



Risk Assessment

City of Yarra

Canning Street Child Care Centre, Carlton

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Noel Arnold & Associates Pty Ltd
Level 3 / 818 Whitehorse Road
Box Hill Victoria 3128 Australia
Ph: (03) 9890 8811 Fax: (03) 9890 8911
www.noel-arnold.com.au

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Executive Summary

At the request of the City of Yarra a risk assessment has been undertaken of the health and safety risks associated with the current co-location of a Citipower high voltage substation inside the Canning Street Child Care Centre.

The risks associated with this co-location are not the type that places the adult and child occupants of the building at immediate health and safety risks. The risks that accompany a high voltage sub-station have a very low likelihood of happening but they could be serious in their consequences if they were to happen. (Low Frequency / High Severity) These risks include transformer fire and explosion, electrocution, and a possible increase in the risk of childhood leukaemia.

Current management practices are generally considered to be adequate. The existence of the sub station does not pose an immediate health or safety risk which is considered unacceptable. Some additional measures have been recommended to further mitigate risk and these are detailed within the report.

The results of the electromagnetic radiation testing indicated that the ELF magnetic field levels are below the NHMRC Interim Voluntary Guideline. It is noted that there is some uncertainty associated with the hazards of ELF magnetic fields and accepted exposure standards. In this context it is recommended that exposure should be kept to levels as low as reasonably practicable. Recommendations have been made in the report to investigate the practicality of further reducing these levels within the Centre.

Statement of Limitations

This report has been prepared in accordance with the agreement between City of Yarra and Noel Arnold & Associates Pty Ltd.

Within the limitations of the agreed upon scope of services, this work has been undertaken and performed in a professional manner, in accordance with generally accepted practices, using a degree of skill and care ordinarily exercised by members of its profession and consulting practice. No other warranty, expressed or implied, is made.

This report is solely for the use of City of Yarra and any reliance on this report by third parties shall be at such party's sole risk and may not contain sufficient information for purposes of other parties or for other uses. This report shall only be presented in full and may not be used to support any other objective than those set out in the report, except where written approval with comments are provided by Noel Arnold & Associates Pty Ltd.

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1. Introduction

The City of Yarra is reviewing sites which are in close proximity to substations. Canning Street Child Care Centre is one such site. Noel Arnold and Associates have been asked by Gordon McVittie, City of Yarra, Building and Maintenance Management Coordinator, to conduct a risk assessment and provide options for the control of any potential risks to health arising from the presence of the Citipower high voltage substation located inside the boundaries of the Child Care Centre.

The substation is located in the middle of the Child Care Centre and shares a wall with the area known as Room 3 of the Child Care Centre which is used by the staff and children in the 3 -5 year old program. The substation is fed by underground High Voltage cables and provides Low Voltage supply to the surrounding neighbourhood.

The Low Voltage cabling, carrying considerable current, also runs sub-floor under Room 3 and on under an outdoor play area to the street where it eventually links into the existing overhead Low Voltage supply system.

There are four possible hazards to consider with this co-location of children's facilities around a High Voltage utility substation.

These are itemised in the pages that follow:

1. **Electrocution:** Access to the substation and contact with any of the substation equipment is usually restricted and controlled by locking the sub-station doors. Nevertheless while not usual industry practice it is possible that the substation doors could be left open.

It is also a possibility that the earthing may become inefficient over time and result in leakage of current, via stray ground return pathways, currents can then flow through water and gas piping and any other conductive structures on the site.

2. **Explosion and Fire:** Under certain loading and short circuit circumstances that can take place remotely from the substation site itself the transformers inside the substation can explode and can catch fire.
3. **Toxic Chemicals on Site:** It is possible that the transformer oils inside the substation may still contain Poly chlorinated biphenyl which is considered to be highly toxic. Although the substation is locked there is some possibility of leakage and fumes. In the event of a substation fire the fumes would be toxic.
4. **Exposure to Extremely Low Frequency magnetic fields:** The substation continuously emits extremely low frequency magnetic fields from the transformers and the sub floor High Voltage and Low Voltage Cabling which pass through the brick walls and permeate both the 3-5 children's areas and the Child Care Manager's office.

2. Risk Assessment Process

A two-stage risk assessment of each of risk has been conducted and is attached at Appendix 1. The first stage looks at the inherent risk taking into account the Likelihood and Consequences of each of the risks actually happening.

In situations where something is inherently dangerous and can kill or maim we consider the hierarchy of controls and we review and assess the effectiveness of the combination of existing controls before determining whether the risk requires more effective control.

This process provides a consistent, rational framework to assist in the weighing up of these issues. Any risk that remains at a significant, moderately significant, or moderate level of risk requires application of further controls. The more significant a risk the more urgent the need for better controls.

We would expect that in due course these risks and proposed controls would be further discussed between the City of Yarra and Citipower. At that stage assumptions about Citipower's existing controls, engineering and maintenance practices can be further verified and amended if necessary.

2.1 Hierarchy of Control

Our consideration and selection of controls is based on the recognised hierarchy of controls.

The Hierarchy of Control is described below in declining effectiveness as the control focus moves from making the workplace safe by eliminating hazards down to living with the hazards and relying on human behaviour and other less reliable and effective means such as administrative measures, personal protective clothing and equipment to maintain health and safety.

The Hierarchy of Control involves the following:

- Elimination - is the most effective means for controlling a hazard.
- Substitution - of something less hazardous when complete elimination is not possible.
- Engineering Controls such as guarding interlocks circuit breakers.
- Administrative Controls such as training and agreed Safe Work Procedures.
- Personal Protective Clothing and Equipment.

3. Extremely Low Frequency Magnetic Field Assessment

The Extremely Low Frequency (ELF) Magnetic fields emitted from the substation and from the High and low voltage cables have been assessed throughout the Child Care Site by on-site measurement using an Emdex 11 calibrated magnetic field logging dosimeter. This is state of the art equipment developed by the Electrical Power Research Institute for surveying property and providing accurate risk control exposure dose information.

3.1 Methods & Instruments

The instrument was programmed to survey mode taking RMS measurements every 1.5 seconds in the frequency range 40 –800 Hz with the primary frequency of 50 Hz.

In a walk through survey the ambient readings were noted in all areas that could be accessed both outside and inside the buildings.

3.2 Regulations & Standards

Reference should be made to Appendix B for discussion of relevant regulations, standards & guidelines.

3.3 Results of Extremely Low Frequency Magnetic Fields Survey

The magnetic field are measured in units called milligauss and we have compared the levels we recorded with the interim Guideline published by the National Health & Medical Research Council (NHMRC)

Area	Average Levels mG	NHMRC Interim Voluntary Guideline in milligauss
Children's Room No 3	10.3	1000 mG
Managers office	5.87	1000 mG

4. Conclusions

There are at this Child Care Centre particular hazards which would not normally be present in children's facilities due to the presence of the High Voltage Substation. Current management practices are generally considered to be adequate. The existence of the sub station does not pose an immediate health or safety risk which is considered unacceptable. Some additional measures can be taken to further mitigate risk and these are detailed in Appendix A.

The results of the electromagnetic radiation testing have indicated that the ELF magnetic field levels are below the NHMRC Interim Voluntary Guideline. It is noted that there is some uncertainty associated with the hazards of ELF magnetic fields and accepted exposure standards. In this context it is recommended that exposure should be kept to levels as low as

reasonably practicable. Reflecting the hierarchy of control approach, there are a range of options which could be considered to reduce ELF exposures levels and potential risks associated with fire, explosion and electrical contact in this environment. These options are discussed in Section 5.

5. Summary of Recommendations

In order to maintain a safe environment the following recommendations have been made:

1. Ensure the sub station remains at all times entirely secured against unauthorised access.
2. Review Citipower Substation Earthing Integrity conduct checks for current flowing in water and gas pipes.
3. Warn trades staff especially plumbers of the need for special Safe Work Practices if working on water or gas supply
4. Seek and review Citipower's Spill, Leakage, containment and clean up decontamination procedures
5. Investigate the practicality of shielding or relocation of substation and Sub Floor Cabling. If deemed practical to do so then request this of Citipower.

Recognising the Prudent Avoidance approach to minimising exposure to ELF magnetic fields, we recommend the investigations be made with Citipower to determine the practicality of shielding or relocation of the transformer. Where it is deemed practical to do so, attempts should be made to further mitigate the risks by implementing such measures as deemed practical.

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Appendix A: Risk Assessment Process

Assessment of Risks & Planned Control Measures

Haz No	Specific	Specific Hazard	C*	L*	IR*	Existing Controls	Management Controls	Residual Risk
1	High Voltage Substation Transformers	Child Electrocuted	VH	VL	M	Substation Access Restricted and Locked, Children Supervised	<i>Reasonable</i>	<i>Moderate</i>
	Stray Ground Return Current	Adult Electrocuted doing maintenance work	VH	L	M	Citipower Program of Testing Earth Integrity Plumbing Trades Safe Work Practices	Reasonable	Moderate
2	Fire and Explosion	Transformer Explodes and Burns	VH	L	M	Citipower Maintenance Practices	Reasonable	Moderate
	Toxic Fumes Emitted	Poly-chlorinated biphenyl's in Transformer Oils	H	L	M	Emergency Evacuation Procedures	Reasonable	Moderate
3	Toxic Chemicals Leak	Contact with Poisons	H	VL	L	Normally Very Minor and Contained within Substation	Very Good	Low
4	50 Hz Extremely Low Frequency Magnetic Fields	Possible Cause of Childhood illness when exposed over long period	VH	VL	M	Exposure assumed to be of limited duration	Reasonable	Moderately

* C – Consequences L – Likelihood IR- Inherent Risk = C x L MC = Existing Management Controls Residual Risk = IR x MC

Risk Control Planner

Hazard No	Moderate -Significant Hazards	Existing Controls	Proposed Controls, Procedures, Equipment
1	Child Electrocuted	Substation Locked, Children Supervised	Ensure the sub station remains at all times entirely secured against unauthorised access.
2	Adult Electrocuted doing maintenance work	Citipower Program of Testing Earth Integrity Plumbing Trades Safe Work Practices	Review Citipower Substation Earthing Integrity conduct checks for current flowing in water and gas pipes. Warn trades staff especially plumbers of the need for special Safe Work Practices if working on water or gas supply
3	Transformer Explodes and Burns	Citipower Maintenance Practices	No control required
4	Poly-chlorinated biphenyl's in Transformer Oils	Emergency Evacuation Procedures	No control required
5	Contact with Poisons	Normally Very Minor and Contained within Substation	Review Citipower's Spill, Leakage, containment and clean up decontamination procedures
6	Possible Cause of Childhood illness when exposed over long period	Exposure at average levels of 10 mG but for limited duration	Investigate the practicality of shielding or relocation of substation and Sub Floor Cabling. If deemed practical to do so then request this of Citipower.

Risk Assessment Module: Combining Likelihood And Consequences

Rating	Likelihood	Injury/Illness Consequences
Very High	<ul style="list-style-type: none"> • Defined consequences are very likely to occur • Clear history of occurrence • Typical operation of this type perhaps to satisfy external demands • Expected to occur more often than daily to several times per week 	<ul style="list-style-type: none"> • One or more fatalities • Permanent or severe health effects for one or more staff members
High	<ul style="list-style-type: none"> • Difficult to control because of some external influences • Some history of occurrence with the defined consequences • Expected to occur once per month to several times per year 	<ul style="list-style-type: none"> • Extended absence (one week or more) for one or more staff members • Moderate to severe health effects
Moderate	<ul style="list-style-type: none"> • Has occurred with the defined consequences • Expected to occur a few times every two years to once per year 	<ul style="list-style-type: none"> • Temporary absences (of less than 1 week) for one staff member • Requires one or more visits to doctor for treatment
Low	<ul style="list-style-type: none"> • Possible but not expected to occur with the defined consequences • Causal events have occurred within the Industry but effects have been controlled so that defined consequences did not occur • No history, in this Company, of situation which resulted in the defined consequences but has occurred in other Companies or Divisions • Expected to occur once every two to five years 	<ul style="list-style-type: none"> • First aid treatment required by doctor • Involves one staff members only
Very Low	<ul style="list-style-type: none"> • Possible but very unlikely to occur with the defined consequences • Causal events have occurred within the Industry but the risk is not difficult to control • Expected to occur once every five years or less often 	<ul style="list-style-type: none"> • Involves one staff members only • First aid treatment given on site

Risk Assessment Module – Determination Of Risk Ranking

Find the ratings for the consequence and the likelihood then refer to the table below:

CONSEQUENCE	Very High		S	S	S	S
	High			S	S	S
	Moderate				S	S
	Low					S
	Very Low					
		Very Low	Low	Moderate	High	Very High

LIKELIHOOD

Residual Risk (the risk that remains after implementing measures to reduce it)

Plot inherent risk against the assessed quality of the existing management control of the risk:

INHERENT RISK	High		S	S
	Medium			S
	Low			
		Very Good	Reasonable	Poor

MANAGEMENT CONTROL

	Residual risk is high - attend to immediately
	Residual risk is moderate - attend to in short term
	Residual risk is low - attend to in longer term

'S' indicates a significant risk - it must be recorded and managed as a matter of urgency

Manage all other moderate risk and all low risks to achieve a continuous improvement in the longer term

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Appendix B: Regulations, Standards & Guidelines

Regulations, Standards & Guidelines

There are no regulations, or standards there is currently a voluntary guideline which sets exposure limits at the level of 1000 mG continuously for non-occupational exposure. This is currently under review. Prudent Avoidance to minimise exposure is recommended especially for children.

International Agency for Research on Cancer Assessment of Extremely Low Frequency Magnetic Field

The IARC is the most scientifically authoritative body in the world charged with assessing cancer risk to humans based on the strength of all peer reviewed published human, animal and cellular evidence.

Depending upon the strength of the overall evidence the IARC will classify the risk:

- **Known** to cause cancer in humans;
- **Probably** causes cancer in humans;
- **Possibly** causes cancer in humans; or
- Inadequate evidence to classify or non classifiable

For many years there has been scientific and public controversy about the potential risks to humans given the widespread exposure to extremely low frequency magnetic fields from electrical distribution systems including transformers, cables and overhead power lines.

Given this uncertainty there have been inquiries in NSW and in Victoria which have recommended the adoption of Prudent Avoidance which is similar to the ALARA Principle in common safety usage to control risks of exposure to ionising radiation. The Electrical Power Association of Australia has adopted Prudent Avoidance as its policy position.

In 2001 the expert panel of the IARC published its findings:

"...pooled analyses of data from a number of well-conducted studies show a fairly consistent statistical association between childhood leukaemia and power-frequency residential magnetic field strengths above 0.4 microTesla, (4 milligauss) with an approximately two-fold increase in risk...."

"Overall, extremely low frequency magnetic fields were evaluated as *possibly carcinogenic to humans (Group 2B)*, based on the statistical association of higher level residential ELF magnetic fields and increased risk for childhood leukaemia". Evidence for excess cancer risks of all other kinds, in children and in adults, as a result of exposure to ELF electric and magnetic fields was considered *inadequate*".