Paper by DuPont

A Report for Vector re: Live Line Work Policies

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Background

Following the 2010 Pike River Mine disaster, a tragedy that resulted in the deaths of 29 workers, significant changes were made to New Zealand's health and safety regime. These included the introduction of the Health and Safety at Work Act (HSWA) 2015 to align substantially with Australian workplace model law, and the establishment of a new regulator, WorkSafe. These regulatory changes, recommended by the Royal Commission on the Pike River Coal Mine Tragedy, cited process safety management failure as a contributing factor to this preventable catastrophic event.[1]

These changes heralded a cultural shift in workplace safety in New Zealand. In response to this, the Vector board reviewed its approach to managing critical risk and its risk controls around high-consequence/low-probability events. Specifically, the board took a decision to cease working on energised lines (also known as live line work) wherever possible. DuPont consider this to be evidence of a commitment to continual critical risk review, and indicative of adaptive business decisions that are fundamental to world-class safety performance.

DuPont notes that, within our own operations and other high-hazard industries (such as oil and gas, nuclear medicine, and petrochemicals), comparable decisions have been taken to reduce risk for workers and the general public. These decisions are often associated with organisations that strive for world-class safety performance, thanks to the deep body of safety management knowledge accumulated over diverse industries, and sadly, significant events such as the Pike River tragedy.

We applaud Vector for taking a proactive approach to managing the risk of live line work, and offer here an historical perspective supporting their decision. We recognise that the current regulatory arrangements between Vector and the Commerce Commission impact the ability of Vector to fully control critical risks in order to eliminate hazards, resulting in the current conflict between reliability performance and Vector's live line policy. We trust that in the interests of the Auckland community, an innovative solution can be found, but note this may take some time and a flexible, win-win approach by all stakeholders.

DuPont Reputation for World-class Safety

For more than 215 years, DuPont has brought world-class science and engineering to the global marketplace. With operations in more than 90 countries, our innovative products, materials, and services have been leading-edge across a diverse range of often highly hazardous industries, starting with a gun powder mill in the 1800s. Given the nature of our first operations, safety has always been synonymous with DuPont, and we have been recognised over our long history as a global safety leader. It is from this position that we offer our deep owner-operator experience combined with over 50 years of international safety consulting work, as Vector pursues a ‘safety always’ commitment within New Zealand’s challenging electricity distribution market regulation framework.

We acknowledge that interruption to power supply and interruption to chemical production have very different impacts. Notwithstanding these differences, the fundamental calculation is about cost vs. benefit and how these align with each company's values and strategies. It may be instructive to consider how DuPont has weighed these apparently conflicting interests when reviewing the appropriateness of energised or 'hot work' as a common practice within our own operations.

DuPont Leadership Stop Energised Work in 1954

In 1954, while DuPont was leading in safety performance compared to the utilities industry at the time (0.65 injuries per million exposures versus the industry's 10.92), the view was taken that fatalities occurring in our business were unacceptable, especially when it was known that de-energising before work would significantly reduce risk. In weighing up the cost-benefit argument, leadership asked themselves, 'How is it possible to justify the continuation of hot work knowing that even the most earnest efforts will probably only delay the next injury?' A no-hot-work policy was established, with line management personnel responsible for integrating the policy into planning and operations in a way that did not result in production loss. The critical shift was in mindset—the belief throughout the business

> '*Based on previous experience Chambers Works (a chemical plant) believes that the practice of “hot work” carries with it too high a price'.*
>
> - Management quote from 1954 DuPont internal paper, 'Is Hot Electrical Work Necessary?'

that it was possible to implement a no-hot-work policy without a cost to production. Finding a way to do that was the next challenge, and over subsequent years this was successfully achieved.

In 2016, the Vector board's conclusion that working on energised lines is, in most situations, an unacceptable risk to workers and the public reflects the sentiment of DuPont management in the early 1950s. While it seems unlikely in the current business context that there would be no impact to supply from the changes to Vectors' live line policies, it also took DuPont a number of years to change long-established mindsets, develop new asset management approaches and different planning regimes, invest in alternative technologies, set new expectations and beliefs, and demonstrate results, but we ultimately achieved our safety and production goals.

We would expect Vector to require a similar period of adaptation and learning about how to best achieve reliable performance within new operating conditions. This should be recognised by regulators as an investment in a better future with gains in safety, reliability, and cost.

From Prescriptive to Performance-based Regulation: A Global Perspective on Continuous Improvement

England's Health and Morals of Apprentices Act 1802, commonly known as the Factory Act, is widely recognised as the first attempt to regulate occupational health and safety in the English-speaking world—making a start on addressing some of the issues of the industrial revolution. It was an example of prescriptive regulation with requirements concerning such matters as windows for ventilation, limits on working hours, and suitable clothing.

The term 'reasonably practicable' has been enshrined in UK case law since the case of Edwards v. National Coal Board (1949). In this ruling, it was determined that risks must be averted unless there is a gross disproportion between the costs and benefits of doing so—the risk must be significant in relation to the sacrifice in terms of money, time, or trouble required to avert it. With this precedent, attention to the assessment

of risks grew throughout the English-speaking world, and especially in those countries which take cues from UK law.

By 1957, the US Atomic Energy Commission had published The Brookhaven Report, 'Theoretical Possibilities and Consequences of Major Accidents in Large Nuclear Power Plants', in which they estimated a 'maximum credible accident' for nuclear reactors as being 3,400 deaths, 43,000 injuries, and property damage of US$7 billion (in 1957 value). The estimate of probability was between one-in-one-hundred-thousand and one-in-one-billion per reactor year. Then, during the 1960s, process/system safety techniques pioneered in the nuclear industry were being picked up by the chemical industry—Dow Chemical Company produced a Process Safety Manual in 1966 and the Institution of Chemical Engineers established a Loss Prevention Panel in 1974.

These early developments in risk-based decision making for hazardous industries gained importance as global industry responded to chemical plant disasters in Flixborough, England (1974), Seveso, Italy (1976), and Bhopal, India (1984). DuPont was a leader in the development of Process Safety Management throughout this time and is proud that its established global practices were a dominant influence in development of the OSHA standard, 'Process Safety Management of Highly Hazardous Chemicals' issued in the US Federal Register on 24 February 1992. Each of these steps forward was not without growing pains, but being necessary, the industries and communities served all adapted over time.

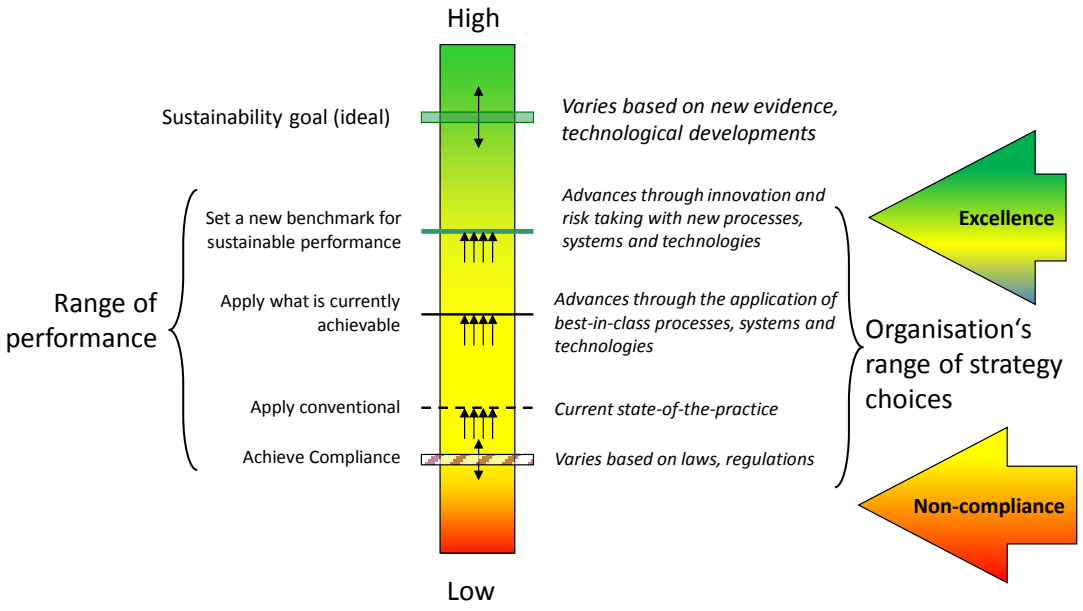
As an international company, DuPont is required to comply with the laws of all countries in which it operates. This global perspective, combined with our own commitment to zero harm, raises DuPont’s awareness of the legislative, cultural, and risk acceptance differences between jurisdictions, as well as their implications for safety performance. It is our observation that the UK generally has a stronger focus on performance-based (or risk-based) legislation than the US and note that with a performance based legislation (like in the UK) we achieved better overall performance than with a prescriptive legislation (like in the US). Australia and New Zealand are considered more performance base, with recent introduction of HSWA in New Zealand understood to be intended further toward performance.

DuPont’s experience with a voluntary commitment to safety best practice—even when the prescriptive regulatory environment is not as demanding—is that

performance benchmarks continue to evolve with changes in scientific knowledge, technology, regulation, market conditions and stakeholder sentiment. Constantly driving risk as low as practicable allows us to achieve new levels of protection and stakeholder value.

This brings us to the current situation facing New Zealand. In taking the decision to cease live work, Vector looked to the 2013 UK Health and Safety Executive (HSE) guidelines in creating a policy that would maximise protection for workers without unduly inconveniencing customers. Figure 1 illustrates the range of performance choices available between noncompliance and excellence. We support Vector's efforts to learn from global best practice rather than default to the current state of practice.

Figure 1: Benchmarks – Compliance or Excellence?



Adapted from FIDIC, Guidelines for Project Sustainability Management (2004)

Reducing Process Safety Risk Requires a Distinct Approach

DuPont is careful to distinguish between the discrete, yet complimentary approaches required for employee safety and process/system safety. The importance of this distinction was brought to the world's attention following a fire and explosion that occurred at BP's Texas City Refinery on 23 March 2005, killing 15 workers, injuring more than 180, and severely damaging the refinery. On the day of the incident, workers were celebrating significant employee safety performance achievements, yet the refinery had overlooked significant opportunities to improve process/system safety by increasing attention to management of high-consequence/low-probability events. The resulting Baker Panel Report issued in 2007 addressed underlying process safety issues in considerable detail.

It is DuPont's experience that improvements in safety performance catalyse synergistic improvement in reliability, quality, and cost reduction. This is particularly evident in electric power systems. A mishap can range from a near miss with little or no actual loss to a catastrophic loss of equipment, significant operations disruption, and serious and fatal injuries. Therefore, efforts to reduce mishaps will positively impact safety, reliability, quality, and cost. In the US, the Society for Maintenance and Reliability Professionals (SMRP) and the Reliability and Maintainability Center at the University of Tennessee, Knoxville actively promote the synergistic relationship linking safety performance and asset effectiveness.

In the context of Vector, it is important to note that the safety performance of an organisation engaged in high-hazard operations such as energy distribution should be judged with consideration of lagging, or previous injury, performance indicators as well as leading, or preventive, performance indicators. Unlike many organisations, it seems clear that Vector is attempting to apply key learning before a serious injury or fatality occurs.

How DuPont Addressed Process Risk: Lessons for Vector

By the mid-1980s, DuPont's lost workday case rate was running at approximately 0.1 injury or illness for every 200,000 workhours. This compared very favourably with the US industry average, which exceeded 3.0 injuries or illnesses for every 200,000 workhours. However, while DuPont in house electrical fraternity realised that DuPont was a safety leader in chemical processes, it was far from being a leader in electrical safety, and was performing at US industry average.

> *'Electrical injuries are sufficiently rare that the absence of electrical injuries in an organisation's experience can create an illusion of electrical safety excellence'.*
>
> - H. Landis Floyd, II, Fellow, IEEE

DuPont's leaders in electrical operations, construction, and maintenance gained corporate support for an initiative to address this inconsistency, and in 1989, DuPont management made the commitment to reduce the likelihood and severity of injuries to employees and contractors from electrical hazards. Goals for sustainable improvement were established, financial support was provided, and dedicated people were empowered to design and implement actions to accomplish a step change in electrical safety performance.

A continual improvement process for applying systems safety concepts in order to reduce risk of serious electrical injuries has resulted in significant improvement, reducing the severity and frequency of electrical injuries at DuPont. Most dramatic has been the impact on the frequency of fatalities from electrical energy. In the 25 years prior to 1993, when the processes were changed, there were 12 fatal injuries from contact with electrical energy in DuPont operations worldwide. Over the 25 years since 1993, there has been one. Electrical hazards were not eliminated—in fact, the potential for exposure has increased due to dependence on electrical technologies for energy, controls, and communications in industrial applications. What changed was the shift in electrical safety culture driven by the continual improvement process.

Today, lost-time occupational injuries from exposure to electrical energy are relatively rare. In the US, less than 0.2% of all lost-time injuries are due to contact with or exposure to electrical energy. However, this low frequency can have effects that undermine the control of critical risk, including:

1) Creating the false perception that the hazard is well managed and under control;

2) Challenging workers to stay vigilant in the face of a low-probability occurrence;

3) Enabling electrical injuries to be viewed as random events rather than due to systemic failure of the safety management system.[2]

DuPont's experience in challenging acceptable risk norms and managing the risk of electrical injuries and fatalities shows that organisations can achieve significant safety performance improvements through continual improvement. We believe Vector has the potential to achieve similar gains.

Learning from Others: Recent Benchmarks

Research published in 2014 showed that the occupational fatality rate in the UK was one-third that of the US. Electrical hazard fatalities in the UK amount to one-quarter of those in the US. One factor contributing to this difference is that the safety management culture in the UK places more emphasis and resources on risk assessment and application of a hierarchy of controls, compared to the prescriptive, rule-based culture common in the US.

In 2013, the UK HSE published 'Electricity at Work: Safe Working Practices', providing guidance on the key elements to consider when devising safe practices for carrying out work on or near electrical equipment. It includes advice for managers and supervisors who control or influence the design, specification, selection, installation, commissioning, maintenance, or operation of electrical equipment. In a chapter on deciding whether to work dead or live, the HSE notes that 'work on or near live exposed conductors should rarely be permitted. Many accidents to electricians, fitters, technicians and engineers occur when they are working on equipment that could have been isolated.'

The guidance goes on to address 'circumstances where it is unreasonable to make equipment dead because of the difficulties it would cause', citing:

- it may be difficult, if not impossible, to commission a complex control cabinet without having it energised at some time with parts live (but not exposed so that they may be easily touched);

- it may not be technically feasible to monitor the operation and performance of a control system or to trace a malfunction of such equipment with it dead, ie, fault-finding;
- a distribution network operator (DNO) needs to connect a new low-voltage service to an existing main, but it might be unreasonable to disconnect many customers. In recognition of the dangers associated with live working, the DNO must have a very strict code of safety rules and procedures to prevent injury;
- switching off a system, such as the supply to an electric railway track, to carry out maintenance or repair work may cause disproportionate disruption and cost.[3]

What's more, the increasing frequency of severe weather events causing power interruption and potentially more complex damage to electrical infrastructure is a concerning trend. It would seem appropriate for Vector to have a risk management approach that enables more conservative safety management when such incidents occur.

DuPont applauds Vector's stance to act in a proactive way to manage its critical risks, that places a higher value on the protection of human life than the financial impact of any penalties that may be imposed for noncompliance with SAIDI and SAIFI targets. The challenge now is to ensure recognition by the Commerce Commission that hazard elimination is the starting point in managing critical safety risks.

Reliability Targets for the Future:
Evolving Solutions for Evolving Challenges

In moving to drastically reduce live work on the electric power infrastructure and its related risks, Vector has identified deterioration of SAIDI performance from compliance. Whilst not currently expressed financially, this can be considered a necessary cost of providing a safer workplace for Vector workers and the public. The question is whether this cost is grossly disproportionate to the risk reduction now being delivered. To that end, we urge that the following be considered:

- In which situations is uninterrupted power critical to the preservation of life?

- What circumstances exist in which it is unreasonable to disconnect many customers?
- When does switching off a critical system cause disproportionate disruption and cost?
- What controls are appropriate if it is not possible to eliminate the risk?

We understand that the Commerce Commission's role is to regulate Vector performance to ensure that appropriate value is delivered to customers connected to the Vector network. It's also clear that the targets based on established SAIDI and SAIFI metrics represent what Vector has historically been able to achieve. Given the traditional 20th-century model of centralised power generation and standardised distribution to a mass market, these network-wide reliability targets have served markets like Vector's well in the past. However, Vector is working hard to transform its business to adapt to the many strategic influences that will shape enduring success for Vector, Auckland, and New Zealand in the 21st century. Vector's ability to make a positive contribution to customer value will be maximised if its investment in improved reliability can be focused:

- First and foremost, on those customers who need global best-practice reliability in power supply because electric power is critical to the immediate preservation of human life (e.g. medical patients on life support). For Vector this would mean never having to choose between the life of a worker, or a customer or a customer's customer.
- Secondly, those customers who operate nationally and regionally critical infrastructure such as water supply and transport systems. The reliability of power supply to such customers could be tailored to recognise the actual impacts of switching off their critical infrastructure systems together with costs of reliability improvements that would avoid disproportionate disruption and cost.
- Thirdly, pursuing continual improvement in default power supply reliability and customer service by ceaselessly working to reduce the frequency and duration of power supply interruption events as far as is reasonably practicable.

It is our view that Vector and the Commerce Commission must work as partners to evaluate the societal and economic benefits and potential costs of Vector improving its SAIDI performance, and that appropriate regulatory action be taken to support delivery of a new SAIDI target. A transparent economic analysis of the costs and benefits will enable customer- and safety-focused strategies to be devised and implemented, assuring the highest achievable levels of customer satisfaction without avoidable loss of human life.

References

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