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Key facts about SRK Consulting
# Mining study levels

<table>
<thead>
<tr>
<th>Study level</th>
<th>Purpose</th>
<th>Detail level</th>
<th>Minimum resource reporting level</th>
<th>Terminology</th>
<th>Appropriate multi-disciplinary studies (*1, required for JORC reporting), purpose:</th>
<th>Financial model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scoping</td>
<td>Determination of viable project options</td>
<td>Broad</td>
<td>Inferred</td>
<td>In-situ tonnes</td>
<td>Identify fatal flaws</td>
<td>Medium detail financial model</td>
</tr>
<tr>
<td></td>
<td></td>
<td>assumptions</td>
<td></td>
<td>Mineable tonnes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-feasibility</td>
<td>Determination of main project parameters e.g. production rate, process route</td>
<td>Option analysis</td>
<td>Indicated</td>
<td>Indicated resource</td>
<td></td>
<td>Detailed financial model</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Reserves</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feasibility (*2, 3)</td>
<td>High level accuracy study to get board approval and funding</td>
<td>Detailed study</td>
<td>Indicated</td>
<td>Indicated resource</td>
<td>Thoroughly assess and plan the cost and impact of managing all issues. Refine capital and operating costs by increased detail level of engineering and higher proportion supported by quotes</td>
<td>Highly detailed financial model</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Reserves</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*1 Multi-disciplinary studies will include exploration and geology, resources and reserves, mining, processing, infrastructure, environmental, project development schedule, capital cost estimate, operating cost estimate, commodity market study, economic evaluation, legal requirements, risk evaluation

*2 Draft Environment and Social Impact Assessment (ESIA) completed

*3 For a project to be bankable, it is normally required that the ESIA and one year baseline have been completed and sufficient permits have been secured to start production
Reconciliation of Russian, CIS and International Reporting Systems

- Russian and CIS technical documents are not generally accepted by international banks for project finance outside Russia.
- Similarly, international study documents are not accepted for permitting in Russia.
- TEO Project approval stipulates certain requirements for annual reporting of production in accordance with statutory obligations. The mine would then submit annual return forms such as the 5GR and others in order to inform the GKZ of changes to resource and reserve status from new information and depletion for example.

<table>
<thead>
<tr>
<th>Ore reserves</th>
<th>Mineral resources</th>
<th>JORC</th>
<th>GKZ instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proved</td>
<td>Measured</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Probable</td>
<td>Indicated</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C1</td>
<td>C1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C2</td>
<td>C2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P1</td>
<td>P1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P2</td>
<td>P2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P3+P3</td>
<td>P3+P3</td>
</tr>
</tbody>
</table>

Confidence level:
- A: Very high
- B: High
- C1: Medium
- C2: Medium to low
- P1: Low
- P2: Very low

Modifying factors: TEO Project approval stipulates certain requirements for annual reporting of production in accordance with statutory obligations. The mine would then submit annual return forms such as the 5GR and others in order to inform the GKZ of changes to resource and reserve status from new information and depletion for example.
# CIS countries project evaluation standards

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>DOCUMENT’S NAME (RUS Pronunciation)</th>
<th>English translation</th>
<th>Types of work involved</th>
<th>International equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Preliminary economic assessment of the project required for obtaining exploration &amp; mining licenses.</td>
<td>TEP (Techniko-Ekonominicheskoe Predlozhenye)</td>
<td>Technical and Economic Proposal</td>
<td>Indicative estimates of capital &amp; operating expenditures for the project.</td>
<td>Scoping / Conceptual Study</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TED (Techniko-Ekonominicheskoy Doklad)</td>
<td>Technical and Economic Report</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Technical and economic studies to determine the conditions at which the project will be profitable. The report presents Reserves for approval by GKZ. Cut-off grades and quality are addressed. It can be done without reserve estimation on cut-off grades only.</td>
<td>TEO Konditsy (Techniko-Ekonominicheskoe Obosnovanie Konditsy) to be approved by GKZ (MANDATORY REQUIREMENT)</td>
<td>Technical and Economic Justification of Conditions</td>
<td>Technical work relating mainly to mining processing and other technical disciplines. Option studies and economics are less detailed.</td>
<td>Partly Scoping &amp; partly Pre-feasibility Study (Depending on the project)</td>
</tr>
<tr>
<td>3</td>
<td>Performed to assess the deposit's mining cost effectiveness.</td>
<td>TER – (Techniko-ekonominicheskie Rasschety)</td>
<td>Technical and Economic Assessment</td>
<td></td>
<td>Pre-feasibility Study</td>
</tr>
<tr>
<td></td>
<td></td>
<td>also OBIN - (Obosnovanie Investitsiy)</td>
<td>Investments Justification</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Russian equivalent of an Environmental and Social Impact Assessment (ESIA)</td>
<td>OVOS</td>
<td>Performed to obtain environmental permits</td>
<td>Environmental studies relating to on site facilities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Part of pre-TEO Project stage, identifies technology and capital investment required.</td>
<td>TES (Techniko-ekonominicheskie Soobranneniya)</td>
<td>Technical and Economic Considerations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>The abridged part of TEP, TEO (conditions). TER, TES or any other pre-project studies undertaken for justification of schedules and investment volumes as well as project cost effectiveness</td>
<td></td>
<td>Business plan</td>
<td></td>
<td>Internal Documents Prepared at company's discretion at any stage</td>
</tr>
<tr>
<td>5</td>
<td>Client’s internal document which is mainly designed to specify priorities and dates for the pre-project preparation works, including: obtaining license, mining and land leases; technical conditions for utilities connection, environmental protection, etc. development of TEP, TEO Konditsy, TES and business plan; seeking investors; drawing contract for design works</td>
<td>Proyekt Sтроительства (Techniko-Ekonominichesko Obosnovanie Proyekta to be approved by GosExpertiza (MANDATORY REQUIREMENT)</td>
<td>Technical &amp; Economic Justification of the Project (sometimes referred to as TEO Project)</td>
<td>Multi disciplinary technical work covering all the disciplines. Documentation will include an OOS (environmental protection statement)</td>
<td>Feasibility Study</td>
</tr>
<tr>
<td></td>
<td>Construction Project / TEO Project - undergoes an expertise &amp; approval assessment at a state body - GosExpertiza. Mine construction works commence upon receiving an approval.</td>
<td>Rabochaya dokumentatsiya</td>
<td>Detailed Design</td>
<td>Design Institutes develop the working documentation and plans for construction.</td>
<td>Detailed Design</td>
</tr>
</tbody>
</table>
# Summary of Technical Study Requirements for Reserve Estimation

<table>
<thead>
<tr>
<th></th>
<th>Scoping Study</th>
<th>Prefeasibility Study</th>
<th>Feasibility Study</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RESERVES</strong></td>
<td>Only resources estimated</td>
<td>Proven and Probable</td>
<td>Proven and Probable</td>
</tr>
<tr>
<td><strong>Calculation</strong></td>
<td>Usually no reserves are estimated</td>
<td>Known or estimated</td>
<td>Detailed analysis and determinations</td>
</tr>
<tr>
<td><strong>Parameters</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cutoff grade (COG)</strong></td>
<td>Usually no reserves are estimated</td>
<td>Calculated from floating cone parameters</td>
<td>Optimised using mining/processing parameters</td>
</tr>
<tr>
<td><strong>Mining Method</strong></td>
<td>Assumed between open pit and underground</td>
<td>Specific method identified</td>
<td>Method and mine plan finalized</td>
</tr>
</tbody>
</table>

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Reasonable Prospect for Eventual Economic Extraction

- Open or Underground mining or a combination, with split Mineral Resource Statements if applicable
- Must define material which has potential for eventual economic extraction:
  - optimistic revenue parameters,
  - realistic technical parameters, and,
  - benchmarked costs
- Methods:
  - Optimised pit shells, i.e. Whittle/NPV Scheduler Shells
  - Mineable stope definition
  - Underground cut-off grade and continuity
- Must calculate and use an appropriate cut-off grade (COG) to the envisaged mining method
- Material above the COG must form spatially contiguous volumes that would/could form mining targets
Reasonable Prospect for Eventual Economic Extraction: Preliminary Open-Pit Assessment

- Pit optimisation using Lerchs-Grossman algorithm:
  - Whittle 4X
  - NPV Scheduler
- Required Data Inputs:
  - Economic information
  - Processing Information
  - Geotechnical information
  - Block Model with ore, waste and air blocks for entire model
- Outputs: Nested Pit shells at different revenue factors (costs), optimistic shell chosen for reporting
Reasonable Prospect for Eventual Economic Extraction: Preliminary Underground Assessment

- Floating Stope Optimisation (Datamine-MRO Module)
- Need to define contiguous areas above cut-off grade, which present practical mining targets given infrastructure/development costs.

- Required Data Inputs:
  - Economic information
  - Processing Information
  - Geotechnical information
  - Block Model with ore, waste and air blocks for entire model

- Outputs:
  - Mining Envelopes representing potentially mineable targets
Reasonable Prospect for Eventual Economic Extraction: Technological Assessment of Oil Shale

- Assessment of oil shale characteristics in terms of product quality and profitability:
  - Mineralogical, chemical and oil yield studies of oil shale;
  - Characterisation of the conditional organic mass, ash, moisture, kerogen oil, pyrolitic water, gases and semi-coke yield, CO2 of carbonates;
  - Characterisation of the chemical composition of mineral part (SiO2; Al2O3; Fe2O3; TiO2; CaO; MgO; SO3; K2O; Na2O; P2O5),
  - Characterisation of the elemental composition of kerogen (H; C; S; N; O; H/C)
  - Introduction of numerical indicators of quality corresponds to manner of the oil shale utilization (for example, minimum oil content 4% or calorific value 1000-1500 kcal/kg and sulphur over 8%. Oil shale with oil yield less than 3% could be classified as marginal resources);
  - Scheduling of oil shale production in a plan that applies appropriate capital and operating costs to determine economic viability.
Reasonable Prospect for Eventual Economic Extraction: Technological Assessment of Oil Shale

• Design of systems and technology for surface mining, underground mining, modified in-situ retorting, true in-situ retorting
• In-situ process thermal and chemical reaction modeling, kerogen oil recovery modeling, geomechanics reservoir simulation
• Investigation of bedrock hydrological and mineral-related elements, soil formation, sediment transport and deposition is aid in understanding the structure and function of natural ecosystems
• Definition of in-situ stress regime
• Identification of local flora and fauna to ecosystem loss or damage
• Long-term environmental monitoring of leaching process (“spent” shale-co-product of in-situ retorting) and it influence on water quality
• Land use and reclamation
## Reasonable Prospect for Eventual Economic Extraction: Oil Shale Grade Assessment

<table>
<thead>
<tr>
<th>Grade</th>
<th>Genetic Type</th>
<th>Quality</th>
<th>Group of Minerals</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Sapropelic</td>
<td>Oil&gt;30% Ash-6%</td>
<td>Carbonate (CaO+MgO- 20%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S\textsubscript{TOTAL}-2%</td>
<td>Aliminosilicate-Carbonate (CaO+MgO- 10-20%)</td>
</tr>
<tr>
<td>Moderate</td>
<td>Sapropelic-Humus</td>
<td>Oil-10-12% Ash-61-70%</td>
<td>Aliminosilicate-Carbonate (CaO+MgO &gt;10%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S\textsubscript{TOTAL}-2-4%</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>Humus-Sapropelic</td>
<td>Oil&lt;10% Ash&gt;70%</td>
<td>Silicate (SiO\textsubscript{2}+ Al\textsubscript{2}O\textsubscript{3} &gt;70%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S\textsubscript{TOTAL}&gt;4%</td>
<td></td>
</tr>
</tbody>
</table>
Location: Impact on Ore Reserves
Economies of Scale: Impact on Oil Shale Reserves
Scheduling and Grade Control: Impact on Ore Reserves
Geotechnical considerations

- Core logging of Geotechnical Boreholes; the following data will be collected from each of the geotechnical boreholes:
  - Recovery logs, on a core run basis; this will comprise Total Core Recovery (TCR), and RQD data, and may be incorporated in the geotechnical log.
  - Structural Log; the Alpha Beta angles and discontinuity characteristics of each orientated structure will be collected. ACE core tools will be used in all inclined holes.
  - Geotechnical Log; a complete Geotechnical Domain log will be collected from each borehole.
  - Point Load Data.
  - All inclined diamond drillholes will be orientated.

Long term strength

Core logging
Geotechnical considerations – Ground Support

Timber

Anchor-bolts

Timber and bolts

Steel sets
Geotechnical considerations - Backfill

Trial recipe

Strength testing

Delivery from surface

Delivery to working area
Processing

- Flow sheets supporting planned process facilities
- Key projects or initiatives to address production shortfalls
- Representative test work to support estimated recoveries for each saleable product from each material type
Waste dump

- Waste dump design including construction method, transportation methods
- Stage capacity curves in respect of volume placed and rate of rise
- Follows the Life of Mine Plan production plan
Infrastructure, Overheads and Capital Expenditure

- Installed power requirements, capacity and annual consumption
- Source of power supplied or generated and mine reticulation
- Additional infrastructure external to the mine and process facilities which support production activities
- Breakdown of significant capital expenditures included in the LOMP specifically for various expansions and expansions of new facilities

Human Resources

- Source of labour and skill levels (Local or Expatriate) and remuneration
- Historical manpower
- Manpower estimate for staff and contractors required to support the LOMP
Environmental

• Current environmental liability
• Additional environmental liability which may be incurred due to execution of the LOMP (new infrastructure, enlarged waste dumps and tailings storage facilities)
• Understanding of the environmental legislation in the country and how this effects the operation
• Environmental management system inclusive of monitoring procedures and policies

Asset Valuation

• Updated technical economic model for each of the Tax Entities
• Opening balances for the following items: debtors, creditors, stores, VAT irrecoverable, taxation, depreciation, outstanding commodity sales
• Other relevant details
Oil shale deposits

• Kenderlyk oil shale deposit in Kazakhstan consists of Kalyn-Kara and Luchshiy seams which carry the kerogen oil 9.4% and 18.2 % respectively. The kerogen oil has yield of gasoline -25 %, diesel – 36% and ligroin-10%.

• Baysunskoe oil shale deposit in Uzbekistan has one productive layer 0.4-0.9 m thick with dip 9-35. The kerogen oil content achieves 13.5 %. The oil shale ash can contain 0.1-1.0% of molybdenum.

• Volzhskiy oil shale basin is most perspective in the western part of Russia. Kashpirskoe oil shale deposit has two horizontal oil shale productive layers with thickness about 0.5-1.5m. Sulphur total is higher than 3% and organic content reaches 20-30%. Also the oil shale contains a small quantity of Ni, Co, Cr, Mo, Zr, V.

• The Boltyshevskoe deposit in Ukraine has „bowl“ an enclosed isometric configuration. Depth of productive oil shale layers is 100-500 m and occurrences of clay seams beneath and above are suitable to recover kerogen oil in-situ. Five oil shale horizons with different properties contain kerogen oil in the range 6-28%.
Factor analysis by oil content and organic matter
Summary

• The results of this study uses analysis of one hundred oil shale deposits of different quality and composition to inform selection of suitable technology for development of different deposits with high potential of oil recovery and minimum environmental and social disturbance.

• The methods will facilitate the best decisions for the technological development of oil shale and can be used in the exploration, planning, and exploitation and closure stages.
Thank You for Your Attention!