Operational Procedure: Risk Ratings Investment Cases and AMP's

CEOP2111.01

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1 INTRODUCTION

The purpose of this operational procedure is to ensure uniform processes are in place to identify, communicate and manage material risks within Essential Energy. This operational procedure provides additional assistance to CEOP2111 for use in Asset Management Plans and investment cases when considering risks associated with network failures, as there is no finite answer to assist in prioritisation of large numbers of programs using CEOP2111 alone.

It is common to find 2 dimensional models for risk assessment which simply look at the Likelihood & Consequence. Another option is to look at probability, exposure, and consequence separately using a nomogram. This can be useful since the exposure to hazards does not always lead to a serious consequence but the probability of a serious consequence may increase due to more frequent exposure. For example, whilst the probability of someone being hurt touching fallen conductors may be high, the actual **exposure** to the hazard maybe low if either the event rate (falling lines frequency) is low or the events occur in areas not regularly frequented by people.

The outcome of applying a consistent risk rating system across the organisation will be improved decision making in management of capital works programs and understanding of their impact.

2 RISK RATING CAPITAL PROGRAMS

For the investment cases and Asset Management Plans (AMP's) Essential Energy has chosen to use an electronic Risk Score Calculator (nomogram) called *Riskex*. This is based on OHS *Risk Assessment AS/NZS 4804:2001* and contained in the *HB205-2004 OHS Risk Management Handbook.* The ratings used for the Risk Calculation have been adapted from Fine, Journal of Safety Research 1971, and page 159. The risk assessment calculator is intended as a guide to identify level of risk. The risk score so calculated should be interpreted with caution. It should only be used as a basis for consistency of reasoned judgement.

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3   UNDERSTANDING THE RISK RATING TOOL

Figure 1: Electronic Risk Score Calculator (nomogram) – Risk Score Calculator
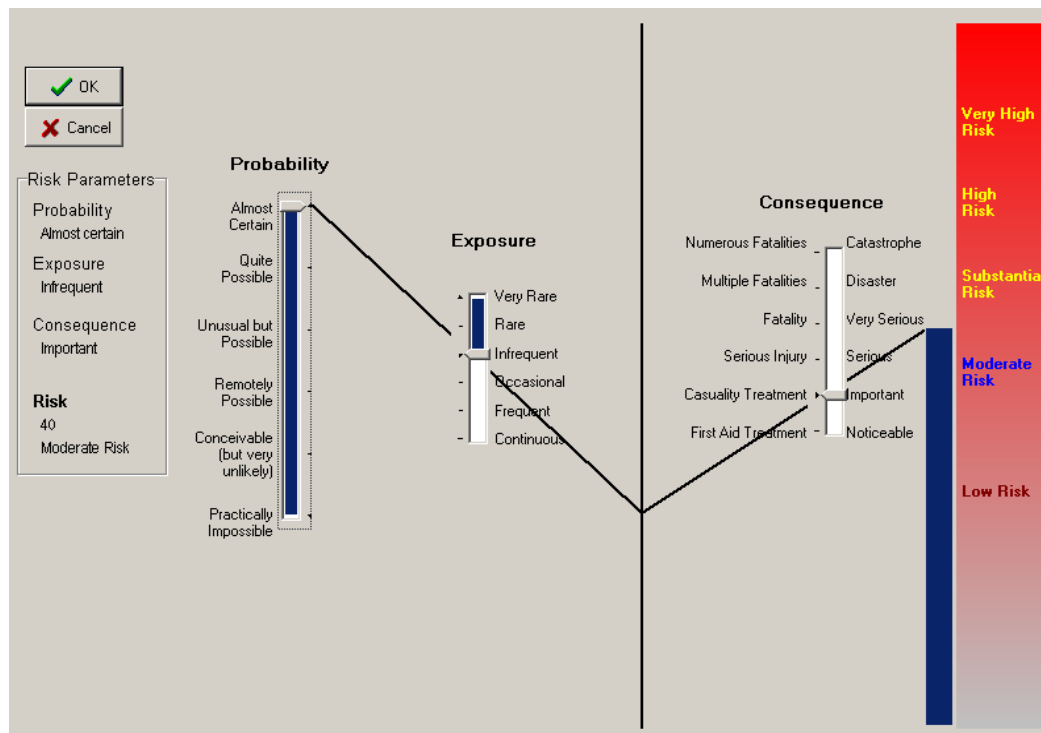
Source: http://www.safetyrisk.net/electronic-risk-score-calculator-nomogram/

Probability:

The likelihood that the complete sequence of events results in a serious or higher consequence.
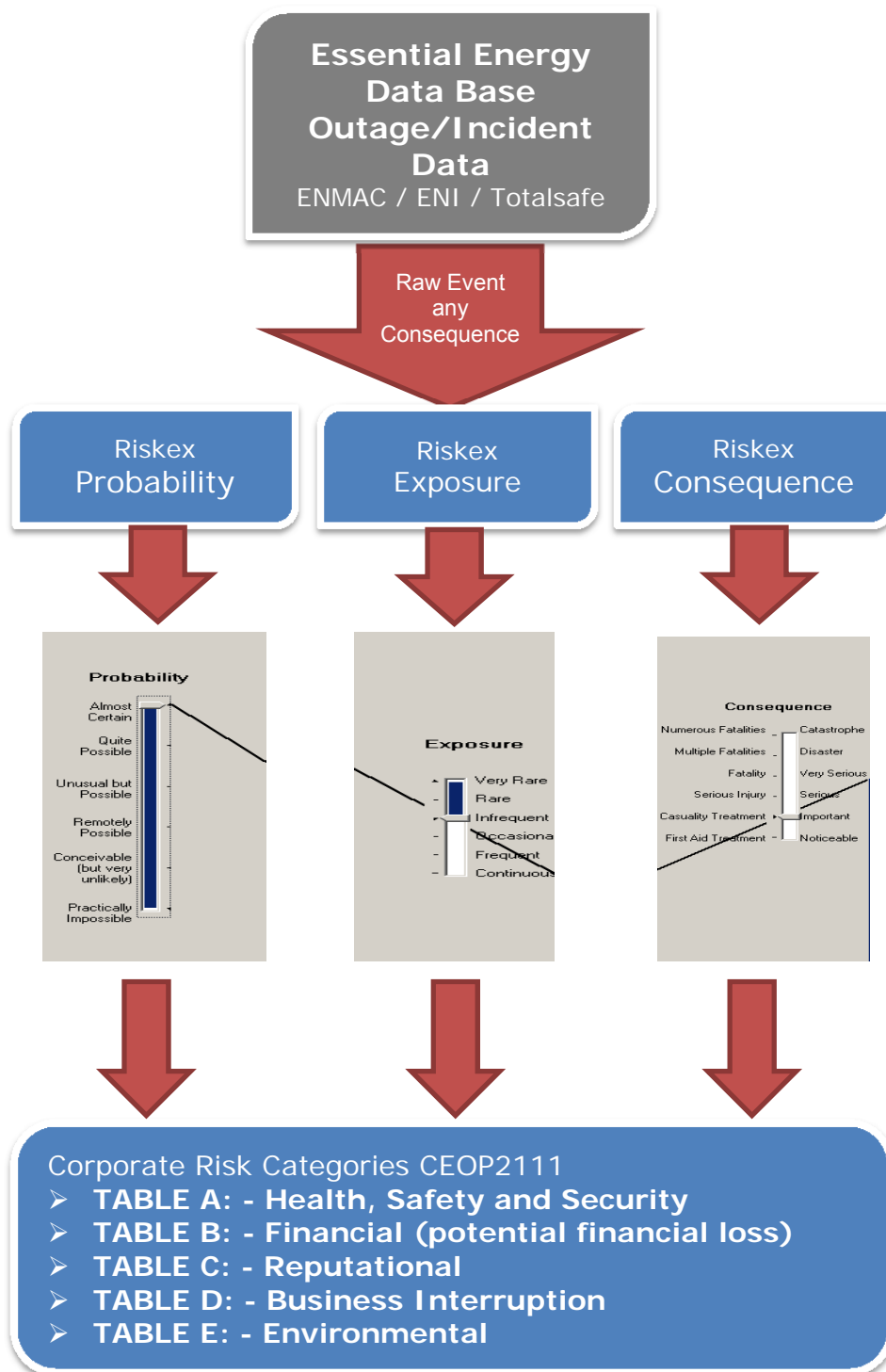
Exposure:

The raw frequency of exposure to the hazard.

Consequence:

The most likely consequence of exposure to the hazard.

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Figure 2: Riskex Calculation Hierarchy

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3.1 Practical help: Hazard/risk assessment AS/NZS4804:2001

(a) Risk assessment

In order for risk assessment to be carried out, the level of risk is first determined. Some legislation requires certain control action to be adopted, regardless of whether the risk has been determined.

Establishing the level of a risk requires clear specification of the actual components of the risk being considered, i.e. the specific scenario of sequence of events including the nature of consequences to be considered, the exposure to the chosen hazard, and finally the probability or likelihood of that scenario taking place. In assessing and determining both the exposure and the probability, the existing controls are considered.

Any scenario involving a particular hazard can lead to different consequences depending on the sequence of exposure events. Hence any risk level needs to be assessed separately for each chosen sequence of events.

To combine the three components of any risk in assessing its level, carry out the following:

1) Choose a specific consequence or outcome severity for one possible sequence of events involving the hazard under consideration. Other possible sequences with different possible consequences need to be assessed separately. The number of persons harmed and the nature of their injuries/illness affects the estimation of the consequence or outcome severity.

2) Determine the exposure for the chosen sequence, i.e. how often (frequency); how long (duration) and to what extent the affected persons are exposed to the particular hazard (for a toxic hazard this would include any time-weighted average or ceiling exposure).

3) Estimate the probability, likelihood or chance that the chosen scenario will lead to the specific consequences being considered. Every scenario considered for any particular hazard has its own specific risk level. The integrity and effectiveness of any existing risk control measures will need to be included in estimating probability.

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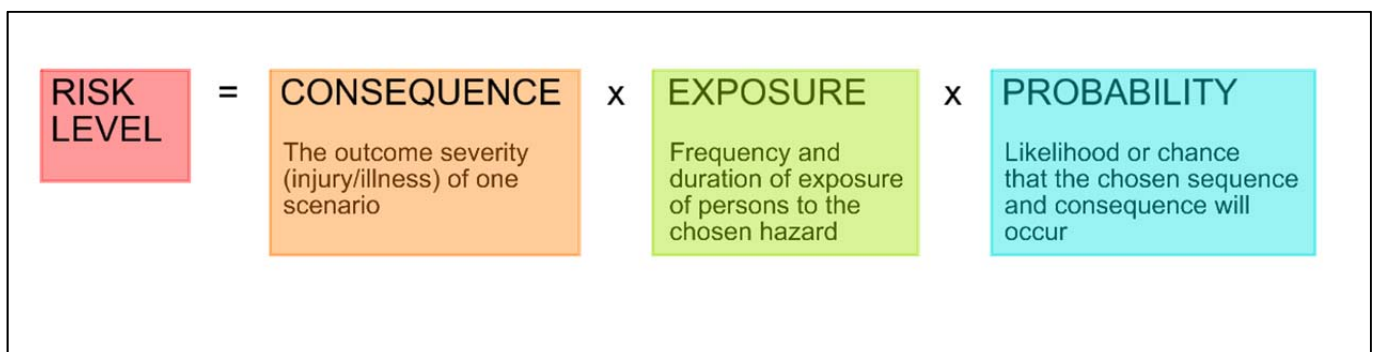
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4   HIERACHY TABLES AND HOW THEY WORK

4.1   TABLE A - Health, Safety and Security

Probability – The likelihood that the complete sequence of events results in a serious or higher consequence	
Almost certain	50% - 100%
Quite Possible	30% - 50%
Unusual but possible	20% - 30%
Remotely possible	10% - 20%
Conceivable (but very unlikely)	5% - 10%
Practically impossible	0% - 5%

Exposure – The raw frequency of exposure to the hazard	
Very rare	Can go several years without any event impact
Rare	Event impact once every year or two
Infrequent	Event impact less than 1 per month or a few a year
Occasional	Event impact 1 or 2 times per month
Frequent	Event impact 1 or 2 times per fortnight
Continuous	Event impact daily or weekly

Consequence – The most likely consequence of exposure to the hazard	Public exposure	Employee exposure
Numerous fatalities - Catastrophe	Many fatalities possible	Death or permanent disability and unable to return to normal work duties
Multiple fatalities - Disaster	More than one fatality possible	Serious injury requiring long time off work and/or surgery and/or long term rehabilitation
Fatality – Very serious	Single fatality possible	Serious injury requiring time off work or more than 4 weeks alternative duties
Serious injury - Serious	An injury that is life threatening or requiring surgery or requires long term treatment	Medical treatment required and/or requires temporary alternative duties for less than 4 weeks
Casualty treatment - Important	An injury that is not serious but requires hospital treatment	Medical treatment required but no hospitalisation, normal work duties can to be continued
First aid treatment - Noticeable	An injury requiring first aid but does not result in hospitalisation	Minor injury requiring first aid treatment

Note: Consequence details from CEOP2111 Appendix A: Detailed Consequence Rating Table.

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4.2   TABLE B – Financial (potential financial loss)

Probability –	
The likelihood that the complete sequence of events results in a serious or higher consequence	
Almost certain	50% – 100%
Quite Possible	30% - 50%
Unusual but possible	20% - 30%
Remotely possible	10% - 20%
Conceivable (but very unlikely)	5% – 10%
Practically impossible	0% - 5%

Exposure –	
The raw frequency of exposure to the hazard	
Very rare	Can go several years without any event impact
Rare	Event impact once every year or two
Infrequent	Event impact less than 1 per month or a few a year
Occasional	Event impact 1 or 2 times per month
Frequent	Event impact 1 or 2 times per fortnight
Continuous	Event impact daily or weekly

Consequence –	
The most likely consequence of exposure to the hazard	
Catastrophe	> $41M
Disaster	$16.1M - $40M
Very serious	$3.3M - $16M
Serious	$801K - $3.2M
Important	$401K - $800K
Noticeable	$100K - $400K

Note: Consequence details from CEOP2111 Appendix A: Detailed Consequence Rating Table.

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4.3   TABLE C – Reputational

Probability – The likelihood that the complete sequence of events results in a serious or higher consequence	
Almost certain	50% – 100%
Quite Possible	30% - 50%
Unusual but possible	20% - 30%
Remotely possible	10% - 20%
Conceivable (but very unlikely)	5% – 10%
Practically impossible	0% - 5%

Exposure – The raw frequency of exposure to the hazard	
Very rare	Can go several years without any event impact
Rare	Event impact once every year or two
Infrequent	Event impact less than 1 per month or a few a year
Occasional	Event impact 1 or 2 times per month
Frequent	Event impact 1 or 2 times per fortnight
Continuous	Event impact daily or weekly

Consequence – The most likely consequence of exposure to the hazard	
Catastrophe	Ministerial enquiry/ Royal Commission and/or resignation or removal of a Senior Executive and /or Minister and/or long term loss of Government trust in Essential Energy's capability
Disaster	Likely to result in loss of confidence by a state Government Minister. Any matter likely to receive negative media coverage by state or national media
Very serious	Likely to be referred to politician, lobby group or the media
Serious	Likely to lead to Ombudsman complaint
Important	likely to lead to customer complaint
Noticeable	Unlikely to lead to customer complaint

Note: Consequence details from CEOP2111 Appendix A: Detailed Consequence Rating Table.

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4.4   TABLE D: Business Interruption (technical and facilities)

Probability – The likelihood that the complete sequence of events results in a serious or higher consequence	
Almost certain	50% – 100%
Quite Possible	30% - 50%
Unusual but possible	20% - 30%
Remotely possible	10% - 20%
Conceivable (but very unlikely)	5% – 10%
Practically impossible	0% - 5%

Exposure – The raw frequency of exposure to the hazard	
Very rare	Can go several years without any event impact
Rare	Event impact once every year or two
Infrequent	Event impact less than 1 per month or a few a year
Occasional	Event impact 1 or 2 times per month
Frequent	Event impact 1 or 2 times per fortnight
Continuous	Event impact daily or weekly

Consequence – The most likely consequence of exposure to the hazard	
Catastrophe	**SAIDI impact:** more than 50 minutes (urban), more than 240 minutes (rural), more than 560 minutes (long rural). Supply outage to more than 10% of customers or critical infrastructure for a period in excess of 24 hours. Many significantly sensitive customers for: a) short time but where there is significant impact e.g. hospital or b) an extended period of time
Disaster	**SAIDI impact:** 10 - 50 minutes (urban), 24 - 240 minutes (rural), 280 - 560 minutes (long rural). Supply outage 5% - 10% of customers or critical infrastructure for a period in excess of 4 hours. Several significantly sensitive customers for: a) short time but where there is significant impact e.g. hospital or b) an extended period of time
Very serious	**SAIDI impact:** 5 - 10 minutes (urban), 12 - 24 minutes (rural), 28 - 280 minutes (long rural). Supply outage of 1% - 5% of customers or critical infrastructure for a period less than 4 hours. Interruption affecting one sensitive load customer for: a)short time but where there is significant impact e.g. hospital or b) an extended period of time

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Consequence – The most likely consequence of exposure to the hazard	
Serious	**SAIDI impact:** 15 seconds – 5 minutes (urban), 35 seconds - 12 minutes (rural), 85 seconds - 28 minutes (long rural). Supply outage to 0.5% - 1% of customers for a period less than 4 hours. Interruption affecting one sensitive load customer for less than 30 minutes where there is little impact on the customer's operations or the public
Important	**SAIDI impact:** less than 15 seconds (urban), less than 35 seconds (rural), less than 85 seconds (long rural). Supply outage to less than 0.5% of customers for a period less than 4 hours. Momentary outage to one or more sensitive load customers where there is no impact to the customer's operations or the public
Noticeable	**SAIDI impact:** less than 15 seconds (urban), less than 35 seconds (rural), less than 85 seconds (long rural). Supply outage to less than 0.5% of customers for a period less than 4 hours. Momentary outage to one or more sensitive load customers where there is no impact to the customer's operations or the public

Note: Consequence details from CEOP2111 Appendix A: Detailed Consequence Rating Table.

4.5   TABLE E: Environmental

Probability – The likelihood that the complete sequence of events results a serious or higher consequence	
Almost certain	50% – 100%
Quite Possible	30% - 50%
Unusual but possible	20% - 30%
Remotely possible	10% - 20%
Conceivable (but very unlikely)	5% – 10%
Practically impossible	0% - 5%

Exposure – The raw frequency of exposure to the hazard	
Very rare	Can go several years without any event impact
Rare	Event impact once every year or two
Infrequent	Event impact less than 1 per month or a few a year
Occasional	Event impact 1 or 2 times per month
Frequent	Event impact 1 or 2 times per fortnight
Continuous	Event impact daily or weekly

Consequence – The most likely consequence of exposure to the hazard	
Catastrophe	Material harm to the environment that is major. Major remediation required. Contamination to soil, water, atmosphere requiring major remediation.
Disaster	Material harm to the environment that is significant. Significant remediation required. Remediation required of contamination to soil, water and atmosphere.
Very serious	Material harm to the environment with remediation required. Actual or foreseeable off or on site contamination of soil, ground/surface water and atmosphere.
Serious	A minor matter with no ecological damage evident. A spill/emission incident exceeding control system.
Important	Localised impact and/or no environmental harm with little need for remediation.
Noticeable	Localised impact and/or no environmental harm with little need for remediation.

Note: Consequence details from CEOP2111 Appendix A: Detailed Consequence Rating Table.

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5   WORKED EXAMPLES

5.1   Worked example 1 – Vehicle pole impacts

Source date Utility Pole Impacts 2003 to 2012 from NSW Transport – Crashlink

EE Region	Fatal	Injury	Non-casualty	Grand total
North Coast	24	570	569	1163
South Eastern	5	216	277	498
Southern	10	229	211	450
Northern	11	213	161	385
Far West	3	25	31	59
Grand Total	53	1253	1249	2555
Annual average total	**5**	**125**	**125**	**256**

The annual average totals were used for evaluating the Riskex Risk calculator choices.

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### Using Table A: Health, Safety and Security definitions

The same steps must also be used for Financial, Reputational, Business Interruption and Environmental to establish an overall risk rating outcome.

Step 1:   Exposure – the raw frequency of exposure to the hazard.
At 256 p/a exposure is *Continuous*, the public are impacted daily or weekly.

Step 2:   Consequence – the most likely consequence of exposure to the hazard.
In this case, *Serious injury – serious*.

Step 3:   Probability – the likelihood that the complete sequence of events results in a serious or higher consequence.

At 125 injuries and 5 fatal crashes the percentage is just over 50%, so the probability will be *Almost certain*.
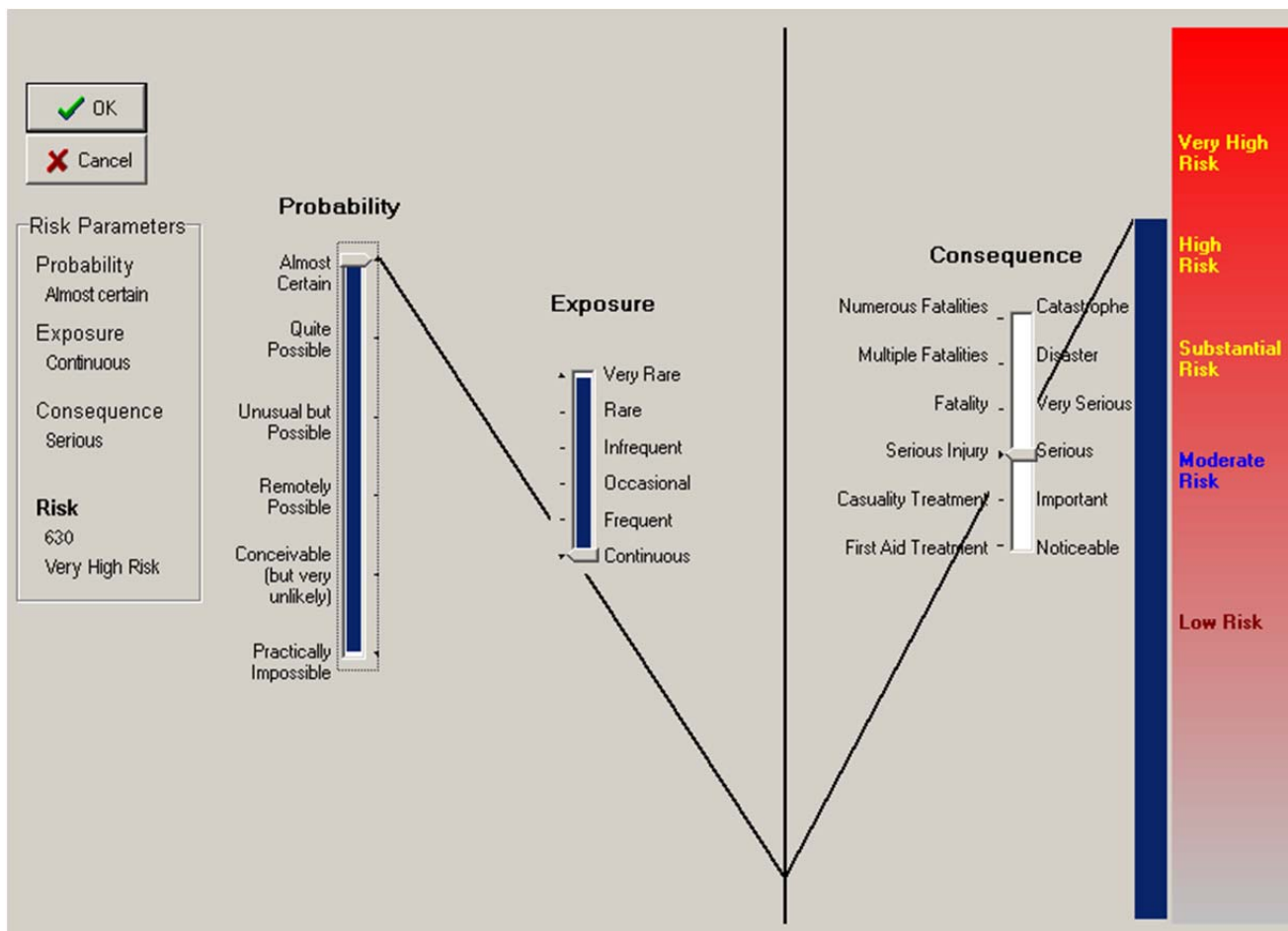
The Riskex Risk calculator rates this risk as Very High Risk with a score of 630.
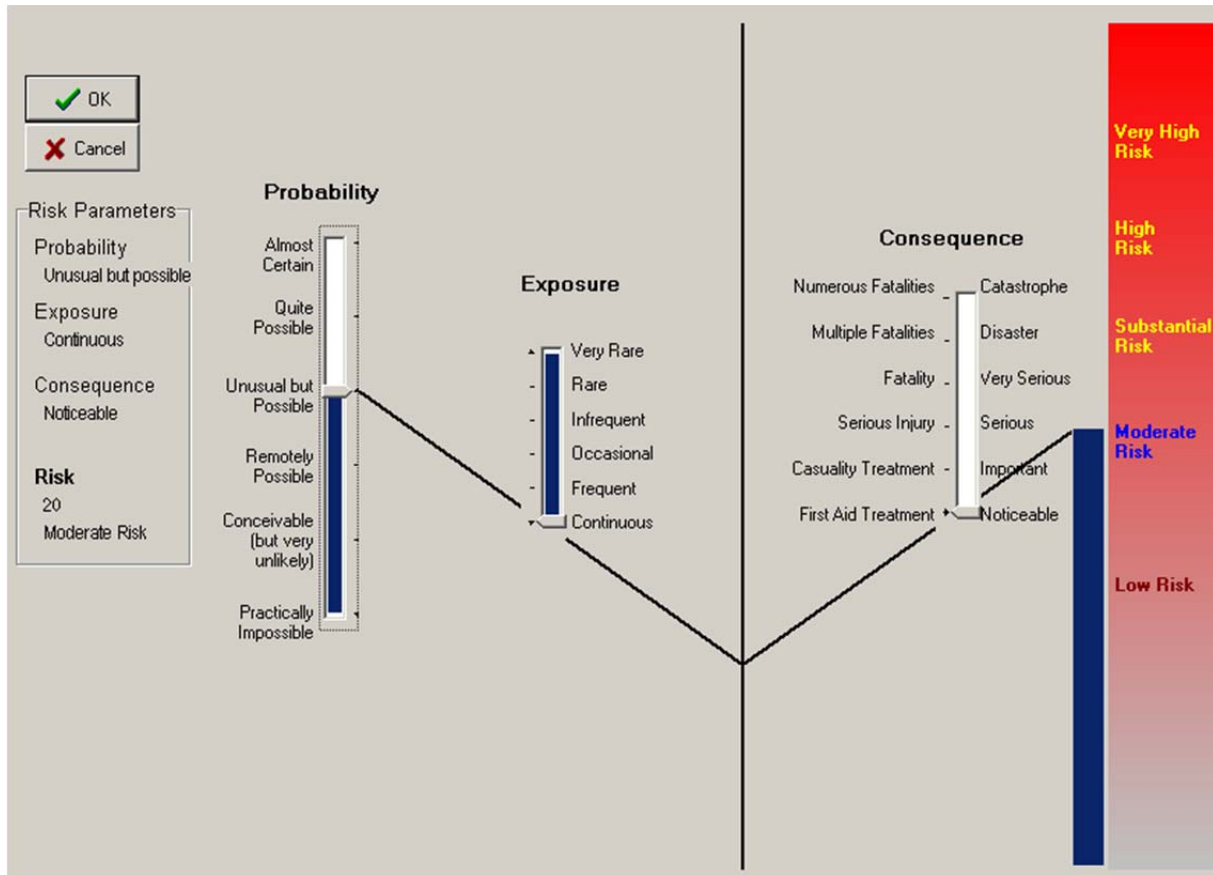
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Using Table B: Financial (potential financial loss of the utility pole impact data)

Step 1:   Exposure – *Continuous*

Step 2:   Consequence – *Noticeable ($100K - $400K)*

Step 3:   Probability – Probability of significant business cost is: *Unusual but possible*

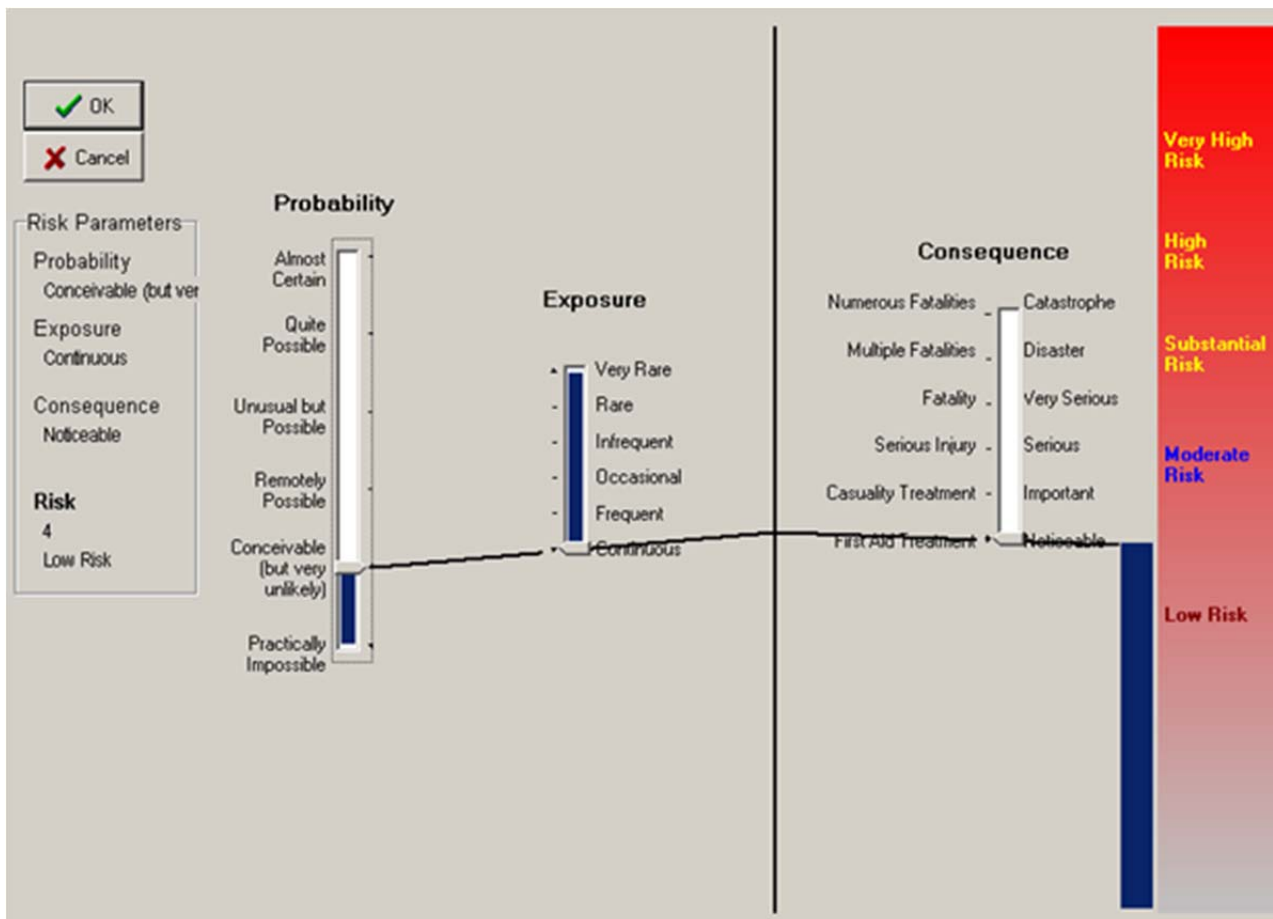The Riskex Risk Calculator rates this risk as Moderate Risk with a score of 20.

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Using Table C: Reputational (potential reputational impact of utility pole impact data).

Step 1:   Exposure – *Continuous*

Step 2:   Consequence – *Noticeable (Unlikely to lead to customer complaint)*

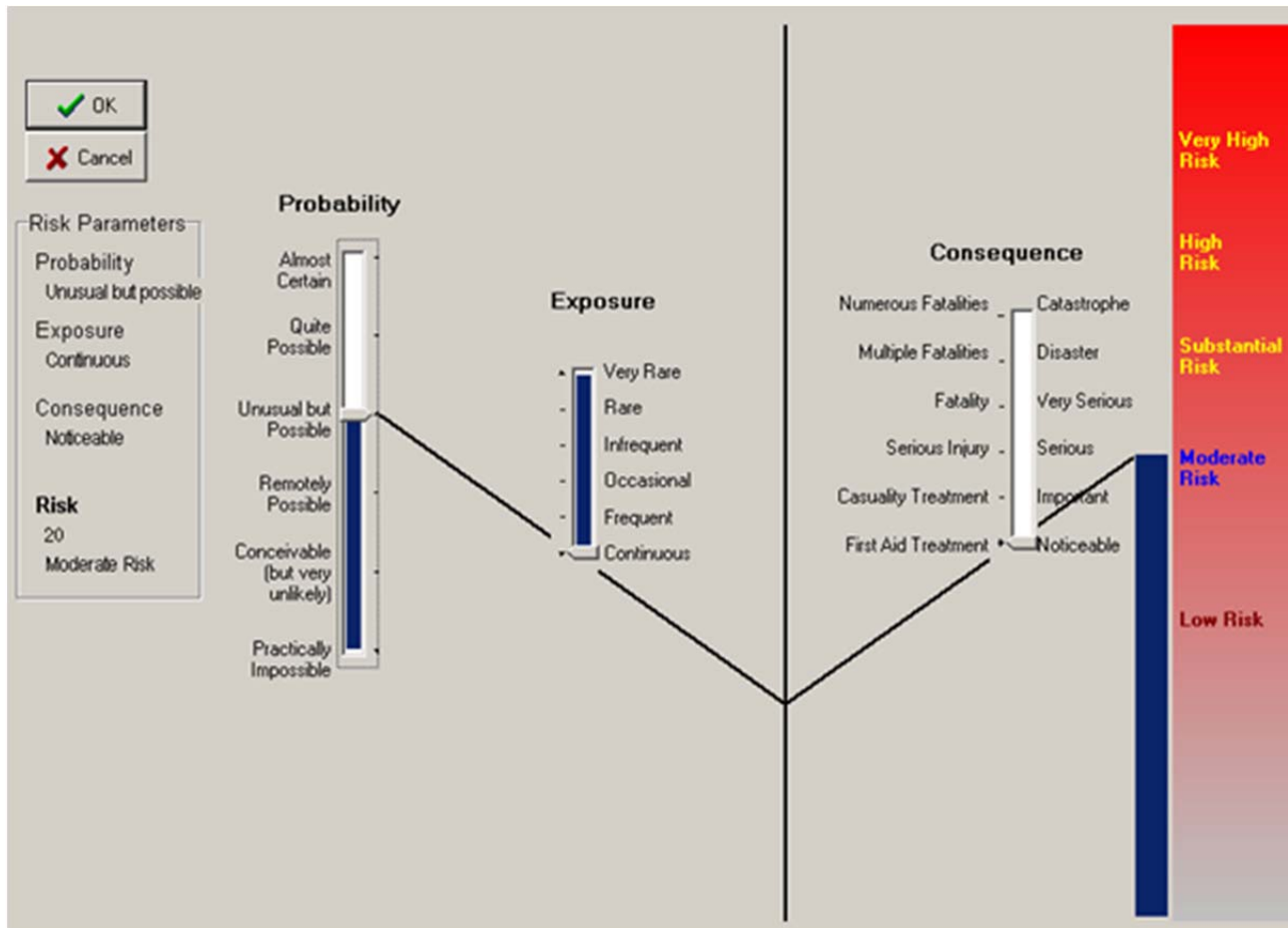**Step 3:**   Probability – Probability of significant impact on reputation: *Conceivable (but very unlikely)*

The Riskex Risk Calculator rates this risk as Low Risk with a score of 4.

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Using Table D: Business Interruption (technical and facilities).

Step 1: Exposure – *Continuous*

Step 2: Consequence – *Noticeable (negative impact on less than 100 households for less than 1 day)*

Step 3: Probability – Probability of significant business cost is: *Unusual but possible* (e.g. 66Kv pole hit resulting in major outage)
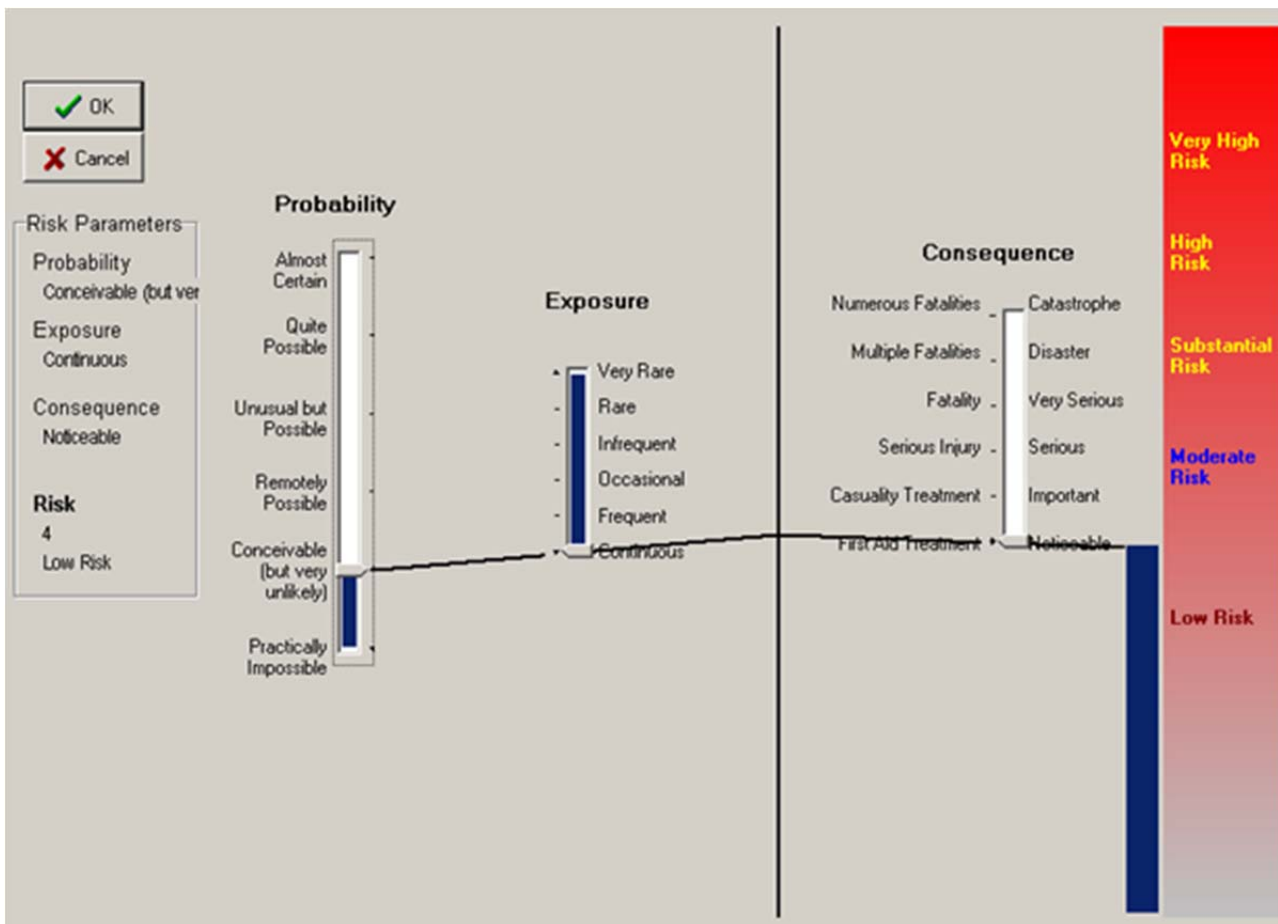

The Riskex Risk Calculator rates this risk as Moderate Risk with a score of 20.

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Using Table E: Environmental

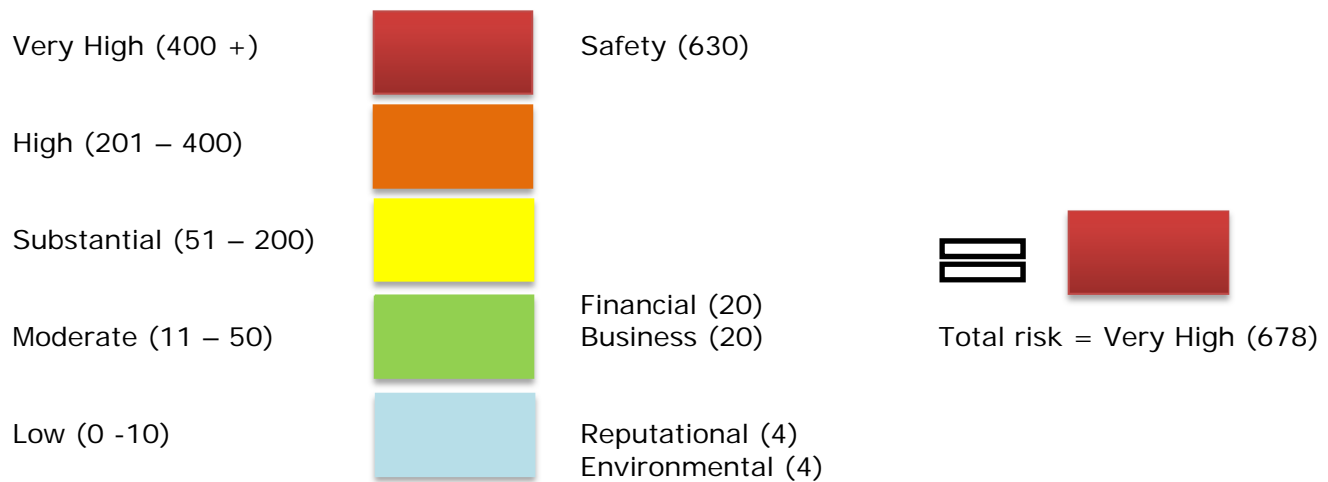**Step 1:**   Exposure – *Continuous*

Step 2:   Consequence – *Noticeable (Localised impact and/or no environmental harm)*

Step 3:   Probability – Probability of significant environmental impact: *Conceivable (but very unlikely)*

The Riskex Risk Calculator rates this risk as Low Risk with a score of 4.

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5.1.1 Overall risk rating for Vehicle Pole Impacts

Very High (400 +)		Safety (630)
High (201 – 400)		
Substantial (51 – 200)		
Moderate (11 – 50)		Financial (20) Business (20)
Low (0 -10)		Reputational (4) Environmental (4)

Total risk = Very High (678)

5.2 Worked example 2 – Distribution Pole Substations

From data supplied at the time that this document was written there were 400 pole substation failures per year. For this example the Health, Safety and Security calculation is employee focused, with 1 fatality recorded.

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Using Table A: Health, Safety and Security

Step 1:   Exposure – raw frequency of exposure to the hazard. 400 P/A exposure is *Continuous*, the exposure to the hazard is daily or weekly.

Step2:   Consequence – the most likely consequence of exposure to the hazard. 1 fatality, consequence is *Fatality – Very serious*

Step 3:   Probability – the likelihood that the complete sequence of events results in a serious or Higher consequence

At 1 fatality the probability is *Conceivable (but very unlikely)*
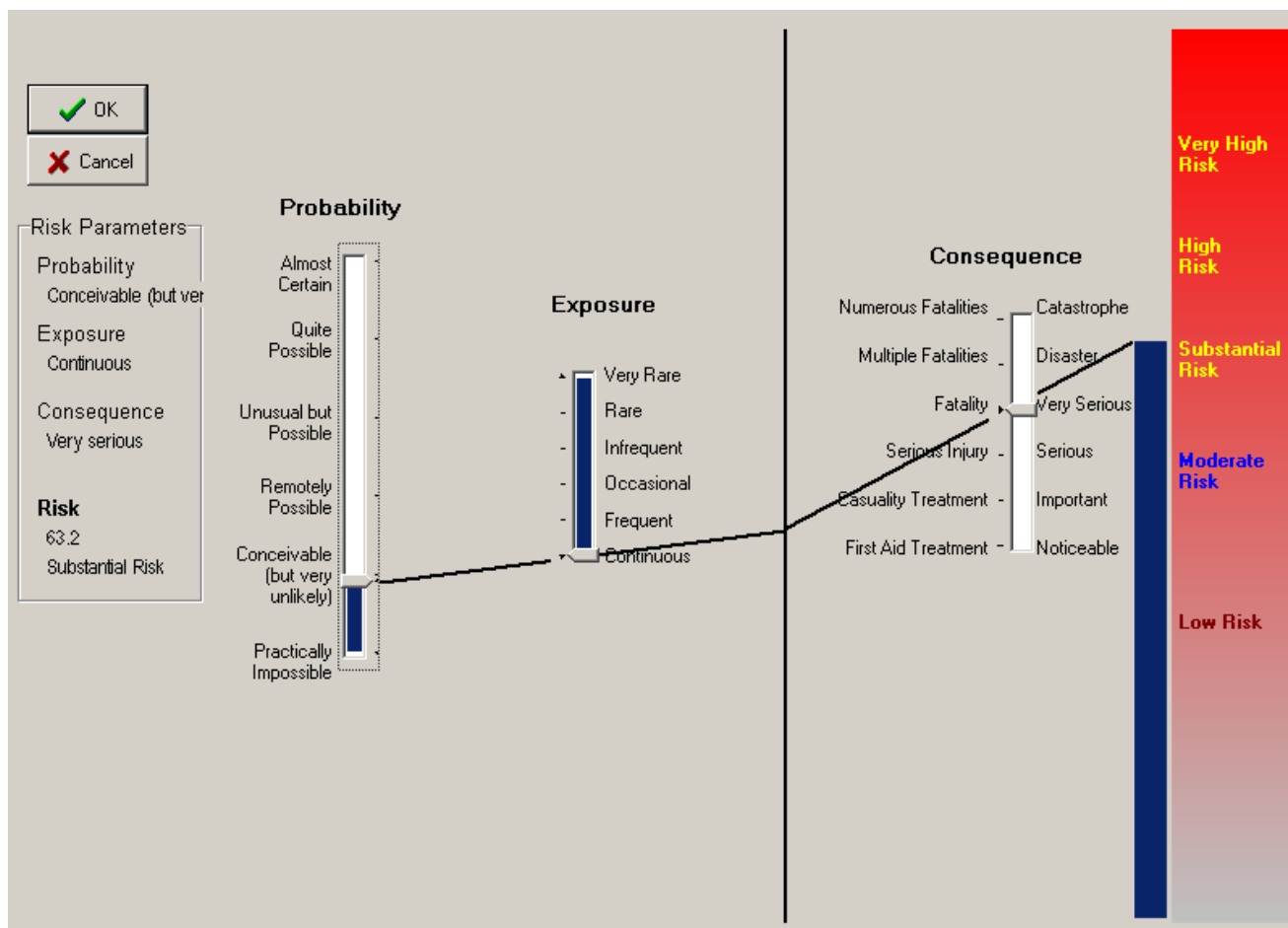
The Riskex Risk calculator rates this risk as Substantial Risk with a score of 63.2

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Using Table B: Financial (potential financial loss of distribution pole substations failures)

The financial cost of distribution substation pole failures is not great.

Step 1:	Exposure – *Continuous*	
Step 2:	Consequence – *Noticeable*	
Step 3:	Probability – *Conceivable (but very unlikely)*	

The Riskex Risk calculator rates this risk as Low Risk with a score of 4.
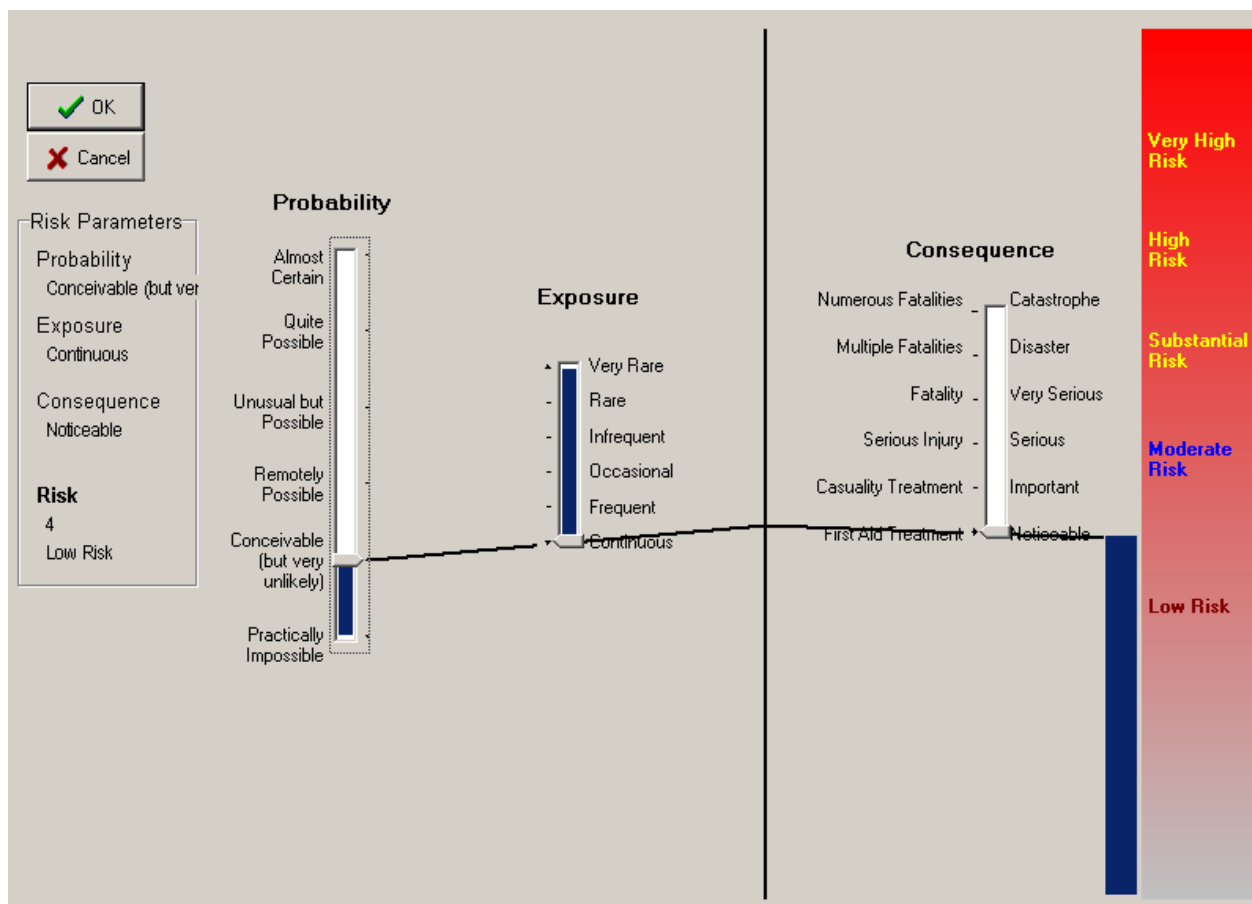
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Using Table C: Reputational (potential reputational impact of distribution pole substation failures)

The failure of distribution pole substations does not usually create media attention.

Step 1:   Exposure – *Continuous*

Step 2:   Consequence – *Noticeable*

Step 3:   Probability – *Practically impossible*

The Riskex Risk calculator rates this risk as Low Risk with a score of 2.

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Using Table D: Business Interruption (technical and facilities)

The failure of distribution pole substations that are less than 500kVA usually interrupt supply to less than 100 customers

Step 1:   Exposure – *Continuous*

Step 2:   Consequence – *Important*

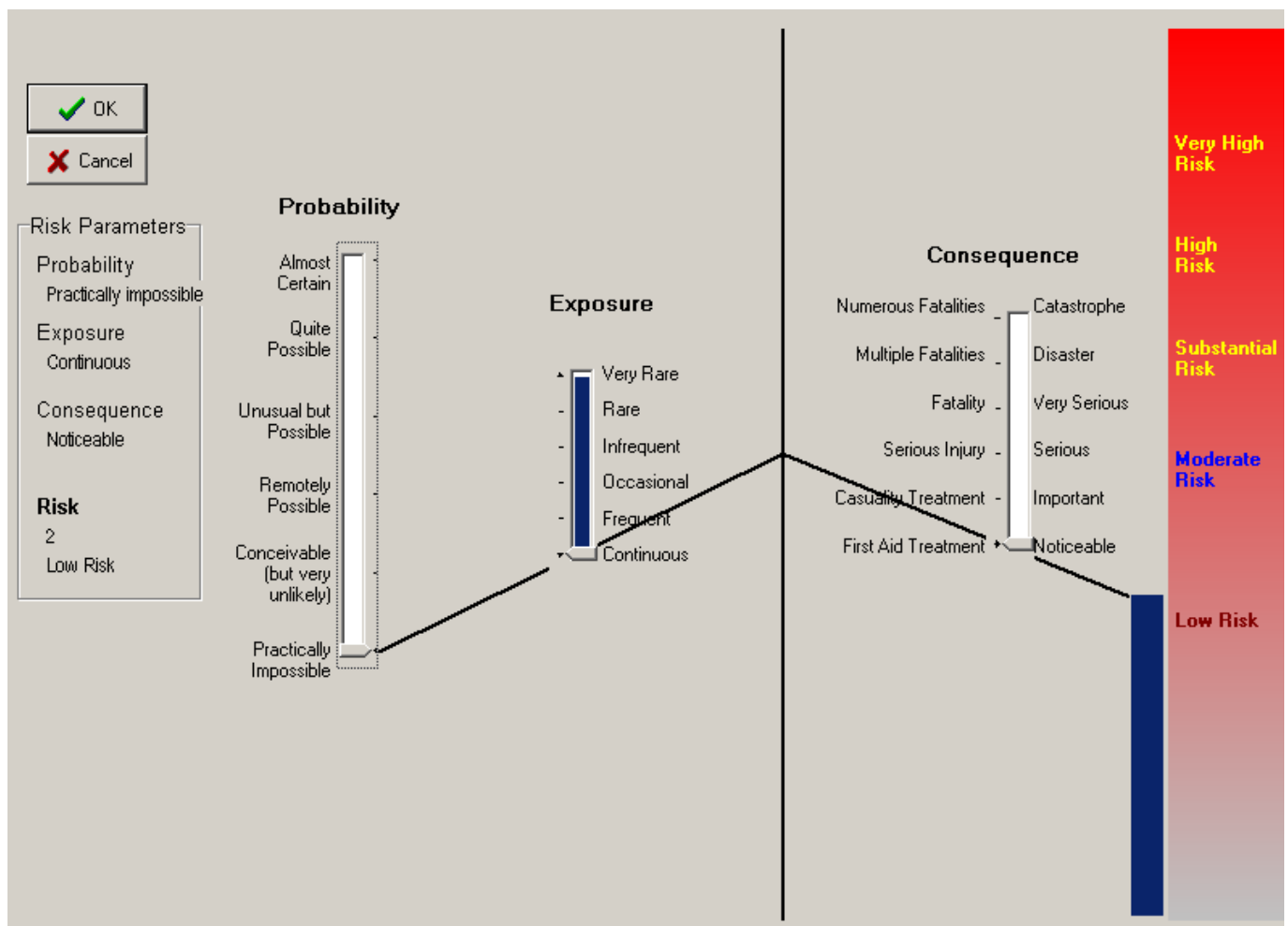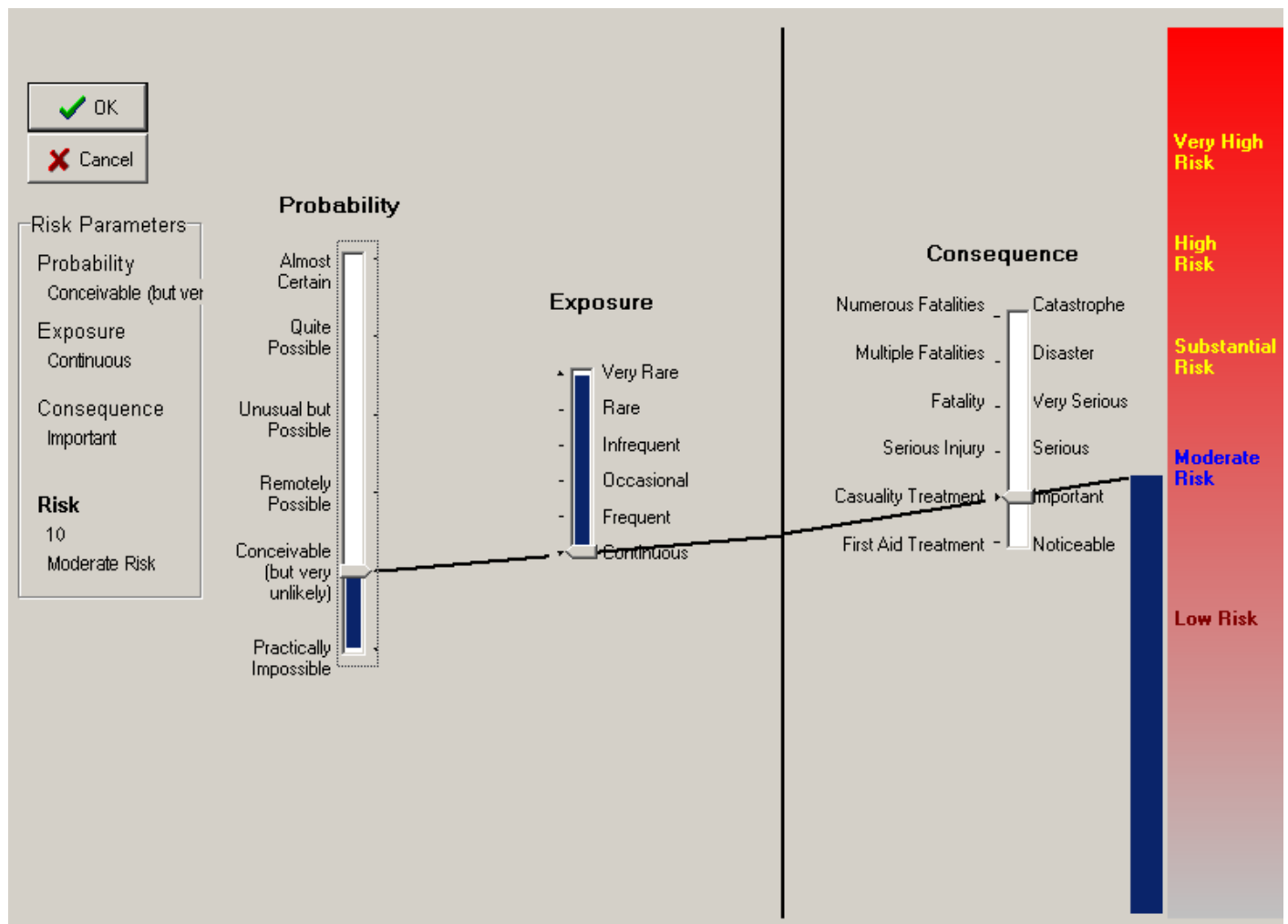**Step 3:**   Probability – *Conceivable (buy very unlikely)*

The Riskex Risk calculator rates this risk as Moderate Risk with a score of 10.

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Using Table E: Environmental

The failure of distribution pole substations could cause major environmental damage not just through oil spills but could cause major fires.

Step 1:   Exposure – *Continuous*

Step 2:   Consequence – *Very serious*

Step 3:   Probability – *Conceivable (buy very unlikely)*

The Riskex Risk calculator rates this risk as Substantial Risk with a score of 63.2.
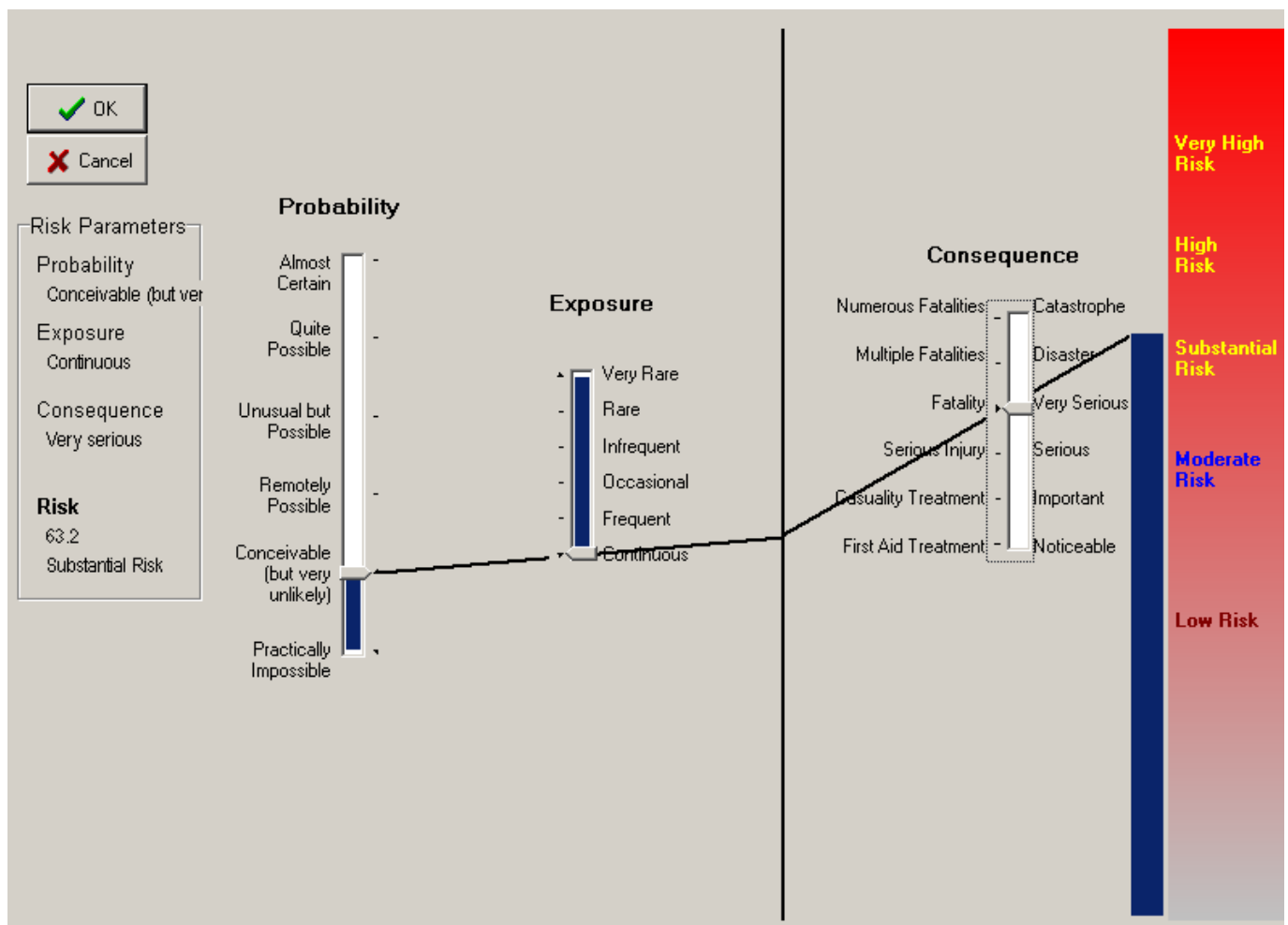
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5.2.1 Overall risk rating for Distribution Pole Substations

Very High (400 +)

High (201 – 400)

Substantial (51 – 200)   Safety (63.2)
Environmental (63.2)

Moderate (11 – 50)

Business (10)

Low (0 -10)   Financial (4)
Reputational (2)

Total risk = Substantial (142.4)
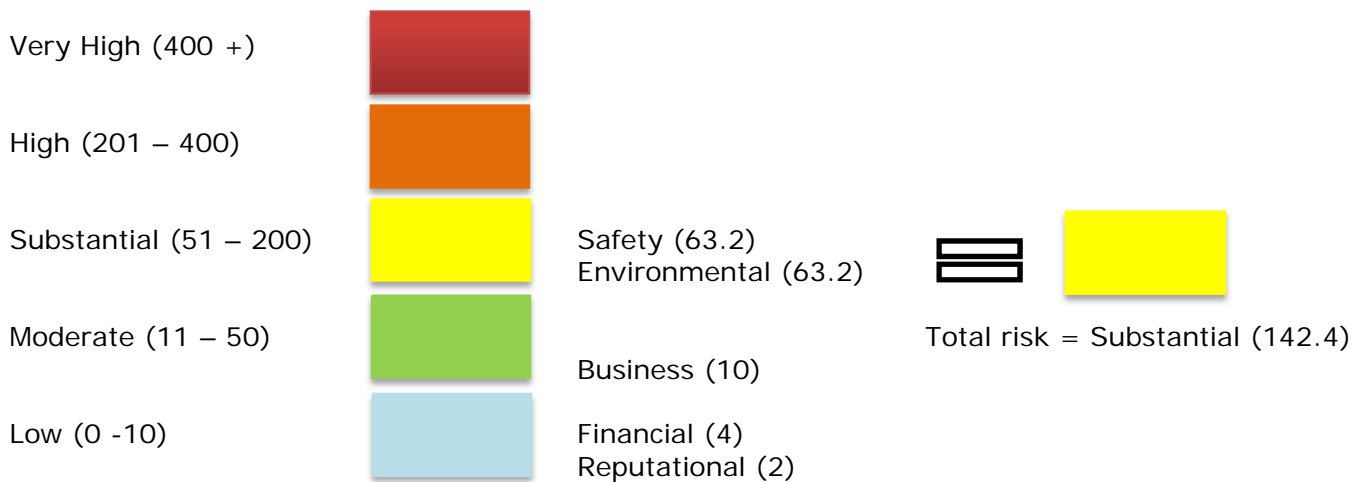
5.3   Worked example 3 – Power Transformers

From data supplied at the time that this document was written there were 4 power transformer failures per year.

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Using Table A: Health, Safety and Security

Step 1: Exposure – raw frequency of exposure to the hazard.
4 P/A exposure is *Infrequent*, the exposure to the hazard is a few a year.

Step2: Consequence – the most likely consequence of exposure to the hazard.
The event would not be life threatening to customers so the consequence is *Important*

Step 3: Probability – the likelihood that the complete sequence of events results in a serious or Higher consequence.

The likelihood that the customers would require medical treatment as a result of the power

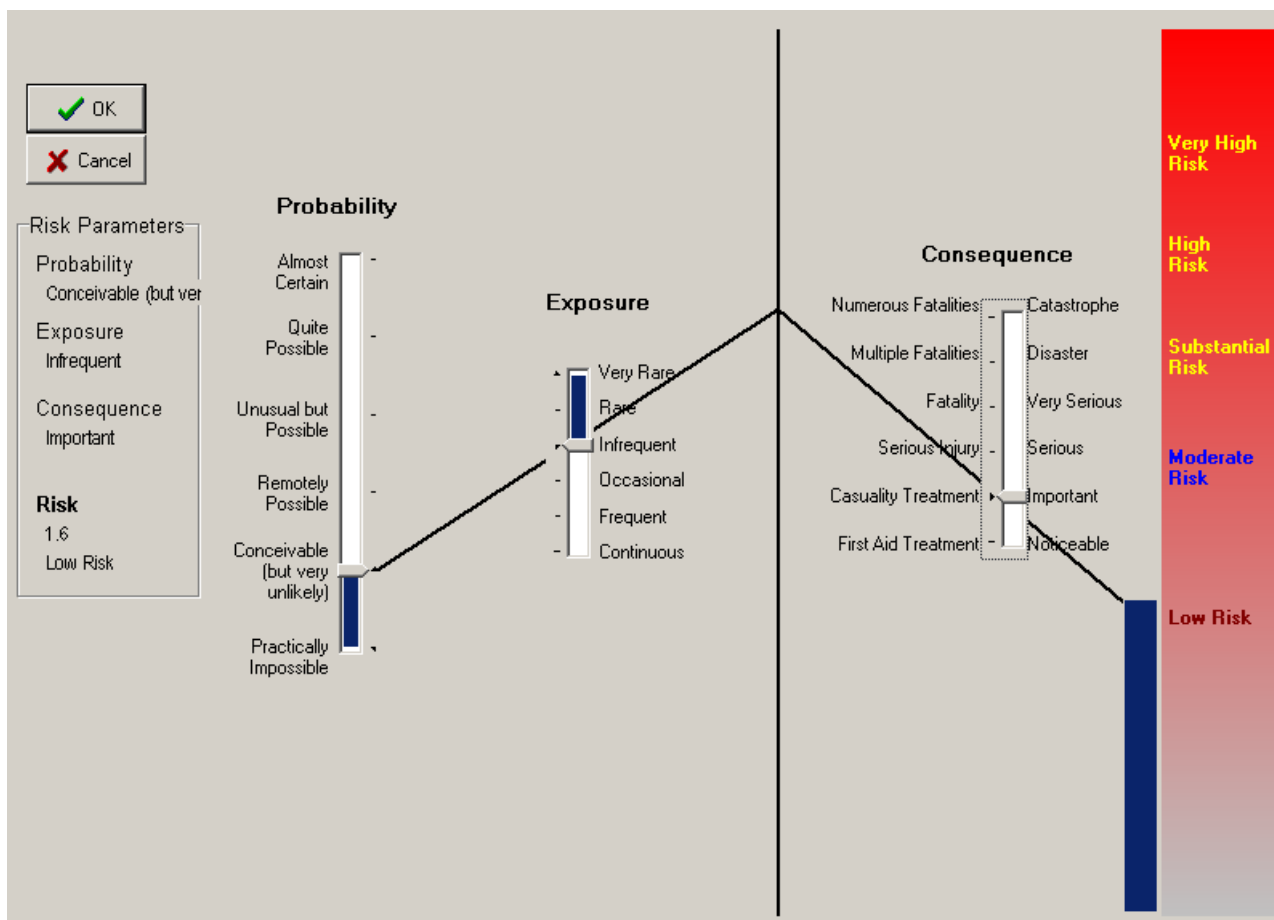Transformer failure is *Conceivable (but very unlikely).*

The Riskex Risk calculator rates this risk as Low Risk with a score of 1.6.

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Using Table B: Financial (potential financial loss of a power transformer failure)

The financial cost of a power transformer failure can be very costly with the cost of the new transformer and the extensive work involved in the new transformer installation and commissioning.

Step 1:   Exposure – *Infrequent*

Step 2:   Consequence – *Serious* ($801K - $3.2M)

Step 3:   Probability – *Unusual but possible*
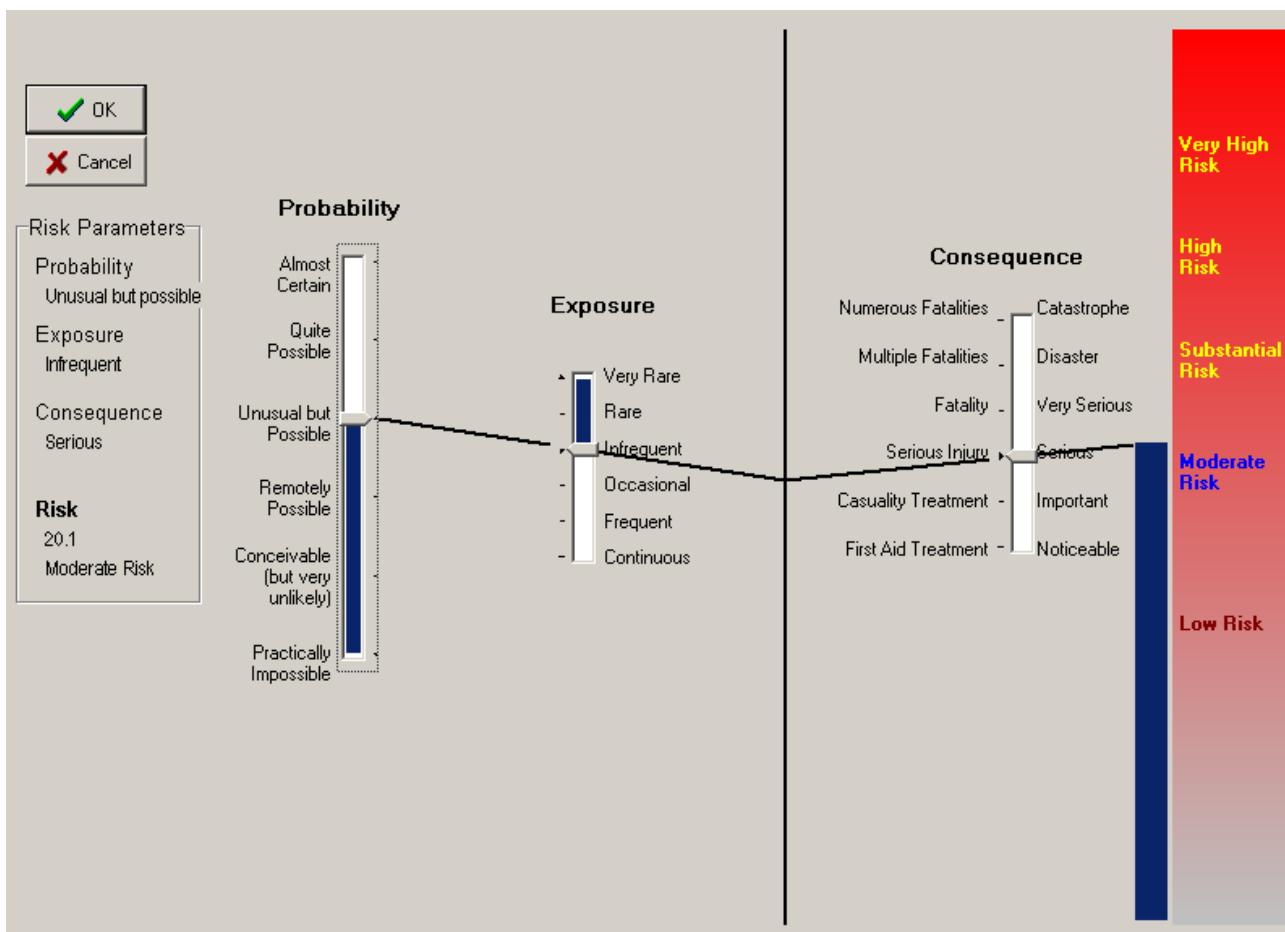
The Riskex Risk calculator rates this risk as Moderate Risk with a score of 20.1.

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Using Table C: Reputational

The failure of a power transformer can impact on company reputation especially when media become involved.

Step 1:   Exposure – *Infrequent*

Step 2:   Consequence – *Serious* (likely to be referred to media)

Step 3:   Probability – *Quite possible* (30% - 50% chance of media involvement)
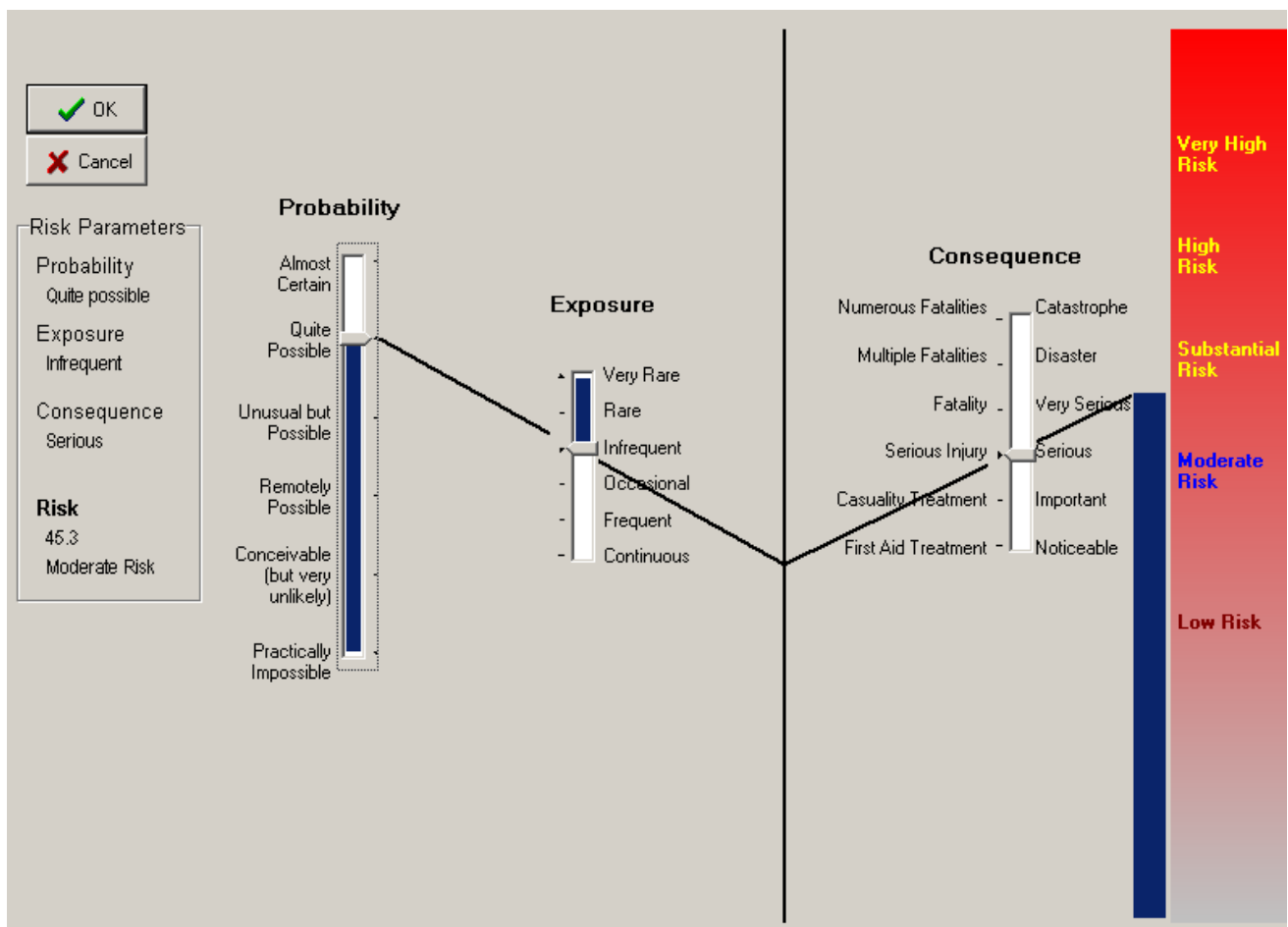
The Riskex Risk calculator rates this risk as Moderate Risk with a score of 45.3.

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Using Table D: Business Interruption (technical and facilities)

The failure of a power transformer can have a large impact the company operations and interruption of supply to a great many customers.

Step 1:   Exposure – *Infrequent*

Step 2:   Consequence – *Disaster* (loss supply to 5% - 10% of customers in excess of 4 hours)

Step 3:   Probability – *Almost certain* (over 50% of the time the loss of a power transformer will result in an extended period of loss of supply to 5% - 10% of customers)
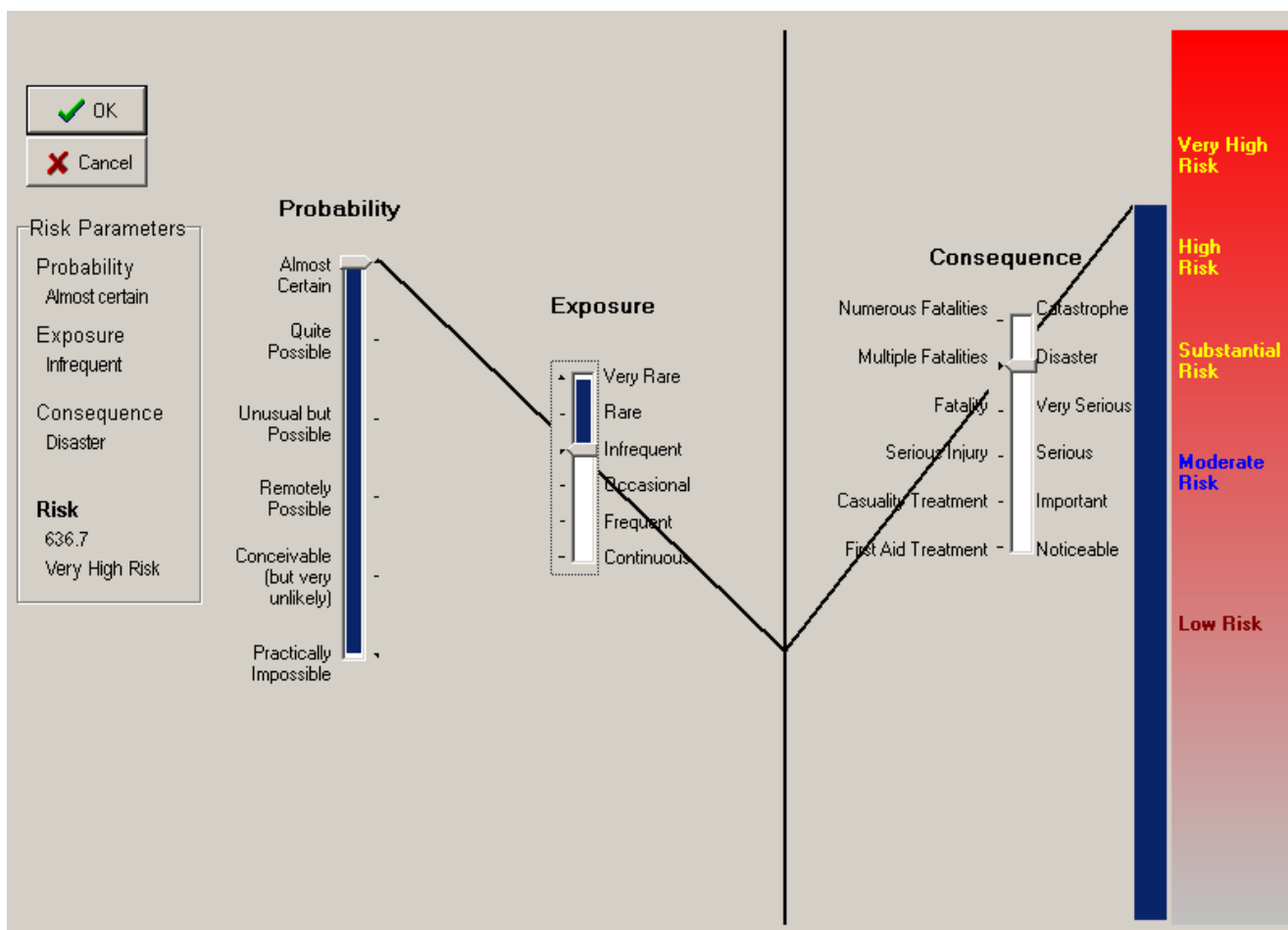
The Riskex Risk calculator rates this risk as Very High Risk with a score of 636.7.

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Using Table E: Environmental

The failure of a power transformer can have a large impact on the environment, not just from the possibly of a bund failure and oil spill, but from any fire that can occur due to the oil spill

Step 1: Exposure – *Infrequent*

Step 2: Consequence – *Serious* (for this example the possibility of a serious fire has been the focus)

Step 3: Probability – *Remotely possible* (the possibility of a serious oil spill and/or fire is remote)
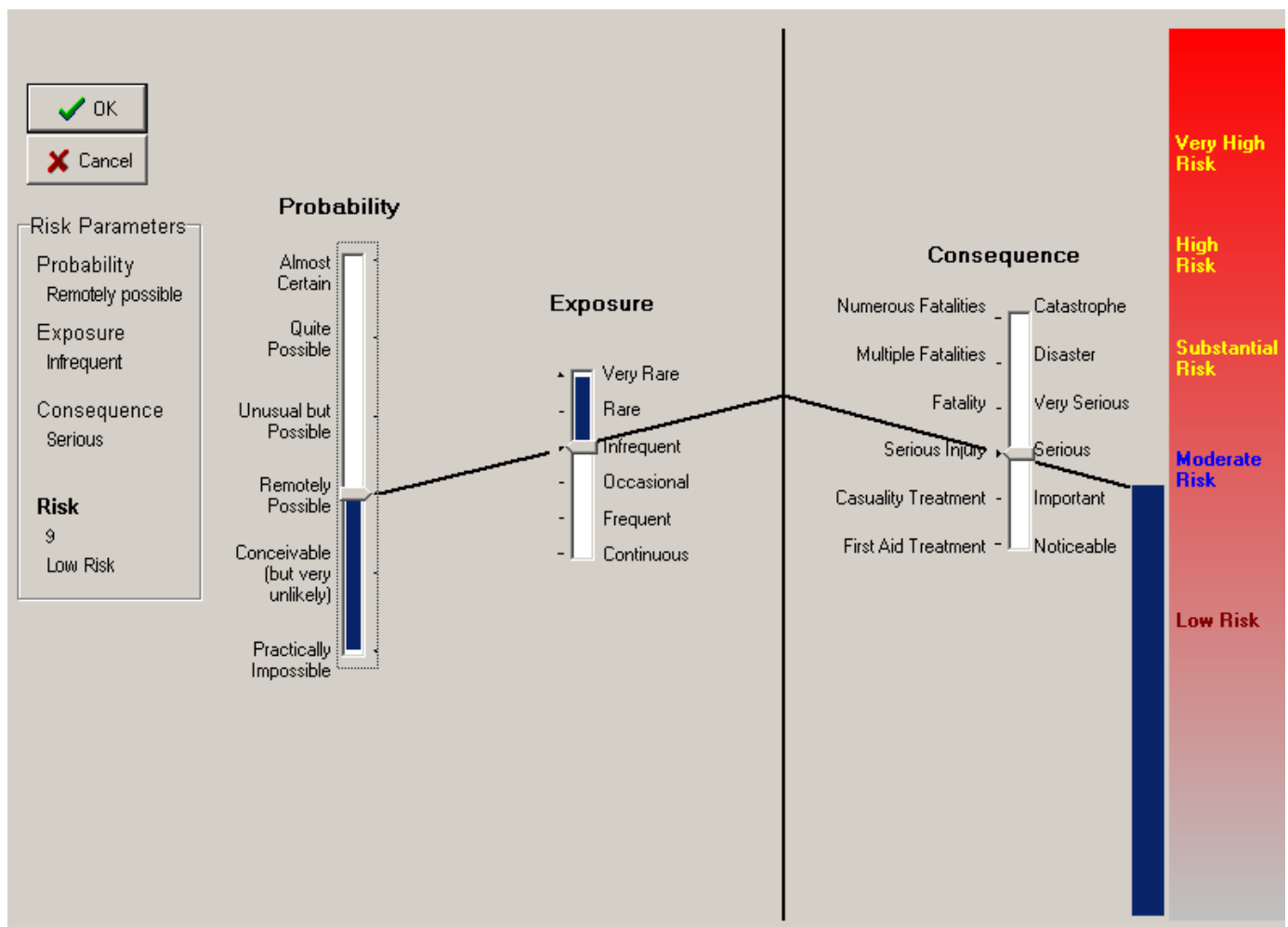
The Riskex Risk calculator rates this risk as Low Risk with a score of 9.

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5.3.1 Overall risk rating for Power Transformer Failure

Very High (400 +)

High (201 – 400)

Substantial (51 – 200)

Moderate (11 – 50)

Low (0 -10)

Business (636.70

Safety (63.2)

Reputational (45.3)
Financial (20.1)

Environmental (9)
Financial (4)
Safety (1.6)

Total risk = Very High (712.7)

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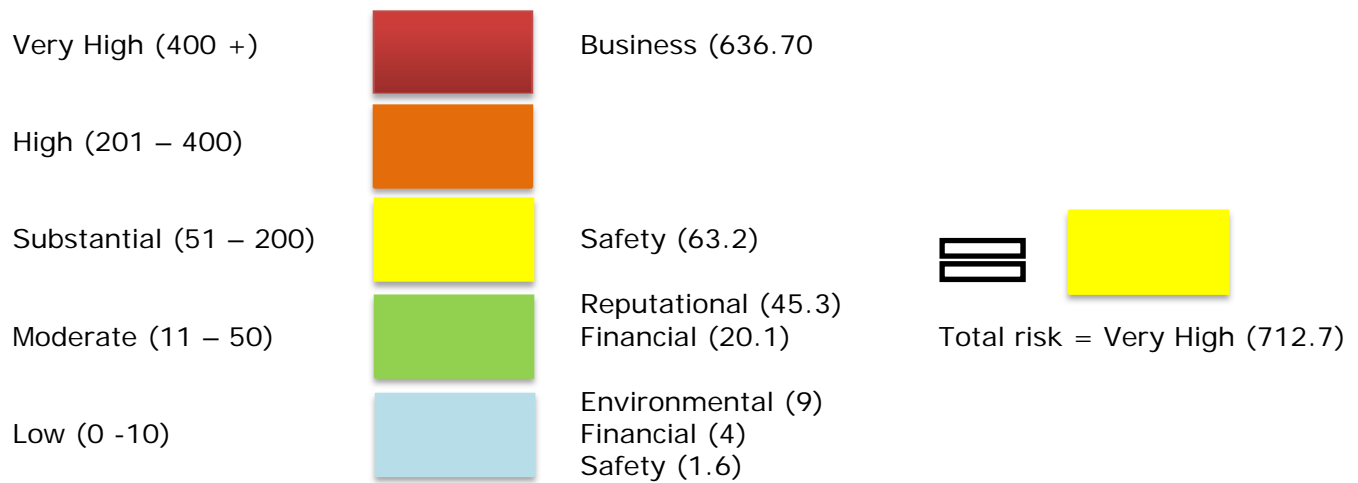
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6   ALARP - QUANTIFYING THE RISK

The Riskex Risk Score calculator is useful in calculating the "qualitive" risk of asset failures, however there is a need to be able to "quantify" the risk for asset failures.

After review of available engineering risk management methods, Essential Energy has decided to adopt the ALARA/ALARP risk model as in HB 436 / IEC 61508-5 and ESAA Guidelines, using the following limits.

Intolerable = $1 * 10^{-4}$ p/a
ALARP/ALARA = Between $1 * 10^{-4}$ and $1 * 10^{-6}$ p/a
Acceptable = Between $1 * 10^{-6}$ and $1 * 10^{-7}$ p/a

Risk Acceptance Criteria

Intolerable Risk
Less than $1*10^{-4}$ p/a

Intolerable

Risk cannot be justified except in extraordinary circumstances

As Low As Reasonably Practical / As Low As Reasonably Achievable

ALARP/ALARA Risk
Between $1 * 10^{-4}$ and $1 * 10^{-6}$ p/a

ALARP/ALARA

Tolerable only if further risk reduction is impractical or if its cost is grossly disproportionate to the improvement gained

Acceptable

Acceptable Risk
Between $1 * 10^{-6}$ and $1 * 10^{-7}$ p/a

It is necessary to maintain assurance that risk remains at this level

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6.1 Worked example 4 – Vehicle Pole Impacts

Using the Vehicle Pole Impacts data from Worked example 1 and Essential Energy existing pole data we can calculate the "As Low As Reasonably Possible" (ALARP) by creating an event hierarchy where:
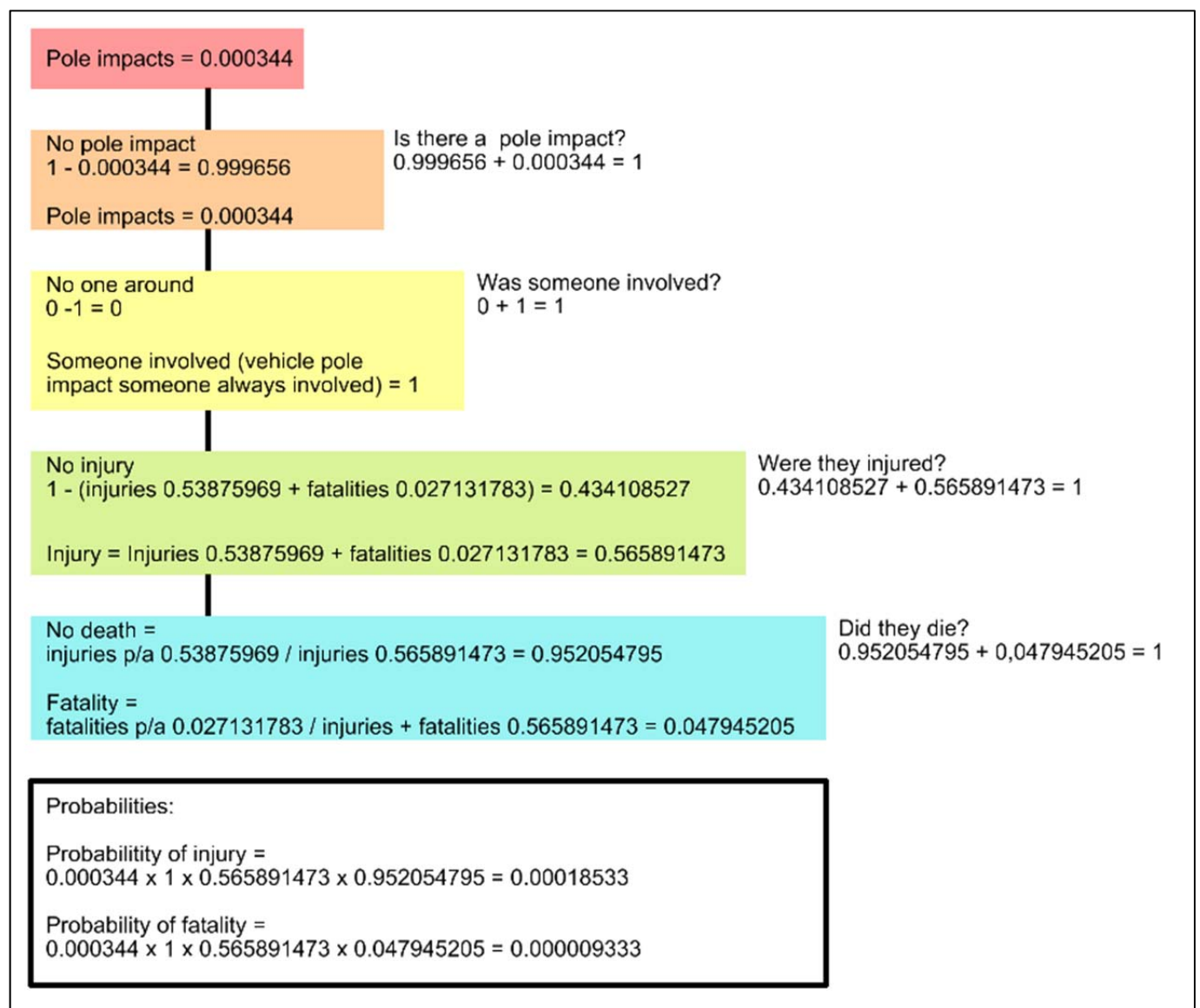
Poles impacted p/a = 258
Total poles on roadways (approx.) = 750000
Individual pole impacts = 0.000344 (258/750000)
Injured from pole impacts = 0.53875969 (139 injured p/a = 53.87%)
Fatalities from pole impacts = 0.027131783 (7 fatalities p/a = 2.71%)

EVENT TREE:

Pole impacts = 0.000344

No pole impact
1 - 0.000344 = 0.999656

Is there a pole impact?
0.999656 + 0.000344 = 1

Pole impacts = 0.000344

No one around
0 -1 = 0

Was someone involved?
0 + 1 = 1

Someone involved (vehicle pole impact someone always involved) = 1

No injury
1 - (injuries 0.53875969 + fatalities 0.027131783) = 0.434108527

Were they injured?
0.434108527 + 0.565891473 = 1

Injury = Injuries 0.53875969 + fatalities 0.027131783 = 0.565891473

No death =
injuries p/a 0.53875969 / injuries 0.565891473 = 0.952054795

Did they die?
0.952054795 + 0,047945205 = 1

Fatality =
fatalities p/a 0.027131783 / injuries + fatalities 0.565891473 = 0.047945205

Probabilities:

Probabilitity of injury =
0.000344 x 1 x 0.565891473 x 0.952054795 = 0.00018533

Probability of fatality =
0.000344 x 1 x 0.565891473 x 0.047945205 = 0.000009333

From the Risk Acceptable Criteria Pyramid

Probability of injury pole crash   = 0.00018522   = $1.85 * 10^{-4}$ = Intolerable
Probability of fatality pole crash   = 0.000009333   = $9.33 * 10^{-6}$ = ALARP/ALARA

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7   Q & A

7.1   When do I apply the Risk Score Calculator

Question:

Do I have to apply the Risk Score Calculator to each asset failure mode within the investment Case?

Answer

No. Do one set of 5 (Safety, Financial, Reputational, Business, Environmental) risk assessments for the summarised program investment in your case.

Question:

If the risk is calculated to be Low on the nomogram or "as low as reasonable possible" (ALARP), is it Ok to "do nothing"?

Answer:

No. The calculations themselves simply indicate at what risk level the activity is NOW (at a point in time). If you have a low risk the ability to keep it low or drive it lower must be considered in the context of effort or resource availability to do so. A reasonable person would apply preventative measures when they have the capacity to do so. Remember it may be low now due to previous expense or efforts. For example, the incident of boat yacht masts hitting overhead lines has come down considerably to very

8   REVISIONS

Issue Number	Section	Details of Changes in this Revision

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