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MAJOR INNOVATIONS IN ISL MINING AT URANIUM ONE MINES IN KAZAKHSTAN

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The successful innovative technical policy in conjunction with the unique by its geological and technical characteristics deposits, provide significant competitive advantage for Uranium One as the global company with the lowest cost uranium production.

Uranium One gain broad expertise in the various aspects of ISL exploration and mining, including: uranium prospecting and exploration for sandstone hosted deposits from greenfield to mining phase; geological geo modelling and resources estimation; pilot ISL testing; feasibility and engineering studies at all stages of deposit development.

The main areas of ISL innovative developments and efficiency improvements at Uranium One mines in Kazakhstan include: geological 3D modelling for resources estimation; ISL process modelling and simulation for projects design and its implementation in ISL process management; implication of modern methods for wells construction and restoration; estimation of additional technogenic and residual resources; rare earth elements and other valuable components recovery from leaching solutions.

Uranium One attributable CIM compliant resources in Kazakhstan have tripled over 10 years through acquisitions, extensive exploration and by applying 3D modelling in resource estimation. Previous technical reports on NI 43-101 codex were based on geological information compiled from Kazakhstan national technical reports on resources (GKZ codex), which assumed polygonal geostatistical method for resources calculation. Uranium One has hired CSA Global to develop a robust methodology for 3D geological modelling and Mineral Resource and Ore Reserve estimation for roll-front deposits in Kazakhstan. This methodology was applied from 2012 through 2017 to Budenovskoye and South Inkai deposits modelling in Chu-Sarysu province, and Zarechnoye and Kharasan-1 deposits modelling in Syrdarya province.

The ISL modelling complex includes the set of integrated systems: geological data room and geological model, technological data room and ISL process simulation model, technical-economical system, ISL development and wellfield design system, mining planning complex. The modelling complex may be applied for ISL process design and management at all stages of deposit development. The complex was developed by Russian Seversk Technological Institute and originally implemented at Russian ISL mine Dalur. In 2017 Uranium One has started pilot project on ISL process modelling and simulation at one of the areas of the Akbastau mine. The developed ISL model for main technical parameters has identified main issues for ISL process optimization in a short, mid and long-term period. The obtained results confirmed the high potential for simulating systems implementation at ISL mines in Kazakhstan.

Wellfields design and installation is one of the most important component of ISL mine development. Drilling and wells installation costs comprise about 70% of mining CAPEX or 25-30% in the total uranium production cost. Major ISL mines in Kazakhstan use unified technique and design for technological wells drilling and installation. The stable performance of wellfield units largely depend on efficiency of wells work over procedures focused on wells flow rates restoration and on plugging impact elimination. Plugging is the process when a well-known screen loose its capacities and the ore bearing horizon loose its permeability. A new method for wells flow rates restoration is based on wells screen treatment by a mixture of reagents with the additive of ammonium bifluoride. The method has no alternatives for the restoration of problematic wells,

when traditional methods of chemical treatments for flow rates recovery do not give significant results. Application of the method restore flow rates to original parameters and increase the workover cycle by 2.5 to 3 times.

Estimation and development of additional technogenic (or newly formed) and residual resources within existing wellfields is a particularly vital issue for a life of mine extension. By technogenic resources we mean uranium concentrations formed due to leaching solutions exposure on primary mineralization and redeposition of dissolved uranium, including the remaining lenses of productive solutions. By residual resources we mean part of remained in situ and not affected by leaching processes uranium mineralisation. In 2016 Akdala mine completed research work focused on the forecast of areas with residual and technogenic resources [4]. Prospective areas for 419 tons of potentially residual resources were allocated within existing wellfield units. Further verification drilling confirmed the presence of residual and newly formed ores. 15 of 25 wells drilled in 2017 identified commercial uranium concentrations in leaching solutions and in hosting sediments.

Off-balance resources of valuable by-product components (rhenium, scandium and rare earth metals) are identified in the contours of uranium resources at ISL mines in Kazakhstan. All valuable components are partially dissolved in sulfuric acid during ISL process. Six mines with Uranium One ownership pump out more than 120 million. cubes of productive solutions annually, which contain up to 1 mg/l of scandium and rhenium and 5-20 mg/l of rare earth elements [5]. Lanthanum, cerium and neodymium give the major input to rare earth elements. About 40t rhenium, 30t scandium, more than 2000t of rare-earth metals is pumped out annually with leaching solutions and returned back to aquifer. Major technologies of by-products extraction from sorption mother liquors has been developed. They assume by products sorption by cationic exchange resins or REE chemical precipitation. Rhenium is partially absorbed together with uranium by anionic ion exchange resins and its concentration in saturated resins may reach 950g/t [5]. The key technological challenge is a selection of sorbents, which provide selective extraction of valuable components free of radioactive metals impurities.

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