



OHS IN MINING
RESEARCH INSTITUTE
UNIVERSITY OF VENDA

Engineering Mining Environments for Women

From PPE to Infrastructure

*For many years, we asked women to fit in mining
The next era requires mining to fit its people*

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What Do We Mean By “Engineering” Mining Environments?

A practical design lens for women in mining.

Engineering mining environments for women means designing the whole work system around real workers — not a historic male-default worker.

Whole-system approach — applying engineering, ergonomics, occupational hygiene, safety, health, procurement and operations together.

Designing risk out — across PPE, tools, equipment, infrastructure, transport, lighting, security and work organisation.

Lived experience as data — using women’s lived experience as design intelligence, not as an afterthought.

Not “special treatment.” It is fit-for-purpose occupational health and safety design.



SAMI CONTEXT

Why This Conversation Matters in the SAMI?

Women are not “new risks” — they expose old design gaps.

The challenge is not whether women belong in mining. The challenge is whether mining environments have been intentionally designed for a diverse workforce.

1

Health risk

Poorly fitting PPE, tools and facilities can increase exposure, fatigue and musculoskeletal risk.

2

Safety risk

Lighting, isolation, transport, communication and emergency response influence vulnerability.

3

Dignity risk

Inadequate facilities and unsafe culture undermine retention, reporting and trust.

Policy anchor: MHSA risk control duties + mandatory PPE COP for Women in Mining + GBVF and psychosocial safety imperatives.





REGULATION

PPE Is Regulated — But It Is Only One Layer

A necessary foundation, not the ceiling of safe-by-design.

In the SAMI, PPE for Women in Mining is currently governed through a mandatory Code of Practice framework.

Mandatory COP — mines must prepare and implement a COP aligned to the Chief Inspector of Mines guideline on selection and provision of PPE for women.

Fit-for-purpose selection — based on risk assessment, anthropometry, comfort, task compatibility, training and maintenance.

Worker consultation — women workers must be consulted in testing, feedback and procurement specifications.

Critical shift: PPE must not be used to compensate for poorly designed infrastructure.

Reference: DMRE/CIOM Guideline for a Mandatory COP for the Selection and Provision of PPE for Women in the SAMI, effective 2023.

INFRASTRUCTURE

From PPE to Infrastructure: Where We Must Zoom In

Inclusive infrastructure protects health, dignity, security and productivity — every shift, every workplace, above and below ground.

Change houses & ablutions

Washrooms and sanitary disposal systems

Underground amenities

Rest areas and emergency facilities

Lighting & wayfinding

Secure waiting points, communications

Transport & shifts

Routes, shuttle bays, fatigue-sensitive design

Workstation ergonomics

Equipment and layouts for diverse bodies

Safe reporting

Survivor-centred GBVF response systems

Infrastructure is not a “soft issue”; it is a risk control.



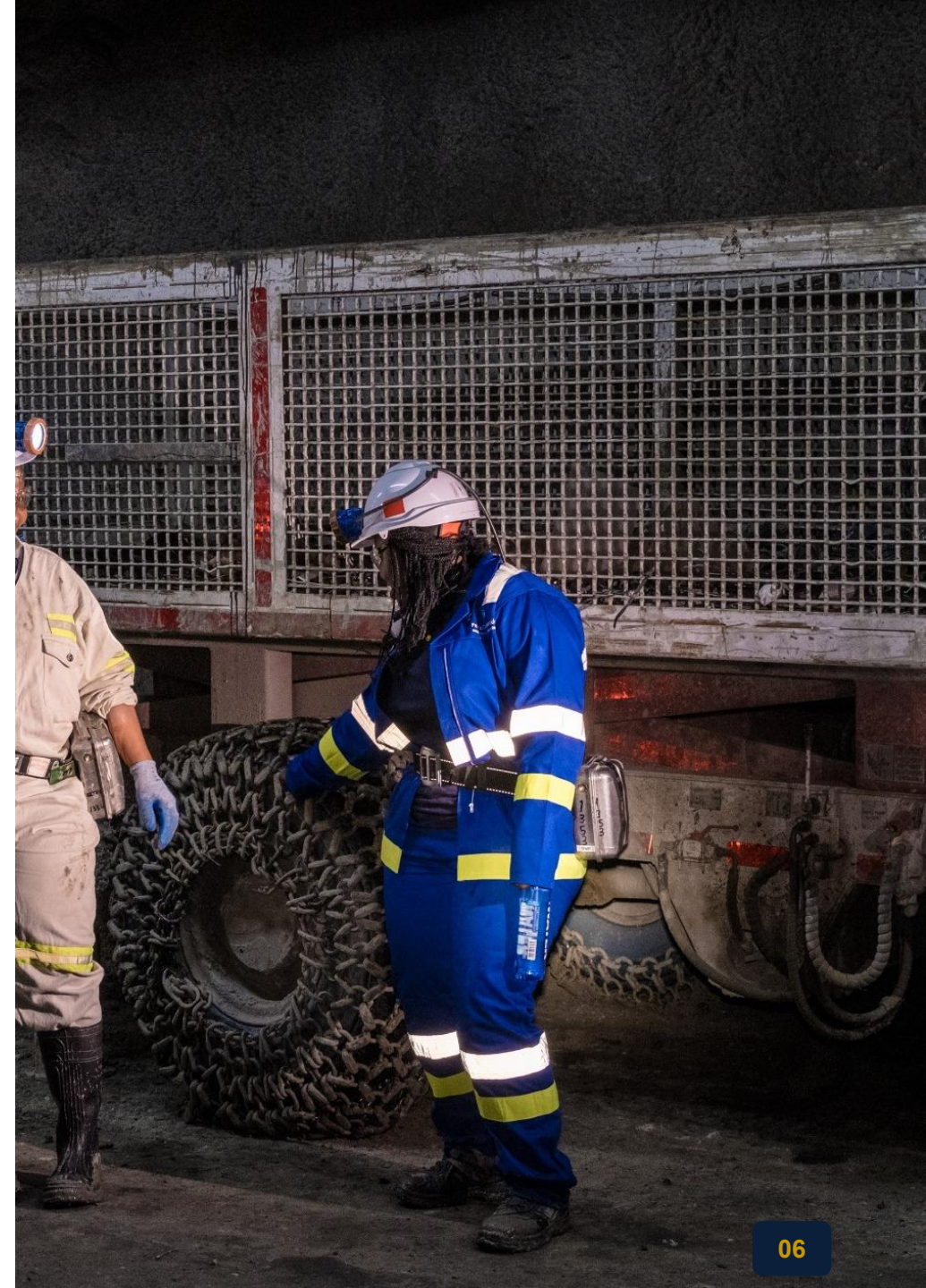
Safe by Design: Layered Controls for Women's Safety

Design risk out before the worker is exposed.

Safe by Design means women are protected by the system — not expected to adapt to unsafe work environments.

- 1 Fit-for-purpose PPE** The personal layer — important but not enough.
- 2 Infrastructure & facilities** Facilities, lighting, transport, communication, secure movement.
- 3 Tools, controls & machinery** Reach, force, seating, vibration, visibility, maintenance access.
- 4 Work organisation & culture** Shift systems, supervision, reporting, GBVF controls, accountability.

Hierarchy principle: higher-order controls must reduce reliance on the worker “coping” with poor design.



PRACTICAL CHECKLIST

Six Design Domains for Inclusive Mine Planning

The shift from PPE to infrastructure requires a whole-system view of occupational health, safety, dignity and productivity.

PPE & workwear

Fit, mobility, thermal burden, respirator seal, footwear

Tools & machinery

Reach, seating, force, vibration, control layout

Facilities & amenities

Change houses, toilets, washrooms, rest areas

Transport & security

Routes, lighting, waiting points, communications

Health life-stage needs

Pregnancy, reproductive health, fatigue, heat stress

Psychosocial & GBVF

Reporting trust, accountability, survivor support





ACTION PLAN

What Needs to Be Done in the SAMI?

*Moving from **compliance** to **transformation**.*

The next step is to convert “women in mining” commitments into mine-level design, procurement, capital planning and accountability systems.

Expand audits — from PPE COP compliance to gender-responsive infrastructure risk audits.

Involve women in process — put women workers into HIRA, design reviews, procurement trials and COP/SOP updates.

Embed in capital planning — inclusive requirements in capital projects, contractor scopes and procurement specifications.

Measure what matters — gender-disaggregated leading indicators: exposure, incidents, facilities, PPE fit, reporting, retention.

Fund now, plan long-term — quick fixes today, integrated into long-term mine planning.

Compliance tells us what must be done. Transformation changes how mines are designed.

Technology as an Accelerator — Not a Substitute for Design

From fragmented wearables to gender-responsive occupational health intelligence.

Digital tools can help mines see risk earlier — but only if they are designed ethically and gender-responsively.

Real-time monitoring — AI, IoT and wearable sensors can support monitoring of heat stress, fatigue, gases, dust, location and physiological strain.

Evidence gap — the evidence still shows limited gender-responsive design and insufficient reproductive and maternal health monitoring.

Integrated intelligence — the future should be integrated digital OHS platforms, not isolated devices or surveillance without trust.

Use technology to prevent harm, protect dignity and strengthen zero harm — not to **shift responsibility onto the worker.**

Evidence anchor: Adeeyo & Zungu scoping review on gender-responsive AI-enabled wearable technologies.





CONCLUSION

The Zero Harm Test

Do not redesign the woman for the mine.

Redesign the mine for its people.

- ✓ **Regulated PPE** is the floor — not the ceiling.
- ✓ **Infrastructure** must protect health, safety, dignity and security.
- ✓ **Women** must be co-engineers of safer mining environments.
- ✓ **Digital innovation** must be ethical, integrated and gender-responsive.

Zero harm means every woman returns home from work unharmed — every day.



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Prof Lindiwe Zungu



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She holds a PhD in Occupational Health and is an accomplished occupational health scientist and research leader with extensive experience in the mining sector. Her expertise includes occupational disease prevention, occupational epidemiology, women's health and safety in mining, mental health, and gender-responsive workplaces, with a growing focus on digital health and artificial intelligence.

She is passionate about translating research into policy and practice to advance the Zero Harm agenda and is a strong advocate for women in mining and the development of future African occupational health scientists.

Every mine worker returning from work unharmed every day. Striving for zero harm in our lifetime.



MHSC

Mine Health and Safety Council