

Commercial and Technical Considerations Associated with CMM Utilization

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CMM Project Commercial Considerations (Worldwide)

- Poor understanding of gas resource
 - Overestimate of gas flow means project power generation installation too large, resulting in low engine operation hours and therefore poor project financial performance
 - Overestimate of average gas concentration, resulting in low engine operation hours and therefore poor project financial performance
- Failure to appreciate that gas engines need expert maintenance
 - Specialist maintenance and high oil consumption mean maintenance and operation costs often underestimated
- Failure to contract for maintenance at the same time that engines are purchased
 - Once engines are purchased, equipment manufacturers can charge what they want for spare parts and maintenance unless you have contracted maintenance long term as part of the engine CAPEX purchase deal

Commercial Considerations - Example



Poor understanding of gas resource

Commercial Considerations - Example



Failure to appreciate that gas engines need expert maintenance

Commercial Considerations - Example



Failure to contract for maintenance at the same time that engines are purchased

Technical Considerations (Worldwide)

- No methane = no electricity
 - Mining production is uncertain and variable, gas concentration must be carefully managed underground to maintain a flow of gas to the generators
 - Pipework suction on methane boreholes must be carefully managed so that air ingress is minimized
 - Disused/worked out faces, where stopped off with good quality stoppings, can be used as a high concentration methane reservoir for blending with face methane when face methane quality drops
 - Faces should be stopped off with future gas control in mind. The more gas in the pipe, the more safe the mine is (disused face gas should be considered a valuable resource)
 - *4.2m³/min pure flow for 1,000kWe of electricity, min 25% CH₄*
- Water in methane at gas engine
 - Methane needs well designed water condensing and extraction systems, problematic in winter
- Back pressure control system design
 - Extraction plant methane to generator pressure control important

Technical Considerations - Examples



No methane = no electricity

Technical Considerations - Examples



Water in methane at gas engine

Kazakhstan Experience

- Very good standard of engineering at ground level
 - Engineers easy to work with and extremely competent team players – gas drainage engineers good at gas drainage efficiency, poor at concentration control (not currently important to them)
- Administratively intensive procurement process
 - Procurement process took a long time, complex contracting
- No methane = no electricity
 - When power generation is installed at a mine, new emphasis on control of methane concentration/blending/drainage to ensure gas is available to generators plus investment in more advanced gas pumps/pipework/systems becomes justified
- Water in methane at gas engine
 - Careful design for gas drainage and dewatering required prior to extraction, extremes of cold and hot weather on steppe
- Expert generator support required/ availability of spares
 - Upfront investment either needs a large stock of long term spares or a comprehensive maintenance contract

Kazakhstan Project Development Recommendations

- Drainage from multiple sources means gas networks required
 - Variable gob gas concentration and low concentration from pre mine drainage means intermittent concentration at each gas source
 - Surface and underground gas drainage networks need interconnection and blending to maintain gas concentration possibly automatic
 - Disused faces and districts should be considered as sources of gas for concentration sweetening (possibly improved stoppings)
- Plan project commercially for 5 or 10 year project lifespan
 - Gas is difficult to predict 12 months in advance, so use history and plan engineering installations so that gas and electrical connections are flexible and generators are portable/temporary
 - Ensure long term maintenance plan in place (expert technical support/spares/overhauls)
 - Ensure that KZ gas drainage engineers become familiar with simple gas control techniques used overseas to improve gas concentration (reduce over-drainage/sweetening/control).

CMM Projects - Conclusions

- Commercial model needs conservative inputs
 - Investigate history of gas make
 - Availability/operation of engines relies on provision of fuel – reliability of engines is not a big factor, unless....
 - Ensure maintenance contract is in place with specialist technicians
- Engineering is simple
 - Equipment is safe for use at a mine and safe to operate
 - Engines are proven technology
 - Electrical engineering simple
 - Design of gas dewatering equipment is important
 - Ongoing improvement in drainage efficiency and concentration possible over time
- If there is gas, the project should be straightforward, administration, procurement and politics cause project delays and problems, not the engineering