NEW PREDICTIVE MODELLING APPROACH TO URANIUM IN SITU RECOVERY

By

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ABSTRACT

Boss Energy are entering into an exciting new phase of development, with the Enhanced Feasibility Study completed in 2021, and the project on track for production of 2.45Mlb of U_3O_8. Boss Energy's Honeymoon project is supported by highly skilled hydrogeologists, geologists, and management with proven operational experience. To further enhance their position, Boss Energy, in collaboration with WGA, have identified an innovative approach to determine recovery of In-situ (Leach) Recovery (ISR) deposits from data available during exploration. Boss Energy and WGA were granted an Accelerated Discovery Initiative (ADI) grant by the South Australian Government to deliver this tool, which has the potential to be rolled out to other operations.

The tool takes information available at the exploration stage of the project to predict ISR decline curve and uranium extraction. The tool has the potential to assist operations in wellfield planning, and be integrated with process plant models for economic optimisation of uranium production. WGA have employed a machine learning approach' tool, based on review of literature, Honeymoon operational datasets, and current modelling methodology. Our key findings are:

- Application of our machine learning approach to predicting decline curve is novel. Although machine learning is used in adjacent applications, such as prediction of mineralisation, iron deposits, stratigraphy, and lithology within the vicinity of the uranium body, it has not been used to predict decline curves in uranium ISR.
- Our approach leverages faster and more simple algorithms than current modelling techniques to predict uranium recovery. Current practices in the industry require a detailed profile of the deposit and require significant computing power: Most of the models use Reactive Transport Modelling (RTM), which couples numerical models of the metallurgical and hydrodynamic processes occurring underground. These sophisticated models can produce and track production curves to a high level of integrity. The disadvantage is that these models use a high level of computing power to produce results, and since they require a detailed understanding of the spatial distribution of both physical and chemical properties within the deposit they can be very sensitive to this data.

We assessed and ranked the suitability of several machine learning models, and progressed a hybrid metallurgical, hydrodynamic and machine learning model, to leverage both known relationships, and the potential increase in accuracy provided by machine learning algorithms. We also identified a second approach that can be leveraged during operations to further boost the model. Systems, also known as compartment, model, which is a mathematical approach to describing material transmission across a system.The systems modelling approach may be used for near real time operational modelling, where the deployed model can learn from and react to the wellfield and plant data as it is collected

We have also identified the following opportunities which have the potential to improve production planning and well field development tooling:

- In this phase of works, the potential for this model to be used in wellfield planning was demonstrated by overlaying several decline curves. This could be further progressed to enhance productivity of the wellfield planning team, enabling them to focus on their core business through integration with a plant production model and operating costs, to create optimised wellfield planning, and operational setpoints, to maximise production and revenue
- Given that the response of a heap leach extraction process is similar to an ISR profile, the modelling approaches proposed in this study could be used to more simply predict heap leach performance.
- The dataset generated by Boss Infill drilling during feasibility evaluation of the deposit contains extensive information (Borehole magnetic resonance tool, and density and neutron logs). This data will be very useful at later stages of the development to link to future production data.

This presentation will summarise the final project reporting and interactive model test interface, aligned with our commitment to the knowledge share requirements of our ADI grant.

Keywords: Uranium, ISR, Machine Learning, South Australia,