Appendix A
Design Engineer's Scope of Work

Initial Definitive Study Planning and Implementation

Fully develop and detail the scope and implementation methodology of the definitive study and submit to the owner for approval. Specific deliverables to be submitted as part of this initial phase are to include:

- Study scope of work and specific study deliverables list.
- Study resourcing plan.
- Study schedule.
- Study budget.
- Study procedures.

Feasibility Studies

Carry out a number of feasibility studies leading to specific recommendations in order to confirm and validate the optimal plant design and configuration. Studies to be undertaken will include but will not be limited to:

- Plant throughput.
- Plant location.
- Onsite production of additives.
- Availability of local supplies of materials.

The following requirements are divided into the different engineering disciplines and their relevant activities, such as process engineering, control systems engineering, mechanical engineering, civil, structural architectural and environmental engineering, and electrical engineering.

R.F. Stapelberg, *Handbook of Reliability, Availability, Maintainability and Safety in Engineering Design*, © Springer 2009

Process Engineering

Testwork Review of all testwork completed to date together with a review of the proposed future testwork program. The results of any additional testwork undertaken are also to be incorporated into the design. The contractor is also expected to participate in any additional testwork program undertaken by way of attendance during testing and logging of results to ensure timely and accurate incorporation of data from testwork into the process design.

Process design Process engineering deliverables generally issued for detail design:

- Process description and block flow diagrams.
- Process design criteria.
- PFDs for normal, start-up, shutdown & upset conditions.
- Heat and material balances for normal, start-up, shutdown and non-steady-state conditions.
- Dynamic mass-balance simulation model.
- Plant water balance (including tailings & evaporation ponds).
- Process and utility P&IDs.
- Consumption, waste and emission summary.
- Utility summary.
- Process/utility integration and optimisation study for normal operation, start-up, shutdown and upset process conditions.
- Preliminary Hazop reviews.

Plant layout

- Dimensional site plan.
- Unit plot plans.
- General arrangement plans, elevations and sections.

Piping

- Piping design criteria.
- Pipe and valve specifications.
- Line and valve lists.
- Site plan review for critical and expensive pipe routings, access arrangements and process requirements.
- Preliminary MTOs in sufficient detail for estimate purposes.

Control Systems Engineering

- Control system, operating philosophy & strategy.
- Advanced controls—where applicable.
- Applicable codes & standards.
- DCS specifications.
- Instrumentation list.

- Inline instrument data sheets.
- Control and automation plan.
- Process package plant control philosophy.
- Emergency shutdown philosophy.
- Fire and gas detection philosophy.
- Plant communications philosophy.
- CCTV & UHF radio requirements.
- Instrument air and UPS requirements.
- Standard installation details.
- Specifications for general instruments, control valves and safety systems.
- Control room layout.

Mechanical Engineering

- Mechanical design criteria.
- Full equipment list.
- Technical specifications.
- Technical data sheets.
- Reliability and maintainability analysis.
- Maintenance spares list.

Civil, Structural and Architectural Engineering

- Civil, structural and architectural design criteria.
- Coordination and integration of geotechnical investigations and topographic surveys.
- Preliminary designs for:
  - Buildings; descriptions and conceptual designs for any required buildings and structures.
  - Water supply systems and dams.
  - Standard steelwork connection details.
  - Underground drainage:
    - sanitary.
    - contaminated storm water.
- Roads and site earthworks.
- Pipe racks—loads and congestion.
- Foundations—design requirements.

Electrical Engineering

- Electrical design criteria.
- Electrical equipment list.
- Electrical load list.
- Motor list.
- Technical specifications and data sheets.
- Preliminary design of all facilities downstream of the main power transformers through to main users including all transformers, sub-stations and MCCs.
- Voltage selection for high-KW motors.
- Emergency power supply requirements.
- Plant lighting design.
- Preliminary data and communication equipment requirements.
- Optimisation study on number and size of generating units.
- Power generation control philosophy.
- Load cycle strategy for various plant operating modes.
- Load sharing study between diesel and steam turbines.
- SLDs for each unit.
- Overall SLD for total power supply system.
- GAs for electrical equipment/sub-stations.
- Standard installation drawings.
- Standard schematic and termination drawings.
- Grounding/earthing system preliminary design.
- Cable ladder route layout drawings.
- MTOs for estimate purposes.

Loss Prevention

- Fire protection, and safety equipment requirements review.
- Plant layout review—spacing of equipment.
- Emergency shutdown plan.
- Area classification (schedule and layout drawings).
- Design of fire and gas detection systems.
- Design of fire protection system.
- Spill control/containment strategy.
- Noise control.
- Ventilation.

Environmental and Permitting

Liase, interface and support the nominated environmental consultant with the evaluation and assessment of impacts as required, including:

- Ambient air quality/source.
- Waste water discharge.
- Fugitive emissions.
- Noise regulations.
- Visual impacts.
- Product transportation issues.
- Permitting/statutory requirements.

Mining

Liase, interface and support the nominated mining consultant as required on activities that will include as a minimum:

- Geotechnical investigations.
- Pit optimisations.
- Preparation of pit designs and ore reserve statements.
- Mine scheduling.
- Preparation of waste dump and haul road designs.
- Pit permeability investigations.
- Determination of materials handling properties.
- Preparation of a detailed report.

Constructability and Logistics

Constructability and logistical study addressing the following:

- Identification of delivery routes and lifting/rigging of heavy equipment.
- Site access for construction equipment.
- Scope for modularisation and offsite assembly.
- Strategy for minimising double handling of equipment and different bulk materials.
- Strategy for minimising clashes onsite.
- Plan for incorporation of locally based contractors as appropriate.

Procurement

- Develop procurement policies and procedures.
- Issue & evaluate bids for major equipment items and sub-contracts.
- Develop installed equipment costs.
- List suitable vendors for key equipment.
- Identify long-lead items.

Development of Capital and Operating Cost

The capital and operating cost estimates will be developed into a format to be agreed by the owner. The estimates will be developed to an accuracy of $\pm 10\%$.

Development of the Project Schedule

- The master schedule will be developed for the project.
- The format and level of detail to be included is to be agreed by the owner.
- The master schedule must reflect the following:
  - Fabrication/installation schedules.
  - Vendor baseline commitments.
  - Construction schedules.
  - Commissioning schedules.

Value Engineering and Risk Assessment

The contractor will ensure that during the definitive study phase, engineering effort is directed at minimising the cost of the *EPC* phase of the project without introducing unacceptable risk. As part of this requirement, a full risk assessment will be undertaken on the project to ensure that all risks have been adequately identified and quantified. Significant effort will be put into the planning of the project delivery to ensure the best approach. The constructability of the plant and such issues as onsite or offsite pre-assembly of structures and vessels will be assessed for the impact on overall cost and schedule. During engineering, discussions will be held with the owner to look at ways to optimise the design especially the full utilisation of services and utilities. Commonality of designs will be considered to reduce spares inventories, and prior studies will be reviewed and incorporated where appropriate.

Project Execution Plan

A project execution plan will be prepared that includes the following sub-plans as a minimum:

- Occupational health and safety plan.
- Contracting plan.
- Industrial relation plan.
- Procurement plan.
- Human resources plan.
- Quality assurance plan.
- Automation plan.
- Procedures for the implementation phase of the project.

General

All work during the course of the definitive study is to be completed in accordance with procedures to be developed by the contractor and approved by the owner. The contractor will make suitable office facilities available for the owner's entire project team including office accommodation and general office administration and IT support. The contractor is to provide progressive reporting on the progress of the program together with cost and schedule status.

Final Report

The contractor will be responsible for the preparation of the final study report. This is to include preparation, compilation, review & editing, and final issue. The contractor will also be responsible for incorporating the owner's contributions into the full report where relevant. The format and content of the final report will be developed by the contractor and approved by the owner.

This report will include:

- A written description of the plant and all of its sub-facilities.
- A written description of the services provided.
- A written description of the major equipment required for each area of the plant.
- All the information produced as part of the services.

Ten copies of the final report (bound) are to be made available to the owner on completion, together with a computer hard disk drive containing the complete report, all of the study deliverables and all of the information/calculations, etc. used to develop the study deliverables. All information is to be appropriately logged to ensure its rapid retrieval if required.

Appendix B
Bibliography of Selected Literature

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