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Multi-criteria site assessment process for candidate deep geological repository sites: Case study from the Czech Republic

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The future deep geological repository for radioactive waste in the Czech Republic will be constructed in a suitable crystalline rock mass around 500 metres below the earth's surface. The commencement of operation is planned for 2065. The current DGR development phase is devoted principally to the determination of the optimum disposal concept and the selection of the most suitable site. A total of nine potential sites have been assessed with the aim of reducing their number to four.

The data set subjected to assessment included site descriptions from the geological point of view (3D geological and hydrogeological model), and long-term site stability (seismotectonic, climate and erosion) and geomechanical data. A further assessed dataset included information on construction issues and on the evaluation of both environmental characteristics and the presence of groundwater resources. All the assessed characteristics were derived from surface-based exploration without the need for borehole drilling.

The key criteria reflected the three main areas of concern i.e. long-term and operational safety (including geological and hydrogeological indicators), technical feasibility and environmental impacts. The assessment of the sites was performed in two stages. The first stage involved the assessment of the probability of fulfilling the exclusion criteria (total 26), while the second stage involved the mutual comparison of the sites in terms of the defined key criteria (total of 13, divided into 38 indicators). The second stage involved the determination of weightings for the various criteria and indicators via the application of the SAATY method for the expert comparison of the significance of criteria. This method distinguished between relatively strongly weighted and less weighted criteria. The sites were graded with respect to the value estimation of the criteria; moreover, the grading of the sites considered various types of data.

A total of eight calculations were performed for five scenarios using various procedures for the estimation of the weightings and for data normalisation purposes. The first assessment stage indicated that all the sites fulfilled the DGR site assessment methodology requirements. The second stage, which comprised the assessment of the comparison of the site calculations (assessment grades) for each of the sites, was based on the levels of significance of the indicators and criteria and the resulting representative values for each site. The results of the subsequent comparison calculations indicated that the same four sites always occupied the first four positions

with only minor variations in the order. The differences in the gradings of the four most suitable sites and the four relatively less suitable five sites ranged between 11% and 17.8% (between the fourth and fifth sites), which convincingly differentiated between the two groups of sites. One site was always in last position according to the calculations. In compliance with the assessment results, the four sites were subsequently recommended to the Government of the Czech Republic for further follow-up research and analysis. Those sites that were not recommended for the next stage of research will continue to be considered as reserve (i.e. backup) sites.