REPRINT

THE INDUSTRY'S LEADING NEWSPAPER SINCE 1889 THE VOICE OF THE MINING INDUSTRY

THE MINING RECORD

INTERNATIONAL MINING NEWS™

128 Years Of Mineral Coverage

www.miningrecord.com

Vol. 128, No. 6 June 2017 Denver, Colorado, USA

Metals Watch (05/26/17): Gold $1,266.70 • Silver $17.31 • Copper $2.56 • Lead $.96 • Zinc $1.19 • Platinum $959.00 • Palladium $789.00 • Molybdenum $7.94

Tailings Stewardship: Training from the Tailings Beach to the Board Room

By Matt Fuller, CPG, Tierra Group International, Ltd.

DENVER, COLORADO - Implementing a Corporate Tailings Stewardship Strategy begins in the Board Room with a corporate pledge to zero-tailings dam failures and, like a safety culture, extends throughout the organization to the boots-on-the-ground TSF operations team personnel. Tierra Group International, Ltd.'s (Tierra Group) Tailings Stewardship implementation strategy includes operations management training (OMT) tailored to (TSF) operations, mine and corporate management teams, after carefully assessing:

- TSF operational safety (dam and facility inspection);
- Routine maintenance and monitoring activities;
- TSF "conditions-reporting" practices;
- Interaction between the mines' TSF operations team, and the engineer of record (EoR);
- Operations Maintenance and Surveillance Manual (OMS);
- Emergency Action/Preparedness Plan (EAP/EPP); and
- Operational conformance with design.

Tailings Stewardship training is important as it provides the Tailings Steward insight to:

- TSF operations personnel' institutional knowledge and "standard of care" practices;
- Maintenance and monitoring activities comprehensiveness and appropriateness to the specific TSF; and
- Both the site and corporate management teams' commitment and preparedness to respond to extraordinary circumstances.

Insight gained from the initial assessment allows the Tailings Steward to tailor training to the specific TSF operations personnel needs and to communicate potential good management practice (GMP) improvements to the operators, mine and corporate management.

There is no question that safely operating a TSF requires experience, and understanding at the day-to-day TSF operations level. Field observations, even and particularly, the "slightest changed condition(s)" are potential indicators of potentially-developing problems. A critical component, to successfully implementing a "corporate" tailings stewardship strategy however, is the upward-reporting of those observations; and mine and corporate managements' conscientious preparedness, willingness and diligence to provide the appropriate attention necessary to avoid potentially disastrous consequences. To this end, tailings stewardship training adds value to a mining company's operation from the beaches of the TSF, to the board room.

TSF good management practices are compromised for a variety of reasons, not the least of which are:

1. Limited understanding of the potential liabilities poor tailings management practices present.

It is not this articles intent to elaborate the negative economic consequences a TSF failure can present to the mining industry, which are well documented elsewhere. Suffice it to say that the economic consequences of a TSF failure can reach into the hundreds-of millions, if not billion-dollar range, impacting not only the mining company experiencing the failure; but the entire mining-industry investment community. This fact alone emphasizes the importance of the boot-on-the-ground TSF operators' role in the grand scheme of corporate sustainability.

2. Lack of understanding between TSF operations personnel, and the EoR's TSF design and facility operations intent.

Design engineers notoriously assume that a TSF design and operational intent are obvious to the practitioner (management and operations personnel). Inevitably however, many of the most important aspects of a TSF operational intent are not clearly articulated in the TSF engineering design report, or the Operations Maintenance and Surveillance (OMS) manual.

A TSF engineering design report sets forth safe and stable TSF design, assuming it is operated within specific operational parameters set forth in a facility=specific OMS manual. The OMS manual prescribes operational parameters under which the TSF should be operated to assure the engineering design intent is fulfilled. As such, the engineering design and the OMS manual are interdependent.

It is not uncommon for a mining company to develop a TSF design to support financing and mine construction; build the TSF; and move right into production (operating the TSF) before preparing an OMS Manual (or, obviously, providing operations training to the TSF operations or mine management personnel). It is imperative that mine management and TSF operations personnel, be intimately familiar with not only the operational protocols prescribed in the OMS; but also, how and why the protocols pertain to safely operating the TSF, to assure the engineering design intent is fulfilled.

Continued On Reverse Side

3. TSF operations personnel' job mobility.

Commonly TSF operations fall under the responsibility of the mill/plant manager/supervisor. The mill-super typically delegates day-to-day TSF operations to a team member (who has other responsibilities as well), commonly as a "stepping-stone" to positions of higher-priority responsibilities. Combined with natural industry transitions (within or between companies); tailings-operations is commonly a short-lived experience (how many individuals in the mining industry have made a career solely out of tailings operations management?). An ever-changing work force introduces discontinuity, and varying levels of expertise and understanding with respect to facility-specific tailings operations management.

4. Limited (if any) university curriculum specific to tailings management.

Classic engineering curriculums (including mining engineering) taught in universities today provide a foundation in the fundamental geotechnical and hydrologic) engineering principles, which apply to TSF design and management (soil, rock, and fluid mechanics, etc.). The combined application of all these engineering principles in real-world tailings management is typically not realized until an engineer is exposed to TSF operations.

On-the-job training is therefore, the primary education vehicle available to engineers entering the mining industry, other than perhaps industry short-courses. Furthermore, on-the-job training only provides TSF operational education specific to the TSF that the engineer is engaged with.

If one considers the potential types of tailings dam construction methods (downstream, upstream, centerline, modified centerline); tailings types (conventional, thickened, paste, filtered); climatological settings (arid, semi-arid, sub-tropical, tropical, sub-arctic, arctic); foundation conditions (sedimentary, volcanic, glacial, karstic, lacustrine, marine, etc.); the myriad of potential tailings "systems", becomes nearly incalculable. No two TSF are the same; and something learned at one TSF site, may or may not be relevant at another. Conversely, years of experience and exposure to all (or at least, most) of these TSF scenarios provides a keen understanding of tailings management principles in a broader variety of applications.

Understanding the interdependency between TSF engineering design, TSF operations, and safety; must be categorically embraced from the TSF operations Team, to the Board Room. Tierra Group's tailings stewardship expertise has experienced shortfalls in this understanding at both ends of the corporate spectrum. In one case operators in the field were not familiar with observation reporting protocols and failed to report-up a small seepage emanating from the toe of a tailings dam. In another instance, corporate management (the C-suite) were not familiar with the OMS protocols regarding operating water pool elevation constraints, and directed the operators to store more water in the TSF than the OMS protocols prescribed. Both these instances resulted in TSF upset conditions that suspended mining operations.

These two case studies demonstrate the critical importance of Tailings Stewardship Training, top to bottom. Tierra Group's Corporate Tailings Stewardship Strategy includes site-specific training to the TSF operations, mine and corporate management teams to ensure safe tailings operations, for all stakeholders. While universities are encouraged to include the fundamentals of TSF operations in mining and environmental curriculums; it is wise for mining companies around the world to engage a professional tailings steward with the requisite broad-based experience to help guide good management practices and operational excellence towards zero TSF failures, or upset conditions.

Matt Fuller, CPG is a Founding Principal with Tierra Group International, Ltd. Tierra Group's Engineering Team has been providing tailings stewardship services around the world since 1990.