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GLOCKNER ENGINEERING & MINING SERVICES

ABN 17 102 795 764



GEMS



Mine Planning

Process Description

including how it integrates with

Mining Resource and Reserve Estimates



www.minesurveying.com.au www.mineplanning.com.au www.mineengineering.com.au

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The GEMS mine planning system is based on an integration of;



- Statutory requirements, such as WA Mining Act and Regulations
- JORC 2012

The Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves ('the JORC Code') is a professional code of practice that sets minimum standards for Public Reporting of minerals Exploration Results, Mineral Resources and Ore Reserves.

http://www.jorc.org/

http://www.jorc.org/docs/jorc_code2012(4).pdf

• WA DMP HIF Audits

High impact function (HIF) audits examine the way in which certain functions with a high hazard potential are performed within an organisation.

The process looks at the function vertically, from inception to completion, down through the organisation.

http://www.dmp.wa.gov.au/15565.aspx

• Project Management practices and tools.





□ Phase 1 – Mineral Resource Estimates

□Phase 2 – Concept or Scoping Study

□ Phase 3 – Preliminary Feasibility Study

□Phase 4 – Preliminary or Draft Ore Reserve Estimate

□ Phase 5 – Feasibility Study

□ Phase 6 – Ore Reserve Statement

□ Phase 7 – Execution and Operational Phase

Phase 8 – Post Investment Review



Phase 1 – Mineral Resource Estimates

Report of a deposit by "Competent Person" and as per JORC 2012 code, that satisfies the requirement that there are reasonable prospects for eventual economic extraction, regardless of the classification of the resource.

Phase 2 – Concept or Scoping Study

The Concept Phase of a project involves defining the project opportunity and associated business benefits, ensuring that this opportunity is aligned with strategic objectives and then securing appropriate support and funding from the relevant business area and/or stakeholders in order to fully define, cost and assess the opportunity.

Phase 3 – Preliminary Feasibility Study

The Pre-Feasibility Study will identify the preferred mining, processing, and infrastructure requirements and capacities, but will not yet have finalised these matters.

Detailed assessments of environmental and socio-economic impacts and requirements will also be well advanced.

The Pre-Feasibility Study will highlight areas that require further refinement within the final study stage.

□ Phase 4 – Preliminary or Draft Ore Reserve Estimate

A preliminary ore reserve estimate, by "Competent Person" and as per JORC 2012 code, based on mine designs and financial assumptions listed in the Pre-Feasibility Study.

Ore Reserves are sub-divided in order of increasing confidence into Probable Ore Reserves and Proved Ore Reserves.





Phase 5 – Feasibility

"Bankable Feasibility Study" and "Definitive Feasibility Study" are equivalent to a Feasibility Study.

A Feasibility Study is of a higher level of confidence than a Pre-Feasibility Study and would normally contain mining, infrastructure and process designs completed with sufficient rigour to serve as the basis for an investment decision or to support project financing.

Social, environmental and governmental approvals, permits and agreements will be in place, or will be approaching finalisation within the expected development timeframe.

The Feasibility Study will contain the application and description of all Modifying factors in a more detailed form than in the Pre-Feasibility Study, and should address implementation issues such as detailed mining schedules, construction ramp up, and project execution plans.

Phase 6 – Ore Reserve Statement

An Ore Reserve report, by "Competent Person" and as per JORC 2012 code, based on mine designs and financial assumptions listed in the Feasibility Study. Ore Reserves are sub-divided in order of increasing confidence into Probable Ore Reserves and Proved Ore Reserves.

This is to include any audits or reviews of Ore Reserve estimates, along with discussion statements of relative accuracy and confidence of the estimate, and of the modifying factors used to derive it.



□ Phase 7 – Execution, Implementation and Operational Phase

The Execution Phase of the project is the actual "Doing" or "Delivering" or "Mining" phase and involves the implementation against the given set of authorised delivery parameters.

Phase 8 – Post Investment Review (PIR)

The Post Investment Review (PIR) is a complete review of the investment and is conducted once the facility or system has achieved or substantially achieved steady state operating conditions, but ideally not later than 12 months. The PIR process is an important mechanism for assessing the business outcomes of an investment against the original investment submission and for identifying lessons learnt through the whole investment cycle.

Throughout the planning system, with particular emphasis on the (Phase 7) execution, implementation and operational phase: it is important for the PIR to document control any change management as a formal process.

Type of Change		Status	Explanation	
А	Scope Change	Agree with stakeholders via formal change request	Change in objectives	
В	Priority Change		Revised business case	
С	Rework Change	Dealt with by Manager within the current scope of work, schedule and	Any circumstance caused by error in approved designs issued for use.	
D	Design Change / Omissions	budget.	Change or omission identified after approvals, but required succeed.	





Capital estimating, budgeting, and approvals in the eight (8) phase approach;

Phase	Phase Where Estimate is Completed	Estimate Type	Estimate Accuracy Range (typical)	Estimate Contingency (typical)
1	Resource Estimate			
2	Concept	Screening Estimate	+/- 30% to 35%	20%
3	Pre-Feasibility	Budgeting Estimate	+/- 20% to 25%	15%
4	Preliminary Reserve			
5	Feasibility Study	Approved Budget	+/- 10% to 15%	10%
6	Ore Reserve Statement			
7	Execution (at approx 50% complete)	Control or Definitive Estimate	+/- 5% to 10%	5%
8	PIR	(Review of above)		





- Phase 1 Mineral Resource Estimates
 - □ Resource Drawings

□ Verification of accuracy and quality of grid system, topographic control, and of surveys used to locate drill hole collars, by an Authorised Mine Surveyor.

□ Resource Report including tabled criteria as per JORC 2012

□Phase 2 – Concept or Scoping Study

- Outline of scope of works and key risks
- □ Outline of business case and key performance indicators (KPI's) to monitor progress
- Outline of costs and schedule
- Concept mine design drawings



- Phase 3 Preliminary Feasibility Study
 - Compile Mine Plans (drawings in plan, section, and long-section) of any existing mine

workings, by an Authorised Mine Surveyor, as per statutory obligations.

□ Review of HIF audit items for systems and practices that will be required.

- □ Preliminary Mine designs (at an approx 75% detail of "for Construction")
- □ Study report based on requirements in JORC 2012
- Long Term (+12 month) Mining Schedule
- Budget Proposal
- □Phase 4 Preliminary or Draft Ore Reserve Estimate
 - □ Preliminary Ore Reserve Drawings for the deposit
 - □ Preliminary Ore Reserve Report including tabled criteria as per JORC 2012



Phase 5 – Feasibility Study

□ Mine designs detailed to extent of being ready for Plan of Intent (POI) drawings.

□ Study report based on requirements in JORC 2012

□ Execution plan outlining how mining is to be carried out and systems implemented (to ensure compliance with HIF audits)

□ Medium Term (6 to 12 month) plus Long Term (+12 month) Mining Schedule

□ Approved Budget

□ Phase 6 – Ore Reserve Statement

□ Ore Reserve Drawings for the deposit

□ Ore Reserve Report as per JORC 2012, including required tabled criteria, suitable for ASX



Phase 7 – Execution and Operational Phase

Detailed 12 week mining schedule based off Medium Term schedules.

Detailed POI's - design drawings

□ Authorised Mine Surveyor to ensure that Mine Plans of excavations are kept up to date, as per statutory requirements and codes of practice.

U Weekly schedules, 'approval to excavate' drawings, and daily progress reports

□ Monthly reports with reconciliation figures

□ Internal, self-audit on practices using HIF template and guidelines.

□ Phase 8 – Post Investment Review

□ Quarterly (3 month or 12 week) reports on KPI's and how Execution and Operational Phase is progressing against Feasibility Study, Ore Reserves, and Execution Plan. This to include a review of Change Management process and documentation.





Common mistakes made by companies regarding these mining phases;

- Not establishing a rigorous planning process,
- Not having an Authorised Mine Surveyor verify survey control, grids, and data prior to establishing resource models (only to often find issues with this at later stages).
- Skipping through, "fast tracking" through, or even missing out on planning phases with risky investment deposits
- Not having Mine Plans (hard copy drawings) of any existing workings readily on hand at all times, with details as per statutory requirements and code of practice.
- Not reviewing HIF audits, as an internal audit process, and ensuring systems and practices are suitable
- Not placing enough emphasis and budget allocations to planning process phases (phase 1 to 6) prior to execution or actual mining phase.
- Not establishing a suitable Work Breakdown Structure (WBS), cost coding structure, and KPI's during phase(s) 3 and 5, that cab be readily reviewed, measured, and compared to, in the PIR - phase 8.

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