NSW FIRE BRIGADES

Fire Research Paper

LPG FUELLED CABINET HEATERS

This research paper provides an analysis of incidents involving LPG fuelled cabinet heaters.

Version	Date	Reviewed by	Authorised by
01	24 SEP 2010	FRO (FIRU), MFIRU	DCS

PREVENT
PREPARE
PROTECT

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INTRODUCTION

Currently NSW Fire Brigades (NSWFB) Fire Investigation and Research Unit (FIRU) and NSW Fair Trading (NSWFT) have a Memorandum of Understanding (MOU) that facilitates improved safety for Firefighters and the Community through prompt and effective intervention for faulty products.

LPG Cabinet Heaters are portable indoor heaters fuelled by a 9 kg. LPG cylinder.

Due to recent incidents attended by the NSWFB involving LPG Cabinet Heaters, significant potential and actual risks have been identified:

- LPG Gas Leaks
- Asphyxiation
- Fire
- Explosion

BACKGROUND – LPG CABINET HEATERS

Gas Leaks: (Edited details from the Reporting Officers)

- AIRS 2777281: 18/06/2010, 16:43 hrs [redacted]
- 9 kg LPG fuelled home heater leaking gas.
- Stop valve not seating properly, rectified by closing the shut off valve.
- Occupant warned of the dangers involved when using LPG inside the home.

- AIRS 2790168: 22/07/2010, 19:09 hrs, [redacted]
- Recently refilled 9 kg LPG cylinder placed on floor in living room prior to connecting it to the cabinet heater. (Similar heater as reported in the first incident, 18/06/2010).
- Cylinder relief valve operated inside the house.
- LPG cylinder removed to a safe location.
- Occupant warned of the dangers involved when using LPG inside the home.

Fires: (Edited details from the Reporting Officers)

- AIRS 2763928: 14/05/2010, 19:30 hrs, [redacted]
- 9 kg LPG fuelled home heater situated in the hallway, alight.
- Fire damage contained to hallway, adjacent doors and near the front entrance.
- Minor heat damage but extensive smoke damage.
- Occupants self evacuated. Occupants warned of dangers when using LPG.

- AIRS 2794956: 04/08/2010, 09:11 hrs, [redacted]
- 9 kg LPG fuelled home heater situated in the kitchen, alight.
- Fire contained to kitchen/lounge area, remainder of house with smoke damage.
- One female occupant self rescued, with minor injuries, transported to hospital by ambulance.

CURRENT ACTIONS

FIRU have notified NSWFT regarding these incidents and are currently monitoring the situation in liaison with NSWFT Gas Safety Section:
Graham Humphreys 9895 0321 (m) 0413 018 620 and Bradley Walker 9895 0728.

NSWFT have requested a report from FIRU to highlight the safety concerns for LPG Cabinet Heaters.

LPG

LPG may be liquefied petroleum gases or liquefied propane gas.

Liquefied petroleum gases marketed as Autogas (or similar) consists of approximately equal parts of propane and butane gases and is commonly used to fuel vehicles.

Liquefied Propane Gas is packed as a liquid under pressure and remains liquid only under pressure. Sudden release of pressure or leakage may result in rapid vaporisation with generation of a large volume of highly flammable/explosive gas. (Chemwatch MSDS).

LPG has an odour added to alert persons to the presence of leaking gas.

Liquefied propane gas available in portable cylinders is used in a range of applications including barbeques and heating.

Liquefied propane gas burns readily in air and has energy content similar to petroleum.

LPG Australia and Australian Standards provide guidelines for the safe applications and use of the product. (LPG Australia Industry Data)

For the purpose of this report Liquefied Propane Gas will be referred to as LPG.

SUMMARY OF PROPANE DATA (UN NO: 1978) (CHEMWATCH 03/11/2008)

(1) Autoignition Temperature = 468°C

(2) Lower Explosive Limit (LEL) = 2.2%
Upper Explosive Limit (UEL) = 9.5%

(3) Vapour Pressure = 853 kPa at 21°C

(4) Flash Point = -104°C

(5) Expansion Ratio = approximately 1:270

(6) Vapour Density = 1.97 @ 0°C (air = 1)

INITIAL FIRU RESEARCH AND ANALYSIS

The RANA brand LPG Cabinet Heater is advertised as an indoor use heater (refer to attached photographs of product and associated packaging). The instructions given for assembly and use are difficult to understand, and there is no reference to compliance with Australian Standards.

The LPG Cabinet Heaters currently do not comply with Australian Standards for indoor or outdoor use. Australian Standards for gas heating appliances: Indoor AS: 4553 and Outdoor AS: 4565.

NSWFT have issued an Interim Prohibition Order (product ban) for LPG Cabinet Heaters.

Information from NSWFT indicates that one retailer at Arncliffe has a supplier who has sold 100 of these heaters and there may be up to another 20 suppliers on e-Bay.

AIRS INCIDENT ANALYSIS: PORTABLE HEATER FIRES 2009 – 2010

From 01/01/2009 to 31/12/2009 there were 25 portable heater fires within a building and none of these reported incidents involved LPG Cabinet Heaters.

From 01/01/2010 to 30/08/2010 there were 31 portable heater fires within a building, including two incidents involving LPG Cabinet Heaters.

LPG Cabinet Heaters – Current Incident Analysis

- Two incidents reported 18/06/2010 and 22/07/2010 involving LPG gas leaks. Brand name RANA.
- One incident reported 14/05/2010 involving fire and occupants self evacuation. Brand name SANAU. Occupant had two LPG Cabinet Heaters, one in the lounge room (not involved in fire) and the other in the hallway that caught fire.
- One incident reported 04/08/2010 involving fire and occupant injury. Brand name is unknown.
- These heaters are a recent addition to the portable heaters available to the public. Therefore, there is limited evidence of incidents involving this product.

NEW ZEALAND RESEARCH AND ANALYSIS

New Zealand Fire Service (NZFS) Analysis (Refer to Appendices for details).

LPG Cabinet Heaters have been sold in New Zealand for at least ten years.

Information from the New Zealand Fire Investigation and Arson Reduction Unit indicates that from 2000-2010 there have been five fire fatalities and 20 serious injuries with the mean estimated cost of damage for that period of approximately $500,000.

New Zealand Environmental Risk Management Authority (ERMA) Report (2004)

Where a cause has been identified for mobile LPG heater incidents:

- Over 60% were attributed to faults in the connection systems between the cylinder and the appliance.
- A strong indication that up to 30% due to misuse of appliance by residential user; heater too close to combustibles and lack of care and maintenance of the system.
- About 6% of incidents due to cylinder overfills.

ANALYSIS OF THE POTENTIAL RISK

An LPG gas leak could occur within the cabinet due to incorrectly seated fittings or fittings not meeting Australian Standards. Due to the vapour density of LPG (heavier than air), the pooling gas could rapidly reach an ignition level or the Lower Explosive Limit (LEL) due to the cylinder being mounted at the rear of the cabinet in a confined space area.

Asphyxiation is a possibility because this style of heater is unflued; therefore there is a risk of a build up of combustion gases (carbon monoxide and carbon dioxide) that could eventually cause displacement of oxygen. Furthermore, if the flame is not adjusted correctly, incomplete combustion could occur resulting in a build up of carbon monoxide which is toxic by inhalation.

The RANA Gas Heater – Heating Equipment Instructions indicate that it has an Oxygen Depletion Switch incorporated into the system that operates when the indoor oxygen drops to 18.5 – 18%. In the event of oxygen depletion it automatically operates and closes the valve to stop burning. There is no indication that this switch meets any safety standard.

The LPG cylinder is mounted at the rear of the cabinet with a very limited "stand off" between the cylinder and the heater element (refer to photograph page 8). Even though LPG has an odour added, small leaks may not be detected immediately, particularly in circumstances where the occupants have olfactory desensitisation or fatigue. Due to the characteristics of LPG (heavier than air), a pool of volatile gas could build up close to the nearby heater element, which is approximately 15cm away. This proximity increases the potential for ignition or explosion.

From the limited information available, it does not appear that the cabinet heaters involved in the gas leak or fires are fitted with a tilt switch. Therefore, if the cabinet heater were knocked over it may cause a sudden surge of the liquefied product being discharged. If the heater were operating there would be an increase in the intensity of the fire.

An ignited gas within the cabinet has the potential to cause damage to the hose and valve fittings. This action could result in a cylinder with ignited gas and the potential for rapid fire propagation.

If there is no fire, any escaping gas has the potential to asphyxiate or flow to an ignition source and result in an explosion. The appliances do not appear to have been fitted with an automatic shut-off mechanism to safeguard against gas leaks.

Explosive mixtures capable of causing damage may result from relatively small volumes of gas collecting in a given area, as described by DeHaan (2008) and NFPA 921 (2008).

A fire involving an LPG fuelled cabinet heater has the potential to cause major damage to a structure and its contents. This situation would create significant risk to occupants and any attending Firefighters.

RECOMMENDATIONS

(1) In consultation with NSWFT ensure that the Community are informed of the significant risks associated with LPG cabinet heaters.

(2) In consultation with NSWFT seek to have cabinet heaters withdrawn from sale.

(3) In consultation with NSWFT seek to have existing LPG cabinet heaters withdrawn from service.

(4) NSWFT to conduct comprehensive testing of LPG Cabinet Heaters.

(5) NSWFB to issue an Operations Bulletin highlighting the operational risks.

(6) FIRU website article to provide details of the product and its associated risks.

(7) NSWFB to update Fact Sheet for LPG Safety.

(8) NSWFB to liaise with GIO to update Home Fire Safety Audit Information.

(9) Notify the Australasian Fire and Emergency Services Authorities Council (AFAC).

(10) Notify the Australian Competition and Consumer Commission (ACCC).

(11) NSWFB and NSWFT to monitor the situation.

CONCLUSION

(1) The New Zealand experience highlights the significant danger to life and property (see Appendices for details)

(2) Due to current increases in electricity costs, it is anticipated that there may be an upward trend in the use of portable LPG appliances for home cooking and heating, particularly in lower socio-economic areas and in culturally and liguisticaly diverse communities.

(3) NSWFT information indicates that the LPG Cabinet Heaters and their associated fittings, do not comply with current Australian Standards.

(4) LPG Cabinet Heaters within the home environment, are at significant risk of causing LPG gas leaks, asphyxiation, fire and explosion.

(5) There is a significant risk to Firefighters and the Community. The risks considerably outweigh the benefits and so the heaters should be withdrawn from sale.

APPENDICES

1 New Zealand Fire Service Analysis

Peter Wilding Manager Fire Investigation and Arson Reduction

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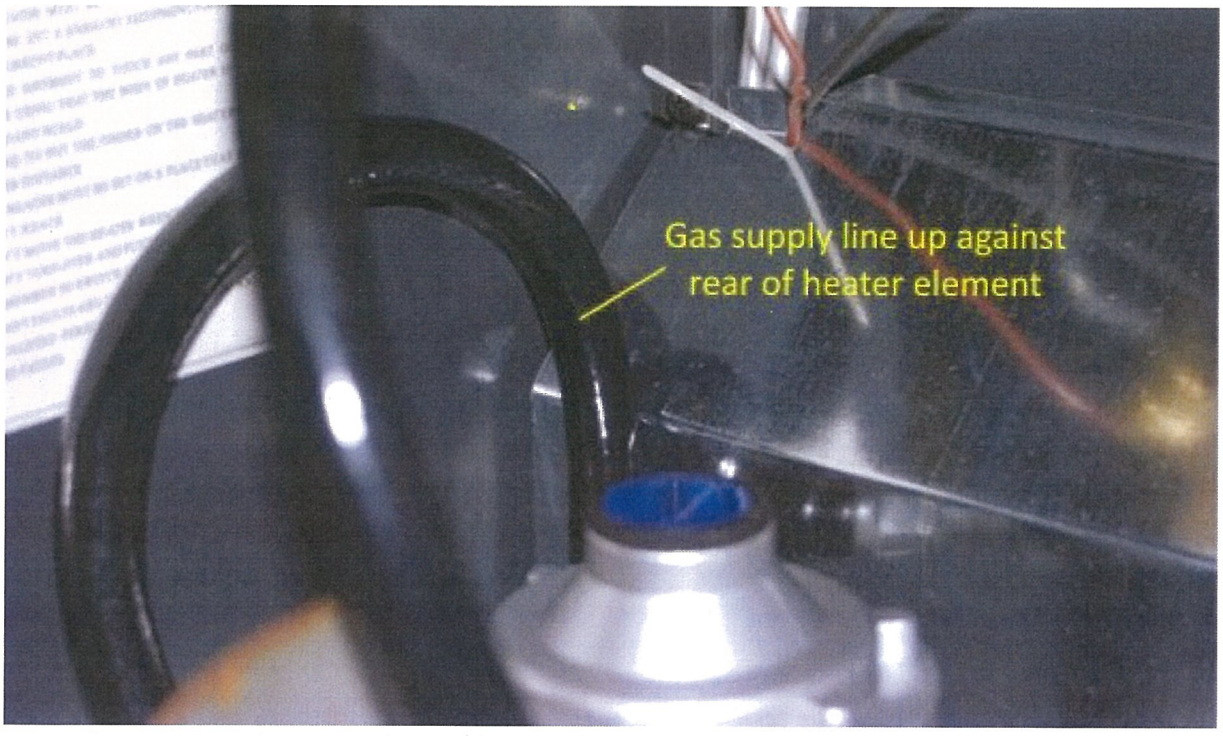
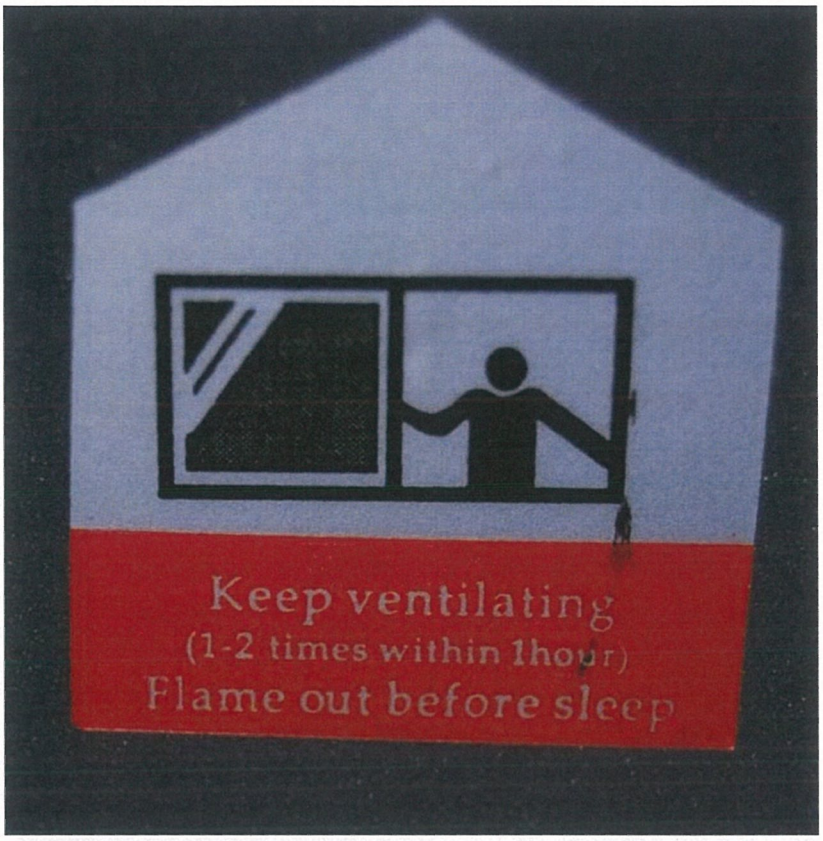
We (NZFS Fire reporting system) only record portable lpg heater with no further detail. These are structure fires involving portable lpg heaters. This was been provided to our Energy Safety Service (Gas regulator) and to NZIER (NZ Institute of Economic Research) who are conducting a review of lpg cabinet heater safety.

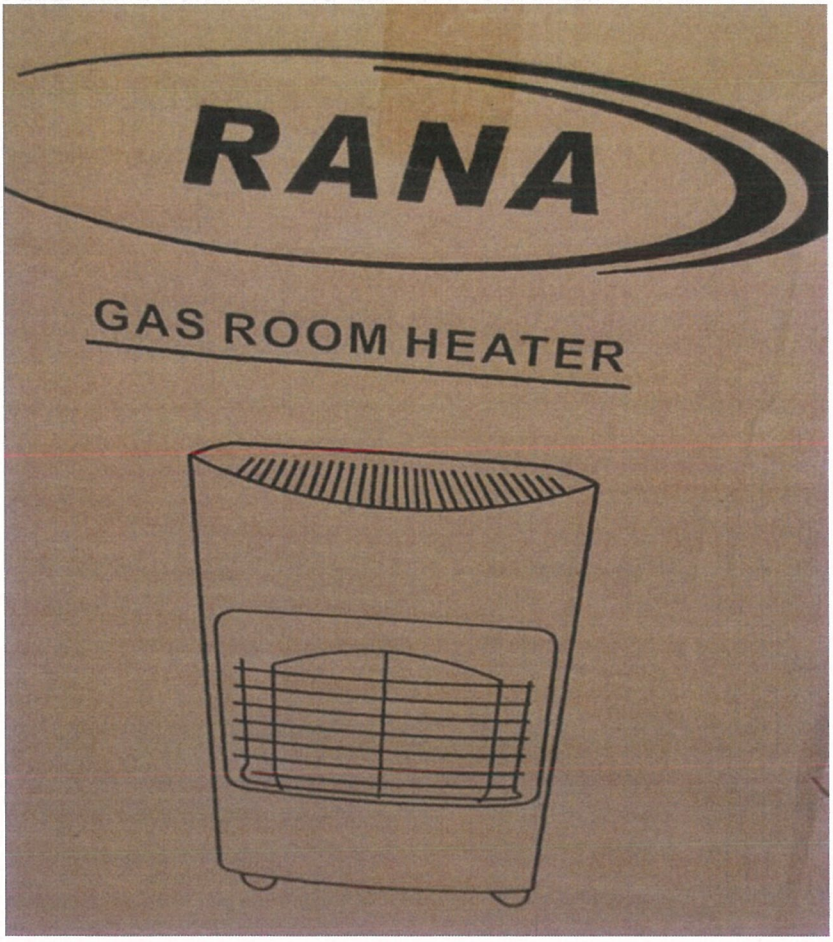
LPG Cabinet heater incidents

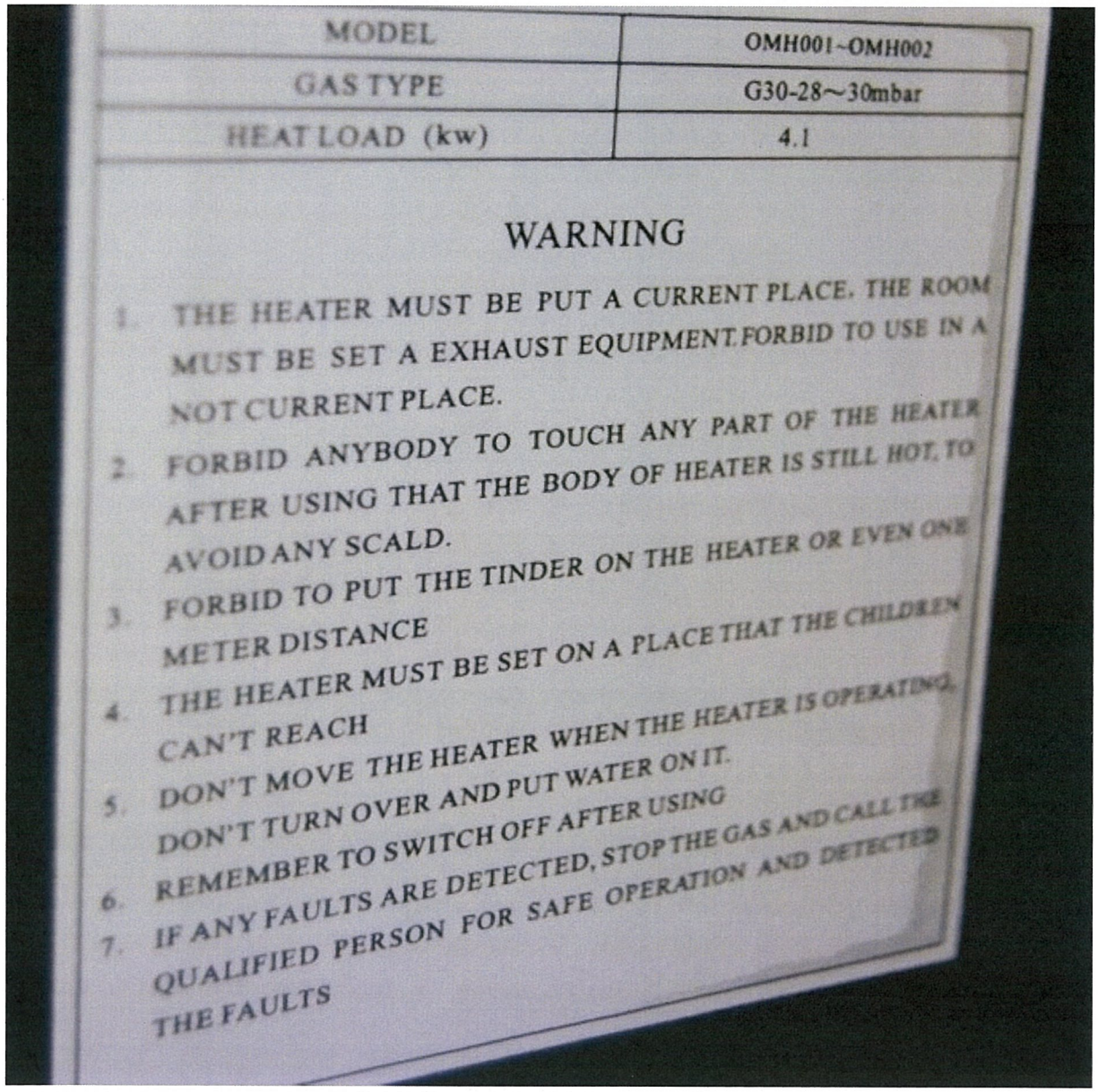
Calendar year	Incident ID	Estimated Cost of Damage ($)	Fatalities	Serious injuries
2000	8	29,500	0	0
2001	20	193,080	1	0
2002	46	1,453,986	0	1
2003	35	1,046,745	2	5
2004	23	474,709	0	2
2005	19	633,050	0	2
2006	20	482,352	0	3
2007	27	1,013,834	1	3
2008	16	580,904	0	1
2009	13	307,891	1	1
2010	15	378,100	0	2

2 Photographs of RANA LPG Cabinet Heater and Packaging









MODEL	OMH001~OMH002
GAS TYPE	G30-28~30mbar
HEAT LOAD (kw)	4.1

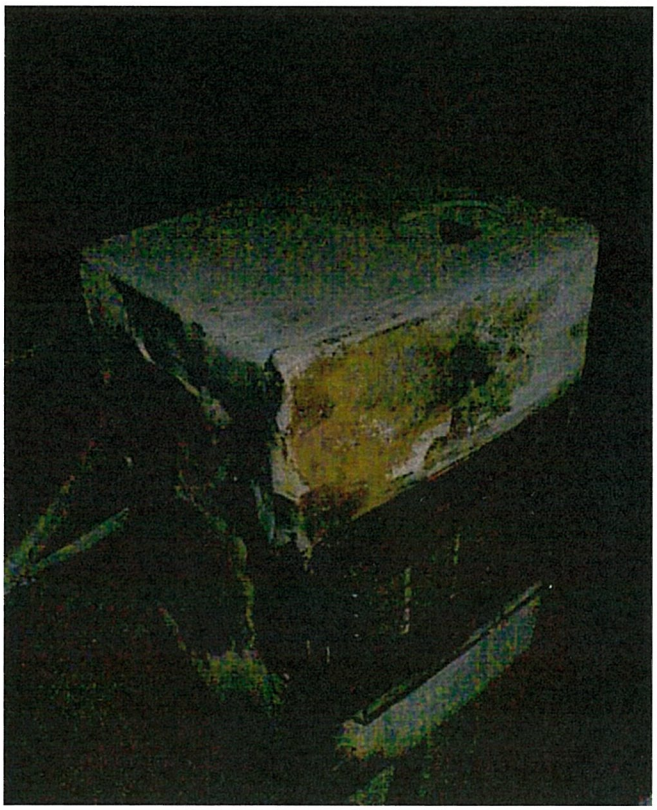
WARNING

1. THE HEATER MUST BE PUT A CURRENT PLACE. THE ROOM MUST BE SET A EXHAUST EQUIPMENT.FORBID TO USE IN A NOT CURRENT PLACE.
2. FORBID ANYBODY TO TOUCH ANY PART OF THE HEATER AFTER USING THAT THE BODY OF HEATER IS STILL HOT, TO AVOID ANY SCALD.
3. FORBID TO PUT THE TINDER ON THE HEATER OR EVEN ONE METER DISTANCE
4. THE HEATER MUST BE SET ON A PLACE THAT THE CHILDREN CAN'T REACH
5. DON'T MOVE THE HEATER WHEN THE HEATER IS OPERATING, DON'T TURN OVER AND PUT WATER ON IT.
6. REMEMBER TO SWITCH OFF AFTER USING
7. IF ANY FAULTS ARE DETECTED, STOP THE GAS AND CALL THE QUALIFIED PERSON FOR SAFE OPERATION AND DETECTED THE FAULTS

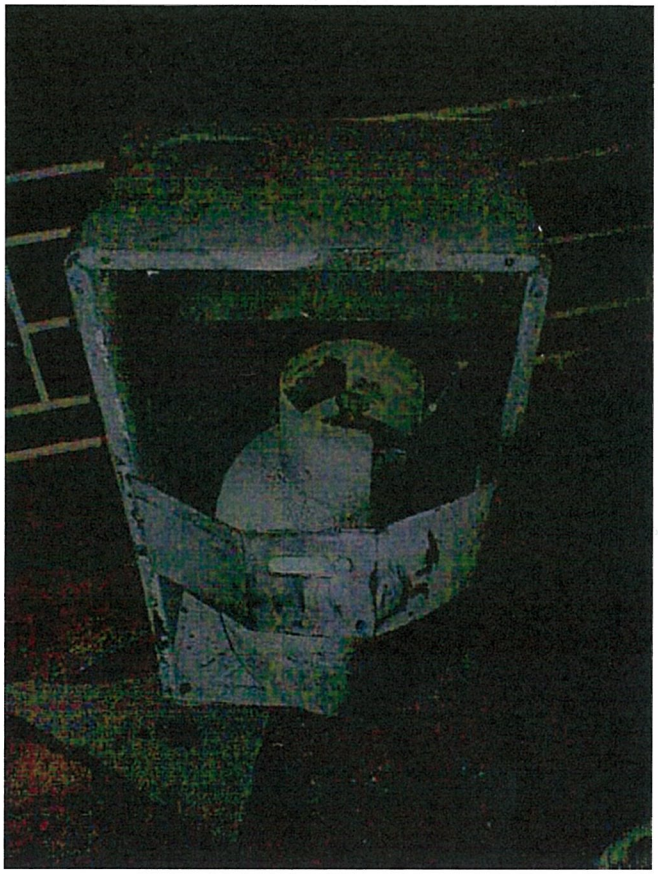
RANA LPG Cabinet Heater Safety Instructions (displayed on side of cabinet)

3 Photographs of Crookwell LPG Cabinet Heater Fire on 14/05/2010

Additional SANAU LPG Cabinet Heater located in the lounge room (not involved in fire)



Fire damaged SANAU LPG Cabinet Heater removed from the hallway



Fire damage in hallway area due to SANAU LPG Cabinet Heater

4 Photographs of Nelson Bay LPG Cabinet Heater Fire on 04/08/2010

Fire damage in kitchen/dining area due to LPG Cabinet Heater

Fire damage to LPG Cabinet Heater (front view) and LPG cylinder

Fire damage to LPG cylinder (normally attached to Cabinet Heater)

Fire damage to LPG Cabinet Heater (rear view)

Fire damage to LPG Cabinet Heater (side view)

Fire damage to the gas fitting for LPG Cabinet Heater

REFERENCES

Chemwatch Independent Material Safety Data Sheet, (Issued 3-Nov-2008) Version No. 5. Propane: Section 9 – Physical and Chemical Properties

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LPG Australia Safety, Standards and Regulations http://www.lpgaustralia.com.au/index.php?option=com_content&view=article&id=54&Itemid=60 (viewed 13/09/2010)

New South Wales Fire Brigades, (2010) Statistical Information Services, Australian Incident Reporting System (AIRS) data, September.

New Zealand Environmental Risk Management Authority, May 2004. *Report of Inquiry into the Use of LPG Cylinders in Indoor Situations (INQ03014).* W. S. Wakelin http://www.ermanz.govt.nz/resources/publications/pdfs/INQ03014.pdf (viewed 13/09/2010)

NFPA 921 Guide for Fire and Explosions 2008 Edition, National Fire Protection Association, Quincy Massachusetts, Issued 11/12/2007.

Standards Association of Australia. (AS 4553 - 2008) *Gas space heating appliances*

Standards Association of Australia. (AS 4565 - 2004) *Radiant Gas Heaters for outdoor and non-residential indoor use.*