

KEM Innovation/Research Question (max. 4 pages + annex)

TITLE *Public seismic hazard and risk model Groningen 2018*

Objective

A first objective is a scientific review on the currently 2017 developed public version of the Groningen hazard and risk assessment model 2017, also identifying priority validation observation on other KEM studies on component developments. Based on the reviews a prioritised list is aimed for to plan further developments of the Groningen seismicity model instrument in 2018.

Second objective is the actual development and validation of a new version of the Groningen seismicity hazard and risk model including prioritised improvements to be released by the end of 2018 and ready to use for providing Groningen seismic risk information in relation to evaluation of production plans, to the strengthening program and citizens.

State of the art, background

For Groningen a public version of the Groningen seismicity hazard and risk model (seismic HRA tool) is being implemented in 2017. This version is 1:1 replicating the NAM Groningen model version 5, including all assumptions and choices made. Not all the recommended improvements coming from developers themselves or the SAC are implemented in this version.

In various parallel KEM projects different modules (component models) of the Groningen seismicity risk model are assessed. Recommendation from KEM projects related to seismological module (KEM-1, KEM-7 and KEM-8), wave propagation module (KEM-4), Site response module (KEM-2, KEM 5a) and impact module (KEM-5b) should be incorporated in an overall assessment for prioritisation of further developments.

The overall external software quality assurance review of this model has not yet been carried out. KEM-panel strongly suggests executing such a review to steer the development of the public Groningen seismicity risk model in 2018 and beyond. Priorities can be of technical nature (such as including vertical ground movement) as well as of organisational nature (such as software maintenance and open access requirements).

Research Questions

- 1. How should the public version of the (NAM-based) Groningen Seismicity hazard risk model version 5 or its components (w.r.t. input data and software) be better compared, validated, performance wise improved?***
- 2. Can all requirements be implemented in the current versions of the public Groningen seismicity risk model as developed by TNO et al? What can be implemented in one year? How can be shown that the next version of model is properly tested and validated?***
- 3. How can anticipated effect on risk predictions help in prioritisation of improvements?***

Deliverables expected

- Quality review of the public version of the Groningen seismicity risk model.
 - A review on assumptions, functionality, data quality used in the Groningen seismic hazard and risk model version 2.
 - Identification and prioritisation of weaknesses in validation and performance.
 - A high level synoptic technical description of the current public model implementation and QA procedures at TNO (e.g., coding language and frameworks, code verification, benchmarking, QA, documentation, computational needs, validation strategies).
 - Recommendations and priorities for future quality control and further developments to improve the functionality and maintainability of the Groningen seismic risk model
- Realisation of a 2018 version of the public seismicity hazard and risk instrument for Groningen
 - Design for including the improvements recommended, including a test and validation plan
 - Implanted and open accessible version of the instrument (data and software), including test and validation reports
 - Reference prediction of seismicity risk based on the instrument
 - Recommendations for improvements (functionally, technically, performance, access, etc.)
- Recommendations

Timeline

The first deliverables in Q1 of 2018. Mid term progress reports in June 2018. Second deliverable end of 2018. Final report in 2019.

Expected use

EZK and SodM will use the results in their responsibility concerning owner of safety instruments for the Mining Law. They will use it to validate NAM models and to investigate risk profiles of different gas production scenarios.

The instrument will be made available to by universities, research institutes, companies and the public at large.

Expertise and tools preferred for the team

Given the wide scientific background of the NAM's model this should be contracted to a broad team of institutions. This task is best done by a small group of experts, with different backgrounds (computation, QA, risk modelling, societal aspects.), and of course with access to the relevant players at NAM, EZK, SodM. A Dutch team (TNO) would be preferred for continuity sake.

The Stanford Centre for Induced and Triggered Seismicity (<https://scits.stanford.edu/research-activities>) would be perfectly suited but some of the members had some review activity for NAM as well. Alternatively a team of two Italian institutions (ReLUIS for engineering and INGV for seismicity could work.

Quality assurance, Organisational and communication requirements

Multidisciplinary team is required covering the different modules. In phase 1 contact has to be made with the developers of the NAM models both from industry and research institutes and the SAC advisory committee. KEM panel members to be consulted. From the pool of all researchers involved and "new" SAC (extended KEM) for MEA could be formed.

For the implementation it is important to have regular progress meetings with the client EZK/SodM and also with the KEM expert panel.

References

NAM portal

- Main literature related to the Groningen seismicity risk model, up to 2017. NAM reports.

KEM projects

- Intermediate results of KEM-3b project describing current state of the Groningen seismicity risk instrument, 2017
 - Preliminary recommendation from KEM projects related to seismological model (KEM-1, KEM-7 and KEM-8), wave propagation model (KEM-4) Site response model (KEM-2, KEM 5a) and impact models (KEM-5b)
- Netherlands Journal of Geosciences
- NJG special issue On Groningen gas field seismicity