GROUP SAFETY STANDARD 17
INRUSH AND OUTBURST

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DATE	NAME	CHANGE	APPROVED	REVISION
20/05/2016	Keith Ashby	Issued for use	Executive Leadership Team (ELT)	0
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1. INTENT

This standard outlines the requirements for identifying and controlling the risks associated with potential inrush or outburst into underground mine workings or similar.

Inrush is the rapid ingress of fluids and or material into mine workings that pose a threat to the health and safety of mine-workers, equipment and or the integrity of the mine. Outburst is the sudden expulsion of gasses and material, resulting from a release of stored potential energy, typically from rock units containing reactive or explosive gasses.

2. APPLICATION

This standard shall apply to all IGO owned and or operated underground mines, and must be adhered to by all IGO employees, contractors, and sub-contractors.

3. RISK ASSESSMENT

A documented inrush and outburst risk assessment, with detailed control measures, must be maintained for each site. The risk assessment must address the following potential hazards as a minimum:

- all significant bodies of water or other fluid material (actual or potential) suspended above or upstream of mine workings. Consideration should be given to water storage dams, ponds and sumps (both on the surface or underground), aquifers, lakes, rivers, and tailings dams
- backfilled stopes (rock, hydraulic and / or paste filled), and ore / waste passes
- unfilled voids (natural or manmade) with the potential to store or capture fluids or gasses
- backfill bulkhead failure
- faults, other geological structures, or strata that may contain, or provide a conduit for fluid flow
- strata that may hold or have the potential to generate flammable or toxic gases, or gases under pressure
- unstable strata that, should it fall, has the potential to generate an air blast
- areas potentially subject to inrush because of storm or surface flooding events
- reticulation that transports services (air and water) as well as backfill material.

Critically, the risk assessments must consider (as relevant) volumes, pressure estimates, speed, potential modes of inrush, and the potential impact zone associated with each hazard.

The completed risk assessments, inclusive of the defined controls, shall be approved by the Registered Manager, or their delegate.

For more information on risk assessment refer to ***IGO GSS 3 – Safety Risk Management***.

4. INRUSH AND OUTBURST MANAGEMENT PLAN

All IGO underground mines shall have a site-specific ***Inrush and Outburst Management Plan.*** The plan shall take the form of a standard IGO management plan, and must include the following as a minimum:

- a description of the nature of inrush hazards and sources present at the site

- the process of how the Inrush and Outburst Management Plan is related to other hazard management plans (ground control, backfill, tailings storage, etc.)
- a relevant mine history including summary of any previous inrush events, plus links to all related documents within the document and training hierarchy as well as other reference material utilized to assist in identifying or managing the hazard
- reference to relevant geological, geotechnical, hydrological and hydrogeological survey data
- a list of the inrush hazards, their associated control measures, definition of the role's responsible for ensuring the integrity of each control, and reference to the inrush risk assessment
- descriptions of the analysis methods (physical, empirical, numerical) used in identifying and assessing the magnitude of the inrush hazard
- reference to a current ***digital mine model*** that identifies:
  - drill holes and drainage holes (open or grouted)
  - voids (both open or backfilled)
  - ponds, dams, and any other water or fluid retaining structures
  - water bearing faults or strata
  - other excavations, structures, or infrastructure that contain, or potentially contain, fluids or other actual or potentially fluid material, suspended above or upstream of mine workings (including water storage dams, ponds, tailings dams, or waste dumps)
- as required, defined ***Inrush & Outburst Control Zones*** into which mining, or drilling is prohibited so as to avoid the risk of inrush or outburst. Any actions (entry, excavation, maintenance, etc.) required in these control zones require specific assessments and controls to be in place and approved by the Registered Manager. Access to Inrush & Outburst Control Zones must be controlled by a barricade (***IGO GSS 7 – Barriers, Barricades and Signage***)
- monitoring parameters and procedures developed to evaluate and control the identified inrush hazards or correct the identified hazard
- maintenance and testing of bulkhead and barricades used as an engineering control for retaining fluid materials or excluding personnel from controlled zones
- thresholds identified for the monitoring parameters, including sump water levels, pumping capability and reliability, and maintenance requirements
- prescribed Trigger Action Response Plans (TARPs), with defined triggers levels and alarms for action, based on empirical or physical measurements of the inrush hazard (e.g. water levels, pressures, volumes, flow rates, etc.). The TARPs must outline the defined actions including reporting to senior site management, increased monitoring frequencies, hazard reduction measures to be implemented, or evacuation requirements. As part of the TARP, defined trigger levels or events for initiating the **Underground Evacuation Plan must be included.** (As per ***IGO GSS 5 – Crisis and Emergency Management***, all sites with an underground mine must have an Underground Evacuation Plan.).
- a clear, easy to follow communication pathway to advise of all inrush hazards, including hazard warnings to the workforce from management, and methods to report observations from the workforce
- reference to all relevant standards, procedures and instructions relevant to inrush management

- workforce training requirements.

The Inrush and Outburst Management Plan must be prepared by qualified and appropriately experienced personnel and approved by the site's Registered Manager.

5. COMMUNICATION, MONITORING, INSPECTIONS AND VERIFICATION

Site's must ensure the effective communication of the plan and the associated control measures to both employees and contractors working underground.

Site's shall verify that work is completed in accordance with the Inrush and Outburst Management Plan. Specifically, site's must ensure that mine planning, design and scheduling is completed with due regard to the Inrush and Outburst Management Plan. Records of verification audits must be documented in INX.

Further, site's must ensure that:

- formal inspections and measurements are completed to schedule to verify the adequacy of control measures
- inspections and measurements are formally documented
- appropriate monitoring of TARPs and alarm thresholds is ongoing and reliable
- inrush events or near misses are communicated to all underground workers
- workforce training and information sessions are scheduled and completed to plan.

6. REVIEW OF MANAGEMENT PLANS

Site's shall have an established process for the reviewing the ***Inrush & Outburst Management Plan***, and relevant sections in other referenced controlled documents. The **plan must be reviewed at least annually** by qualified, competent site staff to confirm that all significant hazards are addressed, and the monitoring systems, controls, and training requirements are fit for purpose. The review must also address how well or otherwise the plan is understood by the underground mine management team.

Additionally, the Inrush & Outburst Management Plan must be reviewed:

- when inrush hazards change, new inrush hazards are identified, or when existing key assumptions are updated because of new information (e.g. new water bearing structure or flow data becomes available)
- prior to the mine being extended into any new area, other than extension at depth, or into an inrush control zone
- biennially by an external expert in collaboration with senior mine-based staff. This process must include a review of the hazards, the risk assessment, the effectiveness of controls, training, and communication of controls and control monitoring, and the general adequacy and likely effectiveness of the overall management plan
- following any inrush incident
- given a proposed change to mining method. In such circumstances, the review must be completed by an external expert in collaboration with senior mine-based staff.

7. TRAINING

Persons working in the mine area shall be trained in the application of the Inrush and Outburst Management Plan as relevant to their role, and in line with local statutory requirements.

8. RELATED DOCUMENTS

8.1 Common Management System Standards

- IGO CMSS 03 - Risk Management

8.2 Group Safety Standards

- IGO GSS 03 – Safety Risk Management
- IGO GSS 05 – Crisis and Emergency Management
- IGO GSS 07 – Barriers, Barricades and Signage
- IGO GSS 10 – Ground Control

9. GLOSSARY OF TERMS

Term	Definition
Barricade	A structure designed and installed between the inrush hazard source and areas where mine workers are present to reduce (or eliminate) the hazard entering accessible mine workings.
Bulkhead	A structure designed to retain materials (fluids or backfill) to store fluid materials for routine pumping, or until curing (or draining) of backfill material.
Fluid Material	Any material that can flow, including gasses, liquids, muds and slurries.
Hazard	A hazard is a source, or a situation, with the potential for harm in terms of human injury or health, damage to property, damage to the environment, or a combination of these. Refer to ***IGO CMSS 3 - Risk Management.***
Hydraulic Fill	A type of mine fill made from either naturally occurring material, or mine tailings with a prescribed particle size, placed into underground voids as a slurry via boreholes and / or pipelines. The material used must be strictly controlled to ensure excess water can freely drain. Hydraulic fills can be either cemented or uncemented, depending on the mine design and long-term fill stability requirements.
Inrush	The occurrence of a liquid, gas, or other substance that can flow into a workplace at a rate or volume that creates a risk to health and safety of mine workers, which may create an emergency situation.
Inrush Control Zone	This is the zone required around an inrush hazard where additional check and controls are required prior to entry.
Inundation	See Inrush
Outburst	An outburst is the failure and sudden ejection of gas and/or material, resulting from a release of stored potential energy.
Paste Fill	A type of mine fill consisting of ultra-high-density thickened tailings with an added binder. This fill type differs from hydraulic fill in that it contains higher quantities of fine material, and only sufficient water to hydrate the binding agent being used.
Risk	A risk is the chance of an unwanted event happening that will have a negative effect. The level of risk reflects the likelihood of the unwanted event, and the potential consequences of the unwanted event. Refer to ***IGO CMSS 3 - Risk Management***.
TARP	Trigger Action Response Plan. A document or process to prevent a risk from escalating by identifying potential indicators to the hazard, assigning an appropriate action or trigger point for each hazard, and outlining responses for each trigger level.