



**STATE CORONER'S COURT
OF NEW SOUTH WALES**

Inquiry	UTS Fire 27 November 2012
Hearing dates:	20 -21 and 23 April and 10 – 11 August 2015
Date of findings:	25 August 2015
Place of findings:	NSW State Coroner Court - Glebe
Findings of:	Magistrate H Barry
File number:	2012/383995
Representation:	Assisting the Coroner Mr W Hunt instructed by Ms J Geddes Mr M Cahill instructed by Ms F Miller representing Work Cover NSW Mr D Jordan SC with Mr S Howell instructed by Ms K Morris representing Marr Contracting Pty Ltd Mr B Hodgkinson SC instructed by Ms C Holt representing Lend Lease Mr A Maroya instructed by Ms V Jovanoska representing the University of Technology, Sydney Mr S Price instructed by A Duvall representing Fire and Rescue NSW Mr David Jordan instructed by K Dobbie representing NSW Police

Findings:	<p>I find that the Fire on 27 November 2012 in a Favelle Favco Tower Crane (serial Number S920) at The University of Technology, Faculty of Engineering and Information Construction Site at 83 – 117 Broadway, Ultimo originated inside the power pack enclosure.</p> <p>I make an open finding as to the cause of the Fire.</p>
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The Inquiry:

A coroner has jurisdiction to hold an inquiry concerning a fire or explosion concerning the cause and origin of the fire or explosion if the Coroner is satisfied that the fire destroyed or damaged any property within the State (Section 30(1)).

The primary function of a Coroner at the conclusion of an inquiry is to be found in Section 81(2). That section requires that the Coroner is to make findings if there is sufficient evidence to enable him or her to do so:

- (a) As to the date and place of the fire or explosion, and
- (b) In the case of an Inquiry that is being concluded – the circumstances of the fire or explosion

Section 82(1) of the Act provides that a Coroner conducting an Inquiry may also make such recommendations as he or she considers necessary or desirable in relation to any matter connected with the fire or explosion. The making of recommendations are discretionary and relate usually, but not necessarily only, to matters of public health, public safety or the conduct of services provided by public instrumentalities.

Introduction

On 27 November 2012, a 200 ton Favelle Favco Crane (serial number S920) owned by Marr Contracting Pty Ltd (Marr Contracting) and being operated by Lend Lease Project Management and Construction Pty Ltd (Lend Lease) was being used on the University of Technology, Faculty of Engineering and Information construction site at 83 – 117 Broadway, Ultimo.

At about 9.30am the driver of the crane, Glen May (employed by Lend Lease) was alerted to white smoke issuing from the power pack of the crane. The power pack is the housing of the engine and associated componentry.

Mr May turned off the engine and attempted to extinguish the fire with an extinguisher kept in the cabin of the crane. The extinguisher ceased working before the fire could be put out. Mr May climbed down the tower of the crane and was directed from the worksite by Fire and Rescue officers.

A site evacuation commenced, with the construction workers leaving the site as flames were seen ejecting from the power pack of the crane. The luffing rope (the rope stabilising the jib of the crane) failed and the jib collapsed. It fell and crashed onto an adjoining building and tower.

It is common ground that given the acceleration of the fire, the heat load caused the luffing rope to fail causing the collapse.

Fortunately, there was no injury to the 10 people then on site nor any injury to pedestrians, onlookers, of whom there was a considerable number, or traffic on Broadway or the adjacent streets including Wattle Street in Ultimo.

Damage was sustained to certain structures including to the perimeter screens and other equipment. A police car parked in Wattle Street was also damaged.

Relevantly, the jib, ropes, frame and particularly the power pack on the S920 were damaged.

The Evidence:

Mr Derek Pryor, an inspector with WorkCover NSW, conducted an extensive investigation and provided documentation and records of that investigation to the inquiry in the form of a 30 volume brief.

His investigation included documentation of the history of the S920 crane and the maintenance history. It also included numerous interviews with persons involved with the crane and the site on which it was positioned, including personnel from Marr Contracting and Lend Lease.

Mr Pryor's investigation revealed that it was not possible to establish with certainty the specific cause of the fire.

In his oral evidence he outlined a number ways in which WorkCover has engaged with industry working groups to review the circumstances of the fire and hopefully resolve some of the matters giving rise to concern.

Such concerns included, inter alia, crane maintenance, the condition of the hydraulic hoses and the issue of the number of fire extinguishers located in each crane. Mr Pryor recommended that these areas of concern be reviewed by forums such as the Construction Industry Plant Consultative Committee – a group that has been established with input from the Master Builders' Association NSW and the CFMEU.

Mr Pryor also attended the joint forum of experts conducted prior to the commencement of the evidence in this inquiry, providing additional factual information when required.

Mr Glen May was the crane driver on the S920 on the 27 November 2012. He is highly experienced and a well-regarded crane driver within the industry. Mr Marr, from Marr Contracting stated that Mr May was not able to identify any issue that was likely to compromise a crane.

Mr May's evidence was that on 27 November, everything was going well. He had no concerns about the operation of the crane.

At about 9.30am, Nuno Nunes, the dogman, called Mr May on the radio and told him that smoke was coming from the back of the crane. He switched the engine off and put the brake on and went out of the cabin with a fire extinguisher.

He attempted to extinguish the fire from the top but could not get to it because of the sound proofing material encasing the engine.

In his statement he records:

“I climbed down into the pit and saw fire underneath.”

Because the sound proofing restricted his vision, he tried to find areas to aim the fire extinguisher through the sound proofing cladding. If there had been two extinguishers he would have used both.

He told Mr Nunes he needed more extinguishers but by then the “smoke started to get to me” and it was becoming difficult for him to breathe.

He climbed down, meeting Mr Nunes on the tower who had been preparing to deliver extra fire extinguishers.

Mr Nunes is also highly regarded in the industry. On the day he was working as the dogman to Mr May. He was giving instructions to Mr May.

Mr Nunes has worked a number of years with Mr May and considers him to be “one of the best”. He said in evidence that the relationship between crane driver and dogman is a close one and it is “essential that they can trust each other”. Essentially, the dogman is the “eyes” of the crane driver.

Meanwhile, Mr Nunes had been told by a co-worker there was a fire on the crane. He told Mr May to “stop, stop”. He observed smoke coming from the crane – on the right hand side of the crane at the back.

After speaking with Mr May he decided to ascend the tower and deliver more extinguishers to him. He was met by an officer from Fire and Rescue who advised him not to ascend. He was also advised by Mr Andreotti, structural foreman not to ascend. He attempted to again contact Mr May but received no answer.

Mr Nune’s paramount concern at that time was Mr May’s welfare, so he continued ascending to ascertain if he was alright. He met Mr May on the tower as Mr May was descending and they both descended.

On his way down Mr Nunes heard a big bang which shook the tower. He “held on for dear life”. The bang was apparently the jib falling.

By chance, Inspector Ferrante from NSW Fire and Rescue was stopped in traffic on 27 November on Broadway, looking toward the building site. He noticed smoke coming from the crane. It was light coloured smoke with no visible flame. Within a few minutes there was a rapid change in smoke colour to white. This indicated to him that a dry chemical powder (DCP) extinguisher had been operated.

Inspector Ferrante then made a number of “Principal decisions”:

- Notifying the Fire Communication Centre to ascertain if there had been any reports of a crane fire on Broadway.
- Moving closer to the site to gather further information
- Ascertaining if a person was in the crane
- To ascend the building deck and offer assistance
- Because Inspector Ferrante had personal protective clothing he thought he could ascend the tower and assist the driver if he was injured in any way.
- Collecting extra fire extinguishers at the base of the crane.
- Because it appeared that a DCP extinguisher had been activated he was concerned that fires suppressed by this method can re-ignite.

Inspector Ferrante stated as a general rule a DCP extinguisher is good enough to “knock a fire down” but does not always extinguish it. Preferably, after using a DCP extinguisher a water mist or foam extinguisher is used.

Given his protective clothing, Inspector Ferrante believed it better for him rather than others, to ascend the tower. His major concern was the knowledge gained from a workman that there was in the vicinity of 1,000 litres of diesel fuel on the crane

Mr S Marr stated in his evidence that in fact the diesel was stored below the top deck and the diesel fuel could not run along the deck and into the sludge tank or tower.

Inspector Ferrante’s concern was that should the fire re-ignite, the fuel could be dumped on the building site and then run into the street leading to a potentially catastrophic situation. Accordingly he advised the workmen to evacuate the site.

Inspector Ferrante made a decision to fight the fire. Lend Lease personnel collected and delivered extra fire extinguishers to the base of the crane with the intention of Inspector Ferrante and other personnel ascending the tower to “shuffle” fire extinguishers to the machine deck.

Before that could happen the jib collapsed and the site evacuated.

Between 10.00 and 10.20am the fire gradually reduced.

Origin and Cause of the Fire

At the outset of the inquiry a conclave of expert witnesses was assembled and a forum conducted by Counsel Assisting and his instructing solicitor.

In that forum a significant consensus was reached relating to the question of the cause of the fire. A number of questions were posed and answered by the four relevant witnesses.

Those witnesses were:

Clayton McLellan Senior Partner and Manager of **CMA Electro-Hydraulic Engineers**; Mechanical engineer specialising in fluid power engineering or hydraulics.

Frank Soto Senior Mechanical Engineer, **SOTO** Consulting Engineers

Geoffrey Woods Managing Director and Principal Engineer **SOTO** Consulting Engineers

Morgan Cook Station Officer **Fire and Rescue** NSW, employed for 24 years and trained in fire investigation.

The essence of their findings is contained in a Joint Memorandum dated 21 April 2015.

Possible Causes of the Fire

In relation to the **possible causes of the fire** their response was:

A small spray (rather than a drip) of combustible fluid emanating either from

- 1. The hydraulic system (as a result of multiple possible causes), or*
- 2. The turbocharger lube oil feed, or*
- 3. The pressurised diesel fuel feed lines to the engine:*

came into contact with either a live spark or a hot part of the mechanism, including, possibly, the turbocharger.

Cause of the Fire

In response to the question whether it was possible to determine, to the level of probability, the **cause of the fire**, their response was:

No. There are a number of competing hypotheses but given the fundamental destruction of relevant areas of the crane, due to the intensity of the fire, no probable cause can be determined by us, and the list of principal hypotheses cannot be reasonably narrowed.

Origin of the Fire

The experts were in agreement that:

The origin (or site) of the initial fire was inside the power pack enclosure but with competing sites of possible ignition within that enclosure.

The cause of the acceleration of the Fire

The experts determined that:

the Failure of the suction hoses between the hydraulic tank and the hydraulic pumps, taking into account that other sources (that is things other than steel components) cannot be excluded from making some contribution to acceleration (save the contents of the diesel tank and hoses to and from that tank, which can be excluded) The failure of the suction hoses resulted from the intensity of the heat applied to them as a result of the fire.

Maintenance

Relevant to this inquiry was the question of the maintenance of cranes.

Mr J Armstrong, Workshop Manager, Marr Contracting, organises repairs and maintenance for Marr's cranes. Any faults are reported to him and servicing is organised by him.

There is a line of communication directly between a crane operator and Mr Armstrong as he is the first point of contact for repairs and maintenance.

Mr Simon Marr, General Manager, Marr Contracting is in charge of operations. He has extensive experience and knowledge of cranes. Essentially it is Marr's policy to provide the "best quality crane that is not going to have a failure".

He explained that servicing and maintenance do not rely on budgetary issues but rely on providing the best possible crane, always ensuring that maintenance meets Australian Standards and often times exceeding Australian Standards.

Mr Marr gave evidence of the history of the S920 crane:

- The crane was purchased early 2009 when it was stripped down. Every single hose was replaced.
- In August 2010 the crane was again stripped down and a new and different type of engine was installed.
- Again in February 2012 the crane was stripped down and a complete service undertaken.

Mr Marr told the inquiry that Marr now employs a designated full – time employee to ensure that all the information concerning usage of any crane on any site is gathered and data entered on a spreadsheet and any necessary action taken.

Crane operators are told to record everything regarding any failings in the logbook and these are to be made available to Marr by 9am each Monday morning. If these log books are not available Mr Marr contacts the operator.

The documentation of maintenance has now improved. In place is an electronic management system and a remote monitoring system. This allows Marr to constantly remotely observe the operation of the crane and if there is any overstepping, then Marr immediately contacts the operator. As Mr Marr stated “being watched makes operators accountable”.

This also allows Marr to monitor the interval for servicing. Service of a crane must take place every 250 hours and because of the logbook system and Elog reports, Marr is able to accurately calculate when the next service is due and alert the operator at 200 hours that a service is due.

In addition to these improvements, Marr has installed the Robway System which is a load movement indicator.

This system has an inbuilt alarm system. If a driver tries to override the system an alarm sounds at Marr and immediate contact is made with the operator.

A further improvement, specifically relevant to this inquiry, has been the introduction of fire resistant suction hoses.

Investigation revealed that the use of IROSF D suction hoses contributed to the intensity of the fire. After the fire started, the IROSF D suction hoses completely incinerated allowing 400 -600 litres of hydraulic fuel to drain into the fire – significantly increasing the intensity of the fire.

This increased intensity directly led to heat damage of the luffing rope and the fall of the jib.

Mr May initially attempted to suppress the fire with a 2kg fire extinguisher. Evidence revealed this fire extinguisher to be under capacity for fire fighting. Marr has now taken steps to increase the volume of fire extinguishers in cranes.

In addition to these improvements, cameras have now been installed in each crane depicting four areas of the crane in order to assist with early fire detection.

Marr has made considerable effort to investigate this fire and issues arising from it. Positive steps have been taken, as outlined, to constructively address those issues.

In his oral evidence Mr Marr spoke of industry concerns. It may be clear that the culture within Marr Contracting is one of ensuring the highest possible standards are maintained regarding servicing and maintenance of cranes, but Mr Marr expressed concerns about other operators in the industry who are not so willing to adopt such a culture.

Without a change in culture amongst crane owners and operators he believes a “catastrophic failure is imminent.”

To address these concerns WorkCover and Marr have worked collaboratively, with input from NSW Fire and Rescue, to develop a number of recommendations.

I propose to incorporate some of these recommendations into this finding.

Public Safety

Evacuation

Notwithstanding the failure of the siren to function on 27 November 2012, the evacuation of personnel from the Lend Lease site, according to Ms Linton, was successful.

The fact that no one was injured supports this conclusion.

Ms Linton at the time was the Environmental Health and Safety Officer employed by Lend Lease.

It had been her task to plan emergency procedures. Her evidence is that all personnel including sub - contractors are inducted into The Emergency Response Plan.

About one month prior to this incident an emergency evacuation drill had been successfully conducted.

On 27 November 2012 the site emergency siren did not function. Mr McDermott, Lend Lease Site Manager explained that the siren had been decommissioned when new premises were obtained.

He was told by the company installing the siren that it had been recommissioned into the new building.

Mr McDermott acknowledged that he had not tested the siren in the new premises and had "accepted what we were told" about the recommissioning.

Ms Linton gave evidence of an updated Environmental Health and Safety Management System. That extensive document details the action to be taken in an Emergency Response and Evacuation Procedure.

One such detail is that the emergency siren is now to be tested monthly.

Mr McDermott and Mr Andreotti, Structures Foreman Lend Lease, both gave evidence of a three staged process to ensure a successful evacuation.

Essentially that involves the following:

- The activation of the emergency siren
- The use of radio communication
- A physical check of all personnel by the designated officer on each floor

Even though a siren is the first indicator of an emergency, the failure to activate, as can be seen in this incident, does not mean that the evacuation fails.

Mr Andreotti stated that it could never be assumed that all persons on a large construction site are in a position to hear a siren. That is why designated personnel have access to radio communication and this is how emergency communications are transmitted.

Once a radio emergency call has been made, the designated warden on each floor activates the Emergency Response Plan.

It is then the duty of each designated warden to make a sweep of each floor to ensure no personnel are remaining.

This mechanism was incorporated in the Lend Lease Project Management Plan (UTS Building F.E.I.T Project First Aid, Emergency Evacuation and Incident Management Plan).

As a result of that plan being followed all personnel were successfully evacuated from the site and not exposed to further risk.

Public Safety

Police who attended the scene demonstrated an impressive command of the implementation of Operating Procedures in an emergency.

Inspector Richards arrived at the site at about 10.05am - a short while after Sergeant Head who had arrived at 9.52am, within 6 minutes of becoming aware of the incident.

At that stage, the jib had already collapsed and the cabin of the crane was still on fire. The site had been evacuated.

Inspector Richards took command of the scene. He identified NSW Fire and Rescue as being in command of the fire ground. He instigated an outer perimeter for the purpose of ensuring public safety.

This involved co-ordinating a perimeter surrounding the site and involved the closure of Broadway and Wattle Street. A number of other road closures were put in place to assist traffic flow. Inspector Richards employed the resources of police trained in traffic management.

Advice was sought from the other experts present, including NSW Fire and Rescue as to the appropriate width of the outer perimeter and advice from Dept Commerce Engineers about the stability of the boom arm and what needed to be done to ensure the site was safe.

Inspector Richards maintained regular communication with the various stakeholders, including RMS, Fire and Rescue NSW, Police Rescue, NSW Ambulance, Engineers and Lend Lease.

Initially updates were conducted every 30 minutes.

In addition to these stakeholders, Inspector Richards liaised with a large contingent of media and 20 – 30 Union Representatives who were seeking to gain access to the site. After speaking with one of the Union leaders, the Inspector was able to corral all persons in one area outside the perimeter where he continued to deliver updates.

Inspector Richards remained the site controller and continued to report to Commander Walton who took command of the site at about 11.00am.

What is clear from the evidence is the credible way in which Police control of the perimeter and Fire and Rescue control of the fire site worked to ensure that the public remained safe. Key to this result was the constant communication between Inspector Richards and the other stakeholders.

Inspector Gelonese, an inspector with WorkCover gave evidence of his concern for the safety of the workers and the safety of the general public.

He liaised with the numerous stakeholders on the site and provided input to police who had jurisdiction in the matter.

Initially this involved his attendance at crisis meetings which were held once or twice daily.

That input involved ensuring rock anchors were to be inspected by engineers, the installation of safety screens on Wattle Street, and discussion about further road closures.

Inspector Gelonese also discussed with Lend Lease the removal of the jump form which Mr McDermott considered might still be at risk of structural collapse.

Further discussions took place between Inspector Gelonese and the various stakeholders over the next few days. It was determined that work needed to be done to rectify the site, including the removal of damaged screening from Wattle Street, the removal of cladding from the jump form and the erection of scaffolding above the hoarding on Wattle Street.

Ultimately, following an inspection of the site WorkCover assumed command on 13 December 2012. Once Inspector Gelonese was satisfied that all hazards had been addressed, work on the site recommenced on 14 December 2012.

Conclusion

In this matter there was an enormous potential for injury both to personnel on the site and to members of the general public.

That no injury was occasioned was largely attributable to luck and to the highly successful operation in evacuating the site and measures taken to protect the general public.

In Mr Pryor's opinion, in hindsight the site should have been evacuated earlier and Wattle Street and Broadway should have been closed sooner, given the number of persons on site and the fact that Broadway and Wattle Street were still open at the time of the jib collapse.

He offers a number of explanations as to why this did not happen

- It was difficult to see the extent of the fire from the areas of the base of the crane where personnel and emergency workers were observing; flame being not fully visible until moments before the collapse of the jib
- The lack of foreseeability relating to the luffing cable becoming flame affected

Even taking into account the element of luck, the roles taken by Lend Lease in evacuating the site successfully and the role taken by Police, Fire and Rescue and WorkCover in ensuring the ongoing protection of the public, deserves commendation.

Also deserving of commendation is the thorough and extensive investigation carried out by Inspector Pryor into this incident. What is clear from Inspector Pryor's investigation is that this incident was unique and could not have been foreseen. Inspector Pryor in his evidence referred to a 2010 report commissioned by the Health and Safety Executive (United Kingdom). That report analysed 86 Tower Crane collapses worldwide in the past decade. The UTS site crane collapse is the only known fire related collapse.

Notwithstanding the unique nature of this event it became clear during this inquiry that Marr Contracting takes very seriously their responsibility in relation to maintenance of cranes and the issue of worker and public safety. Marr Contracting has already put in place several measures designed to prevent a similar incident and to improve the reduction of risk.

The evidence also revealed that not all participants in the industry approach their responsibilities with such attention. WorkCover and Marr with input from Fire and

Rescue, have collaborated on developing a number of recommendations designed to improve the practices of the whole industry.

I propose to make a number of those recommendations:

TO WORKCOVER NSW, I recommend that:

1. Fire control and warning

WorkCover develop standardised guidelines for the provision and/or fitting of appropriate fire early detection systems, and provision of sufficient fire extinguishers, in tower cranes whilst on site. Such guidelines should be developed in consultation with industry through the Construction Industry Plant Consultative Committee (IPCC) and with Fire and Rescue NSW. These guidelines should include guidance for both new and existing tower crane early detections systems and sufficient fire extinguisher capacity, and cover all types of tower crane not just cabin controlled diesel/hydraulic tower cranes.

2. Maintenance

WorkCover develop standardised procedures for the maintenance of tower cranes whilst on site, with such guidelines to be developed in consultation with industry through the Construction Industry Plant Consultative Committee (IPCC). The IPCC document Key messages on tower cranes (as attached to these findings) should be considered in developing these procedures.

In particular, consideration to be given to including time for scheduled on site maintenance of tower cranes as part of the principal contractor's schedule of works.

3. Replacement and/or fitting of IROFSD suction and feed hoses

WorkCover to develop standardised requirements for the replacement of IROFSD suction and feed hoses fitted to tower cranes whether on site or as commissioned. Such requirements should be developed in consultation with industry through the Construction Industry Plant Consultative Committee (IPCC).

The following protocol can be used as a basis for developing the standardised requirements as recommended.

Existing cranes

Owners of all existing cranes should replace any IROFSD hydraulic suction or feed hoses (running from the hydraulic oil tank) with equivalent flame resistant (or higher standard) hydraulic hoses. The selection of replacement flame resistant (or higher standard) hydraulic hoses should be made in consultation with a recognised specialist hydraulic hose supplier or crane manufacturer.

Maintenance manuals should be amended to list the new hose specification to provide information for future replacements.

If the immediate installation of flame resistant hydraulic suction or feed hoses (running from the hydraulic oil tank) is impractical (for example, because the crane is operational on site), flame resistant insulation should be fitted around all hydraulic suction or feed hoses until flame resistant (or higher standard) hoses can be installed.

New cranes

Flame resistant (or higher standard) hydraulic suction or feed hoses (running from the hydraulic oil tank) should be fitted to all new cranes.

The maintenance manual should include the hose specification to provide information for future replacements.

Both new and existing cranes

Logbooks for new or existing cranes should record that flame resistant hydraulic suction or feed hoses have been installed (or temporary insulation provided until hoses can be replaced) to enable operators, principal contractors, unions and WorkCover to confirm what has been done.

4. Notification and compliance

WorkCover, using its database of registered tower cranes, should write to all current tower crane owners in NSW providing them with a copy of these recommendations and outlining WorkCover's expectations and proposed actions in regard to the recommendations.

WorkCover to undertake a verification program to evaluate compliance by industry in response to these recommendations and take appropriate enforcement action when the actions are not in line with WorkCover's expectations.

To Lend Lease Building Pty Ltd, I recommend that:

Lend Lease Building Pty Ltd amend its National EHS Management Plan to require testing of evacuation sirens upon any re positioning or re commissioning of such sirens, in addition to the existing obligation that such systems be tested monthly

I close this inquiry.

Magistrate Helen Barry
25 August 2015