Appendix A Risk assessment

SkillPro bag barrier design risk assessment. To be expanded as needed by contract fillers, before going to mines

Phase	Problem, risk, Issue	Unwanted outcome	Current design controls	Additional controls needed by mine and/or contract fillers
Filling	Under-filled	Inadequate dust density so the system does not work as intended in explosion	At 6kg, the dust is 135mm from the base of a bag that is 310mm wide, when the bag is suspended. The exact mass/bag is covered by SkillPro guidelines and worked examples of barrier designs in the guideline, are based on 6kg/bag	Mines need to order bags filled to the mass required by their design Contract fillers are expected to have an audited scheme to ensure bags are filled to 6kg, or between 5kg and 6kg, should the mine specially request any such value Bag filling mass and numbers are expected to be part of ongoing mine audits of major hazard management systems. Mine procedures should ensure any minor underfilling detected in service, is compensated for by hanging extra bags within the length of the barrier Contract bag fillers should ensure their staff are trained to visually detect gross non-conformance
	Over-filled	Minor economic loss only	The hook cannot be easily fitted in the marked location if it is drastically overfilled, so partially self- managed.	Contract bag fillers should ensure their staff are trained to visually detect gross non-conformance

			SkillPro guidelines deals with fill levels.	Bag fill level/weight is expected to be part of ongoing mine audits of major hazard management systems
	Non-conforming dust used	does not work as intended in explosion	All prior testing is with stone dust as used underground.	The mine/contract bag-fillers are expected to purchase dust that complies with the regulations of the Jurisdiction they are to be sold in. Mine purchasing systems should require proof of compliance with dust Standards. Correct dust usage/compliance is expected to be part of ongoing mine audits of major hazard management systems
	Bag or hook damaged in handling/packaging/freight/storage (The bags are deliberately fragile by special design of the plastic).	No impact on performance-Minor economic loss only	The load capacity of the hook is periodically tested by the suppliers. Hooks, rings and bags are all separately bulk packed and sealed in cardboard crates immediately upon productions The dust packs into the bags and very minor bag damage does not always result in loss of all the dust.	It is expected that technicians filling bags quickly work out how to handle them to avoid damage and put in place any necessary procedures/equipment. As-received condition is expected to be part of ongoing mine audits of major hazard management systems. Contract fillers should ensure crates of pre-filled bags are "top-load" only

			Purpose made divided boxes can be supplied to hold/ship pre-filled bags, and reduce likelihood of transport damage.	Mines and contract fillers should ensure neither bags nor hooks, or filled units, are left exposed to sunlight (UV radiation) for any time except that essential for filling and/or handling operations
	Moisture/water gets into the dust or bag	1) Harder to fill 2) Does not work as intended in explosion	The bag is sealed against accidental water ingress provided the ring is correctly fitted and the top of the bag folded over it. The bag is made so that there is sufficient free material at the top to fold over the hook The ring on the hook is a tight fit to maximize sealing capability Wet dust will not flow easily through the hopper and into the bags.	It is expected that contract fillers will have a procedure to ensure bags are not filled with moist dust It is expected that contract fillers will have a procedure to ensure bags that are accidentally damaged (torn/penetrated) during filling are rejected and not supplied to mines It is expected that mines will have a procedure to ensure bags that are accidentally damaged (torn/penetrated) during hanging, or in-service are rejected and replaced Mine procedures should include a check for workers to visually identify significant moisture ingress by way of hard-caked dust and/or visible moisture beading inside the bag and take remedial action in conjunction with the suppliers and or/contract fillers and/or hanging crews Barrier/bag/dust condition is expected to be part of ongoing mine audits of major hazard management systems

	Wrong, different or sub-standard bag used	Explosion not quenched because the bag does not rupture and disperse the dust as intended	All bags sold by SkillPro have that name and company logs printed on them The installation designs and these guidelines are based are numerous large scale tests with these specific bags & hooks (note there are 2 sizes available and both have been large-scale tested in real coal dust explosions). SkillPro has a program to periodically re-test at large scale, a number of bags and hooks to confirm rupture conditions Test reports available to Mines Inspectorate & Customers on request. The plastic bags have very special anisotropic properties so they will rupture under credible explosion pressures SkillPro show contract fillers how to confirm the bags have intended properties SkillPro routinely subjects the plastic bags to impact tear testing	Contract fillers are expected to have a process to periodically check the bags have the intended properties Correct bag in use is expected to be part of ongoing mine audits of major hazard management systems

	Wrong, different or sub-standard hook	Explosion not quenched because the hook does not hold the bags or hold onto the mesh as intended	All hooks sold by SkillPro have that name printed on them and are specifically designed to retain the SkillPro bags until they shred and dislodge the dust, under explosion conditions The installation designs and these guidelines are based are numerous large scale tests with these specific bags & hooks (note there are 2 sizes available and both have been large-scale tested in real coal dust explosions). SkillPro has a program to periodically re-test at large scale, a number of bags and hooks to confirm rupture conditions Test reports available to Mines Inspectorate & Customers on request. SkillPro routinely subjects the hooks to static load tests as per SP-2016-001	Mines and/or contract fillers should ensure SkillPro bags and hooks are only used as "matched pairs" i.e. SkillPro bag with SkillPro hook and ring
	Hook wrongly placed post bag filling	May make hanging more difficult	There is an upper red line printed on the bags indicating hook placement to provide correct location with 6kg of dust in bag	Contract fillers are expected to have a process to check hook integrity as part of the packing process
	Hook locking ring not correctly secured post bag filling	Bag may slip out of hook when being handled or in an explosion.	The outer plastic ring on the hook is designed to have a positive lock when correctly fitted	Contract fillers are expected to have a process to check lock ring integrity as part of the packing process

		Minor economic loos to contract filler/mine	SkillPro instructs contract bag fillers on required processes	
Transport to mine & underground	Broken bags with dust falling out	Inadequate dust density so the system does not work as intended in explosion	The SkillPro guidelines have a small allowance for damage. SkillPro offers guidance to any mine buying product (via the retailer/bag filler if used)	Mines expected to use the SkillPro guidelines to design a compliant system Mine workers are expected to replace damaged bags/hooks on-job to maintain compliance with guidelines Barrier/bag condition is expected to be part of ongoing mine audits of major hazard management systems Mines are expected to train their staff in requirements and have multiple levels of technical management that should assess installations routinely.
	Accidentally encounter water once installed	Water gets into the dust and explosion not quenched because dust does not disperse as intended	The bags are effectively sealed using the locking ring as part of the purpose-made hook and will not uptake water unless deliberately hosed or submerged.	Barrier/bag condition is expected to be part of ongoing mine audits of major hazard systems. Mines should take particular note of any installations associated with water coming from the roof
Installation	Inadequate number of bags hung	Inadequate dust density or layout so the system fails to	SkillPro guideless specify bag density for specific applications, all based on large-scale testing	Detailed Barrier design is expected to be part of ongoing mine audits of major hazard systems

		work as intended in explosion		
	Excess bags hung	Economic loss only- Not a system problem	SkillPro Design guideless specify bag density for specific applications based on large-scale testing	Barrier/bag numbers are expected to be part of ongoing mine audits of major hazard management systems
	The hooks cannot easily be suspended from the roof line or around conveyors etc	Explosion not quenched because dust bags cannot burst as intended (note, quality suspension hook is critical to them working)	Two different hooks designs allow for use in most modern mine situations (refer to SkillPro for unusual situations including on or around belts---testing may be required) SkillPro guidelines suggest the hooks are optimally placed if they can swing inbye/outbye without jamming, so they should be placed on lines/mesh/rods etc running across the roadway, not longitudinally	Bag hanging arrangements are expected to be part of ongoing mine audits of major hazard management systems
	The barriers are wrongly placed	Explosion not quenched because dust bags cannot burst as intended (ie by pressure front ahead of flame front)	SkillPro Design guidelines specify barrier locations and these should match Legislation	Barrier location is expected to be part of ongoing mine audits of major hazard systems
	Crates/boxes of filled bags are excessive mass	Overturning or toppling of the work platform or associated machine	No controls offered by SkillPro	Mines buying cartons of pre-filled bags should work collaboratively with suppliers of filled bags to ensure all related mechanical

	for the work platform			risks are being appropriately considered and managed. Mines self-managing the bag filling operation should ensure all related mechanical risks are being appropriately considered and managed. It is expected that contract fillers note/advertise the gross mass of packages/crates they supply.
Operation	Bags fall down or are hit/damaged (Note, Bags not designed to be deliberately hit by passing machinery)	Inadequate dust density so the system does not work as intended in explosion	SkillPro guidelines require the mine to have some audit program to replace any damaged/missing bags. To preserve the integrity of the explosion barrier against situations where some bags and hooks are inadvertently damaged, it is envisaged each mine will either have a plan to replace them or install additional bags during construction	Barrier/bag damage is expected to be part of ongoing mine audits of major hazard management systems
	Bags fall down due to premature hook failure (could be high ventilation speed causing swinging or vibration	Personal injury Non-compliant installation	Hook testing is part of large-scale system testing (note, the design intent is the hook remains intact until the bag commences to shred under the influence of an explosion pressure pulse).	SkillPro guidelines require the mine to have some audit program to replace any damaged/missing bags/hook. Contract fillers are expected to have some scheme to periodically test samples of hooks

	Incomplete protection as bags not correctly hung across the road	Inadequate dust density so the system does not work as intended in explosion	SkillPro guidelines cover the arrangements needed for most common scenarios	SkillPro guidelines advise the mine to have some audit program to ensure bags are hung as per guidelines SkillPro guidelines advise the mine to take special note of obstacles such as vent ducts, monorails, suspended belts etc.