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

TITLE ***Cumulative propagation effect of Groningen risk model component uncertainties on hazard and risk predictions and norms***

Objective

It is the objective to verify and quantify the cumulative effect on the predicted hazards and risks and inherent uncertainties under different production scenario's varying between 0-21 BCM caused by Groningen seismic hazard and risk model train component (1) input data, (2) model choices and assumptions, uncertainty propagation in the model train etc. and their relative contribution to overall uncertainty.
It is the objective to especially review the scientific and probabilistic soundness of the working hypotheses with respect to the state-of-the-art knowledge about performance-based seismic risk assessment.
To rank model parameters, assumptions, model choice uncertainties in terms of contributions on resulting impact uncertainty in calculated hazard or risks. To formulate recommendations to validate the probabilistic framework and to possibly reduce the uncertainties with respect to the working assumptions of the Groningen seismicity hazard and risk model train.

State of the art, background

The current risk approach consists of the well-known risk approach decomposing the problem in from source to hazard, fragility and exposure (consequences/loss) models: production level/seismicity, attenuation/site response, fragility/territorial exposure and consequences/impacts. In each component stochastic modelling is required to quantify uncertainty. These uncertainties propagate in the whole risk assessment model.
Quantified hazard and risk results are compared to building code and personnel safety norms. Based on the outcomes and the inherent uncertainties strengthening program measures are designed meeting the safety norm.
Both conservative and un-conservative assumptions, as well as, not state-of-the-art stochastic modelling may result in biased estimates leading to wrong risk-based decisions.

Research Question

Is the statistical approach followed in the Groningen hazard and risk model of NAM and the public model of TNO c.s. over- or underestimating the predicted impacts? If yes, in which component and of what amount or which elements have not been taken into account? What does this mean for conforming to the NPR norms? Is the approach followed acceptable given the uncertainties present or should a precautionary approach being followed using conservative assumptions?

Which modelling assumption, model choices and model parameters contribute most to the predicted impacts calculated and how can the uncertainty bandwidth be further reduced and currently missing parameters included (vertical component, liquefaction)?

How can missing parameters be included in the Groningen model train and the uncertainties in the risk quantification be further reduced? Is the model train applicable for decreasing production scenario's from 0 to 21 BCM/yr?

What is needed in terms of research, if any, to render the risk estimate finally unbiased?

Deliverables expected

1. Report on statistical soundness of the Groningen seismic risk model as a whole. Ranking of these factors in terms of how much they influence uncertainties in hazard or risk. Clear explanation about safety factors (if any) used in the models. Conclusion about the validity of the approach followed.
2. Report on how (risk figures disaggregation) the model train assumptions, model choices and model parameters on the predicted risk output. Conclusions on the risk component which are not at state of the art (if any) in terms of modelling and stochastic modelling (uncertainty treatment and quantification). Indication on conservative approach to these parameters.
3. Recommendation for improving modelling and stochastic model each model component, ranked by the anticipated effect and recommendations to integrate the model components in the integrated risk assessment framework. Suggestions on how a precautionary approach (based on conservative assumptions) can be developed.

Timeline

The project can best start when the public model is available, starting 2020, and nine month duration is expected.

Expected use

The result will be used to plan for improvements the public version of the Groningen seismic hazard and risk model.
The improved model train will produce better predictions enabling SodM and EZK to better inform citizens and to better assess the size of the strengthening program.

Expertise and tools preferred for the team

Knowledge on probabilistic hazard and risk modelling, from seismology to nonlinear structural dynamics, eminent statistical expertise, monitoring techniques.

Quality assurance, Organisational and communication requirements

• May require very strong interaction with NAM and TNO and its consultants
The project to be executed by an external party will be supervised by MEA, SodM and NCG with regular meetings that mark the different study phases and stage gates.
• The project team must organise their own quality reviewing approach, including international scientific experts and relevant organisations in the field.

Remarks and Suggestions

The study requires additional runs of the NAM or TNO Groningen model train including access to intermediate and final calculation results to test sensitivities. This will require cooperation and interaction with TNO and/or other parties involved.

References

• Groningen reports (a.o. NAM portal and KNMI portal)
• Groningen seismicity hazard and risk model (NAM, TNO) and publication on it.
• Overview of Groningen reservoir, geological /geophysical model, seismic and damage data (NAM, KNMI)
• Documentation and access to the TNO version of the Groningen hazard and risk model (see also KEM-10 and KEM-35)
• Oil and Gas UK, Guidelines on Risk related decision making, Issue 2, July 2014.