and possibly even additional drilling work such as a side-track, but also workover work such as pulling of the production assembly from the gas wells.

This project demonstrated that it is technically feasible but financially probably not very attractive. Especially with the new legislation coming into force for geothermal wells.

The companies Vermilion and ECW have endeavoured to work together, also attracting EBN to join underway, but did not succeed to make a successful business case for this project, resulting in the termination in February 2020.

1.3 Project goal

The goal of the project as it was formulated in the original project plan was as follows:

The development of Geothermal projects is currently complex, expensive and risky. At the same time, there are many gas wells in the Netherlands that are nearing the end of their production. The problem is that these activities happen parallel to each other; our goal is to connect these activities by successfully converting gas wells to geothermal wells and generating Geothermal energy from produced gas wells with a depth of more than 2000m below ground level. This experience will be applied in many other locations both in the Netherlands and internationally when successfully applied in this project.

1.4 Scope of work

The scope of work of the project consists of the following items:

1. Modification & cleaning of the wells
2. Well integrity measurement
3. Reservoir engineering
4. Further drill out of the wells, testing of the formation and installation of well hardware
5. Building of geothermal surface facilities
6. Installation of 4km heat transport infrastructure

2 Results

2.1 Results of the project

The project started after promising results of the preliminary paper study and investigation by Panterra. Panterra did extensive data study, core sample study and study of the 4 geothermal wells ECW operates 5 km East from the MDM location.

A full geological report was worked out by Panterra as basis for the SDE+ application but also giving a good insight into the well characteristics of the Middenmeer (MDM) field which was completely watered out (ceased gas production) in 2015. The main characteristics were:

- High reservoir permeability (~100mD);
- Thick reservoir section (200m);
- High connectivity (based on 40+ years of production history).

On the basis of the Panterra studies, MDM-03 was proposed as producer and MDM-02 was proposed as injector for the geothermal doublet. During the project phase it was noticed that the MDM-03 casing limited the size of the pump for the geothermal production well to realize the required warm water production rate. As result, the well duties were changed: the MDM-02 was selected as producer and MDM-03 was selected as injector for the geothermal as doublet. The MDM-01 well was not going to be used. Side-tracks were proposed for both wells to optimize distance away from faults and maximize well injectivity and deliverability.

The plan for conversion of the wells was split into two stages:

- De-completion and inspection of casing integrity
- Side-track of MDM-02 and MDM-03

In the meantime a geothermal permit was applied for and SDE+ subsidy was applied for. Both were successful. In 2017 and 2018 there were delays due to the uncertainty and potential problems from the high amount of gas that was expected to be co-produced and the impact that could have on well design (additional well barriers required due to the presence of gas), pump design (how to handle the gas in the pump) and facility design (design and sizing of facility components to handle the extra gas).

Work however did not stop, the following items were completed in this period:

- Geothermal Exploration permit Middenmeer 3 was submitted
- Basic Engineering of part-abandonment, drilling + completion is executed;
- Basic Seismic Risk Study is executed;
- MER beoordeling was applied for on 7/Dec/2017

In 2019 all critical path permits and notifications were submitted including:

- Aanmeldingsnotitie for MDM-02 and MDM-03 drills (EIA judgement was received July 2019)
- Winningsplan was submitted 28/Feb/2019 (no decision received)
- Winningsvergunning was submitted 28/Feb/2019 (no decision received)
- Aanmeldingsnotitie for Middenmeer 1/2/3 for production of geothermal heat was submitted 21st May 2019 (no decision received)
- Building permit for MDM-02 cellar was submitted and approved for August 2019.

Detailed workover programs for MDM-02 and MDM-03 were created and shared with SodM and a workover window for the HWU was lined up in Q3-2019.

In July 2019 it was decided to terminate the project due to a negative business case caused by loss of SDE subsidy and expected high CAPEX.

2.2 Possibilities for spin-off and follow-up activities.

Vermilion is still open to further development of this project or other combinations of gas/geothermal projects, but for the near future the G2G project will not be further executed.

2.3 Discussion

Although the possibilities of converting a depleted gas well to a geothermal well seem extremely promising as it would take away a great deal of the risk of conventional geothermal projects, namely the drilling of the wells, the reality demonstrated in the G2G project is less straight forward.

One of the main limitations is the casing size in the gas wells: this significantly limits the size of the pump that can be installed in the production well for warm water production; smaller pump size results in lower warm water capacity which has a negative impact on project economics.

The amount of remaining gas, how it will come out and what to be done with it is another point; additional barriers in the well might be required which complicates the well design and increases the well costs. Conventional geothermal wells are normally non-gushing and require less barriers than wells that have pressure build-up like a watered out gas well with a small amount of free gas.

Also the higher than anticipated cost for workover of the wells, or even side-tracks, weighs heavy on the business case.

On the organisational side, (future) operatorship of the wells was an issue in this project and moved between ECW and Vermilion a number of times. As owner of the gas concession operatorship belongs with the oil & gas operator Vermilion, but once in geothermal production, ECW could be a logical choice. In the course of the project Vermilion shifted more towards becoming a geothermal operator as well.

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