

Investigation Report
Worker Fatally Injured While
Dismantling Tower Crane
April 27, 2016

The contents of this report

This document reports Occupational Health and Safety's (OHS) investigation of a workplace accident in which a worker sustained fatal crush injuries while a tower crane was being dismantled in April 2016. It begins with a short summary of what happened. The rest of the report covers this same information in greater detail.

Incident summary

A crew of workers and a third party mobile crane operator were dismantling a tower crane at an industrial construction project. When the mobile crane operator attempted to hoist the apex structure of the tower crane from its mounting lugs, the apex structure swung out of control and struck one of the workers, causing fatal crush injuries.

Background information

NOVA Chemicals Corporation (NOVA) is an international corporation and leading producer of plastics and chemicals. NOVA is headquartered in Calgary, Alberta (AB), and employs approximately 2900 employees world-wide.

NOVA Chemicals' Joffre (Joffre) manufacturing facility lies just east of Red Deer, AB and is one the largest ethylene and polyethylene production complexes in the world. It consists of five manufacturing facilities that produce linear low-density polyethylene (LLDPE), medium density polyethylene (MDPE) and high-density polyethylene (HDPE) plastics.

In November 2012, NOVA contracted Ledcor Projects Inc. (Ledcor) to assume general contractor responsibilities for the construction of the main portion of the Joffre Polyethylene 1 Expansion Project (R3 Project). The R3 project included the construction of a new world-scale polyethylene reactor and associated infrastructure.

Under the terms and conditions of the R3 Project contract and Responsible Care Plan, NOVA maintained responsibility as prime contractor for the R3 Project (Figure 1).



Figure 1. R3 Project with yellow hatched border showing the active construction area.

Ledcor Projects Inc. (Ledcor) is a part of the Ledcor Group of Companies. Ledcor was contracted by NOVA in November 2012, to assume general contractor responsibilities for the construction portion of the R3 project. Ledcor assigned approximately 72 employees to direct, manage and coordinate the work of the Ledcor and contractor workers assigned to the R3 project.

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Rapicon Inc. (Rapicon) is a tower crane sales and rental company based in Brossard, Quebec. Rapicon employs approximately 15 full time and contract employees. Rapicon is co-owned and operated by 2 shareholders, who respectively hold 70% and 30% of the company shares.

The Rapicon co-owner is a director and shareholder in Rapicon, and typically oversees day to day operations for Rapicon. On April 27, 2016, the Rapicon co-owner was present at the R3 Project site overseeing the dismantling of the tower when the workplace fatality occurred.

Summit Crane Works Inc. (Summit) is a sole proprietorship and was contracted by Rapicon to be the lead hand (lead hand) responsible for directing and supervising the dismantling of the Rapicon tower crane at the R3 Project. On April 27, 2016, the Summit lead hand was present at the R3 Project site supervising and directing the dismantling of the tower when the workplace fatality occurred.

Mammoet Western Canada Ltd. (Mammoet) is a subsidiary of Mammoet Holding B.V. and provides mobile crane rentals and related support services. Mammoet was contracted by Rapicon to develop a mobile crane lift plan for dismantling the Rapicon tower crane and to provide a mobile crane and mobile crane operator for the tower crane dismantling work at the R3 Project.

The Mammoet mobile crane operator (mobile crane operator) is a journeyman mobile crane operator and worked intermittently for Mammoet since 2004. On April 27, 2016, the mobile crane operator was operating the Mammoet mobile crane to lift sections of the tower crane during the dismantling procedure.

The worker (worker 1) was a sole proprietor who regularly worked as a contracted labourer for Rapicon since 2006. On April 27, 2016, worker 1 sustained fatal injuries while dismantling the Rapicon tower crane at the R3 project site.

Equipment and materials

Rapicon Potain tower crane, model MR 405 B H24 (tower crane)

The tower crane hoisting system consisted of modular components that were bolted together. They were supported by 11 sections of mast, each 5 metres (m) in length, that when bolted together vertically were a total of 55 m in height. The mast structure was bolted to an engineered concrete pedestal base at ground level (Figure 2).

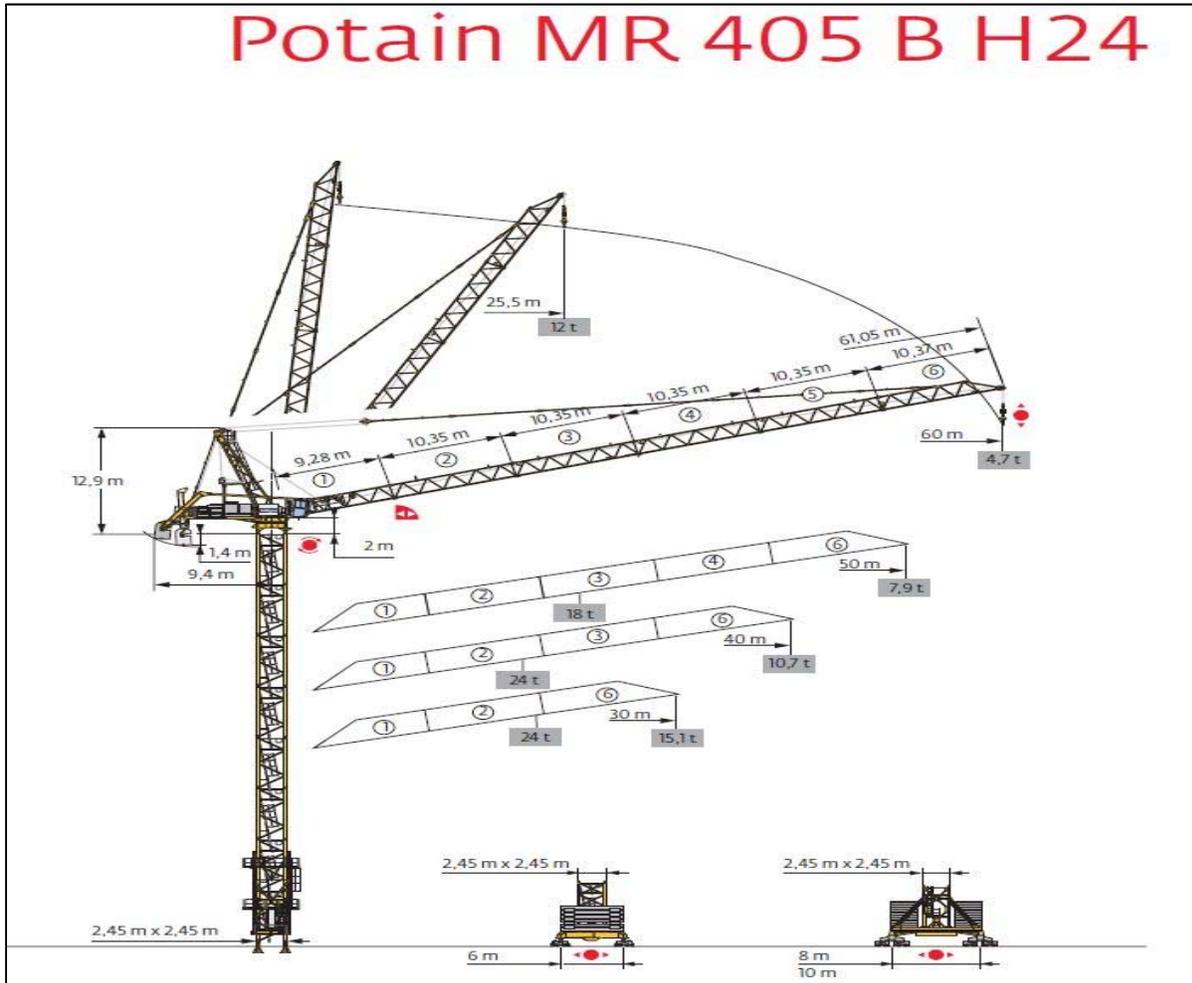


Figure 2. Rapicon Potain tower crane schematic drawing showing the main components of the tower crane hoisting system. (Schematic taken from the Manitowoc Potain MR 405 B H24 technical data brochure as provided to OHS by Rapicon)

The tower crane was designed to lift varying weights ranging from a maximum of 24 050 kilograms (kg) when lifting a load close to the mast end of the jib, to as little as 4710 kg when lifting a load at the outer tip end of the 60 m long jib (Figure 3).



Figure 3. Side view of the Rapicon Potain tower crane with the jib and apex removed. (Royal Canadian Mounted Police (RCMP))

The purpose of the apex was to support the horizontal main jib over which the tower crane load hoisting lines ran. The apex was approximately 11.9 m long and weighed 5.65 tonnes (12 456 pounds) (Figure 4).

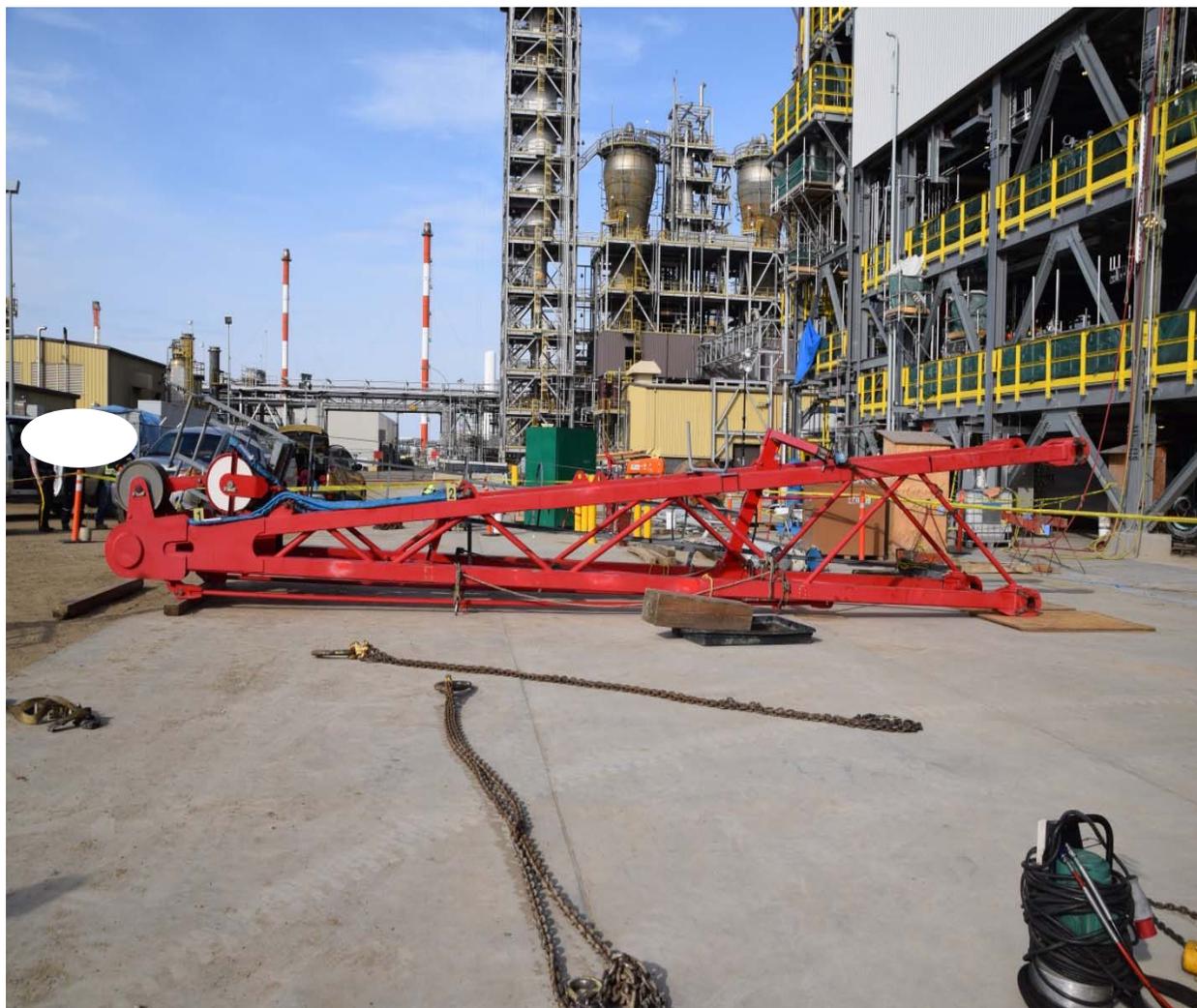


Figure 4. Rapicon Potain tower crane apex structure that was being hoisted by the Mammoet mobile crane when the accident occurred.

The apex was connected diagonally to the horizontal turntable by means of four 12.0 centimetre (cm) diameter steel locking pins. The pins were inserted through the apex lower leg mounting clevises (boots) and through mounting lugs (feet) on the turntable component.

Removing the apex from the tower crane required the apex to be supported by a mobile crane in order to remove the four locking pins and lift the apex free of the tower crane turntable mounting lugs (Figure 5).

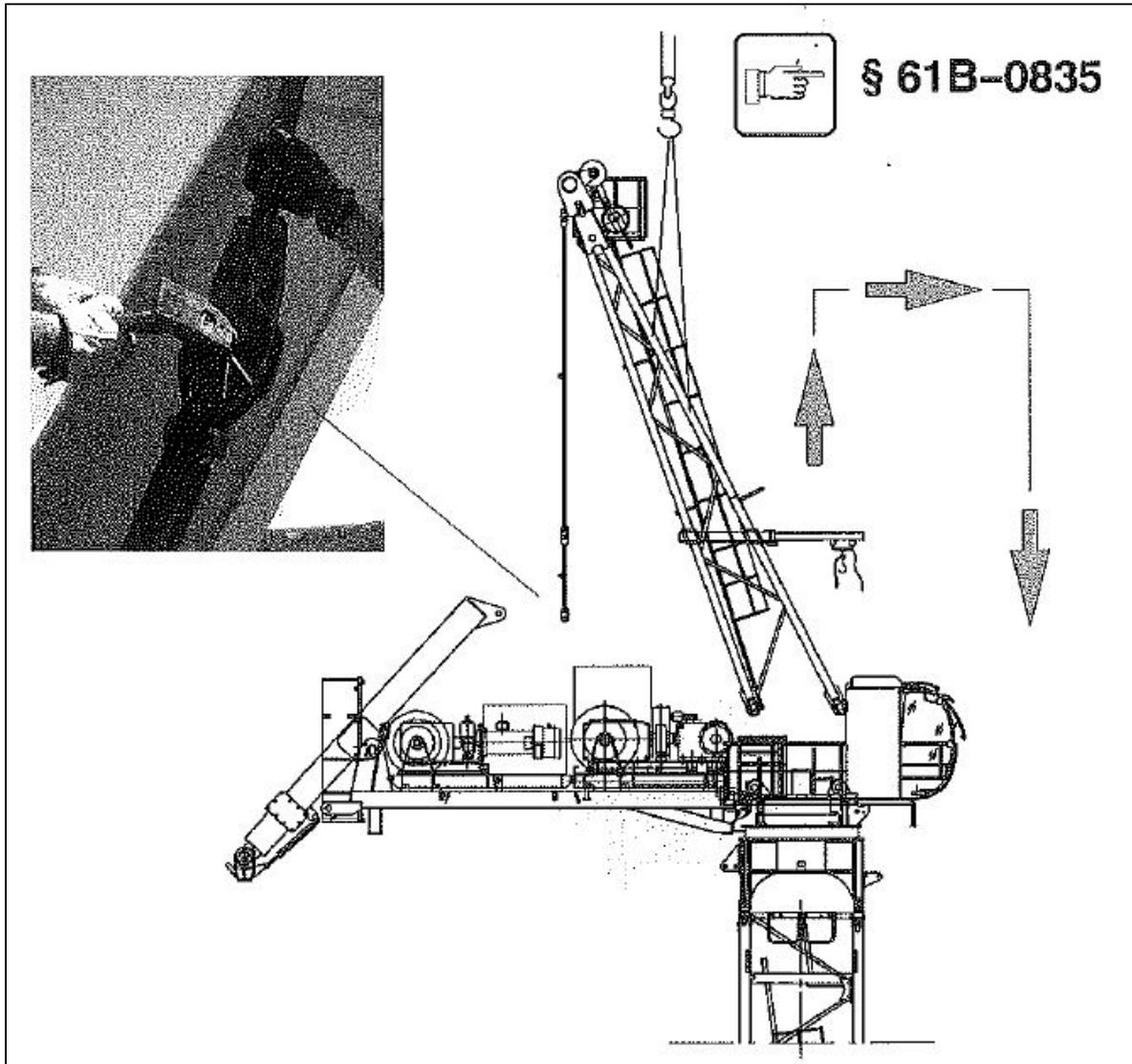


Figure 5. Schematic drawing of the Potain tower crane apex being hoisted by a mobile crane after the four locking pins had been removed from the turntable mounting lugs. (Taken from Potain tower crane specifications manual)

Mammoet Liebherr 250 tonne mobile crane, model LTM 1250-6.1, unit 1937 (mobile crane)

The mobile crane was equipped with a telescopic hydraulic boom that could extend to a maximum length of 72.0 m (236.2 feet). The mobile crane was equipped with an onboard computer system known as a load moment indicator (LMI) (Figure 6).



Figure 6. Mammoet Liebherr mobile crane with the telescopic boom fully retracted following the accident. The Rapicon Potain tower crane is shown in the background.

At the time of the April 27, 2016 accident, the mobile crane was being operated at a radius of 19.8 m (65 feet), with the boom fully extended to 72 m (236.2 feet), and a boom angle of 75.2°. The corresponding height of the mobile crane hoisting hook, as connected to the apex while hoisting the apex, was approximately 62.9 m (226.9 feet) (Figure 7, 8).

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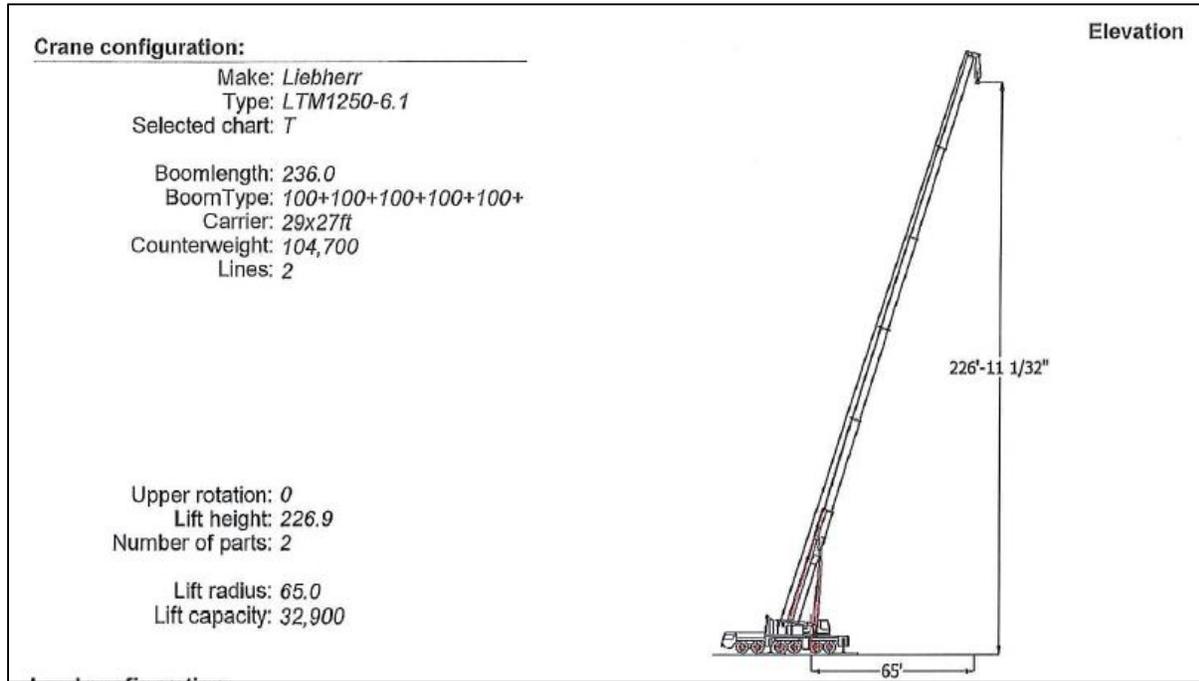


Figure 7. Mammoet mobile crane configuration crane for dismantling the Rapicon Potain tower crane. (Taken from the Mammoet lift plan for dismantling the tower crane)



Figure 8. Side view of the Mammoet mobile crane connected to and attempting to hoist the Potain tower crane apex structure. (Taken from NOVA close circuit video system).

Sequence of events

On March 7, 2016, Leducor advised Rapicon that they wanted Rapicon to dismantle and demobilize the tower crane from the R3 Project site starting April 26, 2016. Rapicon made arrangements with Mammoet to have a mobile crane and mobile crane operator dispatched to the Nova site on April 25, 2016.

A Mammoet crane supervisor visited the R3 Project site on April 3, 2016, to assess the site and prepare a mobile crane lift plan that Rapicon required for the scheduled tower crane dismantling work. No one from Rapicon attended the site on that date to participate in the site assessment by Mammoet. The Mammoet crane supervisor completed the mobile crane lift plan and forwarded a copy of the lift plan to Rapicon.

On April 25, 2016, the Mammoet mobile crane operator drove the Mammoet mobile crane from Calgary to the R3 Project site and attended the NOVA-Leducor safety orientation. The mobile crane operator then started positioning the mobile crane adjacent to the tower crane in preparation to dismantle the tower crane the next day.

On April 26, 2016, the Rapicon crew and mobile crane operator started dismantling the tower crane by first removing the hoist ropes and then the jib structure. They left the R3 Project site at approximately 5:00 p.m., and travelled to their hotel in Red Deer.

On April 27, 2016, the Rapicon crew and mobile crane operator returned to the R3 Project. After attending the NOVA-Leducor weekly safety meeting, they prepared to continue dismantling the tower crane.

At approximately 8:10 a.m., the Summit lead hand, the Rapicon crew and the Leducor tower crane operator climbed to the top of the tower crane. The Leducor tower crane operator rotated the tower crane turntable as instructed by the Summit lead hand to allow the apex to be hoisted.

The Summit Crane lead hand attempted to rig the mobile crane lifting hook to the two top rigging points (lifting lugs) on the apex using the two slings in a basket configuration. They determined the configuration placed the tip of the mobile crane too close to the apex. The Summit Crane lead hand then reconfigured the two slings to full length and rigged the apex to the mobile crane lifting hook.

The Summit Crane lead hand used their radio to direct the mobile crane operator to increase the lifting load on the apex to 6000 pounds, to further aid in the removal of the rear locking pins of the apex.

Worker 1 used a sledgehammer to pound out the rear locking pins while standing between the back edge of the turntable and the adjacent hoist winch motor.

At 8:45 a.m., a Ledcor structural and rigging superintendent arrived at the equipment lay down area next to the tower crane to check the progress of the dismantling work. They then stood off to the side of the lay down area and spoke with a Ledcor crane foreman who was supervising the loading of tower crane components onto the Rapicon transport trucks.

At approximately 8:47 a.m., the Summit Crane lead hand used their radio to instruct the mobile crane operator to increase the lifting load on the apex to 8000 pounds to aid in the removal of the front locking pins of the apex.

The Summit Crane lead hand then directed the mobile crane operator to slowly increase the lifting load on the apex, as the Rapicon workers were having problems removing the front locking pins from the apex.

A Rapicon worker, who was inside the tower crane turntable well, used a sledge hammer to successfully remove the front locking pins from the apex. Another Rapicon worker applied a tag line to the right side of the apex to try to control the movement of the apex once the Mammoet mobile crane started hoisting the apex upwards.

With the locking pins now removed and the apex being supported vertically by the mobile crane, the Summit Crane lead hand instructed the mobile crane operator to continue to slowly increase the lifting load on the apex. At this time, the Summit Crane lead hand, the Rapicon workers, and the Ledcor tower crane operator were all positioned in close proximity to the apex.

The mobile crane operator began increasing the lifting load on the apex in increments of five hundred pounds. The Summit Crane lead hand and Rapicon workers noticed that the front left front leg of the apex was still stuck to its mounting lug on the turntable despite the lifting load being applied by the mobile crane being well in excess of the weight of the apex.

At approximately 8:54 a.m., the Rapicon owner recognized there was a problem with the hoisting of the apex and used their radio to confirm what lifting load was being applied by the mobile crane on the apex. The mobile crane operator replied by radio that the mobile crane load moment indicator (LMI) was showing a lifting load of 8.6 tonnes (19 000 pounds).

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When the mobile crane operator advised by radio that the lifting load being applied to the apex was 8.6 tonnes (19 000 pounds), the Rapicon co-owner realized there was a serious problem with the lifting of the apex. They directed the mobile crane operator to immediately reduce the lifting load being applied to the apex as they knew the apex did not weigh that much.

At approximately 8:56 a.m., while under a lifting load well in excess of the weight of the apex, the apex suddenly released from the front left mounting lug on the turntable. The apex lunged vertically upwards approximately 2 m under the excessive lifting load being applied by the mobile crane (Figure 9).

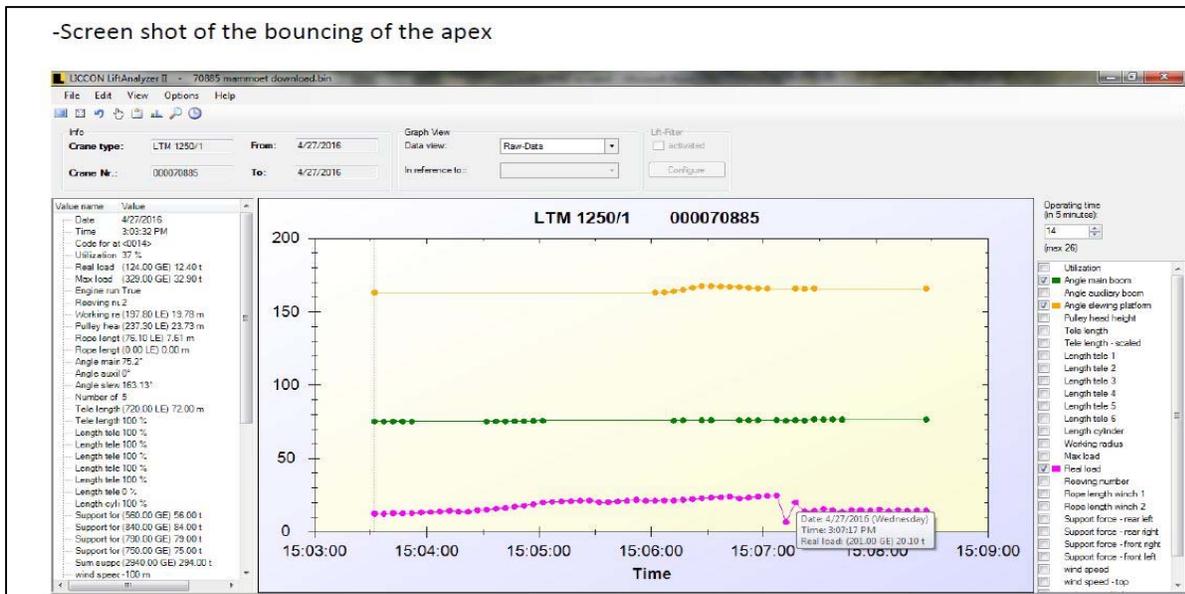


Figure 9. Mammoet mobile crane data download showing the gradual increasing lifting load on the apex (purple dotted line) by the mobile crane from approximately 12 500 pounds to 24 000 pounds over a period of approximately 3.5 minutes and the sudden release of the apex from its turntable mounts at a lifting load of approximately 10.9 tonnes (24 000 pounds).

The Summit Crane lead hand and Rapicon worker who was standing beside them holding the tag line dropped to the upper platform floor deck to avoid being struck by the swinging apex. The Rapicon worker who was positioned inside the well of the turntable below the apex ducked underneath the turntable structure to avoid being struck by the legs of the bouncing apex.

As the apex swung horizontally towards the back end of the upper platform, it struck worker 1 who was standing between the rear edge of the turntable and the adjacent hoist winch motor. Worker 1 was struck in the chest and crushed between the swinging apex and the hoist winch motor.

The apex then swung away from worker 1, and then swung back towards them, striking them a second time in the chest. The apex continued swinging back and forth several times before finally coming to rest up against the door of the tower crane cab (Figure 10).

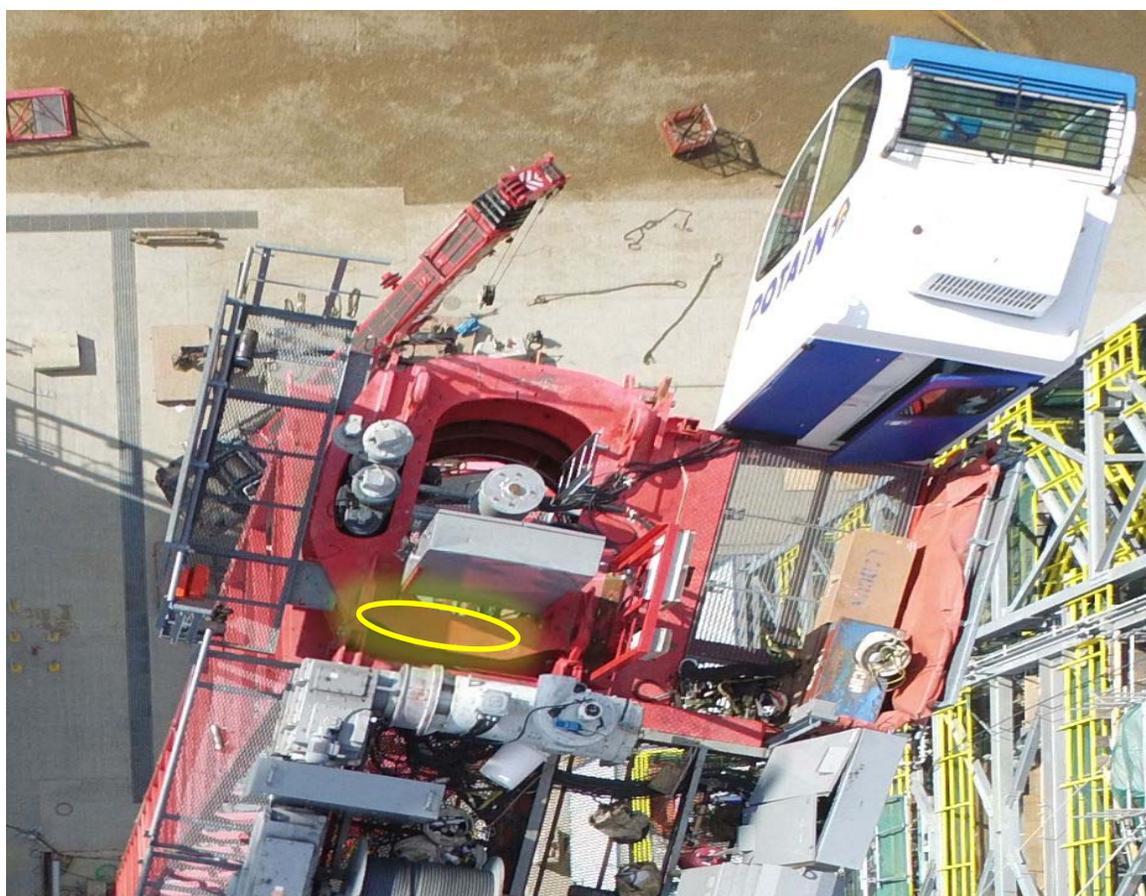


Figure 10. The yellow oval shows the position where worker 1 was standing between the rear of the turntable and the adjacent hoist motor winch when struck by the swinging apex.

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The Summit Crane lead hand, the Rapicon workers and the Leducor tower crane operator immediately attended to worker 1 who was unconscious and unresponsive. The Summit Crane lead hand used their radio to advise the Rapicon co-owner that one of the Rapicon workers had been injured, and they requested an emergency response by the NOVA Loss Prevention team.

The Rapicon co-owner advised the Leducor superintendent that a Rapicon worker had been injured and was unresponsive, and that an emergency response by the NOVA Loss Prevention team was required. Leducor initiated a 911 response and advised NOVA that an emergency response by the NOVA Loss Prevention team was required.

At approximately 9:04 a.m., the mobile crane operator rotated the still suspended apex away from the tower crane cab and lowered the apex to the ground. The Rapicon co-owner and a Rapicon worker disconnected the apex from the mobile crane lifting hook.

While awaiting the NOVA Loss Prevention team, Leducor and Rapicon workers attached an aerial platform (man basket) to the mobile crane, in anticipation of using the man basket to lift the NOVA Loss Prevention team to the top of the tower crane.

At approximately 9:13 a.m., the mobile crane operator lifted the Leducor structural steel general foreman in the man basket to the top of the tower crane to assess the situation and further confirm the status of worker 1.

At approximately 9:15 a.m., the NOVA Loss Prevention team arrived at the tower crane location and rode in the man basket to the top off tower crane to attend to worker 1.

At approximately 9:35 a.m., the NOVA Loss Prevention crew arrived back at ground level in the man basket with worker 1. A NOVA Loss Prevention team member advised Alberta Emergency Medical Services (EMS) that the injured Rapicon worker was going into cardiac arrest.

At approximately 9:38 a.m., worker 1 was transported in the NOVA ambulance to meet the Alberta EMS ambulance that had been dispatched from Red Deer.

At approximately 9:45 a.m., the NOVA ambulance met the Alberta EMS ambulance near Highway 815. One of the Alberta EMS members rode in the NOVA ambulance to assist NOVA Loss Prevention personnel tending to worker 1 while being transported to Red Deer Hospital.

At approximately 10:24 a.m., the NOVA ambulance arrived at Red Deer Hospital where worker 1 was declared deceased.

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At approximately 10:25 a.m., the NOVA Responsible Care team leader contacted the OHS Contact Centre to report the workplace fatality. Two OHS investigators and one OHS officer attended the R3 Project site to conduct an investigation into the workplace fatality.

Completion

A review for enforcement action was completed on May 16, 2017, and it was determined that the file would be referred to Alberta Justice for review. The entire file was sent to Alberta Justice on September 24, 2017.

On March 22, 2018, charges were laid against Rapicon Inc. and its owner, and against Summit Crane Works Inc. and its owner.

On March 19, 2019, the Summit owner pled guilty to a charge under Section 2(2)(a) of the *OHS Act*, for failing to protect the health and safety of another worker. On March 22, 2019, the Summit owner was convicted and fined \$86,250 inclusive of the 15% Victim Fine Surcharge (VFS). Remaining charges against Summit Crane Works Inc. and the Summit owner were withdrawn. On May 10, 2019, Rapicon Inc. pled guilty to a charge under Section 2(5) of the *OHS Act*, for failing as a contractor directing the activities of employers involved in work at a work site, to ensure the employers complied with Section 189 of the OHS Code, whereby equipment that could be dislodged or moved was not contained, restrained to eliminate danger to workers. On May 29, 2019, Rapicon Inc. was convicted and fined \$300,000 inclusive of the VFS. Remaining charges against Rapicon Inc. and its owner were withdrawn.

This investigation was closed on May 30, 2019.

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Signatures

ORIGINAL REPORT SIGNED

October 28, 2019

Lead Investigator

Date

ORIGINAL REPORT SIGNED

October 28, 2019

Manager

Date

ORIGINAL REPORT SIGNED

December 13, 2019

Director

Date