



What's in a word?

Abstract

This paper reviews some recent public safety-related legislation in the New Zealand gas and electricity industries with particular reference to the phrase “significant risk of serious harm ... or significant damage”. A brief survey of risk professionals in relation to the word “significant” is reported and the meanings of words discussed. Recommendations are made for language use when reporting on risks and for revision of related legislation and standards.

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Language and its meanings

The English language is well known for its adaptability; depending on the circumstances, grammar might be ignored (Shakespeare and other famous authors often did this) and words imbued with new meanings. Or as Dryden (1682) wrote in *MacFlecknoe*:

And torture one poor word ten thousand ways.

The trouble with novel meaning of words is that some listeners or readers may interpret a word according to their own usage. Thus, when Parliament creates legislation it should define key words or try to use words in a way that is generally accepted or understood by those who will apply the law. Failing that, Standards organisations or organisations representing industries or sectors might offer interpretations and guidance on the meaning of words used in legislation because, if no authoritative guidance is given, users are likely to interpret words and legislation in their own way.

What does “significant” mean?

Section 61A of the New Zealand Electricity Act 1992 (as amended) requires:

Every electricity generator and every electricity distributor that owns or operates an electricity supply system must implement and maintain, in accordance with regulations made under section 169, a safety management system that requires all practicable steps to be taken to prevent the electricity supply system from presenting a significant risk of:

- (a) serious harm to any member of the public; or*
- (b) significant damage to property owned by a person other than the electricity generator or electricity distributor.*

Section 46A of the Gas Act makes the identical requirement for gas supply systems.

Serious harm

The term “serious harm” is defined in the Gas and Electricity Acts to mean:

- (a) death; or*
- (b) injury that consists of or includes loss of consciousness;*
- or*
- (c) injury that necessitates the person suffering the injury—*
 - (i) being admitted to hospital; or*
 - (ii) receiving medical treatment from a health practitioner who is, or is deemed to be, registered with an authority established or continued by section 114 of the Health Practitioners Competence Assurance Act 2003 as a practitioner of a particular health profession*

This definition is similar to the detail given in schedule 1 of the NZ Health and Safety in Employment Act 1992 (HSIEA). There are, however, some differences in coverage. These are mainly related to occupational injuries or ill-health, that are covered by the HSIEA.



Safe and unsafe

The Electricity Safety Regulations define “electrically unsafe” as meaning:

in relation to works, installations, fittings, appliances, and associated equipment, there is a significant risk that a person or property will be injured or damaged by dangers arising from the use of, or passage of electricity through, the works, installations, fittings, appliances, or associated equipment [emphasis added]

Electrically safe is defined in the Regulations to have the reverse definition (ie, there is no significant risk). The Gas (Safety and Measurement) Regulations use similar definitions of safe and unsafe in relation to gas systems.

Note the differences in language between these definitions and the requirements of the Electricity and Gas Acts which refer to a significant risk of serious harm.

Safety management systems

The Electricity Safety Regulations offer more detail on the requirements of the Act and define a safety management system as:

a system that is implemented by a safety management system operator for the purpose of ensuring that all practicable steps are taken to prevent an electricity supply system (as defined in section 61A(2) of the Act) or other works from presenting a significant risk of:

- (a) serious harm to any member of the public; or*
- (b) significant damage to property owned by a person other than the safety management system operator.*

Similar requirements apply to gas supply systems.

Implementing a safety management system (SMS) might take some effort in terms of an initial risk assessment, writing of documents, training employees in implementation of the system, etc. Clarity of meaning of language used in legislation is therefore important if scarce resources are to be appropriately applied. It therefore is important the definition of a significant risk of serious harm or of significant damage is clear because it might require development of a safety management system.

NZS 7901

A related New Zealand Standard, NZS 7901: 2008 *Electricity and gas industries – Safety management systems for public safety*, defines significant risk as “a high likelihood that a hazard will cause significant harm or significant damage to property” but this replaces one undefined word (significant) with another (high). What is high? And why the change from a “significant risk” to a “high likelihood”, a point returned to later?

As the legislation and standard give no guidance on the meaning of “significant” the word is open to interpretation by users. It could lead to the argument that an insignificant risk of serious harm (found through an effective risk assessment using AS/NZS ISO 31000:2009. *Risk management – Principles and guidelines*) means no SMS is required.

Language has many meanings

It has long been accepted that:

Safety is not measured. Risks are measured. Only when those risks are weighed on the balance of social values can safety be judged: a thing is safe if its attendant risks are judged to be acceptable. Measuring risk is an empirical, scientific activity; judging safety – judging the acceptability of risks – is a normative, political activity.

(Lowrance, 1976)

On this basis, trying to move from safe (and unsafe) to “significant risk” in the legislation appears to recognise the need to distinguish risk assessors and decision-makers. However, risk assessors (and regulatory agencies and legal draftsmen) need to keep in mind that qualitative language means different things to different people. This point is confirmed by research showing people may assign very wide interpretations to words.



See, for example:

- Budescu, Broomell, & Por (2009), who found the term “unlikely” was interpreted by climate scientists to mean a range of certainty, from less than 33% up to 66%
- Kent (2007), who found “serious possibility” could mean between 20% and 80% certainty.

Such findings are (or should be) of interest to all who write legislation and standards or who create consequence/likelihood matrices or compile risk analyses where qualitative words are used. Risk report writers may also refer to the “serious possibility” of an event occurring or a consequence being felt.

What do such words mean to document writers and their readers?

A survey on “significant”

In March 2013 Standards New Zealand convened a scoping workshop to identify and discuss changes needed to NZS 7901. In preparation for that workshop an email survey of members of the NZ Society for Risk Management, NZ Institute of Safety Management and the NZ Institute of Intelligence Professionals and a non-random group of professional contacts was conducted. Members were asked the following question:

The New Zealand Gas Act and Electricity Act refer to a “significant risk of serious harm”. What do you think the word “significant” means as a specific percentage where 0% means serious harm cannot happen and 100% means it is certain to happen?

In the risk management process communication and consultation are “continual and iterative processes that an organisation conducts to provide, share or obtain information and to engage in dialogue with stakeholders regarding the management of risk” (SA/SNZ ISO, 2009). Consultation involves “informed communication between an organisation and its stakeholders on an issue prior to making a decision or determining a direction on that issue”. For communication and consultation to be effective it is essential the language used is mutually understood. The idea for the survey then arose from comments in Evans (2012) on variations in interpretations of words used in risk assessments.

A total of 74 people responded with answers that could be analysed. A further 10 people responded but declined to specify a number for various reasons. Their responses have been analysed qualitatively. Some respondents gave a range (eg, 60%-70%) and the mean of such a range (in the example, 65%) was used in the analysis.

Respondents were grouped as shown in Table 1 (note: the regulatory staff were *not* from the Ministry of Business, Innovation and Employment which is the regulatory agency for Electricity and Gas Acts). Table 2 sets out a simple analysis of the results. The responses were grouped into ranges, see Table 3, and then graphed, see Figure 1.

Table 1. Job type of respondents who gave a percentage

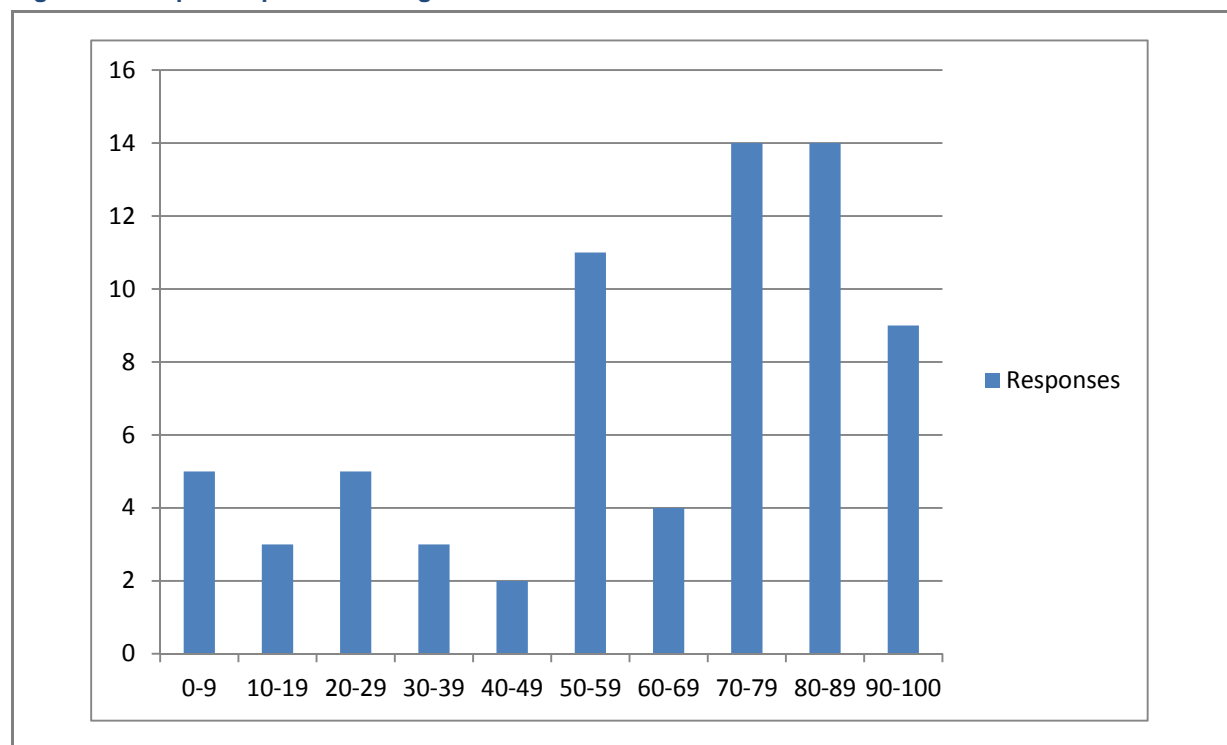
Risk managers	Business continuity practitioners	Safety practitioners	Chartered accountants	Internal auditors	Senior managers	Intelligence professionals	Regulatory staff	Not known
26	3	20	10	2	1	5	5	1


Table 2. Statistical analysis of responses

Number of responses	74
Highest	100%
Lowest	0.01%
Median	70%
Mean of results	58.52%
Standard deviation	28.47%

Table 3. Analysis of percentages into ranges

Range of percentages given	Number of responses in the range
0-9	6
10-19	3
20-29	5
30-39	3
40-49	2
50-59	13
60-69	4
70-79	14
80-89	15
90-100	9
Total	74

Figure 1. Grouped responses in ranges




Discussion of the survey results

Probability and percentages

Respondents were asked to give a specific percentage to indicate what the word “significant” means where 0% means serious harm cannot happen and 100% means it is certain to happen. Probability is defined in ISO Guide 73 *Risk management vocabulary* (ISO, 2009) as a “measure of the chance of occurrence expressed as a number between 0 and 1, where 0 is impossibility and 1 is absolute certainty”. Percentages on a scale of 0% (impossibility) to 100% (absolute certainty) are also used to identify probabilities.

When setting up the survey it was expected responses might fall in a range of about 30%-85%. It therefore was most surprising to find the range was from 0.01% to 100%. Earlier and more formal research has found professional risk assessors are no better than (and may be worse than) lay people when analysing risk. This simple survey suggests the same may be true in New Zealand.

NZS 7901 defines a significant risk as “a high likelihood that a hazard will cause significant harm or significant damage to property”. This moves the definition of “significant risk” closer to the risk management language in AS/NZS ISO 31000 and ISO Guide 73 where the level of risk is defined as the “magnitude of a risk expressed in terms of the combination of consequences and their likelihood”.

Would the legislation have been more easily interpreted if it had referred to a “high level of risk where the consequences are serious harm or significant damage”? Possibly, but, of course, this begs the question “what is high?”.

Range of results

The survey results show a very large range in interpretations of the word “significant”. Put another way, there was no agreement in a sample of New Zealand risk practitioners about the meaning of the word “significant”. Half the sample thought it meant a better than 70% chance serious harm could occur and nearly one-third thought it meant a better than 80% chance. But just over 12% thought less than a 10% chance represented “significant”.

It was not possible to identify any statistically significant patterns between professional groups due to the small sample size. Each professional group offered responses ranging from very low to very high.

Thirteen respondents nominated 50% and some of them expanded their answers to mention “on the balance of probabilities”, the legal test in civil court cases.

Official guidance

How does this relate to any official guidance? The regulatory agency, the Ministry of Business, Innovation and Employment (MBIE), has published no guidance on the words “significant risk” or the requirements for SMS in the two Acts.

The UK safety regulator, the Health and Safety Executive (highly regarded internationally) has defined three broad bands of risk (HSE, 1992, 2001):

- intolerable where action must be taken to eliminate or modify the risk
- the “as low as is reasonably practicable” (ALARP) region where action should be taken if it is cost-effective
- broadly acceptable where no action can be justified on safety grounds.

HSE has set out general limits for fatal accidents as follows:

- the maximum tolerable level of risk for any member of the public is 1 in 10,000 per annum “from any large industrial plant” (ie, 0.0001 or 10^{-4})
- a broadly acceptable level of risk for any member of the public is 1 in 1,000,000 per annum (ie, 0.000001 or 10^{-6}).

Comparison of this guidance with the survey results suggests respondents have generally underestimated the meaning of the word significant. Using the HSE guidance, a “significant risk of serious harm” is probably at or worse than the 10^{-4} level while a level of risk of 10^{-6} might be regarded as broadly acceptable.

The risk from the electricity industry to members of the public has averaged 10^{-6} over the past 20 years and data on fatal accidents from the gas industry shows it has a similar or better performance. This suggests NZ electricity and gas supply systems generally:



- do not present a significant risk of serious harm to members of the public
- did not present a significant risk of serious harm before the Gas and Electricity Acts were amended to require implementation of a SMS.

Written comments from respondents

Rather than not reply, some respondents actively refused to answer the question; some gave as their reasons the poorly worded quote from the two Acts in the question.

It seems to me that the Act confuses the word 'risk' with 'chance' or 'likelihood'. This is a common mistake.

Three people asked that the words from the legislation be changed to make more sense. They then could answer the question.

Some people wrote that assigning percentages to a word might not be appropriate. This overlooked the need to get past idiosyncratic¹ meanings – something that becomes possible when using percentages or probabilities.

Although the question asked for a single percentage number, some respondents noted the problem of idiosyncratic definitions, including:

... using a term such as 'significant' is open to anyone's perception and risk appetite – low for some high for others.

and

Presumably interpretation is reliant on the context of the beholder!

Several people wrote about the need to consider the context of the risk (eg, "The context will make a huge difference"), conduct a risk assessment and treat unacceptable risks. A few people referred to significance testing in research and so arrived at significant being a 95% certainty that a specified cause resulted in a specified harm.

Three people referred to the need to review case law. However, there is, as yet, no case law for this legislation.

Two people discussed the common law legal test of balance of probabilities and one the criminal law test of reasonable doubt.

Safety practitioners giving text responses often discussed exposure, timeframe and the need to take account of the repugnance that serious harm evokes. One discussed the difficulty of analysing rare events and making any reasonable judgement about necessary treatments. Another person thought managers in the gas and electricity industries had:

... their experience that enables them to identify and assess the risks.

One respondent gave a lengthy response including:

The only way you can determine the likelihood [of] risks to the public is to look at statistics. How many public have suffered death or serious injury from gas or electricity industry related accidents per year over an extended time. I'm guessing that numbers is single digits per year so the risk to an individual is very low.

Following up this thoughtful response would have resulted in finding a low level of risk with fatal consequences that was indeed in single digits.

A few people thought almost any likelihood of serious harm was significant (example follows).

If serious harm could occur through any risk in question under the Gas and Electricity Acts, that risk IS a significant risk of serious harm. Therefore, for those two Acts, "significant" means 1% as a specific percentage where 0% means serious harm cannot happen and 100% means it is certain to happen.

And (using the example of the Health and Safety in Employment Act):

... a significant hazard is one that either has resulted in serious harm, or could result in serious harm.

¹ "Idiosyncratic: a way of thought peculiar to an individual"; source Concise Oxford English Dictionary



and

I think significant means anything over 1% - We should operate in a manner whereby serious harm cannot happen

Several responses quoted dictionary definitions of “significant”. One respondent cited use by NZ law drafters of the Shorter English Oxford dictionary and said it defined significant thus:

Important, notable or consequential

Statistical: Of an observed or calculated result: having a low probability of occurrence if the null hypothesis is true (i.e. statistically significant at some conventionally chosen level – frequently 5 percent).

However, the Concise Oxford dictionary defines significant thus:

1. Having an unstated meaning: indicative of something. 2. Extensive or important enough to merit attention. 3. [Statistics] of relating to or having significance.

Webster’s dictionary defines significant as a “measurably large amount” or “probably caused by something other than mere chance”.

One person suggested the use of “significant” without any definition might have been deliberate and intended to cause uncertainty on the part of duty-holders.

The problem with ill-defined legislation is that commercial pressures can often drive the safety approach and consequently the risk culture of the organisation.

If this was the case the legislation may well have achieved this objective: risk professionals do not know what the Acts mean and decision-makers probably will act risk-aversively in the face of such uncertainty. However, this makes for poor law that may need interpretation by the courts.

General discussion

Based on this small study, the legislation can be interpreted to mean that **any** likelihood of serious harm between almost impossible and certain requires the development and implementation of a SMS for the protection of the public.

Looking more closely at the legislation and what it covers, such a SMS in the electricity industry must protect from electric shock:

- motorists, who crash into power poles bringing down the overhead lines, causing harm
- thieves, while they are stealing live electric conductors, who might be killed by a high voltage
- people in hot air balloons landing in an uncontrolled manner on power lines.

None of these is likely to be what Parliament intended.

The survey results seem to support the “illusion of communication” described by Evans (2012, p. 117) when “people may describe the probability of a given event with the same verbal label and conclude on that basis that they agree; however, since each person may implicitly attach different probability ranges to the verbal label, their agreement may be illusory”.

Barclay et al (1978) describe such an illusion: one intelligence analyst said the statement “the cease-fire is holding but could be broken in a week” meant there was a 30% chance the cease-fire would be broken in a week; a second analyst said there was an 80% chance of this. Yet both analysts had worked on the same analysis and thought they agreed about the findings.

This seems a recurring problem that may best be solved by using probability or percentages for the likelihood of a risk event or the consequences of a risk event. Use of percentages opens risk analysts to the criticism that, for example, a consequence with 70% likelihood did not eventuate. Such criticisms miss the point that risk is “the effect of uncertainty on objectives” and a 70% chance still leaves open a 30% chance of the risk not eventuating.

NZS 7901 should be revised to show how to conduct a risk assessment to identify the level of risk for members of the public and, if such a level of risk is deemed unacceptable, the content of the required SMS. However, and as discussed elsewhere (Peace, 2010), neither the content nor the effectiveness of SMS for public safety has been reported in any academic or non-academic research. This leaves



open to doubt what a SMS should cover if there truly is a “significant risk of serious harm or significant damage”.

An SMS cannot cover training or control of members of the public but might discuss the design and construction of supply systems to prevent harm and property damage. However, these are subjects already covered in legislation and standards published by Standards New Zealand.

Regulations made under the principal Acts define a SMS as:

a system that is implemented by a safety management system operator for the purpose of ensuring that all practicable steps are taken to prevent an electricity [or gas] supply system ... or other works from presenting a significant risk ...

This can be taken to suggest that the absence of significant risk releases a safety management system operator from the obligation to have a SMS.

Assuming a SMS is required what should it include? Draft ISO Guide 83 suggests a:

Management system is a set of interrelated or interacting elements of an organisation to establish policies and objectives and processes to achieve those objectives.

Note: 1 A management system can address a single discipline or several disciplines.

Note: 2 The system elements include the organisation's structure, roles and responsibilities, planning, operation, etc.

Note: 3 The scope of a management system may include the whole of the organisation, specific and identified functions of the organisation, specific and identified sections of the organisation, or one or more functions across a group of organisations

(draft ISO guide 83 (ISO, 2011)).

This provides somewhat better guidance on the content of a management system than the Gas and Electricity Acts and related Regulations but leaves a further question:

Is a safety management system the best way to require a reduction in a level of risk that already appears to be at a tolerable (even acceptable) level of risk?

Might not the law simply have set very high penalties for (1) significant harm to members of the public or (2) significant damage to third party property occasioned by the negligent behaviour of a gas or electricity supply system operator? This approach would have allowed for the development of innovative solutions within the electricity and gas industries without developing a new sub-industry of SMS consultants and system auditors focused on avoidance of very low levels of risk.

This report also raises questions about any common use of language by legislators and legal draftsmen. The “significant risk” test and other language in the Electricity and Gas Acts is not aligned with the Health and Safety in Employment Act 1992. Despite this, NZS 7901 is thought by many to be complementary to AS/NZS 4801: 2001 *Occupational Health and Safety Management Systems* even though there are differences in legal requirements and language. This raises the need to align occupational safety and health legislation and public safety legislation so that management systems make no distinctions.

Finally, the requirements for public safety in the New Zealand Gas and Electricity Acts seem needlessly complex. This is in contrast with, for example, section 3 of the UK Health and Safety at Work Act 1974 requirements for safety of the public.

It shall be the duty of every employer to conduct his undertaking in such a way as to ensure, so far as is reasonably practicable, that persons not in his employment who may be affected thereby are not thereby exposed to risks to their health or safety.

The requirement for occupational health and safety is equally succinct:

It shall be the duty of every employer to ensure, so far as is reasonably practicable, the health, safety and welfare at work of all his employees.

These two requirements operate in tandem and are underpinned by fines that can be unlimited, so demonstrating the need to manage public and occupational safety-related risks effectively.



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