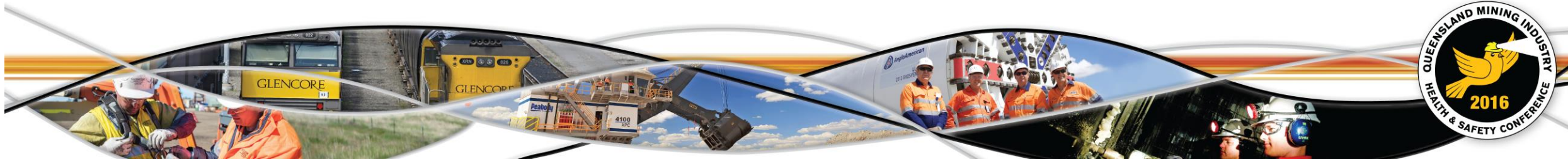


Learning from the past: Pattern causes of death and disaster in extractive industries

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Content

- Background and methods
- Ten pattern causes
- Some evidence on feedback/oversight
- Observations and Policy Implications
- Some conclusions



SUMMARY OF MINE INCIDENTS EXAMINED & REFERRED TO

| DATE | LOCATION | INCIDENT TYPE | FATALITIES |
|-------------------|-------------------|------------------|---------------|
| 20 SEPTEMBER 1975 | KIANGA MINE, QLD | EXPLOSION | 13 |
| 16 JULY 1986 | MOURA NO.4, QLD | EXPLOSION | 12 |
| 8 JULY 1994 | MOURA NO.2, QLD | EXPLOSION | 11 |
| 14 NOVEMBER 1996 | GRETLEY COL.,NSW | INRUSH | 4 |
| 30 OCTOBER 2000 | CORNWALL COL.TAS | ROCKFALL | 1 |
| 6 JUNE 2001 | RENISON MINE, TAS | ROCKFALL | 2 |
| 5 MAY 2003 | RENISON MINE, TAS | ROCKFALL | 1 |
| 19 MAY 2004 | BHP NEWMAN WA | HIT BY MACHINERY | 1 |
| 25 APRIL 2006 | BEACONSFIELD, TAS | ROCK FALL | 1 (2 TRAPPED) |
| 19 MAY 1992 | WESTRAY, CANADA | EXPLOSION | 26 |
| 19 NOVEMBER 2010 | PIKE RIVER, NZ | EXPLOSION | 27 |
| 25 SEPTEMBER 2011 | GLEISION COL, UK | INRUSH | 4 |

SUMMARY OF MINE INCIDENTS CONTINUED

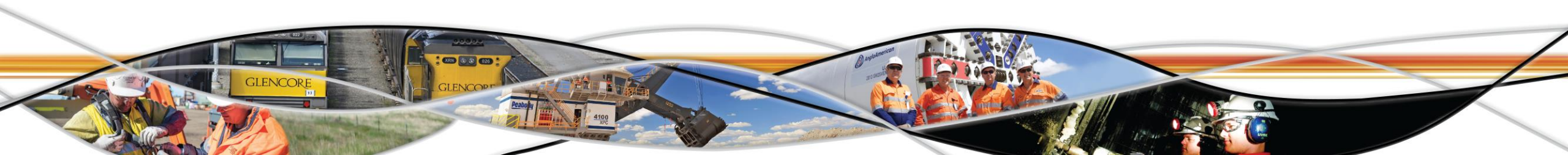
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Background and Methods

- Presentation draws on review of official investigations into 24 fatal incidents and disasters in mine in 5 countries (Australia, New Zealand, USA, UK and Canada) 1990 and 2011. Are the repeat or pattern causes underpinning these events?
- Five countries with similar regulatory regimes and governance facilitate generalisation as did the number of incidents examined.
- 15 involved 3 or more deaths while 9 single fatalities (includes 4 fatal mine incidents in Tasmania). Do the causes vary between multiple and single fatality incidents?
- Most multiple fatality incidents occurred in coal mines (86%) and each incident also killed more on average (11 per incident compared to 6 in metalliferous mines)





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Why look at failures for patterns?

- Failure can be as instructive as success
- examining series of incidents identifies recurring causes, why systems fail & how to remedy
- Strategic decision making needs to draw on past while recognising risk of misinterpretation & change
- Focus on mining but same approach could be used regarding other industries and types of incidents
- Identified 10 causal pathways to fatal incidents (at least 3 present in virtually all while majority had 5 or more – some had all 10)
- More thorough the investigation the more pattern causes identified



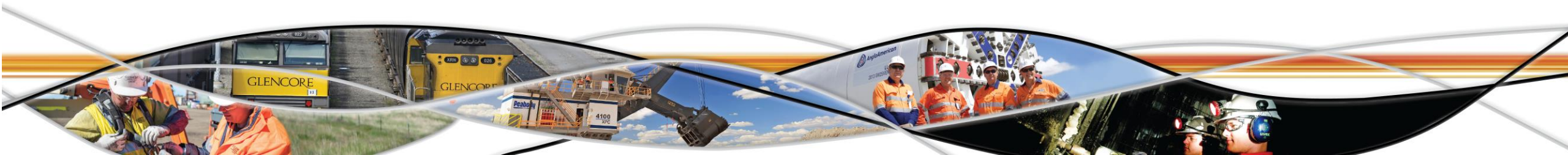


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Pathway 1: Design, engineering & maintenance flaws

How and some incidents where contributed (some examples)

- Failure to provide/maintain plant etc (eg Westray ventilation/monitoring/roof bolting)
- Inadequately planned mining methods & failure to revise (Westray, Crandall Canyon)
- Flawed/misused maps of workings(Gretley)
- Seal design/flaws (Sago & Moura No.2)
- Hydro mining and main ventilator UG (Pike River)
- Inadequate ground support regime (Beaconsfield)
- Poor coal dust control measures (Upper Big Branch)



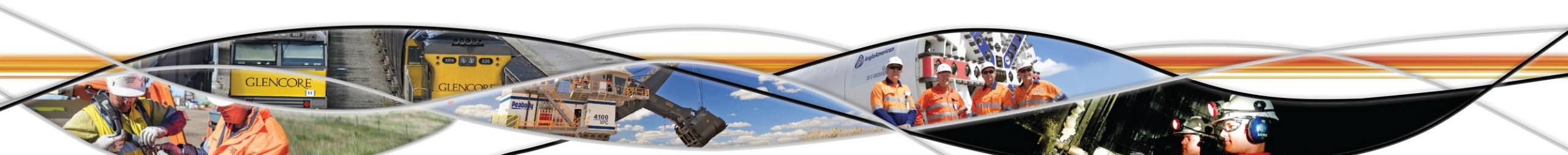


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Pathway 2: Failure to heed clear warning signals

How and some incidents where contributed

- Failure to respond to trends in atmospheric pressure & methane levels (Westray, Pike River)
- Failure to respond to or analyse rockfalls (Cornwall, Renison & Beaconsfield)
- Failure to respond to prior outbursts (Crandall Canyon)
- Failure to adequately respond to evidence of heating (Moura No.2 -note too two prior disasters)
- Evidence of abnormal water prior to inrush (Gretley)



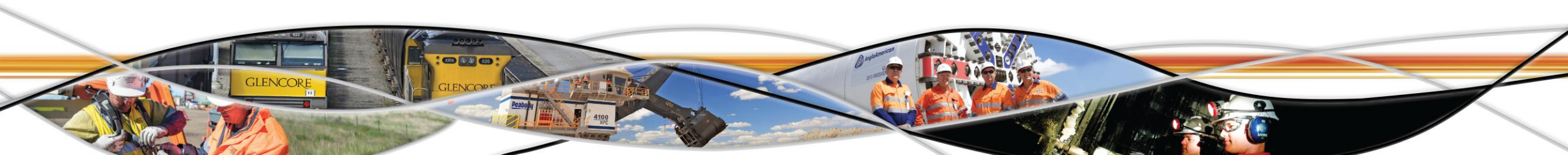


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Pathway 3: Flaws in risk assessment

How and some incidents where contributed

- Failure to assess risk of inrush (Gretley)
- Failure to properly assess risks prior to authorising entry (Jim Walter Resources/JWR)
- Failure to do risk assessment following coal outbursts (Crandall Canyon)
- Failure to undertake comprehensive risk assessment after major rockfall (Beaconsfield/BG)
- Failure to risk assess hydro mining or UG main ventilator (Pike River)



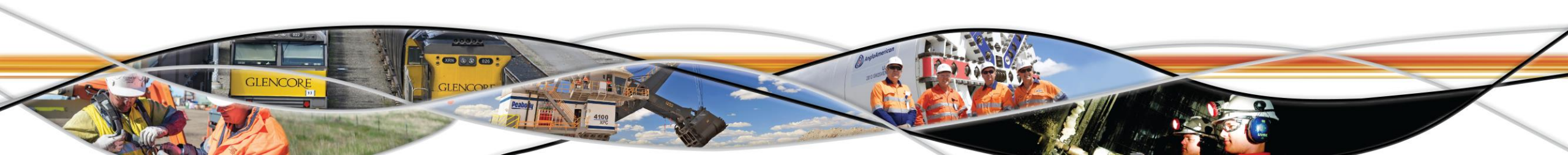


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Pathway 4: Flaws in management systems

How and some incidents where contributed

- Poor system structures/communication & over-focus on behaviour or minor safety issues (JWR, BG)
- Inadequate training/procedures (Sago & Darby No.1)
- Failure to maintain safety critical systems –rock dusting, ventilation, equipment – UBB & Pike R)
- Poor management of contractors/work re-organisation (Renison, BHPB, Pike River)
- Poor hazard/risk management systems & worker feedback mechanisms(BHPB)



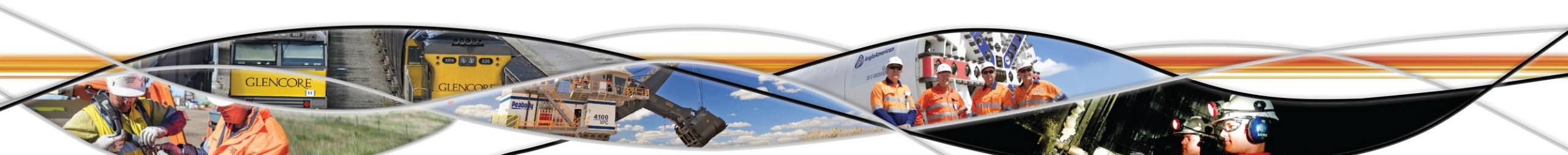


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Pathway 5: Flaws in system auditing

How and some incidents where contributed

- Failure to audit critical safety processes (eg Moura No.2 management of spontaneous combustion)
- Failure to adopt audit findings (BG)
- No proper OHS audit (Pike River)



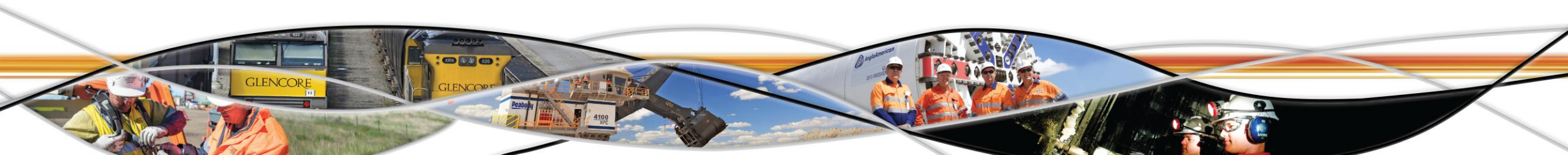


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Pathway 6: Economic/reward pressures compromising safety

How and some incidents where contributed

- Production pressure/cost cutting compromising safe work practices (Westray, UBB, Pike River) or use of consultants/in-house technical expertise (Renison)
- Poor financial state of mine putting miners 'under the pump' (Westray, Renison)
- Incentive pay systems encouraging unsafe practices (Westray & Pike River)



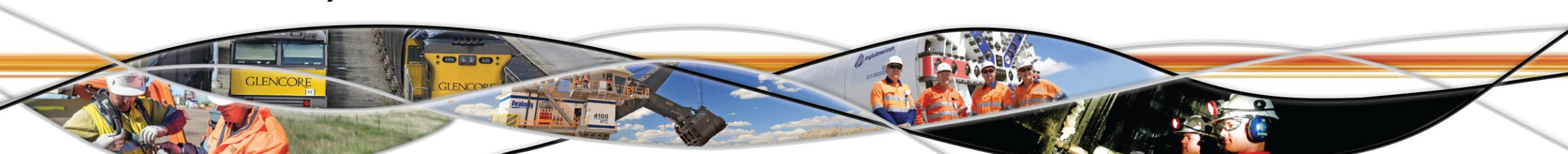


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Pathway 7: Failures in regulatory oversight

How and some incidents where contributed

- Insufficient/inadequately trained or supervised inspectors (3 Tas incidents, Sago, Pike River)
- Poor inspection procedures (Crandall, Darby No.1, JWR) including prior notice (UBB)
- Inadequate/poorly targeted enforcement (Westray, Gretley, Sago, UBB, Pike River)
- Flaws in Legislation - standards, reporting requirements, sanctions, worker rights (3 Tas, Pike River, UBB & other US disasters)





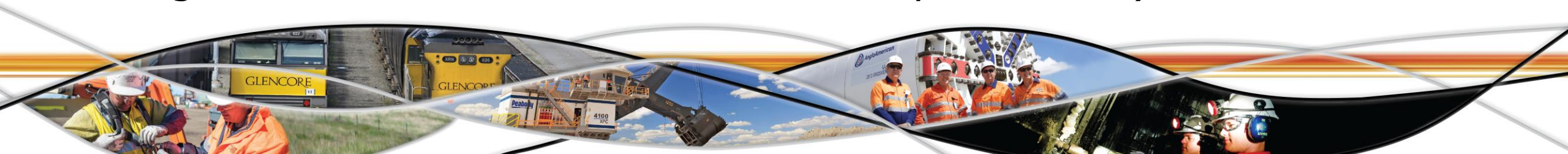
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Pathway 8: Worker, consultant & supervisor concerns prior to incident

How and some incidents where contributed

- Evidence of significant level of serious concerns (Cornwall, BG, UBB)
- worker/supervisors raised concerns but were ignored (Cornwall, BG)
- Supervisor and consultant concerns at Pike River (eg Hydro mining)

Note: this matter seldom seems to be explored in the course of most investigations (BG & UBB exceptional in that interviewed large numbers of miners and even family members)



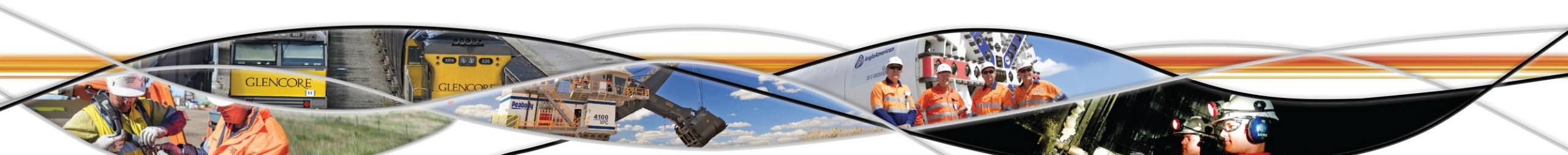


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Pathway 9: Poor management/ worker communication/trust

How and some incidents where contributed

- Prolonged/bitter struggle over unionisation (Westray, BG) or non-union mine (UBB)
- Inadequate input mechanisms (Ctees & HSRs) & poor response to workers raising safety issues (BG, BHPB)
- Poor management communication processes (Moura No.2)
- Poor management response to worker, supervisor and union concerns (Pike River)





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Pathway 10: Flaws in emergency procedures/resources

How and some incidents where contributed

- Flaws in emergency procedures, maps or training (Darby No.1, Sago)
- Poor safety management makes rescue more dangerous (Crandall, BG)
- Poor inspectorate/Mine Rescue Brigade rescue procedures or resources (Moura No.2, Sago, Crandall)
- No second egress (Pike River)





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2014 Queensland ISHR/SSHR study

- Examined 1165 MI, ISHR & SSHR inspection reports for 19 mines (7 ug & 12 o/c) 1984-2013 (75% since 2000)
- Queensland electronic records of all inspections/follow-ups etc kept and exchanged – this is very important (should occur elsewhere if doesn't now)
- MI 605 (52%); ISHR 473 (41%); SSHR 50 (4%)
- Also interviewed ISHRs & SSHRs at 13 of mines, and senior mines inspector
- Both MI & ISHR/SSHR inspections focused on serious hazards (ie fatality risks)
- Over 90% of ISHR/SSHR reports dealt with at least one fatality risk (many more than one)
- Also strong emphasis on HPIs and incident investigation

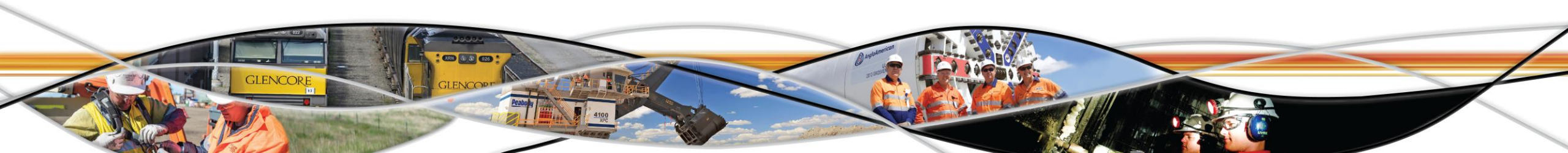




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ISHR/SSHR study continued

- No evidence ISHR/SSHR reports dealt with anything but safety & sparing use of suspension powers (24 SSHR reports & 3 SSHR – all but 1 related to fatal risks/exception was bullying case)
- 54% of ISHR reports examined documents as well as physical (MI 50% and SSHR around 20%)
- Evidence of system corrosion at some mines & suspensions to prevent serious incidents – in some cases management suspended operations, other cases MI, ISHR, SSHR
- Overall good relationship between MI & SSHR & ISHR/strong complementary roles (little disagreement re suspension)
- Some issues re SSHR presence & management turnover





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Policy implications

- Pattern flaws provide reference point for
 - Assessing regulation/identifying gaps
 - Informing inspection practices & incident investigation (eg Pike River, Gleision colliery)
 - Evaluating regulatory regimes
 - Guidance on & auditing of systems and risk assessment
 - Prescription re well known hazards (systems/risk management & prescription balance)
 - Vigorous reporting of any safety critical deviations
 - Strengthening auditing requirements
 - Strengthening regulatory oversight
 - Providing/facilitating meaningful worker input





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Concluding observations

- These pattern causes help to explain fatal incidents in mines and other high hazard workplaces (like quarries) & focusing on them would minimise fatalities
- Safety 'culture' was not a pattern cause rather symptom of failure in OHS management regime and priorities
- Systems as hierarchies of control that corrode over time & better suited to routine risk?
- Pattern causes apply to both single fatalities and multiple fatalities (both low frequency/high impact events)
- Changes to work organisation like subcontracting can weaken as can frequent changes to key management positions (corporate policies can exacerbate)
- Clear lessons in terms regulation but battle to implement these in wealthy democratic countries & largely ignored in newly industrialising countries





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Concluding observations cont.

- Mining has over 200 years experience to learn from and help other high hazard industries.
- Must ask why lessons from past failures lost/forgotten or not kept?
- Qld and NSW learned important lessons from 1990s disasters and since regulatory reforms no disasters notwithstanding major industry expansion & adjudged world's best practice regulation by Pike River Royal Commission
- Reforms recognised number of pattern causes including the need for comprehensive and rigorously audited management of all major hazards, clear requirements re known hazards/controls, well-resourced proactive inspectorate, and strong worker input.
- Important package as it is mutually reinforcing with multiple feedback loops (internal company, inspectors, safety reps/union) to identify failures and ensure constructive dialogue (potential for different viewpoints is critical).





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Concluding observations cont.

- Need to remain vigilant about sustaining these key elements and the ever-present risk of corrosion of even robust regimes (recent black lung cases?)
- Actually entering dangerous period
 - Downturn/job insecurity and industry/corporate restructuring
 - Length of time since last disaster
 - Complacency/over-confidence that paperwork systems reflect actual practices
 - Increased use of subcontractors requires ongoing oversight
 - Must ensure key roles and 'eyes' get trained and encouraged to speak out/identify problems
 - Queensland study found disturbing number of incidents where down to very last line of defence ie late intervention by management, MI, ISHR or SSHR.
- Need reactivated attention from all or history will repeat – a degree of unease is essential





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