



**SDG Mission:
To improve grinding mill starting.**

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Solutions developed for:

1. WRIM with LRS, with and without SER
2. Clutch Mills
3. VSD Mills
4. GMDs

Core focus: WRIM started by LRS

Tested, solved problems and enhanced performance
on LRSs from:

RWW, AKA, AOiP, Uniserve, NHP, Toshiba, etc.

On LRS WRIM, the focus is on:

1. Solving problems and improving performance of LRSs
2. Locked Charge Incident prevention.
(Solidified ore dropping down on mill shell and causing damage.)

Problems and inadequate performance on LRSs leads to:

Torque spikes, resulting in:

1. Girth Gear cracking and failure.
2. Gearbox problems and failure.
3. Pinion gear and shaft failures.
4. Increased maintenance costs of drivetrain.
5. Decreased service life of girth/pinion gears.
6. Decreased service life of gearboxes.

Problems and inadequate performance on LRSs:

High rotor currents and current spikes, resulting in:

1. Slip ring flashing
2. LRS electrode arcing.
3. Motor and/or LRS failure.
4. Increased maintenance costs of motor and LRS
5. Reduced motor and LRS electrode service life.

We execute our mission as follows:

A) **M**easure

- Identify problems with LRS performance:
 - Testing, measuring
 - Online performance monitoring

B) **I**mprove

Solve problems and enhance LRS performance.
(Interventions, performance improvements,
failure prevention)

C) **P**rotect

Protect the mill, drivetrain and motor against
dangerous events. (Protection and diagnostics)

MIP Results in increased plant availability and reduction of maintenance cost.

- Avoidance of unpredictable failures, downtime and production loss. (Increased plant availability.)
- Longer service life of mechanical drivetrain, motor and LRS, decrease in refurbishment and replacement cost. (Decreased maintenance expenditure)
- Barring time reduced or eliminated. (Increased plant availability)
- In case of failure: Minimization and localization of damage, quick operational and root cause diagnostics.

We identify problems or suboptimal performance in 3 ways:

- A1) Start-up test with custom developed test hardware and software to evaluate start-up.
- A2) Install Mill Safe Start, monitoring each and every start-up, with automatic reports emailed to client directly after each start-up and analyzed by SDG every day.
- A3) Temporary installation of monitor, on a lease basis, for longer term monitoring.

With our custom designed test set:

1. Numerous tests conducted over past 10 years
2. Countries including: Ghana, Zimbabwe, Zambia, DRC, Guinea, Mozambique, Peru, Philippines.
3. Numerous difficult problems solved including:
 - Girth gear cracking (e.g. Ngezi)
 - Gearbox problems (e.g. Damang)
 - Slip ring flashing (e.g. Tharisa)
 - Locked charge damage (e.g. Tarkwa)
 - Arcing in LRS (e.g. South Deep)
 - Numerous LRS problems. (Lion, etc.)

Periodic testing with portable test set not ideal for accurate and efficient long term management of a fleet of LRSs due to:

1. Start-ups vary greatly depending on conditions.
2. Cannot get a proper picture looking at a single start, some problems manifest only under worst case conditions.
3. Problems can develop quickly and cause breakdowns before the next scheduled test.
4. Production is affected: Require test starts, stops.
5. Time spent waiting for plant to start is costly.
6. More ideal to start with cubicle door closed, normal operating conditions.

A2. Permanent monitoring with Mill Safe Start system.

- All starts are recorded. Most strenuous starts available to evaluate performance in application.
- All starts analyzed. Problems detected immediately, often before it causes a breakdown.
- In event of breakdown, data immediately available via the internet to be analyzed by SDG.
- Focus shifted from ad hoc failure management to failure prevention.
- Focus shifted from ad hoc spot tests under random conditions, to planning and verifying performance enhancement, condition monitoring and trending.
- All starting KPIs automatically available, and exceptions immediately apparent.

A2. Mill Safe Start systems installed around the world:

- 4 in Ghana; 4 in Peru; 2 in Philippines; 3 in S.A.
- Busy commissioning 2 in USA, South Carolina.
- Busy building one for Siguirri, Guinea.
- Biggest geared mills at time of order:
 - Two 14MW mills at Tarkwa, Ghana
 - Four 16MW mills at Constancia, Peru.
- First installed in 2010 on both 14MW dual pinion mills at Tarkwa, Ghana.
- These systems still working perfectly, with perfect track record and enthusiastic customer reference.

A3. Temporary Online Performance monitoring:

- Evaluate starting over a longer period. (Weeks.)
- Give better picture than single test.
- Applicable when looking for allusive problem.
- Applicable for verification of an intervention.
- Equipment remains property of SDG, leased for limited time period.
- CTs and VTs permanently installed, temporary monitor mounted on outside of LRS control panel, connected with quick disconnecting plug, monitor can in future be reconnected to same LRS in seconds and without stopping mill.

B. After identification of problems or inadequate performance, we solve LRS problems and enhance performance by:

1. Tune existing equipment. (mS/cm, dipper speed)
2. Install problem solving and performance enhancing modifications, or new equipment.
 1. Dipper movement (SmoothStart/MSS with VSD)
 2. Temperature compensation (SmoothStart/MSS)
 3. Temperature control (Heaters and coolers)
 4. Shorting Spike quenching. (uRB small resistor)
 5. Water demineralization (R.O. equipment)
3. Recommend 3rd party actions (OEM upgrades, replacement of electrodes, etc.)

B. With permanent monitoring, early detection and prevention of problems become possible:

Many case studies where Mill Safe Start detected LRS problems before the client was aware of any problem, and the LRS fixed avoiding a breakdown, for example:

- Damang LRS dangerous current rise.
- Lion shorting spike rise
- Tarkwa current spikes due to isolating pipe failure. (Fixed LRS before damage or downtime was incurred.)
- Didipio bad LRS performance.

B. Permanent monitoring with Mill Safe Start system.

Many case studies where breakdowns occur and the Mill Safe Start recorded the fault and revealed the root cause immediately, pointing to future prevention, for example:

- Damang rotor phase open circuit.
- Lion locked rotor case.
- Tarkwa slip ring flashes.
- Didipio LRS flashes.

C. Instantaneous Protection with Mill Safe Start:

Many instances where the Mill Safe Start operated and prevented or limited damage in real time, for example:

- Tarkwa locked charge due to incorrect minution circuit operation.
- Didipio locked charge due to incorrect minution circuit operation.
- LRS arcing. (e.g. Didipio)
- Locked rotor condition. (mill stuck.) (e.g. Lion)
- Slip ring flash (e.g. Tarkwa)
- Motor rotor E/F (e.g. Damang)
- Torque coupling shear. (e.g. Tarkwa)