

Notification: Qualitative risk assessment of long-term sealing behavior of materials and interfaces boreholes

Organization: Dutch State Supervision of Mines

Reference: KEM-18 / 202005048

Purpose of the notification

The Procurement Office of the Ministry of Economic Affairs and Climate Policy is publishing this notification on behalf of the Dutch State Supervision of Mines (SSM). The purpose of this notification is to determine whether there are parties interested to perform the assessment as described below.

Background information

Well abandonment in the Netherlands is regulated through the mining law and regulations. In addition, there are the NOGEPA industry standards 45. These standards have been updated in 2018 and are linked to the newly updated regulations which have come in force in 2019. These standards are based on the current best practices of 'cap-rock restoration', where cement plugs are set over the cap rock interval to seal off the reservoirs below. Most of the current abandonment methods assume integrity and impermeability of cement. Some new materials are being tested or used, such as bentonite or bismuth. Casing strings are often part of the seal plug. Currently it is thought that the most robust plug is cement wall-to-wall without casing strings over the cap-rock interval.

Objective

To enable justified decisions on matters where the safety of old or abandoned wells may have an impact. Currently the long-term behavior of cement and steel is reasonably understood. But how do the interfaces of cement and formations, or cement and casing behave? How do formations behave over uncemented sections? In the Netherlands over 1300 onshore wells have been abandoned and in the coming years this number will increase significantly, as will the number of abandoned wells offshore. The sites above these wells will increasingly be used or earmarked for urban development. This raises the need to determine the risks associated with these sites. The older wells in the Netherlands were constructed from the 1940's onwards and were built and abandoned using traditional steel casing and oilfield cements. The oldest abandoned wells are now nearly 80 years old. While industry assumes that the sealing capability of the casing, cement, and rock formation will not change over time, this assumption is not well founded. In some cases, leak paths were introduced during the construction or production phase; if not addressed during the abandonment phase, these may still exist in the abandoned well as micro annuli. It is not well understood if these micro annuli remain open, become larger, or close over time due to rock formation movement and/or mineral or petroleum deposits. This research question attempts to address this issue. Specifically, the project is aimed at obtaining a better understanding of the long-term behavior and interaction of cement, steel, and rock in abandoned oil and gas wells, and how this influences the integrity of the abandoned well.

Central research questions:

The main part of the proposed research will be an extensive literature review to determine previously-obtained knowledge and understanding of this problem. Specific questions to be investigated include the long-term stability of oilfield cement, the effect of corrosion of the steel casing, and the long-term behavior of the micro annulus.

1. First stage is a literature study of public studies on long term behavior of cement and cemented casing. Presumably a lot of information will be available within companies such as Schlumberger, BHI and Halliburton. This stage will result in an answer to the question: which are the risk critical elements and parameters determining the long-term sealing capacity of boreholes and can they qualitatively or quantitatively be assessed?

Second stage could involve detailed studies on:

2. Cement is known to have low permeability; how permeable for the fluids that concern us (gas, oil, water)? How does the permeability of oilfield cement change over a long period of time (e.g. 100 to 500 years) and how does the change affect its sealing effectiveness?

3. How well is steel casing, surrounded by cement, protected against corrosion? How is the corrosion rate affected by the change in permeability of the cement? Will the encased casing corrode in the long term? Can a corroded casing become a leak path?
4. The micro annulus could be a conduct for fluids. What is the long-term behavior of the micro annulus? Will it be squeezed tight, or can it erode through flowing liquids? Can it be filled with petroleum or mineral deposits?
5. Is there a micro annulus between cement and formation? How does filter-cake behave, is it permeable?
6. How do plastic formations such as rock-salt and claystone or shale behave around a cemented or uncemented casing, and can they form an effective seal?

It is not foreseen that lengthy laboratory studies are required to come to conclusions on the above. Literature studies on documented effects seen in wells around the world or from laboratory studies carried out by companies or research bodies may be able to answer most of the questions.

Deliverables expected

1. An inventory of studies and research related to these issues;
2. An analysis of the risk that micro annuli pose over longer term;
3. An analysis of the risk of cement or casing degradation to the point of failure of the barrier.

Expected use

Contribution to a risk instrument: to help assess the risks of leakage from abandoned wells due to cement degradation in the long term, to help identify any additional mitigation measures, and to help with proper planning by local government / town councils for the future land use above abandoned wells in the Netherlands. It might be used to refine drilling guidelines and inspection.

Timeline

For the first stage the draft report is expected around March 2021, six months after award. Also, an indication if the below timeframe required to answer the second stage questions is achievable. The report with results for the second stage is expected September 2021.

Required skills / experience / capacity

The multidisciplinary expert team should have:

- Understanding of well construction and well integrity;
- Understanding of material behavior;
- Cementing expertise;
- Geological expertise.

Application

Interested companies / consultants, fitting the above mentioned requirements, are invited to respond to the Procurement Office of the Ministry of Economic Affairs and Climate Policy, to the attention of Ms. Marjolein Switzar by e-mail IUCEZteam5@rvo.nl.

You do not have to send documents, only an e-mail if you are interested.

Interested parties will receive the request for the tender by e-mail as soon as possible after the deadline for responding to this notification.

The deadline for responding to this notification is set at the **18th of June 2020**.