

# PILOT PLANT TESTING

## METALLURGICAL OPERATIONS

SGS' experienced metallurgical professionals develop and demonstrate bankable flowsheets and processes for environmentally sustainable metal and mineral extraction processing. These flowsheets are confirmed on-site through bench and pilot plant testing programs that are internationally recognized by the mining, engineering and financial communities.

With SGS, your testing program will:

- Result in a practical, cost effective, environmentally sound flowsheet
- Provide data for capital and operating cost estimates
- Generate higher value through improved recovery or cost savings
- Provide bankable milestones to maximize financing options



## PILOT PLANT TESTING

Pilot plant testing demonstrates and confirms the flowsheet developed at the bench. It is unique in that it operates in an integrated fashion, all unit operations working to provide continuous feed or product typically until the generation of a LME-grade metal. It can be at a variety of scales from < 100 kg/hr to > 1 tonne/hr.

For new projects, piloting demonstrates operational viability and produces the final product that can be expected, thus reducing technical risk. Piloting also generates data used when designing the full-scale plant, thus reducing design and capital risk.

Existing operations can also be simulated at the pilot-scale to evaluate new technology, assess the impact of different ore types or troubleshoot problems without interrupting production at the main plant.

### TYPICAL ACTIVITIES THAT CAN BE UNDERTAKEN DURING PILOT TESTING INCLUDE:

- Establish flowsheet viability. This is especially important for complex deposits, those utilizing new or unusual technologies or projects that are located in high risk areas
- Fine-tune flowsheet parameters
- Demonstrate continuous integrated operation
- Evaluate the impact of local water supply
- Develop a water balance
- Quantify the impact of ore variability
- Prove new industrial processes
- Troubleshoot existing operations
- Produce byproducts for specialized testing (e.g. environmental assessments)
- Generate bulk samples for market evaluation
- Train critical mill staff



### PILOT TESTING IS THE BEST WAY TO:

- Prove critical components of a metallurgical flowsheet
- Establish the viability of new technology
- Verify ability to meet environmental requirements
- Minimize technical, environmental, operational and commercial risk

### WHAT TO EXPECT WHEN YOU BEGIN A METALLURGICAL TESTING PROGRAM

Tips and rules of thumb for flowsheet development and pilot plant testing...

### WHAT IS THE PROCESS?

With you and your consultants, SGS will custom design your project team, then develop a realistic scope of work that suits your objectives. Processing options will be evaluated fairly and objectively, without bias or special interest to ensure the best technology is used. Many of our project managers have had plant experience, so they favor practical solutions, rejecting unrealistic options.

**YOUR INPUT**

At SGS, we think effective management of metallurgical projects is best achieved by encouraging your participation (or that of your representatives) from flowsheet development to pilot plant testing. This creates a continuous flow of information and ideas and insures that your requirements are met in timely and satisfactory manner.

Early in the planning and proposal preparation stages, we encourage you to discuss your timing, anticipated project scope and financial requirements. This allows us to develop the best program for you, be it a phased program with a number of bankable milestones that will help you maximize your financing options or perhaps an intensive program that quickly resolves bottleneck problems.

Discussion and consultation continues throughout the test program. During critical periods or intensive testing, such as complex pilot plant campaigns, many of our clients elect to stay in the immediate vicinity and “work the shifts” with our staff (see below, “logistics”). The project insights and expertise sharing that arises can be very valuable at start-up. In these circumstances, SGS can offer office and meeting spaces for your use.

**HOW IS YOUR PROJECT MANAGED?**

Pilot-plants are managed by a senior metallurgist who has responsibility for scope execution, deadlines, communication and cost management. On bigger projects, a technical manager coordinates day-to-day operations. Interim results are forwarded in a timely manner. A written report will be issued at the

completion of the project or at the end of each phase.

All project managers have access to SGS’ technical experts. These world class leaders provide technical consultation in their respective disciplines and are always available to solve difficult problems.

For some projects, it makes sense to run the project at one site and build an integrated team consisting of SGS in Lakefield from our international offices. In this way, your project can benefit from the best expertise and equipment available.

**HOW MUCH SAMPLE IS NEEDED?**

While each case has to be evaluated individually, typical samples volumes required are below.

FLWSHEET DEVELOPMENT	PILOT PLANT TESTING
40-50 kg	200 kg – 2 tonnes
(composites preferred)	(4-6 composites)

**HOW LONG WILL IT TAKE?**

SGS’ plant facilities can accommodate several pilot-plants simultaneously. Often over a dozen unit operations are integrated. We can operate 24 hours a day and some projects are staffed with over 150 skilled people.

It is obviously difficult to say how long a project will take due to sample availability, ore complexity, etc, but minimum time lines are below.

	FLWSHEET DEVELOPMENT	PILOT PLANT TESTING
Typical Minimum	6 Weeks – 3 Months	3 Months
Planning		2 Weeks
Set-up and Tear-down		1 – 2 Weeks
Piloting		3 – 5 Weeks
Reporting		4 – 8 Weeks

During pilot plant operations, unforeseen problems can arise, usually revealing issues that are better addressed before full-scale operation. As a result of years of experience, our staff can quickly provide workable alternatives.

**WHERE CAN I GET SERVICES?**

SGS offers a global footprint to help meet your testing needs. For logistical and staffing reasons, we have nodes of expertise situated throughout our operations. Depending on your needs, we will work with you to meet your timing and project requirements.

**SAMPLE OWNERSHIP**

You retain ownership of all samples and rejects or test products sent to SGS for testing. This also means that you have the ultimate responsibility for their return or disposal.

The Project Manager will provide you with a list of all your materials (samples, assay and test rejects) that remain at the end of the project. Please let us have your instructions for these samples within 30 days. If we do not hear from you, we will store the samples for 3 months and then dispose of them for you.



## SAMPLE STORAGE

SGS has a variety of ways to store your samples before, during and after your testing program:

- Ambient temperature storage (varies from -20°C to 35°C with variable humidity) is suitable for most samples
- Freezer storage is appropriate for sulphide rich samples that might oxidize readily
- Heated storage is needed for laterites

Sample storage is based on type of storage needed (frozen, ambient or heated), length of time stored and the storage media (pails, drums etc).

## ON-SITE OPERATIONS: HEALTH AND SAFETY

Health and Safety is an important consideration for SGS. All visitors to our site are bound by our health and safety policies, including clients or their representatives such as consultants or engineering firms and suppliers and contractors. Pilot plant testing programs

are prefaced by a HazOp Meeting that all staff working on the project must attend. Clients planning to be on-site, contributing to the project are also encouraged to attend.

In addition, we operate a variety of operational activities such as employee health monitoring programs (hearing, blood lead, silica, others as needed), designated substance monitoring programs, dust collection systems, MSDS-based worker information data bases to ensure health and safety in our workplace. These protocols will be operational during any anticipated operations. We appreciate any involvement or contributions other parties might make in this area but we, SGS, are committed this, our corporate responsibility.

## ON-SITE OPERATIONS: ENVIRONMENTAL ASPECTS

SGS' internal environmental policy insists that sustainable environmental practices are given top priority. As well, SGS is a co-signee to the CIM Environmental

Policy Statement, which promotes environmentally sustainable operations in the mining and exploration industries.

At the Lakefield, Canada site, waste is directed to a fully permitted tailings pond. Our other facilities have waste disposal systems that comply fully with local regulations. On-site environmental conditions are carefully monitored. Responsibilities are clearly outlined for management and employees. Participation is mandatory. Standards and operating procedures are documented and followed, so that our Policy is maintained. While we appreciate any involvement or contributions that other parties might make in this area, SGS knows that this is our responsibility.

## CONTACT INFORMATION

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