# SGS Bateman Gold Capability & Experience

## 1.1 Introduction

SGS Bateman is a global operating company in the SGS Minerals Division, which is in turn a business within the SGS Group. SGS is the world's leading inspection, verification, testing and certification company. SGS has an annual revenue of approximately USD 6 billion and is recognised as the global benchmark for quality and integrity. With more than 99 000 employees, SGS operates a network of over 2 700 offices and laboratories around the world.

Founded in South Africa in 1921, SGS Bateman has served the minerals industry for more than 100 years. SGS Bateman is a uniquely differentiated project execution Group in terms of its focus on "process engineering" in the minerals industry. This process competence together with an extensive and well proven suite of design and project management systems and procedures equips SGS Bateman well to execute global projects. The group has a worldwide reputation for the development and execution of minerals projects for a large number of Clients, in a range of geographical situations in over 50 countries and under a variety of contractual structures.

A key factor in the success of SGS Bateman projects has been its applied in-house engineering capabilities in unit processes. SGS Bateman's ability to provide cost-effective facilities for processing ores is based strongly upon its technological capability and project know-how of minerals processing, smelting and refining operations.

With systems and procedures aligned to ISO 9001:2015 and ISO 45001:2018, SGS Bateman has the competence and experience to support its Clients through the full life cycle of their minerals projects - from initial test work of drill samples, through laboratory and pilot programmes, feasibility studies, front-end engineering, procurement, and construction to commissioning of fully operational plants. These services may be offered on EPCM, EPC or LSTK terms to suit the requirements of Clients.

In all of its developing world project locations SGS Bateman aims to positively engage communities where the projects are sited and to create value and build sustainable capacity within those communities. SGS Bateman sees the community as a vitally important stakeholder in the project and its support as essential to the success of the project as well as the Owner's ongoing business activities.

## 1.2 Gold Process Capability

SGS Bateman is a technology provider and leading project house underpinned by its capability to offer differentiated, project-specific process technology solutions: global, well-proven expertise that covers all commodities from diamonds to precious and base metals, coal, uranium and industrial minerals.

SGS Bateman has an extensive track record of more than 3 000 successful projects across all commodities, the majority of which have been executed in Africa. For the majority of these projects, SGS Bateman has undertaken the process design. This includes feasibility studies and technology supply packages for ultimate conversion into overall projects, incorporating basic engineering design, process guarantees, proprietary equipment definition and supply, and commissioning support.

SGS Bateman has completed many EPCM, EPC and LSTK projects globally including projects where it has held the position of prime contractor supervising mining contractors as well as construction sub-contractors, and others where an EPCM contract has been converted to lump sum during the design phase.

With respect to gold processing specifically, SGS Bateman has been at the forefront of gold project development since the wave of CIP/CIL developments in the eighties. It has maintained its position as a leading player through technology, innovation and quality, fit-for-purpose design and fast track construction. SGS Bateman has designed and constructed over 60 major gold projects at sites in Africa, North and South America, Turkey, FSU and Australia.

As well as conventional heap leaching and CIP technology using cyanide, SGS Bateman has implemented plants using refractory gold technology such as bacterial oxidation (Kasese and Beaconsfield) and roasting. In addition to these existing technologies for gold extraction, SGS Bateman was actively involved in developing Ammonium Thiosulphate Leaching Technology (ATS) as a potential cyanide replacement.

SGS Bateman's gold process engineering skills include: crusher circuit design, large-scale grinding mills, fine grinding mills, flotation, bacterial oxidation and other refractory gold treatments, cyanide leaching, ATS leaching, CIP/RIP/CIL, Merrill-Crowe gold recovery, cyanide destruction and recovery technology, refining of gold and silver, and design and implementation of metals accounting systems. SGS Bateman has practical experience both locally and internationally and can design and build a gold processing plant to best suit local conditions and to treat any type of gold ore.

The SGS Bateman process engineering group has considerable expertise in the treatment of gold ores with several of its current team members having held senior technical and operations positions within precious metals operations and also having designed a number of plants.

The gold process engineering skills that SGS Bateman has available include:

- Crushing and grinding of ores of various ranging from clay to extremely competent rock
- Size classification
- Solid liquid separation including densifying cyclones
- Gravity recovery of gold
- Whole ore leaching
- Heap leaching (including cold weather)
- Treatment of complex ores
- Pyrite flotation
  - Treatment of flotation concentrate
  - Roasting with subsequent treatment of off-gas for acid production and leaching of the calcine for gold
  - Biological oxidation leaching and pressure oxidation leaching
  - Chloride and bromide leaching of refractory ores
  - Leaching with alternative lixiviants
- Recovery of gold from solution
  - Carbon in pulp (CIP)
  - Carbon in leach (CIL)
  - Resin in leach (batch and continuous)
  - Carbon in solution
- Gold elution including AARL and Zadra
- Carbon regeneration
- Gold recovery after elution including electrowinning or zinc precipitation
- Smelting of gold including induction furnaces, arc furnaces, and gas or diesel fired furnaces
- Refining of gold and silver
  - Miller chlorination and electro-refining
  - Wet-chemical refining process including Minataur
  - Silver refining processes
- Reagent and service requirements including
  - Automation of cyanide addition taking into account residual free cyanide, throughput rates, and dissolved oxygen levels
  - Cyanide handling taking into account the latest cyanide handling codes
  - Automation of lime and oxygen addition
- Cyanide destruction
- Design and implementation of metals accounting systems.

Below is an abridged list of gold projects undertaken by SGS Bateman where some of the above technologies where utilised.

## 1.3 Gold Project References

| Project | Client | Year Completed | Contract | Description |
|---|---|---|---|---|
| West Wits Reclamation, RSA | Harmony | 2024 | Concept Study | Conceptual engineering design and costing for the West Wits Reclamation Project |
| Mogale, RSA | Pan African Resources | 2024 | EPCM | EPCM services to construct a new CIL gold process plant capable of processing 800 ktpm of hydraulically mined tailings |
| Doup, Indonesia | J Resources | In progress | Detail Engineering | Design and detail engineering of 1.65 Mtpa gold plant |
| Blagadotnoe, Russia | FLS | On hold | Design & supply | Detox, acid wash and reagent section design and equipment supply |
| Blagadotnoe, Russia | FLS | On hold | Design & supply | CIL plant design and equipment supply |
| Mogale, RSA | Pan African Resources | 2022 | Value Engineering | Value Engineering on DFS done by others |
| Loulo, Mali | Barrick | 2022 | Process Design | Loulo Expansion Process Freeze |
| Kalgold Study, RSA | Harmony | 2021 | DFS | Design and cost estimation of a new 300 ktpm standard leach plant |
| Mispah MTR Study, RSA | Harmony | 2021 | DFS | Treatment of reclaimed tailings from the Mispah 1 TSF through the Kopanang and Noligwa Gold Plants |
| Ladam, Indonesia | AMNT | 2021 | Scoping Study | Gold heap leach and process plant study |
| AuPlata, French Guiana | AuPlata | 2019 | EP | Design and supply of 14 tph modularised gold plant |
| Siguiri, Guinea | AngloGold Ashanti | 2019 | EPCM | CIL, brownfields expansion |
| Belaya Gora DFS, Russia | Highland Gold | 2018 | DFS | Reconstruction and expansion to process 1 500 ktpa of ore |
| Central Gold Plant Elution Upgrade | Harmony | 2018 | Scoping Study | AARL elution plant upgrade to increase capacity to 1 000 ktpm |
| Central Plant Plus | Harmony | 2018 | Concept Study | Increase capacity from 150 ktpm to |

| Project | Client | Year Completed | Contract | Description |
|---|---|---|---|---|
| Project Capacity Increase | | | | 500 ktpm |
| Joel Elution Study | Harmony | 2018 | Concept | Review of Joel elution plant circuit |
| Kalgold Expansion PFS | Harmony | 2018 | PFS | Three trade-off options |
| West Rand Tailings, South Africa | Sibanye | On hold | EPCM | Surface tailings optimisation project |
| Virginia Tailings, RSA | Harmony | 2015 | Scoping Study | Tailings retreatment project |
| Siguiri, Guinea | AngloGold Ashanti | 2015 | PFS Opt & DFS early works | CIL, brownfields expansion |
| Mongbwalu, DRC | Fimosa/AngloGold Ashanti | 2015 | PFS | Plant optimisation study |
| West Rand Tailings, South Africa | Sibanye | 2015 | DFS | Surface tailings optimisation project |
| B2 Gold, South Africa | Mintails Mining | 2015 | Study Review | Study review |
| Khrysanera, Cyprus | Majestic Wealth | 2015 | Scoping | New precious metals refinery |
| Siguiri, Guinea | AngloGold Ashanti | 2014 | PFS | CIL, brownfields expansion |
| Duparquet, Canada | Clifton Star | 2014 | PFS | Pressure leach followed by CIL |
| Hassai, Sudan | Ariab Mining | 2014 | Process Review | CIC/ZADRA plant process review |
| Savmin | Mintek | 2013 | OoM Estimate | Savmin Process OoM Estimate |
| Kusasalethu, South Africa | Harmony | 2013 | EPCM | Elution plant |
| Koulekoun, Guinea | Avocet | 2013 | DFS | Crushing and screening, heap leach and beneficiation up to electrowinning |
| Iduapriem, Ghana | AngloGold Ashanti | 2013 | PFS & Det Eng | Cyanide destruction plant |
| Mine Waste Solutions NIMCIX | AngloGold Ashanti | 2013 | Detail Design | Design review and detail design to retrofit 6 NIMCIX columns |
| AngloGold Ashanti, Namibia | Navachab | 2012 | PFS | Conventional CIP circuit with DMS (for low grade) including jaw crusher, single stage ball mill, AARL type elution and filtration |
| Hope Bay, Canada | Newmont | 2011 | EP | Crushing, grinding and gravity recovery, flotation, leaching and cyanide detox, electrowinning and smelting |
| Mongbwalu, DRC | AngloGold Ashanti | 2010 | PFS | Study for Mongbwalu gold concentrator plant |

| Project | Client | Year Completed | Contract | Description |
|---|---|---|---|---|
| Sukari Gold Project, Egypt | Centamin Egypt Limited | 2010 | EPM | SGS Bateman was awarded the engineering and project management contract. The project incorporates crushing, grinding, flotation, tailing facilities, reagents storage and washdown areas for the 4 Mtpa processing plant |
| Ban Houyxai Gold Project, Laos | Phu Bia Mining Limited | 2009 | PFS | The Pre-Feasibility Study (PSF) on the Ban Houayxai gold-silver deposit commenced in October 2007 and was completed in Q3 2008 |
| Kokpatas Concentrator Upgrade, Uzbekistan | Navoi Mining | 2005 | LSTK Project | Design and construction of a 5 Mtpa flotation circuit, 2000 tpd bio-oxidation (BIOX type) circuit (the world's largest), and expansion of the existing cyanide leach circuit for Navoi Mining. Project commenced September 2003 |
| Taldy Bulak Gold Project, Kyrgyzstan | Central Asia Gold Limited | 2005 | Engineering Design | The project involved an underground mining, crushing, grinding, flotation, CIL, tailings detoxification and disposal, underground paste fill plant, provision of power and water services and refurbishment of a single men's quarters building |
| Doris North | Miramar | 2004 | Study | SAG mill and modular gold plant installation |
| Camp Caiman Gold Project, French Guiana | Cambior Inc | 2003 | PFS | Pre-feasibility study to develop a design, capital costs and operating costs for processing facilities to handle both oxide ore and highly refractory sulphidic ore |
| Dashkasan Costing Study, Iran | Rio Tinto Technical Services | 2003 | PFS | Preliminary study to develop a flowsheet and economic analysis for a 9 Mtpa refractory sulphide process plant for Rio Tinto Technical Services. The flowsheet featured large SAG mills, pressure oxidation and CIP/CIL processing. Heap leaching of oxide ore was also examined |

| Project | Client | Year Completed | Contract | Description |
|---|---|---|---|---|
| Chirano Gold Project, Ghana | Chirano Gold Mines | 2003 | Detail Engineering Design (Cost Reimbursable) | 2,000,000 t/a gold plant, including crushing, ore storage, milling, gravity, CIL, desorption (Zadra), electrowinning, intensive cyanidation, tailings disposal, infrastructure (inc. Plant site buildings), sewage treatment & security |
| Doris North Gold Project, Canada | Miramar Mining Corp | 2002 | BFS | Full feasibility study for a modular style gold processing plant to be located in northern Canada. The plant featured crushing, milling, gravity concentration, flash and conventional flotation, concentrate regrind, carousel CIL and modular gold room. All components would be designed as modules for rapid assembly at site within a heated dome |
| Boroo Gold Project, Mongolia | African Gold Resources | 2002 | Engineering Design | Process, civil, structural, mechanical, piping, electrical & instrumentation engineering design, specification, design drawings & construction documentation for a new 1.75 Mtpa CIP gold processing facility in Mongolia |
| Sepon Gold Project, Laos | Lang Xang Minerals Limited | 2001 | BFS | Bankable feasibility study to develop a process plant and infrastructure design for a 1.25 Mtpa SAG milling oxide CIL type plant |
| Beaconsfield Gold Project, Australia TAS | Beaconsfield JV | 1999 | LSTK Project | Two stage crushing, ball milling, gravity, flotation, bioleach, gold leach and Merrill Crowe |
| Mt. Todd Gold Plant Expansion, Australia NT | Pegasus Gold Corporation | 1997 | EPCM Project | 4 Stage crushing, ball milling, flotation, regrind, CIL |
| Ovacik Gold Project, Turkey | Eurogold Madencilik AS | 1996 | EPCM Project | Two stage crushing, ball milling and CIL, 300,000 tpa. |
| Henty Gold Mine, Australia TAS | Renison Goldfields Consolidated | 1996 | EPCM Project | SAG/ball mill, CIP, elution, CN destruction |

| Project | Client | Year Completed | Contract | Description |
|---|---|---|---|---|
| Tanami Plant Upgrade, Australia NT | Otter Gold Mines Limited | 1996 | LSTK Project | Gravity circuit (Knelson concentrator and Gemini table) and leach upgrade |
| Muruntau Heap Leach Project, Uzbekistan | Newmont (Uzbekistan) | 1996 | EPCM Project | Feasibility study and EPCM for construction of a gold heap leach operation to process approximately 13 800 000 tpy. Engineering services include primary crushed ore stockpile, stockpile reclaim system, secondary, tertiary and quaternary crushing, ancillary buildings and equipment |
| Nolans Bore, Australia QLD | Carpentaria Gold Pty Limited | 1995 | LSTK Project | Crush, SAG/ball milling, CIL, elution, EW, carbon regeneration |
| Union Reefs Gold Mine, Australia NT | Acacia Resources limited | 1994 | EPCM Project | Design and construction of a 1.25 Mtpa gold mining complex |
| Monkland Mine | Gympie Eldorado Gold Mines | 1994 | EPCM Project | CIP plant |
| Mt Leyshon Gold Mine (Qld) | Mt Leyshon Gold Mines | 1993 | Design, Procurement, Construction, Commissioning & Management (Fixed Lump Sum) | Installation of new scats dewatering and handling, CIL, desorption, electrowinning and tailings disposal facilities on the 5 Mtpa plant |
| Carlin Gold Quarry Mine | Newmont | 1992 | EPCM | 2 Circulating fluid bed roasters, gas cleaning and sulphuric acid plant (sub-contractor to Lurgi) |
| Pueblo Viejo, Dominican Republic | Rosasrio Dominicana | 1992 | EPCM | 10,500 tpd CIL plant |

## 1.4 Selection of Other Current & Recent Projects

| Project | Client | Country | Contract Type | Project Value US$ M | Status/ Completion |
|---|---|---|---|---|---|
| Siguiri Gold Project | AngloGold Ashanti | Guinea | EPCM | 176 | 2019 |
| West Rand Tailings Retreatment | Sibanye | South Africa | EPCM | 400 | On hold |
| Lift II Copper Concentrator Project | Palabora Copper | South Africa | EPCM | 100 | 2018 |
| Husab Uranium Project | Swakop Uranium | Namibia | EPCM | 2000 | 2018 |
| Base Metal Refinery Refurbishment | Zimbabwe Platinum Mines | Zimbabwe | EPCM | 120 | 2017 |
| Large Diamond Recovery Pilot Plant | Debswana | Botswana | DFS | - | 2015 |
| Cut 9 Project | Debswana | Botswana | Concept Study | - | 2015 |
| Nickel Bioleach FEED | Mondo minerals | Finland | FEED | 23 | 2015 |
| Khysanera Precious Metals Refinery | Khyrsanera Limited | Cyprus | Scoping | - | 2015 |
| West Rand Tailings | Sibanye | RSA | DFS | - | 2015 |
| AngloGold Ashanti | Siguiri | Guinea | PFS | - | 2015 |
| Husab SX Plant | Swakop Uranium | Namibia | EPCM | 10 | 2015 |
| Lead-zinc DFS | North River | Namibia | DFS | - | 2014 |
| Boabab Tete Iron Ore | Baobab Resources | Mozambique | DFS | - | 2014 |
| Large Diamond Recovery | Debswana | Botswana | PFS | - | 2014 |
| Marampa 10 Iron Ore | London Mining | Sierra Leone | DFS | - | 2013 |
| Namakwa Sands UMM | Exxaro | RSA | EPC | 16 | 2013 |
| Madaouela Uranium Heap Leach | GoviEx | Niger | PFS | - | 2013 |
| Trekkopje Maxi Uranium Heap Leach | Areva | Namibia | EPCM | 650 | 2012 |
| Marampa 2 Iron Ore | London Mining | Sierra Leone | DFS | - | 2012 |
| Jwaneng Cut 8 | Debswana | Botswana | E | 450 | 2012 |
| Trekkopje Midi Uranium Heap Leach | Areva | Namibia | EPCM | 120 | 2011 |
| Cooke Dumps Uranium | Rand Uranium | RSA | FEED | 400 | 2011 |
| Ext 8 Debottlenecking | Foskor | RSA | EPCM | 71 | 2011 |
| Marampa Iron Ore Project | Cape Lambert | Sierra Leone | PFS | - | 2010 |
| Zanaga Iron Ore | Jumelles/Xstrata | Congo | Study | - | 2010 |
| Ambatovy Sulphuric Acid Plant | Dynatec Madagascar | Madagascar | EPC | 150 | 2010 |

| Project | Client | Country | Contract Type | Project Value US$ M | Status/ Completion |
|---|---|---|---|---|---|
| Blue Ridge Platinum Concentrator | Blue Ridge | RSA | EPC | 60 | 2009 |
| Hindustan Zinc Concentrator | HZL | India | EPC | 35 | 2009 |
| Avebury Nickel Concentrator | Allegiance Mining | Tasmania | EPCM | 140 | 2008 |
| Sishen Expansion Project | Kumba Iron Ore | RSA | EPCM | 475 | 2008 |
| Lumwana Copper Concentrator Project | Equinox Minerals | Zambia | EPC | 408 | 2008 |
| Moma Mineral Sands Project | Kenmare Resources | Mozambique | EPC | 265 | 2008 |
| Ferrochrome Sintering & Pelletizing | IFM | RSA | EPC | 48 | 2007 |
| Finsch Concentrator Upgrade | De Beers | RSA | Hybrid LSTK | 64 | 2007 |
| Venetia Primary Crusher | De Beers | RSA | Hybrid LSTK | 36 | 2006 |
| Birla Nifty Copper Project | Birla Nifty | Australia | EPCM | 25 | 2006 |
| Rustenburg PMR Expansion (various) | Anglo Platinum | RSA | EPCM | 194 | 2005 |
| Impala BMR Expansion (Phase 1) | Impala Platinum | RSA | EPCM | 62 | 2005 |
| Sepon Copper Project | Oxiana | Laos | EPCM | 167 | 2005 |
| Elizabeth Bay Upgrade | De Beers | Namibia | Hybrid LSTK | 65 | 2004 |
| Skorpion Zinc Project | Anglo | Namibia | EPCM | 450 | 2003 |
| SA Chrome Project | Xstrata | RSA | EPC | 95 | 2003 |
| Modikwe UG2 Concentrator | Anglo Platinum | RSA | EPCM | 60 | 2002 |