Modelling of multi-lateral well geometries for geothermal applications

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Modelling of geothermal energy production can be done in many different ways. For real field situations, numerical simulators are generally used, since these allow taking into account the complex geological environment of real geothermal field. Accurate simulation of the inflow into the well is central in such approaches. Whether using finite element (FE), finite difference (FD) or finite volume (FV) or combinations thereof, all approaches have their pros and cons. With more complex well geometries becoming possible, the choice for the best simulation approach becomes more complicated. In this study we focus on the inflow modelling of different simulation approaches for a specific type of well, namely a radial well. This type of well can be created using Radial Jet Drilling (RJD). In this technique, powerful hydraulic jets are used to create small diameter laterals (1-2 inch) of limited length (up to 100 m) from a well. The radials leave the backbone at a 90° angle. Mostly 10 to 15 of such laterals are jetted in a single well. Due to such a radial well configuration, accurate well inflow modelling becomes more difficult. In this study we compare three numerical simulators and a semi-analytical tool for calculating inflow into a radial well. The numerical simulators are FE approaches (CSMP, OGS and MOOSE/GOLEM) and an FV approach with explicit well model (Eclipse®). The semi-analytical tool is based on the Analytical Element method. A series of increasingly complex well configurations is simulated, including one with inflow from a fault. Although all simulators generally are reasonably close in terms of the total well flow (deviations < 5 %), the distribution of the flow over the different parts of the well can vary significantly. Also, the FE approaches are more sensitive to grid size when the flow is dominated by radial flow to the well, since they do not include a dedicated well model. In the FE approaches, lower dimensional elements (1D for the well and 2D for the faults) were superimposed into a 3D mesh representing the geological units. This is valid for the FE approaches. In case the flow is dominated by fracture flow, the results from the FV approach in Eclipse deviates from the FE methods, particularly in the transient part.